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Zulassungsstelle für Bauprodukte und Bauarten
Bautechnisches Prüfamt
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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)

Deutsches Institut für Bautechnik

DIBt

Mitglied der EOTA
Member of EOTA

European Technical Approval ETA-02/0022

English translation prepared by DIBt - Original version in German language

Handelsbezeichnung *Trade name*		Injektionsanker System Upat UPM 44 *Injection anchor system Upat UPM 44*
Zulassungsinhaber *Holder of approval*		fischerwerke GmbH & Co. KG Otto-Hahn-Straße 15 79211 Denzlingen DEUTSCHLAND
Zulassungsgegenstand und Verwendungszweck *Generic type and use of construction product*		Verbunddübel in den Größen M6 bis M30 zur Verankerung im ungerissenen Beton *Bonded anchor in the size of M6 to M30 for use in non-cracked concrete*
Geltungsdauer: *Validity:*	vom *from* bis *to*	22 February 2008 29 October 2012
verlängert *extended*	vom *from* bis *to*	30 October 2012 30 October 2017
Herstellwerk *Manufacturing plant*		fischerwerke

Diese Zulassung umfasst *This Approval contains*	38 Seiten einschließlich 29 Anhänge *38 pages including 29 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 Article 2 of the law of 8 November 2011[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 2011*, p. 2178
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 product/ products and intended use

1.1 Definition of the construction product

The Injection anchor system UPM 44 is a bonded anchor (injection type) consisting of a mortar cartridge with injection mortar UPM 44, UPM 44 Relax or UPM 44 Express and a steel element. The steel elements are either

- Upat anchor rods in the range of M6 to M30 or
- Upat internal threaded anchor IST in the range of M8 to M20 or
- Reinforcing bar in the range of Ø 8 to Ø 28 or
- Upat rebar anchor FRA in the range of 12 to 24.

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 Annexes 1 and 2.

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. The internal threaded anchor RG MI and the fischer-anchor rod in the range of M12 to M30 with coaxial cartridges of sizes 380 ml, 400 ml and 410 ml may be installed in flooded holes excepting sea water.

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.

Elements made of stainless steel A4:

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).

Elements made of high corrosion resistant steel C:

The element made of high corrosion resistant steel may be used in structures subject to dry internal conditions and also in structures subject to external atmospheric exposure, in permanently damp internal conditions or in other particular aggressive conditions. 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 chemical pollution (e.g. in desulphurization plants or road tunnels where de-icing materials are used).

Elements made of reinforcing bars:

Post-installed reinforcing bars may only be used as anchors. Such applications are e.g. concrete overlay or shear dowel connections or the connections of a wall predominantly loaded by shear and compression forces with the foundation, where the reinforcing bars act as dowels to take up shear forces. Connections with post-installed reinforcing bars in concrete structures designed in accordance with EN1992-1-1: 2004 are not covered by this European technical approval.

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 7. The characteristic material values, dimensions and tolerances of the anchor not indicated in Annexes 1 to 7 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 10 to 29.

The two components of the Upat injection mortar UPM 44, UPM 44 Relax or UPM 44 Express are delivered in unmixed condition in shuttle cartridges or in coaxial cartridges according to Annex 1. Each cartridge is marked with the imprint "UPM 44", "UPM 44 Relax" or "UPM 44 Express" with processing notes, shelf life, curing time, processing time (depending on temperature), hazard code.

[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.

Each Upat anchor rod is marked with the property class in accordance with Annex 3.

Each Upat internal threaded anchor IST is marked with the marking of steel grade and length in accordance with Annex 4. Each Upat internal threaded anchor IST made of stainless steel is marked with the additional letter "A4". Each Upat internal threaded anchor IST made of high corrosion resistant steel is marked with the additional letter "C".

Each Upat rebar anchor FRA is marked with the identifying mark of the producer and the trade name according to Annex 7.

Elements made of reinforcing bars shall comply with the specifications given in Annex 6.

The marking of embedment depth may be done on jobsite.

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 prescribed control plan;

(b) Tasks for the approved body:
  (3) initial type-testing 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".

[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.

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 producer (legal entity responsible for the manufacture),
- the last two digits of the year in which the CE marking was affixed,

[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.

- 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]

or in accordance with the

- CEN/TS 1992-4-5 "Design of fastenings for use in concrete", Part 4-5: "Post-installed fasteners - Chemical systems",

under the responsibility of an engineer experienced in anchorages and concrete work.

Post-installed reinforcing bars may only be used as anchors. The basic assumptions for the design according to anchor theory shall be observed. This includes the consideration of tension and shear loads and the corresponding failure modes as well as the assumption that the base material (concrete structural element) remains essentially in the serviceability limit state (either non-cracked or cracked) when the connection is loaded to failure. Such applications are e.g. concrete overlay or shear dowel connections or the connections of a wall predominantly loaded by shear and compression forces with the foundation, where the reinforcing bars act as dowels to take up shear forces. Connections with reinforcing bars in concrete structures designed in accordance with EN 1992-1-1:2004 (e.g. connection of a wall loaded with tension forces in one layer of the reinforcement with the foundation) are not covered by this European technical approval.

For the Upat internal threaded anchor IST fastening screws or threaded rods made of appropriate steel and strength class acc. to Annex 5 shall be specified. The minimum and maximum thread engagement length l_E of the fastening screw or the threaded rod for installation of the fixture shall be met the requirements according to Annex 4, Table 2. The length of the fastening screw or the threaded rod shall be determined depending on thickness of fixture, admissible tolerances, available thread length and minimum and maximum thread engagement length l_E.

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

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,
- 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 5, Table 3,
  - 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.
- reinforcing bars shall comply with specifications given in Annex 6,
- 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 may be installed in dry or wet concrete. The internal threaded anchor RG MI and the fischer-anchor rod in the range of M12 to M30 with coaxial cartridges of sizes 380 ml, 400 ml and 410 ml may be installed in flooded holes excepting sea water,
- cleaning the drill hole and installation in accordance with Annexes 8 and 9,
- the anchor component installation temperature shall be at least 0 °C (UPM 44 Express) and +5 °C (UPM 44 and UPM 44 Relax); during curing of the chemical mortar the temperature of the concrete must not fall below -5 °C (UPM 44, UPM 44 Express) and 0 °C (UPM 44 Relax); observing the curing time according to Annex 5, Table 4 until the anchor may be loaded,
- for installation in bore holes h_0 > 150 mm extension hoses acc. Annex 1 shall be used,
- Fastening screw or threaded rods (including nut and washer) must comply with the appropriate material and strength class of the Upat internal threaded anchor IST,

- installation torque moments are not required for functioning of the anchor. However, the torque moments given in Annexes 3 to 7 must not be exceeded.

5 Indications to 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 as well as sections 4.2, 4.3 and 5.2 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 5, Table 3,
- 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,
- maximum 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.

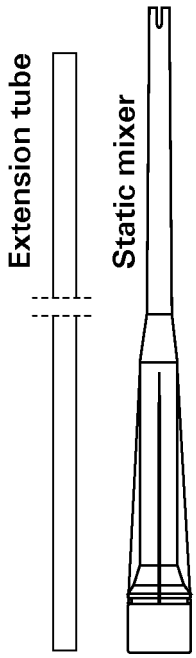
Mortar cartridges with expired shelf life must no longer be used.

The anchor shall only be packaged and supplied as a complete unit. Mortar cartridges may be packed separately from metal parts.

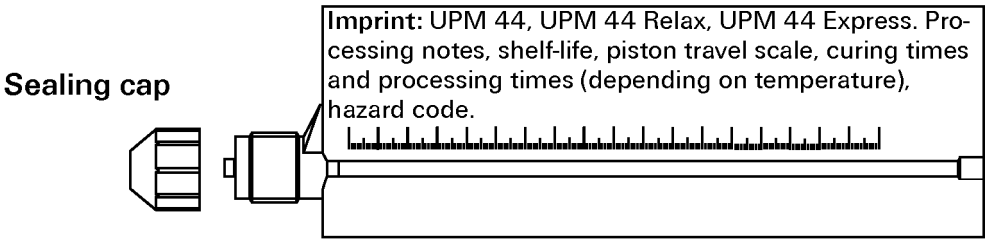
Georg Feistel
Head of Department

beglaubigt:
Baderschneider

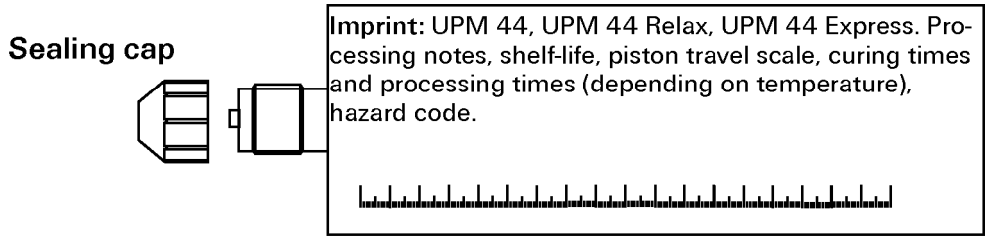
Deutsches Institut für Bautechnik DIBt



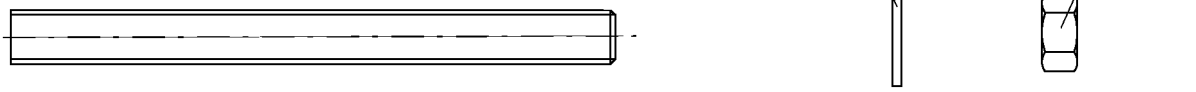
Shuttle cartridge
(Sizes: 345 ml; 360 ml; 390 ml; 950 ml; 1100 ml; 1500 ml)



