

Approval body for construction products  
and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and  
Laender Governments



## European Technical Assessment

**ETA-18/1160**  
**of 27 July 2022**

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 332795-00-0601, Edition 02/2022

This version replaces

ETA-18/1160 issued on 29 April 2022

**European Technical Assessment**

**ETA-18/1160**

English translation prepared by DIBt

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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. 332795-00-0601 the applicable European legal act is: [96/582/EC].

The system to be applied is: 1

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

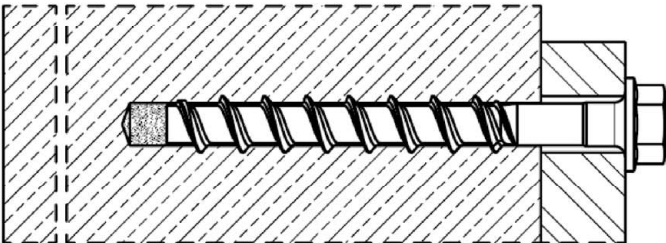
Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited at Deutsches Institut für Bautechnik.

Issued in Berlin on 27 July 2022 by Deutsches Institut für Bautechnik

Dipl.-Ing. Beatrix Wittstock  
Head of Section

*beglaubigt:*  
Tempel

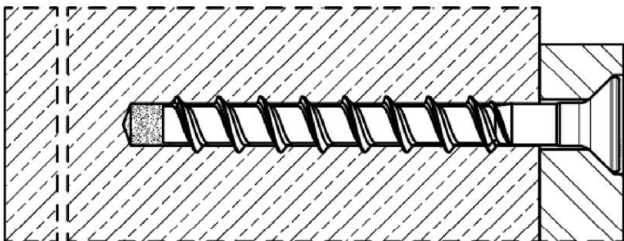
Installed condition without adjustment



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

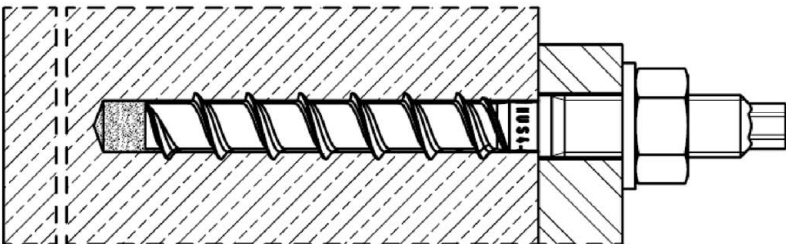
HUS4-HF (hexagon head configuration sizes 10, 14 and 16)

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



HUS4-C (countersunk head configuration size 10)

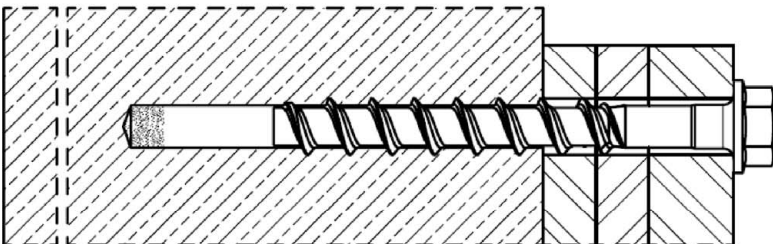
HUS4-CR (countersunk head configuration size 10)



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

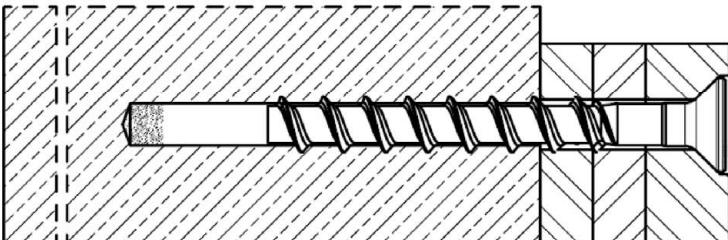
HUS4-AF  
(threaded rod connection sizes 10 with M12 and 14 with M16)

