Einfach. Sicher.

DECLARATION OF PERFORMANCE

DoP: 0082

for Upat Anchor Bolt MAX (Metal anchors for use in concrete (heavy-duty type)) – **EN**

1. Unique identification code of the product-type: **DoP: 0082**

2. Intended use/es: **Post-installed fastening in cracked or uncracked concrete, see appendix, especially Annexes B 1 to B 6**

3. Manufacturer: **Upat Vertriebs GmbH, Bebelstraße 11, 79108 Freiburg im Breisgau, Germany**

4. Authorised representative: --

5. System/s of AVCP: **1**

6. European Assessment Document: **EAD 330232-00-0601**

   European Technical Assessment: **ETA-10/0170; 2018-11-26**

   Technical Assessment Body: **DIBt**

   Notified body/ies: **1343 – MPA Darmstadt**

7. Declared performance/s:

Mechanical resistance and stability (BWR 1)

- **Characteristic resistance to tension load (static and quasi-static loading): See appendix, especially Annex C 1**
- **Characteristic resistance to shear load (static and quasi-static loading): See appendix, especially Annex C 2**
- **Displacements (static and quasi-static loading): See appendix, especially Annex C 5**
- **Characteristic resistance and displacements for seismic performance categories C1 and C2: See appendix, especially Annexes C 4 and C 5**

Safety in case of fire (BWR 2)

- **Reaction to fire: Anchorages satisfy requirements for Class A 1**
- **Characteristic resistance under fire exposure: See appendix, especially Annex C 3**

8. Appropriate Technical Documentation and/or Specific Technical Documentation: ---

The performance of the product identified above is in conformity with the set of declared performance/s. This declaration of performance is issued, in accordance with Regulation (EU) No 305/2011, under the sole responsibility of the manufacturer identified above.

Signed for and on behalf of the manufacturer by:

Andreas Bucher, Dipl.-Ing.

i.V. A. Bucher

Wolfgang Hengesbach, Dipl.-Ing., Dipl.-Wirtsch.-Ing.

i.V. W. Hengesbach

Tumlingen, 2018-12-03

- This DoP has been prepared in different languages. In case there is a dispute on the interpretation the english version shall always prevail.
- The Appendix includes voluntary and complementary information in English language exceeding the (language-neutrally specified) legal requirements.

Specific Part

1 Technical description of the product

The Upat Anchor bolt MAX is an anchor made of galvanised steel (MAX) or made of stainless steel (MAX A4) or high corrosion resistant steel (MAX C) which is placed into a drilled hole and anchored by torque-controlled expansion.

The product description is given in Annex A.

2 Specification of the intended use in accordance with the applicable European Assessment Document

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

The verifications and assessment methods on which this European Technical Assessment is based lead to the assumption of a working life of the anchor of at least 50 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer, 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 its assessment

3.1 Mechanical resistance and stability (BWR 1)

Essential characteristic	**Performance**
Characteristic resistance to tension load (static and quasi-static loading)	See Annex C 1
Characteristic resistance to shear load (static and quasi-static loading)	See Annex C 2
Displacements (static and quasi-static loading)	See Annex C 5
Characteristic resistance and displacements for seismic performance categories C1 and C2	See Annex C 4 and C 5

3.2 Safety in case of fire (BWR 2)

Essential characteristic	**Performance**
Reaction to fire	Class A1
Resistance to fire	see Annex C 3

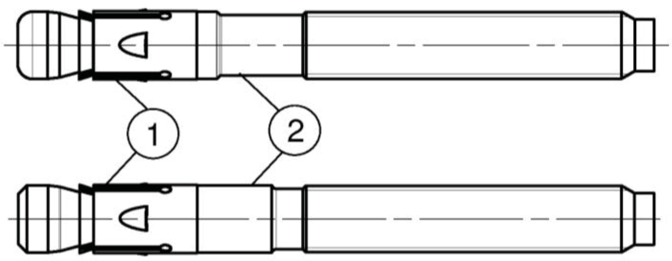
4 Assessment and verification of constancy of performance (AVCP) system applied, with reference to its legal base

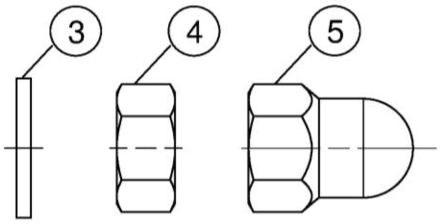
In accordance with the European Assessment Document EAD Nr. 330232-00-0601 the applicable European legal act is: [96/582/EC].

The system to be applied is: 1

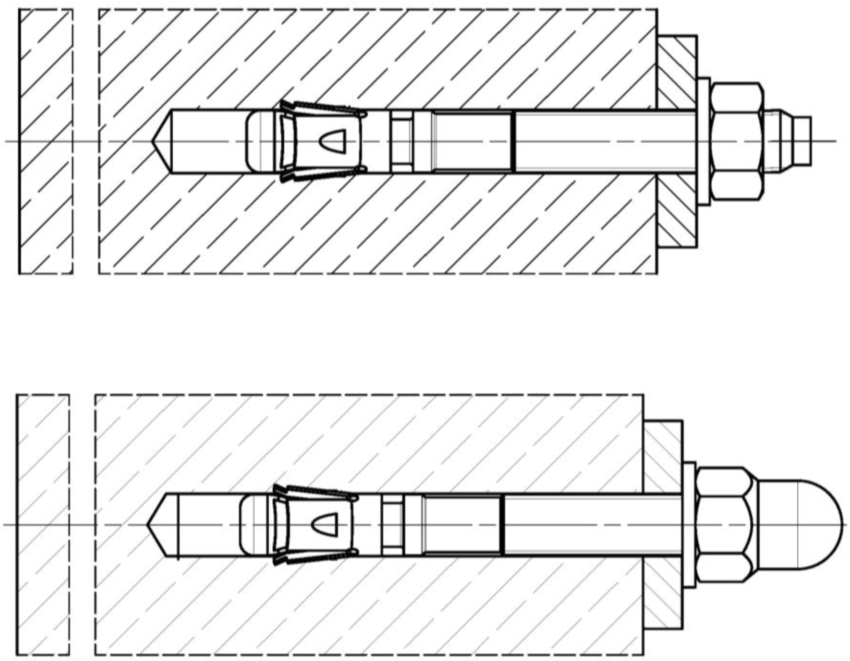
Cone bolt manufactured by cold - forming:

