ULTRABOND® HS-1CC
High-Strength Anchoring Epoxy

ICC ES ESR-4094
DESIGN SOFTWARE COMPATIBLE
CLASSIFIED c UL US WATER QUALITY
DOT STATE DOT LISTED
SEISMIC DESIGN CAPABLE
WIND LOAD QUALIFIED
LEED CERTIFIED

Product Description
ULTRABOND® HS-1CC is a code compliant, two-component, 1:1 mix ratio by volume, high performance epoxy anchoring system approved for use in cartridges and in bulk with threaded rod and reinforcing bar for cracked and uncracked concrete conditions, and internally threaded inserts in uncracked concrete in accordance with ACI 355.4 and ICC-ES AC308. It has an extended application temperature range between 43 °F and 110 °F (6 °C and 43 °C) for structural applications per ICC-ES ESR-4094 and between 38 °F and 125 °F (3 °C and 52 °C) for transportation infrastructure applications to AASHTO M235 & ASTM C881.

General Uses & Applications
- Anchoring threaded rod and reinforcing bar (rebar) into cracked or uncracked concrete using hammer drill or uncracked concrete using core drill
- Suitable for dry, water saturated, water-filled & submerged (underwater) conditions using threaded rod or rebar
- Vertical down, horizontal, upwardly inclined and overhead installations

Advantages & Features
- ICC-ES ESR-4094 evaluation report for cracked and uncracked concrete
- Building code compliant in cartridge and bulk dispensing systems, IBC/IRC: 2018, 2015, 2012 & 2009
- City of Los Angeles Code (LABC/LARC) compliant: 2017
- Florida Building Code (FBC) compliant: 2017
- Abu Dhabi International Building Code (ADIBC) compliant: 2013
- ICC-ES AC308 and ACI 355.4 assessed for resisting short term loading conditions up to 205 °F (96 °C)
- UL Certified – Drinking Water System Components to NSF/ANSI 61 & Lead Free to NSF/ANSI 372
- ULTRABOND HS-1CC contributes toward satisfying credits for Indoor Environmental Quality for Low-Emitting Materials under LEED®
- Suitable for core drilled installations in dry or water saturated concrete
- Multiple anchor types: threaded rod, rebar & internally threaded inserts

STANDARDS & APPROVALS
CODE COMPLIANT:
ICC-ES ESR-4094
IBC/IRC 2018, 2015, 2012, & 2009
City of Los Angeles 2017
Florida Building Code 2017 & 2014
Abu Dhabi International Building Code 2013
Drinking Water System Components NSF/ANSI 61 & 372
ASTM C881-20 / AASHTO M235
Type I, II, IV & V Grade 3 Class A, B & C
Department of Transportation (DOT)
Approved or Pending Nationwide

- OSHA Table 1 compliant drilling/cleaning method using Milwaukee Tool hollow vacuum bit system
- Qualified for Seismic Design Categories A through F
- Nationwide DOT approved or pending
- Made in the USA in accordance with CFR 49 section 50101
- Acceptable for use in USDA inspected facilities
- Compatibe with Adhesives Technology Corp. (ATC) free Pro Anchor Design software

Availability: ATC products are available online and through select distributors serving all your construction needs. Please contact ATC for a distributor near you or visit www.atcepoxy.com for online purchasing options or to search for a distributor by zip code.

Color & Ratio: Part A (Resin) White: Part B (Hardener) Dark Gray, Mixed Ratio: 1:1 by volume, Mixed Color - Gray

Storage & Shelf Life: 24 months when stored in unopened containers in dry and dark conditions. Store between 40 °F (4 °C) and 95 °F (35 °C).

Installation & Estimation: Manufacturer's Printed Installation Instructions (MPII) / Instruction Card (IC) are available within this Technical Data Sheet (TDS). Due to occasional updates and revisions, always verify and use the most current instructions. In order to achieve maximum results, proper installation is imperative. An estimating guide for product usage may be found at www.atcepoxy.com/estimation.

Clean-Up: Always wear appropriate personal protective equipment such as safety glasses and gloves. Clean uncured materials from tools and equipment using a mild solvent, such as CRACKBOND® INDUSTRIAL CITRUS CLEANER from Adhesives Technology Corp. Cured material may only be removed mechanically using a sander or grinder. Collect with absorbent material. Flush area with water. Dispose of in accordance with local, state and federal disposal regulations.

Limitations & Warnings:
- Do not thin with solvents, as this will prevent cure
- For anchoring applications, concrete should be a minimum of 21 days old prior to anchor installation per ACI 355.4
- Bulk versions of ULTRABOND HS-1CC cannot be mixed by hand and must only be mixed using an automatic proportioning plural component pump (see MPII / IC for details)
- Always consult with the Engineer of Record, or a design professional, prior to use to ensure product applicability

Safety: Please refer to the Safety Data Sheet (SDS) for ULTRABOND HS-1CC. Call ATC for more information at 1-800-892-1880.

Specification: Anchoring adhesive shall be a two component, 1:1 ratio by volume, epoxy anchoring system supplied in premeasured cartridges or bulk. Adhesive must meet the requirements of ICC-ES AC308, ACI 355.4. Adhesive must have a compressive yield strength of 14,480 psi (99.8 MPa) at 75 °F (24 °C) after a 7 day cure per ASTM D695. Adhesive shall be ULTRABOND HS-1CC from Adhesives Technology Corp., Pompano Beach, Florida. Anchors shall be installed per the MPII / IC for ULTRABOND HS-1CC anchoring system.

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Ordering Information

TABLE 1: ULTRABOND HS-1CC Adhesive Packaging, Dispensing Tools and Mixing Nozzles

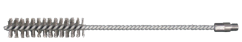
Package Size	8.6 fl. oz. (254 ml) Cartridge[1]	21.2 fl. oz. (627 ml) Cartridge[1]	53 fl. oz. (1.6 L) Cartridge[1]	10 Gallon (38 L) Kit[2]	
				Resin	Hardener
Part #	A9-HS1CC	A22-HS1CC	A53-HS1CC	B5G-HS1CC-A	B5G-HS1CC-B
Recommended Mixing Nozzle	T12 or T34HF			T34HF	
Manual Dispensing Tool	TM9HD	TM22HD	N/A		
Pneumatic Dispensing Tool	N/A	TA22HD-A	TA53HD-A	Pump	
Battery Tool		TB22HD-A	N/A		
Case Qty.	12		6	N/A	
Pallet Qty.	1,116	432	252	12 kits	
SDS Brush Adaptor	BR-SDS				
Brush Extension	BR-EXT				
Nozzle Extension Tubing	TUBE916-EXT				
Retention Wedge	WEDGE				

1. Each cartridge is packaged with one mixing nozzle.
2. ATC recommends AST bulk pump model number RMP 6624-1717.


A9-HS1CC


A22-HS1CC


A53-HS1CC


Small Wire Brush


Manual Brush Handle (included with Wire Brush)


Large Wire Brush


SDS Drill Brush Attachmet BR-SDS


B5G-HS1CC-A / B5G-HS1CC-B


Brush Extension BR-EXT


Piston Plugs (Hole Diameters 7/16 in. to 1 1/2 in.)


TM9HD


TM22HD


Nozzle Extension Tubing TUBE916-EXT


10 in. (254 mm) Small Nozzle T12


TB22HD-A


TA53HD-A


Retention Wedge WEDGE


15 3/4 IN. (400 MM) Large Nozzle T34HF

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Ordering Information

In order to reduce the risks to respirable crystalline silica, ULTRABOND HS-1CC has been tested and approved for use in conjunction with Milwaukee Tool's OSHA compliant, commercially available dust extraction products for use in combination with ULTRABOND HS-1CC installations in dry and water saturated (damp) concrete (see Table 2 for details). When used in accordance with the manufacturer's instructions, and in conjunction with ULTRABOND HS-1CC, these Vacuum Drill Bits along with the Dust Extractor with HEPA filter as specified by Milwaukee Tool, can completely replace the traditional blow-brush-blow cleaning method used to install threaded rod (see Installation Instructions (MPII) for more detail). **Important:** Prior to injecting the adhesive, the hole must always be clean, either by using self-cleaning vacuum bits or by using the blow-brush-blow cleaning method with a traditional hammer drill bit and dust shroud. Only vacuuming out a hole drilled with a standard masonry bit is NOT acceptable and will yield lower performance than published for the anchoring/doweling adhesive. For more information, see Respirable Crystalline Silica White Paper at www.atcepoxy.com/resources.

Milwaukee Tool Dust Extraction System

TABLE 2: Milwaukee Vacuum Drill Components[1]

Part #	Drill Type	Drill Bit Size in.	Overall Length in.	Useable Length in.
48-20-2102	SDS+	7/16	13	7 7/8
48-20-2106		1/2	13	7 7/8
48-20-2110		9/16	14	9 1/2
48-20-2114		5/8	14	9 1/2
48-20-2118		3/4	14	9 1/2
48-20-2152	SDS-Max	5/8	23	15 3/4
48-20-2156		3/4	23	15 3/4
48-20-2160		7/8	23	15 3/4
48-20-2164		1	25	17 1/2
48-20-2168		1-1/8	35	27
48-20-2172		1-3/8	35	27
8960-20	8 Gallon Dust Extractor Vacuum			

1. Vacuum drill accessories available from Milwaukee distributors nationwide.

Material Specifications

TABLE 3: ULTRABOND HS-1CC performance to **ASTM C881-20**[1,2,3]

Property	Cure Time	ASTM Standard	Units	Sample Conditioning Temperature				
				Class A	Class B	Optional	Optional	Class C
				38 °F (3 °C)	50 °F (10 °C)	75 °F (24 °C)	110 °F (43 °C)	125 °F (52 °C)
Gel Time - 60 Gram Mass	----	C881	min	14	13	10	2[4]	2[4]
Consistency or Viscosity	----	C881	----	Non-sag				
Compressive Yield Strength	7 day	D695	psi (MPa)	12,980 (89.5)	13,280 (91.6)	14,480 (99.8)	14,500 (100.0)	13,430 (92.6)
Compressive Modulus	7 day	D695	psi (MPa)	534,900 (3,688)	506,100 (3,489)	475,900 (3,281)	599,600 (4,134)	585,600 (4,038)
Bond Strength Hardened to Hardened Concrete	2 day	C882	psi (MPa)	2,700 (18.6)	2,770 (19.1)	2,780 (19.2)	3,150 (21.7)	2,050 (14.1)
	14 day	C882	psi (MPa)	2,860 (19.7)	2,950 (20.3)	3,110 (21.4)	3,050 (21.0)	2,080 (14.3)
Bond Strength Fresh to Hardened Concrete	14 day	C882	psi (MPa)	2,730 (18.8)				
Tensile Strength[5]	7 day	D638	psi (MPa)	6,780 (46.7)				
Tensile Elongation[5]	7 day	D638	%	1.0				
Heat Deflection Temp.	7 day	D648	°F (°C)	148 (64)				
Dielectric Volume Resistivity	----	D3755	Pass/Fail	Pass				
Water Absorption	24 hr	D570	%	0.02				
Linear Coefficient of Shrinkage	----	D2566	%	0.0003				

1. Product testing results based on representative lot(s). Average results will vary according to the tolerances of the given property.
2. Full cure time is listed above to obtain the given properties for each product characteristic.
3. Results may vary due to environmental factors such as temperature, moisture and type of substrate.
4. Gel time may be lower than the minimum required for ASTM C881.
5. Optional testing for ASTM C881 Grade 3.

TABLE 4: ULTRABOND HS-1CC **NSF/ANSI CERTIFICATIONS**[1]

ANSI Certification	Description	Application	Water Contact Temperature	Anchor Sizes Installed in Concrete
NSF 61	Drinking Water System Componenets - Health Effects	Joining and Sealing Materials	Commercial Hot 180 ± 4 °F (82 ± 2 °C)	Threaded Rod and Rebar ≤ 1 1/4 in. Diameter
NSF 372[2]	Lead Free, U.S. Safe Drinking Water Act			

1. ULTRABOND HS-1CC is certified as a joing and sealing material. Mix Ratio: Part A (Resin): Part B (Hardener) = 1:1 by volume. Application method: Dispensing mixing nozzle system. Final Cure Time: 24 hours at 75 °F (24 °C).
2. ULTRABOND HS-1CC is certified to NSF/ANSI 372 and conforms to the lead content requirements for "lead free" plumbing as defined by California, Louisiana, Maryland and Vermont state law, and the U.S. Safe Drinking Water Act.

TABLE 5: ULTRABOND HS-1CC **CURE SCHEDULE**[1,2,3]

Temperature °F (°C)	Working Time min	Full Cure Time hr
43 (6)	45	144
50 (10)	35	72
75 (24)	16	7
90 (32)	12	4
110 (43)	3	2

1. Working and full cure times are approximate, may be linearly interpolated between listed temperatures and are based on cartridge/nozzle system performance.
2. Application Temperature: Substrate and ambient air temperature should be between 43 - 110 °F (6 - 43 °C) for applications requiring IBC/IRC code compliance.
3. When ambient or base material temperature falls below 70 °F (21 °C), condition the adhesive to 70 - 75 °F (21 - 24 °C) prior to use. A high flow mixing nozzle (T34HF) may also be used to ease dispensing at colder temperatures or to increase flow rate.

