RED HEAD®

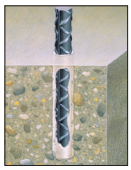
C6+

SUBMITTAL PACKAGE

VERSATILE ADHESIVE ANCHORS FOR
CONCRETE AND MASONRY APPLICATIONS

RED HEAD®
ADHESIVE ANCHORING SPECIALISTS

Adhesive Anchoring Selection Guide


Doweling into Concrete with Rebar


Fastening to Concrete with Threaded Rod

Solid Concrete Applications

PRODUCT SYSTEMS	KEY FEATURES	PROPERTIES	STRENGTH DESIGN PERFORMANCE[1]

A7+ *The Most Versatile Quick Cure*

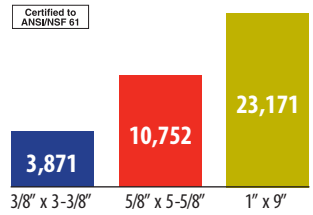
Works in more applications than the competition

5 fluid oz. (150 ml) kit, 9.5 fluid oz. (280 ml) and 28 fluid oz. (825 ml) cartridges

- The only quick-cure ICC-ES listed for use in all wet conditions
- Qualified for use in concrete, block, brick, and clay tile. Solid or hollow base materials
- Cures in only 45 minutes (at substrate temperature of 70°F/21°C)
- ICC-ES listing for cracked concrete and seismic applications (ICC-ES ESR 3903)
- ICC-ES listing for masonry applications (ICC-ES ESR 3951)
- No drip formula that allows direct-injection overhead installation
- 18 month shelf life
- NSF/ANSI 61

BASE MATERIAL (F°/C°)	GEL/WORKING TIME	FULL CURE TIME
110°/ 43°	1.5 minutes	45 minutes
90°/ 32°	3 minutes	45 minutes
70°/ 21°	5 minutes	45 minutes
50°/ 10°	15 minutes	90 minutes
30°/ -1°	35 minutes	4 hours
14°/ -10°	35 minutes	24 hours

NSF® Certified to ANSI/NSF 61



C6+ *For the Most Demanding Jobs*

Red Head's highest strength adhesive

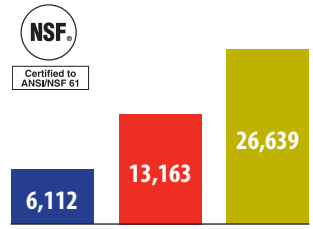
MADE IN USA WITH U.S. AND GLOBAL MATERIALS

15.2 fluid oz. (450 ml) cartridges and 30.4 fluid oz. (900 ml) cartridges

- At least 25% stronger than the old C6+ formulation for threaded rod in cracked concrete and with seismic conditions
- Fastest Cure time in its class, curing in just 2.75 hours at 90°F and in only 2 hours at 110°F!
- ICC-ES listing for concrete (uncracked and cracked concrete, and seismic conditions) and masonry
- ICC-ES listing for use in core-drill holes, even in cracked concrete
- Can be used in oversized holes
- Can be used in all wet conditions (saturated, water-filled, and submerged)
- European fire approval
- 24 month shelf life
- NSF/ANSI 61

BASE MATERIAL (F°/C°)	GEL/WORKING TIME	FULL CURE TIME
110°/ 43°	10 minutes	2 hours
90°/ 32°	14 minutes	2.75 hours
70°/ 21°	16 minutes	6.5 hours
50°/ 13°	30 minutes	24 hours
40°/ 7°	46 minutes	48 hours

NSF® Certified to ANSI/NSF 61



G5+ *Everyday Epoxy*

Economical general-purpose adhesive

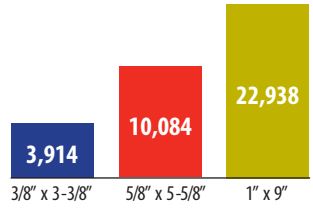
MADE IN USA WITH U.S. AND GLOBAL MATERIALS

15.2 fluid oz. (450 ml) cartridges and 30.4 fluid oz. (900 ml) cartridges

- At least 50% stronger than the old G5 formulation for threaded rod in cracked concrete and with seismic conditions
- Cures 3x faster than the old G5 formula
- Now works down to 40°F
- ICC-ES listing for concrete (uncracked and cracked concrete, and seismic conditions)
- Formulated for warm weather with at least 10 minutes of nozzle life
- Can be used in oversized holes
- Can be used in all wet conditions (saturated, water-filled, and submerged)
- 24 month shelf life
- NSF/ANSI 61

BASE MATERIAL (F°/C°)	GEL/WORKING TIME	FULL CURE TIME
110°/ 43°	10 minutes	4 hours
90°/ 32°	14 minutes	6 hours
70°/ 21°	16 minutes	8 hours
50°/ 13°	30 minutes	30 hours
40°/ 7°	46 minutes	48 hours

NSF® Certified to ANSI/NSF 61

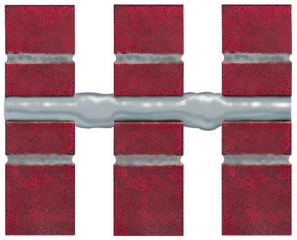


[1] Diameter x Embedment in 4000 psi concrete. All loads given in pounds. Calculated using the ICC-ES threaded rod data in uncracked, dry concrete with periodic inspection. Temperature range A.

