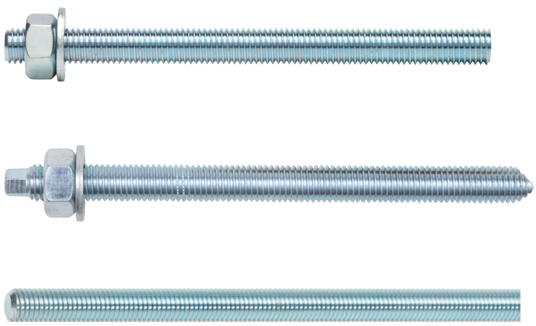
WIT-PM 200 WITH THREADED ROD (METRIC)

300 ml 330 ml 420 ml



Approved for:
Concrete C20/25 to C50/60, non-cracked

Suitable for:
Concrete C12/15, Natural stone with dense structure

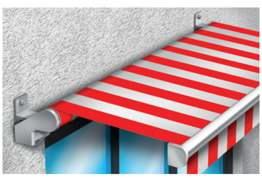
Cartridge sizes		Art. no.
300 ml	foil-in-tube	**5918 242 300**
330 ml	coaxial	**5918 240 330**
420 ml	coaxial	**5918 240 420**

Type of installation		
Pre-positioned	In-place	Stand-off
✓	–	✓

Installation condition		
Dry concrete	Wet concrete	Flooded drill hole
✓	✓	✓

Drilling method		
Hammer drill	Diamond drill	Hollow drill
✓	–	–

Applications

Approvals and certificates

Description	Authority/laboratory	Guideline for assessment	No./date of issue
European Technical Assessment	TZUS, Prag	ETAG 001-T5	ETA-12/0569, 25.01.2016
European Technical Assessment	TZUS, Prag	ETAG 029	ETA-13/0037, 28.04.2016
LEED	eurofins		20.12.18
VOC Emissions Test report	eurofins	DEVL 1101903D, DEVL 1104875A	20.12.18

Basic load data (for a single anchor)

All data in this section applies when:

- Installation is correct (see installation instructions)
- No edge distance and spacing influence
- Base material thickness and embedment depth are according to anchor characteristics
- Anchor material according is to specifications,
- Concrete C 20/25, f_{ck} = 20 N/mm²
- Concrete C 50/60, f_{ck} = 60 N/mm²
- Temperature range I (min. base material temperature -40°C, max long term/short term base material temperature: +24°C/40°C).
- Dry or wet conditions of drill hole, hammer drilling

Characteristic resistance

Thread size				M8	M10	M12	M16	M20	M24
Effective anchorage depth		h_{ef}	[mm]	80	90	110	125	170	210
Non-cracked concrete									
Tension	C20/25	N_{Rk}	[kN]	17.1	22.6	33.2	50.3	85.5	126.7
	C50/60			18.3	24.9	36.5	55.3	94.0	139.3
Shear	≥ C20/25	V_{Rk}	[kN]	11.0	17.4	25.3	47.1	73.5	105.9

Design resistance

Thread size				M8	M10	M12	M16	M20	M24
Effective anchorage depth		h_{ef}	[mm]	80	90	110	125	170	210
Non-cracked concrete									
Tension	C20/25	N_{Rd}	[kN]	9.5	12.6	18.4	27.9	47.5	70.4
	C50/60			10.4	13.8	20.3	30.7	52.2	77.4
Shear	≥ C20/25	V_{Rd}	[kN]	8.8	13.9	20.2	37.7	58.8	84.7

Recommended/allowable Loads [1)]

Thread size				M8	M10	M12	M16	M20	M24
Effective anchorage depth		h_{ef}	[mm]	80	90	110	125	170	210
Non-cracked concrete									
Tension	C20/25	N_{rec}	[kN]	6.8	9.0	13.2	19.9	33.9	50.3
	C50/60			7.5	9.9	14.5	21.9	37.3	55.3
Shear	≥ C20/25	V_{rec}	[kN]	6.3	9.9	14.5	26.9	42.0	60.5

[1)] Material safety factor γ_M and safety factor for action γ_L = 1.4 are included. The material safety factor depends on the failure mode.

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Design method (simplified)

Simplified version of the design method according to Eurocode 2 - Design of concrete structures - Part 4: Design of fastenings for use in concrete (EN 1992-4):

- Influence factors related to concrete strength, edge distance, spacing and others must be considered when applicable
- Valid for a group of anchors. The influencing factors must then be considered for each edge distance and spacing. The calculated design resistances are on the safe side. They will be lower than the exact values according to EN 1992-4. For an economical optimization, we recommend using the anchor design module of the Würth Technical Software II
- The design method is based on the simplification that no different loads are acting on individual anchors (no eccentricity)
- Temperature range 1 (min. base material temperature -40°C, max. long term/short term base material temperature: +24°C/40°C).
- Dry or wet conditions of drill hole, hammer drilling (Installation factors might apply for other drilling methods)
- Anchor material according to specifications, steel grade 5.8 unless otherwise stated in the tables

I. Tension loading

The decisive design resistance in tension is the lowest value of the following failure modes:

1. Steel failure $N_{Rd,s}$
2. Pull-out failure $N_{Rd,p} = N^0_{Rd,p} \cdot f_{b,N} \cdot f_{hef} \cdot f_{sx,p} \cdot f_{sy,p} \cdot f_{cx,1,p} \cdot f_{cx,2,p} \cdot f_{cy,p} \cdot f_{sus}$
3. Concrete cone failure $N_{Rd,c} = N^0_{Rd,c} \cdot f_{b,N} \cdot f_{hef} \cdot f_{sx} \cdot f_{sy} \cdot f_{cx,1} \cdot f_{cx,} \cdot f_{cy}$
4. Concrete splitting failure $N_{Rd,sp} = N^0_{Rd,sp} \cdot f_{b,N} \cdot f_{hef} \cdot f_{sx,sp} \cdot f_{sy,sp} \cdot f_{cx,1,sp} \cdot f_{cx,2,sp} \cdot f_{cy,sp} \cdot f_h$

1. Design steel resistance

Table 1: Design value of steel resistance under tension load $N_{Rd,s}$ of a single anchor

Thread size				M8	M10	M12	M16	M20	M24
Effective anchorage depth		h_{ef}	[mm]	80	90	110	125	170	210
Design steel resistance	5.8	$N_{Rd,s}$	[kN]	12.2	19.3	28.1	52.3	81.7	117.7
	8.8	$N_{Rd,s}$	[kN]	19.3	30.7	44.7	83.3	130.7	188.0
	A4	$N_{Rd,s}$	[kN]	13.9	21.9	31.6	58.8	91.4	132.1