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FIGURE 1 - Flow Chart for the Establishment of **DESIGN STRENGTH**

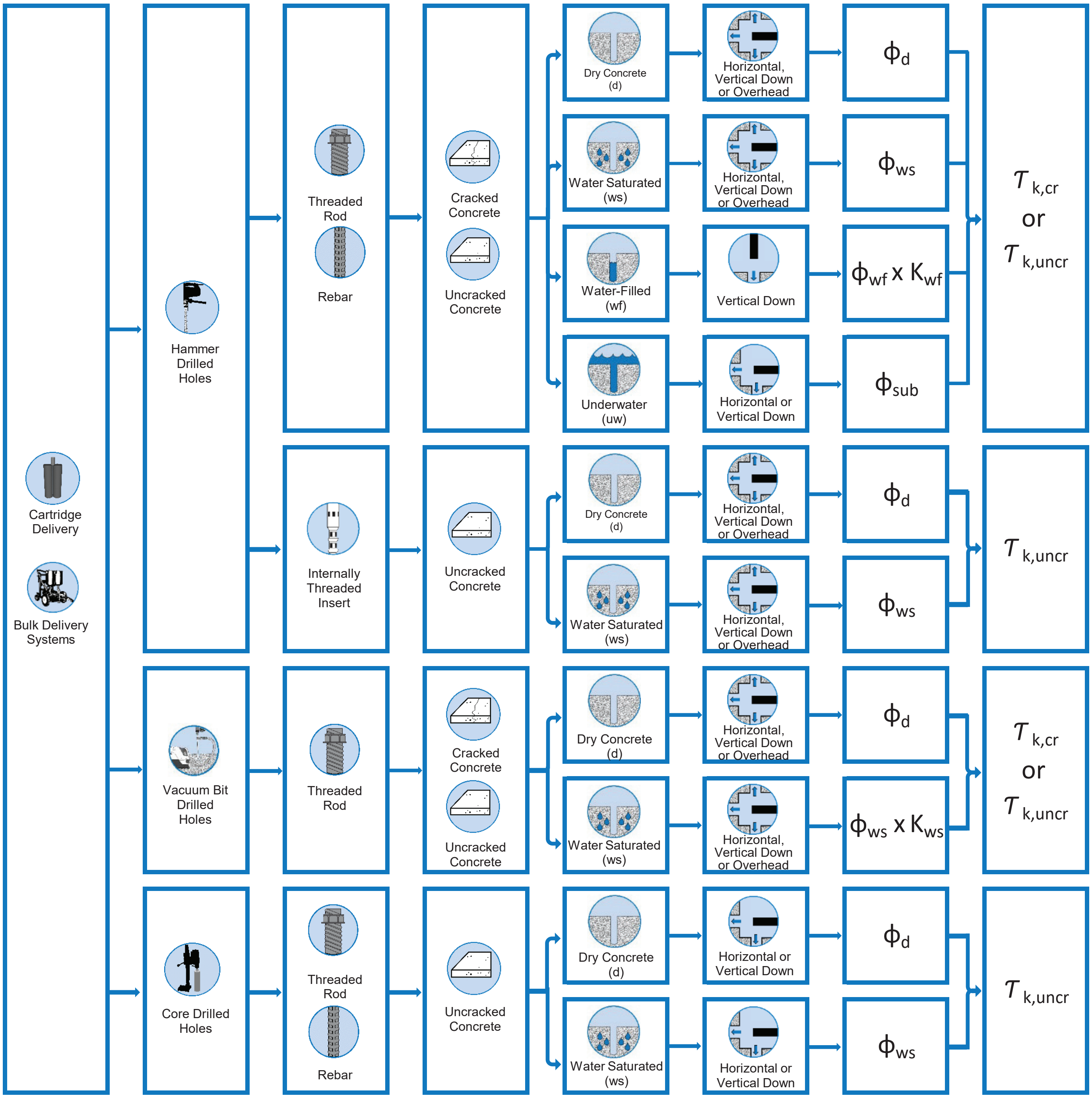


FIGURE 2 - Typical Installation Detail for Threaded Rods or Reinforcement Bars

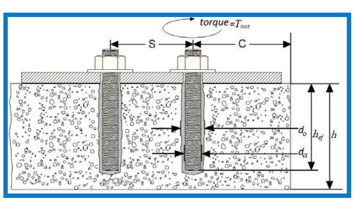
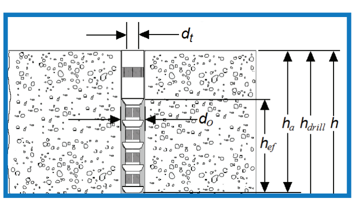


FIGURE 3 - Typical Installation Detail for Power-Sert for Internally Threaded Inserts



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ULTRABOND HS-1CC has been tested and assessed by an accredited independent testing laboratory in accordance with ICC-ES AC308, ACI 355.4 and ASTM E488 for use in cracked and uncracked, normal and lightweight concrete, for loading conditions including seismic and wind, for structural design to ACI 318-14 Chapter 17 (ACI 318-11/08 Appendix D) and is approved per ICC-ES ESR-4094. The design process and parameters for ULTRABOND HS-1CC are shown in Figures 1 - 3, Tables 7 - 18 for Strength Design and Tables 19 - 22 for Allowable Stress Design.

TABLE 6: ULTRABOND HS-1CC **DESIGN STRENGTH INDEX**

<table>
<tr><th colspan="2">DESIGN STRENGTH</th><th>Drilling Method</th><th>Threaded Rod</th><th>Rebar</th><th>Internally Threaded Insert</th></tr>
<tr><td>Steel Strength</td><td>N_{sa}, V_{sa}</td><td>----</td><td>7</td><td>12</td><td>16</td></tr>
<tr><td>Concrete Breakout</td><td>N_{cb}, V_{cb}, V_{cp}</td><td>----</td><td>8</td><td>13</td><td>17</td></tr>
<tr><td rowspan="5">Strength Design Bond Strength (SD)</td><td>Cracked Concrete</td><td rowspan="2">Hammer Drilled</td><td>9</td><td>14</td><td>18</td></tr>
<tr><td>Uncracked Concrete</td><td>9</td><td>14</td><td>----</td></tr>
<tr><td>Cracked Concrete</td><td rowspan="2">Vacuum Bit Drilled</td><td>10</td><td>----</td><td>----</td></tr>
<tr><td>Uncracked Concrete</td><td>10</td><td>----</td><td>----</td></tr>
<tr><td>Uncracked Concrete</td><td>Core Drilled</td><td>11</td><td>15</td><td>----</td></tr>
<tr><td rowspan="2">Allowable Stress Design (ASD)</td><td>Allowable Tension Load</td><td rowspan="2">Hammer Drilled</td><td>19</td><td>21</td><td>----</td></tr>
<tr><td>Allowable Shear Load</td><td>20</td><td>22</td><td>----</td></tr>
</table>

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TABLE 7: ULTRABOND HS-1CC **STEEL** design information for **THREADED ROD**[1]

Material	Specification	Design Information	Symbol	Units	3/8"	1/2"	5/8"	3/4"	7/8"	1"	1 1/4"
		Nominal Anchor Diameter	d	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 Cross-Sectional Area[2]	A_{se}	in.^{2} (mm^2)	0.078 (50)	0.142 (92)	0.226 (146)	0.335 (216)	0.462 (298)	0.606 (391)	0.969 (625)
Carbon Steel	ASTM A36 Grade 36 F1554 Grade 36	Nominal Strength as Governed by Steel Strength	N_{sa}	lb. (kN)	4,495 (20.0)	8,230 (36.6)	13,110 (58.3)	19,370 (86.2)	26,795 (119.2)	35,150 (156.4)	56,200 (250.0)
Carbon Steel	ASTM A36 Grade 36 F1554 Grade 36	Nominal Strength as Governed by Steel Strength	V_{sa}	lb. (kN)	2,695 (12.0)	4,940 (22.0)	7,865 (35.0)	11,625 (51.7)	16,080 (71.5)	21,090 (93.8)	33,720 (150.0)
Carbon Steel	ASTM A36 Grade 36 F1554 Grade 36	Reduction Factor for Seismic Shear	$\alpha_{V,seis}$	----	0.83	0.78	0.74	0.70	0.69	0.67	0.65
Carbon Steel	ASTM A36 Grade 36 F1554 Grade 36	Strength Reduction Factor for Tension[3]	ϕ	----	0.75						
Carbon Steel	ASTM A36 Grade 36 F1554 Grade 36	Strength Reduction actor for Shear[3]	ϕ	----	0.65						
Carbon Steel	ASTM A193 B7 ASTM F1554 Grade 105	Nominal Strength as Governed by Steel Strength	N_{sa}	lb. (kN)	9,685 (43.1)	17,735 (78.9)	28,250 (125.7)	41,750 (185.7)	57,750 (256.9)	75,750 (337.0)	121,125 (538.8)
Carbon Steel	ASTM A193 B7 ASTM F1554 Grade 105	Nominal Strength as Governed by Steel Strength	V_{sa}	lb. (kN)	5,815 (25.9)	10,645 (47.4)	16,950 (75.4)	25,050 (111.4)	34,650 (154.1)	45,450 (202.2)	72,675 (323.3)
Carbon Steel	ASTM A193 B7 ASTM F1554 Grade 105	Reduction Factor for Seismic Shear	$\alpha_{V,seis}$	----	0.60	0.58	0.57	0.55	0.53	0.50	0.46
Carbon Steel	ASTM A193 B7 ASTM F1554 Grade 105	Strength Reduction Factor for Tension[4]	ϕ	----	0.75						
Carbon Steel	ASTM A193 B7 ASTM F1554 Grade 105	Strength Reduction Factor for Shear[4]	ϕ	----	0.65						
Stainless Steel	ASTM F593 CW Stainless Type 304 & 316	Nominal Strength as Governed by Steel Strength	N_{sa}	lb (kN)	7,750 (34.5)	14,190 (63.1)	22,600 (100.5)	28,390 (126.3)	39,270 (174.7)	51,510 (229.1)	82,365 (366.4)
Stainless Steel	ASTM F593 CW Stainless Type 304 & 316	Nominal Strength as Governed by Steel Strength	V_{sa}	lb (kN)	4,650 (20.7)	8,515 (37.9)	13,560 (60.3)	17,035 (75.8)	23,560 (104.8)	30,905 (137.5)	49,420 (219.8)
Stainless Steel	ASTM F593 CW Stainless Type 304 & 316	Reduction Factor for Seismic Shear	$\alpha_{V,seis}$	----	0.65	0.62	0.60	0.58	0.57	0.55	0.53
Stainless Steel	ASTM F593 CW Stainless Type 304 & 316	Strength Reduction Factor for Tension[4]	ϕ	----	0.65						
Stainless Steel	ASTM F593 CW Stainless Type 304 & 316	Strength Reduction Factor for Shear[4]	ϕ	----	0.60						

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

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 or ACI 318-11 Eq. (D-2) and Eq. (D-29), as applicable. Nuts and washers must be appropriate for the rod strength and type.
2. Cross-sectional area is minimum stress area applicable for either tension or shear.
3. For use with load combinations of IBC Section 1605.2, ACI 318-14 5.3 or ACI 318-11 9.2, as applicable, as set forth in ACI 318-14 17.3.3 or ACI 318-11 D.4.3. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 D4.4. Values correspond to a ductile steel element.
4. For use with load combinations of IBC Section 1605.2, ACI 318-14 5.3 or ACI 318-11 9.2, as applicable, as set forth in ACI 318-14 17.3.3 or ACI 318-11 D.4.3. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 D4.4. Values correspond to a brittle steel element.

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TABLE 8: ULTRABOND HS-1CC **CONCRETE BREAKOUT** design information for **THREADED ROD**

Design Information	Symbol	Units	Threaded Rod						
			3/8"	1/2"	5/8"	3/4"	7/8"	1"	1 1/4"
Minimum Embedment Depth	$h_{ef,min}$	in. (mm)	2 3/8 (60)	2 3/4 (70)	3 1/8 (79)	3 1/2 (89)	3 3/4 (95)	4 (102)	5 (127)
Maximum Embedment Depth	$h_{ef,max}$	in. (mm)	7 1/2 (191)	10 (254)	12 1/2 (318)	15 (381)	17 1/2 (445)	20 (508)	25 (635)
Effectiveness Factor for Cracked Concrete	$k_{c,cr}$	---- SI	17 (7.1)						
Effectiveness Factor for Uncracked Concrete	$k_{c,uncr}$	---- SI	24 (10)						
Minimum Spacing Distance	s_{min}	in. (mm)	$S_{min} = C_{min}$						
Minimum Edge Distance	c_{min}	in. (mm)	2 3/16 (56)	2 13/16 (71)	3 3/4 (95)	4 3/8 (111)	5 (127)	5 5/8 (143)	6 7/8 (175)
Minimum Concrete Thickness	h_{min}	in. (mm)	h_{ef} + 1.25 , [≥ 3.937] (h_{ef} + 30 , [≥ 100])	h_{ef} + 2d_0 where d_o is the hole diameter					
Critical Edge Distance (Uncracked Concrete Only)	c_{ac}	in.	$C_{ac} = h_{ef} \cdot \left(\frac{\min(\tau_{k,uncr}; \tau_{k,\max})}{1160} \right)^{0.4} \cdot \max\left[\left(3.1 - 0.7 \frac{h}{h_{ef}} \right); 1.4 \right]$						
		mm	$C_{ac} = h_{ef} \cdot \left(\frac{\min(\tau_{k,uncr}; \tau_{k,\max})}{8} \right)^{0.4} \cdot \max\left[\left(3.1 - 0.7 \frac{h}{h_{ef}} \right); 1.4 \right]$						
Strength Reduction Factor for Tension, Concrete Failure Mode, Condition B[1]	ϕ	----	0.65						
Strength Reduction Factor for Shear, Concrete Failure Mode, Condition B[1]	ϕ	----	0.70						

For **SI**: 1 inch = 25.4 mm, 1lbf = 4.448 N, 1 psi = 0.006897 MPa
For pound-inch units: 1 mm = 0.03937 inch, 1 N = 0.2248 lbf, 1MPa = 145.0 psi
1. Values provided for post-installed anchors with category as determined from ACI 355.4 given for Condition B. Condition B applies without supplementary reinforcement or where pullout (bond) or pryout govern, as set forth in ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, while condition A requires supplemental reinforcement. Values are for use with the load combinations Section 1605.2 of the IBC, ACI 318-14 5.3 or ACI 318-11 Section 9.2, as applicable, as set forth in ACI 318-11 D.4.3. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4.

