Deutsches Institut für Bautechnik
DIBt

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Approval body for construction products and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and Laender Governments

Designated according to Article 29 of Regulation (EU) No 305/2011 and member of EOTA (European Organisation for Technical Assessment)

# European Technical Assessment

# ETA-21/0265 of 19 May 2021

English translation prepared by DIBt - Original version in German language

**General Part**

| | |
|---|---|
| Technical Assessment Body issuing the European Technical Assessment: | Deutsches Institut für Bautechnik |
| Trade name of the construction product | RESINA VINILESTER + SIN ESTIRENO LUSAN for concrete |
| Product family to which the construction product belongs | Bonded fastener for use in concrete |
| Manufacturer | LUSAN FIJACIONES Y ANCLAJES, S.L.<br>C. / Molinos 20<br>29491 ALGATOCIN, MALAGA<br>SPANIEN |
| Manufacturing plant | PLANT 1 |
| This European Technical Assessment contains | 28 pages including 3 annexes which form an integral part of this assessment |
| This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of | EAD 330499-01-0601, Edition 04/2020 |

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## Specific Part

## 1 Technical description of the product

The "RESINA VINILESTER + SIN ESTIRENO LUSAN for concrete" is a bonded anchor consisting of a cartridge with injection mortar VINI or VININ and a steel element. The steel element consists of a commercial threaded rod with washer and hexagon nut in the range of M8 to M30 or reinforcing bar in the range of ∅ 8 to ∅ 32 mm or an internal threaded anchor rod HR-M6 to HR-M20.
The steel element is placed into a drilled hole filled with injection mortar and is anchored via the bond between metal part, injection mortar and concrete.

The product description is given in Annex A.

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

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

The verifications and assessment methods on which this European Technical Assessment is based lead to the assumption of a working life of the anchor of at least 50 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

## 3 Performance of the product and references to the methods used for its assessment

### 3.1 Mechanical resistance and stability (BWR 1)

| Essential characteristic | Performance |
|---|---|
| Characteristic resistance to tension load (static and quasi-static loading) | See Annex B 2, C 1 to C 3, C 5, C 7 |
| Characteristic resistance to shear load (static and quasi-static loading) | See Annex C1, C 4, C 6, C 8 |
| Displacements (static and quasi-static loading) | See Annex C 9 to C 11 |
| Characteristic resistance and displacements for seismic performance categories C1 | See Annex C 12 to C 16 |
| Characteristic resistance and displacements for seismic performance categories C2 | No performance assessed |

### 3.2 Hygiene, health and the environment (BWR 3)

| Essential characteristic | Performance |
|---|---|
| Content, emission and/or release of dangerous substances | No performance assessed |

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

In accordance with the European Assessment Document EAD 330499-01-0601 the applicable European legal act is: [96/582/EC].

The system to be applied is: 1

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

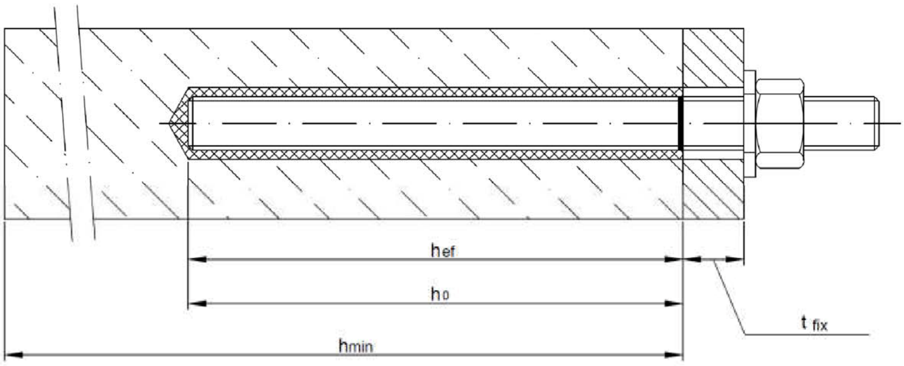
Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited at Deutsches Institut für Bautechnik.

Issued in Berlin on 19 May 2021 by Deutsches Institut für Bautechnik

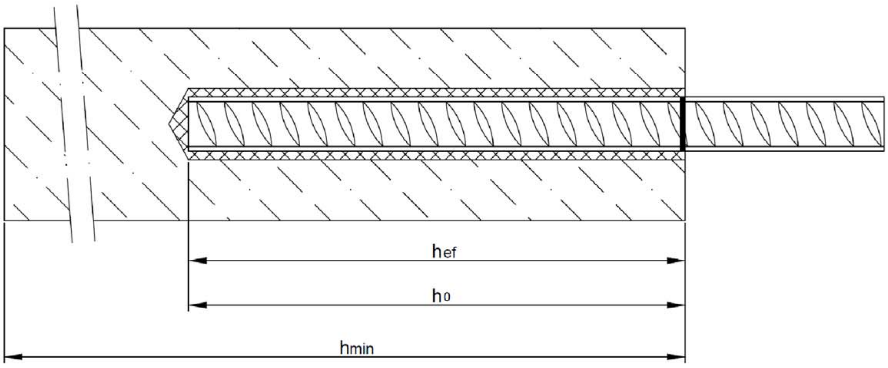
Dipl.-Ing. Beatrix Wittstock
Head of Section

*beglaubigt:*
Baderschneider

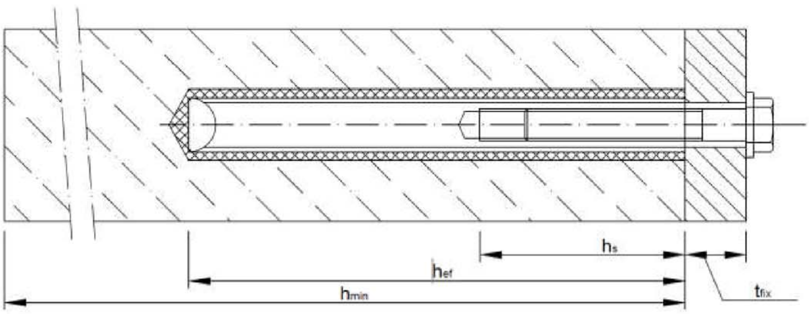
## Installation threaded rod M8 up to M30




## Installation reinforcing bar Ø8 up to Ø32




## Installation internal threaded anchor rod HR-M6 up to HR-M20

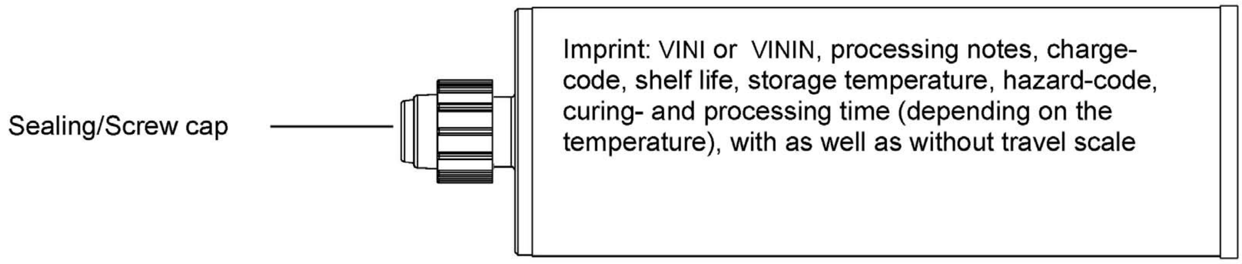



$t_{fix}$ = thickness of fixture
$h_{ef}$ = effective anchorage depth
$h_0$ = depth of drill hole
$h_{min}$ = minimum thickness of member

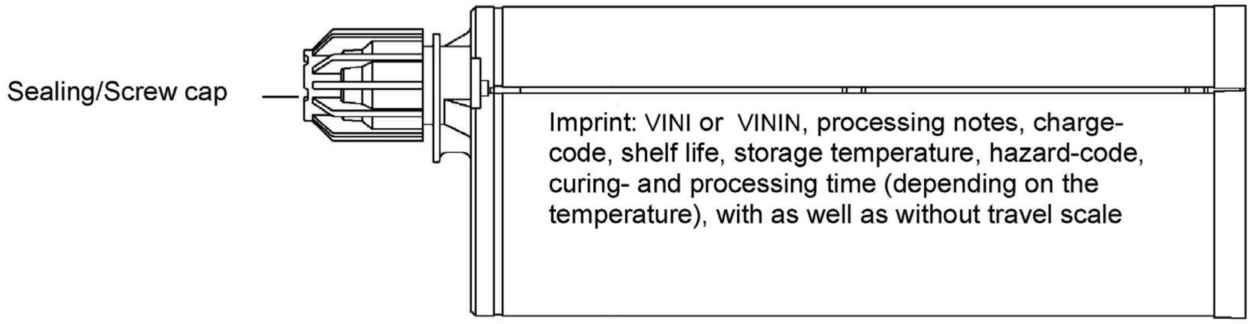
| RESINA VINILESTER + SIN ESTIRENO LUSAN for concrete | Annex A 1 |
|---|---|
| **Product description**<br>Installed condition | |

**Cartridge: VINI or VININ**

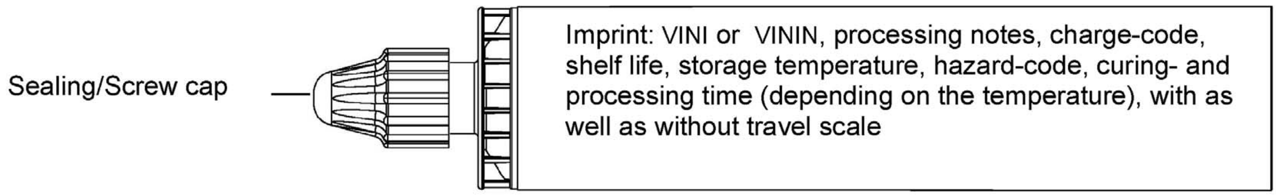
**150 ml, 280 ml, 300 ml up to 333 ml and 380 ml up to 420 ml cartridge (Type: coaxial)**



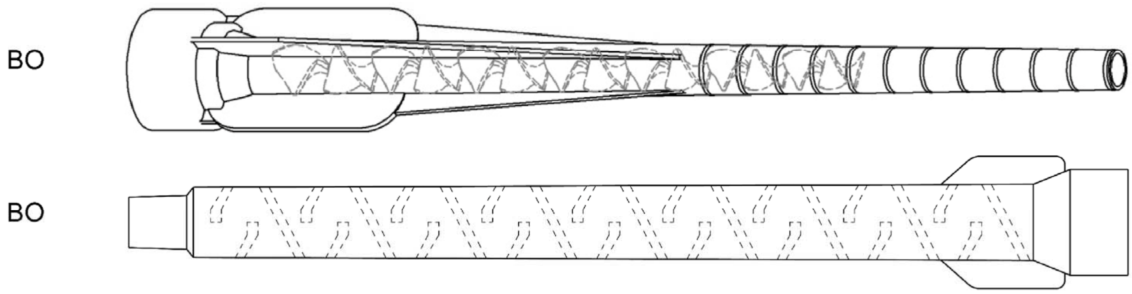

**235 ml, 345 ml up to 360 ml and 825 ml cartridge (Type: "side-by-side")**




**165 ml and 300 ml cartridge (Type: "foil tube")**

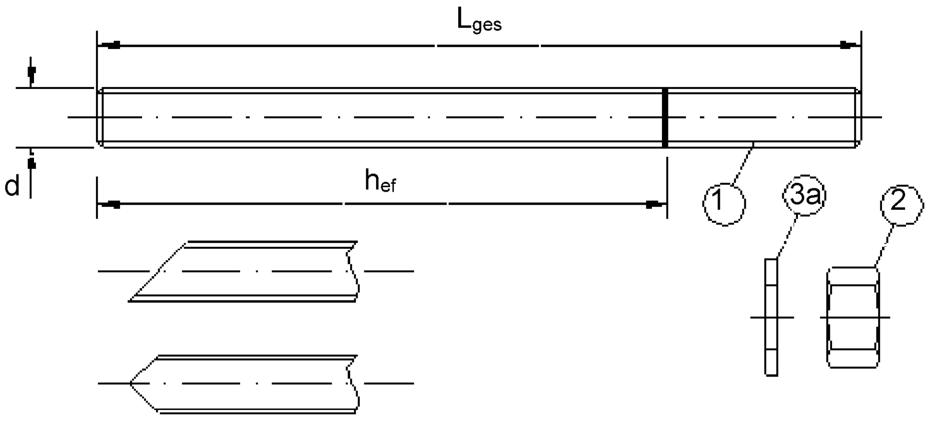



**Static Mixer**




| | |
|---|---|
| **RESINA VINILESTER + SIN ESTIRENO LUSAN for concrete** | **Annex A 2** |
| **Product description**<br>Injection system | |

