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European Technical Assessment

ETA-21/1082 of 26.04.2024

English version prepared by ZAG

General Part

Technical Assessment Body issuing the European Technical Assessment	**ZAG**
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, M12, M16 and M20 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	27 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, M12, M16 and M20 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 (1/13), C (2/13), C(3/13), C(4/13), C(5/13), C(6/13), C(11/13), C(12/13) and C(13/13).

3.2 Safety in case of fire (BWR 2)

The basic work requirements for safety in case of fire are listed in Annexes C (7/13), C(8/13), C(9/13) and C(10/13).

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 Commission[1] 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 26.04.2024

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

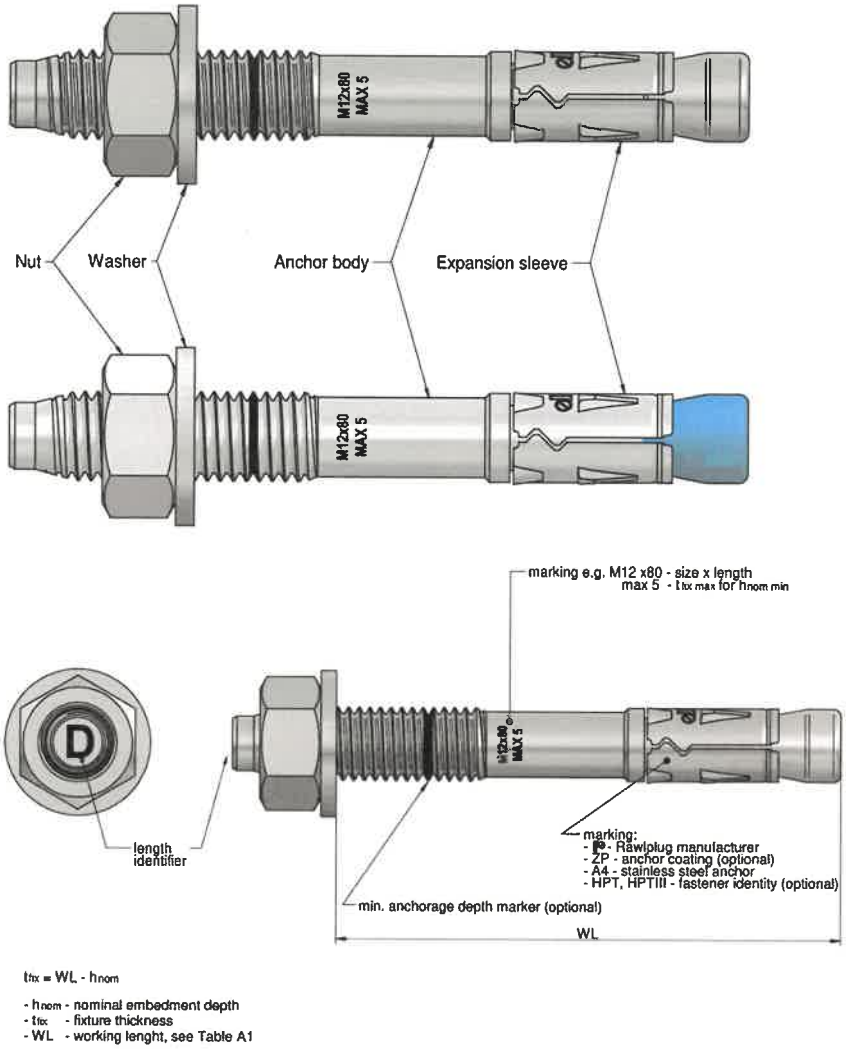


Figure A1: Anchor R-HPT III

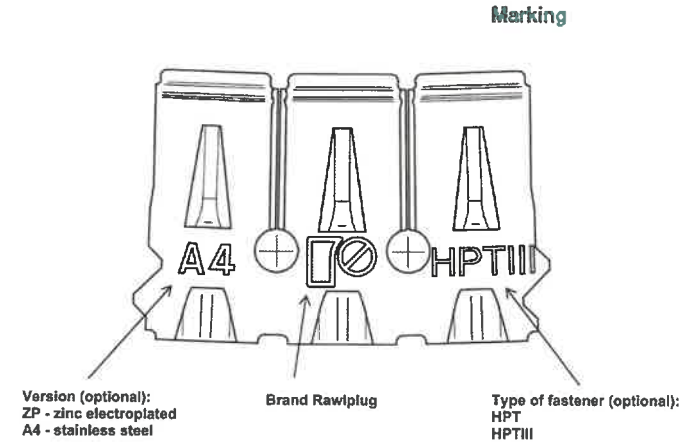


Figure A2: Markings on expansion sleeve

R-HPT III and R-HPT III A4	
Product description Product	**Annex A (1/4)**

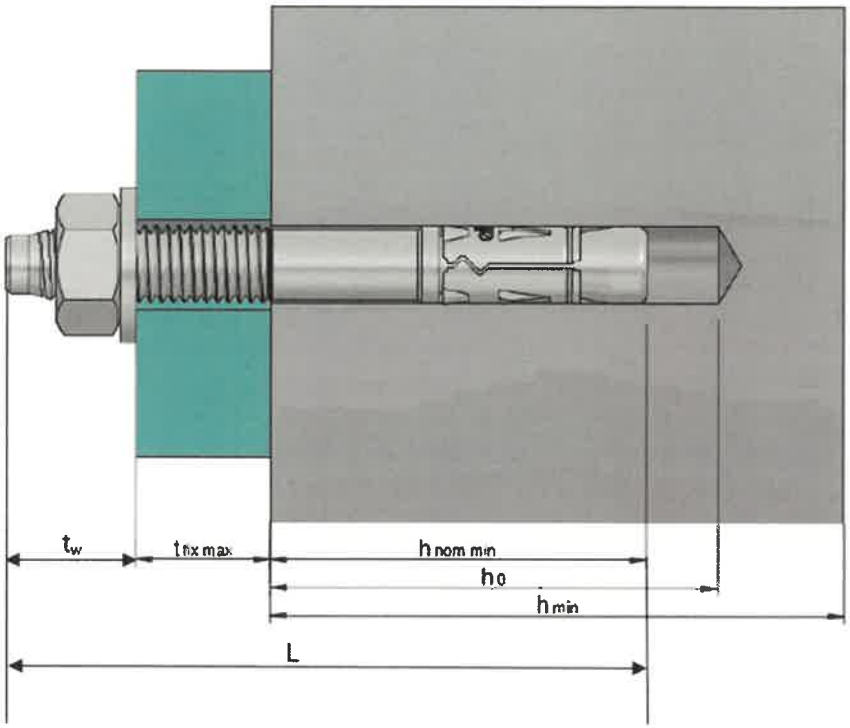


Figure A3: Installation parameters for R-HPT III anchor

R-HPT III and R-HPT III A4	
Product description Installation condition	**Annex A (2/4)**

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

Bolt length L [mm]	Marking	Bolt length L [mm]	Marking
50	A	180	P
55	a	185	o
60	B	190	W
65	b	195	z
70	#	200	R
75	c	205	r
80	D	210	3
85	d	215	4
90	E	220	S
95	e	225	6
100	F	230	7
105	f	235	8
110	G	240	T
115	g	245	t
120	H	250	U
125	h	255	aa
130	J	260	V
135	I	265	bb
140	K	270	CC
145	k	275	dd
150	L	280	X
155	2	285	ee
160	M	290	FF
165	m	295	ff
170	N	300	Y
175	n		

R-HPT III and R-HPT III A4	Annex A (3/4)
Product description Dimensions and marking	

Table A2: 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 A3: 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 (4/4)**

Specifications of intended use

Anchorages subjected to:

- Static, quasi static and seismic load,
- 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.
- For application with resistance under seismic load the anchorage are designed in accordance with EAD 1992-4:2018, Annex C;
- 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	
Intended use Specifications	**Annex B (1/7)**

Table B1: Installation parameters for R-HPT III

			R-HPT III				
