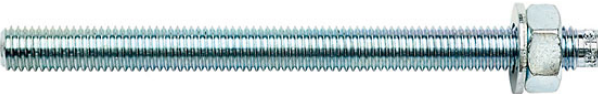
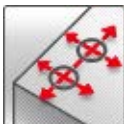


Hilti HIT-RE 500 with HIT-V / HAS in hammer drilled holes

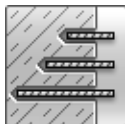
Injection mortar system		Benefits
	Hilti HIT-RE 500 330 ml foil pack (also available as 500 ml and 1400 ml foil pack)	- suitable for non-cracked concrete C 20/25 to C 50/60 - high loading capacity - suitable for dry and water saturated concrete - under water application - large diameter applications - 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
	Statik mixer	
	HAS rod	
	HAS-E rod	
	HIT-V rod	



Concrete



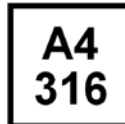
Small edge distance and spacing



Variable embedment depth



Fire resistance



Corrosion resistance



High 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-04/0027 / 2009-05-20
Fire test report	IBMB, Braunschweig	UB 3565 / 4595 / 2006-10-29 UB 3588 / 4825 / 2005-11-15
Assessment report (fire)	warringtonfire	WF 166402 / 2007-10-26 & suppl. WF 172920 / 2008-05-27

a) All data given in this section according ETA-04/0027, issue 2009-05-20.

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, $f_{ck,cube} = 25 \text{ N/mm}^2$
- Temperature range I
(min. base material temperature -40°C , max. long term/short term base material temperature: $+24^\circ\text{C}/40^\circ\text{C}$)
- Installation temperature range $+5^\circ\text{C}$ to $+40^\circ\text{C}$

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	M33	M36	M39
Typical embedment depth [mm]	80	90	110	125	170	210	240	270	300	330	360
Base material thickness [mm]	110	120	140	165	220	270	300	340	380	410	450

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 – $f_{ck,cube} = 25 \text{ N/mm}^2$, anchor HIT-V 5.8

Data according ETA-04/0027, issue 2008-11-03									Additional Hilti technical data		
Anchor size	M8	M10	M12	M16	M20	M24	M27	M30	M33	M36	M39
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	364,4	428,9	459,9
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	182,2	214,5	256,2

Characteristic resistance: concrete C 20/25 – $f_{ck,cube} = 25 \text{ N/mm}^2$, anchor HIT-V 5.8

Data according ETA-04/0027, issue 2008-11-03									Additional Hilti technical data		
Anchor size	M8	M10	M12	M16	M20	M24	M27	M30	M33	M36	M39
Tensile N_{Rk} HIT-V 5.8 [kN]	18,0	29,0	42,0	70,6	111,9	153,7	187,8	224,0	262,4	302,7	344,9
Shear V_{Rk} HIT-V 5.8 [kN]	9,0	15,0	21,0	39,0	61,0	88,0	115,0	140,0	173,5	204,3	244,0

Design resistance: concrete C 20/25 – $f_{ck,cube} = 25 \text{ N/mm}^2$, anchor HIT-V 5.8

Data according ETA-04/0027, issue 2008-11-03									Additional Hilti technical data		
Anchor size	M8	M10	M12	M16	M20	M24	M27	M30	M33	M36	M39
Tensile N_{Rd} HIT-V 5.8 [kN]	12,0	19,3	27,7	33,6	53,3	73,2	89,4	106,7	125,0	144,2	164,3
Shear V_{Rd} HIT-V 5.8 [kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0	138,8	163,4	195,2

Recommended loads ^{a)}: concrete C 20/25 – $f_{ck,cube} = 25 \text{ N/mm}^2$, anchor HIT-V 5.8

Data according ETA-04/0027, issue 2008-11-03									Additional Hilti technical data		
Anchor size	M8	M10	M12	M16	M20	M24	M27	M30	M33	M36	M39
Tensile N_{rec} HIT-V 5.8 [kN]	8,6	13,8	19,8	24,0	38,1	52,3	63,9	76,2	89,3	103,0	117,3
Shear V_{rec} HIT-V 5.8 [kN]	5,1	8,6	12,0	22,3	34,9	50,3	65,7	80,0	99,1	116,7	139,4

a) With 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.

Service temperature range

Hilti HIT-RE 500 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-04/0027, issue 2008-11-03								Additional Hilti technical data		
Anchor size			M8	M10	M12	M16	M20	M24	M27	M30	M33	M36	M39
Nominal tensile strength f_{uk}	HIT-V/HAS 5.8	[N/mm ²]	500	500	500	500	500	500	500	500	500	500	500
	HIT-V/HAS 8.8	[N/mm ²]	800	800	800	800	800	800	800	800	800	800	800
	HIT-V/HAS -R	[N/mm ²]	700	700	700	700	700	700	500	500	500	500	500
	HIT-V/HAS -HCR	[N/mm ²]	800	800	800	800	800	700	700	700	500	500	500
Yield strength f_{yk}	HIT-V/HAS 5.8	[N/mm ²]	400	400	400	400	400	400	400	400	400	400	400
	HIT-V/HAS 8.8	[N/mm ²]	640	640	640	640	640	640	640	640	640	640	640
	HIT-V/HAS -R	[N/mm ²]	450	450	450	450	450	450	210	210	210	210	210
	HIT-V/HAS -HCR	[N/mm ²]	600	600	600	600	600	400	400	400	250	250	250
Stressed cross-section A_s	HAS	[mm ²]	32,8	52,3	76,2	144	225	324	427	519	647	759	913
	HIT-V	[mm ²]	36,6	58,0	84,3	157	245	353	459	561	694	817	976
Moment of resistance W	HAS	[mm ³]	27,0	54,1	93,8	244	474	809	1274	1706	2321	2949	3891
	HIT-V	[mm ³]	31,2	62,3	109	277	541	935	1387	1874	2579	3294	4301

Material quality

Part	Material
Threaded rod HIT-V(F), HAS 5.8 M8 – M24	Strength class 5.8, A ₅ > 8% ductile steel galvanized ≥ 5 µm, (F) hot dipped galvanized ≥ 45 µm,
Threaded rod HIT-V(F), HAS 8.8 M27 – M39	Strength class 8.8, A ₅ > 8% ductile steel galvanized ≥ 5 µm, (F) hot dipped galvanized ≥ 45 µm,
Threaded rod HIT-V-R, HAS-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, HAS-HCR	High corrosion resistant steel, 1.4529; 1.4565 strength ≤ M20: R _m = 800 N/mm ² , R _{p0.2} = 640 N/mm ² , A ₅ > 8% ductile M24 to M30: R _m = 700 N/mm ² , R _{p0.2} = 400 N/mm ² , 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	M33	M36	M39
Anchor rod HAS, HAS-E, HAS-R, HAS-ER HAS-HCR	M8x80	M10x90	M12x110	M16x125	M20x170	M24x210	M27x240	M30x270	M33x300	M36x330	M39x360
Anchor embedment depth [mm]	80	90	110	125	170	210	240	270	300	330	360
Anchor rod HIT-V, HIT-V-R, HIT-V-HCR	Anchor rods HIT-V (-R / -HCR) are available in variable length										

Setting

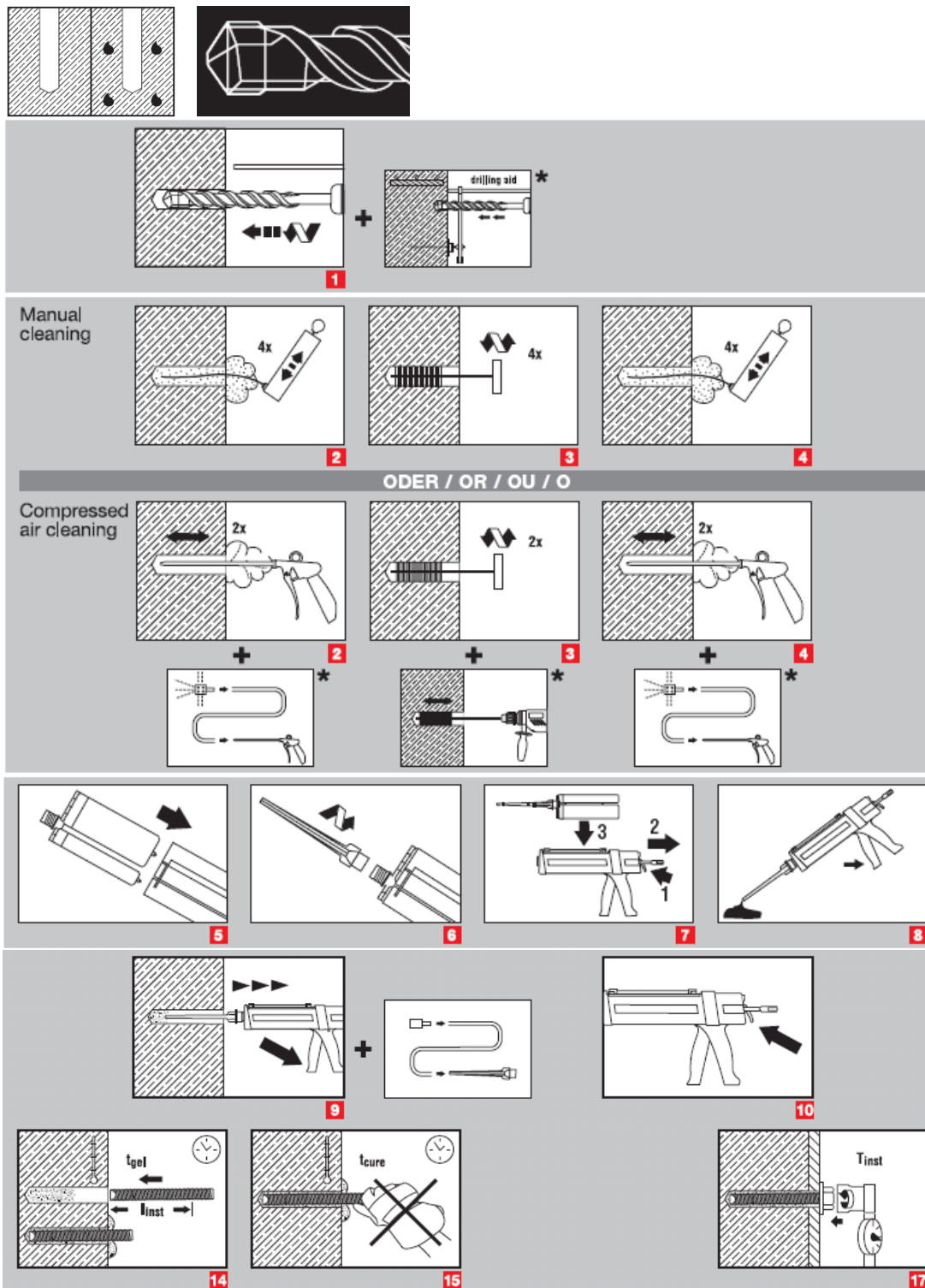
installation equipment

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							
Additional Hilti recommended tools	DD EC-1, DD 100 ... DD xxx ^{a)}							

a) For anchors in diamond drilled holes load values for combined pull-out and concrete cone resistance have to be reduced (see section “Setting instruction”)

