U.S. Department of Transportation
Federal Highway Administration

September 8, 2021

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

In Reply Refer To:
HSST-1/CC-168

Mr. Jesper Sorensen
Blue System AB
Fiskeback Hamn 16
S-426 58 Vastra Frolunda
Sweden

Dear Mr. Sorensen:

This letter is in response to your May 14, 2020 request for the Federal Highway Administration (FHWA) to review a roadside safety device, hardware, or system for eligibility for reimbursement under the Federal-aid highway program. This FHWA letter of eligibility is assigned FHWA control number CC-168 and is valid until a subsequent letter is issued by FHWA that expressly references this device.

Decision

The following device is eligible within the length-of-need, with details provided in the form which is attached as an integral part of this letter:

- SAFENCE T10.0-19 Blue Systems End Terminal

Scope of this Letter

To be found eligible for Federal-aid funding, new roadside safety devices should meet the crash test and evaluation criteria contained in the American Association of State Highway and Transportation Officials'(AASHTO) Manual for Assessing Safety Hardware (MASH). However, the FHWA, the Department of Transportation, and the United States Government do not regulate the manufacture of roadside safety devices. Eligibility for reimbursement under the Federal-aid highway program does not establish approval, certification or endorsement of the device for any particular purpose or use.

This letter is not a determination by the FHWA, the Department of Transportation, or the United States Government that a vehicle crash involving the device will result in any particular outcome, nor is it a guarantee of the in-service performance of this device. Proper manufacturing, installation, and maintenance are required in order for this device to function as tested.

This finding of eligibility is limited to the crashworthiness of the system and does not cover other structural features, nor conformity with the Manual on Uniform Traffic Control Devices.

Eligibility for Reimbursement

Based solely on a review of crash test results and certifications submitted by the manufacturer, and the crash test laboratory, FHWA agrees that the device described herein meets the crash test and evaluation criteria of the AASHTO's MASH. Therefore, the device is eligible for reimbursement under the Federal-aid highway program if installed under the range of tested conditions.

Name of system: SAFENCE T10.0-19 Blue Systems End Terminal
Type of system: End Terminal
Test Level: Test Level 3 (TL3)
Testing conducted by: VTI Crash Safety & Holmes Solutions
Date of request: May 14, 2020

FHWA concurs with the recommendation of the accredited crash testing laboratory on the attached form.

Full Description of the Eligible Device

The device and supporting documentation, including reports of the crash tests or other testing done, videos of any crash testing, and/or drawings of the device, are described in the attached form.

Notice

This eligibility letter is issued for the subject device as tested. Modifications made to the device are not covered by this letter. Any modifications to this device should be submitted to the user (i.e., state DOT) as per their requirements.

You are expected to supply potential users with sufficient information on design, installation and maintenance requirements to ensure proper performance.

You are expected to certify to potential users that the hardware furnished has the same chemistry, mechanical properties, and geometry as that submitted for review, and that it will meet the test and evaluation criteria of AASHTO's MASH.

Issuance of this letter does not convey property rights of any sort or any exclusive privilege. This letter is based on the premise that information and reports submitted by you are accurate and correct. We reserve the right to modify or revoke this letter if: (1) there are any inaccuracies in the information submitted in support of your request for this letter, (2) the qualification testing was flawed, (3) in-service performance or other information reveals safety problems, (4) the system is significantly different from the version that was crash tested, or (5) any other information indicates that the letter was issued in error or otherwise does not reflect full and complete information about the crashworthiness of the system.

Standard Provisions

- To prevent misunderstanding by others, this letter of eligibility designated as FHWA control number CC-168 shall not be reproduced except in full. This letter and the test documentation upon which it is based are public information. All such letters and documentation may be reviewed upon request.

- This letter shall not be construed as authorization or consent by the FHWA to use, manufacture, or sell any patented system for which the applicant is not the patent holder.

- This FHWA eligibility letter is not an expression of any Agency view, position, or determination of validity, scope, or ownership of any intellectual property rights to a specific device or design. Further, this letter does not impute any distribution or licensing rights to the requester. This FHWA eligibility letter determination is made based solely on the crash-testing information submitted by the requester. The FHWA reserves the right to review and revoke an earlier eligibility determination after receipt of subsequent information related to crash testing.

Sincerely,

Michael S. Griffith
Director, Office of Safety Technologies
Office of Safety

Enclosures

Request for Federal Aid Reimbursement Eligibility of Highway Safety Hardware

Submitter	Date of Request:	May 14, 2020	◉ New ○ Resubmission
	Name:	JesperSorensen	
	Company:	BlueSystem AB	
	Address:	FiskebackHamn 16,S-426 58VastraFrolunda	
	Country:	Sweden	
	To:	Michael S. Griffith, Director FHWA, Office of Safety Technologies	

I request the following devices be considered eligible for reimbursement under the Federal-aid highway program.

Device& TestingCriterion -Enter from right to left starting with Test Level !-!-! !-!-!

SystemType	SubmissionType	DeviceName / Variant	TestingCriterion	Test Level
'CC':CrashCushions,Attenua Attenuators,&Terminals	◉ PhysicalCrashTesting ○ Engineering Analysis	SAFENCET10.0-19 BlueSystemsEnd Terminal	AASHTOMASH	TL3

By submitting this request for review and evaluation by the Federal Highway Administration, I certify that the product(s) was (were) tested in conformity with the AASHTO Manual for Assessing Safety Hardware and that the evaluation results meet the appropriate evaluation criteria in the MASH.

Individual or Organization responsible for the product:

ContactName:	JesperSorensen	SameasSubmitter ☒
CompanyName:	BlueSystem AB	SameasSubmitter ☒
Address:	FiskebackHamn 16,S-426 58VastraFrolunda	SameasSubmitter ☒
Country:	Sweden	SameasSubmitter ☒
Enter below all disclosures of financial interests as required by the FHWA `Federal-Aid Reimbursement Eligibility Process for Safety Hardware Devices' document.		
The test facility VTI or any of itsemployeesdoesnot haveany financial interest in BlueSystem ABor Safence, Inc.		

PRODUCT DESCRIPTION

Help

(•) New Hardware or Significant Modification ( ) Modification to Existing Hardware

The barrier terminal BlueSystemsMASH16TL3end terminal - SAFENCET10.0-19- isa 10 meter long sloped down barrier leading and trailing end withaconcrete ground anchor attachment block.Theconcrete block, with a weight close to 4000 kg, is dug down into controlled gravel, compacted per each 300 mm from bottom to top by a 500 kg vibrating ground compactor.The end terminal is tested with alternatively three and four cables, whichever is regarded as the most severe test for each test.

CRASH TESTING

By signature below, theEngineer affiliated with the testing laboratory, agrees in support of thissubmission that all of the critical and relevant crash tests for this device listed above were conducted to meet the MASH test criteria. The Engineer has determined that no other crash testsare necessary to determine the device meets the MASHcriteria.

