Deutsches Institut für Bautechnik

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Approval body for construction products and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and Laender Governments

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European Technical Assessment

ETA-16/0381 of 7 August 2020

English translation prepared by DIBt - Original version in German language

General Part

Technical Assessment Body issuing the European Technical Assessment:	Deutsches Institut für Bautechnik
Trade name of the construction product	AMBFAST europe screws
Product family to which the construction product belongs	Screws for use in timber constructions
Manufacturer	AMBROVIT S.P.A. via Giulio Natta 29 27026 GARLASCO (PV) ITALIEN
Manufacturing plant	668, 1294, 1296, 2645, 7753, 9650, 8603, 9018, 9758
This European Technical Assessment contains	31 pages including 5 annexes which form an integral part of this assessment
This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of	EAD 130118-01-0603
This version replaces	ETA-16/0381 issued on 31 January 2017

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Specific Part

1 Technical description of the product

AMBFAST europe screws with the manufacturer code no. 04364, 04354, 05452, 57062, 67052, 67552, 76352, 76552, 87052, 87352 and 97052 are self-tapping screws made from special carbon steel. The screws are hardened. The screws have a corrosion protection according to Annex A.2.6 and an antifriction coating. AMBFAST europe screws with the manufacturer code no. 04367 are made from stainless steel. The outer thread diameter is not less than 3.0 mm and not greater than 12.0 mm. The overall length of the screws is ranging from 16 mm to 600 mm. Further dimensions are shown in Annex 5.

The washers with the manufacturer code no. 00077 are made from carbon steel. The dimensions of the washers are given in Annex 5.

2 Specification of the intended use in accordance with the applicable European Assessment Document

The performances given in Section 3 are only valid if the screws are used in compliance with the specifications and conditions given in Annex 1 and 2.

Durability is only ensured if the specifications of intended use according to Annex 1 and 2 are taken into account.

The verifications and assessment methods on which this European Technical Assessment is based lead to the assumption of a working life of the AMBFAST europe screws of at least 50 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

3 Performance of the product and references to the methods used for its assessment

3.1 Mechanical resistance and stability (BWR 1)

Essential characteristic	Performance
Dimensions	See Annex 5
Characteristic yield moment	See Annex 2
Bending angle	See Annex 2
Characteristic withdrawal parameter	See Annex 2
Characteristic head pull-through parameter	See Annex 2
Characteristic tensile strength	See Annex 2
Characteristic yield strength	See Annex 2
Characteristic torsional strength	See Annex 2
Insertion moment	See Annex 2
Spacing, end and edge distances of the screws and minimum thickness of the wood based material	See Annex 2
Slip modulus for mainly axially loaded screws	See Annex 2
Durability against corrosion	See Annex 2

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Class A1

3.3 Safety and accessibility in use (BWR 4)

Same as BWR 1

4 Assessment and verification of constancy of performance (AVCP) system applied, with reference to its legal base

In accordance with EAD No. 130118-01-0603 the applicable European legal act is: 97/176/EC.
The system to be applied is: 3

5 Technical details necessary for the implementation of the AVCP system, as provided for in the applicable EAD

Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited with Deutsches Institut für Bautechnik.

Issued in Berlin on 7 August 2020 by Deutsches Institut für Bautechnik

BD Dipl.-Ing. Andreas Kummerow
Head of Department

beglaubigt:
Dewitt

Deutsches Institut für Bautechnik DIBt

Annex 1 Specifications of intended use

A.1.1 Use of the AMBFAST europe screws only for:

– Static and quasi-static loads

A.1.2 Base materials

The screws are used for connections in load bearing timber structures between wood-based members or between those members and steel members:

– Solid timber (softwood) according to EN 14081-1[1],
– Glued laminated timber (softwood) according to EN 14080[2],
– Laminated veneer lumber LVL of softwood according to EN 14374[3], arrangement of the screws only perpendicular to the plane of the veneers,
– Glued solid timber (softwood) according to EN 14080 or national provisions that apply at the installation site,
– Cross-laminated timber (softwood) according to European Technical Approvals/Assessments or national provisions that apply at the installation site.

The screws may be used for connecting the following wood-based panels to the timber members mentioned above:

– Plywood according to EN 636[4] and EN 13986[5],
– Oriented Strand Board, OSB according to EN 300[6] and EN 13986,
– Particleboard according to EN 312[7] and EN 13986,
– Fibreboards according to EN 622-2[8], EN 622-3[9] and EN 13986,
– Cement-bonded particle boards according to EN 634-2[10] and EN 13986,
– Solid-wood panels according to EN 13353[11] and EN 13986.

Wood-based panels are only be arranged on the side of the screw head.

AMBFAST europe screws with an outer thread diameter of at least 6 mm are also used for the fixing of thermal insulation material on top of rafters or on wood-based members in vertical façades.

AMBFAST europe screws 87352 and 76352 are also used for compression reinforcement of timber structures perpendicular to the grain.

1	EN 14081-1:2005+A1:2011	Timber structures – Strength graded structural timber with rectangular cross section – Part 1: General requirements
2	EN 14080:2013	Timber structures - Glued laminated timber and glued solid timber - Requirements
3	EN 14374:2004	Timber structures - Structural laminated veneer lumber - Requirements
4	EN 636:2012+A1:2015	Plywood - Specifications
5	EN 13986:2004+A1:2015	Wood-based panels for use in construction - Characteristics, evaluation of conformity and marking
6	EN 300:2006	Oriented strand boards (OSB) – Definition, classification and specifications
7	EN 312:2010	Particleboards - Specifications
8	EN 622-2:2004	Fibreboards – Specifications – Part 2: Requirements for hardboards
9	EN 622-3:2004	Fibreboards - Specifications - Part 3: Requirements for medium boards
10	EN 634-2:2007	Cement-bonded particleboards – Specifications – Part 2: Requirements for OPC bonded particleboards for use in dry, humid and external conditions
11	EN 13353:2008+A1:2011	Solid wood panels (SWP) – Requirements

AMBFAST europe screws	Annex 1
Specifications of intended use	

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A.1.3 Use Conditions (environmental conditions)

The corrosion protection of the AMBFAST europe screws is specified in Annex A.2.6.

A.1.4 Installation provisions

EN 1995-1-1[12] in conjunction with the respective national annex applies for the installation.

A minimum of two screws is used for connections in load bearing timber structures.

The screws are driven into the wood-based member made of softwood without pre-drilling. The screw holes in steel members are pre-drilled with an adequate diameter greater than the outer thread diameter.

If screws with an outer thread diameter $d \geq 8$ mm are driven into the wood-based member without pre-drilling, the structural solid or glued laminated timber, laminated veneer lumber and similar glued members is from spruce, pine or fir.

In the case of fastening battens on thermal insulation material on top of rafters the screws are driven in the rafter through the battens and the thermal insulation material without pre-drilling in one sequence.

Countersunk head screws 87052 and 87352 can be used with washers according to Annex 5. After inserting the screw the washers touch the surface of the wood-based member completely.

By fastening screws in wood-based members the head of the screws is flush with the surface of the wood-based member. For wafer head, hexagon head and pan head screws the head part remains unconsidered.

[12] EN 1995-1-1: 2004+AC:2006+A1:2008+A2:2014 Eurocode 5: Design of timber structures – Part 1-1: General - Common rules and rules for buildings

AMBFAST europe screws	Annex 1
Installation provisions	

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ANNEX 2 – Characteristic values of the load-carrying capacities

Table A.2.1 Characteristic load-carrying capacities of AMBFAST europe screws made of carbon steel

Outer thread diameter [mm]	**3.0**	**3.2**	**3.5**	**4.0**	**4.5**	**5.0**	**6.0**	**8.0**	**10.0**	**12.0**
Characteristic yield moment $M_{y,k}$ [Nm]	1.0	1.0	1.7	1.7	2.6	3.8	7.0	17.0	23.5	34.0
Characteristic tensile strength $f_{tens,k}$ [kN]	3.0	4.0	5.0	5.0	6.0	6.5	13.0	23.0	29.0	33.0
Characteristic torsional strength $f_{tor,k}$ [Nm]	1.6	1.8	2.5	2.6	3.5	4.5	10.0	26.0	42.0	52.0

Table A.2.2 Characteristic load-carrying capacities of AMBFAST europe screws made of stainless steel (04367)

Outer thread diameter [mm]	**5.0**
Characteristic yield moment $M_{y,k}$ [Nm]	3.0
Characteristic tensile strength $f_{tens,k}$ [kN]	6.5
Characteristic torsional strength $f_{tor,k}$ [Nm]	4.5

A.2.1 General

All AMBFAST europe screws achieve a bending angle α of at least $45/d^{0.7} + 20$, where d is the outer thread diameter of the screws.

The minimum penetration length of the threaded part of the screw in the wood-based members l_{ef} is

$$l_{ef} = \min \begin{cases} \frac{4 \cdot d}{\sin \alpha} \\ 20 \cdot d \end{cases} \qquad (2.1)$$

where

α angle between screw axis and grain direction

d outer thread diameter of the screw.

The outer thread diameter of screws inserted in cross-laminated timber is at least 6 mm. The inner thread diameter d_1 of the screws is greater than the maximal width of the gaps in the layer of cross laminated timber.

