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European Technical Assessment

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General Part

**Technical Assessment Body issuing the
European Technical Assessment**

ZAG Ljubljana

Trade name of the construction product

R-HPT III and R-HPT III A4

**Product family to which the construction
product belongs**

**33: Torque controlled expansion
anchor size M8, M10 and M12 for
use in cracked and uncracked
concrete**

Manufacturer

**Rawlplug S.A.
ul. Kwidzyńska 6
PL-51-416 Wrocław
Poland**

www.rawlplug.com

Manufacturing plant

Manufacturing Plant No 2

**This European Technical Assessment
contains**

**18 pages including 3 annexes, which form
an integral part of the document**

**This European Technical Assessment is
issued in according to Regulation (EU)
No 305/2011, on the basis of**

**EAD 330232-01-0601,
edition December 2019**

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Specific Parts

1 Technical description of the product

The R-HPT III and R-HPT III A4 in the ranges M8, M10 and M12 is a fastener made of zinc plated carbon steel and stainless steel which is placed into a drilled hole and anchored by torque-controlled expansion.

It can be used for variable, effective anchorage depth.

For the anchor and installed anchor see Figures given in Annex A (1/5) and A (2/5).

2 Specification of the intended use(s) in accordance with the applicable European Assessment Document (hereinafter EAD)

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

The provisions made in this European Technical Assessment are based on an assumed working life of the anchor of 50 years. The indications given on the working life cannot be interpreted as a guarantee given by the manufacturer, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

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

3.1 Mechanical resistance and stability (BWR 1)

The basic work requirements for mechanical resistance and stability are listed in Annexes C (1/5), C (2/5) and C (3/5) for static and quasi-static loading.

3.2 Safety in case of fire (BWR 2)

The basic work requirements for safety in case of fire are listed in Annexes C (4/5) and C(5/5).

3.3 General aspects relating to fitness for use

Durability and serviceability are only ensured if specifications of intended use according to Annex B are kept.

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

According to the decision 96/582/EC of the European Commission¹ the system of assessment and verification of constancy of performance (see Annex V to regulation (EU) No 305/2011) 1 apply.

5 Technical details necessary for the implementation of the AVCP system, as provided for on the applicable EAD

Technical details necessary for the implementation of the AVCP system are laid down in chapter 3 of EAD 330232-01-0601.

Issued in Ljubljana on 23.05.2023

Signed by:

Franc Capuder, M.Sc., Research Engineer

Head of Service of TAB



¹ Official Journal of the European Communities L 254 of 8.10.1996

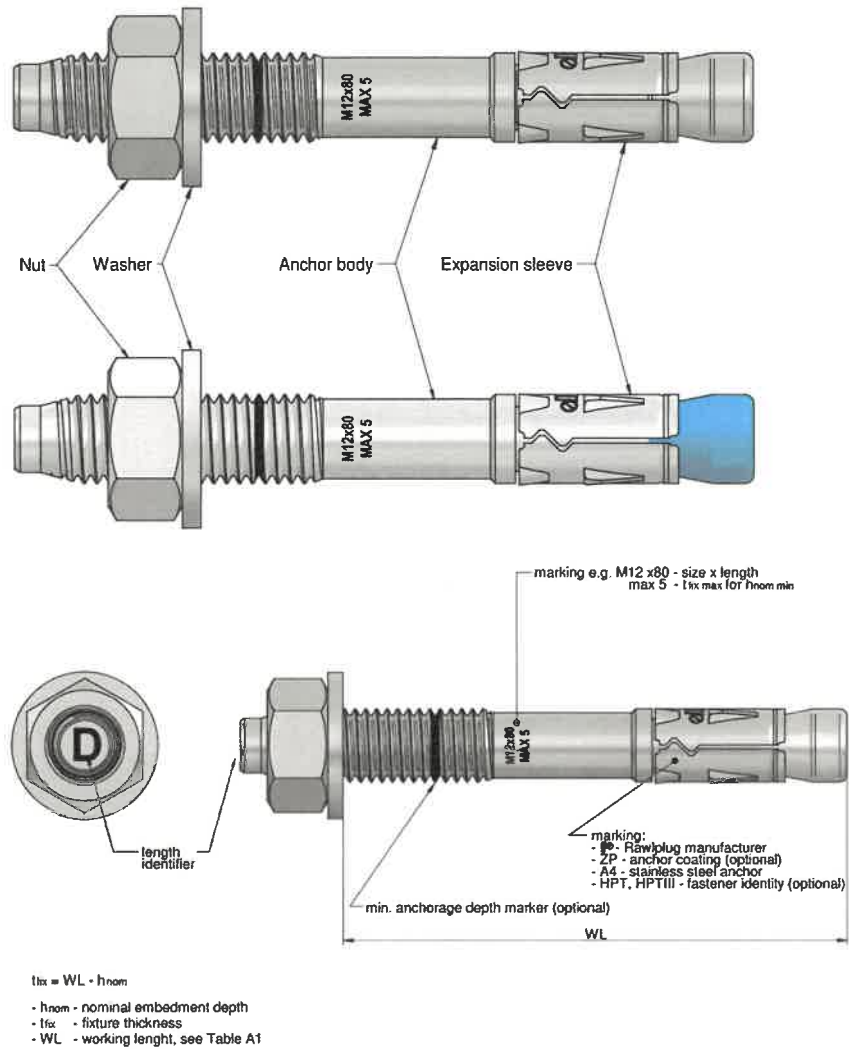


Figure A1: Anchor R-HPT III

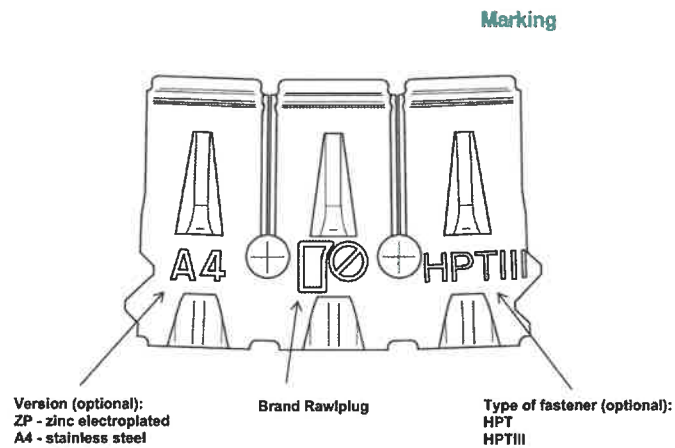


Figure A2: Markings on expansion sleeve

R-HPT III and R-HPT III A4	Annex A (1/5)
Product description Product	

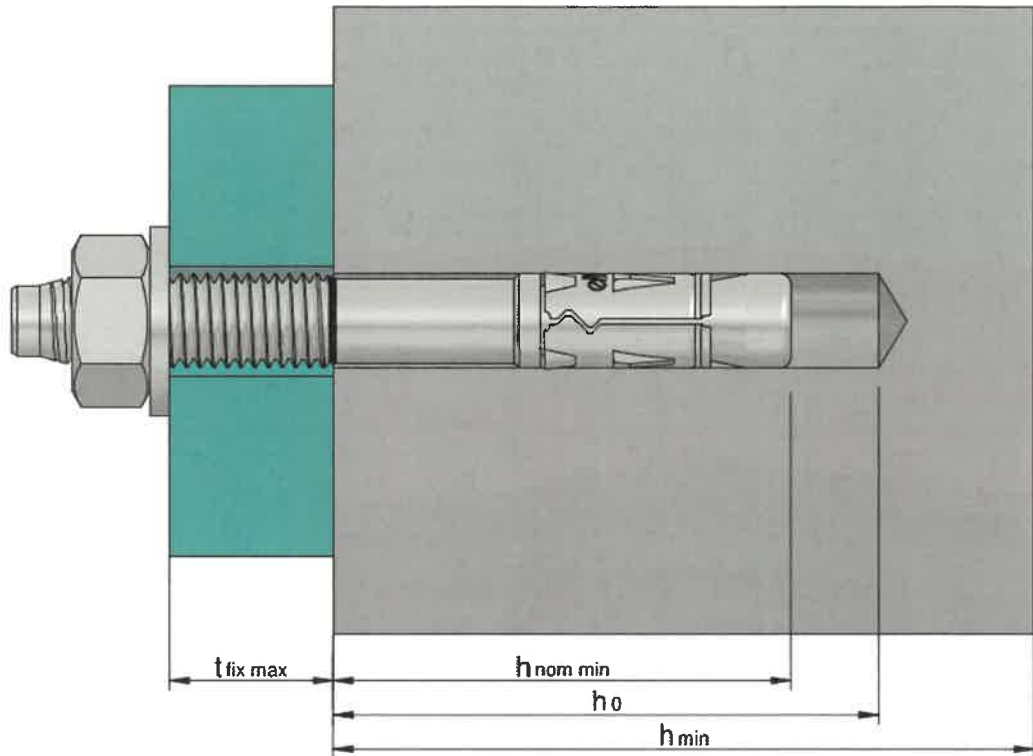


Figure A3: Installation parameters for R-HPT III anchor

R-HPT III and R-HPT III A4	Annex A (2/5)
Product description Installation condition	