Engineer Name:	Jan Wenall	
EngineerSignature:	Jan Wenäll Elektroniskt undertecknad av Jan Wenäll SN: dc=se, dc=vti, ou=Domain Users, ou=Kontoret i Linköping, cn=Jan Wenäll, email=jan.wenall@vti.se Datum:2020.04.28 15:58:54 +02'00'	
Address:	VTI,S-581 95 Linkoping	Same asSubmitter ☐
Country:	Sweden	Same asSubmitter ☐

A brief description of each crash test and its result: Help

RequiredTest Number	Narrative Description	Evaluation Results
3-30 (1100C)	Test report 56969, October 9, 2019. "Test 30 and 40 are designed to examine the risk of vehicle instability, especially for narrow terminal and crash cushion systems" are the directions given by MASH 2016.On such asloped down terminal as tested, it is an expectation to see an impacting vehicle riding on top of the terminal and further down barrier. The sloped down terminal is an active choice between the blunt terminal, stopping the vehicle with high g-forces and the sloped down low g terminal not stopping the vehicle but the sometimes-risky top-of-the-barrier ride. The test 3-30 impact point is¼ vehicle width offset, to as well maximize the risk of both yawing and rolling of the impacting vehicle. The test details are described in the enclosed VTI test report number 56969, dated 2019-12-13. The vehicle came back on four wheelsafter the top wire ride, with vehicle occupant compartment intact.	PASS

RequiredTest Number	Narrative Description	Evaluation Results
3-31 (2270P)	Test report 56970, October 16, 2019. "For devicesintended to decelerate vehicles to a stop, these testsare designed to evaluate the capacity of the feature to absorb sufficient energy to stop the 2270P vehicle in asafe and controlled manner. For gating systems, these testsare intended to evaluate occupant risk and vehicle trajectory criteria during high-energy, head-on impacts." are part of the description given by MASH 2016. This is both a gating and a non-gating system, but on a head-on high-energy impact it is of course likely the vehicle will overrun and override both the sloped down terminal and the adjoining barrier.Which waswhat happened.The test detailsare described in the enclosed VTI test report number 56970, dated 2019-12-13. The vehicle occupant compartment stayed intact.	PASS
3-32 (1100C)	Test report 56971, October 22, 2019."These testsare intended to examine the behavior of terminals and crash cushions during oblique impacts on the end or nose of the system." are part of the description for test 3-32 given by MASH 2016. Impact angles should be selected from a given range, to target the maximized risk of failure. Since the tests 3-32 and 3-33 are more or less similar, but with different vehicles, we did use the option to run on of the tests (3-32) at 5 degree impact angleand one test (3-33) at 15 degree impact angle, to effectively cover both possibilities.Onceagain,as this is both a gating and a non-gating system and with the impact positions oftest 3-32 (and 3-33) it is of course likely the vehicle willoverrun and override the sloped down tenninal. The test detailsare described in the enclosed VTI test report number 56971. The vehicle occupant compartment stayed intact.	PASS

3-33(2270P)	Test report 56972,October 31,2019. "These testsare intended to examine the behavior of terminals and crash cushions during oblique impacts on the end or nose of the system." are part of the description for test 3-33 given by MASH 2016. Impact angles should be selected from a given range, to target the maximized risk of failure. Since the tests 3-32 and 3-33 are more or less similar, but with different vehicles, we did use the option to run on of the tests (3-32) at 5 degree impact angleand one test (3-33) at 15 degree impact angle, to effectively cover both possibilities.Onceagain,as this is both a gating and a non-gating system and with the impact positions of test 3-33 (and 3-32) it is of course likely the vehicle will overrun and override the sloped down terminal. The test detailsare described in the enclosed VTI test report number 56972. The vehicle occupant compartment stayed intact.	PASS
3-34(1100C)	Test report 56973,November 7,2019."Test 34 is intended to evaluate impact performance of terminals and crash cushions at the critical impact point (CIP) where the behavior of these devices changes from gating or capturing to redirection.Vehicle trajectory and occupant risk are the primary concerns for this test" are the directions given by MASH 2016. In this case, CIP is the break point where it is assumed that the uppermost wire rope will start containing and possibly redirecting the impacting vehicle. The test detailsare described in the enclosed VTI test report number 56973. The vehicle occupant compartment stayed intact.	PASS
3-35(2270P)	Due to winter weather in Sweden, it was not possible to perform this last test for the terminal at VTI.We were in process of doing other testing at HolmesSolutions, and decided to do the test 3-35 at Holmes Solution to finish the testing for our end terminal. This report will be submitted in a separate electronic file to complement this application.	PASS
3-36(2270P)		Non-Relevant Test, not conducted

3-37 (2270P)	Test report 56975, October 4, 2019. "Test 37 examines the behavior of crash cushions and terminals during reverse-direction impacts." are the instructions given by MASH 2016. The aim isCIP for reverse-direction impacts, in this case judged to be an impact where the vehicle most likely was under full barrier deflection while reaching the firm and final connection of the terminal to ground, with the risk of both pocketing and snagging by the trailing terminal end. The test 3-37B was chosen and motivated by the description in MASH 2016 "For post-and-beam terminals utilizing a breakaway cable system, the 1100C will generally be the critical vehicle for this test, and the impact point should be selected to maximize the risk of the vehicle snagging on the anchor cable."	PASS
3-38 (1500A)		Non-Critical, not conducted
3-40 (1100C)		Non-Relevant Test, not conducted
3-41 (2270P)		Non-Relevant Test, not conducted
3-42 (1100C)		Non-Relevant Test, not conducted
3-43 (2270P)		Non-Relevant Test, not conducted
3-44 (2270P)		Non-Relevant Test, not conducted
3-45 (1500A)		Non-Relevant Test, not conducted

Full Scale Crash Testing was done in compliance with MASH by the following accredited crash test laboratory (cite the laboratory's accreditation status as noted in the crash test reports.):

Laboratory Name:	Swedish National Road and Transport Research Institute, VTI	
Laboratory Signature:	Anita Ihs — Elektroniskt undertecknad av Anita Ihs Datum: 2020.05.08 13:24:01 +02'00'	
Address:	SE-581 95 Linköping	Same as Submitter ☐
Country:	Sweden	Same as Submitter ☐
Accreditation Certificate Number and Dates of current Accreditation period :	SWEDAC 1132, recent and valid annual inspection 2019-03-15, valid at time of test.	

Submitter Signature*: Jesper Sorensen — Digitally signed by Jesper Sorensen Date: 2020.05.14 12:10:46 -07'00'

Submit Form

ATTACHMENTS

Attach to this form:

1) Additional disclosures of related financial interest as indicated above.
2) A copy of the full test report, video, and a Test Data Summary Sheet for each test conducted in support of this request.
3) A drawing or drawings of the device(s) that conform to the Task Force-13 Drawing Specifications [Hardware Guide Drawing Standards]. For proprietary products, a single isometric line drawing is usually acceptable to illustrate the product, with detailed specifications, intended use, and contact information provided on the reverse. Additional drawings (not in TF-13 format) showing details that are relevant to understanding the dimensions and performance of the device should also be submitted to facilitate our review.