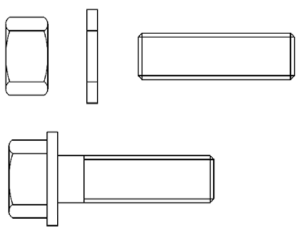
## Threaded rod M8, M10, M12, M16, M20, M24, M27, M30 with washer and hexagon nut



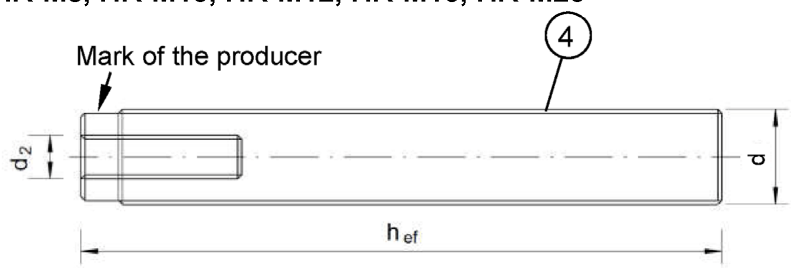

Commercial standard threaded rod with:
- Materials, dimensions and mechanical properties acc. Table A1
- Inspection certificate 3.1 acc. to EN 10204:2004
- Marking of embedment depth

## Internal threaded anchor rod HR-M6, HR-M8, HR-M10, HR-M12, HR-M16, HR-M20

Threaded rod or screw



Mark of the producer



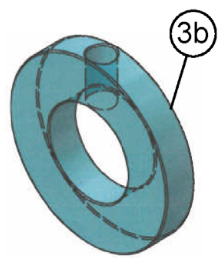

Marking: e.g. ◇I◇ M8

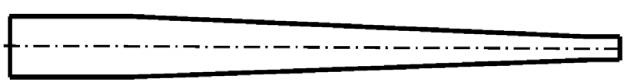
**I** Marking Internal thread

◇ Mark

| | |
|---|---|
| M8 | Thread size (Internal thread) |
| A4 | additional mark for stainless steel |
| HCR | additional mark for high-corrosion resistance steel |

## Filling washer and mixer reduction nozzle for filling the annular gap between anchor rod and fixture



| RESINA VINILESTER + SIN ESTIRENO LUSAN for concrete | Annex A 3 |
|---|---|
| **Product description**<br>Threaded rod, internal threaded rod and filling washer | |

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**Table A1: Materials**

| Part | Designation | Material | | | | |
|---|---|---|---|---|---|---|
| **Steel, zinc plated** (Steel acc. to EN ISO 683-4:2018 or EN 10263:2001)<br>- zinc plated ≥ 5 µm acc. to EN ISO 4042:2018 or<br>- hot-dip galvanised ≥ 40 µm acc. to EN ISO 1461:2009 and EN ISO 10684:2004+AC:2009 or<br>- sherardized ≥ 45 µm acc. to EN ISO 17668:2016 | | | | | | |
| 1 | Threaded rod | Property class | | Characteristic tensile strength | Characteristic yield strength | Elongation at fracture |
| | | acc. to EN ISO 898-1:2013 | 4.6 | $f_{uk}$ = 400 N/mm² | $f_{yk}$ = 240 N/mm² | $A_5$ > 8% |
| | | | 4.8 | $f_{uk}$ = 400 N/mm² | $f_{yk}$ = 320 N/mm² | $A_5$ > 8% |
| | | | 5.6 | $f_{uk}$ = 500 N/mm² | $f_{yk}$ = 300 N/mm² | $A_5$ > 8% |
| | | | 5.8 | $f_{uk}$ = 500 N/mm² | $f_{yk}$ = 400 N/mm² | $A_5$ > 8% |
| | | | 8.8 | $f_{uk}$ = 800 N/mm² | $f_{yk}$ = 640 N/mm² | $A_5$ ≥ 8% |
| 2 | Hexagon nut | acc. to EN ISO 898-2:2012 | 4 | for threaded rod class 4.6 or 4.8 | | |
| | | | 5 | for threaded rod class 5.6 or 5.8 | | |
| | | | 8 | for threaded rod class 8.8 | | |
| 3a | Washer | Steel, zinc plated, hot-dip galvanised or sherardized<br>(e.g.: EN ISO 887:2006, EN ISO 7089:2000, EN ISO 7093:2000 or EN ISO 7094:2000) | | | | |
| 3b | Filling washer | Steel, zinc plated, hot-dip galvanised or sherardized | | | | |
| 4 | Internal threaded anchor rod | Property class | | Characteristic tensile strength | Characteristic yield strength | Elongation at fracture |
| | | acc. to EN ISO 898-1:2013 | 5.8 | $f_{uk}$ = 500 N/mm² | $f_{yk}$ = 400 N/mm² | $A_5$ > 8% |
| | | | 8.8 | $f_{uk}$ = 800 N/mm² | $f_{yk}$ = 640 N/mm² | $A_5$ > 8% |
| **Stainless steel A2** (Material 1.4301 / 1.4307 / 1.4311 / 1.4567 or 1.4541, acc. to EN 10088-1:2014)<br>**Stainless steel A4** (Material 1.4401 / 1.4404 / 1.4571 / 1.4362 or 1.4578, acc. to EN 10088-1:2014)<br>**High corrosion resistance steel** (Material 1.4529 or 1.4565, acc. to EN 10088-1: 2014) | | | | | | |
| 1 | Threaded rod[1)3)] | Property class | | Characteristic tensile strength | Characteristic yield strength | Elongation at fracture |
| | | acc. to EN ISO 3506-1:2020 | 50 | $f_{uk}$ = 500 N/mm² | $f_{yk}$ = 210 N/mm² | $A_5$ ≥ 8% |
| | | | 70 | $f_{uk}$ = 700 N/mm² | $f_{yk}$ = 450 N/mm² | $A_5$ ≥ 8% |
| | | | 80 | $f_{uk}$ = 800 N/mm² | $f_{yk}$ = 600 N/mm² | $A_5$ ≥ 8% |
| 2 | Hexagon nut [1)3)] | acc. to EN ISO 3506-1:2020 | 50 | for threaded rod class 50 | | |
| | | | 70 | for threaded rod class 70 | | |
| | | | 80 | for threaded rod class 80 | | |
| 3a | Washer | A2: Material 1.4301 / 1.4307 / 1.4311 / 1.4567 or 1.4541, acc. to EN 10088-1:2014<br>A4: Material 1.4401 / 1.4404 / 1.4571 / 1.4362 or 1.4578, acc. to EN 10088-1:2014<br>HCR: Material 1.4529 or 1.4565, acc. to EN 10088-1: 2014<br>(e.g.: EN ISO 887:2006, EN ISO 7089:2000, EN ISO 7093:2000 or EN ISO 7094:2000) | | | | |
| 3b | Filling washer | Stainless steel A4, High corrosion resistance steel | | | | |
| 4 | Internal threaded anchor rod[1)2)] | Property class | | Characteristic tensile strength | Characteristic yield strength | Elongation at fracture |
| | | acc. to EN ISO 3506-1:2020 | 50 | $f_{uk}$ = 500 N/mm² | $f_{yk}$ = 210 N/mm² | $A_5$ > 8% |
| | | | 70 | $f_{uk}$ = 700 N/mm² | $f_{yk}$ = 450 N/mm² | $A_5$ > 8% |

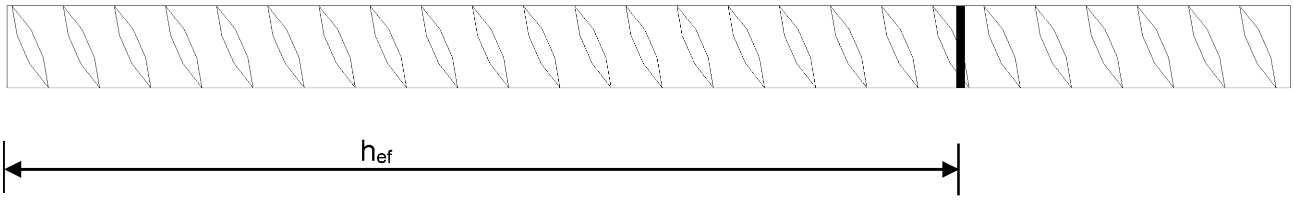
[1)] Property class 70 for threaded rods up to M24 and Internal threaded anchor rods up to HR-M16,
[2)] for HR-M20 only property class 50
[3)] Property class 80 only for stainless steel A4

**RESINA VINILESTER + SIN ESTIRENO LUSAN for concrete**

**Product description**
Materials threaded rod and internal threaded rod

**Annex A 4**

## Reinforcing bar ∅ 8, ∅ 10, ∅ 12, ∅ 14, ∅ 16, ∅ 20, ∅ 25, ∅ 28, ∅ 32




- Minimum value of related rip area $f_{R,min}$ according to EN 1992-1-1:2004+AC:2010
- Rib height of the bar shall be in the range 0,05d ≤ h ≤ 0,07d
  (d: Nominal diameter of the bar; h: Rip height of the bar)

**Table A2: Materials**

| Part | Designation | Material |
|---|---|---|
| **Reinforcing bars** | | |
| 1 | Rebar<br>EN 1992-1-1:2004+AC:2010, Annex C | Bars and de-coiled rods class B or C<br>$f_{yk}$ and k according to NDP or NCL of EN 1992-1-1/NA<br>$f_{uk} = f_{tk} = k \cdot f_{yk}$ |

**RESINA VINILESTER + SIN ESTIRENO LUSAN for concrete**

**Product description**
Materials reinforcing bar

**Annex A 5**

**Specifications of intended use**

**Anchorages subject to:**
- Static and quasi-static loads: M8 to M30, Rebar Ø8 to Ø32, HR-M6 to HR-M20.
- Seismic action for Performance Category C1: M8 to M30, Rebar Ø8 to Ø32.

**Base materials:**
- Compacted, reinforced or unreinforced normal weight concrete without fibres according to EN 206:2013 + A1:2016.
- Strength classes C20/25 to C50/60 according to EN 206:2013 + A1:2016.
- Uncracked concrete: M8 to M30, Rebar Ø8 to Ø32, HR-M6 to HR-M20.
- Cracked concrete: M8 to M30, Rebar Ø8 to Ø32, HR-M6 to HR-M20.

