INDUSTRY AMS s.r.l.

Installation and Maintenance Manual

S.M.A. Crash Cushions

CE

SMA®
safety modular absorber

1. GENERALITY 0

2. MODALITY OF INSTALLATION 1

3. ISPECTION-MAINTENACE 5

4. ABSORBING PANELS SCHEME 5

5. DURABILITY 6

6. TECHNICAL REFERENCE 6

1.Generality

SMA crash cushions are completely made of steel and have a length which is almost the half if compared with the length of the Crash Cushions of the competitors. This feature makes them perfectly suitable for the installation in tunnels and bypass. This document is a manual of installation and maintenance for the S.M.A. (Safety Modular Absorber) Crash Cushion, developed by Industry AMS s.r.l. located in Marcianise (CE), Italy. The crash tests have been performed according to UNI-EN 1317-3-2010 at CSI spa in Milan (Italy).

Table 1 - Sizes

SMA	P	PL	W	WL	Concrete	Metallic wires	N° Fixing devices
50	L=2000 W=670 H=760	L=2000 W=960 H=760			L=4000 W=1200 H=300	L=3800 W=1000 H=240	12
80	L=3300 W=860 H=760	L=3300 W=1150 H=760	L=3300 W=2360 H=760	L=3300 W=2280 H=760	L=4000 W=1500 H=350	L=3800 W=1200 H=290	16
100	L=5100 W=860 H=760	L=5100 W=1150 H=760	L=5100 W=2300 H=760	L=5100 W=2800 H=760	L=5300 W=900 H=250	L=5000 W=700 H=190	20
110	L=6400 W=860 H=760	L=6400 W=1150 H=760	L=6400 W=2500 H=760	L=6400 W=3000 H=760	L=6500 W=900 H=250	L=6300 W=700 H=190	24

The SMA Crash Cushion are made of the following components:

- Three waves beams.
- Back support structure and sliding trolley.
- Steel plates used as separators of the energy absorbers.
- Energy absorber made with a steel honeycomb structure.
- Front Panel.
- Lateral Panel for W and WL version.
- Fixing plate to the ground with holes for anchors.

2. Modality of Installation

The SMA Crash cushion are delivered already mounted and requires only to be fixed to the concrete basement.

MODALITY OF INSTALLATION

Method 1 – Road surface without reinforced concrete:

In this case a concrete basement has to be set in advance (Fig1A). The dimensions are indicated in Table 1, type Rck≥25N/mm^2, reinforced with two metallic wire made of iron rods of 10 mm of diameter, size 200mm (Fig.1B). Once the concrete basement has been set, it is possible to fix the Crash cushion through SPIT MAXI MA (SM24) chemical anchors, positioned in holes situated on the metallic base-plate of the crash cushion (Fig.2). This chemical anchors have to be set following the procedure described in the installation manual (Attachment A). It is possible to see the final installation in figure 3.