FHWA Official Business Only:

Eligibility Letter		
Number	Date	Key Words

Request for Federal Aid Reimbursement Eligibility of Highway Safety Hardware

Submitter	Date of Request:	May 14, 2020	◉ New ○ Resubmission
	Name:	Jesper Sorensen	
	Company:	Blue Systems AB	
	Address:	Fiskeback Hamn 16, S-426 58 Vastra Frolunda	
	Country:	Sweden	
	To:	Michael S. Griffith, Director FHWA, Office of Safety Technologies	

I request the following devices be considered eligible for reimbursement under the Federal-aid highway program.

Device & Testing Criterion - Enter from right to left starting with Test Level

! - ! - !

System Type	Submission Type	Device Name / Variant	Testing Criterion	Test Level
'CC': Crash Cushions, Attenuators, & Terminals	◉ Physical Crash Testing ○ Engineering Analysis	SAFENCE T10.0-19 Blue Systems End Terminal	AASHTO MASH	TL3

By submitting this request for review and evaluation by the Federal Highway Administration, I certify that the product(s) was (were) tested in conformity with the AASHTO Manual for Assessing Safety Hardware and that the evaluation results meet the appropriate evaluation criteria in the MASH.

Individual or Organization responsible for the product:

Contact Name:	Jesper Sorensen	Same as Submitter ☒
Company Name:	Blue Systems AB	Same as Submitter ☒
Address:	Fiskeback Hamn 16, S-426 58 Vastra Frolunda	Same as Submitter ☒
Country:	Sweden	Same as Submitter ☒

Enter below all disclosures of financial interests as required by the FHWA `Federal-Aid Reimbursement Eligibility Process for Safety Hardware Devices' document.

The test facility Holmes Solutions or any of its employees does not have any financial interests in Blue Systems AB.

PRODUCT DESCRIPTION

(●) New Hardware or Significant Modification ( ) Modification to Existing Hardware

The end terminal consist of the Safence cable barrier system (marketed as MashFlex in Australia and new Zealand) with concrete anchor blocks, with the first post in the system located 1.0 m from the cable connection bracket, which is cast into the concrete anchor block. The terminal end system has a space of 9.0 m from the first post to the second, before transiting to the first Length of Need (LoN) post.

This is test 3-35 of the "SAFENCE T10.0-19 Blue Systems End Terminal" all other required tests were performed at VTI in Sweden, and this submittal is to complement that request for Federal Aid Reimbursement Eligibility for Highway Safety Hardware.

CRASH TESTING

By signature below, the Engineer affiliated with the testing laboratory, agrees in support of this submission that all of the critical and relevant crash tests for this device listed above were conducted to meet the MASH test criteria. The Engineer has determined that no other crash tests are necessary to determine the device meets the MASH criteria.

Engineer Name:	Emerson Ryder	
Engineer Signature:	Emerson Ryder — Digitally signed by Emerson Ryder Date: 2020.05.14 09:22:12 +12'00'	
Address:	L2, 254 Montreal St., Christchurch	Same as Submitter ☐
Country:	New Zealand	Same as Submitter ☐

A brief description of each crash test and its result:

Required Test Number	Narrative Description	Evaluation Results
3-30 (1100C)	See other Blue Systems request file BlueSystemAB_SAFENCE_10.0_T_19_date	PASS
3-31 (2270P)	See other Blue Systems request file BlueSystemAB_SAFENCE_10.0_T_19_date	PASS
3-32 (1100C)	See other Blue Systems request file BlueSystemAB_SAFENCE_10.0_T_19_date	PASS
3-33 (2270P)	See other Blue Systems request file BlueSystemAB_SAFENCE_10.0_T_19_date	PASS
3-34 (1100C)	See other Blue Systems request file BlueSystemAB_SAFENCE_10.0_T_19_date	PASS

Required Test Number	Narrative Description	Evaluation Results
3-35 (2270P)	The objective of this study was to evaluate the performance of the Blue Systems AB Safence Cable Barrier System (MashFlex) to the requirements of Test Level 3 (Test 3-35 only) as detailed in the Manual for Assessing Safety Hardware, MASH [2016]. MASH specifically addresses the performance requirements of terminal end barrier systems. Recommended tests to evaluate performance are defined for three different test levels. Test Level 3 (TL-3) is conducted at up to 100 km/h and considered representative of the typical maximum allowable speed on high-speed arterial highways. There are up to ten tests recommended within the MASH Test level 3 matrix for validating the crashworthiness of a non-releasing, gating and redirective terminal end. Testing undertaken with the 2270 kg pick-up (2270P) are primarily focused on evaluating the strength of the system. MASH notes that the safety performance of a highway appurtenance cannot be measured directly but con be judged on the basis of three factors; structural adequacy, occupant risk, and post-impact vehicular response. As per client request only Test 3-35 was required for this report. Holmes Solutions were independently contracted by the client to conduct the impact testing in accordance with MASH (2016). All testing was undertaken in accordance with the requirements of the ISO 17025 accreditation under the ILAC scheme. The test vehicle had a contact length of 43.0 m with the barrier system, a maximum working width and dynamic deflection of 3.10 m. Permanent deflection was measured as 0.57 m. Max roll was 6.7 degrees. Test date was 26th November 2019	PASS
3-36 (2270P)		Non-Relevant Test, not conducted
3-37 (2270P)	See other Blue Systems request file BlueSystemAB_SAFENCE_10.0_T_19_date	PASS
3-38 (1500A)		Non-Critical, not conducted
3-40 (1100C)		Non-Relevant Test, not conducted
3-41 (2270P)		Non-Relevant Test, not conducted
3-42 (1100C)		Non-Relevant Test, not conducted
3-43 (2270P)		Non-Relevant Test, not conducted
3-44 (2270P)		Non-Relevant Test, not conducted
3-45 (1500A)		Non-Relevant Test, not conducted

Full Scale Crash Testing was done in compliance with MASH by the following accredited crash test laboratory (cite the laboratory's accreditation status as noted in the crash test reports.):

Laboratory Name:	Holmes Solutions	
Laboratory Signature:	Emerson Ryder Digitally signed by Emerson Ryder Date: 2020.05.14 09:30:32 +12'00'	
Address:	7 Canterbury Street Hornby Christchurch	Same as Submitter ☐
Country:	New Zealand	Same as Submitter ☐
Accreditation Certificate Number and Dates of current Accreditation period :	accreditation certificate number 1022 accreditation dates 12th July 2019 to 12th July 2020	

Submitter Signature*: Jesper Sorensen Digitally signed by Jesper Sorensen Date: 2020.05.14 12:13:52 -07'00'