			M8	M10	M12	M16	M20
Nominal drill hole diameter	d_o	[mm]	8	10	12	16	20
Maximum diameter of clearance hole in the fixture	d_f	[mm]	9	12	14	18	22
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	8,45	10,45	12,50	16,50	20,55
Minimum effective anchorage depth	$h_{ef,min}$	[mm]	33	40	50	65	80
Maximum effective anchorage depth	$h_{ef,max}$	[mm]	70	100	125	160	180
Thickness of the fixture	t_{fix}	[mm]	$L-h_{nom}-t_w$				
	t_w	[mm]	10	10	15	20	24
Nominal embedment depth	$h_{nom} \geq$	[mm]	$h_{ef}+7$	$h_{ef}+8$	$h_{ef}+10$	$h_{ef}+13$	$h_{ef}+17$
Depth of drill hole	$h_0 \geq$	[mm]	$h_{ef}+12$	$h_{ef}+13$	$h_{ef}+18$	$h_{ef}+25$	$h_{ef}+30$
Installation torque	T_{inst}	[Nm]	15	30	50	80	180

Table B2: Installation parameters for R-HPT III A4

			R-HPT III A4			
			M8	M10	M12	M16
Nominal drill hole diameter	d_o	[mm]	8	10	12	16
Maximum diameter of clearance hole in the fixture	d_f	[mm]	9	12	14	18
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	8,45	10,45	12,50	16,50
Minimum effective anchorage depth	$h_{ef,min}$	[mm]	33	40	50	65
Maximum effective anchorage depth	$h_{ef,max}$	[mm]	70	100	125	160
Thickness of the fixture	t_{fix}	[mm]	$L-h_{nom}-t_w$			
	t_w	[mm]	10	10	15	20
Nominal embedment depth	$h_{nom} \geq$	[mm]	$h_{ef}+7$	$h_{ef}+8$	$h_{ef}+10$	$h_{ef}+13$
Depth of drill hole	$h_0 \geq$	[mm]	$h_{ef}+12$	$h_{ef}+13$	$h_{ef}+18$	$h_{ef}+25$
Installation torque	T_{inst}	[Nm]	15	30	50	100

R-HPT III and R-HPT III A4	
Intended use Installation data	**Annex B (2/7)**

Table B3: Minimum thickness of concrete member, minimum spacing, edge distances and required area for R-HPT III and R-HPT III A4 sizes M8-M12

			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]	$\max\begin{cases}1,5 \cdot h_{ef} \\ 80\end{cases}$	$\max\begin{cases}1,5 \cdot h_{ef} \\ 100\end{cases}$	$\max\begin{cases}1,5 \cdot h_{ef} \\ 80\end{cases}$	$\max\begin{cases}1,5 \cdot h_{ef} \\ 120\end{cases}$	$\max\begin{cases}1,5 \cdot h_{ef} \\ 100\end{cases}$	$\max\begin{cases}1,5 \cdot h_{ef} \\ 140\end{cases}$
Minimum edge distances and spacing								
Minimum edge distance	c_{min}	[mm]	40		45		55	
	$s \geq$	[mm]	see Table B7					
Minimum spacing	s_{min}	[mm]	35		40		50	
	$c \geq$	[mm]	see Table B7					
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								
$A_{sp,req} \leq A_{sp,d}$ Required splitting area $A_{sp,rqd}$ and idealized splitting area $A_{sp,d}$ according to Table B7.								

