Deutsches Institut für Bautechnik DIBt

Approval body for construction products and types of construction

Bautechnisches Prüfamt

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European Technical Assessment

ETA-20/0486 of 8 June 2023

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	Fixanchor W-FAZ PRO dynamic
Product family to which the construction product belongs	Post-installed fasteners in concrete under fatigue cyclic loading
Manufacturer	Adolf Würth GmbH & Co. KG Reinhold-Würth-Straße 12-17 74653 Künzelsau DEUTSCHLAND
Manufacturing plant	Plant 1
This European Technical Assessment contains	23 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 330250-00-0601 Edition 06/2021
This version replaces	ETA-20/0486 issued on 28 July 2020

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Specific Part

1 Technical description of the product

The *Fixanchor W-FAZ PRO dynamic* is a fastener made of zinc plated steel (S) or stainless steel (A4) or high corrosion resistant steel (HCR) 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 fastener 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 fastener 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 (static and quasi-static loading and seismic loading)	Performance
Characteristic resistance to tension load (static and quasi-static loading)	see Annex B3, C2, C3
Characteristic resistance to shear load (static and quasi-static loading)	see Annex C4
Displacements	see Annex C8, C9
Characteristic resistance and displacements for seismic performance categories C1 and C2	see Annex C5

Essential characteristic (fatigue loading, Assessment method B: Fatigue limit resistance)	**Performance**
Characteristic fatigue resistance under cyclic tension loading	
Characteristic steel fatigue resistance $\Delta N_{Rk,s,0,\infty}$	see Annex C1
Characteristic concrete cone, splitting and pull-out fatigue resistance $\Delta N_{Rk,c,0,\infty}$ $\Delta N_{Rk,sp,0,\infty}$ $\Delta N_{Rk,p,0,\infty}$	
Characteristic fatigue resistance under cyclic shear loading	
Characteristic steel fatigue resistance $\Delta V_{Rk,s,0,\infty}$	see Annex C1
Characteristic concrete edge and pry-out fatigue resistance $\Delta V_{Rk,c,0,\infty}$ $\Delta V_{Rk,cp,0,\infty}$	
Characteristic fatigue resistance under combined cyclic tension and shear loading	
Characteristic steel fatigue resistance a_s $(n = \infty)$	see Annex C1
Load transfer factor for cyclic tension, shear and combined tension and shear loading	
Load transfer factor ψ_{FN}, ψ_{FV}	see Annex C1

3.2 Safty in case of fire (BWR 2)

Essential characteristic	**Performance**
Reaction to fire	Class A1
Resistance to fire	see Annex C6, C7

3.3 Aspects of durabilty

Essential characteristic	**Performance**
Durability	see Annex B1

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 330250-00-0601 the applicable European legal act is: 1996/582/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.

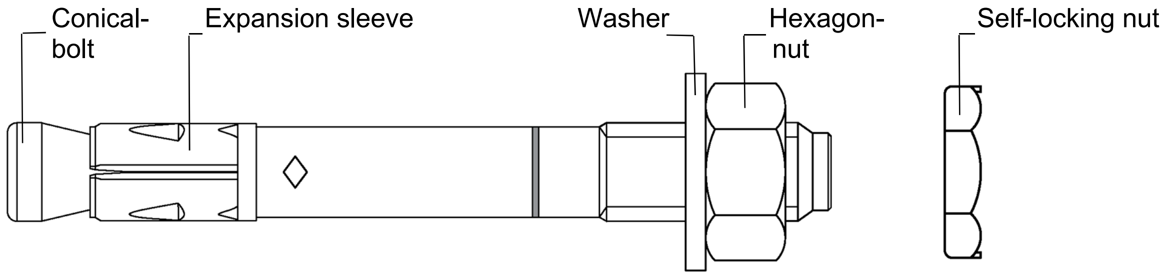
Issued in Berlin on 8 June 2023 by Deutsches Institut für Bautechnik