Table A1: Dimensions and marking for R-HPT III and R-HPT III A4

Bolt length [mm]	Marking	Sizes					
		M8		M10		M12	
		t _{fix,max} [mm]	WL [mm]	t _{fix,max} [mm]	WL [mm]	t _{fix,max} [mm]	WL [mm]
50	A	/	/	/	/	/	/
55	a	5	45	/	/	/	/
60	B	10	50	/	/	/	/
65	b	15	55	5	53	/	/
70	#	20	60	10	58	/	/
75	c	25	65	15	63	/	/
80	D	30	70	20	68	5	65
85	d	35	75	25	73	10	70
90	E	40	80	30	78	15	75
95	e	45	85	35	83	20	80
100	F	50	90	40	88	25	85
105	f	55	95	45	93	30	90
110	G	60	100	50	98	35	95
115	g	65	105	55	103	40	100
120	H	70	110	60	108	45	105
125	h	75	115	65	113	50	110
130	J	80	120	70	118	55	115
135	I	85	125	75	123	60	120
140	K	90	130	80	128	65	125
145	k	95	135	85	133	70	130
150	L	100	140	90	138	75	135
155	2	105	145	95	143	80	140
160	M	110	150	100	148	85	145
165	m	115	155	105	153	90	150
170	N	120	160	110	158	95	155
175	n	125	165	115	163	100	160

R-HPT III and R-HPT III A4

Product description
Dimensions and marking

Annex A (3/5)

Table A2: Dimensions and marking for R-HPT III and R-HPT III A4

Bolt length [mm]	Marking	Sizes					
		M8		M10		M12	
		t _{fix,max} [mm]	WL [mm]	t _{fix,max} [mm]	WL [mm]	t _{fix,max} [mm]	WL [mm]
180	P	130	170	120	168	105	165
185	o	135	175	125	173	110	170
190	W	/	/	130	178	115	175
195	z	/	/	135	183	120	180
200	R	/	/	140	188	125	185
205	r	/	/	/	/	130	190
210	3	/	/	/	/	135	195
215	4	/	/	/	/	140	200
220	S	/	/	/	/	145	205
225	6	/	/	/	/	150	210
230	7	/	/	/	/	155	215
235	8	/	/	/	/	160	220
240	T	/	/	/	/	165	225
245	t	/	/	/	/	170	230
250	U	/	/	/	/	175	235
255	aa	/	/	/	/	180	240
260	V	/	/	/	/	185	245
265	bb	/	/	/	/	190	250
270	CC	/	/	/	/	195	255
275	dd	/	/	/	/	200	260
280	X	/	/	/	/	205	265
285	ee	/	/	/	/	210	270
290	FF	/	/	/	/	215	275
295	ff	/	/	/	/	220	280
300	Y	/	/	/	/	225	285

R-HPT III and R-HPT III A4

Product description
Dimensions and marking

Annex A (4/5)

Table A3: Materials for R-HPT III

Part	Component	Material
1	Anchor body (bolt)	Carbon steel, ISO 898-1 Rupture elongation $A_5 > 8\%$
2	Expansion sleeve	Stainless steel grade 1.4401 or 1.4404 EN 1088-2
3	Washer	Carbon steel according to DIN 125A or DIN 9021
4	Hexagonal nut	Carbon steel according to DIN 934

Table A4: Materials for R-HPT III A4

Part	Component	Material
1	Anchor body (bolt)	Stainless steel
2	Expansion sleeve	Stainless steel grade 1.4401 or 1.4404 EN 1088-2
3	Washer	Stainless steel according to DIN 125A or DIN 9021
4	Hexagonal nut	Stainless steel according to DIN 934

R-HPT III and R-HPT III A4**Product description**
Materials**Annex A (5/5)**

Specifications of intended use

Anchorage subjected to:

- Static, quasi static,
- Fire exposure.

Base materials:

- Cracked and uncracked concrete.
- Reinforced and unreinforced normal weight concrete of strength class C20/25 at minimum and C50/60 at maximum according to EN 206:2013+A1:2016.

Use conditions (Environmental conditions):

- The anchor may be used in concrete subject to dry internal conditions.
- The anchor R-HPT III A4 may be used in concrete subject to dry internal conditions and also in concrete subject to external atmospheric exposure (including industrial and marine environment), or exposure in permanent damp internal conditions, if no particular aggressive conditions exist.

Note: Particular aggressive conditions are e.g. permanent, alternating immersion in seawater or splash zone of seawater, chloride atmosphere of indoor swimming pools or atmosphere with extreme chemical pollution (e.g. desulphurization plants or road tunnels where de-icing materials are used).

Design:

- Anchorages are designed under the responsibility of an engineer experienced in anchorages and concrete work.
- Anchorages under static and quasi-static actions are designed in accordance with EOTA TR 055, Edition December 2016 or EN 1992-4:2018.
- For application with resistance under fire exposure the anchorages are designed in accordance with the method given in EN 1992-4:2018, Annex D.
- Verifiable calculation notes and drawings are prepared taking into account of the load to be anchored. The position of the anchor is indicated on the design drawings.