Cone bolt manufactured by turning:





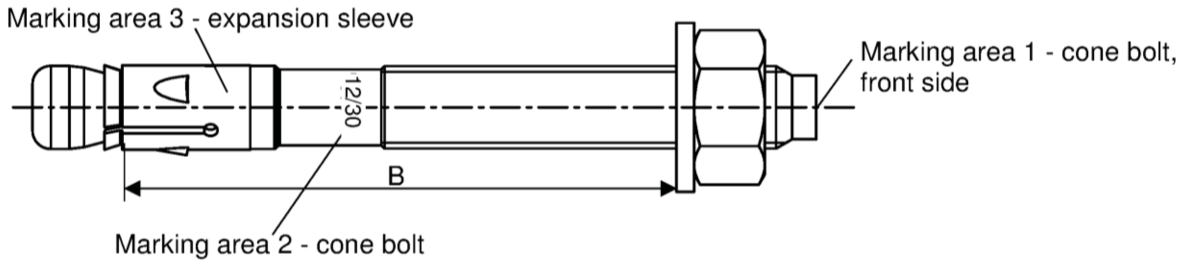
① Expansion sleeve
② Cone bolt (cold – formed or turned)
③ Washer
④ Hexagon nut
⑤ Upat MAX dome nut



(Fig. not to scaled)

Upat Anchor bolt MAX, MAX A4, MAX	**Annex A 1**
Product description Installed condition	

Product label and letter-code:



Product label, example: MAX 12/30 A4

Brand | type of fastener placed at marking area 2 or marking area 3 → MAX

Thread size / max. thickness of the fixture (t_{fix}) identification A4 or C placed at marking area 2 → 12/30 A4

MAX: carbon steel, galvanized
MAX A4: stainless steel
MAX C: high corrosion resistant steel

Table A2.1: Letter - code at marking area 1:

Marking		(a)	(b)	(c)	(d)	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(K)
Max. t_{fix}		5	10	15	20	5	10	15	20	25	30	35	40	45	50
B ≥ [mm]	M6	-				45	50	55	60	65	70	75	80	85	90
	M8	40	45	-		50	55	60	65	70	75	80	85	90	95
	M10	45	50	55	60	65	70	75	80	85	90	95	100	105	110
	M12	55	60	65	70	75	80	85	90	95	100	105	110	115	120
	M16	70	75	80	85	90	95	100	105	110	115	120	125	130	135
	M20	-				105	110	115	120	125	130	135	140	145	150
	M24					130	135	140	145	150	155	160	165	170	175

Marking		(L)	(M)	(N)	(O)	(P)	(R)	(S)	(T)	(U)	(V)	(W)	(X)	(Y)	(Z)
Max. t_{fix}		60	70	80	90	100	120	140	160	180	200	250	300	350	400
B ≥ [mm]	M6	100	110	120	130	140	160	180	200	220	240	290	340	390	440
	M8	105	115	125	135	145	165	185	205	225	245	295	345	395	445
	M10	120	130	140	150	160	180	200	220	240	260	310	360	410	460
	M12	130	140	150	160	170	190	210	230	250	270	320	370	420	470
	M16	145	155	165	175	185	205	225	245	265	285	335	385	435	485
	M20	160	170	180	190	200	220	240	260	280	300	350	400	450	500
	M24	185	195	205	215	225	245	265	285	305	325	375	425	475	525

Calculation existing h_{ef} for installed fasteners:

existing h_{ef} = $B_{(according\ to\ table\ A2.1)}$ – existing t_{fix}

Thickness of the fixture t_{fix} including thickness of fastener plate t and e.g. thickness of grout layer t_{grout} or other non-structural layers

(Fig. not to scaled)

Upat Anchor bolt MAX, MAX A4, MAX	**Annex A 2**
Product description Product label and letter code	

