



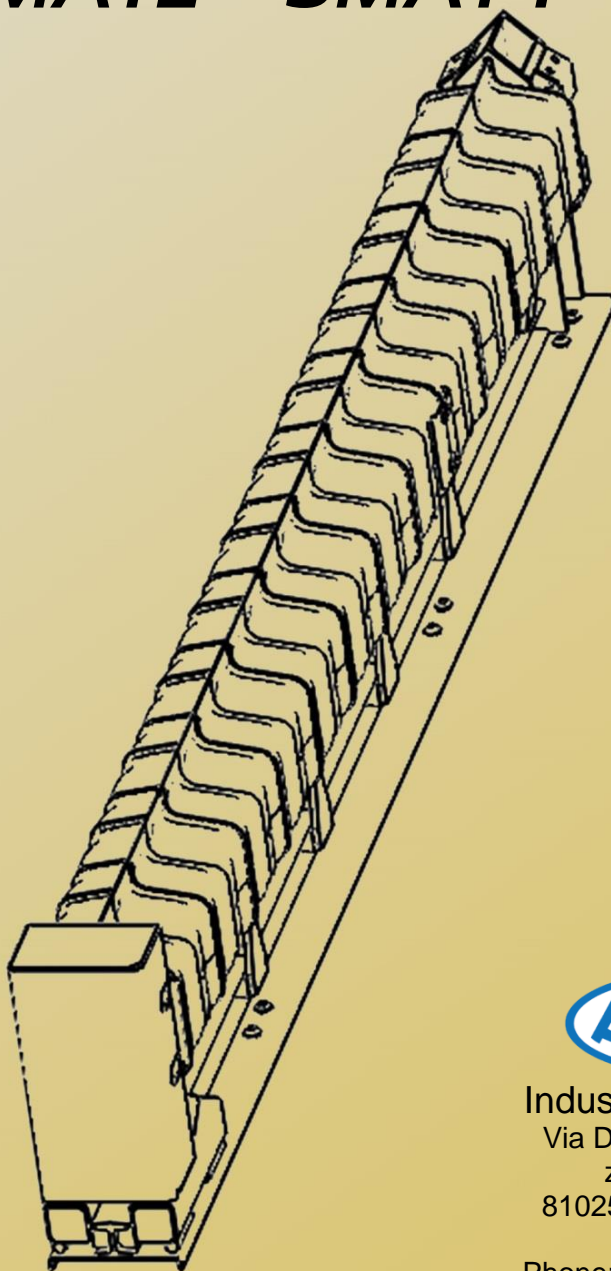
SMA[®]

safety modular absorber

End Terminals

Installation and Repair Manual

SMAT2 – SMAT4



Industry A.M.S. s.r.l.

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1. GENERAL

1.1 Foreword

The following document represents the SMA® (Safety Modular Absorber) Installation and Repair Manual for the End Terminals, developed from the Company Industry A.M.S. srl, which has its seat in Marcianise (CE), ITALY. Copyright 2015, all rights reserved.

1.2 Crash Test

SMA® End Terminals have successfully passed the Crash tests according to the European standard ENV1317-4 and prEN 1317-7.

The crash tests have been performed by the Test Lab of **Certification Security Institute (CSI) S.p.A.**, with its site in Viale Lombardia 20, Bollate (MI), Italy.

The test results are shown in (Tab. 1) below:

Tab. 1: Summary of the test reports, as confirmed by the Certification Security Institute.

Test report code	Test	ASI-1998	ASI-2010	THIV (km/h)	PHD (g)	Exit box	Lateral Displ.	Standard
0136/ME/HRB/14	TT 1.3.110	1.4	1.4	41	20	Z1	D1	ENV 1317-4 / prEN 1317-7
0135/ME/HRB/14	TT 2.1.100	1.3	1.3	43	20	Z1	D1	ENV 1317-4 / prEN 1317-7
0134/ME/HRB/14	TT 4.3.110	1.1	1.1	32	14	Z1	D1	ENV 1317-4 / prEN 1317-7
0137/ME/HRB/14	TT 5.1.100	1.3	1.2	32	7	Z1	D1	ENV 1317-4 / prEN 1317-7
0155/ME/HRB/14	TT 6.3.110*	n.a.	1.3	30	n.a.	Z1	D1	prEN 1317-7
0157/ME/HRB/14	TT 3.3.110	n.a.	1.1	40	n.a.	Z1	D1	prEN 1317-7
0020/ME/HRB/16	TT 6.3.110	n.a.	0.9	20	n.a.	Z1	D1	prEN 1317-7
0154/ME/HRB/14	TT 2.1.80	1.1	1.1	40	18	Z2	D1	ENV 1317-4 / prEN 1317-7

* test on the Critical Impact Point

1.3 SMA End Terminals: Components

All the components described below are assembled with different size and type of bolts in order to make the installation and/or the repair procedure easier.

1	Collapsible steel beam formed by modular bays;
2	End terminal backstop;
3	Tie rods welded to the collapsible steel beam;
4	Trolley;
5	Lateral plates – for fixing the trolley and the modular bays;
6	Post plates for fixing the terminal rail to the posts;
7	Posts with welded post plate
8	Transition Connection Pieces (see Section 1.5)

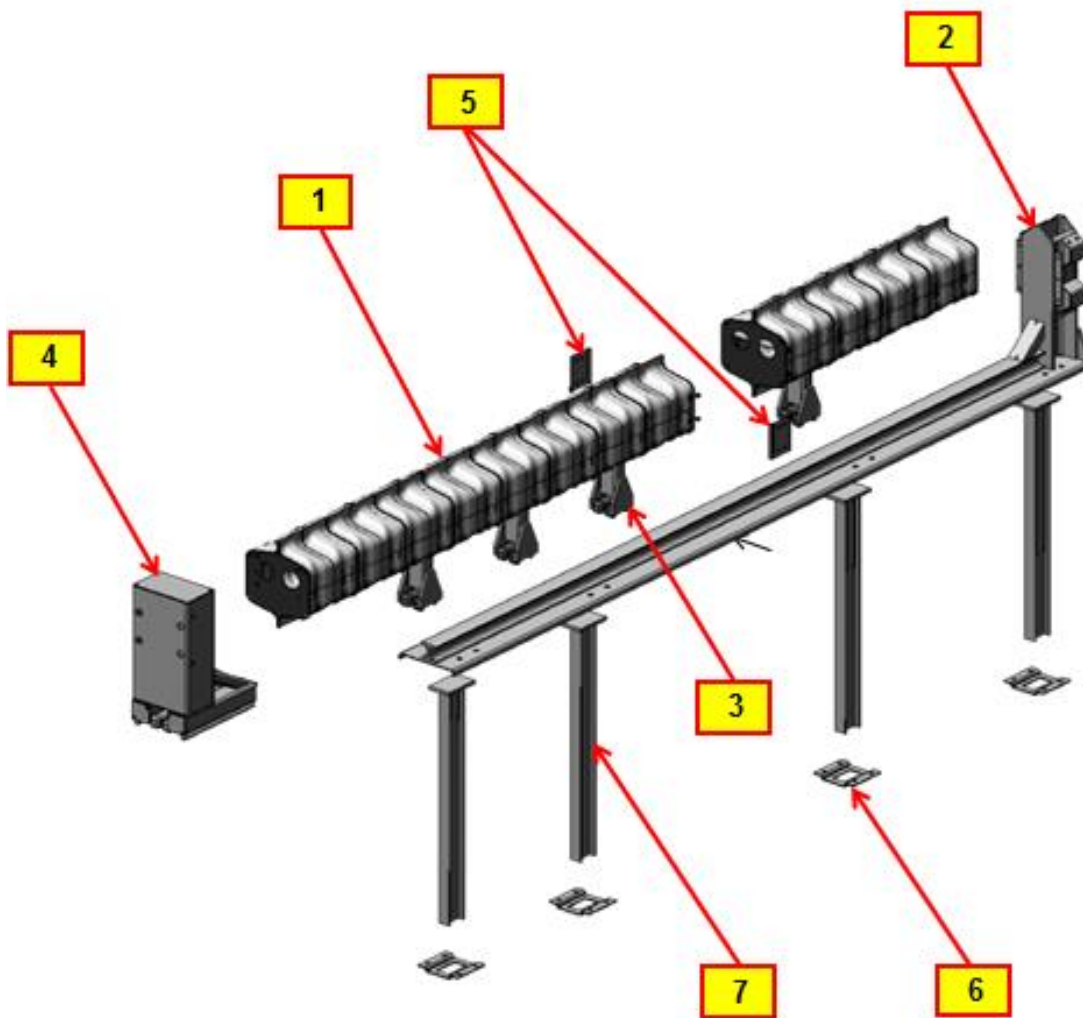


Fig. 1: End Terminal Components SMA T2

1.4 SMA End Terminals: Family and Dimensions

- **SMA T 2** for speed class 80 km/h (also called “P2” according to the Standard ENV 1317-4 or “T 80” according to prEn 1317-7).
- **SMA T 4** for speed class 110 km/h (also called “P4” according to the Standard ENV 1317-4 or “T 110” according to prEn 1317-7).