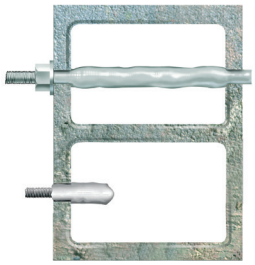
*Red head A7+ replaced Epcon A7 and S7. Red Head C6+ replaced Epcon C6+, and Red Head G5+ replaced Epcon G5. For more information on the retired adhesives (Epcon A7, S7, C6+ and G5), please visit www.itwredhead.com

Hollow Base Material Applications

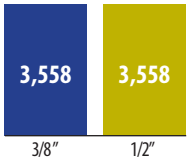
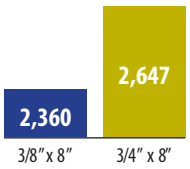
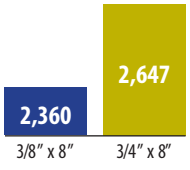
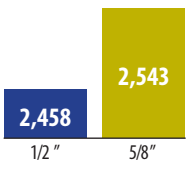
Use the following accessories with the A7+ adhesive anchoring system for all of your hollow base material applications.



Brick Pinning



Fastening to hollow concrete block

SYSTEM ACCESSORIES	KEY FEATURES	ULTIMATE TENSILE [1, 2] PERFORMANCE (LBS.)
Umbrella Anchor  Umbrella Anchor **Makes it possible to use adhesive for fastening to the face of hollow block or tile** (see page 53)	■ Highest hold in hollow block ■ 1/4", 3/8", or 1/2" rods ■ Fasten to front face of blocks ■ Creates large bearing surface inside block to achieve high loads	A7+ 
Nylon Screens  **Makes it possible to use adhesive for fastening to hollow block or brick walls** (see page 56)	■ 3/8" to 3/4" diameter sizes ■ 30%-50% lower cost than stainless screens ■ Special design makes screens easier to insert through block or brick ■ Does not get bent or crushed ■ Corrosion resistant	A7+ 
Stainless Steel Screens  **Makes it possible to use adhesive for fastening to hollow block or brick walls** (see page 56)	■ 1/4" & 3/4" diameter sizes ■ Corrosion resistant ■ Available in 1/4" thicknesses	A7+ 
Stubby Screens  **Makes it possible to use adhesive for fastening to the face of hollow block or tile** (see page 53)	■ 1/4", 3/8", 1/2", 5/8" diameter sizes ■ Fasten to front face of block ■ Anchor remains perpendicular in wall	A7+ 

[1] Testing performed in hollow concrete block. [2] Diameter x Embedment.

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RED HEAD®
ADHESIVE ANCHORING SPECIALISTS

C6+

For the Most Demanding Jobs

C6P-15 C6P-30

MADE IN USA WITH U.S. AND GLOBAL MATERIALS

DESCRIPTION

Maximum strength epoxy for your most heavy-duty and specialty applications

Red Head C6+ is the highest strength adhesive in our history. Designed for use in the most demanding anchoring applications, the maximum strength of Red Head C6+ is backed by ICC-ES (AC308, AC58) approvals for both concrete and masonry. It is also the only adhesive approved for core-drilled holes in cracked concrete without the use of a roughening tool.

- At least 25% stronger than the old Epcon C6+ formulation for threaded rod in cracked concrete with seismic conditions
- Fastest Cure time in its class, curing in just 2.75 hours at 90°F and in only 2 hours at 110°F!
- ICC-ES listing for cracked concrete and seismic applications (ICC-ES ESR 4046)
- ICC-ES listing for masonry applications (ICC-ES ESR 4109)
- ICC-ES listing for use in core-drill holes, even in cracked concrete
- ICC-ES approved for all wet conditions (including underwater)
- Rebar fire performance report in accordance with EAD (European Assessment Document)
- At least 10 minutes of nozzle life (Even at 110F!)
- Can be used down to 40°F and up to 110°F
- Can be used in oversized holes
- Buy American Compliant. Made in USA with U.S. and Global Materials
- Rugged cartridges resist breakage due to rough handling or cold temperatures
- 24-month shelf life
- Store between 50°F and 95°F in a cool, dry place.