Dipl.-Ing. Beatrix Wittstock
Head of Section

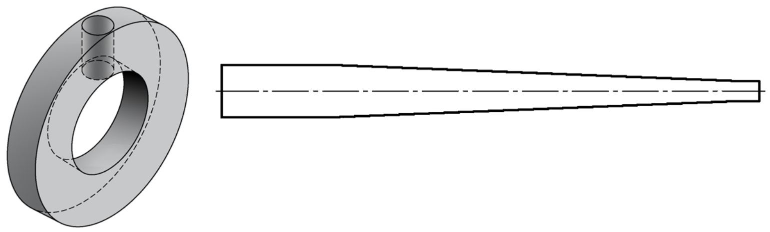
beglaubigt:
Stiller

Fixanchor W-FAZ PRO dynamic

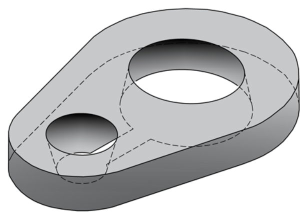
W-FAZ PRO dynamic M10, M12, M16



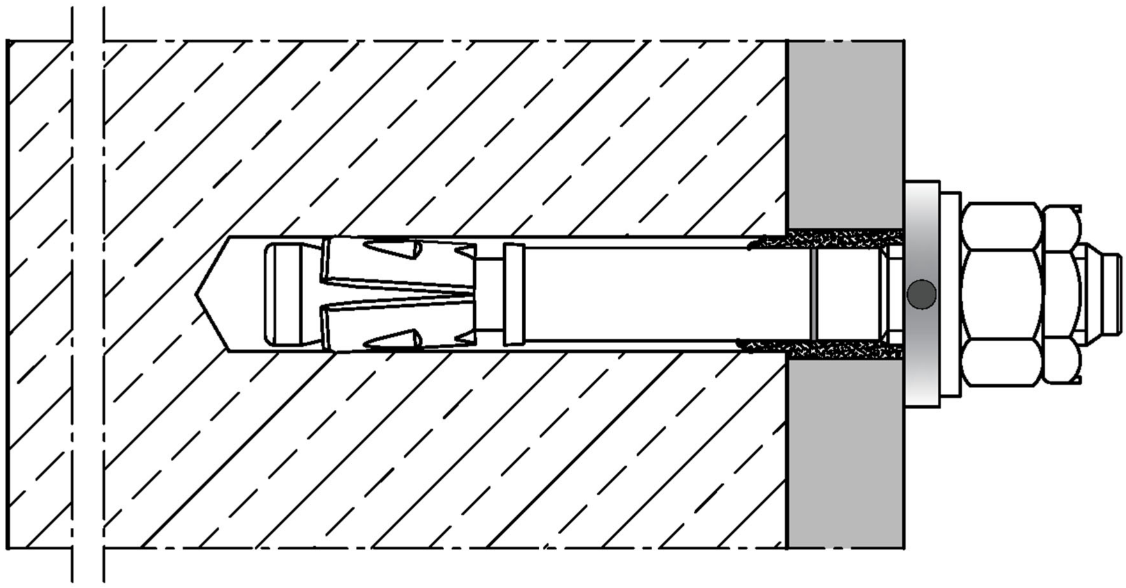
Filling washer WIT-SHB with reducing adapter



Filling washer WIT SHB 2 (alternativ)

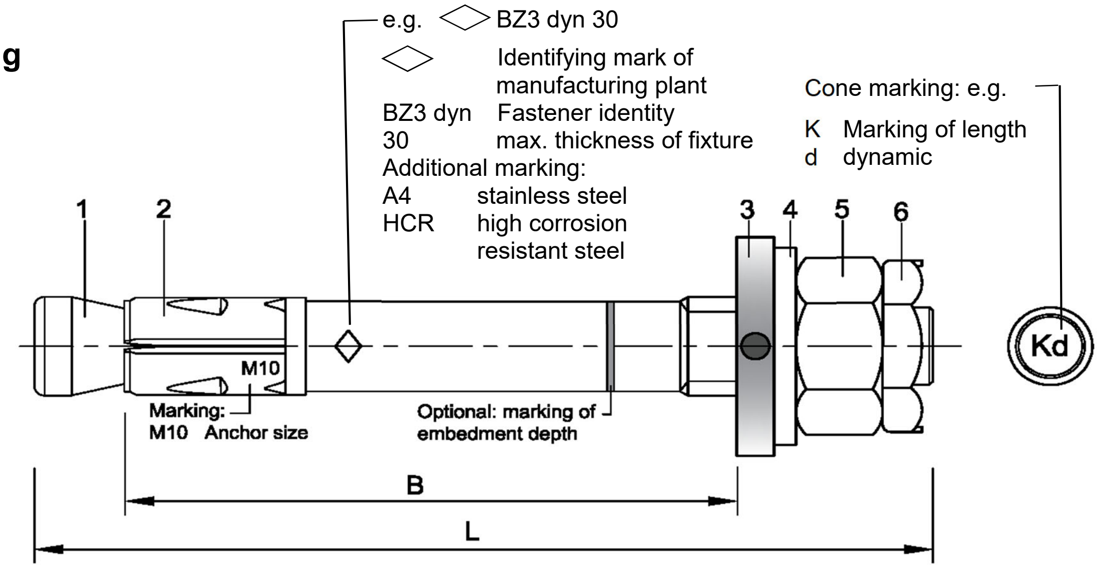


Installation situation



Fixanchor W-FAZ PRO dynamic	Annex A1
Product description Product, installation situation	

Marking



Usable length: **B = h_{ef} + t_{fix}** h_{ef}: (existing) effective anchorage depth t_{fix}: fixture thickness

Table A1: Length identification

Length identifier	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
Usable length B ≥	65	70	75	80	85	90	95	100	105	110	115	120	125	130	135

Length identifier	V	W	X	Y	Z
Usable length B ≥	140	145	150	160	170

Dimensions in mm

Table A2: Material

Part	Designation	W-FAZ PRO dynamic/S	W-FAZ PRO dynamic/A4	W-FAZ PRO dynamic/HCR
		Steel, galvanized (S)	**Stainless steel (A4) CRC III**	**High corrosion resistant steel (HCR) CRC V**
1	Conical bolt	Steel, galvanized ≥ 5 µm, fracture elongation A_5 ≥ 8%	Stainless steel, fracture elongation A_5 ≥ 8%	High corrosion resistant steel, fracture elongation A_5 ≥ 8%
2	Expansion sleeve	Stainless steel	Stainless steel	Stainless steel
3	Filling washer	Steel, galvanized ≥ 5 µm	Stainless steel	High corrosion resistant steel
4	Washer			
5	Hexagon nut			
6	Locking nut			
7	Filling mortar	e.g. Würth injection mortar WIT-VM 250, WIT-UH 300, WIT-PE 1000, WIT-VIZ		

Fixanchor W-FAZ PRO dynamic

Product description
Marking, length identification, material

Annex A2

Specifications of intended use

Anchorages subject to:

- Fatigue cyclic loading
- Static and quasi-static action, fire exposure and seismic performance

Base materials:

- Cracked or uncracked concrete
- Compacted, reinforced or unreinforced normal weight concrete without fibres according to EN 206:2013+A1:2016
- Strength classes C20/25 to C50/60 according to EN 206:2013+A1:2016

Use conditions (Environmental conditions):

- Structures subject to dry internal conditions
- For all other conditions according to EN 1993-1-2006+A1:2015-10, corresponding to corrosion resistance classes CRC according to Annex A2, Table A2

