m1t and m1t-C Throughbolt

Torque-controlled expansion anchor for use in cracked and non-cracked concrete made of zinc electroplated steel

ETA Option 1 | CE | F120 | C1 | C2 | mungo

1 SPECIFICATIONS OF INTENDED USE

Anchorages subject to:
-Static and quasi-static loading
-Seismic load, category C1 and C2 loads
-Resistance to fire (F120)

Base materials:
-Cracked and non-cracked concrete
-Reinforced or unreinforced normal weight concrete of strength classes C20/25 to C50/60 according to ENV 206: 2000-12

Approvals:
-European Technical Approval Option 1 for cracked and non-cracked concrete
-Fire resistance test certification for F120
-Seismic performance category C1 and C2

Reaction to fire:
-Anchorages satisfy requirements for Class A1

Resistance to fire:
-Resistance in cracked and non-cracked concrete under fire exposure (F120)
-For fire design see ETA-12/0547, Annex C 3 to C 8

Installation:
-Hole drilling by hammer drilling only
-Cleaning the holes
-The fastener may only be set once
-For further information see ETA-12/0547, Annex B2

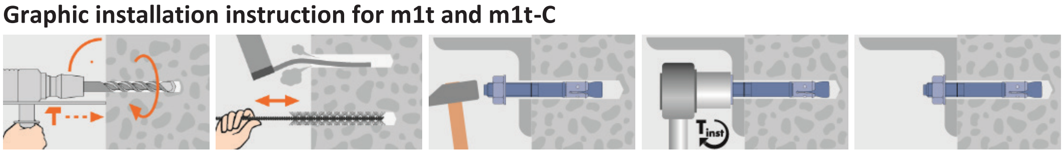
1.1 DESIGNATION OF ANCHOR PARTS AND MATERIALS

Part	Designation	Material	Protection
1	Bolt	M8 and M10: 19MnB4 DIN 1654-T4	Galvanised[1)] ≥ 8µm
		M12 and M16 C30BKD EU 119-74	
2	Expansion sleeve	Stainless steel X2CrNiMo 17-12-2 UNI EN 10088/2	—
3	Washer	C-steel DIN 125/1 (product m1t), DIN 9021 (product m1t-C)	Galvanised[1)] ≥ 8µm
4	Hexagonal nut	C-steel DIN 934, steel grade 8	Galvanised[1)] ≥ 8µm

1.2 INSTALATION INSTRUCTIONS

- Drilling the hole
- Cleaning the hole
- Fixing plug and building material
- Tightening with the torque wrench and predetermined value of Tinst
- Tightened fixation

Graphic installation instruction for m1t and m1t-C



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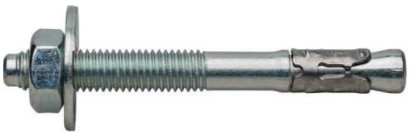
2 PRODUCT INFORMATION