ADVANTAGES

- The industry's first adhesive to be approved for use in core-drilled holes in cracked concrete without the need for a roughening tool
- Install Red Head C6+ and apply the load in the same work shift! (in 70F and above)
- Can be used in wet/damp/underwater applications
- More safe and durable on job sites than sausage packs
- Can use in both concrete and masonry substrates, including hollow and solid base materials

Cure and Gel Times

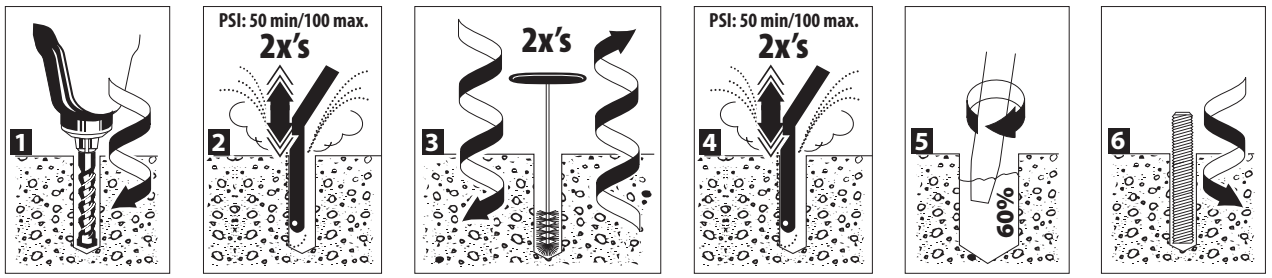
BASE MATERIAL (F°/C°)	GEL TIME[2]	FULL CURE TIME
110°/ 43°	10 minutes	2 hours
90°/ 32°	14 minutes	2.75 hours
70°/ 21°	16 minutes	6.5 hours
50°/ 10°	30 minutes	24 hours
40°/ 4.4°	46 minutes	48 hours

1 For concrete temperatures between 40-50°F adhesive must be maintained at a minimum of 50°F during installation.

2 Gel time is max time from the end of mixing to when the insertion of the threaded rod or rebar into the adhesive shall be completed.

C6+

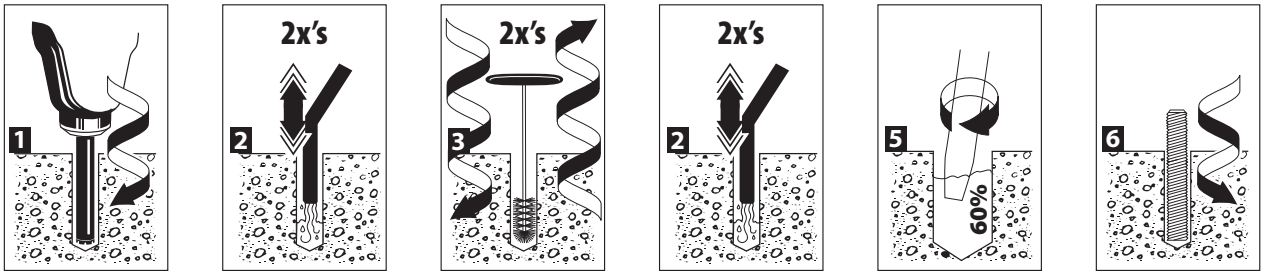
INSTALLATION STEPS *for Carbide-Tipped Bits*



* Damp, submerged and underwater applications require 4x's air, 4x's brushing and 4x's air

** Dust is shown for diagram purposes only. To help mitigate airborne dust and comply with OSHA requirements, we recommend that you either wet the concrete before blowing out the hole, or use a drill dust extractor with your pneumatic air nozzle. We recommend vacuum assisted dust extractors like Milwaukee part numbers 5261-DE or 5317-DE. Call our technical services at (800) 848-5611 for more information."

INSTALLATION STEPS *for Core-Drilled Holes*



Flush with water

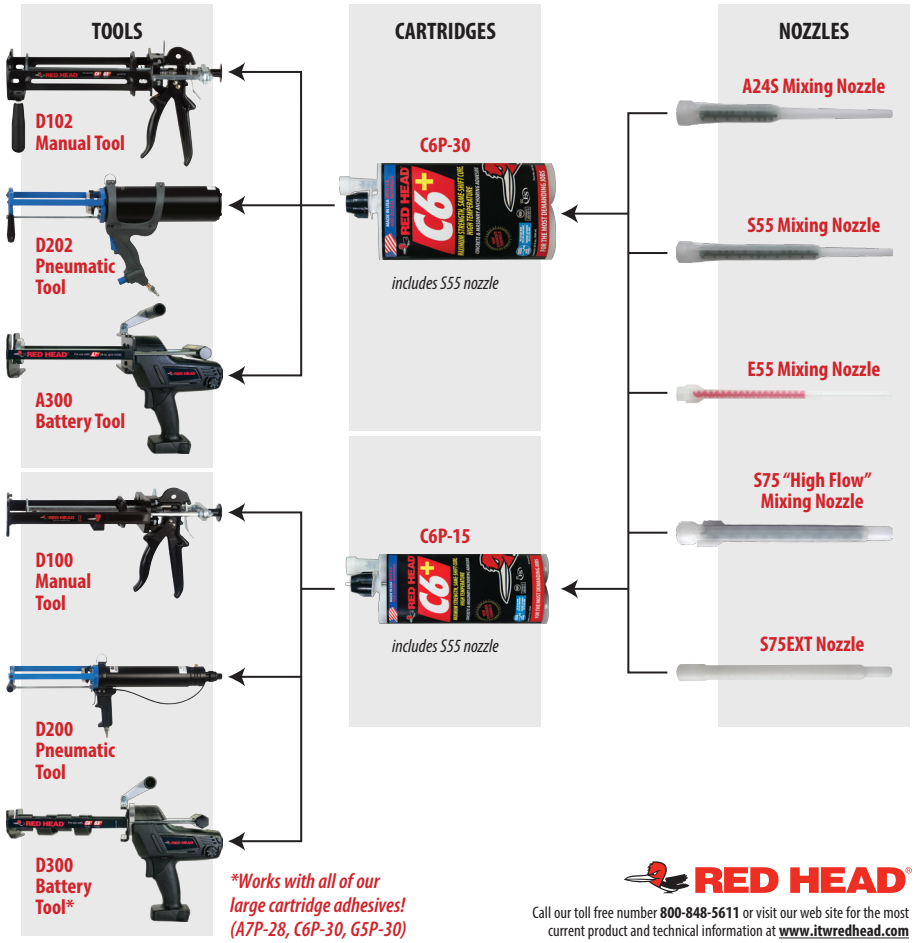
Flush with water & remove any standing water

