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Authorised and notified according to Article 10 of the Council Directive of 21 December 1988 on the approximation of laws, regulations and administrative provisions of Member States relating to construction products (89/106/EEC)

DIBt

Mitglied der EOTA
Member of EOTA

European Technical Approval ETA-10/0171

English translation prepared by DIBt - Original version in German language

Handelsbezeichnung *Trade name*	Injektionssystem Upat UPM 33 *Injection system Upat UPM 33*
Zulassungsinhaber *Holder of approval*	Upat Vertriebs GmbH Otto-Hahn Straße 15 79211 Denzlingen DEUTSCHLAND
Zulassungsgegenstand und Verwendungszweck *Generic type and use of construction product*	Verbunddübel in den Größen M8 bis M30 zur Verankerung im ungerissenen Beton *Bonded anchor in the size of M8 to M30 for use in non-cracked concrete*
Geltungsdauer: vom *Validity: from*	9 July 2010
bis *to*	29 October 2012
Herstellwerk *Manufacturing plant*	Upat

Diese Zulassung umfasst *This Approval contains*	15 Seiten einschließlich 7 Anhänge *15 pages including 7 annexes*

I LEGAL BASES AND GENERAL CONDITIONS

1 This European technical approval is issued by Deutsches Institut für Bautechnik in accordance with:

- Council Directive 89/106/EEC of 21 December 1988 on the approximation of laws, regulations and administrative provisions of Member States relating to construction products[1], modified by Council Directive 93/68/EEC[2] and Regulation (EC) N° 1882/2003 of the European Parliament and of the Council[3];
- Gesetz über das In-Verkehr-Bringen von und den freien Warenverkehr mit Bauprodukten zur Umsetzung der Richtlinie 89/106/EWG des Rates vom 21. Dezember 1988 zur Angleichung der Rechts- und Verwaltungsvorschriften der Mitgliedstaaten über Bauprodukte und anderer Rechtsakte der Europäischen Gemeinschaften (Bauproduktengesetz - BauPG) vom 28. April 1998[4], as amended by law of 31 October 2006[5];
- Common Procedural Rules for Requesting, Preparing and the Granting of European technical approvals set out in the Annex to Commission Decision 94/23/EC[6];
- Guideline for European technical approval of "Metal anchors for use in concrete - Part 5: Bonded anchors", ETAG 001-05.

2 Deutsches Institut für Bautechnik is authorized to check whether the provisions of this European technical approval are met. Checking may take place in the manufacturing plant. Nevertheless, the responsibility for the conformity of the products to the European technical approval and for their fitness for the intended use remains with the holder of the European technical approval.

3 This European technical approval is not to be transferred to manufacturers or agents of manufacturers other than those indicated on page 1, or manufacturing plants other than those indicated on page 1 of this European technical approval.

4 This European technical approval may be withdrawn by Deutsches Institut für Bautechnik, in particular pursuant to information by the Commission according to Article 5(1) of Council Directive 89/106/EEC.

5 Reproduction of this European technical approval including transmission by electronic means shall be in full. However, partial reproduction can be made with the written consent of Deutsches Institut für Bautechnik. In this case partial reproduction has to be designated as such. Texts and drawings of advertising brochures shall not contradict or misuse the European technical approval.

6 The European technical approval is issued by the approval body in its official language. This version corresponds fully to the version circulated within EOTA. Translations into other languages have to be designated as such.

1 Official Journal of the European Communities L 40, 11 February 1989, p. 12
2 Official Journal of the European Communities L 220, 30 August 1993, p. 1
3 Official Journal of the European Union L 284, 31 October 2003, p. 25
4 *Bundesgesetzblatt Teil I 1998*, p. 812
5 *Bundesgesetzblatt Teil I 2006*, p. 2407, 2416
6 Official Journal of the European Communities L 17, 20 January 1994, p. 34

II SPECIFIC CONDITIONS OF THE EUROPEAN TECHNICAL APPROVAL

1 Definition of the product and intended use

1.1 Definition of the construction product

The Injection system Upat UPM 33 is a bonded anchor (injection type) consisting of a mortar cartridge with Upat injection mortar UPM 33 and a steel element. The steel element is an anchor rod with hexagon nut and washer in the range of M8 to M30. The steel elements are made of zinc coated steel or stainless steel.

The steel element is placed into a drilled hole filled with injection mortar and is anchored via the bond between steel element, injection mortar and concrete.

An illustration of the product and intended use is given in Annex 1.

1.2 Intended use

The anchor is intended to be used for anchorages for which requirements for mechanical resistance and stability and safety in use in the sense of the Essential Requirements 1 and 4 of Council Directive 89/106 EEC shall be fulfilled and failure of anchorages made with these products would cause risk to human life and/or lead to considerable economic consequences. Safety in case of fire (Essential Requirement 2) is not covered in this European technical approval. The anchor is to be used only for anchorages subject to static or quasi-static loading in reinforced or unreinforced normal weight concrete of strength classes C20/25 at minimum and C50/60 at most according to EN 206:2000-12.