Installation:

- Anchor installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site.
- Use of the anchor only as supplied by the manufacturer without exchanging any components of the anchor.
- Anchor installation in accordance with the manufacturer's specifications and drawings using the appropriate tools.
- Effective anchoring depth, edge distance and spacing not less than the specified values without minus tolerance.
- In case of aborted drill hole: new drilling at a minimum distance away of twice the depth of the aborted hole or smaller distance if the aborted drill hole is filled with high strength mortar and if under shear or oblique tension load it is not in the direction of load application.

R-HPT III and R-HPT III A4	Annex B (1/5)
Intended use Specifications	

Table B1: Installation parameters for R-HPT III

		R-HPT III		
		M8	M10	M12
Nominal drill hole diameter	d_o [mm]	8	10	12
Maximum diameter of clearance hole in the fixture	d_f [mm]	9	12	14
Cutting diameter of drill bit	$d_{cut} \leq$ [mm]	8,45	10,45	12,50
Minimum effective anchorage depth	$h_{ef,min}$ [mm]	33	40	50
Maximum effective anchorage depth	$h_{ef,max}$ [mm]	70	100	125
Maximum thickness of fixture	$t_{fix,max}$ [mm]	135	140	225
Nominal embedment depth	$h_{nom} \geq$ [mm]	$h_{ef} + 7$	$h_{ef} + 8$	$h_{ef} + 10$
Depth of drill hole	$h_0 \geq$ [mm]	$h_{ef} + 12$	$h_{ef} + 13$	$h_{ef} + 18$
Installation torque	T_{inst} [Nm]	15	30	50

Table B2: Installation parameters for R-HPT III A4

		R-HPT III A4		
		M8	M10	M12
Nominal drill hole diameter	d_o [mm]	8	10	12
Maximum diameter of clearance hole in the fixture	d_f [mm]	9	12	14
Cutting diameter of drill bit	$d_{cut} \leq$ [mm]	8,45	10,45	12,50
Minimum effective anchorage depth	$h_{ef,min}$ [mm]	33	40	50
Maximum effective anchorage depth	$h_{ef,max}$ [mm]	70	100	125
Maximum thickness of fixture	$t_{fix,max}$ [mm]	135	140	225
Nominal embedment depth	$h_{nom} \geq$ [mm]	$h_{ef} + 7$	$h_{ef} + 8$	$h_{ef} + 10$
Depth of drill hole	$h_0 \geq$ [mm]	$h_{ef} + 12$	$h_{ef} + 13$	$h_{ef} + 18$
Installation torque	T_{inst} [Nm]	20	40	60

R-HPT III and R-HPT III A4

Intended use
Installation data

Annex B (2/5)

Table B3: Minimum thickness of concrete member, minimum spacing, edge distances and required area

		R-HPT III and R-HPT III A4					
		M8		M10		M12	
Effective embedment depth	h_{ef} [mm]	33-47	48-70	40-59	60-100	50-69	70-125
Minimum member thickness depending on h_{ef}	$h_{min} \geq$ [mm]	$\max \left\{ \frac{1,5 \cdot h_{ef}}{80} \right\}$	$\max \left\{ \frac{1,5 \cdot h_{ef}}{100} \right\}$	$\max \left\{ \frac{1,5 \cdot h_{ef}}{80} \right\}$	$\max \left\{ \frac{1,5 \cdot h_{ef}}{120} \right\}$	$\max \left\{ \frac{1,5 \cdot h_{ef}}{100} \right\}$	$\max \left\{ \frac{1,5 \cdot h_{ef}}{140} \right\}$
Minimum edge distances and spacing							
Minimum edge distance	c_{min} [mm]	40		45		55	
	$s \geq$ [mm]	see Table B5					
Minimum spacing	s_{min} [mm]	35		40		50	
	$c \geq$ [mm]	see Table B5					
<p>The following equation must be fulfilled for the calculation of the minimum spacing and edge distance during installation in combination with variable anchorage depth and member thickness</p>							
<p>$A_{sp,req} \leq A_{sp,t}$ Required splitting area $A_{sp,req}$ and idealized splitting area $A_{sp,t}$ according to Table B6.</p>							

Table B4: Area A_{sp} to determine characteristic edge distance $c_{cr,sp}$

		R-HPT III and R-HPT III A4		
		M8	M10	M12
Minimum edge distances and spacing				
Area to determine $c_{cr,sp}$ ¹⁾	A_{sp} [mm ²]	$\frac{N_{Rk,sp}^0 + 13,153}{0,0013}$	$\frac{N_{Rk,sp}^0 + 2,147}{0,0008}$	$\frac{N_{Rk,sp}^0 - 12,033}{0,0003}$

¹⁾ $N_{Rk,sp}$ in kN

R-HPT III and R-HPT III A4	Annex B (3/5)
Intended use Installation data Minimum spacing and edge distances Required area and applicable concrete thickness	