Table B4: Minimum thickness of concrete member, minimum spacing, edge distances and required area for R-HPT III sizes M16 – M20 and R-HPT III A4 size M16

			R-HPT III and R-HPT III A4			
			M16		M20	
Effective embedment depth	h_{ef}	[mm]	65-84	85-160	80-99	100-180
Minimum member thickness depending on h_{ef}	$h_{min} \geq$	[mm]	$\max\begin{cases}1,5 \cdot h_{ef} \\ 120\end{cases}$	$\max\begin{cases}1,5 \cdot h_{ef} \\ 140\end{cases}$	$\max\begin{cases}1,5 \cdot h_{ef} \\ 160\end{cases}$	$\max\begin{cases}1,5 \cdot h_{ef} \\ 180\end{cases}$
Minimum edge distances and spacing						
Minimum edge distance	c_{min}	[mm]	65		80	
	$s \geq$	[mm]	see Table B8			
Minimum spacing	s_{min}	[mm]	65		90	
	$c \geq$	[mm]	see Table B8			
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						
$A_{sp,req} \leq A_{sp,t}$ Required splitting area $A_{sp,rqd}$ and idealized splitting area $A_{sp,t}$ according to Table B8.						

R-HPT III and R-HPT III A4

Intended use

Installation data

Minimum spacing and edge distances

Required area and applicable concrete thickness

Annex B (3/7)

Table B5: Area A_{sp} to determine characteristic edge distance $c_{cr,sp}$ for R-HPT III and R-HPT III A4 sizes M8-M12

		R-HPT III and R-HPT III A4		
		M8	M10	M12
Edge distance to prevent splitting				
Area to determine $c_{cr,sp}$	A_{sp} [mm^2]	$\frac{N^0_{Rk,sp}+ 13,147^{1)}}{0,001347}$	$\frac{N^0_{Rk,sp}+ 2,2416^{1)}}{0,0008}$	$\frac{N^0_{Rk,sp}- 12,033^{1)}}{0,00026}$
$c_{cr,sp} = \min\left[\frac{A_{rqd}+0,8\,(h_{min}-h_{ef})^2}{(3,14\cdot h-0,59\cdot h_{ef})}; \frac{A_{rqd}}{(h_{min}\cdot 8^{0,5})}\right] \geq 1,5\cdot h_{ef}$				

[1)] $N^0_{Rk,sp}$ in kN

Table B6: Area A_{sp} to determine characteristic edge distance $c_{cr,sp}$ for R-HPT III sizes M16-M20 and R-HPT III A4 size M16

		R-HPT III and R-HPT III A4	
		M16	M20
Edge distance to prevent splitting spacing			
Area to determine $c_{cr,sp}$	A_{sp} [mm^2]	$\frac{N^0_{Rk,sp}+ 15,42^{1)}}{0,00108}$	$\frac{N^0_{Rk,sp}+190,16^{1)}}{0,003078}$
$c_{cr,sp} = \min\left[\frac{A_{rqd}+0,8\,(h_{min}-h_{ef})^2}{(3,14\cdot h-0,59\cdot h_{ef})}; \frac{A_{rqd}}{(h_{min}\cdot 8^{0,5})}\right] \geq 1,5\cdot h_{ef}$			

[1)] $N^0_{Rk,sp}$ in kN

R-HPT III and R-HPT III A4	
Intended use Required splitting area to determine edge distance to prevent splitting	**Annex B (4/7)**

Table B7: Areas to determine minimum spacing and edge distances for installation of R-HPT III and R-HPT III A4 sizes M8-M12

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: $A_{sp,req} \leq A_{sp,d}$ [1)]						
Idealized projected 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:		$A_{sp,d} = (3 \cdot c_d + s_d) \cdot (1{,}5 \cdot c_d + h_{ef})$ [2)]	[mm²]			
Member thickness: $h \leq h_{ef} + 1{,}5 \cdot c$						
Projected splitting area:		$A_{sp,d} = (3 \cdot c_d + s_d) \cdot h$ [2)]	[mm²]			
Required splitting area $A_{sp,req}$						
				M8	M10	M12
R-HPT III	cracked concrete	$A_{sp,req,cr}$	[mm²]	15294	22222	35040
	uncracked	$A_{sp,req,ucr}$	[mm²]	20000	29060	45822
R-HPT III A4	cracked concrete	$A_{sp,req,cr}$	[mm²]	20392	29630	42049
	uncracked	$A_{sp,req,ucr}$	[mm²]	26667	38746	54987

1) design value of projected splitting area ($A_{sp,d}$)

2) design value of minimum edge distance (c_d) and spacing (s_d)

R-HPT III and R-HPT III A4	
Intended use Projected splitting area to determine minimum spacing and edge distances	**Annex B (5/7)**

Table B8: Areas to determine minimum spacing and edge distances for installation of R-HPT III sizes M16 – M20 and R-HPT III A4 size M16

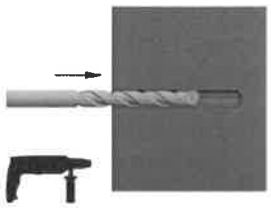
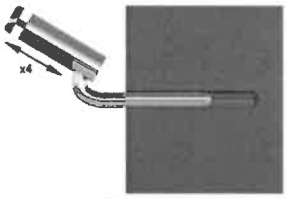
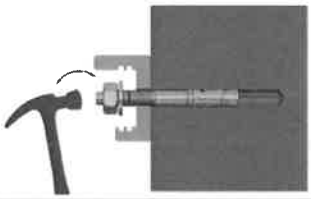
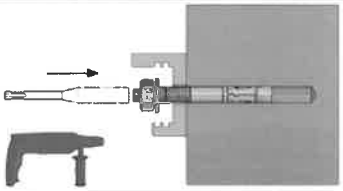
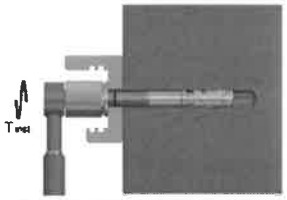
Anchor size				R-HPT III and R-HPT III A4	
				M16	M20
The following equation must be fulfilled for the calculation of the minimum spacing and edge distance during installation in combination with variable anchorage depths and member thickness: $A_{sp,req} \leq A_{sp,d}$ [1)]					
Idealized projected 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:		$A_{sp,d} = (3 \cdot c_d + s_d) \cdot (1{,}5 \cdot c_d + h_{ef})$ [2)]	[mm²]		
Member thickness: $h \leq h_{ef} + 1{,}5 \cdot c$					
Projected splitting area:		$A_{sp,d} = (3 \cdot c_d + s_d) \cdot h$ [2)]	[mm²]		
Required splitting area $A_{sp,req}$					
				M16	M20
R-HPT III	cracked concrete	$A_{sp,req,cr}$	[mm²]	60325	168103
	uncracked	$A_{sp,req,ucr}$		78886	219828
R-HPT III A4	cracked concrete	$A_{sp,req,cr}$	[mm²]	75406	/
	uncracked	$A_{sp,req,ucr}$		98608	/

