



## European Technical Approval ETA-08/0231

English translation prepared by DIBt - Original version in German language

Handelsbezeichnung  
*Trade name*

K-A-L-M Verbundanker VPK-SF  
*K-A-L-M bonded anchor VPK-SF*

Zulassungsinhaber  
*Holder of approval*

KALM  
Befestigungssysteme GmbH  
Marie-Curie-Straße 5  
67661 Kaiserslautern  
DEUTSCHLAND

Zulassungsgegenstand  
und Verwendungszweck  
*Generic type and use  
of construction product*

Verbunddübel mit Ankerstange in den Größen M8, M10, M12, M16,  
M20 und M24 zur Verankerung im ungerissenen Beton  
*Bonded anchor with anchor rod of sizes M8, M10, M12, M16, M20 and  
M24 for use in non-cracked concrete*

Geltungsdauer:  
*Validity:* vom  
*from*  
bis  
*to*

17 June 2013  
17 June 2018

Herstellwerk  
*Manufacturing plant*

KALM  
Befestigungssysteme GmbH  
Marie-Curie-Straße 5  
67661 Kaiserslautern  
DEUTSCHLAND

Diese Zulassung umfasst  
*This Approval contains*

14 Seiten einschließlich 5 Anhänge  
*14 pages including 5 annexes*

Diese Zulassung ersetzt  
*This Approval replaces*

ETA-08/0231 mit Geltungsdauer vom 15.10.2008 bis 14.10.2013  
*ETA-08/0231 with validity from 15.10.2008 to 14.10.2013*

## 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<sup>1</sup>, modified by Council Directive 93/68/EEC<sup>2</sup> and Regulation (EC) N° 1882/2003 of the European Parliament and of the Council<sup>3</sup>;
  - *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<sup>4</sup>, as amended by Article 2 of the law of 8 November 2011<sup>5</sup>;*
  - Common Procedural Rules for Requesting, Preparing and the Granting of European technical approvals set out in the Annex to Commission Decision 94/23/EC<sup>6</sup>;
  - 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.

<sup>1</sup> Official Journal of the European Communities L 40, 11 February 1989, p. 12  
<sup>2</sup> Official Journal of the European Communities L 220, 30 August 1993, p. 1  
<sup>3</sup> Official Journal of the European Union L 284, 31 October 2003, p. 25  
<sup>4</sup> *Bundesgesetzblatt Teil I 1998*, p. 812  
<sup>5</sup> *Bundesgesetzblatt Teil I 2011*, p. 2178  
<sup>6</sup> 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 and intended use

#### 1.1 Definition of the construction product

The K-A-L-M bonded anchor VPK-SF is a bonded anchor consisting of a mortar capsule VPK-SF and a threaded anchor rod with hexagon nut and washer of sizes M8, M10, M12, M16, M20 and M24. The anchor rod (including nut and washer) is made of galvanised steel, hot-dip galvanised steel, stainless steel or made of high corrosion resistant steel.

The mortar capsule is placed in the hole and the anchor rod is driven by machine with simultaneous hammering and turning. The anchor rod is anchored via the bond between anchor rod, chemical 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.

It may be anchored in non-cracked concrete only. The anchor may be installed in dry or wet concrete. The anchor in size M12 to M24 may also be installed in flooded holes excepting sea water.

The anchor may be used in the following temperature range:

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

##### Elements made of zinc plated or hot-dip galvanised steel:

The anchor rod, nut and washer made of zinc plated or hot-dip galvanised steel may only be used in structures subject to dry internal conditions.

##### Elements made of stainless steel 1.4401, 1.4404, 1.4571 or 1.4578:

The anchor rod, nut and washer 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 1.4529 or 1.4565:

The anchor rod, nut and washer 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).

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 the product

The anchor corresponds to the drawings and provisions given in Annexes 1 to 3. The characteristic material values, dimensions and tolerances of the anchor not indicated in Annexes 1 to 3 shall correspond to the respective values laid down in the technical documentation<sup>7</sup> of this European technical approval.

The characteristic values for the design of anchorages are given in Annexes 4 and 5.

Each mortar capsule shall be marked with the capsule type, the capsule size and with the identifying mark of the producer according to Annex 1.

