Deutsches Institut für Bautechnik
Approval body for construction products and types of construction
Bautechnisches Prüfamt
An institution established by the Federal and Laender Governments

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European Technical Assessment

ETA-18/0185 of 14 May 2018

English translation prepared by DIBt - Original version in German language

General Part

Technical Assessment Body issuing the European Technical Assessment:	Deutsches Institut für Bautechnik
Trade name of the construction product	HVU2
Product family to which the construction product belongs	Bonded fastener for use in concrete
Manufacturer	Hilti AG Feldkircherstraße 100 9494 Schaan FÜRSTENTUM LIECHTENSTEIN
Manufacturing plant	Hilti Corporation
This European Technical Assessment contains	24 pages including 3 annexes which form an integral part of this assessment
This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of	EAD 330499-00-0601

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Specific Part

1 Technical description of the product

The HVU2 is a bonded anchor consisting of a mortar capsule HVU2 M… and a steel element. The steel element is a threaded rod with washer and nut HAS-(E) M24 to M30 or an internally threaded sleeve HIS(R)N M20.
The mortar capsule is placed in the hole and the steel element is driven by machine as specified in Annex B6.

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

The product description is given in Annex A.

2 Specification of the intended use in accordance with the applicable European Assessment Document

The performances given in Section 3 are only valid if the anchor is used in compliance with the specifications and conditions given in Annex B.

The verifications and assessment methods on which this European Technical Assessment is based lead to the assumption of a working life of the anchor of at least 50 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

3 Performance of the product and references to the methods used for its assessment

3.1 Mechanical resistance and stability (BWR 1)

Essential characteristic	Performance
Characteristic resistance to tension load (static and quasi-static loading)	See Annex C 1 to C 4
Characteristic resistance to shear load (static and quasi-static loading)	See Annex C 5 to C 6
Displacements (static and quasi-static loading)	See Annex C 7 to C 8
Characteristic resistance and displacements for seismic performance categories C1 and C2	No performance assessed

3.2 Hygiene, health and the environment (BWR 3)

Essential characteristics	Performance
Content, emission and/or release of dangerous substances	No performance assessed

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

In European Assessment Document EAD 330499-00-0601the applicable European legal act is: [96/582/EC].

The system to be applied is: 1

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

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

Issued in Berlin on 14 May 2018 by Deutsches Institut für Bautechnik

BD Dipl.-Ing. Andreas Kummerow
Head of Department

beglaubigt:
Lange

Installed condition

Figure A1:
HAS-(E)…

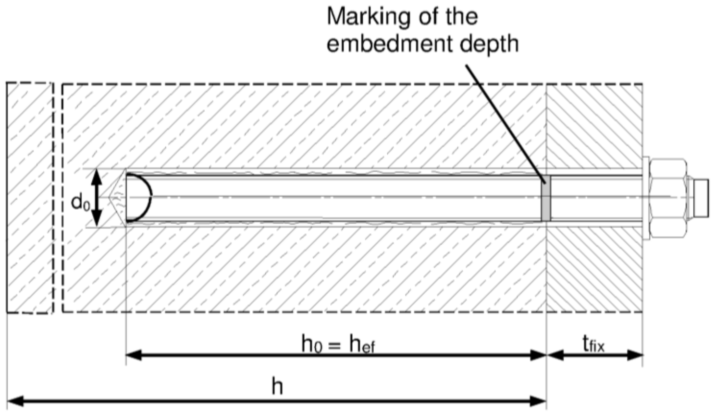
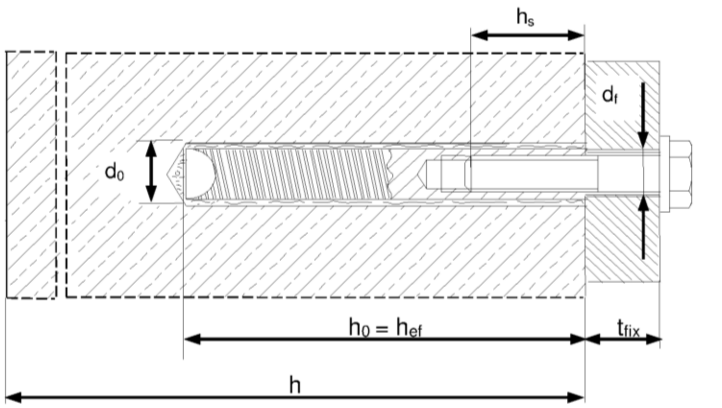