SMA T 2	Speed class: 80 Km/h		
Dimensions	Length: 3470 mm	Height from ground level: 620 mm	Width: 280 mm

SMA T 4	Speed class: 110 Km/h		
Dimensions	Length: 5840 mm	Height from ground level: 620 mm	Width: 280 mm

1.5 Transitions Connection Pieces

SMA End terminal has performed the crash tests with the following transition:

Type of barrier	Containment level	Working width
W Beam barrier	H2	W4

Industry A.M.S. has designed and manufactured the SMA Transition Piece which permits the connection between the End Terminal and the different longitudinal barrier systems.

It will be supplied together with the End Terminal (see also Section **2.7** for further details).

SMA Transition pieces can be:

Single sided: which is used for connections to barriers in the verge;

Double sided: which is used for connections to barriers in the median or central reserve.

Furthermore AMS Srl. provides SMA Transition Pieces to connect to different types of end/start barrier types. For example:

Tab. 2: Transition types

TYPE 1	from double wave to double wave
TYPE 2	from double wave to three wave
TYPE 3	connection to New Jersey
TYPE 4	from double wave to double wave sloped beam

1.6 NFC Technology

SMA® End Terminals are supplied with a tag behind the Backstop (Fig. 2) for the NFC (Near Field Communication) technology compatible with tablet and smartphone provided with OS **Android**.

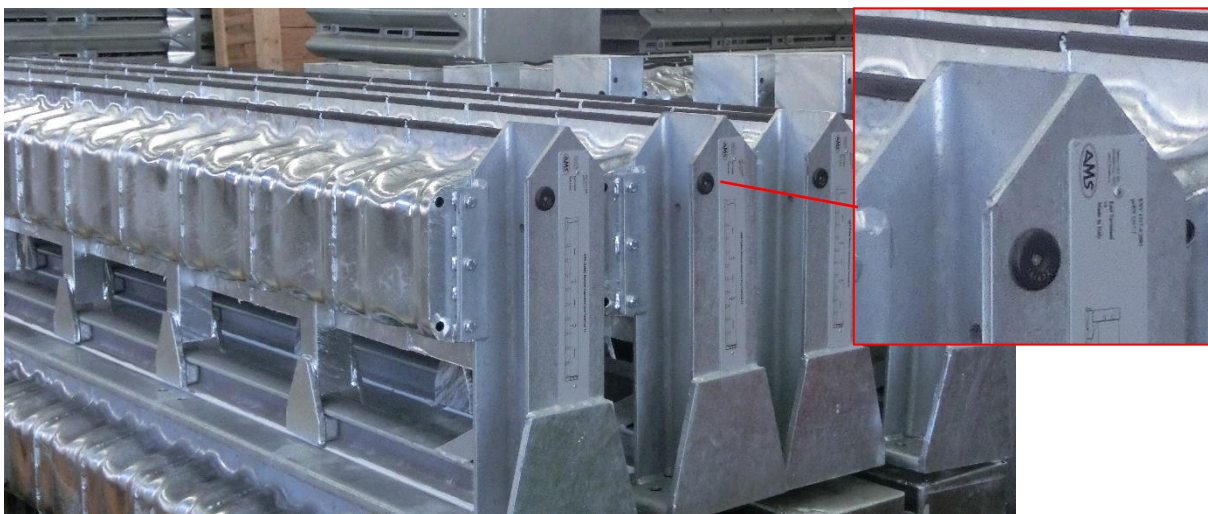


Fig. 2: Tag on the backstop of the End Terminal.

When contacting the tag with a device, an authorization is released by Industry A.M.S. It is then possible to open **SMA Road Safety**, access to the guided procedure for installation and repair.

1.7 Customer service

Industry A.M.S. s.r.l. commits to supply customer service at the highest level.

The Company welcomes the comments concerning the quality and the manufacturing of its products, the installation procedure and the supporting documentation.

The clients are invited to contact the Company in the following ways:

e-mail: info@amssrl.com

phone: +39 0823 821560

2. INSTALLATION PROCEDURE

2.1 Foreword

The End Terminal is provided already assembled in every part. For this reason, it is only necessary to fit the posts into the ground and attach the terminal to the post plates.

It is mandatory to observe the health and safety norms. **Industry A.M.S. srl** does not accept any liability in case of non-fulfillment of the local standards and norms.

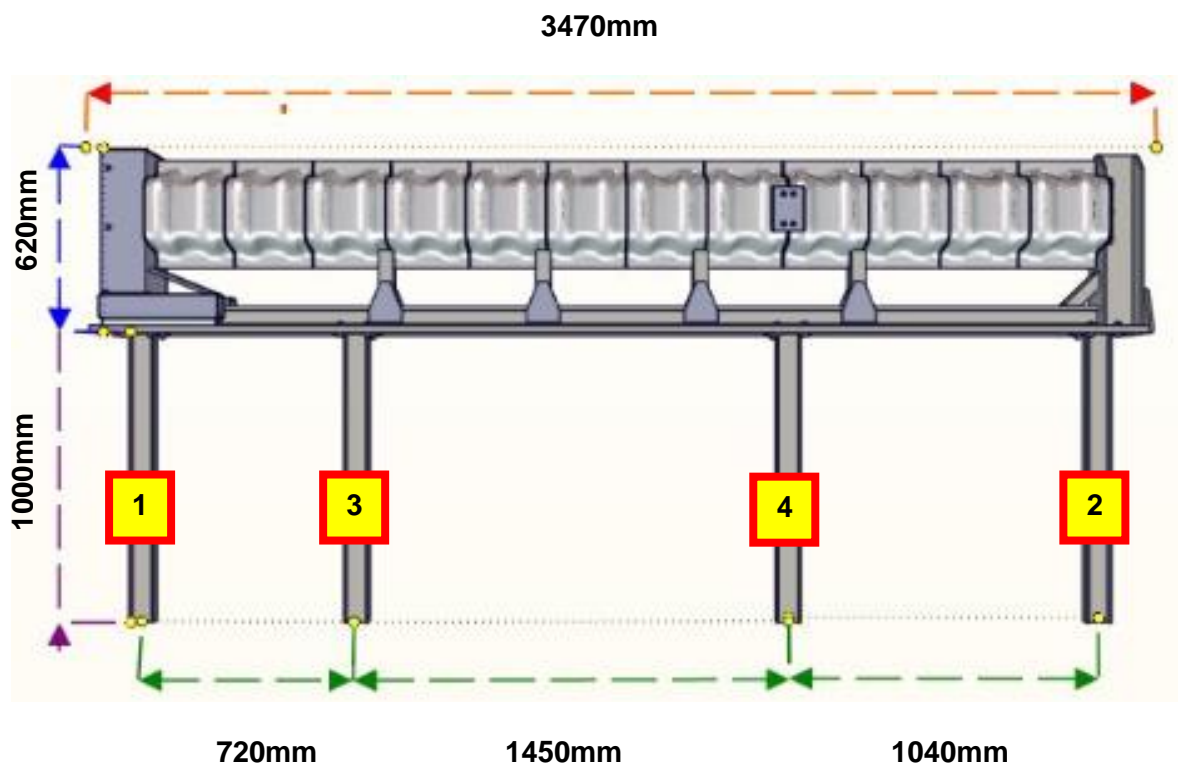


Fig. 3: Side view of the End Terminal SMA T2.

