... eine starke Verbindung

DECLARAÇÃO DE DESEMPENHO
**DoP N.o MKT-111** - pt

1. Código de identificação único do produto-tipo: **MKT Wedge Anchor BZ plus e BZ-IG**

2. Número do tipo, do lote ou da série, ou quaisquer outros elementos que permitam a identificação do produto de construção, nos termos do n.o 4 do artigo 11:
**ETA-99/0010, Anexos A3, A5**
**Número do lote: ver embalagem**

3. Utilização ou utilizações previstas do produto de construção, de acordo com a especificação técnica harmonizada aplicável, tal como previsto pelo fabricante:

| | |
|---|---|
| **Tipo de produto** | de binário controlado bucha de expansão (tipo parafuso (com rosca interna)) |
| **Para utilização em** | betão fissurado e não-fissurado C20/25 - C50/60 (EN 206) |
| **Opção** | 1 |
| **Carga** | estática ou quase estático,<br>sísmico, categoria C1+C2 (tamanhos incluídos BZ plus M10, M12, M16, M20) |
| **Material** | aço galvanizado:<br>somente em locais secos<br>tamanhos incluídos: BZ plus: M8, M10, M12, M16, M20, M24, M27<br>BZ-IG: M6, M8, M10, M12<br>aço inoxidável (gravação em relevo A4):<br>em áreas internas e externas sem condições particularmente agressivas<br>tamanhos incluídos: BZ plus: M8, M10, M12, M16, M20, M24<br>BZ-IG: M6, M8, M10, M12<br>aço de alta resistência à corrosão (gravação em relevo HCR):<br>em áreas interiores e exteriores com condições particularmente agressivas<br>tamanhos incluídos: BZ plus: M8, M10, M12, M16, M20, M24<br>BZ-IG: M6, M8, M10, M12 |
| **Faixa de temperatura** (possivelmente) | -- |

4. Nome, designação comercial ou marca comercial registada e endereço de contacto do fabricante, nos termos do n.o 5 do artigo 11:

**MKT Metall-Kunststoff-Technik GmbH & Co. KG**
**Auf dem Immel 2**
**D - 67685 Weilerbach**

5. Se aplicável, nome e endereço de contacto do mandatário cujo mandato abrange os actos especificados no n.o 2 do artigo 12: --

6. Sistema ou sistemas de avaliação e verificação da regularidade do desempenho do produto de construção tal como previsto no anexo V: **Sistema 1**

7. No caso de uma declaração de desempenho relativa a um produto de construção abrangido por uma norma harmonizada:
--

8. No caso de uma declaração de desempenho relativa a um produto de construção para o qual tenha sido emitida uma Avaliação Técnica Europeia:

**Instituto Alemão de Tecnologia de Construção, Berlin**

emitiu:

**ETA-99/0010**

com base em:

**ETAG 001-2**

O organismo de certificação de produtos notificado 1343-CPR foi realizada de acordo com o sistema 1:

i) na determinação do produto-tipo com base nos ensaios de tipo (incluindo a amostragem), nos cálculos de tipo, nos valores tabelados ou em documentação descritiva do produto;
ii) na inspecção inicial da unidade fabril e no controlo da produção em fábrica;
iii) no acompanhamento, apreciação e aprovação contínuos do controlo da produção em fábrica

e emitiu: Certificado de regularidade do desempenho 1343-CPR-M 550-1

9. Desempenho declarado:

| **Características essenciais** | **Método de projeto** | **Desempenho** | | **Especificações técnicas harmonizadas** |
|---|---|---|---|---|
| | | **BZ plus** | **BZ-IG** | |
| Resistência característica para cargas de tensão | ETAG 001, Anexo C CEN/TS 1992-4 | ETA-99/0010, Anexos C1-C4 | ETA-99/0010, Anexos C10-C11 | ETAG 001 |
| Resistência Característica a cargas de cisalhamento | ETAG 001, Anexo C CEN/TS 1992-4 | ETA-99/0010, Anexo C5 | ETA-99/0010, Anexo C12 | |
| Resistência característica, a acção sísmica | TR 045 | ETA-99/0010, Anexo C6 | NPD | |
| Mudança na utilização | ETAG 001, Anexo C CEN/TS 1992-4 | ETA-99/0010, Anexos C8-C9 | ETA-99/0010, Anexo C14 | |
| Resistência característica sob exposição ao fogo | TR 020 CEN/TS 1992-4 | ETA-99/0010, Anexo C7 | ETA-99/0010, Anexo C13 | |

Quando, nos termos do artigo 37.o ou do artigo 38.o, tenha sido utilizada documentação técnica específica, os requisitos a que o produto obedece: --

10. O desempenho do produto identificado nos pontos 1 e 2 é conforme com o desempenho declarado no ponto 9.

A presente declaração de desempenho é emitida sob a exclusiva responsabilidade do fabricante identificado no ponto 4.

Assinado por e em nome do fabricante por:

**Lore Weustenhagen**
(Administradora)
**Weilerbach, 09.01.2015**

i.V.
**Dipl.-Ing. Detlef Bigalke**
(Director de Desenvolvimento de Produto)



09.01.2015

**Table C1:** Characteristic values for **tension loads,** BZ plus **zinc plated, cracked concrete,** static and quasi-static action, design method A according to ETAG 001, Annex C or CEN/TS 1992-4

