

**FRIULSIDER**  
YOUR FIXING FACTORY

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FIXING  
FACTORY**



**Anchors Technical Catalogue**

# YOUR FIXING FACTORY

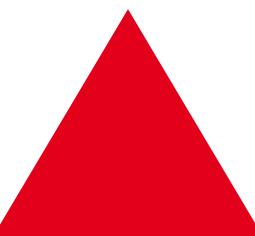


## MISSION

FRIULSIDER CONFIRMS ITS ROLE AS A LEADING INTERNATIONAL REFERENCE IN SAFETY FIXINGS, CONSOLIDATING THE IDENTITY VALUES OF OVER 50 YEARS OF HISTORY.  
A TRUE FIXING FACTORY WHICH PROMOTES THE CULTURE OF COMPLETE QUALITY CERTIFIED PRODUCT SAFETY THROUGH ECO-SUSTAINABLE TECHNOLOGICAL INNOVATION.

## VISION

TO PRODUCE AND DISTRIBUTE SAFE AND INNOVATIVE FIXING SYSTEMS FOR THE CONSTRUCTION TECHNOLOGY OF THE FUTURE.





**FRIULSIDER**  
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## FIXING FACTORY

With over 50 years of experience, FRIULSIDER confirms its role as a true fixing factory. FRIULSIDER designs and manufactures in-house safety and innovative fixings to meet all the demands and trends of the global market. Avant-garde is the keyword: from 3D CAD design to laboratory tests, equipped for the entire ETA procedure on any type of base material; from the 120 production machines dedicated to the 4 product lines (metal/plastic/chemical fixings, selftapping/selfdrilling screws, wood fixings and bolts) to European certifications for construction and industrial use, including seismic risk.

## CODE OF ETHICS

In order to defend and govern the historical and identity values of over 50 years of its history, FRIULSIDER has adopted the Organisation and Management Model, compliant with the Legislative Decree 231/2001, and the related company Code of Ethics.

The Code of Ethics expresses the commitment and responsibility of FRIULSIDER in all of its activities at all levels of the company, respecting the legitimate interests of shareholders, workers, clients, commercial partners and the community, reconciling market competitiveness with respect for the law, social responsibility, environmental safeguarding, the correct use of resources and human dignity.

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## QUALITY AND ENVIRONMENT

## IN THE WORLD

FRIULSIDER has always interpreted the concept of quality as an integrated system that includes, in addition to standards and production performance, worker safety, environmental sustainability and the accuracy of customer service.

The company's history is a path of continuous improvement, for an integrated Management System based on international voluntary standards:

- ▶ Quality Management System  
UNI EN ISO 9001:2015
- ▶ Environmental Management System  
UNI EN ISO 14001:2015

FRIULSIDER has a stable distribution in over 30 European countries, reaching commercially over 70 countries worldwide. The export share is 35% of the total turnover with an ever-expanding territorial trend of application sectors.

This is due to the synergy between planning / production capacity and marketing management, aimed at maximum flexibility of design, product and service, for the satisfaction of each customer.



PRODUCT	BASE MATERIALS	Certifications	page	
<b>FRIULSIDER FIXING GUIDE</b>			<b>7</b>	
<b>ATS-evo</b>		● ● ○ ○ ○ ○ ○ ○ ○ ○	ETA 10/0423 op.1 <b>44</b>	
<b>ATS-evo INOX</b>		● ● ○ ○ ○ ○ ○ ○ ○ ○		<b>46</b>
<b>ATS-evo R</b>		● ● ○ ○ ○ ○ ○ ○ ○ ○		<b>48</b>
<b>FM-753 CRACK</b>		● ● ○ ○ ○ ○ ○ ○ ○ ○	ETA 09/0056 op.1 ETA 10/0293 op.1 <b>50</b>	
<b>FM-753</b>		● ● ○ ○ ○ ○ ○ ○ ○ ○	ETA 01/0014 op.7 ETA 01/0009 op.7 ETA 13/0367 op.7 <b>52</b>	
<b>FM-744</b>		● ● * ○ ○ ○ ○ ○ ○ ○ ○	ETA 05/0169 op.7 <b>54</b>	
<b>FM-MP3 evo</b>		● ● ● * * ○ ○ ○ ○ ○ ○	ETA 09/0067 op.7 ETA 10/0074 ETA 09/0357 op.7 ETA 10/0093 <b>56</b>	
<b>TAP</b>		● ● ○ ○ ○ ○ ○ ○ ○ ○	ETA 18/0432 op.7 ETA 18/0433 <b>58</b>	
<b>CLR</b>		● * ● * ○ ○ ○ ○ ○ ○ ○ ○	Op.1 <b>60</b>	
<b>CLR6</b>		● * ● * ○ ○ ○ ○ ○ ○ ○ ○	ETA 19/0343 op.1 <b>62</b>	
<b>CLR INOX A4</b>		● * ● * ○ ○ ○ ○ ○ ○ ○ ○	ETA 19/0332 op.1 <b>64</b>	
<b>KEM EP</b>		● ● ● ● ● * ○ ● ○ ○	ETA 20/1284 op.1 REBAR <b>68</b>	
<b>KEM ES</b>		● ● ● ● ● ● * ○ ○ ○ ○	ETA 20/1282 op.1 ETA 20/1283 <b>69</b>	
<b>KEM H</b>		● ● ● ● ● ● * ○ ○ ○ ○	ETA 16/0957 op.1 ETA 16/0961 <b>70</b>	
<b>KEM V</b>		● ● ● ● ● ● ● ○ ○ * ○ ○ ○ ○	ETA 08/0383 op.1 ETA 12/0543 ETA 12/0553 <b>71</b>	
<b>KEM HR</b>		● ● ● ● ● ● ● ○ ○ ○ ○ ○ ○ ○ ○	ETA 20/0106 op.7 ETA 20/0104 ETA 20/0105 <b>72</b>	
<b>KEM HP</b>		● ● ● ● ● ● ● ○ ○ ○ ○ ○ ○ ○ ○	ETA 20/0108 ETA 20/0107 <b>73</b>	
<b>PUR</b>				<b>74</b>
<b>G</b>				<b>76</b>
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<b>FM-X5</b>		● ● ● ● ● ● ○ ○ ○ ○ ○ ○ ○ ○ ○	ETA 10/0425 <b>81</b>	

PRODUCT		BASE MATERIALS	Certifications	page
<b>TUP4</b>		● ● ● ● * ● ○ ○		84
<b>TUPP</b>		● ● ● ● * ● ○ ○		86
<b>X1 evo</b>		● ● ● ● ● ● ● ● ○		88
<b>X1 evo-L</b>		● ● ● ● ● ● ● ● ○		92
<b>XP</b>		● ● ● ● ● ● ● ● ○		94
<b>TMT</b>		* * * * * ● ● ● ○		96
<b>TU</b>		● ● ● * * ● ○ ○		98
<b>TSS</b>		● ● ● * * * ○ ○	ETA 10/0190	100
<b>TBB</b>		● ● ● * * * ○ ○	ETA 10/0190	102
<b>TPP</b>		● ● ● * * * ○ ○	ETA 10/0190	104
<b>ISOPLUS II</b>		● ● ● ● ○ ● ○ ○	ETA 20/0067	106
<b>ISOMAX</b>		● ● ● ● ○ ● ○ ○	ETA 08/0094	108
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● Suitable applications    \* Partially suitable applications

**Declaration of Performance:** [www.friulsider.com/dop](http://www.friulsider.com/dop)



For further information please contact: [export@friulsider.com](mailto:export@friulsider.com)

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# **FRIULSIDER FIXING GUIDE**

Practical guide for professionals

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## 1. INTRO

### 1.1 DISCLAIMER

#### IMPORTANT NOTICES

##### Instructions for use

The information and instructions for use given herein are subject to the Friulsider's terms of business and rely on the principles, rules, formulae and safety factors indicated in the Friulsider's data and technical sheets.

These sheets are based on the standard values obtained from test under controlled conditions and are considered to be correct and accurate at time of publishing.

The products must be used and applied exclusively in accordance with all current instructions for use published by Friulsider.

##### Site and base material differences

Construction materials and conditions differ depending on the site.

These differences in base material and conditions make an on-site test necessary to determine performance and efficiency at any specific location. If it's believed that the base material has poor or inadequate strength to obtain an appropriate fastening, please contact the Friulsider Technical Assistance.

The user must take into account the conditions on site and the intended use of the products; he/she is ultimately responsible for choosing the right product for a specific application and for determining its suitability.

##### Warranty limitation

Friulsider excludes and disclaims any implied warranties, including, but not limited to, the warranty of merchantability and fitness for a particular purpose.

##### Liability limitation

In no event shall Friulsider be liable for any direct, indirect, punitive, incidental, special consequential damages, to property or life, losses or expenses whatsoever arising out of, or related to the use of, misuse of, or inability to use the products for any purpose.

##### Modification of Terms and Conditions

Due to the constant development of Friulsider's policy, Friulsider reserves the right to change the terms, specifications and conditions under which our products are offered, without notice.

### 1.2 REFERENCE DATA

The technical data in the Friulsider Fixing Guide derive from the assessment procedures by accredited independent testing institutes according to European Assessment Documents (EADs) or European Technical Approval Guidelines (ETAGs) for the approved products, and according to product test performed at the Friulsider laboratory in San Giovanni al Natisone (Italy) and evaluated by our experienced engineers or tested and evaluated by independent testing institutes in Europe for the other products.

### 1.3 EUROPEAN ANCHOR CERTIFICATION

Up until the 30th of June 2013, European Technical Approval Guidelines (ETA Guidelines or ETAGs) were elaborated upon the mandate of the European Commission in order to establish how Approval Bodies should evaluate the specific characteristics/requirements of a construction product or a family of construction products. ETAGs were used as basis for European Technical Approvals (ETAs), the documents providing information on the assessment of the performance of product regarding its essential characteristics.



From the 1st of July 2013, according to the new Construction Product Regulation (EU/305/2011), the **European Assessment Documents (EADs)** started being developed as harmonized technical specifications and no new ETAGs have been developed. Similarly **European Technical Assessment (ETAs)** replaced the European Technical Approvals.

The **Declaration of Performance (DoP)** is a document issued by the manufacturer detailing information regarding the performance of the product in relation to the essential characteristics, assuming the responsibility for the conformity of the product with the declared performance.

An anchor with ETA and DoP can have the **CE marking**, which enables it to be sold throughout the whole EU plus ensures its safety by guaranteeing the compliance to the EAD (ETAG) guidelines.

A system of **Assessment and Verification of Constancy of Performance (AVCP)** is applied for each family of construction products to ensure the Declaration of Performance (DoP) is strictly respected, involving internal permanent factory production control and notified body continuous surveillance.

All the reference european guidelines and standards can be downloaded from the official EOTA website [www.eota.eu](http://www.eota.eu)



## 2. BASE MATERIALS

Precise knowledge of the base material where the anchor has to be installed is of primary importance for a safe fixing.

This stage can often cause problems, above all when work has to be carried out on existing buildings with no construction records.

In these cases an accurate analysis of the material should be done: tests to verify the material resistance (e.g. sclerometer on concrete) and further pull out tests near the concerned area should be carried out.

If there are doubts on the consistency of the material, it is advised to use fixing systems which do not cause stress in the material through expansion (e.g. chemical fixings).

### 2.1 CONCRETE

**Concrete** is made from combining a binder (cement), aggregates (sand, gravel), additives, water and mineral admixtures. When the binder is mixed with the water it hardens and bonds together all the components creating a resistance similar to that of a stone-like material. Concrete is the most common material used for structural parts of buildings. The density of **normal weight** concrete is greater than 2000 kg/m<sup>3</sup> and less than 2600 kg/m<sup>3</sup>.

Concrete can also be produced using light aggregates, this is called **light weight** concrete, where the density is greater than 800 kg/m<sup>3</sup> and less than 2000 kg/m<sup>3</sup>.

The reference standard for concrete is the EN 206-1 regulation. In accordance with this standard, normal weight concrete is identified by the capital letter "C" and a further two numbers (e.g. C20/25): the first number denotes the compressive strength N/mm<sup>2</sup> measured on a cylindrical test specimen (diameter 150 mm, height 300 mm), the second number denotes the compressive strength measured on a cube (each side being 150 mm).

The normal weight concrete resistance classes are:

C12/15, C16/20, **C20/25**, C25/30, C30/37, C35/45, C40/50, C45/50, **C50/60**

Light weight concrete is identified by the capital letters "LC" and, as per with the normal weight concrete, followed by the compressive strengths of the cylindrical and cubic test specimens.

The light weight concrete resistance classes are:

LC12/13, LC16/28, LC20/22, LC25/28, LC30/33, LC35/38, LC40/44, LC45/50, LC45/55



The guideline EAD-330232-00-0601 applies to the use of anchors in normal weight concrete with resistance classes between C20/25 and C50/60, it is not possible to use metallic anchors in low resistance concrete. The classes C12/15 and C16/20 are permitted when using anchors for non-structural applications (EAD-330747-00-0601) and plastic anchors (ETAG 020).

The guidelines do not cover the use of anchors in light weight concrete.

## 2.2 AERATED CONCRETE

Autoclaved Aerated Concrete (AAC) is made from quartz sand, lime, cement, water and aluminium dust (rising agent). When the components are mixed together gas is formed. After the 2 hours of rising, the material is cured in an autoclave chamber at 190-200 °C for 10-12 hours.

This material is found in blocks, lintel, floor and wall panels.

The reference standard is the 771/4. Only plastic anchors or specifically designed anchors (TMIL, TRZ) can be used on this material. The resistance of the anchor will depend greatly on the density and compressive strength of the base material being used. In fact, the manufacturer of the aerated concrete is obliged to declare values of the dry density and of the compressive strength (mean or characteristic), which must be greater than 1,5 N/mm<sup>2</sup>.

Typical values are from 400 to 700 kg/m<sup>3</sup> for the density and from 2 to 5 N/mm<sup>2</sup> for the compressive strength.



## 2.3 PLASTER

Plaster is a thin protective, smooth and decorative finish usually applied to the surface of masonry. It is traditionally made from a binder (hydraulic lime, cement or plaster), sand with a maximum granulometry of 2mm and water.

One-layer plaster is becoming ever increasingly popular; it is an industrial prepared material and is distributed in bags or in silos. It is mixed with water before use and distributed on site by a tube and applied through spraying.

The mechanical resistance is very variable and it cannot be relied on to have high resistances. A good plaster can have a resistance varying from 5 to 10 N/mm<sup>2</sup>, whereas a scarce plaster can have much lower values. Attention should be made to friable layers and excessively thick layers because they can cause bending effects and dramatically reduce the fixing resistance. When carrying out structural fixings, the plaster on the concrete must be removed.

## 2.4 BRICKWORK

There is no specific standard for the production of masonry blocks, therefore the evaluations carried out are only valid for the type of block used in the tests. It is quite probable that the blocks used in the construction site will be different and the site engineer should evaluate whether to carry out more tests on site to calculate the real resistance values.

### 2.4.1 SOLID BRICK

The solid brick is the oldest type of "industrial" modular element for the construction of buildings. The sizes vary from country to country: in Italy the size is 5,5x12x25 cm, in Europe 6x12x25 cm, in Great Britain 7,5x11,2x22,5 cm.

Bricks which contain a maximum of 15% hollow parts are defined as "solid bricks".

The standard EN 772-1 determines the compressive strength, where values ranging between 10 and 80 N/mm<sup>2</sup> are taken into consideration. The typical compressive strength value for this type of brick however is from 20 to 40 N/mm<sup>2</sup>.

Metallic anchors are suitable for use in this type of base material however it must be taken into consideration that there is discontinuity where the elements are joined together. The fixing resistance will also depend on the type of mortar used and the position of the holes in regards to the joining lines.

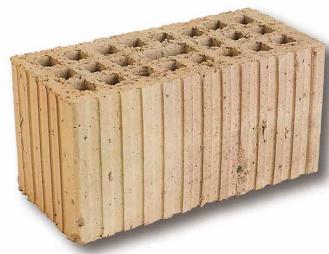


## 2.4.2 HONEYCOMB BRICK

These are defined as bricks which contain 15% - 45% hollow parts (e.g. Double brick UNI). The holes are always kept at a right angle to the laying surface.

Load bearing or curtain walls are made using this material. Bricks made with porous lightened material for improved heat insulation and sound proofing properties are known as Poroton blocks or thermal insulating blocks.

Important fixings are not suitable for this type of base material, despite its good compressive strength value, due to the large amount of hollow parts. The metallic anchors needed for this type of fixing would cause too much tension during the expansion phase. Chemical anchors are more commonly used as the tension can be distributed between several ribs. Plastic anchors are also recommended for use in honeycomb brick.



## 2.4.3 CELL LIKE CLAY BRICK

Cell like clay bricks contain more than 45% of hollow parts. As a rule these bricks are laid with the holes horizontal to the surface.

The high percentage of hollow parts and thickness of this material signifies that important fixings cannot be carried out on it. Anchors suitable for use on this material are: plastic anchors, which are long enough to engage at least, the first partition and chemical anchors used with a retention sleeve. In these cases, the anchor normally fails due to base material failure. The fixing resistances are nonetheless quite low and depend greatly on whether plaster is present.



## 2.4.4 LOAD BEARING CONCRETE BLOCKS

These are blocks made of normal concrete or more and more often made of lightweight concrete in various shapes and sizes containing hollow parts.

Leca® blocks, produced with lightened concrete and expanded clay, are very common due to their high heat insulation properties.

The great variety of shapes and forms means that it is impossible to give a general anchor resistance value, instead the value will depend on individual evaluations of the material used. Typical compressive strengths range between 5 and 10 N/mm<sup>2</sup>.



## 2.4.5 SOLID STONE

Stone is found commonly in the construction of older buildings and despite its variable nature, is a good construction material.

It is rarely used as a load bearing material for new construction, this is also due to its cost. Nowadays, it is used above all for reconstruction work or for façade and paving work.

A fixing with a high resistance can be carried out if the material is compact and as long as the installer has the foresight to drill the hole in the solid part avoiding the joining lines.

Important fixings cannot be carried out on porous base materials such as tuff, and is therefore recommended to avoid the use of metallic anchors. Plastic and chemical anchors however are both suitable for use on this material.

Stonework is regulated according to the standard EN 771-6.



## 2.4.6 MORTAR

Mortar is composed of binders (hydraulic lime and/or cement), aggregates with a maximum granulometry of 2mm and water.

It is used to join together various types of blocks or bricks so that the loads can be distributed between the various blocks and it also makes the masonry more stable.

The European standard that defines mortar is the EN 998-2, the classes being:

M1 - M2,5 - M5 - M10 - M15 - M20

The compressive strengths are respectively:

1 N/mm<sup>2</sup>, 2,5 N/mm<sup>2</sup>, 5 N/mm<sup>2</sup>, 10 N/mm<sup>2</sup>, 15 N/mm<sup>2</sup>, 20 N/mm<sup>2</sup>.

It is generally recommended not to fix anchors knowingly into mortar joints.

## 2.5 PANNELS AND SHEETS

This category refers to sheets such as plasterboard, chipboard, compressed fibre panels etc. These are used for lining or for internal partitions. The fixing resistance on these base materials is nonetheless very low.

Anchors such as our XP, TMT, AM, TAN, TRZ, TPV, TMC and X1 evo which work through hooking or undercutting the panel should be used on these materials. Use the TROMP screws to fix plasterboard panels to the metal uprights.



## 2.6 WOOD

Wood is the oldest construction material used by man. After a long period of disuse, wood has started to make a comeback and can be found above all in roofing constructions. This is mainly due to its weight, mechanical resistance, fire resistance and durability.

The main types of wood timber used in construction are conifer (spruce or silver fir) or broad-leaved (chestnut or oak).

More frequently laminated timber, mainly spruce based, is used nowadays. This is made from gluing several layers of dimensioned wood together, the advantage being that of eliminating defective parts of the wood and of having beams of wide spans and sections or curvilinear beams for a significant architectural impact.

Due to the increase in the use of this product, European standards have been introduced: EN 14080 and EN 1194 for laminated wood, EN 14081 and EN 388 for wood timber. For timber produced in Italy, the standard UNI 11035 parts 1 and 2 which refers to national timber also has to be taken into consideration.

Structural wood is also governed by the CE marking, meaning a more scientific approach to the designing method and a higher level of safety.

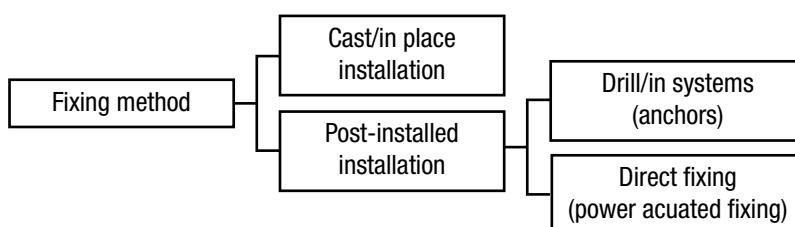
Reference calculation methods usually adopted in Europe are the german DIN 1052, the Eurocode 5 and also several states have developed national standards as the Italian *Norme tecniche per le Costruzioni*.

Traditional wood screws and our FM-WOOD PRO screws are used for wood fixings and structural connections. Epoxy resins used together with steel bars or Friulsider Connottore are also used for important connections and above all for wood floor reinforcements in reconstruction works.



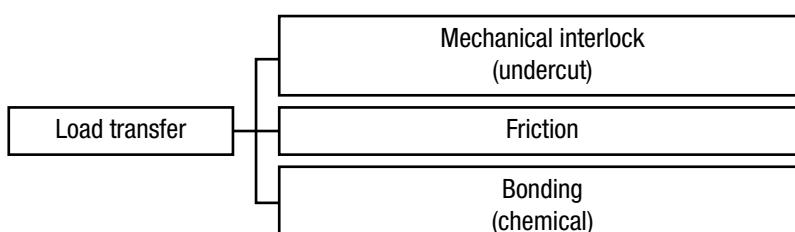
## 3. FIXING SYSTEM CLASSIFICATION

An initial classification can be carried out based on the type of installation:



The types of fixings offered in this catalogue are all drill in anchors; where the anchor is installed in holes drilled into the base material.

A further classification is done according to the way in which the load is transferred from the anchor to the base material:



- **Mechanical interlock** (fig.1 & fig.2): the hole is modified to create a cavity or undercut either by a special drilling apparatus or by the anchor itself. The load is transferred to the base material through the undercut zone. When hollow base materials are used, it is the hollow parts themselves that are used as an undercut zone.
  - **Friction** (fig.3 & fig.4): a friction force between the anchor and the hole walls equalises the load force on the anchor. The expansion of these anchors, known as expansion anchors, occurs usually through the expansion cone which is forced against the expansion sleeve during the installation.
  - **Bond** (fig.5): the load is transferred to the base material through the chemical adhesive inserted between the anchor and the hole walls. The adhesive, normally a resin, which adheres to the anchor on one side and the hole walls on the other, transfers the load through micro keying. For the fixing to work correctly, the anchor must have a rough surface (e.g. a threaded bar) and the hole must be cleaned properly so that the resin can penetrate the micro-craters formed on the hole walls during the drilling phase.
- All of the fixing systems in this catalogue can be attributed to one of the above mechanisms.

### 3.1 DRILL IN ANCHOR TYPES

Drill in anchors are installed in holes drilled into the base material. They are the most common type of fixing used and they have evolved rapidly over the years.

The following types can be identified:

- torque controlled expansion anchors (fig.3)
- displacement controlled expansion anchors (fig.4)
- undercut anchors (fig.1 & fig.2)
- chemical anchors (fig.5)
- screw anchors (fig.6)
- plastic anchors (fig.7)

The object to be fixed is a key installation factor. There are three types of installation configurations:

- **Pre-positioned fixings** (fig.8): the anchor is inserted in the base material before positioning the object to be fixed and then is tightened with a screw. The hole in the object to be fixed is normally smaller than the hole in the base material.
- **Through fixings** (fig.9): the anchor is inserted in the base material through the fixture. The size of the hole of the object to be fixed is either bigger than or equal to the size of the hole in the base material. This hole is drilled either simultaneously with the hole in the base material or if already drilled is used as an outline to drill the hole in the base material.
- **Stand-off fixing** (fig.10): the object to be fixed is mounted at a distance from the base material. An anchor with a prolonged threaded part is used and the element is fixed with a nut and a lock-nut. The part of the anchor which protrudes from the base material is subject to bending (fixing with lever arm) as well as shear loads.

Through fixings are the most common type as they simplify the installation process.

A further anchor classification can be made with regards to the safety:

- anchors for structural fixings where the anchor failure causes the collapse of the whole or part of the work;
- anchors for non-structural fixings where the anchor failure can cause an immediate risk to human life;
- anchors for where the anchor failure does not cause an immediate risk to human life;

This distinction is not only bound to the anchor configuration but above all to the intended use of the anchor.

For this reason the type of anchor could be classified differently depending on the intended use. The European guidelines differ from one another depending on the type of use: the EAD-330232-00-0601 deals mainly with structural anchors; EAD-330747-00-0601 deals with metallic anchors for non structural use.

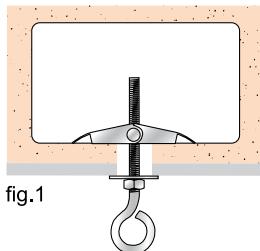


fig.1

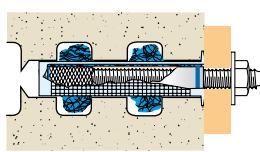


fig.2

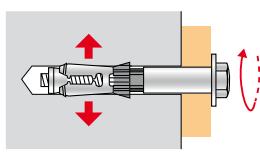


fig.3

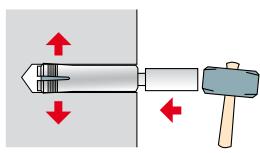


fig.4

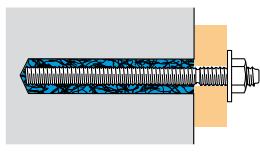


fig.5

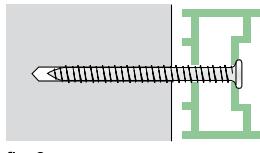


fig.6

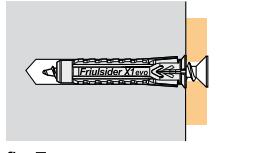


fig.7

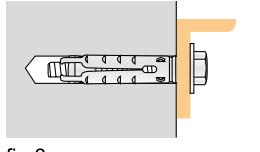


fig.8

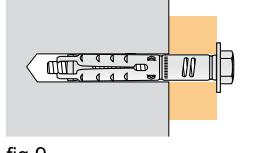


fig.9

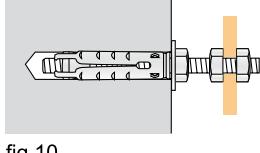


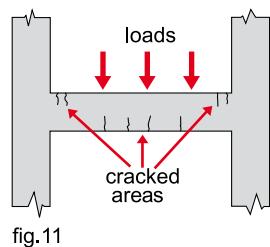
fig.10

The ETAG 001 / EAD 330232-00-0601 also differentiates between non-cracked concrete and cracked concrete.

Cracked concrete (fig.11): concrete has low resistance to tension. The forces in the tension zones are absorbed by the reinforcement, which in turn causes cracks. The reinforcement is designed in such a way to limit the width of the cracks to 0,3 mm. These cracks however have a negative influence on the anchor resistance and functioning. Furthermore it is probable that the crack will pass through the hole due to the tensional state caused by the presence of the anchor.

In the guideline, all the areas of the structure where the compression tension is inferior to 3 N/mm<sup>2</sup> are considered as cracked concrete.

The European guidelines also take into consideration the concrete resistance class, the characterisation of the product in regards to the load direction and the calculation of the minimum spacing and edge distances. There are 12 different options of approval available:



Option n°	Cracked & non-cracked concrete	Non cracked concrete only	C20/25 only	From C20/25 to C50/60	F <sub>Rk</sub> one value	F <sub>Rk</sub> based on direction	c <sub>cr</sub>	s <sub>cr</sub>	c <sub>min</sub>	s <sub>min</sub>	Design method in accordance with Annex C
1	X			X		X	X	X	X	X	A
2	X		X			X	X	X	X	X	
3	X			X	X		X	X	X	X	B
4	X		X		X		X	X	X	X	
5	X			X	X		X	X			C
6	X		X		X		X	X			
7		X		X		X	X	X	X	X	A
8		X	X			X	X	X	X	X	
9		X		X	X		X	X	X	X	B
10		X	X		X		X	X	X	X	
11		X		X	X		X	X			C
12		X	X		X		X	X			

(Table 1)

For **options 1 to 6** anchors can be fixed in cracked concrete. For **options 7 to 12** anchors can only be used in non-cracked concrete.

Option 1 is a mandatory prequalification for the **seismic certification**, which can be level **C1** or level **C2**, the qualification is subject to the most severe testing procedures.

## 4. ANCHOR INSTALLATION

The installation of an anchor is extremely important and none of its factors should ever be overlooked. A poor installation could cause the fixing to fail and have severe safety repercussions on the construction work being carried out.

In addition to the choice and design of the fixing, the following are required factors for a correct installation:

- product installation instructions;
- qualified personnel on the construction site;
- the presence of the works manager to supervise all of the installation work and make sure that it is carried out according to the instructions.

## 4.1 HOLE DRILLING

Drilling techniques:

- **Rotary drilling** (fig.12): drilling is carried out without hammering action to avoid breakage in friable and poor resistance materials such as hollow bricks, panels or porous materials. The hammering could cause the hole to be destroyed which means the fixing cannot be carried out and major repair work will have to be done.
- **Impact drilling** (fig.13): the drill uses short and frequent hammering actions. This type of drilling is suitable for base materials such as concrete, solid brick and solid stone.
- **Hammer drilling** (fig.14): the drill uses a slower rotation with less frequent but more intense hammering actions. The machine used is known as a hammer drill and uses SDS Plus or SDS Max drill bits. This technique is ideal for high resistance material such as concrete or solid stone as it creates a perfect hole quickly and effortlessly.



fig.12



fig.13



fig.14

Before drilling, it is recommended to check the condition of the drill point, cutting edge and the required diameter. Do not use drill bits that are excessively worn out.

When drilling into reinforced concrete, use a detector to check where the reinforcement is. Damaging the reinforcement must be avoided. If reinforcement however is struck, the design engineer responsible for the site must be contacted and he will decide the best course of action to be taken.

Care must also be taken with the perpendicularity of the hole. Exaggerated angles can cause bending stress in the threaded part of the anchor which in turn causes a reduction of the anchor resistance.

Before inserting the anchor, verify that the depth is not inferior to the  $h_0$  value as indicated in the technical sheets and instructions.

## 4.2 HOLE CLEANING

Clean the hole according to the product instructions (fig.15). Often this process is over looked and undervalued. Expansion anchors work principally through friction and if dust is present in the hole this could lead to poor functioning and low performance of the anchor. The hole cleaning is above all fundamental when using resin anchors as dust can cause the resin to not bond correctly to the hole walls.

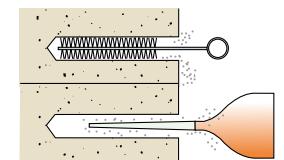


fig.15

## 4.3 ANCHOR INSTALLATION

If the anchor is a pre-positioned fixing, insert the anchor in the hole before the object to be fixed. If however it is a through fixing, insert the anchor through the object to be fixed.

Tighten the screw or the nut according to the recommended tightening torques  $T_{inst}$ . If a dynametric wrench is not available, only insignificant anchors can be fixed. The use of a dynametric wrench is absolutely essential for structural anchors with high loads. Too little or too much torque can jeopardise the resistance and the correct functioning of the anchor. For resin anchors the recommended torque should only be applied once the curing time, as indicated in the product instructions, has elapsed.

## 5. ANCHOR SELECTION

Selection depends on consideration of a variety of influencing factors, which must all be taken into consideration for a correct choice.

The main factors to take into consideration are:

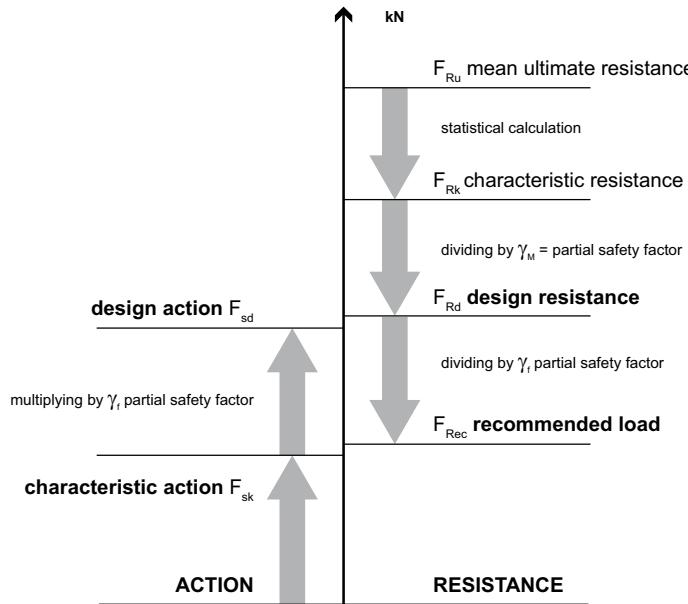
- type of base material;
- size and structure of the construction;
- direction, value and type of load (static, cyclic, seismic, etc);
- expected durability and type of environment;
- the overall work costs.

A design project is mandatory when using structural anchors and anchors whose failure would cause risk to human life, compromise the stability of the works and lead to considerable economic consequences.

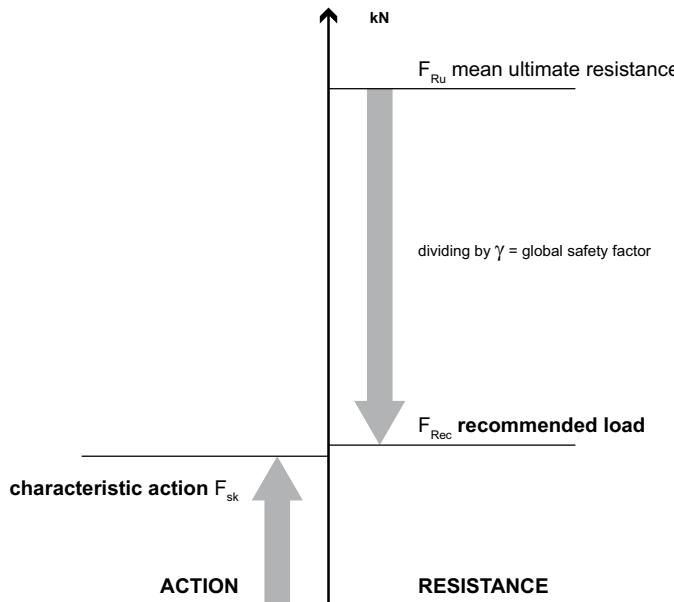
For light duty fixings such as fixing pipes, lights, electrical cables, furnishing accessories etc, the anchor selection can be based on the fixing knowledge of the user.

When design is required, it can be obtained by two methods:

- the ultimate limit state method with partial safety factors according to EOTA standards, Eurocode 2 and relevant ETAs



- the recommended loads method with global safety factors, according to simplified design method and Friulsider technical data sheets



With the first method, design values of resistance and actions are confronted, after calculating them by the use of partial safety factors applied to characteristic values. With the second method, the recommended load is confronted with characteristic action, and a unique global safety factor is applied to calculate the recommended load from mean ultimate resistance.

## 6. ANCHOR TESTS

To determine the anchor loading capacity several tests have to be carried out according to the criteria stated in the European guidelines (ETAG/EAD).

The guidelines set out two types of tests:

- tests for evaluating the admissible service conditions
- tests for confirming their suitability

In the admissible service tests, the anchors are installed observing all of the required conditions such as hole diameter, hole cleaning, torque etc.

The test results will give the reference values for load capacity, edge distances and anchor spacing to be used in the design ( $C_{min}$ ,  $C_{cr,N}$ ,  $C_{cr,sp}$ ,  $S_{min}$ ,  $S_{cr,N}$ ,  $S_{cr,sp}$ ).

In the anchor suitability tests, the guidelines foresee that one of the required conditions should not be adhered to during the installation. The main purpose of this test is to evaluate whether the anchor is capable of working correctly in unfavourable conditions. Repeated anchor loading, installation in crack movements and a maximum torque tests are also carried out.

The results from these tests could entail a reduction in the load capacity obtained from the admissible service tests and also permits the evaluation of the partial safety factor to be used in the design.

As a rule, the anchor suitability tests are more rigid and decisive for the assessment of the product. One of the main assessing criteria of the tests is that the uncontrolled slip in the load/displacement curve (outcome from the pull-out tests) must not be inferior to 70% of the ultimate load in cracked concrete and 80% in non-cracked concrete.

The load values reported in the ETA certificates are characteristic values obtained from a statistic evaluation of the ultimate loads resulting by tests: they are the 5% fractile of the measurements, which means there is a 5% probability that the effective result is lower than the characteristic value. This evaluation takes also in consideration the dispersion of the results.

The characteristic value is calculated using the following formula:

$$F_{5\%} = F_k = \bar{F} - k_s \cdot \sigma \quad (6.1)$$

where  $\bar{F}$  = mean measurement

$\sigma$  = measurement standard deviation

$k_s$  = factor depending on number  $n$  measurements

e.g.:  $n=5 \quad k_s=3,401$

$n=10 \quad k_s=2,568$

Anchors with a constant working behaviour, whose resistances values are near to those of the mean value, will have a characteristic resistance similar to the mean value. On the other hand, if an anchor has a variable load resistance, the characteristic resistance will be a lot lower than the mean value.

## 7. ANCHOR DESIGN

### 7.1 GENERAL

#### 7.1.1 FAILURE MODES

Anchorage failure is caused by specific failure modes which are determined by the type of anchor, loading, shape and characteristics of the base material.

The following modes are taken into consideration when installing into concrete.

Tension load:

- Steel failure (fig.16): where the threaded part of the anchor reaches the resistance limit.
- Pull-out (fig.17a) and "pull through" (fig.17b) failure: where the anchor is pulled out of

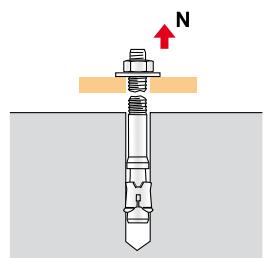
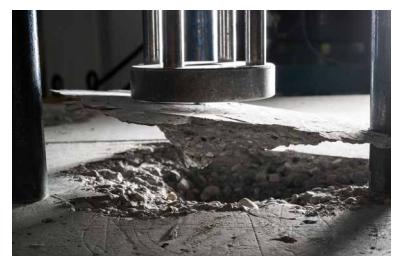
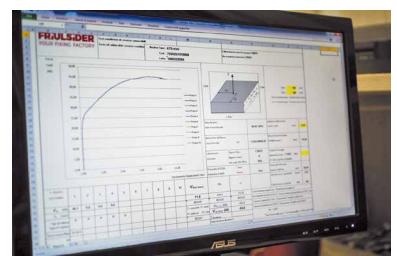


fig.16

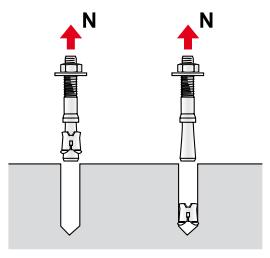


fig.17a

fig.17b

the hole without damaging the base material. "Pull-out" is when the whole anchor is extracted, whereas "pull through" is when only the expanding part is extracted leaving the expansion sleeve in the hole.

- Concrete cone failure (fig.18): where the tensile force acting on the anchor is transferred to the concrete creating a complex tensional state. This causes concrete failure in the form of a cone-shaped area where the vertex is in axis with the anchor, with a depth equal to  $h_{ef}$  and with a width of approximately 100°-110°.
- Splitting failure (fig.19): where the concrete fails due to splitting of the element along the "h" thickness.

**Shear load:**

- Steel failure without lever arm (fig.20): only the resisting section actually involved in the failure mode is taken into account.
- Steel failure with lever arm (fig.21): where the shear load is applied at a certain distance from the wall which causes a bending moment M on the anchor proportional to the shear load V and the lever arm. This type of failure greatly penalises the anchor resistance. In fact the failure with shear arm is often the failure mode with the lowest resistance.
- Pry-out failure (fig.22): where the anchor acting as a lever in the concrete succeeds in dislodging the part of concrete which is on the opposing side to the shear force.
- Concrete edge failure (fig.23): where the shear force acting towards the base material edge breaks the edge.

The failure mode with the lowest load will play an important role in determining the anchor resistance.

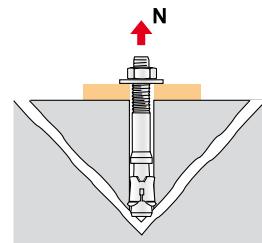


fig.18

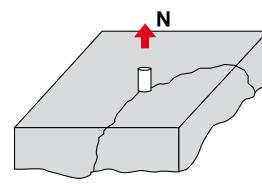


fig.19

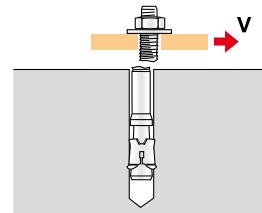


fig.20

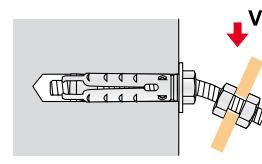


fig.21

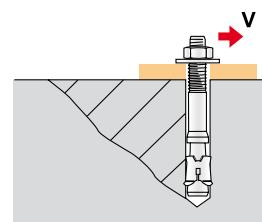


fig.22

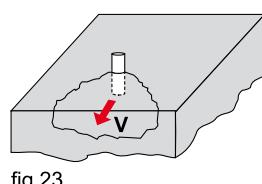


fig.23

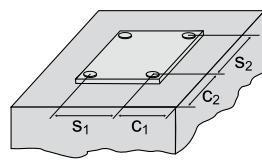


fig.24

## 7.1.2 EDGE AND SPACING DISTANCES

Edge and spacing distances have a crucial role in the failure mode of an anchorage (fig.24). Beneath certain edge and spacing distances, the tensional conditions induced by expansion forces during the anchor installation can cause base material failure (fig. 25). For this reason each anchor is given a minimum edge distance  $c_{min}$  and minimum spacing distance  $s_{min}$  (fig. 26). These distances determine the area where the installation of anchors is prohibited. These values also play an important part in anchor selection as only anchors with low  $c_{min}$  and  $s_{min}$  values can be used in restricted fixing areas.

In the remaining areas of the base material, where anchors can be installed, there are further zones where the behaviour of the anchor interacts with the edge or with other anchors. These are defined as the edge distance  $c_{cr}$  and the spacing distance  $s_{cr}$ ; when fixing beneath these values a reduction in resistance will occur.

An anchor in "full mass" is when an anchor has  $c > c_{cr}$  and  $s > s_{cr}$  in all directions. This type of situation, although not very common, is where an anchor can generate the maximum resistance.

## 7.1.3 ANCHORAGE DEPTH

The anchorage depth  $h_{ef}$  is a determining factor for the pull-out failure mode. It is of utmost importance that the installation is carried out using the anchorage depth stated in the technical and instruction sheets. The anchor must not be installed using an inferior depth. If the anchor however is installed with a greater  $h_{ef}$  value, the resistance increases. This increase in value though is not taken into consideration in the anchor design.

## 7.1.4 CONCRETE MEMBER THICKNESS

The  $h$  thickness of the concrete section used by the anchorage can cause failures such as splitting or edge failure. If the anchor is installed inferior to the  $h_{min}$  thickness, the expansion force can cause the concrete to break. Generally as a rule expansion anchors use the thickness  $h_{min} = 2 \cdot h_{ef}$ .

## 7.1.5 CRACKING

As previously stated, cracks cannot be avoided in the tension zones of concrete.

The cracks have a negative influence on the tensile resistance as they reduce the amount of concrete involved in the failure mode. Instead of having one concrete cone, there will be two partial cones symmetrical to the crack (fig.27).

Furthermore the width of the crack can cause a reduction in the expansion force and as a result a reduction in the pull-out values.

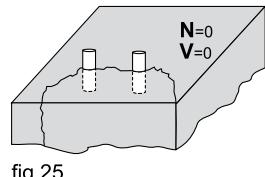


fig.25

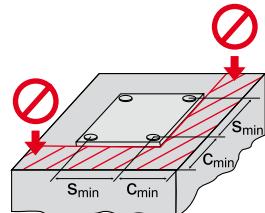


fig.26

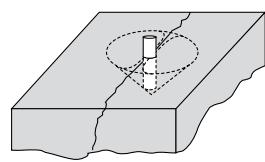


fig.27

## 7.2 ULTIMATE LIMIT STATE DESIGN

For the ultimate limit state design method the Annex C of the ETAG 001 (for non-bonded metal anchors) and TR029 (for bonded anchors), the reference design codes utilised at European level until year 2018, have been replaced by the Eurocode 2: EN1992-4:2018.

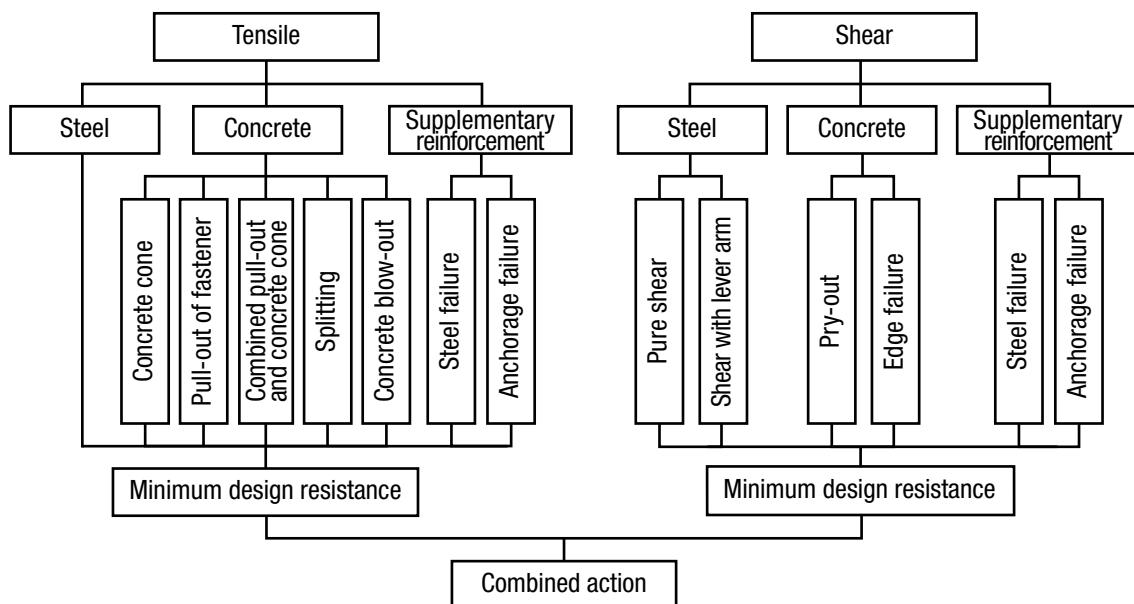
The new standard, released by the CEN (European Committee for Standardisation), covers post-installed mechanical, bonded and bonded expansion fasteners, plus some types of cast-in fasteners such as headed fasteners and anchor channels with rigid connection between anchor and channel.

In the following chapters the main principles of calculation for post-installed bonded and mechanical fasteners will be described, for design details refer to the official document.

These design methods can only be used for anchors which have obtained the European Technical Approval/Assessment, which contains all of the necessary design values based on the different failure modes.

Friulsider product ETAs can be downloaded from [www.friulsider.com](http://www.friulsider.com).

### 7.2.1 EN1992-4:2018 DESIGN PRINCIPLES



The new Eurocode 2 part 4 includes old ETAG/TRs verifications and takes into consideration also additional failure modes concerning the concrete reinforcement: in fact the design of fasteners may rely on supplementary reinforcement, so in this case for tension loads concrete cone failure need not be verified and for shear loads concrete edge failure need not be verified, but steel and anchorage failure of the supplementary reinforcement shall be checked for both types of loads. For each failure method checks are carried out comparing the design action and the design resistance.

For groups of fasteners, two types of verifications are carried out: for steel, pull out of the anchor and supplementary reinforcement steel and anchorage failure modes the comparison is between the design action acting on the most stressed anchor of the group and the resistance of the single anchor; for concrete failure (cone, splitting or blow-out for tensile, edge or pry-out for shear) the design actions result and the design resistance of the group will be compared.

## 7.2.1.1 DESIGN AND SAFETY CONCEPT

The design of anchorages shall be in accordance with the general rules given in EN 1990. It shall be shown that the value of the design actions  $E_d$  does not exceed the value of the design resistance  $R_d$ :

$$E_d \leq R_d \quad (7.1)$$

With:  $E_d$  = design value of effect of action

$R_d$  = design value of resistance

In the ultimate limit state design effects of actions and design resistance derive from characteristic values that are multiplied (actions) or divided (resistances) by partial safety factors. In the case of resistance:

$$R_d = R_k / \gamma_M \quad (7.2)$$

With:  $R_k$  = characteristic resistance of a single anchor or an anchor group  
 $\gamma_M$  = partial safety factor for material

At both the ultimate and the serviceability limit state partial factors for actions shall be in accordance with EN 1990 and EN 1992-4, partial factors for resistances shall be in accordance with EN 1992-4 and product ETA.

## 7.2.1.2 ULTIMATE LIMIT STATE – TENSION LOADS

### 7.2.1.2.1 STEEL FAILURE

The characteristic resistance of an anchor in the case of steel failure,  $N_{RK,S}$ , is given in the relevant ETA.

The value of  $N_{RK,S}$  is obtained from the following equation:

$$N_{RK,S} = A_s \cdot f_{uk} \quad (7.3)$$

With:  $A_s$  = resistant section area of fastener

$f_{uk}$  = characteristic steel ultimate tensile strength

### 7.2.1.2.2 CONCRETE CONE FAILURE

The characteristic resistance of an anchor or a group of anchors, in case of concrete cone failure is (EN1992-4:2018, 7.2.1.4, 7.1):

$$N_{RK,C} = N_{RK,C}^0 \cdot \frac{A_{c,N}}{A_{c,N}^0} \cdot \psi_{s,N} \cdot \psi_{re,N} \cdot \psi_{ec,N} \cdot \psi_{M,N} \quad (7.4)$$

The different factors of Equation (7.4) for anchors according to current experience are given below:

$$N_{RK,C}^0 = k_1 \cdot \sqrt{f_{ck}} \cdot h_{ef}^{1.5} \quad (7.5)$$

Is the initial value of the characteristic resistance (EN1992-4:2018, 7.2.1.4, 7.2), where:

$h_{ef}$  = effective embedment depth

$k_1$  = is given in the corresponding ETA; indicative values for post-installed fasteners are:

$k_1 = 7.7$  for applications in cracked concrete

$k_1 = 11$  for applications in non-cracked concrete

$A_{c,N}/A_{c,N}^0$  takes into account the geometric effect of spacing and edge distance:

$A_{c,N}^0 = s_{cr,N} \times c_{cr,N}$  = area of concrete of an individual anchor with  $s \geq s_{cr,N}$  and  $c \geq c_{cr,N}$ , idealizing the concrete cone as a pyramid with a height equal to  $h_{ef}$  and a base length equal to  $s_{cr,N}$ .