Product dimensions

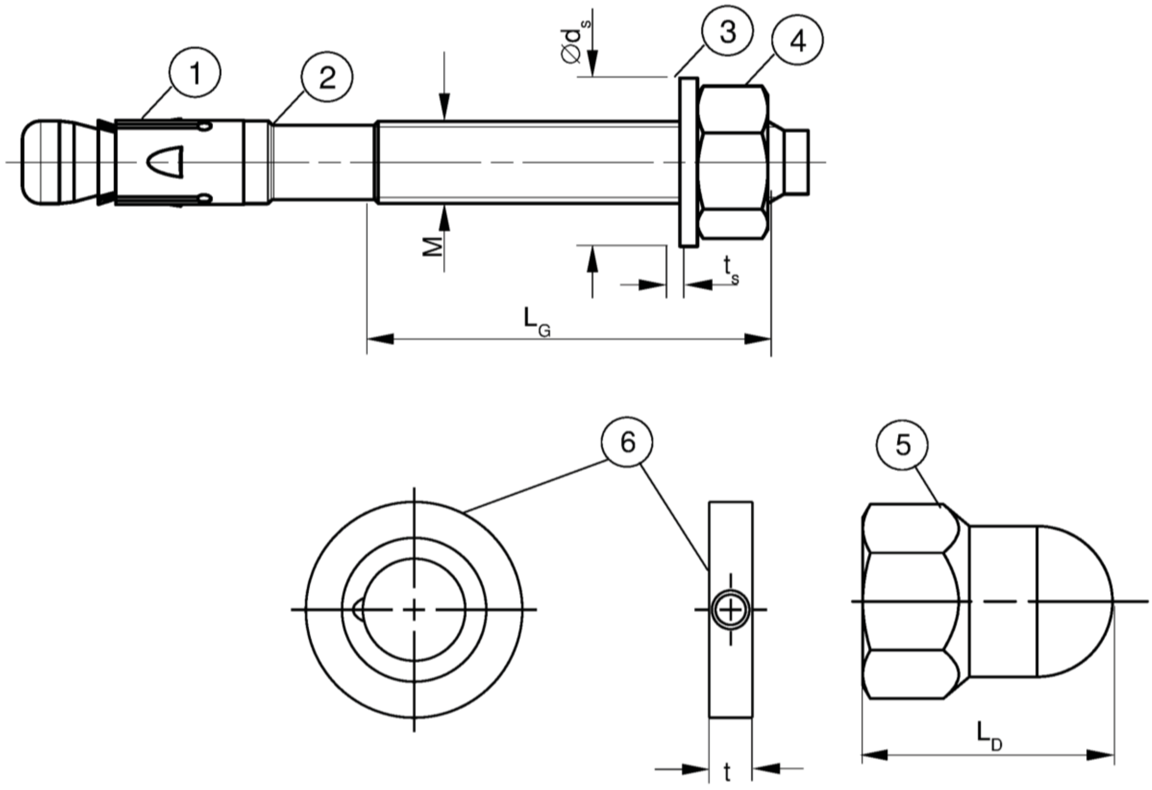


Table A3.1: Dimensions [mm]

Part	Designation			MAX, MAX A4, MAX C						
				M6	M8	M10	M12	M16	M20	M24
1	Expansion sleeve	Sheet thickness		0,8	1,3	1,4	1,6	2,4		3,0
2	Cone bolt	Thread size M		6	8	10	12	16	20	24
		L_G	≥	10	19	26	31	40	50	57
3	Washer	t_S	≥	1,4		1,8	2,3	2,7		3,7
		$\varnothing d_s$		11	15	19	23	29	36	43
4 & 5	Hexagon nut / Upat MAX dome nut	Wrench size		10	13	17	19	24	30	36
5		L_D	≥	-		22	27	33	-	
6	Upat filling disc FFD	t	=	6				7	8	10

(Fig. not to scaled)

Upat Anchor bolt MAX, MAX A4, MAX

Product description
Dimensions

Annex A 3

Specifications of intended use

Anchorages subject to:

Size		MAX, MAX A4, MAX C						
		M6	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Static and quasi-static loads		✓						
Cracked and uncracked concrete								
Fire exposure								
Seismic performance category	C1	-	✓					
	C2[1)]	-		✓				-

[1)] MAX C: Only valid for cold-formed version (according to Annex A1)

Base materials:
- Compacted reinforced and unreinforced normal weight concrete without fibres (cracked and uncracked) according to EN 206: 2013
- Strength classes C20/25 to C50/60 according to EN 206: 2013

Use conditions (Environmental conditions):
- Structures subject to dry internal conditions (MAX, MAX A4, MAX C)
- Structures subject to external atmospheric exposure (including industrial and marine environment) and to permanently damp internal condition, if no particular aggressive conditions exist (MAX A4, MAX C)
- Structures subject to external atmospheric exposure and permanently damp internal condition, if other particular aggressive conditions exist (MAX C)

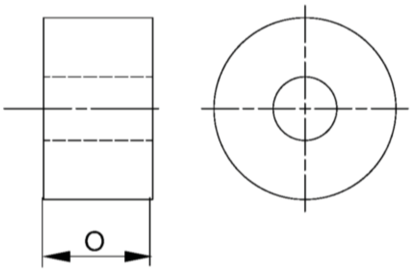
Note: Particular aggressive conditions are e.g. permanent, alternating immersion in seawater or the splash zone of seawater, chloride atmosphere of indoor swimming pools or atmosphere with extreme chemical pollution (e.g. in desulphurization plants or road tunnels where deicing materials are used)

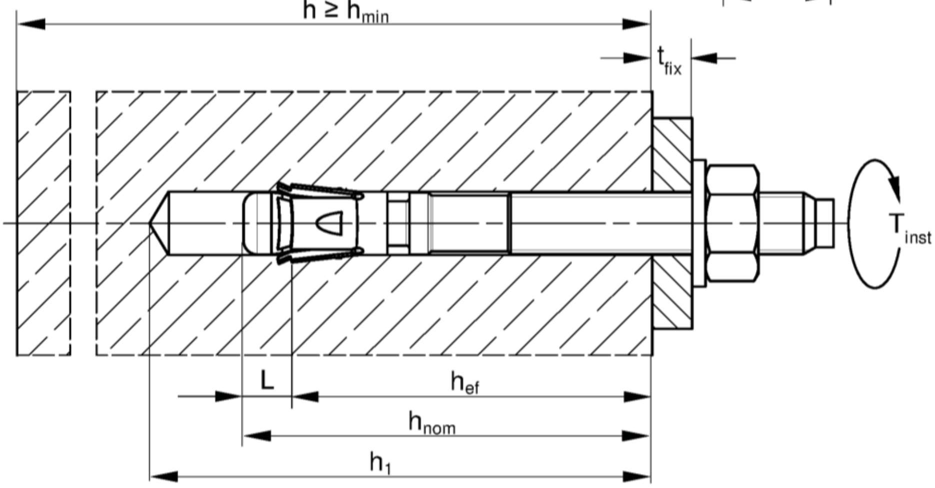
Design:
- Anchorages are to be designed under the responsibility of an engineer experienced in anchorages and concrete work
- Verifiable calculation notes and drawings are to be prepared taking account of the loads to be anchored. The position of the anchor is indicated on the design drawings (e.g. position of the anchor relative to reinforcement or to supports, etc.)
- Design of fastenings according to EN 1992-4: 2018 and Technical Reoprt TR 055
- For effective embedment depth h_{ef} < 40 mm and h_{min} ≥ 80 mm and < 100 mm only statically indeterminate fixings (e.g. light-weight suspended ceilings with internal exposure) are covered by the ETA

