Deutsches Institut für Bautechnik

Public-law institution jointly founded by the federal states and the Federation

European Technical Assessment Body for construction products

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# European Technical Assessment ETA-04/0092 of 10 November 2025

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 | Injection System VMZ |
| Product family to which the construction product belongs | Bonded fasteners and bonded expansion fasteners for use in concrete |
| Manufacturer | MKT<br>Metall-Kunststoff-Technik GmbH & Co. KG<br>Auf dem Immel 2<br>67685 Weilerbach<br>GERMANY |
| Manufacturing plant | Plant 1, D<br>Plant 2, D |
| This European Technical Assessment contains | 32 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 330499-02-0601, Edition 12/2023 |
| This version replaces | ETA-04/0092 issued on 4 August 2021 |

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## Specific Part

### 1 Technical description of the product

The "Injection System VMZ" is a torque controlled bonded anchor consisting of a cartridge with injection mortar VMZ or VMZ Express and an anchor rod with expansion cones and external connection thread (type VMZ-A) or with internal connection thread (type VMZ-IG).

The load transfer is realised by mechanical interlock of several cones in the bonding mortar and then via a combination of bonding and friction forces in the anchorage ground (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 C1 – C3, C10, B4 – B6 |
| Characteristic resistance to shear load (static and quasi-static loading) | See Annex C4 – C5, C11 |
| Displacements under short-term and long-term loading | See Annex C8 – C9, C11 |
| Characteristic resistance and displacements for seismic performance categories C1 and C2 | See Annex C6 – C9 |

#### 3.2 Safety in case of fire (BWR 2)

| Essential characteristic | Performance |
|---|---|
| Reaction to fire | Class A1 |
| Resistance to fire | No performance assessed |

#### 3.3 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 330499-02-0601 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 10 November 2025 by Deutsches Institut für Bautechnik

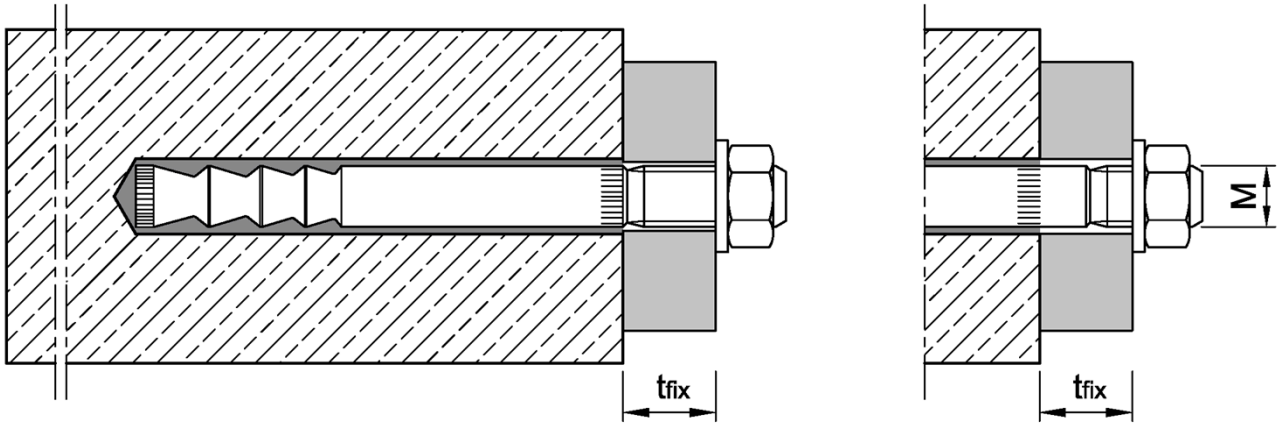
Dipl.-Ing. Beatrix Wittstock
Head of Section

*beglaubigt:*
Stiller

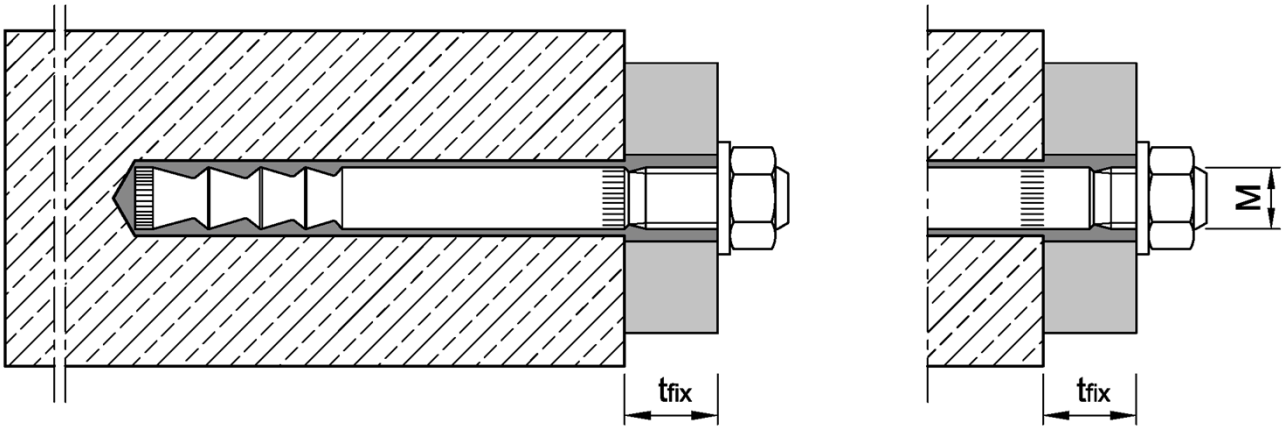
Deutsches Institut für Bautechnik DIBt

## Anchor rod VMZ-A

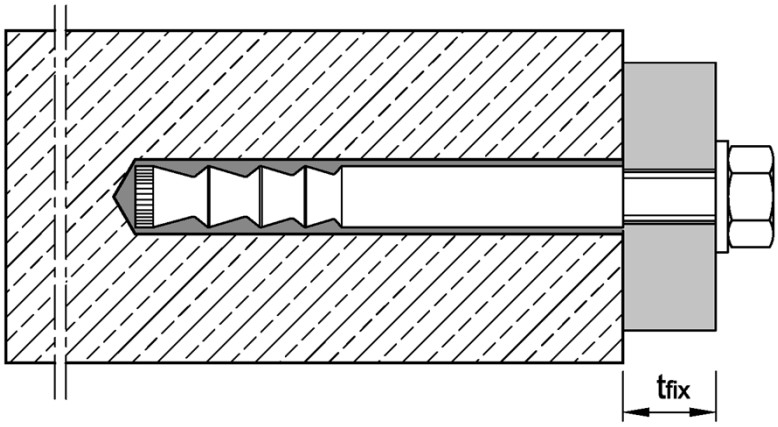
**Pre-setting installation** (and through-setting installation VMZ-A 75 M12, see Annex B11)




**Through-setting installation**




**Anchor rod VMZ-IG with internal thread**[1)]

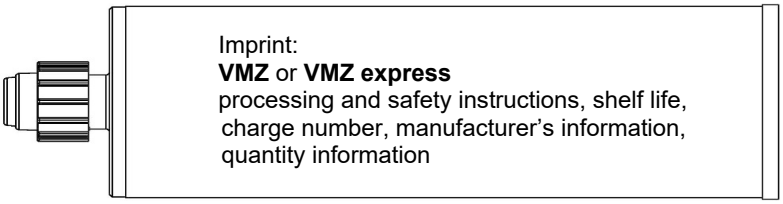



[1)] Illustration with hexagon head screw exemplified; other screws or threaded rods also permitted (see Annex A5, requirements of the fastening screw or threaded rod).

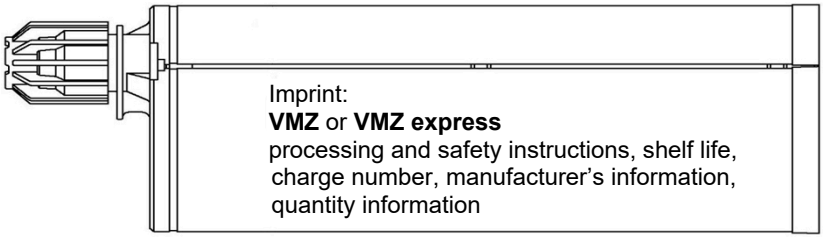
| | |
|---|---|
| **Injection System VMZ** | **Annex A1** |
| **Product description**<br>Installation situation | |

## Injection System VMZ

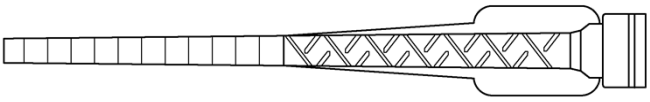
**Coaxial cartridge**




**Side-by-side cartridge**




**Reducing adapter**



**Static mixer VM-X**

**Blow-out pump VM-AP**

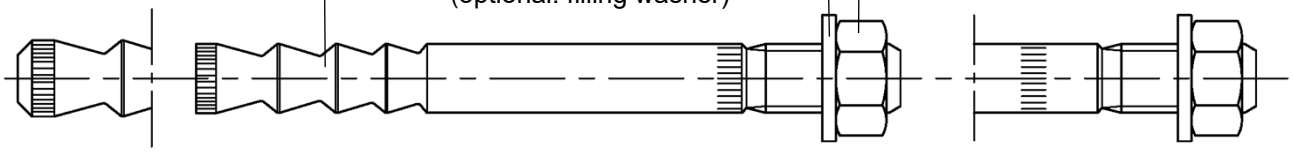
**Air Blower VM-ABP**

**Cleaning Brush RB**

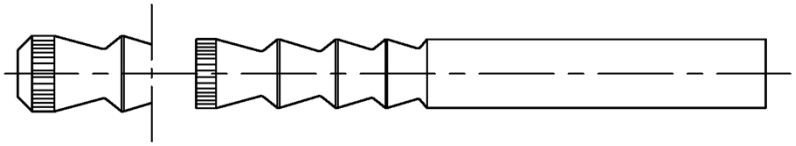
**Anchor rod VMZ-A**

**Washer**
(optional: filling washer)

**Hexagon nut**



**Anchor rod VMZ-IG**

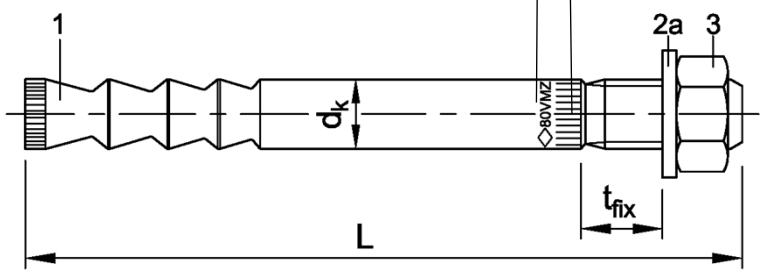


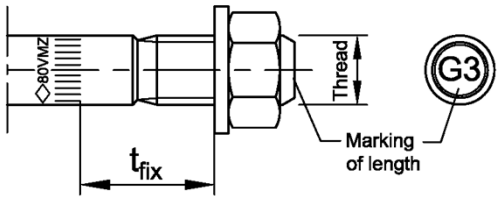
| **Injection System VMZ** | **Annex A2** |
|---|---|
| **Product description**<br>Cartridges, Cleaning tools, Anchor types | |