The anchor may be used in non-cracked concrete only.

The anchor may be installed in dry or wet concrete; it must not be installed in flooded holes.

The drill hole shall be made by hammer drilling or compressed air drilling.

The anchor may be used in the following service temperature ranges:

Temperature range I:	-40 °C to +80 °C	(max long term temperature +50 °C and max short term temperature +80 °C)
Temperature range II:	-40 °C to +120 °C	(max long term temperature +72 °C and max short term temperature +120 °C)

<u>Elements made of zinc coated steel:</u>

The element made of electroplated or hot-dipped galvanised steel may only be used in structures subject to dry internal conditions.

<u>Elements made of stainless steel A4:</u>

The element made of stainless steel may be used in structures subject to dry internal conditions and also in structures subject to external atmospheric exposure (including industrial and marine environment), or exposure in permanently damp internal conditions, if no particular aggressive conditions exist. Such 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 de-icing materials are used).

The provisions made in this European technical approval are based on an assumed working life of the anchor of 50 years. The indications given on the working life cannot be interpreted as a guarantee given by the 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.

2 Characteristics of the product and methods of verification

2.1 Characteristics of product

The anchor corresponds to the drawings and provisions given in Annexes 1 to 2. The characteristic material values, dimensions and tolerances of the anchor not indicated in Annexes 1 to 2 shall correspond to the respective values laid down in the technical documentation[7] of this European technical approval.

The characteristic anchor values for the design of anchorages are given in Annexes 5 to 7.

Each mortar cartridge is marked with the identifying mark of the producer and with the trade name in accordance with Annex 1.

The two components of the Upat injection mortar UPM 33 are delivered in unmixed condition in shuttle cartridges of 360 ml or 950 ml according to Annex 1 or in coaxial cartridges of 100 ml, 150 ml, 300 ml, 380 ml or 400 ml.

2.2 Methods of verification

The assessment of fitness of the anchor for the intended use in relation to the requirements for mechanical resistance and stability and safety in use in the sense of the Essential Requirements 1 and 4 has been made in accordance with the "Guideline for European technical approval of Metal Anchors for Use in Concrete", Part 1 "Anchors in general" and Part 5 "Bonded anchors" on the basis of Option 7.

In addition to the specific clauses relating to dangerous substances contained in this European technical approval, there may be other requirements applicable to the products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). In order to meet the provisions of the Construction Products Directive, these requirements need also to be complied with, when and where they apply.

3 Evaluation and attestation of conformity and CE marking

3.1 System of attestation of conformity

According to the Decision 96/582/EG of the European Commission[8] system 2(i) (referred to as System 1) of the attestation of conformity applies.

This system of attestation of conformity is defined as follows:

System 1: Certification of the conformity of the product by an approved certification body on the basis of:

(a) Tasks for the manufacturer:
  (1) factory production control;
  (2) further testing of samples taken at the factory by the manufacturer in accordance with a control plan;

(b) Tasks for the approved body:
  (3) initial type-esting of the product;
  (4) initial inspection of factory and of factory production control;
  (5) continuous surveillance, assessment and approval of factory production control.

Note: Approved bodies are also referred to as "notified bodies".

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7 The technical documentation of this European technical approval is deposited at the Deutsches Institut für Bautechnik and, as far as relevant for the tasks of the approved bodies involved in the attestation of conformity procedure, is handed over to the approved bodies.

8 Official Journal of the European Communities L 254 of 08.10.1996

3.2 Responsibilities

3.2.1 Tasks for the manufacturer

3.2.1.1 Factory production control

The manufacturer shall exercise permanent internal control of production. All the elements, requirements and provisions adopted by the manufacturer shall be documented in a systematic manner in the form of written policies and procedures, including records of results performed. This production control system shall insure that the product is in conformity with this European technical approval.

The manufacturer may only use initial/raw/constituent materials stated in the technical documentation of this European technical approval.

The factory production control shall be in accordance with the control plan which is part of the technical documentation of this European technical approval. The control plan is laid down in the context of the factory production control system operated by the manufacturer and deposited with Deutsches Institut für Bautechnik.[9]

The results of factory production control shall be recorded and evaluated in accordance with the provisions of the control plan.

3.2.1.2 Other tasks for the manufacturer

The manufacturer shall, on the basis of a contract, involve a body which is approved for the tasks referred to in section 3.1 in the field of anchors in order to undertake the actions laid down in section 3.2.2 For this purpose, the control plan referred to in sections 3.2.1.1 and 3.2.2 shall be handed over by the manufacturer to the approved body involved.

The manufacturer shall make a declaration of conformity, stating that the construction product is in conformity with the provisions of this European technical approval.

3.2.2 Tasks for the approved bodies

The approved body shall perform the

- initial type-testing of the product,
- initial inspection of factory and of factory production control,
- continuous surveillance, assessment and approval of factory production control,

in accordance with the provisions laid down in the control plan.