Figure A2:
Internally threaded sleeve HIS-(R)N



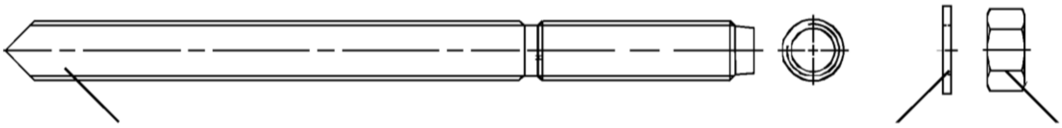
HVU2	
Product description Installed condition	**Annex A1**

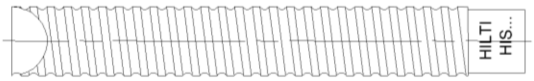
Product description: Mortar capsule and steel elements

Adhesive anchor capsule HVU2 M24 to M30: resin and hardener with aggregate

Marking:
HVU2 M …
Expiry date mm/yyyy

Steel elements





Internally threaded sleeve HIS-(R)N: M20
Dimensions according to Annex B4.

HVU2	
Product description Adhesive anchor capsule / Steel elements	**Annex A2**

Table A1: Materials

Designation	Material
Metal parts made of zinc coated steel	
HAS-(E)	M24: Strength class 5.8, f_{uk} = 500 N/mm², f_{yk} = 400 N/mm² Elongation after fracture A_f > 0,22 (equal to A (l_0 = 5d) > 8% ductile) M24 to M30: Strength class 8.8, f_{uk} = 800 N/mm², f_{yk} = 640 N/mm² Rupture elongation A (l_0 = 5d) > 12% ductile Electroplated zinc coated ≥ 5 µm, (F) hot dip galvanized ≥ 45 µm
Internally threaded sleeve HIS-N	Electroplated zinc coated ≥ 5 µm
Washer	Electroplated zinc coated ≥ 5 µm, hot dip galvanized ≥ 45 µm
Nut	Strength class of nut adapted to strength class of threaded rod. Electroplated zinc coated ≥ 5 µm, hot dip galvanized ≥ 45 µm
Metal parts made of stainless steel	
HAS-(E)R	M24: Strength class 70, f_{uk} = 700 N/mm², f_{yk} = 450 N/mm² M27 and M30: Strength class 70, f_{uk} = 500 N/mm², f_{yk} = 210 N/mm² Rupture elongation A (l_0 = 5d) > 12% ductile Stainless steel 1.4401, 1.4404, 1.4578, 1.4571, 1.4439, 1.4362 EN 10088-1:2014
Internally threaded sleeve HIS-RN	Stainless steel 1.4401, 1.4571 EN 10088-1:2014
Washer	Stainless steel 1.4401, 1.4404, 1.4578, 1.4571, 1.4439, 1.4362 EN 10088-1:2014
Nut	Strength class of nut adapted to strength class of threaded rod. Stainless steel 1.4401, 1.4404, 1.4578, 1.4571, 1.4439, 1.4362 EN 10088-1:2014
Metal parts made of high corrosion resistant steel	
HAS-(E)HCR	M24: f_{uk} = 700 N/mm², f_{yk} = 400 N/mm² Rupture elongation A (l_0 = 5d) > 12% ductile High corrosion resistant steel 1.4529, 1.4565 EN 10088-1:2014
Washer	High corrosion resistant steel 1.4529, 1.4565 EN 10088-1:2014
Nut	Strength class of nut adapted to strength class of threaded rod. High corrosion resistant steel 1.4529, 1.4565 EN 10088-1:2014

HVU2

Product description
Materials

Annex A3

Specifications of intended use

Anchorages subject to:

- Static and quasi static loading.

Base material:

- Reinforced or unreinforced normal weight concrete without fibres according to EN 206:2013.
- Strength classes C20/25 to C50/60 according to EN 206:2013.
- Cracked or uncracked concrete.

Temperature in the base material:

- **At installation**
  0 °C to +40 °C
- **In-service**
  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)

Table B1: Specifications of intended use

	Foil capsule HVU2 with …	
Elements	Threaded rod HAS-(E)…	HIS-(R)N
Hammer drilling with hollow drill bit TE-YD	M24 to M30	M20
Hammer drilling	M24 to M30	M20
Diamond coring	M24 to M30	M20

Use conditions (Environmental conditions):

- Structures subject to dry internal conditions
  (zinc coated steel, stainless steel or high corrosion resistant steel).
- Structures subject to external atmospheric exposure (including industrial and marine environment) and to permanently damp internal conditions, if no particular aggressive conditions exist
  (stainless steel or high corrosion resistant steel).
- Structures subject to external atmospheric exposure and to permanently damp internal conditions, if other particular aggressive conditions exist
  (high corrosion resistant steel).
  Note: 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 products are used).