APPROVALS/LISTINGS

- ICC-ES ESR 4046 (Concrete Report)
- ICC-ES ESR 4109 (Masonry Report)
- 2015, 2012, 2009, 2006 International Building Code (IBC) Compliant
- Florida Building Code (FBC)
- City of Los Angeles (COLA)
- Department of Transportation (DOT) Listings
- NSF/ANSI 61 Approval for use in Drinking Water System Components
- ASTM C881, Types I, II, IV, and V, Grade 3, Classes B & C
- Rebar fire performance report in accordance with EAD (European Assessment Document)

For the most current approvals/listings visit: www.ITW-RedHead.com

Selection Guide



**Works with all of our large cartridge adhesives! (A7P-28, C6P-30, G5P-30)*

RED HEAD

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C6P–30.4 fl. oz. Ordering Information

PART NUMBER	DESCRIPTION	BOX QTY
 C6P-30	30.4 Fluid Ounce Red Head C6+ Cartridge with S55 Nozzle	4
 D102	Heavy-Duty 34:1 thrust ratio hand dispenser for C6P-30 and G5P-30 cartridges	1
 S55	Standard Mixing Nozzle, fits holes for 3/8" diameter anchors and larger. 3-1/2" inch usable length for 3/8" and 1/2" anchors, 8-1/4" usable length for 5/8" anchors and above	24
 E55	Long Mixing Nozzle, fits holes for 3/8" diameter anchors and larger. 5-3/4" inch usable length for 3/8" and ½" anchors, 12-5/8" usable length for 5/8" anchors and above	24

PART NUMBER	DESCRIPTION	BOX QTY
 D202	Pneumatic Dispenser for C6P-30 and G5P-30 cartridges	1
 A300	Cordless Battery Dispenser for A7P-28, C6P-30 and G5P-30 Cartridge. Includes one battery and charger. Works with all Milwaukee® M18™ batteries (Contact Milwaukee® for more information on batteries)	1
 S75	High Flow Mixing Nozzle, fits holes for ¾" diameter anchors and larger. 7-3/8" usable length	24
S75EXT	Extension for High Flow Mixing Nozzle for ¾" diameter anchors and larger. 15-5/8" usable length when attached to S75	24

*See page 65 for nozzle extension tubes and other accessories

ESTIMATING TABLES

C6P-30
30.4 Fluid Ounce Cartridge

Number of Anchoring Installations Per Cartridge* Using Threaded Rod or Rebar with C6+ Adhesive in Solid Concrete

