MITEK USA, INC.

USP STRUCTURAL CONNECTORS CIA-EA ADHESIVE ANCHORING SYSTEM

CSI Section:
03 16 00 Concrete Anchors

CSI Section:
05 05 19 Post-Installed Concrete Anchors

1.0 RECOGNITION

USP Structural Connectors CIA-EA Adhesive Anchoring System recognized in this report have been evaluated for structural properties. The following code editions are recognized:

- 2015, 2012 and 2009 International Building Code® (IBC)
- 2015, 2012 and 2009 International Residential Code® (IRC)

2.0 LIMITATIONS

USP Structural Connectors CIA-EA Adhesive Anchor System described in this report complies with the codes specifically listed in Section 1.0 of this report, subject to the following conditions:

2.1. USP Structural Connectors CIA-EA adhesive anchors shall be installed in accordance with the manufacturer's printed installation instructions (MPII) included in the adhesive packaging and shown in Figures 5a and 5b of this report.

2.2. Prior to installation, calculations and details demonstrating compliance with this report shall be submitted to the code official for review and approval. Calculations and details shall be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed.

2.3. Anchors shall be installed in uncracked, normal-weight or light-weight concrete having a specified compressive strength f_c' = 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa) only.

2.4. Values of f_c' used for calculation purposes shall not exceed 8,000 psi (55.1 MPa).

2.5. Anchors shall be installed in concrete base materials as set forth in Section 4.3.8 of this report and Figures 5a and 5b of this report in holes predrilled with carbide-tipped drill bits complying with ANSI B212.15-1994 for imperial sizes or ISO 5468 for metric sizes.

2.6. Use of the anchors is limited to installation in concrete that is expected to be uncracked during service life of the anchors, subject to the conditions in this report.

2.7. Anchors may be used to resist tension and shear forces in floor (downwardly inclined) or wall (horizontally inclined) orientations only if installation is within base material having a temperature between 32°F to 95°F (0°C to 35°C); or ceiling (upwardly inclined) orientations, if installation is within base material having a temperature between 50°F to 95°F (10°C to 35°C).

2.8. Anchors shall be installed in dry or damp (water-saturated) holes with dry or saturated concrete. Holes shall be free of any standing water.

2.9. USP Structural Connectors CIA-EA adhesive anchors are recognized for use to resist short and long-term loads, including wind and earthquake (Seismic Design Category A or B only), subject to the conditions of this report.

2.10. Anchors designed to resist loads resulting from earthquake shall be limited to installation in structures assigned to Seismic Design Category A or B only.

2.11. Strength Design values shall be established in accordance with Section 3.1 this report. Loads applied to the anchors shall be adjusted in accordance with Section 1605.2 of the IBC, ACI 318-14 5.3 (ACI 318-11 D.4.3) for strength design.

2.12. Allowable Stress Design shall be established in accordance with Section 3.2 of this report. Loads applied to the anchors shall be adjusted in accordance with Section 1605.3 of the IBC.

2.13. Use of zinc-plated carbon steel threaded rods is limited to dry, interior locations. Exterior anchor locations and water saturated conditions require the use of hot-dipped galvanized carbon steel, stainless steel threaded rods. The coating weights for zinc-coated steel shall be in accordance with ASTM A153 Class C or D.

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

2.15. Fire-resistive construction: Anchors are not permitted to support fire-resistive construction. Where not otherwise prohibited in the code, USP Structural Connectors CIA-EA adhesive anchors are permitted for use with fire-resistance rated construction provided that at least one of the following conditions is fulfilled:

i. Anchors are used to resist wind or seismic loads only.

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

iii. Anchors are used to support nonstructural elements.

2.16. Steel anchoring materials in contact with preservative-treated and fire-retardant-treated wood shall be of zinc-coated steel or stainless steel. The coating weights for zinc-coated steel shall be in accordance with ASTM A153 Class C or D.

2.17 USP Structural Connectors CIA-EA adhesive anchors may be used for floor (downwardly inclined orientation), wall (horizontally inclined orientation), and ceiling (upwardly inclined orientation) applications. Upwardly inclined orientation applications are limited to use with the ⅜-, ½-, and ⅝-inch-diameter (9.5, 12.7, and 15.9, 19.1 mm) threaded rods.

2.18. Since an evaluation 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.

2.19. Periodic special inspection shall be provided in accordance with Section 3.5.2 of this report. Continuous special inspection for overhead installations (vertical up) that are designed to resist sustained tension loads shall be provided in accordance with Section 3.5.3 of this report.

2.20 Anchors installed in a horizontally or upwardly inclined orientation to resist sustained tension loads shall be performed by personnel certified by an applicable certification program in accordance with ACI 318-14 17.8.2.2 or 17.8.2.3 (ACI 318-11 D.9.2.2 or D.9.2.3).

2.21. USP Structural Connectors CIA-EA adhesives are manufactured under a quality control program with inspections by IAPMO Uniform ES.

3.0 PRODUCT USE

3.1 General: USP Structural Connectors CIA-EA Adhesive Anchor System is used to resist static, wind, or earthquake (Seismic Design Categories A or B only) tension and shear loads in uncracked normal-weight concrete having a specified compressive strength, f'_c, of 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa). Anchors shall be located in a region of the concrete member where analysis indicates no cracking (uncracked) at service loads in accordance with ACI 318-14 17.4.2.6 and 17.5.2.7 (ACI 318-11 D.5.2.6 and D.6.2.7). The analysis for the determination of crack formation shall include the effects of restrained shrinkage, as applicable in accordance with ACI 318-14 24.4.2 (ACI 318-11 7.12.1.2). The anchor system is an alternative to cast-in-place anchors described in Section 1901.3 of the 2015 IBC, Sections 1908 and 1909 of the 2012 IBC and Sections 1911 and 1912 of the 2009 IBC. The anchor systems may also be used where an engineered design is submitted in accordance with Section R301.1.3 of the IRC.

3.2 DESIGN AND INSTALLATION

3.2.1 General: Strength design under the 2015, 2012 and 2009 IBC, as well as the 2015, 2012 and 2009 IRC shall be in accordance with Section 3.2.2 of this report and Allowable Stress Design shall be in accordance with Section 3.3 of this report.

3.2.2 Strength Design: Design strengths ϕN_n and ϕV_n shall be determined in accordance with ACI 318-14 Chapter 17 for the 2015 IBC and IRC or ACI 318-11 Appendix D for the 2012 and 2009 IBC and IRC and this report. Post-installed Anchor Categories used to determine the strength reduction factors, ϕ, in ACI 318-14 17.3.3 (ACI 318-11 D.4.3 and D.4.4) are given for each diameter in Tables 7, 8, and 9 of this report. Design parameters including strength reduction factors, ϕ, corresponding to each limit state and anchor steel are provided in the tables. Strength reduction factors, ϕ, as described in ACI 318-14 17.3.3 (ACI 318-11 D.4.3) and provided in Tables 5 to 9 of this report shall be used for load combinations calculated in accordance with Section 1605.2 of the IBC and ACI 318-14 5.3 (ACI 318-11 9.2). Strength reduction factors, ϕ, described in ACI 318-11 D.4.4 shall be used for load combinations calculated in accordance with ACI 318-11 Appendix C. This section provides amendments to ACI 318-14 Chapter 17 and ACI 318-11 Appendix D as required for the strength design of adhesive anchors. In conformance with ACI 318, all equations are expressed in inch-pounds units.

3.2.3 Static Steel Strength in Tension: Nominal static steel strength of a single anchor in tension as governed by the steel, N_{sa}, in accordance with ACI 318-14 17.4.1.2 (ACI 318-11 D.5.1.2), is given in this report for the corresponding anchor steel specification. Tables 4, 5, and 6 of this report provide nominal strength values and strength reduction factors, ϕ, in accordance with ACI 318-14 17.3.3 (ACI 318-11 Section D.4.3) for computing design strengths of steel anchor elements.

