Deutsches Institut für Bautechnik
Zulassungsstelle für Bauprodukte und Bauarten
Bautechnisches Prüfamt
Eine vom Bund und den Ländern gemeinsam getragene Anstalt des öffentlichen Rechts

Kolonnenstraße 30 B
D-10829 Berlin
Tel.: +49 30 78730-0
Fax: +49 30 78730-320
E-Mail: dibt@dibt.de
www.dibt.de

Authorised and notified according to Article 10 of the Council Directive of 21 December 1988 on the approximation of laws, regulations and administrative provisions of Member States relating to construction products (89/106/EEC)

Deutsches Institut für Bautechnik DIBt

Mitglied der EOTA
Member of EOTA

European Technical Approval ETA-05/0255

English translation prepared by DIBt - Original version in German language

Handelsbezeichnung *Trade name*	Hilti HVU mit HAS und HIS Elementen *Hilti HVU with HAS and HIS elements*
Zulassungsinhaber *Holder of approval*	Hilti Aktiengesellschaft Business Unit Anchors 9494 Schaan FÜRSTENTUM LIECHTENSTEIN
Zulassungsgegenstand und Verwendungszweck *Generic type and use of construction product*	Verbunddübel mit Ankerstange oder Innengewindehülse in den Größen M8 bis M30 zur Verankerung im ungerissenen Beton *Bonded anchor with anchor rod or internal sleeve of sizes M8 to M30 for use in non-cracked concrete*
Geltungsdauer: *Validity:* vom *from*	23 June 2011
bis *to*	20 January 2016
Herstellwerk *Manufacturing plant*	Hilti Werke
Diese Zulassung umfasst *This Approval contains*	25 Seiten einschließlich 17 Anhänge *25 pages including 17 annexes*
Diese Zulassung ersetzt *This Approval replaces*	ETA-05/0255 mit Geltungsdauer vom 20.01.2011 bis 20.01.2016 *ETA-05/0255 with validity from 20.01.2011 to 20.01.2016*

EOTA

Europäische Organisation für Technische Zulassungen
European Organisation for Technical Approvals

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 products[1], modified by Council Directive 93/68/EEC[2] and Regulation (EC) N° 1882/2003 of the European Parliament and of the Council[3];
- 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 1998[4], as amended by law of 31 October 2006[5];
- Common Procedural Rules for Requesting, Preparing and the Granting of European technical approvals set out in the Annex to Commission Decision 94/23/EC[6];
- Guideline for European technical approval of "Metal anchors for use in concrete - Part 5: Bonded anchors", ETAG 001-05.

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 2006*, p. 2407, 2416
[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/ products and intended use

1.1 Definition of the construction product

The Hilti HVU with HAS and HIS elements is a bonded anchor consisting of a foil capsule Hilti HVU and a steel element. The elements are made of zinc coated steel (threaded rods HAS(-E)(-F) or internal sleeve HIS-N), stainless steel (threaded rods HAS-(E)R or internal sleeve HIS-RN) or high corrosion resistant steel (threaded rods HAS-(E)HCR).

The foil capsule is placed in the hole and the anchor rod is driven by machine with simultaneous hammering and turning.

The anchor rod is anchored via the bond between anchor rod, chemical mortar and concrete.

An illustration of the product and intended use is given in Annex 1 and 2.

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. Safety in case of fire (Essential Requirement 2) is not covered in this European technical approval.

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 C20/25 at minimum and C50/60 at most according to EN 206:2000-12.

The anchor may be anchored in non-cracked concrete only.

It may be installed in dry or wet concrete; it must not be installed in flooded holes.

The anchor may be used in the following temperature ranges:

Temperature range I:	-40 °C to +40 °C	(max long term temperature +24 °C and max short term temperature +40 °C)
Temperature range II:	-40 °C to +80 °C	(max long term temperature +50 °C and max short term temperature +80 °C)
Temperature range III:	-40 °C to +120 °C	(max long term temperature +72 °C and max short term temperature +120 °C)

<u>Elements made of zinc coated steel (threaded rods HAS(-E)(-F), internal sleeve HIS-N):</u>

The element made of electroplated or hot-dipped galvanised steel may only be used in structures subject to dry internal conditions.

<u>Elements made of stainless steel (threaded rods HAS-(E)R, internal sleeve HIS-RN):</u>

The element made of stainless steel 1.4362, 1.4401, 1.4404, 1.4439, 1.4571 or 1.4578, 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 to 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).

Elements made of high corrosion resistant steel (threaded rods HAS-(E)HCR):

The element made of high corrosion resistant steel 1.4529 or 1.4565 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 product and methods of verification

2.1 Characteristics of product

The anchor corresponds to the drawings and provisions given in Annexes 1 to 5. The characteristic material values, dimensions and tolerances of the anchor not indicated in Annexes 1 to 5 shall correspond to the respective values laid down in the technical documentation[7] of this European technical approval.

The characteristic values for the design of anchorages are given in Annexes 8 to 17.

Each foil capsule shall be marked with the imprint HVU, the anchor size and the expiry date in accordance with Annex 1.

Each anchor rod shall be marked with the identifying mark of the producer, marking for the material and with a marking of the effective anchorage depth in accordance with Annex 3.

Each internal sleeve shall be marked with the identifying mark of the producer and an embossing in accordance with Annex 4.

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 5 "Bonded anchors", on the basis of Option 7.

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.

[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.

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 Commission[8] the system 2(i) (referred to as System 1) of attestation of conformity applies.

This system of attestation of conformity is defined as follows:

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

(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 Bautechnik.[9]

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.

[8] Official Journal of the European Communities L 254 of 08.10.1996

[9] The control plan is a confidential part of 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.

3.2.2 Tasks of approved bodies

The approved body shall perform the following tasks in accordance with the provisions laid down in the control plan:

- initial type-testing of the product,
- initial inspection of factory and of factory production control,
- continuous surveillance, assessment and approval of factory production control.

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.

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 anchors. 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 7),
- 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 in the inspection of the plant by the Deutsches Institut für Bautechnik and the approved body and laid down in the technical documentation.

The European technical approval is issued for the product on the basis of agreed data/information, deposited with 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 Deutsches Institut für Bautechnik before the changes are introduced. Deutsches Institut für Bautechnik will decide whether or not such changes affect the European technical approval and consequently the validity of the CE marking on the basis of the European technical approval and if so whether further assessment or alterations to the European technical approval shall be necessary.

4.2 Design of anchorages

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

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 supports).

The anchorages shall be designed under the responsibility of an engineer experienced in anchorages and concrete work either in accordance with Section 4.2.1 or in accordance with Section 4.2.2. The design methods must not be mixed.

Displacements of the anchor under tension and shear load are given in Annexes 16 and 17.

4.2.1 Design according to Technical Report TR 029

The anchorages are designed in accordance with the Technical Report TR 029 "Design of Bonded Anchors" amended version September 2010[10].

The characteristic values for design of anchorages according to Technical Report TR 029 are given in Annexes 8 to 11.