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TABLE 9: ULTRABOND HS-1CC **BOND STRENGTH** design information for **THREADED ROD** in holes drilled with a **HAMMER DRILL** and **CARBIDE BIT** - Maximum Long Term Service Temperature 110 °F (43 °C)[1,2,3,4]

Design Information			Symbol	Units	3/8"	1/2"	5/8"	3/4"	7/8"	1"	1 1/4"
Minimum Embedment Depth			$h_{ef,min}$	in. (mm)	2 3/8 (60)	2 3/4 (70)	3 1/8 (79)	3 1/2 (89)	3 3/4 (95)	4 (102)	5 (127)
Maximum Embedment Depth			$h_{ef,max}$	in. (mm)	7 1/2 (191)	10 (254)	12 1/2 (318)	15 (381)	17 1/2 (445)	20 (508)	25 (635)
Maximum Short Term Temperature **150 °F** (66 °C)	Cracked Concrete Characteristic Bond Strength	With Sustained Load	$\tau_{k,cr}$	psi (MPa)	1,415 (9.8)	1,250 (8.6)	1,415 (9.8)	1,415 (9.7)	1,200 (8.3)	1,330 (9.2)	1,275 (8.8)
		No Sustained Load		psi (MPa)	1,625 (11.2)	1,435 (9.9)	1,625 (11.2)	1,625 (11.2)	1,380 (9.5)	1,525 (10.5)	1,465 (10.1)
	Uncracked Concrete Characteristic Bond Strength	With Sustained Load	$\tau_{k,uncr}$	psi (MPa)	2,495 (17.2)	2,400 (16.5)	2,300 (15.9)	2,205 (15.2)	2,105 (14.5)	2,010 (13.9)	1,810 (12.5)
		No Sustained Load		psi (MPa)	2,870 (19.8)	2,755 (19.0)	2,640 (18.2)	2,530 (17.4)	2,415 (16.7)	2,305 (15.9)	2,080 (14.3)
Maximum Short Term Temperature **180 °F** (82 °C)	Cracked Concrete Characteristic Bond Strength	With Sustained Load	$\tau_{k,cr}$	psi (MPa)	1,245 (8.6)	1,100 (7.6)	1,245 (8.6)	1,245 (8.6)	1,060 (7.3)	1,165 (8.0)	1,125 (7.8)
		No Sustained Load		psi (MPa)	1,430 (9.9)	1,265 (8.7)	1,430 (9.9)	1,430 (9.9)	1,215 (8.4)	1,340 (9.2)	1,290 (8.9)
	Uncracked Concrete Characteristic Bond Strength	With Sustained Load	$\tau_{k,uncr}$	psi (MPa)	2,200 (15.2)	2,110 (14.5)	2,025 (14.0)	1,940 (13.4)	1,855 (12.8)	1,770 (12.2)	1,595 (11.0)
		No Sustained Load		psi (MPa)	2,525 (17.4)	2,425 (16.7)	2,325 (16.0)	2,225 (15.3)	2,130 (14.7)	2,030 (14.0)	1,830 (12.6)
Maximum Short Term Temperature **205 °F** (96 °C)	Cracked Concrete Characteristic Bond Strength	With Sustained Load	$\tau_{k,cr}$	psi (MPa)	530 (3.7)	470 (3.2)	530 (3.7)	530 (3.7)	455 (3.1)	495 (3.4)	480 (3.3)
		No Sustained Load		psi (MPa)	610 (4.2)	540 (3.7)	610 (4.2)	610 (4.2)	420 (2.9)	570 (3.9)	550 (3.8)
	Uncracked Concrete Characteristic Bond Strength	With Sustained Load	$\tau_{k,uncr}$	psi (MPa)	935 (6.4)	900 (6.2)	860 (5.9)	830 (5.7)	790 (5.4)	755 (5.2)	680 (4.7)
		No Sustained Load		psi (MPa)	1,075 (7.4)	1,035 (7.1)	990 (6.8)	950 (6.6)	905 (6.2)	865 (6.0)	780 (5.4)
Reduction Factor for Seismic Tension[5]			$\alpha_{N,seis}$	----	1.00			0.77	1.00	0.97	0.96
Continuous Inspection	Strength Reduction Factors for Permissible Installation Conditions[6,7,8]	Dry Concrete	ϕ_d	----	0.65						
		Water Saturated Concrete	ϕ_{ws}	----	0.65		0.55				
		Water-Filled Holes in Concrete	ϕ_{wf}	----	0.55					0.45	
			K_{wf}	----	1.00					0.96	0.88
		Underwater Holes in Concrete	ϕ_{uw}	----	0.65						
Periodic Inspection	Strength Reduction Factors for Permissible Installation Conditions[6,7,8]	Dry Concrete	ϕ_d	----	0.65						
		Water Saturated Concrete	ϕ_{ws}	----	0.55		0.45				
		Water-Filled Holes in Concrete	ϕ_{wf}	----	0.45						
			K_{wf}	----	1.00					0.92	0.75
		Underwater Holes in Concrete	ϕ_{uw}	----	0.55						

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

1. Characteristic bond strength values correspond to concrete compressive strength f'_c =2,500 psi (17.2 MPa). For uncracked concrete compressive strength f'_c between 2,500 psi (17.2 MPa) and 8,000 psi (55.2 MPa), the tabulated characteristic bond strength may be increased by a factor of $(f'_c/2{,}500)^{0.1}$ (for SI: $(f'_c/17.2)^{0.1}$). For cracked concrete, no increase in bond strength is permitted.
2. Lightweight concrete may be used by applying a reduction factor as given in ACI 318-14 17.2.6 or ACI 318-11 Appendix D section D3.6 as applicable.
3. Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a results of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.
4. Characteristic bond strength values are for sustained loads (when noted), including dead and live loads.
5. For structures in regions assigned to Seismic Design Category C, D, E, or F, the bond strength values shall be multiplied by $\alpha_{n,seis}$.
6. The tabulated value of ϕ applies when load combinations of Section 1605.2 of the IBC or ACI 318-14 5.3 (ACI 318-11 9.2), are used in accordance with 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 appropriate value of ϕ shall be determined in accordance with ACI 318 D.4.4.
7. The values of ϕ correspond to Condition B as described in 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.
8. The values of ϕ correspond to the anchor category as set forth in ACI 318-14 17.3.3 (ACI 318-11 D.4.3). The ϕ factor of 0.65 represents a Category 1, 0.55 a Category 2 and 0.45 a Category 3.

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TABLE 10: ULTRABOND HS-1CC **BOND STRENGTH** design information for **THREADED ROD** in **MILWAUKEE VACUUM BIT DRILLED HOLES -** Maximum Long Term Service Temperature 110 °F (43 °C)[1,2,3,4]

Design Information			Symbol	Units	Threaded Rod 5/8"	3/4"	7/8"	1"	1 1/4"
Minimum Embedment Depth			$h_{ef,min}$	in. (mm)	3 1/8 (79)	3 1/2 (89)	3 3/4 (95)	4 (102)	5 (127)
Maximum Embedment Depth			$h_{ef,max}$	in. (mm)	12 1/2 (318)	15 (381)	17 1/2 (445)	20 (508)	25 (635)
Maximum Short Term Temperature **150 °F** (66 °C)	Cracked Concrete Characteristic Bond Strength	With Sustained Load	$\tau_{k,cr}$	psi (MPa)	1,175 (8.1)	1,005 (6.9)	1,035 (7.1)	1,185 (8.2)	1,140 (7.9)
		No Sustained Load		psi (MPa)	1,350 (9.3)	1,155 (8.0)	1,185 (8.2)	1,360 (9.4)	1,310 (9.0)
	Uncracked Concrete Characteristic Bond Strength	With Sustained Load	$\tau_{k,uncr}$	psi (MPa)	2,105 (14.5)	2,030 (14.0)	1,955 (13.5)	1,880 (13.0)	1,730 (11.9)
		No Sustained Load		psi (MPa)	2,415 (16.7)	2,330 (16.1)	2,245 (15.5)	2,160 (14.9)	1,985 (13.7)
Maximum Short Term Temperature **180 °F** (82 °C)	Cracked Concrete Characteristic Bond Strength	With Sustained Load	$\tau_{k,cr}$	psi (MPa)	1,035 (7.1)	885 (6.1)	910 (6.3)	1,045 (7.2)	1,005 (6.9)
		No Sustained Load		psi (MPa)	1,190 (8.2)	1,015 (7.0)	1,045 (7.2)	1,200 (8.3)	1,155 (8.0)
	Uncracked Concrete Characteristic Bond Strength	With Sustained Load	$\tau_{k,uncr}$	psi (MPa)	1,850 (12.8)	1,785 (12.3)	1,720 (11.9)	1,655 (11.4)	1,525 (10.5)
		No Sustained Load		psi (MPa)	2,125 (14.7)	2,050 (14.1)	1,975 (13.6)	1,900 (13.1)	1,750 (12.1)
Maximum Short Term Temperature **205 °F** (96 °C)	Cracked Concrete Characteristic Bond Strength	With Sustained Load	$\tau_{k,cr}$	psi (MPa)	440 (3.0)	375 (2.6)	385 (2.7)	445 (3.1)	430 (3.0)
		No Sustained Load		psi (MPa)	505 (3.5)	435 (3.0)	445 (3.1)	510 (3.5)	490 (3.4)
	Uncracked Concrete Characteristic Bond Strength	With Sustained Load	$\tau_{k,uncr}$	psi (MPa)	790 (5.4)	760 (5.2)	735 (5.1)	705 (4.9)	650 (4.5)
		No Sustained Load		psi (MPa)	905 (6.2)	875 (6.0)	840 (5.8)	810 (5.6)	745 (5.1)
Reduction Factor for Seismic Tension[5]			$\alpha_{N,seis}$	----	1.00	0.77	1.00	0.97	0.96
Continuous Inspection	Strength Reduction Factors for Permissible Installation Conditions[6,7,8]	Dry Concrete	ϕ_d	----	0.65				
		Water Saturated Concrete	ϕ_{ws}	----	0.45		0.55	0.65	
			κ_{ws}	----	1.00				
Periodic Inspection	Strength Reduction Factors for Permissible Installation Conditions[6,7,8]	Dry Concrete	ϕ_d	----	0.65				
		Water Saturated Concrete	ϕ_{ws}	----	0.45			0.55	
			κ_{ws}	----	0.89	0.96	1.00		

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

1. Characteristic bond strength values correspond to concrete compressive strength f'_c =2,500 psi (17.2 MPa). For uncracked concrete compressive strength f'_c between 2,500 psi (17.2 MPa) and 8,000 psi (55.2 MPa), the tabulated characteristic bond strength may be increased by a factor of $(f'_c/2{,}500)^{0.1}$ (for SI: $(f'_c/17.2)^{0.1}$). For cracked concrete, no increase in bond strength is permitted.
2. Lightweight concrete may be used by applying a reduction factor as given in ACI 318-14 17.2.6 or ACI 318-11 Appendix D section D3.6 as applicable.
3. Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a results of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.
4. Characteristic bond strength values are for sustained loads (when noted), including dead and live loads.
5. For structures in regions assigned to Seismic Design Category C, D, E, or F, the bond strength values shall be multiplied by $\alpha_{n,seis}$.
6. The tabulated value of ϕ applies when load combinations of Section 1605.2 of the IBC or ACI 318-14 5.3 (ACI 318-11 9.2), are used in accordance with 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 appropriate value of ϕ shall be determined in accordance with ACI 318 D.4.4.
7. The values of ϕ correspond to Condition B as described in 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.
8. The values of ϕ correspond to the anchor category as set forth in ACI 318-14 17.3.3 (ACI 318-11 D.4.3). The ϕ factor of 0.65 represents a Category 1, 0.55 a Category 2 and 0.45 a Category 3.

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TABLE 11: ULTRABOND HS-1CC **BOND STRENGTH** design information for **THREADED ROD** in **CORE DRILLED HOLES-** Maximum Long Term Service Temperature 110 °F (43 °C)[1,2,3,4]

Design Information			Symbol	Units	Threaded Rod					
					1/2"	5/8"	3/4"	7/8"	1"	1 1/4"
Minimum Embedment Depth			$h_{ef,min}$	in. (mm)	2 3/4 (70)	3 1/8 (79)	3 1/2 (89)	3 3/4 (95)	4 (102)	5 (127)
Maximum Embedment Depth			$h_{ef,max}$	in. (mm)	10 (254)	12 1/2 (318)	15 (381)	17 1/2 (445)	20 (508)	25 (635)
Maximum Short Term Loading Temperature **150 °F** (66 °C)	Uncracked Concrete Characteristic Bond Strength	With Sustained Load	$\tau_{k,uncr}$	psi (MPa)	995 (6.9)					
		No Sustained Load		psi (MPa)	1,145 (7.9)					
Maximum Short Term Loading Temperature **180 °F** (82 °C)	Uncracked Concrete Characteristic Bond Strength	With Sustained Load	$\tau_{k,uncr}$	psi (MPa)	880 (6.1)					
		No Sustained Load		psi (MPa)	1,010 (7.0)					
Continuous Inspection	Strength Reduction Factors for Permissible Installation Conditions[5,6,7,8]	Dry Concrete	ϕ_d	----	0.65					
		Water Saturated Concrete	ϕ_{ws}	----	0.65					
Periodic Inspection	Strength Reduction Factors for Permissible Installation Conditions[5,6,7,8]	Dry Concrete	ϕ_d	----	0.65					
		Water Saturated Concrete	ϕ_{ws}	----	0.55					

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

1. Characteristic bond strength values correspond to concrete compressive strength f'_c =2,500 psi (17.2 MPa). For uncracked concrete compressive strength f'_c between 2,500 psi (17.2 MPa) and 8,000 psi (55.2 MPa), the tabulated characteristic bond strength may be increased by a factor of $(f'_c/2{,}500)^{0.1}$ (for SI: $(f'_c/17.2)^{0.1}$). For cracked concrete, no increase in bond strength is permitted.
2. Lightweight concrete may be used by applying a reduction factor as given in ACI 318-14 17.2.6 or ACI 318-11 Appendix D section D3.6 as applicable.
3. Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a results of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.
4. Characteristic bond strength values are for sustained loads (when noted), including dead and live loads.
5. K factor not listed for conditions where K = 1.0.
6. The tabulated value of ϕ applies when load combinations of Section 1605.2 of the IBC or ACI 318-14 5.3 (ACI 318-11 9.2), are used in accordance with 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 appropriate value of ϕ shall be determined in accordance with ACI 318 D.4.4.
7. The values of ϕ correspond to Condition B as described in 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.
8. The values of ϕ correspond to the anchor category as set forth in ACI 318-14 17.3.3 (ACI 318-11 D.4.3). The ϕ factor of 0.65 represents a Category 1, 0.55 a Category 2 and 0.45 a Category 3.