Table B2.1: Installation parameters

Size			MAX, MAX A4, MAX C						
			M6	M8	M10	M12	M16	M20	M24
Nominal drill hole diameter	$d_0 =$	[mm]	6	8	10	12	16	20	24
Maximum bit diameter with hammer or hollow drilling	$d_{cut,max}$	[mm]	6,40	8,45	10,45	12,5	16,5	20,55	24,55
Maximum bit diameter with diamond drilling	$d_{cut,max}$	[mm]	-	8,15		12,25	16,45	20,50	24,40
Overall fastener embedment depth in the concrete	$h_{nom} \geq$ (L)	[mm]	46,5 (6,5)	44,5 (9,5)	52,0 (12)	63,5 (13,5)	82,5 (17,5)	120 (20)	148,5 (23,5)
			Existing $h_{ef} + L = h_{nom}$						
Depth of drill hole to deepest point	$h_1 \geq$	[mm]	$h_{nom} + 5$					$h_{nom} + 10$	
Diameter of clearance hole in the fixture	$d_f \leq$	[mm]	7	9	12	14	18	22	26
Required setting torque	$T_{inst} =$	[Nm]	8	20	45	60	110	200	270
Excess length after hammering-in the cone bolt (for Upat dome nut applications according to Annex B6)	O =	[mm]	-		12	16	20	-	

Setting gauge MAX SL-H
for anchor with Upat MAX dome nut:





h_{ef} = Effective embedment depth
t_{fix} = Thickness of the fixture
h_1 = Depth of drill hole to deepest point
h = Thickness of the concrete member
h_{min} = Minimum thickness of concrete member
h_{nom} = Overall fastener embedment depth in the concrete
T_{inst} = Required setting torque

(Fig. not to scaled)

Upat Anchor bolt MAX, MAX A4, MAX

Intended Use
Installation parameters

Annex B 2

Table B3.1: Minimum thickness of concrete members, minimum spacing and minimum edge distance

Size			MAX, MAX A4, MAX C						
			M6	M8	M10	M12	M16	M20	M24
Minimum edge distance									
Uncracked concrete	c_{min}	[mm]	45	40	45	55	65	95	135
Cracked concrete	c_{min}	[mm]	45	40	45	55	65	85	100
Minimum spacing	s_{min}	[mm]	according to Annex B4						
Minimum thickness of concrete member	h_{min}	[mm]	80			100	140	160	200
Thickness of concrete member	h ≥	[mm]	max. $\{h_{min}; h_1$ [1] $+ 30\}$				max. $\{h_{min}; h_1$ [1] $+ 2 \cdot d_o\}$		
Minimum spacing									
Uncracked concrete	s_{min}	[mm]	35	40	40	50	65	95	100
Cracked concrete	s_{min}	[mm]	35	35	40	50	65	95	100
Minimum edge distance	c_{min}	[mm]	according to Annex B4						
Minimum thickness of concrete member	h_{min}	[mm]	80			100	140	160	200
Thickness of concrete member	h ≥	[mm]	max. $\{h_{min}; h_1$ [1] $+ 30\}$				max. $\{h_{min}; h_1$ [1] $+ 2 \cdot d_o\}$		
Minimal splitting area									
Uncracked concrete	$A_{sp,req}$	[·1000 mm²]	5,1	18	37	54	67	100	117,5
Cracked concrete	$A_{sp,req}$	[·1000 mm²]	1,5	12	27	40	50	77	87,5

[1] h_1 according to Annex B2

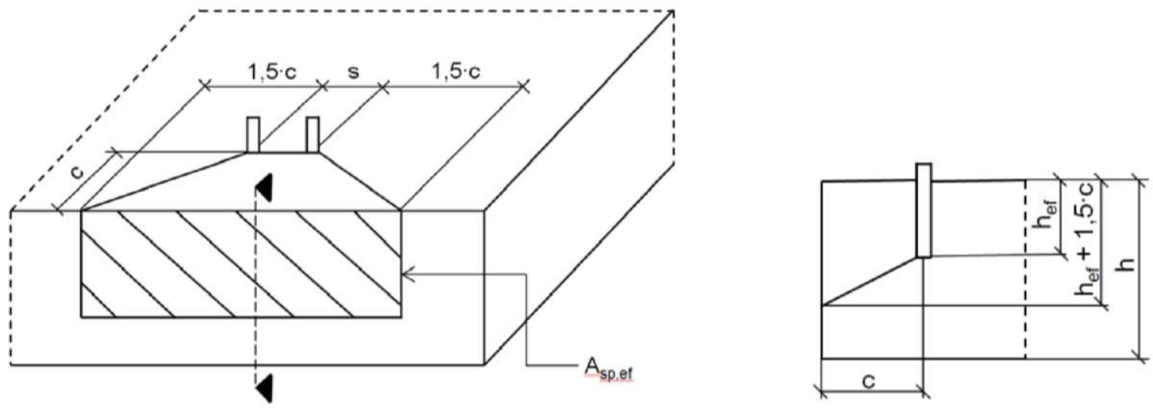
Splitting failure applied for minimum edge distance and spacing in dependence of the h_{ef}