2. Design combined pull-out and concrete cone resistance

$$N_{Rd,p} = N^0_{Rd,p} \cdot f_{b,N} \cdot f_{hef} \cdot f_{sx,p} \cdot f_{sy,p} \cdot f_{cx,1,p} \cdot f_{cx,2,p} \cdot f_{cy,p} \cdot f_{sus}$$

Table 2: Basic design resistance $N^0_{Rd,p}$ in case of combined pull-out and concrete cone failure of a single anchor

Thread size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Effective anchorage depth	h_{ef}	[mm]	80	90	110	125	170	210
Non-cracked concrete								
Combined pull-outand concrete cone resistance	$N^0_{Rd,p}$	[kN]	9.5	12.6	18.4	27.9	47.5	70.4

- $s_{cr,p} = 7.3\, d\, (f_{sus} \cdot \tau_{Rk})^{0.5} \leq 3h_{ef}$
- $c_{cr,p} = s_{cr,p}/2$

Where τ_{Rk} is the value $\tau_{Rk,ucr}$ for non-cracked concrete C20/25

Table 3: Characteristic edge distance $c_{cr,p}$ and spacing $s_{cr,p}$ (f_{sus} = 1)

Thread size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Effective anchorage depth	h_{ef}	[mm]	80	90	110	125	170	210
Spacing	$s_{cr,p}$	[mm]	170	206	248	330	413	496
Edge distance	$c_{cr,p}$	[mm]	85	103	124	165	206	248

a. Influence of concrete strength

Table 4: Influence of concrete strength on combined pull-out and concrete cone resistance

Concrete strength classes (EN 206:2000)			**C12/15**	**C16/20**	**C20/25**	**C25/30**	**C30/37**	**C35/45**	**C40/50**	**C45/55**	**C50/60**
Characteristic compressive strength of concrete determined by testing cylinders[1)]	f_{ck}	[N/mm²]	12	16	20	25	30	35	40	45	50
Characteristic compressive strength of concrete determined by testing cube[2)]	$f_{ck,cube}$	[N/mm²]	15	20	25	30	37	45	50	55	60
Influencing factor	$f_{b,N}$	[-]	0.77	0.89	1.00	1.02	1.04	1.07	1.08	1.09	1.10

[1)] strength at 28 days of 150 mm diameter by 300 mm cylinders

[2)] strength at 28 days of 150 mm cubes

b. Influence of embedment depth

$$f_{hef} = \frac{h_{ef}}{h_{ef,typ}}$$

Consider the approved range of embedment $h_{ef,min} \leq h_{ef} \leq h_{ef,max}$ according to the table „installation parameters".

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c. Influence of spacing

$$f_{sx,p} = f_{sy,p} = \left(1 + \left(n_{x(y)} - 1\right)\frac{s_{x(y)}}{s_{cr,p}}\right) \cdot \frac{1}{n_{x(y)}} \leq 1$$

Table 5: Influence of spacing on combined pull-out and concrete cone resistance

Number of fixing per direction	$s/s_{cr,p}$ [1]	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.75	0.70	0.75	0.90	0.95	≥ 1
2	$f_{sx,p},\ f_{sy,p}$	0.55	0.58	0.60	0.63	0.65	0.68	0.70	0.73	0.75	0.78	0.80	0.83	0.85	0.88	0.85	0.88	0.95	0.98	1.00
3	$f_{sx,p},\ f_{sy,p}$	0.40	0.43	0.47	0.50	0.53	0.57	0.60	0.63	0.67	0.70	0.73	0.77	0.80	0.83	0.80	0.83	0.93	0.97	1.00
4	$f_{sx,p},\ f_{sy,p}$	0.33	0.36	0.40	0.44	0.48	0.51	0.55	0.59	0.63	0.66	0.70	0.74	0.78	0.81	0.78	0.81	0.93	0.96	1.00
5	$f_{sx,p},\ f_{sy,p}$	0.28	0.32	0.36	0.40	0.44	0.48	0.52	0.56	0.60	0.64	0.68	0.72	0.76	0.80	0.76	0.80	0.92	0.96	1.00

[1] Choose always the lowest value of the spacing s, when there are different spacings in one row

d. Influence of edge distance

$$f_{cx,1,p} = 0.7 + 0.3\frac{c_x}{c_{cr,p}} \leq 1 \qquad f_{cx,2,p} = f_{cy,p} = \left(1 + \frac{c_{x(y)}}{c_{cr,p}}\right) \cdot \frac{1}{2} \leq 1$$

Table 6: Influence of edge distance on combined pull-out and concrete cone resistance

$c/c_{cr,P}$	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.75	0.70	0.75	0.90	0.95	≥ 1.0
$f_{cx,1,p}$	0.73	0.75	0.76	0.78	0.79	0.81	0.82	0.84	0.85	0.87	0.88	0.90	0.91	0.93	0.91	0.93	0.97	0.99	1.00
$f_{cx,2,p}$ / $f_{cy,p}$	0.55	0.58	0.60	0.63	0.65	0.68	0.70	0.73	0.75	0.78	0.80	0.83	0.85	0.88	0.85	0.88	0.95	0.98	1.00

e. Influence of sustained loads

$$a_{sus} = \frac{N_{sus,d}}{N_{Ed}}$$

$N_{sus,d}$ = design value of sustained actions (permanent actions & permanent component of variable actions)
N_{Ed} = Value of total actions in tension loading at ultimate limit state

Table 7: Influence of sustained loads on combined pull-out and concrete cone resistance

a_{sus}	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
f_{sus}	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60

3. Design concrete cone resistance

$$N_{Rd,c} = N^0_{Rd,c} \cdot f_{b,N} \cdot f_{sx} \cdot f_{sy} \cdot f_{cx,1} \cdot f_{cx,2} \cdot f_{cy}$$

No verification of splitting is required if at least one of the conditions is fulfilled:

a) The edge distance in all directions is $c \geq c_{cr,sp}$ for single fasteners and $c \geq 1.2\ c_{cr,sp}$ for fastener groups and the member depth is $h \geq h_{min}$ in both cases.

b) The characteristic resistance for concrete cone failure and pull-out failure is calculated for cracked concrete and reinforcement resists the splitting forces and limits the crack width to $w_k \leq 0.3$ mm

Table 8: Basic design resistance $N^0_{Rd,c}$ in case of concrete cone failure of a single anchor

