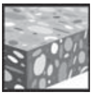
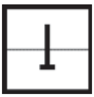
HDA Design anchor

Anchor version		Benefits
	HDA-P HDA-PR HDA-PF Anchor for pre-setting	- suitable for non-cracked and cracked concrete C 20/25 to C 50/60 - mechanical interlock (undercut) - low expansion force (thus small edge distance / spacing) - automatic undercutting (without special undercutting tool) - high loading capacity, performance of a headed stud - complete system (anchor, stop drill bit, setting tool, drill hammer) - setting mark on anchor for control (easy and safe) - completely removable - test reports: fire resistance, fatigue, shock, seismic
	HDA-T HDA-TR HDA-TF Anchor for through-fasting	

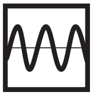

Concrete


Tensile zone

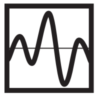

Performance of a headed stud

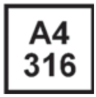

Small edge distance and spacing


Fire resistance


Fatigue


Shock


Seismic



Corrosion resistance


Nuclear power plant approval

European Technical Approval

CE conformity


PROFIS Anchor design software

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval [a)]	CSTB, Paris	ETA-99/0009 / 2013-03-25
ICC-ES report incl. seismic	ICC evaluation service	ESR 1546 / 2012-03-01
Shockproof fastenings in civil defence installations	Federal Office for Cicil Protection, Bern	BZS D 09-601/ 2009-10-21
Nuclear power plants	DIBt, Berlin	Z-21.1-1696 / 2011-02-16
Fatigue loading	DIBt, Berlin	Z-21.1-1693 / 2011-10-01
Fire test report	IBMB, Braunschweig	UB 3039/8151-CM / 2001-01-31
Assessment report (fire)	warringtonfire	WF 166402 / 2007-10-26

a) All data for HDA-P(R) and HDA-T(R) given in this section according ETA-99/0009, issue 2013-03-25. Sherardized versions HDA-PF and HDA-TF anchors are not covered by the approvals.

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
- Concrete as specified in the table
- *Steel* failure
- Minimum base material thickness
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²

Mean ultimate resistance

		Non-cracked concrete				Cracked concrete			
Anchor size		**M10**	**M12**	**M16**	**M20** a)	**M10**	**M12**	**M16**	**M20** a)
Tensile $N_{Ru,m}$									
HDA-P(F), HDA-T(F) b)	[kN]	*48,7*	*70,9*	*133,3*	*203,2*	29,4	41,1	88,1	111,6
HDA-PR, HDA-TR	[kN]	*48,7*	*70,9*	*133,3*	*203,2*	29,4	41,1	88,1	111,6
Shear $V_{Ru,m}$									
HDA-P, HDA-PF b)	[kN]	*23,3*	*31,7*	*65,6*	*97,4*	*23,3*	*31,7*	*65,6*	*97,4*
HDA-PR	[kN]	*24,3*	*36,0*	*66,7*	-	*24,3*	*36,0*	*66,7*	-
HDA-T, HDA-TF b) c)	[kN]	*68,8*	*84,7*	*148,2*	*216,9*	*68,8*	*84,7*	*148,2*	*216,9*
HDA-TR c)	[kN]	*75,1*	*92,1*	*160,9*	-	*75,1*	*92,1*	*160,9*	-

a) HDA M20: only a galvanized 5µm version is available
b) HDA-PF and HDA-TF anchors are not covered by ETA-99/0009
c) Values are valid for minimum thickness of the base plate $t_{fix,min}$ without use of centering washer (see setting details)

Characteristic resistance

		Non-cracked concrete				Cracked concrete			
Anchor size		**M10**	**M12**	**M16**	**M20** a)	**M10**	**M12**	**M16**	**M20** a)
Tensile N_{Rk}									
HDA-P(F), HDA-T(F) b)	[kN]	*46*	*67*	*126*	*192*	25	35	75	95
HDA-PR, HDA-TR	[kN]	*46*	*67*	*126*	-	25	35	75	-

Non-cracked and cracked concrete

Anchor size		**M10**	**M12**	**M16**	**M20** a)
Shear V_{Rk}					
HDA-P, HDA-PF b)	[kN]	*22*	*30*	*62*	*92*
HDA-PR		*23*	*34*	*63*	-