## Table A1: Materials VMZ-A

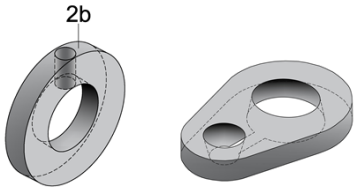
| Part | Designation | Steel, zinc plated | | | Stainless steel A4 (CRC III) | High corrosion resistant steel HCR (CRC V) |
|---|---|---|---|---|---|---|
| | | **galvanized ≥ 5 µm** | **hot-dip galvanized ≥ 50 µm** (on average) | **sherardized ≥ 45 µm** | | |
| 1 | Anchor rod | Steel acc. to EN ISO 683-4:2018 | | | Stainless steel, 1.4401, 1.4404, 1.4571, EN 10088:2023, coated | High corrosion resistant steel 1.4529, 1.4565 EN 10088:2023, coated |
| | | galvanized and coated | hot-dip galvanized and coated | sherardized and coated | | |
| 2a | Washer | Steel, zinc plated | | | Stainless steel, EN 10088:2023 | High corrosion resistant steel 1.4529, 1.4565 EN 10088:2023 |
| 2b | Filling washer | | | | | |
| 3 | Hexagon nut | Property class 8 acc to EN ISO 898-2:2022 | | | EN ISO 3506-2: 2020, A4-70, A4-80 1.4401, 1.4571 EN 10088:2023 | EN ISO 3506-2:2020, Property class 70, high corrosion resistant steel 1.4529, 1.4565 EN 10088:2023 |
| | | galvanized | hot-dip galvanized | sherardized or hot dip-galvanized | | |
| 4 | Mortar cartridge | Vinylester resin, styrene free, mixing ratio 1:10 | | | | |

**Marking** **e.g.:** ◇ **80 VMZ 12-25** — Marking of anchorage depth




◇ identifying mark of manufacturing plant
**80** anchorage depth
**VMZ** fastener identity
**12** size of thread
**25** maximum thickness of fixture $t_{fix}$ (when using washer 2a)
**A4** additional marking of stainless steel
**HCR** additional marking of high corrosion resistant steel




**Filling washer VS or alternative filling washer**

| Marking of length | | B | C | D | E | F | G | H | I | J | K | L | M | N |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Length of anchor | min ≥ | 50,8 | 63,5 | 76,2 | 88,9 | 101,6 | 114,3 | 127,0 | 139,7 | 152,4 | 165,1 | 177,8 | 190,5 | 203,2 |
| | max < | 63,5 | 76,2 | 88,9 | 101,6 | 114,3 | 127,0 | 139,7 | 152,4 | 165,1 | 177,8 | 190,5 | 203,2 | 215,9 |

| Marking of length | | O | P | Q | R | S | T | U | V | W | X | Y | Z | >Z |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Length of anchor | min ≥ | 215,9 | 228,6 | 241,3 | 254,0 | 279,4 | 304,8 | 330,2 | 355,6 | 381,0 | 406,4 | 431,8 | 457,2 | 482,6 |
| | max < | 228,6 | 241,3 | 254,0 | 279,4 | 304,8 | 330,2 | 355,6 | 381,0 | 406,4 | 431,8 | 457,2 | 482,6 | |

**Injection System VMZ**

**Product description**
**VMZ-A:** Materials, Marking, Marking of length

**Annex A3**

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## Table A2: Dimensions of anchor rod, VMZ-A M8 – M12

| **Anchor size** **VMZ-A** | | | **40 M8** | **50 M8** | **60 M10** | **75 M10** | **75 M12** | **70 M12** | **80 M12** | **95 M12** | **100 M12** | **110 M12** | **125 M12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Additional marking | | | 1 | 2 | 1 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 1 | Anchor rod | Thread | M8 | | M10 | | M12 | | | | | | |
| | | Number of cones | 2 | 3 | 3 | 3 | 3 | 3 | 4 | 4 | 6 | 6 | 6 |
| | | $d_{k=}$ | 8,0 | 8,0 | 9,7 | 9,7 | 10,7 | 12,5 | 12,5 | 12,5 | 12,5 | 12,5 | 12,5 |
| | | Length L (with washer 2a) | 52 +$t_{fix}$ | 63 +$t_{fix}$ | 75 +$t_{fix}$ | 90 +$t_{fix}$ | 95 +$t_{fix}$ | 90 +$t_{fix}$ | 100 +$t_{fix}$ | 115 +$t_{fix}$ | 120 +$t_{fix}$ | 130 +$t_{fix}$ | 145 +$t_{fix}$ |
| | | Reduction $t_{fix}$[1] (with filling washer 2b) | 3,4 | 3,4 | 3 | 3 | 2,5 | 2,5 | 2,5 | 2,5 | 2,5 | 2,5 | 2,5 |
| 3 | Hexagon nut | SW | 13 | 13 | 17 | 17 | 19 | 19 | 19 | 19 | 19 | 19 | 19 |

[1] When using filling washer (2b) the thickness of fixture is reduced by the specified value.

Dimensions in mm

## Table A3: Dimensions of anchor rod, VMZ-A M16 – M24

| **Anchor size** **VMZ-A** | | | **90 M16** | **105 M16** | **125 M16** | **145 M16** | **160 M16** | **115 M20** | **170 M20 (LG)** | **190 M20 (LG)** | **170 M24 (LG)** | **200 M24 (LG)** | **225 M24 (LG)** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Additional marking | | | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 1 | 2 | 3 |
| 1 | Anchor rod | Thread | M16 | | | | | M20 | | | M24 | | |
| | | Number of cones | 3 | 4 | 6 | 6 | 6 | 3 | 6 | 6 | 6 | 6 | 6 |
| | | $d_{k=}$ | 16,5 | 16,5 | 16,5 | 16,5 | 16,5 | 19,7 | 22,0 | 22,0 | 24,0 | 24,0 | 24,0 |
| | | Length L (with washer 2a) | 114 +$t_{fix}$ | 129 +$t_{fix}$ | 150 +$t_{fix}$ | 170 +$t_{fix}$ | 185 +$t_{fix}$ | 143 +$t_{fix}$ | 203 +$t_{fix}$ | 223 +$t_{fix}$ | 210 +$t_{fix}$ | 240 +$t_{fix}$ | 265 +$t_{fix}$ |
| | | Reduction $t_{fix}$[1] (with filling washer 2b) | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 3 | Hexagon nut | SW | 24 | 24 | 24 | 24 | 24 | 30 | 30 | 30 | 36 | 36 | 36 |

[1] When using filling washer (2b) the thickness of fixture is reduced by the specified value.

Dimensions in mm

**Injection System VMZ**

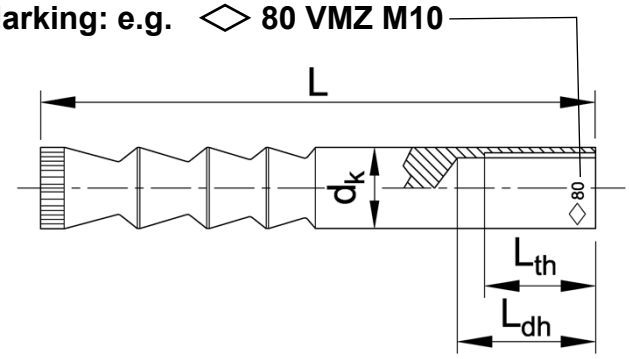
**Product description**
**VMZ-A:** Anchor dimensions

**Annex A4**

## Table A4: Materials VMZ-IG

| Part | Designation | Steel, zinc plated ≥ 5µm | Stainless steel A4 (CRC III) | High corrosion resistant steel HCR (CRC V) |
|---|---|---|---|---|
| 1 | Anchor rod | Steel acc. to EN ISO 683-4:2018, galvanized and coated | Stainless steel, 1.4401, 1.4404, 1.4571 acc. to EN 10088:2023, coated | High corrosion resistant steel 1.4529, 1.4565 acc. to EN 10088:2023, coated |
| 4 | Mortar cartridge | Vinylester resin, styrene free, mixing ratio 1:10 | | |

**Marking: e.g. ◇ 80 VMZ M10**




◇ identifying mark of manufacturing plant
80 anchorage depth
VMZ fastener identity
M10 size of internal thread
A4 additional marking of stainless steel
HCR additional marking of high corrosion resistant steel

## Table A5: Dimensions of anchor rod VMZ-IG

| Anchor size | VMZ-IG | | 40 M6 | 50 M6 | 60 M8 | 75 M8 | 70 M10 | 80 M10 | 90 M12 | 105 M12 | 125 M12 | 115 M16 | 170 M16 | 170 M20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Internal thread | | - | M6 | | M8 | | M10 | | M12 | | | M16 | | M20 |
| Number of cones | | - | 2 | 3 | 3 | 3 | 3 | 4 | 3 | 4 | 6 | 3 | 6 | 6 |
| Outer diameter | $d_k$ | [mm] | 8,0 | 8,0 | 9,7 | 10,7 | 12,5 | 12,5 | 16,5 | 16,5 | 16,5 | 19,7 | 22,0 | 24,0 |
| Thread length | $L_{th}$ | [mm] | 12 | 15 | 16 | 19 | 20 | 23 | 24 | 27 | 30 | 32 | 32 | 40 |
| Total length | L | [mm] | 41 | 52 | 63 | 78 | 74 | 84 | 94 | 109 | 130 | 120 | 180 | 182 |
| Length identifier | | [mm] | $L_{dh}$ < 18 | $L_{dh}$ > 19 | $L_{dh}$ < 22,5 | $L_{dh}$ > 23,5 | $L_{dh}$ < 27 | $L_{dh}$ > 28 | $L_{dh}$ < 31,5 | 32,5 < $L_{dh}$ < 34,5 | $L_{dh}$ > 35,5 | $d_k$ < 21 | $d_k$ > 21 | - |

**Requirements of the fastening screw or the threaded rod and nut**

- Minimum screw-in depth $L_{sdmin}$ see Table B7
- The length of screw or the threaded rod must depending on the thickness of fixture $t_{fix}$, available thread length $L_{th}$ (=maximum available thread length, see Table B7) and the minimum screw-in depth $L_{sdmin}$ be established
- $A_5$ > 8 % ductility
- Material
  - **Steel, zinc plated:** Minimum property class 8.8 according to EN ISO 898-1:2013 or EN ISO 898-2:2022
  - **Stainless steel A4** or **high corrosion resistant steel (HCR):** Minimum property class 70 according to EN ISO 3506-1:2020 or according to EN ISO 3506-2:2020

| **Injection System VMZ** | **Annex A5** |
|---|---|
| **Product description**<br>**VMZ-IG:** Werkstoffe, Prägung, Abmessungen | |

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## Specifications of intended use

| **Injection System VMZ** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Static and quasi-static action** | **VMZ-A** | **M8** | **M10** | **M12** | **M16** | **M20** | **M24** |
| | **VMZ-IG** | **M6** | **M8** | **M10** | **M12** | **M16** | **M20** |
| **Base materials** | | cracked concrete<br>uncracked concrete | | | | | |
| | | Concrete strength classes **C20/25** to **C90/105,** without fibres<br>Concrete strength classes **C20/25** to **C90/105,** with fibres | | | | | |
| **Drilling method** | Hammer drill bit (**HD**) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| | Vacuum drill bit[3] (**VD**) | -[1] | ✓ | ✓ | ✓ | ✓ | ✓ |
| | Diamond drill bit (**DD**) (C20/25 - C50/60; without fibres) | -[1] | ✓ | ✓ | ✓ | ✓ | ✓ |
| **Seismic action** | **VMZ-A** | **M8** | **M10** | **M12** | **M16** | **M20** | **M24** |
| **Performance Category** | | **C1** and **C2** | | | | | |
| **Base materials** | | cracked concrete<br>uncracked concrete | | | | | |
| | | Concrete strength classes **C20/25** to **C50/60,** without fibres | | | | | |
| **Drilling method** | Hammer drill bit (**HD**) | -[1] | ✓ | ✓ | ✓ | ✓ | ✓ |
| | Vacuum drill bit[3] (**VD**) | -[1] | ✓ | ✓ | ✓ | ✓ | ✓ |
| | Diamond drill bit (**DD**) | No performance assessed | | | | | |
| **Installation** | **VMZ-A** | **M8** | **M10** | **M12** | **M16** | **M20** | **M24** |
| | **VMZ-IG** | **M6** | **M8** | **M10** | **M12** | **M16** | **M20** |
| Dry concrete | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Wet concrete | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Water-filled hole | | -[1] | -[1] | ✓[2] | ✓ | ✓ | ✓ |
| Overhead installation | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Pre-setting installation | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Through-setting installation (VMZ-A) | | -[1] | ✓ | ✓ | ✓ | ✓ | ✓ |
| **Temperature Range** | | | | | | | |
| **I:** | -40°C to +80°C | max. long term temperature+50°C and max. short term temperature +80°C | | | | | |
| **II:** | -40°C to +120C | max. long term temperature +72°C and max. short term temperature +120°C | | | | | |