Setting instruction

Dry and water-saturated concrete, hammer drilling

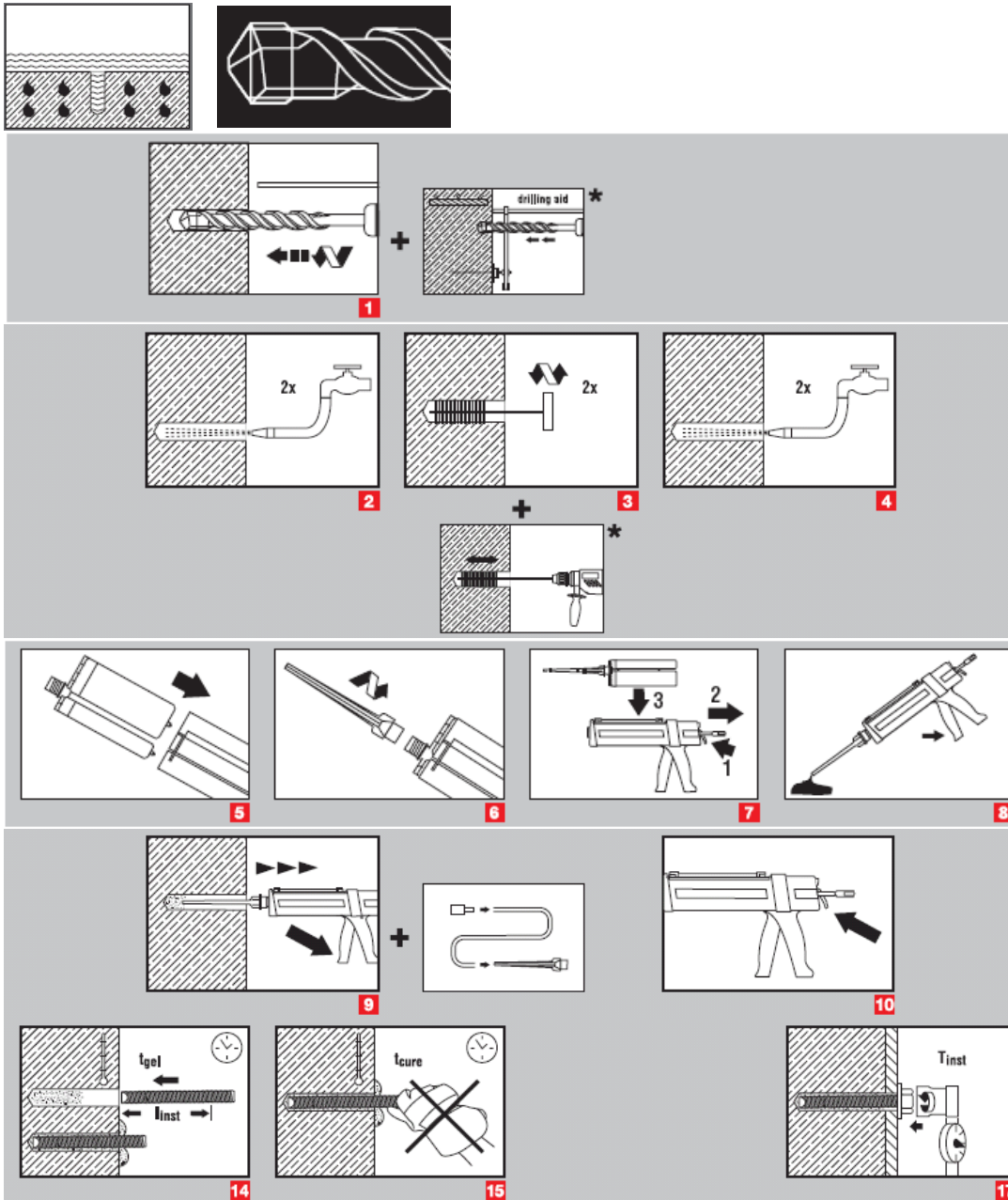


Brush bore hole with required steel brush HIT-RB

a) Note: Manual cleaning only for hef ≤ 250 mm and anchor size ≤ M16

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

Water filled bore hole or submerged, hammer drilling



Brush bore hole with required steel brush HIT-RB

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

Curing time for general conditions

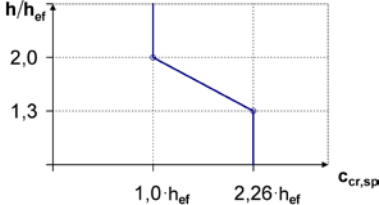
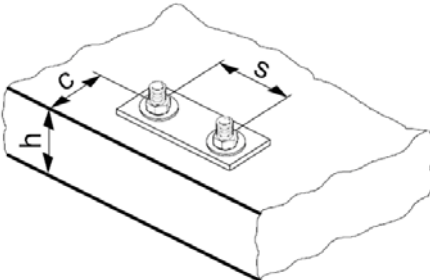
Data according ETA-04/0027, issue 2009-05-20		
Temperature of the base material	Working time in which anchor can be inserted and adjusted t_{gel}	Curing time before anchor can be fully loaded t_{cure}
40 °C	12 min	4 h
30 °C to 39 °C	12 min	8 h
20 °C to 29 °C	20 min	12 h
15 °C to 19 °C	30 min	24 h
10 °C to 14 °C	90 min	48 h
5 °C to 9 °C	120 min	72 h

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	Reduced curing time before anchor can be fully loaded $t_{cure,dry}$	Working time in which anchor can be inserted and adjusted t_{gel}	Load reduction factor
40 °C	4 h	12 min	1
30 °C	8 h	12 min	1
20 °C	12 h	20 min	1
15 °C	18 h	30 min	1
10 °C	24 h	90 min	1
5 °C	36 h	120 min	1
0 °C	50 h	3 h	0,7
-5 °C	72 h	4 h	0,6

Setting details

			Data according ETA-04/0027, issue 2009-05-20							Additional Hilti technical data			
Anchor size			M8	M10	M12	M16	M20	M24	M27	M30	M33	M36	M39
Nominal diameter of drill bit	d ₀	[mm]	10	12	14	18	24	28	30	35	37	40	42
Effective anchorage and drill hole depth range ^{a)}	h _{ef,min}	[mm]	40	40	48	64	80	96	108	120	132	144	156
	h _{ef,max}	[mm]	160	200	240	320	400	480	540	600	660	720	780
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	36	39	42
Minimum spacing	s _{min}	[mm]	40	50	60	80	100	120	135	150	165	180	195
Minimum edge distance	c _{min}	[mm]	40	50	60	80	100	120	135	150	165	180	195
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	330	360	390
													

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 safe 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-04/0027, issue 2009-05-20.

- 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)

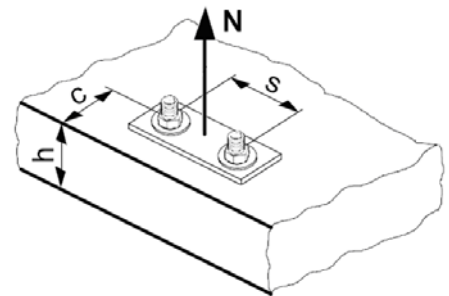
The values are valid for one anchor.

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



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

			Data according ETA-04/0027, issue 2009-05-20							Additional Hilti technical data			
Anchor size			M8	M10	M12	M16	M20	M24	M27	M30	M33	M36	M39
N _{Rd,s}	HAS 5.8	[kN]	11,3	17,3	25,3	48,0	74,7	106,7	-	-	-	-	-
	HIT-V 5.8	[kN]	12,0	19,3	28,0	52,7	82,0	118,0	153,3	187,3	231,3	272,3	325,3
	HAS 8.8	[kN]	-	-	-	-	-	-	231,3	281,3	345,1	404,8	486,9
	HIT-V 8.8	[kN]	19,3	30,7	44,7	84,0	130,7	188,0	244,7	299,3	370,1	435,7	520,5
	HAS (-E)-R	[kN]	12,3	19,8	28,3	54,0	84,0	119,8	75,9	92,0	113,2	132,8	159,8
	HIT-V-R	[kN]	13,9	21,9	31,6	58,8	92,0	132,1	80,4	98,3	122,6	144,3	172,4
	HAS (-E)-HCR	[kN]	18,0	28,0	40,7	76,7	120,0	106,7	144,8	175,7	134,8	158,1	190,2
	HIT-V-HCR	[kN]	19,3	30,7	44,7	84,0	130,7	117,6	152,9	187,1	144,6	170,2	203,3

Design combined pull-out and concrete cone resistance for anchors in diamond drilled holes ^{a)}

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

	Data according ETA-04/0027, issue 2009-05-20								Additional Hilti technical data		
Anchor size	M8	M10	M12	M16	M20	M24	M27	M30	M33	M36	M39
Typical embedment depth $h_{ef,typ}$ [mm]	80	90	110	125	170	210	240	270	300	330	360
$N_{Rd,p}^0$ Temperature range I [kN]	15,3	21,5	31,6	44,9	76,3	105,6	135,7	157,5	171,0	203,3	232,9
$N_{Rd,p}^0$ Temperature range II [kN]	12,4	17,5	25,7	35,9	61,0	82,9	106,6	133,3	136,8	162,6	186,3
$N_{Rd,p}^0$ Temperature range III [kN]	7,7	10,8	15,8	22,4	35,6	52,8	63,0	78,8	82,1	97,6	111,8

a) Additional Hilti technical data (not part of ETA-04/0027, issue 2009-05-20):

The design values for combined pull-out and concrete cone resistance may be increased by 20 % for anchor installation in dry concrete (concrete not in contact with water before/during installation and curing).

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

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

	Data according ETA-04/0027, issue 2009-05-20								Additional Hilti technical data		
Anchor size	M8	M10	M12	M16	M20	M24	M27	M30	M33	M36	M39
$N_{Rd,c}^0$ [kN]	17,2	20,5	27,7	33,6	53,3	73,2	89,4	106,7	125,0	144,2	164,3

a) Additional Hilti technical data (not part of ETA-04/0027, issue 2009-05-20):

The design values for concrete cone and splitting resistance may be increased by 20 % for anchor installation in dry concrete (concrete not in contact with water before/during installation and curing).

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)}

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

- a) 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)}

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

- 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

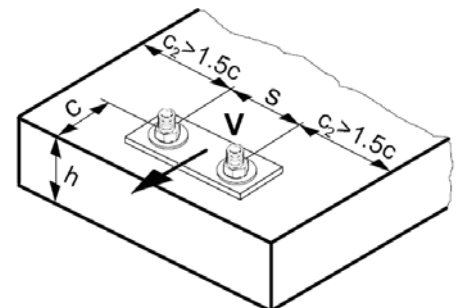
h_{ef} [mm]	40	50	60	70	80	90	≥ 100
$f_{re,N} = 0,5 + h_{ef}/200\text{mm} \leq 1$	0,7 ^{a)}	0,75 ^{a)}	0,8 ^{a)}	0,85 ^{a)}	0,9 ^{a)}	0,95 ^{a)}	1

- 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: $V_{Rd,cp} = k \cdot \text{lower value of } N_{Rd,p} \text{ and } N_{Rd,c}$
- Concrete edge resistance: $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_{\beta} \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

		Data according ETA-04/0027, issue 2009-05-20								Additional Hilti technical data		
Anchor size		M8	M10	M12	M16	M20	M24	M27	M30	M33	M36	M39
$V_{Rd,s}$	HAS 5.8 [kN]	6,8	10,4	15,2	28,8	44,8	64,0	-	-	-	-	-
	HIT-V 5.8 [kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0	138,8	163,4	195,2
	HAS 8.8 [kN]	-	-	-	-	-	-	139,2	168,8	207,0	242,9	292,2
	HIT-V 8.8 [kN]	12,0	18,4	27,2	50,4	78,4	112,8	147,2	179,2	222,1	261,4	312,3
	HAS (-E)-R [kN]	7,7	12,2	17,3	32,7	50,6	71,8	45,8	55,5	67,9	79,7	95,9
	HIT-V-R [kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8	72,9	85,8	102,5
	HAS (-E)-HCR [kN]	10,4	16,8	24,8	46,4	72,0	64,0	86,9	105,7	80,9	94,9	114,1
	HIT-V-HCR [kN]	12,0	18,4	27,2	50,4	78,4	70,9	92,0	112,0	86,8	102,1	122,0

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 $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_{\beta} \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30	M33	M36	M39
Non-cracked concrete											
$V_{Rd,c}^0$ [kN]	5,9	8,6	11,6	18,7	27,0	36,6	44,5	53,0	62,1	71,7	81,9

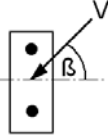
Influencing factors

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 β	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} .

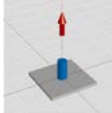
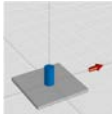
Combined tension and shear loading

For combined tension and shear loading see section "Anchor Design".

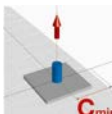
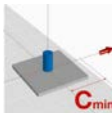
Precalculated values

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.

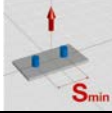
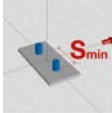
Design resistance: concrete C 20/25 – $f_{ck,cube} = 25 \text{ N/mm}^2$, Temperature range I

	Data according ETA-04/0027, issue 2009-05-20								Additional Hilti technical data		
Anchor size	M8	M10	M12	M16	M20	M24	M27	M30	M33	M36	M39
Embedment depth $h_{ef,1} = [\text{mm}]$	48	60	72	96	120	144	162	180	198	216	234
Base material thickness $h_{min} = [\text{mm}]$	100	100	102	132	168	200	222	250	272	296	324
Tensile N_{Rd}: single anchor, no edge effects											
 HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR [kN]	8,0	11,2	14,7	22,6	31,6	41,6	49,6	58,1	67,0	76,3	86,1
Shear V_{Rd}: single anchor, no edge effects, without lever arm											
 HIT-V 5.8 [kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0	138,8	163,4	195,2
HIT-V 8.8 [kN]	11,2	18,4	27,2	50,4	78,4	112,8	138,8	162,6	187,6	213,8	241,0
HIT-V-R [kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8	72,9	85,8	102,5
HIT-V-HCR [kN]	11,2	18,4	27,2	50,4	78,4	70,9	92,0	112,0	86,8	102,1	122,0

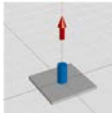
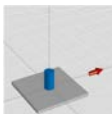
Design resistance: concrete C 20/25 – $f_{ck,cube} = 25 \text{ N/mm}^2$, Temperature range I

	Data according ETA-04/0027, issue 2009-05-20								Additional Hilti technical data		
Anchor size	M8	M10	M12	M16	M20	M24	M27	M30	M33	M36	M39
Embedment depth $h_{ef,1} = [\text{mm}]$	48	60	72	96	120	144	162	180	198	216	234
Base material thickness $h_{min} = [\text{mm}]$	100	100	102	132	168	200	222	250	272	296	324
Edge distance $c = c_{min} = [\text{mm}]$	40	50	60	80	100	120	135	150	165	180	195
Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)											
 HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR [kN]	5,4	7,3	8,5	12,9	18,2	23,8	28,2	33,2	38,1	43,4	49,2
Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$), without lever arm											
 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	36,5	42,2	48,3

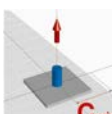
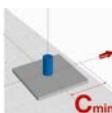
Design resistance: concrete C 20/25 – $f_{ck,cube} = 25 \text{ N/mm}^2$, Temperature range I
(load values are valid for single anchor)

	Data according ETA-04/0027, issue 2009-05-20								Additional Hilti technical data		
Anchor size	M8	M10	M12	M16	M20	M24	M27	M30	M33	M36	M39
Embedment depth $h_{ef,1} = [\text{mm}]$	48	60	72	96	120	144	162	180	198	216	234
Base material thickness $h_{min} = [\text{mm}]$	100	100	102	132	168	200	222	250	272	296	324
Spacing $s = s_{min} = [\text{mm}]$	40	50	60	80	100	120	135	150	165	180	195
Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)											
 HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR [kN]	5,1	7,0	8,8	13,5	19,0	24,9	29,6	34,8	40,1	45,6	51,5
Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$), without lever arm											
 HIT-V 5.8 [kN]	7,2	12,0	16,8	31,2	48,8	70,4	88,7	103,9	119,9	136,6	154,0
HIT-V 8.8 [kN]	7,2	18,4	26,3	40,5	56,5	74,3	88,7	103,9	119,9	136,6	154,0
HIT-V-R [kN]	7,2	12,8	19,2	35,3	55,1	74,3	48,3	58,8	72,9	85,8	102,5
HIT-V-HCR [kN]	7,2	18,4	26,3	40,5	56,5	70,9	88,7	103,9	86,8	102,1	122,0

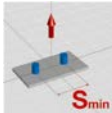
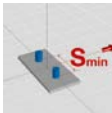
Design resistance: concrete C 20/25 – $f_{ck,cube} = 25 \text{ N/mm}^2$, Temperature range I