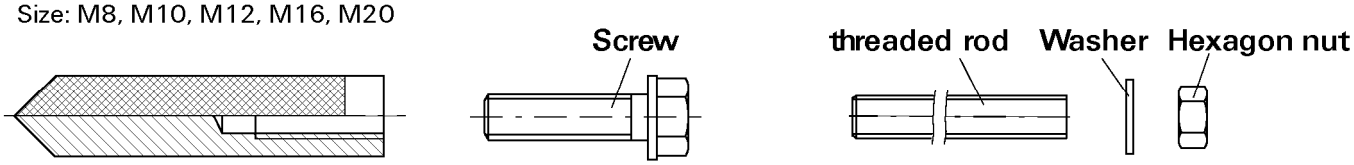
Coaxial cartridge
(Sizes: 100 ml; 150 ml; 300 ml; 380 ml; 400 ml; 410 ml)



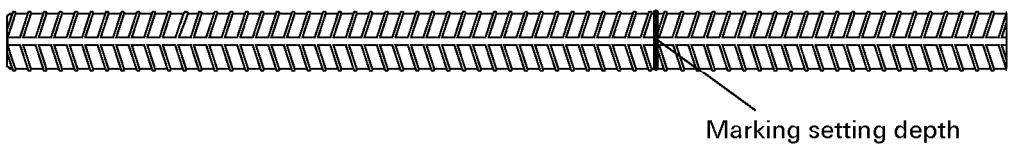
Upat anchor rod
Size: M6, M8, M10, M12, M16, M20, M24, M30



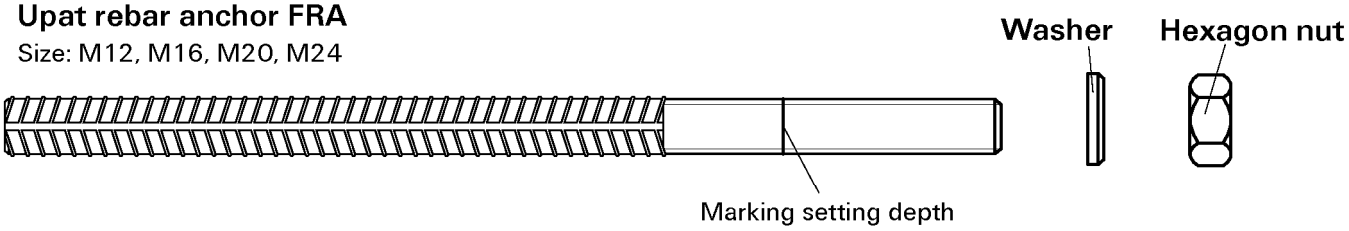
Upat internal threaded anchor IST
Size: M8, M10, M12, M16, M20



Reinforcing bar
Size: Ø8, Ø10, Ø12, Ø14, Ø16, Ø20, Ø25, Ø28



Upat rebar anchor FRA
Size: M12, M16, M20, M24



Injection anchor system UPM 44	Annex 1
Product	

Deutsches Institut für Bautechnik

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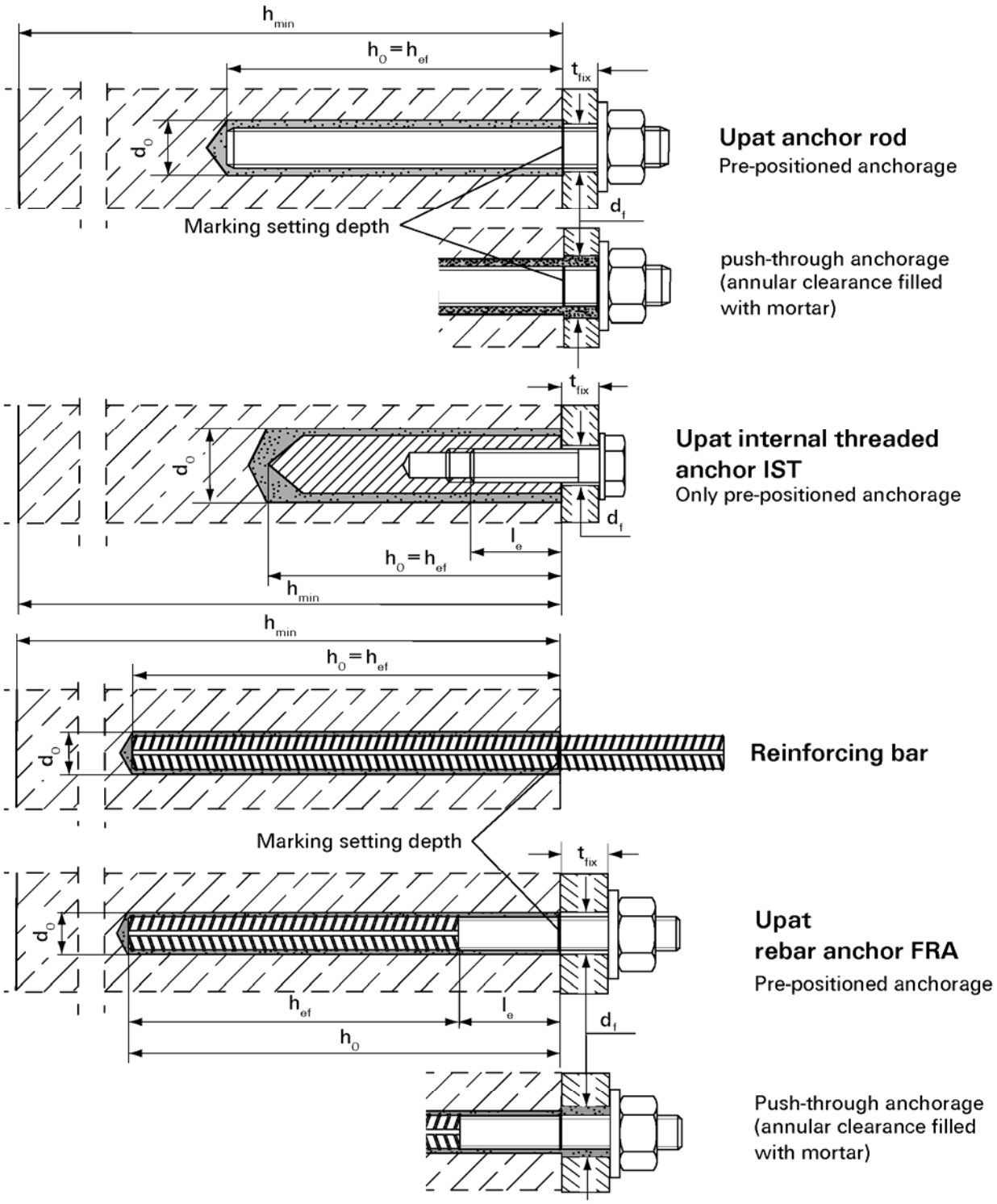


Upat anchor rod
Pre-positioned anchorage

push-through anchorage
(annular clearance filled
with mortar)

Upat internal threaded anchor IST
Only pre-positioned anchorage

Reinforcing bar

Upat
rebar anchor FRA
Pre-positioned anchorage

Push-through anchorage
(annular clearance filled
with mortar)

Injection anchor system UPM 44	Annex 2
Intended Use	

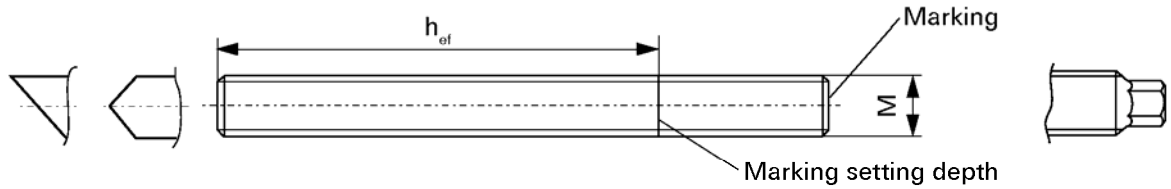
Deutsches Institut für Bautechnik DIBt

Table 1: Installation parameters Upat anchor rods

Size of anchor			[-]	M6	M8	M10	M12	M16	M20	M24	M30
Nominal drill bit diameter		d_0	[mm]	8	10	12	14	18	24	28	35
Drill hole depth		h_0	[mm]	$h_0 = h_{ef}$							
Effective anchorage depth		$h_{ef,min}$	[mm]	50	60	60	70	80	90	96	120
		$h_{ef,max}$	[mm]	72	160	200	240	320	400	480	600
Minimum spacing and minimum edge distance		$s_{min} = c_{min}$	[mm]	40	40	45	55	65	85	105	140
Diameter of clearance hole in the fixture [1]	pre-positioned anchorage	d_f	[mm]	7	9	12	14	18	22	26	33
	push-through anchorage	d_f	[mm]	9	11	14	16	20	26	30	40
Minimum thickness of concrete member		h_{min}	[mm]	h_{ef} + 30 (≥100)				h_{ef} + 2d_0			
Maximum torque moment		$T_{inst,max}$	[Nm]	5	10	20	40	60	120	150	300
Thickness of fixture		$t_{fix,min}$	[mm]	0							
		$t_{fix,max}$	[mm]	3000							

[1] For bigger clearance holes in fixture see chapter 1.1 of the TR 029.

Upat anchor rod



Marking:

Property class 8.8 or high corrosion-resistant steel C, property class 80: •
Stainless steel A4, property class 50 and high corrosion-resistant steel C, property class 50: • •

Application range and intended use

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

Intended use	dry concrete	wet concrete	flooded hole [1]
Anchor rods	M8 – M30		M12 – M30
Internal threaded anchors RG MI	M8 – M20		

[1] Only coaxial cartridge 380 ml, 400 ml and 410 ml.

