In technical application document

Technical Application Document

Technical Evaluation Report 3/10-649

Injection system for rebar connections

Hilti HIT-RE 500-SD

Subject to European Technical Approval

ATE-09/0295

<table>
<thead>
<tr>
<th>Holder of approval:</th>
<th>HILTI France SA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 rue Jean Mermoz</td>
</tr>
<tr>
<td></td>
<td>Rond-Point Mérantais</td>
</tr>
<tr>
<td></td>
<td>F-78778 Magny-les-Hameaux Cedex</td>
</tr>
<tr>
<td></td>
<td>Tel. : 0825 01 05 05</td>
</tr>
<tr>
<td></td>
<td>Fax: 0825 02 55 55</td>
</tr>
<tr>
<td></td>
<td>Internet: <a href="http://www.hilti.fr">www.hilti.fr</a></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Manufacturer:</th>
<th>Hilti AG</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Business Unit Anchors</td>
</tr>
<tr>
<td></td>
<td>9494 Schaan</td>
</tr>
<tr>
<td></td>
<td>Principality of Liechtenstein</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Company:</th>
<th>Hilti Entwicklungsgesellschaft mbH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hiltistrasse 6</td>
</tr>
<tr>
<td></td>
<td>D86916 KAUFERING</td>
</tr>
<tr>
<td></td>
<td>GERMANY</td>
</tr>
</tbody>
</table>

Technical evaluation commission (decree of December 2, 1969)

Technical department no. 3

Concrete and fastenings

Structures, floors and other structural parts

Reviewed on June 17, 2010
The Technical Department no. 3 of the Technical Evaluation Commission examined on April 13, 2010 the injection system for rebar connection HIT-RE 500-SD presented by the company Hilti. This document, together with the attached Technical Documentation prepared by the applicant, represents the evaluation issued by the Technical Department, which summarises the complementary information for the user of the system, such as intended use as well as planning and installation instructions that are needed to ensure normal behaviour of the structures concerned. This report has been prepared for use in the European territory of France.

1. Brief definition

1.1 Brief description

The subject of this approval is the setting, by anchoring or overlap connection joint, of reinforcing bars (rebars) in existing structures made of normal weight concrete, using the Hilti injection system HIT-RE 500-SD in accordance with the regulations for concrete structures.

1.2 Placing on the market

With regard to being placed on the market, the products that are the subject of this evaluation are subject to the regulations of the ordinance of December 24, 2004 on the application of specific anchor bars of decree no. 92-647 of July 8, 1992 relating to the fitness for use of construction materials, as amended by the decrees no. 95-1051 of September 20, 1995 and no. 2003-947 of October 3, 2003.

1.3 Identification of the components

The injection system Hilti HIT-RE 500-SD is delivered in 330 ml, 550 ml or 1400 ml cartridges. The product marking is in accordance with the specifications provided in European Technical Approval ETA-09/0295.

The products carry CE marking which contains all information specified in the European Technical Approval ETA-09/0295.

2. ATTESTATION

2.1 Approved field of application

The product may be used only for the execution of new works or major repair works of classes A, B or C according to the PS92 rules, or of classes I, II, III according to Eurocode 8, for all seismic zones.

2.2 Assessment of the system

2.21 Compliance with all applicable laws and regulations and other requirements relating to fitness for use

Use in seismic zones

The system may be used for the execution of principal structural elements of buildings subject to the provisions of § 2.3 of this document and using the design method described in the technical documentation.

Fire protection

The system as such is not required to meet a fire protection criterion. It is however possible to provide fire resistance by integrating an additional means of fire protection.

Thermal insulation

The HIT-RE 500-SD injection system has no effect on the thermal performance of an existing conventional system using in-situ cast reinforcements.

Acoustic insulation

The HIT-RE 500-SD injection system has no effect on the noise control rates of an existing conventional system using in-situ cast reinforcements.

2.22 Durability / maintenance

The durability of the injection system HIT-RE 500-SD is equivalent to that of conventional systems used under comparable conditions.

