Deutsches Institut für Bautechnik

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-02/0031 of 7 September 2017

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 | Würth High-Performance Anchor W-HAZ/S, W-HAZ/A4 |
| Product family to which the construction product belongs | Mechanical anchor for use in concrete |
| Manufacturer | Adolf Würth GmbH & Co. KG<br>Reinhold-Würth-Straße 12-17<br>74653 Künzelsau<br>DEUTSCHLAND |
| Manufacturing plant | Herstellwerk W1,<br>Deutschland |
| This European Technical Assessment contains | 20 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 | EAD 330232-00-0601 |
| This version replaces | ETA-02/0031 issued on 30 October 2015 |

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## Specific Part

### 1 Technical description of the product

The Würth High-Performance Anchor W-HAZ/S, W-HAZ/A4 is an anchor made of galvanised steel or made of stainless steel which is placed into a drilled hole and anchored by torque-controlled expansion. The following anchor types are covered:

- Anchor type W-HAZ-B with threaded bolt,
- Anchor type W-HAZ-S with hexagon head screw,
- Anchor type W-HAZ-SK with countersunk washer and countersunk screw.

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 loading | See Annex C1 to C5 |
| Characteristic resistance for seismic performance category C1 and C2 | See Annex C6 to C7 |
| Displacements under tension and shear loads | See Annex C9 and C10 |

#### 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 C8 |

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

In accordance with the European Assessment Document EAD Nr. 330232-00-0601 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 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 September 2017 by Deutsches Institut für Bautechnik

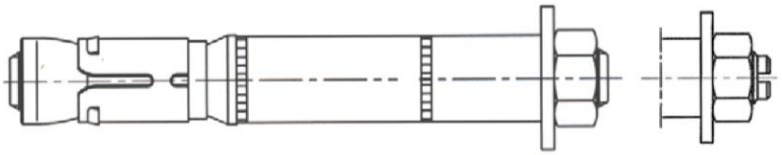
Andreas Kummerow
Head of Department

*beglaubigt:*
Baderschneider

Deutsches Institut für Bautechnik DIBt

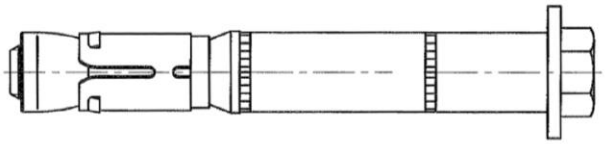
## High-Performance Anchor W-HAZ

### Anchor type W-HAZ-B with threaded bolt



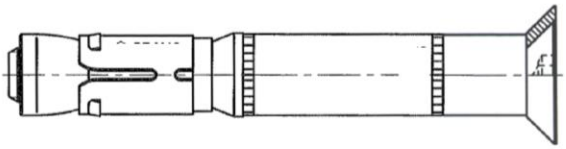
**W-HAZ-B (M6-M20)**
**W-HAZ-B (M8-M16) A4**

### Anchor type W-HAZ-S with hexagon head screw



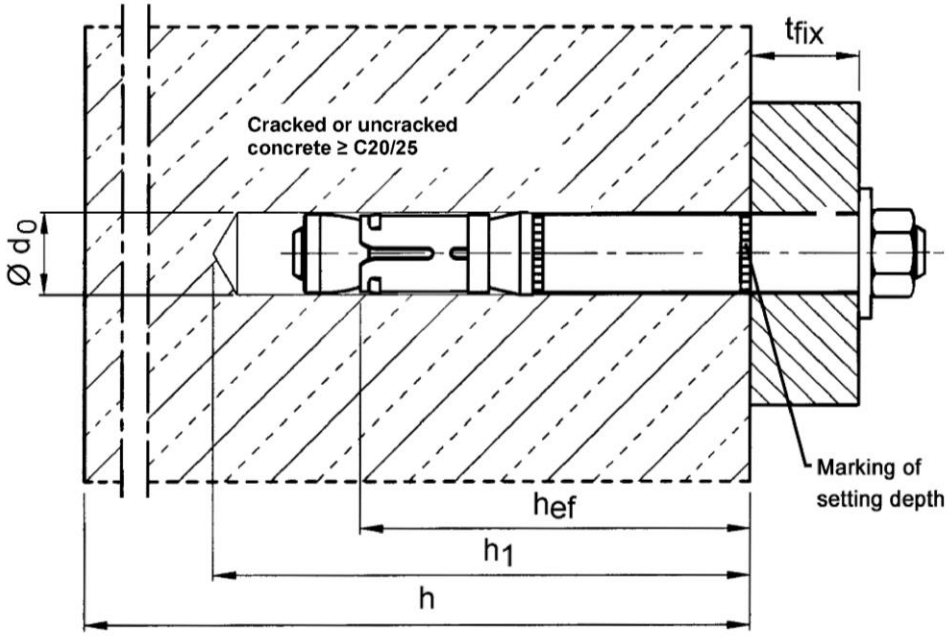
**W-HAZ-S (M6-M20)**
**W-HAZ-S (M8-M16) A4**

### Anchor type W-HAZ-SK with countersunk washer and countersunk screw



**W-HAZ-SK (M6-M12)**
**W-HAZ-SK (M8-M12) A4**

## Installation condition




| Würth High-Performance Anchor W-HAZ/S, W-HAZ/A4 | |
|---|---|
| **Product description**<br>Product and installation situation | **Annex A1** |

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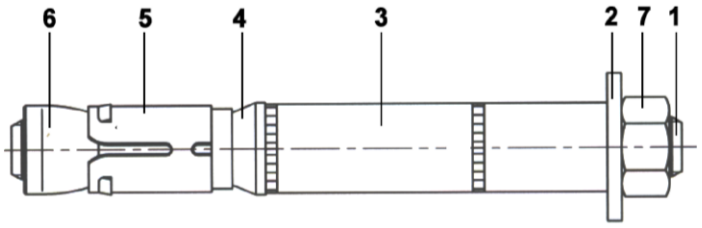
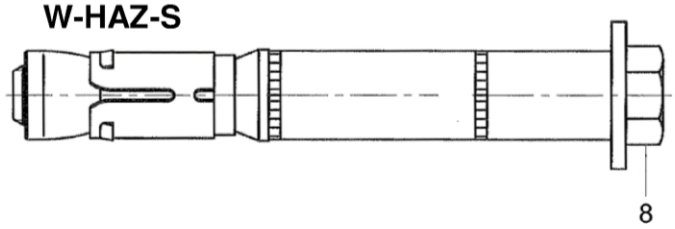
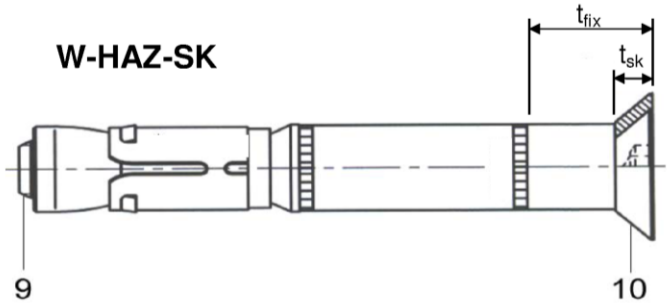
**W-HAZ-B**