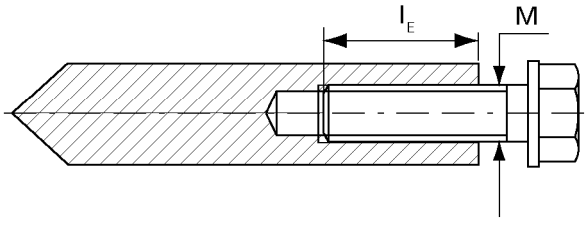
Injection anchor system UPM 44	**Annex 3**
Upat anchor rods Installation parameters and dimensions **Application range and intended use**	

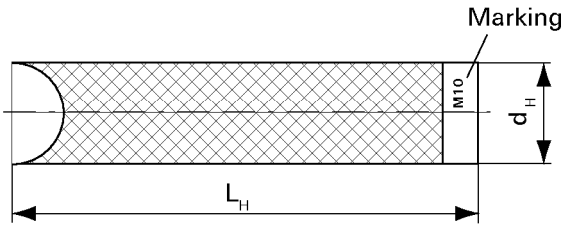
Deutsches Institut für Bautechnik DIBt

Table 2: Installation parameters for Upat internal threaded anchors IST

Size of anchor		M8	M10	M12	M16	M20
Diameter of anchor	d_H [mm]	12	16	18	22	28
Nominal drill bit diameter	d_O [mm]	14	18	20	24	32
Length of anchor	L_H [mm]	90	90	125	160	200
Effective anchorage depth h_{ef} and drill hole depth h_O	$h_{ef} = h_O$ [mm]	90	90	125	160	200
Minimum spacing and edge distance	$s_{min} = c_{min}$ [mm]	55	65	75	95	125
Diameter of clearence hole in the fixture	d_f [mm]	9	12	14	18	22
Minimum thickness of concrete member	h_{min} [mm]	120	125	165	205	260
Screw-in depth	$l_{E,min}$ [mm]	8	10	12	16	20
	$l_{E,max}$ [mm]	18	23	26	35	45
Maximum troque moment	$T_{inst,max}$ [Nm]	10	20	40	80	120

Upat internal threaded anchor IST





Marking: anchor size
e.g.: **M10**
Stainless steel additional A4
e.g.: **M10 A4**
High corrosion-resistant steel additional C
e.g.: **M10 C**

Injection anchor system UPM 44	Annex 4
Upat internal threaded anchors IST Installation parameters and dimensions	

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Table 3: Materials: anchor rods, threaded rods, washers, hexagon nuts and screws

Designation	Materials		
	Steel, zinc plated	**Stainless steel A4**	**high corrosion-resistant steel C**
anchor rod	Property class 5.8 or 8.8; EN ISO 898-1 zinc plated ≥ 5µm, EN ISO 4042 A2K or hot-dip galvanised EN ISO 10684 $f_{uk} \leq 1000$ N/mm² $A_5 > 8\%$	Property class 50, 70 or 80 EN ISO 3506 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362 EN 10088 or 1.4062 pr EN 10088:2011 $f_{uk} \leq 1000$ N/mm² $A_5 > 8\%$	Property class 50 or 80 EN ISO 3506 or property class 70 with $f_{yk} = 560$ N/mm² 1.4565; 1.4529 EN 10088 $f_{uk} \leq 1000$ N/mm² $A_5 > 8\%$
Washer EN ISO 7089	zinc plated ≥ 5µm, EN ISO 4042 A2K or hot-dip galvanised EN ISO 10684	1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362 EN 10088	1.4565;1.4529 EN 10088
Hexagon nut according to EN ISO 4032	Property class 5 or 8; EN ISO 898-2 zinc plated ≥ 5µm, EN ISO 4042 A2K or hot-dip galvanised EN ISO 10684	Property class 50, 70 or 80 EN ISO 3506 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362 EN 10088	Property class 50, 70 or 80 EN ISO 3506 1.4565; 1.4529 EN 10088
Screw or threaded rods for internal-threaded anchors IST	Property class 5.8 or 8.8; EN ISO 898-1 zinc plated ≥ 5µm, EN ISO 4042 A2K or hot-dip galvanised EN ISO 10684	Property class 70 EN ISO 3506 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362 EN 10088	Property class 70 EN ISO 3506-1 1.4565; 1.4529 EN 10088

Table 4: Maximum 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).

Temperature at anchoring base	Minimum curing time[1] t_{cure} [minutes]			System-temperature (mortar)	Maximum processing time t_{work} [minutes]		
[°C]	UPM 44 Express	UPM 44	UPM 44 Relax	[°C]	UPM 44 Express	UPM 44	UPM 44 Relax
-5 to ±0	3 hours	24 hours	—	0	5	—	—
>±0 to +5	3 hours	3 hours	6 hours	+ 5	5	13	—
>+5 to +10	50	90	3 hours	+ 10	3	9	20
>+10 to +20	30	60	2 hours	+ 20	1	5	10
>+20 to +30	—	45	60	+ 30	—	4	6
>+30 to +40	—	35	30	+ 40	—	2	4

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

Injection anchor system UPM 44	Annex 5
Materials Processing time and curing time	

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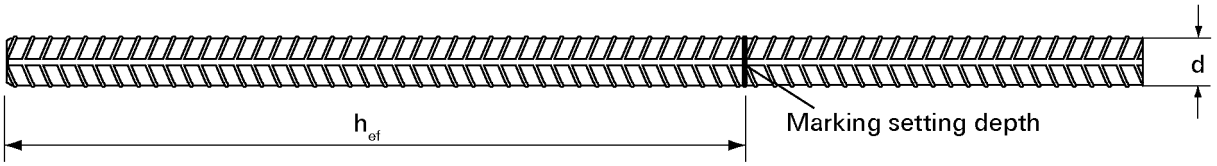
Table 5: Installation parameters reinforcing bars

Rebar diameter d [mm]	8[1)]	10[1)]	12[1)]		14	16	20	25	28
Nominal drill bit diameter d_0 [mm]	(10)12	(12)14	(14)	16	18	20	25	30	35
Drill hole depth h_0 [mm]	$h_0 = h_{ef}$								
Effective anchorage depth $h_{ef,min}$ [mm]	60	60	70		75	80	90	100	112
Effective anchorage depth $h_{ef,max}$ [mm]	160	200	240		280	320	400	500	560
Minimum spacing and minimum edge distance $s_{min} = c_{min}$ [mm]	40	45	55		60	65	85	110	130
Minimum thickness of concrete member h_{min} [mm]	$h_{ef} + 30 \geq 100$			$h_{ef} + 2d_0$					

[1)] Both drill bit diameters can be used

Reinforcing bar



Properties of reinforcement: refer to EN 1992-1-1 Annex C, Table C.1 and C.2N

Produkt form		Non-zinc-plated bars and de-coiled rod	
Class		B	C
Characteristic yield strength f_{yk} or $f_{0,2k}$ [MPa]		400 to 600	
Minimum value of $k = (f_t / f_{yk})$		≥ 1,08	≥ 1,15 < 1,35
Characteristic strain at maximum force ε_{uk} [%]		≥ 5,0	≥ 7,5
Bendability property		Bend / Rebendtest	
Maximum deviation from nominal mass (individual bar) [%]	Nominal bar size [mm] ≤ 8 > 8	± 6,0 ± 4,5	
Bond: Minimum relative rib area, $f_{R,min}$ (determination according to EN 15630)	Nominal bar size [mm] 8 to 12 > 12	0,040 0,056	

Rib height h: The rib height h must be: $0,05 \cdot d \leq h \leq 0,07 \cdot d$ d = nominal bar size

Injection anchor system UPM 44	
Reinforcing bars Installation parameters Materials	Annex 6

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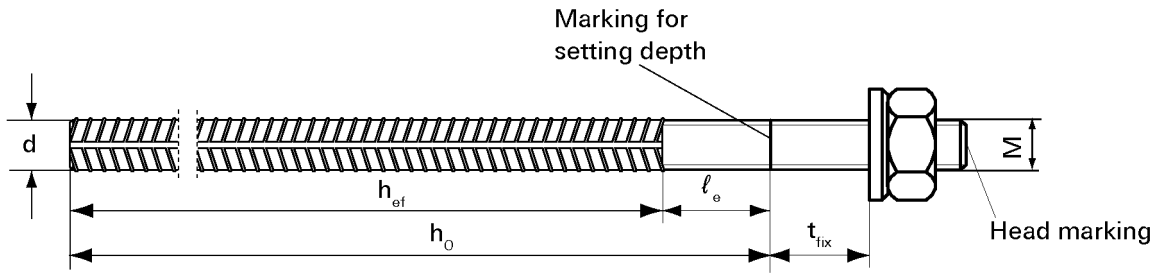
Table 6: Installation parameters Upat rebar anchors FRA

Threaded diameter				M 12[1]		M 16	M 20	M 24
Nominal bar size		d	[mm]	12		16	20	25
Nominal drill bit diameter		d_0	[mm]	(14)	16	20	25	30
Drill hole depth	($h_0 = \ell_{e,ges}$)	h_0	[mm]	$h_{ef} + \ell_e$				
Effective anchorage depth		$h_{ef,min}$	[mm]	70		80	90	96
		$h_{ef,max}$	[mm]	140		220	300	380
Distance concrete surface to welded join		ℓ_e	[mm]	100				
Minimum spacing and minimum edge distance		$s_{min} = c_{min}$	[mm]	55		65	85	105
Clearance hole in the fixture [2]	pre-positioned anchorage	d_f	[mm]	14		18	22	26
	push-through anchorage	d_f	[mm]	18		22	26	32
Minimum thickness of concrete member		h_{min}	[mm]	$h_{ef}+30$ ≥ 100		h_0+2d_0		
Maximum torque moment		$T_{inst,max}$	[Nm]	40		60	120	150
Thickness of fixture	minimum	t_{fix}	[Nm]	0				
	maximum	t_{fix}	[Nm]	3000				

[1] Both drill bit diameter can be used
[2] For bigger clearance holes in the fixture see chapter 1.1 of the TR 029.