$A_{c,N}$  = actual area of concrete cone of the anchorage at the concrete surface. It is limited by

overlapping concrete cones of adjoining anchors ( $s < s_{cr,N}$ ) as well as by edges of the concrete member ( $c < c_{cr,N}$ ).

With:

$$s_{cr,N} = 2c_{cr,N} = 3h_{ef}$$

Examples for the calculation of  $A_{c,N}$  are given on the EN 1992-4.

$\psi_{s,N}$  is a factor that takes account of the disturbance of the distribution of stresses in the concrete due to edges of the concrete member.

$\psi_{re,N}$  is called the shell spalling factor, accounts for the effect of dense reinforcement between which the fastener is installed.

$\psi_{ec,N}$  takes account of a group effect when different tension loads are acting on the individual anchors of a group.

$\psi_{M,N}$  accounts for the effect of a compression force between fixture and concrete in case of bending moments.

For anchorages with three or more edges with an edge distance  $< c_{cr,N}$  the calculation according to equation (7.4) leads to conservative results which are on the safe side. More precise results are obtained with the use of an alternative value  $h'_{ef}$  to determine  $A_{c,N}$ ,  $A_{c,N}^0$  and  $N_{Rk,c}^0$ , as explained on the EN 1992-4.

### 7.2.1.2.3 PULL-OUT FAILURE

Pull-out failure mode check is not required for post-installed bonded fasteners.

The characteristic resistance in the case of pull-out failure,  $N_{Rk,p}$  is given in the relevant ETA.

### 7.2.1.2.4 COMBINED PULL-OUT AND CONCRETE CONE FAILURE

Combined pull-out and concrete cone failure check is not required for post-installed mechanical fasteners.

The characteristic resistance of an anchor or a group of anchors, in case of combined pull-out and concrete cone failure is (EN1992-4:2018, 7.2.1.6, 7.13):

$$N_{Rk,p} = N_{Rk,p}^0 \cdot \frac{A_{p,N}}{A_{p,N}^0} \cdot \psi_{s,Np} \cdot \psi_{g,Np} \cdot \psi_{ec,Np} \cdot \psi_{re,Np} \quad (7.6)$$

The different factors of Equation (7.6) for anchors according to current experience are given below:

$$N_{Rk,p}^0 = \psi_{sus} \cdot \pi \cdot d \cdot h_{ef} \cdot \tau_{Rk} \quad (7.7)$$

Is the initial value of the characteristic resistance (EN1992-4:2018, 7.2.1.6, 7.14), where:

$h_{ef}$  = effective embedment depth

$d$  = diameter of the bar

$\tau_{Rk}$  = characteristic bond resistance, given in the relevant ETA

$\psi_{sus}$  = factor accounting for the influence of sustained load on the bond strength and depending on the ratio between the sustained actions and the total actions all considered at ULS

$A_{p,N}/A_{p,N}^0$  takes into account the geometric effect of spacing and edge distance:

$A_{p,N}^0 = s_{cr,Np} \times s_{cr,Np}$  = influence area of an individual anchor with large spacing and edge distance at the concrete surface, idealizing the concrete cone as a pyramid with a base length equal to  $s_{cr,Np}$ .

$A_{p,N}$  = actual area of concrete cone of the anchorage at the concrete surface. It is limited by overlapping concrete cones of adjoining anchors ( $s < s_{cr,N}$ ) as well as by edges of the concrete member ( $c < c_{cr,N}$ ).

With:

$$S_{cr,Np} = 7,3 \cdot d \cdot (\psi_{sus} \cdot \tau_{Rk})^{0,5} \leq 3 h_{ef} \quad (7.8)$$

(EN1992-4:2018, 7.2.1.6, 7.15)

Where  $\tau_{Rk,ucr}$  = characteristic bond resistance, for uncracked C20/25

$$C_{cr,Np} = \frac{S_{cr,Np}}{2} \quad (7.9)$$

(EN1992-4:2018, 7.2.1.6, 7.16)

The values of equations (7.8) and (7.9) are valid for both cracked and non-cracked concrete. Examples for the calculation of  $A_{p,N}$  are given on the EN 1992-4.

$\psi_{s,Np}$  is a factor that takes account of the disturbance of the distribution of stresses in the concrete due to edges of the concrete member.

$\psi_{g,Np}$  takes account of a group effect for closely spaced bonded fasteners.

$\psi_{ec,Np}$  takes account of a group effect when different tension loads are acting on the individual anchors of a group.

$\psi_{re,Np}$  is called the shell spalling factor, accounts for the effect of dense reinforcement between which the fastener is installed.

For anchorages with three or more edges with an edge distance  $< C_{cr,Np}$  the calculation according to equation (7.6) leads to conservative results which are on the safe side. More precise results are obtained with the use of an alternative value  $h'_{ef}$  to determine  $A_{p,N}$ ,  $A^0_{p,N}$  and  $N^0_{Rk,p}$ , as explained on the EN 1992-4.

## 7.2.1.2.5 CONCRETE SPLITTING FAILURE

Splitting failure can be caused by installation geometry or by loading. Installation geometry splitting failure is avoided by complying with minimum values of edge distance  $c_{min}$ , anchor spacing  $s_{min}$ , member thickness  $h_{min}$  and reinforcement, as given in the relevant ETA. For splitting failure due to loading, see EN 1992-4 for cases that may occur.

## 7.2.1.2.6 CONCRETE BLOW-OUT FAILURE

Blow-out failure must be verified in case of headed fasteners and post-installed mechanical undercut fasteners acting as headed fasteners in the case of edge distance  $c \leq 0,5 h_{ef}$ . Each edge must be considered in turn. The characteristic resistance is (EN1992-4:2018, 7.2.1.8, 7.25):

$$N_{Rk,cb} = N^0_{Rk,cb} \cdot \frac{A_{c,Nb}}{A^0_{c,Nb}} \cdot \psi_{s,Nb} \cdot \psi_{g,Nb} \cdot \psi_{ec,Nb} \quad (7.10)$$

The different factors of Equation (7.10) for anchors according to current experience are given below:

$$N^0_{Rk,cb} = k_5 \cdot c_1 \cdot \sqrt{A_h} \cdot \sqrt{f_{ck}} \quad (7.11)$$

Is the initial value of the characteristic resistance (EN1992-4:2018, 7.2.1.8, 7.26), where:

$k_5 = 8,5$  for applications in cracked concrete

$k_5 = 12,2$  for applications in uncracked concrete

$A_h$  = load bearing area of the head of the fastener, defined in EN 1992-4

$C_1$  = edge distance

$A_{c,Nb}/A^0_{c,Nb}$  takes into account the geometric effect of spacing and edge distance:

$A^0_{c,Nb} = S_{cr,Np} \times S_{cr,Np}$  = reference projected area for an individual fastener with an edge distance  $c_1$

$A_{c,Nb}$  = actual projected area, limited by overlapping concrete break-out bodies of adjacent fasteners as well as proximity of edges or thickness of the concrete member.

Examples for the calculation of actual projected areas are given on the EN 1992-4.

$\psi_{s,Nb}$  is a factor that takes account of the disturbance of the distribution of stresses in the concrete due to the proximity of a corner of the concrete member.

$\psi_{g,Nb}$  takes account of a group effect for a row fasteners parallel to the edge.

$\psi_{ec,Nb}$  takes account of a group effect when different tension loads are acting on the individual anchors of a group.

### 7.2.1.2.7 FAILURE OF SUPPLEMENTARY REINFORCEMENT: STEEL FAILURE

The characteristic yield resistance of the supplementary reinforcement for one fastener is (EN1992-4:2018, 7.2.1.9.1, 7.31):

$$N_{Rk,re} = \sum_{i=1}^{n_{re}} A_{s,re,i} \cdot f_{yk,re} \quad (7.12)$$

where:

$$f_{yk,re} \leq 600 \text{ N/mm}^2$$

$n_{re}$  = number of supplementary reinforcement bars effective for one fastener

$A_{s,re,i}$  = section area of each bar

### 7.2.1.2.8 FAILURE OF SUPPLEMENTARY REINFORCEMENT: ANCHORAGE FAILURE

The design resistance of the supplementary reinforcement for one fastener associated with anchorage failure in the concrete cone is (EN1992-4:2018, 7.2.1.9.2, 7.32):

$$N_{Rd,a} = \sum_{i=1}^{n_{re}} N_{Rd,a,i}^0 \quad (7.13)$$

where  $N_{Rd,a,i}^0$  is the minimum design resistance value between the one from steel yielding and the one from maximum bond strength, as described in EN 1992-4.

### 7.2.1.3 ULTIMATE LIMIT STATE – SHEAR LOADS

#### 7.2.1.3.1 STEEL FAILURE

##### - Shear load without lever arm

The characteristic resistance of an anchor in case of steel failure,  $V_{Rk,s}$ , is given in the relevant ETA. A method to obtain the characteristic resistance from calculation and a method to account for ductility of the fastener in a group considering also possible grout layer are detailed in the EN 1992-4.

##### - Shear load with lever arm

The characteristic resistance of an anchor,  $V_{Rk,s}$ , is given by (EN1992-4:2018, 7.2.2.3.2, 7.37):

$$V_{Rk,s} = \frac{\alpha_M \cdot M_{Rk,s}}{l} \quad (7.14)$$

With:

$\alpha_M$  = depends on the degree of restraint of the anchor at the side of the fixture of the application in question and shall be judged according to good engineering practice; the value can be between 1.0 and 2.0.

$$l = a_3 + e_1$$

$a_3 = 0.5d$  (0 if a washer and a nut are directly clamped to the concrete surface)

$e_1$  = distance between shear load and concrete surface

$$M_{Rk,s} = M_{Rk,s}^0 \cdot (1 - N_{Ed} / N_{Rd,s}) \quad (7.15)$$

$$N_{Rd,s} = N_{Rk,s} / \gamma_{Ms}$$

$N_{Rk,s}$ ,  $\gamma_{Ms}$  are given in the relevant ETA

$M_{Rk,s}^0$  = characteristic bending resistance of an individual anchor, which is given in the relevant ETA.

The formula (7.15) can only be used for tension load  $N_{Ed}$ ; when  $N_{Ed}$  is a compression load the fastener should be designed as a steel element according to EN 1993-1-8.

## 7.2.1.3.2 CONCRETE PRY-OUT FAILURE

Anchorage can fail by a concrete pry-out failure at the side opposite to the load direction. For headed or mechanical post-installed fasteners the corresponding characteristic resistance  $V_{RK,CP}$  shall be calculated from the following equations:

for fastenings without supplementary reinforcement (EN1992-4:2018, 7.2.2.4, 7.39a)

$$V_{RK,CP} = k_8 \cdot N_{RK,C} \quad (7.16)$$

for fastenings with supplementary reinforcement (EN1992-4:2018, 7.2.2.4, 7.39b):

$$V_{RK,CP} = 0,75 \cdot k_8 \cdot N_{RK,C} \quad (7.17)$$

With:

$k_8$  = factor given by the relevant ETA

$N_{RK,C}$  = to be calculated as per equation (7.4)

For bonded fasteners the pry-out characteristic resistance  $V_{RK,CP}$  shall be calculated from the following equations:

for fastenings without supplementary reinforcement (EN1992-4:2018, 7.2.2.4, 7.39c)

$$V_{RK,CP} = k_8 \cdot \min(N_{RK,C}, N_{RK,P}) \quad (7.18)$$

for fastenings with supplementary reinforcement (EN1992-4:2018, 7.2.2.4, 7.39d)

$$V_{RK,CP} = 0,75 \cdot k_8 \cdot \min(N_{RK,C}, N_{RK,P}) \quad (7.19)$$

With:

$N_{RK,P}$  = to be calculated as per equation (7.6)

## 7.2.1.3.3 CONCRETE EDGE FAILURE

Concrete edge failure need not be verified for groups with not more than 4 anchors when the edge distance in all directions is  $c > 10 h_{ef}$  and  $c > 60 d$ .

The characteristic resistance for an anchor or an anchor group in the case of concrete edge failure corresponds to (EN1992-4:2018, 7.2.2.5, 7.40):

$$V_{RK,C} = V_{RK,C}^0 \cdot \frac{A_{c,V}}{A_{c,V}^0} \psi_{s,V} \cdot \psi_{h,V} \cdot \psi_{\alpha,V} \cdot \psi_{ec,V} \cdot \psi_{re,V} \quad (7.20)$$

Where the different factors of the equation are the following:

$$V_{RK,C}^0 = k_g \cdot d_{nom}^{\alpha} \cdot l_f^{\beta} \cdot \sqrt{f_{ck}} \cdot c_1^{1.5} \quad (7.21)$$

(EN1992-4:2018, 7.2.2.4, 7.41)

With:

$k_g$  = 1.7 for applications in cracked concrete

$k_g$  = 2.4 for applications in uncracked concrete

$$\alpha = 0.1 \cdot \left( \frac{l_f}{c_1} \right)^{0.5} \quad (\text{EN1992-4:2018, 7.2.2.4, 7.42})$$

$$\beta = 0.1 \cdot \left( \frac{d_{nom}}{c_1} \right)^{0.2} \quad (\text{EN1992-4:2018, 7.2.2.4, 7.43})$$

$c_1$  = distance between nearest anchor to the edge and the edge

$A_{c,V}/A_{c,V}^0$  takes into account the geometric effect of spacing, edge distance and thickness of the concrete member:

$A_{c,V}^0 = 4.5c_1^2$  = area of concrete cone of an individual anchor at the lateral concrete surface not affected by edges parallel to the assumed loading direction, member thickness or adjacent anchors, assuming the shape of the fracture area as a half pyramid with a height equal to  $c_1$  and a base-length of  $1.5 c_1$  and  $3 c_1$  (fig. 28).

$A_{c,V}$  = actual area of concrete cone of anchorage at the lateral concrete surface. It is limited by

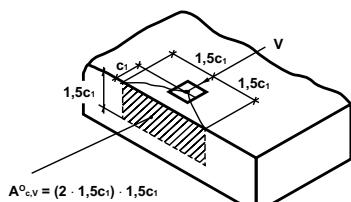


fig.28

the overlapping concrete cones of adjoining anchors ( $s < 3 c_1$ ) as well as by edges parallel to the assumed loading direction ( $c_2 < 1.5 c_1$ ) and by member thickness ( $h < 1.5 c_1$ ). Examples for calculation of  $A_{c,V}$  are given in the EN 1992-4.

$\psi_{s,V}$  is a factor that takes account of the disturbance of the distribution of stresses in the concrete due to further edges of the concrete member on the shear resistance.

$\psi_{h,V}$  takes account of the fact that the shear resistance does not decrease proportionally to the member thickness as assumed by the ratio  $A_{c,V}/A_{c,V}^0$ .

$\psi_{\alpha,V}$  takes account of the angle  $\alpha_V$  between the load applied,  $V_{sd}$ , and the direction perpendicular to the free edge of the concrete member (fig. 29).

$\psi_{ec,V}$  is a factor that takes account of a group effect when different shear loads are acting on the individual anchors of a group.

$\psi_{re,V}$  takes account of the effect of the reinforcement located on the edge.

When anchorages are placed in a corner, both edges resistances shall be calculated and the smallest value is decisive.

For anchorages in a narrow, thin member, where the greatest of the two edge distances parallel to the direction of loading is  $\leq 1.5c_1$ , and  $h \leq 1.5 c_1$  the calculation according to formula (7.20) leads to conservative results. More precise results can be reached with evaluation of  $c_1'$  as explained on the EN 1992-4.

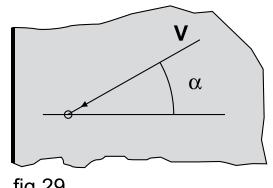


fig.29

#### 7.2.1.3.4 FAILURE OF SUPPLEMENTARY REINFORCEMENT: STEEL FAILURE

The characteristic resistance of one fastener is in case of steel failure of the supplementary reinforcement is:

$$N_{Rk,re} = k_{10} \cdot \sum_{i=1}^{n_{re}} A_{s,re,i} \cdot f_{yk,re} \quad (7.22)$$

(EN1992-4:2018, 7.2.2.6.2, 7.51)

where:

$$f_{yk,re} \leq 600 \text{ N/mm}^2$$

$n_{re}$  = number of supplementary reinforcement bars effective for one fastener

$A_{s,re,i}$  = section area of each bar

$k_{10}$  = efficiency factor, that can be 1,0 or 0,5 depending on the type of reinforcement – as explained on the EN 1992-4

#### 7.2.1.3.5 FAILURE OF SUPPLEMENTARY REINFORCEMENT: ANCHORAGE FAILURE

The design resistance of the supplementary reinforcement not in contact with the fastener associated with anchorage failure in the concrete edge break-out body is (EN1992-4:2018, 7.2.2.6.3, 7.52):

$$N_{Rd,a} = \sum_{i=1}^{n_{re}} N_{Rd,a,i}^0 \quad (7.23)$$

where  $N_{Rd,a,i}^0$  is the minimum design resistance value between the one from steel yielding and the one from maximum bond strength, as described in EN 1992-4.

#### 7.2.1.4 COMBINED TENSION AND SHEAR LOADS

When a single fastener or a group is loaded by combined tension and shear loads the resistance shall be calculated by combining  $N_{Rd}$  and  $V_{Rd}$  and checking with  $N_{Ed}$  and  $V_{Ed}$  by formulations with the following shape:

$$\left( \frac{N_{Ed}}{N_{Rd}} \right)^\alpha + \left( \frac{V_{Ed}}{V_{Rd}} \right)^\alpha \leq k \quad (7.24)$$

Where the factors  $\alpha$  and  $k$  vary depending on the type of verification to be done and are explained in the EN 1992-4.

## 7.3 ANCHORS FOR SEISMIC APPLICATIONS

The seismic qualification of anchors has been regulated in Europe since the publication of the ETAG001 Annex E guideline at the beginning of 2013, which has been replaced by TR049. The anchors subject to this certification procedure must include all the required seismic technical data in the ETA. The suitability of the seismic load is classified as:

- **Seismic category C1:** similar to the USA ICC-ES qualification procedure and comprises cyclic tests on cracks up to 0.5mm.

Most frequent applications can be:

- Mechanical and electrical supports;
- Lighting and false ceilings;
- Connection of steel components (industrial machinery, stairs, railings, shelving);
- Façade systems;
- Fire compartmentation of traversals with pipes and joints.

- **Seismic category C2:** the most restrictive and severe. It comprises of dynamic tests with amplitude variation of the crack up to 0.8 mm and cyclic pulsating loads.

Most frequent applications can be:

- Seismic retrofitting (metallic carpentry, shear reinforcement);
- Fixing steel components onto concrete;
- Fixing industrial machinery;
- Direct fixing metallic or wood cladding anchors.



The European CE marking, due to the peculiarities of construction and design in Europe, foresees stricter test protocols than those in America for civil buildings in seismic risk areas. In Europe, the use of the USA ICC-ES certification is limited to the comparable seismic Category C1.

## 7.4 DESIGN OF FASTENERS UNDER SEISMIC ACTIONS

Eurocode 2 part 4 replaced also the EOTA TR045 guideline, the previous standard for designing anchors under seismic actions. This document complies with the assessment procedure TR049. Here follows a short presentation of the main design principles, for detailed explanation refer to the original standard.

The following table, from EN 1992-4, relates the seismic performance categories C1 and C2 to the seismicity level and building importance class. The level of seismicity is defined as a function of the product  $a_g \cdot S$ , where  $a_g$  is the design ground acceleration on Type A ground and S the soil factor both in accordance with EN 1998-1.

Seismicity level <sup>a</sup>		Importance Class acc. to EN 1998-1:2004, 4.2.5			
Class	$a_g \cdot S^c$	I	II	III	IV
Very low <sup>b</sup>	$a_g \cdot S \leq 0,05 \text{ g}$	No additional requirement			
Low <sup>b</sup>	$0,05 \text{ g} < a_g \cdot S \leq 0,10 \text{ g}$	C1	C1 <sup>d</sup> or C2 <sup>e</sup>	C2	
>Low <sup>b</sup>	$a_g \cdot S > 0,10 \text{ g}$	C1	C2		

<sup>a</sup> The values defining the seismicity levels may be found in the National Annex of EN 1998-1  
<sup>b</sup> Definition according to EN 1998-1:2004, 3.2.1.  
<sup>c</sup>  $a_g$  = Design ground acceleration on type A ground (EN 1998-1:2004, Table 3.2.1)  
<sup>d</sup> S = Soil factor (see e.g. EN 1998-1:2004, 3.2.2)  
<sup>e</sup> C1 for Type "B" connections  
<sup>f</sup> C2 for Type "A" connections

Where type "A" connections are those between structural elements of primary and/or secondary seismic members, type "B" connections are the attachments of non-structural elements.

## 7.5 DESIGN OPTIONS

In the design of fastenings, the following options can be chosen:

### **Design without requirements on the ductility of the anchors**

It shall be assumed that anchors are non-dissipative elements and they are not able to dissipate energy by means of ductile hysteretic behaviour and that they do not contribute to the overall ductile behavior of the structure.

**a1) Capacity design:** the anchor or group of anchors is designed for the maximum tension and/or shear load that can be transmitted to the fastening based on either the development of a ductile yield mechanism in the fixture or the attached element taking into account strain hardening and material over-strength or the capacity of a non-yielding attached element.

**a2) Elastic design:** the fastening is designed for the maximum load obtained from the design load combinations that include seismic actions  $E_{E,d}$  corresponding to the ultimate limit state (EN 1998-1) assuming an elastic behaviour of the fastening and of the structure. Furthermore uncertainties in the model to derive seismic actions on the fastening shall be taken into account.

### **Design with requirements of the ductility of the anchors**

The anchor or group of anchors is designed for the design actions including the seismic actions  $E_{E,d}$  corresponding to the ultimate limit state (EN 1998-1). The tension steel capacity of the fastening shall be smaller than the tension capacity governed by concrete related failure modes. Sufficient elongation capacity of the anchors is required. The fastening shall not be accounted for energy dissipation in the global structural analysis or in the analysis of a non-structural element unless proper justification is provided by a non-linear time history (dynamic) analysis (according to EN 1998-1) and the hysteretic behaviour of the anchor is provided by an ETA. This approach is applicable only for the tension component of the load acting on the anchor.

## 7.6 DESIGN RESISTANCE

The seismic design resistance  $R_{d,eq}$  ( $N_{rd,eq}, V_{rd,eq}$ ) of a fastening is given by (EN1992-4:2018, C.5, C.7):

$$R_{d,eq} = \frac{R_{k,eq}}{\gamma_{M,eq}} \quad (7.25)$$

where the partial safety factor  $\gamma_{M,eq}$  shall be according with paragraph 4.2.2 of EN 1992-4. The characteristic seismic resistance  $R_{k,eq}$  ( $N_{Rk,eq}, V_{Rk,eq}$ ) of a fastening shall be calculated according to the following equation (EN1992-4:2018, C.5, C.8):

$$R_{k,eq} = \alpha_{gap} \cdot \alpha_{eq} \cdot R_{k,eq}^0 \quad (7.26)$$

With:

$\alpha_{gap}$  = reduction factor to take into account inertia effects due to an annular gap between anchor and fixture in case of shear loading; given in the relevant ETA or, in absence, taken from EN 1992-4 as follows:

$\alpha_{gap} = 1,0$  in case of no hole clearance between anchor and fixture;

$\alpha_{gap} = 0,5$  in case of connections with hole clearance according to EN 1992-4.

$\alpha_{eq}$  = reduction factor to take into account the influence of large cracks and scatter of load displacement curves, see  $\alpha_{eq}$  value table on next page;

$R_{k,eq}^0$  = basic characteristic seismic resistance for a given failure mode determined as per EN 1992-4.

$\alpha_{gap}$  values (EN1992-4:2018, C.5, Tab. C.3)

## $\alpha_{eq}$ VALUE TABLE

Loading	Failure mode	Single anchor <sup>1)</sup>	Anchor group
tension	Steel failure	1,0	1,0
	Pull-out failure	1,0	0,85
	Combined pull-out and concrete failure (bonded fastener)	1,0	0,85
	Concrete cone failure		
	- headed fasteners and undercut anchors with $k_1$ factor same as headed fasteners	1,00	0,85
	- all other anchors	0,85	0,75
	Concrete splitting failure	1,0	0,85
	Concrete blow-out failure	1,0	0,85
	Steel failure of reinforcement	1,0	1,0
shear	Anchorage failure of reinforcement	0,85	0,75
	Steel failure	1,0	0,85
	Concrete edge failure	1,0	0,85
	Concrete pry-out failure		
	- headed fasteners and undercut anchors with $k_1$ factor same as headed fasteners	1,00	0,85
	- all other anchors	0,85	0,75
shear	Steel failure of reinforcement	1,0	1,0
	Anchorage failure of reinforcement	0,85	0,75

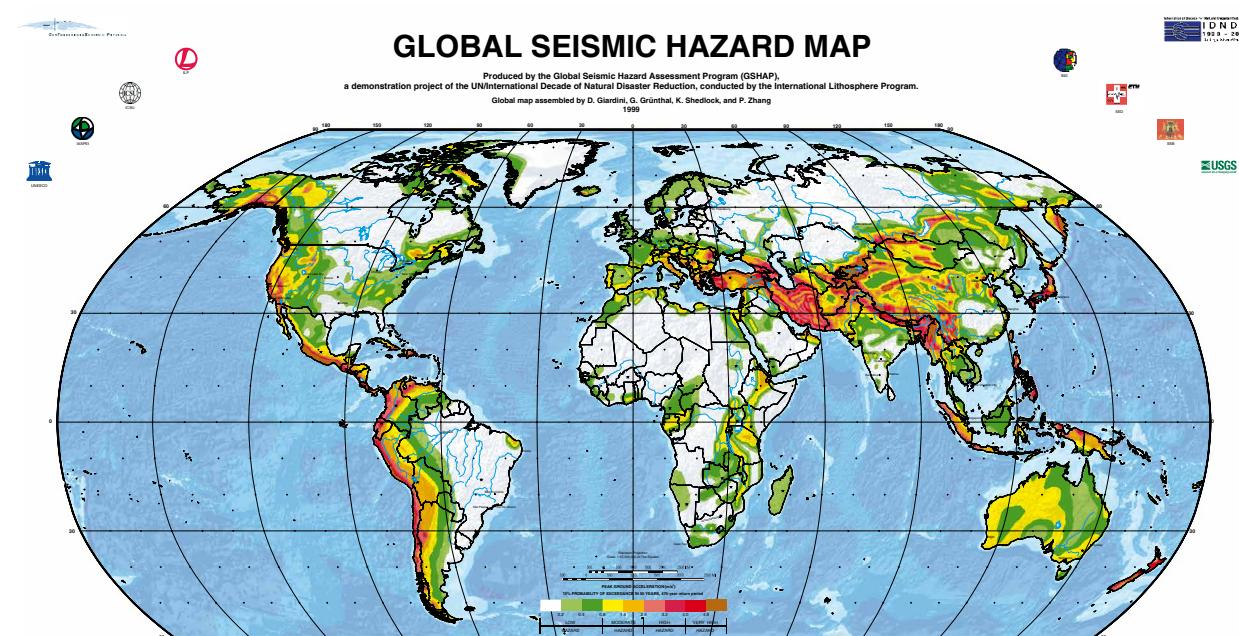
<sup>1)</sup> This applies also where only 1 anchor in a group is subjected to tension.

## 7.6.1 COMBINED TENSION AND SHEAR LOADS

When a single fastener or a group is loaded by combined tension and shear loads the resistance shall be calculated by combining  $N_{Rd}$  and  $V_{Rd}$  and checking with  $N_{Ed}$  and  $V_{Ed}$  by formulations with the following shape (EN1992-4:2018, C.5, C.9):

$$\left( \frac{N_{Ed}}{N_{Rd,i,eq}} \right)^{k_{15}} + \left( \frac{V_{Ed}}{V_{Rd,i,eq}} \right)^{k_{15}} \leq 1 \quad (7.27)$$

Where the factor  $k_{15}$  vary depending on the failure mode taken in consideration and is explained in the EN 1992-4.



## 7.7 RECOMMENDED LOADS SIMPLIFIED DESIGN METHOD

### 7.7.1 TENSILE LOAD

The verification is carried out using the following formula:

$$N_s \leq N_{red} \quad (7.28)$$

$N_s$  is the tensile load acting on a single anchor,  $N_{red}$  is the recommended tensile load reduced to allow for the fixing design, concrete resistance, the tensional state of the concrete (cracked or non-cracked).

Where:

$$N_{red} = N \cdot \psi_r \cdot \psi_a \cdot \psi_c \cdot \psi_{ucr,N} \quad (7.29)$$

$N$  is obtained from the anchor tensile resistance  $N_u$ :

$$N = \frac{N_u}{\gamma} \quad (7.30)$$

The safety factor  $\gamma$  varies depending on whether it is applied to mean resistance values or characteristic values. In the case of mean resistance values, a higher  $\gamma$  factor will be applied to take into account the variability of the anchor behaviour.

The global safety factor  $\gamma$  in our technical data sheets refers to the mean resistance value. As a rule  $\gamma=4$  is used for metallic anchors and  $\gamma=6$  is used for plastic anchors (refer to the technical data sheet for the correct  $\gamma$  factor).

For ETA certified products the  $N$  value is calculated by applying a partial safety factor  $\gamma$  to the design load  $N_{rd}$ .

The  $\psi$  factors have the following meaning:

- a) The factor  $\psi_r$  takes account of the anchor spacing distances. Beneath the critical spacing  $s_{cr,N}$ , normally equal to  $3 \cdot h_{ef}$ , the overlapping of the concrete cones causes a reduction in performance. The factor is calculated according to the following formula:

$$\psi_r = 0,5 + 0,5 \cdot \frac{S}{s_{cr,N}} \quad (7.31)$$

- b) The factor  $\psi_a$  takes account of the edge distances. Beneath the distance  $c_{cr,N}$  from the edge, normally equal to  $0,5 \cdot s_{cr} = 1,5 \cdot h_{ef}$ , the resistance is reduced as the concrete involved in the failure mode is limited by the edge. The factor is calculated according to the following formula:

$$\psi_a = 0,25 + 0,75 \cdot \frac{c}{c_{cr,N}} \quad (7.32)$$

- c) The recommended loads in the technical sheets refer to installation on concrete C20/25. When installing into other concrete classes, use the following corrective factor:

$$\psi_c = \sqrt{\frac{f_{ck, cube}}{25}} \quad (7.33)$$

with  $f_{ck, cube}$  corresponding to the concrete class to be used.

For plastic anchors always use  $\psi_c=1$ .

- d) The recommended loads derive from tests carried out on non-cracked concrete. When installing into cracked concrete, the resistance has to be reduced. Use:

$\psi_{ucr,N} = 1$	non-cracked concrete
$\psi_{cr,N} = 0,6$	cracked concrete

The reduction load factors for edge and spacing distances are calculated in all directions, for example if the anchor is near to a corner and where  $c_1 < c_{cr}$  and  $c_2 < c_{cr}$ , both the factor  $\psi_{a,N1}$  and factor  $\psi_{a,N2}$  should be applied in the formula:

$$N_{red} = N \cdot \psi_{a,N1} \cdot \psi_{a,N2}$$

## 7.7.2 SHEAR LOAD

The verification is carried out using the following formula:

$$V_s \leq V \quad (7.34)$$

$V_s$  is the shear load working on a single anchor,  $V$  is the recommended load calculated taking account predominately of the steel and concrete edge failure modes.

The technical data sheets use, in the event of cracked concrete, the shear resistance value  $V$  with  $c \geq 10 \cdot h_{\text{eff}}$ , where predominately steel failure is taken into account, and the shear resistance  $V_c^0$  in correspondence to  $c = c_{\min}$ , where predominately concrete edge failure is taken into account.

To calculate the resistance of concrete edge failure at the edge distance  $c_1$ , the following formula is used:

$$V_c = V_c^0 \cdot \psi_b \cdot \psi_e \cdot \psi_c \cdot \psi_h \cdot \psi_\alpha \cdot \psi_{ucr,V} \quad (7.35)$$

The factors  $\psi$  have the following meaning:

- a) The factors  $\psi_b$  take account of both the edge and spacing distances. For example if there are  $n$  anchors aligned parallel to the edge with edge distance  $c_1$  and with spacing  $s_1, s_2, \dots, s_{n-1}$  (fig.30):

$$\psi_b = \frac{3 \cdot c_1 + \sum_{i=1}^{n-1} s_i}{3 \cdot n \cdot c_{\min}} \cdot \sqrt{\frac{c_1}{c_{\min}}} \quad (7.36)$$

where  $s_i = \min(s_i; 3 \cdot c_1)$

In the case of a single anchorage:

$$\psi_b = \frac{c_1}{c_{\min}} \cdot \sqrt{\frac{c_1}{c_{\min}}} \quad (7.37)$$

in the case of dual anchorages (s spacing) (fig.31):

$$\psi_b = \frac{3 \cdot c_1 + s'}{6 \cdot c_{\min}} \cdot \sqrt{\frac{c_1}{c_{\min}}} \quad (7.38)$$

- b) The factor  $\psi_e$  takes account of the presence of an edge lateral to the external anchors of the group. If the lateral edge distance is  $c_2$  (fig.32):

$$\psi_e = 0,7 + 0,3 \cdot \frac{c_2}{1,5 \cdot c_1} \leq 1 \quad (7.39)$$

- c) The factor  $\psi_c$  which takes account of the effective concrete resistance is the same used for the tensile (7.33).

- d) The factor  $\psi_h$  takes account of the  $h$  thickness of the concrete in the event that  $h < 1,5 \cdot c_1$ .

$$\psi_h = \left( \frac{h}{1,5 \cdot c_1} \right)^{\frac{2}{3}} \leq 1 \quad (7.40)$$

- e) The factor  $\psi_\alpha$  takes account of the angle between the shear load and the normal on the edge ( $\alpha = 0^\circ$  for orthogonal shear towards the edge,  $\alpha = 180^\circ$  for orthogonal shear on the edge or away from it) (fig. 33),

$$\psi_\alpha = 1 \quad \text{for } 0^\circ \leq \alpha \leq 55^\circ$$

$$\psi_\alpha = \frac{1}{\cos \alpha + 0,5 \cdot \sin \alpha} \quad \text{for } 55^\circ < \alpha < 90^\circ \quad (7.41)$$

$$\psi_\alpha = 2 \quad \text{for } 90^\circ \leq \alpha \leq 180^\circ$$

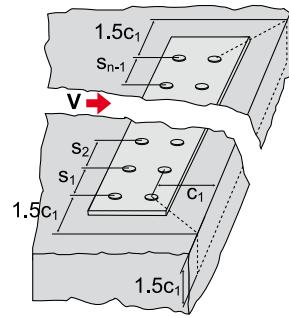


fig.30

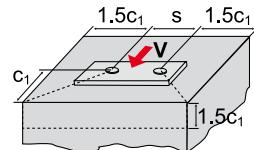


fig.31

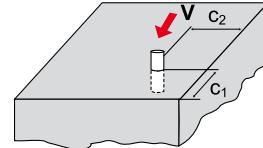


fig.32

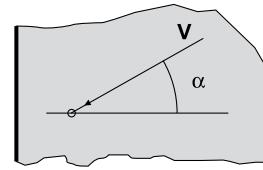


fig.33

- f) The factor  $\psi_{ucr,V}$  takes account of cracked or non-cracked concrete:
- |                      |   |
|----------------------|---|
| $\psi_{ucr,V} = 1,0$ | for cracked concrete  |
| $\psi_{ucr,V} = 1,4$ | for non-cracked concrete or reinforced concrete with edge reinforcement $\geq \emptyset 12$ and connectors with $\leq 100$ mm spacing |

Finally, the following must be taken into account:

$$V = \min (V_c; V_{steel}) \quad (7.42)$$

In case of lever arm verify that (fig.34a & 34b):

$$M_s \leq M_{cons} \quad (7.43)$$

where

$$M_s = V_s \cdot \frac{l}{\alpha_M} \quad (7.44)$$

with

- $l = e_1 + a_3$
- $a_3 = 0,5 \cdot d$
- $a_3 = 0$  if a washer and a nut is directly clamped to the wall surface
- $d$  = nominal screw diameter
- $\alpha_M = 1$  if the fixture cannot rotate
- $\alpha_M = 2$  if the fixture can rotate freely

The recommended load  $M$  is found in the product technical sheet.

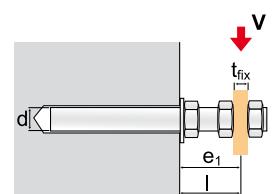


fig.34a

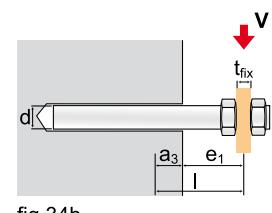


fig.34b

## 8. POST-INSTALLED REINFORCING BARS

### 8.1 DIFFERENT BEHAVIOURS OF POST-INSTALLED REBARS

Post-installed rebars are used in many different applications, in both cases of misplaced or missing bars and consciously planning (for contractor method choice, easier construction process, extension of existing buildings, strengthening / retrofitting for new loads to be considered).

The most frequent applications are:

- Connection of new slabs;
- Close openings;
- Slab enlargements;
- Balcony extensions;
- Staircase connections;
- New columns;
- Columns extinctions;
- Beam connections;
- Bridge enlargements;
- Wall extensions.

If the design and installation are performed correctly, the new structure together with the existing structure can be considered as if the concrete was poured in one.

A post-installed rebar can have two different types of behaviour:

#### - Rebar used as a post-installed anchor

when the concrete needs to take up the tensile load from the rebar or the rebar is designed to carry shear loads: in this case the design reference standard is Eurocode 2-4.

#### - Rebar used as concrete steel reinforcing

when the bar is designed to carry only tension loads and concrete only compression forces, according to structural reinforced concrete design principles. The reference standard is Eurocode 2-1.

In this second case, the behaviour of a post-installed rebar is assumed to be the same as if it was a cast-in-place reinforcing bar.

In the following paragraphs we will deal with this last case.

## 8.2 TYPES OF CONNECTION WITH STRAIGHT BARS

The only possible configuration for post-installed rebars is the straight one, because no hooks or bends can be obtained once concrete is cured, and the types of connection that can be realized are two:

### - Anchorage

it is the case when a bar is no more needed, considering for example a strut and tie model, where the rebar tension is compensated without causing tensile stress on concrete.

### - Overlap splices

when the new bars are installed in combination to existing ones so as to transmit the tension forces.

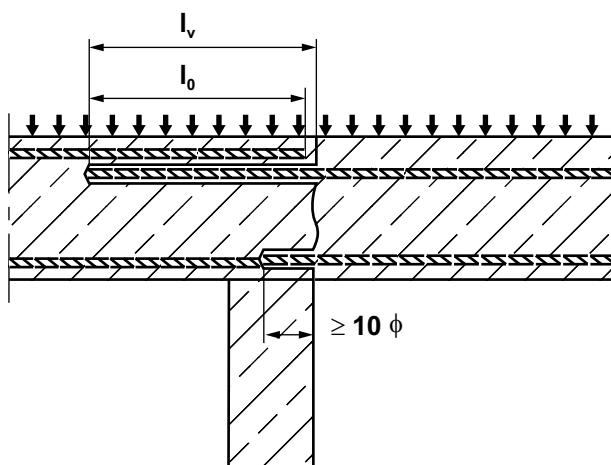
In both cases the force is transmitted to concrete by bonding.

### 8.2.1 APPROVED REBAR CONNECTIONS

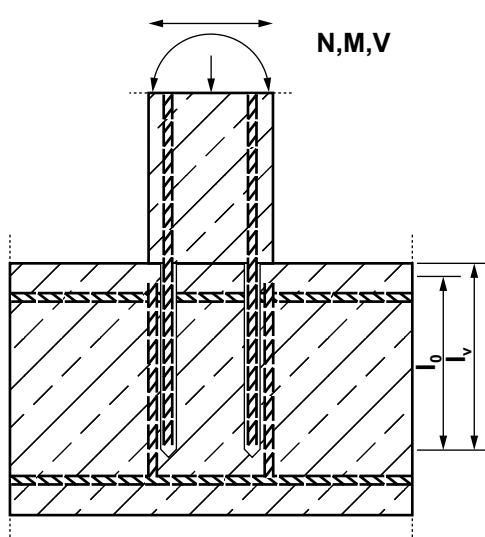
In Europe not all adhesive mortars can be used for post-installed rebar applications, but only those who have obtained the European Technical Assessment according to the EOTA procedure EAD 330087-00-0601, which superseded the TR023. This standard specifies a series of tests which have to be performed in order to qualify products for post-installed rebar applications. Once all requirements are met, the ETA is obtained and it means that the qualified post-installed rebar system has at least the same behaviour of a cast-in reinforcing steel bar.

All rebar systems that are ETA certified according to EAD 330087-00-0601 can be designed following Eurocode 2-1.

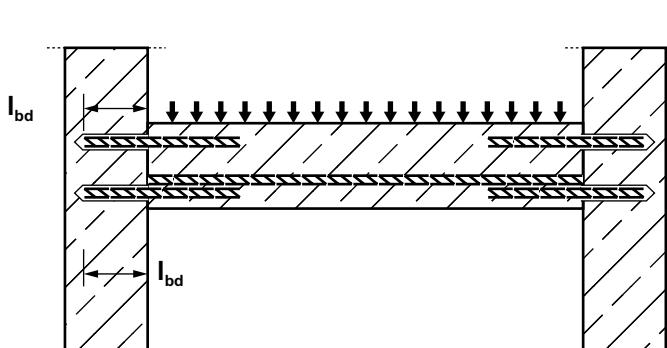
The application range of EAD 330087-00-0601 assessed products is reported in the following figures, taken directly from the standard:



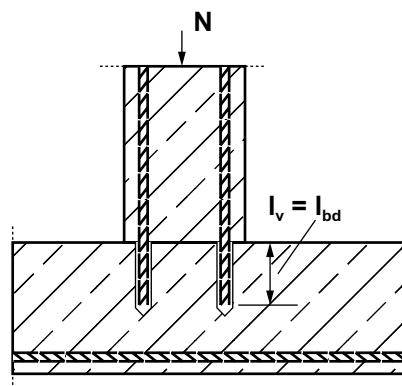
**Figure 1.1:** Overlap joint for rebar connections of slabs and beams



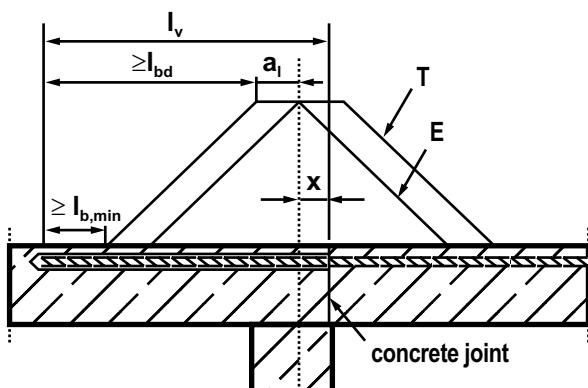
**Figure 1.2** Overlap joint at a foundation of a column or wall where the rebar is stressed in tension



**Figure 1.3:** End anchoring of slabs or beams, designed as simply supported



**Figure 1.4:** Rebar connection for components stressed primarily in compression; rebar is stressed in compression



**Figure 1.5:** Anchoring of reinforcement to cover the line of acting tensile force

#### Key to Figure 1.5

- T acting tensile force
- E envelope of  $M_{ed}/z + N_{ed}$  (see EN 1992-1-1, Figure 9.2)
- x distance between the theoretical point of support and concrete joint

#### Note to Figure 1.1 to 1.5

In the Figures no transverse reinforcement is plotted, the transverse reinforcement as required by EN 1992-1-1 shall be present.

The shear transfer between old and new concrete shall be designed according to EN 1992-1-1.

## 8.3 BOND STRENGTH

The efficiency of post-installed rebar connections depends on the capacity of load transfer from the ribs of the reinforcing bar to the resin and from the resin to the concrete surface of the drilled hole.

The bond strength of resins is usually higher than cast-in bars, but in calculations smaller values are adopted because spacing between rebars and distance from the concrete edge should be increased significantly to avoid failure by splitting or spalling.

The design values of bond strength to be used in calculations of injection resins for post-installed rebar connections are stated in each ETA.

In Eurocode 2-1, chapter 8.4.2, is defined the design value of the ultimate bond stress,  $f_{bd}$ , for ribbed bars (EN1992-1-1:2004, 8.4.2, 8.2):

$$f_{bd} = 2.25 \eta_1 \eta_2 f_{ctd} \quad (8.1)$$

With:

- $\eta_1 = 1.0$  for good bond conditions
- $= 0.7$  for all other conditions
- (see following figures for the meaning of 'good bond conditions')

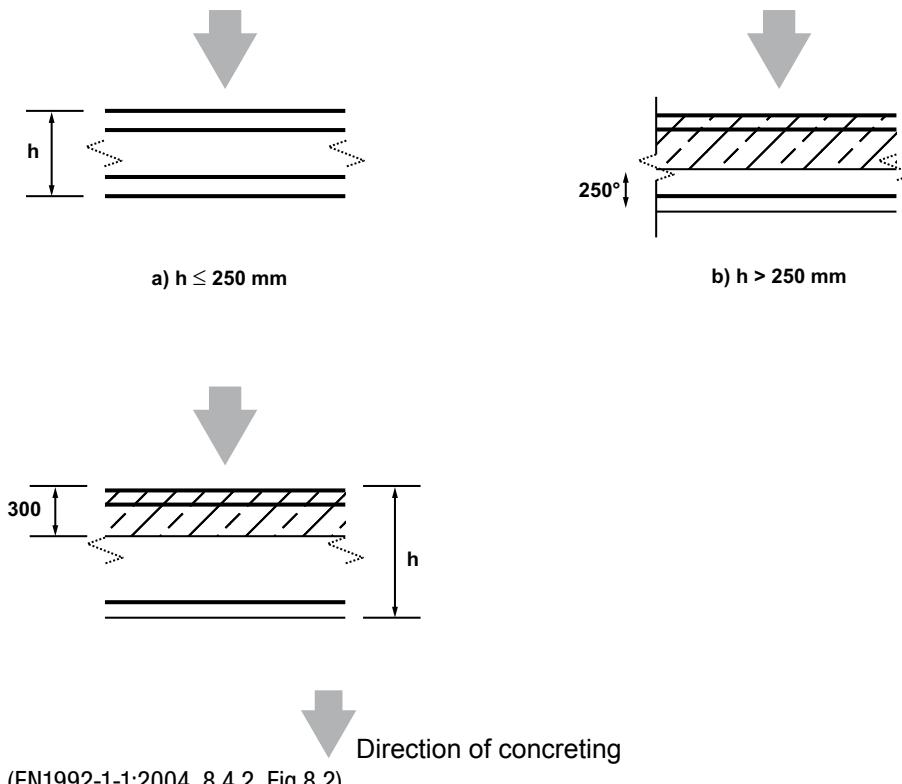
$$\begin{aligned} \eta_2 &= 1.0 && \text{for } \varnothing \leq 32 \text{ mm} \\ &= (132 - \varnothing)/100 && \text{for } \varnothing > 32 \text{ mm} \end{aligned}$$

$$f_{ctd} = \alpha_{ct} f_{ctk,0.05}/\gamma_c$$

$\alpha_{ct}$  = influence of long-term performance = 1.0

$f_{ctk,0.05}$  = characteristic tensile strength of concrete (5% fractile), values reported on table 3.1, chapter 3.1.2 of Eurocode 2

$\gamma_c$  = concrete safety factor = 1.5



(EN1992-1-1:2004, 8.4.2, Fig.8.2)

"Good bond conditions" are the un-hatched areas, "poor bond conditions" are hatched areas. Good bond conditions are achieved when:

In case a) when the thickness of the concrete part in the direction of concreting is not greater than 250 mm.

In case b) when the thickness of the structural component is greater than 250 mm and the rebars are positioned in the lower 250 mm height part.

In case c) when the thickness of the structural part is greater than 600 mm and the rebars are positioned at least 300 mm from the upper side of the component.

## 8.4 BASIC ANCHORAGE LENGTH

For both post-installed rebar application cases, anchorage and overlap splices, the required length is calculated starting from a common starting value, which is the basic anchorage length.

It is defined as the length which is required to transfer by bond stress, assumed to be constant, the maximum force the rebar can bear.

The steel maximum resistance of a rebar is:

$$N_{rd,s} = \frac{\pi}{4} \varnothing^2 \frac{f_{yk}}{\gamma_s} \quad (8.2)$$

With:

$N_{rd,s}$	= design resistance of the rebar for steel failure
$\varnothing$	= diameter of the rebar
$f_{yk}$	= yield strength of the rebar
$\gamma_s$	= partial safety factor for steel = 1.15

The design resistance of a rebar for bond failure is the following:

$$N_{rd,c} = \pi \cdot \varnothing \cdot l \cdot f_{bd} \quad (8.3)$$

With:

$N_{rd,c}$	= design resistance of the rebar for bond failure
$\varnothing$	= diameter of the rebar
$l$	= embedment depth
$f_{bd}$	= design value of the ultimate bond stress

So the basic anchorage length will be the embedment depth which is needed to develop by bonding the maximum force the steel can take:

$$N_{rd,s} = N_{rd,c} \quad (8.4)$$

That leads to the following definition for the value of the **basic anchorage length** (EN1992-1-1:2004, 8.4.3, 8.3):

$$l_{b,rqd} = \frac{\emptyset}{4} \cdot \frac{\sigma_{sd}}{f_{bd}} \quad (8.5)$$

With:

$$\sigma_{sd} = \frac{f_{yk}}{\gamma_s} \quad = \text{maximum design stress of the rebar}$$

**Note:** since the basic anchorage length is the embedment depth which is needed to transfer the maximum design stress of the steel by bonding into the concrete, increasing the anchorage length would not increase the capacity.