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

Product description  
Installed condition

Annex A1

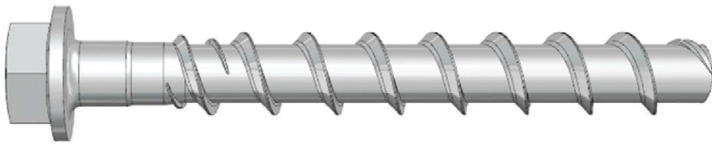

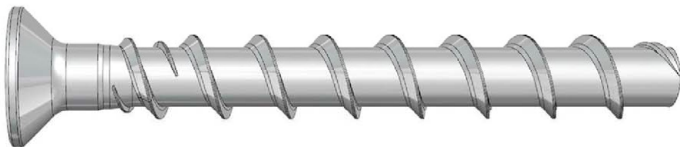


## Product description: Foil capsule and steel elements

Foil capsule HUS4-MAX size 10 to 16: resin and hardener

Marking:  
HUS4-MAX size  
Expiry date mm/yyyy



**Table A1: Screw types**

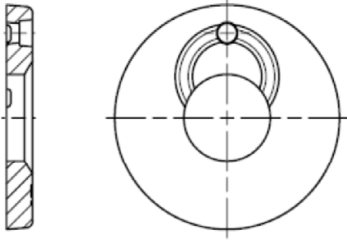
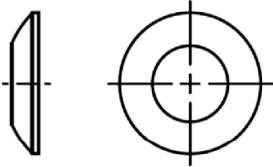

<b>Hilti HUS4-H</b> , sizes 10, 12, 14 and 16, hexagonal head configuration, galvanized <b>Hilti HUS4-HF</b> , sizes 10, 14 and 16, hexagonal head configuration, multilayer coating	
	
<b>Hilti HUS4-HR</b> , sizes 10 and 14 hexagonal head configuration, stainless steel	
	
<b>Hilti HUS4-C</b> , size 10, countersunk head configuration, galvanized	
	
<b>Hilti HUS4-CR</b> , size 10 countersunk head configuration, stainless steel	
	
<b>Hilti HUS4-A</b> , size 10 with external thread M12 and size 14 with external thread M16, galvanized <b>Hilti HUS4-AF</b> , size 10 with external thread M12 and size 14 with external thread M16, multilayer coating	
	

### HUS4 Bonded screw

**Product description**  
Foil capsule / Steel elements

**Annex A2**

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

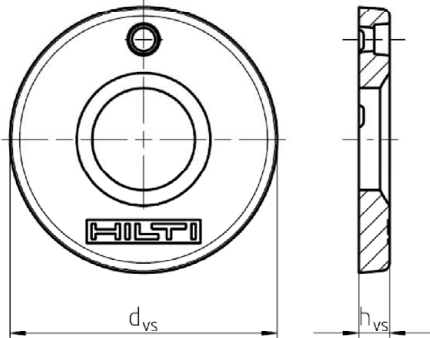


Annex A3



**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 $A_5 > 8\%$ 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]	44	52	60	
Thickness $h_{vs}$ [mm]	5	6	6	
HUS4-H (F, R) 	10	12 + 14	16	
HUS4-A (F) 	10	14	-	

**HUS4 Bonded screw**

**Product description**  
Materials and fastener dimensions

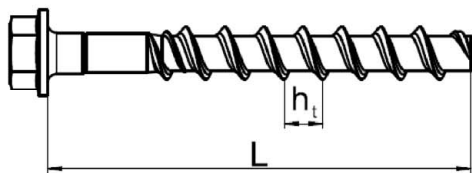

**Annex A4**



**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
Length of screw (min / max)	L	[mm]	90 / 305	130 / 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
Length of screw min / max	L	[mm]	95 / 130	120 / 135

		<b>HUS4:</b> Hilti Universal Screw 4 <sup>th</sup> generation <b>H:</b> Hexagonal head, galvanized <b>HF:</b> Hexagonal head, multilayer coating <b>HR:</b> Hexagonal head, stainless steel <b>10:</b> Nominal screw diameter d [mm] <b>100:</b> Length of screw L [mm]
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**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
Length of screw (min / max)	L	[mm]	100 / 120	105

