ICC-ES Evaluation Report

ESR-3051*

Issued June 1, 2010

This report is subject to re-examination in one year.

www.icc-es.org | (800) 423-6587 | (562) 699-0543 *A Subsidiary of the International Code Council®*

DIVISION: 03—CONCRETE
Section: 03151—Concrete Anchoring

REPORT HOLDER:

ADOLF WÜRTH GmbH & CO. KG
REINHOLD-WÜRTH-STRASSE 12-17
74653 KÜNZELSAU
GERMANY
+49 (7940) 15 0
www.wuerth.de
info@wuerth.de

EVALUATION SUBJECT:

WÜRTH WIT-PE500 EPOXY ADHESIVE ANCHOR SYSTEM

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2006 *International Building Code*® (2006 IBC)
- 2006 *International Residential Code*® (2006 IRC)
- 2003 *International Building Code*® (2003 IBC)
- 2003 *International Residential Code*® (2003 IRC)
- 2000 *International Building Code*® (2000 IBC)
- 2000 *International Residential Code*® (2000 IRC)
- 1997 *Uniform Building Code*™ (UBC)

Property evaluated:

Structural

2.0 USES

Würth WIT-PE500 Epoxy Adhesive Anchors are used to resist static, wind and seismic tension and shear loads in cracked and uncracked normal-weight concrete with $^1/_2$-, $^5/_8$-, $^3/_4$-, and $^7/_8$-inch-diameter (12.7, 15.9, 19.1, and 22.2 mm) threaded steel rods and No. 4 through No. 7 steel reinforcing bars; and in uncracked normal-weight concrete only with $^3/_8$-, 1-, and $1^1/_4$-inch-diameter (9.5, 25.4, and 31.8 mm) threaded steel rods and No. 3, No. 8, No. 9, and No. 10 steel reinforcing bars. Use is limited to normal-weight concrete with a specified compressive strength, f'_c, of 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa). The anchor system is an alternative to cast-in-place anchors described in Sections 1911 and 1912 of the 2006 IBC, Sections 1912 and 1913 of the 2003 and 2000 IBC, and Section 1923 of the UBC. The anchor systems may also be used where an engineered design is submitted in accordance with Section R301.1.3 of the 2006 and 2003 IRC, or Section R301.1.2 of the 2000 IRC.

3.0 DESCRIPTION

3.1 General:

The Würth WIT-PE500 Epoxy Adhesive Anchor System is comprised of two-component epoxy adhesive filled in cartridges, static mixing nozzles, manual dispensing tools, hole cleaning equipment and adhesive injection accessories.

Würth WIT-PE500 epoxy adhesive may be used with continuously threaded steel rods or deformed steel reinforcing bars. The primary components of the Würth WIT-PE500 Epoxy Adhesive Anchor System, including the epoxy adhesive cartridge, static mixing nozzle, the nozzle extension tube, and steel anchor elements, are shown in Figure 3 of this report. Installation instructions and parameters, as included with each adhesive unit package, are replicated in Figure 4 of this report.

3.2 Materials:

3.2.1 Würth WIT-PE500 Epoxy Adhesive: Würth WIT-PE500 epoxy adhesive is an injectable two-component epoxy. The two components are separated by means of a labeled dual-cylinder cartridge. The two components combine and react when dispensed through a static mixing nozzle attached to the cartridge. A nozzle extension tube is also packaged with the cartridge. The Würth WIT-PE500 epoxy adhesive is available in 13-ounce (385 mL) and 20-ounce (585 mL) cartridges. Each cartridge label is marked with the adhesive expiration date. The shelf life, as indicated by the expiration date, is two years when unopened cartridges are stored in a dry, dark, and cool environment.

3.2.2 Hole Cleaning Equipment: Hole cleaning equipment is comprised of steel wire brushes and air pump supplied by the manufacturer, and a compressed air nozzle. The equipment is shown in Figure 4 of this report.

3.2.3 Dispensers: Würth WIT-PE500 epoxy adhesive must be dispensed with manual dispensers supplied by the manufacturer.

3.2.4 Steel Anchor Elements:

3.2.4.1 Threaded Steel Rods: Threaded steel rods must be clean and continuously threaded (all-thread) in diameters as described in Table 4 and Figure 4 of this report. Specifications for grades of threaded rod, including the mechanical properties and corresponding nuts and washers, are described in Table 2. Carbon steel threaded

***Revised July 2010**

rods must be furnished with a minimum 0.0002-inch-thick (0.005 mm) zinc electroplated coating complying with ASTM B 633, SC1, or a minimum 0.0021-inch-thick (0.053 mm) mechanically deposited zinc coating complying with ASTM B 695, Class 65. The stainless steel threaded rods must comply with ASTM F 593. Steel grades and material types (carbon, stainless) of the washers and nuts must be matched to the threaded rod. Threaded steel rods must be straight and free of indentations or other defects along their length. The embedded end may be either flat cut or cut on the bias to a chisel point.

3.2.4.2 Steel Reinforcing Bars: Steel reinforcing bars are deformed reinforcing bars. Table 7 and Figure 4 of this report summarize reinforcing bar size ranges. Table 3 summarizes specifications of permitted reinforcing bar types and grades. The embedded portions of reinforcing bars must be clean, straight, and free of mill scale, rust and other coatings that may impair the bond with the adhesive. Reinforcing bars must not be bent after installation.

3.2.4.3 Ductility: In accordance with ACI 318-05 Section D1.1, in order for a steel anchor element to be considered ductile, the tested elongation must be at least 14 percent and the reduction of area must be at least 30 percent. Steel elements with a tested elongation of less than 14 percent or a reduction of area less than 30 percent, or both, are considered brittle. Values for various steel materials are provided in Table 2 of this report. Where no elongation and reduction of area values are given, the steel must be considered brittle, unless evidence otherwise is shown to the satisfaction of the registered design professional and code official.

3.2.5 Concrete: Normal-weight concrete must comply with Sections 1903 and 1905 of the IBC and UBC, as applicable.

4.0 DESIGN AND INSTALLATION

4.1 Strength Design:

4.1.1 General: Design strengths must be determined in accordance with ACI 318-05 Appendix D and this report. An example set of calculations is given in Figure 1 of this report. The anchor design must satisfy the requirements in ACI 318.0.

Design parameters, including strength reduction factors, ϕ, corresponding to each limit state and steel anchor, element are provided in Tables 4 through Table 9, of this report. Strength reduction factors, ϕ, as described in ACI 318 Section D.4.4 must be used for load combinations calculated in accordance with Section 1605.2 of the 2006, 2003 and 2000 IBC, ACI 318 Section 9.2 or Section 1612.2 of the UBC. Strength reduction factors, ϕ, as described in ACI 318 Section D.4.5 must be used for load combinations calculated in accordance with ACI 318 Appendix C or Section 1909.2 of the UBC.

The following provides amendments to ACI 318 Appendix D as required for the strength design of adhesive anchors in hardened concrete. In conformance with ACI 318, all equations are expressed in inch-pound units.

Modify ACI 318 Section D.4.1.2 as follows:

D.4.1.2—In Eq. (D-1) and (D-2), ϕN_n and ϕV_n are the lowest design strengths determined from all appropriate failure modes. ϕN_n is the lowest design strength in tension of an anchor or group of anchors as determined from consideration of ϕN_{sa}, either ϕN_a or ϕN_{ag}, and either ϕN_{cb} or ϕN_{cbg}. ϕV_n is the lowest design strength in shear of an anchor or a group of anchors as determined from consideration of ϕV_{sa}, either ϕV_{cb} or ϕV_{cbg}, and either ϕV_{cp} or ϕV_{cpg}. For adhesive anchors subjected to tension resulting from sustained loading, refer to D.4.1.4 in this report for additional requirements.

Add ACI 318 Section D.4.1.4 as follows:

D.4.1.4—For adhesive anchors subjected to tension resulting from sustained loading, a supplementary design check shall be performed using Eq. (D-1) whereby N_{ua} is determined from the sustained load alone, e.g., the dead load and that portion of the live load acting that may be considered as sustained and ϕN_n is determined as follows:

D.4.1.4.1—For single anchors, $\phi N_n = 0.75\phi N_{a0}$.

D.4.1.4.2—For anchor groups, Eq. (D-1) shall be satisfied by taking $\phi N_n = 0.75\phi N_{a0}$ for that anchor in an anchor group that resists the highest tension load.

D.4.1.4.3—Where shear loads act concurrently with the sustained tension load, interaction of tension and shear shall be analyzed in accordance with Section D.4.1.3.

4.1.2 Static Steel Strength in Tension, N_{sa}: The nominal static steel strength of a single anchor in tension, N_{sa}, in accordance with ACI 318 Section D.5.1.2, is given in Table 4 and Table 7 of this report for the corresponding steel anchor element.

4.1.3 Static Concrete Breakout Strength in Tension, N_{cb} or N_{cbg}: The nominal static concrete breakout strength of a single anchor or group of anchors in tension, N_{cb} or N_{cbg}, must be calculated in accordance with ACI 318 Section D.5.2 with the following additions:

D.5.2.9—The limiting concrete strength of adhesive anchors in tension shall be calculated in accordance with D.5.2.1 to D.5.2.8, where the value of k_c to be used in Eq. (D-7) shall be:

$k_{c,cr}$ = *17 where analysis indicates cracking at service load levels in the anchor vicinity (cracked concrete).*

$k_{c,uncr}$ = *24 where analysis indicates no cracking ($f_t < f_r$) at service load levels in the anchor vicinity (uncracked concrete).*

The basic concrete breakout strength of a single anchor in tension, N_b, must be calculated in accordance with ACI 318 Section D.5.2.2 using the actual values of h_{ef} and $k_{c,cr}$ or $k_{c,uncr}$ as given in Table 5 and Table 8 of this report. The value of f'_c must be limited to a maximum of 8,000 psi (55 MPa), in accordance with ACI Section 318 D.3.5. Additional information for the determination of the nominal concrete breakout strength is given in Table 5 and Table 8 of this report for the corresponding steel anchor element.