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TABLE 12: ULTRABOND HS-1CC **STEEL** design information for **REBAR**[1]

Design Information		Symbol	Units	Rebar Size #3	#4	#5	#6	#7	#8	#9	#10
Nominal Bar Diameter		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)	1.127 (28.6)	1.270 (32.3)
Rebar Cross-Sectional Area[2]		A_{se}	in.^{2} (mm^2)	0.110 (71)	0.200 (129)	0.310 (200)	0.440 (284)	0.600 (387)	0.790 (510)	1.000 (645)	1.270 (819)
ASTM A615 Grade 40	Nominal Strength as Governed by Steel Strength	N_{sa}	lb. (kN)	6,600 (29.4)	12,000 (53.4)	18,600 (82.7)	26,400 (117.4)	Grade 40 reinforcing bars are only available in sizes #3 through #6 per ASTM A615			
		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	0.74	0.78	0.82				
	Strength Reduction Factor for Tension[3]	ϕ	----	0.75							
	Strength Reduction Factor for Shear[3]	ϕ	----	0.65							
ASTM A706 Grade 60	Nominal Strength as Governed by Steel Strength	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 (451.9)
		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	0.74	0.78	0.82	0.73	0.63	0.53	0.42
	Strength Reduction Factor for Tension[3]	ϕ	----	0.75							
	Strength Reduction Factor for Shear[3]	ϕ	----	0.65							
ASTM A615 Grade 60	Nominal Strength as Governed by Steel Strength	N_{sa}	lb. (kN)	9,900 (44.0)	18,000 (80.1)	27,900 (124.1)	39,600 (176.1)	54,000 (240.2)	71,100 (316.3)	90,000 (400.3)	114,300 (508.4)
		V_{sa}	lb. (kN)	5,940 (26.4)	10,800 (48.0)	16,740 (74.5)	23,760 (105.7)	32,400 (144.1)	42,660 (189.8)	54,000 (240.2)	68,580 (305.1)
	Reduction Factor for Seismic Shear	$\alpha_{V,seis}$	----	0.70	0.74	0.78	0.82	0.73	0.63	0.53	0.42
	Strength Reduction Factor for Tension[4]	ϕ	----	0.65							
	Strength Reduction Factor for Shear[4]	ϕ	----	0.60							
ASTM A615 Grade 75	Nominal Strength as Governed by Steel Strength	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 (339.0)
	Reduction Factor for Seismic Shear	$\alpha_{V,seis}$	----	0.70	0.74	0.78	0.82	0.73	0.63	0.54	0.42
	Strength Reduction Factor for Tension[4]	ϕ	----	0.65							
	Strength Reduction Factor for Shear[4]	ϕ	----	0.60							

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

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 or ACI 318-11 Eq. (D-2) and Eq. (D-29), as applicable. Nuts and washers must be appropriate for the rod strength and type.
2. Cross-sectional area is minimum stress area applicable for either tension or shear
3. For use with load combinations of IBC Section 1605.2, ACI 318-14 5.3 or ACI 318-11 9.2, as applicable, as set forth in ACI 318-14 17.3.3 or ACI 318-11 D.4.3. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 D4.4. Values correspond to a ductile steel element.
4. For use with load combinations of IBC Section 1605.2, ACI 318-14 5.3 or ACI 318-11 9.2, as applicable, as set forth in ACI 318-14 17.3.3 or ACI 318-11 D.4.3. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 D4.4. Values correspond to a brittle steel element.

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TABLE 13: ULTRABOND HS-1CC **CONCRETE BREAKOUT** design information for **REBAR,** in holes drilled with a **HAMMER DRILL** and **CARBIDE BIT**

Design Information	Symbol	Units	Rebar Size							
			#3	#4	#5	#6	#7	#8	#9	#10
Minimum Embedment Depth	$h_{ef,min}$	in. (mm)	2 3/8 (60)	2 3/4 (70)	3 1/8 (79)	3 1/2 (89)	3 3/4 (95)	4 (102)	4 1/2 (114)	5 (127)
Maximum Embedment Depth	$h_{ef,max}$	in. (mm)	7 1/2 (191)	10 (254)	12 1/2 (318)	15 (381)	17 1/2 (445)	20 (508)	22 1/2 (572)	25 (635)
Effectiveness Factor Cracked Concrete	$k_{c,cr}$	---- SI	17 (7.1)							
Effectiveness Factor Uncracked Concrete	$k_{c,uncr}$	---- SI	24 (10)							
Minimum Spacing Distance	s_{min}	in. (mm)	$S_{min} = C_{min}$							
Minimum Edge Distance	c_{min}	in. (mm)	2 3/16 (56)	2 13/16 (71)	3 3/4 (95)	4 3/8 (111)	5 (127)	5 5/8 (143)	6 1/4 (159)	6 7/8 (175)
Minimum Concrete Thickness	h_{min}	in. (mm)	h_{ef} + 1.25 , [≥ 3.937] (h_{ef} + 30 , [≥ 100])	h_{ef} + 2d_0 where d_o is the hole diameter						
Critical Edge Distance (Uncracked Concrete Only)	c_{ac}	in.	$C_{ac} = h_{ef} \cdot \left(\frac{\min(\tau_{k,uncr};\tau_{k,\max})}{1160}\right)^{0.4} \cdot \max\left[\left(3.1 - 0.7\frac{h}{h_{ef}}\right);1.4\right]$							
		mm	$C_{ac} = h_{ef} \cdot \left(\frac{\min(\tau_{k,uncr};\tau_{k,\max})}{8}\right)^{0.4} \cdot \max\left[\left(3.1 - 0.7\frac{h}{h_{ef}}\right);1.4\right]$							
Strength Reduction Factor for Tension, Concrete Failure Mode, Condition B[1]	ϕ	----	0.65							
Strength Reduction Factor for Shear, Concrete Failure Mode, Condition B[1]	ϕ	----	0.70							

For **SI**: 1 inch = 25.4 mm, 1lbf = 4.448 N, 1 psi = 0.006897 MPa
For pound-inch units: 1 mm = 0.03937 inch, 1 N = 0.2248 lbf, 1MPa = 145.0 psi
1. Values provided for post-installed anchors with category as determined from ACI 355.4 given for Condition B. Condition B applies without supplementary reinforcement or where pullout (bond) or pryout govern, as set forth in ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, while condition A requires supplemental reinforcement. Values are for use with the load combinations Section 1605.2 of the IBC, ACI 318-14 5.3 or ACI 318-11 Section 9.2, as applicable, as set forth in ACI 318-11 D.4.3. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4.

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TABLE 14: ULTRABOND HS-1CC **BOND STRENGTH** design information for **REBAR** in holes drilled with a **HAMMER DRILL** and **CARBIDE BIT -** Maximum Long Term Service Temperature 110 °F (43 °C)[1,2,3,4]

<table>
<tr><th colspan="3" rowspan="2">Design Information</th><th rowspan="2">Symbol</th><th rowspan="2">Units</th><th colspan="8">Rebar Size</th></tr>
<tr><th>#3</th><th>#4</th><th>#5</th><th>#6</th><th>#7</th><th>#8</th><th>#9</th><th>#10</th></tr>
<tr><td colspan="3">Minimum Embedment Depth</td><td>$h_{ef,min}$</td><td>in.
(mm)</td><td>2 3/8
(60)</td><td>2 3/4
(70)</td><td>3 1/8
(79)</td><td>3 1/2
(89)</td><td>3 3/4
(95)</td><td>4
(102)</td><td>4 1/2
(114)</td><td>5
(127)</td></tr>
<tr><td colspan="3">Maximum Embedment Depth</td><td>$h_{ef,max}$</td><td>in.
(mm)</td><td>7 1/2
(191)</td><td>10
(254)</td><td>12 1/2
(318)</td><td>15
(381)</td><td>17 1/2
(445)</td><td>20
(508)</td><td>22 1/2
(572)</td><td>25
(635)</td></tr>
<tr><td rowspan="4">Maximum Short Term Temperature **150 °F** (66 °C)</td><td rowspan="2">Cracked Concrete Characteristic Bond Strength</td><td>With Sustained Load</td><td rowspan="2">$\tau_{k,cr}$</td><td>psi
(MPa)</td><td>1,450
(10.0)</td><td>1,420
(9.8)</td><td>1,400
(9.7)</td><td>1,365
(9.4)</td><td>1,295
(8.9)</td><td>1,230
(8.5)</td><td>1,160
(8.0)</td><td>1,080
(7.4)</td></tr>
<tr><td>No Sustained Load</td><td>psi
(MPa)</td><td>1,665
(11.5)</td><td>1,635
(11.3)</td><td>1,605
(11.1)</td><td>1,570
(10.8)</td><td>1,490
(10.3)</td><td>1,410
(9.7)</td><td>1,330
(9.2)</td><td>1,240
(8.5)</td></tr>
<tr><td rowspan="2">Uncracked Concrete Characteristic Bond Strength</td><td>With Sustained Load</td><td rowspan="2">$\tau_{k,uncr}$</td><td>psi
(MPa)</td><td>2,180
(15.0)</td><td>2,095
(14.4)</td><td>2,010
(13.9)</td><td>1,930
(13.3)</td><td>1,845
(12.7)</td><td>1,760
(12.1)</td><td>1,675
(11.5)</td><td>1,580
(10.9)</td></tr>
<tr><td>No Sustained Load</td><td>psi
(MPa)</td><td>2,505
(17.3)</td><td>2,405
(16.6)</td><td>2,310
(15.9)</td><td>2,215
(15.3)</td><td>2,120
(14.6)</td><td>2,020
(13.9)</td><td>1,925
(13.3)</td><td>1,815
(12.5)</td></tr>
<tr><td rowspan="4">Maximum Short Term Temperature **180 °F** (82 °C)</td><td rowspan="2">Cracked Concrete Characteristic Bond Strength</td><td>With Sustained Load</td><td rowspan="2">$\tau_{k,cr}$</td><td>psi
(MPa)</td><td>1,275
(8.8)</td><td>1,255
(8.7)</td><td>1,230
(8.5)</td><td>1,205
(8.3)</td><td>1,140
(7.9)</td><td>1,080
(7.4)</td><td>1,020
(7.0)</td><td>950
(6.6)</td></tr>
<tr><td>No Sustained Load</td><td>psi
(MPa)</td><td>1,465
(10.1)</td><td>1,440
(9.9)</td><td>1,415
(9.8)</td><td>1,380
(9.5)</td><td>1,310
(9.0)</td><td>1,240
(8.5)</td><td>1,170
(8.1)</td><td>1,090
(7.5)</td></tr>
<tr><td rowspan="2">Uncracked Concrete Characteristic Bond Strength</td><td>With Sustained Load</td><td rowspan="2">$\tau_{k,uncr}$</td><td>psi
(MPa)</td><td>1,920
(13.2)</td><td>1,845
(12.7)</td><td>1,770
(12.2)</td><td>1,700
(11.7)</td><td>1,625
(11.2)</td><td>1,550
(10.7)</td><td>1,475
(10.2)</td><td>1,390
(9.6)</td></tr>
<tr><td>No Sustained Load</td><td>psi
(MPa)</td><td>2,205
(15.2)</td><td>2,120
(14.6)</td><td>2,035
(14.0)</td><td>1,950
(13.4)</td><td>1,865
(12.9)</td><td>1,780
(12.3)</td><td>1,695
(11.7)</td><td>1,595
(11.0)</td></tr>
<tr><td rowspan="4">Maximum Short Term Temperature **205 °F** (96 °C)</td><td rowspan="2">Cracked Concrete Characteristic Bond Strength</td><td>With Sustained Load</td><td rowspan="2">$\tau_{k,cr}$</td><td>psi
(MPa)</td><td>545
(3.8)</td><td>535
(3.7)</td><td>525
(3.6)</td><td>515
(3.6)</td><td>485
(3.3)</td><td>460
(3.2)</td><td>435
(3.0)</td><td>405
(2.8)</td></tr>
<tr><td>No Sustained Load</td><td>psi
(MPa)</td><td>625
(4.3)</td><td>615
(4.2)</td><td>600
(4.1)</td><td>590
(4.1)</td><td>560
(3.9)</td><td>530
(3.7)</td><td>500
(3.4)</td><td>465
(3.2)</td></tr>
<tr><td rowspan="2">Uncracked Concrete Characteristic Bond Strength</td><td>With Sustained Load</td><td rowspan="2">$\tau_{k,uncr}$</td><td>psi
(MPa)</td><td>820
(5.7)</td><td>785
(5.4)</td><td>755
(5.2)</td><td>725
(5.0)</td><td>690
(4.8)</td><td>660
(4.6)</td><td>630
(4.3)</td><td>590
(4.1)</td></tr>
<tr><td>No Sustained Load</td><td>psi
(MPa)</td><td>940
(6.5)</td><td>905
(6.2)</td><td>865
(6.0)</td><td>830
(5.7)</td><td>795
(5.5)</td><td>760
(5.2)</td><td>720
(5.0)</td><td>680
(4.7)</td></tr>
<tr><td colspan="3">Reduction Factor - Seismic Tension[5]</td><td>$\alpha_{N,seis}$</td><td>----</td><td colspan="5">1</td><td colspan="2">0.97</td><td>0.96</td></tr>
<tr><td rowspan="6">Continuous Inspection</td><td rowspan="6">Strength Reduction Factors for Permissible Installation Conditions[6,7,8]</td><td>Dry Concrete</td><td>ϕ_d</td><td>----</td><td colspan="8">0.65</td></tr>
<tr><td>Water Saturated Concrete</td><td>ϕ_{ws}</td><td>----</td><td colspan="2">0.65</td><td colspan="6">0.55</td></tr>
<tr><td rowspan="2">Water-Filled Holes in Concrete</td><td>ϕ_{wf}</td><td>----</td><td colspan="5">0.55</td><td colspan="3">0.45</td></tr>
<tr><td>K_{wf}</td><td>----</td><td colspan="5">1.00</td><td>0.96</td><td>0.92</td><td>0.88</td></tr>
<tr><td>Underwater Holes in Concrete</td><td>ϕ_{uw}</td><td>----</td><td colspan="8">0.65</td></tr>
<tr></tr>
<tr><td rowspan="5">Periodic Inspection</td><td rowspan="5">Strength Reduction Factors for Permissible Installation Conditions[6,7,8]</td><td>Dry Concrete</td><td>ϕ_d</td><td>----</td><td colspan="8">0.65</td></tr>
<tr><td>Water Saturated Concrete</td><td>ϕ_{ws}</td><td>----</td><td colspan="2">0.55</td><td colspan="6">0.45</td></tr>
<tr><td rowspan="2">Water-Filled Holes in Concrete</td><td>ϕ_{wf}</td><td>----</td><td colspan="8">0.45</td></tr>
<tr><td>K_{wf}</td><td>----</td><td colspan="5">1.00</td><td>0.92</td><td>0.83</td><td>0.75</td></tr>
<tr><td>Underwater Holes in Concrete</td><td>ϕ_{uw}</td><td>----</td><td colspan="8">0.55</td></tr>
</table>