3.2.4 Static Concrete Breakout Strength in Tension: Nominal static concrete breakout strength of a single anchor or group of anchors in tension, N_{cb} *or* N_{cbg}, shall be calculated in accordance with ACI 318-14 17.4.2 (ACI 318-11 D.5.2) with the following addition:

Basic concrete breakout strength of a single anchor in tension, N_b, shall be calculated in accordance with ACI 318-14 17.4.2.2 (ACI 318-11 D.5.2.2) using the values of h_{ef} and $k_{c,uncr}$ as described in Table 7 of this report. In accordance with ACI 318-14 17.4.2.6 (ACI 318-11 D.5.2.6) N_b shall be calculated using $k_{c,uncr}$ and $\Psi_{c,N}$ =1. For anchors in lightweight concrete, the modification factor λ_a shall be applied to ACI 318-14 Eq. (17.4.2.2a) (ACI 318-11 Eq. (D-6)) in accordance with ACI 318-14 17.2.6 (ACI 318-11 D.3.6). The value of f_c' used in design shall be limited to a maximum of 8,000 psi (55 MPa) in accordance with ACI 318-14 17.2.7 (ACI 318-11 D.3.7).

3.2.5 Static Bond Strength in Tension: The nominal static bond strength of a single adhesive anchor, N_a, or group of adhesive anchors, $N_{ag,}$ in tension shall be calculated in accordance with ACI 318-14 17.4.5 (ACI 318-11 D.5.5) using $\tau_{k,uncr}$ from Table 8 or 9 of this report in lieu of τ_{cr} . For anchors designed to resist sustained tension loads, bond strength shall be calculated in accordance with ACI 318-14 17.2.5 and 17.3.1.2 (ACI 318-11 D.3.5 and D.4.1.2). Embedment depths shall comply with ACI 318-14 17.3.2.3 (ACI 318-11 D.4.2.3) and Tables 8 and 9 of this report. Bond strength values are a function of load type (seismic, sustained) and installation conditions (i.e. dry, water saturated). The USP Structural Connectors CIA-EA Adhesive Anchor System has been tested at elevated temperatures in uncracked concrete using a hammer drill in water saturated concrete. Therefore, permitted bond strengths, anchor categories, and strength reduction factors, ϕ, for each anchor diameter for installation in normal weight concrete are listed in Tables 8 and 9 of this report. Elevated concrete temperatures arise from a number of factors, including sun exposure, proximity to operating machinery, or containment of liquids or gases at elevated temperature. Permitted installation requirements are uncracked concrete, dry or water-saturated concrete prepared using hammer drill bits, under periodic inspection (except for conditions as explained in Section 3.5.3 of this report, where continuous inspection is required). For anchors installed in lightweight concrete, the value of τ_{uncr} shall be taken from Tables 8 or 9 of this report and the corresponding modification factor, λ_a, shall be applied to ACI 318-14 Eq. (17.4.5.2) in accordance with ACI 318-14 17.2.6 (ACI 318-11 Eq. (D-22) in accordance with ACI 318-11 D.3.6).

3.2.6 Splitting Control: Replace ACI 318-14 17.4.5.5 (ACI 318-11 D.5.5.5) as follows:

17.4.5.5 (D.5.5.5) – The modification factor for adhesive anchors designed for uncracked concrete in accordance with 17.4.5.2 (D.5.5.2) without supplementary reinforcement to control splitting, $\psi_{cp,Na}$ *, shall be calculated as:*

If $c_{a,min} \geq c_{ac}$ then $\psi_{cp,Na} = 1.0$ *(Eq.17.4.5.5.a for ACI 318-14) ((D-26) for ACI 318-11)*
If $c_{a,min} < c_{ac}$ then $\psi_{cp,Na} = c_{a,min} / c_{ac}$ *(Eq.17.4.5.5.b for ACI 318-14) ((D-27) for ACI 318-11)*

where
c_{ac} *shall be determined in accordance with (Eq. 17.4.5.5.c for ACI 318-14) (D-27a for ACI 318-11)*

$c_{ac} = h_{ef} \times (\tau_{k,uncr}/1160)^{0.4} \times [3.1–0.7(h/h_{ef})]$ (inches)
(Eq. 17.4.5.5.c for ACI 318-14) (D-27a for ACI 318-11)

where
(h/h_{ef}) *need not be taken as larger than 2.4; and* $\tau_{k,uncr}$ *= characteristic bond strength stated in Tables 7 through 14 of this Evaluation Report, whereby* $\tau_{k,uncr}$ *need not be taken as larger than:*

$\tau_{k,uncr} = (k_{uncr} (h_{ef} \times f'_c)^{0.5})/(\pi \times d_a)$

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

3.2.7 Static Steel Strength in Shear: The nominal static strength of a single anchor in shear as governed by the steel, V_{sa}, in accordance with ACI 318-14 17.5.1.2 (ACI 318-11 D.6.1.2) and corresponding strength reduction factors, ϕ, in accordance with ACI 318-14 17.3.3 (ACI 318-11 D.4.3), depending on whether the steel is considered brittle or ductile, are given in Tables 5 and 6 of this report for the anchor steel specification. Where grout pads are present, the nominal strengths shall be reduced in accordance with ACI 318-14 17.5.1.3 or ACI 318-11 D.6.1.3.

3.2.8 Static Concrete Breakout Strength in Shear: The nominal concrete breakout strength of a single anchor or group of anchors in shear, V_{cb}, or V_{cbg}, shall be calculated in accordance with ACI 318-14 17.5.2 (ACI 318-11 D.6.2) based on information given in Table 7 of this report for the corresponding anchor steel type. The basic concrete breakout strength of a single anchor in shear, V_b, shall be calculated in accordance with ACI 318-14 17.5.2.2 (ACI 318-11 D.6.2.2). In addition, $h_{ef,}$ shall be substituted for l_e.

In no case shall h_{ef} exceed $8d_a$. For anchors in lightweight concrete, the modification factor λ_a shall be applied in accordance with ACI 318-14 17.2.6 (ACI 318-11 D.3.6). The value of f_c' shall be limited to a maximum of 8,000 psi (55 MPa) in accordance with ACI 318-14 17.2.7 (ACI 318-11 D.3.7). Corresponding strength reduction factors, ϕ, are given in Table 7 of this report, as defined in ACI 318-14 17.3.3 (ACI 318-11 D.4.3).

3.2.9 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} in accordance with ACI 318-14 17.5.3.1 (ACI 318-11 D.6.3.1). Corresponding strength reduction factors, ϕ, are given in Table 7 of this report, as defined in ACI 318-14 17.3.3 (ACI 318-11 D.4.3).

3.2.10 Interaction of Tensile and Shear Forces: The interaction of tension and shear loads shall be calculated in accordance with ACI 318-14 17.6 (ACI 318-11 D.7) when designs include combined tension and shear.

3.2.11 Minimum Member Thickness h_{min}, Anchor Spacing s_{min} and Minimum Edge Distance c_{min}: In lieu of ACI 318-14 17.7.1 and 17.7.3 (ACI 318-11 D.8.1 and D.8.3), values of c_{min} and s_{min} described in Table 7 of this report shall be observed for anchor design and installation. Likewise, in lieu of ACI 318-14 17.7.5 (ACI 318-11 D.8.5), the minimum member thickness, h_{min}, described in Tables 3 and 7 of this report shall be observed for anchor design and installation. In determining minimum edge distances, c_{min}, the following section shall be added to ACI 318-14 Chapter 17 (ACI 318-11, Appendix D):

For adhesive anchors that will remain untorqued, the minimum edge distances shall be based on minimum cover requirements for reinforcement in ACI 318-14 20.6.1 and 17.7.4 (ACI 318-11 7.7 and D.8.4). For adhesive anchors that will be torqued, the minimum edge distance and spacing shall be taken as described in Table 7 of this report.