4.1.4 Static Pullout Strength in Tension: In lieu of determining the nominal static pullout strength in accordance with ACI 318 Section D.5.3, nominal static bond strength in tension must be calculated in accordance with the following sections added to ACI 318:

D.5.3.7—The nominal bond strength of a single adhesive anchor, N_a, or group of adhesive anchors, N_{ag}, in tension shall not exceed:

For a single anchor

$$N_a = \frac{A_{Na}}{A_{Na0}} \cdot \psi_{ed,Na} \cdot \psi_{p,Na} \cdot N_{a0} \qquad \text{(D-16a)}$$

For a group of anchors

$$N_{ag} = \frac{A_{Na}}{A_{Na0}} \cdot \psi_{ed,Na} \cdot \psi_{g,Na} \cdot \psi_{ec,Na} \cdot \psi_{p,Na} \cdot N_{a0} \qquad \text{(D-16b)}$$

where:

A_{Na} is the projected area of the failure surface for the single anchor or group of anchors that shall be approximated as the base of the rectilinear geometrical figure that results from projecting the failure surface outward a distance, $c_{cr,Na}$, from the centerline of the anchor, or in the case of a group of anchors, from a line through a row of adjacent anchors. A_{Na} shall not exceed nA_{Na0} where n is the number of anchors in tension in the group. In ACI 318 Figures RD.5.2.1a and RD.5.2.1b, the terms $1.5h_{ef}$ and $3.0h_{ef}$ shall be replaced with $c_{cr,Na}$ and $s_{cr,Na}$, respectively.

A_{Na0} is the projected area of the failure surface of a single anchor without the influence of proximate edges in accordance with Eq. (D-16c).

$$A_{Na0} = (s_{cr,Na})^2 \qquad \text{(D-16c)}$$

with

$s_{cr,Na}$ = as given by Eq. (D-16d)

D.5.3.8—The critical spacing and critical edge distance shall be calculated as follows:

$$s_{cr,Na} = 20 \cdot d \cdot \sqrt{\frac{\tau_{k,uncr}}{1,450}} \le 3 \cdot h_{ef} \qquad \text{(D-16d)}$$

$$c_{cr,Na} = \frac{s_{cr,Na}}{2} \qquad \text{(D-16e)}$$

D.5.3.9—The basic strength of a single adhesive anchor in tension in cracked concrete shall not exceed:

$$N_{a0} = \tau_{k,cr} \cdot \pi \cdot d \cdot h_{ef} \qquad \text{(D-16f)}$$

D.5.3.10—The modification factor for the influence of the failure surface of a group of adhesive anchors is:

$$\psi_{g,Na} = \psi_{g,Na0} + \left[\left(\frac{s}{s_{cr,Na}}\right)^{0.5} \cdot (1 - \psi_{g,Na0})\right] \qquad \text{(D-16g)}$$

where

$$\psi_{g,Na0} = \sqrt{n} - \left[(\sqrt{n} - 1) \cdot \left(\frac{\tau_{k,cr}}{\tau_{k,max,cr}}\right)^{1.5}\right] \ge 1.0 \qquad \text{(D-16h)}$$

where

n = *the number of tension-loaded adhesive anchors in a group.*

$$\tau_{k,max,cr} = \frac{k_{c,cr}}{\pi \cdot d} \cdot \sqrt{h_{ef} \cdot f'_c} \qquad \text{(D-16i)}$$

The value of f'_c must be limited to 8,000 psi (55 MPa), maximum, in accordance with ACI 318 Section D.3.5.

D.5.3.11—The modification factor for eccentrically loaded adhesive anchor groups is:

$$\psi_{ec,Na} = \frac{1}{1 + \frac{2e'_N}{s_{cr,Na}}} \le 1.0 \qquad \text{(D-16j)}$$

Eq. (D-16j) is valid for $e'_n \le \frac{s}{2}$

If the loading on an anchor group is such that only certain anchors are in tension, only those anchors that are in tension shall be considered when determining the eccentricity, e'_N, for use in Eq. (D-16j).

In the case where eccentric loading exists about two orthogonal axis, the modification factor $\psi_{ec,Na}$ shall be computed for each axis individually and the product of these factors used as $\psi_{ec,Na}$ in Eq. (D-16b).

D.5.3.12—The modification factor for the edge effects for a single adhesive anchor or a group of adhesive anchors loaded in tension is:

for $c_{a,min} \ge c_{cr,Na}$ (D-16l)

$$\psi_{ed,Na} = 1.0$$

or

for $c_{a,min} < c_{cr,Na}$ (D-16m)

$$\psi_{ed,Na} = \left(0.7 + 0.3 \cdot \frac{c_{a,min}}{c_{cr,Na}}\right) \le 1.0$$

D.5.3.13—When an adhesive anchor or a group of adhesive anchors is located in a region of a concrete member where analysis indicates no cracking at service load levels, the nominal strength N_a or N_{ag} of a single adhesive anchor or a group of adhesive anchors shall be calculated according to Eq. (D-16a) and Eq. (D-16b) with $\tau_{k,uncr}$ substituted for $\tau_{k,cr}$ in the calculation of the basic strength N_{a0} in accordance with Eq. (D-16f). The factor $\Psi_{g,Na0}$ shall be calculated in accordance with Eq. (D-16h) whereby the value of $\tau_{k,max,uncr}$ shall be calculated in accordance with Eq. (D-16n) and substituted for $\tau_{k,max,cr}$ in Eq. (D-16h).

$$\tau_{k,max,uncr} = \frac{k_{c,uncr}}{\pi \cdot d} \cdot \sqrt{h_{ef} \cdot f'_c} \qquad \text{(D-16n)}$$

The value of f'_c must be limited to a maximum of 8,000 psi (55 MPa) in accordance with ACI 318 Section D.3.5.

D.5.3.14—When an adhesive anchor or a group of adhesive anchors is located in a region of a concrete member where analysis indicates no cracking at service load levels, the modification factor shall be taken as:

$$\psi_{p,Na} = 1.0 \text{ when } c_{a,min} \ge c_{ac} \qquad \text{(D-16o)}$$

$$\psi_{p,Na} = \frac{max|c_{a,min}; c_{cr,Na}|}{c_{ac}} \text{ when } c_{a,min} < c_{ac} \qquad \text{(D-16p)}$$

Additional information for the determination of nominal bond strength in tension is given in Section 4.1.8, Table 6 and Table 9 of this report.

4.1.5 Static Steel Strength in Shear, V_{sa}: The nominal static steel strength of a single anchor in shear, V_{sa}, in accordance with ACI 318 Section D.6.1.2 is given in Table 4 and Table 7 of this report for the corresponding anchor steel.

4.1.6 Static Concrete Breakout Strength in Shear, V_{cb} or V_{cbg}: The nominal static concrete breakout strength in shear of a single adhesive anchor or a group of adhesive anchors, V_{cb} or V_{cbg}, respectively, must be calculated in accordance with ACI 318 Section D.6.2 based on information given in Tables 5 and 8 of this report for the corresponding anchor steel. The basic concrete breakout strength in shear of a single anchor in cracked concrete, V_b, must be calculated in accordance with ACI 318 Section D.6.2.2 using the value of d given in Table 4 or Table 7 of this report in lieu of d_o. In addition, h_{ef} must be substituted for P_e, and in no case must h_{ef} exceed $8d$. The value of f'_c must be limited to a maximum of 8,000 psi (55 MPa), in accordance with ACI 318 Section D.3.5.

4.1.7 Static Concrete Pryout Strength in Shear: In lieu of determining the nominal static pryout strength in shear in accordance with ACI 318 Section D.6.3.1, nominal pryout strength must be calculated in accordance with the following sections added to ACI 318:

D.6.3.2—The nominal pryout strength of an adhesive anchor or group of adhesive anchors shall not exceed:

for a single adhesive anchor:

$$V_{cp} = min\left|k_{cp} \cdot N_a ; k_{cp} \cdot N_{cb}\right| \quad (D\text{-}30a)$$

for a group of adhesive anchors:

$$V_{cpg} = min\left|k_{cp} \cdot N_{ag} ; k_{cp} \cdot N_{cbg}\right| \quad (D\text{-}30b)$$

where:

k_{cp} = *1.0 for* h_{ef} *< 2.5 inches (64 mm)*

k_{cp} = *2.0 for* h_{ef} *≥ 2.5 inches (64 mm)*

N_a *shall be calculated in accordance with Eq. (D-16a)*

N_{ag} *shall be calculated in accordance with Eq. (D-16b)*

N_{cb} *and* N_{cbg} *are determined in accordance with D.5.2.1*

4.1.8 Bond Strength Determination: Bond strength values are a function of concrete compressive strength, concrete state (cracked, uncracked), drilling method (hammer drill) and installation conditions (dry concrete, water-saturated concrete, water-filled holes).

Bond strength values must be modified with the factor κ_{nn} for cases where holes are drilled in water-saturated concrete (κ_{ws}) or where the holes are water-filled at the time of anchor installation (κ_{wf}), as follows:

CONCRETE STATE	DRILLING METHOD	PERMISSIBLE INSTALLATION CONDITIONS	BOND STRENGTH	ASSOCIATED STRENGTH REDUCTION FACTOR
Cracked	Hammer drill	Dry concrete	$\tau_{k,cr}$	ϕ_d
		Water-saturated concrete	$\tau_{k,cr} \cdot \kappa_{ws}$	ϕ_{ws}
		Water-filled hole	$\tau_{k,cr} \cdot \kappa_{wf}$	ϕ_{wf}
Uncracked	Hammer drill	Dry concrete	$\tau_{k,uncr}$	ϕ_d
		Water-saturated concrete	$\tau_{k,uncr} \cdot \kappa_{ws}$	ϕ_{ws}
		Water-filled hole	$\tau_{k,uncr} \cdot \kappa_{wf}$	ϕ_{wf}

The bond strength values in Table 6 and Table 9 of this report correspond to concrete compressive strength f'_c equal to 2,500 psi (17.2 MPa). For concrete compressive strength, f'_c between 2,500 psi and 8,000 psi (17.2 MPa and 55 MPa), the tabulated characteristic bond strength may be increased by a factor of $(f'_c / 2{,}500)^{0.12}$ [For **SI:** $(f'_c / 17.2)^{0.12}$].