1) design value of projected splitting area ($A_{sp,d}$)

2) design value of minimum edge distance (c_d) and spacing (s_d)

R-HPT III and R-HPT III A4	
Intended use Projected effective area to determine spacing and edge distances	**Annex B (6/7)**

Table B9: 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	
Intended use Installation instructions	**Annex B (7/7)**

Table C1: Characteristic values for tension loads in case of static and quasi-static loading for design acc. to EOTA TR 055 or EN 1992-4:2018 for R-HPT III sizes M8-M12

Essential characteristics			R-HPT III					
			M8		M10		M12	
Steel failure								
Characteristic tension steel failure	$N_{Rk,s}$	[kN]	19,8		31,1		48,7	
Partial safety factor	γ_{Ms} [1)]	[-]	1,40		1,40		1,50	
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	$N^0_{Rk,sp}$	[kN]	$\min(N_{RK,p}; N^0_{Rk,c})$					
Characteristic edge distance	$c_{cr,sp}$	[mm]	$c_{cr,sp} = \min\left[\frac{A_{rqd}+0{,}8\,(h_{min}-h_{ef})^2}{(3{,}14\cdot h-0{,}59\cdot h_{ef})}\cdot\frac{A_{rqd}}{(h_{min}\cdot 8^{0,5})}\right] \geq 1{,}5\cdot h_{ef}$					
Characteristic spacing	$s_{cr,sp}$	[mm]	$2\cdot c_{cr,sp}$					
Installation safety factor	γ_{inst}	[-]	1,0					
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]	$1{,}5\,h_{ef}$					
Installation safety factor	γ_{inst}	[-]	1,0					
Displacement under tension load $\delta_{N0} = \delta_{N0\text{-factor}} \cdot N$ $\delta_{N\infty} = \delta_{N\infty\text{-factor}} \cdot N$	N: acting tension load							
Cracked concrete C20/25 – C50/60								
Factors for short term displacement	$\delta_{N0\text{-factor}}$	[mm/kN]	0,11		0,06		0,05	
Factors for long term displacement	$\delta_{N\infty\text{-factor}}$	[mm/kN]	0,27		0,18		0,13	
Uncracked concrete C20/25 – C50/60								
Factors for short term displacement	$\delta_{N0\text{-factor}}$	[mm/kN]	0,01		0,02		0,01	
Factors for long term displacement	$\delta_{N\infty\text{-factor}}$	[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	Annex C (1/13)
Performance Characteristic resistance under tension load	

Table C2: Characteristic values for tension loads in case of static and quasi-static loading for design acc. to EOTA TR 055 or EN 1992-4:2018 for R-HPT III sizes M16-M20

Essential characteristics			R-HPT III			
			M16		M20	
Steel failure						
Characteristic tension steel failure	$N_{Rk,s}$	[kN]	69,7		121,4	
Partial safety factor	γ_{Ms} [1)]	[-]	1,41			
Pull-out failure						
Effective embedment depth	h_{ef}	[mm]	65-84	85-160	80-99	100-180
Characteristic resistance in **cracked** concrete C20/25	$N_{Rk,p}$	[kN]	27,0	27,0	40,9	40,9
Characteristic resistance in **uncracked** concrete C20/25	$N_{Rk,p}$	[kN]	45,0	45,0	50,0	50,0
Installation safety factor	γ_{inst}	[-]	1,0			
Increasing factor for $N_{Rk,p}$	ψ_c	C30/37	1,19	1,17	1,22	1,22
		C40/50	1,34	1,32	1,40	1,41
		C50/60	1,48	1,45	1,56	1,58
Splitting						
Characteristic resistance	$N^0_{Rk,sp}$	[kN]	$\min(N_{RK,p}\ ;\ N^0_{Rk,c})$			
Characteristic edge distance	$c_{cr,sp}$	[mm]	$c_{cr,sp} = \min\left[\frac{A_{rqd}+0{,}8\,(h_{min}-h_{ef})^2}{(3{,}14\cdot h-0{,}59\cdot h_{ef})}\ ;\ \frac{A_{rqd}}{(h_{min}\cdot 8^{0,5})}\right] \geq 1{,}5\cdot h_{ef}$			
Characteristic spacing	$s_{cr,sp}$	[mm]	$2\cdot c_{cr,sp}$			
Installation safety factor	γ_{inst}	[-]	1,0			
Concrete cone failure						
Minimum effective anchorage depth	$h_{ef,min}$	[mm]	65		80	
Maximum effective anchorage depth	$h_{ef,max}$	[mm]	160		180	
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]	$1{,}5\,h_{ef}$			
Installation safety factor	γ_{inst}	[-]	1,0			
Displacement under tension load $\delta_{N0} = \delta_{N0\text{-factor}} \cdot N$ $\delta_{N\infty} = \delta_{N\infty\text{-factor}} \cdot N$	N: acting tension load					
Cracked concrete C20/25 – C50/60						
Factors for short term displacement	$\delta_{N0\text{-factor}}$	[mm/kN]	0,03		0,02	
Factors for long term displacement	$\delta_{N\infty\text{-factor}}$	[mm/kN]	0,15		0,02	
Uncracked concrete C20/25 – C50/60						
Factors for short term displacement	$\delta_{N0\text{-factor}}$	[mm/kN]	0,02		0,01	
Factors for long term displacement	$\delta_{N\infty\text{-factor}}$	[mm/kN]	0,09		0,02	

[1)] In absence of other national regulations

R-HPT III and R-HPT III A4	Annex C (2/13)
Performance Characteristic resistance under tension load	

