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Autorisé et notifié conformément à l'article 10 de la directive 89/106/EEC du Conseil, du 21 décembre 1988, relative au rapprochement des dispositions législatives, réglementaires et administratives des Etats membres concernant les produits de construction.

CSTB le futur en construction

MEMBRE DE L'EOTA

European Technical Approval ETA-99/0001

(English language translation, the original version is in French language)

Nom commercial : **Trade name:**	**Hilti HSA and HSA-R**
Titulaire : **Holder of approval:**	**Hilti AG, Business Unit Anchor FL-9494 SCHAAN Principality of Liechtenstein**
Type générique et utilisation prévue du produit de construction : **Generic type and use of construction product:**	Cheville métallique en acier galvanisé ou inoxydable, à expansion par vissage à couple contrôlé, de fixation dans le béton non fissuré : diamètres M6, M8, M10, M12, M16 et M20. **Torque-controlled expansion anchor, made of galvanised or stainless steel, for use in non cracked concrete: sizes M6, M8, M10, M12, M16 and M20.**
Validité du : au : **Validity from / to:**	**13/03/2008 13/03/2013**
Usine de fabrication : **Manufacturing plant:**	**Hilti AG, usine 1 (plant 1)**
Le présent Agrément technique européen contient : **This European Technical Approval contains:**	15 pages incluant 8 annexes faisant partie intégrante du document. **15 pages including 8 annexes which form an integral part of the document.**

This European Technical Approval cancels and replaces ETA-99/0001 with validity from 08/03/2005 to 08/03/2010.

Cet Agrément Technique Européen annule et remplace l'ETA-99/0001 valide du 08/03/2005 au 08/03/2010.

I LEGAL BASES AND GENERAL CONDITIONS

1. This European Technical Approval is issued by the Centre Scientifique et Technique du Bâtiment 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 products[1], modified by the Council Directive 93/68/EEC of 22 July 1993[2];

   – Décret n°92-647 du 8 juillet 1992[3] concernant l'aptitude à l'usage des produits de construction;

   – Common Procedural Rules for Requesting, Preparing and the Granting of European Technical Approvals set out in the Annex of Commission Decision 94/23/EC[4];

   – Guideline for European Technical Approval of « Metal Anchors for use in Concrete » ETAG 001, edition 1997, Part 1 « Anchors in general » and Part 2 « Torque-controlled expansion anchors ».

2. The Centre Scientifique et Technique du Bâtiment is authorised to check whether the provisions of this European Technical Approval are met. Checking may take place in the manufacturing plant (for example concerning the fulfilment of assumptions made in this European Technical Approval with regard to manufacturing). Nevertheless, the responsibility for the conformity of the products with 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 manufacturer 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 the Centre Scientifique et Technique du Bâtiment pursuant to Article 5 (1) of the 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 the Centre Scientifique et Technique du Bâtiment. 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 to the version circulated within EOTA. Translations into other languages have to be designated as such.

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1 Official Journal of the European Communities n° L 40, 11.2.1989, p. 12
2 Official Journal of the European Communities n° L 220, 30.8.1993, p. 1
3 Journal officiel de la République française du 14 juillet 1992
4 Official Journal of the European Communities n° L 17, 20.1.1994, p. 34

II SPECIFIC CONDITIONS OF THE EUROPEAN TECHNICAL APPROVAL

1 Definition of product and intended use

1.1. Definition of product

The Hilti HSA anchor in the range of M6 to M20 is an anchor made of galvanised steel. The Hilti HSA-R anchor in the range of M6 to M12 is an anchor made of stainless steel. Both are placed into a drilled hole and anchored by torque-controlled expansion.
For the installed anchor see Figure 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 compromise the stability of the works, cause risk to human life and/or lead to considerable economic consequences. The anchor is to be used only for anchorages subject to static or quasi-static loading in reinforced or unreinforced normal weight concrete of strength classes C 20/25 minimum to C50/60 maximum according to ENV 206: 2000-12. It may be anchored in non-cracked concrete only.

