Deutsches Institut für Bautechnik

Public-law institution jointly founded by the federal states and the Federation

European Technical Assessment Body for construction products

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

European Technical Assessment ETA-18/1160 of 16 January 2025

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	HUS4 Bonded screw
Product family to which the construction product belongs	Bonded screw fastener for use in concrete
Manufacturer	HILTI Corporation Feldkircherstraße 100 9494 SCHAAN FÜRSTENTUM LIECHTENSTEIN
Manufacturing plant	Hilti Plants
This European Technical Assessment contains	28 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 332795-01-0601, Edition 11/2024
This version replaces	ETA-18/1160 issued on 27 July 2022

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Specific Part

1 Technical description of the product

The HUS4 Bonded screw consists of a foil capsule HUS4-MAX and a steel element HUS4 according to Annex A1. The anchor made of galvanized or stainless steel is screwed into a predrilled cylindrical drill hole, filled with a mortar capsule HUS4-MAX. The special thread of the anchor cuts an internal thread into the member while setting. The anchorage is characterized by mechanical interlock in the special thread.

Product and product description are 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 to tension load (static and quasi-static loading)	See Annex B5 and B6, Annex C1 and C2
Characteristic resistance to shear load (static and quasi-static loading)	See Annex C3
Displacements (static and quasi-static loading)	See Annex C7 and C8
Characteristic resistance and displacements for seismic performance category C1	See Annex C4
Characteristic resistance and displacements for seismic performance category C2	See Annex C5 and C8

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Class A1
Resistance to fire	See Annex C6

3.3 Aspects of durability linked with the basic works requirements

See Annex B1.

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

In accordance with European Assessment Document EAD No. 332795-01-0601 the applicable European legal act is: [96/582/EC].

The system to be applied is: 1

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

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

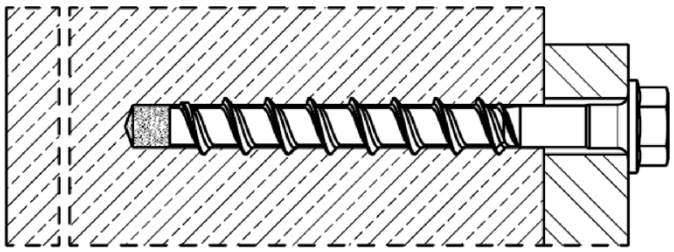
Issued in Berlin on 16 January 2025 by Deutsches Institut für Bautechnik

Dipl.-Ing. Beatrix Wittstock
Head of Section

beglaubigt:
Tempel

Deutsches Institut für Bautechnik DIBt

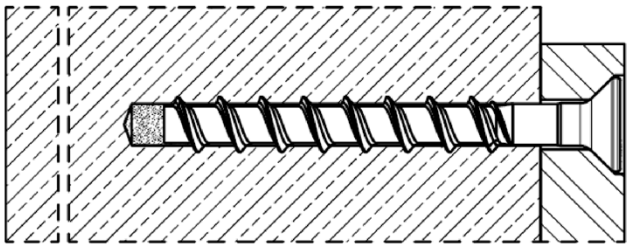
Installed condition without adjustment



HUS4-H (hexagon head configuration sizes 10, 12, 14 and 16)

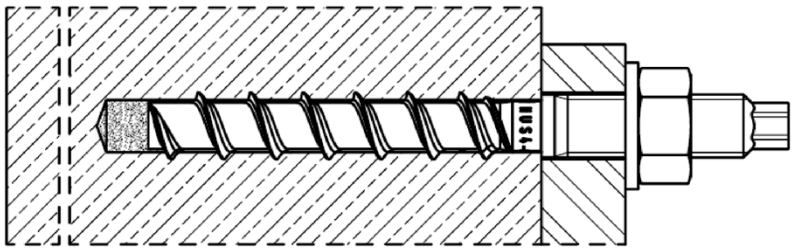
HUS4-HF (hexagon head configuration sizes 10, 14 and 16)

HUS4-HR (hexagon head configuration sizes 10 and 14)



HUS4-C (countersunk head configuration size 10)

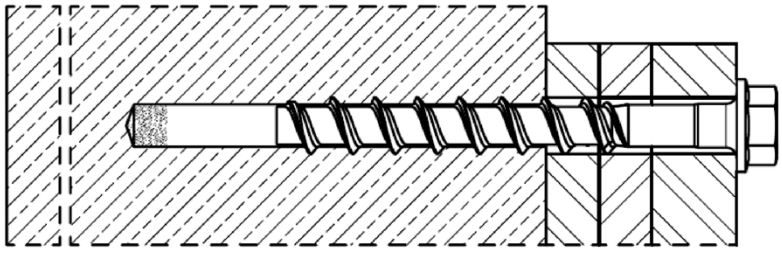
HUS4-CR (countersunk head configuration size 10)



HUS4-A
(threaded rod connection
sizes 10 with M12 and 14 with M16)

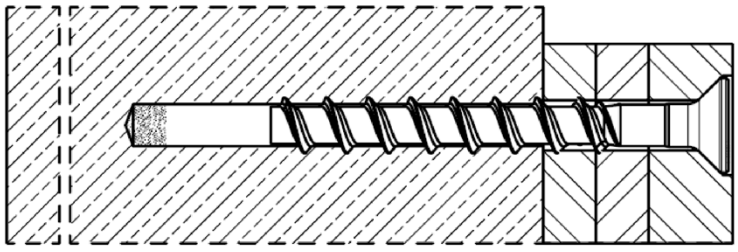
HUS4-AF
(threaded rod connection
sizes 10 with M12 and 14 with M16)

Installed condition with adjustment



HUS4-H (hexagon head configuration sizes 10, 12, and 14)

HUS4-HF (hexagon head configuration sizes 10, and 14)



HUS4-C (countersunk head configuration size 10)

HUS4 Bonded screw	**Annex A1**
Product description Installed condition	

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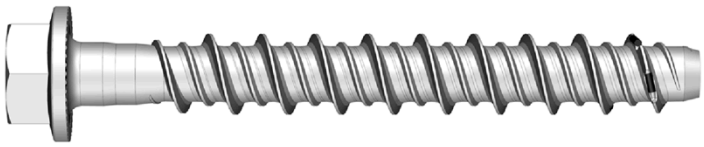
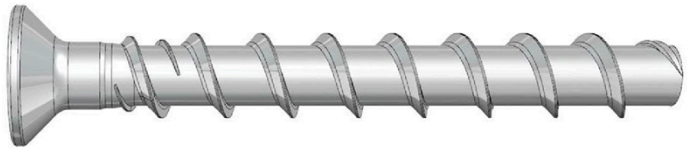
Product description: Foil capsule and steel elements