Table B5: Areas to determine spacing and edge distances for installation

Anchor size		R-HPT III and R-HPT III A4			
		M8	M10	M12	
The following equation must be fulfilled for the calculation of the minimum spacing and edge distance during installation in combination with variable anchorage depths and member thickness:					
$A_{sp,req} \leq A_{sp,t}$					
Idealized splitting area $A_{sp,t}$ The edge distance and spacing shall be selected or rounded in steps of 5 mm					
Member thickness: $h > h_{ef} + 1,5 \cdot c$					
Projected splitting area:		$A_{sp,t} = (3 \cdot c_t + s_t) \cdot (1,5 \cdot c_t + h_{ef})$ [mm ²]			
Member thickness: $h \leq h_{ef} + 1,5 \cdot c$					
Projected splitting area:		$A_{sp,t} = (3 \cdot c_t + s_t) \cdot h$ [mm ²]			
Required splitting area $A_{sp,req}$					
Member thickness		M8	M10	M12	
R-HPT III	cracked concrete	[mm ²]	15000	21667	34211
	uncracked concrete		19615	28333	44737
R-HPT III A4	cracked concrete	[mm ²]	20000	28889	41053
	uncracked concrete		26154	37778	53684

R-HPT III and R-HPT III A4	Annex B (4/5)
Intended use Projected effective area to determine spacing and edge distances	

Table B6: Installation instructions

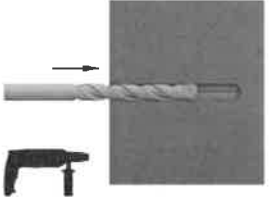

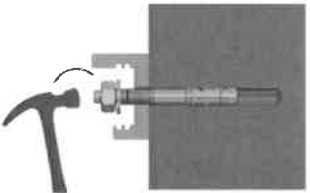
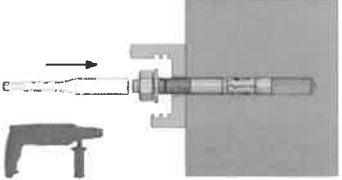

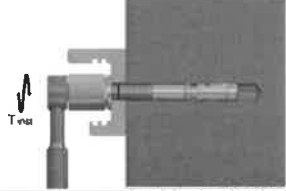
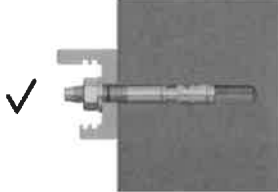
1		Drill hole perpendicular to concrete surface.
2		4x blow out dust. Alternatively vacuum clean down to the bottom of the hole.
3a		Installation by hammer.
3b		Installation by setting tool SDS plus.
3c		Set fastener.
4		Apply installation torque.
5		Installed product.
R-HPT III and R-HPT III A4		Annex B (5/5)
Intended use Installation instructions		

Table C1: Characteristic values for tension loads in case of static and quasi-static loading for design method A acc. EOTA TR 055 or EN 1992-4:2018

Essential characteristics			R-HPT III					
			M8		M10		M12	
Steel failure								
Characteristic tension steel failure	$N_{RK,s}$	[kN]	20,4		32,2		48,7	
Partial safety factor	$\gamma_{Ms}^{1)}$	[-]	1,4		1,4		1,5	
Pull-out failure								
Effective embedment depth	h_{ef}	[mm]	33 ²⁾ -47	48-70	40-59	60-100	50-69	70-125
Characteristic resistance in cracked concrete C20/25	$N_{RK,p}$	[kN]	7,1	7,5	16,0	16,0	20,2	20,2
Characteristic resistance in uncracked concrete C20/25	$N_{RK,p}$	[kN]	8,5	12,0	22,9	22,9	30,0	30,0
Installation safety factor	γ_{inst}	[-]	1,0					
Increasing factor for $N_{RK,p}$	ψ_c	C30/37	1,20	1,12	1,17	1,10	1,08	1,18
		C40/50	1,37	1,22	1,30	1,19	1,15	1,33
		C50/60	1,51	1,29	1,42	1,25	1,20	1,47
Splitting								
Characteristic resistance	$N_{RK,sp}^0$	[kN]	$\min(N_{RK,p}; N_{RK,c}^0)$					
Characteristic edge distance	$c_{cr,sp}$	[mm]	$A_{sp} + 0,8 \cdot (h_{min} - h_{ef})^2$ $(3,41 \cdot h_{min} - 0,59 \cdot h_{ef})$					
Characteristic spacing	$s_{cr,sp}$	[mm]	$2 \cdot c_{cr,sp}$					
Concrete cone failure								
Minimum effective anchorage depth	$h_{ef,min}$	[mm]	33 ²⁾		40		50	
Maximum effective anchorage depth	$h_{ef,max}$	[mm]	70		100		125	
Factor for cracked concrete	k_{cr}	[-]	7,7					
Factor for uncracked concrete	k_{ucr}	[-]	11,0					
Spacing	$s_{cr,N}$	[mm]	$3 h_{ef}$					
Edge distance	$c_{cr,N}$	[mm]	$1,5 h_{ef}$					
Displacement under tension load								
$\delta_{N0} = \delta_{N0-factor} \cdot N$			N: acting tension load					
$\delta_{N_{sc}} = \delta_{N_{sc-factor}} \cdot N$								
Cracked concrete C20/25 – C50/60								
Factors for short term displacement	$\delta_{N0-factor}$	[mm/kN]	0,11		0,06		0,05	
Factors for long term displacement	$\delta_{N_{sc-factor}}$	[mm/kN]	0,27		0,18		0,13	
Uncracked concrete C20/25 – C50/60								
Factors for short term displacement	$\delta_{N0-factor}$	[mm/kN]	0,01		0,02		0,01	
Factors for long term displacement	$\delta_{N_{sc-factor}}$	[mm/kN]	0,19		0,13		0,09	