Where applicable, the modified bond strength values must be used in lieu of $\tau_{k,cr}$ and $\tau_{k,uncr}$ in Equations (D-16d), (D-16f) and (D-16h). The resulting nominal bond strength must be multiplied by the associated strength reduction factor ϕ_{nn}.

4.1.9 Minimum Member Thickness h_{min}, Anchor Spacing s_{min}, Edge Distance c_{min}: In lieu of ACI Section 318 D.8.3, values of c_{min} and s_{min} described in this report must be observed for anchor design and installation. Likewise, in lieu of ACI 318 Section D.8.5, the minimum member thicknesses, h_{min}, described in this report must be observed for anchor design and installation. In determining minimum edge distance, c_{min}, the following section must be added to ACI 318:

D.8.8—For adhesive anchors that will remain untorqued after installation, the minimum edge distance shall be based on minimum cover requirements for reinforcement in ACI 318 Section 7.7. For adhesive anchors that will be torqued during installation, the minimum edge distance and spacing distances are given in Tables 5 and 8 and Figure 4 of this report.

4.1.10 Critical Edge Distance c_{ac}: In lieu of ACI 318 Section D.8.6, c_{ac} must be determined as follows:

$c_{ac} = 1.7 \cdot h_{ef}$

when $h \geq h_{ef} + 5 \cdot (c_{a,min})^{3/4}$

otherwise $c_{ac} = 2.7 \cdot h_{ef}$

4.1.11 Requirements for Seismic Design: For load combinations including seismic loads, the design must be performed in accordance with ACI 318 Section D.3.3, as modified by Section 1908.1.16 of the 2006 IBC or the following:

CODE	ACI 318 SECTION D.3.3 SEISMIC REGION	CODE EQUIVALENT DESIGN
2003 IBC and 2003 IRC	Moderate or high seismic risk	Seismic design categories C, D, E, and F
UBC	Moderate or high seismic risk	Seismic zones 2B, 3 and 4

For brittle steel elements, the anchor strength must be adjusted in accordance with 2006 IBC Section 1908.1.16 with modifications to ACI 318 Section D.3.3.5. For structures assigned to Seismic Design Categories C, D, E or F, the nominal steel shear strength, V_{sa}, must be adjusted by $\alpha_{V,seis}$ as given in Table 4 and Table 7 of this report for the corresponding anchor steel. For structures assigned to Seismic Design Categories C, D, E or F, the nominal bond strength $\tau_{k,cr}$ must be adjusted by $\alpha_{N,seis}$ as noted in Table 6 and Table 9 of this report for the corresponding anchor steel.

For the 2000 IBC and 2000 IRC, for anchors installed in Seismic Design Categories C, D, E and F, compliance with Section 1913.3.3 is required.

4.1.12 Interaction of Tensile and Shear Forces: For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318 Section D.7.

4.2 Allowable Stress Design (ASD):

4.2.1 General: For anchors designed using load combinations in accordance with IBC Section 1605.3 allowable stress design loads (working stress design) must be established using the equations below:

$$T_{allowable,ASD} = \phi N_n / \alpha$$

and

$$V_{allowable,ASD} = \phi V_n / \alpha$$

where

$T_{allowable,ASD}$ = Allowable tension load (lbf or kN).

$V_{allowable,ASD}$ = Allowable shear load (lbf or kN).

ϕN_n = Lowest design strength of an anchor or anchor group in tension as determined in accordance with ACI 318 Appendix D with amendments in Section 4.1 of this report and Section 1908.1.16 of the 2006 IBC as applicable (lbf or kN).

ϕV_n = Lowest design strength of an anchor or anchor group in shear as determined in accordance with ACI 318 Appendix D with amendments in Section 4.1 of this report and Section 1908.1.16 of the 2006 IBC as applicable (lbf or kN).

α = Conversion factor calculated as a weighted average of the load factors for the controlling load combination. In addition, α must include all applicable factors to account for nonductile failure modes and required over-strength.

The requirements for member thickness, edge distance and spacing, described in this report must apply. An example of allowable stress design values for illustrative purposes is shown in Table 10, Table 11 and Table 12 of this report.

4.2.2 Interaction of Tensile and Shear Forces: Interaction must be calculated in accordance with ACI 318 Section D.7 as follows:

For shear loads $V \leq 0.2\ V_{allowable,\ ASD}$, the full allowable load in tension shall be permitted.

For tension loads $T \leq 0.2\ T_{allowable,\ ASD}$, the full allowable load in shear shall be permitted.

For all other cases:

$$\frac{T}{T_{allowable}} + \frac{V}{V_{allowable}} \leq 1.2$$

4.3 Installation:

Installation parameters are illustrated in Figure 2 of this report. Anchor locations must comply with this report and the plans and specifications approved by the code official. Installation of the Würth WIT-PE500 Epoxy Adhesive Anchor System must be in accordance with the published installation instructions included in each unit package as described in Figure 4 of this report.

4.4 Special Inspection:

Periodic special inspection must be performed where required in accordance with Section 1701.5 of the UBC and Sections 1704.4 and 1704.13 of the 2006, 2003 and 2000 IBC, whereby periodic special inspection is defined in Section 1702.1 of the 2006, 2003 and 2000 IBC, Section 1701.6.2 of the UBC, and this report. The special inspector must be on the jobsite initially during anchor installation to verify the anchor type, anchor dimensions, concrete type, concrete compressive strength, hole dimensions, hole cleaning procedures, anchor spacing, edge distances, concrete thickness, anchor embedment, and maximum applied torque moment as applicable. The special inspector must verify the initial installations of each type and size of adhesive anchor by construction personnel on the site. Subsequent installations of the same anchor type and size by the same construction personnel are permitted to be performed in the absence of the special inspector. Any change in the anchor product being installed or the personnel performing the installation requires an initial inspection. For ongoing installations over an extended period, the special inspector must make regular inspections to confirm correct handling and installation of the product.

For all cases where overhead installations (vertical up) are designed to resist sustained tension loads, continuous special inspection is required.

Under the IBC, additional requirements as set forth in Sections 1705 and 1706 must be observed, where applicable.

4.5 Compliance with NSF/ANSI Standard 61:

The Würth WIT-PE500 Epoxy Adhesive Anchor System complies with the requirements of NSF/ANSI Standard 61, as referenced in Section 605 of the 2006 *International Plumbing Code*® (IPC), and is certified for use as an anchoring adhesive for installing threaded rods less than or equal to 1.3 inches (33 mm) in diameter in concrete for water treatment applications.

5.0 CONDITIONS OF USE

The Würth WIT-PE500 Epoxy Adhesive Anchor System described in this report complies with the codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 Würth WIT-PE500 epoxy adhesive anchors must be installed in accordance with the manufacturer's published installation instructions as attached to each cartridge and described in Figure 4 of this report.

5.2 The anchors of all diameters described in this report must be installed in uncracked normal-weight concrete having a specified compressive strength, f'_c, from 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa); subject to the conditions of this report.

5.3 The anchors with $^1/_2$-, $^5/_8$-, $^3/_4$-, and $^7/_8$-inch-diameter (12.7, 15.9, 19.1, and 22.2 mm) threaded steel rods and No. 4 through No. 7 steel reinforcing bars may be installed in normal-weight concrete that is cracked or that may be expected to crack during the service life of the anchor. The anchors with $^3/_8$-, 1- and $1^1/_4$-inch-diameter (9.5 mm, 25.4 mm and 31.8 mm) threaded steel rods and No. 3, 8, 9 and 10 steel reinforcing bars are limited to installation in uncracked concrete. The anchors may be installed in concrete having a compressive strength f'_c, from 2,500 to 8,500 psi (17.2 MPa to 58.6 MPa) subject to the conditions of this report.

5.4 The values of f'_c used for calculation purposes must not exceed 8,000 psi (55 MPa).

5.5 Anchors must be installed in concrete base materials in holes predrilled in accordance with the instructions provided in Figure 4 of this report.

5.6 Würth WIT-PE500 epoxy adhesive anchors are recognized for use to resist short-term and long-term loads, including wind and earthquake loads, subject to the conditions of this report.

5.7 In structures assigned to Seismic Design Categories C, D, E, and F under the IBC or IRC, or Seismic Zones 2B, 3, and 4 under the UBC, anchor design must comply with Section 4.1.11 of this report.

5.8 Strength design values must be established in accordance with Section 4.1 of this report.

5.9 Allowable design values must be established in accordance with Section 4.2 of this report.

5.10 Minimum anchor spacing and edge distance, as well as minimum member thickness, must comply with the values noted in this report.

5.11 Prior to anchor installation, calculations and details demonstrating compliance with this report must be submitted to the code official. The calculations and details must be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed.

5.12 Where not otherwise prohibited in the code, Würth WIT-PE500 epoxy adhesive anchors are permitted for use with fire-resistance-rated construction provided that at least one of the following conditions is fulfilled:

- Anchors are used to resist wind or seismic forces only.
- Anchors that support fire-resistance-rated construction or gravity load–bearing structural elements are within a fire-resistance-rated envelope or a fire-resistance-rated membrane, are protected by approved fire-resistance-rated materials, or have been evaluated for resistance to fire exposure in accordance with recognized standards.
- Anchors are used to support only nonstructural elements.

5.13 Since an ICC-ES acceptance criteria for evaluating data to determine the performance of adhesive anchors subjected to fatigue or shock loading is unavailable at this time, the use of these anchors under such conditions is beyond the scope of this report.

5.14 Use of threaded rods made of carbon steel with zinc electroplated coating as specified in Section 3.2.4.1 of this report, or steel reinforcing bars, must be limited to dry, interior locations.

5.15 Use of threaded rods made of stainless steel or carbon steel with mechanically deposited zinc coating as specified in Section 3.2.4.1 of this report is permitted for exterior exposure or damp environments.

5.16 Steel anchoring materials in contact with preservative-treated and fire-retardant-treated wood must be of zinc-coated steel or stainless steel. The coating weights for zinc-coated steel must comply with ASTM A 153.