Foil capsule HUS4-MAX size10 to 16: resin and hardener

Marking:
HUS4-MAX size
Expiry date mm/yyyy

Table A1: Screw types

Hilti HUS4-H, sizes 10, 12, 14 and 16, hexagonal head configuration, galvanized **Hilti HUS4-HF,** sizes 10, 14 and 16, hexagonal head configuration, multilayer coating

Hilti HUS4-HR, sizes 10 and 14 hexagonal head configuration, stainless steel

Hilti HUS4-C, size 10, countersunk head configuration, galvanized

Hilti HUS4-CR, size10 countersunk head configuration, stainless steel

Hilti HUS4-A, size 10 with external thread M12 and size 14 with external thread M16, galvanized **Hilti HUS4-AF,** size 10 with external thread M12 and size 14 with external thread M16, multilayer coating


HUS4 Bonded screw	**Annex A2**
Product description Foil capsule / Steel elements	

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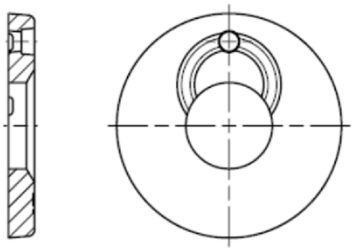
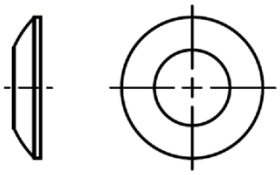
Table A2: Hilti filling set (for HUS4-H (F, R) and HUS4-A (F)) and Hilti injection mortar

Filling washer	Spherical washer	Injection mortar
		 Hilti HIT-HY … with ETA Hilti HIT-RE … with ETA

HUS4 Bonded screw

Product description
Foil capsule / Steel elements

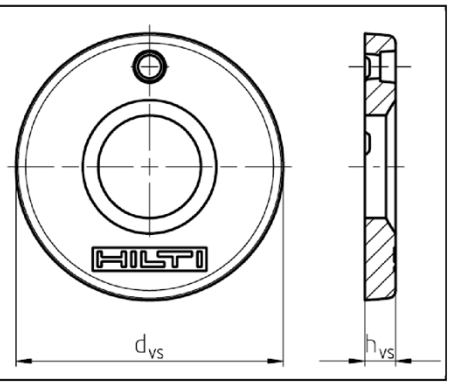
Annex A3

Table A3: Materials

Part	Material
HUS4-H(F), HUS4-C and HUS4-A(F) screw anchor	Carbon steel Rupture elongation $A_5 \leq 8\%$
HUS4-HR and HUS4-CR screw anchor	Stainless steel (A4 grade) Rupture elongation A5 > 8% Corrosion resistance class CRC III according to EN1993-1-4:2006+A1:2015 1.4401 or 1.4404 according to EN 10088-1:2014
Hilti Filling set (carbon steel)	Filling washer: Carbon steel Spherical washer: Carbon steel
Hilti Filling set (stainless steel)	Filling washer: Stainless steel A4 according to ASTM A240/A 240M:2019 Spherical washer: Stainless steel A4 according to EN 10088-1:2014 Corrosion resistance class CRC III according to EN 1993-1-4:2006+A1:2015

Table A4: Filling set dimensions

Filling set size		M12	M16	M20
Diameter	d_{vs} [mm]	52	44	60
Thickness	h_{vs} [mm]	5	6	6
HUS4-H (F, R) 		10	12 + 14	16
HUS4-A (F) 		10	14	-

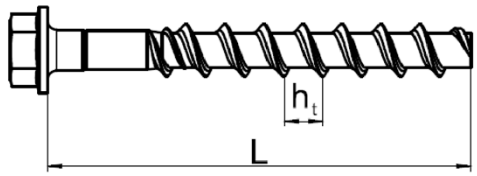


HUS4 Bonded screw	**Annex A4**
Product description Materials and fastener dimensions	

Table A5: Fastener dimensions and marking HUS4-H(F, R)

Fastener size HUS4-			**H(F) 10**	**H 12**	**H(F) 14**	**H(F) 16**
Nominal fastener diameter	d	[mm]	10	12	14	16
Nominal embedment depth	h_{nom}	[mm]	85	100	115	130
Effective embedment depth	h_{ef}	[mm]	85	100	115	130
Pitch of the thread	h_t	[mm]	10	12	14	13,2
Length of screw (min / max)	L	[mm]	90 / 305	110 / 150	130 / 150	140 / 205

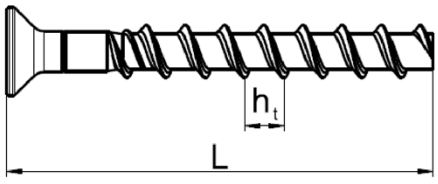
Fastener size HUS4-			**HR 10**	**HR 14**
Nominal fastener diameter	d	[mm]	10	14
Nominal embedment depth	h_{nom}	[mm]	90	110
Effective embedment depth	h_{ef}	[mm]	90	110
Pitch of the thread	h_t	[mm]	8	9,8
Length of screw min / max	L	[mm]	95 / 130	120 / 135



HUS4: Hilti Universal Screw 4th generation
H: Hexagonal head, galvanized
HF: Hexagonal head, multilayer coating
HR: Hexagonal head, stainless steel
10: Nominal screw diameter d [mm]
100: Length of screw L [mm]

Table A6: Fastener dimensions and marking HUS4-C and HUS4-CR

Fastener size HUS4-			**C 10**	**CR 10**
Nominal fastener diameter	d	[mm]	10	10
Nominal embedment depth	h_{nom}	[mm]	85	90
Effective embedment depth	h_{ef}	[mm]	85	90
Pitch of the thread	h_t	[mm]	10	8
Length of screw (min / max)	L	[mm]	100 / 120	105



HUS4: Hilti Universal Screw 4th generation
C: Countersunk head, galvanized
CR: Countersunk head, stainless steel
10: Nominal screw diameter d [mm]
100: Length of screw L [mm]

HUS4 Bonded screw

Product description
Fastener dimensions

Annex A5

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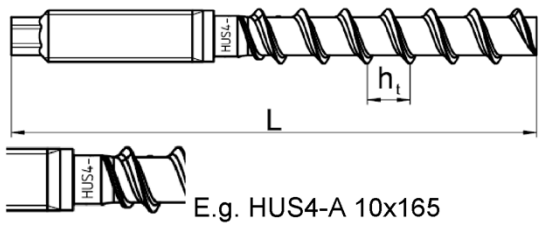
Table A7: Fastener dimensions and marking HUS4-A (AF)

