Einfach. Sicher. Upat

**DECLARATION OF PERFORMANCE**

**No. 0043 – EN**

1. Unique identification code of the product-type: **Upat Anchor Bolt MAX**

2. Intended use/es:

| Product | Intended use/es |
|---|---|
| Metal anchors for use in concrete (heavy-duty type) | For fixing and/or supporting concrete structural elements or heavy units such as cladding and suspended ceilings, see appendix, especially Annexes B 1 to B 4 |

3. Manufacturer: **Upat Vertriebs GmbH, Otto-Hahn-Straße 15, 79211 Denzlingen, Germany**

4. Authorised representative: **--**

5. System/s of AVCP: **1**

6a. Harmonised standard: ---

Notified body/ies: ---

6b. European Assessment Document: **ETAG 001; 2013-04**

European Technical Assessment: **ETA-10/0170; 2015-05-07**

Technical Assessment Body: **DIBt**

Notified body/ies: **1343 – MPA Darmstadt**

7. Declared performance/s:

**Mechanical resistance and stability (BWR 1)**

| Essential characteristic | Performance |
|---|---|
| Characteristic resistance for static and quasi static action for design according to ETAG 001 Annex C or CEN/TS 1992-4:2009 | See appendix, especially Annexes C 1 to C 3 |
| Characteristic resistance for Seismic performance categories C1 and C2 | See appendix, especially Annexes C 6 to C 7 |
| Displacements under static and quasi static action | See appendix, especially Annex C 8 |
| Displacements under seismic action | See appendix, especially Annex C 9 |

**Safety in case of fire (BWR 2)**

| Essential characteristic | Performance |
|---|---|
| Reaction to fire | Anchorages satisfy requirements for Class A 1 |
| Characteristic resistance under fire exposure | See appendix, especially Annex C 4, C 5 |

8. Appropriate Technical Documentation and/or Specific Technical Documentation: ---

The performance of the product identified above is in conformity with the set of declared performance/s. This declaration of performance is issued, in accordance with Regulation (EU) No 305/2011, under the sole responsibility of the manufacturer identified above.

Signed for and on behalf of the manufacturer by:

Andreas Bucher, Dipl.-Ing.

Wolfgang Hengesbach, Dipl.-Ing., Dipl.-Wirtsch.-Ing.

Tumlingen, 2015-05-18

- This DoP has been prepared in different languages. In case there is a dispute on the interpretation the english version shall always prevail.
- The Appendix includes voluntary and complementary information in English language exceeding the (language-neutrally specified) legal requirements.

**Specific Part**

## 1 Technical description of the product

The UPAT Anchor bolt MAX is an anchor made of galvanised steel (MAX) or made of stainless steel (MAX A4) or high corrosion resistant steel (MAX C) which is placed into a drilled hole and anchored by torque-controlled expansion.

The 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 |
|---|---|
| Characteristic resistance for static and quasi static action for design according to ETAG 001 Annex C or CEN/TS 1992-4:2009 | See Annex C 1 to C 3 |
| Characteristic resistance for Seismic performance categories C1 and C2 | See Annex C 6 to C 7 |
| Displacements under static and quasi static action | See Annex C 8 |
| Displacements under seismic action | See Annex C 9 |

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

| Essential characteristic | Performance |
|---|---|
| Reaction to fire | Anchorages satisfy requirements for Class A1 |
| Characteristic resistance under fire exposure | See Annex C 4,C 5 |

### 3.3 Hygiene, health and the environment (BWR 3)

Not applicable.

### 3.4 Safety in use (BWR 4)

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

### 3.5 Protection against noise (BWR 5)

Not applicable.

### 3.6 Energy economy and heat retention (BWR 6)

Not applicable.

### 3.7 Sustainable use of natural resources (BWR 7)

The sustainable use of natural resources was not investigated.

### 3.8 General aspects

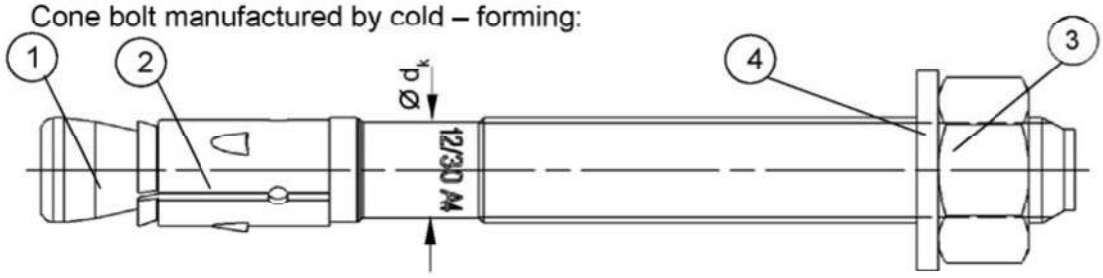
The verification of durability is part of testing the essential characteristics. Durability is only ensured if the specifications of intended use according to Annex B are taken into account.

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

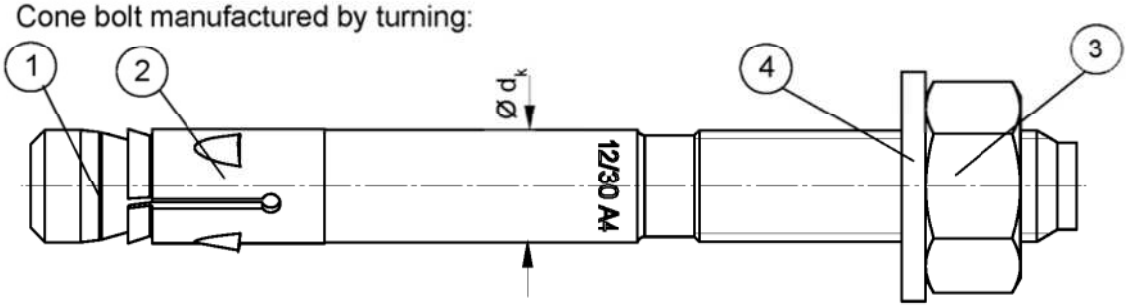
According to Decision of the Commission of 24 June 1996 (96/582/EC) (OJ L 254 of 08.10.96 p. 62-65), the system of assessment and verification of constancy of performance (see Annex V and Article 65 Paragraph 2 to Regulation (EU) No 305/2011) given in the following table applies.