Design:

- Anchorages are designed under the responsibility of an engineer experienced in anchorages and concrete work.
- Verifiable calculation notes and drawings are prepared taking account of the loads to be anchored. The position of the anchor is indicated on the design drawings (e. g. position of the anchor relative to reinforcement or to supports, etc.).
- Anchorages under static or quasi-static loading are designed in accordance with:
  FprEN 1992-4:2017 and EOTA Technical Report TR 055

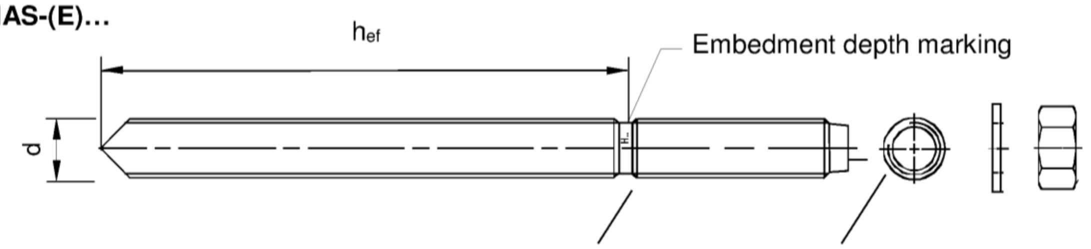
Installation:

- Concrete condition I1:
  Installation in dry or wet (water saturated) concrete and use in service in dry or wet concrete.
- Drilling technique: hammer drilling, diamond coring (e.g. Hilti DD 30-W or other Hilti DD machines), hammer drilling with hollow drill bit TE-YD.
- Installation direction:
  D2: downward and horizontal installation for threaded rod (HAS) M24 to M30 and internally threaded sleeve HIS-N M20.
  D3: downward and horizontal and upward (e.g. overhead) installation for threaded rod (HAS) M24 and internally threaded sleeve HIS-N M20.
- Anchor installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site.

Table B2: Installation parameters of HAS-(E)…

HAS-(E)…			**M24**	**M27**	**M30**
Foil capsule HVU2 M…			**24x210**	**27x240**	**30x270**
Diameter of fastener	$d = d_{nom}$	[mm]	24	27	30
Nominal diameter of drill bit	d_0	[mm]	28	30	35
Effective embedment depth and drill hole depth	$h_{ef} = h_0$	[mm]	210	240	270
Maximum diameter of clearance hole in the fixture	d_f	[mm]	26	30	33
Minimum allowed thickness of concrete member	h_{min}	[mm]	270	300	340
Maximum torque moment	max T_{fix}	[Nm]	200	270	300
Minimum allowable spacing	s_{min}	[mm]	115	120	140
Minimum allowable edge distance	c_{min}	[mm]	60	75	80

HAS-(E)…



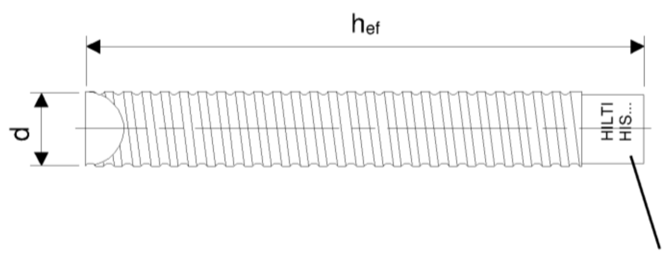
Marking:
identifying mark - H, embossing "1" HAS-(E)
identifying mark - H, embossing "=" HAS-(E)R
identifying mark - H, embossing "CR" HAS-(E)HCR

HVU2	**Annex B3**
Intended Use Installation parameters	

Table B3: Installation parameters of internally threaded sleeve HIS-(R)N

Internally threaded sleeve HIS-(R)N			**M20**
Foil capsule HVU2 M…			**24x210**
Diameter of fastener	$d = d_{nom}$	[mm]	27,8
Nominal diameter of drill bit	d_0	[mm]	32
Effective embedment depth and drill hole depth	$h_{ef} = h_0$	[mm]	205
Maximum diameter of clearance hole in the fixture	d_f	[mm]	22
Minimum allowed thickness of concrete member	h_{min}	[mm]	270
Maximum torque moment	max T_{fix}	[Nm]	150
Thread engagement length min-max	h_s	[mm]	20-50
Minimum allowable spacing	s_{min}	[mm]	130
Minimum allowable edge distance	c_{min}	[mm]	90