Each anchor rod shall be marked with the identifying mark of manufacturing plant, the anchor size, marking of effective anchorage depth (undercut) and additional one letter for the material properties in accordance with Annex 1.

### 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 8.

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.

<sup>7</sup> 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.

### 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<sup>8</sup> the system 2(i) (referred to as System 1) of 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 test 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".

#### 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 of September 2008 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.<sup>9</sup>

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.

<sup>8</sup> Official Journal of the European Communities L 254 of 08.10.1996

<sup>9</sup> 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.

### 3.2.2 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,
- 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 8),
- 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 European technical approval and consequently the validity of the CE marking on the basis of the European technical approval and if so whether further assessment or alterations to the European technical 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 "Guideline for European technical approval of Metal Anchors for Use in Concrete", Annex C, Method A, for bonded anchors under the responsibility of an engineer experienced in anchorages and concrete work.

For the verifications given below according to Annex C the following shall be observed:

- For the verification 'concrete cone failure' (clause 5.2.2.4, Annex C of the Guideline)  $N_{Rk,c}$  shall be determined according to (1) and (2): The smaller of the values according to (1) and (2) is decisive.

(1)  $N_{Rk,c}$  according to equation (5.2), Annex C of the Guideline

where:  $N_{Rk,c}^0$  according to Annex 4

$s_{cr,N}$  according to Annex 4

$c_{cr,N}$  according to Annex 4

$\psi_{ucr,N} = 1,0$

In special cases according to clause 5.2.2.4 g, Annex C of the Guideline the method given there is valid. However, the value  $N_{Rk,c}^0$  shall be calculated according to the following equation:

$$N_{Rk,c}^0 = N_{Rk,c}^0 (\text{Annex 4}) \times \frac{h'_{ef}}{h_{ef}}$$

(2)  $N_{Rk,c}$  according to equation (5.2), Annex C of the Guideline

where:  $N_{Rk,c}^0 = 0,75 \times 15,5 \times h_{ef}^{1,5} \times f_{ck,cube}^{0,5}$

$s_{cr,N} = 3 h_{ef}$

$c_{cr,N} = 1,5 h_{ef}$

$\psi_{ucr,N} = 1,0$

- For the verification 'splitting failure due to loading' (clause 5.2.2.6, Annex C of the Guideline)  $N_{Rk,sp}$  shall be determined according to (3).

(3)  $N_{Rk,sp}$  according to equation (5.3), Annex C of the Guideline

where:  $N_{Rk,c}^0$  according to Annex 4

$s_{cr,sp}$  according to Annex 4

$c_{cr,sp}$  according to Annex 4

$\psi_{ucr,N} = 1,0$

$\psi_{h,sp} = 1,0$

- For the verification 'concrete pryout failure' (clause 5.2.3.3, Annex C of the Guideline)  $N_{Rk,c}$  for equation (5.6), Annex C of the Guideline, shall be determined according to (1).

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,
- 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,
- 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,
- in case of aborted drill hole: the drill hole shall be filled with mortar,
- the anchor in size M12 to M24 may be installed in flooded holes excepting sea water,
- cleaning the drill hole:  
cleaning the drill hole by at least two blowing operation, by at least two brushing operation followed again by at least two blowing operation and one brushing operation by using the steel brush supplied by the manufacturer; before brushing cleaning the brush and checking whether the brush diameter according to Annex 3 is still sufficient,
- the mortar capsule is placed into the drilled hole; connecting the anchor rod with the percussion drill by using a corresponding adapter; driving the anchor rod into the mortar capsule by simultaneous hammering and turning of the drill; if the anchorage depth is achieved the drill must stopped immediately by using some pressure; if the anchor is proper installed mortar must be visible at the member surface,
- 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 until the anchor may be loaded,
- after the curing time fixing the member to be anchored by using a calibrated torque wrench by not exceeding the torque moment given in Annex 3,
- installation torque moments are not required for functioning of the anchor.

## 5 Indications to the manufacturer

### 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 as well as 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 diameter,
- hole depth,
- diameter of anchor rod,
- minimum effective anchorage depth,
- maximum thickness of the fixture,
- information on the installation procedure, including cleaning of the hole with the cleaning equipments, preferably by means of an illustration,
- metal parts (anchor rod, washer and hexagon nut) must be of the same material and corresponding mechanical properties according to Annex 2,
- anchor component installation temperature,
- ambient temperature of the concrete during installation of the anchor,
- 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.