¹⁾ In absence of other national regulations

²⁾ Fastenings with anchorage depth $h_{ef} < 40$ mm are restricted to the use of structural components which are statically indeterminate and subjected to internal exposure conditions only

R-HPT III and R-HPT III A4

Performance

Characteristic resistance under tension load

Annex C (1/5)

Table C2: Characteristic values for tension loads in case of static and quasi-static loading for design method A acc. EOTA TR 055 or EN 1992-4:2018

Essential characteristics			R-HPT III A4					
			M8		M10		M12	
Steel failure								
Characteristic tension steel failure	$N_{Rk,s}$	[kN]	21,9	33,3	48,7			
Partial safety factor	$\gamma_{Ms}^{1)}$	[-]	1,4	1,4	1,5			
Pull-out failure								
Effective embedment depth	h_{ef}	[mm]	33 ²⁾ -47	48-70	40-59	60-100	50-69	70-125
Characteristic resistance in cracked concrete C20/25	$N_{Rk,p}$	[kN]	6,0	9,5	13,4	15,0	20,2	20,2
Characteristic resistance in uncracked concrete C20/25	$N_{Rk,p}$	[kN]	6,5	13,0	18,5	20,0	28,8	28,8
Installation safety factor	γ_{inst}	[-]	1,0					
Increasing factor for $N_{Rk,p}$	ψ_c	C30/37	1,21	1,15	1,18	1,09	1,18	1,18
		C40/50	1,39	1,26	1,34	1,16	1,33	1,34
		C50/60	1,54	1,36	1,47	1,21	1,45	1,47
Splitting								
Characteristic resistance	$N^0_{Rk,sp}$	[kN]	$\min(N_{Rk,p}; N^0_{Rk,c})$					
Characteristic edge distance	$c_{cr,sp}$	[mm]	$A_{sp} + 0,8 \cdot (h_{min} - h_{ef})^2$ $(3,41 \cdot h_{min} - 0,59 \cdot h_{ef})$					
Characteristic spacing	$s_{cr,sp}$	[mm]	$2 \cdot c_{cr,sp}$					
Concrete cone failure								
Minimum effective anchorage depth	$h_{ef,min}$	[mm]	33 ²⁾	40	50			
Maximum effective anchorage depth	$h_{ef,max}$	[mm]	70	100	125			
Factor for cracked concrete	k_{cr}	[-]	7,7					
Factor for uncracked concrete	k_{ucr}	[-]	11,0					
Spacing	$s_{cr,N}$	[mm]	$3 h_{ef}$					
Edge distance	$c_{cr,N}$	[mm]	$1,5 h_{ef}$					
Displacement under tension load								
$\delta_{N0} = \delta_{N0-factor} \cdot N$			N: acting tension load					
$\delta_{Nc} = \delta_{Nc-factor} \cdot N$								
Cracked concrete C20/25 – C50/60								
Factors for short term displacement	$\delta_{N0-factor}$	[mm/kN]	0,12	0,05	0,05			
Factors for long term displacement	$\delta_{Nc-factor}$	[mm/kN]	0,42	0,18	0,15			
Uncracked concrete C20/25 – C50/60								
Factors for short term displacement	$\delta_{N0-factor}$	[mm/kN]	0,02	0,01	0,02			
Factors for long term displacement	$\delta_{Nc-factor}$	[mm/kN]	0,36	0,13	0,11			

¹⁾ In absence of other national regulations

²⁾ Fastenings with anchorage depth $h_{ef} < 40$ mm are restricted to the use of structural components which are statically indeterminate and subjected to internal exposure conditions only

R-HPT III and R-HPT III A4

Performance

Characteristic resistance under tension load

Annex C (2/5)

Table C3: Characteristic values for shear loads under static and quasi-static action