The Hilti HSA anchor may only be used in concrete subject to dry internal conditions.

The Hilti HSA-R anchor may be used in concrete subject to dry internal conditions and also in concrete 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 polls or atmosphere with extreme 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 intended 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 product and methods of verification

2.1. Characteristics of product

The Hilti HSA and HSA-R anchors correspond to the drawings and provisions given in Annexes 1 to 3. The characteristic material values, dimensions and tolerances of the anchor not indicated in Annexes 1 to 3 shall correspond to the respective values laid down in the technical documentation[5] of this European Technical Approval. The characteristic anchor values for the design of anchorages are given in Annexes 4 to 8.

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5 The technical documentation of this European Technical Approval is deposited at the Centre Scientifique et Technique du Bâtiment 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.

Each anchor is marked with the commercial name, the nominal diameter of the anchor and the two maximum thickness of the fixture according to Annex 2 and 3. A blue colour ring marking identifies the standard embedment depth and the reduced embedment depth corresponds to the end of the threaded part to the concrete surface. A letter code corresponding to the total length of the bolt is punched on the head of the bolt.

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 7 for the Hilti HSA anchors and on the basis of Option 8 for the Hilti HSA-R anchors.

3 Evaluation of Conformity and CE marking

3.1. Attestation of conformity system

The system of attestation of conformity 2 (i) (referred to as system 1) according to Council Directive 89/106/EEC Annex III laid down by the European Commission provides:

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 test 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.

3.2. Responsibilities

3.2.1. Tasks of the manufacturer, factory production control

The manufacturer has a factory production control system in the plant and exercises permanent internal control of production. All the elements, requirements and provisions adopted by the manufacturer are documented in a systematic manner in the form of written policies and procedures. This production control system ensures that the product is in conformity with the European Technical Approval.

The manufacturer shall only use raw materials supplied with the relevant inspection documents as laid down in the prescribed test plan[6]. The incoming raw materials shall be subject to controls and tests by the manufacturer before acceptance. Check of incoming materials such

[6] The prescribed test plan has been deposited at the Centre Scientifique et Technique du Bâtiment and is only made available to the approved bodies involved in the conformity attestation procedure.

as nuts, washers, wire for bolts and metal band for expansion sleeves shall include control of the inspection documents presented by suppliers (comparison with nominal values) by verifying dimension and determining material properties, e.g. tensile strength, hardness, surface finish.

The manufactured components of the anchor shall be subjected to the following tests:

- Dimensions of component parts:
  bolt (diameters, lengths, thread, geometry of the cone, marking);
  sleeve (length, thickness, catch sizes);
  hexagonal nut (proper running, wrench size across flats);
  washer (diameters, thickness).
- Material properties: bolt (yielding and ultimate tensile strengths), sleeve (ultimate tensile strength), hexagonal nut (proof load), washer (hardness).
- Thickness of the galvanised treatment of the elements in the case of the HSA anchors.
- Coating of the cone in the case of the HSA-R anchors.
- Visual control of correct assembly and of completeness of the anchor.

The frequency of controls and tests conducted during production and on the assembled anchor is laid down in the prescribed test plan taking account of the automated manufacturing process of the anchor.

The results of factory production control are recorded and evaluated. The records include at least the following information:

- designation of the product, basic material and components;
- type of control or testing;
- date of manufacture of the product and date of testing of the product or basic material and components;
- result of control and testing and, if appropriate, comparison with requirements;
- signature of person responsible for factory production control.

The records shall be presented to the inspection body during the continuous surveillance. On request, they shall be presented to the Centre Scientifique et Technique du Bâtiment.

Details of the extent, nature and frequency of testing and controls to be performed within the factory production control shall correspond to the prescribed test plan which is part of the technical documentation of this European Technical Approval.

3.2.2. Tasks of approved bodies

3.2.2.1. Initial type-testing of the product

For initial type-testing the results of the tests performed as part of the assessment for the European Technical Approval shall be used unless there are changes in the production line or plant. In such cases the necessary initial type-testing has to be agreed between the Centre Scientifique et Technique du Bâtiment and the approved bodies involved.