A.2.2 Laterally loaded screws

The outer thread diameter d is used as effective diameter of the screw according to EN 1995-1-1.
The embedding strength for the screws in wood-based members or in wood-based panels shall be taken from EN 1995--1-1 or from national provisions that apply at the installation site unless otherwise specified in the following.

A.2.3 Axially loaded screws

The axial slip modulus K_{ser} of the threaded part of a screw for the serviceability limit state shall be taken independent of angle α to the grain as:

$$K_{ser} = 780 \cdot d^{0,2} \cdot l_{ef}^{0,4} \quad [N/mm] \qquad (2.2)$$

Where

d outer thread diameter of the screw [mm]
l_{ef} penetration length of the threaded part of the screw in the wood-based member [mm].

A.2.3.1 Axial withdrawal capacity

The characteristic withdrawal capacity in solid timber, glued laminated timber, cross laminated timber or laminated veneer lumber members made from softwood at an angle of 0° ≤ α ≤ 90° to the grain shall be calculated as:

$$F_{ax,\alpha,Rk} = n_{ef} \cdot k_{ax} \cdot f_{ax,k} \cdot d \cdot \ell_{ef} \cdot \left(\frac{\rho_k}{350}\right)^{0.8} \qquad (2.3)$$

where

$F_{ax,\alpha,Rk}$ Characteristic withdrawal capacity of a screw group at an angle α to the grain [N]
n_{ef} Effective number of screws according to EN 1995-1-1:2008, clause 8.7.2 (8)
k_{ax} Factor, taking into account the angle α between screw axis and grain direction

$k_{ax} = 1.0$ for 45° ≤ α ≤ 90°

$$k_{ax} = 0.3 + \frac{0.7 \cdot \alpha}{45°} \quad \text{for } 15° \le \alpha < 45° \qquad (2.4)$$

Equation (2.3) may be used for angles α between screw axis and grain direction 0° ≤ α < 15° if the following requirements are fulfilled:

1. The screws are inserted in solid timber, glued laminated timber, glued solid timber or laminated veneer lumber made from softwood.
2. The penetration length of the threaded part of the screws is

$$l_{ef} = \min\begin{cases} \dfrac{4 \cdot d}{\sin\alpha} \\ 20 \cdot d \end{cases}$$

3. At least four screws are used in a connection.

AMBFAST europe screws	Annex 2
Characteristic values of the load-carrying capacities	

$f_{ax,k}$ Characteristic withdrawal parameter at an angle $\alpha = 90°$ based on a characteristic density of the wood-based member ρ_k of 350 kg/m³

$f_{ax,k}$ = 12.0 N/mm² for screws with 3 mm ≤ d ≤ 4.5 mm

$f_{ax,k}$ = 10.0 N/mm² for screws with d = 5 mm

$f_{ax,k}$ = 8.0 N/mm² for screws with d ≥ 6 mm

The characteristic withdrawal parameter is also valid for softwood layers of cross-laminated timber.

ρ_k Characteristic density of the wood-based member, for LVL ρ_k ≤ 500 kg/m

A.2.3.2 Head pull-through capacity

The characteristic value of the head pull-through parameter for AMBFAST europe screws for a characteristic density of 350 kg/m³ of the timber and for wood-based panels like

- Plywood according to EN 636 and EN 13986
- Oriented Strand Board, OSB according to EN 300 and EN 13986
- Particleboard according to EN 312 and EN 13986
- Fibreboards according to EN 622-2, EN 622-3 and EN 13986
- Cement-bonded particle boards according to EN 634-2 and EN 13986,
- Solid-wood panels according to EN 13353 and EN 13986

with a thickness of more than 20 mm is

$f_{head,k}$ = 9.5 N/mm²
$f_{head,k}$ = 7.3 N/mm² for screws 87052 and 87352 in combination with washer 00077.

For wood-based panels a maximum characteristic density of 380 kg/m³ and for LVL a maximum characteristic density of 500 kg/m³ shall be used in equation (8.40b) of EN 1995-1-1.

The head diameter shall be equal to or greater than $1.8 \cdot d_s$, where d_s is the smooth shank or the inner thread diameter. Otherwise the characteristic head pull-through capacity in equation (8.40b) of EN 1995-1-1 is for all wood-based materials: $F_{ax,\alpha,RK} = 0$.
For wood based panels with a thickness 12 mm ≤ t ≤ 20 mm the characteristic value of the head pull-through parameter for the screws is:

$f_{head,k}$ = 8 N/mm²

For wood based panels with a thickness of less than 12 mm the characteristic head pull-through capacity for screws shall be based on a characteristic value of the head pull-through parameter of 8 N/mm², and limited to 400 N complying with the minimum thickness of the wood based panels of 1.2·d, with d as outer thread diameter and the values in Table A.2.3.

Table A.2.3 Minimum thickness of wood based panels

Wood based panel	**Minimum thickness [mm]**
Plywood	6
Fibreboards (hardboards and medium boards)	6
Oriented Strand Boards, OSB	8
Particleboards	8
Cement-bonded particle board	8
Solid wood Panels	12

Outer diameter of washer d_k > 32 mm shall not be considered.
In steel-to-timber connections the head pull-through capacity is not governing.

A.2.3.3 Compressive capacity of AMBFAST europe screws

The design axial capacity $F_{ax,Rd}$ of AMBFAST europe screws 87352 and 76352 embedded in solid timber, glued solid timber or glued laminated timber made from softwood with an angle between screw axis and grain direction of $30° \le \alpha \le 90°$ is the minimum of the axial resistance against pushing-in and the buckling resistance of the screw.

$$F_{ax,Rd} = \min \left\{ f_{ax,d} \cdot d \cdot \ell_{ef};\ \kappa_c \cdot N_{pl,d} \right\} \quad (2.5)$$

$f_{ax,d}$ design value of the axial withdrawal capacity of the threaded part of the screw [N/mm²]
d outer thread diameter of the screw [mm]
l_{ef} penetration length of the threaded part of the screw in the timber member [mm]

$$\kappa_c = 1 \quad \text{for } \bar{\lambda}_k \le 0{,}2 \quad (2.6)$$

$$\kappa_c = \frac{1}{k + \sqrt{k^2 - \bar{\lambda}_k^2}} \quad \text{for } \bar{\lambda}_k > 0{,}2 \quad (2.7)$$

$$k = 0{,}5 \cdot \left[1 + 0{,}49 \cdot \left(\bar{\lambda}_k - 0{,}2 \right) + \bar{\lambda}_k^2 \right] \quad (2.8)$$

and a relative slenderness ratio $\bar{\lambda}_k = \sqrt{\frac{N_{pl,k}}{N_{ki,k}}}$ (2.9)

where:

$N_{pl,k}$ characteristic plastic normal force related to the net cross-section of the inner thread diameter: $N_{pl,k} = \pi \cdot \frac{d_1^2}{4} \cdot f_{y,k}$ (2.10)

$f_{y,k}$ characteristic yield strength,
$f_{y,k}$ = 900 N/mm² for AMBFAST europe screws 87352 and 76352

d_1 inner thread diameter of the screw [mm]

$$N_{pl,d} = \frac{N_{pl,k}}{\gamma_{M1}} \quad (2.11)$$

γ_{M1} partial factor according to EN 1993-1-1 in conjunction with the particular national annex

Characteristic ideal elastic buckling load:

$$N_{ki,k} = \sqrt{c_h \cdot E_S \cdot I_S} \ \text{[N]} \quad (2.12)$$

Elastic foundation of the screw:

$$c_h = \left(0{,}19 + 0{,}012 \cdot d\right) \cdot \rho_k \cdot \left(\frac{90° + \alpha}{180°} \right) \ \text{[N/mm²]} \quad (2.13)$$

ρ_k characteristic density of the wood-based member [kg/m³],
α angle between screw axis and grain direction, $30° \le \alpha \le 90°$

Modulus of elasticity:

E_s = 210000 N/mm²

Second moment of area:

$$I_s = \frac{\pi \cdot d_1^4}{64} \ \text{[mm}^4\text{]} \quad (2.14)$$

AMBFAST europe screws	Annex 2
Compressive capacity	

A.2.4 Spacing, end and edge distances of the screws and minimum thickness of the wood based material

The provisions given in EN 1995-1-1 apply, if not specified otherwise in the following.

A.2.4.1 Laterally and/or axially loaded screws

Screws in non pre-drilled holes

For AMBFAST europe screws minimum spacing and distances are given in EN 1995-1-1: 2004+AC:2006+A1: 2008+A2:2014, clause 8.3.1.2 and Table 8.2 as for nails in non-predrilled holes. Here, the outer thread diameter d shall be considered.

For Douglas fir members minimum spacing and distances parallel to the grain shall be increased by 50%.

Minimum distances from loaded or unloaded ends shall be at least 15·d for screws with outer thread diameter d ≥ 8 mm and timber thickness t < 5·d.

Minimum distances from the unloaded edge perpendicular to the grain may be reduced to 3·d also for timber thickness t < 5·d, if the spacing parallel to the grain and the end distance is at least 25·d.

