ICC EVALUATION SERVICE®

ICC-ES Evaluation Report

ESR-5144

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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: DEWALT	EVALUATION SUBJECT: PURE220+™ ADHESIVE ANCHOR SYSTEM AND POST-INSTALLED REINFORCING BAR IN CRACKED AND UNCRACKED CONCRETE (DEWALT)	

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2024, 2021, 2018 and 2015 *International Building Code*® (IBC)
- 2024, 2021, 2018 and 2015 *International Residential Code*® (IRC)

Main references of this report are for the 2024 IBC and IRC. See Table 22 and Table 23 for applicable sections of the code for previous IBC and IRC editions

Property evaluated:

Structural

2.0 USES

DEWALT Pure220+ 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 EU metric size, and 10M, 15M, 20M, 25M, and 30M Canadian metric size steel reinforcing bars in hammer-drilled holes (or DEWALT hollow drill bit system). 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).

DEWALT Pure220+ 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 threaded steel rods in diamond core-drilled 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).

DEWALT Pure220+ adhesive anchor system is used as anchorage to resist static, wind or earthquake (IBC Seismic Design Categories A and B only) tension and shear loads in uncracked normal-weight and lightweight concrete with No. 3 through No. 10 fractional size steel reinforcing bars in diamond core-drilled 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).

DEWALT Pure220+ adhesive post-installed reinforcing bars are used as reinforcing bar connections (for development lengths and non-contact splice lengths) 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 EU metric size, and 10M, 15M, 20M, 25M, and 30M Canadian metric size steel reinforcing bars in hammer-drilled (or DEWALT 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 2024 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 DEWALT Pure220+ Adhesive Anchor System is comprised of 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 DEWALT Pure220+ Adhesive Anchor System).

The primary components of the DEWALT Pure220+ Adhesive Anchor System, including the adhesive cartridge, static mixing nozzle, dispenser, and steel anchor elements, are shown in Figure 2 of this report. The manufacturer's printed installation instructions (MPII), included with each adhesive unit package, are shown in Figure 4 of this report.

3.2 Materials:

3.2.1 DEWALT Pure220+ Adhesive: DEWALT Pure220+ adhesive is an injectable two-component epoxy adhesive. The two components are kept separate by means of a labelled dual-cylinder cartridge. The two components combine and react when dispensed through a static mixing nozzle, supplied by DEWALT, which is attached to the cartridge. DEWALT Pure220+ adhesive is available in 9.5-ounce (280 mL), 13.5-ounce (400 mL), 20.5-ounce (610 mL) 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 MPII, as illustrated in Figure 4 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 DEWALT, and air blowers which are shown in Figure 4 of this report. The DEWALT 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 DEWALT Hollow Drill Bit System (DustX+™): The DEWALT hollow drill bit system shown in Figure 1 is comprised of DEWALT hollow drill bits with carbide tips conforming to ANSI B212.15 attached to a HEPA vacuum that has a minimum air flow rating of 90 cfm (150 m^3/h, 42 l/s), e.g. DWV015, DWV905M, DWV905H or equivalent approved by DEWALT (applicable for both post-installed adhesive anchor system and post-installed reinforcing bar connections). The vacuum dust extractor system removes the drilling dust during the drilling operation, eliminating the need for additional hole cleaning.

3.2.3 Dispensers: DEWALT Pure220+ adhesive must be dispensed with manual dispensers, pneumatic dispensers, or electric powered dispensers supplied by DEWALT.

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 12 and Figure 4 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 may be furnished with a minimum 0.0002-inch-thick (0.005 mm) zinc electroplated coating complying with ASTM B633 SC1 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 8 and 15, and Figure 4 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), 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 Section 2.3 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 19, 20 and 21. 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) 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 2024 IBC, as well as the 2024 IRC, must be determined in accordance with ACI 318-19 and this report.

The strength design of anchors must comply with ACI 318-19 17.5.1.2, except as required in ACI 318-19 17.10.

Design parameters are provided in Tables 4 through 18 of this report. Strength reduction factors, ϕ, as given in ACI 318-19 17.5.3, must be used for load combinations calculated in accordance with Section 1605.1 of the 2024 IBC or ACI 318-19 5.3.

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 and the associated strength reduction factors, ϕ, in accordance with ACI 318-19 17.5.3 are provided in Tables 4, 8, 12 and 15 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 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 using the values of $k_{c,cr}$ and $k_{c,uncr}$ as provided in Tables 5, 9, 13, and 16 of this report. Where analysis indicates no cracking in accordance with ACI 318-19 17.6.2.5, 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. 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. 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.

Bond strength values ($\tau_{k,cr}$, $\tau_{k,uncr}$) are a function of concrete compressive strength, concrete state (cracked, uncracked), drilling method (hammer-drilled, core-drilled), and installation conditions (dry concrete, water-saturated concrete, water-filled holes, submerged concrete). Special inspection level is qualified as periodic for all anchors except as noted in Section 4.4 of this report. The selection of continuous special inspection level, with an onsite proof loading program, is not necessary and does not provide a benefit of a lower anchor category or an increase in the associated strength reduction factors for design. The following table summarizes the requirements:

CONCRETE STATE	DRILLING METHOD	BOND STRENGTH	CONCRETE COMPRESSIVE STRENGTH	PERMISSIBLE INSTALLATION CONDITIONS	ASSOCIATED STRENGTH REDUCTION FACTOR
Cracked and Uncracked	Hammer-drill with carbide drill bit or DEWALT hollow bit	$\tau_{k,cr}$ or $\tau_{k,uncr}$	f'_c	Dry concrete	ϕ_d
				Water-saturated concrete	ϕ_{ws}
	Hammer-drill with carbide drill bit			Water-filled hole (flooded)	$K_{wf} \cdot \phi_{wf}$
				Underwater (submerged)	ϕ_{uw}
Cracked and Uncracked	Core-drill with diamond core bit	$\tau_{k,cr}$ or $\tau_{k,uncr}$	f'_c	Dry concrete	ϕ_d
				Water-saturated concrete	ϕ_{ws}

Strength reduction factors for determination of the bond strength are given in Tables 6, 7, 10, 11, 14, 17 and 18 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, 7, 10, 11, 14, 17 and 18 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 in hammer-drilled (or DEWALT hollow drill bit system) holes 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:** $f'_c / 17.2)^{0.14}$]; fractional and EU metric reinforcing bar in uncracked concrete by $(f'_c / 2{,}500)^{0.18}$ [For **SI:** $f'_c / 17.2)^{0.18}$]. Canadian metric reinforcing bar in uncracked concrete by $(f'_c / 2{,}500)^{0.09}$ [For **SI:** $f'_c / 17.2)^{0.09}$]; Canadian metric reinforcing bar in cracked concrete by $(f'_c / 2{,}500)^{0.08}$ [For **SI:** $f'_c / 17.2)^{0.08}$]

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 in diamond core drilled holes may be increased as follows: threaded rod in uncracked concrete by $(f'_c / 2{,}500)^{0.24}$ [For **SI:** $f'_c / 17.2)^{0.24}$]; threaded rod in cracked concrete by $(f'_c / 2{,}500)^{0.20}$ [For **SI:** $f'_c / 17.2)^{0.20}$]; and fractional and EU metric reinforcing bar in uncracked concrete by $(f'_c / 2{,}500)^{0.35}$ [For **SI:** $f'_c / 17.2)^{0.35}$].

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).

The resulting nominal bond strength must be multiplied by the associated strength reduction factor ϕ_d, ϕ_{ws}, ϕ_{wf} 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 and the strength reduction factor, ϕ, in accordance with ACI 318-19 17.5.3 are given in Tables 4, 8, 12, and 15 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 based on information given in Tables 5, 9, 13, and 16 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 using the values of d given in Tables 5, 9, 13, and 16 for the corresponding anchor steel in lieu of d_a. 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.

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.

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.

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 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.

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. #5 to #8 M16 to M27 Ø14 to Ø25 15M to 25M	1.75 in. (45 mm)	5*d*	0.45·T_{max}
$1^{1}/_{4}$ in. #9 to #10 M30 Ø28 to Ø32 30M	2.75 in. (70 mm)		

For values of T_{max}, see Figure 4 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 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, 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, in lieu of ACI 318-19 17.9.5.

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

(Eq. 17.6.5.5.1c for ACI 318-19)

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:

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

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.

The nominal steel shear strength, V_{sa}, must be adjusted by $\alpha_{V,seis}$ as given in Tables 4, 8, 12, and 15 for the corresponding anchor steel. The nominal bond strength $\tau_{k,cr}$ must be adjusted by $\alpha_{N,seis}$ as given in Tables 6, 7, 10, 14, 17 and 18 for the corresponding anchor steel.

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 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 ≤ No. 6 (d_b ≤ 16mm; d_b ≤ 15M)	1-$^{3}/_{16}$ in. (30mm)
No. 6 < d_b ≤ No. 11 (16mm < d_b ≤ 36mm; 15M < d_b ≤ 35M)	1-$^{9}/_{16}$ in. (40 mm)

The following requirements apply for minimum concrete edge and spacing for hef > 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 Chapter 18.

