



ICC-ES Evaluation Report ESR-4901

Issued November 2022

Revised March 2023

This report is subject to renewal November 2023.

DIVISION: 03 00 00—CONCRETE
Section: 03 16 00—Concrete Anchors

DIVISION: 05 00 00—METALS
Section: 05 05 19—Post-Installed Concrete Anchors

REPORT HOLDER:

CHEMOFAST ANCHORING GmbH

EVALUATION SUBJECT:

CHEMOFAST EP 800 ADHESIVE ANCHOR AND POST-INSTALLED REINFORCING BAR CONNECTION SYSTEM IN CRACKED AND UNCRACKED CONCRETE

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2021, 2018, 2015, and 2012 *International Building Code*® (IBC)
- 2021, 2018, 2015, and 2012, *International Residential Code*® (IRC)

For evaluation for compliance with codes adopted by the Los Angeles Department of Building and Safety (LADBS), see [ESR-4901 LABC and LARC Supplement](#).

Property evaluated:

Structural

2.0 USES

Chemofast EP 800 adhesive anchor system is used as anchorage to resist static, wind or earthquake (IBC Seismic Design Categories A through F) tension and shear loads in cracked and uncracked normal-weight and lightweight concrete with 3/8-, 1/2-, 5/8-, 3/4-, 7/8-, 1-, and 1 1/4-inch fractional diameter, and M10, M12, M16, M20, M24, M27 and M30 metric diameter threaded steel rods and No. 3 through No. 10 fractional size and ø10, ø12, ø14, ø16, ø20, ø25, ø28 and ø32 metric size steel reinforcing bars in hammer-drilled (or Chemofast hollow drill bit system) holes. Use is limited to normal-weight and lightweight concrete with a specified compressive strength, f_c , of 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa).

Chemofast EP 800 adhesive post-installed reinforcing bars are used as reinforcing bar connections (for development length and splice length) to resist static, wind and earthquake (IBC Seismic Design Categories A through F) tension loads in concrete with No. 3 through No. 11 fractional size and ø10, ø12, ø14, ø16, ø20, ø25, ø28, ø32 and ø36 metric size steel reinforcing bars in hammer-drilled (or Chemofast hollow drill bit system) and diamond core drilled holes. 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 complies with anchors as described in Section 1901.3 of the 2021, 2018 and 2015 IBC, Section 1909 of the 2012 IBC and is an alternative to cast-in-place and post-installed anchors described in Section 1908 of the 2012 IBC. The anchor systems may also be used where an engineered design is submitted in accordance with Section R301.1.3 of the IRC.

The post-installed reinforcing bar connection system is an alternative to cast-in-place reinforcing bars governed by ACI 318 and IBC Chapter 19.

3.0 DESCRIPTION

3.1 General:

The Chemofast EP 800 Adhesive Anchor System is comprised of Chemofast EP 800 two-component adhesive filled in cartridges, static mixing nozzles and manual or powered dispensing tools, hole cleaning equipment and adhesive injection accessories, and steel anchor elements, which are continuously threaded steel rods or steel reinforcing bars (to form the Chemofast EP 800 Adhesive Anchor System).

The primary components of the Chemofast EP 800 Adhesive Anchor System, including the Chemofast EP 800 adhesive cartridge, static mixing nozzle, dispenser, and steel anchor elements, are shown in Figures 2 and 3 of this report. The manufacturer's printed installation instructions (MPII), included with each adhesive unit package, are shown in Figure 5 of this report.

3.2 Materials:

3.2.1 Chemofast EP 800 Adhesive: Chemofast EP 800 adhesive is an injectable two-component epoxy adhesive. The two components are kept separate by means of a

labeled dual-cylinder cartridge. The two components combine and react when dispensed through a static mixing nozzle, supplied by Chemofast, which is attached to the cartridge. Chemofast EP 800 is available in 9.5-ounce (280ml), 13.5-ounce (400ml), 20 up to 20.5-ounce (600 up to 610ml) and 50.5-ounce (1500 ml) cartridges. Each cartridge label is marked with the adhesive expiration date. The shelf life, as indicated by the expiration date, applies to an unopened cartridge stored in a dry, dark, and cool environment, in accordance with the MP11, as illustrated in Figure 5 of this report.

3.2.2 Hole Cleaning Equipment:

3.2.2.1 Standard Equipment: Hole cleaning equipment is comprised of steel wire brushes supplied by Chemofast Anchoring GmbH, and air blowers which are shown in Figure 5 of this report. The Chemofast dust extraction system shown in Figure 1 of this report removes dust with a HEPA dust extractor during the hole drilling and cleaning operation.

3.2.2.2 Chemofast Hollow Drill Bit System: The Chemofast hollow drill bit system shown in Figure 1 is comprised of Heller Duster Expert Hollow drill bit with carbide tips conforming to ANSI B212.15 attached to a class M vacuum that has a minimum air flow rating of 90cfm (150m³/h, 42l/s). The vacuum dust extractor system removes the drilling dust during the drilling operation, eliminating the need for additional hole cleaning.

3.2.3 Dispensers: Chemofast EP 800 adhesive must be dispensed with manual dispensers, pneumatic dispensers, or electric powered dispensers supplied by Chemofast Anchoring GmbH.

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 described in Tables 4 and 10 and Figure 5 of this report. Specifications for grades of threaded rod, including the mechanical properties, and corresponding nuts and washers, are included in Table 2 of this report. Carbon steel threaded rods must be furnished with a minimum 0.0002-inch-thick (0.005 mm) zinc electroplated coating complying with ASTM B633 SC 1 or a minimum 0.0021-inch-thick (0.053 mm) mechanically deposited zinc coating complying with ASTM B695, Class 55. The stainless steel threaded rods must comply with Table 2 of this report. Steel grades and types of material (carbon, stainless) for the washers and nuts must match the threaded rods. Threaded steel rods must be clean, straight and free of indentations or other defects along their length. The embedded end may be 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 as described in Table 3 of this report. Tables 7 and 13, and Figure 5 summarize reinforcing bar size ranges. The embedded portions of reinforcing bars must be clean, straight, and free of mill scale, rust, mud, oil and other coatings (other than zinc) that may impair the bond with the adhesive. Reinforcing bars must not be bent after installation except as set forth in ACI 318-19 Section 26.6.3.2 (b), ACI 318-14 Section 26.6.3.1 (b) or ACI 318-11 Section 7.3.2, as applicable, with the additional condition that the bars must be bent cold, and heating of reinforcing bars to facilitate field bending is not permitted.

3.2.4.3 Ductility: In accordance with ACI 318-19 and ACI 318-14 2.3 or ACI 318-11 D.1, as applicable, in order for a steel anchor element to be considered ductile, the tested elongation must be at least 14 percent and reduction of area must be at least 30 percent. Steel elements with a

tested elongation 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 values are nonconforming or unstated, the steel must be considered brittle.

3.2.4.4 Steel Reinforcing Bars for use in Post-Installed Reinforcing Bar Connections: Steel reinforcing bars used in post-installed reinforcing bar connections are deformed reinforcing bars (rebar), with size ranges summarized in Tables 16 and 17. The embedded portions of reinforcing bars must be 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 except as set forth in ACI 318-19 Section 26.6.3.2 (b), ACI 318-14 Section 26.6.3.1 (b) or ACI 318-11 Section 7.3.2, as applicable, with the additional condition that the bars must be bent cold, and heating of reinforcing bars to facilitate field bending is not permitted.

3.3 Concrete:

Normal-weight and lightweight concrete must comply with Sections 1903 and 1905 of the IBC. The specified compressive strength of the concrete must be from 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa).

4.0 DESIGN AND INSTALLATION

4.1 Strength Design:

4.1.1 General: The design strength of anchors under the 2021 IBC, as well as the 2021 IRC, must be determined in accordance with ACI 318-19 and this report. The design strength of anchors under the 2018 and 2015 IBC, as well as the 2018 and 2015 IRC, must be determined in accordance with ACI 318-14 and this report. The design strength of anchors under the 2012 IBC, as well as the 2012 IRC, must be determined in accordance with ACI 318-11 and this report.

The strength design of anchors must comply with ACI 318-19 17.5.1.2 or ACI 318-14 17.3.1 or 318-11 D.4.1, as applicable, except as required in ACI 318-19 17.10 or ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable.

Design parameters are provided in Tables 4 through Table 9 of this report. Strength reduction factors, ϕ , as given in ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, must be used for load combinations calculated in accordance with Section 1605.1 of the 2021 IBC, Section 1605.2 of the 2018, 2015, or 2012 IBC, ACI 318-14 5.3 or ACI 318-11 9.2, as applicable.

Strength reduction factors, ϕ , as given in ACI 318-11 D.4.4 must be used for load combinations calculated in accordance with ACI 318-11 Appendix C.

4.1.2 Static Steel Strength in Tension: The nominal static steel strength of a single anchor in tension, N_{sa} , in accordance with ACI 318-19 17.6.1.2, ACI 318-14 17.4.1.2 or ACI 318-11 D.5.1.2, as applicable, and the associated strength reduction factors, ϕ , in accordance with ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are provided in Tables 4, 7, 10 and 13 of this report for the corresponding anchor steel.

4.1.3 Static Concrete Breakout Strength in Tension: 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 318-19 17.6.2, ACI 318-14 17.4.2 or ACI 318-11 D.5.2, as applicable, with the following addition:

The basic concrete breakout strength of a single anchor in tension, N_b , must be calculated in accordance with ACI 318-19 17.6.2.2, ACI 318-14 17.4.2.2 or ACI 318-11 D.5.2.2, as applicable, using the values of $k_{C,cr}$ and $k_{C,uncr}$

as provided in Tables 5, 8, 11, and 14 of this report. Where analysis indicates no cracking in accordance with ACI 318-19 17.6.2.5, ACI 318-14 17.4.2.6 or ACI 318-11 D.5.2.6, as applicable, N_b must be calculated using $K_{c,uncr}$ and $\Psi_{c,N} = 1.0$. For anchors in lightweight concrete see ACI 318-19 17.2.4, ACI 318-14 17.2.6 or ACI 318-11 D.3.6, as applicable. The value of f'_c used for calculation must be limited to 8,000 psi (55 MPa) in accordance with ACI 318-19 17.3.1, ACI 318-14 17.2.7 or ACI 318-11 D.3.7, as applicable. Additional information for the determination of nominal bond strength in tension is given in Section 4.1.4 of this report.

4.1.4 Static Bond Strength in Tension: The nominal static bond strength of a single adhesive anchor or group of adhesive anchors in tension, N_a or N_{ag} , must be calculated in accordance with ACI 318-19 17.6.5, ACI 318-14 17.4.5 or ACI 318-11 D.5.5, as applicable.

Bond strength values ($\tau_{k,cr}$, $\tau_{k,uncr}$) are a function of concrete compressive strength, concrete state (cracked, uncracked), and installation conditions (dry concrete, water-saturated concrete, water-filled holes, submerged concrete). The following table summarizes the requirements:

| CONCRETE STATE | BOND STRENGTH | CONCRETE COMPRESSIVE STRENGTH | PERMISSIBLE INSTALLATION CONDITIONS | ASSOCIATED STRENGTH REDUCTION FACTOR |
|----------------|-----------------|-------------------------------|-------------------------------------|--------------------------------------|
| Cracked | $\tau_{k,cr}$ | f'_c | Dry concrete | ϕ_d |
| | | | Water-saturated concrete | ϕ_{ws} |
| | | | Water-filled hole (flooded) | $K_{wrf} \cdot \phi_{wrf}$ |
| | | | Underwater (submerged) | ϕ_{uw} |
| Uncracked | $\tau_{k,uncr}$ | f'_c | Dry concrete | ϕ_d |
| | | | Water-saturated concrete | ϕ_{ws} |
| | | | Water-filled hole (flooded) | $K_{wrf} \cdot \phi_{wrf}$ |
| | | | Underwater (submerged) | ϕ_{uw} |

Strength reduction factors for determination of the bond strength are given in Tables 6, 9, 12, and 15 of this report. Adjustments to the bond strength may also be made for increased concrete compressive strength as noted in the footnotes to the corresponding tables and this section.

The bond strength values in Tables 6, 9, 12, and 15 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 the following as follows: threaded rod in uncracked concrete by $(f'_c / 2,500)^{0.21}$ [For **SI**: $f'_c / 17.2)^{0.21}$]; threaded rod in cracked concrete by $(f'_c / 2,500)^{0.14}$ [For **SI**: $f'_c / 17.2)^{0.14}$]; reinforcing bar in uncracked concrete by $(f'_c / 2,500)^{0.18}$ [For **SI**: $f'_c / 17.2)^{0.18}$]. Where applicable, the modified bond strength values must be used in lieu of $\tau_{k,cr}$ and $\tau_{k,uncr}$ in ACI 318-19 (17.6.5.1.2b) and (17.6.5.2.1), ACI 318-14 Equations (17.4.5.1d) and (17.4.5.2) or ACI 318-11 Equations (D-21) and (D-22), as applicable.

The resulting nominal bond strength must be multiplied by the associated strength reduction factor ϕ_d , ϕ_{ws} , ϕ_{wrf} or ϕ_{uw} , as applicable.

4.1.5 Static Steel Strength in Shear: The nominal static steel strength of a single anchor in shear as governed by the steel, V_{sa} , in accordance with ACI 318-19 17.7.1.2, ACI 318-14 17.5.1.2 or ACI 318-11 D.6.1.2, as applicable, and the strength reduction factor, ϕ , in accordance with ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are given in Tables 4, 7, 10, and 13 of this report for the corresponding anchor steel.

4.1.6 Static Concrete Breakout Strength in Shear: The nominal static concrete breakout strength of a single anchor or group of anchors in shear, V_{cb} or V_{cbg} , must be calculated in accordance with ACI 318-19 17.7.2, ACI 318-14 17.5.2 or 318-11 D.6.2, as applicable, based on information given in Tables 5, 8, 11, and 14 in this report.

The basic concrete breakout strength of a single anchor in shear, V_b , must be calculated in accordance with ACI 318-19 17.7.2.2, ACI 318-14 17.5.2.2 or ACI 318-11 D.6.2.2, as applicable using the values of d given in Tables 5, 8, 11, and 14 for the corresponding anchor steel in lieu of d_a (2021, 2018, 2015, and 2012 IBC). In addition, h_{ef} must be substituted for ℓ_e . In no case shall ℓ_e exceed $8d$. The value of f'_c shall be limited to a maximum of 8,000 psi (55 MPa) in accordance with ACI 318-19 17.3.1, ACI 318-14 17.2.7 or ACI 318-11 D.3.7, as applicable.

