



European Technical Approval ETA-98/0001

English translation prepared by DIBt - Original version in German language

Handelsbezeichnung <i>Trade name</i>	Hilti Durchsteckanker HST, HST-R und HST-HCR <i>Hilti stud anchor HST, HST-R and HST-HCR</i>
Zulassungsinhaber <i>Holder of approval</i>	Hilti Aktiengesellschaft Business Unit Anchors 9494 Schaan FÜRSTENTUM LIECHTENSTEIN
Zulassungsgegenstand und Verwendungszweck <i>Generic type and use of construction product</i>	Kraftkontrolliert spreizender Dübel in den Größen M8, M10, M12, M16, M20 und M24 zur Verankerung im Beton <i>Torque controlled expansion anchor of sizes M8, M10, M12, M16, M20 and M24 for use in concrete</i>
Geltungsdauer: <i>Validity:</i>	vom <i>from</i> bis <i>to</i> 8 May 2013 20 February 2018
Herstellwerk <i>Manufacturing plant</i>	Hilti Werke

Diese Zulassung umfasst
This Approval contains

29 Seiten einschließlich 21 Anhänge
29 pages including 21 annexes

Diese Zulassung ersetzt
This Approval replaces

ETA-98/0001 mit Geltungsdauer vom 20.02.2013 bis 20.02.2018
ETA-98/0001 with validity from 20.02.2013 to 20.02.2018

I LEGAL BASES AND GENERAL CONDITIONS

- 1 This European technical approval is issued by Deutsches Institut für Bautechnik in accordance with:
 - Council Directive 89/106/EEC of 21 December 1988 on the approximation of laws, regulations and administrative provisions of Member States relating to construction products¹, modified by Council Directive 93/68/EEC² and Regulation (EC) N° 1882/2003 of the European Parliament and of the Council³;
 - *Gesetz über das In-Verkehr-Bringen von und den freien Warenverkehr mit Bauprodukten zur Umsetzung der Richtlinie 89/106/EWG des Rates vom 21. Dezember 1988 zur Angleichung der Rechts- und Verwaltungsvorschriften der Mitgliedstaaten über Bauprodukte und anderer Rechtsakte der Europäischen Gemeinschaften (Bauproduktengesetz - BauPG) vom 28. April 1998⁴, as amended by Article 2 of the law of 8 November 2011⁵;*
 - Common Procedural Rules for Requesting, Preparing and the Granting of European technical approvals set out in the Annex to Commission Decision 94/23/EC⁶;
 - Guideline for European technical approval of "Metal anchors for use in concrete - Part 2: Torque controlled expansion anchors ", ETAG 001-02.
- 2 Deutsches Institut für Bautechnik is authorized to check whether the provisions of this European technical approval are met. Checking may take place in the manufacturing plant. Nevertheless, the responsibility for the conformity of the products to the European technical approval and for their fitness for the intended use remains with the holder of the European technical approval.
- 3 This European technical approval is not to be transferred to manufacturers or agents of manufacturers other than those indicated on page 1, or manufacturing plants other than those indicated on page 1 of this European technical approval.
- 4 This European technical approval may be withdrawn by Deutsches Institut für Bautechnik, in particular pursuant to information by the Commission according to Article 5(1) of Council Directive 89/106/EEC.
- 5 Reproduction of this European technical approval including transmission by electronic means shall be in full. However, partial reproduction can be made with the written consent of Deutsches Institut für Bautechnik. In this case partial reproduction has to be designated as such. Texts and drawings of advertising brochures shall not contradict or misuse the European technical approval.
- 6 The European technical approval is issued by the approval body in its official language. This version corresponds fully to the version circulated within EOTA. Translations into other languages have to be designated as such.

¹ Official Journal of the European Communities L 40, 11 February 1989, p. 12
² Official Journal of the European Communities L 220, 30 August 1993, p. 1
³ Official Journal of the European Union L 284, 31 October 2003, p. 25
⁴ *Bundesgesetzblatt Teil I 1998*, p. 812
⁵ *Bundesgesetzblatt Teil I 2011*, p. 2178
⁶ Official Journal of the European Communities L 17, 20 January 1994, p. 34

II SPECIFIC CONDITIONS OF THE EUROPEAN TECHNICAL APPROVAL

1 Definition of product and intended use

1.1 Definition of the construction product

The Hilti stud anchor HST, HST-R and HST-HCR is an anchor made of galvanised steel (designated as HST) or stainless steel (designated as HST-R) of sizes M8, M10, M12, M16, M20 and M24 or made of high corrosion resistant steel (designated as HST-HCR) of sizes M8, M10, M12 and M16 which is placed into a drilled hole and anchored by torque-controlled expansion.

An illustration of the product and intended use is given in Annex 1.

1.2 Intended use

The anchor is intended to be used for anchorages for which requirements for mechanical resistance and stability and safety in use in the sense of the Essential Requirements 1 and 4 of Council Directive 89/106 EEC shall be fulfilled and failure of anchorages made with these products would cause risk to human life and/or lead to considerable economic consequences.

The anchor may be used for anchorages with requirements related to resistance to fire.

The anchor is to be used for anchorages subject to static, quasi-static or seismic action (anchor performance categories C1 and C2 only for anchor sizes specified for in Annex 2).

It may be used in reinforced or unreinforced normal weight concrete of strength classes C20/25 at minimum and C50/60 at most according to EN 206:2000-12.

It may be anchored in cracked and non-cracked concrete.

Hilti Stud Anchor HST made of galvanised steel:

The anchor may only be used in structures subject to dry internal conditions.

Hilti Stud Anchor HST-R made of stainless steel A4:

The anchor made of stainless steel A4 may be used in structures subject to dry internal conditions and also in structures subject to external atmospheric exposure (including industrial and marine environment), or exposure in permanently damp internal conditions, if no particular aggressive conditions exist. Such particular aggressive conditions are e.g. permanent, alternating immersion in seawater or the splash zone of seawater, chloride atmosphere of indoor swimming pools or atmosphere with extreme chemical pollution (e.g. in desulphurization plants or road tunnels where de-icing materials are used).

Hilti Stud Anchor HST-HCR made of high corrosion resistant steel:

The anchor made of high corrosion resistant steel may be used in structures subject to dry internal conditions and also in structures subject to external atmospheric exposure, in permanently damp internal conditions or in other particular aggressive conditions. Such particular aggressive conditions are e.g. permanent, alternating immersion in seawater or the splash zone of seawater, chloride atmosphere of indoor swimming pools or atmosphere with chemical pollution (e.g. in desulphurization plants or road tunnels where de-icing materials are used).

The provisions made in this European technical approval are based on an assumed working life of the anchor of 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.

2 Characteristics of the product and methods of verification

2.1 Characteristics of the product

The anchor corresponds to the drawings and provisions given in the Annexes. The characteristic material values, dimensions and tolerances of the anchor not given in the Annexes shall correspond to the respective values laid down in the technical documentation⁷ of this European technical approval.

Regarding the requirements concerning safety in case of fire it is assumed that the anchor meets the requirements of class A1 in relation to reaction to fire in accordance with the stipulations of the Commission decision 96/603/EC, amended by 2000/605/EC.

The characteristic values for the design of anchorages are given in the Annexes.

Each anchor is marked in accordance with Annex 1 and 3.

The anchor shall only be packaged and supplied as a complete unit.

2.2 Methods of verification

The assessment of fitness of the anchor for the intended use in relation to the requirements for mechanical resistance and stability and safety in use in the sense of the Essential Requirements 1 and 4 has been made in accordance with the "Guideline for European technical approval of Metal Anchors for Use in Concrete", Part 1 "Anchors in general" and Part 2 "Torque-controlled expansion anchors", on the basis of Option 1 and ETAG 001 Annex E "Assessment of Metal Anchors under Seismic Action".

The assessment of the anchor for the intended use in relation to the requirements for resistance to fire has been made in accordance with the Technical Report TR 020 "Evaluation of anchorages in concrete concerning resistance to fire".

In addition to the specific clauses relating to dangerous substances contained in this European technical approval, there may be other requirements applicable to the products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). In order to meet the provisions of the Construction Products Directive, these requirements need also to be complied with, when and where they apply.

3 Evaluation and attestation of conformity and CE marking

3.1 System of attestation of conformity

According to the decision 96/582/EG of the European Commission⁸ the system 2(i) (referred to as system 1) of attestation of conformity applies.

System 1: Certification of the conformity of the product by an approved certification body on the basis of:

⁷ The technical documentation of this European technical approval is deposited at the Deutsches Institut für Bautechnik and, as far as relevant for the tasks of the approved bodies involved in the attestation of conformity procedure, is handed over to the approved bodies.

⁸ Official Journal of the European Communities L 254 of 08.10.1996.