2.23 Manufacturing

The manufacturer, the company Hilti, shall implement a permanent factory production control schedule to supervise the production of the sealing resins. The manufacturer shall ensure the continued validity of the CE certificate of conformity by facilitating the application of an in-house quality control system.

2.24 Installation

The system shall be installed by a skilled worker who is under on-site supervision.

2.3 Particular technical specifications

2.31 Design conditions for use outside of seismic zones

In order to be used outside seismic zone, the injection system for post-installed rebars HIT-RE 500-SD shall be designed to meet the requirements described in European Technical Approval ATE-09/0295; in particular the issues described in section 4.1 of the technical documentation shall be checked.

2.32 Planning conditions for use in seismic zones

When planning the structural works the design office shall review the specific properties of the system and calculate the reinforcements with a view to ensuring the transfer of loads within the structure. The reinforcements for reinforced concrete shall have a specific elasticity limit which is lower than or equal to 500 MPa. To ensure that the reinforcements have a specific elasticity limit below 500 MPa, the calculation of $l_{b,\text{seism}}$ as defined in the technical documentation shall be made using $f_{\text{c}}=500\text{MPa}$ in order to ensure that the anchoring length of the reinforcement is not reduced.

The resistance of the concrete structure in a seismic zone shall be C20/25 minimum and C45/55 maximum.

In the critical zones of primary structural parts of DCH classified structures the reinforcement bars must be class C according to Table C1 of EN 1992-1-1. Anchoring in existing structures that are subject to large-scale repair work shall be limited to the newly built parts. The combination of cast-in re bars and post-installed re bars is not admissible as it might lead to displacement compatibility problems. The shear forces shall be taken up by steel tie bars cast on site; the system that is the subject of this document may only be used for absorbing tensile or compression forces.

When the normal force in a column is a tensile force, the anchor lengths must be increased by 50 % with reference to the lengths specified in EN 1992-1-1 for the part that is situated in the critical zone. Whenever possible, overlaps in the critical zone shall be avoided. In the overlap zones the transversal reinforcements shall comply with the tie bar measure resulting from the transmission of forces between the longitudinal bars.

The design load in the reinforcement bar $\sigma_{\text{sd,seism}}$ shall be calculated under combined seismic assumptions, with particular attention to compliance with § 4.4 - Verification of safety of EN 1998-1-1 (Eurocode 8).

2.33 Conditions of installation

The installation of the injection system for post-installed re bars HIT-RE 500-SD shall be in accordance with the specifications provided in European Technical Approval ETA-09/0295.

This report has been translated from French to English by Hilti Corporation in Schaan, Liechtenstein.
The holder of this attestation shall offer a training programme on how to use the injection system, in particular to the companies which install the system (distribution of approvals, observance of the enclosed provisions, ...).

Conclusions

Global assessment
The examination of the use of the system in the proposed field of application has produced a favourable assessment.

Validity
Same as European Technical Approval ETA-09/0295, i.e. until May 8 2013.

For the Technical Department no. 3
The President
JP. BRIN

Complementary remarks of the Technical Department

The design anchoring length is the result of both structural and seismic engineering calculations. Moreover, the design load in the reinforcement bar shall be calculated under combined seismic assumptions; it cannot simply be deduced from static design.

Despite the fact that structures can be designed in accordance with Eurocode 8, only the PS 92 rules are applicable as of today. In both cases, the design method, based on tests, can be used.

Bore holes are made with hammer drilling or compressed air drilling, and holes are cleaned with compressed air using the equipment listed in ETA-09/0295.

The structure in which the rebar is set shall be designed for seismic action and the reinforcement shall be designed to pick up the forces that are generated by the subsequently post-installed rebars.

The concrete connections shall be executed by roughening the joints until the aggregates protrude.

The Examiner of Technical Department No. 3
Nicolas RUAUX
A. Description

1. Description

The system Hilti HIT-RE 500-SD is used for the connection, by anchoring or overlap connection joint, of reinforcing bars (rebars) in new structures made with concrete of strength classes C20/25 through C45/50 (in a seismic zone). The design for these post-installed rebars is performed in accordance with ETA-09/0295 and EN 1992-1-1: October, 2005 (Eurocode 2).

