Hilti HIT-HY 150 MAX with HIT-TZ

Injection mortar system		Benefits
	Hilti HIT-HY 150 MAX 330 ml foil pack (also available as 500 ml and 1400 ml foil pack)	- suitable for cracked and non-cracked concrete C 20/25 to C 50/60 - hammer drilled and diamond cored bore holes - high loading capacity - suitable for dry and water saturated concrete - under water application - No cleaning required
	Statik mixer	
	HIT-TZ HIT-RTZ rod	

Concrete | Tensile zone | 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-04/0084 / 2009-12-09

a) All data given in this section according ETA-04/0084, issue 2009-12-09.

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
- Embedment depth, as specified in the table
- One anchor material, as specified in the tables
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²
- Temperate range I
  (min. base material temperature -40°C, max. long term/short term base material temperature: +50°C/80°C)
- Installation temperature range +5°C to +40°C

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

Anchor size	M8	M10	M12	M16	M20
Embedment depth [mm]	55	65	75	90	120
Base material thickness [mm]	110	130	150	180	240

Mean ultimate resistance [a)]: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm², anchor HIT-TZ

Anchor size			M8	M10	M12	M16	M20
Non-cracked concrete							
Tensile $N_{Ru,m}$	HIT-TZ	[kN]	21,3	26,7	33,3	57,5	88,5
Shear $V_{Ru,m}$	HIT-TZ	[kN]	*11,6*	*17,9*	*26,3*	*49,4*	*77,7*
Cracked concrete							
Tensile $N_{Ru,m}$	HIT-TZ	[kN]	12,0	21,3	26,7	40,0	53,3
Shear $V_{Ru,m}$	HIT-TZ	[kN]	12,0	*17,9*	*26,3*	*49,4*	*77,7*

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

Anchor size			M8	M10	M12	M16	M20
Non-cracked concrete							
Tensile N_{Rk}	HIT-TZ	[kN]	16,0	20,0	25,0	43,1	66,4
Shear V_{Rk}	HIT-TZ	[kN]	*11,0*	*17,0*	*25,0*	*47,0*	*74,0*
Cracked concrete							
Tensile N_{Rk}	HIT-TZ	[kN]	9,0	16,0	20,0	30,0	40,0
Shear V_{Rk}	HIT-TZ	[kN]	9,0	*17,0*	*25,0*	*47,0*	*74,0*

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

Anchor size			M8	M10	M12	M16	M20
Non-cracked concrete							
Tensile N_{Rd}	HIT-TZ	[kN]	10,7	13,3	16,7	28,7	44,3
Shear V_{Rd}	HIT-TZ	[kN]	8,8	13,6	20,0	37,6	59,2
Cracked concrete							
Tensile N_{Rd}	HIT-TZ	[kN]	6,0	10,7	13,3	20,0	26,7
Shear V_{Rd}	HIT-TZ	[kN]	6,0	13,6	20,0	37,6	53,3

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

Anchor size			M8	M10	M12	M16	M20
Non-cracked concrete							
Tensile N_{rec}	HIT-TZ	[kN]	7,6	9,5	11,9	20,5	31,6
Shear V_{rec}	HIT-TZ	[kN]	6,3	9,7	14,3	26,9	42,3
Cracked concrete							
Tensile N_{rec}	HIT-TZ	[kN]	4,3	7,6	9,5	14,3	19,0
Shear V_{rec}	HIT-TZ	[kN]	4,3	9,7	14,3	26,9	38,1

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

Service temperature range

Hilti HIT-HY 150 MAX injection mortar with anchor rod HIT-TZ 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 +80 °C	+50 °C	+80 °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-(R)TZ

Anchor size			M8	M10	M12	M16	M20
Nominal tensile strength f_{uk}	HIT-TZ	[N/mm²]	600	600	600	600	600
	HIT-RTZ	[N/mm²]	600	600	600	600	600
Yield strength f_{yk}	HIT-TZ	[N/mm²]	480	480	480	480	480
	HIT-RTZ	[N/mm²]	480	480	480	480	480
Stressed cross-section A_s	HIT-TZ	[mm²]	36,6	58,0	84,3	157	245
Moment of resistance W	HIT-TZ	[mm³]	31,9	62,5	109,7	278	542

Material quality

Part	Material
HIT-TZ	C-steel cold formed steel galvanized ≥ 5µm
HIT-RTZ	stainless steel cold formed 1.4404 and 1.4401

Anchor dimensions

Anchor size		M8	M10	M12	M16	M20
HIT-(R)TZ		M8x55	M10x65	M12x75	M16x90	M20x120
Anchor embedment depth	[mm]	55	65	75	90	120

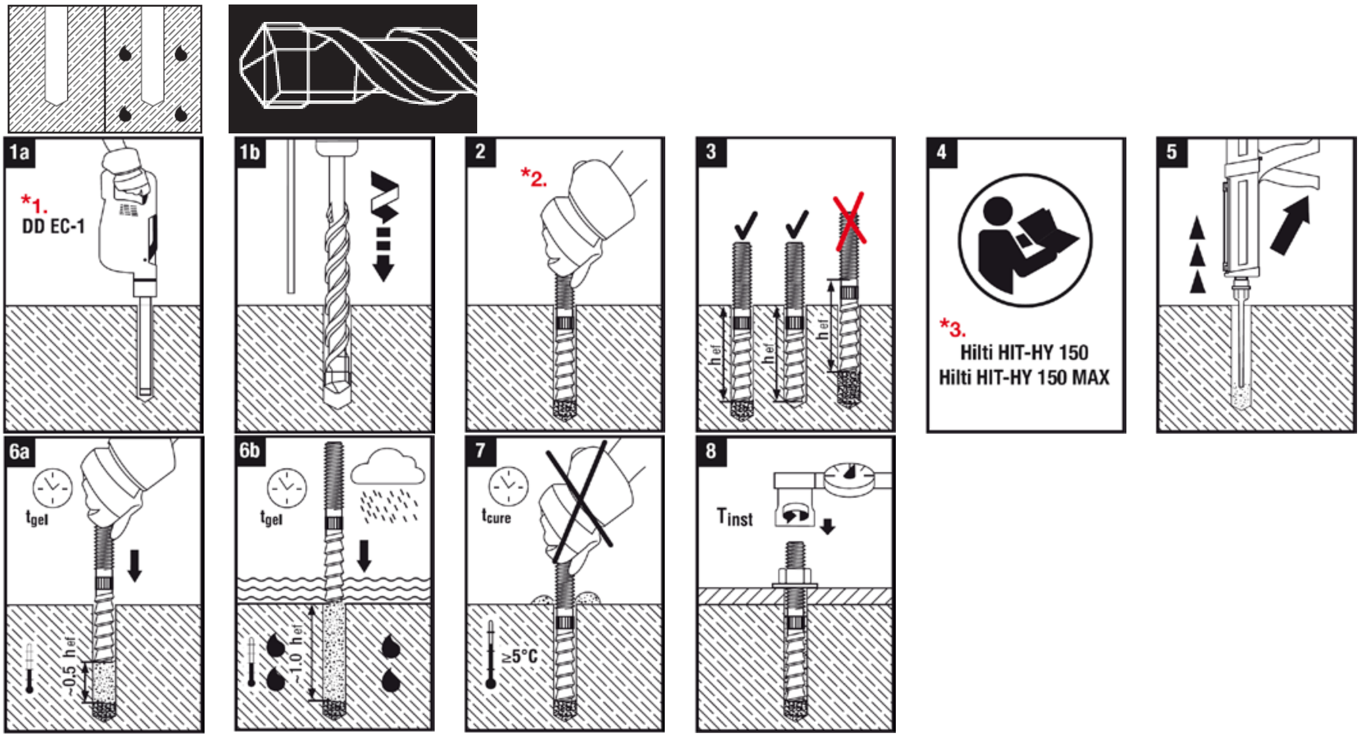
Setting

installation equipment

Anchor size	M8	M10	M12	M16	M20
Rotary hammer	TE 2 – TE 16				TE 40 - TE 70

Setting instruction

Dry, water-saturated concrete, under water, hammer drilling and diamond coring



1. Diamond coring is permissible only when the Hilti DD EC-1 diamond core drilling machine and the corresponding DD-C core bit are used.
2. Check the setting depth and compress the drilling dust. It is not necessary to clean the hole.
3. For use with Hilti HIT-HY 150 / Hilti HIT-HY 150 MAX. Read the instructions before use.

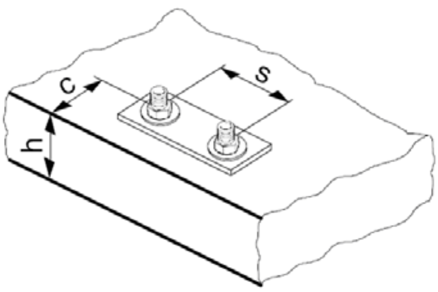
For detailed information on installation see instruction for use given with the package of the product.

Curing time for general conditions

Temperature of the base material	**Curing time before anchor can be fully loaded t_{cure}**
30 °C to 40 °C	30 min
20 °C to <30 °C	30 min
5 °C to <20 °C	60 min

Setting details

Anchor size			M8	M10	M12	M16	M20
Nominal diameter of drill bit	d_0	[mm]	10	12	14	18	22
Diameter of element	d	[mm]	8	10	12	16	20
Effective anchorage depth	h_{ef}	[mm]	55	65	75	90	120
Drill hole depth	h_0	[mm]	60	70	80	95	125
Minimum base material thickness	h_{min} a)	[mm]	110	130	150	180	240
Diameter of clearance hole in the fixture	d_f	[mm]	9	12	14	18	22
Non cracked concrete							
Minimum spacing	s_{min}	[mm]	40	50	55	70	80
for	c	[mm]	50	70	75	80	90
Minimum edge distance	c_{min}	[mm]	40	50	55	70	80
for	s	[mm]	70	80	85	85	90
Cracked concrete							
Minimum spacing	s_{min}	[mm]	40	60	70	80	100
for	c	[mm]	65	85	100	100	120
Minimum edge distance	c_{min}	[mm]	50	60	70	80	100
for	s	[mm]	80	120	130	140	150
Critical spacing for splitting failure	$s_{cr,sp}$	[mm]	$2\ c_{cr,sp}$				
Critical edge distance for splitting failure	$c_{cr,sp}$	[mm]	$2\ h_{ef}$				
Critical spacing for concrete cone failure	$s_{cr,N}$		$2\ c_{cr,N}$				
Critical edge distance for concrete cone failure	$c_{cr,N}$		$1{,}5\ h_{ef}$				
Torque moment	T_{inst}	[Nm]	12	23	40	70	130



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

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

Simplified design method

Simplified version of the design method according ETAG 001, Annex C. Design resistance according data given in ETA-04/0084, issue 2009-12-09.

- 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, Annex C. To avoid this, it is recommended to use the anchor design software PROFIS anchor)

The design method is based on the following simplification:

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

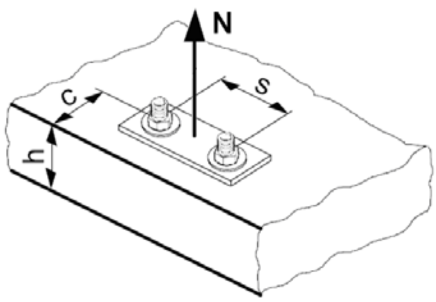
The values are valid for one anchor.

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

Tension loading

The design tensile resistance is the lower value of

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



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

Anchor size			M8	M10	M12	M16	M20
$N_{Rd,s}$	HIT-TZ	[kN]	14,7	23,3	34,0	62,7	98,0

Design combined pull-out and concrete cone resistance $N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{h,p}$

Anchor size			M8	M10	M12	M16	M20
Embedment depth h_{ef} [mm]			55	65	75	90	120
Non-cracked concrete							
$N^0_{Rd,p}$	Temperature range I	[kN]	10,7	13,3	16,7	28,7	44,3
Cracked concrete							
$N^0_{Rd,p}$	Temperature range I	[kN]	6,0	10,7	13,3	20,0	26,7

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

Anchor size			M8	M10	M12	M16	M20
$N^0_{Rd,c}$	Non cracked concrete	[kN]	13,7	17,6	21,9	28,7	44,3
$N^0_{Rd,c}$	Cracked concrete	[kN]	9,8	12,6	15,6	20,5	31,5

Influencing factors

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

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_{B,p} = (f_{ck,cube}/25N/mm^2)^{0.1}$ a)	1	1,02	1,04	1,06	1,07	1,08	1,09

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

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

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

Influence of concrete strength on concrete cone resistance

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

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

Influence of edge distance a)

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

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

Influence of anchor spacing a)

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

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

Influence of embedment depth on concrete cone resistance

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

Influence of reinforcement

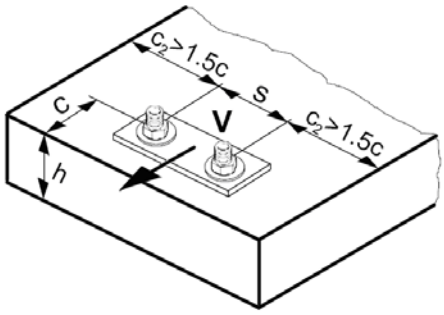
h_{ef} [mm]	80	90	≥ 100
$f_{re,N} = 0,5 + h_{ef}/200mm \leq 1$	0,9 a)	0,95 a)	1

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



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

Anchor size	M8	M10	M12	M16	M20
$V_{Rd,s}$ HIT-(R)TZ [kN]	8,8	13,6	20,0	37,6	59,2

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

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

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

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

	Non-cracked concrete					Cracked concrete				
Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**	**M8**	**M10**	**M12**	**M16**	**M20**
$V^0_{Rd,c}$ [kN]	3,1	4,5	6,1	8,5	13,4	1,6	2,4	3,1	5,0	6,9

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

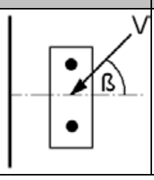
Influencing factors

Influence of concrete strength

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

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

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

Angle ß	0°	10°	20°	30°	40°	50°	60°	70°	80°	≥ 90°
$f_\beta = \frac{1}{\sqrt{(\cos\alpha_V)^2 + \left(\frac{\sin\alpha_V}{2{,}5}\right)^2}}$ 	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
$f_h = \{h/(1{,}5 \cdot c)\}^{2/3} \leq 1$	0,22	0,34	0,45	0,54	0,63	0,71	0,79	0,86	0,93	1,00