**W-HAZ-S**




**W-HAZ-SK**




**Marking:**

expansion sleeve:
- Identifying mark of manufacturing plant ◇
- additional marking of stainless steel A4 A4
- Trade name (alternatively on distance sleeve) SZ
- size of thread (alternatively on distance sleeve) M10

Distance sleeve:
- Diameter 15
- max. thickness of fixture 25
- additional marking for countersunk version SK

additional marking on the washer of anchor size SZ 24/M16L L

**Table A1: Designation of anchor parts and materials**

| Part | Designation | Materials galvanised ≥ 5 µm, acc. to EN ISO 4042:1999 | Stainless steel A4 |
|---|---|---|---|
| 1 | Threaded bolt | Steel, Strength class 8.8, EN ISO 898-1:2013 | Stainless steel, 1.4401, 1.4404 or 1.4571, EN 10088:2005 |
| 2 | Washer | Steel, EN 10139:1997 | Stainless steel, 1.4401, 1.4404 or 1.4571, EN 10088:2005 |
| 3 | Distance sleeve | Precision steel tubes DIN 2394/2393 | Stainless steel, 1.4401, 1.4404 or 1.4571, EN 10088:2005 |
| 4 | Ring | Polyethylene | Polyethylene |
| 5 | Expansion sleeve | Steel, EN 10139:1997 | Stainless steel, 1.4401, 1.4404 or 1.4571, EN 10088:2005 |
| 6 | Threaded cone | Steel, Strength class 8, EN ISO 898-2:2012 | Stainless steel, 1.4401, 1.4404 or 1.4571, EN 10088:2005 |
| 7 | Hexagon nut | Steel, Strength class 8, EN ISO 898-2:2012 | ISO 3506, strength class 70, stainless steel 1.4401 or 1.4571, EN 10088:2005 |
| 8 | Hexagon head screw | Steel, Strength class 8.8, EN ISO 898-1:2013 | Stainless steel, 1.4401, 1.4404 or 1.4571, EN 10088:2005 |
| 9 | Countersunk screw | Steel, Strength class 8.8, EN ISO 898-1:2013 | Stainless steel, 1.4401, 1.4404 or 1.4571, EN 10088:2005 |
| 10 | Countersunk washer | Steel, EN 10083-2:2006 | Stainless steel, 1.4401, 1.4404 or 1.4571, EN 10088:2005, zinc plated |

**Würth High-Performance Anchor W-HAZ/S, W-HAZ/A4**

**Product description**
Marking and materials

**Annex A2**

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## Specifications of intended use

| **High-Performance Anchor W-HAZ, steel zinc plated** | **10/M6** | **12/M8** | **15/M10** | **18/M12** | **24/M16** | **24/M16L** | **28/M20** |
|---|---|---|---|---|---|---|---|
| Static or quasi-static action | ✓ | | | | | | |
| Seismic action (W-HAZ-B and W-HAZ-S) | - | C1 + C2 | | | | | |
| Seismic action (W-HAZ-SK) | - | C1 + C2 | | | - | | |
| Fire exposure | R 30 … R 120 | | | | | | |

| **High-Performance Anchor W-HAZ, stainless steel A4** | **12/M8** | **15/M10** | **18/M12** | **24/M16** |
|---|---|---|---|---|
| Static or quasi-static action | ✓ | | | |
| Seismic action (W-HAZ-B and W-HAZ-S) | C1 + C2 | | | |
| Seismic action (W-HAZ-SK) | C1 + C2 | | | - |
| Fire exposure | R30 … R120 | | | |

**Base materials:**

- Cracked and uncracked concrete
- Reinforced or unreinforced normal weight concrete 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 (zinc plated steel or stainless steel).
- Structures subject to external atmospheric exposure (including industrial and marine environment) and to permanently damp internal condition, if no particular aggressive conditions exist (stainless steel).

  Note: Particular aggressive conditions are e.g. permanent, alternating immersion in seawater or the splash zone of seawater, chloride atmosphere of indoor pools or atmosphere with extreme 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, seismic actions and under fire exposure are designed in accordance with FprEN 1992-4:2016 and TR 055.

**Installation:**

- Anchor installation carried out by appropriately qualified personnel 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 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.
- Anchor installation such that the effective anchorage depth is complied with. This compliance is ensured when the embedment mark of the anchor does no more exceed the concrete surface.
- Drill hole by hammer drilling only (use of vacuum drill bits is admissible)



| **Würth High-Performance Anchor W-HAZ/S, W-HAZ/A4** | |
|---|---|
| **Intended use**<br>Specifications | **Annex B1** |

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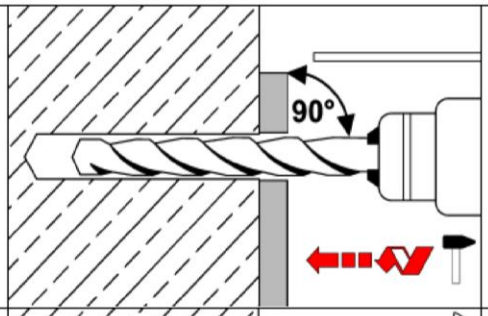
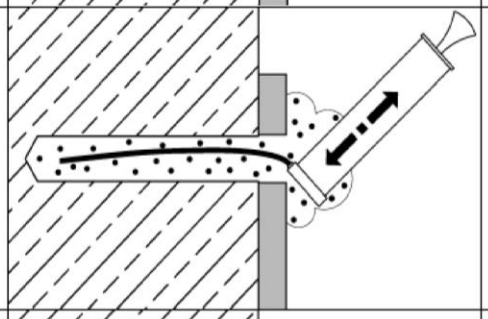
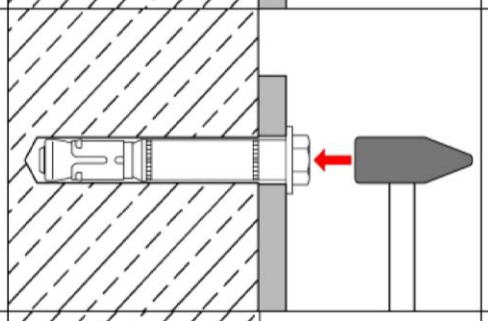
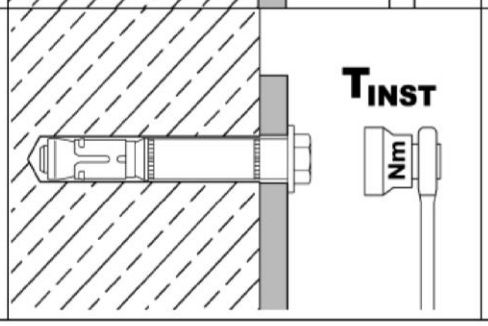
## Installation instructions

| | | |
|---|---|---|
| 1 |  | Drill hole perpendicular to concrete surface. If using a vacuum drill bit, proceed with step 3. |
| 2 |  | Blow out dust. Alternatively vacuum clean down to the bottom of the hole. |
| 3 |  | Drive in anchor. |
| 4 |  | Apply tightening torque $T_{inst}$ by using calibrated torque wrench. |