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

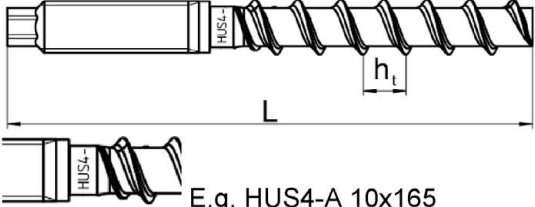

**HUS4 Bonded screw**

**Product description**  
Fastener dimensions

**Annex A5**

**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 connection			M12	M16
Nominal embedment depth	$h_{nom}$	[mm]	85	115
Effective embedment depth	$h_{ef}$	[mm]	85	115
Length of screw (min / max)	L	[mm]	140 / 165	185 / 205

		<b>HUS4:</b> Hilti Universal Screw 4 <sup>th</sup> generation <b>A:</b> Thread connection, galvanized <b>AF:</b> Thread connection, multilayer coating <b>10:</b> Nominal screw diameter d [mm] <b>165:</b> Length of screw L [mm] <b>8:</b> Carbon steel <b>K:</b> Length identification HUS4-A 10x165			
		<b>I</b>	<b>K</b>	<b>L</b>	<b>N</b>
		10x140	10x165	14x185	14x205

**HUS4 Bonded screw**

**Product description**  
Fastener dimensions

**Annex A6**

## Specifications of intended use

### Anchorage 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 10/2020.
- 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

### Intended Use Specifications

## Annex B1


## 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
<b>Uncracked or cracked concrete</b>			
Hammer drilling (HD) <sup>1)</sup>	cleaned		size 10 to 16
	not cleaned		
Hammer drilling with Hilti hollow drill bit TE-CD or TE-YD (HDB) <sup>1)</sup>		sizes 12 to 16	-


<sup>1)</sup> 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) <sup>1)</sup>	cleaned	
	not cleaned	
Hammer drilling with Hilti hollow drill bit TE-CD or TE-YD (HDB) <sup>1)</sup>		sizes 12 and 14

<sup>1)</sup> 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) <sup>1)</sup>	cleaned	
	not cleaned	



<sup>1)</sup> Adjustment according to annex B9 is possible for HUS4 carbon steel sizes 10 to 14.