The approved body shall retain the essential points of its actions referred to above and state the results obtained and conclusions drawn in a written report.

The approved certification body involved by the manufacturer shall issue an EC certificate of conformity of the product stating the conformity with the provisions of this European technical approval.

In cases where the provisions of the European technical approval and its control plan are no longer fulfilled the certification body shall withdraw the certificate of conformity and inform Deutsches Institut für Bautechnik without delay.

[9] The control plan is a confidential part of the European technical approval and only handed over to the approved body involved in the procedure of attestation of conformity. See section 3.2.2.

3.3 CE marking

The CE marking shall be affixed on each packaging of the anchor. The letters "CE" shall be followed by the identification number of the approved certification body, where relevant, and be accompanied by the following additional information:

- the name and address of the holder of the approval (legal entity responsible for the manufacture),
- the last two digits of the year in which the CE marking was affixed,
- the number of the EC certificate of conformity for the product,
- the number of the European technical approval,
- the number of the guideline for European technical approval
- use category (ETAG 001-1, Option 7)
- size

4 Assumptions under which the fitness of the product for the intended use was favourably assessed

4.1 Manufacturing

The European technical approval is issued for the product on the basis of agreed data/information, deposited with Deutsches Institut für Bautechnik, which identifies the product that has been assessed and judged. Changes to the product or production process, which could result in this deposited data/information being incorrect, should be notified to Deutsches Institut für Bautechnik before the changes are introduced. Deutsches Institut für Bautechnik will decide whether or not such changes affect the approval and consequently the validity of the CE marking on the basis of the approval and if so whether further assessment or alterations to the approval shall be necessary.

4.2 Design of anchorages

The fitness of the anchor for the intended use is given under the following conditions:

The anchorages are designed in accordance with the EOTA Technical Report TR 029 "Design of bonded anchors"[10] 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.).

4.3 Installation of anchors

The fitness for use of the anchor can only be assumed if the anchor is installed as follows:

- 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 tools indicated in the technical documentation of this European technical approval,

10 The Technical Report TR 029 "Design of Bonded Anchors" is published in English on EOTA website www.eota.eu.

- commercial standard threaded rods, washers and hexagon nuts may also be used if the following requirements are fulfilled:
  - material, dimensions and mechanical properties of the metal parts according to the specifications given in Annex 2, Table 2,
  - confirmation of material and mechanical properties of the metal parts by inspection certificate 3.1 according to EN 10204:2004, the documents should be stored,
  - marking of the threaded rod with the envisage embedment depth. This may be done by the manufacturer of the rod or the person on jobsite.
- checks before placing the anchor to ensure that the strength class of the concrete in which the anchor is to be placed is in the range given and is not lower than that of the concrete to which the characteristic loads apply,
- check of concrete being well compacted, e.g. without significant voids,
- marking and keeping the effective anchorage depth,
- edge distance and spacing not less than the specified values without minus tolerances,
- positioning of the drill holes without damaging the reinforcement,
- drilling by hammer drilling or compressed air drilling,
- in case of aborted drill hole: the drill hole shall be filled with mortar,
- the anchor must not be installed in flooded holes,
- anchor installation in accordance with manufacturers installation instructions (Annex 4)
- the anchor component installation temperature shall be at least +5 °C; during curing of the chemical mortar the temperature of the concrete must not fall below -5 °C; observing the curing time according to Annex 3, Table 4 until the anchor may be loaded,
- installation torque moments are not required for functioning of the anchor. However, the torque moments given in Annex 3, Table 5 must not be exceeded.

5 Indications to for the manufacture

5.1 Responsibility of the manufacturer

It is in the responsibility of the manufacturer to ensure that the information on the specific conditions according to 1 and 2 including Annexes referred to and 4.2 and 4.3 is given to those who are concerned. This information may be made by reproduction of the respective parts of the European technical approval. In addition all installation data shall be shown clearly on the package and/or on an enclosed instruction sheet, preferably using illustration(s).

The minimum data required are:

- drill bit;
- hole depth;
- diameter of anchor rod;
- minimum effective anchorage depth;
- information on the installation procedure, including cleaning of the hole with the cleaning equipments, preferably by means of an illustration;
- anchor component installation temperature;
- material and property class of metal parts acc. to Annex 2, Table 2,

- ambient temperature of the concrete during installation of the anchor;
- admissible processing time (open time) of a cartridge;
- curing time until the anchor may be loaded as a function of the ambient temperature in the concrete during installation;
- torque moment;
- identification of the manufacturing batch.

All data shall be presented in a clear and explicit form.

5.2 Recommendations concerning packaging, transport and storage

The injection cartridges shall be protected against sun radiation and shall be stored according to the manufacture's installation instructions in dry condition at temperatures of at least +5 °C to not more than +25 °C.

Mortar cartridges with expired shelf life must no longer be used.

The Anchor shall only be packaged and supplied as a complete unit. Injection cartridges and the elements for in-place anchorages being packed separately from anchor rods, nuts and washers or internal threaded anchor.