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

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

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

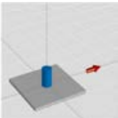
Combined tension and shear loading

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

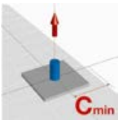
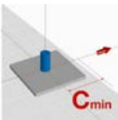
Precalculated values

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

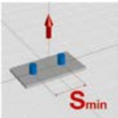
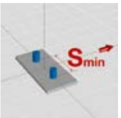
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm²

	Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**
	Embedment depth h_{ef} = [mm]	55	65	75	90	120
	Base material thickness h_{min}= [mm]	110	130	150	180	240
	Tensile N_{Rd}: single anchor, no edge effects					
	Non-cracked concrete					
	HIT-(R)TZ [kN]	10,7	13,3	16,7	28,7	44,3
	Cracked concrete					
	HIT-(R)TZ [kN]	6,0	10,7	13,3	20,0	26,7
	Shear V_{Rd}: single anchor, no edge effects, without lever arm					
	Non-cracked concrete					
	HIT-(R)TZ [kN]	8,8	13,6	20,0	37,6	59,2
	Cracked concrete					
	HIT-(R)TZ [kN]	6,0	13,6	20,0	37,6	53,3

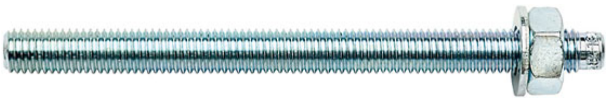
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm²

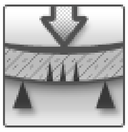
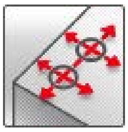
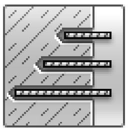
	Anchor size	**M8**	**M10**	**M12**	**M16**	**M20**
	Embedment depth h_{ef} = [mm]	55	65	75	90	120
	Base material thickness h_{min}= [mm]	110	130	150	180	240
	Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)					
	Non-cracked concrete					
	c_{min} [mm]	50	60	70	80	100
	HIT-(R)TZ [kN]	6,5	8,2	10,3	17,3	25,9
	Cracked concrete					
	c_{min} [mm]	40	50	55	70	80
	HIT-(R)TZ [kN]	3,3	6,0	7,4	11,3	14,2
	Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$) , without lever arm					
	Non-cracked concrete					
	c_{min} [mm]	50	60	70	80	100
	HIT-(R)TZ [kN]	3,1	4,5	6,1	8,5	13,4
	Cracked concrete					
	c_{min} [mm]	40	50	55	70	80
	HIT-(R)TZ [kN]	1,6	2,4	3,1	5,0	6,9

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

	Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**
	Embedment depth h_{ef} =	[mm]	55	65	75	90	120
	Base material thickness h_{min}=	[mm]	110	130	150	180	240
	Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)						
	Non-cracked concrete						
	s_{min}	[mm]	40	60	70	80	100
	HIT-(R)TZ	[kN]	6,3	8,2	10,3	17,6	26,7
	Cracked concrete						
	s_{min}	[mm]	40	50	55	70	80
	HIT-(R)TZ	[kN]	3,5	6,4	7,9	11,9	15,6
	Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$) , without lever arm						
	Non-cracked concrete						
	s_{min}	[mm]	40	60	70	80	100
	HIT-(R)TZ	[kN]	6,6	13,6	20,0	37,3	56,5
	Cracked concrete						
	s_{min}	[mm]	40	50	55	70	80
	HIT-(R)TZ	[kN]	3,7	13,4	16,6	25,2	32,6

Hilti HIT-HY 150 MAX with HIT-V / HAS

Injection mortar system		Benefits
	Hilti HIT-HY 150 MAX 330 ml foil pack (also available as 500 ml and 1400 ml foil pack)	- suitable for non-cracked concrete and cracked concrete C 20/25 to C 50/60 - suitable for dry and water saturated concrete - high loading capacity - rapid curing - small edge distance and anchor spacing possible - large diameter applications - high corrosion resistant - in service temperature range up to 120°C short term/ 72°C long term - manual cleaning for anchor size M8 to M16 and embedment depth $h_{ef} \leq 10d$ for non-cracked concrete only - embedment depth range: from 60 ... 160 mm for M8 to 120 ... 600 mm for M30
	Static mixer	
	HAS rods HAS-R rods HAS-HCR rods	
	HAS-E rods HAS-E-R rods	
	HIT-V rods HIT-V-R rods HIT-V-HCR rods	

				A4 316	HCR highMo			
Concrete	Tensile zone	Small edge distance and spacing	Variable embedment depth	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-08/0352 / 2010-04-01
Fire test report	MFPA, Leipzig	GS 3.2/09-121 Ä / 2011-08-19

a) All data given in this section according ETA-08/0352 issue 2010-04-01.

Basic loading data (for a single anchor)

All data in this section applies to

For details see Simplified design method

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- *Steel* failure
- Base material thickness, as specified in the table
- One typical embedment depth, as specified in the table
- One anchor material, as specified in the tables
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²
- Temperate range I
  (min. base material temperature -40°C, max. long term/short term base material temperature: +24°C/40°C)
- Installation temperature range -10°C to +40°C

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

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
Typical embedment depth h_{ef} [mm]	80	90	110	125	170	210	240	270
Base material thickness h [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 , anchor HIT-V 5.8

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Non-cracked concrete										
Tensile $N_{Ru,m}$	HIT-V 5.8	[kN]	*18,9*	*30,5*	*44,1*	*83,0*	*129,2*	*185,9*	*241,5*	288,4
Shear $V_{Ru,m}$	HIT-V 5.8	[kN]	*9,5*	*15,8*	*22,1*	*41,0*	*64,1*	*92,4*	*120,8*	*147,0*
Cracked concrete										
Tensile $N_{Ru,m}$	HIT-V 5.8	[kN]	-	20,7	30,4	50,3	85,5	126,7	-	-
Shear $V_{Ru,m}$	HIT-V 5.8	[kN]	-	*15,8*	*22,1*	*41,0*	*64,1*	*92,4*	-	-

Characteristic resistance: concrete C 20/25 , anchor HIT-V 5.8

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Non-cracked concrete										
Tensile N_{Rk}	HIT-V 5.8	[kN]	*18,0*	*29,0*	*42,0*	70,6	111,9	153,7	187,8	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*
Cracked concrete										
Tensile N_{Rk}	HIT-V 5.8	[kN]	-	15,6	22,8	37,7	64,1	95,0	-	-
Shear V_{Rk}	HIT-V 5.8	[kN]	-	*15,0*	*21,0*	*39,0*	*61,0*	*88,0*	-	-

Design resistance: concrete C 20/25 , anchor HIT-V 5.8

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Non-cracked concrete										
Tensile N_{Rd}	HIT-V 5.8	[kN]	12,0	19,3	28,0	47,1	74,6	102,5	125,2	120,2
Shear V_{Rd}	HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
Cracked concrete										
Tensile N_{Rd}	HIT-V 5.8	[kN]	-	10,4	15,2	25,1	42,7	63,3	-	-
Shear V_{Rd}	HIT-V 5.8	[kN]	-	12,0	16,8	31,2	48,8	70,4	-	-

Recommended loads [a)]: concrete C 20/25 , anchor HIT-V 5.8

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Non-cracked concrete										
Tensile N_{rec}	HIT-V 5.8	[kN]	8,6	13,8	20,0	33,6	53,3	73,2	89,4	85,8
Shear V_{rec}	HIT-V 5.8	[kN]	5,1	8,6	12,0	22,3	34,9	50,3	65,7	80,0
Cracked concrete										
Tensile N_{rec}	HIT-V 5.8	[kN]	-	7,4	10,9	18,0	30,5	45,2	-	-
Shear V_{rec}	HIT-V 5.8	[kN]	-	8,6	12,0	22,3	34,9	50,3	-	-

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

Service temperature range

Hilti HIT-HY 150 MAX 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 +80 °C	+50 °C	+80 °C
Temperature range III	-40 °C to +120 °C	+72 °C	+120 °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

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Nominal tensile strength f_{uk}	HIT-V/HAS 5.8	[N/mm²]	500	500	500	500	500	500	500	500
	HIT-V/HAS 8.8	[N/mm²]	800	800	800	800	800	800	800	800
	HIT-V/HAS -R	[N/mm²]	700	700	700	700	700	700	500	500
	HIT-V/HAS -HCR	[N/mm²]	800	800	800	800	800	700	700	700
Yield strength f_{yk}	HIT-V/HAS 5.8	[N/mm²]	400	400	400	400	400	400	400	400
	HIT-V/HAS 8.8	[N/mm²]	640	640	640	640	640	640	640	640
	HIT-V/HAS -R	[N/mm²]	450	450	450	450	450	450	210	210
	HIT-V/HAS -HCR	[N/mm²]	600	600	600	600	600	400	400	400
Stressed cross-section A_s	HAS	[mm²]	32,8	52,3	76,2	144	225	324	427	519
	HIT-V	[mm²]	36,6	58,0	84,3	157	245	353	459	561
Moment of resistance W	HAS	[mm³]	27,0	54,1	93,8	244	474	809	1274	1706
	HIT-V	[mm³]	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 ≥ 5 µm, (F) hot dipped galvanized ≥ 45 µm,
Threaded rod HIT-V(F), HAS 8.8 M27 – M30	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/mm², $R_{p\,0.2}$ = 640 N/mm², A_5 > 8% ductile M24 to M30: R_m = 700 N/mm², $R_{p\,0.2}$ = 400 N/mm², A_5 > 8% ductile
Washer ISO 7089	Steel galvanized, hot dipped galvanized,
	Stainless steel, 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362
	High corrosion resistant steel, 1.4529; 1.4565
Nut EN ISO 4032	Strength class 8, steel galvanized ≥ 5 µm, hot dipped galvanized ≥ 45 µm,
	Strength class 70, stainless steel grade A4, 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362
	Strength class 70, high corrosion resistant steel, 1.4529; 1.4565

Anchor dimensions

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

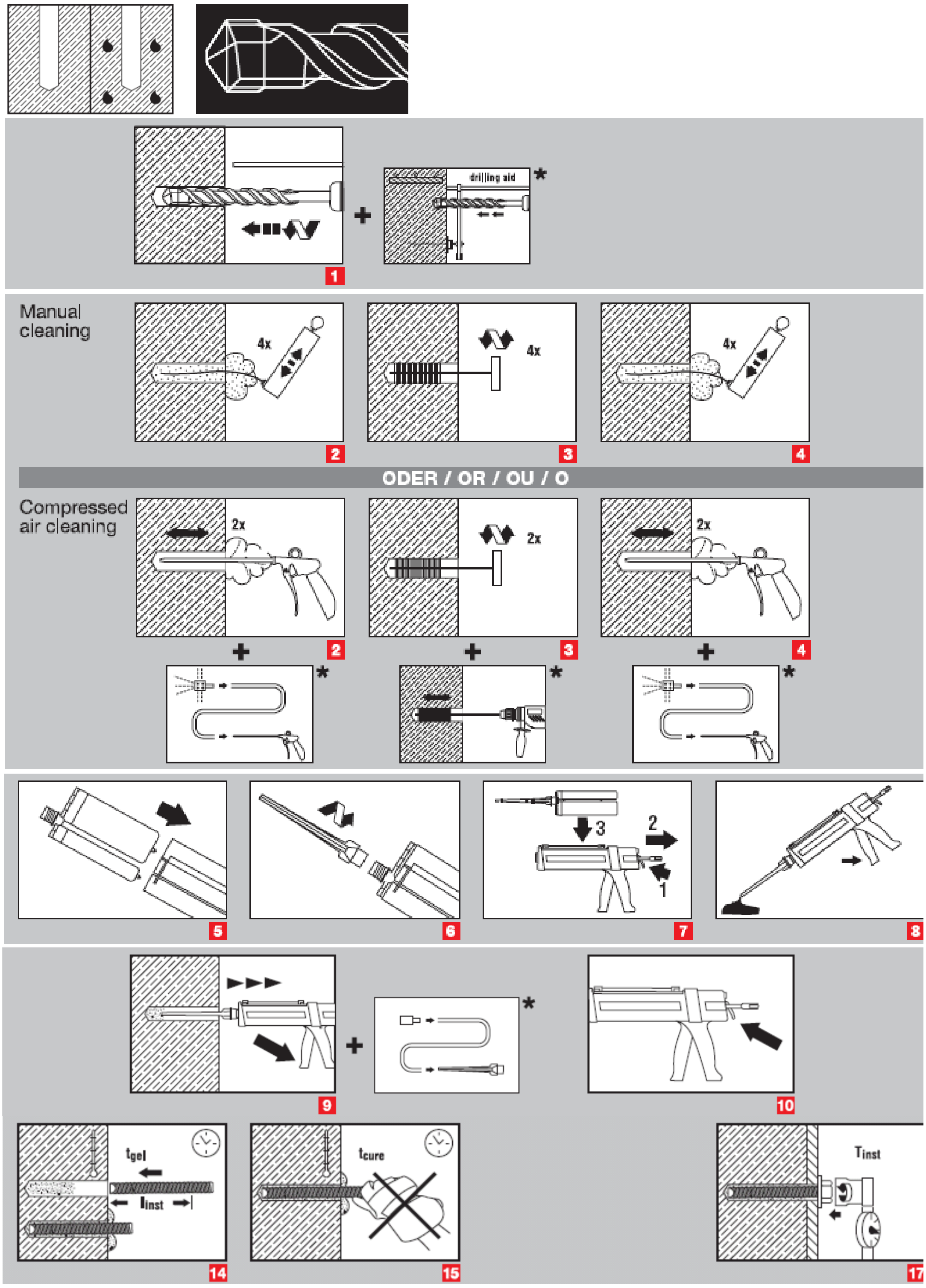
Setting

installation equipment

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
Rotary hammer	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)

b)

a) Note: **Manual cleaning for non-cracked concrete, element sizes d ≤ 16mm and embedment depth h_{ef} ≤ 10 d only!**