3.2.12 Design Strength in Seismic Design Categories A or B: Anchors designed to resist loads resulting from earthquake shall be limited to installation in structures assigned to Seismic Design Categories A and B only under the IBC or IRC. The design of the anchors shall comply with this report.

3.3 Allowable Stress Design (ASD)

3.3.1 General: For anchors designed using load combinations in accordance with IBC Section 1605.3 (Allowable Stress Design), allowable loads shall be established using Eq. (3-3) or Eq. (3-4).

$$T_{allowable,ASD} = \frac{\phi N_n}{\alpha} \quad \text{Eq. (3-3)}$$

and

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

Where:

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

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

ϕN_n = lowest design strength of an anchor or anchor group in tension as determined in accordance with ACI 318-14 Chapter 17 and 2015 IBC Section 1905.1.8, ACI 318-11 Appendix D and as amended in Section 3.2 of this report and 2009 IBC Section 1908.1.9 and 1908.1.10

ϕV_n = lowest design strength of an anchor or anchor group in shear as determined in accordance with ACI 318-14 Chapter 17 and 2015 IBC Section 1905.1.8, ACI 318-11 Appendix D and as amended in Section 3.3 of this report and 2009 IBC Sections 1908.1.9 and 1908.1.10

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

Table 10 of this report provides an illustration of calculated Allowable Stress Design (ASD) values for each anchor diameter at minimum embedment depth. Limits on edge distance, anchor spacing and member thickness described in this report shall apply.

3.3.2 Interaction of Tensile and Shear Forces: In lieu of ACI 318-14 17.6.1, 17.6.2, and 17.6.3 (ACI 318-11 D.7.1, D.7.2 and D.7.3), interaction shall be calculated as follows:

17.6.1 (D.7.1): If $V_{applied} \leq 0.2\ V_{allowable,ASD}$, for the governing strength in shear, then the full allowable strength in tension, $T_{allowable,ASD}$, shall be permitted.

17.6.2 (D.7.2): If $T_{applied} \leq 0.2\ T_{allowable,ASD}$, for the governing for the governing strength in tension, then the full allowable strength in shear, $V_{allowable,ASD}$, shall be permitted.

17.6.3 (D.7.3): If $V_{applied} \leq 0.2\ V_{allowable,ASD}$, for the governing strength in shear and $T_{applied} \leq 0.2\ T_{allowable,ASD}$ for the governing strength in tension.

For all other cases, Eq. (3-5) applies: Eq. (3-5)

$$\frac{T}{T_{allow,ASD}} + \frac{V}{V_{allow,ASD}} \leq 1.2$$

3.4 Installation

3.4.1 General: Installation shall be in accordance with this report and the manufacturer's printed installation instructions (MPII). Where conflicts occur, the more restrictive shall govern. Installation parameters are provided in Tables 2 and 3 and Figures 1 and 5 of this report. Installation shall be in accordance with ACI 318-14 17.8.1 and 17.8.2 (ACI 318-11 D.9.1 and D.9.2). Anchor locations shall comply with this report and the plans and specifications approved by the building official. Installation of the USP Structural Connectors CIA-EA Anchoring System shall conform to the MPII included in each package unit and as described in Figures 5a and 5b of this report. Nozzles, brushes, dispensing tools and adhesive retaining caps shown in Figures 2, 3, and 4 and Table 11 of this report as supplied by the manufacturer, shall be used along with the adhesive compound cartridges. Installation orientation of anchor elements may be downwardly inclined (floors), horizontally inclined (walls) and upwardly inclined (ceilings). Installation may occur into dry or water-saturated holes in normal-weight or lightweight concrete. Use of anchors in water-filled holes or submerged concrete is beyond the scope of this report.

3.4.2 Manufacturer's Printed Installation Instructions (MPII): A copy of the MPII shall be maintained at the jobsite during installation of the product. These instructions are replicated in Figures 5a and 5b of this report.

3.4.3 Anchor Placement: Locations shall comply with this report and the plans and specifications approved by the code official.

3.5 Inspections

3.5.1 General: All adhesive anchor systems shall be installed with special inspection. Continuous special inspection is required for all cases where anchors installed in horizontally or upwardly inclined orientations are designed to resist sustained tension loads as performed in accordance with ACI 318-14 17.8.2.4, 26.7.1(h) and 26.13.3.2 (c) (ACI 318-11 D.9.2.4). Other installations shall be made under periodic special inspection.

Installations made under special inspection shall be performed in accordance with Sections 1705.1 and 1705.3 of the 2015 and 2012 IBC, Sections 1704.4 and 1704.15 of the 2009 IBC, with continuous or periodic special inspection as defined in Section 1702.1 of the IBC and this report. Additional requirements in IBC Sections 1705, 1706, 1707 and 1709 shall be observed, as applicable.

3.5.2 Periodic Inspection: Periodic special inspection shall be provided in accordance with 2015 and 2012 IBC Sections 1705.1 and 1705.3 or 2009 IBC Sections 1704.4 and 1704.15. The special inspector shall verify the initial installations of each type and size of adhesive anchor by construction personnel on site. Subsequent installations of the same anchor size and type by the same construction personnel are permitted to be performed in the absence of the special inspector. Where there is any change in the anchor product being installed or the personnel performing the installation, another initial inspection is required. For ongoing installations over an extended period of time the special inspector shall make regular inspections to confirm correct handling and installation of the product.

As a minimum, the following items shall be verified by the special inspector:

- Hole drilling method in accordance with the manufacturer's printed installation instructions (MPII) shown in Figures 5a and 5b of this report.
- Hole depth, location, spacing, edge distances and diameter. Hole cleaning in accordance with the manufacturer's printed installation instructions (MPII) shown in Figures 5a and 5b of this report.
- Anchor diameter, length, material, and element type.
- Tightening torque.
- Concrete type, compressive strength, and thickness.
- Adhesive installation in accordance with the manufacturer's printed installation instructions (MPII) shown in Figures 5a and 5b of this report.
- The adhesive expiration date.
- Product identification in accordance with Section 5.0 of this report.

3.5.3 Continuous Inspection: Continuous special shall be provided in accordance with 2015 and 2012 IBC Sections 1705.1 and 1705.3 or 2009 IBC Sections 1704.4 and 1704.15, whereby continuous special inspection is defined in IBC Section 1702.1 and this report. For all cases where anchors installed horizontally or upwardly inclined and are designed to resist sustained tension loads in accordance with ACI 318-14 Sections 17.8.2.4, 26.7.1(h) and 26.13.3.2(c) (ACI 318-11 D.9.2.4). The special inspector shall observe all aspects of the anchor installation except holes shall be permitted to be drilled in the absence of the special inspector provided the special inspector examines the drill bits used for the drilling and verifies the hole sizes. The special inspector shall verify the items listed in Section 3.5.2 of this report.

4.0 PRODUCT DESCRIPTION

4.1 General: The USP Structural Connectors CIA-EA Adhesive Anchoring System, are post-installed anchors inserted into a pre-drilled hole in hardened normal weight or lightweight concrete, that transfer loads to the concrete by bond between the anchor and the adhesive, and bond

between the adhesive and the concrete.

