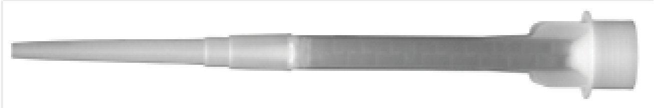
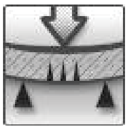
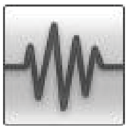
Hilti HIT-RE 500-SD mortar with HIT-V rod

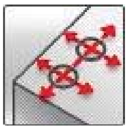
Injection mortar system		Benefits
	Hilti HIT-RE 500-SD 330 ml foil pack (also available as 500 ml and 1400 ml foil pack)	- **SAFEset** technology: drilling and borehole cleaning in one step with Hilti hollow drill bit - suitable for non-cracked and cracked concrete C 20/25 to C 50/60 - ETA seismic approval C1 - high loading capacity - suitable for dry and water saturated concrete - large diameter applications - high corrosion resistant - long working time at elevated temperatures - odourless epoxy - embedment depth range: from 40 … 160 mm for M8 to 120 … 600 mm for M30
	Static mixer	
	HIT-V rod	

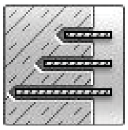

Concrete


Tensile zone


Seismic ETA-C1


Shock


Small edge distance and spacing


Variable embedment depth


Fire resistance

SAFEset
Hilti SAFEset technology with hollow drill bit

A4 316
Corrosion resistance

HCR highMo
High corrosion resistance


European Technical Approval

CE
CE conformity


PROFIS Anchor design software

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval [a)]	DIBt, Berlin	ETA-07/0260 / 2013-06-26
ES report icl. seismic	ICC evaluation service	ESR 2322 / 2014-02-01
Shockproof fastenings in civil defence installations	Federal Office for Cicil Protection, Bern	BZS D 08-604 / 2009-10-21
Fire test report	MFPA, Leipzig	GS-III/B-07-070 / 2008-01-18
Assessment report (fire)	warringtonfire	WF 327804/B / 2013-07-10

a) All data given in this section according ETA-07/0260, issue 2013-06-26.

Basic loading data (for a single anchor)

All data in this section applies to For details see Simplified design method

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- *Steel* failure
- Base material thickness, as specified in the table
- One typical embedment depth, as specified in the table
- One anchor material, as specified in the tables
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²
- Temperate range I
  (min. base material temperature -40°C, max. long term/short term base material temperature: +24°C/40°C)
- Installation temperature range +5°C to +40°C

Embedment depth [a)] and base material thickness for the basic loading data. Mean ultimate resistance, characteristic resistance, design resistance, recommended loads.

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
Typical embedment depth [mm]	80	90	110	125	170	210	240	270
Base material thickness [mm]	110	120	140	165	220	270	300	340

a) The allowed range of embedment depth is shown in the setting details. The corresponding load values can be calculated according to the simplified design method.

Mean ultimate resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HIT-V 5.8

	Data according ETA-07/0260, issue 2013-06-26							
Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
Non cracked concrete								
Tensile $N_{Ru,m}$ HIT-V 5.8 [kN]	*18,9*	*30,5*	*44,1*	*83,0*	*129,2*	*185,9*	*241,5*	*295,1*
Shear $V_{Ru,m}$ HIT-V 5.8 [kN]	*9,5*	*15,8*	*22,1*	*41,0*	*64,1*	*92,4*	*120,8*	*147,0*
Cracked concrete								
Tensile $N_{Ru,m}$ HIT-V 5.8 [kN]	*18,9*	*30,5*	*44,1*	65,2	110,8	146,1	196,0	226,2
Shear $V_{Ru,m}$ HIT-V 5.8 [kN]	*9,5*	*15,8*	*22,1*	*41,0*	*64,1*	*92,4*	*120,8*	*147,0*

Characteristic resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HIT-V 5.8

	Data according ETA-07/0260, issue 2013-06-26							
Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
Non cracked concrete								
Tensile N_{Rk} HIT-V 5.8 [kN]	*18,0*	*29,0*	*42,0*	70,6	111,9	153,7	187,8	224,0
Shear V_{Rk} HIT-V 5.8 [kN]	*9,0*	*15,0*	*21,0*	*39,0*	*61,0*	*88,0*	*115,0*	*140,0*
Cracked concrete								
Tensile N_{Rk} HIT-V 5.8 [kN]	*16,1*	*22,6*	*31,1*	44,0	74,8	109,6	132,3	152,7
Shear V_{Rk} HIT-V 5.8 [kN]	*9,0*	*15,0*	*21,0*	*39,0*	*61,0*	*88,0*	*115,0*	*140,0*

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HIT-V 5.8

	Data according ETA-07/0260, issue 2013-06-26							
Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
Non cracked concrete								
Tensile N_{Rd} HIT-V 5.8 [kN]	12,0	19,3	28,0	33,6	53,3	73,2	89,4	106,7
Shear V_{Rd} HIT-V 5.8 [kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
Cracked concrete								
Tensile N_{Rd} HIT-V 5.8 [kN]	8,9	12,6	17,3	20,9	35,6	52,2	63,0	72,7
Shear V_{Rd} HIT-V 5.8 [kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0

Recommended loads a): concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HIT-V 5.8

			Data according ETA-07/0260, issue 2013-06-26							
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Non cracked concrete										
Tensile N_{rec}	HIT-V 5.8	[kN]	8,6	13,8	20,0	24,0	38,1	52,3	63,9	76,2
Shear V_{rec}	HIT-V 5.8	[kN]	5,1	8,6	12,0	22,3	34,9	50,3	65,7	80,0
Cracked concrete										
Tensile N_{rec}	HIT-V 5.8	[kN]	6,4	9,0	12,3	15,0	25,4	37,3	45,0	51,9
Shear V_{rec}	HIT-V 5.8	[kN]	5,1	8,6	12,0	22,3	34,9	50,3	65,7	80,0

a) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Service temperature range

Hilti HIT-RE 500-SD injection mortar may be applied in the temperature ranges given below. An elevated base material temperature may lead to a reduction of the design bond resistance.

Temperature range	Base material temperature	Maximum long term base material temperature	Maximum short term base material temperature
Temperature range I	-40 °C to +40 °C	+24 °C	+40 °C
Temperature range II	-40 °C to +58 °C	+35 °C	+58 °C
Temperature range III	-40 °C to +70 °C	+43 °C	+70 °C

Max short term base material temperature
Short-term elevated base material temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.

Max long term base material temperature
Long-term elevated base material temperatures are roughly constant over significant periods of time.

Materials

Mechanical properties of HIT-V / HAS

			Data according ETA-07/0260, issue 2013-06-26							
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Nominal tensile strength f_{uk}	HIT-V 5.8	[N/mm²]	500	500	500	500	500	500	500	500
	HIT-V 8.8	[N/mm²]	800	800	800	800	800	800	800	800
	HIT-V-R	[N/mm²]	700	700	700	700	700	700	500	500
	HIT-V-HCR	[N/mm²]	800	800	800	800	800	700	700	700
Yield strength f_{yk}	HIT-V 5.8	[N/mm²]	400	400	400	400	400	400	400	400
	HIT-V 8.8	[N/mm²]	640	640	640	640	640	640	640	640
	HIT-V -R	[N/mm²]	450	450	450	450	450	450	210	210
	HIT-V -HCR	[N/mm²]	600	600	600	600	600	400	400	400
Stressed cross-section A_s	HIT-V	[mm²]	36,6	58,0	84,3	157	245	353	459	561
Moment of resistance W	HIT-V	[mm³]	31,2	62,3	109	277	541	935	1387	1874

Material quality

Part	Material
Threaded rod HIT-V(F) 5.8	Strength class 5.8, A_5 > 8% ductile steel galvanized ≥ 5 µm, (F) hot dipped galvanized ≥ 45 µm,
Threaded rod HIT-V(F) 8.8	Strength class 8.8, A_5 > 8% ductile steel galvanized ≥ 5 µm, (F) hot dipped galvanized ≥ 45 µm,
Threaded rod HIT-V-R	Stainless steel grade A4, A_5 > 8% ductile strength class 70 for ≤ M24 and class 50 for M27 to M30, 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362
Threaded rod HIT-V-HCR	High corrosion resistant steel, 1.4529; 1.4565 strength ≤ M20: R_m = 800 N/mm², $R_{p\ 0.2}$ = 640 N/mm², A_5 > 8% ductile M24 to M30: R_m = 700 N/mm², $R_{p\ 0.2}$ = 400 N/mm², A_5 > 8% ductile
Washer ISO 7089	Steel galvanized, hot dipped galvanized
	Stainless steel, 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362
	High corrosion resistant steel, 1.4529; 1.4565
Nut EN ISO 4032	Strength class 8, steel galvanized ≥ 5 µm, hot dipped galvanized ≥ 45 µm
	Strength class 70, stainless steel grade A4, 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362
	Strength class 70, high corrosion resistant steel, 1.4529; 1.4565

Anchor dimensions

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
Anchor embedment depth [mm]	80	90	110	125	170	210	240	270
Anchor rod HIT-V, HIT-V-R, HIT-V-HCR	Anchor rods HIT-V (-R / -HCR) are available in variable length							

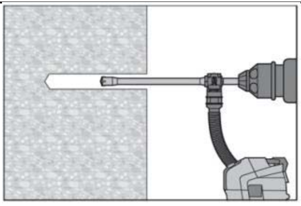
Setting

installation equipment

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
Rotary hammer	TE2 – TE16				TE40 – TE70			
Other tools	compressed air gun or blow out pump, set of cleaning brushes, dispenser							

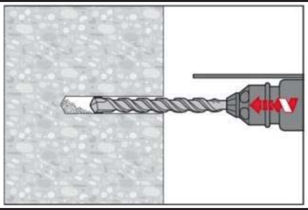
Setting instruction

Bore hole drilling



Drill hole to the required embedment depth with an appropriately sized Hilti TE-CD or TE-YD hollow drill bit with Hilti vacuum attachment. This drilling system removes the dust and cleans the borehole during drilling when using in accordance with the user's manual.

After drilling is complete, proceed to the "injection preparation" step in the instructions for use.

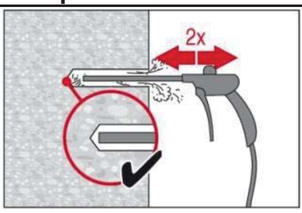


Drill Hole to the required embedment depth with a hammer drill set in rotation-hammer mode using an appropriately sized carbide drill bit.

Bore hole cleaning

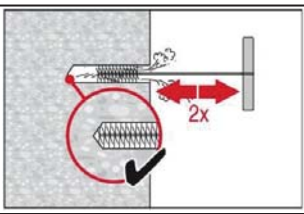
Just before setting an anchor, the bore hole must be free of dust and debris.

Compressed air cleaning (CAC) for all bore hole diameters d_0 and all bore hole depth h_0

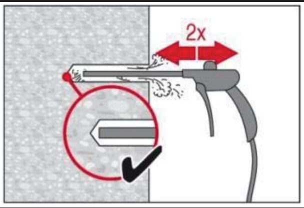


Blow 2 times from the back of the hole (if needed with nozzle extension) over the hole length with oil-free compressed air (min. 6 bar at 6 m³/h) until return air stream is free of noticeable dust.

Bore hole diameter ≥ 32 mm the compressor must supply a minimum air flow of 140 m³/hour.

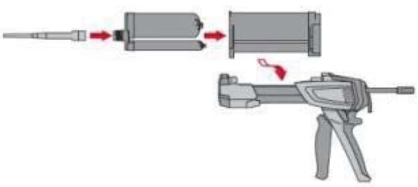


Brush 2 times with the specified brush size by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it.
The brush must produce natural resistance as it enters the bore hole -- if not the brush is too small and must be replaced with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

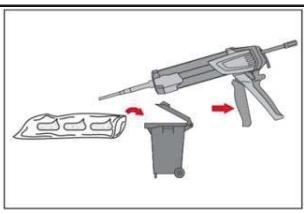


Blow again with compressed air 2 times until return air stream is free of noticeable dust.

Injection preparation



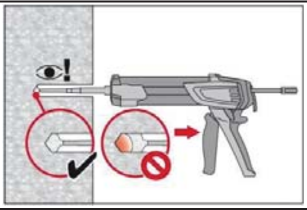
Tightly attach new Hilti mixing nozzle HIT-RE-M to foil pack manifold (snug fit). Do not modify the mixing nozzle.
Observe the instruction for use of the dispenser and the mortar. Check foil pack holder for proper function. Do not use damaged foil packs / holders. Insert foil pack into foil pack holder and put holder into HIT-dispenser.



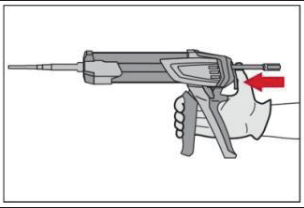
The foil pack opens automatically as dispensing is initiated. Discard initial adhesive. Depending on the size of the foil pack an initial amount of adhesive has to be discarded.
Discard quantities are:

- 3 strokes for 330 ml foil pack,
- 4 strokes for 500 ml foil pack,
- 65 ml for 1400 ml foil pack ≤ 5°C.

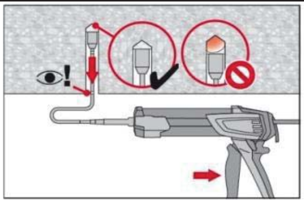
Inject adhesive from the back of the borehole without forming air voids



Inject the adhesive starting at the back of the hole, slowly withdrawing the mixer with each trigger pull.
Fill holes approximately 2/3 full It is required that the annular gap between the anchor and the concrete is completely filled with adhesive along the embedment length.

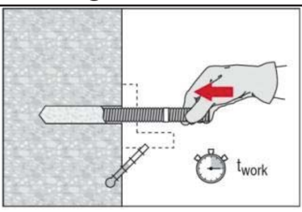


After injection is completed, depressurize the dispenser by pressing the release trigger. This will prevent further adhesive discharge from the mixer.

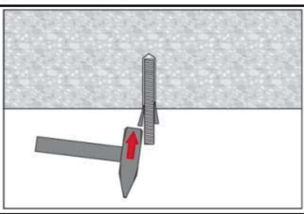


Overhead installation and/or installation with embedment depth h_{ef} > 250mm.
For overhead installation the injection is only possible with the aid of extensions and piston plugs. Assemble HIT-RE-M mixer, extension(s) and appropriately sized piston plug (HIT-SZ). Insert piston plug to back of the hole and inject adhesive. During injection the piston plug will be naturally extruded out of the bore hole by the adhesive pressure.

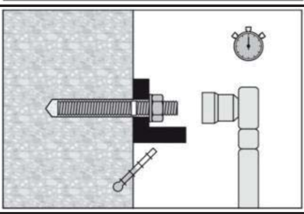
Setting the element



Before use, verify that the element is dry and free of oil and other contaminants.
Mark and set element to the required embedment depth untill working time t_{work} has elapsed.



For overhead installation use piston plugs and fix embedded parts with e.g. wedges HIT-OHW.



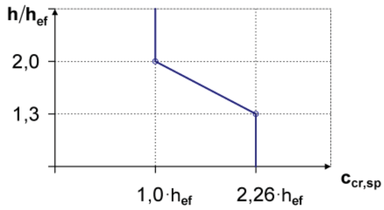
Loading the anchor:
After required curing time t_{cure} the anchor can be loaded.
The applied installation torque shall not exceed given T_{max}.

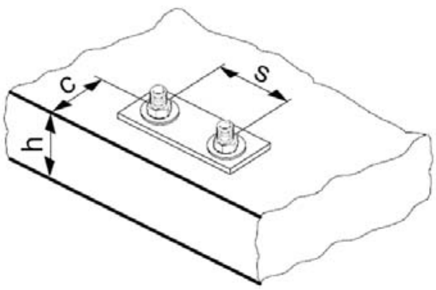
For detailed information on installation see instruction for use given with the package of the product.

Curing time for general conditions

Data according ETA-07/0260, issue 2013-06-26		
Temperature of the base material	Working time in which anchor can be inserted and adjusted t_{gel}	Curing time before anchor can be fully loaded t_{cure}
40 °C	12 min	4 h
30 °C to 39 °C	12 min	8 h
20 °C to 29 °C	20 min	12 h
15 °C to 19 °C	30 min	24 h
10 °C to 14 °C	90 min	48 h
5 °C to 9 °C	120 min	72 h

Setting details

			Data according ETA-07/0260, issue 2013-06-26							
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Nominal diameter of drill bit	d_0	[mm]	10	12	14	18	24	28	30	35
Effective anchorage and drill hole depth range a)	$h_{ef,min}$	[mm]	40	40	48	64	80	96	108	120
	$h_{ef,max}$	[mm]	160	200	240	320	400	480	540	600
Minimum base material thickness	h_{min}	[mm]	h_{ef} + 30 mm ≥ 100 mm			h_{ef} + 2 d_0				
Diameter of clearance hole in the fixture	d_f	[mm]	9	12	14	18	22	26	30	33
Minimum spacing	s_{min}	[mm]	40	50	60	80	100	120	135	150
Minimum edge distance	c_{min}	[mm]	40	50	60	80	100	120	135	150
Critical spacing for splitting failure	$s_{cr,sp}$		2 $c_{cr,sp}$							
Critical edge distance for splitting failure b)	$c_{cr,sp}$	[mm]	**1,0 · h_{ef}** for h / h_{ef} ≥ 2,0 **4,6 h_{ef} - 1,8 h** for 2,0 > h / h_{ef} > 1,3 **2,26 h_{ef}** for h / h_{ef} ≤ 1,3							
Critical spacing for concrete cone failure	$s_{cr,N}$		2 $c_{cr,N}$							
Critical edge distance for concrete cone failure c)	$c_{cr,N}$		1,5 h_{ef}							
Torque moment d)	T_{max}	[Nm]	10	20	40	80	150	200	270	300



For spacing (edge distance) smaller than critical spacing (critical edge distance) the design loads have to be reduced.

a) $h_{ef,min}$ ≤ h_{ef} ≤ $h_{ef,max}$ (h_{ef}: embedment depth)

b) h: base material thickness (h ≥ h_{min})

c) The critical edge distance for concrete cone failure depends on the embedment depth h_{ef} and the design bond resistance. The simplified formula given in this table is on the save side.

d) This is the maximum recommended torque moment to avoid splitting failure during installation for anchors with minimum spacing and/or edge distance.

Simplified design method

Simplified version of the design method according ETAG 001, TR 029. Design resistance according data given in ETA-07/0260, issue 2013-06-26.

- Influence of concrete strength
- Influence of edge distance
- Influence of spacing
- Valid for a group of two anchors. (The method may also be applied for anchor groups with more than two anchors or more than one edge distance. The influencing factors must then be considered for each edge distance and spacing. The calculated design loads are then on the save side: They will be lower than the exact values according ETAG 001, TR 029. To avoid this, it is recommended to use the anchor design software PROFIS anchor)

The design method is based on the following simplification:

- No different loads are acting on individual anchors (no eccentricity)

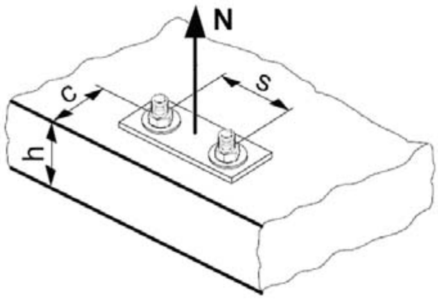
The values are valid for one anchor.

For more complex fastening applications please use the anchor design software PROFIS Anchor.

Tension loading

The design tensile resistance is the lower value of

- Steel resistance: $N_{Rd,s}$
- Combined pull-out and concrete cone resistance:
  $N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,p} \cdot f_{re,N}$
- Concrete cone resistance: $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$
- Concrete splitting resistance (only non-cracked concrete):
  $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,N} \cdot f_{re,N}$



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

			Data according ETA-07/0260, issue 2013-06-26							
Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
$N_{Rd,s}$	HIT-V 5.8	[kN]	12,0	19,3	28,0	52,7	82,0	118,0	153,3	187,3
	HIT-V 8.8	[kN]	19,3	30,7	44,7	84,0	130,7	188,0	244,7	299,3
	HIT-V-R	[kN]	13,9	21,9	31,6	58,8	92,0	132,1	80,4	98,3
	HIT-V-HCR	[kN]	19,3	30,7	44,7	84,0	130,7	117,6	152,9	187,1

Design combined pull-out and concrete cone resistance

$N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,p} \cdot f_{re,N}$

	Data according ETA-07/0260, issue 2013-06-26							
Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Typical embedment depth $h_{ef,typ}$ [mm]	**80**	**90**	**110**	**125**	**170**	**210**	**240**	**270**
Non cracked concrete								
$N^0_{Rd,p}$ Temperature range I [kN]	17,9	25,1	36,9	44,9	76,3	105,6	135,7	157,5
$N^0_{Rd,p}$ Temperature range II [kN]	14,5	20,4	29,9	35,9	61,0	82,9	106,6	133,3
$N^0_{Rd,p}$ Temperature range III [kN]	8,9	12,6	18,4	22,4	35,6	52,8	63,0	78,8
Cracked concrete								
$N^0_{Rd,p}$ Temperature range I [kN]	8,9	12,6	17,3	20,9	35,6	52,8	63,0	72,7
$N^0_{Rd,p}$ Temperature range II [kN]	7,3	9,4	13,8	18,0	28,0	41,5	48,5	60,6
$N^0_{Rd,p}$ Temperature range III [kN]	4,5	5,5	8,1	10,5	15,3	22,6	29,1	36,4

Design concrete cone resistance $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$
Design splitting resistance a) $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,N} \cdot f_{re,N}$

	Data according ETA-07/0260, issue 2013-06-26							
Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
$N^0_{Rd,c}$ Non cracked concrete [kN]	20,1	24,0	32,4	33,6	53,3	73,2	89,4	106,7
$N^0_{Rd,c}$ Cracked concrete [kN]	14,3	17,1	23,1	24,0	38,0	52,2	63,7	76,1

a) Splitting resistance must only be considered for non-cracked concrete

Influencing factors

Influence of concrete strength on combined pull-out and concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_{B,p} = (f_{ck,cube}/25N/mm^2)^{0,1}$ a)	1	1,02	1,04	1,06	1,07	1,08	1,09

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of embedment depth on combined pull-out and concrete cone resistance

$$f_{h,p} = h_{ef}/h_{ef,typ}$$

Influence of concrete strength on concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of edge distance [a)]

$c/c_{cr,N}$ $c/c_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{1,N} = 0{,}7 + 0{,}3 \cdot c/c_{cr,N}$ $f_{1,sp} = 0{,}7 + 0{,}3 \cdot c/c_{cr,sp}$	0,73	0,76	0,79	0,82	0,85	0,88	0,91	0,94	0,97	1
$f_{2,N} = 0{,}5 \cdot (1 + c/c_{cr,N})$ $f_{2,sp} = 0{,}5 \cdot (1 + c/c_{cr,sp})$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The the edge distance shall not be smaller than the minimum edge distance c_{min} given in the table with the setting details. These influencing factors must be considered for every edge distance smaller than the critical edge distance.