Essential characteristics			R-HPT III		
			M8	M10	M12
Steel failure without lever arm					
Characteristic resistance	$V_{Rk,s}^0$	[kN]	14,6	24,7	32,6
Partial safety factor	γ_{Ms}	[-]	1,50	1,50	1,25
Factor for considering ductility	k_7	[-]		1,0	
Steel failure with lever arm					
Characteristic resistance	$M_{Rk,s}^0$	[Nm]	31	60	104
Partial safety factor	γ_{Ms}	[-]	1,50	1,50	1,25
Concrete pryout failure					
Installation safety factor	γ_{inst}	[-]		1,0	
k-factor	k_8	[-]	2,9	3,6	3,6
Concrete edge failure					
Installation safety factor	γ_{inst}	[-]		1,0	
Effective length of anchor under shear load	l_{ef}	[mm]		$h_{ef}^{1)}$	
Outside diameter of anchor	d_{nom}	[mm]	8	10	12
Displacement under tension load					
$\delta_{V0} = \delta_{V0-factor} \cdot V$			V: acting shear load		
$\delta_{V_{sc}} = \delta_{V_{sc-factor}} \cdot V$					
Factors for short term displacement	$\delta_{V0-factor}$	[mm/kN]	0,32	0,24	0,15
Factors for Long term displacement	$\delta_{V_{sc-factor}}$	[mm/kN]	0,47	0,36	0,23

¹⁾ Fastening with anchorage depth $h_{ef} < 40$ mm are restricted to the use of structural components which are statistically indeterminate and subject to internal exposure conditions only.

Table C4: Characteristic values for shear loads under static and quasi-static action

Essential characteristics			R-HPT III A4		
			M8	M10	M12
Steel failure without lever arm					
Characteristic resistance	$V_{Rk,s}^0$	[kN]	13,7	22,8	35,8
Partial safety factor	γ_{Ms}	[-]	1,50	1,50	1,25
Factor for considering ductility	k_7	[-]		1,0	
Steel failure with lever arm					
Characteristic resistance	$M_{Rk,s}^0$	[Nm]	24	51	92
Partial safety factor	γ_{Ms}	[-]	1,50	1,50	1,25
Concrete pryout failure					
Installation safety factor	γ_{inst}	[-]		1,0	
k-factor	k_8	[-]	2,9	3,6	3,6
Concrete edge failure					
Installation safety factor	γ_{inst}	[-]		1,0	
Effective length of anchor under shear load	l_{ef}	[mm]		$h_{ef}^{1)}$	
Outside diameter of anchor	d_{nom}	[mm]	8	10	12
Displacement under shear load					
$\delta_{V0} = \delta_{V0-factor} \cdot V$			V: acting shear load		
$\delta_{V_{sc}} = \delta_{V_{sc-factor}} \cdot V$					
Factor for short term displacement	$\delta_{V0-factor}$	[mm/kN]	0,28	0,24	0,16
Factor for long term displacement	$\delta_{V_{sc-factor}}$	[mm/kN]	0,43	0,36	0,23

¹⁾ Fastening with anchorage depth $h_{ef} < 40$ mm are restricted to the use of structural components which are statistically indeterminate and subject to internal exposure conditions only.

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Performance Characteristic values for shear loads	

Table C5: Characteristic resistance under tension loads in case of fire exposure for design acc. EN 1992-4:2018, Annex D

Essential characteristics			Anchor size											
			M8		M8-A4		M10		M10-A4		M12		M12-A4	
			$h_{ef,min}$	$h_{ef,max}$	$h_{ef,min}$	$h_{ef,max}$	$h_{ef,min}$	$h_{ef,max}$	$h_{ef,min}$	$h_{ef,max}$	$h_{ef,min}$	$h_{ef,max}$	$h_{ef,min}$	$h_{ef,max}$
Steel failure														
Characteristic resistance $N_{Rk,s,fi}$	R30	[kN]	0,23	0,47	0,54	0,89	1,08	1,62						
	R60	[kN]	0,21	0,37	0,46	0,72	0,81	1,35						
	R90	[kN]	0,16	0,28	0,36	0,57	0,70	1,08						
	R120	[kN]	0,12	0,23	0,29	0,50	0,54	0,87						
Pull-out failure														
Characteristic resistance $N_{Rk,p,fi}$	R30	[kN]	1,78	1,88	1,50	2,38	3,90	4,00	3,35	3,75	4,93	5,05	4,93	5,05
	R60	[kN]	1,78	1,88	1,50	2,38	3,90	4,00	3,35	3,75	4,93	5,05	4,93	5,05
	R90	[kN]	1,78	1,88	1,50	2,38	3,90	4,00	3,35	3,75	4,93	5,05	4,93	5,05
	R120	[kN]	1,42	1,50	1,20	1,90	3,12	3,20	2,68	3,00	3,94	4,04	3,94	4,04
Concrete cone and splitting failure¹⁾														
The characteristic resistance $N_{Rk,c,fi}^0$ of a single fastener not influenced by neighbouring fasteners or concrete edges installed in concrete C20/25 to C50/60 under fire exposure may be determined by:														
$N_{Rk,c,fi}^0 = \frac{h_{ef}}{200} \times N_{Rk,c}^0 (\leq R90) \qquad N_{Rk,c,fi}^0 = 0,8 \frac{h_{ef}}{200} \times N_{Rk,c}^0 (R120)$														
where $N_{Rk,c}^0$ is a characteristic resistance of a single fastener in cracked concrete C20/25 under normal temperature														
$S_{cr,N,fi}$	Spacing	[mm]	4 x h_{ef}											
S_{min}		[mm]	33	70	33	70	40	100	40	100	50	125	50	125
$C_{cr,N,fi}$	Edge distance	[mm]	2 x h_{ef}											
C_{min}		[mm]	Fire attack from one side: $C_{min} = 2 \times h_{ef}$ Fire attack from more than one side: $C_{min} \geq 300 \text{ mm}$ and $\geq 2 \times h_{ef}$											