**Temperature Range:**
- I: - 40 °C to +40 °C (max long term temperature +24 °C and max short term temperature +40 °C)
- II: - 40 °C to +80 °C (max long term temperature +50 °C and max short term temperature +80 °C)
- III: - 40 °C to +120 °C (max long term temperature +72 °C and max short term temperature +120 °C)

**Use conditions (Environmental conditions):**
- Structures subject to dry internal conditions (all materials).
- For all other conditions according to EN 1993-1-4:2006+A1:2015 corresponding to corrosion resistance class:
  - Stainless steel Stahl A2 according to Annex A 4, Table A1: CRC II
  - Stainless steel Stahl A4 according to Annex A 4, Table A1: CRC III
  - High corrosion resistance steel HCR according to Annex A 4, Table A1: CRC V

**Design:**
- Verifiable calculation notes and drawings are prepared taking account of the loads to be anchored. The position of the anchor is indicated on the design drawings (e. g. position of the anchor relative to reinforcement or to supports, etc.).
- Anchorages are designed under the responsibility of an engineer experienced in anchorages and concrete work.
- The anchorages are designed in accordance to EN 1992-4:2018 and Technical Report TR055, Edition February 2018

**Installation:**
- Dry or wet concrete: M8 to M30, Rebar Ø8 to Ø32, HR-M6 to HR-M20.
- Flooded holes (not sea water): M8 to M16, Rebar Ø8 to Ø16, HR-M6 to HR-M10.
- Hole drilling by hammer (HD), hollow (HDB) or compressed air drill mode (CD).
- Overhead installation allowed.
- Anchor installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site.
- The injection mortar is assessed for installation at minimum concrete temperature of -10°C resp. -20°C, where subsequently the temperature in the concrete does not rise at a rapid rate, i.e. from the minimum installation temperature to 24°C within a 12-hour period.

**Table B1: Installation parameters for threaded rod**

| Anchor size | | M8 | M10 | M12 | M16 | M20 | M24 | M27 | M30 |
|---|---|---|---|---|---|---|---|---|---|
| Outer diameter of anchor | $d_{nom}$ [mm] = | 8 | 10 | 12 | 16 | 20 | 24 | 27 | 30 |
| Nominal drill hole diameter | $d_0$ [mm] = | 10 | 12 | 14 | 18 | 24 | 28 | 32 | 35 |
| Effective embedment depth | $h_{ef,min}$ [mm] = | 60 | 60 | 70 | 80 | 90 | 96 | 108 | 120 |
| | $h_{ef,max}$ [mm] = | 160 | 200 | 240 | 320 | 400 | 480 | 540 | 600 |
| Diameter of clearance hole in the fixture | $d_f$ [mm] ≤ | 9 | 12 | 14 | 18 | 22 | 26 | 30 | 33 |
| Diameter of steel brush | $d_b$ [mm] ≥ | 12 | 14 | 16 | 20 | 26 | 30 | 34 | 37 |
| Maximum torque moment | max $T_{inst}$ [Nm] ≤ | 10 | 20 | 40 | 80 | 120 | 160 | 180 | 200 |
| Minimum thickness of member | $h_{min}$ [mm] | $h_{ef}$ + 30 mm ≥ 100 mm | | | $h_{ef} + 2d_0$ | | | | |
| Minimum spacing | $s_{min}$ [mm] | 40 | 50 | 60 | 80 | 100 | 120 | 135 | 150 |
| Minimum edge distance | $c_{min}$ [mm] | 40 | 50 | 60 | 80 | 100 | 120 | 135 | 150 |

**Table B2: Installation parameters for rebar**

| Rebar size | | Ø 8 | Ø 10 | Ø 12 | Ø 14 | Ø 16 | Ø 20 | Ø 25 | Ø 28 | Ø 32 |
|---|---|---|---|---|---|---|---|---|---|---|
| Outer diameter of anchor | $d_{nom}$ [mm] = | 8 | 10 | 12 | 14 | 16 | 20 | 25 | 28 | 32 |
| Nominal drill hole diameter | $d_0$ [mm] = | 12 | 14 | 16 | 18 | 20 | 24 | 32 | 35 | 40 |
| Effective embedment depth | $h_{ef,min}$ [mm] = | 60 | 60 | 70 | 75 | 80 | 90 | 100 | 112 | 128 |
| | $h_{ef,max}$ [mm] = | 160 | 200 | 240 | 280 | 320 | 400 | 500 | 580 | 640 |
| Diameter of steel brush | $d_b$ [mm] ≥ | 14 | 16 | 18 | 20 | 22 | 26 | 34 | 37 | 41,5 |
| Minimum thickness of member | $h_{min}$ [mm] | $h_{ef}$ + 30 mm ≥ 100 mm | | $h_{ef} + 2d_0$ | | | | | | |
| Minimum spacing | $s_{min}$ [mm] | 40 | 50 | 60 | 70 | 80 | 100 | 125 | 140 | 160 |
| Minimum edge distance | $c_{min}$ [mm] | 40 | 50 | 60 | 70 | 80 | 100 | 125 | 140 | 160 |

**Table B3: Installation parameters for internal threaded anchor rod**

| Size internal threaded anchor rod | | HR-M6 | HR-M8 | HR-M10 | HR-M12 | HR-M16 | HR-M20 |
|---|---|---|---|---|---|---|---|
| Internal diameter of anchor | $d_2$ [mm] = | 6 | 8 | 10 | 12 | 16 | 20 |
| Outer diameter of anchor [1)] | $d_{nom}$ [mm] = | 10 | 12 | 16 | 20 | 24 | 30 |
| Nominal drill hole diameter | $d_0$ [mm] = | 12 | 14 | 18 | 22 | 28 | 35 |
| Effective embedment depth | $h_{ef,min}$ [mm] = | 60 | 70 | 80 | 90 | 96 | 120 |
| | $h_{ef,max}$ [mm] = | 200 | 240 | 320 | 400 | 480 | 600 |
| Diameter of clearance hole in the fixture | $d_f$ [mm] = | 7 | 9 | 12 | 14 | 18 | 22 |
| Maximum torque moment | max $T_{inst}$ [Nm] ≤ | 10 | 10 | 20 | 40 | 60 | 100 |
| Thread engagement length min/max | $l_{IG}$ [mm] = | 8/20 | 8/20 | 10/25 | 12/30 | 16/32 | 20/40 |
| Minimum thickness of member | $h_{min}$ [mm] | $h_{ef}$ + 30 mm ≥ 100 mm | | $h_{ef} + 2d_0$ | | | |
| Minimum spacing | $s_{min}$ [mm] | 50 | 60 | 80 | 100 | 120 | 150 |
| Minimum edge distance | $c_{min}$ [mm] | 50 | 60 | 80 | 100 | 120 | 150 |

[1)] With metric threads according to EN 1993-1-8:2005+AC:2009

| | |
|---|---|
| **RESINA VINILESTER + SIN ESTIRENO LUSAN for concrete** | **Annex B 2** |
| **Intended Use**<br>Installation parameters | |

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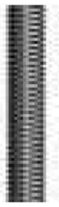
**Table B4: Parameter cleaning and setting tools**

|  |  |  |  |  | | |  | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Threaded Rod** | **Rebar** | **Internal threaded Anchor rod** | **$d_0$ Drill bit - ∅ HD, HDB, CA** | **$d_b$ Brush - ∅** | | **$d_{b,min}$ min. Brush - ∅** | **Piston plug** | **Installation direction and use of piston plug** | | |
| [mm] | [mm] | [mm] | [mm] | | [mm] | [mm] | | ↓ | → | ↑ |
| M8 | | | 10 | C1-10 | 12 | 10,5 | No piston plug required | | | |
| M10 | 8 | HR-M6 | 12 | C1-12 | 14 | 12,5 | | | | |
| M12 | 10 | HR-M8 | 14 | C1-14 | 16 | 14,5 | | | | |
| | 12 | | 16 | C1-16 | 18 | 16,5 | | | | |
| M16 | 14 | HR-M10 | 18 | C1-18 | 20 | 18,5 | VS18 | $h_{ef}$ > 250 mm | $h_{ef}$ > 250 mm | all |
| | 16 | | 20 | C1-20 | 22 | 20,5 | VS20 | | | |
| M20 | 20 | HR-M12 | 24 | C1-24 | 26 | 24,5 | VS24 | | | |
| M24 | | HR-M16 | 28 | C1-28 | 30 | 28,5 | VS28 | | | |
| M27 | 25 | | 32 | C1-32 | 34 | 32,5 | VS32 | | | |
| M30 | 28 | HR-M20 | 35 | C1-35 | 37 | 35,5 | VS35 | | | |
| | 32 | | 40 | C1-40 | 41,5 | 40,5 | VS40 | | | |

**MAC - Hand pump (volume 750 ml)**
Drill bit diameter ($d_0$): 10 mm to 20 mm
Drill hole depth ($h_0$): < 10 $d_{nom}$
Only in uncracked concrete

**CAC - Rec. compressed air tool (min 6 bar)**
Drill bit diameter ($d_0$): all diameters

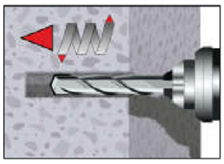
**Piston plug for overhead or horizontal installation VS**
Drill bit diameter ($d_0$): 18 mm to 40 mm


**Steel brush C1-**
Drill bit diameter ($d_0$): all diameters

| **RESINA VINILESTER + SIN ESTIRENO LUSAN for concrete** | **Annex B 3** |
|---|---|
| **Intended Use**<br>Cleaning and setting tools | |

## Installation instructions

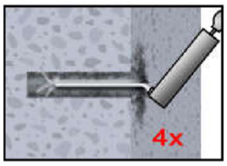
### Drilling of the bore hole



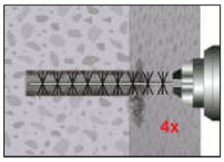
1. Drill with hammer drill a hole into the base material to the size and embedment depth required by the selected anchor (Table B1, B2, or B3), with hammer (HD), hollow (HDB) or compressed air (CD) drilling. The use of a hollow drill bit is only in combination with a sufficient vacuum permitted.
In case of aborted drill hole: The drill hole shall be filled with mortar

**Attention! Standing water in the bore hole must be removed before cleaning.**

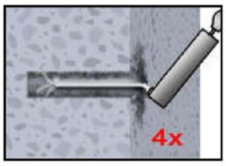
### MAC: Cleaning for bore hole diameter $d_0 \leq$ 20mm and bore hole depth $h_0 \leq 10d_{nom}$ (uncracked concrete only!)




2a. Starting from the bottom or back of the bore hole, blow the hole clean by a hand pump [1] (Annex B 3) a minimum of four times.



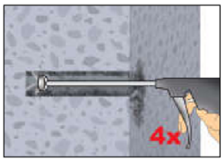

2b. Check brush diameter (Table B4). Brush the hole with an appropriate sized wire brush > $d_{b,min}$ (Table B4) a minimum of four times in a twisting motion.
If the bore hole ground is not reached with the brush, a brush extension must be used.



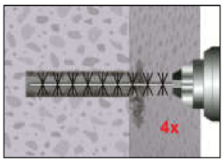

2c. Finally blow the hole clean again with a hand pump (Annex B 3) a minimum of four times.

[1] It is permitted to blow bore holes with diameter between 14 mm and 20 mm and an embedment depth up to $10d_{nom}$ also in cracked concrete with hand-pump.