m1t Throughbolt with washer DIN 125A

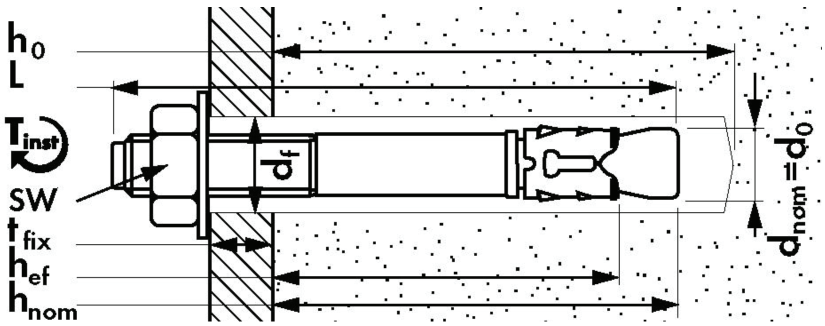
Article code	Dimensions [mm]	Length [mm] L	Length of screw in building material [mm] h_{nom}	Usable length [mm] t_{fix}	Effective anchorage depth [mm] h_{ef}
3600806	M8 x 68 / 4	68	54	4	48
3600807	M8 x 75 / 10	75	54	10	48
3600809	M8 x 90 / 25	90	54	25	48
3600811	M8 x 115 / 50	115	54	50	48
3600813	M8 x 135 / 70	135	54	70	48
3600816	M8 x 165 / 100	165	54	100	48
3601009	M10 x 90 / 10	90	67	10	60
3601010	M10 x 105 / 25	105	67	25	60
3601011	M10 x 115 / 35	115	67	35	60
3601013	M10 x 135 / 55	135	67	55	60
3601015	M10 x 155 / 75	155	67	75	60
3601018	M10 x 185 / 105	185	67	105	60
3601211	M12 x 110 / 10	110	81	10	72
3601212	M12 x 120 / 20	120	81	20	72
3601214	M12 x 145 / 45	145	81	45	72
3601217	M12 x 170 / 70	170	81	70	72
3601220	M12 x 200 / 100	200	81	100	72
3601613	M16 x 130 / 10	130	97	10	86
3601615	M16 x 150 / 30	150	97	30	86
3601618	M16 x 185 / 60	185	97	60	86
3601622	M16 x 220 / 100	220	97	100	86

m1t-C Throughbolt with big washer DIN 9021



Article code	Dimensions [mm]	Length [mm] L	Length of screw in building material [mm] h_{nom}	Usable length [mm] t_{fix}	Effective anchorage depth [mm] h_{ef}
3610807	M8 x 75 / 10	75	54	10	48
3611009	M10 x 90 / 10	90	67	10	60

3 INSTALATION DATA m1t and m1t-C



FASTENER SIZE m1t and m1t-C			M8	M10	M12	M16
Anchor/Thread diameter	d	[mm]	8	10	12	16
Diameter of clearence hole in the fixture	d_f	[mm]	9	12	14	18
Spanner	SW	[mm]	13	17	19	24
INSTALLATION DATA						
Drill hole diameter in substrate	d_0	[mm]	8	10	12	16
Dept of drill hole in substrate	h_1	[mm]	70	80	100	115
Anchor embedment depth	h_{nom}	[mm]	54	67	81	97
Effective anchorage depth	h_{ef}	[mm]	48	60	72	86
Installation torque	T_{inst}	[Nm]	20	40	60	120
Minimum thickness of concrete memeber	h_{min}	[mm]	100	120	150	170
Minimum edge distane	c_{min}	[mm]	50	60	70	85
Corresponding spacing	s ≥	[mm]	75	120	150	170
Minimum spacing	s_{min}	[mm]	50	60	70	80
Corresponding edge distance	c ≥	[mm]	65	80	90	120

3.1 BASIC PERFORMANCE DATA

Basic performance data for m1t and m1t-C in cracked and non-cracked concrete C20/25 without influence of edge distance, spacing and splitting failure due to dimensions of concrete member