Upat rebar anchor FRA



Head marking e.g.: FRA (for stainless steel);
FRA C (for high corrosion-resistant steel)

Injection anchor system UPM 44	Annex 7
Upat rebar anchor FRA Installation parameters	

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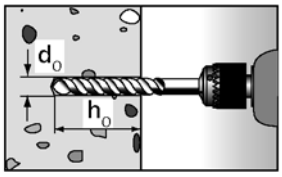
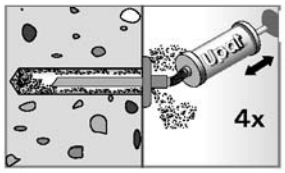
Drilling and cleaning the hole

1

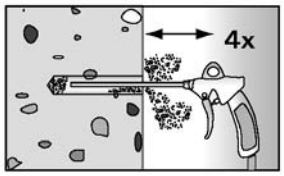


Drill the hole.
Drill hole diameter d_0 and drill hole depth h_0
see **Table 1.**

2

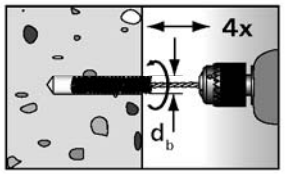


$h_{ef} \leq 12d$; $d_0 < 18$mm:
Blow out the drill hole four times by hand.



$h_{ef} > 12d$; $d_0 \geq 18$mm:
Blow out the drill hole four times, using oil-free pressure air (p > 6 bar).

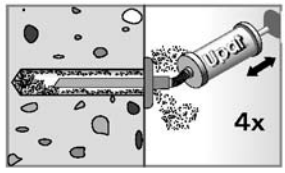
3



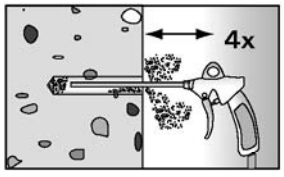
Brush the drill hole four times using a adequate steel brush and a drill machine. For deep drill holes use an extension.

d_0 [mm]	8	10	12	14	16	18	20	24	25	28	30	35
d_b [mm]	9	11	14	16	20	20	25	26	27	30	40	40

4



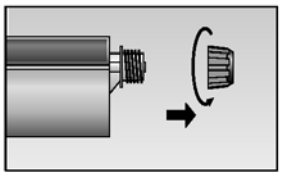
$h_{ef} \leq 12d$; $d_0 < 18$mm:
Blow out the drill hole four times by hand.



$h_{ef} > 12d$; $d_0 \geq 18$mm:
Blow out the drill hole four times, using oil-free pressure air (p > 6 bar).

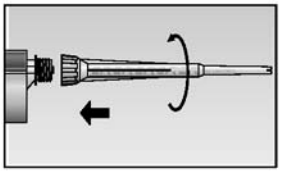
Preparing the cartridge

5



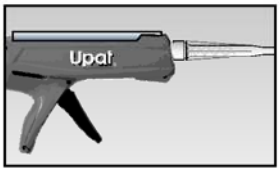
Twist off the sealing cap.

6



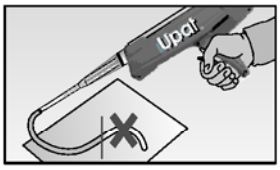
Twist on the mixing nozzle (the spiral in the mixing nozzle must be clearly visible).

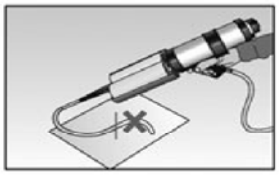
7



Place the cartridge into the dispenser.

8





Press out approx. 10 cm of mortar until the resin is permanent grey in colour.
Don`t use uniformly grey unreal mortar.

Injection anchor system UPM 44	Annex 8
Installation instructions Part 1	

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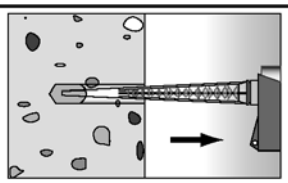
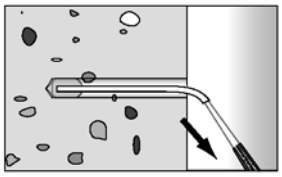
Injection of the mortar

9



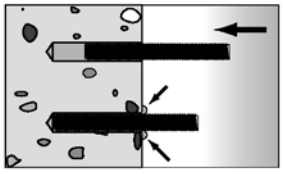
Fill approx. 2/3 of the drill hole with mortar. Always begin from the bottom of the hole to eliminate voids.

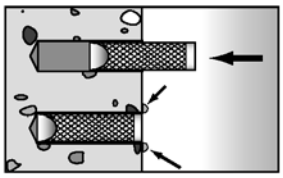


For drill hole depth ≥ 150 mm use an extension tube.

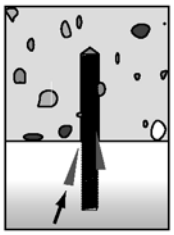
Installation Upat anchor rods or internal threaded anchors IST

10

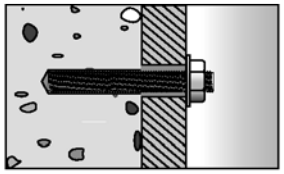




Only use clean and oil-free anchor elements. Mark the anchor element for setting depth. Press the anchor rod or internal threaded anchor down to the bottom of the hole, turning it slightly while doing so. After inserting the anchor element, excess mortar must emerge around the anchor element.



For overhead installation support the anchor rod with wedges.

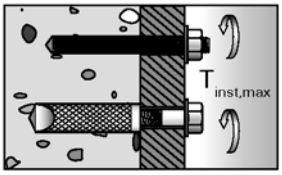


For push-through installation fill the annular gap with mortar.

11

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

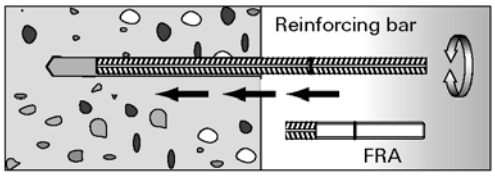
12



Mounting the fixture
$T_{inst,max}$ see
Table 1 or **2.**

Installation reinforcing bars and Upat rebar anchors FRA

10

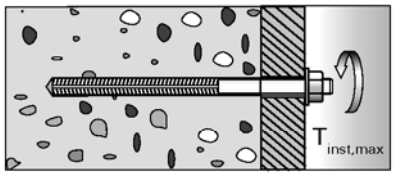


Only use clean and oil-free rebars. Mark the reinforcing bar for setting depth. Using a turning movement, push the reinforcing bar or the FRA vigorously into the filled hole up to the insertion depth marking. When reaching the setting depth marking surplus mortar must emerge around the anchor.

11

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

12



Mounting the fixture
$T_{inst,max}$ see
Table 6.

Injection anchor system UPM 44	Annex 9
Installation instructions Part 2	

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Table 7: Design of Bonded Anchors acc. to TR 029 Characteristic values to tension load for Upat anchor rods

Size				M 6	M 8	M 10	M 12	M 16	M 20	M 24	M 30
Steel failure											
Characteristic resistance $N_{Rk,s}$		Property class	5.8 [kN]	11	19	29	43	79	123	177	281
			8.8 [kN]	16	30	47	68	126	196	282	449
	stainless steel A4 and steel C	Property class	50 [kN]	11	19	29	43	79	123	177	281
			70 [kN]	14	26	41	59	110	172	247	393
			80 [kN]	16	30	47	68	126	196	282	449
Partial safety factor $\gamma_{Ms,N}$ [1]		Property class	5.8 [-]	1,50							
			8.8 [-]	1,50							
	stainless steel A4 and steel C	Property class	50 [-]	2,86							
			70 [-]	1,50[3]/1,87							
			80 [-]	1,60							
Combined pullout and concrete cone failure											
Diameter of calculation			d [mm]	6	8	10	12	16	20	24	30
Characteristic bond resistance in concrete C20/25 Intended use: dry and wet concrete											
Temperature range I[4]			$\tau_{Rk,ucr}$ [N/mm²]	9	11	11	11	10	9,5	9,0	8,5
Temperature range II[4]			$\tau_{Rk,ucr}$ [N/mm²]	6,5	9,5	9,5	9,0	8,5	8,0	7,5	7,0
Characteristic bond resistance in concrete C20/25 Intended use: flooded hole[6]											
Temperature range I[4]			$\tau_{Rk,ucr}$ [N/mm²]	—	—	—	9,5	8,5	8,0	7,5	7,0
Temperature range II[4]			$\tau_{Rk,ucr}$ [N/mm²]	—	—	—	7,5	7,0	6,5	6,0	6,0
Increasing factors for $\tau_{RK,ucr}$			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							
Splitting failure											
Edge distance $C_{cr,sp}$ [mm]			$h / h_{ef} \geq 2,0$	$1,0\ h_{ef}$							
			$2,0 > h / h_{ef} > 1,3$	$4,6\ h_{ef} - 1,8\ h$							
			$h / h_{ef} \leq 1,3$	$2,26\ h_{ef}$							
Spacing			$s_{cr,sp}$ [mm]	$2c_{cr,sp}$							
Partial safety factor $\gamma_{MP} = \gamma_{MC} = \gamma_{Msp}$ [1] [-]			dry and wet	1,5[2]							
			flooded hole[6]	1,8[5]							