Anchor size		M10	M10	M12	M12	M12	M16	M16	M16	M16	M16	M20 a)	M20 a)	M20 a)	M20 a)
for t_{fix}	[mm]	10≤	15≤	10≤	15≤	20≤	15≤	20≤	25≤	30≤	35≤	20≤	25≤	40≤	55≤
	[mm]	<15	≤20	<15	<20	≤50	<20	<25	<30	<35	≤60	<25	<40	<55	≤100
HDA-T, HDA-TF b)	[kN]	*65* c)	*65*	*80* c)	*80*	*100*	*140* c)	*140*	*155*	*170*	*190*	*205* c)	*205*	*235*	*250*

Anchor size		M10	M10	M12	M12	M12	M12	M16	M16	M16	M16	M20 a)
for t_{fix}	[mm]	10≤	15≤	10≤	15≤	20≤	30≤	20≤	25≤	30≤	35≤	-
	[mm]	<15	≤20	<15	<20	<30	≤50	<25	<30	<35	≤60	-
HDA-TR	[kN]	*71* c)	*71*	*87* c)	*87*	*94*	*109*	*152* c)	*152*	*158*	*170*	-

a) HDA M20: only a galvanized 5µm version is available
b) HDA-PF and HDA-TF anchors are not covered by ETA-99/0009
c) With use of centering washer (t = 5 mm) only

Design resistance

		Non-cracked concrete				Cracked concrete			
Anchor size		**M10**	**M12**	**M16**	**M20 a)**	**M10**	**M12**	**M16**	**M20 a)**
Tensile N_{Rd}									
HDA-P(F), HDA-T(F) b)	[kN]	30,7	44,7	84,0	128,0	16,7	23,3	50,0	63,3
HDA-PR, HDA-TR	[kN]	28,8	41,9	78,8	-	16,7	23,3	50,0	-

Non-cracked and cracked concrete

Anchor size		**M10**	**M12**	**M16**	**M20 a)**
Shear V_{Rd}					
HDA-P, HDA-PF b)	[kN]	17,6	24,0	49,6	73,6
HDA-PR		17,3	25,6	47,4	-

		M10		M12			M16					M20 a)			
for t_{fix}	[mm]	10≤	15≤	10≤	15≤	20≤	15≤	20≤	25≤	30≤	35≤	20≤	25≤	40≤	55≤
	[mm]	<15	≤20	<15	<20	≤50	<20	<25	<30	<35	≤60	<25	<40	<55	≤100
HDA-T, HDA-TF b)	[kN]	22 c)	22	27 c)	27	33	47 c)	47	52	57	63	68 c)	68	79	83

		M10		M12				M16				M20 a)
for t_{fix}	[mm]	10≤	15≤	10≤	15≤	20≤	30≤	20≤	25≤	30≤	35≤	-
	[mm]	<15	≤20	<15	<20	<30	≤50	<25	<30	<35	≤60	-
HDA-TR	[kN]	24 c)	24	29 c)	29	31	36	51 c)	51	53	57	-

a) HDA M20: only a galvanized 5µm version is available
b) HDA-PF and HDA-TF anchors are not covered by ETA-99/0009
c) With use of centering washer (t = 5 mm) only

Recommended loads

		Non-cracked concrete				Cracked concrete			
Anchor size		**M10**	**M12**	**M16**	**M20 a)**	**M10**	**M12**	**M16**	**M20 a)**
Tensile N_{Rec} b)									
HDA-P(F), HDA-T(F) c)	[kN]	15,3	22,3	42	64	8,3	11,6	25	31,6
HDA-PR, HDA-TR	[kN]	15,3	22,3	42	-	8,3	11,6	25	-

Non-cracked and cracked concrete

Anchor size		**M10**	**M12**	**M16**	**M20 a)**
Shear V_{Rec} b)					
HDA-P, HDA-PF c)	[kN]	7,3	10	20,6	30,6
HDA-PR		7,6	11,3	21	-

		M10		M12			M16					M20 a)			
for t_{fix}	[mm]	10≤	15≤	10≤	15≤	20≤	15≤	20≤	25≤	30≤	35≤	20≤	25≤	40≤	55≤
	[mm]	<15	≤20	<15	<20	≤50	<20	<25	<30	<35	≤60	<25	<40	<55	≤100
HDA-T, HDA-TF c)	[kN]	21,7 d)	21,7	26,7 d)	26,7	33,3	46,7 d)	46,7	51,7	56,7	63,7	68,3 d)	68,3	78,3	83,3