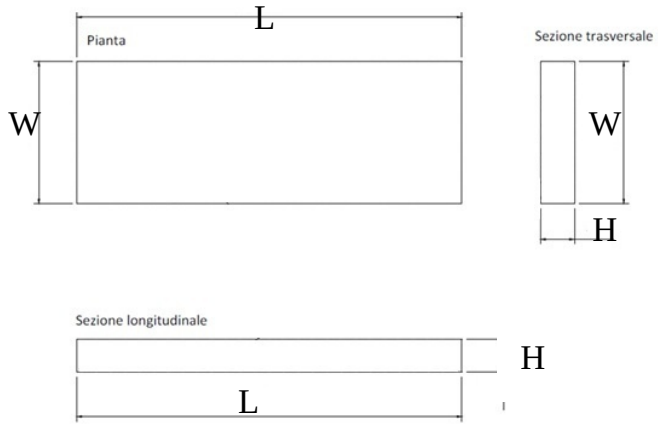


Fig. 1A. – Reinforced concrete basement

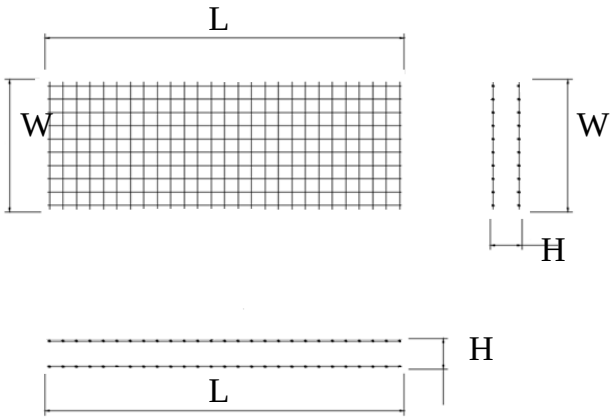
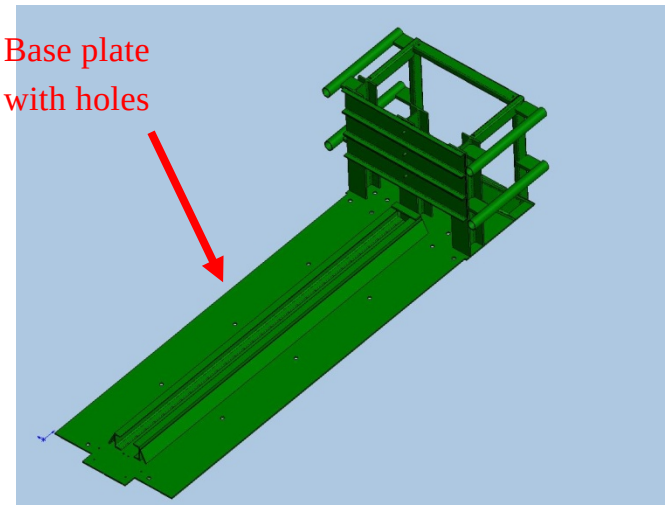
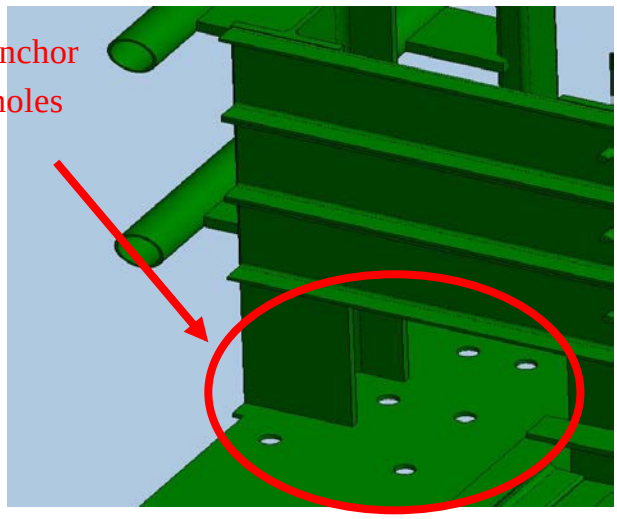