Thread size			M8	M10	M12	M16	M20	M24
Effective anchorage depth	h_{ef}	[mm]	80	90	110	125	170	210
Non-cracked concrete								
Concrete cone resistance	$N^0_{Rd,c}$	[kN]	19.6	23.3	31.5	38.2	60.6	83.2

Table 9: Characteristic edge distance $c_{cr,N}$ and spacing $s_{cr,N}$

Thread size			M8	M10	M12	M16	M20	M24
Effective anchorage depth	h_{ef}	[mm]	80	90	110	125	170	210
spacing	$s_{cr,N}$	[mm]	240	270	330	375	510	630
edge distance	$c_{cr,N}$	[mm]	120	135	165	188	255	315

Above characteristic spacing and edge distances are given for the typical effective anchorage depths. Calculating for smaller depths leads to conservative load capacities. For calculation with bigger depths, use the following:

$$s_{cr,N} = 3\ h_{ef} \text{ and } c_{cr,N} = 1.5\ h_{ef}$$

a. Influence of concrete strength

Table 10: Influence of concrete strength on concrete cone resistance

Concrete strength classes (EN 206:2000)			C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
Characteristic compressive strength of concrete determined by testing cylinders[1]	f_{ck}	[N/mm²]	12	16	20	25	30	35	40	45	50
Characteristic compressive strength of concrete determined by testing cube[2]	$f_{ck,cube}$	[N/mm²]	15	20	25	30	37	45	50	55	60
Influencing factor	$f_{b,N}$	[-]	0.77	0.89	1.00	1.12	1.22	1.32	1.41	1.50	1.58

[1] strength at 28 days of 150 mm diameter by 300 mm cylinders

[2] strength at 28 days of 150 mm cubes

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b. Influence of embedment depth

$$f_{hef} = \left(\frac{h_{ef}}{h_{ef,\,typ}}\right)^{1.5}$$

Consider the approved range of embedment $h_{ef,min} \leq h_{ef} \leq h_{ef,max}$ according to the table „anchor characteristics".

c. Influence of spacing

$$f_{sx} = f_{sy} = \left(1 + \left(n_{x(y)} - 1\right)\frac{s_{x(y)}}{s_{cr,N}}\right) \cdot \frac{1}{n_{x(y)}} \leq 1$$

Table 11: Influence of spacing on concrete cone resistance

Number of fixing per direction	$s/s_{cr,p}$ 1)	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.75	0.70	0.75	0.90	0.95	≥ 1
2	f_{sx}, f_{sy}	0.55	0.58	0.60	0.63	0.65	0.68	0.70	0.73	0.75	0.78	0.80	0.83	0.85	0.88	0.85	0.88	0.95	0.98	1.00
3	f_{sx}, f_{sy}	0.40	0.43	0.47	0.50	0.53	0.57	0.60	0.63	0.67	0.70	0.73	0.77	0.80	0.83	0.80	0.83	0.93	0.97	1.00
4	f_{sx}, f_{sy}	0.33	0.36	0.40	0.44	0.48	0.51	0.55	0.59	0.63	0.66	0.70	0.74	0.78	0.81	0.78	0.81	0.93	0.96	1.00
5	f_{sx}, f_{sy}	0.28	0.32	0.36	0.40	0.44	0.48	0.52	0.56	0.60	0.64	0.68	0.72	0.76	0.80	0.76	0.80	0.92	0.96	1.00

1) Choose always the lowest value of the spacing s, when there are different spacings in one row

d. Influence of edge distance

$$f_{cx,1} = 0.7 + 0.3\frac{c_x}{c_{cr,N}} \leq 1 \qquad f_{cx,2} = f_{cy} = \left(1 + \frac{c_{x(y)}}{c_{cr,N}}\right) \cdot \frac{1}{2} \leq 1$$

Table 12: Influence of edge distance on concrete cone resistance

$c/c_{cr,N}$	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.75	0.70	0.75	0.90	0.95	≥ 1.0
$f_{cx,1}$	0.73	0.75	0.76	0.78	0.79	0.81	0.82	0.84	0.85	0.87	0.88	0.90	0.91	0.93	0.91	0.93	0.97	0.99	1.00
$f_{cx,2}$ / f_{cy}	0.55	0.58	0.60	0.63	0.65	0.68	0.70	0.73	0.75	0.78	0.80	0.83	0.85	0.88	0.85	0.88	0.95	0.98	1.00

4. Design splitting resistance

$$N_{Rd,sp} = N^0_{Rd,sp} \cdot f_{b,N} \cdot f_{hef} \cdot f_{sx,sp} \cdot f_{sy,sp} \cdot f_{cx,1,sp} \cdot f_{cx,2,sp} \cdot f_{cy,sp} \cdot f_h$$

Table 13: Design resistance $N_{Rd,sp}$ in case of concrete splitting failure of a single anchor

Thread size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Effective anchorage depth	h_{ef}	[mm]	80	90	110	125	170	210
Non-cracked concrete								
Concrete splitting failure	$N^0_{Rd,sp}$	[kN]	9.5	12.6	18.4	27.9	47.5	70.4

Table 14: Characteristic edge distance $c_{cr,sp}$ and spacing $s_{cr,sp}$

Thread size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Effective anchorage depth	h_{ef}	[mm]	80	90	110	125	170	210
Characteristic spacing	$s_{cr,sp}$	[mm]	360	420	528	600	816	1008
Characteristic edge distance	$c_{cr,sp}$	[mm]	180	210	264	300	408	504
Minimum member thickness	h_{min}	[mm]	110	120	140	161	218	266

Above characteristic spacing and edge distances are given for the typical effective anchorage depth. Calculating for smaller depths leads to conservative load capacities. For calculation with bigger depths, use the following:

$$s_{cr,sp} = 2 \cdot c_{cr,sp} \quad \text{and} \quad c_{cr,sp} = \left\{ h_{ef} \leq 2\, h_{ef} \cdot \left(2.5 - \left(\frac{h_{min}}{h_{ef}} \right) \right) \leq 2.4\, h_{ef} \right\}$$

and h_{min} according to the table „anchor characteristics".

a. Influence of concrete strength

Table 15: Influence of concrete strength on splitting resistance

Concrete strength classes (EN 206:2000)			**C12/15**	**C16/20**	**C20/25**	**C25/30**	**C30/37**	**C35/45**	**C40/50**	**C45/55**	**C50/60**
Characteristic compressive strength of concrete determined by testing cylinders [1)]	f_{ck}	[N/mm²]	12	16	20	25	30	35	40	45	50
Characteristic compressive strength of concrete determined by testing cube [2)]	$f_{ck,cube}$	[N/mm²]	15	20	25	30	37	45	50	55	60
Influencing factor	$f_{b,N}$	[-]	0.77	0.89	1.00	1.12	1.22	1.32	1.41	1.50	1.58