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

1. Characteristic bond strength values correspond to concrete compressive strength f'_c =2,500 psi (17.2 MPa). For uncracked concrete compressive strength f'_c between 2,500 psi (17.2 MPa) and 8,000 psi (55.2 MPa), the tabulated characteristic bond strength may be increased by a factor of $(f'_c/2{,}500)^{0.1}$ (for SI: $(f'_c/17.2)^{0.1}$). For cracked concrete, no increase in bond strength is permitted.
2. Lightweight concrete may be used by applying a reduction factor as given in ACI 318-14 17.2.6 or ACI 318-11 Appendix D section D3.6 as applicable.
3. Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a results of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.
4. Characteristic bond strength values are for sustained loads (when noted), including dead and live loads.
5. For structures in regions assigned to Seismic Design Category C, D, E, or F, the bond strength values shall be multiplied by $\alpha_{n,seis}$.
6. The tabulated value of ϕ applies when load combinations of Section 1605.2 of the IBC or ACI 318-14 5.3 (ACI 318-11 9.2), are used in accordance with 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 appropriate value of ϕ shall be determined in accordance with ACI 318 D.4.4.
7. The values of ϕ correspond to Condition B as described in 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.
8. The values of ϕ correspond to the anchor category as set forth in ACI 318-14 17.3.3 (ACI 318-11 D.4.3). The ϕ factor of 0.65 represents a Category 1, 0.55 a Category 2 and 0.45 a Category 3.

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SD STRENGTH DESIGN

TABLE 15: ULTRABOND HS-1CC **BOND STRENGTH** design information for **REBAR** in **CORE DRILLED HOLES -** Maximum Long Term Service Temperature 110 °F (43 °C)[1,2,3,4]

Design Information			Symbol	Units	Rebar Size						
					#4	#5	#6	#7	#8	#9	#10
Minimum Embedment Depth			$h_{ef,min}$	in. (mm)	2 3/4 (70)	3 1/8 (79)	3 1/2 (89)	3 3/4 (95)	4 (102)	4 1/2 (114)	5 (127)
Maximum Embedment Depth			$h_{ef,max}$	in. (mm)	10 (254)	12 1/2 (318)	15 (381)	17 1/2 (445)	20 (508)	22 1/2 (572)	25 (635)
Maximum Short Term Temperature **150 °F** (66 °C)	Uncracked Concrete Characteristic Bond Strength	With Sustained Load	$\tau_{k,uncr}$	psi (MPa)	1,535 (10.6)	1,490 (10.3)	1,380 (9.5)	1,270 (8.8)	1,160 (8.0)	1,045 (7.2)	920 (6.3)
		No Sustained Load		psi (MPa)	1,760 (12.1)	1,715 (11.8)	1,585 (10.9)	1,460 (10.1)	1,330 (9.2)	1,200 (8.3)	1,055 (7.3)
Maximum Short Term Temperature **180 °F** (82 °C)	Uncracked Concrete Characteristic Bond Strength	With Sustained Load	$\tau_{k,uncr}$	psi (MPa)	1,350 (9.3)	1,315 (9.1)	1,215 (8.4)	1,120 (7.7)	1,020 (7.0)	920 (6.3)	810 (5.6)
		No Sustained Load		psi (MPa)	1,550 (10.7)	1,510 (10.4)	1,395 (9.6)	1,285 (8.9)	1,170 (8.1)	1,060 (7.3)	930 (6.4)
Continuous Inspection	Strength Reduction Factors for Permissible Installation Conditions[5,6,7,8]	Dry Concrete	ϕ_d	----	0.65						
		Water Saturated Concrete	ϕ_{ws}	----	0.65						
Periodic Inspection	Strength Reduction Factors for Permissible Installation Conditions[5,6,7,8]	Dry Concrete	ϕ_d	----	0.65						
		Water Saturated Concrete	ϕ_{ws}	----	0.55						

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

1. Characteristic bond strength values correspond to concrete compressive strength f'_c =2,500 psi (17.2 MPa). For uncracked concrete compressive strength f'_c between 2,500 psi (17.2 MPa) and 8,000 psi (55.2 MPa), the tabulated characteristic bond strength may be increased by a factor of $(f'_c/2{,}500)^{0.1}$ (for SI: $(f'_c/17.2)^{0.1}$). For cracked concrete, no increase in bond strength is permitted.
2. Lightweight concrete may be used by applying a reduction factor as given in ACI 318-14 17.2.6 or ACI 318-11 Appendix D section D3.6 as applicable.
3. Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a results of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.
4. Characteristic bond strength values are for sustained loads (when noted), including dead and live loads.
5. *K* factor not listed for conditions where *K* = 1.0.
6. The tabulated value of ϕ applies when load combinations of Section 1605.2 of the IBC or ACI 318-14 5.3 (ACI 318-11 9.2), are used in accordance with 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 appropriate value of ϕ shall be determined in accordance with ACI 318 D.4.4.
7. The values of ϕ correspond to Condition B as described in 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.
8. The values of ϕ correspond to the anchor category as set forth in ACI 318-14 17.3.3 (ACI 318-11 D.4.3). The ϕ factor of 0.65 represents a Category 1, 0.55 a Category 2 and 0.45 a Category 3.

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SD STRENGTH DESIGN

TABLE 16: ULTRABOND HS-1CC **STEEL** design information for **POWER-SERT INTERNALLY THREADED INSERTS**[1]

Design Information		Symbol	Units	Insert Designation				
				PS2-38	PS2-12	PS2-58	PS2-34	PS2-1
Internal Thread Size (UNC)		d_t	in.-TPI	3/8 - 16	1/2-13	5/8 - 11	3/4 - 10	1 - 8
Nominal Anchor Diameter		d_a	in. (mm)	0.488 (12.4)	0.595 (15.1)	0.819 (20.8)	0.898 (22.8)	1.450 (36.8)
Cross-Sectional Area[2]		A_{se}	in.^{2} (mm^2)	0.102 (66)	0.135 (87)	0.302 (195)	0.385 (248)	0.785 (506)
Specified Tensile Strength		F_{uta}	psi (MPa)	64,000 (440)				
Carbon Steel Inserts (PS2)	Nominal Strength as Governed by Steel Strength	N_{sa}	lb. (kN)	6,525 (29.0)	8,670 (38.6)	19,320 (85.9)	24,630 (109.6)	50,265 (223.6)
		V_{sa}	lb. (kN)	3,915 (17.4)	5,200 (23.1)	11,595 (51.6)	14,780 (65.7)	30,160 (134.2)
	Strength Reduction Factor for Tension[3]	ϕ	----	0.75				
	Strength Reduction Factor for Shear[3]	ϕ	----	0.65				
Design Information		Symbol	Units	Insert Designation				
				PS6-38	PS6-12	PS6-58	PS6-34	PS6-1
Specified Tensile Strength		F_{uta}	psi (Mpa)	100,000 (690)		85,000 (590)		
316 Stainless Steel Inserts (PS6)	Nominal Strength as Governed by Steel Strength	N_{sa}	lb. (kN)	10,195 (45.3)	13,550 (60.3)	25,660 (114.1)	32,710 (145.5)	66,760 (297.0)
		V_{sa}	lb. (kN)	6,115 (27.2)	8,130 (36.2)	15,395 (68.5)	19,625 (87.3)	40,055 (178.2)
	Strength Reduction Factor for Tension[4]	ϕ	----	0.65				
	Strength Reduction Factor for Shear[4]	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 or ACI 318-11 Eq. (D-2) and Eq. (D-29), as applicable. Nuts and washers shall be appropriate for the rod strength and type.
2. Cross-sectional area is minimum stress area applicable for either tension or shear.
3. For use with load combinations of IBC Section 1605.2, ACI 318-14 5.3 or ACI 318-11 9.2, as applicable, as set forth in ACI 318-14 17.3.3 or ACI 318-11 D.4.3. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ shall be determined in accordance with ACI 318-11 D4.4. Values correspond to a ductile steel element.
4. For use with load combinations of IBC Section 1605.2, ACI 318-14 5.3 or ACI 318-11 9.2, as applicable, as set forth in ACI 318-14 17.3.3 or ACI 318-11 D.4.3. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ shall be determined in accordance with ACI 318-11 D4.4. Values correspond to a brittle steel element.

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SD STRENGTH DESIGN

TABLE 17: ULTRABOND HS-1CC **CONCRETE BREAKOUT** design information for **POWER-SERT INTERNALLY THREADED INSERTS**

Design Information	Symbol	Units	PS2-38 PS6-38	PS2-12 PS6-12	PS2-58 PS6-58	PS2-34 PS6-34	PS2-1 PS6-1
Internal Thread Size (UNC)	d_t	in.-TPI	3/8 - 16	1/2-13	5/8 - 11	3/4 - 10	1 - 8
Nominal Anchor Diameter	d_a	in. (mm)	0.488 (12.4)	0.595 (15.1)	0.819 (20.8)	0.898 (22.8)	1.450 (36.8)
Effective Embedment depth for Concrete Breakout	h_{ef}	in. (mm)	2.5 (64)	3.5 (89)	5.5 (140)	6.2 (157)	8.2 (208)
Minimum Nominal Embedment Depth	h_a	in. (mm)	2 3/4 (70)	3 11/16 (94)	5 3/4 (146)	6 1/2 (165)	8 1/2 (216)
Effectiveness Factor for Uncracked Concrete	$k_{c,uncr}$	In.-lb. SI	24 (10)				
Minimum Spacing Distance	s_{min}	in. (mm)	$S_{min} = C_{min}$				
Minimum Edge Distance	c_{min}	in. (mm)	2 1/2 (64)	3 1/8 (79)	4 3/8 (111)	5 (127)	7 1/2 (191)
Minimum Concrete Thickness	h_{min}	in. (mm)	4 1/2 (114)	5 3/8 (137)	8 (203)	9 1/2 (241)	12 1/2 (318)
Critical Edge Distance (Uncracked Concrete Only)	c_{ac}	in.	$C_{ac} = h_{ef} \cdot \left(\frac{\min(\tau_{k,uncr};\tau_{k,\max})}{1160}\right)^{0.4} \cdot \max\left[\left(3.1 - 0.7\frac{h}{h_{ef}}\right);1.4\right]$				
		mm	$C_{ac} = h_{ef} \cdot \left(\frac{\min(\tau_{k,uncr};\tau_{k,\max})}{8}\right)^{0.4} \cdot \max\left[\left(3.1 - 0.7\frac{h}{h_{ef}}\right);1.4\right]$				
Strength Reduction Factor for Tension, Concrete Failure Mode, Condition B[1]	ϕ	----	0.65				
Strength Reduction Factor for Shear, Concrete Failure Mode, Condition B[1]	ϕ	----	0.70				

For **SI**: 1 inch = 25.4 mm, 1lbf = 4.448 N, 1 psi = 0.006897 MPa
For pound-inch units: 1 mm = 0.03937 inch, 1 N = 0.2248 lbf, 1MPa = 145.0 psi
1. Values provided for post-installed anchors with category as determined from ACI 355.4 given for Condition B. Condition B applies without supplementary reinforcement or where pullout (bond) or pryout govern, as set forth in ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, while condition A requires supplemental reinforcement. Values are for use with the load combinations Section 1605.2 of the IBC, ACI 318-14 5.3 or ACI 318-11 Section 9.2, as applicable, as set forth in ACI 318-11 D.4.3. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4.