		M10		M12				M16				M20 a)
for t_{fix}	[mm]	10≤	15≤	10≤	15≤	20≤	30≤	20≤	25≤	30≤	35≤	-
	[mm]	<15	≤20	<15	<20	<30	≤50	<25	<30	<35	≤60	-
HDA-TR	[kN]	23,7 d)	23,7	29 d)	29	31,3	36,3	50,7 d)	50,7	52,7	56,7	-

a) HDA M20: only a galvanized 5µm version is available
b) With overall global safety factor γ = 3. The recommended loads vary according to the safety factor requirement from national regulations.
c) HDA-PF and HDA-TF anchors are not covered by ETA-99/0009
d) With use of centering washer (t = 5 mm) only

Materials

Mechanical properties of HDA

Anchor size		HDA-P(F), HDA-T(F)				HDA-PR, HDA-TR		
		M10	M12	M16	M20 [a)]	M10	M12	M16
Anchor bolt								
Nominal tensile strength f_{uk}	[N/mm²]	800	800	800	800	800	800	800
Yield strength f_{yk}	[N/mm²]	640	640	640	640	600	600	600
Stressed cross-section A_s	[mm²]	58,0	84,3	157	245	58,0	84,3	157
Moment of resistance W_{el}	[mm³]	62,3	109,2	277,5	540,9	62,3	109,2	277,5
Characteristic bending resistance without sleeve $M^0_{Rk,s}$ [b)]	[Nm]	60	105	266	519	60	105	266
Anchor sleeve								
Nominal tensile strength f_{uk}	[N/mm²]	850	850	700	550	850	850	700
Yield strength f_{yk}	[N/mm²]	600	600	600	450	600	600	600

a) HDA M20: only a galvanized 5µm version is available

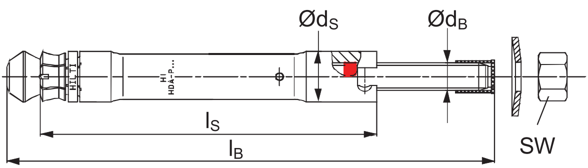
b) The recommended bending moment of the HDA anchor bolt may be calculated from $M_{rec} = M_{Rd,s} / \gamma_F = M_{Rk,s} / (\gamma_{Ms} \cdot \gamma_F) = (1,2 \cdot W_{el} \cdot f_{uk}) / (\gamma_{Ms} \cdot \gamma_F)$, where the partial safety factor for bolts of grade 8.8 is γ_{MS} = 1,25, for A4-80 equal to 1,33 and the partial safety factor for action may be taken as γ_F = 1,4. In case of HDA-T/TR/TF the bending capacity of the sleeve is neglected, only the capacity of the bolt is taken into account.

Material quality

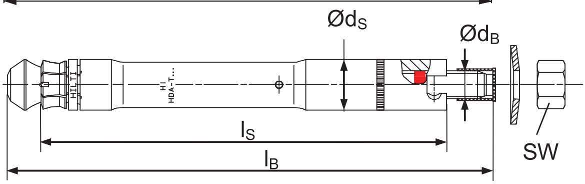
Part	Material
HDA-P / HDA-T (Carbon steel version)	
Sleeve:	Machined steel with brazed tungsten carbide tips, galvanised to min. 5 µm
Bolt M10 - M16:	Cold formed steel, grade 8.8, galvanised to min. 5 µm
Bolt M20:	Cone machined, rod grade 8.8, galvanised to min. 5 µm
HDA-PR / HDA-TR (Stainless steel version)	
Sleeve:	Machined stainless steel with brazed tungsten carbide tips
Bolt M10 - M16:	Cone/rod: machined stainless steel
HDA-PF / HDA-TF (Sherardized version)	
Sleeve:	Machined steel with brazed tungsten carbide tips, shearadized
Bolt M10 - M16:	Cold formed steel, grade 8.8, shearadized