Fig. 1B – Metallic Wire

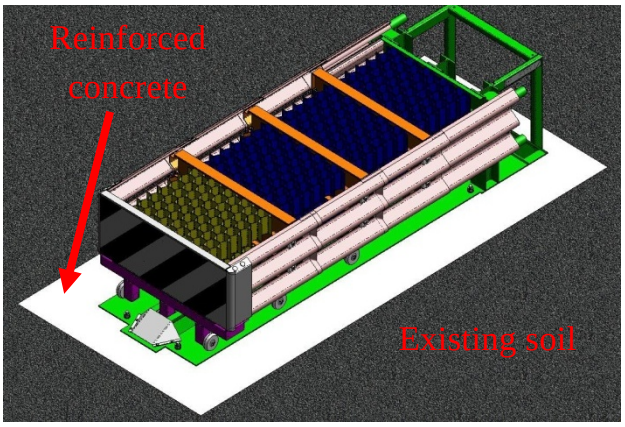


Base plate with holes

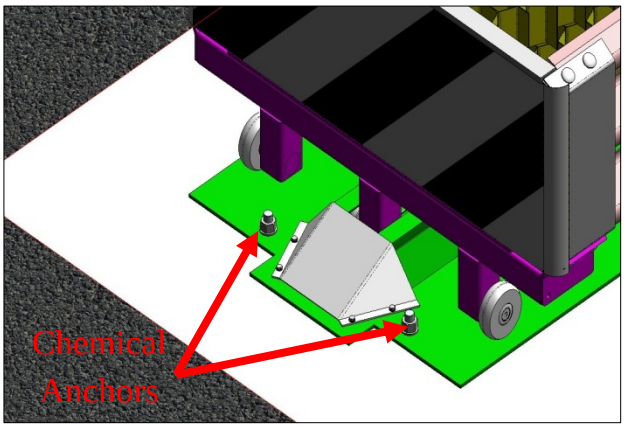


Holes details on the base plate

Figure 2



Crash cushion on reinforced concrete basement



Chemical anchors details

Figure 3

Modality 1bis – Road surface without reinforced concrete

The SMA crash cushion can be fixed on the reinforced concrete basement using screws rather than chemical anchors. If this procedure of installation is selected by the customer, AMS will provide the metallic wires welded with a steel frame. The metallic wires with the metallic frame must be embedded in the concrete basement and acts as reinforcement for the concrete basement. The steel frame contains bolts that allow to fix the crash cushion with the concrete basement using screws. This modality of installation is described in the figures 4-9: the metallic wires welded with the steel frame and screwed with the crash cushion will be set in the excavation where the concrete casting will be done, the crash cushion is going to be set with leveling bars (figure 7). After this procedure occur the concrete casting (figure 8) and then the leveling bars will be removed (figure 9).