3.2.2.2. Initial inspection of factory and of factory production control

The approved body shall ascertain that, in accordance with the prescribed test plan, the factory and the factory production control are suitable to ensure continuous and orderly manufacturing of the anchor according to the specifications mentioned in 2.1. as well as to the Annexes to the European Technical Approval.

3.2.2.3. Continuous surveillance

The approved body shall visit the factory at least once a year for regular inspection. It has to be verified that the system of factory production control and the specified automated manufacturing process are maintained taking account of the prescribed test plan.

Continuous surveillance and assessment of factory production control have to be performed according to the prescribed test plan.

The results of product certification and continuous surveillance shall be made available on demand by the certification body or inspection body, respectively, to the Centre Scientifique et Technique du Bâtiment. In cases where the provisions of the European Technical Approval and the prescribed test plan are no longer fulfilled the conformity certificate shall be withdrawn.

3.3. CE-Marking

The CE marking shall be affixed on each packaging of anchors. The symbol « CE » shall be accompanied by the following information:

- identification number of the certification body;
- name or identifying mark of the producer and manufacturing plant;
- the last two digits of the year in which the CE-marking was affixed;
- number of the EC certificate of conformity;
- number of the European Technical Approval;
- use category (ETAG 001-1 Option 7 for HSA; ETAG 001-1 Option 8 for HSA-R);
- size.

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

4.1. Manufacturing

The anchor is manufactured in accordance with the provisions of the European Technical Approval using the automated manufacturing process as identified during inspection of the plant by the Centre Scientifique et Technique du Bâtiment and the approved body and laid down in the technical documentation.

4.2. Installation

4.2.1. Design of anchorages

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

The anchorages are designed in accordance with the « Guideline for European Technical Approval of Metal Anchors for Use in Concrete », Annex C, Method A, for torque-controlled expansion anchors under the responsibility of an engineer experienced in anchorages and concrete work.

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

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

4.2.2. 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 on 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 prepared for that purpose and using the appropriate special tools;
- thickness of the fixture corresponding to the range of required thickness values for the type of anchor;
- 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;
- clearing the hole of drilling dust;
- anchor installation ensuring the specified embedment depth, that is the appropriate depth marking of the anchor not exceeding the concrete surface or embedment depth control;
- keeping of the edge distance and spacing to 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 to the anchor in the direction of load application;
- application of the torque moment given in Annex 3 using a calibrated torque wrench.

4.2.3. Responsibility of the manufacturer

It is the manufacturer's responsibility to ensure that the information on the specific conditions according to 1 and 2 including Annexes referred to in 4.2.1. and 4.2.2. 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:

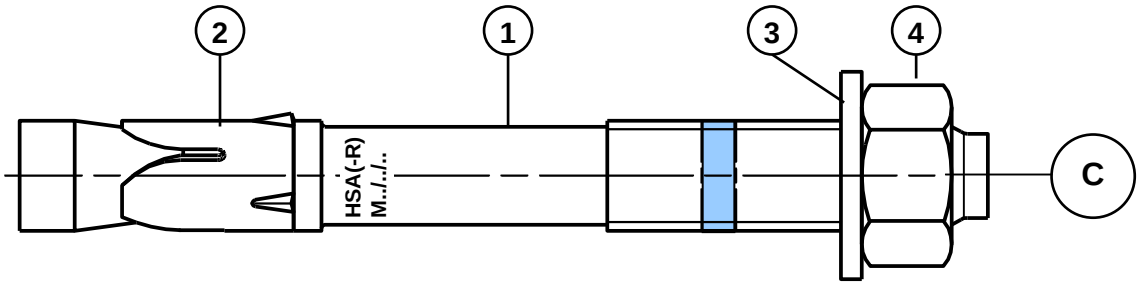
- drill bit diameter,
- thread diameter,
- maximum thickness of the fixture,
- minimum installation depth,
- minimum hole depth,
- required torque moment,
- information on the installation procedure, including cleaning of the hole, preferably by means of an illustration,
- reference to any special installation equipment needed,
- identification of the manufacturing batch.