**Würth High-Performance Anchor W-HAZ/S, W-HAZ/A4**

**Intended use**
Installation instructions

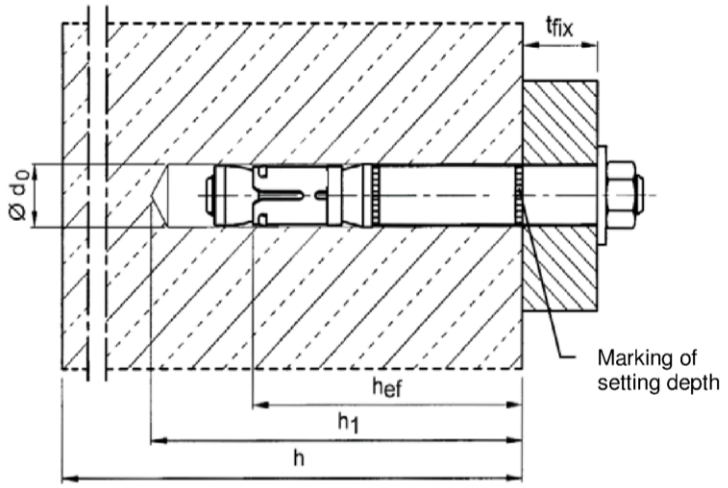
**Annex B2**

Deutsches Institut für Bautechnik DIBt

## Table B1: Installation parameters, steel zinc plated

| Anchor size | | | 10/M6 | 12/M8 | 15/M10 | 18/M12 | 24/M16 | 24/M16L | 28/M20 |
|---|---|---|---|---|---|---|---|---|---|
| Size of thread | | [-] | M6 | M8 | M10 | M12 | M16 | M16 | M20 |
| Effective anchorage depth | $h_{ef}$ | [mm] | 50 | 60 | 71 | 80 | 100 | 115 | 125 |
| Nominal diameter of drill bit | $d_0$ = | [mm] | 10 | 12 | 15 | 18 | 24 | 24 | 28 |
| Cutting diameter of drill bit | $d_{cut} \leq$ | [mm] | 10.45 | 12.5 | 15.5 | 18.5 | 24.55 | 24.55 | 28.55 |
| Depth of drill hole | $h_1 \geq$ | [mm] | 65 | 80 | 95 | 105 | 130 | 145 | 160 |
| Diameter of clearance hole in the fixture | $d_f \leq$ | [mm] | 12 | 14 | 17 | 20 | 26 | 26 | 31 |
| Thickness of fixture | $t_{fix\ min}$ | [mm] | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| W-HAZ-B and W-HAZ-S | $t_{fix\ max}$ | [mm] | 200 | 200 | 200 | 250 | 300 | 300 | 300 |
| Thickness of fixture | $t_{fix\ min}$ [2] | [mm] | 8 | 10 | 14 | 18 | - | - | - |
| W-HAZ-SK | $t_{fix\ max}$ | [mm] | 200 | 200 | 200 | 250 | - | - | - |
| Thickness of countersunk washer W-HAZ-SK | $t_{sk}$ | [mm] | 4 | 5 | 6 | 7 | - | - | - |
| Required setting torque | $T_{inst}$ (W-HAZ-B, W-HAZ-S) | [Nm] | 15 | 30 | 50 | 80 | 160 | 160 | 280 |
| | $T_{inst}$ (W-HAZ-SK) | [Nm] | 10 | 25 | 55 | 70 | - | - | - |
| Minimum thickness of member | $h_{min}$ | [mm] | 100 | 120 | 140 | 160 | 200 | 230 | 250 |
| Minimum spacing [1) 3)] | $s_{min}$ | [mm] | 50 | 50 | 60 | 70 | 100 | 100 | 125 |
| cracked concrete | for c ≥ | [mm] | 50 | 80 | 120 | 140 | 180 | 180 | 300 |
| Minimum edge distance [1) 3)] | $c_{min}$ | [mm] | 50 | 55 | 60 | 70 | 100 | 100 | 180 |
| cracked concrete | for s ≥ | [mm] | 50 | 100 | 120 | 160 | 220 | 220 | 540 |
| Minimum spacing [1) 3)] | $s_{min}$ | [mm] | 50 | 60 | 60 | 70 | 100 | 100 | 125 |
| uncracked concrete | for c ≥ | [mm] | 80 | 100 | 120 | 140 | 180 | 180 | 300 |
| Minimum edge distance [1) 3)] | $c_{min}$ | [mm] | 50 | 60 | 60 | 70 | 100 | 100 | 180 |
| uncracked concrete | for s ≥ | [mm] | 100 | 120 | 120 | 160 | 220 | 220 | 540 |

[1] Intermediate values by linear interpolation
[2] Depending on the existing shear load, the thickness of the fixture may be reduced to the thickness of the countersunk washer $t_{sk}$ (see Annex A2). It must be verified that the present shear load can be transferred completely into the distance sleeve (bearing of hole).
[3] For fire exposure from more than one side c ≥ 300 mm or $c_{min}$ ≥ 300 mm applies.