| **Anchor size** | | | **M8** | **M10** | **M12** | **M16** | **M20** | **M24** | **M27** |
|---|---|---|---|---|---|---|---|---|---|
| Installation safety factor | $\gamma_2 = \gamma_{inst}$ | [-] | 1,0 | | | | | | |
| **Steel failure** | | | | | | | | | |
| Characteristic tension resistance | $N_{Rk,s}$ | [kN] | 16 | 27 | 40 | 60 | 86 | 126 | 196 |
| Partial safety factor | $\gamma_{Ms}$ | [-] | 1,53 | | 1,5 | | 1,6 | 1,5 | |
| **Pull-out** | | | | | | | | | |
| **Standard** anchorage depth | | | | | | | | | |
| Characteristic resistance in concrete C20/25 | $N_{Rk,p}$ | [kN] | 5 | 9 | 16 | 25 | 1) | 1) | 1) |
| **Reduced** anchorage depth | | | | | | | | | |
| Characteristic resistance in concrete C20/25 | $N_{Rk,p,red}$ | [kN] | 5 | 7,5 | 1) | 1) | | | |
| Increasing factor for $N_{Rk,p}$ and $N_{Rk,p,red}$ | $\psi c$ | [-] | $\left(\frac{f_{ck,cube}}{25}\right)^{0,5}$ | | | | | | |
| **Concrete cone failure** | | | | | | | | | |
| Effective anchorage depth | $h_{ef}$ | [mm] | 46 | 60 | 70 | 85 | 100 | 115 | 125 |
| Reduced anchorage depth | $h_{ef,red}$ | [mm] | 35 2) | 40 | 50 | 65 | | | |
| Factor for cracked concrete | $k_{cr}$ | [-] | 7,2 | | | | | | |

1) Pull-out is not decisive.
2) Use restricted to anchoring of structural components statically indeterminate.

**Table C2:** Characteristic values for **tension loads,** BZ plus **A4 / HCR,**
**cracked concrete,** static and quasi-static action,
design method A according to ETAG 001, Annex C or CEN/TS 1992-4

| **Anchor size** | | | **M8** | **M10** | **M12** | **M16** | **M20** | **M24** |
|---|---|---|---|---|---|---|---|---|
| Installation safety factor | $\gamma_2 = \gamma_{inst}$ | [-] | 1,0 | | | | | |
| **Steel failure** | | | | | | | | |
| Characteristic tension resistance | $N_{Rk,s}$ | [kN] | 16 | 27 | 40 | 64 | 108 | 110 |
| Partial safety factor | $\gamma_{Ms}$ | [-] | 1,5 | | | | 1,68 | 1,5 |
| **Pull-out** | | | | | | | | |
| **Standard** anchorage depth | | | | | | | | |
| Characteristic resistance in concrete C20/25 | $N_{Rk,p}$ | [kN] | 5 | 9 | 16 | 25 | 1) | 40 |
| **Reduced** anchorage depth | | | | | | | | |
| Characteristic resistance in concrete C20/25 | $N_{Rk,p,red}$ | [kN] | 5 | 7,5 | 1) | 1) | | |
| Increasing factor for $N_{Rk,p}$ and $N_{Rk,p,red}$ | $\psi c$ | [-] | $\left(\frac{f_{ck,cube}}{25}\right)^{0,5}$ | | | | | |
| **Concrete cone failure** | | | | | | | | |
| Effective anchorage depth | $h_{ef}$ | [mm] | 46 | 60 | 70 | 85 | 100 | 125 |
| Reduced anchorage depth | $h_{ef,red}$ | [mm] | 35 2) | 40 | 50 | 65 | | |
| Factor for cracked concrete | $k_{cr}$ | [-] | 7,2 | | | | | |

1) Pull-out is not decisive.
2) Use restricted to anchoring of structural components statically indeterminate.

**Table C3:** Characteristic values for **tension loads,** BZ plus **zinc plated, non-cracked concrete,** static and quasi-static action, design method A according to ETAG 001, Annex C or CEN/TS 1992-4

| **Anchor size** | | | **M8** | **M10** | **M12** | **M16** | **M20** | **M24** | **M27** |
|---|---|---|---|---|---|---|---|---|---|
| Installation safety factor | $\gamma_2 = \gamma_{inst}$ | [-] | 1,0 | | | | | | |
| **Steel failure** | | | | | | | | | |
| Characteristic tension resistance | $N_{Rk,s}$ | [kN] | 16 | 27 | 40 | 60 | 86 | 126 | 196 |
| Partial safety factor | $\gamma_{Ms}$ | [-] | 1,53 | | 1,5 | | 1,6 | 1,5 | |
| **Pull-out** | | | | | | | | | |
| **Standard anchorage depth** | | | | | | | | | |
| Characteristic resistance in non-cracked concrete C20/25 | $N_{Rk,p}$ | [kN] | 12 | 16 | 25 | 35 | 1) | 1) | 1) |
| **Reduced anchorage depth** | | | | | | | | | |
| Characteristic resistance in non-cracked concrete C20/25 | $N_{Rk,p,red}$ | [kN] | 7,5 | 9 | 1) | 1) | | | |
| **Splitting** For the proof against splitting failure $N^0_{Rk,c}$ has to be replaced by $N^0_{Rk,sp}$ with consideration of the member thickness | | | | | | | | | |
| **Standard anchorage depth** | | | | | | | | | |
| Splitting for **standard thickness of concrete member** (The higher resistance of case 1 and case 2 may be applied; the values $s_{cr,sp}$ and $c_{cr,sp}$ may be linearly interpolated for the member thickness $h_{min} < h < h_{std}$ (Case 2); $\psi_{h,sp}$= 1,0) | | | | | | | | | |
| Standard thickness of concrete | $h_{min,1} \geq$ | [mm] | 100 | 120 | 140 | 170 | 200 | 230 | 250 |
| **Case 1** | | | | | | | | | |
| Characteristic resistance in non-cracked concrete C20/25 | $N^0_{Rk,sp}$ | [kN] | 9 | 12 | 20 | 30 | 40 | 1) | 50 |
| Spacing (edge distance) | $s_{cr,sp}$ (= 2 $c_{cr,sp}$) | [mm] | 3 $h_{ef}$ | | | | | | |
| **Case 2** | | | | | | | | | |
| Characteristic resistance in non-cracked concrete C20/25 | $N^0_{Rk,sp}$ | [kN] | 12 | 16 | 25 | 35 | 1) | 1) | 1) |
| Spacing (edge distance) | $s_{cr,sp}$ (= 2 $c_{cr,sp}$) | [mm] | 4 $h_{ef}$ | | | | 4,4 $h_{ef}$ | 3 $h_{ef}$ | 5 $h_{ef}$ |
| Splitting for **minimum thickness of concrete member** | | | | | | | | | |
| Minimum thickness of concrete | $h_{min,2} \geq$ | [mm] | 80 | 100 | 120 | 140 | | | |
| Characteristic resistance in non-cracked concrete C20/25 | $N^0_{Rk,sp}$ | [kN] | 12 | 16 | 25 | 35 | | | |
| Spacing (edge distance) | $s_{cr,sp}$ (= 2 $c_{cr,sp}$) | [mm] | 5 $h_{ef}$ | | | | | | |
| **Reduced anchorage depth** | | | | | | | | | |
| Minimum thickness of concrete | $h_{min,3} \geq$ | [mm] | 80 | 80 | 100 | 140 | | | |
| Characteristic resistance in non-cracked concrete C20/25 | $N^0_{Rk,sp}$ | [kN] | 7,5 | 9 | 1) | 1) | | | |
| Spacing (edge distance) | $s_{cr,sp}$ (= 2 $c_{cr,sp}$) | [mm] | 200 | 200 | 250 | 300 | | | |
| Increasing factor for $N_{Rk,p(red)}$ and $N^0_{Rk,sp}$ | $\psi c$ | [-] | $\left(\frac{f_{ck,cube}}{25}\right)^{0,5}$ | | | | | | |
| **Concrete cone failure** | | | | | | | | | |
| Effective anchorage depth | $h_{ef}$ | [mm] | 46 | 60 | 70 | 85 | 100 | 115 | 125 |
| Reduced anchorage depth | $h_{ef,red}$ | [mm] | 35 2) | 40 | 50 | 65 | | | |
| Factor for non-cracked concrete | $k_{ucr}$ | [-] | 10,1 | | | | | | |