Anchor dimensions

HDA-P / HDA-PR / HDA-PF



HDA-T / HDA-TR / HDA-TF



Dimensions of HDA

Anchor size			HDA-P / HDA-PR / HDA-PF / HDA-T / HDA-TR / HDA-TF						
			M10	M12		M16		M20	
			x100/20	x125/30	x125/50	x190/40	x190/60	x250/50	x250/100
Length code letter			I	L	N	R	S	V	X
Total length of bolt	l_B	[mm]	150	190	210	275	295	360	410
Diameter of bolt	d_B	[mm]	10	12		16		20	
Total length of sleeve									
HDA-P	l_s	[mm]	100	125	125	190	190	250	250
HDA-T	l_s	[mm]	120	155	175	230	250	300	350
Max. diameter of sleeve	d_S	[mm]	19	21		29		35	
Washer diameter	d_w	[mm]	27,5	33,5		45,5		50	
Width across flats	S_w	[mm]	17	19		24		30	

Setting

Drilling

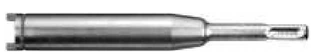
The stop drill is required for drilling in order to achieve the correct hole depth.

Anchor	Stop drill bit with TE-C (SDS plus) connection end	Stop drill bit with TE-Y (SDS max) connection end
HDA-P/ PF/ PR M10x100/20	TE-C-HDA-B 20*100	TE-Y-HDA-B 20*100
HDA-T/ TF/ TR M10x100/20	TE-C-HDA-B 20*120	TE-Y-HDA-B 20*120
HDA-P/ PF/ PR M12*125/30 HDA-P/ PF/ PR M12*125/50	TE-C HDA-B 22*125	TE-Y HDA-B 22*125
HDA-T/ TF/ TR M12*125/30	TE-C HDA-B 22*155	TE-Y HDA-B 22*155
HDA-T/ TF/ TR M12*125/50	TE-C HDA-B 22*175	TE-Y HDA-B 22*175
HDA-P/ PF/ PR M16 *190/40 HDA-P/ PF/ PR M16 *190/60		TE-Y HDA-B 30*190
HDA-T/ TF/ TR M16*190/40		TE-Y HDA-B 30*230
HDA-T/ TF/ TR M16*190/60		TE-Y HDA-B 30*250
HDA-P M20 *250/50 HDA-P M20 *250/100		TE-Y HDA-B 37*250
HDA-T M20*250/50		TE-Y HDA-B 37*300
HDA-T M20*250/100		TE-Y HDA-B 37*350

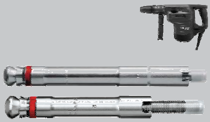
Setting

Drilling hammer

Setting tool



The setting system (tool and setting tool) is required for transferring the specific energy for the undercutting process.

Anchor 	TE 24 a) TE 25 a)	TE 35	TE 40 TE 40 AVR	TE 56 TE 56-ATC	TE 60 TE 60-ATC	TE 70 TE 70-ATC	TE 75	TE 76 TE 76-ATC	TE 80-ATC TE 80-ATC AVR	Setting tool 
HDA-P/T20-M10x100/20	■		■							TE-C-HDA-ST 20 M10
				■	■					TE-Y-HDA-ST 20 M10
HDA-P/T 22-M12x125/30 HDA-P/T 22-M12x125/50	■		■							TE-C-HDA-ST 22 M12
	■		■	■	■					TE-Y-HDA-ST 22 M12
HDA-P/T 30-M16x190/40 HDA-P/T 30-M16x190/60						■	■	■	■	TE-Y-HDA-ST 30 M16
HDA-P/T 37-M20x250/50 HDA-P/T 37-M20x250/100						■		■	■	TE-Y-HDA-ST 37 M20

a) 1st gear

Anchor 	TE 24 a) TE 25 a)	TE 35	TE 40 TE 40 AVR	TE 56 TE 56-ATC	TE 60 TE 60-ATC	TE 70 TE 70-ATC	TE 75	TE 76 TE 76-ATC	TE 80-ATC TE 80-ATC AVR	Setting tool 
HDA-PR/TR20-M10x100/20	■	■	■							TE-C-HDA-ST 20 M10
				■	■					TE-Y-HDA-ST 20 M10
HDA-PR/TR 22-M12x125/30 HDA-PR/TR 22-M12x125/50	■	■	■							TE-C-HDA-ST 22 M12
	■	■	■	■	■					TE-Y-HDA-ST 22 M12
HDA-PR/TR 30-M16x190/40 HDA-PR/TR 30-M16x190/60						■	■	■	■	TE-Y-HDA-ST 30 M16