FASTENER SIZE m1t and m1t-C				M8	M10	M12	M16
Effective anchorage depth		h_{ef}	[mm]	48	60	72	86
CHARACTERISTIC RESISTANCE							
Tension load	non-cracked	$N_{Rk,ucr}$	[kN]	9.00	16.00	20.00	35.00
	cracked	$N_{Rk,cr}$	[kN]	6.00	12.00	16.00	20.00
Shear load	non-cracked	$V_{Rk,ucr}$	[kN]	12.90[1)]	24.20[1)]	33.80[1)]	66.40[1)]
	cracked	$V_{Rk,cr}$	[kN]	11.97[3)]	24.20[1)]	33.80[1)]	57.42[3)]
Bending moment, steel failure		$M^0_{Rk,s}$	[Nm]	34	67	118	300
DESIGN RESISTANCE							
Tension load	non-cracked	$N_{Rd,ucr}$	[kN]	6.00	10.67	13.33	23.33
	cracked	$N_{Rd,cr}$	[kN]	4.00	8.00	10.67	13.33
Shear load	non-cracked	$V_{Rd,ucr}$	[kN]	8.60[1)]	16.13[1)]	22.53[1)]	44.27[1)]
	cracked	$V_{Rd,cr}$	[kN]	7.98[3)]	16.13[1)]	22.53[1)]	38.28[3)]
Bending moment, steel failure		$M^0_{Rd,s}$	[Nm]	22.7	44.7	78.7	200.0
RECOMMENDED RESISTANCE							
Tension load (safety fac. 1,4)	non-cracked	$N_{rec,ucr}$	[kN]	4.29	7.62	9.52	16.66
	cracked	$N_{rec,cr}$	[kN]	2.86	5.71	7.62	9.52
Shear load (safety fac. 1,4)	non-cracked	$V_{rec,ucr}$	[kN]	6.14[1)]	11.52[1)]	16.09[1)]	31.62[1)]
	cracked	$V_{rec,cr}$	[kN]	5.70[3)]	11.52[1)]	16.09[1)]	27.34[3)]
Bending moment, steel failure (safety fac. 1,4)		$M^0_{rec,s}$	[Nm]	16.2	31.9	56.2	142.9

[1)] Steel failure

[2)] Concrete cone failure

[3)] Pry-out failure

4 INCREASING DESIGN RESISTANCE FOR CONCRETE STRENGTH CLASSES

Increasing resistance to tension and shear load in non-cracked concrete for different strength classes

NON-CRACKED CONCRETE, FASTENER SIZE m1t and m1t-C			M8	M10	M12	M16
INCREASING DESIGN RESISTANCE FOR CONCRETE STRENGTH CLASSES						
Tension load (non cracked concrete), N_{Rd}	**C20/25**	**[kN]**	6.00	10.67	13.33	23.33
	C25/30		6.57	11.69	14.60	25.56
	C30/37		7.30	12.98	16.22	28.39
	C35/45		8.05	14.32	17.89	31.31
	C40/50		8.49	15.10	18.86	33.01
	C45/55		8.90	15.83	19.78	34.62
	C50/60		9.30	16.54	20.66	36.16
Shear load (non cracked concrete), V_{Rd}	**C20/25 to C50/60**	**[kN]**	8.60	16.13	22.53	44.27

Increasing resistance to tension and shear load in cracked concrete for different strength classes

CRACKED CONCRETE, FASTENER SIZE m1t and m1t-C			M8	M10	M12	M16
INCREASING DESIGN RESISTANCE FOR CONCRETE STRENGTH CLASSES						
Tension load (cracked concrete), N_{Rd}	**C20/25**	**[kN]**	4.00	8.00	10.67	13.33
	C25/30		4.38	8.76	11.69	14.61
	C30/37		4.87	9.73	12.98	16.22
	C35/45		5.37	10.74	14.32	17.89
	C40/50		5.66	11.32	15.09	18.86
	C45/55		5.94	11.87	15.83	19.79
	C50/60		6.20	12.40	16.53	20.67
Shear load (cracked concrete), V_{Rd}	**C20/25**	**[kN]**	7.98	16.13	22.53	38.28
	C25/30		8.60	16.13	22.53	41.94
	C30/37 to C50/60		8.60	16.13	22.53	44.27

Increasing resistance for pull-out failure based on ETA-05/0070

For minimum spacing, minimum edge distance and thickness of concrete member the above described loads have to be reduced.