## 8.5 CASE OF ANCHORAGE

In the case when the rebar is no longer needed, the design value of the anchorage length  $l_{bd}$  is the following (EN1992-1-1:2004, 8.4.4, 8.4):

$$l_{bd} = \alpha_1 \cdot \alpha_2 \cdot \alpha_3 \cdot \alpha_4 \cdot \alpha_5 \cdot l_{b,rqd} \geq l_{b,min} \quad (8.6)$$

With:

- $\alpha_1$  = influence of the bar shape
- $\alpha_2$  = influence of the concrete cover
- $\alpha_3$  = influence of the transverse reinforcement  
(not welded)
- $\alpha_4$  = influence of the transverse reinforcement (welded)
- $\alpha_5$  = influence of transverse pressure
- $l_{b,rqd}$  = basic anchorage length
- $l_{b,min}$  = minimum anchorage length

And where (EN1992-1-1:2004, 8.4.4, 8.5):

$$\alpha_2 \cdot \alpha_3 \cdot \alpha_5 \geq 0,7$$

The values of  $\alpha_1$ ,  $\alpha_2$ ,  $\alpha_3$ ,  $\alpha_4$ ,  $\alpha_5$  factors are given in the table 8.2 of Eurocode 2 part 1 paragraph 8.4.4, here below reported:

Influencing factor	Type of anchor (straight or bent bar)	Reinforcement bar	
		In tension	In compression
Shape of bar	Straight bar	$\alpha_1 = 1,0$	$\alpha_1 = 1,0$
Concrete cover	Straight bar	$\alpha_2 = 1 - 0,15(C_d - \emptyset)/\emptyset$ $\geq 0,7$ $\leq 1,0$	$\alpha_2 = 1,0$
Confinement by transverse reinforcement not welded to main reinforcement	All types	$\alpha_3 = 1 - K\lambda$ $\geq 0,7$ $\leq 1,0$	$\alpha_3 = 1,0$
Confinement by welded transverse reinforcement*	All types, position and size as specified in Figure 8. 1 (e) of the standard	$\alpha_4 = 0,7$	$\alpha_4 = 0,7$
Confinement by transverse pressure	All types	$\alpha_5 = 1 - 0,04\rho$ $\geq 0,7$ $\leq 1,0$	-

\* see note under table 8.2 of the standard

Where:

$C_d$  = see figure 8.3 of the same paragraph

$$\lambda = (\sum A_{st} - \sum A_{st,min}) / A_s$$

$\sum A_{st}$  = cross-sectional area of the transverse reinforcement along the design anchorage length  $l_{bd}$

$\sum A_{st,min}$  = cross-sectional area of the minimum transverse reinforcement = 0.25  $A_s$  for beams and 0 for slabs

$A_s$  = area of a single anchored bar with maximum bar diameter

$K$  = values shown in figure 8.4 of the same paragraph

$p$  = transverse pressure (MPa) at ultimate limit state along lbd

The values of the minimum anchorage length are the following:

- Rebars in tension

$$l_{b,min} > \max \{0.3 l_{b,rqd}; 10\phi; 100 \text{ mm}\}$$

- Rebars in compression

$$l_{b,min} > \max \{0.6 l_{b,rqd}; 10\phi; 100 \text{ mm}\}$$

## 8.6 CASE OF OVERLAP SPLICES

In the case when the rebar must transfer the force to another one by overlapping, the lap length shall be calculated as follows (EN1992-1-1:2004, 8.7.3, 8.10):

$$l_0 = \alpha_1 \cdot \alpha_2 \cdot \alpha_3 \cdot \alpha_5 \cdot \alpha_6 \cdot l_{b,rqd} \geq l_{0,min} \quad (8.7)$$

With  $\alpha_1, \alpha_2, \alpha_3, \alpha_5$  and  $l_{b,rqd}$  calculated as previously explained.

The factor  $\alpha_6$  depends on the percentage of lapped bars relative to the total cross-section area; its reference values are given on the table 8.3 of Eurocode 2 part 1 paragraph 8.7.3, here below reported:

Percentage of lapped bars relative to the total cross-section area	< 25%	33%	50%	>50%
$\alpha_6$	1	1,15	1,4	1,5

**Note:** Intermediate values may be determined by interpolation.

So in the case that all bars are overlapping in cross-section, we have  $\alpha_6 = 1.5$ .

The clear distance between lapped bars should not be greater than  $4\phi$ : if the spacing is  $s > 4\phi$  the lap length  $l_0$  shall be increased by  $s - 4\phi$ .

The value of the minimum lap length is the following:

$$l_{0,min} > \max \{0.3 \alpha_6 l_{b,rqd}; 15\phi; 200 \text{ mm}\}$$

## 8.7 ANCHORAGE AND LAP LENGTH IN CRACKED CONCRETE

To account for potentially different behaviour of post-installed and cast-in-place rebars in cracked concrete, in general, the minimum anchorage length  $l_{b,min}$  and minimum lap length  $l_{0,min}$  given in the EN1992-1-1 for anchorages and overlap splices shall be multiplied by the amplification factor of  $\alpha_{lb}$ , which is reported in resins ETA.

Investigations shown that post installed rebars have a reduction of the bond strength of about -50% from uncracked to cracked concrete, while for cast-in-place rebars the reduction is about -25%. However not all post-installed systems have the same behaviour, in some cases the influence of cracks may be smaller, therefore the increasing factor for minimum anchorage length or lap length may be also smaller or =1.

## 8.8 MINIMUM CONCRETE COVER AND SPACING

### 8.8.1 MINIMUM CONCRETE COVER

For post-installed rebars the minimum concrete cover has to be evaluated not only according to Eurocode 2 (part 1, paragraph 4.4.1), but there are also limitations deriving from the drilling method which is used for installation, therefore additional limitations are given in EAD 330087-00-0601 tables 1.1 and 1.2 and sometimes also in relevant ETA certificates.

### 8.8.2 MINIMUM SPACING

For post-installed rebars the minimum spacing of adjacent laps is increased compared to Eurocode values (part 1, paragraph 8.7.2). The EAD 330087-00-0601 gives the following reference values:

$$s_{\min} = 40 \text{ mm} \geq 4\phi$$

with

$\phi$  = diameter of rebar

If a drilling aid is used the requirement of  $4\phi$  may be replaced by  $2\phi$ . The relevant ETA certificates of each resin report also smin values to be respected, that may be more stringent than these.

## 9. CORROSION

### 9.1 GENERAL

Corrosion is a natural process, which converts a refined metal to a more chemically-stable form, such as its oxide, hydroxide, or sulphide. It is the gradual destruction of the material by chemical and/or electrochemical reaction with the environment: the most common case is the oxidation of metals in reaction with an oxidant such as oxygen or sulphur.

There are two ways in which the metals react with oxygen:

- a) An oxidised layer is formed on the surface which prevents further corrosion. This is known as passivation, and can either be natural or artificially forced. With this mechanism less noble materials gain a substantial durability. Typical examples are aluminium and chromium. With steel, this type of phenomena is achieved using weathering steel such as Cor-Ten or using stainless steel where the patina is formed by the alloy elements.
- b) The reaction with oxygen forms a porous oxidised layer which causes further oxidisation in the internal layers. The result of this progressive process is the complete breakdown of the material. A typical example is the corrosion of steel, where contact with air leads to rust formation.

### 9.2 TYPES OF CORROSION

#### 9.2.1 UNIFORM ATTACK CORROSION

The material is in constant contact with the corrosive agent causing an uniform and continuous corrosion along all of the surface area. The material's durability can be calculated by the rate of corrosion. For example when zinc and air are in contact it is possible to estimate the duration of the corrosion resistance for a certain type of environment by taking into account the corroded  $\mu\text{m}$  per unit of time and the material thickness to be sacrificed (see below table).

Type of environment	Zinc loss ( $\mu\text{m}/\text{year}$ )
Rural	1.3 – 2.5
Urban	1.9 – 5.2
Industrial	6.4 – 13.8
Proximity of the sea	2.2 – 7.2

## 9.2.2 PITTING CORROSION

Pitting corrosion is present in materials which have a certain level of self-protection in the form of a passivated layer.

The attack initiates in a very aggressive way on a damaged part of the protective film, it then is accelerated by galvanic corrosion located between the opening surface and passivated layer.

The calculation of the pitting resistance is known as PREN = pitting resistance equivalent number:

$$\text{PREN} = \% \text{Cr} + 3.3\% \text{Mo} + x\% \text{N}$$

With  $x=0$  for ferritic steel, 16 for austenitic steel and 30 for ferritic-austenitic steel.

An index of at least 26 as in the case of stainless steel AISI 316 in the presence of salty water with low chloride contents will guarantee the protection from corrosion.

## 9.2.3 CREVICE CORROSION

Crevice corrosion refers to corrosion occurring in confined spaces to which the access of the working fluid from the environment is limited. These spaces are generally called crevices. Examples of crevices are gaps and contact areas between parts, under gaskets or seals, inside cracks and seams, spaces filled with deposits which become stagnant. The phenomena manifests itself in cracks less than 0,1 mm, typical examples are when there are two metallic surfaces in contact with each other or between a metallic and non-metallic surface. Austenitic steels in the presence of chlorides are particularly prone to this type of corrosion.

## 9.2.4 GALVANIC CONTACT CORROSION

When two diverse metallic materials in contact with each other are exposed to an aggressive environment there is an increase in the rate of corrosion of the less noble material. The presence of a passivated layer contributes to the "nobility" of the material.

The following is a partial sequence of less noble materials to the most noble materials:

Magnesium

Zinc

Aluminium

Carbon steel

Non-passivated stainless steel AISI 304

Non-passivated stainless steel AISI 316

Lead

Tin

Non-passivated nickel

Brass

Copper

Bronze

Passivated nickel

Passivated stainless steel AISI 304

Passivated stainless steel AISI 316

Silver

Titanium

Gold

Platinum

To limit this effect: avoid putting materials at opposite ends of the noble scale in contact with each other; ascertain that area exposed is greater for the less noble material than that of the more noble metal; isolate the two metals from each other.

One protection method is to electrically connect the material to protect with a less noble material which will be sacrificed (e.g. Zinc or aluminium anodes for steel).

<b>Fixed Part</b> (large area)	<b>Fastener</b> (small area)			
	Stainless steel	Hot dip galvanised steel	Zinc electroplated steel	Lamellar Zinc coated steel
Stainless steel	●	*	*	*
Hot dip galvanised steel	**	●	●	●
Zinc electroplated steel	**	●	●	●
Aluminium and Alluminium alloys	**	***	***	***
Copper and Copper alloys	**	*	*	*
Low carbon steel	**	*	*	*

● Contact allowed

\* The Fastener corrodes

\*\* The Fixed Part can corrode, the corrosion starting on a small area around the metal anchor

\*\*\* The Fastener has acceptable corrosion in several cases

## 9.2.5 STRESS CORROSION

This type of corrosion is caused by a simultaneous presence of tensile forces and specific aggressive environments, which on their own would normally only be mildly aggressive.

The corrosion originates in cracks positioned perpendicular to the stress directions.

Carbon steel with high yield limits, above 1100 N/mm<sup>2</sup>, are more susceptible to this type of corrosion as stress cracks can manifest themselves even in the presence of humid air.

Austenitic stainless steel can corrode in the presence of chlorides at 70-80 °C or in caustic environments at higher temperatures.

## 9.3 CORROSION PROTECTION

There are two ways to protect materials subject to corrosion:

a) Use materials with inherent corrosion resistance characteristics. A typical example is stainless steel, where chromium, nickel and molybdenum guarantee the durability of the product even in diverse environmental conditions.

b) Treat the product surface so that corrosion sensitive materials are not in contact with corrosive agents. Typical examples are zinc plating or lacquering. The protection is only guaranteed if no damage occurs to the protective coating.

The choice of protection should be based on the type of environment where the fixing is to be installed.

Friulside uses diverse product protection methods.

## 9.3.1 ZINC PLATING

Zinc is one of the most popular materials used for protective coatings as it forms a compact oxide layer, on contact with the atmosphere, to prevent further oxidisation. Furthermore, being less noble than steel, zinc has a *sacrificial* effect on the steel by oxidising it offers a cathodic protection which remains even in the presence of small damaged areas of the zinc layer (self-reparation).

The following types of zinc plating can be used:

- Galvanic zinc plating. The piece is immersed, after been pickled, in a zinc salt bath. A current is created between the piece and the solution, depositing zinc on the surface of the piece. Normally a minimum thickness of 5 µm is applied. Subsequently, the surface can be passivated and immersed in a lubricant bath to improve the level of protection and the friction in the anchor's expansion zone. Friulsider, in addition to standard galvanizing, also offers a high resistance multilayer galvanic coating called **3DG**.
- Hot dip galvanizing. The piece is pickled, fluxed and heated to 100°C before being immersed in a bath of molten zinc at 455°C. The thickness obtained is a lot greater than that of galvanic zinc plating and ranges from 43 and 100 µm. On account of its high level of protection, hot dip galvanising is often used an economic alternative to stainless steel.
- Cold galvanising. Although the anti-corrosive properties are due to the zinc, the process is similar to that of varnishing. The coating is composed of zinc powder bound by a resin. The piece is immersed, centrifuged and then polymerised in an oven at a low temperature (170-200°C).

## 9.3.2 CORROSION RESISTANT METALS

Friulsider products for the most part use austenitic steels such as AISI 316 (material number 1.4401, grade A4). The products produced in this material are able to guarantee a long durability even in internal humid environments subject to condensation, external environments in proximity to the sea and in aggressive environments on a whole.

Corrosivity categories according to ISO 9223			STEEL	STEEL	STAINLESS STEEL A4 (wr.1.4404 EN10088)
			WHITE ZINC PLATED 5µm ISO4042	3DG	-
C5-I	very high	Industrial			*
C5-M	very high	Marine			*
C4-I	high	Industrial			●
C4-M	high	Marine		*	●
C3	medium	Industrial-Marine-Urban		●	●
C2	low	Urban		●	●
C1	very low	Rural	*	●	●

● Suitable applications

\* Partially suitable applications

# **TECHNICAL CATALOGUE**

for designers

**DYNAMIC AND SEISMIC LOADS****HIGH SHEAR RESISTANCE****SCREW grade 8.8**

ETA 10/0423 - op. 1

**ATS-evo S****Hex head screw grade 8.8  
White zinc plated**

Code	do/tfix-d	L mm	tfix mm	df mm	sw	Pkg.
79302b10070 <sup>(1)</sup>	10/10-M6	70	10	12	10	50
79302b10080 <sup>(1)</sup>	10/20-M6	80	20	12	10	50
79302b10110 <sup>(1)</sup>	10/50-M6	110	50	12	10	50
79302b12080	12/10-M8	80	10	14	13	25
79302b12090	12/20-M8	90	20	14	13	25
79302b12120	12/50-M8	120	50	14	13	25
79302b15090	15/10-M10	90	10	17	17	20
79302b15100	15/20-M10	100	20	17	17	20
79302b15130	15/50-M10	130	50	17	17	20
79302b15180	15/100-M10	180	100	17	17	20
79302b18110	18/10-M12	110	10	20	19	20
79302b18125	18/25-M12	125	25	20	19	20
79302b18150	18/50-M12	150	50	20	19	20
79302b18200	18/100-M12	200	100	20	19	20
79302b24125	24/10-M16	125	10	26	24	10
79302b24140	24/25-M16	140	25	26	24	10
79302b24165	24/50-M16	165	50	26	24	10
79302b24215	24/100-M16	215	100	26	24	10
79302b28160	28/10-M20	160	10	31	30	4
79302b28180	28/30-M20	180	30	31	30	4
79302b28210	28/60-M20	210	60	31	30	4
79302b28250	28/100-M20	250	100	31	30	4
79302b32180	32/10-M24	180	10	35	36	4
79302b32200	32/30-M24	200	30	35	36	4
79302b32230	32/60-M24	230	60	35	36	4

<sup>(1)</sup> Seismic certification category C1 only**ATS-evo B****Threaded bar grade 8.8  
Hex nut grade 8  
White zinc plated**

Code	do/tfix-d	L mm	tfix mm	df mm	sw	Pkg.
79402b10080 <sup>(1)</sup>	10/20-M6	80	20	12	10	50
79402b10110 <sup>(1)</sup>	10/50-M6	110	50	12	10	50
79402b12080	12/10-M8	80	10	14	13	25
79402b12090	12/20-M8	90	20	14	13	25
79402b12120	12/50-M8	120	50	14	13	25
79402b15090	15/10-M10	90	10	17	17	20
79402b15100	15/20-M10	100	20	17	17	20
79402b15130	15/50-M10	130	50	17	17	20
79402b15180	15/100-M10	180	100	17	17	20
79402b18110	18/10-M12	110	10	20	19	20
79402b18125	18/25-M12	125	25	20	19	20
79402b18150	18/50-M12	150	50	20	19	20
79402b18200	18/100-M12	200	100	20	19	20
79402b24125	24/10-M16	125	10	26	24	10
79402b24140	24/25-M16	140	25	26	24	10
79402b24165	24/50-M16	165	50	26	24	10
79402b24215	24/100-M16	215	100	26	24	10
79402b28160▲	28/10-M20	160	10	31	30	4
79402b28180▲	28/30-M20	180	30	31	30	4
79402b28210▲	28/60-M20	210	60	31	30	4
79402b28250▲	28/100-M20	250	100	31	30	4
79402b32180▲	32/10-M24	180	10	35	36	4
79402b32200▲	32/30-M24	200	30	35	36	4
79402b32230▲	32/60-M24	230	60	35	36	4

<sup>(1)</sup> Seismic certification category C1 only

**VERSIONS:**

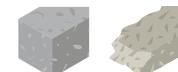
- hex head screw
- threaded bar with hex nut
- hex socket countersunk head screw

**PRODUCT FEATURES:**

- 8.8 grade steel screw and threaded bar
- thick shear sleeve for high shear strength
- special nylon bush
- white zinc plated

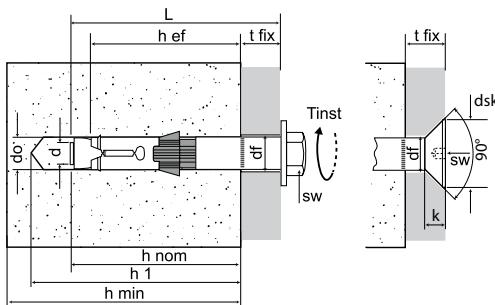
**CERTIFICATIONS**

Seismic performance C1 and C2  
Cracked and non-cracked concrete  
Fire resistance R120

**BASE MATERIALS:****ATS-evo SK****Hex socket countersunk head****screw grade 8.8****White zinc plated**

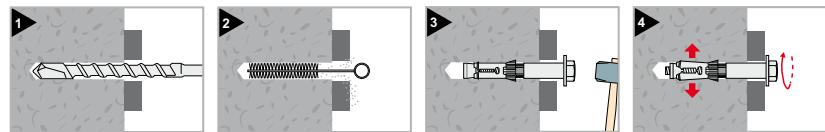
Code	do/tfix-d	L mm	tfix mm	df mm	dsk mm	k mm	sw	Pkg.
79303b10070 <sup>(1)</sup>	10/15-M6	70	15	12	17	5	5	50
79303b10080 <sup>(1)</sup>	10/25-M6	80	25	12	17	5	5	50
79303b12080	12/16-M8	80	16	14	21	6	6	25
79303b12090	12/26-M8	90	26	14	21	6	6	25
79303b12120	12/56-M8	120	56	14	21	6	6	25
79303b15090	15/17-M10	90	17	17	26	7	8	20
79303b15100	15/27-M10	100	27	17	26	7	8	20
79303b18125	18/33-M12	125	33	20	31	8	10	20

<sup>(1)</sup> Seismic certification category C1 only



**d** = screw/bar diameter  
**df** = hole diameter of fixing element  
**do** = hole diameter  
**dsk** = countersunk head diameter  
**h1** = minimum hole depth  
**hef** = minimum depth of anchorage  
**hmin** = minimum support thickness

**hnom** = nominal embedment depth  
**k** = countersunk head depth  
**L** = anchor length  
**sw** = wrench  
**tfix** = fixture thickness  
**Tinst** = torque

**DESIGN<sup>(1)</sup> AND RECOMMENDED<sup>(2)</sup> LOADS****Single anchor with large anchor spacing and edge distances in cracked and non-cracked concrete C20/25**

Anchor		M6	M8	M10	M12	M16	M20	M24
Minimum support thickness	$h_{\min}$ mm	100	120	140	180	200	250	300
Minimum hole depth	$h_1$ mm	75	85	95	115	130	160	180
Nominal embedment depth	$h_{\text{nom}}$ mm	60	70	80	100	115	145	165
Minimum depth of anchorage	$h_{\text{ef}}$ mm	49	59	67	88	99	125	150
Hole diameter	$d_0$ mm	10	12	15	18	24	28	32
Spacing	$S_{\text{cr},N}$ mm	147	177	201	264	297	375	450
Edge distance	$C_{\text{cr},N}$ mm	74	89	101	132	149	188	225
Tensile non-cracked concrete	$N_{\text{rd},ucr}$ kN	10,7	14,9	18,0	27,1	32,3	45,8	60,3
	$N_{\text{ucr}}$ kN	7,6	10,6	12,9	19,3	23,1	32,7	43,0
Tensile cracked concrete	$N_{\text{rd},cr}$ kN	6,0	8,0	10,7	16,7	22,6	32,1	42,2
	$N_{\text{cr}}$ kN	4,3	5,7	7,6	11,9	16,2	22,9	30,1
Shear <sup>(3)</sup> non-cracked concrete	$V_{\text{rd},ucr}$ kN	11,2	14,9	33,6	40,0	64,6	91,7	120,5
	$V_{\text{ucr}}$ kN	8,0	10,6	24,0	28,6	46,2	65,5	86,1
	$N_{\text{rd},eq C1}$ kN	4,5	8,0	10,7	16,1	19,2	27,3	35,9
	$N_{\text{eq C1}}$ kN	3,2	5,7	7,6	11,5	13,7	19,5	25,6
	$V_{\text{rd},eq C1}$ kN	6,7	8,8	16,0	16,0	38,4	54,5	71,7
	$V_{\text{eq C1}}$ kN	4,8	6,3	11,4	11,4	27,5	39,0	51,2
	$N_{\text{rd},eq C2}$ kN	-	2,6	5,2	10,2	19,2	21,9	27,5
	$N_{\text{eq C2}}$ kN	-	1,9	3,7	7,3	13,7	15,6	19,7
	$V_{\text{rd},eq C2}$ kN	-	8,2	13,6	13,6	35,1	54,5	59,7
	$V_{\text{eq C2}}$ kN	-	5,8	9,7	9,7	25,1	39,0	42,6
Seismic Resistance Category C1	$S_{\min}$ mm	50	60	70	80	100	125	150
	$\text{for C}$ mm	75	90	100	150	200	250	300
Seismic Resistance Category C2	$C_{\min}$ mm	50	60	70	80	100	125	150
	$\text{for S}$ mm	75	90	100	150	200	250	300
Shear C = $C_{\min}$ cracked concrete	$V_{\text{rd},cmin}$ kN	3,0	4,1	5,3	6,9	9,8	14,1	19,0
	$V_{\text{cmi}}$ kN	2,1	2,9	3,8	4,9	7,0	10,1	13,6
Torque	$T_{\text{inst}}$ Nm	10	20	45	80	150	170	200

1kN ≈ 100 kgf

<sup>(1)</sup> The design loads  $N_{\text{rd}}$  and  $V_{\text{rd}}$  derive from the characteristic loads on the ETA 10/0423 certification and are inclusive of the partial safety factors  $\gamma_m$  ( $\gamma_{m,N} = 1,5$  tensile /  $\gamma_{m,SV} = 1,25$  shear)

<sup>(2)</sup> The recommended loads  $N$  and  $V$  derive from the characteristic loads on the ETA 10/0423 certification and are inclusive of the partial safety factors  $\gamma_f = 1,4$  and  $\gamma_m$  ( $\gamma_{m,N} = 1,5$  tensile /  $\gamma_{m,SV} = 1,25$  shear).

<sup>(3)</sup> Shear values valid with distance from the edge  $C \geq 10 \times h_{\text{ef}}$

The load values are only valid if the installation has been carried out correctly. The design engineer is responsible for the designing and calculation of the fixing. The designing and calculation of the anchorage should be carried out in accordance with EN 1992-4.

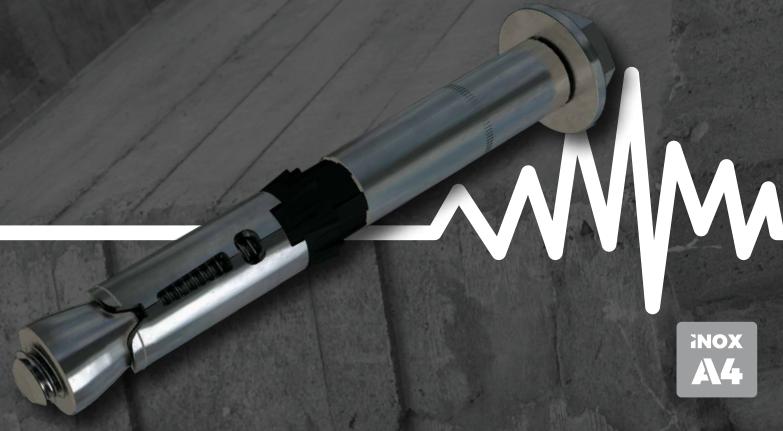
# ATS-evo INOX A4

Heavy duty safety bolt

STAINLESS STEEL A4

HIGH SHEAR RESISTANCE

SCREW grade A4-70



## ATS-evo S INOX A4

Stainless steel A4  
hex head screw

Code	do/tfix-d	L mm	tfix mm	df mm	sw	Pkg.
79302012090▲	12/20-M8	90	20	14	13	25



## ATS-evo SK INOX A4

Stainless steel A4  
hex socket countersunk head

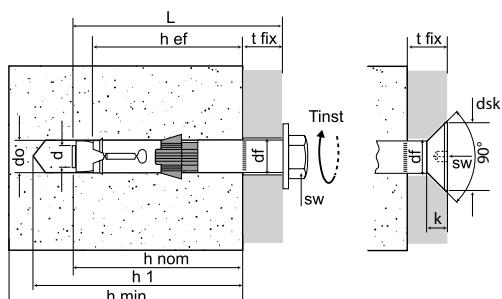
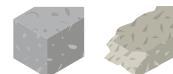
Code	do/tfix-d	L mm	tfix mm	df mm	dsk mm	k mm	sw	Pkg.
79303012090▲	12/26-M8	90	26	14	21	6	6	25

**Versions:**

- hex head screw
- hex socket countersunk head screw

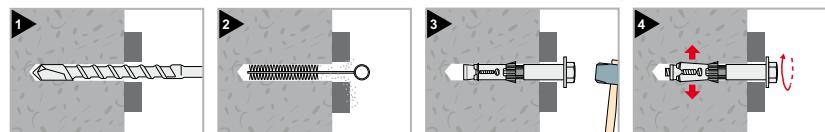
**PRODUCT FEATURES:**

- stainless steel EN 10088-3 grade A4-70 grade steel screw
- thick shear sleeve for high shear strength
- special nylon bush
- white zinc plated

**BASE MATERIALS:**

d	=	screw/bar diameter
df	=	hole diameter of fixing element
do	=	hole diameter
dsk	=	countersunk head diameter
h1	=	minimum hole depth
hef	=	minimum depth of anchorage
hmin	=	minimum support thickness

hnom	=	nominal embedment depth
k	=	countersunk head depth
L	=	anchor length
sw	=	wrench
tfix	=	fixture thickness
Tinst	=	torque

**RECOMMENDED<sup>(1)</sup> LOADS**

Single anchor with large anchor spacing and edge distances in non-cracked concrete C20/25

Anchor	M8
Minimum support thickness	h <sub>min</sub> mm 120
Minimum hole depth	h <sub>1</sub> mm 85
Nominal embedment depth	h <sub>nom</sub> mm 70
Minimum depth of anchorage	h <sub>ef</sub> mm 59
Hole diameter	d <sub>0</sub> mm 12
Tensile non-cracked concrete	N <sub>rd</sub> kN 11,8 N kN 8,4
Shear <sup>(2)</sup> non-cracked concrete	V <sub>rd</sub> kN 12,5 V kN 8,9
Minimum spacing	S <sub>min</sub> mm 60
Minimum edge distance	C <sub>min</sub> mm 90 for C mm 90
Shear C = C <sub>min</sub>	C <sub>min</sub> mm 60 for S mm 90
Torque	V <sub>rd,cmin</sub> kN 4,1 V <sub>cmin</sub> kN 2,9 T <sub>inst</sub> Nm 20

1kN ≈ 100 kgf

<sup>(1)</sup>The recommended loads derive from the mean ultimate loads and are inclusive of the total safety factor  $\gamma=4$  (shear  $\gamma=3$ )

<sup>(2)</sup>Shear values valid with distance from the edge C  $\geq 10 \times h_{ef}$

In the absence of CE markings, the recommended loads derive from tests carried out in the Friulside laboratory in accordance with the appropriate standards. The load values are only valid if the installation has been carried out correctly. The design engineer is responsible for the designing and calculation of the fixing.

**REDUCED EMBEDMENT DEPTH FOR  
INSTALLATION ON THIN PANELS**

**HIGH RESISTANCE STEEL SCREW**

**MARKING ON HEAD FOR IMMEDIATE  
RECOGNITION EVEN AFTER INSTALLATION**



**3DG  
COATING**



**Hex head screw  
grade 10.9  
White zinc plated  
Large washer Ø44x4 DIN 440**

Code	do/tfix-d	L mm	tfix mm	df mm	sw	Pkg.
79309b18090▲	18/12-M12	90	12	20	22	20



**3DG  
COATING**

**Hex head screw  
grade 10.9  
Special anti-corrosion coating  
with matte finish  
Large washer Ø44x4 DIN 440**

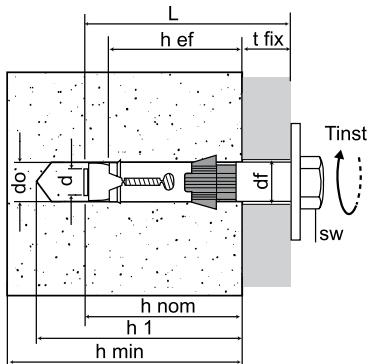
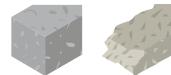
Code	do/tfix-d	L mm	tfix mm	df mm	sw	Pkg.
79309r18090▲	18/12-M12	90	12	20	22	20

**VERSIONS:**

- white zinc plated
- 3DG special anti-corrosion coating

**PRODUCT FEATURES:**

- steel screw grade 10.9
- thick shear sleeve for high shear strength
- large and thick washer 44x4 DIN 440
- special nylon bush

**BASE MATERIALS:**

$d$  = screw diameter  
 $df$  = hole diameter of fixing element  
 $do$  = hole diameter  
 $h_1$  = minimum hole depth  
 $hef$  = minimum depth of anchorage  
 $h_{min}$  = minimum support thickness

$h_{nom}$  = nominal embedment depth  
 $L$  = anchor length  
 $sw$  = wrench  
 $t_{fix}$  = fixture thickness  
 $T_{inst}$  = torque

**RECOMMENDED<sup>(1)</sup> LOADS**

Single anchor with large anchor spacing and edge distances in concrete  $f_{cyl} = 36 \text{ MPa}$

Anchor	M12	
Minimum support thickness	$h_{min}$	mm
Minimum hole depth	$h_1$	mm
Nominal embedment depth	$h_{nom}$	mm
Minimum depth of anchorage	$hef$	mm
Hole diameter	$d_0$	mm
Spacing	$S$	mm
Edge distance	$C$	mm
Tensile non-cracked concrete	$N^{(1)}$	kN
Shear	perpendicular to edge - distance C	$V_{90^{\circ}}^{(1)}$
	parallel to edge - distance C	$V_{0^{\circ}}^{(1)}$
Torque	$T_{inst}$	Nm

1kN  $\approx$  100 kgf

<sup>(1)</sup>The recommended loads N and V derive from the mean loads and are inclusive of the safety factors  $\gamma=4$  ( $\gamma=3$  for shear V).

The recommended loads derive from tests carried out in an external third party laboratory in accordance with the appropriate standards. The load values are only valid if the installation has been carried out correctly. The design engineer is responsible for the designing and calculation of the fixing.

# FM-753 CRACK

Heavy duty through anchor with seismic certification

DYNAMIC AND SEISMIC LOADS

IMMEDIATE EXPANSION

HARDENED AND TEMPERED STEEL BODY  
grade 9.8 - STAINLESS STEEL A4 CLIP



ETA 09/0056 - op. 1



ETA 10/0293 - op. 1

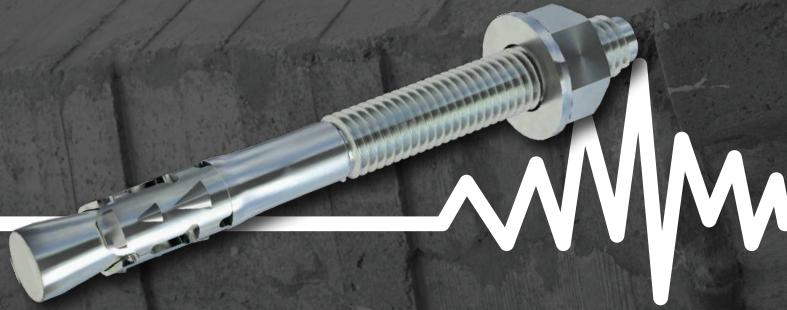


C1 C2



**3DG**  
COATING

**FIX**  
CALC



## FM-753 CRACK 3DG

Assembled  
Hardened and tempered  
anchor body grade 9.8  
Stainless steel A4 clip  
Special anti-corrosion coating  
with glossy finish



Code	d x L mm	Thread length mm	do mm	tfix mm	df mm	sw	Pkg.	Outer box
75350b08068 <sup>(1)</sup>	M8x68	30	8	4	9	13	100	400
75350b08075 <sup>(1)</sup>	M8x75	30	8	10	9	13	100	400
75350b08090 <sup>(1)</sup>	M8x90	40	8	25	9	13	100	400
75350b08115 <sup>(1)</sup>	M8x115	60	8	50	9	13	100	400
75350b08135 <sup>(1)</sup>	M8x135	80	8	70	9	13	100	400
75350b08165 <sup>(1)</sup>	M8x165	80	8	100	9	13	50	200
75350b10090	M10x90	40	10	10	12	17	50	200
75350b10105	M10x105	55	10	25	12	17	50	200
75350b10115	M10x115	55	10	35	12	17	50	200
75350b10135	M10x135	85	10	55	12	17	50	200
75350b10155	M10x155	85	10	75	12	17	50	200
75350b10185	M10x185	85	10	105	12	17	25	100
75350b12110	M12x110	65	12	10	14	19	50	200
75350b12120	M12x120	65	12	20	14	19	50	200
75350b12145	M12x145	85	12	45	14	19	25	100
75350b12170	M12x170	85	12	70	14	19	25	100
75350b12200	M12x200	85	12	100	14	19	25	100
75350b16130	M16x130	65	16	10	18	24	20	80
75350b16150	M16x150	85	16	30	18	24	20	80
75350b16185	M16x185	85	16	60	18	24	20	80
75350b16220	M16x220	85	16	100	18	24	15	60

<sup>(1)</sup> Seismic certification category C1 only

## FM-753 CRACK INOX A4

Assembled  
Stainless steel A4



Code	d x L mm	Thread length mm	do mm	tfix mm	df mm	sw	Pkg.	Outer box
75350008068 <sup>(1)</sup>	M8x68	30	8	4	9	13	100	400
75350008075 <sup>(1)</sup>	M8x75	30	8	10	9	13	100	400
75350008090 <sup>(1)</sup>	M8x90	40	8	25	9	13	100	400
75350008115 <sup>(1)</sup>	M8x115	60	8	50	9	13	100	400
75350008135 <sup>(1)</sup>	M8x135	80	8	70	9	13	100	400
75350008165 <sup>(1)</sup>	M8x165	80	8	100	9	13	50	200
75350010090	M10x90	40	10	10	12	17	50	200
75350010105	M10x105	55	10	25	12	17	50	200
75350010115	M10x115	55	10	35	12	17	50	200
75350010135	M10x135	85	10	55	12	17	50	200
75350010155	M10x155	85	10	75	12	17	50	200
75350010185	M10x185	85	10	105	12	17	25	100
75350012110	M12x110	65	12	10	14	19	50	200
75350012120	M12x120	65	12	20	14	19	50	200
75350012145	M12x145	85	12	45	14	19	25	100
75350012170	M12x170	85	12	70	14	19	25	100
75350012200	M12x200	85	12	100	14	19	25	100
75350016130	M16x130	65	16	10	18	24	20	80
75350016150	M16x150	85	16	30	18	24	20	80
75350016185	M16x185	85	16	60	18	24	20	80
75350016220	M16x220	85	16	100	18	24	15	60

<sup>(1)</sup> Seismic certification category C1 only

**VERSIONS:**

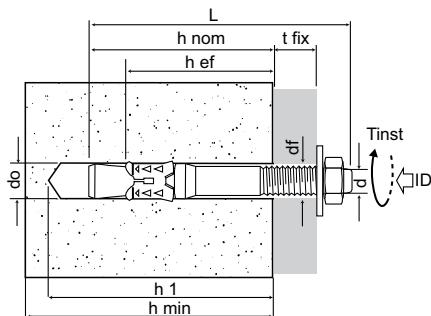
- 3DG special anti-corrosion coating
- stainless steel A4

**PRODUCT FEATURES:**

- hardened and tempered steel grade 9.8 anchor body
- stainless steel A4 expander clip
- increased thickness of three expander segments
- nine gripping dents for greater adhesion to hole wall

**CERTIFICATIONS**

- Seismic performance C1 and C2  
Cracked and non-cracked concrete  
Fire resistance R120

**BASE MATERIALS:**

$d$  = screw diameter  
 $df$  = hole diameter of fixing element  
 $do$  = hole diameter  
 $h_1$  = minimum hole depth  
 $hef$  = minimum depth of anchorage  
 $h_{min}$  = minimum support thickness

$h_{nom}$  = nominal embedment depth  
 $L$  = anchor length  
 $sw$  = wrench  
 $t_{fix}$  = fixture thickness  
 $T_{inst}$  = torque

**DESIGN<sup>(1)</sup> AND RECOMMENDED<sup>(2)</sup> LOADS**

Single anchor with large anchor spacing and edge distances in cracked and non-cracked concrete C20/25

Anchor		M8	M10	M12	M16
Minimum support thickness	$h_{min}$ mm	100	120	150	170
Minimum hole depth	$h_1$ mm	70	80	100	115
Nominal embedment depth	$h_{nom}$ mm	54	67	81	97
Minimum depth of anchorage	$h_{ef}$ mm	48	60	72	86
Hole diameter	$d_0$ mm	8	10	12	16
Spacing	$S_{cr,N}$ mm	140	180	220	260
Edge distance	$C_{cr,N}$ mm	70	90	110	130
<b>Tensile non-cracked concrete</b>					
Seismic Resistance Category C1	$N_{rd,ucr}$ kN	6,0	10,7	13,3	23,3
	$N_{ucr}$ kN	4,3	7,6	9,5	16,7
Seismic Resistance Category C2	$N_{rd,cr}$ kN	4,0	8,0	10,7	13,3
	$N_{cr}$ kN	2,9	5,7	7,6	9,5
<b>Tensile cracked concrete</b>					
Seismic Resistance Category C1	$V_{rd,ucr}$ kN	8,6	16,1	22,5	44,3
	$V_{ucr}$ kN	6,1	11,5	16,1	31,6
Seismic Resistance Category C2	$N_{rd,eqC1}$ kN	4,0	8,0	10,7	13,3
	$N_{eqC1}$ kN	2,9	5,7	7,6	9,5
<b>Shear<sup>(3)</sup> non-cracked concrete</b>					
Seismic Resistance Category C1	$V_{rd,eqC1}$ kN	5,1	11,3	20,3	38,4
	$V_{eqC1}$ kN	3,7	8,1	14,5	27,4
Seismic Resistance Category C2	$N_{rd,eqC2}$ kN	-	2,2	7,9	13,3
	$N_{eqC2}$ kN	-	1,6	5,6	9,5
	$V_{rd,eqC2}$ kN	-	7,9	12,9	20,8
	$V_{eqC2}$ kN	-	5,7	9,2	14,9
<b>Minimum spacing</b>					
FM-753 CRACK	$S_{min}$ mm	50	60	70	80
3DG coating	for C mm	65	80	90	120
glossy finish	$C_{min}$ mm	50	60	70	85
ETA 09/0056	for S mm	75	120	150	170
<b>Minimum edge distance</b>					
Seismic Resistance Category C1	$V_{rd,cmin}$ kN	2,9	3,9	5,1	7,2
	$V_{cmin}$ kN	2,1	2,8	3,7	5,1
Seismic Resistance Category C2	$N_{rd,cr}$ kN	6,0	10,7	13,3	23,3
	$N_{cr}$ kN	4,3	7,6	9,5	16,7
<b>Tensile non-cracked concrete</b>					
Seismic Resistance Category C1	$N_{rd,ucr}$ kN	3,3	6,0	8,0	16,7
	$N_{ucr}$ kN	2,4	4,3	5,7	11,9
Seismic Resistance Category C2	$V_{rd,ucr}$ kN	9,2	14,5	21,1	39,2
	$V_{ucr}$ kN	6,5	10,3	15,1	28,0
<b>Tensile cracked concrete</b>					
Seismic Resistance Category C1	$N_{rd,cr}$ kN	2,7	6,0	8,0	15,6
	$N_{cr}$ kN	2,0	4,3	5,7	11,1
Seismic Resistance Category C2	$V_{rd,cr}$ kN	6,2	9,5	12,2	28,2
	$V_{cr}$ kN	4,4	6,8	8,7	20,1
<b>Shear<sup>(3)</sup> non-cracked concrete</b>					
Seismic Resistance Category C1	$N_{rd,eqC1}$ kN	-	1,6	5,9	14,6
	$N_{eqC1}$ kN	-	1,1	4,2	10,4
Seismic Resistance Category C2	$N_{rd,eqC2}$ kN	-	9,5	12,2	28,2
	$N_{eqC2}$ kN	-	6,8	8,7	20,1
<b>Minimum spacing</b>					
FM-753 CRACK	$S_{min}$ mm	50	55	60	70
stainless steel A4	for C mm	50	70	80	100
ETA 10/0293	$C_{min}$ mm	50	50	60	70
<b>Minimum edge distance</b>					
Seismic Resistance Category C1	$V_{rd,cmin}$ kN	2,9	3,1	4,2	5,6
	$V_{cmin}$ kN	2,1	2,2	3,0	4,0
Seismic Resistance Category C2	$T_{inst}$ Nm	20	40	60	120
<b>Torque</b>					

$1\text{kN} \approx 100 \text{ kgf}$

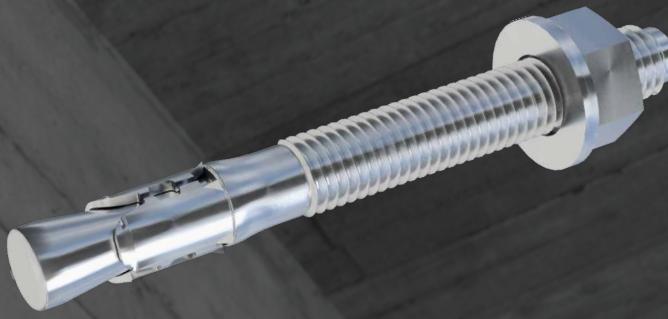
(1) The design loads  $N_{rd}$  and  $V_{rd}$  derive from the characteristic loads on the ETA certification and are inclusive of the partial safety factors  $\gamma_m$  proportional to each diameter (see ETA).

(2) The recommended loads  $N$  and  $V$  derive from the characteristic loads on the ETA certification and are inclusive of the partial safety factors  $\gamma_i=1,4$  and  $\gamma_m$  proportional to each diameter (see ETA).

(3) Shear values valid with distance from the edge  $C \geq 10 \times h_{ef}$

The load values are only valid if the installation has been carried out correctly. The design engineer is responsible for the designing and calculation of the fixing.

The designing and calculation of the anchorage should be carried out in accordance with EN 1992-4.

**WIDE RANGE****EASY INSTALLATION****VERSATILE**

ETA 01/0014 - op. 7



ETA 13/0367 - op. 7



ETA 01/0009 - op. 7

**FM-753****Assembled  
white zinc plated**

ETA 01/0014 - op. 7



White zinc plated Code	3DG Code	Stainless steel A4 Code	d x L mm	Thread length mm	do mm	tfix mm	df mm	sw	Pkg.	Outer box
75320b06045 <sup>(1)(2)</sup>	75320c06045		M6x45	20	6	3	7	10	200	2000
75320b06065	75320c06065	75320006065 <sup>(2)</sup>	M6x65	40	6	15	7	10	100	1000
75320b06085	75320c06085	75320006085 <sup>(2)</sup>	M6x85	60	6	35	7	10	100	1000
75320b06100	75320c06100		M6x100	60	6	50	7	10	50	500
75320b08050 <sup>(1)(2)</sup>	75320c08050	75320008050 <sup>(1)(2)</sup>	M8x50	23	8	5	9	13	100	1000
75320b08065	75320c08065	75320008065	M8x65	38	8	7	9	13	100	1000
75320b08075	75320c08075	75320008075	M8x75	48	8	15	9	13	100	400
75320b08090	75320c08090	75320008090	M8x90	63	8	30	9	13	100	400
75320b08115	75320c08115	75320008115	M8x115	83	8	55	9	13	100	400
75320b08135	75320c08135	75320008135	M8x135	88	8	75	9	13	100 <sup>(4)</sup>	400 <sup>(4)</sup>
75320b08165	75320c08165	75320008165	M8x165	88	8	105	9	13	50	200
75320b10060 <sup>(1)(2)</sup>	75320c10060	75320010060 <sup>(1)(2)</sup>	M10x60	28	10	5	12	17	50	500
75320b10075	75320c10075	75320010075	M10x75	43	10	5	12	17	50	500
75320b10090	75320c10090	75320010090	M10x90	55	10	20	12	17	50	200
75320b10100	75320c10100		M10x100	60	10	30	12	17	50	200
75320b10120	75320c10120	75320010120	M10x120	85	10	50	12	17	50	200
75320b10145	75320c10145		M10x145	85	10	75	12	17	50	200
75320b10170	75320c10170		M10x170	85	10	100	12	17	50 <sup>(3)</sup>	200 <sup>(3)</sup>
75320b10210 <sup>(2)</sup>	75320c10210		M10x210	85	10	140	12	17	25	100
75320b12080 <sup>(1)(2)</sup>	75320c12080	75320012080 <sup>(1)(2)</sup>	M12x80	40	12	7	14	19	50	200
75320b12100	75320c12100	75320012100	M12x100	58	12	10	14	19	50	200
75320b12110	75320c12110	75320012110	M12x110	68	12	20	14	19	50	200
75320b12120			M12x120	68	12	30	14	19	25	100
75320b12135	75320c12135	75320012135	M12x135	93	12	45	14	19	25	100
75320b12160	75320c12160	75320012160	M12x160	93	12	70	14	19	25	100
75320b12185	75320c12185	75320012185	M12x185	93	12	100	14	19	25	100
75320b12200 <sup>(2)</sup>	75320c12200		M12x200	93	12	115	14	19	20	80
75320b12220 <sup>(2)</sup>	75320c12220		M12x220	93	12	135	14	19	20	80
75320b12240 <sup>(2)</sup>	75320c12240		M12x240	93	12	155	14	19	20	80
75320b12255 <sup>(2)</sup>	75320c12255		M12x255	93	12	170	14	19	20	80
75320b12285 <sup>(2)</sup>	75320c12285		M12x285	93	12	200	14	19	20	80
75320b12300 <sup>(2)</sup>	75320c12300		M12x300	93	12	215	14	19	20	80
75320b12325 <sup>(2)</sup>	75320c12325		M12x325	93	12	240	14	19	20	80
75320b12355 <sup>(2)</sup>			M12x355	93	12	270	14	19	20	-
75320b14100			M14x100	50	14	3	16	22	25	100
75320b14110			M14x110	60	14	10	16	22	25	100
75320b14130			M14x130	65	14	30	16	22	25	100
75320b14150			M14x150	90	14	50	16	22	25	100
75320b14170			M14x170	90	14	70	16	22	25	100
75320b14200			M14x200	90	14	100	16	22	25	100
75320b16110 <sup>(1)(2)</sup>	75320c16110	75320016110 <sup>(1)(2)</sup>	M16x110	53	16	15	18	24	20	80
75320b16125	75320c16125	75320016125	M16x125	68	16	10	18	24	20	80
75320b16145	75320c16145	75320016145	M16x145	88	16	30	18	24	20	80
75320b16175	75320c16175	75320016175	M16x175	88	16	60	18	24	20	80
75320b16215	75320c16215		M16x215	88	16	100	18	24	15	60
75320b16230 <sup>(2)</sup>	75320c16230		M16x230	88	16	115	18	24	10	40
75320b16250 <sup>(2)</sup>	75320c16250		M16x250	88	16	135	18	24	10	40
75320b16270 <sup>(2)</sup>	75320c16270		M16x270	88	16	155	18	24	10	40
75320b16285 <sup>(2)</sup>			M16x285	88	16	170	18	24	10	40
75320b16320 <sup>(2)</sup>	75320c16320		M16x320	88	16	205	18	24	10	40
75320b20170 <sup>(2)</sup>	75320c20170		M20x170	60	20	30	22	30	10	40
75320b20215 <sup>(2)</sup>	75320c20215		M20x215	60	20	75	22	30	10	40
75320b20260 <sup>(2)</sup>			M20x260	60	20	120	22	30	10	40
	75320c20280		M20x280	60	20	140	22	30	10	40
75320b24160 <sup>(1)(2)</sup>			M24x160	60	24	10	26	36	10	40
75320b24180 <sup>(2)</sup>			M24x180	60	24	10	26	36	10	40
75320b24200 <sup>(2)</sup>			M24x200	80	24	30	26	36	10	-
75320b24220 <sup>(2)</sup>			M24x220	100	24	50	26	36	10	-
75320b24260 <sup>(2)</sup>			M24x260	100	24	90	26	36	10	-
75320b24310 <sup>(2)</sup>			M24x310	100	24	140	26	36	10	-

**FM-753 INOX A4****Assembled  
Stainless steel A4**

ETA 01/0009 - op. 7

<sup>(1)</sup> Anchors with reduced embedment depths.<sup>(2)</sup> Codes not covered by CE certification<sup>(3)</sup> Half quantity for 3DG version.<sup>(4)</sup> Half quantity for stainless steel version.