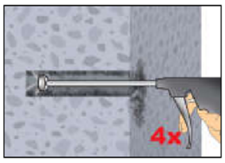
### CAC: Cleaning for all bore hole diameter in uncracked and cracked concrete




2a. Starting from the bottom or back of the bore hole, blow the hole clean with compressed air (min. 6 bar) (Annex B 3) a minimum of four times until return air stream is free of noticeable dust. If the bore hole ground is not reached an extension must be used.




2b. Check brush diameter (Table B4). Brush the hole with an appropriate sized wire brush > $d_{b,min}$ (Table B4) a minimum of four times in a twisting motion.
If the bore hole ground is not reached with the brush, a brush extension must be used.

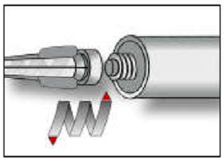



2c. Finally blow the hole clean again with compressed air (min. 6 bar) (Annex B 3) a minimum of four times until return air stream is free of noticeable dust. If the bore hole ground is not reached an extension must be used.

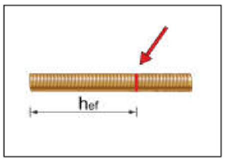
**After cleaning, the bore hole has to be protected against re-contamination in an appropriate way, until dispensing the mortar in the bore hole. If necessary, the cleaning has to be repeated directly before dispensing the mortar.**
**In-flowing water must not contaminate the bore hole again.**

| | |
|---|---|
| **RESINA VINILESTER + SIN ESTIRENO LUSAN for concrete** | **Annex B 4** |
| **Intended Use**<br>Installation instructions | |

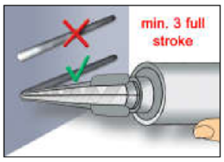
**Installation instructions (continuation)**



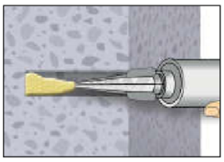
3. Attach the supplied static-mixing nozzle to the cartridge and load the cartridge into the correct dispensing tool. Cut off the foil tube clip before use.
For every working interruption longer than the recommended working time (Annex B 6) as well as for new cartridges, a new static-mixer shall be used.



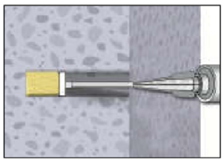

4. Prior to inserting the anchor rod into the filled bore hole, the position of the embedment depth shall be marked on the anchor rods.



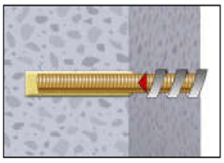

5. Prior to dispensing into the anchor hole, squeeze out separately a minimum of three full strokes and discard non-uniformly mixed adhesive components until the mortar shows a consistent grey colour. For foil tube cartridges it must be discarded a minimum of six full strokes.



6. Starting from the bottom or back of the cleaned anchor hole, fill the hole up to approximately two-thirds with adhesive. Slowly withdraw the static mixing nozzle as the hole fills to avoid creating air pockets. If the bottom or back of the anchor hole is not reached, an appropriate extension nozzle must be used. Observe the gel-/ working times given in Annex B 6.

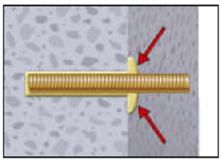


7. Piston plugs and mixer nozzle extensions shall be used according to Table B4 for the following applications:
   - Horizontal assembly (horizontal direction) and ground erection (vertical downwards direction): Drill bit-Ø $d_0 \geq 18$ mm and embedment depth $h_{ef} > 250$mm
   - Overhead assembly (vertical upwards direction): Drill bit-Ø $d_0 \geq 18$ mm

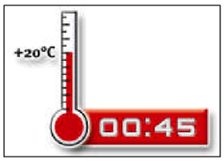


8. Push the threaded rod or reinforcing bar into the anchor hole while turning slightly to ensure positive distribution of the adhesive until the embedment depth is reached.

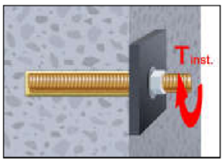
   The anchor shall be free of dirt, grease, oil or other foreign material.



9. Be sure that the anchor is fully seated at the bottom of the hole and that excess mortar is visible at the top of the hole. If these requirements are not maintained, the application has to be renewed. For overhead application the anchor rod shall be fixed (e.g. wedges).




10. Allow the adhesive to cure to the specified time prior to applying any load or torque. Do not move or load the anchor until it is fully cured (attend Annex B 6).




11. After full curing, the add-on part can be installed with up to the max. torque (Table B1 or B3) by using a calibrated torque wrench. It can be optional filled the annular gap between anchor and fixture with mortar. Therefor substitute the washer by the filling washer and connect the mixer reduction nozzle to the tip of the mixer. The annular gap is filled with mortar, when mortar oozes out of the washer.

| | |
|---|---|
| **RESINA VINILESTER + SIN ESTIRENO LUSAN for concrete** | **Annex B 5** |
| **Intended Use**<br>Installation instructions (continuation) | |

**Table B5: Maximum working time and minimum curing time VINI**

| Concrete temperature | Gelling- / working time | Minimum curing time in dry concrete [1] |
|---|---|---|
| -10 °C to -6°C | 90 min[2] | 24 h[2] |
| -5 °C to -1°C | 90 min | 14 h |
| 0 °C to +4°C | 45 min | 7 h |
| +5 °C to +9°C | 25 min | 2 h |
| + 10 °C to +19°C | 15 min | 80 min |
| + 20 °C to +29°C | 6 min | 45 min |
| + 30 °C to +34°C | 4 min | 25 min |
| + 35 °C to +39°C | 2 min | 20 min |
| + 40 °C | 1,5 min | 15 min |
| Cartridge temperature | +5°C to +40°C | |

[1] In wet concrete the curing time must be doubled.
[2] Cartridge temperature must be at min. +15°C.

**Table B6: Maximum working time and minimum curing time VININ**

| Concrete temperature | Gelling- / working time | Minimum curing time in dry concrete [1] |
|---|---|---|
| -20 °C to -16°C | 75 min | 24 h |
| -15 °C to -11°C | 55 min | 16 h |
| -10 °C to -6°C | 35 min | 10 h |
| -5 °C to -1°C | 20 min | 5 h |
| 0 °C to +4°C | 10 min | 2,5 h |
| +5 °C to +9°C | 6 min | 80 Min |
| + 10 °C | 6 min | 60 Min |
| Cartridge temperature | -20°C to +10°C | |

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

**RESINA VINILESTER + SIN ESTIRENO LUSAN for concrete**

**Intended Use**
Curing time

**Annex B 6**

| **Table C1:** | **Characteristic values for steel tension resistance and steel shear resistance of threaded rods** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Size** | | | | **M8** | **M10** | **M12** | **M16** | **M20** | **M24** | **M27** | **M30** |
| Cross section area | | $A_s$ | [mm²] | 36,6 | 58 | 84,3 | 157 | 245 | 353 | 459 | 561 |
| Characteristic tension resistance, Steel failure [1] | | | | | | | | | | | |
| Steel, Property class 4.6 and 4.8 | | $N_{Rk,s}$ | [kN] | 15 (13) | 23 (21) | 34 | 63 | 98 | 141 | 184 | 224 |
| Steel, Property class 5.6 and 5.8 | | $N_{Rk,s}$ | [kN] | 18 (17) | 29 (27) | 42 | 78 | 122 | 176 | 230 | 280 |
| Steel, Property class 8.8 | | $N_{Rk,s}$ | [kN] | 29 (27) | 46 (43) | 67 | 125 | 196 | 282 | 368 | 449 |
| Stainless steel A2, A4 and HCR, class 50 | | $N_{Rk,s}$ | [kN] | 18 | 29 | 42 | 79 | 123 | 177 | 230 | 281 |
| Stainless steel A2, A4 and HCR, class 70 | | $N_{Rk,s}$ | [kN] | 26 | 41 | 59 | 110 | 171 | 247 | -[3] | -[3] |
| Stainless steel A4 and HCR, class 80 | | $N_{Rk,s}$ | [kN] | 29 | 46 | 67 | 126 | 196 | 282 | -[3] | -[3] |
| Characteristic tension resistance, Partial factor [2] | | | | | | | | | | | |
| Steel, Property class 4.6 and 5.6 | | $\gamma_{Ms,N}$ | [-] | 2,0 | | | | | | | |
| Steel, Property class 4.8, 5.8 and 8.8 | | $\gamma_{Ms,N}$ | [-] | 1,5 | | | | | | | |
| Stainless steel A2, A4 and HCR, class 50 | | $\gamma_{Ms,N}$ | [-] | 2,86 | | | | | | | |
| Stainless steel A2, A4 and HCR, class 70 | | $\gamma_{Ms,N}$ | [-] | 1,87 | | | | | | | |
| Stainless steel A4 and HCR, class 80 | | $\gamma_{Ms,N}$ | [-] | 1,6 | | | | | | | |
| Characteristic shear resistance, Steel failure [1] | | | | | | | | | | | |
| Without lever arm | Steel, Property class 4.6 and 4.8 | $V^0_{Rk,s}$ | [kN] | 9 (8) | 14 (13) | 20 | 38 | 59 | 85 | 110 | 135 |
| | Steel, Property class 5.6 and 5.8 | $V^0_{Rk,s}$ | [kN] | 11 (10) | 17 (16) | 25 | 47 | 74 | 106 | 138 | 168 |
| | Steel, Property class 8.8 | $V^0_{Rk,s}$ | [kN] | 15 (13) | 23 (21) | 34 | 63 | 98 | 141 | 184 | 224 |
| | Stainless steel A2, A4 and HCR, class 50 | $V^0_{Rk,s}$ | [kN] | 9 | 15 | 21 | 39 | 61 | 88 | 115 | 140 |
| | Stainless steel A2, A4 and HCR, class 70 | $V^0_{Rk,s}$ | [kN] | 13 | 20 | 30 | 55 | 86 | 124 | -[3] | -[3] |
| | Stainless steel A4 and HCR, class 80 | $V^0_{Rk,s}$ | [kN] | 15 | 23 | 34 | 63 | 98 | 141 | -[3] | -[3] |
| With lever arm | Steel, Property class 4.6 and 4.8 | $M^0_{Rk,s}$ | [Nm] | 15 (13) | 30 (27) | 52 | 133 | 260 | 449 | 666 | 900 |
| | Steel, Property class 5.6 and 5.8 | $M^0_{Rk,s}$ | [Nm] | 19 (16) | 37 (33) | 65 | 166 | 324 | 560 | 833 | 1123 |
| | Steel, Property class 8.8 | $M^0_{Rk,s}$ | [Nm] | 30 (26) | 60 (53) | 105 | 266 | 519 | 896 | 1333 | 1797 |
| | Stainless steel A2, A4 and HCR, class 50 | $M^0_{Rk,s}$ | [Nm] | 19 | 37 | 66 | 167 | 325 | 561 | 832 | 1125 |
| | Stainless steel A2, A4 and HCR, class 70 | $M^0_{Rk,s}$ | [Nm] | 26 | 52 | 92 | 232 | 454 | 784 | -[3] | -[3] |
| | Stainless steel A4 and HCR, class 80 | $M^0_{Rk,s}$ | [Nm] | 30 | 59 | 105 | 266 | 519 | 896 | -[3] | -[3] |
| Characteristic shear resistance, Partial factor [2] | | | | | | | | | | | |
| Steel, Property class 4.6 and 5.6 | | $\gamma_{Ms,V}$ | [-] | 1,67 | | | | | | | |
| Steel, Property class 4.8, 5.8 and 8.8 | | $\gamma_{Ms,V}$ | [-] | 1,25 | | | | | | | |
| Stainless steel A2, A4 and HCR, class 50 | | $\gamma_{Ms,V}$ | [-] | 2,38 | | | | | | | |
| Stainless steel A2, A4 and HCR, class 70 | | $\gamma_{Ms,V}$ | [-] | 1,56 | | | | | | | |
| Stainless steel A4 and HCR, class 80 | | $\gamma_{Ms,V}$ | [-] | 1,33 | | | | | | | |

