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Designated according to Article 29 of Regulation (EU) No 305/2011

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# European Technical Assessment

# ETA-14/0383 of 13/10/2014

*English translation prepared by CSTB - Original version in French language*

## General Part

**Technical Assessment Body issuing the ETA and designated according to Article 29 of the Regulation (EU) No 305/2011:**

| | |
|---|---|
| Nom commercial<br>*Trade name* | **AT-HP** |
| Famille de produit<br>*Product family* | **Cheville à scellement de type "à injection" pour fixation dans le béton non fissuré M8 à M30.**<br>***Bonded injection type anchor for use in non-cracked concrete: sizes M8 to M30*** |
| Titulaire<br>*Manufacturer* | **Simpson Strong-Tie ®**<br>**ZAC. Les 4 chemins**<br>**85400 Sainte-Gemme-la-Plaine**<br>**France** |
| Usine de fabrication<br>*Manufacturing plant* | **Simpson Strong-Tie Manufacturing Facilities** |
| Cette evaluation contient:<br>*This Assessment contains* | 17 pages incluant 13 annexes qui font partie intégrante de cette évaluation<br>17 *pages including 13 annexes which form an integral part of this assessment* |
| Base de l'ETE<br>*Basis of ETA* | ETAG 001, Version April 2013, utilisée en tant que EAD<br>*ETAG 001, Edition April 2013 used as EAD* |
| Cette evaluation remplace:<br>*This Assessment replaces* | |

## 1 Technical description of the product

The Simpson Strong-Tie® AT-HP injection system is a bonded anchor (injection type) consisting of a mortar cartridge with injection mortar AT-HP and a steel element (threaded rod).

The steel element can be made of zinc plated carbon steel, stainless steel, or high corrosion resistant stainless steel.

The steel element is placed into a rotary/percussion drilled hole filled with the injection mortar and is anchored via the bond between the metal part and concrete.

The illustration and the description of the product are given in Annexes A.

## 2 Specification of the intended use

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

The provisions made in this European Technical Assessment are based on an assumed working life of the anchor of 50 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

## 3 Performance of the product

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

| Essential characteristic | Performance |
|---|---|
| Characteristic tension resistance and shear resistance for threaded rods acc. TR029 | See Annex C1, C2 |
| Characteristic tension resistance and shear resistance for threaded rods acc. CEN/TS 1992-4-5 | See Annex C3, C4 |
| Displacements | See Annex C5 |

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

| Essential characteristic | Performance |
|---|---|
| Reaction to fire | Anchorages satisfy requirements for Class A1 |
| Resistance to fire | No performance determined (NPD) |

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

Regarding dangerous substances contained in this European Technical Assessment, there may be requirements applicable to the products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). In order to meet the provisions of the Construction Products Directive, these requirements need also to be complied with, when and where they apply.

### 3.4 Safety in use (BWR 4)

For Basic Requirement Safety in use the same criteria are valid as for Basic Requirement Mechanical Resistance and Stability.

### 3.5 Protection against noise (BWR 5)

Not relevant.

### 3.6 Energy economy and heat retention (BWR 6)

Not relevant.

### 3.7 General aspects relating to fitness for use

Durability and Serviceability are only ensured if the specifications of intended use according to Annex B1 are kept.

## 4 Assessment and Verification of Constancy of Performance (AVCP)

According to the Decision 96/582/EC of the European Commission[1], as amended, the system of assessment and verification of constancy of performance (see Annex V to Regulation (EU) No 305/2011) given in the following table apply.

| Product | Intended use | Level or class | System |
|---|---|---|---|
| Metal anchors for use in concrete | For fixing and/or supporting to concrete, structural elements (which contributes to the stability of the works) or heavy units | — | 1 |

## 5 Technical details necessary for the implementation of the AVCP system

Technical details necessary for the implementation of the Assessment and verification of constancy of performance (AVCP) system are laid down in the control plan deposited at Centre Scientifique et Technique du Bâtiment.

The manufacturer shall, on the basis of a contract, involve a notified body approved in the field of anchors for issuing the certificate of conformity CE based on the control plan.

Issued in Marne La Vallée on 13-10-2014 by

Charles Baloche *The original French version is signed*

Directeur technique

1 Official Journal of the European Communities L 254 of 08.10.1996

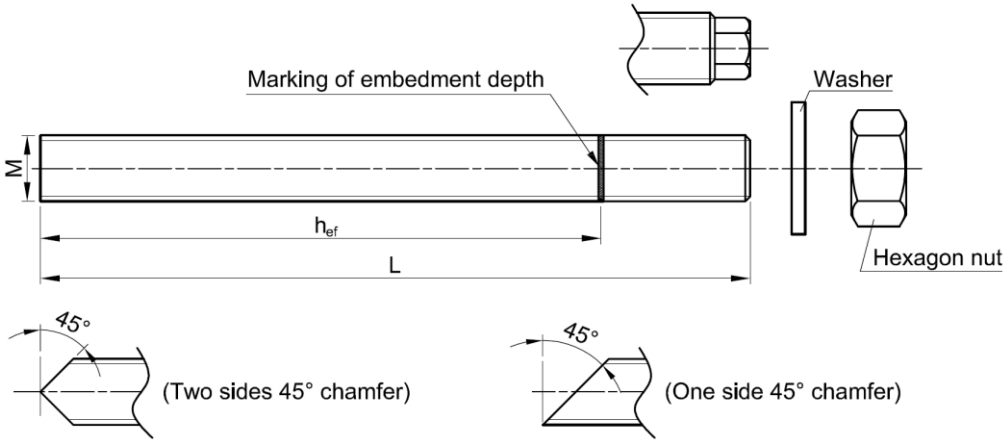
**Simpson Strong-Tie ®**
## AT-HP Injection Mortar