**HUS4 Bonded screw**

**Intended Use  
Specifications**

**Annex B2**

**Table B4: Static and quasi static loading under fire exposure**

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

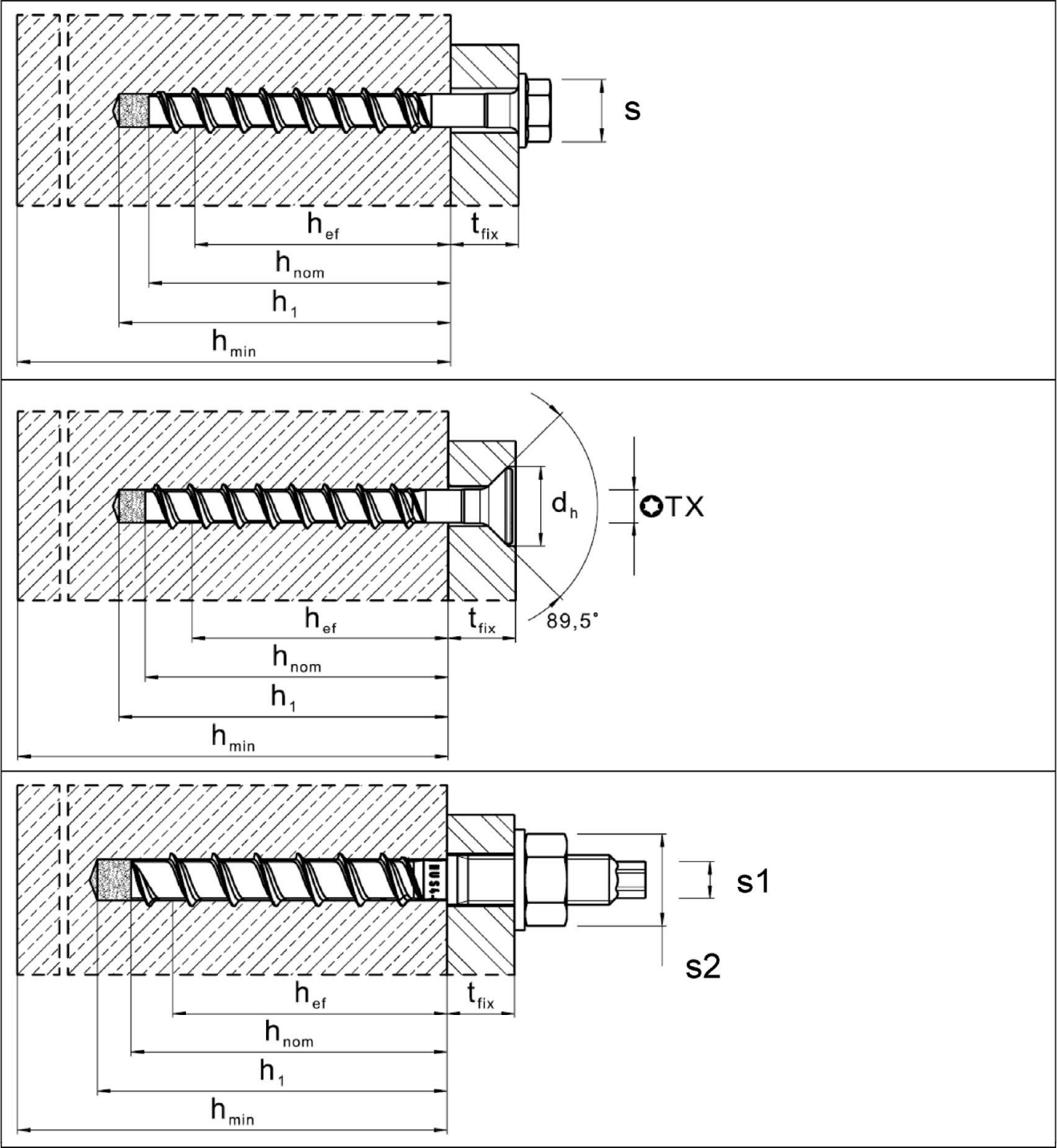
<sup>1)</sup> Adjustment according to annex B9 is possible for HUS4 carbon steel sizes 10 to 14

**HUS4 Bonded screw**

**Intended Use  
Specifications**

**Annex B3**

Installation parameters



HUS4 Bonded screw

Annex B4

Intended Use  
Installation parameters

**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 embedment 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	$d_f \frac{\min}{\max}$	[mm]	13	15	17
			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]	$(h_{nom} + 10 \text{ mm})$		
			95	110	125
Depth of drill hole for uncleaned hole hammer drilling in wall and floor position	$h_1 =$	[mm]	$(h_{nom} + 10 \text{ mm}) + 2 \cdot d_0$		
			115	134	153
Depth of drill hole (with adjustability) cleaned hole or for uncleaned hole when drilling upwards	$h_1 =$	[mm]	$(h_{nom} + 20 \text{ mm})$		
			105	120	135
Depth of drill hole (with adjustability) for uncleaned hole hammer drilling in wall and floor position	$h_1 =$	[mm]	$(h_{nom} + 20 \text{ mm}) + 2 \cdot d_0$		
			125	144	163
Minimum thickness of concrete member	$h_{min} \geq$	[mm]	$(h_1 + 30 \text{ mm})$		
			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 <sup>1)</sup>			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"	

<sup>1)</sup> Installation with other impact screw driver of equivalent power is possible.