Fastener size HUS4-			**A(F) 10**	**A(F) 14**
Nominal fastener diameter	d	[mm]	10	14
Metric thread conection			M12	M16
Nominal embedment depth	h_{nom}	[mm]	85	115
Effective embedment depth	h_{ef}	[mm]	85	115
Pitch of the thread	h_t	[mm]	10	14
Length of screw (min / max)	L	[mm]	140 / 165	185 / 205



E.g. HUS4-A 10x165

8K

HUS4: Hilti Universal Screw 4th generation
A: Thread connection, galvanized
AF: Thread connection, multilayer coating
10: Nominal screw diameter d [mm]
165: Length of screw L [mm]
8: Carbon steel
K: Length identification HUS4-A 10x165

I	**K**	**L**	**N**
10x140	10x165	14x185	14x205

HUS4 Bonded screw

Product description
Fastener dimensions

Annex A6

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Specifications of intended use

Anchorages subject to:
- Static and quasi static loading
- Seismic performance category C1 and C2 for carbon steel types
- Fire exposure for carbon steel types

Base material:
- 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 206-1:2010+A1:2016.
- Cracked or uncracked concrete.

Temperature in the base material:
- **at installation**

  -10 °C to +40 °C
- **in-service**

  Temperature range I: -40 °C to +120 °C
  (max. long term temperature +72 °C and max. short term temperature +120 °C)

Use conditions (Environmental conditions):
- Anchorages subject to dry internal conditions: all screw types.
- For all other conditions corresponding to corrosion resistance classes CRC according to EN 1993-1-4:2006+A1:2015
  - Stainless steel according to Annex A3 Table A3, screw types HUS4-HR/-CR: CRC III

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.).
- The anchorages are designed in accordance with EN 1992-4:2018 and EOTA Technical Report TR 075, Edition 12/2024.
- In case of requirements to resistance to fire local spalling of the concrete cover must be avoided.

Installation:
- Concrete condition I1: installation in dry or wet (water saturated) concrete and use in service in dry concrete for carbon steel.
- Concrete condition I1: installation in dry or wet (water saturated) concrete and use in service in dry or wet concrete for stainless steel.
- Fastener 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 hole is filled with high strength mortar and if under shear or oblique tension load it is not the direction of the load application.
- After installation further turning of the fastener must not be possible.
- The head of the fastener (HUS4-H (F, R) and HUS4-C/CR) must be supported on the fixture and is not damaged.
- Hilti filling set is suitable for HUS4-H (F, R) and HUS4-A (F).

HUS4 Bonded screw	**Annex B1**
Intended Use Specifications	

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Specifications of intended use: Drilling and cleaning for HUS4

Table B1: Static and quasi static loading

HUS4-		**H(F); C; A(F) carbon steel**	**HR; CR stainless steel**
Uncracked or cracked concrete			
Hammer drilling (HD)[1)]	cleaned / not cleanded 	size 10 to 16	size 10 and 14
Hammer drilling with Hilti hollow drill bit TE-CD or TE-YD (HDB) [1)] 		sizes 12 to 16	-

[1)] Adjustment according to annex B9 is possible for HUS4 carbon steel sizes 10 to 14.

Table B2: Seismic performance category C1

HUS4		**H(F); C; A(F) carbon steel**
Hammer drilling (HD)[1)]	cleaned / not cleanded 	sizes 10 to 14
Hammer drilling with Hilti hollow drill bit TE-CD or TE-YD (HDB) [1)] 		sizes 12 and 14

[1)] Adjustment according to annex B9 is possible for HUS4 carbon steel sizes 10 to 14.

Table B3: Seismic performance category C2

HUS4		**H(F); C; A(F) carbon steel**
Hammer drilling (HD)[1)]	cleaned / not cleanded 	sizes 10 to 14

[1)] Adjustment according to annex B9 is possible for HUS4 carbon steel sizes 10 to 14.

HUS4 Bonded screw	**Annex B2**
Intended Use Specifications	

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Table B4: Static and quasi static loading under fire exposure

HUS4		**H(F); C; A(F) carbon steel**
Hammer drilling (HD)[1)]	cleaned / not cleanded 	sizes 10 to 16
Hammer drilling with Hilti hollow drill bit TE-CD or TE-YD (HDB) [1)] 		sizes 12 to 16

[1)] Adjustment according to annex B9 is possible for HUS4 carbon steel sizes 10 to 14