	Data according ETA-04/0027, issue 2009-05-20								Additional Hilti technical data		
Anchor size	M8	M10	M12	M16	M20	M24	M27	M30	M33	M36	M39
Embedment depth $h_{ef,typ} = [\text{mm}]$	80	90	110	125	170	210	240	270	300	330	360
Base material thickness $h_{min} = [\text{mm}]$	110	120	140	161	218	266	300	340	374	410	450
Tensile N_{Rd}: single anchor, no edge effects											
 HIT-V 5.8 [kN]	12,0	19,3	27,7	33,6	53,3	73,2	89,4	106,7	125,0	144,2	164,3
HIT-V 8.8 [kN]	15,3	20,5	27,7	33,6	53,3	73,2	89,4	106,7	125,0	144,2	164,3
HIT-V-R [kN]	13,9	20,5	27,7	33,6	53,3	73,2	80,4	98,3	122,6	144,2	164,3
HIT-V-HCR [kN]	15,3	20,5	27,7	33,6	53,3	73,2	89,4	106,7	125,0	144,2	164,3
Shear V_{Rd}: single anchor, no edge effects, without lever arm											
 HIT-V 5.8 [kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0	138,8	163,4	195,2
HIT-V 8.8 [kN]	12,0	18,4	27,2	50,4	78,4	112,8	147,2	179,2	222,1	261,4	312,3
HIT-V-R [kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8	72,9	85,8	102,5
HIT-V-HCR [kN]	12,0	18,4	27,2	50,4	78,4	70,9	92,0	112,0	86,8	102,1	122,0

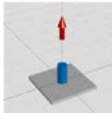
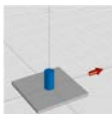
Design resistance: concrete C 20/25 – $f_{ck,cube} = 25 \text{ N/mm}^2$, Temperature range I

	Data according ETA-04/0027, issue 2009-05-20								Additional Hilti technical data		
Anchor size	M8	M10	M12	M16	M20	M24	M27	M30	M33	M36	M39
Embedment depth $h_{ef,typ} = [\text{mm}]$	80	90	110	125	170	210	240	270	300	330	360
Base material thickness $h_{min} = [\text{mm}]$	110	120	140	161	218	266	300	340	374	410	450
Edge distance $c = c_{min} = [\text{mm}]$	40	50	60	80	100	120	135	150	165	180	195
Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)											
 HIT-V 5.8 [kN]	8,2	10,0	13,3	16,9	26,1	35,6	43,3	51,4	60,0	69,1	78,6
HIT-V 8.8 [kN]											
HIT-V-R [kN]											
HIT-V-HCR [kN]											
Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$), without lever arm											
 HIT-V 5.8 [kN]	3,7	5,3	7,3	11,5	17,2	23,6	29,0	34,8	41,1	47,8	54,9
HIT-V 8.8 [kN]											
HIT-V-R [kN]											
HIT-V-HCR [kN]											

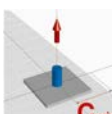
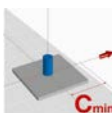
Design resistance: concrete C 20/25 – $f_{ck,cube} = 25 \text{ N/mm}^2$, Temperature range I
(load values are valid for single anchor)

	Data according ETA-04/0027, issue 2009-05-20								Additional Hilti technical data		
Anchor size	M8	M10	M12	M16	M20	M24	M27	M30	M33	M36	M39
Embedment depth $h_{ef,typ} = [\text{mm}]$	80	90	110	125	170	210	240	270	300	330	360
Base material thickness $h_{min} = [\text{mm}]$	110	120	140	161	218	266	300	340	374	410	450
Spacing $s = s_{min} = [\text{mm}]$	40	50	60	80	100	120	135	150	165	180	195
Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)											
 HIT-V 5.8 [kN]	9,3	11,6	15,5	19,2	30,1	41,2	50,3	59,9	70,1	80,8	92,0
HIT-V 8.8 [kN]											
HIT-V-R [kN]											
HIT-V-HCR [kN]											
Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$), without lever arm											
 HIT-V 5.8 [kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0	138,8	163,4	195,2
HIT-V 8.8 [kN]	12,0	18,4	27,2	50,4	78,4	112,8	147,2	177,0	207,0	238,5	271,5
HIT-V-R [kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8	72,9	85,8	102,5
HIT-V-HCR [kN]	12,0	18,4	27,2	50,4	78,4	70,9	92,0	112,0	86,8	102,1	122,0

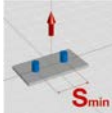
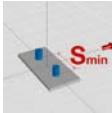
Design resistance: concrete C 20/25 – $f_{ck,cube} = 25 \text{ N/mm}^2$, Temperature range I

	Data according ETA-04/0027, issue 2009-05-20								Additional Hilti technical data		
Anchor size	M8	M10	M12	M16	M20	M24	M27	M30	M33	M36	M39
Embedment depth $h_{ef,2} = [\text{mm}]$	96	120	144	192	240	288	324	360	396	432	468
Base material thickness $h_{min} = [\text{mm}]$	126	150	174	228	288	344	384	430	470	512	558
Tensile N_{Rd}: single anchor, no edge effects											
 HIT-V 5.8 [kN]	12,0	19,3	28,0	52,7	82,0	117,5	140,2	164,3	189,5	215,9	243,5
HIT-V 8.8 [kN]	18,4	28,7	41,4	64,0	89,4	117,5	140,2	164,3	189,5	215,9	243,5
HIT-V-R [kN]	13,9	21,9	31,6	58,8	89,4	117,5	80,4	98,3	122,6	144,3	172,4
HIT-V-HCR [kN]	18,4	28,7	41,4	64,0	89,4	117,5	140,2	164,3	144,6	170,2	203,3
Shear V_{Rd}: single anchor, no edge effects, without lever arm											
 HIT-V 5.8 [kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0	138,8	163,4	195,2
HIT-V 8.8 [kN]	12,0	18,4	27,2	50,4	78,4	112,8	147,2	179,2	222,1	261,4	312,3
HIT-V-R [kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8	72,9	85,8	102,5
HIT-V-HCR [kN]	12,0	18,4	27,2	50,4	78,4	70,9	92,0	112,0	86,8	102,1	122,0

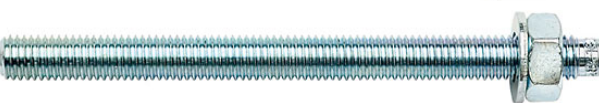
Design resistance: concrete C 20/25 – $f_{ck,cube} = 25 \text{ N/mm}^2$, Temperature range I

	Data according ETA-04/0027, issue 2009-05-20								Additional Hilti technical data		
Anchor size	M8	M10	M12	M16	M20	M24	M27	M30	M33	M36	M39
Embedment depth $h_{ef,2} = [\text{mm}]$	96	120	144	192	240	288	324	360	396	432	468
Base material thickness $h_{min} = [\text{mm}]$	126	150	174	228	288	344	384	430	470	512	558
Edge distance $c = c_{min} = [\text{mm}]$	40	50	60	80	100	120	135	150	165	180	195
Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)											
 HIT-V 5.8 [kN]	9,9	14,1	18,6	28,6	40,0	52,6	62,7	73,5	84,8	96,6	108,9
HIT-V 8.8 [kN]											
HIT-V-R [kN]											
HIT-V-HCR [kN]											
Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$), without lever arm											
 HIT-V 5.8 [kN]	3,9	5,7	7,8	12,9	18,9	25,9	31,8	38,1	45,0	52,3	60,0
HIT-V 8.8 [kN]											
HIT-V-R [kN]											
HIT-V-HCR [kN]											

Design resistance: concrete C 20/25 – $f_{ck,cube} = 25 \text{ N/mm}^2$, Temperature range I
(load values are valid for single anchor)

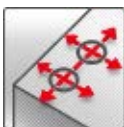
	Data according ETA-04/0027, issue 2009-05-20								Additional Hilti technical data		
Anchor size	M8	M10	M12	M16	M20	M24	M27	M30	M33	M36	M39
Embedment depth $h_{ef,2} = [\text{mm}]$	96	120	144	192	240	288	324	360	396	432	468
Base material thickness $h_{min} = [\text{mm}]$	126	150	174	228	288	344	384	430	470	512	558
Spacing $s = s_{min} = [\text{mm}]$	40	50	60	80	100	120	135	150	165	180	195
Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)											
 HIT-V 5.8 [kN]	11,5	17,3	22,7	34,9	48,8	64,2	76,6	89,7	103,5	117,9	133,0
HIT-V 8.8 [kN]											
HIT-V-R [kN]											
HIT-V-HCR [kN]											
Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$), without lever arm											
 HIT-V 5.8 [kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0	138,8	163,4	195,2
HIT-V 8.8 [kN]	12,0	18,4	27,2	50,4	78,4	112,8	147,2	179,2	222,1	261,4	312,3
HIT-V-R [kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8	72,9	85,8	102,5
HIT-V-HCR [kN]	12,0	18,4	27,2	50,4	78,4	70,9	92,0	112,0	86,8	102,1	122,0

Hilti HIT-RE 500 with HIT-V / HAS in diamond drilled holes

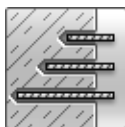
Injection mortar system	Benefits
 Hilti HIT-RE 500 330 ml foil pack (also available as 500 ml and 1400 ml foil pack)  Statik mixer  HAS rod  HAS-E rod  HIT-V rod	- suitable for non-cracked concrete C 20/25 to C 50/60 - high loading capacity - suitable for dry and water saturated concrete - large diameter 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



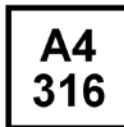
Concrete



Small edge distance and spacing



Variable embedment depth



Corrosion resistance



High corrosion resistance



Diamond drilled holes



PROFIS Anchor design software

Basic loading data for a single anchor

All data in this section applies to

- 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, $f_{ck,cube} = 25 \text{ N/mm}^2$
- Temperature range I
(min. base material temperature -40°C , max. long term/short term base material temperature: $+24^\circ\text{C}/40^\circ\text{C}$)
- Installation temperature range $+5^\circ\text{C}$ to $+40^\circ\text{C}$

For details see Simplified design method

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 – $f_{ck,cube} = 25 \text{ N/mm}^2$, anchor HIT-V 5.8

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
Tensile $N_{Ru,m}$ HIT-V 5.8 [kN]	18,9	30,5	44,1	83,0	129,2	185,9	229,7	287,2
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 – $f_{ck,cube} = 25 \text{ N/mm}^2$, anchor HIT-V 5.8

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
Tensile N_{Rk} HIT-V 5.8 [kN]	18,0	29,0	42,0	66,0	101,5	142,5	173,0	216,3
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 – $f_{ck,cube} = 25 \text{ N/mm}^2$, anchor HIT-V 5.8

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
Tensile N_{Rd} HIT-V 5.8 [kN]	12,0	18,8	27,6	31,4	48,3	67,9	82,4	103,0
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 – $f_{ck,cube} = 25 \text{ N/mm}^2$, anchor HIT-V 5.8

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
Tensile N_{rec} HIT-V 5.8 [kN]	8,6	13,5	19,7	22,4	34,5	48,5	58,9	73,6
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 $\gamma = 1,4$. 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 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

			Hilti technical data							
Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Nominal tensile strength f_{uk}	HIT-V/HAS 5.8	[N/mm ²]	500	500	500	500	500	500	500	500
	HIT-V/HAS 8.8	[N/mm ²]	800	800	800	800	800	800	800	800
	HIT-V/HAS -R	[N/mm ²]	700	700	700	700	700	700	500	500
	HIT-V/HAS -HCR	[N/mm ²]	800	800	800	800	800	700	700	700
Yield strength f_{yk}	HIT-V/HAS 5.8	[N/mm ²]	400	400	400	400	400	400	400	400
	HIT-V/HAS 8.8	[N/mm ²]	640	640	640	640	640	640	640	640
	HIT-V/HAS -R	[N/mm ²]	450	450	450	450	450	450	210	210
	HIT-V/HAS -HCR	[N/mm ²]	600	600	600	600	600	400	400	400
Stressed cross- section A_s	HAS	[mm ²]	32,8	52,3	76,2	144	225	324	427	519
	HIT-V	[mm ²]	36,6	58,0	84,3	157	245	353	459	561
Moment of resistance W	HAS	[mm ³]	27,0	54,1	93,8	244	474	809	1274	1706
	HIT-V	[mm ³]	31,2	62,3	109	277	541	935	1387	1874

Material quality

Part	Material
Threaded rod HIT-V(F), HAS 5.8 M8 – M24	Strength class 5.8, $A_5 > 8\%$ ductile, steel galvanized $\geq 5 \mu\text{m}$, (F) hot dipped galvanized $\geq 45 \mu\text{m}$,
Threaded rod HIT-V(F), HAS 8.8 M27 – M30	Strength class 8.8, $A_5 > 8\%$ ductile, steel galvanized $\geq 5 \mu\text{m}$, (F) hot dipped galvanized $\geq 45 \mu\text{m}$,
Threaded rod HIT-V-R, HAS-R	Stainless steel grade A4, $A_5 > 8\%$ ductile, strength class 70 for $\leq M24$ and class 50 for M27 to M30, 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362
Threaded rod HIT-V-HCR, HAS-HCR	High corrosion resistant steel, 1.4529; 1.4565, strength $\leq M20$: $R_m = 800 \text{ N/mm}^2$, $R_{p0.2} = 640 \text{ N/mm}^2$, $A_5 > 8\%$ ductile M24 to M30: $R_m = 700 \text{ N/mm}^2$, $R_{p0.2} = 400 \text{ N/mm}^2$, $A_5 > 8\%$ 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 $\geq 5 \mu\text{m}$, hot dipped galvanized $\geq 45 \mu\text{m}$,
	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