**HUS4 Bonded screw**

**Intended Use**  
Installation parameters

**Annex B5**



**Table B6: Installation parameters HUS4 Bonded screw carbon steel**

<b>Fastener size HUS4</b>			<b>16</b>
<b>Type</b>			<b>H(F)</b>
Nominal embedment 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]	$(h_{nom} + 10 \text{ mm})$
			140
Depth of drill hole for uncleaned hole hammer drilling in wall and floor position	$h_1 =$	[mm]	$(h_{nom} + 10 \text{ mm}) + 2 \cdot d_0$
			172
Minimum thickness of concrete member	$h_{min} \geq$	[mm]	$(h_1 + 32 \text{ mm})$
			200
Minimum spacing	$s_{min} \geq$	[mm]	90
Minimum edge distance	$c_{min} \geq$	[mm]	65
Hilti setting tool <sup>1)</sup>			SIW 22T-A 1/2" SIW 6-22 1/2" SIW 8-22 1/2" SIW 9-A22 3/4"

<sup>1)</sup> Installation with other impact screw driver of equivalent power is possible.

**HUS4 Bonded screw**

**Intended Use**  
Installation parameters

**Annex B6**

**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]	$(h_{nom} + 10\text{mm})$	
			100	120
Depth of drill hole for uncleaned hole hammer drilling in wall and floor position	$h_1 =$	[mm]	$(h_{nom} + 10\text{ mm}) + 2 * d_0$	
			120	148
Minimum thickness of concrete member	$h_{min} \geq$	[mm]	$(h_1 + 30\text{ mm})$	
			140	160
Minimum spacing	$s_{min} \geq$	[mm]	50	60
Minimum edge distance	$c_{min} \geq$	[mm]	50	60
Hilti setting tool <sup>1)</sup>			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"

<sup>1)</sup> Installation with other impact screw driver of equivalent power is possible.

**HUS4 Bonded screw**

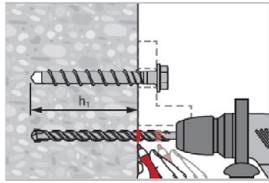
**Intended Use**  
Installation parameters

**Annex B7**

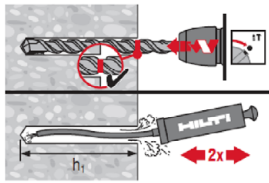
## Installation

### Hole drilling and cleaning

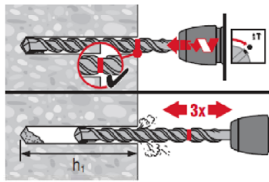
#### Hammer drilling (HD) all sizes for carbon and stainless steel screw types



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  
 $h_1 = h_{nom} + 10 \text{ mm}$

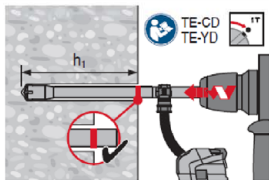


No cleaning is allowed in upward installation direction.  
No cleaning is allowed in downward and horizontal installation direction when 3x ventilation<sup>1)</sup> after drilling is executed.

Drill hole depth  $h_1 = h_{nom} + 10 \text{ mm} + 2 \cdot d_0$

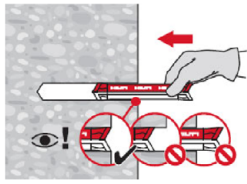
<sup>1)</sup> moving the drill bit in and out of the drill hole 3 times after the recommended drilling depth  $h_1$  is achieved. This procedure shall be done with both revolution and hammer functions activated in the drilling machine. For more details read the relevant installation instruction (MPII).

#### 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  
 $h_1 = h_{nom} + 10 \text{ mm}$

#### Insert of HUS4-MAX foil capsule



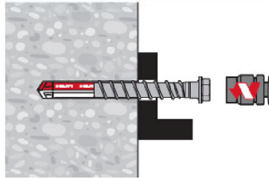
### HUS4 Bonded screw

Intended Use  
Installation instructions

Annex B8

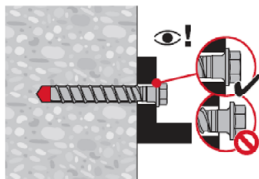
### Fastener setting without adjustment for carbon and stainless steel screw types

