Deutsches Institut für Bautechnik DIBt

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**Approval body for construction products and types of construction**

**Bautechnisches Prüfamt**

An institution established by the Federal and Laender Governments

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

# European Technical Assessment

# ETA-18/0132 of 25 July 2018

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 | Hilti pipe ring saddle MQA-M10-B,<br>Hilti pipe ring saddle MQA-M12-B and<br>Hilti pipe ring saddle MQA-M16-B |
| Product family to which the construction product belongs | Products related to installation systems supporting technical equipment for building services such as pipes, conduits, ducts and cables |
| Manufacturer | Hilti AG<br>Feldkircherstraße 100<br>9494 Schaan<br>FÜRSTENTUM LIECHTENSTEIN |
| Manufacturing plant | L 1000446 |
| This European Technical Assessment contains | 16 pages including 12 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 280016-00-0602 |

**Specific Part**

## 1 Technical description of the product

Objects of this European Technical Assessment are the Hilti pipe ring saddle MQA-M10-B, Hilti pipe ring saddle MQA-M12-B and Hilti pipe ring saddle MQA-M16-B. The MQA-M10-B, MQA-M12-B and MQA-M16-B pipe ring saddles consist of a nut and a clamping plate made of steel, which are connected to one another by means of a spring element made of PET. The pipe ring saddles have a centred round opening. The opening in the nut is used to fasten threaded elements, e.g. threaded rods.

Annex A describes the dimensions and materials of the MQA-M10-B, MQA-M12-B and MQA-M16-B pipe ring saddles.

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

The performance given in Section 3 can only be assumed if the Hilti MQA-M10-B, MQA-M12-B and MQA-M16-B pipe ring saddles are used in compliance with the specifications and under boundary conditions set out in Annex B. The test and assessment methods on which this European Technical Assessment is based lead to an assumption of a working life of the Hilti MQA-M10-B, MQA-M12-B and MQA-M16-B pipe ring saddles of at least 50 years in final use under ambient temperatures in indoor areas. 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.

In accordance with the European Assessment Document EAD 280016-00-0602, the product is intended to be used in

a) installations for the support of sprinkler kits;

b) installations for the support of other building service elements such as pipes, conduits, ducts and cables.

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

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

| Essential characteristic | Performance |
|---|---|
| Reaction to fire: Steel | Class A1 |
| Reaction to fire: Plastic parts | not relevant for fire growth in accordance with TR021 and therefore do not need to be classified |

### 3.2 Safety and accessibility in use (BWR 4)

| Essential characteristic | Performance |
|---|---|
| Shape | see Annex A |
| Dimensions | see Annex A |
| Material | see Annex A |
| Characteristic pull-out resistance at ambient temperatures | see Annex C |
| Pull-out resistance with $\varepsilon_{B,\theta a} \leq 2\%$ at elevated temperatures | see Annex D |
| Pull-out resistance with $\varepsilon_{B,\theta a} > 2\%$ at elevated temperatures | see Annex D |

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

In accordance with the European Assessment Document EAD 280016-00-0602, the following legal bases apply:

- In case of intended use a) specified in Section 2:
  Decision of the commission N° 1996/577/EC:
  System 1 applies for the assessment and verification of constancy of performance (AVCP).
- In case of intended use b) specified in Section 2:
  Decision of the commission N° 1999/472/EC:
  System 3 applies for the assessment and verification of constancy of performance (AVCP).

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

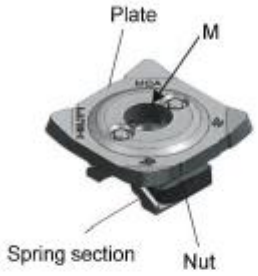
The technical details necessary for the implementation of the system for the assessment and verification of constancy of performance are laid down in the control plan (confidential part of this European Technical Assessment) deposited at Deutsches Institut für Bautechnik.

Issued in Berlin on 25 Juli 2018 by Deutsches Institut für Bautechnik

BD Dipl.-Ing. Andreas Kummerow
Head of Department

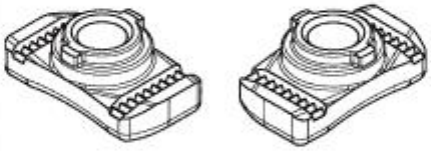
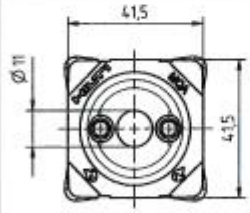
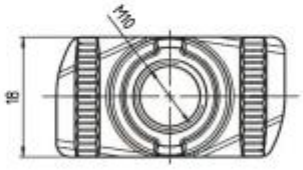
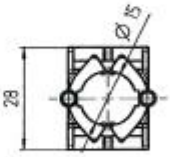
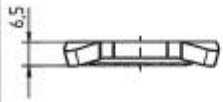
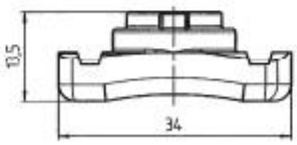
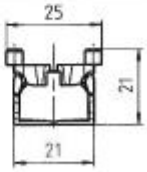
*beglaubigt:*
Dr. Häßler