HUS4 Bonded screw	**Annex B3**
Intended Use Specifications	

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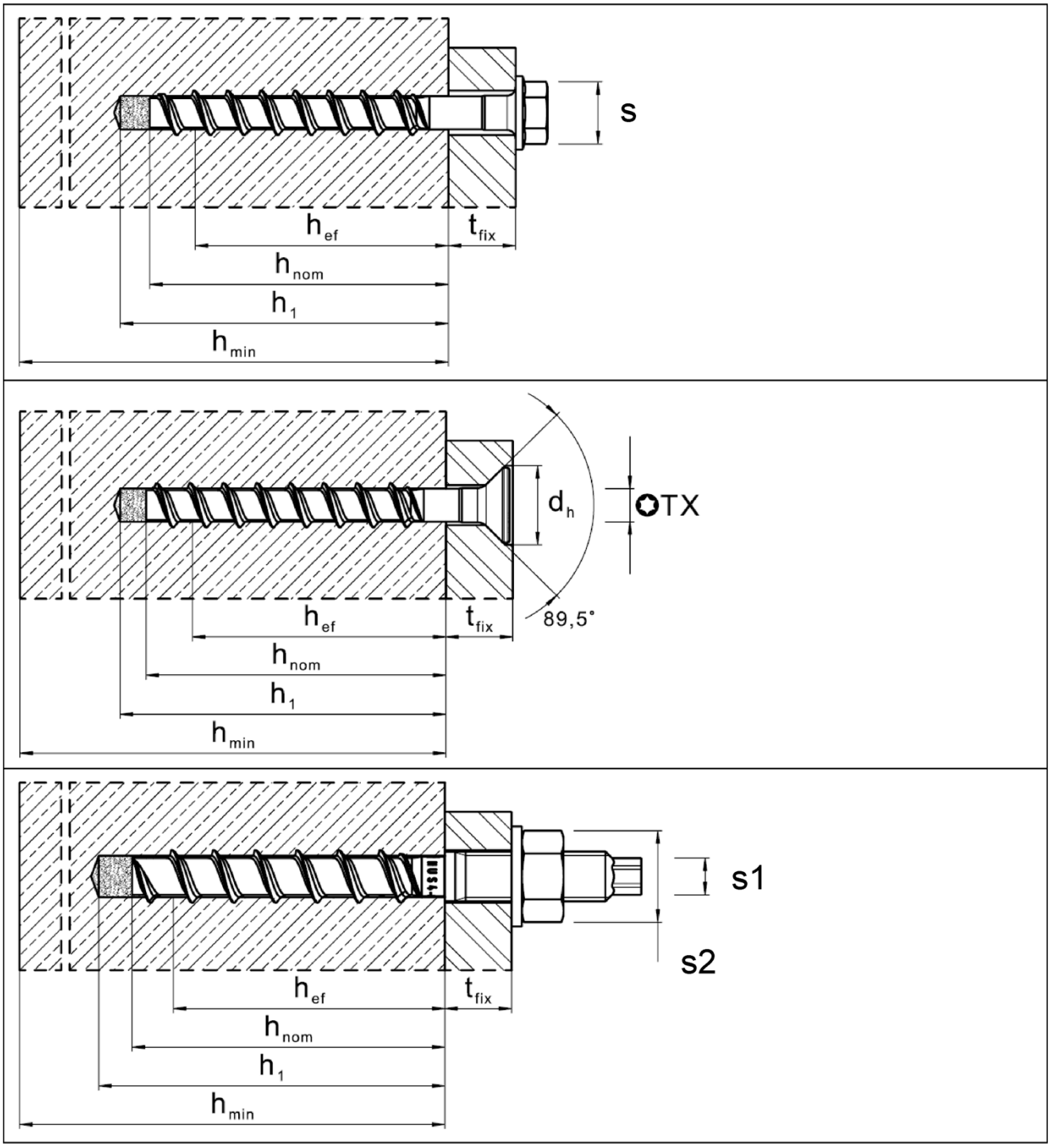
Installation parameters



HUS4 Bonded screw	
Intended Use Installation parameters	**Annex B4**

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Table B5: Installation parameters HUS4 Bonded screw carbon steel

Fastener size HUS4			**10**	**12**	**14**
Type			**H(F), C, A(F)**	**H**	**H(F), A(F)**
Nominal embedmenth depth	h_{nom}	[mm]	85	100	115
Nominal drill hole diameter	d_0	[mm]	10	12	14
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	10,45	12,50	14,50
Clearance hole diameter through setting	d_f min	[mm]	13	15	17
	d_f max	[mm]	14	16	18
Clearance hole diameter pre setting (A-type)	$d_f \leq$	[mm]	14	-	18
Wrench size (H, HF-type)	s	[mm]	15	17	21
Wrench size for hex head (A-type)	s1	[mm]	8	-	12
Wrench size (A-type)	s2	[mm]	19	-	24
Maximum torque (A-type)	max T_{inst}	[Nm]	40	-	80
Torx size (C-type)	TX	-	50	-	-
Diameter of countersunk head	d_h	[mm]	21	-	-
Depth of drill hole for cleaned hole or for uncleaned hole when drilling upwards	h_1 =	[mm]	(h_{nom} + 10 mm)		
			95	110	125
Depth of drill hole for uncleanded hole hammer drilling in wall and floor position	h_1 =	[mm]	(h_{nom} + 10 mm) + 2 * d_0		
			115	134	153
Depth of drill hole (with adjustability) cleaned hole or for uncleaned hole when drilling upwards	h_1 =	[mm]	(h_{nom} + 20 mm)		
			105	120	135
Depth of drill hole (with adjustability) for uncleaned hole hammer drilling in wall and floor position	h_1 =	[mm]	(h_{nom} + 20 mm) + 2 * d_0		
			125	144	163
Minimum thickness of concrete member	$h_{min} \geq$	[mm]	(h_1 + 30 mm)		
			140	160	200
Minimum spacing	$s_{min} \geq$	[mm]	40	50	60
Minimum edge distance	$c_{min} \geq$	[mm]	40	50	60
Hilti setting tool [1)]			SIW 6AT-A22 1/2” SIW 22T-A 1/2” SIW 6-22 1/2” SIW 8-22 1/2" gear 1 SIW 9-A22 3/4”	SIW 22T-A 1/2” SIW 6-22 1/2” SIW 8-22 1/2" SIW 9-A22 3/4”	

[1)] Installation with other impact screw driver of equivalent power is possible.

HUS4 Bonded screw	**Annex B5**
Intended Use Installation parameters	

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Table B6: Installation parameters HUS4 Bonded screw carbon steel

Fastener size HUS4			**16**
Type			**H(F)**
Nominal embedmenth depth	h_{nom}	[mm]	130
Nominal drill hole diameter	d_0	[mm]	16
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	16,50
Clearance hole diameter through setting	$d_f \leq$	[mm]	20
Wrench size (H, HF-type)	s	[mm]	24
Depth of drill hole for cleaned hole or for uncleaned hole when drilling upwards	h_1 =	[mm]	(h_{nom} + 10 mm)
			140
Depth of drill hole for uncleanded hole hammer drilling in wall and floor position	h_1 =	[mm]	(h_{nom} + 10 mm) + 2 * d_0
			172
Minimum thickness of concrete member	$h_{min} \geq$	[mm]	(h_1 + 32 mm)
			200
Minimum spacing	$s_{min} \geq$	[mm]	90
Minimum edge distance	$c_{min} \geq$	[mm]	65
Hilti setting tool [1)]			SIW 22T-A 1/2” SIW 6-22 1/2” SIW 8-22 1/2" SIW 9-A22 3/4”

[1)] Installation with other impact screw driver of equivalent power is possible.