### Cartridge: 160ml, 170ml, 280ml, 300ml, 345ml, 380ml, 825ml

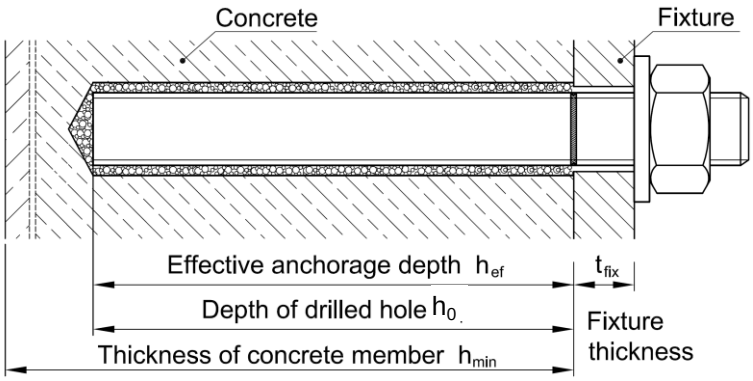
Imprints:
Commercial name,
Manufacturer identification,
Installation instructions,
Expiration date, Batch-no.,
Hazard codes

### Mixing nozzle «MN1»

### Threaded rod: M8, M10, M12, M16, M20, M24, M27 or M30




### Installation



**Simpson Strong-Tie ®**
## AT-HP Injection Mortar

### Table A1: Materials (Threaded rod)

| Designation | Material |
|---|---|
| Steel, zinc plated ≥ 5μm according EN ISO 4042 (A2),<br>Steel, hot dipped galvanized > 40 μm EN ISO 10684 | |
| Threaded rod | Carbon steel: Property class 5.8, 8.8 and 10.9 acc. EN ISO 898-1; A5 ≥ 8% ductile |
| Washer | Steel: EN ISO 7089 (DIN 125), EN ISO 7094 (DIN 440), EN ISO 7093 (DIN 9021) |
| Hexagon nut | Steel: EN ISO 4032 (DIN 934), property class 8 or classe 10 acc. EN ISO 898-2 |
| Stainless steel | |
| Threaded rod | Stainless steel: 1.4362; 1.4401; 1.4404; 1.4439; 1.4571; 1.4578 acc. EN 10088<br>≤ M24: Property class 70 acc. EN ISO 3506-1; A5 ≥ 8% ductile<br>> M24: Property class 50 acc. EN ISO 3506-1; A5 ≥ 8% ductile |
| Washer | EN ISO 7089 (DIN 125); EN ISO 7094 (DIN 440), EN ISO 7093 (9021)<br>Stainless steel: 1.4362; 1.4401; 1.4404; 1.4439; 1.4571; 1.4578 acc. EN 10088 |
| Hexagon nut | EN ISO 4032 (DIN 934)<br>≤ M24: Property class 70 acc. EN ISO 3506-2;<br>> M24: Property class 50 or 70 acc. EN ISO 3506-2;<br>Stainless steel: 1.4362; 1.4401; 1.4404; 1.4439; 1.4571; 1.4578 acc. EN 10088 |
| Stainless steel - High corrosion resistant steel | |
| Threaded rod | Stainless steel 1.4529, 1.4565 acc. EN 10088<br>≤ M24: $R_m$ = 700 N/mm²; $R_{p0,2}$ = 450N/mm²; A5 ≥ 8% ductile; EN ISO 3506-1<br>> M24: $R_m$ = 500 N/mm²; $R_{p0,2}$ = 210N/mm²; A5 ≥ 8% ductile; EN ISO 3506-1 |
| Washer | ISO 7089 (DIN 125), EN ISO 7094 (DIN 440), EN 7093 (DIN 9021)<br>Stainless steel: 1.4529, 1.4565 acc. EN 10088 |
| Hexagon nut | EN ISO 4032 (DIN 934)<br>Strength class 70 acc. EN ISO 3506-2<br>Stainless steel: 1.4529, 1.4565 acc. EN 10088 |

| Commercial threaded rods with: |
|---|
| Inspection certificate 3.1 according to EN 10204: 2004 |
| Marking of embedment depth (This may be done by the manufacturer of the rod or by the worker on jobsite) |

## Specifications of intended use

### Table B1: Overview use categories and performance categories

| **Use conditions** | | **Simpson Strong-Tie® AT-HP with …** | |
|---|---|---|---|
| | | **Threaded rods**  | |
| hammer drilling or compressed air drilling mode.  | | ✓ | |
| Static and quasi static loading, in non-cracked concrete | | M8 to M30<br>Table C1, C2, C3, C4, C5 | |
| Use category: dry or wet concrete | | ✓ | |
| Installation temperature | | Standard pack : mortar +5°C, concrete -5°C<br>Winter pack : mortar 0°C, concrete -15°C | |
| In-service temperature | Temperature range I: | -40°C to +40°C | (max long term temperature +24°C and max short term temperature +40°C) |
| | Temperature range II: | -40°C to +80°C | (max long term temperature +50°C and max short term temperature +80°C) |

**Base materials:**

- Reinforced or unreinforced normal weight concrete according to EN 206-1:2000-12.
- Strength classes C20/25 to C50/60 according to EN 206-1:2000-12.
- Maximum chloride concrete of 0,40% (CL 0.40) related to the cement content according to EN 206-1:2000-12.