4.2 Product information: The components of the USP Structural Connectors CIA-EA Adhesive Anchor System, include the CIA-EA adhesive cartridges and EA-SMN static mixing nozzle, HDT-9 or Cox 41004-2T 280 ml manual dispensers and HDT-28 or Cox M750X/10 825 ml manual dispensers, and steel anchoring elements. Cure and gel times after placement into holes occurs according to conditions given in Table 2 of this report. The Manufacturer's Printed Installation Instructions (MPII) and parameters, as included with each adhesive unit package, are replicated as Figure 5 of this report. Installation may occur into dry or water-saturated holes in normal-weight or lightweight concrete.

4.3 Material information

4.3.1 CIA-EA Adhesive: CIA-EA adhesive contains two components: styrene-free epoxy acrylate resin and benzoyl peroxide catalyst. Shelf life is 15 months when in unopened cartridges stored at temperatures ranging from 41°F (+5°C) to 77°F (+25°C) in accordance with the MPII.

4.3.2.1 CIA-EA PLR Cartridges: CIA-EA PLR is a two-part foil capsule containing CIA-EA adhesive and labeled CIA-EA-10 for the volume shown as 280 ml (9.47 ounces). Figure 4 of this report depicts the cartridges.

4.3.2.2 CIA-EA S-CN Cartridges: CIA-EA S-CN are side-by-side cartridges containing CIA-EA adhesive and labeled as CIA-EA-28 for the volume shown as 825/10 – 825 ml (27.90 ounces). Figure 4 of this report depicts the cartridge.

4.3.3 Mixing Nozzles: Figure 3 of this report illustrates mixing nozzle EA-SMN.

4.3.4 Dispensing Tools: USP Structural Connectors CIA-EA adhesive may be dispensed by manual dispensers. Figure 2 of this report shows the dispensers.

4.3.5: Permitted Combinations: Table 1 of this report contains the allowable combinations of cartridges, mixer nozzles, and dispensing tools.

4.3.6 Anchors

4.3.6.1 Threaded Rods: Threaded steel rods shall be clean, continuously threaded rods in diameters as described in Table 4 and Figure 1 of this report. Specifications for carbon and stainless steel rod, nut, and washer are provided in Table 4 of this report. Steel design information is detailed in Tables 5 and 6 of this report. Carbon steel threaded rods shall be furnished with a minimum 0.0002-inch-thick (0.005 mm) zinc electroplated coating complying with ASTM B 633 SC 1 or shall be hot-dipped galvanized complying with ASTM A153, Class C or D. Threaded steel rods shall be straight and free of indentations or other defects along their length. The embedded portions of the threaded rods shall be free of mill scale, rust, mud, oil, and other coatings that may impair the bond with the adhesive. The tensile strength of the threaded anchor rods shall not exceed 145,000 psi (1,000 MPa).

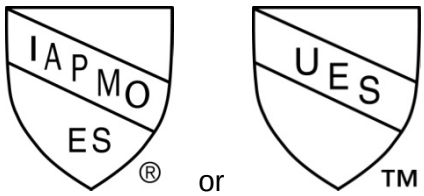
4.3.7 Ductility: In accordance with ACI 318-14 2.3 (ACI 318-11 Appendix D.1), anchor elements are considered ductile if the tensile test elongation is at least 14 percent and reduction of area is at least 30 percent in accordance with ACI 318-14 2.3 (ACI 318-11 Section D.1). Steel elements not complying with these criteria are considered brittle. Values for various steel specifications are provided in Table 5 and Table 6 of this report. Where values are nonconforming or unstated, the steel shall be considered brittle for the purposes of design.

4.3.8 Concrete: Normal-weight and lightweight concrete shall comply with Sections 1901 and 1903 of the 2015 and 2012 IBC or Sections 1903 and 1905 of the 2009 and 2006 IBC and have a compressive strength at the time of anchor installation from 2,500 psi (17.2 MPa) to 8,500 psi (58.6 MPa), but not less than that required by the applicable code requirements, including IBC Section 1904 and ACI 318-14 19.3.2 (ACI 318-11 4.3), or the structural design.

4.3.9 Hole Preparation Equipment: Holes shall be cleaned with hole-cleaning brushes and air nozzles. Brushes shall be the appropriate size brush from the list shown in Table 11 of this report, and the MPII shown in Figures 5a and 5b of this report, which provides additional information. Air nozzles shall be equipped with an extension capable of reaching the bottom of the drilled-hole and having an inside bore diameter of not less than 1/4 inch (6 mm). Holes shall be prepared in accordance with the MPII shown in Figures 5a and 5b of this report.

5.0 IDENTIFICATION

The adhesive material packaging shall be marked with a permanent label bearing the name and address of the manufacturers, the model number, IAPMO UES Mark of Conformity, Uniform Evaluation Report Number (Evaluation Report ER-311), lot number, packing date and shelf life or expiration date, and name or logo of the inspection agency (IAPMO UES) to identify the products listed in this report.



IAPMO ER-311

6.0 SUBSTANTIATING DATA

Data and Test results are from laboratories accredited in accordance with ISO/IEC 17025 and in conformance with ICC-ES Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements, (AC308) approved January 2016.

7.0 CONTACT INFORMATION

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8.0 STATEMENT OF RECOGNITION

This evaluation report describes the results of research carried out by IAPMO Uniform Evaluation Service on USP Structural Connectors CIA-EA Adhesive Anchoring System to assess their conformance to the codes shown in Section 1.0 of this report and documents the product's certification.

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Table 1 - ALLOWABLE COMBINATIONS OF CARTRIDGE, MIXER NOZZLE AND DISPENSER			
Cartridge	Mixer Nozzle	Dispenser	
	EA-SMN	HDT-9 or Cox 41004-2T 280ml manual	HDT-28 or Cox M750X/10 825ml manual
CIA-EA-10	X		X
CIA-EA-28	X	X	

Table 2 – PROCESSING TIME – CURING TIME					
Base Material Temperature[1]	32°F < T ≤ 50°F (0°C < T ≤ 10°C)	50°F < T ≤ 68°F (10°C < T ≤ 20°C)	68°F < T ≤ 77°F (20°C < T ≤ 25°C)	77°F < T ≤ 86°F (25°C < T ≤ 30°C)	86°F < T ≤ 95°F (30°C < T ≤ 35°C)
Processing Time	4 min	4 min	3 min	2 min	1 min
Curing Time	48 hours	70 min	40 min	40 min	40 min

For SI: (°F - 32) x 5/9 = °C

[1] When base material temperature is 32°F < T ≤50°F, cartridge shall be conditioned to 68°F (20°C) prior to use.

Table 3 – SPECIFICATION FOR INSTALLATION OF ANCHORS IN CONCRETE															
Anchor Size	d_a	in. mm	5/16 M8		3/8 M10		1/2 M12		5/8 M16		3/4 M20	
Nominal drill diameter size	d_0	in. mm	3/8 10		7/16 12		9/16 14		11/16 18		13/16 22	
Minimum effective embedment depth	$h_{ef,min}$	in. mm	2-3/8 60	3-3/4 96	2-3/8 60	4-1/2 120	2-3/4 70	6 144	3-1/8 80	7-1/2 192	3-1/2 90	9 240
Maximum effective embedment depth	$h_{ef,max}$	in. mm	6¼ 160		7½ 200		10 240		12½ 320		15 400	
Minimum slab thickness	h_{min}	in. mm	4 100	5 127	4-1/4 108	6-1/2 165	5-1/4 133	7-1/4 184	6-1/2 165	9 240	8 203	11-1/4 285
Maximum tightening torque	T_{inst}	ft-lb N-m	7.5 10		15 20		25 35		55 75		80 110	

For SI: 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m

TABLE 4– SPECIFICATIONS AND PHYSICAL PROPERTIES OF COMMON FRACTIONAL AND METRIC THREADED CARBON AND STAINLESS STEEL ROD MATERIALS