4.1.7 Static Concrete Pryout Strength in Shear: The nominal static pryout strength of a single anchor or group of anchors in shear, V_{cp} or V_{cpg} , shall be calculated in accordance with ACI 318-19 17.7.3, ACI 318-14 17.5.3 or ACI 318-11 D.6.3, as applicable.

4.1.8 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 318-19 17.8, ACI 318-14 17.6 or ACI 318-11 D.7, as applicable.

4.1.9 Minimum Member Thickness h_{min} , Anchor Spacing s_{min} , Edge Distance c_{min} : In lieu of ACI 318-19 17.9.2, ACI 318-14 17.7.1 and 17.7.3 or ACI 318-11 D.8.1 and D.8.3, as applicable, values of s_{min} and c_{min} described in this report must be observed for anchor design and installation. The minimum member thicknesses, h_{min} , described in this report must be observed for anchor design and installation. For adhesive anchors that will remain untorqued, ACI 318-19 17.9.3, ACI 318-14 17.7.4 or ACI 318-11 D.8.4, as applicable.

For anchors that will be torqued during installation, the maximum torque, T_{max} , must be reduced for edge distances less than five anchor diameters ($5d$). T_{max} is subject to the edge distance, c_{min} , and anchor spacing, s_{min} , and shall comply with the following requirements:

| INSTALLATION TORQUE SUBJECT TO EDGE DISTANCE | | | |
|--|----------------------------------|-----------------------------------|---------------------------|
| NOMINAL ANCHOR SIZE, D | MINIMUM EDGE DISTANCE, c_{min} | MINIMUM ANCHOR SPACING, s_{min} | MAXIMUM TORQUE, T_{max} |
| $5/8$ in. to 1 in. M16 to M27 | 1.75 in. (45 mm) | $5d$ | $0.45 \cdot T_{max}$ |
| $1\ 1/4$ in. M30 | 2.75 in. (70 mm) | | |

For values of T_{max} , see Figure 5 of this report.

4.1.10 Critical Edge Distance c_{ac} and $\psi_{cp,Na}$: The modification factor, $\psi_{cp,Na}$, must be determined in

accordance with ACI 318-19 17.6.5.5, ACI 318-14 17.4.5.5 or ACI 318-11 D.5.5.5, as applicable, except as noted below:

For all cases where $c_{Na}/c_{ac} < 1.0$, $\psi_{cp,Na}$ determined from ACI 318-19 Eq. 17.6.5.5.1b, ACI 318-14 Eq. 17.4.5.5b or ACI 318-11 Eq. D-27, as applicable, need not be taken less than c_{Na}/c_{ac} . For all other cases, $\psi_{cp,Na}$ shall be taken as 1.0.

The critical edge distance, c_{ac} must be calculated according to Eq. 17.6.5.5.1c of ACI 318-19, Eq. 17.4.5.5c for ACI 318-14 or Eq. D-27a for ACI 318-11, in lieu of ACI 318-19 17.9.5, ACI 318-14 17.7.6 or ACI 318-11 D.8.6, as applicable.

$$c_{ac} = h_{ef} \left(\frac{\tau_{k,uncr}}{1160} \right)^{0.4} \cdot \left[3.1 - 0.7 \frac{h}{h_{ef}} \right]$$

(Eq. 17.6.5.5.1c for ACI 318-19 or Eq. 17.4.5.5c for ACI 318-14 or Eq. D-27a for ACI 318-11)

where

$\left[\frac{h}{h_{ef}} \right]$ need not be taken as larger than 2.4; and

$\tau_{k,uncr}$ = the characteristic bond strength stated in the tables of this report whereby $\tau_{k,uncr}$ need not be taken as larger than:

$$\tau_{k,uncr} = \frac{k_{uncr} \sqrt{h_{ef} f'_c}}{\pi d_a} \quad \text{Eq. (4-1)}$$

4.1.11 Requirements for Seismic Design Categories C, D, E and F: In structures assigned to Seismic Design Category C, D, E or F under the IBC or IRC, anchors must be designed in accordance with ACI 318-19 17.10, ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable.

The nominal steel shear strength, V_{sa} , must be adjusted by $\alpha_{V,seis}$ as given in Tables 4, 7, 10, and 13 for the corresponding anchor steel. The nominal bond strength $\tau_{k,cr}$ must be adjusted by $\alpha_{N,seis}$ as given in Tables 6, 9, 12, and 15 for the corresponding anchor steel.

As an exception to ACI 318-11 Section D.3.3.4.2:

Anchors designed to resist wall out-of-plane forces with design strengths equal to or greater than the force determined in accordance with ASCE 7 Equation 12.11-1 or 12.14-10 shall be deemed to satisfy Section ACI 318-11 D.3.3.4.3(d).

Under ACI 318-11 D.3.3.4.3(d), in lieu of requiring the anchor design tensile strength to satisfy the tensile strength requirements of ACI 318-11 D.4.1.1, the anchor design tensile strength shall be calculated from ACI 318-11 D.3.3.4.4.

The following exceptions apply to ACI 318-11 D.3.3.5.2:

1. For the calculation of the in-plane shear strength of anchor bolts attaching wood sill plates of bearing or non-bearing walls of light-frame wood structures to foundations or foundation stem walls, the in-plane shear strength in accordance with ACI 318-11 D.6.2 and D.6.3 need not be computed and ACI 318-11 D.3.3.5.3 need not apply provided all of the following are satisfied:

1.1. The allowable in-plane shear strength of the anchor is determined in accordance with AF&PA NDS Table 11E for lateral design values parallel to grain.

1.2. The maximum anchor nominal diameter is $5/8$ inch (16 mm).

1.3. Anchor bolts are embedded into concrete a minimum of 7 inches (178 mm).

1.4. Anchor bolts are located a minimum of $1\ 3/4$ inches (45 mm) from the edge of the concrete parallel to the length of the wood sill plate.

1.5. Anchor bolts are located a minimum of 15 anchor diameters from the edge of the concrete perpendicular to the length of the wood sill plate.

1.6. The sill plate is 2-inch or 3-inch nominal thickness.

2. For the calculation of the in-plane shear strength of anchor bolts attaching cold-formed steel track of bearing or non-bearing walls of light-frame construction to foundations or foundation stem walls, the in-plane shear strength in accordance with ACI 318-11 D.6.2 and D.6.3 need not be computed and ACI 318-11 D.3.3.5.3 need not apply provided all of the following are satisfied:

2.1. The maximum anchor nominal diameter is $5/8$ inch (16 mm).

2.2. Anchors are embedded into concrete a minimum of 7 inches (178 mm).

2.3. Anchors are located a minimum of $1\ 3/4$ inches (45 mm) from the edge of the concrete parallel to the length of the track.

2.4. Anchors are located a minimum of 15 anchor diameters from the edge of the concrete perpendicular to the length of the track.

2.5. The track is 33 to 68 mil designation thickness.

Allowable in-plane shear strength of exempt anchors, parallel to the edge of concrete, shall be permitted to be determined in accordance with AISI S100 Section E3.3.1.

3. In light-frame construction, bearing or nonbearing walls, shear strength of concrete anchors less than or equal to 1 inch [25 mm] in diameter attaching a sill plate or track to foundation or foundation stem wall need not satisfy ACI 318-11 D.3.3.5.3(a) through (c) when the design strength of the anchors is determined in accordance with ACI 318-11 D.6.2.1(c).

4.2 Strength Design of Post-Installed Reinforcing Bars:

4.2.1 General: The design of straight post-installed deformed reinforcing bars must be determined in accordance with ACI 318 rules for cast-in-place reinforcing bar development and splices and this report.

4.2.2 Determination of bar development length l_d : Values of l_d must be determined in accordance with the ACI 318 development and splice length requirements for straight cast-in-place reinforcing bars.

Exceptions:

1. For uncoated and zinc-coated (galvanized) post-installed reinforcing bars, the factor ψ_e shall be taken as 1.0. For all other cases, the requirements in ACI 318-19 Table 25.4.2.5, ACI 318-14 Table 25.4.2.4 or ACI 318-11 Section 12.2.4 (b) shall apply.

2. When using alternate methods to calculate the development length (e.g. anchor theory), the applicable factors for post-installed anchors generally apply.

4.2.3 Minimum Member Thickness, h_{min} , Minimum Concrete Cover, $c_{c,min}$, Minimum Concrete Edge Distance, $c_{b,min}$, Minimum Spacing, $s_{b,min}$: For post-installed reinforcing bars, there is no limit on the minimum member thickness. In general, all requirements on concrete cover and spacing applicable to straight cast-in-bars designed in accordance with ACI 318 shall be maintained.

For post-installed reinforcing bars installed at embedment depths greater than $20d$ ($h_{ef} > 20d$), the minimum concrete cover shall be as follows:

| REBAR SIZE | MINIMUM CONCRETE COVER, $c_{c,min}$ |
|---|-------------------------------------|
| $d_b \leq$ No. 6 (16 mm) | 1 3/16 in. (30mm) |
| No. 6 < $d_b \leq$ No. 11 (16mm < $d_b \leq$ 36mm) | 1 9/16 in. (40 mm) |

The following requirements apply for minimum concrete edge and spacing for $h_{ef} > 20d$:

Required minimum edge distance for post-installed reinforcing bars (measured from the center of the bar):

$$c_{b,min} = d_o/2 + c_{c,min}$$

Required minimum center-to-center spacing between post-installed bars:

$$s_{b,min} = d_o + c_{c,min}$$

Required minimum center-to-center spacing from existing (parallel reinforcing):

$$s_{b,min} = d_b/2 \text{ (existing reinforcing)} + d_o/2 + c_{c,min}$$

All other requirements applicable to straight cast-in place bars designed in accordance with ACI 318 shall be maintained.

4.2.4 Design Strength in Seismic Design Categories C, D, E and F:

In structures assigned to Seismic Category C, D, E or F under the IBC or IRC, design of straight post-installed reinforcing bars must consider the provisions of ACI 318-19 or ACI 318-14 Chapter 18 or ACI 318-11 Chapter 21, as applicable.

4.2.5 Design in Fire Resistive Construction Conditions:

For post-installed reinforcing bars, the relationship of bond stress to temperature under fire conditions suitable for use in determining conformance with fire resistance rating requirements is as given in Figure 4.

For temperatures above θ_{max} of 477°F (247°C), $\tau_{fire}(\theta) = 0$. The bond stress $\tau_{fire}(\theta)$, shall not exceed 1,090 psi (7.5 N/mm²).

Where θ is the temperature in the concrete at the post-installed reinforcing bar in °F (for psi) or °C (for N/mm²), as applicable.

Determination of the temperature in the concrete at the location of the post-installed reinforcing bar is dependent on the geometry of the concrete members under consideration and its calculation is the responsibility of the design professional. The design professional shall use the bond strength / temperature curves in Figure 4 along with a determination of the temperature in the concrete appropriate for the member geometry under consideration to calculate the reinforcing bar development length l_d .

4.3 Installation:

Installation parameters are illustrated in Figures 2 and 5 and Tables 5, 8, 11, and 14 of this report. Installation must be in accordance with ACI 318-19 26.7.2, ACI 318-14 17.8.1 and 17.8.2 or ACI 318-11 D.9.1 and D.9.2. Anchor locations must comply with this report and the plans and specifications approved by the code official. Installation of the Chemofast EP 800 Adhesive Anchor System must conform to the manufacturer's printed installation instructions included in each unit package as described in Figure 5 of this report.

The adhesive anchor system may be installed in downwards, horizontally and upwardly inclined orientation applications (e.g. overhead). If the bottom or back of the bore hole is not reached with the mixing nozzle, a mixer extension tube, supplied by Chemofast must be attached

to the mixing nozzle as described in Figure 5 of this report. Additionally, horizontal or upwardly inclined orientation applications of all bore hole depths, and downwards applications with a bore hole depth of more than 10 inch (250 mm) are to be installed using piston plugs for the 5/8-inch and M16 through 1 1/4-inch and M30 diameter threaded steel rods, and No. 5 and ø14 through No. 10 and ø32, steel reinforcing bars, installed in the specified hole diameter, and attached to the mixing nozzle and extension tube supplied by Chemofast as described in Figure 5 in this report. For installation with the 3/8-inch, 1/2-inch, M10 and M12 diameter threaded steel rods, and No. 3, No. 4, ø10 and ø12 steel reinforcing bars only, a piston plug is not required.

Installation of anchors in horizontal or upwardly inclined orientations shall be fully restrained from movement throughout the specified curing period through the use of temporary wedges, external supports, or other methods. Where temporary restraint devices are used, their use shall not result in impairment of the anchor shear resistance.

4.4 Special Inspection:

Periodic special inspection must be performed where required in accordance with Section 1705.1.1 and Table 1705.3 of the 2021, 2018, 2015 and 2012 IBC and this report. The special inspector must be on the jobsite initially during anchor installation to verify the anchor type, adhesive expiration date, anchor dimensions, concrete type, concrete compressive strength, hole dimensions, hole cleaning procedures, anchor spacing, edge distances, concrete thickness, anchor embedment, tightening torque, and adherence to the manufacturer's printed installation instructions.

The special inspector must verify the initial installations of each type and size of adhesive anchor by construction personnel on 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.

Continuous special inspection of adhesive anchors installed in horizontal or upwardly inclined orientations to resist sustained tension loads must be performed in accordance with ACI 318-19 26.13.3.2(e), ACI 318-14 17.8.2.4, 26.7.1(h) and 26.13.3.2 (c) or ACI 318-11 D.9.2.4, as applicable.

Under the IBC, additional requirements as set forth in Sections 1705, 1706 or 1707 must be observed, where applicable.

5.0 CONDITIONS OF USE

The Chemofast EP 800 Adhesive Anchor and Post Installed Reinforcing Bar Connection System described in this report complies with, or is a suitable alternative to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

- 5.1 Chemofast EP 800 adhesive anchors and post-installed reinforcing bars must be installed in accordance with the manufacturer's printed installation instructions included with each cartridge and provided in Figure 5 of this report.
- 5.2 Anchors [3/8-, 1/2-, 5/8-, 3/4-, 7/8-, 1-, and 1 1/4-inch fractional diameter and M10, M12, M16, M20, M24, M27 and M30 metric diameter threaded steel rods, and No. 3 through No. 10 fractional size and ø10,

ø12, ø14, ø16, ø20, ø25, ø28 and ø32 metric steel reinforcing bars] described in this report must be installed in cracked and uncracked normal-weight concrete having a specified compressive strength $f_c = 2,500$ psi to 8,500 psi (17.2 MPa to 58.6 MPa).