2. Primary materials and elements

2.1 Resin HIT-RE 500-SD

The injection system HIT-RE 500-SD is based on a two-component resin. These two components are kept separate in dual-component cartridges of 330 ml, 500 ml or 1400 ml in accordance with Annex 1 of ETA-09/0295.

2.2 Reinforcement bars

The injection system HIT-RE 500-SD is used with straight reinforcement bars with diameters ranging from 8 to 40 mm and properties complying with Annex C of EN 1992-1-1 and EN 10080. The characteristics are described in Annex 4 of ETA-09/0295.

3. Manufacturing and control

3.1 Production process

The resin HIT-RE 500-SD is manufactured in the Hilti plant of Kaufering with the aid of an automated production line. The plant has been certified acc. to ISO 9001 and ISO 14001 by the Swiss Association for Quality Management Systems.

3.2 Marking

The resin HIT-RE 500-SD is identified by a marking affixed to its packaging. The marking indicates the name of the product, the production date and time, the expiry date, the number of the European Technical Approval and the number of the CE marking.

All cartridges containing HIT-RE 500-SD resin are individually packed in plastic bags containing both the mixing nozzle and the setting instructions.

3.3 Controls

The manufacturing of the resin HIT-RE 500-SD builds on an internal production control system. All requirements and provisions applicable to the production process are systematically adopted in operating procedures and written rules. The manufacturing plant is audited by an independent body once a year within the framework of the follow-up audits for the CE marking.

4. Design

4.1 Design outside of seismic zones

For utilisation outside of seismic zones, the injection system for the post-installed rebars HIT-RE 500-SD shall be designed to meet the provisions of European Technical Approval ATE-09/0295 verifying in particular:

- The verification of the local transfer of loads in the concrete shall be performed.
- The verification of the transfer of anchored loads in the structure shall be performed.
- The spacing between the post-installed rebars shall be greater than the maximum of 5d, and 50mm acc. to European Technical Approval ETA-09/0295.

4.2 Design in a seismic zone

For utilisation in seismic zones, the injection system for the anchoring of reinforcement bars HIT-RE 500-SD shall be designed by verifying in particular:

- Use of the system is limited to new constructions or structures undergoing major repair work
- The structure in which the rebar is set shall be designed for seismic action and the reinforcement shall be designed to pick up the forces that are generated by the subsequently post-installed rebars.
- The design study shall be performed at the same time as the reinforcement of the initial structure is tested.
- The study shall allow for tie bars to pick up the shear forces.
The verification of the transfer of anchored loads in the structure shall be performed.

The distance between the reinforcement bars shall be greater than the maximum of 5d, and 50mm acc. to European Technical Approval ETA-09/0295.

The basic anchorage length \( l_b, \text{rd,seism} \) required for transferring force \( A_{\text{fbd, seism}} \) in the reinforcement bar where a hypothetical constant load equal to \( f_{\text{t,seism}} \) over the length of the bar is equal to:

\[
l_b, \text{rd,seism} = \frac{d_b}{4} \cdot (\tau_{\text{tot,seism}}/f_{\text{t,seism}})
\]

where:
- \( d_b \) = diameter of the rebar
- \( \sigma_{\text{rd,seism}} \) = design stress in the reinforcement bar calculated acc. to § 4.4 - Verification of safety of EN 1998-1-1 (Eurocode 8)
- \( f_{\text{t,seism}} \) = design bond strength in seismic zones as listed in table 2 of this DTA

The design anchorage length \( l_b, \text{rd,seism} \) shall be determined using the following formula:

\[
l_b, \text{rd,seism} = a_1 \cdot a_2 \cdot a_3 \cdot a_4 \cdot a_5 \cdot l_b, \text{rd,seism} \geq l_b, \text{min,seism}
\]

where:
- \( a_1 = 1.0 \) for straight bars
- \( a_2 = \) between 0.7 and 1.0 as calculated acc. to EN 1992-1-1. Table 8.2.
- \( a_3 = 1.0 \) even in the presence of transverse reinforcement
- \( a_4 = 1.0 \) in the absence of welded transverse reinforcement
- \( a_5 = \) between 0.7 and 1.0 for influence of transverse pressure acc. to EN 1992-1-1. Table 8.2.