Internally threaded sleeve HIS-(R)N…



Marking:
Identifying mark - HILTI and
embossing "HIS-N" (for zinc coated steel)
embossing "HIS-RN" (for stainless steel)

Table B4: Minimum curing time

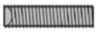
Temperature in the base material T	**Minimum curing time t_{cure}**
0 °C to 4 °C	40 min
5 °C to 9 °C	20 min
10 °C to 19 °C	10 min
20 °C to 40 °C	5 min

HVU2

Intended Use
Installation parameters
Minimum curing time

Annex B4

Table B5: Parameters of drilling and cleaning tools

Elements		Drill and clean			
		Hammer drilling			
HAS-(E)…	HIS-(R)N	Standard drill bit	Hollow drill bit TE-YD	Diamond coring	Brush
					
Size	Name	d_0 [mm]	d_0 [mm]	d_0 [mm]	HIT-RB
M24	-	28	28	28	28
M27	-	30	-	30	30
-	M20	32	32	32	32
M30	-	35	35	35	35

Cleaning alternatives

Compressed Air Cleaning (CAC):
Air nozzle with an orifice opening of minimum 3,5 mm in diameter.

Automatic Cleaning (AC):
Cleaning is performed during drilling with Hilti TE-YD drilling system including vacuum cleaner.

HVU2	**Annex B5**
Intended Use Cleaning tools	

Table B6: Parameters of setting tools HAS-(E)…

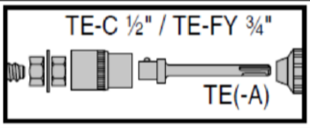
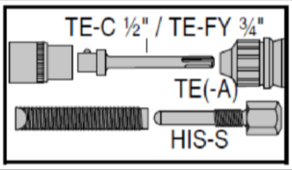
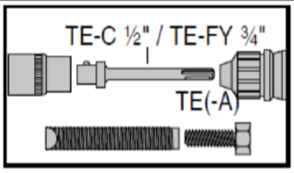
Elements	Setting tools		Operating mode
HAS-(E) M24 to M30 		HAS-(E) with double nut and TE-FY ¾" adapter	Rotary hammer tool in rotation hammer mode

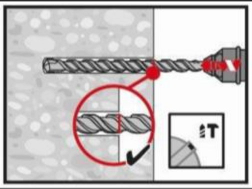
Table B7: Parameters of setting tools HIS-(R)N…

Elements	Setting tools		Setting mode
HIS-(R)N M20 		HIS-N with HIS-S and TE-FY ¾" adapter	Rotary hammer tool in rotation hammer mode
		HIS-N with screw and TE-FY ¾" adapter	Rotary hammer tool in rotation hammer mode

Installation instruction

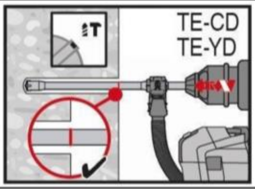
Hole drilling

a) Hammer drilling: For dry or wet concrete



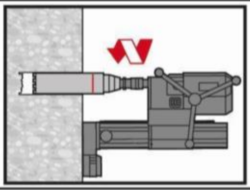
Drill hole to the required embedment depth with a hammer drill set in rotation-hammer mode using an appropriately sized carbide drill bit.

b) Hammer drilling with Hilti hollow drill bit: For dry and wet concrete



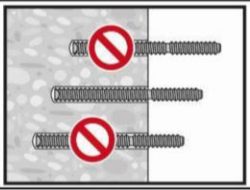
Drill hole to the required embedment depth with an appropriately sized Hilti TE-YD hollow drill bit with Hilti vacuum attachment. This drilling system removes the dust and cleans the drill hole during drilling when used in accordance with the user's manual. After drilling is completed, proceed to the “setting the element” step in the installation instruction.

c) Diamond coring: For dry or wet concrete



Diamond coring is permissible when suitable diamond core drilling machines and the corresponding core bits are used.

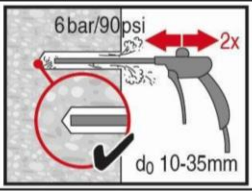
Check setting depth



Check the setting depth with the marked element.
The element has to fit in the hole until the required embedment depth, not deeper.
If it is not possible to insert the element to the required embedment depth, drill deeper.

Drill hole cleaning: Just before setting an anchor, the drill hole must be free of dust and debris.
Inadequate hole cleaning = poor load values.

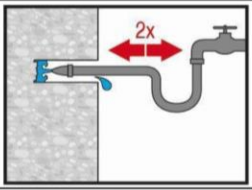
Compressed Air Cleaning (CAC): For all drill hole diameters d_0 and all drill hole depths h_0.