- 5.3 Post-installed reinforcing bars with diameters No. 3 through No. 11 fractional size and ø10, ø12, ø14, ø16, ø20, ø25, ø28, ø32 and ø36 metric size steel reinforcing bars in hammer-drilled (or Chemofast hollow drill bit system) and diamond core holes are used in cracked and uncracked normal-weight concrete only, to resist static, wind or earthquake (IBC Seismic Design Categories A through F) tension and shear loads. Use is limited to normal-weight concrete with a specified compressive strength, $f_c = 2,500$ psi to 8,500 psi (17.2 MPa to 58.6 MPa)
- 5.4 The values of f_c used for calculation purposes must not exceed 8,000 psi (55 MPa).
- 5.5 Anchors and post-installed reinforcing bars must be installed in concrete base materials in holes predrilled in accordance with the instructions provided in Figure 5 of this report.
- 5.6 Loads applied to the anchors must be adjusted in accordance with Section 1605.1 of the 2021 IBC, or Section 1605.2 of the 2018, 2015, and 2012 IBC for strength design.
- 5.7 In structures assigned to Seismic Design Categories C, D, E, and F under the IBC or IRC, anchor strength must be adjusted in accordance with Section 4.1.11 of this report.
- 5.8 Chemofast EP 800 adhesive anchors are permitted to be installed in concrete that is cracked or that may be expected to crack during the service life of the anchor, subject to the conditions of this report.
- 5.9 Strength design values are established in accordance with Section 4.1 of this report.
- 5.10 Minimum anchor spacing and edge distance as well as minimum member thickness must comply with the values described 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 Anchors are not permitted to support fire-resistive construction. Where not otherwise prohibited by the code, Chemofast EP 800 adhesive anchors are permitted for installation in fire-resistive 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 gravity load-bearing structural elements are within a fire-resistive envelope or a fire-resistive membrane, are protected by approved fire-resistive materials, or have been evaluated for resistance to fire exposure in accordance with recognized standards.
 - Anchors are used to support nonstructural elements.
 - Post-installed reinforcing bars designed in accordance with Section 4.2.5 of this report.
- 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 zinc-plated carbon steel threaded rods or steel reinforcing bars is limited to dry, interior locations.
- 5.15 Use of hot-dipped galvanized carbon steel and stainless steel rods is permitted for exterior exposure or damp environments.
- 5.16 Steel anchoring materials in contact with preservative-treated and fire-retardant-treated wood shall be of zinc-coated steel or stainless steel. The minimum coating weights for zinc-coated steel shall be in accordance with ASTM A153.
- 5.17 Periodic special inspection must be provided in accordance with Section 4.3 in this report. Continuous special inspection for anchors installed in horizontal or upwardly inclined orientations to resist sustained tension loads must be provided in accordance with Section 4.3 of this report.
- 5.18 Installation of anchors and post-installed reinforcing bars in horizontal or upwardly inclined orientations to resist sustained tension loads must be performed by personnel certified by an applicable certification program in accordance with ACI 318-19 26.7.2(e), ACI 318-14 17.8.2.2 or 17.8.2.3 or ACI 318-11 D.9.2.2 or D.9.2.3, as applicable.
- 5.19 Chemofast EP 800 adhesive anchors and post-installed reinforcing bars may be used to resist tension and shear forces in floor, wall or overhead installations into concrete with a temperature between 41°F and 104°F (5°C and 40°C) for threaded rods and reinforcing bars.
- 5.20 Chemofast EP 800 adhesive is manufactured in Willich, Germany, and Lonoke, Arkansas under a quality control program with inspections by ICC-ES.

6.0 EVIDENCE SUBMITTED



Data in accordance with the ICC-ES Acceptance Criteria for Post-installed Adhesive Anchors and Reinforcing Bar Connections in Concrete (AC308), dated October 2022, which incorporates requirements in ACI 355.4-11 and ACI 355.4-19 for use in cracked and uncracked concrete.

7.0 IDENTIFICATION

- 7.1 The ICC-ES mark of conformity, electronic labeling, or the evaluation report number (ICC-ES ESR-4901) along with the name, registered trademark, or registered logo of the report holder must be included in the product label.
- 7.2 Chemofast EP 800 adhesive is identified by packaging labeled with the manufacturer's name (Chemofast Anchoring GmbH) and address, anchor name, the lot number, the expiration date, and the evaluation report number (ESR-4901). 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 Tables 2 and 3 of this report.
- 7.3 The report holder's contact information is the following:

CHEMOFAST ANCHORING GMBH
HANNS-MARTIN-SCHLEYER-STRASSE 23
47877 WILLICH
GERMANY
+49 (2154) 8123-0
www.chemofast.de
info@chemofast.de

TABLE 1—DESIGN TABLE INDEX

| DESIGN STRENGTH ¹ - THREADED RODS | | Fractional | Metric |
|---|--|------------|----------|
|  | Steel Strength - N_{sa}, V_{sa} | Table 4 | Table 10 |
| | Concrete Strength - $N_{pn}, N_{sb}, N_{sbg}, N_{cb}, N_{cbg}, V_{cb}, V_{cbg}, V_{cp}, V_{cpg}$ | Table 5 | Table 11 |
| | Bond Strength ² - N_b, N_{bg} | Table 6 | Table 12 |
| DESIGN STRENGTH ¹ - REINFORCING STEEL | | Fractional | Metric |
|  | Steel Strength - N_{sa}, V_{sa} | Table 7 | Table 13 |
| | Concrete Strength - $N_{pn}, N_{sb}, N_{sbg}, N_{cb}, N_{cbg}, V_{cb}, V_{cbg}, V_{cp}, V_{cpg}$ | Table 8 | Table 14 |
| | Bond Strength ² - N_b, N_{bg} | Table 9 | Table 15 |
| | Determination of development length for post-installed reinforcing bar connections | Table 16 | Table 17 |

¹Ref. ACI 318-19 17.5.2, ACI 318-14 17.3.1.1 or 318-11 D.4.1.1, as applicable.

²See Section 4.1 of this evaluation report.

TABLE 2—SPECIFICATIONS AND PHYSICAL PROPERTIES OF COMMON CARBON AND STAINLESS STEEL THREADED ROD MATERIALS¹

| THREADED ROD SPECIFICATION | | MINIMUM SPECIFIED ULTIMATE STRENGTH, f_{uta} | MINIMUM SPECIFIED YIELD STRENGTH 0.2 PERCENT OFFSET, f_{ya} | f_{uta}/f_{ya} | ELONGATION, MIN. PERCENT ¹¹ | REDUCTION OF AREA, MIN. PERCENT | SPECIFICATION FOR NUTS ¹² | |
|----------------------------------|---|--|---|------------------|--|---------------------------------|--------------------------------------|--|
| CARBON STEEL | ASTM A193 ² Grade B7 all sizes | psi (MPa) | 125,000 (862) | 105,000 (724) | 1.19 | 16 | 50 | ASTM A194 / A563 Grade DH |
| | ASTM A36 ³ / F1554 ⁴ , Grade 36 all sizes | psi (MPa) | 58,000 (400) | 36,000 (250) | 1.61 | 23 | 40 | ASTM A194 / A563 Grade A |
| | ASTM F1554 ⁴ Grade 55 | psi (MPa) | 75,000 (517) | 55,000 (380) | 1.36 | 23 | 40 | |
| | ASTM F1554 ⁴ Grade 105 | psi (MPa) | 125,000 (860) | 105,000 (724) | 1.19 | 15 | 45 | ASTM A194 / A563 Grade DH |
| | ASTM A449 ⁵ ³ / ₈ to 1 in. | psi (MPa) | 120,000 (830) | 92,000 (635) | 1.30 | 14 | 35 | |
| | ASTM A449 ⁵ 1 ¹ / ₄ in | psi (MPa) | 105,000 (720) | 81,000 (560) | 1.30 | 14 | 35 | |
| | ASTM F568M ⁶ Class 5.8 (equivalent to ISO 898-1) | psi (MPa) | 72,500 (500) | 58,000 (400) | 1.25 | 10 | 35 | ASTM A563 Grade DH DIN 934 (8-A2K) ¹³ |
| | ISO 898-1 ⁷ Class 5.8 | MPa (psi) | 500 (72,500) | 400 (58,000) | 1.25 | 22 | - | EN ISO 4032 Grade 6 |
| ISO 898-1 ⁷ Class 8.8 | MPa (psi) | 800 (116,000) | 640 (92,800) | 1.25 | 12 | 52 | EN ISO 4032 Grade 8 | |
| STAINLESS STEEL | ASTM F593 ⁸ CW1 ³ / ₈ to ⁵ / ₈ in. (316) | psi (MPa) | 100,000 (690) | 65,000 (450) | 1.54 | 20 | - | ASTM F594 Alloy Group 1, 2 or 3 |
| | ASTM F593 ⁸ CW2 ³ / ₄ to 1 ¹ / ₄ in. (316) | psi (MPa) | 85,000 (590) | 45,000 (310) | 1.89 | 25 | - | |
| | ASTM A193/A193M ⁹ Grade B8/B8M2, Class 2B | psi (MPa) | 95,000 (655) | 75,000 (515) | 1.27 | 25 | 40 | ASTM A194/A194M |
| | ISO 3506-1 ¹⁰ A4-70 (M8-M24) | MPa (psi) | 700 (101,500) | 450 (65,250) | 1.56 | 40 | - | EN ISO 4032 |
| | ISO 3506-1 ¹⁰ A4-50 (M27-M30) | MPa (psi) | 500 (72,500) | 210 (30,450) | 2.38 | 40 | - | EN ISO 4032 |

¹Adhesive must be used with continuously threaded carbon or stainless steel rod (all-thread) having thread characteristics complying with ANSI B1.1 UNC Coarse Thread Series.

²Standard Specification for Alloy-Steel and Stainless steel Bolting Materials for High temperature of High Pressure service and Other Special Purpose Applications.

³Standard Specification for Carbon Structural steel

⁴Standard Specification for Anchor Bolts, Steel 36, 55 and 105-ksi Yield Strength.

⁵Standard Specification for Hex Cap Screws, Bolts and Studs, Heat Treated, 120/105/50 ksi Minimum Tensile Strength, General Use.

⁶Standard Specification for Carbon and Alloy Steel external Threaded Metric Fasteners.

⁷Mechanical properties of fasteners made of carbon steel and alloy steel - Part 1: Bolts, Screws and Studs.

⁸Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.

⁹Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.

¹⁰Mechanical properties of corrosion-resistant stainless steel fasteners - Part 1: Bolts, Screws and Studs.

¹¹Based on 2-in. (50 mm) gauge length except for ASTM A193, which is based on a gauge length of 4d.

¹²Nuts 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.

¹³Nuts for metric rods.

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

| REINFORCING SPECIFICATION | UNITS | MINIMUM SPECIFIED ULTIMATE STRENGTH, f_{uta} | MINIMUM SPECIFIED YEILD STRENGTH, f_{ya} |
|--|--------------|--|--|
| ASTM A615 ¹ , A767 ³ Grade 75 | psi (MPa) | 100,000 (690) | 75,000 (520) |
| ASTM A615 ¹ , A767 ³ , A996 ⁴ Grade 60 | psi (MPa) | 90,000 (620) | 60,000 (414) |
| ASTM A706 ² , A757 ³ Grade 60 | psi (MPa) | 80,000 (550) | 60,000 (414) |
| ASTM A615 ¹ , Grade 40 | psi (MPa) | 60,000 (415) | 40,000 (275) |
| DIN 488 ⁵ Bst 500 | MPa (psi) | 550 (80,000) | 500 (72,500) |

¹Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

²Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.

³Standard specification for Zinc-Coated (Galvanized) steel Bars for Concrete Reinforcement.

⁴Standard specification for Rail-Steel and Axle-steel Deformed bars for Concrete Reinforcement.

⁵Reinforcing steel, reinforcing steel bars; dimensions and masses.

| Drilling and cleaning | Tool | Accessories and Shrouds | Vacuum |
|---|--|--|---|
| Dust extraction system for standard drilling and cleaning equipment |  |  SDS-Plus and SDS-Max Drill Bit  Capture Device CAT# 01128 |  Dust Extractor |
| Chemofast hollow drill bit system | Rotary Drill Hammer |  Heller Duster Expert SDS-Plus and SDS-Max Hollow Drill Bit |  Class M vacuum with a minimum air flow rating of 90cfm (150m ³ /h resp. 42l/s). |

