Deutsches Institut für Bautechnik

DIBt

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and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and
Laender Governments

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European Technical Assessment

ETA-04/0098 of 11 October 2019

English translation prepared by DIBt - Original version in German language

General Part

Technical Assessment Body issuing the European Technical Assessment:	Deutsches Institut für Bautechnik
Trade name of the construction product	Liebig® Ultraplus A4 undercut anchor
Product family to which the construction product belongs	Mechanical fastener for use in concrete
Manufacturer	EJOT Baubefestigungen GmbH In der Stockwiese 35 57334 Bad Laasphe DEUTSCHLAND
Manufacturing plant	EJOT Herstellwerk 26
This European Technical Assessment contains	17 pages including 3 annexes which form an integral part of this assessment
This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of	EAD 330232-00-0601
This version replaces	ETA-04/0098 issued on 9 April 2018

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Specific Part

1 Technical description of the product

The Liebig® Ultraplus™ undercut anchor of sizes M10, M12, M16 and M20 is an anchor made of galvanised steel or made of stainless steel which is placed in an undercut hole and anchored by mechanical interlock with displacement-controlled installation.

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 C1
Characteristic resistance to shear load (static and quasi-static loading)	See Annex C2
Displacements (static and quasi-static loading)	See Annex C5
Characteristic resistance and displacements for seismic performance categories C1 and C2	No performance assessed
Durability	See Annex B1

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Class A1
Resistance to fire	See Annex C3 and C4

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 330232-00-0601 the applicable European legal act is: [96/582/EC].

The system to be applied is: 1

5 Technical details necessary for the implementation of the AVCP system, as provided for in the applicable European Assessment Document

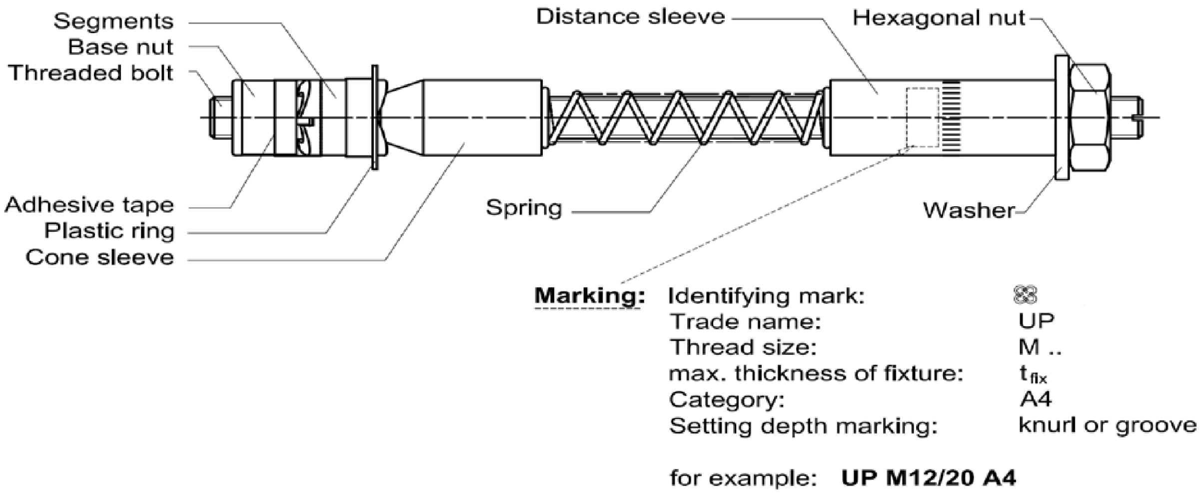
Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited with Deutsches Institut für Bautechnik.