Influence of anchor spacing [a)]

$s/s_{cr,N}$ $s/s_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{3,N} = 0{,}5 \cdot (1 + s/s_{cr,N})$ $f_{3,sp} = 0{,}5 \cdot (1 + s/s_{cr,sp})$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The anchor spacing shall not be smaller than the minimum anchor spacing s_{min} given in the table with the setting details. This influencing factor must be considered for every anchor spacing.

Influence of embedment depth on concrete cone resistance

$$f_{h,N} = (h_{ef}/h_{ef,typ})^{1,5}$$

Influence of reinforcement

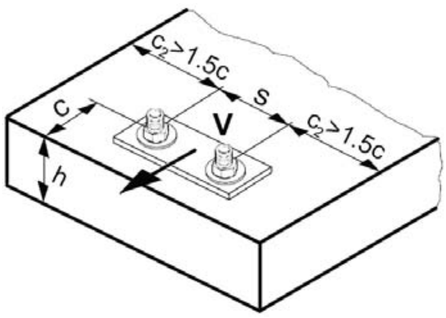
h_{ef} [mm]	40	50	60	70	80	90	≥ 100
$f_{re,N} = 0{,}5 + h_{ef}/200\text{mm} \leq 1$	0,7 [a)]	0,75 [a)]	0,8 [a)]	0,85 [a)]	0,9 [a)]	0,95 [a)]	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing ≥ 150 mm (any diameter) or with a diameter ≤ 10 mm and a spacing ≥ 100 mm, then a factor f_{re} = 1 may be applied.

Shear loading

The design shear resistance is the lower value of

- Steel resistance: $V_{Rd,s}$
- Concrete pryout resistance: $V_{Rd,cp} = k \cdot$ lower value of $N_{Rd,p}$ and $N_{Rd,c}$
- Concrete edge resistance: $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

			Data according ETA-07/0260, issue 2013-06-26							
Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
$V_{Rd,s}$	HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
	HIT-V 8.8	[kN]	12,0	18,4	27,2	50,4	78,4	112,8	147,2	179,2
	HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8
	HIT-V-HCR	[kN]	12,0	18,4	27,2	50,4	78,4	70,9	92,0	112,0

Design concrete pryout resistance $V_{Rd,cp}$ = lower value[a)] of $k \cdot N_{Rd,p}$ and $k \cdot N_{Rd,c}$

$k = 1$ for $h_{ef} < 60$ mm
$k = 2$ for $h_{ef} \geq 60$ mm

a) $N_{Rd,p}$: Design combined pull-out and concrete cone resistance
$N_{Rd,c}$: Design concrete cone resistance

Design concrete edge resistance $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size		M8	M10	M12	M16	M20	M24	M27	M30
Non-cracked concrete									
$V^0_{Rd,c}$	[kN]	5,9	8,6	11,6	18,7	27,0	36,6	44,5	53,0
Cracked concrete									
$V^0_{Rd,c}$	[kN]	4,2	6,1	8,2	13,2	19,2	25,9	31,5	37,5

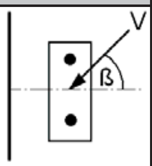
Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of angle between load applied and the direction perpendicular to the free edge

Angle ß	0°	10°	20°	30°	40°	50°	60°	70°	80°	≥ 90°
$f_\beta = \sqrt{\frac{1}{(\cos\alpha_V)^2 + \left(\frac{\sin\alpha_V}{2,5}\right)^2}}$ 	1	1,01	1,05	1,13	1,24	1,40	1,64	1,97	2,32	2,50

Influence of base material thickness

h/c	0,15	0,3	0,45	0,6	0,75	0,9	1,05	1,2	1,35	≥ 1,5
$f_h = \{h/(1,5 \cdot c)\}^{1/2} \leq 1$	0,32	0,45	0,55	0,63	0,71	0,77	0,84	0,89	0,95	1,00

Influence of anchor spacing and edge distance [a)] for concrete edge resistance: f_4

$f_4 = (c/h_{ef})^{1,5} \cdot (1 + s / [3 \cdot c]) \cdot 0,5$

c/h_{ef}	Single anchor	Group of two anchors s/h_{ef}														
		0,75	1,50	2,25	3,00	3,75	4,50	5,25	6,00	6,75	7,50	8,25	9,00	9,75	10,50	11,25
0,50	0,35	0,27	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35
0,75	0,65	0,43	0,54	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65
1,00	1,00	0,63	0,75	0,88	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
1,25	1,40	0,84	0,98	1,12	1,26	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40
1,50	1,84	1,07	1,22	1,38	1,53	1,68	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84
1,75	2,32	1,32	1,49	1,65	1,82	1,98	2,15	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32
2,00	2,83	1,59	1,77	1,94	2,12	2,30	2,47	2,65	2,83	2,83	2,83	2,83	2,83	2,83	2,83	2,83
2,25	3,38	1,88	2,06	2,25	2,44	2,63	2,81	3,00	3,19	3,38	3,38	3,38	3,38	3,38	3,38	3,38
2,50	3,95	2,17	2,37	2,57	2,77	2,96	3,16	3,36	3,56	3,76	3,95	3,95	3,95	3,95	3,95	3,95
2,75	4,56	2,49	2,69	2,90	3,11	3,32	3,52	3,73	3,94	4,15	4,35	4,56	4,56	4,56	4,56	4,56
3,00	5,20	2,81	3,03	3,25	3,46	3,68	3,90	4,11	4,33	4,55	4,76	4,98	5,20	5,20	5,20	5,20
3,25	5,86	3,15	3,38	3,61	3,83	4,06	4,28	4,51	4,73	4,96	5,18	5,41	5,63	5,86	5,86	5,86
3,50	6,55	3,51	3,74	3,98	4,21	4,44	4,68	4,91	5,14	5,38	5,61	5,85	6,08	6,31	6,55	6,55
3,75	7,26	3,87	4,12	4,36	4,60	4,84	5,08	5,33	5,57	5,81	6,05	6,29	6,54	6,78	7,02	7,26
4,00	8,00	4,25	4,50	4,75	5,00	5,25	5,50	5,75	6,00	6,25	6,50	6,75	7,00	7,25	7,50	7,75
4,25	8,76	4,64	4,90	5,15	5,41	5,67	5,93	6,18	6,44	6,70	6,96	7,22	7,47	7,73	7,99	8,25
4,50	9,55	5,04	5,30	5,57	5,83	6,10	6,36	6,63	6,89	7,16	7,42	7,69	7,95	8,22	8,49	8,75
4,75	10,35	5,45	5,72	5,99	6,27	6,54	6,81	7,08	7,36	7,63	7,90	8,17	8,45	8,72	8,99	9,26
5,00	11,18	5,87	6,15	6,43	6,71	6,99	7,27	7,55	7,83	8,11	8,39	8,66	8,94	9,22	9,50	9,78
5,25	12,03	6,30	6,59	6,87	7,16	7,45	7,73	8,02	8,31	8,59	8,88	9,17	9,45	9,74	10,02	10,31
5,50	12,90	6,74	7,04	7,33	7,62	7,92	8,21	8,50	8,79	9,09	9,38	9,67	9,97	10,26	10,55	10,85

a) The anchor spacing and the edge distance shall not be smaller than the minimum anchor spacing s_{min} and the minimum edge distance c_{min}.

Influence of embedment depth

h_{ef}/d	4	4,5	5	6	7	8	9	10	11
$f_{hef} = 0,05 \cdot (h_{ef} / d)^{1,68}$	0,51	0,63	0,75	1,01	1,31	1,64	2,00	2,39	2,81
h_{ef}/d	12	13	14	15	16	17	18	19	20
$f_{hef} = 0,05 \cdot (h_{ef} / d)^{1,68}$	3,25	3,72	4,21	4,73	5,27	5,84	6,42	7,04	7,67

Influence of edge distance [a)]

c/d	4	6	8	10	15	20	30	40
$f_c = (d / c)^{0,19}$	0,77	0,71	0,67	0,65	0,60	0,57	0,52	0,50

a) The edge distance shall not be smaller than the minimum edge distance c_{min}.

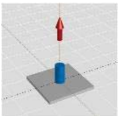
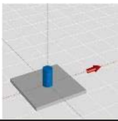
Combined tension and shear loading

For combined tension and shear loading see section “Anchor Design”.

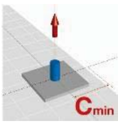
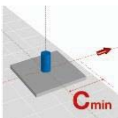
Precalculated values

Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

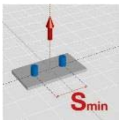
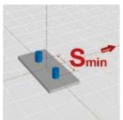
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I

		Data according ETA-07/0260, issue 2013-06-26							
Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Embedment depth $h_{ef,1}$ = [mm]		48	60	72	96	120	144	162	180
Base material thickness h_{min}= [mm]		100	100	102	132	168	200	222	250
	Tensile N_{Rd}: single anchor, no edge effects								
	Non cracked concrete								
	HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR [kN]	9,3	13,0	17,1	22,6	31,6	41,6	49,6	58,1
	Cracked concrete								
	HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR [kN]	5,4	8,4	11,3	16,1	22,5	29,6	35,3	41,4
	Shear V_{Rd}: single anchor, no edge effects, without lever arm								
	Non cracked concrete								
	HIT-V 5.8 [kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
	HIT-V 8.8 [kN]	11,2	18,4	27,2	50,4	78,4	112,8	138,8	162,6
	HIT-V-R [kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8
	HIT-V-HCR [kN]	11,2	18,4	27,2	50,4	78,4	70,9	92,0	112,0
	Cracked concrete								
	HIT-V 5.8 [kN]	6,4	12,0	16,8	31,2	48,8	70,4	92,0	112,0
	HIT-V 8.8 [kN]	6,4	18,4	27,1	45,0	63,1	82,9	99,0	115,9
	HIT-V-R [kN]	6,4	12,8	19,2	35,3	55,1	79,5	48,3	58,8
	HIT-V-HCR [kN]	6,4	18,4	27,1	45,0	63,1	70,9	92,0	112,0

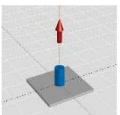
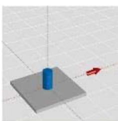
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I

		Data according ETA-07/0260, issue 2013-06-26							
Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Embedment depth $h_{ef,1}$ = [mm]		48	60	72	96	120	144	162	180
Base material thickness h_{min}= [mm]		100	100	102	132	168	200	222	250
Edge distance $c = c_{min}$= [mm]		40	50	60	80	100	120	135	150
	Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)								
	Non cracked concrete								
	HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR [kN]	6,3	8,5	9,9	12,9	18,2	23,8	28,2	33,2
	Cracked concrete								
	HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR [kN]	3,6	5,6	7,1	9,2	12,9	16,9	20,1	23,7
	Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$), without lever arm								
	Non cracked concrete								
	HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR [kN]	3,4	4,9	6,7	10,8	15,7	21,4	26,0	31,1
	Cracked concrete								
	HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR [kN]	2,4	3,5	4,7	7,6	11,1	15,1	18,4	22,0

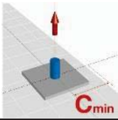
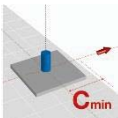
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I
(load values are valid for single anchor)

		Data according ETA-07/0260, issue 2013-06-26							
Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Embedment depth $h_{ef,1}$ =	[mm]	48	60	72	96	120	144	162	180
Base material thickness h_{min}=	[mm]	100	100	102	132	168	200	222	250
Spacing s = s_{min}=	[mm]	40	50	60	80	100	120	135	150
Tensile N_{Rd}: double anchor, no edge effects, min. spacing (s = s_{min})									
Non cracked concrete									
HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	6,0	8,2	10,3	13,5	19,0	24,9	29,6	34,8
Cracked concrete									
 HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	3,6	5,5	7,4	9,6	13,5	17,8	21,1	24,8
Shear V_{Rd}: double anchor, no edge effects, min. spacing (s = s_{min}) , without lever arm									
Non cracked concrete									
HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	88,7	103,9
HIT-V 8.8	[kN]	7,2	18,4	26,3	40,5	56,5	74,3	88,7	103,9
HIT-V-R	[kN]	7,2	12,8	19,2	35,3	55,1	74,3	48,3	58,8
HIT-V-HCR	[kN]	7,2	18,4	26,3	40,5	56,5	70,9	88,7	103,9
Cracked concrete									
 HIT-V 5.8	[kN]	4,1	12,0	16,8	28,8	40,3	53,0	63,2	74,1
HIT-V 8.8	[kN]	4,1	12,8	17,3	28,8	40,3	53,0	63,2	74,1
HIT-V-R	[kN]	4,1	12,8	17,3	28,8	40,3	53,0	48,3	58,8
HIT-V-HCR	[kN]	4,1	12,8	17,3	28,8	40,3	53,0	63,2	74,1

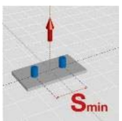
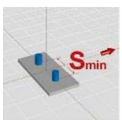
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I

		Data according ETA-07/0260, issue 2013-06-26							
Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Embedment depth $h_{ef,typ}$ =	[mm]	80	90	110	125	170	210	240	270
Base material thickness h_{min}=	[mm]	110	120	140	161	218	266	300	340
Tensile N_{Rd}: single anchor, no edge effects									
Non cracked concrete									
HIT-V 5.8	[kN]	12,0	19,3	28,0	33,6	53,3	73,2	89,4	106,7
HIT-V 8.8	[kN]	17,9	24,0	32,4	33,6	53,3	73,2	89,4	106,7
HIT-V-R	[kN]	13,9	21,9	31,6	33,6	53,3	73,2	80,4	98,3
HIT-V-HCR	[kN]	17,9	24,0	32,4	33,6	53,3	73,2	89,4	106,7
Cracked concrete									
 HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	8,9	12,6	17,3	20,9	35,6	52,2	63,0	72,7
Shear V_{Rd}: single anchor, no edge effects, without lever arm									
Non cracked concrete									
HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
HIT-V 8.8	[kN]	12,0	18,4	27,2	50,4	78,4	112,8	147,2	179,2
HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8
HIT-V-HCR	[kN]	12,0	18,4	27,2	50,4	78,4	70,9	92,0	112,0
Cracked concrete									
 HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
HIT-V 8.8	[kN]	12,0	18,4	27,2	50,4	78,4	112,8	147,2	179,2
HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8
HIT-V-HCR	[kN]	12,0	18,4	27,2	41,9	71,2	70,9	92,0	112,0

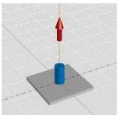
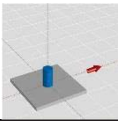
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I

		Data according ETA-07/0260, issue 2013-06-26							
Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Embedment depth $h_{ef,typ}$ =	[mm]	80	90	110	125	170	210	240	270
Base material thickness h_{min} =	[mm]	110	120	140	161	218	266	300	340
Edge distance c = c_{min} =	[mm]	40	50	60	80	100	120	135	150
Tensile N_{Rd}: single anchor, min. edge distance (c = c_{min})									
Non cracked concrete									
HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	9,6	11,6	15,5	16,9	26,1	35,6	43,3	51,4
Cracked concrete									
 HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	4,8	7,0	9,5	12,1	18,6	25,4	30,8	36,7
Shear V_{Rd}: single anchor, min. edge distance (c = c_{min}), without lever arm									
Non cracked concrete									
HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	3,7	5,3	7,3	11,5	17,2	23,6	29,0	34,8
Cracked concrete									
 HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	2,6	3,8	5,2	8,1	12,2	16,7	20,5	24,7

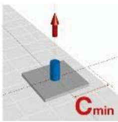
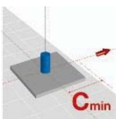
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I
(load values are valid for single anchor)

		Data according ETA-07/0260, issue 2013-06-26							
Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Embedment depth $h_{ef,typ}$ =	[mm]	80	90	110	125	170	210	240	270
Base material thickness h_{min} =	[mm]	110	120	140	161	218	266	300	340
Spacing s = s_{min} =	[mm]	40	50	60	80	100	120	135	150
Tensile N_{Rd}: double anchor, no edge effects, min. spacing (s = s_{min})									
Non cracked concrete									
HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	10,9	13,5	18,1	19,2	30,1	41,2	50,3	59,9
Cracked concrete									
 HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	5,9	8,1	11,1	13,2	21,5	29,4	35,8	42,7
Shear V_{Rd}: double anchor, no edge effects, min. spacing (s = s_{min}), without lever arm									
Non cracked concrete									
HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
HIT-V 8.8	[kN]	12,0	18,4	27,2	50,4	78,4	112,8	147,2	177,0
HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8
HIT-V-HCR	[kN]	12,0	18,4	27,2	50,4	78,4	70,9	92,0	112,0
Cracked concrete									
 HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
HIT-V 8.8	[kN]	12,0	17,9	24,5	35,6	59,6	86,9	104,8	120,6
HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8
HIT-V-HCR	[kN]	12,0	17,9	24,5	35,6	59,6	70,9	92,0	112,0

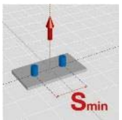
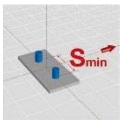
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I

		Data according ETA-07/0260, issue 2013-06-26							
Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Embedment depth	$h_{ef,2}$ = [mm]	96	120	144	192	240	288	324	360
Base material thickness	h_{min}= [mm]	126	150	174	228	288	344	384	430
	Tensile N_{Rd}: single anchor, no edge effects								
	Non cracked concrete								
	HIT-V 5.8 [kN]	12,0	19,3	28,0	52,7	82,0	117,5	140,2	164,3
	HIT-V 8.8 [kN]	19,3	30,7	44,7	64,0	89,4	117,5	140,2	164,3
	HIT-V-R [kN]	13,9	21,9	31,6	58,8	89,4	117,5	80,4	98,3
	HIT-V-HCR [kN]	19,3	30,7	44,7	64,0	89,4	117,5	140,2	164,3
	Cracked concrete								
	HIT-V 5.8 [kN]	10,7	16,8	22,6	32,2	50,3	72,4	85,1	96,9
	HIT-V 8.8 [kN]	10,7	16,8	22,6	32,2	50,3	72,4	85,1	96,9
	HIT-V-R [kN]	10,7	16,8	22,6	32,2	50,3	72,4	80,4	96,9
	HIT-V-HCR [kN]	10,7	16,8	22,6	32,2	50,3	72,4	85,1	96,9
	Shear V_{Rd}: single anchor, no edge effects, without lever arm								
	Non cracked and cracked concrete								
	HIT-V 5.8 [kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
	HIT-V 8.8 [kN]	12,0	18,4	27,2	50,4	78,4	112,8	147,2	179,2
	HIT-V-R [kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8
	HIT-V-HCR [kN]	12,0	18,4	27,2	50,4	78,4	70,9	92,0	112,0

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I

		Data according ETA-07/0260, issue 2013-06-26							
Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Embedment depth	$h_{ef,2}$ = [mm]	96	120	144	192	240	288	324	360
Base material thickness	h_{min} = [mm]	126	150	174	228	288	344	384	430
Edge distance	$c = c_{min}$= [mm]	40	50	60	80	100	120	135	150
	Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)								
	Non cracked concrete								
	HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR [kN]	11,6	16,5	21,7	28,6	40,0	52,6	62,7	73,5
	Cracked concrete								
	HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR [kN]	5,8	9,0	12,2	17,5	27,4	37,5	44,7	52,4
	Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$) , without lever arm								
	Non cracked concrete								
	HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR [kN]	3,9	5,7	7,8	12,9	18,9	25,9	31,8	38,1
	Cracked concrete								
	HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR [kN]	2,8	4,0	5,5	9,1	13,4	18,4	22,5	27,0

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I
(load values are valid for single anchor)

		Data according ETA-07/0260, issue 2013-06-26							
Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Embedment depth $h_{ef,2}$ =	[mm]	96	120	144	192	240	288	324	360
Base material thickness h_{min}=	[mm]	126	150	174	228	288	344	384	430
Spacing $s = s_{min}$=	[mm]	40	50	60	80	100	120	135	150
Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)									
Non cracked concrete									
HIT-V 5.8	[kN]	12,0	19,3	26,5	34,9	48,8	64,2	76,6	89,7
HIT-V 8.8	[kN]	13,4	20,1	26,5	34,9	48,8	64,2	76,6	89,7
HIT-V-R	[kN]	13,4	20,1	26,5	34,9	48,8	64,2	76,6	89,7
HIT-V-HCR	[kN]	13,4	20,1	26,5	34,9	48,8	64,2	76,6	89,7
Cracked concrete									
 HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	7,2	11,0	14,8	20,8	31,7	44,9	52,9	61,1
Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$), without lever arm									
Non cracked concrete									
HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
HIT-V 8.8	[kN]	12,0	18,4	27,2	50,4	78,4	112,8	147,2	179,2
HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8
HIT-V-HCR	[kN]	12,0	18,4	27,2	50,4	78,4	70,9	92,0	112,0
Cracked concrete									
 HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
HIT-V 8.8	[kN]	12,0	18,4	27,2	50,4	78,4	112,8	135,6	154,6
HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8
HIT-V-HCR	[kN]	12,0	18,4	27,2	50,4	78,4	70,9	92,0	112,0

Seismic design C1

Basic loading data for concrete C20/25 – C50/60

All data in this section applies to:
- Seismic design according to TR045

The following technical data are based on: ETA-07/0260, issue 2013-06-26

Anchorage depth range

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Effective anchorage depth range	$h_{ef,min}$	[mm]	40	40	48	64	80	96	108	120
	$h_{ef,max}$	[mm]	160	200	240	320	400	480	540	600

Tension resistance in case of seismic performance category C1

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Characteristic tension resistance to steel failure										
HIT-V-5.8(F)	$N_{Rk,s,seis}$	[kN]	18	29	42	79	123	177	230	281
HIT-V-8.8(F)	$N_{Rk,s,seis}$	[kN]	29	46	67	126	196	282	367	449
Partial safety factor	$\gamma_{Ms,seis}$	[-]	1,5							
HIT-V-R	$N_{Rk,s,seis}$	[kN]	26	41	59	110	172	247	230	281
Partial safety factor	$\gamma_{Ms,seis}$	[-]	1,87						2,86	
HIT-V-HCR	$N_{Rk,s,seis}$	[kN]	29	46	67	126	196	247	321	393
Partial safety factor	$\gamma_{Ms,seis}$	[-]	1,5					2,1		
Characteristic bond resistance in cracked concrete C20/25 to C50/60										
Temperature range I: 40°C/24°C	$\tau_{Rk,seis}$	[N/mm²]	6,4	6,4	6	5,3	5	4,6	4,1	3,6
Temperature range II: 58°C/35°C	$\tau_{Rk,seis}$	[N/mm²]	5,2	4,8	4,8	4,5	3,9	3,6	3,1	3
Temperature range III: 70°C/43°C	$\tau_{Rk,seis}$	[N/mm²]	3,2	2,8	2,8	2,6	2,1	2	1,9	1,8
Partial safety factor	$\gamma_{Mp,seis}$	[-]	1,8			2,1				
Concrete cone resistance and splitting resistance										
Partial safety factor	$\gamma_{Mc,seis} = \gamma_{Msp,seis}$	[-]	1,8			2,1				

Displacement under tension load in case of seismic performance category C1 1)

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Displacement 1)	$\delta_{N,seis}$	[mm]	1,5	1,7	1,9	2,3	2,7	3,1	3,4	3,7

1) Maximum displacement during cycling (seismic event).