- (a) Tasks for the manufacturer:
 - (1) factory production control;
 - (2) further testing of samples taken at the factory by the manufacturer in accordance with a prescribed control plan;
- (b) Tasks for the approved body:
 - (3) initial type-testing of the product;
 - (4) initial inspection of factory and of factory production control;
 - (5) continuous surveillance, assessment and approval of factory production control.

Note: Approved bodies are also referred to as "notified bodies".

3.2 Responsibilities

3.2.1 Tasks of the manufacturer

3.2.1.1 Factory production control

The manufacturer shall exercise permanent internal control of production. All the elements, requirements and provisions adopted by the manufacturer shall be documented in a systematic manner in the form of written policies and procedures, including records of results performed. This production control system shall insure that the product is in conformity with this European technical approval.

The manufacturer may only use initial / raw / constituent materials stated in the technical documentation of this European technical approval.

The factory production control shall be in accordance with the control plan which is part of the technical documentation of this European technical approval. The control plan is laid down in the context of the factory production control system operated by the manufacturer and deposited at Deutsches Institut für Bautechnik⁹.

The results of factory production control shall be recorded and evaluated in accordance with the provisions of the control plan.

3.2.1.2 Other tasks of manufacturer

The manufacturer shall, on the basis of a contract, involve a body which is approved for the tasks referred to in section 3.1 in the field of anchors in order to undertake the actions laid down in section 3.2.2. For this purpose, the control plan referred to in sections 3.2.1.1 and 3.2.2 shall be handed over by the manufacturer to the approved body involved.

The manufacturer shall make a declaration of conformity, stating that the construction product is in conformity with the provisions of this European technical approval.

3.2.2 Tasks of approved bodies

The approved body shall perform the

- initial type-testing of the product ,
 - initial inspection of factory and of factory production control,
 - continuous surveillance, assessment and approval of factory production control,
- in accordance with the provisions laid down in the control plan.

The approved body shall retain the essential points of its actions referred to above and state the results obtained and conclusions drawn in a written report.

⁹

The control plan is a confidential part of the documentation of the European technical approval, but not published together with the European technical approval and only handed over to the approved body involved in the procedure of attestation of conformity.
See section 3.2.2.

The approved certification body involved by the manufacturer shall issue an EC certificate of conformity of the product stating the conformity with the provisions of this European technical approval.

In cases where the provisions of the European technical approval and its control plan are no longer fulfilled the certification body shall withdraw the certificate of conformity and inform Deutsches Institut für Bautechnik without delay.

3.3 CE marking

The CE marking shall be affixed on each packaging of the anchor. The letters "CE" shall be followed by the identification number of the approved certification body, where relevant, and be accompanied by the following additional information:

- the name and address of the producer (legal entity responsible for the manufacturer),
- the last two digits of the year in which the CE marking was affixed,
- the number of the EC certificate of conformity for the product,
- the number of the European technical approval,
- the number of the guideline for European technical approval
- use category (ETAG 001-1 Option 1, in addition: seismic performance category C1 and C2 where applicable),
- size.

4 Assumptions under which the fitness of the product for the intended use was favourably assessed

4.1 Manufacturing

The European technical approval is issued for the product on the basis of agreed data/information, deposited with the Deutsches Institut für Bautechnik, which identifies the product that has been assessed and judged. Changes to the product or production process, which could result in this deposited data/information being incorrect, should be notified to the Deutsches Institut für Bautechnik before the changes are introduced. Deutsches Institut für Bautechnik will decide whether or not such changes affect the approval and consequently the validity of the CE marking on the basis of the approval and if so whether further assessment or alterations to the approval shall be necessary.

4.2 Design of anchorages

The fitness of the anchor for the intended use is given under the following conditions:

The anchorages are designed either in accordance with the

- "Guideline for European technical approval of Metal Anchors for use in concrete", Annex C, method A

or in accordance with the

- CEN/TS 1992-4:2009, design method A

and Technical Report TR 045 "Design of metal Anchors under Seismic Action" under the responsibility of an engineer experienced in anchorages and concrete work.

Anchorages shall be positioned outside of critical regions (e.g. plastic hinges) of the concrete structure. Fastenings in stand-off installation or with a grout layer under seismic action are not covered.

Verifiable calculation notes and drawings are taking account of the loads to be anchored.

The position of the anchor is indicated on the design drawings (e.g. position of the anchor relative to reinforcement or to supports).

Local spalling is possible at fire attack. To avoid any influence of the spalling on the anchorage, the concrete member must be designed according to EN 1992-1-2. The members shall be made of concrete with quartzite additives and have to be protected from direct moisture; and the moisture content of the concrete has to be like in dry internal conditions respectively. The anchorage depth has to be increased for wet concrete by at least 30 mm compared to the given value in the approval.

The design method under fire exposure covers anchors with a fire attack from one side only. If the fire attack is from more than one side, the design method may be taken only, if the edge distance of the anchor is $c \geq 300$ mm.

4.3 Installation of anchors

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

- Anchor installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site,
- Use of the anchor only as supplied by the manufacturer without exchanging the components of an anchor,
- Anchor installation in accordance with the manufacturer's specifications and drawings and using the appropriate tools,
- Checks before placing the anchor to ensure that the strength class of the concrete in which the anchor is to be placed is in the range given and is not lower than that of the concrete to which the characteristic loads apply,
- Check of concrete being well compacted, e.g. without significant voids,
- Edge distances and spacing not less than the specified values without minus tolerances,
- Positioning of the drill holes without damaging the reinforcement,
- In case of aborted hole: new drilling at a minimum distance away of twice the depth of the aborted hole or smaller distance if the aborted drill hole is filled with high strength mortar and if under shear or oblique tension load it is not in the direction of load application,
- Cleaning of the hole of drilling dust,
- Anchor installation such that the effective anchorage depth is complied with. This compliance is ensured, if the exist thickness of fixture is not greater than the maximum thickness of fixture marked on the anchor,
- Application of the torque moment given in Annex 3 using a calibrated torque wrench.

5 Indications to the manufacturer

The manufacturer is responsible to ensure that the information on the specific conditions according to 1 and 2 including Annexes referred to as well as sections 4.2 and 4.3 is given to those who are concerned. This information may be made by reproduction of the respective parts of the European technical approval. In addition all installation data shall be shown clearly on the package and/or on an enclosed instruction sheet, preferably using illustration(s).

The minimum data required are:

- Diameter of drill bit,
- Thread diameter,
- Maximum thickness of the fixture,
- Minimum effective anchorage depth,
- Minimum hole depth,

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- Torque moment,
- Information on the installation procedure, including cleaning of the hole, preferably by means of an illustration,
- Reference to any special installation equipment needed,
- Identification of the manufacturing batch.

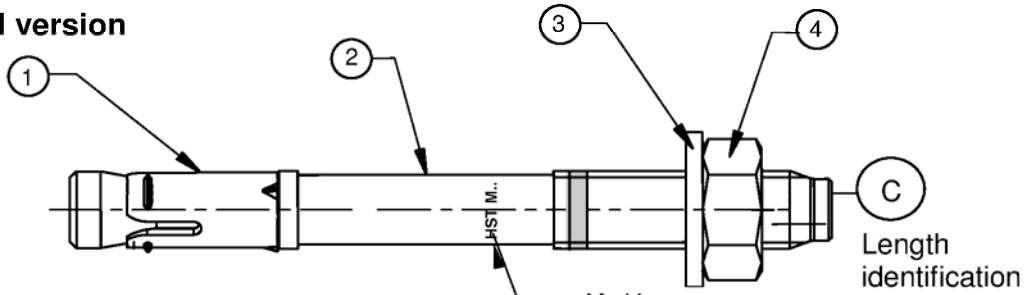
All data shall be presented in a clear and explicit form

Uwe Bender
Head of Department

beglaubigt:
Lange

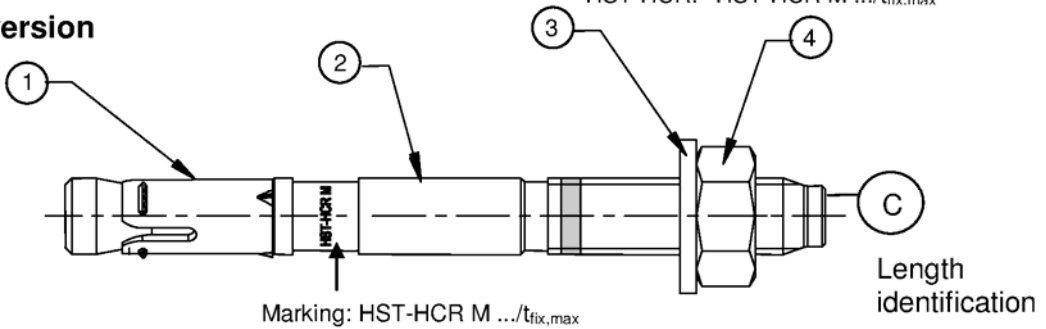
**HST (steel galvanised)
HST-R (stainless steel)
HST-HCR (high corrosion resistant steel)**