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TABLE 18: ULTRABOND HS-1CC **BOND STRENGTH** design information for **POWER-SERT INTERNALLY THREADED INSERT** in holes drilled with a **HAMMER DRILL** and **CARBIDE BIT** - Maximum Long Term Service Temperature 110 °F (43 °C)[1,2,3,4]

Design Information			Symbol	Units	PS2-38 PS6-38	PS2-12 PS6-12	PS2-58 PS6-58	PS2-34 PS6-34	PS2-1 PS6-1
Internal Thread Size (UNC)			d_t	in.-TPI	3/8 - 16	1/2 - 13	5/8 - 11	3/4 - 10	1 - 8
Anchor Diameter			d_a	in.	0.488	0.595	0.819	0.898	1.450
Drill Bit Diameter			d_o	in.	1/2	5/8	7/8	1	1 1/2
Recommended Drill Depth			h_{drill}	in. (mm)	3 1/4 (83)	4 1/8 (105)	6 1/4 (159)	7 1/2 (191)	9 1/2 (241)
Overall Anchor Length			h_a	in. (mm)	2 3/4 (70)	3 11/16 (94)	5 3/4 (146)	6 1/2 (165)	8 1/2 (216)
Bond Effective Embedment Depth			h_{ef}	in. (mm)	1.55 (39)	2.49 (63)	3.75 (95)	3.74 (95)	5.00 (127)
Maximum Short Term Loading Temperature **150 °F** (66 °C)	Uncracked Concrete Characteristic Bond Strength	With Sustained Load	$\tau_{k,uncr}$	psi (MPa)	2,410 (16.6)	2,325 (16.0)	2,150 (14.8)	2,090 (14.4)	1,655 (11.4)
		No Sustained Load		psi (MPa)	2,765 (19.1)	2,670 (18.4)	2,470 (17.0)	2,400 (16.5)	1,900 (13.1)
Maximum Short Term Loading Temperature **180 °F** (82 °C)	Uncracked Concrete Characteristic Bond Strength	With Sustained Load	$\tau_{k,uncr}$	psi (MPa)	2,120 (14.6)	2,045 (14.1)	1,895 (13.1)	1,840 (12.7)	1,460 (10.1)
		No Sustained Load		psi (MPa)	2,435 (16.8)	2,350 (16.2)	2,175 (15.0)	2,110 (14.5)	1,675 (11.5)
Maximum Short Term Loading Temperature **205 °F** (96 °C)	Uncracked Concrete Characteristic Bond Strength	With Sustained Load	$\tau_{k,uncr}$	psi (MPa)	905 (6.2)	870 (6.0)	805 (5.6)	785 (5.4)	620 (4.3)
		No Sustained Load		psi (MPa)	1,035 (7.1)	1,000 (6.9)	925 (6.4)	900 (6.2)	715 (4.9)
Continuous Inspection	Strength Reduction Factors for Permissible Installation Conditions[5,6,7]	Dry Concrete	ϕ_d	----	0.65				
		Water Saturated Concrete	ϕ_{ws}	----	0.65	0.55			
Periodic Inspection	Strength Reduction Factors for Permissible Installation Conditions[5,6,7]	Dry Concrete	ϕ_d	----	0.65				
		Water Saturated Concrete	ϕ_{ws}	----	0.55	0.45			

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

1. Characteristic bond strength values correspond to concrete compressive strength f'_c =2,500 psi (17.2 MPa). For uncracked concrete compressive strength f'_c between 2,500 psi (17.2 MPa) and 8,000 psi (55.2 MPa), the tabulated characteristic bond strength may be increased by a factor of $(f'_c/2,500)^{0.1}$ (for SI: $(f'_c/17.2)^{0.1}$).
2. Lightweight concrete may be used by applying a reduction factor as given in ACI 318-14 17.2.6 or ACI 318-11 Appendix D section D3.6 as applicable.
3. Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a results of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.
4. Characteristic bond strength values are for sustained loads (when noted), including dead and live loads.
5. The tabulated value of ϕ applies when load combinations of Section 1605.2 of the IBC or ACI 318-14 5.3 (ACI 318-11 9.2), are used in accordance with 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 appropriate value of ϕ shall be determined in accordance with ACI 318 D.4.4.
6. The values of ϕ correspond to Condition B as described in 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.
7. The values of ϕ correspond to the anchor category as set forth in ACI 318-14 17.3.3 (ACI 318-11 D.4.3). The ϕ factor of 0.65 represents a Category 1, 0.55 a Category 2 and 0.45 a Category 3.

Technical Data

ASD Allowable Stress Design

TABLE 19: ULTRABOND HS-1CC allowable **TENSION** loads for **THREADED ROD,** in holes drilled with a **HAMMER DRILL**, in normal-weight concrete[1]

Threaded Rod Diameter in.	Nominal Drill Bit Diameter in.	Embedment Depth in. (mm)	Allowable Tension Load Based on Bond Strength / Concrete Capacity[2,3] lbs. (kN) f'c ≥ 2,500 psi (17.4 MPa)	Allowable Tension Load Based on Steel Strength[4] ASTM F1554 Grade 36 lbs. (kN)	ASTM A193 Grade B7 lbs. (kN)	ASTM F593 304/316 SS lbs. (kN)
3/8	7/16	2 3/8 (60)	1,681 (7.5)	2,114 (9.4)	4,556 (20.3)	3,645 (16.2)
		3 3/8 (86)	2,655 (11.8)			
		4 1/2 (114)	3,858 (17.2)			
		7 1/2 (191)	7,838 (34.9)			
1/2	9/16	2 3/4 (70)	2,282 (10.2)	3,758 (16.7)	8,099 (36.0)	6,480 (28.8)
		4 1/2 (114)	4,329 (19.3)			
		6 (152)	6,292 (28.0)			
		10 (254)	12,266 (54.6)			
5/8	3/4	3 1/8 (79)	2,911 (13.0)	5,872 (26.1)	12,655 (56.3)	10,124 (45.0)
		5 5/8 (143)	6,326 (28.1)			
		7 1/2 (191)	9,195 (40.9)			
		12 1/2 (318)	17,863 (79.5)			
3/4	7/8	3 1/2 (86)	3,451 (13.7)	8,456 (37.6)	18,224 (81.1)	12,392 (55.1)
		6 3/4 (171)	8,625 (38.4)			
		9 (229)	12,536 (55.8)			
		15 (381)	24,354 (108.3)			
7/8	1	3 3/4 (95)	3,827 (17.0)	11,509 (51.2)	24,804 (110.3)	16,867 (75.0)
		7 7/8 (200)	11,209 (49.9)			
		10 1/2 (267)	16,292 (72.5)			
		17 1/2 (445)	31,650 (140.8)			
1	1 1/8	4 (102)	4,216 (18.8)	15,033 (66.9)	32,398 (144.1)	22,030 (98.0)
		9 (229)	14,065 (62.6)			
		12 (305)	20,444 (90.9)			
		20 (508)	39,716 (176.7)			
1 1/4	1 3/8	5 (127)	5,892 (26.2)	23,488 (104.5)	50,621 (225.2)	34,423 (153.1)
		11 1/4 (286)	19,887 (88.5)			
		15 (381)	29,875 (132.9)			
		25 (635)	58,038 (258.2)			

For **SI**: 1 inch = 25.4 mm, 1lbf = 4.448 N, 1 psi = 0.006897 MPa.
For pound-inch units: 1 mm = 0.03937 inch, 1 N = 0.2248 lbf, 1MPa = 145.0 psi
1. The lower value of either the allowable bond strength/concrete capacity or steel strength should be used as the allowable tension value for design.
2. Allowable tension loads calculated based on strength design provisions of IBC Section 1605.3 with the following assumptions: Maximum short term temperature = 150 °F (66 °C), Maximum long term temperature = 110 °F (43°C). Load combination from ACI based on 1.2D + 1.6L assuming dead load of 0.3 and live load of 0.7 giving a weighted average of 1.48. f'_c = 2,500 psi normal-weight uncracked concrete. Single anchor, drilled with either hammer drill or carbide bit, vertically down with periodic special inspection and no seismic loading. $\phi_d = 0.65$ for dry concrete, $C_{a1} \geq 1.5 \times h_{ef}$, $h_{min} \geq 1.5 \times C_{a1}$, $C_{a2} \geq 1.5 \times C_{a1}$. Load values based on characteristic uncracked bond strength with sustained load.
3. For short term temperature exposure greater than 150 °F (66 °C) and up to and including 180 °F (82 °C), apply a reduction factor of 0.88 to the allowable tension load. For short term temperature exposure greater than 180 °F (82 °C) and up to and including 205 °F (96 °C), apply a reduction factor of 0.375 to the allowable tension load.
4. Allowable steel strengths calculated in accordance with AISC Manual of Steel Construction: Tensile = $0.33 * F_u * A_{nom}$.

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ASD
ALLOWABLE STRESS DESIGN

TABLE 20: ULTRABOND HS-1CC allowable **SHEAR** loads for **THREADED ROD,** in holes drilled with **HAMMER DRILL**, in normal-weight concrete[1]

Threaded Rod Diameter in.	Nominal Drill Bit Diameter in.	Embedment Depth in. (mm)	Allowable Shear Load Based on Bond Strength / Concrete Capacity[2,3] lbs. (kN)	Allowable Shear Load Based on Steel Strength[4]		
			$f'_c \geq$ 2,500 psi (17.4 MPa)	ASTM F1554 Grade 36 lbs. (kN)	ASTM A193 Grade B7 lbs. (kN)	ASTM F593 304/316 SS lbs. (kN)
3/8	7/16	2 3/8 (60)	1,608 (7.2)	1,089 (4.8)	2,347 (10.4)	1,878 (8.4)
		3 3/8 (86)	3,140 (14.0)			
		4 1/2 (114)	5,006 (22.3)			
		7 1/2 (191)	11,272 (50.1)			
1/2	9/16	2 3/4 (70)	2,401 (10.7)	1,936 (8.6)	4,172 (18.6)	3,338 (14.8)
		4 1/2 (114)	5,780 (25.7)			
		6 (152)	9,152 (40.7)			
		10 (254)	20,407 (90.8)			
5/8	3/4	3 1/8 (79)	3,163 (14.1)	3,025 (13.5)	6,519 (29.0)	5,216 (23.2)
		5 5/8 (143)	9,071 (40.4)			
		7 1/2 (191)	14,349 (63.8)			
		12 1/2 (318)	31,958 (142.2)			
3/4	7/8	3 1/2 (86)	4,024 (13.7)	4,356 (19.4)	9,388 (41.8)	6,384 (28.4)
		6 3/4 (171)	12,832 (57.1)			
		9 (229)	20,286 (90.2)			
		15 (381)	45,142 (200.8)			
7/8	1	3 3/4 (95)	4,687 (20.8)	5,929 (26.4)	12,778 (56.8)	8,689 (38.7)
		7 7/8 (200)	16,205 (72.1)			
		10 1/2 (267)	25,605 (113.9)			
		17 1/2 (445)	56,946 (253.3)			
1	1 1/8	4 (102)	5,255 (23.4)	7,744 (34.4)	16,690 (74.2)	11,349 (50.5)
		9 (229)	19,830 (88.2)			
		12 (305)	31,323 (139.3)			
		20 (508)	69,631 (309.7)			
1 1/4	1 3/8	5 (127)	7,374 (32.8)	12,100 (53.8)	26,078 (116.0)	17,733 (78.9)
		11 1/4 (286)	27,774 (123.5)			
		15 (381)	43,852 (195.1)			
		25 (635)	97,421 (433.4)			

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

1. The lower value of either the allowable bond strength/concrete capacity or steel strength should be used as the allowable shear value for design.
2. Allowable shear loads calculated based on strength design provisions of IBC Section 1605.3 with the following assumptions: Maximum short term temperature = 150 °F (66 °C), Maximum long term temperature = 110 °F (43°C). Load combination from ACI based on 1.2D + 1.6L assuming dead load of 0.3 and live load of 0.7 giving a weighted average of 1.48. f'_c = 2,500 psi normal-weight uncracked concrete. Single anchor, drilled with either hammer drill or carbide bit, vertically down with periodic special inspection and no seismic loading. ϕ_d = 0.65 for dry concrete, $C_{a1} \geq 1.5 \times h_{ef}$, $h_{min} \geq 1.5 \times C_{a1}$, $C_{a2} \geq 1.5 \times C_{a1}$. Load values based on characteristic uncracked bond strength with sustained load.
3. For short term temperature exposure greater than 150 °F (66 °C) and up to and including 180 °F (82 °C), apply a reduction factor of 0.88 to the allowable tension load. For short term temperature exposure greater than 180 °F (82 °C) and up to and including 205 °F (96 °C), apply a reduction factor of 0.375 to the allowable tension load.
4. Allowable steel strengths calculated in accordance with AISC Manual of Steel Construction: Shear = $0.17 * F_u * A_{nom}$.