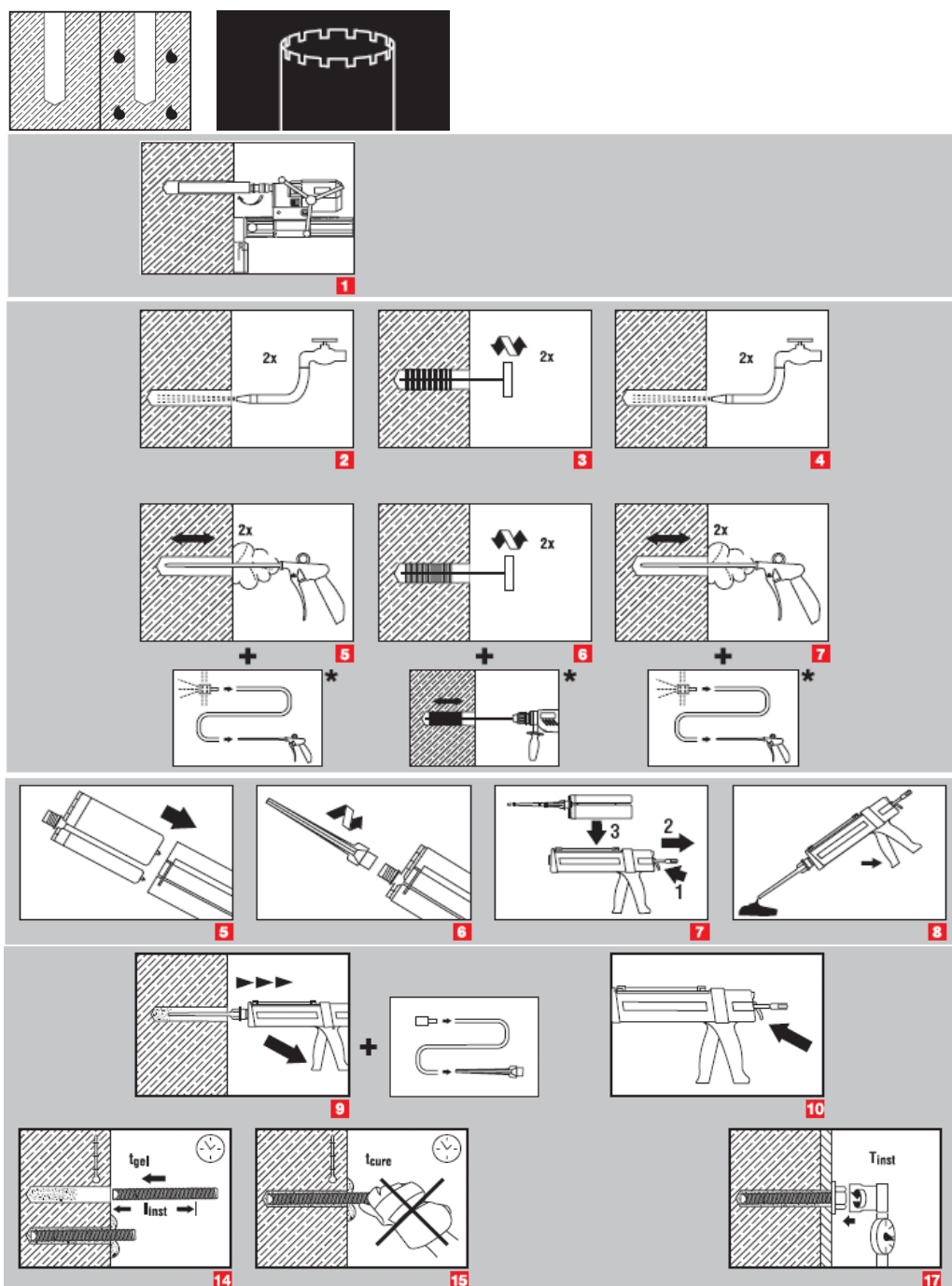
Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
Anchor rod HAS, HAS-E, HAS-R, HAS-ER HAS-HCR	M8x80	M10x90	M12x110	M16x125	M20x170	M24x210	M27x240	M30x270
Anchor embedment depth [mm]	80	90	110	125	170	210	240	270
Anchor rod HIT-V, HIT-V-R, HIT-V-HCR	Anchor rods HIT-V (-R / -HCR) are available in variable length							

Setting installation equipment

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
Drilling tools	DD EC-1, DD 100 ... DD xxx							
Other tools	compressed air gun or blow out pump, set of cleaning brushes, dispenser							

Setting instruction

Dry and water-saturated concrete, diamond coring drilling; Hilti technical information only



Brush bore hole with required steel brush HIT-RB

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

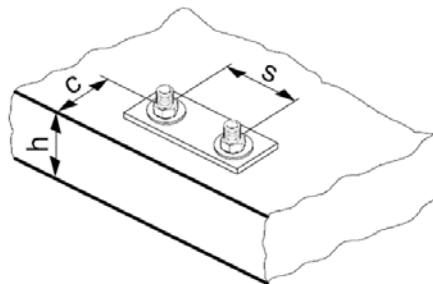
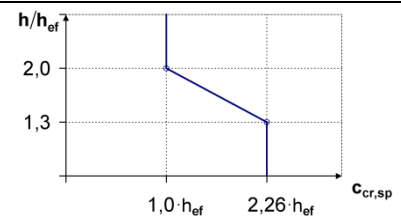
Important! Remove all water from the borehole and blow out with oil free compressed air until borehole is completely dried before mortar injection (not applicable to hammer drilled hole in underwater application).

Curing time for general conditions

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

Setting details

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)}	$h_{\text{ef,min}}$ [mm]	40	40	48	64	80	96	108	120
	$h_{\text{ef,max}}$ [mm]	160	200	240	320	400	480	540	600
Minimum base material thickness h_{min} [mm]		$h_{\text{ef}} + 30 \text{ mm}$ $\geq 100 \text{ mm}$			$h_{\text{ef}} + 2 d_0$				
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 $s_{\text{cr,sp}}$		$2 c_{\text{cr,sp}}$							
Critical edge distance for splitting failure ^{b)} $c_{\text{cr,sp}}$ [mm]		$1,0 \cdot h_{\text{ef}}$ for $h / h_{\text{ef}} \geq 2,0$							
		$4,6 h_{\text{ef}} - 1,8 h$ for $2,0 > h / h_{\text{ef}} > 1,3$							
		$2,26 h_{\text{ef}}$ for $h / h_{\text{ef}} \leq 1,3$							
Critical spacing for concrete cone failure $s_{\text{cr,N}}$		$2 c_{\text{cr,N}}$							
Critical edge distance for concrete cone failure ^{c)} $c_{\text{cr,N}}$		$1,5 h_{\text{ef}}$							
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) $h_{ef,min} \leq h_{ef} \leq h_{ef,max}$ (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 safe 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.

- 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 conservative: 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)

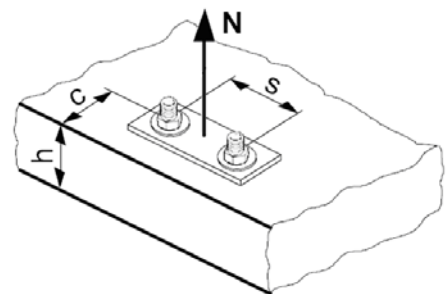
The values are valid for one anchor.

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



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
$N_{Rd,s}$	HAS 5.8	[kN]	11,3	17,3	25,3	48,0	74,7	106,7	-	-
	HIT-V 5.8	[kN]	12,0	19,3	28,0	52,7	82,0	118,0	153,3	187,3
	HAS 8.8	[kN]	-	-	-	-	-	-	231,3	281,3
	HIT-V 8.8	[kN]	19,3	30,7	44,7	84,0	130,7	188,0	244,7	299,3
	HAS (-E)-R	[kN]	12,3	19,8	28,3	54,0	84,0	119,8	75,9	92,0
	HIT-V-R	[kN]	13,9	21,9	31,6	58,8	92,0	132,1	80,4	98,3
	HAS (-E)-HCR	[kN]	18,0	28,0	40,7	76,7	120,0	106,7	144,8	175,7
	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 for anchors in diamond drilled holes

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

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
$N_{Rd,p}^0$	Temperature range I	[kN]	13,4	18,8	27,6	31,4	48,3	67,9	82,4	103,0
$N_{Rd,p}^0$	Temperature range II	[kN]	10,9	15,3	22,4	25,4	39,1	55,0	66,7	83,4
$N_{Rd,p}^0$	Temperature range III	[kN]	6,8	9,6	14,0	15,9	24,5	34,4	41,8	52,3

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

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

	Data according ETA-04/0027, issue 2009-05-20							
Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
$N_{Rd,c}^0$ [kN]	17,2	20,5	27,7	33,6	53,3	73,2	89,4	106,7

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
$f_{B,p} = (f_{ck,cube}/25\text{N/mm}^2)^{0,1 \text{ a)}}$	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
$f_B = (f_{ck,cube}/25\text{N/mm}^2)^{1/2 \text{ a)}}$	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)}

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

- a) 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)}

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

- 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

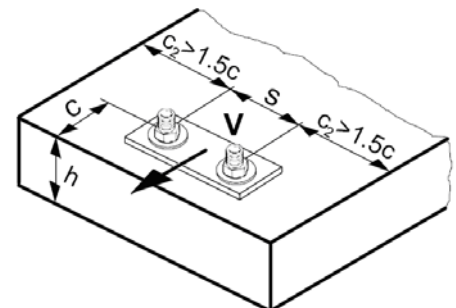
h_{ef} [mm]	40	50	60	70	80	90	≥ 100
$f_{re,N} = 0,5 + h_{ef}/200\text{mm} \leq 1$	0,7 ^{a)}	0,75 ^{a)}	0,8 ^{a)}	0,85 ^{a)}	0,9 ^{a)}	0,95 ^{a)}	1

- 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: $V_{Rd,cp} = k \cdot \text{lower value of } N_{Rd,p} \text{ and } N_{Rd,c}$
- Concrete edge resistance: $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_{\beta} \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

		Data according ETA-04/0027, issue 2009-05-20							
Anchor size		M8	M10	M12	M16	M20	M24	M27	M30
$V_{Rd,s}$	HAS 5.8 [kN]	6,8	10,4	15,2	28,8	44,8	64,0	-	-
	HIT-V 5.8 [kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
	HAS 8.8 [kN]	-	-	-	-	-	-	139,2	168,8
	HIT-V 8.8 [kN]	12,0	18,4	27,2	50,4	78,4	112,8	147,2	179,2
	HAS (-E)-R [kN]	7,7	12,2	17,3	32,7	50,6	71,8	45,8	55,5
	HIT-V-R [kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8
	HAS (-E)-HCR [kN]	10,4	16,8	24,8	46,4	72,0	64,0	86,9	105,7
	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 $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_{\beta} \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
Non-cracked concrete								
$V_{Rd,c}^0$ [kN]	5,9	8,6	11,6	18,7	27,0	36,6	44,5	53,0

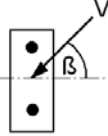
Influencing factors

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 β	0°	10°	20°	30°	40°	50°	60°	70°	80°	$\geq 90^\circ$
$f_{\beta} = \sqrt{\frac{1}{(\cos \alpha_V)^2 + \left(\frac{\sin \alpha_V}{2,5}\right)^2}}$ 	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	$\geq 1,5$
$f_h = \{h/(1,5 \cdot c)\}^{1/2} \leq 1$	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

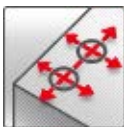
For combined tension and shear loading see section "Anchor Design".

Hilti HIT-RE 500 with HIS-(R)N

Injection mortar system		Benefits
 Hilti HIT-RE 500 330 ml foil pack (also available as 500 ml and 1400 ml foil pack)  Statik mixer  HIS-(R)N sleeve		- suitable for non-cracked concrete C 20/25 to C 50/60 - high loading capacity - suitable for dry and water saturated concrete - under water application for hammer drilled holes - long working time at elevated temperatures - odourless epoxy



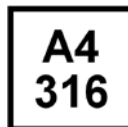
Concrete



Small edge distance and spacing



Fire resistance



Corrosion resistance



European Technical Approval



CE conformity



Diamond drilled holes



PROFIS Anchor design software

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval ^{a)}	DIBt, Berlin	ETA-04/0027 / 2009-05-20
Fire test report	IBMB, Brunswick	UB 3565 / 4595 / 2006-10-29 UB 3588 / 4825 / 2005-11-15
Assessment report (fire)	warringtonfire	WF 166402 / 2007-10-26 & suppl. WF 172920 / 2008-05-27

a) All data given in this section according ETA-04/0027, issue 2009-05-20.

Basic loading data (for a single anchor)

All data in this section applies to

- 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, $f_{ck,cube} = 25 \text{ N/mm}^2$
- Temperature range I
(min. base material temperature -40°C , max. long term/short term base material temperature: $+24^\circ\text{C}/40^\circ\text{C}$)
- Installation temperature range $+5^\circ\text{C}$ to $+40^\circ\text{C}$

For details see Simplified design method

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 ^{a)}: concrete C 20/25 – $f_{ck,cube} = 25 \text{ N/mm}^2$, anchor HIS-N

Data according ETA-04/0027, issue 2009-05-20						
Anchor size	M8	M10	M12	M16	M20	
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	

Characteristic resistance: concrete C 20/25 – $f_{ck,cube} = 25 \text{ N/mm}^2$, anchor HIS-N

Data according ETA-04/0027, issue 2009-05-20						
Anchor size	M8	M10	M12	M16	M20	
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	

Design resistance: concrete C 20/25 – $f_{ck,cube} = 25 \text{ N/mm}^2$, anchor HIS-N

Data according ETA-04/0027, issue 2009-05-20						
Anchor size	M8	M10	M12	M16	M20	
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	

Recommended loads ^{a)}: concrete C 20/25 – $f_{ck,cube} = 25 \text{ N/mm}^2$, anchor HIS-N

Data according ETA-04/0027, issue 2009-05-20						
Anchor size	M8	M10	M12	M16	M20	
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	

a) With 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.