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 3.

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/ mm^2); Where θ is the temperature in the concrete at the post-installed reinforcing bar in ºF (for psi) or ºC (for N/mm^2), 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 Allowable Stress Design (ASD):

4.3.1 General: For anchors designed using load combinations in accordance with Section 1605.1 of the 2024 IBC (Allowable Stress Design), allowable loads shall be established using Eq. (4-2) or Eq. (4-3):

$T_{allowable,ASD} = \phi N_n/\alpha$ Eq. (4-2)

and

$V_{allowable,ASD} = \phi V_n/\alpha$ Eq. (4-3)

where:

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

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

ϕN_n = The lowest design strength of an anchor or anchor group in tension as determined in accordance with ACI 318-19 Chapter 17, 2024 IBC Section 1905.7, and Section 4.1 of this report, as applicable.

ϕV_n = The lowest design strength of an anchor or anchor group in shear as determined in accordance with ACI 318-19 Chapter 17, 2024 IBC Section 1905.7, and Section 4.1 of this report, as applicable.

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

The requirements for member thickness, edge distance and spacing, described in Table 1 of this report, must apply.

4.3.2 Interaction of Tensile and Shear Forces: In lieu of ACI 318-19 17.8.2 and 17.8.3, interaction of tension and shear loads must be calculated as follows:

If $T_{applied} \leq 0.2\ T_{allowable,ASD}$, then the full allowable strength in shear, $V_{allowable,ASD}$, shall be permitted.

If $V_{applied} \leq 0.2\ V_{allowable,ASD}$, then the full allowable strength in tension, $T_{allowable,ASD}$, must be permitted.

For all other cases:

$$\frac{T_{applied}}{T_{allowable,\ ASD}} + \frac{V_{applied}}{V_{allowable,ASD}} \leq 1.2 \qquad \text{Eq. (4-4)}$$

4.4 Installation:

Installation parameters are illustrated in Figures 2 and 4 and Tables 5, 9, 13, and 16 of this report. Installation must be in accordance with ACI 318-19 26.7.2. Anchor locations must comply with this report and the plans and specifications approved by the code official. Installation of the DEWALT Pure220+ Adhesive Anchor System must conform to the manufacturer's printed installation instructions included in each unit package as described in Figure 3 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 drilled hole is not reached with the mixing nozzle, a mixer extension tube, supplied by DEWALT must be attached to the mixing nozzle as described in Figure 4 of this report. Additionally, for upwardly inclined or between horizontal and upwardly inclined orientation applications of all drilled hole depths, and downward and horizontal applications with a drilled 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, ø14, and 15M through No. 10, ø32 and 30M, steel reinforcing bars, installed in the specified hole diameter, and attached to the mixing nozzle and extension tube supplied by DEWALT as described in Figure 4 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, ø12 and 10M 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 using 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.

4.5 Special Inspection:

Periodic special inspection must be performed where required in accordance with Section 1705.1.1 and Table 1705.3 of the 2024 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).

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 DEWALT Pure220+ 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 DEWALT Pure220+ 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 4 of this report.

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, ø10, ø12, ø14, ø16, ø20, ø25, ø28 and ø32 EU metric, and 10M, 15M, 20M, 25M, and 30M Canadian 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).

5.2 Post-installed reinforcing bars with diameters No. 3 through No. 11 fractional size and ø10, ø12, ø14, ø16, ø20, ø25, ø28, ø32 and ø36 EU metric, and 10M, 15M, 20M, 25M, and 30M Canadian size steel reinforcing bars in hammer-drilled (or DEWALT 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)

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

5.4 Anchors and post-installed reinforcing bars must be installed in concrete base materials in holes predrilled in accordance with the instructions provided in Figure 4 of this report.

5.5 Loads applied to the anchors must be adjusted in accordance with Section 1605.1 of the 2024 IBC for strength design or for allowable stress design.

5.6 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.

5.7 DEWALT Pure220+ 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.

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

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

5.10 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.

5.11 Anchors are not permitted to support fire-resistive construction. Where not otherwise prohibited by the code, DEWALT Pure220+ 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.

5.12 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.

5.13 Use of zinc-plated carbon steel threaded rods or steel reinforcing bars is limited to dry, interior locations.

5.14 Use of hot-dipped galvanized carbon steel and stainless-steel rods is permitted for exterior exposure or damp environments.

5.15 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.

5.16 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.

5.17 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).

5.18 DEWALT Pure220+ adhesive anchors and post-installed reinforcing bars may be used to resist tension and shear forces in floor, wall for overhead installations into concrete with a temperature between 41°F and 104°F (5°C and 40°C) for threaded rods and reinforcing bars.

5.19 DEWALT Pure220+ adhesive is manufactured under a quality control program with inspections by ICC-ES.

6.0 EVIDENCE SUBMITTED

6.1 Data in accordance with the ICC-ES Acceptance Criteria for Post-installed Adhesive Anchors and Reinforcing Bar Connections in Concrete (AC308) (24), published April 2025, which incorporates requirements in ACI 355.4-19 for use in cracked and uncracked concrete.

7.0 IDENTIFICATION

7.1 The ICC-ES mark of conformity, electronic labelling, or the evaluation report number (ICC-ES ESR-5144) along with the name, registered trademark, or registered logo of the report holder must be included in the product label.

7.2 In addition, DEWALT Pure220+ adhesive is identified by packaging labelled with the manufacturer's name (DEWALT) and address, anchor name, the lot number, the expiration date, and the evaluation report number (ESR-5144). 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:

DEWALT
701 EAST JOPPA ROAD
TOWSON, MARYLAND 21286
(800) 524-3244
www.DEWALT.com
anchors@DEWALT.com

TABLE 1—DESIGN TABLE INDEX

DESIGN STRENGTH[1] - THREADED RODS		Fractional	Metric	
	Steel Strength - N_{sa}, V_{sa}	Table 4	Table 12	
	Concrete Strength - N_{pn}, N_{sb}, N_{sbg}, N_{cb}, N_{cbg}, V_{cb}, V_{cbg}, V_{cp}, V_{cpg}	Table 5	Table 13	
	Bond Strength[2] - N_a, N_{ag}	Table 6 and Table 7	Table 14	
DESIGN STRENGTH[1] – REINFORCING STEEL		**Fractional**	**Metric**	**Canadian**
	Steel Strength - N_{sa}, V_{sa}	Table 8	Table 15	Table 15
	Concrete Strength - N_{pn}, N_{sb}, N_{sbg}, N_{cb}, N_{cbg}, V_{cb}, V_{cbg}, V_{cp}, V_{cpg}	Table 9	Table 16	Table 16
	Bond Strength[2] - N_a, N_{ag}	Table 10 and Table 11	Table 17	Table 18
	Determination of development lengths and non-contact lap splices for post-installed reinforcing bar connections[3]	Table 19	Table 20	Table 21

[1]Ref. ACI 318-19 17.5.2.
[2]See Section 4.1 of this evaluation report.
[3]For design of post-installed reinforcing bars in fire resistive construction conditions, see Section 4.2.5 and Figure 3 of this evaluation report.

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

THREADED ROD SPECIFICATION		UNITS	MINIMUM SPECIFIED ULTIMATE STRENGTH, f_{uta}	MIN. 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	psi (MPa)	125,000 (862)	105,000 (724)	1.19	16	50	ASTM A194 / A563 Grade D
	ASTM A36[3] / F1554[4], Grade 36	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.	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.	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

[1]Adhesive 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.
[2]Standard Specification for Alloy-Steel and Stainless steel Bolting Materials for High temperature of High Pressure service and Other Special Purpose Applications.
[3]Standard Specification for Carbon Structural steel
[4]Standard Specification for Anchor Bolts, Steel 36, 55 and 105-ksi Yield Strength.
[5]Standard Specification for Hex Cap Screws, Bolts and Studs, Heat Treated, 120/105/50 ksi Minimum Tensile Strength, General Use.
[6]Standard Specification for Carbon and Alloy Steel external Threaded Metric Fasteners.
[7]Mechanical properties of fasteners made of carbon steel and alloy steel - Part 1: Bolts, Screws and Studs.
[8]Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
[9]Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
[10]Mechanical properties of corrosion-resistant stainless steel fasteners - Part 1: Bolts, Screws and Studs.
[11]Based on 2-in. (50 mm) gauge length except for ASTM A193, which is based on a gauge length of 4d.
[12]Nuts and washers of other grades and style having specified proof load stress greater than the specified grade and style are also suitable. Nuts must have specified proof load stresses equal to or greater than the minimum tensile strength of the specified threaded.