**VERSIONS:**

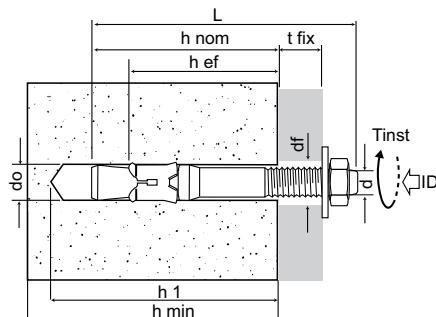
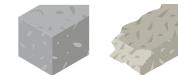
- white zinc plated
- stainless steel A4
- 3DG special anti-corrosion coating with stainless steel A4 clip

**PRODUCT FEATURES:**

- cold forged anchor body
- increased thickness of three expander segments
- six teeth and anti-slip ridge to prevent slip during tightening

**CERTIFICATIONS**

Non-cracked concrete

**BASE MATERIALS:**

$d$  = screw diameter  
 $df$  = hole diameter of fixing element  
 $do$  = hole diameter  
 $h_1$  = minimum hole depth  
 $hef$  = minimum depth of anchorage  
 $h_{min}$  = minimum support thickness

$h_{nom}$  = nominal embedment depth  
 $L$  = anchor length  
 $sw$  = wrench  
 $t_{fix}$  = fixture thickness  
 $T_{inst}$  = torque

**DESIGN<sup>(1)</sup> AND RECOMMENDED<sup>(2)</sup> LOADS**

Single anchor with large anchor spacing and edge distances in non-cracked concrete C20/25 - Standard embedment depth

Anchor		M6	M8	M10	M12	M14	M16	M20	M24
Minimum support thickness	$h_{min}$ mm	100	100	100	120	140	170	200	240
Minimum hole depth	$h_1$ mm	50	60	70	85	95	115	130	165
Nominal embedment depth	$h_{nom}$ mm	41	48	59	71	80	96	115	145
Minimum depth of anchorage	$hef$ mm	35	40	50	60	70	85	95	120
Hole diameter	$d_0$ mm	6	8	10	12	14	16	20	24
Spacing	$S_{cr,N}$ mm	105	120	150	180	210	260	290	360
Edge distance	$C_{cr,N}$ mm	53	60	75	90	105	130	145	180
FM-753 - CE certified white zinc plated ETA 01/0014	<b>Tensile</b> non-cracked concrete	$N_{rd}$ kN	3,3	5,0	6,7	13,3	16,7	23,4	23,3 <sup>(3)</sup>
		N kN	2,4	3,6	4,8	9,5	11,9	16,7	17,0 <sup>(3)</sup>
	<b>Shear <math>C \geq 10x_{hef}</math></b>	$V_{rd}$ kN	4,0	6,1	9,9	12,3	21,4	28,2	37,1 <sup>(3)</sup>
		V kN	2,9	4,3	7,1	8,8	15,3	20,1	32,0 <sup>(3)</sup>
FM-753 - CE certified stainless steel A4 ETA 01/0009	<b>Tensile</b> non-cracked concrete	$N_{rd}$ kN	2,2 <sup>(3)</sup>	5,0	8,0	15,2	-	23,3	-
		N kN	1,6 <sup>(3)</sup>	3,6	5,7	10,9	-	16,7	-
	<b>Shear <math>C \geq 10x_{hef}</math></b>	$V_{rd}$ kN	4,2 <sup>(3)</sup>	7,6	10,7	20,7	-	38,5	-
		V kN	3,0 <sup>(3)</sup>	5,4	7,6	14,8	-	27,5	-
FM-753 - CE certified 3DG matte finish ETA 13/0367	<b>Tensile</b> non-cracked concrete	$N_{rd}$ kN	4,0	8,0	8,0	14,0	-	23,3	26,6
		N kN	2,9	5,7	5,7	10,0	-	16,7	19,0
	<b>Shear <math>C \geq 10x_{hef}</math></b>	$V_{rd}$ kN	4,3	6,2	9,2	13,4	-	28,4	34,3
		V kN	3,1	4,4	6,6	9,6	-	20,3	24,5
Minimum spacing	$S_{min}$ mm	50	60	75	90	105	130	200	180
Minimum edge distance	$C_{min}$ mm	50	60	75	90	105	130	145	180
Shear $C = C_{min}$	$V_{rd,min}$ kN	3,5	5,0	6,9	9,3	12,0	16,9	21,6	23,2
Torque	$V_{cmin}$ kN	2,5	3,4	4,9	6,6	8,6	12,1	15,4	16,6
	$T_{inst}$ Nm	6	15	25	50	70	100	160	200

Single anchor with large anchor spacing and edge distances in non-cracked concrete C20/25 - Reduced embedment depth

Anchor		M6	M8	M10	M12	M16	M24
Minimum support thickness	$h_{min}$ mm	100	100	100	100	130	200
Minimum hole depth	$h_1$ mm	45	50	55	70	95	145
Nominal embedment depth	$h_{nom}$ mm	36	38	44	56	76	125
Minimum depth of anchorage	$hef$ mm	30	30	35	45	65	100
Hole diameter	$d_0$ mm	6	8	10	12	16	24
Spacing	$S_{cr,N}$ mm	90	90	105	135	195	400
Edge distance	$C_{cr,N}$ mm	45	45	53	80	100	300
FM-753 - CE certified 3DG matte finish ETA 13/0367	<b>Tensile</b> non-cracked concrete	$N_{rd}$ kN	3,3	4,0	4,0	8,0	17,2
		N kN	2,4	2,9	2,9	5,7	12,3
	<b>Shear <math>C \geq 10x_{hef}</math></b>	$V_{rd}$ kN	4,3	5,4	8,3	9,9	28,4
		V kN	3,1	3,9	5,9	7,1	20,3
Tensile/Shear non-cracked concrete Not certified <sup>(3)</sup>	$F_{rd}$ kN	1,8	2,0	3,5	4,9	8,4	11,2
	F kN	1,3	1,4	2,5	3,5	6,0	8,0
Minimum spacing	$S_{min}$ mm	45	45	50	120	140	150
Minimum edge distance	$C_{min}$ mm	45	45	50	80	100	150
Torque	$T_{inst}$ Nm	6	15	25	50	100	200

1kN ≈ 100 kgf

(1) The design loads  $N_{rd}$  and  $V_{rd}$  derive from the characteristic loads on the ETA certification and are inclusive of the partial safety factors  $\gamma_m$  proportional to each diameter (see ETA).(2) The recommended loads N and V derive from the characteristic loads on the ETA certification and are inclusive of the partial safety factors  $\gamma_l=1,4$  and  $\gamma_m$  proportional to each diameter (see ETA).(3) Versions Not Certified: white zinc plated and size M6 of stainless steel A4. The recommended loads N, V or F derive from the mean ultimate loads and are inclusive of the total safety factor  $\gamma=4$  (shear  $\gamma=3$ ).

In the absence of CE markings, the recommended loads derive from tests carried out in the Friulside laboratory in accordance with the appropriate standards. The load values are only valid if the installation has been carried out correctly. The designing and calculation of the anchorage should be carried out in accordance with EN 1992-4.

**SINGLE SHELL BODY****ANTI-ROTATION****SELF-CENTRING****Anchor only**  
White zinc plated

Code	Plug do x L mm	For screw	tfix mm	df mm	Pkg.	Outer box
74400b10040	10x40	M6	Lv - hnom	8	50	500
74400b14050	14x50	M8	Lv - hnom	10	50	500
74400b16060	16x60	M10	Lv - hnom	12	25	250
74400b20080	20x80	M12	Lv - hnom	14	20	200

Certified product when coupled with hex head screw DIN933 grade 8.8 and washer DIN125-1

**Hex head screw grade 8.8**  
White zinc plated

Code	Plug do x L mm	d x Lv mm	tfix mm	df mm	sw mm	Pkg.	Outer box
74411b10040	10x40	M6x50	12	8	10	50	500
74411b14050	14x50	M8x60	15	10	13	50	250
74411b16060	16x60	M10x80	20	12	17	25	125
74411b20080	20x80	M12x90	15	14	19	20	100

**Threaded bar grade 5.8**  
White zinc plated

Code <sup>(1)</sup>	Plug do x L mm	d x Lv mm	tfix mm	df mm	sw mm	Pkg.	Outer box
74412b10040	10x40	M6x65	20	8	10	50	500
74412b14050	14x50	M8x75	20	10	13	50	250
74412b16060	16x60	M10x95	25	12	17	25	125
74412b20080	20x80	M12x115	25	14	19	20	100

<sup>(1)</sup> Codes not covered by CE certification**Forged cup hook**  
White zinc plated

Code <sup>(1)</sup>	Plug do x L mm	d x Lv mm	0 mm	sw mm	Pkg.	Outer box
74413b10040	10x40	M6x50	9,5	10	50	500
74413b14050	14x50	M8x60	11	13	50	250
74413b16060	16x60	M10x73	14	17	25	125
74413b20080	20x80	M12x90	16	19	20	80

<sup>(1)</sup> Codes not covered by CE certification**Forged eye**  
White zinc plated

Code <sup>(1)</sup>	Plug do x L mm	d x Lv mm	0 mm	sw mm	Pkg.	Outer box
74414b10040	10x40	M6x50	10	10	50	500
74414b14050	14x50	M8x60	11,5	13	50	250
74414b16060	16x60	M10x73	14,5	17	25	125
74414b20080	20x80	M12x90	17	19	20	80

<sup>(1)</sup> Codes not covered by CE certification

**Versions:**

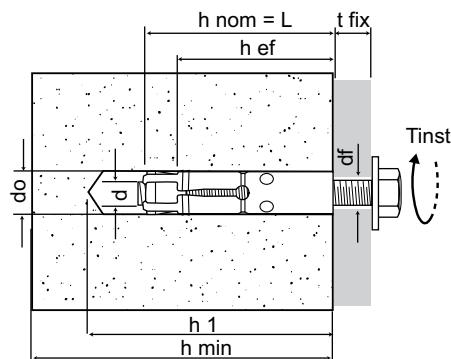
- anchor only, hex head screw, threaded bar, forged cup and forged eye
- white zinc plated

**PRODUCT FEATURES:**

- higher resistance due to the single piece body
- four lugs prevent rotation in the hole
- exclusive cone containing system

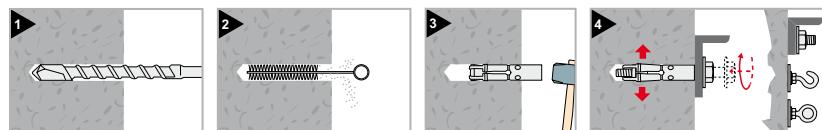
**CERTIFICATIONS**

Non-cracked concrete

**BASE MATERIALS:**

d	=	screw diameter
df	=	hole diameter of fixing element
do	=	hole diameter
h1	=	minimum hole depth
hef	=	minimum depth of anchorage
hmin	=	minimum support thickness
hnom	=	nominal embedment depth

L	=	anchor length
Lv	=	screw or accessory length
O	=	internal Ø hook or eye
sw	=	wrench
tfix	=	fixture thickness
Tinst	=	torque
ØA	=	cap diameter

**DESIGN<sup>(1)</sup> AND RECOMMENDED<sup>(2)</sup> LOADS**

Single anchor with large anchor spacing and edge distances in non-cracked concrete C20/25

Anchor		M6	M8	M10	M12
Minimum support thickness	h <sub>min</sub> mm	100	100	100	135
Minimum hole depth	h <sub>1</sub> mm	55	65	75	95
Nominal embedment depth	h <sub>nom</sub> mm	40	50	60	80
Minimum depth of anchorage	h <sub>ef</sub> mm	33,5 <sup>(5)</sup>	41	50	66,5
Hole diameter	d <sub>0</sub> mm	10	14	16	20
Spacing	S <sub>cr,N</sub> mm	101	123	150	200
Edge distance	C <sub>cr,N</sub> mm	50	62	75	100
<b>Tensile non-cracked concrete</b>					
	N <sub>rd</sub> kN	4,0	8,0	11,6	17,8
	N kN	2,9	5,7	8,3	12,7
Shear <sup>(3)</sup>	V <sub>rd</sub> kN	5,9	8,6	11,6	25,6
	V kN	4,2	6,1	8,2	18,3
Minimum spacing	S <sub>min</sub> mm	35	40	50	70
Minimum edge distance	C <sub>min</sub> mm	35	40	50	70
Shear C = C <sub>min</sub>	V <sub>rd,cr,min</sub> kN	2,5	3,2	4,6	7,8
	V <sub>cr,min</sub> kN	1,8	2,3	3,3	5,6
Torque	T <sub>inst</sub> Nm	6	15	30	50
EYE not certified <sup>(4)</sup>	<b>Tensile non-cracked concrete<sup>(4)</sup></b>		N <sub>rd</sub> kN	2,5	4,2
			N kN	1,8	3,0
CUP HOOK not certified <sup>(4)</sup>	<b>Tensile non-cracked concrete<sup>(4)</sup></b>		N <sub>rd</sub> kN	0,6	1,1
			N kN	0,4	0,8
Torque eye/cup hook	T <sub>inst</sub> Nm	5	10	18	30

1kN ≈ 100 kgf

<sup>(1)</sup> The design loads N<sub>rd</sub> and V<sub>rd</sub> derive from the characteristic loads on the ETA 05/0169 certification and are inclusive of the partial safety factors γ<sub>m</sub> proportional to each diameter (see ETA).<sup>(2)</sup> The recommended loads N and V derive from the characteristic loads on the ETA 05/0169 certification and are inclusive of the partial safety factors γ<sub>f</sub>=1,4 and γ<sub>m</sub> proportional to each diameter (see ETA).<sup>(3)</sup> Shear values valid with distance from the edge C ≥ 10x<sub>hef</sub>.<sup>(4)</sup> The recommended loads N derive from the mean ultimate loads and are inclusive of the total safety factor γ=4.<sup>(5)</sup> Use restricted to anchoring of structural components statically indeterminate.

In the absence of CE markings, the recommended loads derive from tests carried out in the Friulside laboratory in accordance with the appropriate standards.

The load values are only valid if the installation has been carried out correctly. The design engineer is responsible for the designing and calculation of the fixing.

## UNIVERSAL METALLIC ANCHOR EVEN FOR HOLLOW BASE MATERIALS

SINGLE SHELL BODY



EXCLUSIVE CONE CONTAINING SYSTEM

## FM-MP3 evo



Anchor only

White zinc plated Code <sup>(2)</sup>	Stainless steel A4 Code <sup>(3)</sup>	Plug do x L mm	For screw	tfix mm	df mm	Pkg.	Outer box
73300b10045	73300010045	10x45	M6	Lv - hnom	8	50	500
73300b12050	73300012050	12x50	M8	Lv - hnom	10	50	500
73300b15060	73300015060	15x60	M10	Lv - hnom	12	25	250
73300b18080	73300018080	18x80	M12	Lv - hnom	14	20	200



Hex head screw

White zinc plated Code	White zinc plated Large washer Code*	Stainless steel A4 Code	Large washer dimensions Øint x Øext x s	Plug do x L mm	d x Lv mm	tfix mm	df mm	sw	Pkg.	Outer box
73301b10045	73307b10045	73301010045	6,4x18x2	10x45	M6x50	5	8	10	50	500
73301b12050	73307b12050	73301012050	8,4x20x2	12x50	M8x60	10	10	13	50	250 <sup>(4)</sup>
73301b15060	73307b15060	73301015060	10,5x25x3	15x60	M10x80	20	12	17	25	125 <sup>(4)</sup>
73301b18080	73307b18080	73301018080	13x30x3	18x80	M12x100	20	14	19	20	100



Threaded bar grade 5.8  
White zinc plated

White zinc plated Code <sup>(1)</sup>	Plug do x L mm	d x Lv mm	tfix mm	df mm	sw	Pkg.	Outer box
73302b10045	10x45	M6x65	15	8	10	50	500
73302b12050	12x50	M8x75	15	10	13	50	250
73302b15060	15x60	M10x95	25	12	17	25	125
73302b18080	18x80	M12x115	25	14	19	20	100



Forged cup hook  
White zinc plated

White zinc plated Code <sup>(1)</sup>	Plug do x L mm	d x Lv mm	0 mm	sw	Pkg.	Outer box
73303b10045	10x45	M6x50	9,5	10	50	500
73303b12050	12x50	M8x60	11	13	50	250
73303b15060	15x60	M10x73	14	17	25	125
73303b18080	18x80	M12x90	16	19	20	80



Forged eye  
White zinc plated

White zinc plated Code <sup>(1)</sup>	Plug do x L mm	d x Lv mm	0 mm	sw	Pkg.	Outer box
73304b10045	10x45	M6x50	10	10	50	500
73304b12050	12x50	M8x60	11,5	13	50	250
73304b15060	15x60	M10x73	14,5	17	25	125
73304b18080	18x80	M12x90	17	19	20	80



Hex head screw grade 8.8  
White zinc plated

Code	Plug do x L mm	d x Lv mm	tfix mm	df mm	sw	Pkg.	Outer box
73310b10070	10x70	M6x70	25	12	10	50	500
73310b12075	12x75	M8x80	25	14	13	50	250
73310b15085	15x85	M10x90	25	17	17	25	125
73310b18105	18x105	M12x110	25	20	19	20	100



Hex socket countersunk head screw  
grade 8.8  
White zinc plated

Code	Plug do x L mm	d x Lv mm	tfix mm	df mm	sw	Pkg.	Outer box
73311b10070	10x70	M6x75	30	12	5	50	500
73311b12075	12x75	M8x80	30	14	6	50	250
73311b15085	15x85	M10x90	30	17	8	25	125
73311b18105	18x105	M12x110	30	20	10	20	100



Anti-intrusion screw grade 5.8  
White zinc plated

Code <sup>(1)</sup>	Plug do x L mm	d x Lv mm	ØA mm	tfix mm	df mm	recess	Pkg.	Outer box
73312b12075	12x75	M8x80	17	25	13	T40	50	250
73313b12050 <sup>(2)</sup>	12x50	M8x60	17	5	13	17	50	250
73313b12075	12x75	M8x84	17	30	13	17	50	250

<sup>(1)</sup> Codes not covered by CE certification

<sup>(2)</sup>The code should be considered as a FM-MP3 evo version

**VERSIONS:**

- non through anchor - white zinc plated
- non through anchor - stainless steel A4
- through anchor - white zinc plated

**PRODUCT FEATURES:**

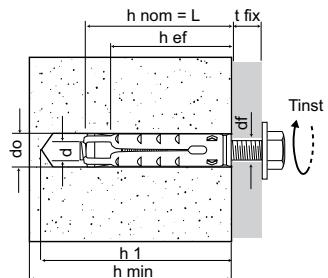
- monolithic steel body
- also suitable for hollow base materials
- accessories for all types of fixing requirements

**CERTIFICATIONS**

Non-cracked concrete

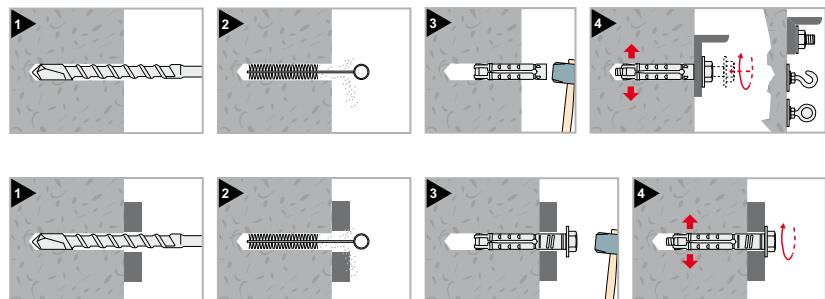
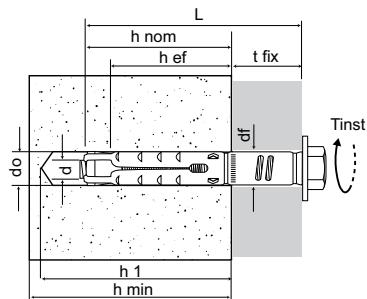
Multiple use for non-structural applications on cracked and non-cracked concrete

Fire resistance R120

**BASE MATERIALS:**

$d$  = screw diameter  
 $df$  = hole diameter of fixing element  
 $do$  = hole diameter  
 $h_1$  = minimum hole depth  
 $hef$  = minimum depth of anchorage  
 $h_{min}$  = minimum support thickness  
 $hnom$  = nominal embedment depth

$L$  = anchor length  
 $L_v$  = screw or accessory length  
 $O$  = internal Ø hook or eye  
 $sw$  = wrench  
 $t_{fix}$  = fixture thickness  
 $T_{inst}$  = torque  
 $\emptyset A$  = cap diameter

**DESIGN<sup>(1)</sup> AND RECOMMENDED<sup>(2)</sup> LOADS**

Single anchor with large anchor spacing and edge distances in non-cracked concrete C20/25

Anchor		M6	M8	M10	M12
Minimum support thickness	$h_{min}$ mm	100	100	100	140
Minimum hole depth	$h_1$ mm	60	70	80	100
Nominal embedment depth	$h_{nom}$ mm	45	50	60	80
Minimum depth of anchorage	$hef$ mm	36	43	50	69
Hole diameter	$d_o$ mm	10	12	15	18
Spacing	$S_{cr,N}$ mm	108	130	150	208
Edge distance	$C_{cr,N}$ mm	54	65	75	104
FM-MP3 CE certified white zinc plated ETA 09/0067	<b>Tensile non-cracked concrete</b>	$N_{rd}$ kN	5,0	8,0	11,6
		N kN	3,6	5,7	8,3
	<b>Shear <math>C \geq 10xh_{ef}</math></b>	$V_{rd}$ kN	5,1	9,3	11,6
		V kN	3,7	6,6	8,3
FM-MP3 CE certified stainless steel A4 ETA 09/0357	<b>Tensile non-cracked concrete</b>	$N_{rd}$ kN	3,3	6,7	8,9
		N kN	2,4	4,8	6,4
	<b>Shear <math>C \geq 10xh_{ef}</math></b>	$V_{rd}$ kN	4,5	7,7	9,7
		V kN	3,2	5,5	6,9
Minimum spacing	$S_{min}$ mm	35	45	50	75
Minimum edge distance	$C_{min}$ mm	35	45	50	75
Shear $C = C_{min}$	$V_{rd,min}$ kN	2,5	3,7	4,5	8,6
	$V_{min}$ kN	1,8	2,6	3,2	6,1
Torque	$T_{inst}$ Nm	8	15	30	50
EYE not certified <sup>(3)</sup>	<b>Tensile non-cracked concrete<sup>(3)</sup></b>	$N_{rd}$ kN	2,5	4,2	6,7
		N kN	1,8	3,0	4,8
CUP HOOK not certified <sup>(3)</sup>	<b>Tensile non-cracked concrete<sup>(3)</sup></b>	$N_{rd}$ kN	0,6	1,1	1,7
		N kN	0,4	0,8	1,2
Torque eye/cup hook	$T_{inst}$ Nm	5	10	18	30

1kN ≈ 100 kgf

(1) The design loads  $N_{rd}$  and  $V_{rd}$  derive from the characteristic loads on the ETA certification and are inclusive of the partial safety factors  $\gamma_m$  proportional to each diameter (see ETA).(2) The recommended loads N and V derive from the characteristic loads on the ETA certification and are inclusive of the partial safety factors  $\gamma_1=1,4$  and  $\gamma_m$  proportional to each diameter (see ETA).(3) The recommended loads N derive from the mean ultimate loads and are inclusive of the total safety factor  $\gamma=4$ .

NOTE: ETA certifications available for multiple use ETAG001 part 6.

In the absence of CE markings, the recommended loads derive from tests carried out in the Friulside laboratory in accordance with the appropriate standards.

The load values are only valid if the installation has been carried out correctly. The design engineer is responsible for the designing and calculation of the fixing.

SAFE AND CONTROLLED EXPANSION

FAST APPLICATION

SHALLOW EMBEDMENT DEPTH


**Rimmed plug**  
White zinc plated


(1)

(2)

Code	Plug do x L mm	Lth mm	Ls, min mm	d	Pkg.	Outer box
75205b06000 <sup>(2)</sup>	8x25	11	6	M6	100	2000
75205b08000 <sup>(1)(2)</sup>	10x30	13	8	M8	100	1000
75205b10030 <sup>(2)</sup>	12x30	12	10	M10	100	600
75205b10000 <sup>(1)(2)</sup>	12x40	17	10	M10	100	600
75205b12000 <sup>(1)(2)</sup>	15x50	21	12	M12	50	300
75205b16000 <sup>(1)</sup>	20x65	30	16	M16	25	150

Screw Length: minimum: Ls,min + tfix - maximum: Lth + tfix

<sup>(1)</sup> ETA 18/0432 - op. 7<sup>(2)</sup> ETA 18/0433 - Multiple use
**Rimmed plug**

White zinc plated Code <sup>(1)</sup>	Stainless steel A2 Code <sup>(1)</sup>	Plug do x L mm	Lth mm	Ls, min mm	d	Pkg.	Outer box
75203b06000	75204006000	8x25	11	6	M6	100	2000
75203b08000	75204008000	10x30	13	8	M8	100	1000
75203b10000	75204010000	12x40	17	10	M10	100	600
75203b12000	75204012000	15x50	21	12	M12	50	300
75203b16000	75204016000	20x65	30	16	M16	25	150

Screw Length: minimum: Ls,min + tfix - maximum: Lth + tfix

<sup>(1)</sup> Codes not covered by CE certification
**Rimless plug**  
White zinc plated

Code <sup>(1)</sup>	Plug do x L mm	Lth mm	Ls, min mm	d	Pkg.	Outer box
75200b06000	8x25	11	6	M6	100	2000
75200b08000	10x30	13	8	M8	100	1000
75200b10000	12x40	17	10	M10	100	600
75200b12000	15x50	21	12	M12	50	300
75200b16000	20x65	30	16	M16	25	150

Screw Length: minimum: Ls,min + tfix - maximum: Lth + tfix

<sup>(1)</sup> Codes not covered by CE certification
**Setting tool**

Code	Setting tool	Pkg.
49902b06000	for M6	1
49902b08000	for M8	1
49902b10000	for M10	1
49902b12000	for M12	1
49902b16000	for M16	1

**VERSIONS:**

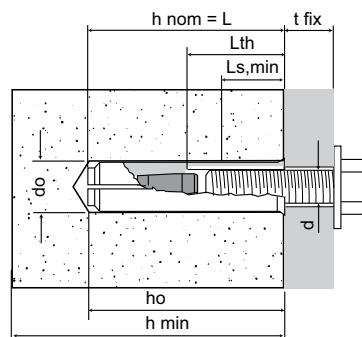
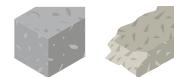
- CE certified rimmed white zinc plated anchor
- rimmed white zinc plated or stainless steel A2 anchor
- rimless white zinc plated anchor

**PRODUCT FEATURES:**

- rimmed plug version for easy installation flush with base material
- high strength in relation to embedment depths

**CERTIFICATIONS**

**Non-cracked concrete**  
**Multiple use for non-structural applications on cracked and non-cracked concrete**  
**Fire resistance R120**

**BASE MATERIALS:**

\*Only for rimless version

d = screw diameter  
do = hole diameter  
hmin = minimum support thickness  
hnom = nominal embedment depth  
ho = cylindrical hole depth  
L = anchor length

Lth = threaded length  
Ls,min = minimum thread engagement  
Lv = metric screw length  
tfix = fixture thickness  
Tmax = maximum torque

**DESIGN<sup>(1)</sup> AND RECOMMENDED<sup>(2)</sup> LOADS**

Single anchor with large anchor spacing and edge distances in non-cracked concrete C20/25

Anchor		M6	M8	M10	M10	M12	M16
Nominal embedment depth	h <sub>nom</sub>	mm	25	30	30	40	50
Hole diameter	d <sub>0</sub>	mm	8	10	12	12	15
TAP CE	N <sub>rd</sub>	kN	-	4,5	-	6,9	8,3
ETA 18/0432 - op.7	N	kN	-	3,2	-	4,9	5,9
	V <sub>rd</sub>	kN	-	5,4	-	8,3	11,6
	V	kN	-	3,9	-	5,9	8,3
	V <sub>rd</sub>	kN	-	5,4	-	8,3	11,6
	V	kN	-	3,9	-	5,9	8,3
Minimum support thickness	h <sub>min</sub>	mm	-	100	-	100	100
Spacing	S <sub>cr,N</sub>	mm	-	90	-	120	150
Edge distance	C <sub>cr,N</sub>	mm	-	45	-	60	75
Minimum depth of anchorage	h <sub>ef</sub>	mm	25	30	30	40	50
TAP CE	F <sub>rd</sub>	kN	0,7	1,0	1,4	1,4	1,9
ETA 18/0433 ETAG001 part 6	F	kN	0,5	0,7	1,0	1,0	1,4
Minimum support thickness	h <sub>min</sub>	mm	80	80	80	80	100
Minimum spacing	S <sub>min</sub>	mm	200	200	200	200	200
Minimum edge distance	C <sub>min</sub>	mm	150	150	150	150	150

1kN ≈ 100 kgf

<sup>(1)</sup> The design loads N<sub>rd</sub> and V<sub>rd</sub> derive from the characteristic loads on the ETA certification and are inclusive of the partial safety factors  $\gamma_m$  proportional to each diameter (see ETA).

<sup>(2)</sup> The recommended loads N and V derive from the characteristic loads on the ETA certification and are inclusive of the partial safety factors  $\gamma_r=1,4$  and  $\gamma_m$  proportional to each diameter (see ETA).

<sup>(3)</sup> Shear values valid with distance from the edge C ≥ 10xh<sub>ef</sub>.

**DESIGN AND RECOMMENDED<sup>(1)</sup> LOADS**

Single anchor with large anchor spacing and edge distances in non-cracked concrete C20/25 - Not certified

Anchor		M6	M8	M10	M12	M16
Depth of the hole	h <sub>0</sub>	mm	25	30	40	50
Nominal embedment depth	h <sub>nom</sub>	mm	25	30	40	50
Hole diameter	d <sub>0</sub>	mm	8	10	12	15
Spacing	S <sub>cr</sub>	mm	125	150	200	250
Edge distance	C <sub>cr</sub>	mm	90	105	140	175
Tensile non-cracked concrete	N	kN	1,7	2,7	3,5	4,5
Shear C ≥ 10xh <sub>0</sub> , screw grade 5.6	V <sub>5,6</sub>	kN	2,0	3,7	5,8	8,4
Shear C ≥ 10xh <sub>0</sub> , screw screw stainless steel A2-70	V <sub>A2-70</sub>	kN	3,0 <sup>(2)</sup>	3,9 <sup>(2)</sup>	6,1 <sup>(2)</sup>	8,5 <sup>(2)</sup>
Minimum spacing	S <sub>min</sub>	mm	50	60	80	100
Minimum edge distance	C <sub>min</sub>	mm	90	105	140	175

1kN ≈ 100 kgf

<sup>(1)</sup> The recommended loads derive from the mean ultimate loads and are inclusive of the total safety factor  $\gamma=4$  (shear  $\gamma=3$ ).

<sup>(2)</sup> Concrete failure.

In the absence of CE markings, the recommended loads derive from tests carried out in the Friulside laboratory in accordance with the appropriate standards. The load values are only valid if the installation has been carried out correctly. The design engineer is responsible for the designing and calculation of the fixing.

**QUICK INSTALLATION****REDUCED EDGE DISTANCE  
AND SPACING DISTANCES****3 CERTIFIED EMBEDMENT DEPTHS**

**Hex head with built-in washer screw  
White zinc plated**

Code	do mm	d x Lv	tfix mm			dc mm	sw	Pkg.	Outer box
			tfix,1	tfix,2	tfix,3				
72005b10060	8	10x60	15	10	-	18,5	13	100	600
72005b10075	8	10x75	30	25	10	18,5	13	100	500
72005b10100	8	10x100	55	50	35	18,5	13	100	400
72005b10130	8	10x130	85	80	65	18,5	13	50	300
72005b10150	8	10x150	105	100	85	18,5	13	50	300
72005b12060	10	12x60	10	-	-	23	15	50	300
72005b12075	10	12x75	25	15	-	23	15	50	300
72005b12100	10	12x100	50	40	25	23	15	50	200
72005b12130	10	12x130	80	70	55	23	15	25	150
72005b12150	10	12x150	100	90	75	23	15	25	150
72005b14075	12	14x75	25	15	-	25	16	50	200
72005b14100	12	14x100	50	40	5	25	16	50	150
72005b14130	12	14x130	80	70	35	25	16	20	120
72005b16080	14	16x80	20	10	-	30,5	18	20	160
72005b16100	14	16x100	40	30	-	30,5	18	25	150
72005b16130	14	16x130	70	60	15	30,5	18	20	120
72005b16150	14	16x150	90	80	35	30,5	18	10	60

**Versions:**

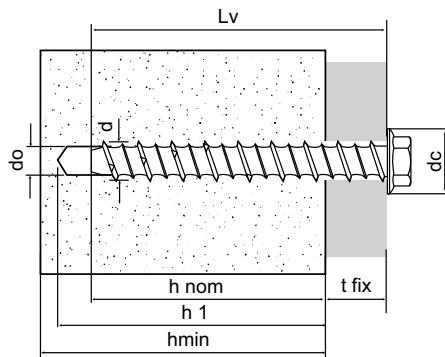
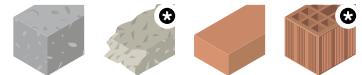
- hex head with built-in washer screw
- white zinc plated
- diameters 10, 12, 14, 16

**Product Features:**

- no plug required
- high loading capacity in relation to diameter
- high load values near edges and with reduced spacing distances

**CERTIFICATIONS**

Cracked and non-cracked concrete  
Fire resistance R120

**BASE MATERIALS:**

$d$  = screw diameter  
 $dc$  = built-in washer diameter  
 $do$  = hole diameter  
 $h_1$  = minimum hole depth  
 $h_{\min}$  = minimum support thickness

$h_{\text{nom}}$  = nominal embedment depth  
 $L_v$  = screw length  
 $sw$  = wrench  
 $t_{\text{fix}}$  = fixture thickness

**DESIGN<sup>(1)</sup> AND RECOMMENDED<sup>(2)</sup> LOADS**

Single anchor with large anchor spacing and edge distances in non-cracked concrete C20/25

Anchor size	$d_0$	mm	8			10			12			14		
Screw diameter	$d$	mm	$\emptyset 10$			$\emptyset 12$			$\emptyset 14$			$\emptyset 16$		
Minimum support thickness	$h_{\min}$	mm	110			110			130			150		
Depth of hole	$h_1$	mm	$h_{\text{nom}} + 10$			$h_{\text{nom}} + 10$			$h_{\text{nom}} + 10$			$h_{\text{nom}} + 10$		
Nominal embedment depth	$h_{\text{nom}}$	mm	45	50	65	50	60	75	50	60	95	60	70	115
Spacing	$S_{cr,N}$	mm	90	102	142	100	124	162	100	124	213	118	144	258
Edge distance	$C_{cr,N}$	mm	45	51	71	50	62	81	50	62	107	59	72	129
Tensile non-cracked concrete	$N_{rd}$	kN	3,3	3,3	6,7	3,3	5,0	8,9	3,3	5,0	13,9	5,0	6,7	19,7
	$N$	kN	2,4	2,4	4,8	2,4	3,6	6,3	2,4	3,6	9,9	3,6	4,8	13,9
Tensile cracked concrete	$N_{rd,cr}$	kN	1,7	2,2	4,2	2,2	3,3	5,0	2,2	3,3	8,9	2,8	4,2	11,1
	$N_{cr}$	kN	1,2	1,6	3,0	1,6	2,4	3,6	1,6	2,4	6,4	2,0	3,0	7,9
Shear <sup>(3)</sup> non-cracked concrete	$V_{rd}$	kN	5,4	6,5	10,6	6,2	8,9	13,0	12,4	17,9	26,5	16,6	21,8	35,7
	$V$	kN	3,9	4,6	7,6	4,4	6,4	9,3	8,9	12,8	19,0	11,9	15,6	25,5
Minimum spacing	$S_{\min}$	mm	60	60	60	70	70	70	80	80	80	90	90	90
Minimum edge distance	$C_{\min}$	mm	45	51	60	50	62	70	50	62	80	59	72	90
Shear $C = C_{\min}$	$V_{rd,cmin}$	kN	2,3	2,8	4,6	2,8	3,9	5,8	2,9	4,0	9,0	3,8	5,1	12,3
	$V_{cmin}$	kN	1,7	2,0	3,3	2,0	2,8	4,1	2,0	2,8	6,5	2,7	3,6	8,8

1kN ≈ 100 kgf

<sup>(1)</sup>  $N_{rd}, V_{rd}$  = Design loads (included  $\gamma_m$  see ETA).

<sup>(2)</sup>  $N, V$  = Recommended loads (included  $\gamma_m \gamma_f$  see ETA, with  $\gamma_f = 1,4$ ).

<sup>(3)</sup> Value of pure shear with distance from the edge  $C \geq 10h_{\text{nom}}$

In the absence of CE markings, the recommended loads derive from tests carried out in the Friulside laboratory in accordance with the appropriate standards. The load values are only valid if the installation has been carried out correctly. The design engineer is responsible for the designing and calculation of the fixing.

**THE QUICKEST INSTALLATION OF ALL THE CLR RANGE**

**MINIMUM DRILL HOLE DIAMETER REQUIRED FOR REDUCED EDGE DISTANCES AND ANCHOR SPACINGS**

**4 HEADS FOR A WIDE RANGE OF APPLICATIONS**



## CLR6 - H

Hex head with built-in washer screw  
White zinc plated



Code	do mm	d x Lv	tfix mm	dc mm	sw	Pkg.	Outer box
72009b08045 <sup>(1)</sup>	6	7,5x45	15	14	10	100	1200
72009b08060	6	7,5x60	5	14	10	100	1200
72009b08080	6	7,5x80	25	14	10	100	1200
72009b08100	6	7,5x100	45	14	10	50	600
72009b08120	6	7,5x120	65	14	10	50	600

<sup>(1)</sup> Codes not covered by CE certification

## CLR6 - P

Pan head screw  
White zinc plated  
Torx T30 recess



Code	do mm	d x Lv	tfix mm	dc mm	Pkg.	Outer box
72006b08040 <sup>(1)</sup>	6	7,5x40	10	16	100	1200
72006b08060	6	7,5x60	5	16	100	1200
72006b08075	6	7,5x75	20	16	100	1200

<sup>(1)</sup> Codes not covered by CE certification

## CLR6 - E

Special head screw with metric thread  
White zinc plated



Code	do mm	d x Lv	Metric thread	dc mm	sw	Pkg.	Outer box
72007b08055	6	7,5x55	M8	14	10	100	1200

## CLR6 - I

Special head screw assembled with double metric thread hex connecting nut  
White zinc plated



Code	do mm	d x Lv	Metric thread	dc mm	sw	Pkg.	Outer box
72008b08055	6	7,5x55	M8-M10	14	13	50	600

**VERSIONS:**

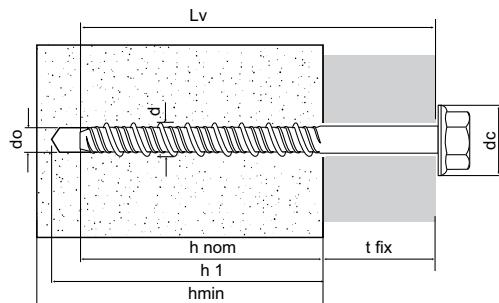
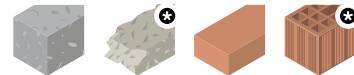
- hex head with built-in washer screw, pan head screw, special screw with metric thread, special head screw assembled with double metric thread hex connecting nut
- white zinc plated
- diameter 6

**PRODUCT FEATURES:**

- no plug required
- correct functioning near edges and with reduced spacing distances

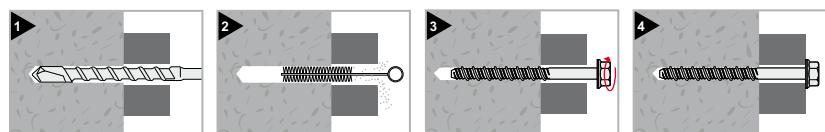
**CERTIFICATIONS**

Cracked and non-cracked concrete  
Fire resistance R120

**BASE MATERIALS:**

$d$  = screw diameter  
 $dc$  = built-in washer diameter  
 $do$  = hole diameter  
 $h_1$  = minimum hole depth  
 $h_{\min}$  = minimum support thickness

$h_{\text{nom}}$  = nominal embedment depth  
 $L_v$  = screw length  
 $sw$  = wrench  
 $t_{\text{fix}}$  = fixture thickness

**DESIGN<sup>(1)</sup> AND RECOMMENDED<sup>(2)</sup> LOADS****Single anchor with large anchor spacing and edge distances in concrete C20/25**

Anchor size	$d_0$	mm	6
Screw diameter	$d$	mm	Ø7,5
Minimum support thickness	$h_{\min}$	mm	100
Depth of hole	$h_1$	mm	65
Nominal embedment depth	$h_{\text{nom}}$	mm	55
Spacing	$S_{\text{cr},N}$	mm	126
Edge distance	$C_{\text{cr},N}$	mm	63
Tensile non-cracked concrete	$N_{rd}$	kN	5,0
	$N$	kN	3,6
Tensile cracked concrete	$N_{rd,cr}$	kN	3,3
	$N_{cr}$	kN	2,4
Shear <sup>(3)</sup> non-cracked concrete	$V_{rd}$	kN	6,0
	$V$	kN	4,3
Minimum spacing	$S_{\min}$	mm	45
Minimum edge distance	$C_{\min}$	mm	45
Shear $C = C_{\min}$	$V_{rd,cmin}$	kN	2,4
	$V_{cmin}$	kN	1,7

1kN ≈ 100 kgf

<sup>(1)</sup>  $N_{rd}, V_{rd}$  = Design loads (included  $\gamma_m$  see ETA).

<sup>(2)</sup>  $N, V$  = Recommended loads (included  $\gamma_m \times \gamma_f$  see ETA, with  $\gamma_f = 1,4$ ).

<sup>(3)</sup> Value of pure shear with distance from the edge  $C \geq 10x_{\text{nom}}$

**DESIGN AND RECOMMENDED<sup>(1)</sup> LOADS****Single anchor with large anchor spacing and edge distances in non-cracked concrete C20/25 - Not certified**

Anchor	$d_0$	mm	6
Screw diameter	$d$	mm	Ø7,5
Minimum support thickness	$h_{\min}$	mm	100
Depth of hole	$h_1$	mm	40
Nominal embedment depth	$h_{\text{nom}}$	mm	30
Spacing	$S_{\text{cr},N}$	mm	55
Edge distance	$C_{\text{cr},N}$	mm	35
Tensile non-cracked concrete	$N$	kN	0,67
Minimum spacing	$S_{\min}$	mm	35
Minimum edge distance	$C_{\min}$	mm	35

1kN ≈ 100 kgf

<sup>(1)</sup> Recommended loads (included  $\gamma_m \times \gamma_f$  with  $\gamma_m = 1,8$  and  $\gamma_f = 1,4$ )

In the absence of CE markings, the recommended loads derive from tests carried out in the Friulside laboratory in accordance with the appropriate standards. The load values are only valid if the installation has been carried out correctly. The design engineer is responsible for the designing and calculation of the fixing.

BIMETAL

STAINLESS STEEL A4 SCREW BODY

HIGH RESISTANCE STEEL POINT FOR  
A SAFER INSTALLATION



## Hex head with built-in washer screw

Stainless steel A4

Code	do mm	d x Lv	tfix mm	dc mm	sw	Pkg.	Outer box
72010010100	8	10x100	15	17	13	25	150
72010010110	8	10x110	25	17	13	25	150
72010010120	8	10x120	35	17	13	25	150
72010012115	10	12x115	15	22	17	25	150
72010012125	10	12x125	25	22	17	25	150
72010012135	10	12x135	35	22	17	25	150

**VERSIONS:**

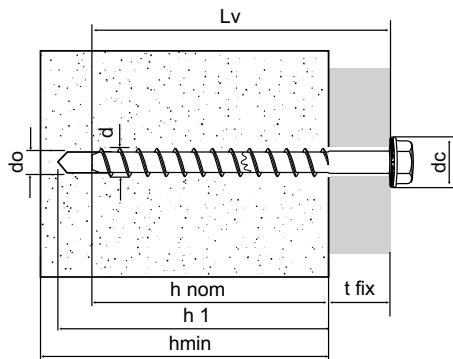
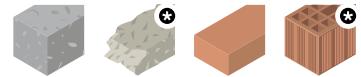
- hex head with built-in washer screw
- bimetal
- diameters 10, 12

**PRODUCT FEATURES:**

- no plug required
- high loading capacity in relation to diameter
- correct functioning near edges and with reduced spacing distances

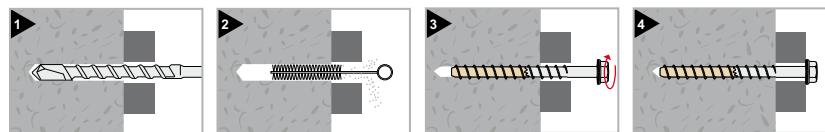
**CERTIFICATIONS**

Cracked and non-cracked concrete  
Fire resistance R120

**BASE MATERIALS:**

$d$  = screw diameter  
 $dc$  = built-in washer diameter  
 $do$  = hole diameter  
 $h_1$  = minimum hole depth  
 $h_{\min}$  = minimum support thickness

$h_{\text{nom}}$  = nominal embedment depth  
 $L_v$  = screw length  
 $sw$  = wrench  
 $t_{\text{fix}}$  = fixture thickness

**DESIGN<sup>(1)</sup> AND RECOMMENDED<sup>(2)</sup> LOADS**

Single anchor with large anchor spacing and edge distances in concrete C20/25

<b>Anchor size</b>	$d_0$	mm	<b>8</b>	<b>10</b>
<b>Screw diameter</b>	$d$	mm	$\emptyset 10$	$\emptyset 12$
<b>Minimum support thickness</b>	$h_{\min}$	mm	125	140
<b>Depth of hole</b>	$h_1$	mm	95	110
<b>Nominal embedment depth</b>	$h_{\text{nom}}$	mm	85	100
<b>Spacing</b>	$S_{\text{cr},N}$	mm	156	176
<b>Edge distance</b>	$C_{\text{cr},N}$	mm	78	88
<b>Tensile non-cracked concrete</b>	$N_{rd}$	kN	4,3	10,7
	$N$	kN	3,1	7,6
<b>Tensile cracked concrete</b>	$N_{rd,cr}$	kN	2,1	4,7
	$N_{cr}$	kN	1,5	3,3
<b>Shear<sup>(3)</sup> non-cracked concrete</b>	$V_{rd}$	kN	12,3	14,8
	$V$	kN	8,8	10,5
<b>Minimum spacing</b>	$S_{\min}$	mm	50	60
<b>Minimum edge distance</b>	$C_{\min}$	mm	50	60
<b>Shear <math>C = C_{\min}</math></b>	$V_{rd,c\min}$	kN	2,9	3,9
	$V_{c\min}$	kN	2,1	2,9

1kN ≈ 100 kgf

<sup>(1)</sup>  $N_{rd}, V_{rd}$  = Design loads (included  $\gamma_m$  see ETA).

<sup>(2)</sup>  $N, V$  = Recommended loads (included  $\gamma_m \times \gamma_f$  see ETA, with  $\gamma_f = 1,4$ ).

<sup>(3)</sup> Value of pure shear with distance from the edge  $C \geq 10x_{\text{nom}}$

# KEM



## CHEMICAL FIXINGS

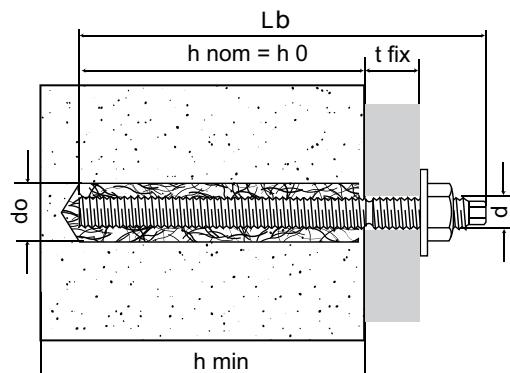
**FRIULSIDER**  
YOUR FIXING FACTORY

**COMPLETE RANGE OF CHEMICAL  
FIXINGS FOR ANY NEED**

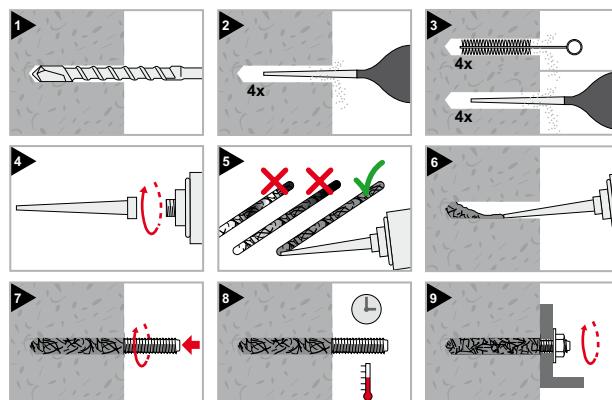
**CE CERTIFICATION FOR ALL OF  
THE KEM RANGE**

**FOR ANY TYPE OF  
FIXING REQUIREMENT**

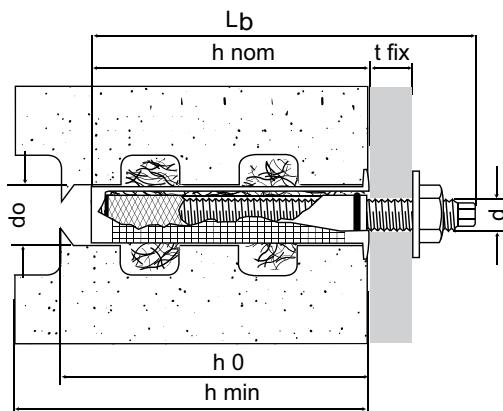
## APPLICATION ON SOLID BASE MATERIALS



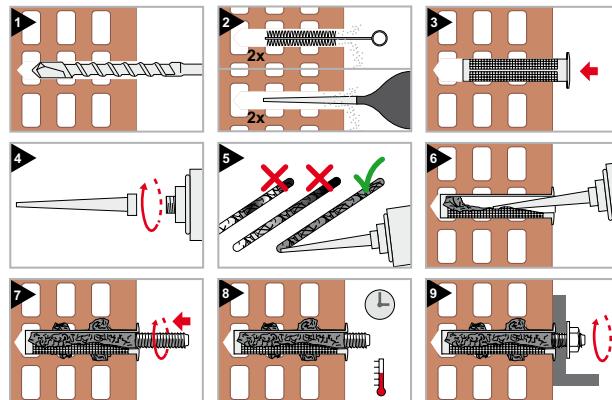
$d$  = threaded bar diameter  
 $do$  = hole diameter  
 $h_0$  = minimum hole depth  
 $h_{min}$  = minimum support thickness  
 $h_{nom}$  = nominal embedment depth  
 $L_b$  = threaded bar length  
 $t_{fix}$  = fixture thickness  
 $T_{max}$  = torque



## APPLICATION ON HOLLOW BASE MATERIALS



$d$  = threaded bar diameter  
 $do$  = hole diameter  
 $h_0$  = minimum hole depth  
 $h_{min}$  = minimum support thickness  
 $h_{nom}$  = nominal embedment depth  
 $L_b$  = threaded bar length  
 $t_{fix}$  = fixture thickness  
 $T_{max}$  = torque



# KEM EP - EPOXY PREMIUM

Pure epoxy with seismic certification

## VERSIONS:

- KEM EP 934 - Pure epoxy - SEISMIC - 585 ml
- KEM EP 933 - Pure epoxy - SEISMIC - 440 ml

## PRODUCT FEATURES:

- Excellent performance
- For heavy duty and structural fixings in seismic areas
- Suitable for various types of base materials, including wood
- Suitable for damp concrete and flooded holes
- Excellent adhesive properties and low shrinkage, suitable for use with smooth/diamond cored holes
- High chemical resistance suitable in highly aggressive environments
- Slow curing time
- 100 year design life
- Styrene free



## CERTIFICATIONS

- Seismic performance C1 and C2**  
**Cracked and non-cracked concrete**  
**Post-installed rebar connections**  
**Diamond drilled holes**  
**Fire resistance R120**



## BASE MATERIALS:



Product line: KEM EP - EPOXY PREMIUM

Code: 93401000000 / 93300000000

ETA ID: KEM EP

Code	Name	Content	Pkg.	Pcs/Pallet
93401000000	KEM 934	585 ml	12	672
93300000000	KEM 933	440 ml	12	840

### KEM EP

Temperature °C	+ 5°C	+ 10°C	+ 20°C	+ 25°C	+ 35°C
Gel time	80 min	60 min	30 min	12 min	8 min
Curing time on dry base materials	48 h	28 h	12 h	9 h	6 h
Curing time on wet base materials	96 h	56 h	24 h	18 h	12 h

Working temperature: -40 / +50°C (max 72°C for short period)

## DESIGN<sup>(1)</sup> AND RECOMMENDED<sup>(2)</sup> LOADS

Single anchor with large anchor spacing and edge distances in cracked and non-cracked concrete C20/25

(24°C - dry or wet hole, 50 year design life,  $\psi_{sus} = 1$ )

Anchor	M8	M10	M12	M16	M20	M24	M27	M30
Minimum support thickness	$h_{min}$ mm	$h_{ef} + 30 \text{ mm}$ $\geq 100 \text{ mm}$			$h_{ef} + 2 \cdot d_0$			
Nominal embedment depth = depth of hole	$h_{nom} = h_0$ mm	80	90	110	125	170	210	240
Hole diameter	$d_0$ mm	10	12	14	18	22	28	30
Spacing	$S_{cr,N}$ mm	$2 \times C_{cr,N}$						
Edge distance	$C_{cr,N}$ mm	120	135	165	190	255	315	360
Tensile non-cracked concrete	$N_{rd,ucr}$ kN	12,3	19,3	28,0	45,8	72,7	99,8	121,9
	$N_{ucr}$ kN	8,8	13,8	20,0	32,7	51,9	71,3	87,1
Tensile cracked concrete	$N_{rd,cr}$ kN	9,4	13,2	23,5	32,1	50,9	69,9	85,4
	$N_{cr}$ kN	6,7	9,4	16,8	22,9	36,4	49,9	61,0
Shear <sup>(3)</sup> (grade 5.8)	$V_{rd, 5.8}$ kN	8,9	13,9	20,2	37,7	58,8	84,7	110,2
	$V_{5.8}$ kN	6,3	9,9	14,4	26,9	42,0	60,5	78,7
Tensile Seismic Resistance Category C1	$N_{rd,eq\ C1}$ kN	9,4	13,2	22,5	27,3	43,3	59,4	72,6
	$N_{eq\ C1}$ kN	6,7	9,4	16,1	19,5	30,9	42,4	51,8
Shear <sup>(3)</sup> Seismic Resistance Category C1 (grade 5.8)	$V_{rd, 5.8\ C1}$ kN	6,2	9,7	14,1	26,4	41,2	59,3	77,1
	$V_{5.8\ C1}$ kN	4,4	7,0	10,1	18,8	29,4	42,4	55,1
Tensile Seismic Resistance Category C2	$N_{rd,eq\ C2}$ kN	-	-	16,0	20,1	35,6	53,8	-
	$N_{eq\ C2}$ kN	-	-	11,5	14,4	25,4	38,5	-
Shear <sup>(3)</sup> Seismic Resistance Category C2 (grade 5.8)	$V_{rd, 5.8\ C2}$ kN	-	-	14,1	26,4	41,2	59,3	-
	$V_{5.8\ C2}$ kN	-	-	10,1	18,8	29,4	42,4	-
Minimum spacing	$S_{min}$ mm	40	50	60	75	95	115	125
Minimum edge distance	$C_{min}$ mm	35	40	45	50	60	65	75
Shear C = $C_{min}$ cracked concrete	$V_{rd,cmin}$ kN	2,0	2,6	3,2	4,1	5,9	7,3	9,3
	$V_{cmin}$ kN	1,4	1,8	2,2	2,9	4,2	5,2	6,6
Torque max	$T_{max}$ Nm	10	20	40	60	100	170	250

1kN ≈ 100 kgf

<sup>(1)</sup>  $N_{rd}, V_{rd}$  = Design loads (included  $\gamma_m$  see ETA).