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## 5.2 Packaging, transport and storage

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

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

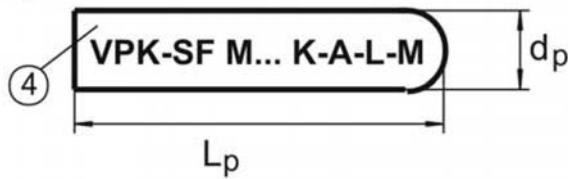
The anchor shall only be packaged and supplied as a complete unit. Mortar capsules may be packed separately from anchor rods (including nuts and washers).

The manufacturer's installation instruction shall indicate that the mortar capsules shall be used with the anchor rods according to Annex 1.

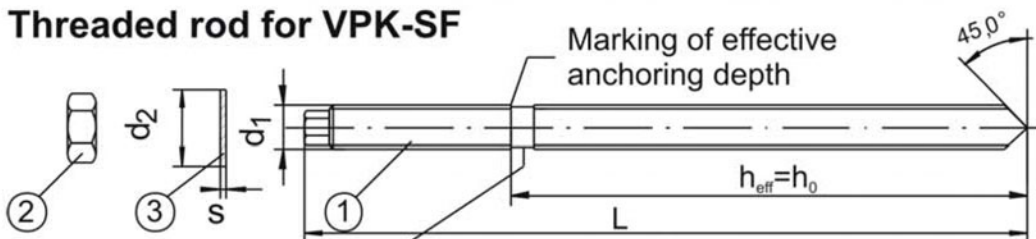
Andreas Kummerow  
p. p . Head of Department

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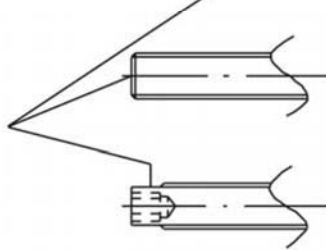
### Mortar Capsule



### Threaded rod for VPK-SF

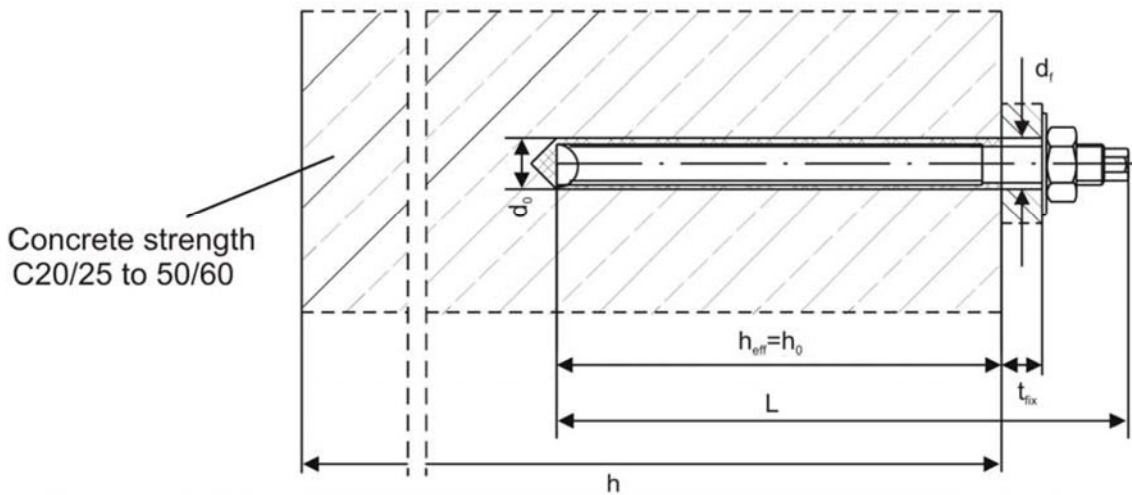


### Marking



Marking: Identifying mark of manufacturing plant K  
Size of thread M...  
Example KM10, for stainless steel plus E,  
for high corrosion plus H

### Intended use



Use category 2: Installation in dry or wet concrete  
or installation for anchor size M12 to M24  
in a hole with flooded water, no seawater