**Würth High-Performance Anchor W-HAZ/S, W-HAZ/A4**

**Intended use**
Installation parameters, **steel zinc plated**

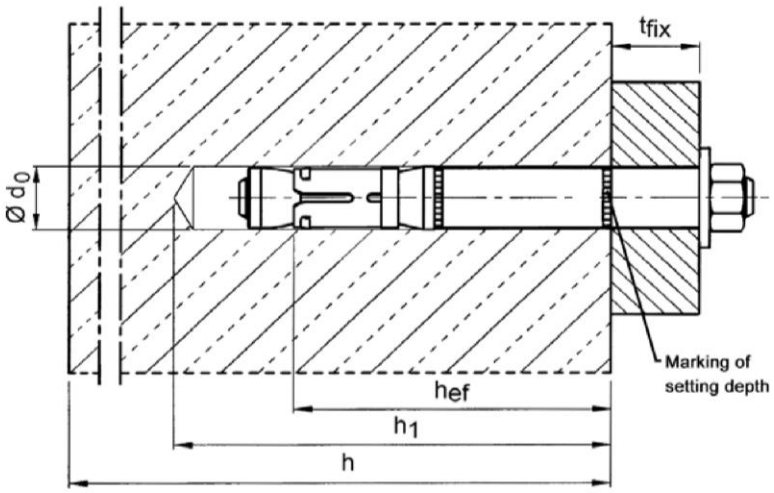
**Annex B3**

Deutsches Institut für Bautechnik DIBt

## Table B2: Installation parameters, stainless steel A4

| Anchor size | | | [-] | 12/M8 | 15/M10 | 18/M12 | 24/M16 |
|---|---|---|---|---|---|---|---|
| Size of thread | | | [-] | M8 | M10 | M12 | M16 |
| Effective anchorage depth | | $h_{ef}$ | [mm] | 60 | 71 | 80 | 100 |
| Nominal diameter of drill bit | | $d_0$ = | [mm] | 12 | 15 | 18 | 24 |
| Cutting diameter of drill bit | | $d_{cut} \leq$ | [mm] | 12.5 | 15.5 | 18.5 | 24.55 |
| Depth of drill hole | | $h_1 \geq$ | [mm] | 80 | 95 | 105 | 130 |
| Diameter of clearance hole in the fixture | | $d_f \leq$ | [mm] | 14 | 17 | 20 | 26 |
| Thickness of fixture | | $t_{fix\ min}$ | [mm] | 0 | 0 | 0 | 0 |
| W-HAZ-B and W-HAZ-S | | $t_{fix\ max}$ | [mm] | 200 | 200 | 250 | 300 |
| Thickness of fixture | | $t_{fix\ min}$ [2] | [mm] | 10 | 14 | 18 | - |
| W-HAZ-SK | | $t_{fix\ max}$ | [mm] | 200 | 200 | 250 | - |
| Thickness of countersunk washer W-HAZ-SK | | $t_{sk}$ | [mm] | 5 | 6 | 7 | - |
| Required setting torque | $T_{inst}$ (W-HAZ-B) | | [Nm] | 35 | 55 | 90 | 170 |
| | $T_{inst}$ (W-HAZ-S) | | [Nm] | 30 | 50 | 80 | 170 |
| | $T_{inst}$ (W-HAZ-SK) | | [Nm] | 17.5 | 42.5 | 50 | - |
| Minimum thickness of member | | $h_{min}$ | [mm] | 120 | 140 | 160 | 200 |
| Minimum spacing [1] [3] | | $s_{min}$ | [mm] | 50 | 60 | 70 | 80 |
| cracked concrete | | for c ≥ | [mm] | 80 | 120 | 140 | 180 |
| Minimum edge distance [1] [3] | | $c_{min}$ | [mm] | 50 | 60 | 70 | 80 |
| cracked concrete | | for s ≥ | [mm] | 80 | 120 | 160 | 200 |
| Minimum spacing [1] [3] | | $s_{min}$ | [mm] | 50 | 60 | 70 | 80 |
| uncracked concrete | | for c ≥ | [mm] | 80 | 120 | 140 | 180 |
| Minimum edge distance [1] [3] | | $c_{min}$ | [mm] | 50 | 85 | 70 | 180 |
| uncracked concrete | | for s ≥ | [mm] | 80 | 185 | 160 | 80 |

[1] Intermediate values by linear interpolation
[2] Depending on the existing shear load, the thickness of the fixture may be reduced to the thickness of the countersunk washer $t_{sk}$ (see Annex A2). It must be verified that the present shear load can be transferred completely into the distance sleeve (bearing of hole).
[3] For fire exposure from more than one side c ≥ 300 mm or $c_{min}$ ≥ 300 mm applies.




**Würth High-Performance Anchor W-HAZ/S, W-HAZ/A4**

**Intended use**
Installation parameters, **stainless steel A4**

**Annex B4**

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**Table C1:** Characteristic values for **tension load, cracked concrete** under static or quasi-static action**, steel zinc plated**

| **Anchor size** | | | **10/M6** | **12/M8** | **15/M10** | **18/M12** | **24/M16** | **24/M16L** | **28/M20** |
|---|---|---|---|---|---|---|---|---|---|
| Installation safety factor | $\gamma_{inst}$ | [-] | 1.0 | | | | | | |
| **Steel failure** | | | | | | | | | |
| Characteristic resistance | $N_{Rk,s}$ | [kN] | 16 | 29 | 46 | 67 | 126 | 126 | 196 |
| Partial safety factor | $\gamma_{Ms}$ | [-] | 1.5 | | | | | | |
| **Pull-out failure** | | | | | | | | | |
| Characteristic resistance in cracked concrete C20/25 | $N_{Rk,p}$ | [kN] | 5 | 12 | 16 | 1) | 1) | 1) | 1) |
| Increasing factor for $N_{Rk,p}$ | $\psi_C$ | [-] | $\left(\frac{f_{ck}}{20}\right)^{0,5}$ | | | | | | |
| **Concrete cone failure** | | | | | | | | | |
| Effective anchorage depth | $h_{ef}$ | [mm] | 50 | 60 | 71 | 80 | 100 | 115 | 125 |
| Factor for $k_1$ | $k_{cr,N}$ | [-] | 7.7 | | | | | | |

1) Pull-out is not decisive.

**Table C2:** Characteristic values for **tension load**, **cracked concrete** under static or quasi-static action**, stainless steel A4**

| **Anchor size** | | | **12/M8** | **15/M10** | **18/M12** | **24/M16** |
|---|---|---|---|---|---|---|
| Installation safety factor | $\gamma_{inst}$ | [-] | 1.0 | | | |
| **Steel failure** | | | | | | |
| **W-HAZ-B** | | | | | | |
| Characteristic resistance | $N_{Rk,s}$ | [kN] | 26 | 41 | 60 | 110 |
| Partial safety factor | $\gamma_{Ms}$ | [-] | 1.5 | | | |
| **W-HAZ-S and W-HAZ-SK** | | | | | | |
| Characteristic resistance | $N_{Rk,s}$ | [kN] | 26 | 41 | 60 | 110 |
| Partial safety factor | $\gamma_{Ms}$ | [-] | 1.87 | | | |
| **Pull-out failure** | | | | | | |
| Characteristic resistance in cracked concrete C20/25 | $N_{Rk,p}$ | [kN] | 9 | 16 | 1) | 1) |
| Increasing factor for $N_{Rk,p}$ | $\psi_C$ | [-] | $\left(\frac{f_{ck}}{20}\right)^{0,5}$ | | | |
| **Concrete cone failure** | | | | | | |
| Effective anchorage depth | $h_{ef}$ | [mm] | 60 | 71 | 80 | 100 |
| Factor for $k_1$ | $k_{cr,N}$ | [-] | 7.7 | | | |

1) Pull-out is not decisive.