Submit Form

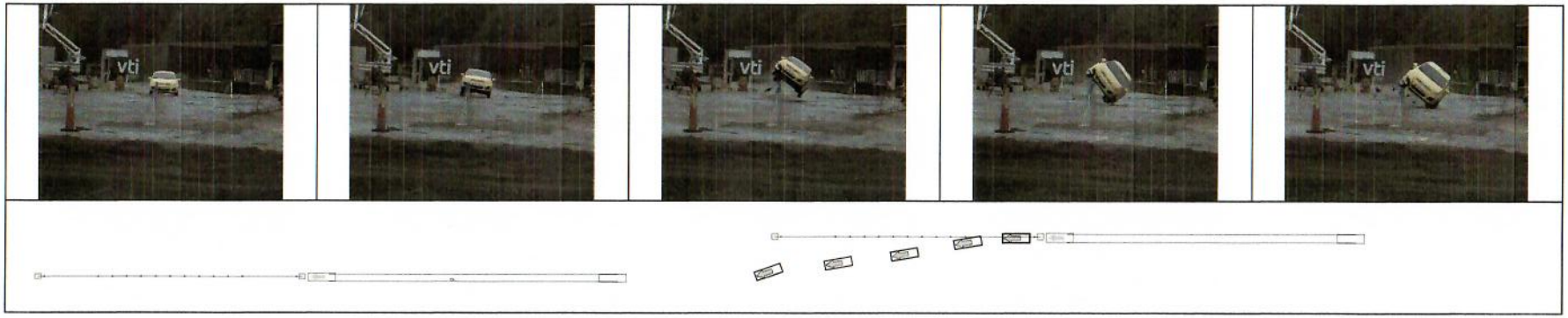
ATTACHMENTS

Attach to this form:

1) Additional disclosures of related financial interest as indicated above.
2) A copy of the full test report, video, and a Test Data Summary Sheet for each test conducted in support of this request.
3) A drawing or drawings of the device(s) that conform to the Task Force-13 Drawing Specifications [Hardware Guide Drawing Standards]. For proprietary products, a single isometric line drawing is usually acceptable to illustrate the product, with detailed specifications, intended use, and contact information provided on the reverse. Additional drawings (not in TF-13 format) showing details that are relevant to understanding the dimensions and performance of the device should also be submitted to facilitate our review.

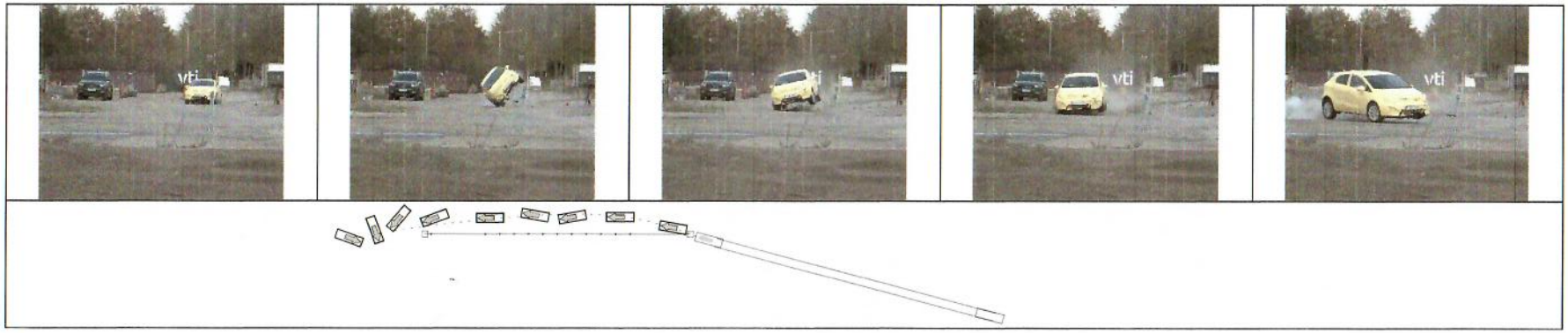
FHWA Official Business Only:

Eligibility Letter		
Number	Date	Key Words

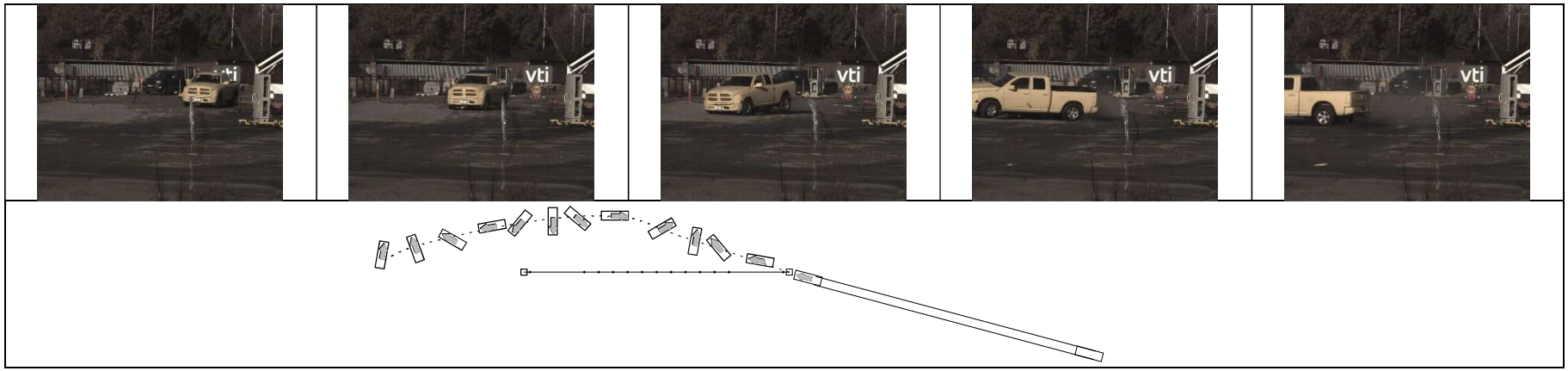


- Test Agency: VTI
- Test Number: R191009-1
- Date: 9th of October 2019
- Test Article: Blue Systems wire terminal
- Total Length: 10 meter over ground
- Key Elements – Terminal and barrier
  - Description – Wire rope sloped down end anchor/terminal
  - Length – 10 meters plus 1,7 meters below ground
  - Base Width – concrete anchor 1,1 meters wide at base
  - Height – barrier fullheight 0,83 meters
- Test Vehicle
  - Type/Designation: 1100C
  - Make and Model: KIA Rio 1,2 Edition komf
  - Curb: 1062 kg
  - Test Inertial: 1100 kg
  - Gross Static: 1175 kg
- Impact Conditions: MASH 3-30
  - Speed: 103,5 km/h
  - Angle: 0°
  - Location/Orientation - Vehicle centreline ¼ vehicular width offset, impact on terminal end anchor.
- Exit Conditions – continue up and over terminal and barrier.
  - Speed NA, neglectable speed reduction over terminal
  - Angle NA, along barrier.
- Post-impact Trajectory – on two wheels, then down along barrier
  - Vehicle Stability – on two wheels along terminal
  - Stopping Distance ~ NA, vehicle stops in perimeter protection 93 meter after barrier end.
- Vehicle Snagging – NA
- Vehicle Pocketing – NA
- Occupant Impact Velocity Longitudinal, OIV_x, 0,84 m/s
- Occupant Impact Velocity Lateral, OIV_y, 0,54 m/s
- Occupant Ridedown Acceleration Longitudinal, ORA_x, 4,55 g
- Occupant Ridedown Acceleration Lateral, ORA_y, 9,83 g
- THIV: 3,61 km/h
- PHD: 6,32 g
- ASI: 0,52
- Test Article Damage: top of posts are bent
- Test Article Deflections
  - Permanent Set: NA
  - Dynamic: NA
  - Working Width: NA
- Vehicle Damage
  - VDS: 12-FD-1
  - CDC: 12FZLN1
  - Maximum Deformation: NA

