

January 28, 2004

Refer to: HSA-10/B-88A

Mr. Michael Kempen
Safence, Incorporated
46-04 245th Street
Douglaston, New York 11362

Dear Mr. Kempen:

In your September 15, 2003, letter addressed to Mr. Richard Powers of my staff, you requested formal acceptance of a tensioned 4-wire rope system (named Safence 350 4RI) as an National Cooperative Highway Research Program (NCHRP) Report 350 test level 3 (TL-3) bi-directional (median) traffic barrier. A similar 4-wire design intended for use as a roadside barrier was accepted for use on the National Highway System (NHS) in Mr. Frederick G. Wright's July 13, 2001, letter to Mr. Mats Heinevik. To support the current request, you also sent copies of test reports prepared by the VTI test laboratory in Linköping, Sweden under the direction of Messrs. Thomas Turbell and Jan Wenall, and digitized videos of the two tests that were conducted. These tests were NCHRP Report 350 test 3-11 (Test No. 56592) with a pickup truck and CEN test TB 11 (Test No. 56379) that uses a small car and is comparable to NCHRP Report 350 test 3-10.

The Safence 350 4RI test installations were 116 meters long for test 3-11 and 71-m long for test TB 11, including anchorages. For test 3-11, the four 19-mm diameter steel cables were supported on 1900-mm long I-section steel posts driven directly into a strong soil and spaced on 2500-mm centers. These posts were made with 4-mm thick steel and had flange and web widths of 41 mm and 80 mm, respectively. For test TB 11, the posts were 1230-mm long and set into concrete cylinders 200-mm in diameter and 600-mm deep. For both installations, the posts were 780 mm above the ground. The cables were set, using spacers, into a vertical slot cut into the web of each post at heights of 720 mm, 640 mm, 560 mm, and 480 mm above the ground for test 3-11. Each cable was set 20 mm higher for test TB 11. Once in place, the cables were tensioned to the manufacturer's specifications, the exact amount depending on the ambient temperature at the time of installation. This tension can vary from just under 8 kN at 38 degrees Celsius to just over 31 kN at -40 degrees Celsius. Enclosure 1 includes a schematic drawing of the Safence 350 4RI as tested with the pickup truck as well as additional barrier layout and installation information.

For test 3-11, a 2095-kg pickup truck impacted the barrier at 97.7 km/h at 25degrees. Accelerometer data was lost in this test so occupant impact velocity and maximum ridedown accelerations were not calculated. However, these evaluation criteria have always been well below allowable limits with flexible barrier systems when smooth vehicular redirection is observed in the test as was the case for test 3-11. Dynamic deflection was 2.7 meters. For test 3-10, a Ford Fiesta impacted the wire rope at 105 km/h and an impact angle of 19 degrees. Maximum occupant impact velocity was 5.5 m/sec and maximum ridedown acceleration was reported as 6 g's. Dynamic deflection was 0.8 meters.

Based on staff review of the information you provided, I concur that the 4-strand Safence 350, as tested with either vehicle, meets all evaluation criteria for an NCHRP Report 350 roadside barrier at TL-3 and it may be used on the NHS when such use is proposed by the contracting agency. Since this product is made from steel and is proprietary, the provisions of Sections 635.410 (Buy America) and 635.411 (Use of Proprietary Products) of Title 23 Code of Federal Regulations, copies of which have been previously sent to you, are both applicable to the Safence 350 4RI design.

You have not developed a crashworthy terminal for either system. The terminal design used in the test may be used for field installations if it is located beyond the minimum clear zone or appropriately shielded.

Sincerely yours,

/Original Signed By/

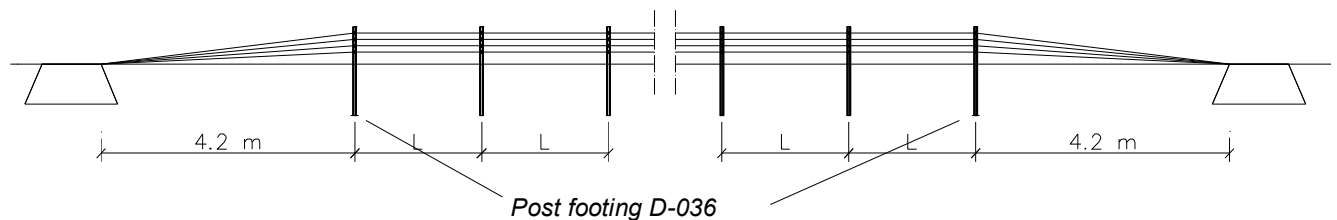
John R. Baxter, P.E.
Director, Office of Safety Design
Office of Safety

Enclosure

Wire Rope Safety Fence

Product description Safence 350 4RI

Positioning of fence



The post nearest the anchoring point is provided with a post footing (D-036) that absorbs vertical forces.