All data shall be presented in a clear and explicit form.

The original French version is signed by

Le Directeur Technique
H. BERRIER

Assembled anchor HSA (galvanised steel) / HSA-R(stainless steel)



Marking:

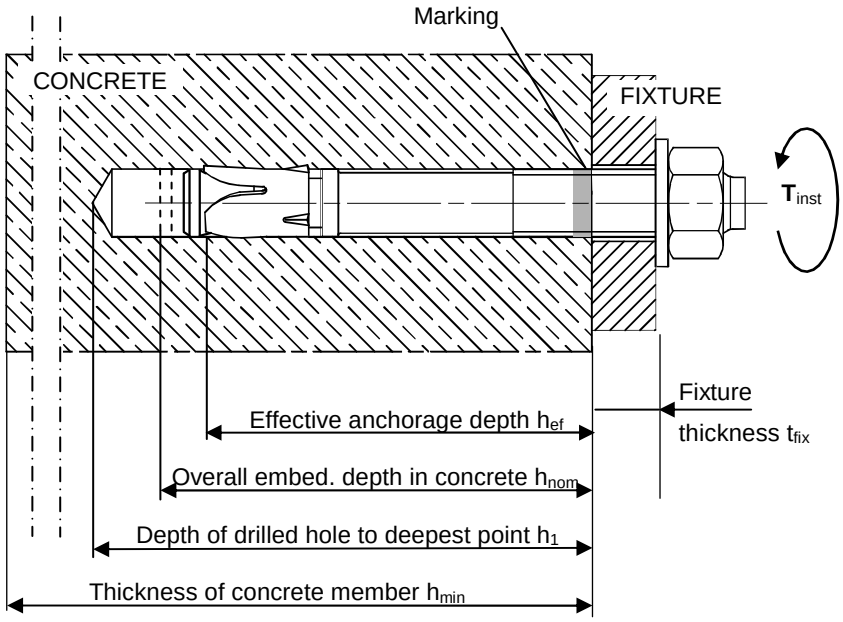
on the bolt: commercial name, nominal diameter, maximum fixture thickness $t_{fix,max}$ corresponding to respecting standard / reduced embedment depth.

- galvanised steel: HSA M../$t_{fix,max,stand}$/$t_{fix,max,red}$
- stainless steel: HSA-R M../$t_{fix,max,stand}$/$t_{fix,max,red}$

on the thread: a blue colour ring identifies the standard embedment depth.
(the end of the threaded part corresponds to the reduced embedment)

on the head: letter code C referring to the total length of the bolt.

Illustration of the anchor in use



Hilti stud anchor HSA	Annex 1
Product and intended use	of European Technical Approval **ETA-99/0001**

Table 1: Materials

Part	Designation	Material
HSA (galvanised steel)		
1	Bolt	Carbon-steel, cold-formed, galvanised (≥ 5µm)
2	Sleeve	M6: stainless steel M8, M10, M12, M16, M20: carbon steel, galvanised (≥ 5µm)
3	Washer	Steel, galvanised (≥ 5µm) acc. ISO 4042
4	Hexagonal nut	Steel, grade 8 acc. EN 20898-2, galvanised (≥ 5µm) acc. EN ISO 4042
HSA-R (stainless steel, grade A4)		
1	Bolt	Cold-formed stainless steel, grade A4, cone coated
2	Sleeve	Cold-formed stainless steel, grade A4
3	Washer	Stainless steel, grade A4
4	Hexagonal nut	Stainless steel, grade A4