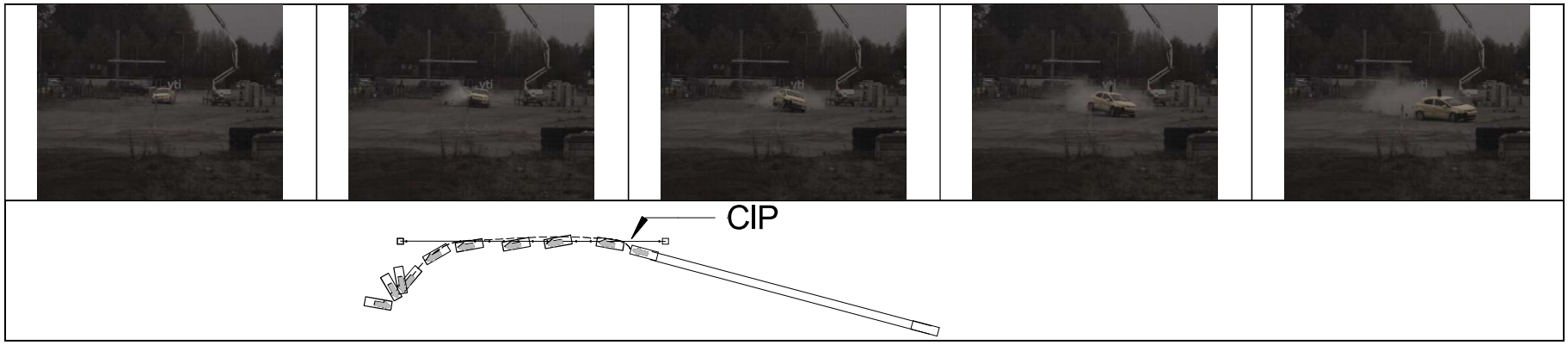
- Test Agency: VTI
- Test Number: R191016-1
- Date: 16th of October 2019
- Test Article: Blue Systems wire terminal
- Total Length: 10 meter over ground
- Key Elements – Terminal and barrier
  - Description – Wire rope sloped down end anchor/terminal
  - Length – 10 meters plus 1,7 meters below ground
  - Base Width – concrete anchor 1,1 meters wide at base
  - Height – barrier fullheight 0,83 meters
- Test Vehicle
  - Type/Designation: 2270P
  - Make and Model: DODGE 1500 RAM
  - Curb: 2640 kg
  - Test Inertial: 2175 kg
  - Gross Static: 2250 kg
- Impact Conditions: MASH 3-31
  - Speed: 101,98 km/h
  - Angle: 0°
  - Location/Orientation - Vehicle centreline aiming along barrier/terminal.
- Exit Conditions – vehicle runs over entire installation
  - Speed NA, continues over installation
  - Angle NA
- Post-impact Trajectory – runs over installation
  - Vehicle Stability – still on four wheels
  - Stopping Distance ~more than 120 meters
- Vehicle Snagging – no
- Vehicle Pocketing – no
- Occupant Impact Velocity Longitudinal, OIV_x, 1,06 m/s
- Occupant Impact Velocity Lateral, OIV_y, 0,79 m/s
- Occupant Ridedown Acceleration Longitudinal, ORA_x, 2,05 g
- Occupant Ridedown Acceleration Lateral, ORA_y, 1,12 g
- THIV: 4,64 km/h
- PHD: 1,76 g
- ASI: 0,18
- Test Article Damage: posts are bent
- Test Article Deflections
  - Permanent Set: NA
  - Dynamic: NA
  - Working Width: NA
- Vehicle Damage
  - VDS: 12-FD-1
  - CDC: 12FZLN1
  - Maximum Deformation



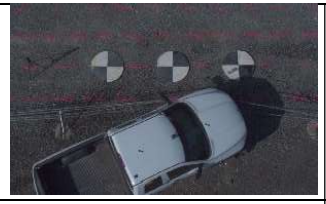
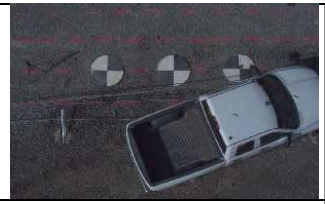
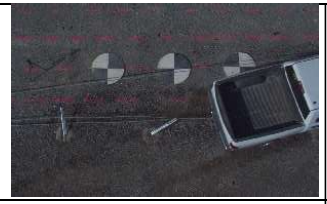
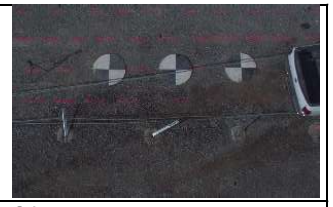
- Test Agency: VTI
- Test Number: R191022-1
- Date: 22nd of October 2019
- Test Article: Blue Systems wire terminal
- Total Length: 10 meter over ground
- Key Elements – Terminal and barrier
  - Description – Wire rope sloped down end anchor/terminal
  - Length – 10 meters plus 1,7 meters below ground
  - Base Width – concrete anchor 1,1 meters wide at base
  - Height – barrier fullheight 0,83 meters
- Test Vehicle
  - Type/Designation: 1100C
  - Make and Model: KIA Rio 1,2 Edition komf
  - Curb: 1062 kg
  - Test Inertial: 1090 kg
  - Gross Static: 1165 kg
- Impact Conditions: MASH 3-32
  - Speed: 106,19 km/h
  - Angle: 5°
  - Location/Orientation - Vehicle centreline aiming ground terminal end anchor.
- Exit Conditions – vehicle passes over terminal, rear left wheel partly caught by wire.
  - Speed NA, continues over terminal
  - Angle NA
- Post-impact Trajectory – Vehicle over terminal, left rear wheel partly caught by top wire, thus vehicle forced bak towards barrier and top wire removed from posts.
  - Vehicle Stability – no rollover.
  - Stopping Distance ~more than 120 meters, atopped in arrester bed.
- Vehicle Snagging – no
- Vehicle Pocketing – no
- Occupant Impact Velocity Longitudinal, OIV_x, 1,54 m/s
- Occupant Impact Velocity Lateral, OIV_y, 3,24 m/s
- Occupant Ridedown Acceleration Longitudinal, ORA_x, 1,42 g
- Occupant Ridedown Acceleration Lateral, ORA_y, 3,78 g
- THIV: 12,97 km/h
- PHD: 5,26 g
- ASI: 0,40
- Test Article Damage: posts are bent
- Test Article Deflections
  - Permanent Set: NA
  - Dynamic: NA
  - Working Width: NA
- Vehicle Damage
  - VDS: 12-FC-2
  - CDC: 12FCLN2
  - Maximum Deformation: top wire lifted