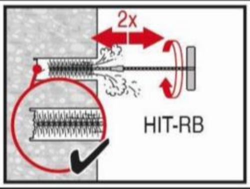
Blow 2 times from the back of the hole (if needed with nozzle extension) over the whole length with oil-free compressed air (min. 6 bar at 6 m³/h) until return air stream is free of noticeable dust.

Cleaning of hammer drilled flooded holes and diamond cored holes:

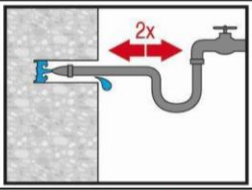
For all drill hole diameters d_0 and all drill hole depths h_0.



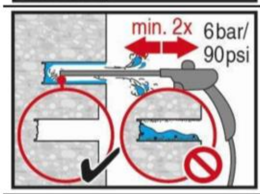
Flush 2 times by inserting a water hose (water-line pressure) to the back of the hole until water runs clear.



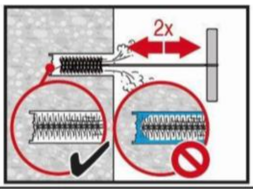
Brush 2 times with the specified brush (see table B5) by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it.
The brush must produce natural resistance as it enters the drill hole (brush Ø ≥ drill hole Ø) - if not, the brush is too small and must be replaced with the proper brush diameter.



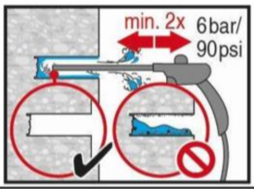
Flush 2 times by inserting a water hose (water-line pressure) to the back of the hole until water runs clear.



Blow 2 times from the back of the hole (if needed with nozzle extension) over the whole length with oil-free compressed air (min. 6 bar at 6 m³/h) until return air stream is free of noticeable dust and water.



Brush 2 times with the specified brush (see table B5) by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it.
The brush must produce natural resistance as it enters the drill hole (brush Ø ≥ drill hole Ø) - if not, the brush is too small and must be replaced with the proper brush diameter.



Blow again with compressed air 2 times until return air stream is free of noticeable dust and water.

HVU2	**Annex B8**
Intended Use Installation instructions	

Setting the element

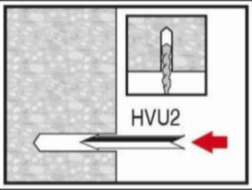
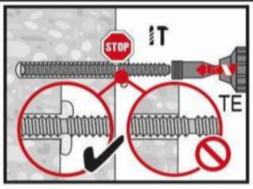
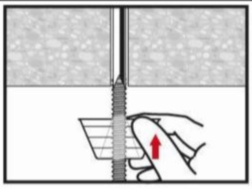
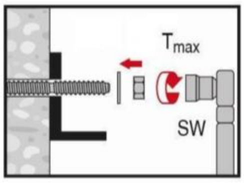
	Overhead application is permitted for HVU2 size M24. Insert the foil capsule with the peak ahead to the back of the hole.
	Drive the anchor rod with the plugged tool into the hole, applying moderate pressure. Rotary hammer tool in rotation hammer mode (450 RPM to maximum 1300 RPM). Setting tool see Annex B6. After reaching the embedment depth switch off setting machine immediately.
	Overhead installation. For overhead installation use the overhead dripping cup HIT-OHC.
	Loading the anchor: After required curing time t_{cure} (see Table B4) the anchor can be loaded. The applied installation torque shall not exceed the values $maxT_{fix}$ given in Table B2 and B3.