Table A1.1: Dimensions and materials of the pipe ring saddles

| Illustration | Item number | Designation | M [mm] | Materials |
|---|---|---|---|---|
|   | 2199452 | MQA-M10-B | 10 | Plate:<br>DD11 in accordance with EN 10111[1)],<br>zinc coated<br><br>Nut:<br>C4C in accordance with EN 10263-2, zinc coated<br><br>Spring section:<br>PET |
| | 2199453 | MQA-M12-B | 12 | |
| | 2199454 | MQA-M16-B | 16 | |

[1)] with 235 N/mm² ≤ $R_{eL}$ ≤ 340 N/mm², Method of deoxidation: fully killed

Table A1.2: Dimensions of the components of the pipe ring saddle MQA-M10-B [in mm]

| Plate | Nut | Spring section |
|---|---|---|
|  |  |  |
|   |   |   |
|   |   |   |

| | |
|---|---|
| Hilti pipe ring saddle MQA-M10-B, Hilti pipe ring saddle MQA-M12-B and Hilti pipe ring saddle MQA-M16-B | Annex A1 |
| Description of the product<br>Dimensions and materials | |

Table A2.1: Dimensions of the components of the pipe ring saddle MQA-M12-B [in mm]

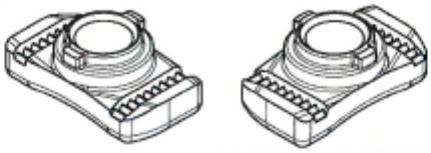
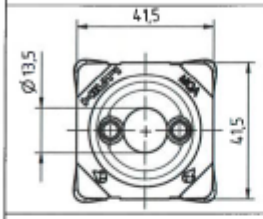
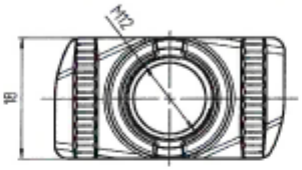
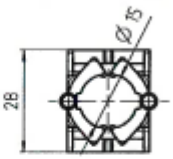
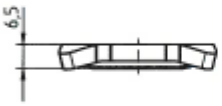
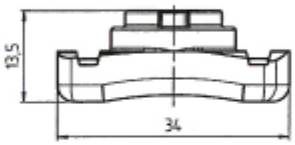
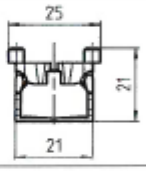
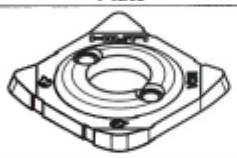
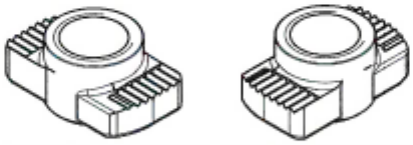
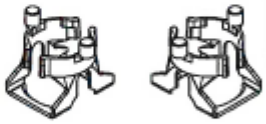
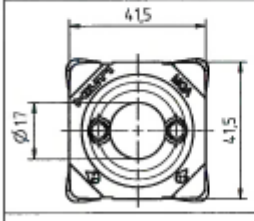
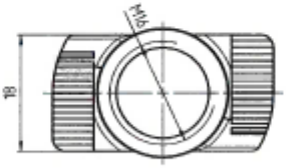
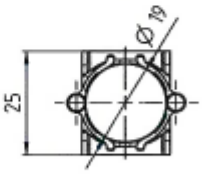
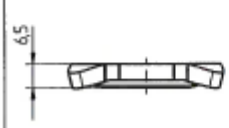
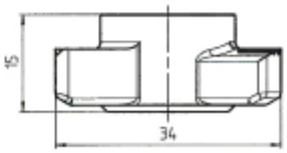
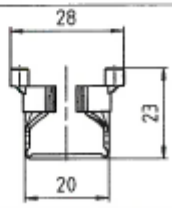
| Plate | Nut | Spring section |
|---|---|---|
|  |  |  |
|  |  |  |
|  |  |  |

Table A2.2: Dimensions of the components of the pipe ring saddle MQA-M16-B [in mm]

| Plate | Nut | Spring section |
|---|---|---|
|  |  |  |
|  |  |  |
|  |  |  |

| | |
|---|---|
| Hilti pipe ring saddle MQA-M10-B, Hilti pipe ring saddle MQA-M12-B and Hilti pipe ring saddle MQA-M16-B | Annex A2 |
| Description of the product<br>Dimensions and materials | |

- Hilti pipe ring saddles MQA-M10-B, MQA-M12-B und MQA-M16-B are used to transfer building services component loads such as ducts and equipment for sprinklers, water, heating, cooling, ventilation, electrical and other systems. Hilti pipe ring saddles MQA-M10-B, MQA-M12-B und MQA-M16-B are performing this loadbearing function at ambient and elevated temperatures under the conditions described in Section 2 of this European Technical Assessment.