1) Values are only valid for the given stress area $A_s$. Values in brackets are valid for undersized threaded rods with smaller stress area $A_s$ for hot-dip galvanised threaded rods according to EN ISO 10684:2004+AC:2009.
2) in absence of national regulation
3) Anchor type not part of the ETA



| **RESINA VINILESTER + SIN ESTIRENO LUSAN for concrete** | **Annex C 1** |
|---|---|
| **Performances**<br>Characteristic values for steel tension resistance and steel shear resistance of threaded rods | |

**Table C2: Characteristic values for Concrete cone failure and Splitting with all kind of action**

| Anchor size | | | | All Anchor types and sizes |
|---|---|---|---|---|
| **Concrete cone failure** | | | | |
| Uncracked concrete | | $k_{ucr,N}$ | [-] | 11,0 |
| Cracked concrete | | $k_{cr,N}$ | [-] | 7,7 |
| Edge distance | | $c_{cr,N}$ | [mm] | 1,5 $h_{ef}$ |
| Axial distance | | $s_{cr,N}$ | [mm] | 2 $c_{cr,N}$ |
| **Splitting** | | | | |
| Edge distance | $h/h_{ef} \geq 2,0$ | $c_{cr,sp}$ | [mm] | 1,0 $h_{ef}$ |
| | $2,0 > h/h_{ef} > 1,3$ | | | $2 \cdot h_{ef} \left( 2,5 - \frac{h}{h_{ef}} \right)$ |
| | $h/h_{ef} \leq 1,3$ | | | 2,4 $h_{ef}$ |
| Axial distance | | $s_{cr,sp}$ | [mm] | 2 $c_{cr,sp}$ |

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**Table C3: Characteristic values of tension loads under static and quasi-static action**

| Anchor size threaded rod | | | | | M8 | M10 | M12 | M16 | M20 | M24 | M27 | M30 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Steel failure | | | | | | | | | | | | |
| Characteristic tension resistance | | $N_{Rk,s}$ | [kN] | | $A_s \cdot f_{uk}$ (or see Table C1) | | | | | | | |
| Partial factor | | $\gamma_{Ms,N}$ | [-] | | see Table C1 | | | | | | | |
| **Combined pull-out and concrete failure** | | | | | | | | | | | | |
| Characteristic bond resistance in uncracked concrete C20/25 | | | | | | | | | | | | |
| Temperature range I: 40°C/24°C | Dry, wet concrete | $\tau_{Rk,ucr}$ | [N/mm²] | | 10 | 12 | 12 | 12 | 12 | 11 | 10 | 9 |
| Temperature range II: 80°C/50°C | Dry, wet concrete | $\tau_{Rk,ucr}$ | [N/mm²] | | 7,5 | 9 | 9 | 9 | 9 | 8,5 | 7,5 | 6,5 |
| Temperature range III: 120°C/72°C | Dry, wet concrete | $\tau_{Rk,ucr}$ | [N/mm²] | | 5,5 | 6,5 | 6,5 | 6,5 | 6,5 | 6,5 | 5,5 | 5,0 |
| Temperature range I: 40°C/24°C | flooded bore hole | $\tau_{Rk,ucr}$ | [N/mm²] | | 7,5 | 8,5 | 8,5 | 8,5 | No Performance Assessed | | | |
| Temperature range II: 80°C/50°C | flooded bore hole | $\tau_{Rk,ucr}$ | [N/mm²] | | 5,5 | 6,5 | 6,5 | 6,5 | No Performance Assessed | | | |
| Temperature range III: 120°C/72°C | flooded bore hole | $\tau_{Rk,ucr}$ | [N/mm²] | | 4,0 | 5,0 | 5,0 | 5,0 | No Performance Assessed | | | |
| Characteristic bond resistance in cracked concrete C20/25 | | | | | | | | | | | | |
| Temperature range I: 40°C/24°C | Dry, wet concrete | $\tau_{Rk,cr}$ | [N/mm²] | | 4,0 | 5,0 | 5,5 | 5,5 | 5,5 | 5,5 | 6,5 | 6,5 |
| Temperature range II: 80°C/50°C | Dry, wet concrete | $\tau_{Rk,cr}$ | [N/mm²] | | 2,5 | 3,5 | 4,0 | 4,0 | 4,0 | 4,0 | 4,5 | 4,5 |
| Temperature range III: 120°C/72°C | Dry, wet concrete | $\tau_{Rk,cr}$ | [N/mm²] | | 2,0 | 2,5 | 3,0 | 3,0 | 3,0 | 3,0 | 3,5 | 3,5 |
| Temperature range I: 40°C/24°C | flooded bore hole | $\tau_{Rk,cr}$ | [N/mm²] | | 4,0 | 4,0 | 5,5 | 5,5 | No Performance Assessed | | | |
| Temperature range II: 80°C/50°C | flooded bore hole | $\tau_{Rk,cr}$ | [N/mm²] | | 2,5 | 3,0 | 4,0 | 4,0 | No Performance Assessed | | | |
| Temperature range III: 120°C/72°C | flooded bore hole | $\tau_{Rk,cr}$ | [N/mm²] | | 2,0 | 2,5 | 3,0 | 3,0 | No Performance Assessed | | | |
| Reduktion factor $\psi^0_{sus}$ in cracked and uncracked concrete C20/25 | | | | | | | | | | | | |
| Temperature range I: 40°C/24°C | Dry, wet concrete and flooded bore hole | $\psi^0_{sus}$ | [-] | | 0,73 | | | | | | | |
| Temperature range II: 80°C/50°C | Dry, wet concrete and flooded bore hole | $\psi^0_{sus}$ | [-] | | 0,65 | | | | | | | |
| Temperature range III: 120°C/72°C | Dry, wet concrete and flooded bore hole | $\psi^0_{sus}$ | [-] | | 0,57 | | | | | | | |
| Increasing factors for concrete $\psi_c$ | | C25/30 | | | 1,02 | | | | | | | |
| | | C30/37 | | | 1,04 | | | | | | | |
| | | C35/45 | | | 1,07 | | | | | | | |
| | | C40/50 | | | 1,08 | | | | | | | |
| | | C45/55 | | | 1,09 | | | | | | | |
| | | C50/60 | | | 1,10 | | | | | | | |
| **Concrete cone failure** | | | | | | | | | | | | |
| Relevant parameter | | | | | see Table C2 | | | | | | | |
| **Splitting** | | | | | | | | | | | | |
| Relevant parameter | | | | | see Table C2 | | | | | | | |
| **Installation factor** | | | | | | | | | | | | |
| for dry and wet concrete | | $\gamma_{inst}$ | [-] | | 1,0 | 1,2 | | | | | | |
| for flooded bore hole | | $\gamma_{inst}$ | [-] | | 1,4 | | | | No Performance Assessed | | | |

**RESINA VINILESTER + SIN ESTIRENO LUSAN for concrete**

**Performances**
Characteristic values of tension loads under static and quasi-static action

**Annex C 3**

| **Table C4:** | **Characteristic values of shear loads under static and quasi-static action** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Anchor size threaded rod** | | | **M8** | **M10** | **M12** | **M16** | **M20** | **M24** | **M27** | **M30** |
| **Steel failure without lever arm** | | | | | | | | | | |
| Characteristic shear resistance Steel, strength class 4.6, 4.8, 5.6 and 5.8 | $V^0_{Rk,s}$ | [kN] | $0{,}6 \cdot A_s \cdot f_{uk}$ (or see Table C1) | | | | | | | |
| Characteristic shear resistance Steel, strength class 8.8 Stainless Steel A2, A4 and HCR, all classes | $V^0_{Rk,s}$ | [kN] | $0{,}5 \cdot A_s \cdot f_{uk}$ (or see Table C1) | | | | | | | |
| Partial factor | $\gamma_{Ms,V}$ | [-] | see Table C1 | | | | | | | |
| Ductility factor | $k_7$ | [-] | 1,0 | | | | | | | |
| **Steel failure with lever arm** | | | | | | | | | | |
| Characteristic bending moment | $M^0_{Rk,s}$ | [Nm] | $1{,}2 \cdot W_{el} \cdot f_{uk}$ (or see Table C1) | | | | | | | |
| Elastic section modulus | $W_{el}$ | [mm³] | 31 | 62 | 109 | 277 | 541 | 935 | 1387 | 1874 |
| Partial factor | $\gamma_{Ms,V}$ | [-] | see Table C1 | | | | | | | |
| **Concrete pry-out failure** | | | | | | | | | | |
| Factor | $k_8$ | [-] | 2,0 | | | | | | | |
| Installation factor | $\gamma_{inst}$ | [-] | 1,0 | | | | | | | |
| **Concrete edge failure** | | | | | | | | | | |
| Effective length of fastener | $l_f$ | [mm] | $\min(h_{ef}; 12 \cdot d_{nom})$ | | | | | | $\min(h_{ef}; 300\text{mm})$ | |
| Outside diameter of fastener | $d_{nom}$ | [mm] | 8 | 10 | 12 | 16 | 20 | 24 | 27 | 30 |
| Installation factor | $\gamma_{inst}$ | [-] | 1,0 | | | | | | | |