[1] No performance assessed
[2] Exception: VMZ-A 75 M12 (Installation in water-filled drill hole is not allowed)
[3] e.g. MKT vacuum drill bit, Würth hammer drill bit with suction or Heller Duster Expert

| **Injection System VMZ** | **Annex B1** |
|---|---|
| **Intended use**<br>Specifications and installation conditions | |

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## Specifications of intended use

**Base material:**

- Compacted, reinforced or unreinforced normal weight concrete with strength classes C20/25 to C90/105 acc. to EN 206:2013+A2:2021
- Steel fiber reinforced concrete according to EN 206:2013+A2:2021**.** with steel fibers according to EN 14889-1:2006, section 5, group 1, with a maximum fiber content of 80kg/m³

**Use conditions (Environmental conditions):**

- Structures subject to dry internal conditions: all versions VMZ-A and VMZ-IG
- For all other conditions:
  Intended use of materials according to Annex A3, Table A1 and Annex A5, Table A4 corresponding to the corrosion resistance class CRC acc. to EN 1993-1-4:2006+A1:2015

**Design:**

- Anchorages are designed under the responsibility of an engineer experienced in anchorages and concrete work.
- Verifiable calculation notes and drawings are prepared taking account of the loads to be anchored. The position of the anchor is indicated on the design drawings (e.g. position of the anchor relative to reinforcement or to supports, etc.).
- Anchorages are designed in accordance with EN 1992-4:2018 and Technical Report TR 055, Edition February 2018

**Installation:**

- Drill hole must be cleaned directly prior to installation of the anchor or the drill hole has to be protected against re-contamination in an appropriate way until dispensing the mortar in the drill hole.
- Water filled drill holes must not be polluted – otherwise the cleaning of the drill hole must be repeated.
- The anchor component installation temperature shall be at least +5 °C; during curing of the injection mortar the temperature of the concrete must not fall below -15 °C (for the standard variation of temperature after installation).
- It must be ensured that icing does not occur in the drill hole.
- Optionally, the annular gap between anchor rod and fixture may be filled with injection adhesive VMZ using the filling washer (Part 2b, Annex A3) instead of the washer (Part 2a, Annex A3).

| **Injection System VMZ** | **Annex B2** |
|---|---|
| **Intended use**<br>Specifications | |

## Table B1: Working and curing time VMZ

| Temperature in the drill hole | Maximum working time | Minimum curing time dry concrete [1)] |
|---|---|---|
| - 15 °C to -10 °C | 45 min | 7 d |
| - 9 °C to - 5 °C | 45 min | 10:30 h |
| - 4 °C to - 1 °C | 45 min | 6:00 h |
| 0 °C to + 4 °C | 20 min | 3:00 h |
| +5 °C to + 9 °C | 12 min | 2:00 h |
| +10 °C to +19 °C | 6 min | 1:20 h |
| +20 °C to +29 °C | 4 min | 45 min |
| +30 °C to +34 °C | 2 min | 25 min |
| +35 °C to +39 °C | 1,4 min | 20 min |
| + 40 °C | 1,4 min | 15 min |
| **Cartridge temperature** | ≥ 5°C | |

[1)] Curing time in wet concrete shall be doubled.

## Table B2: Working and curing time VMZ express

| Temperature in the drill hole | Maximum working time | Minimum curing time dry concrete [1)] |
|---|---|---|
| - 5 °C to - 1 °C | 20 min | 4:00 h |
| 0 °C to + 4 °C | 10 min | 2:00 h |
| + 5 °C to + 9 °C | 6 min | 1:00 h |
| +10 °C to +19 °C | 3 min | 40 min |
| +20 °C to +29 °C | 1 min | 20 min |
| + 30 °C | 1 min | 10 min |
| **Cartridge temperature** | ≥ 5° C | |

[1)] Curing time in wet concrete shall be doubled.

| **Injection System VMZ** | **Annex B3** |
|---|---|
| **Intended use**<br>Working and curing time | |

## Table B3: Installation parameters, VMZ-A M8 – M12

| Anchor size | VMZ-A | | 40 M8 | 50 M8 | 60 M10 | 75 M10 | 75 M12 | 70 M12 | 80 M12 | 95 M12 | 100 M12 | 110 M12 | 125 M12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective anchorage depth | $h_{ef} \geq$ | [mm] | 40 | 50 | 60 | 75 | 75 | 70 | 80 | 95 | 100 | 110 | 125 |
| Nominal diameter of drill hole | $d_0 =$ | [mm] | 10 | 10 | 12 | 12 | 12 | 14 | 14 | 14 | 14 | 14 | 14 |
| Depth of drill hole | $h_0 \geq$ | [mm] | 42 | 55 | 65 | 80 | 80 | 75 | 85 | 100 | 105 | 115 | 130 |
| Diameter of cleaning brush | $D \geq$ | [mm] | 10,8 | 10,8 | 13,0 | 13,0 | 13,0 | 15,0 | 15,0 | 15,0 | 15,0 | 15,0 | 15,0 |
| Installation torque | $T_{inst} \leq$ | [Nm] | 10[1)] | 10[1)] | 15 | 15 | 25 | 25 | 25 | 25 | 30 | 30 | 30 |
| Diameter of clearance hole in the fixture | | | | | | | | | | | | | |
| Pre-setting installation | $d_f \leq$ | [mm] | 9 | 9 | 12 | 12 | 14 | 14 | 14 | 14 | 14 | 14 | 14 |
| Through-setting installation | $d_f \leq$ | [mm] | -[2)] | -[2)] | 14 | 14 | 14[3)] / 16 | 16 | 16 | 16 | 16 | 16 | 16 |

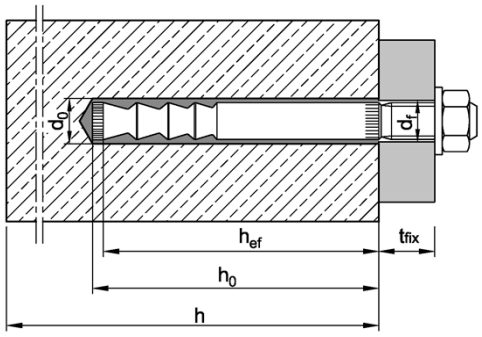
[1)] VMZ-A M8: $T_{inst}$ = 10Nm
[2)] No performance assessed
[3)] See Annex B11

## Table B4: Installation parameters, VMZ-A M16 – M24

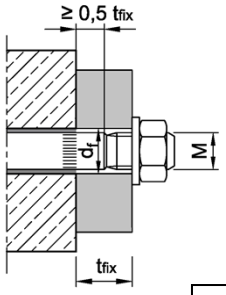
| Anchor size | VMZ-A | | 90 M16 | 105 M16 | 125 M16 | 145 M16 | 160 M16 | 115 M20 | 170 M20 (LG) | 190 M20 (LG) | 170 M24 (LG) | 200 M24 (LG) | 225 M24 (LG) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective anchorage depth | $h_{ef} \geq$ | [mm] | 90 | 105 | 125 | 145 | 160 | 115 | 170 | 190 | 170 | 200 | 225 |
| Nominal diameter of drill hole | $d_0 =$ | [mm] | 18 | 18 | 18 | 18 | 18 | 22 | 24 | 24 | 26 | 26 | 26 |
| Depth of drill hole | $h_0 \geq$ | [mm] | 98 | 113 | 133 | 153 | 168 | 120 | 180 | 200 | 185 | 215 | 240 |
| Diameter of cleaning brush | $D \geq$ | [mm] | 19,0 | 19,0 | 19,0 | 19,0 | 19,0 | 23,0 | 25,0 | 25,0 | 27,0 | 27,0 | 27,0 |
| Installation torque | $T_{inst} \leq$ | [Nm] | 50 | 50 | 50 | 50 | 50 | 80 | 80 | 80 | 100 | 120 | 120 |
| Diameter of clearance hole in the fixture | | | | | | | | | | | | | |
| Pre-setting installation | $d_f \leq$ | [mm] | 18 | 18 | 18 | 18 | 18 | 22 | 24 (22) | 24 (22) | 26 | 26 | 26 |
| Through-setting installation | $d_f \leq$ | [mm] | 20 | 20 | 20 | 20 | 20 | 24 | 26 | 26 | 28 | 28 | 28 |

**Pre-setting installation**

Size M8 to M16, M20 LG, M24 LG

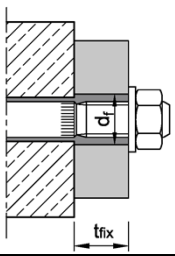



Size M20 + M24

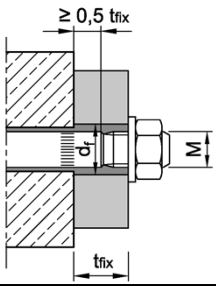



**Through-setting installation**

Size M10 - M16, M20 LG, M24 LG




Size M20 + M24




The annular gap in the clearance hole in the fixture has to be filled completely by excess mortar!

**Injection System VMZ**

**Intended use**
Installation parameters **VMZ-A**

**Annex B4**

## Table B5: Minimum spacing and edge distance, VMZ-A M8 – M12

| **Anchor size** | **VMZ-A** | | **40 M8** | **50 M8** | **60 M10** | **75 M10** | **75 M12** | **70 M12** | **80 M12** | **95 M12** | **100 M12** | **110 M12** | **125 M12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Minimum thickness of concrete | $h_{min}$ | [mm] | 80 | 80 | 100 | 110<br>100[1)] | 110 | 110 | 110 | 130<br>125[1)] | 130 | 140 | 160 |
| **Cracked concrete** | | | | | | | | | | | | | |
| Minimum spacing | $s_{min}$ | [mm] | 40 | 40 | 40 | 40 | 50 | 55 | 40 | 40 | 50 | 50 | 50 |
| Minimum edge distance | $c_{min}$ | [mm] | 40 | 40 | 40 | 40 | 50 | 55 | 50 | 50 | 50 | 50 | 50 |
| **Uncracked concrete** | | | | | | | | | | | | | |
| Minimum spacing | $s_{min}$ | [mm] | 40 | 40 | 50 | 50 | 50 | 55 | 55 | 55 | 80[2)] | 80[2)] | 80[2)] |
| Minimum edge distance | $c_{min}$ | [mm] | 40 | 40 | 50 | 50 | 50 | 55 | 55 | 55 | 55[2)] | 55[2)] | 55[2)] |

[1)] The reverse of the concrete member must not be damaged after drilling and must be filled with high-strength mortar if drilled through.

[2)] For an edge distance c ≥ 80 mm a minimum spacing $s_{min}$ = 55 mm is applicable.