5 REDUCE DESIGN RESISTANCE TO TENSION LOADS FOR LIMITED EDGE AND SPACING DISTANCE

REQUIRED PROOFS FOR DESIGN TENSION RESISTANCE FOLLOWING ETAG 001 Annex C:

1. **For use in non-cracked concrete;** $N_{Rd,ucr} = \min(N_{Rd,s}; N_{Rd,p}; N_{Rd,c}; N_{Rd,sp})$
   For use in cracked concrete; $N_{Rd,cr} = \min(N_{Rd,s}; N_{Rd,p}; N_{Rd,c})$

2. Reduction design resistance to tension loads is only valid for one limited edge distance or one limited spacing

3. It may be assumed that splitting failure will not occur, if the edge distance in all directions is $c \geq 1.2\ c_{cr,sp}$ and the member depth is $h \geq 2\ h_{ef}$ (see ETA ETA-12/0547 and ETAG 001 Annex C)

4. With anchoring in cracked concrete, the calculation of the resistance splitting failure may be omitted if a reinforcement is present which limits the crack and resistance for concrete cone failure and pull-out failure is calculated for cracked concrete according to conditions given in ETAG 001 Annex C, 5.2.2.6 and 7.3

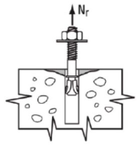
5.1 Steel failure $N_{Rd,s}$

Design resistance of one anchor in case of steel failure.

$N_{Rd,s} = N_{Rk,s} / \gamma_{Ms}$

FASTENER SIZE m1t and m1t-C			M8	M10	M12	M16
STEEL FAILURE						
Tension load γ_{Ms} = 1,5	$N_{Rd,s}$	[kN]	15.87	25.80	36.47	65.60

5.2 Pull-out failure $N_{Rd,p}$

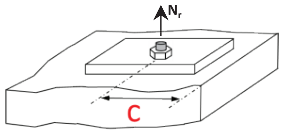


Design resistance in case of failure of one anchor by pull-out.

$N_{Rd,p} = N_{Rk,p} / \gamma_{Mp}$

FASTENER SIZE m1t and m1t-C				M8	M10	M12	M16
PULL-OUT FAILURE, CONCRETE C20/25							
Tension load γ_{Mp} = 1,5	non-cracked	$N_{Rd,ucr}$	[kN]	6.00	10.67	13.33	23.33
	cracked	$N_{Rd,cr}$	[kN]	4.00	8.00	10.67	13.33

5.3 Concrete cone failure and splitting failure in case of one limited edge



5.3.1 Design tension resistance of one anchor in case of concrete cone failure ($N_{Rd,c}$) with one limited edge

Reduction factor $\Psi_{edge} = (A_{c,N}/A^0_{c,N}) \cdot \Psi_{s,N}$ for concrete cone failure is only valid for one limited edge and without influence of spacing

$N_{Rd,c} = N^0_{Rd,c} \cdot \Psi_{edge}$ **;** $N^0_{Rd,c} = N^0_{Rk,c} / \gamma_{Mc}$

FASTENER SIZE m1t and m1t-C				M8	M10	M12	M16
Minimum thickness of concrete memeber		hmin	[mm]	100	120	150	170
CONCRETE CONE FAILURE IN CASE OF LIMITED EDGE, CONCRETE C20/25							
Tension load γ_{Mc} = 1,5	non-cracked	$N^0_{Rd,c}$	[kN]	11.20	15.65	20.57	26.85
	cracked	$N^0_{Rd,c}$	[kN]	7.98	11.15	14.66	19.14
				x	x	x	x
				Ψedge	Ψedge	Ψedge	Ψedge

Edge distance [mm]		M8	M10	M12	M16
	50	0.78			
	55	0.84			
	60	0.89	0.75		
	65	0.94	0.79		
	70	1.00	0.83	0.73	
	75	1.00	0.87	0.76	
	85	1.00	0.96	0.83	0.74
	100	1.00	1.00	0.93	0.82
	110	1.00	1.00	1.00	0.88
	120	1.00	1.00	1.00	0.94
	130	1.00	1.00	1.00	1.00
	140	1.00	1.00	1.00	1.00
	150	1.00	1.00	1.00	1.00
	170	1.00	1.00	1.00	1.00
	200	1.00	1.00	1.00	1.00
	250	1.00	1.00	1.00	1.00
	300	1.00	1.00	1.00	1.00