A.2.4.2 Only axially loaded screws

For AMBFAST europe screws the minimum spacings, end and edge distances are given in EN 1995-1-1: 2004+AC:2006+A1:2008+A2:2014, clause 8.3.1.2 and Table 8.2 as for nails in non-predrilled holes and clause 8.7.2, Table 8.6.

A.2.5 Insertion moment

The ratio between the characteristic torsional strength $f_{tor,k}$ and the mean value of insertion moment $R_{tor,mean}$ fulfills the requirement for all screws.

A.2.6 Durability against corrosion

Screws and washers made from carbon steel may have the coatings according to Table A.2.4

Table A.2.4 Coatings of the AMBFAST europe screws

Coating	**Mean thickness of the coating [µm]**
electrogalvanised	4
	5
	8
electrogalvanized and yellow chromated	4
	5
	8

Stainless steel no. 1.4401 is used for screws 04367.
Contact corrosion shall be avoided.

AMBFAST europe screws	Annex 2
Spacing, end and edge distances of the screws, insertion moment and durability against corrosion	

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ANNEX 3 Compression reinforcement perpendicular to the grain

A.3.1 General

Only AMBFAST europe screws 87352 and 76352 are used for compression reinforcement perpendicular to the grain. The provisions are valid for timber members made from solid timber, glued solid timber and glued laminated timber made from softwood.
The compression force shall evenly be distributed to the screws used as compression reinforcement.
The screws are driven into the timber member perpendicular to the contact surface under an angle between the screw axis and the grain direction of 45° to 90°. The screw heads must be flush with the timber surface.

A.3.2 Design

For the design of reinforced contact areas the following conditions must be met independently of the angle between the screw axis and the grain direction.

The design resistance of a reinforced contact area is:

$$R_{90,d} = \min \begin{Bmatrix} k_{c,90} \cdot B \cdot \ell_{ef,1} \cdot f_{c,90,d} + n \cdot \min\left\{R_{ax,d}; \kappa_c \cdot N_{pl,d}\right\} \\ B \cdot \ell_{ef,2} \cdot f_{c,90,d} \end{Bmatrix} \quad (3.1)$$

where:

$k_{c,90}$ Parameter according to EN 1995-1-1:2004+A1: 2008, 6.1.5

B Bearing width [mm]

$\ell_{ef,1}$ Effective contact length according to EN 1995-1-1:2004+A1: 2008, 6.1.5 [mm]

$f_{c,90,d}$ Design compressive strength perpendicular to the grain [N/mm²]

n Number of reinforcing screws, $n = n_0 \cdot n_{90}$

n_0 Number of reinforcing screws arranged in a row parallel to the grain

n_{90} Number of reinforcing screws arranged in a row perpendicular to the grain

$$R_{ax,d} = f_{ax,d} \cdot d \cdot \ell_{ef} \quad [N] \quad (3.2)$$

$f_{ax,d}$ design value of the axial withdrawal capacity of the threaded part of the screw [N/mm²]

d outer thread diameter of the screw [mm]

κ_c according to annex A.2.3.3

$N_{pl,d}$ according to annex A.2.3.3 [N]

$\ell_{ef,2}$ Effective contact length in the plane of the screw tips (see Figure 3.1) [mm]
$\ell_{ef,2} = \{\ell_{ef} + (n_0 - 1) \cdot a_1 + \min(\ell_{ef}\ ;\ a_{1,C})\}$ for end supports (see Figure 3.1 left)
$\ell_{ef,2} = \{2 \cdot \ell_{ef} + (n_0 - 1) \cdot a_1\}$ for intermediate supports (see Figure 3.1 right)

ℓ_{ef} Penetration length of the threaded part of the screw in the timber member [mm]

a_1 Spacing a_1 in a plane parallel to grain, see chapter A.2.4.2 [mm]

$a_{1,CG}$ End distance of the centre of gravity of the threaded part in the timber member, see chapter A.2.4.2 [mm]

AMBFAST europe screws	Annex 3
Compression reinforcement perpendicular to the grain	

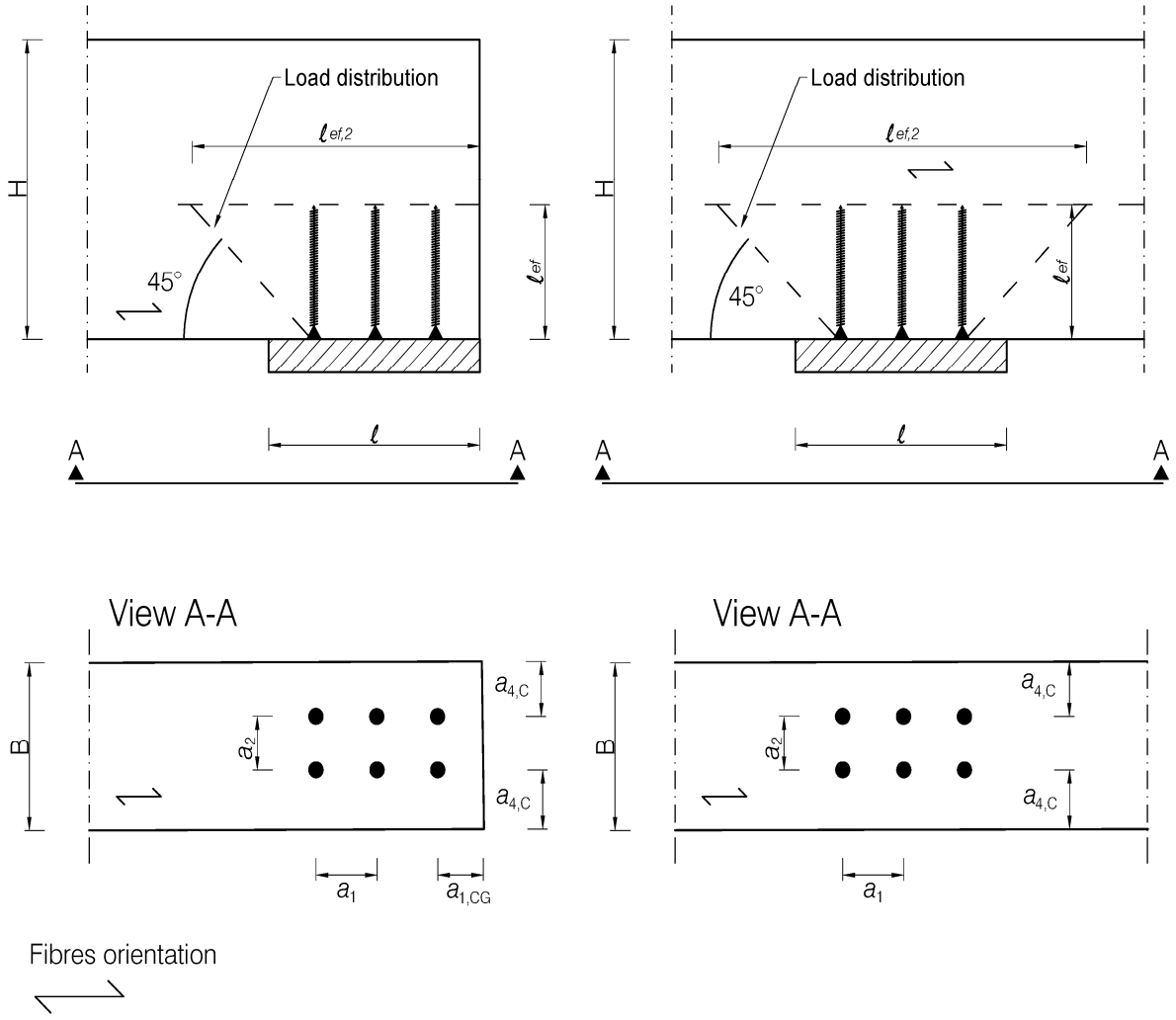

Figure A.3.1: Reinforced end support (left) and reinforced intermediate support (right)

AMBFAST europe screws	Annex 3
Compression reinforcement perpendicular to the grain	

ANNEX 4 - Fastening of thermal insulation material on top of rafters

A.4.1 General

AMBFAST europe screws with an outer thread diameter of at least 6 mm are also used for the fixing of thermal insulation material on top of rafters or on wood-based members in vertical façades. In the following, the meaning of the word rafter includes wood-based members with inclinations between 0° and 90°.
The thickness of the thermal insulation material is up to 300 mm. A thermal insulation material is used that is applicable as insulation on top of rafters or on wood-based members in vertical façades.
The battens have to be from solid timber according to EN 338/ EN 14081-1. The minimum thickness t and the minimum width b of the battens are given in table A.4.1:

Table A.4.1 Minimum thickness and minimum width of the battens

Outer thread diameter [mm]	Minimum thickness t [mm]	Minimum width b [mm]
6 and 8	30	50
10	40	60
12	80	100

Instead of battens the wood-based panels specified in chapter A.4.2.1 may be used. Only screws with countersunk head shall be used for fixing wood-based panels on rafters with thermal insulation material as interlayer.

The minimum width of the rafters shall be 60 mm.

The spacing between screws shall be not more than 1.75 m.

Friction forces shall not be considered for the design of the characteristic axial load of the screws.

The anchorage of wind suction forces as well as the bending stresses of the battens shall be considered for design. Screws perpendicular to the grain of the rafter (angle α = 90 °) may be arranged where required considering the design of the battens.