[1] In absence of other national regulations
[2] The partial factor $\gamma_2 = 1,0$ is included
[3] For steel C: $f_{uk} = 700$ N/mm² ; $f_{yk} = 560$ N/mm²
[4] See Annex 2
[5] The partial factor $\gamma_2 = 1,2$ is included
[6] Only for coaxial cartrigde 380ml, 400ml and 410ml

Injection anchor system UPM 44	**Annex 10**
Design of Bonded Anchors acc. to TR 029 Upat anchor rods Characteristic values to tension load	

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Table 8: Design of Bonded Anchors acc. to TR 029
Characteristic values to shear load for Upat anchor rods

Size				M6	M8	M10	M12	M16	M20	M24	M30
Steel failure without lever arm											
Characteristic resistance $V^0_{Rk,s}$		Property class	5.8 [kN]	5	9	15	21	39	61	89	141
			8.8 [kN]	8	15	23	34	63	98	141	225
	stainless steel A4 and steel C	Property class	50 [kN]	5	9	15	21	39	61	89	141
			70 [kN]	7	13	20	30	55	86	124	197
			80 [kN]	8	15	23	34	63	98	141	225
Steel failure with lever arm											
Characteristic bending moment $M^0_{Rk,s}$		Property class	5.8 [Nm]	8	19	37	65	166	324	561	1124
			8.8 [Nm]	12	30	60	105	266	519	898	1799
	stainless steel A4 and steel C	Property class	50 [Nm]	8	19	37	65	166	324	561	1124
			70 [Nm]	11	26	52	92	233	454	785	1574
			80 [Nm]	12	30	60	105	266	519	898	1799
Partial safety factor steel failure											
$\gamma_{Ms,V}$ [1]		Property class	5.8 [-]	1,25							
			8.8 [-]	1,25							
	stainless steel A4 and steel C	Property class	50 [-]	2,38							
			70 [-]	1,25[3] / 1,56							
			80 [-]	1,33							
Concrete pryout failure											
Factor k in Equation (5.7) of Technical Report TR 029 Section 5.2.3.3			k [-]	2,0							
Partial safety failure			γ_{Mcp} [1] [-]	1,5[2]							
Concrete edge failure				See Technical Report TR 029, Section 5.2.3.4							
Partial safety failure			γ_{Mc} [1] [-]	1,5[2]							

[1] In absence of other national regulations.
[2] The partial safety factor γ_2 = 1,0 is included.
[3] For steel C: f_{uk} = 700 N/mm² ; f_{yk} = 560 N/mm²

Injection anchor system UPM 44	
Design of Bonded Anchors acc. to TR 029 Upat anchor rods Characteristic values to shear load	Annex 11

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Table 9: Displacements of Upat anchor rods to tension load

Size			M6	M8	M10	M12	M16	M20	M24	M30
Temperature range I -40°C / +80°C			Effective anchorage depth h_{ef} = 8 d[1]							
Tension load	N	[kN]	2,5	7,7	11,0	15,8	25,5	37,9	51,7	76,3
Displacement	δ_{N0}	[mm]	0,1	0,2	0,2	0,2	0,2	0,3	0,3	0,3
Displacement	$\delta_{N\infty}$	[mm]	0,3	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} = 8 d[1]							
Tension load	N	[kN]	2,0	6,4	9,5	12,9	21,7	31,9	43,1	62,8
Displacement	δ_{N0}	[mm]	0,1	0,15	0,15	0,15	0,15	0,25	0,25	0,25
Displacement	$\delta_{N\infty}$	[mm]	0,3	0,45	0,45	0,45	0,45	0,75	0,75	0,75

[1] Values for $8d \le h_{ef} \le 20d$ can be calculated:

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

$\delta_{N\infty} = \delta_{N\infty1} \frac{h_{ef}}{8d}$ $\delta_{N\infty1}$ for h_{ef} 8d

Table 10: Displacements of Upat anchor rods to shear load

Size			M6	M8	M10	M12	M16	M20	M24	M30
Temperature range I -40°C / + 80°C and temperature range II -40°C /+120°C										
Property class 5.8 / A4-50 / C-50										
Shear load	V	[kN]	2,8	5,1	8,1	11,8	21,9	34,2	49,1	78,3
Displacement	δ_{V0}	[mm]	0,7	0,9	1,2	1,4	2,0	2,4	2,6	3,7
Displacement	$\delta_{V\infty}$	[mm]	1,2	1,4	1,7	2,1	2,9	3,7	4,1	5,6
Property class A4-70										
Shear load	V	[kN]	3,2	5,9	9,3	13,5	25,2	39,3	56,4	89,9
Displacement	δ_{V0}	[mm]	0,8	1,0	1,3	1,6	2,2	2,8	3,4	4,3
Displacement	$\delta_{V\infty}$	[mm]	1,1	1,6	2,0	2,4	3,4	4,2	5,6	6,4
Property class C-70[1]										
Shear load	V	[kN]	4,0	7,3	11,6	16,9	31,4	49,0	70,4	112,2
Displacement	δ_{V0}	[mm]	1,0	1,3	1,7	2,0	2,8	3,5	4,2	5,3
Displacement	$\delta_{V\infty}$	[mm]	1,4	2,0	2,5	3,0	4,2	5,3	6,3	8,0
Property class 8.8 / A4-80 / C-80										
Shear load	V	[kN]	4,6	7,0	11,1	15,2	30,1	47,0	67,7	107,7
Displacement	δ_{V0}	[mm]	1,0	1,2	1,6	1,9	2,8	3,3	3,6	5,1
Displacement	$\delta_{V\infty}$	[mm]	1,6	1,9	2,3	2,9	4,0	5,1	5,6	7,7

[1] f_{uk} = 700 N/mm² ; f_{yk} = 560 N/mm²

Injection anchor system UPM 44	
Upat anchor rods Displacements	Annex 12

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Table 11: Design of Bonded Anchors acc. to TR 029
Characteristic values to tension load for Upat internal threaded anchors IST

Size				M 8	M 10	M 12	M 16	M 20
Steel failure								
Characteristic resitance with screw	$N_{Rk,s}$	Property-class	5.8 [kN]	19	29	43	79	123
			8.8 [kN]	29	47	68	108	179
		Property-class 70	A4 [kN]	26	41	59	110	172
			C [kN]	26	41	59	110	172
Partial safety factor	$\gamma_{Ms,N}$ [1]	Property-class	5.8 [-]	1,50				
			8.8 [-]	1,50				
		Property-class 70	A4 [-]	1,87				
			C [-]	1,87				
Combined pullout and concrete failure								
Diameter for calculation			d_H [mm]	12	16	18	22	28
Effective anchorage depth			h_{ef} [mm]	90	90	125	160	200
Characteristic values in concrete C20/25 Intended use: dry and wet concrete								
Temperature range I (-40°C/+80°C)[3]			$N^0_{Rk,p}$ [kN]	30	40	50	75	115
Temperature range II (-40°C/+120°C)[3]			$N^0_{Rk,p}$ [kN]	25	30	40	60	95
Characteristic values in concrete C20/25 Intended use: flooded hole[5]								
Temperature range I (-40°C/+80°C)[3]			$N^0_{Rk,p}$ [kN]	25	35	50	60	95
Temperature range II (-40°C/+120°C)[3]			$N^0_{Rk,p}$ [kN]	20	25	35	50	75
Increasing factors for $N^0_{Rk,p}$	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				
Splitting failure								
Edge distance $c_{cr,sp}$ [mm]			$h / h_{ef} \geq 2,0$	$1,0\ h_{ef}$				
			$2,0 > h / h_{ef} > 1,3$	$4,6\ h_{ef} - 1,8\ h$				
			$h / h_{ef} \leq 1,3$	$2,26\ h_{ef}$				
Spacing			$s_{cr,sp}$ [mm]	$2c_{cr,sp}$				
Partial safety factor $\gamma_{Mp} = \gamma_{Mc} = \gamma_{Msp}$ [1] [-]			dry and wet	1,5 [2]				
			flooded hole[5]	1,8 [4]				

[1] In absence of other national regulations
[2] The partial factor $\gamma_2 = 1,0$ is included
[3] See Annex 2
[4] The partial factor $\gamma_2 = 1,2$ is included
[5] Only for coaxial cartrigde 380ml, 400ml and 410ml

Injection anchor system UPM 44	**Annex 13**
Design of Bonded Anchors acc. to TR 029 Upat internal threaded anchors IST Characteristic values to tension load	

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Table 12: Design of Bonded Anchors acc. to TR 029
Characteristic values to shear load for Upat internal threaded anchors IST

Size				**M 8**	**M 10**	**M 12**	**M 16**	**M 20**
Steel failure without lever arm								
Characteristic resistance	$V_{Rk,s}$	Property class	5.8 [kN]	9,2	14,5	21,1	39,2	62
			8.8 [kN]	14,6	23,2	33,7	62,7	90
		Property class 70	A4 [kN]	12,8	20,3	29,5	54,8	86
			C [kN]	12,8	20,3	29,5	54,8	86
Partial safety factor	$\gamma_{Ms,V}$	Property class	5.8 [-]	1,25				
			8.8 [-]	1,25				1,5
		Property class 70	A4 [-]	1,56				
			C [-]	1,56				
Steel failure with lever arm								
Characteristic bending moment	$M^0_{Rk,s}$	Property class	5.8 [Nm]	20	39	68	173	337
			8.8 [Nm]	30	60	105	266	519
		Property class 70	A4 [Nm]	26	52	92	232	454
			C [Nm]	26	52	92	232	454
Partial safety factor	$\gamma_{Ms,V}$	Property class	5.8 [-]	1,25				
			8.8 [-]	1,25				
		Property class 70	A4 [-]	1,56				
			C [-]	1,56				
Concrete pryout failure								
Factor k in Equation (5.7) of Technical Report TR 029, Section 5.2.3.3			k [-]	2,0				
Partial safety factor			γ_{Mcp} [1] [-]	1,5 [2]				
Concrete edge failure				See Technical Report TR 029, Section 5.2.3.4				
Partial safety factor			γ_{Mc} [1] [-]	1,5 [2]				

[1] In absence of other national regulations.