FIGURE 1—CHEMOFAST DUST REMOVAL DRILLING SYSTEM WITH HEPA DUST EXTRACTOR OPTIONS

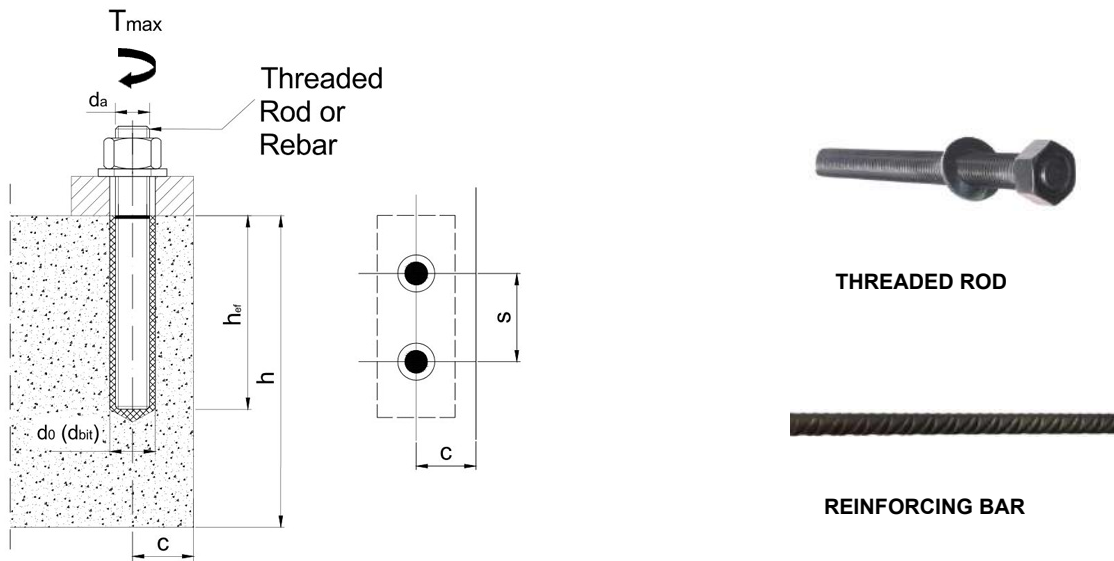


FIGURE 2—INSTALLATION PARAMETERS FOR THREADED RODS AND REINFORCING BARS

TABLE 4—STEEL DESIGN INFORMATION FOR U.S. CUSTOMARY UNIT THREADED ROD¹

| DESIGN INFORMATION | | Symbol | Units | Nominal Rod Diameter (inch) | | | | | | |
|--|--|-------------------|--|-----------------------------|------------------|-------------------|-------------------|-------------------|-------------------|--------------------|
| | | | | 3/8 | 1/2 | 5/8 | 3/4 | 7/8 | 1 | 1 1/4 |
| Threaded rod O.D. | | d_a | in. (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} | in. ² (mm ²) | 0.0775 (50) | 0.1419 (92) | 0.2260 (146) | 0.3345 (216) | 0.4617 (298) | 0.6057 (391) | 0.9691 (625) |
| ASTM A36/F1554, Grade 36 | Nominal strength as governed by steel strength (for a single anchor) | N_{sa} | lb (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} | lb (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 | $\alpha_{V,seis}$ | - | 0.70 | | | | | | |
| | Strength reduction factor for tension ² | ϕ | - | 0.75 | | | | | | |
| | Strength reduction factor for shear ² | ϕ | - | 0.65 | | | | | | |
| ASTM F 1554 Grade 55 | Nominal strength as governed by steel strength (for a single anchor) | N_{sa} | lb (kN) | 5,815 (25.9) | 10,645 (47.6) | 16,950 (75.5) | 25,090 (111.7) | 34,630 (154.1) | 45,430 (202.1) | 72,685 (323.1) |
| | | V_{sa} | lb (kN) | 3,490 (15.5) | 6,385 (28.6) | 10,170 (45.3) | 15,055 (67) | 20,780 (92.5) | 27,260 (121.3) | 43,610 (193.9) |
| | Reduction factor for seismic shear | $\alpha_{V,seis}$ | - | 0.70 | | | | | | |
| | Strength reduction factor for tension ² | ϕ | - | 0.75 | | | | | | |
| | Strength reduction factor for shear ² | ϕ | - | 0.65 | | | | | | |
| ASTM A193 Grade B7 ASTM F1554 Grade 105 | Nominal strength as governed by steel strength (for a single anchor) | N_{sa} | lb (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} | lb (kN) | 5,810 (25.9) | 10,640 (47.3) | 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 | $\alpha_{V,seis}$ | - | 0.70 | | | | | | |
| | Strength reduction factor for tension ² | ϕ | - | 0.75 | | | | | | |
| | Strength reduction factor for shear ² | ϕ | - | 0.65 | | | | | | |
| ASTM A449 | Nominal strength as governed by steel strength (for a single anchor) | N_{sa} | lb (kN) | 9,300 (41.4) | 17,030 (76.2) | 27,120 (120.9) | 40,140 (178.8) | 55,405 (246.7) | 72,685 (323.7) | 101,755 (450.0) |
| | | V_{sa} | lb (kN) | 5,580 (24.8) | 10,220 (45.7) | 16,270 (72.5) | 24,085 (107.3) | 33,240 (148) | 43,610 (194.2) | 61,055 (270.0) |
| | Reduction factor for seismic shear | $\alpha_{V,seis}$ | - | 0.70 | | | | | | |
| | Strength reduction factor for tension ² | ϕ | - | 0.75 | | | | | | |
| | Strength reduction factor for shear ² | ϕ | - | 0.65 | | | | | | |
| ASTM F568M Class 5.8 | Nominal strength as governed by steel strength (for a single anchor) | N_{sa} | lb (kN) | 5,620 (25) | 10,290 (46) | 16,385 (73) | 24,250 (108) | 33,470 (149) | 43,910 (195.5) | 70,260 (312.5) |
| | | V_{sa} | lb (kN) | 3,370 (15) | 6,175 (27.6) | 9,830 (43.8) | 14,550 (64.8) | 20,085 (89.4) | 26,350 (117.3) | 42,155 (187.5) |
| | Reduction factor for seismic shear | $\alpha_{V,seis}$ | - | 0.70 | | | | | | |
| | Strength reduction factor for tension ² | ϕ | - | 0.65 | | | | | | |
| | Strength reduction factor for shear ² | ϕ | - | 0.60 | | | | | | |
| ASTM F593 CW Stainless | Nominal strength as governed by steel strength (for a single anchor) | N_{sa} | lb (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} | lb (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 | $\alpha_{V,seis}$ | - | 0.70 | | | | | | |
| | Strength reduction factor for tension ² | ϕ | - | 0.65 | | | | | | |
| | Strength reduction factor for shear ² | ϕ | - | 0.60 | | | | | | |
| ASTM A193/A193M Grade B8/B8M2, Class 2B | Nominal strength as governed by steel strength (for a single anchor) | N_{sa} | lb (kN) | 7,365 (32.8) | 13,480 (60.3) | 21,470 (95.6) | 31,780 (141.5) | 43,860 (195.2) | 57,540 (256.1) | 92,065 (409.4) |
| | | V_{sa} | lb (kN) | 4,420 (19.7) | 8,090 (36.2) | 12,880 (57.4) | 19,070 (84.9) | 26,320 (117.1) | 34,525 (153.7) | 55,240 (245.6) |
| | Reduction factor for seismic shear | $\alpha_{V,seis}$ | - | 0.70 | | | | | | |
| | Strength reduction factor for tension ² | ϕ | - | 0.75 | | | | | | |
| | Strength reduction factor for shear ² | ϕ | - | 0.65 | | | | | | |

¹Values provided for common rod material types based on specified strengths and calculated in accordance with ACI 318-19 Eq. 17.6.1.2 and Eq. 17.7.1.2b or ACI 318-14 Eq. 17.4.1.2 and Eq. 17.5.1.2b or ACI 318-11 Eq. (D-2) and Eq. (D-29), as applicable. Nuts and washers must comply with requirements for the rod.

²The tabulated value of ϕ applies when the load combinations of Section 1605.1 of the 2021 IBC or Section 1605.2 of the 2018, 2015, and 2012 IBC, ACI 318-19 and ACI 318-14 5.3 or ACI 318-11 9.2, as applicable, as set forth in ACI 318-19 17.5.3 or ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are used. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4.

TABLE 5—CONCRETE BREAKOUT DESIGN INFORMATION FOR U.S. CUSTOMARY UNIT THREADED ROD IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT (OR CHEMOFAST HOLLOW CARBIDE DRILL 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) | 17 (7) | | | | | | |
| Effectiveness factor for uncracked concrete | $k_{c,uncr}$ | in-lb (SI) | 24 (10) | | | | | | |
| Min. anchor spacing | s_{min} | in. (mm) | 1 7/8 (48) | 2 3/8 (60) | 3 (76) | 3 3/4 (95) | 4 1/4 (108) | 4 3/4 (121) | 5 7/8 (149) |
| Min. edge distance | c_{min} | in. (mm) | 1 5/8 (41) | 1 3/4 (44) | 2 (51) | 2 3/8 (60) | 2 1/2 (64) | 2 3/4 (70) | 3 1/4 (82) |
| | | | | | See Section 4.1.9 of this report for smaller edge distance with 0.45 T_{max} | | | | |
| Min. member thickness | h_{min} | in. (mm) | $h_{ef} + 1 1/4$ ($h_{ef} + 30$) | | $h_{ef} + 2d_o^3$ | | | | |
| Critical edge distance - splitting (for uncracked concrete) ² | c_{ac} | - | See Section 4.1.10 of this report. | | | | | | |
| Critical anchor spacing – splitting | s_{ac} | - | $2 \cdot c_{ac}$ | | | | | | |
| Strength reduction factor for tension, concrete failure modes ² | ϕ | - | 0.65 | | | | | | |
| Strength reduction factor for shear, concrete failure modes ² | ϕ | - | 0.70 | | | | | | |

For **SI**: 1 inch = 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006894 MPa.
 For **pound-inch** units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi.

¹Additional setting information is described in Figure 5, installation instructions.
²The strength reduction factor applies when the load combinations from the IBC or ACI 318 are used and the requirements of ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are met. If the load combinations of ACI 318-11 Appendix C are used, the appropriate strength reduction factor must be determined in accordance with ACI 318-11 D.4.4.
³ d_o = hole diameter.



VARIOUS AVAILABLE TWO-COMPONENT CARTRIDGES



STATIC MIXING NOZZLE



CHEMOFAST DISPENSER

FIGURE 3—EP 800 ADHESIVE ANCHOR SYSTEM

TABLE 6—BOND STRENGTH DESIGN INFORMATION FOR U.S. CUSTOMARY UNIT THREADED ROD IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT(OR CHEMOFAST HOLLOW CARBIDE DRILL BIT)¹

| DESIGN INFORMATION | | Symbol | Units | Nominal Rod Diameter (inch) | | | | | | |
|--------------------------------------|--|--|-----------------------------|-----------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| | | | | 3/8 | 1/2 | 5/8 | 3/4 | 7/8 | 1 | 1 1/4 |
| Minimum embedment | | $h_{ef,min}$ | in. (mm) | 2 3/8 (60.3) | 2 3/4 (69.9) | 3 1/8 (79.4) | 3 1/2 (88.9) | 3 1/2 (88.9) | 4 (101.6) | 5 (127.0) |
| Maximum embedment | | $h_{ef,max}$ | in. (mm) | 7 1/2 (191) | 10 (254) | 12 1/2 (318) | 15 (381) | 17 1/2 (445) | 20 (508) | 25 (635) |
| Temperature range A ^{2,3} | Characteristic bond strength in uncracked concrete | $\tau_{k,uncr}$ | psi (N/mm ²) | 2,200 (15.1) | 2,135 (14.7) | 2,075 (14.3) | 2,010 (13.8) | 1,950 (13.4) | 1,885 (13.0) | 1,760 (12.1) |
| | Characteristic bond strength in cracked concrete | $\tau_{k,cr}$ | psi (N/mm ²) | 1,525 (10.5) | 1,535 (10.6) | 1,375 (9.4) | 1,555 (10.7) | 1,530 (10.5) | 1,495 (10.3) | 1,445 (9.9) |
| Temperature range B ^{2,3} | Characteristic bond strength in uncracked concrete | $\tau_{k,uncr}$ | psi (N/mm ²) | 1,720 (11.8) | 1,675 (11.5) | 1,625 (11.2) | 1,575 (10.8) | 1,525 (10.5) | 1,480 (10.1) | 1,380 (9.5) |
| | Characteristic bond strength in cracked concrete | $\tau_{k,cr}$ | psi (N/mm ²) | 1,195 (8.2) | 1,205 (8.3) | 1,080 (7.4) | 1,215 (8.3) | 1,200 (8.2) | 1,170 (8.0) | 1,135 (7.8) |
| Permissible installation conditions | Dry concrete | Anchor Category | - | 1 | | | | | | |
| | | Strength reduction factor | ϕ_d | - | 0.65 | | | | | |
| | Water-saturated concrete | Anchor Category | - | 2 | | | | | | |
| | | Strength reduction factor | ϕ_{ws} | - | 0.55 | | | | | |
| | Water-filled hole (flooded) | Anchor Category | - | 3 | | | | | | |
| | | Strength reduction factor | ϕ_{wf} | - | 0.45 | | | | | |
| | | Modification factor for Water-filled holes | K_{wf} | - | 0.85 | | | | | |
| | Underwater (submerged) | Anchor Category | - | 2 | | | | | | |
| Strength reduction factor | | ϕ_{uw} | - | 0.55 | | | | | | |
| Reduction factor for seismic tension | | $\alpha_{N,seis}$ | - | 1.00 | 1.00 | 0.90 | 1.00 | 0.95 | 1.00 | 1.00 |

For **SI**: 1 inch = 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006894 MPa.
 For **pound-inch** units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi.

¹Bond strength values correspond to concrete compressive strength $f'_c = 2,500$ psi (17.2 N/mm²). For concrete compressive strength, f'_c between 2,500 (17.2 N/mm²) psi and 8,000 psi (55.2 N/mm²), the tabulated characteristic bond strength may be increased by a factor of $(f'_c / 2500)^{0.21}$ [For SI: $(f'_c / 17.2)^{0.21}$] for uncracked concrete, and $(f'_c / 2500)^{0.14}$ [For SI: $(f'_c / 17.2)^{0.14}$] for cracked concrete. See Section 4.1.4 of this report.
²Temperature range A: Maximum short term temperature = 140°F (60°C), maximum long term temperature = 110°F (43°C); Temperature range B: Maximum short term temperature = 176°F (80°C), maximum long term temperature = 110°F (43°C).
 Short term elevated concrete temperatures are those that occur over brief intervals, e.g. as result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.
³Characteristic bond strengths are for sustained loads including dead and live loads. For load combinations consisting of short-term loads only such as wind, bond strengths may be increased by 17 percent.

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 O.D. | | d_b | in. (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 (28.6) | 1.270 (31.8) |
| Reinforcing bar effective cross-sectional area | | A_{se} | in. ² (mm ²) | 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 A615, A767 Grade 75 | Nominal strength as governed by steel strength (for a single anchor) | N_{sa} | lb (kN) | 11,000 (48.9) | 20,000 (89.0) | 31,000 (137.9) | 44,000 (195.7) | 60,000 (266.9) | 79,000 (351.4) | 100,000 (444.8) | 127,000 (564.9) |
| | | V_{sa} | lb (kN) | 6,600 (29.4) | 12,000 (53.4) | 18,600 (82.7) | 26,400 (117.4) | 36,000 (160.1) | 47,400 (210.8) | 60,000 (266.9) | 76,200 (338.9) |
| | Reduction factor for seismic shear | $\alpha_{V,seis}$ | - | 0.70 | | | | | | | |
| | Strength reduction factor for tension ² | ϕ | - | 0.65 | | | | | | | |
| | Strength reduction factor for shear ² | ϕ | - | 0.60 | | | | | | | |
| ASTM A615, A767, A996 Grade 60 | Nominal strength as governed by steel strength (for a single anchor) | N_{sa} | lb (kN) | 9,900 (44.0) | 18,000 (80.1) | 27,900 (124.1) | 39,600 (176.0) | 54,000 (240.0) | 71,100 (316.0) | 90,000 (400.0) | 114,300 (508.0) |
| | | V_{sa} | lb (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 | $\alpha_{V,seis}$ | - | 0.70 | | | | | | | |
| | Strength reduction factor for tension ² | ϕ | - | 0.65 | | | | | | | |
| | Strength reduction factor for shear ² | ϕ | - | 0.60 | | | | | | | |
| ASTM A706 Grade 60 | Nominal strength as governed by steel strength (for a single anchor) | N_{sa} | lb (kN) | 8,800 (39.1) | 16,000 (71.2) | 24,800 (110.3) | 35,200 (156.6) | 48,000 (213.5) | 63,200 (281.1) | 80,000 (355.9) | 101,600 (452.0) |
| | | V_{sa} | lb (kN) | 5,280 (23.5) | 9,600 (42.7) | 14,880 (66.2) | 21,120 (93.9) | 28,800 (128.1) | 37,920 (168.7) | 48,000 (213.5) | 60,960 (271.2) |
| | Reduction for seismic shear | $\alpha_{V,seis}$ | ---- | 0.70 | | | | | | | |
| | Strength reduction factor ϕ for tension ² | ϕ | ---- | 0.75 | | | | | | | |
| | Strength reduction factor ϕ for shear ² | ϕ | ---- | 0.65 | | | | | | | |
| ASTM A615 Grade 40 | Nominal strength as governed by steel strength (for a single anchor) | N_{sa} | lb (kN) | 6,600 (29.4) | 12,000 (53.4) | 18,600 (82.7) | 26,400 (117.4) | In accordance with ASTM A615, Grade 40 bars are furnished only in sizes No. 3 through No. 6 | | | |
| | | V_{sa} | lb (kN) | 3,960 (17.6) | 7,200 (32.0) | 11,160 (49.6) | 15,840 (70.5) | | | | |
| | Reduction factor for seismic shear | $\alpha_{V,seis}$ | - | 0.70 | | | | | | | |
| | Strength reduction factor for tension ² | ϕ | - | 0.65 | | | | | | | |
| | Strength reduction factor for shear ² | ϕ | - | 0.60 | | | | | | | |

For **SI**: 1 inch = 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006894 MPa.
 For **pound-inch** units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi.