**Würth High-Performance Anchor W-HAZ/S, W-HAZ/A4**

**Performance**
Characteristic values for **tension load** in **cracked concrete** under static or quasi-static action

**Annex C1**

Deutsches Institut für Bautechnik DIBt

**Table C3:** Characteristic values for **tension load in uncracked concrete**, under static or quasi-static action, **steel zinc plated**

| **Anchor size** | | | **10/M6** | **12/M8** | **15/M10** | **18/M12** | **24/M16** | **24/M16L** | **28/M20** |
|---|---|---|---|---|---|---|---|---|---|
| Installation safety factor | $\gamma_{inst}$ | [-] | 1.0 | | | | | | |
| **Steel failure** | | | | | | | | | |
| Characteristic resistance | $N_{Rk,s}$ | [kN] | 16 | 29 | 46 | 67 | 126 | 126 | 196 |
| Partial safety factor | $\gamma_{Ms}$ | [-] | 1.5 | | | | | | |
| **Pull-out failure** | | | | | | | | | |
| Characteristic resistance in uncracked concrete C20/25 | $N_{Rk,p}$ | [kN] | 1) | 20 | 1) | 1) | 1) | 1) | 1) |
| **Splitting failure** (The higher resistance of case 1 and case 2 may be applied.) | | | | | | | | | |
| Case 1 | | | | | | | | | |
| Characteristic resistance in uncracked concrete C20/25 | $N^0_{Rk,sp}$ | [kN] | 12 | 16 | 25 | 30 | 40 | 70 | 50 |
| Edge distance | $c_{cr,sp}$ | [mm] | $1.5\ h_{ef}$ | | | | | | |
| Case 2 | | | | | | | | | |
| Characteristic resistance in uncracked concrete C20/25 | $N^0_{Rk,sp}$ | [kN] | 17.4 | 20.0 | 29.4 | 35.2 | 49.2 | 60.7 | 68.8 |
| Edge distance | $c_{cr,sp}$ | [mm] | $2.5\ h_{ef}$ | | | | | $1.5\ h_{ef}$ | $2.5\ h_{ef}$ |
| Increasing factor for $N_{Rk,p}$ and $N^0_{Rk,sp}$ | $\psi_c$ | [-] | $\left(\frac{f_{ck}}{20}\right)^{0,5}$ | | | | | | |
| **Concrete cone failure** | | | | | | | | | |
| Effective Anchorage depth | $h_{ef}$ | [mm] | 50 | 60 | 71 | 80 | 100 | 115 | 125 |
| Edge distance | $c_{cr,N}$ | [mm] | $1.5\ h_{ef}$ | | | | | | |
| Factor for $k_1$ | $k_{ucr,N}$ | [-] | 11.0 | | | | | | |

1) Pull-out is not decisive.



**Würth High-Performance Anchor W-HAZ/S, W-HAZ/A4**

**Performance**
Characteristic values for **tension load** in **uncracked concrete,** under static or quasi-static action, **steel zinc plated**

**Annex C2**

Deutsches Institut für Bautechnik DIBt

**Table C4:** Characteristic values for **tension load** in **uncracked concrete** under static or quasi-static action, **stainless steel A4**

| **Anchor size** | | | **12/M8** | **15/M10** | **18/M12** | **24/M16** |
|---|---|---|---|---|---|---|
| Installation safety factor | $\gamma_{inst}$ | [-] | 1.0 | | | |
| **Steel failure** | | | | | | |
| **W-HAZ-B** | | | | | | |
| Characteristic resistance | $N_{Rk,s}$ | [kN] | 26 | 41 | 60 | 110 |
| Partial safety factor | $\gamma_{Ms}$ | [-] | 1.5 | | | |
| **W-HAZ-S and W-HAZ-SK** | | | | | | |
| Characteristic resistance | $N_{Rk,s}$ | [kN] | 26 | 41 | 60 | 110 |
| Partial safety factor | $\gamma_{Ms}$ | [-] | 1.87 | | | |
| **Pull-out failure** | | | | | | |
| Characteristic resistance in uncracked concrete C20/25 | $N_{Rk,p}$ | [kN] | 16 | 25 | 35 | [1] |
| **Splitting failure** | | | | | | |
| Characteristic resistance in uncracked concrete C20/25 | $N^0_{Rk,sp}$ | [kN] | 16 | 25 | 35 | 49.2 |
| Edge distance | $c_{cr,sp}$ | [mm] | 180 | 235 | 265 | 300 |
| Increasing factor for $N_{Rk,p}$ and $N^0_{Rk,sp}$ | $\psi_c$ | [-] | $\left(\frac{f_{ck}}{20}\right)^{0,5}$ | | | |
| **Concrete cone failure** | | | | | | |
| Effective anchorage depth | $h_{ef}$ | [mm] | 60 | 71 | 80 | 100 |
| Edge distance | $c_{cr,N}$ | [mm] | 1.5 $h_{ef}$ | | | |
| Factor for $k_1$ | $k_{ucr,N}$ | [-] | 11.0 | | | |

[1] Pull-out is not decisive.



**Würth High-Performance Anchor W-HAZ/S, W-HAZ/A4**

**Performance**
Characteristic values for **tension loads** in **uncracked concrete** under static or quasi-static action, **stainless steel A4**

**Annex C3**

Deutsches Institut für Bautechnik DIBt

**Table C5:** Characteristic values of **shear load** under static or quasi-static action, **steel zinc plated**

| **Anchor size** | | | **10/M6** | **12/M8** | **15/M10** | **18/M12** | **24/M16** | **24/M16L** | **28/M20** |
|---|---|---|---|---|---|---|---|---|---|
| **Steel failure without lever arm** | | | | | | | | | |
| **W-HAZ-B** | | | | | | | | | |
| Characteristic resistance | $V_{Rk,s}$ | [kN] | 16 | 25 | 36 | 63 | 91 | 91 | 122 |
| Factor | $k_7$ | [-] | 1.0 | | | | | | |
| **W-HAZ-S** | | | | | | | | | |
| Characteristic resistance | $V_{Rk,s}$ | [kN] | 18 | 30 | 48 | 73 | 126 | 126 | 150 |
| Factor | $k_7$ | [-] | 1.0 | | | | | | |
| **W-HAZ-SK** | | | | | | | | | |
| Characteristic resistance | $V_{Rk,s}$ | [kN] | 18 | 30 | 48 | 73 | 126 | 126 | 150 |
| Factor | $k_7$ | [-] | 1.0 | | | | | | |
| Partial safety factor | $\gamma_{Ms}$ | [-] | 1.25 | | | | | | |
| **Steel failure with lever arm** | | | | | | | | | |
| Characteristic resistance | $M^0_{Rk,s}$ | [Nm] | 12 | 30 | 60 | 105 | 266 | 266 | 519 |
| Partial safety factor | $\gamma_{Ms}$ | [-] | 1.25 | | | | | | |
| **Concrete pry-out failure** | | | | | | | | | |
| Factor | $k_8$ | [-] | 1.8 | 2.0 | | | | | |
| **Concrete edge failure** | | | | | | | | | |
| Effective length of anchor in shear loading | $l_f$ | [mm] | 50 | 60 | 71 | 80 | 100 | 115 | 125 |
| Outside diameter of anchor | $d_{nom}$ | [mm] | 10 | 12 | 15 | 18 | 24 | 24 | 28 |