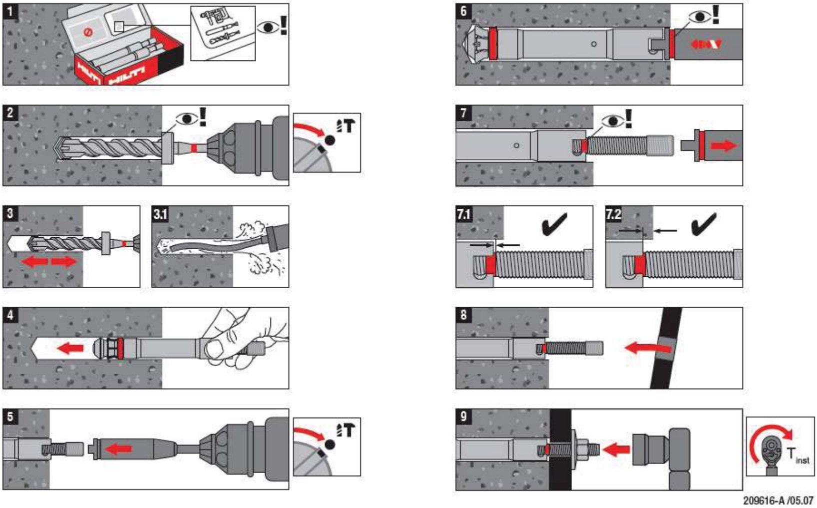
a) 1st gear

Anchor 	TE 24 a) TE 25 a)	TE 35	TE 40 TE 40 AVR	TE 56 TE 56-ATC	TE 60 TE 60-ATC	TE 70 TE 70-ATC	TE 75	TE 76 TE 76-ATC	TE 80-ATC TE 80-ATC AVR	Setting tool 
HDA-PF/TF 20-M10x100/20		■	■		■					TE-C-HDA-ST 20 M10
HDA-PF/TF 22-M12x125/30 HDA-PF/TF 22-M12x125/50		■	■		■					TE-C-HDA-ST 22 M12
HDA-PF/TF 30-M16x190/40 HDA-PF/TF 30-M16x190/60						■	■	■	■	TE-Y-HDA-ST 30 M16