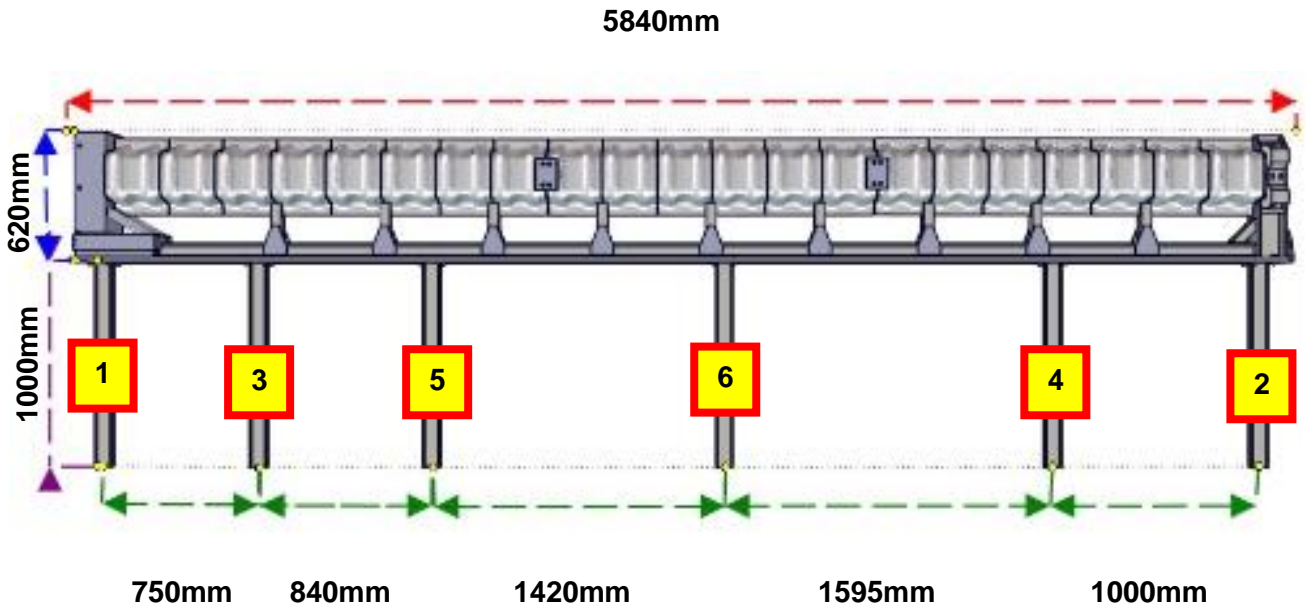


Fig. 4: Side view of the End Terminal SMA T4

2.2 Installation tools

- Post template to accurately positioning of posts (supplied on request);
- Impact wrench and Dynamometric wrench for bolts M16 – M10;
- Hand tools;
- Pile driver;
- Post head piece for post driver.
- Drill or Down The Hole (DTH) hammers (only for harder grounds)

2.3 Positioning of the End Terminal to the barrier

SMA® End terminal must be placed parallel to the roadway and perpendicular to the ground.

Moreover it must be connected to the barrier with the **SMA® transition**.

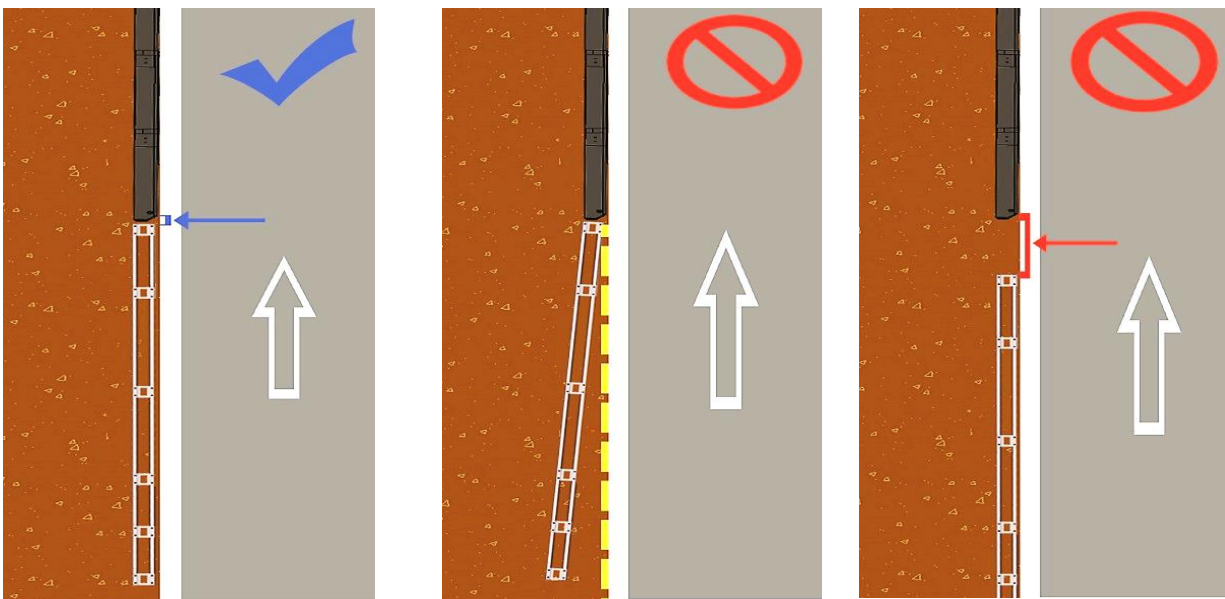


Fig. 5: Top view of the post template position and possible errors.

2.4 Installation procedure

SMA[®] End Terminals can be installed in soil and/or on asphalt.

It is mandatory that the ground class is between **3** and **5** according to the Soil Condition Classification **DIN 18300**.

Before starting the installation, it is required to:

- adequately level the ground;
- secure the working zone;
- provide safety equipment;
- set-up Traffic Management system.

⚠ If the ground conditions are too soft or there are services in the installation line, proceed as described in Appendix A.

⚠ If rock is encountered in the subsoil during the works, **Industry A.M.S.** suggests to proceed as indicated at Paragraph 2.5.

Ramming the posts

Please ram the posts in the sequence as indicated in the pictures Fig. 2 -3 (optionally it is possible to follow the procedure as described at par. 2.5).

*You can find a video of the installation procedure on our Youtube channel **SMA Road Safety** at the following link:*

<https://www.youtube.com/watch?v=VwH0rrY8skg&feature=youtu.be>

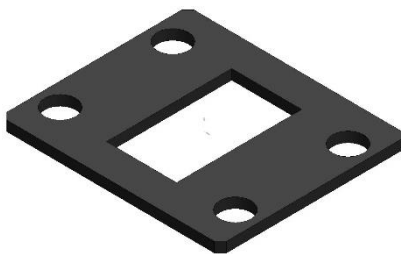


Fig. 6: Installation plate



Fig. 7: Template for positioning the installation plates.



Fig. 8: Positioning of the installation plates by using the template for SMA T2-SMA T4

1. Place the installation plates (Fig. 6) on the ground in front of the barrier. The plates must be placed according to the post spacing as indicated by the green line in Fig. 2-3.
2. Screw the couple of brackets¹ (Fig. 7) to the installation plates as shown in Fig. 8.
3. Drive the post no.1 into the ground through the hole of the installation plate with the post driver (Fig.9). To avoid damage to the post, it is recommended to use the adaptor for the post driver². It is inserted into the pile driver and screwed on the plate of the post to be rammed. This tool can be supplied by **Industry AMS srl** (Fig. 10).



Fig. 9: Driving of the post type IPE 80 with welded plate.



Fig. 10: Tool for the post driver screwed onto the post

¹ The brackets are supplied on request by Industry A.M.S.

² The adaptor for the pile driver is supplied on request by Industry A.M.S.

- ⚠ It is compulsory that the post is in a vertical position during the ramming (Fig. 11).



Fig. 11: Check with a spirit level

- ⚠ The post must be driven into the soil as deep as the upper plate on the post so that it is at the same level as the ground. (Fig. 12).

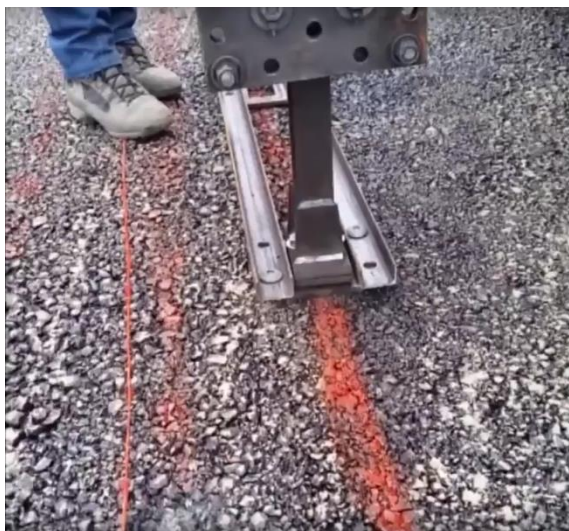


Fig. 12: Ramming complete

4. Proceed with the insertion of the posts numerically next to the no. 1 as in Fig. 3-4.
5. Unscrew the brackets from the installation plates.
6. Clean the plates from dusts and debris before connecting the **SMA**[®] End Terminal

Fixing of End Terminal and Transition

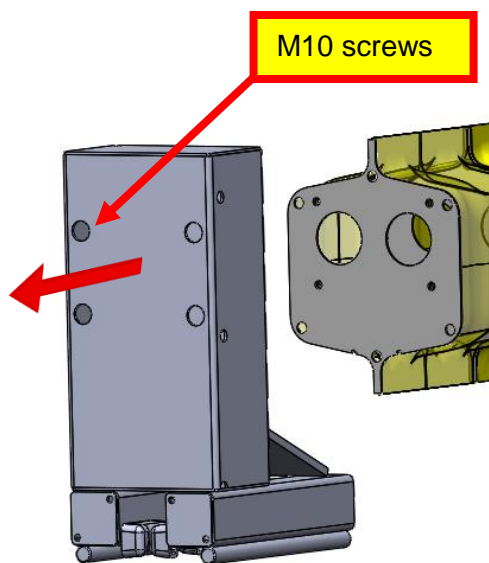


Fig. 13: The Trolley is slid forward along the rail to permit the fixing of the installation plates.