**Würth High-Performance Anchor W-HAZ/S, W-HAZ/A4**

**Performance**
Characteristic values for **shear load** under static or quasi-static action, **steel zinc plated**

**Annex C4**

Deutsches Institut für Bautechnik DIBt

**Table C6:** Characteristic values for **shear load** under static or quasi-static action, **stainless steel A4**

| **Anchor size** | | | **12/M8** | **15/M10** | **18/M12** | **24/M16** |
|---|---|---|---|---|---|---|
| **Steel failure without lever arm** | | | | | | |
| Characteristic resistance | $V_{Rk,s}$ | [kN] | 24 | 37 | 62 | 92 |
| **W-HAZ-B** | | | | | | |
| Factor | $k_7$ | [-] | 1.0 | | | |
| Partial safety factor | $\gamma_{Ms}$ | [-] | 1.25 | | | |
| **W-HAZ-S** | | | | | | |
| Factor | $k_7$ | [-] | 1.0 | | | |
| Partial safety factor | $\gamma_{Ms}$ | [-] | 1.36 | | | |
| **W-HAZ-SK** | | | | | | |
| Factor | $k_7$ | [-] | 0.8 | | | |
| Partial safety factor | $\gamma_{Ms}$ | [-] | 1.36 | | | |
| **Steel failure with lever arm** | | | | | | |
| Characteristic resistance | $M^0_{Rk,s}$ | [Nm] | 26 | 52 | 92 | 232 |
| **W-HAZ-B** | | | | | | |
| Factor | $k_7$ | [-] | 1.0 | | | |
| Partial safety factor | $\gamma_{Ms}$ | [-] | 1.25 | | | |
| **W-HAZ-S** | | | | | | |
| Factor | $k_7$ | [-] | 1.0 | | | |
| Partial safety factor | $\gamma_{Ms}$ | [-] | 1.56 | | | |
| **W-HAZ-SK** | | | | | | |
| Factor | $k_7$ | [-] | 0.8 | | | |
| Partial safety factor | $\gamma_{Ms}$ | [-] | 1.56 | | | |
| **Concrete pry-out failure** | | | | | | |
| Factor | $k_8$ | [-] | 2.0 | | | |
| **Concrete edge failure** | | | | | | |
| Effective length of anchor in shear loading | $l_f$ | [mm] | 60 | 71 | 80 | 100 |
| Outside diameter of anchor | $d_{nom}$ | [mm] | 12 | 15 | 18 | 24 |



**Würth High-Performance Anchor W-HAZ/S, W-HAZ/A4**

**Performance**
Characteristic values for **shear load** under static or quasi-static action, **stainless steel A4**

**Annex C5**

Deutsches Institut für Bautechnik DIBt

**Table C7:** Characteristic values for **seismic action, Category C1 and C2, steel zinc plated**

| **Anchor size** | | | **12/M8** | **15/M10** | **18/M12** | **24/M16** | **24/M16L** | **28/M20** |
|---|---|---|---|---|---|---|---|---|
| **Tension load** | | | | | | | | |
| Installation safety factor | $\gamma_{inst}$ | [-] | 1.0 | | | | | |
| **Steel failure** | | | | | | | | |
| Characteristic tension resistance category **C1** | $N_{Rk,s,eq,C1}$ | [kN] | 29 | 46 | 67 | 126 | 126 | 196 |
| Characteristic tension resistance category **C2** | $N_{Rk,s,eq,C2}$ | [kN] | 29 | 46 | 67 | 126 | 126 | 196 |
| Partial safety factor | $\gamma_{Ms}$ | [-] | 1.5 | | | | | |
| **Pull-out failure** | | | | | | | | |
| Characteristic tension resistance category **C1** | $N_{Rk,p,eq,C1}$ | [kN] | 12 | 16 | 25 | 36 | 44.4 | 50.3 |
| Characteristic tension resistance category **C2** | $N_{Rk,p,eq,C2}$ | [kN] | 5.4 | 16.4 | 22.6 | 29.0 | 41.2 | 43.6 |
| **Shear load** | | | | | | | | |
| **Steel failure without lever arm** | | | | | | | | |
| **W-HAZ-B** | | | | | | | | |
| Characteristic shear resistance category **C1** | $V_{Rk,s,eq,C1}$ | [kN] | 18.0 | 27.1 | 43.4 | 51.9 | 51.9 | 96.4 |
| Characteristic shear resistance category **C2** | $V_{Rk,s,eq,C2}$ | [kN] | 12.7 | 20.5 | 31.5 | 50.1 | 50.1 | 67.1 |
| **W-HAZ-S** | | | | | | | | |
| Characteristic shear resistance category **C1** | $V_{Rk,s,eq,C1}$ | [kN] | 18.0 | 27.1 | 43.4 | 51.9 | 51.9 | 96.4 |
| Characteristic shear resistance category **C2** | $V_{Rk,s,eq,C2}$ | [kN] | 12.7 | 20.5 | 31.5 | 69.3 | 69.3 | 67.1 |
| **W-HAZ-SK** | | | | | | | | |
| Characteristic shear resistance category **C1** | $V_{Rk,s,eq,C1}$ | [kN] | 25.2 | 36.5 | 50.4 | - | - | - |
| Characteristic shear resistance category **C2** | $V_{Rk,s,eq,C2}$ | [kN] | 19.2 | 29.3 | 39.4 | - | - | - |
| Partial safety factor | $\gamma_{Ms}$ | [-] | 1.25 | | | | | |