Table C1: Essential characteristics for HAS-(E) under tension load in concrete

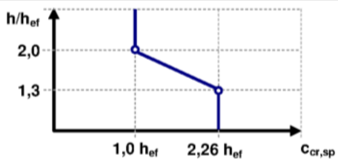
HAS-(E)...			**M24**	**M27**	**M30**
Robustness					
Hammer drilling and drilling with hollow drill bit TE-YD	γ_{inst}	[-]		1,0	
Diamond coring	γ_{inst}	[-]		1,0	
Steel failure					
HAS-(E) 5.8	$N_{Rk,s}$	[kN]	160,2	-	
Partial factor	$\gamma_{Ms,N}$ [1)]	[-]	1,50	-	
HAS-(E) 8.8	$N_{Rk,s}$	[kN]	256,4	347	421,5
Partial factor	$\gamma_{Ms,N}$ [1)]	[-]		1,50	
HAS-R	$N_{Rk,s}$	[kN]	224,3	216,9	263,4
Partial factor	$\gamma_{Ms,N}$ [1)]	[-]	1,87	2,86	
HAS-HCR	$N_{Rk,s}$	[kN]	224,3	-	
Partial factor	$\gamma_{Ms,N}$ [1)]	[-]	2,1	-	
Combined pullout and concrete cone failure in					
uncracked concrete C20/25 in **hammer drilled holes and with hollow drill bit TE-YD**					
Temperature range I: 24°C / 40°C	$\tau_{Rk,ucr}$	[N/mm²]		16,0	
Temperature range II: 50°C / 80°C	$\tau_{Rk,ucr}$	[N/mm²]		13,0	
Temperature range III: 72°C / 120°C	$\tau_{Rk,ucr}$	[N/mm²]		7,5	
uncracked concrete C20/25 in **diamond cored holes**					
Temperature range I: 24°C / 40°C	$\tau_{Rk,ucr}$	[N/mm²]		14,0	
Temperature range II: 50°C / 80°C	$\tau_{Rk,ucr}$	[N/mm²]		12,0	
Temperature range III: 72°C / 120°C	$\tau_{Rk,ucr}$	[N/mm²]		7,0	
Factor for concrete compressive strength	ψ_c	C30/37		1,08	
		C40/50		1,15	
		C50/60		1,20	

HVU2

Performances
Essential characteristics under tension load HAS-(E)

Annex C1

Table C1: continued

HAS-(E)...			**M24**	**M27**	**M30**
cracked concrete C20/25 in **hammer drilled holes and with hollow drill bit TE-YD**					
Temperature range I: 24°C / 40°C	$\tau_{Rk,cr}$	[N/mm²]	8,5		
Temperature range II: 50°C / 80°C	$\tau_{Rk,cr}$	[N/mm²]	6,5		
Temperature range III: 72°C / 120°C	$\tau_{Rk,cr}$	[N/mm²]	4,0		
Factor for concrete compressive strength for hammer drilled holes and hollow drill bit TE-YD	ψ_c	C30/37	1,08		
		C40/50	1,13		
		C50/60	1,18		
cracked concrete C20/25 in **diamond cored holes**					
Temperature range I: 24°C / 40°C	$\tau_{Rk,cr}$	[N/mm²]	7,0		
Temperature range II: 50°C / 80°C	$\tau_{Rk,cr}$	[N/mm²]	6,0		
Temperature range III: 72°C / 120°C	$\tau_{Rk,cr}$	[N/mm²]	3,5		
Factor for concrete compressive strength for diamond cored holes	ψ_c	C50/60	1,0		
Concrete cone failure					
Factor for uncracked concrete	k_{ucr}	[-]	11,0		
Factor for cracked concrete	k_{cr}	[-]	7,7		
Edge distance	$c_{cr,N}$	[mm]	$1,5 \cdot h_{ef}$		
Spacing	$s_{cr,N}$	[mm]	$3,0 \cdot h_{ef}$		
Splitting failure					
Edge distance $c_{cr,sp}$ [mm] for	$h / h_{ef} \geq 2,0$		$1,0 \cdot h_{ef}$		
	$2,0 > h / h_{ef} > 1,3$		$4,6 \cdot h_{ef} - 1,8 \cdot h$		
	$h / h_{ef} \leq 1,3$		$2,26 \cdot h_{ef}$		
Spacing	$s_{cr,sp}$	[mm]	$2 \cdot c_{cr,sp}$		

[1] In absence of other national regulations

HVU2

Performances
Essential characteristics under tension load HAS-(E)

Annex C2

Table C2: Essential characteristics for internally threaded sleeve HIS-(R)N under tension load in concrete

HIS-(R)N			**M20**
Robustness			
Hammer drilling and drilling with hollow drill bit TE-YD	γ_{inst}	[-]	1,0
Diamond coring	γ_{inst}	[-]	1,0
Steel failure			
HIS-N with with screw or threaded rod grade 8.8	$N_{Rk,s}$	[kN]	116
Partial factor	$\gamma_{Ms,N}$ 1)	[-]	1,5
HIS-RN with with screw or threaded rod grade 70	$N_{Rk,s}$	[kN]	166
Partial factor	$\gamma_{Ms,N}$ 1)	[-]	2,4
Combined pullout and concrete cone failure in			
uncracked concrete C20/25 in **hammer drilled holes and hammer drilled holes with hollow drill bit TE-YD**			
Diameter of fastener	d	[mm]	27,6
Temperature range I: 24°C / 40°C	$\tau_{Rk,ucr}$	[N/mm²]	11,0
Temperature range II: 50°C / 80°C	$\tau_{Rk,ucr}$	[N/mm²]	9,0
Temperature range III: 72°C / 120°C	$\tau_{Rk,ucr}$	[N/mm²]	5,5
uncracked concrete C20/25 in **diamond cored holes**			
Temperature range I: 24°C / 40°C	$\tau_{Rk,ucr}$	[N/mm²]	11,0
Temperature range II: 50°C / 80°C	$\tau_{Rk,ucr}$	[N/mm²]	9,0
Temperature range III: 72°C / 120°C	$\tau_{Rk,ucr}$	[N/mm²]	5,5
Factor for concrete compressive strength	ψ_c	C50/60	1,0