Dipl.-Ing. Georg Feistel
Head of Division Construction Engineering
of Deutsches Institut für Bautechnik
Berlin, 9 July 2010

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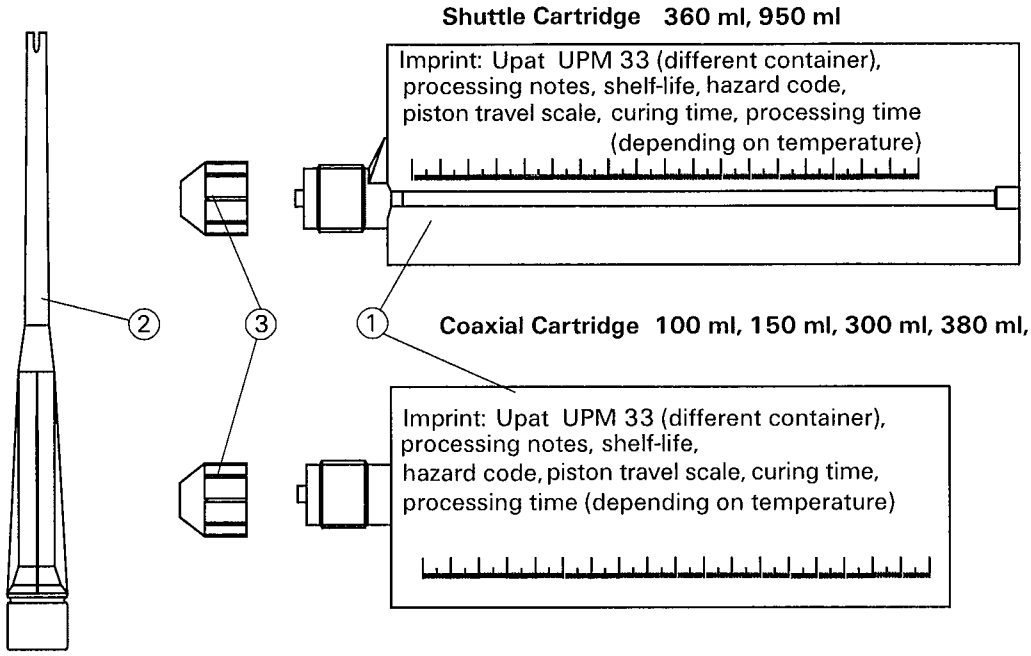
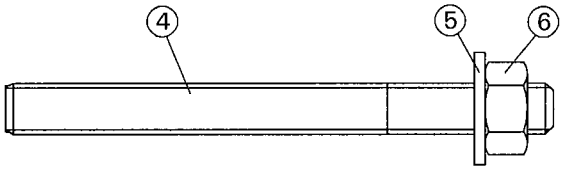
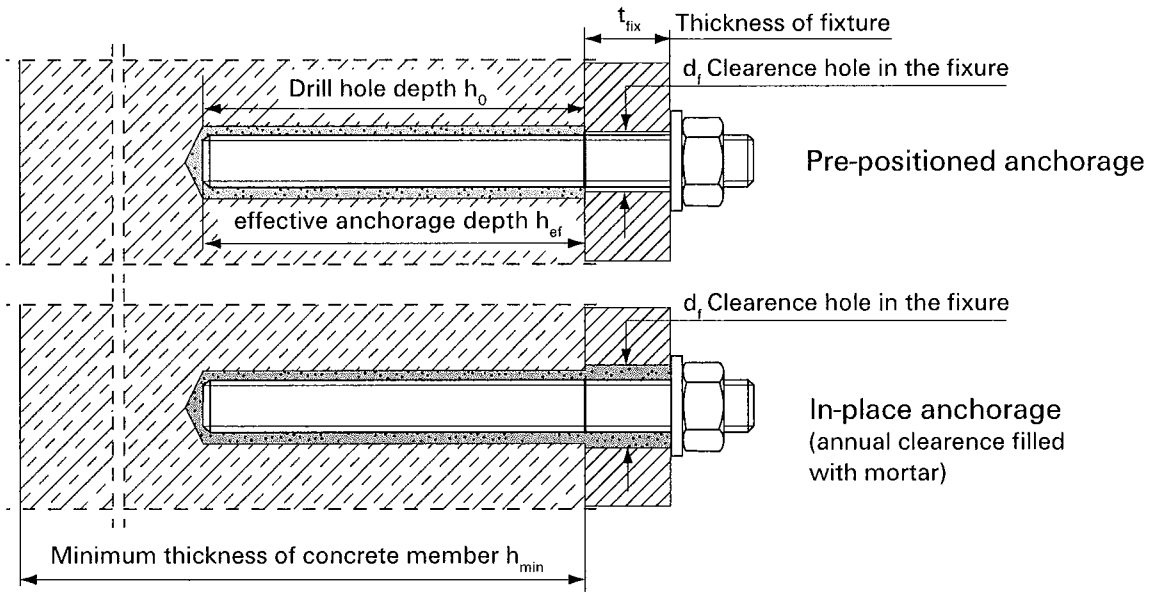