## Table B6: Minimum spacing and edge distance, VMZ-A M16 – M24

| **Anchor size** | **VMZ-A** | | **90 M16** | **105 M16** | **125 M16** | **145 M16** | **160 M16** | **115 M20** | **170 M20 (LG)** | **190 M20 (LG)** | **170 M24 (LG)** | **200 M24 (LG)** | **225 M24 (LG)** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Minimum thickness of concrete | $h_{min}$ | [mm] | 130 | 150 | 170<br>160[1)] | 190<br>180[1)] | 205<br>200[1)] | 160 | 230<br>220[1)] | 250<br>240[1)] | 230<br>220[1)] | 270<br>260[1)] | 300<br>290[1)] |
| **Cracked concrete** | | | | | | | | | | | | | |
| Minimum spacing | $s_{min}$ | [mm] | 50 | 50 | 60 | 60 | 60 | 80 | 80 | 80 | 80 | 80 | 80 |
| Minimum edge distance | $c_{min}$ | [mm] | 50 | 50 | 60 | 60 | 60 | 80 | 80 | 80 | 80 | 80 | 80 |
| **Uncracked concrete** | | | | | | | | | | | | | |
| Minimum spacing | $s_{min}$ | [mm] | 50 | 60 | 60 | 60 | 60 | 80 | 80 | 80 | 80 | 105 | 105 |
| Minimum edge distance | $c_{min}$ | [mm] | 50 | 60 | 60 | 60 | 60 | 80 | 80 | 80 | 80 | 105 | 105 |

[1)] The reverse of the concrete member must not be damaged after drilling and must be filled with high-strength mortar if drilled through.

**Injection System VMZ**

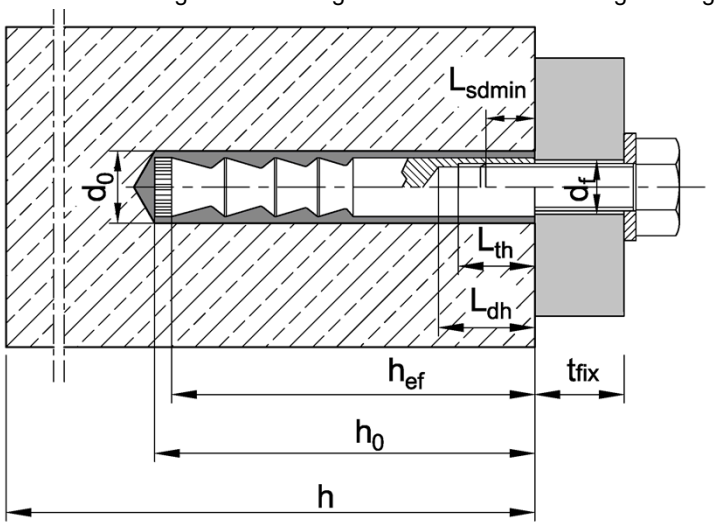
**Intended use**
Minimum spacing and edge distance, **VMZ-A**

**Annex B5**

## Table B7: Installation parameters VMZ-IG

| Anchor size | VMZ-IG | | 40 M6 | 50 M6 | 60 M8 | 75 M8 | 70 M10 | 80 M10 | 90 M12 | 105 M12 | 125 M12 | 115 M16 | 170 M16 | 170 M20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective anchorage depth | $h_{ef}$ | [mm] | 40 | 50 | 60 | 75 | 70 | 80 | 90 | 105 | 125 | 115 | 170 | 170 |
| Nominal diameter of drill hole | $d_0$ | [mm] | 10 | 10 | 12 | 12 | 14 | 14 | 18 | 18 | 18 | 22 | 24 | 26 |
| Depth of drill hole | $h_0 \geq$ | [mm] | 42 | 55 | 65 | 80 | 80 | 85 | 98 | 113 | 133 | 120 | 180 | 185 |
| Diameter of cleaning brush | D ≥ | [mm] | 10,8 | 10,8 | 13,0 | 13,0 | 15,0 | 15,0 | 19,0 | 19,0 | 19,0 | 23,0 | 25,0 | 27,0 |
| Installation torque | $T_{inst} \leq$ | [Nm] | 8 | 8 | 10 | 10 | 15 | 15 | 25 | 25 | 25 | 50 | 50 | 80 |
| Diameter of clearance hole in the fixture | $d_f \leq$ | [mm] | 7 | 7 | 9 | 9 | 12 | 12 | 14 | 14 | 14 | 18 | 18 | 22 |
| Available thread length | $L_{th}$ | [mm] | 12 | 15 | 16 | 19 | 20 | 23 | 24 | 27 | 30 | 32 | 32 | 40 |
| Minimum screw-in depth | $L_{sdmin}$ | [mm] | 7 | 7 | 9 | 9 | 12 | 12 | 14 | 14 | 14 | 18 | 18 | 22 |
| Minimum thickness of concrete | $h_{min}$ | [mm] | 80 | 80 | 100 | 110 | 110 | 110 | 130 | 150 | 170<br>160[1)] | 160 | 230<br>220[1)] | 230<br>220[1)] |
| **Cracked concrete** | | | | | | | | | | | | | | |
| Minimum spacing | $s_{min}$ | [mm] | 40 | 40 | 40 | 40 | 55 | 40 | 50 | 50 | 60 | 80 | 80 | 80 |
| Minimum edge distance | $c_{min}$ | [mm] | 40 | 40 | 40 | 40 | 55 | 50 | 50 | 50 | 60 | 80 | 80 | 80 |
| **Uncracked concrete** | | | | | | | | | | | | | | |
| Minimum spacing | $s_{min}$ | [mm] | 40 | 40 | 50 | 50 | 55 | 55 | 50 | 60 | 60 | 80 | 80 | 80 |
| Minimum edge distance | $c_{min}$ | [mm] | 40 | 40 | 50 | 50 | 55 | 55 | 50 | 60 | 60 | 80 | 80 | 80 |

[1)] The reverse of the concrete member must not be damaged after drilling and must be filled with high-strength mortar if drilled through.




**Injection System VMZ**

**Intended use**
Installation parameters **VMZ-IG**

**Annex B6**

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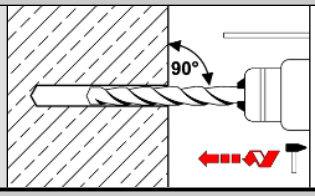
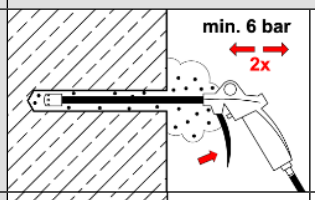
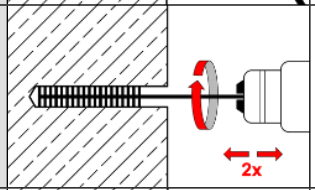
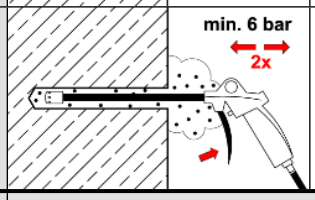
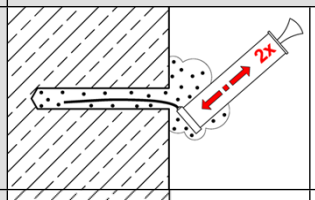
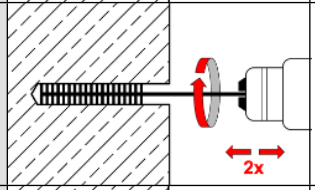
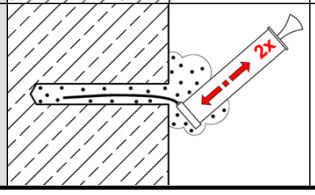
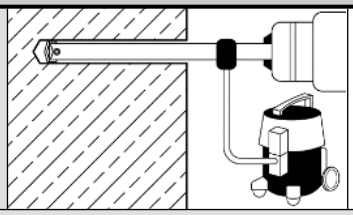
## **Installation instructions** - Hammer drill bit

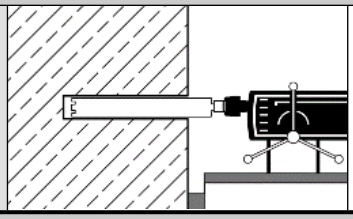
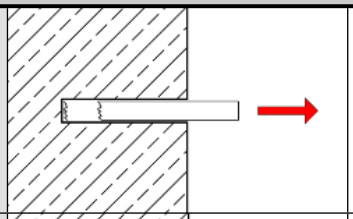
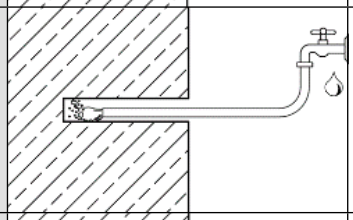
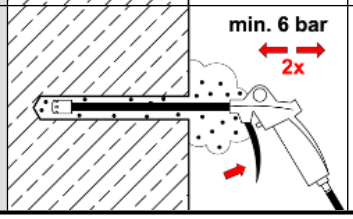
| **Hammer drill bit** | | |
|---|---|---|
| **Hole drilling** | | |
| 1 |  | Use hammer drill or compressed air drill with drill bit and depth gauge. Drill perpendicular to concrete surface. |
| **Cleaning** | | |
| | **<u>Cleaning with compressed air</u>** (all sizes) | |
| 2a |  | Connect Air Blower to compressed air (min. 6 bar, oil-free). Open air valve and blow out drill hole along the entire depth with back-and-forth motion at least **two** times. |
| 3a |  | Check diameter of cleaning brush. If the brush can be pushed into the drill hole without any resistance, it must be replaced. Chuck brush into drill machine. Turn on drill machine and brush drill hole back and forth along the entire drill hole depth at least **two** times while rotated by drill machine. |
| 4a |  | Connect Air Blower to compressed air (min. 6 bar, oil-free). Open air valve and blow out drill hole along the entire depth with back-and-forth motion at least **two** times. |
| | **<u>Manual cleaning</u>** (alternatively, up to drill hole diameter 18mm) | |
| 2b |  | Blow out drill hole from the bottom with Blow-out pump at least **two** times. |
| 3b |  | Check diameter of cleaning brush. If the brush can be pushed into the drill hole without any resistance, it must be replaced. Chuck brush into drill machine. Turn on drill machine and brush drill hole back and forth along the entire drill hole depth at least **two** times while rotated by drill machine. |
| 4b |  | Blow out drill hole from the bottom with Blow-out pump at least **two** times. |

| **Injection System VMZ** | **Annex B7** |
|---|---|
| **Intended use**<br>Installation instructions<br>Hole drilling and cleaning (hammer drill bit) | |

## **Installation instructions** - Vacuum drill bit

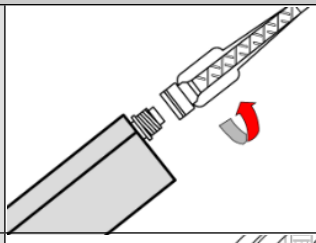
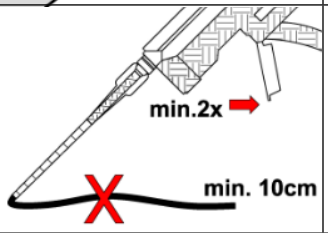
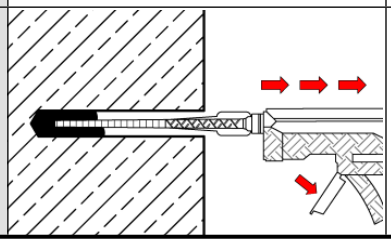
| **Vacuum drill bit** | | |
|---|---|---|
| **Hole drilling and cleaning** | | |
| 1 |  | Drill hole perpendicular to concrete surface by using a vacuum drill bit (see Annex B1). The nominal under pressure of the vacuum cleaner must be at least 230 mbar / 23kPa.<br>**Pay attention to the function of the dust extraction system!**<br>Make sure the dust extraction is working properly throughout the whole drilling process. |
| **Additional cleaning is not necessary - continue with step 5!** | | |

## **Installation instructions** - Diamond drilling

| **Diamond drilling** | | |
|---|---|---|
| **Hole drilling** | | |
| **1** |  | Use diamond drill with diamond drill bit and depth gauge.<br>Drill perpendicular to concrete surface. |
| **Cleaning** | | |
| **2** |  | Remove drill core at least up to the nominal hole depth and check drill hole depth. |
| **3** |  | Flushing of drill hole:<br>Flush drill hole with water, starting from the bottom, until clear water gets out of the drill hole. |
| **4** |  | Connect Air Blower to compressed air (min. 6 bar, oil-free).<br>Open air valve and blow out drill hole along the entire depth with back-and-forth motion at least **two** times. |

| **Injection System VMZ** | **Annex B8** |
|---|---|
| **Intended use**<br>Installation instructions<br>Hole drilling and cleaning (vacuum drill bit and diamond drill bit) | |