[2] The partial safety factor γ_2 = 1,0 is included.

Injection anchor system UPM 44	
Design of Bonded Anchors acc. to TR 029 Upat internal threaded anchors IST Characteristic values to shear load	Annex 14

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Table 13: Displacement of Upat internal threaded anchors IST to tension load

Size			M8	M10	M12	M16	M20
Temperature range I (-40°C / + 80°C)							
Tension load	N	[kN]	11,9	13,8	19,8	29,8	69,4
Displacement	δ_{N0}	[mm]	0,2	0,2	0,3	0,3	0,7
Displacement	$\delta_{N\infty}$	[mm]	0,6	0,6	0,9	0,9	2,1
Temperature range II (-40°C / + 120°C)							
Tension load	N	[kN]	9,9	11,9	15,8	23,8	37,7
Displacement	δ_{N0}	[mm]	0,15	0,15	0,25	0,25	0,6
Displacement	$\delta_{N\infty}$	[mm]	0,45	0,45	0,75	0,75	1,8

Table 14: Displacement of Upat internal threaded anchors IST to shear load

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

[1)] f_{uk} = 700 N/mm² ; f_{yk} = 560 N/mm²

Injection anchor system UPM 44	
Upat internal threaded anchors IST Displacements	Annex 15

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Table 15: Design of Bonded Anchors acc. to TR 029
Characteristic values to tension load for reinforcing bars[4)]

Size	**Ø d**	**8**	**10**	**12**	**14**	**16**	**20**	**25**	**28**
Steel failure									
Characteristic resistance	$N_{Rk,s}$ [kN]	28	44	63	85	111	173	270	339
Partial safety factor	$\gamma_{Ms,N}$ [1)] [-]	1,4							
Combined pullout and concrete failure									
Diameter for calculation	d [mm]	8	10	12	14	16	20	25	28
Characteristic bond resistance in concrete C20/25									
Temperature range I[3)] (-40°C/+80°C)	$\tau_{Rk,ucr}$ [N/mm²]	11,0	11,0	11,0	10,0	10,0	9,5	9,0	8,5
Temperature range II[3)] (-40°C/+120°C)	$\tau_{Rk,ucr}$ [N/mm²]	9,5	9,5	9,0	8,5	8,5	8,0	7,5	7,0
Increasing factor for $\tau_{Rk,ucr}$	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							
Splitting failure									
Edge distance $c_{cr,sp}$ [mm]	$h / h_{ef} \geq 2,0$	$1,0\ h_{ef}$							
	$2,0 > h / h_{ef} > 1,3$	$4,6\ h_{ef} - 1,8\ h$							
	$h / h_{ef} \leq 1,3$	$2,26\ h_{ef}$							
Spacing	$s_{cr,sp}$ [mm]	$2\ c_{cr,sp}$							
Partial safety factor	$\gamma_{Mp} = \gamma_{Mc} = \gamma_{Msp}$ [1)] [-]	1,5[2)]							

[1)] In absence of other national regulations.
[2)] The partial safety factor γ_2 = 1,0 is included
[3)] See Annex 2
[4)] The values given in Table 15 are valid for reinforcing bars B 500 B with f_{uk} = 550 N/mm² and f_{yk} = 500 N/mm². Other reinforcing bars have to be calculated according to TR 029, Equation (5.1).

Injection anchor system UPM 44	
Design of Bonded Anchors acc. to TR 029 Reinforcing bars Characteristic values to tension load	Annex 16

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Table 16: Design of Bonded Anchors acc. to TR 029
Characteristic values to shear load for reinforcing bars[1)]

Size Ø d	8	10	12	14	16	20	25	28
Steel failure without lever arm								
Characteristic resistance $V_{Rk,s}$ [kN]	13,8	21,6	31,1	42,4	55,3	87	135	170
Partial safety factor $\gamma_{Ms,V}$ [-]	1,5							
Steel failure with lever arm								
Characteristic bending moment $M^0_{Rk,s}$ [Nm]	33	65	112	178	265	518	1012	1422
Partial safety factor $\gamma_{Ms,V}$ [-]	1,5							
Concrete pryout failure								
Factor k in Equation (5.7) of Technical Report TR 029, Section 5.2.3.3 k [-]	2,0							
Partial safety factor γ_{Mcp} [2)] [-]	1,5[3)]							
Concrete edge failure	See Technical Report TR 029, Section 5.2.3.4							
Partial safety factor γ_{Mc} [2)] [-]	1,5[3)]							

[1)] The values given in Table 16 are valid for reinforcing bars B 500 B with f_{uk} = 550 N/mm² and f_{yk} = 500 N/mm². Other reinforcing bars have to be calculated according to TR 029, Equation (5.1).

[2)] In absence of other national regulations.

[3)] The partial safety factor γ_2 = 1,0 is included.

Injection anchor system UPM 44	
Design of Bonded Anchors acc. to TR 029 Reinforcing bars Characteristic values to shear load	Annex 17

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Table 17: Displacements of reinforcing bars to tension load [1)]

Size Ø d			8	10	12	14	16	20	25	28
Temperature range I -40°C / +80°C			Effective anchorage depth h_{ef} = 8 d [2)]							
Tension load	N	[kN]	7,7	11,0	15,8	19,5	25,5	37,9	51,7	76,3
Displacement	δ_{N0}	[mm]	0,2	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	0,6	0,9	0,9	0,9
Temperature range II -40°C /+120°C			Effective anchorage depth h_{ef} = 8 d [2)]							
Tension load	N	[kN]	6,4	9,5	12,9	16,6	21,7	31,9	43,1	62,8
Displacement	δ_{N0}	[mm]	0,15	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	0,45	0,75	0,75	0,75

[1)] The values given in Table 17 are valid for reinforcing bars B 500 B with f_{uk} = 550 N/mm² and f_{yk} = 500 N/mm². Other reinforcing bars have to be calculated according to TR 029, Equation (5.1).

[2)] Values for $8d \le h_{ef} \le 20d$ can be calculated:

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

$$\delta_{N\infty} = \delta_{N\infty1} \frac{h_{ef}}{8d}$$ $\delta_{N\infty1}$ for h_{ef} 8d

Tabelle 18: Displacements of reinforcing bars to shear load [1)]

Size Ø d			8	10	12	14	16	20	25	28
Temperature range I -40°C / + 80°C and temperature range II -40°C /+120°C										
Shear load	V	[kN]	5,1	8,1	11,8	16,0	21,9	34,2	49,1	78,3
Displacement	δ_{V0}	[mm]	0,9	1,2	1,4	0,7	2,0	2,4	2,6	3,7
Displacement	$\delta_{V\infty}$	[mm]	1,4	1,7	2,1	1,2	2,9	3,7	4,1	5,6

[1)] The values given in Table 18 are valid for reinforcing bars B 500 B with f_{uk} = 550 N/mm² and f_{yk} = 500 N/mm². Other reinforcing bars have to be calculated according to TR 029, Equation (5.1).

Injection anchor system UPM 44	Annex 18
Reinforcing bars Displacements	

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Table 19: Design of Bonded Anchors acc. to TR 029
Characteristic values to tension load for Upat rebar anchors FRA

Size		**M12**	**M16**	**M20**	**M24**
Steel failure					
Characteristic resistance	$N_{Rk,s}$ [kN]	63	111	173	270
Partial safety factor	$\gamma_{Ms,N}$ [1] [-]	1,4			
Combined pullout and concrete failure					
Diameter of calculation	d [mm]	12	16	20	25
Characteristic bond resistance in concrete C20/25					
Temperature range I [3] (-40°C / +80°C)	$\tau_{Rk,ucr}$ [N/mm²]	11,0	10,0	9,5	9,0
Temperature range II [3] (-40°C /+120°C)	$\tau_{Rk,ucr}$ [N/mm²]	9,0	8,5	8,0	7,5
Increasing factors for $\tau_{Rk,ucr}$	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			
Splitting failure					
Edge distance $c_{cr,sp}$ [mm]	$h / h_{ef} \geq 2,0$	$1,0\ h_{ef}$			
	$2,0 > h / h_{ef} > 1,3$	$4,6\ h_{ef} - 1,8\ h$			
	$h / h_{ef} \leq 1,3$	$2,26\ h_{ef}$			
Spacing	$s_{cr,sp}$ [mm]	$2\ c_{cr,sp}$			
Partial safety factor	$\gamma_{Mp} = \gamma_{Mc} = \gamma_{Msp}$ [1] [-]	1,5 [2]			

[1] In absence of other national regulations.
[2] The partial safety factor γ_2 = 1,0 is included
[3] See Annex 2

Injection anchor system UPM 44	
Design of Bonded Anchors acc. to TR 029 Upat rebar anchor FRA Characteristic values to tension load	Annex 19

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Table 20: Design of Bonded Anchors acc. to TR 029
Characteristic values to shear load for Upat rebar anchors FRA

Size			**M12**	**M16**	**M20**	**M24**
Steel failure without lever arm						
Characteristic resistance	$V_{Rk,s}$	[kN]	30	55	86	124
Partial safety factor	$\gamma_{Ms,V}$	[-]	1,56			
Steel failure with lever arm						
Characteristic bending moment	$M^0_{Rk,s}$	[Nm]	92	233	454	785
Partial safety factor	$\gamma_{Ms,V}$	[-]	1,56			
Concrete pryout failure						
Factor k in Equation (5.7) of Technical Report TR 029, Section 5.2.3.3	k	[-]	2,0			
Partial safety factor	γ_{Mcp} [1)]	[-]	1,5[2)]			
Concrete edge failure			See Technical Report TR 029, Section 5.2.3.4			
Partial safety factor	γ_{Mc} [1)]	[-]	1,5[2)]			

[1)] In absence of other national regulations.