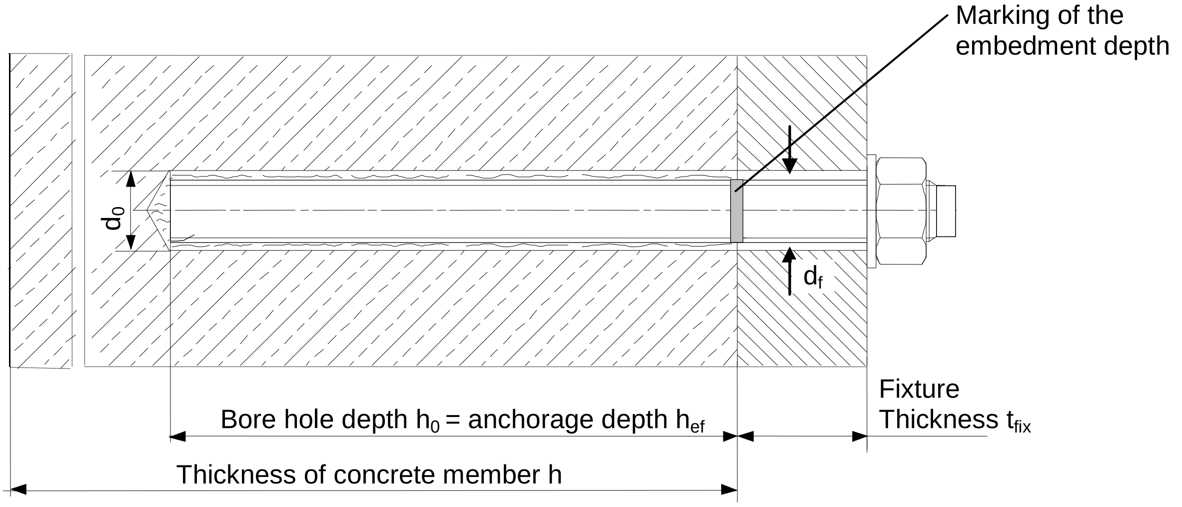
b) Note: **Extension and piston plug needed for overhead installation and/or embedment depth > 250mm!**

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

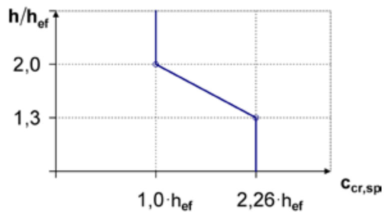
Working time, Curing time

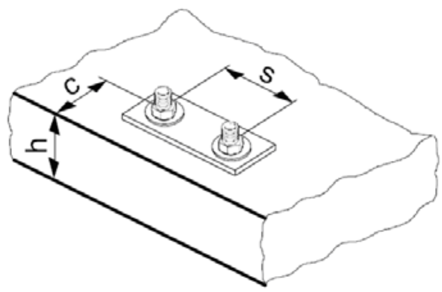
Temperature of the base material T_{BM}	Working time t_{gel}	Curing time t_{cure}
-10 °C ≤ T_{BM} < -5 °C	180 min	12 h
-5 °C ≤ T_{BM} < 0 °C	40 min	4 h
0 °C ≤ T_{BM} < 5 °C	20 min	2 h
5 °C ≤ T_{BM} < 20 °C	8 min	1 h
20 °C ≤ T_{BM} < 30 °C	5 min	30 min
30 °C ≤ T_{BM} ≤ 40 °C	2 min	30 min

Setting details



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 embedment and drill hole depth range a) **for HIT-V**	$h_{ef,min}$	[mm]	60	60	70	80	90	100	110	120
	$h_{ef,max}$	[mm]	160	200	240	320	400	480	540	600
Effective anchorage and drill hole depth **for HAS**	h_{ef}	[mm]	80	90	110	125	170	210	240	270
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
Torque moment	T_{max} b)	[Nm]	10	20	40	80	150	200	270	300
Minimum spacing	s_{min}	[mm]	40	50	60	80	100	120	135	150
Minimum edge distance	c_{min}	[mm]	40	50	60	80	100	120	135	150
Critical spacing for splitting failure	$s_{cr,sp}$	[mm]	$2\ c_{cr,sp}$							
Critical edge distance for splitting failure c)	$c_{cr,sp}$	[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	$s_{cr,N}$	[mm]	$2\ c_{cr,N}$							
Critical edge distance for concrete cone failure d)	$c_{cr,N}$	[mm]	$1{,}5\ h_{ef}$							



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

a) Embedment depth range: $h_{ef,min} \leq h_{ef} \leq h_{ef,max}$

b) Maximum recommended torque moment to avoid splitting failure during installation with minimum spacing and/or edge distance.

c) h: base material thickness ($h \geq h_{min}$), h_{ef}: embedment depth

d) 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-08/0352, issue 2010-04-01.

- 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)

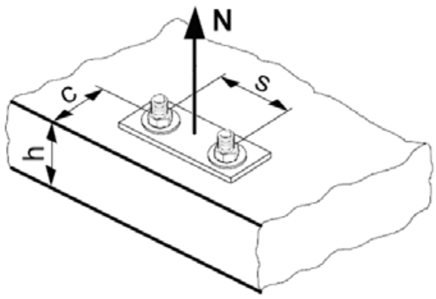
The values are valid for one anchor.

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



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

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

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

Anchor size		M8	M10	M12	M16	M20	M24	M27	M30
Typical embedment depth $h_{ef} = h_{ef,typ}$	[mm]	80	90	110	125	170	210	240	270
Non-cracked concrete									
$N^0_{Rd,p}$ Temperature range I	[kN]	15,6	22,0	32,3	54,5	85,5	116,1	135,7	120,2
$N^0_{Rd,p}$ Temperature range II	[kN]	13,4	18,8	27,6	50,3	78,3	105,6	122,1	99,0
$N^0_{Rd,p}$ Temperature range III	[kN]	8,9	12,6	18,4	29,3	46,3	63,3	74,6	63,6
Cracked concrete									
$N^0_{Rd,p}$ Temperature range I	[kN]	-	10,4	15,2	25,1	42,7	63,3	-	-
$N^0_{Rd,p}$ Temperature range II	[kN]	-	8,5	13,8	23,0	42,7	63,3	-	-
$N^0_{Rd,p}$ Temperature range III	[kN]	-	5,7	8,3	14,7	24,9	42,2	-	-

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

Anchor size		M8	M10	M12	M16	M20	M24	M27	M30
$N^0_{Rd,c}$ Non-cracked concrete	[kN]	20,1	24,0	32,4	47,1	74,6	102,5	125,2	124,5
$N^0_{Rd,c}$ Cracked concrete	[kN]	-	20,5	27,7	33,5	53,2	73,0	-	-

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

Influencing factors

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

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_{B,p} = (f_{ck,cube}/25N/mm^2)^{0,10}$ [a)]	1,00	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
$f_B = (f_{ck,cube}/25N/mm^2)^{0,5}$ [a)]	1	1,1	1,22	1,34	1,41	1,48	1,55

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

Influence of edge distance [a)]

$c/c_{cr,N}$ / $c/c_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{1,N} = 0,7 + 0,3 \cdot c/c_{cr,N} \leq 1$ $f_{1,sp} = 0,7 + 0,3 \cdot c/c_{cr,sp} \leq 1$	0,73	0,76	0,79	0,82	0,85	0,88	0,91	0,94	0,97	1
$f_{2,N} = 0,5 \cdot (1 + c/c_{cr,N}) \leq 1$ $f_{2,sp} = 0,5 \cdot (1 + c/c_{cr,sp}) \leq 1$	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}. These influencing factors must be considered for every edge distance smaller than the critical edge distance.

Influence of anchor spacing [a)]

$s/s_{cr,N}$ $s/s_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{3,N} = 0{,}5\cdot(1 + s/s_{cr,N}) \leq 1$ $f_{3,sp} = 0{,}5\cdot(1 + s/s_{cr,sp}) \leq 1$	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}. This influencing factor must be considered for every anchor spacing.

Influence of embedment depth on concrete cone resistance

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

Influence of reinforcement

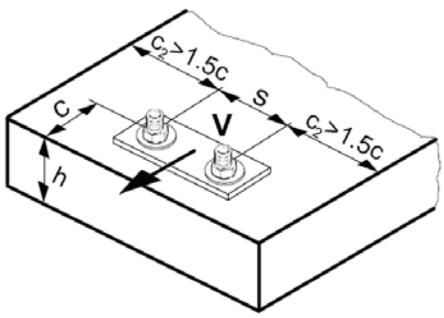
h_{ef} [mm]	40	50	60	70	80	90	≥ 100
$f_{re,N} = 0{,}5 + h_{ef}/200mm \leq 1$	0,7 [a)]	0,75 [a)]	0,8 [a)]	0,85 [a)]	0,9 [a)]	0,95 [a)]	1

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

SHEAR loading

The design shear resistance is the lower value of

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



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

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 $k \cdot N_{Rd,c}$

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

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

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

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

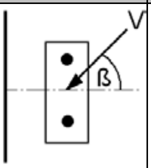
Influencing factors

Influence of concrete strength

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

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

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

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

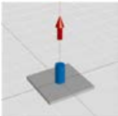
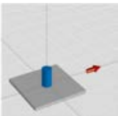
For combined tension and shear loading see section “Anchor Design”.

Precalculated values – design resistance values

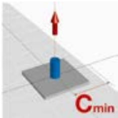
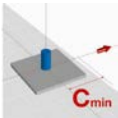
All data applies to:
- non-cracked concrete C 20/25 – $f_{ck,cube}$ =25 N/mm²
- temperature range I (see service temperature range)
- minimum thickness of base material
- no effects of dense reinforcement

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

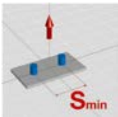
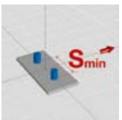
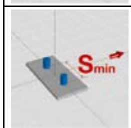
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - minimum embedment depth

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth	h_{ef} = $h_{ef,min}$	[mm]	60	60	70	80	90	100	110	120
Base material thickness	h = h_{min}	[mm]	100	100	100	116	138	156	170	190
	**Tensile N_{Rd}: single anchor, no edge effects**									
	Non-cracked concrete									
	HIT-V 5.8 / 8.8 HIT-V-R / -HCR	[kN]	11,7	13,0	16,4	24,1	28,7	33,7	38,8	36,9
	Cracked concrete									
	HIT-V 5.8 / 8.8 HIT-V-R / -HCR	[kN]	-	6,9	9,7	16,1	20,5	24,0	-	-
	**Shear V_{Rd}: single anchor, no edge effects, without lever arm**									
	Non-cracked concrete									
	HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	67,3	77,7	88,5
	HIT-V 8.8	[kN]	12,0	18,4	27,2	48,2	57,5	67,3	77,7	88,5
	HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	67,3	48,3	58,8
	HIT-V-HCR	[kN]	12,0	18,4	27,2	48,2	57,5	67,3	77,7	88,5
	Cracked concrete									
	HIT-V 5.8	[kN]	-	12,0	16,8	31,2	41,0	48,0	-	-
	HIT-V 8.8	[kN]	-	13,8	19,4	32,2	41,0	48,0	-	-
	HIT-V-R	[kN]	-	12,8	19,2	32,2	41,0	48,0	-	-
	HIT-V-HCR	[kN]	-	13,8	19,4	32,2	41,0	48,0	-	-

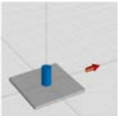
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - minimum embedment depth

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth	$h_{ef} = h_{ef,min}$	[mm]	60	60	70	80	90	100	110	120
Base material thickness	$h = h_{min}$	[mm]	100	100	100	116	138	156	170	190
Edge distance	$c = c_{min}$	[mm]	40	50	60	80	100	120	135	150
	**Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)**									
	Non-cracked concrete									
	HIT-V 5.8 / 8.8 HIT-V-R / -HCR	[kN]	7,1	8,5	9,7	15,4	20,3	25,3	29,4	28,9
	Cracked concrete									
	HIT-V 5.8 / 8.8 HIT-V-R / -HCR	[kN]	-	4,7	6,6	12,1	16,4	20,3	-	-
	**Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$), without lever arm**									
	Non-cracked concrete									
	HIT-V 5.8 / 8.8 HIT-V-R / -HCR	[kN]	3,5	4,9	6,6	10,2	14,1	18,3	21,8	25,9
	Cracked concrete									
	HIT-V 5.8 / 8.8 HIT-V-R / -HCR	[kN]	-	3,5	4,7	7,2	10,0	12,9	-	-

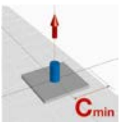
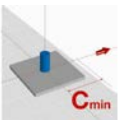
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - minimum embedment depth
(load values are valid for single anchor)

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth	$h_{ef} = h_{ef,min}$	[mm]	60	60	70	80	90	100	110	120
Base material thickness	$h = h_{min}$	[mm]	100	100	100	116	138	156	170	190
Spacing	$s = s_{min}$	[mm]	40	50	60	80	100	120	135	150
	**Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)**									
	Non-cracked concrete									
	HIT-V 5.8 / 8.8 HIT-V-R / -HCR	[kN]	7,4	8,2	10,0	15,1	18,7	22,5	26,0	25,0
	Cracked concrete									
	HIT-V 5.8 / 8.8 HIT-V-R / -HCR	[kN]	-	4,9	6,7	10,7	13,3	16,0	-	-
	Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$), without lever arm									
	Non-cracked concrete									
	HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	39,4	47,1	54,7	62,7
	HIT-V 8.8	[kN]	12,0	18,4	25,4	32,1	39,4	47,1	54,7	62,7
	HIT-V-R	[kN]	8,3	12,8	19,2	32,1	39,4	47,1	48,3	58,8
	HIT-V-HCR	[kN]	12,0	18,4	25,4	32,1	39,4	47,1	54,7	62,7
	Cracked concrete									
	HIT-V 5.8 / 8.8 HIT-V-R / -HCR	[kN]	-	8,8	12,4	21,4	28,1	33,6	-	-

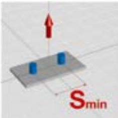
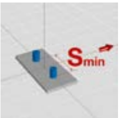
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - typical embedment depth

Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Embedment depth $h_{ef} = h_{ef,typ}$	[mm]	80	90	110	125	170	210	240	270
Base material thickness $h = h_{min}$	[mm]	110	120	140	161	218	266	300	340
 **Tensile N_{Rd}: single anchor, no edge effects**									
Non-cracked concrete									
HIT-V 5.8	[kN]	12,0	19,3	28,0	47,1	74,6	102,5	125,2	120,2
HIT-V 8.8	[kN]	15,6	22,0	32,3	47,1	74,6	102,5	125,2	120,2
HIT-V-R	[kN]	13,9	21,9	31,6	47,1	74,6	102,5	80,4	98,3
HIT-V-HCR	[kN]	15,6	22,0	32,3	47,1	74,6	102,5	125,2	120,2
Cracked concrete									
HIT-V 5.8 / 8.8 HIT-V-R / -HCR	[kN]	-	10,4	15,2	25,1	42,7	63,3	-	-
 **Shear V_{Rd}: single anchor, no edge effects, without lever arm**									
Non-cracked concrete									
HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
HIT-V 8.8	[kN]	12,0	18,4	27,2	50,4	78,4	112,8	147,2	179,2
HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8
HIT-V-HCR	[kN]	12,0	18,4	27,2	50,4	78,4	70,9	92,0	112,0
Cracked concrete									
HIT-V 5.8	[kN]	-	12,0	16,8	31,2	48,8	70,4	-	-
HIT-V 8.8	[kN]	-	18,4	27,2	50,3	78,4	112,8	-	-
HIT-V-R	[kN]	-	12,8	19,2	35,3	55,1	79,5	-	-
HIT-V-HCR	[kN]	-	18,4	27,2	50,3	78,4	70,9	-	-