¹Values provided for common bar material types based on specified strengths and calculated in accordance with ACI 318-19 Eq. 17.6.1.2, ACI 318-14 Eq. 17.4.1.2 and Eq. 17.5.1.2 b or ACI 318-11 Eq. (D-2) and Eq. (D-29), as applicable.

²The tabulated value of ϕ applies when the load combinations of Section 1605.1 of the 2021 IBC, Section 1605.2 of the 2018, 2015, or 2012 IBC, ACI 318-19 and ACI 318-14 5.3 or ACI 318-11 9.2, as applicable, as set forth in ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are used. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4.

³In accordance with ASTM A615, Grade 40 bars are furnished only in sizes No. 3 through No. 6.

TABLE 8—CONCRETE BREAKOUT DESIGN INFORMATION FOR U.S. CUSTOMARY UNIT REINFORCING BARS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT (OR CHEMOFAST HOLLOW CARBIDE DRILL 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) | 17 (7) | | | | | | | |
| Effectiveness factor for uncracked concrete | $k_{c,uncr}$ | in.-lb. (SI) | 24 (10) | | | | | | | |
| Min. anchor spacing | s_{min} | in. (mm) | 1 ⁷ / ₈ (48) | 2 ³ / ₈ (60) | 3 (77) | 3 ³ / ₄ (95) | 4 ¹ / ₄ (108) | 4 ³ / ₄ (121) | 5 ¹ / ₄ (135) | 5 ⁷ / ₈ (149) |
| Min. edge spacing ⁴ | c_{min} | in. (mm) | 1 ⁵ / ₈ (41) | 1 ³ / ₄ (44) | 2 (51) | 2 ³ / ₈ (60) | 2 ¹ / ₂ (64) | 2 ³ / ₄ (70) | 3 (76) | 3 ¹ / ₄ (82) |
| Min. member thickness | h_{min} | in. (mm) | $h_{ef} + 1\frac{1}{4}$ ($h_{ef} + 30$) | | $h_{ef} + 2d_o^3$ | | | | | |
| Critical edge spacing – splitting (for uncracked concrete) ² | c_{ac} | - | See Section 4.1.10 of this report. | | | | | | | |
| Critical anchor spacing – splitting | s_{ac} | - | 2 · c_{ac} | | | | | | | |
| Strength reduction factor for tension, concrete failure modes ² | ϕ | - | 0.65 | | | | | | | |
| Strength reduction factor for shear, concrete failure modes ² | 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 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi.

¹Additional setting information is described in Figure 5, installation instructions.

²The strength reduction factor applies when the load combinations from the IBC or ACI 318 are used and the requirements of ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are met. If the load combinations of ACI 318-11 Appendix C are used, the appropriate strength reduction factor must be determined in accordance with ACI 318-11 D.4.4.

³ d_o = hole diameter.

TABLE 9—BOND STRENGTH DESIGN INFORMATION FOR U.S. CUSTOMARY UNIT REINFORCING BARS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT¹

| DESIGN INFORMATION | Symbol | Units | Nominal Bar Size | | | | | | | | |
|--------------------------------------|--|--|--------------------------------------|--------------------------------------|--------------------------------------|--------------------------------------|--------------------------------------|--------------|-------------------------------------|--------------|--------------|
| | | | No.3 | No. 4 | No. 5 | No. 6 | No. 7 | No. 8 | No. 9 | No.10 | |
| Minimum embedment | $h_{ef,min}$ | in. (mm) | 2 ³ / ₈ (60.3) | 2 ³ / ₄ (69.9) | 3 ¹ / ₈ (79.4) | 3 ¹ / ₂ (88.9) | 3 ¹ / ₂ (88.9) | 4 (101.6) | 4 ¹ / ₂ (114) | 5 (127.0) | |
| Maximum embedment | $h_{ef,max}$ | in. (mm) | 7 ¹ / ₂ (191) | 10 (254) | 12 ¹ / ₂ (318) | 15 (381) | 17 ¹ / ₂ (445) | 20 (508) | 22.5 (572) | 25 (635) | |
| Temperature range A ^{2,3} | Characteristic bond strength in uncracked concrete | $\alpha_{k,uncr}$ | psi (N/mm ²) | 1,945 (13.4) | 1,910 (13.1) | 1,875 (12.9) | 1,845 (12.7) | 1,810 (12.4) | 1,775 (12.2) | 1,705 (11.7) | 1,705 (11.7) |
| | Characteristic bond strength in cracked concrete | $\alpha_{k,cr}$ | psi (N/mm ²) | 1,460 (10.0) | 1,460 (10.0) | 1,315 (9.0) | 1,460 (10.0) | 1,460 (10.0) | 1,460 (10.0) | 1,430 (9.8) | 1,430 (9.8) |
| Temperature range B ^{2,3} | Characteristic bond strength in uncracked concrete | $\alpha_{k,uncr}$ | psi (N/mm ²) | 1,525 (10.5) | 1,495 (10.3) | 1,470 (10.1) | 1,445 (9.9) | 1,420 (9.7) | 1,390 (9.5) | 1,330 (9.1) | 1,335 (9.2) |
| | Characteristic bond strength in cracked concrete | $\alpha_{k,cr}$ | psi (N/mm ²) | 1,145 (7.8) | 1,145 (7.8) | 1,030 (7.1) | 1,145 (7.8) | 1,145 (7.8) | 1,145 (7.8) | 1,120 (7.7) | 1,120 (7.7) |
| Permissible installation conditions | Dry concrete | Anchor Category | - | - | 1 | | | | | | |
| | | Strength reduction factor | ϕ_d | - | 0.65 | | | | | | |
| | Water-saturated concrete | Anchor Category | - | - | 2 | | | | | | |
| | | Strength reduction factor | ϕ_{ws} | - | 0.55 | | | | | | |
| | Water-filled hole (flooded) | Anchor Category | - | - | 3 | | | | | | |
| | | Strength reduction factor | ϕ_{wf} | - | 0.45 | | | | | | |
| | | Modification factor for Water-filled holes | K_{wf} | - | 0.85 | | | | | | |
| | Underwater (submerged) | Anchor Category | - | - | 2 | | | | | | |
| Strength reduction factor | | ϕ_{uw} | - | 0.55 | | | | | | | |
| Reduction factor for seismic tension | | $\alpha_{N,seis}$ | - | 1.00 | | | | | | | |

For **SI**: 1 inch = 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006894 MPa.
 For **pound-inch** units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi.

¹Bond strength values correspond to concrete compressive strength $f'_c = 2,500$ psi (17.2 N/mm²). For uncracked concrete compressive strength, f'_c between 2,500 psi (17.2 N/mm²) and 8,000 psi (55.2 N/mm²), the tabulated characteristic bond strength may be increased by a factor of $(f'_c / 2500)^{0.18}$ [For SI: $(f'_c / 17.2)^{0.18}$]. See Section 4.1.4 of this report.

²Temperature range A: Maximum short term temperature = 140°F (60°C), maximum long term temperature = 110°F (43°C); Temperature range B: Maximum short term temperature = 176°F (80°C), maximum long term temperature = 110°F (43°C).

Short term elevated concrete temperatures are those that occur over brief intervals, e.g. as result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.

³Characteristic bond strengths are for sustained loads including dead and live loads. For load combinations consisting of short-term loads only such as wind, bond strengths may be increased by 17 percent.

TABLE 10—STEEL DESIGN INFORMATION FOR METRIC THREADED ROD¹

| DESIGN INFORMATION | Symbol | Units | Nominal Rod Diameter (mm) | | | | | | | |
|---|--|--|---------------------------|------------------|------------------|-------------------|-------------------|-------------------|-------------------|--------------------|
| | | | M10 | M12 | M16 | M20 | M24 | M27 | M30 | |
| Threaded rod O.D. | d_a | mm (in.) | 10 (0.39) | 12 (0.47) | 16 (0.63) | 20 (0.79) | 24 (0.94) | 27 (1.06) | 30 (1.18) | |
| Threaded rod effective cross-sectional area | A_{se} | mm ² (in. ²) | 58.0 (0.090) | 84.3 (0.131) | 157 (0.243) | 245 (0.380) | 353 (0.547) | 459 (0.711) | 561 (0.870) | |
| ISO 898-1 Class 5.8 | Nominal strength as governed by steel strength (for a single anchor) | N_{sa} | kN (lb) | 29.0 (6,518) | 42.2 (9,473) | 78.5 (17,643) | 122.5 (27,532) | 176.5 (39,668) | 229.5 (51,580) | 280.5 (63,043) |
| | | V_{sa} | kN (lb) | 14.5 (3,260) | 25.3 (5,684) | 47.1 (10,586) | 73.5 (16,519) | 105.9 (23,801) | 137.7 (30,948) | 168.3 (37,826) |
| | Reduction factor for seismic shear | $\alpha_{V,seis}$ | - | 0.70 | | | | | | |
| | Strength reduction factor for tension ² | ϕ | - | 0.65 | | | | | | |
| | Strength reduction factor for shear ² | ϕ | - | 0.60 | | | | | | |
| ISO 898-1 Class 8.8 | Nominal strength as governed by steel strength (for a single anchor) | N_{sa} | kN (lb) | 46.4 (10,428) | 67.4 (15,157) | 125.6 (28,229) | 196 (44,051) | 282.4 (63,470) | 367.2 (82,528) | 448.8 (100,868) |
| | | V_{sa} | kN (lb) | 23.0 (5,216) | 40.5 (9,094) | 75.4 (16,937) | 117.6 (26,431) | 169.4 (38,082) | 220.3 (49,517) | 269.3 (60,521) |
| | Reduction factor for seismic shear | $\alpha_{V,seis}$ | - | 0.70 | | | | | | |
| | Strength reduction factor for tension ² | ϕ | - | 0.65 | | | | | | |
| | Strength reduction factor for shear ² | ϕ | - | 0.60 | | | | | | |
| ISO 3506-1, A4 stainless steel ³ | Nominal strength as governed by steel strength (for a single anchor) | N_{sa} | kN (lb) | 40.6 (9,125) | 59 (13,263) | 109.9 (24,700) | 171.5 (38,545) | 247.1 (55,536) | 229.5 (51,580) | 280.5 (63,043) |
| | | V_{sa} | kN (lb) | 20.3 (4,564) | 35.4 (7,958) | 65.9 (14,820) | 102.9 (23,127) | 148.3 (33,322) | 137.7 (30,948) | 168.3 (37,826) |
| | Reduction factor for seismic shear | $\alpha_{V,seis}$ | - | 0.70 | | | | | | |
| | Strength reduction factor for tension ² | ϕ | - | 0.65 | | | | | | |
| | Strength reduction factor for shear ² | ϕ | - | 0.60 | | | | | | |

¹Values provided for common rod material types based on specified strengths and calculated in accordance with ACI 318-19 Eq. 17.6.1.2 and Eq. 17.7.1.2b or ACI 318-14 Eq. 17.4.1.2 and Eq. 17.5.1.2b or ACI 318-11 Eq. (D-2) and Eq. (D-29), as applicable. Nuts and washers must comply with requirements for the rod.

²The tabulated value of ϕ applies when the load combinations of Section 1605.1 of the 2021 IBC or Section 1605.2 of the 2018, 2015, and 2012 IBC, ACI 318-19 and ACI 318-14 5.3 or ACI 318-11 9.2, as applicable, as set forth in ACI 318-19 17.5.3 or ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are used. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4.

³A4-70 Stainless steel (M8-M24); A4-50 Stainless steel (M27-M30).

TABLE 11—CONCRETE BREAKOUT DESIGN INFORMATION FOR METRIC THREADED ROD IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT (OR CHEMOFAST HOLLOW CARBIDE DRILL BIT)¹

| DESIGN INFORMATION | Symbol | Units | Nominal Rod Diameter (mm) | | | | | | |
|--|--------------|---------------|--|--|--|--|---|---|---|
| | | | M10 | M12 | M16 | M20 | M24 | M27 | M30 |
| Effectiveness factor for cracked concrete | $k_{c,cr}$ | SI (in-lb) | 7 (17) | | | | | | |
| Effectiveness factor for uncracked concrete | $k_{c,uncr}$ | SI (in-lb) | 10 (24) | | | | | | |
| Min. anchor spacing | s_{min} | mm (in.) | 50 (2) | 60 (2 ³ / ₈) | 80 (3 ¹ / ₈) | 95 (3 ³ / ₄) | 115 (4 ¹ / ₂) | 130 (5 ¹ / ₈) | 145 (5 ¹ / ₂) |
| Min. edge distance | c_{min} | mm (in.) | 40 (1 ⁵ / ₈) | 45 (1 ³ / ₄) | 55 (2 ¹ / ₄) | 60 (2 ³ / ₈) | 70 (2 ³ / ₄) | 75 (3) | 80 (3 ¹ / ₈) |
| | | | See Section 4.1.9 of this report for smaller edge distance with 0.45 T_{max} | | | | | | |
| Min. member thickness | h_{min} | mm (in.) | $h_{ef} + 30$ ($h_{ef} + 1\frac{1}{4}$) | | | $h_{ef} + 2d_o^3$ | | | |
| Critical edge distance - splitting (for uncracked concrete) ² | c_{ac} | - | See Section 4.1.10 of this report. | | | | | | |
| Strength reduction factor for tension, concrete failure modes ² | ϕ | - | 0.65 | | | | | | |
| Strength reduction factor for shear, concrete failure modes ² | ϕ | - | 0.70 | | | | | | |

¹Additional setting information is described in Figure 5, installation instructions.