The product verifies \((a_2 \cdot a_3 \cdot a_5) \geq 0.7\)

\[
l_b, \text{min,seism} = \text{minimum anchorage length}
\]

\[
l_b, \text{min,seism} = \text{Max} \left( 0.6 \cdot l_b, \text{rd,seism}; 10 \cdot d_b; 100 \text{mm} \right)
\]

under tension

\[
l_b, \text{min,seism} = \text{Max} \left( 0.6 \cdot l_b, \text{rd,seism}; 10 \cdot d_b; 100 \text{mm} \right)
\]

under compression

The permissible maximum anchorage depth is specified in European Technical Approval ETA 09/0295.

The design lap length \( l_{bd} \) shall be determined acc. to EN 1992-1-1, section 8.7.3:

\[
l_{bd}, \text{seism} = a_1 \cdot a_2 \cdot a_3 \cdot a_4 \cdot a_5 \cdot l_{bd, \text{seism}} \geq l_{bd, \text{min,seism}}
\]

where:
- \( a_1 = 1.0 \) for straight bars
- \( a_2 = \) between 0.7 and 1.0 as calculated acc. to EN 1992-1-1. Table 8.2.
- \( a_3 = 1.0 \) even in the presence of transverse reinforcement
- \( a_5 = \) between 0.7 and 1.0 for influence of transverse pressure compression acc. to EN 1992-1-1. Table 8.2.
- \( a_6 = \) between 1.0 and 1.5 for influence of percentage of lapped length relative to total cross-section area according to EN 1992-1-1 Table 8.3.

\[
l_{bd, \text{min,seism}} = \text{minimum lap length}
\]

\[
l_{bd, \text{min,seism}} = \text{Max} \left( 0.3 \cdot d_b; l_{bd, \text{seism}}; 15 \phi; 200 \text{mm} \right)
\]

The permissible maximum anchorage depth is specified in European Technical Approval ETA-09/0295.

When the normal force in a column is a tensile force, the anchorage length shall be increased by 50% with reference to the lengths specified in EN 1992-1-1 for the part that is situated in the critical zone.

A table with pre-calculated values is provided in Table 3 of this DTA.

5. Installation

5.1 Construction site phases

The decision to design for seismic zone is taken by the site supervisor, who commissions the design office.

The design office calculates the stresses acting on the bars (taking account of the acceleration applicable to the respective zone) and determines the anchorage length of the post-installed rebars using the formulas quoted in this DTA. The office is free to contact the company Hilti for dimensioning support.

The design office checks the structure for its aptitude to pick up the loads and the tie bars for proper design engineering.

The inspection body validates the study prior to the setting of the anchors.

5.2 Setting procedure

The installation of the injection system for rebar connection HIT-RE 500-SD shall be performed according to the setting instructions provided by the manufacturer and the annexes 10 to 19 of ETA 09/0295.

Bore holes are made with hammer drilling or compressed air drilling, and holes are cleaned with compressed air using the equipment listed in ETA-09/0295.

5.3 Operating procedure

The installation of the reinforcement bars shall be performed by a skilled worker who is subject to on-site supervision.

Hilti may provide training for workers via Hilti representatives or key project managers having the required expertise and a license to provide training courses on post-installed rebars in concrete.

Participants in these training courses are required to sign an attendance list which will be forwarded to the quality department of Hilti France, which will then issue training certificates.

Training will cover the following issues:

- Drilling of bore holes of appropriate diameter and length (indicated on the plans)
- Cleaning the bore hole in compliance with the requirements of ETA 09/0295 (proper use of tools and accessories and observance of procedure)
- Injection of the resin in compliance with the requirements of ETA 09/0295 (proper use of tools and accessories and observance of procedure)

5.4 Aspects to observe for proper setting

Table 4 of this DTA offers a checklist of items to be checked in order to ensure the correct settings of reinforcement bars inside and outside a seismic zone.