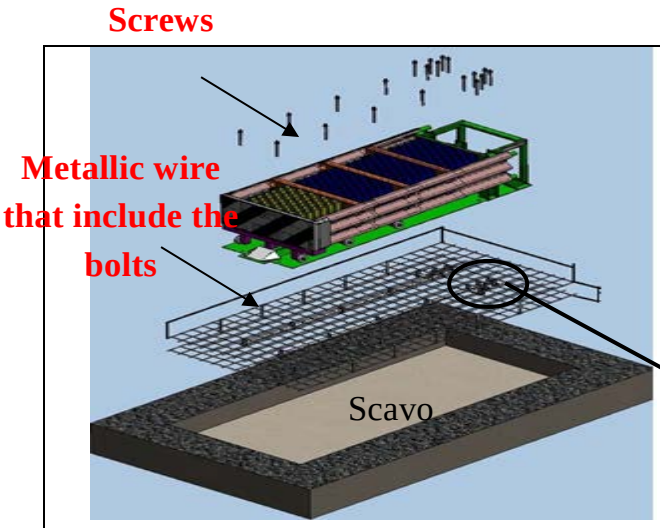


Fig.4 – Exploted View

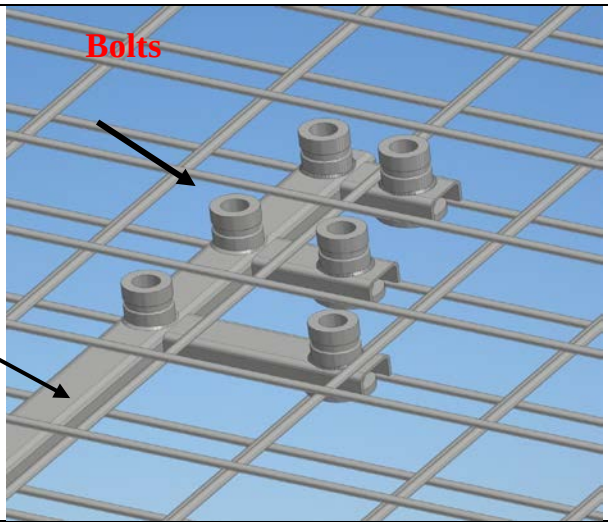


Fig.5 – Bolts

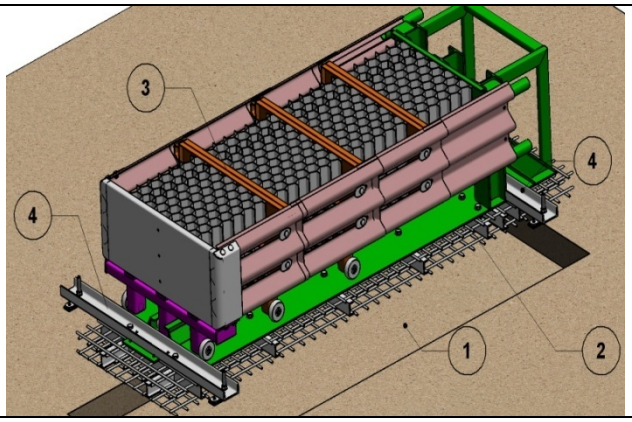


Fig. 6 – Crash cushion with anchoring structure

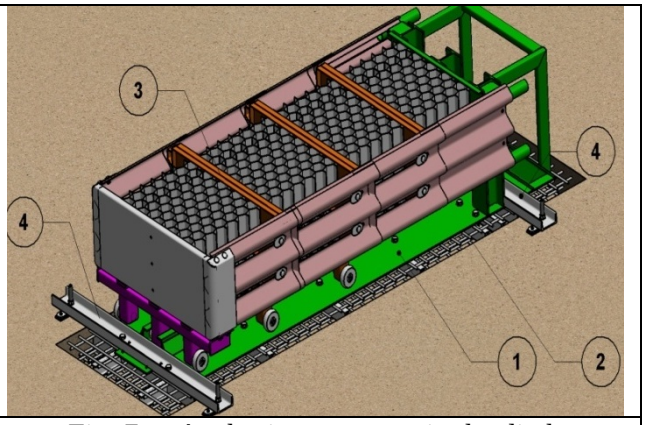


Fig. 7 – Anchoring structure in the ditch

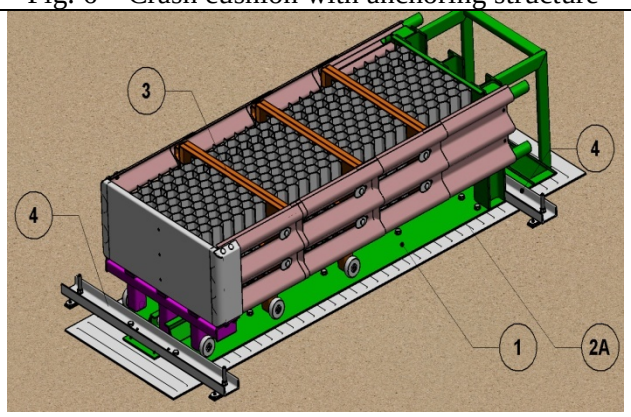


Fig 8 – Concrete casting

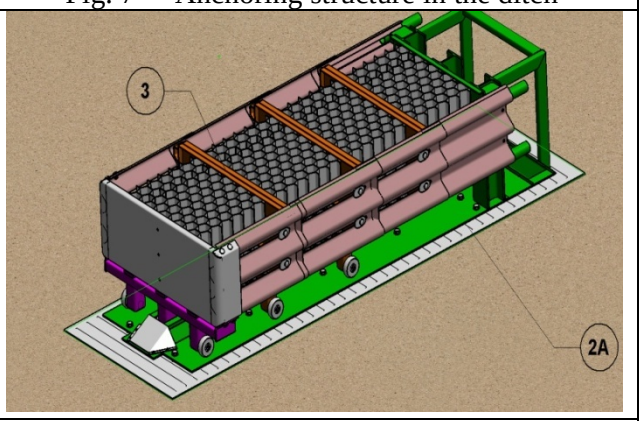


Fig 9 – Removal of the leveling bars

1 Excavation

2 Anchoring Structure

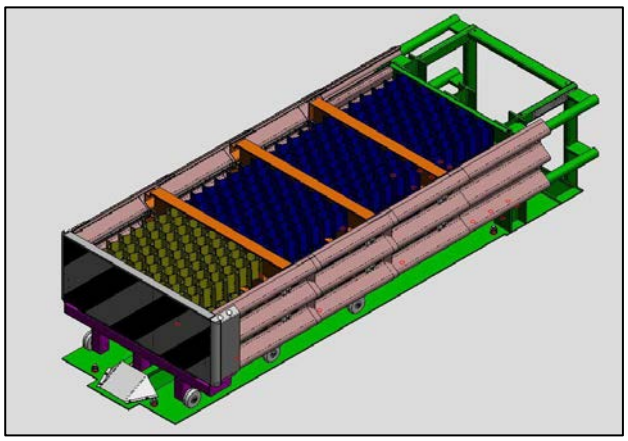
3 Crash cushion

4 Leveling Bars (to be removed after set crash cushion)

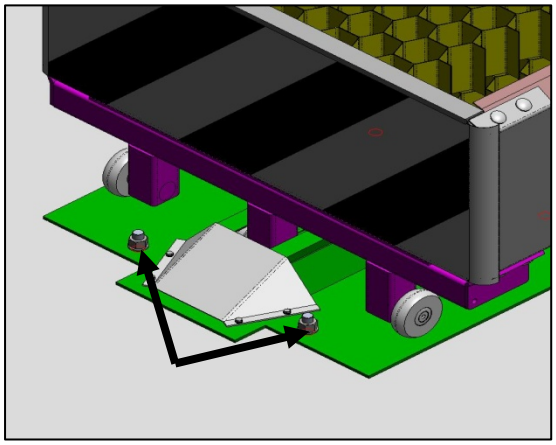
2A Concrete

Modality 2 – Road surface made of reinforce concrete

The crash cushion can be directly fixed to the road ground if the road ground is already made of reinforced concrete. The only requirement is that the thickness of the reinforced concrete is larger than 250 mm. In this case the crash cushion will be fixed using chemical anchors made with galvanized steel Spit Maxi-Ma (SM24), placed in correspondence of the holes that are located on the bottom plate of the crash cushion (figure 10). The concrete basement must be drilled in order to put the bonded anchors. The holes position on the concrete basement must coincide with the holes position of the metallic base-plate of the crash cushion (see figure 2). The installation procedure of the chemical anchors is detailed in their specific manual and reported as attachment A of the present manual. It is possible to see the final installation on figure n.3



Crash cushion on existing reinforced concrete



Chemical anchors details

Figure 10

Positioning in front of the obstacle

As figures 11 and 12 show the crash cushion can be installed in front of the obstacle with 0 mm distance.