²The strength reduction factor applies when the load combinations from the IBC or ACI 318 are used and the requirements of ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are met. If the load combinations of ACI 318-11 Appendix C are used, the appropriate strength reduction factor must be determined in accordance with ACI 318-11 D.4.4.

³ d_o = hole diameter.

TABLE 12—BOND STRENGTH DESIGN INFORMATION FOR METRIC THREADED ROD IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT (OR CHEMOFAST HOLLOW CARBIDE DRILL BIT)¹

| DESIGN INFORMATION | | Symbol | Units | Nominal Rod Diameter (inch) | | | | | | | |
|--------------------------------------|--|--|----------------------------|-----------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|--|
| | | | | M10 | M12 | M16 | M20 | M24 | M27 | M30 | |
| Minimum embedment | | $h_{ef,min}$ | mm (in.) | 60 (2.4) | 70 (2.8) | 80 (3.1) | 90 (3.5) | 96 (3.8) | 108 (4.3) | 120 (4.7) | |
| Maximum embedment | | $h_{ef,max}$ | mm (in.) | 200 (7.8) | 240 (14.8) | 320 (12.6) | 400 (15.8) | 480 (18.8) | 540 (21.4) | 600 (23.6) | |
| Temperature range A ^{2,3} | Characteristic bond strength in uncracked concrete | $\bar{a}_{k,uncr}$ | N/mm ² (psi) | 15.0 (2,190) | 14.8 (2,150) | 14.2 (2,070) | 13.7 (1,995) | 13.2 (1,915) | 12.7 (1,855) | 12.3 (1,795) | |
| | Characteristic bond strength in cracked concrete | $\bar{a}_{k,cr}$ | N/mm ² (psi) | 10.5 (1,525) | 10.6 (1,540) | 9.4 (1,375) | 10.7 (1,555) | 10.5 (1,535) | 10.3 (1,495) | 9.9 (1,450) | |
| Temperature range B ^{2,3} | Characteristic bond strength in uncracked concrete | $\bar{a}_{k,uncr}$ | N/mm ² (psi) | 11.8 (1,715) | 11.6 (1,685) | 11.1 (1,625) | 10.7 (1,560) | 10.3 (1,500) | 10.0 (1,453) | 9.7 (1,405) | |
| | Characteristic bond strength in cracked concrete | $\bar{a}_{k,cr}$ | N/mm ² (psi) | 8.2 (1,195) | 8.3 (1,205) | 7.4 (1,080) | 8.3 (1,215) | 8.2 (1,200) | 8.0 (1,170) | 7.8 (1,135) | |
| Permissible installation conditions | Dry Concrete | Anchor category | - | 1 | | | | | | | |
| | | Strength reduction factor | ϕ_{dt} | - | 0.65 | | | | | | |
| | Water-saturated Concrete | Anchor category | - | 2 | | | | | | | |
| | | Strength reduction factor | ϕ_{ws} | - | 0.55 | | | | | | |
| | Water-filled hole (flooded) | Anchor category | - | 3 | | | | | | | |
| | | Strength reduction factor | ϕ_{wf} | - | 0.45 | | | | | | |
| | | Modification factor for water filled holes | K_{wf} | - | 0.85 | | | | | | |
| | Underwater (submerged) | Anchor Category | - | 2 | | | | | | | |
| Strength reduction factor | | ϕ_{uw} | - | 0.55 | | | | | | | |
| Reduction factor for seismic tension | | $\alpha_{N,seis}$ | - | 1.00 | 1.00 | 0.90 | 0.94 | 0.94 | 1.00 | 1.00 | |

¹Bond strength values correspond to concrete compressive strength $f'_c = 2,500$ psi (17.2 N/mm²). For concrete compressive strength, f'_c between 2,500 psi (17.2 N/mm²) and 8,000 psi (55.2 N/mm²), the tabulated characteristic bond strength may be increased by a factor of $(f'_c / 2500)^{0.21}$ [For SI: $(f'_c / 17.2)^{0.21}$] for uncracked concrete and $(f'_c / 2500)^{0.14}$ [For SI: $(f'_c / 17.2)^{0.14}$] for cracked concrete. See Section 4.1.4 of this report.

²Temperature range A: Maximum short term temperature = 140°F (60°C), maximum long term temperature = 110°F (43°C); Temperature range B: Maximum short term temperature = 176°F (80°C), maximum long term temperature = 110°F (43°C).

Short term elevated concrete temperatures are those that occur over brief intervals, e.g. as result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.

³Characteristic bond strengths are for sustained loads including dead and live loads. For load combinations consisting of short-term loads only such as wind, bond strengths may be increased by 17 percent.

TABLE 13—STEEL DESIGN INFORMATION FOR METRIC REINFORCING BARS¹

| DESIGN INFORMATION | Symbol | Units | Nominal Bar Size | | | | | | | | |
|--|--|--|------------------|------------------|------------------|------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| | | | Ø 10 | Ø 12 | Ø 14 | Ø 16 | Ø 20 | Ø 25 | Ø 28 | Ø 32 | |
| Reinforcing bar O.D. | d_b | mm (in.) | 10 (0.394) | 12 (0.472) | 14 (0.551) | 16 (0.630) | 20 (0.787) | 25 (0.984) | 28 (1.102) | 32 (1.260) | |
| Reinforcing bar effective cross-sectional area | A_{se} | mm ² (in. ²) | 78.5 (0.121) | 113.1 (0.175) | 153.9 (0.239) | 201.1 (0.312) | 314.2 (0.487) | 490.9 (0.761) | 615.8 (0.954) | 804.2 (1.247) | |
| DIN 488 BSt 500 | Nominal strength as governed by steel strength (for a single anchor) | N_{sa} | kN (lb) | 43.2 (9,739) | 62.2 (14,024) | 84.7 (19,088) | 110.6 (24,932) | 172.8 (38,956) | 270.0 (60,868) | 338.7 (76,353) | 442.3 (99,727) |
| | | V_{sa} | kN (lb) | 25.9 (5,843) | 37.3 (8,414) | 50.8 (11,453) | 66.4 (14,959) | 103.7 (23,373) | 162.0 (36,521) | 203.2 (45,812) | 265.4 (59,836) |
| | Reduction factor for seismic shear | $\alpha_{V,seis}$ | - | 0.70 | | | | | | | |
| | Strength reduction factor for tension ² | ϕ | - | 0.65 | | | | | | | |
| | Strength reduction factor for shear ² | ϕ | - | 0.60 | | | | | | | |

¹Values provided for common bar material types based on specified strengths and calculated in accordance with ACI 318-19 Eq. 17.6.1.2 and Eq. 17.7.1.2b or ACI 318-14 Eq. 17.4.1.2 and Eq. 17.5.1.2b or ACI 318-11 Eq. (D-2) and Eq. (D-29), as applicable.

²The tabulated value of ϕ applies when the load combinations of Section 1605.1 of the 2021 IBC or Section 1605.2 of the 2018, 2015, 2012 and 2009 IBC, ACI 318-19 and ACI 318-14 5.3 or ACI 318-11 9.2, as applicable, as set forth in ACI 318-19 17.5.3 or ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are used. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4.

TABLE 14—CONCRETE BREAKOUT DESIGN INFORMATION FOR METRIC REINFORCING BARS IN HOLES DRILLED WITH ALL DRILLING METHODS¹

| DESIGN INFORMATION | Symbol | Units | Nominal Bar Size | | | | | | | |
|--|--------------|---------------|--------------------------------------|---------------------------|---------------------------|------------------------------|---------------------------|----------------------------|----------------------------|----------------------------|
| | | | Ø 10 | Ø 12 | Ø 14 | Ø 16 | Ø 20 | Ø 25 | Ø 28 | Ø 32 |
| Effectiveness factor for cracked concrete | $k_{c,cr}$ | SI (in-lb) | 7 (17) | | | | | | | |
| Effectiveness factor for uncracked concrete | $k_{c,uncr}$ | SI (in-lb) | 10 (24) | | | | | | | |
| Min. anchor spacing | s_{min} | mm (in.) | 50 (2) | 60 (2 ^{3/8}) | 70 (2 ^{3/4}) | 80 (3 ^{1/8}) | 95 (3 ^{3/4}) | 120 (4 ^{5/8}) | 135 (5 ^{1/4}) | 150 (5 ^{7/8}) |
| Min. edge spacing | c_{min} | mm (in.) | 40 (1 ^{5/8}) | 45 (1 ^{3/4}) | 50 (2) | 55 (2 ^{1/4}) | 60 (2 ^{3/8}) | 70 (2 ^{3/4}) | 75 (3) | 85 (3 ^{1/8}) |
| Min. member thickness | h_{min} | mm (in.) | $h_{ef} + 30$ ($h_{ef} + 11/4$) | | | $h_{ef} + 2d_o$ ³ | | | | |
| Critical edge spacing – splitting (for uncracked concrete) ² | c_{ac} | - | See Section 4.1.10 of this report. | | | | | | | |
| Strength reduction factor for tension, concrete failure modes ² | ϕ | - | 0.65 | | | | | | | |
| Strength reduction factor for shear, concrete failure modes ² | ϕ | - | 0.70 | | | | | | | |

¹Additional setting information is described in Figure 5, installation instructions.

²The strength reduction factor applies when the load combinations from the IBC or ACI 318 are used and the requirements of ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are met. If the load combinations of ACI 318-11 Appendix C are used, the appropriate strength reduction factor must be determined in accordance with ACI 318-11 D.4.4.

³ d_o = hole diameter.

**TABLE 15—BOND STRENGTH DESIGN INFORMATION METRIC REINFORCING BARS
IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT (OR CHEMOFAST HOLLOW CARBIDE DRILL BIT)¹**

| DESIGN INFORMATION | | Symbol | Units | Nominal Rod Diameter (inch) | | | | | | | |
|--------------------------------------|--|--|-----------------------------|-----------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| | | | | ø 10 | ø 12 | ø 14 | ø 16 | ø 20 | ø 25 | ø 28 | ø 32 |
| Minimum embedment | | $h_{ef,min}$ | mm. (in.) | 60 (2.4) | 70 (2.8) | 75 (3.0) | 80 (3.1) | 90 (3.5) | 100 (3.9) | 112 (4.4) | 128 (5.0) |
| Maximum embedment | | $h_{ef,max}$ | mm (in.) | 200 (7.9) | 240 (9.4) | 280 (11.0) | 320 (12.6) | 400 (15.7) | 500 (19.7) | 560 (22.0) | 640 (25.2) |
| Temperature range A ^{2,3} | Characteristic bond strength in uncracked concrete | $\bar{a}_{k,uncr}$ | psi (N/mm ²) | 13.3 (1,940) | 13.2 (1,920) | 13.0 (1,895) | 12.8 (1,855) | 12.5 (1,815) | 12.2 (1,775) | 12.0 (1,745) | 11.7 (1,705) |
| | Characteristic bond strength in cracked concrete | $\bar{a}_{k,cr}$ | psi (N/mm ²) | 10.0 (1,460) | 10.0 (1,460) | 10.0 (1,460) | 9.0 (1,315) | 10.0 (1,460) | 10.0 (1,460) | 9.8 (1,430) | 9.8 (1,430) |
| Temperature range B ^{2,3} | Characteristic bond strength in uncracked concrete | $\bar{a}_{k,uncr}$ | psi (N/mm ²) | 10.4 (1,520) | 10.3 (1,505) | 10.2 (1,485) | 10.0 (1,455) | 9.7 (1,420) | 9.5 (1,390) | 9.4 (1,365) | 9.2 (1,335) |
| | Characteristic bond strength in cracked concrete | $\bar{a}_{k,cr}$ | psi (N/mm ²) | 7.8 (1,145) | 7.8 (1,145) | 7.8 (1,145) | 7.1 (1,030) | 7.8 (1,145) | 7.8 (1,145) | 7.7 (1,120) | 7.7 (1,120) |
| Permissible installation conditions | Dry Concrete | Anchor category | - | - | 1 | | | | | | |
| | | Strength reduction factor | ϕ_{cl} | - | 0.65 | | | | | | |
| | Water-saturated Concrete | Anchor category | - | - | 2 | | | | | | |
| | | Strength reduction factor | ϕ_{ws} | - | 0.55 | | | | | | |
| | Water-filled hole (flooded) | Anchor category | - | - | 3 | | | | | | |
| | | Strength reduction factor | ϕ_{wf} | - | 0.45 | | | | | | |
| | | Modification factor for water filled holes | K_{wf} | - | 0.85 | | | | | | |
| | Underwater (submerged) | Anchor Category | - | - | 2 | | | | | | |
| Strength reduction factor | | ϕ_{uw} | - | 0.55 | | | | | | | |
| Reduction factor for seismic tension | | $\alpha_{N,seis}$ | - | 1.0 | | | | | | | |

For SI: 1 inch = 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006894 MPa.

For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi.

¹Bond strength values correspond to concrete compressive strength $f'_c = 2,500$ psi (17.2 N/mm²). For uncracked concrete compressive strength, f'_c between 2,500 psi (17.2 N/mm²) and 8,000 psi (55.2 N/mm²), the tabulated characteristic bond strength may be increased by a factor of $(f'_c / 2500)^{0.18}$ [For SI: $(f'_c / 17.2)^{0.18}$]. See Section 4.1.4 of this report.

²Temperature range A: Maximum short term temperature = 140°F (60°C), maximum long term temperature = 110°F (43°C); Temperature range B: Maximum short term temperature = 176°F (80°C), maximum long term temperature = 110°F (43°C).

Short term elevated concrete temperatures are those that occur over brief intervals, e.g. as result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.

³Characteristic bond strengths are for sustained loads including dead and live loads. For load combinations consisting of short-term loads only such as wind, bond strengths may be increased by 17 percent.