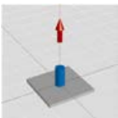
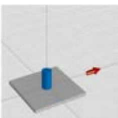
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - typical embedment depth

Anchor size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Embedment depth $h_{ef} = h_{ef,typ}$	[mm]	80	90	110	125	170	210	240	270
Base material thickness $h = h_{min}$	[mm]	110	120	140	161	218	266	300	340
Edge distance $c = c_{min}$	[mm]	40	50	60	80	100	120	135	150
 **Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)**									
Non-cracked concrete									
HIT-V 5.8 / 8.8 HIT-V-R / -HCR	[kN]	8,6	11,6	15,5	23,7	36,6	49,8	60,6	60,0
Cracked concrete									
HIT-V 5.8 / 8.8 HIT-V-R / -HCR	[kN]	-	5,8	8,4	14,8	24,4	36,9	-	-
 **Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$) , without lever arm**									
Non-cracked concrete									
HIT-V 5.8 / 8.8 HIT-V-R / -HCR	[kN]	3,7	5,3	7,3	11,5	17,2	23,6	29,0	34,8
Cracked concrete									
HIT-V 5.8 / 8.8 HIT-V-R / -HCR	[kN]	-	3,8	5,2	8,1	12,2	16,7	-	-

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

Anchor size		M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth $h_{ef} = h_{ef,typ}$	[mm]	80	90	110	125	170	210	240	270
Base material thickness $h = h_{min}$	[mm]	110	120	140	161	218	266	300	340
Spacing s	[mm]	40	50	60	80	100	120	135	150
 **Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)**									
Non-cracked concrete									
HIT-V 5.8 / 8.8 HIT-V-R / -HCR	[kN]	9,9	13,4	18,1	26,9	42,2	57,7	70,4	69,9
Cracked concrete									
HIT-V 5.8 / 8.8 HIT-V-R / -HCR	[kN]	-	7,1	10,3	16,5	27,3	39,9	-	-
 **Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$), without lever arm**									
Non-cracked concrete									
HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
HIT-V 8.8	[kN]	12,0	18,4	27,2	50,4	78,4	112,8	147,2	170,9
HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8
HIT-V-HCR	[kN]	12,0	18,4	27,2	50,4	78,4	70,9	92,0	112,0
Cracked concrete									
HIT-V 5.8	[kN]	-	12,0	16,8	30,5	48,8	70,4	-	-
HIT-V 8.8	[kN]	-	12,3	18,0	30,5	51,1	75,4	-	-
HIT-V-R	[kN]	-	12,3	18,0	30,5	51,1	75,4	-	-
HIT-V-HCR	[kN]	-	12,3	18,0	30,5	51,1	70,9	-	-

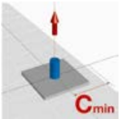
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - embedment depth = 12 d a)

Anchor size		M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth h_{ef} = 12 d a)	[mm]	96	120	144	192	240	288	324	360
Base material thickness $h = h_{min}$	[mm]	126	150	174	228	288	344	384	430
 **Tensile N_{Rd}: single anchor, no edge effects**									
Non-cracked concrete									
HIT-V 5.8	[kN]	12,0	19,3	28,0	52,7	82,0	118,0	153,3	160,2
HIT-V 8.8	[kN]	18,8	29,3	42,2	83,6	120,6	159,2	183,2	160,2
HIT-V-R	[kN]	13,9	21,9	31,6	58,8	92,0	132,1	80,4	98,3
HIT-V-HCR	[kN]	18,8	29,3	42,2	83,6	120,6	117,6	152,9	160,2
Cracked concrete									
HIT-V 5.8 / 8.8 HIT-V-R / -HCR	[kN]	-	13,8	19,9	38,6	60,3	86,9	-	-
 **Shear V_{Rd}: single anchor, no edge effects, without lever arm**									
Non-cracked concrete									
HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
HIT-V 8.8	[kN]	12,0	18,4	27,2	50,4	78,4	112,8	147,2	179,2
HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8
HIT-V-HCR	[kN]	12,0	18,4	27,2	50,4	78,4	70,9	92,0	112,0
Cracked concrete									
HIT-V 5.8	[kN]	-	12,0	16,8	31,2	48,8	70,4	-	-
HIT-V 8.8	[kN]	-	18,4	27,2	50,4	78,4	112,8	-	-
HIT-V-R	[kN]	-	12,8	19,2	35,3	55,1	79,5	-	-
HIT-V-HCR	[kN]	-	18,4	27,2	50,4	78,4	70,9	-	-

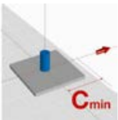
a) d = element diameter

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - embedment depth = 12 d [a)]

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth	h_{ef} = 12 d [a)]	[mm]	96	120	144	192	240	288	324	360
Base material thickness	h = h_{min}	[mm]	126	150	174	228	288	344	384	430
Edge distance	c = c_{min}	[mm]	40	50	60	80	100	120	135	150



Tensile N_{Rd}: single anchor, min. edge distance (c = c_{min})		M8	M10	M12	M16	M20	M24	M27	M30
Non-cracked concrete									
HIT-V 5.8	[kN]	10,4	16,2	21,7	40,1	56,0	73,6	87,8	85,7
HIT-V 8.8	[kN]	10,4	16,2	21,7	40,1	56,0	73,6	87,8	85,7
HIT-V-R	[kN]	10,4	16,2	21,7	40,1	56,0	73,6	80,4	85,7
HIT-V-HCR	[kN]	10,4	16,2	21,7	40,1	56,0	73,6	87,8	85,7
Cracked concrete									
HIT-V 5.8 / 8.8 HIT-V-R / -HCR	[kN]	-	7,6	11,0	21,7	34,4	50,6	-	-

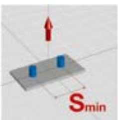


Shear V_{Rd}: single anchor, min. edge distance (c = c_{min}) , without lever arm		M8	M10	M12	M16	M20	M24	M27	M30
Non-cracked concrete									
HIT-V 5.8 / 8.8 HIT-V-R / -HCR	[kN]	3,9	5,7	7,8	12,9	18,9	25,9	31,8	38,1
Cracked concrete									
HIT-V 5.8 / 8.8 HIT-V-R / -HCR	[kN]	-	4,0	5,5	9,1	13,4	18,4	-	-

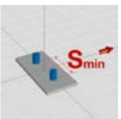
a) d = element diameter

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - embedment depth = 12 d [a)]
(load values are valid for single anchor)

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth	h_{ef} = 12 d [a)]	[mm]	96	120	144	192	240	288	324	360
Base material thickness	h = h_{min}	[mm]	126	150	174	228	288	344	384	430
Spacing	s=s_{min}	[mm]	40	50	60	80	100	120	135	150



Tensile N_{Rd}: double anchor, no edge effects, min. spacing (s = s_{min})		M8	M10	M12	M16	M20	M24	M27	M30
Non-cracked concrete									
HIT-V 5.8	[kN]	12,0	18,5	26,0	48,9	68,4	89,9	107,2	103,8
HIT-V 8.8	[kN]	12,1	18,5	26,0	48,9	68,4	89,9	107,2	103,8
HIT-V-R	[kN]	12,1	18,5	26,0	48,9	68,4	89,9	80,4	98,3
HIT-V-HCR	[kN]	12,1	18,5	26,0	48,9	68,4	89,9	107,2	103,8
Cracked concrete									
HIT-V 5.8 / 8.8 HIT-V-R / -HCR	[kN]	-	9,6	13,6	25,8	39,8	56,7	-	-

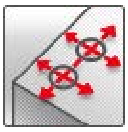


Shear V_{Rd}: double anchor, no edge effects, min. spacing (s = s_{min}) , without lever arm		M8	M10	M12	M16	M20	M24	M27	M30
Non-cracked concrete									
HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
HIT-V 8.8	[kN]	12,0	18,4	27,2	50,4	78,4	112,8	147,2	179,2
HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8
HIT-V-HCR	[kN]	12,0	18,4	27,2	50,4	78,4	70,9	92,0	112,0
Cracked concrete									
HIT-V 5.8	[kN]	-	12,0	16,8	31,2	48,8	70,4	-	-
HIT-V 8.8	[kN]	-	15,7	22,7	44,0	68,7	98,9	-	-
HIT-V-R	[kN]	-	12,8	19,2	35,3	55,1	79,5	-	-
HIT-V-HCR	[kN]	-	15,7	22,7	44,0	68,7	70,9	-	-

a) d = element diameter

Hilti HIT-HY 150 MAX with HIS-(R)N

Injection mortar system		Benefits
	Hilti HIT-HY 150 MAX 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 - suitable for dry and water saturated concrete - high loading capacity - rapid curing - small edge distance and anchor spacing possible - corrosion resistant - in service temperature range up to 120°C short term/72°C long term - manual cleaning for anchor size M8 and M10
	Static mixer	
	Internal threaded sleeve HIS-N HIS-RN	

		A4 316			
Concrete	Small edge distance and spacing	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-08/0352 / 2010-04-01

a) All data given in this section according ETA-08/0352 issue 2010-04-01

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 anchor material, as specified in the tables
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²
- Temperate range I
  (min. base material temperature -40°C, max. long term/short term base material temperature: +24°C/40°C)
- Installation temperature range -10°C to +40°C

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

Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
Embedment depth	h_{ef}	[mm]	90	110	125	170	205
Base material thickness	h	[mm]	120	150	170	230	270

Mean ultimate resistance: non-cracked concrete C 20/25 , anchor HIS-N

Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
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: non-cracked concrete C 20/25 , anchor HIS-N

Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
Tensile N_{Rk}	HIS-N	[kN]	*25,0*	*46,0*	*67,0*	95,0	*109,0*
Shear V_{Rk}	HIS-N	[kN]	*13,0*	*23,0*	*39,0*	*59,0*	*55,0*

Design resistance: non-cracked concrete C 20/25 , anchor HIS-N

Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
Tensile N_{Rd}	HIS-N	[kN]	17,5	26,7	40,0	62,2	74,1
Shear V_{Rd}	HIS-N	[kN]	10,4	18,4	26,0	39,3	36,7

Recommended loads [a)]: non-cracked concrete C 20/25 , anchor HIS-N

Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
Tensile N_{rec}	HIS-N	[kN]	12,5	19,8	31,9	45,2	53,0
Shear V_{rec}	HIS-N	[kN]	7,4	13,1	18,6	28,1	26,2

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

Service temperature range

Hilti HIT-HY 150 MAX 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 +80 °C	+50 °C	+80 °C
Temperature range III	-40 °C to +120 °C	+72 °C	+120 °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

Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
Nominal tensile strength f_{uk}	HIS-N	[N/mm²]	490	490	460	460	460
	Screw 8.8	[N/mm²]	800	800	800	800	800
	HIS-RN	[N/mm²]	700	700	700	700	700
	Screw A4-70	[N/mm²]	700	700	700	700	700
Yield strength f_{yk}	HIS-N	[N/mm²]	410	410	375	375	375
	Screw 8.8	[N/mm²]	640	640	640	640	640
	HIS-RN	[N/mm²]	350	350	350	350	350
	Screw A4-70	[N/mm²]	450	450	450	450	450
Stressed cross-section A_s	HIS-(R)N	[mm²]	51,5	108,0	169,1	256,1	237,6
	Screw	[mm²]	36,6	58	84,3	157	245
Moment of resistance W	HIS-(R)N	[mm³]	145	430	840	1595	1543
	Screw	[mm³]	31,2	62,3	109	277	541

Material quality

Part	Material
Internal threaded sleeve [a)] HIS-N	C-steel 1.0718, Steel galvanized ≥ 5µm
Internal threaded sleeve [a)] HIS-RN	Stainless steel 1.4401 and 1.4571

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

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

Anchor dimensions

Anchor size Internal threaded sleeve HIS-N / HIS-RN			M8x90	M10x110	M12x125	M16x170	M20x205
Embedment depth	h_{ef}	[mm]	80	90	110	125	170

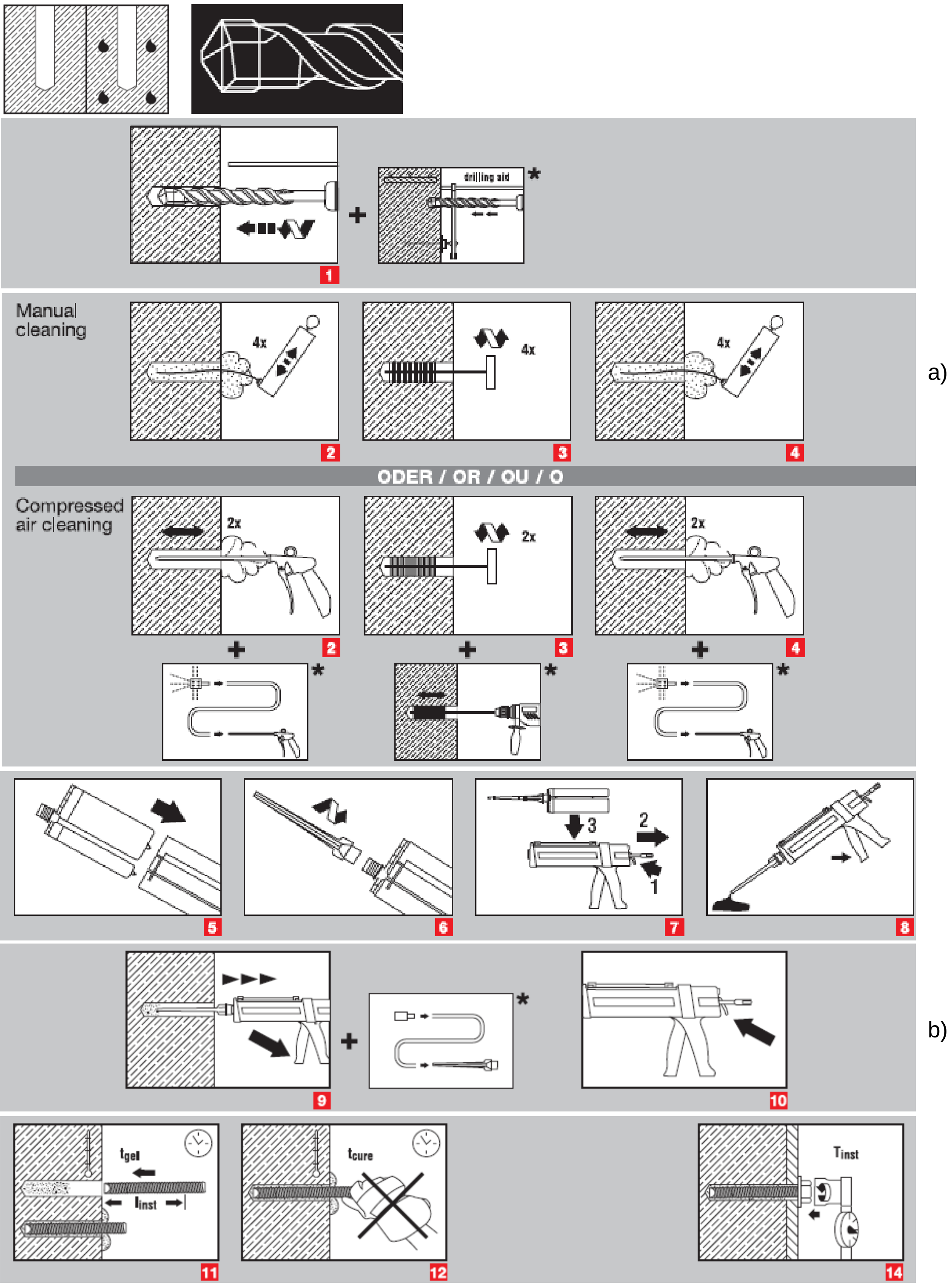
Setting

installation equipment

Anchor size	M8x90	M10x110	M12x125	M16x170	M20x205
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