- Hilti pipe ring saddles MQA-M10-B, MQA-M12-B und MQA-M16-B are deployed for the fixation of threaded rods in installation systems in combination with hexagonal nuts.

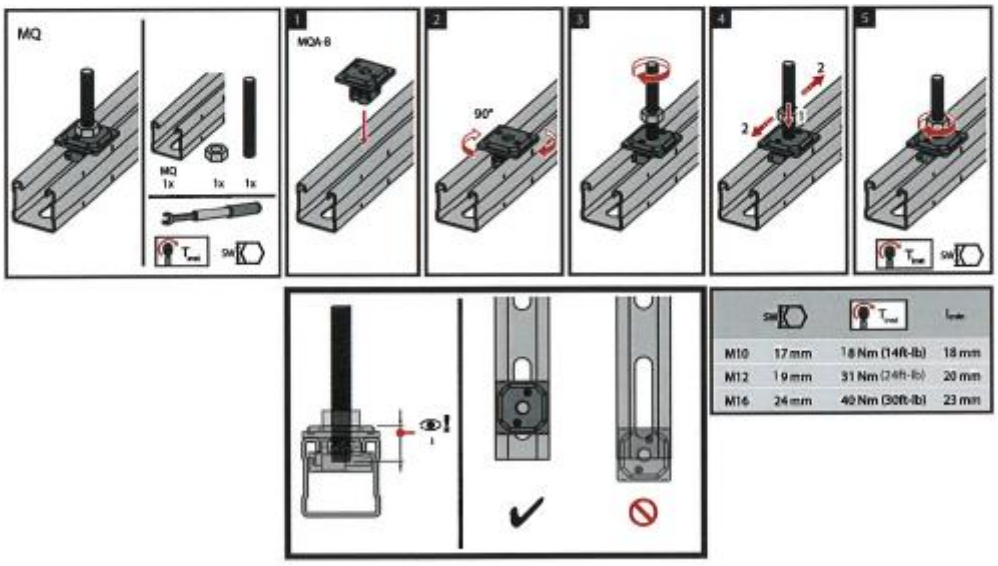
- The performance of MQA-M10-B, MQA-M12-B and MQA-M16-B results in connection with zinc coated threaded rods of strength class 4.8 in accordance with DIN 976-1 as per Table B2.1, zinc coated hexagonal nuts of strength class 8 in accordance with ISO 4032 as per Table B2.2 and installation channels according to Annex B3 to B6.

- Information on resistance at ambient and elevated temperatures applies to static and centric actions. The time values in conjunction with the resistance values at elevated temperatures refer to the boundary conditions of the standard temperature / time curve (STTC) according to EN 1363-1.

- The channels are cut to length centrally between the longholes or the roundholes at the marking. The cut channel lies within a range of 2 mm from both sides of the marking.

- Prior to installation, it must be ensured that the supported components, the threaded rods, the anchoring to the base material and the base material itself are suitable to withstand the resistance values of the pipe ring saddles as well as of the installation system and that they have a fireproof certificate.

- Installation must be carried out by qualified personnel and under the supervision of the site manager. The general assembly instructions of the manufacturer apply.

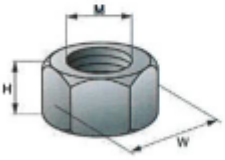



| | |
|---|---|
| Hilti pipe ring saddle MQA-M10-B, Hilti pipe ring saddle MQA-M12-B and Hilti pipe ring saddle MQA-M16-B | Annex B1 |
| Requirements for performance assessment | |

Table B2.1: Dimensions and materials of threaded rods for use with MQA-M10-B, MQA-M12-B, MQA-M16-B