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 fastener is indicated on the design drawings (e.g. position of the fastener relative to reinforcement or to supports, etc.).
- Design method EN 1992-4:2018, TR 055:2018 and TR 061:2020 (design method II)

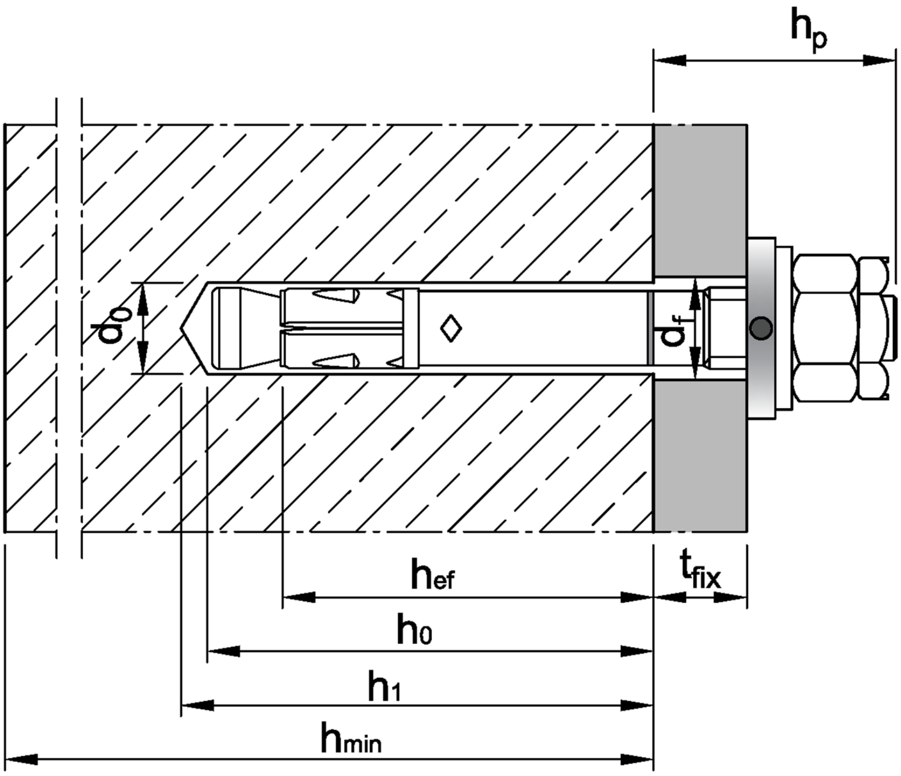
Installation:

- Hole drilling by hammer drill bit or vacuum drill bit
- Use of the fastener only as supplied by the manufacturer without exchanging the components of the fastener
- Fastener installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters on the site
- The anchor can be set in pre-positioned or in-place installation.

Table B1: Installation parameters

Anchor size				M10	M12	M16
Nominal drill hole diameter		$d_0 =$	[mm]	10	12	16
Cutting diameter of drill bit		$d_{cut} \leq$	[mm]	10,45	12,5	16,5
Effective anchorage depth[1]		$h_{ef} \geq$	[mm]	60	70	85
Depth of drill hole		$h_0 \geq$	[mm]	h_{ef} + 9	h_{ef} + 10	h_{ef} + 14
		$h_1 \geq$	[mm]	h_{ef} + 11	h_{ef} + 13	h_{ef} + 17
Diameter of clearance hole in the fixture		$d_f =$	[mm]	12	14	18
Minimum fixture thickness		$t_{fix,min} =$	[mm]	5	6	8
Installation torque	S	$T_{inst} =$	[Nm]	40	60	110
	A4 and HCR	$T_{inst} =$	[Nm]	40	55	100
Overstand		$h_p \leq$	[mm]	21,5 + t_{fix}	25,5 + t_{fix}	29,5 + t_{fix}
Length of fastener		L	[mm]	h_{ef} + t_{fix} + 30,5	h_{ef} + t_{fix} + 35,5	h_{ef} + t_{fix} + 43
Hexagon nut		width across nut	[mm]	17	19	24
Locking nut		width across nut	[mm]	17	19	24

[1] End of thread must be above the concrete surface



Fixanchor W-FAZ PRO dynamic

Intended use
Installation parameters

Annex B2

Table B2: Minimum thickness of concrete member, minimum spacings, edge distances and required area

Anchor size			M10	M12	M16
Minimum member thickness depending on h_{ef}	$h_{min} \geq$	[mm]	$1{,}5 \cdot h_{ef}$		
Minimum edge distances and spacings					
Minimum edge distance	c_{min}	[mm]	45	55	65
	for s ≥	[mm]	see Table B4		
Minimum spacings	s_{min}	[mm]	40	50	65
	for c ≥	[mm]	see Table B4		
The following equation must be fulfilled for the calculation of the minimum spacing and edge distance during installation in connection with the anchorage depth and the member thickness:					
$A_{sp,rqd} \leq A_{sp,ef}$ Required splitting area $A_{sp,rqd}$ and idealized splitting area $A_{sp,ef}$ acc. to Table B4.					