HUS4 Bonded screw	**Annex B6**
Intended Use Installation parameters	

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Table B7: Installation parameters HUS4 Bonded screw stainless steel

Fastener size HUS4			**10**	**14**
Type			**HR, CR**	**HR**
Nominal embedment depth	h_{nom}	[mm]	90	110
Nominal drill hole diameter	d_0	[mm]	10	14
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	10,45	14,50
Clearance hole diameter	$d_f \leq$	[mm]	14	18
Wrench size (H-type)	s	[mm]	15	21
Torx size (C-type)	TX	-	50	-
Diameter of countersunk head (CR)	d_h	[mm]	21	-
Depth of drill hole for cleaned hole or for uncleaned hole when drilling upwards	h_1	[mm]	(h_{nom} + 10mm)	
			100	120
Depth of drill hole for uncleanded hole hammer drilling in wall and floor position	h_1 =	[mm]	(h_{nom} + 10 mm) + 2 * d_0	
			120	148
Minimum thickness of concrete member	$h_{min} \geq$	[mm]	(h_1 + 30 mm)	
			140	160
Minimum spacing	$s_{min} \geq$	[mm]	50	60
Minimum edge distance	$c_{min} \geq$	[mm]	50	60
Hilti setting tool [1)]			SIW 22T-A 1/2” SIW 6AT-A22 1/2” gear 3 SIW 6-22 1/2” gear 2	SIW 22T-A 1/2” SIW 6-22 1/2” gear 2 SIW 8-22 1/2" gear 1 SIW 9-A22 3/4”

[1)] Installation with other impact screw driver of equivalent power is possible.

HUS4 Bonded screw	**Annex B7**
Intended Use Installation parameters	

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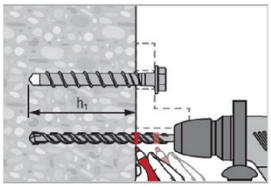
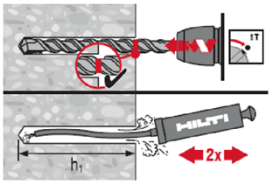
Installation

Hole drilling and cleaning

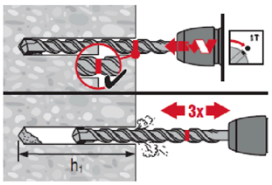
Hammer drilling (HD) all sizes for carbon and stainless steel screw types



Mark drilling depth h_1 for drilling with or without fixture in place.
Details for drilling depth h_1 see table B5, B6 and B7.



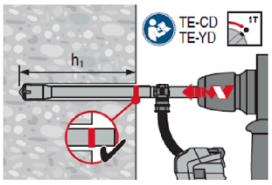
Cleaning needed in downward and horizontal installation direction with drill hole depth
$h_1 = h_{nom} + 10$ mm



No cleaning is allowed in upward installation direction.
No cleaning is allowed in downward and horizontal installation direction when 3x ventilation[1)] after drilling is executed.
Drill hole depth $h_1 = h_{nom} + 10$ mm$+ 2 * d_0$

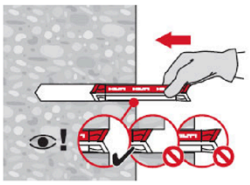
[1)] moving the drill bit in and out of the drill hole 3 times after the recommended drilling depth h_1 is achieved. This procedure shall be done with both revolution and hammer functions activated in the drilling machine. For more details read the relevant installation instruction (MPII).

Hammer drilling with Hilti hollow drill bit (HDB) TE-CD or TE-YD size 12 to 16 for carbon steel screw types



No cleaning needed
$h_1 = h_{nom} + 10$ mm

Insert of HUS4-MAX foil capsule



HUS4 Bonded screw	**Annex B8**
Intended Use Installation instructions	

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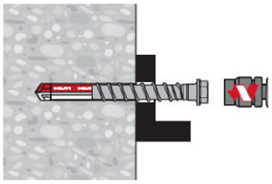
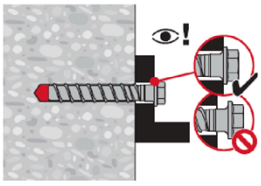
Fastener setting without adjustment for carbon and stainless steel screw types

Setting by impact screw driver



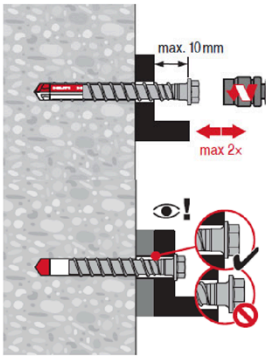
Setting parameters listed in Table B5, B6 and B7

Setting check



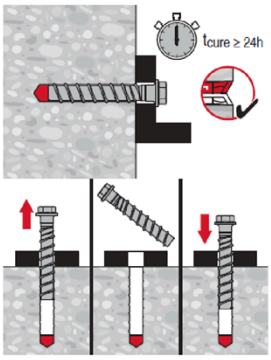
Fastener setting with adjustment for size 10 to size 14 for carbon steel screw types

Adjusting process 1



A screw can get adjusted maximum two times. The total allowed maximum thickness of shims added during the adjustment process is 10 mm. The final embedment depth after adjustment process must be larger or equal than h_{nom}.

Adjusting process 2



After minimum curing time of 24 h the HUS4 screw can screw out and in for 1 time.

HUS4 Bonded screw

Intended Use
Installation instructions

Annex B9

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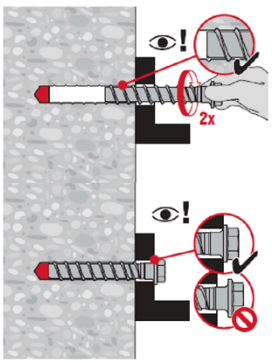
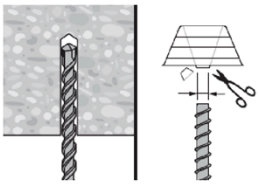
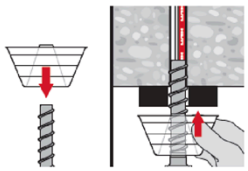


Find the thread in the drilled hole
The screw should be screw in 2 revolutions by hand and finish with the setting tool.

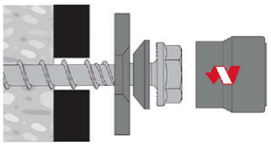
Overhead installation



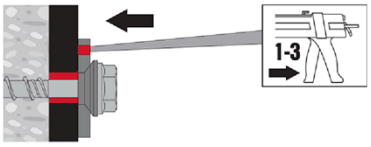
For upward installation direction use the overhead dripping cup HIT-OHC.



Fastener setting with Hilti filling set for carbon steel screw types



Injection of Hilti HIT mortar and curing time



Fill the annular gap between screw and fixture with 1-3 strokes of a Hilti injection mortar HIT-HY … or HIT-RE … .
Follow the installation instructions supplied with the respective Hilti injection mortar.
After required curing time t_{cure} the fastening can be loaded.