[2)] The partial safety factor $\gamma_2 = 1,0$ is included.

Injection anchor system UPM 44	
Design of Bonded Anchors acc. to TR 029 Upat rebar anchor FRA Characteristic values to shear load	Annex 20

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Table 21: Displacements of Upat rebar anchors FRA to tension load

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

[1)] Values for 8d ≤ h_{ef} ≤ 20d can be calculated:

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

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

Table 22: Displacements of Upat rebar anchors FRA to shear load

Size			M12	M16	M20	M24
Temperature range I -40°C /+ 80°C and temperature range II -40°C /+120°C						
Shear load		V [kN]	11,8	21,9	34,2	49,1
Displacement	δ_{V0}	[mm]	1,4	2,0	2,4	2,6
Displacement	$\delta_{V\infty}$	[mm]	2,1	2,9	3,7	4,1

Injection anchor system UPM 44	Annex 21
Upat rebar anchor FRA Displacements	

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Table 23: Design of Bonded Anchors acc. to CEN/TS 1992-4: 2009 Characteristic values to tension load for Upat anchor rods

Size				M 6	M 8	M 10	M 12	M 16	M 20	M 24	M 30
Steel failure											
Characteristic resistance $N_{Rk,s}$		Property class	5.8 [kN]	11	19	29	43	79	123	177	281
			8.8 [kN]	16	30	47	68	126	196	282	449
	stainless steel A4 and steel C	Property class	50 [kN]	11	19	29	43	79	123	177	281
			70 [kN]	14	26	41	59	110	172	247	393
			80 [kN]	16	30	47	68	126	196	282	449
Partial safety factor $\gamma_{Ms,N}$ [1]		Property class	5.8 [-]	1,50							
			8.8 [-]	1,50							
	stainless steel A4 and steel C	Property class	50 [-]	2,86							
			70 [-]	1,50[3]/1,87							
			80 [-]	1,60							
Combined pullout and concrete cone failure											
Diameter of calculation			d [mm]	6	8	10	12	16	20	24	30
Characteristic bond resistance in concrete C20/25. Intended use: dry and wet concrete											
Temperature range I[4]			$\tau_{Rk,ucr}$ [N/mm²]	9	11	11	11	10	9,5	9,0	8,5
Temperature range II[4]			$\tau_{Rk,ucr}$ [N/mm²]	6,5	9,5	9,5	9,0	8,5	8,0	7,5	7,0
Characteristic bond resistance in concrete C20/25. Intended use: flooded hole[6]											
Temperature range I[4]			$\tau_{Rk,ucr}$ [N/mm²]	—	—	—	9,5	8,5	8,0	7,5	7,0
Temperature range II[4]			$\tau_{Rk,ucr}$ [N/mm²]	—	—	—	7,5	7,0	6,5	6,0	6,0
Factor for uncracked concrete			k_{ucr} [-]	10,1							
Increasing factors for $\tau_{RK,ucr}$			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							
Splitting failure											
Edge distance $C_{cr,sp}$ [mm]			$h / h_{ef} \geq 2,0$	$1,0\ h_{ef}$							
			$2,0 > h / h_{ef} > 1,3$	$4,6\ h_{ef} - 1,8\ h$							
			$h / h_{ef} \leq 1,3$	$2,26\ h_{ef}$							
Spacing			$s_{cr,sp}$ [mm]	$2c_{cr,sp}$							
Partial safety factor $\gamma_{MP} = \gamma_{MC} = \gamma_{Msp}$ [1] [-]			dry and wet	1,5[2]							
			flooded hole[6]	1,8[5]							

[1] In absence of other national regulations

[2] The partial factor γ_2 =1,0 is included

[3] For steel C: f_{uk} = 700 N/mm² ; f_{yk} = 560 N/mm²

[4] See Annex 2

[5] The partial factor γ_2 =1,2 is included

[6] Only for coaxial cartrigde 380ml, 400ml and 410ml

Displacements see Annex 12

Injection anchor system UPM 44	**Annex 22**
Design of Bonded Anchors acc. to CEN/TS 1992-4: 2009 Upat anchor rods Characteristic values to tension load	

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Table 24: Design of Bonded Anchors acc. to CEN/TS 1992-4: 2009
Characteristic values to shear load for Upat anchor rods

Size				M6	M8	M10	M12	M16	M20	M24	M30
Steel failure without lever arm											
Characteristic resistance $V^0_{Rk,s}$		Property class	5.8 [kN]	5	9	15	21	39	61	89	141
			8.8 [kN]	8	15	23	34	63	98	141	225
	stainless steel A4 and steel C	Property class	50 [kN]	5	9	15	21	39	61	89	141
			70 [kN]	7	13	20	30	55	86	124	197
			80 [kN]	8	15	23	34	63	98	141	225
Steel failure with lever arm											
Characteristic bending moment $M^0_{Rk,s}$		Property class	5.8 [Nm]	8	19	37	65	166	324	561	1124
			8.8 [Nm]	12	30	60	105	266	519	898	1799
	stainless steel A4 and steel C	Property class	50 [Nm]	8	19	37	65	166	324	561	1124
			70 [Nm]	11	26	52	92	233	454	785	1574
			80 [Nm]	12	30	60	105	266	519	898	1799
Ductility factor			k_2 [-]	0,8							
Partial safety factor steel failure											
$\gamma_{Ms,V}$ [1]		Property class	5.8 [-]	1,25							
			8.8 [-]	1,25							
	stainless steel A4 and steel C	Property class	50 [-]	2,38							
			70 [-]	1,25 [3] / 1,56							
			80 [-]	1,33							
Concrete pryout failure											
Factor in Equation (5.7) of CEN/TS 1992-4-4 Section 6.3.3			k_3 [-]	2,0							
Partial safety failure			γ_{Mcp} [1] [-]	1,5 [2]							
Concrete edge failure				See CEN/TS 1992-4: Section 6.3.4							
Partial safety failure			γ_{Mc} [1] [-]	1,5 [2]							

[1] In absence of other national regulations.
[2] The partial safety factor $\gamma_2 = 1,0$ is included.
[3] For steel C: $f_{uk} = 700$ N/mm² ; $f_{yk} = 560$ N/mm²

Displacements see Annex 12.

Injection anchor system UPM 44	
Design of Bonded Anchors acc. to CEN/TS 1992-4: 2009 Upat anchor rods Characteristic values to shear load	Annex 23

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Table 25: Design of Bonded Anchors acc. to CEN/TS 1992-4: 2009
Characteristic values to tension load for Upat internal threaded anchors IST

Size				M 8	M 10	M 12	M 16	M 20
Steel failure								
Characteristic resitance with screw	$N_{Rk,s}$	Property-class	5.8 [kN]	19	29	43	79	123
			8.8 [kN]	29	47	68	108	179
		Property-class 70	A4 [kN]	26	41	59	110	172
			C [kN]	26	41	59	110	172
Partial safety factor	$\gamma_{Ms,N}$ [1]	Property-class	5.8 [-]	1,50				
			8.8 [-]	1,50				
		Property-class 70	A4 [-]	1,87				
			C [-]	1,87				
Combined pullout and concrete failure								
Diameter for calculation			d_H [mm]	12	16	18	22	28
Effective anchorage depth			h_{ef} [mm]	90	90	125	160	200
Characteristic values in concrete C20/25. Intended use: dry and wet concrete								
Temperature range I (-40°C/+80°C)[3]			$N^0_{Rk,p}$ [kN]	30	40	50	75	115
Temperature range II (-40°C/+120°C)[3]			$N^0_{Rk,p}$ [kN]	25	30	40	60	95
Characteristic values in concrete C20/25. Intended use: flooded hole[5]								
Temperature range I (-40°C/+80°C)[3]			$N^0_{Rk,p}$ [kN]	25	35	50	60	95
Temperature range II (-40°C/+120°C)[3]			$N^0_{Rk,p}$ [kN]	20	25	35	50	75
Factor for uncracked concrete			k_{ucr} [-]	10,1				
Increasing factors for $N^0_{Rk,p}$	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				
Splitting failure								
Edge distance	$c_{cr,sp}$ [mm]		$h / h_{ef} \geq 2,0$	$1,0\ h_{ef}$				
			$2,0 > h / h_{ef} > 1,3$	$4,6\ h_{ef} - 1,8\ h$				
			$h / h_{ef} \leq 1,3$	$2,26\ h_{ef}$				
Spacing			$s_{cr,sp}$ [mm]	$2c_{cr,sp}$				
Partial safety factor $\gamma_{Mp} = \gamma_{Mc} = \gamma_{Msp}$ [1] [-]			dry and wet	1,5 [2]				
			flooded hole[5]	1,8 [4]				

[1] In absence of other national regulations
[2] The partial factor $\gamma_2 = 1,0$ is included
[3] See Annex 2
[4] The partial factor $\gamma_2 = 1,2$ is included
[5] Only for coaxial cartrigde 380ml, 400ml and 410ml

Displacements see 15

Injection anchor system UPM 44	**Annex 24**
Design of Bonded Anchors acc. to CEN/TS 1992-4: 2009 Upat internal threaded anchors IST Characteristic values to tension load	

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Table 26: Design of Bonded Anchors acc. to CEN/TS 1992-4: 2009
Characteristic values to shear load for Upat internal threaded anchors IST