ANCHOR DIA.		DRILL HOLE DIA.	NUMBER OF ANCHORING INSTALLATIONS PER CARTRIDGE* USING THREADED ROD OR REBAR WITH C6+ ADHESIVE IN SOLID CONCRETE														
in.	# rebar	(in.)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
3/8	#3	7/16	608.9	304.5	203.0	152.2	121.8	101.5	87.0	76.1	67.7	60.9	55.4	50.7	46.8	43.5	40.6
1/2		9/16	368.3	184.2	122.8	92.1	73.7	61.4	52.6	46.0	40.9	36.8	33.5	30.7	28.3	26.3	24.6
	#4	5/8	298.4	149.2	99.5	74.6	59.7	49.7	42.6	37.3	33.2	29.8	27.1	24.9	23.0	21.3	19.9
5/8	#5	3/4	207.2	103.6	69.1	51.8	41.4	34.5	29.6	25.9	23.0	20.7	18.8	17.3	15.9	14.8	13.8
3/4	#6	7/8	152.2	76.1	50.7	38.1	30.4	25.4	21.7	19.0	16.9	15.2	13.8	12.7	11.7	10.9	10.1
7/8	#7	1	116.5	58.3	38.8	29.1	23.3	19.4	16.6	14.6	12.9	11.7	10.6	9.7	9.0	8.3	7.8
1	#8	1-1/8	92.1	46.0	30.7	23.0	18.4	15.3	13.2	11.5	10.2	9.2	8.4	7.7	7.1	6.6	6.1
	#9	1-1/4	74.6	37.3	24.9	18.6	14.9	12.4	10.7	9.3	8.3	7.5	6.8	6.2	5.7	5.3	5.0
1-1/4		1-3/8	61.6	30.8	20.5	15.4	12.3	10.3	8.8	7.7	6.8	6.2	5.6	5.1	4.7	4.4	4.1
	#10	1-1/2	51.8	25.9	17.3	12.9	10.4	8.6	7.4	6.5	5.8	5.2	4.7	4.3	4.0	3.7	3.5
1-1/2"		1-5/8"	44.1	22.1	14.7	11.0	8.8	7.4	6.3	5.5	4.9	4.4	4.0	3.7	3.4	3.2	2.9
	#11	1-3/4	38.1	19.0	12.7	9.5	7.6	6.3	5.4	4.8	4.2	3.8	3.5	3.2	2.9	2.7	2.5

*The estimated number of anchoring installations per cartridge is based upon calculations of filling the hole 60% full of adhesive per the recommendation in our installation instructions. Hole volumes are calculated using ANSI tolerance carbide tipped drill bits. These estimates do not account for any waste.

C6P–15 fl. oz. Ordering Information

PART NUMBER	DESCRIPTION	BOX QTY
 C6P-15	15.2 Fluid Ounce Red Head C6+ Cartridge with S55 Nozzle	4
 D100	Heavy-Duty 34:1 thrust ratio hand dispenser for C6P-15 and G5P-15 cartridges	1
S55	Standard Mixing Nozzle, fits holes for 3/8" diameter anchors and larger. 3-1/2" inch usable length for 3/8" and 1/2" anchors, 8-1/4" usable length for 5/8" anchors and above	24
 E55	Long Mixing Nozzle, fits holes for 3/8" diameter anchors and larger. 5-3/4" inch usable length for 3/8" and ½" anchors, 12-5/8" usable length for 5/8" anchors and above	24

PART NUMBER	DESCRIPTION	BOX QTY
 D200	Ergonomic Pneumatic Dispenser for C6P-15 and G5P-15 cartridges	1
 D300	Cordless Battery Dispenser for C6P-15 and G5P-15 Cartridge. Includes one battery and charger. Works with all Milwaukee® M18™ batteries	1
 S75	High Flow Mixing Nozzle, fits holes for ¾" diameter anchors and larger. 7-3/8" usable length	24
S75EXT	Extension for High Flow Mixing Nozzle for ¾" diameter anchors and larger. 15-5/8" usable length when attached to S75	24

*See page 65 for nozzle extension tubes and other accessories

ESTIMATING TABLES

C6P-15
15.2 Fluid Ounce Cartridge

Number of Anchoring Installations Per Cartridge* Using Threaded Rod or Rebar with C6+ Adhesive in Solid Concrete

ANCHOR DIA. in.	ANCHOR DIA. # rebar	DRILL HOLE DIA. (in.)	EMBEDMENT DEPTH IN INCHES 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
3/8	#3	7/16	304.5	152.2	101.5	76.1	60.9	50.7	43.5	38.1	33.8	30.4	27.7	25.4	23.4	21.7	20.3
1/2		9/16	184.2	92.1	61.4	46.0	36.8	30.7	26.3	23.0	20.5	18.4	16.7	15.3	14.2	13.2	12.3
	#4	5/8	149.2	74.6	49.7	37.3	29.8	24.9	21.3	18.6	16.6	14.9	13.6	12.4	11.5	10.7	9.9
5/8	#5	3/4	103.6	51.8	34.5	25.9	20.7	17.3	14.8	12.9	11.5	10.4	9.4	8.6	8.0	7.4	6.9
3/4	#6	7/8	76.1	38.1	25.4	19.0	15.2	12.7	10.9	9.5	8.5	7.6	6.9	6.3	5.9	5.4	5.1
7/8	#7	1	58.3	29.1	19.4	14.6	11.7	9.7	8.3	7.3	6.5	5.8	5.3	4.9	4.5	4.2	3.9
1	#8	1-1/8	46.0	23.0	15.3	11.5	9.2	7.7	6.6	5.8	5.1	4.6	4.2	3.8	3.5	3.3	3.1
	#9	1-1/4	37.3	18.6	12.4	9.3	7.5	6.2	5.3	4.7	4.1	3.7	3.4	3.1	2.9	2.7	2.5
1-1/4		1-3/8	30.8	15.4	10.3	7.7	6.2	5.1	4.4	3.9	3.4	3.1	2.8	2.6	2.4	2.2	2.1
	#10	1-1/2	25.9	12.9	8.6	6.5	5.2	4.3	3.7	3.2	2.9	2.6	2.4	2.2	2.0	1.8	1.7
1-1/2"		1-5/8"	22.1	11.0	7.4	5.5	4.4	3.7	3.2	2.8	2.5	2.2	2.0	1.8	1.7	1.6	1.5
	#11	1-3/4	19.0	9.5	6.3	4.8	3.8	3.2	2.7	2.4	2.1	1.9	1.7	1.6	1.5	1.4	1.3

*The estimated number of anchoring installations per cartridge is based upon calculations of filling the hole 60% full of adhesive per the recommendation in our installation instructions. Hole volumes are calculated using ANSI tolerance carbide tipped drill bits. These estimates do not account for any waste.