<sup>(2)</sup> N, V = Recommended loads (included  $\gamma_m \cdot \gamma_f$  see ETA, with  $\gamma_f = 1,4$ ).

<sup>(3)</sup> Value of pure shear with distance from the edge  $C \geq 10 \times h_{nom}$ , seismic C1 and C2 shear values with no hole clearance between fixing and fixture.

The load values are only valid if the installation has been carried out correctly. The design engineer is responsible for the designing and calculation of the fixing. The designing and calculation of the anchorage should be carried out in accordance with EN 1992-4.

**VERSIONS:**

- KEM ES 935 - Pure epoxy - 585 ml

**PRODUCT FEATURES:**

- Excellent performance
- For heavy duty and structural fixings
- Suitable for various types of base materials, including wood
- Suitable for damp concrete and flooded holes
- Slow curing time
- Styrene free

**CERTIFICATIONS**

Cracked and non-cracked concrete  
Post-installed rebar connections



STYRENE FREE

**BASE MATERIALS:**

Product line: KEM ES - EPOXY STANDARD

Code: 93501000000

ETA ID: KEM ES

Code	Name	Content	Pkg.	Pcs/Pallet
93501000000	KEM 935	585 ml	12	672

**KEM ES**

Temperature °C	+ 5°C	+ 10°C	+ 20°C	+ 25°C	+ 35°C
Gel time	80 min	60 min	30 min	12 min	8 min
Curing time on dry base materials	60 h	48 h	12 h	10 h	7 h
Curing time on wet base materials	120 h	96 h	24 h	20 h	14 h

Working temperature: -40 / +43°C (max 70°C for short period)

**DESIGN<sup>(1)</sup> AND RECOMMENDED<sup>(2)</sup> LOADS**

Single anchor with large anchor spacing and edge distances in cracked and non-cracked concrete C20/25

(24°C - dry, wet or flooded hole,  $\psi_{sus} = 1$ )

Anchor	M8	M10	M12	M16	M20	M24	M27	M30
Minimum support thickness	$h_{min}$ mm	$h_{ef} + 30 \text{ mm}$ $\geq 100 \text{ mm}$			$h_{ef} + 2 \cdot d_0$			
Nominal embedment depth = depth of hole	$h_{nom} = h_0$ mm	80	90	110	125	170	210	240
Hole diameter	$d_0$ mm	10	12	14	18	22	28	30
Spacing	$S_{cr,N}$ mm	$2 \times C_{cr,N}$						
Edge distance	$C_{cr,N}$ mm	120	135	165	190	255	315	360
Tensile non-cracked concrete	$N_{rd,ucr}$ kN	12,3	19,3	27,0	32,7	51,9	71,3	87,1
	$N_{ucr}$ kN	8,8	13,8	19,3	23,4	37,1	50,9	62,2
Tensile cracked concrete	$N_{rd,cr}$ kN	6,7	9,4	13,8	20,9	35,6	45,2	58,2
	$N_{cr}$ kN	4,8	6,7	9,9	15,0	25,4	32,3	41,6
Shear <sup>(3)</sup> (grade 5.8)	$V_{rd,5.8}$ kN	8,9	13,9	20,2	37,7	58,8	84,7	110,2
	$V_{5.8}$ kN	6,3	9,9	14,4	26,9	42,0	60,5	78,7
Minimum spacing	$S_{min}$ mm	40	50	60	75	95	115	125
Minimum edge distance	$C_{min}$ mm	35	40	45	50	60	65	75
Shear $C = C_{min}$ cracked concrete	$V_{rd,cmin}$ kN	2,0	2,6	3,2	4,1	5,9	7,3	9,3
	$V_{cmin}$ kN	1,4	1,8	2,2	2,9	4,2	5,2	6,6
Torque max	$T_{max}$ Nm	10	20	40	60	100	170	250

1kN ≈ 100 kgf

<sup>(1)</sup>  $N_{rd}, V_{rd}$  = Design loads (included  $\gamma_m$  see ETA).<sup>(2)</sup>  $N, V$  = Recommended loads (included  $\gamma_m \gamma_f$  see ETA, with  $\gamma_f = 1,4$ ).<sup>(3)</sup> Value of pure shear with distance from the edge  $C \geq 10 \times h_{nom}$ .

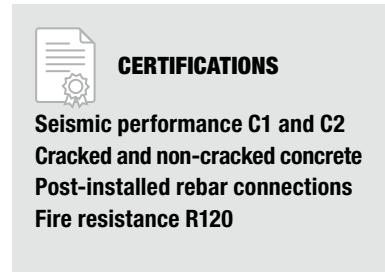
The load values are only valid if the installation has been carried out correctly. The design engineer is responsible for the designing and calculation of the fixing. The designing and calculation of the anchorage should be carried out in accordance with EN 1992-4.

## VERSIONS:

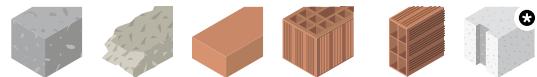
- KEM 936 - Hybrid - SEISMIC - 420 ml

## PRODUCT FEATURES:

- High performance even at high temperatures
- For structural fixings in seismic areas
- Can be used up to 160°C
- High chemical resistance suitable in highly aggressive environments
- Suitable for damp concrete and flooded holes
- Excellent mechanical and thermal characteristics
- Styrene free



## BASE MATERIALS:



Product line: KEM H - HYBRID

Code: 93600000000

ETA ID: KEM HYBRID

Code	Name	Content	Pkg.	Pcs/Pallet
93600000000	KEM 936	420 ml	12	840

## KEM 936

Temperature °C	-5°C	0°C	+ 5°C	+ 10°C	+ 15°C	+ 20°C	+ 30°C
Gel time	50 min	25 min	15 min	10 min	6 min	3 min	2 min
Curing time on dry base materials	5 h	3,5 h	2 h	1 h	40 min	30 min	30 min
Curing time on wet base materials	10 h	7 h	4 h	2 h	80 min	60 min	60 min
Working temperature: -40 / +100°C (max 160°C for short period)							

## DESIGN<sup>(1)</sup> AND RECOMMENDED<sup>(2)</sup> LOADS

Single anchor with large anchor spacing and edge distances in cracked and non-cracked concrete C20/25

Anchor	M8	M10	M12	M16	M20	M24	M27	M30
Minimum support thickness	$h_{min}$ mm	$h_{ef} + 30$ mm ≥ 100 mm				$h_{ef} + 2 \cdot d_0$		
Nominal embedment depth = depth of hole	$h_{nom} = h_0$ mm	80	90	110	125	170	210	240
Hole diameter	$d_0$ mm	10	12	14	18	22	28	30
Spacing	$S_{cr,N}$ mm					2 x $C_{cr,N}$		
Edge distance	$C_{cr,N}$ mm	120	135	165	190	255	315	360
Tensile non-cracked concrete	$N_{rd,ucr}$ kN	12,3	19,3	28,0	45,8	72,7	99,8	121,9
	$N_{ucr}$ kN	8,8	13,8	20,0	32,7	51,9	71,3	87,1
Tensile cracked concrete 50°C <sup>(3)</sup>	$N_{rd,cr}$ kN	9,4	14,1	22,1	32,1	50,9	69,9	85,4
	$N_{cr}$ kN	6,7	10,1	15,8	22,9	36,4	49,9	61,0
Shear <sup>(4)</sup> (grade 5.8)	$V_{rd, 5.8}$ kN	8,8	13,9	20,1	37,6	58,8	84,7	110,1
	$V_{5.8}$ kN	6,3	9,9	14,4	26,9	42,0	60,5	78,7
Tensile Seismic Resistance Category C1 <sup>(5)</sup> 50°C <sup>(3)</sup>	$N_{rd,eq C1}$ kN	9,4	14,1	22,1	27,3	43,3	59,4	72,6
	$N_{eq C1}$ kN	6,7	10,1	15,8	19,5	30,9	42,4	51,8
Shear <sup>(4)</sup> Seismic Resistance Category C1 (grade 5.8)	$V_{rd, 5.8 C1}$ kN	6,1	9,7	14,2	26,4	41,2	59,3	77,2
	$V_{5.8 C1}$ kN	4,4	7,0	10,1	18,8	29,4	42,4	55,1
Tensile Seismic Resistance Category C2 <sup>(5)</sup> 50°C <sup>(3)</sup>	$N_{rd,eq C2}$ kN	-	-	10,0	14,7	23,5	24,3	-
	$N_{eq C2}$ kN	-	-	7,1	10,5	16,8	17,3	-
Shear <sup>(4)</sup> Seismic Resistance Category C2 (grade 8.8)	$V_{rd, 8.8 C2}$ kN	-	-	16,9	24,9	40,0	41,3	-
	$V_{8.8 C2}$ kN	-	-	12,1	17,8	28,5	29,5	-
Minimum spacing	$S_{min}$ mm	40	50	60	75	95	115	125
Minimum edge distance	$C_{min}$ mm	35	40	45	50	60	65	75
Shear C = $C_{min}$ cracked concrete	$V_{rd,c,min}$ kN	1,9	2,5	3,2	4,1	5,9	7,3	9,3
	$V_{c,min}$ kN	1,4	1,8	2,3	2,9	4,2	5,2	6,6
Torque max	$T_{max}$ Nm	10	20	40	60	100	170	250

1kN ≈ 100 kgf

<sup>(1)</sup> Design loads include  $\gamma_m$  see ETA and are valid for CAC hole cleaning

<sup>(2)</sup> Recommended loads include  $\gamma_m \gamma_f$ , see ETA, with  $\gamma_f = 1,4$ .

<sup>(3)</sup> For higher temperatures see the certification ETA 16/0957

<sup>(4)</sup> Value of pure shear with distance from the edge  $C \geq 10 \times h_{nom}$ .

<sup>(5)</sup> Seismic resistances include the factors  $\alpha_{eq} = 0,85$  (single anchor under tension in the case of concrete cone failure) and  $\alpha_{gap} = 1,0$  (shear in the case of no hole clearance). The load values are only valid if the installation has been carried out correctly. The design engineer is responsible for the designing and calculation of the fixing.

**VERSIONS:**

- KEM-UP 941 - Vinylester - SEISMIC - 420 ml
- KEM-UP 943 - Vinylester - SEISMIC - 300 ml

**PRODUCT FEATURES:**

- High performance
- For heavy duty fixings in seismic areas
- Suitable for damp concrete
- Excellent mechanical and thermal characteristics
- High chemical resistance suitable in highly aggressive environments
- Styrene free

**CERTIFICATIONS**

**Seismic performance C1**  
**Cracked and non-cracked concrete**  
**Masonry**  
**Post-installed rebar connection**  
**Fire resistance R120**

**BASE MATERIALS:**

Product line: KEM V - VINYLESTER

Code: 94103000000 / 94301000000

ETA ID: KEM-UP + Vinylester

Code	Name	Content	Pkg.	Pcs/Pallet
94103000000	KEM-UP 941	420 ml	12	840
94301000000	KEM-UP 943	300 ml	12	1152

**KEM-UP 941-943**

Temperature °C	- 10°C	- 5°C	0°C	+ 5°C	+ 10°C	+ 20°C	+ 30°C	+ 35°C	+ 40°C
Gel time	90 min <sup>(1)</sup>	90 min	45 min	25 min	15 min	6 min	4 min	2 min	1,5 min
Curing time on dry base materials	24 h <sup>(1)</sup>	14 h	7 h	120 min	80 min	45 min	25 min	20 min	15 min
Curing time on wet base materials	48 h <sup>(1)</sup>	28 h	14 h	4 h	160 min	90 min	50 min	40 min	30 min
Working temperature: -40 / +72°C (max 120°C for short period)									

<sup>(1)</sup> Cartridge temperature must be minimum +15 °C**DESIGN<sup>(1)</sup> AND RECOMMENDED<sup>(2)</sup> LOADS**

Single anchor with large anchor spacing and edge distances in cracked and non-cracked C20/25

Anchor	M8	M10	M12	M16	M20	M24	M30	
Minimum support thickness	$h_{min}$ mm	$h_{ef} + 30$ mm			$h_{ef} + 2 \cdot d_0$			
Nominal embedment depth = depth of hole	$h_{nom} = h_0$ mm	80	90	110	125	170	210	270
Hole diameter	$d_0$ mm	10	12	14	18	24	28	35
Spacing	$S_{cr,N}$ mm	$2 \times C_{cr,N}$						
Edge distance	$C_{cr,N}$ mm	120	135	165	190	255	315	405
Tensile non-cracked concrete	$N_{rd,ucr}$ kN	12,0	18,9	27,6	38,2	60,6	83,2	121,3
	$N_{ucr}$ kN	8,6	13,5	19,7	27,3	43,3	59,4	86,6
Tensile cracked concrete	$N_{rd,cr}$ kN	5,4	7,9	12,7	19,2	32,6	48,4	84,9
	$N_{cr}$ kN	3,8	5,6	9,1	13,7	23,3	34,5	60,6
Shear <sup>(3)</sup> (grade 5.8)	$V_{rd, 5,8}$ kN	8,8	13,9	20,2	37,7	58,8	84,7	134,6
	$V_{5,8}$ kN	6,3	9,9	14,5	26,9	42,0	60,5	96,2
Tensile Seismic Resistance Category C1	$N_{rd,eq C1}$ kN	3,3	4,9	8,5	12,9	22,0	33,4	63,6
	$N_{eq C1}$ kN	2,4	3,5	6,1	9,2	15,7	23,9	45,4
Shear <sup>(3)</sup> Seismic Resistance Category C1 (grade 5.8)	$V_{rd, 5,8 C1}$ kN	5,7	9,7	14,1	26,3	41,2	59,3	94,3
	$V_{5,8 C1}$ kN	4,1	7,0	10,1	18,8	29,4	42,4	67,3
Minimum spacing	$S_{min}$ mm	40	50	60	80	100	120	150
Minimum edge distance	$C_{min}$ mm	40	50	60	80	100	120	150
Shear $C = C_{min}$	$V_{rd,cmn}$ kN	2,3	3,3	4,5	7,3	10,7	14,6	21,3
	$V_{cmn}$ kN	1,6	2,4	3,2	5,2	7,6	10,4	15,2
Torque max	$T_{max}$ Nm	10	20	40	80	120	160	200

1kN ≈ 100 kgf

<sup>(1)</sup>  $N_{rd}$  e  $V_{rd}$  = Design loads (included  $\gamma_m$  see ETA).<sup>(2)</sup>  $N$  e  $V$  = Recommended loads (included  $\gamma_m \gamma_f$  see ETA, with  $\gamma_f = 1,4$ ).<sup>(3)</sup> Value of pure shear with distance from the edge  $C \geq 10 \times h_{nom}$ .<sup>(4)</sup> For higher temperatures and/or flooded bore holes see the certification ETA.

The load values are only valid if the installation has been carried out correctly. The design engineer is responsible for the designing and calculation of the fixing.

# KEM HR - HYBRID REBAR

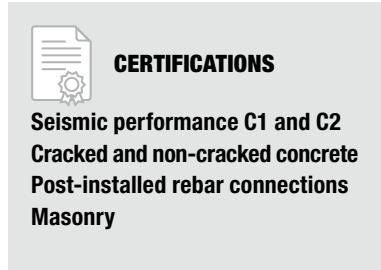
Hybrid with seismic certification - rebar

## VERSIONS:

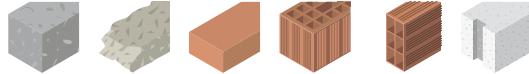
- KEM 954 - Hybrid - SEISMIC - 420 ml
- KEM 955 - Hybrid - SEISMIC - 300 ml

## PRODUCT FEATURES:

- High performance
- For structural fixings in seismic areas
- Suitable for damp concrete and flooded holes
- Styrene free



## BASE MATERIALS:



Product line: KEM HR - HYBRID REBAR

Code: 95403000000 / 95502000000

ETA ID: KEM HR

Code	Name	Content	Pkg.	Pcs/Pallet
95403000000	KEM 954	420 ml	12	840
95502000000	KEM 955	300 ml	12	1152

### KEM 954-955

Temperature °C	- 5°C	+ 0°C	+ 5°C	+ 10°C	+ 20°C	+ 30°C	+ 35°C
Gel time	90 min	45 min	25 min	20 min	6 min	4 min	2 min
Curing time on dry base materials	6 h	3 h	2 h	100 min	45 min	25 min	20 min
Curing time on wet base materials	12 h	6 h	4 h	200 min	90 min	50 min	40 min

Working temperature: -40 / +50°C (max 80°C for short period)

## DESIGN<sup>(1)</sup> AND RECOMMENDED<sup>(2)</sup> LOADS

Single anchor with large anchor spacing and edge distances in cracked and non-cracked concrete C20/25

Anchor	M8	M10	M12	M16	M20	M24
Minimum support thickness	$h_{min}$ mm	$h_{ef} + 30 \text{ mm} \geq 100 \text{ mm}$			$h_{ef} + 2 \cdot d_0$	
Nominal embedment depth = depth of hole	$h_{nom} = h_0$ mm	80	90	110	125	170
Hole diameter	$d_0$ mm	10	12	14	18	24
Spacing	$S_{cr,N}$ mm	$2 \times C_{cr,N}$				
Edge distance	$C_{cr,N}$ mm	120	135	165	190	255
Tensile non-cracked concrete 24°C <sup>(3)</sup>	$N_{rd,ucr}$ kN	9,5	12,6	18,4	27,9	47,5
	$N_{ucr}$ kN	6,8	9,0	13,2	20,0	33,9
Tensile cracked concrete 24°C <sup>(3)</sup>	$N_{rd,cr}$ kN	5,0	7,1	10,4	15,7	-
	$N_{cr}$ kN	3,6	5,1	7,4	11,2	-
Shear <sup>(4)</sup> (grade 5.8)	$V_{rd, 5.8}$ kN	8,8	13,9	20,2	37,7	58,8
	$V_{5.8}$ kN	6,3	9,9	14,4	26,9	42,0
Tensile Seismic Resistance Category C1 24°C <sup>(3)</sup>	$N_{rd,eq C1}$ kN	2,6	3,5	5,3	7,7	-
	$N_{eq C1}$ kN	1,8	2,5	3,8	5,5	-
Shear <sup>(4)</sup> Seismic Resistance Category C1 (grade 5.8)	$V_{rd,5.8 C1}$ kN	5,2	7,2	10,8	15,7	-
	$V_{5.8 C1}$ kN	3,7	5,2	7,7	11,2	-
Tensile Seismic Resistance Category C2 24°C <sup>(3)</sup>	$N_{rd,eq C2}$ kN	-	-	1,7	3,3	-
	$N_{eq C2}$ kN	-	-	1,2	2,4	-
Shear <sup>(4)</sup> Seismic Resistance Category C2 (grade 8.8)	$V_{rd,8.8 C2}$ kN	-	-	3,5	6,8	-
	$V_{8.8 C2}$ kN	-	-	2,5	4,8	-
Minimum spacing	$S_{min}$ mm	40	50	60	80	100
Minimum edge distance	$C_{min}$ mm	40	50	60	80	100
Shear C = $C_{min}$ cracked concrete	$V_{rd,c,min}$ kN	2,3	3,4	4,6	7,3	10,9
	$V_{c,min}$ kN	1,7	2,4	3,3	5,2	7,8
Torque max	$T_{max}$ Nm	10	20	40	80	120

1kN ≈ 100 kgf

<sup>(1)</sup> The design loads  $N_{rd}$  and  $V_{rd}$  derive from the characteristic loads on the ETA certification and are inclusive of the partial safety factors  $\gamma_m$  proportional to each diameter (see ETA).

<sup>(2)</sup> The recommended loads  $N$  and  $V$  derive from the characteristic loads on the ETA certification and are inclusive of the partial safety factors  $\gamma_f = 1,4$  and  $\gamma_m$  proportional to each diameter (see ETA).

<sup>(3)</sup> For higher temperatures see the certification ETA.

<sup>(4)</sup> Value of pure shear with distance from the edge  $C \geq 10 \times h_{nom}$ .

Seismic resistances include the factors  $\alpha_{eq} = 0,85$  (single anchor under tension in the case of concrete cone failure) and  $\alpha_{gap} = 1,0$  (shear in the case of no hole clearance).

The load values are only valid if the installation has been carried out correctly. The design engineer is responsible for the designing and calculation of the fixing.

**VERSIONS:**

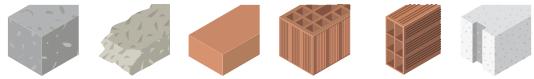
- KEM 950 - Hybrid polyester - 420 ml
- KEM 951 - Hybrid polyester - 300 ml

**PRODUCT FEATURES:**

- Medium-heavy weights
- Suitable for damp concrete and flooded holes
- Styrene free

**CERTIFICATIONS**

Non-cracked concrete  
Masonry

**BASE MATERIALS:**

Product line: KEM HP - HYBRID POLYESTER

Code: 95006000000 / 95103000000

ETA ID: KEM HP

Code	Name	Content	Pkg.	Pcs/Pallet
95006000000	KEM 950	400 ml	12	840
95103000000	KEM 951	300 ml	12	1152

**KEM 950-951**

Temperature °C	- 5°C	+ 0°C	+ 5°C	+ 10°C	+ 20°C	+ 30°C	+ 35°C
Gel time	90 min	45 min	25 min	20 min	6 min	4 min	2 min
Curing time on dry base materials	6 h	3 h	2 h	100 min	45 min	25 min	20 min
Curing time on wet base materials	12 h	6 h	4 h	200 min	90 min	50 min	40 min

Working temperature: -40 / +50°C (max 80°C for short period)

**DESIGN<sup>(1)</sup> AND RECOMMENDED<sup>(2)</sup> LOADS**

Single anchor with large anchor spacing and edge distances in non-cracked concrete C20/25

Anchor	M8	M10	M12	M16	M20	M24
Minimum support thickness	$h_{min}$ mm	110	120	140	160	220
Nominal embedment depth = depth of hole	$h_{nom} = h_0$ mm	80	90	110	125	170
Hole diameter	$d_0$ mm	10	12	14	18	24
Spacing	$S_{cr,N}$ mm				2 x $C_{cr,N}$	
Edge distance	$C_{cr,N}$ mm	120	135	165	190	255
Tensile non-cracked concrete	$N_{rd}$ kN	9,5	12,6	18,4	27,9	47,5
	$N$ kN	6,8	9,0	13,2	20,0	33,9
Shear <sup>(3)</sup> (grade 5.8)	$V_{rd,5.8}$ kN	7,3	11,6	16,9	31,4	49,0
	$V_{5.8}$ kN	5,2	8,3	12,0	22,4	35,0
Minimum spacing	$S_{min}$ mm	40	50	60	80	100
Minimum edge distance	$C_{min}$ mm	40	50	60	80	100
Shear $C = C_{min}$ cracked concrete	$V_{rd,cmn}$ kN	3,3	4,8	6,5	10,3	15,3
	$V_{cmn}$ kN	2,4	3,4	4,7	7,3	10,9
Torque max	$T_{max}$ Nm	10	20	40	80	120

1kN ≈ 100 kgf

(1) The design loads  $N_{rd}$  and  $V_{rd}$  derive from the characteristic loads on the ETA-20/0108 certification and are inclusive of the partial safety factors  $\gamma_m$  proportional to each diameter (see ETA).(2) The recommended loads  $N$  and  $V$  derive from the characteristic loads on the ETA-20/0108 certification and are inclusive of the partial safety factors  $\gamma_i = 1,4$  and  $\gamma_m$  proportional to each diameter (see ETA).(3) Value of pure shear with distance from the edge  $C \geq 10 \times h_{nom}$ .

The load values are only valid if the installation has been carried out correctly. The design engineer is responsible for the designing and calculation of the fixing.

**FRIULSIDER PUR**  
**POLYURETHANE FOAMS ARE THE IDEAL SOLUTION TO FIX, SEAL, FILL UP, BLOCK AND INSULATE MOST OF THE MATERIALS USED IN THE CONSTRUCTION FIELD.**



## PUR 969 - 974 Polyurethane adhesive - INSULATION PANELS



Code	Content	Volume (free foamed)	Colour	Use	Pkg.	Pcs/Pallet
96900000000	800 ml	43 - 47 lt	yellow	for gun	12	624
97400000000	800 ml	43 - 47 lt	yellow	manual	12	624

## PUR 972 Polyurethane foam - WATERPROOF



Code	Content	Volume (free foamed)	Colour	Use	Pkg.	Pcs/Pallet
97200000000	750 ml	40 - 45 lt	yellow	manual	12	624

## PUR 968 Polyurethane foam - THERMAL ACOUSTIC



Code	Content	Volume (free foamed)	Colour	Use	Pkg.	Pcs/Pallet
96800000000	750 ml	40 - 45 lt	yellow	for gun	12	624

## PUR 973 Polyurethane foam - WINDOW FRAMES



Code	Content	Volume (free foamed)	Colour	Use	Pkg.	Pcs/Pallet
97300000000	750 ml	40 - 45 lt	yellow	for gun	12	624

## PUR 967 Polyurethane foam - FIRE RETARDANT



Code	Content	Volume (free foamed)	Colour	Use	Pkg.	Pcs/Pallet
96701000000	750 ml	40 - 45 lt	pink	for gun	12	624
96720000000	750 ml	40 - 45 lt	pink	manual	12	624

## PUR 965 - 966 Polyurethane foam - ROOF TILES



Code	Content	Volume (free foamed)	Colour	Use	Pkg.	Pcs/Pallet
96500000000	750 ml	40 - 45 lt	grey	for gun	12	624
96600000000	750 ml	40 - 45 lt	grey	manual	12	624

## PUR 962 Polyurethane foam - WINTER FORMULA



Code	Content	Volume (free foamed)	Colour	Use	Pkg.	Pcs/Pallet
96200000000▲	750 ml	40 - 45 lt (25 lt -10°C)	yellow	for gun	12	624

## PUR 963 Polyurethane foam - ALL-POSITIONS



Code	Content	Volume (free foamed)	Colour	Use	Pkg.	Pcs/Pallet
96301000000	750 ml	35 - 40 lt	yellow	manual	12	624

**VERSIONS:**

- For gluing of insulation panels
- For waterproof sealing
- For thermo-acoustic insulation
- For window frames
- For installation of firebreak doors and windows
- For roof tiles
- For cold temperatures
- For use in any position
- For multipurpose use

**PRODUCT FEATURES:**

- Manual or for gun use

**PUR 964 Polyurethane foam - MULTIPURPOSE PRO**

Code	Content	Volume (free foamed)	Colour	Use	Pkg.	Pcs/Pallet
96400000000	750 ml	40 - 45 lt	yellow	for gun	12	624

**PUR 961 - 960 Polyurethane foam - MULTIPURPOSE**

Code	Content	Volume (free foamed)	Colour	Use	Pkg.	Pcs/Pallet
96100000000	750 ml	40 - 45 lt	yellow	for gun	12	624
96000000000	750 ml	40 - 45 lt	yellow	manual	12	624

**TECHNICAL DATA**

	969 (see also Table1)	974	972 (see also Table2)	968	973	967 (see also Table3)	967 manual	965	966	962	963 all-positions	964	961	960
<b>Density</b>	kg/m <sup>3</sup>	16-18	18-20	20-25	15-20	16-18	18-22	18-22	18-20	18-20	16-18	18-20	16-18	16-18
<b>Min. application temperature</b>	surface can	+5°C +20-25°C	+5°C +20-25°C	+5°C +20-25°C	+5°C +20-25°C	+5°C +20-25°C	+5°C +20-25°C	+5°C +20-25°C	+5°C +20-25°C	+5°C +20-25°C	-10°C -10-25°C	+5°C +20-25°C	+5°C +20-25°C	+5°C +20-25°C
<b>Tack free time</b>	18°C 60% R.H.	10' - 15'	10' - 15'	7' - 10'	5' - 10'	5' - 10'	5' - 10'	5' - 10'	5' - 10'	5' - 10'	5' - 10'	5' - 10'	5' - 10'	5' - 10'
<b>Hardening time</b> (depending on temperature and humidity)		1-2 h	1-2 h	1,5-5 h	1,5-5 h	1,5-5 h	1,5-5 h	1,5-5 h	1,5-5 h	1,5-5 h	(see Table5)	1,5-5 h	1,5-5 h	1,5-5 h
<b>Cutting time</b>	Ø3cm 18°C 60% R.H	(~25')	(~25')	20'-25'	20'-25'	20'-25'	20'-25'	20'-25'	20'-25'	20'-25'	25'-30'	20'-25'	20'-25'	25'-30'
<b>Temperature resistance</b>											-40°C - +90°C			
<b>Dimensional stability</b>											max -1%			
<b>Water absorbtion</b>	DIN 53428										max 1 vol. %			
<b>Compression strength</b>	DIN 53421										0,04 - 0,05 MPa			
<b>Tensile strength</b>	DIN 53455										0,07 - 0,08 MPa			
<b>Elongation at break</b>	DIN 53455	20-30%	20-30%	20-25%	35-45%	20-30%	15-20%	15-20%	20-30%	20-25%	20-30%	20-30%	20-25%	20-25%
<b>Thermal conductivity</b>	20°C DIN 52612	0,036 W/mK	0,036 W/mK	0,039 W/mK	0,036 W/mK	0,036 W/mK	0,029 W/mK	0,029 W/mK	0,036 W/mK	0,036 W/mK	0,036 W/mK	0,036 W/mK	0,036 W/mK	0,039 W/mK
<b>Acoustic insulation</b>	EN ISO 717-1					58 dB	62 dB				58 dB			

Table 1 (PUR 969)

Adhesion strength at break	ETAG004*	brick 0,16 N/mm <sup>2</sup>	wood 0,23 N/mm <sup>2</sup>	osb 0,15 N/mm <sup>2</sup>
Yield	~10m <sup>2</sup> /etics			

\*Data from ZAG Report nr. P 425/09-460-1.

Table 2 (PUR 972)

Remains watertight to a pressure <sup>1)</sup>	Up to 0,5 bar
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1) Water tightness of the connection between shaft rings (SR-F 1200x500 DIN 4034 p.2) sealed with PUR 972 foam exposed to internal pressure of 0,5 bar for 48 hours

Table 3 (PUR 967)

Fire Resistance*	EN 1366-4 (Classification EN 13501-3)	EI 60 max joint 40 mm EI 90 max joint 30 mm EI 120 max joint 20 mm EI 240 max joint 10 mm
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\*Test Report PB3.2/16-129-1 (DIN EN 1366-4:2010-08 – DIN EN 1363-1:2012-10) for vertical and horizontal linear joints.

Table 4 (PUR 965-966)

Yield	~8m <sup>2</sup> of roof surface
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Table 5 (PUR 962)

Temperature of application °C	Expansion lt	Hardening time h (ø = 2 cm)
-10	25	8 – 10
-5	30	5 – 8
0	35	3 – 5
20	45	1,5 – 2

**COMPACT, HANDY AND WITH PRACTICAL DISPENSERS. THE FRIULSIDER TECHNICAL SPRAY G RANGE IS PERFECT FOR ALL FIELDS OF APPLICATION, BOTH DOMESTIC AND INDUSTRIAL.**



## G10 RUST STOP - 10 in 1 with MoS2



Code	Content	Pkg
G1000	400 ml	12

## G30 MULTI SPRAY - 5 in 1



Code	Content	Pkg
G3000	400 ml	12

## G40 MULTIPURPOSE UNBLOCKING SPRAY



Code	Content	Pkg
G4000	400 ml	12

## G41 ALL-PURPOSE LITHIUM GREASE



Code	Content	Pkg
G4100	400 ml	12

## G42 SILICONE SPRAY



Code	Content	Pkg
G4200	400 ml	12

## G43 CUTTING OIL



Code	Content	Pkg
G4300	400 ml	12

## G45 CHAIN LUBRICANT



Code	Content	Pkg
G4500	400 ml	12

## G46 HIGH TEMPERATURES COPPER GREASE



Code	Content	Pkg
G4600	400 ml	12

## G60 LIGHT ZINC



Code	Content	Pkg
G6000	400 ml	12

## G61 ZINC 98%



Code	Content	Pkg
G6100	400 ml	12

## G62 BRIGHT ZINC



Code	Content	Pkg
G6200	400 ml	12

## G63 LAMELLAR 98% ZINC



Code	Content	Pkg
G6300	400 ml	12

## G70 ELECTRICAL CONTACT CLEANER



Code	Content	Pkg
G7000	400 ml	12

## G71 ANTI-SPATTER FOR WELDING



Code	Content	Pkg
G7100	400 ml	12

## G80 SILICONE REMOVER - GEL



Code	Content	Pkg
G8000	400 ml	12

## G81 POLYURETHANE FOAM CLEANER



Code	Content	Pkg
G8100	500 ml	12

## G82 HIGH PRESSURE CLEANER



Code	Content	Pkg
G8200	400 ml	12

## G91 TRANSPARENT ACRYLIC ENAMEL



Code	Content	Pkg
G9100	400 ml	12

## G92 BITUMINOUS ANTI-CORROSION



Code	Content	Pkg
G9200	400 ml	12

## G90 360° TRACER



Code	Content	Colour	Pkg
G9002	500 ml	blue	12
G9003	500 ml	red	12
G9004	500 ml	orange	12
G9005	500 ml	yellow	12
G9006	500 ml	green	12

	RUST STOP	MULTI SPRAY	MULTIPURPOSE UNBLOCKING SPRAY	ALL-PURPOSE LITHIUM GREASE	SILICONE SPRAY	CUTTING OIL	CHAIN LUBRICANT	HIGH TEMPERATURES COPPER GREASE	LIGHT ZINC	ZINC 98%	BRIGHT ZINC	LAMELLAR 98% ZINC	ELECTRICAL CONTACT CLEANER	ANTI-SPATTER FOR WELDING	SILICONE REMOVER GEL	POLYURETHANE FOAM CLEANER	HIGH PRESSURE CLEANER	360° TRACER	TRANSPARENT ACRYLIC ENAMEL	BITUMINOUS ANTI-CORROSIVE	
PRODUCT	G10	G30	G40	G41	G42	G43	G45	G46	G60	G61	G62	G63	G70	G71	G80	G81	G82	G90	G91	G92	
PROPERTIES	Adherent				▲		▲	▲											▲	▲	▲
	Anti-adhesive				▲										▲						
	Anti-corrosion	▲						▲							▲				▲	▲	▲
	Anti-rust								▲	▲	▲	▲									▲
	Anti-seizure	▲		▲				▲													
	Atmospheric agents								▲	▲	▲	▲							▲	▲	▲
	Coolant					▲															
	Degreaser	▲	▲												▲						
	Detergent	▲													▲						
	High temperature	▲	▲			▲	▲	▲													
	High visibility																			▲	
	Lubricant	▲	▲	▲	▲	▲	▲	▲	▲	▲					▲						
	Moisture repellent	▲	▲	▲											▲						
	Multipurpose	▲	▲																	▲	
	Over-paintable								▲	▲	▲	▲									
	Penetrant	▲	▲																		
	Protective	▲		▲		▲		▲	▲	▲	▲	▲								▲	▲
	Reactivator													▲							
	Remover														▲			▲	▲	▲	
	Solvent														▲	▲					
	Solvent (dissolves rust)	▲		▲																	
	Unblocking	▲		▲	▲	▲															
	Water repellent	▲	▲	▲	▲	▲	▲	▲									▲				
	Wear resistant				▲	▲	▲	▲	▲	▲	▲										

## TECHNICAL DATA

PRODUCT	Colore	Odour	Relative density: 20°C	Flash point	Pressure: 20°C	Dispensing valve
G10 RUST STOP 10 in 1	light grey	characteristic of solvent	0,70 - 0,74 g/ml	Inf. 0° C	3/5 bar	dual position
G30 MULTISPRAY 5 in 1	light brown	characteristic of solvent	0,63 - 0,67 g/ml	Inf. 0° C	4/6 bar	triple action
G40 MULTIPURPOSE UNBLOCKING SPRAY	light yellow	characteristic of solvent	0,68 - 0,72 g/ml	Inf. 0° C	4/6 bar	dispensing valve and nozzle
G41 ALL-PURPOSE LITHIUM GREASE	light brown	characteristic of solvent	0,61 - 0,65 g/ml	Inf. 0° C	4/6 bar	dispensing valve and nozzle
G42 SILICONE SPRAY	transparent	characteristic of solvent	0,54 - 0,58 g/ml	Inf. 0° C	4/6 bar	dispensing valve and nozzle
G43 CUTTING OIL	light brown	characteristic of solvent	0,64 - 0,68 g/ml	Inf. 0° C	4/6 bar	dispensing valve and nozzle
G45 CHAIN LUBRICANT	dark brown	characteristic of solvent	0,63 - 0,67 g/ml	Inf. 0° C	4/6 bar	dispensing valve and nozzle
G46 HIGH TEMPERATURES COPPER GREASE	light brown	characteristic of solvent	0,64 - 0,68 g/ml	Inf. 0° C	4/6 bar	dispensing valve and nozzle
G60 LIGHT ZINC	aluminium/light grey	characteristic of solvent	0,70 - 0,74 g/ml	Inf. 0° C	5,5 bar	wide range spray
G61 ZINC 98%	aluminium/dark grey	characteristic of solvent	0,75 - 0,79 g/ml	Inf. 0° C	5,5 bar	wide range spray
G62 BRIGHT ZINC	aluminium/bright grey	characteristic of solvent	0,71 - 0,75 g/ml	Inf. 0° C	5,5 bar	wide range spray
G63 LAMELLAR 98% ZINC	aluminium/semi-light grey	characteristic of solvent	0,70 - 0,74 g/ml	Inf. 0° C	5,5 bar	wide range spray
G70 ELECTRICAL CONTACT CLEANER	transparent	characteristic of solvent	0,60 - 0,64 g/ml	Inf. 0° C	4/6 bar	dispensing valve and nozzle
G71 ANTI-SPATTER FOR WELDING	light yellow	no odour	0,54 - 0,58 g/ml	Inf. 0° C	3/5 bar	wide range spray
G80 SILICONE REMOVER - GEL	pale white	characteristic of solvent	0,65 g/ml	Inf. 0° C	4/6 bar	dispensing valve and nozzle
G81 POLYURETHANE FOAM CLEANER	transparent	characteristic of solvent	0,66 - 0,70 g/ml	Inf. 0° C	4/6 bar	gun attachment and dispensing valve
G82 HIGH PRESSURE CLEANER	no colour	no odour	0,52 - 0,56 g/ml	Inf. 0° C	4/6 bar	wide range and precision
G90 360° TRACER	blue, red, orange, yellow or green	characteristic of solvent	0,82- 0,86 g/ml	Inf. 0° C	5,5 ± 0,5 bar	360°
G91 TRANSPARENT ACRYLIC ENAMEL	transparent	characteristic of solvent	0,72 - 0,76 g/ml	Inf. 0° C	5,5 ± 0,5 bar	wide range spray
G92 BITUMINOUS ANTI-CORROSIVE	black	characteristic of solvent	0,81 - 0,85 g/ml	Inf. 0° C	5,5 ± 0,5 bar	wide range spray

**MAXIMUM PULL-OUT VALUES****UP TO 3 EMBEDMENT DEPTHS****INCREASED EXPANSION**

**Countersunk rim plug  
countersunk head screw  
white zinc plated  
Ø 4,5 Pozidrive n°2 recess  
Ø 6 Pozidrive n°3 or Torx T30 recess  
Ø 7 Pozidrive n°4 or Torx T40 recess**

Pozidrive Code	Torx Code	Plug only <sup>(1)</sup> Code	Plug do x L mm	Screw d x Lv mm	tfix,1	tfix,2	tfix,3 <sup>(2)</sup>	df mm	Pkg. <sup>(3)</sup>	Outer box <sup>(3)</sup>
64601b06035 <sup>(1)</sup>		64600006035	6x35	4,5x40	10	5	-	6,5	100	1000
64601b06050 <sup>(1)</sup>		64600006050	6x50	4,5x55	25	20	-	6,5	100	1000
64601b06060 <sup>(1)</sup>		64600006060	6x60	4,5x65	35	30	-	6,5	100	1000
64601b06070 <sup>(1)</sup>		64600006070	6x70	4,5x75	45	40	-	6,5	100	1000
64601b08060	64602b08060	64600008060	8x60	6x68	20	10	-	8,5	50	500
64601b08080	64602b08080	64600008080	8x80	6x88	40	30	-	8,5	50	500
64601b08100	64602b08100	64600008100	8x100	6x108	60	50	-	8,5	50	500
64601b08120	64602b08120	64600008120	8x120	6x128	80	70	-	8,5	50	500
64601b10060	64602b10060	64600010060	10x60	7x68	10	-	-	10,5	50	500
64601b10080	64602b10080	64600010080	10x80	7x88	30	10	-	10,5	50	500
64601b10100	64602b10100	64600010100	10x100	7x108	50	30	10	10,5	50	500
64601b10120	64602b10120	64600010120	10x120	7x128	70	50	30	10,5	50	500
64601b10140	64602b10140	64600010140	10x140	7x148	90	70	50	10,5	50	300
64601b10160	64602b10160	64600010160	10x160	7x168	110	90	70	10,5	50	250
	64602b10260	64600010260	10x260	7x268	210	190	170	10,5	50	200 <sup>(4)</sup>
	64602b10290	64600010290	10x290	7x298	240	220	200	10,5	50	200 <sup>(4)</sup>

<sup>(1)</sup> Codes not covered by CE certification<sup>(2)</sup> Only for aerated concrete<sup>(3)</sup> For plug only codes: Pkg. 100 and Outerbox 1000, except codes 64600010260 and 64300010290<sup>(4)</sup> Only for plug only codes

**Countersunk rim plug  
special hex head screw  
with built-in washer Ø19  
white zinc plated  
wrench 13, Torx T40 recess**

Code	Plug do x L mm	Screw d x Lv mm	dr mm	tfix,1	tfix,2	tfix,3 <sup>(1)</sup>	df mm	sw/recess	Pkg.	Outer box.
64603b10060	10x60	7x68	19	10	-	-	10,5	13/T40	50	500
64603b10080	10x80	7x88	19	30	10	-	10,5	13/T40	50	500
64603b10100	10x100	7x108	19	50	30	10	10,5	13/T40	50	500
64603b10120	10x120	7x128	19	70	50	30	10,5	13/T40	50	300
64603b10140	10x140	7x148	19	90	70	50	10,5	13/T40	50	300
64603b10160	10x160	7x168	19	110	90	70	10,5	13/T40	50	250

<sup>(1)</sup> Only for aerated concrete

**Plug with large rim Ø18  
special hex head screw  
with built-in washer Ø19  
white zinc plated  
wrench 13, Torx T40 recess**

Code	Plug only <sup>(1)</sup>	Plug do x L mm	db mm	Screw d x Lv mm	dr mm	tfix,1	tfix,2	tfix,3 <sup>(2)</sup>	df mm	sw/ recess	Pkg. <sup>(3)</sup>	Outer box <sup>(3)</sup>
64703b10060	64700010060	10x60	18	7x68	19	10	-	-	10,5	13/T40	50	500
64703b10080	64700010080	10x80	18	7x88	19	30	10	-	10,5	13/T40	50	500
64703b10100	64700010100	10x100	18	7x108	19	50	30	10	10,5	13/T40	50	500
64703b10120	64700010120	10x120	18	7x128	19	70	50	30	10,5	13/T40	50	300
64703b10140	64700010140	10x140	18	7x148	19	90	70	50	10,5	13/T40	50	300
64703b10160	64700010150	10x160	18	7x168	19	110	90	70	10,5	13/T40	50	250

<sup>(1)</sup> Codes not covered by CE certification<sup>(2)</sup> Only for aerated concrete<sup>(3)</sup> For plug only codes: Pkg. 100 and Outerbox 1000

**VERSIONS:**

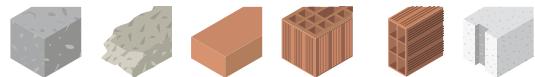
- plug with white zinc plated, 3DG or stainless steel A4 countersunk screw
- plug with white zinc plated, 3DG or stainless steel A4 hex head screw
- large rim plug with white zinc plated, 3DG or stainless steel A4 hex head screw

**CERTIFICATIONS**

Multiple use for non structural applications

**PRODUCT FEATURES:**

- nylon plug with dynamic tip
- special screw
- maxi longitudinal antirotation wings

**BASE MATERIALS:**

**Countersunk rim plug countersunk head screw  
Ø 6 Torx T30 recess  
Ø 7 Torx T40 recess**

3DG matte finish Code	Stainless steel A4-70 Code	Plug do x L mm	Screw d x Lv mm	tfix, mm	tfix, mm	tfix, mm	df mm	Pkg.	Outer box
			tfix,1	tfix,2	tfix,3 <sup>(1)</sup>				
64602c08060▲	64602008060	8x60	6x68	20	10	-	8,5	50	500
64602c08080▲	64602008080	8x80	6x88	40	30	-	8,5	50	500
64602c08100▲	64602008100	8x100	6x108	60	50	-	8,5	50	500
64602c08120▲	64602008120	8x120	6x128	80	70	-	8,5	50	500
64602c10060▲	64602010060	10x60	7x68	10	-	-	10,5	50	500
64602c10080▲	64602010080	10x80	7x88	30	10	-	10,5	50	500
64602c10100▲	64602010100	10x100	7x108	50	30	10	10,5	50	500
64602c10120▲	64602010120	10x120	7x128	70	50	30	10,5	50	500
64602c10140▲	64602010140	10x140	7x148	90	70	50	10,5	50	300
64602c10160▲	64602010160	10x160	7x168	110	90	70	10,5	50	250

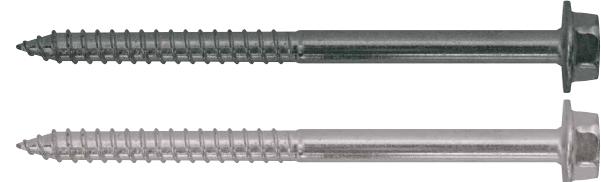
<sup>(1)</sup> Only for aerated concrete



**Countersunk rim plug  
special hex head screw  
with built-in washer Ø19  
wrench 13, Torx T40 recess**

3DG matte finish Code	Stainless steel A4-70 Code	Plug do x L mm	Screw d x Lv mm	dr mm	tfix, mm	tfix, mm	tfix, mm	df mm	sw/recess	Pkg.	Outer box
			tfix,1	tfix,2	tfix,3 <sup>(1)</sup>						
64603c10060▲	64603010060	10x60	7x68	19	10	-	-	10,5	13/T40	50	500
64603c10080▲	64603010080	10x80	7x88	19	30	10	-	10,5	13/T40	50	500
64603c10100▲	64603010100	10x100	7x108	19	50	30	10	10,5	13/T40	50	500
64603c10120▲	64603010120	10x120	7x128	19	70	50	30	10,5	13/T40	50	300
64603c10140▲	64603010140	10x140	7x148	19	90	70	50	10,5	13/T40	50	300
64603c10160▲	64603010160	10x160	7x168	19	110	90	70	10,5	13/T40	50	250