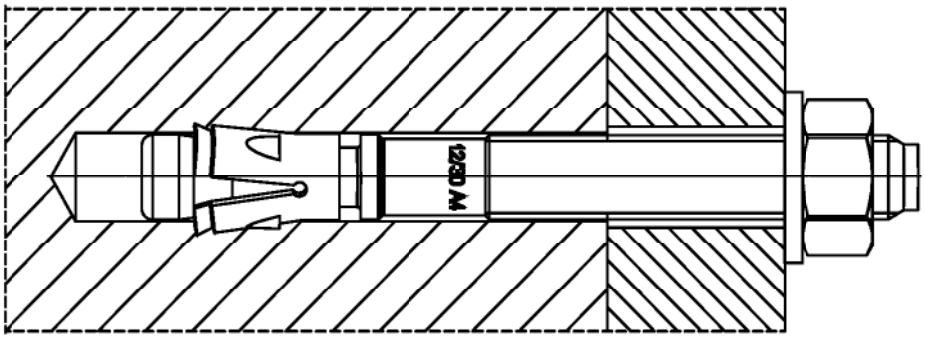
| Product | Intended use | Level or class | System |
|---|---|---|---|
| Metal anchors for use in concrete (heavy-duty type) | For fixing and/or supporting concrete structural elements or heavy units such as cladding and suspended ceilings | — | 1 |

Cone bolt manufactured by cold – forming:




Cone bolt manufactured by turning:




① Cone bolt (cold – formed or turned)

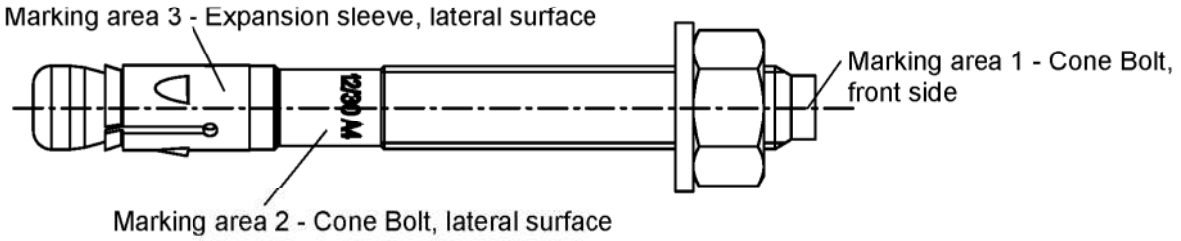
② Expansion sleeve

③ Hexagon nut

④ Washer

| | |
|---|---|
| UPAT Anchor bolt MAX, MAX A4, MAX C | **Annex A 1** |
| **Product description**<br>Installed condition | |

## MAX for use with standard and reduced anchorage depth ($h_{ef,\,sta}$ and $h_{ef,\,red}$):




Product label, example: MAX 12/10 A4

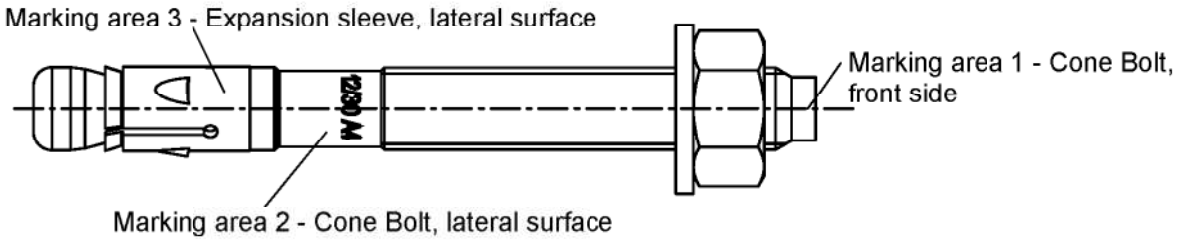
Brand | type of anchor
placed on marking area 2 or marking area 3

thread size / max. thickness of fixture ($t_{fix}$) for $h_{ef,\,sta}$
identification A4
placed on marking area 2

**Table A1:** Letter-code on marking area 1 and maximum thickness of fixture $t_{fix}$:

| marking | | (A) | (B) | (C) | (D) | (E) | (F) | (G) | (H) | (I) | (K) | (L) | (M) | (N) | (O) | (P) | (R) | (S) | (T) | (U) | (V) | (W) | (X) | (Y) | (Z) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| max. $t_{fix}$ for $h_{ef,\,sta}$ | M8-M24 | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 60 | 70 | 80 | 90 | 100 | 120 | 140 | 160 | 180 | 200 | 250 | 300 | 350 | 400 |
| max. $t_{fix}$ for $h_{ef,\,red}$ | M10-M16 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 65 | 70 | 80 | 90 | 100 | 110 | 120 | 140 | 160 | 180 | 200 | 220 | 270 | 320 | 370 | 420 |

## MAX K for use with reduced anchorage depth only ($h_{ef,\,red}$):




Product label, example: MAX 12/10 K A4

Brand | type of anchor
placed on marking area 2 or marking area 3

thread size / max. thickness of fixture ($t_{fix}$)
identification K for $h_{ef,\,red}$ | identification A4
placed on marking area 2

**Table A2:** Letter-code on marking area 1 and maximum thickness of fixture $t_{fix}$:

| marking | | (a) | (b) | (c) | (d) |
|---|---|---|---|---|---|
| max. $t_{fix}$ for $h_{ef,\,red}$ | M10-M16 | 5 | 10 | 15 | 20 |

Identification for $h_{ef,\,red}$ are lower-case letters

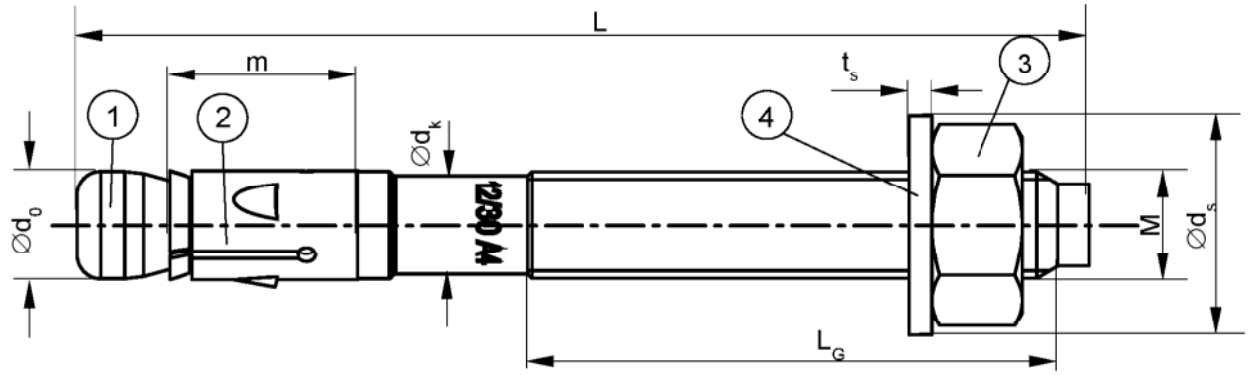



**Table A3:** Anchor dimensions [mm]

| Part | Designation | | | MAX, MAX A4, MAX C | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | **M8** | **M10** | **M12** | **M16** | **M20** | **M24** |
| 1 | Cone bolt | thread size M | | M8 | M10 | M12 | M16 | M20 | M24 |
| | | $\varnothing d_0$ | | 7,8 | 9,8 | 11,8 | 15,7 | 19,8 | 23,5 |
| | | $\varnothing d_k$ | | 7,1 | 8,9 | 10,7 | 14,5 | 19,8 | 23,5 |
| | | $L_G$ | ≥ | 19 | 26 | 31 | 40 | 50 | 57 |
| 2 | Expansion sleeve | m | | 17,8 | 20,0 | 20,6 | 27,5 | 33,4 | 40,2 |
| | | sheet thickness | | 1,3 | 1,4 | 1,6 | 2,4 | 2,4 | 3,0 |
| 3 | Hexagon nut | wrench size | | 13 | 17 | 19 | 24 | 30 | 36 |
| 4 | Washer | $t_S$ | ≥ | 1,4 | 1,8 | 2,3 | 2,7 | 2,7 | 3,7 |
| | | $\varnothing d_s$ | ≥ | 15 | 19 | 23 | 29 | 36 | 43 |
| Thickness of fixture | | $t_{fix}$ | ≥ | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | ≤ | 200 | 250 | 300 | 400 | 500 | 600 |
| Length of anchor | | $L_{min}$ | = | 64,5 | 64,5 | 79 | 102 | 141 | 174 |
| | | $L_{max}$ | = | 267 | 336 | 401 | 524,5 | 644 | 777 |