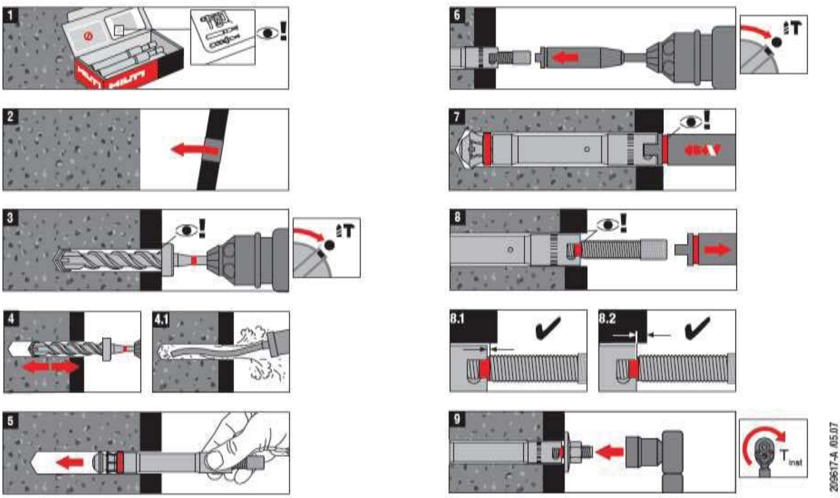
a) 1st gear

Setting instruction

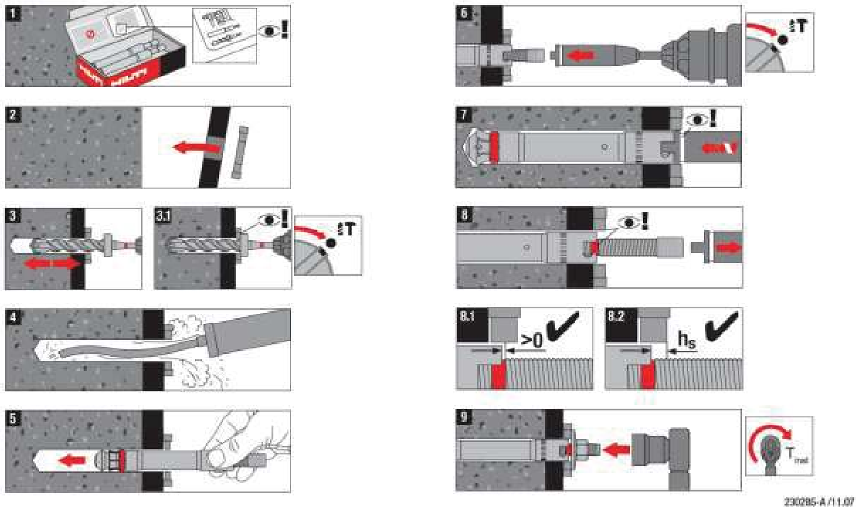
HDA-P, HDA-PR, HDA-PF



HDA-T, HDA-TR, HDA-TF



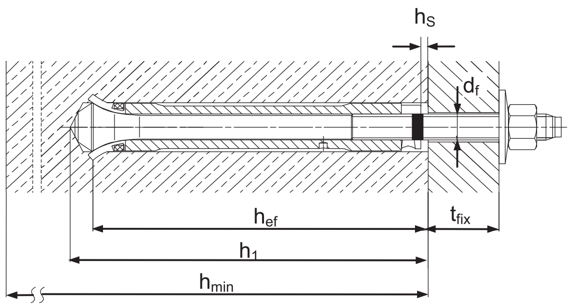
HDA-F-CW, HDA-R-CW (to be set with HDA-T, HDA-TF, HDA-TR)



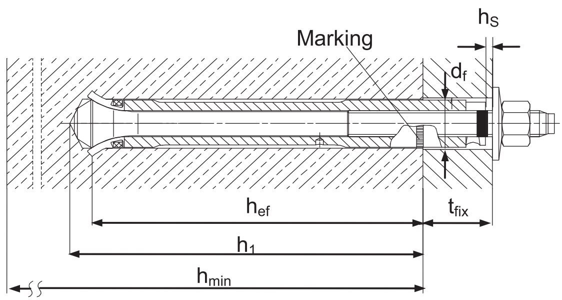
For detailed information on installation see instruction for use given with the package of the product.

Setting details

HDA-P / HDA-PR / HDA-PF



HDA-T / HDA-TR / HDA-TF

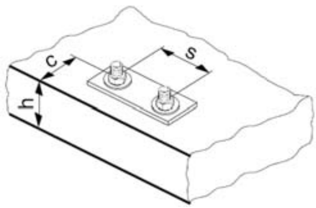


Anchor size			HDA-P / HDA-PR / HDA-PF / HDA-T / HDA-TR / HDA-TF						
			M10	M12		M16		M20	
			x100/20	x125/30	x125/50	x190/40	x190/60	x250/50	x250/100
Head marking			I	L	N	R	S	V	X
Nominal drill bit diameter	d_0	[mm]	20	22		30		37	
Cutting diameter of drill bit	$d_{cut,min}$	[mm]	20,10	22,10		30,10		37,15	
	$d_{cut,max}$	[mm]	20,55	22,55		30,55		37,70	
Depth of drill hole [a]	$h_1 \geq$	[mm]	107	133		203		266	
Anchorage depth	h_{ef}	[mm]	100	125		190		250	
Sleeve recess	$h_{s,min}$	[mm]	2	2		2		2	
	$h_{s,max}$	[mm]	6	7		8		8	
Torque moment	T_{inst}	[Nm]	50	80		120		300	
For HDA-P/-PF/-PR									
Clearance hole	d_f	[mm]	12	14		18		22	
Minimum base material thickness	h_{min}	[mm]	180	200		270		350	
Fixture thickness	$t_{fix,min}$	[mm]	0	0		0		0	
	$t_{fix,max}$	[mm]	20	30	50	40	60	50	100
For HDA-T/-TF/-TR									
Clearance hole	d_f	[mm]	21	23		32		40	
Minimum base material thickness	h_{min}	[mm]	200-t_{fix}	230-t_{fix}	250-t_{fix}	310-t_{fix}	330-t_{fix}	400-t_{fix}	450-t_{fix}
Min. fixture thickness									
-Tension load only!	$t_{fix,min}$	[mm]	10	10		15		20	50
-Shear load - **without** use of centering washer	$t_{fix,min}$	[mm]	15	15		20		25	50
-Shear load - **with** use of centering washer	$t_{fix,min}$ [b]	[mm]	10	10		15		20	-
Max. fixture thickness	$t_{fix,max}$	[mm]	20	30	50	40	60	50	100