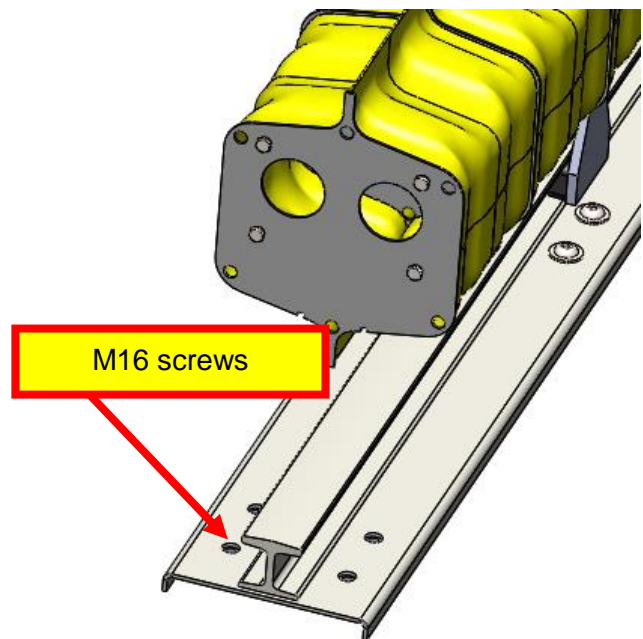


Fig. 14: Top view of the End terminal without the Trolley.

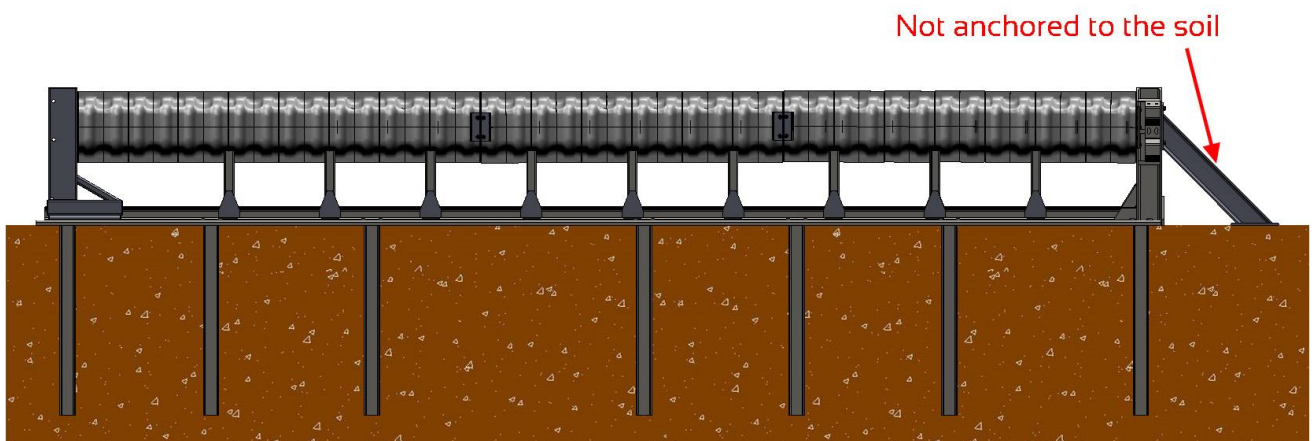


Fig. 15: Side view of the End terminal installed on the soil

7. Unscrew the 4 no. M10 bolts of the Trolley in the frontal holes, then remove it by sliding it long the rail with the support of a handling device (Fig. 13-14).

8. Fix the **SMA**[®] End Terminal on the post plates and screw the M16 screws to the plate with a tightening torque of min. 90Nm and max 210Nm (class 8.8).



The last inclined element behind the backstop does not need to be anchored to the soil.

9. Replace the Trolley and tighten the M10 screws with a tightening torque of min. 41 and max. 60 Nm.
10. Place the End terminal transition piece in order to connect the back-up to the barrier (see par. 2.7).
11. Fix the transition piece (see par. 2.7) with M16 bolts, tightening torque 90-210Nm (class 8.8). In case of double sided transitions, the same procedure applies to both sides.

2.5 Installation in harder soil conditions

If the ground is too hard to drive the posts with the pile driver (ground classes **6** and **7**), it is necessary to use a different installation procedure. This procedure can also be used as optional to the standard procedure.

1. Drill the ground with a drill or DHT hammer for the post insertion (depth **1 m. Ø 120 mm**)
2. Place the installation plates beside the holes.
3. Fill the holes with concrete $R_{ck} \geq 25$ Mpa.
4. Insert the post and ensure that the post plate is at ground level.
5. Wait for the concrete cure time and make sure the post plates are clean.
6. Proceed as described at paragraph 2.7.

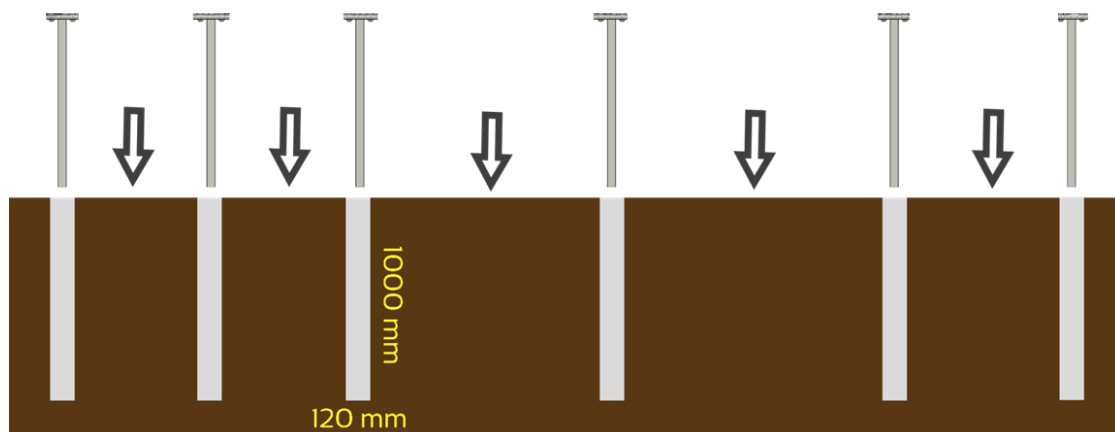


Fig. 16: The picture shows the post insertion of the SMA T 4 after filling in the concrete.

2.6 Solution for working zones

The SMA[®] End Terminal can also be used as a temporary re-directive solution for working zones (Fig. 16).

In this case, the SMA device is fixed on a steel plate which is positioned in front of the obstacle without drilling the ground.



Fig. 17: SMA temporary solution for working zones

The device is supplied already mounted on the steel plate, so the installation procedure is very simple and fast:

- 1) Place the End Terminal for working zones in front of the obstacle.
- 2) Fix the End Terminal to the obstacle with a suitable connection.

After the road works, it is possible to unscrew the connection and remove the SMA End Terminal by lifting it from the ground.

2.7 Installation of the standard Transition Piece

The transition piece will be supplied according to the barrier specifications.

⚠ The customer has to advise the following information:

- Beam profile of the barrier system;
- Height from the ground;
- Dynamic deflection;
- Position of the bolt holes on the beam profile;
- Connection side of the barrier (Fig. 15)

Fixing procedure

1. Match the holes on the transition with the holes on the end/begin of the barrier
2. Screw the transition to the end/begin of the barrier by mean of M16 bolts, with a tightening torque of min. 90Nm and max 210 Nm (bolts class 8.8).