B. Experimental results

Within the framework of the issuance of ETA 09/0295, the system HIT-RE 500-SD has been the subject of test reports of the university of Stuttgart nos. H 174/05-06/03 and H 154/01-05/21 (laboratory IAS-accredited under no. TL-230). These tests were performed in accordance with the European Technical Approval Guideline ETAG001 + Technical Report TR023 relating to post-installed rebars and the American code AC308 (Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Element) for the part relating to seismic tests.

C. References

The system HIT-RE 500-SD which is the subject of this technical documentation has been in production since 01/12/2007. By 31/12/2009, this accounted for more than 474,000 cartridges with a volume of 203,222,600 ml used in the United States and 67,000 cartridges with a volume of 32,728,040 ml in Europe.

3/10-649 This report has been translated from French to English by Hilti Corporation in Schaan, Liechtenstein.
Description of product and intended use

The post-installed rebar connection consists of the injection system Hilti HIT-RE 500-SD and a straight reinforcement bar with properties corresponding to classes B and C in accordance with annex C of Eurocode 2 (EC2).

Injection system HIT-RE 500-SD:

![Injection system HIT-RE 500-SD](image)

- **Marking:**
  - HILTI HIT
  - Production date
  - Production time
  - Expiry date

- **Foil pack:**
  - 330 ml, 500 ml and 1400 ml

Static mixer Hilti HIT-RE-M:

![Static mixer Hilti HIT-RE-M](image)

Reinforcing bar in conformity with EC2:

![Reinforcing bar in conformity with EC2](image)

Covered are post-installed rebar connections in non-carbonated concrete on the assumption only that the design of post-installed rebar connections is done in accordance to EN 1992-1-1.

Installation in dry or wet concrete, it must not installed in flooded holes

Temperature range: -40 °C to +80 °C

(maximum long term temperature +50 °C and maximum short term temperature +80 °C)
## Design bond strength

**Table 1: Design values of bond strength $f_{bd}$ in N/mm² outside seismic zones**
hammer drilling or compressed air drilling acc. to EC 2 for good bond conditions
(for all other bond conditions, multiply the values by 0.7)

<table>
<thead>
<tr>
<th>Rebar Ø</th>
<th>Concrete class</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C20/25</td>
</tr>
<tr>
<td>8 mm</td>
<td>2.3</td>
</tr>
<tr>
<td>10 mm</td>
<td>2.3</td>
</tr>
<tr>
<td>12 mm</td>
<td>2.3</td>
</tr>
<tr>
<td>14 mm</td>
<td>2.3</td>
</tr>
<tr>
<td>16 mm</td>
<td>2.3</td>
</tr>
<tr>
<td>20 mm</td>
<td>2.3</td>
</tr>
<tr>
<td>25 mm</td>
<td>2.3</td>
</tr>
<tr>
<td>32 mm</td>
<td>2.2</td>
</tr>
<tr>
<td>36 mm</td>
<td>2.2</td>
</tr>
<tr>
<td>40 mm</td>
<td>2.1</td>
</tr>
</tbody>
</table>

**Table 2: Design values of bond strength $f_{bd,seism}$ in N/mm² in seismic zones**
hammer drilling or compressed air drilling acc. to EC 2 for good bond conditions
(for all other bond conditions, multiply the values by 0.7)

<table>
<thead>
<tr>
<th>Rebar Ø</th>
<th>Concrete class</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C20/25</td>
</tr>
<tr>
<td>8 mm</td>
<td>2.3</td>
</tr>
<tr>
<td>10 mm</td>
<td>2.3</td>
</tr>
<tr>
<td>12 mm</td>
<td>2.3</td>
</tr>
<tr>
<td>14 mm</td>
<td>2.3</td>
</tr>
<tr>
<td>16 mm</td>
<td>2.3</td>
</tr>
<tr>
<td>20 mm</td>
<td>2.3</td>
</tr>
<tr>
<td>25 mm</td>
<td>2.3</td>
</tr>
<tr>
<td>32 mm</td>
<td>2.3</td>
</tr>
<tr>
<td>36 mm</td>
<td>2.2</td>
</tr>
<tr>
<td>40 mm</td>
<td>2.1</td>
</tr>
</tbody>
</table>

## Pre-calculated values

### Table 3: Pre-calculated values for post-installed rebars using Hilti HIT-RE 500-SD in seismic zone

Examples of C20/25, good bond conditions, rebar yield strength 500 N/mm² with hammer drilling for all drilling methods.