For the calculation of minimum spacing and minimum edge distance of anchors in combination with different embedment depths and thicknesses of concrete members the following equation shall be fulfilled:

$$\mathbf{A_{sp,req} < A_{sp,ef}}$$

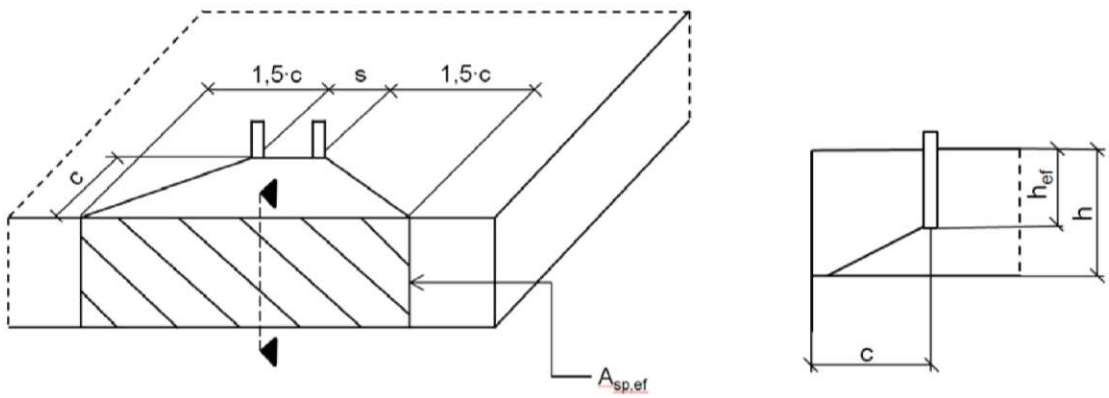
$A_{sp,req}$ = required splitting area
$A_{sp,ef}$ = effective splitting area (according to Annex B4)

Table B4.1: Effective splitting area $A_{sp,ef}$ with member thickness $h > h_{ef} + 1,5 \cdot c$ and $h \geq h_{min}$



Single anchor and group of anchors with $s > 3 \cdot c$	$A_{sp,ef} = (6 \cdot c) \cdot (h_{ef} + 1,5 \cdot c)$	[mm²]	with $c \geq c_{min}$
Group of anchors with $s \leq 3 \cdot c$	$A_{sp,ef} = (3 \cdot c + s) \cdot (h_{ef} + 1,5 \cdot c)$	[mm²]	with $c \geq c_{min}$ and $s \geq s_{min}$

Table B4.2: Effective splitting area $A_{sp,ef}$ with member thickness $h \leq h_{ef} + 1,5 \cdot c$ and $h \geq h_{min}$



Single anchor and group of anchors with $s > 3 \cdot c$	$A_{sp,ef} = 6 \cdot c \cdot$ existing h	[mm²]	with $c \geq c_{min}$
Group of anchors with $s \leq 3 \cdot c$	$A_{sp,ef} = (3 \cdot c + s) \cdot$ existing h	[mm²]	with $c \geq c_{min}$ and $s \geq s_{min}$

Edge distance and axial spacing shall be rounded to at least 5 mm

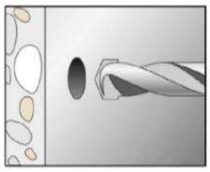
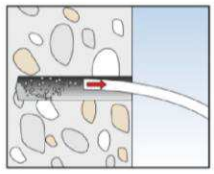
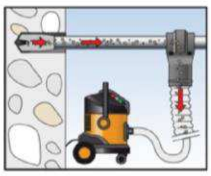
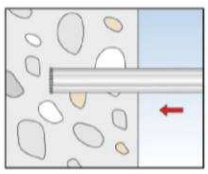
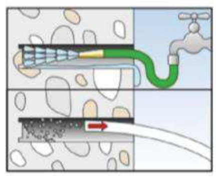
(Fig. not to scaled)

Installation instructions:

- 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 the components of the anchor Exception: Upat MAX dome nut.
- Hammer, hollow or diamond drilling according to Annex B5
- Drill hole created perpendicular +/- 5° to concrete surface, positioning without damaging the reinforcement
- In case of aborted hole: new drilling at a minimum distance twice the depth of the aborted drill 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

Installation instructions: Drilling and cleaning the hole

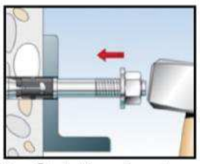
Types of drills and cleaning

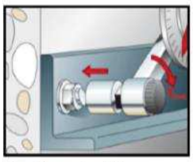
Hammer drill		 1: Drill the hole	 2: Clean the hole
Hollow drill		 1: Drill the hole with automatic cleaning	-
Diamond drill, for non seismic applications only and ≥ drill ∅ 8		 1: Drill the hole	 2: Clean the hole

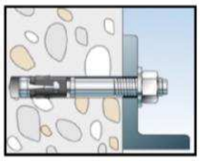
Upat Anchor bolt MAX, MAX A4, MAX	**Annex B 5**
Intended Use Installation instructions	

Installation instructions: Installation of the anchor

HEXAGON NUT:

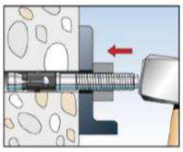

3: Set the fastener

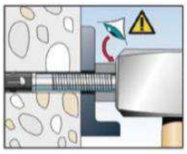

4: Apply T_{inst}

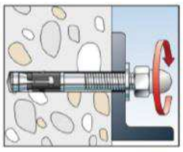

5: Installed fastener

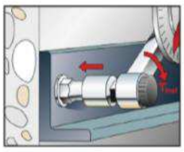
Upat MAX DOME NUT:

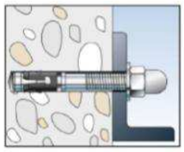
Option 1: Push through installation with setting gauge SL-H:


3: Set the fastener using setting gauge

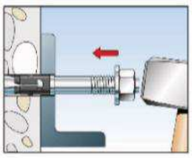

4: Check offset

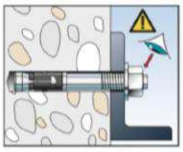

5: Turn on the washer and Upat MAX dome nut

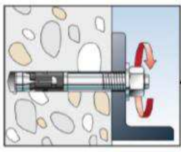

6: Apply T_{inst}


7: Installed fastener

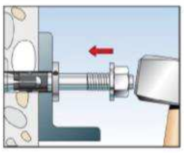
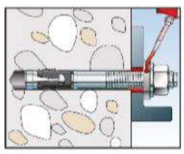
Option 2: Push through installation with hexagon nut:


3: Set the fastener


4: check setting position: Visible one turn of a thread


4.1: Remove nut

Upat FILLING DISC FFD optional for seismic C2 application or minimizing the annular gap:

Optional	The gap between bolt and fixture may be filled with mortar (compressive strength ≥ 50 N/mm² e.g. UPM 33) after step 7 (for eliminating the annular gap). The filling disc is additional to the standard washer. The thickness of the filling disc must be considered for definition of t_{fix} Countersunk of the filling disc in direction to the anchor plate.	 

Upat Anchor bolt MAX, MAX A4, MAX

Intended Use
Installation instructions

Annex B 6

<table>
<tr><th colspan="12">**Table C1.1:** Characteristic **tension** resistance under static and quasi-static action</th></tr>
<tr><td colspan="4" rowspan="2">Size</td><td colspan="8">MAX, MAX A4, MAX C</td></tr>
<tr><td>M6</td><td colspan="2">M8</td><td>M10</td><td>M12</td><td>M16</td><td>M20</td><td>M24</td></tr>
<tr><td colspan="12">**Steel failure**</td></tr>
<tr><td rowspan="2">Characteristic resistance</td><td>MAX</td><td rowspan="2">$N_{Rk,s}$</td><td rowspan="2">[kN]</td><td>7,6</td><td colspan="2">16,6</td><td>28,3</td><td>43,2</td><td>67,0</td><td>123,3</td><td>176,7</td></tr>
<tr><td>MAX A4/C</td><td>11,4</td><td colspan="2">17,0</td><td>29,0</td><td>44,3</td><td>70,6</td><td>124,9</td><td>183,6</td></tr>
<tr><td colspan="2">Partial factor for steel failure</td><td>γ_{Ms} [1)]</td><td>[-]</td><td colspan="8">1,5</td></tr>
<tr><td colspan="12">**Pullout failure**</td></tr>
<tr><td colspan="2">Effective embedment depth for calculation</td><td>h_{ef}</td><td>[mm]</td><td>40</td><td>35 - < 45</td><td>45</td><td>40 - 60</td><td>50 - 70</td><td>65 - 85</td><td>100</td><td>125</td></tr>
<tr><td colspan="2">Characteristic resistance in cracked concrete C20/25</td><td rowspan="2">$N_{Rk,p}$</td><td rowspan="2">[kN]</td><td>1,5</td><td>5,5</td><td>8</td><td>13</td><td>20</td><td colspan="3" rowspan="2">- [2)]</td></tr>
<tr><td colspan="2">Characteristic resistance in uncracked concrete C20/25</td><td>10,5</td><td colspan="2">14</td><td>20</td><td>22</td></tr>
<tr><td rowspan="6">Increasing factors for $N_{Rk,p}$ for cracked and uncracked concrete</td><td rowspan="6">ψ_c</td><td colspan="2">C25/30</td><td colspan="8">1,12</td></tr>
<tr><td colspan="2">C30/37</td><td colspan="8">1,22</td></tr>
<tr><td colspan="2">C35/45</td><td colspan="8">1,32</td></tr>
<tr><td colspan="2">C40/50</td><td colspan="8">1,41</td></tr>
<tr><td colspan="2">C45/55</td><td colspan="8">1,50</td></tr>
<tr><td colspan="2">C50/60</td><td colspan="8">1,58</td></tr>
<tr><td colspan="2">Installation factor</td><td>γ_{inst}</td><td>[-]</td><td colspan="8">1,0</td></tr>
<tr><td colspan="12">**Concrete cone and splitting failure**</td></tr>
<tr><td colspan="2">Factor for uncracked concrete</td><td>$k_1 = k_{ucr,N}$</td><td rowspan="2">[-]</td><td colspan="8">11,0</td></tr>
<tr><td colspan="2">Factor for cracked concrete</td><td>$k_1 = k_{cr,N}$</td><td colspan="8">7,7</td></tr>
<tr><td colspan="2">Characteristic spacing</td><td>$s_{cr,N}$</td><td rowspan="2">[mm]</td><td colspan="8">$3 \cdot h_{ef}$</td></tr>
<tr><td colspan="2">Characteristic edge distance</td><td>$c_{cr,N}$</td><td colspan="8">$1,5 \cdot h_{ef}$</td></tr>
<tr><td colspan="2">Spacing</td><td>$s_{cr,sp}$</td><td rowspan="7">[mm]</td><td colspan="8">$2 \cdot c_{cr,sp}$</td></tr>
<tr><td colspan="2">Edge distance for h = 80</td><td rowspan="6">$c_{cr,sp}$</td><td rowspan="6">40</td><td colspan="2">$2,4 \cdot h_{ef}$</td><td>$2 \cdot h_{ef}$</td><td>-</td><td colspan="3" rowspan="3">-</td></tr>
<tr><td colspan="2">Edge distance for h = 100</td><td colspan="2" rowspan="5">$2 \cdot h_{ef}$</td><td>$2,4 \cdot h_{ef}$</td><td>$2 \cdot h_{ef}$</td></tr>
<tr><td colspan="2">Edge distance for h = 120</td><td rowspan="4">$1,9 \cdot h_{ef}$</td><td>$2,1 \cdot h_{ef}$</td></tr>
<tr><td colspan="2">Edge distance for h = 140</td><td rowspan="3">$1,5 \cdot h_{ef}$</td><td rowspan="3">$2 \cdot h_{ef}$</td><td colspan="2">-</td></tr>
<tr><td colspan="2">Edge distance for h = 160</td><td rowspan="2">$2,4 \cdot h_{ef}$</td><td>-</td></tr>
<tr><td colspan="2">Edge distance for h = 200</td><td>$2,2 \cdot h_{ef}$</td></tr>
</table>