<sup>(1)</sup> Only for aerated concrete



**Plug with large rim Ø18  
special hex head screw  
with built-in washer Ø19  
wrench 13, Torx T40 recess**

3DG matte finish Code	Stainless steel A4-70 Code	Plug do x L mm	db mm	Screw d x Lv mm	dr mm	tfix, mm	tfix, mm	df mm	sw/ recess	Pkg.	Outer box	
				tfix,1	tfix,2	tfix,3 <sup>(1)</sup>						
64703c10060	64703010060	10x60	18	7x68	19	10	-	-	10,5	13/T40	50	500
64703c10080	64703010080	10x80	18	7x88	19	30	10	-	10,5	13/T40	50	500
64703c10100	64703010100	10x100	18	7x108	19	50	30	10	10,5	13/T40	50	500
64703c10120	64703010120	10x120	18	7x128	19	70	50	30	10,5	13/T40	50	300
64703c10140	64703010140	10x140	18	7x148	19	90	70	50	10,5	13/T40	50	300
64703c10160	64703010160	10x160	18	7x168	19	110	90	70	10,5	13/T40	50	250

<sup>(1)</sup> Only for aerated concrete

**VERSIONS:**

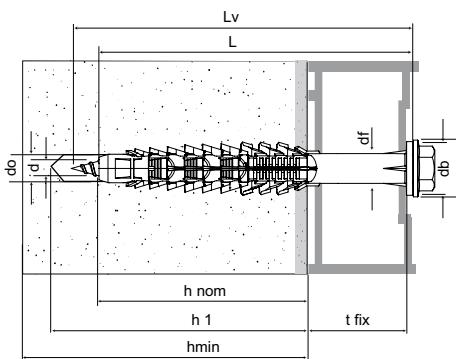
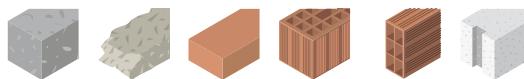
- plug with white zinc plated, 3DG or stainless steel A4 countersunk screw
- plug with white zinc plated, 3DG or stainless steel A4 hex head screw
- large rim plug with white zinc plated, 3DG or stainless steel A4 hex head screw

**CERTIFICATIONS**

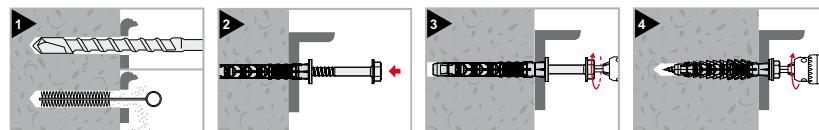
Multiple use for non structural applications

**PRODUCT FEATURES:**

- nylon plug with dynamic tip
- special screw
- maxi longitudinal antirotation wings

**BASE MATERIALS:**

d	=	screw diameter	hmin	=	minimum support thickness
db	=	rim diameter	hnom	=	nominal embedment depth
df	=	hole diameter of fixing element	L	=	anchor length
do	=	hole diameter	Lv	=	screw length
dr	=	washer diameter	sw	=	wrench
h1	=	minimum hole depth	tfix	=	fixture thickness

**DESIGN<sup>(1)</sup> AND RECOMMENDED<sup>(2)</sup> LOADS**

Single anchor with large anchor spacing and edge distances (Temperature  $\leq 40^\circ\text{C}$ )

Anchor		<b>Ø6<sup>(3)</sup></b>	<b>Ø8</b>	<b>Ø10</b>
<b>Minimum hole depth</b>	h <sub>1</sub> mm	h <sub>nom+10</sub>	h <sub>nom+15</sub>	h <sub>nom+15</sub>
<b>Nominal embedment depth</b>	h <sub>nom</sub> mm	25 30	40 50	50 70
<b>Hole diameter</b>	d <sub>0</sub> mm	6 6	8 8	10 10
<b>Tensile/Shear</b>	F <sub>rd</sub> kN	- -	0,70 0,85	1,70 2,50
<b>Concrete C12/C15</b>	F kN	- -	0,50 0,60	1,20 1,80
<b>Edge distance</b>	C <sub>cr,N</sub> mm	- -	85 85	140 140
<b>Minimum spacing</b>	S <sub>min</sub> mm	- -	85 85	210 210
<b>Minimum edge distance</b>	C <sub>min</sub> mm	- -	70 70	70 70
<b>Tensile/Shear</b>	F <sub>rd</sub> kN	0,55 0,63	0,85 1,10	2,20 3,60
<b>Concrete C16/C20</b>	F kN	0,40 0,45	0,60 0,80	1,60 2,60
<b>Edge distance</b>	C <sub>cr,N</sub> mm	50 50	60 60	100 100
<b>Minimum spacing</b>	S <sub>min</sub> mm	50 50	60 60	150 150
<b>Minimum edge distance</b>	C <sub>min</sub> mm	50 50	50 50	50 50
<b>Minimum support thickness</b>	h <sub>min</sub> mm	80 80	100 100	100 120
<b>Autoclaved Aerated Concrete AAC 2</b> EN771-4 p $\geq$ 0,35kg/dm <sup>3</sup> fb $\geq$ 2,0MPa	Tensile/Shear	F <sub>rd</sub> kN	- -	- -
<b>Autoclaved Aerated Concrete AAC 6</b> EN771-4 p $\geq$ 0,65kg/dm <sup>3</sup> fb $\geq$ 6,0MPa	Tensile/Shear	F <sub>rd</sub> kN	- -	- -
<b>Minimum spacing</b>	F kN	- -	- -	1,00 1,25
<b>Minimum edge distance</b>	S <sub>min</sub> mm	- -	- -	0,71 0,90
<b>Minimum support thickness</b>	C <sub>min</sub> mm	- -	- -	250 250
<b>Solid brick - MZ 2,0/20 verzahnt 3DF</b> EN771-1 fb $\geq$ 20MPa	Tensile/Shear	F <sub>rd</sub> kN	- -	- -
<b>Minimum support thickness</b>	F kN	- -	1,40 1,60	0,20 0,30
<b>Hollow clay brick - Poroton P800 30.19.25</b> EN771-1 fb $\geq$ 10,5MPa	Tensile/Shear	F <sub>rd</sub> kN	- -	- -
<b>Minimum support thickness</b>	F kN	- -	0,60 0,80	0,60 0,60
<b>Hollow clay brick - Doppio UNI 12x25x12</b> EN771-1 fb $\geq$ 22MPa	Tensile/Shear	F <sub>rd</sub> kN	0,29 -	0,57 0,57
<b>Minimum support thickness</b>	F kN	0,21 -	0,43 0,57	0,57 0,57
<b>Hollow clay brick - Poroton P700TS 35.24.5.25 inc.35</b> EN771-1 fb $\geq$ 11MPa	Tensile/Shear	F <sub>rd</sub> kN	0,19 -	0,60 0,36
<b>Minimum support thickness</b>	F kN	0,14 -	0,43 0,26	0,36 0,26
<b>Hollow lightweight concrete block - Leca Universalblockk 20</b> EN771-3 fb $\geq$ 3MPa	Tensile/Shear	F <sub>rd</sub> kN	350 -	350 350
<b>Minimum support thickness</b>	F kN	- -	120 120	120 120
<b>Max torque on concrete<sup>(5)</sup></b>	<b>zincplated screw</b>	T <sub>max</sub> Nm	3	9
	<b>3DG screw</b>	T <sub>max</sub> Nm	-	9
	<b>stainless steel screw</b>	T <sub>max</sub> Nm	-	10
				100 (125) <sup>(4)</sup>

1kN  $\approx$  100 kgf

NOTE: The above load values refer to a working temperature of  $\leq 40^\circ\text{C}$ . For temperature higher than  $40^\circ$ , please consult ETA 19/0245 for values.

<sup>(1)</sup> The design loads F<sub>rd</sub> derive from the characteristic loads on the ETA 19/0245 certification and are inclusive of the partial safety factors  $\gamma_f$  for each construction support category (see ETA). The design loads F<sub>rd</sub> for non-certified anchors, derive from the mean ultimate loads and are inclusive of the total safety factor  $\gamma = 6$ . Base material without plaster, avoid rotary percussion when drilling into honeycomb brick and cell like clay brick.

<sup>(2)</sup> The recommended loads F derive from the characteristic loads on the ETA 10/0245 certification and are inclusive of the partial safety factors  $\gamma_f = 1,4$  and  $\gamma_m$  for each construction support category (see ETA). The recommended loads F for non-certified anchors, derive from the mean ultimate loads and are inclusive of the partial safety factor  $\gamma_f = 1,4$  and  $\gamma = 6$ . Base material without plaster, avoid rotary percussion when drilling into honeycomb brick and cell like clay brick. In case of broken bricks double the distances of the indicative data.

<sup>(3)</sup> Not covered by CE certification

<sup>(4)</sup> Values in brackets valid only for solid masonry Mz 2,0/20 verzahnt 3DF for size X3 Ø10.

<sup>(5)</sup> The values shown refer to the product Friulsiider sold in combination plug with the standard screws of this technical catalogue. For other types of base materials, the torque has to be regulated according to the type of installation and base material.

The load values are only valid if the installation has been carried out correctly. The design engineer is responsible for the designing and calculation of the fixing.

**LOW TIGHTENING TORQUE****ULTRA FLEXIBLE NYLON****SCREW ALWAYS PREASSEMBLED**

**Assembled**  
countersunk rim plug  
countersunk head screw  
white zinc plated  
Ø6 Torx T30 recess  
Ø7 Torx T40 recess

Code	Plug do x L mm	Screw d x Lv mm	tfix mm	df mm	recess	Pkg.	Outer box
64301b08080	8x80	6x85	10	8,5	T30	100	1000
64301b08100	8x100	6x105	30	8,5	T30	50	500
64301b08120	8x120	6x125	50	8,5	T30	50	500
64301b08150	8x150	6x155	80	8,5	T30	50	-
64301b08170	8x170	6x175	100	8,5	T30	50	-
64301b10085	10x85	7x90	15	10,5	T40	50	500
64301b10100	10x100	7x105	30	10,5	T40	50	500
64301b10115	10x115	7x120	45	10,5	T40	50	500
64301b10135	10x135	7x140	65	10,5	T40	50	200
64301b10160	10x160	7x165	90	10,5	T40	50	-
64301b10200	10x200	7x205	130	10,5	T40	50	-
64301b10230	10x230	7x235	160	10,5	T40	50	-



**Assembled**  
countersunk rim plug  
special hex head screw with built-in washer  
white zinc plated  
Ø 6 built-in washer Ø15  
wrench 10, Torx T30 recess  
Ø 7 built-in washer Ø19  
wrench 13, Torx T40 recess

Code	Plug do x L mm	Screw d x Lv mm	dr mm	tfix mm	df mm	sw/recess	Pkg.	Outer box
64302b08080	8x80	6x85	15	10	8,5	10/T30	100	1000
64302b08100	8x100	6x105	15	30	8,5	10/T30	50	500
64302b08120	8x120	6x125	15	50	8,5	10/T30	50	500
64302b08150	8x150	6x155	15	80	8,5	10/T30	50	-
64302b10085	10x85	7x90	19	15	10,5	13/T40	50	500
64302b10100	10x100	7x105	19	30	10,5	13/T40	50	500
64302b10115	10x115	7x120	19	45	10,5	13/T40	50	500
64302b10135	10x135	7x140	19	65	10,5	13/T40	50	200
64302b10160	10x160	7x165	19	90	10,5	13/T40	50	-



**Assembled**  
plug with large rim Ø18  
special hex head screw with built-in washer Ø19  
white zinc plated  
wrench 13, Torx T40 recess

Code	Plug do x L mm	db mm	Screw d x Lv mm	dr mm	tfix mm	df mm	sw/recess	Pkg.	Outer box
64402b10085	10x85	18	7x90	19	15	10,5	13/T40	50	500
64402b10100	10x100	18	7x105	19	30	10,5	13/T40	50	500
64402b10115	10x115	18	7x120	19	45	10,5	13/T40	50	500
64402b10135	10x135	18	7x140	19	65	10,5	13/T40	50	200
64402b10160	10x160	18	7x165	19	90	10,5	13/T40	50	-

**LOW TIGHTENING TORQUE****ULTRA FLEXIBLE NYLON****SCREW ALWAYS PREASSEMBLED****3DG  
COATING****INOX  
A4  
70**

3DG matte finish Code	Stainless steel A4-70 Code	Plug do x L mm	Screw d x Lv mm	tfix mm	df mm	recess	Pkg.	Outer box
64301c08080	64301008080	8x80	6x85	10	8,5	T30	100	1000
64301c08100	64301008100	8x100	6x105	30	8,5	T30	50	500
64301c08120	64301008120	8x120	6x125	50	8,5	T30	50	500
64301c08150	64301008150	8x150	6x155	80	8,5	T30	50	-
64301c08170	64301008170	8x170	6x175	100	8,5	T30	50	-
64301c10085	64301010085	10x85	7x90	15	10,5	T40	50	500
64301c10100	64301010100	10x100	7x105	30	10,5	T40	50	500
64301c10115	64301010115	10x115	7x120	45	10,5	T40	50	500
64301c10135	64301010135	10x135	7x140	65	10,5	T40	50	200
64301c10160	64301010160	10x160	7x165	90	10,5	T40	50	-
64301c10200	64301010200	10x200	7x205	130	10,5	T40	50	-
64301c10230	64301010230	10x230	7x235	160	10,5	T40	50	-

**3DG  
COATING****INOX  
A4  
70**

3DG matte finish Code	Stainless steel A4-70 Code	Plug do x L mm	Screw d x Lv mm	dr mm	tfix mm	df mm	sw/recess	Pkg.	Outer box
64302c10085	64302010085	10x85	7x90	19	15	10,5	13/T40	50	500
64302c10100	64302010100	10x100	7x105	19	30	10,5	13/T40	50	500
64302c10115	64302010115	10x115	7x120	19	45	10,5	13/T40	50	500
64302c10135	64302010135	10x135	7x140	19	65	10,5	13/T40	50	200
64302c10160	64302010160	10x160	7x165	19	90	10,5	13/T40	50	-

**3DG  
COATING****INOX  
A4  
70**

3DG matte finish Code	Stainless steel A4-70 Code	Plug do x L mm	db mm	Screw d x Lv mm	dr mm	tfix mm	df mm	sw/ recess	Pkg.	Outer box
64402c10085	64402010085	10x85	18	7x90	19	15	10,5	13/T40	50	500
64402c10100	64402010100	10x100	18	7x105	19	30	10,5	13/T40	50	500
64402c10115	64402010115	10x115	18	7x120	19	45	10,5	13/T40	50	500
64402c10135	64402010135	10x135	18	7x140	19	65	10,5	13/T40	50	200
64402c10160	64402010160	10x160	18	7x165	19	90	10,5	13/T40	50	-

**Assembled  
plug with large rim Ø18  
special hex head screw with built-in washer Ø19  
wrench 13, Torx T40 recess**

**VERSIONS:**

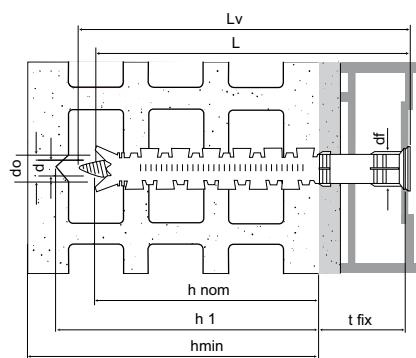
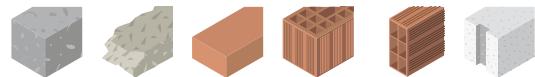
- plug with white zinc plated, 3DG or stainless steel A4 countersunk screw
- plug with white zinc plated, 3DG or stainless steel A4 hex head screw
- large rim plug with white zinc plated, 3DG or stainless steel A4 hex head screw

**CERTIFICATIONS**

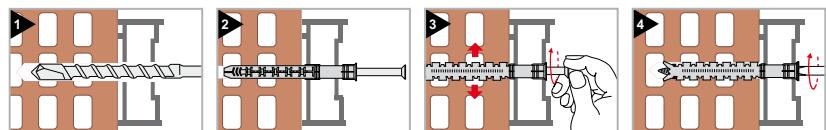
Multiple use for non structural applications

**PRODUCT FEATURES:**

- nylon plug with multi-expansion variable geometry
- screw always preassembled
- CE certification for guaranteed safety

**BASE MATERIALS:**

$d$	=	screw diameter	$h_{min}$	=	minimum support thickness
$db$	=	rim diameter	$h_{nom}$	=	nominal embedment depth
$df$	=	hole diameter of fixing element	$L$	=	anchor length
$do$	=	hole diameter	$Lv$	=	screw length
$dr$	=	head screw diameter	$sw$	=	wrench
$h1$	=	minimum hole depth	$t_{fix}$	=	fixture thickness

**DESIGN<sup>(1)</sup> AND RECOMMENDED<sup>(2)</sup> LOADS**

Single anchor with large anchor spacing and edge distances (Temperature  $\leq 40^\circ\text{C}$ )

Anchor		Ø8	Ø10
<b>Minimum hole depth</b>	$h_1$ mm	80	80
<b>Nominal embedment depth</b>	$h_{nom}$ mm	70	70
<b>Hole diameter</b>	$d_0$ mm	8	10
<b>Concrete C12/C15</b>	<b>Tensile/Shear</b> $F_{rd}$ kN	0,8	1,4
	$F$ kN	0,6	1,0
	<b>Edge distance</b> $C_{cr,N}$ mm	140	140
	<b>Minimum spacing</b> $S_{min}$ mm	80	80
<b>Concrete C16/C20</b>	<b>Minimum edge distance</b> $C_{min}$ mm	80	80
	<b>Tensile/Shear</b> $F_{rd}$ kN	1,4	1,9
	$F$ kN	1,0	1,4
	<b>Edge distance</b> $C_{cr,N}$ mm	100	100
<b>Minimum support thickness</b>	<b>Minimum spacing</b> $S_{min}$ mm	60	60
	<b>Minimum edge distance</b> $C_{min}$ mm	60	60
	$h_{min}$ mm	100	100
	<b>Tensile/Shear</b> $F_{rd}$ kN	0,3	0,3
<b>Autoclaved Aerated Concrete AAC EN771-4 <math>\rho=0,5\text{kg}/\text{dm}^3</math> <math>fb \geq 2,5\text{MPa}</math></b>	$F$ kN	0,21	0,21
	<b>Edge distance</b> $C_{cr,N}$ mm	100	100
	<b>Minimum spacing</b> $S_{min}$ mm	250	250
	<b>Minimum edge distance</b> $C_{min}$ mm	100	100
<b>Minimum support thickness</b>	$h_{min}$ mm	200	200
	<b>Tensile/Shear</b> $F_{rd}$ kN	1,4	1,4
	$F$ kN	1,0	1,0
	<b>Solid brick</b> $F_{rd}$ kN	0,6	0,6
<b>Hollow clay brick double UNI EN771-1 <math>fb \geq 28\text{MPa}</math></b>	$F$ kN	0,43	0,43
	<b>Tensile/Shear</b> $F_{rd}$ kN	0,6	0,6
<b>Hollow brick - Alveolater UNI EN771-1 <math>fb \geq 13\text{MPa}</math></b>	$F$ kN	0,43	0,43
	<b>Tensile/Shear</b> $F_{rd}$ kN	0,6	0,6
<b>Hollow brick - Alveolater 35 UNI EN771-1 <math>fb \geq 10\text{MPa}</math></b>	$F$ kN	0,43	0,43
	<b>Tensile/Shear</b> $F_{rd}$ kN	0,6	0,6
<b>Hollow brick - Light UNI EN771-1 <math>fb \geq 7\text{MPa}</math></b>	$F$ kN	0,36	0,36
	<b>Tensile/Shear</b> $F_{rd}$ kN	0,26	0,26
<b>Hollow brick - Poroton 25x30x19 UNI EN771-1 <math>fb \geq 22\text{MPa}</math></b>	$F$ kN	0,43	0,57
	<b>Tensile/Shear</b> $F_{rd}$ kN	0,6	0,8
<b>Minimum support thickness on masonry</b>	$h_{min}$ mm	110	110
<b>Minimum spacing on masonry</b>	$S_{min}$ mm	250	250
<b>Minimum edge distance on masonry</b>	$C_{min}$ mm	100	100
<b>Max torque on concrete support</b>	<b>zincplated / 3DG screw</b> $T_{max}$ Nm	9	15
	<b>stainless steel screw</b> $T_{max}$ Nm	10	20

1kN  $\approx 100$  kgf

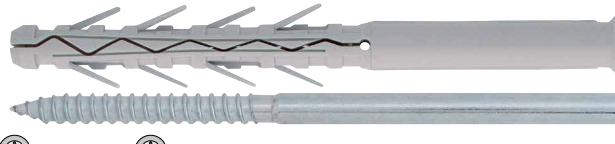
NOTE: The above load values refer to a working temperature of  $\leq 40^\circ\text{C}$ . For temperature higher than  $40^\circ$ , please consult ETA 10/0425 for values.

(1) The design loads  $F_{rd}$  derive from the characteristic loads on the ETA 10/0425 certification and are inclusive of the partial safety factors  $\gamma_m$  proportional to each diameter (see ETA).

(2) The recommended loads  $F$  derive from the characteristic loads on the ETA 10/0425 certification and are inclusive of the partial safety factors  $\gamma_f=1,4$  and  $\gamma_m$  proportional to each diameter (see ETA). The torque has to be regulated according to the type of installation and base material. The load values are only valid if the installation has been carried out correctly. The design engineer is responsible for the designing and calculation of the fixing.

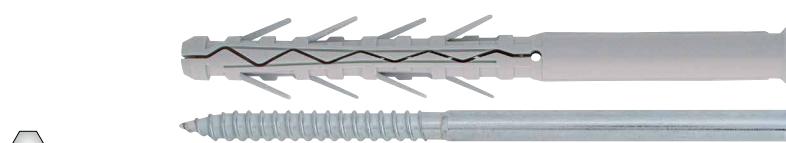
**TOP PERFORMANCE****CONTROLLED EXPANSION****ROUNDED THREAD SCREW****Plug only**

Code	Plug do x L mm	tfix mm	df mm	Pkg.	Outer box
64100008080	8x80	10	8	100	1000
64100008100	8x100	30	8	100	1000
64100008120	8x120	50	8	100	1000
64100010085	10x85	15	10	100	1000
64100010100	10x100	30	10	100	1000
64100010115	10x115	45	10	100	1000
64100010135	10x135	65	10	100	1000
64100010160	10x160	90	10	100	-
64100010200	10x200	130	10	100	-
64100012135	12x135	65	10	100	-
64100012160	12x160	90	10	100	-
64100012200	12x200	130	10	100	-
64100012240	12x240	170	10	100	-



**Countersunk head screw**  
**Ø 8 Pozidrive n°3 recess**  
**Ø 8 Torx T30 recess**  
**Ø10 Pozidrive n°4 recess**  
**Ø10 Torx T40 recess**

White zinc plated Pozidrive Code	White zinc plated Torx Code	Stainless steel A4 Torx Code	Plug do x L mm	Screw d x Lv mm	tfix mm	df mm	Pkg.	Outer box
64102b08080	64103b08080	64103008080	8x80	5,5x85	10	8	100	1000
64102b08100	64103b08100	64103008100	8x100	5,5x105	30	8	50	500
64102b08120	64103b08120	64103008120	8x120	5,5x125	50	8	50	500
64102b10085	64103b10085	64103010085	10x85	7x90	15	10	100	500
64102b10100	64103b10100	64103010100	10x100	7x105	30	10	50	500
64102b10115	64103b10115	64103010115	10x115	7x120	45	10	50	500
64102b10135	64103b10135	64103010135	10x135	7x140	65	10	50	250
64102b10160	64103b10160	64103010160	10x160	7x165	90	10	50	250
64102b10200	64103b10200	64103010200	10x200	7x205	130	10	50	250



**Hex head screw**  
**white zinc plated**  
**Ø 8 wrench 10**  
**Ø 10 wrench 13**  
**Ø 12 wrench 17**

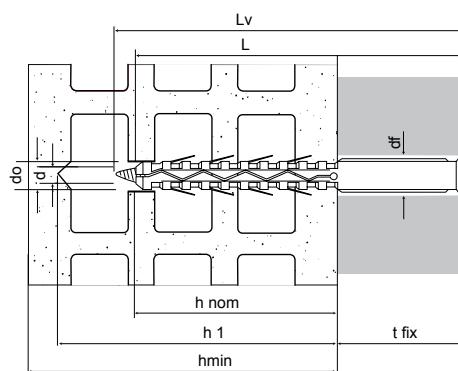
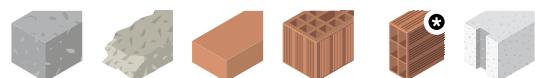
Code	Plug do x L mm	Screw d x Lv mm	tfix mm	df mm	sw	Pkg.	Outer box
64101b08080	8x80	5,5x85	10	8	10	100	1000
64101b08100	8x100	5,5x105	30	8	10	50	500
64101b08120	8x120	5,5x125	50	8	10	50	500
64101b10085	10x85	7x90	15	10	13	100	500
64101b10100	10x100	7x105	30	10	13	50	500
64101b10115	10x115	7x120	45	10	13	50	500
64101b10135	10x135	7x140	65	10	13	50	250
64101b10160	10x160	7x165	90	10	13	50	250
64101b10200	10x200	7x205	130	10	13	50	250
64101b12135	12x135	10x140	65	12	17	25	250
64101b12160	12x160	10x165	90	12	17	25	125
64101b12200	12x200	10x205	130	12	17	25	125
64101b12240	12x240	10x245	170	12	17	25	-

**VERSIONS:**

- plug with white zinc plated Pozidrive countersunk screw
- plug with white zinc plated or stainless steel A4 Torx countersunk screw
- plug with white zinc plated hex head screw

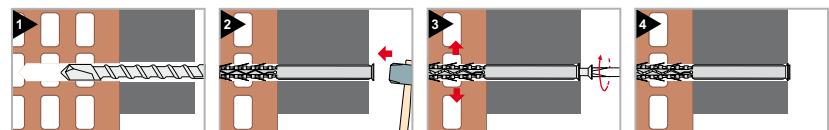
**PRODUCT FEATURES:**

- nylon plug
- various types of screws for different types of fixing requirements
- large fixing thickness

**BASE MATERIALS:**

$d$  = screw diameter  
 $df$  = hole diameter of fixing element  
 $do$  = hole diameter  
 $h_1$  = minimum hole depth  
 $h_{\min}$  = minimum support thickness  
 $h_{\text{nom}}$  = nominal embedment depth

$L$  = anchor length  
 $L_v$  = screw length  
 $sw$  = wrench  
 $t_{\text{fix}}$  = fixture thickness  
 $T_{\max}$  = maximum torque

**DESIGN AND RECOMMENDED<sup>(1)</sup> LOADS****Single anchor with large anchor spacing and edge distances**

Anchor		<b>Ø8</b>	<b>Ø10</b>	<b>Ø12</b>
Minimum support thickness	$h_{\min}$ mm	125	125	125
Minimum hole depth	$h_1$ mm	80	80	80
Nominal embedment depth	$h_{\text{nom}}$ mm	70	70	70
Hole diameter	$d_0$ mm	8	10	12
Concrete C20/C25 <sup>(2)</sup>	Tensile	$N_{rd}$ kN	1,70	1,80
		N kN	1,20	1,30
	Shear	$V_{rd}$ kN	1,70	2,10
		V kN	1,20	1,50
Cell like clay brick <sup>(3)</sup>	Tensile	$N_{rd}$ kN	0,17	0,21
		N kN	0,12	0,15
	Shear	$V_{rd}$ kN	0,21	0,28
		V kN	0,15	0,20
Autoclaved Aerated Concrete AAC EN771-4 $\rho=0,5 \text{ kg/dm}^3$ $f_b \geq 2,5 \text{ MPa}$	Tensile	V kN	0,31	0,31
	Shear	N kN	0,70	0,80
Hollow clay brick double UNI <sup>(3)</sup>	Tensile	$N_{rd}$ kN	0,35	0,50
		N kN	0,25	0,35
	Shear	$V_{rd}$ kN	1,10	1,40
		V kN	0,80	1,00
Spacing <sup>(4)</sup>	S mm	105	105	105
Edge distance <sup>(4)</sup>	C mm	105	105	105
Max torque - white zinc plated screw used on concrete <sup>(5)</sup>	$T_{\max}$ Nm	7	15	25
Max torque - stainless steel screw used on concrete <sup>(5)</sup>	$T_{\max}$ Nm	10	20	-
Recommended bending moment - white zinc plated screw	M Nm	5	8	25
Recommended bending moment - stainless steel screw	M Nm	6	9	-

1kN ≈ 100 kgf

<sup>(1)</sup> The recommended loads derive from the mean ultimate loads and are inclusive of the total safety factor  $\gamma=6$ .

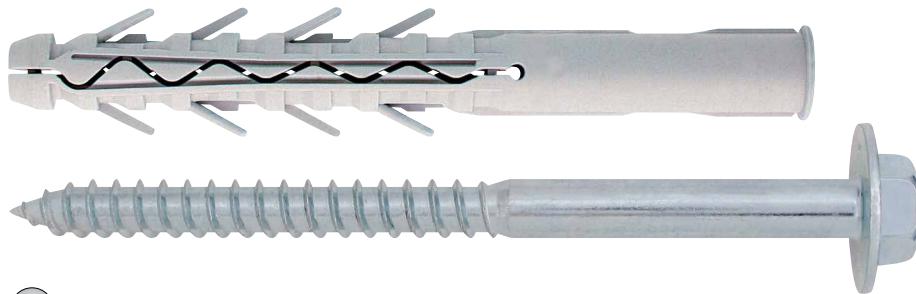
<sup>(2)</sup> Base material without plaster.

<sup>(3)</sup> Base material with plaster thickness around 10-15 mm.

<sup>(4)</sup> In case of broken bricks double the distances of the indicative data.

<sup>(5)</sup> The torque has to be regulated according to the type of installation and base material.

In the absence of CE markings, the recommended loads derive from tests carried out in the Friulside laboratory in accordance with the appropriate standards. The load values are only valid if the installation has been carried out correctly. The design engineer is responsible for the designing and calculation of the fixing.

**EFFECTIVE ANTIROTATION****CONTROLLED EXPANSION****LARGE FIXING THICKNESS**

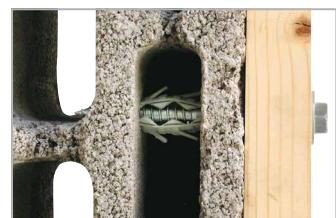
**Hex head screw  
with built-in washer Ø34  
white zinc plated**



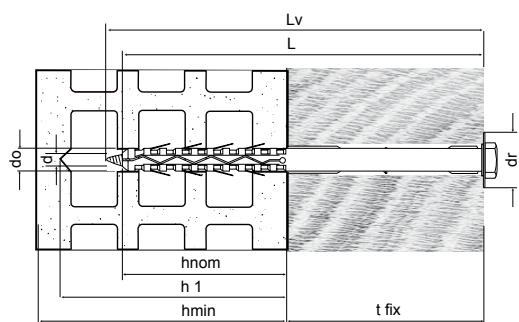
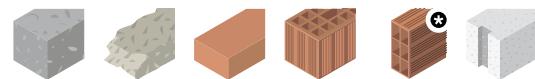
Code	Plug d x L mm	Screw d x Lv mm	tfix mm	dr mm	sw	Pkg.
64001b16140	16x140	12x150	45	34	19	25
64001b16160	16x160	12x170	65	34	19	25
64001b16200	16x200	12x210	105	34	19	25
64001b16240	16x240	12x250	145	34	19	25

**Versions:**

- plug with white zinc plated hex head screw

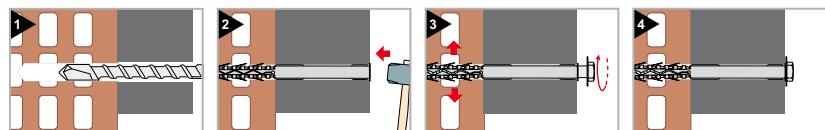
**PRODUCT FEATURES:**

- nylon plug
- special screw with large built-in washer
- large fixing thickness

**BASE MATERIALS:**

$d$  = screw diameter  
 $do$  = hole diameter  
 $dr$  = washer diameter  
 $h1$  = minimum hole depth  
 $hnom$  = nominal embedment depth  
 $hmin$  = minimum support thickness

$l_{nom}$  = nominal embedment depth  
 $L$  = anchor length  
 $l_v$  = screw length  
 $sw$  = wrench  
 $t_{fix}$  = fixture thickness

**DESIGN AND RECOMMENDED<sup>(1)</sup> LOADS****Single anchor with large anchor spacing and edge distances**

			<b>Ø16</b>
<b>Anchor</b>			
Minimum support thickness	$h_{min}$	mm	140
Minimum hole depth	$h_1$	mm	110
Nominal embedment depth	$h_{nom}$	mm	95
Hole diameter	$d_0$	mm	16
Concrete C20/C25 <sup>(2)</sup>			
Tensile			2,50
$N_{rd}$	N	kN	1,80
Shear			3,50
$V_{rd}$	V	kN	2,50
Solid brick <sup>(2)</sup>			
Tensile			2,40
$N_{rd}$	N	kN	1,70
Shear			2,80
$V_{rd}$	V	kN	2,00
Hollow clay brick double UNI <sup>(3)</sup>			
Tensile			0,56
$N_{rd}$	N	kN	0,40
Shear			2,10
$V_{rd}$	V	kN	1,50
<b>Spacing<sup>(4)</sup></b>	S	mm	140
<b>Edge distance<sup>(4)</sup></b>	C	mm	140

1kN ≈ 100 kgf

<sup>(1)</sup> The recommended loads derive from the mean ultimate loads and are inclusive of the total safety factor  $\gamma=6$ .

<sup>(2)</sup> Base material without plaster.

<sup>(3)</sup> Base material with plaster thickness around 10-15 mm.

<sup>(4)</sup> In case of broken bricks double the distances of the indicative data.

NOTE: The torque has to be regulated according to the type of installation and base material.

In the absence of CE markings, the recommended loads derive from tests carried out in the Friulsider laboratory in accordance with the appropriate standards. The load values are only valid if the installation has been carried out correctly. The design engineer is responsible for the designing and calculation of the fixing.

**ALL BASE MATERIALS****ALL SCREWS****EVEN METRIC SCREWS****Plug only**

Code	Plug do x L mm	Per box		Per bag		Outerbox
		Pkg.	Outerbox	Pkg.	Outerbox	
60070005025	5x25	100	3200	1000	10000	15000
60070006030	6x30	100	3200	1000	10000	10000
60070008040	8x40	100	1600	1000	5000	4000
60070010050	10x50	50	800	500	2500	2000
60070012060	12x60	25	400	250	1500	1200
60070014070	14x70	20	160			600

**Chipboard screw  
white zinc plated  
Pozidrive recess**

Code	Plug do x L mm	Screw d x Lv mm	tfix mm	Pkg.		Outer box
				Pkg.	Outer box	
60071b05025	5x25	4x30	1,5	100	3200	
60071b06030	6x30	4,5x40	5	100	1600	
60071b08040	8x40	5x50	5	50	800	
60071b10050	10x50	6x60	5	25	400	

**Wide rounded head chipboard screw  
white zinc plated  
Pozidrive recess**

Code	Plug do x L mm	Screw d x Lv mm	tfix mm	Pkg.		Outer box
				Pkg.	Outer box	
60072b05025	5x25	3,5x30	1,5	100	1200	
60072b06030	6x30	4,5x40	5	100	1200	
60072b08040	8x40	5x50	5	50	600	

**Hex head wood screw  
with built-in washer  
white zinc plated**

Code	Plug do x L mm	Screw d x Lv mm	tfix mm	sw	Pkg.		Outer box
					Pkg.	Outer box	
60073b08040	8x40	6x50	5	10	100	600	
60073b10050	10x50	6x60	5	10	100	400	
60073b12060	12x60	8x70	5	13	50	200	
60073b14070	14x70	10x80	5	17	25	150	

**VERSIONS:**

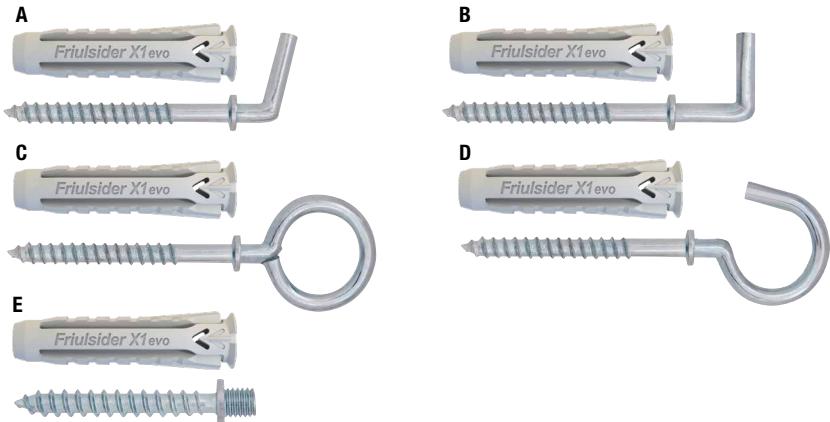
- plug only
- plug with white zinc plated chipboard, wood or metric screw
- plug with white zinc plated accessories

**PRODUCT FEATURES:**

- collapsible rim: through or pre-positioned fixing
- dynamic geometry: ideal for tiled walls
- maxi dynamic anti-rotation wings: differentiated expansion

**BASE MATERIALS:****Hex head metric screw with washer white zinc plated**

Code	Plug do x L mm	Screw d x Lv mm	tfix mm	sw	Washer Ø	Pkg.	Outer box
60074b06030▲	6x30	M4x40	5	7	4,3x9	100	1200
60074b08040▲	8x40	M5x50	5	8	5,3x10	50	600
60074b10050▲	10x50	M6x60	5	10	6,4x12	25	300
60074b12060▲	12x60	M8x70	5	13	8,4x16	25	150
60074b14070▲	14x70	M10x80	5	17	10,5x20	20	120

**White zinc plated accessories**

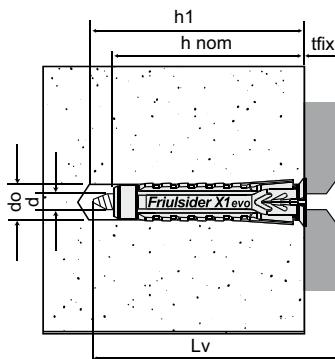
Code	Plug do x L mm	Accessory	Pkg.	Outer box
60076b06030	6x30	A - Short hook	100	1200
60077b06030	6x30	B - Medium hook	100	1200
60078b06030	6x30	C - Eye	100	600
60079b06030	6x30	D - Cup hook	100	600
60091b06030	6x30	E-Double threaded screw M6	100	1000
60076b08040	8x40	A - Short hook	25	300
60079b08040	8x40	D - Cup hook	25	300

**VERSIONS:**

- plug only
- plug with white zinc plated chipboard, wood or metric screw
- plug with white zinc plated accessories

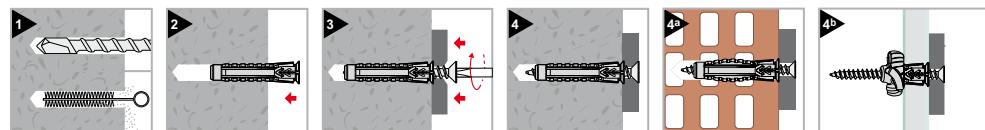
**PRODUCT FEATURES:**

- collapsible rim: through or pre-positioned fixing
- dynamic geometry: ideal for tiled walls
- maxi dynamic anti-rotation wings: differentiated expansion

**BASE MATERIALS:**

$d$  = screw diameter  
 $do$  = hole diameter  
 $h1$  = minimum hole depth  
 $h_{nom}$  = nominal embedment depth

$L$  = anchor length  
 $Lv$  = screw length  
 $tfix$  = fixture thickness

**DESIGN AND RECOMMENDED<sup>(1)</sup> LOADS**

## Single anchor with large anchor spacing and edge distances

Anchor	Ø5x25				Ø6x30				Ø8x40				Ø10x50				Ø12x60				Ø14x70											
Minimum hole depth $h_1$ mm	35				40				50				60				70				80											
Nominal emb. depth $h_{nom}$ mm	25				30				40				50				60				70											
Hole diameter $d_0$ mm	5				6				8				10				12				14											
Diameter and type of screw	$d$ mm	Chip.	Chip.	Chip.	Wood	Chip.	Chip.	Chip.	Wood	Wood	Wood	Metr.	Chip.	Chip.	Wood	Wood	Wood	Metr.	Chip.	Wood	Wood	Metr.	Wood	Wood	Metr.							
Concrete C20/C25 <sup>(2)</sup>	Tensile	$N_{rd}$ kN	0.14	0.20	0.32	0.33	0.12	0.22	0.35	0.21	0.46	0.17	0.26	0.49	0.73	0.56	0.84	0.35	0.70	1.65	0.87	1.74	1.70	0.72	1.14	2.00	0.95					
	Shear	$N$ kN	0.10	0.14	0.23	0.24	0.09	0.16	0.25	0.15	0.33	0.12	0.19	0.35	0.52	0.40	0.60	0.25	0.50	1.18	0.62	1.24	1.20	0.52	0.82	1.48	0.68					
Solid brick <sup>(2)</sup> EN771-1 fb ≥ 43MPa	Tensile	$N_{rd}$ kN	0.21	0.35	0.45	0.56	0.25	0.32	0.63	0.32	0.70	0.32	0.35	0.70	1.05	0.70	1.12	0.42	1.00	1.54	1.05	1.54	1.96	0.84	1.54	2.80	1.54					
	Shear	$V_{rd}$ kN	0.15	0.25	0.30	0.40	0.18	0.23	0.45	0.23	0.50	0.23	0.25	0.50	0.75	0.50	0.80	0.30	0.70	1.10	0.75	1.10	1.40	0.60	1.10	2.00	1.10					
	Tensile	$N_{rd}$ kN	0.18	0.22	0.35	0.42	0.15	0.25	0.42	0.27	0.45	0.21	0.21	0.36	0.78	0.59	1.00	0.49	0.84	1.75	1.12	1.75	2.24	1.00	0.86	1.26	2.24	1.28				
	Shear	$V_{rd}$ kN	0.13	0.16	0.25	0.30	0.11	0.18	0.30	0.19	0.32	0.15	0.15	0.26	0.56	0.42	0.70	0.35	0.60	1.25	0.80	1.25	1.60	0.70	0.62	0.90	1.60	0.92				
Solid brick <sup>(2)</sup> EN771-1 fb ≥ 43MPa	Tensile	$N$ kN	0.13	0.16	0.25	0.30	0.11	0.18	0.30	0.19	0.32	0.15	0.15	0.26	0.56	0.42	0.70	0.35	0.60	1.25	0.80	1.25	1.60	0.70	0.62	0.90	1.60	0.92				
	Shear	$V$ kN	0.15	0.20	0.30	0.40	0.18	0.23	0.45	0.23	0.50	0.23	0.20	0.35	0.75	0.50	0.90	0.40	0.80	1.10	0.75	1.10	1.40	0.80	1.10	2.00	1.10	1.40				
Cell like clay brick <sup>(3)</sup> EN771-1 fb ≥ 8MPa	Tensile	$N_{rd}$ kN	0.10	0.11	0.15	0.22	0.11	0.17	0.21	0.18	0.25	0.15	0.21	0.29	0.39	0.38	0.56	0.30	0.36	0.70	0.50	0.77	0.85	0.49	0.63	0.64	1.12	0.70	0.72	1.54	0.84	
	Shear	$V_{rd}$ kN	0.07	0.08	0.11	0.16	0.08	0.12	0.15	0.13	0.18	0.11	0.15	0.21	0.28	0.27	0.40	0.21	0.26	0.50	0.36	0.55	0.61	0.35	0.45	0.46	0.80	0.50	0.52	1.10	0.60	
	Tensile	$N$ kN	0.21	0.28	0.42	0.56	0.25	0.32	0.63	0.32	0.70	0.32	0.28	0.49	1.05	0.70	1.26	0.56	1.12	1.54	1.05	1.54	1.96	0.84	1.54	2.80	1.54	1.96	4.20	1.96		
	Shear	$V$ kN	0.15	0.20	0.30	0.40	0.18	0.23	0.45	0.23	0.50	0.23	0.20	0.35	0.75	0.50	0.90	0.40	0.80	1.10	1.00	1.10	1.40	0.80	1.10	2.00	1.10	1.40	3.00	1.40		
Hollow clay brick double UNI <sup>(3)</sup> EN771-1 fb ≥ 28MPa	Tensile	$N_{rd}$ kN	0.15	0.20	0.22	0.29	0.12	0.17	0.25	0.19	0.33	0.15	0.21	0.29	0.42	0.38	0.56	0.35	0.39	0.72	0.59	0.79	0.88	0.52	0.49	0.56	0.82	0.58	0.70	1.05	0.78	
	Shear	$V_{rd}$ kN	0.11	0.14	0.16	0.21	0.09	0.12	0.18	0.14	0.24	0.11	0.15	0.21	0.30	0.27	0.40	0.25	0.28	0.51	0.42	0.56	0.63	0.37	0.35	0.40	0.59	0.42	0.50	0.75	0.56	
	Tensile	$N$ kN	0.15	0.22	0.28	0.39	0.18	0.31	0.42	0.28	0.56	0.28	0.28	0.35	0.48	0.45	0.67	0.42	0.50	0.81	0.70	0.88	1.08	0.61	0.63	0.84	0.98	0.84	0.97	1.96	0.98	
	Shear	$V$ kN	0.15	0.16	0.20	0.28	0.13	0.22	0.30	0.20	0.40	0.20	0.20	0.25	0.34	0.32	0.48	0.30	0.36	0.58	0.50	0.63	0.77	0.44	0.45	0.60	0.70	0.60	0.70	1.40	0.70	
Plasterboard 12,5 mm	Tensile	$N_{rd}$ kN	0.06	0.06	0.06	0.06	0.07	0.07	0.07	0.07	0.07	0.11	0.11	0.11	0.11	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.15	0.15	0.15	0.15	0.15	0.15	
	Shear	$V_{rd}$ kN	0.07	0.07	0.07	0.08	0.07	0.07	0.07	0.07	0.07	0.06	0.10	0.10	0.10	0.10	0.14	0.14	0.14	0.14	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.18	0.18	0.18
Autoclaved Aerated Concrete AAC EN 771-4 p=0,5 kg/dm <sup>3</sup> fb≥2,5 MPa <sup>(2)</sup>	Tensile	$N_{rd}$ kN	0.07	0.08	0.11	0.12	0.07	0.08	0.12	0.11	0.14	0.12	0.15	0.21	0.26	0.24	0.26	0.25	0.35	0.42	0.35	0.42	0.42	0.39	0.43	0.49	0.60	0.53	0.44	0.61	0.61	
	Shear	$V_{rd}$ kN	0.11	0.14	0.14	0.17	0.11	0.14	0.17	0.14	0.18	0.17	0.18	0.28	0.31	0.28	0.32	0.31	0.42	0.49	0.42	0.49	0.49	0.45	0.70	0.70	0.70	0.70	0.70	0.84	0.84	
Edge distance <sup>(4)</sup>	C mm	45				55				70				90				110				130										
Spacing <sup>(4)</sup>	S mm	40				55				60				75				90				110										

1kN ≈ 100 kgf

(1) The recommended loads derive from the mean ultimate loads and are inclusive of the total safety factor  $\gamma=6$ .

(2) Base material without plaster.

(3) Base material with plaster thickness around 10 - 15 mm.

(4) In case of broken bricks double the distances of the indicative data.

NOTE: The torque has to be regulated according to the type of installation and base material.

In the absence of CE markings, the recommended loads derive from tests carried out in the Friulside laboratory in accordance with the appropriate standards. The load values are only valid if the installation has been carried out correctly. The design engineer is responsible for the designing and calculation of the fixing.



### TYPICAL APPLICATIONS PER DIAMETER

## DESIGN AND RECOMMENDED<sup>(1)</sup> LOADS

Single anchor with large anchor spacing and edge distances

Anchor	d	mm	Ø6x30					Ø8x40		
			A Short hook	B Medium hook	C Eye	D Cup hook	E** Double threaded screw	A Short hook	D Cup hook	
Minimum hole depth	h <sub>1</sub>	mm			40			50		
Nominal emb. depth	h <sub>nom</sub>	mm			30			40		
Hole diameter	d <sub>0</sub>	mm			6			8		
Diameter and type of accessory	d	mm	A Short hook	B Medium hook	C Eye	D Cup hook	E** Double threaded screw	A Short hook	D Cup hook	
Concrete C20/C25 <sup>(2)</sup>	Tensile	N <sub>rd</sub>	kN	-	-	0,14	0,08*	0,21	-	0,19*
		N	kN	-	-	0,10	0,06*	0,15	-	0,14*
	Shear	V <sub>rd</sub>	kN	0,16	0,14*	-	-	0,32	0,32	-
		V	kN	0,12	0,10*	-	-	0,23	0,23	-
Solid brick <sup>(2)</sup> EN771-1 fb ≥ 43MPa	Tensile	N <sub>rd</sub>	kN	-	-	0,14	0,08*	0,27	-	0,19*
		N	kN	-	-	0,10	0,06*	0,19	-	0,14*
	Shear	V <sub>rd</sub>	kN	0,16	0,14*	-	-	0,32	0,32	-
		V	kN	0,12	0,10*	-	-	0,23	0,23	-
Cell like clay brick <sup>(3)</sup> EN771-1 fb ≥ 8MPa	Tensile	N <sub>rd</sub>	kN	-	-	0,14	0,08*	0,18	-	0,19*
		N	kN	-	-	0,10	0,06*	0,13	-	0,14*
	Shear	V <sub>rd</sub>	kN	0,14	0,14*	-	-	0,28	0,22	-
		V	kN	0,10	0,10*	-	-	0,20	0,16	-
Hollow clay brick double UNI <sup>(3)</sup> EN771-1 fb ≥ 28MPa	Tensile	N <sub>rd</sub>	kN	-	-	0,14	0,08*	0,18	-	0,19*
		N	kN	-	-	0,10	0,06*	0,13	-	0,14*
	Shear	V <sub>rd</sub>	kN	0,14	0,14*	-	-	0,28	0,22	-
		V	kN	0,10	0,10*	-	-	0,20	0,16	-
Plasterboard 12,5 mm	Tensile	N <sub>rd</sub>	kN	-	-	0,08	0,08*	0,08	-	0,11
		N	kN	-	-	0,06	0,06*	0,06	-	0,08
	Shear	V <sub>rd</sub>	kN	0,08	0,08	-	-	0,09	0,11	-
		V	kN	0,06	0,06	-	-	0,07	0,08	-
Autoclaved Aerated Concrete AAC EN 771-4 p=0,5 kg/dm <sup>3</sup> fb≥2,5 MPa <sup>(2)</sup>	Tensile	N <sub>rd</sub>	kN	-	-	0,08	0,08*	0,11	-	0,15
		N	kN	-	-	0,06	0,06*	0,08	-	0,11
	Shear	V <sub>rd</sub>	kN	0,08	0,08	-	-	0,14	0,15	-
		V	kN	0,06	0,06	-	-	0,10	0,11	-
Edge distance <sup>(4)</sup>	C	mm			55			70		
Spacing <sup>(4)</sup>	S	mm			55			60		

1kN ≈ 100 kgf

<sup>(1)</sup> The recommended loads derive from the mean ultimate loads and are inclusive of the total safety factor γ=6.