Table C3: Characteristic values for tension loads in case of static and quasi-static loading for design acc. to EOTA TR 055 or EN 1992-4:2018 for R-HPT III A4 sizes M8-M12

Essential characteristics			R-HPT III A4					
			M8		M10		M12	
Steel failure								
Characteristic tension steel failure	$N_{Rk,s}$	[kN]	19,4		30,4		46,0	
Partial safety factor	γ_{Ms} [1)]	[-]	1,42		1,40		1,42	
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 $N_{Rk,p}$	ψc	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]	$c_{cr,sp} = \min \left[\frac{A_{rqd} + 0{,}8\,(h_{min} - h_{ef})^2}{(3{,}14 \cdot h - 0{,}59 \cdot h_{ef})} ; \frac{A_{rqd}}{(h_{min} \cdot 8^{0{,}5})} \right] \geq 1{,}5 \cdot h_{ef}$					
Characteristic spacing	$s_{cr,sp}$	[mm]	$2 \cdot c_{cr,sp}$					
Installation safety factor	γ_{inst}	[-]	1,0					
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					
Spacng	$s_{cr,N}$	[mm]	$3\,h_{ef}$					
Edge distance	$c_{cr,N}$	[mm]	$1{,}5\,h_{ef}$					
Installation safety factor	γ_{inst}	[-]	1,0					
Displacement under tension load $\delta_{N0} = \delta_{N0\text{-factor}} \cdot N$ $\delta_{N\infty} = \delta_{N\infty\text{-factor}} \cdot N$	N: acting tension load							
Cracked concrete C20/25 – C50/60								
Factors for short term displacement	$\delta_{N0\text{-factor}}$	[mm/kN]	0,12		0,05		0,05	
Factors for long term displacement	$\delta_{N\infty\text{-factor}}$	[mm/kN]	0,42		0,18		0,15	
Uncracked concrete C20/25 – C50/60								
Factors for short term displacement	$\delta_{N0\text{-factor}}$	[mm/kN]	0,02		0,01		0,02	
Factors for long term displacement	$\delta_{N\infty\text{-factor}}$	[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

Table C4: Characteristic values for tension loads in case of static and quasi-static loading for design acc. to EOTA TR 055 or EN 1992-4:2018 for R-HPT III A4 size M16

Essential characteristics			R-HPT III A4 M16	
Steel failure				
Characteristic tension steel failure	$N_{Rk,s}$	[kN]	77,4	
Partial safety factor	γ_{Ms} [1)]	[-]	1,46	
Pull-out failure				
Effective embedment depth	h_{ef}	[mm]	65-84	85-160
Characteristic resistance in **cracked** concrete C20/25	$N_{Rk,p}$	[kN]	27,0	27,0
Characteristic resistance in **uncracked** concrete C20/25	$N_{Rk,p}$	[kN]	50,0	50,0
Installation safety factor	γ_{inst}	[-]	1,0	
Increasing factor for $N_{Rk,p}$	ψ_c	C30/37	1,20	1,18
		C40/50	1,38	1,33
		C50/60	1,53	1,46
Splitting				
Characteristic resistance	$N^0_{Rk,sp}$	[kN]	$\min(N_{RK,p}\,;\, N^0_{Rk,c})$	
Characteristic edge distance	$c_{cr,sp}$	[mm]	$c_{cr,sp} = \min\left[\frac{A_{rqd}+0{,}8\,(h_{min}-h_{ef})^2}{(3{,}14\cdot h-0{,}59\cdot h_{ef})} ; \frac{A_{rqd}}{(h_{min}\cdot 8^{0,5})}\right] \geq 1{,}5\cdot h_{ef}$	
Characteristic spacing	$s_{cr,sp}$	[mm]	$2\cdot c_{cr,sp}$	
Installation safety factor	γ_{inst}	[-]	1,0	
Concrete cone failure				
Minimum effective anchorage depth	$h_{ef,min}$	[mm]	65	
Maximum effective anchorage depth	$h_{ef,max}$	[mm]	160	
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]	$1{,}5\,h_{ef}$	
Installation safety factor	γ_{inst}	[-]	1,0	
Displacement under tension load $\delta_{N0} = \delta_{N0\text{-factor}} \cdot N$ N: acting tension load				
Cracked concrete C20/25 – C50/60				
Factors for short term displacement	$\delta_{N0\text{-factor}}$	[mm/kN]	0,09	
Factors for long term displacement	$\delta_{N\infty\text{-factor}}$	[mm/kN]	0,21	
Uncracked concrete C20/25 – C50/60				
Factors for short term displacement	$\delta_{N0\text{-factor}}$	[mm/kN]	0,05	
Factors for long term displacement	$\delta_{N\infty\text{-factor}}$	[mm/kN]	0,11	

[1)] In absence of other national regulations

R-HPT III and R-HPT III A4	Annex C (4/13)
Performance Characteristic resistance under tension load	

Table C5: Characteristic values for shear loads under static and quasi-static action for design acc. to EOTA TR 055 or EN 1992-4:2018 for R-HPT III for sizes M8-M12

Essential characteristics			R-HPT III		
			M8	M10	M12
Steel failure without lever arm					
Characteristic resistance	$V^0_{Rk,s}$	[kN]	14,5	24,4	32,6
Partial safety factor	γ_{Ms} [1)]	[-]	1,5	1,5	1,5
Factor for considering ductility	k_7	[-]		1,0	
Steel failure with lever arm					
Characteristic resistance	$M^0_{Rk,s}$	[Nm]	30	57	104
Partial safety factor	γ_{Ms} [1)]	[-]	1,5	1,5	1,5
Concrete pryout failure					
k-factor	k_8	[-]	2,9	3,6	3,6
Installation safety factor	γ_{inst}	[-]		1,0	
Concrete edge failure					
Effective length of anchor under shear load	l_{ef}	[mm]		h_{ef} [2)]	
Outside diameter of anchor	d_{nom}	[mm]	8	10	12
Installation safety factor	γ_{inst}	[-]		1,0	
Displacement under tension load $\delta_{V0} = \delta_{V0\text{-factor}} \cdot V$ V: acting shear load $\delta_{V\infty} = \delta_{V\infty\text{-factor}} \cdot V$					
Factors for short term displacement	$\delta_{V0\text{-factor}}$	[mm/kN]	0,32	0,24	0,17
Factors for Long term displacement	$\delta_{V\infty\text{-factor}}$	[mm/kN]	0,48	0,37	0,25