4.2.2 Design according to CEN/TS 1992-4:2009

The anchorages are designed in accordance with CEN/TS 1992-4-1:2009 "Design of fastenings for use in concrete", Part 4-1: "General" and CEN/TS 1992-4-5:2009 "Design of fastenings for use in concrete", Part 4-5: "Post-installed fasteners – Chemical systems", Design method A.

The characteristic values for design of anchorages according to CEN/TS 1992-4:2009 are given in Annexes 12 to 15.

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 using the tools indicated in the technical documentation of this European technical approval,
- 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,
- keeping the effective anchorage depth,
- edge distance and spacing not less than the specified values without minus tolerances,
- drilling using hard metal hammer-drill bits in accordance with ISO or National Standards,
- positioning of the drill holes without damaging the reinforcement,
- in case of aborted drill hole: the drill hole shall be filled with mortar,
- cleaning the drill hole and anchor installation in accordance with manufacturers installation given in Annex 6,
- during installation and curing of the chemical mortar the temperature of the anchor components and the concrete must not fall below -5 °C; the curing time according to Annex 6 shall be observed before the anchor may be loaded,

[10] The Technical Report TR 029 "Design of Bonded Anchors" is published in English on EOTA website www.eota.eu.

- using only fastening screws or threaded rods (including nut and washer) for the internal sleeves HIS-(R)N made of appropriate steel grade and property class,
- installation torque moments are not required for functioning of the anchor. However, the torque moments given in Annex 7, respectively, must not be exceeded.

5 Indications to the manufacturer

5.1 Responsibility of the manufacturer

The manufacturer is responsible to ensure that the information on the specific conditions according to 1 and 2 including Annexes referred to and 4.2 and 4.3 as well as 5.2 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,
- hole depth,
- diameter of anchor rod,
- minimum effective anchorage depth,
- maximum thickness of the fixture,
- information on the installation procedure, including cleaning of the hole with the cleaning equipments, preferably by means of an illustration,
- anchor component installation temperature,
- ambient temperature of the concrete during installation of the anchor,
- admissible processing time (open time) of the mortar,
- curing time until the anchor may be loaded as a function of the ambient temperature in the concrete during installation,
- torque moment,
- identification of the manufacturing batch.

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

5.2 Packaging, transport and storage

The foil capsules shall be protected against sun radiation and shall be stored according to the manufacture's installation instructions in dry condition at temperatures of at least +5 °C to not more than +25 °C.

Foil capsules with expired shelf life must no longer be used.

The anchor shall only be packaged and supplied as a complete unit. Foil capsules may be packed separately from anchor rods, nuts and washers or internal sleeves, respectively.

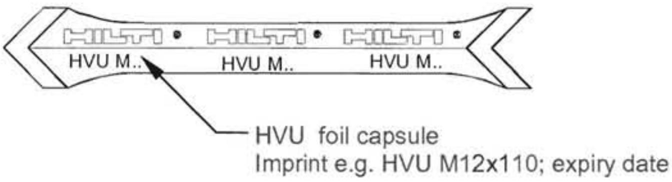
The manufacturer's installation instruction shall indicate that the foil capsules shall be used with the anchor rods HAS(-E)(-F) or internal sleeves HIS-N, respectively, according to Annexes 3 and 4.

Georg Feistel
Head of Department

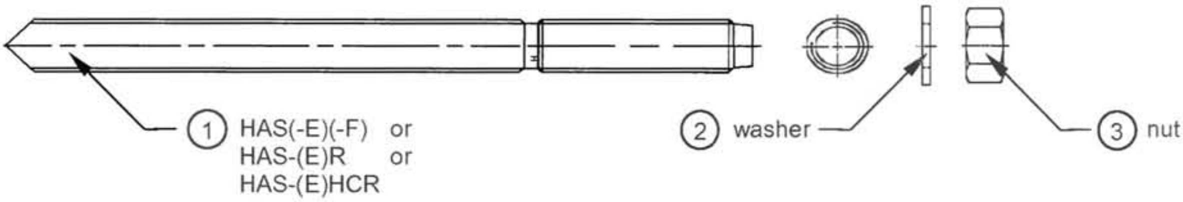
beglaubigt:
Wittstock

HVU with HAS(-E)(-F), HIS-N ... carbon steel, zinc coated
HVU with HAS-(E)R, HIS-RN ... stainless steel
HVU with HAS-(E)HCR ... high corrosion resistant steel

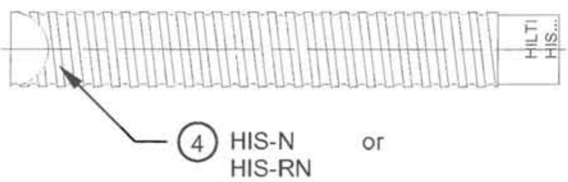
Foil capsule HVU



Threaded rod: HAS

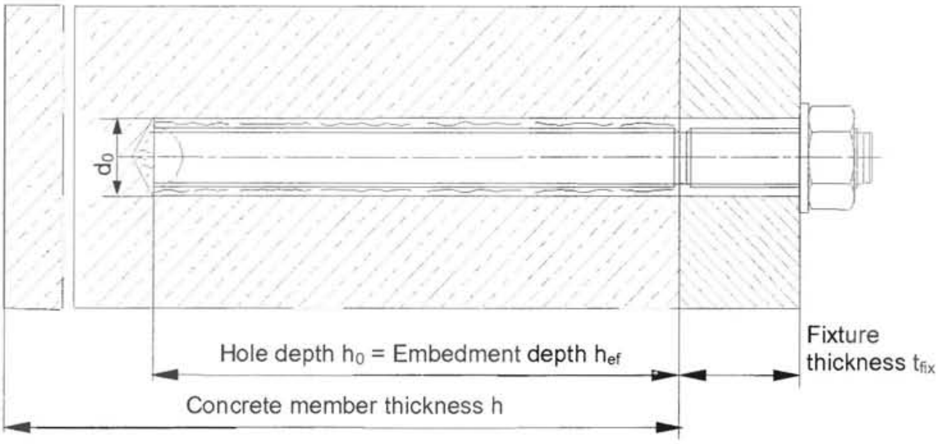


Internal sleeve: HIS

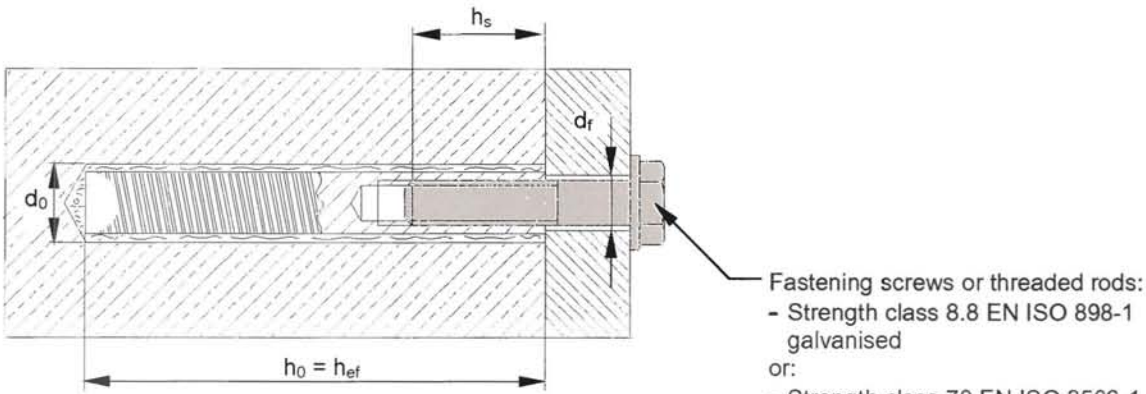


Hilti HVU with HAS and HIS elements	Annex 1
Anchor and Intended Use	

HVU with HAS



HVU with HIS



Use category according to ETAG 001 part 5:

Use category 1: The anchor may be installed in dry or wet concrete; it must not be installed in flooded holes.