**Use conditions (Environmental conditions):**

- Structures subject to dry internal conditions (zinc coated steel, stainless steel or high corrosion resistant steel).
- Structures subject to external atmospheric exposure including industrial and marine environment (stainless steel or high corrosion resistant steel).
- Structures subject to permanently damp internal condition, if no particular aggressive conditions exist (stainless steel or high corrosion resistant steel).
  *Note: Particular aggressive conditions are e.g. permanent, alternating immersion in seawater or the splash zone of seawater, chloride atmosphere of indoor swimming pools or atmosphere with extreme chemical pollution (e.g. in desulphurization plants or road tunnels where de-icing materials are used).*
- Overhead installations are permitted

**Design:**

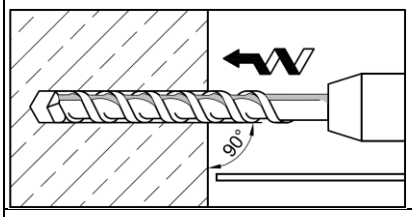
- Anchorages are designed under the responsibility of an engineer experienced in anchorages and concrete work.
- Verifiable calculation notes and drawings are prepared taking account of the forces to be transmitted. The position of the anchor is indicated on the design drawings (e. g. position of the anchor relative to reinforcement or to supports, etc.).
- Anchorages under static or quasi-static actions are designed in accordance with (please choose the relevant design method): EOTA Technical Report TR 029, Edition September 2010; CEN/TS 1992-4-5

## Table B2: Installation data for threaded rod

| **Simpson Strong-Tie ®** **AT-HP Injection Mortar** | | | **Threaded rod** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | **M8** | **M10** | **M12** | **M16** | **M20** | **M24** | **M27** | **M30** |
| Nom. threaded rod diameter | d | [mm] | 8 | 10 | 12 | 16 | 20 | 24 | 27 | 30 |
| Drill hole diameter | $d_o$ | [mm] | 10 | 12 | 14 | 18 | 22 | 28 | 30 | 35 |
| Embedment depth and drill hole depth | $h_{ef,\ min}$ | [mm] | 60 | 60 | 70 | 80 | 90 | 96 | 108 | 120 |
| | $h_{ef,\ max}$ | | 160 | 200 | 240 | 320 | 400 | 480 | 540 | 600 |
| Diameter of clearance hole in the fixture [1)] | $d_f \leq$ | [mm] | 9 | 12 | 14 | 18 | 22 | 26 | 30 | 33 |
| Installation torque | $T_{inst,max}$ | [Nm] | 10 | 20 | 40 | 80 | 150 | 200 | 270 | 300 |
| Minimum thickness of concrete member | $h_{min}$ | [mm] | $h_{ef}$ +30 mm ≥ 100 mm | | | $h_{ef} + 2d_0$ | | | | |
| Minimum allowable spacing | $s_{min}$ | [mm] | 40 | 50 | 60 | 80 | 100 | 120 | 135 | 150 |
| Minimum allowable edge distance | $c_{min}$ | [mm] | 40 | 50 | 60 | 80 | 100 | 120 | 135 | 150 |

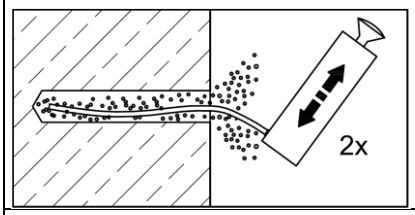
[1)] for larger clearance hole in the fixture see TR 029 section 1.1 and/or CEN/TS 1992-4-1:2009, section 1.2.3

## Installation instructions



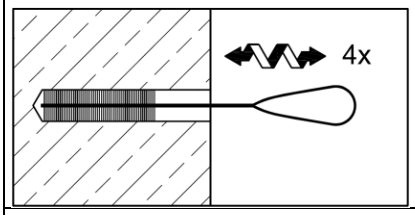

Drill hole to the required embedment depth ($h_{ef}$) with a hammer drill using specified carbide drill bit diameter ($d_0$).

**a.) Manual Cleaning**

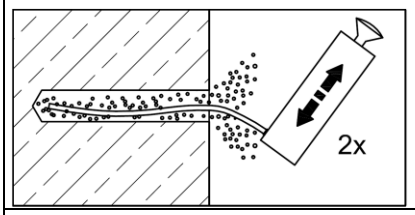



The manual pump can be used up to drill holes ≤ Ø22 mm and embedment depths up to $h_{ef}$ ≤ 10d.

Blow out dust from the hole 2 times with manual pump starting from the bottom of the hole.

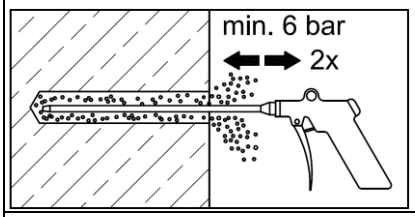



Brush 4 times with specified brush size (brush diameter ≥ drill hole diameter $d_0$) by inserting the brush to the bottom of the hole with a twisting motion and removing. The brush shall have a resistance as it enters the drilled hole. If this is not the case a new brush shall be used.



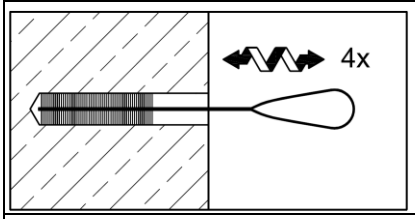

Finally blow out dust from hole 2 times with manual pump starting from the bottom of the hole until return air stream is free of noticeable dust.

**b.) Compressed air cleaning (CAC)** for drilled holes > Ø22 mm or $h_{ef}$ ≥10d

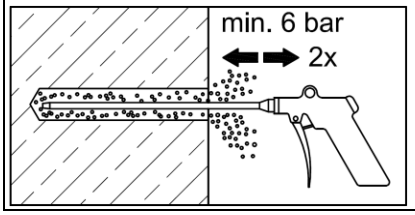



For larger drilled holes > Ø22 mm or $h_{ef}$ ≥10d, compressed air (min. 6 bar) shall be used.