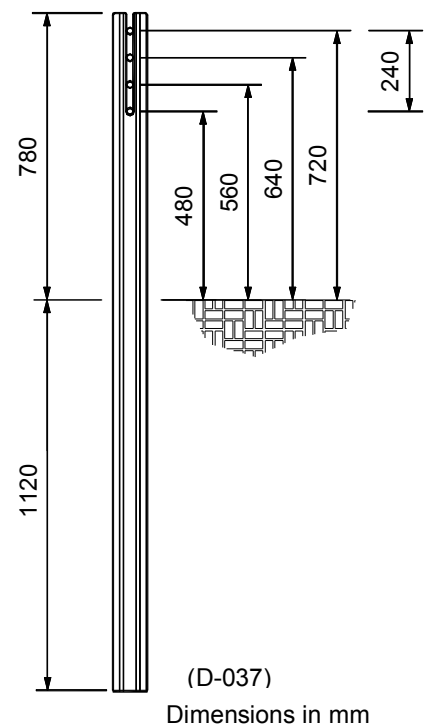
The fence has been tested in accordance with NCHRP 350, with a distance (L) between posts of 2,5 m. If the working width is to be reduced, the distance between the posts must also be reduced.

| Post distance (m) | Working width (m) |
|-------------------|-------------------|
| 2,5 | 2,7 |
| | |

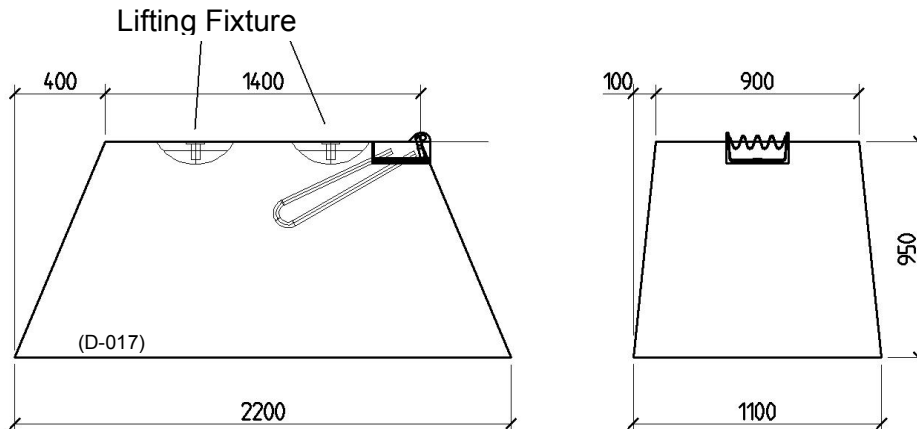
Founding of posts

Normal founding

The fence posts are founded as shown in the drawing.



End anchors

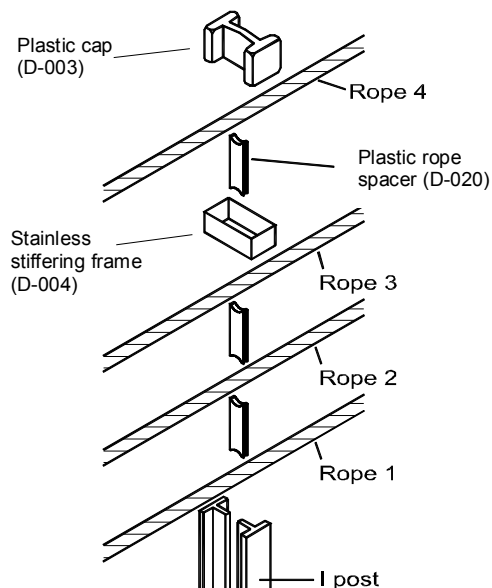


Dimensions in mm

- End anchors can be either cast on site or prefabricated.
- Make sure that anchors are aligned with the fence.
- The galvanised anchor box embedded in the concrete is to lie at ground level, be placed horizontally at the side of the road and follow the slope of the road longitudinally.
- Backfilling around end anchors is to be done with gravel, which is then vibrated.
- Anchors are to be well covered.

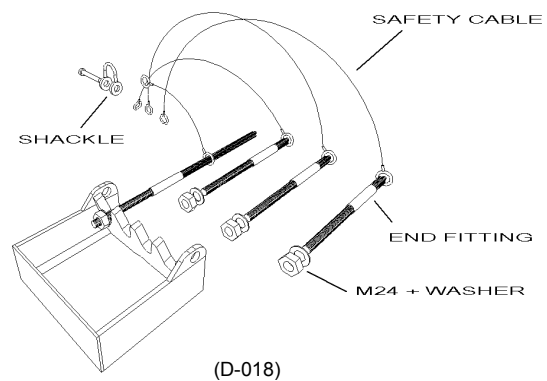
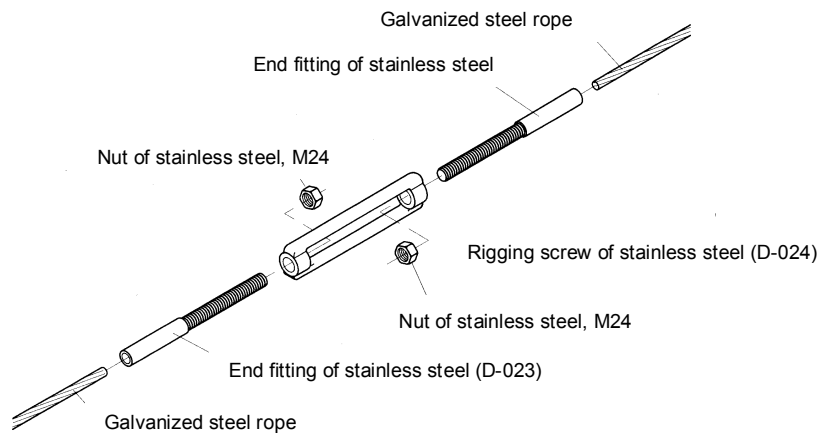
Wire rope installation