Table B3: Applicable concrete thickness h_{sp} and area A_{sp} to determine characteristic edge distance $c_{cr,sp}$

Anchor size				M10	M12	M16
Applicable concrete thickness		h_{sp}	[mm]	$\min(h\,;\ h_{ef} + 1{,}5 \cdot c \cdot \sqrt{2})$		
Area to determine $c_{cr,sp}$	S	A_{sp}	[mm²]	$\frac{N^0_{Rk,sp} + 2{,}040}{0{,}000693}$	$\frac{N^0_{Rk,sp} + 3{,}685}{0{,}000692}$	$\frac{N^0_{Rk,sp} + 3{,}738}{0{,}000875}$
	A4 HCR	A_{sp}	[mm²]	$\frac{N^0_{Rk,sp} + 7{,}235}{0{,}000967}$	$\frac{N^0_{Rk,sp} + 7{,}847}{0{,}000951}$	$\frac{N^0_{Rk,sp} + 11{,}415}{0{,}000742}$

Table B4: Areas to determine spacings and edge distances for installation

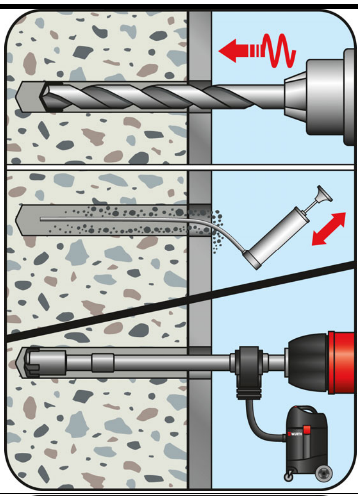
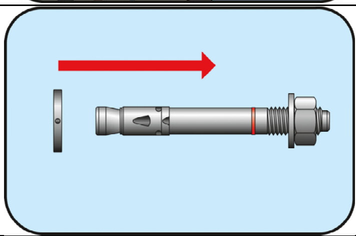
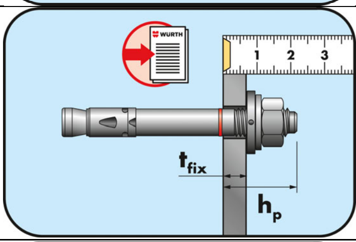
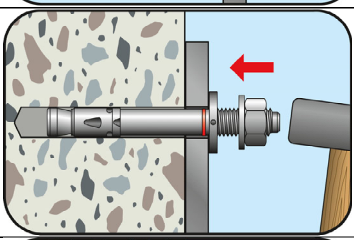
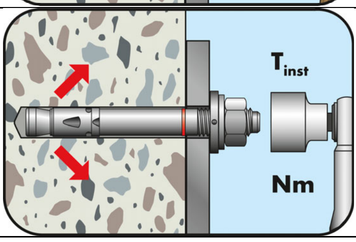
Anchor size				**M10**	**M12**	**M16**
The following equation must be fulfilled for the calculation of the minimum spacing and edge distance during installation in combination with variable anchorage depth and member thickness: $A_{sp,rqd} \leq A_{sp,ef}$						
Idealized splitting area $A_{sp,ef}$ The spacings and edge distances shall be selected or rounded in steps of 5 mm.						
Member thickness: $h > h_{ef} + 1{,}5 \cdot c$						
Single anchor or anchor group with $s \geq 3 \cdot c$						
Effective anchorage depth	$h_{ef} < 1{,}5 \cdot c$			$A_{sp,ef} = (6 \cdot c) \cdot (1{,}5 \cdot c + h_{ef})$ [mm²]		
Effective anchorage depth	$h_{ef} \geq 1{,}5 \cdot c$			$A_{sp,ef} = (6 \cdot c) \cdot (3 \cdot c)$ [mm²]		
Anchor group ($s < 3 \cdot c$)						
Effective anchorage depth	$h_{ef} < 1{,}5 \cdot c$			$A_{sp,ef} = (3 \cdot c + s) \cdot (1{,}5 \cdot c + h_{ef})$ [mm²]		
Effective anchorage depth	$h_{ef} \geq 1{,}5 \cdot c$			$A_{sp,ef} = (3 \cdot c + s) \cdot (3 \cdot c)$ [mm²]		
Member thickness: $h \leq h_{ef} + 1{,}5 \cdot c$						
Single anchor or anchor group with $s \geq 3 \cdot c$						
Effective anchorage depth	$h_{ef} < 1{,}5 \cdot c$			$A_{sp,ef} = (6 \cdot c) \cdot h$ [mm²]		
Effective anchorage depth	$h_{ef} \geq 1{,}5 \cdot c$			$A_{sp,ef} = (6 \cdot c) \cdot (h - h_{ef} + 1{,}5 \cdot c)$ [mm²]		
Anchor group ($s < 3 \cdot c$)						
Effective anchorage depth	$h_{ef} < 1{,}5 \cdot c$			$A_{sp,ef} = (3 \cdot c + s) \cdot h$ [mm²]		
Effective anchorage depth	$h_{ef} \geq 1{,}5 \cdot c$			$A_{sp,ef} = (3 \cdot c + s) \cdot (h - h_{ef} + 1{,}5 \cdot c)$ [mm²]		
Required splitting area $A_{sp,rqd}$						
S	cracked concrete	$A_{sp,rqd}$	[mm²]	23 700	31 500	42 300
	uncracked concrete	$A_{sp,rqd}$	[mm²]	34 700	41 300	50 200
A4 and HCR	cracked concrete	$A_{sp,rqd}$	[mm²]	25 900	29 800	44 300
	uncracked concrete	$A_{sp,rqd}$	[mm²]	35 700	35 300	54 800

Fixanchor W-FAZ PRO dynamic

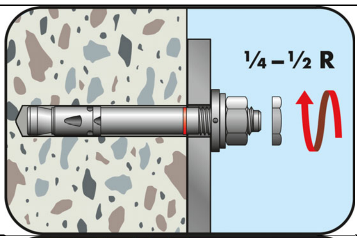
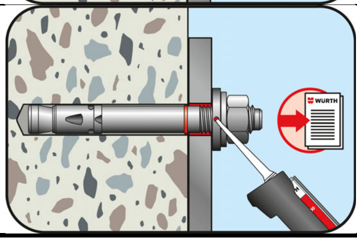
Intended use
Areas to determine spacings and edge distances