TABLE 16—DEVELOPMENT LENGTH FOR U.S. CUSTOMARY UNIT REINFORCING BARS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT (OR CHEMOFAST HOLLOW CARBIDE DRILL BIT) OR DIAMOND CORE BIT ^{1, 2, 4, 5, 6}

| DESIGN INFORMATION | Symbol | Criteria Section of Reference Standard | Units | Bar size | | | | | | | | | |
|--|--------|---|--------------------|----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| | | | | #3 | #4 | #5 | #6 | #7 | #8 | #9 | #10 | #11 | |
| Nominal reinforcing bar diameter | d_b | ASTM A615/A706 Grade 60 | in. | 0.375 | 0.500 | 0.625 | 0.750 | 0.875 | 1.000 | 1.128 | 1.270 | 1.410 | |
| | | | (mm) | (9.5) | (12.7) | (15.9) | (19.1) | (22.2) | (25.4) | (28.7) | (32.3) | (35.8) | |
| Nominal bar area | A_b | | in ² | 0.11 | 0.20 | 0.31 | 0.44 | 0.60 | 0.79 | 1.00 | 1.27 | 1.56 | |
| | | | (mm ²) | (71) | (129) | (199) | (284) | (387) | (510) | (645) | (819) | (1006) | |
| Development length for $f_y = 60$ ksi and $f'_c = 2,500$ psi (normal weight concrete) ³ | l_d | ACI 318-19 25.4.2.4 or ACI 318-14 25.4.2.3 or ACI 318-11 12.2.3 | in. | 12.0 | 14.4 | 18.0 | 21.6 | 31.5 | 36.0 | 40.6 | 45.7 | 50.8 | |
| | | | (mm) | (305) | (366) | (457) | (549) | (800) | (914) | (1031) | (1161) | (1289) | |
| Development length for $f_y = 60$ ksi and $f'_c = 3,000$ psi (normal weight concrete) ³ | l_d | | | in. | 12.0 | 13.1 | 16.4 | 19.7 | 28.8 | 32.9 | 37.1 | 41.7 | 46.3 |
| | | | | (mm) | (305) | (334) | (417) | (501) | (730) | (835) | (942) | (1060) | (1177) |
| Development length for $f_y = 60$ ksi and $f'_c = 4,000$ psi (normal weight concrete) ³ | l_d | | | in. | 12.0 | 12.0 | 14.2 | 17.1 | 24.9 | 28.5 | 32.1 | 36.1 | 40.1 |
| | | | | (mm) | (305) | (305) | (361) | (434) | (633) | (723) | (815) | (918) | (1019) |
| Development length for $f_y = 60$ ksi and $f'_c = 6,000$ psi (normal weight concrete) ³ | l_d | | in. | 12.0 | 12.0 | 12.0 | 13.9 | 20.3 | 23.2 | 26.2 | 29.5 | 32.8 | |
| | | | (mm) | (305) | (305) | (305) | (354) | (516) | (590) | (666) | (750) | (832) | |
| Development length for $f_y = 60$ ksi and $f'_c = 8,000$ psi (normal weight concrete) ³ | l_d | | in. | 12.0 | 12.0 | 12.0 | 12.1 | 17.6 | 20.1 | 22.7 | 25.6 | 28.4 | |
| | | | (mm) | (305) | (305) | (305) | (307) | (447) | (511) | (577) | (649) | (721) | |

For **SI**: 1 inch \equiv 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 Development lengths valid for static, wind, and earthquake loads (SDC A and B).

² Development lengths in SDC C through F must comply with ACI 318-19 and ACI 318-14 Chapter 18 or ACI 318-11 Chapter 21 and section 4.2.4 of this report.

³ f_y and f'_c used in this table are for example purposes only. For sand-lightweight concrete, increase development length by 33%, unless the provisions of ACI 318-19 25.4.2.5, ACI 318-14 25.4.2.4 or ACI 318-11 12.2.4 (d) are met to permit $\lambda > 0.75$.

$$^4 \left(\frac{C_b + K_{tr}}{d_b} \right) = 2.5, \psi_t = 1.0, \psi_e = 1.0, \psi_s = 0.8 \text{ for } d_b \leq \#6, 1.0 \text{ for } d_b > \#6.$$

⁵ Calculations may be performed for other steel grades per ACI 318 (-19 or -14) Chapter 25 or ACI 318-11 Chapter 12.

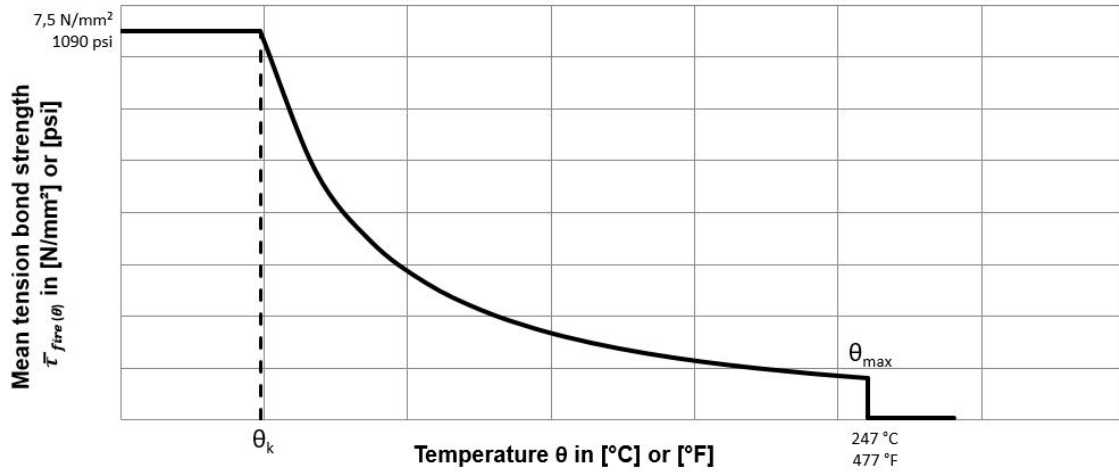
⁶ Minimum development length shall not be less than 12 in (305 mm) per ACI (-19 or -14) Section 25.4.2.1

TABLE 17—DEVELOPMENT LENGTH FOR EU METRIC REINFORCING BARS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT (OR CHEMOFAST HOLLOW CARBIDE DRILL BIT) OR DIAMOND CORE BIT^{1, 2, 4, 5, 6}

| DESIGN INFORMATION | Symbol | Criteria Section of Reference Standard | Units | Bar size | | | | | | | |
|--|--------|--|--------------------|----------|---------|---------|---------|---------|---------|---------|---------|
| | | | | φ 10 | φ 12 | φ 16 | φ 20 | φ 25 | φ 28 | φ 32 | φ 36 |
| Nominal reinforcing bar diameter | d_b | DIN 488, BSt 500 (BS 4449:2005) | mm | 10 | 12 | 16 | 20 | 25 | 28 | 32 | 36 |
| | | | (in.) | (0.394) | (0.472) | (0.630) | (0.787) | (0.984) | (1.102) | (1.260) | (1.417) |
| Nominal bar area | A_b | | mm ² | 79 | 113 | 201 | 314 | 491 | 616 | 804 | 1018 |
| | | | (in ²) | (0.12) | (0.18) | (0.31) | (0.49) | (0.76) | (0.95) | (1.25) | (1.58) |
| Development length for $f_y = 72.5$ ksi and $f'_c = 2,500$ psi (normal weight concrete) ³ | l_d | ACI 318-19 25.4.2.4 ⁷ or ACI 318-14 25.4.2.3 or ACI 318-11 12.2.3 | mm | 348 | 418 | 557 | 870 | 1088 | 1218 | 1392 | 1566 |
| | | | (in.) | (13.7) | (16.4) | (21.9) | (34.3) | (42.8) | (48.0) | (54.8) | (61.7) |
| Development length for $f_y = 72.5$ ksi and $f'_c = 3,000$ psi (normal weight concrete) ³ | l_d | | mm | 318 | 381 | 508 | 794 | 993 | 1112 | 1271 | 1430 |
| | | | (in.) | (12.5) | (15.0) | (20.0) | (31.3) | (39.1) | (43.8) | (50.0) | (56.3) |
| Development length for $f_y = 72.5$ ksi and $f'_c = 4,000$ psi (normal weight concrete) ³ | l_d | | mm | 305 | 330 | 440 | 688 | 860 | 963 | 1100 | 1238 |
| | | | (in.) | 12.0 | 13.0 | 17.3 | 27.1 | 33.8 | 37.9 | 43.3 | 48.7 |
| Development length for $f_y = 72.5$ ksi and $f'_c = 6000$ psi (normal weight concrete) ³ | l_d | mm | 305 | 305 | 359 | 562 | 702 | 786 | 899 | 1011 | |
| | | (in.) | (12.0) | (12.0) | (14.2) | (22.1) | (27.6) | (31.0) | (35.4) | (39.8) | |
| Development length for $f_y = 72.5$ ksi and $f'_c = 8000$ psi (normal weight concrete) ³ | l_d | mm | 305 | 305 | 311 | 486 | 608 | 681 | 778 | 875 | |
| | | (in.) | (12.0) | (12.0) | (12.3) | (19.1) | (23.9) | (26.8) | (30.6) | (34.5) | |

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

¹Development lengths valid for static, wind, and earthquake loads (SDC A and B).
²Development lengths in SDC C through F must comply with ACI 318-19 and ACI 318-14 Chapter 18 or ACI 318-11 Chapter 21 and section 4.2.4 of this report.
³ f_y and f'_c used in this table are for example purposes only. For sand-lightweight concrete, increase development length by 33%, unless the provisions of ACI 318-19 25.4.2.5, ACI 318-14 25.4.2.4 or ACI 318-11 12.2.4 (d) are met to permit $\lambda > 0.75$.
⁴ $\left(\frac{C_b + K_{tr}}{d_b}\right) = 2.5$, $\psi_t = 1.0$, $\psi_e = 1.0$, $\psi_s = 0.8$ for $d_b < 20$ mm, 1.0 for $d_b \geq 20$ mm.
⁵Calculations may be performed for other steel grades per ACI 318-11 Chapter 12 or ACI 318-14 and ACI 318-19 Chapter 25.
⁶Minimum development length shall not be less than 12 in (305 mm) per ACI (-19 or -14) Section 25.4.2.1
⁷ l_d must be increased by 9.5% to account for ψ_g in ACI 318-19 25.4.2.4. ψ_g has been interpolated from Table 25.4.2.5 of ACI 318-19 for $f_y = 72.5$ ksi.



The mean tension bond strength $\bar{\tau}_{fire}(\theta)$ under fire conditions shall be determined in accordance with the following equations:

For hammer drill and carbide bit (or Chemofast hollow carbide bit):

$$\bar{\tau}_{fire}(\theta) = 1955671 \cdot \theta^{-1.585} \leq 1090 \text{ [psi] with } \theta \text{ in } ^{\circ}F$$

$$\bar{\tau}_{fire}(\theta) = 1277 \cdot \theta^{-1.341} \leq 7.5 \text{ [N/mm}^2\text{] with } \theta \text{ in } ^{\circ}C$$

$$\theta_k = 113^{\circ}F (46^{\circ}C)$$

For diamond core bit:

$$\bar{\tau}_{fire}(\theta) = 1814842 \cdot \theta^{-1.585} \leq 1090 \text{ [psi] with } \theta \text{ in } ^{\circ}F$$

$$\bar{\tau}_{fire}(\theta) = 1185 \cdot \theta^{-1.341} \leq 7.5 \text{ [N/mm}^2\text{] with } \theta \text{ in } ^{\circ}C$$

$$\theta_k = 108^{\circ}F (44^{\circ}C)$$

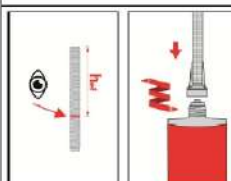
¹ With $\theta_{max} = 247^{\circ}C (477^{\circ}F)$. For temperatures larger than θ_{max} the bond strength $\bar{\tau}_{fire}(\theta) = 0$.
² For application with rebar #11 (36mm) or larger for overhead installation, bond strengths must be decreased by 11 percent.
³ Bond strengths under fire are for short-term loads such as wind, for sustained loads including dead and live, and for seismic loads.

FIGURE 4— BOND STRENGTH VS TEMPERATURE FOR POST INSTALLED REINFORCING BAR APPLICATIONS SUBJECT TO ELEVATED TEMPERATURE / FIRE IN HOLES DRILLED WITH HAMMER DRILL AND CARBIDE BIT (OR CHEMOFAST HOLLOW CARBIDE DRILL BIT) OR DIAMOND CORE BIT ^{1,2,3}

CHEMOFAST® EP 800 - Instruction Card

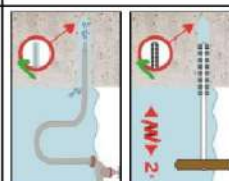
1. Setting instructions for solid base material with Hammer drilling or Chemofast hollow drill bit system - ESR-4901

Preparing



- Check adhesive expiration date on cartridge label. Do not use expired product. Review Safety Data Sheet (SDS) before use. For the permitted range of the base material and cartridge temperature see Table 2. 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.
- Always use a new mixing nozzle with new cartridges. *Caution and also for all work intervals exceeding the published set working time of the adhesive.* Prior to inserting the anchor rod or rebar into the filled drilled hole, the position of the embedment depth has to be marked on the anchor. Verify anchor element is straight and free of surface damage.

Hole cleaning



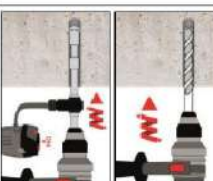
UWC: Cleaning (submerge d) for all bore hole diameter in uncracked and cracked concrete

- Starting from the bottom or back of the bore hole, raise flush the hole clean until clean water comes out. If the back of the drilled hole is not reached an extension shall be used.
- Determine brush diameter (see Table 3) for the drilled hole. Brush the hole with the selected wire brush a minimum of two times (2x). A brush extension (supplied by Chemofast Anchoring GmbH) must be used for drill hole depth > 6" (150mm). The wire brush diameter must be checked periodically during use (check diameter see Table 3a or 3b). 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. If the back of the drilled hole is not reached a brush extension shall be used.
- Finally blow the hole clean again with compressed air (min. 6 bar / 90 psi) a minimum of two times, until return air stream is free of noticeable dust. If the back of the drilled hole is not reached an extension shall be used. When finished the hole should be clean and free of dust, debris, ice, grease, oil or other foreign material.