Coldformed version



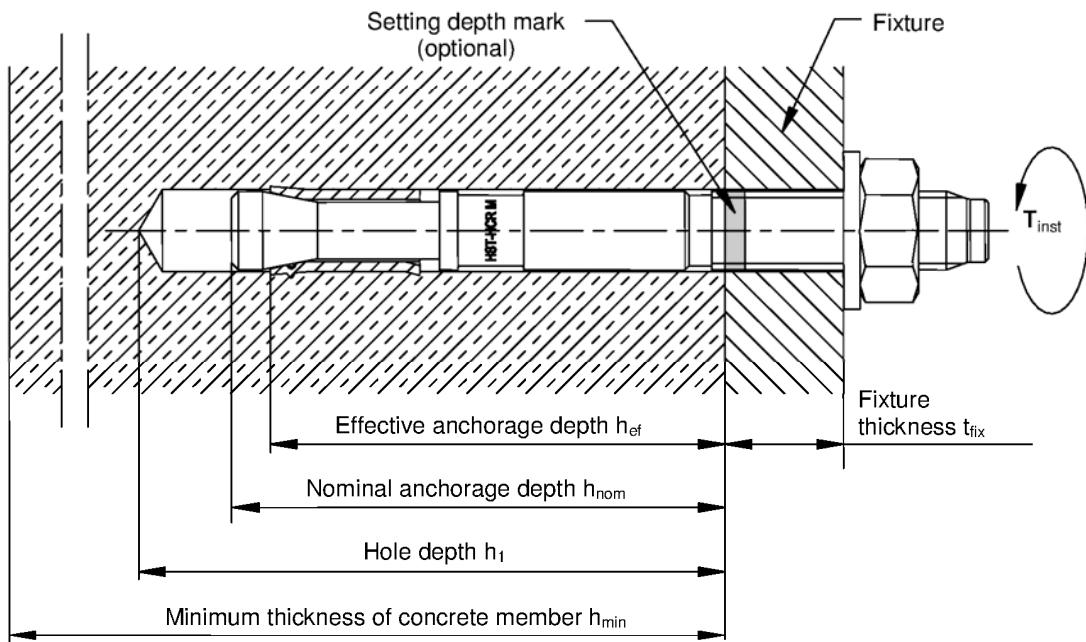
Marking:
HST: HST M .../t_{fix,max}
HST-R: HST-R M .../t_{fix,max}
HST-HCR: HST-HCR M .../t_{fix,max}

Machined version



Marking: HST-HCR M .../t_{fix,max}

Intended use



Hilti stud anchor HST, HST-R, HST-HCR

Product and intended use

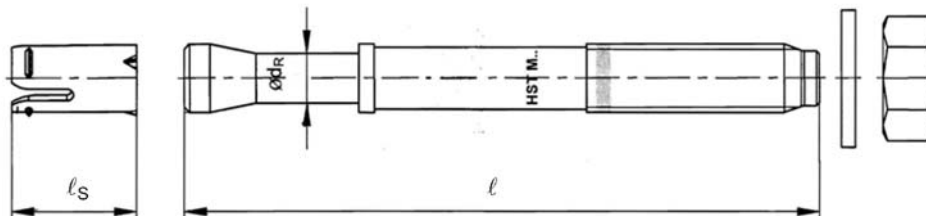
Annex 1

Table 1: Use category

Anchor size	Annex	M8	M10	M12	M16	M20	M24
Static and quasi-static loading in cracked and non-cracked concrete	5-8 17-19	HST HST-R HST-HCR				HST HST-R	
Fire resistances R30 - R120	15-16 20-21	HST HST-R				-	
Seismic performance category C1	9-10	-				-	
Seismic performance category C2	11-12	-				-	

Table 2: Materials

Part	Designation	Material						
		M8	M10	M12	M16	M20	M24	
HST (steel galvanised)								
1	Expansion sleeve	Stainless steel A4						
2	Bolt	Carbon steel galvanised and coated (transparent)						
		f_{uk} [N/mm ²]	800	800	800	720	700	530
		f_{yk} [N/mm ²]	640	640	640	580	560	450
3	Washer	Steel galvanised, EN ISO 4042						
4	Hexagon nut	Class 8 EN 20898-2, galvanised						
HST- R (stainless steel)								
1	Expansion sleeve	Stainless steel A4						
2	Bolt	Stainless steel A4, cone coated (red or transparent)						
		f_{uk} [N/mm ²]	720	700	700	650	650	650
		f_{yk} [N/mm ²]	575	560	560	500	560	450
3	Washer	Stainless steel A4						
4	Hexagon nut	Stainless steel A4, coated						
HST-HCR (high corrosion resistant steel)								
1	Expansion sleeve	Stainless steel A4						
2	Bolt	High corrosion resistant steel, cone coated (red)						
		f_{uk} [N/mm ²]	800	800	800	800	-	
		f_{yk} [N/mm ²]	640	640	640	-		
3	Washer	High corrosion resistant steel						
4	Hexagon nut	High corrosion resistant steel, coated						



Hilti stud anchor HST, HST-R, HST-HCR

Use category and materials

Annex 2

Table 3: Anchor dimensions and Installation data

Anchor type / size		M8	M10	M12	M16	M20 HST, HST-R only	M24 HST, HST-R only	
all types (HST, HST-R, HST-HCR)								
Nominal diameter of drill bit	d_0	[mm]	8	10	12	16	20	24
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	8,45	10,45	12,50	16,50	20,55	24,55
Depth of drill hole	$h_1 \geq$	[mm]	65	80	95	115	140	170
Clearance hole in the fixture	$d_f \leq$	[mm]	9	12	14	18	22	26
Effective anchorage depth	h_{ef}	[mm]	47	60	70	82	101	125
Nominal anchorage depth	h_{nom}	[mm]	55	69	80	95	117	143
Torque moment	T_{inst}	[Nm]	20	45	60	110	240	300
Maximum thickness of fixture	$t_{fix,max}$	[mm]	195	200	200	235	305	330
Maximum length of anchor	l_{max}	[mm]	260	280	295	350	450	500
Shaft diameter at the cone	d_R	[mm]	5,5	7,2	8,5	11,6	14,6	17,4
Length of expansion sleeve	l_S	[mm]	14,8	18,2	22,7	24,3	28,3	36,0
Width across flats	S_W	[mm]	13	17	19	24	30	36

Table 4: Length identification

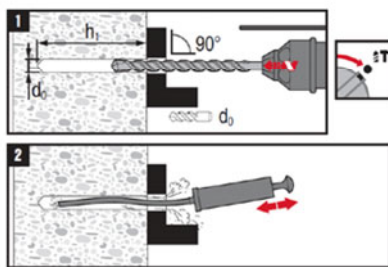
Letter	A	B	C	D	E	f	F	G	H	I	J	K	L	M	N	O	P
Anchor length [mm] \geq	38,1	50,8	63,5	76,2	88,9	100,0	101,6	114,3	127,0	139,7	152,4	165,1	177,8	190,5	203,2	215,9	228,6
Anchor length [mm] $<$	50,8	63,5	76,2	88,9	101,6	100,0	114,3	127,0	139,7	152,4	165,1	177,8	190,5	203,2	215,9	228,6	241,3

Letter	Q	R	r	S	T	U	V	W	X	Y	Z	AA	BB	CC	DD	EE	FF
Anchor length [mm] \geq	241,3	254,0	260,0	279,4	304,8	330,2	355,6	381,0	406,4	431,8	457,2	482,6	508,0	533,4	558,8	584,2	609,6
Anchor length [mm] $<$	254,0	279,4	260,0	304,8	330,2	355,6	381,0	406,4	431,8	457,2	482,6	508,0	533,4	558,8	584,2	609,6	635,0

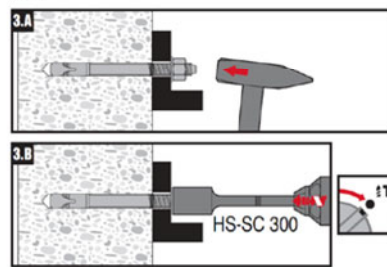
Letter	GG	HH	II	JJ	KK	LL	MM	NN	OO	PP	QQ	RR	SS	TT	UU	VV
Anchor length [mm] \geq	635,0	660,4	685,8	711,2	736,6	762,0	787,4	812,8	838,2	863,6	889,0	914,4	939,8	965,2	990,6	1016,0
Anchor length [mm] $<$	660,4	685,8	711,2	736,6	762,0	787,4	812,8	838,2	863,6	889,0	914,4	939,8	965,2	990,6	1016,0	1041,4