1 Cartridge UPM 33
2 Static mixer
3 Sealing cap
4 Anchor rod
5 Washer
6 Hexagon nut



Intended use in dry and wet concrete

Injection system Upat UPM 33	**Annex 1** of European Technical Approval ETA-10/0171
Product and intented use	

Doc: UPM 33.03.10

Anchor rod M8, M10, M12, M16, M20, M24, M30

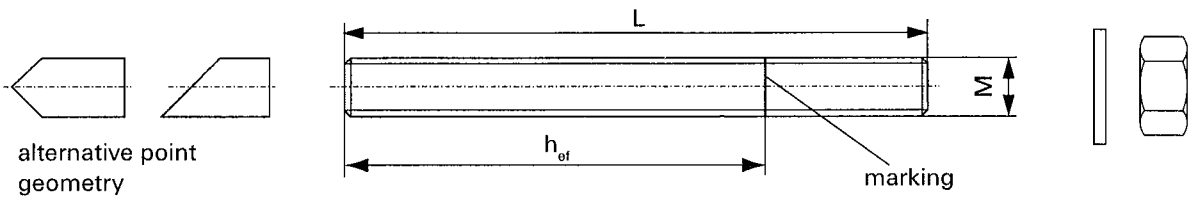


Table 1: Anchor dimensions

Size			M8	M10	M12	M16	M20	M24	M30
Effective anchorage depth h_{ef}	$h_{ef\,min}$	[mm]	64	80	96	125	160	192	240
	$h_{ef\,max}$	[mm]	96	120	144	192	240	288	360
Length of threaded rod L	L_{min}	[mm]	75	95	115	150	190	230	280
	L_{max}	[mm]	1500						

Table 2: Materials

Designation	Materials	
	Steel, zinc plated	**Stainless steel (A4)**
Anchor rod	Property class 5.8 or 8.8; EN ISO 898-1 zinc plated ≥ 5µm, EN ISO 4042 A2K or hot-dip galvanised ≥ 45 µm, EN ISO 10684	Property class 70 EN ISO 3506 EN 10 088 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362
Washer	EN ISO 898-1 zinc plated ≥ 5µm, EN ISO 4042 A2K or hot-dip galvanised ≥ 45 µm, EN ISO 10684	EN 10 088 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362
Hexagon nut according to EN 24 032	Property class 5 or 8; EN ISO 20898-2 zinc plated ≥ 5µm, EN ISO 4042 A2K or hot-dip galvanised ≥ 45 µm, EN ISO 10684	Property class 70 EN ISO 3506 EN 10 088 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362

Table 3: Temperatur ranges

Temperature range	max long term temperature	max short term temperature
I (-40°C to +80°C)	+50°C	+80°C
II (-40°C to +120°C)	+72°C	+120°C

Injection system Upat UPM 33	**Annex 2** of European Technical Approval ETA-10/0171
Anchor dimensions Materials Temperature ranges	

Table 4: Processing time of the mortar and minimum curing time

(During the curing time of the mortar the concrete temperature may not fall below the listed minimum temperature).

Concrete temperature [°C]	Minimum curing time[1] [minutes]
-5 to 0	24 hours
≥0 to +5	3 hours
≥+5 to +10	90
≥+10 to +20	60
≥+20 to +30	45
≥+30 to +40	35

System-temperature (mortar) [°C]	Processing time [minutes]
+ 5	13
+ 10	9
+ 20	5
+ 30	4
+ 40	2

[1] For wet concrete the curing time must be doubled.

Table 5: Installation parameters

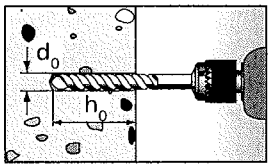
Size			**M 8**	**M 10**	**M 12**	**M 16**	**M 20**	**M 24**	**M 30**
Nominal drill hole diameter		d_0 = [mm]	10	12	14	18	24	28	35
Cutting diameter of drill bit		$d_{cut} \leq$ [mm]	10,45	12,50	14,50	18,50	24,55	28,55	35,70
Depth of drill hole for	$h_{ef\,min}$	$h_0 \geq$ [mm]	64	80	96	125	160	192	240
Depth of drill hole for	$h_{ef\,max}$	$h_0 \geq$ [mm]	96	120	144	192	240	288	360
Diameter of clearance hole in the fixture	Pre-positioned anchorage	$d_f \leq$ [mm]	9	12	14	18	22	26	33
	In-place anchorage	$d_f \leq$ [mm]	11	14	16	20	26	30	40
Diameter of steel brush		d_b = [mm]	11	13	16	20	26	30	40
Torque moment		$T_{inst,max}$ = [Nm]	10	20	40	60	120	150	300
Thickness of fixture	t_{fix}	min [mm]	0						
		max [mm]	1.500						

Steel brush

Injection system Upat UPM 33	**Annex 3** of European Technical Approval ETA-10/0171
Processing time and curing time Installation parameters Steel brush	

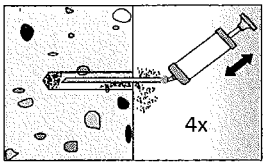
Drilling and cleaning the hole

1



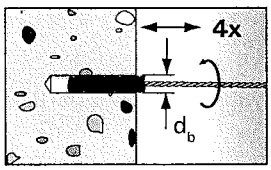
Drill the hole.
Drill hole diameter $\mathbf{d_0}$ and
drill hole depth $\mathbf{h_0}$ see **Table 5**.