Issued in Berlin on 19 October 2018 by Deutsches Institut für Bautechnik

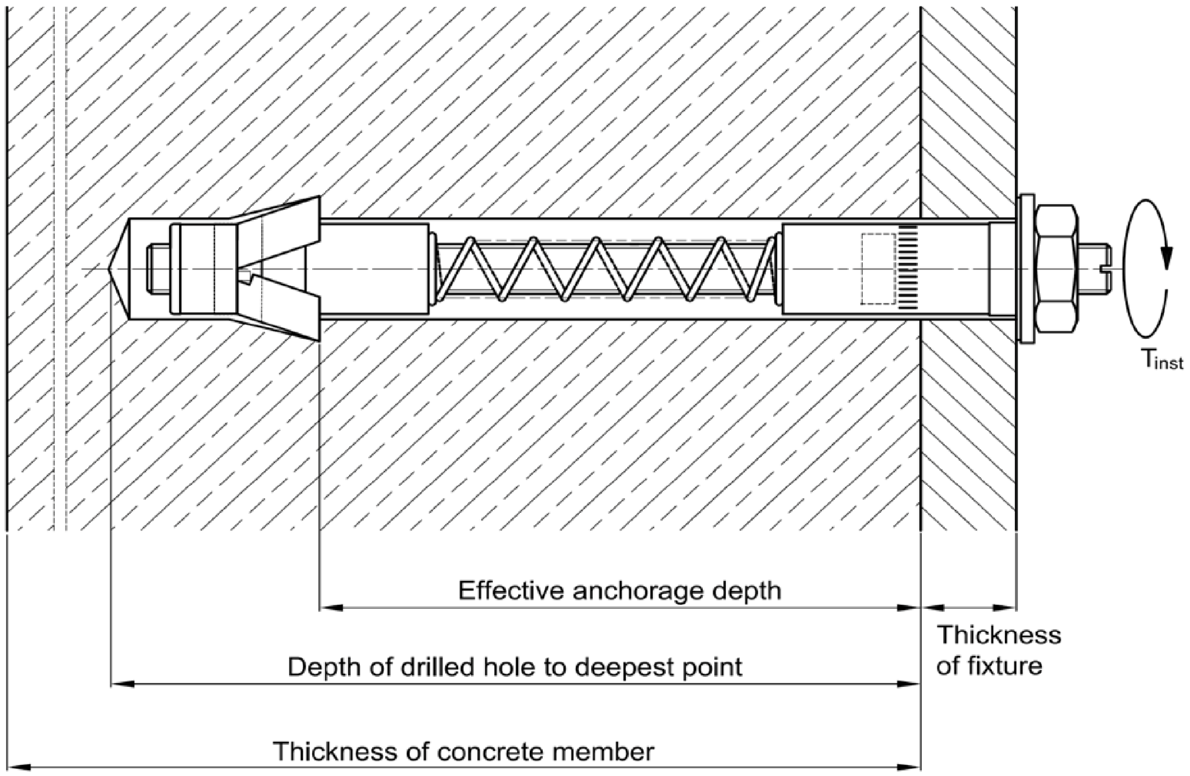
Dr.-Ing. Lars Eckfeldt
p.p. Head of Department

beglaubigt:
Baderschneider

Liebig® Ultraplus™ undercut anchor



Liebig® Ultraplus™ after installation



Liebig® Ultraplus™ undercut anchor	**Annex A1**
Product description Product and installation situation	

Liebig® Ultraplus™ undercut anchor

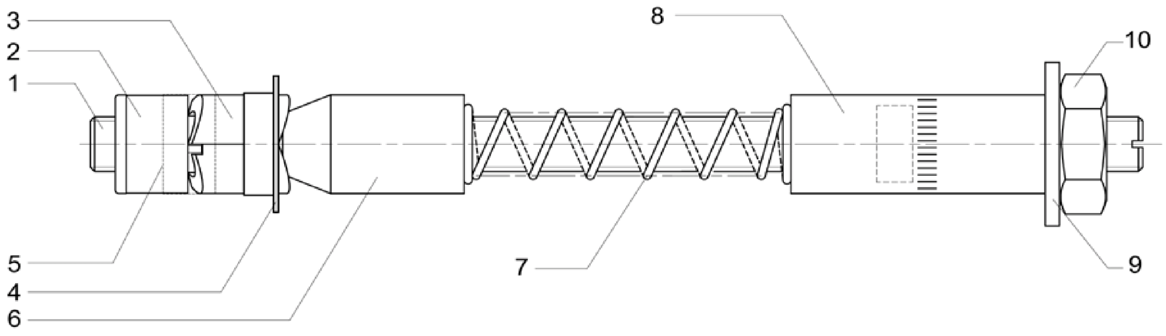


Table A1: Materials

Part	Designation	Material: stainless steel A4	Materail: zinc plated [2)]
1	Threaded Bolt		
2	Base Nut	stainless steel	Carbon steel
3	Segment		
4	Plastic Ring	PE	PE
5	Adhesive Tabe	according to specifications	according to specifications
6	Cone Sleeve		
7	Spring		
8	Distance Sleeve	stainless steel	Carbon steel
9	Washer		
10	Hexagonal Nut[1)]		