HUS4 Bonded screw	**Annex B10**
Intended Use Installation instructions	

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Table C1: Essential characteristics for HUS4 Bonded screw carbon steel under tension load in case of static and quasi static loading

HUS4-MAX with HUS4 screw			**10 H(F); A(F); C**	**12 H**	**14 H(F); A(F)**	**16 H(F)**
Nominal embedment depth	h_{nom}	[mm]	85	100	115	130
Installation factor	γ_{inst}	[-]	1,0			
Adjustment						
Total max. thickness of adjustment layers	t_{adj}	[mm]	10			-
Max. number of adjustments	n_a	[-]	2			-
Steel failure						
Characteristic resistance	$N_{Rk,s}$	[kN]	55,0	79,0	101,5	107,7
Partial factor	$\gamma_{Ms,N}$ [1)]	[-]	1,5			
Combined pull-out and concrete failure [3)]						
Uncracked concrete, Temperature range I						
Concrete screw contribution	$N^0_{Rk,p,CS,ucr}$	[kN]	$\geq N^0_{Rk,c}$ [2)]			46,0
Bond material contribution	$N^0_{Rk,p,B,ucr}$	[kN]	10,0	20,0	26,0	34,0
Increasing factor for $N_{Rk,p,ucr} = N_{Rk,p,ucr(C20/25)} * \psi_c$	ψ_c	[-]	$(f_{ck}/20)^{0,30}$			
Cracked concrete, Temperature range I:						
Concrete screw contribution	$N^0_{Rk,p,CS,ucr}$	[kN]	$\geq N^0_{Rk,c}$ [2)]			32,0
Bond material contribution	$N^0_{Rk,p,B,ucr}$	[kN]	4,5	11,0	11,0	23,0
Increasing factor for $N_{Rk,p,cr} = N_{Rk,p,cr(C20/25)} * \psi_c$	ψ_c	[-]	$(f_{ck}/20)^{0,50}$			
Sustained load factor	ψ^0_{sus}	[-]	0,94			
Concrete cone failure						
Effective embedment depth	h_{ef}	[mm]	85	100	115	130
Factor for uncracked concrete	$k_{ucr,N}$	[-]	11,0			
Factor for cracked concrete	$k_{cr,N}$	[-]	7,7			
Increasing factor for $N_{Rk,c} = N_{Rk,c(C20/25)} * \psi_c$	ψ_c	[-]	$(f_{ck}/20)^{0,50}$			
Edge distance	$c_{cr,N}$	[mm]	1,5 h_{ef}			
Spacing	$s_{cr,N}$	[mm]	3 h_{ef}			
Splitting failure						
Characteristic resistance	$N^0_{Rk,sp}$	[kN]	$= N'_{Rk,p}$			
Edge distance	$c_{cr,sp}$	[mm]	1,6 h_{ef}	1,7 h_{ef}	1,85 h_{ef}	1,95 h_{ef}
Spacing	$s_{cr,sp}$	[mm]	3,2 h_{ef}	3,4 h_{ef}	3,7 h_{ef}	3,9 h_{ef}

[1)] In absence of other national regulations.
[2)] $N^0_{Rk,c}$ is calculated according to EN1992-4:2018 with $h_{ef} = 0,85(h_{nom} - 0,5h_t)$
[3)] $N^0_{Rk,p,CS,(u)cr}$ and $N^0_{Rk,p,CS,(u)cr}$ should be combined for the total bonded screw capacity $N_{Rk,p,(u)cr}$ according to EOTA TR 075

HUS4 Bonded screw	**Annex C1**
Performances Essential characteristics under tension loads in case of static and quasi-static loading	

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Table C2: Essential characteristics for HUS4 Bonded screw stainless steel under tension load in case of static and quasi static loading

HUS4-MAX with HUS4 screw			**10 HR; CR**	**14 HR**
Nominal embedment depth	h_{nom}	[mm]	90	110
Installation factor	γ_{inst}	[-]	1,0	
Steel failure				
Characteristic resistance	$N_{Rk,s}$	[kN]	52,6	102,2
Partial factor	$\gamma_{Ms,N}$ [1)]	[-]	1,4	
Combined pull-out and concrete failure [3)]				
Uncracked concrete, Temperature range I				
Concrete screw contribution	$N^0_{Rk,p,CS,ucr}$	[kN]	25,0	$\geq N^0_{Rk,c}$ [2)]
Bond material contribution	$N^0_{Rk,p,B,ucr}$	[kN]	15,0	22,0
Increasing factor for $N_{Rk,p,ucr} = N_{Rk,p,ucr(C20/25)} * \psi_c$	ψ_c	[-]	$(f_{ck}/20)^{0,30}$	
Cracked concrete, Temperature range I				
Concrete screw contribution	$N^0_{Rk,p,CS,cr}$	[kN]	16	25
Bond material contribution	$N^0_{Rk,p,B,cr}$	[kN]	8	15
Increasing factor for $N_{Rk,p,cr} = N_{Rk,p,cr(C20/25)} * \psi_c$	ψ_c	[-]	$(f_{ck}/20)^{0,50}$	
Sustained load factor	ψ^0_{sus}	[-]	0,90	
Concrete cone failure				
Effective embedment depth	h_{ef}	[mm]	90	110
Factor for uncracked concrete	$k_{ucr,N}$	[-]	11,0	
Factor for cracked concrete	$k_{cr,N}$	[-]	7,7	
Increasing factor for $N_{Rk,c} = N_{Rk,c(C20/25)} * \psi_c$	ψ_c	[-]	$(f_{ck}/20)^{0,50}$	
Edge distance	$c_{cr,N}$	[mm]	1,5 h_{ef}	
Spacing	$s_{cr,N}$	[mm]	3 h_{ef}	
Splitting failure				
Characteristic resistance	$N^0_{Rk,sp}$	[kN]	= $N'_{Rk,p}$	
Edge distance	$c_{cr,sp}$	[mm]	1,95 h_{ef}	1,85 h_{ef}
Spacing	$s_{cr,sp}$	[mm]	3,9 h_{ef}	3,7 h_{ef}

1) In absence of other national regulations.
2) $N^0_{Rk,c}$ is calculated according to EN1992-4:2018 with $h_{ef} = 0,85(h_{nom} - 0,5h_t)$
3) $N^0_{Rk,p,CS,(u)cr}$ and $N^0_{Rk,p,CS,(u)cr}$ should be combined for the total bonded screw capacity $N_{Rk,p,(u)cr}$ according to EOTA TR 075

HUS4 Bonded screw	**Annex C2**
Performances Essential characteristics under tension loads in case of static and quasi-static loading	

Deutsches Institut für Bautechnik DIBt

Table C3: Essential characteristics for HUS4 Bonded screw carbon steel under shear load in case of static and quasi static loading

HUS4-MAX with HUS4 screw			**10 H(F); A(F); C**	**12 H**	**14 H(F); A(F)**	**16 H(F)**
Nominal embedment depth	h_{nom}	[mm]	85	100	115	130
Steel failure for shear load						
Characteristic resistance	$V^0_{Rk,s}$	[kN]	32,0	44,9	62	73,1
Partial factor	$\gamma_{Ms,V}$ [1)]	[-]	1,25			
Ductility factor	k_7	[-]	0,8			
Characteristic resistance	$M^0_{Rk,s}$	[Nm]	64	120	186	240
Concrete pry-out failure						
Pry-out factor	k_8	[-]	2,0			
Concrete edge failure						
Effective length of fastener	l_f	[mm]	85	100	115	130
Diameter of fastener	d	[mm]	10	12	14	16

[1)] In absence of other national regulations.