Temperature ranges

Range I: -40°C to +40°C (max. short term temperature +40°C; max. long term temperature +24°C)

Range II: -40°C to +80°C (max. short term temperature +80°C; max. long term temperature +50°C)

Range III: -40°C to +120°C (max. short term temperature +120°C; max. long term temperature +72°C)

Hilti HVU with HAS and HIS elements	Annex 2
Anchor and Intended Use	

Foil capsule HVU

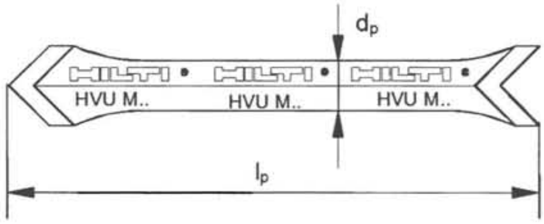
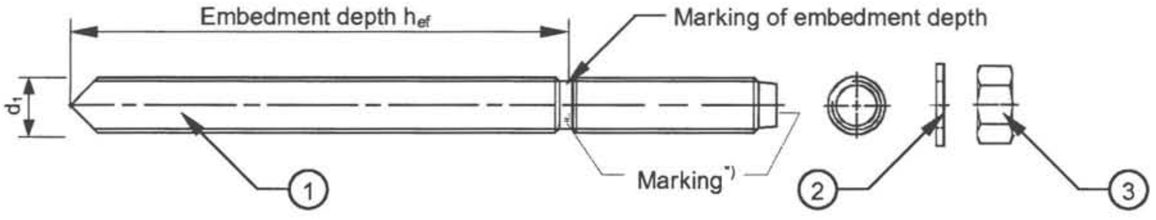


Table 1: Dimensions of foil capsules, assignment of foil capsules and elements

Foil capsule HVU	M8x80	M10x90	M12x110	M16x125	M20x170	M24x210	M27x240	M30x270
Diameter d_p [mm]	9,3	10,7	12,9	16,9	22,0	25,7	26,8	31,5
Length l_p [mm]	100	110	127	140	170	200	225	260
Assigned elements								
HAS(-E)(-F) HAS-(E)R	M8x80	M10x90	M12x110	M16x125	M20x170	M24x210	M27x240	M30x270
HAS-(E)HCR	M8x80	M10x90	M12x110	M16x125	M20x170	M24x210	-	-
HIS-N HIS-RN	-	M8x90	M10x110	M12x125	M16x170	M20x205	-	-



*) Marking: identifying mark - H and embossing "1" ... for carbon steel, M8-M24, class 5.8
identifying mark - H and embossing "8" ... for carbon steel, M8-M30, class 8.8
identifying mark - H and embossing "=" ... for stainless steel
identifying mark - H and embossing "CR" ... for high corrosion resistant steel

Table 2: Dimensions and embedment depth of HAS rods

HAS(-E)(-F) HAS-(E)R	M8x80	M10x90	M12x110	M16x125	M20x170	M24x210	M27x240	M30x270
HAS-(E)HCR	**M8x80**	**M10x90**	**M12x110**	**M16x125**	**M20x170**	**M24x210**	**-**	**-**
Diameter $Ød_1$ [mm]	8	10	12	16	20	24	27	30
Embedment depth h_{ef} [mm]	80	90	110	125	170	210	240	270

Hilti HVU with HAS and HIS elements	Annex 3
Dimensions	

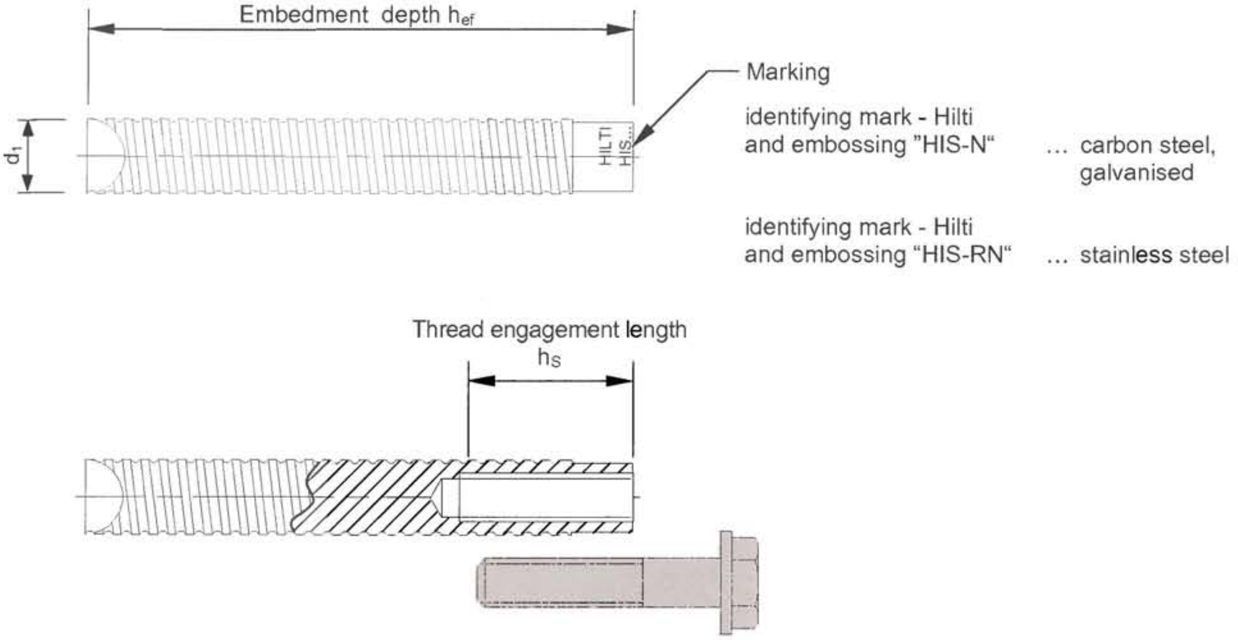


Table 3: Dimensions and embedment depth of internal sleeves

HIS-N HIS-RN			M8x90	M10x110	M12x125	M16x170	M20x205
Outer diameter	$Ød_1$	[mm]	12,5	16,5	20,5	25,4	27,6
Embedment depth	h_{ef}	[mm]	90	110	125	170	205