Instruction for use

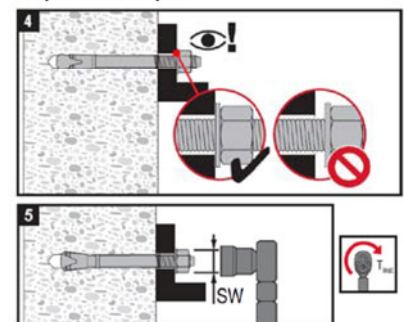
Drill and clean borehole



Set anchor with hammer or setting tool



Check setting and apply the required torque



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**Anchor dimensions and installation data,
length identification and instruction for use**

Annex 3

Table 5: Minimum member thickness, spacing and edge distance

Anchor type / size		M8	M10	M12	M16	M20 HST, HST-R only	M24 HST, HST-R only
all types (HST, HST-R, HST-HCR)							
Minimum thickness of concrete member	h_{min} [mm]	100	120	140	160	200	250
Cracked concrete							
HST (steel galvanised)							
Minimum spacing	s_{min} [mm]	40	55	60	70	100	125
	for $c \geq$ [mm]	50	70	75	100	160	180
Minimum edge distance	c_{min} [mm]	45	55	55	70	100	125
	for $s \geq$ [mm]	50	90	120	150	225	240
HST- R (stainless steel)							
Minimum spacing	s_{min} [mm]	40	55	60	70	100	125
	for $c \geq$ [mm]	50	65	75	100	130	130
Minimum edge distance	c_{min} [mm]	45	50	55	60	100	125
	for $s \geq$ [mm]	50	90	110	160	160	140
HST-HCR (high corrosion resistant steel)							
Minimum spacing	s_{min} [mm]	40	55	60	70		
	for $c \geq$ [mm]	50	70	75	100		
Minimum edge distance	c_{min} [mm]	45	50	55	60		
	for $s \geq$ [mm]	50	90	110	160		
Non-cracked concrete							
HST (steel galvanised)							
Minimum spacing	s_{min} [mm]	60	55	60	70	100	125
	for $c \geq$ [mm]	50	80	85	110	225	255
Minimum edge distance	c_{min} [mm]	50	55	55	85	140	170
	for $s \geq$ [mm]	60	115	145	150	270	295
HST- R (stainless steel)							
Minimum spacing	s_{min} [mm]	60	55	60	70	100	125
	for $c \geq$ [mm]	60	70	80	110	195	205
Minimum edge distance	c_{min} [mm]	60	50	55	70	140	150
	for $s \geq$ [mm]	60	115	145	160	210	235
HST-HCR (high corrosion resistant steel)							
Minimum spacing	s_{min} [mm]	60	55	60	70		
	for $c \geq$ [mm]	50	70	80	110		
Minimum edge distance	c_{min} [mm]	60	55	55	70		
	for $s \geq$ [mm]	60	115	145	160		

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Minimum member thickness, spacing and edge distance

Annex 4

Table 6: Displacements under tension loads for static and quasi-static loading

Anchor type / size			M8	M10	M12	M16	M20 HST, HST-R only	M24 HST, HST-R only
HST (steel galvanised)								
Tension load in cracked concrete	N	[kN]	2	4,3	5,7	9,5	14,3	19,0
Corresponding displacement	δ_{N0}	[mm]	1,3	0,2	0,1	0,5	1,9	2,2
	$\delta_{N\infty}$	[mm]	1,2	1,0	1,2	1,2	2,3	2,5
Tension load in non-cracked concrete	N	[kN]	3,6	7,6	9,5	16,7	23,8	28,6
Corresponding displacement	δ_{N0}	[mm]	0,2	0,1	0,1	0,4	0,6	0,5
	$\delta_{N\infty}$	[mm]	1,1	1,1	1,1	1,1	1,4	1,4
HST-R (stainless steel) and HST-HCR (high corrosion resistant steel)								
Tension load in cracked concrete	N	[kN]	2,4	4,3	5,7	11,9	14,3	19,0
Corresponding displacement	δ_{N0}	[mm]	0,6	0,2	0,8	1,0	1,1	0,8
	$\delta_{N\infty}$	[mm]	1,5	1,2	1,4	1,2	1,2	1,7
Tension load in non-cracked concrete	N	[kN]	4,3	7,6	9,5	16,7	23,8	28,6
Corresponding displacement	δ_{N0}	[mm]	0,1	0,1	0,1	0,1	0,5	0,8
	$\delta_{N\infty}$	[mm]	1,5	1,2	1,4	1,2	1,2	1,7

Table 7: Displacements under shear loads for static and quasi-static loading

Anchor type / size			M8	M10	M12	M16	M20 HST, HST-R only	M24 HST, HST-R only
HST (steel galvanised)								
Shear load in cracked and non-cracked concrete	V	[kN]	8,0	13,4	20,0	31,4	48,0	45,0
Corresponding displacement	δ_{V0}	[mm]	2,5	2,5	3,7	4,0	2,7	2,0
	$\delta_{V\infty}$	[mm]	3,8	3,7	5,5	6,0	4,1	3,0
HST-R (stainless steel) and HST-HCR (high corrosion resistant steel)								
Shear load in cracked and non-cracked concrete	V	[kN]	7,4	11,0	17,0	27,5	40,0	57,0
Corresponding displacement	δ_{V0}	[mm]	1,6	3,3	4,9	2,2	2,5	2,5
	$\delta_{V\infty}$	[mm]	2,4	4,9	7,4	3,3	3,7	3,7

Hilti stud anchor HST, HST-R, HST-HCR

Displacements under tension and shear loads for
static and quasi-static loading

Annex 5

**Table 8: Characteristic tension resistance for static and quasi-static loading:
design method A acc. ETAG 001, Annex C**

Anchor type / size			M8	M10	M12	M16	M20 HST, HST-R only	M24 HST, HST-R only	
Steel failure									
HST (steel galvanised)									
Characteristic resistance	$N_{Rk,s}$	[kN]	19	32	45	76	117	127	
Partial safety factor	$\gamma_{Ms}^{1)}$	[-]	1,5					1,41	
HST-R (stainless steel)									
Characteristic resistance	$N_{Rk,s}$	[kN]	17	28	40	69	109	156	
Partial safety factor	$\gamma_{Ms}^{1)}$	[-]	1,5			1,56	1,73		
HST-HCR (high corrosion resistant steel)									
Characteristic resistance	$N_{Rk,s}$	[kN]	19,4	32,3	45,7	84,5	-		
Partial safety factor	$\gamma_{Ms}^{1)}$	[-]	1,5					-	
Pullout failure									
HST (steel galvanised)									
Characteristic resistance in cracked concrete C20/25	$N_{Rk,p}$	[kN]	5	9	12	20	30	40	
Characteristic resistance in non-cracked concrete C20/25	$N_{Rk,p}$	[kN]	9	16	20	35	50	60	
Partial safety factor	$\gamma_{Mp}^{1)}$	[-]	1,8 ²⁾	1,5 ³⁾					
HST-R (stainless steel)									
Characteristic resistance in cracked concrete C20/25	$N_{Rk,p}$	[kN]	5	9	12	25	30	40	
Characteristic resistance in non-cracked concrete C20/25	$N_{Rk,p}$	[kN]	9	16	20	35	50	60	
Partial safety factor	$\gamma_{Mp}^{1)}$	[-]	1,5 ³⁾					-	
HST-HCR (high corrosion resistant steel)									
Characteristic resistance in cracked concrete C20/25	$N_{Rk,p}$	[kN]	5	9	12	25	-		
Characteristic resistance in non-cracked concrete C20/25	$N_{Rk,p}$	[kN]	9	16	20	35	-		
Partial safety factor	$\gamma_{Mp}^{1)}$	[-]	1,5 ³⁾					-	
all types (HST, HST-R, HST-HCR)									
Increasing factors for cracked and non-cracked concrete	ψ_c	C20/25				1,0			
	ψ_c	C30/37				1,22			
	ψ_c	C40/50				1,41			
	ψ_c	C50/60				1,55			

¹⁾ In absence of other national regulations.

²⁾ The partial safety factor $\gamma_2 = 1,2$ is included.

³⁾ The partial safety factor $\gamma_2 = 1,0$ is included.

Hilti stud anchor HST, HST-R, HST-HCR

**Characteristic tension resistance for static and quasi-static loading:
design method A acc. ETAG 001, Annex C**

Annex 6

**Table 9: Characteristic tension resistance for static and quasi-static loading:
design method A acc. ETAG 001, Annex C**

Anchor type / size	M8	M10	M12	M16	M20 <small>HST, HST-R only</small>	M24 <small>HST, HST-R only</small>
Concrete cone failure and splitting failure						
all types (HST, HST-R, HST-HCR)						
Effective anchorage depth h_{ef} [mm]	47	60	70	82	101	125
Spacing $s_{cr,N} = s_{cr,sp}$ [mm]	$3 \times h_{ef}$					
Edge distance $c_{cr,N} = c_{cr,sp}$ [mm]	$1,5 \times h_{ef}$					
Partial safety factor $\gamma_{Mc} = \gamma_{Msp}$ ¹⁾ [-]	$1,8$ ²⁾		$1,5$ ³⁾			

¹⁾ In absence of other national regulations.