<table>
<thead>
<tr>
<th>Rebar diameter</th>
<th>Hole diameter</th>
<th>Load applied to bar under accidental seismic action</th>
<th>Anchorage length</th>
<th>Mortar volume</th>
<th>Load applied to bar under accidental seismic action</th>
<th>Anchorage length</th>
<th>Mortar volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>mm</td>
<td>mm</td>
<td>daN</td>
<td>mm</td>
<td>ml</td>
<td>daN</td>
<td>mm</td>
<td>ml</td>
</tr>
<tr>
<td>8</td>
<td>12 (10)</td>
<td>754</td>
<td>130</td>
<td>10 (4)</td>
<td>1,077</td>
<td>130</td>
<td>10 (4)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1,156</td>
<td>200</td>
<td>15 (7)</td>
<td>1,404</td>
<td>170</td>
<td>13 (6)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1,619</td>
<td>280</td>
<td>21</td>
<td>1,734</td>
<td>210</td>
<td>16 (7)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2,023</td>
<td>350</td>
<td>26</td>
<td>2,147</td>
<td>260</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2,513</td>
<td>435</td>
<td>33</td>
<td>2,513</td>
<td>304</td>
<td>23</td>
</tr>
<tr>
<td>10</td>
<td>14 (12)</td>
<td>1,178</td>
<td>163</td>
<td>15 (7)</td>
<td>1,683</td>
<td>163</td>
<td>15 (7)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1,806</td>
<td>250</td>
<td>23 (10)</td>
<td>2,168</td>
<td>210</td>
<td>19 (9)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2,529</td>
<td>350</td>
<td>32</td>
<td>2,787</td>
<td>270</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3,179</td>
<td>440</td>
<td>40</td>
<td>3,303</td>
<td>320</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3,927</td>
<td>543</td>
<td>49</td>
<td>3,927</td>
<td>380</td>
<td>34</td>
</tr>
<tr>
<td>12</td>
<td>16 (14)</td>
<td>1,696</td>
<td>196</td>
<td>21 (10)</td>
<td>2,424</td>
<td>196</td>
<td>21 (10)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2,601</td>
<td>300</td>
<td>32</td>
<td>3,221</td>
<td>260</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3,642</td>
<td>420</td>
<td>44</td>
<td>3,964</td>
<td>320</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4,596</td>
<td>530</td>
<td>56</td>
<td>4,831</td>
<td>390</td>
<td>41</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5,655</td>
<td>652</td>
<td>69</td>
<td>5,655</td>
<td>457</td>
<td>48</td>
</tr>
<tr>
<td>14</td>
<td>18</td>
<td>2,309</td>
<td>228</td>
<td>28</td>
<td>3,299</td>
<td>228</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3,642</td>
<td>360</td>
<td>43</td>
<td>4,335</td>
<td>300</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4,957</td>
<td>490</td>
<td>59</td>
<td>5,492</td>
<td>380</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6,272</td>
<td>620</td>
<td>75</td>
<td>6,503</td>
<td>450</td>
<td>54</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7,697</td>
<td>761</td>
<td>92</td>
<td>7,697</td>
<td>533</td>
<td>64</td>
</tr>
<tr>
<td>16</td>
<td>20</td>
<td>3,016</td>
<td>261</td>
<td>35</td>
<td>4,308</td>