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

REINFORCING SPECIFICATION	UNITS	MINIMUM SPECIFIED ULTIMATE STRENGTH, f_{uta}	MINIMUM SPECIFIED YIELD 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)	80,000 (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)
CAN/CSA-G30.18[6] Gr. 400	MPa (psi)	540 (78,300)	400 (58,000)

[1]Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
[2]Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
[3]Standard specification for Zinc-Coated (Galvanized) steel Bars for Concrete Reinforcement.
[4]Standard specification for Rail-Steel and Axle-steel Deformed bars for Concrete Reinforcement.
[5]Reinforcing steel, reinforcing steel bars; dimensions and masses.
[6]Billet-Steel Bars for Concrete Reinforcement

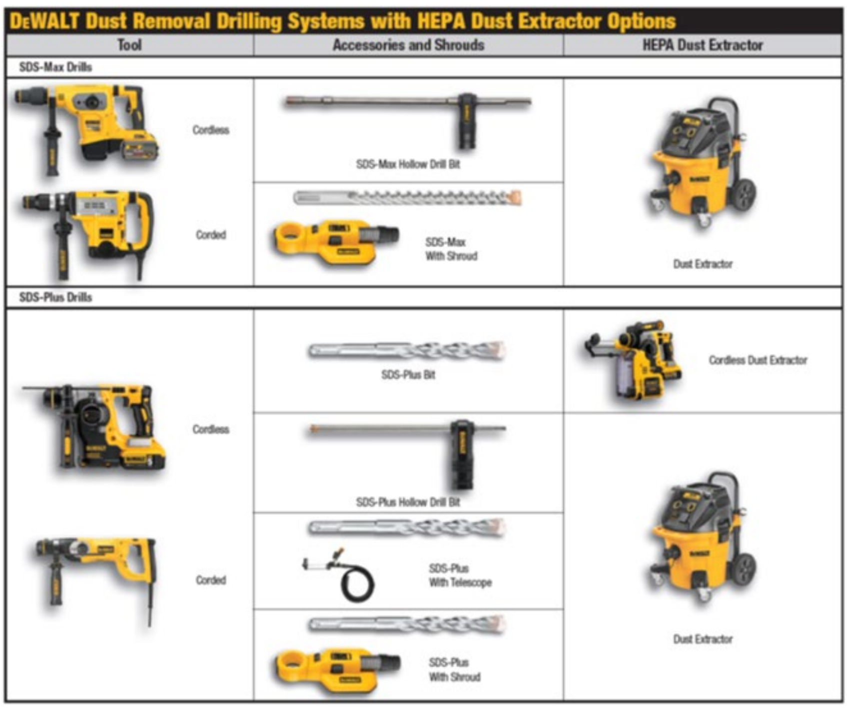

FIGURE 1— EXAMPLES OF DEWALT DUST REMOVAL DRILLING SYSTEMS WITH HEPA DUST EXTRACTORS FOR ILLUSTRATION

FIGURE 2— PURE220+ ADHESIVE ANCHOR SYSTEM INCLUDING TYPICAL STEEL ANCHOR ELEMENTS AND BASIC INSTALLATION PARAMETERS

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

DESIGN INFORMATION		Symbol	Units	Nominal Rod Diameter (inch)						
				3/8	1/2	5/8	3/4	7/8	1	1 1/4
Threaded rod 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 (mm²)	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 F1554 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						

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.

[1]Values 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. Nuts and washers must comply with requirements for the rod.

[2]The tabulated value of ϕ applies when the load combinations of Section 1605.1 of the 2024 IBC or ACI 318-19, as set forth in ACI 318-19 17.5.3 are used.

TABLE 5—CONCRETE BREAKOUT DESIGN INFORMATION FOR U.S. CUSTOMARY UNIT THREADED ROD[1]

DESIGN INFORMATION	Symbol	Units	Nominal Rod Diameter (inch)						
			$^{3}/_{8}$	$^{1}/_{2}$	$^{5}/_{8}$	$^{3}/_{4}$	$^{7}/_{8}$	1	$1^{1}/_{4}$
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)		$h_{ef} + 2d_0$ where d_0 is hole diameter				
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.

[1]Additional setting information is described in Figure 4, installation instructions.

[2] The 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 are met.

TABLE 6—BOND STRENGTH DESIGN INFORMATION FOR U.S. CUSTOMARY UNIT THREADED ROD IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT (OR DEWALT 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/mm²)	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/mm²)	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/mm²)	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/mm²)	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)
Temperature range C[2,3]	Characteristic bond strength in uncracked concrete		$\tau_{k,uncr}$	psi (N/mm²)	970 (6.7)	940 (6.5)	915 (6.3)	885 (6.1)	855 (5.9)	825 (5.7)	770 (5.3)
	Characteristic bond strength in cracked concrete		$\tau_{k,cr}$	psi (N/mm²)	665 (4.6)	680 (4.7)	610 (4.2)	680 (4.7)	665 (4.6)	665 (4.6)	640 (4.4)
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.

[1]Bond 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.

[2]Temperature 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); Temperature range C: Maximum short term temperature = 176°F (80°C), maximum long term temperature = 140°F (60°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.

[3]Characteristic bond strengths are for sustained loads including dead and live loads. For load combinations consisting of short-term loads only such as wind or seismic, bond strengths may be increased by 17 percent for temperature range A and B and by 92 percent for temperature range C.

TABLE 7—BOND STRENGTH DESIGN INFORMATION FOR U.S. CUSTOMARY UNIT THREADED ROD IN HOLES DRILLED WITH A DIAMOND CORE BIT[1]

DESIGN INFORMATION			Symbol	Units	Nominal Rod Diameter (inch)						
					3/8	½	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/mm²)	1655 (11.4)	1550 (10.7)	1495 (10.3)	1435 (9.9)	1390 (9.6)	1350 (9.3)	1290 (8.9)
	Characteristic bond strength in cracked concrete		$\tau_{k,cr}$	psi (N/mm²)	1205 (8.3)	1116 (7.7)	1045 (7.2)	1000 (6.9)	970 (6.7)	945 (6.5)	945 (6.5)
Temperature range B[2,3]	Characteristic bond strength in uncracked concrete		$\tau_{k,uncr}$	psi (N/mm²)	1350 (9.3)	1275 (8.8)	1220 (8.4)	1160 (8.0)	1130 (7.8)	1100 (7.6)	1045 (7.2)
	Characteristic bond strength in cracked concrete		$\tau_{k,cr}$	psi (N/mm²)	970 (6.7)	915 (6.3)	855 (5.9)	810 (5.6)	800 (5.5)	770 (5.3)	770 (5.3)
Temperature range C[2,3]	Characteristic bond strength in uncracked concrete		$\tau_{k,uncr}$	psi (N/mm²)	970 (6.7)	915 (6.3)	885 (6.1)	840 (5.8)	810 (5.6)	800 (5.5)	755 (5.2)
	Characteristic bond strength in cracked concrete		$\tau_{k,cr}$	psi (N/mm²)	650 (4.5)	610 (4.2)	580 (4.0)	550 (3.8)	535 (3.7)	520 (3.6)	520 (3.6)
Permissible installation conditions	Dry concrete	Anchor Category	-	-	1						
		Strength reduction factor	ϕ_d	-	0.65						
	Water-saturated concrete	Anchor Category	-	-	1	2	2	2	3	3	3
		Strength reduction factor	ϕ_{ws}	-	0.65	0.55	0.55	0.55	0.45	0.45	0.45
Reduction factor for seismic tension			$\alpha_{N,seis}$	-	1.00	1.00	1.00	0.98	0.99	0.98	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.

[1]Bond 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 $(f'_c / 2500)^{0.24}$ [For SI: $(f'_c / 17.2)^{0.24}$] for uncracked concrete, and $(f'_c / 2500)^{0.20}$ [For SI: $(f'_c / 17.2)^{0.20}$] for cracked concrete. See Section 4.1.4 of this report.
[2]Temperature 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); Temperature range C: Maximum short term temperature = 176°F (80°C), maximum long term temperature = 140°F (60°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.
[3]Characteristic bond strengths are for sustained loads including dead and live loads. For load combinations consisting of short-term loads only such as wind or seismic, bond strengths may be increased by 20 percent for temperature range A and B and by 61 percent for temperature range C.

TABLE 8—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_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)	1.128 (28.6)	1.270 (31.8)
Reinforcing bar effective cross-sectional area		A_{se}	in.² (mm²)	0.110 (71)	0.200 (129)	0.310 (200)	0.440 (284)	0.600 (387)	0.790 (510)	1.000 (645)	1.270 (819)
ASTM 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)	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 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.

[1]Values provided for common bar material types based on specified strengths and calculated in accordance with ACI 318-19 Eq. 17.6.1.
[2]The tabulated value of ϕ applies when the load combinations of Section 1605.1 of the 2024 IBC or ACI 318-19 as set forth in ACI 318-19 17.5.3 are used.
[3]In accordance with ASTM A615, Grade 40 bars are furnished only in sizes No. 3 through No. 6.

TABLE 9—CONCRETE BREAKOUT 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
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)	$1\frac{7}{8}$ (48)	$2\frac{3}{8}$ (60)	3 (77)	$3\frac{3}{4}$ (95)	$4\frac{1}{4}$ (108)	$4\frac{3}{4}$ (121)	$5\frac{1}{4}$ (135)	$5\frac{7}{8}$ (149)
Min. edge spacing[4]	c_{min}	in. (mm)	$1\frac{5}{8}$ (41)	$1\frac{3}{4}$ (44)	2 (51)	$2\frac{3}{8}$ (60)	$2\frac{1}{2}$ (64)	$2\frac{3}{4}$ (70)	3 (76)	$3\frac{1}{4}$ (82)
					See Section 4.1.9 of this report for smaller edge distances with 0.45 T_{max}					
Min. member thickness	h_{min}	in. (mm)	$h_{ef} + 1\frac{1}{4}$ (h_{ef} + 30)		$h_{ef} + 2d_0$ where d_0 is hole diameter					
Critical edge spacing – splitting (for uncracked concrete)[2]	c_{ac}	-	See Section 4.1.10 of this report.							
Critical anchor spacing – splitting	s_{ac}	-	$2 \cdot c_{ac}$							
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 = 0.006897 MPa. For **pound-inch** units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi.