Threaded Rod Specification		Units	Minimum Specified Ultimate Strength, $f_{u,ta}$	Minimum Specified Yield Strength, f_{ya}	f_{uta} – f_{ya}	Minimum Percent Elongation	Minimum Percent Reduction of Area	Specification for Nuts and Washers
Carbon Steel	ASTM F1554 Grade 36 (A 307 Gr.C)[1]	psi (MPa)	58,000 (400)	36,000 (250)	1.61	23	40	ASTM A563 Grade A
	ASTM A193 Grade B7[1]	psi (MPa)	125,000 (860)	105,000 (725)	1.19	16	50	ASTM A194
	ASTM A307 Grade A[1]	psi (MPa)	60,000 413	-	-	18	-	ASTM A563 Grade A
	ISO 898-1 Class 5.8[1]	psi (MPa)	72,500 (500)	58,000 (400)	1.25	22	35	DIN 934 (Grade 6)
	ISO 898-1 Class 8.8[2]	psi (MPa)	116,000 (800)	92,800 (640)	1.25	12	52	DIN 934 (Grade 8)
Stainless Steel	ASTM F593 CW1 (¼ -⅝)[2]	psi (MPa)	95,000 (690)	60000 (450)	1.58	20	-	ASTM F594
	ASTM F593 CW2 (¾-1¼)[2]	psi (MPa)	80,000 (585)	40,000 (310)	2.00	25	-	ASTM F594
	ASTM F593 SH1 (¼ - ⅝)[2]	psi (MPa)	115,000 (800)	90,000 (620)	1.28	12	-	ASTM F594
	ASTM F593 SH2 (¾ - 1)[2]	psi (MPa)	105,000 (725)	70,000 (480)	1.50	15	-	ASTM F594
	ISO 3506-1 A4-70[2]	psi (MPa)	101,500 (700)	65,250 (450)	1.56	40	-	ISO 4032
	ISO 3506-1 A4-80[2]	psi (MPa)	116,000 (800)	87,000 (600)	1.33	30	-	-

[1] Rods are considered ductile steel elements in accordance with Sections 3.2.3, 3.2.7, and 4.3.7 of this report.

[2] Rods are considered brittle steel elements in accordance with Sections 3.2.3, 3.2.7, and 4.3.7 of this report.

Table 5 – STEEL DESIGN INFORMATION FOR FRACTIONAL THREADED ROD[1]

Design Information		Symbol	Units	Nominal Rod Diameter (in.)				
				5/16	3/8	1/2	5/8	3/4
Rod outside diameter		d_a	in.	5/16	3/8	1/2	5/8	3/4
Rod effective cross-sectional area[2]		A_{se}	in^2	0.0524	0.0775	0.1419	0.2260	0.3345
ASTM F1554 Grade 36	Nominal strength as governed by steel strength	N_{sa}	lb	3,039	4,495	8,230	13,108	19,401
		V_{sa}	lb	1,824	2,697	4,938	7,865	11,641
	Strength reduction factor for tension[3]	ϕ	-	0.75				
	Strength reduction factor for shear[3]	ϕ	-	0.65				
ASTM A307 Grade A	Nominal strength as governed by steel strength	N_{sa}	lb	3,144	4,650	8,514	13,560	20,070
		V_{sa}	lb	1,886	2,790	5,108	8,136	12,042
	Strength reduction factor for tension[3]	ϕ	-	0.75				
	Strength reduction factor for shear[3]	ϕ	-	0.65				
ASTM 193 Grade B7	Nominal strength as governed by steel strength	N_{sa}	lb	6,550	9,688	17,738	28,250	41,813
		V_{sa}	lb	3,930	5,813	10,643	16,950	25,088
	Strength reduction factor for tension[3]	ϕ	-	0.75				
	Strength reduction factor for shear[3]	ϕ	-	0.65				
ASTM F593, CW	Nominal strength as governed by steel strength	N_{sa}	lb	5,240	7,750	14,190	22,600	28,433
		V_{sa}	lb	3,144	4,650	8,514	13,560	17,060
	Strength reduction factor for tension[3]	ϕ	-	0.65				
	Strength reduction factor for shear[3]	ϕ	-	0.60				
ASTM F593, SH	Nominal strength as governed by steel strength	N_{sa}	lb	6,288	9,300	17,028	27,120	36,795
		V_{sa}	lb	3,773	5,580	10,217	16,272	22,077
	Strength reduction factor for tension[3]	ϕ	-	0.65				
	Strength reduction factor for shear[3]	ϕ	-	0.60				

For SI: 1 inch = 25.4 mm, 1 in^2 = 645 mm^2, 1 lb. = 4.448 N

[1] Values provided for common rod material types are based on specified strength and calculated in accordance with ACI 318-14 Eq. (17.4.1.2) and Eq. (17.5.1.2b) (ACI 318-11 Eq. (D-2) and Eq. (D-29)). Nuts and washers shall be appropriate for the rod as set forth in Table 4 of this report.

[2]Effective Area is minimum area applicable for either tension or shear.

[3]Tabulated value of ϕ complies with ACI 318-14 Section 17.3.3 (ACI 318-11 Section D.4.3) and applies when load combinations of IBC Section 1605.2 or ACI 318-11 Section 9.2 as set forth in ACI 318-14 17.3.3 (ACI 318-11 D.4.3). If the load combinations of ACI 318-11 Appendix C are used, the value of ϕ shall be determined in accordance with ACI 318-11 D.4.4.

Table 6 – STEEL DESIGN INFORMATION FOR METRIC THREADED ROD[1]

Design Information		Symbol	Units	Nominal Rod Diameter				
				M8	M10	M12	M16	M20
Rod outside diameter		d_a	mm in.	8 0.31	10 0.39	12 0.47	16 0.63	20 0.79
Rod effective cross-sectional area[2]		A_{se}	mm^2 in^2.	36.6 0.057	58.0 0.090	84.3 0.131	157 0.243	245 0.380
ISO 898-1 Class 5.8	Nominal strength as governed by steel strength	N_{sa}	kN lb	16.90 3,800	25.00 5,620	45.78 10,291	72.91 16,390	107.90 24,258
		V_{sa}	kN lb	10.14 2,280	15.00 3,372	27.46 6,174	43.74 9,834	64.74 14,555
	Strength reduction factor for tension[3]	ϕ	-	0.75				
	Strength reduction factor for shear[3]	ϕ	-	0.65				
ISO 898-1 Class 8.8	Nominal strength as governed by steel strength	N_{sa}	kN lb	27.05 6,080	40.00 8,992	73.24 16,465	116.65 26,223	172.65 38,813
		V_{sa}	kN lb	16.23 3,648	24.00 5,395	43.94 9,879	69.99 15,734	103.59 23,288
	Strength reduction factor for tension[3]	ϕ	-	0.65				
	Strength reduction factor for shear[3]	ϕ	-	0.60				
ISO 3506-1 Class A4-70 Stainless	Nominal strength as governed by steel strength	N_{sa}	kN lb	23.66 5,320	35.00 7,868	64.09 14,407	102.06 22,945	151.07 33,961
		V_{sa}	kN lb	14.20 3,192	21.00 4,721	38.45 8,644	61.24 13,767	90.64 20,377
	Strength reduction factor for tension[3]	ϕ	-	0.65				
	Strength reduction factor for shear[3]	ϕ	-	0.60				
ISO 3506-1 Class A4-80 Stainless	Nominal strength as governed by steel strength	N_{sa}	kN lb	27.05 6,080	40.00 8,992	73.24 16,465	116.65 26,223	172.65 38,813
		V_{sa}	kN lb	16.23 3,648	24.00 5,395	43.94 9,879	69.99 15,734	103.59 23,288
	Strength reduction factor for tension[3]	ϕ	-	0.65				
	Strength reduction factor for shear[3]	ϕ	-	0.60				

[1]Values provided for common rod material types are based on specified strength and calculated in accordance with ACI 318-14 Eq. (17.4.1.2) and Eq. (17.5.1.2b) (ACI 318-11 Eq. (D-2) and Eq. (D-29)). Nuts and washers shall be appropriate for the rod as set forth in Table 4 of this report.