Annex B4

Installation instructions in-place installation

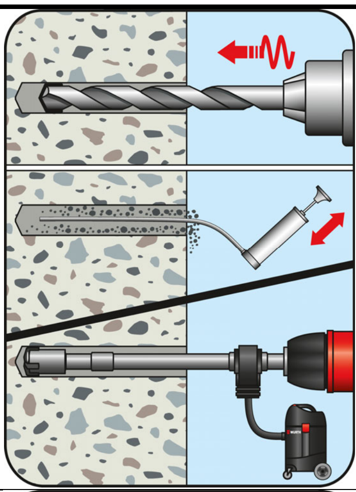
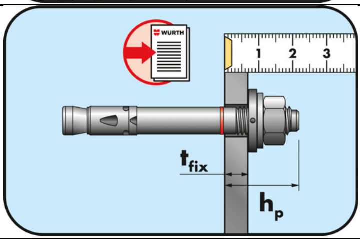
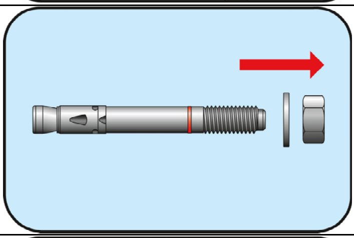
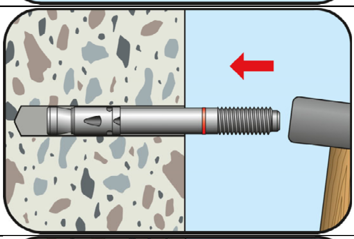
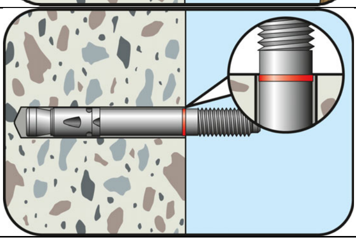
1		Drill hole perpendicular to concrete surface. Blow out dust. Alternatively, vacuum clean down to the bottom of the hole If using a vacuum drill bit, no further cleaning is necessary.
2		Clip-on the filling washer
3		Adjust the overstand of the bolt. The end of the thread shall be above the concrete surface after the anchor has been driven in. Pay attention to the minimum embedment depth.
4		Drive in the anchor
5		Apply installation torque T_{inst} according to Table B2 by using a torque wrench.

Fixanchor W-FAZ PRO dynamic	**Annex B5**
Intended use Installation instructions	

6		Screw on self-locking nut until hand tight then tighten ¼ to ½ turn.
7		Fill the annular gap between anchor and fixture with mortar (compressive strength ≥ 40 N/mm², e.g. Würth WIT-VM 250, WIT-UH 300, WIT-PE 1000, WIT-VIZ). Use enclosed reducing adapter. Observe the processing information of the mortar! The annular gap is completely filled, when excess mortar seeps out.

Fixanchor W-FAZ PRO dynamic	**Annex B6**
Intended use Installation instructions	

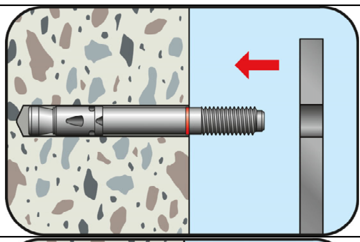
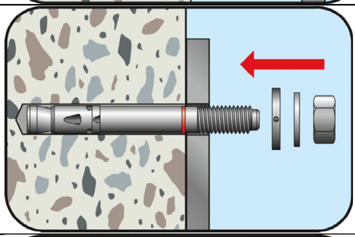
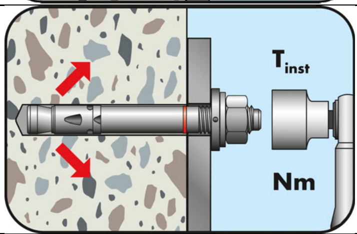
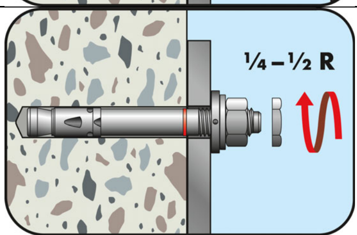
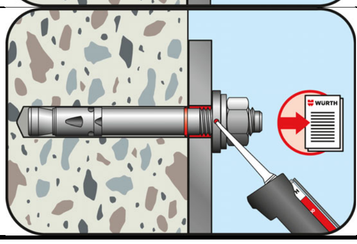
Installation instructions pre-positioned installation

1		Drill hole perpendicular to concrete surface. Blow out dust. Alternatively, vacuum clean down to the bottom of the hole If using a vacuum drill bit, no further cleaning is necessary.
2		Pay attention to the overstand of the bolt and the minimum embedment depth. Mark embedment depth if necessary.
3		Remove nut and washer
4		Drive in the anchor
5		Control the minimum embedment depth. The marking shall be under the concrete surface. The end of the thread shall be above the concrete surface after the anchor has been driven in

Fixanchor W-FAZ PRO dynamic

Intended use
Installation instructions

Annex B7

6		Position the fixture
7		Mount filling washer, washer and nut
8		Apply installation torque T_{inst} according to Table B2 by using a torque wrench.
9		Screw on self-locking nut until hand tight then tighten $^{1}/_{4}$ to ½ turn.
10		Fill the annular gap between anchor and fixture with mortar (compressive strength ≥ 40 N/mm², e.g. Würth WIT-VM 250, WIT-UH 300, WIT-PE 1000, WIT-VIZ). Use enclosed reducing adapter. Observe the processing information of the mortar! The annular gap is completely filled, when excess mortar seeps out.