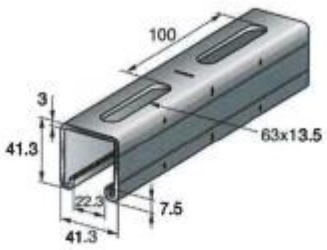
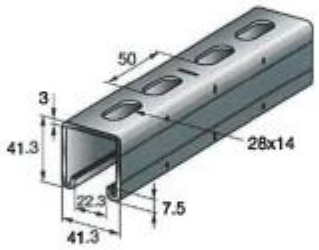
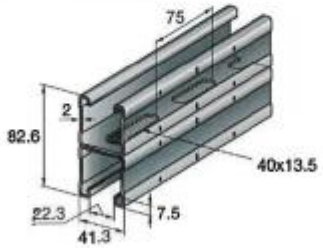
| Illustration | Item number | Designation | M thread | L [mm] | Material |
|---|---|---|---|---|---|
|   | 339795 | AM10x1000 4.8 | M10 | 1000 | Strength class 4.8 in accordance with DIN 976-1, zinc coated |
| | 339796 | AM10x2000 4.8 | M10 | 2000 | |
| | 216418 | AM10x3000 4.8 | M10 | 3000 | |
| | 339797 | AM12x1000 4.8 | M12 | 1000 | |
| | 216420 | AM12x2000 4.8 | M12 | 2000 | |
| | 216421 | AM12x3000 4.8 | M12 | 3000 | |
| | 216422 | AM16x1000 4.8 | M16 | 1000 | |
| | 216423 | AM16x2000 4.8 | M16 | 2000 | |
| | 216424 | AM16x3000 4.8 | M16 | 3000 | |

Table B2.2: Dimensions and materials of hexagonal nuts for use with MQA-M10-B, MQA-M12-B, MQA-M16-B

| Illustration | Item number | Designation | M thread | W [mm] | H [mm] | Material |
|---|---|---|---|---|---|---|
|   | 216466 | M10 hexagonal nut | M10 | 17 | 8 | Strength class 8 in accordance with ISO 4032, zinc coated |
| | 216467 | M12 hexagonal nut | M12 | 19 | 10 | |
| | 216468 | M16 hexagonal nut | M16 | 24 | 13 | |

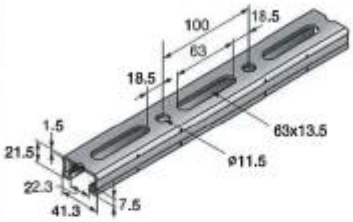
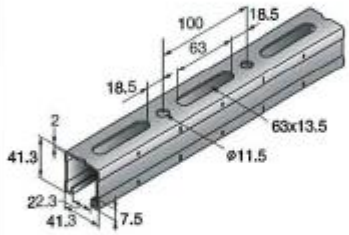
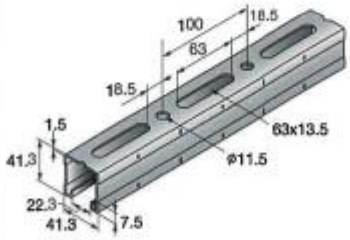
| | |
|---|---|
| Hilti pipe ring saddle MQA-M10-B, Hilti pipe ring saddle MQA-M12-B and Hilti pipe ring saddle MQA-M16-B | Annex B2 |
| Requirements for performance assessment | |

Table B3: Dimensions and materials of installation channels MQ-41/3, MQ-41/3 LL und MQ-41 D

| Illustration[2)] | Item number | Designation | Length [m] | Materials |
|---|---|---|---|---|
|  | 369596 | MQ-41/3 3M | 3 | S250GD+Z275-M-A-C in accordance with EN 10346 |
| | 369597 | MQ-41/3 6M | 6 | |
|  | 2048102 | MQ-41/3 3M LL | 3 | S250GD+Z275-M-A-C in accordance with EN 10346 |
| | 2048103 | MQ-41/3 6M LL | 6 | |
|  <br>Two profiles of MQ-41 D channel are connected in the area of the holes in the back of the channels in a shape-fitting and force-fitting way as a kind of riveted connection. | 369603 | MQ-41 D 3m | 3 | S250GD+Z275-M-A-C in accordance with EN 10346 |
| | 369604 | MQ-41 D 6m | 6 | |

[2)] Dimensions in mm

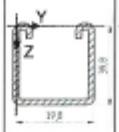
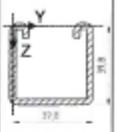
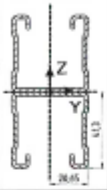
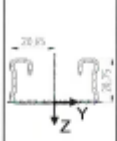
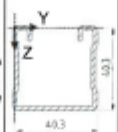
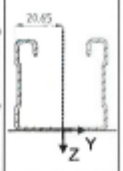
Table B4: Dimensions and materials of installation channels MQ-21.5, MQ-41 und MQ-41-L

| Illustration[2)] | Item number | Designation | Length [m] | Materials |
|---|---|---|---|---|
|  | 2184773 | MQ-21.5 6m | 6 | S280GD+Z140-M-A-C in accordance with EN 10346 |
| | 2184772 | MQ-21.5 3m | 3 | |
| | 2184771 | MQ-21.5 2m | 2 | |
|  | 369592 | MQ-41 6m | 6 | S250GD+Z275-M-A-C in accordance with EN 10346 |
| | 369591 | MQ-41 3m | 3 | |
| | 304559 | MQ-41 2m | 2 | |
|  | 2141964 | MQ-41-L 6m | 6 | S250GD+Z140-M-A-C in accordance with EN 10346 |
| | 2141965 | MQ-41-L 3m | 3 | |
| | 2141966 | MQ-41-L 2m | 2 | |