[2]Effective Area is minimum area applicable for either tension or shear.

[3]Tabulated value of ϕ complies with ACI D.4.3 and applies when load combinations of IBC Section 1605.2 or ACI 318-14 Section 5.3 (ACI 318-11 Section 9.2) as set forth in ACI 318-14 17.3.3 (ACI 318-11 D.4.3). If the load combinations of ACI 318-11 Appendix C are used, the value of ϕ shall be determined in accordance with ACI 318-11 D.4.4.

Table 7 – CONCRETE BREAKOUT DESIGN INFORMATION							
Design Information	Symbol	Units	Nominal Rod Diameter				
			5/16" M8	3/8" M10	1/2" M12	5/8" M16	3/4" M20
Effective embedment depth	$h_{ef,min}$	in.	2 3/8	2 3/8	2 3/4	3 1/8	3 1/2
		mm	60	60	70	80	90
	$h_{ef,max}$	in.	3 3/4	4 1/2	6	7 1/2	9
		mm	96	120	144	192	240
Effectiveness factor for uncracked concrete	$k_{c,uncr}$	in.lb	24				
		SI	10				
Min. anchor spacing	s_{min}	in.	1 1/4	1 5/8	1 7/8	2 1/2	3 1/8
		mm	32	40	45	65	80
Min. edge distance	c_{min}	in.	1 1/4	1 5/8	1 7/8	2 1/2	3 1/8
		mm	32	40	45	65	80
Critical edge distance	c_{ac}	in.	Section 3.2.6 of this report				
		mm					
Minimum member thickness	h_{min}	in.	$h_{min} \approx h_{ef} + \Delta h$ with $\Delta h = \max(1.25 \text{ in.}; 2d_o) \geq 4$ in.				
		mm	$h_{min} \approx h_{ef} + \Delta h$ with $\Delta h = \max(32 \text{ mm.}; 2d_o) \geq 100$ mm.				
Anchor Category	-	-	Anchor Category 2				
Strength reduction factor for tension, concrete failure modes, Condition B[1,2]	ϕ	-	0.55				
Strength reduction factor for shear, concrete failure modes, Condition B[1,2]	ϕ	-	0.70				
Strength reduction factor for pryout failure, Condition B[1,2]	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] For use with load combinations of IBC Section 1605.2.1 or ACI 318-14 5.3 (ACI 318-11 9.2) as set forth in ACI 318-14 17.3.3 (ACI 318-11 D.4.3). The ϕ values correspond to post-installed anchors installed under Condition B without supplementary reinforcement as described in ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. For Condition A, ACI 318-14 17.3.3 (ACI 318-11 D.4.3) shall be consulted.

[2] For load combinations in ACI 318-11 Appendix C, strength reduction factors shall be determined from ACI 318-11 D.4.4.

Table 8 - BOND STRENGTH DESIGN INFORMATION FOR FRACTIONAL-SIZED THREADED RODS								
Design Information		Symbol	Units	Nominal Threaded Rod Diameter				
				5/16"	3/8"	1/2"	5/8"	3/4"
Effective Embedment Depth		$h_{ef,min}$	in. mm	2-3/8 60	2-3/8 60	2-3/4 70	3-1/8 80	3-1/2 90
		$h_{ef,max}$	in. mm	3-3/4 96	4-1/2 120	6 144	7-1/2 192	9 240
Temperature Category A[1]	Characteristic Bond Strength in uncracked oncrete[2]	$\tau_{k,uncr}$	psi MPa	1,404 9.68	1,337 9.22	1,270 8.75	1,135 7.83	1,000 6.90
Anchor Category		-	-	Anchor Category 2				
Strength Reduction Factor for Permissible Installation Conditions in Dry and Water-saturated Concrete[3]		ϕ	-	0.55				
Adjustment for Sustained Tension Loading[4]		α_{sust}	-	0.72				

[1]. Temperature Category A: Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 176°F (80°C).

[2]. Bond strength values correspond to compressive strength of 2,500 psi (17.24 MPa). For higher values in the range 2,500 psi $\le f'_c \le$ 8,000 psi (17.24 MPa $\le f'_c \le$ 55 MPa), the characteristic bond strength may be increased by the ratio $(f'_c / 2500)^{0.1}$ for imperial units, or $(f'_c / 17.24)^{0.1}$ for SI units.

[3]. The strength reduction factor ϕ corresponds to Condition B in accordance with ACI 318-14 17.3.3 (ACI 318-11 D.4.3) for post-installed anchors designed using the load combinations of IBC Section 1605.2. If the load combinations in ACI 318-11 Appendix C are used, the corresponding value of ϕ shall be determined.

[4] Additional reduction factor shall be applied if tension loads are sustained: $\tau_{k,sust,uncr} = \tau_{k,uncr} \cdot \alpha_{p,sust}$

Table 9 - BOND STRENGTH DESIGN INFORMATION FOR METRIC-SIZED THREADED RODS								
Design Information		Symbol	Units	Nominal Threaded Rod Diameter				
				M8	M10	M12	M16	M20
Effective Embedment Depth		$h_{ef,min}$	in. mm	2-3/8 60	2-3/8 60	2-3/4 70	3-1/8 80	3-1/2 90
		$h_{ef,max}$	in. mm	3-3/4 96	4-1/2 120	6 144	7-1/2 192	9 240
Temperature Category A[1]	Characteristic Bond Strength in uncracked Concrete[2]	$\tau_{k,uncr}$	psi MPa	1,404 9.68	1,337 9.22	1,270 8.75	1,135 7.83	1,000 6.90
Anchor Category		-	-	Anchor Category 2				
Strength Reduction Factor for Permissible Installation Conditions in Dry and Water-saturated Concrete[3]		ϕ	-	0.55				
Adjustment for Sustained Tension Loading[4]		α_{sust}	-	0.72				

[1]. Temperature Category A: Maximum Long Term Temperature: 110°F (43°C); Maximum Short Term Temperature: 176°F (80°C).

[2]. Bond strength values correspond to compressive strength of 2,500 psi (17.24 MPa). For higher values in the range 2,500 psi $\le f'_c \le$ 8,000 ps characteristic bond strength may be increased by the ratio $(f'_c / 2500)^{0.1}$ for imperial units, or $(f'_c / 17.24)^{0.1}$ for SI units.

[3]. The strength reduction factor ϕ corresponds to Condition B in accordance with ACI 318-14 17.3.3 (ACI 318-11 D.4.3) for post-installed anchors designed using the load combinations of IBC Section 1605.2. If the load combinations in ACI 318-11 Appendix C are used, the corresponding value of ϕ shall be determined.

[4]. Additional reduction factor shall be applied if tension loads are sustained: $\tau_{k,sust,uncr} = \tau_{k,uncr} \cdot \alpha_{p,sust}$.