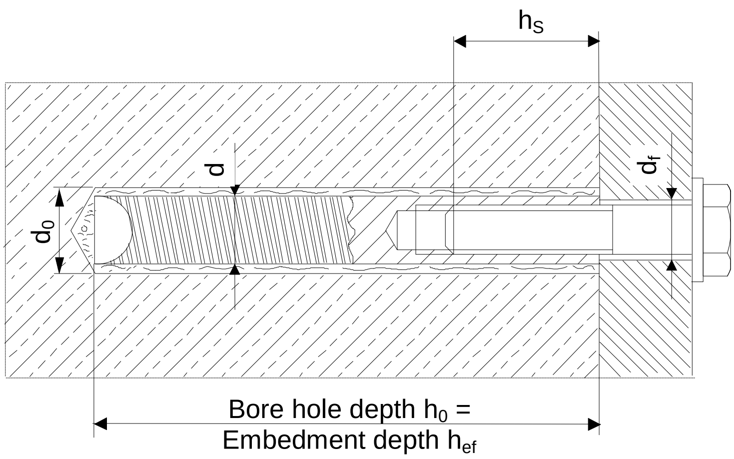
a) Note: **Manual cleaning for HIS-(R)N M8 and HIS-(R)N M10 only!**
b) Note: **Extension and piston plug needed for overhead installation!**

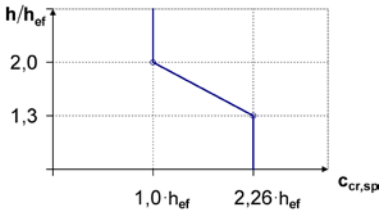
For detailed information on installation see instruction for use given with the package of the product.

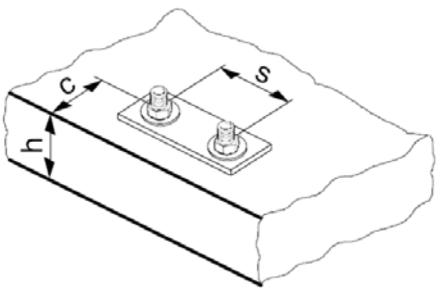
Working time, Curing time

Temperature of the base material T_{BM}	Working time t_{gel}	Curing time t_{cure}
-10 °C ≤ T_{BM} < -5 °C	180 min	12 h
-5 °C ≤ T_{BM} < 0 °C	40 min	4 h
0 °C ≤ T_{BM} < 5 °C	20 min	2 h
5 °C ≤ T_{BM} < 20 °C	8 min	1 h
20 °C ≤ T_{BM} < 30 °C	5 min	30 min
30 °C ≤ T_{BM} ≤ 40 °C	2 min	30 min

Setting details



Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
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
Torque moment [a]	T_{max}	[Nm]	10	20	40	80	150
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	$s_{cr,sp}$	[mm]	2 $c_{cr,sp}$				
Critical edge distance for splitting failure [c]	$c_{cr,sp}$	[mm]	**1,0 · h_{ef}** for $h / h_{ef} \geq 2,0$ **4,6 h_{ef} - 1,8 h** for $2,0 > h / h_{ef} > 1,3$ **2,26 h_{ef}** for $h / h_{ef} \leq 1,3$		 		
Critical spacing for concrete cone failure	$s_{cr,N}$	[mm]	2 $c_{cr,N}$				
Critical edge distance for concrete cone failure [c]	$c_{cr,N}$	[mm]	1,5 h_{ef}				



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

a) Maximum recommended torque moment to avoid splitting failure during installation with minimum spacing and/or edge distance.

b) h: base material thickness ($h \geq h_{min}$), h_{ef}: embedment depth

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-08/0352, issue 2010-04-01.

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

The design method is based on the following simplification:

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

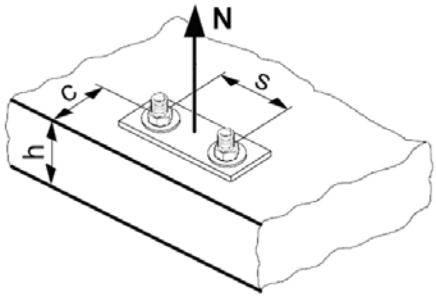
The values are valid for one anchor.

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

TENSION loading

The design tensile resistance is the lower value of

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



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
$N_{Rd,s}$	HIS-N	[kN]	17,5	30,7	44,7	80,3	74,1
	HIS-RN	[kN]	13,9	21,9	31,6	58,8	69,2

Design combined pull-out and concrete cone resistance
$N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,p} \cdot f_{re,N}$

Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
Embedment depth	h_{ef}	[mm]	90	110	125	170	205
$N^0_{Rd,p}$	Temperature range I	[kN]	19,4	27,8	50,0	63,3	76,7
$N^0_{Rd,p}$	Temperature range II	[kN]	16,7	27,8	40,0	63,3	63,3
$N^0_{Rd,p}$	Temperature range III	[kN]	11,1	16,7	26,7	40,0	40,0

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

Anchor size		M8	M10	M12	M16	M20
$N^0_{Rd,c}$	[kN]	24,0	32,4	47,1	74,6	98,8

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
$f_{B,p} = (f_{ck,cube}/25N/mm^2)^{0,10}$ a)	1,00	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
$f_B = (f_{ck,cube}/25N/mm^2)^{0,5}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

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

Influence of edge distance a)

$c/c_{cr,N}$ $c/c_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{1,N} = 0,7 + 0,3 \cdot c/c_{cr,N} \leq 1$ $f_{1,sp} = 0,7 + 0,3 \cdot c/c_{cr,sp} \leq 1$	0,73	0,76	0,79	0,82	0,85	0,88	0,91	0,94	0,97	1
$f_{2,N} = 0,5 \cdot (1 + c/c_{cr,N}) \leq 1$ $f_{2,sp} = 0,5 \cdot (1 + c/c_{cr,sp}) \leq 1$	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}. These influencing factors must be considered for every edge distance smaller than the critical edge distance.

Influence of anchor spacing a)

$s/s_{cr,N}$ $s/s_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{3,N} = 0,5 \cdot (1 + s/s_{cr,N}) \leq 1$ $f_{3,sp} = 0,5 \cdot (1 + s/s_{cr,sp}) \leq 1$	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}. 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

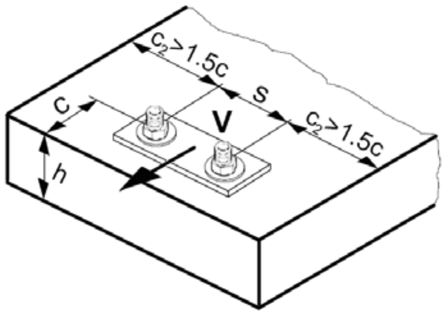
h_{ef} [mm]	40	50	60	70	80	90	≥ 100
$f_{re,N} = 0,5 + h_{ef}/200mm \leq 1$	0,7 a)	0,75 a)	0,8 a)	0,85 a)	0,9 a)	0,95 a)	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing ≥ 150 mm (any diameter) or with a diameter ≤ 10 mm and a spacing ≥ 100 mm, then a factor $f_{re,N}$ = 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 · lower value of $N_{Rd,p}$ and $N_{Rd,c}$
- Concrete edge resistance: $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
$V_{Rd,s}$	HIS-N	[kN]	10,4	18,4	26,0	39,3	36,7
	HIS-RN	[kN]	8,3	12,8	19,2	35,3	41,5

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

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

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

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

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

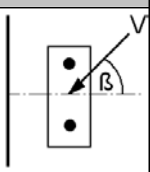
Influencing factors

Influence of concrete strength

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

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

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

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

Influence of base material thickness

h/c	0,15	0,3	0,45	0,6	0,75	0,9	1,05	1,2	1,35	≥ 1,5
$f_h = \{h/(1{,}5 \cdot c)\}^{1/2} \leq 1$	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

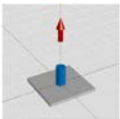
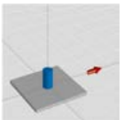
For combined tension and shear loading see section “Anchor Design”.

Precalculated values – design resistance values

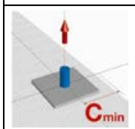
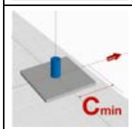
All data applies to:
- non-cracked concrete C 20/25 – $f_{ck,cube}$ =25 N/mm²
- temperature range I (see service temperature range)
- minimum thickness of base material
- no effects of dense reinforcement

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

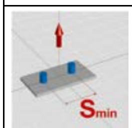
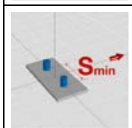
Design resistance: non-cracked- concrete C 20/25

Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
Embedment depth	h_{ef}	[mm]	90	110	125	170	205
Base material thickness	$h = h_{min}$	[mm]	120	150	170	230	270
	**Tensile N_{Rd}: single anchor, no edge effects**						
	HIS-N	[kN]	17,5	27,8	44,7	63,3	74,1
	HIS-RN	[kN]	13,9	21,9	31,6	58,8	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: non-cracked- concrete C 20/25

Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
Embedment depth	h_{ef}	[mm]	90	110	125	170	205
Base material thickness	$h = h_{min}$	[mm]	120	150	170	230	270
Edge distance	$c = c_{min}$	[mm]	40	45	55	65	90
	**Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)**						
	HIS-N	[kN]	9,9	13,8	21,6	31,2	41,7
	HIS-RN	[kN]	9,9	13,8	21,6	31,2	41,7
	**Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$), without lever arm**						
	HIS-N	[kN]	4,2	5,5	7,6	10,8	17,2
	HIS-RN	[kN]	4,2	5,5	7,6	10,8	17,2

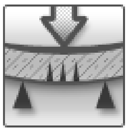
Design resistance: non-cracked- concrete C 20/25

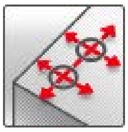
Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
Embedment depth	h_{ef}	[mm]	90	110	125	170	205
Base material thickness	$h = h_{min}$	[mm]	120	150	170	230	270
Spacing	$s = s_{min}$	[mm]	40	45	55	65	90
	**Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)**						
	HIS-N	[kN]	11,9	16,6	25,9	37,9	48,4
	HIS-RN	[kN]	11,9	16,6	25,9	37,9	48,4
	**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

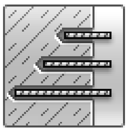
Hilti HIT-HY 150 MAX with rebar

Injection mortar system		Benefits
	Hilti HIT-HY 150 MAX 330 ml foil pack (also available as 500 ml and 1400 ml foil pack)	- suitable for non-cracked and cracked concrete C 20/25 to C 50/60 - suitable for dry and water saturated concrete - high loading capacity - rapid curing - small edge distance and anchor spacing possible - large diameter applications - in service temperature range up to 120°C short term/72°C long term - manual cleaning for anchor size Ø8 to Ø14 and embedment depth $h_{ef} \leq 10d$ for non-cracked concrete - embedment depth range: from 60 ... 160 mm for Ø8 to 100 ... 500 mm for Ø25
	Static mixer	
	rebar BSt 500 S	


Concrete


Tensile zone


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-08/0352 / 2010-04-01

a) All data given in this section according ETA-08/0352 issue 2010-04-01.