[1)] stainless steel with lubrication
[2)] Part 1 - 3 and 6 - 10 zinc electroplated to EN ISO 4042 ≥ 5 µm

Liebig® Ultraplus™ undercut anchor	**Annex A2**
Product description Materials	

Liebig® Ultraplus™ undercut anchor

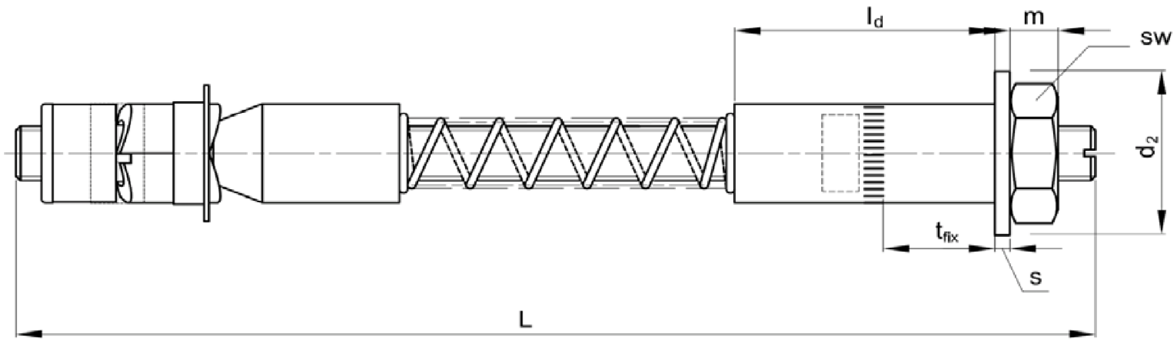


Table A2: Dimensions of the anchor

Main dimensions			Distance sleeve	Hexagonal nut		Washer		
Anchor size	L [mm]	t_{fix} [mm]	l_d [mm]	m [mm]	SW [mm]	d_2 [mm]	d_1 [mm]	s [mm]
UP M10	160…360	0…200	35…235	8	22	27	10,2	2,5
UP M12	200…400	0…200	40…240	10	24	32	12,2	3,5
UP M16	295…495	0…200	40…240	13	36	48	16,2	4,0
UP M20	330…530	0…200	40…240	16	41	50	20,2	5,0

Specifications of intended use

Anchorages subject to:

- Static and quasi-static loading (all steel elements)
- Fire exposure

Base materials:

- Reinforced or unreinforced compacted normal weight concrete without fibres of strength classes C20/25 to C50/60 acc. to EN 206:2013
- Cracked or uncracked concrete

Use conditions (Environmental conditions):

- Structures subject to dry internal conditions (zinc coated steel or stainless steel).
- Structures subject to external atmospheric exposure (including industrial and marine environment) and to permanently damp internal condition, if no particular aggressive conditions exist (stainless steel).

  Note: Particular aggressive conditions are e.g. permanent, alternating immersion in seawater or the splash zone of seawater, chloride atmosphere of indoor pools or atmosphere with extreme chemical pollution (e.g. in 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.
- Verifiable calculation notes and drawings are 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.).
- Anchorages are designed in accordance with EN 1992-4:2018 and TR 055.

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 the components of an anchor.
- Anchor installation in accordance with the manufacturer's specifications and drawings using the appropriate tools.
- Positioning of the drill holes without damaging the reinforcement.
- In case of aborted 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.
- Anchor installation such that the effective anchorage depth is complied with. This compliance is ensured, if the thickness of fixture is not greater than the maximum thickness of fixture marked on the anchor.
- Application of the required torque moment given in Annex B2 using a calibrated torque wrench.