Shear resistance in case of seismic performance category C1

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Characteristic shear resistance to steel failure										
for HIT-V-5.8(F)	$V_{Rk,s,seis}$	[kN]	6	11	15	27	43	62	81	98
for HIT-V-8.8(F)	$V_{Rk,s,seis}$	[kN]	11	16	24	44	69	99	129	157
Partial safety factor	$\gamma_{Ms,seis}$	[-]	1,25							
for HIT-V-R	$V_{Rk,s,seis}$	[kN]	9	14	21	39	60	87	81	98
Partial safety factor	$\gamma_{Ms,seis}$	[-]	1,56						2,38	
for HIT-V-HCR	$V_{Rk,s,seis}$	[kN]	11	16	24	44	69	87	113	137
Partial safety factor	$\gamma_{Ms,seis}$	[-]	1,25					1,75		
Concrete pryout resistance and concrete edge resistance										
Partial safety factor	$\gamma_{Mcp,seis} = \gamma_{Mc,seis}$	[-]	1,5							

Displacement under shear load in case of seismic performance category C1 1)

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Displacement 1)	$\delta_{V,seis}$	[mm]	3,2	3,5	3,8	4,4	5,0	5,6	6,1	6,5

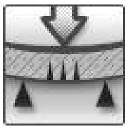
1) Maximum displacement during cycling (seismic event).

For seismic resistent fastening applications please use the anchor design software PROFIS Anchor.

Hilti HIT-RE 500-SD mortar with HIS-(R)N sleeve

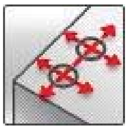
Injection mortar system		Benefits
	Hilti HIT-RE 500-SD 330 ml foil pack (also available as 500 ml and 1400 ml foil pack) Statik mixer HIS-(R)N sleeve	- **SAFEset** technology: drilling and borehole cleaning in one step with Hilti hollow drill bit - suitable for cracked and non-cracked concrete C 20/25 to C 50/60 - ETA seismic approval C1 - high loading capacity - suitable for dry and water saturated concrete - long working time at elevated temperatures - odourless epoxy


Concrete


Tensile zone


Seismic ETA-C1


Shock


Small edge distance and spacing


Fire resistance

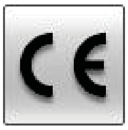
SAFEset

Hilti SAFEset technology with hollow drill bit

A4 316

Corrosion resistance


European Technical Approval


CE conformity

PROFIS Anchor design software

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval a)	DIBt, Berlin	ETA-07/0260 / 2013-06-26
ES report icl. seismic	ICC evaluation service	ESR 2322 / 2014-02-01
Shockproof fastenings in civil defence installations	Federal Office for Cicil Protection, Bern	BZS D 08-604 / 2009-10-21
Fire test report	MFPA, Leipzig	GS-III/B-07-070 / 2008-01-18
Assessment report (fire)	warringtonfire	WF 327804/B / 2013-07-10

a) All data given in this section according ETA-07/0260, issue 2013-06-26.

Basic loading data (for a single anchor)

All data in this section applies to For details see Simplified design method

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- *Steel* failure
- Screw strength class 8.8
- Base material thickness, as specified in the table
- One typical embedment depth, as specified in the table
- One anchor material, as specified in the tables
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²
- Temperate range I
  (min. base material temperature -40°C, max. long term/short term base material temperature: +24°C/40°C)
- Installation temperature range +5°C to +40°C

Embedment depth and base material thickness for the basic loading data. Mean ultimate resistance, characteristic resistance, design resistance, recommended loads.

Anchor size	M8	M10	M12	M16	M20
Embedment depth [mm]	90	110	125	170	205
Base material thickness [mm]	120	150	170	230	270

Mean ultimate resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HIS-N

			Data according ETA-07/0260, issue 2013-06-26				
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**
Non cracked concrete							
Tensile $N_{Ru,m}$	HIS-N	[kN]	*26,3*	*48,3*	*70,4*	*123,9*	*114,5*
Shear $V_{Ru,m}$	HIS-N	[kN]	*13,7*	*24,2*	*41,0*	*62,0*	*57,8*
Cracked concrete							
Tensile $N_{Ru,m}$	HIS-N	[kN]	*26,3*	*48,3*	67,1	106,4	*114,5*
Shear $V_{Ru,m}$	HIS-N	[kN]	*13,7*	*24,2*	*41,0*	*62,0*	*57,8*

Characteristic resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HIS-N

			Data according ETA-07/0260, issue 2013-06-26				
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**
Non cracked concrete							
Tensile N_{Rk}	HIS-N	[kN]	*25,0*	*46,0*	*67,0*	111,9	*109,0*
Shear V_{Rk}	HIS-N	[kN]	*13,0*	*23,0*	*39,0*	*59,0*	*55,0*
Cracked concrete							
Tensile N_{Rk}	HIS-N	[kN]	25,0	40,0	50,3	79,8	105,7
Shear V_{Rk}	HIS-N	[kN]	*13,0*	*23,0*	*39,0*	*59,0*	*55,0*

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HIS-N

			Data according ETA-07/0260, issue 2013-06-26				
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**
Non cracked concrete							
Tensile N_{Rd}	HIS-N	[kN]	16,8	27,7	33,6	53,3	70,6
Shear V_{Rd}	HIS-N	[kN]	10,4	18,4	26,0	39,3	36,7
Cracked concrete							
Tensile N_{Rd}	HIS-N	[kN]	13,9	19,0	24,0	38,0	50,3
Shear V_{Rd}	HIS-N	[kN]	10,4	18,4	26,0	39,3	36,7

Recommended loads [a)]: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HIS-N

			Data according ETA-07/0260, issue 2013-06-26				
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**
Non cracked concrete							
Tensile N_{rec}	HIS-N	[kN]	12,0	19,8	24,0	38,1	50,4
Shear V_{rec}	HIS-N	[kN]	7,4	13,1	18,6	28,1	26,2
Cracked concrete							
Tensile N_{rec}	HIS-N	[kN]	9,9	13,6	17,1	27,1	35,9
Shear V_{rec}	HIS-N	[kN]	7,4	13,1	18,6	28,1	26,2

a) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Service temperature range

Hilti HIT-RE 500-SD injection mortar may be applied in the temperature ranges given below. An elevated base material temperature may lead to a reduction of the design bond resistance.

Temperature range	Base material temperature	Maximum long term base material temperature	Maximum short term base material temperature
Temperature range I	-40 °C to +40 °C	+24 °C	+40 °C
Temperature range II	-40 °C to +58 °C	+35 °C	+58 °C
Temperature range III	-40 °C to +70 °C	+43 °C	+70 °C

Max short term base material temperature
Short-term elevated base material temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.

Max long term base material temperature
Long-term elevated base material temperatures are roughly constant over significant periods of time.

Materials

Mechanical properties of HIS-(R)N

			Data according ETA-07/0260, issue 2013-06-26				
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**
Nominal tensile strength f_{uk}	HIS-N	[N/mm²]	490	490	460	460	460
	Screw 8.8	[N/mm²]	800	800	800	800	800
	HIS-RN	[N/mm²]	700	700	700	700	700
	Screw A4-70	[N/mm²]	700	700	700	700	700
Yield strength f_{yk}	HIS-N	[N/mm²]	410	410	375	375	375
	Screw 8.8	[N/mm²]	640	640	640	640	640
	HIS-RN	[N/mm²]	350	350	350	350	350
	Screw A4-70	[N/mm²]	450	450	450	450	450
Stressed cross-section A_s	HIS-(R)N	[mm²]	51,5	108,0	169,1	256,1	237,6
	Screw	[mm²]	36,6	58	84,3	157	245
Moment of resistance W	HIS-(R)N	[mm³]	145	430	840	1595	1543
	Screw	[mm³]	31,2	62,3	109	277	541

Material quality

Part	Material
internally threaded sleeves [a] HIS-N	C-steel 1.0718, steel galvanized ≥ 5µm
internally threaded sleeves [b] HIS-RN	stainless steel 1.4401 and 1.4571

[a] related fastening screw: strength class 8.8, A5 > 8% Ductile
steel galvanized ≥ 5µm

[b] related fastening screw: strength class 70, A5 > 8% Ductile
stainless steel 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362

Anchor dimensions

Anchor size	M8	M10	M12	M16	M20
Internal sleeve HIS-(R)N	M8x90	M10x110	M12x125	M16x170	M20x205
Anchor embedment depth [mm]	90	110	125	170	205

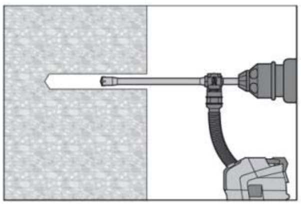
Setting

installation equipment

Anchor size	M8	M10	M12	M16	M20
Rotary hammer	TE 2 – TE 16		TE 40 – TE 70		
Other tools	compressed air gun or blow out pump, set of cleaning brushes, dispenser				

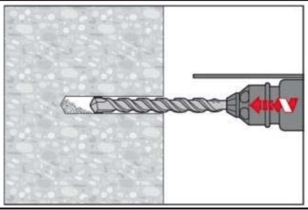
Setting instruction

Bore hole drilling



Drill hole to the required embedment depth with an appropriately sized Hilti TE-CD or TE-YD hollow drill bit with Hilti vacuum attachment. This drilling system removes the dust and cleans the borehole during drilling when using in accordance with the user's manual.

After drilling is complete, proceed to the "injection preparation" step in the instructions for use.

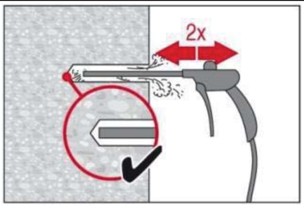


Drill Hole to the required embedment depth with a hammer drill set in rotation-hammer mode using an appropriately sized carbide drill bit.

Bore hole cleaning

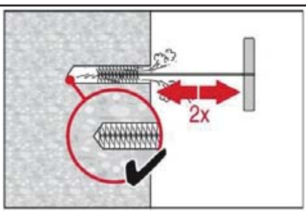
Just before setting an anchor, the bore hole must be free of dust and debris.

Compressed air cleaning (CAC) for all bore hole diameters d_0 and all bore hole depth h_0

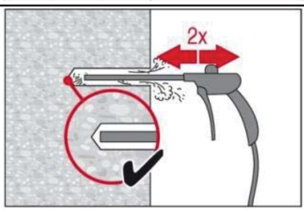


Blow 2 times from the back of the hole (if needed with nozzle extension) over the hole length with oil-free compressed air (min. 6 bar at 6 m³/h) until return air stream is free of noticeable dust.

Bore hole diameter ≥ 32 mm the compressor must supply a minimum air flow of 140 m³/hour.

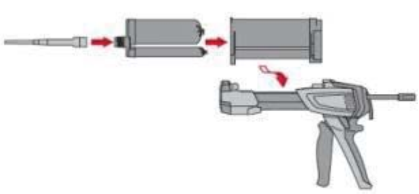


Brush 2 times with the specified brush size by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it.
The brush must produce natural resistance as it enters the bore hole -- if not the brush is too small and must be replaced with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

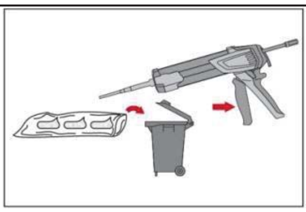


Blow again with compressed air 2 times until return air stream is free of noticeable dust.

Injection preparation



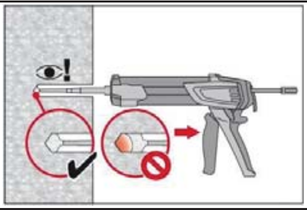
Tightly attach new Hilti mixing nozzle HIT-RE-M to foil pack manifold (snug fit). Do not modify the mixing nozzle.
Observe the instruction for use of the dispenser and the mortar. Check foil pack holder for proper function. Do not use damaged foil packs / holders. Insert foil pack into foil pack holder and put holder into HIT-dispenser.



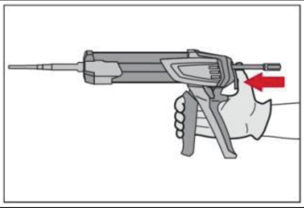
The foil pack opens automatically as dispensing is initiated. Discard initial adhesive. Depending on the size of the foil pack an initial amount of adhesive has to be discarded.
Discard quantities are:

- 3 strokes for 330 ml foil pack,
- 4 strokes for 500 ml foil pack,
- 65 ml for 1400 ml foil pack ≤ 5°C.

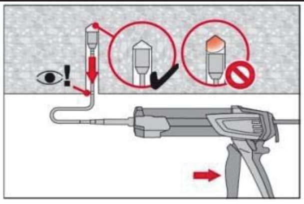
Inject adhesive from the back of the borehole without forming air voids



Inject the adhesive starting at the back of the hole, slowly withdrawing the mixer with each trigger pull.
Fill holes approximately 2/3 full It is required that the annular gap between the anchor and the concrete is completely filled with adhesive along the embedment length.

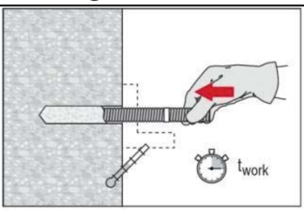


After injection is completed, depressurize the dispenser by pressing the release trigger. This will prevent further adhesive discharge from the mixer.

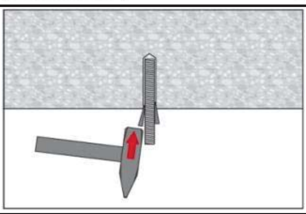


Overhead installation and/or installation with embedment depth h_{ef} > 250mm.
For overhead installation the injection is only possible with the aid of extensions and piston plugs. Assemble HIT-RE-M mixer, extension(s) and appropriately sized piston plug (HIT-SZ). Insert piston plug to back of the hole and inject adhesive. During injection the piston plug will be naturally extruded out of the bore hole by the adhesive pressure.

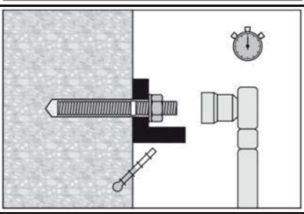
Setting the element



Before use, verify that the element is dry and free of oil and other contaminants.
Mark and set element to the required embedment depth untill working time t_{work} has elapsed.



For overhead installation use piston plugs and fix embedded parts with e.g. wedges HIT-OHW.



Loading the anchor:
After required curing time t_{cure} the anchor can be loaded.
The applied installation torque shall not exceed given T_{max}.

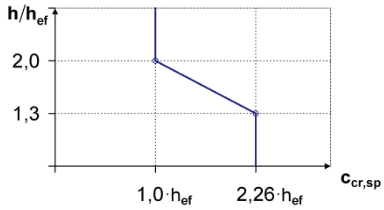
For detailed information on installation see instruction for use given with the package of the product.

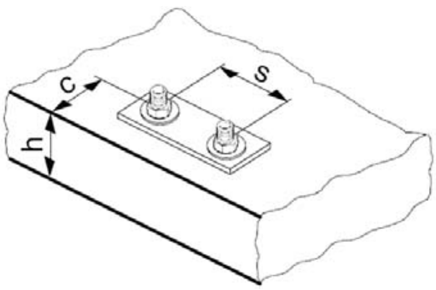
Curing time for general conditions

Data according ETA-07/0260, issue 2013-06-26		
Temperature of the base material	Working time in which anchor can be inserted and adjusted t_{gel}	Curing time before anchor can be fully loaded t_{cure}
40 °C	12 min	4 h
30 °C to 39 °C	12 min	8 h
20 °C to 29 °C	20 min	12 h
15 °C to 19 °C	30 min	24 h
10 °C to 14 °C	90 min	48 h
5 °C to 9 °C	120 min	72 h

Setting details

			Data according ETA-07/0260, issue 2013-06-26				
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**
Nominal diameter of drill bit	d_0	[mm]	14	18	22	28	32
Diameter of element	d	[mm]	12,5	16,5	20,5	25,4	27,6
Effective anchorage and drill hole depth	h_{ef}	[mm]	90	110	125	170	205
Minimum base material thickness	h_{min}	[mm]	120	150	170	230	270
Diameter of clearance hole in the fixture	d_f	[mm]	9	12	14	18	22
Thread engagement length; min - max	h_s	[mm]	8-20	10-25	12-30	16-40	20-50
Minimum spacing	s_{min}	[mm]	40	45	55	65	90
Minimum edge distance	c_{min}	[mm]	40	45	55	65	90
Critical spacing for splitting failure	$s_{cr,sp}$		$2\ c_{cr,sp}$				
Critical edge distance for splitting failure a)	$c_{cr,sp}$	[mm]	**$1{,}0 \cdot h_{ef}$** for $h / h_{ef} \geq 2{,}0$ **$4{,}6\ h_{ef} - 1{,}8\ h$** for $2{,}0 > h / h_{ef} > 1{,}3$ **$2{,}26\ h_{ef}$** for $h / h_{ef} \leq 1{,}3$				
Critical spacing for concrete cone failure	$s_{cr,N}$		$2\ c_{cr,N}$				
Critical edge distance for concrete cone failure b)	$c_{cr,N}$		$1{,}5\ h_{ef}$				
Torque moment c)	T_{max}	[Nm]	10	20	40	80	150





For spacing (edge distance) smaller than critical spacing (critical edge distance) the design loads have to be reduced.

a) h: base material thickness ($h \geq h_{min}$)

b) The critical edge distance for concrete cone failure depends on the embedment depth h_{ef} and the design bond resistance. The simplified formula given in this table is on the save side.

c) This is the maximum recommended torque moment to avoid splitting failure during installation for anchors with minimum spacing and/or edge distance.

Simplified design method

Simplified version of the design method according ETAG 001, TR 029. Design resistance according data given in ETA-07/0260, issue 2013-06-26.

- Influence of concrete strength
- Influence of edge distance
- Influence of spacing
- Valid for a group of two anchors. (The method may also be applied for anchor groups with more than two anchors or more than one edge distance. The influencing factors must then be considered for each edge distance and spacing. The calculated design loads are then on the save side: They will be lower than the exact values according ETAG 001, TR 029. To avoid this, it is recommended to use the anchor design software PROFIS anchor)

The design method is based on the following simplification:

- No different loads are acting on individual anchors (no eccentricity)

The values are valid for one anchor.

For more complex fastening applications please use the anchor design software PROFIS Anchor.

Tension loading

The design tensile resistance is the lower value of

- Steel resistance: $N_{Rd,s}$

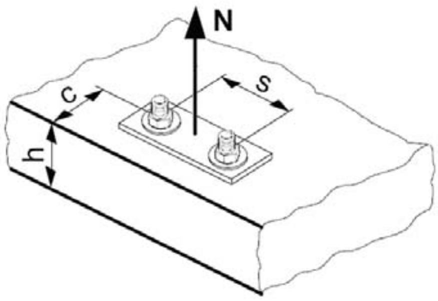
- Combined pull-out and concrete cone resistance:

$$N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,p} \cdot f_{re,N}$$

- Concrete cone resistance: $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$

- Concrete splitting resistance (only non-cracked concrete):

$$N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,N} \cdot f_{re,N}$$



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

			Data according ETA-07/0260, issue 2013-06-26				
Anchor size			**M8**	**M10**	**M12**	**M16**	**M20**
$N_{Rd,s}$	HIS-N	[kN]	17,4	30,7	44,7	80,3	74,1
	HIS-RN	[kN]	13,9	21,9	31,6	58,8	69,2

Design combined pull-out and concrete cone resistance

$N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,p} \cdot f_{re,N}$

	Data according ETA-07/0260, issue 2013-06-26				
Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**
Embedment depth h_{ef} [mm]	**90**	**110**	**125**	**170**	**205**
Non cracked concrete					
$N^0_{Rd,p}$ Temperature range I [kN]	22,2	28,6	45,2	81,0	95,2
$N^0_{Rd,p}$ Temperature range II [kN]	19,4	23,8	35,7	66,7	81,0
$N^0_{Rd,p}$ Temperature range III [kN]	11,1	14,3	19,0	35,7	45,2
Cracked concrete					
$N^0_{Rd,p}$ Temperature range I [kN]	13,9	19,0	28,6	45,2	54,8
$N^0_{Rd,p}$ Temperature range II [kN]	11,1	16,7	19,0	35,7	45,2
$N^0_{Rd,p}$ Temperature range III [kN]	6,7	9,5	11,9	19,0	23,8

Design concrete cone resistance $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$
Design splitting resistance a) $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,N} \cdot f_{re,N}$

	Data according ETA-07/0260, issue 2013-06-26				
Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**
$N^0_{Rd,c}$ Non cracked concrete [kN]	24,0	27,7	33,6	53,3	70,6
$N^0_{Rd,c}$ Cracked concrete [kN]	17,1	19,8	24,0	38,0	50,3

a) Splitting resistance must only be considered for non-cracked concrete

Influencing factors

Influence of concrete strength on combined pull-out and concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_{B,p} = (f_{ck,cube}/25N/mm^2)^{0,1}$ a)	1	1,02	1,04	1,06	1,07	1,08	1,09

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of embedment depth on combined pull-out and concrete cone resistance

$f_{h,p} = 1$

Influence of concrete strength on concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of edge distance a)

$c/c_{cr,N}$ / $c/c_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{1,N} = 0{,}7 + 0{,}3 \cdot c/c_{cr,N}$ / $f_{1,sp} = 0{,}7 + 0{,}3 \cdot c/c_{cr,sp}$	0,73	0,76	0,79	0,82	0,85	0,88	0,91	0,94	0,97	1
$f_{2,N} = 0{,}5 \cdot (1 + c/c_{cr,N})$ / $f_{2,sp} = 0{,}5 \cdot (1 + c/c_{cr,sp})$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The the edge distance shall not be smaller than the minimum edge distance c_{min} given in the table with the setting details. These influencing factors must be considered for every edge distance smaller than the critical edge distance.