5.17 Periodic special inspection must be provided in accordance with Section 4.4 of this report. Continuous special inspection for overhead installations must be provided in accordance with Section 4.4 of this report.

5.18 Würth WIT-PE500 epoxy adhesive is manufactured in Willich, Germany, with inspections by Ingenieurbüro Eligehausen und Asmus (IEA) (AA-707).

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Post-installed Adhesive Anchors in Concrete (AC308), dated November 2009.

7.0 IDENTIFICATION

Würth WIT-PE500 epoxy adhesive is identified by packaging labeled with the Würth GmbH name and address, the product name, the lot number, the expiration date, the evaluation report number (ICC-ES ESR-3051), and the name of the inspection agency (IEA). Threaded rods, nuts, washers and deformed reinforcing bars are standard steel anchor elements and must conform to applicable national or international specifications as set forth in Table 2 and Table 3 of this report.

TABLE 1—DESIGN TABLE INDEX

DESIGN STRENGTH[1]		THREADED ROD	DEFORMED REINFORCING BAR
Steel	N_{sa}, V_{sa}	Table 4	Table 7
Concrete	N_{pn}, N_{sb}, N_{sbg}, N_{cb}, N_{cbg}, V_{cb}, V_{cbg}, V_{cp}, V_{cpg}	Table 5	Table 8
Bond[2]	N_a, N_{ag}	Table 6	Table 9

[1]Reference ACI 318 Section D.4.1.2.
[2]Section 4.1 of this report.

TABLE 2—SPECIFICATIONS AND PHYSICAL PROPERTIES OF COMMON CARBON AND STAINLESS STEEL THREAD ROD MATERIALS[1]

THREADED ROD SPECIFICATION			MINIMUM SPECIFIED ULTIMATE STRENGTH, f_{uta}	MINIMUM SPECIFIED YIELD STRENGTH 0.2 PERCENT OFFSET, f_{ya}	f_{uta}/f_{ya}	ELONGATION MINIMUM PERCENT	REDUCTION OF AREA MINIMUM PERCENT	SPECIFICATION FOR NUTS[5]	SPECIFICATION FOR WASHERS[6]
Carbon Steel	ASTM A 193[2] Grade B7 all sizes	psi (MPa)	125,000 (862)	105,000 (724)	1.19	16	50	ASTM A 563 Grade D	ASTM F 436
	ASTM A 36[3]/A307 Grade C all sizes	psi (MPa)	58,000 (400)	36,000 (250)	1.61	23	50	ASTM A 563 Grade A	ASTM B 18.22.1 Type A Plain
Stainless Steel (Types 304 and 316)	ASTM F 593[4] CW1 $^3/_8$ to $^5/_8$ inch	psi (MPa)	100,000 (690)	65,000 (450)	1.54	20	—	ASTM F 594 Alloy Group 1, 2 or 3	ASTM B 18.22. Type A Plain
	ASTM F 593[4] CW2 $^3/_4$ to $1^1/_4$ inches	psi (MPa)	85,000 (590)	45,000 (310)	1.89	25	—		

For **SI:** 1 inch = 25.4 mm, 1 psi = 0.006897 MPa.

[1]Adhesive must be used with continuously threaded carbon or stainless steel rod (all-thread) that have thread characteristics comparable with ANSI B1.1 UNC Coarse Thread Series.
[2]Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications.
[3]Standard Specification for Carbon Structural Steel.
[4]Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
[5]Nuts and washers of other grades and style having specified proof load stress greater than the specified grade and style are also suitable. Nuts must have specified proof load stresses equal to or greater than the minimum tensile strength of the specified threaded rod.

TABLE 3—SPECIFICATIONS AND PHYSICAL PROPERTIES OF COMMON STEEL REINFORCING BARS

REINFORCING SPECIFICATION	UNITS	MINIMUM SPECIFIED ULTIMATE STRENGTH, f_{uta}	MINIMUM SPECIFIED YIELD STRENGTH, f_{ya}
ASTM A 615[1], A 706[2], A 767[3], A 996[4], Grade 60	psi (MPa)	90,000 (620)	60,000 (414)

For **SI:** 1 psi = 0.006897 MPa.

[1]Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
[2]Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
[3]Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.
[4]Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement.

TABLE 4—STEEL DESIGN INFORMATION FOR U.S. CUSTOMARY UNIT THREADED ROD[1]

DESIGN INFORMATION		SYMBOL	UNITS	NOMINAL ROD DIAMETER (inch)						
				3/8	1/2	5/8	3/4	7/8	1	1 1/4
Threaded rod outside diameter		d	inch (mm)	0.375 (9.5)	0.500 (12.7)	0.625 (15.9)	0.750 (19.1)	0.875 (22.2)	1.000 (25.4)	1.250 (31.8)
Threaded rod effective cross-sectional area		A_{se}	inch² (mm²)	0.0775 (50)	0.1419 (92)	0.2260 (146)	0.3345 (216)	0.4617 (298)	0.6057 (391)	0.9691 (625)
ASTM A 36/A 307 Grade C	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	pound (kN)	4,495 (20.0)	8,230 (36.6)	13,110 (58.3)	19,400 (86.3)	26,780 (119.1)	35,130 (156.3)	56,210 (250.0)
		V_{sa}	pound (kN)	2,695 (12.0)	4,940 (22.0)	7,860 (35.0)	11,640 (51.8)	16,070 (71.4)	21,080 (93.8)	33,725 (150.0)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	—	Not applicable	0.85	0.85	0.85	0.85	Not applicable	Not applicable
	Strength reduction factor for tension[2]	ϕ	—	0.75						
	Strength reduction factor for shear[2]	ϕ	—	0.65						
ASTM A 193 Grade B7	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	pound (kN)	9,685 (43.1)	17,735 (78.9)	28,250 (125.7)	41,810 (186.0)	57,710 (256.7)	75,710 (336.8)	121,135 (538.8)
		V_{sa}	pound (kN)	4,845 (21.5)	10,640 (7.3)	16,950 (75.4)	25,085 (111.6)	34,625 (154.0)	45,425 (202.1)	72,680 (323.3)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	—	Not applicable	0.85	0.85	0.85	0.85	Not applicable	Not applicable
	Strength reduction factor for tension[2]	ϕ	—	0.75						
	Strength reduction factor for shear[2]	ϕ	—	0.65						
ASTM F 593 CW Stainless	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	pound (kN)	7,750 (34.5)	14,190 (63.1)	22,600 (100.5)	28,430 (126.5)	39,245 (174.6)	51,485 (229.0)	82,370 (366.4)
		V_{sa}	pound (kN)	4,650 (20.7)	8,515 (37.9)	13,560 (60.3)	17,060 (75.9)	23,545 (104.7)	30,890 (137.4)	49,425 (219.8)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	—	Not applicable	0.85	0.85	0.85	0.85	Not applicable	Not applicable
	Strength reduction factor for tension[2]	ϕ	—	0.75						
	Strength reduction factor for shear[2]	ϕ	—	0.65						

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.
For **pound-inch** units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi.

[1]Values provided for common threaded rod material types based on specified strengths and calculated in accordance with ACI 318 Eq. (D-3) and Eq. (D-20). Nuts and washers must be appropriate for the rod, as listed in Table 2 of this report.

[2]The tabulated value of ϕ applies when the load combinations of Section 1605.2.1 of the IBC, Section 1612.2.1 of the UBC, or ACI 318 Section 9.2 are used. If the load combinations of ACI 318 Appendix C or Section 1909.2 of the UBC are used, the appropriate value of ϕ must be determined in accordance with ACI 318 Section D.4.5.

TABLE 5—CONCRETE BREAKOUT DESIGN INFORMATION FOR U.S. CUSTOMARY UNIT THREADED ROD IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT[1]

DESIGN INFORMATION	SYMBOL	UNITS	NOMINAL ROD DIAMETER (inch)						
			$^{3}/_{8}$	$^{1}/_{2}$	$^{5}/_{8}$	$^{3}/_{4}$	$^{7}/_{8}$	1	$1^{1}/_{4}$
Effectiveness factor for cracked concrete	$k_{c,cr}$	in-lb (si)	Not Applicable	17 (7.1)	17 (7.1)	17 (7.1)	17 (7.1)	Not applicable	Not Applicable
Effectiveness factor for uncracked concrete	$k_{c,uncr}$	in-lb (si)	24 (10)						
Minimum embedment	$h_{ef,min}$	inch (mm)	$2^{3}/_{8}$ (60)	$2^{3}/_{4}$ (70)	$3^{1}/_{8}$ (79)	$3^{1}/_{2}$ (89)	$3^{1}/_{2}$ (89)	4 (102)	5 (127)
Minimum anchor spacing	s_{min}	inch (mm)	$1^{7}/_{8}$ (48)	$2^{1}/_{2}$ (64)	$3^{1}/_{8}$ (79)	$3^{3}/_{4}$ (95)	$4^{3}/_{8}$ (111)	5 (127)	$6^{1}/_{4}$ (159)
Minimum edge spacing	c_{min}	inch (mm)	$1^{7}/_{8}$ (48)	$2^{1}/_{2}$ (64)	$3^{1}/_{8}$ (79)	$3^{3}/_{4}$ (95)	$4^{3}/_{8}$ (111)	5 (127)	$6^{1}/_{4}$ (159)
Minimum member thickness	h_{min}	inch (mm)	$h_{ef} + 1^{1}/_{4}$ (h_{ef} + 30)		$h_{ef} + 2d_o$				
Critical edge distance—splitting (for uncracked concrete)[2]	c_{ac}	inch (mm)	where $h \geq h_{ef} + 5 \cdot (c_{a,min})^{3/4}$: $c_{ac} = 1.7\ h_{ef}$ otherwise $c_{ac} = 2.7 \cdot h_{ef}$						
Critical anchor spacing—splitting	s_{ac}	inch (mm)	$2 \cdot c_{ac}$						
Strength reduction factor for tension, concrete failure modes, Condition B[3]	ϕ	—	0.65						
Strength reduction factor for shear, concrete failure modes, Condition B[3]	ϕ	—	0.70						

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.
For **pound-inch** units: 1 mm = 0.03937 inch, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi.