Service temperature range

Hilti HIT-RE 500 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-04/0027, issue 2009-05-20				
Anchor size			M8	M10	M12	M16	M20
Nominal tensile strength f_{uk}	HIS-N	[N/mm ²]	490	490	460	460	460
	Screw 8.8	[N/mm ²]	800	800	800	800	800
	HIS-RN	[N/mm ²]	700	700	700	700	700
	Screw A4-70	[N/mm ²]	700	700	700	700	700
Yield strength f_{yk}	HIS-N	[N/mm ²]	410	410	375	375	375
	Screw 8.8	[N/mm ²]	640	640	640	640	640
	HIS-RN	[N/mm ²]	350	350	350	350	350
	Screw A4-70	[N/mm ²]	450	450	450	450	450
Stressed cross-section A_s	HIS-(R)N	[mm ²]	51,5	108,0	169,1	256,1	237,6
	Screw	[mm ²]	36,6	58	84,3	157	245
Moment of resistance W	HIS-(R)N	[mm ³]	145	430	840	1595	1543
	Screw	[mm ³]	31,2	62,3	109	277	541

Material quality

Part	Material
internally threaded sleeves ^{a)} HIS-N	C-steel 1.0718, steel galvanized $\geq 5\mu\text{m}$
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 $\geq 5\mu\text{m}$

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

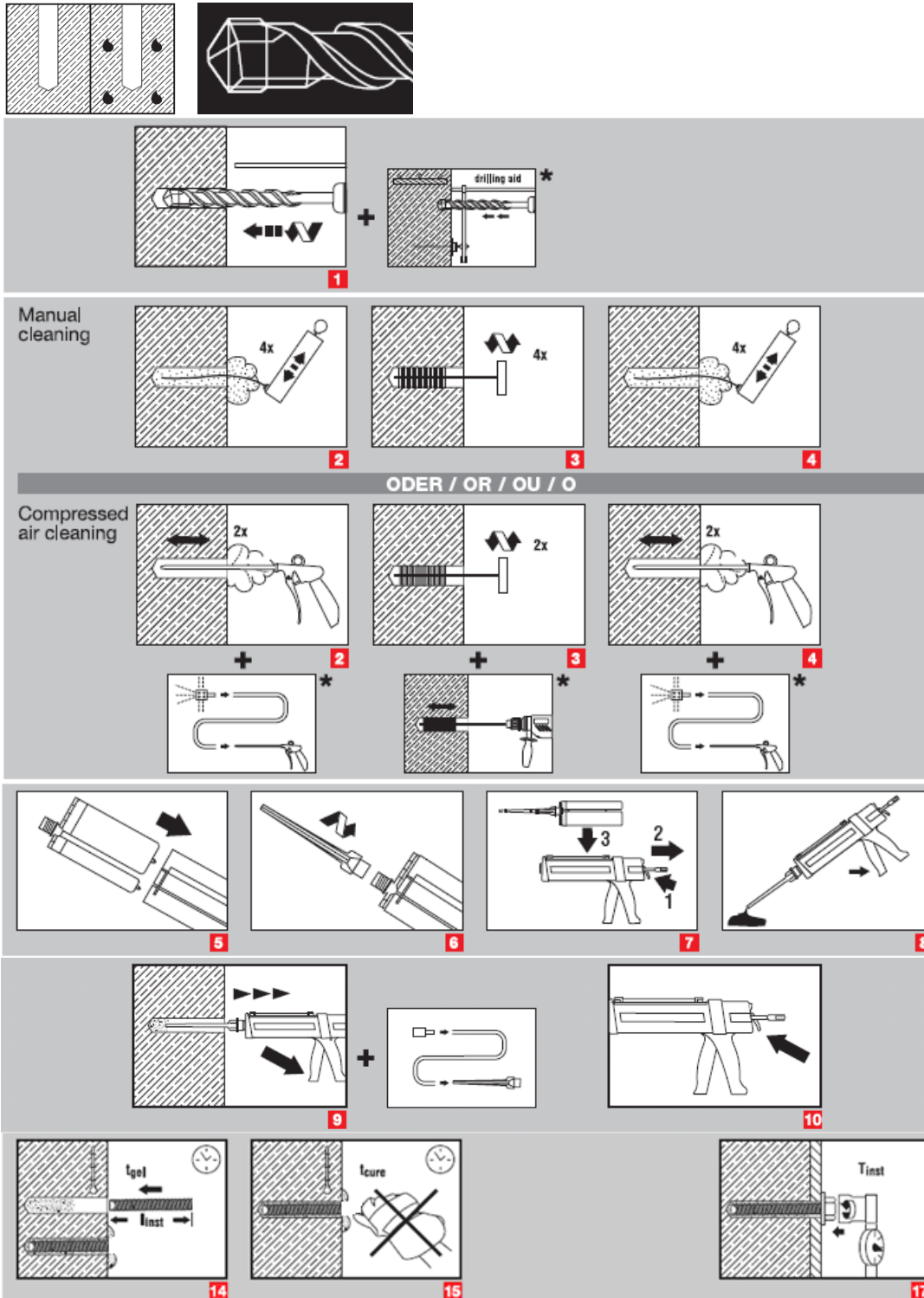
installation equipment

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				
Additional Hilti recommended tools	DD EC-1, DD 100 ... DD xxx ^{a)}				

a) For anchors in diamond drilled holes load values for combined pull-out and concrete cone resistance have to be reduced (see section "Setting instruction")

Setting instruction

Dry and water-saturated concrete, hammer drilling



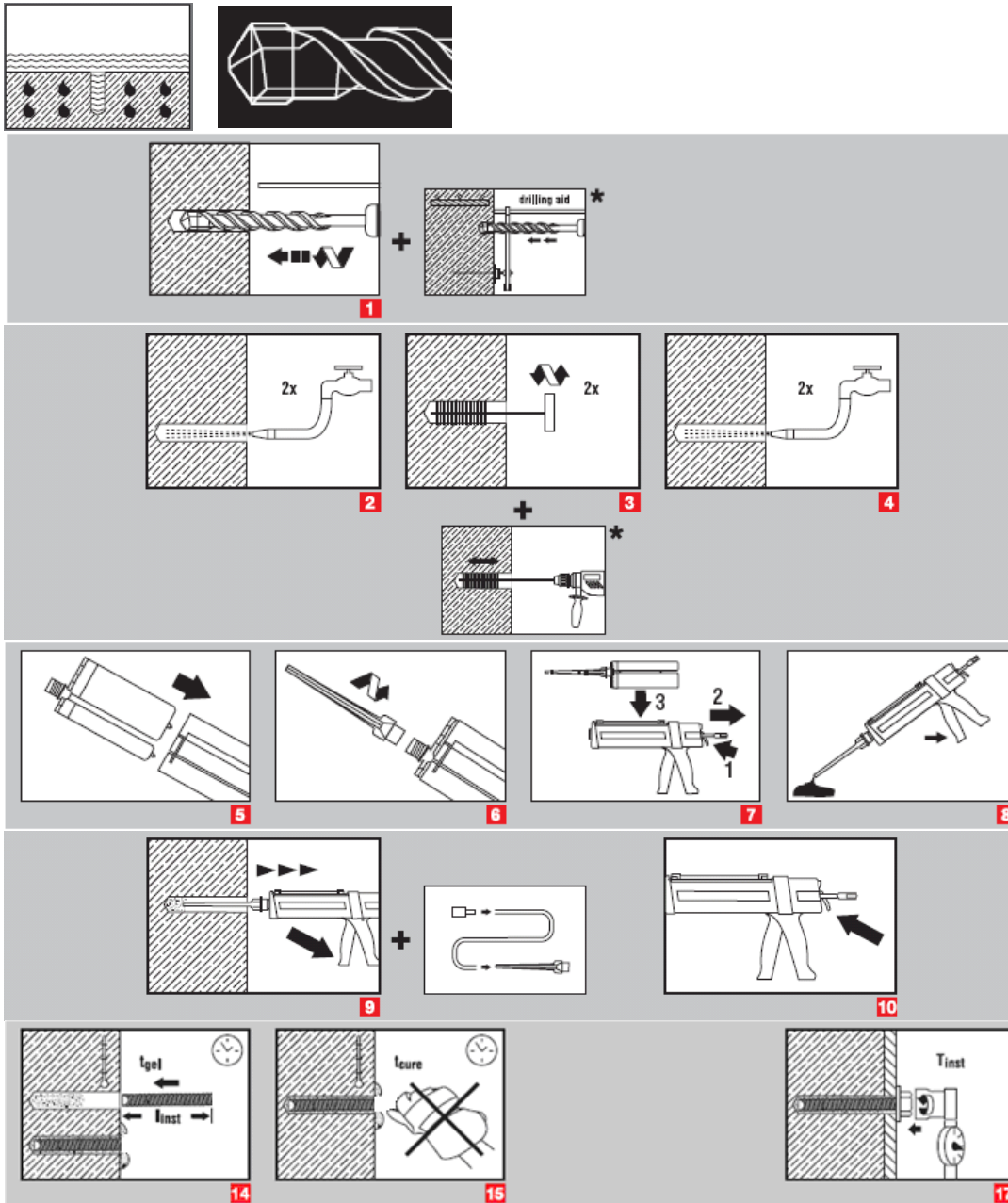
a)

a) Note: Manual cleaning for HIS-(R)N M8 and HIS-(R)N M10 only!

Brush bore hole with required steel brush HIT-RB

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

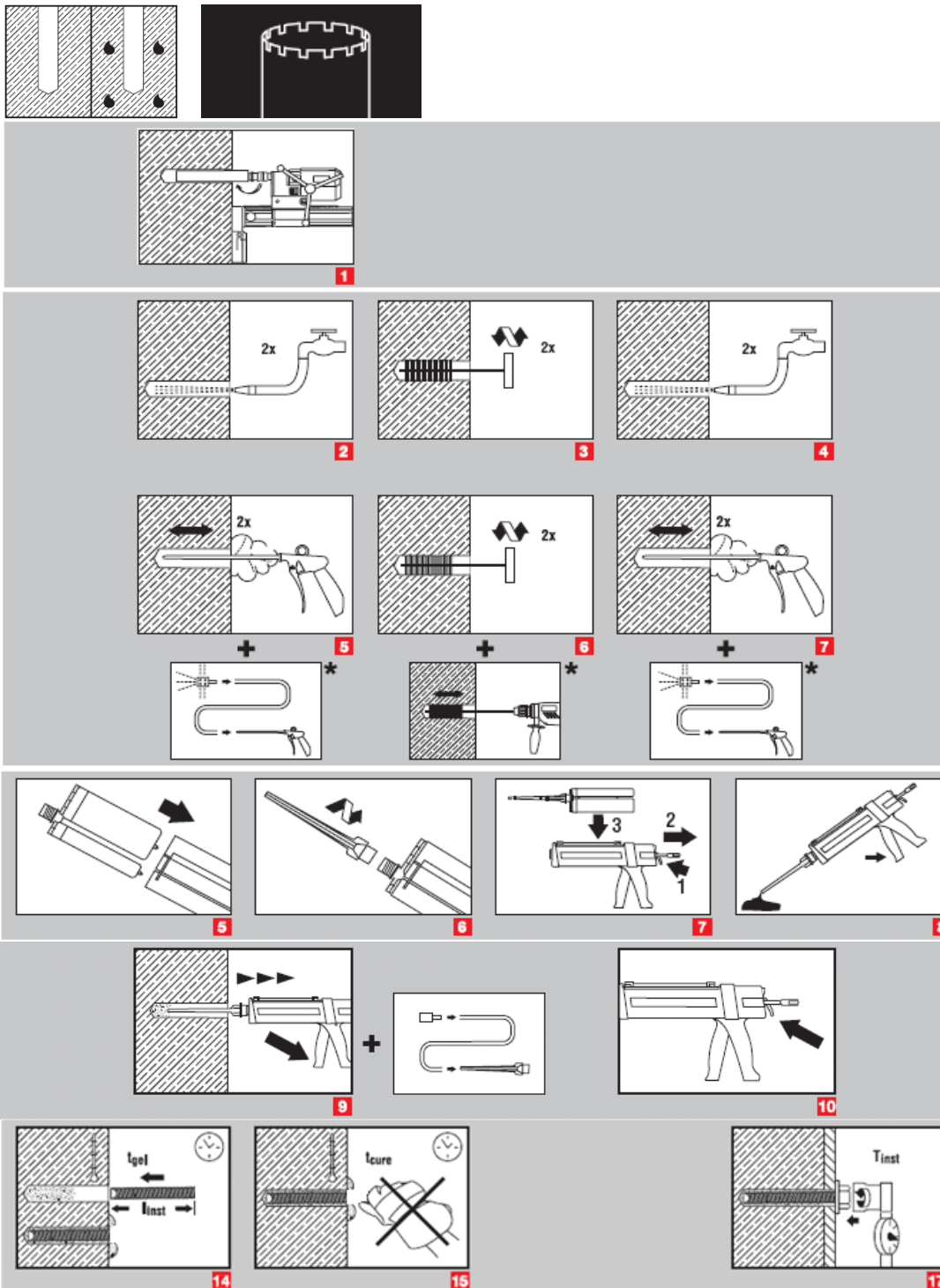
Water filled bore hole or submerged, hammer drilling



Brush bore hole with required steel brush HIT-RB

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

Dry and water-saturated concrete, diamond coring drilling; Hilti technical information only



For anchors in diamond drilled holes load values for combined pull-out and concrete cone resistance have to be reduced. Load reduction factor: 0.7

Brush bore hole with required steel brush HIT-RB

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

Important! Remove all water from the borehole and blow out with oil free compressed air until borehole is completely dried before mortar injection (not applicable to hammer drilled hole in underwater application).

Curing time for general conditions

Data according ETA-04/0027, issue 2009-05-20		
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

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	Reduced curing time before anchor can be fully loaded $t_{cure,dry}$	Working time in which anchor can be inserted and adjusted t_{gel}	Load reduction factor
40 °C	4 h	12 min	1
30 °C	8 h	12 min	1
20 °C	12 h	20 min	1
15 °C	18 h	30 min	1
10 °C	24 h	90 min	1
5 °C	36 h	120 min	1
0 °C	50 h	3 h	0,7
-5 °C	72 h	4 h	0,6

Setting details

		Data according ETA-04/0027, issue 2009-05-20				
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 ^{c)}	$c_{cr,N}$	$1,5 h_{ef}$				
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-04/0027, issue 2009-05-20.

- 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)

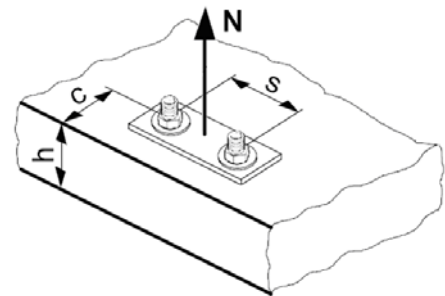
The values are valid for one anchor.