**Table C5: Characteristic values of tension loads under static and quasi-static action**

| Anchor size internal threaded anchor rods | | | | HR-M6 | HR-M8 | HR-M10 | HR-M12 | HR-M16 | HR-M20 |
|---|---|---|---|---|---|---|---|---|---|
| **Steel failure**[1] | | | | | | | | | |
| Characteristic tension resistance, Steel, strength class | 5.8 | $N_{Rk,s}$ | [kN] | 10 | 17 | 29 | 42 | 76 | 123 |
| | 8.8 | $N_{Rk,s}$ | [kN] | 16 | 27 | 46 | 67 | 121 | 196 |
| Partial factor, strength class 5.8 and 8.8 | | $\gamma_{Ms,N}$ | [-] | 1,5 | | | | | |
| Characteristic tension resistance, Stainless Steel A4 and HCR, Strength class 70 [2] | | $N_{Rk,s}$ | [kN] | 14 | 26 | 41 | 59 | 110 | 124 |
| Partial factor | | $\gamma_{Ms,N}$ | [-] | 1,87 | | | | | 2,86 |
| **Combined pull-out and concrete cone failure** | | | | | | | | | |
| Characteristic bond resistance in uncracked concrete C20/25 | | | | | | | | | |
| Temperature range I: 40°C/24°C | Dry, wet concrete | $\tau_{Rk,ucr}$ | [N/mm²] | 12 | 12 | 12 | 12 | 11 | 9 |
| Temperature range II: 80°C/50°C | Dry, wet concrete | $\tau_{Rk,ucr}$ | [N/mm²] | 9 | 9 | 9 | 9 | 8,5 | 6,5 |
| Temperature range III: 120°C/72°C | Dry, wet concrete | $\tau_{Rk,ucr}$ | [N/mm²] | 6,5 | 6,5 | 6,5 | 6,5 | 6,5 | 5,0 |
| Temperature range I: 40°C/24°C | flooded bore hole | $\tau_{Rk,ucr}$ | [N/mm²] | 8,5 | 8,5 | 8,5 | No Performance Assessed | | |
| Temperature range II: 80°C/50°C | flooded bore hole | $\tau_{Rk,ucr}$ | [N/mm²] | 6,5 | 6,5 | 6,5 | No Performance Assessed | | |
| Temperature range III: 120°C/72°C | flooded bore hole | $\tau_{Rk,ucr}$ | [N/mm²] | 5,0 | 5,0 | 5,0 | No Performance Assessed | | |
| Characteristic bond resistance in cracked concrete C20/25 | | | | | | | | | |
| Temperature range I: 40°C/24°C | Dry, wet concrete | $\tau_{Rk,cr}$ | [N/mm²] | 5,0 | 5,5 | 5,5 | 5,5 | 5,5 | 6,5 |
| Temperature range II: 80°C/50°C | Dry, wet concrete | $\tau_{Rk,cr}$ | [N/mm²] | 3,5 | 4,0 | 4,0 | 4,0 | 4,0 | 4,5 |
| Temperature range III: 120°C/72°C | Dry, wet concrete | $\tau_{Rk,cr}$ | [N/mm²] | 2,5 | 3,0 | 3,0 | 3,0 | 3,0 | 3,5 |
| Temperature range I: 40°C/24°C | flooded bore hole | $\tau_{Rk,cr}$ | [N/mm²] | 4,0 | 5,5 | 5,5 | No Performance Assessed | | |
| Temperature range II: 80°C/50°C | flooded bore hole | $\tau_{Rk,cr}$ | [N/mm²] | 3,0 | 4,0 | 4,0 | No Performance Assessed | | |
| Temperature range III: 120°C/72°C | flooded bore hole | $\tau_{Rk,cr}$ | [N/mm²] | 2,5 | 3,0 | 3,0 | No Performance Assessed | | |
| Reduktion factor $\psi^0_{sus}$ in cracked and uncracked concrete C20/25 | | | | | | | | | |
| Temperature range I: 40°C/24°C | Dry, wet concrete and flooded bore hole | $\psi^0_{sus}$ | [-] | 0,73 | | | | | |
| Temperature range II: 80°C/50°C | Dry, wet concrete and flooded bore hole | $\psi^0_{sus}$ | [-] | 0,65 | | | | | |
| Temperature range III: 120°C/72°C | Dry, wet concrete and flooded bore hole | $\psi^0_{sus}$ | [-] | 0,57 | | | | | |
| Increasing factors for concrete $\psi_c$ | | C25/30 | | 1,02 | | | | | |
| | | C30/37 | | 1,04 | | | | | |
| | | C35/45 | | 1,07 | | | | | |
| | | C40/50 | | 1,08 | | | | | |
| | | C45/55 | | 1,09 | | | | | |
| | | C50/60 | | 1,10 | | | | | |
| **Concrete cone failure** | | | | | | | | | |
| Relevant parameter | | | | see Table C2 | | | | | |
| **Splitting failure** | | | | | | | | | |
| Relevant parameter | | | | see Table C2 | | | | | |
| **Installation factor** | | | | | | | | | |
| for dry and wet concrete | | $\gamma_{inst}$ | [-] | 1,2 | | | | | |
| for flooded bore hole | | $\gamma_{inst}$ | [-] | 1,4 | | | No Performance Assessed | | |

[1] Fastenings (incl. nut and washer) must comply with the appropriate material and property class of the internal threaded rod. The characteristic tension resistance for steel failure is valid for the internal threaded rod and the fastening element.
[2] For HR-M20 strength class 50 is valid

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**Table C6: Characteristic values of shear loads under static and quasi-static action**

| Anchor size for internal threaded anchor rods | | | | HR-M6 | HR-M8 | HR-M10 | HR-M12 | HR-M16 | HR-M20 |
|---|---|---|---|---|---|---|---|---|---|
| **Steel failure without lever arm[1]** | | | | | | | | | |
| Characteristic shear resistance, Steel, strength class | 5.8 | $V^0_{Rk,s}$ | [kN] | 5 | 9 | 15 | 21 | 38 | 61 |
| | 8.8 | $V^0_{Rk,s}$ | [kN] | 8 | 14 | 23 | 34 | 60 | 98 |
| Partial factor, strength class 5.8 and 8.8 | | $\gamma_{Ms,V}$ | [-] | 1,25 | | | | | |
| Characteristic shear resistance, Stainless Steel A4 and HCR, Strength class 70[2] | | $V^0_{Rk,s}$ | [kN] | 7 | 13 | 20 | 30 | 55 | 40 |
| Partial factor | | $\gamma_{Ms,V}$ | [-] | 1,56 | | | | | 2,38 |
| Ductility factor | | $k_7$ | [-] | 1,0 | | | | | |
| **Steel failure with lever arm[1]** | | | | | | | | | |
| Characteristic bending moment, Steel, strength class | 5.8 | $M^0_{Rk,s}$ | [Nm] | 8 | 19 | 37 | 66 | 167 | 325 |
| | 8.8 | $M^0_{Rk,s}$ | [Nm] | 12 | 30 | 60 | 105 | 267 | 519 |
| Partial factor, strength class 5.8 and 8.8 | | $\gamma_{Ms,V}$ | [-] | 1,25 | | | | | |
| Characteristic bending moment, Stainless Steel A4 and HCR, Strength class 70[2] | | $M^0_{Rk,s}$ | [Nm] | 11 | 26 | 52 | 92 | 233 | 456 |
| Partial factor | | $\gamma_{Ms,V}$ | [-] | 1,56 | | | | | 2,38 |
| **Concrete pry-out failure** | | | | | | | | | |
| Factor | | $k_8$ | [-] | 2,0 | | | | | |
| Installation factor | | $\gamma_{inst}$ | [-] | 1,0 | | | | | |
| **Concrete edge failure** | | | | | | | | | |
| Effective length of fastener | | $l_f$ | [mm] | $\min(h_{ef}; 12 \cdot d_{nom})$ | | | | | $\min(h_{ef}; 300mm)$ |
| Outside diameter of fastener | | $d_{nom}$ | [mm] | 10 | 12 | 16 | 20 | 24 | 30 |
| Installation factor | | $\gamma_{inst}$ | [-] | 1,0 | | | | | |

[1] Fastenings (incl. nut and washer) must comply with the appropriate material and property class of the internal threaded rod. The characteristic tension resistance for steel failure is valid for the internal threaded rod and the fastening element.
[2] For HR-M20 strength class 50 is valid



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| **RESINA VINILESTER + SIN ESTIRENO LUSAN for concrete** | **Annex C 6** |
| **Performances**<br>Characteristic values of shear loads under static and quasi-static action | |

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**Table C7: Characteristic values of tension loads under static and quasi-static action**

| Anchor size reinforcing bar | | | | Ø 8 | Ø 10 | Ø 12 | Ø 14 | Ø 16 | Ø 20 | Ø 25 | Ø 28 | Ø 32 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Steel failure** | | | | | | | | | | | | |
| Characteristic tension resistance | | $N_{Rk,s}$ | [kN] | $A_s \cdot f_{uk}$ [1] | | | | | | | | |
| Cross section area | | $A_s$ | [mm²] | 50 | 79 | 113 | 154 | 201 | 314 | 491 | 616 | 804 |
| Partial factor | | $\gamma_{Ms,N}$ | [-] | 1,4 [2] | | | | | | | | |
| **Combined pull-out and concrete failure** | | | | | | | | | | | | |
| Characteristic bond resistance in uncracked concrete C20/25 | | | | | | | | | | | | |
| Temperature range I: 40°C/24°C | Dry, wet concrete | $\tau_{Rk,ucr}$ | [N/mm²] | 10 | 12 | 12 | 12 | 12 | 12 | 11 | 10 | 8,5 |
| Temperature range II: 80°C/50°C | Dry, wet concrete | $\tau_{Rk,ucr}$ | [N/mm²] | 7,5 | 9 | 9 | 9 | 9 | 9 | 8,0 | 7,0 | 6,0 |
| Temperature range III: 120°C/72°C | Dry, wet concrete | $\tau_{Rk,ucr}$ | [N/mm²] | 5,5 | 6,5 | 6,5 | 6,5 | 6,5 | 6,5 | 6,0 | 5,0 | 4,5 |
| Temperature range I: 40°C/24°C | flooded bore hole | $\tau_{Rk,ucr}$ | [N/mm²] | 7,5 | 8,5 | 8,5 | 8,5 | 8,5 | No Performance Assessed | | | |
| Temperature range II: 80°C/50°C | flooded bore hole | $\tau_{Rk,ucr}$ | [N/mm²] | 5,5 | 6,5 | 6,5 | 6,5 | 6,5 | No Performance Assessed | | | |
| Temperature range III: 120°C/72°C | flooded bore hole | $\tau_{Rk,ucr}$ | [N/mm²] | 4,0 | 5,0 | 5,0 | 5,0 | 5,0 | No Performance Assessed | | | |
| Characteristic bond resistance in cracked concrete C20/25 | | | | | | | | | | | | |
| Temperature range I: 40°C/24°C | Dry, wet concrete | $\tau_{Rk,cr}$ | [N/mm²] | 4,0 | 5,0 | 5,5 | 5,5 | 5,5 | 5,5 | 5,5 | 6,5 | 6,5 |
| Temperature range II: 80°C/50°C | Dry, wet concrete | $\tau_{Rk,cr}$ | [N/mm²] | 2,5 | 3,5 | 4,0 | 4,0 | 4,0 | 4,0 | 4,0 | 4,5 | 4,5 |
| Temperature range III: 120°C/72°C | Dry, wet concrete | $\tau_{Rk,cr}$ | [N/mm²] | 2,0 | 2,5 | 3,0 | 3,0 | 3,0 | 3,0 | 3,0 | 3,5 | 3,5 |
| Temperature range I: 40°C/24°C | flooded bore hole | $\tau_{Rk,cr}$ | [N/mm²] | 4,0 | 4,0 | 5,5 | 5,5 | 5,5 | No Performance Assessed | | | |
| Temperature range II: 80°C/50°C | flooded bore hole | $\tau_{Rk,cr}$ | [N/mm²] | 2,5 | 3,0 | 4,0 | 4,0 | 4,0 | No Performance Assessed | | | |
| Temperature range III: 120°C/72°C | flooded bore hole | $\tau_{Rk,cr}$ | [N/mm²] | 2,0 | 2,5 | 3,0 | 3,0 | 3,0 | No Performance Assessed | | | |
| Reduktion factor $\psi^0_{sus}$ in cracked and uncracked concrete C20/25 | | | | | | | | | | | | |
| Temperature range I: 40°C/24°C | Dry, wet concrete and flooded bore hole | $\psi^0_{sus}$ | [-] | 0,73 | | | | | | | | |
| Temperature range II: 80°C/50°C | Dry, wet concrete and flooded bore hole | $\psi^0_{sus}$ | [-] | 0,65 | | | | | | | | |
| Temperature range III: 120°C/72°C | Dry, wet concrete and flooded bore hole | $\psi^0_{sus}$ | [-] | 0,57 | | | | | | | | |
| Increasing factors for concrete $\psi_c$ | | C25/30 | | 1,02 | | | | | | | | |
| Increasing factors for concrete $\psi_c$ | | C30/37 | | 1,04 | | | | | | | | |
| Increasing factors for concrete $\psi_c$ | | C35/45 | | 1,07 | | | | | | | | |
| Increasing factors for concrete $\psi_c$ | | C40/50 | | 1,08 | | | | | | | | |
| Increasing factors for concrete $\psi_c$ | | C45/55 | | 1,09 | | | | | | | | |
| Increasing factors for concrete $\psi_c$ | | C50/60 | | 1,10 | | | | | | | | |
| **Concrete cone failure** | | | | | | | | | | | | |
| Relevant parameter | | | | see Table C2 | | | | | | | | |
| **Splitting** | | | | | | | | | | | | |
| Relevant parameter | | | | see Table C2 | | | | | | | | |
| **Installation factor** | | | | | | | | | | | | |
| for dry and wet concrete | | $\gamma_{inst}$ | [-] | 1,2 | 1,2 | | | | | | | |
| for flooded bore hole | | $\gamma_{inst}$ | [-] | 1,4 | | | | | No Performance Assessed | | | |