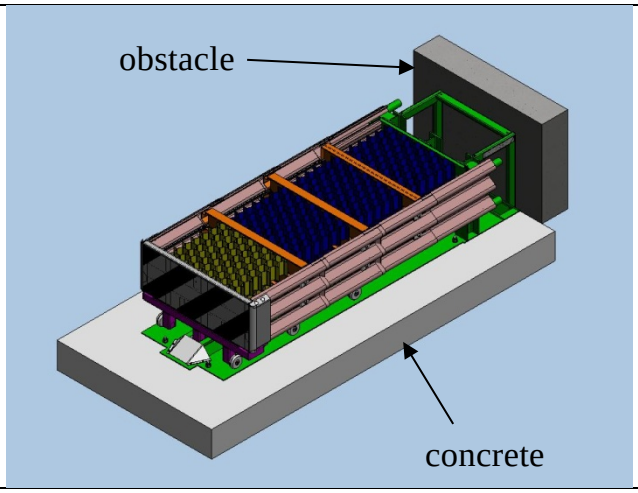


Fig. 11 – crash cushion in front of the obstacle

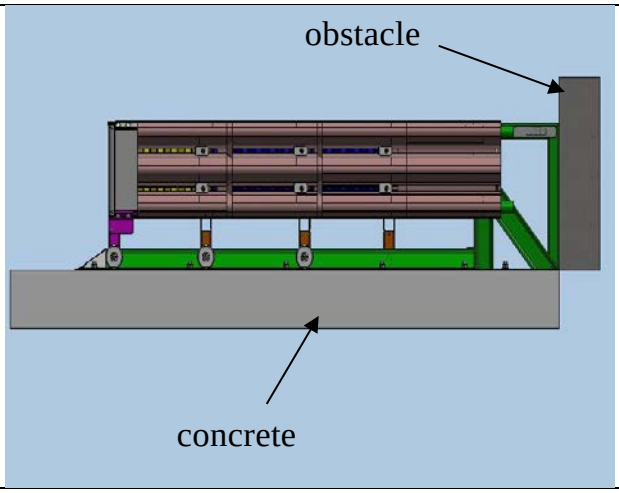


Fig. 12 – Side View

The maximum inclination (fig.13-14) is ±5°.

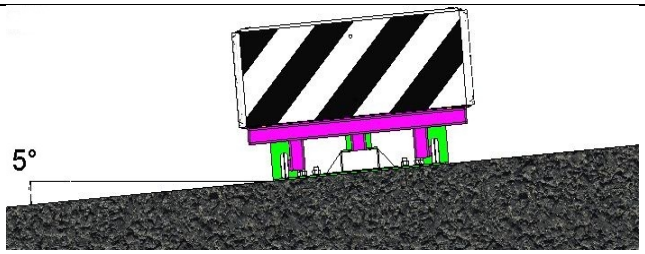


Fig 13

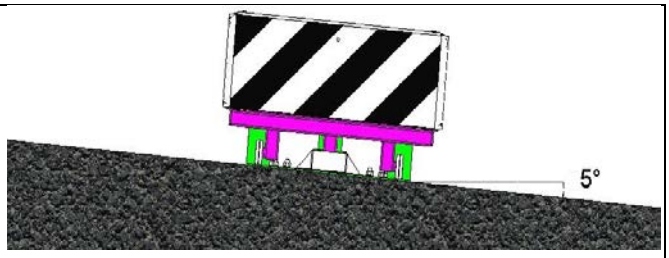


Fig 14

3. ISPECTION-MAINTENANCE

SMA crash cushion does not need maintenance in regular use conditions. If a car impacts the crash cushion, as in one of the crash test described in the UNI-EN1317-3/2010, it can be restored only by replacing the honeycombs structures (figure 15-18): the replacement of the honeycomb structures will allow the total recover of the structure. In order to replace the honeycomb absorbers the sliding structure must be opened (it has been closed after the crash) by unscrewing the carter highlighted with a red circle in the figure 15. Once the honeycomb absorbers have been replaced the carter must be mounted again and the crush cushion is finally restored.

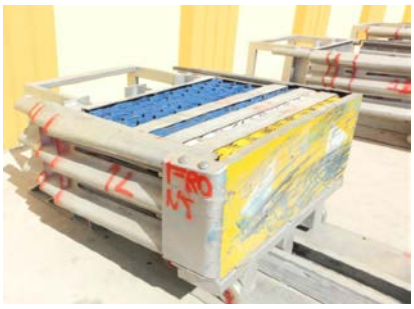


Fig.15 Structure closed after crash

Fig.16 – Damaged honeycomb removal

Fig.17 – Honeycomb structure replacement

Fig.18 – Restored Crash cushion

4. ABSORBER PANEL SCHEME

After the crash the panels must be mounted according to the instructions on the tag located on the back of the SMA (fig.19), taking care of the colors of each panel and the number of hexagonal components. In the tag instructions it is reported the color of the panels for each part of the crash cushion and the number of hexagonal cells in each honeycomb absorbers (this number is indicated as 5x6 or 5x7).