²⁾ The partial safety factor $\gamma_2 = 1,2$ is included.

³⁾ The partial safety factor $\gamma_2 = 1,0$ is included.

Hilti stud anchor HST, HST-R, HST-HCR

**Characteristic tension resistance for static and quasi-static loading:
design method A acc. ETAG 001, Annex C**

Annex 7

**Table 10: Characteristic shear resistance for static and quasi-static loading:
design method A acc. ETAG 001, Annex C**

Anchor type / size		M8	M10	M12	M16	M20 HST, HST-R only	M24 HST, HST-R only	
Steel failure without lever arm								
HST (steel galvanised)								
Characteristic resistance	$V_{Rk,s}$ [kN]	14	23,5	35	55	84	94	
Partial safety factor	$\gamma_{Ms}^{1)}$ [-]	1,25					1,5	
HST-R (stainless steel)								
Characteristic resistance	$V_{Rk,s}$ [kN]	13	20	30	50	80	115	
Partial safety factor	$\gamma_{Ms}^{1)}$ [-]	1,25			1,3	1,44		
HST-HCR (high corrosion resistant steel)								
Characteristic resistance	$V_{Rk,s}$ [kN]	13	20	30	55	-		
Partial safety factor	$\gamma_{Ms}^{1)}$ [-]	1,25						
Steel failure with lever arm								
HST (steel galvanised)								
Characteristic resistance	$M_{Rk,s}^0$ [Nm]	30	60	105	240	454	595	
Partial safety factor	$\gamma_{Ms}^{1)}$ [-]	1,25					1,5	
HST-R (stainless steel)								
Characteristic resistance	$M_{Rk,s}^0$ [Nm]	27	53	92	216	422	730	
Partial safety factor	$\gamma_{Ms}^{1)}$ [-]	1,25			1,3	1,44		
HST-HCR (high corrosion resistant steel)								
Characteristic resistance	$M_{Rk,s}^0$ [Nm]	30	60	105	266	-		
Partial safety factor	$\gamma_{Ms}^{1)}$ [-]	1,25						
Concrete pryout failure								
all types (HST, HST-R, HST-HCR)								
Factor in equation (5.6) of ETAG 001 Annex C, 5.2.3.3	k [-]	2,0		2,2	2,5	2,5	2,5	
Partial safety factor	$\gamma_{Mc}^{1)}$ [-]	1,5 ²⁾						
Concrete edge failure								
all types (HST, HST-R, HST-HCR)								
Effective length of anchor in shear loading	l_f [mm]	47	60	70	82	101	125	
Diameter of anchor	d_{nom} [mm]	8	10	12	16	20	24	
Partial safety factor	$\gamma_{Mc}^{1)}$ [-]	1,5 ²⁾						

¹⁾ In absence of other national regulations.

²⁾ The partial safety factor $\gamma_2 = 1,0$ is included.

Hilti stud anchor HST, HST-R, HST-HCR

**Characteristic shear resistance for static and quasi-static loading:
design method A acc. ETAG 001, Annex C**

Annex 8

Table 11: Characteristic tension resistance for seismic loading, performance category C1: design acc. TR 045

Anchor type / size		M10	M12	M16
Steel failure				
HST (steel galvanised)				
Characteristic resistance	$N_{Rk,s,seis}$ [kN]	32	45	76
Partial safety factor	$\gamma_{Ms,seis}^{1)}$ [-]	1,5		
HST-R (stainless steel)				
Characteristic resistance	$N_{Rk,s,seis}$ [kN]	28	40	69
Partial safety factor	$\gamma_{Ms,seis}^{1)}$ [-]	1,5		
Pullout failure				
HST (steel galvanised) and HST-R (stainless steel)				
Characteristic resistance	$N_{Rk,p,seis}$ [kN]	8,0	10,7	18,0
Partial safety factor	$\gamma_{Mp,seis}^{1)}$ [-]	1,5 ²⁾		
Concrete cone failure³⁾				
HST (steel galvanised) and HST-R (stainless steel)				
Partial safety factor	$\gamma_{Mc,seis}^{1)}$ [-]	1,5 ²⁾		
Splitting failure³⁾				
HST (steel galvanised) and HST-R (stainless steel)				
Partial safety factor	$\gamma_{Msp,seis}^{1)}$ [-]	1,5 ²⁾		

¹⁾ In absence of other national regulations.

²⁾ The partial safety factor $\gamma_2 = 1,0$ is included.

³⁾ For concrete cone failure and splitting failure see Annex 14.

Table 12: Displacements under tension loads for seismic loading, performance category C1¹⁾

Anchor type / size		M10	M12	M16
Displacement HST and HST-R	$\delta_{N,seis}$ [mm]	1,1	0,8	1,0

¹⁾ Maximum displacement during cycling (seismic event).

The definition of seismic performance category C1 is given in Annex 13.

Hilti stud anchor HST, HST-R, HST-HCR

Characteristic tension resistance and displacements under tension loads for seismic loading, performance category C1: design acc. TR 045

Annex 9

Table 13: Characteristic shear resistance for seismic loading, performance category C1: design acc. TR 045

Anchor type / size		M10	M12	M16
Steel failure				
HST (steel galvanised)				
Characteristic resistance	$V_{Rk,s,seis}$ [kN]	16	27	41,3
Partial safety factor	$\gamma_{Ms,seis}^{1)}$ [-]	1,25		
HST-R (stainless steel)				
Characteristic resistance	$V_{Rk,s,seis}$ [kN]	13,6	23,1	37,5
Partial safety factor	$\gamma_{Ms,seis}^{1)}$ [-]	1,25		
Concrete pryout failure ³⁾				
HST (steel galvanised) and HST-R (stainless steel)				
Partial safety factor	$\gamma_{Mcp,seis}^{1)}$ [-]	1,5 ²⁾		
Concrete edge failure ³⁾				
HST (steel galvanised) and HST-R (stainless steel)				
Partial safety factor	$\gamma_{Mc,seis}^{1)}$ [-]	1,5 ²⁾		

¹⁾ In absence of other national regulations.

²⁾ The partial safety factor $\gamma_2 = 1,0$ is included.

³⁾ For concrete pryout failure and concrete edge failure see Annex 14.

Table 14: Displacements under shear loads for seismic loading, performance category C1 ¹⁾

Anchor type / size		M10	M12	M16
Displacement HST and HST-R	$\delta_{v,seis}$ [mm]	6,2	7,3	6,2

¹⁾ Maximum displacement during cycling (seismic event)

The definition of seismic performance category C1 is given in Annex 13.

Hilti stud anchor HST, HST-R, HST-HCR

Characteristic shear resistance and displacements under shear loads for seismic loading, performance category C1: design acc. TR 045

Annex 10

Table 15: Characteristic tension resistance for seismic loading, performance category C2: design acc. TR 045

Anchor type / size		M10	M12	M16
Steel failure				
HST (steel galvanised)				
Characteristic resistance	$N_{Rk,s,seis}$ [kN]	32	45	76
Partial safety factor	$\gamma_{Ms,seis}^{1)}$ [-]	1,5		
HST-R (stainless steel)				
Characteristic resistance	$N_{Rk,s,seis}$ [kN]	28	40	69
Partial safety factor	$\gamma_{Ms,seis}^{1)}$ [-]	1,5		
Pullout failure				
HST (steel galvanised) and HST-R (stainless steel)				
Characteristic resistance	$N_{Rk,p,seis}$ [kN]	3,3	10,0	12,8
Partial safety factor	$\gamma_{Mp,seis}^{1)}$ [-]	1,5 ²⁾		
Concrete cone failure³⁾				
HST (steel galvanised) and HST-R (stainless steel)				
Partial safety factor	$\gamma_{Mc,seis}^{1)}$ [-]	1,5 ²⁾		
Splitting failure³⁾				
HST (steel galvanised) and HST-R (stainless steel)				
Partial safety factor	$\gamma_{Msp,seis}^{1)}$ [-]	1,5 ²⁾		

¹⁾ In absence of other national regulations.

²⁾ The partial safety factor $\gamma_2 = 1,0$ is included.

³⁾ For concrete cone failure and splitting failure see Annex 14.

Table 16: Displacements under tension loads for seismic loading, performance category C2

Anchor type / size		M10	M12	M16
HST and HST-R				
Displacement DLS	$\delta_{N,seis(DLS)}$ [mm]	1,4	6,7	4,0
Displacement ULS	$\delta_{N,seis(ULS)}$ [mm]	8,6	15,9	13,3

The definition of seismic performance category C2 is given in Annex 13.