**Würth High-Performance Anchor W-HAZ/S, W-HAZ/A4**

**Performance**
Characteristic values for **seismic action, steel zinc plated**

**Annex C6**

Deutsches Institut für Bautechnik DIBt

**Table C8:** Characteristic values for **seismic action, Category C1 and C2, stainless steel A4**

| **Anchor size** | | | **12/M8** | **15/M10** | **18/M12** | **24/M16** |
|---|---|---|---|---|---|---|
| **Tension load** | | | | | | |
| Installation safety factor | $\gamma_{inst}$ | [-] | 1.0 | | | |
| **Steel failure** | | | | | | |
| Characteristic tension resistance, category **C1** | $N_{Rk,s,eq,C1}$ | [kN] | 26 | 41 | 60 | 110 |
| Characteristic tension resistance, category **C2** | $N_{Rk,s,eq,C2}$ | [kN] | 26 | 41 | 60 | 110 |
| Partial safety factor **W-HAZ-B** | $\gamma_{Ms}$ | [-] | 1.5 | | | |
| Partial safety factor **W-HAZ-S and W-HAZ-SK** | $\gamma_{Ms}$ | [-] | 1.87 | | | |
| **Pull-out failure** | | | | | | |
| Characteristic tension resistance, category **C1** | $N_{Rk,p,eq,C1}$ | [kN] | 9 | 16 | 26 | 36 |
| Characteristic tension resistance, category **C2** | $N_{Rk,p,eq,C2}$ | [kN] | 4.8 | 16.5 | 24.8 | 44.5 |
| **Shear load** | | | | | | |
| **Steel failure without lever arm** | | | | | | |
| **W-HAZ-B** | | | | | | |
| Characteristic shear resistance, category **C1** | $V_{Rk,s,eq,C1}$ | [kN] | 9.6 | 13.3 | 25.4 | 75.4 |
| Characteristic shear resistance, category **C2** | $V_{Rk,s,eq,C2}$ | [kN] | 9.7 | 14.0 | 18.0 | 32.2 |
| Partial safety factor | $\gamma_{Ms}$ | [-] | 1.25 | | | |
| **W-HAZ-S** | | | | | | |
| Characteristic shear resistance, category **C1** | $V_{Rk,s,eq,C1}$ | [kN] | 9.6 | 13.3 | 25.4 | 75.4 |
| Characteristic shear resistance, category **C2** | $V_{Rk,s,eq,C2}$ | [kN] | 9.7 | 14.0 | 18.0 | 32.2 |
| Partial safety factor | $\gamma_{Ms}$ | [-] | 1.36 | | | |
| **W-HAZ-SK** | | | | | | |
| Characteristic shear resistance, category **C1** | $V_{Rk,s,eq,C1}$ | [kN] | 11.5 | 23.3 | 31.6 | - |
| Characteristic shear resistance, category **C2** | $V_{Rk,s,eq,C2}$ | [kN] | 10.8 | 17.4 | 15.4 | - |
| Partial safety factor | $\gamma_{Ms}$ | [-] | 1.36 | | | - |



**Würth High-Performance Anchor W-HAZ/S, W-HAZ/A4**

**Performance**
Characteristic values for **seismic action, stainless steel A4**

**Annex C7**

Deutsches Institut für Bautechnik DIBt

**Table C9:** Characteristic values under **fire exposure** in cracked and uncracked concrete C20/25 to C50/60

| **Anchor size** | | | | **10/M6** | **12/M8** | **15/M10** | **18/M12** | **24/M16** | **24/M16L** | **28/M20** |
|---|---|---|---|---|---|---|---|---|---|---|
| **Tension load** | | | | | | | | | | |
| **Steel failure** | | | | | | | | | | |
| **Steel zinc plated** | | | | | | | | | | |
| Characteristic resistance | R30 | $N_{Rk,s,fi}$ | [kN] | 1.0 | 1.9 | 4.3 | 6.3 | 11.6 | | 18.3 |
| | R60 | | | 0.8 | 1.5 | 3.2 | 4.6 | 8.6 | | 13.5 |
| | R90 | | | 0.6 | 1.0 | 2.1 | 3.0 | 5.0 | | 7.7 |
| | R120 | | | 0.4 | 0.8 | 1.5 | 2.0 | 3.1 | | 4.9 |
| **Stainless steel A4** | | | | | | | | | | |
| Characteristic resistance | R30 | $N_{Rk,s,fi}$ | [kN] | - | 6.1 | 10.2 | 15.7 | 29.2 | - | - |
| | R60 | | | - | 4.4 | 7.3 | 11.1 | 20.6 | - | - |
| | R90 | | | - | 2.6 | 4.3 | 6.4 | 12.0 | - | - |
| | R120 | | | - | 1.8 | 2.8 | 4.1 | 7.7 | - | - |
| **Shear load** | | | | | | | | | | |
| **Steel failure without lever arm** | | | | | | | | | | |
| **Steel zinc plated** | | | | | | | | | | |
| Characteristic resistance | R30 | $V_{Rk,s,fi}$ | [kN] | 1.0 | 1.9 | 4.3 | 6.3 | 11.6 | | 18.3 |
| | R60 | | | 0.8 | 1.5 | 3.2 | 4.6 | 8.6 | | 13.5 |
| | R90 | | | 0.6 | 1.0 | 2.1 | 3.0 | 5.0 | | 7.7 |
| | R120 | | | 0.4 | 0.8 | 1.5 | 2.0 | 3.1 | | 4.9 |
| **Stainless steel A4** | | | | | | | | | | |
| Characteristic resistance | R30 | $V_{Rk,s,fi}$ | [kN] | - | 14.3 | 22.7 | 32.8 | 61.0 | - | - |
| | R60 | | | - | 11.1 | 17.6 | 25.5 | 47.5 | - | - |
| | R90 | | | - | 7.9 | 12.6 | 18.3 | 34.0 | - | - |
| | R120 | | | - | 6.3 | 10.0 | 14.6 | 27.2 | - | - |
| **Steel failure with lever arm** | | | | | | | | | | |
| **Steel zinc plated** | | | | | | | | | | |
| Characteristic resistance | R30 | $M^0_{Rk,s,fi}$ | [Nm] | 0.8 | 2.0 | 5.6 | 9.7 | 24.8 | | 42.4 |
| | R60 | | | 0.6 | 1.5 | 4.1 | 7.2 | 18.3 | | 29.8 |
| | R90 | | | 0.4 | 1.0 | 2.7 | 4.7 | 11.9 | | 17.1 |
| | R120 | | | 0.3 | 0.8 | 1.9 | 3.1 | 6.6 | | 10.7 |
| **Stainless steel A4** | | | | | | | | | | |
| Characteristic resistance | R30 | $M^0_{Rk,s,fi}$ | [Nm] | - | 6.2 | 13.2 | 24.4 | 61.8 | - | - |
| | R60 | | | - | 4.5 | 9.4 | 17.2 | 43.6 | - | - |
| | R90 | | | - | 2.7 | 5.6 | 10.0 | 25.3 | - | - |
| | R120 | | | - | 1.8 | 3.6 | 6.4 | 16.2 | - | - |

If pull-out is not decisive in Equation (D.4) and (D.5), $N_{Rk,p}$ must be replaced by $N^0_{Rk,c}$.