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ALLOWABLE STRESS DESIGN

C6+
For the Most Demanding Jobs

Average Ultimate Tension and Shear Loads[1,2,3] for Threaded Rod Installed in Solid Concrete

THREADED ROD DIA. (in.)	EMBEDMENT IN CONCRETE (in.)	MAX. CLAMPING FORCE AFTER PROPER CURE ft./lbs.	ULTIMATE TENSION (lbs.)			ULTIMATE SHEAR (lbs.)
			3,000 PSI CONCRETE	5,000 PSI CONCRETE	7,000 PSI CONCRETE	3,000 PSI CONCRETE & HIGHER
3/8	1-1/2	9	3,160	3,785	4,405	N/A
	3-3/8		11,640	12,315	12,985	5,200
1/2	2	16	6,075	7,015	7,950	N/A
	4-1/2		20,005	23,305	26,605	11,420
5/8	2-1/2	47	8,570	9,995	11,420	N/A
	5-5/8		24,905	29,015	33,125	18,300
3/4	3	70	12,030	13,570	15,105	N/A
	6-3/4		36,645	42,695	48,740	25,720
7/8	3-1/2	90	15,005	17,335	19,660	N/A
	7-7/8		55,575	70,338	85,100	32,120
1	4	110	17,735	20,390	23,045	N/A
	9		62,250	73,850	85,450	38,520
1-1/4	5	370	34,695	36,935	39,170	N/A
	11-1/4		77,815	90,655	103,495	65,080
1-1/2	13	450	101,085	117,765	134,445	N/A

1. Allowable working loads for the single installations under static loading should not exceed 25% capacity of the ultimate load (to get the allowable load of the anchor rod, divide the ultimate load by 4).
2. Performance values are based on the use of high strength threaded rod (ASTM A193 Gr. B7). The use of lower strength rods will result in lower ultimate tension and shear loads.
3. Linear interpolation may be used for intermediate spacing and edge distances.

ALLOWABLE STRESS DESIGN

C6+
For the Most Demanding Jobs

Allowable Tension Loads[1] for Threaded Rod Installed In Solid Concrete

THREADED ROD DIA in.	EMBEDMENT IN CONCRETE in.	ALLOWABLE TENSION LOAD BASED ON CONCRETE STRENGTH (lbs.)			ALLOWABLE TENSION LOAD BASED ON STEEL STRENGTH (lbs.)		
		3,000 psi concrete	5,000 psi concrete	7,000 psi concrete	ASTM A307	ASTM A193 GRADE B7	ASTM F593 AISI 304 SS
3/8	1-1/2	790	945	1,100	2,080	4,340	3,995
	3-3/8	2,910	3,080	3,245	2,080	4,340	3,995
1/2	2	1,520	1,755	1,990	3,730	7,780	7,155
	4-1/2	5,000	5,825	6,650	3,730	7,780	7,155
5/8	2-1/2	2,145	2,500	2,855	5,870	12,230	11,250
	5-5/8	6,225	7,255	8,280	5,870	12,230	11,250
3/4	3	3,010	3,395	3,775	8,490	17,690	14,860
	6-3/4	9,160	10,675	12,185	8,490	17,690	14,860
7/8	3-1/2	3,750	4,335	4,915	11,600	25,510	20,835
	7-7/8	13,895	17,585	21,275	11,600	25,510	20,835
1	4	4,435	5,100	5,760	15,180	31,620	26,560
	9	15,565	18,465	21,365	15,180	31,620	26,560
1-1/4	5	8,675	9,235	9,795	23,800	49,580	34,670
	11-1/4	19,455	22,665	25,875	23,800	49,580	34,670
1-1/2	13	25,270	29,440	33,610	33,720	70,250	47,770

1. Use lower value of either bond or steel strength for allowable tension load.

ALLOWABLE STRESS DESIGN

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Allowable Shear Loads[1] for Threaded Rod Installed in Solid Concrete