Temperature range:  $-40^{\circ}\text{C}$  to  $+80^{\circ}\text{C}$  (max short term temperature  $+80^{\circ}\text{C}$  and  
-max long term temperature  $+50^{\circ}\text{C}$ )

K-A-L-M bonded anchor VPK-SF

Product and intended use

Annex 1

## Dimensions

| Anchor size    |                   |      | M8 | M10  | M12  | M16  | M20 | M24 |
|----------------|-------------------|------|----|------|------|------|-----|-----|
| Threaded rod   | $\varnothing d_1$ | [mm] | M8 | M10  | M12  | M16  | M20 | M24 |
|                | $L \geq$          | [mm] | 90 | 100  | 120  | 140  | 190 | 235 |
|                | $h_{eff}$         | [mm] | 80 | 90   | 110  | 125  | 170 | 210 |
| Mortar Capsule | $d_p$             | [mm] | 9  | 10,5 | 12,5 | 16,5 | 23  | 23  |
|                | $L_p$             |      | 80 | 85   | 95   | 95   | 160 | 190 |

## Materials

| Part | Designation                               | Steel, zinc plated<br>$\geq 5 \mu\text{m}$ plated acc. to<br>DIN EN ISO 4042 | Steel, hot-dip galvanised<br>$\geq 40 \mu\text{m}$ acc. to<br>EN ISO 1461 |
|------|---|--|---|
| 1    | Threaded rod                              | Steel, Property class<br>5.8, 8.8, acc. to<br>DIN EN ISO 898-1               | Steel, Property class<br>5.8, 8.8, acc. to<br>DIN EN ISO 898-1            |
| 2    | Hexagon nut<br>DIN EN 24032<br>or DIN 934 | Property class 8<br>acc. to EN20898-2<br>galvanised                          | Property class 8<br>acc. to EN20898-2<br>hot-dip galvanised               |
| 3    | Washer                                    | Steel, galvanised  | Steel, hot-dip<br>galvanised  |
| 4    | Mortar capsule                            | Glass, Quartz, Resin, Hardener   |   |

| Part | Designation                               | Stainless steel A4   | High corrosion resistant steel<br>(HCR)  |
|------|---|--|--|
| 1    | Threaded rod                              | Stainless steel, 1.4401,<br>1.4404, 1.4571, 1.4578,<br>EN 10088, Property<br>class 70, EN ISO 3506 | High corrosion resistant steel<br>1.4529, 1.4565,<br>EN 10088, Property<br>class 70, EN ISO 3506 |
| 2    | Hexagon nut<br>DIN EN 24032<br>or DIN 934 | Stainless steel, 1.4401,<br>1.4404, 1.4571, EN 10088,<br>Property class 70,<br>EN ISO 3506         | High corrosion resistant steel<br>1.4529, 1.4565,<br>EN 10088, Property class 70,<br>EN ISO 3506 |
| 3    | Washer                                    | Stainless steel, 1.4401,<br>1.4404, 1.4571, EN 10088   | High corrosion resistant steel<br>1.4529, 1.4565, EN 10088                                       |
| 4    | Mortar capsule                            | Glass, Quartz, Resin, Hardener   |  |