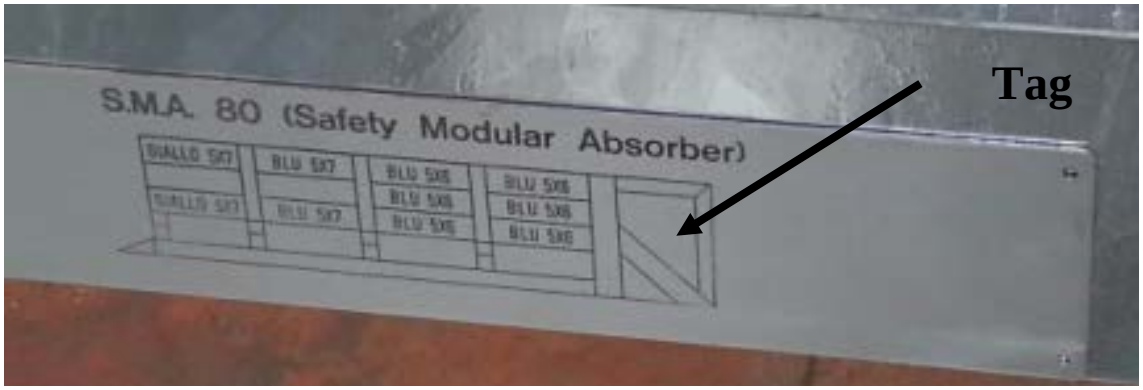
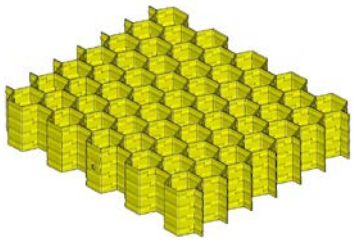


FIG. 19
TAG WITH THE POSITION SCHEME OF THE ABSORBING PANELS

ABSORBING PANELS DETAILS



Colour	Tipology	Drawing n°
Yellow	5 x 7	3664.01.00
Blue	5 x 7	3664.01.01 T2 A
Blue	5 x 6	3664.01.01 T1 A
White	5 x 6	4015.00.13
Grey	3 x 6	3981.02.00
Violet	5 x 6	4015.00.12

5. Durability

The structure and 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 under the law n ° FIAT 5.00604, 20/12/2001

6. Technical Reference

UNI EN 1317-3/2010 (Crash cushion).

UNI EN 22768: 1996 (tolerances)

UNI 1461 (hot-dip galvanized process)

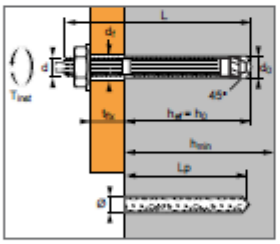
Norma FIAT n°5.00604 del 20/12/2001 (cataphoresis)

Attachement A

SPIT MAXIMA

Zinc coated steel

ETA Option 7
n° 03/0007



Bonded anchor in glass capsule

Technical data

SPIT MAXIMA	Max. anchor depth (mm)	Max. thick of part to be fixed (mm)	Min thick of base material (mm)	Ø thread (mm)	Drilling depth (mm)	Ø drill bit (mm)	Ø clearance (mm)	Total rod lenth (mm)	Total capsule torque (mm)	Max. tighten (Nm)	Code rod	Code capsule
	h_{ef}	t_{fix}	h_{min}	d	h_O	d_O	d_f	L	L_p	T_{inst}		
MAXIMA M8	80	15	120	8	80	10	9	110	80	10	050950	051500
MAXIMA M10	90	20	130	10	90	12	12	130	85	20	050960	051510
MAXIMA M12	110	25	160	12	110	14	14	160	107	30	050970	051520
MAXIMA M16	125	35	175	16	125	18	18	190	107	60	050980	051530
MAXIMA M20	170	65	220	20	170	25	22	260	162	120	655220	051540
MAXIMA M24	210	63	270	24	210	28	26	300	200	200	655240	051550
MAXIMA M30	280	70	340	30	280	35	33	380	260	400	050940	051560