[1]Additional setting information is described in the installation instructions, Figure 4 of this report.
[2]See Section 4.1 of this report.
[3]Condition A requires supplemental reinforcement, while Condition B applies where supplemental reinforcement is not provided or where pullout or pryout governs, as set forth in ACI 318 Section D.4.4. The tabulated value of ϕ applies when the load combinations of Section 1605.2.1 of the IBC, Section 1612.2.1 of the UBC, or ACI 318 Section 9.2 are used. If the load combinations of ACI 318 Appendix C or Section 1909.2 of the UBC are used, the appropriate value of ϕ must be determined in accordance with ACI 318 Section D.4.5.

TABLE 6—BOND STRENGTH DESIGN INFORMATION FOR U.S. CUSTOMARY UNIT THREADED ROD IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT[1,4]

DESIGN INFORMATION		SYMBOL	UNITS	NOMINAL ROD DIAMETER (inches)						
				$^3/_8$	$^1/_2$	$^5/_8$	$^3/_4$	$^7/_8$	1	$1^1/_4$
Minimum embedment		$h_{ef,min}$	inch (mm)	$2^3/_8$ (60)	$2^3/_4$ (70)	$3^1/_8$ (79)	$3^1/_2$ (89)	$3^1/_2$ (89)	4 (102)	5 (127)
Temperature Range A[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (N/mm^2)	Not applicable	930 (6.4)	765 (5.3)	712 (4.9)	671 (4.6)	Not applicable	Not applicable
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (N/mm^2)	2,049 (14.1)	1,926 (13.3)	1,836 (12.7)	1,765 (12.2)	1,708 (11.8)	1,659 (11.4)	1,582 (10.9)
Temperature Range B[2,3]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (N/mm^2)	Not applicable	512 (3.5)	421 (2.9)	392 (2.7)	369 (2.5)	Not applicable	Not applicable
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (N/mm^2)	1,126 (7.8)	1,059 (7.3)	1,009 (7.0)	971 (6.7)	939 (6.5)	912 (6.3)	870 (6.0)
Temperature Range C[2,3]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (N/mm^2)	Not applicable	460 (3.2)	378 (2.6)	353 (2.4)	332 (2.4)	Not applicable	Not applicable
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (N/mm^2)	1,014 (7.0)	953 (6.6)	908 (6.3)	874 (6.0)	845 (5.8)	821 (5.7)	783 (5.2)
Permissible Installation Conditions	Dry concrete	ϕ_d	—	0.65	0.65	0.65	0.65	0.65	0.65	0.65
	Water-saturated Concrete	ϕ_{ws}	—	0.55	0.55	0.55	0.45	0.45	0.45	0.45
		κ_{ws}	—	1.0	1.0	1.0	1.0	1.0	1.0	0.97
	Water-filled hole	ϕ_{wf}	—	0.45	0.45	0.45	0.45	0.45	0.45	0.45
		κ_{wf}	—	0.89	0.80	0.73	0.68	0.63	0.60	0.55

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.
For **pound-inch** units: 1 mm = 0.03937 inch, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi.

[1]Bond strength values correspond to concrete compressive strength f'_c = 2,500 psi. For concrete compressive strength, f'_c between 2,500 psi and 8,000 psi, the tabulated characteristic bond strength may be increased by a factor of $(f'_c / 2,500)^{0.12}$ [For **SI:** $(f'_c / 17.2)^{0.12}$].

[2] Temperature range A: Maximum short-term temperature = 104°F (40°C), maximum long-term temperature = 75°F (24°C).
Temperature range B: Maximum short-term temperature = 140°F (60°C), maximum long-term temperature = 110°F (43°C).
Temperature range C: Maximum short-term temperature = 162°F (72°C), maximum long-term temperature = 110°F (43°C).
Short-term elevated concrete temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling. Long-term concrete temperatures are roughly constant over significant periods of time.

[3]Characteristic bond strengths are for sustained loads including dead and live loads. For load combinations consisting of short-term loads only such as wind or seismic, bond strengths may be increased by 75 percent for temperature ranges B and C.

[4]For structures assigned to Seismic Design Categories C, D, E or F, bond strength values do not require an additional reduction factor applied ($\alpha_{N,seis}$ = 1.0).

TABLE 7—STEEL DESIGN INFORMATION FOR U.S. CUSTOMARY UNIT REINFORCING BARS[1]

DESIGN INFORMATION		SYMBOL	UNITS	NOMINAL BAR SIZE							
				No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10
Reinforcing bar nominal outside diameter		d	inch (mm)	0.375 (9.5)	0.500 (12.7)	0.625 (15.9)	0.750 (19.1)	0.875 (22.2)	1.000 (25.4)	1.128 (28.7)	1.270 (32.3)
Reinforcing bar effective cross-sectional area		A_{se}	inch² (mm²)	0.110 (71)	0.200 (129)	0.310 (200)	0.440 (284)	0.600 (387)	0.790 (510)	1.000 (645)	1.270 (819)
ASTM A 615, A 706, A 767, A 996 Grade 60	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	pound (kN)	9,900 (44.0)	18,000 (80.1)	27,900 (124.1)	39,600 (176.1)	54,000 (240.2)	71,100 (316.3)	90,000 (400.3)	114,300 (508.4)
		V_{sa}	pound (kN)	5,940 (26.4)	10,800 (48.0)	16,740 (74.5)	23,760 (105.7)	32,400 (144.1)	42,660 (189.8)	54,000 (240.2)	68,580 (305.0)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	—	Not applicable	0.70	0.70	0.70	0.70	Not applicable	Not applicable	Not applicable
	Strength reduction factor for tension[2]	ϕ	—	0.75							
	Strength reduction factor for shear[2]	ϕ	—	0.65							

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.
For **pound-inch** units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi.

[1]Values provided for common bar material types based on specified strengths and calculated in accordance with ACI 318 Eq. (D-3) and Eq. (D-20).

[2]For the tabulated value of ϕ applies when the load combinations of Section 1605.2.1 of the IBC, Section 1612.2.1 of the UBC, or ACI 318 Section 9.2 are used. If the load combinations of ACI 318 Appendix C or Section 1909.2 of the UBC are used, the appropriate value of ϕ must be determined in accordance with ACI 318 Section D.4.5.

TABLE 8—CONCRETE BREAKOUT DESIGN INFORMATION FOR U.S. CUSTOMARY UNIT REINFORCING BARS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT[1]

DESIGN INFORMATION	SYMBOL	UNITS	NOMINAL BAR SIZE							
			No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10
Effectiveness factor for cracked concrete	$k_{c,cr}$	in.-lb. (SI)	Not applicable	17 (7.1)	17 (7.1)	17 (7.1)	17 (7.1)	Not Applicable	Not Applicable	Not Applicable
Effectiveness factor for uncracked concrete	$k_{c,uncr}$	in.-lb. (SI)	24 (10)							
Minimum embedment	$h_{ef,min}$	in. (mm)	$2^3/_8$ (60)	$2^3/_4$ (70)	$3^1/_8$ (79)	$3^1/_2$ (89)	$3^1/_2$ (89)	4 (102)	$4^1/_2$ (114)	5 (127)
Minimum anchor spacing	s_{min}	in. (mm)	$1^7/_8$ (48)	$2^1/_2$ (64)	$3^1/_8$ (79)	$3^3/_4$ (95)	$4^3/_8$ (111)	5 (127)	$5^5/_8$ (143)	$6^1/_4$ (159)
Minimum edge spacing	c_{min}	in. (mm)	$1^7/_8$ (48)	$2^1/_2$ (64)	$3^1/_8$ (79)	$3^3/_4$ (95)	$4^3/_8$ (111)	5 (127)	$5^5/_8$ (143)	$6^1/_4$ (159)
Minimum member thickness	h_{min}	in. (mm)	$h_{ef} + 1^1/_4$ (h_{ef} + 30)		$h_{ef} + 2d_o$					
Critical edge distance–splitting (for uncracked concrete)[2]	c_{ac}	in. (mm)	where $h \geq h_{ef} + 5 \cdot (c_{a,min})^{3/4}$: $c_{ac} = 1.7\ h_{ef}$ otherwise $c_{ac} = 2.7 \cdot h_{ef}$							
Critical anchor spacing–splitting	s_{ac}	in. (mm)	$2 \cdot c_{ac}$							
Strength reduction factor for tension, concrete failure modes, Condition B[3]	ϕ	—	0.65							
Strength reduction factor for shear, concrete failure modes, Condition B[3]	ϕ	—	0.70							

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.
For **pound-inch** units: 1 mm = 0.03937 inch, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi.

[1]Additional setting information is described in the installation instructions and Figure 4 of this report.
[2]See Section 4.1 of this report.
[3]Condition A requires supplemental reinforcement, while Condition B applies where supplemental reinforcement is not provided or where pullout or pryout governs, as set forth in ACI 318 Section D.4.4. The tabulated value ϕ of applies when the load combinations of Section 1605.2.1 of the IBC, Section 1612.2.1 of the UBC, or ACI 318 Section 9.2 are used. If the load combinations of ACI 318 Appendix C or Section 1909.2 of the UBC are used, the appropriate value of ϕ must be determined in accordance with ACI 318 Section D.4.5.