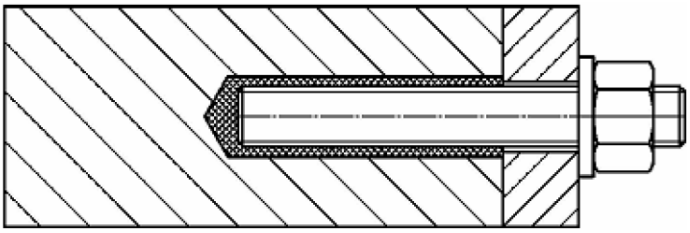


Figure 1a: Standard threaded rod with flat tip end

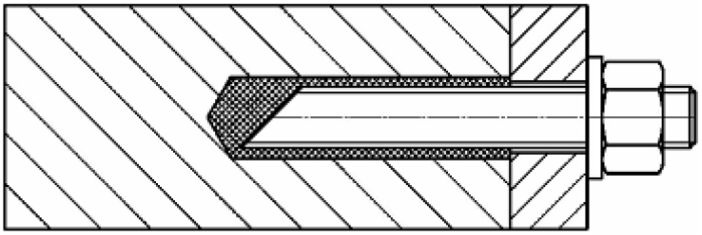


Figure 1b: Standard threaded rod with one side 45° chamfer

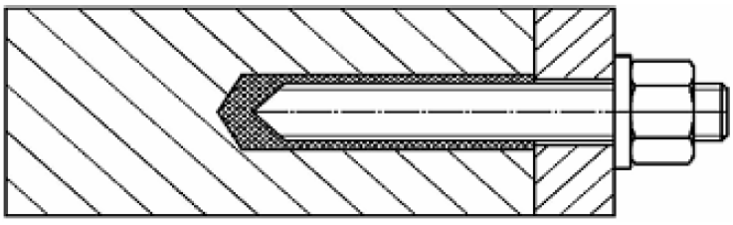


Figure 1c: Standard threaded rod with two side 45° chamfer

Figure 2: Allowable dispenser tools

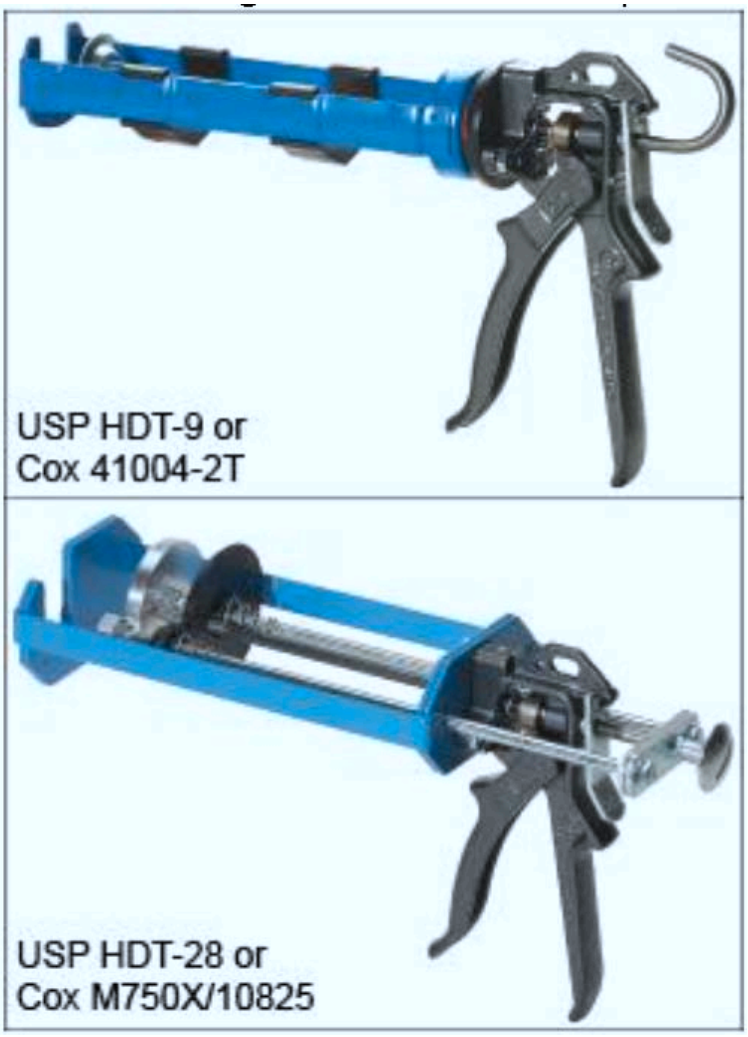


Figure 3: Allowable mixer nozzle type

EA-SMN nozzle

Figure 4: Cartridge types

Peeler cartridge (CIA-EA PLR)

CIA-EA-10 – 9.47oz (280 mL)

Side by side cartridge (CIA-EA S-CN)

CIA-EA-28 – 27.90 oz (825 mL)

Table 10 – ADHESIVE ANCHOR ALLOWABLE STRESS DESIGN (ASD) TENSION VALUES FOR ILLUSTRATIVE PURPOSES			
Nominal anchor diameter (in.)	Drill bit diameter, d_0 (in.)	Effective embedment depth, h_{ef} (in.)	Allowable tension load, $\varphi N_n/\alpha$ (lbf)
5/16	3/8	2-3/8	828
3/8	7/16	2-3/8	946
1/2	9/16	2-3/4	1,388
5/8	11/16	3-1/8	1,762
3/4	13/16	3-1/2	2,920

For SI: 1 inch = 25.4 mm, 1 lb = 4.45N

Design Assumptions:
1. Single anchor with static tension load only; ASTM A Grade B7 threaded rod
2. Downwardly inclined orientation installation direction.
3. Inspection Regimen = periodic.
4. Installation temperature = 32°F to 95°F
5. Long term temperature = 110°F
6. Short term temperature = 176°F
7. Dry hole condition – carbide drilled hole
8. Embedment = $h_{ef,min}$
9. Concrete determined to remain uncracked for the life of the anchor.
10. Load combinations from ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2 (no seismic loading).
11. 30% Dead Load (D) and 70% Live Load (L); Controlling load combination is 1.2D + 1.6L
12. Calculation of α based on weighted average: α = 1.2D + 1.6L = 1.2(0.3) + 1.6(0.7) = 1.48
13. Normal weight concrete: f'_c = 2,500 psi
14. $c_{a1} = c_{a2} \geq c_{ac}$
15. $h \geq h_{min}$

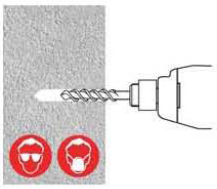
Illustrative Procedure:
¾" CIA-EA Adhesive Anchor (ASTM A193, Grade B7 Threaded Rod) with an Effective Embedment, h_{ef} = 3½ inches.
Step 1: Calculate Static Steel Strength in Tension per ACI 318-14 Section 17.4.1 or ACI 318-11 Section D.5.1 = $\varphi_{sa}N_{sa}$ = 0.75 x 41,813 = 31,360 lbs
Step 2: Calculate Static Concrete Breakout Strength in Tension per ACI 318-14 Section 17.4.2 or ACI 318-11 Section D.5.2 = $\varphi_{cb}N_{cb}$ = 0.55 x 7,857 = 4,321 lbs
Step 3: Calculate Static Bond Strength in Tension per ACI 318-14 Section 17.4.5 or ACI 318-11 Section D.5.5 = $\varphi_p N_a$ = 0.55 x 8,247 = 4,535 lbs.
Step 4: The controlling value (from steps 1-3 above) per ACI 318-14 Section 17.3.1.2 or ACI 318-11 Section D4.1.2 = 4,321 lbs.
Step 5: Divide the controlling value by the conversion factor α as determined in Note 12 above: $T_{allowable,ASD}$ = 4,321/ 1.48 = 2,920 lbs