**Table A4:** Materials MAX

| Part | Designation | Material |
|---|---|---|
| 1 | Cone bolt | Cold form steel or free cutting steel (zinc plated)<br>Nominal steel tensile strength: $f_{uk} \leq 1000$ N/mm² |
| 2 | Expansion sleeve | Cold strip, EN 10139:2013 (zinc plated) |
| 3 | Hexagon nut | Steel, property class min. 8, EN ISO 898-2:2012 (zinc plated) |
| 4 | Washer | Cold strip, EN 10139:2013 (zinc plated) |

**Table A5:** Materials MAX A4

| Part | Designation | Material |
|---|---|---|
| 1 | Cone bolt | stainless steel EN 10088:2014<br>Nominal steel tensile strength: $f_{uk} \leq 1000$ N/mm² |
| 2 | Expansion sleeve | stainless steel EN 10088:2014 |
| 3 | Hexagon nut | stainless steel EN 10088:2014;<br>ISO 3506-2: 2009; property class – min. 70 |
| 4 | Washer | stainless steel EN 10088:2014 |

**Table A6:** Materials MAX C

| Part | Designation | Material |
|---|---|---|
| 1 | Cone bolt | high corrosion resistant steel EN 10088:2014<br>Nominal steel tensile strength: $f_{uk} \leq 1000$ N/mm² |
| 2 | Expansion sleeve | stainless steel EN 10088:2014 |
| 3 | Hexagon nut | high corrosion resistant steel EN 10088:2014;<br>ISO 3506-2:2009; property class – min. 70 |
| 4 | Washer | high corrosion resistant steel EN 10088:2014 |

## Specifications of intended use

**Anchorages subject to:**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Standard anchorage depth | | ✓ | | | | | |
| Anchor bolt MAX, MAX A4, MAX C | | M8 | M10 | M12 | M16 | M20 | M24 |
| Static and quasi-static action | | ✓ | | | | | |
| Cracked and non-cracked concrete | | ✓ | | | | | |
| Fire exposure | | ✓ | | | | | |
| Seismic action for Performance Category | C1 | ✓ | | | | | |
| | C2[1)] | - | ✓ | | | | - |
| Reduced anchorage depth | | - | ✓ | | | - | |
| Anchor bolt MAX, MAX A4, MAX C | | - | M10 | M12 | M16 | - | |
| Static and quasi-static action | | - | ✓ | | | - | |
| Cracked and non-cracked concrete | | - | ✓ | | | - | |
| Fire exposure | | - | ✓ | | | - | |
| Seismic action for Performance Category | C1 | - | ✓ | | | - | |
| | C2[1)] | - | ✓ | | | - | |

[1)] MAX C: Only valid for cold-formed version (see A1)

**Base materials:**

- Reinforced and unreinforced normal weight concrete (cracked and non-cracked according to EN 206-1:2000.
- Strength classes C20/25 to C50/60 according to EN 206-1:2000

**Use conditions (Environmental conditions):**

- Structures subject to dry internal conditions (MAX, MAX A4, MAX C).
- Structures subject to external atmospheric exposure (including industrial and marine environment) and to permanently damp internal condition, if no particular aggressive conditions exist.
  (MAX A4, MAX C).
- Structures subject to external atmospheric exposure and permanently damp internal, if other particular aggressive conditions exist
  (MAX C).
  Note: 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 extreme chemical pollution (e.g. in desulphurization plants or road tunnels where de-icing materials are used).

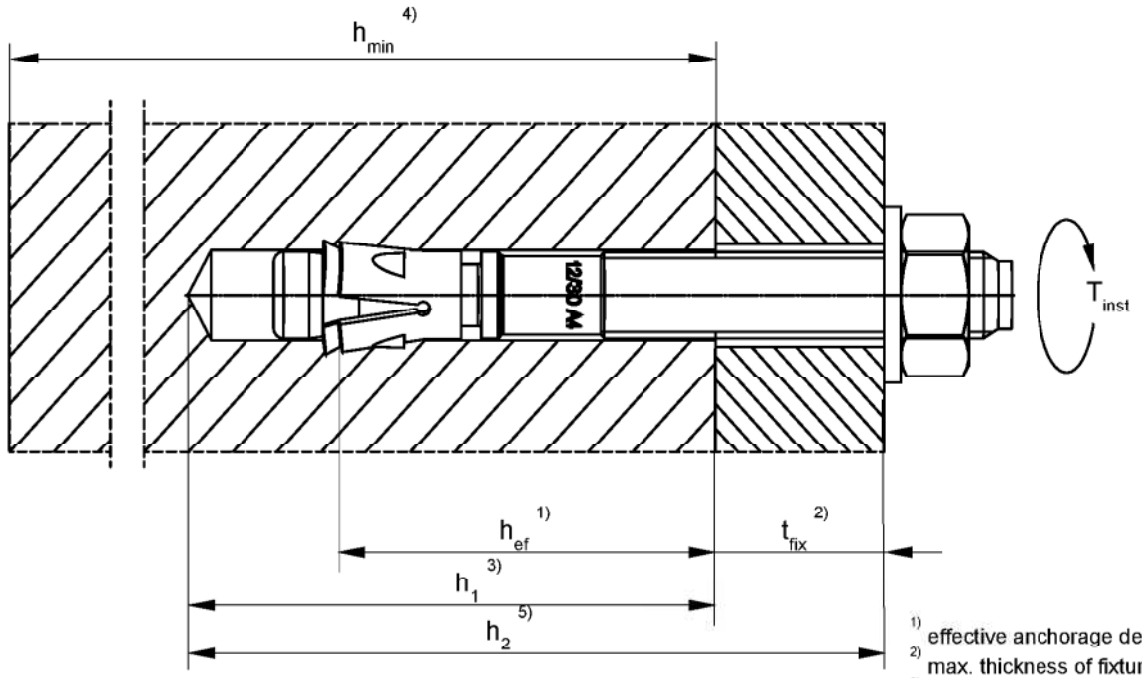
**Design:**

- Anchorages are to be designed under the responsibility of an engineer experienced in anchorages and concrete work.
- Verifiable calculation notes and drawings are to be 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 to be designed in accordance with (please choose the relevant design method):
  - ETAG 001, Annex C, design method A, Edition August 2010 or
  - CEN/TS 1992-4:2009, design method A
- Anchorages under seismic actions (cracked concrete) are to be 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 under seismic action are not allowed.
- Anchorages under fire exposure are to be designed in accordance with:
  - EOTA Technical Report TR 020, Edition May 2004
  - CEN/TS 1992-4:2009, Annex D
  - It must be ensured that local spalling of the concrete cover does not occur.