For end posts, steel rope spacers are used (D-022).





End fittings and rigging screws



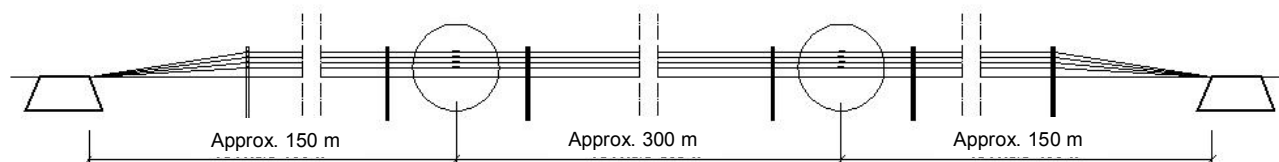


Tensioning

1. Tension the wire ropes with nuts at both the end anchors.
2. Tension the wire ropes to the correct tensioning force at each rigging screw (see table). Start in the middle of the section and work alternately towards each respective anchoring.

If the length of the rigging screws is not sufficient to reach the correct tensioning force, tighten them to half the length of the rigging screw. Then readjust them so that all the rigging screws have the correct tensioning force.

| Tensioning table | |
|-------------------------|-----------------------|
| Temperature (°C) | Tensioning force (kp) |
| -40 | 3 200 |
| -30 | 2 900 |
| -20 | 2 600 |
| -10 | 2 300 |
| 0 | 2 000 |
| 10 | 1 700 |
| 20 | 1 400 |
| 30 | 1 100 |
| 40 | 800 |



Radii

Horizontal curvature

The fence shall follow the road curvature without any visible break in its alignment in either the horizontal or the vertical axes.

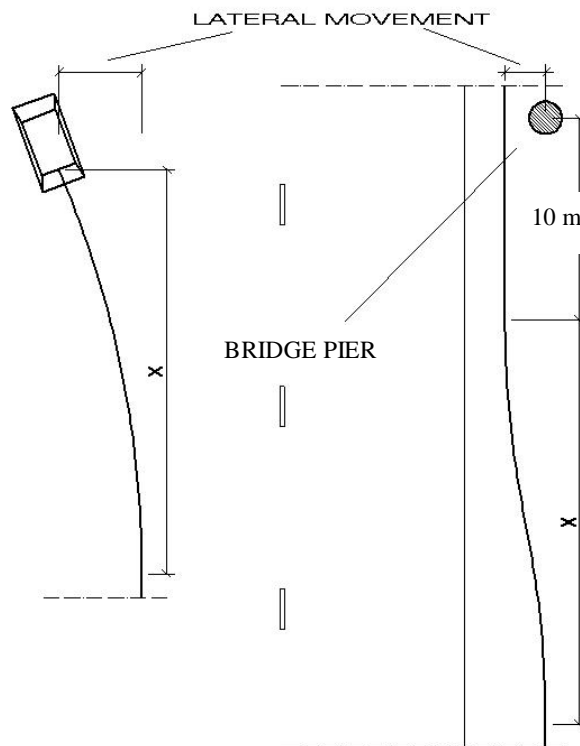
Normally, the radius of the road should not be less than 200 m.

If a smaller radius is required, the distance between the posts shall be reduced in accordance with the table below:

| Radius (m) | Post distance (m) |
|------------|-------------------|
| 200 | 2,5 |
| 150 | 2 |
| 100 | 1,5 |

Negotiation of obstacles (e.g. bridge piers).

| Lateral movement (m) | X (m) |
|----------------------|-------|
| 0,5 | 30 |
| 1 | 50 |
| 1,5 | 60 |
| 2 | 70 |



Vertical curvature

Fences should not be constructed in depressions with a radius of < 1200 m.

Shortening of posts

Posts for Safence fences may be reduced in length according to the table below:

| Shortened post | Measure to be taken |
|--|----------------------------------|
| 0-10 cm | No action |
| One post is shortened 10-70 cm with five whole post on each side | No action |
| The post is shortened 10-30 cm | Reduce post distance to 2 m |
| The post is shortened 30 – 50 cm | Reduce post distance to 1,5 m |
| The post is shortened 50 – 70 cm | Reduce post distance to 1 m |
| The post is shortened > 70 cm | Drill a hole 50 cm into the rock |