Setting by impact screw driver



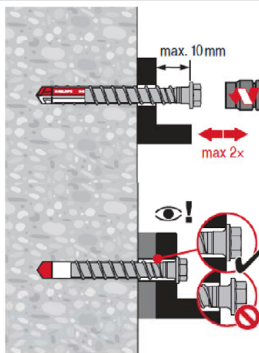
Setting parameters listed in Table B5, B6 and B7

### Setting check



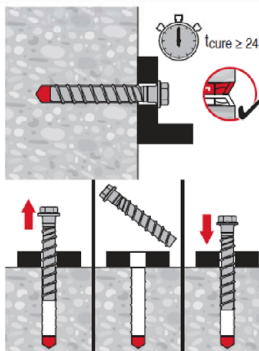
### Fastener setting with adjustment for size 10 to size 14 for carbon steel screw types

#### 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

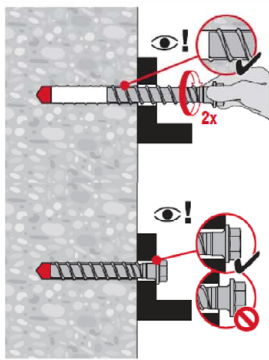


After minimum curing time of 24 h the HUS4 screw can screw out and in for 1 time.

### HUS4 Bonded screw

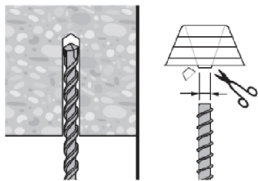
Intended Use  
Installation instructions

Annex B9

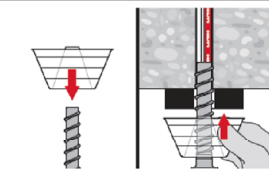


Find the thread in the drilled hole  
The screw should be screw in 2 revolutions by hand and finish with the setting tool.

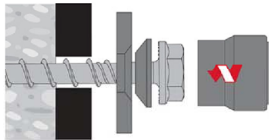
#### Overhead installation



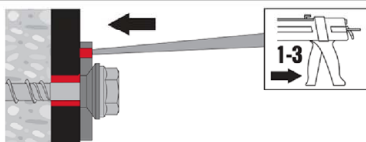
For upward installation direction use the overhead dripping cup HIT-OHC.



#### 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

Intended Use  
Installation instructions

Annex B10

**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	$\gamma_{inst}$	[-]	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						
Uncracked concrete						
Temperature range I:	$N'_{Rk,p,ucr}$	[kN]	38,0	55,0	70,0	80,0
Increasing factor for $N_{Rk,p,ucr} = N_{Rk,p,ucr}(C20/25) \cdot \psi_c$	$\psi_c$	[-]	$(f_{ck}/20)^{0,30}$			
Cracked concrete						
Temperature range I:	$N'_{Rk,p,cr}$	[kN]	24,0	36,0	42,0	55,0
Increasing factor for $N_{Rk,p,cr} = N_{Rk,p,cr}(C20/25) \cdot \psi_c$	$\psi_c$	[-]	$(f_{ck}/20)^{0,50}$			
Sustained load factor	$\psi_{sus}^0$	[-]	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 $N_{Rk,c} = N_{Rk,c}(C20/25) \cdot \psi_c$	$\psi_c$	[-]	$(f_{ck}/20)^{0,50}$			
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 $h_{ef}$

<sup>1)</sup> In absence of other national regulations.

#### HUS4 Bonded screw

#### Performances

Essential characteristics under tension loads in case of static and quasi-static loading

#### Annex C1

**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	$\gamma_{inst}$	[-]	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				
Uncracked concrete				
Temperature range I:	$N'_{Rk,p,ucr}$	[kN]	40	65
Increasing factor for $N_{Rk,p,ucr} = N_{Rk,p,ucr}(C20/25) * \psi_c$	$\psi_c$	[-]	$(f_{ck}/20)^{0,30}$	
Cracked concrete				
Temperature range I:	$N'_{Rk,p,cr}$	[kN]	24	40
Increasing factor for $N_{Rk,p,cr} = N_{Rk,p,cr}(C20/25) * \psi_c$	$\psi_c$	[-]	$(f_{ck}/20)^{0,50}$	
Sustained load factor	$\psi_{sus}^0$	[-]	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 $N_{Rk,c} = N_{Rk,c}(C20/25) * \psi_c$	$\psi_c$	[-]	$(f_{ck}/20)^{0,50}$	
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 $h_{ef}$

<sup>1)</sup> In absence of other national regulations.