[2)] Dimensions in mm

| | |
|---|---|
| Hilti pipe ring saddle MQA-M10-B, Hilti pipe ring saddle MQA-M12-B and Hilti pipe ring saddle MQA-M16-B | Annex B4 |
| Requirements for performance assessment | |

Table B5: Section properties of installation channels for use with MQA-M10-B, MQA-M12-B, MQA-M16-B

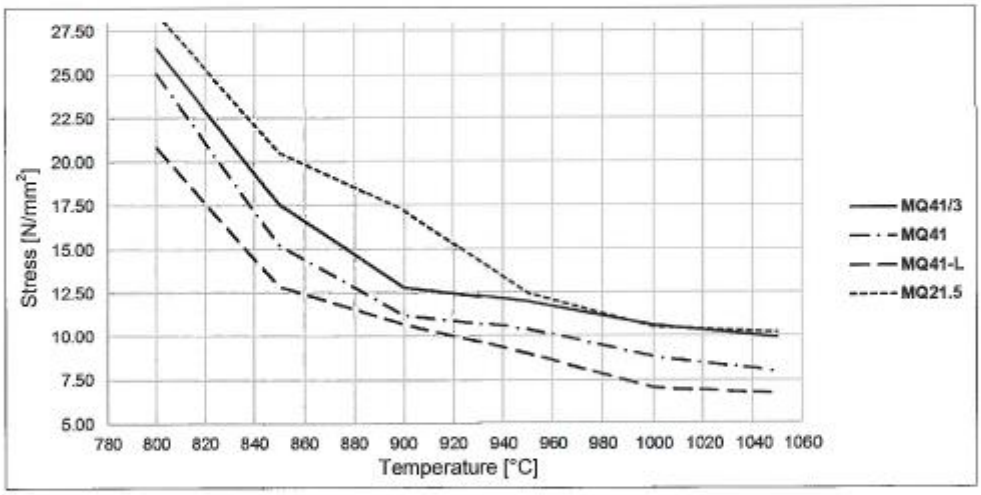
| Description | Symbol | MQ-41/3 | MQ-41/3 LL | MQ-41 D | MQ-21.5 | MQ-41 | MQ-41-L | Unit |
|---|---|---|---|---|---|---|---|---|
| | |  |  |  |  |  |  | |
| Classification cross section in accordance with EN 1993-1-1 | - | 3 | 3 | 3 | 3 | 3 | 3 | - |
| Cross section areas | $A$ | 375.88 | 379.93 | 545.97 | 142.71 | 263.62 | 199.57 | $mm^2$ |
| | $A_{tot}$ | 375.88 | 379.93 | 545.97 | 142.71 | 263.62 | 199.57 | $mm^2$ |
| Shear areas | $A_y$ | 48.69 | 54.43 | 66.37 | 23.47 | 27.23 | 20.24 | $mm^2$ |
| | $A_z$ | 195.47 | 194.59 | 197.58 | 41.86 | 131.51 | 98.37 | $mm^2$ |
| Centroid position | $y_{C,0}$ | 19.15 | 19.15 | 0.00 | 0.00 | 19.65 | 0.00 | mm |
| | $z_{C,0}$ | 20.57 | 20.76 | 0.00 | -9.12 | 20.52 | -19.91 | mm |
| Moments of inertia | $I_y$ | 76963.50 | 78224.80 | 323585.00 | 9168.75 | 57501.00 | 44773.00 | $mm^4$ |
| | $I_z$ | 107949.00 | 108011.00 | 154070.00 | 37416.40 | 76416.00 | 58981.50 | $mm^4$ |
| Inclination of principal axes | $\alpha$ | 90.00 | 90.00 | 0.00 | 90.00 | 90.00 | 90.00 | ° |
| Polar moments of inertia | $I_p$ | 184913.00 | 186236.00 | 477656.00 | 46585.10 | 133917.00 | 103754.00 | $mm^4$ |
| | $I_{p,M}$ | 778900.00 | 780561.00 | 477656.00 | 115093.00 | 601859.00 | 469974.00 | $mm^4$ |
| Radii of gyration | $i_y$ | 14.31 | 14.35 | 24.35 | 8.02 | 14.77 | 14.98 | mm |
| | $i_z$ | 16.95 | 16.86 | 16.80 | 16.19 | 17.03 | 17.19 | mm |
| Polar radii of gyration | $i_p$ | 22.18 | 22.14 | 29.58 | 18.07 | 22.54 | 22.80 | mm |
| | $i_{p,M}$ | 45.52 | 45.33 | 29.58 | 28.40 | 47.78 | 48.53 | mm |
| Warping radius of gyration | $i_{\omega,M}$ | 7.02 | 7.02 | 17.32 | 6.85 | 7.19 | 7.44 | mm |
| Torsional constant | $J$ | 848.88 | 856.29 | 575.03 | 76.58 | 269.75 | 112.13 | $mm^4$ |
| Secondary torsional constant | $J_s$ | 105319.00 | 105394.00 | 91246.30 | 25157.50 | 74075.40 | 565590.00 | $mm^4$ |
| Location of the shear center | $y_{M,0}$ | 19.15 | 19.15 | 0.00 | 0.00 | 19.65 | 0.00 | mm |
| | $z_{M,0}$ | 60.32 | 60.31 | 0.00 | 12.77 | 62.63 | 22.92 | mm |
| | $y_M$ | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | mm |
| | $z_M$ | 39.75 | 39.55 | 0.00 | 21.90 | 42.11 | 42.84 | mm |
| Warping constants | $I_{\omega,C}$ | 2.09277E+08 | 2.07678E+08 | 1.43225E+08 | 23255400.00 | 1.66135E+08 | 1.34296E+08 | $mm^6$ |
| | $I_{\omega,M}$ | 38387600 | 38417600.00 | 1.43225E+08 | 5395050.00 | 31116700.00 | 26017600 | $mm^6$ |
| | $r_{\omega,M}$ | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | - |
| Section moduli | $S_{y,max}$ | 4002.48 | 4108.45 | 7834.29 | 928.54 | 2906.72 | 2248.07 | $mm^3$ |
| | $S_{y,min}$ | -3487.10 | -3514.15 | -7833.74 | -788.66 | -2672.22 | -2093.62 | $mm^3$ |
| | $S_{z,max}$ | 5227.58 | 5230.56 | 7460.71 | 1811.93 | 3700.53 | 2856.29 | $mm^3$ |
| | $S_{z,min}$ | -5277.58 | -5230.56 | -7460.71 | -1811.93 | -3700.54 | -2856.25 | $mm^3$ |
| Torsional section modulus | $S_t$ | 282.96 | 285.43 | 287.51 | 51.06 | 134.88 | 75.76 | $mm^3$ |
| Max. plastic bending moment | $M_{pl,y,k}$ | NPA[3] | NPA | NPA | NPA | NPA | NPA | kNm |
| | $M_{pl,z,k}$ | NPA | NPA | NPA | NPA | NPA | NPA | kNm |
| Max. plastic section moduli | $Z_y$ | NPA | NPA | NPA | NPA | NPA | NPA | $mm^3$ |
| | $Z_z$ | NPA | NPA | NPA | NPA | NPA | NPA | $mm^3$ |
| Plastic shear areas | $A_{pl,y}$ | NPA | NPA | NPA | NPA | NPA | NPA | $mm^2$ |
| | $A_{pl,z}$ | NPA | NPA | NPA | NPA | NPA | NPA | $mm^2$ |
| Area bisecting axis position | $f_{y,0}$ | NPA | NPA | NPA | NPA | NPA | NPA | mm |
| | $f_{z,0}$ | NPA | NPA | NPA | NPA | NPA | NPA | mm |
| Plastic shear forces | $V_{pl,y,k}$ | NPA | NPA | NPA | NPA | NPA | NPA | kN |
| | $V_{pl,z,k}$ | NPA | NPA | NPA | NPA | NPA | NPA | kN |
| Plastic axial force | $N_{pl,k}$ | NPA | NPA | NPA | NPA | NPA | NPA | kN |
| Buckling curves | $BC_y$ | c | c | c | c | c | c | - |
| | $BC_z$ | c | c | c | c | c | c | - |