[1]Additional setting information is described in Figure 4, installation instructions.
[2] The 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 are met.

TABLE 10—BOND STRENGTH DESIGN INFORMATION FOR U.S. CUSTOMARY UNIT REINFORCING BARS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT (OR DEWALT 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
Minimum embedment			$h_{ef,min}$	in. (mm)	2 3/8 (60)	2 3/4 (70)	3 1/8 (79)	3 1/2 (89)	3 1/2 (89)	4 (102)	4 1/2 (114)	5 (127)
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		$\tau_{k,uncr}$	psi (N/mm²)	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		$\tau_{k,cr}$	psi (N/mm²)	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		$\tau_{k,uncr}$	psi (N/mm²)	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		$\tau_{k,cr}$	psi (N/mm²)	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)
Temperature range C[2,3]	Characteristic bond strength in uncracked concrete		$\tau_{k,uncr}$	psi (N/mm²)	855 (5.9)	840 (5.8)	825 (5.7)	810 (5.6)	795 (5.5)	785 (5.4)	755 (5.2)	755 (5.2)
	Characteristic bond strength in cracked concrete		$\tau_{k,cr}$	psi (N/mm²)	680 (4.7)	680 (4.7)	680 (4.7)	680 (4.7)	680 (4.7)	680 (4.7)	680 (4.7)	680 (4.7)
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 = 006894 MPa. For **pound-inch** units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi.

[1]Bond 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.

[2]Temperature 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); Temperature range C: Maximum short term temperature = 176°F (80°C), maximum long term temperature = 140°F (60°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.

[3]Characteristic bond strengths are for sustained loads including dead and live loads. For load combinations consisting of short-term loads only such as wind or seismic, bond strengths may be increased by 17 percent for temperature range A and B and by 92 percent for temperature range C.

TABLE 11—BOND STRENGTH DESIGN INFORMATION FOR U.S. CUSTOMARY UNIT REINFORCING BARS IN HOLES DRILLED WITH A DIAMOND CORE 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
Minimum embedment			$h_{ef,min}$	in. (mm)	2 3/8 (60)	2 3/4 (70)	3 1/8 (79)	3 1/2 (89)	3 1/2 (89)	4 (102)	4 1/2 (114)	5 (127)
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		$\tau_{k,uncr}$	psi (N/mm²)	1,480 (10.2)	1,465 (10.1)	1,350 (9.3)	1,350 (9.3)	1,350 (9.3)	1,350 (9.3)	1,350 (9.3)	1,350 (9.3)
Temperature range B[2,3]	Characteristic bond strength in uncracked concrete		$\tau_{k,uncr}$	psi (N/mm²)	1,205 (8.3)	1,205 (8.3)	1,100 (7.6)	1,100 (7.6)	1,100 (7.6)	1,100 (7.6)	1,100 (7.6)	1,100 (7.6)
Temperature range C[2,3]	Characteristic bond strength in uncracked concrete		$\tau_{k,uncr}$	psi (N/mm²)	870 (6.0)	870 (6.0)	800 (5.5)	800 (5.5)	800 (5.5)	800 (5.5)	800 (5.5)	800 (5.5)
Permissible installation conditions	Dry concrete	Anchor Category	-	-	1							
		Strength reduction factor	ϕ_d	-	0.65							
	Water-saturated concrete	Anchor Category	-	-	1	2	2	2	3	3	3	3
		Strength reduction factor	ϕ_{ws}	-	0.65	0.55	0.55	0.55	0.45	0.45	0.45	0.45

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.

[1]Bond strength values correspond to concrete compressive strength f'_c = 2,500 psi (17.2 N/mm²). For 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 $(f'_c / 2500)^{0.35}$ [For SI: $(f'_c / 17.2)^{0.35}$]. See Section 4.1.4 of this report.
[2]Temperature 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); Temperature range C: Maximum short term temperature = 176°F (80°C), maximum long term temperature = 140°F (60°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.
[3]Characteristic bond strengths are for sustained loads including dead and live loads. For load combinations consisting of short-term loads only such as wind or seismic, bond strengths may be increased by 20 percent for temperature range A and B and by 61 percent for temperature range C.

TABLE 12—STEEL DESIGN INFORMATION FOR METRIC THREADED ROD[1]

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}	mm² (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						

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

[1]Values 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. Nuts and washers must comply with requirements for the rod.
[2]The tabulated value of ϕ applies when the load combinations of Section 1605.1 of the 2024 IBC or ACI 318-19 5.3 as set forth in ACI 318-19 17.5.3 are used.
[3]A4-70 Stainless steel (M8-M24); A4-50 Stainless steel (M27-M30).

TABLE 13—CONCRETE BREAKOUT DESIGN INFORMATION FOR METRIC THREADED ROD [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} + $1^1/_4$)		$h_{ef} + 2d_0$ where d_0 is hole diameter				
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						

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.

[1]Additional setting information is described in Figure 4, installation instructions.
[2]The 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 are met.

TABLE 14—BOND STRENGTH DESIGN INFORMATION FOR METRIC THREADED ROD IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT (OR DEWALT 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		$\tau_{k,uncr}$	N/mm² (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		$\tau_{k,cr}$	N/mm² (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		$\tau_{k,uncr}$	N/mm² (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		$\tau_{k,cr}$	N/mm² (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)
Temperature range C[2,3]	Characteristic bond strength in uncracked concrete		$\tau_{k,uncr}$	N/mm² (psi)	6.7 (970)	6.4 (930)	6.0 (870)	5.8 (840)	5.5 (800)	5.4 (785)	5.3 (770)
	Characteristic bond strength in cracked concrete		$\tau_{k,cr}$	N/mm² (psi)	4.5 (650)	4.2 (610)	4.0 (580)	3.8 (550)	3.7 (535)	3.6 (520)	3.6 (520)
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	0.94	0.94	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.

[1]Bond 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.
[2]Temperature 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); Temperature range C: Maximum short term temperature = 176°F (80°C), maximum long term temperature = 140°F (60°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.
[3]Characteristic bond strengths are for sustained loads including dead and live loads. For load combinations consisting of short-term loads only such as wind or seismic, bond strengths may be increased by 17 percent for temperature range A and B and by 92 percent for temperature range C.

TABLE 15—STEEL DESIGN INFORMATION FOR EU METRIC AND CANADIAN METRIC REINFORCING BARS [1]

DESIGN INFORMATION		Symbol	Units	Nominal Bar Size (EU)							
				Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32
Reinforcing bar O.D.		d_a	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}	mm² (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							

DESIGN INFORMATION		Symbol	Units	Nominal Bar Size (Canadian)				
				10M	15M	20M	25M	30M
Reinforcing bar O.D.		d_a	mm (in.)	11.3 (0.445)	16.0 (0.630)	19.5 (0.768)	25.2 (0.992)	29.9 (1.177)
Reinforcing bar effective cross-sectional area		A_{se}	mm² (in.²)	100.3 (0.155)	201.1 (0.312)	298.6 (0.463)	498.8 (0.773)	702.2 (1.088)
CAN/CSA G30.18	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	kN (lb)	54.0 (12,175)	108.5 (24,410)	161.5 (36,255)	270.0 (60,550)	380.0 (85,240)
		V_{sa}	kN (lb)	32.5 (7,305)	65.0 (14,645)	97.0 (21,755)	161.5 (36,330)	227.5 (51,145)
	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.

[1]Values 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.
[2]The tabulated value of ϕ applies when the load combinations of Section 1605.1 of the 2024 IBC or ACI 318-19 5.3 as set forth in ACI 318-19 17.5.3 are used.

TABLE 16—CONCRETE BREAKOUT DESIGN INFORMATION FOR EU AND CANADIAN METRIC REINFORCING BARS [1]

DESIGN INFORMATION	Symbol	Units	Nominal Bar Size												
			Ø 10	10M	Ø 12	Ø 14	15M	Ø 16	Ø 20	20M	Ø 25	25M	Ø 28	30M	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)	55 (2$^1/_8$)	60 (2$^3/_8$)	70 (2$^3/_4$)	75 (3)	80 (3$^1/_8$)	95 (3$^3/_4$)	95 (3$^3/_4$)	120 (4$^5/_8$)	120 (4$^5/_8$)	135 (5$^1/_4$)	140 (5$^1/_2$)	150 (5$^7/_8$)
Min. edge spacing	c_{min}	mm (in.)	40 (1$^5/_8$)	45 (1$^3/_4$)	45 (1$^3/_4$)	50 (2)	50 (2)	55 (2$^1/_4$)	60 (2$^3/_8$)	60 (2$^3/_8$)	70 (2$^3/_4$)	70 (2$^3/_4$)	75 (3)	80 (3$^1/_8$)	85 (3$^1/_8$)
						See Section 4.1.9 of this report for smaller edge distances with 0.45 T_{max}									
Min. member thickness	h_{min}	mm (in.)	h_{ef} + 30 (h_{ef} + 1$^1/_4$)			h_{ef} + 2d_0 where d_0 is hole diameter									
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												

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.