2



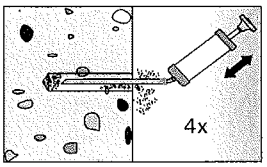
Blow out the drill hole four times. For drill hole diameter $d_0 \geq 18$ mm and drill hole depth $h_0 \geq 150$ mm use oil-free pressure air (P > 6 bar).

3



Brush the drill hole four times, using a steel brush. Diameter of steel brush see **Table 5**. For deep holes use an extension.

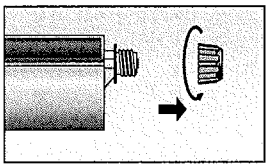
4



Blow out the drill hole four times. For drill hole diameter $d_0 \geq 18$ mm and drill hole depth $h_0 \geq 150$ mm use oil-free pressure air (P > 6 bar).

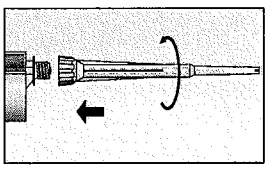
Preparing the cartridge

5



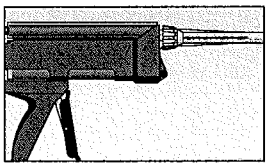
Remove the sealingcap.

6



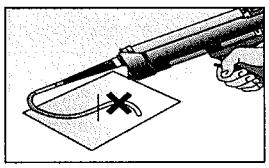
Screw down the static mixer. (the spiral mixer in the statik mixer must be clearly visible)

7



Place the cartridge into the applicator gun.

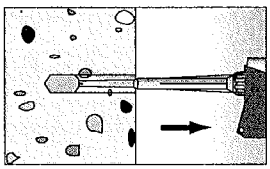
8



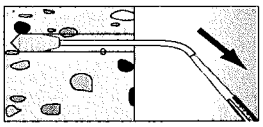
Press approx 10 cm of material out until the resin is evenly grey in colour. Don`t use mortar that is not uniformly gray.

Install the anchor rod

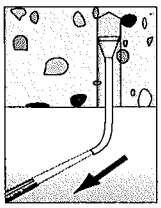
9



Fill approx. 2/3 of the drill hole with mortar. Allways begin from the surface of the hole and avoid bubbles.

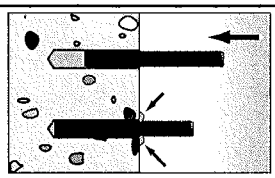


For $h_0 \geq 150$ mm use an extention hose.

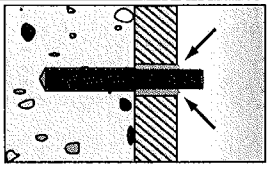


For overhead installation or deep holes $h_0 > 250$ mm use an injectionadapter.

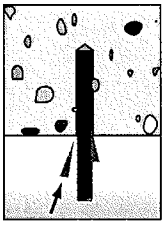
10



Only use clean and oil-free anchors. Mark the anchor for setting depth. Press the anchor rod down to the bottom of the hole, turning it slightly while doing so. Inserting the anchor element, excess mortar must emerge from the mouth of the hole.



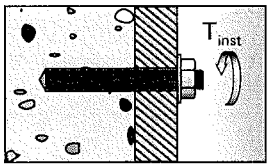
For in-place anchorage fill the annual clearence with mortar.



For overhead installation support the anchor-rod with wedges.

11

Wait for the specified curing time, t_{cure} see **Table 4**



Mounting the fixure.
$T_{inst,max}$ see **Table 5**

Injection system Upat UPM 33	**Annex 4** of European Technical Approval ETA-10/0171
Installation instructions	

Table 6: Minimum distances and member thickness

Anchor size		M8		M10		M12		M16		M20		M24		M30	
	[2]	$h_{ef,min}$	$h_{ef,max}$	$h_{ef,min}$	$h_{ef,max}$	$h_{ef,min}$	$h_{ef,max}$	$h_{ef,min}$	$h_{ef,max}$	$h_{ef,min}$	$h_{ef,max}$	$h_{ef,min}$	$h_{ef,max}$	$h_{ef,min}$	$h_{ef,max}$
Effective anchorage depth[1]	h_{ef} [mm]	64	96	80	120	96	144	125	192	160	240	192	288	240	360
Minimum thickness of concrete member	h_{min} [mm]	h_{ef} + 30 mm ≥ 100 mm						h_{ef} + 2 d_0							
Minimum edge distance and spacing	min s = min c [mm]	40		45		55		65		85		105		140	

[1] Anchorage depth $h_{ef,min} \le h_{ef} \le h_{ef,max}$ is possible. The minimum member thickness may be interpolate straight proportional.