Size				**M 8**	**M 10**	**M 12**	**M 16**	**M 20**
Steel failure without lever arm								
Characteristic resistance	$V_{Rk,s}$	Property class 5.8	[kN]	9,2	14,5	21,1	39,2	62
		Property class 8.8	[kN]	14,6	23,2	33,7	62,7	90
		Property class 70 A4	[kN]	12,8	20,3	29,5	54,8	86
		Property class 70 C	[kN]	12,8	20,3	29,5	54,8	86
Partial safety factor	$\gamma_{Ms,V}$	Property class 5.8	[-]	1,25				
		Property class 8.8	[-]	1,25				1,5
		Property class 70 A4	[-]	1,56				
		Property class 70 C	[-]	1,56				
Steel failure with lever arm								
Characteristic bending moment	$M^0_{Rk,s}$	Property class 5.8	[Nm]	20	39	68	173	337
		Property class 8.8	[Nm]	30	60	105	266	519
		Property class 70 A4	[Nm]	26	52	92	232	454
		Property class 70 C	[Nm]	26	52	92	232	454
Ductility factor		k_2	[-]	0,8				
Partial safety factor	$\gamma_{Ms,V}$	Property class 5.8	[-]	1,25				
		Property class 8.8	[-]	1,25				
		Property class 70 A4	[-]	1,56				
		Property class 70 C	[-]	1,56				
Concrete pryout failure								
Factor in Equation (27) CEN/TS 1992-4-4, Section 6.3.3		k_3	[-]	2,0				
Partial safety factor		γ_{Mcp} [1]	[-]	1,5[2]				
Concrete edge failure				See CEN/TS 1992-4; Section 6.3.4				
Partial safety factor		γ_{Mc} [1]	[-]	1,5[2]				

[1] In absence of other national regulations.

[2] The partial safety factor $\gamma_2 = 1,0$ is included.

Displacements see annex 15.

Injection anchor system UPM 44	
Design of Bonded Anchors acc. to CEN/TS 1992-4: 2009 Upat internal threaded anchors IST Characteristic values to shear load	Annex 25

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Table 27: Design of Bonded Anchors acc. to CEN/TS 1992-4: 2009
Characteristic values to tension load for reinforcing bars [4)]

Size Ø d		8	10	12	14	16	20	25	28
Steel failure									
Characteristic resistance	$N_{Rk,s}$ [kN]	28	44	63	85	111	173	270	339
Partial safety factor	$\gamma_{Ms,N}$ [1)] [-]	1,4							
Combined pullout and concrete failure									
Diameter for calculation	d [mm]	8	10	12	14	16	20	25	28
Characteristic bond resistance in concrete C20/25									
Temperature range I [3)] (-40°C/+80°C)	$\tau_{Rk,ucr}$ [N/mm²]	11,0	11,0	11,0	10,0	10,0	9,5	9,0	8,5
Temperature range II [3)] (-40°C/+120°C)	$\tau_{Rk,ucr}$ [N/mm²]	9,5	9,5	9,0	8,5	8,5	8,0	7,5	7,0
Factor for uncracked concrete	k_{ucr} [-]	10,1							
Increasing factor for $\tau_{Rk,ucr}$	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							
Splitting failure									
Edge distance $c_{cr,sp}$ [mm]	h / h_{ef} ≥ 2,0	1,0 h_{ef}							
	2,0 > h / h_{ef} >1,3	4,6 h_{ef} - 1,8 h							
	h / h_{ef} ≤1,3	2,26 h_{ef}							
Spacing	$s_{cr,sp}$ [mm]	2 $c_{cr,sp}$							
Partial safety factor	$\gamma_{Mp}=\gamma_{Mc}=\gamma_{Msp}$ [1)] [-]	1,5 [2)]							

[1)] In absence of other national regulations.
[2)] The partial safety factor γ_2 = 1,0 is included
[3)] See Annex 2
[4)] The values given in Table 27 are valid for reinforcing bars B 500 B with f_{uk} = 550 N/mm² and f_{yk} = 500 N/mm². Other reinforcing bars have to be calculated according to aquation:

$$N_{Rk,s} = A_s \bullet f_{uk} \text{ [N]}$$

$$\gamma_{Ms} = \frac{1,2}{f_{yk} / f_{uk}} \geq 1,4$$

Displacements see Annex 18.

Injection anchor system UPM 44	
Design of Bonded Anchors acc. to CEN/TS 1992-4: 2009 Reinforcing bars Characteristic values to tension load	Annex 26

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Table 28: Design of Bonded Anchors acc. to CEN/TS 1992-4: 2009
Characteristic values to shear load for reinforcing bars [1)]

Size Ø d	8	10	12	14	16	20	25	28
Steel failure without lever arm								
Charac-teristic resistance $V_{Rk,s}$ [kN]	13,8	21,6	31,1	42,4	55,3	87	135	170
Partial safety factor $\gamma_{Ms,V}$ [-]	1,5							
Steel failure with lever arm								
Characte-ristic bending moment $M^0_{Rk,s}$ [Nm]	33	65	112	178	265	518	1012	1422
Ductility factor k_2 [-]	0,8							
Partial safety factor $\gamma_{Ms,V}$ [-]	1,5							
Concrete pryout failure								
Factor in Equation (27) CEN/TS 1992-4-4 Section 6.3.3 k_3 [-]	2,0							
Partial safety factor γ_{Mcp} [2)] [-]	1,5 [3)]							
Concrete edge failure	See CEN/TS 1992-4, Section 6.3.4							
Partial safety factor γ_{Mc} [2)] [-]	1,5 [3)]							

[1)] The values given in Table 28 are valid for reinforcing bars B 500 B with $f_{uk} = 550$ N/mm² and $f_{yk} = 500$ N/mm².
Other reinforcing bars have to be calculated according to aquation:

$$V_{Rk,s} = 0{,}5 \bullet A_s \bullet f_{uk} \text{ [N]}$$

$$\gamma_{Ms} = \frac{1{,}0}{f_{yk} / f_{uk}} \geq 1{,}25 \quad \text{for } f_{uk} \leq 800 \text{ N/mm}^2 \text{ and } f_{yk}/f_{uk} \leq 0.8$$

$$\gamma_{Ms} = 1{,}5 \quad \text{for } f_{uk} > 800 \text{ N/mm}^2 \text{ or } f_{yk}/f_{uk} > 0.8$$

[2)] In absence of other national regulations.
[3)] The partial safety factor $\gamma_2 = 1{,}0$ is included.

Displacements see Annex 18.

Injection anchor system UPM 44	
Design of Bonded Anchors acc. to CEN/TS 1992-4: 2009 Reinforcing bars Characteristic values to shear load	Annex 27

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Table 29: Design of Bonded Anchors acc. to CEN/TS 1992-4: 2009
Characteristic values to tension load for Upat rebar anchors FRA

Size		**M12**	**M16**	**M20**	**M24**
Steel failure					
Characteristic resistance	$N_{Rk,s}$ [kN]	63	111	173	270
Partial safety factor	$\gamma_{Ms,N}$ [1)] [-]	1,4			
Combined pullout and concrete failure					
Diameter of calculation	d [mm]	12	16	20	25
Characteristic bond resistance in concrete C20/25					
Temperature range I [3)] (-40°C / +80°C)	$\tau_{Rk,ucr}$ [N/mm²]	11,0	10,0	9,5	9,0
Temperature range II [3)] (-40°C /+120°C)	$\tau_{Rk,ucr}$ [N/mm²]	9,0	8,5	8,0	7,5
Factor for uncracked conxcrete	k_{ucr} [-]	10,1			
Increasing factors for $\tau_{Rk,ucr}$	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			
Splitting failure					
Edge distance $c_{cr,sp}$ [mm]	h / h_{ef} ≥ 2,0	1,0 h_{ef}			
	2,0 > h / h_{ef} > 1,3	4,6 h_{ef} - 1,8 h			
	h / h_{ef} ≤ 1,3	2,26 h_{ef}			
Spacing	$s_{cr,sp}$ [mm]	2 $c_{cr,sp}$			
Partial safety factor	$\gamma_{Mp} = \gamma_{Mc} = \gamma_{Msp}$ [1)] [-]	1,5 [2)]			

[1)] In absence of other national regulations.
[2)] The partial safety factor γ_2 = 1,0 is included
[3)] See Annex 2

Displacements see Annex 21.

Injection anchor system UPM 44	
Design of Bonded Anchors acc. to CEN/TS 1992-4: 2009 Upat rebar anchor FRA Characteristic values to tension load	Annex 28

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Table 30: Design of Bonded Anchors acc. to CEN/TS 1992-4: 2009
Characteristic values to shear load for Upat rebar anchors FRA

Size		**M12**	**M16**	**M20**	**M24**
Steel failure without lever arm					
Characteristic resistance	$V_{Rk,s}$ [kN]	30	55	86	124
Partial safety factor	$\gamma_{Ms,V}$ [-]	1,56			
Steel failure with lever arm					
Characteristic bending moment	$M^0_{Rk,s}$ [Nm]	92	233	454	785
Partial safety factor	$\gamma_{Ms,V}$ [-]	1,56			
Ductility factor	k_2 [-]	0,8			
Concrete pryout failure					
Factor in Equation (27) CEN/TS 1992-4-4, Section 6.3.3	k_3 [-]	2,0			
Partial safety factor	γ_{Mcp} [1)] [-]	1,5[2)]			
Concrete edge failure		See CEN/TS 1992-4, Section 6.3.4			
Partial safety factor	γ_{Mc} [1)] [-]	1,5[2)]			

[1)] In absence of other national regulations.

[2)] The partial safety factor γ_2 = 1,0 is included.

Displacements see Annex 21.

Injection anchor system UPM 44	
Design of Bonded Anchors acc. to CEN/TS 1992-4: 2009 Upat rebar anchor FRA Characteristic values to shear load	Annex 29