[1]Additional setting information is described in Figure 4, installation instructions.
[2]The 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 are met.

TABLE 17—BOND STRENGTH DESIGN INFORMATION EU METRIC REINFORCING BARS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT (OR DEWALT HOLLOW CARBIDE DRILL BIT)[1]

DESIGN INFORMATION			Symbol	Units	Nominal Bar Size (EU)							
					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		$\tau_{k,uncr}$	N/mm² (psi)	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		$\tau_{k,cr}$	N/mm² (psi)	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		$\tau_{k,uncr}$	N/mm² (psi)	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		$\tau_{k,cr}$	N/mm² (psi)	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)
Temperature range C[2,3]	Characteristic bond strength in uncracked concrete		$\tau_{k,uncr}$	N/mm² (psi)	5.9 (855)	5.8 (840)	5.7 (825)	5.6 (810)	5.5 (795)	5.4 (785)	5.3 (770)	5.2 (755)
	Characteristic bond strength in cracked concrete		$\tau_{k,cr}$	N/mm² (psi)	4.7 (680)	4.7 (680)	4.7 (680)	4.7 (680)	4.7 (680)	4.7 (680)	4.7 (680)	4.7 (680)
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	κ_{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.

[1]Bond 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.

[2]Temperature 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); Temperature range C: Maximum short term temperature = 176°F (80°C), maximum long term temperature = 140°F (60°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.

[3]Characteristic bond strengths are for sustained loads including dead and live loads. For load combinations consisting of short-term loads only such as wind or seismic, bond strengths may be increased by 17 percent for temperature range A and B and by 92 percent for temperature range C.

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TABLE 18—BOND STRENGTH DESIGN INFORMATION METRIC CANADIAN REINFORCING BARS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT (OR DEWALT HOLLOW CARBIDE DRILL BIT)[1]

DESIGN INFORMATION			Symbol	Units	Nominal Rod Diameter (CA)				
					10M	15M	20M	25M	30M
Minimum embedment			$h_{ef,min}$	mm. (in.)	60 (2.4)	80 (3.1)	90 (3.5)	100 (3.9)	120 (4.7)
Maximum embedment			$h_{ef,max}$	mm (in.)	200 (7.9)	300 (11.8)	400 (15.7)	500 (19.7)	600 (23.6)
Temperature range A[2,3]	Characteristic bond strength in uncracked concrete		$\tau_{k,uncr}$	N/mm² (psi)	12.7 (1,850)	12.2 (1,780)	12.0 (1,745)	11.8 (1,720)	11.4 (1,665)
	Characteristic bond strength in cracked concrete		$\tau_{k,cr}$	N/mm² (psi)	9.0 (1,305)	7.9 (1,155)	8.6 (1,253)	8.4 (1,225)	8.1 (1,175)
Temperature range B[2,3]	Characteristic bond strength in uncracked concrete		$\tau_{k,uncr}$	N/mm² (psi)	9.9 (1,450)	9.6 (1,395)	9.4 (1,370)	9.2 (1,350)	8.9 (1,300)
	Characteristic bond strength in cracked concrete		$\tau_{k,cr}$	N/mm² (psi)	7.0 (1,020)	6.2 (905)	6.7 (980)	6.6 (960)	6.3 (920)
Temperature range C[2,3]	Characteristic bond strength in uncracked concrete		$\tau_{k,uncr}$	N/mm² (psi)	5.6 (810)	5.5 (795)	5.4 (785)	5.2 (755)	5.1 (740)
	Characteristic bond strength in cracked concrete		$\tau_{k,cr}$	N/mm² (psi)	4.2 (610)	4.1 (595)	4.0 (580)	4.0 (580)	4.0 (580)
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			$\alpha_{N,seis}$	-	1.0				

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.

[1]Bond 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 $(f'_c / 2500)^{0.08}$ [For **SI**: $(f'_c / 17.2)^{0.08}$] for uncracked concrete and $(f'_c / 2500)^{0.09}$ [For **SI**: $(f'_c / 17.2)^{0.09}$] for cracked concrete. See Section 4.1.4 of this report.
[2] Temperature 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); Temperature range C: Maximum short term temperature = 176°F (80°C), maximum long term temperature = 140°F (60°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.
[3]Characteristic bond strengths are for sustained loads including dead and live loads. For load combinations consisting of short-term loads only such as wind or seismic, bond strengths may be increased by 17 percent for temperature range A and B and by 92 percent for temperature range C.

TABLE 19—DEVELOPMENT LENGTH FOR U.S. CUSTOMARY UNIT REINFORCING BARS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT (OR DEWALT HOLLOW CARBIDE DRILL BIT) OR DIAMOND CORE BIT[1,2,4,5,6]

DESIGN INFORMATION	Symbol	Criteria Section of Reference Standard	Units	Nominal 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	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 ≡ 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 Chapter 18 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 are met to permit λ > 0.75.
[4]$\left(\frac{c_b + K_{tr}}{d_b}\right) = 2.5$, ψ_t = 1.0, ψ_e = 1.0, ψ_s = 0.8 for $d_b \leq$ #6, 1.0 for d_b > #6.
[5]Calculations may be performed for other steel grades per ACI 318-19 Chapter 25.
[6]Minimum development length shall not be less than 12 in (305 mm) per ACI-19 Section 25.4.2.1.

TABLE 20—DEVELOPMENT LENGTH FOR EU METRIC REINFORCING BARS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT (OR DEWALT HOLLOW CARBIDE DRILL BIT) OR DIAMOND CORE BIT [1,2,4,5,6]

DESIGN INFORMATION	Symbol	Criteria Section of Reference Standard	Units	Nominal 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]	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.

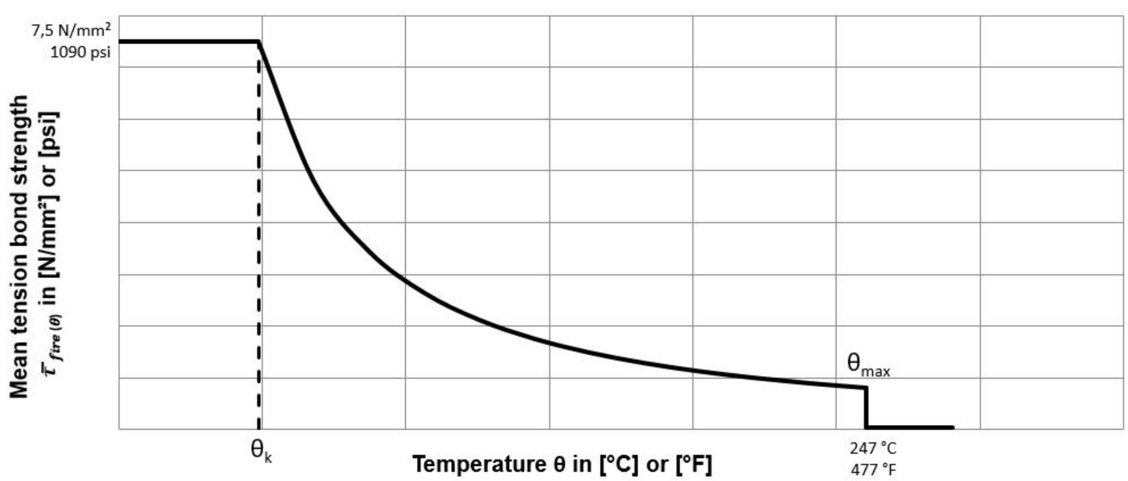
[1]Development lengths valid for static, wind, and earthquake loads (SDC A and B).
[2]Development lengths in SDC C through F must comply with ACI 318-19 Chapter 18 and section 4.2.4 of this report.
[3]f_y and f'_c used in this table are for example purposes only. For sand-lightweight concrete, increase development length by 33%, unless the provisions of ACI 318-19 25.4.2.5 are met to permit λ > 0.75.
[4]$\left(\frac{c_b + K_{tr}}{d_b}\right) = 2.5$, ψ_t = 1.0, ψ_e = 1.0, ψ_s = 0.8 for d_b < 20mm, 1.0 for $d_b \geq$ 20mm.
[5]Calculations may be performed for other steel grades per ACI 318-19 Chapter 25.
[6]Minimum development length shall not be less than 12 in (305 mm) per ACI-19 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.