1) In absence of other national regulations

2) 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 C6: Characteristic values for shear loads under static and quasi-static action for design acc. to EOTA TR 055 or EN 1992-4:2018 for R-HPT III for sizes M16-M20

Essential characteristics			R-HPT III	
			M16	M20
Steel failure without lever arm				
Characteristic resistance	$V^0_{Rk,s}$	[kN]	43,6	60,7
Partial safety factor	γ_{Ms} [1)]	[-]	1,5	1,5
Factor for considering ductility	k_7	[-]	1,0	
Steel failure with lever arm				
Characteristic resistance	$M^0_{Rk,s}$	[Nm]	169	402
Partial safety factor	γ_{Ms} [1)]	[-]	1,5	1,5
Concrete pryout failure				
k-factor	k_8	[-]	3,5	3,7
Installation safety factor	γ_{inst}	[-]	1,0	
Concrete edge failure				
Effective length of anchor under shear load	l_{ef}	[mm]	h_{ef}	
Outside diameter of anchor	d_{nom}	[mm]	16	20
Installation safety factor	γ_{inst}	[-]	1,0	
Displacement under tension load $\delta_{V0} = \delta_{V0\text{-factor}} \cdot V$ V: acting shear load $\delta_{V\infty} = \delta_{V\infty\text{-factor}} \cdot V$				
Factors for short term displacement	$\delta_{V0\text{-factor}}$	[mm/kN]	0,15	0,13
Factors for Long term displacement	$\delta_{V\infty\text{-factor}}$	[mm/kN]	0,22	0,19

1) In absence of other national regulations

R-HPT III and R-HPT III A4	
Performance Characteristic values for shear loads	**Annex C (5/13)**

Table C7: Characteristic values for shear loads under static and quasi-static action for design acc. to EOTA TR 055 or EN 1992-4:2018 for R-HPT III A4 for sizes M8-M12

Essential characteristics			R-HPT III A4		
			M8	M10	M12
Steel failure without lever arm					
Characteristic resistance	$V^0_{Rk,s}$	[kN]	13,7	22,8	34,0
Partial safety factor	γ_{Ms} [1)]	[-]	1,5	1,5	1,5
Factor for considering ductility	k_7	[-]	1,0		
Steel failure with lever arm					
Characteristic resistance	$M^0_{Rk,s}$	[Nm]	24	50	85
Partial safety factor	γ_{Ms} [1)]	[-]	1,5	1,5	1,5
Concrete pryout failure					
k-factor	k_8	[-]	2,9	3,6	3,6
Installation safety factor	γ_{inst}	[-]	1,0		
Concrete edge failure					
Effective length of anchor under shear load	l_{ef}	[mm]	h_{ef} [2)]		
Outside diameter of anchor	d_{nom}	[mm]	8	10	12
Installation safety factor	γ_{inst}	[-]	1,0		
Displacement under shear load $\delta_{V0} = \delta_{V0\text{-factor}} \cdot V$ V: acting shear load $\delta_{V\infty} = \delta_{V\infty\text{-factor}} \cdot V$					
Factor for short term displacement	$\delta_{V0\text{-factor}}$	[mm/kN]	0,28	0,24	0,17
Factor for long term displacement	$\delta_{V\infty\text{-factor}}$	[mm/kN]	0,43	0,36	0,26

1) In absence of other national regulations

2) 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 C8: Characteristic values for shear loads under static and quasi-static action for design acc. to EOTA TR 055 or EN 1992-4:2018 for R-HPT III for size M16

Essential characteristics			R-HPT III A4
			M16
Steel failure without lever arm			
Characteristic resistance	$V^0_{Rk,s}$	[kN]	60,0
Partial safety factor	γ_{Ms} [1)]	[-]	1,50
Factor for considering ductility	k_7	[-]	1,0
Steel failure with lever arm			
Characteristic resistance	$M^0_{Rk,s}$	[Nm]	169
Partial safety factor	γ_{Ms} [1)]	[-]	1,50
Concrete pryout failure			
k-factor	k_8	[-]	3,5
Installation safety factor	γ_{inst}	[-]	1,0
Concrete edge failure			
Effective length of anchor under shear load	l_{ef}	[mm]	h_{ef}
Outside diameter of anchor	d_{nom}	[mm]	16
Installation safety factor	γ_{inst}	[-]	1,0
Displacement under shear load $\delta_{V0} = \delta_{V0\text{-factor}} \cdot V$ V: acting shear load $\delta_{V\infty} = \delta_{V\infty\text{-factor}} \cdot V$			
Factor for short term displacement	$\delta_{V0\text{-factor}}$	[mm/kN]	0,15
Factor for long term displacement	$\delta_{V\infty\text{-factor}}$	[mm/kN]	0,17

1) In absence of other national regulations

R-HPT III and R-HPT III A4	Annex C (6/13)
Performance Characteristic values for shear loads	

Table C9: Characteristic resistance under tension loads in case of fire exposure for design acc. to EN 1992-4:2018, Annex D for R-HPT III and R-HPT III A4 sizes M8-M12