Fixanchor W-FAZ PRO dynamic	**Annex B8**
Intended use Installation instructions	

Table C1: Characteristic values of fatigue resistance

Anchor size				M10	M12	M16
Tension load						
Steel failure						
Characteristic fatigue resistance	S	$\Delta N_{Rk,s,0,\infty}$	[kN]	4,6	6,2	9,7
	A4		[kN]	3,2	5,3	9,2
	HCR		[kN]	2,8	5,5	9,7
Load-transfer factor for fastener groups		ψ_{FN}	[-]	0,5		
Pull-out						
Characteristic fatigue resistance		$\Delta N_{Rk,p,0,\infty}$	[kN]	0,5 $N_{Rk,p}$		
Concrete cone and splitting failure						
Characteristic fatigue resistance		$\Delta N_{Rk,c,0,\infty}$	[kN]	0,5 $N_{Rk,c}$		
		$\Delta N_{Rk,sp,0,\infty}$	[kN]	0,5 $N_{Rk,sp}$		
Effective anchorage depth		h_{ef}	[mm]	60	70	85
Shear load						
Steel failure without lever arm						
Characteristic fatigue resistance	S	$\Delta V_{Rk,s,0,\infty}$	[kN]	2,5	4,0	7,5
	A4		[kN]	1,5	2,8	6,0
	HCR		[kN]	2,3	2,8	5,0
Load-transfer factor for fastener groups		ψ_{FV}	[-]	0,5		
Concrete pry-out failure						
Characteristic fatigue resistance		$\Delta V_{Rk,cp,0,\infty}$	[kN]	0,5 $V_{Rk,cp}$		
Concrete edge failure						
Characteristic fatigue resistance		$\Delta V_{Rk,c,0,\infty}$	[kN]	0,5 $V_{Rk,c}$		
Effective length of anchor		l_f	[mm]	60	70	85
Diameter of anchor		d_{nom}	[mm]	10	12	16
Tension and shear load						
Partial factor [1)]		$\gamma_{Ms,fat}$	[-]	1,35		
		$\gamma_{Mc,fat}$	[-]	1,5		
		$\gamma_{Msp,fat}$	[-]	1,5		
		$\gamma_{Mp,fat}$	[-]	1,5		
Exponents for combined loading		α_s	[-]	0,5	0,5	0,7
		α_c	[-]	1,5		

[1)] In absence of other national regulations

Fixanchor W-FAZ PRO dynamic

Performance
Characteristic values of fatigue resistance

Annex C1

Table C2: Characteristic values for **tension load** under static and quasi-static action, **steel galvanized (S)**

Anchor size			**M10**	**M12**	**M16**
Installation factor	γ_{inst}	[-]	1,0		
Steel failure					
Characteristic resistance	$N_{Rk,s}$	[kN]	30,4	44,9	79,3
Partial factor [1]	γ_{Ms}	[-]	1,5		
Pull-out					
Characteristic resistance in cracked concrete C20/25	$N_{Rk,p,cr}$	[kN]	15	22	30
Increasing factor $N_{Rk,p,cr} = \psi_C \cdot N_{Rk,p,cr}$ (C20/25)	ψ_C	[-]	$\left(\frac{f_{ck}}{20}\right)^{0,265}$	$\left(\frac{f_{ck}}{20}\right)^{0,5}$	$\left(\frac{f_{ck}}{20}\right)^{0,339}$
Characteristic resistance in uncracked concrete C20/25	$N_{Rk,p,ucr}$	[kN]	24	30	50
Increasing factor $N_{Rk,p,ucr} = \psi_C \cdot N_{Rk,p,ucr}$ (C20/25)	ψ_C	[-]	$\left(\frac{f_{ck}}{20}\right)^{0,448}$	$\left(\frac{f_{ck}}{20}\right)^{0,5}$	$\left(\frac{f_{ck}}{20}\right)^{0,203}$
Splitting					
Characteristic resistance	$N^0_{Rk,sp}$	[kN]	min ($N_{Rk,p}$; $N^0_{Rk,c}$ [3])		
Characteristic edge distance [2]	$c_{cr,sp}$	[mm]	$\frac{A_{sp} + 0,8 \cdot (h_{sp} - h_{ef})^2}{(3,41 \cdot h_{sp} - 0,59 \cdot h_{ef})}$		
Characteristic spacing	$s_{cr,sp}$	[mm]	$2 \cdot c_{cr,sp}$		
Concrete cone failure					
Effective anchorage depth	h_{ef}	[mm]	60	70	85
Characteristic edge distance	$c_{cr,N}$	[mm]	$1,5 \cdot h_{ef}$		
Characteristic spacing	$s_{cr,N}$	[mm]	$2 \cdot c_{cr,N}$		
Factor — cracked concrete	$k_{cr,N}$	[-]	7,7		
Factor — uncracked concrete	$k_{ucr,N}$	[-]	11,0		

[1] In absence of other national regulations
[2] Applicable concrete thickness h_{sp} and area A_{sp} to determine characteristic edge distance $c_{cr,sp}$ according to Table B3
[3] $N^0_{Rk,c}$ according to EN 1992-4:2018

Table C3: Characteristic values for **tension load** under static or quasi-static action, **A4** and **HCR**