**Table B1:** Installation parameters

| Type of anchor / size | | MAX, MAX A4, MAX C | | | | | |
|---|---|---|---|---|---|---|---|
| | | M8 | M10 | M12 | M16 | M20 | M24 |
| Nominal drill hole diameter | $d_0$ = [mm] | 8 | 10 | 12 | 16 | 20 | 24 |
| Cutting diameter of drill bit | $d_{cut} \leq$ [mm] | 8,45 | 10,45 | 12,5 | 16,5 | 20,55 | 24,55 |
| Standard anchorage depth | $h_{ef,sta} \geq$ [mm] | 45 | 60 | 70 | 85 | 100 | 125 |
| Depth of drill hole in concrete for $h_{ef,sta}$ | $h_{1,sta} \geq$ [mm] | 55 | 75 | 90 | 110 | 125 | 155 |
| Reduced anchorage depth | $h_{ef,red} \geq$ [mm] | - | 40 | 50 | 65 | - | - |
| Depth of drill hole in concrete for $h_{ef,red}$ | $h_{1,red} \geq$ [mm] | - | 55 | 70 | 90 | - | - |
| Diameter of clearance hole in the fixture[1)] | $d_f <$ [mm] | 9 | 12 | 14 | 18 | 22 | 26 |
| Required torque moment | $T_{inst}$ = [Nm] | 20 | 45 | 60 | 110 | 200 | 270 |

[1)] If a larger diameter of the clearance hole in the fixture is used, see Chapter 4.2.2.1 of ETAG 001, Annex C




1) effective anchorage depth
2) max. thickness of fixture
3) drill hole depth
4) min. thickness of concrete member
5) min. drill hole depth at push-through installation

UPAT Anchor bolt MAX, MAX A4, MAX C

**Intended Use**
Installation parameters

**Annex B 2**

**Table B2:** Minimum thickness of concrete members, minimum spacings and minimum edge distances of anchors for **standard anchorage depth ($h_{ef,\,sta}$)**

| Type of anchor / size | | | MAX, MAX A4, MAX C | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | M8 | M10 | M12 | M16 | M20 | M24 |
| **Standard effective anchorage depth** | | $h_{ef,sta} \geq$ [mm] | **45** | **60** | **70** | **85** | **100** | **125** |
| **Applications with concrete members of thickness ≥ 2 x $h_{ef}$** | **Minimum thickness of concrete member** | $h_{min,\,1}$ [mm] | **100** | **120** | **140** | **170** | **200** | **250** |
| | **Non – cracked concrete** | | | | | | | |
| | Minimum spacing | $s_{min}$ [mm] | 40 | 40 | 50 | 65 | 95 | 100 |
| | | for c ≥ [mm] | 50 | 60 | 70 | 95 | 180 | 200 |
| | Minimum edge distance | $c_{min}$ [mm] | 40 | 45 | 55 | 65 | 95 | 135 |
| | | for s ≥ [mm] | 100 | 80 | 110 | 150 | 190 | 235 |
| | **Cracked concrete** | | | | | | | |
| | Minimum spacing | $s_{min}$ [mm] | 35 | 40 | 50 | 65 | 95 | 100 |
| | | for c ≥ [mm] | 50 | 55 | 70 | 95 | 140 | 170 |
| | Minimum edge distance | $c_{min}$ [mm] | 40 | 45 | 55 | 65 | 85 | 100 |
| | | for s ≥ [mm] | 70 | 80 | 110 | 150 | 190 | 220 |
| **Applications with concrete members of thickness < 2 x $h_{ef}$** | **Minimum thickness of concrete member** | $h_{min,\,2}$ [mm] | **80** | **100** | **120** | **140** | **160** | **200** |
| | **Cracked and non-cracked concrete** | | | | | | | |
| | Minimum spacing | $s_{min}$ [mm] | 35 | 40 | 50 | 80 | 125 | 150 |
| | | for c ≥ [mm] | 70 | 100 | 90 | 130 | 220 | 230 |
| | Minimum edge distance | $c_{min}$ [mm] | 40 | 60 | 60 | 65 | 125 | 135 |
| | | for s ≥ [mm] | 100 | 90 | 120 | 180 | 230 | 235 |

Intermediate values for $s_{min}$ and $c_{min}$ inside of the same thickness of concrete member by linear interpolation.

**Table B3:** Minimum thickness of concrete members, minimum spacings and minimum edge distances of anchors for **reduced anchorage depth ($h_{ef,\,red}$)**

| Type of anchor / size | | | MAX, MAX A4, MAX C | | |
|---|---|---|---|---|---|
| | | | M10 | M12 | M16 |
| **Reduced effective anchorage depth** | | $h_{ef,red} \geq$ [mm] | **40** | **50** | **65** |
| **Applications with concrete members of thickness ≥ 2 x $h_{ef}$** | **Minimum thickness of concrete member** | $h_{min,\,3}$ [mm] | **80** | **100** | **140** |
| | **Non – cracked concrete** | | | | |
| | Minimum spacing | $s_{min}$ [mm] | 40 | 50 | 65 |
| | | for c ≥ [mm] | 100 | 110 | 130 |
| | Minimum edge distance | $c_{min}$ [mm] | 45 | 55 | 65 |
| | | for s ≥ [mm] | 180 | 220 | 250 |
| | **Cracked concrete** | | | | |
| | Minimum spacing | $s_{min}$ [mm] | 40 | 50 | 65 |
| | | for c ≥ [mm] | 90 | 110 | 130 |
| | Minimum edge distance | $c_{min}$ [mm] | 45 | 55 | 65 |
| | | for s ≥ [mm] | 180 | 220 | 250 |

Intermediate values for $s_{min}$ and $c_{min}$ by linear interpolation.

UPAT Anchor bolt MAX, MAX A4, MAX C

**Intended Use**
Minimum thickness, minimum spacings and edge distances

**Annex B 3**

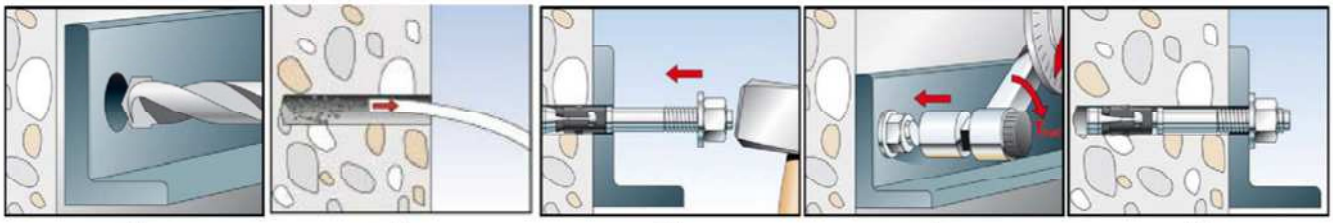
**Table B4:** Minimum spacings and minimum edge distances of anchors according to **TR 020 and ETAG 001, Annex C** under **fire exposure** and according to **CEN/TS 1992-4: 2009, Annex D** under **fire exposure**

| Type of anchor / size | | | MAX, MAX A4, MAX C | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | M8 | M10 | M12 | M16 | M20 | M24 |
| Spacing | $s_{min}$ | [mm] | 35 | 40 | 45 | 60 | 95 | 100 |
| Edge distance | $c_{min}$ | [mm] | $c_{min} = 2 \times h_{ef}$ , for fire exposure from more than one side $c_{min} \geq 300$ mm | | | | | |

## Installation instructions

The fitness for use of the anchor can only be assumed if the anchor is installed as follows:

- Anchor installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site.
- Use of the anchor only as supplied by the manufacturer without exchanging the components of the anchor
- Checking before placing the anchor to ensure that the strength class of the concrete in which the anchor is to be placed is in the range given and is not lower than that of the concrete to which the characteristic loads apply.
- Check of concrete being well compacted, e.g. without significant voids
- Edge distances and spacing not less than the specified values without minus tolerances.