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]	0,79		3,23		1,66		4,58		3,21		6,41	
	R60	[kN]	0,60		1,76		1,28		2,97		2,48		4,91	
	R90	[kN]	0,41		1,01		0,78		1,79		1,36		3,07	
	R120	[kN]	0,32		0,70		0,51		1,25		0,79		2,15	
Pull-out failure														
Characteristic resistance $N_{Rk,p,fi}$	R30	[kN]	1,78	1,88	1,50	2,38	4,00	4,00	3,35	3,75	5,05	5,05	5,05	5,05
	R60	[kN]	1,78	1,88	1,50	2,38	4,00	4,00	3,35	3,75	5,05	5,05	5,05	5,05
	R90	[kN]	1,78	1,88	1,50	2,38	4,00	4,00	3,35	3,75	5,05	5,05	5,05	5,05
	R120	[kN]	1,42	1,50	1,20	1,90	3,20	3,20	2,68	3,00	4,04	4,04	4,04	4,04
Concrete cone and splitting failure[1)]														
The characteristic resistance $N^0_{Rk,c,fi}$ 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: $N^0_{Rkc,fi} = \frac{h_{ef}}{200} \times N^0_{Rk,c}$ (≤ R90) $N^0_{Rkc,fi} = 0{,}8\,\frac{h_{ef}}{200} \times N^0_{Rk,c}$ (R120) where $N^0_{Rk,c}$ is a characteristic resistance of a single fastener in cracked concrete C20/25 under normal temperature														
$s_{cr,N,fi}$	Spacing	[mm]	$4 \times h_{ef}$											
s_{min}		[mm]	40	35	40	35	40	40	40	40	50	50	50	50
$c_{cr,N,fi}$	Edge distance	[mm]	$2 \times h_{ef}$											
c_{min}		[mm]	Fire attack from one side: $c_{min} = 2 \times h_{ef}$											
			Fire attack from more than one side: $c_{min} \geq 300$ 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.

R-HPT III and R-HPT III A4	
Performance Characteristic tension resistance under fire exposure	**Annex C (7/13)**

Table C10: Characteristic resistance under tension loads in case of fire exposure for design acc. to EN 1992-4:2018, Annex D for R-HPT III and R-HPT III A4 sizes M16-M20

Essential characteristics			Anchor size					
			M16		M16-A4		M20	
			$h_{ef,min}$	$h_{ef,max}$	$h_{ef,min}$	$h_{ef,max}$	$h_{ef,min}$	$h_{ef,max}$
Steel failure								
Characteristic resistance $N_{Rk,s,fi}$	R30	[kN]	4,38		9,89		7,74	
	R60	[kN]	3,39		7,56		5,99	
	R90	[kN]	1,85		4,74		2,77	
	R120	[kN]	1,09		3,32		1,92	
Pull-out failure								
Characteristic resistance $N_{Rk,p,fi}$	R30	[kN]	9,00	9,00	7,30	7,30	10,55	10,55
	R60	[kN]	9,00	9,00	7,30	7,30	10,55	10,55
	R90	[kN]	9,00	9,00	7,30	7,30	10,55	10,55
	R120	[kN]	7,20	7,20	5,84	5,84	8,44	8,44
Concrete cone and splitting failure[1)]								
The characteristic resistance $N^0_{Rk,c,fi}$ 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: $N^0_{Rkc,fi} = \frac{h_{ef}}{200} \times N^0_{Rk,c}$ ($\leq$ R90) $N^0_{Rkc,fi} = 0{,}8\,\frac{h_{ef}}{200} \times N^0_{Rk,c}$ (R120) where $N^0_{Rk,c}$ is a characteristic resistance of a single fastener in cracked concrete C20/25 under normal temperature									
$s_{cr,N,fi}$	Spacing	[mm]	$4 \times h_{ef}$					
s_{min}		[mm]	65	50	65	50	80	80
$c_{cr,N,fi}$	Edge distance	[mm]	$2 \times h_{ef}$					
c_{min}		[mm]	Fire attack from one side: $c_{min} = 2 \times h_{ef}$					
			Fire attack from more than one side: $c_{min} \geq 300$ 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.

R-HPT III and R-HPT III A4	
Performance Characteristic tension resistance under fire exposure	**Annex C (8/13)**

Table C11: Characteristic resistance under shear loads in case of fire exposure for design acc. to EN 1992-4:2018, Annex D for R-HPT III and R-HPT III A4 sizes M8-M12

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]	1,25		5,07		2,70		7,43		5,00		10,00	
	R60	[kN]	0,95		2,78		2,08		4,81		3,87		9,17	
	R90	[kN]	0,65		1,59		1,26		2,90		2,12		5,74	
	R120	[kN]	0,50		1,10		0,82		2,02		1,21		4,06	
Steel failure with lever arm														
Characteristic resistance $M^0_{Rk,s,fi}$	R30	[Nm]	1,28		5,19		3,48		9,58		7,77		15,54	
	R60	[Nm]	0,97		2,83		2,68		6,20		6,01		11,88	
	R90	[Nm]	0,66		1,63		1,63		3,74		3,29		7,44	
	R120	[Nm]	0,51		1,13		1,06		2,60		1,88		5,22	
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:

$V_{RK,cp,fi} = k_8 \cdot N_{Rk,c,fi}$ (≤ 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:

$V^0_{Rk,c,fi} = 0,25 \times V^0_{Rk,c}$ (≤ 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.

R-HPT III and R-HPT III A4	
Performance Characteristic shear resistance under fire exposure	**Annex C (9/13)**

Table C12: Characteristic resistance under shear loads in case of fire exposure for design acc. to EN 1992-4:2018, Annex D for R-HPT III and R-HPT III A4 sizes M16-M20

Essential characteristics			Anchor size					
			M16		M16-A4		M20	
			$h_{ef,min}$	$h_{ef,max}$	$h_{ef,min}$	$h_{ef,max}$	$h_{ef,min}$	$h_{ef,max}$
Steel failure without lever arm								
Characteristic resistance $V_{Rk,s,fi}$	R30	[kN]	7,31		16,50		11,40	
	R60	[kN]	5,65		12,61		8,82	
	R90	[kN]	3,09		7,90		4,82	
	R120	[kN]	1,81		5,54		2,82	
Steel failure with lever arm								
Characteristic resistance $M^0_{Rk,s,fi}$	R30	[Nm]	15,50		34,99		30,21	
	R60	[Nm]	11,99		26,75		23,37	
	R90	[Nm]	6,56		16,75		12,78	
	R120	[Nm]	3,84		11,75		7,48	
Concrete pryout failure								
k-factor	k_8	[-]	3,5				3,7	
The Characteristic resistance $V_{Rk,cp,fi}$ in case of fasteners installed in concrete class C20/25 to C50/60 may be determined by: $V_{RK,cp,fi} = k_8 \cdot N_{Rk,c,fi}$ (≤ R90) $V_{RK,cp,fi} = k_8 \cdot N_{Rk,c,fi}$ (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: $V^0_{Rk,c,fi} = 0,25 \times V^0_{Rk,c}$ (≤ R90) $V^0_{Rk,c,fi} = 0,20 \times V^0_{Rk,c}$ (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.