Influence of anchor spacing a)

$s/s_{cr,N}$ / $s/s_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{3,N} = 0{,}5 \cdot (1 + s/s_{cr,N})$ / $f_{3,sp} = 0{,}5 \cdot (1 + s/s_{cr,sp})$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The anchor spacing shall not be smaller than the minimum anchor spacing s_{min} given in the table with the setting details. This influencing factor must be considered for every anchor spacing.

Influence of embedment depth on concrete cone resistance

$$f_{h,N} = 1$$

Influence of reinforcement

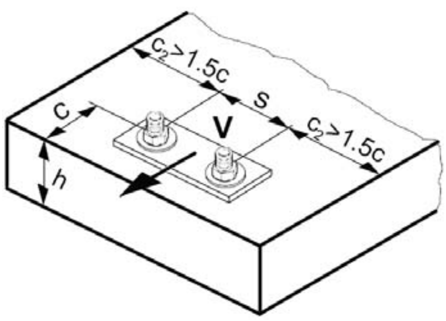
h_{ef} [mm]	80	90	≥ 100
$f_{re,N} = 0{,}5 + h_{ef}/200mm \le 1$	0,9 a)	0,95 a)	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing ≥ 150 mm (any diameter) or with a diameter ≤ 10 mm and a spacing ≥ 100 mm, then a factor f_{re} = 1 may be applied.

Shear loading

The design shear resistance is the lower value of

- Steel resistance: $V_{Rd,s}$
- Concrete pryout resistance: $V_{Rd,cp} = k \cdot$ lower value of $N_{Rd,p}$ and $N_{Rd,c}$
- Concrete edge resistance: $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

			Data according ETA-07/0260, issue 2013-06-26				
Anchor size			M8	M10	M12	M16	M20
$V_{Rd,s}$	HIS-N	[kN]	10,4	18,4	26,0	39,3	36,7
	HIS-RN	[kN]	8,3	12,8	19,2	35,3	41,5

Design concrete pryout resistance $V_{Rd,cp}$ = lower value[a)] of $k \cdot N_{Rd,p}$ and $k \cdot N_{Rd,c}$

k = 1 for h_{ef} < 60 mm
k = 2 for $h_{ef} \geq$ 60 mm

a) $N_{Rd,p}$: Design combined pull-out and concrete cone resistance
$N_{Rd,c}$: Design concrete cone resistance

Design concrete edge resistance $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size		M8	M10	M12	M16	M20
Non-cracked concrete						
$V^0_{Rd,c}$	[kN]	12,4	19,6	28,2	40,2	46,2
Cracked concrete						
$V^0_{Rd,c}$	[kN]	8,8	13,9	20,0	28,5	32,7

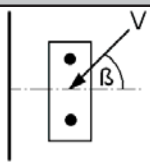
Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2\ a)}$	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of angle between load applied and the direction perpendicular to the free edge

Angle ß	0°	10°	20°	30°	40°	50°	60°	70°	80°	≥ 90°
$f_\beta = \frac{1}{\sqrt{(\cos\alpha_V)^2 + \left(\frac{\sin\alpha_V}{2,5}\right)^2}}$ 	1	1,01	1,05	1,13	1,24	1,40	1,64	1,97	2,32	2,50

Influence of base material thickness

h/c	0,15	0,3	0,45	0,6	0,75	0,9	1,05	1,2	1,35	≥ 1,5
$f_h = \{h/(1,5 \cdot c)\}^{1/2} \leq 1$	0,32	0,45	0,55	0,63	0,71	0,77	0,84	0,89	0,95	1,00

Influence of anchor spacing and edge distance a) for concrete edge resistance: f_4
$f_4 = (c/h_{ef})^{1,5} \cdot (1 + s / [3 \cdot c]) \cdot 0,5$

c/h_{ef}	Single anchor	Group of two anchors s/h_{ef}														
		0,75	1,50	2,25	3,00	3,75	4,50	5,25	6,00	6,75	7,50	8,25	9,00	9,75	10,50	11,25
0,50	0,35	0,27	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35
0,75	0,65	0,43	0,54	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65
1,00	1,00	0,63	0,75	0,88	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
1,25	1,40	0,84	0,98	1,12	1,26	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40
1,50	1,84	1,07	1,22	1,38	1,53	1,68	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84
1,75	2,32	1,32	1,49	1,65	1,82	1,98	2,15	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32
2,00	2,83	1,59	1,77	1,94	2,12	2,30	2,47	2,65	2,83	2,83	2,83	2,83	2,83	2,83	2,83	2,83
2,25	3,38	1,88	2,06	2,25	2,44	2,63	2,81	3,00	3,19	3,38	3,38	3,38	3,38	3,38	3,38	3,38
2,50	3,95	2,17	2,37	2,57	2,77	2,96	3,16	3,36	3,56	3,76	3,95	3,95	3,95	3,95	3,95	3,95
2,75	4,56	2,49	2,69	2,90	3,11	3,32	3,52	3,73	3,94	4,15	4,35	4,56	4,56	4,56	4,56	4,56
3,00	5,20	2,81	3,03	3,25	3,46	3,68	3,90	4,11	4,33	4,55	4,76	4,98	5,20	5,20	5,20	5,20
3,25	5,86	3,15	3,38	3,61	3,83	4,06	4,28	4,51	4,73	4,96	5,18	5,41	5,63	5,86	5,86	5,86
3,50	6,55	3,51	3,74	3,98	4,21	4,44	4,68	4,91	5,14	5,38	5,61	5,85	6,08	6,31	6,55	6,55
3,75	7,26	3,87	4,12	4,36	4,60	4,84	5,08	5,33	5,57	5,81	6,05	6,29	6,54	6,78	7,02	7,26
4,00	8,00	4,25	4,50	4,75	5,00	5,25	5,50	5,75	6,00	6,25	6,50	6,75	7,00	7,25	7,50	7,75
4,25	8,76	4,64	4,90	5,15	5,41	5,67	5,93	6,18	6,44	6,70	6,96	7,22	7,47	7,73	7,99	8,25
4,50	9,55	5,04	5,30	5,57	5,83	6,10	6,36	6,63	6,89	7,16	7,42	7,69	7,95	8,22	8,49	8,75
4,75	10,35	5,45	5,72	5,99	6,27	6,54	6,81	7,08	7,36	7,63	7,90	8,17	8,45	8,72	8,99	9,26
5,00	11,18	5,87	6,15	6,43	6,71	6,99	7,27	7,55	7,83	8,11	8,39	8,66	8,94	9,22	9,50	9,78
5,25	12,03	6,30	6,59	6,87	7,16	7,45	7,73	8,02	8,31	8,59	8,88	9,17	9,45	9,74	10,02	10,31
5,50	12,90	6,74	7,04	7,33	7,62	7,92	8,21	8,50	8,79	9,09	9,38	9,67	9,97	10,26	10,55	10,85

a) The anchor spacing and the edge distance shall not be smaller than the minimum anchor spacing s_{min} and the minimum edge distance c_{min}.

Influence of embedment depth

Anchor size	M8	M10	M12	M16	M20
f_{hef} =	1,38	1,21	1,04	1,22	1,45

Influence of edge distance a)

c/d	4	6	8	10	15	20	30	40
$f_c = (d / c)^{0,19}$	0,77	0,71	0,67	0,65	0,60	0,57	0,52	0,50

a) The edge distance shall not be smaller than the minimum edge distance c_{min}.

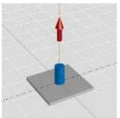
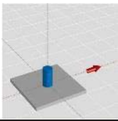
Combined tension and shear loading

For combined tension and shear loading see section “Anchor Design”.

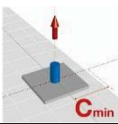
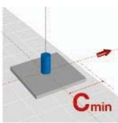
Precalculated values

Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

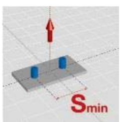
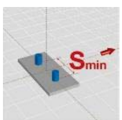
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I

	Data according ETA-07/0260, issue 2013-06-26				
Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**
Embedment depth h_{ef} : [mm]	90	110	125	170	205
Base material thickness h_{min}: [mm]	120	150	170	230	270
Tensile N_{Rd}: single anchor, no edge effects					
 Non cracked concrete					
HIS-N [kN]	17,4	27,7	33,6	53,3	70,6
HIS-RN [kN]	13,9	21,9	31,6	53,3	69,2
Cracked concrete					
HIS-(R)N [kN]	13,9	19,0	24,0	38,0	50,3
Shear V_{Rd}: single anchor, no edge effects, without lever arm					
 Non cracked and cracked concrete					
HIS-N [kN]	10,4	18,4	26,0	39,3	36,7
HIS-RN [kN]	8,3	12,8	19,2	35,3	41,5

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I

	Data according ETA-07/0260, issue 2013-06-26				
Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**
Embedment depth h_{ef} = [mm]	90	110	125	170	205
Base material thickness h_{min}= [mm]	120	150	170	230	270
Edge distance $c = c_{min}$= [mm]	40	45	55	65	90
Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)					
 Non cracked concrete					
HIS-(R)N [kN]	11,0	12,4	15,4	23,5	32,0
Cracked concrete					
HIS-(R)N [kN]	7,1	8,9	11,0	16,8	22,8
Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$) , without lever arm					
 Non cracked concrete					
HIS-(R)N [kN]	4,2	5,5	7,6	10,8	17,2
Cracked concrete					
HIS-(R)N [kN]	3,0	3,9	5,4	7,7	12,2

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I
(load values are valid for single anchor)

	Data according ETA-07/0260, issue 2013-06-26				
Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**
Embedment depth h_{ef} = [mm]	90	110	125	170	205
Base material thickness h_{min}= [mm]	120	150	170	230	270
Spacing $s = s_{min}$= [mm]	40	45	55	65	90
Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)					
 Non cracked concrete					
HIS-(R)N [kN]	13,1	15,2	18,5	29,0	38,8
Cracked concrete					
HIS-(R)N [kN]	8,5	10,8	13,2	20,6	27,6
Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$) , without lever arm					
 Non cracked and cracked concrete					
HIS-N [kN]	10,4	18,4	26,0	39,3	36,7
HIS-RN [kN]	8,3	12,8	19,2	35,3	41,5

Seismic design C1

Basic loading data for concrete C20/25 – C50/60

All data in this section applies to:

- Seismic design according to TR045

The following technical data are based on: ETA-07/0260, issue 2013-06-26

Anchorage depth range

Anchor size			M8	M10	M12	M16	M20
Effective anchorage depth	h_{ef}	[mm]	90	110	125	170	205

Tension resistance in case of seismic performance category C1

Anchor size			M8	M10	M12	M16	M20
Diameter of element			12,5	16,5	20,5	25,4	27,6
Characteristic tension resistance to steel failure							
HIS-N steel grade 8.8	$N_{Rk,s,seis}$	[kN]	25	46	67	118	109
Partial safety factor	$\gamma_{Ms,seis}$	[-]	1,43	1,5		1,47	
HIS-RN steel grade 70	$N_{Rk,s,seis}$	[kN]	26	41	59	110	166
Partial safety factor	$\gamma_{Ms,seis}$	[-]	1,87				2,4
Characteristic bond resistance in cracked concrete C20/25 to C50/60							
Temperature range I: 40°C/24°C	$N_{Rk,p,seis}$	[N/mm²]	20	30	42	61	71
Temperature range II: 58°C/35°C	$N_{Rk,p,seis}$	[N/mm²]	16	26	28	48	59
Temperature range III: 70°C/43°C	$N_{Rk,p,seis}$	[N/mm²]	9,5	15	17	25	31
Partial safety factor	$\gamma_{Mp,seis}$	[-]	1,8	2,1			
Concrete cone resistance and splitting resistance							
Partial safety factor	$\gamma_{Mc,seis} = \gamma_{Msp,seis}$	[-]	1,8	2,1			

Displacement under tension load in case of seismic performance category C1 1)

Anchor size			M8	M10	M12	M16	M20
Displacement 1)	$\delta_{N,seis}$	[mm]	1,5	1,7	1,9	2,3	2,7

1) Maximum displacement during cycling (seismic event).

Shear resistance in case of seismic performance category C1

Anchor size			M8	M10	M12	M16	M20
Characteristic shear resistance to steel failure							
HIS-N steel grade 8.8	$N_{Rk,s,seis}$	[kN]	9	16	27	41	39
Partial safety factor	$\gamma_{Ms,seis}$	[-]	1,25		1,5		
HIS-RN steel grade 70	$N_{Rk,s,seis}$	[kN]	9	14	21	39	58
Partial safety factor	$\gamma_{Ms,seis}$	[-]	1,56				2,0
Concrete pryout resistance and concrete edge resistance							
Partial safety factor	$\gamma_{Mcp,seis} = \gamma_{Mc,seis}$	[-]	1,5				

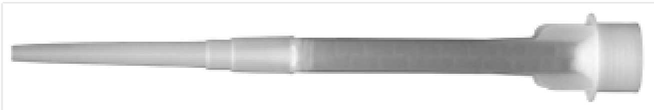
Displacement under shear load in case of seismic performance category C1 1)

Anchor size			M8	M10	M12	M16	M20
Displacement 1)	$\delta_{V,seis}$	[mm]	3,2	3,5	3,8	4,4	5,0

1) Maximum displacement during cycling (seismic event).

For seismic resistent fastening applications please use the anchor design software PROFIS Anchor.

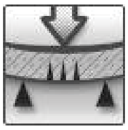
Hilti HIT-RE 500-SD mortar with rebar (as anchor)

<table>
<tr><th colspan="2">Injection mortar system</th><th>Benefits</th></tr>
<tr><td>

</td><td>Hilti HIT-RE 500-SD 330 ml foil pack
(also available as 500 ml and 1400 ml foil pack)

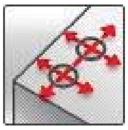
Statik mixer

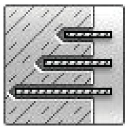
rebar BSt 500 S</td><td>- SAFEset technology: drilling and borehole cleaning in one step with Hilti hollow drill bit
- suitable for non-cracked and cracked concrete C 20/25 to C 50/60
- ETA seismic approval C1
- high loading capacity
- suitable for dry and water saturated concrete
- large diameter applications
- high corrosion resistant
- long working time at elevated temperatures
- odourless epoxy
- embedment depth range:
from 60 … 160 mm for Ø8
to 128 … 640 mm for Ø32</td></tr>
</table>


Concrete


Tensile zone


Seismic ETA-C1


Small edge distance and spacing


Variable embedment depth


Fire resistance

SAFEset
Hilti SAFEset technology with hollow drill bit

European Technical Approval

CE conformity

PROFIS Anchor design software

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval a)	DIBt, Berlin	ETA-07/0260 / 2013-06-26
ES report icl. seismic	ICC evaluation service	ESR 2322 / 2014-02-01
Fire test report	MFPA, Leipzig	GS-III/B-07-070 / 2008-01-18
Assessment report (fire)	warringtonfire	WF 327804/B / 2013-07-10

a) All data given in this section according ETA-07/0260, issue 2013-06-26.

Basic loading data (for a single anchor)

All data in this section applies to For details see Simplified design method

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- *Steel* failure
- Base material thickness, as specified in the table
- One typical embedment depth, as specified in the table
- One anchor material, as specified in the tables
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²
- Temperate range I
  (min. base material temperature -40°C, max. long term/short term base material temperature: +24°C/40°C)
- Installation temperature range +5°C to +40°C

Embedment depth [a)] and base material thickness for the basic loading data. Mean ultimate resistance, characteristic resistance, design resistance, recommended loads.

	Data according ETA-07/0260, issue 2013-06-26								
Anchor size	**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Typical embedment depth [mm]	80	90	110	125	125	170	210	270	300
Base material thickness [mm]	110	120	145	165	165	220	275	340	380

a) The allowed range of embedment depth is shown in the setting details. The corresponding load values can be calculated according to the simplified design method.

Mean ultimate resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor rebar BSt 500S

	Data according ETA-07/0260, issue 2013-06-26								
Anchor size	**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Non cracked concrete									
Tensile $N_{Ru,m}$ BSt 500 S [kN]	*29,4*	*45,2*	*65,1*	*89,3*	94,1	149,2	204,9	298,7	349,9
Shear $V_{Ru,m}$ BSt 500 S [kN]	*14,7*	*23,1*	*32,6*	*44,1*	*57,8*	*90,3*	*141,8*	*177,5*	*232,1*
Cracked concrete									
Tensile $N_{Ru,m}$ BSt 500 S [kN]	23,8	33,5	46,1	57,0	65,2	110,8	146,1	228,7	268,1
Shear $V_{Ru,m}$ BSt 500 S [kN]	*14,7*	*23,1*	*32,6*	*44,1*	*57,8*	*90,3*	*141,8*	*177,5*	*232,1*

Characteristic resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor rebar BSt 500 S

	Data according ETA-07/0260, issue 2013-06-26								
Anchor size	**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Non cracked concrete									
Tensile N_{Rk} BSt 500 S [kN]	*28,0*	42,4	58,3	70,6	70,6	111,9	153,7	224,0	262,4
Shear V_{Rk} BSt 500 S [kN]	*14,0*	*22,0*	*31,0*	*42,0*	*55,0*	*86,0*	*135,0*	*169,0*	*221,0*
Cracked concrete									
Tensile N_{Rk} BSt 500 S [kN]	16,1	22,6	31,1	38,5	44,0	74,8	109,6	154,4	181,0
Shear V_{Rk} BSt 500 S [kN]	*14,0*	*22,0*	*31,0*	*42,0*	*55,0*	*86,0*	*135,0*	*169,0*	*221,0*

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor rebar BSt 500 S

	Data according ETA-07/0260, issue 2013-06-26								
Anchor size	**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Non cracked concrete									
Tensile N_{Rd} BSt 500 S [kN]	16,8	23,6	32,4	39,2	33,6	53,3	73,2	106,7	125,0
Shear V_{Rd} BSt 500 S [kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0	112,7	147,3
Cracked concrete									
Tensile N_{Rd} BSt 500 S [kN]	8,9	12,6	17,3	21,4	20,9	35,6	52,2	73,5	86,2
Shear V_{Rd} BSt 500 S [kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0	112,7	147,3

Recommended loads a): concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor rebar BSt 500 S

			Data according ETA-07/0260, issue 2013-06-26								
Anchor size			**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Non cracked concrete											
Tensile N_{rec}	BSt 500 S	[kN]	12,0	16,8	23,1	28,0	24,0	38,1	52,3	76,2	89,3
Shear V_{rec}	BSt 500 S	[kN]	6,7	10,5	14,8	20,0	26,2	41,0	64,3	80,5	105,2
Cracked concrete											
Tensile N_{rec}	BSt 500 S	[kN]	6,4	9,0	12,3	15,3	15,0	25,4	37,3	52,5	61,5
Shear V_{rec}	BSt 500 S	[kN]	6,7	10,5	14,8	20,0	26,2	41,0	64,3	80,5	105,2

a) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Service temperature range

Hilti HIT-RE 500-SD injection mortar may be applied in the temperature ranges given below. An elevated base material temperature may lead to a reduction of the design bond resistance.

Temperature range	Base material temperature	Maximum long term base material temperature	Maximum short term base material temperature
Temperature range I	-40 °C to +40 °C	+24 °C	+40 °C
Temperature range II	-40 °C to +58 °C	+35 °C	+58 °C
Temperature range III	-40 °C to +70 °C	+43 °C	+70 °C

Max short term base material temperature
Short-term elevated base material temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.

Max long term base material temperature
Long-term elevated base material temperatures are roughly constant over significant periods of time.

Materials

Mechanical properties of rebar BSt 500S

			Data according ETA-07/0260, issue 2013-06-26								
Anchor size			**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Nominal tensile strength f_{uk}	BSt 500 S	[N/mm²]	550	550	550	550	550	550	550	550	550
Yield strength f_{yk}	BSt 500 S	[N/mm²]	500	500	500	500	500	500	500	500	500
Stressed cross-section A_s	BSt 500 S	[mm²]	50,3	78,5	113,1	153,9	201,1	314,2	490,9	615,8	804,2
Moment of resistance W	BSt 500 S	[mm³]	50,3	98,2	169,6	269,4	402,1	785,4	1534	2155	3217

Material quality

Part	Material
rebar BSt 500 S	Geometry and mechanical properties according to DIN 488-2:1986 or E DIN 488-2:2006

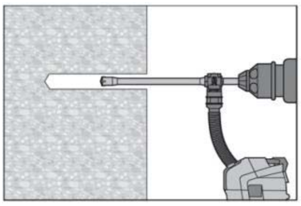
Setting

installation equipment

Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Rotary hammer	TE 2 – TE 16					TE 40 – TE 70			
Other tools	compressed air gun or blow out pump, set of cleaning brushes, dispenser								

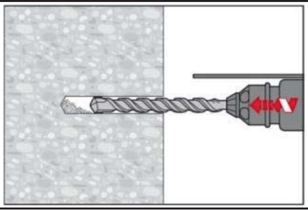
Setting instruction

Bore hole drilling



Drill hole to the required embedment depth with an appropriately sized Hilti TE-CD or TE-YD hollow drill bit with Hilti vacuum attachment. This drilling system removes the dust and cleans the borehole during drilling when using in accordance with the user's manual.

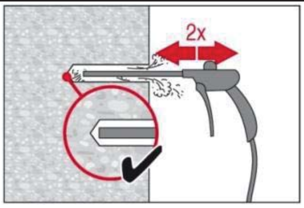
After drilling is complete, proceed to the "injection preparation" step in the instructions for use.



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

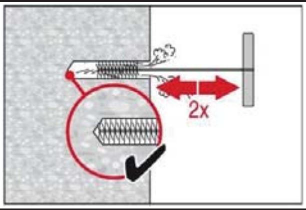
Bore hole cleaning Just before setting an anchor, the bore hole must be free of dust and debris.