Blow out dust from the hole 2 times with oil-free compressed air (min. 6 bar) starting from the bottom of the hole.



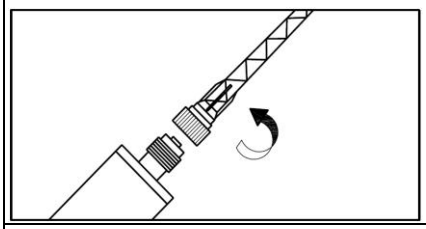

Brush 4 times with specified brush size (brush diameter ≥ drill hole diameter $d_0$) by inserting the brush to the bottom of the hole with a twisting motion and removing. The brush shall have a resistance as it enters the drilled hole. If this is not the case a new brush shall be used.




Finally blow out dust from the hole 2 times with oil-free compressed air (min. 6 bar) starting from the bottom of the hole until return air stream is free of noticeable dust. If required use additional accessories and extensions for air nozzle to reach the bottom of the hole.

| | |
|---|---|
| **Simpson Strong-Tie ®**<br>**AT-HP Injection Mortar** | **Annex B3** |
| **Installation instruction I** | |

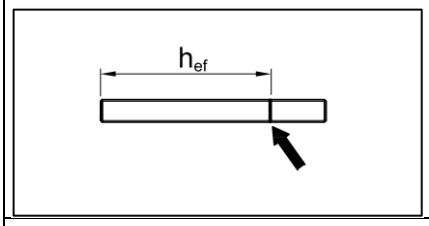
## Installation instructions



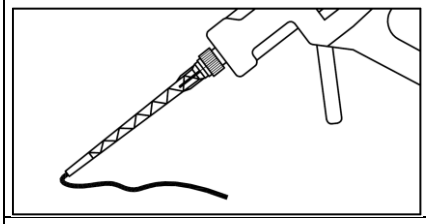
Check cartridge expiration date. Do not use expired products.

Attach the static-mixing nozzle supplied by the manufacturer to the cartridge.

Using foil pack cartridges: Cutting open the foil pack 

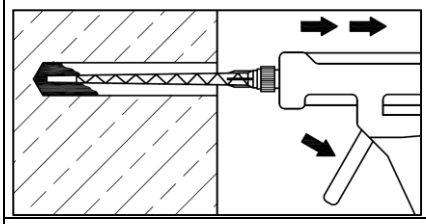



Before setting the threaded rod into the filled drill hole, mark the required embedment depth on the anchor rod.



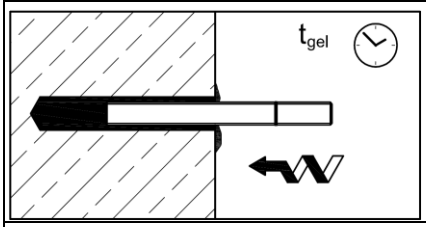
Dispense adhesive to the side until properly mixed (uniform color).

(3 pressures at least)



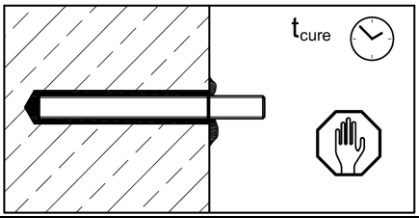
Fill up the hole approximately 2/3rd with mortar starting from the bottom of the cleaned drilled hole. Withdraw the nozzle slowly step by step after each trigger to avoid creating air pockets.

For drill holes deeper than 150 mm an extension tube shall be used.



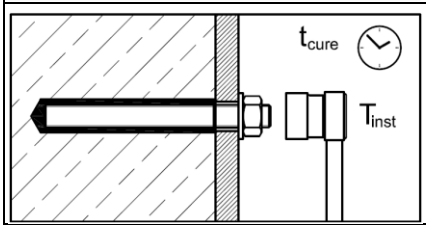

Insert a clean, oil free threaded rod, turning slowly until the stud contacts the bottom of the hole or until to the marking of $h_{ef}$. After installing the stud the annular gap must be completely filled with adhesive mortar.

Setting control: After the stud has been fully inserted until the marking of embedment depth, excess mortar flows out of the drilled hole.




Do not disturb the threaded rod until fully cured.

The curing time $t_{cure}$ is given in Table B3.




After required curing time, the anchor can be loaded. Apply the installation torque $T_{inst}$ using calibrated torque wrench.

| | |
|---|---|
| **Simpson Strong-Tie ®**<br>**AT-HP Injection Mortar** | **Annex B3** |
| **Installation instruction II** | |

## Table B3: Gel time $t_{gel}$ and minimum curing time $t_{cure}$

| Mortar temperature C° $T_{mortar}$ | Base material temperature C° $T_{base\ material}$ | Gel time (working time) in dry/wet concrete $t_{gel}$ | Curing time, in dry/wet concrete * $t_{cure}$ |
|---|---|---|---|
| Standard version | | | |
| +5°C | -5 °C to -1 °C | 15 min | 9 h |
| +5°C | 0 °C to 4 °C | 12 min | 4 h |
| +5°C | 5 °C to 9 °C | 9 min | 1,5 h |
| +10°C | 10 °C to 19 °C | 4 min | 60 min |
| +20°C | 20 °C to 29 °C | 1 min | 30 min |
| +30°C | 30 °C and above | < 1 min | 20 min |

Concerning the version of the mortar with changing color proof, after the minimum curing time the blue colored injection mortar changed into grey. The curing color proof is available for standard version of the mortar only, and the curing color proof is working above 5°C.

| Mortar temperature C° $T_{mortar}$ | Base material temperature C° $T_{base\ material}$ | Gel time (working time) in dry/wet concrete $t_{gel}$ | Curing time, in dry/wet concrete * $t_{cure}$ |
|---|---|---|---|
| Winter version | | | |
| 0°C | -15 °C to -11 °C | 30 min | 14 h |
| 0°C | -10 °C to -6 °C | 10 min | 8 h |
| 0°C | -5 °C to -1 °C | 7 min | 4 h |
| 0°C | 0 °C to 4 °C | 5 min | 2,5 h |
| +5°C | 5 °C to 9 °C | 3 min | 1,5 h |
| +10°C | 10 °C to 19 °C | 2 min 30” | 60 min |
| +20°C | 20 °C and above | < 2 min 30” | 50 min |

* Installation in water-filled holes is not allowed.