## **Installation instructions** - Continuation

| **Injection** | | |
|---|---|---|
| **5** |  | Check the expiration date on cartridge. Never use when expired. Remove cap from cartridge. Attach the supplied static mixer to the cartridge. For every working interruption longer than the recommended working time (Table B1 or Table B2) as well as for a new cartridge, always use a new static mixer. Never use static mixer without helix inside. |
| **6** |  | Insert cartridge in Dispenser. Before injecting discard mortar (at least 2 full strokes or a line of 10 cm) until it shows a consistent grey colour. Never use this mortar. |
| **7** |  | Prior to injection, check if static mixer reaches the bottom of the drill hole. If it does not reach the bottom, plug Mixer Extension onto static mixer to fill the drill hole properly. Fill hole with a sufficient quantity of injection mortar. Start from the bottom of the drill hole and work out to avoid trapping air pockets. |

| **Injection System VMZ** | **Annex B9** |
|---|---|
| **Intended use**<br>Installation instructions<br>Injection | |

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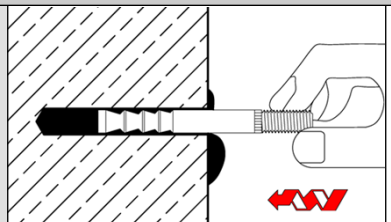
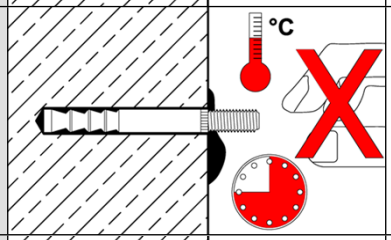
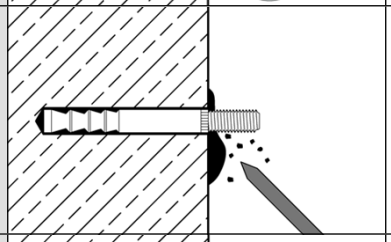
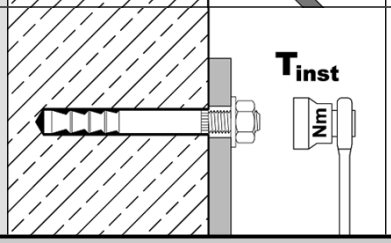
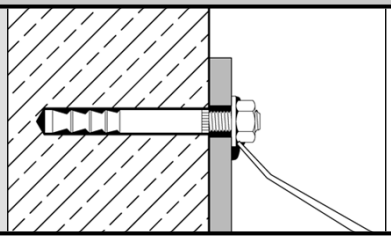
## **Installation instructions** - Continuation

### Anchor rod VMZ-A

**Inserting the anchor rod**

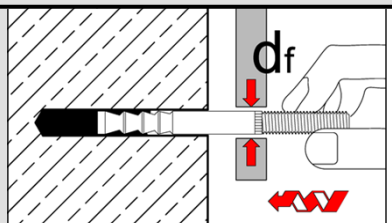
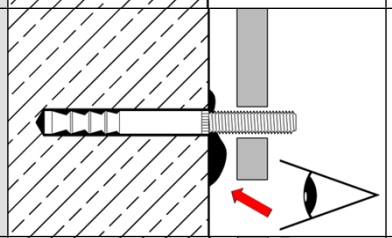
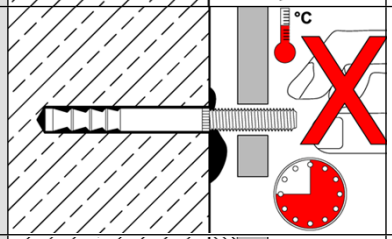
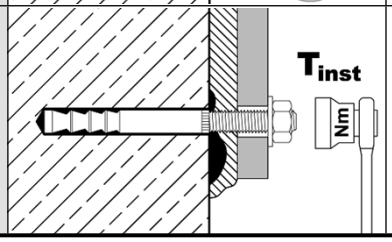
| | | |
|---|---|---|
| 8 |  | Insert the anchor rod VMZ-A by hand, rotating slightly up to the full embedment depth as marked on the anchor rod. The anchor rod is properly set when excess mortar seeps from the hole (Pre-setting installation) or the annular gap in the clearance hole in the fixture is completely filled by excess mortar (Through-setting installation). If the hole is not completely filled, pull out anchor rod, let mortar cure, drill out hole and repeat the entire cleaning process. |
| 9 |  | Follow minimum curing time shown in Table B1 or Table B2<br>During curing time, anchor rod must not be moved or loaded. |
| 10 |  | Remove excess mortar. |
| 11 |  | The fixture can be mounted after curing time. Apply installation torque $T_{inst}$ according to Table B3 or Table B4 by using torque wrench. |

**Filling annular gap**

| | | |
|---|---|---|
| Optional |  | Annular gap between anchor rod and attachment may optionally be filled with mortar. Therefore, replace regular washer by filling washer and plug on reducing adapter on static mixer.<br>Annular gap is completely filled, when excess mortar seeps out. |

| | |
|---|---|
| **Injection System VMZ** | **Annex B10** |
| **Intended use**<br>Installation instructions<br>Installation Anchor rod **VMZ-A** | |

## Installation instructions – Stand-off Installation

| **Stand-off installation with anchor rod VMZ-A 75 M12**<br>**Requirement: Diameter of clearance hole in the fixture $d_f \leq 14$ mm** | | |
|---|---|---|
| Work step **1-7** as illustrated in Annexes **B7 – B9** | | |
| **8** |  | Insert the anchor rod VMZ-A by hand, rotating slightly up to the full embedment depth. |
| **9** |  | Check if excess mortar seeps from the hole. If the hole is not completely filled, pull out anchor rod, let mortar cure, drill out hole and repeat the entire cleaning process.<br>**The annular gap in the fixture does not have to be filled.** |
| **10** |  | During curing time according to Table B1 or Table B2 anchor rod must not be moved or loaded. |
| **11** |  | Washer and nut can be mounted after curing time and backfilling of anchor plate. Apply installation torque $T_{inst}$ according to Table B3 by using torque wrench. |

| **Injection System VMZ** | **Annex B11** |
|---|---|
| **Intended use**<br>Installation instructions **VMZ-A 75 M12**<br>Through-setting installation with clearance between concrete and anchor plate | |

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## **Installation instructions** - Continuation

### Anchor rod VMZ-IG

**Setting of anchor rod**

Work step **1-7** as illustrated in Annexes **B7 – B9**

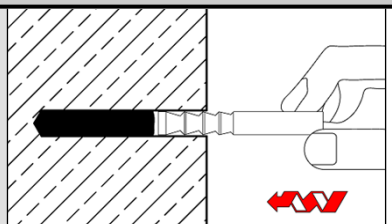
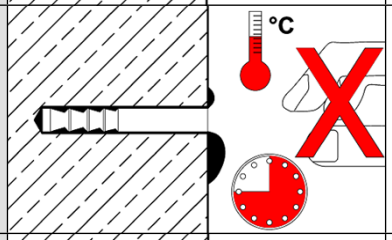
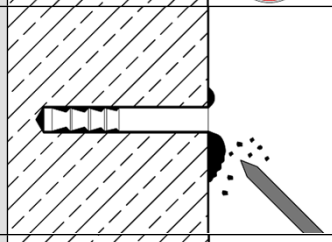
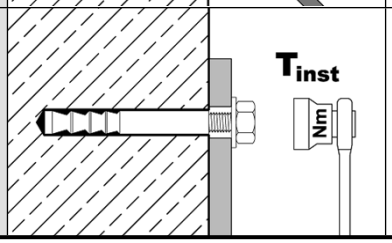
| | | |
|---|---|---|
| **8** |  | Insert the anchor rod VMZ-IG by hand, rotating slightly up to about 1 mm below the concrete surface in the drill hole. The anchor rod is properly set when excess mortar seeps from the hole. If the hole is not completely filled, pull out anchor rod, let mortar cure, drill out hole and repeat the entire cleaning process. |
| **9** |  | Follow minimum curing time shown in Table B1 and Table B2. During curing time anchor rod must not be moved or loaded. |
| **10** |  | Remove excess mortar. |
| **11** |  | The fixture can be mounted after curing time. Apply installation torque $T_{inst}$ according to Table B7 by using torque wrench. |

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**Table C1:** Characteristic values for **concrete failure** and **splitting**

| **Anchor size** | | | **VMZ-A VMZ-IG** | **all sizes** |
|---|---|---|---|---|
| **Concrete cone failure** | | | | |
| Factor for | uncracked concrete | $k_{ucr,N}$ | [-] | 11,0 |
| | cracked concrete | $k_{cr,N}$ | [-] | 7,7 |
| Characteristic edge distance | | $c_{cr,N}$ | [mm] | $1,5 \cdot h_{ef}$ |
| Characteristic spacing | | $s_{cr,N}$ | [mm] | $2 \cdot c_{cr,N}$ |
| **Splitting**<br>For each proof of splitting failure, $N_{Rk,sp}$ shall be calculated according to EN 1992-4:2018, equation (7.23).<br>The higher value for $N_{Rk,sp}$ of case 1 and case 2 may be applied for the design. | | | | |
| Case 1 | | | | |
| Characteristic resistance | | $N^0_{Rk,sp}$ | [kN] | see following tables |
| Characteristic edge distance | | $c_{cr,sp}$ | [mm] | $1,5 \cdot h_{ef}$ |
| Characteristic spacing | | $s_{cr,sp}$ | [mm] | $2 \cdot c_{cr,sp}$ |
| Case 2 | | | | |
| Characteristic resistance | | $N^0_{Rk,sp}$ | [kN] | min [$N_{Rk,p}$ ; $N^0_{Rk,c}$] |
| Characteristic edge distance | | $c_{cr,sp}$ | [mm] | see following tables |
| Characteristic spacing | | $s_{cr,sp}$ | [mm] | $2 \cdot c_{cr,sp}$ |