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
- Anchor material: rebar BSt 500 S
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²
- Temperate range I
  (min. base material temperature -40°C, max. long term/short term base material temperature: +24°C/40°C)
- Installation temperature range -10°C to +40°C

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

Anchor size	ø8	ø10	ø12	ø14	ø16	ø20	ø25
Embedment depth $h_{ef} = h_{ef,typ}$ b) [mm]	80	90	110	125	145	170	210
Base material thickness h [mm]	110	120	140	165	185	220	274

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.
b) $h_{ef,typ}$: Typical embedment depth

Mean ultimate resistance: non-cracked concrete C 20/25 , anchor BSt 500 S

Anchor size			ø8	ø10	ø12	ø14	ø16	ø20	ø25
Non-cracked concrete									
Tensile $N_{Ru,m}$	BST 500 S	[kN]	25,5	35,8	52,5	69,6	92,3	135,3	204,9
Shear $V_{Ru,m}$	BST 500 S	[kN]	*14,7*	*23,1*	*32,6*	*44,1*	*57,8*	*90,3*	*141,8*
Cracked concrete									
Tensile $N_{Ru,m}$	BST 500 S	[kN]	-	20,7	30,4	44,0	58,3	85,5	131,9
Shear $V_{Ru,m}$	BST 500 S	[kN]	-	*23,1*	*32,6*	*44,1*	*57,8*	*90,3*	*141,8*

Characteristic resistance: non-cracked concrete C 20/25 , anchor BSt 500 S

Anchor size			ø8	ø10	ø12	ø14	ø16	ø20	ø25
Non-cracked concrete									
Tensile N_{Rk}	BST 500 S	[kN]	19,1	26,9	39,4	52,2	69,2	101,5	153,7
Shear V_{Rk}	BST 500 S	[kN]	*14,0*	*22,0*	*31,0*	*42,0*	*55,0*	*86,0*	*135,0*
Cracked concrete									
Tensile N_{Rk}	BST 500 S	[kN]	-	15,6	22,8	33,0	43,7	64,1	99,0
Shear V_{Rk}	BST 500 S	[kN]	-	*22,0*	*31,0*	*42,0*	*55,0*	*86,0*	*135,0*

Design resistance: non-cracked concrete C 20/25 , anchor BSt 500 S

Anchor size			ø8	ø10	ø12	ø14	ø16	ø20	ø25
Non-cracked concrete									
Tensile N_{Rd}	BST 500 S	[kN]	10,6	14,9	21,9	29,0	46,2	67,6	85,4
Shear V_{Rd}	BST 500 S	[kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0
Cracked concrete									
Tensile N_{Rd}	BST 500 S	[kN]	-	10,4	15,2	22,0	29,2	42,7	55,0
Shear V_{Rd}	BST 500 S	[kN]	-	14,7	20,7	28,0	36,7	57,3	90,0

Recommended loads a): non-cracked concrete C 20/25 , anchor BSt 500 S

Anchor size			ø8	ø10	ø12	ø14	ø16	ø20	ø25
Non-cracked concrete									
Tensile N_{rec}	BST 500 S	[kN]	7,6	10,7	15,6	20,7	33,0	48,3	61,0
Shear V_{rec}	BST 500 S	[kN]	6,7	10,5	14,8	20,0	26,2	41,0	64,3
Cracked concrete									
Tensile N_{rec}	BST 500 S	[kN]	-	7,4	10,9	15,7	20,8	30,5	39,3
Shear V_{rec}	BST 500 S	[kN]	-	10,5	14,8	20,0	26,2	41,0	64,3

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

Service temperature range

Hilti HIT-HY 150 MAX 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 +80 °C	+50 °C	+80 °C
Temperature range III	-40 °C to +120 °C	+72 °C	+120 °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
Nominal tensile strength f_{uk}	BSt 500 S	[N/mm²]	550						
Yield strength f_{yk}	BSt 500 S	[N/mm²]	500						
Stressed cross-section A_s	BSt 500 S	[mm²]	50,3	78,5	113,1	153,9	201,1	314,2	490,9
Moment of resistance W	BSt 500 S	[mm³]	50,3	98,2	169,6	269,4	402,1	785,4	1534

Material quality

Part	Material
rebar BSt 500 S	Mechanical properties according to DIN 488-1:1984 Geometry according to DIN 488-21:1986

Anchor dimensions

Anchor size	ø8	ø10	ø12	ø14	ø16	ø20	ø25
rebar BSt 500 S	rebar are available in variable length						

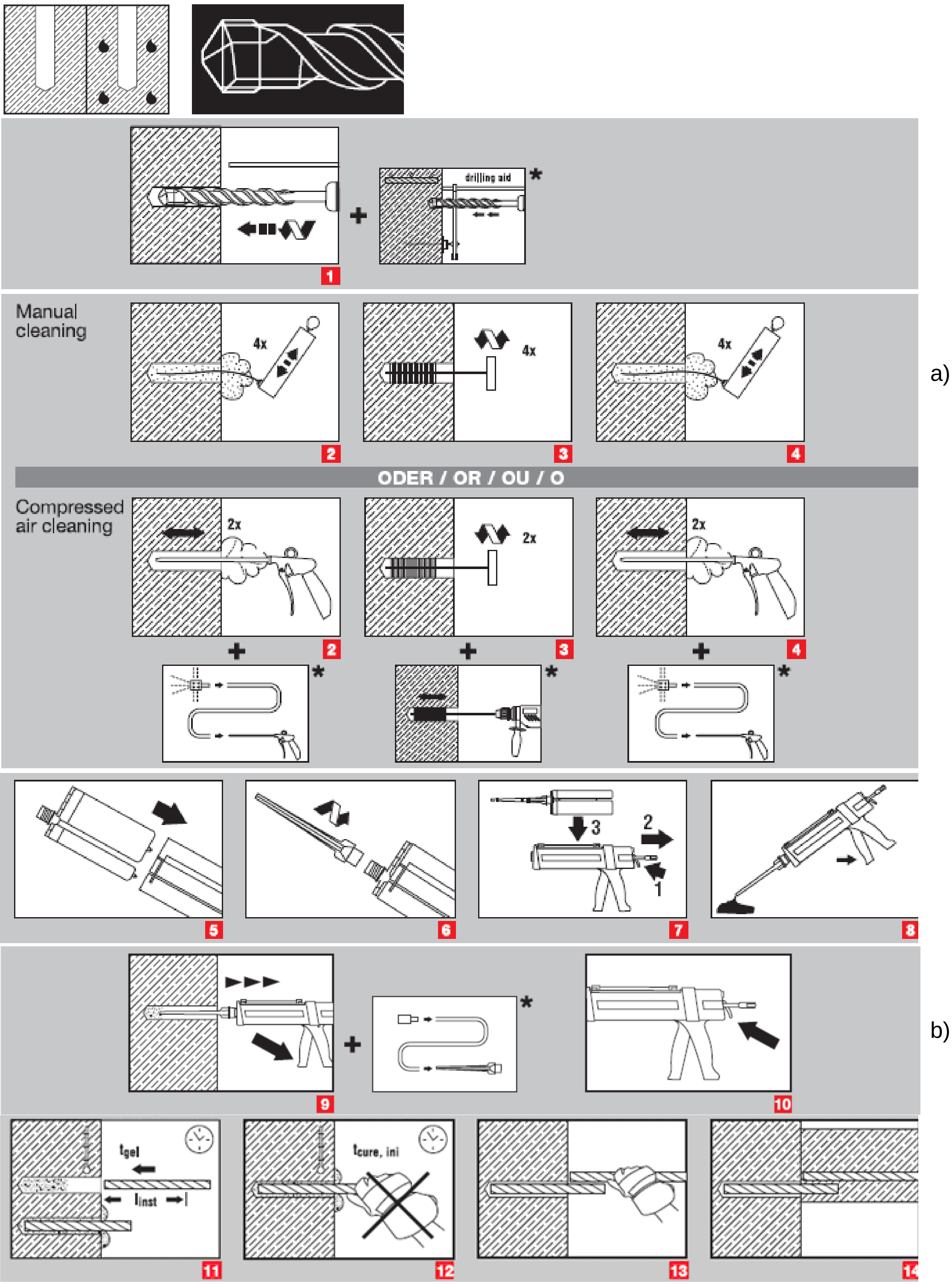
Setting

installation equipment

Anchor size	ø8	ø10	ø12	ø14	ø16	ø20	ø25
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 for non-cracked concrete, element sizes d ≤ 14mm and embedment depth h_{ef} ≤ 10 d only!**

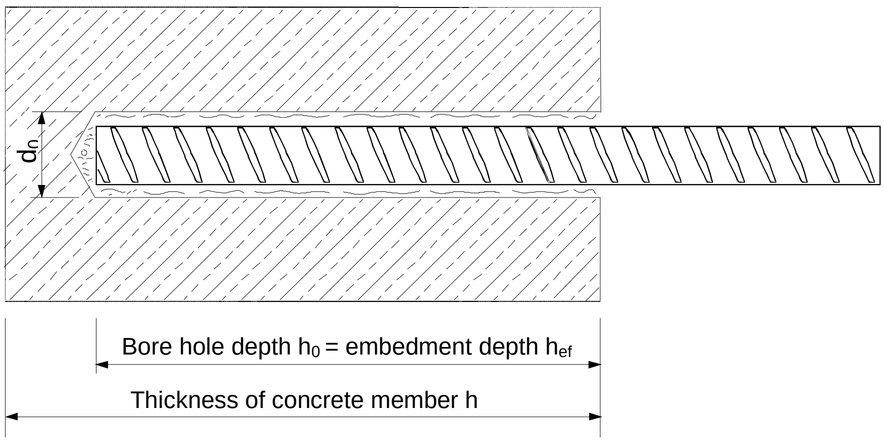
b) Note: **Extension and piston plug needed for overhead installation and/or embedment depth > 250mm!**

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

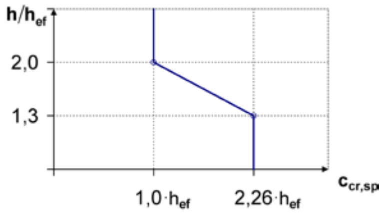
Working time, Curing time

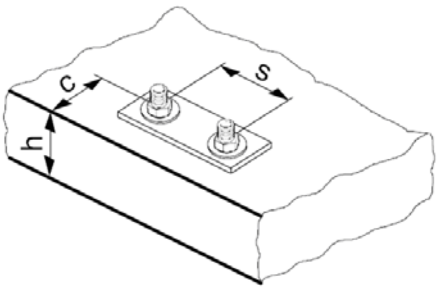
Temperature of the base material T_{BM}	Working time t_{gel}	Curing time t_{cure}
-10 °C ≤ T_{BM} < -5 °C	180 min	12 h
-5 °C ≤ T_{BM} < 0 °C	40 min	4 h
0 °C ≤ T_{BM} < 5 °C	20 min	2 h
5 °C ≤ T_{BM} < 20 °C	8 min	1 h
20 °C ≤ T_{BM} < 30 °C	5 min	30 min
30 °C ≤ T_{BM} ≤ 40 °C	2 min	30 min

Setting details



Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Nominal diameter of drill bit	d_0	[mm]	10-12 [d]	12-14 [d]	14-16 [d]	18	20	25	32
Effective embedment and drill hole depth range [a]	$h_{ef,min}$	[mm]	60	60	70	75	80	90	100
for rebar BSt 500 S	$h_{ef,max}$	[mm]	160	200	240	280	320	400	500
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	150
Minimum edge distance	c_{min}	[mm]	40	50	60	80	100	120	150
Critical spacing for splitting failure	$s_{cr,sp}$	[mm]	$2\ c_{cr,sp}$						
Critical edge distance for splitting failure [c]	$c_{cr,sp}$	[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	$s_{cr,N}$	[mm]	$2\ c_{cr,N}$						
Critical edge distance for concrete cone failure [c]	$c_{cr,N}$	[mm]	$1{,}5\ h_{ef}$						





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

a) Embedment depth range: $h_{ef,min} \leq h_{ef} \leq h_{ef,max}$

b) h: base material thickness ($h \geq h_{min}$), h_{ef}: embedment depth

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

d) both given values for drill bit diameter can be used

Simplified design method

Simplified version of the design method according ETAG 001, TR 029. Design resistance according data given in ETA-08/0352, issue 2010-04-01.

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

The design method is based on the following simplification:

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

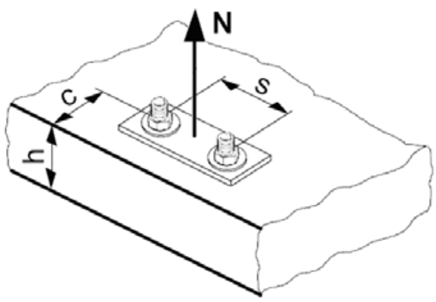
The values are valid for one anchor.

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

TENSION loading

The design tensile resistance is the lower value of

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



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
$N_{Rd,s}$	BSt 500 S	[kN]	20,0	30,7	44,3	60,7	79,3	123,6	192,9

Design combined pull-out and concrete cone resistance

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

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Embedment depth h_{ef} = Typical embedment depth $h_{ef,typ}$		[mm]	80	90	110	125	145	170	210
Non-cracked concrete									
$N^0_{Rd,p}$	Temperature range I	[kN]	10,6	14,9	21,9	29,0	46,2	67,6	87,0
$N^0_{Rd,p}$	Temperature range II	[kN]	8,9	12,6	18,4	24,4	38,9	57,0	73,3
$N^0_{Rd,p}$	Temperature range III	[kN]	5,6	7,9	11,5	15,3	24,3	35,6	45,8
Cracked concrete									
$N^0_{Rd,p}$	Temperature range I	[kN]	-	10,4	15,2	22,0	29,2	42,7	55,0
$N^0_{Rd,p}$	Temperature range II	[kN]	-	8,5	13,8	18,3	26,7	42,7	55,0
$N^0_{Rd,p}$	Temperature range III	[kN]	-	5,7	8,3	12,8	17,0	24,9	36,7

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

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

Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
$N^0_{Rd,c}$ Non-cracked concrete [kN]	20,1	24,0	32,4	39,2	58,8	74,6	85,4
$N^0_{Rd,c}$ Cracked concrete [kN]	-	28,7	38,8	47,1	58,8	74,6	85,4

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

Influencing factors

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

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_{B,p} = (f_{ck,cube}/25N/mm^2)^{0,10}$ a)	1,00	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
$f_B = (f_{ck,cube}/25N/mm^2)^{0,5}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

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

Influence of edge distance a)

$c/c_{cr,N}$ / $c/c_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{1,N} = 0,7 + 0,3 \cdot c/c_{cr,N} \leq 1$ / $f_{1,sp} = 0,7 + 0,3 \cdot c/c_{cr,sp} \leq 1$	0,73	0,76	0,79	0,82	0,85	0,88	0,91	0,94	0,97	1
$f_{2,N} = 0,5 \cdot (1 + c/c_{cr,N}) \leq 1$ / $f_{2,sp} = 0,5 \cdot (1 + c/c_{cr,sp}) \leq 1$	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}. These influencing factors must be considered for every edge distance smaller than the critical edge distance.

Influence of anchor spacing a)

$s/s_{cr,N}$ / $s/s_{cr,sp}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$f_{3,N} = 0,5 \cdot (1 + s/s_{cr,N}) \leq 1$ / $f_{3,sp} = 0,5 \cdot (1 + s/s_{cr,sp}) \leq 1$	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}. This influencing factor must be considered for every anchor spacing.