Table 2: Installation data

HSA (galvanised steel)			**M6**	**M8**	**M10**	**M12**	**M16**	**M20**
Total length of the bolt	L_{min}	[mm]	50	57	68	80	100	125
	L_{max}	[mm]	100	137	140	300	240	170
Nominal diameter of drill bit	d_{cut}	[mm]	6	8	10	12	16	20
Diameter of clearance hole in the fixture	d_f	[mm]	7	9	12	14	18	22
Required torque moment	T_{inst}	[mm]	5	15	30	50	100	200
Standard embedment depth	$\mathbf{h_{ef,sta}}$							
Minimum thickness of concrete member	h_{min}	[mm]	100	100	100	140	170	210
Depth of drilled hole to deepest point	h_1	[mm]	55	65	70	95	115	130
Overall anchor embedment depth in the concrete	h_{nom}	[mm]	47	55	59	80	95	115
Effective anchorage depth	$h_{ef,sta}$	[mm]	40	48	50	70	84	103
Maximum thickness of fixture (from – to)	$t_{fix,max}$	[mm]	0-45	0-72	0-70	0-205	0–125	0-30
Minimum allowable spacing	s_{min}	[mm]	40	50	55	75	90	105
Minimum allowable edge distance	c_{min}	[mm]	50	60	65	90	105	125
Reduced embedment depth	$\mathbf{h_{ef,red}}$							
Minimum thickness of concrete member	h_{min}	[mm]	100	100	100	100	130	160
Depth of drilled hole to deepest point	h_1	[mm]	45	50	60	70	90	105
Overall anchor embedment depth in the concrete	h_{nom}	[mm]	37	42	51	60	75	90
Effective anchorage depth	$h_{ef,red}$	[mm]	30[1)]	35[1)]	42	50	64	78
Maximum thickness of fixture (from – to)	$t_{fix,max}$	[mm]	5-55	5-85	5-77	5-225	5-145	10-55
Minimum allowable spacing	s_{min}	[mm]	35	35	55	100	100	100
Minimum allowable edge distance	c_{min}	[mm]	40	45	65	100	100	115

[1)] use restricted to anchoring of structural components which are statically indeterminate.

Hilti stud anchor HSA	**Annex 2**
Materials and Installation data for HSA and HSA-R	of European Technical Approval **ETA-99/0001**

Table 2: Installation data (continued)

HSA-R (stainless steel, grade A4)			M6	M8	M10	M12
Total length of the bolt	L_{min}	[mm]	65	57	68	80
	L_{max}	[mm]	85	115	120	120
Nominal diameter of drill bit	d_{cut}	[mm]	6	8	10	12
Diameter of clearance hole in the fixture	d_f	[mm]	7	9	12	14
Required torque moment	T_{inst}	[mm]	5	15	30	50
Standard embedment depth	$\mathbf{h_{ef,sta}}$					
Minimum thickness of concrete member	h_{min}	[mm]	100	100	100	140
Depth of drilled hole to deepest point	h_1	[mm]	55	65	70	95
Overall anchor embedment depth in the concrete	h_{nom}	[mm]	47	55	59	80
Effective anchorage depth	$h_{ef,sta}$	[mm]	40	48	50	70
Maximum thickness of fixture (from – to)	$t_{fix,max}$	[mm]	10-30	10-50	20-50	5-25
Minimum allowable spacing	s_{min}	[mm]	40	50	65	100
Minimum allowable edge distance	c_{min}	[mm]	50	60	75	100
Reduced embedment depth	$\mathbf{h_{ef,red}}$					
Minimum thickness of concrete member	h_{min}	[mm]	-	100	100	100
Depth of drilled hole to deepest point	h_1	[mm]	-	50	60	70
Overall anchor embedment depth in the concrete	h_{nom}	[mm]	-	42	51	60
Effective anchorage depth	$h_{ef,red}$	[mm]	-	35[1)]	42	50
Maximum thickness of fixture (from – to)	$t_{fix,max}$	[mm]	-	5-63	5-57	5-45
Minimum allowable spacing	s_{min}	[mm]	-	35	55	100
Minimum allowable edge distance	c_{min}	[mm]	-	45	65	100

[1)] use restricted to anchoring of structural components which are statically indeterminate.