¹⁾ As a rule, splitting failure can be neglected when cracked concrete and reinforcement is assumed

Design under fire exposure is performed according to the design method given in EN 1992-4:2018, Annex D.

Under fire exposure usually cracked concrete is assumed. The design equations are given in EN 1992-4:2018, Annex D.

In the absence of other national regulations the partial safety factor for resistance under fire exposure $\gamma_{M,fi} = 1,0$ is recommended.

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Performance

Characteristic tension resistance under fire exposure

Annex C (4/5)

Table C6: Characteristic resistance under shear loads in case of fire exposure for design acc. EN 1992-4:2018, Annex D

Essential characteristics			Anchor size											
			M8		M8-A4		M10		M10-A4		M12		M12-A4	
			$h_{ef,min}$	$h_{ef,max}$	$h_{ef,min}$	$h_{ef,max}$	$h_{ef,min}$	$h_{ef,max}$	$h_{ef,min}$	$h_{ef,max}$	$h_{ef,min}$	$h_{ef,max}$	$h_{ef,min}$	$h_{ef,max}$
Steel failure without lever arm														
Characteristic resistance $V_{Rk,s,fi}$	R30	[kN]	0,58	1,16	0,87	1,45	1,69	2,53						
	R60	[kN]	0,52	0,93	0,75	1,16	1,26	2,11						
	R90	[kN]	0,41	0,70	0,58	0,93	1,10	1,69						
	R120	[kN]	0,29	0,58	0,46	0,81	0,84	1,35						
Steel failure with lever arm														
Characteristic resistance $M^0_{Rk,s,fi}$	R30	[Nm]	1,12	0,75	1,12	1,87	2,62	3,93						
	R60	[Nm]	0,97	0,60	0,97	1,50	1,97	3,28						
	R90	[Nm]	0,75	0,45	0,75	1,20	1,70	2,62						
	R120	[Nm]	0,60	0,37	0,60	1,05	1,31	2,10						
Concrete pryout failure														
k-factor	k_8	[-]	2,9				3,6				3,6			
The Characteristic resistance $V_{Rk,cp,fi}$ in case of fasteners installed in concrete class C20/25 to C50/60 may be determined by: $V_{Rk,cp,fi} = k_8 \cdot N_{Rk,c,fi} (\leq R90) \qquad V_{Rk,cp,fi} = k_8 \cdot N_{Rk,c,fi} (R120)$ where $N_{Rk,c,fi}$ is characteristic resistance of a single fastener not influenced by neighbouring fasteners or concrete edges installed in concrete C20/25 to C50/60 under fire exposure														
Concrete edge failure														
The initial value $V^0_{Rk,c,fi}$ of the characteristic resistance in concrete C20/25 to C50/60 under fire exposure may be determined by: $V^0_{Rk,c,fi} = 0,25 \times V^0_{Rk,c} (\leq R90) \qquad V^0_{Rk,c,fi} = 0,20 \times V^0_{Rk,c} (R120)$ with $V^0_{Rk,c}$ initial value of the characteristic resistance in cracked concrete C20/25 under normal temperature														

Design under fire exposure is performed according to the design method given in EN 1992-4:2018, Annex D. Under fire exposure usually cracked concrete is assumed. The design equations are given in EN 1992-4:2018, Annex D. covers design for fire exposure from one side. For fire attack from more than one side the edge distance must be increased to $c_{min} \geq 300$ mm and $\geq 2 \times h_{ef}$.

In the absence of other national regulations the partial safety factor for resistance under fire exposure $\gamma_{M,fi} = 1,0$ is recommended.

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Performance Characteristic shear resistance under fire exposure	