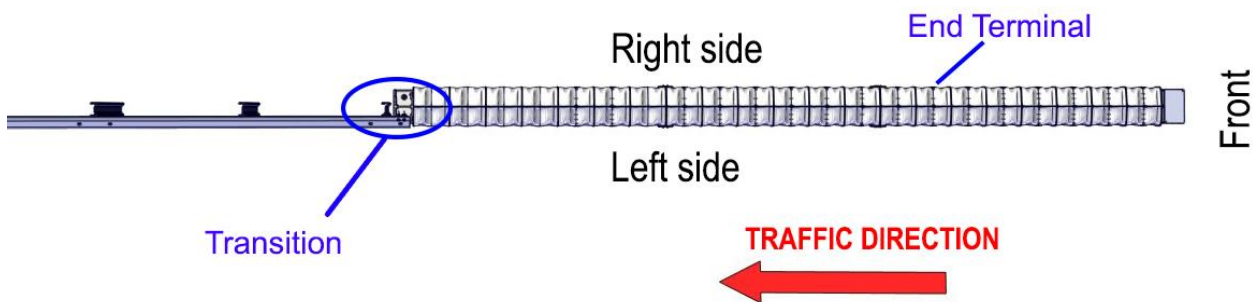


Fig.18: Top view of the End Terminal connected to the barrier.

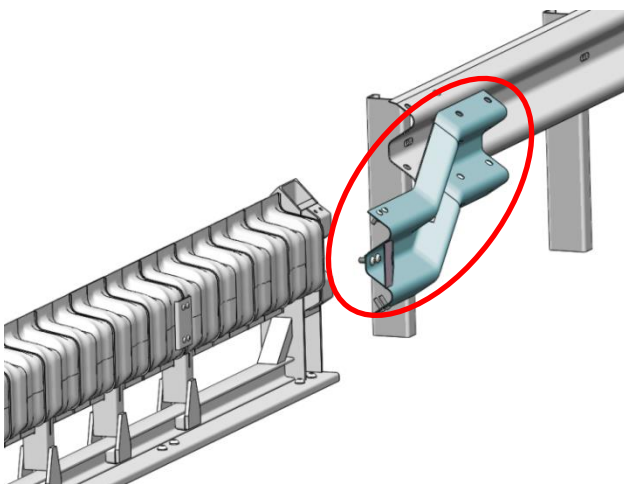


Fig. 19: Example of standard transition piece to two wave beam barrier

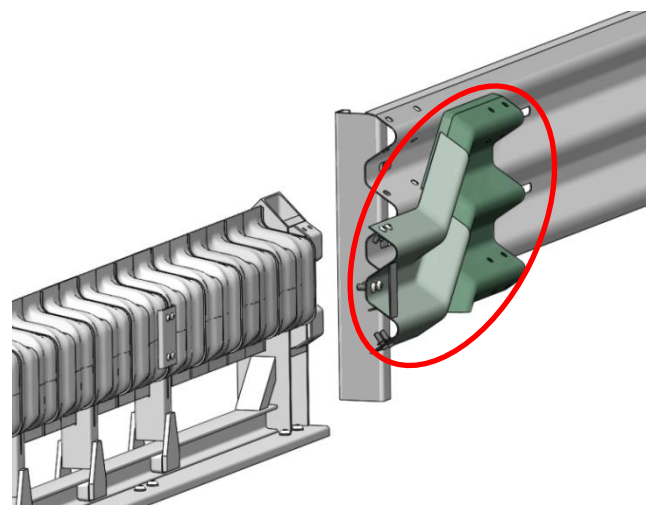


Fig. 20: Example of transition piece to three wave beam barrier

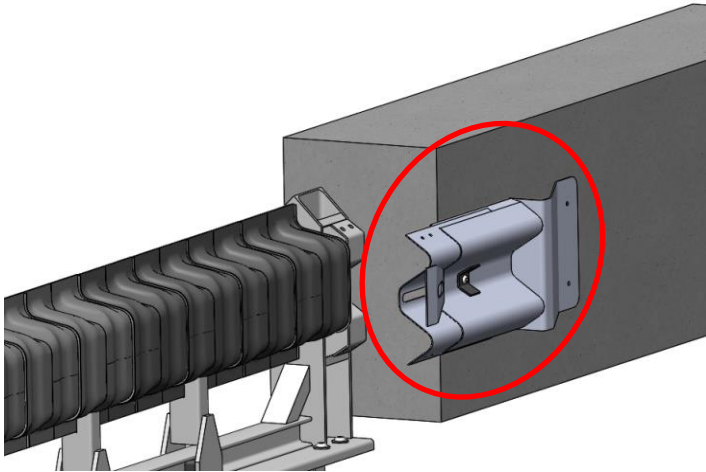


Fig. 21: Example of transition piece to concrete barrier.

2.8 Crash test on the transition

The SMA End terminal has been tested according to the standard EN 1317 by using a Transition Section between the safety barrier system and the terminal.

For the Crash test TT 6.3.110 the End Terminal has been connected to the barrier **Marcegaglia N2W2**. Such barrier has performed the crash test TB11 with the following results.

Tab 3: Test results of the Crash Test TB11 on the 2 wave side N2W2 Guardrail manufactured by Marcegaglia.

Test	Facility	Type	Barrier length m	Mass kg	Speed km/h	ASI max 1.4	D m	W m
TB32	Aisico	Side 20°	84	1.500	110	1=A	0,7	0,8=W2
TB11	Aisico	Side 20°	84	900	100	0,9=A	0,6	0,7=W2

The results of the Crash test on the End terminal are indicated in Tab. 1 at the paragraph 1.2.

According to the draft **FprEN1317-7:2014** the SMA End terminal can be connected to each type of N2W2 barrier without the any requirement of further tests. In fact, at the paragraph 5 of the draft **FprEN1317-7:2014** it is explained as follows:


“After a successful test with Approach 6, the Approach 6 test shall not be repeated if the terminal is connected to a barrier with a lower dynamic deflection (in the EN1317-2 TB11 test), but shall be retested with Approach 6 if connected to a barrier with a greater dynamic deflection (in the EN1317-2 TB11 test).

If the difference between the two dynamic deflections is less than 20%, the Approach 6 test shall not be performed with the barrier with a greater dynamic deflection.”

2.9 Transition Section and Installation

The Transition Section consists of 8m of an N2W2 barrier system. (Fig.22 & 23).

The 4m section at the terminal end is sloped down to connect with the backstop of the terminal by means of a connection piece.

 Industry A.M.S. does not supply this Transition Section but only the component which connects the End Terminal and the barrier (Fig. 24). If the existing barrier has a Working Width higher than W2, the installer must fit appropriate transition sections between the different Working Widths as per the manufacturers recommendations or local standards.

In the example below (Fig. 22 & 23) the last section of the transition barrier is sloped down.

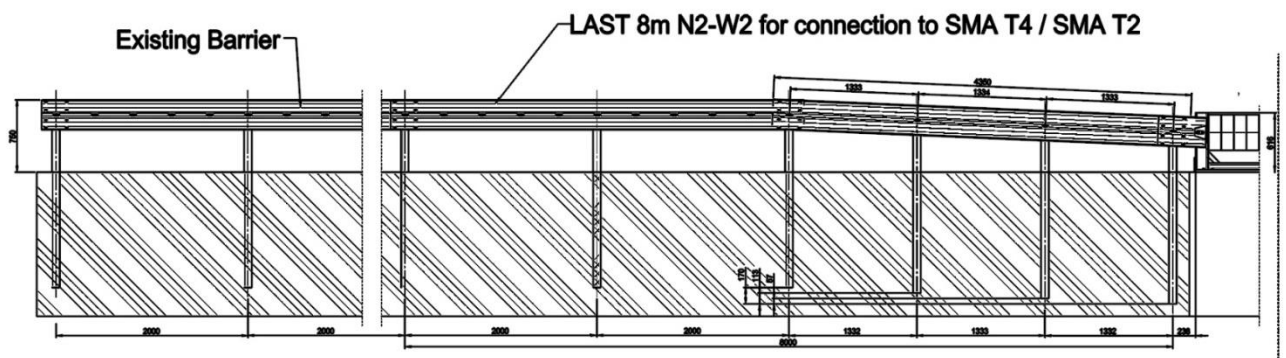


Fig. 22: Connection of the barrier to the End Terminal – complete view.

Ram the posts with the pile driver in order to connect the barrier to the End Terminal.