[1] $f_{uk}$ shall be taken from the specifications of reinforcing bars
[2] in absence of national regulation



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| **RESINA VINILESTER + SIN ESTIRENO LUSAN for concrete** | **Annex C 7** |
| **Performances**<br>Characteristic values of tension loads under static and quasi-static action | |

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| **Table C8:** | **Characteristic values of shear loads under static and quasi-static action** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Anchor size reinforcing bar** | | | **Ø 8** | **Ø 10** | **Ø 12** | **Ø 14** | **Ø 16** | **Ø 20** | **Ø 25** | **Ø 28** | **Ø 32** |
| **Steel failure without lever arm** | | | | | | | | | | | |
| Characteristic shear resistance | $V^0_{Rk,s}$ | [kN] | $0{,}50 \cdot A_s \cdot f_{uk}$ 1) | | | | | | | | |
| Cross section area | $A_s$ | [mm²] | 50 | 79 | 113 | 154 | 201 | 314 | 491 | 616 | 804 |
| Partial factor | $\gamma_{Ms,V}$ | [-] | 1,5 2) | | | | | | | | |
| Ductility factor | $k_7$ | [-] | 1,0 | | | | | | | | |
| **Steel failure with lever arm** | | | | | | | | | | | |
| Characteristic bending moment | $M^0_{Rk,s}$ | [Nm] | $1.2 \cdot W_{el} \cdot f_{uk}$ 1) | | | | | | | | |
| Elastic section modulus | $W_{el}$ | [mm³] | 50 | 98 | 170 | 269 | 402 | 785 | 1534 | 2155 | 3217 |
| Partial factor | $\gamma_{Ms,V}$ | [-] | 1,5 2) | | | | | | | | |
| **Concrete pry-out failure** | | | | | | | | | | | |
| Factor | $k_8$ | [-] | 2,0 | | | | | | | | |
| Installation factor | $\gamma_{inst}$ | [-] | 1,0 | | | | | | | | |
| **Concrete edge failure** | | | | | | | | | | | |
| Effective length of fastener | $l_f$ | [mm] | $\min(h_{ef};\ 12 \cdot d_{nom})$ | | | | | | $\min(h_{ef};\ 300\text{mm})$ | | |
| Outside diameter of fastener | $d_{nom}$ | [mm] | 8 | 10 | 12 | 14 | 16 | 20 | 25 | 28 | 32 |
| Installation factor | $\gamma_{inst}$ | [-] | 1,0 | | | | | | | | |

1) $f_{uk}$ shall be taken from the specifications of reinforcing bars
2) in absence of national regulation

**Table C9: Displacements under tension load[1] (threaded rod)**

| Anchor size threaded rod | | | M8 | M10 | M12 | M16 | M20 | M24 | M27 | M30 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Uncracked concrete C20/25 under static and quasi-static action** | | | | | | | | | | |
| Temperature range I: 40°C/24°C | $\delta_{N0}$-factor | [mm/(N/mm²)] | 0,021 | 0,023 | 0,026 | 0,031 | 0,036 | 0,041 | 0,045 | 0,049 |
| | $\delta_{N\infty}$-factor | [mm/(N/mm²)] | 0,030 | 0,033 | 0,037 | 0,045 | 0,052 | 0,060 | 0,065 | 0,071 |
| Temperature range II: 80°C/50°C | $\delta_{N0}$-factor | [mm/(N/mm²)] | 0,050 | 0,056 | 0,063 | 0,075 | 0,088 | 0,100 | 0,110 | 0,119 |
| | $\delta_{N\infty}$-factor | [mm/(N/mm²)] | 0,072 | 0,081 | 0,090 | 0,108 | 0,127 | 0,145 | 0,159 | 0,172 |
| Temperature range III: 120°C/72°C | $\delta_{N0}$-factor | [mm/(N/mm²)] | 0,050 | 0,056 | 0,063 | 0,075 | 0,088 | 0,100 | 0,110 | 0,119 |
| | $\delta_{N\infty}$-factor | [mm/(N/mm²)] | 0,072 | 0,081 | 0,090 | 0,108 | 0,127 | 0,145 | 0,159 | 0,172 |
| **Cracked concrete C20/25 under static and quasi-static action** | | | | | | | | | | |
| Temperature range I: 40°C/24°C | $\delta_{N0}$-factor | [mm/(N/mm²)] | 0,090 | | 0,070 | | | | | |
| | $\delta_{N\infty}$-factor | [mm/(N/mm²)] | 0,105 | | 0,105 | | | | | |
| Temperature range II: 80°C/50°C | $\delta_{N0}$-factor | [mm/(N/mm²)] | 0,219 | | 0,170 | | | | | |
| | $\delta_{N\infty}$-factor | [mm/(N/mm²)] | 0,255 | | 0,245 | | | | | |
| Temperature range III: 120°C/72°C | $\delta_{N0}$-factor | [mm/(N/mm²)] | 0,219 | | 0,170 | | | | | |
| | $\delta_{N\infty}$-factor | [mm/(N/mm²)] | 0,255 | | 0,245 | | | | | |

[1] Calculation of the displacement
$\delta_{N0} = \delta_{N0}\text{-factor} \cdot \tau$; τ: action bond stress for tension
$\delta_{N\infty} = \delta_{N\infty}\text{-factor} \cdot \tau$;

**Table C10: Displacements under shear load[1] (threaded rod)**

| Anchor size threaded rod | | | M8 | M10 | M12 | M16 | M20 | M24 | M27 | M30 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Uncracked concrete C20/25 under static and quasi-static action** | | | | | | | | | | |
| All temperature ranges | $\delta_{V0}$-factor | [mm/kN] | 0,06 | 0,06 | 0,05 | 0,04 | 0,04 | 0,03 | 0,03 | 0,03 |
| | $\delta_{V\infty}$-factor | [mm/kN] | 0,09 | 0,08 | 0,08 | 0,06 | 0,06 | 0,05 | 0,05 | 0,05 |
| **Cracked concrete C20/25 under static and quasi-static action** | | | | | | | | | | |
| All temperature ranges | $\delta_{V0}$-factor | [mm/kN] | 0,12 | 0,12 | 0,11 | 0,10 | 0,09 | 0,08 | 0,08 | 0,07 |
| | $\delta_{V\infty}$-factor | [mm/kN] | 0,18 | 0,18 | 0,17 | 0,15 | 0,14 | 0,13 | 0,12 | 0,10 |

[1] Calculation of the displacement
$\delta_{V0} = \delta_{V0}\text{-factor} \cdot V$; V: action shear load
$\delta_{V\infty} = \delta_{V\infty}\text{-factor} \cdot V$;

**RESINA VINILESTER + SIN ESTIRENO LUSAN for concrete**

**Performances**
Displacements (threaded rods)

**Annex C 9**

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**Table C11: Displacements under tension load[1] (Internal threaded anchor rod)**

| **Anchor size Internal threaded anchor rod** | | | **HR-M6** | **HR-M8** | **HR-M10** | **HR-M12** | **HR-M16** | **HR-M20** |
|---|---|---|---|---|---|---|---|---|
| **Uncracked concrete C20/25 under static and quasi-static action** | | | | | | | | |
| Temperature range I: 40°C/24°C | $\delta_{N0}$-factor | [mm/(N/mm²)] | 0,023 | 0,026 | 0,031 | 0,036 | 0,041 | 0,049 |
| | $\delta_{N\infty}$-factor | [mm/(N/mm²)] | 0,033 | 0,037 | 0,045 | 0,052 | 0,060 | 0,071 |
| Temperature range II: 80°C/50°C | $\delta_{N0}$-factor | [mm/(N/mm²)] | 0,056 | 0,063 | 0,075 | 0,088 | 0,100 | 0,119 |
| | $\delta_{N\infty}$-factor | [mm/(N/mm²)] | 0,081 | 0,090 | 0,108 | 0,127 | 0,145 | 0,172 |
| Temperature range III: 120°C/72°C | $\delta_{N0}$-factor | [mm/(N/mm²)] | 0,056 | 0,063 | 0,075 | 0,088 | 0,100 | 0,119 |
| | $\delta_{N\infty}$-factor | [mm/(N/mm²)] | 0,081 | 0,090 | 0,108 | 0,127 | 0,145 | 0,172 |
| **Cracked concrete C20/25 under static and quasi-static action** | | | | | | | | |
| Temperature range I: 40°C/24°C | $\delta_{N0}$-factor | [mm/(N/mm²)] | 0,090 | 0,070 | | | | |
| | $\delta_{N\infty}$-factor | [mm/(N/mm²)] | 0,105 | 0,105 | | | | |
| Temperature range II: 80°C/50°C | $\delta_{N0}$-factor | [mm/(N/mm²)] | 0,219 | 0,170 | | | | |
| | $\delta_{N\infty}$-factor | [mm/(N/mm²)] | 0,255 | 0,245 | | | | |
| Temperature range III: 120°C/72°C | $\delta_{N0}$-factor | [mm/(N/mm²)] | 0,219 | 0,170 | | | | |
| | $\delta_{N\infty}$-factor | [mm/(N/mm²)] | 0,255 | 0,245 | | | | |

[1] Calculation of the displacement
$\delta_{N0} = \delta_{N0}\text{-factor} \cdot \tau$; τ: action bond stress for tension
$\delta_{N\infty} = \delta_{N\infty}\text{-factor} \cdot \tau$;

**Table C12: Displacements under shear load[1] (Internal threaded anchor rod)**

| **Anchor size Internal threaded anchor rod** | | | **HR-M6** | **HR-M8** | **HR-M10** | **HR-M12** | **HR-M16** | **HR-M20** |
|---|---|---|---|---|---|---|---|---|
| **Uncracked and cracked concrete C20/25 under static and quasi-static action** | | | | | | | | |
| All temperature ranges | $\delta_{V0}$-factor | [mm/kN] | 0,07 | 0,06 | 0,06 | 0,05 | 0,04 | 0,04 |
| | $\delta_{V\infty}$-factor | [mm/kN] | 0,10 | 0,09 | 0,08 | 0,08 | 0,06 | 0,06 |

[1] Calculation of the displacement
$\delta_{V0} = \delta_{V0}\text{-factor} \cdot V$; V: action shear load
$\delta_{V\infty} = \delta_{V\infty}\text{-factor} \cdot V$;