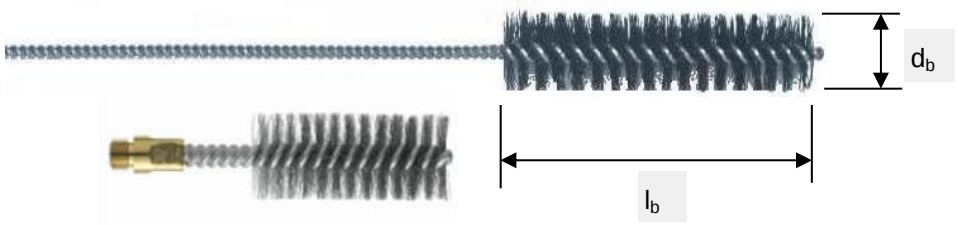
## Mortar cartridges, Dispensing tools

| Name | Cartridge | Dispensing tool |
|---|---|---|
| Coaxial cartridge: 160/280ml |  |  DT300 |
| Foil pack cartridge: 170/300ml |  | |
| Side by Side cartridge: 345ml |  |  DT345 |
| Coaxial cartridge: 380ml |  |  DT380 |
| Side by Side cartridge: 825ml |  |  DT825 |

## Table B4: Cleaning equipment

| **Simpson Strong-Tie ®**<br>**AT-HP Injection Mortar** | | | **Threaded rod** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | **M8** | **M10** | **M12** | **M16** | **M20** | **M24** | **M27** | **M30** |
| **Drill bit** | Diameter $d_0$ | [mm] | 10 | 12 | 14 | 18 | 22 | 28 | 30 | 35 |
| **Cleaning brush -Nylon-** | Diameter $d_b$ | [mm] | 12 | 17 | 17 | 30 | 30 | - | | |
| | Length $l_b$ | [mm] | 85 | 80 | | | | - | | |
| **Cleaning brush -Steel-** | Diameter $d_b$ | [mm] | 11 | 13 | 15 | 20 | 24 | 30 | 32 | 37 |
| | Length $l_b$ | [mm] | 80 | | | | | 100 | | |

### Cleaning brush

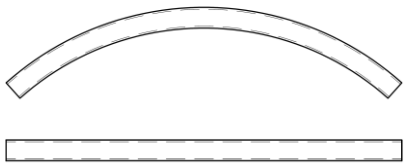



### Compressed air cleaning tool

Air pressure : min. 6 bar (≥120 l/min)

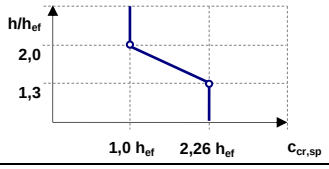
### Manual pump (Volume min. 750ml)

### Extension tubes for mixing nozzle MN1:
**Flexible plastic hose: ø8,0 - ø8,5 mm**
**Rigid plastic tube: MNE**



## Table C1: Characteristic values of resistance to tension loads. Design method TR 029

| **Simpson Strong-Tie ®** **AT-HP Injection Mortar** | | | **Threaded rod** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | **M8** | **M10** | **M12** | **M16** | **M20** | **M24** | **M27** | **M30** |
| **Steel failure** | | | | | | | | | | |
| Characteristic resistance, Steel grade 5.8 | $N_{Rk,s}$ | [kN] | 18.3 | 29 | 42.2 | 78.5 | 122.5 | 176.5 | 229.5 | 280.5 |
| Characteristic resistance; Steel grade 8.8 | $N_{Rk,s}$ | [kN] | 29.3 | 46.4 | 67.4 | 125.6 | 196 | 282.4 | 367.2 | 448.8 |
| Partial safety factor | $\gamma_{Ms}$ 1) | [ - ] | 1.5 | | | | | | | |
| Characteristic resistance; Steel grade 10.9 | $N_{Rk,s}$ | [kN] | 36.6 | 58 | 84.3 | 157 | 245 | 353 | 459 | 561 |
| Partial safety factor | $\gamma_{Ms}$ 1) | [ - ] | 1.4 | | | | | | | |
| | | | | | | | | | | |
| Characteristic resistance, Stainless steel A4 and HCR, property class 50 (>M24) and 70 (≤M24) | $N_{Rk,s}$ | [kN] | 25.6 | 40.6 | 59 | 109.9 | 171.5 | 247.1 | 229.5 | 280.5 |
| Partial safety factor | $\gamma_{Ms}$ 1) | [ - ] | 1.87 | | | | | | 2.86 | |
| **Combined pull-out and concrete cone failure** | | | | | | | | | | |
| Nom. threaded rod diameter | d | [mm] | 8 | 10 | 12 | 16 | 20 | 24 | 27 | 30 |
| Characteristic bond resistance in **non-cracked** concrete C20/25 | | | | | | | | | | |
| Temperature range I: 40°C / 24°C 2) | $\tau_{Rk,ucr}$ | [N/mm²] | 9.0 | 8.5 | 8.5 | 8.0 | 7.5 | 6.5 | 6.5 | 6.0 |
| Temperature range II: 80°C / 50°C 2) | $\tau_{Rk,ucr}$ | [N/mm²] | 7.0 | 6.5 | 6.5 | 6.0 | 5.5 | 5.0 | 5.0 | 4.5 |
| Increasing factor for $\tau_{Rk}$ in non-cracked concrete | $\Psi_c$ | C25/30 | 1.06 | | | | | | | |
| | | C30/37 | 1.12 | | | | | | | |
| | | C35/45 | 1.19 | | | | | | | |
| | | C40/50 | 1.23 | | | | | | | |
| | | C45/55 | 1.27 | | | | | | | |
| | | C50/60 | 1.30 | | | | | | | |
| Partial safety factor | $\gamma_{Mp} = \gamma_{Mc}$ 1) | [ - ] | 2.1 3) | | | | | 1.8 4) | | |
| **Splitting failure** | | | | | | | | | | |
| Edge distance $c_{cr,sp}$ [mm] | $h/h_{ef} \geq 2.0$ | | 1.0 $h_{ef}$ | | | | | | | |
| | $2.0 > h/h_{ef} > 1.3$ | | 4.6 $h_{ef}$ - 1.8 h | | | | | | | |
| | $h/h_{ef} \leq 1.3$ | | 2.26 $h_{ef}$ | | | | | | | |
| Center spacing (splitting) | $s_{cr,sp}$ | [mm] | 2 x $c_{cr,sp}$ | | | | | | | |
| Partial safety factor | $\gamma_{Msp}$ 1) | [ - ] | 2.1 3) | | | | | 1.8 4) | | |