Influence of embedment depth on concrete cone resistance

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

Influence of reinforcement

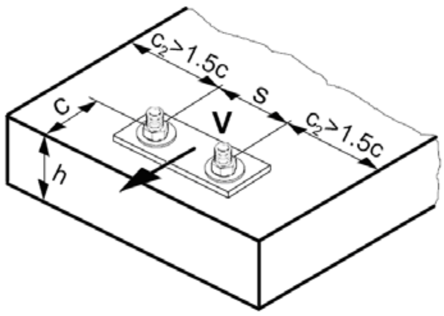
h_{ef} [mm]	40	50	60	70	80	90	≥ 100
$f_{re,N}$ = 0,5 + h_{ef}/200mm ≤ 1	0,7 [a)]	0,75 [a)]	0,8 [a)]	0,85 [a)]	0,9 [a)]	0,95 [a)]	1

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



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
$V_{Rd,s}$	Rebar BSt 500 S	[kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0

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

k = 2 for h_{ef} ≥ 60 mm

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

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

Anchor size		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Non-cracked concrete								
$V^0_{Rd,c}$	[kN]	5,9	8,6	11,6	15,0	18,7	27,0	39,2
Cracked concrete								
$V^0_{Rd,c}$	[kN]	-	6,1	8,2	10,6	13,2	19,2	27,7

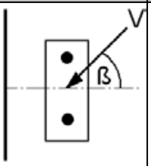
Influencing factors

Influence of concrete strength

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

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

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

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

Influence of base material thickness

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

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

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

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

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

Influence of embedment depth

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

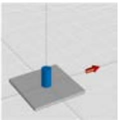
For combined tension and shear loading see section “Anchor Design”.

Precalculated values – design resistance values

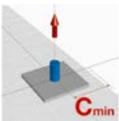
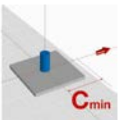
All data applies to:
- non-cracked concrete C 20/25 – $f_{ck,cube}$ =25 N/mm²
- temperature range I (see service temperature range)
- minimum thickness of base material
- no effects of dense reinforcement

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

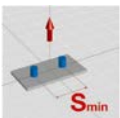
Design resistance: concrete C 20/25 - minimum embedment depth

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Embedment depth	$h_{ef} = h_{ef,min}$	[mm]	60	60	70	80	90	100	110
Base material thickness	$h = h_{min}$	[mm]	100	100	102	116	130	150	174
	Tensile N_{Rd}: single anchor, no edge effects								
	Non-cracked concrete								
	BSt 500 S	[kN]	8,0	9,9	13,9	18,6	28,7	33,7	32,4
	Cracked concrete								
	BSt 500 S	[kN]	-	6,9	9,7	14,1	18,1	24,0	23,1
	Shear V_{Rd}: single anchor, no edge effects, without lever arm								
	Non-cracked concrete								
	BSt 500 S	[kN]	9,3	14,7	20,7	28,0	36,7	57,3	64,7
	Cracked concrete								
	BSt 500 S	[kN]	-	13,8	19,4	28,0	36,2	48,0	46,1

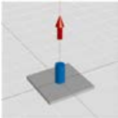
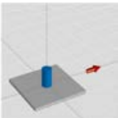
Design resistance: concrete C 20/25 - minimum embedment depth

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Embedment depth	$h_{ef} = h_{ef,min}$	[mm]	60	60	70	80	90	100	110
Base material thickness	$h = h_{min}$	[mm]	100	100	102	116	130	150	174
Edge distance	$c = c_{min}$	[mm]	40	50	60	80	100	120	135
	Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)								
	Non-cracked concrete								
	BSt 500 S	[kN]	4,8	6,7	9,5	12,8	19,4	24,4	25,0
	Cracked concrete								
	BSt 500 S	[kN]	-	4,7	6,6	10,6	14,5	20,3	19,8
	Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$), without lever arm								
	Non-cracked concrete								
	BSt 500 S	[kN]	3,5	4,9	6,6	10,0	13,2	17,4	21,8
	Cracked concrete								
	BSt 500 S	[kN]	-	3,5	4,7	7,1	9,4	12,3	15,4

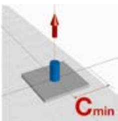
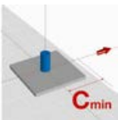
Design resistance: concrete C 20/25 - minimum embedment depth (load values are valid for single anchor)

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Embedment depth	$h_{ef} = h_{ef,min}$	[mm]	60	60	70	80	90	100	110
Base material thickness	$h = h_{min}$	[mm]	100	100	100	116	138	156	170
Spacing	$s = s_{min}$	[mm]	40	50	60	80	100	120	135
	Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)								
	Non-cracked concrete								
	BSt 500 S	[kN]	5,4	6,8	9,3	12,2	17,6	21,3	22,5
	Cracked concrete								
	BSt 500 S	[kN]	-	4,9	6,7	9,5	12,1	15,2	16,0
	Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$), without lever arm								
	Non-cracked concrete								
	BSt 500 S	[kN]	9,3	12,7	17,9	24,0	36,7	44,9	47,1
	Cracked concrete								
	BSt 500 S	[kN]	-	8,8	12,4	18,2	23,5	32,0	33,6

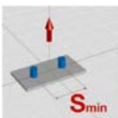
Design resistance: concrete C 20/25 - typical embedment depth

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Embedment depth	$h_{ef} = h_{ef,typ}$	[mm]	80	90	110	125	145	170	210
Base material thickness	$h = h_{min}$	[mm]	110	120	142	161	185	220	274
	**Tensile N_{Rd}: single anchor, no edge effects**								
	Non-cracked concrete								
	BSt 500 S	[kN]	10,6	14,9	21,9	29,0	46,2	67,6	85,4
	Cracked concrete								
	BSt 500 S	[kN]	-	10,4	15,2	22,0	29,2	42,7	55,0
	**Shear V_{Rd}: single anchor, no edge effects, without lever arm**								
	Non-cracked concrete								
	BSt 500 S	[kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0
	Cracked concrete								
	BSt 500 S	[kN]	-	14,7	20,7	28,0	36,7	57,3	90,0

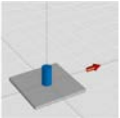
Design resistance: concrete C 20/25 - typical embedment depth

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Embedment depth	$h_{ef} = h_{ef,typ}$	[mm]	80	90	110	125	145	170	210
Base material thickness	$h = h_{min}$	[mm]	110	120	142	161	185	220	274
Edge distance	$c = c_{min}$	[mm]	40	50	60	80	100	120	135
	**Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)**								
	Non-cracked concrete								
	BSt 500 S	[kN]	6,4	9,0	13,2	18,6	30,4	38,9	43,1
	Cracked concrete								
	BSt 500 S	[kN]	-	6,2	9,1	14,1	19,6	28,2	34,3
	**Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$), without lever arm**								
	Non-cracked concrete								
	BSt 500 S	[kN]	3,7	5,3	7,3	11,2	15,8	21,5	27,5
	Cracked concrete								
	BSt 500 S	[kN]	-	3,8	5,2	7,9	11,2	15,2	19,5

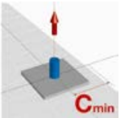
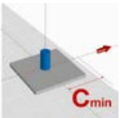
Design resistance concrete C 20/25 - typical embedment depth (load values are valid for single anchor)

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Embedment depth	$h_{ef} = h_{ef,typ}$	[mm]	80	90	110	125	145	170	210
Base material thickness	$h = h_{min}$	[mm]	110	120	142	161	185	220	274
Spacing	$s = s_{min}$	[mm]	40	50	60	80	100	120	135
	**Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)**								
	Non-cracked concrete								
	BSt 500 S	[kN]	7,4	10,1	14,7	19,1	30,1	42,2	49,5
	Cracked concrete								
	BSt 500 S	[kN]	-	7,2	10,5	14,8	19,5	27,7	35,3
	**Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$), without lever arm**								
	Non-cracked concrete								
	BSt 500 S	[kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0
	Cracked concrete								
	BSt 500 S	[kN]	-	12,3	18,0	26,1	34,5	51,1	68,1

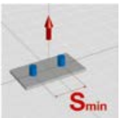
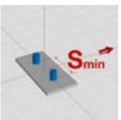
Design resistance: concrete C 20/25 - embedment depth = 12 d [a)]

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Embedment depth	h_{ef} = 12 d [a)]	[mm]	96	120	144	168	192	240	300
Base material thickness	h = h_{min}	[mm]	126	150	176	204	232	290	364
	**Tensile N_{Rd}: single anchor, no edge effects**								
	Non-cracked concrete								
	BSt 500 S	[kN]	12,7	19,9	28,7	39,0	61,1	95,5	124,4
	Cracked concrete								
	BSt 500 S	[kN]	-	13,8	19,9	29,6	38,6	60,3	78,5
	**Shear V_{Rd}: single anchor, no edge effects, without lever arm**								
	Non-cracked concrete								
	BSt 500 S	[kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0
	Cracked concrete								
	BSt 500 S	[kN]	-	14,7	20,7	28,0	36,7	57,3	90,0

Design resistance: concrete C 20/25 - embedment depth = 12 d [a)]

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Embedment depth	h_{ef} = 12 d [a)]	[mm]	96	120	144	168	192	240	300
Base material thickness	h = h_{min}	[mm]	126	150	176	204	232	290	364
Edge distance	c = c_{min}	[mm]	40	50	60	80	100	120	135
	**Tensile N_{Rd}: single anchor, min. edge distance (c = c_{min})**								
	Non-cracked concrete								
	BSt 500 S	[kN]	7,7	12,0	17,2	25,1	41,2	58,6	66,4
	Cracked concrete								
	BSt 500 S	[kN]	-	8,3	12,0	19,0	26,0	39,8	49,0
	**Shear V_{Rd}: single anchor, min. edge distance (c = c_{min}), without lever arm**								
	Non-cracked concrete								
	BSt 500 S	[kN]	3,9	5,7	7,8	12,0	16,9	23,6	30,5
	Cracked concrete								
	BSt 500 S	[kN]	-	4,0	5,5	8,5	12,0	16,7	21,6

Design resistance: concrete C 20/25 - embedment depth = 12 d [a)] (load values are valid for single anchor)

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Embedment depth	h_{ef} = 12 d [a)]	[mm]	96	120	144	168	192	240	300
Base material thickness	h = h_{min}	[mm]	126	150	176	204	232	290	364
Spacing	s = s_{min}	[mm]	40	50	60	80	100	120	135
	**Tensile N_{Rd}: double anchor, no edge effects, min. spacing (s = s_{min})**								
	Non-cracked concrete								
	BSt 500 S	[kN]	8,9	13,8	19,6	26,4	40,9	62,6	81,0
	Cracked concrete								
	BSt 500 S	[kN]	-	9,8	13,9	20,3	26,3	40,5	53,2
	**Shear V_{Rd}: double anchor, no edge effects, min. spacing (s = s_{min}), without lever arm**								
	Non-cracked concrete								
	BSt 500 S	[kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0
	Cracked concrete								
	BSt 500 S	[kN]	-	14,7	20,7	28,0	36,7	57,3	90,0

a) d = element diameter

Hilti HIT-HY 150 MAX post-installed rebars

Injection mortar system		Benefits
	Hilti HIT-HY 150 MAX 330 ml foil pack (also available as 500 ml and 1400 ml foil pack)	- suitable for concrete C 12/15 to C 50/60 - high loading capacity and fast cure - suitable for dry and water saturated concrete - for rebar diameters up to 25 mm - non corrosive to rebar elements - good load capacity at elevated temperatures - hybrid chemistry - multiplication factor for minimum anchoring and splice length 1.0 - suitable for embedment length till 2000 mm - suitable for applications down to -10 °C
	Static mixer	
	Rebar	

Concrete | Fire resistance | European Technical Approval | CE conformity | Drinking water appoved | Corossion tested | PROFIS Rebar design software

Service temperature range

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

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval [a)]	CSTB, France	ETA-08/0202 / 2008-07-24
European technical approval [a)]	CSTB, France	ETA-08/0352 / 2009-12-18
National Approval	DIBt, Berlin	DIBt Z-21.8-1882 / 2010-08-13
Fire test report	DIBt, Berlin	DIBt Z-21.8-1882 / 2010-08-13
Assessment report (fire)	Warringtonfire	WF 166402 / 2007-10-26

a) All data given in this section according ETA-08/0202, issue 2008-07-24.

Materials

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

Properties of reinforcement

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

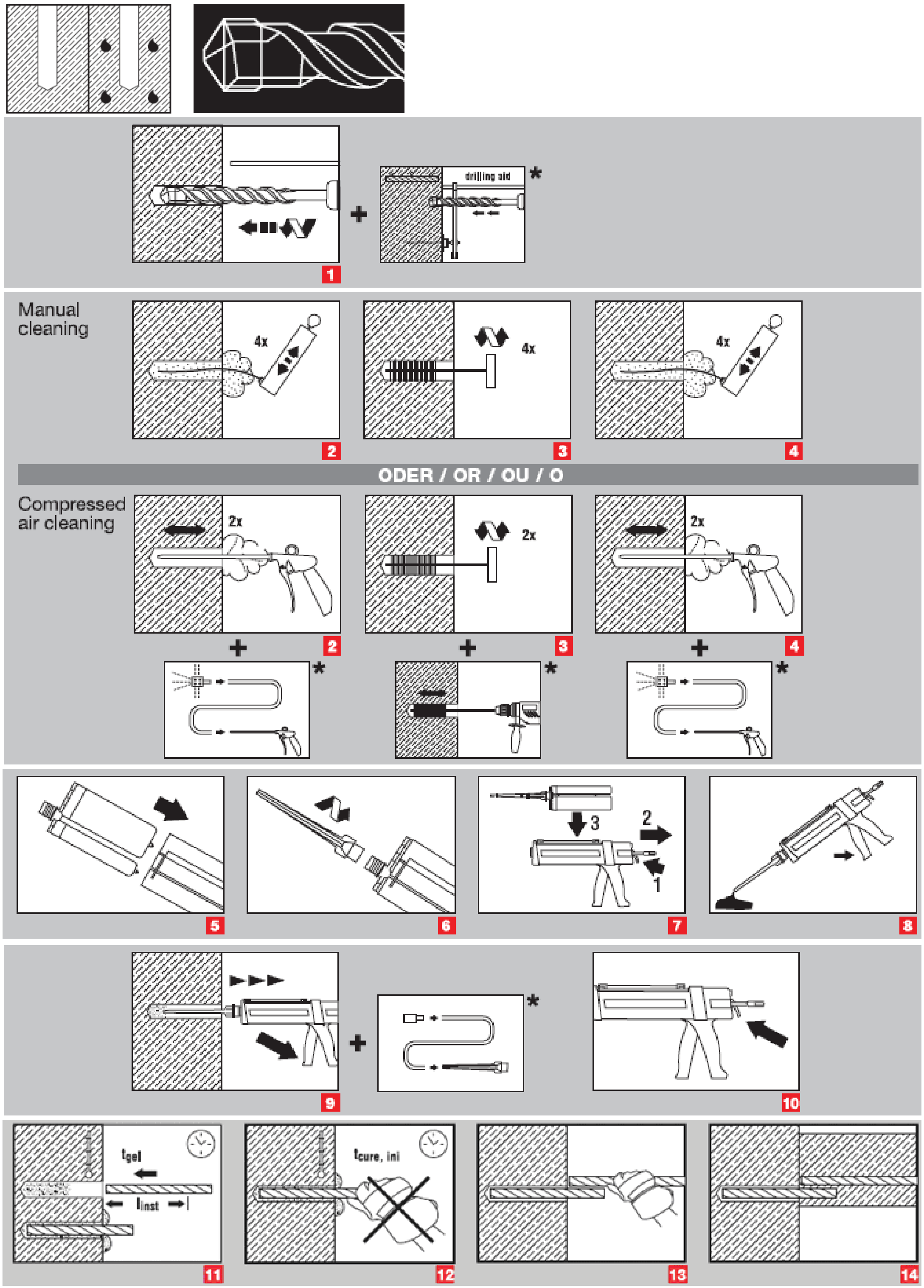
Setting details

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

Working time, Curing time

Temperature of the base material T_{BM}	**Working time t_{gel}**	**Curing time t_{cure}**
-10 °C ≤ T_{BM} < -5 °C	180 min	12 h
-5 °C ≤ T_{BM} < -0 °C	90 min	9 h
0 °C ≤ T_{BM} < 5 °C	45 min	4,5 h
5 °C ≤ T_{BM} < 10 °C	20 min	2 h
10 °C ≤ T_{BM} < 15 °C	7 min	50 min
15 °C ≤ T_{BM} < 20 °C	6 min	40 min
20 °C ≤ T_{BM} < 25 °C	5 min	30 min
25 °C ≤ T_{BM} < 30 °C	3 min	30 min
30 °C ≤ T_{BM} ≤ 40 °C	2 min	30 min

Dry and water-saturated concrete, hammer drilling



a)

a) Note: **Manual cleaning for element sizes d ≤ 16mm and embedment depth h_{ef} ≤ 10 d only!**

Fitness for use

Creep behaviour

Creep tests have been conducted in accordance with ETAG guideline 001 part 5 and TR 023 in the following conditions: in dry environnement at 50 °C during 90 days.