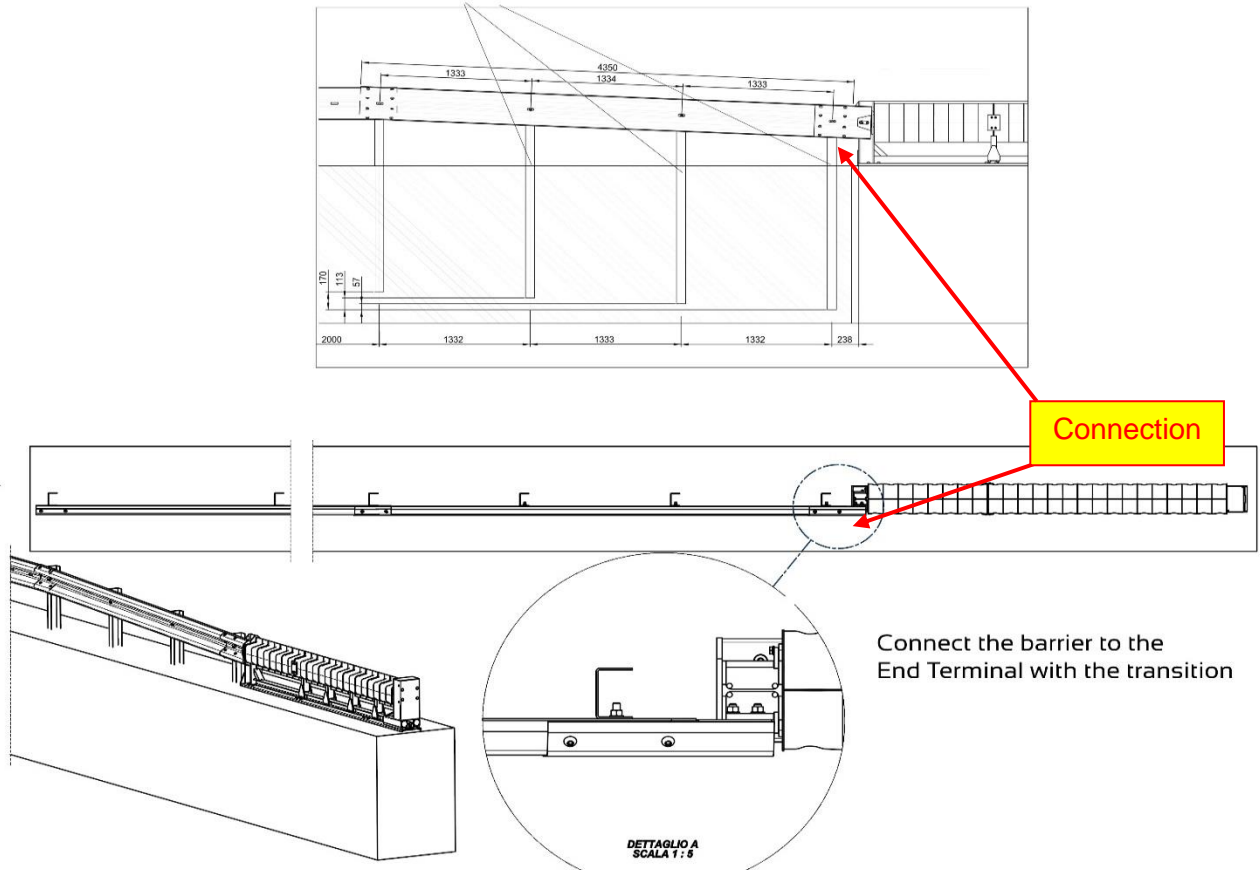


Fig. 23: End Terminal SMA T2 connected to a slope down N2W2 barrier.

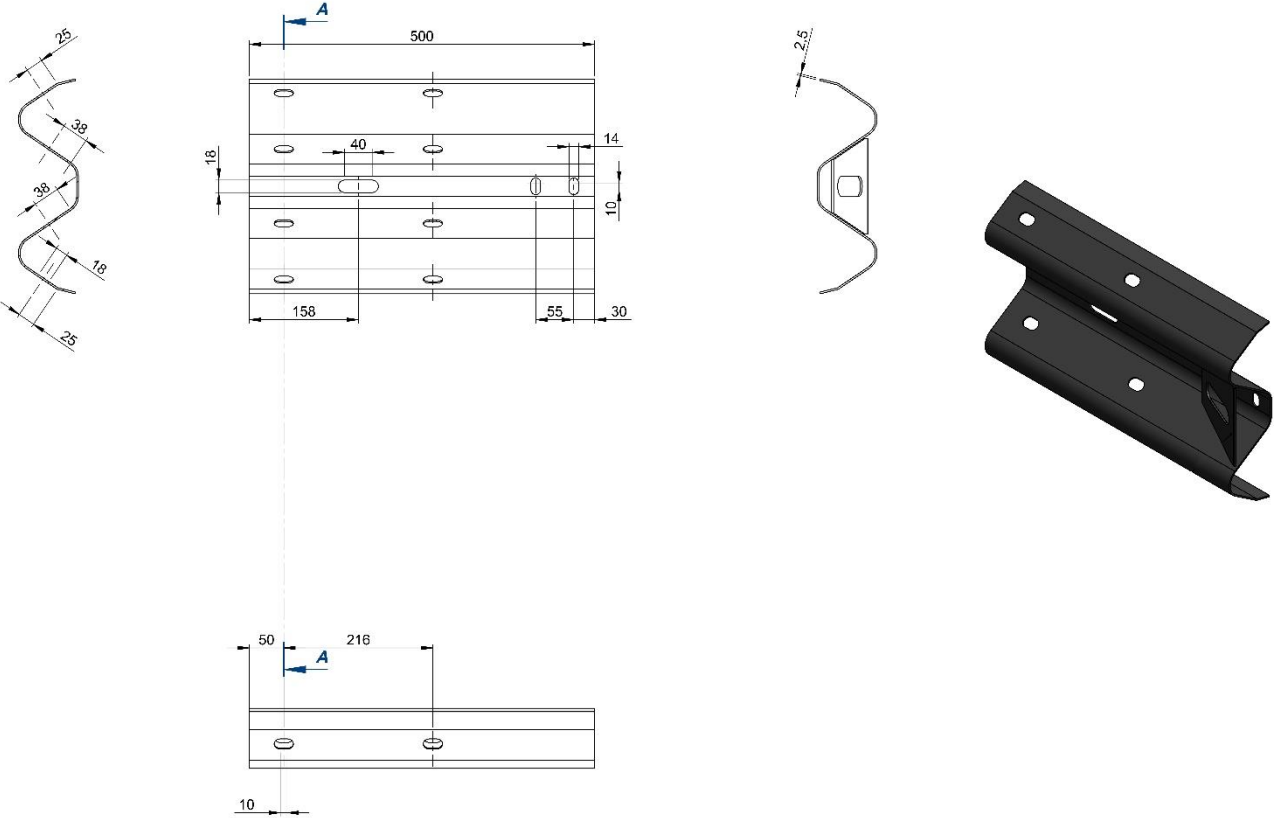


Fig. 24: Sloped down connection.