**Injection System VMZ**

**Performance**
Characteristic values for **concrete failure and splitting, VMZ-A and VMZ-IG**

**Annex C1**

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## Table C2: Characteristic values for **tension loads, VMZ-A M8 – M12,** static and quasi-static action

| **Anchor size** | | | **VMZ-A** | **40 M8** | **50 M8** | **60 M10** | **75 M10** | **75 M12** | **70 M12** | **80 M12** | **95 M12** | **100 M12** | **110 M12** | **125 M12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Installation factor | | $\gamma_{inst}$ | [-] | 1,0 | | | | | | | | | | |
| **Steel failure** | | | | | | | | | | | | | | |
| Characteristic resistance | | $N_{Rk,s}$ | [kN] | 15 | 18 | 25 | | 35 | 49 | 54 | | 57 | | |
| Partial factor | | $\gamma_{Ms}$ | [-] | 1,5 | | | | | | | | | | |
| **Pull-out** | | | | | | | | | | | | | | |
| Characteristic resistance (concrete C20/25) | | | | | | | | | | | | | | |
| uncracked concrete | 50°C / 80°C[1)] | $N_{Rk,p}$ | [kN] | 9,0 | 17,4 | 22,9 | 32,0 | 32,0 | 28,8 | 35,2 | 40,0 | 49,2 | 50,0 | 50,0 |
| | 72°C / 120°C[1)] | | [kN] | 6 | 9 | 16 | 16 | 16 | 16 | 25 | 25 | 30 | 30 | 30 |
| cracked concrete | 50°C / 80°C[1)] | $N_{Rk,p}$ | [kN] | 8,7 | 12,2 | 16,0 | 22,4 | 22,4 | 20,2 | 24,6 | 31,9 | 34,4 | 39,7 | 48,1 |
| | 72°C / 120°C[1)] | | [kN] | 5 | 7,5 | 12 | 12 | 12 | 16 | 20 | 20 | 30 | 30 | 30 |
| **Splitting** | | | | | | | | | | | | | | |
| Splitting for **standard thickness of concrete member** | | | | | | | | | | | | | | |
| Standard thickness of concrete | | $h_{min,1} \geq$ | [mm] | 100 | | 120 | 150 | 150 | 140 | 160 | 190 | 200 | 220 | 250 |
| **Case 1** | | | | | | | | | | | | | | |
| Characteristic resistance (concrete C20/25) | | $N^0_{Rk,sp}$ | [kN] | 7,5 | 9,0 | 16,0 | 20,0 | 20,0 | | 35,2 | 30,0 | 40,0 | | |
| **Case 2** | | | | | | | | | | | | | | |
| Characteristic edge distance | | $c_{cr,sp}$ | [mm] | 3 $h_{ef}$ | | $2{,}5h_{ef}$ | $3{,}5h_{ef}$ | $3{,}5h_{ef}$ | $2{,}5h_{ef}$ | $1{,}5h_{ef}$ | $2{,}5h_{ef}$ | 2 $h_{ef}$ | 3 $h_{ef}$ | $2{,}5h_{ef}$ |
| Splitting for **minimum thickness of concrete member** | | | | | | | | | | | | | | |
| Minimum thickness of concrete | | $h_{min,2} \geq$ | [mm] | 80 | | 100 | | 110 | | | 125 | 130 | 140 | 160 |
| **Case 1** | | | | | | | | | | | | | | |
| Characteristic resistance (concrete C20/25) | | $N^0_{Rk,sp}$ | [kN] | 7,5 | [2)] | 16 | | 16 | 20 | 25 | 25 | 30 | | |
| **Case 2** | | | | | | | | | | | | | | |
| Characteristic edge distance | | $c_{cr,sp}$ | [mm] | $3h_{ef}$ | $3{,}5h_{ef}$ | 3 $h_{ef}$ | $3{,}5h_{ef}$ | $3{,}5h_{ef}$ | | $3h_{ef}$ | $3{,}5h_{ef}$ | $3h_{ef}$ | | |
| Increasing factor for $N_{Rk,p} = \psi_c \cdot N_{Rk,p\,(C20/25)}$ and $N^0_{Rk,sp} = \psi_c \cdot N^0_{Rk,sp\,(C20/25)}$[3)] | | $\psi_c$ | [-] | $\left(\frac{f_{ck}}{20}\right)^{0,5} \leq 1{,}58$ | | | | | | | | | | |
| **Concrete cone failure** | | | | | | | | | | | | | | |
| Effective anchorage depth | | $h_{ef}$ | [mm] | 40 | 50 | 60 | 75 | 75 | 70 | 80 | 95 | 100 | 110 | 125 |

[1)] Maximum long-term temperature / maximum short-term temperature
[2)] No performance assessed
[3)] increasing factor for $N^0_{Rk,sp}$ only for case 1

**Injection System VMZ**

**Performance**
Characteristic values for **tension loads, VMZ-A M8 – M12,** static and quasi-static action

**Annex C2**

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## Table C3: Characteristic values for **tension loads, VMZ-A M16 – M24,** static and quasi-static action

| **Anchor size** | | | **VMZ-A** | **90 M16** | **105 M16** | **125 M16** | **145 M16** | **160 M16** | **115 M20** | **170 M20 (LG)** | **190 M20 (LG)** | **170 M24 (LG)** | **200 M24 (LG)** | **225 M24 (LG)** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Installation factor | | $\gamma_{inst}$ | [-] | 1,0 | | | | | | | | | | |
| **Steel failure** | | | | | | | | | | | | | | |
| Characteristic tension resistance $N_{Rk,s}$ | Steel, zinc plated | | [kN] | 88 | 95 | 111 | | 97 | 96 | 188 | | 222 | | |
| | A4, HCR | | [kN] | 88 | 95 | 111 | | 97 | 114 | 165 | | 194 | | |
| Partial factor | | $\gamma_{Ms}$ | [-] | 1,5 | | | | | 1,68 | 1,5 | | 1,5 | | |
| **Pull-out** | | | | | | | | | | | | | | |
| Characteristic resistance (concrete C20/25) | | | | | | | | | | | | | | |
| uncracked concrete | 50°C/80°C[1] | $N_{Rk,p}$ | [kN] | 42,0 | 52,9 | 68,8 | 75,0 | 90,0 | 60,7 | 109,0 | 128,8 | 109,0 | 139,1 | 166,0 |
| | 72°C/120°C[1] | $N_{Rk,p}$ | [kN] | 25 | 35 | 50 | | 53 | 40 | 75 | | 95 | | |
| cracked concrete | 50°C/80°C[1] | $N_{Rk,p}$ | [kN] | 29,4 | 37,1 | 48,1 | 60,1 | 69,7 | 42,5 | 76,3 | 90,2 | 76,3 | 97,4 | 116,2 |
| | 72°C/120°C[1] | $N_{Rk,p}$ | [kN] | 25 | 30 | 50 | | 51 | 30 | 60 | | 75 | | |
| **Splitting** | | | | | | | | | | | | | | |
| Splitting for **standard thickness of concrete** | | | | | | | | | | | | | | |
| Standard thickness of concrete | | $h_{min,1} \geq$ | [mm] | 180 | 200 | 250 | 290 | 320 | 230 | 340 | 380 | 340 | 400 | 450 |
| **Case 1** | | | | | | | | | | | | | | |
| Characteristic resistance (concrete C20/25) | | $N^0_{Rk,sp}$ | [kN] | 40 | 50 | | 60 | 80 | 60,7 | 109 | 115 | 109 | 139,1 | 140 |
| **Case 2** | | | | | | | | | | | | | | |
| Characteristic edge distance | | $c_{cr,sp}$ | [mm] | 2 $h_{ef}$ | | | | | 1,5 $h_{ef}$ | | 2 $h_{ef}$ | 1,5 $h_{ef}$ | | 1,8 $h_{ef}$ |
| Splitting for **minimum thickness of concrete** | | | | | | | | | | | | | | |
| Minimum thickness of concrete | | $h_{min,2} \geq$ | [mm] | 130 | 150 | 160 | 180 | 200 | 160 | 220 | 240 | 220 | 260 | 290 |
| **Case 1** | | | | | | | | | | | | | | |
| Characteristic resistance (concrete C20/25) | | $N^0_{Rk,sp}$ | [kN] | 35 | 50 | 40 | 50 | 71 | [2] | 75 | | 109 | 115 | |
| **Case 2** | | | | | | | | | | | | | | |
| Characteristic edge distance | | $c_{cr,sp}$ | [mm] | 2,5$h_{ef}$ | | 3,0$h_{ef}$ | 2,5$h_{ef}$ | | 2,5$h_{ef}$ | 2,6$h_{ef}$ | 2,2$h_{ef}$ | 2,6$h_{ef}$ | 2,2$h_{ef}$ | |
| Increasing factor for $N_{Rk,p} = \psi_c \cdot N_{Rk,p\,(C20/25)}$ and $N^0_{Rk,sp} = \psi_c \cdot N^0_{Rk,sp\,(C20/25)}$[3] | | $\psi_c$ | [-] | $\left(\frac{f_{ck}}{20}\right)^{0,5} \leq 1,58$ | | | | | | | | | | |
| **Concrete cone failure** | | | | | | | | | | | | | | |
| Effective anchorage depth | | $h_{ef}$ | [mm] | 90 | 105 | 125 | 145 | 160 | 115 | 170 | 190 | 170 | 200 | 225 |

[1] Maximum long-term temperature / Maximum short-term temperature
[2] No performance assessed
[3] Increasing factor for $N^0_{Rk,sp}$ only for Case 1

**Injection System VMZ**

**Performance**
Characteristic values for **tension loads, VMZ-A M16 – M24,** static and quasi-static action

**Annex C3**

Deutsches Institut für Bautechnik DIBt

**Table C4:** Characteristic values for **shear load**, **VMZ-A M8 – M12,** static and quasi-static action

| **Anchor size** | | **VMZ-A** | **40 M8** | **50 M8** | **60 M10** | **75 M10** | **75 M12** | **70 M12** | **80 M12** | **95 M12** | **100 M12** | **110 M12** | **125 M12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Installation factor | $\gamma_{inst}$ | [-] | 1,0 | | | | | | | | | | |
| **Steel failure <u>without</u> lever arm** | | | | | | | | | | | | | |
| Characteristic resistance $V^0_{Rk,s}$ | Steel, zinc plated | [kN] | 14 | | 21 | | 34 | | | | | | |
| | A4, HCR | [kN] | 15 | | 23 | | 34 | | | | | | |
| Partial factor | $\gamma_{Ms}$ | [-] | 1,25 | | | | | | | | | | |
| Ductility factor | $k_7$ | [-] | 1,0 | | | | | | | | | | |
| **Steel failure <u>with</u> lever arm** | | | | | | | | | | | | | |
| Characteristic bending resistance $M^0_{Rk,s}$ | Steel, zinc plated | [Nm] | 30 | | 60 | | 105 | | | | | | |
| | A4, HCR | [Nm] | 30 | | 60 | | 105 | | | | | | |
| Partial factor | $\gamma_{Ms}$ | [-] | 1,25 | | | | | | | | | | |
| **Concrete pry-out failure** | | | | | | | | | | | | | |
| Pry-out factor | $k_8$ | [-] | 2 | | | | | | | | | | |
| **Concrete edge failure** | | | | | | | | | | | | | |
| Effective length of anchor in shear load | $l_f$ | [mm] | 40 | 50 | 60 | 75 | 75 | 70 | 80 | 95 | 100 | 110 | 125 |
| Outside diameter of anchor | $d_{nom}$ | [mm] | 10 | | 12 | | 12 | 14 | | | | | |

**Injection System VMZ**

**Performance**
Characteristic values for **shear load**, **VMZ-A M8 – M12,** static and quasi-static action

**Annex C4**

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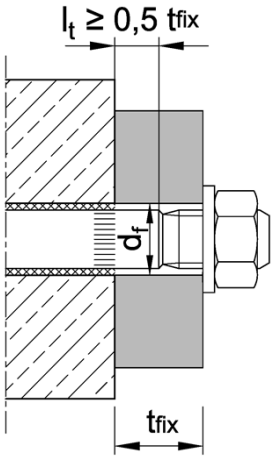
**Table C5:** Characteristic values for **shear load, VMZ-A M16 – M24,** static or quasi-static action

| **Anchor size** | | **VMZ-A** | **90 M16** | **105 M16** | **125 M16** | **145 M16** | **160 M16** | **115 M20** | **170 M20 (LG)** | **190 M20 (LG)** | **170 M24 (LG)** | **200 M24 (LG)** | **225 M24 (LG)** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Installation factor | $\gamma_{inst}$ | [-] | 1,0 | | | | | | | | | | |
| **Steel failure <u>without</u> lever arm** | | | | | | | | | | | | | |
| Characteristic resistance $V^0_{Rk,s}$ | Steel, zinc plated | [kN] | 63 | | | | | 70 | 149 [1] (98) | | 178 [1] (141) | | |
| | A4, HCR | [kN] | 63 | | | | | 86 | 131 [1] (86) | | 156 [1] (123) | | |
| Partial factor | $\gamma_{Ms}$ | [-] | 1,25 | | | | | 1,4 | 1,25 | | 1,25 | | |
| Ductility factor | $k_7$ | [-] | 1,0 | | | | | | | | | | |
| **Steel failure <u>with</u> lever arm** | | | | | | | | | | | | | |
| Characteristic bending resistance $M^0_{Rk,s}$ | Steel, zinc plated | [Nm] | 266 | | | | | 392 | 519 | | 896 | | |
| | A4, HCR | [Nm] | 266 | | | | | 454 | | | 784 | | |
| Partial factor | $\gamma_{Ms}$ | [-] | 1,25 | | | | | 1,4 | 1,25 | | 1,25 | | |
| **Concrete pry-out failure** | | | | | | | | | | | | | |
| Pry-out factor | $k_8$ | [-] | 2,0 | | | | | | | | | | |
| **Concrete edge failure** | | | | | | | | | | | | | |
| Effective length of anchor in shear load | $l_f$ | [mm] | 90 | 105 | 125 | 145 | 160 | 115 | 170 | 190 | 170 | 200 | 225 |
| Outside diameter of anchor | $d_{nom}$ | [mm] | 18 | | | | | 22 | 24 | | 26 | | |