These tests show an excellent behaviour of the post-installed connection made with HIT-HY 150 MAX: low displacements with long term stability, failure load after exposure above reference load.

Water behaviour

- Water: HIT-HY 150 MAX is water tight and water resistant, without any toxicity risk for the environnement.
- Drinking water: HIT-HY 150 MAX is «NSF» certified, in accordance with NSF/ANSI St 61 «Drinking Water System Components - Health Effects». Tests are done at 60 °C, which corresponds to domestic hot water. The use of HIT-HY 150 MAX is possible for water tanks.

Resistance to chemical substances

Chemical substance	Comment	Resistance
Sulphuric acid	23°C	+
Under sea water	23°C	+
Under water	23°C	+
Alkaline medium	pH = 13,2, 23°C	+

Drilling diameters

Rebar (mm)	Drill bit diameters d_0 [mm]	
	Hammer drill (HD)	Compressed air drill (CA)
8	12 (10 [a)])	-
10	14 (12 [a)])	-
12	16 (14 [a)])	17
14	18	17
16	20	20
18	22	22
20	25	26
22	28	28
24	32	32
25	32	32

a) Max. installation length l = 250 mm.

Basic design data for rebar design according to rebar ETA

Bond strength in N/mm² according to ETA 08/0202 for good bond conditions for all drilling methods

<table>
<tr><th rowspan="2">Rebar (mm)</th><th colspan="9">Concrete class</th></tr>
<tr><th>C12/15</th><th>C16/20</th><th>C20/25</th><th>C25/30</th><th>C30/37</th><th>C35/45</th><th>C40/50</th><th>C45/55</th><th>C50/60</th></tr>
<tr><td>8 - 24</td><td>1,6</td><td>2,0</td><td>2,3</td><td>2,7</td><td>3,0</td><td>3,4</td><td>3,4</td><td>3,4</td><td>3,7</td></tr>
<tr><td>25</td><td>1,6</td><td>2,0</td><td>2,3</td><td>2,7</td><td>3,0</td><td>3,4</td><td>3,7</td><td>3,7</td><td>3,7</td></tr>
</table>

Pullout design bond strength for Hit Rebar design

Design bond strength in N/mm² according to ETA 08/0352 (values in table are design values, $f_{bd,po} = \tau_{Rk}/\gamma_{Mp}$

<table>
<tr><th colspan="10">Hammer or compressed air drilling. Uncracked concrete C20/25.</th></tr>
<tr><th rowspan="2">temperature range</th><th colspan="9">Bar diameter</th></tr>
<tr><th>8</th><th>10</th><th>12</th><th>14</th><th>16</th><th>20</th><th>22</th><th>24</th><th>25</th></tr>
<tr><td>I: 40°C/24°C</td><td colspan="4">5,3</td><td colspan="2">6,3</td><td colspan="3">5,3</td></tr>
<tr><td>II: 80°C/50°C</td><td colspan="4">4,4</td><td colspan="2">5,3</td><td colspan="3">4,4</td></tr>
<tr><td>III: 120°C/72°C</td><td colspan="4">2,8</td><td colspan="2">3,3</td><td colspan="3">2,8</td></tr>
</table>

<table>
<tr><th colspan="10">Hammer or compressed air drilling. Cracked concrete C20/25.</th></tr>
<tr><th rowspan="2">temperature range</th><th colspan="9">Bar diameter</th></tr>
<tr><th>8</th><th>10</th><th>12</th><th>14</th><th>16</th><th>20</th><th>22</th><th>24</th><th>25</th></tr>
<tr><td>I: 40°C/24°C</td><td>-</td><td colspan="2">3,7</td><td colspan="3">4,0</td><td colspan="3">3,3</td></tr>
<tr><td>II: 80°C/50°C</td><td>-</td><td>3,0</td><td colspan="2">3,3</td><td>3,7</td><td>4,0</td><td colspan="3">3,3</td></tr>
<tr><td>III: 120°C/72°C</td><td>-</td><td colspan="2">2,0</td><td colspan="3">2,3</td><td colspan="3">2,2</td></tr>
</table>

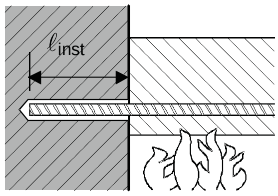
Increasing factor in non-cracked concrete: $f_{B,p}=(f_{cck}/25)^{0,1}$ (f_{cck}: characteristic compressive strength on cube)

Additional Hilti Technical Data

Reduction factor for splitting with large concrete cover: $\delta = 0{,}306$

Fire Resistance according to DIBt Z-21.8-1882

a) fire situation “anchorage”



Maximum force in rebar in conjunction with Hilti HIT-HY 150 Max as a function of embedment depth for the fire resistance classes F30 to F240 (yield strength f_{yk} = 500 N/mm²) according EC2[a)].

Bar ∅ [mm]	Drill hole ∅ [mm]	Max. $F_{s,T}$ [kN]	ℓ_{inst} [mm]	R30 [kN]	R60 [kN]	R90 [kN]	R120 [kN]	R180 [kN]
8	**12**	**16,2**	80	3,0	0,7	0,2	0	0
			120	7,0	2,2	1,3	0,7	0,2
			170	16,2	10,2	9,2	4,0	1,7
			210		16,2	16,2	11,0	7,5
			230				14,5	10,9
			250				16,2	14,4
			300					16,2
10	**14**	**25,3**	100	6,1	2,0	1,0	0,4	0
			150	19,3	9,3	7,1	2,2	1,0
			190	25,3	18,0	15,9	9,3	4,9
			230		25,3	24,7	18,1	13,7
			260			25,3	24,7	20,3
			280				25,3	24,7
			320					25,3
12	**16**	**36,4**	120	15,3	6,0	1,9	1,1	0,3
			180	31,0	19,0	17,8	8,5	7,0
			220	36,4	29,6	27,0	19,1	13,8
			260		36,4	36,4	29,7	24,4
			280				35,0	29,6
			300				36,4	34,9
			340					36,4
14	**18**	**49,6**	140	24,0	9,9	6,9	2,6	1,0
			210	45,0	31,4	28,5	25,7	13,0
			240	49,6	40,6	37,7	32,8	22,3
			280		49,6	49,6	40,7	34,6
			300				44,7	40,7
			330				49,6	49,6
16	**20**	**64,8**	160	34,5	18,4	14,9	4,4	2,3
			240	62,6	46,4	43,0	37,7	25,5
			260	64,8	53,5	50,0	44,7	32,5
			300		64,8	57,0	51,7	46,6
			330			64,8	61,3	57,2
			360				64,8	64,8
20	**25**	**101,2**	200	60,7	40,0	36,3	29,3	14,2
			250	78,3	62,5	58,3	51,3	36,3
			310	101,2	88,9	84,6	77,6	62,6
			350		101,2	101,2	94,2	80,2
			370				101,2	83,5
			390					97,8
			430					101,2

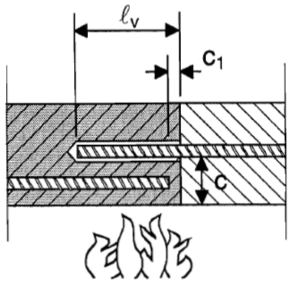
Bar ∅ [mm]	Drill hole ∅ [mm]	Max. $F_{s,T}$ [kN]	ℓ_{inst} [mm]	R30 [kN]	R60 [kN]	R90 [kN]	R120 [kN]	R180 [kN]
25	**32**	**158,1**	250	97,9	78,1	72,9	64,7	45,3
			280	126,5	94,6	89,4	81,2	61,8
			370	158,1	144,0	127,9	119,7	111,2
			410		158,1	150,0	141,8	123,2
			430			158,1	150,0	144,2
			450				158,1	155,2
			500					158,1

[a] For Hilti HIT-HY 150 MAX rebar only the standard acc. EC2 is available (Data also in Warringtonfire report WF 166402 or/and IBMB Braunschweig report No 3884/8246-CM.

b) fire situation “anchorage”

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

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



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

ℓ_s = lap length

$\varnothing$ = nominal diameter of bar

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

τ_T = bond stress when exposed to fire

Critical temperature-dependent bond stress, τ_c, concerning “overlap joint” for Hilti HIT-HY 150 MAX injection adhesive in relation to fire resistance class and required minimum concrete coverage c.

<table>
<tr><th>Clear concrete cover c</th><th colspan="5">Max. bond stress, τ_c [N/mm²]</th></tr>
<tr><th>[mm]</th><th>R30</th><th>R60</th><th>R90</th><th>R120</th><th>R180</th></tr>
<tr><td>30</td><td>0,6</td><td>0,3</td><td rowspan="2">0</td><td rowspan="5">0</td><td rowspan="9">0</td></tr>
<tr><td>35</td><td>0,7</td><td>0,3</td></tr>
<tr><td>40</td><td>0,9</td><td>0,4</td><td>0,2</td></tr>
<tr><td>45</td><td>1,0</td><td>0,4</td><td>0,2</td></tr>
<tr><td>50</td><td>1,2</td><td>0,5</td><td>0,3</td></tr>
<tr><td>55</td><td>1,5</td><td>0,6</td><td>0,3</td><td>0,2</td></tr>
<tr><td>60</td><td>1,8</td><td>0,8</td><td>0,4</td><td>0,3</td></tr>
<tr><td>65</td><td>2,2</td><td>0,9</td><td>0,5</td><td>0,3</td></tr>
<tr><td>70</td><td>2,7</td><td>1,0</td><td>0,5</td><td>0,3</td></tr>
<tr><td>75</td><td>3,4</td><td>1,2</td><td>0,6</td><td>0,4</td><td>0,2</td></tr>
<tr><td>80</td><td rowspan="25">3,7</td><td>1,5</td><td>0,7</td><td>0,5</td><td>0,3</td></tr>
<tr><td>85</td><td>1,7</td><td>0,8</td><td>0,5</td><td>0,3</td></tr>
<tr><td>90</td><td>2,0</td><td>1,0</td><td>0,6</td><td>0,3</td></tr>
<tr><td>95</td><td>2,2</td><td>1,1</td><td>0,7</td><td>0,4</td></tr>
<tr><td>100</td><td>2,4</td><td>1,3</td><td>0,8</td><td>0,4</td></tr>
<tr><td>105</td><td>2,7</td><td>1,5</td><td>0,9</td><td>0,5</td></tr>
<tr><td>110</td><td>3,0</td><td>1,7</td><td>1,1</td><td>0,5</td></tr>
<tr><td>115</td><td>3,4</td><td>2,0</td><td>1,2</td><td>0,6</td></tr>
<tr><td>120</td><td rowspan="17">3,7</td><td>2,2</td><td>1,4</td><td>0,6</td></tr>
<tr><td>125</td><td>2,5</td><td>1,6</td><td>0,7</td></tr>
<tr><td>130</td><td>2,8</td><td>1,9</td><td>0,8</td></tr>
<tr><td>135</td><td>3,0</td><td>2,1</td><td>0,9</td></tr>
<tr><td>140</td><td>3,4</td><td>2,3</td><td>1,0</td></tr>
<tr><td>145</td><td rowspan="12">3,7</td><td>2,6</td><td>1,1</td></tr>
<tr><td>150</td><td>2,9</td><td>1,2</td></tr>
<tr><td>155</td><td>3,1</td><td>1,3</td></tr>
<tr><td>160</td><td>3,4</td><td>1,4</td></tr>
<tr><td>165</td><td>3,5</td><td>1,5</td></tr>
<tr><td>170</td><td rowspan="7">3,7</td><td>1,6</td></tr>
<tr><td>175</td><td>1,7</td></tr>
<tr><td>180</td><td>1,8</td></tr>
<tr><td>185</td><td>1,9</td></tr>
<tr><td>190</td><td>2,1</td></tr>
<tr><td>195</td><td>2,2</td></tr>
<tr><td>200</td><td>2,3</td></tr>
</table>

Minimum anchorage length

According to ETA-08/0202, the multiplication factor for minimum anchorage length is 1,0 for all approved drilling methods.

Minimum anchorage and lap lengths for C20/25; maximum hole lengths

Rebar		Hammer drilling, Compressed air drilling		
Diameter d_s [mm]	$f_{y,k}$ [N/mm²]	$l_{b,min}$* [mm]	$l_{0,min}$ * [mm]	l_{max} [mm]
8	500	113	200	1000
10	500	142	200	1000
12	500	170	200	1000
14	500	198	210	1000
16	500	227	240	1500
18	500	255	270	2000
20	500	284	300	2000
22	500	312	330	2000
24	500	340	360	2000
25	500	354	375	2000

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