1) In absence of other national regulations
2) Maximum short and long term temperatures
3) The partial safety factor $\gamma_2$ =1,4 is included
4) The partial safety factor $\gamma_2$ =1,2 is included

## Table C2: Characteristic values of resistance to shear loads. Design method TR 029

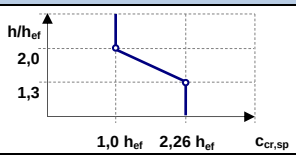
| **Simpson Strong-Tie ®** **AT-HP Injection Mortar** | | | **Threaded rod** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | **M8** | **M10** | **M12** | **M16** | **M20** | **M24** | **M27** | **M30** |
| **Steel failure without lever arm** | | | | | | | | | | |
| Characteristic resistance, Steel grade 5.8 | $V_{Rk,s}$ | [kN] | 9.2 | 14.5 | 21.1 | 39.3 | 61.3 | 88.3 | 114.8 | 140.3 |
| Characteristic resistance; Steel grade 8.8 | $V_{Rk,s}$ | [kN] | 14.7 | 23.2 | 33.7 | 62.8 | 98 | 141.2 | 183.6 | 224.4 |
| Partial safety factor | $\gamma_{Ms}$ [1)] | [ - ] | 1.25 | | | | | | | |
| Characteristic resistance; Steel grade 10.9 | $V_{Rk,s}$ | [kN] | 18.3 | 29 | 42.2 | 78.5 | 122.5 | 176.5 | 229.5 | 280.5 |
| Partial safety factor | $\gamma_{Ms}$ [1)] | [ - ] | 1.5 | | | | | | | |
| | | | | | | | | | | |
| Characteristic resistance, Stainless steel A4 and HCR, property class 50 (>M24) and 70 (≤M24) | $V_{Rk,s}$ | [kN] | 12.8 | 20.3 | 29.5 | 55.0 | 85.8 | 123.6 | 114.8 | 140.3 |
| Partial safety factor | $\gamma_{Ms}$ [1)] | [ - ] | 1.56 | | | | | | 2.38 | |
| **Steel failure with lever arm** | | | | | | | | | | |
| Characteristic resistance, Steel grade 5.8 | $M^0_{Rk,s}$ | [Nm] | 18.7 | 37.4 | 65.5 | 166.5 | 324.5 | 561.3 | 832.2 | 1125 |
| Characteristic resistance; Steel grade 8.8 | $M^0_{Rk,s}$ | [Nm] | 30.0 | 59.8 | 104.8 | 266.4 | 519.3 | 898.0 | 1332 | 1799 |
| Partial safety factor | $\gamma_{Ms}$ [1)] | [ - ] | 1.25 | | | | | | | |
| Characteristic resistance; Steel grade 10.9 | $M^0_{Rk,s}$ | [Nm] | 37.5 | 74.8 | 131.0 | 333.0 | 649.1 | 1123 | 1664 | 2249 |
| Partial safety factor | $\gamma_{Ms}$ [1)] | [ - ] | 1.5 | | | | | | | |
| | | | | | | | | | | |
| Characteristic resistance, Stainless steel A4 and HCR, property class 50 (>M24) and 70 (≤M24) | $M^0_{Rk,s}$ | [Nm] | 26.2 | 52.3 | 91.7 | 233.1 | 454.4 | 785.8 | 832.2 | 1125 |
| Partial safety factor | $\gamma_{Ms}$ [1)] | [ - ] | 1.56 | | | | | | 2.38 | |
| **Concrete pry-out failure** | | | | | | | | | | |
| Factor in equation (5.7) acc. 5.2.3.3 of TR 029 for Design of Bonded Anchors | k | [ - ] | 2.0 | | | | | | | |
| Partial safety factor | $\gamma_{Mp} = \gamma_{Mc}$ [1)] | [ - ] | 2.1 [2)] | | | | | 1.8 [3)] | | |
| **Concrete edge failure** | | | | | | | | | | |
| See section 5.2.3.4 of the Technical Report TR 029 for the Design of Bonded Anchors | | | | | | | | | | |
| Partial safety factor | $\gamma_{Msp}$ [1)] | [ - ] | 2.1 [2)] | | | | | 1.8 [3)] | | |