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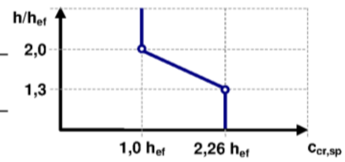
Table C2: continued

HIS-(R)N			**M20**
cracked concrete C20/25 in **hammer drilled holes and hammer drilled holes with hollow drill bit TE-YD**			
Temperature range I: 24°C / 40°C	$\tau_{Rk,cr}$	[N/mm²]	6,5
Temperature range II: 50°C / 80°C	$\tau_{Rk,cr}$	[N/mm²]	5,0
Temperature range III: 72°C / 120°C	$\tau_{Rk,cr}$	[N/mm²]	3,0
Factor for concrete compressive strength for hammer drilled holes and hollow drill bit TE-YD	ψ_c	C30/37	1,08
		C40/50	1,15
		C50/60	1,20
cracked concrete C20/25 in **diamond cored holes**			
Temperature range I: 24°C / 40°C	$\tau_{Rk,cr}$	[N/mm²]	4,5
Temperature range II: 50°C / 80°C	$\tau_{Rk,cr}$	[N/mm²]	3,5
Temperature range III: 72°C / 120°C	$\tau_{Rk,cr}$	[N/mm²]	2,5
Factor for concrete compressive strength for diamond cored holes	ψ_c	C50/60	1,0
Concrete cone failure			
Factor for uncracked concrete	k_{ucr}	[-]	11,0
Factor for cracked concrete	k_{cr}	[-]	7,7
Edge distance	$c_{cr,N}$	[mm]	$1,5 \cdot h_{ef}$
Spacing	$s_{cr,N}$	[mm]	$3,0 \cdot h_{ef}$
Splitting failure			
Edge distance $c_{cr,sp}$ [mm] for		$h / h_{ef} \geq 2,0$	$1,0 \cdot h_{ef}$
		$2,0 > h / h_{ef} > 1,3$	$4,6 h_{ef} - 1,8 h$
		$h / h_{ef} \leq 1,3$	$2,26 h_{ef}$
Spacing	$s_{cr,sp}$	[mm]	$2 \cdot c_{cr,sp}$



[1)] In absence of national regulations.

HVU2	**Annex C4**
Performances Essential characteristics under tension load HIS-(R)N	

Table C3: Essential characteristics for HAS-(E) under shear load in concrete

HAS-(E)...			M24	M27	M30
Robustness					
Hammer drilling and drilling with hollow drill bit TE-YD	γ_{inst}	[-]	1,0		
Diamond coring	γ_{inst}	[-]	1,0		
Steel failure without lever arm					
HAS-(E) 5.8	$V^0_{Rk,s}$	[kN]	80,1	-	-
Partial factor	$\gamma_{Ms,V}$ [1]	[-]	1,25	-	-
HAS-(E) 8.8	$V^0_{Rk,s}$	[kN]	128,2	173,5	210,7
Partial factor	$\gamma_{Ms,V}$ [1]	[-]	1,25		
HAS-R	$V^0_{Rk,s}$	[kN]	112,2	108,4	131,7
Partial factor	$\gamma_{Ms,V}$ [1]	[-]	1,56	2,38	
HAS-HCR	$V^0_{Rk,s}$	[kN]	112,2	-	-
Partial factor	$\gamma_{Ms,V}$ [1]	[-]	1,75	-	-
Ductility factor	k_7	[-]	1,0		
Steel failure with lever arm					
HAS-(E) 5.8	$M^0_{Rk,s}$	[kN]	486	-	-
Partial factor	$\gamma_{Ms,V}$ [1]	[-]	1,25	-	-
HAS-(E) 8.8	$M^0_{Rk,s}$	[kN]	777	1223	1638
Partial factor	$\gamma_{Ms,V}$ [1]	[-]	1,25		
HAS-R	$M^0_{Rk,s}$	[kN]	680	765	1023
Partial factor	$\gamma_{Ms,V}$ [1]	[-]	1,56	2,38	
HAS-HCR	$M^0_{Rk,s}$	[kN]	680	-	-
Partial factor	$\gamma_{Ms,V}$ [1]	[-]	1,75	-	-
Ductility factor	k_7	[-]	1,0		
Concrete pry-out failure					
Pry-out factor	k_8	[-]	2,0		
Concrete edge failure					
Effective length of fastener	l_f	[mm]	210	240	270
Outside diameter of fastener	d_{nom}	[mm]	24	27	30

[1] In absence of national regulations.