THREADED ROD DIA. (in.)	EMBEDMENT IN CONCRETE (in.)	ALLOWABLE SHEAR LOAD BASED ON CONCRETE STRENGTH (lbs.)	ALLOWABLE SHEAR LOAD BASED ON STEEL STRENGTH (lbs.)		
		3,000 psi concrete & higher	ASTM A307	ASTM A193 GRADE B7	ASTM F593 AISI 304 SS
3/8	1-1/2 3-3/8	N/A 1,300	1,040 1,040	2,170 2,170	1,995 1,995
1/2	2 4-1/2	N/A 2,855	1,870 1,870	3,895 3,895	3,585 3,585
5/8	2-1/2 5-5/8	N/A 4,575	2,940 2,940	6,125 6,125	5,635 5,635
3/4	3 6-3/4	N/A 6,430	4,250 4,250	8,855 8,855	7,440 7,440
7/8	3-1/2 7-7/8	N/A 8,030	5,800 5,800	12,760 12,760	10,730 10,730
1	4 9	N/A 9,630	7,590 7,590	15,810 15,810	13,285 13,285
1-1/4	5 11-1/4	N/A 16,270	11,900 11,900	24,790 24,790	18,840 18,840

1. Use lower value of either concrete or steel strength for allowable shear load.

ALLOWABLE STRESS DESIGN

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Average Ultimate Tension Loads[1,2,3] for Reinforcing Bar Installed In Solid Concrete

REINFORCING BAR	EMBEDMENT IN CONCRETE (in.)	ULTIMATE TENSION (lbs.)			ULTIMATE YIELD STRENGTH GRADE 60 REBAR (lbs.)	ULTIMATE TENSILE STRENGTH GRADE 60 REBAR (lbs.)
		3,000 psi concrete	5,000 psi concrete	7,000 psi concrete		
#3	1-1/2	3,160	3,785	4,405	6,600	9,900
	3-3/8	11,640	12,315	12,985		
#4	2	6,075	7,015	7,950	12,000	18,000
	4-1/2	20,005	23,305	26,605		
#5	2-1/2	8,570	9,995	11,420	18,600	27,900
	5-5/8	24,905	29,015	33,125		
#6	3	12,030	13,570	15,105	26,400	39,600
	6-3/4	36,645	42,695	48,740		
#7	3-1/2	15,005	17,335	19,660	36,000	54,000
	7-7/8	55,575	70,338	85,100		
#8	4	17,735	20,390	23,045	47,400	71,100
	9	62,250	73,850	85,450		
#10	5	34,695	36,935	39,170	79,200	114,300
	11-1/4	77,815	90,655	103,495		
#11	13	101,085	117,764	134,443	93,600	140,400

1. Allowable working loads for the single installations under static loading should not exceed 25% capacity of the ultimate load (to get the allowable load of the anchor rod, divide the ultimate load by 4).
2. Performance values are based on the use of ASTM A615 Grade 60 reinforcing bar. The use of lower strength rebar will result in lower ultimate tension loads
3. SHEAR DATA: Provided the distance from the rebar to the edge of the concrete member exceeds 1.25 times the embedment depth of the rebar, calculate the ultimate shear load for the rebar anchorage as 60% of the ultimate tensile strength of the rebar.

ALLOWABLE STRESS DESIGN

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Adhesive Edge/Spacing Distance Load Factor Summary for Installation of Threaded Rod and Reinforcing Bar [1,2]

LOAD FACTOR	DISTANCE FROM EDGE OF CONCRETE
Critical Edge Distance—Tension	
100% Tension Load	→ 1.25 x Anchor Embedment (or greater)
Minimum Edge Distance—Tension	
70% Tension Load	→ 0.50 x Anchor Embedment
Critical Edge Distance—Shear	
100% Shear Load	→ 1.25 x Anchor Embedment (or greater)
Minimum Edge Distance—Shear	
30% Shear Load	→ 0.30 x Anchor Embedment

LOAD FACTOR	DISTANCE FROM ANOTHER ANCHOR
Critical Spacing—Tension	
100% Tension Load	→ 1.50 x Anchor Embedment (or greater)
Minimum Spacing—Tension	
75% Tension Load	→ 0.75 x Anchor Embedment
Critical Spacing—Shear	
100% Shear Load	→ 1.50 x Anchor Embedment (or greater)
Minimum Spacing—Shear	
30% Shear Load	→ 0.50 x Anchor Embedment

1 Use linear interpolation for load factors at edge distances or spacing distances between critical and minimum.
2 Anchors are affected by multiple combination of spacing and/or edge distance loading and direction of the loading. Use the product of tension and shear loading factors in design.