1) In absence of other national regulations

2) The partial safety factor $\gamma_2$ =1,4 is included

3) The partial safety factor $\gamma_2$ =1,2 is included

## Table C3: Characteristic values of resistance to tension loads. Design acc. CEN/TS 1992-4-5

| **Simpson Strong-Tie ®** **AT-HP Injection Mortar** | | | **Threaded rod** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | **M8** | **M10** | **M12** | **M16** | **M20** | **M24** | **M27** | **M30** |
| **Steel failure** | | | | | | | | | | |
| Characteristic resistance, Steel grade 5.8 | $N_{Rk,s}$ | [kN] | 18.3 | 29 | 42.2 | 78.5 | 122.5 | 176.5 | 229.5 | 280.5 |
| Characteristic resistance; Steel grade 8.8 | $N_{Rk,s}$ | [kN] | 29.3 | 46.4 | 67.4 | 125.6 | 196 | 282.4 | 367.2 | 448.8 |
| Partial safety factor | $\gamma_{Ms}$ 1) | [ - ] | 1.5 | | | | | | | |
| Characteristic resistance; Steel grade 10.9 | $N_{Rk,s}$ | [kN] | 36.6 | 58 | 84.3 | 157 | 245 | 353 | 459 | 561 |
| Partial safety factor | $\gamma_{Ms}$ 1) | [ - ] | 1.4 | | | | | | | |
| Characteristic resistance, Stainless steel A4 and HCR, property class 50 (>M24) and 70 (≤M24) | $N_{Rk,s}$ | [kN] | 25.6 | 40.6 | 59 | 109.9 | 171.5 | 247.1 | 229.5 | 280.5 |
| Partial safety factor | $\gamma_{Ms}$ 1) | [ - ] | 1.87 | | | | | | 2.86 | |
| **Combined pull-out and concrete cone failure** | | | | | | | | | | |
| Nom. threaded rod diameter | d | [mm] | 8 | 10 | 12 | 16 | 20 | 24 | 27 | 30 |
| Characteristic bond resistance in **non-cracked** concrete C20/25 | | | | | | | | | | |
| Temperature range I: 40°C/24°C 2) | $\tau_{Rk,ucr}$ | [N/mm²] | 9.0 | 8.5 | 8.5 | 8.0 | 7.5 | 6.5 | 6.5 | 6.0 |
| Temperature range II: 80°C/50°C 2) | $\tau_{Rk,ucr}$ | [N/mm²] | 7.0 | 6.5 | 6.5 | 6.0 | 5.5 | 5.0 | 5.0 | 4.5 |
| Increasing factor for $\tau_{Rk}$ in non-cracked concrete | $\Psi_c$ | C25/30 | 1.06 | | | | | | | |
| | | C30/37 | 1.12 | | | | | | | |
| | | C35/45 | 1.19 | | | | | | | |
| | | C40/50 | 1.23 | | | | | | | |
| | | C45/55 | 1.27 | | | | | | | |
| | | C50/60 | 1.30 | | | | | | | |
| Partial safety factor | $\gamma_{Mp} = \gamma_{Mc}$ 1) | [ - ] | 2.1 3) | | | | | 1.8 4) | | |
| Factor acc. CEN/TS 1992-4-5, § 6.2.2.3 | $k_{ucr}$ | [ - ] | 10.1 | | | | | | | |
| **Concrete cone failure** | | | | | | | | | | |
| Factor acc. CEN/TS 1992-4-5, § 6.2.3.1 | $k_{ucr}$ | [ - ] | 10.1 | | | | | | | |
| Edge distance | $c_{cr,N}$ | [ - ] | 1.5 $h_{ef}$ | | | | | | | |
| Spacing | $S_{cr,N}$ | [ - ] | 3 $h_{ef}$ | | | | | | | |
| **Splitting failure** | | | | | | | | | | |
| Edge distance $c_{cr,sp}$ [mm] | $h/h_{ef} \geq 2.0$ | 1.0 $h_{ef}$ |   | | | | | | | |
| | $2.0 > h/h_{ef} > 1.3$ | 4.6 $h_{ef}$ - 1.8 h | | | | | | | | |
| | $h/h_{ef} \leq 1.3$ | 2.26 $h_{ef}$ | | | | | | | | |
| Center spacing (splitting) | $s_{cr,sp}$ | [mm] | 2 x $c_{cr,sp}$ | | | | | | | |
| Partial safety factor | $\gamma_{Msp}$ 1) | [ - ] | 2.1 3) | | | | | 1.8 4) | | |

1) In absence of other national regulations;
2) Maximum short and long term temperatures;
3) The partial safety factor $\gamma_2$ =1,4 is included
4) The partial safety factor $\gamma_2$ =1,2 is included