A.4.2 Parallel inclined screws and thermal insulation material in compression

A.4.2.1 Mechanical model

The system of rafter, thermal insulation material on top of rafter and counter battens parallel to the rafter may be considered as a beam on elastic foundation. The counter batten represents the beam, and the thermal insulation material on top of the rafter the elastic foundation. The minimum compressive stress of the thermal insulation material at 10 % deformation, measured according to EN 826[13], shall be $\sigma_{(10\,\%)}$ = 0.05 N/mm². The counter batten is loaded perpendicular to the axis by point loads F_b transferred by regularly spaced battens. Further point loads F_s are caused by the shear load of the roof due to dead and snow load, which are transferred from the screw heads into the counter battens.

Instead of battens the following wood-based panels may be used to cover the thermal insulation material if they are suitable for that use:

- Plywood according to EN 636 and EN 13986,
- Oriented Strand Board, OSB according to EN 300 and EN 13986,
- Particleboard according to EN 312 and EN 13986
- Fibreboards according to EN 622-2, EN 622-3 and EN 13986.

The minimum thickness of the wood-based panels shall be 22 mm.

The word batten includes the meaning of wood-based panels in the following.

[13] EN 826:2013 Thermal insulating products for building applications - Determination of compression behaviour

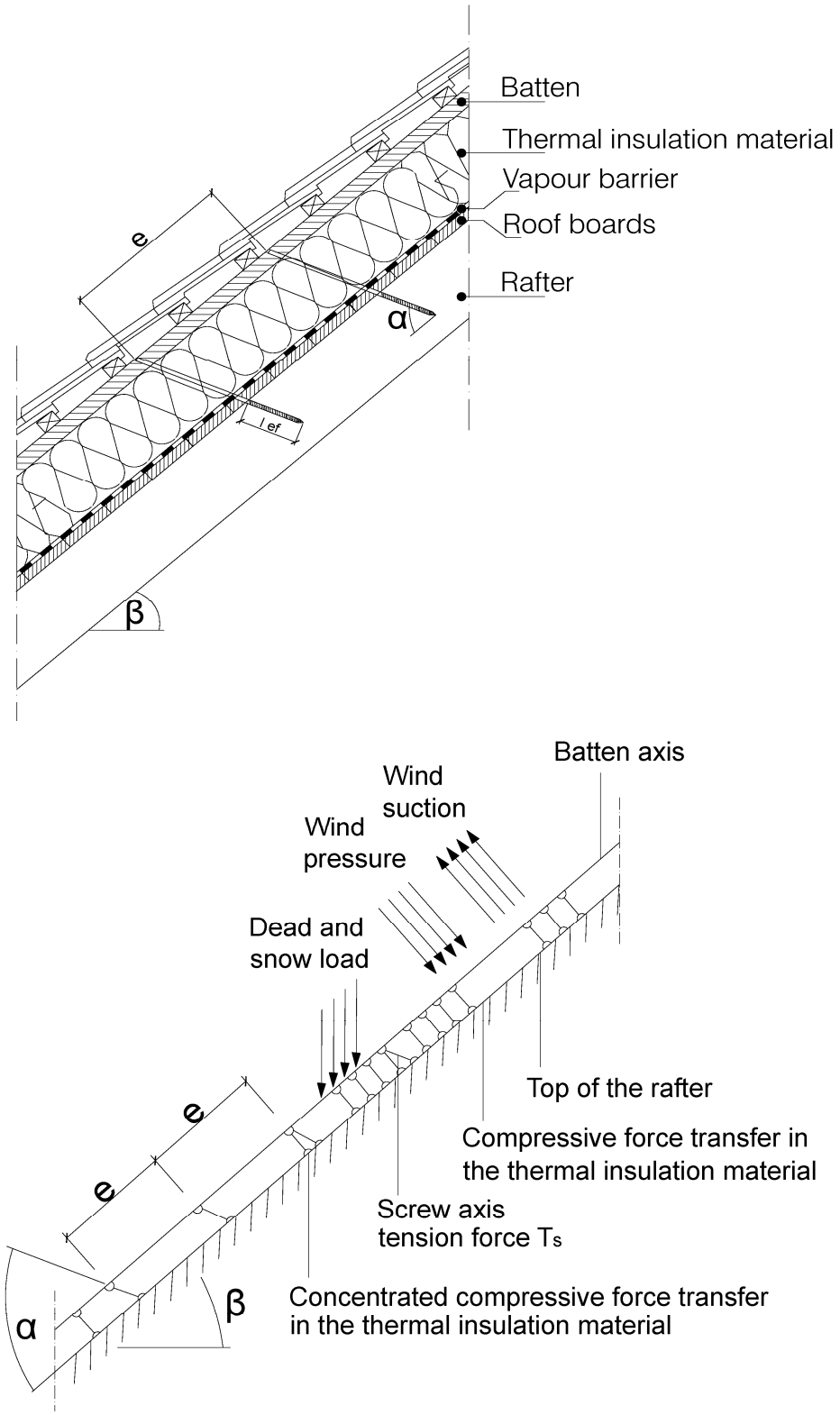

Figure A.4.1 Fastening of the thermal insulation material on top of rafters - structural system

AMBFAST europe screws	Annex 4
Fastening of thermal insulation material on top of rafters	

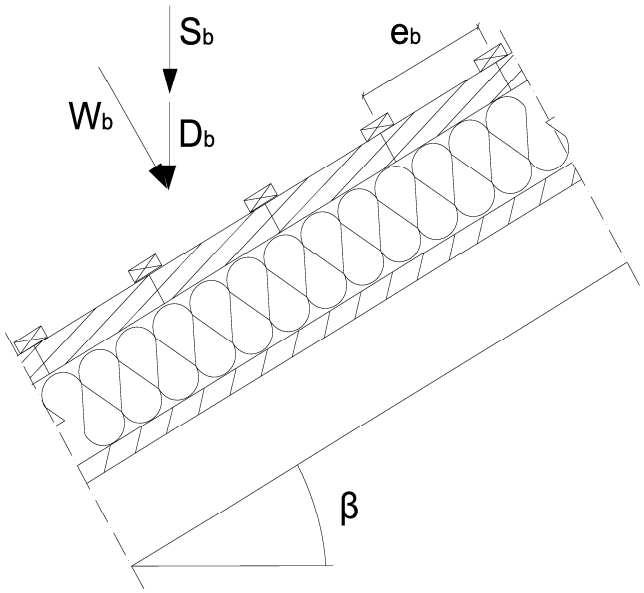

Figure A.4.2 Point loads F_b perpendicular to the battens

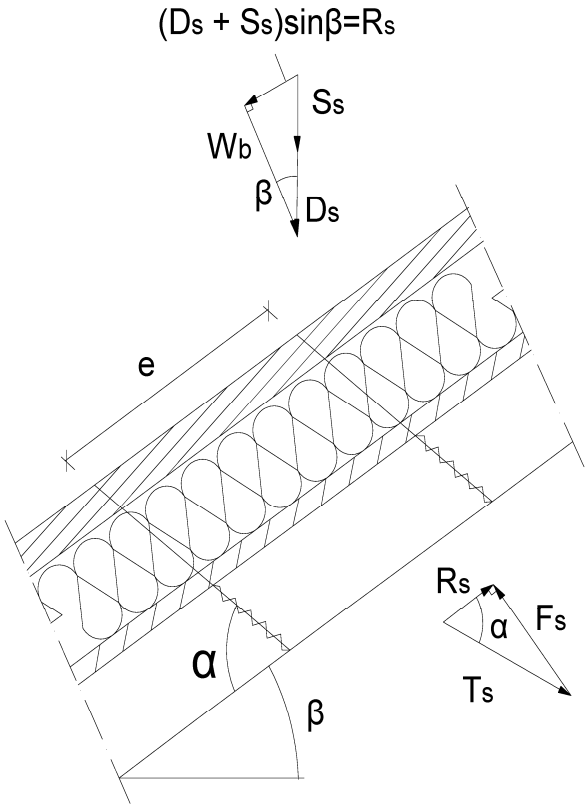

Figure A.4.3 Point loads F_s perpendicular to the battens, load application in the area of the screw heads

AMBFAST europe screws	Annex 4
Fastening of thermal insulation material on top of rafters	

A.4.2.2 Design of the battens

It's assumed that the spacing between the counter battens exceeds the characteristic length l_{char}.