Anchor size			**M10**	**M12**	**M16**
Installation factor	γ_{inst}	[-]	1,0		
Steel failure					
Characteristic resistance	$N_{Rk,s}$	[kN]	30,4	44,9	74,6
Partial factor [1]	γ_{Ms}	[-]	1,5		
Pull-out					
Characteristic resistance in cracked concrete C20/25	$N_{Rk,p,cr}$	[kN]	17	22	35
Increasing factor $N_{Rk,p,cr} = \psi_C \cdot N_{Rk,p,cr}$ (C20/25)	ψ_C	[-]	$\left(\frac{f_{ck}}{20}\right)^{0,5}$	$\left(\frac{f_{ck}}{20}\right)^{0,435}$	$\left(\frac{f_{ck}}{20}\right)^{0,350}$
Characteristic resistance in uncracked concrete C20/25	$N_{Rk,p,ucr}$	[kN]	25	42	50
Increasing factor $N_{Rk,p,ucr} = \psi_C \cdot N_{Rk,p,ucr}$ (C20/25)	ψ_C	[-]	$\left(\frac{f_{ck}}{20}\right)^{0,364}$	$\left(\frac{f_{ck}}{20}\right)^{0,213}$	$\left(\frac{f_{ck}}{20}\right)^{0,196}$
Splitting					
Characteristic resistance	$N^0_{Rk,sp}$	[kN]	min ($N_{Rk,p}$; $N^0_{Rk,c}$ [3])		
Characteristic edge distance [2]	$c_{cr,sp}$	[mm]	$\frac{A_{sp} + 0,8 \cdot (h_{sp} - h_{ef})^2}{(3,41 \cdot h_{sp} - 0,59 \cdot h_{ef})}$		
Characteristic spacing	$s_{cr,sp}$	[mm]	$2 \cdot c_{cr,sp}$		
Concrete cone failure					
Effective anchorage depth	h_{ef}	[mm]	60	70	85
Characteristic edge distance	$c_{cr,N}$	[mm]	$1,5 \cdot h_{ef}$		
Characteristic spacing	$s_{cr,N}$	[mm]	$2 \cdot c_{cr,N}$		
Factor – cracked concrete	$k_{cr,N}$	[-]	7,7		
Factor – uncracked concrete	$k_{ucr,N}$	[-]	11,0		

[1] In absence of other national regulations
[2] Applicable concrete thickness h_{sp} and area A_{sp} according to Table B3 to determine characteristic edge distance $c_{cr,sp}$
[3] $N^0_{Rk,c}$ according to EN 1992-4:2018

Table C4: Characteristic values for **shear load** under static and quasi-static action

Anchor size				M10	M12	M16
Installation factor		γ_{inst}	[-]	1,0		
Steel failure without lever arm						
Characteristic resistance	S	$V^0_{Rk,s}$	[kN]	26,8	38,3	60,0
	A4 and HCR	$V^0_{Rk,s}$	[kN]	27,8	39,8	69,5
Partial factor [1)]		γ_{Ms}	[-]	1,25		
Ductility factor		k_7	[-]	1,0		
Steel failure with lever arm						
Characteristic bending resistance	S	$M^0_{Rk,s}$	[Nm]	60	105	240
	A4 and HCR	$M^0_{Rk,s}$	[Nm]	55	99	223
Partial factor [1)]		γ_{Ms}	[-]	1,25		
Concrete pry-out failure						
Pry-out factor	S	k_8	[-]	3,1	3,0	3,6
	A4 and HCR	k_8	[-]	2,8	3,3	3,4
Concrete edge failure						
Effective length of fastener in shear loading		l_f	[mm]	h_{ef}		
Outside diameter of fastener		d_{nom}	[mm]	10	12	16

1) In absence of other national regulations

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Performance
Characteristic values for **shear load**

Annex C4

Table C5: Characteristic values for **seismic loading,** performance category **C1**

Anchor size				**M10**	**M12**	**M16**
Effective anchorage depth		$h_{ef} \geq$	[mm]	60	70	85
Tension load						
Installation factor		γ_{inst}	[-]	1,0		
Steel failure						
Characteristic resistance	S	$N_{Rk,s,C1}$	[kN]	30,4	44,9	79,3
	A4 / HCR	$N_{Rk,s,C1}$	[kN]	30,4	44,9	74,6
Pull-out						
Characteristic resistance	S	$N_{Rk,p,C1}$	[kN]	15,0	22,0	30,0
	A4 / HCR	$N_{Rk,p,C1}$	[kN]	17,0	22,0	35,0
Shear load						
Steel failure without lever arm						
Characteristic resistance	S	$V_{Rk,s,C1}$	[kN]	24,4	33,8	52,3
	A4 / HCR	$V_{Rk,s,C1}$	[kN]	22,2	33,2	64,3
Factor for anchorages without annular gap		α_{gap}	[-]	1,0		

Table C6: Characteristic values for **seismic loading,** performance category **C2**

Anchor size				**M10**	**M12**	**M16**
Effective anchorage depth		$h_{ef} \geq$	[mm]	60	70	85
Tension load						
Installation factor		γ_{inst}	[-]	1,0		
Steel failure						
Characteristic resistance	S	$N_{Rk,s,C2}$	[kN]	30,4	44,9	79,3
	A4 / HCR	$N_{Rk,s,C2}$	[kN]	30,4	44,9	74,6
Pull-out						
Characteristic resistance	S	$N_{Rk,p,C2}$	[kN]	12,5	19,0	35,2
	A4 / HCR	$N_{Rk,p,C2}$	[kN]	7,7	13,8	29,4
Shear load						
Steel failure without lever arm						
Characteristic resistance	S	$V_{Rk,s,C2}$	[kN]	19,0	28,0	43,3
	A4 / HCR	$V_{Rk,s,C2}$	[kN]	15,9	25,6	46,1
Factor for anchorages without annular gap		α_{gap}	[-]	1,0		

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Performance
Characteristic resistance for **seismic loading**

Annex C5

Table C7: Characteristic values **for tension and shear load** under **fire exposure, steel galvanized (S)**