[2] $h_{ef,min} < h_{ef} < h_{ef,max}$ is possible

Table 7: Characteristic values to tension loads

Steel failure										
Anchor size			M8	M10	M12	M16	M20	M24	M30	
Characteristic resistance	$N_{Rk,s}$	property class 5.8 [kN]	19	30	44	82	127	183	292	
		property class 8.8 [kN]	29	46	67	126	196	282	449	
		property class A4 [kN]	26	41	59	110	171	247	392	
		property class 70 C [kN]	26	41	59	110	171	247	392	
Partial safety factor	γ_{Ms} [1]	property class 5.8 [-]	1,48							
		property class 8.8 [-]	1,50							
		property class A4 [-]	1,87							
		property class 70 C [-]	1,50							
Combined pullout and concrete failure										
Diameter for calculation		d [mm]	8	10	12	16	20	24	30	
Effective anchorage depth[3]	h_{ef}	$h_{ef,min}$ [mm]	64	80	96	125	160	196	240	
		$h_{ef,max}$ [mm]	96	120	144	192	240	288	360	
Temperature range I (-40°C/+80°C), non-cracked concrete C20/25										
Characteristic bond resistance	$\tau_{Rk,ucr}$	[N/mm²]	10,5	10,5	10,5	10,0	9,5	9,0	8,5	
Edge distance	$c_{cr,Np}$	[mm]	100	125	145	185	225	265	320	
Spacing	$s_{cr,Np}$	[mm]	200	250	290	370	450	530	640	
Temperature range II (-40°C/+120°C), non-cracked concrete C20/25										
Characteristic bond resistance	$\tau_{Rk,ucr}$	[N/mm²]	9,0	9,0	9,0	8,5	8,0	7,5	7,0	
Edge distance	$c_{cr,Np}$	[mm]	95	115	135	170	210	240	290	
Spacing	$s_{cr,Np}$	[mm]	190	230	270	340	420	480	580	
Increasing factors	ψ_c	C25/30 [-]	1,05							
		C30/37 [-]	1,10							
		C35/45 [-]	1,15							
		C40/50 [-]	1,19							
		C45/55 [-]	1,22							
		C50/60 [-]	1,26							
Partial safety factor	$\gamma_{Mc} = \gamma_{Mp}$ [1]	[-]	1,8 [2]							

[1] In absence of other national regulations. [2] The partial safety factor $\gamma_2 = 1,2$ is included.

[3] $h_{ef,min} < h_{ef} < h_{ef,max}$ is possible.

Injection system Upat UPM 33	**Annex 5** of European Technical Approval ETA-10/0171
Minimum distances and minimum member thicknesses Characteristic values to tension load	

Table 8: Characteristic values of splitting failure

Anchor size		M8		M10		M12		M16		M20		M24		M30	
[4]		$h_{ef,min}$	$h_{ef,max}$	$h_{ef,min}$	$h_{ef,max}$	$h_{ef,min}$	$h_{ef,max}$	$h_{ef,min}$	$h_{ef,max}$	$h_{ef,min}$	$h_{ef,max}$	$h_{ef,min}$	$h_{ef,max}$	$h_{ef,min}$	$h_{ef,max}$
	[mm]	64	96	80	120	96	144	125	192	160	240	192	288	240	360
h_{min} [1)3)]	[mm]	h_{ef} + 30 mm ≥ 100 mm						h_{ef} + 2 d_0							
$c_{cr,sp}$	[mm]	160	205	200	260	240	310	315	415	395	515	475	620	590	770
h [2)]	[mm]	128	192	160	240	192	288	250	384	320	480	384	576	480	720
$c_{cr,sp}$	[mm]	120	150	150	185	180	225	240	300	300	370	360	445	450	555

[1] $h_{min} = h_{ef} + \Delta h \geq 100mm$; $\Delta h \geq \max\{2d_0; 30mm\}$

[2] $h \geq 2h_{ef}$

[3] For member thickness $h_{min} \leq h \leq 2h_{ef}$ the characteristic edge distances and spacing can be derived by linear interpolation.