Hilti stud anchor HST, HST-R, HST-HCR

Characteristic tension resistance and displacements under tension loads for seismic loading, performance category C2: design acc. TR 045

Annex 11

Table 17: Characteristic shear resistance for seismic loading, performance category C2: design acc. TR 045

Anchor type / size		M10	M12	M16
Steel failure				
HST (steel galvanised)				
Characteristic resistance	$V_{Rk,s,seis}$ [kN]	14,3	21	41,3
Partial safety factor	$\gamma_{Ms,seis}^{1)}$ [-]	1,25		
HST-R (stainless steel)				
Characteristic resistance	$V_{Rk,s,seis}$ [kN]	12	18	37,5
Partial safety factor	$\gamma_{Ms,seis}^{1)}$ [-]	1,25		
Concrete pryout failure ³⁾				
HST (steel galvanised) and HST-R (stainless steel)				
Partial safety factor	$\gamma_{Mcp,seis}^{1)}$ [-]	1,5 ²⁾		
Concrete edge failure ³⁾				
HST (steel galvanised) and HST-R (stainless steel)				
Partial safety factor	$\gamma_{Mc,seis}^{1)}$ [-]	1,5 ²⁾		

¹⁾ In absence of other national regulations.

²⁾ The partial safety factor $\gamma_2 = 1,0$ is included.

³⁾ For concrete pryout failure and concrete edge failure see Annex 14.

Table 18: Displacements under shear loads for seismic loading, performance category C2

Anchor type / size		M10	M12	M16
HST and HST-R				
Displacement DLS	$\delta_{V,seis(DLS)}$ [mm]	4,2	5,3	5,7
Displacement ULS	$\delta_{V,seis(ULS)}$ [mm]	7,5	7,9	8,9

The definition of seismic performance category C2 is given in Annex 13.

Hilti stud anchor HST, HST-R, HST-HCR

Characteristic shear resistance and displacements under shear loads for seismic loading, performance category C2: design acc. TR 045

Annex 12

Table 19: Recommended seismic performance categories¹⁾ for metal anchors

Seismicity level ^a		Importance Class acc. to EN 1998-1:2004, 4.2.5			
Class	$a_g \cdot S^c$	I	II	III	IV
Very low ^b	$a_g \cdot S \leq 0,05 g$	No additional requirement			
Low ^b	$0,05 g < a_g \cdot S \leq 0,1 g$	C1	C1 ^d or C2 ^e		C2
> low	$a_g \cdot S > 0,1 g$	C1	C2		

^a The values defining the seismicity levels may be found in the National Annex of EN 1998-1.
^b Definition according to EN 1998-1: 2004, 3.2.1.
^c a_g = Design ground acceleration on Type A ground (EN 1998-1: 2004, 3.2.1),
 S = Soil factor (see e.g. EN 1998-1: 2004, 3.2.2).
^d C1 for attachments of non-structural elements
^e C2 for connections between structural elements of primary and/or secondary seismic members

¹⁾ The seismic performance of anchors subjected to seismic loading is categorized by performance categories C1 and C2.

Table 19 relates the seismic performance categories C1 and C2 to the seismicity level and building importance class. The level of seismicity is defined as a function of the product $a_g \cdot S$, where a_g is the design ground acceleration on Type A ground and S the soil factor, both in accordance with EN 1998-1: 2004.

The value of a_g or that of the product $a_g \cdot S$ used in a Member State to define thresholds for the seismicity classes may be found in its National Annex of EN 1998-1 and may be different to the values given in Table 19. Furthermore, the assignment of the seismic performance categories C1 and C2 to the seismicity level and building importance classes is in the responsibility of each individual Member State.

Hilti stud anchor HST, HST-R, HST-HCR

Seismic performance categories

Annex 13

Table 20: Reduction factor α_{seis}

Loading	Failure mode	Single anchor ¹⁾	Anchor group
tension	Steel failure	1,0	1,0
	Pull-out failure	1,0	0,85
	Concrete cone failure	0,85	0,75
	Splitting failure	1,0	0,85
shear	Steel failure	1,0	0,85
	Concrete edge failure	1,0	0,85
	Concrete pry-out failure	0,85	0,75

¹⁾ In case of tension loading single anchor also addresses situations where only 1 anchor in a group of anchors is subjected to tension.

Design information for seismic actions:

The seismic design shall be carried out according to the TR 045 „Design of metal anchors for use in concrete under seismic actions“. For every failure mode the characteristic seismic resistance $R_{k,seis}$ of a fastening shall be determined as follows:

$$R_{k,seis} = \alpha_{gap} \cdot \alpha_{seis} \cdot R_{k,seis}^0$$

where

α_{gap} reduction factor to take into account inertia effects due to an annular gap between anchor and fixture in case of shear loading;
 = 1,0 in case of no hole clearance between anchor and fixture;
 = 0,5 in case of connections with standard hole clearance according ETAG 001, Annex C, Table 4.1

α_{seis} reduction factor to take into account the influence of large cracks and scatter of load displacement curves, see Table 20;

$R_{k,seis}^0$ basic characteristic seismic resistance for a given failure mode:
 For steel and pull out failure under tension load and steel failure under shear load $R_{k,seis}^0$ (i.e. $N_{Rk,s,seis}$, $N_{Rk,p,seis}$, $V_{Rk,s,seis}$) shall be taken from Annex 9 and Annex 10 (in case of seismic performance category C1) and from Annex 11 and Annex 12 (in case of seismic performance category C2).
 For all other failure modes $R_{k,seis}^0$ shall be determined as for the design situation for static and quasi-static loading according to ETAG 001, Annex C (i.e. $N_{Rk,c}$, $N_{Rk,sp}$, $V_{Rk,c}$, $V_{Rk,cp}$).

Hilti stud anchor HST, HST-R, HST-HCR

Reduction factors and characteristic seismic resistances

Annex 14

**Table 21: Characteristic tension resistance under fire exposure in cracked and non-cracked concrete C20/25 to C50/60:
design method A acc. **ETAG 001, Annex C****

Anchor type / size				M8	M10	M12	M16	M20 HST, HST-R only	M24 HST, HST-R only
Steel failure									
HST (steel galvanised)									
Characteristic resistance	R30	$N_{Rk,s,fi}$	[kN]	0,9	2,5	5	9	15	20
	R60	$N_{Rk,s,fi}$	[kN]	0,7	1,5	3,5	6	10	15
	R90	$N_{Rk,s,fi}$	[kN]	0,6	1	2	3,5	6	8
	R120	$N_{Rk,s,fi}$	[kN]	0,5	0,7	1	2	3,5	5
HST-R (stainless steel) and HST-HCR (high corrosion resistant steel)									
Characteristic resistance	R30	$N_{Rk,s,fi}$	[kN]	4,9	11,8	17,2	32	49,9	71,9
	R60	$N_{Rk,s,fi}$	[kN]	3,6	8,4	12,2	22,8	35,5	51,2
	R90	$N_{Rk,s,fi}$	[kN]	2,4	5	7,3	13,5	21,1	30,4
	R120	$N_{Rk,s,fi}$	[kN]	1,7	3,3	4,8	8,9	13,9	20
Pullout failure									
HST (steel galvanised)									
Characteristic resistance in concrete \geq C20/25	R30	$N_{Rk,p,fi}$	[kN]	1,3	2,3	3	5	7,5	10
	R60								
	R90	$N_{Rk,p,fi}$	[kN]	1,0	1,8	2,4	4	6	8
	R120								
HST-R (stainless steel) and HST-HCR (high corrosion resistant steel)									
Characteristic resistance in concrete \geq C20/25	R30	$N_{Rk,p,fi}$	[kN]	1,3	2,3	3	6,3	7,5	10
	R60								
	R90	$N_{Rk,p,fi}$	[kN]	1	1,8	2,4	5	6	8
	R120								
Concrete cone failure									
all types (HST, HST-R, HST-HCR)									
Characteristic resistance in concrete \geq C20/25	R30	$N^0_{Rk,c,fi}$	[kN]	2,7	5	7,4	11	18,5	31,4
	R60								
	R90	$N^0_{Rk,c,fi}$	[kN]	2,2	4	5,9	8,8	14,8	25,2
	R120								
Spacing	$s_{cr,N}$	[mm]	$4 \times h_{ef}$						
	s_{min}	[mm]	40	55	60	70	100	125	
Edge distance	$c_{cr,N}$	[mm]	$2 \times h_{ef}$						
	c_{min}	[mm]	Fire attack from one side: $2 \times h_{ef}$ Fire attack from more than one side: ≥ 300						

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

Hilti stud anchor HST, HST-R, HST-HCR

**Characteristic tension resistance under fire exposure:
design method A acc. **ETAG 001, Annex C****

Annex 15

Table 22: Characteristic shear resistance under fire exposure in cracked and non-cracked concrete C20/25 to C50/60: design method A acc. ETAG 001, Annex C