[3] NPA: No performance assessed

| | |
|---|---|
| Hilti pipe ring saddle MQA-M10-B, Hilti pipe ring saddle MQA-M12-B and Hilti pipe ring saddle MQA-M16-B | Annex B5 |
| Requirements for performance assessment | |

Table B6.1: Channel material stress[4] at different temperatures of the component and $\varepsilon_{B,ea}$ = 2%

| Temperature [°C] | Stress [N/mm²] | | | |
|---|---|---|---|---|
| | MQ-41/3 or MQ-41/3 LL | MQ-41 | MQ-41-L | MQ-21.5 |
| **800** | 26.51 | 25.06 | 20.83 | 28.53 |
| **842*** | 19.00 | 16.77 | 14.11 | 21.80 |
| **850** | 17.57 | 15.19 | 12.83 | 20.52 |
| **900** | 12.82 | 11.21 | 10.69 | 17.24 |
| **945*** | 12.05 | 10.49 | 9.19 | 12.91 |
| **950** | 11.96 | 10.41 | 9.02 | 12.43 |
| **1000** | 10.58 | 8.82 | 7.02 | 10.52 |
| **1006*** | 10.50 | 8.72 | 6.98 | 10.48 |
| **1049*** | 9.91 | 7.97 | 6.73 | 10.18 |
| **1050** | 9.90 | 7.96 | 6.73 | 10.17 |