[1] This value may only be applied if $l_t \geq 0{,}5\ t_{fix}$

**<u>M20 + M24</u>**




| **Injection System VMZ** | **Annex C5** |
|---|---|
| **Performance**<br>Characteristic values for **shear load, VMZ-A M16 – M24,**<br>static and quasi-static action | |

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**Table C6:** Characteristic values for **seismic action, VMZ-A M10 – M12,** performance category **C1** and **C2**

| **Anchor size** | | | | **VMZ-A** | **60 M10** | **75 M10** | **75 M12** | **70 M12** | **80 M12** | **95 M12** | **100 M12** | **110 M12** | **125 M12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Tension loads** | | | | | | | | | | | | | |
| Installation factor | | | $\gamma_{inst}$ | [-] | 1,0 | | | | | | | | |
| **Steel failure, steel zinc plated, stainless steel A4, HCR** | | | | | | | | | | | | | |
| Characteristic resistance | | $N_{Rk,s,C1}$<br>$N_{Rk,s,C2}$ | | [kN] | 25 | | 35 | 49 | 54 | | 57 | | |
| Partial factor | | | $\gamma_{Ms}$ | [-] | 1,5 | | | | | | | | |
| **Pull-out** (concrete C20/25 to C50/60) | | | | | | | | | | | | | |
| Characteristic resistance | | $N_{Rk,p,C1}$ | 50°C / 80°C [1] | [kN] | 14,5 | | 14,5 | | 30,6 | | 36,0 | 41,5 | 42,8 |
| | | | 72°C / 120°C [1] | [kN] | 10,9 | | 10,9 | | 20,0 | | 30,0 | | |
| | | $N_{Rk,p,C2}$ | 50°C / 80°C [1] | [kN] | 7,4 | | 7,4 | | 8,7 | | 17,6 | | |
| | | | 72°C / 120°C [1] | [kN] | 5,1 | | 5,1 | | 6,5 | | 12,3 | | |
| **Shear loads** | | | | | | | | | | | | | |
| **Steel failure <u>without</u> lever arm, steel zinc plated** | | | | | | | | | | | | | |
| Characteristic resistance | | | $V_{Rk,s,C1}$ | [kN] | 11,8 | | 27,2 | | | | | | |
| | | | $V_{Rk,s,C2}$ | [kN] | 12,6 | | 27,2 | | | | | | |
| Partial factor | | | $\gamma_{Ms}$ | [-] | 1,25 | | | | | | | | |
| **Steel failure <u>without</u> lever arm, stainless steel A4, HCR** | | | | | | | | | | | | | |
| Characteristic resistance | | | $V_{Rk,s,C1}$ | [kN] | 12,9 | | 27,2 | | | | | | |
| | | | $V_{Rk,s,C2}$ | [kN] | 13,8 | | 27,2 | | | | | | |
| Partial factor | | | $\gamma_{Ms}$ | [-] | 1,25 | | | | | | | | |
| Factor for anchorages with | filled annular gap | | $\alpha_{gap}$ | [-] | 1,0 | | | | | | | | |
| | unfilled annular gap | | $\alpha_{gap}$ | [-] | 0,5 | | | | | | | | |

[1] Maximum long-term temperature / Maximum short-term temperature

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**Table C7:** Characteristic values for **seismic action**, **VMZ-A M16 – M24,** performance category **C1** and **C2**

| **Anchor size** | **VMZ-A** | | | **90 M16** | **105 M16** | **125 M16** | **145 M16** | **160 M16** | **115 M20** | **170 M20 (LG)** | **190 M20 (LG)** | **170 M24 (LG)** | **200 M24 (LG)** | **225 M24 (LG)** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Tension loads** | | | | | | | | | | | | | | |
| Installation factor | | $\gamma_{inst}$ | [-] | 1,0 | | | | | | | | | | |
| **Steel failure, steel zinc plated** | | | | | | | | | | | | | | |
| Characteristic resistance | | $N_{Rk,s,C1}$<br>$N_{Rk,s,C2}$ | [kN] | 88 | 95 | 111 | | 97 | 96 | 188 | | 222 | | |
| **Steel failure, stainless steel A4, HCR** | | | | | | | | | | | | | | |
| Characteristic resistance | | $N_{Rk,s,C1}$<br>$N_{Rk,s,C2}$ | [kN] | 88 | 95 | 111 | | 97 | 114 | 165 | | 194 | | |
| Partial factor | | $\gamma_{Ms}$ | [-] | 1,5 | | | | | 1,68 | 1,5 | | 1,5 | | |
| **Pull-out** (concrete C20/25 to C50/60) | | | | | | | | | | | | | | |
| Characteristic resistance | $N_{Rk,p,C1}$ | 50°C / 80°C [1] | [kN] | 30,7 | 38,7 | 43,7 | | | 44,4 | 88,2 | | 90,7 | | |
| | | 72°C / 120°C [1] | [kN] | 25,0 | 30,0 | 38,5 | | | 29,4 | 55,8 | | 59,3 | | |
| | $N_{Rk,p,C2}$ | 50°C / 80°C [1] | [kN] | 16,3 | 22,1 | 26,1 | | | 30,9 | 59,7 | | 59,7 | | |
| | | 72°C / 120°C [1] | [kN] | 10,5 | 14,4 | 19,5 | | | 16,2 | 44,4 | | 44,4 | | |
| **Shear loads** | | | | | | | | | | | | | | |
| **Steel failure <u>without</u> lever arm, steel zinc plated** | | | | | | | | | | | | | | |
| Characteristic resistance | | $V_{Rk,s,C1}$ | [kN] | 39,1 | | | | | 39,1 | 82,3 | | 107 | | |
| | | $V_{Rk,s,C2}$ | [kN] | 50,4 | | | | | 51 | 108,8 [1] (71,5) | | 154,9 [1] (122,7) | | |
| Partial factor | | $\gamma_{Ms}$ | [-] | 1,25 | | | | | 1,4 | 1,25 | | 1,25 | | |
| **Steel failure <u>without</u> lever arm, stainless steel A4, HCR** | | | | | | | | | | | | | | |
| Characteristic resistance | | $V_{Rk,s,C1}$ | [kN] | 39,1 | | | | | 39,1 | 72,2 | | 93 | | |
| | | $V_{Rk,s,C2}$ | [kN] | 50,4 | | | | | 62,6 | 95,6 [1] (62,8) | | 135,7 [1] (107) | | |
| Partial factor | | $\gamma_{Ms}$ | [-] | 1,25 | | | | | 1,4 | 1,25 | | 1,25 | | |
| Factor for anchorages with | filled annular gap | $\alpha_{gap}$ | [-] | 1,0 | | | | | | | | | | |
| | unfilled annular gap | $\alpha_{gap}$ | [-] | 0,5 | | | | | | | | | | |

[1] This value may only be applied if $l_t \geq 0{,}5\ t_{fix,}$ (see Annex C4)

| **Injection System VMZ** | **Annex C7** |
|---|---|
| **Performance**<br>Characteristic values for **seismic action, VMZ-A M16 – M24**, performance category **C1** and **C2** | |

## Table C8: Displacements under tension loads, VMZ-A M8 – M12

| **Anchor size** | | | **VMZ-A** | **40 M8** | **50 M8** | **60 M10** | **75 M10** | **75 M12** | **70 M12** | **80 M12** | **95 M12** | **100 M12** | **110 M12** | **125 M12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Tension load in **cracked** concrete | N | [kN] | | 4,3 | 6,1 | 8,0 | 11,1 | 11,1 | 10,0 | 12,3 | 15,9 | 17,1 | 19,8 | 24,0 |
| Displacement | $\delta_{N0}$ | [mm] | | 0,5 | | 0,5 | 0,6 | 0,6 | | | | | 0,7 | |
| | $\delta_{N\infty}$ | [mm] | | 1,3 | | | | | | | | | | |
| Tension load in **uncracked** concrete | N | [kN] | | 4,3 | 8,5 | 11,1 | 15,6 | 15,6 | 14,1 | 17,2 | 19,0 | 24,0 | 23,8 | 23,8 |
| Displacement | $\delta_{N0}$ | [mm] | | 0,2 | 0,4 | 0,4 | | 0,4 | | | | | 0,6 | |
| | $\delta_{N\infty}$ | [mm] | | 1,3 | | | | | | | | | | |
| **Displacements under seismic tension loads C2** | | | | | | | | | | | | | | |
| Displacements for DLS | $\delta_{N,C2(DLS)}$ | [mm] | No performance assessed | | | 1,0 | | 1,0 | | 1,3 | | 1,1 | | |
| Displacements for ULS | $\delta_{N,C2(ULS)}$ | [mm] | | | | 3,0 | | 3,0 | | 3,9 | | 3,0 | | |

## Table C9: Displacements under tension loads, VMZ-A M16 – M24

| **Anchor size** | | | **VMZ-A** | **90 M16** | **105 M16** | **125 M16** | **145 M16** | **160 M16** | **115 M20** | **170 M20 (LG)** | **190 M20 (LG)** | **170 M24 (LG)** | **200 M24 (LG)** | **225 M24 (LG)** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Tension load in **cracked** concrete | N | [kN] | | 14,6 | 18,4 | 24,0 | 30,0 | 34,7 | 21,1 | 38,0 | 44,9 | 38,0 | 48,5 | 57,9 |
| Displacement | $\delta_{N0}$ | [mm] | | 0,7 | | | 0,8 | 1,2 | 0,7 | 0,8 | | 0,8 | 0,9 | |
| | $\delta_{N\infty}$ | [mm] | | 1,3 | | | | 1,6 | 1,1 | 1,3 | | 1,3 | | |
| Tension load in **uncracked** concrete | N | [kN] | | 20,5 | 25,9 | 33,0 | 35,7 | 48,1 | 29,6 | 53,3 | 63,0 | 53,3 | 67,9 | 81,1 |
| Displacement | $\delta_{N0}$ | [mm] | | 0,6 | | | | 0,8 | 0,5 | 0,6 | | 0,6 | | |
| | $\delta_{N\infty}$ | [mm] | | 1,3 | | | | 1,6 | 1,1 | 1,3 | | 1,3 | | |
| **Displacements under seismic tension loads C2** | | | | | | | | | | | | | | |
| Displacements for DLS | $\delta_{N,C2(DLS)}$ | [mm] | | 1,6 | | 1,5 | | | 1,7 | 1,9 | | 1,9 | | |
| Displacements for ULS | $\delta_{N,C2(ULS)}$ | [mm] | | 3,7 | | 4,4 | | | 4,0 | 4,5 | | 4,5 | | |

**Injection System VMZ**

**Performance**
Displacements under tension loads, **VMZ-A**

**Annex C8**

## Table C10: Displacements under shear loads VMZ-A M8 – M12

| **Anchor size** | | **VMZ-A** | **40 M8** | **50 M8** | **60 M10** | **75 M10** | **75 M12** | **70 M12** | **80 M12** | **95 M12** | **100 M12** | **110 M12** | **125 M12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Shear load | V | [kN] | 8,3 | | 13,3 | | 19,3 | | | | | | |
| Displacements | $\delta_{V0}$ | [mm] | 2,4 | 2,5 | 2,9 | | 3,3 | | | | | | |
| | $\delta_{V\infty}$ | [mm] | 3,6 | 3,8 | 4,4 | | 5,0 | | | | | | |
| **Displacements under seismic shear loads C2** | | | | | | | | | | | | | |
| Displacements for DLS | $\delta_{V,C2(DLS)}$ | [mm] | No performance assessed | | 2,1 | | 2,5 | | | | | | |
| Displacements for ULS | $\delta_{V,C2(ULS)}$ | [mm] | | | 3,7 | | 5,1 | | | | | | |