5.3.2 Design tension resistance of one anchor in case of splitting failure ($N_{Rd,sp}$) with one limited edge

Reduction factor $\Psi_{edge} = (A_{c,N}/A^0_{c,N}) \cdot \Psi_{sp,N}$ for splitting failure is only valid for one limited edge and without influence of spacing

$N_{Rd,sp} = N^0_{Rd,sp} \cdot \Psi_{edge}$; $N^0_{Rd,sp} = N^0_{Rk,sp} / \gamma_{Msp}$

FASTENER SIZE m1t and m1t-C				M8	M10	M12	M16
Minimum thickness of concrete memeber		hmin	[mm]	100	120	150	170
SPLITTING FAILURE IN CASE OF LIMITED EDGE, CONCRETE C20/25							
Tension load $\gamma_{Msp} = 1,5$	non-cracked	$N^0_{Rd,sp}$	[kN]	11.20	15.65	20.57	26.85
				x	x	x	x
				Ψedge	Ψedge	Ψedge	Ψedge

Factor $\Psi_{h,sp}$ for splitting failure can be considered if $h > h_{min}$

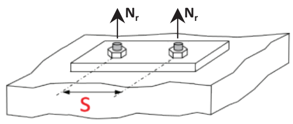
$N_{Rd,sp} = N^0_{Rd,sp} \cdot \Psi_{edge} \cdot \Psi_{h,sp}$

$\Psi_{h,sp} = \left(\frac{h}{h_{min}}\right)^{2/3} \leq 1.5$

h = actual thickness of the member
hmin = minimum thickness of concrete member

Edge distance [mm]	M8	M10	M12	M16
50	0.54			
55	0.56			
60	0.58	0.53		
65	0.60	0.55		
70	0.63	0.57	0.53	
75	0.65	0.58	0.54	
85	0.69	0.62	0.57	0.53
100	0.77	0.67	0.62	0.56
110	0.82	0.71	0.65	0.59
120	0.87	0.75	0.68	0.61
130	0.92	0.79	0.71	0.64
140	0.97	0.83	0.74	0.66
150	1.00	0.87	0.77	0.69
170	1.00	0.96	0.84	0.74
200	1.00	1.00	0.94	0.82
250	1.00	1.00	1.00	0.97
300	1.00	1.00	1.00	1.00

5.4 Concrete cone failure and splitting failure in case of limited spacing



5.4.1 Design tension resistance of one anchor in case of concrete cone failure ($N_{Rd,c}$) with one limited spacing

Reduction factor $\Psi_{spacing} = (A_{c,N}/A^0_{c,N})$ for concrete cone failure is only valid for one limited spacing and without influence of edge

$N_{Rd,c} = N^0_{Rd,c} \cdot \Psi_{spacing}$; $N^0_{Rd,c} = N^0_{Rk,c} / \gamma_{Mc}$

FASTENER SIZE m1t and m1t-C				M8	M10	M12	M16
Minimum thickness of concrete memeber		hmin	[mm]	100	120	150	170
CONCRETE CONE FAILURE IN CASE OF LIMITED SPACING BETWEEN ANCHORS, CONCRETE C20/25							
Tension load $\gamma_{Mc} = 1,5$	non-cracked	$N^0_{Rd,c}$	[kN]	11.20	15.65	20.57	26.85
	cracked	$N^0_{Rd,c}$	[kN]	7.98	11.15	14.66	19.14
				x	x	x	x
				Ψspacing	Ψspacing	Ψspacing	Ψspacing