Liebig® Ultraplus™ undercut anchor	**Annex B1**
Intended use Specifications	

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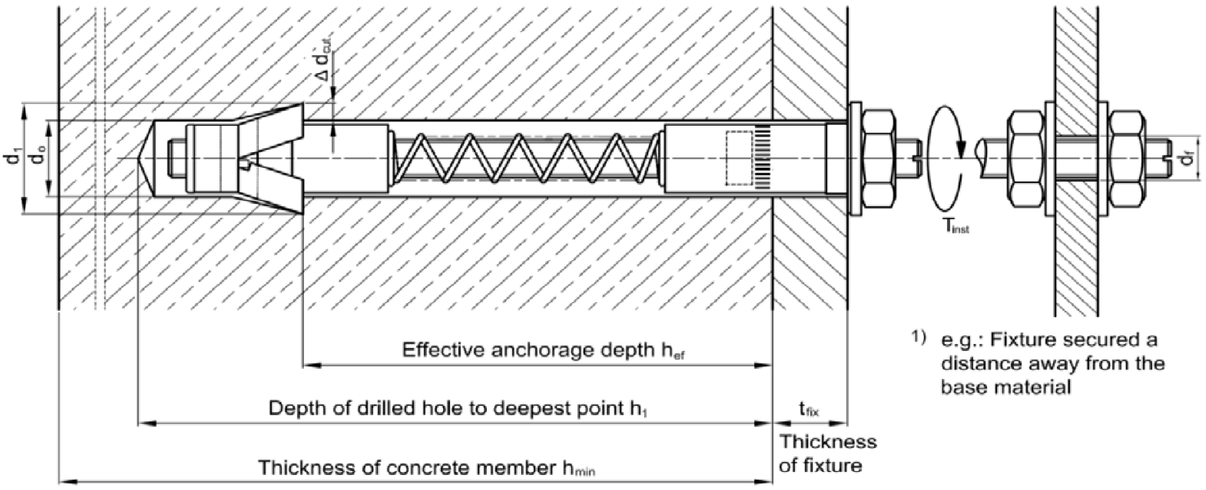


Table B1: Installation data

Liebig® Ultraplus™				UP M10	UP M12	UP M16	UP M20
Drill hole diameter		d_o	[mm]	19	23	30	36
Cutting diameter at the upper tolerance limit (maximum diameter bit)		$d_{cut,max} \leq$	[mm]	19,5	23,55	30,55	36,7
Undercutting		Δd_{cut}	[mm]	4,25	6	8,5	8,75
Diameter of undercutting hole		d_1	[mm]	27,5	35	47	53,5
Depth of drilled hole to deepest point		$h_1 \geq$	[mm]	150	190	300	330
Effective anchorage depth		$h_{ef} \geq$	[mm]	110	140	220	250
Diameter of clearance hole in the fixture	In-place anchorage	$d_f \leq$	[mm]	20	24	32	38
	Mounting on the threaded bolt[1)]	$d_f \leq$	[mm]	12	14	18	22
Thickness of fixture		$t_{fix} \leq$	[mm]	50	60	70	100
Width across flats		SW	[mm]	22	24	36	41
Torque moment, **zinc plated**		T_{inst}	[Nm]	70	120	250	300
Torque moment, **A4**		T_{inst}	[Nm]	45	80	250	300

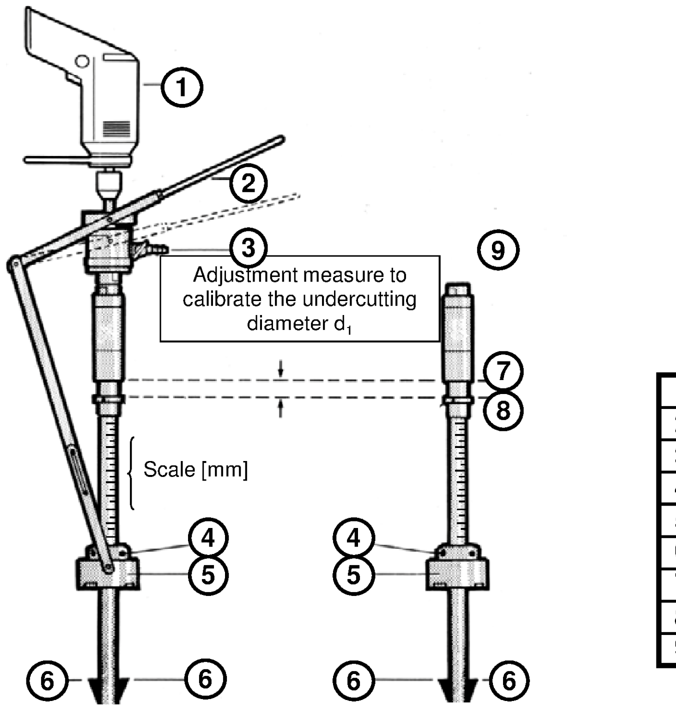
Table B2: Minimum thickness of concrete member, center spacing and edge distance

Liebig® Ultraplus™			UP M10	UP M12	UP M16	UP M20
Minimum thickness of concrete member	h_{min}	[mm]	200	240	360	400
Minimum thickness of concrete member...[2)]	h_{min}	[mm]	-	-	330	360
Minimum spacing	s_{min}	[mm]	110	140	220	250
Minimum edge distance	c_{min}	[mm]	110	140	220	250

2) only where the remote face of the concrete member is inspected to ensure there has been no break-through.