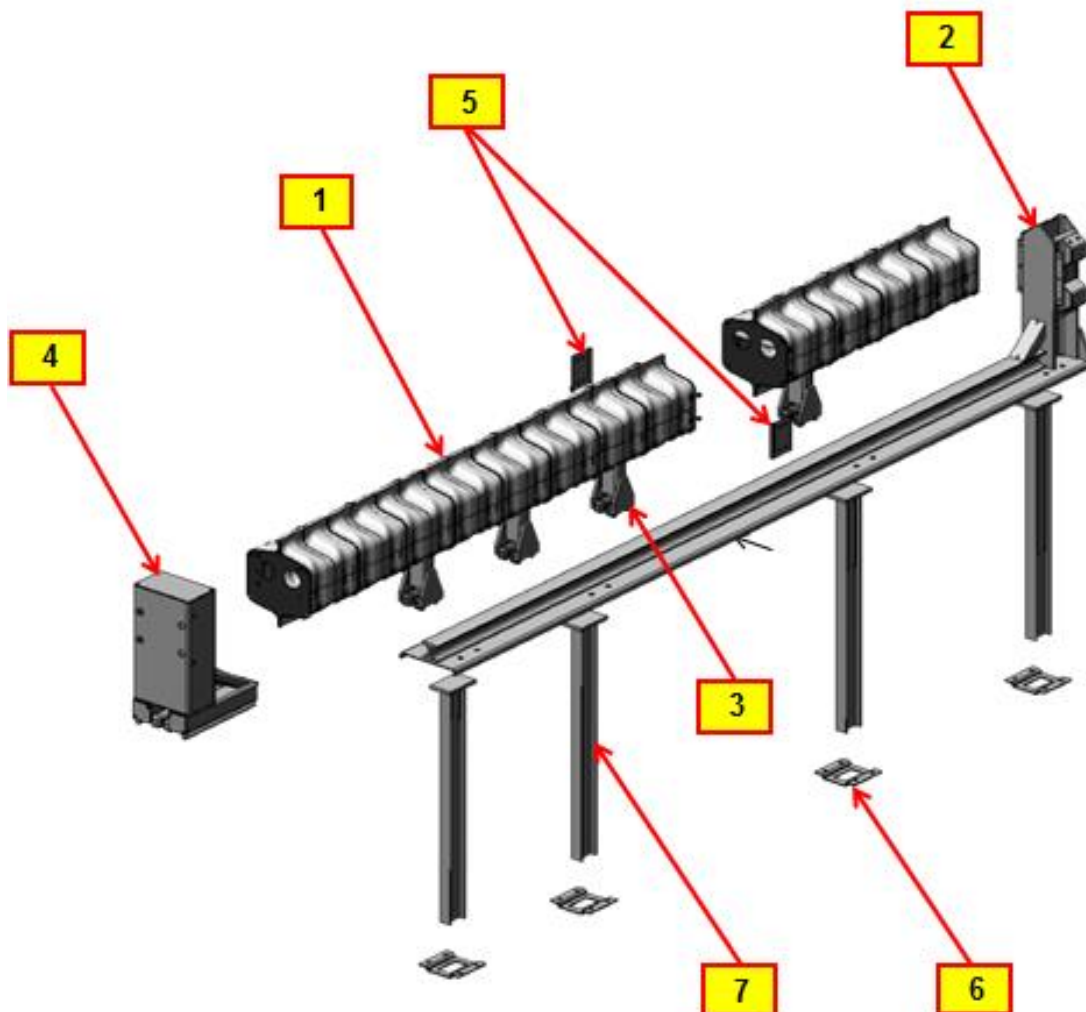
3. INSPECTION - REPAIR

3.1 Foreword

SMA End Terminals don't need maintenance under standard condition of use. If the vehicle impacts according to EN 1317 it can be restored by simply replacing the damaged components with the opportunity to totally recover the remaining part of the structure.

End Terminal components:

1	Collapsible steel beam formed by modular bays;
2	End terminal backstop;
3	Tie rods welded to the collapsible steel beam;
4	Trolley;
5	Lateral plates – for fixing the Trolley and the modular bays;
6	Post plates for fixing the terminal rail to the posts;
7	Posts with welded post plate



3.2 Component replacement

Each component has a Rif. code with the related drawing number.

They are listed in Section 5: SPARE PARTS

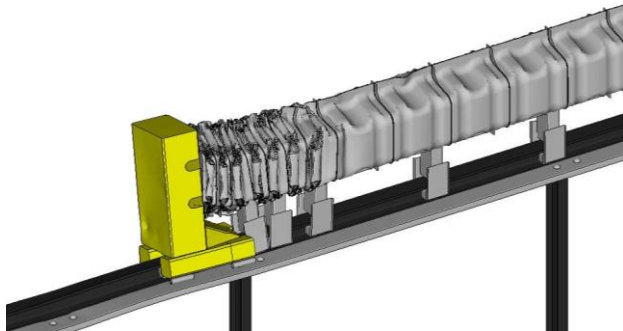


Fig. 25: SMA T 4 head-on impact

Trolley (Rif. S)

1. Remove the reflective sticker (if present) and unscrew the 4 no. M10 screws which connect the Trolley to the collapsible modular bay (Fig. 26).

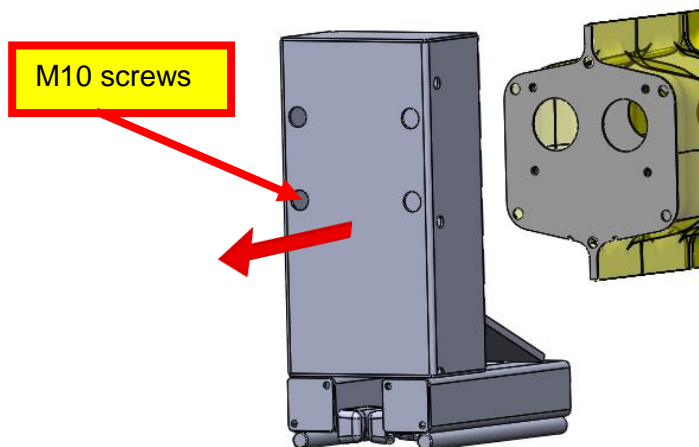


Fig. 26: Trolley

2. Slide the **Trolley** forward along the rail manually and pull the unit out (Fig. 26).
3. Replace the damaged component with the new one by fitting the new **Trolley** onto the rail and sliding the new **Trolley** along the rail until it comes into contact with the collapsible modular bay.
4. Screw the M10 screws (tightening torque of min. 41 and max. 60 Nm for bolts class 8.8).

Modular Bay (Rif. M)

1. Remove the Trolley (as in the previous explanation).
2. Remove the lateral plates which connect the different bays of the collapsible beam

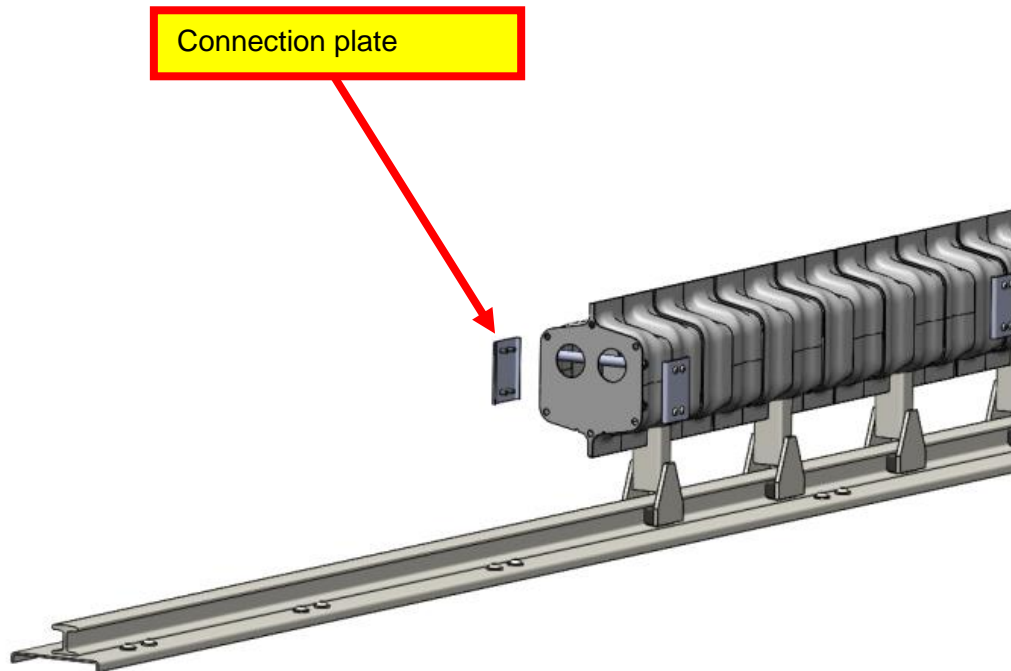


Fig. 27: Removing procedure of the modular bay

3. Unscrew the 4 no. M10 bolts on the 2 no. lateral plates (Fig. 27) which connects the back part of the first modular bay with the front part of the next one.
4. Slide the modular bay forward along the rail manually and remove it.
5. Replace the damaged component with the new one, then slide it back until contact with the next bay or with the backstop of the structure.(Fig 28)
6. Screw the 2 no. lateral plates with 4 no. M10 bolts, by applying a tightening torque of min. 41 and max. 60 Nm. (bolts class 8.8).