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Technical Data

ASD Allowable Stress Design

TABLE 21: ULTRABOND HS-1CC allowable **TENSION** loads for **REBAR,** in holes drilled with a **HAMMER DRILL**, in normal-weight concrete[1]

Rebar Size	Nominal Drill Bit Diameter in.	Embedment Depth in. (mm)	Allowable Tension Load Based on Bond Strength / Concrete Capacity[2,3] lbs. (kN)	Allowable Tension Load Based on Steel Strength[4]	
			$f'_c \geq$ 2,500 psi (17.4 MPa)	ASTM A615 Grade 60 lbs. (kN)	ASTM A615 Grade 75 lbs. (kN)
#3	1/2	2 3/8 (60)	1,805 (8.0)	2,640 (11.7)	3,300 (14.7)
		3 3/8 (86)	2,777 (12.4)		
		4 1/2 (114)	3,150 (14.0)		
		7 1/2 (191)	5,344 (23.8)		
#4	5/8	2 3/4 (70)	2,403 (10.7)	4,800 (21.4)	6,000 (26.7)
		4 1/2 (114)	4,431 (19.7)		
		6 (152)	5,071 (22.6)		
		10 (254)	8,308 (37.0)		
#5	3/4	3 1/8 (79)	2,911 (13.0)	7,440 (33.1)	9,300 (41.4)
		5 5/8 (143)	6,335 (28.2)		
		7 1/2 (191)	7,314 (32.5)		
		12 1/2 (318)	11,731 (52.2)		
#6	7/8	3 1/2 (89)	3,451 (15.4)	10,560 (47.0)	13,200 (58.7)
		6 3/4 (171)	8,449 (37.6)		
		9 (229)	9,842 (43.8)		
		15 (381)	15,591 (69.4)		
#7	1 1/8	3 3/4 (95)	3,827 (17.0)	14,400 (64.1)	18,000 (80.1)
		7 7/8 (200)	10,757 (47.8)		
		10 1/2 (267)	12,632 (56.2)		
		17 1/2 (445)	19,944 (88.7)		
#8	1 1/4	4 (102)	4,216 (18.8)	18,960 (84.3)	23,700 (105.4)
		9 (229)	13,205 (58.7)		
		12 (305)	15,642 (69.6)		
		20 (508)	24,864 (110.6)		
#9	1 3/8	4 1/2 (114)	5,031 (22.4)	24,000 (106.8)	30,000 (133.4)
		10 1/8 (257)	15,782 (70.2)		
		13 1/2 (343)	18,853 (83.9)		
		22 1/2 (572)	30,175 (134.2)		
#10	1 1/2	5 (127)	5,892 (26.2)	30,480 (135.6)	38,100 (169.5)
		11 1/4 (286)	18,395 (81.8)		
		15 (381)	22,192 (98.7)		
		25 (635)	35,807 (159.3)		

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

1. The lower value of either the allowable bond strength/concrete capacity or steel strength should be used as the allowable tension value for design.
2. Allowable tension loads calculated based on strength design provisions of IBC Section 1605.3 with the following assumptions: Maximum short term temperature = 150 °F (66 °C), Maximum long term temperature = 110 °F (43°C). Load combination from ACI based on 1.2D + 1.6L assuming dead load of 0.3 and live load of 0.7 giving a weighted average of 1.48. f'_c = 2,500 psi normal-weight uncracked concrete. Single anchor, drilled with either hammer drill or carbide bit, vertically down with periodic special inspection and no seismic loading. ϕ_d = 0.65 for dry concrete, $C_{a1} \geq 1.5 \times h_{ef}$, $h_{min} \geq 1.5 \times C_{a1}$, $C_{a2} \geq 1.5 \times C_{a1}$. Load values based on characteristic uncracked bond strength with sustained load.
3. For short term temperature exposure greater than 150 °F (66 °C) and up to and including 180 °F (82 °C), apply a reduction factor of 0.88 to the allowable tension load. For short term temperature exposure greater than 180 °F (82 °C) and up to and including 205 °F (96 °C), apply a reduction factor of 0.375 to the allowable tension load.
4. Allowable steel strengths calculated in accordance with AISC Manual of Steel Construction: Tensile = $0.33 * F_u * A_{nom}$.

Technical Data

ASD Allowable Stress Design

TABLE 22: ULTRABOND HS-1CC allowable **SHEAR** loads for **REBAR,** in holes drilled with a **HAMMER DRILL,** in normal-weight concrete[1]

Rebar Size	Nominal Drill Bit Diameter in.	Embedment Depth in. (mm)	Allowable Shear Load Based on Bond Strength / Concrete Capacity[2,3] lbs. (kN)	Allowable Shear Load Based on Steel Strength[4]	
			$f'_c \geq$ 2,500 psi (17.4 MPa)	ASTM A615 Grade 60 lbs. (kN)	ASTM A615 Grade 75 lbs. (kN)
#3	1/2	2 3/8 (60)	1,608 (7.2)	1,683 (7.5)	1,870 (8.3)
		3 3/8 (86)	3,140 (14.0)		
		4 1/2 (114)	3,915 (17.4)		
		7 1/2 (191)	5,290 (23.5)		
#4	5/8	2 3/4 (70)	2,401 (10.7)	3,060 (13.6)	3,400 (15.1)
		4 1/2 (114)	5,780 (25.7)		
		6 (152)	7,016 (31.2)		
		10 (254)	9,388 (41.8)		
#5	3/4	3 1/8 (79)	3,163 (14.1)	4,743 (21.1)	5,270 (23.4)
		5 5/8 (143)	9,071 (40.4)		
		7 1/2 (191)	10,776 (47.9)		
		12 1/2 (318)	14,400 (64.1)		
#6	7/8	3 1/2 (86)	4,024 (13.7)	6,732 (29.9)	7,480 (33.3)
		6 3/4 (171)	12,574 (55.9)		
		9 (229)	14,908 (66.3)		
		15 (381)	19,906 (88.5)		
#7	1 1/8	3 3/4 (95)	4,687 (20.8)	9,180 (40.8)	10,200 (45.4)
		7 7/8 (200)	15,546 (69.1)		
		10 1/2 (267)	18,423 (81.9)		
		17 1/2 (445)	24,584 (109.4)		
#8	1 1/4	4 (102)	5,255 (23.4)	12,087 (53.8)	13,430 (59.7)
		9 (229)	18,580 (82.6)		
		12 (305)	22,011 (97.9)		
		20 (508)	29,359 (130.6)		
#9	1 3/8	4 1/2 (114)	6,285 (28.0)	15,300 (68.1)	17,000 (75.6)
		10 1/8 (257)	21,655 (96.3)		
		13 1/2 (343)	25,648 (114.1)		
		22 1/2 (572)	34,197 (152.1)		
#10	1 1/2	5 (127)	7,374 (32.8)	19,431 (86.4)	21,590 (96.0)
		11 1/4 (286)	24,618 (109.5)		
		15 (381)	29,151 (129.7)		
		25 (635)	38,858 (172.8)		

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

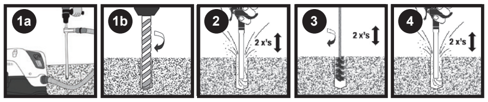
1. The lower value of either the allowable bond strength/concrete capacity or steel strength should be used as the allowable shear value for design.
2. Allowable shear loads calculated based on strength design provisions of IBC Section 1605.3 with the following assumptions: Maximum short term temperature = 150 °F (66 °C), Maximum long term temperature = 110 °F (43°C). Load combination from ACI based on 1.2D + 1.6L assuming dead load of 0.3 and live load of 0.7 giving a weighted average of 1.48. f'_c = 2,500 psi normal-weight uncracked concrete. Single anchor, drilled with either hammer drill or carbide bit, vertically down with periodic special inspection and no seismic loading. ϕ_d = 0.65 for dry concrete, $C_{a1} \geq 1.5 \times h_{ef}$, $h_{min} \geq 1.5 \times C_{a1}$, $C_{a2} \geq 1.5 \times C_{a1}$. Load values based on characteristic uncracked bond strength with sustained load.
3. For short term temperature exposure greater than 150 °F (66 °C) and up to and including 180 °F (82 °C), apply a reduction factor of 0.88 to the allowable tension load. For short term temperature exposure greater than 180 °F (82 °C) and up to and including 205 °F (96 °C), apply a reduction factor of 0.375 to the allowable tension load.
4. Allowable steel strengths calculated in accordance with AISC Manual of Steel Construction: Shear = $0.17 * F_u * A_{nom}$.

Revision 5.0

ULTRABOND® HS-1CC Adhesive Anchor Installation Instructions

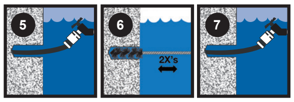
Installation Instructions

Drilling and Cleaning - Hammer Drilled Holes



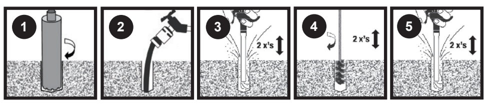
1a. Using a rotary hammer drill & properly connected hollow vacuum bit system, ensure vacuum is on and drill hole to specified diameter and depth. No other cleaning is necessary - go to step 8.
1b. If a rotary hammer drill and standard carbide bit is used, drill hole to specified diameter and depth, go to step 2. For submerged conditions, skip to step 5.
2. Remove standing water and blow out hole 2 cycles (2X) using oil free compressed air.
3. Brush for 2 cycles (2X) in up/down twisting motion.
4. Repeat step 2, then go to step 8.

Submerged Holes



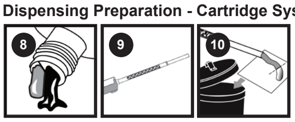
5. Flush hole with pressurized water until water flowing from hole is clean and free of debris.
6. Brush for 2 cycles (2X) in up/down twisting motion.
7. Repeat step 5, then go to step 8.

Drilling and Cleaning - Core Drilled Holes



1. Using a core drill bit, drill hole to specified diameter and depth and remove the core.
2. Flush hole with pressurized water until water flowing from hole is clean and free of debris.
3. Remove standing water & blow out hole two cycles (2X) using oil free compressed air.
4. Brush for 2 cycles (2X) in up/down twisting motion.
5. Repeat step 3, then go to step 8.

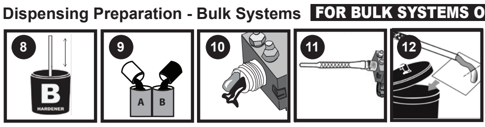
Dispensing Preparation - Cartridge Systems **FOR CARTRIDGE SYSTEMS ONLY**



(When using two-component bulk product skip to step 8 for BULK SYSTEMS)

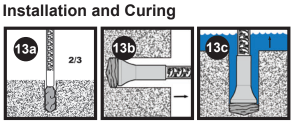
8. Remove protective cap, insert cartridge into recommended dispensing tool and balance until both components come out evenly.
9. Screw on proper, non-modified ATC mixing nozzle to cartridge.
10. Dispense and waste enough material to ensure uniform gray color before injecting into hole. For a new cartridge (or if working time has been exceeded), ensure cartridge opening is clean, install new nozzle and repeat steps 8 & 9. Go to step 13a.

Dispensing Preparation - Bulk Systems **FOR BULK SYSTEMS ONLY**

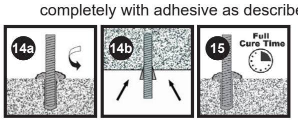


8. Epoxy materials may separate. This is normal and may be expected when stored over a period of time. Part A (Resin) should not be remixed. Part B (Hardener) should be remixed with a clean 5 gallon paint stick in a "butter churning" motion to homogenize the product.
9. Pour Resin into Side A pump reservoir then close lid on Side A. Only after separately mixing Part B, pour hardener into Side B reservoir then close lid on Side B. Follow bulk pump instructions for filling the metering pump and outlet assembly, then bleed the air from the system and fill the hose and applicator.
10. Balance the bulk pump machine following instructions in the Bulk Pump Operations Manual and test to ensure that it is dispensing the material on ratio (1:1).
11. Screw on the proper, non-modified ATC mixing nozzle onto the bulk pump wand.
12. Dispense and waste enough material to ensure uniform gray color before injecting into hole.

Installation and Curing



13a. Fill hole 2/3 full with adhesive starting at the bottom and withdraw as hole fills, using an extension tube as needed. Only fill hole 1/2 full when installing inserts.
13b. Use piston plugs for overhead and vertically inclined installations.
13c. If injecting in a water-filled hole, or underwater in a submerged condition, fill hole completely with adhesive as described in 13b.



14a. Fully insert clean threaded rod or rebar with slow turning motion to the bottom of the hole. For internally threaded inserts, thread a bolt into the insert and press it into the hole, finishing with hammer strikes until it is flush with the surface of the concrete.
14b. For horizontal, inclined or overhead installations, use wedges to support the anchor while curing.
15. Do not disturb, torque or apply load until full cure time has passed.

Reference Commentary

Drilling and Cleaning - Hammer Drilled Holes

Read and follow manufacturer's operations manual for the selected rotary drill.

R1a. Recommended hollow vacuum bit systems[1] for drilling dry & damp cracked and uncracked concrete. Drill bit should conform to ANSI B212.15. Once visual inspection confirms that hole is clean, proceed to step 8 for either Cartridge or Bulk Systems.

R1b. Traditional drilling method for drilling dry, water saturated and water-filled holes in cracked and uncracked concrete. Drill bit should conform to ANSI B212.15. **CAUTION:** Always wear appropriate personal protection equipment (PPE) for eyes, ears and skin to help avoid inhalation of dust during the drilling and cleaning process. Refer to the Safety Data Sheet (SDS) for details prior to proceeding.

R2. **BLOW (2X) – BRUSH (2X) – BLOW (2X)**. The compressed air wand should be inserted to the bottom of the hole, have a minimum pressure of 87 psi (6 bar) and be moved in an up/down motion to remove debris.

R3. Select the correct wire brush for the hole diameter, making sure it is long enough to reach the bottom of the drilled hole, using a brush extension if necessary. **CAUTION:** The brush should be clean and contact the walls of the hole. If it does not, the brush is either too worn or small and should be replaced with a new brush of the correct diameter.

R4. After final blow step is completed, visually inspect the hole to confirm it is clean. **NOTE:** If installation will be delayed for any reason, cover cleaned holes to prevent contamination. Proceed to step 8 for either Cartridge or Bulk Systems.

R5. For submerged (underwater) installations, **FLUSH – BRUSH (2X) – FLUSH**. Start at the bottom or back of the hole when flushing.

R6. Select the correct wire brush for the hole diameter, making sure it is long enough to reach the bottom of the drilled hole, using a brush extension if necessary. **CAUTION:** The brush should be clean and contact the walls of the hole. If it does not, the brush is either too worn or small and should be replaced with a new brush of the correct diameter.

R7. After final flush is completed, go to step 8 for either Cartridge or Bulk Systems.

[1]The Milwaukee 8-Gallon Dust Extractor vacuum-bit system is recommended by Adhesives Technology Corp.

Drilling and Cleaning - Core Drilled Holes

Read and follow manufacturer's operations manual for the selected core drill.