TABLE 21—DEVELOPMENT LENGTH FOR CA METRIC REINFORCING BARS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT (OR DEWALT HOLLOW CARBIDE DRILL BIT) OR DIAMOND CORE BIT[1,2,4,5,6]

DESIGN INFORMATION	Symbol	Criteria Section of Reference Standard	Units	Bar size					
				10M	15M	20M	25M	30M	35M
Nominal reinforcing bar diameter	d_b	CAN/CSA G30.18 Grade 400	mm (in.)	11.3 (0.445)	16.0 (0.630)	19.5 (0.768)	25.2 (0.992)	29.9 (1.177)	35.7 (1.406)
Nominal bar area	A_b	CAN/CSA G30.18 Grade 400	mm^2 (in^2)	100 (0.16)	200 (0.31)	300 (0.46)	500 (0.77)	700 (1.09)	1000 (1.56)
Development length for f_y = 58 ksi and f'_c = 2,500 psi (normal weight concrete)[3]	l_d	ACI 318-19 25.4.2.4[7]	mm (in.)	315 (12.4)	446 (17.5)	679 (26.7)	877 (34.5)	1041 (41.0)	1243 (48.9)
Development length for f_y = 58 ksi and f'_c = 3,000 psi (normal weight concrete)[3]	l_d	ACI 318-19 25.4.2.4[7]	mm (in.)	305 (12.0)	407 (16.0)	620 (24.4)	801 (31.5)	950 (37.4)	1134 (44.7)
Development length for f_y = 58 ksi and f'_c = 4,000 psi (normal weight concrete)[3]	l_d	ACI 318-19 25.4.2.4[7]	mm (in.)	305 (12.0)	352 (13.9)	537 (21.1)	693 (27.3)	823 (32.4)	982 (38.7)
Development length for f_y = 58 ksi and f'_c = 6000 psi (normal weight concrete)[3]	l_d	ACI 318-19 25.4.2.4[7]	mm (in.)	305 (12.0)	305 (12.0)	438 (17.2)	566 (22.3)	672 (26.4)	802 (31.6)
Development length for f_y = 58 ksi and f'_c = 8000 psi (normal weight concrete)[3]	l_d	ACI 318-19 25.4.2.4[7]	mm (in.)	305 (12.0)	305 (12.0)	379 (14.9)	490 (19.3)	582 (22.9)	695 (27.3)

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

[1]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 Chapter 18 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 are met to permit $\lambda > 0.75$.
[4] $\left(\frac{c_b + K_{tr}}{d_b}\right) = 2.5$, ψ_t = 1.0, ψ_e = 1.0, ψ_s = 0.8 for d_b < 20mm, 1.0 for d_b ≥ 20mm.
[5] Calculations may be performed for other steel grades per ACI 318-19 Chapter 25.
[6] Minimum development length shall not be less than 12 in (305 mm) per ACI-19 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 DEWALT hollow carbide bit):	For diamond core bit:
$\bar{\tau}_{fire}(\theta) = 1955671 \cdot \theta^{-1.585} \leq 1090$ [psi] with θ in °F $\bar{\tau}_{fire}(\theta) = 1277 \cdot \theta^{-1.341} \leq 7.5$ [N/mm²] with θ in °C θ_k = 113°F (46°C)	$\bar{\tau}_{fire}(\theta) = 1814842 \cdot \theta^{-1.585} \leq 1090$ [psi] with θ in °F $\bar{\tau}_{fire}(\theta) = 1185 \cdot \theta^{-1.341} \leq 7.5$ [N/mm²] with θ in °C θ_k = 108°F (44°C)

[1]See Section 4.2.5 of this report. With θ_{max} = 247°C (477°F). For temperatures larger than θ_{max} the bond strength $\bar{\tau}_{fire}(\theta) = 0$.
[2]For application with rebar #11 (36mm) or larger in an overhead installation, the bond strengths must be decreased by 11 percent.
[3]Bond strengths under fire are for short-term loads such as wind and seismic, and for long-term/sustained loads including dead and live loads.
[4]For post-installed reinforcing bar applications in holes drilled with a hammer drill and carbide bit (or DEWALT hollow carbide drill bit) or diamond core bit.

FIGURE 3— BOND STRENGTH VS TEMPERATURE FOR POST-INSTALLED REINFORCING BAR APPLICATIONS SUBJECT TO ELEVATED TEMPERATURE / FIRE[1,2,3,4]

TABLE 22— APPLICABLE SECTIONS OF THE IBC CODE UNDER EACH EDITION OF THE IBC

2024 IBC	2021 IBC	2018 IBC	2015 IBC
Section 1605.1		Section 1605.2 or 1605.3	
Section 1705.1.1			
Table 1705.3			
Section 1705			
Section 1706			
Section 1707			
Chapter 19			
Section 1901.3			
Section 1903			
Section 1905			
Section 1905.7	Section 1905.1.8		

TABLE 23— APPLICABLE SECTIONS OF ACI 318 UNDER EACH EDITION OF THE IBC

2024 IBC	2021 IBC	2018 IBC	2015 IBC
ACI 318-19		**ACI 318-14**	
2.3		2.3	
5.3		5.3	
Chapter 17		Chapter 17	
17.2.4		17.2.6	
17.3.1		17.2.7	
17.5.1.2		17.3.1	
17.5.2		17.3.1.1	
17.5.3		17.3.3	
17.6.1.2		17.4.1.2	
17.6.2		17.4.2	
17.6.2.2		17.4.2.2	
17.6.2.5		17.4.2.6	
17.6.5		17.4.5	
17.6.5.1.2b		17.4.1.5d	
17.6.5.2.1		17.4.5.2	
17.6.5.5		17.4.5.5	
Eq. 17.6.5.5.1b		Eq. 17.4.5.5b	
Eq. 17.6.5.5.1c		Eq. 17.4.5.5c	
17.7.1.2		17.5.1.2	
17.7.2		17.5.2	
17.7.2.2		17.5.2.2	
17.7.3		17.5.3	
17.8		17.6	
17.8.2 and 17.8.3		17.6.1, 17.6.2 and 17.6.3	
17.9.2		17.7.1 and 17.7.3	
17.9.3		17.7.4	
17.9.5		17.7.6	
17.10		17.2.3	
Chapter 18		Chapter 18	
Chapter 19		Chapter 19	
Chapter 25		Chapter 25	
25.4.2.5		25.4.2.4	
26.6.3.2 (b)		26.6.3.1 (b)	
26.7.2		17.8.1 and 17.8.2	
26.7.1(l) and 26.7.2(e)		17.8.2.2 or 17.8.2.3	
26.13.3.2(e)		17.8.2.4, 26.7.1(h) and 26.13.3.2(c)	

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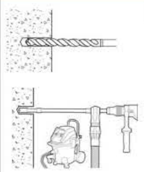
DEWALT ENGINEERED BY Powers

PURE220+ Instruction Card

Follow steps #1 through #10 for recommended installation

1. Setting instructions for Adhesive Anchors and Post-installed Reinforcing Bar Connections in solid base material

Hammer drilling



1. Drill a hole into the base material with a hammer drill (i.e. percussion drill) and a carbide drill bit to the size and embedment required by the selected steel hardware element (see Table 4). The tolerances of the carbide drill bit must meet the requirements of ANSI Standard B212.15.

For holes drilled with hollow drill bits: a HEPA vacuum with air flow 90 cfm (150 m³/h) must be used (vacuum must be on) and drilling in dry concrete is recommended.

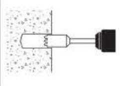
Precaution: Wear eye and skin protection. Avoid inhalation of dusts during drilling and /or removal (*see dust extraction equipment by DEWALT to minimize dust emissions*).

Note: 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.

→ In the case of an underwater (submerged) installation condition go to Step 2a-uw.

→ Go to Step 3 for holes drilled with DustX+™ extraction system (no further hole cleaning is required). Otherwise go to Step 2a for cleaning hammer drilled holes.

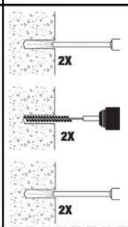
Core drilling



1. Drill a hole into the base material with a core drill and diamond core drill bit to the size and embedment required by the selected steel hardware element (see Table 4).

Precaution: Wear eye and skin protection. Avoid inhalation of dusts during drilling and /or removal (*see dust extraction equipment by DEWALT to minimize dust emissions*).

Hole cleaning, dry or wet, hammer drilled holes

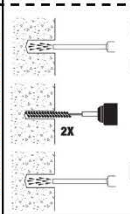


2a. Starting from the bottom or back of the anchor hole, blow the hole clean with compressed air (min. 6 bar / 90 psi) a minimum of two times, until return air stream is free of noticeable dust. If the back of the hole is not reached an extension shall be used.

2b. Determine brush diameter (see Table 3) for the drilled hole. Brush the hole with the selected wire brush a minimum of two times (2x). If the back of the drilled hole is not reached a brush extension shall be used. A brush extension (supplied by DEWALT) must be used for drill hole depth > 6 in. (150 mm). The wire brush diameter must be checked periodically during use. The brush should resist insertion into the drilled hole - if not the brush is too small and must be replaced with the proper brush diameter.

2c. Finally blow the hole clean again with compressed air (min. 6 bar / 90 psi) a minimum of two times, until return air stream is free of noticeable dust. When finished the hole should be clean and free of dust, debris, ice, grease, oil or other foreign material.