Liebig® Ultraplus™ undercut anchor	**Annex B2**
Intended use Installation data, Minimum thickness of concrete member, spacing and edge distance	

Liebig® Ultraplus™ undercutting tool

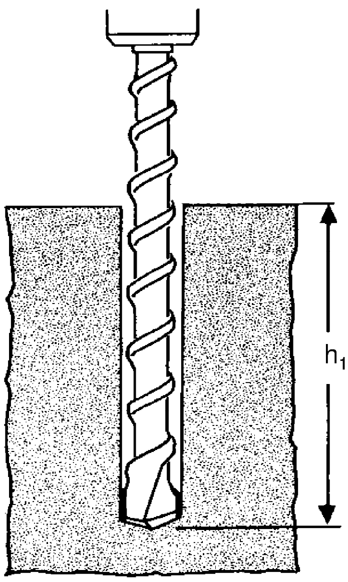


Hand undercutting tool Type DH

Undercutting tool for core drilling rigs Type D

1	Drilling machine, rated input ≥1000 W
2	Hand lever
3	Water supply
4	Hexagon socket screws
5	Embedment depth gauge
6	Diamond cutting blades
7	Undercutting gauge
8	Depth gauge
9	1/2" connector

1. Drill hole



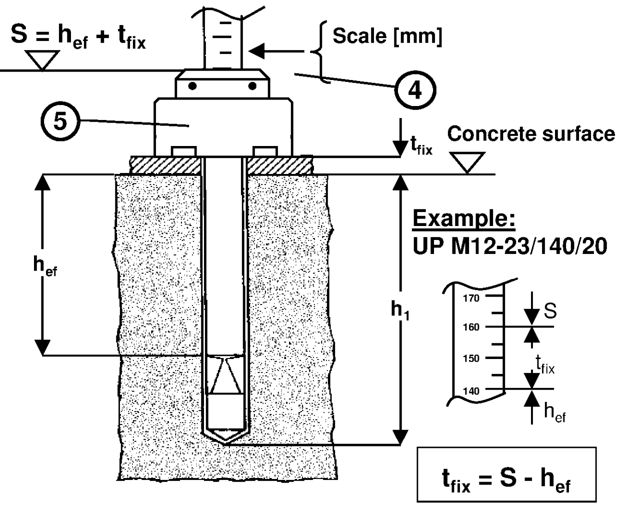
Type	Depth of drilled hole h_1
UP M10-19/110/..	150 mm
UP M12-23/140/..	190 mm
UP M16-30/220/..	300 mm
UP M20-36/250/..	330 mm

- Drill cylindrical hole with rotary hammer or a diamond drilling machine (core drilling).
- Remove drilling dust.

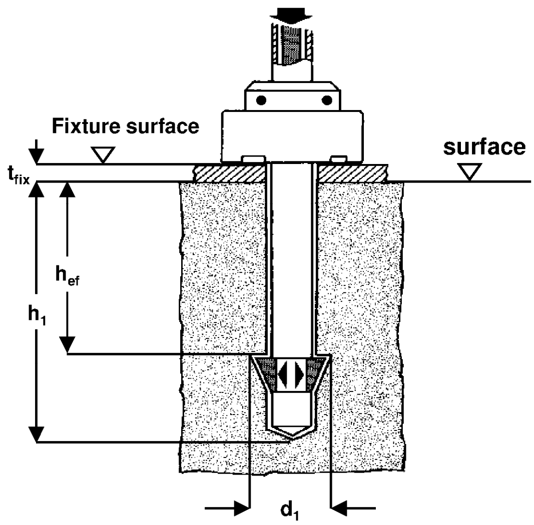
2. Undercut operation

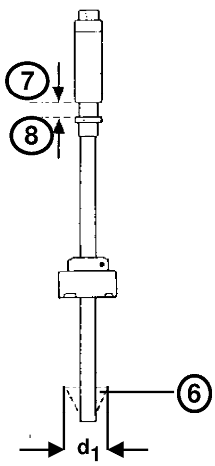
The undercutting tool is pre-adjusted by the manufacturer to the effective embedment depth h_{ef} (measured from the concrete surface).

When drilling through the fixture, the effective embedment depth h_{ef} has to be re-adjusted by sliding the embedment depth gauge **(5)** on the handle with a distance corresponding to the fixture thickness t_{fix} in order to get the total drill depth S. This can be easily done by using the scale on the handle.