<td>261</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4,740</td>
<td>410</td>
<td>56</td>
<td>5,615</td>
<td>340</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6,474</td>
<td>560</td>
<td>76</td>
<td>7,102</td>
<td>430</td>
<td>58</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8,208</td>
<td>710</td>
<td>96</td>
<td>8,588</td>
<td>520</td>
<td>71</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10,053</td>
<td>870</td>
<td>118</td>
<td>10,053</td>
<td>609</td>
<td>83</td>
</tr>
<tr>
<td>20</td>
<td>25</td>
<td>4,712</td>
<td>326</td>
<td>69</td>
<td>6,732</td>
<td>326</td>
<td>69</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7,370</td>
<td>510</td>
<td>108</td>
<td>8,877</td>
<td>430</td>
<td>91</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10,116</td>
<td>700</td>
<td>148</td>
<td>11,148</td>
<td>540</td>
<td>115</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12,862</td>
<td>890</td>
<td>189</td>
<td>13,419</td>
<td>650</td>
<td>138</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15,708</td>
<td>1,087</td>
<td>230</td>
<td>15,708</td>
<td>761</td>
<td>161</td>
</tr>
<tr>
<td>25</td>
<td>32</td>
<td>7,363</td>
<td>408</td>
<td>153</td>
<td>10,519</td>
<td>408</td>
<td>153</td>
</tr>
<tr>
<td></td>
<td></td>
<td>11,561</td>
<td>640</td>
<td>241</td>
<td>13,935</td>
<td>540</td>
<td>203</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15,896</td>
<td>880</td>
<td>331</td>
<td>17,290</td>
<td>670</td>
<td>252</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20,232</td>
<td>1,120</td>
<td>421</td>
<td>20,903</td>
<td>810</td>
<td>305</td>
</tr>
<tr>
<td></td>
<td></td>
<td>24,544</td>
<td>1,359</td>
<td>511</td>
<td>24,544</td>
<td>951</td>
<td>358</td>
</tr>
<tr>
<td>32</td>
<td>40</td>
<td>12,064</td>
<td>522</td>
<td>283</td>
<td>17,234</td>
<td>522</td>
<td>283</td>
</tr>
<tr>
<td></td>
<td></td>
<td>18,960</td>
<td>820</td>
<td>445</td>
<td>22,792</td>
<td>690</td>
<td>375</td>
</tr>
<tr>
<td></td>
<td></td>
<td>26,128</td>
<td>1,130</td>
<td>613</td>
<td>28,407</td>
<td>860</td>
<td>467</td>
</tr>
<tr>
<td></td>
<td></td>
<td>33,065</td>
<td>1,430</td>
<td>776</td>
<td>34,353</td>
<td>1040</td>
<td>565</td>
</tr>
<tr>
<td></td>
<td></td>
<td>40,212</td>
<td>1,739</td>
<td>944</td>
<td>40,212</td>
<td>1217</td>
<td>661</td>
</tr>
<tr>
<td>40</td>
<td>55</td>
<td>18,850</td>
<td>652</td>
<td>876</td>
<td>26,928</td>
<td>652</td>
<td>876</td>
</tr>
<tr>
<td></td>
<td></td>
<td>29,770</td>
<td>1,030</td>
<td>1,383</td>
<td>35,509</td>
<td>860</td>
<td>1155</td>
</tr>
<tr>
<td></td>
<td></td>
<td>40,753</td>
<td>1,410</td>
<td>1,894</td>
<td>44,593</td>
<td>1080</td>
<td>1450</td>
</tr>
<tr>
<td></td>
<td></td>
<td>51,736</td>
<td>1,790</td>
<td>2,404</td>
<td>53,676</td>
<td>1300</td>
<td>1746</td>
</tr>
<tr>
<td></td>
<td></td>
<td>62,832</td>
<td>2,174</td>
<td>2,920</td>
<td>62,832</td>
<td>1522</td>
<td>2044</td>
</tr>
</tbody>
</table>