Hole cleaning, underwater, hammer drilled holes

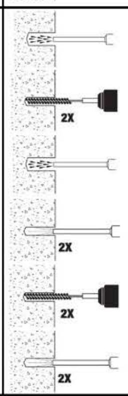


2a-uw. Starting from the bottom or back of the anchor hole, rinse/flush the hole until clean water comes out. If the back of the hole is not reached an extension shall be used.

2b-uw. Determine brush diameter (see Table 3) for the drilled hole. Brush the hole with the selected wire brush a minimum of two times (2x). If the back of the drilled hole is not reached a brush extension shall be used. A brush extension (supplied by DEWALT) must be used for drill hole depth > 6 in. (150 mm). The wire brush diameter must be checked periodically during use. The brush should resist insertion into the drilled hole; if not the brush is too small and must be replaced with the proper brush diameter.

2c-uw. Finally, starting from the bottom or back of the anchor hole, rinse/flush the hole clean again until clean water comes out. When finished the hole should be clean and free of dust, debris, ice, grease, oil or other foreign material.

Hole cleaning, core drilled holes



2a. Starting from the bottom or back of the anchor hole, rinse/flush the hole until clean water comes out. If the back of the drilled hole is not reached an extension shall be used.

2b. Determine brush diameter (see Table 3) for the drilled hole. Brush the hole with the selected wire brush a minimum of two times (2x). If the back of the drilled hole is not reached a brush extension shall be used. A brush extension (supplied by DEWALT) must be used for drill hole depth > 6 in. (150 mm). The wire brush diameter must be checked periodically during use. The brush should resist insertion into the drilled hole; if not the brush is too small and must be replaced with the proper brush diameter.

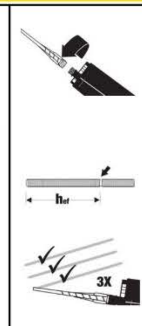
2c. Again, starting from the bottom or back of the anchor hole, rinse/flush the hole until clean again until water comes out.

2d. 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 hole is not reached an extension shall be used.

2e. Brush the hole again with the selected wire brush a minimum of two times (2x). The wire brush diameter must be checked periodically during use. 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.

2f. Finally, starting from the bottom or back of the anchor hole, 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. When finished the hole should be clean and free of dust, debris, ice, grease, oil or other foreign material.

Preparing



3. Check adhesive expiration date on cartridge label. Do not use expired product. Review Safety Data Sheet (SDS) before use. Cartridge temperature must be between 41°F - 104°F (5°C - 40°C) when in use. Review working and cure times. Consideration should be given to the reduced gel (working) time of the adhesive in warm temperatures. For the permitted range of the base material 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.

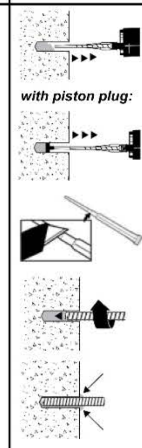
Note: Always use a new mixing nozzle with new cartridges of adhesive and also for all work interruptions exceeding the published gel (working) time of the adhesive.

4. 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.

5. 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 ***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. Consideration should be given to the reduced gel (working) time of the adhesive in warm temperatures.

Installation



6. Fill the cleaned hole approximately two-thirds full with mixed adhesive starting from the bottom or back of the anchor hole. Slowly withdraw the mixing nozzle as the hole fills to avoid creating air pockets or voids. For embedment depths greater than 8" (200 mm) an extension tube supplied by DEWALT must be used.

Note: 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 and horizontal installations with drill hole depth d_o >10 in. (250 mm). They are suggested for use in underwater installations.

Insert piston plug to the back of the drilled hole and inject. During installation the piston plug will be naturally extruded from the drilled hole by the adhesive pressure.

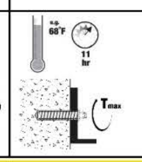
In case of that flexible tubing is used (Cat. #PFC1640600), the mixing nozzle may be trimmed at the perforation on the front port before attachment of the tubing.

Attention! Do not install anchors overhead without installation hardware supplied by DEWALT and receiving proper training.

7. The anchor should be free of dirt, grease, oil or other foreign material. Push clean threaded rod or reinforcing bar into the anchor hole while turning slightly to ensure positive distribution of the adhesive until the embedment depth is reached. Observe the gel (working) time.

8. Be sure that the anchor is fully seated at the bottom of the hole and that some adhesive has flowed from the hole and all around the top of the anchor. Following installation of the anchor element, remove excess adhesive / protect fouling anchor element threads. 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 only.

Curing and fixture



9. Allow the adhesive anchor to cure to the specified full curing time prior to applying any load (see Table 2).

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

10. After full curing of the adhesive anchor, a fixture can be installed to the anchor and tightened up to the maximum torque (shown in Table 4) by using a calibrated torque wrench.

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

2. Gel (working) times and curing times

Temperature of base material	Gel (working) time	Initial curing time[1]	Full curing time
41 °F (+5 °C) to 49 °F (+9 °C)	80 min	24 h	48 h
50 °F (+10 °C) to 58 °F (+14 °C)	60 min	15 h	30 h
59 °F (+15 °C) to 67 °F (+19 °C)	40 min	10 h	20 h
68 °F (+20 °C) to 76 °F (+24 °C)	30 min	5 h	11 h
77 °F (+25 °C) to 85 °F (+29 °C)	12 min	4 h	9 h
86 °F (+30 °C) to 103 °F (+39 °C)	8 min	3 h	6 h
104 °F (+40 °C) to 109 °F (+42 °C)	6 min	2 h	4 h
110 °F (+43 °C)	5 min	2 h	4 h

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

FIGURE 4—INSTALLATION INSTRUCTIONS

3a. Wire brush / piston plug info (fractional sizes)[1]

Threaded Rod [inch]	Rebar [inch]	Drill bit - ∅ [inch]	Brush size - ∅ [mm]	Brush size - ∅ [inch]	Cat. #	Piston plug (Size)	Cat. # Standard	Cat. # Premium
3/8"	-	7/16	13.5	0.53	PFC1671050	No piston plugs required		
-	#3	1/2	14.3	0.56	PFC1671100			
1/2"	-	9/16	16.3	0.65	PFC1671150			
-	#4	5/8	18.3	0.72	PFC1671200			
5/8"		11/16	20.0	0.79	PFC1671225	11/16"	08258-PWR	PFC1691515
	#5	3/4	21.5	0.85	PFC1671250	3/4"	08259-PWR	PFC1691520
3/4"	#6	7/8	24.8	0.98	PFC1671300	7/8"	08300-PWR	PFC1691530
7/8"	#7	1	28.5	1.12	PFC1671350	1"	08301-PWR	PFC1691540
1"	#8	1-1/8	31.8	1.25	PFC1671400	1-1/8"	08303-PWR	PFC1691550
1-1/4"	#9	1-3/8	38.2	1.50	PFC1671450	1-3/8"	08305-PWR	PFC1691560
-	#10	1-1/2	41.4	1.63	PFC1671500	1-1/2"	08309-PWR	PFC1691570
-	#11	1-3/4	47.0	1.85	PFC1671550	1-3/4"	-	PFC1691580

1) If hollow drill bits are used to automatically clean the holes during drilling, standard hole cleaning (following drilling) is not required.

3b. Wire brush / piston plug info (EU and CA metric sizes)[1]

Threaded Rod [mm]	Rebar EU | CA [mm]	Drill bit - ∅ EU | CA [mm]	Drill bit - ∅ EU | CA [inch]	Brush size - ∅ [mm]	Brush size - ∅ [inch]	Cat. # EU | CA		Piston plug (Size)		Cat. # EU | CA	
M10	-	12	-	13.5	0.53	DFC1670120	-	No piston plugs required			
M12	∅10|10M	14	9/16	15.5	0.61	DFC1670140	PFC1671150				
-	∅12	16	-	17.5	0.69	DFC1670160	-				
-	15M	-	3/4	-	0.75	DFC1671250	-	3/4"		-	08259-PWR
M16	∅14	18	-	20.0	0.79	DFC1670180	-	18mm		DFC1690100	-
-	∅16	20	-	22.0	0.87	DFC1670190	-	20mm		DFC1690150	-
M20	-	22	-	24.0	0.94	DFC1670220	-	22mm		DFC1690180	-
-	∅20|20M	25	1	27.0	1.06	DFC1670240	PFC1671350	25mm	1"	DFC1690250	08301-PWR
M24	-	28	-	30.0	1.18	DFC1670280	-	28mm		DFC1690300	-
M27	-	30	-	31.8	1.25	DFC1670310	-	30mm		DFC1690310	-
-	∅25|25M	32	$1^1/_4$	34.0	1.34	DFC1670320	PFC1671425	32mm	$1^1/_4$"	DFC1690350	08290-PWR
M30	∅28	35	-	37.0	1.46	DFC1670330	-	35mm		DFC1690400	-
-	30M	-	$1^1/_2$	-	1.50	DFC1670335	PFC1671500	$1^1/_2$"		-	08291-PWR
-	∅32	40	-	43.5	1.71	DFC1670340	-	40mm		DFC1690420	-
-	∅36	45	-	47.0	1.85	DFC1670350	-	45mm		DFC1690450	-