K-A-L-M bonded anchor VPK-SF

Anchor sizes and materials

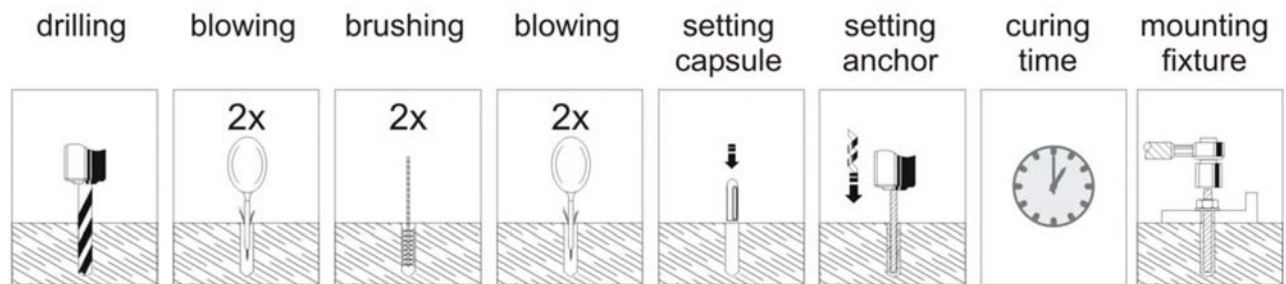
Annex 2

### Installation parameters

| Anchor size                           |            |      | M8    | M10   | M12  | M16  | M20  | M24  |
|---------------------------------------|------------|------|-------|-------|------|------|------|------|
| Nominal diameter of drill hole        | $d_0$      | [mm] | 10    | 12    | 14   | 18   | 25   | 28   |
| Cutting diameter of drill hole        | $d_{cut}$  | [mm] | 10,45 | 12,45 | 14,5 | 18,5 | 25,5 | 28,5 |
| Depth of drill hole                   | $h_0$      | [mm] | 80    | 90    | 110  | 125  | 170  | 210  |
| Diameter of clearance hole in fixture | $d_f$      | [mm] | 9     | 12    | 14   | 18   | 22   | 26   |
| Diameter of steel brush               | $d$        | [mm] | 12    | 14    | 16   | 20   | 27   | 30   |
| Installation torque                   | $T_{inst}$ | [Nm] | 10    | 20    | 40   | 60   | 120  | 150  |
| Minimum thickness of concrete         | $h_{min}$  | [mm] | 110   | 120   | 150  | 160  | 220  | 300  |
| Minimum edge distance                 | $c_{min}$  | [mm] | 60    | 70    | 85   | 95   | 130  | 160  |
| Minimum spacing                       | $s_{min}$  | [mm] | 60    | 70    | 85   | 95   | 130  | 160  |



### Installation procedure



Installation in dry or wet concrete

### Minimum curing time

| Temperature in the anchorage base [°C] | Minimum curing time in dry concrete [min] | Minimum curing time in wet concrete [min] |
|--|---|---|
| -5 – 0                                 | 360                                       | 720                                       |
| 0 – 5                                  | 180                                       | 360                                       |
| 5 – 10                                 | 90  | 180                                       |
| 10 – 20                                | 40  | 80  |
| >20                                    | 20  | 40  |

K-A-L-M bonded anchor VPK-SF

Installation parameters and curing time

Annex 3

### Characteristic values of resistance to tension load

|             |           |            |            |            |            |            |
|-------------|-----------|------------|------------|------------|------------|------------|
| anchor size | <b>M8</b> | <b>M10</b> | <b>M12</b> | <b>M16</b> | <b>M20</b> | <b>M24</b> |
|-------------|-----------|------------|------------|------------|------------|------------|

#### steel failure for anchor rods made of galvanised steel, strength class 5.8

|                           |                    |      |      |    |    |    |     |     |
|---------------------------|--------------------|------|------|----|----|----|-----|-----|
| characteristic resistance | $N_{Rk,s}$         | [kN] | 17   | 26 | 38 | 72 | 114 | 165 |
| partial safety factor     | $\gamma_{Ms}^{1)}$ | [-]  | 1,56 |    |    |    |     |     |

#### steel failure for anchor rods made of stainless steel, strength class 70

|                           |                    |      |      |    |    |    |     |     |
|---------------------------|--------------------|------|------|----|----|----|-----|-----|
| characteristic resistance | $N_{Rk,s}$         | [kN] | 23   | 34 | 52 | 97 | 153 | 222 |
| partial safety factor     | $\gamma_{Ms}^{1)}$ | [-]  | 1,87 |    |    |    |     |     |

#### pullout failure in concrete C20/25 to C50/60

|   |                    |      |                         |     |     |                   |     |     |
|---|--------------------|------|-------------------------|-----|-----|-------------------|-----|-----|
| characteristic resistance in non-cracked concrete 50/80°C <sup>2)</sup> | $N_{Rk,p}$         | [kN] | 9                       | 12  | 16  | 25                | 40  | 60  |
| partial safety factor in dry and wet concrete                           | $\gamma_{Mc}^{3)}$ | [-]  | 1,8 <sup>3)</sup>       |     |     |                   |     |     |
| partial safety factor on flooded holes                                  | $\gamma_{Mc}^{3)}$ | [-]  | application not allowed |     |     | 1,8 <sup>3)</sup> |     |     |
| edge distance   | $c_{cr,N}$         | [mm] | 120                     | 135 | 165 | 190               | 255 | 315 |
| spacing   | $s_{cr,N}$         | [mm] | 240                     | 270 | 330 | 380               | 510 | 630 |