**Würth High-Performance Anchor W-HAZ/S, W-HAZ/A4**

**Performance**
Characteristic values under **fire exposure**

**Annex C8**

Deutsches Institut für Bautechnik DIBt

**Table C10:** Displacements under tension and shear load, **steel zinc plated**

| **Anchor size** | | | **10/M6** | **12/M8** | **15/M10** | **18/M12** | **24/M16** | **24/M16L** | **28/M20** |
|---|---|---|---|---|---|---|---|---|---|
| **Tension load** | | | | | | | | | |
| Tension load in cracked concrete | N | [kN] | 2.4 | 5.7 | 7.6 | 12.3 | 17.1 | 21.1 | 24 |
| Displacement | $\delta_{N0}$ | [mm] | 0.5 | 0.5 | 0.5 | 0.7 | 0.8 | 0.7 | 0.9 |
| | $\delta_{N\infty}$ | [mm] | 2.0 | 2.0 | 1.3 | 1.3 | 1.3 | 1.3 | 1.4 |
| Tension load in uncracked concrete | N | [kN] | 8.5 | 9.5 | 14.3 | 17.2 | 24 | 29.6 | 34 |
| Displacement | $\delta_{N0}$ | [mm] | 0.8 | 1.0 | | 1.1 | | 1.3 | 0.3 |
| | $\delta_{N\infty}$ | [mm] | 3.4 | | | 1.7 | | 2.3 | 1.4 |
| Seismic action C2 | | | | | | | | | |
| Displacement for DLS | $\delta_{N,eq\ (DLS)}$ | [mm] | - | 3.3 | 3.0 | 5.0 | 3.0 | 3.0 | 4.0 |
| Displacement for ULS | $\delta_{N,eq\ (ULS)}$ | [mm] | - | 12.2 | 11.3 | 16.0 | 9.2 | 9.2 | 13.8 |
| **Shear load** | | | | | | | | | |
| **W-HAZ-B** | | | | | | | | | |
| Shear load in cracked and uncracked concrete | V | [kN] | 9.1 | 14 | 20.7 | 35.1 | 52.1 | 52.1 | 77 |
| Displacement | $\delta_{V0}$ | [mm] | 2.5 | 2.1 | 2.7 | 3.0 | 5.1 | 5.1 | 4.3 |
| | $\delta_{V\infty}$ | [mm] | 3.8 | 3.1 | 4.1 | 4.5 | 7.6 | 7.6 | 6.5 |
| Seismic action C2 | | | | | | | | | |
| Displacement for DLS | $\delta_{V,eq\ (DLS)}$ | [mm] | - | 2.3 | 3.1 | 3.0 | 2.6 | 2.6 | 1.6 |
| Displacement for ULS | $\delta_{V,eq\ (ULS)}$ | [mm] | - | 4.8 | 6.4 | 6.1 | 6.6 | 6.6 | 4.8 |
| **W-HAZ-S** | | | | | | | | | |
| Shear load in cracked and uncracked concrete | V | [kN] | 10.1 | 17.1 | 27.5 | 41.5 | 72 | 72 | 77 |
| Displacement | $\delta_{V0}$ | [mm] | 2.9 | 2.5 | 3.6 | 3.5 | 7.0 | 7.0 | 4.3 |
| | $\delta_{V\infty}$ | [mm] | 4.4 | 3.8 | 5.4 | 5.3 | 10.5 | 10.5 | 6.5 |
| Seismic action C2 | | | | | | | | | |
| Displacement for DLS | $\delta_{V,eq\ (DLS)}$ | [mm] | - | 2.3 | 3.1 | 3.0 | 3.3 | 3.3 | 1.6 |
| Displacement for ULS | $\delta_{V,eq\ (ULS)}$ | [mm] | - | 4.8 | 6.4 | 6.1 | 8.2 | 8.2 | 4.8 |
| **W-HAZ-SK** | | | | | | | | | |
| Shear load in cracked and uncracked concrete | V | [kN] | 10.1 | 17.1 | 27.5 | 41.5 | 72 | 72 | 77 |
| Displacement | $\delta_{V0}$ | [mm] | 2.9 | 2.5 | 3.6 | 3.5 | 7.0 | 7.0 | 4.3 |
| | $\delta_{V\infty}$ | [mm] | 4.4 | 3.8 | 5.4 | 5.3 | 10.5 | 10.5 | 6.5 |
| Seismic action C2 | | | | | | | | | |
| Displacement for DLS | $\delta_{V,eq\ (DLS)}$ | [mm] | - | 3.1 | 3.9 | 3.9 | - | - | - |
| Displacement for ULS | $\delta_{V,eq\ (ULS)}$ | [mm] | - | 10.2 | 11.8 | 13.0 | - | - | - |



**Würth High-Performance Anchor W-HAZ/S, W-HAZ/A4**

**Performance**
Displacements under tension and shear load, **steel zinc plated**

**Annex C9**

Deutsches Institut für Bautechnik DIBt

**Table C11:** Displacements under tension and shear load, **stainless steel A4**

| **Anchor size** | | | **12/M8** | **15/M10** | **18/M12** | **24/M16** |
|---|---|---|---|---|---|---|
| **Tension load** | | | | | | |
| Tension load in cracked concrete | N | [kN] | 4.3 | 7.6 | 12.1 | 17.0 |
| Displacement | $\delta_{N0}$ | [mm] | 0.5 | 0.5 | 1.3 | 0.5 |
| | $\delta_{N\infty}$ | [mm] | 1.2 | 1.6 | 1.8 | 1.6 |
| Tension load in uncracked concrete | N | [kN] | 7.6 | 11.9 | 16.7 | 24.1 |
| Displacement | $\delta_{N0}$ | [mm] | 0.2 | 0.3 | 1.2 | 1.5 |
| | $\delta_{N\infty}$ | [mm] | 1.1 | - | - | - |
| Seismic action C2 | | | | | | |
| Displacement for DLS | $\delta_{N,eq\ (DLS)}$ | [mm] | 4.7 | 4.5 | 4.3 | 4.9 |
| Displacement for ULS | $\delta_{N,eq\ (ULS)}$ | [mm] | 13.3 | 12.7 | 9.7 | 10.1 |
| **Shear load** | | | | | | |
| Shear load in cracked concrete | V | [kN] | 13.9 | 21.1 | 34.7 | 50.8 |
| Displacement | $\delta_{V0}$ | [mm] | 3.4 | 4.9 | 4.8 | 6.7 |
| | $\delta_{V\infty}$ | [mm] | 5.1 | 7.4 | 7.1 | 10.1 |
| Seismic action C2 | | | | | | |
| **W-HAZ-B, W-HAZ-S** | | | | | | |
| Displacement for DLS | $\delta_{V,eq(DLS)}$ | [mm] | 2.8 | 3.1 | 2.6 | 3.3 |
| Displacement for ULS | $\delta_{V,eq\ (ULS)}$ | [mm] | 5.6 | 5.8 | 5.0 | 6.9 |
| **W-HAZ-SK** | | | | | | |
| Displacement for DLS | $\delta_{V,eq(DLS)}$ | [mm] | 2.5 | 2.8 | 2.9 | - |
| Displacement for ULS | $\delta_{V,eq\ (ULS)}$ | [mm] | 5.8 | 5.9 | 6.9 | - |



**Würth High-Performance Anchor W-HAZ/S, W-HAZ/A4**

**Performance**
Displacements under tension and shear load, **stainless steel A4**

**Annex C10**