Table 3: Design method A
Characteristic values of resistance to tension loads

HSA (galvanised steel)			M6	M8	M10	M12	M16	M20
Steel failure								
characteristic resistance (reduced part)	$N_{Rk,s}$	[kN]	9,5	18	31,5	44,5	76	134
Partial safety factor	γ_{Ms}	[-]	1,5					
Pull-out failure								
Standard embedment depth	$\mathbf{h_{ef,sta}}$							
Characteristic resistance in non-cracked concrete C20/25	$N_{Rk,p}$	[kN]	6	12	16	25	2)	2)
Partial safety factor in non-cracked concrete	γ_{Mp}	[-]	1,8 4)	1,5 3)				
Reduced embedment depth	$\mathbf{h_{ef,red}}$							
Characteristic resistance in non-cracked concrete C20/25	$N_{Rk,p}$	[kN]	5 1)	9 1)	12	2)	2)	2)
Partial safety factor in non-cracked concrete	γ_{Mp}	[-]	1,8 1)4)	1,5 1)3)	1,5 3)			
Increasing factors for $N_{Rk,p}$	ψ_c	C30/37	1,17					
	ψ_c	C40/50	1,32					
	ψ_c	C50/60	1,42					
Concrete cone failure and splitting failure								
Standard embedment depth	$\mathbf{h_{ef,sta}}$							
Effective anchorage depth	$h_{ef,sta}$	[mm]	40	48	50	70	84	103
Partial safety factor in non-cracked concrete	$\gamma_{Mc} = \gamma_{M,sp}$	[-]	1,8 4)	1,5 3)				
Spacing	$s_{cr,N}$	[mm]	120	144	150	210	252	309
	$s_{cr,sp}$	[mm]	200	240	270	378	454	556
Edge distance	$c_{cr,N}$	[mm]	60	72	75	105	126	155
	$c_{cr,sp}$	[mm]	100	120	135	189	227	278
Reduced embedment depth	$\mathbf{h_{ef,red}}$							
Effective anchorage depth	$h_{ef,red}$	[mm]	30 1)	35 1)	42	50	64	78
Partial safety factor in non-cracked concrete	$\gamma_{Mc} = \gamma_{M,sp}$	[-]	1,8 1)4)	1,5 1)3)	1,5 3)			
Spacing	$s_{cr,N}$	[mm]	90 1)	105 1)	126	150	192	234
	$s_{cr,sp}$	[mm]	150 1)	176 1)	226	270	346	422
Edge distance	$c_{cr,N}$	[mm]	45 1)	53 1)	63	75	96	117
	$c_{cr,sp}$	[mm]	75 1)	88 1)	113	135	173	211

1) use restricted to anchoring of structural components which are statically indeterminate

2) pull-out failure not decisive for design

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

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

Hilti stud anchor HSA	**Annex 4**
Design method A Characteristic values of resistance to tension loads for HSA	of European Technical Approval **ETA-99/0001**

Table 3: Design method A
Characteristic values of resistance to tension loads (continued)