Compressed air cleaning (CAC) for all bore hole diameters d_0 and all bore hole depth h_0

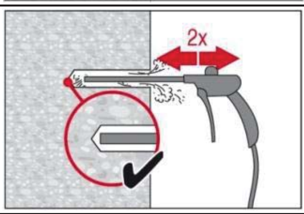


Blow 2 times from the back of the hole (if needed with nozzle extension) over the hole length with oil-free compressed air (min. 6 bar at 6 m^3/h) until return air stream is free of noticeable dust.

Bore hole diameter ≥ 32 mm the compressor must supply a minimum air flow of 140 m^3/hour.

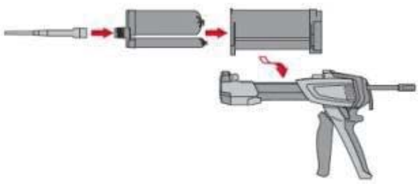


Brush 2 times with the specified brush size by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it.
The brush must produce natural resistance as it enters the bore hole -- if not the brush is too small and must be replaced with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

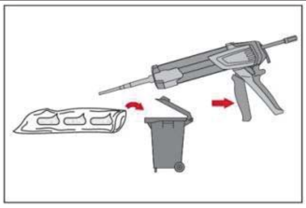


Blow again with compressed air 2 times until return air stream is free of noticeable dust.

Injection preparation



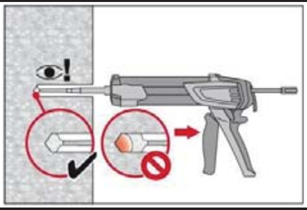
Tightly attach new Hilti mixing nozzle HIT-RE-M to foil pack manifold (snug fit). Do not modify the mixing nozzle.
Observe the instruction for use of the dispenser and the mortar. Check foil pack holder for proper function. Do not use damaged foil packs / holders. Insert foil pack into foil pack holder and put holder into HIT-dispenser.



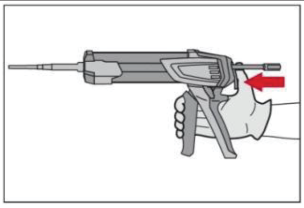
The foil pack opens automatically as dispensing is initiated. Discard initial adhesive. Depending on the size of the foil pack an initial amount of adhesive has to be discarded.
Discard quantities are:

- 3 strokes for 330 ml foil pack,
- 4 strokes for 500 ml foil pack,
- 65 ml for 1400 ml foil pack ≤ 5°C.

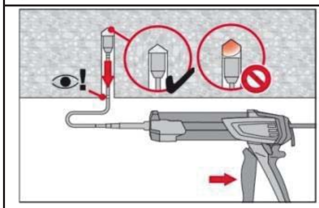
Inject adhesive from the back of the borehole without forming air voids



Inject the adhesive starting at the back of the hole, slowly withdrawing the mixer with each trigger pull.
Fill holes approximately 2/3 full It is required that the annular gap between the anchor and the concrete is completely filled with adhesive along the embedment length.

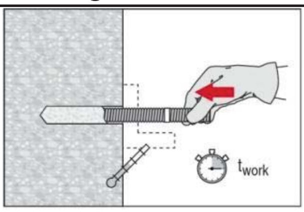


After injection is completed, depressurize the dispenser by pressing the release trigger. This will prevent further adhesive discharge from the mixer.

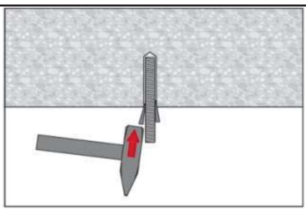


Overhead installation and/or installation with embedment depth h_{ef} > 250mm.
For overhead installation the injection is only possible with the aid of extensions and piston plugs. Assemble HIT-RE-M mixer, extension(s) and appropriately sized piston plug (HIT-SZ). Insert piston plug to back of the hole and inject adhesive. During injection the piston plug will be naturally extruded out of the bore hole by the adhesive pressure.

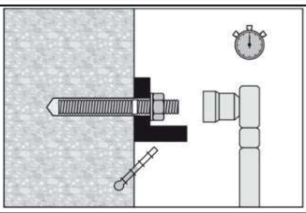
Setting the element



Before use, verify that the element is dry and free of oil and other contaminants.
Mark and set element to the required embedment depth untill working time t_{work} has elapsed.



For overhead installation use piston plugs and fix embedded parts with e.g. wedges HIT-OHW.



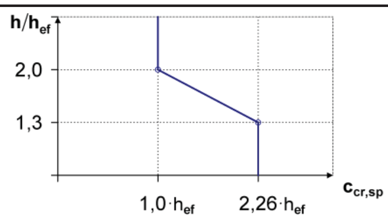
Loading the anchor:
After required curing time t_{cure} the anchor can be loaded.
The applied installation torque shall not exceed given T_{max}.

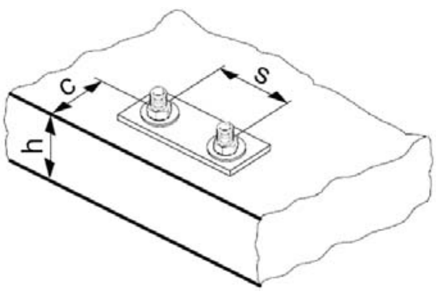
For detailed information on installation see instruction for use given with the package of the product.

Curing time for general conditions

Data according ETA-07/0260, issue 2013-06-26		
Temperature of the base material	**Working time in which anchor can be inserted and adjusted t_{gel}**	**Curing time before anchor can be fully loaded t_{cure}**
40 °C	12 min	4 h
30 °C to 39 °C	12 min	8 h
20 °C to 29 °C	20 min	12 h
15 °C to 19 °C	30 min	24 h
10 °C to 14 °C	90 min	48 h
5 °C to 9 °C	120 min	72 h

Setting details

			Data according ETA-07/0260, issue 2013-06-26								
Anchor size			**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Nominal diameter of drill bit	d_0	[mm]	12	14	16	18	20	25	32	35	40
Effective anchorage and drill hole depth range [a)]	$h_{ef,min}$	[mm]	60	60	70	75	80	90	100	112	128
	$h_{ef,max}$	[mm]	160	200	240	280	320	400	500	560	640
Minimum base material thickness	h_{min}	[mm]	h_{ef} + 30 mm ≥ 100 mm	h_{ef} + 2 d_0							
Minimum spacing	s_{min}	[mm]	40	50	60	70	80	100	125	140	160
Minimum edge distance	c_{min}	[mm]	40	50	60	70	80	100	125	140	160
Critical spacing for splitting failure	$s_{cr,sp}$		2 $c_{cr,sp}$								
Critical edge distance for splitting failure [b)]	$c_{cr,sp}$	[mm]	**1,0 · h_{ef}** for $h / h_{ef} \geq 2,0$								
			4,6 h_{ef} - 1,8 h for $2,0 > h / h_{ef} > 1,3$								
			2,26 h_{ef} for $h / h_{ef} \leq 1,3$								
Critical spacing for concrete cone failure	$s_{cr,N}$		2 $c_{cr,N}$								
Critical edge distance for concrete cone failure [c)]	$c_{cr,N}$		1,5 h_{ef}								



For spacing (edge distance) smaller than critical spacing (critical edge distance) the design loads have to be reduced.

a) $h_{ef,min} \leq h_{ef} \leq h_{ef,max}$ (h_{ef}: embedment depth)

b) h: base material thickness ($h \geq h_{min}$)

c) The critical edge distance for concrete cone failure depends on the embedment depth h_{ef} and the design bond resistance. The simplified formula given in this table is on the save side.

Simplified design method

Simplified version of the design method according ETAG 001, TR 029. Design resistance according data given in ETA-07/0260, issue 2009-01-12.

- Influence of concrete strength
- Influence of edge distance
- Influence of spacing
- Valid for a group of two anchors. (The method may also be applied for anchor groups with more than two anchors or more than one edge distance. The influencing factors must then be considered for each edge distance and spacing. The calculated design loads are then on the save side: They will be lower than the exact values according ETAG 001, TR 029. To avoid this, it is recommended to use the anchor design software PROFIS anchor)

The design method is based on the following simplification:

- No different loads are acting on individual anchors (no eccentricity)

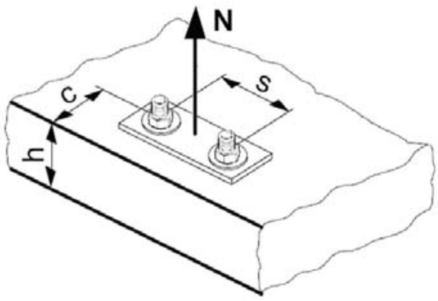
The values are valid for one anchor.

For more complex fastening applications please use the anchor design software PROFIS Anchor.

Tension loading

The design tensile resistance is the lower value of

- Steel resistance: $N_{Rd,s}$
- Combined pull-out and concrete cone resistance:
  $N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,p} \cdot f_{re,N}$
- Concrete cone resistance: $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$
- Concrete splitting resistance (only non-cracked concrete):
  $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,N} \cdot f_{re,N}$



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

	Data according ETA-07/0260, issue 2013-06-26								
Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
$N_{Rd,s}$ BSt 500 S [kN]	20,0	30,7	44,3	60,7	79,3	123,6	192,9	242,1	315,7

Design combined pull-out and concrete cone resistance

$N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,p} \cdot f_{re,N}$

	Data according ETA-07/0260, issue 2013-06-26								
Anchor size	**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Typical embedment depth $h_{ef,typ}$ [mm]	**80**	**90**	**110**	**125**	**125**	**170**	**210**	**270**	**300**
Non cracked concrete									
$N^0_{Rd,p}$ Temperature range I [kN]	16,8	23,6	34,6	42,8	41,9	71,2	102,1	147,0	186,7
$N^0_{Rd,p}$ Temperature range II [kN]	13,4	18,8	27,6	36,7	32,9	56,0	86,4	113,1	143,6
$N^0_{Rd,p}$ Temperature range III [kN]	7,8	11,0	16,1	21,4	20,9	33,1	51,1	67,9	86,2
Cracked concrete									
$N^0_{Rd,p}$ Temperature range I [kN]	8,9	12,6	17,3	21,4	20,9	35,6	55,0	73,5	86,2
$N^0_{Rd,p}$ Temperature range II [kN]	7,3	10,2	13,8	18,3	18,0	28,0	43,2	56,5	71,8
$N^0_{Rd,p}$ Temperature range III [kN]	4,5	5,5	8,1	10,7	10,5	15,3	23,6	33,9	43,1

Design concrete cone resistance $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$

Design splitting resistance a) $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,N} \cdot f_{re,N}$

	Data according ETA-07/0260, issue 2013-06-26								
Anchor size	**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
$N^0_{Rd,c}$ Non cracked concrete [kN]	20,1	24,0	32,4	39,2	33,6	53,3	73,2	106,7	125,0
$N^0_{Rd,c}$ Cracked concrete [kN]	14,3	17,1	23,1	28,0	24,0	38,0	52,2	76,1	89,1

a) Splitting resistance must only be considered for non-cracked concrete

Influencing factors

Influence of concrete strength on combined pull-out and concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_{B,p} = (f_{ck,cube}/25N/mm^2)^{0,1}$ a)	1	1,02	1,04	1,06	1,07	1,08	1,09

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of embedment depth on combined pull-out and concrete cone resistance

$f_{h,p} = h_{ef}/h_{ef,typ}$

Influence of concrete strength on concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of edge distance a)

$c/c_{cr,N}$ / $c/c_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{1,N} = 0,7 + 0,3 \cdot c/c_{cr,N}$ / $f_{1,sp} = 0,7 + 0,3 \cdot c/c_{cr,sp}$	0,73	0,76	0,79	0,82	0,85	0,88	0,91	0,94	0,97	1
$f_{2,N} = 0,5 \cdot (1 + c/c_{cr,N})$ / $f_{2,sp} = 0,5 \cdot (1 + c/c_{cr,sp})$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The the edge distance shall not be smaller than the minimum edge distance c_{min} given in the table with the setting details. These influencing factors must be considered for every edge distance smaller than the critical edge distance.

Influence of anchor spacing a)

$s/s_{cr,N}$ / $s/s_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{3,N} = 0,5 \cdot (1 + s/s_{cr,N})$ / $f_{3,sp} = 0,5 \cdot (1 + s/s_{cr,sp})$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The anchor spacing shall not be smaller than the minimum anchor spacing s_{min} given in the table with the setting details. This influencing factor must be considered for every anchor spacing.

Influence of embedment depth on concrete cone resistance

$$f_{h,N} = (h_{ef}/h_{ef,typ})^{1,5}$$

Influence of reinforcement

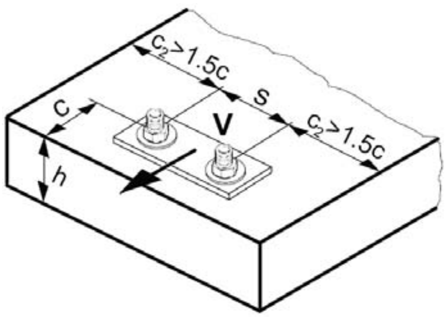
h_{ef} [mm]	40	50	60	70	80	90	≥ 100
$f_{re,N} = 0,5 + h_{ef}/200mm \leq 1$	0,7 a)	0,75 a)	0,8 a)	0,85 a)	0,9 a)	0,95 a)	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing ≥ 150 mm (any diameter) or with a diameter ≤ 10 mm and a spacing ≥ 100 mm, then a factor $f_{re} = 1$ may be applied.

Shear loading

The design shear resistance is the lower value of

- Steel resistance: $V_{Rd,s}$
- Concrete pryout resistance: $V_{Rd,cp} = k \cdot$ lower value of $N_{Rd,p}$ and $N_{Rd,c}$
- Concrete edge resistance: $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

	Data according ETA-07/0260, issue 2013-06-26								
Anchor size	**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
$V_{Rd,s}$ BSt 500 S [kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0	112,7	147,3

Design concrete pryout resistance $V_{Rd,cp}$ = lower value[a)] of $k \cdot N_{Rd,p}$ and $k \cdot N_{Rd,c}$

k = 1 for h_{ef} < 60 mm
k = 2 for h_{ef} ≥ 60 mm

a) $N_{Rd,p}$: Design combined pull-out and concrete cone resistance
$N_{Rd,c}$: Design concrete cone resistance

Design concrete edge resistance $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

	Data according ETA-07/0260, issue 2013-06-26								
Anchor size	**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Non-cracked concrete									
$V^0_{Rd,c}$ [kN]	5,9	8,6	11,6	15,0	18,7	27,0	39,2	47,3	59,0
Cracked concrete									
$V^0_{Rd,c}$ [kN]	4,2	6,1	8,2	10,6	13,2	19,2	27,7	33,5	41,8

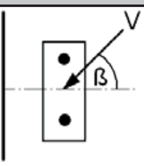
Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ [a)]	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of angle between load applied and the direction perpendicular to the free edge

Angle ß	0°	10°	20°	30°	40°	50°	60°	70°	80°	≥ 90°
$f_\beta = \sqrt{\frac{1}{(\cos\alpha_V)^2 + \left(\frac{\sin\alpha_V}{2,5}\right)^2}}$ 	1	1,01	1,05	1,13	1,24	1,40	1,64	1,97	2,32	2,50

Influence of base material thickness

h/c	0,15	0,3	0,45	0,6	0,75	0,9	1,05	1,2	1,35	≥ 1,5
$f_h = \{h/(1,5 \cdot c)\}^{1/2} \leq 1$	0,32	0,45	0,55	0,63	0,71	0,77	0,84	0,89	0,95	1,00

Influence of anchor spacing and edge distance a) for concrete edge resistance: f_4

$f_4 = (c/h_{ef})^{1,5} \cdot (1 + s / [3 \cdot c]) \cdot 0,5$

c/h_{ef}	Single anchor	Group of two anchors s/h_{ef}														
		0,75	1,50	2,25	3,00	3,75	4,50	5,25	6,00	6,75	7,50	8,25	9,00	9,75	10,50	11,25
0,50	0,35	0,27	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35
0,75	0,65	0,43	0,54	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65
1,00	1,00	0,63	0,75	0,88	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
1,25	1,40	0,84	0,98	1,12	1,26	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40
1,50	1,84	1,07	1,22	1,38	1,53	1,68	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84
1,75	2,32	1,32	1,49	1,65	1,82	1,98	2,15	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32
2,00	2,83	1,59	1,77	1,94	2,12	2,30	2,47	2,65	2,83	2,83	2,83	2,83	2,83	2,83	2,83	2,83
2,25	3,38	1,88	2,06	2,25	2,44	2,63	2,81	3,00	3,19	3,38	3,38	3,38	3,38	3,38	3,38	3,38
2,50	3,95	2,17	2,37	2,57	2,77	2,96	3,16	3,36	3,56	3,76	3,95	3,95	3,95	3,95	3,95	3,95
2,75	4,56	2,49	2,69	2,90	3,11	3,32	3,52	3,73	3,94	4,15	4,35	4,56	4,56	4,56	4,56	4,56
3,00	5,20	2,81	3,03	3,25	3,46	3,68	3,90	4,11	4,33	4,55	4,76	4,98	5,20	5,20	5,20	5,20
3,25	5,86	3,15	3,38	3,61	3,83	4,06	4,28	4,51	4,73	4,96	5,18	5,41	5,63	5,86	5,86	5,86
3,50	6,55	3,51	3,74	3,98	4,21	4,44	4,68	4,91	5,14	5,38	5,61	5,85	6,08	6,31	6,55	6,55
3,75	7,26	3,87	4,12	4,36	4,60	4,84	5,08	5,33	5,57	5,81	6,05	6,29	6,54	6,78	7,02	7,26
4,00	8,00	4,25	4,50	4,75	5,00	5,25	5,50	5,75	6,00	6,25	6,50	6,75	7,00	7,25	7,50	7,75
4,25	8,76	4,64	4,90	5,15	5,41	5,67	5,93	6,18	6,44	6,70	6,96	7,22	7,47	7,73	7,99	8,25
4,50	9,55	5,04	5,30	5,57	5,83	6,10	6,36	6,63	6,89	7,16	7,42	7,69	7,95	8,22	8,49	8,75
4,75	10,35	5,45	5,72	5,99	6,27	6,54	6,81	7,08	7,36	7,63	7,90	8,17	8,45	8,72	8,99	9,26
5,00	11,18	5,87	6,15	6,43	6,71	6,99	7,27	7,55	7,83	8,11	8,39	8,66	8,94	9,22	9,50	9,78
5,25	12,03	6,30	6,59	6,87	7,16	7,45	7,73	8,02	8,31	8,59	8,88	9,17	9,45	9,74	10,02	10,31
5,50	12,90	6,74	7,04	7,33	7,62	7,92	8,21	8,50	8,79	9,09	9,38	9,67	9,97	10,26	10,55	10,85

a) The anchor spacing and the edge distance shall not be smaller than the minimum anchor spacing s_{min} and the minimum edge distance c_{min}.

Influence of embedment depth

h_{ef}/d	4	4,5	5	6	7	8	9	10	11
$f_{hef} = 0,05 \cdot (h_{ef} / d)^{1,68}$	0,51	0,63	0,75	1,01	1,31	1,64	2,00	2,39	2,81

h_{ef}/d	12	13	14	15	16	17	18	19	20
$f_{hef} = 0,05 \cdot (h_{ef} / d)^{1,68}$	3,25	3,72	4,21	4,73	5,27	5,84	6,42	7,04	7,67

Influence of edge distance a)

c/d	4	6	8	10	15	20	30	40
$f_c = (d / c)^{0,19}$	0,77	0,71	0,67	0,65	0,60	0,57	0,52	0,50

a) The edge distance shall not be smaller than the minimum edge distance c_{min}.

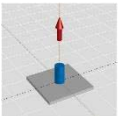
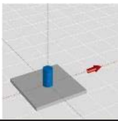
Combined tension and shear loading

For combined tension and shear loading see section “Anchor Design”.