[4] $h_{ef,min} \leq h_{ef} \leq h_{ef,max}$ is possible

Table 9: Characteristic values to shear load

Anchor size				M8	M10	M12	M16	M20	M24	M30
Effective anchorage depth	h_{ef} [2)]	h_{min}	[mm]	64	80	96	125	160	192	240
		h_{max}	[mm]	96	120	144	192	240	288	360
Steel failure without lever arm										
characteristic resistance $V_{Rk,s}$	property class	5.8	[kN]	9,2	14,5	21,1	39,2	61,2	88,2	140,2
		8.8	[kN]	14,6	23,2	33,7	62,8	98,0	141,2	224,4
	property class 70	A4	[kN]	12,8	20,3	29,5	54,8	85,7	123,4	196,2
		C	[kN]	12,8	20,3	29,5	54,8	85,7	123,4	196,2
partial safety factor γ_{Ms} [1)]	property class	5.8	[-]	1,25						
		8.8	[-]	1,25						
	property class 70	A4	[-]	1,56						
		C	[-]	1,25						
Steel failure with lever arm										
characteristisc resistance $M^0_{Rk,s}$	property class	5.8	[Nm]	20	39	68	173	338	583	1169
		8.8	[Nm]	30	60	105	266	519	896	1797
	property class 70	A4	[Nm]	26	52	92	233	454	785	1574
		C	[Nm]	26	52	92	233	454	785	1574
partial safety factor γ_{Ms} [1)]	property class	5.8	[-]	1,25						
		8.8	[-]	1,25						
	property class 70	A4	[-]	1,56						
		C	[-]	1,25						
Concrete pryout										
Factor k in Equation (5.7) of Technical Report TR 029, Section 5.2.3.3			[-]	2,0						
partial safety factor	γ_{Mc} [1)]		[-]	1,5						
Concrete edge failure										
effective length of anchor l_f		h_{min}	[mm]	64	80	96	125	160	192	240
		h_{max}	[mm]	96	120	144	192	240	288	360
effective diameter of anchor		d	[mm]	8	10	12	16	20	24	30
partial safety factor	γ_{Mc} [1)]		[-]	1,5						

[1] In absence of other national regulations.

[2] $h_{ef\,min} \leq h_{ef} \leq h_{ef\,max}$ is possible.

Injection system Upat UPM 33

Characteristic values of splitting failure
Characteristic values to shear loads

Annex 6
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Table 10: Displacements under tension load

Anchor size		M8	M10	M12	M16	M20	M24	M30
Temperature range I -40°C / +80°C		Effective anchorage depth h_{ef} = 8d[1)]						
Tension load in non-cracked concrete	N [kN]	7,7	11,0	15,8	25,5	37,9	51,7	76,3
Displacement	δ_{N0} [mm]	0,2	0,2	0,2	0,2	0,3	0,3	0,3
Displacement	$\delta_{N\infty}$ [mm]	0,6	0,6	0,6	0,6	0,9	0,9	0,9
Temperature range II -40°C /+120°C		Effective anchorage depth h_{ef} = 8d[1)]						
Tension load in non-cracked concrete	N [kN]	6,4	9,5	12,9	21,7	31,9	43,1	62,8
Displacement	δ_{N0} [mm]	0,15	0,15	0,15	0,15	0,25	0,25	0,25
Displacement	$\delta_{N\infty}$ [mm]	0,45	0,45	0,45	0,45	0,75	0,75	0,75

[1)] Values $8d \le h_{ef} \le 12d$ should be calculated:

$\delta_{N0} = \delta_{N01} \frac{h_{ef}}{8d}$ δ_{N01} to h_{ef} 8d

$\delta_{N0} = \delta_{N\infty 1} \frac{h_{ef}}{8d}$ $\delta_{N\infty 1}$ to h_{ef} 8d

Table 11: Displacements under shear load

Anchor size		M8	M10	M12	M16	M20	M24	M30
Temperature range I -40°C /+ 80°C and temperature range II -40°C /+120°C								
Shear load in non-cracked concrete (property class 5.8)	V [kN]	5,1	8,1	11,8	21,9	34,2	49,1	78,3
Displacement	δ_{V0} [mm]	0,9	1,2	1,4	2,0	2,4	2,6	37
Displacement	$\delta_{V\infty}$ [mm]	1,4	1,7	2,1	2,9	3,7	4,1	5,6
Shear load in non-cracked concrete (property class 8.8)	V [kN]	7,0	11,1	16,2	30,1	47,0	67,7	107,7
Displacement	δ_{V0} [mm]	1,2	1,6	1,9	2,8	3,3	3,6	5,1
Displacement	$\delta_{V\infty}$ [mm]	1,9	2,3	2,9	4,0	5,1	5,6	7,7
Shear load in non-cracked concrete (property class 70 / A4)	V [kN]	5,9	9,3	13,5	25,2	39,3	56,4	89,9
Displacement	δ_{V0} [mm]	1,0	1,3	1,6	2,2	2,8	3,4	4,3
Displacement	$\delta_{V\infty}$ [mm]	1,6	2,0	2,4	3,4	4,2	5,6	6,4
Shear load in non-cracked concrete (property class 70 / C)	V [kN]	7,3	11,6	16,9	31,4	49,0	70,4	112,2
Displacement	δ_{V0} [mm]	1,3	1,7	2,0	2,8	3,5	4,2	5,3
Displacement	$\delta_{V\infty}$ [mm]	2,0	2,5	3,0	4,2	5,3	6,3	8,0