Table C4: Essential characteristics for HUS4 Bonded screw stainless steel under shear load in case of static and quasi static loading

HUS4-MAX with HUS4 screw			**10 HR; CR**	**14 HR**
Nominal embedment depth	h_{nom}	[mm]	90	110
Steel failure for shear load				
Characteristic resistance	$V^0_{Rk,s}$	[kN]	33,0	77,0
Partial factor	$\gamma_{Ms,V}$ [1)]	[-]	1,5	
Ductility factor	k_7	[-]	1,0	
Characteristic resistance	$M^0_{Rk,s}$	[Nm]	66	193
Concrete pry-out failure				
Pry-out factor	k_8	[-]	2,0	
Concrete edge failure				
Effective length of fastener	l_f	[mm]	90	110
Diameter of fastener	d	[mm]	10	14

[1)] In absence of other national regulations.

HUS4 Bonded screw	**Annex C3**
Performances Essential characteristics under shear load in case of static and quasi static loading	

Table C5: Essential characteristics for HUS4 Bonded screw carbon steel seismic performance category C1 in concrete

HUS4-MAX with HUS4 screw			**10 H(F); A(F); C**	**12 H**	**14 H(F); A(F)**
Nominal embedment depth	h_{nom}	[mm]	85	100	115
Adjustment					
Total max. thickness of adjustment layers	t_{adj}	[mm]	10		
Max. number of adjustments	n_a	[-]	2		
Steel failure for tension and shear load					
Characteristic resistance	$N_{Rk,s,C1}$	[kN]	55,0	79,0	101,5
Partial factor	$\gamma_{Ms,N}$ [1)]	[-]	1,5		
Characteristic resistance	$V_{Rk,s,C1}$	[kN]	26,7	38,9	34,5
Partial factor	$\gamma_{Ms,V}$ [1)]	[-]	1,25		
Reduction factor acc. to EN 1992-4:2018 annular gap unfilled	α_{gap}	[-]	0,5		
Reduction factor acc. to EN 1992-4:2018 annular gap filled	α_{gap}	[-]	1,0		
Combined pullout and concrete cone failure Cracked concrete C20/25, Temperature range I [3)]					
Concrete screw contribution	$N^0_{Rk,p,CS,C1}$	[kN]	$\geq N^0_{Rk,c}$ [2)]		
Bond material contribution	$N^0_{Rk,p,B,C1}$	[kN]	4,5	11,0	11,0
Concrete cone failure					
Effective embedment depth	h_{ef}	[mm]	85	100	115
Edge distance	$c_{cr,N}$	[mm]	1,5 h_{ef}		
Spacing	$s_{cr,N}$	[mm]	3 h_{ef}		
Installation factor	γ_{inst}	[-]	1,0		
Concrete pry-out failure					
Pry-out factor	k_8	[-]	2,0		
Concrete edge failure					
Effective length of fastener	$l_f = h_{ef}$	[mm]	85	100	115
Outside diameter of fastener	d_{nom}	[mm]	10	12	14

[1)] In absence of other national regulations.
[2)] $N^0_{Rk,c}$ is calculated according to EN1992-4:2018 with $h_{ef} = 0{,}85(h_{nom} - 0{,}5h_t)$
[3)] $N^0_{Rk,p,CS,(u)cr}$ and $N^0_{Rk,p,CS,(u)cr}$ should be combined for the total bonded screw capacity $N_{Rk,p,(u)cr}$ according to EOTA TR 075

HUS4 Bonded screw	**Annex C4**
Performances Essential characteristics for seismic performance category C1 in concrete	

Deutsches Institut für Bautechnik DIBt

Table C6: Essential characteristics for HUS4 Bonded screw carbon steel seismic performance category C2 in concrete

HUS4-MAX with HUS4 screw			**10 H(F); A(F); C**	**12 H**	**14 H(F); A(F)**
Nominal embedment depth	h_{nom}	[mm]	85	100	115
Adjustment					
Total max. thickness of adjustment layers	t_{adj}	[mm]	10		
Max. number of adjustments	n_a	[-]	2		
Steel failure for tension					
Characteristic resistance	$N_{Rk,s,C2}$	[kN]	55,0	79,0	101,5
Partial factor	$\gamma_{Ms,N}$ [1)]	[-]	1,5		
Steel failure shear load					
Partial factor	$\gamma_{Ms,V}$ [1)]	[-]	1,25		
Installation with Hilti filling set (HUS4-H and HUS4-A)					
Characteristic resistance	$V_{Rk,s,C2}$	[kN]	23,2	28,6	46,5
Reduction factor acc. to EN 1992-4:2018 annular gap filled	α_{gap}	[-]	1,0		
Installation without Hilti filling set					
Characteristic resistance	$V_{Rk,s,C2}$	[kN]	14,8	23,7	34,4
Reduction factor acc. to EN 1992-4:2018 annular gap unfilled	α_{gap}	[-]	0,5		
Combined pullout and concrete cone failure Cracked concrete C20/25, Temperature range I [2)]					
Concrete screw contribution	$N^0_{Rk,p,CS,C2}$	[kN]	5,4	11,4	17,7
Bond material contribution	$N^0_{Rk,p,B,C2}$	[kN]	5,3	5,8	0,5
Concrete cone failure					
Effective embedment depth	h_{ef}	[mm]	85	100	115
Edge distance	$c_{cr,N}$	[mm]	1,5 h_{ef}		
Spacing	$s_{cr,N}$	[mm]	3 h_{ef}		
Installation factor	γ_{inst}	[-]	1,0		
Concrete pry-out failure					
Pry-out factor	k_8	[-]	2,0		
Concrete edge failure					
Effective length of fastener	$l_f = h_{ef}$	[mm]	85	100	115
Outside diameter of fastener	d_{nom}	[mm]	10	12	14