Anchor type / size				M8	M10	M12	M16	M20 HST, HST-R only	M24 HST, HST-R only	
Steel failure without lever arm										
HST (steel galvanised)										
Characteristic resistance	R30	$V_{Rk,s,fi}$	[kN]	0,9	2,5	5	9	15	20	
	R60	$V_{Rk,s,fi}$	[kN]	0,7	1,5	3,5	6	10	15	
	R90	$V_{Rk,s,fi}$	[kN]	0,6	1	2	3,5	6	8	
	R120	$V_{Rk,s,fi}$	[kN]	0,5	0,7	1	2	3,5	5	
HST-R (stainless steel) and HST-HCR (high corrosion resistant steel)										
Characteristic resistance	R30	$V_{Rk,s,fi}$	[kN]	4,9	11,8	17,2	32	49,9	71,9	
	R60	$V_{Rk,s,fi}$	[kN]	3,6	8,4	12,2	22,8	35,5	51,2	
	R90	$V_{Rk,s,fi}$	[kN]	2,4	5	7,3	13,5	21,1	30,4	
	R120	$V_{Rk,s,fi}$	[kN]	1,7	3,3	4,8	8,9	13,9	20	
Steel failure with lever arm										
HST (steel galvanised)										
Characteristic resistance	R30	$M^0_{Rk,s,fi}$	[Nm]	1	3,3	8,1	20,6	40,2	69,5	
	R60	$M^0_{Rk,s,fi}$	[Nm]	0,8	2,4	5,7	14,4	28,1	48,6	
	R90	$M^0_{Rk,s,fi}$	[Nm]	0,7	1,6	3,2	8,2	16	27,7	
	R120	$M^0_{Rk,s,fi}$	[Nm]	0,6	1,2	2	5,1	9,9	17,2	
HST-R (stainless steel) and HST-HCR (high corrosion resistant steel)										
Characteristic resistance	R30	$M^0_{Rk,s,fi}$	[Nm]	5	15,2	26,6	67,7	132,3	228,6	
	R60	$M^0_{Rk,s,fi}$	[Nm]	3,7	10,8	19	48,2	94,1	162,6	
	R90	$M^0_{Rk,s,fi}$	[Nm]	2,4	6,4	11,3	28,6	55,9	96,6	
	R120	$M^0_{Rk,s,fi}$	[Nm]	1,8	4,2	7,4	18,9	36,8	63,7	
Concrete pryout failure										
all types (HST, HST-R, HST-HCR)										
Factor in equation (5.6) of ETAG 001 Annex C, 5.2.3.3				k	[-]	2,0	2,0	2,2	2,5	2,5
Characteristic resistance	R30	$V_{Rk,cp,fi}$	[kN]	5,4	10	16	27,2	49,4	84,5	
	R60			5,4	10	16	27,2	49,4	84,5	
	R90			5,4	10	16	27,2	49,4	84,5	
	R120			4,4	8	12,9	21,7	39,6	67,5	
Concrete edge failure										
all types (HST, HST-R, HST-HCR)										
The initial value $V^0_{Rk,c,fi}$ of the characteristic resistance in concrete C20/25 to C50/60 under fire exposure may be determined by:										
$V^0_{Rk,c,fi} = 0,25 \times V^0_{Rk,c} \quad (\leq R90) \quad \quad V^0_{Rk,c,fi} = 0,20 \times V^0_{Rk,c} \quad (R120)$										
with $V^0_{Rk,c}$ initial value of the characteristic resistance in cracked concrete C20/25 under normal temperature.										
In absence of other national regulations the partial safety factor for resistance under fire exposure $\gamma_{M,fi} = 1,0$ is recommended.										
Hilti stud anchor HST, HST-R, HST-HCR								Annex 16		
Characteristic tension resistance under fire exposure: design method A acc. ETAG 001, Annex C										

**Table 23: Characteristic tension resistance for static and quasi-static loading:
design method A acc. CEN/TS 1992-4**

Anchor type / size		M8	M10	M12	M16	M20 HST, HST-R only	M24 HST, HST-R only	
Steel failure								
HST (steel galvanised)								
Characteristic resistance	$N_{Rk,s}$ [kN]	19	32	45	76	117	127	
Partial safety factor	$\gamma_{Ms}^{1)}$ [-]	1,5					1,41	
HST-R (stainless steel)								
Characteristic resistance	$N_{Rk,s}$ [kN]	17	28	40	69	109	156	
Partial safety factor	$\gamma_{Ms}^{1)}$ [-]	1,5			1,56	1,73		
HST-HCR (high corrosion resistant steel)								
Characteristic resistance	$N_{Rk,s}$ [kN]	19,4	32,3	45,7	84,5	-		
Partial safety factor	$\gamma_{Ms}^{1)}$ [-]	1,5					-	
Pullout failure								
HST (steel galvanised)								
Characteristic resistance in cracked concrete C20/25	$N_{Rk,p}^0$ [kN]	5	9	12	20	30	40	
Characteristic resistance in non-cracked concrete C20/25	$N_{Rk,p}^0$ [kN]	9	16	20	35	50	60	
Partial safety factor	$\gamma_{Mp}^{1)}$ [-]	1,8 ²⁾	1,5 ³⁾					
HST-R (stainless steel)								
Characteristic resistance in cracked concrete C20/25	$N_{Rk,p}^0$ [kN]	5	9	12	25	30	40	
Characteristic resistance in non-cracked concrete C20/25	$N_{Rk,p}^0$ [kN]	9	16	20	35	50	60	
Partial safety factor	$\gamma_{Mp}^{1)}$ [-]	1,5 ³⁾					-	
HST-HCR (high corrosion resistant steel)								
Characteristic resistance in cracked concrete C20/25	$N_{Rk,p}^0$ [kN]	5	9	12	25	-		
Characteristic resistance in non-cracked concrete C20/25	$N_{Rk,p}^0$ [kN]	9	16	20	35	-		
Partial safety factor	$\gamma_{Mp}^{1)}$ [-]	1,5 ³⁾					-	
all types (HST, HST-R, HST-HCR)								
Increasing factors for cracked and non-cracked concrete	ψ_c C20/25				1,0			
	ψ_c C30/37				1,22			
	ψ_c C40/50				1,41			
	ψ_c C50/60				1,55			

¹⁾ In absence of other national regulations.

²⁾ The partial safety factor $\gamma_{inst} = 1,2$ is included.

³⁾ The partial safety factor $\gamma_{inst} = 1,0$ is included.

Hilti stud anchor HST, HST-R, HST-HCR

**Characteristic tension resistance for static and quasi-static loading:
design method A acc. CEN/TS 1992-4**

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**Table 24: Characteristic tension resistance for static and quasi-static loading:
design method A acc. **CEN/TS 1992-4****

Anchor type / size		M8	M10	M12	M16	M20 HST, HST-R only	M24 HST, HST-R only
Concrete cone failure and splitting failure							
all types (HST, HST-R, HST-HCR)							
Effective anchorage depth	h_{ef} [mm]	47	60	70	82	101	125
Factor for cracked concrete	k_{cr} [-]	7,2					
Factor for non-cracked concrete	k_{ucr} [-]	10,1					
Spacing	$s_{cr,N} = s_{cr,sp}$ [mm]	3 x h_{ef}					
Edge distance	$c_{cr,N} = c_{cr,sp}$ [mm]	1,5 x h_{ef}					
Partial safety factor	$\gamma_{Mc} = \gamma_{Msp}$ ¹⁾ [-]	1,8 ²⁾	1,5 ³⁾				

¹⁾ In absence of other national regulations.

²⁾ The partial safety factor $\gamma_{inst} = 1,2$ is included.

³⁾ The partial safety factor $\gamma_{inst} = 1,0$ is included.