1 2 3 4 5

| No. | Description |
|---|---|
| 1 | Create drill hole<br>Drill hole perpendicular to concrete surface, positioning without damaging the reinforcement. In case of aborted hole: new drilling at a minimum distance away of twice the depth of the aborted hole or smaller distance if the aborted drill hole is filled with high strength mortar and if under shear or oblique tension load it is not in the direction of load application. |
| 2 | Clean bore hole |
| 3 | Set anchor |
| 4 | Expand anchor with prescribed installation torque $T_{inst}$ |
| 5 | Finished installation |

**Table C1:** Characteristic values of **tension** resistance for **standard anchorage depth** under static and quasi-static action (Design method A, according to **ETAG 001, Annex C** or **CEN/TS 1992-4**)

| Type of anchor / size | | | MAX, MAX A4, MAX C | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | M8 | M10 | M12 | M16 | M20 | M24 |
| **Steel failure for standard anchorage depth** | | | | | | | | |
| Characteristic resistance | $N_{Rk,s}$ | [kN] | 16,0 | 27,0 | 41,5 | 66,0 | 111,0 | 150,0 |
| Partial safety factor | $\gamma_{Ms}$ 3) | | 1,5 | | | | | |
| **Pullout failure for standard anchorage depth** | | | | | | | | |
| Effective anchorage depth | $h_{ef,sta} \geq$ | [mm] | 45 | 60 | 70 | 85 | 100 | 125 |
| Characteristic resistance in cracked concrete C20/25 | $N_{Rk,p}$ | [kN] | 5 | 9 | 16 | - 1) | | |
| Characteristic resistance in non - cracked concrete C20/25 | $N_{Rk,p}$ | [kN] | 9 | 16 | 25 | - 1) | | |
| Increasing factors for $N_{Rk,p}$ for cracked and non – cracked concrete | $\psi_c$ | C25/30 | 1,10 | | | | | |
| | | C30/37 | 1,22 | | | | | |
| | | C35/45 | 1,34 | | | | | |
| | | C40/50 | 1,41 | | | | | |
| | | C45/55 | 1,48 | | | | | |
| | | C50/60 | 1,55 | | | | | |
| Installation safety factor | $\gamma_2 = \gamma_{inst}$ | | 1,0 | | | | | |
| **Concrete cone and splitting failure for standard anchorage depth in applications with concrete members of thickness ≥ 2x $h_{ef}$** | | | | | | | | |
| Effective anchorage depth | $h_{ef}$ | [mm] | 45 | 60 | 70 | 85 | 100 | 125 |
| Factor for non-cracked concrete | $k_{ucr}$ | [-] | 10,1 | | | | | |
| Factor for cracked concrete | $k_{cr}$ | [-] | 7,2 | | | | | |
| Min. thickness of concrete member | $h_{min,1}$ | [mm] | 100 | 120 | 140 | 170 | 200 | 250 |
| Characteristic spacing | $s_{cr,N}$ | [mm] | 3 $h_{ef}$ | | | | | |
| Characteristic edge distance | $c_{cr,N}$ | [mm] | 1,5 $h_{ef}$ | | | | | |
| Spacing (splitting failure) 2) | $s_{cr,sp}$ | [mm] | 140 | 180 | 210 | 260 | 370 | 430 |
| Edge distance (splitting failure) 2) | $c_{cr,sp}$ | [mm] | 70 | 90 | 105 | 130 | 185 | 215 |
| **Concrete cone and splitting failure for standard anchorage depth in applications with concrete members of thickness < 2x $h_{ef}$** | | | | | | | | |
| Effective anchorage depth | $h_{ef}$ | [mm] | 45 | 60 | 70 | 85 | 100 | 125 |
| Factor for non-cracked concrete | $k_{ucr}$ | [-] | 10,1 | | | | | |
| Factor for cracked concrete | $k_{cr}$ | [-] | 7,2 | | | | | |
| Min. thickness of concrete member | $h_{min,2}$ | [mm] | 80 | 100 | 120 | 140 | 160 | 200 |
| Characteristic spacing | $s_{cr,N}$ | [mm] | 3 $h_{ef}$ | | | | | |
| Characteristic edge distance | $c_{cr,N}$ | [mm] | 1,5 $h_{ef}$ | | | | | |
| Spacing (splitting failure) 2) | $s_{cr,sp}$ | [mm] | 180 | 240 | 280 | 340 | 480 | 550 |
| Edge distance (splitting failure) 2) | $c_{cr,sp}$ | [mm] | 90 | 120 | 140 | 170 | 240 | 275 |

1) Pullout failure not relevant.
2) Intermediate values for $s_{cr,sp}$ and $c_{cr,sp}$ between concrete thickness $h_{min,2}$ and $h_{min,1}$ by linear interpolation.
3) In absence of other national regulations

UPAT Anchor bolt MAX, MAX A4, MAX C

**Performances**
Characteristic values of resistance under **tension** loads for **standard anchorage depth**
(Design method A, according to **ETAG 001, Annex C** or **CEN/TS 1992-4)**

**Annex C 1**

**Table C2:** Characteristic values of **tension** resistance for **reduced anchorage depth** under static and quasi-static action (Design method A, according to **ETAG 001, Annex C** or **CEN/TS 1992-4:2009**)

| Type of anchor / size | | | MAX, MAX A4, MAX C | | |
|---|---|---|---|---|---|
| | | | **M10** | **M12** | **M16** |
| **Steel failure for reduced anchorage depth** | | | | | |
| Characteristic resistance | $N_{Rk,s}$ | [kN] | 27,0 | 41,5 | 66,0 |
| Partial safety factor | $\gamma_{Ms}$ [2)] | | 1,5 | | |
| **Pullout failure for reduced anchorage depth** | | | | | |
| Effective anchorage depth | $h_{ef,red} \geq$ | [mm] | 40 | 50 | 65 |
| Characteristic resistance in cracked concrete C20/25 | $N_{Rk,p}$ | [kN] | - [1)] | | |
| Characteristic resistance in non - cracked concrete 20/25 | $N_{Rk,p}$ | [kN] | - [1)] | | |
| Increasing factors for $N_{Rk,p}$ for cracked and non – cracked concrete | $\psi_c$ | C25/30 | 1,10 | | |
| | | C30/37 | 1,22 | | |
| | | C35/45 | 1,34 | | |
| | | C40/50 | 1,41 | | |
| | | C45/55 | 1,48 | | |
| | | C50/60 | 1,55 | | |
| Installation safety factor | $\gamma_2 = \gamma_{inst}$ | | 1,0 | | |
| **Concrete cone and splitting failure for reduced anchorage depth** | | | | | |
| Effective anchorage depth | $h_{ef}$ | [mm] | 40 | 50 | 65 |
| Factor for non-cracked concrete | $k_{ucr}$ | [-] | 10,1 | | |
| Factor for cracked concrete | $k_{cr}$ | [-] | 7,2 | | |
| Min. thickness of concrete member | $h_{min,3}$ | [mm] | 80 | 100 | 140 |
| Characteristic spacing | $_{scr,N}$ | [mm] | 3 $h_{ef}$ | | |
| Characteristic edge distance | $c_{cr,N}$ | [mm] | 1,5 $h_{ef}$ | | |
| Spacing (splitting failure) | $s_{cr,sp}$ | [mm] | 160 | 200 | 260 |
| Edge distance (splitting failure) | $c_{cr,sp}$ | [mm] | 80 | 100 | 130 |