CAC: Cleaning (dry, water saturated and water-filled) for all bore hole diameter in uncracked and cracked concrete

- Starting from the bottom or back of the anchor hole, blow the hole clean with compressed air (min. 6 bar / 90 psi) a minimum of two times, until return air stream is free of noticeable dust. If the back of the drilled hole is not reached an extension shall be used.
- Determine brush diameter (see Table 3) for the drilled hole. Brush the hole with the selected wire brush a minimum of two times (2x). A brush extension (supplied by Chemofast Anchoring GmbH) must be used for drill hole depth > 6" (150mm). The wire brush diameter must be checked periodically during use (check diameter see Table 3a or 3b). 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. If the back of the drilled hole is not reached a brush extension shall be used.
- Finally blow the hole clean again with compressed air (min. 6 bar / 90 psi) a minimum of two times, until return air stream is free of noticeable dust. If the back of the drilled hole is not reached an extension shall be used. When finished the hole should be clean and free of dust, debris, ice, grease, oil or other foreign material.

Drilling



Precautions: Wear suitable eye and skin protection. Avoid inhalation of dusts during drilling and/or rebarcut. (see dust extraction equipment by Chemofast to minimize dust emissions)

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). The tolerances of the embossed drill bit must meet the requirements of ANSI Standard B312.15.

For bore holes drilled with the Chemofast hollow drill bit system (consisting of Hammer Duster Expert drill bit and a Class M vacuum with air flow 150m³/h resp. 42l/s resp. 9l/min; the vacuum must be on!) no further cleaning is required → go to Step 3, otherwise to Step 2a for CAC hole cleaning instructions.

In case of standing water in the drilled hole, except for submerged concrete, all the water has to be removed from the hole (e.g. vacuum, compressed air, etc.) prior to cleaning.

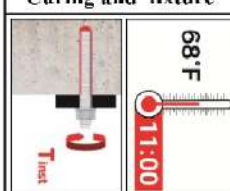
2. Working and curing times

| Temperature of base material | Maximum working time | Initial curing time ¹⁾ | Full curing time |
|-------------------------------------|----------------------|-----------------------------------|------------------|
| 41 °F (1.5 °C) to 49 °F (1.9 °C) | 60 min | 24 h | 48 h |
| 50 °F (1.10 °C) to 58 °F (1.14 °C) | 60 min | 15 h | 30 h |
| 59 °F (+1.5 °C) to 67 °F (+1.9 °C) | 40 min | 10 h | 20 h |
| 68 °F (+2.0 °C) to 76 °F (+2.4 °C) | 30 min | 5 h | 11 h |
| 77 °F (+2.5 °C) to 85 °F (+2.9 °C) | 12 min | 4 h | 9 h |
| 86 °F (+3.0 °C) to 103 °F (+3.9 °C) | 8 min | 3 h | 6 h |
| 104 °F (+4.0 °C) | 7 min | 2 h | 4 h |

Cartridge temperature must be between 41 °F (+1.5 °C) and 104 °F (+4.0 °C)

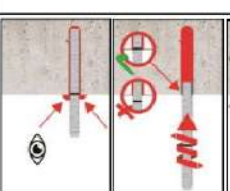
¹⁾ Initial cure times are for post-installed rebar applications only. After the initial curing time, the installation of connecting reinforcements and formwork attachments is permitted.

Curing and fixture



- Allow the adhesive anchor to cure to the specified minimum curing time prior to applying any load (see Table 2).
- Do not disturb, touch or load the adhesive until it is fully cured.
- 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 and applications between horizontal and overhead 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 cure time but the anchor shall not be moved after placement and during cure.

Installation

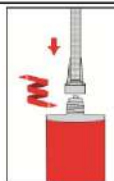
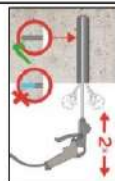
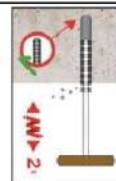
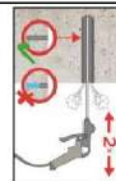

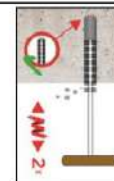




- Adhesive must be properly mixed to achieve published properties. Prior to dispensing adhesive into the drilled hole, separately dispense at least three full strokes of adhesive through the mixing nozzle until the adhesive is a consistent gray or red color. Review and note the published working and cure times (see Table 2) prior to injection of the mixed adhesive into the cleaned anchor hole.
- 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. If the bottom or back of the anchor hole is not reached with the mixing nozzle, only an extension tube supplied by Chemofast Anchoring GmbH (Cat# 16009 or Cat# 16004) must be used with the mixing nozzle.
- In case of using the extension tube V1161.8 (Cat# 16004), run the tip of the mixer nozzle at position "X".
- Piston plugs (see Table 3a or 3b) must be used with and attached to mixing nozzle and extension tube for:
 - overhead installations and installations between horizontal and overhead
 - all installations with drill hole depth > 16" (420mm)
 - all installations in elongated bore holes
- 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 or upwardly inclined without installation hardware supplied by Chemofast and also receiving proper training and/or certification. Contact Chemofast for details prior to use.
- The anchor should be free of dirt, grease, oil or other foreign material. Push clean displaced rod or reinforcing bar into the anchor hole while turning slightly to ensure positive distribution of the adhesive until the embedment depth is reached. Observe the gel (working) time.

FIGURE 5—INSTALLATION INSTRUCTIONS

CHEMFAST® EP 800 - Instruction Card

1. Setting instructions for solid base material with Diamond drilling - ESR-4901

| Preparing | Hole cleaning | | | | Drilling |
|---|--|--|--|--|---|
|  <p>1 Check adhesive expiration date on cartridge label. Do not use expired product. Review Safety Data Sheet (SDS) before use. For the permitted range of the base material and cartridge temperature see Table 2. 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.</p> <p>Note: Always use a new mixing nozzle with new cartridges of adhesive and also for all work interruptions exceeding the published gel (working) time of the adhesive.</p> |  <p>2 Starting from the bottom or back of the bore hole, rinse/flush the hole clean until clean water comes out. If the back of the drilled hole is not reached, an extension shall be used.</p>  <p>3 Determine brush diameter (see Table 3) for the drilled hole. Brush the hole with the selected wire brush a minimum of two times (2X). A brush extension (supplied by Chemfast Anchoring GmbH) must be used for drill hole depth > 6" (150mm). The wire brush diameter must be checked periodically during use (clean > 60 sec; see Table 3a or 3b). 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. If the back of the drilled hole is not reached a brush extension shall be used.</p>  <p>4 Starting from the bottom or back of the bore hole, blow the hole clean with compressed air (min. 6 bar / 90 psi) a minimum of two times, until return air stream is free of noticeable dust. If the back of the drilled hole is not reached an extension shall be used.</p>  <p>5 Finally, starting from the bottom or back of the bore hole, rinse/flush the hole clean until clean water comes out. If the back of the drilled hole is not reached, an extension shall be used.</p>  <p>6 Determine brush diameter (see Table 3) for the drilled hole. Brush the hole with the selected wire brush a minimum of two times (2X). A brush extension (supplied by Chemfast Anchoring GmbH) must be used for drill hole depth > 6" (150mm). The wire brush diameter must be checked periodically during use (clean > 60 sec; see Table 3a or 3b). 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. If the back of the drilled hole is not reached a brush extension shall be used.</p>  <p>7 Starting from the bottom or back of the bore hole, rinse/flush the hole clean until clean water comes out. If the back of the drilled hole is not reached, an extension shall be used.</p> | | | |  <p>8 Drill a hole in the base material with a diamond drill tool to the size and embedment required by the selected metal hardware element (see Table 4).</p> <p>In case of standing water in the drilled hole, all the water has to be removed from the hole (e.g. vacuum, compressed air, etc.) prior to cleaning.</p> <p>SPEC. AC: Cleaning for all bore hole diameter in uncracked concrete</p> <p>Precaution: Wear suitable eye and skin protection. Avoid inhalation of dusts during drilling and/or removal. (see dust extraction equipment by Chemfast to minimize dust emissions)</p> |

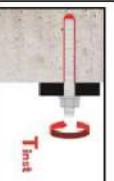
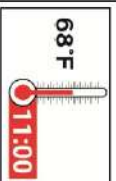
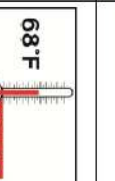

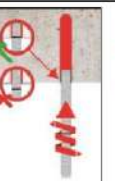




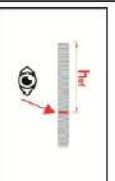
| Curing and fixture | Installation | | | Preparing |
|--|---|--|--|---|
|  <p>9 Allow the adhesive anchor to cure to the specified minimum curing time prior to applying any load (see Table 2). Do not disturb, torque or load the anchor until it is fully cured.</p>  <p>10 After full curing of the adhesive anchor, a fixture can be installed to the anchor and tightened up to the maximum torque (shown in Table 4) by using a calibrated torque wrench. Take care not to exceed the maximum torque for the selected anchor.</p> |  <p>11 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. Observe the gel (working) time.</p>  <p>12 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 and applications between horizontal and overhead 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 placement and during cure.</p>  <p>13 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 or upwardly finished without installation hardware supplied by Chemfast, and also receiving proper training and/or certification. Contact Chemfast for details prior to use.</p>  <p>14 - all installations with drill hole depth > 10" (250mm) with anchor rod 5/8" to 1-1/4" (M16 to M30) and rebar sizes 3/8 to #10 (#14 to #32).</p>  <p>15 Piston plugs (see Table 3a or 3b) must be used with and attached to mixing nozzle and extension tube for: - overhead installations and installations between horizontal and overhead - all installations with drill hole depth > 10" (250mm)</p>  <p>16 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. If the bottom or back of the anchor hole is not reached with the mixing nozzle only an extension tube supplied by Chemfast Anchoring GmbH (Cat# 16009 or Cat# 16005) must be used with the mixing nozzle. In case of using the extension tube V1.0/1.8 (Cat# 16004), cut the tip of the mixer nozzle at position "X".</p> | | |  <p>17 Adhesive must be properly mixed to achieve published properties. Prior to dispensing adhesive into the drilled hole, separately dispense at least three full strokes of adhesive through the mixing nozzle until the adhesive is a consistent gray or red color. Review and note the published working and cure times (see Table 2) prior to injection of the mixed adhesive into the cleaned anchor hole.</p>  <p>18 Prior to inserting the anchor rod or rebar into the filled drilled hole, the position of the embedment depth has to be marked on the anchor. Verify anchor element is straight and free of surface damage.</p> |

FIGURE 5—INSTALLATION INSTRUCTIONS (Continued)

DIVISION: 03 00 00—CONCRETE

Section: 03 16 00—Concrete Anchors

DIVISION: 05 00 00—METALS

Section: 05 05 19—Post-Installed Concrete Anchors

REPORT HOLDER:

CHEMOFAST ANCHORING GmbH

EVALUATION SUBJECT:

CHEMOFAST EP 800 ADHESIVE ANCHOR SYSTEM IN CRACKED AND UNCRACKED CONCRETE

1.0 REPORT PURPOSE AND SCOPE**Purpose:**

The purpose of this evaluation report supplement is to indicate that Chemofast EP800 Adhesive Anchor System in Cracked and Uncracked Concrete, described in ICC-ES evaluation report [ESR-4901](#), has also been evaluated for compliance with the codes noted below as adopted by the Los Angeles Department of Building and Safety (LADBS).

Applicable code editions:

- 2020 *City of Los Angeles Building Code* (LABC)
- 2020 *City of Los Angeles Residential Code* (LARC)

2.0 CONCLUSIONS

The Chemofast EP800 Adhesive Anchor System in Cracked and Uncracked Concrete, described in Sections 2.0 through 7.0 of the evaluation report [ESR-4901](#), complies with the LABC Chapter 19, and the LARC, and are subject to the conditions of use described in this supplement.

3.0 CONDITIONS OF USE

The Chemofast EP800 Adhesive Anchor System in Cracked and Uncracked Concrete described in this evaluation report must comply with all of the following conditions:

- All applicable sections in the evaluation report [ESR-4901](#).
- The design, installation, conditions of use and identification of the anchors are in accordance with the 2018 *International Building Code*® (IBC) provisions noted in the evaluation report [ESR-4901](#).
- The design, installation and inspection are in accordance with additional requirements of LABC Chapters 16 and 17, as applicable.
- Under the LARC, an engineered design in accordance with LARC Section R301.1.3 must be submitted.
- The design strength values listed in the evaluation report and tables are for the connection of the anchors to the concrete. The connection between the anchors and the connected members shall be checked for capacity (which may govern).
- For use in wall anchorage assemblies to flexible diaphragms, anchors shall be designed per the requirements of City of Los Angeles Information Bulletin P/BC 2020-071

This supplement expires concurrently with the evaluation report, issued November 2022 and revised March 2023.

DIVISION: 03 00 00—CONCRETE
Section: 03 16 00—Concrete Anchors

DIVISION: 05 00 00—METALS
Section: 05 05 19—Post-Installed Concrete Anchors

REPORT HOLDER:

CHEMOFAST ANCHORING GmbH

EVALUATION SUBJECT:

CHEMOFAST EP 800 ADHESIVE ANCHOR SYSTEM IN CRACKED AND UNCRACKED CONCRETE

1.0 REPORT PURPOSE AND EVALUATION SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that Chemofast EP800 Adhesive Anchor System in Cracked and Uncracked Concrete, recognized in ICC-ES evaluation report ESR-4901, has also been evaluated for compliance with the codes noted below.

Compliance with the following codes:

- 2020 Florida Building Code—Building
- 2020 Florida Building Code—Residential

2.0 PURPOSE OF THIS SUPPLEMENT

The Chemofast EP800 Adhesive Anchor System in Cracked and Uncracked Concrete, described in Sections 2.0 through 7.0 of the evaluation report ESR-4901, complies with the *Florida Building Code—Building* and the *Florida Building Code—Residential*, as applicable, provided the design requirements are determined in accordance with the *Florida Building Code—Building* or the *Florida Building Code—Residential*, as applicable. The installation requirements noted in ICC-ES evaluation report ESR-4901 for the 2018 *International Building Code*® meet the requirements of the *Florida Building Code—Building* or the *Florida Building Code—Residential*, as applicable.

Use of the Chemofast EP800 Adhesive Anchor System in Cracked and Uncracked Concrete has also been found to be in compliance with the High-Velocity Hurricane Zone provision of the *Florida Building Code—Building* and the *Florida Building Code—Residential* with the following condition.

- a) For connections subject to uplift, the connection must be designed for no less than 700 pounds (3114 N).

For products falling under Florida Rule 61G20-3, verification that the report holder's quality assurance program is audited by a quality assurance entity approved by the Florida Building Commission for the type of inspections being conducted is the responsibility of an approved validation entity (or the code official when the report holder does not possess an approval by the Commission).

This supplement expires concurrently with the evaluation report, issued November 2022 and revised March 2023.