TABLE 9—BOND STRENGTH DESIGN INFORMATION FOR U.S. CUSTOMARY UNIT REINFORCING BARS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT[1,4]

DESIGN INFORMATION		SYMBOL	UNITS	NOMINAL BAR SIZE (inch)							
				No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10
Minimum embedment		$h_{ef,min}$	inch (mm)	$2^3/_8$ (60)	$2^3/_4$ (70)	$3^1/_8$ (79)	$3^1/_2$ (89)	$3^1/_2$ (89)	4 (102)	$4^1/_2$ (114)	5 (127)
Temperature Range A[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (N/mm²)	Not applicable	930 (6.4)	765 (5.3)	712 (4.9)	671 (4.6)	Not applicable	Not applicable	Not applicable
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (N/mm²)	2,049 (14.1)	1,926 (13.3)	1,836 (12.7)	1,765 (12.2)	1,708 (11.8)	1,659 (11.4)	1,618 (11.2)	1,582 (10.9)
Temperature Range B[2,3]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (N/mm²)	Not applicable	512 (3.5)	421 (2.9)	392 (2.7)	369 (2.5)	Not applicable	Not applicable	Not applicable
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (N/mm²)	1,126 (7.8)	1,059 (7.3)	1,009 (7.0)	971 (6.7)	939 (6.5)	912 (6.3)	890 (6.1)	870 (6.0)
Temperature Range C[2,3]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (N/mm²)	Not applicable	460 (3.2)	378 (2.6)	353 (2.4)	332 (2.3)	Not applicable	Not applicable	Not applicable
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (N/mm²)	1,014 (7.0)	953 (6.6)	908 (6.3)	874 (6.0)	845 (5.8)	821 (5.7)	801 (5.1)	783 (5.2)
Permissible installation conditions	Dry concrete	ϕ_d	—	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
	Water-saturated Concrete	ϕ_{ws}	—	0.55	0.55	0.55	0.45	0.45	0.45	0.45	0.45
		κ_{ws}	—	1.0	1.0	1.0	1.0	1.0	1.0	0.99	0.97
	Water-filled hole	ϕ_{wf}	—	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
		κ_{wf}	—	0.89	0.80	0.73	0.68	0.63	0.60	0.57	0.55

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.
For **pound-inch** units: 1 mm = 0.03937 inch, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi.

[1]Bond strength values correspond to concrete compressive strength f'_c = 2,500 psi. For concrete compressive strength, f'_c between 2,500 psi and 8,000 psi, the tabulated characteristic bond strength may be increased by a factor of $(f'_c / 2{,}500)^{0.12}$ [For **SI:** $(f'_c / 17.2)]^{0.12}$.

[2]Temperature range A: Maximum short-term temperature = 104°F (40°C), maximum long-term temperature = 75°F (24°C).
Temperature range B: Maximum short-term temperature = 140°F (60°C), maximum long-term temperature = 110°F (43°C).
Temperature range C: Maximum short-term temperature = 162°F (72°C), maximum long-term temperature = 110°F (43°C).
Short-term elevated concrete temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling. Long-term concrete temperatures are roughly constant over significant periods of time.

[3]Characteristic bond strengths are for sustained loads including dead and live loads. For load combinations consisting of short-term loads only, such as wind or seismic, bond strengths may be increased by 75 percent for temperature ranges B and C.

[4]For structures assigned to Seismic Design Categories C, D, E or F, bond strength values do not require an additional reduction factor applied ($\alpha_{N,seis}$ = 1.0).

TABLE 10—EXAMPLE OF Würth WIT-PE500 EPOXY ADHESIVE ANCHOR ALLOWABLE STRESS DESIGN VALUES FOR ILLUSTRATIVE PURPOSES, TEMPERATURE RANGE A[1,2,3,4,5,6,7,8,9,10,11,12,13,14,15]

NOMINAL ANCHOR DIAMETER		EFFECTIVE EMBEDMENT (inches)	ALLOWABLE TENSION LOAD (pounds)
Threaded Rod (inch)	**Reinforcing Bar (No.)**		
$^3/_8$	3	$2^3/_8$	1,930
$^1/_2$	4	$2^3/_4$	2,400
$^5/_8$	5	$3^1/_8$	2,910
$^3/_4$	6	$3^1/_2$	3,450
$^7/_8$	7	$3^1/_2$	3,450
1	8	4	4,215
—	9	$4^1/_2$	5,030
$1^1/_4$	10	5	5,890

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.

[1]Single anchor with static tension load only; ASTM A 193 Grade B7 threaded rod and Grade 60 reinforcing bar.
[2]Vertical downward installation direction.
[3]Special inspection interval = Periodic.
[4]Installation temperature = 41°F (5°C) to 104°F (40°C) for base material; 41°F (5°C) to 104°F (40°C) for cartridge adhesive.
[5]Long-term temperature = 75°F (24°C).
[6]Short-term temperature = 104°F (40°C).
[7]Dry hole condition; carbide drilled hole.
[8]Embedment = $h_{ef,min}$.
[9]Concrete determined to remain uncracked for the life of the anchorage.
[10]Load combinations are based on ACI 318 Section 9.2 with no seismic loading.
[11]Thirty percent dead load and seventy percent live load, controlling load combination 1.2*D* + 1.6*L*.
[12]Calculation of weighted average for α = 1.2(0.3) + 1.6(0.7) = 1.48.
[13] f'_c = 2,500 psi (normal-weight concrete)
[14]$c_{a1} = c_{a2} \geq c_{ac}$
[15]$h \geq h_{min}$.

TABLE 11—EXAMPLE OF Würth WIT-PE500 EPOXY ADHESIVE ANCHOR ALLOWABLE STRESS DESIGN VALUES FOR ILLUSTRATIVE PURPOSES, TEMPERATURE RANGE B[1,2,3,4,5,6,7,8,9,10,11,12,13,14,15]

NOMINAL ANCHOR DIAMETER		EFFECTIVE EMBEDMENT (inches)	ALLOWABLE TENSION LOAD (pounds)
Threaded Rod (inch)	**Reinforcing Bar (No.)**		
$^3/_8$	3	$2^3/_8$	1,385
$^1/_2$	4	$2^3/_4$	2,010
$^5/_8$	5	$3^1/_8$	2,720
$^3/_4$	6	$3^1/_2$	3,450
$^7/_8$	7	$3^1/_2$	3,450
1	8	4	4,215
—	9	$4^1/_2$	5,030
$1^1/_4$	10	5	5,890

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.

[1]Single anchor with static tension load only; ASTM A 193 Grade B7 threaded rod and Grade 60 reinforcing bar.
[2]Vertical downward installation direction.
[3]Special inspection interval = Periodic.
[4] Installation temperature = 41°F (5°C) to 104°F (40°C) for base material; 41°F (5°C) to 104°F (40°C) for cartridge adhesive.
[5]Long-term temperature = 110°F (43°C).
[6]Short-term temperature = 140°F (60°C).
[7]Dry hole condition; carbide drilled hole.
[8]Embedment = $h_{ef,min}$.
[9]Concrete determined to remain uncracked for the life of the anchorage.
[10]Load combinations are based on ACI 318 Section 9.2 with no seismic loading.
[11]Thirty percent dead load and seventy percent live load, controlling load combination 1.2*D* + 1.6*L*.
[12]Calculation of weighted average for α = 1.2(0.3) + 1.6(0.7) = 1.48.
[13] f'_c = 2,500 psi (normal-weight concrete).
[14]$c_{a1} = c_{a2} \geq c_{ac}$.
[15]$h \geq h_{min}$.

TABLE 12—EXAMPLE OF Würth WIT-PE500 EPOXY ADHESIVE ANCHOR ALLOWABLE STRESS DESIGN VALUES FOR ILLUSTRATIVE PURPOSES, TEMPERATURE RANGE C[1,2,3,4,5,6,7,8,9,10,11,12,13,14,15]

NOMINAL ANCHOR DIAMETER		EFFECTIVE EMBEDMENT (inches)	ALLOWABLE TENSION LOAD (pounds)
Threaded Rod (inch)	Reinforcing Bar (No.)		
$^{3}/_{8}$	3	$2^{3}/_{8}$	1,245
$^{1}/_{2}$	4	$2^{3}/_{4}$	1,805
$^{5}/_{8}$	5	$3^{1}/_{8}$	2,445
$^{3}/_{4}$	6	$3^{1}/_{2}$	3,165
$^{7}/_{8}$	7	$3^{1}/_{2}$	3,450
1	8	4	4,215
—	9	$4^{1}/_{2}$	5,030
$1^{1}/_{4}$	10	5	5,890

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.

[1]Single anchor with static tension load only; ASTM A 193 Grade B7 threaded rod and Grade 60 reinforcing bar.
[2]Vertical downward installation direction.
[3]Special inspection regimen = Periodic.
[4]Installation temperature = 41°F (5°C) to 104°F (40°C) for base material; 41°F (5°C) to 104°F (40°C) for cartridge adhesive.
[5]Long-term temperature = 110°F (43°C).
[6]Short-term temperature = 162°F (72°C).
[7]Dry hole condition; carbide drilled hole.
[8]Embedment = $h_{ef,min}$.
[9]Concrete determined to remain uncracked for the life of the anchorage.
[10]Load combinations are based on ACI 318 Section 9.2 with no seismic loading.
[11]Thirty percent dead load and seventy percent live load, controlling load combination $1.2D + 1.6L$.
[12]Calculation of weighted average for $\alpha = 1.2(0.3) + 1.6(0.7) = 1.48$.
[13] f'_c = 2,500 psi (normal-weight concrete).
[14]$c_{a1} = c_{a2} \geq c_{ac}$.
[15]$h \geq h_{min}$.

Given: Calculate the factored resistance strength, ϕN_n, and the allowable stress design value $T_{allowable, ASD}$, for a 5/8-inch diameter, ASTM A 193 B7 threaded rod installed with Würth WIT-PE500 adhesive assuming the given conditions in Table 10.