HSA-R (stainless steel, grade A4)			M6	M8	M10	M12
Steel failure						
characteristic resistance (reduced part)	$N_{Rk,s}$	[kN]	11	20	35	49
Partial safety factor	γ_{Ms}	[-]	1,6	1,6	1,6	1,6
Pull-out failure						
Standard embedment depth	$\mathbf{h_{ef,sta}}$					
Characteristic resistance in non-cracked concrete C20/25 to C50/60	$N_{Rk,p}$	[kN]	6	12	12	25
Partial safety factor in non-cracked concrete	γ_{Mp}	[-]	1,8 4)			2,1 5)
Reduced embedment depth	$\mathbf{h_{ef,red}}$					
Characteristic resistance in non-cracked concrete C20/25 to C50/60	$N_{Rk,p}$	[kN]	-	7,5 1)	12	2)
Partial safety factor in non-cracked concrete	γ_{Mp}	[-]	-	1,8 1)4)	2,1 5)	
Concrete cone failure and splitting failure						
Standard embedment depth	$\mathbf{h_{ef,sta}}$					
Effective anchorage depth	$h_{ef,sta}$	[mm]	40	48	50	70
Partial safety factor in non-cracked concrete	$\gamma_{Mc} = \gamma_{M,sp}$	[-]	1,8 4)			2,1 5)
Spacing	$s_{cr,N}$	[mm]	120	150	150	210
	$s_{cr,sp}$	[mm]	200	240	270	380
Edge distance	$c_{cr,N}$	[mm]	60	75	75	105
	$c_{cr,sp}$	[mm]	100	120	135	190
Reduced embedment depth	$\mathbf{h_{ef,red}}$					
Effective anchorage depth	$h_{ef,red}$	[mm]	-	35 1)	42	50
Partial safety factor in non-cracked concrete	$\gamma_{Mc} = \gamma_{M,sp}$	[-]	-	1,8 1)4)	2,1 5)	
Spacing	$s_{cr,N}$	[mm]	-	110 1)	130	150
	$s_{cr,sp}$	[mm]	-	180 1)	230	270
Edge distance	$c_{cr,N}$	[mm]	-	55 1)	65	100
	$c_{cr,sp}$	[mm]	-	90 1)	115	135

1) use restricted to anchoring of structural components which are statically indeterminate

2) pull-out failure not decisive for design

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

5) The partial safety factor $\gamma_2 = 1,4$ is included

Hilti stud anchor HSA	**Annex 5**
Design method A **Characteristic values of resistance to tension loads for HSA-R**	of European Technical Approval **ETA-99/0001**

Table 4: Displacements under tension loads

HSA (galvanised steel)			M6	M8	M10	M12	M16	M20
Standard embedment depth	$h_{ef,sta}$							
Tension load in non-cracked concrete C20/25 to C50/60		[kN]	2,0	4,0	4,0	7,1	11,6	19,9
Displacement	δ_{N0}	[mm]	0,2	0,2	0,2	0,2	0,2	0,1
	$\delta_{N\infty}$	[mm]	0,8	0,8	0,8	0,8	0,8	0,8
Reduced embedment depth	$h_{ef,red}$							
Tension load in non-cracked concrete C20/25 to C50/60		[kN]	1,1	3,6	4,0	4,5	8,3	13,9
Displacement	δ_{N0}	[mm]	0,1	0,1	0,1	0,1	0,1	0,1
	$\delta_{N\infty}$	[mm]	0,8	0,8	0,8	0,8	0,8	0,8

HSA-R (stainless steel, grade A4)			M6	M8	M10	M12
Standard embedment depth	$h_{ef,sta}$					
Tension load in non-cracked concrete C20/25 to C50/60		[kN]	2,5	4,0	4,0	7,1
Displacement	δ_{N0}	[mm]	0,3	0,3	0,3	0,2
	$\delta_{N\infty}$	[mm]	0,8	0,8	0,8	0,8
Reduced embedment depth	$h_{ef,red}$					
Tension load in non-cracked concrete C20/25 to C50/60		[kN]	-	3,6	4,0	4,5
Displacement	δ_{N0}	[mm]	-	0,1	0,1	0,1
	$\delta_{N\infty}$	[mm]	-	0,8	0,8	0,8