HVU2	Annex C5
Performances Essential characteristics under shear load HAS-(E)	

Table C4: Essential characteristics for internally threaded sleeve HIS-(R)N under shear load in concrete

HIS-(R)N			**M20**
Robustness			
Hammer drilling and drilling with hollow drill bit TE-YD	γ_{inst}	[-]	1,0
Diamond coring	γ_{inst}	[-]	1,0
Steel failure without lever arm			
HIS-N with screw or threaded rod grade 8.8	$V^0_{Rk,s}$	[kN]	58
Partial factor	$\gamma_{Ms,V}$ 1)	[-]	1,25
HIS-RN with screw or threaded rod grade 70	$V^0_{Rk,s}$	[kN]	83
Partial factor	$\gamma_{Ms,V}$ 1)	[-]	2,0
Ductility factor	k_7	[-]	1,0
Steel failure with lever arm			
HIS-N with screw or threaded rod grade 8.8	$M^0_{Rk,s}$	[Nm]	519
Partial factor	$\gamma_{Ms,V}$ 1)	[-]	1,25
HIS-RN with screw or threaded rod grade 70	$M^0_{Rk,s}$	[Nm]	454
Partial factor	$\gamma_{Ms,V}$ 1)	[-]	1,56
Ductility factor	k_7	[-]	1,0
Concrete pry-out failure			
Pry-out factor	k_8	[-]	2,0
Concrete edge failure			
Effective length of fastener	l_f	[mm]	205
Outside diameter of fastener	d_{nom}	[mm]	27,6

1) In absence of national regulations.

HVU2	**Annex C6**
Performances Essential characteristics under shear load HIS-(R)N	

Table C5: Displacements for HAS-(E) under tension load[1)]

HAS-(E)-…			M24	M27	M30
Uncracked concrete					
Temperature range I to III					
Displacement	δ_{N0}-factor	[mm/(N/mm²)]	0,06	0,15	
Displacement	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	0,10	0,30	
Cracked concrete					
Temperature range I to III					
Displacement	δ_{N0}-factor	[mm/(N/mm²)]	0,10	0,15	
Displacement	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	0,14	0,30	

1) Calculation of the displacement
$\delta_{N0} = \delta_{N0}\text{-factor} \cdot \tau$; $\delta_{N\infty} = \delta_{N\infty}\text{-factor} \cdot \tau$ (τ: action bond stress).

Table C6: Displacements for HAS-(E) under shear load[1)]

HAS-(E)-…			M24	M27	M30
Displacement	δ_{V0}-factor	[mm/kN]	0,03	0,03	
Displacement	$\delta_{V\infty}$-factor	[mm/kN]	0,05	0,05	

1) Calculation of the displacement
$\delta_{V0} = \delta_{V0}\text{-factor} \cdot V$; $\delta_{V\infty} = \delta_{V\infty}\text{-factor} \cdot V$ (V: action shear load).

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Table C7: Displacements for internally threaded sleeves HIS-(R)N under tension load[1)]

HIS-(R)N			**M20**
Uncracked concrete			
Temperature range I to III			
Displacement	δ_{N0}-factor	[mm/(N/mm²)]	0,15
Displacement	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	0,15
Cracked concrete			
Temperature range I to III			
Displacement	δ_{N0}-factor	[mm/10kN]	0,20
Displacement	$\delta_{N\infty}$-factor	[mm/10kN]	0,20

[1)] Calculation of the displacement
$\delta_{N0} = \delta_{N0}\text{-factor} \cdot N$; $\delta_{N\infty} = \delta_{N\infty}\text{-factor} \cdot N$ (N: action tension load).

Table C8: Displacements for internally threaded sleeves HIS-(R)N under shear load[1)]

HIS-(R)N			**M20**
Displacement	δ_{V0}-factor	[mm/kN]	0,04
Displacement	$\delta_{V\infty}$-factor	[mm/kN]	0,06

[1)] Calculation of the displacement
$\delta_{V0} = \delta_{V0}\text{-factor} \cdot V$; $\delta_{V\infty} = \delta_{V\infty}\text{-factor} \cdot V$ (V: action shear load).

HVU2

Performances
Displacements HIS-(R)N

Annex C8