[1)] Pullout failure not relevant.
[2)] In absence of other national regulations

**Table C3:** Characteristic values of **shear** resistance for **standard and reduced anchorage depth** under static and quasi-static action (Design method A, according to **ETAG 001, Annex C or CEN/TS 1992-4:2009**))

| Type of anchor / size | | | MAX, MAX A4, MAX C | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | **M8** | **M10** | **M12** | **M16** | **M20** | **M24** |
| Steel failure without lever arm for **standard and reduced anchorage depth** | | | | | | | | |
| Characteristic resistance | $V_{Rk,s}$ | [kN] | 12,0 | 20,0 | 29,5 | 55,0 | 70,0 | 86,0 |
| Partial safety factor | $\gamma_{Ms}$ [1)] | | 1,25 | | | | | |
| Factor for ductility | $k_2$ | [-] | 1,0 | | | | | |
| **Standard anchorage depth** | | | | | | | | |
| **Steel failure with lever arm** | | | | | | | | |
| Characteristic bending resistance | $M^0_{Rk,s}$ | [Nm] | 26 | 52 | 92 | 233 | 487 | 769 |
| Partial safety factor | $\gamma_{Ms}$ [1)] | | 1,25 | | | | | |
| Factor for ductility | $k_2$ | [-] | 1,0 | | | | | |
| **Concrete pryout failure** | | | | | | | | |
| Factor k according to ETAG 001, Annex C or $k_3$ according to CEN/TS 1992-4 | $k_{(3)}$ | | 2,2 | | 2,4 | 2,8 | | |
| **Concrete edge failure** | | | | | | | | |
| Effective length of anchor in shear loading | $l_f$ | [mm] | 45 | 60 | 70 | 85 | 100 | 125 |
| Effective diameter of anchor | $d_{nom}$ | [mm] | 8 | 10 | 12 | 16 | 20 | 24 |
| Installation safety factor | $\gamma_2 = \gamma_{inst}$ | | 1,0 | | | | | |
| **Reduced anchorage depth** | | | | | | | | |
| **Steel failure with lever arm** | | | | | | | | |
| Characteristic bending resistance | $M^0_{Rk,s}$ | [Nm] | - | 40 | 89 | 171 | - | - |
| Partial safety factor | $\gamma_{Ms}$ [1)] | | 1,25 | | | | | |
| Factor for ductility | $k_2$ | [-] | 1,0 | | | | | |
| **Concrete pryout failure** | | | | | | | | |
| Factor k according to ETAG 001, Annex C or $k_3$ according to CEN/TS 1992-4 | $k_{(3)}$ | | - | 2,0 | 2,3 | | - | - |
| **Concrete edge failure** | | | | | | | | |
| Effective length of anchor in shear loading | $l_f$ | [mm] | - | 40 | 50 | 65 | - | - |
| Effective diameter of anchor | $d_{nom}$ | [mm] | - | 10 | 12 | 16 | - | - |

[1)] In absence of other national regulations

**Table C4:** Characteristic values of **tension** resistance under **fire exposure** in cracked and non-cracked concrete for **standard and reduced anchorage depth** (Design according to **TR 020 and ETAG 001, Annex C** or **CEN/TS 1992-4: 2009, Annex D)**

| Type of anchor / size **MAX, MAX A4, MAX C** | **R30** Fire resistance 30 minutes | | | **R60** Fire resistance 60 minutes | | |
|---|---|---|---|---|---|---|
| | $N_{Rk,s,fi,30}$ [kN] | $N_{Rk,p,fi,30}$ [kN] | $N^0_{Rk,c,fi,30}$ [kN] | $N_{Rk,s,fi,60}$ [kN] | $N_{Rk,p,fi,60}$ [kN] | $N^0_{Rk,c,fi,60}$ [kN] |
| **Standard anchorage depth** | | | | | | |
| M8 | 1,4 | 1,3 | 2,4 | 1,2 | 1,3 | 2,4 |
| M10 | 2,8 | 2,3 | 5,0 | 2,3 | 2,3 | 5,0 |
| M12 | 5,0 | 4,0 | 7,4 | 4,1 | 4,0 | 7,4 |
| M16 | 9,4 | 7,1 | 12,0 | 7,7 | 7,1 | 12,0 |
| M20 | 14,7 | 9,0 | 18,0 | 12,0 | 9,0 | 18,0 |
| M24 | 21,1 | 12,6 | 31,4 | 17,3 | 12,6 | 31,4 |
| **Reduced anchorage depth** | | | | | | |
| M10 | 2,8 | 2,3 | 1,8 | 2,3 | 2,3 | 1,8 |
| M12 | 5,0 | 3,2 | 3,2 | 4,1 | 3,2 | 3,2 |
| M16 | 9,4 | 4,7 | 6,1 | 7,7 | 4,7 | 6,1 |

| | **R90** Fire resistance 90 minutes | | | **R120** Fire resistance 120 minutes | | |
|---|---|---|---|---|---|---|
| | $N_{Rk,s,fi,90}$ [kN] | $N_{Rk,p,fi,90}$ [kN] | $N^0_{Rk,c,fi,90}$ [kN] | $N_{Rk,s,fi,120}$ [kN] | $N_{Rk,p,fi,120}$ [kN] | $N^0_{Rk,c,fi,120}$ [kN] |
| **Standard anchorage depth** | | | | | | |
| M8 | 0.9 | 1.3 | 2.4 | 0.8 | 1.0 | 1.9 |
| M10 | 1,9 | 2,3 | 5,0 | 1,6 | 1,8 | 4,0 |
| M12 | 3,2 | 4,0 | 7,4 | 2,8 | 3,2 | 5,9 |
| M16 | 6,0 | 7,1 | 12,0 | 5,2 | 5,6 | 9,6 |
| M20 | 9,4 | 9,0 | 18,0 | 8,1 | 7,2 | 14,4 |
| M24 | 13,5 | 12,6 | 31,4 | 11,6 | 10,1 | 25,1 |
| **Reduced anchorage depth** | | | | | | |
| M10 | 1,9 | 2,3 | 1,8 | 1,6 | 1,8 | 1,4 |
| M12 | 3,2 | 3,2 | 3,2 | 2,8 | 2,5 | 2,5 |
| M16 | 6,0 | 4,7 | 6,1 | 5,2 | 3,8 | 4,9 |

In absence of other national regulations the partial safety factor for resistance under fire exposure $\gamma_{M,fi}$ = 1,0 is recommended.