1) Pull-out is not decisive.
2) Use restricted to anchoring of structural components statically indeterminate.

**Wedge Anchor BZ plus**

**Performance**
Characteristic values for **tension loads,** BZ plus **zinc plated, non-cracked concrete,** static and quasi-static action, design method A according to ETAG 001, Annex C or CEN/TS 1992-4

**Annex C3**

**Table C4:** Characteristic values for **tension loads,** BZ plus **A4 / HCR, non-cracked concrete,** static and quasi-static action, design method A according to ETAG 001, Annex C or CEN/TS 1992-4

| **Anchor size** | | | **M8** | **M10** | **M12** | **M16** | **M20** | **M24** |
|---|---|---|---|---|---|---|---|---|
| Installation safety factor | $\gamma_2 = \gamma_{inst}$ | [-] | 1,0 | | | | | |
| **Steel failure** | | | | | | | | |
| Characteristic tension resistance | $N_{Rk,s}$ | [kN] | 16 | 27 | 40 | 64 | 108 | 110 |
| Partial safety factor | $\gamma_{Ms}$ | [-] | 1,5 | | | | 1,68 | 1,5 |
| **Pull-out** | | | | | | | | |
| **Standard anchorage depth** | | | | | | | | |
| Characteristic resistance in non-cracked concrete C20/25 | $N_{Rk,p}$ | [kN] | 12 | 16 | 25 | 35 | 1) | 1) |
| **Reduced anchorage depth** | | | | | | | | |
| Characteristic resistance in non-cracked concrete C20/25 | $N_{Rk,p,red}$ | [kN] | 7,5 | 9 | 1) | 1) | | |
| **Splitting** For the proof against splitting failure $N^0_{Rk,c}$ has to be replaced by $N^0_{Rk,sp}$ with consideration of the member thickness | | | | | | | | |
| **Standard anchorage depth** | | | | | | | | |
| Splitting for **standard thickness of concrete member** (The higher resistance of case 1 and case 2 may be applied; the values $s_{cr,sp}$ and $c_{cr,sp}$ may be linearly interpolated for the member thickness $h_{min} < h < h_{std}$ (Case 2); $\psi_{h,sp}$= 1,0) | | | | | | | | |
| Standard thickness of concrete | $h_{min,1} \geq$ | [mm] | 100 | 120 | 140 | 160 | 200 | 250 |
| **Case 1** | | | | | | | | |
| Characteristic resistance in non-cracked concrete C20/25 | $N^0_{Rk,sp}$ | [kN] | 9 | 12 | 20 | 30 | 40 | |
| Spacing (edge distance) | $s_{cr,sp}$ (= 2 $c_{cr,sp}$) | [mm] | 3 $h_{ef}$ | | | | | |
| **Case 2** | | | | | | | | |
| Characteristic resistance in non-cracked concrete C20/25 | $N^0_{Rk,sp}$ | [kN] | 12 | 16 | 25 | 35 | 1) | 1) |
| Spacing (edge distance) | $s_{cr,sp}$ (= 2 $c_{cr,sp}$) | [mm] | 230 | 250 | 280 | 400 | 440 | 500 |
| Splitting for **minimum thickness of concrete member** | | | | | | | | |
| Minimum thickness of concrete | $h_{min,2} \geq$ | [mm] | 80 | 100 | 120 | 140 | | |
| Characteristic resistance in non-cracked concrete C20/25 | $N^0_{Rk,sp}$ | [kN] | 12 | 16 | 25 | 35 | | |
| Spacing (edge distance) | $s_{cr,sp}$ (= 2 $c_{cr,sp}$) | [mm] | 5 $h_{ef}$ | | | | | |
| **Reduced anchorage depth** | | | | | | | | |
| Minimum thickness of concrete | $h_{min,3} \geq$ | [mm] | 80 | 80 | 100 | 140 | | |
| Characteristic resistance in non-cracked concrete C20/25 | $N^0_{Rk,sp}$ | [kN] | 7,5 | 9 | 1) | 1) | | |
| Spacing (edge distance) | $s_{cr,sp}$ (= 2 $c_{cr,sp}$) | [mm] | 200 | 200 | 250 | 300 | | |
| Increasing factor for $N_{Rk,p(red)}$ and $N^0_{Rk,sp}$ | $\psi c$ | [-] | $\left(\frac{f_{ck,cube}}{25}\right)^{0,5}$ | | | | | |
| **Concrete cone failure** | | | | | | | | |
| Effective anchorage depth | $h_{ef}$ | [mm] | 46 | 60 | 70 | 85 | 100 | 125 |
| Reduced anchorage depth | $h_{ef,red}$ | [mm] | 35 2) | 40 | 50 | 65 | | |
| Factor for non-cracked concrete | $k_{ucr}$ | [-] | 10,1 | | | | | |

1) Pull-out is not decisive.
2) Use restricted to anchoring of structural components statically indeterminate.