**Table C13: Displacements under tension load[1] (rebar)**

| Anchor size reinforcing bar | | | Ø 8 | Ø 10 | Ø 12 | Ø 14 | Ø 16 | Ø 20 | Ø 25 | Ø 28 | Ø 32 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Uncracked concrete C20/25 under static and quasi-static action** | | | | | | | | | | | |
| Temperature range I: 40°C/24°C | $\delta_{N0}$-factor | [mm/(N/mm²)] | 0,021 | 0,023 | 0,026 | 0,028 | 0,031 | 0,036 | 0,043 | 0,047 | 0,052 |
| | $\delta_{N\infty}$-factor | [mm/(N/mm²)] | 0,030 | 0,033 | 0,037 | 0,041 | 0,045 | 0,052 | 0,061 | 0,071 | 0,075 |
| Temperature range II: 80°C/50°C | $\delta_{N0}$-factor | [mm/(N/mm²)] | 0,050 | 0,056 | 0,063 | 0,069 | 0,075 | 0,088 | 0,104 | 0,113 | 0,126 |
| | $\delta_{N\infty}$-factor | [mm/(N/mm²)] | 0,072 | 0,081 | 0,090 | 0,099 | 0,108 | 0,127 | 0,149 | 0,163 | 0,181 |
| Temperature range III: 120°C/72°C | $\delta_{N0}$-factor | [mm/(N/mm²)] | 0,050 | 0,056 | 0,063 | 0,069 | 0,075 | 0,088 | 0,104 | 0,113 | 0,126 |
| | $\delta_{N\infty}$-factor | [mm/(N/mm²)] | 0,072 | 0,081 | 0,090 | 0,099 | 0,108 | 0,127 | 0,149 | 0,163 | 0,181 |
| **Cracked concrete C20/25 under static and quasi-static action** | | | | | | | | | | | |
| Temperature range I: 40°C/24°C | $\delta_{N0}$-factor | [mm/(N/mm²)] | 0,090 | | 0,070 | | | | | | |
| | $\delta_{N\infty}$-factor | [mm/(N/mm²)] | 0,105 | | 0,105 | | | | | | |
| Temperature range II: 80°C/50°C | $\delta_{N0}$-factor | [mm/(N/mm²)] | 0,219 | | 0,170 | | | | | | |
| | $\delta_{N\infty}$-factor | [mm/(N/mm²)] | 0,255 | | 0,245 | | | | | | |
| Temperature range III: 120°C/72°C | $\delta_{N0}$-factor | [mm/(N/mm²)] | 0,219 | | 0,170 | | | | | | |
| | $\delta_{N\infty}$-factor | [mm/(N/mm²)] | 0,255 | | 0,245 | | | | | | |

[1] Calculation of the displacement
$\delta_{N0} = \delta_{N0}\text{-factor} \cdot \tau$;  τ: action bond stress for tension
$\delta_{N\infty} = \delta_{N\infty}\text{-factor} \cdot \tau$;

**Table C14: Displacement under shear load[1] (rebar)**

| Anchor size reinforcing bar | | | Ø 8 | Ø 10 | Ø 12 | Ø 14 | Ø 16 | Ø 20 | Ø 25 | Ø 28 | Ø 32 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Uncracked concrete C20/25 under static and quasi-static action** | | | | | | | | | | | |
| All temperature ranges | $\delta_{V0}$-factor | [mm/kN] | 0,06 | 0,05 | 0,05 | 0,04 | 0,04 | 0,04 | 0,03 | 0,03 | 0,03 |
| | $\delta_{V\infty}$-factor | [mm/kN] | 0,09 | 0,08 | 0,08 | 0,06 | 0,06 | 0,05 | 0,05 | 0,04 | 0,04 |
| **Cracked concrete C20/25 under static and quasi-static action** | | | | | | | | | | | |
| All temperature ranges | $\delta_{V0}$-factor | [mm/kN] | 0,12 | 0,12 | 0,11 | 0,11 | 0,10 | 0,09 | 0,08 | 0,07 | 0,06 |
| | $\delta_{V\infty}$-factor | [mm/kN] | 0,18 | 0,18 | 0,17 | 0,16 | 0,15 | 0,14 | 0,12 | 0,11 | 0,10 |

[1] Calculation of the displacement
$\delta_{V0} = \delta_{V0}\text{-factor} \cdot V$;  V: action shear load
$\delta_{V\infty} = \delta_{V\infty}\text{-factor} \cdot V$;

| | |
|---|---|
| **RESINA VINILESTER + SIN ESTIRENO LUSAN for concrete** | **Annex C 11** |
| **Performances**<br>Displacements (rebar) | |

**Table C15: Characteristic values of tension loads under seismic action (performance category C1)**

| **Anchor size threaded rod** | | | | | **M8** | **M10** | **M12** | **M16** | **M20** | **M24** | **M27** | **M30** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Steel failure | | | | | | | | | | | | |
| Characteristic tension resistance | | | $N_{Rk,s,eq,C1}$ | [kN] | $1,0 \cdot N_{Rk,s}$ | | | | | | | |
| Partial factor | | | $\gamma_{Ms,N}$ | [-] | see Table C1 | | | | | | | |
| **Combined pull-out and concrete failure** | | | | | | | | | | | | |
| Characteristic bond resistance in uncracked and cracked concrete C20/25 | | | | | | | | | | | | |
| Temperature range | I: 40°C/24°C | Dry, wet concrete | $\tau_{Rk,eq,C1}$ | [N/mm²] | 2,5 | 3,1 | 3,7 | 3,7 | 3,7 | 3,8 | 4,5 | 4,5 |
| Temperature range | II: 80°C/50°C | Dry, wet concrete | $\tau_{Rk,eq,C1}$ | [N/mm²] | 1,6 | 2,2 | 2,7 | 2,7 | 2,7 | 2,8 | 3,1 | 3,1 |
| Temperature range | III: 120°C/72°C | Dry, wet concrete | $\tau_{Rk,eq,C1}$ | [N/mm²] | 1,3 | 1,6 | 2,0 | 2,0 | 2,0 | 2,1 | 2,4 | 2,4 |
| Temperature range | I: 40°C/24°C | flooded bore hole | $\tau_{Rk,eq,C1}$ | [N/mm²] | 2,5 | 2,5 | 3,7 | 3,7 | No Performance Assessed | | | |
| Temperature range | II: 80°C/50°C | flooded bore hole | $\tau_{Rk,eq,C1}$ | [N/mm²] | 1,6 | 1,9 | 2,7 | 2,7 | No Performance Assessed | | | |
| Temperature range | III: 120°C/72°C | flooded bore hole | $\tau_{Rk,eq,C1}$ | [N/mm²] | 1,3 | 1,6 | 2,0 | 2,0 | No Performance Assessed | | | |
| Increasing factors for concrete $\psi_c$ | | | C25/30 to C50/60 | | 1,0 | | | | | | | |
| **Installation factor** | | | | | | | | | | | | |
| for dry and wet concrete | | | $\gamma_{inst}$ | [-] | 1,0 | 1,2 | | | | | | |
| for flooded bore hole | | | $\gamma_{inst}$ | [-] | 1,4 | | | | No Performance Assessed | | | |

**Table C16: Characteristic values of shear loads under seismic action (performance category C1)**

| **Anchor size threaded rod** | | | **M8** | **M10** | **M12** | **M16** | **M20** | **M24** | **M27** | **M30** |
|---|---|---|---|---|---|---|---|---|---|---|
| **Steel failure without lever arm** | | | | | | | | | | |
| Characteristic shear resistance (Seismic C1) | $V_{Rk,s,eq,C1}$ | [kN] | $0,70 \cdot V^0_{Rk,s}$ | | | | | | | |
| Partial factor | $\gamma_{Ms,V}$ | [-] | see Table C1 | | | | | | | |
| **Factor for annular gap** | $\alpha_{gap}$ | [-] | 0,5 (1,0)[1)] | | | | | | | |

[1)] Value in brackets valid for filled annular gab between anchor and clearance hole in the fixture. Use of special filling washer Annex A 3 is required



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| **RESINA VINILESTER + SIN ESTIRENO LUSAN for concrete** | **Annex C 12** |
| **Performances**<br>Characteristic values of tension loads and shear loads under seismic action (performance category C1) | |

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**Table C17: Characteristic values of tension loads under seismic action (performance category C1)**

| Anchor size reinforcing bar | | | Ø 8 | Ø 10 | Ø 12 | Ø 14 | Ø 16 | Ø 20 | Ø 25 | Ø 28 | Ø 32 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Steel failure** | | | | | | | | | | | |
| Characteristic tension resistance | $N_{Rk,s,eq,C1}$ | [kN] | $1,0 \cdot A_s \cdot f_{uk}$ [1)] | | | | | | | | |
| Cross section area | $A_s$ | [mm²] | 50 | 79 | 113 | 154 | 201 | 314 | 491 | 616 | 804 |
| Partial factor | $\gamma_{Ms,N}$ | [-] | 1,4 [2)] | | | | | | | | |
| **Combined pull-out and concrete failure** | | | | | | | | | | | |
| Characteristic bond resistance in uncracked and cracked concrete C20/25 | | | | | | | | | | | |
| Temperature range I: 40°C/24°C, Dry, wet concrete | $\tau_{Rk,eq,C1}$ | [N/mm²] | 2,5 | 3,1 | 3,7 | 3,7 | 3,7 | 3,7 | 3,8 | 4,5 | 4,5 |
| Temperature range II: 80°C/50°C, Dry, wet concrete | $\tau_{Rk,eq,C1}$ | [N/mm²] | 1,6 | 2,2 | 2,7 | 2,7 | 2,7 | 2,7 | 2,8 | 3,1 | 3,1 |
| Temperature range III: 120°C/72°C, Dry, wet concrete | $\tau_{Rk,eq,C1}$ | [N/mm²] | 1,3 | 1,6 | 2,0 | 2,0 | 2,0 | 2,0 | 2,1 | 2,4 | 2,4 |
| Temperature range I: 40°C/24°C, flooded bore hole | $\tau_{Rk,eq,C1}$ | [N/mm²] | 2,5 | 2,5 | 3,7 | 3,7 | 3,7 | No Performance Assessed | | | |
| Temperature range II: 80°C/50°C, flooded bore hole | $\tau_{Rk,eq,C1}$ | [N/mm²] | 1,6 | 1,9 | 2,7 | 2,7 | 2,7 | No Performance Assessed | | | |
| Temperature range III: 120°C/72°C, flooded bore hole | $\tau_{Rk,eq,C1}$ | [N/mm²] | 1,3 | 1,6 | 2,0 | 2,0 | 2,0 | No Performance Assessed | | | |
| Increasing factors for concrete $\psi_C$ | C25/30 to C50/60 | | 1,0 | | | | | | | | |
| **Installation factor** | | | | | | | | | | | |
| for dry and wet concrete | $\gamma_{inst}$ | [-] | 1,2 | 1,2 | | | | | | | |
| for flooded bore hole | $\gamma_{inst}$ | [-] | 1,4 | | | | | No Performance Assessed | | | |

1) $f_{uk}$ shall be taken from the specifications of reinforcing bars
2) in absence of national regulation

**Table C18: Characteristic values of shear loads under seismic action (performance category C1)**

| Anchor size reinforcing bar | | | Ø 8 | Ø 10 | Ø 12 | Ø 14 | Ø 16 | Ø 20 | Ø 25 | Ø 28 | Ø 32 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Steel failure without lever arm** | | | | | | | | | | | |
| Characteristic shear resistance | $V_{Rk,s,eq,C1}$ | [kN] | $0,35 \cdot A_s \cdot f_{uk}$ [2)] | | | | | | | | |
| Cross section area | $A_s$ | [mm²] | 50 | 79 | 113 | 154 | 201 | 314 | 491 | 616 | 804 |
| Partial factor | $\gamma_{Ms,V}$ | [-] | 1,5 [2)] | | | | | | | | |
| **Factor for annular gap** | $\alpha_{gap}$ | [-] | 0,5 (1,0) [3)] | | | | | | | | |

1) $f_{uk}$ shall be taken from the specifications of reinforcing bars
2) in absence of national regulation
3) Value in brackets valid for filled annular gab between anchor and clearance hole in the fixture. Use of special filling washer Annex A 3 is required



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|---|---|
| **RESINA VINILESTER + SIN ESTIRENO LUSAN for concrete** | **Annex C 13** |
| **Performances**<br>Characteristic values of tension loads and shear loads under seismic action (performance category C1) | |