**Table C5:** Characteristic values of **shear** resistance under **fire exposure** in cracked and non-cracked concrete for **standard and reduced anchorage depth** (Design according to **TR 020 and ETAG 001, Annex C** or **CENT/TS 1992-4:2009, Anhang D)**

| Type of anchor / size **MAX, MAX A4, MAX C** | **R30** Fire resistance 30 minutes | | | **R60** Fire resistance 60 minutes | | |
|---|---|---|---|---|---|---|
| | $V_{Rk,s,fi,30}$ [kN] | $M^0_{Rk,s,fi,30}$ [Nm] | k | $V_{Rk,s,fi,60}$ [kN] | $M^0_{Rk,s,fi,60}$ [Nm] | k |
| **Standard anchorage depth** | | | | | | |
| M8 | 1,8 | 1,4 | 2,2 | 1,6 | 1,2 | 2,2 |
| M10 | 3,6 | 3,6 | 2,2 | 2,9 | 3,0 | 2,2 |
| M12 | 6,3 | 7,8 | 2,4 | 4,9 | 6,4 | 2,4 |
| M16 | 11,7 | 19,9 | 2,8 | 9,1 | 16,3 | 2,8 |
| M20 | 18,2 | 39,0 | 2,8 | 14,2 | 31,8 | 2,8 |
| M24 | 26,3 | 67,3 | 2,8 | 20,5 | 55,0 | 2,8 |
| **Reduced anchorage depth** | | | | | | |
| M10 | 3,6 | 3,6 | 2,0 | 2,9 | 3,0 | 2,0 |
| M12 | 6,3 | 7,8 | 2,3 | 4,9 | 6,4 | 2,3 |
| M16 | 11,7 | 20,0 | 2,3 | 9,1 | 16,3 | 2,3 |

| | **R90** Fire resistance 90 minutes | | | **R120** Fire resistance 120 minutes | | |
|---|---|---|---|---|---|---|
| | $V_{Rk,s,fi,90}$ [kN] | $M^0_{Rk,s,fi,90}$ [Nm] | k | $V_{Rk,s,fi,120}$ [kN] | $M^0_{Rk,s,fi,120}$ [Nm] | k |
| **Standard anchorage depth** | | | | | | |
| M8 | 1,3 | 1,0 | 2,2 | 1,2 | 0,8 | 2,2 |
| M10 | 2,2 | 2,4 | 2,2 | 1,9 | 2,1 | 2,2 |
| M12 | 3,5 | 5,0 | 2,4 | 2,8 | 4,3 | 2,4 |
| M16 | 6,6 | 12,6 | 2,8 | 5,3 | 11,0 | 2,8 |
| M20 | 10,3 | 24,6 | 2,8 | 8,3 | 21,4 | 2,8 |
| M24 | 14,8 | 42,6 | 2,8 | 11,9 | 37,0 | 2,8 |
| **Reduced anchorage depth** | | | | | | |
| M10 | 2,2 | 2,4 | 2,0 | 1,9 | 2,1 | 2,0 |
| M12 | 3,5 | 5,0 | 2,3 | 2,8 | 4,3 | 2,3 |
| M16 | 6,6 | 12,6 | 2,3 | 5,3 | 11,0 | 2,3 |

**Concrete pryout failure:** In Equation (5.6) of ETAG 001, Annex C, 5.2.3.3 the $k_{(3)}$-factor of Table C3 and the relevant values of $N_{0Rk,c,fi}$ of Table C4 have to be considered.
**Concrete edge failure:** The characteristic resistance $V^0_{Rk,c,fi}$ in concrete C20/25 to C50/60 is determined by: $V^0_{Rk,c,fi} = 0,25 \times V^0_{Rk,c}$ (R30, R60, R90), $V^0_{Rk,c,fi} = 0,20 \times V^0_{Rk,c}$ (R120) with $V^0_{Rk,c}$ as initial value of the characteristic resistance in cracked concrete C20/25 under normal temperature according to ETAG 001, Annex C, 5.2.3.4.
In absence of other national regulations the partial safety factor for resistance under fire exposure $\gamma_{M,fi} = 1,0$ is recommended.

UPAT Anchor bolt MAX, MAX A4, MAX C

**Performances:**
Characteristic values of resistance under **shear** loads and **fire exposure**
(Design according to **TR 020 and ETAG 001, Annex C or CEN/TS 1992-4:2009, Annex D**)

**Annex C 5**

**Table C6:** Valid anchor sizes for seismic design, **performance category C1, standard and reduced anchorage depth**

| Type of anchor / size | | MAX, MAX A4, MAX C | | | | | |
|---|---|---|---|---|---|---|---|
| | | **M8** | **M10** | **M12** | **M16** | **M20** | **M24** |
| **Standard effective anchorage depth** | $h_{ef,sta} \geq$ [mm] | 45 | 60 | 70 | 85 | 100 | 125 |
| Thickness of fixture | $t_{fix,min}$ = [mm] | 0 | 0 | 0 | 0 | 0 | 0 |
| | $t_{fix,max}$ = [mm] | 100 | 100 | 120 | 160 | 250 | 300 |
| Length of anchor | $L_{min}$ = [mm] | 64,5 | 84,5 | 99 | 122 | 141 | 174 |
| | $L_{max}$ = [mm] | 167 | 186 | 221 | 284,5 | 394 | 477 |
| **Reduced effective anchorage depth** | $h_{ef,red} \geq$ [mm] | - | 40 | 50 | 65 | - | - |
| Thickness of fixture | $t_{fix,min}$ = [mm] | - | 0 | 0 | 0 | - | - |
| | $t_{fix,max}$ = [mm] | - | 120 | 140 | 180 | - | - |
| Length of anchor | $L_{min}$ = [mm] | - | 64,5 | 79 | 102 | - | - |
| | $L_{max}$ = [mm] | - | 186 | 221 | 284,5 | - | - |

**Table C7:** Valid anchor sizes for seismic design, **performance category C2, standard and reduced anchorage depth**

| Type of anchor / size | | MAX, MAX A4, MAX C [1)] | | | | | |
|---|---|---|---|---|---|---|---|
| | | **M8** | **M10** | **M12** | **M16** | **M20** | **M24** |
| **Standard effective anchorage depth** | $h_{ef,sta} \geq$ [mm] | - | 60 | 70 | 85 | 100 | - |
| Thickness of fixture | $t_{fix,min}$ = [mm] | - | 0 | 0 | 0 | 0 | - |
| | $t_{fix,max}$ = [mm] | - | 100 | 120 | 160 | 250 | - |
| Length of anchor | $L_{min}$ = [mm] | - | 84,5 | 99 | 122 | 141 | - |
| | $L_{max}$ = [mm] | - | 186 | 221 | 284,5 | 394 | - |
| **Reduced effective anchorage depth** | $h_{ef,red} \geq$ [mm] | - | 40 | 50 | 65 | - | - |
| Thickness of fixture | $t_{fix,min}$ = [mm] | - | 0 | 0 | 0 | - | - |
| | $t_{fix,max}$ = [mm] | - | 120 | 140 | 180 | - | - |
| Length of anchor | $L_{min}$ = [mm] | - | 64,5 | 79 | 102 | - | - |
| | $L_{max}$ = [mm] | - | 186 | 221 | 284,5 | - | - |

[1)] MAX C: Only valid for cold-formed version (see A1)