**Table C5:** Characteristic values for **shear loads**, BZ plus, **cracked** and **non-cracked concrete,** static or quasi static action, design method A according to ETAG 001, Annex C or CEN/TS 1992-4

| **Anchor size** | | | | **M8** | **M10** | **M12** | **M16** | **M20** | **M24** | **M27** |
|---|---|---|---|---|---|---|---|---|---|---|
| Installation safety factor | $\gamma_2 = \gamma_{inst}$ | [-] | | 1,0 | | | | | | |
| **Steel failure without lever arm, Steel zinc plated** | | | | | | | | | | |
| Characteristic shear resistance | $V_{Rk,s}$ | [kN] | | 12,2 | 20,1 | 30 | 55 | 69 | 114 | 169,4 |
| Factor for ductility | $k_2$ | [-] | | 1,0 | | | | | | |
| Partial safety factor | $\gamma_{Ms}$ | [-] | | 1,25 | | | | 1,33 | 1,25 | 1,25 |
| **Steel failure without lever arm, Stainless steel A4, HCR** | | | | | | | | | | |
| Characteristic shear resistance | $V_{Rk,s}$ | [kN] | | 13 | 20 | 30 | 55 | 86 | 123,6 | |
| Factor for ductility | $k_2$ | [-] | | 1,0 | | | | | | |
| Partial safety factor | $\gamma_{Ms}$ | [-] | | 1,25 | | | | 1,4 | 1,25 | |
| **Steel failure with lever arm, Steel zinc plated** | | | | | | | | | | |
| Characteristic bending resistance | $M^0_{Rk,s}$ | [Nm] | | 23 | 47 | 82 | 216 | 363 | 898 | 1331,5 |
| Partial safety factor | $\gamma_{Ms}$ | [-] | | 1,25 | | | | 1,33 | 1,25 | 1,25 |
| **Steel failure with lever arm, Stainless steel A4, HCR** | | | | | | | | | | |
| Characteristic bending resistance | $M^0_{Rk,s}$ | [Nm] | | 26 | 52 | 92 | 200 | 454 | 785,4 | |
| Partial safety factor | $\gamma_{Ms}$ | [-] | | 1,25 | | | | 1,4 | 1,25 | |
| **Concrete pry-out failure** | | | | | | | | | | |
| k factor | $k_{(3)}$ | [-] | | 2,4 | | | | 2,8 | | |
| **Concrete edge failure** | | | | | | | | | | |
| Effective length of anchor in shear loading with $\mathbf{h_{ef}}$ | Steel zinc plated | $l_f$ | [mm] | 46 | 60 | 70 | 85 | 100 | 115 | 125 |
| | Stainless steel A4, HCR | $l_f$ | [mm] | 46 | 60 | 70 | 85 | 100 | 125 | |
| Effective length of anchor in shear loading with $\mathbf{h_{ef,red}}$ | Steel zinc plated | $l_{f,red}$ | [mm] | 35 | 40 | 50 | 65 | | | |
| | Stainless steel A4, HCR | $l_{f,red}$ | [mm] | 35 | 40 | 50 | 65 | | | |
| Outside diameter of anchor | | $d_{nom}$ | [mm] | 8 | 10 | 12 | 16 | 20 | 24 | 27 |

**Wedge Anchor BZ plus**

**Performance**
Characteristic values for **shear loads**, BZ plus, **cracked** and **non-cracked concrete,** static or quasi static action, design method A according to ETAG 001, Annex C or CEN/TS 1992-4

**Annex C5**

**Table C6:** Characteristic resistance for **seismic loading**, BZ plus, **standard anchorage depth,** performance category **C1** and **C2,** design according to TR045

| **Tension loads** | | | | | | |
|---|---|---|---|---|---|---|
| **Anchor size** | | | **M10** | **M12** | **M16** | **M20** |
| Installation safety factor | $\gamma_2 = \gamma_{inst}$ | [-] | 1,0 | | | |
| **Steel failure, steel zinc plated** | | | | | | |
| Characteristic resistance **C1** | $N_{Rk,s,seis,C1}$ | [kN] | 27 | 40 | 60 | 86 |
| Characteristic resistance **C2** | $N_{Rk,s,seis,C2}$ | [kN] | 27 | 40 | 60 | 86 |
| Partial safety factor | $\gamma_{Ms,seis}$ | [-] | 1,53 | 1,5 | | 1,6 |
| **Steel failure, stainless steel A4, HCR** | | | | | | |
| Characteristic resistance **C1** | $N_{Rk,s,seis,C1}$ | [kN] | 27 | 40 | 64 | 108 |
| Characteristic resistance **C2** | $N_{Rk,s,seis,C2}$ | [kN] | 27 | 40 | 64 | 108 |
| Partial safety factor | $\gamma_{Ms,seis}$ | [-] | 1,5 | | | 1,68 |
| **Pull-out** | | | | | | |
| Characteristic resistance **C1** | $N_{Rk,p,seis,C1}$ | [kN] | 9 | 16 | 25 | 36 |
| Characteristic resistance **C2** | $N_{Rk,p,seis,C2}$ | [kN] | 3,6 | 10,2 | 13,8 | 22,4 |

| **Shear loads** | | | | | | |
|---|---|---|---|---|---|---|
| **Steel failure without lever arm, Steel zinc plated** | | | | | | |
| Characteristic resistance **C1** | $V_{Rk,s,seis,C1}$ | [kN] | 20 | 27 | 44 | 69 |
| Characteristic resistance **C2** | $V_{Rk,s,seis,C2}$ | [kN] | 14 | 16,2 | 35,7 | 55,2 |
| Partial safety factor | $\gamma_{Ms,seis}$ | [-] | 1,25 | | | 1,33 |
| **Steel failure without lever arm, Stainless steel A4, HCR** | | | | | | |
| Characteristic resistance **C1** | $V_{Rk,s,seis,C1}$ | [kN] | 20 | 27 | 44 | 69 |
| Characteristic resistance **C2** | $V_{Rk,s,seis,C2}$ | [kN] | 14 | 16,2 | 35,7 | 55,2 |
| Partial safety factor | $\gamma_{Ms,seis}$ | [-] | 1,25 | | | 1,4 |