Table 11 – DIMENSIONS OF BRUSHES							
Design Information	Units	Nominal rod diameter					
		5/16 M8	3/8 M10	1/2 M12	5/8 M16	3/4 M20	1 M24
Wire brush length	in. mm	2.95 75					
nominal brush diameter	in. mm	0.551 14		0.787 22		1.142 29	
Brushes for cleaning drill holes							

Figure 5a: USP Structural Connectors CIA-EA installation instructions

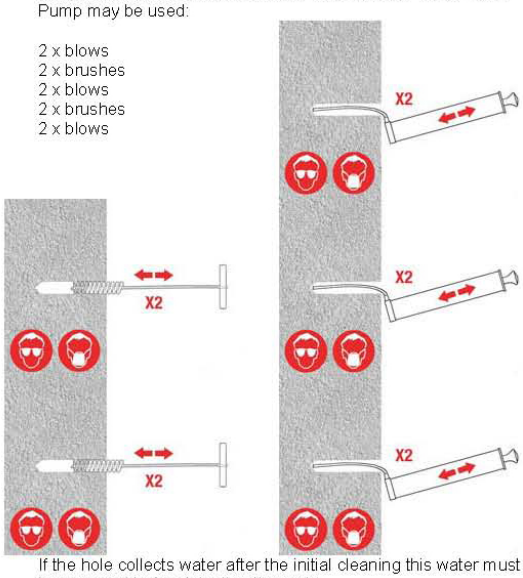
Solid Substrate Installation Method

1. Drill the hole to the correct diameter and depth. This can be done with either a rotary percussive or rotary machine depending upon the substrate.



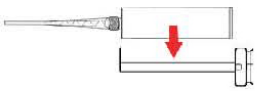
2. Thoroughly clean the hole in the following sequence using the USP Brush with the required extensions and a source of clean compressed air. For holes of 15 ¾" or less deep, a USP Blow Pump may be used:

2 x blows
2 x brushes
2 x blows
2 x brushes
2 x blows



If the hole collects water after the initial cleaning this water must be removed before injecting the resin.

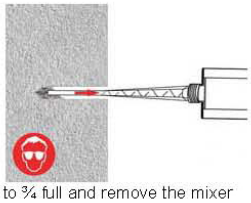
3. Select the appropriate static mixer nozzle for the installation, open the cartridge/foil and screw onto the mouth of the cartridge. Insert the cartridge into the correct applicator gun after checking that the applicator gun is in good working order.



4. Extrude the first part of the cartridge to waste until an even colour has been achieved without streaking in the resin.

5. If necessary, cut the extension tube to the depth of the hole and push onto the end of the mixer nozzle, and (for rebars ⅝" dia. or more) fit the correct resin stopper to the other end. Attach extension tubing and resin stopper.

6. Insert the mixer nozzle (resin stopper / extension tube if applicable) to the bottom of the hole. Begin to extrude the resin and slowly withdraw the mixer nozzle from the hole ensuring that there are no air voids as the mixer nozzle is withdrawn.



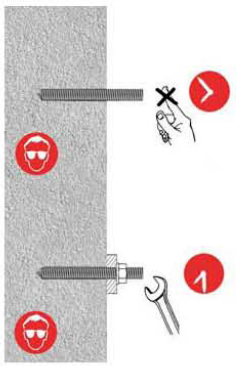
Fill the hole to approximately ½ to ¾ full and remove the mixer nozzle and cartridge completely.

7. Insert the threaded bar (this should be free from oil or other release agents) to the bottom of the hole using a back and forth twisting motion ensuring all the threads are thoroughly coated. Adjust to the correct position within the stated working time.

8. Any excess resin should be expelled from the hole evenly around the steel element showing that the hole is full. This excess resin should be removed from around the mouth of the hole before it sets.

9. Leave the anchor to cure. Do not disturb the anchor until the appropriate loading/curing time has elapsed depending on the substrate conditions and ambient temperature.

10. Attach the fixture and tighten the nut to the recommended torque, DO NOT OVER TIGHTEN.

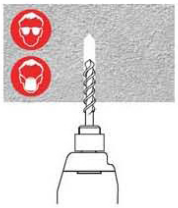


Note for decreased installation temperature:
When installing CIA-EA at decreased installation temperature (32°F < T < 50°F) the cartridge must be conditioned to 68°F.

Figure 5b: USP Structural Connectors CIA-EA installation instructions (continued)

Overhead Solid Substrate Installation Method

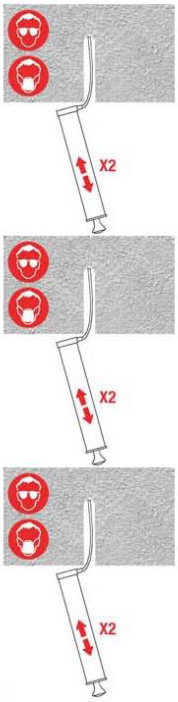
1. Drill the hole to the correct diameter and depth. This can be done with either a rotary percussive or rotary machine depending upon the substrate.



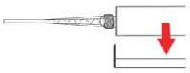
2. Thoroughly clean the hole in the following sequence using the USP Brush with the required extensions and a source of clean compressed air. For holes of 15 3/4" or less deep, a USP Blow Pump may be used:

   2 x blows
   2 x brushes
   2 x blows
   2 x brushes
   2 x blows

   If the hole collects water after the initial cleaning this water must be removed before injecting the resin.



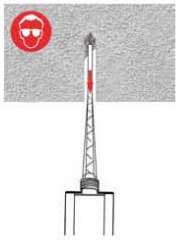
3. Select the appropriate static mixer nozzle for the installation, open the cartridge/foil and screw onto the mouth of the cartridge. Insert the cartridge into the correct applicator gun after checking that the applicator gun is in good working order.



4. Extrude the first part of the cartridge to waste until an even colour has been achieved without streaking in the resin.

5. If necessary, cut the extension tube to the depth of the hole and push onto the end of the mixer nozzle, and (for rebars 5/8" dia. or more) fit the correct resin stopper to the other end. Attach extension tubing and resin stopper.

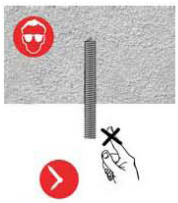
6. Insert the mixer nozzle (resin stopper / extension tube if applicable) to the bottom of the hole. Begin to extrude the resin and slowly withdraw the mixer nozzle from the hole ensuring that there are no air voids as the mixer nozzle is withdrawn. Fill the hole to approximately ½ to ¾ full and remove the mixer nozzle and cartridge completely.



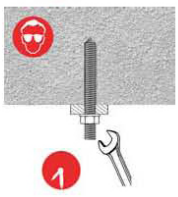
7. Insert the threaded bar (this should be free from oil or other release agents) to the bottom of the hole using a back and forth twisting motion ensuring all the threads are thoroughly coated. Adjust to the correct position within the stated working time.

8. Any excess resin should be expelled from the hole evenly around the steel element showing that the hole is full.
   This excess resin should be removed from around the mouth of the hole before it sets.

9. Leave the anchor to cure.
   Do not disturb the anchor until the appropriate loading/curing time has elapsed depending on the substrate conditions and ambient temperature.



10. Attach the fixture and tighten the nut to the recommended torque, DO NOT OVER TIGHTEN.



Note for decreased installation temperature:
When installing CIA-EA at decreased installation temperature (32°F < T < 50°F) the cartridge must be conditioned to 68°F.

Notes for Overhead Installation:

- *Overhead installation is limited to a maximum effective embedment depth of 10x rod diameter. All other directions may be installed up to a maximum effective embedment depth of 12x rod diameter.*
- *The use of wedges is not required for overhead installations. However, when ambient temperatures exceed 70°F, it is advised to use wedges to fix anchors installed overhead until the full cure time has elapsed as a precautionary measure.*