NOTE: The required volume of resin, calculated by increasing the theoretical volume by 20% in order to account for any losses occurring on site during the setting.

For small diameters (10, 12 and 14), the bracketed values correspond to the minimum drilling diameter where the anchor length is below 250 mm.
**Table 4: Aspects to observe for proper setting**

There is a certain number of parameters which cannot be controlled subsequently. It is recommended that such parameters are checked prior to the injection of the resin. If this is not possible, the table below offers recommendations for subsequent control.

<table>
<thead>
<tr>
<th>Element to be verified</th>
<th>Type of verification</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Recommended injection depth</td>
<td>Information available at the construction site level</td>
<td>Design by a design office is mandatory, and the results shall be forwarded to the construction site.</td>
</tr>
<tr>
<td>2. Correspondence of diameter of bar with diameter of drilling</td>
<td>Geometry</td>
<td>According to table below</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nominal diameter of HA bar ( d_s ) (mm)</th>
<th>8</th>
<th>10</th>
<th>12</th>
<th>14</th>
<th>16</th>
<th>20</th>
<th>25</th>
<th>32*</th>
<th>40*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drilling with hammer drill (mm)</td>
<td>12</td>
<td>14</td>
<td>16</td>
<td>18</td>
<td>20</td>
<td>25</td>
<td>32</td>
<td>40</td>
<td>55</td>
</tr>
<tr>
<td>All drill holes with lengths of anchoring below 250 mm</td>
<td>10</td>
<td>12</td>
<td>14</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Element to be verified</th>
<th>Type of verification</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. Quantity of injected resin</td>
<td>The resin must spill over the hole</td>
<td>Diameter of bar, bore hole and depth of injection</td>
</tr>
<tr>
<td>4. Verification of the availability of tools and accessories required for setting and cleaning</td>
<td>Drills and machines for the required drilling diameter and injection depth</td>
<td>Cleaning using compressed air is mandatory</td>
</tr>
<tr>
<td></td>
<td>Compressed air, air nozzle and metal brush of appropriate diameter</td>
<td>If injection depth greater than 250 mm</td>
</tr>
<tr>
<td></td>
<td>Injection nozzle</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rebar diameter</th>
<th>Hole diameter</th>
<th>Air nozzle HIT-DL</th>
<th>Round metal brush HIT-RB</th>
<th>Injection nozzle HIT-SZ</th>
</tr>
</thead>
<tbody>
<tr>
<td>( d_s ) (mm)</td>
<td>(mm)</td>
<td>Designation</td>
<td>Designation</td>
<td>Designation</td>
</tr>
<tr>
<td>8</td>
<td>10</td>
<td>HIT-DL</td>
<td>HIT-RB 10</td>
<td>HIT-SZ</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>HIT-DL</td>
<td>HIT-RB 12</td>
<td>HIT-SZ</td>
</tr>
<tr>
<td>10</td>
<td>12</td>
<td>HIT-DL</td>
<td>HIT-RB 12</td>
<td>HIT-SZ</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>HIT-DL</td>
<td>HIT-RB 14</td>
<td>HIT-SZ</td>
</tr>
<tr>
<td>12</td>
<td>14</td>
<td>HIT-DL</td>
<td>HIT-RB 14</td>
<td>HIT-SZ</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>HIT-DL</td>
<td>HIT-RB 16</td>
<td>HIT-SZ</td>
</tr>
<tr>
<td>14</td>
<td>18</td>
<td>HIT-DL</td>
<td>HIT-RB 18</td>
<td>HIT-SZ</td>
</tr>
<tr>
<td>16</td>
<td>20</td>
<td>HIT-DL</td>
<td>HIT-RB 20</td>
<td>HIT-SZ</td>
</tr>
<tr>
<td>20</td>
<td>25</td>
<td>HIT-DL</td>
<td>HIT-RB 25</td>
<td>HIT-SZ</td>
</tr>
<tr>
<td>25</td>
<td>32</td>
<td>HIT-DL</td>
<td>HIT-RB 32</td>
<td>HIT-SZ</td>
</tr>
<tr>
<td>32</td>
<td>40</td>
<td>HIT-DL</td>
<td>HIT-RB 40</td>
<td>HIT-SZ</td>
</tr>
<tr>
<td>40</td>
<td>55</td>
<td>HIT-DL</td>
<td>HIT-RB 55</td>
<td>HIT-SZ</td>
</tr>
</tbody>
</table>

5. Mortar | Expiry date (if there are remaining cartridges) | |

---

This report has been translated from French to English by Hilti Corporation in Schaan, Liechtenstein.