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



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

		Data according ETA-04/0027, issue 2009-05-20				
Anchor size		M8	M10	M12	M16	M20
$N_{Rd,s}$	HIS-N [kN]	16,8	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 ^{a)}

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

		Data according ETA-04/0027, issue 2009-05-20				
Anchor size		M8	M10	M12	M16	M20
Embedment depth h_{ef} [mm]		90	110	125	170	205
$N_{Rd,p}^0$	Temperature range I [kN]	19,0	28,6	45,2	81,0	95,2
$N_{Rd,p}^0$	Temperature range II [kN]	16,7	23,8	35,7	66,7	81,0
$N_{Rd,p}^0$	Temperature range III [kN]	9,5	14,3	19,0	35,7	45,2

a) Additional Hilti technical data (not part of ETA-04/0027, issue 2009-05-20):

The design values for combined pull-out and concrete cone resistance may be increased by 20 % for anchor installation in dry concrete (concrete not in contact with water before/during installation and curing).

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

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

	Data according ETA-04/0027, issue 2009-05-20				
Anchor size	M8	M10	M12	M16	M20
$N_{Rd,c}^0$ [kN]	20,5	27,7	33,6	53,3	70,6

a) **Additional Hilti technical data (not part of ETA-04/0027, issue 2009-05-20):**

The design values for concrete cone and splitting resistance may be increased by 20 % for anchor installation in dry concrete (concrete not in contact with water before/during installation and curing).

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)

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

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

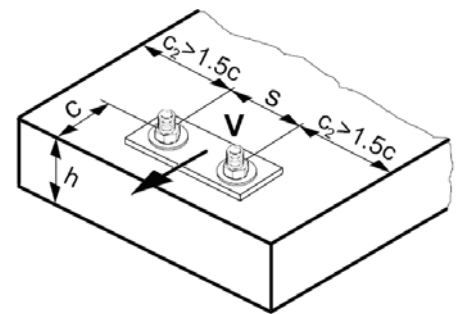
h_{ef} [mm]	80	90	≥ 100
$f_{re,N} = 0,5 + h_{ef}/200\text{mm} \leq 1$	0,9 ^{a)}	0,95 ^{a)}	1

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



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

		Data according ETA-04/0027, issue 2009-05-20				
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 $V_{Rd,cp} = \text{lower value}^a)$ 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 $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_{f_h} \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size	M8	M10	M12	M16	M20
Non-cracked concrete					
$V_{Rd,c}^0$ [kN]	12,4	19,6	28,2	40,2	46,2

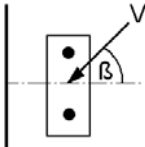
Influencing factors

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
$f_B = (f_{ck,cube}/25\text{N/mm}^2)^{1/2}$ 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 β	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 $\gamma = 1,4$. 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 – $f_{ck,cube} = 25 \text{ N/mm}^2$, Temperature range I

Data according ETA-04/0027, issue 2009-05-20						
Anchor size		M8	M10	M12	M16	M20
Embedment depth $h_{ef} = [\text{mm}]$		90	110	125	170	205
Base material thickness $h_{min} = [\text{mm}]$		120	150	170	230	270
Tensile N_{Rd}: single anchor, no edge effects						
HIS-N [kN]		16,8	27,7	33,6	53,3	70,6
HIS-RN [kN]		13,9	21,9	31,6	53,3	69,2
Shear V_{Rd}: single anchor, no edge effects, without lever arm						
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 – $f_{ck,cube} = 25 \text{ N/mm}^2$, Temperature range I

Data according ETA-04/0027, issue 2009-05-20						
Anchor size		M8	M10	M12	M16	M20
Embedment depth $h_{ef} = [\text{mm}]$		90	110	125	170	205
Base material thickness $h_{min} = [\text{mm}]$		120	150	170	230	270
Edge distance $c = c_{min} = [\text{mm}]$		40	45	55	65	90
Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)						
HIS-(R)N [kN]		9,4	12,4	15,4	23,5	32,0
Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$), without lever arm						
HIS-(R)N [kN]		4,2	5,5	7,6	10,8	17,2

Design resistance: concrete C 20/25 – $f_{ck,cube} = 25 \text{ N/mm}^2$, Temperature range I
(load values are valid for single anchor)

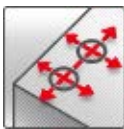
Data according ETA-04/0027, issue 2009-05-20						
Anchor size		M8	M10	M12	M16	M20
Embedment depth $h_{ef} = [\text{mm}]$		90	110	125	170	205
Base material thickness $h_{min} = [\text{mm}]$		120	150	170	230	270
Spacing $s = s_{min} = [\text{mm}]$		40	45	55	65	90
Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)						
HIS-(R)N [kN]		11,2	15,2	18,5	29,0	38,8
Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$), without lever arm						
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

Hilti HIT-RE 500 with rebar in hammer drilled holes

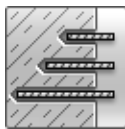
Injection mortar system		Benefits
  		- suitable for non-cracked concrete C 20/25 to C 50/60 - high loading capacity - suitable for dry and water saturated concrete - under water application - large diameter applications - long working time at elevated temperatures - odourless epoxy - embedment depth range: from 60 ... 160 mm for Ø8 to 128 ... 640 mm for Ø32
	Hilti HIT-RE 500 330 ml foil pack (also available as 500 ml and 1400 ml foil pack) Statik mixer rebar BSt 500 S	



Concrete



Small edge distance and spacing



Variable embedment depth



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-04/0027 / 2009-05-20

a) All data given in this section according ETA-04/0027, issue 2009-05-20.

Basic loading data (for a single anchor)

All data in this section applies to

- 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, $f_{ck,cube} = 25 \text{ N/mm}^2$
- 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

For details see Simplified design method

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

	Data according ETA-04/0027, issue 2009-05-20									Additional Hilti tech. data	
Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32	Ø36	Ø40
Typical embedment depth [mm]	80	90	110	125	125	170	210	270	300	330	360
Base material thickness [mm]	110	120	145	165	165	220	275	340	380	420	470

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 – $f_{ck,cube} = 25 \text{ N/mm}^2$, anchor rebar BSt 500S

	Data according ETA-04/0027, issue 2009-05-20									Additional Hilti tech. data	
Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32	Ø36	Ø40
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	403,6	459,9
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	293,9	362,9

Characteristic resistance: concrete C 20/25 – $f_{ck,cube} = 25 \text{ N/mm}^2$, anchor rebar BSt 500 S

	Data according ETA-04/0027, issue 2009-05-20									Additional Hilti tech. data	
Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32	Ø36	Ø40
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	302,7	344,9
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	279,9	345,6

Design resistance: concrete C 20/25 – $f_{ck,cube} = 25 \text{ N/mm}^2$, anchor rebar BSt 500 S

	Data according ETA-04/0027, issue 2009-05-20									Additional Hilti tech. data	
Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32	Ø36	Ø40
Tensile N_{Rd} BSt 500 S [kN]	14,4	20,2	27,7	33,6	33,6	53,3	73,2	106,7	125,0	144,2	164,3
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	186,6	230,4

Recommended loads ^{a)}: concrete C 20/25 – $f_{ck,cube} = 25 \text{ N/mm}^2$, anchor rebar BSt 500 S

	Data according ETA-04/0027, issue 2009-05-20									Additional Hilti tech. data	
Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32	Ø36	Ø40
Tensile N_{rec} BSt 500 S [kN]	10,3	14,4	19,8	24,0	24,0	38,1	52,3	76,2	89,3	103,0	117,3
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	133,3	164,6

a) With 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.

Service temperature range

Hilti HIT-RE 500 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-04/0027, issue 2009-05-20									Additional Hilti tech. data	
Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32	Ø36	Ø40
Nominal tensile strength f_{uk}	BSt 500 S	[N/mm ²]	550	550	550	550	550	550	550	550	550	550	550
Yield strength f_{yk}	BSt 500 S	[N/mm ²]	500	500	500	500	500	500	500	500	500	500	500
Stressed cross-section A_s	BSt 500 S	[mm ²]	50,3	78,5	113,1	153,9	201,1	314,2	490,9	615,8	804,2	1018	1257
Moment of resistance W	BSt 500 S	[mm ³]	50,3	98,2	169,6	269,4	402,1	785,4	1534	2155	3217	4580	6283

Material quality

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

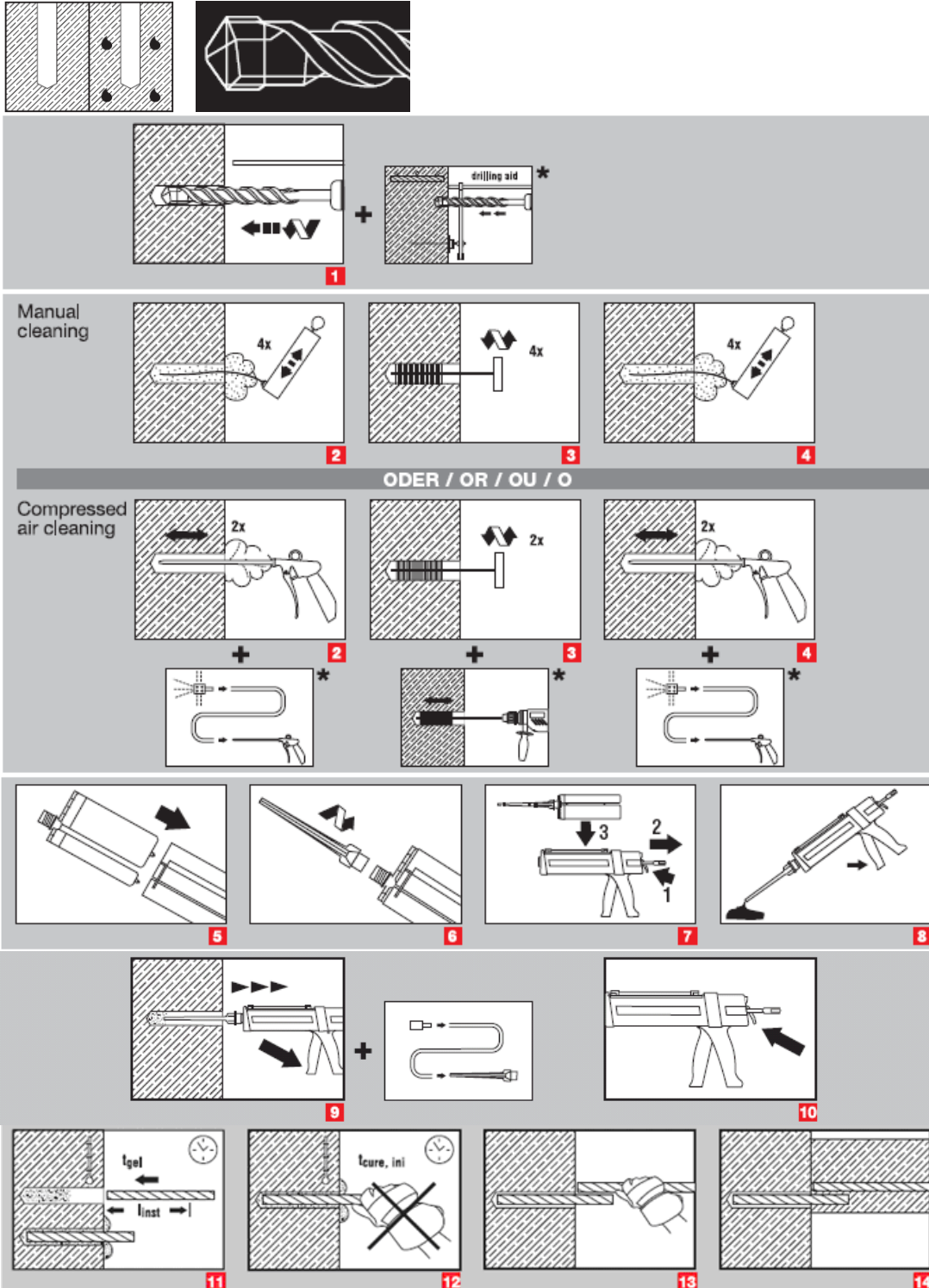
Setting

installation equipment

Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32	Ø36
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

Dry and water-saturated concrete, hammer drilling

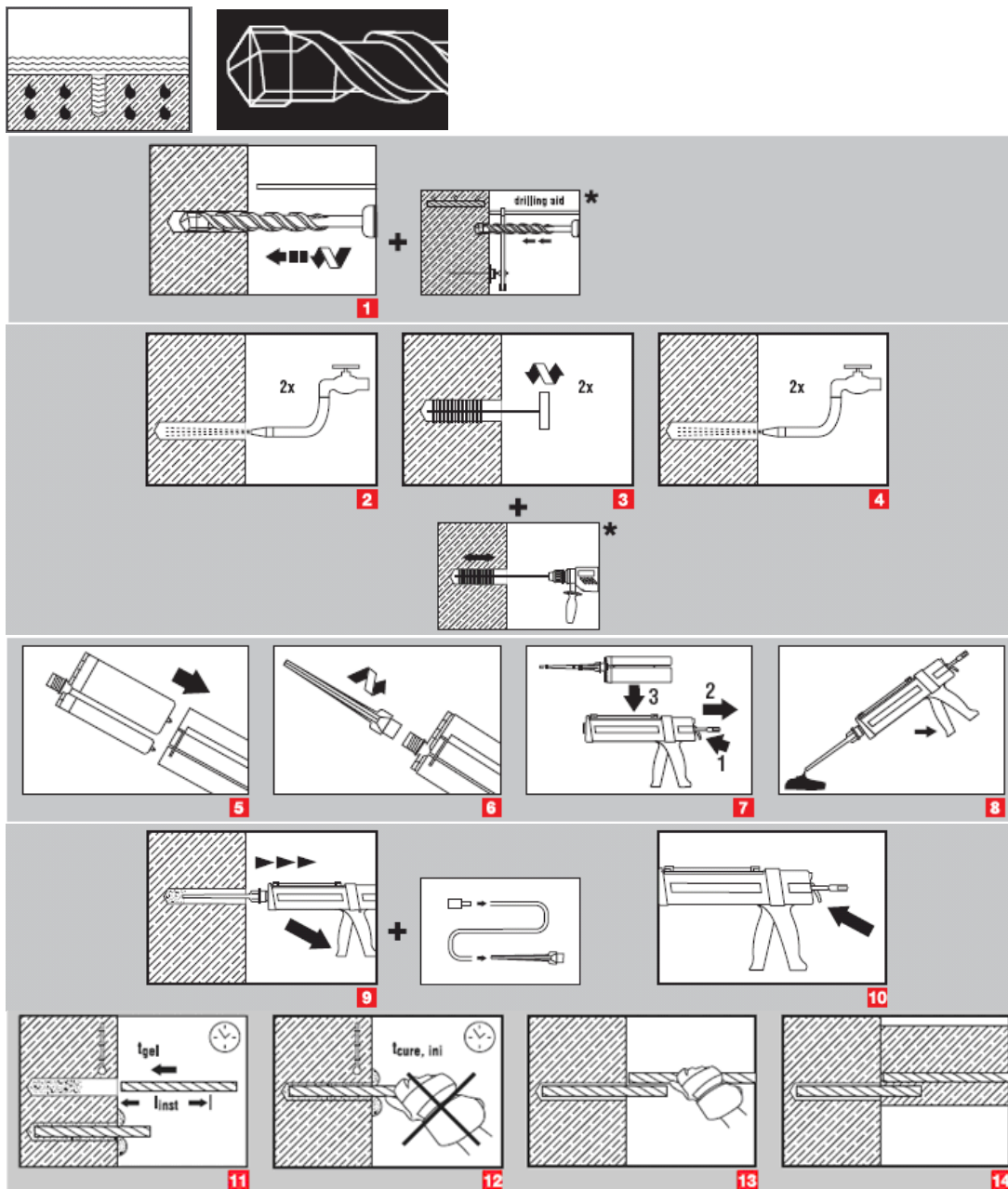


a) Note: Manual cleaning only for $h_{ef} \leq 250$ mm and anchor size $d \leq 16$ mm