[1)] strength at 28 days of 150 mm diameter by 300 mm cylinders

[2)] strength at 28 days of 150 mm cubes

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b. Influence of embedment depth

$$f_{hef} = \left(\frac{h_{ef}}{h_{ef,typ}}\right)^{1.5}$$

Consider the approved range of embedment $h_{ef,min} \leq h_{ef} \leq h_{ef,max}$ according to the table „anchor characteristics".

c. Influence of spacing

$$f_{sx,p} = f_{sy,p} = \left(1 + \left(n_{x(y)} - 1\right)\frac{s_{x(y)}}{s_{cr,p}}\right) \cdot \frac{1}{n_{x(y)}} \leq 1$$

Table 16: Influence of spacing on splitting resistance

Number of fixing per direction	$s/s_{cr,sp}$ [1)]	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.75	0.70	0.75	0.90	0.95	≥ 1
2	$f_{sx,sp}$, $f_{sy,sp}$	0.55	0.58	0.60	0.63	0.65	0.68	0.70	0.73	0.75	0.78	0.80	0.83	0.85	0.88	0.85	0.88	0.95	0.98	1.00
3	$f_{sx,sp}$, $f_{sy,sp}$	0.40	0.43	0.47	0.50	0.53	0.57	0.60	0.63	0.67	0.70	0.73	0.77	0.80	0.83	0.80	0.83	0.93	0.97	1.00
4	$f_{sx,sp}$, $f_{sy,sp}$	0.33	0.36	0.40	0.44	0.48	0.51	0.55	0.59	0.63	0.66	0.70	0.74	0.78	0.81	0.78	0.81	0.93	0.96	1.00
5	$f_{sx,sp}$, $f_{sy,sp}$	0.28	0.32	0.36	0.40	0.44	0.48	0.52	0.56	0.60	0.64	0.68	0.72	0.76	0.80	0.76	0.80	0.92	0.96	1.00

[1)] Choose always the lowest value of the spacing s, when there are different spacings in one row

c. Influence of edge distance

$$f_{cx,1,sp} = 0.7 + 0.3\frac{c_x}{c_{cr,sp}} \leq 1 \qquad f_{cx,2,sp} = f_{cy,sp} = \left(1 + \frac{c_{x(y)}}{c_{cr,sp}}\right) \cdot \frac{1}{2} \leq 1$$

Table 17: Influence of edge distance on splitting resistance

$c/c_{cr,sp}$	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.75	0.70	0.75	0.90	0.95	≥ 1
$f_{cx,1,sp}$	0.73	0.75	0.76	0.78	0.79	0.81	0.82	0.84	0.85	0.87	0.88	0.90	0.91	0.93	0.91	0.93	0.97	0.99	1.00
$f_{cx,2,sp}$ / $f_{cy,sp}$	0.55	0.58	0.60	0.63	0.65	0.68	0.70	0.73	0.75	0.78	0.80	0.83	0.85	0.88	0.85	0.88	0.95	0.98	1.00

d. Influence of concrete member thickness

$$f_h = \left(\frac{h}{h_{min}}\right)^{2/3} \leq max\left(1; \left(\frac{h_{ef} + 1.5c_1}{h_{min}}\right)^{2/3}\right)$$

Table 14: Influence of concrete member thickness on splitting resistance

h/h_{min}	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.4	2.3	2.4	2.7	2.8	2.9
f_h	1.00	1.07	1.13	1.19	1.25	1.31	1.37	1.42	1.48	1.53	1.59	1.64	1.69	1.74	1.79	1.74	1.79	1.94	1.99	2.00

II. Shear loading

The decisive design resistance in shear is the lowest value of the following failure modes:

1. Steel failure V_{Rds}
2. Concrete pry-out failure $V_{Rd,c} = k \cdot min\ \{N_{Rd,p;}\ N_{Rd,c}\}$
3. Concrete edge failure $V_{Rd,c} = V^0_{Rd,c} \cdot f_{b,V} \cdot f_{hef,V} \cdot f_{s,V} \cdot f_{c1,V} \cdot f_{c2,V} \cdot f_a \cdot f_h$

1. Design steel shear resistance

Table 19: Design value of steel resistance $V_{Rd,s}$ of a single anchor

Thread size				M8	M10	M12	M16	M20	M24
Effective anchorage depth		h_{ef}	[mm]	80	90	110	125	170	210
Design steel resistance	5.8	$V_{Rd,s}$	[kN]	8.8	13.9	20.2	37.7	58.8	84.7
	8.8		[kN]	12.0	18.4	27.2	50.4	78.4	112.8
	A4		[kN]	8.3	12.8	19.2	35.3	55.1	79.5

2. Design concrete pry-out resistance

$$V_{Rd,c} = k_8 \cdot min\ \{N_{Rd,p};N_{Rd,c}\}$$

Table 20: factor k_8 for calculating design pry-out resistance

Thread size			M8	M10	M12	M16	M20	M24
Effective anchorage depth	h_{ef}	[mm]	80	90	110	125	170	210
Concrete pry-out resistance factor	k_8	[-]	2.0	2.0	2.0	2.0	2.0	2.0

3. Design concrete edge resistance

$$V_{Rd,c} = V^0_{Rd,c} \cdot f_{b,V} \cdot f_{hef,V} \cdot f_{s,V} \cdot f_{c1,V} \cdot f_{c2,V} \cdot f_a \cdot f_h$$

Verification of concrete edge failure may be omitted for single fasteners and groups with an edge distance in all directions $c \geq max\ (10\ h_{ef}\ ;\ 60\ d)$. For anchorages with more than one edge, the resistance for all edges shall be calculated. The smallest value should be used in the verification.