**Table C7:** Characteristic values **for tension and shear load** under **fire exposure,** BZ plus, **standard anchorage depth,** cracked and non-cracked concrete C20/25 to C50/60, design acc. to TR 020 or CEN/TS 1992-4, Annex D

| **Anchor size** | | | | **M8** | **M10** | **M12** | **M16** | **M20** | **M24** | **M27** |
|---|---|---|---|---|---|---|---|---|---|---|
| **Tension load** | | | | | | | | | | |
| **Steel failure** | | | | | | | | | | |
| **Steel zinc plated** | | | | | | | | | | |
| Characteristic resistance | R30 | $N_{Rk,s,fi}$ | [kN] | 1,4 | 2,2 | 3,2 | 6,0 | 9,4 | 13,6 | 17,6 |
| | R60 | | | 1,1 | 1,8 | 2,8 | 5,2 | 8,2 | 11,8 | 15,3 |
| | R90 | | | 0,8 | 1,4 | 2,4 | 4,4 | 6,9 | 10,0 | 13,0 |
| | R120 | | | 0,7 | 1,2 | 2,2 | 4,0 | 6,3 | 9,1 | 11,8 |
| **Stainless steel A4, HCR** | | | | | | | | | | |
| Characteristic resistance | R30 | $N_{Rk,s,fi}$ | [kN] | 3,8 | 6,9 | 11,5 | 21,5 | 33,5 | 48,2 | |
| | R60 | | | 2,9 | 5,2 | 8,6 | 16 | 25,0 | 35,9 | |
| | R90 | | | 2,0 | 3,5 | 5,6 | 10,5 | 16,4 | 23,6 | |
| | R120 | | | 1,6 | 2,7 | 4,2 | 7,8 | 12,1 | 17,4 | |
| **Shear load** | | | | | | | | | | |
| **Steel failure without lever arm** | | | | | | | | | | |
| **Steel zinc plated** | | | | | | | | | | |
| Characteristic resistance | R30 | $V_{Rk,s,fi}$ | [kN] | 1,6 | 2,6 | 3,8 | 7,0 | 11 | 16 | 20,6 |
| | R60 | | | 1,5 | 2,5 | 3,6 | 6,8 | 11 | 15 | 19,8 |
| | R90 | | | 1,2 | 2,1 | 3,5 | 6,5 | 10 | 15 | 19,0 |
| | R120 | | | 1,0 | 2,0 | 3,4 | 6,4 | 10 | 14 | 18,6 |
| **Stainless steel A4, HCR** | | | | | | | | | | |
| Characteristic resistance | R30 | $V_{Rk,s,fi}$ | [kN] | 3,8 | 6,9 | 11,5 | 21,5 | 33,5 | 48,2 | |
| | R60 | | | 2,9 | 5,2 | 8,6 | 16 | 25,0 | 35,9 | |
| | R90 | | | 2,0 | 3,5 | 5,6 | 10,5 | 16,4 | 23,6 | |
| | R120 | | | 1,6 | 2,7 | 4,2 | 7,8 | 12,1 | 17,4 | |
| **Steel failure with lever arm** | | | | | | | | | | |
| **Steel zinc plated** | | | | | | | | | | |
| Characteristic resistance | R30 | $M^0_{Rk,s,fi}$ | [Nm] | 1,7 | 3,3 | 5,9 | 15 | 29 | 50 | 75 |
| | R60 | | | 1,6 | 3,2 | 5,6 | 14 | 28 | 48 | 72 |
| | R90 | | | 1,2 | 2,7 | 5,4 | 14 | 27 | 47 | 69 |
| | R120 | | | 1,1 | 2,5 | 5,3 | 13 | 26 | 46 | 68 |
| **Stainless steel A4, HCR** | | | | | | | | | | |
| Characteristic resistance | R30 | $M^0_{Rk,s,fi}$ | [Nm] | 3,8 | 9,0 | 17,9 | 45,5 | 88,8 | 153,5 | |
| | R60 | | | 2,9 | 6,8 | 13,3 | 33,9 | 66,1 | 114,3 | |
| | R90 | | | 2,1 | 4,5 | 8,8 | 22,2 | 43,4 | 75,1 | |
| | R120 | | | 1,6 | 3,4 | 6,5 | 16,4 | 32,1 | 55,5 | |

The characteristic resistance for pull-out failure, concrete cone failure, concrete pry-out and concrete edge failure can be calculated according to TR020 / CEN/TS 1992-4. If pull-out is not decisive $N_{Rk,p}$ in Eq. 2.4 and Eq. 2.5, TR 020 must be replaced by $N^0_{Rk,c}$.