Spacing between anchors [mm]	M8	M10	M12	M16
50	0.68			
55	0.70			
60	0.71	0.67		
65	0.73	0.68		
70	0.75	0.69	0.66	
75	0.77	0.71	0.67	
85	0.80	0.74	0.69	0.66
100	0.86	0.78	0.73	0.69
110	0.89	0.81	0.75	0.71
120	0.93	0.83	0.77	0.73
130	0.96	0.86	0.80	0.75
140	1.00	0.89	0.82	0.77
150	1.00	0.92	0.84	0.79
170	1.00	0.97	0.89	0.83
200	1.00	1.00	0.95	0.88
250	1.00	1.00	1.00	0.98
300	1.00	1.00	1.00	1.00
400	1.00	1.00	1.00	1.00
500	1.00	1.00	1.00	1.00
600	1.00	1.00	1.00	1.00

5.4.2 Design tension resistance of one anchor in case of splitting failure ($N_{Rd,sp}$) with one limited spacing

Reduction factor $\Psi_{spacing} = (A_{c,N}/A^0_{c,N})$ for splitting failure is only valid for one limited spacing and without influence of edge

$N_{Rd,sp} = N^0_{Rd,sp} \cdot \Psi_{spacing}$ **;** $N^0_{Rd,sp} = N^0_{Rk,sp} / \gamma_{Msp}$

FASTENER SIZE m1t and m1t-C			**M8**	**M10**	**M12**	**M16**
Minimum thickness of concrete memeber	**hmin**	**[mm]**	100	120	150	170
SPLITTING FAILURE IN CASE OF LIMITED SPACING BETWEEN ANCHORS, CONCRETE C20/25						
Tension load $\gamma_{Msp} = 1{,}5$ non-cracked	$\mathbf{N^0_{Rd,sp}}$	**[kN]**	11.20	15.65	20.57	26.85
			x	x	x	x
			Ψspacing	**Ψspacing**	**Ψspacing**	**Ψspacing**
	Spacing between anchors [mm]	**50**	1.00			
		55	1.00			
		60	1.00	0.58		
		65	1.00	0.59		
		70	1.00	0.60	1.00	
		75	1.00	0.60	1.00	
		85	1.00	0.62	1.00	0.58
		100	1.00	0.64	1.00	0.60
		110	1.00	0.65	1.00	0.61
		120	1.00	0.67	1.00	0.62
		130	1.00	0.68	1.00	0.63
		140	1.00	0.69	1.00	0.63
		150	1.00	0.71	1.00	0.64
		170	1.00	0.74	1.00	0.66
		200	1.00	0.78	1.00	0.69
		250	1.00	0.85	1.00	0.74
		300	1.00	0.92	1.00	0.79
		400	1.00	1.00	1.00	0.88
		500	1.00	1.00	1.00	0.98
		600	1.00	1.00	1.00	1.00

Factor $\Psi_{h,sp}$ for splitting failure can be considered if $h > h_{min}$

$N_{Rd,sp} = N^0_{Rd,sp} \cdot \Psi_{spacing} \cdot \Psi_{h,sp}$

$$\Psi_{h,sp} = \left(\frac{h}{hmin}\right)^{2/3} \leq 1.5$$

h = actual thickness of the member
hmin = minimum thickness of concrete member

6 IMPORTANT NOTICE

Values given above are valid under the assumptions of sufficient cleaning of the drill hole and anchoring in non-cracked or cracked concrete. For the design the complete assessment ETA-12-0547 from 29 April 2014 has to be considered. In recommended resistance the partial safety factor for material as regulated in the ETA as well as a partial safety factor for load action $\gamma_L = 1.4$ are considered. For combination of tensile loads, shear loads, bending moments as well as well as reduced edge distances or spacing's (anchor groups) see ETA or Mungo design software. The data must be checked by the user under the responsibility of an engineer experienced in anchorage and concrete work. This is to ensure there are no errors and all data is complete and accurate and complies with all rules and regulations for the actual conditions and application. Anchor design is performed according to the ETAG 001, Annex C in combination with assessment ETA-12-0547 from 29 April 2014.