Calculation in accordance with ACI 318-05 Appendix D and this report:	Code Ref.	Report Ref.
Step 1. Calculate steel strength of a single anchor in tension:	D.5.1	Section 4.1.2
$N_{sa} = n(A_{se})(f_{uta}) = (1)(0.2260)(125{,}000) = 28{,}250\ lbs.$	D.5.1.2 and Eq. (D-3)	Table 4
$\boldsymbol{\phi N_{sa}} = (0.75)(28{,}250) = 21{,}187\ lbs.$		Table 4
Step 2. Calculate concrete breakout strength in tension:	D.5.2	Section 4.1.3
$N_{cb} = \frac{A_{Nc}}{A_{Nc0}}\psi_{ed,N}\psi_{c,N}\psi_{cp,N}N_b$	D.5.2.1 and Eq. (D-4)	
$A_{Nc} = (1.5h_{ef} + 1.5h_{ef})(1.5h_{ef} + 1.5h_{ef}) = 9(h_{ef})^2 = 87.9\ in^2$		
$A_{Nc0} = 9(h_{ef})^2 = 87.9\ in^2$	D.5.2.1 and Eq. (D-6)	
$\psi_{ed,N} = 1.0$ if $c_{a,min} \geq 1.5h_{ef}$	D.5.2.5 and Eq. (D-10)	
$\psi_{c,N} = 1.0$ uncracked concrete assumed $(k_{c,uncr} = 24)$	D.5.2.6	
$\psi_{cp,N} = 1.0$ if $c_{a,min} \geq c_{ac}$	D.5.2.7 and Eq. (D-12)	
$N_b = k_{c,uncr}\sqrt{f'_c}(h_{ef})^{1.5}$	D.5.2.2 and Eq. (D-7)	
$N_b = (24)\sqrt{2{,}500}(3.125)^{1.5} = 6{,}629\ lbs.$		Table 5
$\boldsymbol{\phi N_{cb}} = (0.65)\frac{(87.9)}{(87.9)}(1.0)(1.0)(1.0)(6{,}629) = 4{,}309\ lbs.$		Table 5
Step 3. Calculate bond strength in tension:		Section 4.1.4
$N_a = \frac{A_{Na}}{A_{Na0}}\psi_{ed,Na}\psi_{p,Na}N_{a0}$		Section 4.1.4 (D.5.3.7) and Eq. (D-16a)
$s_{cr,Na} = \min\left(20d\left(\frac{\tau_{k,uncr}}{1{,}450}\right)^{0.5} \middle\vert\ 3h_{ef}\right)$		Section 4.1.4 (D.5.3.8) and Eq. (D-16d) and Table 6
$s_{cr,Na} = \min\left(20(0.625)\left(\frac{1{,}836}{1{,}450}\right)^{0.5} \middle\vert\ 3(3.125)\right) = 9.38\ in.$		
$c_{cr,Na} = \frac{s_{cr,Na}}{2} = 4.69\ in.$		Section 4.1.4 (D.5.3.8) and Eq. (D-16e)
$A_{Na} = (c_{cr,Na} + c_{cr,Na})(c_{cr,Na} + c_{cr,Na}) = 4(c_{cr,Na})^2 = 87.9\ in^2$		Section 4.1.4 (D.5.3.7)
$A_{Na0} = (s_{cr,Na})^2 = 87.9\ in^2$		Section 4.1.4 (D.5.3.7) and Eq. (D-16c)
$\psi_{ed,Na} = 1.0$ for $c_{a,min} \geq c_{cr,Na}$		Section 4.1.4 (D.5.3.12) and Eq. (D-16k)
$\psi_{p,Na} = 1.0$ when $c_{a,min} \geq c_{ac}$		Section 4.1.4 (D.5.3.14) and Eq. (D-16m)
$N_{a0} = (\tau_{k,uncr})\pi \cdot d \cdot h_{ef} = (1{,}836)(\pi)(0.625)(3.125) = 11{,}265\ lbs.$		Section 4.1.4 (D.5.3.9), Eq. (D-16f) and Table 6
$\boldsymbol{\phi N_a} = (0.65)(1.0)(1.0)(11{,}265) = 7{,}322\ lbs.$		Table 6

FIGURE 1—EXAMPLE CALCULATION FOR ILLUSTRATIVE PURPOSES

Calculation in accordance with ACI 318-05 Appendix D and this report (continued):	Code Ref.	Report Ref.
Step 4. Determine controlling resistance strength in tension:	D.4.1.2	Section 4.1.1
$\boldsymbol{\phi N_n} = \min\lvert\phi N_{sa}, \phi N_{cb}, \phi N_a\rvert = \phi N_{cb} = 4{,}309\ lbs.$		
Step 5. Calculate allowable stress design conversion factor for loading condition:	9.2	Section 4.2
Controlling load combination: 1.2*D* + 1.6*L*		
$\boldsymbol{\alpha}$ = 1.2(30%) + 1.6(70%) = 1.48		
Step 6. Calculate allowable stress design value:		Section 4.2
$\boldsymbol{T_{allowable,ASD}} = \frac{\phi N_n}{\alpha} = \frac{4{,}309}{1.48} = 2{,}911\ lbs.$		Section 4.2

FIGURE 1—EXAMPLE CALCULATION FOR ILLUSTRATIVE PURPOSES (Continued)

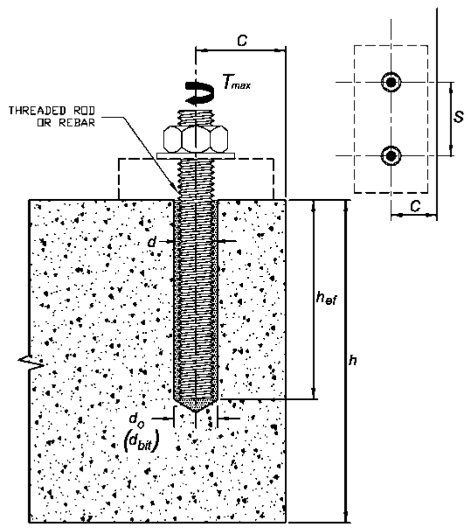
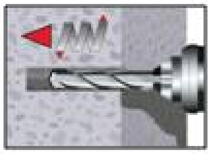


FIGURE 2—INSTALLATION PARAMETERS FOR THREADED RODS AND REINFORCING BARS

FIGURE 3—Würth WIT-PE500 EPOXY ADHESIVE ANCHOR SYSTEM INCLUDING TYPICAL STEEL ANCHOR ELEMENTS

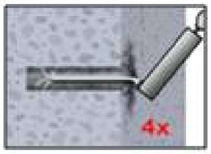
Drilling

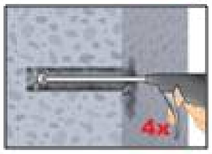


1. Drill a hole into the base material with a hammer drill tool to the size and embedment required by the selected steel hardware element (see Table 4.1 or Table 4.2). The tolerances of the carbide drill bit must meet the requirements of ANSI Standard B212.15.

Precaution: Wear suitable eye and skin protection. Avoid inhalation of dusts during drilling and/or removal.

Hole cleaning → In order: *Blow 4x, Brush 4x, Blow 4x*

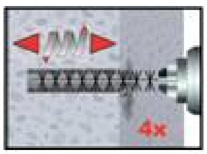




2a. In case of standing water in the drilled bore hole, all the water has to be removed from the hole (e.g. vacuum, compressed air, etc.) prior to cleaning.
Starting from the bottom or back of the anchor hole, blow the hole clean a minimum of *four* times (4x).

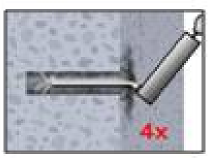
- Use a compressed air nozzle (min. 90 psi) ***or*** a hand pump (min. volume 25 fl. oz.) for anchor rod 3/8" to 3/4" diameter or reinforcing bar (rebar) sizes #3 to #6.

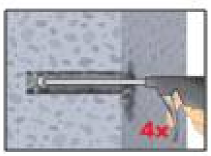
- Use a compressed air nozzle (min. 90 psi) for anchor rod 7/8" to 1-1/4" diameter and rebar sizes #7 to #10. A hand pump must not be used with these anchor sizes.



2b. Determine brush diameter (see Table 2) for the drilled hole and attach the brush with adaptor to a rotary drill tool or battery screwgun. Brush the hole with the selected wire brush a minimum of *four* times (4x). A brush extension (supplied by Würth) must be used for holes drilled deeper than the listed brush length.

The wire brush diameter must be checked periodically during use ($\varnothing_{brush} < D_{min}$, see Table 2). The brush should resist insertion into the drilled hole - if not the brush is too small and must be replaced with the proper brush diameter.





2c. Finally, blow the hole clean again a minimum of *four* times (4x).

- Use a compressed air nozzle (min. 90 psi) ***or*** a hand pump (min. volume 25 fl. oz. supplied by Würth) for anchor rod 3/8" to 3/4" diameter or reinforcing bar (rebar) sizes #3 to #6.

- Use a compressed air nozzle (min. 90 psi) for anchor rod 7/8" to 1-1/4" diameter and rebar sizes #7 to #10. A hand pump must not be used with these anchor sizes.

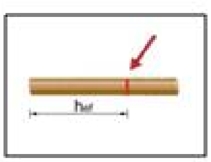
When finished the hole should be clean and free of dust, debris, ice, grease, oil or other foreign material.

Preparing

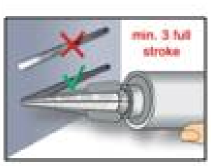
3. Check adhesive expiration date on cartridge label. Do not use expired product. Review Material Safety Data Sheet (MSDS) before use. Cartridge temperature must be between 41°F - 104°F (5°C - 40°C) when in use. Review working and cure times (see Table 3).

For the permitted range of the base material temperature see Table 3.

Attach a supplied mixing nozzle to the cartridge. Do not modify the mixer in any way and make sure the mixing element is inside the nozzle. Load the cartridge into the correct dispensing tool. A new mixing nozzle must be used for every working interruption longer than the published working times as well as for new cartridges.



4. Prior to inserting the anchor rod or rebar into the filled bore hole, the position of the embedment depth has to be marked on the anchor.

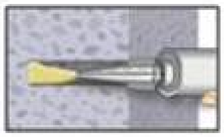


5. For new cartridges and nozzles: Prior to dispensing into the drilled hole, squeeze out separately a minimum three full strokes of the mixed adhesive. Discard non-uniform adhesive until the mixed adhesive shows a consistent **red or grey** colour.

Review and note the published working and cure times (see Table 3) prior to injection of the mixed adhesive into the cleaned anchor hole.