## Table C8: Displacements under tension load, BZ plus

| Anchor size | | | M8 | M10 | M12 | M16 | M20 | M24 | M27 |
|---|---|---|---|---|---|---|---|---|---|
| **Standard anchorage depth** | | | | | | | | | |
| **Steel zinc plated** | | | | | | | | | |
| Tension load in cracked concrete | N | [kN] | 2,4 | 4,3 | 7,6 | 11,9 | 17,1 | 21,1 | 24 |
| Displacement | $\delta_{N0}$ | [mm] | 0,6 | 1,0 | 0,4 | 1,0 | 0,9 | 0,7 | 0,9 |
| | $\delta_{N\infty}$ | [mm] | 1,4 | 1,2 | 1,4 | 1,3 | 1,0 | 1,2 | 1,4 |
| Tension load in non-cracked concrete | N | [kN] | 5,7 | 7,6 | 11,9 | 16,7 | 23,8 | 29,6 | 34 |
| Displacement | $\delta_{N0}$ | [mm] | 0,4 | 0,5 | 0,7 | 0,3 | 0,4 | 0,5 | 0,3 |
| | $\delta_{N\infty}$ | [mm] | 0,8 | | 1,4 | | 0,8 | | 1,4 |
| Displacements under seismic tension loads **C2** | | | | | | | | | |
| Displacements for DLS | $\delta_{N,seis,C2(DLS)}$ | [mm] | | 4,1 | 4,9 | 3,6 | 5,1 | | |
| Displacements for ULS | $\delta_{N,seis,C2(ULS)}$ | [mm] | | 13,8 | 15,7 | 9,5 | 15,2 | | |
| **Stainless steel A4, HCR** | | | | | | | | | |
| Tension load in cracked concrete | N | [kN] | 2,4 | 4,3 | 7,6 | 11,9 | 17,1 | 19,0 | |
| Displacement | $\delta_{N0}$ | [mm] | 0,7 | 1,8 | 0,4 | 0,7 | 0,9 | 0,5 | |
| | $\delta_{N\infty}$ | [mm] | 1,2 | 1,4 | 1,4 | 1,4 | 1,0 | 1,8 | |
| Tension load in non-cracked concrete | N | [kN] | 5,8 | 7,6 | 11,9 | 16,7 | 23,8 | 33,5 | |
| Displacement | $\delta_{N0}$ | [mm] | 0,6 | 0,5 | 0,7 | 0,2 | 0,4 | 0,5 | |
| | $\delta_{N\infty}$ | [mm] | 1,2 | 1,0 | 1,4 | 0,4 | 0,8 | 1,1 | |
| Displacements under seismic tension loads **C2** | | | | | | | | | |
| Displacements for DLS | $\delta_{N,seis,C2(DLS)}$ | [mm] | | 4,1 | 4,9 | 3,6 | 5,1 | | |
| Displacements for ULS | $\delta_{N,seis,C2(ULS)}$ | [mm] | | 13,8 | 15,7 | 9,5 | 15,2 | | |
| **Reduced anchorage depth** | | | | | | | | | |
| Tension load in cracked concrete | N | [kN] | 2,4 | 3,6 | 6,1 | 9,0 | | | |
| Displacement | $\delta_{N0}$ | [mm] | 0,8 | 0,7 | 0,5 | 1,0 | | | |
| | $\delta_{N\infty}$ | [mm] | 1,2 | 1,0 | 0,8 | 1,1 | | | |
| Tension load in non-cracked concrete | N | [kN] | 3,7 | 4,3 | 8,5 | 12,6 | | | |
| Displacement | $\delta_{N0}$ | [mm] | 0,1 | 0,2 | 0,2 | 0,2 | | | |
| | $\delta_{N\infty}$ | [mm] | 0,7 | 0,7 | 0,7 | 0,7 | | | |

## Table C9: Displacements under shear load, BZ plus

| Anchor size | | | M8 | M10 | M12 | M16 | M20 | M24 | M27 |
|---|---|---|---|---|---|---|---|---|---|
| **Standard anchorage depth** | | | | | | | | | |
| **Steel zinc plated** | | | | | | | | | |
| Shear load in cracked and non-cracked concrete | V | [kN] | 6,9 | 11,4 | 17,1 | 31,4 | 36,8 | 64,9 | 96,8 |
| Displacement | $\delta_{V0}$ | [mm] | 2,0 | 3,2 | 3,6 | 3,5 | 1,8 | 3,5 | 3,6 |
| | $\delta_{V\infty}$ | [mm] | 3,0 | 4,7 | 5,5 | 5,3 | 2,7 | 5,3 | 5,4 |
| Displacements under seismic shear loads **C2** | | | | | | | | | |
| Displacements for DLS | $\delta_{V,seis,C2(DLS)}$ | [mm] | | 2,7 | 3,5 | 4,3 | 4,7 | | |
| Displacements for ULS | $\delta_{V,seis,C2(ULS)}$ | [mm] | | 5,3 | 9,5 | 9,6 | 10,1 | | |
| **Stainless steel A4, HCR** | | | | | | | | | |
| Shear load in cracked and non-cracked concrete | V | [kN] | 7,3 | 11,4 | 17,1 | 31,4 | 43,8 | 70,6 | |
| Displacement | $\delta_{V0}$ | [mm] | 1,9 | 2,4 | 4,0 | 4,3 | 2,9 | 2,8 | |
| | $\delta_{V\infty}$ | [mm] | 2,9 | 3,6 | 5,9 | 6,4 | 4,3 | 4,2 | |
| Displacements under seismic shear loads **C2** | | | | | | | | | |
| Displacements for DLS | $\delta_{V,seis,C2(DLS)}$ | [mm] | | 2,7 | 3,5 | 4,3 | 4,7 | | |
| Displacements for ULS | $\delta_{V,seis,C2(ULS)}$ | [mm] | | 5,3 | 9,5 | 9,6 | 10,1 | | |
| **Reduced anchorage depth** | | | | | | | | | |
| **Steel zinc plated** | | | | | | | | | |
| Shear load in cracked and non-cracked concrete | V | [kN] | 6,9 | 11,4 | 17,1 | 31,4 | | | |
| Displacement | $\delta_{V0}$ | [mm] | 2,0 | 3,2 | 3,6 | 3,5 | | | |
| | $\delta_{V\infty}$ | [mm] | 3,0 | 4,7 | 5,5 | 5,3 | | | |
| **Stainless steel A4, HCR** | | | | | | | | | |
| Shear load in cracked and non-cracked concrete | V | [kN] | 7,3 | 11,4 | 17,1 | 31,4 | | | |
| Displacement | $\delta_{V0}$ | [mm] | 1,9 | 2,4 | 4,0 | 4,3 | | | |
| | $\delta_{V\infty}$ | [mm] | 2,9 | 3,6 | 5,9 | 6,4 | | | |