- Loosen the hexagon socket screws **(4)**, slide the gauge **(5)** on the handle. The total drill depth S equates to the effective embedment depth h_{ef} plus the fixture thickness t_{fix}.
- Re-tighten the hexagon socket screws.
- The undercutting diameter d_1 has to be adjusted with the help of an adjusting gauge provided with the undercutting tool or with a sliding caliper vernier gauge and has to be checked regularly during the drilling operation (due to abrasion or wearing down of of the diamond cutting elements).
- Insert undercutting tool into concrete hole until embedment depth gauge touches the concrete surface or the fixture.
- Turn on the water supply before beginning the undercut drilling process.





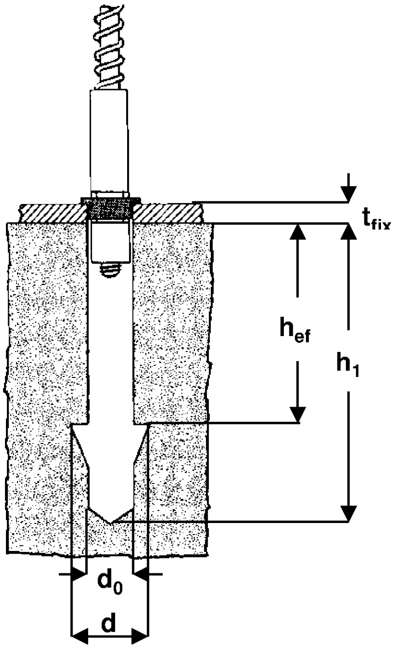
By pressing the upper part of the undercutting tool **(7)** telescopically down to the depth gauge **(8)** until they have contact, the segments **(6)** open automatically to the correctly adjusted diameter d_1.

The drilling dust is washed out by the flowing water, which should be allowed to continue flowing for a few seconds to flush out the hole.

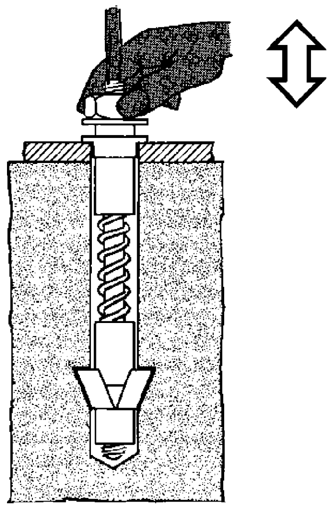
Do not move the undercut tool. Turn off the drilling machine with the undercut tool still at its deepest position within the hole, release the diamond cutting blades and finally remove the undercutting tool from the hole.

Liebig® Ultraplus™ undercut anchor	**Annex B4**
Intended use Installation instruction	

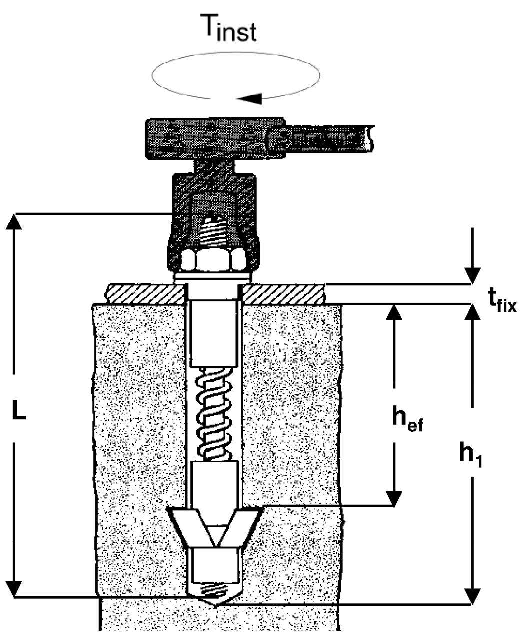
3. Anchor setting



The Liebig® Ultraplus™ undercut anchor is inserted into the hole through the fixture. The plastic ring, that holds the clamping segments together, remains at the top of the hole in the fixture. The clamping segments open automatically when located in the undercut (this can be felt and heard).



Ensure that the clamping segments have located into the undercut by trying to move the anchor up and down.



Apply installation torque T_{inst} using a calibrated torque-wrench.