<sup>(2)</sup> Base material without plaster.

<sup>(3)</sup> Base material with plaster thickness around 10 - 15 mm.

<sup>(4)</sup> In case of broken bricks double the distances of the indicative data.

\* Deformation of accessory

\*\* The values refer to the tension loads of the plug on the base material, they do not refer to the loading values on the M6 threaded part of the screw.

NOTE: The torque has to be regulated according to the type of installation and base material. In the absence of CE markings, the recommended loads derive from tests carried out in the Friulside laboratory in accordance with the appropriate standards. The load values are only valid if the installation has been carried out correctly. The design engineer is responsible for the designing and calculation of the fixing.

# X1 evo-L

Four segments universal nylon plug - increased length

**GREATER ANCHORING DEPTH**

**ALL BASE MATERIALS**

**ALL SCREWS**



## Plug only

Code	Plug do x L mm	Pkg.	Outerbox
60070006050	6x50	200	1600
60070008060	8x60	100	800
60070010070	10x70	50	400

**Chipboard screw  
white zinc plated  
Pozidrive recess**



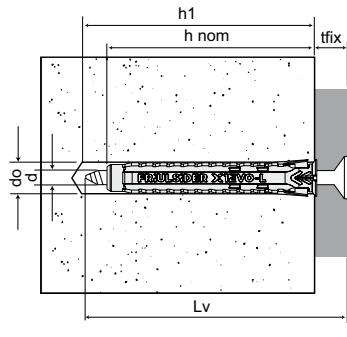
Code	Plug do x L mm	Screw d x Lv	tfix mm	Pkg.	Outerbox
60071b06050	6x50	4,5x60	5	100	800
60071b08060	8x60	5x70	5	50	400
60071b10070	10x70	6x80	5	25	200

**VERSIONS:**

- plug only
- plug with white zinc plated countersunk screw

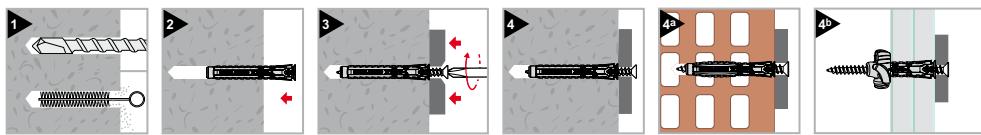
**PRODUCT FEATURES:**

- increased length:  
knot guaranteed even on double plasterboard panels

**BASE MATERIALS:**

$d$  = screw diameter  
 $d_0$  = hole diameter  
 $h1$  = minimum hole depth  
 $h_{nom}$  = nominal embedment depth

$L$  = anchor length  
 $L_v$  = screw length  
 $t_{fix}$  = fixture thickness

**DESIGN AND RECOMMENDED<sup>(1)</sup> LOADS****Single anchor with large anchor spacing and edge distances**

Anchor		Ø6x50						Ø8x60						Ø10x70					
Minimum hole depth $h_1$ mm	Nominal emb. depth $h_{nom}$ mm	60			70			80			70			10					
Hole diameter $d_0$ mm	6																		
Diameter and type of screw	$d$ mm	Chip. Ø4	Chip. Ø4,5	Chip. Ø5	Wood Ø4	Wood Ø5	Metr. M4	Chip. Ø4,5	Chip. Ø5	Chip. Ø6	Wood Ø5	Wood Ø6	Metr. M5	Chip. Ø6	Chip. Ø8	Wood Ø6	Wood Ø7	Wood Ø8	Metr. M6
Concrete C20/C25 <sup>(2)</sup>	Tensile N KN	0,28	0,56	0,81	0,63	1,19	0,35	0,39	0,63	1,12	1,40	1,48	0,84	1,06	2,10	1,40	2,52	2,24	0,70
	N KN	0,20	0,40	0,58	0,45	0,85	0,25	0,28	0,45	0,80	1,00	1,06	0,60	0,76	1,50	1,00	1,80	1,60	0,50
Solid brick <sup>(2)</sup> EN771-1 fb ≥ 43MPa	Shear V KN	0,35	0,59	0,91	0,56	1,19	0,49	0,49	0,85	1,47	1,47	1,68	0,98	1,40	2,15	1,61	2,15	2,57	0,84
	V KN	0,25	0,42	0,65	0,40	0,85	0,35	0,35	0,61	1,05	1,05	1,20	0,70	1,00	1,54	1,15	1,54	1,84	0,60
Cell like clay brick <sup>(3)</sup> EN771-1 fb ≥ 8MPa	Tensile N KN	0,29	0,45	0,63	0,57	1,15	0,32	0,35	0,59	0,98	1,12	1,40	0,75	0,98	2,10	1,54	2,24	2,38	1,12
	N KN	0,21	0,32	0,45	0,41	0,82	0,23	0,25	0,42	0,70	0,80	1,00	0,54	0,70	1,50	1,10	1,60	1,70	0,80
Hollow clay brick double UNI <sup>(3)</sup> EN771-1 fb ≥ 28MPa	Shear V KN	0,35	0,49	0,88	0,49	1,15	0,49	0,42	0,70	1,29	1,37	1,76	0,86	1,37	2,15	1,82	2,15	2,66	1,47
	V KN	0,25	0,35	0,63	0,35	0,82	0,35	0,30	0,50	0,92	0,98	1,26	0,62	0,98	1,54	1,30	1,54	1,90	1,05
Plasterboard 12,5 mm	Tensile N KN	0,17	0,22	0,33	0,31	0,56	0,21	0,25	0,32	0,42	0,56	0,63	0,33	0,42	0,75	0,53	0,84	0,92	0,50
	N KN	0,12	0,16	0,24	0,22	0,40	0,15	0,18	0,23	0,30	0,40	0,45	0,24	0,30	0,54	0,38	0,60	0,66	0,36
Double plasterboard 12,5 mm x 2	Shear V KN	0,24	0,31	0,50	0,39	0,67	0,32	0,33	0,39	0,50	0,63	0,70	0,40	0,50	0,84	0,61	0,98	1,12	0,59
	V KN	0,17	0,22	0,36	0,28	0,48	0,23	0,21	0,28	0,36	0,45	0,50	0,29	0,36	0,60	0,44	0,70	0,80	0,42
Autoclaved Aerated Concrete AAC EN 771-4 ρ=0,5 kg/dm³ fb≥2,5 MPa <sup>(2)</sup>	Tensile N KN	0,19	0,25	0,31	0,22	0,28	0,15	0,18	0,18	0,22	0,22	0,22	0,19	0,24	0,24	0,24	0,24	0,24	0,19
	N KN	0,14	0,18	0,18	0,18	0,18	0,18	0,28	0,28	0,32	0,32	0,32	0,29	0,35	0,35	0,35	0,35	0,35	0,32
Edge distance <sup>(4)</sup>	C mm	85			110			120											
	S mm	85			100			110											

1kN ≈ 100 kgf

(1) The recommended loads derive from the mean ultimate loads and are inclusive of the total safety factor  $\gamma=6$ .

(2) Base material without plaster.

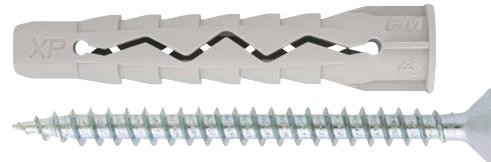
(3) Base material with plaster thickness around 10 - 15 mm.

(4) In case of broken bricks double the distances of the indicative data.

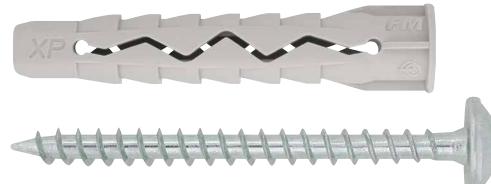
NOTE: The torque has to be regulated according to the type of installation and base material. In the absence of CE markings, the recommended loads derive from tests carried out in the Friulside laboratory in accordance with the appropriate standards. The load values are only valid if the installation has been carried out correctly. The design engineer is responsible for the designing and calculation of the fixing.

**IDEAL FOR ALL BASE MATERIALS****CONTROLLED EXPANSION****KNOT GUARANTEED EVEN ON DOUBLE PLASTERBOARD PANELS****Plug only**

Code	Plug do x L mm	Per box		Per bag		Bulk Outerbox
		Pkg.	Outerbox	Pkg.	Outerbox	
66000006033	6x33	200	2000	1000	10000	10000
66000006045	6x45	200	-	1000	5000	10000
66000008052	8x52	100	-	500	3500	4000
6600010065	10x65	50	-	250	2500	1000

**Chipboard screw  
white zinc plated  
Pozidrive recess**

Code	Plug do x L mm	Screw d x Lv mm	tfix mm	Pkg.		Outer box
				Pkg.	Outer box	
66001006033	6x33	4,5x45	5	100	1000	
66001006045	6x45	4,5x55	5	100	-	
66001008052	8x52	5x60	5	100	-	
66001010065	10x65	6x75	5	50	-	

**Wide rounded head chipboard screw  
white zinc plated  
Pozidrive recess**

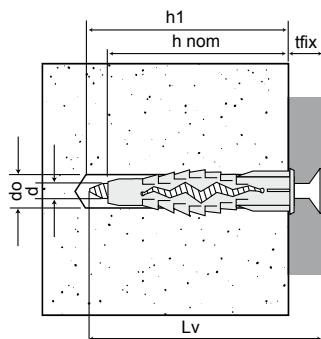
Code	Plug do x L mm	Screw d x Lv mm	tfix mm	Pkg.	
				Pkg.	Outer box
66003006033	6x33	4,5x45	5	100	
66003006045	6x45	4,5x55	5	100	
66003008052	8x52	5x60	5	50	

**Versions:**

- plug only
- plug with Pozidrive chipboard screw
- plug with Pozidrive wide rounded head chipboard screw

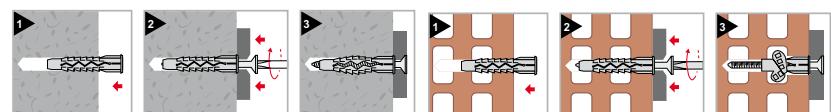
**PRODUCT FEATURES:**

- nylon plug
- white zinc plated screw
- Ø6 available in two different lengths

**BASE MATERIALS:**

$d$  = screw diameter  
 $d_0$  = hole diameter  
 $h_1$  = minimum hole depth  
 $h_{\text{nom}}$  = nominal embedment depth

$L$  = anchor length  
 $L_v$  = screw length  
 $t_{\text{fix}}$  = fixture thickness

**DESIGN AND RECOMMENDED<sup>(1)</sup> LOADS****Single anchor with large anchor spacing and edge distances**

Anchor	d	Ø6x33				Ø6x45				Ø8x52				Ø10x65								
		Chip. 04	Chip. 04,5	Chip. 05	Wood 05	Chip. 04	Chip. 04,5	Chip. 05	Wood 05	Chip. 04,5	Chip. 05	Chip. 06	Wood 05	Wood 06	Chip. 05	Chip. 06	Wood 05	Wood 06	Wood 07	Wood 08		
Concrete C20/C25 <sup>(2)</sup>	Tensile	N <sub>rd</sub>	kN	0,21	0,35	0,63	1,33	0,28	0,42	0,84	1,33	0,24	0,42	0,87	1,26	1,40	0,28	0,60	1,04	1,34	2,35	2,86
	Shear	N	kN	0,15	0,25	0,45	0,95	0,20	0,30	0,60	0,95	0,17	0,30	0,62	0,90	1,00	0,20	0,43	0,74	0,96	1,68	2,04
	Tensile	V <sub>rd</sub>	kN	0,50	0,64	0,70	1,05	0,50	0,64	0,70	1,05	0,64	0,70	1,26	1,26	1,40	0,70	1,64	1,26	1,93	2,44	3,33
	Shear	V	kN	0,36	0,46	0,50	0,75	0,36	0,46	0,50	0,75	0,46	0,50	0,90	0,90	1,00	0,50	1,17	0,90	1,38	1,74	2,38
Solid brick <sup>(2)</sup>	Tensile	N <sub>rd</sub>	kN	0,21	0,35	0,56	1,12	0,25	0,39	0,77	1,26	0,21	0,39	0,84	1,19	1,26	0,31	0,64	1,08	1,82	(*)	(*)
	Shear	N	kN	0,15	0,25	0,40	0,80	0,18	0,28	0,55	0,90	0,15	0,28	0,60	0,85	0,90	0,22	0,46	0,77	1,30	(*)	(*)
	Tensile	V <sub>rd</sub>	kN	0,49	0,63	0,70	0,70	0,49	0,63	0,70	0,98	0,63	0,70	1,19	1,19	1,26	0,70	1,64	1,26	1,93	(*)	(*)
	Shear	V	kN	0,35	0,45	0,50	0,50	0,35	0,45	0,50	0,70	0,45	0,50	0,85	0,85	0,90	0,50	1,17	0,90	1,38	(*)	(*)
Cell like clay brick <sup>(3)</sup>	Tensile	N <sub>rd</sub>	kN	0,11	0,17	0,21	0,34	0,25	0,27	0,35	0,39	0,21	0,39	0,42	0,45	0,50	0,13	0,22	0,32	0,34	0,36	0,39
	Shear	N	kN	0,08	0,12	0,15	0,24	0,18	0,19	0,25	0,28	0,15	0,28	0,30	0,32	0,36	0,09	0,16	0,23	0,24	0,26	0,28
	Tensile	V <sub>rd</sub>	kN	0,49	0,49	0,49	0,49	0,49	0,49	0,49	0,49	0,49	0,49	0,49	0,56	0,56	0,48	0,63	0,66	0,69	0,80	0,80
	Shear	V	kN	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,40	0,40	0,34	0,45	0,47	0,49	0,57	0,63
Hollow clay brick double UNI <sup>(3)</sup>	Tensile	N <sub>rd</sub>	kN	0,14	0,25	0,42	0,63	0,21	0,35	0,59	0,70	0,27	0,38	0,55	0,84	0,84	0,18	0,25	0,36	0,42	0,84	0,98
	Shear	N	kN	0,10	0,18	0,30	0,45	0,15	0,25	0,42	0,50	0,19	0,27	0,39	0,60	0,60	0,13	0,18	0,26	0,30	0,58	0,70
	Tensile	V <sub>rd</sub>	kN	0,42	0,42	0,42	0,56	0,42	0,49	0,63	0,98	0,53	0,53	0,98	1,05	1,09	0,64	0,95	0,77	1,11	1,43	1,76
	Shear	V	kN	0,30	0,30	0,30	0,40	0,30	0,35	0,45	0,70	0,38	0,38	0,70	0,75	0,78	0,46	0,68	0,55	0,79	1,02	1,26
Plasterboard 12,5 mm	Tensile	N <sub>rd</sub>	kN	0,07	0,07	0,07	0,08	0,07	0,08	0,10	0,10	0,08	0,10	0,14	0,14	0,14	0,13	0,14	0,14	0,14	0,14	0,14
	Shear	N	kN	0,05	0,05	0,05	0,06	0,05	0,06	0,07	0,07	0,06	0,07	0,10	0,10	0,10	0,09	0,10	0,10	0,10	0,10	0,10
	Tensile	V <sub>rd</sub>	kN	0,17	0,21	0,21	0,21	0,17	0,21	0,21	0,21	0,28	0,28	0,28	0,28	0,28	0,28	0,32	0,32	0,32	0,32	0,32
	Shear	V	kN	0,12	0,15	0,15	0,15	0,12	0,15	0,15	0,15	0,20	0,20	0,20	0,20	0,20	0,20	0,23	0,23	0,23	0,23	0,23
<b>Edge distance<sup>(4)</sup></b>	C	mm	50			60			80								100					
<b>Spacing<sup>(4)</sup></b>	S	mm	50			60			70								90					

1kN ≈ 100 kgf

(1) The recommended loads derive from the mean ultimate loads and are inclusive of the total safety factor  $\gamma=6$ .

(2) Base material without plaster.

(3) Base material with plaster thickness around 10 - 15 mm.

(4) In case of broken bricks double the distances of the indicative data.

\* Unsuitable application due to low consistency of the base material.

NOTE: The torque has to be regulated according to the type of installation, the base material and the characteristics of the screw. In the absence of CE markings, the recommended loads derive from tests carried out in the Friulside laboratory in accordance with the appropriate standards. The load values are only valid if the installation has been carried out correctly. The design engineer is responsible for the designing and calculation of the fixing.

**PRACTICAL AND FAST TO INSTALL****ANTIROTATION ENSURED  
BY THE 4 SIDE LUGS****UNDERCUT EXPANSION  
WITH KNOT FORMATION****Plug only**

Code	Plug do x L mm	Per box			Outer box	Bulk Outer box
		Pkg.	Outer box			
65000006033	6x33	100	1000			7000
65000006046	6x46	100	1000			4000
65000008051	8x51	100	1000			2500
65000010066	10x66	100	1000			1200
65000012072	12x72	50	500			800

**Chipboard screw  
white zinc plated  
Pozidrive recess**

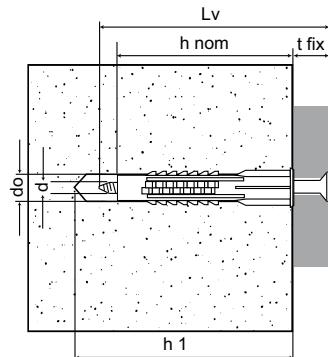
Code	Plug do x L mm	Screw d x Lv mm	tfix mm	Pkg.	Outer box
65002006033	6x33	4x40	5	100	1000
65002006046	6x46	4x55	5	100	1000
65002008051	8x51	5x60	5	100	1000
65002010066	10x66	6x75	5	100	1000
65002012072	12x72	8x90	5	50	500

**Versions:**

- plug only
- plug with Pozidrive chipboard screw

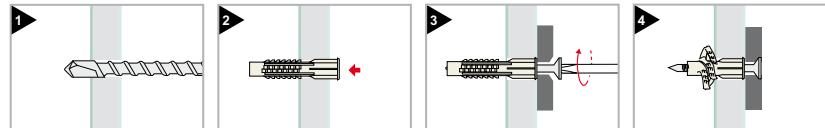
**Product Features:**

- polypropylene plug
- white zinc plated screw
- Ø6 available in two different lengths

**BASE MATERIALS:**

$d$  = screw diameter  
 $do$  = hole diameter  
 $h1$  = minimum hole depth  
 $h_{\text{min}}$  = minimum support thickness

$h_{\text{nom}}$  = nominal embedment depth  
 $L$  = anchor length  
 $Lv$  = screw length  
 $t_{\text{fix}}$  = fixture thickness

**DESIGN AND RECOMMENDED<sup>(1)</sup> LOADS****Single anchor with large anchor spacing and edge distances**

Anchor		Ø6x33	Ø6x46	Ø8x51	Ø10x66	Ø12x72
Minimum hole depth	$h_1$ mm	45	60	65	75	90
Nominal embedment depth	$h_{\text{nom}}$ mm	32	45	50	65	70
Hole diameter	$d_0$ mm	6	6	8	10	12
Diameter of chipboard screw	$d$ mm	Ø4	Ø4	Ø5	Ø6	Ø8
Concrete C20/C25 <sup>(2)</sup>	Tensile	$N_{rd}$ kN	0,07	0,11	0,14	0,17
		N kN	0,05	0,08	0,10	0,12
	Shear	$V_{rd}$ kN	0,22	0,28	0,35	0,63
		V kN	0,16	0,20	0,25	0,45
Cell like clay brick <sup>(3)</sup>	Tensile	$N_{rd}$ kN	0,06	0,10	0,20	0,21
		N kN	0,04	0,07	0,14	0,15
	Shear	$V_{rd}$ kN	0,11	0,20	0,25	0,35
		V kN	0,08	0,14	0,18	0,25
Hollow clay brick double UNI <sup>(3)</sup>	Tensile	$N_{rd}$ kN	0,04	0,07	0,14	0,17
		N kN	0,03	0,05	0,10	0,12
	Shear	$V_{rd}$ kN	0,20	0,25	0,32	0,49
		V kN	0,14	0,18	0,23	0,35
Plasterboard 12,5 mm	Tensile	$N_{rd}$ kN	0,06	0,07	0,08	0,11
		N kN	0,04	0,05	0,06	0,08
	Shear	$V_{rd}$ kN	0,07	0,08	0,14	0,17
		V kN	0,05	0,06	0,10	0,12
Edge distance <sup>(4)</sup>	C mm	45	65	70	90	100
Spacing <sup>(4)</sup>	S mm	45	65	70	90	100

1kN ≈ 100 kgf

<sup>(1)</sup> The recommended loads derive from the mean ultimate loads and are inclusive of the total safety factor  $\gamma=6$ .

<sup>(2)</sup> Base material without plaster.

<sup>(3)</sup> Base material with plaster thickness around 10-15 mm.

<sup>(4)</sup> In case of broken bricks double the distances of the indicative data.

NOTE: The torque has to be regulated according to the type of installation and base material. In the absence of CE markings, the recommended loads derive from tests carried out in the Friulside laboratory in accordance with the appropriate standards. The load values are only valid if the installation has been carried out correctly. The design engineer is responsible for the designing and calculation of the fixing.

**SUITABLE FOR MOST  
LIGHT FIXING APPLICATIONS**

**ANTI-ROTATION WINGS**

**MAXIMUM EXPANSION**



**Rimmed plug**

Code	Plug do x L mm	Per box		Per bag		Outer box
		Pkg.	Outerbox	Pkg.	Outerbox	
60001004020 <sup>(1)</sup>	4x20	300	9600	1000	20000	30000
60001005025	5x25	100	3200	1000	20000	15000
60001006030	6x30	100	3200	1000	10000	10000
60001007035 <sup>(1)</sup>	7x35	150	2400			7000
60001008040	8x40	100	1600	1000	5000	4000
60001010050	10x50	50	800	500	2500	2000
60001010060	10x60	25	400			1800
60001012060 <sup>(1)</sup>	12x60	25	400	250	1500	1200
60001014080 <sup>(1)</sup>	14x80	20	160			600
60001016080 <sup>(1)</sup>	16x80	15	120			500

<sup>(1)</sup> Previous version geometry. More information available on the technical data sheet



**Rimless plug**

Code	Plug do x L mm	Per box		Per bag		Outer box
		Pkg.	Outerbox	Pkg.	Outerbox	
60101004020 <sup>(1)</sup>	4x20	300	9600	1000	20000	30000
60101005025	5x25	100	3200	1000	20000	15000
60101006030	6x30	100	3200	1000	10000	10000
60101007035 <sup>(1)</sup>	7x35	150	2400			7000
60101008040	8x40	100	1600	1000	5000	4000
60101010050	10x50	50	800	500	2500	2000
60101010060	10x60	25	400			1800
60101012060 <sup>(1)</sup>	12x60	25	400	250	1500	1200
60101014080 <sup>(1)</sup>	14x80	20	160			600
60101016080 <sup>(1)</sup>	16x80	15	120			500

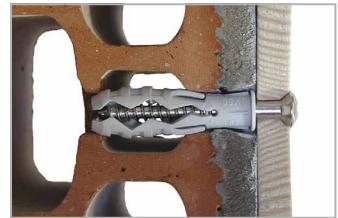
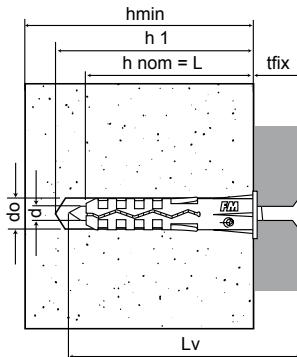
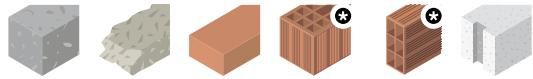
<sup>(1)</sup> Previous version geometry. More information available on the technical data sheet

**Versions:**

- rimmed plug
- rimless plug

**PRODUCT FEATURES:**

- nylon plug
- Ø10 available in two different lengths

**BASE MATERIALS:**

$d$  = screw diameter  
 $do$  = hole diameter  
 $h_1$  = minimum hole depth  
 $h_{\min}$  = minimum support thickness

$h_{\text{nom}}$  = nominal embedment depth  
 $L$  = anchor length  
 $L_v$  = screw length  
 $t_{\text{fix}}$  = fixture thickness

**DESIGN AND RECOMMENDED<sup>(1)</sup> LOADS****Single anchor with large anchor spacing and edge distances**

Anchor	Ø5x25			Ø6x30			Ø7x35			Ø8x40			Ø10x50			Ø12x60		
<b>Minimum support thickness</b>	$h_{\min}$	mm	50			60			80			80			100		120	
<b>Minimum hole depth</b>	$h_1$	mm	35			40			45			55			65		75	
<b>Nominal embedment depth</b>	$h_{\text{nom}}$	mm	25			30			35			40			50		60	
<b>Hole diameter</b>	$d_0$	mm	5			6			7			8			10		12	
<b>Diameter of chipboard screw<sup>(2)</sup></b>	$d$	mm	Ø3,5	Ø4	Ø4	Ø4,5	Ø5	Ø5	Ø6	Ø5	Ø6	Ø6	Ø6	Ø8	Ø8	Ø8		
<b>Concrete C20/C25</b>	Tensile	$N_{rd}$	kN	0,25	0,39	0,35	0,49	0,63	0,42	0,84	0,70	0,98	0,70	1,82	1,40			
	Shear	$V_{rd}$	kN	0,42	0,56	0,56	0,76	1,01	0,70	1,05	0,91	1,48	1,29	1,54	1,54			
<b>Solid brick</b>	Tensile	$N_{rd}$	kN	0,25	0,35	0,35	0,49	0,63	0,51	0,77	0,63	0,84	0,70	1,68	1,01			
	Shear	$V_{rd}$	kN	0,28	0,42	0,45	0,56	0,84	0,63	0,84	0,98	1,26	1,26	1,54	1,54			
<b>Autoclaved Aerated Concrete AAC EN 771-4 <math>\rho=0,5 \text{ kg/dm}^3</math> <math>fb \geq 2,5 \text{ MPa}</math></b>	Tensile	$N_{rd}$	kN	0,11	0,14	0,17	0,20	0,20	0,14	0,18	0,22	0,25	0,27	0,42	0,42			
	Shear	$V_{rd}$	kN	0,17	0,17	0,22	0,22	0,25	0,18	0,22	0,31	0,42	0,49	0,70	0,70			
<b>Hollow clay brick double UNI<sup>(3)</sup></b>	Tensile	$N_{rd}$	kN	0,17	0,22	0,28	0,39	0,56	0,39	0,56	0,42	0,56	0,48	0,84	0,98			
	Shear	$V_{rd}$	kN	0,21	0,28	0,42	0,49	0,70	0,49	0,63	0,56	0,70	0,70	0,84	0,84			
<b>Cell like clay brick<sup>(3)</sup></b>	Tensile	$N_{rd}$	kN	0,11	0,20	0,21	0,24	0,28	0,28	0,39	0,31	0,36	0,42	0,56	0,63			
	Shear	$V_{rd}$	kN	0,14	0,22	0,28	0,35	0,35	0,35	0,42	0,35	0,42	0,56	0,70	0,70			
<b>Spacing<sup>(4)</sup></b>	$S$	mm	40			55			60			60		75		90		
<b>Edge distance<sup>(4)</sup></b>	$C$	mm	45			55			60			70		90		105		

1kN ≈ 100 kgf

<sup>(1)</sup> The recommended loads derive from the mean ultimate loads and are inclusive of the total safety factor  $\gamma=6$ .

<sup>(2)</sup> When tightening, the screw must protrude out of the plug by at least 1 diameter.

<sup>(3)</sup> Base material with plaster thickness around 10-15 mm, avoid rotary percussion when drilling.

<sup>(4)</sup> In case of broken bricks double the distances of the indicative data.

NOTE: The torque has to be regulated according to the type of installation and base material.

In the absence of CE markings, the recommended loads derive from tests carried out in the Friulside laboratory in accordance with the appropriate standards.

The load values are only valid if the installation has been carried out correctly. The design engineer is responsible for the designing and calculation of the fixing.

CE CERTIFIED

COUNTERSUNK RIM  
FOR ROOFING PROFESSIONALS

INNOVATIVE GEOMETRY



**White zinc plated screw  
Pozidrive recess  
grey plug**



Code	Plug do x L mm	Screw d x Lv mm	tfix mm	dr mm	Pkg.	Outer box
62200b05030 <sup>(1)</sup>	5x30	3,4x35	5	8,5	300	3000
62200b05040 <sup>(1)</sup>	5x40	3,4x45	15	8,5	200	2000
62200b05050 <sup>(1)</sup>	5x50	3,4x55	25	8,5	200	2000
62200b06040	6x40	3,8x45	10	10	200	2000
62200b06050	6x50	3,8x55	20	10	100	1000
62200b06060	6x60	3,8x65	30	10	100	1000
62200b06080	6x80	3,8x85	50	10	100	1000
62200b08060	8x60	4,8x65	20	12	150	1500
62200b08080	8x80	4,8x85	40	12	150	1500
62200b08100	8x100	4,8x105	60	12	100	1000
62200b08120	8x120	4,8x125	80	12	100	1000
62200b08140	8x140	4,8x145	100	12	100	1000
62200b10080 <sup>(1)</sup>	10x80	7x85	30	14	100	1000
62200b10100 <sup>(1)</sup>	10x100	7x105	50	14	100	400
62200b10135 <sup>(1)</sup>	10x135	7x140	85	14	50	500
62200b10160 <sup>(1)</sup>	10x160	7x165	110	14	50	500

<sup>(1)</sup> Codes not covered by CE certification

**Stainless steel A2 screw  
Pozidrive recess  
grey plug**



Code	Plug do x L mm	Screw d x Lv mm	tfix mm	dr mm	Pkg.	Outer box
62203x05030 <sup>(1)▲</sup>	5x30	3,4x35	5	8,5	300	3000
62203x05040 <sup>(1)▲</sup>	5x40	3,4x45	15	8,5	200	2000
62203x05050 <sup>(1)▲</sup>	5x50	3,4x55	25	8,5	200	2000
62203x06040	6x40	3,8x45	10	10	200	1600
62203x06050	6x50	3,8x55	20	10	100	1000
62203x06060	6x60	3,8x65	30	10	100	800
62203x06080	6x80	3,8x85	50	10	100	800

<sup>(1)</sup> Codes not covered by CE certification

**Double threaded screw**



Code	Plug do x L mm	Screw d x Lv mm	dr mm	Thread	Pkg.	Outer box
62202b06040▲	6x40	3,8x52	10	M6x6	200	2000
62202b06050▲	6x50	3,8x66	10	M6x6	100	1000
62204b06040▲	6x40	3,8x52	10	M7x6	100	1000
62204b06050▲	6x50	3,8x62	10	M7x6	100	1000

**VERSIONS:**

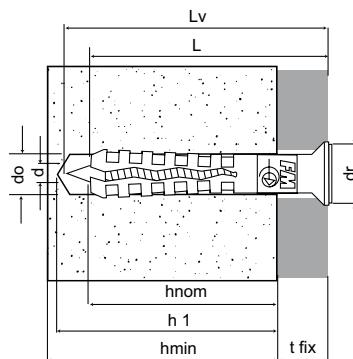
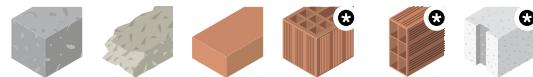
- white zinc plated screw, grey plug
- stainless steel A2 screw, grey plug
- white zinc plated double threaded screw, grey plug

**PRODUCT FEATURES:**

- nylon plug

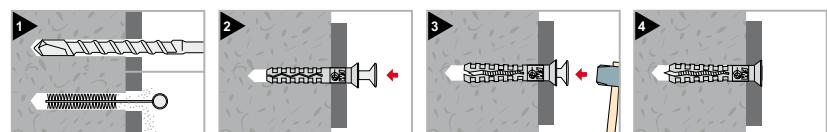
**CERTIFICATIONS**

ETICS

**BASE MATERIALS:**

$d$  = screw diameter  
 $do$  = hole diameter  
 $dr$  = collar diameter  
 $h_1$  = minimum hole depth  
 $h_{\min}$  = minimum support thickness

$h_{\text{nom}}$  = nominal embedment depth  
 $L$  = anchor length  
 $L_v$  = screw length  
 $t_{\text{fix}}$  = fixture thickness

**DESIGN AND RECOMMENDED<sup>(1)</sup> LOADS****Single anchor with large anchor spacing and edge distances**

Anchor		<b>Ø5</b>	<b>Ø6</b>	<b>Ø8</b>	<b>Ø10</b>
<b>Minimum support thickness</b>	$h_{\min}$ mm	50	100	100	100
<b>Minimum hole depth</b>	$h_1$ mm	35	40	50	60
<b>Nominal embedment depth</b>	$h_{\text{nom}}$ mm	25	30	40	50
<b>Hole diameter</b>	$d_0$ mm	5	6	8	10
<b>Concrete C20/C25<sup>(2)</sup></b>	Tensile	$N_{rd}$ kN	0,23	0,60	0,60
		$N$ kN	0,15	0,40	0,40
	Shear	$V_{rd}$ kN	0,60	0,60	1,20
		$V$ kN	0,40	0,40	0,80
<b>Solid brick<sup>(2)</sup></b>	Tensile	$N_{rd}$ kN	0,20	0,36	0,45
		$N$ kN	0,13	0,24	0,30
	Shear	$V_{rd}$ kN	0,60	0,60	1,20
		$V$ kN	0,40	0,40	0,80
<b>Spacing<sup>(3)</sup></b>	$S$ mm	50	100	100	100
<b>Edge distance<sup>(3)</sup></b>	$C$ mm	50	100	100	100

1kN ≈ 100 kgf

<sup>(1)</sup> The recommended loads derive from the mean ultimate loads and are inclusive of the total safety factor  $\gamma=6$ . Certified CE for ETICS ETAG014 following size Ø6-Ø8 on concrete, the recommended loads derive from the characteristic loads on the ETA 10/0190 certification and are inclusive of the partial safety factors  $\gamma_t=1,5$  and  $\gamma_m=2,0$ .

<sup>(2)</sup> Base material without plaster.

<sup>(3)</sup> In case of broken bricks double the distances of the indicative data.

In the absence of CE markings, the recommended loads derive from tests carried out in the Friulside laboratory in accordance with the appropriate standards. The load values are only valid if the installation has been carried out correctly. The design engineer is responsible for the designing and calculation of the fixing.

**CE CERTIFIED****LARGE RIM  
FOR TINSMITH PROFESSIONALS****INNOVATIVE GEOMETRY**

**White zinc plated screw  
Pozidrive recess  
grey plug**

Code	Plug do x L mm	Screw d x Lv mm	tfix mm	dr mm	Pkg.	Outer box
62100b05030 <sup>(1)</sup>	5x30	3,4x35	5	11	300	3000
62100b05040 <sup>(1)</sup>	5x40	3,4x45	15	11	200	2000
62100b05050 <sup>(1)</sup>	5x50	3,4x55	25	11	200	2000
62100b06040	6x40	3,8x45	10	13	200	1600
62100b06050	6x50	3,8x55	20	13	100	1000
62100b06060	6x60	3,8x65	30	13	100	1000
62100b08080	8x80	4,8x85	40	15	150	1500
62100b08100	8x100	4,8x105	60	15	100	1000
62100b08120	8x120	4,8x125	80	15	100	1000
62100b08140	8x140	4,8x145	100	15	50	500
62100b08160	8x160	4,8x165	120	15	50	500

<sup>(1)</sup> Codes not covered by CE certification



**Stainless steel A2 screw  
Pozidrive recess**

Grey plug Code	Dark brown plug Code	Natural plug Code	Plug do x L mm	Screw d x Lv mm	tfix mm	dr mm	Pkg.	Outer box
62102x06040	62103x06040 <sup>(1)</sup> ▲	62107x06040 <sup>(1)</sup> ▲	6x40	3,8x45	10	13	200	1600
62102x06050▲	62103x06050 <sup>(1)</sup> ▲	62107x06050 <sup>(1)</sup> ▲	6x50	3,8x55	20	13	100	1000
62102x06060▲	62103x06060 <sup>(1)</sup> ▲	62107x06060 <sup>(1)</sup> ▲	6x60	3,8x65	30	13	100	1000 <sup>(2)</sup>

<sup>(1)</sup> Codes not covered by CE certification

<sup>(2)</sup> 800 for Cod. 62102x06060



**Pozidrive recess screw  
dark brown plug**

Black zinc ptd. screw Code	Copper plated stainless steel A2 screw Code	Plug do x L mm	Screw d x Lv mm	tfix mm	dr mm	Pkg.	Outer box
	62105005030 <sup>(1)</sup> ▲	5x30	3,4x35	5	11	300	3000
62109e06040 <sup>(1)</sup>	62105006040 <sup>(1)</sup>	6x40	3,8x45	10	13	200	1600
62109e06050 <sup>(1)</sup>	62105006050 <sup>(1)</sup>	6x50	3,8x55	20	13	100	1000
62109e06060 <sup>(1)</sup>	62105006060 <sup>(1)</sup> ▲	6x60	3,8x65	30	13	100	1000 <sup>(2)</sup>

<sup>(1)</sup> Codes not covered by CE certification

<sup>(2)</sup> 800 for Cod. 62105006060

**Versions:**

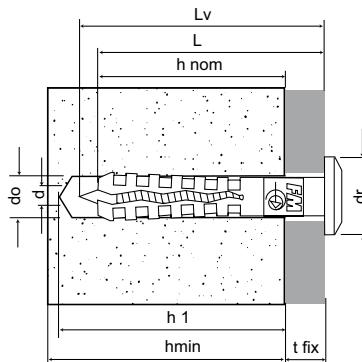
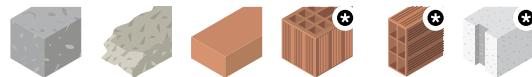
- white zinc plated screw, grey plug
- stainless steel A2 screw, grey, dark brown or natural plug
- black zinc plated screw or copper plated stainless steel A2 screw, dark brown plug

**PRODUCT FEATURES:**

- nylon plug
- available with different plug colours and different screw materials

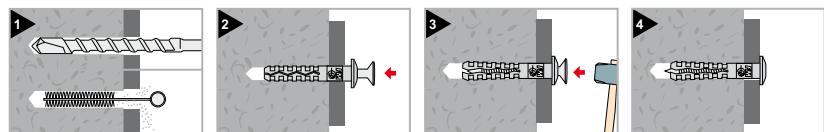
**CERTIFICATIONS**

ETICS

**BASE MATERIALS:**

$d$  = screw diameter  
 $do$  = hole diameter  
 $dr$  = collar diameter  
 $h_1$  = minimum hole depth  
 $h_{\min}$  = minimum support thickness

$h_{\text{nom}}$  = nominal embedment depth  
 $L$  = anchor length  
 $Lv$  = screw length  
 $t_{\text{fix}}$  = fixture thickness

**DESIGN AND RECOMMENDED<sup>(1)</sup> LOADS****Single anchor with large anchor spacing and edge distances**

Anchor		<b>Ø5</b>	<b>Ø6</b>	<b>Ø8</b>
<b>Minimum support thickness</b>	$h_{\min}$ mm	50	100	100
<b>Minimum hole depth</b>	$h_1$ mm	35	40	50
<b>Nominal embedment depth</b>	$h_{\text{nom}}$ mm	25	30	40
<b>Hole diameter</b>	$d_0$ mm	5	6	8
<b>Concrete C20/C25<sup>(2)</sup></b>	Tensile	$N_{rd}$ kN	0,23	0,60
	Shear	$N$ kN	0,15	0,40
<b>Solid brick<sup>(2)</sup></b>	Tensile	$N_{rd}$ kN	0,20	0,36
	Shear	$N$ kN	0,13	0,24
<b>Spacing<sup>(3)</sup></b>	$S$ mm	50	100	100
<b>Edge distance<sup>(3)</sup></b>	$C$ mm	50	100	100

1kN ≈ 100 kgf

<sup>(1)</sup> The recommended loads derive from the mean ultimate loads and are inclusive of the total safety factor  $\gamma_f=6$ . Certified CE for ETICS ETAG014 following size Ø6-Ø8 on concrete, the recommended loads derive from the characteristic loads on the ETA 10/0190 certification and are inclusive of the partial safety factors  $\gamma_f=1,5$  and  $\gamma_m=2,0$ .

<sup>(2)</sup> Base material without plaster.

<sup>(3)</sup> In case of broken bricks double the distances of the indicative data.

In the absence of CE markings, the recommended loads derive from tests carried out in the Friulside laboratory in accordance with the appropriate standards.

The load values are only valid if the installation has been carried out correctly. The design engineer is responsible for the designing and calculation of the fixing.

CE CERTIFIED

CYLINDRICAL RIM  
FOR ROOFING PROFESSIONALS

INNOVATIVE GEOMETRY



**White zinc plated screw  
Pozidrive recess  
grey plug**



Code	Plug do x L mm	Screw d x Lv mm	tfix mm	dr mm	Pkg.	Outer box
62700b05030 <sup>(1)</sup>	5x30	3,4x35	5	9	300	3000
62700b05040 <sup>(1)</sup>	5x40	3,4x45	15	9	200	2000
62700b05050 <sup>(1)</sup>	5x50	3,4x55	25	9	200	2000
62703b06035 <sup>(1)(2)</sup>	6x35	3,8x40	5	11	200	2000
62700b06040	6x40	3,8x45	10	10	200	2000
62700b06050	6x50	3,8x55	20	10	100	1000
62700b06060	6x60	3,8x65	30	10	100	1000
62703b08040 <sup>(1)(2)</sup>	8x40	4,8x45	5	11	200	2000
62700b08060	8x60	4,8x65	20	11,5	150	1500
62700b08080	8x80	4,8x85	40	11,5	150	1500
62700b08100	8x100	4,8x105	60	11,5	100	1000
62700b08120	8x120	4,8x125	80	11,5	100	1000
62700b08140	8x140	4,8x145	100	11,5	100	400

<sup>(1)</sup> Codes not covered by CE certification<sup>(2)</sup> With reduced embedment depths

**Stainless steel A2 screw  
Pozidrive recess  
grey plug**



Code	Plug do x L mm	Screw d x Lv mm	tfix mm	dr mm	Pkg.	Outer box
62701x06040	6x40	3,8x45	10	10	200	1600
62701x06050	6x50	3,8x55	20	10	100	1000
62701x06060	6x60	3,8x65	30	10	100	1000
62701x08080	8x80	4,8x85	40	11,5	100	1000

**VERSIONS:**

- white zinc plated screw, grey plug
- stainless steel A2 screw, grey plug

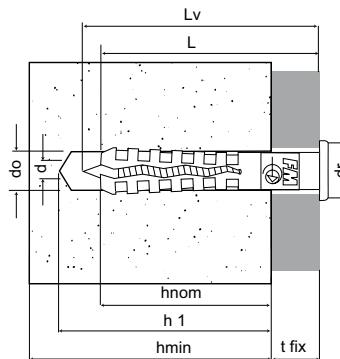
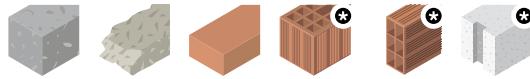
**PRODUCT FEATURES:**

- nylon plug



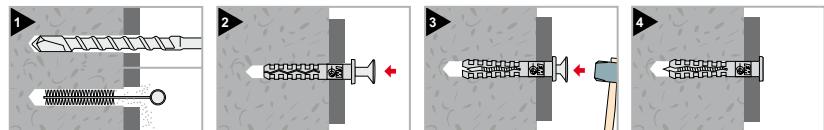
CERTIFICATIONS

ETICS

**BASE MATERIALS:**

$d$  = screw diameter  
 $do$  = hole diameter  
 $dr$  = collar diameter  
 $h1$  = minimum hole depth  
 $h_{\text{min}}$  = minimum support thickness

$h_{\text{nom}}$  = nominal embedment depth  
 $L$  = anchor length  
 $Lv$  = screw length  
 $t_{\text{fix}}$  = fixture thickness

**DESIGN AND RECOMMENDED<sup>(1)</sup> LOADS****Single anchor with large anchor spacing and edge distances**

Anchor		<b>Ø5</b>	<b>Ø6</b>	<b>Ø8</b>
<b>Minimum support thickness</b>	$h_{\text{min}}$ mm	50	100	100
<b>Minimum hole depth</b>	$h_1$ mm	35	40	50
<b>Nominal embedment depth</b>	$h_{\text{nom}}$ mm	25	30	40
<b>Hole diameter</b>	$d_0$ mm	5	6	8
<b>Concrete C20/C25<sup>(2)</sup></b>	Tensile	$N_{rd}$ kN	0,23	0,60
	Shear	$N$ kN	0,15	0,40
<b>Solid brick<sup>(2)</sup></b>	Tensile	$V_{rd}$ kN	0,60	1,20
	Shear	$V$ kN	0,40	0,80
	Tensile	$N_{rd}$ kN	0,20	0,36
	Shear	$N$ kN	0,13	0,24
<b>Spacing<sup>(3)</sup></b>	$S$ mm	50	100	100
<b>Edge distance<sup>(3)</sup></b>	$C$ mm	50	100	100

1kN ≈ 100 kgf

<sup>(1)</sup> The recommended loads derive from the mean ultimate loads and are inclusive of the total safety factor  $\gamma_f=6$ . Certified CE for ETICS ETAG014 following size Ø6-Ø8 on concrete, the recommended loads derive from the characteristic loads on the ETA 10/0190 certification and are inclusive of the partial safety factors  $\gamma_f=1,5$  and  $\gamma_m=2,0$ .

<sup>(2)</sup> Base material without plaster.

<sup>(3)</sup> In case of broken bricks double the distances of the indicative data.

In the absence of CE markings, the recommended loads derive from tests carried out in the Friulside laboratory in accordance with the appropriate standards. The load values are only valid if the installation has been carried out correctly. The design engineer is responsible for the designing and calculation of the fixing.

# ISOPLUS II

Screw in fixing for ETICS thermal insulation systems

**HIGH PULL-OUT RESISTANCE**

**SAFE FIXING ON ALL TYPES OF  
WALLS, NEW AND OLD**

**PROGRESSIVE INSTALLATION DURING SCREWING,  
PREVENTING DAMAGE TO THE INSULATING PANELS**

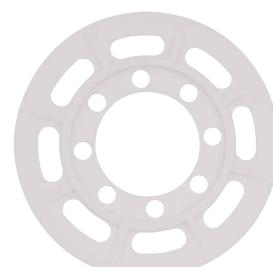


**Polypropylene copolymer plug  
washer Ø60  
screw cap cover incorporated in the plug  
white zinc plated steel screw  
Torx T25 recess  
not preassembled**

Code	L mm	d <sub>0</sub> <sup>(1)</sup> mm	d <sub>r</sub> mm	tfix <sup>(2)</sup>			Pkg.
				A	B	C	
61953008080	80	8	60	40 - 50		30	200
61953008100	100	8	60	60 - 70		40 - 50	200
61953008120	120	8	60	80 - 90		60 - 70	200
61953008140	140	8	60	100 - 110		80 - 90	200
61953008160	160	8	60	120 - 130		100 - 110	200
61953008180	180	8	60	140 - 150		120 - 130	200
61953008200	200	8	60	160 - 170		140 - 150	200
61953008220	220	8	60	180 - 190		160 - 170	200
61953008240	240	8	60	200 - 210		180 - 190	200
61953008260	260	8	60	220 - 230		200 - 210	200
61953008280	280	8	60	240 - 250		220 - 230	200
61953008300	300	8	60	260 - 270		240 - 250	200

<sup>(1)</sup> In the case of hollow and aerated concrete base materials avoid drilling with rotary percussion.

<sup>(2)</sup> **NEW BUILDINGS:** Fixing thickness = insulation panel thickness + glue thickness (~10 mm);  
**RENOVATIONS:** Fixing thickness = insulation panel thickness + glue thickness (~10 mm) + old plaster thickness (~20 mm).



**Polypropylene washer  
for ISOPLUS II fixing  
for soft panels**

Code	Washer Ø	Pkg.
61925000100	100	200

**VERSIONS:**

- polypropylene copolymer plug, white zinc plated steel screw

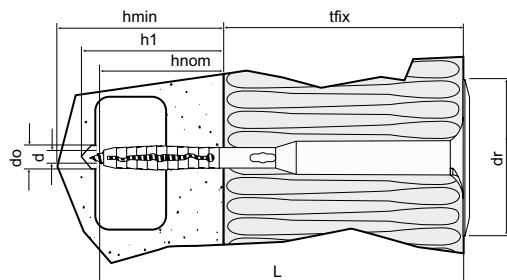
**PRODUCT FEATURES:**

- for rigid and semi-rigid panels
- high pull-out resistance, in all conditions
- progressive installation during screwing, preventing damage to the insulating panels
- safe fixing on all types of walls, new and old (renovations)
- safe fixing on overlaid ETICS (renovations)

**CERTIFICATIONS****ETICS**

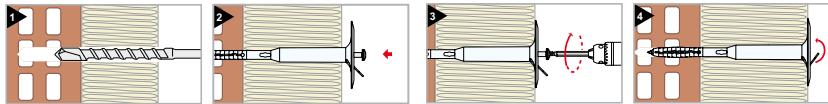
CE certification attained for the following categories of base materials

- A: concrete
- B: solid brick
- C: cell like clay brick
- D: hollow dense aggregate block
- E: aerated concrete

**BASE MATERIALS:**

$d$  = screw diameter  
 $d_0$  = hole diameter  
 $dr$  = head diameter  
 $h1$  = minimum hole depth

$h_{\text{min}}$  = minimum support thickness  
 $h_{\text{nom}}$  = nominal embedment depth  
 $L$  = anchor length  
 $t_{\text{fix}}$  = fixture thickness

**DESIGN<sup>(1)</sup> AND RECOMMENDED<sup>(2)</sup> TENSILE LOADS****Single anchor with large anchor spacing and edge distances**

Anchor		Ø8		
Hole diameter		$d_0$	mm	8
Use category			A B C	D E
Minimum hole depth		$h_1$	mm	50
Nominal embedment depth		$h_{\text{nom}}$	mm	30
Concrete	C16/20 - C50/60 EN 206-1	Hammer	$N_{rd}$ N	0,45 0,30
Solid clay brick Terca Wandklinker	$fb \geq 35 \text{ N/mm}^2 - \rho \geq 1,54 \text{ kg/dm}^3$ EN 771-1	Hammer	$N_{rd}$ N	0,45 0,30
Hollow clay brick Bloco termico GT 25 PU	$fb \geq 15 \text{ N/mm}^2 - \rho \geq 0,83 \text{ kg/dm}^3$ EN 771-1	Rotary	$N_{rd}$ N	0,45 0,30
Light aggregate concrete Topterm	$fb \geq 2,7 \text{ N/mm}^2 - \rho \geq 0,65 \text{ kg/dm}^3$ EN 1520	Hammer	$N_{rd}$ N	0,20 0,13
Autoclaved aerated concrete AAC Termo Blok	$fb \geq 2,5 \text{ N/mm}^2 - \rho \geq 0,35 \text{ kg/dm}^3$ EN 771-4	Rotary	$N_{rd}$ N	0,20 0,13
Minimum support thickness			$h_{\text{min}}$	100
Minimum spacing			$S_{\text{min}}$	100
Minimum edge distance			$C_{\text{min}}$	100

1kN ≈ 100 kgf

<sup>(1)</sup> The design loads  $N_{rd}$  derive from the characteristic loads on the ETA certification for ETICS EAD 330196-01-0604 and are inclusive of the partial safety factors  $\gamma_m = 2,0$ .