**Table C10:** Characteristic values for **tension loads, BZ-IG, cracked concrete,** static and quasi-static action, design method A according to ETAG 001, Annex C or CEN/TS 1992-4

| **Anchor size** | | | **M6** | **M8** | **M10** | **M12** |
|---|---|---|---|---|---|---|
| Installation safety factor | $\gamma_2 = \gamma_{inst}$ | [-] | 1,2 | | | |
| **Steel failure** | | | | | | |
| Characteristic tension resistance, steel zinc plated | $N_{Rk,s}$ | [kN] | 16,1 | 22,6 | 26,0 | 56,6 |
| Partial safety factor | $\gamma_{Ms}$ | [-] | 1,5 | | | |
| Characteristic tension resistance, stainless steel A4, HCR | $N_{Rk,s}$ | [kN] | 14,1 | 25,6 | 35,8 | 59,0 |
| Partial safety factor | $\gamma_{Ms}$ | [-] | 1,87 | | | |
| **Pull-out failure** | | | | | | |
| Characteristic resistance in cracked concrete C20/25 | $N_{Rk,p}$ | [kN] | 5 | 9 | 12 | 20 |
| Increasing factor | $\psi c$ | [-] | $\left(\frac{f_{ck,cube}}{25}\right)^{0,5}$ | | | |
| **Concrete cone failure** | | | | | | |
| Effective anchorage depth | $h_{ef}$ | [mm] | 45 | 58 | 65 | 80 |
| Factor for cracked concrete | $k_{cr}$ | [-] | 7,2 | | | |

**Table C11:** Characteristic values for **tension loads, BZ-IG, non-cracked concrete,** static and quasi-static action, design method A according to ETAG 001, Annex C or CEN/TS 1992-4

| **Anchor size** | | | **M6** | **M8** | **M10** | **M12** |
|---|---|---|---|---|---|---|
| Installation safety factor | $\gamma_2 = \gamma_{inst}$ | [-] | 1,2 | | | |
| **Steel failure** | | | | | | |
| Characteristic tension resistance, steel zinc plated | $N_{Rk,s}$ | [kN] | 16,1 | 22,6 | 26,0 | 56,6 |
| Partial safety factor | $\gamma_{Ms}$ | [-] | 1,5 | | | |
| Characteristic tension resistance, stainless steel A4, HCR | $N_{Rk,s}$ | [kN] | 14,1 | 25,6 | 35,8 | 59,0 |
| Partial safety factor | $\gamma_{Ms}$ | [-] | 1,87 | | | |
| **Pull-out** | | | | | | |
| Characteristic resistance in non-cracked concrete C20/25 | $N_{Rk,p}$ | [kN] | 12 | 16 | 20 | 30 |
| **Splitting** ($N^0_{Rk,c}$ has to be replaced by $N^0_{Rk,sp}$. The higher resistance of Case 1 and Case 2 may be applied.) | | | | | | |
| Minimum thickness of concrete member | $h_{min}$ | [mm] | 100 | 120 | 130 | 160 |
| **Case 1** | | | | | | |
| Characteristic resistance in non-cracked concrete C20/25 | $N^0_{Rk,sp}$ | [kN] | 9 | 12 | 16 | 25 |
| Spacing (edge distance) | $s_{cr,sp}$ (= 2 $c_{cr,sp}$) | [mm] | 3 $h_{ef}$ | | | |
| **Case 2** | | | | | | |
| Characteristic resistance in non-cracked concrete C20/25 | $N^0_{Rk,sp}$ | [kN] | 12 | 16 | 20 | 30 |
| Spacing (edge distance) | $s_{cr,sp}$ (= 2 $c_{cr,sp}$) | [mm] | 5 $h_{ef}$ | | | |
| Increasing factor for $N_{Rk,p}$ and $N^0_{Rk,sp}$ | $\psi c$ | [-] | $\left(\frac{f_{ck,cube}}{25}\right)^{0,5}$ | | | |
| **Concrete cone failure** | | | | | | |
| Effective anchorage depth | $h_{ef}$ | [mm] | 45 | 58 | 65 | 80 |
| Factor for non-cracked concrete | $k_{ucr}$ | [-] | 10,1 | | | |

**Table C12:** Characteristic values for **shear loads, BZ-IG, cracked and non-cracked concrete,** static and quasi-static action, design method A according to ETAG 001, Annex C or CEN/TS 1992-4

| **Anchor size** | | | **M6** | **M8** | **M10** | **M12** |
|---|---|---|---|---|---|---|
| Installation safety factor | $\gamma_2 = \gamma_{inst}$ | [-] | 1,0 | | | |
| **BZ-IG, steel zinc plated** | | | | | | |
| **Steel failure without lever arm, Installation type V** | | | | | | |
| Characteristic shear resistance | $V_{Rk,s}$ | [kN] | 5,8 | 6,9 | 10,4 | 25,8 |
| **Steel failure without lever arm, Installation type D** | | | | | | |
| Characteristic shear resistance | $V_{Rk,s}$ | [kN] | 5,1 | 7,6 | 10,8 | 24,3 |
| **Steel failure with lever arm, Installation type V** | | | | | | |
| Characteristic bending resistance | $M^0_{Rk,s}$ | [Nm] | 12,2 | 30,0 | 59,8 | 104,6 |
| **Steel failure with lever arm, Installation type D** | | | | | | |
| Characteristic bending resistance | $M^0_{Rk,s}$ | [Nm] | 36,0 | 53,2 | 76,0 | 207 |
| Partial safety factor for $V_{Rk,s}$ and $M^0_{Rk,s}$ | $\gamma_{Ms}$ | [-] | 1,25 | | | |
| Factor of ductility | $k_2$ | [-] | 1,0 | | | |
| **BZ-IG, stainless steel A4, HCR** | | | | | | |
| **Steel failure without lever arm, Installation type V** | | | | | | |
| Characteristic shear resistance | $V_{Rk,s}$ | [kN] | 5,7 | 9,2 | 10,6 | 23,6 |
| Partial safety factor | $\gamma_{Ms}$ | [-] | 1,25 | | | |
| **Steel failure without lever arm, Installation type D** | | | | | | |
| Characteristic shear resistance | $V_{Rk,s}$ | [kN] | 7,3 | 7,6 | 9,7 | 29,6 |
| Partial safety factor | $\gamma_{Ms}$ | [-] | 1,25 | | | |
| **Steel failure with lever arm, Installation type V** | | | | | | |
| Characteristic bending resistance | $M^0_{Rk,s}$ | [Nm] | 10,7 | 26,2 | 52,3 | 91,6 |
| Partial safety factor | $\gamma_{Ms}$ | [-] | 1,56 | | | |
| **Steel failure with lever arm, Installation type D** | | | | | | |
| Characteristic bending resistance | $M^0_{Rk,s}$ | [Nm] | 28,2 | 44,3 | 69,9 | 191,2 |
| Partial safety factor | $\gamma_{Ms}$ | [-] | 1,25 | | | |
| Factor of ductility | $k_2$ | [-] | 1,0 | | | |
| **Concrete pry-out failure** | | | | | | |
| k factor | $k_{(3)}$ | [-] | 1,5 | 1,5 | 2,0 | 2,0 |
| **Concrete edge failure** | | | | | | |
| Effective length of anchor in shear loading | $l_f$ | [mm] | 45 | 58 | 65 | 80 |
| Effective diameter of anchor | $d_{nom}$ | [mm] | 8 | 10 | 12 | 16 |