Table 21: Design resistance $V^0_{Rd,c}$ in case of concrete edge failure

Thread size			M8	M10	M12	M16	M20	M24
Effective anchorage depth	h_{ef}	[mm]	80	90	110	125	170	210
Non-cracked concrete								
Basic design edge resistance	$V^0_{Rd,c}$	[kN]	3.3	4.8	6.5	10.3	15.3	21.1

WIT-PM 200 WITH THREADED ROD (METRIC)

a. Influence of concrete strength

Table 22: Influence of concrete strength on concrete edge resistance

Concrete strength classes (EN 206:2000)			C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
Characteristic compressive strength of concrete determined by testing cylinders[1]	f_{ck}	[N/mm²]	12	16	20	25	30	35	40	45	50
Characteristic compressive strength of concrete determined by testing cube[2]	$f_{ck,cube}$	[N/mm²]	15	20	25	30	37	45	50	55	60
Influencing factor	$f_{b,N}$	[-]	0.77	0.89	1.00	1.12	1.22	1.32	1.41	1.50	1.58

[1] strength at 28 days of 150 mm diameter by 300 mm cylinders

[2] strength at 28 days of 150 mm cubes

b. Influence of embedment depth

Table 23: Influence of embedment depth on concrete edge resistance

h_{ef}/d	4	5	6	7	8	9	10	11	≥ 12
$f_{hef,V}$	0.87	0.91	0.94	0.97	1.00	1.02	1.05	1.07	1.08

c. Influence of spacing

In groups loaded perpendicular to the edge only two adjacent anchors closest and parallel to the edge carry the load. The smallest spacing should be used for the verification.

$$f_{s,V} = \frac{1}{3} \cdot \frac{s}{c_1} + 1 \leq 2$$

Table 24: Influence of spacing on concrete edge resistance

s/c_1[1]	0.50	0.60	0.70	0.80	0.90	1.00	1.20	1.40	1.60	1.80	2.00	2.20	2.40	2.60	2.80	2.60	2.80
$f_{s,V}$	1.17	1.20	1.23	1.27	1.30	1.33	1.40	1.47	1.53	1.60	1.67	1.73	1.80	1.87	1.93	1.87	1.93

[1] Always choose the lowest value of the spacing s, when there are different spacing in the row closest to the edge.

d. Influence of edge distance c_1

Table 20: Influence of edge distance on concrete edge resistance

$c_{1/d}$	4	8	12	15	20	30	40	50	60	100	150	200
$f_{c1,V}$	0.47	1.19	2.05	2.76	4.05	6.95	10.22	13.76	17.54	34.66	59.52	87.35

e. Influence of edge distance c_2

$$f_{c2,V} = \left(\frac{1}{2} + \frac{1}{3}\frac{c_2}{c_1}\right)\left(0.7 + 0.3\frac{c_2}{1.5c_1}\right) \leq 1$$

Table 26: Influence of edge distance c2 on concrete edge resistance

c_2/c_1 [1)]	1	1.1	1.2	1.3	1.4	1.5
$f_{c,V}$	0.75	0.80	0.85	0.90	0.95	1.00

[1)] Distance to the second edge: c1 ≤ c2

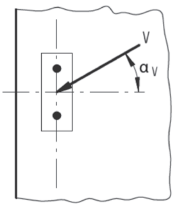
f. Influence of load direction

$$f_\alpha = \sqrt{\frac{1}{\cos^2\alpha_V + \left(\frac{\sin\alpha_V}{2}\right)^2}} \leq 2$$

Table 27: Influence of load direction on concrete edge resistance

α [1)]	0	10	20	30	40	50	60	70	80	90
$f_{\alpha,V}$	1.00	1.01	1.05	1.11	1.20	1.34	1.51	1.72	1.92	2.00

[1)] For a ≥ 90° the component of the shear load acting away from the edge may be neglected and the verification may be done with component acting parallel to the edge only.



g. Influence of concrete member thickness

$$f_{h,V} = \left(\frac{h}{1.5c_1}\right)^{1/2}$$

Table 28: Influence of concrete member thickness on edge resistance

h/c_1	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	≥ 1.50
$f_{h,V}$	0.26	0.37	0.45	0.52	0.58	0.63	0.68	0.73	0.77	0.82	0.86	0.89	0.93	0.97	1.00

WIT-PM 200 WITH THREADED ROD (METRIC)

Structural verification

N_{Ed} = Design value of tension load acting on a fastener
V_{Ed} = Design value of a shear load acting on a fastener

	Failure mode	Verification
1	Steel failure of fastener [1)]	$\left(\frac{N_{Ed}}{N_{Rd}}\right)^2 + \left(\frac{V_{Ed}}{V_{Rd}}\right)^2 \leq 1$ If N_{Ed} and V_{Ed} are different for the individual fasteners of the group, the interaction shall be verified for all fasteners.
2	Failure modes other than steel failure	$\left(\frac{N_{Ed}}{N_{Rd,i}}\right)^{1.5} + \left(\frac{V_{Ed}}{V_{Rd,i}}\right)^{1.5} \leq 1$ or $\left(\frac{N_{Ed}}{N_{Rd,i}}\right) + \left(\frac{V_{Ed}}{V_{Rd,i}}\right) \leq 1.2$ With $N_{Ed} / N_{Rd,i} \leq 1$ and $V_{Ed} / V_{Rd,i} \leq 1$ The largest value of $N_{Ed} / N_{Rd,i}$ and $V_{Ed} / V_{Rd,i}$ for the different failure modes shall be taken.

[1)] This verification is not required in case of shear load with lever arm

Design bond strength

Service temperature

	Base material temperature	Maximum long-term base material temperature	Maximum short-term base material temperature
Temperature range I	- 40°C to +40°C	+24°C	+40°C
Temperature range II	- 40°C to +80°C	+50°C	+80°C

Working life of 50 years

1- Non-cracked concrete

Thread size				**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Design bond resistance in non-cracked concrete C20/25									
Temperature range I	Dry and wet concrete	$\tau_{Rd,ucr}$	[N/mm^2]	4.7	4.4	4.4	4.4	4.4	4.4
	Flooded bore hole			4.7	4.4	4.4	4.4	4.4	4.4
Temperature range II	Dry and wet concrete			3.6	3.3	3.3	3.3	3.3	3.3
	Flooded bore hole			3.6	3.3	3.3	3.3	3.3	3.3

Reduction factor

Working life of 50 years

1- Non-cracked concrete

Thread size				**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Reduction factor for non-cracked concrete C20/25									
Temperature range I	Dry and wet concrete	$\tau_{Rd,ucr}$	[N/mm^2]	1.00	1.00	1.00	1.00	1.00	1.00
	Flooded bore hole			1.00	1.00	1.00	1.00	1.00	1.00
Temperature range II	Dry and wet concrete			1.00	1.00	1.00	1.00	1.00	1.00
	Flooded bore hole			1.00	1.00	1.00	1.00	1.00	1.00

WIT-PM 200 WITH THREADED ROD (METRIC)