Anchor mechanical properties

		M8	M10	M12	M16	M20	M24	M30
Threaded part								
f_{uk} (N/mm²)	Min. tensile strength	600	600	600	600	520	520	520
f_{yk}(N/mm²)	Yield strength	420	420	420	420	420	420	420
As (mm²)	Stressed cross-section	36,6	58	84,3	157	227	326,9	522,8
W_{el} (mm³)	Elastic section modulus	31,2	62,3	109,2	277,5	482,4	833,7	1686,0
$M^0_{Rk,s}$ (Nm)	Characteristic bending moment	22	45	78	200	301	520	1052
M (Nm)	Recommended bending moment	9,0	18,4	31,8	81,6	122,9	212,2	429,4

Setting time before tightening torque and applying a load

Ambient temperature (°C)	SPIT MAXIMA resin	
	Dry concrete	Wet concrete
T ≥ 20°c	20 min.	40 min.
10°c < T < 20°c	30 min.	60 min.
0°c < T ≤ 10°c	1 hour	2 hours
-5°c < T ≤ 0°c	5 hours	10 hours

Chemical resistance of the SPIT MAXIMA anchor

Chemical substances	Concentration (%)	Resistance
Nitric acid	< 20	(+)
Nitric acid	20 - 70	(o)
Phosphoric acid	< 10	(+)
Sulphurous acid	100	(o)
Sulphuric acid	≤ 30	(+)
Ethyl alcohol	≤ 15	(+)
Beer	100	(+)
Carbon dioxide	100	(+)
Engine petrol without benzene	100	(o)
Hydrogen fluoride	≤ 20	(+)
Ammonia	100	(+)

Chemical substances	Concentration (%)	Resistance
Ethylene glycol	100	(+)
Heptane	100	(o)
Hexane	100	(o)
Methanol	≤ 15	(o)
Carbon monoxide	100	(+)
Washing powder	100	(+)
Perchloroethylene	100	(o)
Hydrogen peroxide	≤ 40	(o)
Caustic potash	100	(+)
Cement in suspension	saturated solution	(+)

Resistant (+): the samples in contact with the substances did not show any visible damage such as cracks, attacked surfaces, burst corners nor large swelling.

Sensitive (o): use with care regarding exposure of the field of usage, precautions to be taken. The samples in contact with the substance slightly attacked the material.

* Using the installation tool available in each box of studs.

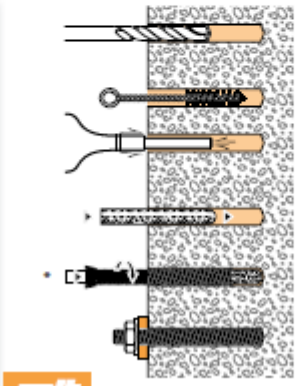
APPLICATION

- Fixing steel framed structures
- Fixing machinery (resistant to vibration)
- Fixing of storage silos, refinery pipework supports
- Fixing motorway signs
- Fixing safety barriers

MATERIAL

- **Threaded rod M8-M16:** cold formed steel NF A35-053
- **Threaded rod M20-M30:** 11 SMnPb37 - NFA 35-561
- **Nut:** Steel, EN 20898-2 grade 6 or 8
- **Washer:** Steel DIN 513
- **Zinc coating 5 µm min.** NF E25-009

INSTALLATION



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