[1)] In absence of other national regulations
[2)] Pullout failure not relevant

Table C2.1: Characteristic values of **shear** resistance under static and quasi-static action

Size				M6	M8	M10	M12	M16	M20	M24
				MAX, MAX A4, MAX C						
Steel failure without lever arm										
Characteristic resistance	MAX	$V^0_{Rk,s}$	[kN]	5,9	13,6	21,4	30,6	55,0	81,4	110,1
	MAX A4/C			8,8	16,8	26,5	38,3	69,8	106,3	148,5
Partial factor for steel failure		γ_{Ms} 1)	[-]	1,25						
Ductility factor		k_7		1,0						
Steel failure with lever arm and Concrete pryout failure										
Effective embedment depth for calculation		h_{ef}	[mm]	40	45	60	70	85	100	125
Characteristic bending resistance	MAX	$M^0_{Rk,s}$	[Nm]	11,4	26	52	92	233	513	865
	MAX A4/C			10,7	29	59	100	256	519	898
Factor for pryout failure		k_8	[-]	2,6	2,8	3,2		3,0	2,6	2,4
Effective embedment depth for calculation		h_{ef}	[mm]	-	35 - < 45	40 - < 60	50 - < 70	65 - < 85	-	
Characteristic bending resistance	MAX	$M^0_{Rk,s}$	[Nm]		20	44	92	184		
	MAX A4/C				21	45	100	193		
Factor for pryout failure		k_8	[-]		2,5	2,6	3,1	3,2		
Partial factor for steel failure		γ_{Ms} 1)	[-]	1,25						
Ductility factor		k_7		1,0						
Concrete edge failure										
Effective anchor length		l_f =	[mm]	h_{ef}						
Outside diameter of a fastener		d_{nom}		6	8	10	12	16	20	24

1) In absence of other national regulations

Table C3.1: Characteristic values of **tension** resistance under **fire exposure**

Size					MAX, MAX A4, MAX C						
					M6	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
		$h_{ef} \geq$		[mm]	40	35 / 45	40 / 60	50 / 70	65 / 85	100	125
Characteristic resistance **steel failure**	$N_{Rk,s,fi}$	R30		[kN]	$0,6^{1)}$ / $0,9^{2)}$	1,4	2,8	5,0	9,4	14,7	21,1
		R60			$0,4^{1)}$ / $0,9^{2)}$	1,2	2,3	4,1	7,7	12,0	17,3
		R90			$0,3^{1)}$ / $0,9^{2)}$	0,9	1,9	3,2	6,0	9,4	13,5
		R120			$0,2^{1)}$ / $0,7^{2)}$	0,8	1,6	2,8	5,2	8,1	11,6
Characteristic resistance **Concrete cone failure**	$N_{Rk,c,fi}$	R30 - R90			$7,7 \cdot h_{ef}^{1,5} \cdot (20)^{0,5} \cdot h_{ef} / 200 / 1000$						
		R120			$7,7 \cdot h_{ef}^{1,5} \cdot (20)^{0,5} \cdot h_{ef} / 200 / 1000 \cdot 0,8$						
Characteristic resistance **pullout failure**	$N_{Rk,p,fi}$	R30			0,4	0,9 / 2,0	2,2 / 3,3	3,0 / 5,0	4,5 / 6,8	8,6	12,0
		R60				0,8 / 2,0					
		R90				0,5 / 2,0					
		R120			0,3	0,3 / 1,6	1,7 / 2,6	2,4 / 4,0	3,6 / 5,4	6,9	9,6

1) MAX gvz
2) MAX A4 / C

Table C3.2: Characteristic values of **shear** resistance under **fire exposure**

Size **MAX, MAX A4, MAX C**			R30		R60	
			$V_{Rk,s,fi,30}$ [kN]	$M^0_{Rk,s,fi,30}$ [Nm]	$V_{Rk,s,fi,60}$ [kN]	$M^0_{Rk,s,fi,60}$ [Nm]
M6	$h_{ef} \geq$	40	$0,6^{1)}$ / $0,9^{2)}$	$0,5^{1)}$ / $0,2^{2)}$	$0,4^{1)}$ / $0,9^{2)}$	$0,3^{1)}$ / $0,1^{2)}$
M8		35	1,8	1,4	1,6	1,2
M10		40	3,6		2,9	3,0
M12		50	6,3	7,8	4,9	6,4
M16		65	11,7	19,9	9,1	16,3
M20		100	18,2	39,0	14,2	31,8
M24		125	26,3	67,3	20,5	55,0

Size **MAX, MAX A4, MAX C**			R90		R120	
			$V_{Rk,s,fi,90}$ [kN]	$M^0_{Rk,s,fi,90}$ [Nm]	$V_{Rk,s,fi,120}$ [kN]	$M^0_{Rk,s,fi,120}$ [Nm]
M6	$h_{ef} \geq$	40	$0,3^{1)}$ / $0,9^{2)}$	$0,2^{1)}$ / $0,1^{2)}$	$0,2^{1)}$ / $0,7^{2)}$	$0,2^{1)}$ / $0,1^{2)}$
M8		35	1,3	1,0	1,2	0,8
M10		40	2,2	2,4	1,9	2,1
M12		50	3,5	5,0	2,8	4,3
M16		65	6,6	12,6	5,3	11,0
M20		100	10,3	24,6	8,3	21,4
M24		125	14,8	42,6	11,9	37,0

1) MAX gvz
2) MAX A4 / C

Table C3.3: Minimum spacings and minimum edge distances of anchors under **fire exposure** for **tension** and **shear** load