a) use specified stop drill bit
b) with use of centering washer a reduction of $t_{fix,min}$ is possible for shear loading, details see ETA-99/0009

Setting parameters

<table>
<tr><td colspan="3" rowspan="3">Anchor size</td><td colspan="7">HDA-P / HDA-PR / HDA-PF / HDA-T / HDA-TR / HDA-TF</td></tr>
<tr><td>M10</td><td colspan="2">M12</td><td colspan="2">M16</td><td colspan="2">M20</td></tr>
<tr><td>x100/20</td><td>x125/30</td><td>x125/50</td><td>x190/40</td><td>x190/60</td><td>x250/50</td><td>x250/100</td></tr>
<tr><td>Minimum spacing</td><td>s_{min}</td><td>[mm]</td><td>100</td><td colspan="2">125</td><td colspan="2">190</td><td colspan="2">250</td></tr>
<tr><td>Minimum edge distance</td><td>c_{min}</td><td>[mm]</td><td>80</td><td colspan="2">100</td><td colspan="2">150</td><td colspan="2">200</td></tr>
<tr><td>Critical spacing for splitting failure</td><td>$s_{cr,sp}$</td><td>[mm]</td><td>300</td><td colspan="2">375</td><td colspan="2">570</td><td colspan="2">750</td></tr>
<tr><td>Critical edge distance for splitting failure</td><td>$c_{cr,sp}$</td><td>[mm]</td><td>150</td><td colspan="2">190</td><td colspan="2">285</td><td colspan="2">375</td></tr>
<tr><td>Critical spacing for concrete cone failure</td><td>$s_{cr,N}$</td><td>[mm]</td><td>300</td><td colspan="2">375</td><td colspan="2">570</td><td colspan="2">750</td></tr>
<tr><td>Critical edge distance for concrete cone failure</td><td>$c_{cr,N}$</td><td>[mm]</td><td>150</td><td colspan="2">190</td><td colspan="2">285</td><td colspan="2">375</td></tr>
</table>



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

Critical spacing and critical edge distance for splitting failure apply only for non-cracked concrete. For cracked concrete only the critical spacing and critical edge distance for concrete cone failure are decisive.

Simplified design method

Simplified version of the design method according ETAG 001, Annex C. Design resistance according data given in ETA-99/0009, issue 2013-03-25.

- 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. 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.

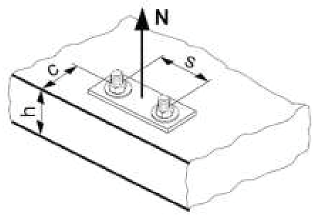
For more complex fastening applications please use the anchor design software PROFIS Anchor.

Tension loading

The design tensile resistance is the lower value of

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

$\gamma_{Ms} \geq 1.5$

Anchor size			M10	M12	M16	M20 [a]
$N_{Rd,s}$	HDA-P(F), HDA-T(F)	[kN]	30,7	44,7	84,0	128,0
	HDA-PR, HDA-TR	[kN]	28,8	41,9	78,8	-

a) HDA M20: only a galvanized 5µm version is available

Design pull-out resistance [a] $N_{Rd,p} = N^0_{Rd,p} \cdot f_B$ (only in cracked concrete)

$\gamma_{Mp} \geq 1.5$

		Non-cracked concrete				Cracked concrete			
Anchor size		M10	M12	M16	M20 [b]	M10	M12	M16	M20 [b]
$N^0_{Rd,p}$	[kN]	-	-	-	-	16,7	23,3	50,0	63,3

a) Design pull-out resistance is not decisive in non-cracked concrete
b) HDA M20: only a galvanized 5µm version is available