[4] determined based on unsteady thermal creep tests
*) interpolated values of the channel material stress

Table B6.2: Temperatures[5] after 30, 60, 90 and 120 minutes according to standard temperature / time curve (STTC)

| **Time according to STTC [min]** | 30 | 60 | 90 | 120 |
|---|---|---|---|---|
| **Temperature [°C]** | 842 | 945 | 1006 | 1049 |

[5] Furnace temperatures according to STTC;
It can be assumed that the component temperature corresponds to the furnace temperature.

Table C1: Characteristic pull-out resistance at ambient temperatures

| Pipe ring saddle | Installation channel | Characteristic pull-out resistance | Partial safety coefficient[6)] |
|---|---|---|---|
| | | $F_{Rk}$ [kN] | $\gamma_M$ |
| MQA-M10-B | MQ-41/3 | 23.26 | 2.08 |
| | MQ-41/3 LL | | |
| | MQ-41 | 15.08 | 2.15 |
| | MQ-41 D | | |
| | MQ-41-L | 7.39 | 1.76 |
| | MQ-21.5 | 7.09 | 1.69 |
| MQA-M12-B | MQ-41/3 | 20.63 | 1.84 |
| | MQ-41/3 LL | | |
| | MQ-41 | 15.92 | 2.27 |
| | MQ-41 D | | |
| | MQ-41-L | 8.02 | 1.91 |
| | MQ-21.5 | 6.93 | 1.65 |
| MQA-M16-B | MQ-41/3 | 21.70 | 1.94 |
| | MQ-41/3 LL | | |
| | MQ-41 | 11.79 | 1.68 |
| | MQ-41 D | | |
| | MQ-41-L | 6.89 | 1.64 |
| | MQ-21.5 | 6.29 | 1.50 |

[6)] provided that no other national regulations apply

Table D1.1: Parameter of the regression curve $F_{Rk}(t) = c_3 (c_1 + c_2 / t)$ for $\varepsilon_{B,\theta a} \leq 2\%$

| Pipe ring saddle | Installation channel | $c_1$ [-] | $c_2$ [-] | $c_3$ [-] | $t_{min}$ [minutes] | $t_{max}$ [minutes] |
|---|---|---|---|---|---|---|
| MQA-M10-B<br>MQA-M12-B | MQ-41/3 | 695.324 | 27657.410 | 0.704 | 20 | 150 |
| | MQ-41/3 LL | | | | | |
| | MQ-41 | 345.949 | 28750.936 | 0.713 | 26 | 120 |
| | MQ-41 D | | | | | |
| | MQ-41-L | -462.03 | 35853.38 | 0.8808 | 30 | 33 |
| | MQ-21.5 | 110.27 | 19232.88 | 0.9786 | 30 | 48 |
| MQA-M16-B | MQ-41/3 | 758.416 | 38174.329 | 0.844 | 26 | 130 |
| | MQ-41/3 LL | | | | | |
| | MQ-41 | 345.949 | 28750.936 | 0.713 | 26 | 120 |
| | MQ-41 D | | | | | |
| | MQ-41-L | -462.03 | 35853.38 | 0.8808 | 30 | 33 |
| | MQ-21.5 | 110.27 | 19232.88 | 0.9786 | 30 | 48 |

Table D1.2: Pull-out resistance $F_{Rk,t}$ at elevated temperatures and $\varepsilon_{B,\theta a} \leq 2\%$

| Pipe ring saddle | Installation channel | $F_{Rk,30}$ [N] | $F_{Rk,60}$ [N] | $F_{Rk,90}$ [N] | $F_{Rk,120}$ [N] |
|---|---|---|---|---|---|
| MQA-M10-B<br>MQA-M12-B | MQ-41/3 | 1138 | 813 | 705 | 651 |
| | MQ-41/3 LL | | | | |
| | MQ-41 | 930 | 589 | 475 | NPA[7)] |
| | MQ-41 D | | | | |
| | MQ-41-L | 646 | NPA | NPA | NPA |
| | MQ-21.5 | 735 | NPA | NPA | NPA |
| MQA-M16-B | MQ-41/3 | 1710 | 1176 | 998 | 909 |
| | MQ-41/3 LL | | | | |
| | MQ-41 | 930 | 589 | 475 | NPA |
| | MQ-41 D | | | | |
| | MQ-41-L | 646 | NPA | NPA | NPA |
| | MQ-21.5 | 735 | NPA | NPA | NPA |