Hilti HVU with HAS and HIS elements	Annex 4
Dimensions	

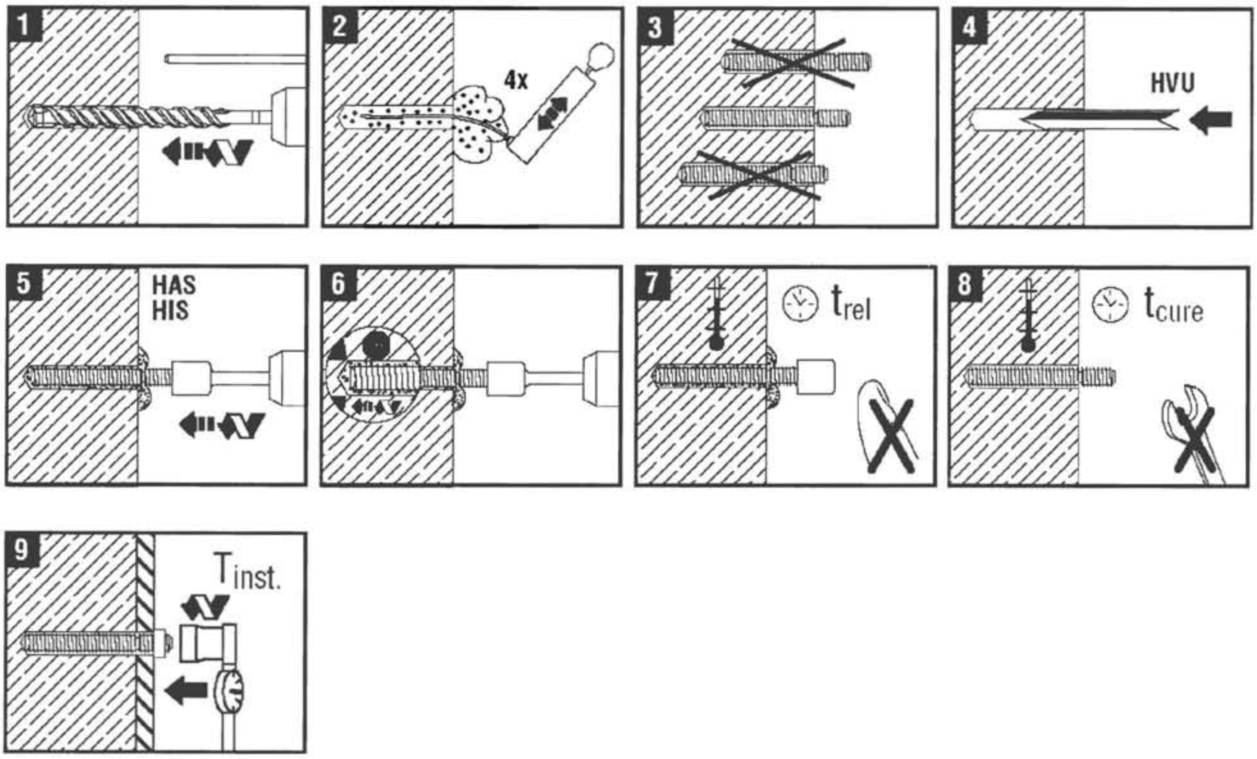
Table 4: Materials

Designation	Material
Foil capsule	
Foil tube	PP-PET-PE Composition foil
Aggregate	Corundum, HVU M8, M10 Quartz sand, HVU M12 … M30
Binder	Reaction resin (styrene free)
Hardener	Dibenzoylperoxid
Metal parts made of carbon steel	
Threaded rod HAS(-E) M8 to M24	strength class 5.8 EN ISO 898-1, A_5 > 8% ductile steel galvanised ≥ 5µm EN ISO 4042 (F) hot dipped galvanised ≥ 45µm EN ISO 10684
Threaded rod HAS(-E) M27 and M30	strength class 8.8 EN ISO 898-1, A_5 > 8% ductile steel galvanised ≥ 5µm EN ISO 4042 (F) hot dipped galvanised ≥ 45µm EN ISO 10684
Washer ISO 7089	steel galvanised EN ISO 4042; hot dipped galvanised EN ISO 10684
Nut EN ISO 4032	strength class 8 ISO 898-2 steel galvanised ≥ 5µm EN ISO 4042 hot dipped galvanised ≥ 45µm EN ISO 10684
Internally threaded sleeves [1)] HIS-N	carbon steel 1.0718, EN 10277-3 steel galvanised ≥ 5µm EN ISO 4042
Metal parts made of stainless steel	
Threaded rod HAS-(E)R	for ≤ M24: strength class 70 EN ISO 3506-1; A_5 > 8% ductile for > M24: strength class 50 EN ISO 3506-1; A_5 > 8% ductile stainless steel 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362 EN 10088
Washer ISO 7089	stainless steel 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362 EN 10088
Nut EN ISO 4032	strength class 70 EN ISO 3506-2 stainless steel 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362 EN 10088
Internally threaded sleeves [2)] HIS-RN	stainless steel 1.4401 und 1.4571 EN 10088
Metal parts made of high corrosion resistant steel	
Threaded rod HAS-(E)HCR	for ≤ M20: R_m = 800 N/mm²; $R_{p\,0,2}$ = 640 N/mm², A_5 > 8% ductile for > M20: R_m = 700 N/mm²; $R_{p\,0,2}$ = 400 N/mm², A_5 > 8% ductile high corrosion resistant steel 1.4529, 1.4565 EN 10088
Washer ISO 7089	high corrosion resistant steel 1.4529, 1.4565 EN 10088
Nut EN ISO 4032	strength class 70 EN ISO 3506-2 high corrosion resistant steel 1.4529, 1.4565 EN 10088

1) related fastening screw: strength class 8.8 EN ISO 898-1, A_5 > 8% ductile
steel galvanized ≥ 5µm EN ISO 4042

2) related fastening screw: strength class 70 EN ISO 3506-1, A_5 > 8% ductile
stainless steel 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362 EN 10088

Installation Instruction



a) Manual pump

b) Compressed air

Figure 1: Installation instruction and required cleaning accessories (manual pump or oil-free compressed air)

Table 5: Curing time[1]

Base material temperature	Curing time "t_{cure}"
-5 °C to -1 °C	5 h
0 °C to 9 °C	1 h
10 °C to 19 °C	30 min
20 °C to 40 °C	20 min

[1] This table is valid for dry base materials only. In wet base materials the curing times must be doubled.