The characteristic values of the bending stresses are calculated as:

$$M_k = \frac{(F_{b,k} + F_{s,k}) \cdot l_{char}}{4} \quad (4.1)$$

where

$$l_{char} = \text{characteristic length } l_{char} = \sqrt[4]{\frac{4 \cdot EI}{w_{ef} \cdot K}} \quad (4.2)$$

EI = bending stiffness of the batten
K = coefficient of subgrade
w_{ef} = effective width of the thermal insulation material
$F_{b,k}$ = point loads perpendicular to the battens
$F_{s,k}$ = point loads perpendicular to the battens, load application in the area of the screw heads

The coefficient of subgrade K may be calculated from the modulus of elasticity E_{HI} and the thickness t_{HI} of the thermal insulation material if the effective width w_{ef} of the thermal insulation material under compression is known. Due to the load extension in the thermal insulation material the effective width w_{ef} is greater than the width of the batten or rafter, respectively. For further calculations, the effective width w_{ef} of the thermal insulation material may be determined according to:

$$w_{ef} = w + t_{HI} / 2 \quad (4.3)$$

where
w = minimum from width of the batten or rafter, respectively
t_{HI} = thickness of the thermal insulation material

$$K = \frac{E_{HI}}{t_{HI}} \quad (4.4)$$

The following condition shall be satisfied:

$$\frac{\sigma_{m,d}}{f_{m,d}} = \frac{M_d}{W \cdot f_{m,d}} \le 1 \quad (4.5)$$

For the calculation of the section modulus W the net cross section shall be considered.

The characteristic values of the shear stresses shall be calculated according to:

$$V_k = \frac{(F_b + F_s)}{2} \quad (4.6)$$

The following condition need to be satisfied:

$$\frac{\tau_d}{f_{v,d}} = \frac{1.5 \cdot V_d}{A \cdot f_{v,d}} \le 1 \quad (4.7)$$

For the calculation of the cross section area the net cross section shall be considered.

A.4.2.3 Design of the thermal insulation material

The characteristic value of the compressive stresses in the thermal insulation material shall be calculated according to:

$$\sigma_k = \frac{1.5 \cdot F_{b,k} + F_{s,k}}{2 \cdot l_{char} \cdot w} \qquad (4.8)$$

The design value of the compressive stress shall not be greater than 110 % of the compressive strength at 10 % deformation calculated according to EN 826.

A.4.2.4 Design of the screws

The screws are loaded predominantly axial. The characteristic value of the axial tension force in the screw may be calculated from the shear loads of the roof R_s:

$$T_{S,k} = \frac{R_{S,k}}{\cos \alpha} \qquad (4.9)$$

The load-carrying capacity of axially loaded screws is the minimum design value of the axial withdrawal capacity of the threaded part of the screw, the head pull-through capacity of the screw and the tensile capacity of the screw according to Annex 2.

In order to limit the deformation of the screw head for thermal insulation material with thickness over 220 mm or with compressive strength below 0.12 N/mm², respectively, the axial withdrawal capacity of the screws shall be reduced by the factors k_1 and k_2:

$$F_{ax,\alpha,Rd} = \min \left\{ k_{ax} \cdot f_{ax,d} \cdot d \cdot l_{ef} \cdot k_1 \cdot k_2 \cdot \left(\frac{\rho_k}{350} \right)^{0.8} ; f_{head,d} \cdot d_h^2 \cdot \left(\frac{\rho_k}{350} \right)^{0.8} ; \frac{f_{tens,k}}{\gamma_{M2}} \right\} \qquad (4.10)$$

where:

k_{ax}	factor, taking into account the angle α between screw axis and grain direction according to A.2.3.1
$f_{ax,d}$	design value of the axial withdrawal parameter of the threaded part of the screw [N/mm²]
d	outer thread diameter of the screw [mm]
l_{ef}	penetration length of the threaded part of the screw in the rafter [mm], 40 mm ≤ l_{ef} ≤ 100 mm
ρ_k	characteristic density of the wood-based member [kg/m³], for LVL the assumed characteristic density shall not exceed 500 kg/m³
α	angle α between screw axis and grain direction, 30° ≤ α ≤ 90°
$f_{head,d}$	design value of the head pull-through parameter of the screw [N/mm²]
d_h	head diameter of the screw [mm]
$f_{tens,k}$	characteristic tensile capacity of the screw according to Annex 2 [N]
γ_{M2}	partial factor according to EN 1993-1-1 in conjunction with the particular national annex
k_1	min {1; 220/t_{HI}}
k_2	min {1; $\sigma_{10\%}$/0.12}
t_{HI}	thickness of the thermal insulation material [mm]
$\sigma_{10\%}$	compressive stress of the thermal insulation material under 10 % deformation [N/mm²]

If equation (4.10) is fulfilled, the deflection of the battens does not need to be considered when designing the load-carrying capacity of the screws.

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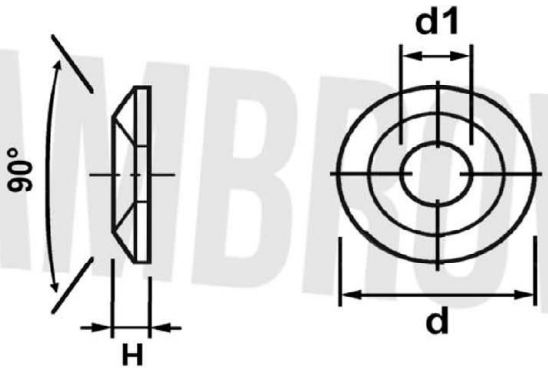
00077



Rif.	Nominal Diameter			
	Ø 6,00	Ø 8,00	Ø 10,00	Ø 12,00
H	4,60 + 0,30 - 0,30	5,40 + 0,30 - 0,30	6,40 + 0,30 - 0,30	8,50 + 0,30 - 0,30
d	19,50 + 0,30 - 0,30	24,50 + 0,30 - 0,30	30,00 + 0,30 - 0,30	37,50 + 0,30 - 0,30
d1	7,50 + 0,30 - 0,30	8,50 + 0,30 - 0,30	10,80 + 0,30 - 0,30	14,00 + 0,30 - 0,30

AMBFAST europe screws	Annex 5.1
Washers for TX flat head carpentry screws	

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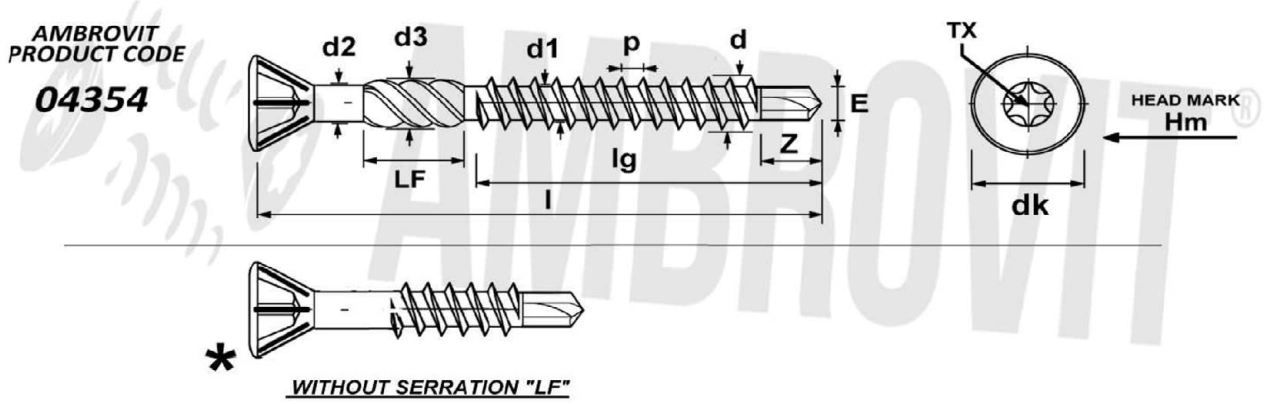

Rif.	Nominal Diameter	
	Ø 3,20	
Hm	N/A	
d	3,18	+ 0,13 / - 0,13
d1	2,07	+ 0,13 / - 0,13
d2	2,38	+ 0,10 / - 0,10
d3	2,90	+ 0,10 / - 0,10
p max	1,30	
LF	5,25	+ 0,25 / - 0,25
E	2,10	+ 0,10 / - 0,10
Z	3,85	+ 0,15 / - 0,15
dk	5,20	+ 0,20 / - 0,20
TX	10	

l +0 /-1,00	*20,00	*25,00	*30,00	*35,00	*40,00	45,00	50,00	60,00
lg ± 1,00	FULL	18,00	18,00	24,00	29,00	29,00	34,00	39,00

AMBFAST europe screws

Floor Board Screws TX 60° small head w/ drill point and ribs

Annex 5.2

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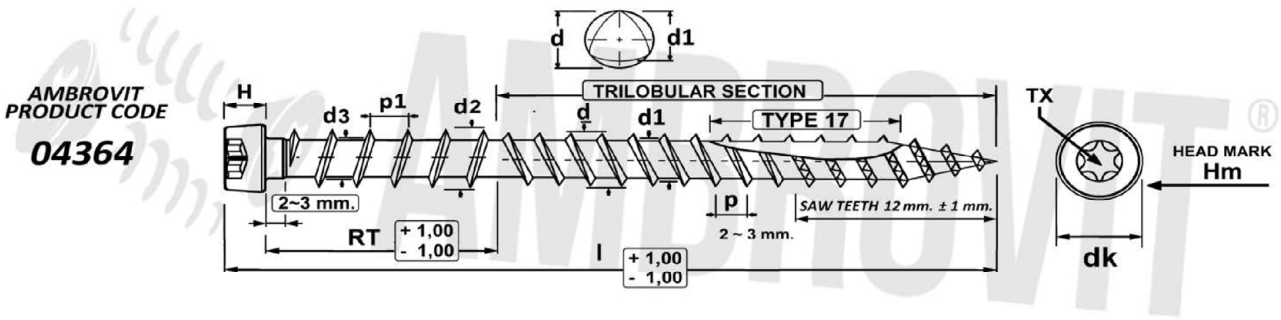