## Table C11: Displacements under shear loads VMZ-A M16 – M24

| **Anchor size** | | **VMZ-A** | **90 M16** | **105 M16** | **125 M16** | **145 M16** | **160 M16** | **115 M20** | **170 M20 (LG)** | **190 M20 (LG)** | **170 M24 (LG)** | **200 M24 (LG)** | **225 M24 (LG)** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Shear load | V | [kN] | 36 | | | | | 44 | 75 (49) | | 89 (71) | | |
| Displacements | $\delta_{V0}$ | [mm] | 3,8 | | | | | 3,0 | 4,3 (3,0) | | 4,6 (3,5) | | |
| | $\delta_{V\infty}$ | [mm] | 5,7 | | | | | 4,5 | 6,5 (4,5) | | 6,9 (5,3) | | |
| **Displacements under seismic shear loads C2** | | | | | | | | | | | | | |
| Displacements for DLS | $\delta_{V,C2(DLS)}$ | [mm] | 2,9 | | | | | 3,5 | | | 3,7 | | |
| Displacements for ULS | $\delta_{V,C2(ULS)}$ | [mm] | 6,8 | | | | | 9,3 | | | 9,3 | | |

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## Table C12: Characteristic values for **tension load**, VMZ-IG

| **Anchor size** | | **VMZ-IG** | | **40 M6** | **50 M6** | **60 M8** | **75 M8** | **70 M10** | **80 M10** | **90 M12** | **105 M12** | **125 M12** | **115 M16** | **170 M16** | **170 M20** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Installation factor | $\gamma_{inst}$ | [-] | | 1,0 | | | | | | | | | | | |
| **Steel failure** | | | | | | | | | | | | | | | |
| Characteristic resistance $N_{Rk,s}$ | Steel, zinc plated | [kN] | | 15 | 16 | 19 | 29 | 35 | | 67 | | | 52 | 125 | 108 |
| | A4, HCR | [kN] | | 11 | | 19 | 21 | 33 | | 47 | | | 65 | 88 | 94 |
| Partial factor | $\gamma_{Ms}$ | [-] | | 1,5 | | | | | | | | | | | |
| **Pull-out** | | | | | | | | | | | | | | | |
| Characteristic resistance (concrete C20/25) | | | | | | | | | | | | | | | |
| uncracked concrete | 50°C / 80°C[1] | $N_{Rk,p}$ | [kN] | 9 | 17,4 | 22,9 | 32 | 28,8 | 35,2 | 42 | 52,9 | 68,8 | 60,7 | 109 | 109 |
| | 72°C / 120°C[1] | | [kN] | 6 | 9 | 16 | 16 | 16 | 25 | 25 | 35 | 50 | 40 | 75 | 95 |
| cracked concrete | 50°C / 80°C[1] | $N_{Rk,p}$ | [kN] | 8,7 | 12,2 | 16 | 22,4 | 20,2 | 24,6 | 29,4 | 37,1 | 48,1 | 42,5 | 76,3 | 76,3 |
| | 72°C / 120°C[1] | | [kN] | 5 | 7,5 | 12 | 12 | 16 | 20 | 20 | 30 | 50 | 30 | 60 | 75 |
| **Splitting** | | | | | | | | | | | | | | | |
| **Splitting for standard thickness of concrete** | | | | | | | | | | | | | | | |
| Standard thickness of concrete | $h_{min,1} \geq$ | [mm] | | 100 | | 120 | 150 | 140 | 160 | 180 | 200 | 250 | 230 | 340 | 340 |
| **Case 1** | | | | | | | | | | | | | | | |
| Characteristic resistance (concrete C20/25) | $N^0_{Rk,sp}$ | [kN] | | 7,5 | 9 | 16 | 20 | 20 | 35,2 | 40 | 50 | 50 | 60,7 | 109 | 109 |
| **Case 2** | | | | | | | | | | | | | | | |
| Characteristic edge distance | $c_{cr,sp}$ | [mm] | | 3 $h_{ef}$ | | $2{,}5h_{ef}$ | $3{,}5h_{ef}$ | $2{,}5h_{ef}$ | $1{,}5h_{ef}$ | 2 $h_{ef}$ | | | 1,5 $h_{ef}$ | | $1{,}5h_{ef}$ |
| **Splitting for minimum thickness of concrete** | | | | | | | | | | | | | | | |
| Minimum thickness of concrete | $h_{min,2} \geq$ | [mm] | | 80 | | 100 | 110 | 110 | | 130 | 150 | 160 | 160 | 220 | 220 |
| **Case 1** | | | | | | | | | | | | | | | |
| Characteristic resistance (concrete C20/25) | $N^0_{Rk,sp}$ | [kN] | | 7,5 | 2) | 16 | | 20 | 25 | 35 | 50 | 40 | 2) | 75 | 109 |
| **Case 2** | | | | | | | | | | | | | | | |
| Characteristic edge distance | $c_{cr,sp}$ | [mm] | | $3h_{ef}$ | $3{,}5h_{ef}$ | $3h_{ef}$ | $3{,}5h_{ef}$ | $3{,}5h_{ef}$ | $3h_{ef}$ | $2{,}5h_{ef}$ | $2{,}5h_{ef}$ | $3h_{ef}$ | $2{,}5h_{ef}$ | $2{,}6h_{ef}$ | $2{,}6h_{ef}$ |
| Increasing factor for $N_{Rk,p} = \psi_c \cdot N_{Rk,p\,(C20/25)}$ and $N^0_{Rk,sp} = \psi_c \cdot N^0_{Rk,sp\,(C20/25)}$[3] | $\psi_c$ | [-] | | $\left(\frac{f_{ck}}{20}\right)^{0,5} \leq 1{,}58$ | | | | | | | | | | | |
| **Concrete cone failure** | | | | | | | | | | | | | | | |
| Effective anchorage depth | $h_{ef}$ | [mm] | | 40 | 50 | 60 | 75 | 70 | 80 | 90 | 105 | 125 | 115 | 170 | 170 |

[1] Maximum long-term temperature / Maximum short-term temperature
[2] No performance assessed
[3] Increasing factor for $N^0_{Rk,sp}$ only for Case 1

**Injection System VMZ**

**Performance**
Characteristic values for tension loads, **VMZ-IG**

**Annex C10**

## Table C13: Characteristic values for **shear load, VMZ-IG**

| **Anchor size** | | **VMZ-IG** | | **40 M6** | **50 M6** | **60 M8** | **75 M8** | **70 M10** | **80 M10** | **90 M12** | **105 M12** | **125 M12** | **115 M16** | **170 M16** | **170 M20** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Installation factor | | $\gamma_{inst}$ | [-] | 1,0 | | | | | | | | | | | |
| **Steel failure without lever arm** | | | | | | | | | | | | | | | |
| Characteristic resistance $V^0_{Rk,s}$ | Steel, zinc plated | | [kN] | 8,0 | | 9,5 | 15 | 18 | | 34 | | | 26 | 63 | 54 |
| | A4, HCR | | [kN] | 5,5 | | 9,5 | 10 | 16 | | 24 | | | 32 | 44 | 47 |
| Partial factor | | $\gamma_{Ms}$ | [-] | 1,25 | | | | | | | | | | | |
| Ductility factor | | $k_7$ | [-] | 1,0 | | | | | | | | | | | |
| **Steel failure with lever arm** | | | | | | | | | | | | | | | |
| Characteristic bending resistance $M^0_{Rk,s}$ | Steel, zinc plated | | [kN] | 12 | | 30 | | 60 | | 105 | | | 212 | 266 | 519 |
| | A4, HCR | | [kN] | 8,5 | | 21 | | 42 | | 74 | | | 187 | 187 | 365 |
| Partial factor | | $\gamma_{Ms}$ | [-] | 1,25 | | | | | | | | | | | |
| **Concrete pry-out failure** | | | | | | | | | | | | | | | |
| Pry-out factor | | $k_8$ | [-] | 2,0 | | | | | | | | | | | |
| **Concrete edge failure** | | | | | | | | | | | | | | | |
| Effective length of anchor in shear load | | $l_f$ | [mm] | 40 | 50 | 60 | 75 | 70 | 80 | 90 | 105 | 125 | 115 | 170 | 170 |
| Outside diameter of anchor | | $d_{nom}$ | [mm] | 10 | | 12 | | 14 | | 18 | | | 22 | 24 | 26 |

## Table C14: **Displacements** under **tension loads, VMZ-IG**

| **Anchor size** | **VMZ-IG** | | **40 M6** | **50 M6** | **60 M8** | **75 M8** | **70 M10** | **80 M10** | **90 M12** | **105 M12** | **125 M12** | **115 M16** | **170 M16** | **170 M20** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Tension load in **cracked** concrete | N | [kN] | 4,3 | 6,1 | 8,0 | 11,1 | 10,0 | 12,3 | 14,6 | 18,4 | 24,0 | 21,1 | 38,0 | 38,0 |
| Displacement | $\delta_{N0}$ | [mm] | 0,5 | | 0,5 | 0,6 | 0,6 | | 0,7 | | | 0,7 | 0,8 | 0,8 |
| | $\delta_{N\infty}$ | [mm] | 1,3 | | | | | | | | | 1,1 | 1,3 | 1,3 |
| Tension load in **uncracked** concrete | N | [kN] | 4,3 | 8,5 | 11,1 | 15,6 | 14,1 | 17,2 | 20,5 | 25,9 | 33,0 | 29,6 | 53,3 | 53,3 |
| Displacement | $\delta_{N0}$ | [mm] | 0,2 | 0,4 | 0,4 | | 0,4 | | 0,6 | | | 0,5 | 0,6 | 0,6 |
| | $\delta_{N\infty}$ | [mm] | 1,3 | | | | | | | | | 1,1 | 1,3 | 1,3 |

## Table C15: Displacements under shear loads, VMZ-IG

| **Anchor size** | **VMZ-IG** | | **40 M6** | **50 M6** | **60 M8** | **75 M8** | **70 M10** | **80 M10** | **90 M12** | **105 M12** | **125 M12** | **115 M16** | **170 M16** | **170 M20** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Shear load, **Steel, zinc plated** | V | [kN] | 4,6 | | 5,4 | 8,4 | 10,1 | | 19,3 | | | 14,8 | 35,8 | 30,7 |
| Displacement | $\delta_{V0}$ | [mm] | 0,4 | | 0,5 | 0,4 | 0,5 | | 1,2 | | | 0,8 | 1,9 | 1,2 |
| | $\delta_{V\infty}$ | [mm] | 0,7 | | 0,8 | 0,7 | 0,8 | | 1,9 | | | 1,2 | 2,8 | 1,9 |
| Shear load, **Stainless steel A4 / HCR** | V | [kN] | 3,2 | | 5,4 | 5,9 | 9,3 | | 13,5 | | | 18,5 | 25,2 | 26,9 |
| Displacement | $\delta_{V0}$ | [mm] | 0,3 | | 0,5 | 0,3 | 0,5 | | 0,9 | | | 1,0 | 1,4 | 1,1 |
| | $\delta_{V\infty}$ | [mm] | 0,4 | | 0,7 | 0,5 | 0,7 | | 1,4 | | | 1,5 | 2,1 | 1,6 |

**Injection System VMZ**

**Performance**
Characteristic values for **shear load VMZ-IG, Displacements VMZ-IG**

**Annex C11**