#### splitting failure

|   |                    |      |                         |     |     |                   |     |     |
|---|--------------------|------|-------------------------|-----|-----|-------------------|-----|-----|
| minimum thickness of member                   | $h_{min}$          | [mm] | 110                     | 120 | 150 | 160               | 220 | 300 |
| partial safety factor in dry and wet concrete | $\gamma_{Mc}^{3)}$ | [-]  | 1,8 <sup>3)</sup>       |     |     |                   |     |     |
| partial safety factor on flooded holes        | $\gamma_{Mc}^{3)}$ | [-]  | application not allowed |     |     | 1,8 <sup>3)</sup> |     |     |
| edge distance                                 | $c_{cr,Sp}$        | [mm] | 120                     | 135 | 165 | 190               | 255 | 315 |
| spacing                                       | $s_{cr,Sp}$        | [mm] | 240                     | 270 | 330 | 380               | 510 | 630 |

1) in absence of other national regulations

2) max. long term temperature / max. short term temperature

3) the installation safety factor  $\gamma_2 = 1,2$  is included

K-A-L-M bonded anchor VPK-SF

Characteristic values of resistance to tension load

Annex 4

### Characteristic values of resistance to shear load

|             |  |           |            |            |            |            |            |
|-------------|--|-----------|------------|------------|------------|------------|------------|
| anchor size |  | <b>M8</b> | <b>M10</b> | <b>M12</b> | <b>M16</b> | <b>M20</b> | <b>M24</b> |
|-------------|--|-----------|------------|------------|------------|------------|------------|

|  |                    |      |      |    |    |     |     |     |
|--|--------------------|------|------|----|----|-----|-----|-----|
| steel failure without lever arm for anchor rods made of galvanised steel, strength class 5.8 |                    |      |      |    |    |     |     |     |
| characteristic resistance  | $V_{Rk,s}$         | [kN] | 8    | 13 | 19 | 36  | 57  | 83  |
| characteristic bending moment  | $M^0_{Rk,s}$       | [Nm] | 16   | 30 | 56 | 144 | 285 | 498 |
| partial safety factor  | $\gamma_{Ms}^{1)}$ | [-]  | 1,30 |    |    |     |     |     |

|  |                    |      |      |    |    |     |     |     |
|--|--------------------|------|------|----|----|-----|-----|-----|
| steel failure without lever arm for anchor rods made of stainless steel, strength class 70 |                    |      |      |    |    |     |     |     |
| characteristic resistance  | $V_{Rk,s}$         | [kN] | 11   | 17 | 26 | 49  | 77  | 111 |
| characteristic bending moment  | $M^0_{Rk,s}$       | [Nm] | 22   | 41 | 75 | 194 | 384 | 670 |
| partial safety factor  | $\gamma_{Ms}^{1)}$ | [-]  | 1,56 |    |    |     |     |     |

|  |                    |     |                    |  |  |  |  |  |
|--|--------------------|-----|--------------------|--|--|--|--|--|
| concrete pryout failure  |                    |     |                    |  |  |  |  |  |
| factor k in equation (5.6) of ETAG 001, Annex C, section 5.2.3.3 |                    |     | 2,0                |  |  |  |  |  |
| partial safety factor  | $\gamma_{Mc}^{1)}$ | [-] | 1,50 <sup>2)</sup> |  |  |  |  |  |

|   |                    |      |                    |    |     |     |     |     |
|---|--------------------|------|--------------------|----|-----|-----|-----|-----|
| concrete edge failure                       |                    |      |                    |    |     |     |     |     |
| effective length of anchor in shear loading | $l_f$              | [mm] | 80                 | 90 | 110 | 125 | 170 | 210 |
| outside diameter of anchor                  | $d_{nom}$          | [mm] | 10                 | 12 | 14  | 18  | 25  | 28  |
| partial safety factor                       | $\gamma_{Mc}^{1)}$ | [-]  | 1,50 <sup>2)</sup> |    |     |     |     |     |

- 1) in absence of other national regulations  
2) the installation factor  $\gamma_2 = 1,0$  is included

K-A-L-M bonded anchor VPK-SF

Characteristic values of resistance to shear load

Annex 5