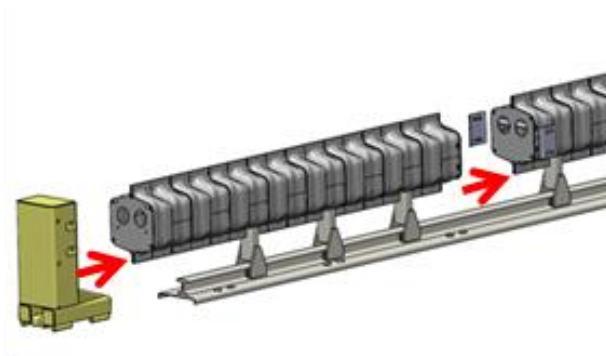


Fig. 28: Assembling of the new components

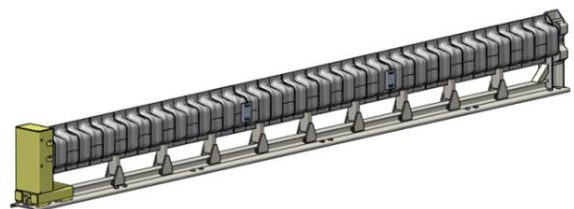


Fig. 29: Repaired End Terminal

Transition Piece (Rif. T)

1. Unscrew the M16 screws on the End Terminal junction;
2. Remove the damaged transition piece;
3. Fit the new transition piece;
4. Screw the M16 bolts (tightening torque: 90 - 210 Nm for bolts class 8.8).

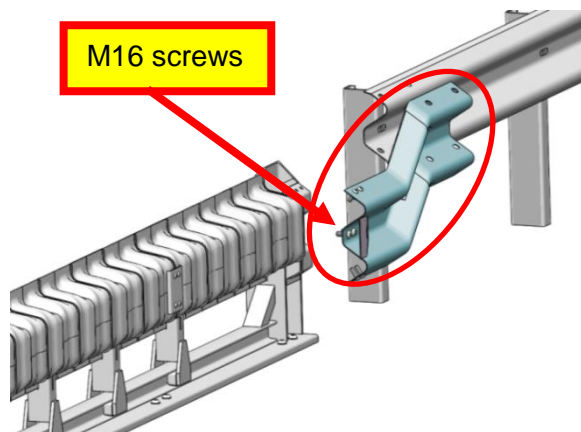


Fig. 30: Universal Transition Piece to double beam profile

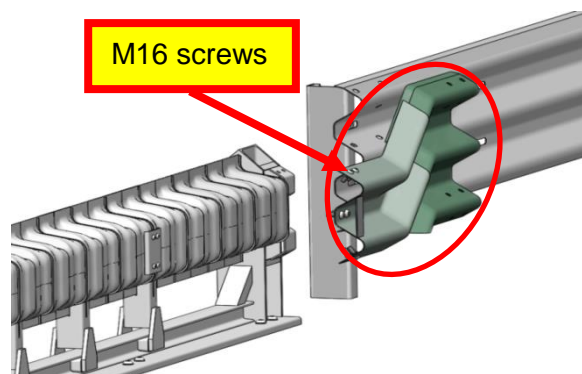


Fig. 31: Universal Transition Piece to three wave beam profile

4. PLAN OF THE COLLAPSIBLE MODULAR BAYS

SMA End Terminals are supplied with collapsible beams split into modular bays.

The beam components are mounted according to the plan as also shown on the tag on the back side of the structure.

The modular bays have different dimensions depending on their respective position on the rail and type of system. During assembly it is important to make sure that the correct modular bay is fitted. Details of the modular bays

The positioning of the modular bays in each single device is shown below. The modular bays are connected through 4 no. bolts that fasten 2 connection plates to ensure the stability.

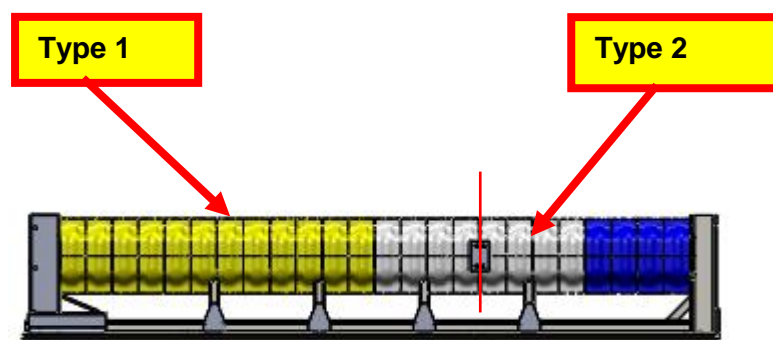


Fig. 32: Collapsible beam sections SMA T 2

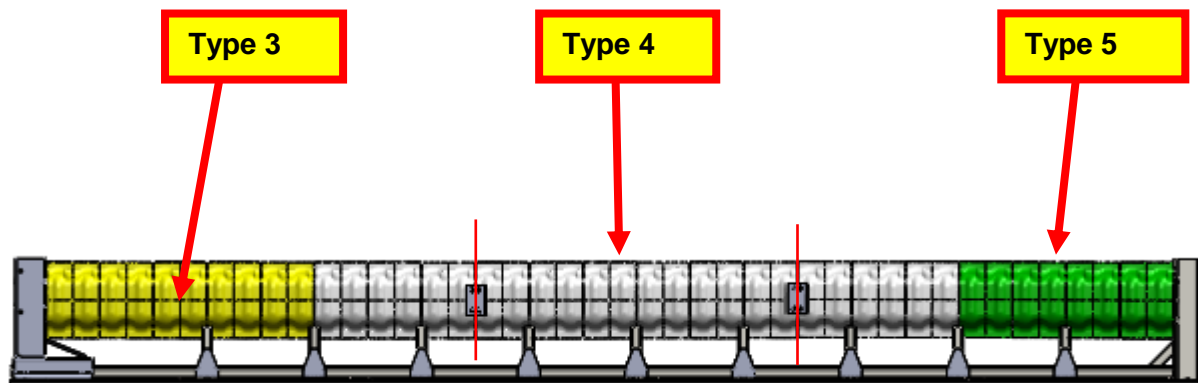


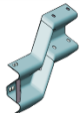

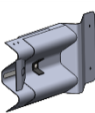



Fig. 33: Collapsible beam sections SMA T 4

5. SPARE PARTS

Rif.	Description	No.	Drawing number
SMA T 2			
S	 Trolley	1	D43760002
M1	 Modular bay Type 1	1	D45470102
M2	 Modular bay Type 2	1	D45470101
p	 Post	4	D43760039
a	 Installation plate	4	D43760048
b	 Backstop with Rail	1	D45470001
SMA T 4			
S	 Trolley	1	D43760002
M3	 Modular bay Type 3	1	D43760103
M4	 Modular bay Type 4	1	D43760102
M5	 Modular bay Type 5	1	D43760101
p	 Post	6	D43760039

a		Installation plate	6	D43760048
b		Backstop with Rail	1	D43760001
TRANSITION PIECES				
		Transition piece to two wave beam barrier single / double sided	1 / 2	D41922606
		Transition piece to three wave beam barrier single / double sided	1 / 2	D41922811
		Transition piece to concrete barrier single / double sided	1 / 2	D41923303
		Transition piece to two wave beam barrier single/ double sided	1 / 2	D41920029

6. DURABILITY

The structure and the main parts are treated with hot-dip galvanized process according to UNI 1461 and galvanized according to ISO 2081. The absorbing panels are treated with cataphoresis treatment according to the regulations n ° FIAT 5.00604, 20/12/2001.

The SMA devices are guaranteed for 10 years against the corrosion.

7. STORAGE

In order to fit the Crash Cushion/End Terminals in the containers, they are loaded in groups of 3x3 or 3x4.

8. TECHNICAL REFERALS AND NORMATIVES

UNI EN 1317 /2010	End Terminals
UNI EN 22768: 1996	Tolerances
UNI 1461	Hot-dip galvanized process
Norma FIAT n°5.00604 del 20/12/2001	Cataphoresis
UNI 2081	Electrolytic galvanizing

9. LIMITATION AND WARNINGS

SMA End Terminals have been tested to meet the requirements and guidelines of the P2 and P4 performance classes using the EN criteria described in European Standard ENV1317-4 and prEN 1317-7 (Terminals and Transitions).

The required tests are not intended to represent the performance of products when impacted by every vehicle type or every impact condition.

Industry A.M.S. srl does not represent nor warrant that the results of these controlled tests show that vehicle impacts with the products in other conditions would necessarily avoid injury to person(s) or property. Impacts that exceed the tested specifications of the product may not result in acceptable crash performance as outlined in ENV 1317-4 and prEN 1317-7, relative to structural adequacy, occupant risk and vehicle trajectory.

Industry A.M.S. srl expressly disclaims any warrant or liability far injury or damage to persons or property resulting from any impact, collision, or harmful contact with products, other vehicles, or nearby hazards or objects by any vehicle, object or person, whether or not the products were assembled in consultation with Industry A.M.S. or by third parties.

SMA End Terminals may be connected directly to W-Beam barrier with a containment level of N2 and a working width of W2. For connections to barriers having different containment levels and/or different working widths, appropriate connections according to local regulations and manufacturers recommendations should be used.

For further information, please contact our office.