Table 6: Installation data, minimum edge distance and spacing - HAS rods

HVU with HAS			M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth = Depth of drilled hole	h_{ef} h_0	[mm]	80	90	110	125	170	210	240	270
Nominal diameter of drill bit	d_0	[mm]	10	12	14	18	24	28	30	35
Diameter of clearance hole in the fixture	d_f	[mm]	9	12	14	18	22	26	30	33
Max. installation torque moment	T_{inst}	[Nm]	10	20	40	80	150	200	270	300
Minimum concrete member thickness	h_{min}	[mm]	110	120	140	170	220	270	300	340
Minimum spacing	s_{min}	[mm]	40	45	55	65	90	120	130	135
Minimum edge distance	c_{min}	[mm]	40	45	55	65	90	120	130	135

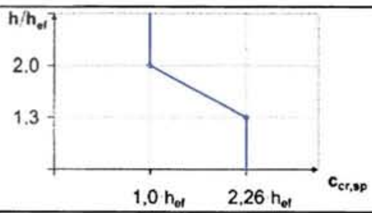
Table 7: Installation data, minimum edge distance and spacing - HIS elements

HVU with HIS			M8	M10	M12	M16	M20
Embedment depth = Depth of drilled hole	h_{ef} h_0	[mm]	90	110	125	170	205
Nominal diameter of drill bit	d_0	[mm]	14	18	22	28	32
Diameter of clearance hole in the fixture	d_f	[mm]	9	12	14	18	22
Max. installation torque moment	T_{inst}	[Nm]	10	20	40	80	150
Thread engagement length (min-max)	h_s	[mm]	8-20	10-25	12-30	16-40	20-50
Minimum concrete member thickness	h_{min}	[mm]	120	150	170	230	270
Minimum spacing	s_{min}	[mm]	40	45	60	80	125
Minimum edge distance	c_{min}	[mm]	40	45	60	80	125

Hilti HVU with HAS and HIS elements	Annex 7
Installation data	

Table 8: Characteristic values for tension loads: HAS rods Design acc. Technical Report TR 029

HVU with HAS			M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth	h_{ef}	[mm]	80	90	110	125	170	210	240	270
Steel failure HAS-...										
Characteristic resistance HAS 5.8	$N_{Rk,s}$	[kN]	**17**	**26**	**38**	**72**	**112**	**160**	-	-
Characteristic resistance HAS 8.8	$N_{Rk,s}$	[kN]	**27**	**42**	**61**	**115**	**179**	**256**	**347**	**422**
Characteristic resistance HAS-R	$N_{Rk,s}$	[kN]	**23**	**37**	**53**	**101**	**157**	**224**	**217**	**263**
Characteristic resistance HAS-HCR	$N_{Rk,s}$	[kN]	**27**	**42**	**61**	**115**	**179**	**224**	-	-
Partial safety factor steel failure										
HAS 5.8 or 8.8	γ_{Ms} 1)	[-]	1,50							
HAS-R	γ_{Ms} 1)	[-]	1,87						2,86	
HAS-HCR	γ_{Ms} 1)	[-]	1,50					2,1	-	
Combined pull-out and Concrete Cone failure										
Characteristic resistance in non-cracked concrete C20/25										
Temperature Range I 2): **40°C/24°C**	$N^0_{Rk,p}$ 3)	[kN]	**25**	**35**	**50**	**60**	**115**	**140**	**200**	**250**
Temperature Range II 2): **80°C/50°C**	$N^0_{Rk,p}$ 3)	[kN]	**20**	**25**	**40**	**50**	**75**	**115**	**140**	**170**
Temperature Range III 2): **120°C/72°C**	$N^0_{Rk,p}$ 3)	[kN]	**9**	**12**	**16**	**25**	**40**	**60**	**75**	**75**
Increasing factor for $N_{Rk,p}$ in non-cracked concrete	ψ_c	C30/37	1,06							
		C40/50	1,10							
		C50/60	1,13							
Splitting failure										
Edge distance $c_{cr,sp}$ [mm] for		h/h_{ef} 4) ≥ 2,0	**1,0 h_{ef}**							
		2,0 > h/h_{ef} 4) > 1,3	**4,6 h_{ef} - 1,8 h**							
		h/h_{ef} 4) ≤ 1,3	**2,26 h_{ef}**							
Spacing	$s_{cr,sp}$	[mm]	2 $c_{cr,sp}$							
Partial safety factor	$\gamma_{Mp} = \gamma_{Msp} = \gamma_{Mc}$ 1)	[-]	1,5 5)							



1) In absence of national regulations
2) Explanation see chapter 1.2
3) For design according TR029, the characteristic bond resistance may be calculated from the characteristic tension load values for combined pull-out and concrete cone failure according: $\tau_{Rk,ucr} = N^0_{Rk}/(h_{ef}\cdot d_1\cdot\pi)$;
4) h ... concrete member thickness, h_{ef} ... embedment depth
5) The partial safety factor γ_2 = 1,0 is included.

Hilti HVU with HAS and HIS elements	Annex 8
Characteristic Values for Tension Loads Design acc. Technical Report TR 029	

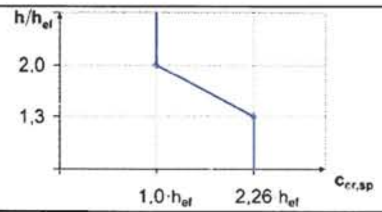
Deutsches Institut für Bautechnik

Table 9: Characteristic values for shear loads: HAS rods
Design acc. Technical Report TR 029

HVU with HAS			M8	M10	M12	M16	M20	M24	M27	M30
Steel failure without lever arm HAS-...										
Characteristic resistance HAS 5.8	$V_{Rk,s}$	[kN]	8,5	13	19	36	56	80	-	-
Characteristic resistance HAS 8.8	$V_{Rk,s}$	[kN]	13,5	21	30,5	58	90	128	174	211
Characteristic resistance HAS-R	$V_{Rk,s}$	[kN]	12	18	27	51	79	112	108	132
Characteristic resistance HAS-HCR	$V_{Rk,s}$	[kN]	13	21	31	58	90	112	-	-
Steel failure with lever arm HAS-...										
Characteristic resistance HAS 5.8	$M^0_{Rk,s}$	[Nm]	16	33	56	147	284	486	-	-
Characteristic resistance HAS 8.8	$M^0_{Rk,s}$	[Nm]	25,5	53	90	234	455	777	1223	1637
Characteristic resistance HAS-R	$M^0_{Rk,s}$	[Nm]	23	45	79	205	398	680	765	1023
Characteristic resistance HAS-HCR	$M^0_{Rk,s}$	[Nm]	26	52	90	234	455	680	-	-
Partial safety factor steel failure										
HAS 5.8 or 8.8	γ_{Ms} [1)]	[-]	1,25							
HAS-R	γ_{Ms} [1)]	[-]	1,56						2,38	
HAS-HCR	γ_{Ms} [1)]	[-]	1,25					1,75	-	
Concrete pryout failure										
Factor in equation (5.7) of TR 029 for the design of bonded anchors	k	[-]	2							
Partial safety factor	γ_{Mcp} [1)]	[-]	1,5 [2)]							
Concrete edge failure [3)]										
Effective embedment depth	h_{ef}	[mm]	80	90	110	125	170	210	240	270
Effective diameter of anchor	d	[mm]	8	10	12	16	20	24	27	30
Partial safety factor	γ_{Mc} [1)]	[-]	1,5 [2)]							

[1)] In absence of national regulations.
[2)] The partial safety factor γ_2 = 1,0 is included.
[3)] Concrete edge failure see chapter 5.2.3.4 of Technical Report TR 029.