**Table C8:** Characteristic values of **tension and shear** resistance for **standard- and reduced anchorage depth** under **seismic action**
(Design according to **TR 045: Performance category C1**)

| Type of anchor / size | | MAX, MAX A4, MAX C | | | | | |
|---|---|---|---|---|---|---|---|
| | | **M8** | **M10** | **M12** | **M16** | **M20** | **M24** |
| **Steel failure for standard anchorage depth** | | | | | | | |
| Characteristic resistance tension load C1 | $\frac{h_{ef,sta}}{h_{ef,red.}}$ $N_{Rk,s,C1}$ [kN] | 16,0<br>- | 27,0 | 41,0 | 66,0 | 111,0<br>- | 150,0<br>- |
| Partial safety factor | $\gamma_{Ms,C1}$ [1] [-] | 1,5 | | | | | |
| **Pullout failure for standard anchorage depth** | | | | | | | |
| Characteristic resistance tension load in cracked concrete C1 | $\frac{h_{ef,sta}}{h_{ef,red.}}$ $N_{Rk,p,C1}$ [kN] | 4,6<br>- | 8,0 | 16,0 | 28,2 | 36,0<br>- | 50,3<br>- |
| Installation safety factor | $\gamma_{2,C1}$ [-] | 1,0 | | | | | |
| **Steel failure without lever arm for standard anchorage depth** | | | | | | | |
| Characteristic resistance shear load C1 | $\frac{h_{ef,sta}}{h_{ef,red.}}$ $V_{Rk,s,C1}$ [kN] | 11<br>- | 17 | 27 | 47 | 56<br>- | 69<br>- |
| Partial safety factor | $\gamma_{Ms,C1}$ [1] [-] | 1,25 | | | | | |

**Table C9:** Characteristic values of **tension and shear** resistance for **standard- and reduced anchorage depth** under **seismic action**
(Design according to **TR 045: Performance category C2**)

| Type of anchor / size | | MAX, MAX A4, MAX C [2] | | | | | |
|---|---|---|---|---|---|---|---|
| | | **M8** | **M10** | **M12** | **M16** | **M20** | **M24** |
| **Steel failure for standard anchorage depth** | | | | | | | |
| Characteristic resistance tension load C2 | $\frac{h_{ef,sta}}{h_{ef,red.}}$ $N_{Rk,s,C2}$ [kN] | - | 27 | 41 | 66 | 111<br>- | - |
| Partial safety factor | $\gamma_{Ms,C2}$ [1] [-] | 1,5 | | | | | |
| **Pullout failure for standard anchorage depth** | | | | | | | |
| Characteristic resistance tension load in cracked concrete C2 | $\frac{h_{ef,sta}}{h_{ef,red.}}$ $N_{Rk,p,C2}$ [kN] | - | 5,1<br>2,7 | 7,4<br>4,4 | 21,5<br>16,4 | 30,7<br>- | - |
| Installation safety factor | $\gamma_{2,C2}$ [-] | 1,0 | | | | | |
| **Steel failure without lever arm for standard anchorage depth** | | | | | | | |
| Characteristic resistance shear load C2 | $\frac{h_{ef,sta}}{h_{ef,red.}}$ $V_{Rk,s,C2}$ [kN] | - | 10,0<br>7,0 | 17,4<br>12,7 | 27,5<br>22,0 | 39,9<br>- | - |
| Partial safety factor | $\gamma_{Ms,C2}$ [1] [-] | 1,25 | | | | | |

[1] In absence of other national regulations
[2] MAX C: Only valid for cold-formed version (see A1)

**Table C10:** Displacements due to tension loads for **standard and reduced anchorage depth** (Design method A, according to **ETAG 001, Annex C** or **CEN/TS 1992-4:2009**)

| Type of anchor / size | | | MAX, MAX A4, MAX C | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | **M8** | **M10** | **M12** | **M16** | **M20** | **M24** |
| **Values for standard anchorage depth** | | | | | | | | |
| Tension load in cracked concrete | N | [kN] | 2,3 | 4,2 | 7,5 | 13,2 | 16,4 | 22,9 |
| Displacement | $\delta_{N0}$ | [mm] | 0,5 | 0,5 | 0,7 | 1,0 | 1,2 | 1,2 |
| | $\delta_{N\infty}$ | [mm] | 1,2 | | | | 1,4 | 1,5 |
| Tension load in non - cracked concrete | N | [kN] | 4,2 | 7,5 | 11,7 | 18,7 | 23,3 | 32,5 |
| Displacement | $\delta_{N0}$ | [mm] | 0,3 | 0,3 | 0,5 | 0,7 | 1,2 | 1,2 |
| | $\delta_{N\infty}$ | [mm] | 1,2 | | | | 1,4 | 1,5 |
| **Values for reduced anchorage depth** | | | | | | | | |
| Tension load in cracked concrete | N | [kN] | - | 4,2 | 6,0 | 9,0 | - | - |
| Displacement | $\delta_{N0}$ | [mm] | - | 0,5 | 0,7 | 1,0 | - | - |
| | $\delta_{N\infty}$ | [mm] | 1,2 | | | | - | - |
| Tension load in non - cracked concrete | N | [kN] | - | 5,7 | 8,5 | 12,6 | - | - |
| Displacement | $\delta_{N0}$ | [mm] | - | 0,3 | 0,5 | 0,7 | - | - |
| | $\delta_{N\infty}$ | [mm] | 1,2 | | | | - | - |

**Table C11:** Displacements due to shear loads for **standard and reduced anchorage depth** (Design method A, according to **ETAG 001, Annex C** or **CEN/TS 1992-4:2009**)

| Type of anchor / size | | | MAX, MAX A4, MAX C | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | **M8** | **M10** | **M12** | **M16** | **M20** | **M24** |
| Shear load in cracked and non-cracked concrete | V | [kN] | 6,9 | 11,4 | 16,9 | 31,4 | 39,4 | 48,5 |
| Displacement | $\delta_{V0}$ | [mm | 2,4 | 4,2 | 4,5 | 3,0 | 3,6 | 3,6 |
| | $\delta_{V\infty}$ | [mm | 3,6 | 6,3 | 6,8 | 4,5 | 5,4 | 5,4 |

**Table C12:** Displacements due to tension loads for **standard and reduced anchorage depth** (Design according to **TR 045: Performance category C2**)

| Type of anchor / size | | | MAX, MAX A4, MAX C | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | M8 | M10 | M12 | M16 | M20 | M24 |
| **Values for standard anchorage depth** | | | | | | | | |
| Displacement DLS | $\delta_{N,C2\,(DLS)}$ | [mm] | - | 2,7 | 4,4 | 4,4 | 5,6 | - |
| Displacement ULS | $\delta_{N,C2\,(ULS)}$ | [mm] | - | 11,5 | 13,0 | 12,3 | 14,4 | - |
| **Values for reduced anchorage depth** | | | | | | | | |
| Displacement DLS | $\delta_{N,C2\,(DLS)}$ | [mm] | - | 2,7 | 4,4 | 4,4 | - | - |
| Displacement ULS | $\delta_{N,C2\,(ULS)}$ | [mm] | - | 11,5 | 13,0 | 12,3 | - | - |

**Table C13:** Displacements due to shear loads for **standard and reduced anchorage depth** (Design according to **TR 045: Performance category C2**)

| Type of anchor / size | | | MAX, MAX A4, MAX C | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | M8 | M10 | M12 | M16 | M20 | M24 |
| **Values for standard anchorage depth** | | | | | | | | |
| Displacement DLS | $\delta_{V,C2\,(DLS)}$ | [mm] | - | 4,1 | 4,4 | 4,3 | 4,8 | - |
| Displacement ULS | $\delta_{V,C2\,(ULS)}$ | [mm] | - | 6,2 | 7,8 | 8,1 | 11,2 | - |
| **Values for reduced anchorage depth** | | | | | | | | |
| Displacement DLS | $\delta_{V,C2\,(DLS)}$ | [mm] | - | 3,6 | 4,7 | 5,5 | - | - |
| Displacement ULS | $\delta_{V,C2\,(ULS)}$ | [mm] | - | 5,0 | 7,5 | 10,1 | - | - |