Size			MAX, MAX A4, MAX C						
			M6	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Spacing	s_{min}	[mm]	Annex B3						
Edge distance	c_{min}		$c_{min} = 2 \cdot h_{ef}$, for fire exposure from more than one side $c_{min} \geq 300$ mm						

Table C4.1: Characteristic values of **tension and shear** resistance under **seismic action category C1**

Size			MAX, MAX A4, MAX C						
			M6	M8	M10	M12	M16	M20	M24
Length of anchor	L_{max}	[mm]	-	167	186	221	285	394	477
Effective embedment depth	h_{ef}	[mm]	-	45	40 - 60	50 - 70	65 - 85	100	125
Steel failure									
Characteristic resistance tension load C1	$N_{Rk,s,eq,C1}$	[kN]	-	16,0	27,0	41,0	66,0	111,0	150,0
Partial factor for steel failure	$\gamma_{Ms,C1}$ [1]	[-]	-	1,5					
Pullout failure									
Characteristic resistance tension load in cracked concrete C1	$N_{Rk,p,eq,C1}$	[kN]	-	4,6	8,0	16,0	28,2	36,0	50,3
Installation factor	γ_{inst}	[-]	-	1,0					
Steel failure without lever arm									
Characteristic resistance shear load C1	$V_{Rk,s,eq,C1}$	[kN]	-	11	17	27	47	56	69
Partial factor for steel failure	$\gamma_{Ms,C1}$ [1]	[-]	-	1,25					

[1] In absence of other national regulations

Table C4.2: Characteristic values of **tension and shear** resistance under **seismic action category C2**

Size			MAX, MAX A4, MAX C [1]						
			M6	M8	M10	M12	M16	M20	M24
Length of anchor	L_{max}	[mm]	-		186	221	285	394	-
Steel failure									
Characteristic resistance tension load C2	$N_{Rk,s,eq,C2}$	[kN]	-		27	41	66	111	-
Partial factor for steel failure	$\gamma_{Ms,C2}$ [2]	[-]	-		1,5				-
Pullout failure									
Characteristic resistance tension load in cracked concrete C2	h_{ef}	[mm]	-		60	70	85	100	-
	$N_{Rk,p,eq,C2}$	[kN]	-		5,1	7,4	21,5	30,7	-
	h_{ef}	[mm]	-		40-59	50-69	65-84	-	
	$N_{Rk,p,eq,C2}$	[kN]	-		2,7	4,4	16,4	-	
Installation factor	γ_{inst}	[-]	1,0						
Steel failure without lever arm									
Characteristic resistance shear load C2	h_{ef}	[mm]	-		60	70	85	100	-
	$V_{Rk,s,eq,C2}$	[kN]	-		10,0	17,4	27,5	39,9	-
	h_{ef}	[mm]	-		40-59	50-69	65-84	-	
	$V_{Rk,s,eq,C2}$	[kN]	-		7,0	12,7	22,0	-	
Partial factor for steel failure	$\gamma_{Ms,C2}$ [2]	[-]	1,25						
Factor for annular gap	α_{gap}	[-]	0,5 (1,0) [3]						

[1] MAX C: Only valid for cold-formed version (according to Annex A1)
[2] In absence of other national regulations
[3] Value in brackets valid for filled annular gab between anchor and clearance hole in the fixture. Use of special Upat filling Disc FFD is required.

Upat Anchor bolt MAX, MAX A4, MAX	**Annex C 4**
Performances Characteristic values of resistance under tension and shear loads under seismic action	

Table C5.1: Displacements under **tension** loads

Size		MAX, MAX A4, MAX C						
		M6	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Displacement – factor for tensile load [1]								
δ_{N0} - factor	[mm/kN]	0,13	0,22	0,12	0,09	0,08	0,07	0,05
		1,00	0,78	0,40	0,19	0,09		0,07
$\delta_{N\infty}$ - factor	[mm/kN]	0,16	0,07	0,05	0,06		0,05	0,04
		0,24	0,29	0,21	0,14	0,10	0,06	0,05

Table C5.2: Displacements under **shear** loads

Size		MAX						
		M6	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Displacement – factor for shear load [2]								
δ_{V0} - factor	[mm/kN]	0,6	0,35	0,37	0,27	0,10	0,09	0,07
		0,9	0,52	0,55	0,40	0,14	0,15	0,11
		MAX A4, MAX C						
$\delta_{V\infty}$ - factor	[mm/kN]	0,6	0,23	0,19	0,18	0,10	0,11	0,07
		0,9	0,27	0,22	0,16	0,11	0,05	0,09

[1] Calculation of effective displacement:
$\delta_{N0} = \delta_{N0}$ – factor $\cdot N_{ED}$
$\delta_{N\infty} = \delta_{N\infty}$ – factor $\cdot N_{ED}$
(N_{ED}: Design value of the applied tension force)

[2] Calculation of effective displacement:
$\delta_{V0} = \delta_{V0}$ – factor $\cdot V_{ED}$
$\delta_{V\infty} = \delta_{V\infty}$ – factor $\cdot V_{ED}$
(V_{ED}: Design value of the applied shear force)

Table C5.3: Displacements under **tension** loads for **seismic category C2** for all embedment depths

Size			MAX, MAX A4, MAX C						
			M6	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Displacement DLS	$\delta_{N,eq(DLS)}$	[mm]	-		2,7	4,4		5,6	-
Displacement ULS	$\delta_{N,eq(ULS)}$	[mm]			11,5	13,0	12,3	14,4	

Table C5.4: Displacements under **shear** loads for **seismic category C2** for all embedment depths

Size			MAX, MAX A4, MAX C						
			M6	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Displacement DLS	$\delta_{V,eq\ (DLS)}$	[mm]	-		4,1	4,7	5,5	4,8	-
Displacement ULS	$\delta_{V,eq\ (ULS)}$	[mm]			6,2	7,8	10,1	11,2	