<sup>(2)</sup> The recommended loads N derive from the characteristic loads on the ETA certification for ETICS EAD 330196-01-0604 and are inclusive of the partial safety factors  $\gamma_i = 1,5$  and  $\gamma_m = 2,0$ . The load values are only valid if the installation has been carried out correctly. The design engineer is responsible for the designing and calculation of the fixing.

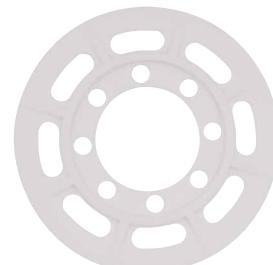
**CE CERTIFICATION****STEEL NAIL****NAIL WITH POLYPROPYLENE HEAD**

**Polypropylene plug  
steel nail with polypropylene head  
for rigid and semi-rigid panels  
washer Ø60  
not preassembled**

Code	L mm	d <sup>(1)</sup> mm	d <sub>r</sub> mm	L <sub>c</sub> mm	t <sub>ffix</sub> <sup>(2)</sup> min-max	Pkg.
61925008100	100	8	60	100	35-45	200
61925008120	120	8	60	120	55-65	200
61925008140	140	8	60	140	75-85	200
61925008160	160	8	60	160	95-105	200
61925008180	180	8	60	180	115-125	200
61925008200	200	8	60	200	135-145	200
61925008220	220	8	60	220	155-165	200
61925008240	240	8	60	240	175-185	200
61925008260	260	8	60	260	195-205	200
61925008280	280	8	60	280	215-225	200
61925008300	300	8	60	300	235-245	200
61925008330	330	8	60	330	265-275	200
61925008360	360	8	60	360	295-305	200
61925008400	400	8	60	400	335-345	100

<sup>(1)</sup> In the case of hollow base materials avoid drilling with rotary percussion.

<sup>(2)</sup> In presence of plaster (non-load equalizing layer) and glue, the thickness must be added to that of the fixture thickness tfix.



**Polypropylene washer  
for ISOMAX fixing  
for soft panels**

Code	Washer Ø	Pkg.
61925000100	100	200

**Versions:**

- polypropylene plug and steel nail with polypropylene head

**PRODUCT FEATURES:**

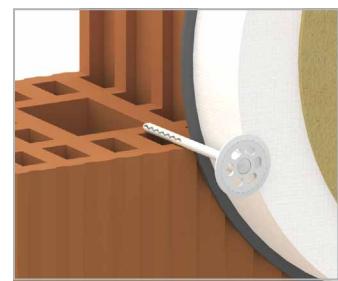
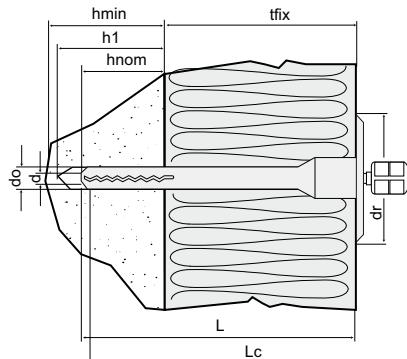
- for rigid and semi-rigid panels
- excellent shear resistance, suitable for fixing heavy insulating panels
- high fixing thicknesses
- strong reductions in thermal conductivity
- reduced hole

**CERTIFICATIONS**

ETICS

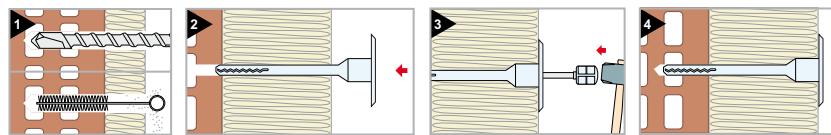
CE certification attained for the following categories of base materials

- A: concrete
- B: solid brick
- C: cell like clay brick

**BASE MATERIALS:**

$d$  = nail diameter  
 $d_0$  = hole diameter  
 $dr$  = head diameter  
 $h_1$  = minimum hole depth  
 $h_{\text{min}}$  = minimum support thickness

$h_{\text{nom}}$  = nominal embedment depth  
 $L$  = anchor length  
 $L_c$  = nail length  
 $t_{\text{fix}}$  = fixture thickness

**DESIGN<sup>(1)</sup> AND RECOMMENDED<sup>(2)</sup> TENSILE LOADS****Single anchor with large anchor spacing and edge distances**

Anchor				<b>Ø8</b>
Hole diameter		$d_0$	mm	8
Use category				A B C
Minimum hole depth		$h_1$	mm	70
Nominal embedment depth		$h_{\text{nom}}$	mm	55
Concrete	C16/20 - C50/60 EN 206-1	Hammer	$N_{rd}$ kN	0,20
			N kN	0,13
Solid clay brick	$fb > 28 \text{ MPa} - \rho \geq 1,6 \text{ kg/dm}^3$ EN 771-1	Hammer	$N_{rd}$ kN	0,20
			N kN	0,13
Vertically perforated clay brick Modulartec	$fb > 13 \text{ MPa} - \rho \geq 1,77 \text{ kg/dm}^3$ EN 771-1	Rotary	$N_{rd}$ kN	0,15
			N kN	0,10
Vertically perforated clay brick Poroterm	$fb > 12 \text{ MPa} - \rho \geq 1,77 \text{ kg/dm}^3$ EN 771-1	Rotary	$N_{rd}$ kN	0,15
			N kN	0,10
Minimum support thickness			$h_{\text{min}}$ mm	100
Minimum spacing			$S_{\text{min}}$ mm	100
Minimum edge distance			$C_{\text{min}}$ mm	100

1kN ≈ 100 kgf

<sup>(1)</sup> The design loads  $N_{rd}$  derive from the characteristic loads on the ETA 08/0094 certification for ETICS ETAG014 and are inclusive of the partial safety factors  $\gamma_m = 2,0$ .

<sup>(2)</sup> The recommended loads N derive from the characteristic loads on the ETA 08/0094 certification for ETICS ETAG014 and are inclusive of the partial safety factors  $\gamma_f = 1,5$  and  $\gamma_m = 2,0$ . The load values are only valid if the installation has been carried out correctly. The design engineer is responsible for the designing and calculation of the fixing.

**CE CERTIFICATION**

**NYLON NAIL REINFORCED  
WITH GLASS FIBRE**

**HIGH FIXING THICKNESSES**



**Polypropylene plug  
nylon nail reinforced with glass fibre  
for rigid and semi-rigid panels  
washer Ø60  
not preassembled**

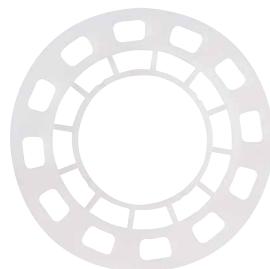


Code	L mm	d <sup>(1)</sup> mm	dr mm	tfix <sup>(2)</sup>			Pkg.
				A	B	C	
61943010070	70	10	60	45	30	10	250
61943010090	90	10	60	65	50	30	250
61943010120	120	10	60	95	80	60	250
61943010140	140	10	60	115	100	80	250
61943010160	160	10	60	135	120	100	250
61943010180	180	10	60	155	140	120	200
61943010200	200	10	60	175	160	140	200
61943010220	220	10	60	195	180	160	200

<sup>(1)</sup> In the case of hollow base materials avoid drilling with rotary percussion.

<sup>(2)</sup> **NEW BUILDINGS:** Fixing thickness = insulation panel thickness + glue thickness (~10 mm);  
**RENOVATIONS:** Fixing thickness = insulation panel thickness + glue thickness (~10 mm) + old plaster thickness (~20 mm).

**Polypropylene washer  
for ISOFAST fixing  
for soft panels**



Code	Washer Ø	Pkg.
61927000090	90	250

**VERSIONS:**

- polypropylene plug, nylon nail reinforced with glass fibre

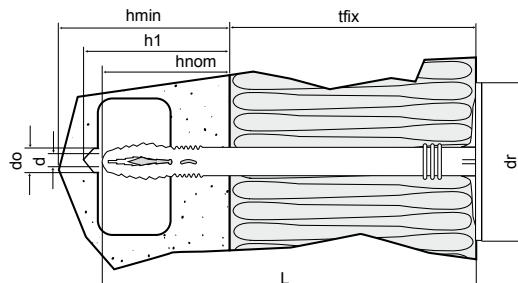
**PRODUCT FEATURES:**

- for rigid and semi-rigid panels
- high fixing thicknesses
- no thermal conductivity

**CERTIFICATIONS****ETICS**

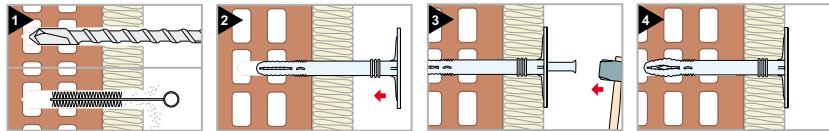
CE certification attained for the following categories of base materials

- A: concrete
- B: solid brick
- C: cell like clay brick
- D: hollow dense aggregate block
- E: aerated concrete

**BASE MATERIALS:**

$d$  = nail diameter  
 $d_0$  = hole diameter  
 $dr$  = head diameter  
 $h_1$  = minimum hole depth

$h_{\text{min}}$  = minimum support thickness  
 $h_{\text{nom}}$  = nominal embedment depth  
 $L$  = anchor length  
 $t_{\text{fix}}$  = fixture thickness

**DESIGN<sup>(1)</sup> AND RECOMMENDED<sup>(2)</sup> TENSILE LOADS****Single anchor with large anchor spacing and edge distances**

Anchor		<b>Ø10</b>				
Hole diameter		$d_0$	mm	10		
Use category				A	B	C
Minimum support thickness		$h_{\text{min}}$	mm	100		
Minimum hole depth		$h_1$	mm	35	50	70
Nominal embedment depth		$h_{\text{nom}}$	mm	25	40	60
Concrete	C12/15 - C50/60 EN 206-1	Hammer	$N_{rd}$ N	0,20 0,13		
Solid clay brick DIN 105	$fb \geq 30 \text{ MPa} - \rho \geq 1,70 \text{ kg/dm}^3$ EN 771-1	Hammer	$N_{rd}$ N	0,20 0,13		
Vertically perforated clay brick HZ DIN 105	$fb \geq 12 \text{ MPa} - \rho \geq 0,95 \text{ kg/dm}^3$ EN 771-1	Rotary	$N_{rd}$ N	0,15 0,10		
Vertically perforated Porotherm brick 25P+W	$fb \geq 15 \text{ MPa} - \rho \geq 0,80 \text{ kg/dm}^3$ EN 771-1	Rotary	$N_{rd}$ N	0,20 0,13		
Calcium silicate brick KS Vollstein DIN 106	$fb \geq 20 \text{ MPa} - \rho \geq 2,00 \text{ kg/dm}^3$ EN 771-2	Rotary	$N_{rd}$ N	0,20 0,13		
Lightweight concrete solid block	$fb \geq 20 \text{ MPa} - \rho \geq 1,56 \text{ kg/dm}^3$ EN 771-3	Hammer	$N_{rd}$ N	0,38 0,25		
Autoclaved aerated concrete AAC	$fb \geq 2 \text{ MPa} - \rho \geq 0,35 \text{ kg/dm}^3$ EN 771-4	Rotary	$N_{rd}$ N	0,045 0,030		
Minimum spacing			$S_{\text{min}}$	mm	100	
Minimum edge distance			$C_{\text{min}}$	mm	100	

1kN ≈ 100 kgf

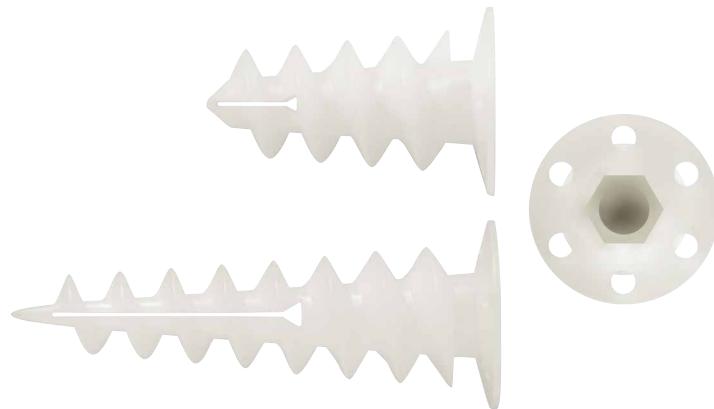
<sup>(1)</sup> The design loads  $N_{rd}$  derive from the characteristic loads on the ETA 14/0342 certification and are inclusive of the partial safety factors  $\gamma_m = 2,0$ .

<sup>(2)</sup> The recommended loads  $N$  derive from the characteristic loads on the ETA 14/0342 certification and are inclusive of the partial safety factors  $\gamma_f = 1,5$  and  $\gamma_m = 2,0$ . The load values are only valid if the installation has been carried out correctly. The design engineer is responsible for the designing and calculation of the fixing.

**HIGH LOADING CAPACITY****SELFDRILLING POINT****MAXIMUM VERSATILITY**

**Torx recess T40  
combinable screw: chipboard Ø4,5**

Code	Plug dr x L mm	s mm	Pkg.
61951025050	25x50	30	50
61951025085	25x85	40	25



**Hexagonal recess 12  
combinable screw: wood Ø8 / metric M8**

Code	Plug dr x L mm	s mm	Pkg.
61951033050	33x50	50	50
61951033085	33x85	50	25

Each box contains a screwdriver bit

**VERSIONS:**

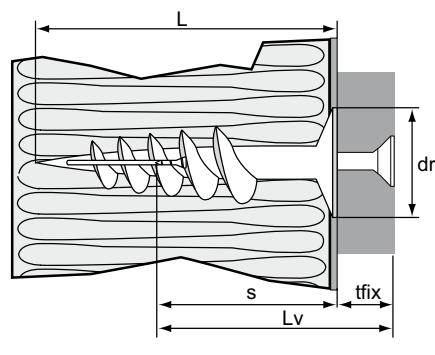
- torx recess T40
- hexagonal recess 12

**PRODUCT FEATURES:**

- direct fixing onto insulation panels
- no thermal transmission
- rapid and easy installation without pilot hole

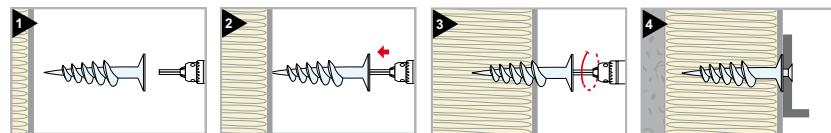
**SUITABLE FOR FIXING:**

- lighting
- post boxes
- signs
- electrical applications
- drain pipe collars
- heating/cooling applications



$d$  = screw diameter  
 $dr$  = plug diameter  
 $L$  = anchor length  
 $L_v$  = screw length

$s$  = minimum screw insertion depth into plug  
 $t_{fix}$  = fixture thickness

**DESIGN AND RECOMMENDED<sup>(1)</sup> LOADS****Single anchor with large anchor spacing and edge distances**

Anchor	Ø25				Ø33	
Anchor length	$L$	mm	50	85	55	85
EPS 20	Tensile	$F_{cons}$	kN	0,02	0,04	0,03
XPS 20	Tensile	$F_{cons}$	kN	0,03	0,04	0,06
PUR	Tensile	$F_{cons}$	kN	0,04	0,06	-

1kN ≈ 100 kgf

<sup>(1)</sup> The recommended loads derive from the mean ultimate loads and are inclusive of the total safety factor  $\gamma=5$ .

The load values are only valid if the installation has been carried out correctly. The design engineer is responsible for the designing and calculation of the fixing. In the absence of CE markings, the recommended loads derive from tests carried out in the Friulside laboratory in accordance with the appropriate standards.

# DRILLNOX

## SELFDRILLING STAINLESS STEEL A4 BIMETAL SCREW



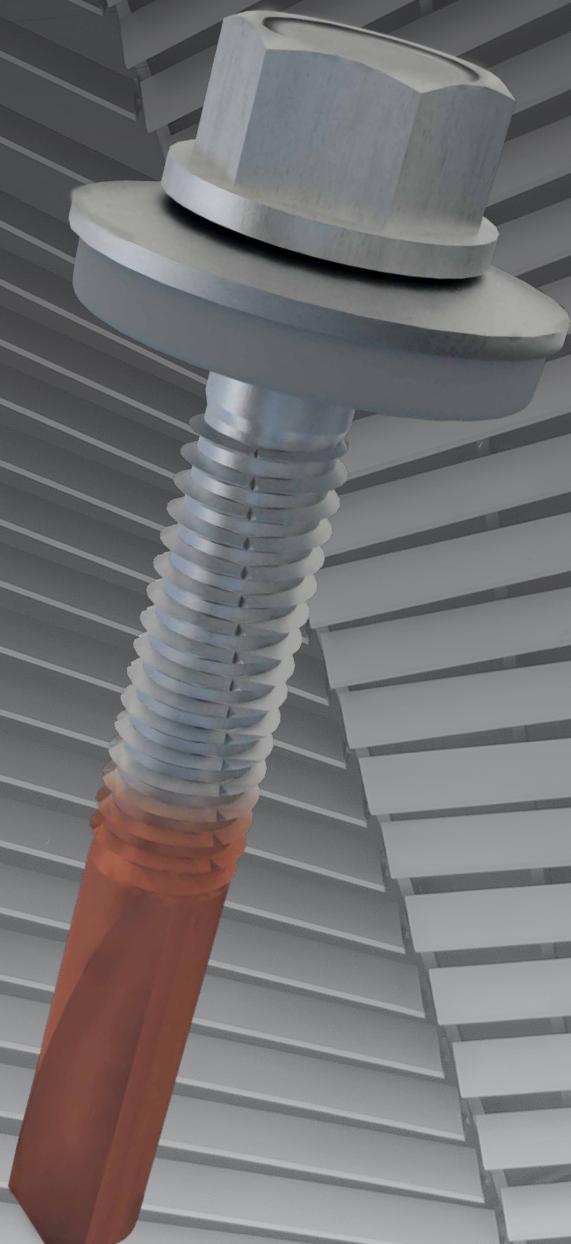
MAXIMUM CORROSION RESISTANCE



STAINLESS STEEL A4 SCREW



HARDENED CARBON STEEL POINT



**FRIULSIDER**  
YOUR FIXING FACTORY

## DRILLNOX TH 1

Selfdrilling screw STAINLESS STEEL A4 BIMETAL

**FUNCTION:**

Fixing photovoltaic panels directly onto the roofing panel

**MAIN USE:**  
For roofing

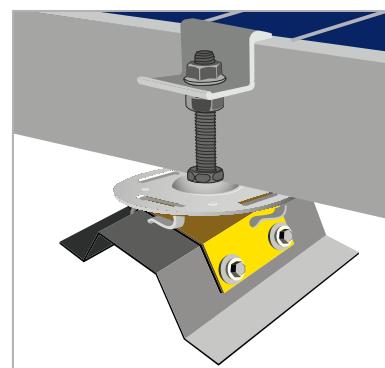
**DRILL CAPACITY:**  
min 0,4<sup>(1)</sup> max 1 mm

**PRODUCT FEATURES:**

Coating: special anti-friction plating  
Head: hex head with flat collar Ø10,5  
Wrench: 8  
Pitch: 1,81  
Drilling speed: 1800 r.p.m

**PLUS:**

High pull-out, even in small thicknesses



Screw only Code	Screw Ø x L	Fixing thickness max <sup>(2)</sup>	Pkg.
39652x06025	6,3x25	8	100

<sup>(1)</sup> Hole on element to be fixed max Ø7

<sup>(2)</sup> Thickness refers to screw without accessory

## DRILLNOX TH 2

Selfdrilling screw STAINLESS STEEL A2 BIMETAL

**FUNCTION:**

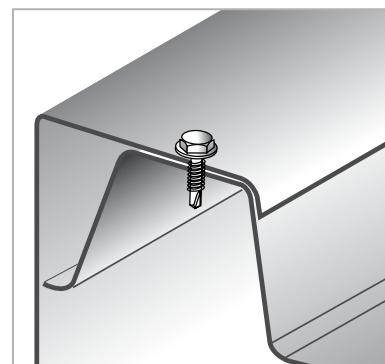
Metal sheet jointing

**MAIN USE:**  
For roofing and facades

**DRILL CAPACITY:**  
max 2x1 mm

**PRODUCT FEATURES:**

Coating: special anti-friction plating  
Head: hex head with flat collar Ø10,5  
Wrench: 8  
Pitch: 1,81  
Drilling speed: 1300 r.p.m  
Washer: stainless steel A2 / EPDM Ø14



INOX  
A2

With preassembled washer Code	Screw Ø x L	Fixing thickness max	Pkg.
39673x04020	4,8x20	3	100

## DRILLNOX TH 3

Selfdrilling screw STAINLESS STEEL A4 BIMETAL

**FUNCTION:**

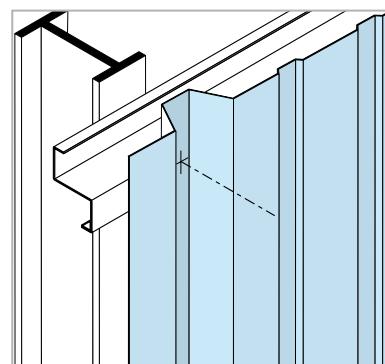
Fixing single steel sheet on metal supporting structures

**MAIN USE:**  
For roofing and facades

**DRILL CAPACITY:**  
min 1,5 max 3 mm

**PRODUCT FEATURES:**

Coating: special anti-friction plating  
Head: hex head with flat collar Ø10,5  
Wrench: 8  
Pitch: 1,81  
Drilling speed: 1800 r.p.m  
Washer: stainless steel A2 / EPDM Ø16



Screw only Code	With preassembled washer Code	Screw Ø x L	Fixing thickness max <sup>(1)</sup>	Pkg.
39650x06025	39689x06025▲	6,3x25	8	100
39650x06035	39689x06035▲	6,3x35	18	100
39650x06045	39689x06045▲	6,3x45	28	100

<sup>(1)</sup> Thickness refers to screw without accessory

**DRILLNOX TH 6**

## Selfdrilling screw STAINLESS STEEL A4 BIMETAL

**FUNCTION:**

Fixing single steel sheet  
on metal supporting structures

**MAIN USE:**

For roofing and facades

**DRILL CAPACITY:**

min 2 max 6 mm

**PRODUCT FEATURES:**

Coating: special anti-friction plating

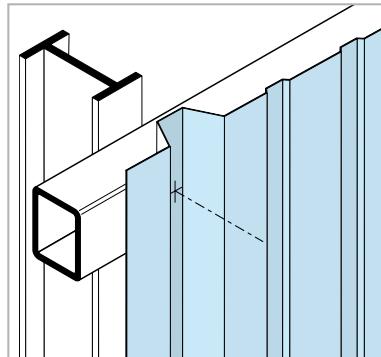
Head: hex head with flat collar Ø10,5

Wrench: 8

Pitch: 1,81

Drilling speed: 1800 r.p.m

Washer: stainless steel A2 / EPDM Ø16



Certified product when  
coupled with washer



Screw only Code	With preassembled washer Code	Screw Ø x L	Fixing thickness max <sup>(1)</sup>	Pkg.
39644x05026	39691x05026▲	5,5x26	8	100
39644x05032	39691x05032▲	5,5x32	14	100
39644x05050	39691x05050▲	5,5x50	32	100
39644x05065	39691x05065▲	5,5x65	47	100

<sup>(1)</sup> Thickness refers to screw without accessory

**DRILLNOX TH 6 DF**

## Selfdrilling screw STAINLESS STEEL A4 BIMETAL double thread

**FUNCTION:**

Fixing sandwich panels  
on metal structures

**MAIN USE:**

For roofing and facades

**DRILL CAPACITY:**

min 1,2 max 6 mm

**PRODUCT FEATURES:**

Coating: special anti-friction plating

Head: hex head with flat collar Ø10,5

Wrench: 8

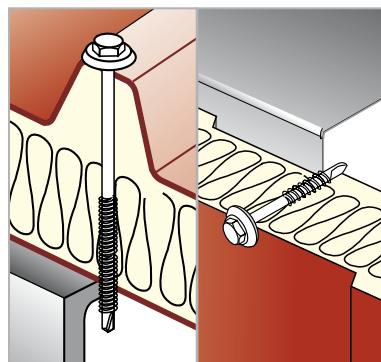
Pitch: 1,81 (thread under head pitch 2,54)

Drilling speed: 1800 r.p.m

Washer: stainless steel A2 / EPDM Ø16<sup>(1)</sup>

**PLUS:**

Double thread: avoids crushing  
the panel when stepped on  
by the operator



Screw only Code	With preassembled washer Code	Screw Ø x L	Fixing thickness min <sup>(2)</sup>	Fixing thickness max <sup>(2)</sup>	Pkg.
39672x05070	39674x05070▲	5,5x70	30	49	100
39672x05085	39674x05085▲	5,5x85	40	64	100
39672x05110	39674x05110▲	5,5x110	55	89	100
39672x05125	39674x05125▲	5,5x125	65	104	100
39672x05145	39674x05145▲	5,5x145	75	124	100
39672x05175	39674x05175▲	5,5x175	105	155	100
39672x05195	39674x05195▲	5,5x195	125	175	100

<sup>(2)</sup> Thickness refers to screw without accessory

<sup>(1)</sup> Screw with preassembled washers stainless steel A2 / EPDM Ø19 or Ø22 are available upon request. For further information please contact the Export department.

## DRILLNOX TH 12

Selfdrilling screw STAINLESS STEEL A4 BIMETAL

**FUNCTION:**

Fixing single steel sheet  
on metal supporting structures

**MAIN USE:**

For roofing and facades

**DRILL CAPACITY:**

min 4 max 12 mm

**PRODUCT FEATURES:**

Coating: special anti-friction plating

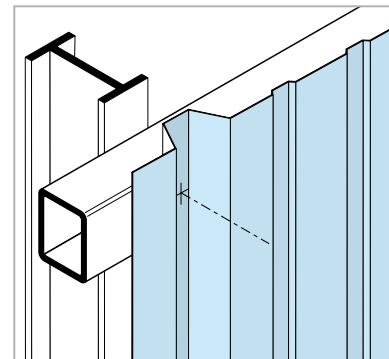
Head: hex head with flat collar Ø10,5

Wrench: 8

Pitch: 1

Drilling speed: 1800 r.p.m

Washer: stainless steel A2 / EPDM Ø16



Certified product when  
coupled with washer



Screw only Code	With preassembled washer Code	Screw Ø x L	Fixing thickness min <sup>(1)</sup>	Fixing thickness max <sup>(1)</sup>	Pkg.
39640x05040	39692x05040▲	5,5x40	1	14	100
39640x05062	39692x05062▲	5,5x62	10	32	100
39640x05080	39692x05080▲	5,5x80	30	51	100

<sup>(1)</sup> Thickness refers to screw without accessory

## DRILLNOX TH 12 DF

Selfdrilling screw STAINLESS STEEL A4 BIMETAL double thread

**FUNCTION:**

Fixing sandwich panels  
on metal structures

**MAIN USE:**

For roofing and facades

**DRILL CAPACITY:**

min 4 max 12,5 mm

**PRODUCT FEATURES:**

Coating: special anti-friction plating

Head: hex head with flat collar Ø10,5

Wrench: 8

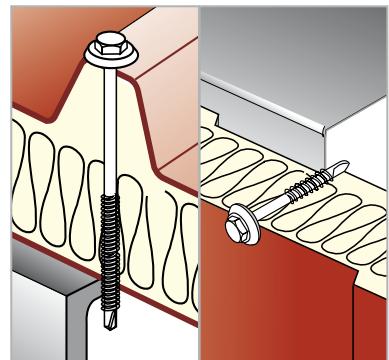
Pitch: 1,00 (thread under head pitch 2,54)

Drilling speed: 1800 r.p.m

Washer: stainless steel A2 / EPDM Ø16<sup>(1)</sup>

**PLUS:**

Double thread: avoids crushing  
the panel when stepped on  
by the operator



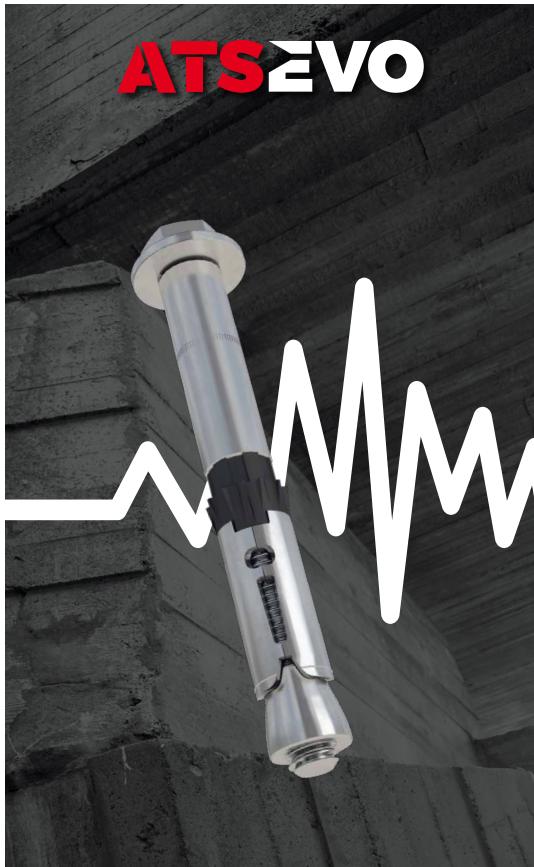
Screw only Code	With preassembled washer Code	Screw Ø x L	Fixing thickness min <sup>(1)</sup>	Fixing thickness max <sup>(1)</sup>	Pkg.
39641x05080	39686x05080▲	5,5x80	25	49	100
39641x05095	39686x05095▲	5,5x95	40	64	100
39641x05115	39686x05115▲	5,5x115	60	89	100
39641x05135	39686x05135▲	5,5x135	80	104	100
39641x05155	39686x05155▲	5,5x155	100	124	100
39641x05190	39686x05190▲	5,5x190	135	155	100

<sup>(1)</sup> Thickness refers to screw without accessory

<sup>(1)</sup> Screw with preassembled washers stainless steel A2 / EPDM Ø19 or Ø22 are available upon request. For further information please contact the Export department.

# Product Range

## ANCHORS



### METALLIC HEAVY DUTY FIXINGS WITH SEISMIC CERTIFICATION



**ATS-EVO** CE



**FM-753 CRACK** CE

### METALLIC FIXINGS



**FM-753** CE



**FM-MP3 EVO LONG** CE



**FM-744** CE



**FM-MP3 EVO** CE

### CONCRETE SCREWS



**CLR** CE



**CLR6** CE



**CLR INOX A4** CE



**VF** CE

### LIGHT FIXINGS



**X1 EVO**



**X1 EVO-L**



**XP**



**TSS** CE



**TBB** CE



**TPP** CE



**FX**



**TU**



**TA/TAM**

### SCAFFOLD FIXINGS



**FM-MP3 EVO-P**



**FM-744-P**



**LONG-P**

### ANTI-INTRUSION FIXINGS



**FM-MP3 EVO SAFER**

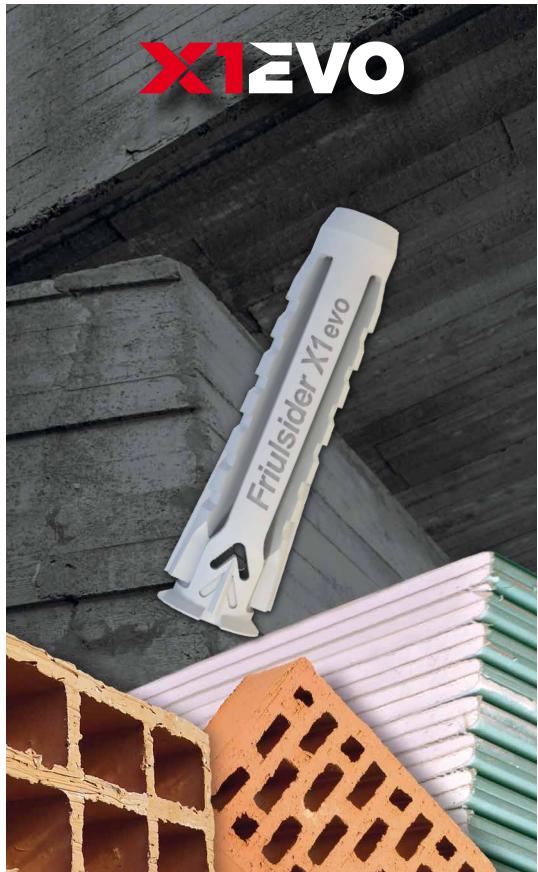


**SAFER RIVETTO**



**SAFER DADO**

# YOUR FIXING



**X1EVO**

## LONG FIXINGS



**X3** CE



**FM-X5** CE



**TUP4**

## PLASTERBOARD FIXINGS



**TAN**



**TRZ**



**TMC**



**VM** CE

## METALLIC CLAMPS



**SUPERCLAMP**



**CLAMPEX**



**CLAMPEX BAND**

## ELECTRICAL FIXINGS



**FS** CE



**CTB**



**CTND**

## THERMO-SANITARY FIXINGS



**CPA**



**CPI**



**RAIN**



**BAND**



**SPC**



**FL**



**FLB**



**TDE**



**FSN**

## RIVETS



**RIVEX** CE

## FIXINGS FOR INSULATING MATERIALS



**ISOPLUS II** CE



**ISOMAX** CE



**ISOFAST** CE

## DRILL BITS



**WALL**



**IRON**



**WOOD**

# YOUR FIXING FACTORY



**KEM**

CHEMICAL  
FIXINGS



**A S**

ADHESIVES,  
SILICONES  
AND SEALANTS



**PUR**

POLYURETHANE  
FOAMS



**G**

TECHNICAL  
SPRAYS

## SELFDRILLING AND SELFTAPPING SCREWS



### STAINLESS STEEL A4 BIMETAL SELFDRILLING SCREWS



**DRILLNOX TH 6 CE**



**DRILLNOX TH 12 CE**

### SCREWS FOR WINDOW FRAMES



**AP-STEEL**



**AF-STEEL**

### ROOFING AND CLADDING FIXINGS



**AP6**



**APL CE**



**AFM**



**AFL CE**



**VL CE**



**CAPP**



**BAZ**



**RG**

## WOOD FIXINGS - BOLTS



### WOOD SCREWS



**FM-WOOD PRO CE**



**VBU-PRO CE**



**FM-WOOD PRO TL CE**



**VBU CE**



**VCN TC CE**



**VCN TPS CE**



**FM-WOOD ISO CE**



**VPT**



**TIRAFONDO CE**

### WOOD CONNECTORS



**SHD  
CE**



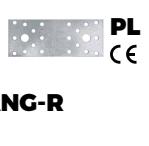
**EJH  
CE**



**HDW-B  
CE**



**ANG-RS  
CE**



**PL  
CE**

### BOLTS



**TE**



**DE**



**BLOK**



**DE LONG**



**DCZ**

# **SEISMIC CERTIFIED SYSTEMS**



# ATSEVO

C1: M6 - M24  
C2: M8 - M24



# FM 753 CRACK

C1: M8 - M16  
C2: M10 - M16



# KEM EP

C1: M8 - M30  
C2: M12 - M24



# KEM H

C1: M8 - M30  
C2: M12 - M24



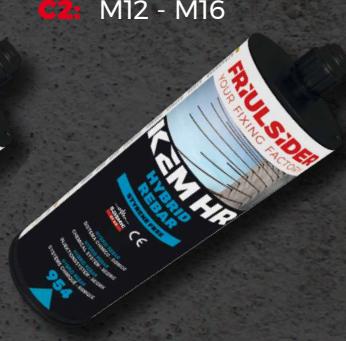
# KEM V

C1: M8 - M30



# KEM HR

C1: M8 - M16  
C2: M12 - M16

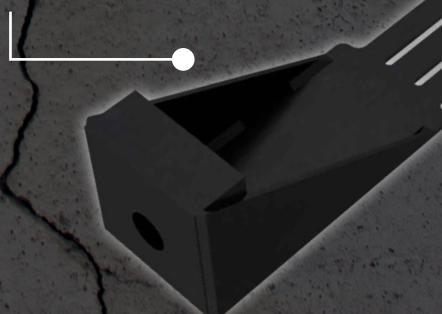


Resistance to cyclic loads  
in crack up to 0.5 mm



Resistance to cyclic loads in variable  
crack up to 0.8 mm with definition of  
the maximum displacement

# SHD



Fixing system for  
wooden buildings  
in seismic areas



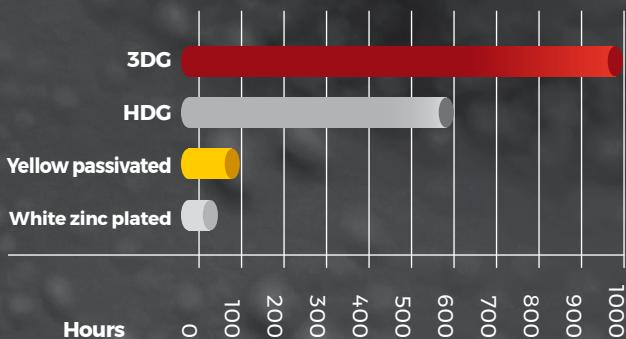
**3DG**  
**COATING**

## ► CHARACTERISTICS

- Corrosion resistance in Salt Spray up to 1000 hours (minimum values depending on the geometry of the fixing)
- Thin (matte finish:  $\geq 10 \mu\text{m}$  / glossy finish:  $\geq 8 \mu\text{m}$ ): no interference on the threads
- Respect for the environment: 3DG complies with the RoHS directive 2011/65/EU, the European CE Reach regulation 1907/2006 and is free from Chromium VI

## ► MAX RESISTANCE CORROSION

(Red rust appearance)



CORROSIVITY CATEGORIES ACCORDING TO ISO 9223			STEEL	STEEL	STAINLESS STEEL A4 (wr.1.4404 EN10088)
			WHITE ZINC PLATED 5µM ISO4042	3DG	
C5-I	very high	Industrial			*
C5-M	very high	Marine			*
C4-I	high	Industrial			●
C4-M	high	Marine		*	●
C3	medium	Industrial-Marin-Urban		●	●
C2	low	Urban		●	●
C1	very low	Rural	*	●	●

Suitable applications ●

Partially suitable applications \*

- C5-I = industrial environments with high air pollution (sulfur dioxide-chloride-etc.);  
C5-M = marine environment with very high salinity and very close to the sea <0.2 km;  
C4-I = industrial environment with high sulfur dioxide pollution;  
C4-M = coastal areas with high salinity, distance from the sea 0,2-1 km;  
C3 = urban or industrial environment with low sulfur dioxide pollution, coastal areas with moderate salinity, distance from the sea 1-3 km;  
C2 = urban environment contaminated mainly from densely populated areas with no significant industrial activity, distance from the sea > 3 km;  
C1 = rural non-contaminated environment, mainly natural areas, distance from the sea > 20 km.

The environmental assessment must be carried out by designers and/or competent personal, the influence of the above factors must be considered in the use of the fixings shown in the table, and therefore suitable protective and design-construction factors must be implemented.

# FIXCALC

## ENGINEERING SOFTWARE

A VALUABLE TOOL FOR DESIGNERS

### ► SOFTWARE DIMENSIONAMENTO ANCORANTI:

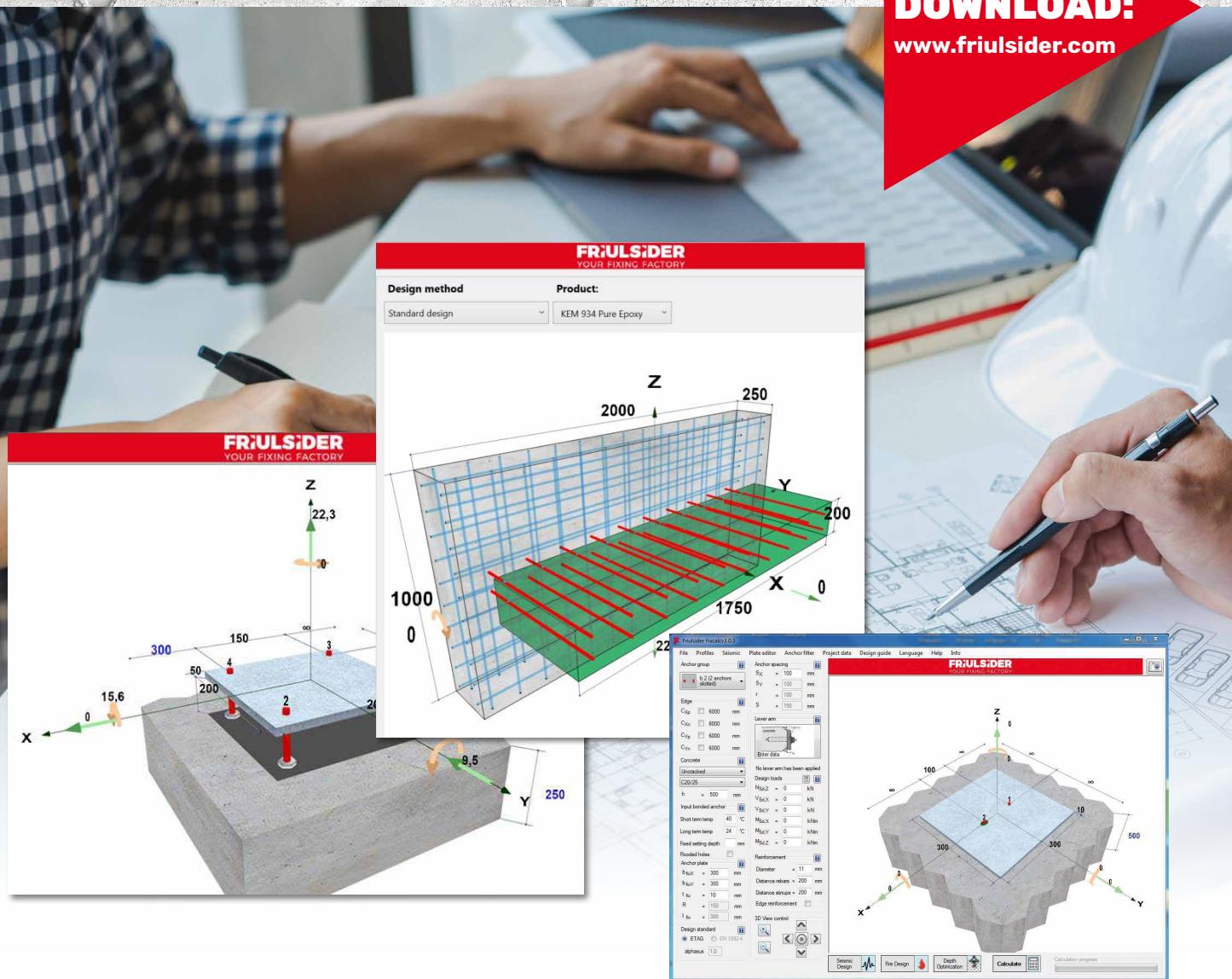
- The FIX-CALC engineering software can be downloaded directly from the Friulsider website.
- The suite consists of two modules, one for anchor calculations + one for rebar calculations.
- All Friulsider certified fixings can be calculated using the anchor module.
- Calculation according to ETAG 001 annex C / TR029 or EN1992-4:2018

Also available:

WOOD ENGINEERING SOFTWARE



**FIX  
CALC  
DOWNLOAD:**  
[www.friulsider.com](http://www.friulsider.com)



# WOOD TECHNICAL CATALOGUE

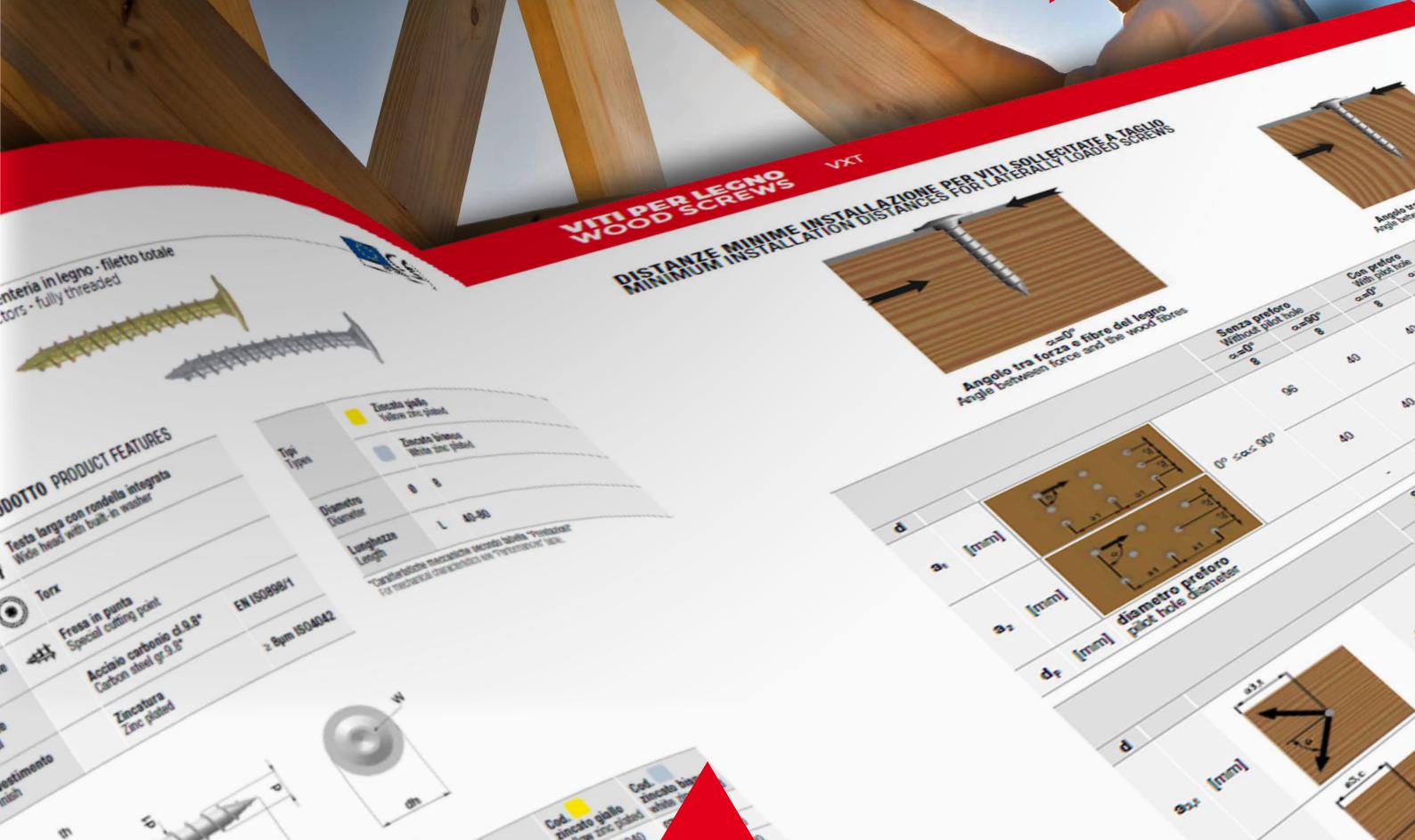
AN ESSENTIAL TOOL FOR DESIGNERS AND PROFESSIONALS.

► IT CONTAINS ALL THE DETAILED INFORMATION FOR A CORRECT USE OF THE FRIULSIDER FIXINGS:

- wood product range
- design loads
- references to CE certifications
- installation instructions
- application examples

**DOWNLOAD:**

[www.friulsider.com](http://www.friulsider.com)



**FRIULSIDER**  
YOUR FIXING FACTORY

Code	Page	Code	Page	Code	Page	Code	Page
39640	117	62200	100	73304	56	96500	74
39641	117	62202	100	73307	56	96600	74
39644	116	62203	100	73310	56	96701	74
39650	115	62204	100	73311	56	96720	74
39652	115	62700	104	73312	56	96800	74
39672	116	62701	104	73313	56	96900	74
39673	115	62703	104	74400	54	97200	74
39674	116	64001	86	74411	54	97300	74
39686	117	64100	84	74412	54	97400	74
39689	115	64101	84	74413	54	G1000	76
39691	116	64102	84	74414	54	G3000	76
39692	117	64103	84	75200	58	G4000	76
49902	58	64301	81/82	75203	58	G4100	76
60001	98	64302	81/82	75204	58	G4200	76
60070	88/92	64402	81/82	75205	58	G4300	76
60071	88/92	64600	78	75320	52	G4500	76
60072	88	64601	78	75350	50	G4600	76
60073	88	64602	78/79	79302	44/46	G6000	76
60074	89	64603	78/79	79303	45/46	G6100	76
60076	89	64700	78	79309	48	G6200	76
60077	89	64703	78/79	79402	44	G6300	76
60078	89	65000	96	93300	68	G7000	76
60079	89	65002	96	93401	68	G7100	76
60091	89	66000	94	93501	69	G8000	76
60101	98	66001	94	93600	70	G8100	76
61925	106/108	66003	94	94103	71	G8200	76
61927	110	72005	60	94301	71	G9002	76
61943	110	72006	62	95006	73	G9003	76
61951	112	72007	62	95103	73	G9004	76
61953	106	72008	62	95403	72	G9005	76
62100	102	72009	62	95502	72	G9006	76
62102	102	72010	64	96000	75	G9100	76
62103	102	73300	56	96100	75	G9200	76
62105	102	73301	56	96200	74		
62107	102	73302	56	96301	74		
62109	102	73303	56	96400	75		

# KEY TO SYMBOLS

concrete



solid stone



solid brick



honeycomb brick



cell like clay brick



aerated concrete



plasterboard



wood



partially suitable applications



quantity and delivery terms to be agreed



anchor engineering software



FRIULSIDER is a company associated with ECAP  
European Consortium of Anchors Producers

<http://www.ecap-sme.org/>

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In the case of translations, the official reference documents are those in Italian.

**10000eng01302**



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