## Table C4: Characteristic values of resistance to shear loads.
## Design acc. CEN/TS 1992-4-5

| **Simpson Strong-Tie ®** **AT-HP Injection Mortar** | | | **Threaded rod** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | **M8** | **M10** | **M12** | **M16** | **M20** | **M24** | **M27** | **M30** |
| **Steel failure without lever arm** | | | | | | | | | | |
| Characteristic resistance, Steel grade 5.8 | $V_{Rk,s}$ | [kN] | 9.2 | 14.5 | 21.1 | 39.3 | 61.3 | 88.3 | 114.8 | 140.3 |
| Characteristic resistance; Steel grade 8.8 | $V_{Rk,s}$ | [kN] | 14.7 | 23.2 | 33.7 | 62.8 | 98 | 141.2 | 183.6 | 224.4 |
| Partial safety factor | $\gamma_{Ms}$ [1)] | [ - ] | 1.25 | | | | | | | |
| Characteristic resistance; Steel grade 10.9 | $V_{Rk,s}$ | [kN] | 18.3 | 29 | 42.2 | 78.5 | 122.5 | 176.5 | 229.5 | 280.5 |
| Partial safety factor | $\gamma_{Ms}$ [1)] | [ - ] | 1.5 | | | | | | | |
| Ductility factor acc. CEN/TS 1992-4-5, § 6.3.2.1 | $k_2$ | [ - ] | 0.8 | | | | | | | |
| | | | | | | | | | | |
| Characteristic resistance, Stainless steel A4 and HCR, property class 50 (>M24) and 70 (≤M24) | $V_{Rk,s}$ | [kN] | 12.8 | 20.3 | 29.5 | 55.0 | 85.8 | 123.6 | 114.8 | 140.3 |
| Partial safety factor | $\gamma_{Ms}$ [1)] | [ - ] | 1.56 | | | | | | 2.38 | |
| **Steel failure with lever arm** | | | | | | | | | | |
| Characteristic resistance, Steel grade 5.8 | $M^0_{Rk,s}$ | [Nm] | 18.7 | 37.4 | 65.5 | 166.5 | 324.5 | 561.3 | 832.2 | 1125 |
| Characteristic resistance; Steel grade 8.8 | $M^0_{Rk,s}$ | [Nm] | 30.0 | 59.8 | 104.8 | 266.4 | 519.3 | 898.0 | 1332 | 1799 |
| Partial safety factor | $\gamma_{Ms}$ [1)] | [ - ] | 1.25 | | | | | | | |
| Characteristic resistance; Steel grade 10.9 | $M^0_{Rk,s}$ | [Nm] | 37.5 | 74.8 | 131.0 | 333.0 | 649.1 | 1123 | 1664 | 2249 |
| Partial safety factor | $\gamma_{Ms}$ [1)] | [ - ] | 1.5 | | | | | | | |
| | | | | | | | | | | |
| Characteristic resistance, Stainless steel A4 and HCR, property class 50 (>M24) and 70 (≤M24) | $M^0_{Rk,s}$ | [Nm] | 26.2 | 52.3 | 91.7 | 233.1 | 454.4 | 785.8 | 832.2 | 1125 |
| Partial safety factor | $\gamma_{Ms}$ [1)] | [ - ] | 1.56 | | | | | | 2.38 | |
| **Concrete pry-out failure** | | | | | | | | | | |
| Factor in equation (27) of CEN/TS 1992-4-5, § 6.3.3 | $k_3$ | [ - ] | 2.0 | | | | | | | |
| Partial safety factor | $\gamma_{Mc}$ [1)] | [ - ] | 2.1 [2)] | | | | | 1.8 [3)] | | |
| **Concrete edge failure** | | | | | | | | | | |
| Concrete Edge failure, see CEN/TS 1992-4-5, § 6.3.4 | | | | | | | | | | |
| Partial safety factor | $\gamma_{Mc}$ [1)] | [ - ] | 2.1 [2)] | | | | | 1.8 [3)] | | |

1) In absence of other national regulations

2) The partial safety factor $\gamma_2$ =1,4 is included

3) The partial safety factor $\gamma_2$ =1,2 is included

## Table C5: Displacement under tension loads

| **Simpson Strong-Tie ®** **AT-HP with threaded rods** | | | **Threaded rod** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | **M8** | **M10** | **M12** | **M16** | **M20** | **M24** | **M27** | **M30** |
| **Non-cracked concrete** | | | | | | | | | | |
| **Temperature range I: 40°C / 24°C [2)]** | | | | | | | | | | |
| Displacement [1)] | $\delta_{N0}$ | [mm/(N/mm²)] | 0.02 | 0.03 | 0.03 | 0.03 | 0.03 | 0.04 | 0.04 | 0.05 |
| | $\delta_{N\infty}$ | [mm/(N/mm²)] | 0.04 | 0.04 | 0.05 | 0.05 | 0.06 | 0.07 | 0.07 | 0.08 |
| **Temperature range II: 80°C / 50°C [2)]** | | | | | | | | | | |
| Displacement [1)] | $\delta_{N0}$ | [mm/(N/mm²)] | 0.10 | 0.11 | 0.12 | 0.13 | 0.15 | 0.17 | 0.18 | 0.19 |
| | $\delta_{N\infty}$ | [mm/(N/mm²)] | 0.16 | 0.18 | 0.19 | 0.22 | 0.25 | 0.27 | 0.29 | 0.32 |

1) Calculation of the displacement for design load:
Displacement for short term load = $\delta_{N0} \cdot [\tau_{Sd} / 1,4]$
Displacement for long term load = $\delta_{N\infty} \cdot [\tau_{Sd} / 1,4]$ ($\tau_{Sd}$ = design bond strength)

2) Maximum short and long term temperatures

## Table C6: Displacement under shear loads

| **Simpson Strong-Tie ®** **AT-HP with threaded rods** | | | **Threaded rod** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | **M8** | **M10** | **M12** | **M16** | **M20** | **M24** | **M27** | **M30** |
| Admissible service load : V | | [kN] | 5.9 | 9.3 | 13.5 | 25.2 | 39.3 | 50.4 | 65.6 | 80.2 |
| Displacement [3)] | $\delta_{V0}$ | [mm/kN] | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| | $\delta_{V\infty}$ | [mm/kN] | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |

3) Calculation of the displacement for design load:
Displacement for short term load = $\delta_{V0} \cdot [V_d / 1,4]$
Displacement for long term load = $\delta_{V\infty} \cdot [V_d / 1,4]$

| **Simpson Strong-Tie ®** **AT-HP Injection Mortar** | **Annex C5** |
|---|---|
| **Displacements - Threaded rods** | |