Table 10: Characteristic values for tension loads: HIS elements Design acc. Technical Report TR 029

HVU with HIS			**M8**	**M10**	**M12**	**M16**	**M20**
Embedment depth	h_{ef}	[mm]	90	110	125	170	205
Steel failure HIS-...							
Characteristic resistance HIS-N	$N_{Rk,s}$	[kN]	**25**	**46**	**67**	**118**	**109**
Characteristic resistance HIS-RN	$N_{Rk,s}$	[kN]	**26**	**41**	**59**	**110**	**166**
Partial safety factor steel failure							
HIS-N / screw strength class 8.8	γ_{Ms} [1)]	[-]	1,43	1,5		1,47	
HIS-RN / screw strength class 70	γ_{Ms} [1)]	[-]	1,87				2,4
Combined pull-out and Concrete Cone failure							
Embedment depth	h_{ef}	[mm]	90	110	125	170	205
Effective diameter of anchor	d_1	[mm]	12,5	16,5	20,5	25,4	27,6
Characteristic resistance in non-cracked concrete C20/25							
Temperature Range I [2)]: **40°C/24°C**	$N^0_{Rk,p}$ [3)]	[kN]	**25**	**40**	**60**	**95**	**140**
Temperature Range II [2)]: **80°C/50°C**	$N^0_{Rk,p}$ [3)]	[kN]	**20**	**35**	**50**	**75**	**95**
Temperature Range III [2)]: **120°C/72°C**	$N^0_{Rk,p}$ [3)]	[kN]	**9**	**16**	**20**	**40**	**50**
Increasing factor for $N^0_{Rk,p}$ in non cracked concrete	ψ_c	C30/37	1,12				
		C40/50	1,21				
		C50/60	1,28				
Splitting failure							
Edge distance $c_{cr,sp}$ [mm] for		h/h_{ef} [4)] $\geq 2{,}0$	**1,0 h_{ef}**				
		$2{,}0 > h/h_{ef}$ [4)] $> 1{,}3$	**4,6 h_{ef} - 1,8 h**				
		h/h_{ef} [4)] $\leq 1{,}3$	**2,26 h_{ef}**				
Spacing	$s_{cr,sp}$	[mm]	2 $c_{cr,sp}$				
Partial safety factor $\gamma_{Mp} = \gamma_{Msp} =$	γ_{Mc} [1)]	[-]	1,5 [5)]				

1) In absence of national regulations.
2) Explanation see chapter 1.2
3) For design according TR029, the characteristic bond resistance may be calculated from the characteristic tension load values for combined pull-out and concrete cone failure according: $\tau_{Rk,ucr} = N^0_{Rk}/(h_{ef} \cdot d_1 \cdot \pi)$
4) h ... concrete member thickness; h_{ef} ... embedment depth
5) The partial safety factor γ_2 = 1,0 is included.

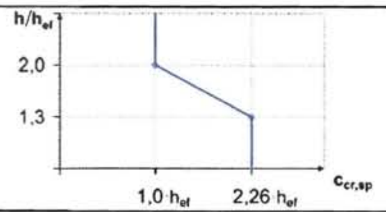
**Table 11: Characteristic values for shear loads: HIS elements
Design acc. Technical Report TR 029**

HVU with HIS			M8	M10	M12	M16	M20
Steel failure without lever arm HIS							
HIS-N / screw strength class 8.8	$V_{Rk,s}$	[kN]	**13**	**23**	**39**	**59**	**55**
HIS-RN / screw strength class 70	$V_{Rk,s}$	[kN]	**13**	**20**	**30**	**55**	**83**
Steel failure with lever arm HIS							
HIS-N / screw strength class 8.8	$M^0_{Rk,s}$	[Nm]	**30**	**60**	**105**	**266**	**519**
HIS-RN / screw strength class 70	$M^0_{Rk,s}$	[Nm]	**26**	**52**	**92**	**233**	**454**
Partial safety factor steel failure							
HIS-N / screw strength class 8.8	γ_{Ms} [1]	[-]	1,25		1,5 [2]		
HIS-RN / screw strength class 70	γ_{Ms} [1]	[-]	1,56				2,0 [3]
Concrete pryout failure							
Factor in equation (5.7) of TR 029 for the design of bonded anchors	k	[-]	2				
Partial safety factor	γ_{Mcp} [1]	[-]	1,5 [4]				
Concrete edge failure [5]							
Effective embedment depth	h_{ef}	[mm]	90	110	125	170	205
Effective diameter of anchor	d	[mm]	12,5	16,5	20,5	25,4	27,6
Partial safety factor	γ_{Mc} [1]	[-]	1,5 [4]				

[1] In absence of national regulations.
[2] Partial safety factor for steel failure (screw steel strength 8.8) with lever arm: γ_{Ms}=1,25
[3] Partial safety factor for steel failure (screw steel strength 70) with lever arm: γ_{Ms}=1,56
[4] The partial safety factor γ_2 = 1,0 is included.
[5] Concrete edge failure see chapter 5.2.3.4 of Technical Report TR 029.

Table 12: Characteristic values for tension loads: HAS rods
Design acc. CEN/TS 1992-4-5

HVU with HAS			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Embedment depth	h_{ef}	[mm]	80	90	110	125	170	210	240	270
Steel failure HAS-...										
Characteristic resistance HAS 5.8	$N_{Rk,s}$	[kN]	**17**	**26**	**38**	**72**	**112**	**160**	**-**	**-**
Characteristic resistance HAS 8.8	$N_{Rk,s}$	[kN]	**27**	**42**	**61**	**115**	**179**	**256**	**347**	**422**
Characteristic resistance HAS-R	$N_{Rk,s}$	[kN]	**23**	**37**	**53**	**101**	**157**	**224**	**217**	**263**
Characteristic resistance HAS-HCR	$N_{Rk,s}$	[kN]	**27**	**42**	**61**	**115**	**179**	**224**	**-**	**-**
Partial safety factor steel failure										
HAS 5.8 or 8.8	γ_{Ms} [1)]	[-]	1,50							
HAS-R	γ_{Ms} [1)]	[-]	1,87						2,86	
HAS-HCR	γ_{Ms} [1)]	[-]	1,50					2,1	-	
Combined pull-out and Concrete Cone failure										
Characteristic resistance in non-cracked concrete C20/25										
Temperature Range I [2)]: **40°C/24°C**	$N^0_{Rk,p}$ [3)]	[kN]	**25**	**35**	**50**	**60**	**115**	**140**	**200**	**250**
Temperature Range II [2)]: **80°C/50°C**	$N^0_{Rk,p}$ [3)]	[kN]	**20**	**25**	**40**	**50**	**75**	**115**	**140**	**170**
Temperature Range III [2)]: **120°C/72°C**	$N^0_{Rk,p}$ [3)]	[kN]	**9**	**12**	**16**	**25**	**40**	**60**	**75**	**75**
Increasing factor for $N_{Rk,p}$ in non cracked concrete	ψ_c	C30/37	1,06							
		C40/50	1,10							
		C50/60	1,13							
Factor acc. CEN/TS 1992-4-5, chapter 6.2.2.3	k_8	[-]	10,1							
Concrete Cone failure										
Factor acc. CEN/TS1992-4-5, chapter 6.2.3.1	k_{ucr}	[-]	10,1							
Edge distance	$c_{cr,N}$	[mm]	**1,5 h_{ef}**							
Spacing	$s_{cr,N}$	[mm]	**3,0 h_{ef}**							
Splitting failure										
Edge distance $c_{cr,sp}$ [mm] for	h/h_{ef} [4)] $\geq 2,0$		**1,0 h_{ef}**							
	$2,0 > h/h_{ef}$ [4)] $> 1,3$		**4,6 h_{ef} - 1,8 h**							
	h/h_{ef} [4)] $\leq 1,3$		**2,26 h_{ef}**							
Spacing	$s_{cr,sp}$	[mm]	2 $c_{cr,sp}$							
Partial safety factor $\gamma_{Mp} = \gamma_{Msp} =$	γ_{Mc} [1)]	[-]	1,5 [5)]							