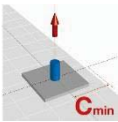
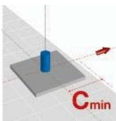
Precalculated values

Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action $\gamma = 1,4$. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

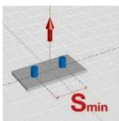
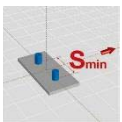
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I

	Data according ETA-07/0260, issue 2013-06-26								
Anchor size	**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Embedment depth $h_{ef,1}$ = [mm]	60	60	72	84	96	120	150	168	192
Base material thickness h_{min}= [mm]	100	100	104	120	136	170	214	238	272
 **Tensile N_{Rd}: single anchor, no edge effects**									
Non cracked concrete									
BSt 500 S [kN]	12,6	13,0	17,1	21,6	22,6	31,6	44,2	52,4	64,0
Cracked concrete									
BSt 500 S [kN]	6,7	8,4	11,3	14,4	16,1	22,5	31,5	37,3	45,6
 **Shear V_{Rd}: single anchor, no edge effects, without lever arm**									
Non cracked concrete									
BSt 500 S [kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0	112,7	147,3
Cracked concrete									
BSt 500 S [kN]	9,3	14,7	20,7	28,0	36,7	57,3	88,2	104,5	127,7

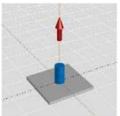
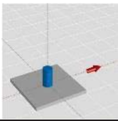
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I

	Data according ETA-07/0260, issue 2013-06-26								
Anchor size	**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Embedment depth $h_{ef,1}$ = [mm]	60	60	72	84	96	120	150	168	192
Base material thickness h_{min}= [mm]	100	100	104	120	136	170	214	238	272
Edge distance $c = c_{min}$= [mm]	40	50	60	70	80	100	125	140	160
 **Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)**									
Non cracked concrete									
BSt 500 S [kN]	7,6	8,5	10,0	12,5	13,1	18,3	25,6	30,3	37,0
Cracked concrete									
BSt 500 S [kN]	4,0	5,6	7,6	9,7	10,8	15,2	21,2	25,2	30,7
 **Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$), without lever arm**									
Non cracked concrete									
BSt 500 S [kN]	3,5	4,9	6,7	8,6	10,8	15,7	22,9	27,7	34,6
Cracked concrete									
BSt 500 S [kN]	2,5	3,5	4,7	6,1	7,6	11,1	16,2	19,6	24,5

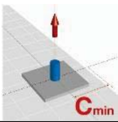
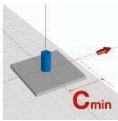
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I (load values are valid for single anchor)

	Data according ETA-07/0260, issue 2013-06-26								
Anchor size	**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Embedment depth $h_{ef,1}$ = [mm]	60	60	72	84	96	120	150	168	192
Base material thickness h_{min}= [mm]	100	100	104	120	136	170	214	238	272
Spacing $s = s_{min}$= [mm]	40	50	60	70	80	100	125	140	160
 **Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)**									
Non cracked concrete									
BSt 500 S [kN]	7,8	8,2	10,4	13,0	13,6	19,0	26,6	31,5	38,5
Cracked concrete									
BSt 500 S [kN]	4,4	5,5	7,4	9,3	9,7	13,6	19,0	22,5	27,4
 **Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$), without lever arm**									
Non cracked concrete									
BSt 500 S [kN]	9,3	14,7	20,7	28,0	36,7	56,5	79,0	93,7	114,4
Cracked concrete									
BSt 500 S [kN]	9,3	12,8	17,3	22,0	28,8	40,3	56,3	66,8	81,6

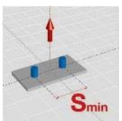
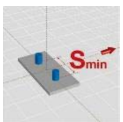
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I

	Data according ETA-07/0260, issue 2013-06-26								
Anchor size	**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Embedment depth $h_{ef,typ}$ = [mm]	80	90	110	125	125	170	210	270	300
Base material thickness h_{min}= [mm]	110	120	142	161	165	220	274	340	380
 **Tensile N_{Rd}: single anchor, no edge effects**									
Non cracked concrete									
BSt 500 S [kN]	16,8	23,6	32,4	39,2	33,6	53,3	73,2	106,7	125,0
Cracked concrete									
BSt 500 S [kN]	8,9	12,6	17,3	21,4	20,9	35,6	52,2	73,5	86,2
 **Shear V_{Rd}: single anchor, no edge effects, without lever arm**									
Non cracked concrete									
BSt 500 S [kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0	112,7	147,3
cracked concrete									
BSt 500 S [kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0	112,7	147,3

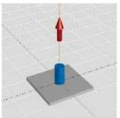
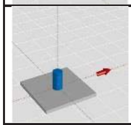
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I

	Data according ETA-07/0260, issue 2013-06-26								
Anchor size	**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Embedment depth $h_{ef,typ}$ = [mm]	80	90	110	125	125	170	210	270	300
Base material thickness h_{min}= [mm]	110	120	142	161	165	220	274	340	380
Edge distance $c = c_{min}$= [mm]	40	50	60	70	80	100	125	140	160
 **Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)**									
Non cracked concrete									
BSt 500 S [kN]	9,1	11,6	15,5	18,9	17,0	26,1	36,1	50,4	59,5
Cracked concrete									
BSt 500 S [kN]	4,3	6,0	8,4	10,5	10,3	17,4	25,7	35,9	42,4
 **Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$), without lever arm**									
Non cracked concrete									
BSt 500 S [kN]	3,7	5,3	7,3	9,5	11,5	17,2	25,0	31,6	39,3
Cracked concrete									
BSt 500 S [kN]	2,6	3,8	5,2	6,7	8,1	12,2	17,7	22,4	27,9

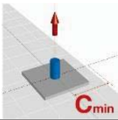
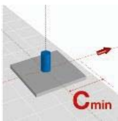
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I
(load values are valid for single anchor)

	Data according ETA-07/0260, issue 2013-06-26								
Anchor size	**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Embedment depth $h_{ef,typ}$ = [mm]	80	90	110	125	125	170	210	270	300
Base material thickness h_{min}= [mm]	110	120	142	161	165	220	274	340	380
Spacing $s = s_{min}$= [mm]	40	50	60	70	80	100	125	140	160
 **Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)**									
Non cracked concrete									
BSt 500 S [kN]	10,4	13,5	18,1	22,0	19,2	30,1	41,4	59,5	69,8
Cracked concrete									
BSt 500 S [kN]	5,9	8,1	11,1	13,7	13,2	21,5	29,5	42,4	49,8
 **Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$), without lever arm**									
Non cracked concrete									
BSt 500 S [kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0	112,7	147,3
Cracked concrete									
BSt 500 S [kN]	9,3	14,7	20,7	28,0	35,6	57,3	87,5	112,7	142,1

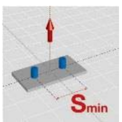
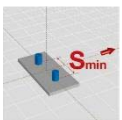
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I

	Data according ETA-07/0260, issue 2013-06-26								
Anchor size	**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Embedment depth $h_{ef,2}$ = [mm]	96	120	144	168	192	240	300	336	384
Base material thickness h_{min}= [mm]	126	150	176	204	232	290	364	406	464
 **Tensile N_{Rd}: single anchor, no edge effects**									
Non cracked concrete									
BSt 500 S [kN]	20,0	30,7	44,3	57,5	64,0	89,4	125,0	148,1	181,0
Cracked concrete									
BSt 500 S [kN]	10,7	16,8	22,6	28,7	32,2	50,3	78,5	91,5	110,3
 **Shear V_{Rd}: single anchor, no edge effects, without lever arm**									
Non cracked and cracked concrete									
BSt 500 S [kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0	112,7	147,3

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I

	Data according ETA-07/0260, issue 2013-06-26								
Anchor size	**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Embedment depth $h_{ef,2}$ = [mm]	96	120	144	168	192	240	300	336	384
Base material thickness h_{min}= [mm]	126	150	176	204	232	290	364	406	464
Edge distance $c = c_{min}$= [mm]	40	50	60	70	80	100	125	140	160
 **Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)**									
Non cracked concrete									
BSt 500 S [kN]	11,0	16,5	21,7	27,3	28,6	40,0	55,9	66,2	80,9
Cracked concrete									
BSt 500 S [kN]	5,8	9,1	12,3	15,9	17,8	27,8	44,1	51,4	61,9
 **Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$), without lever arm**									
Non cracked and cracked concrete									
BSt 500 S [kN]	3,9	5,7	7,8	10,2	12,9	18,9	27,8	33,9	42,6
Cracked concrete									
BSt 500 S [kN]	2,8	4,0	5,5	7,2	9,1	13,4	19,7	24,0	30,2

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², Temperature range I
(load values are valid for single anchor)

	Data according ETA-07/0260, issue 2013-06-26								
Anchor size	**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø25**	**Ø28**	**Ø32**
Embedment depth $h_{ef,2}$ = [mm]	96	120	144	168	192	240	300	336	384
Base material thickness h_{min}= [mm]	126	150	176	204	232	290	364	406	464
Spacing $s = s_{min}$= [mm]	40	50	60	70	80	100	125	140	160
 **Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)**									
Non cracked concrete									
BSt 500 S [kN]	12,8	19,4	26,5	33,4	34,9	48,8	68,2	80,9	98,8
Cracked concrete									
BSt 500 S [kN]	7,2	11,0	14,8	18,9	20,9	31,9	48,6	56,9	68,9
 **Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$), without lever arm**									
Non cracked concrete									
BSt 500 S [kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0	112,7	147,3
Cracked concrete									
BSt 500 S [kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0	112,7	147,3

Seismic design C1

Basic loading data for concrete C20/25 – C50/60

All data in this section applies to:
- Seismic design according to TR045

The following technical data are based on: ETA-07/0260, issue 2013-06-26

Anchorage depth range

Anchor size			Φ8	Φ10	Φ12	Φ14	Φ16	Φ20	Φ25	Φ26	Φ28	Φ30	Φ32
Effective anchorage depth range	$h_{ef,min}$	[mm]	60	60	70	80	80	90	100	104	115	120	130
	$h_{ef,max}$	[mm]	160	200	240	280	320	400	500	520	540	600	660

Tension resistance in case of seismic performance category C1

Anchor size			Φ8	Φ10	Φ12	Φ14	Φ16	Φ20	Φ25	Φ26	Φ28	Φ30	Φ32
Characteristic tension resistance to steel failure													
Rebar B500B Acc. to DIN 488:2009-08	$N_{Rk,s,seis}$	[kN]	28	43	62	85	111	173	270	-	339	-	442
Partial safety factor Acc. to DIN 488:2009-08	$\gamma_{Ms,seis}$	[-]	1,4							-	1,4	-	1,4
Characteristic bond resistance in cracked concrete C20/25 to C50/60													
Temp. range I: 40°C/24°C	$\tau_{Rk,seis}$	[N/mm²]	6,4	6,4	6	5,4	5,3	5	4,6	4,5	4	3,6	3,4
Temp. range II: 58°C/35°C	$\tau_{Rk,seis}$	[N/mm²]	5,2	5,2	4,8	4,7	4,5	3,9	3,6	3,5	3,1	3,0	2,9
Temp. range III: 70°C/43°C	$\tau_{Rk,seis}$	[N/mm²]	3,2	2,8	2,8	2,7	2,6	2,1	2	1,9	1,8	1,8	1,7
Partial safety factor	$\gamma_{Mp,seis}$	[-]	1,8				2,1						
Concrete cone resistance and splitting resistance													
Partial safety factor	$\gamma_{Mc,seis} = \gamma_{Msp,seis}$	[-]	1,8				2,1						

Displacement under tension load in case of seismic performance category C1 1)

Anchor size			Φ8	Φ10	Φ12	Φ14	Φ16	Φ20	Φ25	Φ26	Φ28	Φ30	Φ32
Displacement 1)	$\delta_{N,seis}$	[mm]	1,5	1,7	1,9	2,1	2,3	2,7	3,2	3,3	3,5	3,7	3,9

1) Maximum displacement during cycling (seismic event).

Shear resistance in case of seismic performance category C1

Anchor size			Φ8	Φ10	Φ12	Φ14	Φ16	Φ20	Φ25	Φ26	Φ28	Φ30	Φ32
Characteristic shear resistance to steel failure													
Rebar B500B Acc. to DIN 488:2009-08	$N_{Rk,s,seis}$	[kN]	10	15	22	29	39	60	95	-	118	-	155
Partial safety factor Acc. to DIN 488:2009-08	$\gamma_{Ms,seis}$	[-]	1,5							-	1,5	-	1,5
Concrete pryout resistance and concrete edge resistance													
Partial safety factor	$\gamma_{Mcp,seis} = \gamma_{Mc,seis}$	[-]	1,5										

Displacement under shear load in case of seismic performance category C1 [1)]

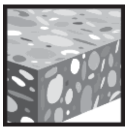
Anchor size			Φ8	Φ10	Φ12	Φ14	Φ16	Φ20	Φ25	Φ26	Φ28	Φ30	Φ32
Displacement[1)]	$\delta_{V,seis}$	[mm]	3,2	3,5	3,8	4,1	4,4	5,0	5,8	5,9	6,2	6,5	6,8

1) Maximum displacement during cycling (seismic event).

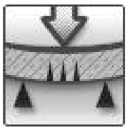
For seismic resistent fastening applications please use the anchor design software PROFIS Anchor.

Hilti HIT-RE 500-SD mortar with HIT-CS(-F) rod

Injection mortar system		Benefits
	Hilti HIT-RE 500-SD (available as 330 ml, 500 ml or 1400 ml foil pack)	- suitable for cracked and non-cracked concrete C 20/25 to C 50/60 - wet and dry concrete - high loading capacity - 8.8. steel grade - hot dip galvanized coating 55 µm (HIT-CS-F) - electrogalvanized 5 µm (HIT-CS)
	Static mixer	
	HIT-CS-F rod (55µm)	
	HIT-CS rod (5µm)	



Concrete



Tensile zone

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
Test report	CMA *	20121C01764 / 2012-08-10

* National Research Center of Testing Techniques for Building Materials, only valid for HIT-CS-F

Basic loading data (for a single anchor)

All data in this section is Hilti technical data and applies to

For details see Simplified design method

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- *Steel* failure
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²
- min. in service base material temperature -40°C, max. long term/short term base material temperature: +24°C/40°C
- Installation temperature range +5°C to +40°C

Mean Ultimate Resistance

		non-cracked concrete			cracked concrete		
Anchor size		M12x110	M16x125	M20x170	M12x110	M16x125	M20x170
Tensile $N_{Ru,m}$	[kN]	*68,6*	93,7	148,6	55,1	66,8	105,9
Shear $V_{Ru,m}$	[kN]	*35,4*	*65,9*	*102,9*	*35,4*	*65,9*	*102,9*

Characteristic Resistance

		non-cracked concrete			cracked concrete		
Anchor size		M12x110	M16x125	M20x170	M12x110	M16x125	M20x170
Tensile N_{Rk}	[kN]	58,3	70,6	111,9	41,5	50,3	79,8
Shear V_{Rk}	[kN]	*33,7*	*62,8*	*98,0*	*33,7*	*62,8*	*98,0*

Design Resistance

		non-cracked concrete			cracked concrete		
Anchor size		M12x110	M16x125	M20x170	M12x110	M16x125	M20x170
Tensile N_{Rd}	[kN]	32,4	39,2	62,2	23,1	28,0	44,3
Shear V_{Rd}	[kN]	27,0	50,2	78,4	27,0	50,2	78,4

Recommended loads a)

		non-cracked concrete			cracked concrete		
Anchor size		M12x110	M16x125	M20x170	M12x110	M16x125	M20x170
Tensile N_{rec}	[kN]	23,1	28,0	44,4	16,5	20,0	31,7
Shear V_{rec}	[kN]	19,3	35,9	56,0	19,3	35,9	56,0

c) With overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Materials

Mechanical properties of HIT-CS-F

Anchor size		M12x110	M16x125	M20x170
Nominal tensile strength f_{uk}	[N/mm²]	800	800	800
Yield strength f_{yk}	[N/mm²]	640	640	640
Stressed cross-section of the thread for shear A_s	[mm²]	84,3	157	245
relevant cross-section for tensile loading $A_{s,c}$	[mm²]	81,7	157	237,8
Moment of resistance W	[mm³]	109	277	541
Char. bending resistance $M^0_{Rk,s}$ with 8.8 Steel Grade	[Nm]	105	266	519

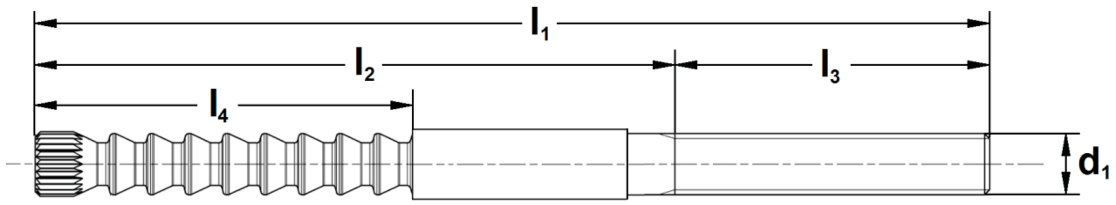
Material quality

Part	Material	
	HIT-CS-F	HIT-CS
Anchor Body	Carbon steel; hot dip galvanized to min. 55 µm, coated	Carbon steel; electrogalvanized to min. 5 µm, coated
Washer	DIN 934-class 8-AZ (according to DIN ISO 965-5); hot dip galvanized to min. 55 µm	Property class 8 acc.to DIN EN ISO 898-2, electrogalvanized to min. 5 µm
Nut	Carbon steel; hot dip galvanized to min. 55 µm	DIN 125-1-size-140HV, electrogalvanized to min. 5 µm

Anchor dimensions of HIT-CS-F

Anchor size			M12x110	M16x125	M20x170
Norminal diameter	d_1	[mm]	12	16	20
Length of anchor	l_1	[mm]	160 to 660	190 to 675	240 to 720
Embedment depth	$l_2 = h_{nom}$	[mm]	110	125	170
Length of thread	l_3	[mm]	50 to 550	65 to 550	70 to 550
Length of helix	l_4	[mm]	60	80	110

Anchor rod



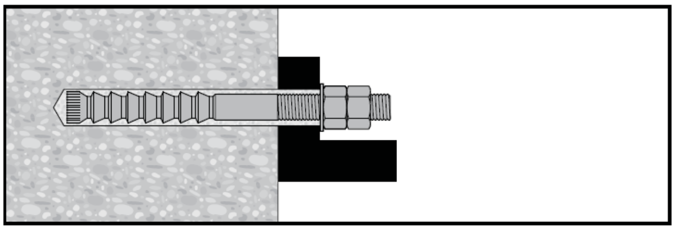
Setting

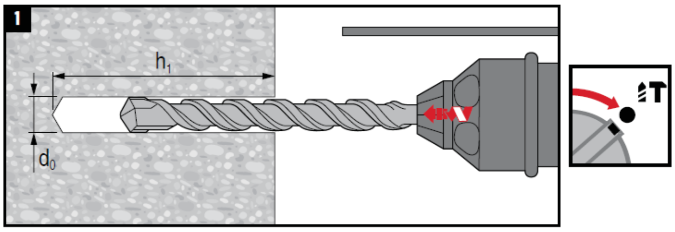
Installation equipment

Anchor size	M12x110	M16x125	M20x170
Rotary hammer	TE 16 – TE 80		
Other tools	Compressed air gun, set of brushes, dispenser		

Setting instruction

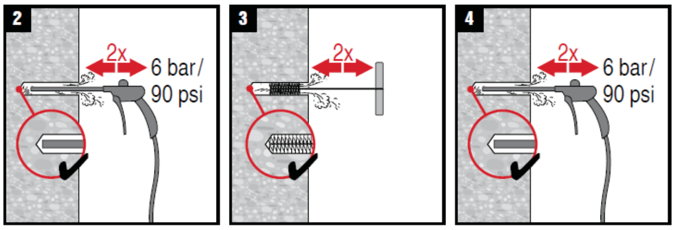
For detailed information on installation see instruction for use given with the package of the product.

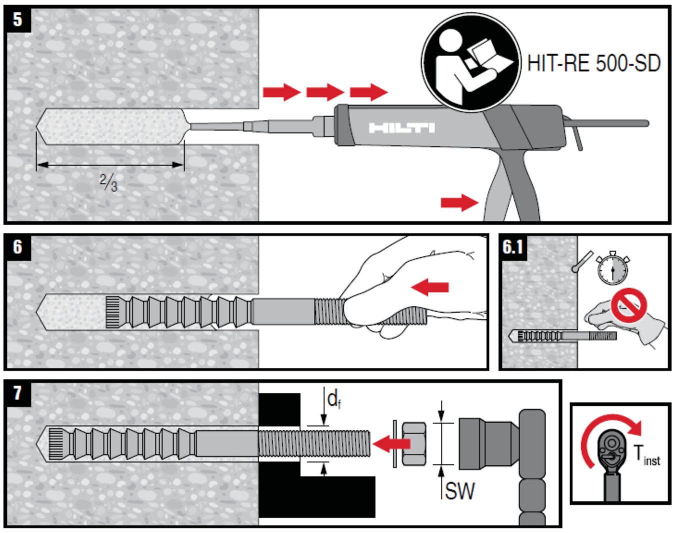




1.1

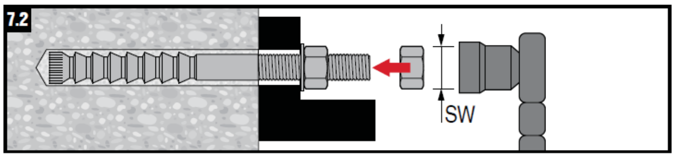
HIT-CS-F	Ø d_0 [mm]	h_1 [mm]
M12 x 110	Ø 14	115
M16 x 125	Ø 18	130
M20 x 170	Ø 24	175





7.1

HIT-CS-F	d_f [mm]	SW [mm]	T_{inst} [Nm]
M12 x 110	14	19	40
M16 x 125	18	24	80
M20 x 170	22	30	150

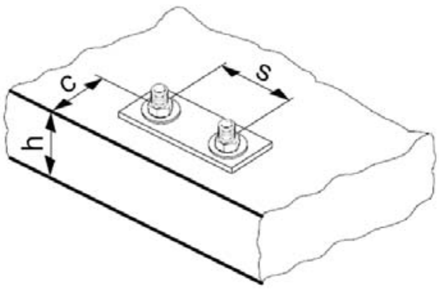


Curing time for general conditions

Temperature of the base material	Working time in which anchor can be inserted and adjusted t_{gel}	Curing time before anchor can be fully loaded t_{cure}
40 °C	12 min	4 h
30 °C to 39 °C	12 min	8 h
20 °C to 29 °C	20 min	12 h
15 °C to 19 °C	30 min	24 h
10 °C to 14 °C	90 min	48 h
5 °C to 9 °C	120 min	72 h

Setting details

Anchor size			M12x110		M16x125		M20x170	
Anchor type			HIT-CS-F	HIT-CS	HIT-CS-F	HIT-CS	HIT-CS-F	HIT-CS
Nominal diameter of drill bit	d_o	[mm]	14		18		22	
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	14,5		18,5		22,5	
Effective anchorage depth	h_{ef}	[mm]	102		117		158	
Nominal anchorage depth	h_{nom}	[mm]	110		125		170	
Depth of drill hole	$h_1 \geq$	[mm]	115		130		175	
Minimum base material thickness	h_{min} a)	[mm]	140		170	200	230	250
Diameter of clearance hole in the fixture	$d_f \leq$	[mm]	14		18		22	
Minimum spacing and minimum edge distance	s_{min}	[mm]	60	90	80	100	100	120
	c_{min}	[mm]	60	90	80	100	100	120
Critical edge distance for splitting failure	$s_{cr,sp}$	[mm]	7 hef		7 hef		7 hef	
	$c_{cr,sp}$	[mm]	3,5 hef		3,5 hef		3,5 hef	
Critical edge distance for concrete cone failure	$s_{cr,N}$	[mm]	330		375		510	
	$c_{cr,N}$	[mm]	165		187,5		255	
Max. torque moment	T_{inst}	[Nm]	40		80		150	



For spacing (edge distance) smaller than critical spacing (critical edge distance) the design loads have to be reduced.

a) h: base material thickness ($h \geq h_{min}$)

Simplified design method

Simplified version of the design method according ETAG 001, Annex C.

- Influence of concrete strength
- Influence of edge distance
- Influence of spacing
- Valid for a group of two anchors. The method may also be applied for anchor groups with more than two anchors or more than one edge distance. The influencing factors must then be considered for each edge distance and spacing.

The design method is based on the following simplification:

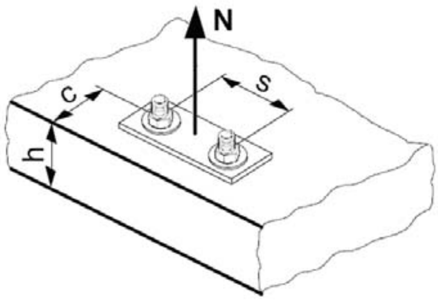
- No different loads are acting on individual anchors (no eccentricity)

The values are valid for one anchor.