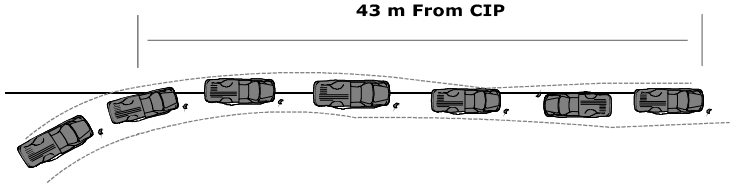
- Test Agency: VTI
- Test Number: R191031-1
- Date: 31st of October 2019
- Test Article: Blue Systems wire terminal
- Total Length: 10 meter over ground
- Key Elements – Terminal and barrier
  - Description – Wire rope sloped down end anchor/terminal
  - Length – 10 meters plus 1,7 meters below ground
  - Base Width – concrete anchor 1,1 meters wide at base
  - Height – barrier fullheight 0,83 meters
- Test Vehicle
  - Type/Designation: 2270P
  - Make and Model: DODGE 1500 RAM
  - Curb: 2640 kg
  - Test Inertial: 2250 kg
  - Gross Static: 2250 kg
- Impact Conditions: MASH 3-33
  - Speed: 103,15 km/h
  - Angle: 15°
  - Location/Orientation - Vehicle centreline aiming terminal ground end anchor.
- Exit Conditions – vehicles pass over terminal end
  - Speed NA, vehicle continues over terminal end
  - Angle NA
- Post-impact Trajectory – rotation, due to one wire attaching to rear axle aand wheel suspension.
  - Vehicle Stability – still on four wheels
  - Stopping Distance ~more than 65 meter, in arrester bed
- Vehicle Snagging – vehicle left rear wheel stuck on top wire
- Vehicle Pocketing – no
- Occupant Impact Velocity Longitudinal, OIV_x, 1,16 m/s
- Occupant Impact Velocity Lateral, OIV_y, 2,31 m/s
- Occupant Ridedown Acceleration Longitudinal, ORA_x, 1,63 g
- Occupant Ridedown Acceleration Lateral, ORA_y, 1,84 g
- THIV: 9,40 km/h
- PHD: 1,55 g
- ASI: 0,21
- Test Article Damage: post tops are bent sideways, top wire out of slot
- Test Article Deflections
  - Permanent Set: ~0,35 meters post sideways
  - Dynamic: NA
  - Working Width: NA
- Vehicle Damage
  - VDS: 12-FL-1
  - CDC: 12FYLN1
  - Maximum Deformation



- Test Agency — VTI
- Test Number — R191107-1
- Date — 7th of November 2019
- Test Article — Blue Systems wire terminal
- Total Length — 10 meter over ground
- Key Elements – Terminal and barrier
  - Description – Wire rope sloped down end anchor/terminal
  - Length – 10 meters plus 1,7 meters below ground
  - Base Width – concrete anchor 1,1 meters wide at base
  - Height – barrier fullheight 0,83 meters
- Test Vehicle
  - Type/Designation — 1100C
  - Make and Model — KIA Rio 1,2 Edition komf
  - Curb — 1062 kg
  - Test Inertial — 1100 kg
  - Gross Static — 1175 kg
- Impact Conditions — MASH 3-34
  - Speed — 100,0 km/h
  - Angle — 15°
  - Location/Orientation – Critical impact point, point assumed to be the point where terminal changes from gating to non-gating functionality.
- Exit Conditions – vehicle contained, like a barrier.
  - Speed 65 km/h
  - Angle ~5°
- Post-impact Trajectory – vehicle contained, but rear right hand wheel stuck on wire, which affect vehicle trajectory out of barrier.
  - Vehicle Stability – stable, still on four wheels
  - Stopping Distance – NA, vehicle into concrete perimeter protection by end of test area.
- Vehicle Snagging – rear right vehicle wheel stuck on wire
- Vehicle Pocketing – vehicle wheel stuck on wire
- Occupant Impact Velocity Longitudinal, OIV_x, — 1,58 m/s
- Occupant Impact Velocity Lateral, OIV_y, — 4,13 m/s
- Occupant Ridedown Acceleration Longitudinal, ORA_x, — 4,77 g
- Occupant Ridedown Acceleration Lateral, ORA_y, — 6,94 g
- THIV — 15,8 km/h
- PHD — 9,3 g
- ASI — 0,47
- Test Article Damage — posts are bent forward, wire detached, contact length 30 meters.
- Test Article Deflections
  - Permanent Set — 0 meters
  - Dynamic — 0,70 meters
  - Working Width — 0,70 meters
- Vehicle Damage
  - VDS — 1-FR-3
  - CDC — 01FREW3
  - Maximum Deformation — NA