**Table C13:** Characteristic values for **tension** and **shear load** under **fire exposure, BZ-IG**
cracked and non-cracked concrete C20/25 to C50/60,
design acc. to TR 020 or CEN/TS 1992-4, Annex D

| **Anchor size** | | | | **M6** | **M8** | **M10** | **M12** |
|---|---|---|---|---|---|---|---|
| **Tension load** | | | | | | | |
| **Steel failure** | | | | | | | |
| **Steel zinc plated** | | | | | | | |
| Characteristic resistance | R30 | $N_{Rk,s,fi}$ | [kN] | 0,7 | 1,4 | 2,5 | 3,7 |
| | R60 | | | 0,6 | 1,2 | 2,0 | 2,9 |
| | R90 | | | 0,5 | 0,9 | 1,5 | 2,2 |
| | R120 | | | 0,4 | 0,8 | 1,3 | 1,8 |
| **Stainless steel A4, HCR** | | | | | | | |
| Characteristic resistance | R30 | $N_{Rk,s,fi}$ | [kN] | 2,9 | 5,4 | 8,7 | 12,6 |
| | R60 | | | 1,9 | 3,8 | 6,3 | 9,2 |
| | R90 | | | 1,0 | 2,1 | 3,9 | 5,7 |
| | R120 | | | 0,5 | 1,3 | 2,7 | 4,0 |
| **Shear load** | | | | | | | |
| **Steel failure without lever arm** | | | | | | | |
| **Steel zinc plated** | | | | | | | |
| Characteristic resistance | R30 | $V_{Rk,s,fi}$ | [kN] | 0,7 | 1,4 | 2,5 | 3,7 |
| | R60 | | | 0,6 | 1,2 | 2,0 | 2,9 |
| | R90 | | | 0,5 | 0,9 | 1,5 | 2,2 |
| | R120 | | | 0,4 | 0,8 | 1,3 | 1,8 |
| **Stainless steel A4, HCR** | | | | | | | |
| Characteristic resistance | R30 | $V_{Rk,s,fi}$ | [kN] | 2,9 | 5,4 | 8,7 | 12,6 |
| | R60 | | | 1,9 | 3,8 | 6,3 | 9,2 |
| | R90 | | | 1,0 | 2,1 | 3,9 | 5,7 |
| | R120 | | | 0,5 | 1,3 | 2,7 | 4,0 |
| **Steel failure with lever arm** | | | | | | | |
| **Steel zinc plated** | | | | | | | |
| Characteristic resistance | R30 | $M^0_{Rk,s,fi}$ | [Nm] | 0,5 | 1,4 | 3,3 | 5,7 |
| | R60 | | | 0,4 | 1,2 | 2,6 | 4,6 |
| | R90 | | | 0,4 | 0,9 | 2,0 | 3,4 |
| | R120 | | | 0,3 | 0,8 | 1,6 | 2,8 |
| **Stainless steel A4, HCR** | | | | | | | |
| Characteristic resistance | R30 | $M^0_{Rk,s,fi}$ | [Nm] | 2,2 | 5,5 | 11,2 | 19,6 |
| | R60 | | | 1,5 | 3,9 | 8,1 | 14,3 |
| | R90 | | | 0,7 | 2,2 | 5,1 | 8,9 |
| | R120 | | | 0,4 | 1,3 | 3,5 | 6,2 |

The characteristic resistance for pull-out failure, concrete cone failure, concrete pry-out failure and concrete edge failure can be designed according to TR020 / CEN/TS 1992-4.

## Table C14: Displacements under tension load, BZ-IG

| Anchor size | | | M6 | M8 | M10 | M12 |
|---|---|---|---|---|---|---|
| Tension load in cracked concrete | N | [kN] | 2,0 | 3,6 | 4,8 | 8,0 |
| Displacements | $\delta_{N0}$ | [mm] | 0,6 | 0,6 | 0,8 | 1,0 |
| | $\delta_{N\infty}$ | [mm] | 0,8 | 0,8 | 1,2 | 1,4 |
| Tension load in non-cracked concrete | N | [kN] | 4,8 | 6,4 | 8,0 | 12,0 |
| Displacements | $\delta_{N0}$ | [mm] | 0,4 | 0,5 | 0,7 | 0,8 |
| | $\delta_{N\infty}$ | [mm] | 0,8 | 0,8 | 1,2 | 1,4 |

## Table C15: Displacements under shear load, BZ-IG

| Anchor size | | | M6 | M8 | M10 | M12 |
|---|---|---|---|---|---|---|
| Shear load in cracked and non-cracked concrete | V | [kN] | 4,2 | 5,3 | 6,2 | 16,9 |
| Displacements | $\delta_{V0}$ | [mm] | 2,8 | 2,9 | 2,5 | 3,6 |
| | $\delta_{V\infty}$ | [mm] | 4,2 | 4,4 | 3,8 | 5,3 |