4. Anchor property / setting information (fractional and metric sizes)

Anchor Parameters	Nominal threaded rod (fractional) Units: inch; ft.-lb.							Nominal threaded rod (metric) Units: mm; N-m						
Nominal anchor size	3/8"	1/2"	5/8"	3/4"	7/8"	1"	1-1/4"	M10	M12	M16	M20	M24	M27	M30
d_a = Nominal anchor diameter	0.375	0.500	0.625	0.750	0.875	1.00	1.250	10	12	16	20	24	27	30
d_o (d_{bit}) = Nominal drill bit size	7/16	9/16	11/16	7/8	1	1-1/8	1-3/8	12	14	18	22	28	30	35
T_{max} = Maximum torque	20 [(1)]	30	44	66	96	147	221	20 [(1)]	40	80	120	170	250	300
$h_{ef,min}$ = Minimum embedment	2-3/8	2-3/4	3-1/8	3-1/2	3-1/2	4	5	60	70	80	90	96	108	120
$h_{ef,max}$ = Maximum embedment	7-1/2	10	12-1/2	15	17-1/2	20	25	200	240	320	400	480	540	600
s_{min} = Min. spacing	1-7/8	2-1/2	3	3-5/8	4-1/4	4-3/4	5-7/8	50	60	80	95	115	130	145
c_{min} = Min. edge distance w/100% T_{max}	1-5/8	1-3/4	2	2-3/8	2-1/2	2-3/4	3-1/4	40	45	55	60	70	75	80
c_{min} = Min. edge distance w/ 45% T_{max}	-		1-3/4				2-3/4	-		45				70
h_{min} = Minimum member thickness	h_{ef} + 1-1/4		h_{ef} + $2d_o$					h_{ef} + 30		h_{ef} + $2d_o$				
Post-installed Rebar Connections														
$h_{ef,max}$ = Maximum embedment	-							-						

Anchor Parameters	Reinforcing bar (fractional) Units: inch; ft.-lb.								
Nominal anchor size	#3	#4	#5	#6	#7	#8	#9	#10	#11
d_a = Nominal anchor diameter	3/8	1/2	5/8	3/4	7/8	1	1-1/8	1-1/4	1-3/8
d_o (d_{bit}) = Nominal drill bit size	1/2	5/8	3/4	7/8	1	1-1/8	1-3/8	1-1/2	1-3/4
T_{max} = Maximum torque	20	30	44	66	96	147	185	221	-
$h_{ef,min}$ = Minimum embedment	2-3/8	2-3/4	3-1/8	3-1/2	3-1/2	4	4-1/2	5	-
$h_{ef,max}$ = Maximum embedment	7-1/2	10	12-1/2	15	17-1/2	20	22-1/2	25	-
s_{min} = Min. spacing	1-7/8	2-1/2	3	3-5/8	4-1/4	4-3/4	5-1/4	5-7/8	-
c_{min} = Min. edge distance w/100% T_{max}	1-5/8	1-3/4	2	2-3/8	2-1/2	2-3/4	3	3-1/4	-
c_{min} = Min. edge distance w/ 45% T_{max}	-		1-3/4				2-3/4		-
h_{min} = Minimum member thickness	h_{ef} + 1-1/4		h_{ef} + $2d_o$						-
Post-installed Rebar Connections									
$h_{ef,max}$ = Maximum embedment	$22^1/_2$	30	$37^1/_2$	45	$52^1/_2$	60	$67^1/_2$	75	$82^1/_2$

Anchor Parameters	Reinforcing bar (metric) Units: mm; N-m													
Nominal anchor size	∅10	10M	∅12	∅14	15M	∅16	∅20	20M	∅25	25M	∅28	30M	∅32	∅36
d_a = Nominal anchor diameter	10		12	14	14	16	20		25		28	32	32	36
d_o (d_{bit}) = Nominal drill bit size	14	9/16	16	18	3/4	20	25	1	32	$1^1/_4$	35	$1^1/_2$	40	45
T_{max} = Maximum torque	20		40	45	80	80	120		175		250	275	300	-
$h_{ef,min}$ = Minimum embedment	60		70	75	80	80	90		100		112	120	128	-
$h_{ef,max}$ = Maximum embedment	200		240	280	320	320	400		500		560	600	640	-
s_{min} = Min. spacing	50		60	70	80	80	95		120		135	150	150	-
c_{min} = Min. edge distance w/100% T_{max}	40		45	50	55	55	60		70		75	80	85	-
c_{min} = Min. edge distance w/ 45% T_{max}	-			45							70			-
h_{min} = Minimum member thickness	h_{ef} + 30			h_{ef} + $2d_o$										-
Post-installed Rebar Connections														
$h_{ef,max}$ = Maximum embedment	600		720	840	960		1200		1500		1680	1920		2160

1. For ASTM A36 and F1554 Grade 36 threaded rods with 3/8" diameter: T_{max} = 11 ft-lbs.

5. System and accessories for Adhesive Anchors and Post-installed Reinforcing Bar Connections

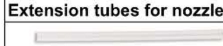
Injection tools	Cartridges	Mixing nozzles	Piston plugs	Compressed air nozzle	SDS connector for brush	Brush extension w/handle
9.5 fl. oz. manual dispenser Cat. #08437-PWR 9.5 fl. oz. cordless battery dispenser Cat. DCE560D1	9.5 fl. oz. (280 mL) Pure220+ Quick-shot coaxial cartridge with mixing nozzle	Pure220+ mixing nozzle Cat. #PFC1641600	 See Table 3a or 3b For sizes and Cat. #	 Note: If the back of the drilled hole is not reached an extension shall be used.	 Cat. #PFC1671830	 Cat. #PFC1671000
13.5 fl. oz. manual dispenser Cat. #08298-PWR	13.5 fl. oz. (400 mL) Pure220+ dual cartridge with mixing nozzle					
					Extension tubes for nozzles	**Brush extension**
20.5 fl. oz. manual dispenser Cat. #08409-PWR 20.5 fl. oz. cordless battery dispenser Cat. DCE591D1 20.5 fl. oz. pneumatic dispenser Cat. #08459-PWR	20.5 fl. oz. (610 mL) Pure220+ dual cartridge with mixing nozzle	Pure220+ mixing nozzle Cat. #PFC1641600 or Cat. #8609-PWR			 Cat. #08281-PWR or #08297-PWR; Cat. #PFC1640600 for flex tubing	 Cat. #PFC1671820
50.5 fl. oz. pneumatic dispenser Cat. #08438-PWR	50.5 fl. oz. (1500 mL) Pure220+ dual cartridge with mixing nozzle					

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FIGURE 4—INSTALLATION INSTRUCTIONS (Continued)

ICC-ES Evaluation Report

ESR-5144 City of LA Supplement

Reissued November 2024

Revised August 2025

This report is subject to renewal November 2025.

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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:

DEWALT

EVALUATION SUBJECT:

PURE220+™ ADHESIVE ANCHOR SYSTEM AND POST-INSTALLED REINFORCING BAR IN CRACKED AND UNCRACKED CONCRETE (DEWALT)

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that DEWALT Pure220+ Adhesive Anchor System and Post-Installed Reinforcing Bar in Cracked and Uncracked Concrete, described in ICC-ES evaluation report ESR-5144, 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:

- 2023 *City of Los Angeles Building Code (LABC)*
- 2023 *City of Los Angeles Residential Code (LARC)*

2.0 CONCLUSIONS

The DEWALT Pure220+ Adhesive Anchor System and Post-Installed Reinforcing Bar in Cracked and Uncracked Concrete, described in Sections 2.0 through 7.0 of the evaluation report ESR-5144, 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 DEWALT Pure220+ Adhesive Anchor System and Post-Installed Reinforcing Bar 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-5144.
- The design, installation, conditions of use and identification of the anchors are in accordance with the 2021 *International Building Code®* (IBC) provisions noted in the evaluation report ESR-5144.
- 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 or post installed reinforcing bars to the concrete. The connection between the anchors or post installed reinforcing bars 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, reissued November 2024 and revised August 2025.

ICC-ES Evaluation Report

ESR-5144 FL Supplement w/ HVHZ

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1.0 REPORT PURPOSE AND EVALUATION SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that DEWALT Pure220+ Adhesive Anchor System and Post-Installed Reinforcing Bar in Cracked and Uncracked Concrete, recognized in ICC-ES evaluation report ESR-5144, has also been evaluated for compliance with the codes noted below.

Compliance with the following codes:

- 2023 *Florida Building Code—Building*
- 2023 *Florida Building Code—Residential*

2.0 PURPOSE OF THIS SUPPLEMENT

The DEWALT Pure220+ Adhesive Anchor System and Post-Installed Reinforcing Bar in Cracked and Uncracked Concrete, described in Sections 2.0 through 7.0 of the evaluation report ESR-5144, 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-5144 for the 2021 *International Building Code®* meet the requirements of the *Florida Building Code—Building* or the *Florida Building Code—Residential,* as applicable.

Use of the DEWALT Pure220+ Adhesive Anchor System and Post-Installed Reinforcing Bar 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, reissued November 2024 and revised August 2025.