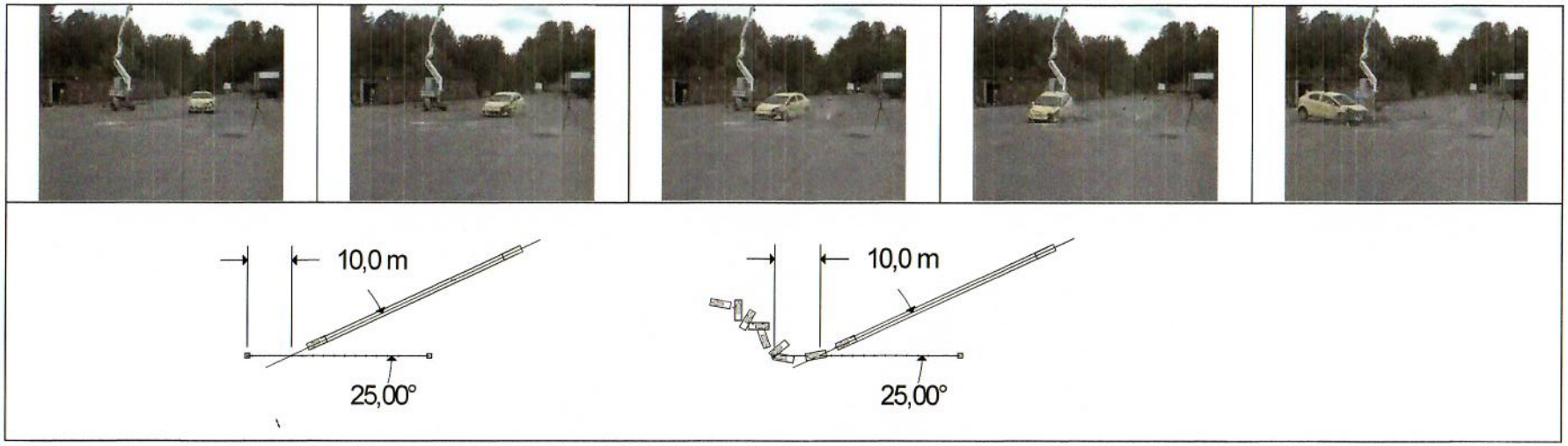






0.0 s	0.1 s	0.2 s	0.3 s	0.4 s



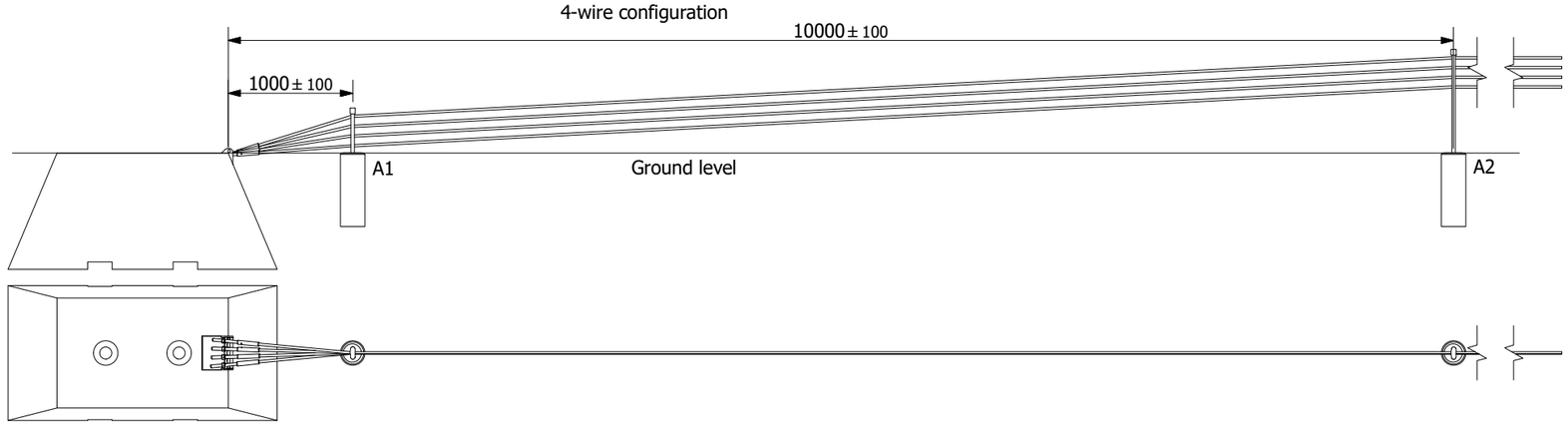
Test Article:	MashFlex WRSB
Total Length	137.5 m
Key Elements - Barrier	MASH TL3-35
Description	Wire Rope Safety Barrier 2.5 m Post Spacing
Length of Barrier Installation	137.5 m
Cable Heights	Transitioning from 0mm to 570 mm, 670 mm, 780 mm & 800 mm
Ground Conditions	AASHTO Standard Soil
Test Vehicle	
Designation	2270P
Make/Model	Dodge Ram
Dimensions (LxWxH)	5750 mm x 2000 mm x 3550 mm
Curb Wt	2184.5 kg
Test Inertial Wt	2234.5 kg
Gross Static	2235.5 kg
Impact Conditions	
Speed	99.1 km/h
Angle	24.8°
Impact Point	770 mm Upstream of LoN Post 1
Exit Conditions	
Exit Speed:	n/a
Exit Angle:	n/a
Test Number	138879.3-35
Test Date	26th November 2019

Post Impact Vehicle Behaviour	
Vehicle Stability	Good
Stopping Distance	43.0 m from CIP
Vehicle Snagging	None
Vehicle Pocketing	None
Occupant Impact Velocity	at 0.2131 seconds on left side of interior
Longitudinal	2.6 m/s
Lateral (optional)	-2.8 m/s
Occupant Ride-down Deceleration	
X-direction	-4.1 (1.4724 - 1.4824 seconds)
Y-direction	3.5 (0.4860 - 0.4960 seconds)
THIV (optional) m/s	3.6 at 0.1940 seconds on left side of interior
PHD (optional) g	4.2 (0.5179 - 0.5279 seconds)
ASI (optional)	0.37 (0.3532 - 0.4032 seconds)
Test Article Damage	Minor
Test Article Deflections	
Dynamic	3.10 m
Permanent	0.57 m
Working Width	3.10 m
Vehicle Damage Exterior	
VDS	11LF-3
CDC	11LFEE3
Maximum Deformation	80 MM