Mechanical characteristics

Steel grade	Thread size			M8	M10	M12	M16	M20	M24	M27	M30
	Stressed cross section	A_s	[mm²]	37	58	84	157	245	352	459	561
	Section modulus	W	[mm³]	31	62	109	277	541	935	1387	1874
4.6	Yield strength	f_y	[N/mm²]	240	240	240	240	240	240	240	240
	Tensile strength	f_u	[N/mm²]	400	400	400	400	400	400	400	400
	Design bending moment	$M^0_{Rd,s}$	[Nm]	9.0	18.0	31.1	79.6	155.7	268.9	398.8	538.9
4.8	Yield strength	f_y	[N/mm²]	320	320	320	320	320	320	320	320
	Tensile strength	f_u	[N/mm²]	400	400	400	400	400	400	400	400
	Design bending moment	$M^0_{Rd,s}$	[Nm]	12.0	24.0	41.6	106.4	208.0	359.2	532.8	720.0
5.6	Yield strength	f_y	[N/mm²]	300	300	300	300	300	300	300	300
	Tensile strength	f_u	[N/mm²]	500	500	500	500	500	500	500	500
	Design bending moment	$M^0_{Rd,s}$	[Nm]	11.4	22.2	38.9	99.4	194.0	335.3	498.8	672.5
5.8	Yield strength	f_y	[N/mm²]	400	400	400	400	400	400	400	400
	Tensile strength	f_u	[N/mm²]	500	500	500	500	500	500	500	500
	Design bending moment	$M^0_{Rd,s}$	[Nm]	15.2	29.6	52	132.8	259.2	448	666.4	898.4
8.8	Yield strength	f_y	[N/mm²]	640	640	640	640	640	640	640	640
	Tensile strength	f_u	[N/mm²]	800	800	800	800	800	800	800	800
	Design bending moment	$M^0_{Rd,s}$	[Nm]	24.0	48.0	84.0	212.8	415.2	716.8	1066.4	1437.6
A4-50	Yield strength	f_y	[N/mm²]	210	210	210	210	210	210	210	210
	Tensile strength	f_u	[N/mm²]	500	500	500	500	500	500	500	500
	Design bending moment	$M^0_{Rd,s}$	[Nm]	8.0	15.5	27.7	70.2	136.6	235.7	349.6	472.7
A4-70	Yield strength	f_y	[N/mm²]	450	450	450	450	450	450	-	-
	Tensile strength	f_u	[N/mm²]	700	700	700	700	700	700	-	-
	Design bending moment	$M^0_{Rd,s}$	[Nm]	16.7	33.3	59.0	148.7	291.0	502.6	-	-

Material specifications

<table>
<tr><th>Part</th><th>Designation</th><th colspan="5">Material</th></tr>
<tr><td colspan="7">Steel, zinc plated (Steel acc. to EN 10087:1998 or EN 10263:2001)
- zinc plated ≥ 5 µm acc. to EN ISO 4042:1999
- hot-dip galvanized ≥ 40 µm acc. to EN ISO 1461:2009 and EN ISO 10684:2004+AC:2009
- sherardized ≥ 45 µm acc. to EN ISO 17668:2016</td></tr>
<tr><td rowspan="6">1</td><td rowspan="6">Anchor rod</td><td colspan="2">Property class</td><td>Characteristic tensile strength</td><td>Characteristic yield strength</td><td>Elongation at fracture</td></tr>
<tr><td rowspan="5">acc. to EN ISO 898-1:2013</td><td>4.6</td><td>f_{uk} = 400 N/mm²</td><td>f_{yk} = 240 N/mm²</td><td>A5 > 8%</td></tr>
<tr><td>4.8</td><td>f_{uk} = 400 N/mm²</td><td>f_{yk} = 320 N/mm²</td><td>A5 > 8%</td></tr>
<tr><td>5.6</td><td>f_{uk} = 500 N/mm²</td><td>f_{yk} = 300 N/mm²</td><td>A5 > 8%</td></tr>
<tr><td>5.8</td><td>f_{uk} = 500 N/mm²</td><td>f_{yk} = 400 N/mm²</td><td>A5 > 8%</td></tr>
<tr><td>8.8</td><td>f_{uk} = 800 N/mm²</td><td>f_{yk} = 640 N/mm²</td><td>A5 > 12% [3)]</td></tr>
<tr><td rowspan="3">2</td><td rowspan="3">Hexagon nut</td><td rowspan="3">acc. to EN ISO 898-2:2012</td><td>4</td><td colspan="3">for anchor rod class 4.6 or 4.8</td></tr>
<tr><td>5</td><td colspan="3">for anchor rod class 5.6 or 5.8</td></tr>
<tr><td>8</td><td colspan="3">for anchor rod class 8.8</td></tr>
<tr><td>3a</td><td>Washer</td><td colspan="5">Steel, zinc plated, hot-dip galvanized or sherardized
(e.g.: EN ISO 887:2006, EN ISO 7089:2000, EN ISO 7093:2000, or EN ISO 7094:2000)</td></tr>
<tr><td>3b</td><td>Filling washer</td><td colspan="5">Steel, zinc plated, hot-dip galvanized or sherardized</td></tr>
<tr><td rowspan="3">4</td><td rowspan="3">Internal threaded anchor rod</td><td colspan="2">Property class</td><td>Characteristic tensile strength</td><td>Characteristic yield strength</td><td>Elongation at fracture</td></tr>
<tr><td rowspan="2">acc. to EN ISO 898-1:2013</td><td>5.8</td><td>f_{uk} = 500 N/mm²</td><td>f_{yk} = 400 N/mm²</td><td>A5 > 8%</td></tr>
<tr><td>8.8</td><td>f_{uk} = 800 N/mm²</td><td>f_{yk} = 640 N/mm²</td><td>A5 > 8%</td></tr>
</table>

WIT-PM 200 WITH THREADED ROD (METRIC)