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

$\gamma_{Mc} \geq 1.5$

		Non-cracked concrete				Cracked concrete			
Anchor size		M10	M12	M16	M20 [b]	M10	M12	M16	M20 [b]
$N^0_{Rd,c}$	[kN]	38,7	54,1	101,4	153,1	27,7	38,7	72,5	109,3

a) Splitting resistance must only be considered for non-cracked concrete
b) HDA M20: only a galvanized 5µm version is available

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
b) For design data of $f_{ck,cube}$ = 15 and 20, please contact Hilti technical advisory service

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} given in the table with the setting details. These influencing factors must be considered for every 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} given in the table with the setting details. This influencing factor must be considered for every anchor spacing.

Influence of base material thickness

h/h_{ef}	2	2,2	2,4	2,6	2,8	3	3,2	3,4	3,6	≥ 3,68
$f_{h,sp} = [h/(2 \cdot h_{ef})]^{2/3}$	1	1,07	1,13	1,19	1,25	1,31	1,37	1,42	1,48	1,5

Influence of reinforcement

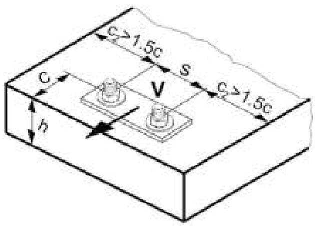
Anchor size	M8	M10	M12	M16	M20	M24
$f_{re,N} = 0{,}5 + h_{ef}/200mm \leq 1$	0,8 a)	0,85 a)	0,9 a)	1	1	1

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: $V_{Rd,cp} = V^0_{Rd,cp} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{re,N}$
- Concrete edge resistance: $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_ß \cdot f_h \cdot f_4$



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

$\gamma_{Ms} \geq 1.25$

Anchor size			M10	M12	M16	M20 a)
$V_{Rd,s}$	HDA-P, HDA-PF	[kN]	17,6	24,0	49,6	73,6
	HDA-PR	[kN]	17,3	25,6	47,4	-
	HDA-T, HDA-TF b)	[kN]	43,3	53,3	93,3	136,7
	HDA-TR b)	[kN]	53,4	65,4	114,3	-

a) HDA M20: only a galvanized 5µm version is available
b) Values are valid for minimum thickness of the base plate $t_{fix,min}$. For characteristic resistance to shear loads with thicker base plates see ETA-99/0009 or use PROFIS software.

Design concrete pryout resistance $V_{Rd,cp} = V^0_{Rd,cp} \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{re,N}$

$\gamma_{Mc} = 1.5$

		Non-cracked concrete				Cracked concrete			
Anchor size		M10	M12	M16	M20 a)	M10	M12	M16	M20 a)
$V^0_{Rd,cp}$	[kN]	77,5	108,3	202,9	306,2	55,3	77,3	144,9	218,7

a) HDA M20: only a galvanized 5µm version is available

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

$\gamma_{Mc} = 1.5$

		Non-cracked concrete				Cracked concrete			
Anchor size		M10	M12	M16	M20 b)	M10	M12	M16	M20 b)
c_{min}	[mm]	80	100	150	200	80	100	150	200
$V^0_{Rd,c}$	[kN]	8,5	12,8	26,1	45,0	6,1	9,2	18,6	32,1

a) For anchor groups with more than two anchors only the anchors close to the edge must be considered.
b) HDA M20: only a galvanized 5µm version is available

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
b) For design data of $f_{ck,cube}$ = 15 and 20, please contact Hilti technical advisory service

Influence of edge distance a)

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

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

Influence of anchor spacing a)

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

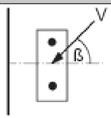
a) The anchor spacing shall not be smaller than the minimum anchor spacing s_{min} given in the table with the setting details. This influencing factor must be considered for every anchor spacing.

Influence of dense reinforcement

Anchor size	M8	M10	M12	M16	M20	M24
$f_{re,N}$ = 0,5 + h_{ef}/200mm ≤ 1	0,8 a)	0,85 a)	0,9 a)	1	1	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.

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

Angle ß	0° - 55°	60°	65°	70°	75°	80°	85°	90° - 180°
$f_ß$ 	1	1,07	1,14	1,23	1,35	1,50	1,71	2

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”.