Table 5: Design method A
Characteristic values of resistance to shear loads

HSA (galvanised steel)				M6	M8	M10	M12	M16	M20
Steel failure without lever arm									
Characteristic resistance		$V_{Rk,s}$	[kN]	6,5	12	19,5	30,5	55	85
Partial safety factor		γ_{Ms}	[-]	1,25					
Steel failure with lever arm									
Characteristic resistance		$M^0_{Rk,s}$	[Nm]	11	27	54	94	223	454
Partial safety factor		γ_{Ms}	[-]	1,25					
Concrete pryout failure									
Factor in equation (5.6) of	for $h_{ef,sta}$	k	[-]	1	1	2	2	2	2
ETAG Annex C, § 5.2.3.3	for $h_{ef,red}$	k	[-]	1[1)]	1,5[1)]	2,0	2,0	2,9	3,5
Partial safety factor		γ_{Mc}	[-]	1,5[2)]					
Concrete edge failure									
Effective length of anchor	for $h_{ef,sta}$	l_f	[mm]	40	48	50	70	84	103
under shear loading	for $h_{ef,red}$	l_f	[mm]	30[1)]	35[1)]	42	50	64	78
Outside diameter of anchor		d_{nom}	[mm]	6	8	10	12	16	20
Partial safety factor		γ_{Mc}	[-]	1,5[2)]					

HSA-R (stainless steel, grade A4)				M6	M8	M10	M12
Steel failure without lever arm							
Characteristic resistance		$V_{Rk,s}$	[kN]	6	11	17	25
Partial safety factor		γ_{Ms}	[-]	1,5			
Steel failure with lever arm							
Characteristic resistance		$M^0_{Rk,s}$	[Nm]	9	22	45	79
Partial safety factor		γ_{Ms}	[-]	1,5			
Concrete pryout failure							
Factor in equation (5.6) of	for $h_{ef,sta}$	k	[-]	1	1	1	2
ETAG Annex C, § 5.2.3.3	for $h_{ef,red}$	k	[-]	-	1[1)]	1	1
Partial safety factor		γ_{Mc}	[-]	1,5[2)]			
Concrete edge failure							
Effective length of anchor	for $h_{ef,sta}$	l_f	[mm]	40	48	50	70
under shear loading	for $h_{ef,red}$	l_f	[mm]	-	35[1)]	42	50
Outside diameter of anchor		d_{nom}	[mm]	6	8	10	12
Partial safety factor		γ_{Mc}	[-]	1,5[2)]			

[1)] use restricted to anchoring of structural components which are statically indeterminate

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

Hilti stud anchor HSA	Annex 7
Design method A **Characteristic values of resistance to shear loads** **for HSA, HSA-R**	of European Technical Approval **ETA-99/0001**

Table 6: Displacements under shear loads

HSA (galvanised steel)			M6	M8	M10	M12	M16	M20
Standard embedment depth	$h_{ef,sta}$							
Shear load in non-cracked concrete C20/25 to C50/60		[kN]	2,9	4,4	7,1	10,2	19,0	29,6
Displacement	δ_{N0}	[mm]	1,5	1,6	1,7	1,8	1,9	2,1
	$\delta_{N\infty}$	[mm]	2,3	2,4	2,5	2,7	2,9	3,1
Reduced embedment depth	$h_{ef,red}$							
Shear load in non-cracked concrete C20/25 to C50/60		[kN]	2,9	4,4	7,1	10,2	19,0	29,6
Displacement	δ_{N0}	[mm]	1,5	1,6	1,7	1,8	1,9	2,1
	$\delta_{N\infty}$	[mm]	2,3	2,4	2,5	2,7	2,9	3,1

HSA-R (stainless steel, grade A4)			M6	M8	M10	M12
Standard embedment depth	$h_{ef,sta}$					
Shear load in non-cracked concrete C20/25 to C50/60		[kN]	2,9	4,4	7,1	10,2
Displacement	δ_{N0}	[mm]	1,2	1,4	1,3	1,9
	$\delta_{N\infty}$	[mm]	1,9	2,1	1,9	2,8
Reduced embedment depth	$h_{ef,red}$					
Shear load in non-cracked concrete C20/25 to C50/60		[kN]	-	4,4	7,1	10,2
Displacement	δ_{N0}	[mm]	-	1,4	1,3	1,9
	$\delta_{N\infty}$	[mm]	-	2,1	1,9	2,8

Note: The displacements published in this table indicate the deformation expected from the anchor itself. An additional displacement can occur due to the movement between the anchor body and the hole drilled in the concrete member or the hole in the fixture.