[7)] NPA: No performance assessed

**Symbols and designation**

$\varepsilon_{B,\theta a}$ Channel bending strain at elevated temperatures $\theta_a$
$F_{Rk,t}$ Resistance after an exposure time t to elevated temperatures
$F_{Rk}(t)$ Resistance time function at elevated temperatures

| | |
|---|---|
| Hilti pipe ring saddle MQA-M10-B, Hilti pipe ring saddle MQA-M12-B and Hilti pipe ring saddle MQA-M16-B | Annex D1 |
| Pull-out resistance with $\varepsilon_{B,\theta a} \leq 2\%$ at elevated temperatures | |

Table D2: Parameter of the regression curve $F_{Rk}(t) = c_3 (c_1 + c_2 / t)$ for $\varepsilon_{B,\theta a} > 2\%$

| Pipe ring saddle | Installation channel | $c_1$ [-] | $c_2$ [-] | $c_3$ [-] | $t_{min}$ [minutes] | $t_{max}$ [minutes] |
|---|---|---|---|---|---|---|
| MQA-M10-B | MQ-41/3 | 445.338 | 18381.52 | 0.917 | 26 | 130 |
| | MQ-41/3 LL | | | | | |
| | MQ-41 | 255.989 | 15310.519 | 0.865 | 22 | 120 |
| | MQ-41 D | | | | | |
| | MQ-41-L | 102.97 | 16294.33 | 0.9344 | 21 | 60 |
| | MQ-21.5 | 406.83 | 11709.31 | 0.9900 | 33 | 49 |
| MQA-M12-B | MQ-41/3 | 434.765 | 24088.663 | 0.872 | 26 | 123 |
| | MQ-41/3 LL | | | | | |
| | MQ-41 | 255.989 | 15310.519 | 0.865 | 22 | 120 |
| | MQ-41 D | | | | | |
| | MQ-41-L | 102.97 | 16294.33 | 0.9344 | 21 | 60 |
| | MQ-21.5 | 406.83 | 11709.31 | 0.9900 | 33 | 49 |
| MQA-M16-B | MQ-41/3 | 434.382 | 19535.05 | 0.907 | 22 | 139 |
| | MQ-41/3 LL | | | | | |
| | MQ-41 | 255.989 | 15310.519 | 0.865 | 22 | 120 |
| | MQ-41 D | | | | | |
| | MQ-41-L | NPA[7)] | NPA | NPA | NPA | NPA |
| | MQ-21.5 | NPA | NPA | NPA | NPA | NPA |

[7)] NPA: No performance assessed

Symbols and designation see Annex D1

| | |
|---|---|
| Hilti pipe ring saddle MQA-M10-B, Hilti pipe ring saddle MQA-M12-B and Hilti pipe ring saddle MQA-M16-B | Annex D2 |
| Pull-out resistance with $\varepsilon_{B,\theta a} > 2\%$ at elevated temperatures | |

Table D3: Pull-out resistance $F_{Rk,t}$ at elevated temperatures and $\varepsilon_{B,8a}$ > 2%

| Pipe ring saddle | Installation channel | $F_{Rk,30}$ [N] | $F_{Rk,60}$ [N] | $F_{Rk,90}$ [N] | $F_{Rk,120}$ [N] |
|---|---|---|---|---|---|
| MQA-M10-B | MQ-41/3 | 970 | 689 | 595 | 549 |
| | MQ-41/3 LL | | | | |
| | MQ-41 | 663 | 442 | 369 | NPA[7] |
| | MQ-41 D | | | | |
| | MQ-41-L | 604 | NPA | NPA | NPA |
| | MQ-21.5 | 789 | NPA | NPA | NPA |
| MQA-M12-B | MQ-41/3 | 1080 | 729 | 613 | 554 |
| | MQ-41/3 LL | | | | |
| | MQ-41 | 663 | 442 | 369 | NPA |
| | MQ-41 D | | | | |
| | MQ-41-L | 604 | NPA | NPA | NPA |
| | MQ-21.5 | 789 | NPA | NPA | NPA |
| MQA-M16-B | MQ-41/3 | 984 | 689 | 590 | 541 |
| | MQ-41/3 LL | | | | |
| | MQ-41 | 663 | 442 | 369 | NPA |
| | MQ-41 D | | | | |
| | MQ-41-L | NPA | NPA | NPA | NPA |
| | MQ-21.5 | NPA | NPA | NPA | NPA |

[7] NPA: No performance assessed

Symbols and designation see Annex D1

| | |
|---|---|
| Hilti pipe ring saddle MQA-M10-B, Hilti pipe ring saddle MQA-M12-B and Hilti pipe ring saddle MQA-M16-B | Annex D3 |
| Pull-out resistance with $\varepsilon_{B,8a}$ > 2% at elevated temperatures | |