**HUS4 Bonded screw**

**Performances**

Essential characteristics under tension loads in case of static and quasi-static loading

**Annex C2**



**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

<sup>1)</sup> 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	$V_{Rk,s}^0$	[kN]	33,0	77,0
Partial factor	$\gamma_{Ms,V}^{1)}$	[-]	1,5	
Ductility factor	$k_7$	[-]	1,0	
Characteristic resistance	$M_{Rk,s}^0$	[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

<sup>1)</sup> In absence of other national regulations.

**HUS4 Bonded screw**

**Performances**

Essential characteristics under shear load in case of static and quasi static loading

**Annex C3**

**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	$\alpha_{gap}$	[-]	0,5		
Reduction factor acc. to EN 1992-4:2018 annular gap filled	$\alpha_{gap}$	[-]	1,0		
Combined pullout and concrete cone failure Cracked concrete C20/25					
Temperature range I	$N_{Rk,p,C1}$	[kN]	24,0	36,0	42,0
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	$\gamma_{inst}$	[-]	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

<sup>1)</sup> In absence of other national regulations.

**HUS4 Bonded screw**

**Performances**

Essential characteristics for seismic performance category C1 in concrete

**Annex C4**

**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
<b>Adjustment</b>				
Total max. thickness of adjustment layers	$t_{adj}$ [mm]	10		
Max. number of adjustments	$n_a$ [-]	2		
<b>Steel failure for tension</b>				
Characteristic resistance	$N_{Rk,s,C2}$ [kN]	55,0	79,0	101,5
Partial factor	$\gamma_{Ms,N}^{1)}$ [-]	1,5		
<b>Steel failure shear load</b>				
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]	21,5	27,2	46,5
Reduction factor acc. to EN 1992-4:2018 annular gap filled	$\alpha_{gap}$ [-]	1,0		
Installation without Hilti filling set				
Characteristic resistance	$V_{Rk,s,C2}$ [kN]	13,7	22,5	34,4
Reduction factor acc. to EN 1992-4:2018 annular gap unfilled	$\alpha_{gap}$ [-]	0,5		
<b>Combined pullout and concrete cone failure</b> Cracked concrete C20/25				
Temperature range I	$N_{Rk,p,C2}$ [kN]	10,7	17,2	18,2
<b>Concrete cone failure</b>				
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	$\gamma_{inst}$ [-]	1,0		
<b>Concrete pry-out failure</b>				
Pry-out factor	$k_8$ [-]	2,0		
<b>Concrete edge failure</b>				
Effective length of fastener	$l_f = h_{ef}$ [mm]	85	100	115
Outside diameter of fastener	$d_{nom}$ [mm]	10	12	14

<sup>1)</sup> In absence of other national regulations.

**HUS4 Bonded screw**

**Performances**

Essential characteristics for seismic performance category C2 in concrete

**Annex C5**

**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	$N^0_{Rk,p,fi}$	[kN]	4,7			6,1	7,5		8,7
	R60									
	R90									
	R120									
Edge distance										
R30 to R120										

**HUS4 Bonded screw**

**Performances**  
Essential characteristics under fire exposure in concrete

**Annex C6**

**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
	$\delta_{N0}$	[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
	$\delta_{N0}$	[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
	$\delta_{N0}$	[mm]	0,3	0,5	0,5	0,8
	$\delta_{N\infty}$	[mm]	0,5	0,5	0,5	0,8

**HUS4 Bonded screw**

**Performances**  
Displacements

**Annex C7**

**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
	$\delta_{V0}$ [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
	$\delta_{V0}$ [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

**HUS4 Bonded screw**

**Performances**  
Displacements

**Annex C8**