Brush bore hole with required steel brush HIT-RB

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

Water filled bore hole or submerged, hammer drilling



Brush bore hole with required steel brush HIT-RB

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

Curing time for general conditions

Data according ETA-04/0027, issue 2009-05-20			Additional Hilti technical data
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}	Preparation work may continue. Do not apply design load. $t_{cure, ini}$
40 °C	12 min	4 h	2 h
30 °C to 39 °C	12 min	8 h	4 h
20 °C to 29 °C	20 min	12 h	6 h
15 °C to 19 °C	30 min	24 h	8 h
10 °C to 14 °C	90 min	48 h	12 h
5 °C to 9 °C	120 min	72 h	18 h

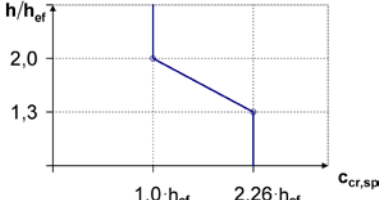
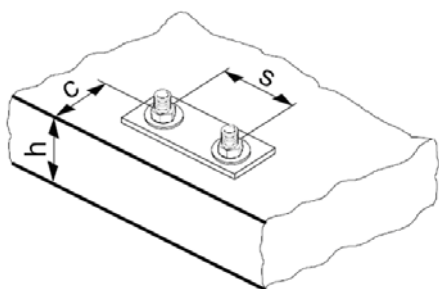
For dry concrete curing times may be reduced according to the following table.

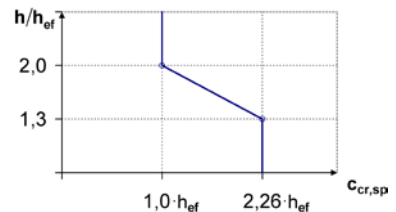
For installation temperatures below +5 °C all load values have to be reduced according to the load reduction factors given below.

Curing time for dry concrete

Additional Hilti technical data			
Temperature of the base material	Reduced curing time before anchor can be fully loaded $t_{cure, dry}$	Working time in which anchor can be inserted and adjusted t_{gel}	Load reduction factor
40 °C	4 h	12 min	1
30 °C	8 h	12 min	1
20 °C	12 h	20 min	1
15 °C	18 h	30 min	1
10 °C	24 h	90 min	1
5 °C	36 h	120 min	1
0 °C	50 h	3 h	0,7
-5 °C	72 h	4 h	0,6

Setting details

			Data according ETA-04/0027, issue 2009-05-20									Additional Hilti tech. data	
Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32	Ø36	Ø40
Nominal diameter of drill bit	d ₀	[mm]	12	14	16	18	20	25	32	35	40	45	55
Effective anchorage and drill hole depth range ^{a)}	h _{ef,min}	[mm]	60	60	70	75	80	90	100	112	128	144	160
	h _{ef,max}	[mm]	160	200	240	280	320	400	500	560	640	720	800
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	180	200
Minimum edge distance	c _{min}	[mm]	40	50	60	70	80	100	125	140	160	180	200
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}										
													



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-04/0027, issue 2009-05-20.

- 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 same 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)

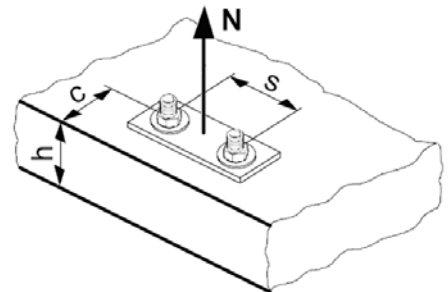
The values are valid for one anchor.

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



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

	Data according ETA-04/0027, issue 2009-05-20										Additional Hilti tech. data	
Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32	Ø36	Ø40	
$N_{Rd,s}$ BSt 500 S [kN]	20,0	30,7	44,3	60,7	79,3	123,6	192,9	242,1	315,7	400	494	

Design combined pull-out and concrete cone resistance ^{a)}

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

	Data according ETA-04/0027, issue 2009-05-20										Additional Hilti tech. data	
Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32	Ø36	Ø40	
Typical embedment depth $h_{ef,typ}$ [mm]	80	90	110	125	125	170	210	270	300	330	360	
$N_{Rd,p}^0$ Temperature range I [kN]	14,4	20,2	29,6	36,7	41,9	71,2	102,1	147,0	186,7	192,8	216,1	
$N_{Rd,p}^0$ Temperature range II [kN]	11,5	16,2	23,7	31,4	32,9	56,0	86,4	113,1	143,6	154,2	172,9	
$N_{Rd,p}^0$ Temperature range III [kN]	6,7	9,4	13,8	18,3	20,9	33,1	51,1	67,9	86,2	92,5	103,7	

a) Additional Hilti technical data (not part of ETA-04/0027, issue 2009-05-20):

The design values for combined pull-out and concrete cone resistance may be increased by 20 % for anchor installation in dry concrete (concrete not in contact with water before/during installation and curing).

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

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

	Data according ETA-04/0027, issue 2009-05-20									Additional Hilti tech. data	
Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32	Ø36	Ø40
$N_{Rd,c}^0$ [kN]	17,2	20,5	27,7	33,6	33,6	53,3	73,2	106,7	125,0	144,2	164,3

a) **Additional Hilti technical data (not part of ETA-04/0027, issue 2009-05-20):**

The design values for concrete cone and splitting resistance may be increased by 20 % for anchor installation in dry concrete (concrete not in contact with water before/during installation and curing).

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
$f_{B,p} = (f_{ck,cube}/25N/mm^2)^{0,1} \text{ a)}$	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

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

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
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2} \text{ a)}$	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)}

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

a) 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)}

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

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

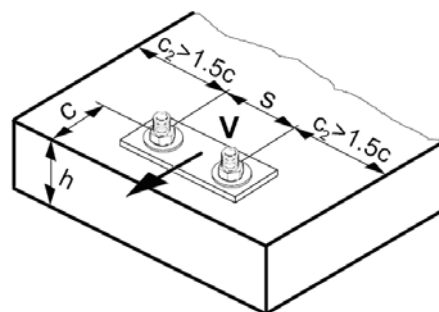
h_{ef} [mm]	40	50	60	70	80	90	≥ 100
$f_{re,N} = 0,5 + h_{ef}/200\text{mm} \leq 1$	0,7 ^{a)}	0,75 ^{a)}	0,8 ^{a)}	0,85 ^{a)}	0,9 ^{a)}	0,95 ^{a)}	1

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: $V_{Rd,cp} = k \cdot \text{lower value of } N_{Rd,p} \text{ and } N_{Rd,c}$
- Concrete edge resistance: $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_{\beta} \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

	Data according ETA-04/0027, issue 2009-05-20										Additional Hilti technical data
Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32	Ø36	Ø40
$V_{Rd,s}$ BSt 500 S [kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0	112,7	147,3	186,6	230,4

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

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

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

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

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

Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32	Ø36	Ø40
Non-cracked concrete											
$V_{Rd,c}^0$ [kN]	5,9	8,6	11,6	15,0	18,7	27,0	39,2	47,3	59,0	71,7	85,5

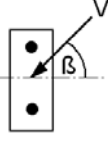
Influencing factors

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
$f_B = (f_{ck,cube}/25\text{N/mm}^2)^{1/2}$ 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 β	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} .

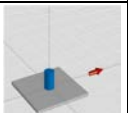
Combined tension and shear loading

For combined tension and shear loading see section "Anchor Design".

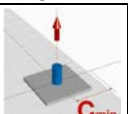
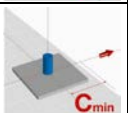
Precalculated values

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.

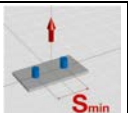
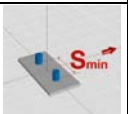
Design resistance: concrete C 20/25 – $f_{ck,cube} = 25 \text{ N/mm}^2$, Temperature range I

		Data according ETA-04/0027, issue 2009-05-20									Additional Hilti tech. data	
Anchor size		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32	Ø36	Ø40
Embedment depth $h_{ef,1} =$ [mm]		60	60	72	84	96	120	150	168	192	216	240
Base material thickness $h_{min} =$ [mm]		100	100	104	120	136	170	214	238	272	306	350
	Tensile N_{Rd}: single anchor, no edge effects											
	BSt 500 S [kN]	10,8	11,2	14,7	18,5	22,6	31,6	44,2	52,4	64,0	76,3	89,4
	Shear V_{Rd}: single anchor, no edge effects, without lever arm											
	BSt 500 S [kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0	112,7	147,3	186,6	230,4

Design resistance: concrete C 20/25 – $f_{ck,cube} = 25 \text{ N/mm}^2$, Temperature range I

		Data according ETA-04/0027, issue 2009-05-20									Additional Hilti tech. data	
Anchor size		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32	Ø36	Ø40
Embedment depth $h_{ef,1} =$ [mm]		60	60	72	84	96	120	150	168	192	216	240
Base material thickness $h_{min} =$ [mm]		100	100	104	120	136	170	214	238	272	306	350
Edge distance $c = c_{min} =$ [mm]		40	50	60	70	80	100	125	140	160	180	200
	Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)											
	BSt 500 S [kN]	6,5	7,3	8,6	10,8	13,1	18,3	25,6	30,3	37,0	44,1	52,5
	Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$), without lever arm											
	BSt 500 S [kN]	3,5	4,9	6,7	8,6	10,8	15,7	22,9	27,7	34,6	42,2	50,4

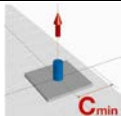
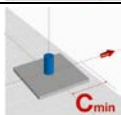
Design resistance: concrete C 20/25 – $f_{ck,cube} = 25 \text{ N/mm}^2$, Temperature range I
(load values are valid for single anchor)

		Data according ETA-04/0027, issue 2009-05-20									Additional Hilti tech. data	
Anchor size		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32	Ø36	Ø40
Embedment depth $h_{ef,1} =$ [mm]		60	60	72	84	96	120	150	168	192	216	240
Base material thickness $h_{min} =$ [mm]		100	100	104	120	136	170	214	238	272	306	350
Spacing $s = s_{min} =$ [mm]		40	50	60	70	80	100	125	140	160	180	200
	Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)											
	BSt 500 S [kN]	6,7	7,0	8,9	11,2	13,6	19,0	26,6	31,5	38,5	45,9	54,1
	Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$), without lever arm											
	BSt 500 S [kN]	9,3	14,7	20,7	28,0	36,7	56,5	79,0	93,7	114,4	136,6	159,9

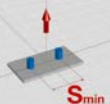
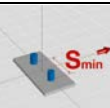
Design resistance: concrete C 20/25 – $f_{ck,cube} = 25 \text{ N/mm}^2$, Temperature range I

		Data according ETA-04/0027, issue 2009-05-20									Additional Hilti tech. data	
Anchor size		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32	Ø36	Ø40
Embedment depth $h_{ef,typ}$ = [mm]		80	90	110	125	125	170	210	270	300	330	360
Base material thickness h_{min} = [mm]		110	120	142	161	165	220	274	340	380	420	470
	Tensile N_{Rd} : single anchor, no edge effects											
	BSt 500 S [kN]	14,4	20,2	27,7	33,6	33,6	53,3	73,2	106,7	125,0	144,2	164,3
	Shear V_{Rd} : single anchor, no edge effects, without lever arm											
	BSt 500 S [kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0	112,7	147,3	186,6	230,4

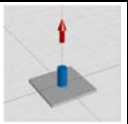
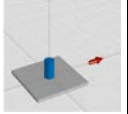
Design resistance: concrete C 20/25 – $f_{ck,cube} = 25 \text{ N/mm}^2$, Temperature range I

		Data according ETA-04/0027, issue 2009-05-20									Additional Hilti tech. data	
Anchor size		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32	Ø36	Ø40
Embedment depth $h_{ef,typ}$ = [mm]		80	90	110	125	125	170	210	270	300	330	360
Base material thickness h_{min} = [mm]		110	120	142	161	165	220	274	340	380	420	470
Edge distance $c = c_{min}$ = [mm]		40	50	60	70	80	100	125	140	160	180	200
	Tensile N_{Rd} : single anchor, min. edge distance ($c = c_{min}$)											
	BSt 500 S [kN]	7,8	10,0	13,3	16,2	17,0	26,1	36,1	50,4	59,5	69,1	79,3
	Shear V_{Rd} : single anchor, min. edge distance ($c = c_{min}$) , without lever arm											
	BSt 500 S [kN]	3,7	5,3	7,3	9,5	11,5	17,2	25,0	31,6	39,3	47,8	56,9

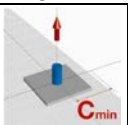
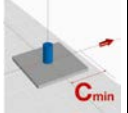
Design resistance: concrete C 20/25 – $f_{ck,cube} = 25 \text{ N/mm}^2$, Temperature range I
(load values are valid for single anchor)