Part	Designation	Material				
Stainless steel A2 (Material 1.4301 / 1.4303 / 1.4307 / 1.4567 or 1.4541, acc. to EN 1088-1:2014) **Stainless steel A4** (Material 1.4401 / 1.4404 / 1.4571 / 1.4362 or 1.4578, acc. to EN 10088-1:2014) **High corrosion resistance steel** (Material 1.4529 or 1.4565, acc. to EN 10088-1:2014)						
1	Anchor rod [1) 4)]	Property class		Characteristic tensile strength	Characteristic yield strength	Elongation at fracture
		acc. to EN ISO 3506-1:2009	50	$f_{uk} = 400\ N/mm^2$	$f_{yk} = 240\ N/mm^2$	A5 > 12% [3)]
			70	$f_{uk} = 400\ N/mm^2$	$f_{yk} = 320\ N/mm^2$	A5 > 12% [3)]
			80	$f_{uk} = 500\ N/mm^2$	$f_{yk} = 300\ N/mm^2$	A5 > 12% [3)]
2	Hexagon nut [1) 4)]	acc. to EN ISO 3506-1:2009	50	for anchor rod class 50		
			70	for anchor rod class 70		
			80	for anchor rod class 80		
3a	Washer	Stainless steel A2 (Material 1.4301 / 1.4303 / 1.4307 / 1.4567 or 1.4541, acc. to EN 1088-1:2014) Stainless steel A4 (Material 1.4401 / 1.4404 / 1.4571 / 1.4362 or 1.4578, acc. to EN 10088-1:2014) HCR: Material 1.4529 or 1.4565, acc. to EN 10088-1:2014 (e.g.: EN ISO 887:2006, EN ISO 7089:2000, EN ISO 7093:2000, or EN ISO 7094:2000)				
3b	Filling washer	Stainless steel A4, High corrosion resistance steel				
4	Internal threaded anchor rod [1) 2)]	Property class		Characteristic tensile strength	Characteristic yield strength	Elongation at fracture
		acc. to EN ISO 3506-1:2009	50	$f_{uk} = 500\ N/mm^2$	$f_{yk} = 210\ N/mm^2$	A5 > 8%
			70	$f_{uk} = 700\ N/mm^2$	$f_{yk} = 450\ N/mm^2$	A5 > 8%

1) Property class 70 for anchor rods up to M24 and Internal threaded anchor rods up to IG-M16

2) for IG-M20 only property class 50

3) A5 > 8% fracture elongation if no requirement for performance category C2 exists

4) Property class 80 only for stainless steel A4

Chemical resistance

Chemical agent	Concentration	Resistant	Not resistant
Accumulator acid			●
Acetic acid	40		●
Acetic acid	10	●	
Acetone	10		●
Ammonia, aqueous solution	5	●	
Aniline	100		●
Beer		●	
Benzene (kp 100-140°F)	100	●	
Benzole	100		●
Boric Acid, aqueous solution			●
Calcium carbonate, suspended in water	all	●	
Calcium chloride, suspended in water		●	
Calcium hydroxide, suspended in water		●	
Carbon tetrachloride	100	●	
Caustic soda solution	10	●	
Citric acid	all	●	
Diesel oil	100	●	
Ethyl alcohol, aqueous solution	50		●
Formic acid	100		●
Formaldehyde, aqueous solution	30	●	
Freon		●	
Fuel Oil		●	
Gasoline (premium grade)	100	●	
Glycol (Ethylene glycol)		●	
Hydraulic fluid	conc.	●	
Hydrochloric acid (Muriatic Acid)	conc.		●
Hydrogen peroxide	30		●
Isopropyl alcohol	100		●
Lactic acid	all	●	
Linseed oil	100	●	
Lubricating oil	100	●	
Magnesium chloride, aqueous solution	all	●	
Methanol	100		●
Motor oil (SAE 20 W-50)	100	●	
Nitric acid	10		●
Oleic acid	100	●	
Perchloroethylene	100	●	
Petroleum	100	●	
Phenol, aqueous solution	8		●
Phosphoric acid	85	●	
Potash lye (Potassium hydroxide)	10	●	
Potassium carbonate, aqueous solution	all	●	
Potassium chlorite, aqueous solution	all	●	
Potassium nitrate, aqueous solution	all	●	
Sodium carbonate	all	●	
Sodium Chloride, aqueous solution	all	●	
Sodium phosphate, aqueous solution	all	●	
Sodium silicate	all	●	
Standard Benzine	100	●	
Sulfuric acid	10		●
Sulfuric acid	70		●
Tartaric acid	all	●	
Tetrachloroethylene	100	●	
Toluene			●
Trichloroethylene	100		●
Turpentine	100	●	

WIT-PM 200 WITH THREADED ROD (METRIC)

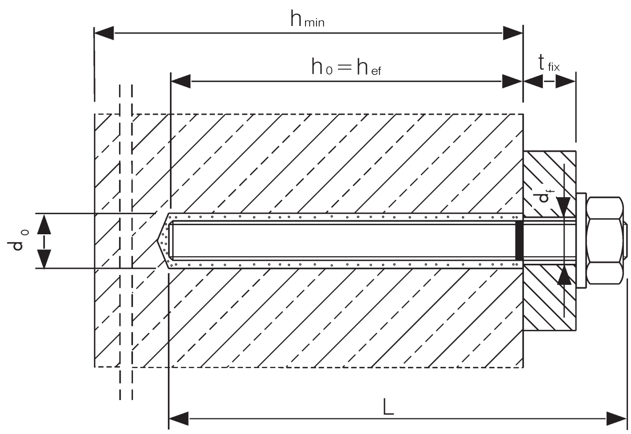
Working and curing times

Temperature of base material (°C)	Gelling - working time (min)	Min. curing time - dry conditions (min) [1]
-5 to -1	90	360
0 to +4	45	180
+5 to +9	25	120
+10 to +14	20	100
+15 to +19	15	80
+20 to 29	6	45
+30 to 34	4	25
+35 to +39	2	20
> 40°C	90 s	15

[1] for wet base material the curing time must be doubled

Installation parameters

Anchor size			M8	M10	M12	M16	M20	M24
Nominal drill hole diameter	d_0	[mm]	10	12	14	18	24	28
Effective anchorage depth	$h_{ef,min}$	[mm]	60	60	70	80	90	96
	$h_{ef,max}$	[mm]	160	200	240	320	400	480
Diameter of clearance in hole in the fixture	$d_f \leq$	[mm]	9	12	14	18	22	26
Diameter of steel brush	$d_b \leq$	[mm]	12	14	16	20	26	30
Maximum torque moment	$T_{inst} \leq$	[Nm]	10	20	40	80	120	160
Thickness of fixture	$t_{fix,min} >$	[mm]	0					
	$t_{fix,max} <$	[mm]	1500					
Minimum thickness of member	h_{min}	[mm]	h_{ef} + 30 mm ≥ 100 mm			$h_{ef} + 2d_0$		
Minimum spacing	s_{min}	[mm]	40	50	60	80	100	120
Minimum edge distance	c_{min}	[mm]	40	50	60	80	100	120

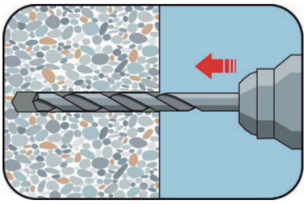


WIT-PM 200 M

WIT-PM 200 WITH THREADED ROD (METRIC)

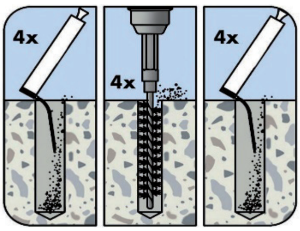
Installation instructions

A) Bore hole drilling

	**1a.**	**Hammer (HD) or compressed air drilling (CD)** Drill a hole into the base material to the size and embedment depth required by the selected reinforcing bar. In case of aborted drill hole, the drill hole shall be filled with mortar.