Hilti stud anchor HST, HST-R, HST-HCR

**Characteristic tension resistance for static and quasi-static loading:
design method A acc. **CEN/TS 1992-4****

Annex 18

**Table 25: Characteristic shear resistance for static and quasi-static loading:
design method A acc. CEN/TS 1992-4**

Anchor type / size		M8	M10	M12	M16	M20 HST, HST-R only	M24 HST, HST-R only
Steel failure without lever arm							
HST (steel galvanised)							
Characteristic resistance	$V_{Rk,s}$ [kN]	14	23,5	35	55	84	94
Factor considering ductility	k_2 [-]	1,0					
Partial safety factor	$\gamma_{Ms}^{1)}$ [-]	1,25					1,5
HST-R (stainless steel)							
Characteristic resistance	$V_{Rk,s}$ [kN]	13	20	30	50	80	115
Factor considering ductility	k_2 [-]	1,0					
Partial safety factor	$\gamma_{Ms}^{1)}$ [-]	1,25		1,3		1,44	
HST-HCR (high corrosion resistant steel)							
Characteristic resistance	$V_{Rk,s}$ [kN]	13	20	30	55	-	
Factor considering ductility	k_2 [-]	1,0					
Partial safety factor	$\gamma_{Ms}^{1)}$ [-]	1,25					
Steel failure with lever arm							
HST (steel galvanised)							
Characteristic resistance	$M_{Rk,s}^0$ [Nm]	30	60	105	240	454	595
Partial safety factor	$\gamma_{Ms}^{1)}$ [-]	1,25					1,5
HST-R (stainless steel)							
Characteristic resistance	$M_{Rk,s}^0$ [Nm]	27	53	92	216	422	730
Partial safety factor	$\gamma_{Ms}^{1)}$ [-]	1,25		1,3		1,44	
HST-HCR (high corrosion resistant steel)							
Characteristic resistance	$M_{Rk,s}^0$ [Nm]	30	60	105	266	-	
Partial safety factor	$\gamma_{Ms}^{1)}$ [-]	1,25					
Concrete pryout failure							
all types (HST, HST-R, HST-HCR)							
Factor in equation (16) of CEN/TS 1992-4-4, 6.2.2.3	k_3 [-]	2,0		2,2	2,5	2,5	2,5
Partial safety factor	$\gamma_{Mcp}^{1)}$ [-]	1,5 ²⁾					
Concrete edge failure							
all types (HST, HST-R, HST-HCR)							
Effective length of anchor in shear loading	l_f [mm]	47	60	70	82	101	125
Diameter of anchor	d_{nom} [mm]	8	10	12	16	20	24
Partial safety factor	$\gamma_{Mc}^{1)}$ [-]	1,5 ²⁾					

¹⁾ In absence of other national regulations.

²⁾ The partial safety factor $\gamma_{inst} = 1,0$ is included.

Hilti stud anchor HST, HST-R, HST-HCR

**Characteristic shear resistance for static and quasi-static loading:
design method A acc. CEN/TS 1992-4**

Annex 19

Table 26: Characteristic tension resistance under fire exposure in cracked and non-cracked concrete C20/25 to C50/60: design method A acc. CEN/TS 1992-4

Anchor type / size				M8	M10	M12	M16	M20 HST, HST-R only	M24 HST, HST-R only
Steel failure									
HST (steel galvanised)									
Characteristic resistance	R30	$N_{Rk,s,fi}$	[kN]	0,9	2,5	5	9	15	20
	R60	$N_{Rk,s,fi}$	[kN]	0,7	1,5	3,5	6	10	15
	R90	$N_{Rk,s,fi}$	[kN]	0,6	1	2	3,5	6	8
	R120	$N_{Rk,s,fi}$	[kN]	0,5	0,7	1	2	3,5	5
HST-R (stainless steel) and HST-HCR (high corrosion resistant steel)									
Characteristic resistance	R30	$N_{Rk,s,fi}$	[kN]	4,9	11,8	17,2	32	49,9	71,9
	R60	$N_{Rk,s,fi}$	[kN]	3,6	8,4	12,2	22,8	35,5	51,2
	R90	$N_{Rk,s,fi}$	[kN]	2,4	5	7,3	13,5	21,1	30,4
	R120	$N_{Rk,s,fi}$	[kN]	1,7	3,3	4,8	8,9	13,9	20
Pullout failure									
HST (steel galvanised)									
Characteristic resistance in concrete \geq C20/25	R30	$N_{Rk,p,fi}$	[kN]	1,3	2,3	3	5	7,5	10
	R60								
	R90	$N_{Rk,p,fi}$	[kN]	1,0	1,8	2,4	4	6	8
	R120								
HST-R (stainless steel) and HST-HCR (high corrosion resistant steel)									
Characteristic resistance in concrete \geq C20/25	R30	$N_{Rk,p,fi}$	[kN]	1,3	2,3	3	6,3	7,5	10
	R60								
	R90	$N_{Rk,p,fi}$	[kN]	1	1,8	2,4	5	6	8
	R120								
Concrete cone failure									
all types (HST, HST-R, HST-HCR)									
Characteristic resistance in concrete \geq C20/25	R30	$N^0_{Rk,c,fi}$	[kN]	2,7	5	7,4	11	18,5	31,4
	R60								
	R90	$N^0_{Rk,c,fi}$	[kN]	2,2	4	5,9	8,8	14,8	25,2
	R120								
Spacing	$s_{cr,N}$	[mm] $4 \times h_{ef}$							
	s_{min}	[mm] 40 55 60 70 100 125							
Edge distance	$c_{cr,N}$	[mm] $2 \times h_{ef}$							
	c_{min}	[mm] Fire attack from one side: $2 \times h_{ef}$ Fire attack from more than one side: ≥ 300							
Partial safety factor	$\gamma_{M,fi}$ ¹⁾	[-] 1,0							

¹⁾ In absence of other national regulations.

Hilti stud anchor HST, HST-R, HST-HCR

Characteristic tension resistance under fire exposure:
design method A acc. CEN/TS 1992-4

Annex 20

Table 27: Characteristic shear resistance under fire exposure in cracked and non-cracked concrete C20/25 to C50/60: design method A acc. CEN/TS 1992-4

Anchor type / size				M8	M10	M12	M16	M20 HST, HST-R only	M24 HST, HST-R only	
Steel failure without lever arm										
HST (steel galvanised)										
Characteristic resistance	R30	$V_{Rk,s,fi}$	[kN]	0,9	2,5	5	9	15	20	
	R60	$V_{Rk,s,fi}$	[kN]	0,7	1,5	3,5	6	10	15	
	R90	$V_{Rk,s,fi}$	[kN]	0,6	1	2	3,5	6	8	
	R120	$V_{Rk,s,fi}$	[kN]	0,5	0,7	1	2	3,5	5	
HST-R (stainless steel) and HST-HCR (high corrosion resistant steel)										
Characteristic resistance	R30	$V_{Rk,s,fi}$	[kN]	4,9	11,8	17,2	32	49,9	71,9	
	R60	$V_{Rk,s,fi}$	[kN]	3,6	8,4	12,2	22,8	35,5	51,2	
	R90	$V_{Rk,s,fi}$	[kN]	2,4	5	7,3	13,5	21,1	30,4	
	R120	$V_{Rk,s,fi}$	[kN]	1,7	3,3	4,8	8,9	13,9	20	
Steel failure with lever arm										
HST (steel galvanised)										
Characteristic resistance	R30	$M^0_{Rk,s,fi}$	[Nm]	1	3,3	8,1	20,6	40,2	69,5	
	R60	$M^0_{Rk,s,fi}$	[Nm]	0,8	2,4	5,7	14,4	28,1	48,6	
	R90	$M^0_{Rk,s,fi}$	[Nm]	0,7	1,6	3,2	8,2	16	27,7	
	R120	$M^0_{Rk,s,fi}$	[Nm]	0,6	1,2	2	5,1	9,9	17,2	
HST-R (stainless steel) and HST-HCR (high corrosion resistant steel)										
Characteristic resistance	R30	$M^0_{Rk,s,fi}$	[Nm]	5	15,2	26,6	67,7	132,3	228,6	
	R60	$M^0_{Rk,s,fi}$	[Nm]	3,7	10,8	19	48,2	94,1	162,6	
	R90	$M^0_{Rk,s,fi}$	[Nm]	2,4	6,4	11,3	28,6	55,9	96,6	
	R120	$M^0_{Rk,s,fi}$	[Nm]	1,8	4,2	7,4	18,9	36,8	63,7	
Concrete pryout failure										
all types (HST, HST-R, HST-HCR)										
Factor in equation (D.6, D.7) of CEN/TS 1992-4-1 Annex D, D.3.3.2				k^2	[-]	2,0	2,0	2,2	2,5	2,5
Characteristic resistance	R30	$V_{Rk,cp,fi}$	[kN]	5,4	10	16	27,2	49,4	84,5	
	R60			4,4	8	12,9	21,7	39,6	67,5	
	R90									
	R120									
Concrete edge failure										
all types (HST, HST-R, HST-HCR)										
The initial value $V^0_{Rk,c,fi}$ of the characteristic resistance in concrete C20/25 to C50/60 under fire exposure may be determined by:										
$V^0_{Rk,c,fi} = 0,25 \times V^0_{Rk,c} \quad (\leq R90) \quad \quad V^0_{Rk,c,fi} = 0,20 \times V^0_{Rk,c} \quad (R120)$										
with $V^0_{Rk,c}$ initial value of the characteristic resistance in cracked concrete C20/25 under normal temperature.										
Partial safety factor				$\gamma_{M,fi}$ ¹⁾	[-]	1,0				

¹⁾ In absence of other national regulations.

²⁾ k is equivalent to k_3 for ambient temperature (see Table 15).

Hilti stud anchor HST, HST-R, HST-HCR

**Characteristic shear resistance under fire exposure:
design method A acc. CEN/TS 1992-4**

Annex 21