[1)] In absence of national regulations.
[2)] Explanation see chapter 1.2.
[3)] For design according CEN/TS 1992-4 the characteristic bond resistance may be calculated from the characteristic tension load values for combined pull-out and concrete cone failure according: $\tau_{Rk,ucr} = N^0_{Rk}/(h_{ef} \cdot d_1 \cdot \pi)$
[4)] h … concrete member thickness; h_{ef} … embedment depth
[5)] The partial safety factor $\gamma_{inst} = 1{,}0$ is included.

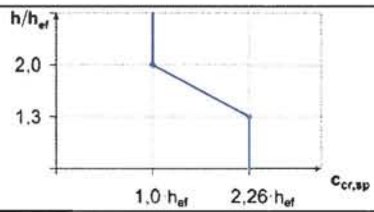
Hilti HVU with HAS and HIS elements	Annex 12
Characteristic Values for Tension Loads Design acc. CEN/TS 1992-4-5	

Table 13: Characteristic values for shear loads: HAS rods
Design acc. CEN/TS 1992-4-5

HVU with HAS			M8	M10	M12	M16	M20	M24	M27	M30
Steel failure without lever arm HAS-...										
Characteristic resistance HAS 5.8	$V_{Rk,s}$	[kN]	8,5	13	19	36	56	80	-	-
Characteristic resistance HAS 8.8	$V_{Rk,s}$	[kN]	13,5	21	30,5	58	90	128	174	211
Characteristic resistance HAS-R	$V_{Rk,s}$	[kN]	12	18	27	51	79	112	108	132
Characteristic resistance HAS-HCR	$V_{Rk,s}$	[kN]	13	21	31	58	90	112	-	-
Factor acc. CEN/TS 1992-4-5, Chapter 6.3.2.1	k_2	[-]	1,0							
Steel failure with lever arm HAS-...										
Characteristic resistance HAS 5.8	$M^0_{Rk,s}$	[Nm]	16	33	56	147	284	486	-	-
Characteristic resistance HAS 8.8	$M^0_{Rk,s}$	[Nm]	25,5	53	90	234	455	777	1223	1637
Characteristic resistance HAS-R	$M^0_{Rk,s}$	[Nm]	23	45	79	205	398	680	765	1023
Characteristic resistance HAS-HCR	$M^0_{Rk,s}$	[Nm]	26	52	90	234	455	680	-	-
Partial safety factor steel failure										
HAS 5.8 or 8.8	γ_{Ms} [1)]	[-]	1,25							
HAS-R	γ_{Ms} [1)]	[-]	1,56						2,38	
HAS-HCR	γ_{Ms} [1)]	[-]	1,25				1,75		-	
Concrete pry-out failure										
Factor in equation (27) of CEN/TS 1992-4-5, Chapter 6.3.3	k_3	[-]	2							
Partial safety factor	γ_{Mcp} [1)]	[-]	1,5 [2)]							
Concrete edge failure [3)]										
Effective length of anchor	l_f	[mm]	64	80	96	125	160	192	216	240
Effective diameter of anchor	d_{nom}	[mm]	8	10	12	16	20	24	27	30
Partial safety factor	γ_{Mc} [1)]	[-]	1,5 [2)]							

1) In absence of national regulations.
2) The partial safety factor γ_{inst} = 1,0 is included.
3) Concrete edge failure see CEN/TS 1992-4-5, chapter 6.3.4

Table 14: Characteristic values for tension loads: HIS elements Design acc. CEN/TS 1992-4-5

HVU with HIS			**M8**	**M10**	**M12**	**M16**	**M20**
Embedment depth	h_{ef}	[mm]	90	110	125	170	205
Steel failure HIS-…							
Characteristic resistance HIS-N	$N_{Rk,s}$	[kN]	**25**	**46**	**67**	**118**	**109**
Characteristic resistance HIS-RN	$N_{Rk,s}$	[kN]	**26**	**41**	**59**	**110**	**166**
Partial safety factor steel failure							
HIS-N / screw strength class 8.8	γ_{Ms} 1)	[-]	1,43	1,5		1,47	
HIS-RN / screw strength class 70	γ_{Ms} 1)	[-]	1,87				2,4
Combined pull-out and Concrete Cone failure							
Embedment depth	h_{ef}	[mm]	90	110	125	170	205
Effective diameter of anchor	d_1	[mm]	12,5	16,5	20,5	25,4	27,6
Characteristic resistance in non-cracked concrete C20/25							
Temperature Range I 2): **40°C/24°C**	$N^0_{Rk,p}$ 3)	[kN]	**25**	**40**	**60**	**95**	**140**
Temperature Range II 2): **80°C/50°C**	$N^0_{Rk,p}$ 3)	[kN]	**20**	**35**	**50**	**75**	**95**
Temperature Range III 2): **120°C/72°C**	$N^0_{Rk,p}$ 3)	[kN]	**9**	**16**	**20**	**40**	**50**
Increasing factor for $N^0_{Rk,p}$ in non cracked concrete	ψ_c	C30/37	1,12				
		C40/50	1,21				
		C50/60	1,28				
Factor acc. CEN/TS, chapter 6.2.2.3	k_8	[-]	10,1				
Concrete Cone failure							
Factor acc. CEN/TS, chapter 6.2.3.1	k_{ucr}	[-]	10,1				
Edge distance	$c_{cr,N}$	[mm]	1,5 h_{ef}				
Spacing	$s_{cr,N}$	[mm]	3,0 h_{ef}				
Splitting failure							
Edge distance $c_{cr,sp}$ [mm] for		h/h_{ef} 4) $\geq 2,0$	**1,0 h_{ef}**				
		$2,0 > h/h_{ef}$ 4) $> 1,3$	**4,6 h_{ef} - 1,8 h**				
		h/h_{ef} 4) $\leq 1,3$	**2,26 h_{ef}**				
Spacing	$s_{cr,sp}$	[mm]	2 $c_{cr,sp}$				
Partial safety factor	$\gamma_{Mp} = \gamma_{Msp} = \gamma_{Mc}$ 1)	[-]	1,5 5)				

1) In absence of national regulations.
2) Explanation see chapter 1.2
3) For design according CEN/TS 1992-4-5 the characteristic bond resistance may be calculated from the characteristic tension load values for combined pull-out and concrete cone failure according: $\tau_{Rk,ucr} = N^0_{Rk}/(h_{ef} \cdot d_1 \cdot \pi)$;
4) h … concrete member thickness, h_{ef} … embedment depth
5) The partial safety factor γ_{inst} = 1,0 is included.