Type	**Installation torque T_{inst} [Nm]**	
	zinc plated	A4
UP M10 - 19/110/..	70	45
UP M12 - 23/140/..	120	80
UP M16 - 30/220/..	250	250
UP M20 - 36/250/..	300	300

Liebig® Ultraplus™ undercut anchor

Intended use
Installation instruction

Annex B5

Table C1: Characteristic values of resistance to tensile loads - Design method A

Liebig® Ultraplus™			UP M10	UP M12	UP M16	UP M20
Steel failure, zinc plated						
Characteristic resistance	$N_{Rk,s}$	[kN]	58	85	157	245
Partial factor	γ_{Ms} [1)]	[-]	1,4			
Steel failure, A4						
Characteristic resistance	$N_{Rk,s}$	[kN]	46	67	126	196
Partial factor	γ_{Ms} [1)]	[-]	1,6			
Pullout failure						
Characteristic resistance in **cracked** concrete C20/25	$N_{Rk,p}$	[kN]	25	40	75	95
Characteristic resistance in **non-cracked** concrete C20/25	$N_{Rk,p}$	[kN]	35	60	95	140
Increasing factor $N_{Rk,p}$	Ψ_C	C30/37	1,22			
		C40/50	1,41			
		C50/60	1,58			
Robustness to installation	γ_{inst}	[-]	1,0			
Concrete cone failure and splitting failure						
Effective anchorage depth	h_{ef}	[mm]	110	140	220	250
Factor for k1	$k_{ucr,N}$		11,0			
Factor for k1	$k_{cr,N}$		7,7			
Center spacing	$s_{cr,N}$	[mm]	330	420	660	750
Edge disatance	$c_{cr,N}$	[mm]	165	210	330	375
Center spacing (splitting)	$s_{cr,sp}$	[mm]	330	420	660	750
Edge distance (splitting)	$c_{cr,sp}$	[mm]	165	210	330	375
Robustness to installation	γ_{inst}	[-]	1,0			

1) In absence of other national regulations

Table C2: Characteristic values of resistance to shear loads - Design method A

Liebig® Ultraplus™			UP M10	UP M12	UP M16	UP M20
Steel failure without lever arm, zinc plated						
Characteristic resistance for in-place anchorage	$V^0_{Rk,s}$	[kN]	55	95	170	230
Ductility factor	k_7	[-]	0,8			
Partial factor	γ_{Ms} 1)	[-]	1,5			
Steel failure with lever arm, zinc plated						
Characteristic bending restistance	$M^0_{Rk,s}$	[Nm]	75	131	332	649
Ductility factor	k_7	[-]	0,8			
Partial factor	γ_{Ms} 1)	[-]	1,5			
Steel failure without lever arm, A4						
Characteristic resistance for in-place anchorage	$V^0_{Rk,s}$	[kN]	55	90	160	230
Ductility factor	k_7	[-]	0,8			
Partial factor	γ_{Ms} 1)	[-]	1,33			
Steel failure with lever arm, A4						
Characteristic bending restistance	$M^0_{Rk,s}$	[Nm]	60	105	266	519
Ductility factor	k_7	[-]	0,8			
Partial factor	γ_{Ms} 1)	[-]	1,33			
Concrete pryout failure						
Factor	k_8	[-]	2			
Robustness to installation	γ_{inst}	[-]	1,0			
Concrete edge failure						
Effective length of anchor under shear load	ℓ_f	[mm]	110	140	220	250
Outside diameter of anchor	d_{nom}	[mm]	17,5	21,7	25	25
Partial factor	γ_{inst}	[-]	1,0			

1) In absence of other national regulations

Liebig® Ultraplus™ undercut anchor	**Annex C2**
Performance Design method A: Characteristic values of shear loads	

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Table C3: Characteristic tension resistance in cracked and non-cracked concrete C20/25 to C50/60 under fire exposure - Design method A

Liebig® Ultraplus™		UP M10				UP M12				UP M16				UP M20			
Fire resistance duration	R… [min]	30	60	90	120	30	60	90	120	30	60	90	120	30	60	90	120
Steel failure, zinc plated																	
Characteristic resistance	$N_{Rk,s,fi}$ [kN]	0,9	0,8	0,6	0,5	1,7	1,3	1,1	0,8	3,1	2,3	2,0	1,6	4,9	3,7	3,2	2,4
Steel failure, A4																	
Characteristic resistance	$N_{Rk,s,fi}$ [kN]	1,4	1,2	0,9	0,8	2,5	2,1	1,7	1,3	4,7	3,9	3,1	2,5	7,3	6,1	4,9	3,9
Pull-out failure																	
Characteristic resistance	$N_{Rk,p,fi}$ [kN]	6,3			5	10			8	18,8			15	23,8			19
Concrete cone failure																	
Characteristic resistance	$N^0_{Rk,c,fi}$ [kN]	22,8			18,3	41,7			33,4	117,5			103,4	142,3			
Center spacing	$s_{cr,N}$ [mm]	$4 \times h_{ef}$															
	s_{min} [mm]	110				140				220				250			
Edge distance	$c_{cr,N}$ [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 und $\geq 2 \times h_{ef}$							