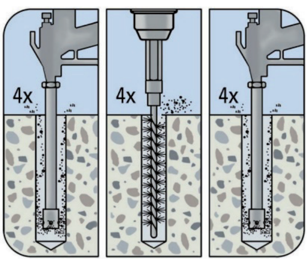
B) Bore hole cleaning

MAC: Cleaning for bore hole diameter $d_0 \leq 20$ mm and bore hole depth $h_0 \leq 150$ mm (non-cracked concrete only!)



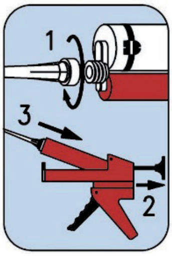
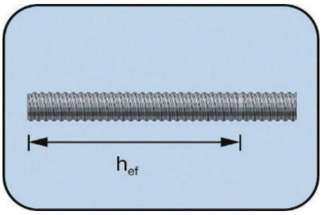
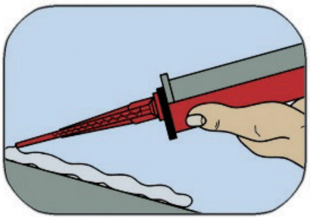
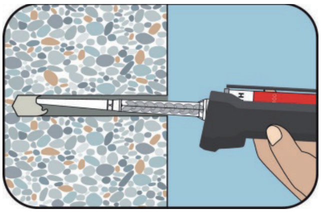
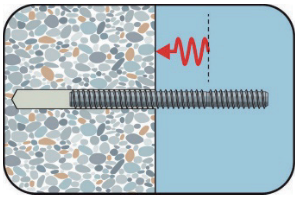
2a.	Starting from the bottom or back of the bore hole, blow the hole clean using a hand pump a minimum of four times.
2b.	Check brush diameter and attach the brush to a drilling machine or a battery screwdriver. Brush the hole with an appropriate sized wire brush > $d_{b,min}$ a minimum of four times. If the bore hole ground is not reached with the brush, a brush extension shall be used.
2c.	Finally blow the hole clean again with a hand pump a minimum of four times. If the bore hole ground is not reached, an extension shall be used.

CAC: Cleaning for dry, wet and water-filled bore holes with all diameters (non-cracked concrete only!)

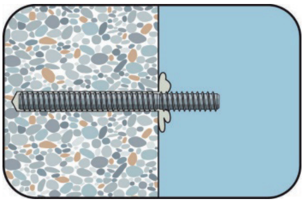
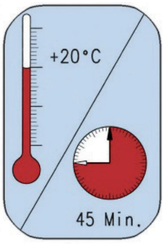
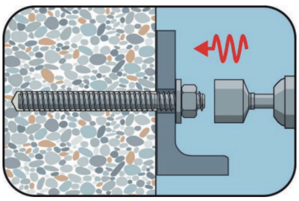


2a.	Starting from the bottom or back of the bore hole, blow the hole clean with compressed air (min. 6 bar) a minimum of four times until return air stream is free of noticeable dust. If the bore hole ground is not reached an extension shall be used.
2b.	Check brush diameter and attach the brush to a drilling machine or a battery screwdriver. Brush the hole with an appropriate sized wire brush > $d_{b,min}$ a minimum of four times. If the bore hole ground is not reached with the brush, a brush extension shall be used.
2c.	Finally blow the hole clean again with compressed air (min. 6 bar) a minimum of four times until return air stream is free of noticeable dust. If the bore hole ground is not reached, an extension shall be used.

After cleaning, the bore hole has to be protected against rec-contamination in an appropriate way, until dispensing the mortar in the bore hole. If necessary, the cleaning has to be repeated directly before dispensing the mortar. In-flowing water must not contaminate the bore hole again.

C) Preparation of anchor rod and cartridge		
	**3a.**	Attach the supplied static-mixing nozzle to the cartridge and load the cartridge into the correct dispensing tool. For every working interruption longer than the recommended working time as well as for every new cartridge, a new static-mixer shall be used.
	**3b.**	Prior to inserting the anchor rod into the filled bore hole, the position of the embedment depth shall be marked on the anchor rod.
	**3c.**	Prior to dispensing into the bore hole, squeeze out separately the mortar until it shows a consistent grey or red color (minimum of three full strokes) and discard non-uniformly mixed adhesive components.
D) Filling the bore hole		
	**4.**	Starting from the bottom or back of the cleaned bore hole, fill the hole up to approximately two-thirds with adhesive. Slowly withdraw the static mixing nozzle as the hole fills to avoid creating air pockets. For embedment larger than 190 mm, an appropriate extension nozzle must be used. Observe the gel-/ working times.
E) Setting the anchor rod		
	**5a.**	Push the threaded rod into the bore hole while turning slightly to ensure positive distribution of the adhesive until the embedment depth is reached. The bar should be free of dirt, grease, oil or other foreign material.

WIT-PM 200 WITH THREADED ROD (METRIC)

	**5b.**	Be sure that the anchor is fully seated at the bottom of the hole and that excess mortar is visible at the top of the hole. If these requirements are not maintained, the application has to be renewed. For overhead applications, the anchor rod should be fixed (e.g. wedges).
	**5c.**	Allow the adhesive to cure to the specified time prior to applying any load or torque. Do not move or load the anchor until it is fully cured.
	**5d.**	After fully curing, the add-on part can be installed with up to the max. torque by using a calibrated torque wrench.

Filling Quantity

Anchor type: M8 - M30

Thread size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Nominal drill hole diameter	d_0	[mm]	10	12	14	18	24	28
Drill depth	h_0 / h_1	[mm]			$= h_{ef}$			
Filling volume per 10mm embedment depth		[ml]	0.53	0.70	0.89	1.27	2.61	3.35

Assumed waste of 15 % included.