Hilti HVU with HAS and HIS elements	**Annex 14**
Characteristic Values for Tension Loads Design acc. CEN/TS 1992-4-5	

Table 15: Characteristic values for shear loads: HIS elements Design acc. CEN/TS 1992-4-5

HVU with HIS			M8	M10	M12	M16	M20
Steel failure without lever arm HIS							
HIS-N / screw strength class 8.8	$V_{Rk,s}$	[kN]	**13**	**23**	**39**	**59**	**55**
HIS-RN / screw strength class 70	$V_{Rk,s}$	[kN]	**13**	**20**	**30**	**55**	**83**
Factor acc. CEN/TS 1992-4-5, Chapter 6.3.2.1	k_2	[-]	1,0				
Steel failure with lever arm HIS							
HIS-N / screw strength class 8.8	$M^0_{Rk,s}$	[Nm]	**30**	**60**	**105**	**266**	**519**
HIS-RN / screw strength class 70	$M^0_{Rk,s}$	[Nm]	**26**	**52**	**92**	**233**	**454**
Partial safety factor steel failure							
HIS-N / screw strength class 8.8	γ_{Ms} [1]	[-]	1,25		1,5 [2]		
HIS-RN / screw strength class 70	γ_{Ms} [1]	[-]	1,56				2,0 [3]
Concrete pryout failure							
Factor in equation (27) of CEN/TS 1992-4-5, Chapter 6.3.3	k_3	[-]	2				
Partial safety factor	γ_{Mcp} [1]	[-]	1,5 [4]				
Concrete edge failure [5]							
Effective length of anchor	l_f	[mm]	90	110	125	170	205
Effective diameter of anchor	d_{nom}	[mm]	12,5	16,5	20,5	25,4	27,6
Partial safety factor	γ_{Mc} [1]	[-]	1,5 [4]				

[1] In absence of national regulations.
[2] Partial safety factor for steel failure with lever arm (screw strength class 8.8): γ_{Ms}=1,25
[3] Partial safety factor for steel failure with lever arm (screw strength class 70): γ_{Ms}=1,56
[4] The partial safety factor γ_{inst} = 1,0 is included.
[5] Concrete edge failure see CEN/TS 1992-4-5, chapter 6.3.4

Hilti HVU with HAS and HIS elements

Characteristic Values for Shear Load Design acc. CEN/TS 1992-4-5

Annex 15

Table 16: Displacement under tension load: HAS rods

HVU with HAS			M8	M10	M12	M16	M20	M24	M27	M30
Temperature range I [1]: 40°C / 24°C										
Tension load in non-cracked concrete	N	[kN]	8,1	12,4	18,1	28,6	53,3	66,7	95,2	119
Displacement	δ_{N0}	[mm]	0,15	0,2	0,2	0,2	0,3	0,3	0,4	0,45
Displacement	$\delta_{N\infty}$	[mm]	0,4	0,45	0,5	0,55	0,8	0,8	1,0	1,1
Temperature range II [1]: 80°C / 50°C										
Tension load in non-cracked concrete	N	[kN]	8,1	11,9	18,1	23,8	35,7	54,8	66,7	81,0
Displacement	δ_{N0}	[mm]	0,15	0,15	0,2	0,2	0,2	0,25	0,25	0,3
Displacement	$\delta_{N\infty}$	[mm]	0,4	0,4	0,5	0,5	0,55	0,65	0,65	0,7
Temperature range III [1]: 120°C / 72°C										
Tension load in non-cracked concrete	N	[kN]	4,3	5,7	7,6	11,9	19,0	28,6	35,7	35,7
Displacement	δ_{N0}	[mm]	0,1	0,1	0,1	0,1	0,1	0,15	0,15	0,15
Displacement	$\delta_{N\infty}$	[mm]	0,2	0,2	0,2	0,25	0,3	0,35	0,35	0,35

[1] Explanation see chapter 1.2

Table 17: Displacement under shear load: HAS rods

HVU with HAS			M8	M10	M12	M16	M20	M24	M27	M30
Shear load in non-cracked concrete	V	[kN]	4,9	7,4	10,9	20,6	32	45,7	99,4	120,6
Displacement	δ_{V0}	[mm]	0,4	0,6	0,7	0,9	1,1	1,3	2,8	3,4
Displacement	$\delta_{V\infty}$	[mm]	0,6	0,9	1,1	1,4	1,7	2	4,2	5,1

Hilti HVU with HAS and HIS elements	Annex 16
Displacements under Tension and Shear Load (HAS rods)	

Table 18: Displacement under tension load: HIS elements

HVU with HIS			M8	M10	M12	M16	M20
Temperature range I [1]**: 40°C / 24°C**							
Tension load in non-cracked concrete	N	[kN]	11,9	19,0	28,6	45,2	53,0
Displacement	δ_{N0}	[mm]	0,2	0,2	0,25	0,3	0,35
Displacement	$\delta_{N\infty}$	[mm]	0,5	0,55	0,65	0,8	0,85
Temperature range II [1]**: 80°C / 50°C**							
Tension load in non-cracked concrete	N	[kN]	9,5	15,7	22,5	35,7	45,2
Displacement	δ_{N0}	[mm]	0,15	0,2	0,2	0,25	0,3
Displacement	$\delta_{N\infty}$	[mm]	0,4	0,45	0,5	0,65	0,7
Temperature range III [1]**: 120°C / 72°C**							
Tension load in non-cracked concrete	N	[kN]	4,3	7,6	9,5	19,0	23,8
Displacement	δ_{N0}	[mm]	0,1	0,1	0,1	0,15	0,15
Displacement	$\delta_{N\infty}$	[mm]	0,2	0,2	0,2	0,35	0,4

[1] Explanation see chapter 1.2

Table 19: Displacement under shear loads: HIS elements

HVU with HIS			M8	M10	M12	M16	M20
Shear load in non-cracked concrete	V	[kN]	7,4	13,1	18,6	28,1	26,2
Displacement	δ_{V0}	[mm]	0,7	1,0	1,1	1,6	2,0
Displacement	$\delta_{V\infty}$	[mm]	1,1	1,5	1,7	2,4	3,0