Anchor size				**M10**	**M12**	**M16**
Tension load						
Steel failure						
Characteristic resistance	R30	$N_{Rk,s,fi}$	[kN]	2,6	4,6	7,7
	R60			1,9	3,3	5,6
	R90			1,3	2,1	3,5
	R120			1,0	1,5	2,5
Shear load						
Steel failure <u>without</u> lever arm						
Characteristic resistance	R30	$V_{Rk,s,fi}$	[kN]	7,5	12,3	20,7
	R60			5,1	8,5	14,2
	R90			2,7	4,6	7,7
	R120			1,6	2,7	4,5
Steel failure <u>with</u> lever arm						
Characteristic resistance	R30	$M^0_{Rk,s,fi}$	[Nm]	9,6	19,1	43,8
	R60			6,6	13,1	30,1
	R90			3,5	7,2	16,4
	R120			2,0	4,2	9,6

$N_{Rk,p,fi}$ and $N_{Rk,c,fi}$ according to EN 1992-4:2018

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Performance Characteristic values under **fire exposure, steel galvanized**	

Table C8: Characteristic values **for tension and shear load** under **fire exposure, A4** and **HCR**

Anchor size				**M10**	**M12**	**M16**
Tension load						
Steel failure						
Characteristic resistance	R30	$N_{Rk,s,fi}$	[kN]	6,9	11,0	18,1
	R60			5,0	8,0	13,1
	R90			3,1	4,9	8,1
	R120			2,1	3,4	5,6
Shear load						
Steel failure without lever arm						
Characteristic resistance	R30	$V_{Rk,s,fi}$	[kN]	17,6	32,0	52,6
	R60			12,6	22,6	37,1
	R90			7,5	13,1	21,5
	R120			5,0	8,4	13,8
Steel failure with lever arm						
Characteristic resistance	R30	$M^0_{Rk,s,fi}$	[Nm]	22,7	49,8	111,5
	R60			16,2	35,1	78,6
	R90			9,7	20,4	45,6
	R120			6,5	13,0	29,2

$N_{Rk,p,fi}$ and $N_{Rk,c,fi}$ according to EN 1992-4:2018

Table C9: Displacements under **tension load, steel galvanized (S)**

Anchor size			**M10**	**M12**	**M16**
Displacements under static or quasi-static action $\delta_{N0} = \delta_{N0\text{-factor}} \cdot N$; $\delta_{N\infty} = \delta_{N\infty\text{-factor}} \cdot N$; N: acting tension load					
Cracked concrete					
Factor for displacement	$\delta_{N0\text{-factor}}$	[mm/kN]	0,05	0,04	0,03
	$\delta_{N\infty\text{-factor}}$	[mm/kN]	0,20	0,15	0,11
Uncracked concrete					
Factor for displacement	$\delta_{N0\text{- factor}}$	[mm/kN]	0,01	0,004	0,005
	$\delta_{N\infty\text{- factor}}$	[mm/kN]	0,03	0,03	0,03
Displacement under seismic action C2					
Displacements for DLS	$\delta_{N,C2(DLS)}$	[mm]	4,7	4,2	4,5
Displacements for ULS	$\delta_{N,C2(ULS)}$	[mm]	16,1	12,9	12,8

Table C10: Displacements under **tension load, A4** and **HCR**

Anchor size			**M10**	**M12**	**M16**
Displacements under static or quasi-static action $\delta_{N0} = \delta_{N0\text{-factor}} \cdot N$; $\delta_{N\infty} = \delta_{N\infty\text{-factor}} \cdot N$; N: acting tension load					
Cracked concrete					
Factor for displacement	$\delta_{N0\text{-factor}}$	[mm/kN]	0,06	0,05	0,02
	$\delta_{N\infty\text{-factor}}$	[mm/kN]	0,17	0,16	0,08
Uncracked concrete					
Factor for displacement	$\delta_{N0\text{- factor}}$	[mm/kN]	0,00	0,001	0,00
	$\delta_{N\infty\text{- factor}}$	[mm/kN]	0,05	0,05	0,05
Displacement under seismic action C2					
Displacements for DLS	$\delta_{N,C2(DLS)}$	[mm]	4,1	5,7	5,1
Displacements for ULS	$\delta_{N,C2(ULS)}$	[mm]	16,8	18,0	13,9

Table C11: Displacements under **shear load, steel galvanized (S)**

Anchor size			**M10**	**M12**	**M16**
Displacements under static or quasi-static action $\delta_{V0} = \delta_{V0\text{-factor}} \cdot V$ V: acting shear load $\delta_{V\infty} = \delta_{V\infty\text{-factor}} \cdot V$					
Factor for displacement	$\delta_{V0\text{- factor}}$	[mm/kN]	0,09	0,09	0,07
	$\delta_{V\infty\text{- factor}}$	[mm/kN]	0,13	0,14	0,11
Displacement under seismic action C2					
Displacements for DLS	$\delta_{V,C2(DLS)}$	[mm]	3,1	3,7	3,8
Displacements for ULS	$\delta_{V,C2(ULS)}$	[mm]	5,5	9,9	9,6

Table C12: Displacements under **shear load, A4** and **HCR**

Anchor size			**M10**	**M12**	**M16**
Displacements under static or quasi-static action $\delta_{V0} = \delta_{V0\text{-factor}} \cdot V$ V: acting shear load $\delta_{V\infty} = \delta_{V\infty\text{-factor}} \cdot V$					
Factor for displacement	$\delta_{V0\text{- factor}}$	[mm/kN]	0,14	0,12	0,09
	$\delta_{V\infty\text{- factor}}$	[mm/kN]	0,20	0,17	0,14
Displacement under seismic action C2					
Displacements for DLS	$\delta_{V,C2(DLS)}$	[mm]	3,5	4,2	4,4
Displacements for ULS	$\delta_{V,C2(ULS)}$	[mm]	8,4	11,8	11,1