Tension loading

The design tensile resistance is the lower value of

- Steel resistance: $N_{Rd,s}$
- Pull-out resistance: $N_{Rd,p} = N^0_{Rd,p} \cdot f_B$
- Concrete cone resistance: $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N}$
- Concrete splitting resistance (only non-cracked concrete):
  $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,sp}$



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

Anchor size	M12	M16	M20
$N_{Rd,s}$ [kN]	43,6	98,1	126,8

Design pull-out a resistance $N_{Rd,p} = N^0_{Rd,p}$

	Non-cracked concrete			Cracked concrete		
Anchor size	M12	M16	M20	M12	M16	M20
Embedment depth h_{ef} [mm]	110	125	170	110	125	170
$N^0_{Rd,p}$ [kN]	No pull-out failure					

Design concrete cone resistance $N_{Rd,c} = N^0_{Rd,c} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N}$
Design splitting resistance $N_{Rd,sp} = N^0_{Rd,c} \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp}$

	Non-cracked concrete			Cracked concrete		
Anchor size	M12	M16	M20	M12	M16	M20
$N^0_{Rd,c}$ [kN]	32,4	39,2	62,2	23,1	28,0	44,3

Influencing factors

Influence of concrete strength on concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{0,5}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of edge distance a)

$c/c_{cr,N}$ $c/c_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{1,N} = 0{,}7 + 0{,}3 \cdot c/c_{cr,N}$ $f_{1,sp} = 0{,}7 + 0{,}3 \cdot c/c_{cr,sp}$	0,73	0,76	0,79	0,82	0,85	0,88	0,91	0,94	0,97	1
$f_{2,N} = 0{,}5 \cdot (1 + c/c_{cr,N})$ $f_{2,sp} = 0{,}5 \cdot (1 + c/c_{cr,sp})$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The the edge distance shall not be smaller than the minimum edge distance c_{min} given in the table with the setting details. These influencing factors must be considered for every edge distance smaller than the critical edge distance.

Influence of anchor spacing a)

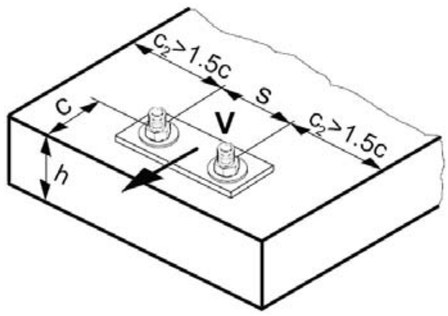
$s/s_{cr,N}$ $s/s_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{3,N} = 0{,}5 \cdot (1 + s/s_{cr,N})$ $f_{3,sp} = 0{,}5 \cdot (1 + s/s_{cr,sp})$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1

a) The anchor spacing shall not be smaller than the minimum anchor spacing s_{min} given in the table with the setting details. This influencing factor must be considered for every anchor spacing.

Shear loading

The design shear resistance is the lower value of

- Steel resistance: $V_{Rd,s}$
- Concrete pryout resistance: $V_{Rd,cp} = k \cdot$ lower value of $N_{Rd,p}$ and $N_{Rd,c}$
- Concrete edge resistance: $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4$



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

Anchor size		M12	M16	M20
$V_{Rd,s}$ HIT-CS-F	[kN]	27,0	50,2	78,4

Design concrete pryout resistance $V_{Rd,cp} = k \cdot N_{Rd,c}$

k = 2

Design concrete edge resistance a) $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4$

		Non-cracked concrete			Cracked concrete		
Anchor size		M12	M16	M20	M12	M16	M20
$V^0_{Rd,c}$	[kN]	11,6	18,7	27,0	8,2	13,2	19,2

a) For anchor groups only the anchors close to the edge must be considered.

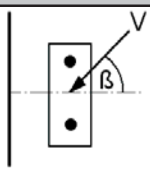
Influencing factors

Influence of concrete strength

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2\ a)}$	1	1,1	1,22	1,34	1,41	1,48	1,55

a) $f_{ck,cube}$ = concrete compressive strength, measured on cubes with 150 mm side length

Influence of angle between load applied and the direction perpendicular to the free edge

Angle ß	0°	10°	20°	30°	40°	50°	60°	70°	80°	≥ 90°
$f_\beta = \sqrt{\dfrac{1}{(\cos\alpha_V)^2 + \left(\dfrac{\sin\alpha_V}{2,5}\right)^2}}$ 	1	1,01	1,05	1,13	1,24	1,40	1,64	1,97	2,32	2,50

Influence of base material thickness

h/c	0,15	0,3	0,45	0,6	0,75	0,9	1,05	1,2	1,35	≥ 1,5
$f_h = \{h/(1,5 \cdot c)\}^{2/3} \leq 1$	0,22	0,34	0,45	0,54	0,63	0,71	0,79	0,86	0,93	1,00

Influence of anchor spacing and edge distance a) for concrete edge resistance: f_4

$f_4 = (c/h_{ef})^{1,5} \cdot (1 + s / [3 \cdot c]) \cdot 0,5$

c/h_{ef}	Single anchor	Group of two anchors s/h_{ef}														
		0,75	1,50	2,25	3,00	3,75	4,50	5,25	6,00	6,75	7,50	8,25	9,00	9,75	10,50	11,25
0,50	0,35	0,27	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35
0,75	0,65	0,43	0,54	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65	0,65
1,00	1,00	0,63	0,75	0,88	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
1,25	1,40	0,84	0,98	1,12	1,26	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40	1,40
1,50	1,84	1,07	1,22	1,38	1,53	1,68	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84
1,75	2,32	1,32	1,49	1,65	1,82	1,98	2,15	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32	2,32
2,00	2,83	1,59	1,77	1,94	2,12	2,30	2,47	2,65	2,83	2,83	2,83	2,83	2,83	2,83	2,83	2,83
2,25	3,38	1,88	2,06	2,25	2,44	2,63	2,81	3,00	3,19	3,38	3,38	3,38	3,38	3,38	3,38	3,38
2,50	3,95	2,17	2,37	2,57	2,77	2,96	3,16	3,36	3,56	3,76	3,95	3,95	3,95	3,95	3,95	3,95
2,75	4,56	2,49	2,69	2,90	3,11	3,32	3,52	3,73	3,94	4,15	4,35	4,56	4,56	4,56	4,56	4,56
3,00	5,20	2,81	3,03	3,25	3,46	3,68	3,90	4,11	4,33	4,55	4,76	4,98	5,20	5,20	5,20	5,20
3,25	5,86	3,15	3,38	3,61	3,83	4,06	4,28	4,51	4,73	4,96	5,18	5,41	5,63	5,86	5,86	5,86
3,50	6,55	3,51	3,74	3,98	4,21	4,44	4,68	4,91	5,14	5,38	5,61	5,85	6,08	6,31	6,55	6,55
3,75	7,26	3,87	4,12	4,36	4,60	4,84	5,08	5,33	5,57	5,81	6,05	6,29	6,54	6,78	7,02	7,26
4,00	8,00	4,25	4,50	4,75	5,00	5,25	5,50	5,75	6,00	6,25	6,50	6,75	7,00	7,25	7,50	7,75
4,25	8,76	4,64	4,90	5,15	5,41	5,67	5,93	6,18	6,44	6,70	6,96	7,22	7,47	7,73	7,99	8,25
4,50	9,55	5,04	5,30	5,57	5,83	6,10	6,36	6,63	6,89	7,16	7,42	7,69	7,95	8,22	8,49	8,75
4,75	10,35	5,45	5,72	5,99	6,27	6,54	6,81	7,08	7,36	7,63	7,90	8,17	8,45	8,72	8,99	9,26
5,00	11,18	5,87	6,15	6,43	6,71	6,99	7,27	7,55	7,83	8,11	8,39	8,66	8,94	9,22	9,50	9,78
5,25	12,03	6,30	6,59	6,87	7,16	7,45	7,73	8,02	8,31	8,59	8,88	9,17	9,45	9,74	10,02	10,31
5,50	12,90	6,74	7,04	7,33	7,62	7,92	8,21	8,50	8,79	9,09	9,38	9,67	9,97	10,26	10,55	10,85

a) The anchor spacing and the edge distance shall not be smaller than the minimum anchor spacing s_{min} and the minimum edge distance c_{min}.

Combined tension and shear loading

The following equations must be satisfied

$ß_N \leq 1$

$ß_V \leq 1$

$ß_N + ß_V \leq 1{,}2$ or $ß_N^{\alpha} + ß_V^{\alpha} \leq 1$

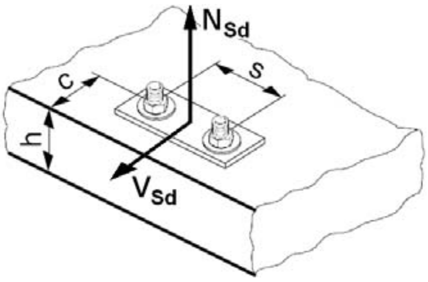
With

$ß_N = N_{Sd} / N_{Rd}$ and

$ß_V = V_{Sd} / V_{Rd}$

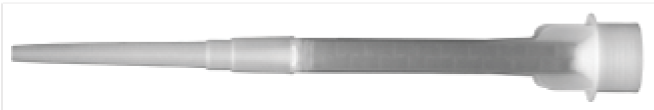
N_{Sd} (V_{Sd}) = **tension (shear) design action**

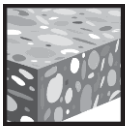
N_{Rd} (V_{Rd}) = **tension (shear) design resistance**



Annex C of ETAG 001	**Simplified design method**
α = **2,0** if N_{Rd} and V_{Rd} are governed by steel failure	Failure mode is not considered for the simplified method
α = **1,5** for all other failure modes	α = **1,5** for all failure modes (leading to conservative results

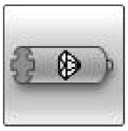
Hilti HIT-RE 500-SD mortar with rebar (as post-installed connection)

Injection mortar system		Benefits
	Hilti HIT-RE 500-SD 330 ml foil pack (also available as 500 ml and 1400 ml foil pack)	- **SAFEset** technology: drilling and borehole cleaning in one step with Hilti hollow drill bit - suitable for concrete C 12/15 to C 50/60 - high loading capacity - suitable for dry and water saturated concrete - for rebar diameters up to 40 mm - non corrosive to rebar elements - long working time at elevated temperatures - odourless epoxy - suitable for embedment length till 3200 mm
	Statik mixer	
	Rebar	



Concrete

Fire resistance



Diamond drilled holes

European Technical Approval

Corossion tested

PROFIS Rebar design software

Hilti SAFEset technology with hollow drill bit

Service temperature range

Temperature range: -40°C to +80°C (max. long term temperature +50°C, max. short term temperature +80°C).

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval	DIBt, Berlin	ETA-09/0295 / 2013-05-09
Application document	CSTB, Marne la Vallée	DTA-3/10-649 / 2010-06-17
European technical approval	DIBt, Berlin	ETA-07/0260 / 2013-06-26
Assessment	MFPA Leipzig GmbH	GS 3.2/09-122 / 2010-05-26

a) All data given in this section according to the approvals mentioned above, ETA-09/0295 issue 2013-05-09 and ETA-07/0260 issue 2013-06-26.

Materials

Reinforcmenent bars according to EC2 Annex C Table C.1 and C.2N.

Properties of reinforcement

Product form		Bars and de-coiled rods	
Class		B	C
Characteristic yield strength f_{yk} or $f_{0,2k}$ (MPa)		400 to 600	
Minimum value of $k = (f_t/f_y)_k$		≥ 1,08	≥ 1,15 < 1,35
Characteristic strain at maximum force, ε_{uk} (%)		≥ 5,0	≥ 7,5
Bendability		Bend / Rebend test	
Maximum deviation from nominal mass (individual bar) (%)	Nominal bar size (mm) ≤ 8 > 8	 ± 6,0 ± 4,5	
Bond: Minimum relative rib area, $f_{R,min}$	Nominal bar size (mm) 8 to 12 > 12	 0,040 0,056	

Setting details

For detailed information on installation see instruction for use given with the package of the product.

Curing time for general conditions

Data according ETA-09/0295, issue 2013-05-09			
Temperature of the base material	Working time in which rebar can be inserted and adjusted t_{gel}	Initial curing time $t_{cure,ini}$	Curing time before rebar can be fully loaded t_{cure}
5 °C ≤ T_{BM} < 10 °C	2 h	18 h	72 h
10 °C ≤ T_{BM} < 15 °C	90 min	12 h	48 h
15 °C ≤ T_{BM} < 20 °C	30 min	9 h	24 h
20 °C ≤ T_{BM} < 25 °C	20 min	6 h	12 h
25 °C ≤ T_{BM} < 30 °C	20 min	5 h	12 h
30 °C ≤ T_{BM} < 40 °C	12 min	4 h	8 h
T_{BM} = 40 °C	12 min	4 h	4 h

For dry concrete curing times may be reduced according to the following table. For installation temperatures below +5 °C all load values have to be reduced according to the load reduction factors given below.

Curing time for dry concrete

Additional Hilti technical data				
Temperature of the base material	Working time in which rebar can be inserted and adjusted t_{gel}	Initial curing time $t_{cure,ini}$	Reduced curing time before rebar can be fully loaded t_{cure}	Load reduction factor
T_{BM} = -5 °C	4 h	36 h	72 h	0,6
T_{BM} = 0 °C	3 h	25 h	50 h	0,7
T_{BM} = 5 °C	2 ½ h	18 h	36 h	1
T_{BM} = 10 °C	2 h	12 h	24 h	1
T_{BM} = 15 °C	1 ½ h	9 h	18 h	1
T_{BM} = 20 °C	30 min	6 h	12 h	1
T_{BM} = 30 °C	20 min	4 h	8 h	1
T_{BM} = 40 °C	12 min	2 h	4 h	1

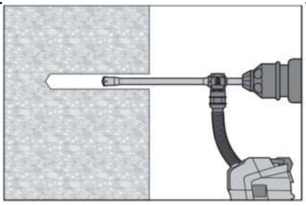
Setting instruction

Safety Regulations:

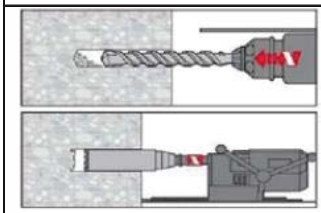
Review the Material Safety Data Sheet (MSDS) before use for proper and safe handling!
Wear well-fitting protective goggles and protective gloves when working with Hilti HIT-RE 500-SD.
Important: Observe the installation instruction of the manufacturer provided with each foil pack.

1. Drill hole

Note: Before drilling, remove carbonized concrete; clean contact areas (see Annex B1)
In case of aborted drill hole the drill hole shall be filled with mortar.



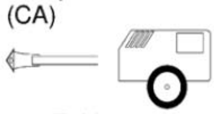
Drill hole to the required embedment depth with an appropriately sized Hilti TE-CD or TE-YD hollow drill bit with Hilti vacuum attachment.
This drilling system removes the dust and cleans the bore hole during drilling when used in accordance with the user’s manual.
After drilling is complete, proceed to the “injection preparation” step in the instructions for use.



Drill the hole to the required embedment depth using a hammer-drill with carbid drill bit set in rotation hammer mode, a compressed air drill or a diamond core machine.

Hammer drill (HD)

Compressed air drill (CA)



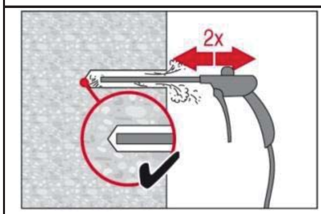
Diamond core wet (DD) and dry (PCC)

3. Bore hole cleaning

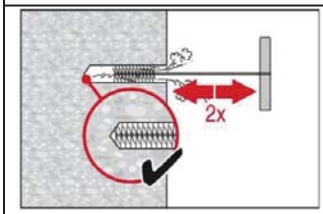
(Not needed with Hilti TE-CD and Hilti TE-YD drill bit)
The borehole must be free of dust, debris, water, ice, oil, grease and other contaminants prior to mortar injection.

Just before setting an anchor, the bore hole must be free of dust and debris by one of two cleaning methods described below

Compressed air cleaning (CAC)

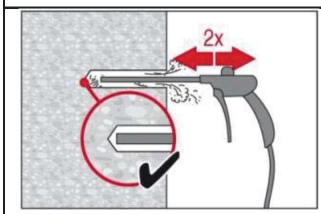


Blowing
2 times from the back of the hole with oil-free compressed air (min. 6 bar at 100 litres per minute (LPM)) until return air stream is free of noticeable dust. Bore hole diameter ≥ 32 mm the compressor must supply a minimum air flow of 140 m³/hour.
If required use additional accessories and extensions for air nozzle and brush to reach back of hole.



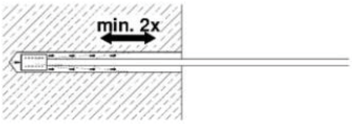
Brushing

2 times with the specified brush HIT-RB size (brush Ø ≥ borehole Ø) by inserting the round steel brush to the back of the hole in a twisting motion. The brush shall produce natural resistance as it enters the anchor hole. If this is not the case, please use a new brush or a brush with a larger diameter.



Blowing

2 times again with compressed air until return air stream is free of noticeable dust.
If required use additional accessories and extensions for air nozzle and brush to reach back of hole.

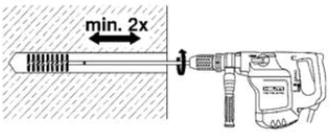


Deep boreholes – Blowing

For boreholes deeper than 250mm (for Ø=8mm – 12mm) or deeper than 20 Ø (for Ø>12mm) use the appropriate air nozzle Hilti HIT-DL

Safety tip: Do not inhale concrete dust.

The application of the dust collector Hilti HIT-DRS is recommended.



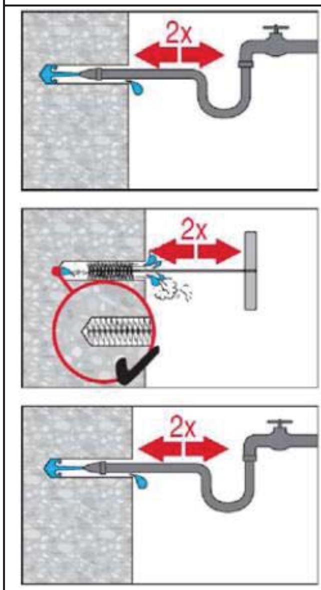
Deep boreholes – Brushing

For boreholes deeper than 250 mm (for Ø=8mm – 12mm) or deeper than 20 Ø (for Ø>12mm) use machine brushing and brush extensions HIT-RBS.

Screw the round steel brush HIT-RB in one end of the brush extension(s) HIT-RBS, so that the overall length of the brush is sufficient to reach the base of the borehole. Attach the other end of the extension to the TE-C/TE-Y chuck.

Safety tip:

- Start machine brushing operational slowly.
- Start brushing operation once brush is inserted in borehole.

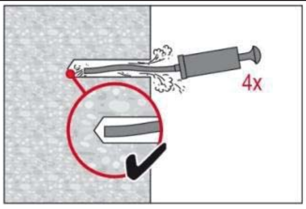
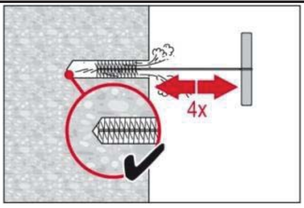
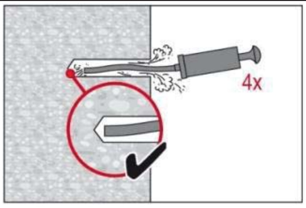


In addition for wet diamond coring (DD):

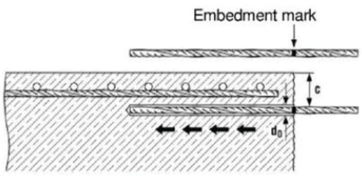
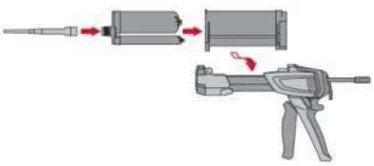
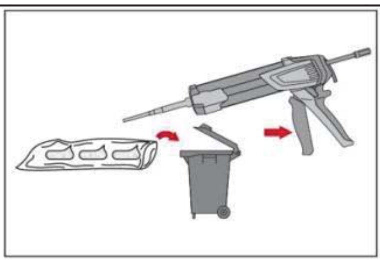
For wet diamond coring please observe the following steps in addition **prior to** compressed air cleaning:

Remove all core fragments from the anchor hole. Flush the anchor hole with clear running water until water runs clear. Brush the anchor hole again 2 times with the appropriate sized brush over the entire depth of the anchor hole. Repeat the flushing process until water runs out of the anchor hole.

Manual Cleaning (MC) Manual cleaning is permitted for hammer drilled boreholes up to hole diameters d_0 ≤ 20mm and depths ℓ_v resp. $\ell_{e,ges.}$ ≤ 160mm.

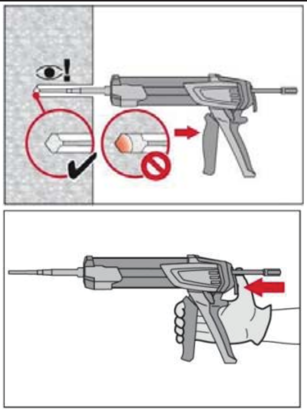
	Blowing 4 strokes with Hilti blow-out pump from the back of the hole until return air stream is free of noticeable dust.
	Brushing 4 times with the specified brush HIT_RB size (brush Ø ≥ borehole Ø) by inserting the round steel wire brush to the back of the hole with a twisting motion. The brush shall produce natural resistance as it enters the anchor hole. If this is not the case, please use a new brush or a brush with a larger diameter.
	Blowing 4 strokes with Hilti blow-out pump from the back of the hole until return air stream is free of noticeable dust.
	Manual Cleaning (MC) Hilti hand pump recommended for blowing out bore hole with diameters d<20mm and bore hole depth h_0<160mm

3.Rebar preparation and foil pack preparation

	Before use, make sure the rebar is dry and free of oil or other residue. Mark the embedment depth on the rebar. (e.g. with tapte) , ℓ_v Insert rebar in borehole, to verify hole and setting depth ℓ_v resp. $\ell_{e,ges}$
	- Observe the Instruction for Use of the dispenser and the mortar. - Tightly attach Hilti HIT-RE-M mixing nozzle to foil pack manifold. - Insert foil pack into foil pack holder and swing holder into the dispenser.
	Discard initial mortar. The foil pack opens automatically as dispensing is initiated. Depending on the size of the foil pack an initial amount of adhesive has to be discarded. After changing a mixing nozzle, the first few trigger pulls must be discarded as decribed above. For each new foil pack a new mixing nozzle must be used. Discard quantities are 3 strokes for 330 ml foil pack, 4 strokes for 500 ml foil pack, 65 ml for 1400 ml foil pack,

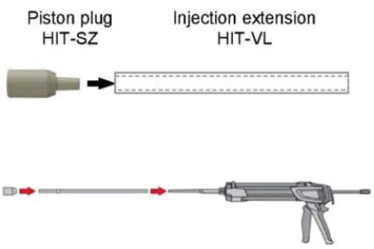
4.Inject mortar into borehole Forming air pockets be avoided

4.1 Injection method for borehole depth ≤ 250 mm

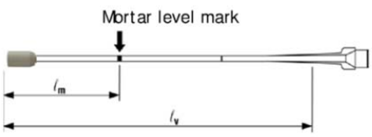


Inject the mortar from the back of the hole towards the front and slowly withdraw the mixing nozzle step by step after each trigger pull.
Fill holes approximately 2/3 full, or as required to ensure that the annular gap between the rebar and the concrete is completely filled with adhesive over the embedment length.
After injecting, depressurize the dispenser by pressing the release trigger. This will prevent further mortar discharge from the mixing nozzle.