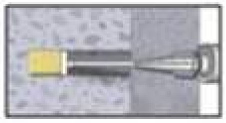
FIGURE 4—INSTALLATION INSTRUCTIONS

Installation



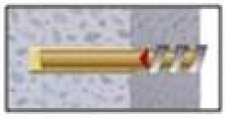
6. Fill the cleaned hole approximately two-thirds full with mixed adhesive starting from the bottom or back of the anchor hole. Slowly withdraw the mixing nozzle as the hole fills to avoid creating air pockets or voids. For embedment depths greater than 7-1/2" an extension nozzle supplied by Würth must be used with the mixing nozzle.

with piston plug:

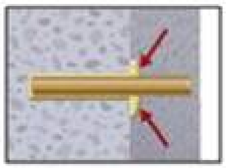


Piston plugs (see Table 6) must be used with and attached to mixing nozzle and extension tube for horizontal and overhead installations with anchor rod 3/4" to 1-1/4" diameter and rebar sizes #6 to #10. Insert piston plug to the back of the drilled hole and inject as described in the method above. During installation the piston plug will be naturally extruded from the drilled hole by the adhesive pressure.

Attention! Do not install anchors overhead without proper training and installation hardware provided by Würth. Contact Würth for details prior to use.

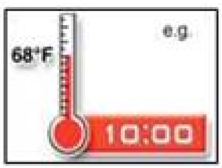


7. The anchor should be free of dirt, grease, oil or other foreign material. Push clean threaded rod or reinforcing bar into the anchor hole while turning slightly to ensure positive distribution of the adhesive until the embedment depth is reached. Air pockets are present when the threaded rod or rebar springs or air pockets burst during installation. In case of air pockets: remove rod or rebar, let the adhesive harden, re-drill the hole and repeat the complete installation.



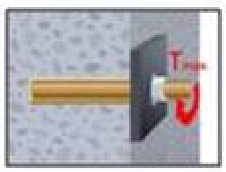
8. Be sure that the anchor is fully seated at the bottom of the hole and that some adhesive has flowed from the hole and all around the top of the anchor. If there is not enough adhesive in the hole, the installation must be repeated. For overhead applications the anchor must be secured from moving/falling during the cure time (e.g. wedges). Minor adjustments to the anchor may be performed during the gel time but the anchor shall not be moved after final placement and during cure.

Curing and Fixture



9. Allow the adhesive anchor to cure to the specified full curing time prior to applying any load (see Table 3).

Do not disturb, torque or load the anchor until it is fully cured.



10. After full curing of the adhesive anchor, a fixture can be installed to the anchor and tightened up to the maximum torque (shown in Table 4.1) by using a calibrated torque wrench.

Take care not to exceed the maximum torque for the selected anchor.

2. Hole cleaning tools - wire brushes and air blowers

Threaded rod diameter (inch)	Rebar size (no.)	ANSI drill bit diameter (inch)	Min. brush diameter, D_{min} (inches)	Brush length, L^1 (inches)	Steel wire brush (Cat. #)
3/8	#3	7/16	0.475	6-3/4	0903489010
1/2	#4	9/16	0.600	6-3/4	0903489012
5/8	#5	11/16	0.735	7-7/8	0903489016
3/4	#6	7/8	0.920	7-7/8	0903489020
7/8	#7	1	1.045	11-7/8	0903489020
1	#8	1-1/8	1.175	11-7/8	0903489025
1-1/4	#9	1-3/8	1.425	11-7/8	0903489028
-	#10	1-1/2	1.550	11-7/8	0903489028

Air blowers

Hand pump (volume 25 fl. oz.) or compressed air nozzle (min. 90 psi)

Hand pump - Cat. #0891009

Compressed air nozzle only (min. 90 psi)

Compressed air nozzle

[1]A brush extension (Cat. #0905499111) must be used with a steel wire brush for holes drilled deeper than the listed brush length.

FIGURE 4—INSTALLATION INSTRUCTIONS (Continued)

Würth WIT-PE 500
Instruction Card

DESCRIPTION:
WIT-PE 500 is an easy dispensing, high strength, 100% solids epoxy anchoring adhesive which is formulated for use in anchoring applications by trained professionals. Please refer to Würth installation instructions and MSDS for additional detailed information.

PRECAUTION:
Safety glasses and dust masks should be used when drilling holes into concrete, stone and masonry. Wear gloves and safety glasses when handling and dispensing adhesive. Do not sand the adhesive and create silica dust which could be inhaled. Avoid skin and eye contact. use a NIOSH-approved chemical mask to avoid respiratory discomfort if working indoors or in a confined area, or if sensitive to adhesive odors. Wash hands or other affected body parts with soap and water if skin contact occurs. Flush eyes with plenty of water and seek immediate medical attention if eye contact occurs. Move to fresh air if adhesive odour begins to cause discomfort.

IMPORTANT!
Before using, read and review Material Safety Data Sheet (MSDS).

This product contains crystalline silica and as supplied does not pose a dust hazard. IARC classifies crystalline silica (quartz sand) as a Group I carcinogen based upon evidence among workers in industries where there has been long-term and chronic exposure (via inhalation) to silica dust; e.g. mining, quarry, stone crushing, refractory brick and pottery workers. This product does not pose a dust hazard; therefore, this classification is not relevant. However, if reacted (fully cured) product is further processed (e.g. sanded, drilled) be sure to wear proper respiratory and eye protection to avoid health risk.

HANDLING AND STORAGE:
Store in a cool, dry, well ventilated area at temperatures between 32°F (0°C) and 95°F (35°C). Keep away from excessive heat and flame. Keep partially used containers closed when not in use. Protect from damage. Store away from heat and light.

Note expiration date on product label before use. Do not use expired product. Cartridge temperature must be between 41°F - 104°F (5°C - 40°C) when in use. Partially used cartridges may be stored with hardened adhesive in the attached mixing nozzle. If the cartridge is reused, attach a new mixing nozzle and discard the initial quantity of the anchor adhesive as described in the setting instructions (steps #3 and #5).

6. ADHESIVE PISTON PLUGS

Threaded rod diameter (inch)	Rebar size (no.)	ANSI drill bit diameter (inch)	Plug Size (inch)	Plastic Plug (Cat. #)	Horizontal and overhead installations
3/4	#6	7/8	7/8	0903488010	
7/8	#7	1	1	0903488025	
1	#8	1-1/8	1-1/8	0903488025	
1-1/4	#9	1-3/8	1-3/8	0903488028	
-	#10	1-1/2	1-1/2	0903488028	

A nozzle extension (3/8" dia., Cat# 0903488121 must be used with piston plugs.

3. Gel (working) times and curing times

Temperature of base material		Gel (working) time	Full curing time
41°F	5°C	180 minutes	50 hours
50°F	10°C	120 minutes	30 hours
68°F	20°C	30 minutes	10 hours
86°F	30°C	20 minutes	6 hours
104°F	40°C	12 minutes	4 hours

It is recommended that the cartridge temperature when in use does not differ significantly from the temperature of the base material.

4. Setting parameters

Table 4.1 Specifications for installation of threaded rods

Anchor property/Setting information	Nominal threaded rod size						
	3/8"	1/2"	5/8"	3/4"	7/8"	1"	1-1/4"
d = Nominal anchor rod diameter (in.)	0.375	0.500	0.625	0.750	0.875	1.000	1.250
A_{se} = Nominal area of threaded rod (in.^{2})	0.078	0.142	0.226	0.335	0.462	0.606	0.969
d_o (d_{bit}) = Nominal ANSI drill bit size (in.)	7/16	9/16	11/16	7/8	1	1-1/8	1-3/8
T_{max} = Maximum torque (ft.-lb.) for A193 B7 carbon steel rod or F593 SS rod	16	33	60	105	125	165	280
T_{max} = Maximum torque (ft.-lb.) for A36/A307 carbon steel rod **only**	10	25	50	90			
$h_{ef,min}$ = Minimum embedment (inches)	2-3/8	2-3/4	3-1/8	3-1/2	3-1/2	4	5
$h_{ef,max}$ = Maximum embedment (inches)	4-1/2	6	7-1/2	9	10-1/2	12	15
s_{min} = Minimum spacing (inches)	1-7/8	2-1/2	3-1/8	3-3/4	4-3/8	5	6-1/4
c_{min} = Minimum edge distance (inches)	1-7/8	2-1/2	3-1/8	3-3/4	4-3/8	5	6-1/4
h_{min} = Minimum member thickness (inches)	h_{ef} + 1-1/4		$h_{ef} + 2d_o$				

Table 4.2 Specifications for installation of deformed steel reinforcing bars

Anchor property/Setting information	Reinforcing bar size							
	#3	#4	#5	#6	#7	#8	#9	#10
d = Nominal bar diameter (in.)	3/8	1/2	5/8	3/4	7/8	1	1-1/8	1-1/4
d_o (d_{bit}) = Nominal ANSI drill bit size (in.)	7/16	9/16	11/16	7/8	1	1-1/8	1-3/8	1-1/2
$h_{ef,min}$ = Minimum embedment (inches)	2-3/8	2-3/4	3-1/8	3-1/2	3-1/2	4	4-1/2	5
$h_{ef,max}$ = Maximum embedment (inches)	4-1/2	6	7-1/2	9	10-1/2	12	13-1/2	15
s_{min} = Minimum spacing (inches)	1-7/8	2-1/2	3-1/8	3-3/4	4-3/8	5	5-5/8	6-1/4
c_{min} = Minimum edge distance (inches)	1-7/8	2-1/2	3-1/8	3-3/4	4-3/8	5	5-5/8	6-1/4
h_{min} = Minimum member thickness (inches)	h_{ef} + 1-1/4		$h_{ef} + 2d_o$					

5. C-RE 385 adhesive anchor system selection table

Injection tool	Plastic cartridge system	Extra mixing nozzle
C-RE 385 13 fl. oz. manual dispenser Cat. #30218	C-RE 385 13 fl. oz. dual cartridge w/mixing nozzle and extension - Cat. #10338	C-RE 385 mixing nozzle and extension Cat. #40125 or 40122
C-RE 385 13 & 20 fl. oz. manual dispenser Cat. #30222	C-RE 385 20 fl. oz. dual cartridge w/mixing nozzle and extension - Cat. #10363	C-RE 385 mixing nozzle and extension Cat. #40125 or 40122