	Data according ETA-04/0027, issue 2009-05-20										Additional Hilti tech. data	
Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32	Ø36	Ø40	
Embedment depth $h_{ef,typ} =$ [mm]	80	90	110	125	125	170	210	270	300	330	360	
Base material thickness $h_{min}=$ [mm]	110	120	142	161	165	220	274	340	380	420	470	
Spacing $s = s_{min}=$ [mm]	40	50	60	70	80	100	125	140	160	180	200	
	Tensile N_{Rd} : double anchor, no edge effects, min. spacing ($s = s_{min}$)											
	BSt 500 S [kN]	8,9	11,6	15,5	18,9	19,2	30,1	41,4	59,5	69,8	80,8	92,3
	Shear V_{Rd} : double anchor, no edge effects, min. spacing ($s = s_{min}$) , without lever arm											
	BSt 500 S [kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0	112,7	147,3	186,6	230,4

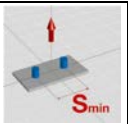
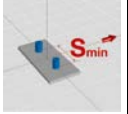
Design resistance: concrete C 20/25 – $f_{ck,cube} = 25 \text{ N/mm}^2$, Temperature range I

	Data according ETA-04/0027, issue 2009-05-20										Additional Hilti tech. data
Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32	Ø36	Ø40
Embedment depth $h_{ef,2} = [\text{mm}]$	96	120	144	168	192	240	300	336	384	432	480
Base material thickness $h_{min} = [\text{mm}]$	126	150	176	204	232	290	364	406	464	522	590
	Tensile N_{Rd}: single anchor, no edge effects										
	BSt 500 S [kN]	17,2	26,9	38,8	49,3	64,0	89,4	125,0	148,1	181,0	215,9
	Shear V_{Rd}: single anchor, no edge effects, without lever arm										
	BSt 500 S [kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0	112,7	147,3	186,6

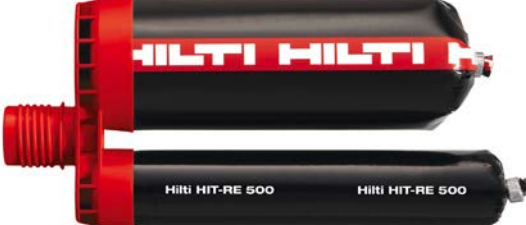
Design resistance: concrete C 20/25 – $f_{ck,cube} = 25 \text{ N/mm}^2$, Temperature range I

	Data according ETA-04/0027, issue 2009-05-20										Additional Hilti tech. data
Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32	Ø36	Ø40
Embedment depth $h_{ef,2} = [\text{mm}]$	96	120	144	168	192	240	300	336	384	432	480
Base material thickness $h_{min} = [\text{mm}]$	126	150	176	204	232	290	364	406	464	522	590
Edge distance $c = c_{min} = [\text{mm}]$	40	50	60	70	80	100	125	140	160	180	200
	Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)										
	BSt 500 S [kN]	9,4	14,1	18,6	23,4	28,6	40,0	55,9	66,2	80,9	96,6
	Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$), without lever arm										
	BSt 500 S [kN]	3,9	5,7	7,8	10,2	12,9	18,9	27,8	33,9	42,6	52,3

Design resistance: concrete C 20/25 – $f_{ck,cube} = 25 \text{ N/mm}^2$, Temperature range I
(load values are valid for single anchor)

	Data according ETA-04/0027, issue 2009-05-20										Additional Hilti tech. data
Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32	Ø36	Ø40
Embedment depth $h_{ef,2} = [\text{mm}]$	96	120	144	168	192	240	300	336	384	432	480
Base material thickness $h_{min} = [\text{mm}]$	126	150	176	204	232	290	364	406	464	522	590
Spacing $s = s_{min} = [\text{mm}]$	40	50	60	70	80	100	125	140	160	180	200
	Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)										
	BSt 500 S [kN]	10,9	16,6	22,7	28,6	34,9	48,8	68,2	80,9	98,8	117,9
	Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$), without lever arm										
	BSt 500 S [kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0	112,7	147,3	186,6

Hilti HIT-RE 500 with rebar in diamond drilled holes

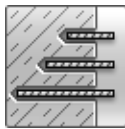
Injection mortar system		Benefits
  	Hilti HIT-RE 500 330 ml foil pack	- suitable for non-cracked concrete C 20/25 to C 50/60 - high loading capacity - suitable for dry and water saturated concrete -- large diameter applications - long working time at elevated temperatures - odourless epoxy - embedment depth range: from 60 ... 160 mm for Ø8 to 128 ... 640 mm for Ø32
	(also available as 500 ml and 1400 ml foil pack)	
	Statik mixer	
	rebar BSt 500 S	



Concrete



Small edge
distance
and spacing



Variable
embedment
depth



Diamond
drilled
holes



PROFIS
Anchor
design
software

Basic loading data (for a single anchor)

All data in this section applies to

- 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, $f_{ck,cube} = 25 \text{ N/mm}^2$
- Temperature range I
(min. base material temperature -40°C , max. long term/short term base material temperature: $+24^\circ\text{C}/40^\circ\text{C}$)
- Installation temperature range $+5^\circ\text{C}$ to $+40^\circ\text{C}$

For details see Simplified design method

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

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 – $f_{ck,cube} = 25 \text{ N/mm}^2$, anchor rebar BSt 500S

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Tensile $N_{Ru,m}$	BSt 500 S	[kN]	29,4	45,0	65,1	83,9	87,6	134,7	197,1	268,0	320,3
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 – $f_{ck,cube} = 25 \text{ N/mm}^2$, anchor rebar BSt 500 S

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Tensile N_{Rk}	BSt 500 S	[kN]	24,1	33,9	49,8	63,2	66,0	101,5	148,4	201,9	241,3
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 – $f_{ck,cube} = 25 \text{ N/mm}^2$, anchor rebar BSt 500 S

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Tensile N_{Rd}	BSt 500 S	[kN]	13,4	18,8	27,6	30,1	31,4	48,3	70,7	96,1	114,9
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 – $f_{ck,cube} = 25 \text{ N/mm}^2$, anchor rebar BSt 500 S

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Tensile N_{rec}	BSt 500 S	[kN]	9,6	13,5	19,7	21,5	22,4	34,5	50,5	68,7	82,1
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 $\gamma = 1,4$. 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 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

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Nominal tensile strength f_{uk}	BSt 500 S	[N/mm ²]	550	550	550	550	550	550	550	550	550
Yield strength f_{yk}	BSt 500 S	[N/mm ²]	500	500	500	500	500	500	500	500	500
Stressed cross-section A_s	BSt 500 S	[mm ²]	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	[mm ³]	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

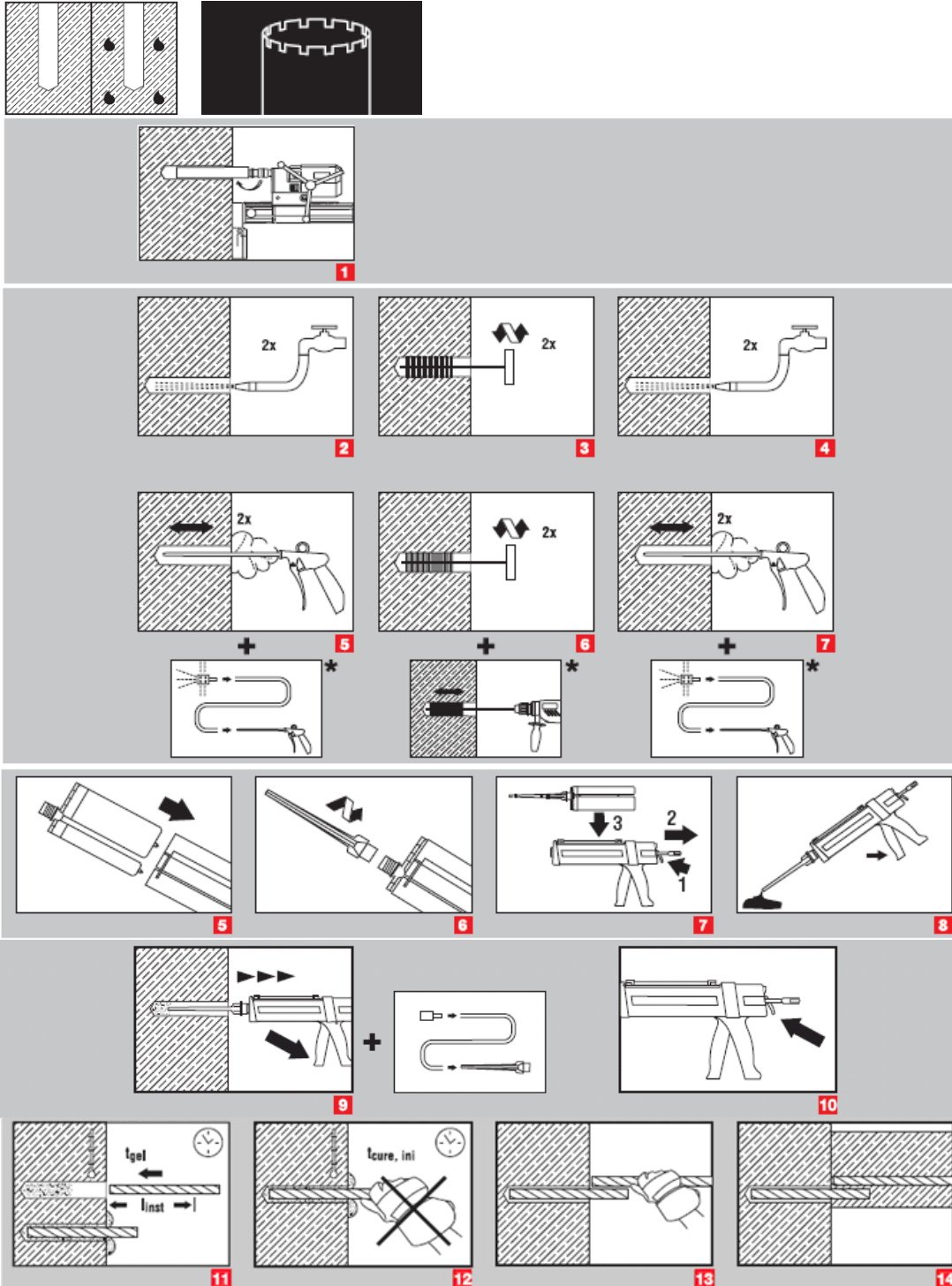
Setting

installation equipment

Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Drilling tools	DD EC-1, DD 100 ... DD xxx								
Other tools	compressed air gun or blow out pump, set of cleaning brushes, dispenser								

Setting instruction

Dry and water-saturated concrete, diamond coring drilling; Hilti technical information only



Brush bore hole with required steel brush HIT-RB

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

Important! Remove all water from the borehole and blow out with oil free compressed air until borehole is completely dried before mortar injection (not applicable to hammer drilled hole in underwater application).

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}	Preparation work may continue. Do not apply design load. $t_{cure, ini}$
40 °C	12 min	4 h	2 h
30 °C to 39 °C	12 min	8 h	4 h
20 °C to 29 °C	20 min	12 h	6 h
15 °C to 19 °C	30 min	24 h	8 h
10 °C to 14 °C	90 min	48 h	12 h
5 °C to 9 °C	120 min	72 h	18 h

Setting details

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]		$h_{ef} + 30 \text{ mm}$ $\geq 100 \text{ mm}$		$h_{ef} + 2 d_0$						
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]		$1,0 \cdot h_{ef}$ 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 ^{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.

- 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)

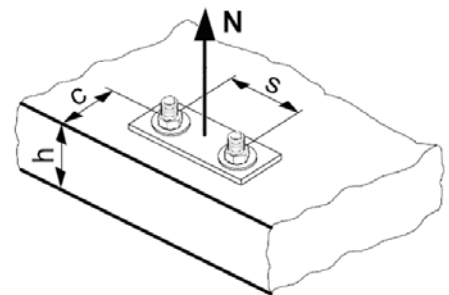
The values are valid for one anchor.

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



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

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

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

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
$N_{Rd,p}^0$ Temperature range I [kN]	13,4	18,8	27,6	30,1	31,4	48,3	70,7	96,1	114,9
$N_{Rd,p}^0$ Temperature range II [kN]	10,9	15,3	22,4	24,4	25,4	39,1	57,3	77,9	93,1
$N_{Rd,p}^0$ Temperature range III [kN]	6,8	9,6	14,0	15,3	15,9	24,5	35,9	48,8	58,3

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

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

Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
$N_{Rd,c}^0$ [kN]	17,2	20,5	27,7	33,6	33,6	53,3	73,2	106,7	125,0

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
$f_{B,p} = (f_{ck,cube}/25\text{N/mm}^2)^{0,1}$ 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
$f_B = (f_{ck,cube}/25\text{N/mm}^2)^{1/2}$ 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)

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

a) The 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)

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

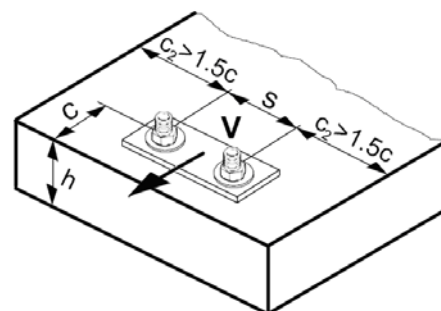
h_{ef} [mm]	40	50	60	70	80	90	≥ 100
$f_{re,N} = 0,5 + h_{ef}/200\text{mm} \leq 1$	0,7 a)	0,75 a)	0,8 a)	0,85 a)	0,9 a)	0,95 a)	1

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: $V_{Rd,cp} = k \cdot \text{lower value of } N_{Rd,p} \text{ and } N_{Rd,c}$
- Concrete edge resistance: $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_\beta \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

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 $V_{Rd,cp} = \text{lower value}^a)$ 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 $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_\beta \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32	Ø36	Ø40
Non-cracked concrete											
$V_{Rd,c}^0$ [kN]	5,9	8,6	11,6	15,0	18,7	27,0	39,2	47,3	59,0	71,7	85,5

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
$f_B = (f_{ck,cube}/25\text{N/mm}^2)^{1/2}$ 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 β	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

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".