[1)] In absence of other national regulations.
[2)] $N^0_{Rk,p,CS,(u)cr}$ and $N^0_{Rk,p,CS,(u)cr}$ should be combined for the total bonded screw capacity $N_{Rk,p,(u)cr}$ according to EOTA TR 075

HUS4 Bonded screw	**Annex C5**
Performances Essential characteristics for seismic performance category C2 in concrete	

Deutsches Institut für Bautechnik DIBt

Table C7: Essential characteristics under fire exposure in concrete for HUS4 Bonded screw carbon steel

HUS4-MAX with HUS4 screw				**10**			**12**	**14**		**16**
				H(F)	**C 10**	**A(F)**	**H**	**H(F)**	**A(F)**	**H(F)**
Nominal embedment depth		h_{nom}	[mm]	85	85	85	100	115	115	130
Steel failure for tension and shear load ($F_{Rk,s,fi} = N_{Rk,s,fi} = V_{Rk,s,fi}$)										
Characteristic resistance	R30	$F_{Rk,s,fi}$	[kN]	4,2	1,0	4,2	7,7	10,5	8,4	10,7
	R60	$F_{Rk,s,fi}$	[kN]	3,2	0,9	3,3	5,9	8,1	6,8	8,2
	R90	$F_{Rk,s,fi}$	[kN]	2,4	0,7	2,5	4,1	5,8	5,1	5,9
	R120	$F_{Rk,s,fi}$	[kN]	1,7	0,6	2,1	3,1	4,4	4,3	4,5
	R30	$M^0_{Rk,s,fi}$	[Nm]	4,9	1,2	4,8	11,6	19,3	15,4	23,9
	R60	$M^0_{Rk,s,fi}$	[Nm]	3,7	1,0	3,8	8,9	14,8	12,4	18,3
	R90	$M^0_{Rk,s,fi}$	[Nm]	2,7	0,8	2,9	6,2	10,7	9,3	13,2
	R120	$M^0_{Rk,s,fi}$	[Nm]	1,9	0,6	2,4	4,7	8,1	7,8	10,0
Pull-out failure										
Characteristic resistance	R30 R60 R90	$N^0_{Rk,p,fi}$	[kN]	4,7			6,1	7,5		8,7
	R120	$N^0_{Rk,p,fi}$	[kN]	3,7			4,9	6,0		7,0
Edge distance										
R30 to R120		$c_{cr,fi}$	[mm]	2 h_{ef}						
In case of fire attack from more than one side, the minimum edge distance shall be ≥ 300 mm										
Fastener spacing										
R30 to R120		$s_{cr,fi}$	[mm]	2 $c_{cr,fi}$						
Concrete pry-out failure										
R30 to R120		k_8	[-]	2,0						
The anchorage depth shall be increased for wet concrete by at least 30 mm.										

HUS4 Bonded screw

Performances
Essential characteristics under fire exposure in concrete

Annex C6

Deutsches Institut für Bautechnik DIBt

Table C8: Displacements under tension load for HUS4 Bonded screw carbon steel in case of static and quasi static loading

HUS4 MAX with HUS4 screw			10 H(F); A(F); C		12 H	
			Uncracked concrete	Cracked concrete	Uncracked concrete	Cracked concrete
Temperature range I						
Displacement	N	[kN]	17,1	10,5	23,8	16,2
	δ_{N0}	[mm]	0,3	0,3	0,4	0,5
	$\delta_{N\infty}$	[mm]	0,6	0,6	0,6	0,6

Table C9: Displacements under tension load for HUS4 Bonded screw carbon steel in case of static and quasi static loading

HUS4 MAX with HUS4 screw			14 H(F); A(F)		16 H(F)	
			Uncracked concrete	Cracked concrete	Uncracked concrete	Cracked concrete
Temperature range I						
Displacement	N	[kN]	31,0	18,1	38,1	26,2
	δ_{N0}	[mm]	0,5	0,6	0,6	0,8
	$\delta_{N\infty}$	[mm]	0,8	0,8	0,8	0,8

Table C10: Displacements under tension load for HUS4 Bonded screw stainless steel in case of static and quasi static loading

HUS4 MAX with HUS4 screw			10 HR; CR		14 HR	
			Uncracked concrete	Cracked concrete	Uncracked concrete	Cracked concrete
Temperature range I						
Displacement	N	[kN]	19,0	11,4	31,0	19,0
	δ_{N0}	[mm]	0,3	0,5	0,5	0,8
	$\delta_{N\infty}$	[mm]	0,5	0,5	0,5	0,8

HUS4 Bonded screw	**Annex C7**
Performances Displacements	

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Table C11: Displacements under shear load for HUS4 Bonded screw carbon steel in case of static and quasi static loading

HUS4 MAX with HUS4 screw			10 H(F); A(F); C	12 H	14 H(F); A(F)	16 H(F)
Temperature range I						
Displacement	V	[kN]	18,3	25,7	35,4	41,8
	δ_{V0}	[mm]	1,0	0,9	4,0	1,8
	$\delta_{V\infty}$	[mm]	1,5	1,4	6,0	2,7

Table C12: Displacements under shear load for HUS4 Bonded screw stainless steel in case of static and quasi static loading

HUS4 MAX with HUS4 screw			10 HR; CR	14 HR
Temperature range I				
Displacement	V	[kN]	15,7	27,3
	δ_{V0}	[mm]	1,7	3,9
	$\delta_{V\infty}$	[mm]	2,4	4,3

Table C13: Displacements under tension and shear load for HUS4 Bonded screw carbon steel for seismic category C2

HUS4 MAX with HUS4 screw			10 H(F); A(F); C	12 H	14 H(F); A(F)
Temperature range I					
Tension load					
Displacement DLS	$\delta_{N,C2\ (DLS)}$	[mm]	0,75	0,70	0,77
Displacement ULS	$\delta_{N,C2\ (ULS)}$	[mm]	2,07	3,43	4,24
Shear load with Hilti filling set (HUS4-H and HUS4-A)					
Displacement DLS	$\delta_{V,C2\ (DLS)}$	[mm]	1,72	1,73	2,52
Displacement ULS	$\delta_{V,C2\ (ULS)}$	[mm]	6,88	5,62	6,79
Shear load without Hilti filling set (HUS4-H and HUS4-A)					
Displacement DLS	$\delta_{V,C2\ (DLS)}$	[mm]	5,02	4,90	4,93
Displacement ULS	$\delta_{V,C2\ (ULS)}$	[mm]	8,97	7,00	9,14