4.2 Injection method for borehole depth > 250 mm or overhead application

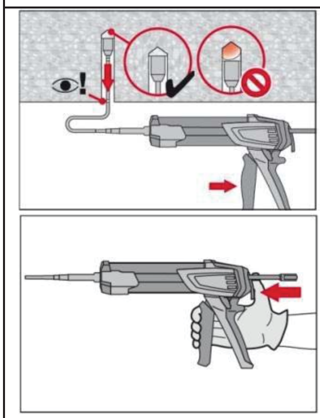


Assemble mixing nozzle HIT-RE-M, extension(s) and piston plug HIT-SZ.
For combinations of several injection extansions use coupler HIT-VL K. A substitution of the injection extansion for a plastic hose or a combination of both is permitted.
The combination of HIT-SZ piston plug with HIT-VL 16 pipe and then HIT-VL 16 tube support proper injection.



Mark the required mortar level ℓ_m and embedment depth ℓ_b resp.

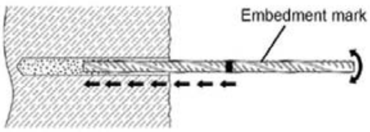
$\ell_{e,ges}$ with tape or marker on the injection extension.



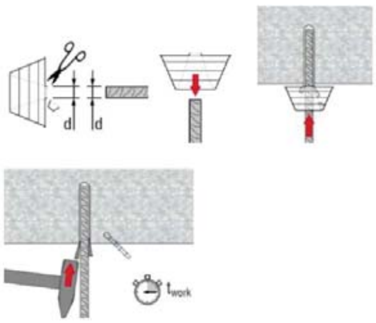
Insert piston plug to back of the hole. Begin injection allowing the pressure of the injected adhesive mortar to push the piston plug towards the front of the hole.
Fill holes approximately 2/3 full, or as required to ensure that the annular gap between the rebar and the concrete is completely filled with adhesive over the embedment length.
Injection until the morat level mark ℓ_m becomes visible.

After injecting, depressurize the dispenser by pressing the release trigger. This will prevent further mortar discharge from the mixing nozzle.

5.Insert rebar



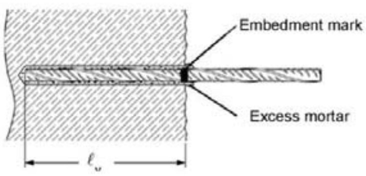
For easy installation insert the rebar slowly twisted into the boreholeuntil the embedment mark is at the concrete surface level.



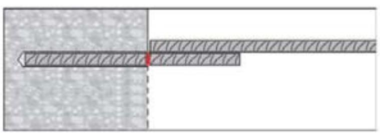
Overhead application:

During insertion of the rebar, mortar might flow out of the borehole. For collection of the flowing mortar, HIT-OHC may be used.

Support the rebar and secure it from falling till mortar started to harden, e.g. using wedges HIT-OHW.



After installing the rebar the annular gap must be completely filled with mortar.

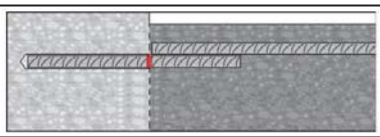


After installing the rebar the annular gap must be completely filled with mortar.

Proper installation can be verified when:

Desired anchoring embedment is reached ℓ_v: embedment mark at concrete surface.

Excess mortar flows out of the borehole after the rebar has been fully inserted until the embedment mark.



Full load may be applied only after the curing time "t_{cure}" has elapsed.

Fitness for use

Some creep tests have been conducted in accordance with ETAG guideline 001 part 5 and TR 023 in the following conditions : in dry environnement at 50 °C during 90 days.
These tests show an excellent behaviour of the post-installed connection made with HIT-RE 500-SD: low displacements with long term stability, failure load after exposure above reference load.

Resistance to chemical substances

Categories	Chemical substances	Resistant	Non resistant
Alkaline products	Drilling dust slurry pH = 12,6	+	
	Potassium hydroxide solution (10%) pH = 14	+	
Acids	Acetic acid (10%)		+
	Nitric acid (10%)		+
	Hydrochloric acid (10%)		+
	Sulfuric acid (10%)		+
Solvents	Benzyl alcohol		+
	Ethanol		+
	Ethyl acetate		+
	Methyl ethyl keton (MEK)		+
	Trichlor ethylene		+
	Xylol (mixture)	+	
Products from job site	Concrete plasticizer	+	
	Diesel	+	
	Engine oil	+	
	Petrol	+	
	Oil for form work	+	
Environnement	Sslt water	+	
	De-mineralised water	+	
	Sulphurous atmosphere (80 cycles)	+	

Electrical Conductivity

HIT-RE 500-SD in the hardened state **is not conductive electrically**. Its electric resistivity is $66 \cdot 10^{12}$ Ω.m (DIN IEC 93 – 12.93). It is adapted well to realize electrically insulating anchorings (ex: railway applications, subway).

Drilling diameters

Rebar (mm)	Drill bit diameters d_0 [mm]			
	Hammer drill (HD) Hollow Drill Bit (HDB)	Compressed air drill (CA)	Diamond coring	
			Wet (DD)	Dry (PCC)
8	12 (10 [a)])	-	12 (10 [a)])	-
10	14 (12 [a)])	-	14 (12 [a)])	-
12	16 (14 [a)])	17	16 (14 [a)])	-
14	18	17	18	-
16	20	20	20	-
18	22	22	22	-
20	25	26	25	-
22	28	28	28	-
24	32	32	32	35
25	32	32	32	35
26	35	35	35	35
28	35	35	35	35
30	37	35	37	35
32	40	40	40	47
34	45	42	42	47
36	45	45	47	47
40	55	57	52	52

a) Max. installation length l = 250 mm.

Basic design data for rebar design according to rebar ETA

Bond strength in N/mm² according to ETA 09/0295 for good bond conditions for hammer drilling, compressed air drilling, dry diamond core drilling

Rebar (mm)	Concrete class								
	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
8 - 32	1,6	2,0	2,3	2,7	3,0	3,4	3,7	4,0	4,3
34	1,6	2,0	2,3	2,6	2,9	3,3	3,6	3,9	4,2
36	1,5	1,9	2,2	2,6	2,9	3,3	3,6	3,8	4,1
40	1,5	1,8	2,1	2,5	2,8	3,1	3,4	3,7	4,0

Bond strength in N/mm² according to ETA 09/0295 for good bond conditions for wet diamond core drilling

Rebar (mm)	Concrete class								
	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
8 - 25	1,6	2,0	2,3	2,7	3,0	3,4	3,7	4,0	4,3
26 - 32	1,6	2,0	2,3	2,7	2,7	2,7	2,7	2,7	2,7
34	1,6	2,0	2,3	2,6	2,6	2,6	2,6	2,6	2,6
36	1,5	1,9	2,2	2,6	2,6	2,6	2,6	2,6	2,6
40	1,5	1,8	2,1	2,5	2,5	2,5	2,5	2,5	2,5

Pullout design bond strength for Hit Rebar design

Design bond strength in N/mm² according to ETA 07/0260 (values in table are design values, $f_{bd,po} = \tau_{Rk}/\gamma_{Mp}$

<table>
<tr><td colspan="16">Hammer or compressed air drilling.
Water saturated, water filled or submerged hole.
Uncracked concrete C20/25.</td></tr>
<tr><td rowspan="3">temperature range</td><td colspan="15">Bar diameter</td></tr>
<tr><td colspan="13">Data according to ETA 04/0027</td><td colspan="2">Hilti tech data</td></tr>
<tr><td>8</td><td>10</td><td>12</td><td>14</td><td>16</td><td>20</td><td>22</td><td>24</td><td>25</td><td>26</td><td>28</td><td>30</td><td>32</td><td>36</td><td>40</td></tr>
<tr><td>I: 40°C/24°C</td><td colspan="3">7,1</td><td colspan="3">6,7</td><td colspan="7">6,2</td><td>5,2</td><td>4,8</td></tr>
<tr><td>II: 58°C/35°C</td><td colspan="4">5,7</td><td colspan="6">5,2</td><td colspan="3">4,8</td><td>4,3</td><td>3,8</td></tr>
<tr><td>III: 70°C/43°C</td><td colspan="5">3,3</td><td colspan="5">3,1</td><td colspan="3">2,9</td><td colspan="2">2,4</td></tr>
</table>

Increasing factor in non-cracked concrete: $f_{B,p}=(f_{cck}/25)^{0,1}$ (f_{cck}: characteristic compressive strength on cube)

Additional Hilti Technical Data:

If the concrete is dry (not in contact with water before/during installation and curing), the pullout design bond strength may be increased by 20%.

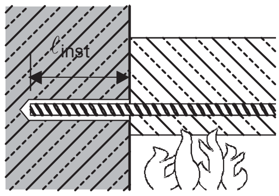
If the hole was produced by wet diamond coring, the pullout design bond strength has to be reduced by 30%.

Reduction factor for splitting with large concrete cover: δ= 0,306 (Hilti additional data)

Fire Resistance

according to MFPA Leipzig, report GS 3.2/09-122

a) fire situation "anchorage"



Maximum force in rebar in conjunction with HIT-RE 500 SD as a function of embedment depth for the fire resistance classes F30 to F240 (yield strength f_{yk} = 500 N/mm²) according EC2[a].

Bar ∅	Drill hole ∅	Max. $F_{s,T}$	ℓ_{inst}	Fire resistance of bar in [kN]					
[mm]	[mm]	[kN]	[mm]	R30	R60	R90	R120	R180	R240
8	10	16,19	65	1,38	0,57	0,19	0,05	0	0
			80	2,35	1,02	0,47	0,26	0	0
			95	3,87	1,68	0,88	0,55	0,12	0
			115	7,30	3,07	1,71	1,14	0,44	0,18
			150	16,19	8,15	4,59	3,14	1,41	0,8
			180		16,19	9,99	6,75	2,94	1,7
			205			16,19	12,38	5,08	2,86
			220				16,19	6,95	3,82
			265					16,19	8,57
			305						16,19
10	12	25,29	80	2,94	1,27	0,59	0,33	0	0
			100	5,68	2,45	1,31	0,85	0,24	0
			120	10,66	4,44	2,48	1,68	0,68	0,31
			140	17,57	7,76	4,38	2,99	1,33	0,73
			165	25,29	15,06	8,5	5,79	2,58	1,5
			195		25,29	17,63	12,18	5,12	2,93
			220			25,29	20,66	8,69	4,78
			235				25,29	11,8	6,30
			280					25,29	13,86
			320						25,29
12	16	36,42	95	5,80	2,52	1,32	0,83	0,18	0
			120	12,79	5,33	2,97	2,01	0,82	0,37
			145	23,16	10,68	6,02	4,12	1,84	1,03
			180	36,42	24,29	14,99	10,12	4,41	2,55
			210		36,42	27,38	20,65	8,47	4,74
			235			36,42	31,01	14,16	7,56
			250				36,42	19,13	9,89
			295					36,42	21,43
			335						36,42
14	18	49,58	110	10,92	4,65	2,55	1,70	0,61	0,20
			140	24,60	10,87	6,13	4,19	1,86	1,03
			170	39,12	23,50	13,55	9,20	4,07	2,37
			195	49,58	35,6	24,69	17,05	7,17	4,10
			225		49,58	39,20	31,34	13,48	7,34
			250			49,58	43,44	22,32	11,54
			265				49,58	29,49	15,00
			310					49,58	31,98
			350						49,58

Bar ∅	Drill hole ∅	Max. $F_{s,T}$	ℓ_{inst}	Fire resistance of bar in [kN]					
[mm]	[mm]	[kN]	[mm]	R30	R60	R90	R120	R180	R240
16	20	64,75	130	22,59	9,42	5,30	3,61	1,56	0,80
			160	39,17	21,33	11,95	8,15	3,65	2,11
			190	55,76	37,92	24,45	17,25	7,35	4,22
			210	64,75	48,98	36,51	27,53	11,29	6,32
			240		64,75	53,10	44,12	20,88	11,04
			265			64,75	57,94	33,7	17,14
			280				64,75	42,0	22,17
			325					64,75	44,84
			365						64,75
20	25	101,18	160	48,97	26,67	14,93	10,18	4,56	2,64
			200	76,61	54,31	38,73	27,5	11,42	6,48
			240	101,18	81,96	66,37	55,15	26,10	13,8
			270		101,18	87,11	75,88	45,58	23,36
			295			101,18	93,16	62,86	35,72
			310				101,18	73,23	45,69
			355					101,18	76,79
			395						101,18
25	30	158,09	200	95,77	67,89	48,41	34,37	14,27	8,10
			250	138,96	111,09	91,60	77,51	39,86	20,61
			275	158,09	132,69	113,2	99,17	61,30	31,81
			305		158,09	139,12	125,09	87,22	52,79
			330			158,09	146,69	108,82	74,39
			345				158,09	121,77	87,34
			390					158,09	126,22
			430						158,09
32	40	259,02	255	183,40	147,72	122,78	104,82	56,35	28,80
			275	205,52	169,84	144,90	126,94	78,46	40,71
			325	259,02	225,13	200,19	182,23	133,75	89,68
			368		259,02	238,89	220,93	172,46	128,39
			380			259,02	243,05	194,58	150,51
			395				259,02	211,16	167,09
			440					259,02	216,86
			480						259,02
36	42 - 46	327,82	290	249,87	209,73	181,67	161,46	106,93	59,10
			325	293,41	253,27	225,21	205,01	150,47	100,89
			355	327,82	290,59	262,54	242,33	187,80	138,22
			385		327,82	299,86	279,65	225,12	175,54
			410			327,82	310,75	256,22	206,64
			425				327,82	274,88	225,30
			470					327,82	281,28
			510						327,82
40	47	404,71	320	319,10	274,50	243,33	220,87	160,28	105,19
			355	367,48	322,88	291,71	269,25	208,66	153,57
			385	404,71	364,35	333,18	310,72	250,13	195,04
			415		404,71	374,64	352,19	291,60	236,51
			440			404,71	386,75	326,16	271,07
			455				404,71	346,89	291,80
			500					404,71	354,01
			540						404,71

b) bar connection parallel to slab or wall surface exposed to fire

Max. bond stress, τ_T , depending on actual clear concrete cover for classifying the fire resistance.

It must be verified that the actual force in the bar during a fire, $F_{s,T}$, can be taken up by the bar connection of the selected length, ℓ_{inst}. Note: Cold design for ULS is mandatory.

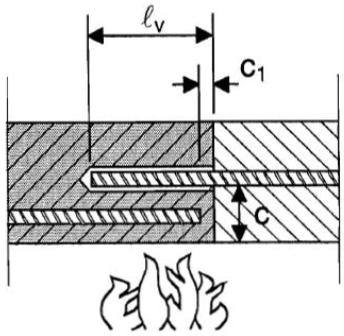
$F_{s,T} \leq (\ell_{inst} - c_f) \cdot \phi \cdot \pi \cdot \tau_T$ where: $(\ell_{inst} - c_f) \geq \ell_s$;

ℓ_s = lap length

ϕ = nominal diameter of bar

$\ell_{inst} - c_f$ = selected overlap joint length; this must be at least ℓ_s, but may not be assumed to be more than 80 ϕ

τ_T = bond stress when exposed to fire



Critical temperature-dependent bond stress, τ_c, concerning "overlap joint" for Hilti HIT-RE 500-SD injection adhesive in relation to fire resistance class and required minimum concrete coverage c.

<table>
<tr><th rowspan="2">Clear concrete cover c
[mm]</th><th colspan="6">Max. bond stress, τ_c [N/mm²]</th></tr>
<tr><th>R30</th><th>R60</th><th>R90</th><th>R120</th><th>R180</th><th>R240</th></tr>
<tr><td>10</td><td>0</td><td rowspan="3">0</td><td rowspan="5">0</td><td rowspan="6">0</td><td rowspan="8">0</td><td rowspan="10">0</td></tr>
<tr><td>20</td><td>0,49</td></tr>
<tr><td>30</td><td>0,66</td></tr>
<tr><td>40</td><td>0,89</td><td>0,48</td></tr>
<tr><td>50</td><td>1,21</td><td>0,62</td></tr>
<tr><td>60</td><td>1,63</td><td>0,80</td><td>0,51</td></tr>
<tr><td>70</td><td>2,19</td><td>1,04</td><td>0,65</td><td>0,49</td></tr>
<tr><td>80</td><td>2,96</td><td>1,35</td><td>0,83</td><td>0,61</td></tr>
<tr><td>90</td><td>3,99</td><td>1,75</td><td>1,06</td><td>0,77</td><td>0,45</td></tr>
<tr><td>100</td><td>5,38</td><td>2,26</td><td>1,36</td><td>0,97</td><td>0,55</td></tr>
<tr><td>110</td><td>7,25</td><td>2,93</td><td>1,73</td><td>1,23</td><td>0,67</td><td>0,47</td></tr>
<tr><td>120</td><td>9,78</td><td>3,79</td><td>2,21</td><td>1,55</td><td>0,81</td><td>0,55</td></tr>
<tr><td>130</td><td rowspan="19">11,00</td><td>4,91</td><td>2,81</td><td>1,96</td><td>0,98</td><td>0,64</td></tr>
<tr><td>140</td><td>6,35</td><td>3,59</td><td>2,47</td><td>1,18</td><td>0,76</td></tr>
<tr><td>150</td><td>8,22</td><td>4,58</td><td>3,12</td><td>1,43</td><td>0,89</td></tr>
<tr><td>160</td><td>10,65</td><td>5,84</td><td>3,94</td><td>1,73</td><td>1,04</td></tr>
<tr><td>170</td><td rowspan="15">11,00</td><td>7,45</td><td>4,97</td><td>2,10</td><td>1,23</td></tr>
<tr><td>180</td><td>9,51</td><td>6,27</td><td>2,54</td><td>1,44</td></tr>
<tr><td>190</td><td rowspan="13">11,00</td><td>7,91</td><td>3,07</td><td>1,69</td></tr>
<tr><td>200</td><td>9,99</td><td>3,71</td><td>1,99</td></tr>
<tr><td>210</td><td rowspan="11">11,00</td><td>4,49</td><td>2,34</td></tr>
<tr><td>220</td><td>5,44</td><td>2,75</td></tr>
<tr><td>230</td><td>6,58</td><td>3,22</td></tr>
<tr><td>240</td><td>7,96</td><td>3,79</td></tr>
<tr><td>250</td><td>9,64</td><td>4,45</td></tr>
<tr><td>260</td><td rowspan="6">11,00</td><td>5,23</td></tr>
<tr><td>270</td><td>6,14</td></tr>
<tr><td>280</td><td>7,21</td></tr>
<tr><td>290</td><td>8,47</td></tr>
<tr><td>300</td><td>9,95</td></tr>
<tr><td>310</td><td>11,00</td></tr>
</table>

Basic design data for seismic rebar design

Bond strength $f_{bd,seism}$ in N/mm² according to DTA-3/10-649 for good bond conditions for hammer drilling, compressed air drilling, dry diamond core drilling

Rebar (mm)	Concrete class					
	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55
8	2,3	2,7	3,0	3,4	3,7	4,0
10	2,3	2,7	3,0	3,4	3,7	4,0
12	2,3	2,7	3,0	3,4	3,7	3,7
14	2,3	2,7	3,0	3,4	3,7	3,7
16	2,3	2,7	3,0	3,4	3,7	3,7
18	2,3	2,7	3,0	3,4	3,7	3,7
20	2,3	2,7	3,0	3,4	3,7	3,7
22	2,3	2,7	3,0	3,0	3,4	3,4
24	2,3	2,7	3,0	3,0	3,4	3,4
25	2,3	2,7	3,0	3,0	3,4	3,4
26	2,3	2,7	3,0	3,0	3,0	3,0
28	2,3	2,7	3,0	3,0	3,0	3,0
30	2,3	2,7	3,0	3,0	3,0	3,0
32	2,3	2,7	3,0	3,0	3,0	3,0
34	2,3	2,6	2,9	2,7	2,7	2,7
36	2,2	2,6	2,9	2,7	2,7	2,7
40	2,1	2,5	2,7	2,7	2,7	2,7

Minimum anchorage length

The multiplication factor for minimum anchorage length shall be considered as 1,0 for all drilling methods.

Minimum anchorage and lap lengths for C20/25; maximum hole lengths (ETA 09/0295)

Rebar		Hammer drilling, Compressed air drilling, Dry diamond coring drilling		Wet diamond coring drilling		
Diameter d_s [mm]	**$f_{y,k}$ [N/mm²]**	**$l_{b,min}$* [mm]**	**$l_{0,min}$ * [mm]**	**$l_{b,min}$* [mm]**	**$l_{0,min}$ * [mm]**	**l_{max} [mm]**
8	500	113	200	170	300	1000
10	500	142	200	213	300	1000
12	500	170	200	255	300	1200
14	500	198	210	298	315	1400
16	500	227	240	340	360	1600
18	500	255	270	383	405	1800
20	500	284	300	425	450	2000
22	500	312	330	468	495	2200
24	500	340	360	510	540	2400
25	500	354	375	532	563	2500
26	500	369	390	553	585	2600
28	500	397	420	595	630	2800
30	500	425	450	638	675	3000
32	500	454	480	681	720	3200
34	500	492	510	738	765	3200
36	500	532	540	797	810	3200
40	500	616	621	925	932	3200

$l_{b,min}$ (8.6) and $l_{0,min}$ (8.11) are calculated for good bond conditions with maximum utilisation of rebar yield strength f_{yk} = 500 N/mm² and α_6 = 1,0