Rif.	Nominal Diameter	
	Ø 5,00	
Hm	N/A	
d3	3,27	+ 0,13 / - 0,12
d2	5,05	+ 0,15 / - 0,15
d1	4,65	+ 0,10 / - 0,10
d	4,92	+ 0,13 / - 0,12
p	2,10	± 5%
p1	2,80	± 5%
RT	15,00	+ 1,00 / - 1,00
dk	6,85	+ 0,15 / - 0,15
TX	20	

	l	RT
SIZE	40,00	15,00
	45,00	
	50,00	
	55,00	
	60,00	
	65,00	
	70,00	
	75,00	
	80,00	

AMBFAST europe screws	Annex 5.3
Terrace screws TX trim head reverse and trilobular thread w/type 17	

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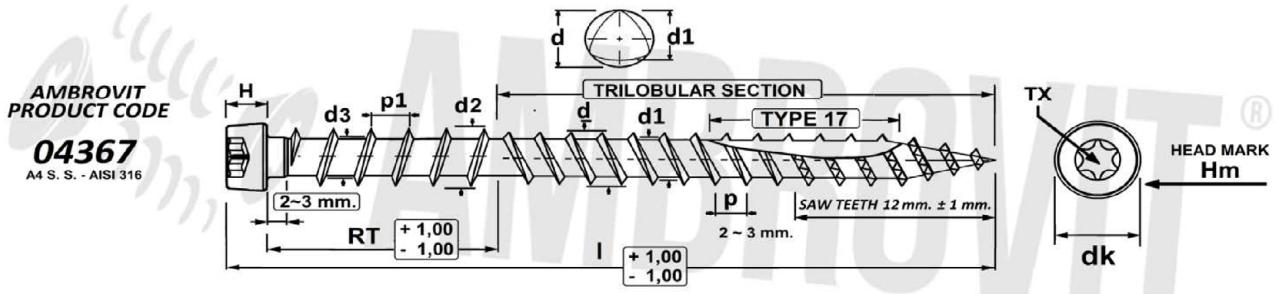

Rif.	Nominal Diameter
	Ø 5,00
Hm	N/A
d3	3,27 + 0,13 / - 0,12
d2	5,05 + 0,15 / - 0,15
d1	4,65 + 0,10 / - 0,10
d	4,92 + 0,13 / - 0,12
p	2,10 ± 5%
p1	2,80 ± 5%
RT	15,00 + 1,00 / - 1,00
dk	6,85 + 0,15 / - 0,15
TX	20

SIZE	l	RT
	40,00	15,00
	45,00	
	50,00	
	55,00	
	60,00	
	65,00	
	70,00	
	75,00	
	80,00	

AMBFAST europe screws	Annex 5.4
S.S. A4 Terrace screws TX trim head reverse and trilobular thread w/type 17	

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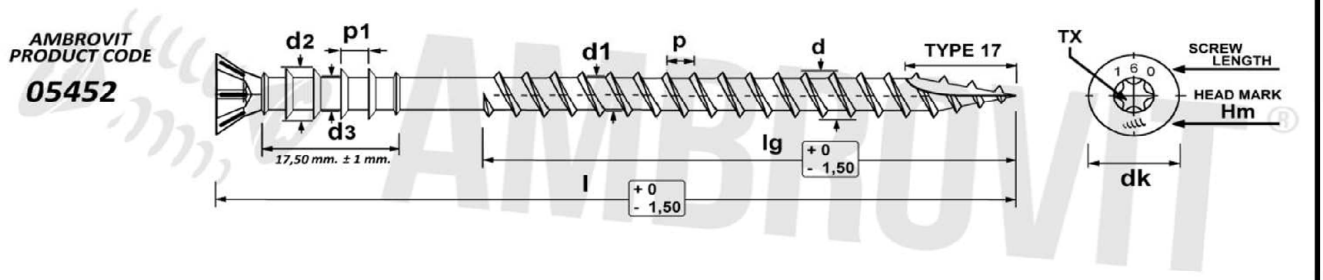

Rif.	Nominal Diameter
	Ø 6,00
Hm	
d3	4,00 + 0,05 / - 0,05
d2	6,65 + 0,10 / - 0,10
d1	3,72 + 0,12 / - 0,12
d	5,85 + 0,15 / - 0,15
p	2,60 ± 5%
p1	3,70 + 0,10 / - 0,10
dk	10,00 + 0,20 / - 0,20
TX	25

SIZE	l	lg
	60,00	30,00
	70,00	40,00
	80,00	50,00
	90,00	50,00
	100,00	60,00
	110,00	60,00
	120,00	60,00
	130,00	60,00
	145,00	60,00
	160,00	60,00

AMBFAST europe screws	Annex 5.5
Spacer Screws TX flat head w/b-ring type 17	

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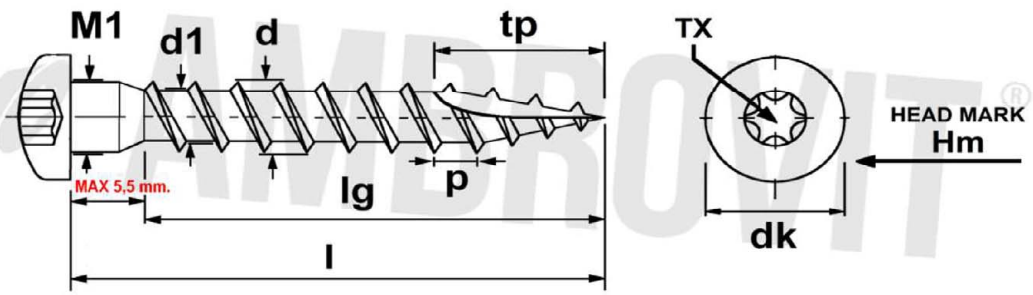
AMBROVIT PRODUCT CODE
57062



Rif.	Nominal Diameter Ø 5,00	
Hm	N/A	
d1	3,00	+ 0,15 - 0,15
d	4,90	+ 0,10 - 0,10
tp	12,00	+ 1,00 - 1,00
p	2,20	+ 0,22 - 0,22
dk	7,30	+ 0,20 - 0,20
M1	4,75	+ 0,15 - 0,15
TX	20	

l +0 /-1,00	25,00	30,00	35,00	40,00	45,00	50,00	60,00	70,00
lg ± 1,00	20,00	25,00	30,00	35,00	40,00	45,00	55,00	65,00

AMBFAST europe screws

Angle bracket screws TX reinforced pan head w/type 17

Annex 5.6

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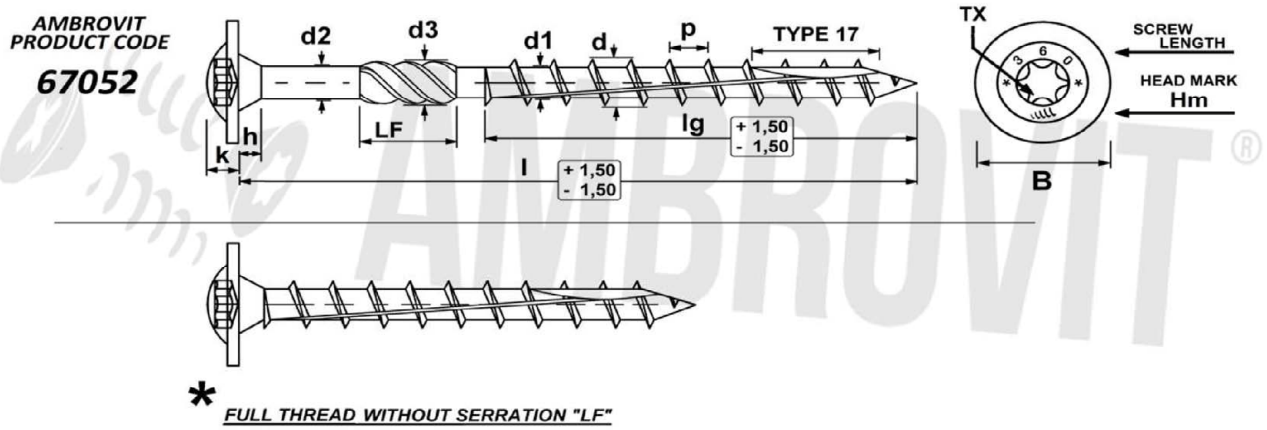

* FULL THREAD WITHOUT SERRATION "LF"

Rif.	Nominal Diameter		
	Ø 6,00	Ø 8,00	Ø 10,00
Hm			
d2	4,25 +0,05 -0,05	5,77 +0,05 -0,05	7,00 +0,05 -0,05
d3	5,05 +0,25 -0,25	7,00 +0,20 -0,20	7,00 +0,30 -0,30
d1	5,40 +0,20 -0,20	5,60 +10% -10%	6,00 +10% -10%
d	6,00 +0,20 -0,20	8,00 +0,20 -0,20	10,00 +0,30 -0,30
p	4,50 ± 5%	5,50 ± 5%	6,50 ± 5%
LF	12,00 +1,00 -1,00	12,00 +1,00 -1,00	12,00 +1,00 -1,00
B	14,00 +0,50 -0,50	22,50 +0,50 -0,50	25,50 +1,00 -1,00
h	≈ 2,50	≈ 3,00	≈ 4,00
k	≈ 2,50	≈ 3,50	≈ 3,50
TX	30	40	40

SIZE	l	lg	l	lg	l	lg
	from 30 to 50	FULL	50,00	FULL	80,00	40,00
	60,00	35,00	60,00	35,00	from 100 to 120	50,00
	70,00	42,00	70,00	42,00	from 140 to 400	80,00
	from 80 to 120	50,00	from 80 to 120	50,00		
	130,00	60,00	from 140 to 400	80,00		
	from 140 to 300	70,00	from 420 to 450	100,00		

AMBFAST europe screws	Annex 5.7
Carpentry screws TX wafer head w/serration type 17	

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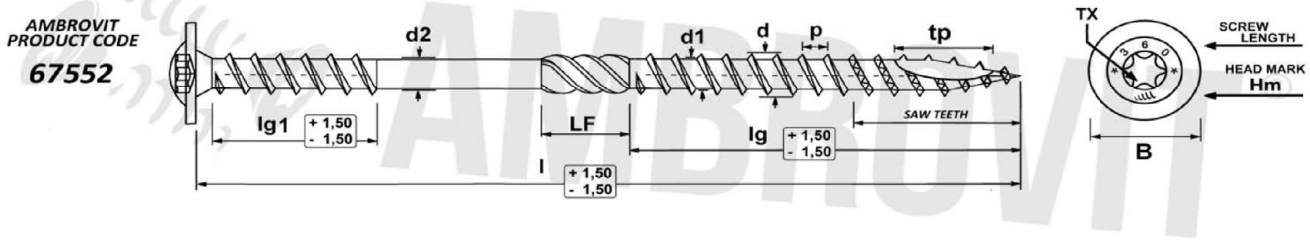

Rif.	Nominal Diameter	
	Ø 8,00	
Hm		
d2	5,80	+ 0,05 / - 0,05
d1	5,20	+ 0,25 / - 0,25
d	8,00	+ 0,20 / - 0,20
p	5,20	± 10%
tp	18,00	+ 3,00 / - 3,00
LF	12,00	+ 1,50 / - 1,50
B	22,00	+ 1,00 / - 1,00
TX	40	

	l	lg	lg1
SIZE	165,00	80,00	60,00
	195,00	80,00	60,00
	225,00	100,00	60,00
	235,00	100,00	60,00
	255,00	100,00	60,00
	275,00	100,00	60,00
	302,00	100,00	60,00
	335,00	100,00	60,00
	365,00	100,00	60,00
	397,00	100,00	60,00
	435,00	100,00	60,00
	472,00	100,00	60,00

AMBFAST europe screws	Annex 5.8
Insulation screws TX wafer head type 17 double thread	

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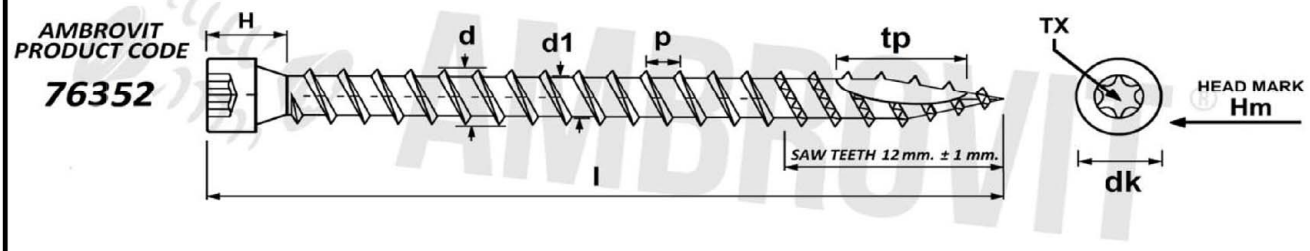

Rif.	Nominal Diameter			
	Ø 6,00	Ø 8,00	Ø 10,00	Ø 12,00
Hm	N/A	N/A	N/A	N/A
d	6,00 + 0,20 - 0,20	8,00 + 0,20 - 0,20	10,00 + 0,20 - 0,20	12,00 + 0,20 - 0,20
d1	4,00 + 0,20 - 0,20	5,20 + 0,25 - 0,25	6,20 + 0,30 - 0,30	7,00 + 0,30 - 0,30
p	3,80 + 10% - 10%	4,80 + 10% - 10%	5,60 + 10% - 10%	6,00 + 10% - 10%
tp	17,00 + 3,00 - 3,00	18,00 + 3,00 - 3,00	19,00 + 3,00 - 3,00	20,00 + 3,00 - 3,00
dk	11,50 + 0,50 - 0,50	14,50 + 0,50 - 0,50	18,00 + 0,50 - 0,50	21,00 + 0,50 - 0,50
H (max)	12,00	19,00	20,00	20,50
TX	30	40	50	50
l limit	from 80,00 to 300,00	from 160,00 to 500,00	600,00	
	± 1,50			

AMBFAST europe screws	Annex 5.9
Carpentry screws TX cylinder head type 17 full thread	

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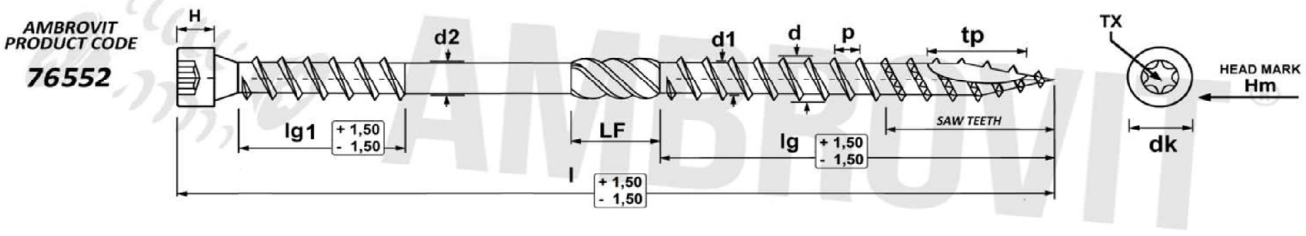

Rif.	Nominal Diameter	
	Ø 8,00	
Hm	N/A	
d2	5,80	+ 0,05 / - 0,05
d1	5,20	+ 0,25 / - 0,25
d	8,00	+ 0,20 / - 0,20
p	5,20	± 10%
tp	18,00	+ 3,00 / - 3,00
LF	12,00	+ 1,50 / - 1,50
dk	11,00	+ 0,00 / - 1,00
H	6,00	+ 0,05 / - 0,05
TX	40	

	l	lg	lg1
SIZE	165,00	80,00	60,00
	195,00	80,00	60,00
	225,00	100,00	60,00
	235,00	100,00	60,00
	255,00	100,00	60,00
	275,00	100,00	60,00
	302,00	100,00	60,00
	335,00	100,00	60,00
	365,00	100,00	60,00
	397,00	100,00	60,00
	435,00	100,00	60,00
	472,00	100,00	60,00

AMBFAST europe screws	Annex 5.10
Insulation screws TX cylinder head type 17 double thread	

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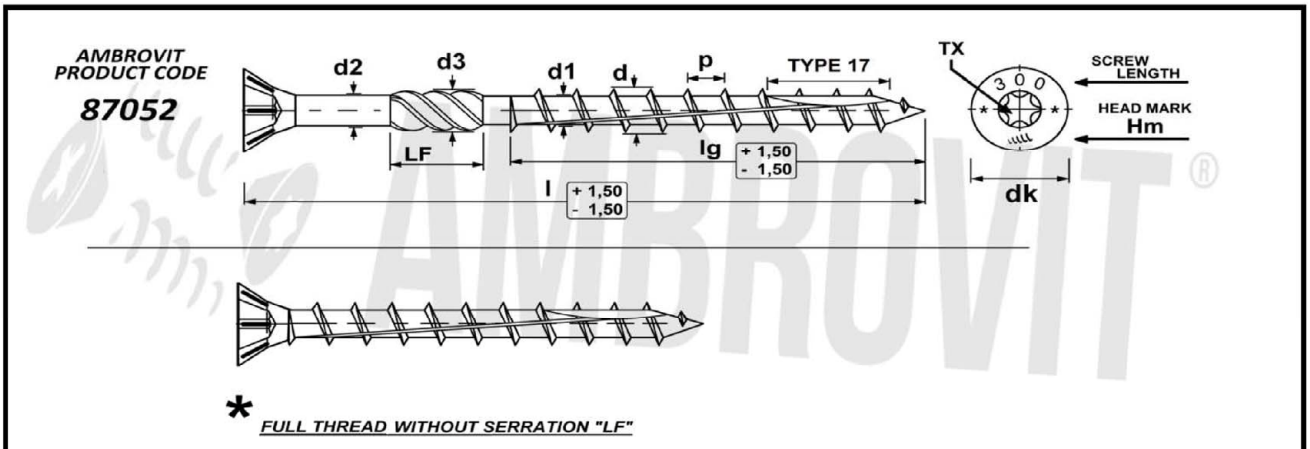

Rif.	Nominal Diameter								
	Ø 3,00	Ø 3,50	Ø 4,00	Ø 4,50	Ø 5,00	Ø 6,00	Ø 8,00	Ø 10,00	Ø 12,00
Hm	n/a	n/a	n/a	n/a	n/a	✓	✓	✓	✓
TX	10	15	20	25	25	30	40	40	50
dk	5,85 +0,20 -0,20	6,85 +0,20 -0,20	7,75 +0,25 -0,25	8,75 +0,25 -0,25	9,80 +0,20 -0,20	11,80 +0,30 -0,30	14,65 +0,35 -0,35	17,80 +0,40 -0,40	21,50 +0,50 -0,50
d2	2,15 +0,05 -0,05	2,50 +0,05 -0,05	2,85 +0,05 -0,05	3,15 +0,05 -0,05	3,50 +0,05 -0,05	4,25 +0,05 -0,05	5,78 +0,05 -0,05	7,00 +0,05 -0,05	8,00 +0,05 -0,05
d3	3,00 +0,20 -0,20	3,25 +0,15 -0,15	3,65 +0,15 -0,15	3,85 +0,15 -0,15	4,15 +0,25 -0,25	5,00 +0,20 -0,20	7,00 +0,20 -0,20	8,25 +0,25 -0,25	9,65 +0,20 -0,20
d1	1,95 +0,15 -0,15	2,20 +0,15 -0,15	2,45 +0,15 -0,15	2,70 +0,15 -0,15	3,10 +0,20 -0,20	3,85 +0,25 -0,25	5,30 +0,20 -0,20	6,30 +0,25 -0,25	6,60 +0,10 -0,10
d	3,00 +0,05 -0,15	3,50 +0,05 -0,15	4,00 +0,05 -0,30	4,50 +0,05 -0,30	5,00 +0,10 -0,30	6,00 +0,25 -0,25	8,00 +0,25 -0,25	10,00 +0,30 -0,30	12,00 +0,20 -0,20
p	1,45 +0,10% -0,10%	2,15 +0,10% -0,10%	2,52 +0,10% -0,10%	2,80 +0,10% -0,10%	3,20 +0,10% -0,10%	4,70 +0,10% -0,10%	5,50 +0,10% -0,10%	6,60 +0,10% -0,10%	6,00 +0,10% -0,10%
LF	4,00 +1,00 -1,00	5,00 +1,00 -1,00	5,00 +1,00 -1,00	7,00 +1,00 -1,00	8,00 +1,00 -1,00	11,00 +1,00 -1,00	12,00 +1,00 -1,00	12,00 +1,00 -1,00	12,00 +1,00 -1,00

SIZE	l	lg	l	lg	l	lg	l	lg	l	lg	l	lg	l	lg	l	lg	l	lg
	16*	FULL 13,50	20*	FULL 16	25	15	30	18	30*	FULL 24	40	24	50*	FULL 40	80	40	600	120
	20*	FULL 16	25	15	30	18	35	20	35	20	45	27	60	35	100	60		
	25	15	30	18	35	20	40	24	40	24	50	30	70	42	120	60		
	30	18	35	20	40	24	45	27	45	27	60	35	80	50	120 to 400	80		
	35	20	40	24	45	27	50	30	50	30	70	42	90	50				
	40	24	45	27	50	30	60	35	60	35	80	50	100	50				
			50	30	60	35	70	42	70	42	90	50	120 to 400	80				
			60	35	70	42	80	50	80	50	100	50						
									90	50	110	60						
									100	50	120 to 300	70	420 to 500	100				
									110	60								
									120	70								

AMBFAST europe screws

Carpentry screws TX flat head w/serration type 17

Annex 5.11

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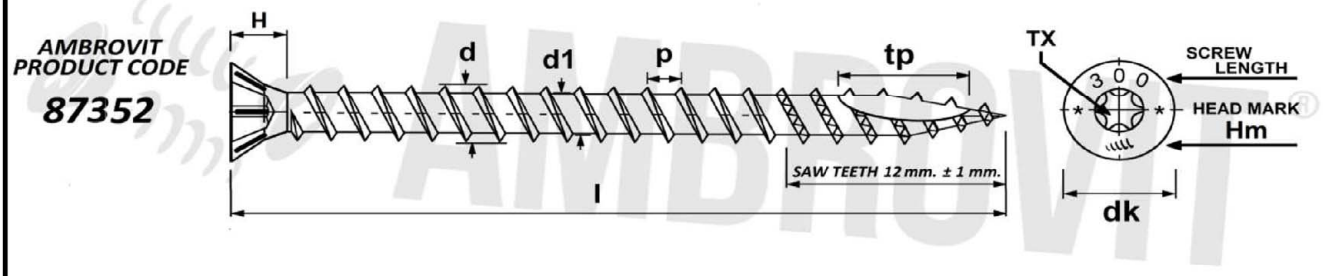

Rif.	Nominal Diameter			
	Ø 6,00	Ø 8,00	Ø 10,00	Ø 12,00
Hm				
d	6,00 + 0,20 - 0,20	8,00 + 0,20 - 0,20	10,00 + 0,20 - 0,20	12,00 + 0,20 - 0,20
d1	4,00 + 0,20 - 0,20	5,20 + 0,25 - 0,25	6,20 + 0,30 - 0,30	7,00 + 0,30 - 0,30
p	3,80 + 10% - 10%	4,80 + 10% - 10%	5,60 + 10% - 10%	6,00 + 10% - 10%
tp	17,00 + 3,00 - 3,00	18,00 + 3,00 - 3,00	19,00 + 3,00 - 3,00	20,00 + 3,00 - 3,00
dk	11,50 + 0,50 - 0,50	14,50 + 0,50 - 0,50	18,00 + 0,50 - 0,50	21,00 + 0,50 - 0,50
H (max)	12,00	19,00	20,00	20,50
TX	30	40	50	50
l limit	from 80,00 to 300,00	from 160,00 to 500,00	600,00	
	± 1,50			

AMBFAST europe screws	Annex 5.12
Carpentry screws TX flat head type 17 full thread	

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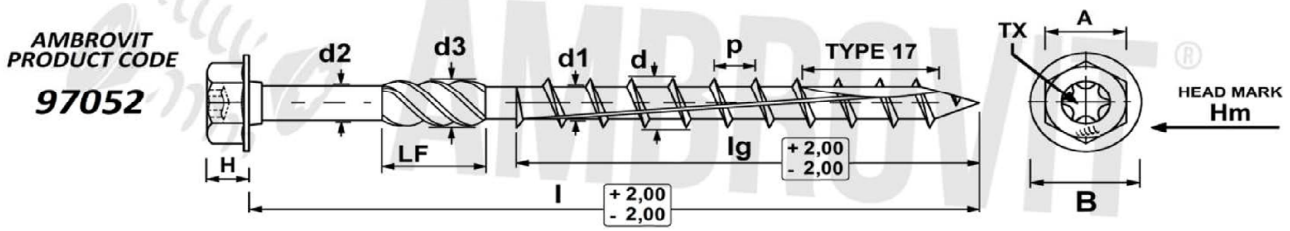

Rif.	Nominal Diameter		
	Ø 8,00	Ø 10,00	Ø 12,00
Hm			
d2	5,78 +0,05 -0,05	10,00 +0,20 -0,20	12,00 +0,20 -0,20
d3	7,00 +0,20 -0,20	6,20 +0,30 -0,30	7,00 +0,30 -0,30
d1	5,40 +0,20 -0,20	5,60 +10% -10%	6,00 +10% -10%
d	8,00 +0,20 -0,20	10,00 +3,00 -3,00	12,00 +3,00 -3,00
p	5,50 ± 5%	6,60 ± 5%	6,00 ± 5%
LF	12,00 +1,00 -1,00	12,00 +1,00 -1,00	12,00 +1,00 -1,00
B	14,50 +0,50 -0,50	17,50 +0,50 -0,50	23,00 +1,00 -1,00
A	11,90 +0,10 -0,12	14,90 +0,10 -0,12	16,85 +0,15 -0,12
H	6,00 +0,20 -0,20	6,90 +0,20 -0,20	7,95 +0,25 -0,25
TX	40	40	50

SIZE	l	lg	l	lg	l	lg
	140,00	80,00	160,00	80,00	160,00	80,00
	160,00	80,00	180,00	80,00	180,00	80,00
	180,00	80,00	180,00	100,00	200,00	80,00
	200,00	80,00	200,00	80,00	220,00	80,00
	220,00	80,00	220,00	80,00	220,00	120,00
	240,00	80,00	240,00	80,00	240,00	80,00
	260,00	80,00	260,00	80,00	260,00	80,00
	280,00	80,00	280,00	80,00	280,00	80,00
	300,00	80,00	300,00	80,00	300,00	80,00
			320,00	80,00	320,00	80,00
			340,00	80,00	340,00	80,00
			360,00	80,00	360,00	80,00
			380,00	80,00	380,00	80,00
			400,00	80,00	400,00	80,00

AMBFAST europe screws	Annex 5.13
Carpentry screws TX hex washer head w/serration type 17	