R-HPT III and R-HPT III A4	
Performance Characteristic shear resistance under fire exposure	**Annex C (10/13)**

Table C13: Characteristic resistance in case of seismic action for design acc. to EN 1992-4:2018: Performance Category C1 and C2 for R-HPT III and R-HPT III sizes M8-M12

			Anchor size					
			M8	M8-A4	M10	M10-A4	M12	M12-A4
Tension - steel failure								
Characteristic resistance **C1**	$N_{Rk,s,seis,C1}$	[kN]	19,8	19,4	31,1	30,4	48,7	46,0
Characteristic resistance **C2**	$N_{Rk,s,seis,C2}$	[kN]	-	-	31,1	30,4	48,7	46,0
Partial safety factor	$\gamma_{Ms,seis}$ [1)]	[-]	1,40	1,42	1,40	1,40	1,50	1,42
Tension - pull-out failure								
Characteristic resistance **C1**	$N_{Rk,p,seis,C1}$	[kN]	7,05	9,03	14,88	13,80	20,20	16,56
Characteristic resistance **C2**	$N_{Rk,p,seis,C2}$	[kN]	-	-	10,73	8,05	9,71	10,37
Installation safety factor	γ_{inst}	[-]	1,0					
Concrete cone and splitting failure [2)]								
Effective anchorage depth	h_{ef}	[mm]	48		60		70	
Installation safety factor	γ_{inst}	[-]	1,0					
Shear - steel failure without lever arm								
Characteristic resistance **C1**	$V_{Rk,s,seis,C1}$	[kN]	9,43	8,08	17,32	15,50	26,08	24,48
Characteristic resistance **C2**	$V_{Rk,s,seis,C2}$	[kN]	-	-	17,32	15,50	26,08	24,48
Partial safety factor	$\gamma_{Ms,seis}$ [1)]	[-]	1,5					
Concrete pryout and concrete edge failure [3)]								
Effective anchorage depth	h_{ef}	[mm]	48		60		70	
Installation safety factor	γ_{inst}	[-]	1,0					

[1)] In absence of other national regulations
[2)] For concrete cone, splitting, pryout and edge failure, see EN 1992-4:2018

R-HPT III and R-HPT III A4	
Performance Characteristic resistances under seismic action Performance category C1 and C2	**Annex C(11/13)**

Table C14: Characteristic resistance in case of seismic action for design acc. to EN 1992-4:2018: Performance Category C1 and C2 for R-HPT III and R-HPT III sizes M16-M20

			Anchor size		
			M16	M16-A4	M20
Tension - steel failure					
Characteristic resistance **C1**	$N_{Rk,s,seis,C1}$	[kN]	69,67	87,08	121,36
Characteristic resistance **C2**	$N_{Rk,s,seis,C2}$	[kN]	69,67	87,08	121,36
Partial safety factor	$\gamma_{Ms,seis}$ [1)]	[-]	1,41	1,46	1,41
Tension - pull-out failure					
Characteristic resistance **C1**	$N_{Rk,p,seis,C1}$	[kN]	24,84	23,22	26,49
Characteristic resistance **C2**	$N_{Rk,p,seis,C2}$	[kN]	22,81	12,77	13,12
Installation safety factor	γ_{inst}	[-]	1,0		
Concrete cone and splitting failure [2)]					
Effective anchorage depth	h_{ef}	[mm]	85		100
Installation safety factor	γ_{inst}	[-]	1,0		
Shear - steel failure without lever arm					
Characteristic resistance **C1**	$V_{Rk,s,seis,C1}$	[kN]	39,24	45,00	54,63
Characteristic resistance **C2**	$V_{Rk,s,seis,C2}$	[kN]	39,24	45,00	54,63
Partial safety factor	$\gamma_{Ms,seis}$ [1)]	[-]	1,5		
Concrete pryout and concrete edge failure [3)]					
Effective anchorage depth	h_{ef}	[mm]	85		100
Installation safety factor	γ_{inst}	[-]	1,0		

[1)] In absence of other national regulations
[2)] For concrete cone, splitting, pryout and edge failure, see EOTA TR 045

R-HPT III and R-HPT III A4	
Performance Characteristic resistances under seismic action Performance category C1 and C2	**Annex C(12/13)**

Table C15: Displacements in case of seismic action for desgin acc. to EN 1992-4:2018: Performance Category C2 for R-HPT III and R-HPT III A4 sizes M10-M20

			Anchor size						
			M10	M10-A4	M12	M12-A4	M16	M16-A4	M20
Displacement under tension loads									
Displacement **DLS**	$d_{N,C2(DLS)}$	[mm]	4,05	4,79	6,16	5,83	6,31	6,90	6,89
Displacement **ULS**	$d_{N,C2(ULS)}$	[mm]	13,12	14,62	20,56	19,39	21,16	16,71	25,04
Displacement under shear loads									
Displacement **DLS**	$\delta_{V,C2(DLS)}$	[mm]	5,76	5,42	4,77	4,70	4,65	6,14	6,79
Displacement **ULS**	$\delta_{V,C2(ULS)}$	[mm]	10,28	11,88	10,77	8,81	8,07	11,91	11,98

R-HPT III and R-HPT III A4	**Annex C(13/13)**
Performance Displacements under seismic action Performance category C2	