Liebig® Ultraplus™ undercut anchor

Performance
Design method A: Characteristic values of tension resistance under fire exposure

Annex C3

Table C4: Characteristic shear resistance in cracked and non-cracked concrete C20/25 to C50/60 under fire exposure - Design method A

Liebig® Ultraplus™		UP M10				UP M12				UP M16				UP M20			
Fire resistance duration	R… [min]	30	60	90	120	30	60	90	120	30	60	90	120	30	60	90	120
Steel failure without lever arm, zinc plated																	
Characteristic resistance	$V_{Rk,s,fi}$ [kN]	0,9	0,8	0,6	0,5	1,7	1,3	1,1	0,8	3,1	2,3	2,0	1,6	4,9	3,7	3,2	2,4
Steel failure with lever arm, zinc plated																	
Characteristic bending moment	$M^0_{Rk,s,fi}$ [Nm]	1,1	1,0	0,7	0,6	2,6	2,0	1,7	1,3	6,6	5,0	4,3	3,3	13,0	9,7	8,4	6,5
Steel failure without lever arm, A4																	
Characteristic resistance	$V_{Rk,s,fi}$ [kN]	1,4	1,2	0,9	0,8	2,5	2,1	1,7	1,3	4,7	3,9	3,1	2,5	7,3	6,1	4,9	3,9
Steel failure with lever arm, A4																	
Characteristic bending moment	$M^0_{Rk,s,fi}$ [Nm]	1,9	1,5	1,2	1,0	3,9	3,3	2,6	2,1	9,9	8,3	6,6	5,3	19,5	16,2	13,0	10,4
Concrete pry-out failure																	
Factor	k_8 [-]	2															
Characteristic resistance	$V^0_{Rk,cp,fi}$ [kN]	45,6			36,6	83,4			66,8	235			206,8	284,6			

Liebig® Ultraplus™ undercut anchor

Performance
Characteristic values of shear resistance under fire exposure

Annex C4

Table C5: Displacements under tensile loads

Liebig® Ultraplus™			UP M10	UP M12	UP M16	UP M20
Displacements and tensile loads in C20/25 to C50/60, zinc plated						
Cracked concrete	N	[kN]	9,9	15,9	29,8	37,7
	δ_{N0}	[mm]	0,5	0,6	0,8	1,0
	$\delta_{N\infty}$	[mm]	1,3	1,3	1,3	1,3
Non-cracked concrete	N	[kN]	13,9	23,8	37,7	55,6
	δ_{N0}	[mm]	0,9	0,9	0,9	0,9
	$\delta_{N\infty}$	[mm]	1,8	1,8	1,8	1,8
Displacements and tensile loads in C20/25 to C50/60, A4						
Cracked concrete	N	[kN]	9,9	15,9	29,8	37,7
	δ_{N0}	[mm]	0,7	0,8	1,1	1,4
	$\delta_{N\infty}$	[mm]	1,8	1,8	1,8	1,8
Non-cracked concrete	N	[kN]	13,9	23,8	37,7	55,6
	δ_{N0}	[mm]	1,3	1,3	1,3	1,3
	$\delta_{N\infty}$	[mm]	2,5	2,5	2,5	2,5

Table C6: Displacements under shear loads

Liebig® Ultraplus™			UP M10	UP M12	UP M16	UP M20
Displacements and shear loads in C20/25 to C50/60, zinc plated						
Cracked and non-cracked concrete	V	[kN]	26,2	45,2	81	109,5
	δ_{V0}	[mm]	2,1	3	4,2	4,5
	$\delta_{V\infty}$	[mm]	3	4	6,3	6,7
Displacements and shear loads in C20/25 to C50/60, A4						
Cracked and non-cracked concrete	V	[kN]	29,5	48,2	85,9	123,5
	δ_{V0}	[mm]	2,4	3,2	4,5	5,1
	$\delta_{V\infty}$	[mm]	3,6	4,8	6,7	7,6