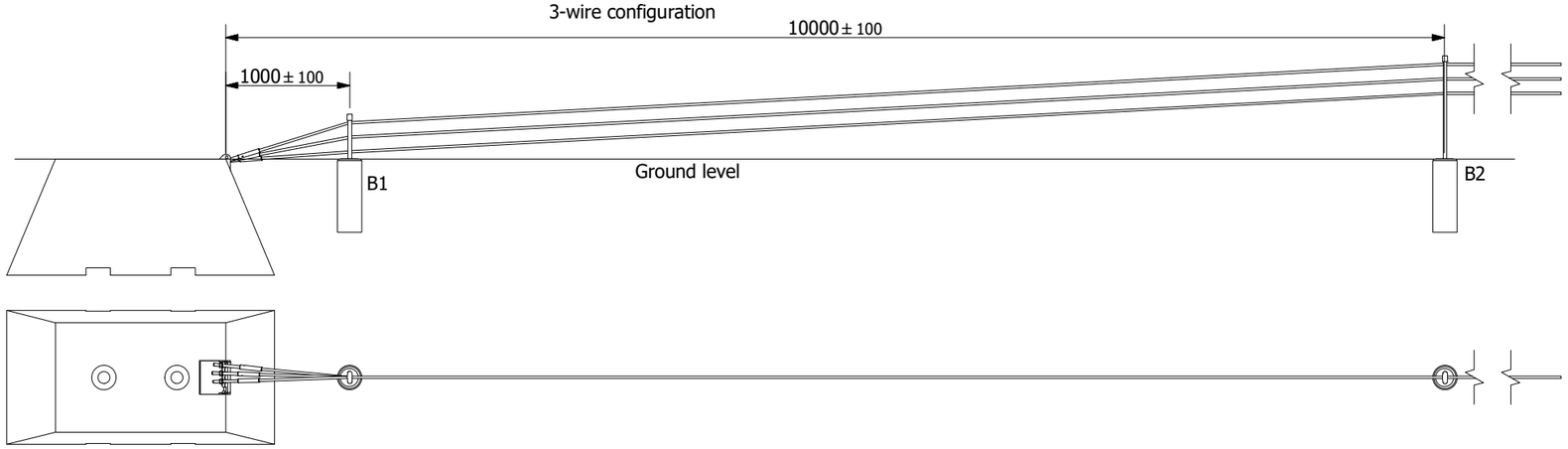


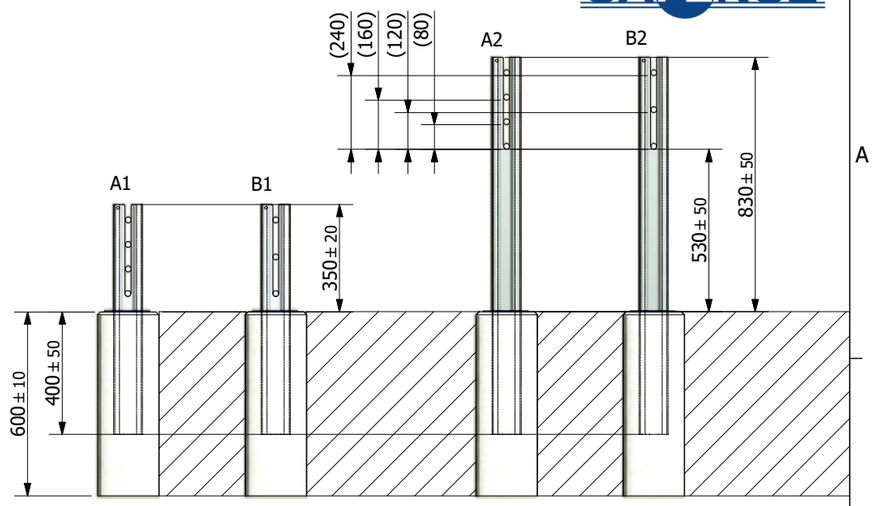
- Test Agency: VTI
- Test Number: R191004-1
- Date: 4th of October 2019
- Test Article: Blue Systems wire terminal
- Total Length: 10 meter over ground
- Key Elements – Terminal and barrier
  - Description – Wire rope sloped down end anchor/terminal
  - Length – 10 meters plus 1,7 meters below ground
  - Base Width – concrete anchor 1,1 meters wide at base
  - Height – barrier fullheight 0,83 meters
- Test Vehicle
  - Type/Designation: 1100C
  - Make and Model: KIA Rio 1,2 Edition komf
  - Curb: 1062 kg
  - Test Inertial: 1112 kg
  - Gross Static: 1187 kg
- Impact Conditions: MASH 3-37b
  - Speed: 100,6 km/h
  - Angle: 25°
  - Location/Orientation - Vehicle centreline aiming first/last fullheight barrier post.
- Exit Conditions – snagging, rotation to full stop
  - Speed NA, comes to full halt
  - Angle NA
- Post-impact Trajectory – snagging, rotation to full stop
  - Vehicle Stability – still on four wheels
  - Stopping Distance ~46,9 meters from terminal end
- Vehicle Snagging – vehicle wheel stuck on terminal
- Vehicle Pocketing – vehicle wheel stuck on terminal
- Occupant Impact Velocity Longitudinal, OIV_x, 3,35 m/s
- Occupant Impact Velocity Lateral, OIV_y, 4,78 m/s
- Occupant Ridedown Acceleration Longitudinal, ORA_x, 12,57 g
- Occupant Ridedown Acceleration Lateral, ORA_y, 8,06 g
- THIV: 20,73 km/h
- PHD: 12,29 g
- ASI: 0,97
- Test Article Damage: posts are bent
- Test Article Deflections
  - Permanent Set: ~0,65 meters (post)
  - Dynamic: 1,52 meters
  - Working Width: NA
- Vehicle Damage
  - VDS: 12-FD-5
  - CDC: 11FYEW4
  - Maximum Deformation

SAFENCE T10.0-19
4-wire configuration



SAFENCE T10.0-19
3-wire configuration

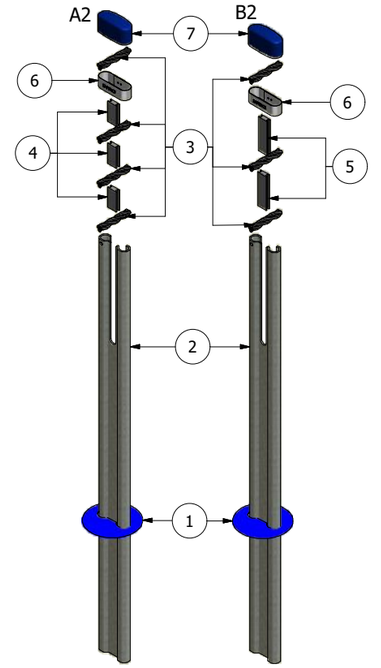


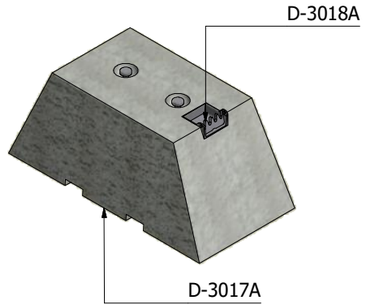


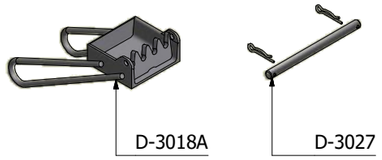
Posts (A1, B1) are to be shortened by bottom-end to the specified length. The wire-rope terminal is to follow the contours and line of the road without any visible horizontal or vertical deviations.

Safence T10.0-19 deploys either Safence C-post or Safence I-post. Safence C- and I-post profiles are fully equivalent in terms of methods of assembly and functionality, differing in profile dependent installation components.

For further enquires regarding installation or functionality of Safence wire-rope safety barrier please contact Safence, Inc.







Wire-rope fixation

SAFENCE T10.0-19 is approved with the following wire-rope fixation:
- Closed anchor axis (D-3027A)
- Wire fitting (D-3023A)
- Embedded anchor part (D-3018A)

Footing options

SAFENCE T10.0-19 is approved with the following post foundations:
- Concrete footing (D-3012)
- Steel sleeve (D-3034)

Post Assembly Part List

Balloon	Detail name	Stock number	Drawing No.	Note
1	C-Ground cover	AVC38-200BL	D-3009A	
2	C-Post	AVC30-1230-G	D-3008A	
3	Wire-rope			
4	Steel spreader	AVI/C35-061-G	D-3022A	4 Wire-ropes
5	Steel spreader	AVI/C35-101-G	D-3021B	3 Wire-ropes
6	Stiffening frame	AVC37-030-SS	D-3011A	
7	C-Cap	AVC39-085BL	D-3010A	

Drawn	Date	Acceptance standard	Units	Sheet size
Daniel Maglica	2019-10-21	MASH	mm	A3

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Name: SAFENCE T10.0-19

Drawing no.: SRB-3105

Rev: