Deutsches Institut für Bautechnik

Approval body for construction products and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and Laender Governments

Member of EOTA
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Designated according to Article 29 of Regulation (EU) No 305/2011 and member of EOTA (European Organisation for Technical Assessment)

# European Technical Assessment

# ETA-15/0514 of 2 December 2016

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 | TSM high performance, TSM high performance A4, TSM high performance HCR |
| Product family to which the construction product belongs | Concrete screw of sizes 6, 8, 10, 12 and 14 mm for use in concrete |
| Manufacturer | TOGE Dübel GmbH & Co. KG<br>Illesheimer Straße 10<br>90431 Nürnberg<br>DEUTSCHLAND |
| Manufacturing plant | TOGE Dübel GmbH & Co. KG |
| This European Technical Assessment contains | 16 pages including 3 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 | Guideline for European technical approval of "Metal anchor for use in concrete", ETAG 001 Part 3: "Undercut anchors, April 2013,<br>used as European Assessment Document (EAD) according to Article 66 Paragraph 3 of Regulation (EU) No 305/2011 and European Assessment Document (EAD) 330011-00-0601. |
| This version replaces | ETA-15/0514 issued on 13 April 2016 |

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## Specific Part

### 1 Technical description of the product

The TOGE Concrete screw TSM high performance is an anchor in size 6, 8, 10, 12 and 14 mm made of galvanised steel respectively steel with zinc flake coating, made of stainless or high corrosion resistant steel. The anchor is screwed into a predrilled cylindrical drill hole. The special thread of the anchor cuts an internal thread into the member while setting. The anchorage is characterised by mechanical interlock in the special thread.

Product and product description is given in Annex A.

### 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 anchor is used in compliance with the specifications and conditions given in Annex B.

The verifications and assessment methods on which this European Technical Assessment is based lead to the assumption of a working life of the anchor 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 |
|---|---|
| Product performance for static and quasi static action | See Annex C 1 and C 2 |
| Product performance for seismic category C1 | See Annex C 4 |
| Displacements under tension and shear loads | See Annex C 3 |

#### 3.2 Safety in case of fire (BWR 2)

| Essential characteristic | Performance |
|---|---|
| Reaction to fire | Anchorages satisfy requirements for Class A1 |
| Resistance to fire | See Annex C 5 |

#### 3.3 Safety in use (BWR 4)

The essential characteristics regarding Safety in use are included under the Basic Works Requirement Mechanical resistance and stability.

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

In accordance with guideline for European technical approval ETAG 001, April 2013 used as European Assessment Document (EAD) according to Article 66 Paragraph 3 of Regulation (EU) No 305/2011, and European Assessment Document EAD 330011-00-0601 the applicable European legal act is: [96/582/EC].

The system to be applied is: 1

## 5 Technical details necessary for the implementation of the AVCP system, as provided for in the applicable European Assessment Document

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

Issued in Berlin on 2 December 2016 by Deutsches Institut für Bautechnik

Uwe Bender
Head of Department

*beglaubigt:*
Tempel

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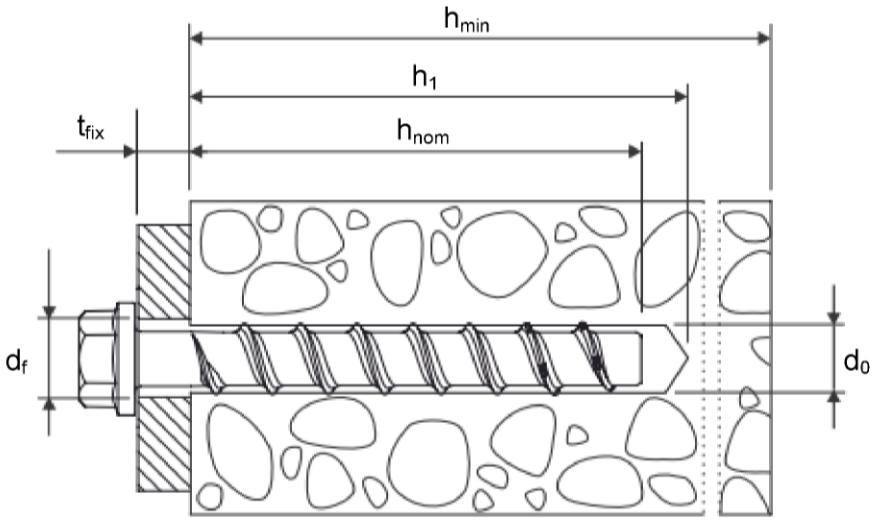
## product and installed condition

**Toge concrete screw TSM high performance**

**carbon steel**

**stainless steel A4 and HCR**




| | | |
|---|---|---|
| $d_0$ | = | nominal drill bit diameter |
| $h_{nom}$ | = | nominal anchorage depth |
| $h_1$ | = | depth of the drill hole |
| $h_{min}$ | = | minimum thickness of member |
| $t_{fix}$ | = | thickness of fixture |
| $d_f$ | = | diameter of clearance hole in the fixture |

| | |
|---|---|
| **TOGE concrete screw TSM high performance** | **Annex A 1** |
| **Product description**<br>Installed condition | |

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## Table A1: materials and variants

| part | name | Material | | | |
|---|---|---|---|---|---|
| 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 | Concrete screw | TSM high performance | Steel EN 10263-4 galvanized acc. to EN ISO 4042 or zinc flake coating acc. to EN ISO 10683 (≥ 5µm) | | |
| | | TSM high performance A4 | 1.4401, 1.4404, 1.4571, 1.4578 | | |
| | | TSM high performance HCR | 1.4529 | | |
| | | | | | TSM high performance<br>TSM high performance A4<br>TSM high performance HCR |
| | | nominal characteristic steel yield strength | $f_{yk}$ | [N/mm²] | 560 |
| | | nominal characteristic steel ultimate strength | $f_{uk}$ | [N/mm²] | 700 |
| | | elongation at rupture | $A_5$ | [%] | ≤ 8 |


1) Anchor version with connection thread and hexagon socket
e.g. TSM 8x105 M10 SW5


2) Anchor version with connection thread and hexagon drive
e.g. TSM 8x105 M10 SW7


3) Anchor version with washer, hexagon head and TORX
e.g. TSM 8x80 SW13 VZ 40


4) Anchor version with washer and hexagon head
e.g. TSM 8x80 SW13


5) Anchor version with washer, hexagon head and
e.g. TSM 8x80 SW13 OS


6) Anchor version with countersunk head
e.g. TSM 8x80 C VZ 40


7) Anchor version with pan head
e.g. TSM 8x80 P VZ 40


8) Anchor version with large pan head
e.g. TSM 8x80 LP VZ 40


9) Anchor version with countersunk head and connection thread
e.g. TSM 6x55 AG M8


10) Anchor version with hexagon drive and connection thread
e.g. TSM 6x55 M8 SW10


11) Anchor version with internal thread and hexagon drive
e.g. TSM 6x55 IM M8/10

**TOGE concrete screw TSM high performance**

**Product descriptions**

Materials und versions

**Annex A 2**

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## Table A2: dimensions and markings

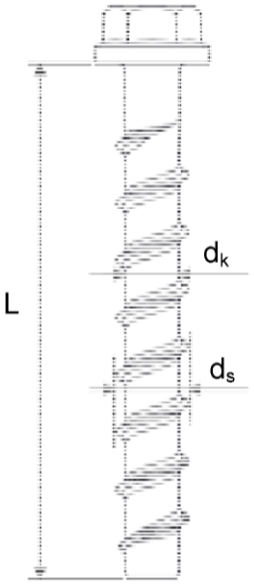
| **Anchor size TSM high performance** | | | **6** | | **8** | | | **10** | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Nominal embedment depth $h_{nom}$ [mm]** | | | $h_{nom1}$ | $h_{nom2}$ | $h_{nom1}$ | $h_{nom2}$ | $h_{nom3}$ | $h_{nom1}$ | $h_{nom2}$ | $h_{nom3}$ |
| | | | 40 | 55 | 45 | 55 | 65 | 55 | 75 | 85 |
| Length of the anchor | L ≤ | [mm] | 500 | | | | | | | |
| Diameter of shaft | $d_k$ | [mm] | 5,1 | | 7,1 | | | 9,1 | | |
| Diameter of thread | $d_s$ | [mm] | 7,5 | | 10,6 | | | 12,6 | | |

| **Anchor size TSM high performance** | | | **12** | | | **14** | | |
|---|---|---|---|---|---|---|---|---|
| **Nominal embedment depth $h_{nom}$ [mm]** | | | $h_{nom1}$ | $h_{nom2}$ | $h_{nom3}$ | $h_{nom1}$ | $h_{nom2}$ | $h_{nom3}$ |
| | | | 65 | 85 | 100 | 75 | 100 | 115 |
| Length of the anchor | L ≤ | [mm] | 500 | | | | | |
| Diameter of shaft | $d_k$ | [mm] | 11,1 | | | 13,1 | | |
| Diameter of thread | $d_s$ | [mm] | 14,6 | | | 16,6 | | |


Marking:
TSM high performance
Anchor type: TSM
Anchor size: 10
Length of the anchor: 100


TSM high performance A4
Anchor type: TSM
Anchor size: 10
Length of the anchor: 100
Material: A4


TSM high performance HCR
Anchor type: TSM
Anchor size: 10
Length of the anchor: 100
Material: HCR




**TOGE concrete screw TSM high performance**

**Product descriptions**
Dimensions and markings

**Annex A 3**

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## Intended use

**Anchorages subject to:**

- static and quasi-static loads, all sizes and all embedment depth,
- Used for anchorages with requirements related to resistance of fire, all sizes and all embedment depth,
- used for anchorages with seismic actions category C1, sizes 8-14 for maximum embedment depth $h_{nom3}$.

**Base materials:**

- reinforced and unreinforced concrete according to EN 206-1:2000-12,
- strength classes C20/25 to C50/60 according to EN 206-1:2000-12,
- cracked and non-cracked concrete.

**Use conditions (Environmental conditions):**

- The anchor may only be used in dry internal conditions: All screw types,
- Structural subject to external atmospheric exposure (including industrial and marine environment) and to permanently damp internal condition no particular aggressive conditions exits: screw types made of stainless steel with marking A4,
- Structural subject to external atmospheric exposure (including industrial and marine environment) and to permanently damp internal condition if particular aggressive conditions exits: screw types made of stainless steel with marking HCR.
- Note: Such particular aggressive conditions are e.g. permanent, alternating immersion in seawater or the splash zone of seawater, chloride atmosphere of indoor swimming pools or atmosphere with chemical pollution (e.g. in desulphurization plants or road tunnels where de-icing materials are used)

**Design:**

- Anchorages are designed under the responsibility of an engineer experienced in anchorages and concrete work,
- Verifiable calculation notes and drawings are prepared taking account of the loads to be anchored. The position of the anchor is indicated on the design drawings (e.g. position of the anchor relative to reinforcement or to supports, etc.),
- Anchorages under static or quasi-static actions are designed for design Method A in accordance with:
  - ETAG 001, Annex C, Edition August 2010 or
  - CEN/TS 1992-4:2009.
- Anchorages under seismic actions are designed in accordance with:
  - EOTA Technical Report TR 045, Edition February 2013.
  - Anchorages shall be positioned outside of critical regions (e.g. plastic hinges) of the concrete structure.
  - Fastenings in stand-off installation or with a grout layer are not allowed.
- Anchorages under fire exposure are designed in accordance with:
  - EOTA Technical Report TR 020, Edition May 2004 or
  - CEN/TS 1992-4:2009, Annex D (It must be ensured that local spalling of the concrete cover does not occur).
- The design method according to ETAG 001, Annex C, section 4.2.2 also applies for the specified diameter $d_f$ of clearance hole in the fixture in Annex B2, Table B1.
- In CEN/TS 1992-4-1, section 5.2.3.1 the 3. indent will be replaced as follow: only the most unfavorable anchors of an anchor group take up shear loads, if diameter of the clearance hole $d_f$ is larger than given CEN/TS 1992-4-1, Table 1.
- The condition according to CEN / TS 1992-4-1, Section 5.2.3.3, no. 3) are also fulfilled for the specified diameter df of clearance hole in the fixture in Annex B2, Table B1.

**Installation:**

- Hammer drilling only.
- Anchor installation carried out by appropriately qualified personal and under the supervision of the person responsible for technical matters of the site.
- In case of aborted hole: new drilling at a minimum distance away of twice the depth of aborted hole or smaller distance if the aborted hole is filled with high strength mortar and if under shear or oblique tension load it is not the direction of the load application.
- After installation further turning of the anchor is not possible. The head of the anchor is supported on the fixture and is not damaged.
- The drill hole may be filled with injection mortar Chemofast CF-T 300 V.
- Adjustability according to Annex B4: sizes 8-14, all anchorage depths.



| TOGE concrete screw TSM high performance | Annex B 1 |
|---|---|
| **Intended use**<br>Specifications | |

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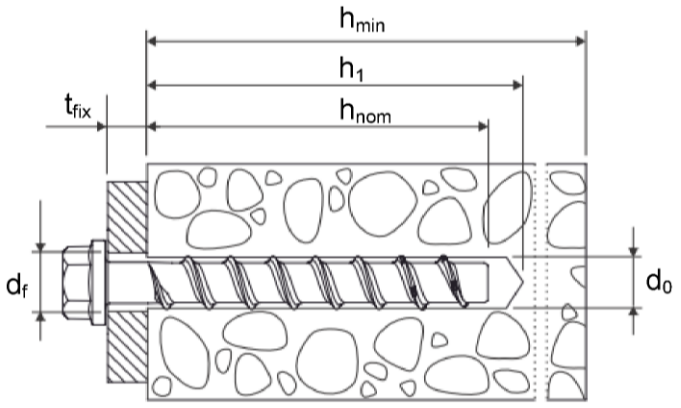
## Table B1: Installation parameters

| **Anchor size TSM high performance** | | | **6** | | **8** | | | **10** | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Nominal embedment depth $h_{nom}$ [mm]** | | | $h_{nom1}$ | $h_{nom2}$ | $h_{nom1}$ | $h_{nom2}$ | $h_{nom3}$ | $h_{nom1}$ | $h_{nom2}$ | $h_{nom3}$ |
| | | | 40 | 55 | 45 | 55 | 65 | 55 | 75 | 85 |
| Nominal drill bit diameter | $d_0$ | [mm] | 6 | | 8 | | | 10 | | |
| Cutting diameter of drill bit | $d_{cut} \leq$ | [mm] | 6,40 | | 8,45 | | | 10,45 | | |
| Depth of drill hole | $h_1 \geq$ | [mm] | 45 | 60 | 55 | 65 | 75 | 65 | 85 | 95 |
| Diameter of clearing hole in the fixture | $d_f \leq$ | [mm] | 8 | | 12 | | | 14 | | |
| Installation torque for version with connection thread | $T_{inst}$ | [Nm] | 10 | | 20 | | | 40 | | |
| Impact screw driver | | [Nm] | Max. torque according to manufacturer's instructions | | | | | | | |
| | | | 160 | | 300 | | | 400 | | |

| **Anchor size TSM high performance** | | | **12** | | | **14** | | |
|---|---|---|---|---|---|---|---|---|
| **Nominal embedment depth $h_{nom}$ [mm]** | | | $h_{nom1}$ | $h_{nom2}$ | $h_{nom3}$ | $h_{nom1}$ | $h_{nom2}$ | $h_{nom3}$ |
| | | | 65 | 85 | 100 | 75 | 100 | 115 |
| Nominal drill bit diameter | $d_0$ | [mm] | 12 | | | 14 | | |
| Cutting diameter of drill bit | $d_{cut} \leq$ | [mm] | 12,50 | | | 14,50 | | |
| Depth of drill hole | $h_1 \geq$ | [mm] | 75 | 95 | 110 | 85 | 110 | 125 |
| Diameter of clearing hole in the fixture | $d_f \leq$ | [mm] | 16 | | | 18 | | |
| Installation torque for version with connection thread metrical | $T_{inst}$ | [Nm] | 60 | | | 80 | | |
| Impact screw driver | | | Max. torque according to manufacturer's instructions | | | | | |
| | | | 650 | | | 650 | | |




**TOGE concrete screw TSM high performance**

**Intended use**

Installation parameters

**Annex B 2**

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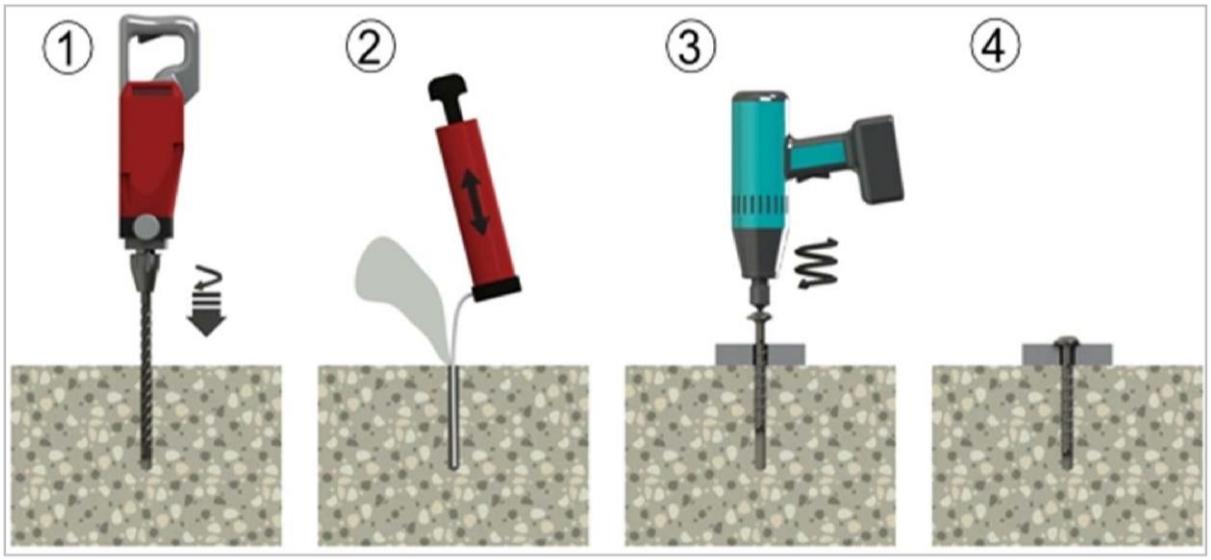
## Table B2: Minimum thickness of member, minimum edge distance and minimum spacing

| **Anchor size TSM high performance** | | | **6** | | **8** | | | **10** | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Nominal embedment depth $h_{nom}$ [mm]** | | | $h_{nom1}$ | $h_{nom2}$ | $h_{nom1}$ | $h_{nom2}$ | $h_{nom3}$ | $h_{nom1}$ | $h_{nom2}$ | $h_{nom3}$ |
| | | | 40 | 55 | 45 | 55 | 65 | 55 | 75 | 85 |
| Minimum thickness of member | $h_{min}$ | [mm] | 100 | | 100 | | 120 | 100 | 130 | 130 |
| Minimum edge distance | $c_{min}$ | [mm] | 40 | | 40 | 50 | | 50 | | |
| Minimum spacing | $s_{min}$ | [mm] | 40 | | 40 | 50 | | 50 | | |

| **Anchor size TSM high performance** | | | **12** | | | **14** | | |
|---|---|---|---|---|---|---|---|---|
| **Nominal embedment depth $h_{nom}$ [mm]** | | | $h_{nom1}$ | $h_{nom2}$ | $h_{nom3}$ | $h_{nom1}$ | $h_{nom2}$ | $h_{nom3}$ |
| | | | 65 | 85 | 100 | 75 | 100 | 115 |
| Minimum thickness of member | $h_{min}$ | [mm] | 120 | 130 | 150 | 130 | 150 | 170 |
| Minimum edge distance | $c_{min}$ | [mm] | 50 | | 70 | 50 | 70 | |
| Minimum spacing | $s_{min}$ | [mm] | 50 | | 70 | 50 | 70 | |

## Installation instructions




**TOGE concrete screw TSM high performance**

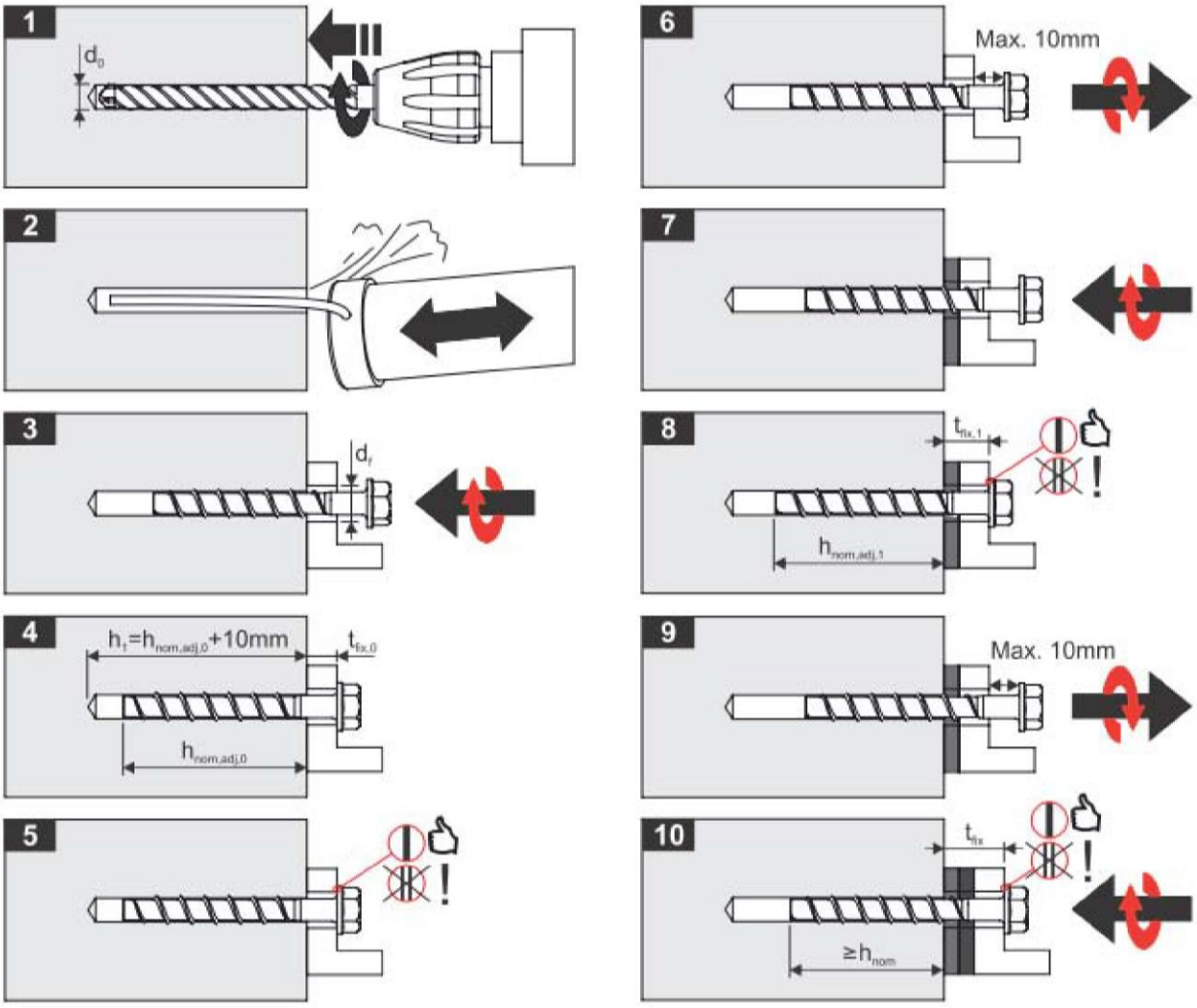
**Intended use**

Minimum thickness of member, minimum spacing, minimum edge distance and installation instructions

**Annex B 3**

Deutsches Institut für Bautechnik DIBt

## Installation instructions for adjustability




## Installation instructions

The anchor may be adjusted maximum two times while the anchor may turn back at most 10 mm.
The total allowed thickness of shims added during the adjustment process is 10mm.
The final embedment depth after adjustment process must be equal or larger than $h_{nom}$.

| | |
|---|---|
| **TOGE concrete screw TSM high performance** | |
| **Intended use**<br>Installation instruction for adjustability | **Annex B 4** |

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## Table C1: Characteristic values for design method A according to ETAG 001, Annex C or CEN/TS 1992-4 for TSM high performance 6, 8 and 10

| **Anchor size TSM high performance** | | | | **6** | | **8** | | | **10** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Nominal embedment depth $h_{nom}$ [mm]** | | | | $h_{nom1}$ | $h_{nom2}$ | $h_{nom1}$ | $h_{nom2}$ | $h_{nom3}$ | $h_{nom1}$ | $h_{nom2}$ | $h_{nom3}$ |
| | | | | 40 | 55 | 45 | 55 | 65 | 55 | 75 | 85 |
| **steel failure for tension- and shear load** | | | | | | | | | | | |
| characteristic load | | $N_{Rk,s}$ | [kN] | 14,0 | | 27,0 | | | 45,0 | | |
| | | $V_{Rk,s}$ | [kN] | 7,0 | | 13,5 | | 17,0 | 22,5 | 34,0 | |
| | | $k_2$ [1] | [ - ] | 0,8 | | 0,8 | | | 0,8 | | |
| | | $M^0_{Rk,s}$ | [Nm] | 10,9 | | 26,0 | | | 56,0 | | |
| **pull-out failure** | | | | | | | | | | | |
| characteristic tension load in cracked concrete C20/25 | | $N_{Rk,p}$ | [kN] | 2,0 | 4,0 | 5,0 | 9,0 | 12,0 | 9,0 | Pull-out failure is not decisive | |
| characteristic tension load in uncracked concrete C20/25 | | $N_{Rk,p}$ | [kN] | 4,0 | 9,0 | 7,5 | 12,0 | 16,0 | 12,0 | 20,0 | 25,0 |
| increasing factor for $N_{Rk,p}$ | | $\Psi_C$ | C30/37 | 1,22 | | | | | | | |
| | | | C40/50 | 1,41 | | | | | | | |
| | | | C50/60 | 1,55 | | | | | | | |
| **concrete cone and splitting failure** | | | | | | | | | | | |
| effective anchorage depth | | $h_{ef}$ | [mm] | 31 | 44 | 35 | 43 | 52 | 43 | 60 | 68 |
| factor for | cracked | $k_{cr}$ [1] | [ - ] | 7,2 | | | | | | | |
| | non cracked | $k_{ucr}$ [1] | [ - ] | 10,1 | | | | | | | |
| concrete cone failure | spacing | $s_{cr,N}$ | [mm] | 3 x $h_{ef}$ | | | | | | | |
| | edge distance | $c_{cr,N}$ | [mm] | 1,5 x $h_{ef}$ | | | | | | | |
| splitting failure | spacing | $s_{cr,Sp}$ | [mm] | 120 | 160 | 120 | 140 | 150 | 140 | 180 | 210 |
| | edge distance | $c_{cr,Sp}$ | [mm] | 60 | 80 | 60 | 70 | 75 | 70 | 90 | 105 |
| installation safety factor | | $\gamma_2$ [2] / $\gamma_{inst}$ [1] | [ - ] | 1,0 | | | | | | | |
| **concrete pry out failure (pry-out)** | | | | | | | | | | | |
| k-Factor | | $k$ [2] / $k_3$ [1] | [ - ] | 1,0 | | | | | 2,0 | | |
| **concrete edge failure** | | | | | | | | | | | |
| effective length of anchor | | $l_f = h_{ef}$ | [mm] | 31 | 44 | 35 | 43 | 52 | 43 | 60 | 68 |
| outside diameter of anchor | | $d_{nom}$ | [mm] | 6 | | 8 | | | 10 | | |

[1] Parameter relevant only for design according to CEN/TS 1992-4:2009

[2] Parameter relevant only for design according to ETAG 001, Annex C



**TOGE concrete screw TSM high performance**

**Performances**

Characteristic values for TSM high performance 6, 8 and 10

**Annex C 1**

Deutsches Institut für Bautechnik DIBt

## Table C2: Characteristic values for design method A according to ETAG 001, Annex C or CEN/TS 1992-4 for TSM high performance 12 and 14

| **Anchor size TSM high performance** | | | | **12** | | | **14** | | |
|---|---|---|---|---|---|---|---|---|---|
| **Nominal embedment depth $h_{nom}$ [mm]** | | | | $h_{nom1}$ | $h_{nom2}$ | $h_{nom3}$ | $h_{nom1}$ | $h_{nom2}$ | $h_{nom3}$ |
| | | | | **65** | **85** | **100** | **75** | **100** | **115** |
| **steel failure for tension- and shear load** | | | | | | | | | |
| characteristic load | | $N_{Rk,s}$ | [kN] | 67,0 | | | 94,0 | | |
| | | $V_{Rk,s}$ | [kN] | 33,5 | 42,0 | | 56,0 | | |
| | | $k_2$ [1] | [ - ] | 0,8 | | | 0,8 | | |
| | | $M^0_{Rk,s}$ | [Nm] | 113,0 | | | 185,0 | | |
| **pull-out failure** | | | | | | | | | |
| characteristic tension load in cracked concrete C20/25 | | $N_{Rk,p}$ | [kN] | 12,0 | Pull-out failure is not decisive | | Pull-out failure is not decisive | | |
| characteristic tension load in uncracked concrete C20/25 | | $N_{Rk,p}$ | [kN] | 16,0 | | | | | |
| increasing factor for $N_{Rk,p}$ | | $\Psi_C$ | C30/37 | 1,22 | | | | | |
| | | | C40/50 | 1,41 | | | | | |
| | | | C50/60 | 1,55 | | | | | |
| **concrete cone and splitting failure** | | | | | | | | | |
| effective anchorage depth | | $h_{ef}$ | [mm] | 50 | 67 | 80 | 58 | 79 | 92 |
| factor for | cracked | $k_{cr}$ [1] | [ - ] | 7,2 | | | | | |
| | non cracked | $k_{ucr}$ [1] | [ - ] | 10,1 | | | | | |
| concrete cone failure | spacing | $s_{cr,N}$ | [mm] | 3 x $h_{ef}$ | | | | | |
| | edge distance | $c_{cr,N}$ | [mm] | 1,5 x $h_{ef}$ | | | | | |
| splitting failure | spacing | $s_{cr,Sp}$ | [mm] | 150 | 210 | 240 | 180 | 240 | 280 |
| | edge distance | $c_{cr,Sp}$ | [mm] | 75 | 105 | 120 | 90 | 120 | 140 |
| installation safety factor | | $\gamma_2$ [2] / $\gamma_{inst}$ [1] | [ - ] | 1,0 | | | | | |
| **concrete pry out failure (pry-out)** | | | | | | | | | |
| k-Factor | | $k$ [2] / $k_3$ [1] | [ - ] | 1,0 | 2,0 | | 1,0 | 2,0 | |
| **concrete edge failure** | | | | | | | | | |
| effective length of anchor | | $l_f = h_{ef}$ | [mm] | 50 | 67 | 80 | 58 | 79 | 92 |
| outside diameter of anchor | | $d_{nom}$ | [mm] | 12 | | | 14 | | |

[1] Parameter relevant only for design according to CEN/TS 1992-4:2009

[2] Parameter relevant only for design according to ETAG 001, Annex C



**TOGE concrete screw TSM high performance**

**Performances**

Characteristic values for TSM high performance 12 and 14

**Annex C 2**

Deutsches Institut für Bautechnik DIBt

## Table C3: Displacements under tension load for TSM high performance

| **Anchor size TSM high performance** | | | | **6** | | **8** | | | **10** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Nominal embedment depth $h_{nom}$ [mm]** | | | | $h_{nom1}$ | $h_{nom2}$ | $h_{nom1}$ | $h_{nom2}$ | $h_{nom3}$ | $h_{nom1}$ | $h_{nom2}$ | $h_{nom3}$ |
| | | | | **40** | **55** | **45** | **55** | **65** | **55** | **75** | **85** |
| Cracked concrete | tension load | N | [kN] | 0,95 | 1,9 | 2,4 | 4,3 | 5,7 | 4,3 | 7,9 | 9,6 |
| | displacement | $\delta_{N0}$ | [mm] | 0,3 | 0,6 | 0,6 | 0,7 | 0,8 | 0,6 | 0,5 | 0,9 |
| | | $\delta_{\infty}$ | [mm] | 0,4 | 0,4 | 0,6 | 1,0 | 0,9 | 0,4 | 1,2 | 1,2 |
| un-cracked concrete | tension load | N | [kN] | 1,9 | 4,3 | 3,6 | 5,7 | 7,6 | 5,7 | 9,5 | 11,9 |
| | displacement | $\delta_{N0}$ | [mm] | 0,4 | 0,6 | 0,7 | 0,9 | 0,5 | 0,7 | 1,1 | 1,0 |
| | | $\delta_{N\infty}$ | [mm] | 0,4 | 0,4 | 0,6 | 1,0 | 0,9 | 0,4 | 1,2 | 1,2 |

| **Anchor size TSM high performance** | | | | **12** | | | **14** | | |
|---|---|---|---|---|---|---|---|---|---|
| **Nominal embedment depth $h_{nom}$ [mm]** | | | | $h_{nom1}$ | $h_{nom2}$ | $h_{nom3}$ | $h_{nom1}$ | $h_{nom2}$ | $h_{nom3}$ |
| | | | | **65** | **85** | **100** | **75** | **100** | **115** |
| Cracked concrete | tension load | N | [kN] | 5,7 | 9,4 | 12,3 | 7,6 | 12,0 | 15,1 |
| | displacement | $\delta_{N0}$ | [mm] | 0,9 | 0,5 | 1,0 | 0,5 | 0,8 | 0,7 |
| | | $\delta_{\infty}$ | [mm] | 1,0 | 1,2 | 1,2 | 0,9 | 1,2 | 1,0 |
| un-cracked concrete | tension load | N | [kN] | 7,6 | 13,2 | 17,2 | 10,6 | 16,9 | 21,2 |
| | displacement | $\delta_{N0}$ | [mm] | 1,0 | 1,1 | 1,2 | 0,9 | 1,2 | 0,8 |
| | | $\delta_{N\infty}$ | [mm] | 1,0 | 1,2 | 1,2 | 0,9 | 1,2 | 1,0 |

## Table C4 : Displacements under shear load for TSM high performance

| **Anchor size TSM high performance** | | | **6** | | **8** | | | **10** | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Nominal embedment depth $h_{nom}$ [mm]** | | | $h_{nom1}$ | $h_{nom2}$ | $h_{nom1}$ | $h_{nom2}$ | $h_{nom3}$ | $h_{nom1}$ | $h_{nom2}$ | $h_{nom3}$ |
| | | | **40** | **55** | **45** | **55** | **65** | **55** | **75** | **85** |
| shear load | V | [kN] | 3,3 | | 8,6 | | | 16,2 | | |
| displacement | $\delta_{V0}$ | [mm] | 1,55 | | 2,7 | | | 2,7 | | |
| | $\delta_{V\infty}$ | [mm] | 3,10 | | 4,1 | | | 4,3 | | |

| **Anchor size TSM high performance** | | | **12** | | | **14** | | |
|---|---|---|---|---|---|---|---|---|
| **Nominal embedment depth $h_{nom}$ [mm]** | | | $h_{nom1}$ | $h_{nom2}$ | $h_{nom3}$ | $h_{nom1}$ | $h_{nom2}$ | $h_{nom3}$ |
| | | | **65** | **85** | **100** | **75** | **100** | **115** |
| shear load | V | [kN] | 20,0 | | | 30,5 | | |
| displacement | $\delta_{V0}$ | [mm] | 4,0 | | | 3,1 | | |
| | $\delta_{V\infty}$ | [mm] | 6,0 | | | 4,7 | | |

**TOGE concrete screw TSM high performance**

**Performances**

Displacements under tension and shear loads

**Annex C 3**

Deutsches Institut für Bautechnik DIBt

## Table C5: Characteristic values for seismic category C1

| **Anchor size TSM high performance** | | | **8** | **10** | **12** | **14** |
|---|---|---|---|---|---|---|
| **Nominal embedment depth $h_{nom}$ [mm]** | | | **$h_{nom3}$** | | | |
| | | | **65** | **85** | **100** | **115** |
| **steel failure for tension- and shear load** | | | | | | |
| characteristic load | $N_{Rk,s,seis}$ | [kN] | 27,0 | 45,0 | 67,0 | 94,0 |
| | $V_{Rk,s,\ seis}$ | [kN] | 8,5 | 15,3 | 21,0 | 22,4 |
| **pull-out failure** | | | | | | |
| characteristic tension load in cracked concrete C20/25 | $N_{Rk,p,seis}$ | [kN] | 12,0 | Pull-out failure is not decisive | | |
| **concrete cone failure** | | | | | | |
| effective anchorage depth | $h_{ef}$ | [mm] | 52 | 68 | 80 | 92 |
| concrete cone failure – spacing | $s_{cr,N}$ | [mm] | $3 \times h_{ef}$ | | | |
| concrete cone failure – edge distance | $c_{cr,N}$ | [mm] | $1{,}5 \times h_{ef}$ | | | |
| installation safety factor | $\gamma_2$ | [ - ] | 1,0 | | | |
| **concrete pry out failure (pry-out)** | | | | | | |
| k-Factor | k | [ - ] | 1,0 | 2,0 | | |
| **concrete edge failure** | | | | | | |
| effective length of anchor | $l_f = h_{ef}$ | [mm] | 52 | 68 | 80 | 92 |
| outside diameter of anchor | $d_{nom}$ | [mm] | 8 | 10 | 12 | 14 |



**TOGE concrete screw TSM high performance**

**Performances**

Characteristic values for seismic category C1

**Annex C 4**

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## Table C6: Characteristic values of resistance to fire exposure for TSM high performance

| **Anchor size TSM high performance** | | | | **6** | | **8** | | | **10** | | | **12** | | | **14** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Nominal embedment depth** | | $h_{nom}$ | | 1 | 2 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 |
| | | | [mm] | 40 | 55 | 45 | 55 | 65 | 55 | 75 | 85 | 65 | 85 | 100 | 75 | 100 | 115 |
| **steel failure for tension- and shear load ($F_{Rk,s,fi} = N_{Rk,s,fi} = V_{Rk,s,fi}$)** | | | | | | | | | | | | | | | | | |
| Fire resistance class | | | | | | | | | | | | | | | | | |
| R30 | Characteristic Resistance | $F_{Rk,s,fi30}$ | [kN] | 0,9 | | 2,4 | | | 4,4 | | | 7,4 | | | 10,3 | | |
| R60 | | $F_{Rk,s,fi60}$ | [kN] | 0,8 | | 1,7 | | | 3,3 | | | 5,8 | | | 8,2 | | |
| R90 | | $F_{Rk,s,fi90}$ | [kN] | 0,6 | | 1,1 | | | 2,3 | | | 4,2 | | | 5,9 | | |
| R120 | | $F_{Rk,s,fi120}$ | [kN] | 0,4 | | 0,7 | | | 1,7 | | | 3,4 | | | 4,8 | | |
| R30 | | $M^0_{Rks,,fi30}$ | [Nm] | 0,7 | | 2,4 | | | 5,9 | | | 12,3 | | | 20,4 | | |
| R60 | | $M^0_{Rk,s,fi60}$ | [Nm] | 0,6 | | 1,8 | | | 4,5 | | | 9,7 | | | 15,9 | | |
| R90 | | $M^0_{Rk,s,fi90}$ | [Nm] | 0,5 | | 1,2 | | | 3,0 | | | 7,0 | | | 11,6 | | |
| R120 | | $M^0_{Rks,,fi120}$ | [Nm] | 0,3 | | 0,9 | | | 2,3 | | | 5,7 | | | 9,4 | | |
| **edge distance** | | | | | | | | | | | | | | | | | |
| R30 bis R120 | | $c_{cr,\,fi}$ | [mm] | $2 \times h_{ef}$ | | | | | | | | | | | | | |
| **spacing** | | | | | | | | | | | | | | | | | |
| R30 bis R120 | | $s_{cr,\,fi}$ | [mm] | $4 \times h_{ef}$ | | | | | | | | | | | | | |

The characteristic resistance to fire exposure for pull-out failure, concrete cone failure, concrete pry-out failure and concrete edge failure shall be calculated according to TR 020 or CEN/TS 1992-4. If no value for $N_{Rk,p}$ is given, in the equation 2.4 and 2.5, TR 020 or in equation D.1 and D.2, CEN/TS 1992-4 the value of $N^0_{Rk,c}$ shall be inserted instead of $N_{Rk,p}$.



**TOGE concrete screw TSM high performance**

**Performances**

Characteristic values of resistance to fire exposure

**Annex C 5**