R1. Once hole is cored to the proper diameter and depth, remove center core and measure to ensure that specified embedment depth can be achieved. **CAUTION:** Always wear appropriate personal protection equipment (PPE) for eyes, ears and skin to help avoid inhalation of dust during the drilling and cleaning process. Refer to the Safety Data Sheet (SDS) for details prior to proceeding.

R2. **FLUSH – BLOW (2X) – BRUSH (2X) – BLOW (2X)**. Start at the bottom or back of the hole when flushing.

R3. The compressed air wand should be inserted to the bottom of the hole, have a minimum pressure of 87 psi (6 bar) and be moved in an up/down motion to remove debris.

R4. Select the correct wire brush for the hole diameter, making sure it is long enough to reach the bottom of the drilled hole, using a brush extension if necessary. **CAUTION:** The brush should be clean and contact the walls of the hole. If it does not, the brush is either too worn or small and should be replaced with a new brush of the correct diameter.

R5. After final blow step is completed, visually inspect the hole to confirm it is clean. **NOTE:** If installation will be delayed for any reason, cover cleaned holes to prevent contamination. Proceed to step 8 for either Cartridge or Bulk Systems.

Dispensing Preparation - Cartridge Systems **FOR CARTRIDGE SYSTEMS ONLY**

R8. **CAUTION:** Check the expiration date on the cartridge to ensure it is not expired. **Do not use expired product!** Shelf life of ULTRABOND HS-1CC is 24 months when stored at temperatures between 40 °F (4 °C) and 95 °F (35 °C). Before attaching mixing nozzle, balance the cartridge by dispensing a small amount of material until both components are flowing evenly. For a cleaner environment, hand mix the two components and let cure prior to disposal in accordance with local regulations.

R9. Do not modify mixing nozzle and confirm that internal mixing element is in place prior to dispensing adhesive. Take note of the air and base material temperatures and review the working/full cure time chart prior to starting the injection process.

R10. Test bead of mixed adhesive must be uniform in color and free of streaks, as adhesive must be properly mixed in order to perform as published. Dispose of the test bead according to federal, state and local regulations. **CAUTION:** When changing cartridges, never re-use nozzles and do not attempt to force adhesive out of a hardened mixing nozzle. Leave the mixing nozzle attached to the cartridge upon completion of work.

Dispensing Preparation - Bulk Systems **FOR BULK SYSTEMS ONLY**

The bulk pump uses a two-component delivery system whereby metering individual components and mixing of the two components are automatically controlled during dispensing through a metering manifold and disposable mixing nozzle. The bulk pump has a minimum input air pressure requirement of 80 - 90 psi @ 15 CFM, supplied through a regulator which reduces the pressure in order to control the rate of dispensing. The two individual adhesive components stay separate throughout the system, until they reach the specified disposable mixing nozzle via a manifold at the end of the bulk pump wand. Under normal operation, the bulk pump must be capable of dispensing the individual components at a 1:1 mix ratio by volume with a tolerance of ± 2%.

R8. **CAUTION:** Check the expiration dates on the bulk containers to ensure they are not expired. **Do not use expired product!** Shelf life of ULTRABOND HS-1CC is 24 months when stored at temperatures between 40 °F (4 °C) and 95 °F (35 °C). Mix Part B carefully to avoid whipping air into product.

R9. **NOTE: Review Bulk Pump Operations Manual thoroughly before proceeding and follow all steps necessary for set-up and operation of the pump**. Fill each reservoir (hopper) to at least one-half full. Incoming air supply pressure should be maintained at approximately 100 psi (6.9 bar).

R10. Be sure to establish proper flow of both materials at the applicator tip prior to attaching mixing nozzle. A ratio check should always be performed before installation begins to confirm that equal volumes of Part A and Part B are being dispensed. This check must be completed prior to attaching the mixing nozzle.

R11. Do not modify mixing nozzle and confirm that internal mixing element is in place prior to dispensing adhesive. Take note of the air and base material temperatures and review the working/full cure time chart prior to starting the injection process.

R12. Test bead of mixed adhesive must be uniform in color and free of streaks, as adhesive must be properly mixed in order to perform as published. Dispose of the test bead according to federal, state and local regulations. **CAUTION:** Never re-use nozzles and do not attempt to force adhesive out of a hardened mixing nozzle.

Installation and Curing

NOTE: Building Code Requirements for Structural Concrete (ACI 318-14 and later) requires the Installer to be certified where adhesive anchors are to be installed in horizontal to vertically inclined (overhead) installations. The engineering drawings must be followed. For all applications not covered by this document, or for all installation questions, please contact Adhesives Technology Corp.

R13a. Be careful not to withdraw the mixing nozzle too quickly as this may trap air in the adhesive. Extension tubing can be connected as needed onto the outside of the tip of both the small mixing nozzle (T12) and the large mixing nozzle (T34HF). **NOTE:** When using a pneumatic dispensing tool, ensure that pressure is set at 90 psi (6.2 bar) maximum.

R13b. Select the proper piston plug for the drill hole diameter. The piston plug fits directly onto the tip of both the small and large mixing nozzle. Extension tubing may also be used if needed in order to reach the bottom of the drill hole.

R13c. Be careful not to withdraw the mixing nozzle assembly too quickly as this may trap water in the adhesive. The piston plug should push itself out of the hole from the pressure of the injected adhesive.

R14a. Prior to inserting the threaded rod or rebar into the hole, make sure it is straight, clean and free of oil/dirt and that the necessary embedment depth is marked on the anchor element. Insert the anchor elements into the hole while turning 1 - 2 rotations prior to the anchor reaching the bottom of the hole. Excess adhesive should be visible on all sides of the fully installed rod or rebar, but may not be visible on all sides of the insert. **CAUTION:** Use extra care with deep embedment or high temperature installations to ensure that the working time has not elapsed prior to the anchor being fully installed. Adjustments to the anchor alignment may only performed during the published working time for a given temperature.

R14b. For overhead, horizontal and inclined (between horizontal and overhead), wedges should be used to support the anchor while the adhesive is curing. Take appropriate steps to protect the exposed threads of the anchor element from uncured adhesive until after the full cure time has elapsed.

R15. The amount of time needed to reach full cure is base material dependent. Refer to the chart for appropriate full cure time for a given temperature.

ULTRABOND® HS-1CC Adhesive Anchor Installation Instructions

INSTALLATION PARAMETERS FOR THREADED ROD AND REBAR

	Characteristic		Symbol	Units	Threaded Rod Diameter (inch)							
					3/8	1/2	5/8	3/4	7/8	1	N/A	1 1/4
					Rebar Size							
					#3	#4	#5	#6	#7	#8	#9	#10
Threaded Rod	Nominal Anchor Diameter		d_a	in.	0.375	0.500	0.625	0.750	0.875	1.000	N/A	1.250
	Drill Size		d_o	in.	7/16	9/16	3/4	7/8	1	1 1/8	N/A	1 3/8
	Brush Part #		----	----	B716	B916	B34	B78	B100	B118	N/A	B138
	Piston Plug Part #		----	----	PP716	PP916	PP34	PP78	PP100	PP118	N/A	PP138
	Piston Plug Color		----	----	Black[1]	Blue	Yellow	Green	Black	Orange	N/A	Brown
	Maximum Tightening Torque	A36/A307 Carbon Steel	$T_{inst,max}$	Ft-lb (N-m)	10 (14)	25 (34)	50 (68)	90 (122)	125 (169)	165 (224)	N/A	280 (380)
		A193 B7 Carbon Steel or F593 SS			16 (22)	33 (45)	60 (81)	105 (142)	125 (169)	165 (224)	N/A	280 (380)
Rebar	Nominal Bar Diameter		d_a	in.	0.375	0.500	0.625	0.750	0.875	1.000	1.127	1.270
	Drill Size		d_o	in.	1/2	5/8	3/4	7/8	1	1 1/8	1 3/8	1 1/2
	Brush Part #		----	----	B12	B58	B34	B78	B100	B118	B138	B112
	Piston Plug Part #		----	----	PP716	PP58	PP34	PP78	PP100	PP118	PP138	PP112
	Piston Plug Color		----	----	Black[1]	Red	Yellow	Green	Black	Orange	Brown	Gray
Brush Length			----	in.	6					9		

[1]Black nozzle adaptor with extension tubing for deep embedment depths in 7/16 and 1/2 inch hole diameters.

CONCRETE BREAKOUT DESIGN INFORMATION FOR THREADED ROD AND REBAR

Design Information	Symbol	Units	Threaded Rod Diameter (inch)							
			3/8	1/2	5/8	3/4	7/8	1	N/A	1 1/4
			Rebar Size							
			#3	#4	#5	#6	#7	#8	#9	#10
Minimum Embedment Depth	$h_{ef,min}$	in. (mm)	2 3/8 (60)	2 3/4 (70)	3 1/8 (79)	3 1/2 (89)	3 3/4 (95)	4 (102)	4 1/2 (114)	5 (127)
Maximum Embedment Depth	$h_{ef,max}$	in. (mm)	7 1/2 (191)	10 (254)	12 1/2 (318)	15 (381)	17 1/2 (445)	20 (508)	22 1/2 (572)	25 (635)
Minimum Spacing Distance	s_{min}	in. (mm)	2 3/16 (56)	2 13/16 (71)	3 3/4 (95)	4 3/8 (111)	5 (127)	5 5/8 (143)	6 1/4 (159)	6 7/8 (175)
Minimum Edge Distance	c_{min}	in. (mm)	2 3/16 (56)	2 13/16 (71)	3 3/4 (95)	4 3/8 (111)	5 (127)	5 5/8 (143)	6 1/4 (159)	6 7/8 (175)
Minimum Concrete Thickness	h_{min}	in. (mm)	h_{ef} + 1.25 , [≥ 3.937] (h_{ef} + 30 , [≥ 100])		h_{ef} + 2d_0 where d_o is the hole diameter					

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.

CONCRETE BREAKOUT DESIGN INFORMATION AND INSTALLATION PARAMETERS FOR INTERNALLY THREADED INSERTS

Design Information or Characteristic		Symbol	Units	Internally Threaded Insert				
Insert Part #		----	----	PS2-38 or PS6-38	PS2-12 or PS6-12	PS2-58 or PS6-58	PS2-34 or PS6-34	PS2-1 or PS6-1
Internal Thread Size (UNC)		d_t	in.-TPI	3/8" - 16	1/2" - 13	5/8" - 11	3/4" - 10	1" - 8
Drill Size		d_o	in.	1/2	5/8	7/8	1	1 1/2
Nominal Anchor Diameter		d_a	in. (mm)	0.488 (12.4)	0.595 (15.1)	0.819 (20.8)	0.898 (22.8)	1.450 (36.8)
Minimum Nominal Embedment Depth		$h_{ef,min}$	in. (mm)	2 3/4 (70)	3 11/16 (94)	5 3/4 (146)	6 1/2 (165)	8 1/2 (216)
Minimum Spacing Distance		c_{min}	in. (mm)	2 1/2 (64)	3 1/8 (79)	4 3/8 (111)	5 (127)	7 1/2 (191)
Minimum Edge Distance		c_{min}	in. (mm)	2 1/2 (64)	3 1/8 (79)	4 3/8 (111)	5 (127)	7 1/2 (191)
Minimum Concrete Thickness		h_{min}	in. (mm)	4 1/2 (114)	5 3/8 (137)	8 (203)	9 1/2 (241)	12 1/2 (318)
Maximum Tightening Torque	A36/A307 Carbon Steel	$T_{inst,max}$	Ft-lb (N-m)	10 (14)	25 (34)	50 (68)	90 (122)	165 (224)
	A193 B7 Carbon Steel or F593 SS			16 (22)	33 (45)	60 (81)	105 (142)	165 (224)
Brush Part #		----	----	B12	B58	B78	B100	B112
Piston Plug Part #		----	----	PP12	PP58	PP78	PP100	PP112
Piston Plug Color		----	----	Black[1]	Red	Green	Black	Gray
Brush Length		----	in.	6			9	

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]Black nozzle adaptor with extension tubing for deep embedment depths in 7/16 and 1/2 inch hole diameters.

CURE SCHEDULE[1,2,3]

Base Material Temperature °F (°C)	Working Time min	Full Cure Time hr
43 (6)	45	144
50 (10)	35	72
75 (24)	16	7
90 (32)	12	4
110 (43)	3	2

[1]Working and full cure times are approximate, may be linearly interpolated between listed temperatures and are based on cartridge/nozzle system performance.
[2]Application Temperature: Substrate and ambient air temperature should be between 43 - 110 °F (6 - 43 °C).
[3]When ambient or base material temperature falls below 70 °F (21 °C), condition the adhesive to 70 - 75 °F (21 - 24 °C) prior to use. A high flow mixing nozzle (T34HF) may also be used to ease dispensing at colder temperatures or to increase flow rate.

ADHESIVE DISPENSING TOOLS AND MIXING NOZZLES[1]

Package Size	8.6 fl.oz. (254 ml) Cartridge	21.2 fl. oz. (627 ml) Cartridge	53 fl. oz. (1.6 L) Cartridge	10 Gallon (38 L) Kit	
				Resin	Hardener
Part #	A9-HS1CC	A22-HS1CC	A53-HS1CC	B5G-HS1CC-A	B5G-HS1CC-B
Manual Dispensing Tool	TM9HD	TM22HD	----		
Pneumatic Dispensing Tool	----	TA22HD-A	TA53HD-A	AST Pump Model Number RMP 6624-1717	
Battery Tool		TB22HD-A	----		
Recommended Mixing Nozzle	T12 or T34HF			T34HF	
SDS Brush Adaptor	BR-SDS				
Brush Extension	BR-EXT				
Nozzle Extension Tubing	TUBE916-EXT				
Retention Wedge	WEDGE				

[1]Call for bulk packaging availability and lead times.

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