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Tension (lbf) and Shear (lbf) in Uncracked Concrete with ASTM A193 B7 Threaded Rod[1,2,3,4]

ANCHOR DIAMETER (in.)	EMBEDMENT DEPTH (in.)	TENSION (lbf) 2500 psi	3000 psi	4000 psi	5000 psi	6000 psi	7000-8000 psi	SHEAR (lbf) 2500-8000 psi
3/8	3 3/8	4,835	5,295	6,115	6,380	6,380	6,380	3,775
	4 1/2	7,265	7,265	7,265	7,265	7,265	7,265	3,775
	7 1/2	7,265	7,265	7,265	7,265	7,265	7,265	3,775
1/2	4 1/2	7,445	8,155	9,415	10,530	10,980	10,980	6,915
	6	11,460	12,555	13,305	13,305	13,305	13,305	6,915
	10	13,305	13,305	13,305	13,305	13,305	13,305	6,915
5/8	5 5/8	10,405	11,395	13,160	14,715	16,120	16,615	11,015
	7 1/2	16,020	17,550	20,265	21,185	21,185	21,185	11,015
	12 1/2	21,185	21,185	21,185	21,185	21,185	21,185	11,015
3/4	6 3/4	13,675	14,980	17,300	19,345	19,590	19,590	16,305
	9	21,060	23,070	26,125	26,125	26,125	26,125	16,305
	15	31,355	31,355	31,355	31,355	31,355	31,355	16,305
7/8	7 7/8	17,235	18,880	21,800	24,375	25,715	25,715	22,505
	10 1/2	26,535	29,070	33,565	34,285	34,285	34,285	22,505
	17 1/2	43,280	43,280	43,280	43,280	43,280	43,280	22,505
1	9	21,060	23,070	26,635	29,780	32,420	32,420	29,525
	12	32,420	35,515	41,010	43,230	43,230	43,230	29,525
	20	56,780	56,780	56,780	56,780	56,780	56,780	29,525
1 1/4	11 1/4	29,430	32,240	37,225	41,620	45,595	46,895	47,240
	15	45,310	49,635	57,315	62,525	62,525	62,525	47,240
	25	90,855	90,855	90,855	90,855	90,855	90,855	47,240

1. Tabulated values are for estimation purposes only and should not be used for design (please use our free TruSpec anchorage design software at www.ITW-redhead.com)
2. Tabulated values represent strength design per ACI 318 for a single anchor in adequate concrete thickness, not near an edge nor adjacent anchorage, and not for sustained loading.
3. Bond strengths are for dry, uncracked concrete with periodic inspection
4. Bond strengths are for Temperature Range A (maximum long term temperature of 110F, maximum short term temperature of 142F).

STRENGTH DESIGN

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Tension (lbf) and Shear (lbf) in 4,000 psi Uncracked Concrete by Threaded Rod Type[1,2,3,4]

ANCHOR DIAMETER (in.)	EMBEDMENT DEPTH (in.)	ASTM A193 B7 THREAD ROD		CARBON STEEL A36		STAINLESS STEEL F593	
		TENSION (lbf)	SHEAR (lbf)	TENSION (lbf)	SHEAR (lbf)	TENSION (lbf)	SHEAR (lbf)
3/8	3 3/8	6,115	3,775	3,375	1,755	4,785	2,280
	4 1/2	7,265	3,775	3,375	1,755	4,785	2,280
	7 1/2	7,265	3,775	3,375	1,755	4,785	2,280
1/2	4 1/2	9,415	6,915	6,170	3,210	8,760	4,040
	6	13,305	6,915	6,170	3,210	8,760	4,040
	10	13,305	6,915	6,170	3,210	8,760	4,040
5/8	5 5/8	13,160	11,015	9,830	5,115	13,160	6,440
	7 1/2	20,265	11,015	9,830	5,115	13,955	6,440
	12 1/2	21,185	11,015	9,830	5,115	13,955	6,440
3/4	6 3/4	17,300	16,305	14,550	7,565	16,500	7,610
	9	26,125	16,305	14,550	7,565	16,500	7,610
	15	31,355	16,305	14,550	7,565	16,500	7,610
7/8	7 7/8	21,800	22,505	20,085	10,445	21,800	10,530
	10 1/2	33,565	22,505	20,085	10,445	22,820	10,530
	17 1/2	43,280	22,505	20,085	10,445	22,820	10,530
1	9	26,635	29,525	26,345	13,700	26,635	13,815
	12	41,010	29,525	26,345	13,700	29,935	13,815
	20	56,780	29,525	26,345	13,700	29,935	13,815
1 1/4	11 1/4	37,225	47,240	37,225	21,920	37,225	22,090
	15	57,315	47,240	42,155	21,920	47,865	22,090
	25	90,855	47,240	42,155	21,920	47,865	22,090

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2. Tabulated values represent strength design per ACI 318 for a single anchor in adequate concrete thickness, not near an edge nor adjacent anchorage, and not for sustained loading.
3. Bond strengths are for dry, uncracked concrete with periodic inspection
4. Bond strengths are for Temperature Range A (maximum long term temperature of 110F, maximum short term temperature of 142F).

C6+ For the Most Demanding Jobs

Tension (lbf) and Shear (lbf) in Cracked Concrete with ASTM A193 B7 Threaded Rod[1,2,3,4]

ANCHOR DIAMETER (in.)	EMBEDMENT DEPTH (in.)	TENSION (lbf) 2500 psi	3000 psi	4000 psi	5000 psi	6000 psi	7000-8000 psi	SHEAR (lbf) 2500-8000 psi
3/8	3 3/8	2,905	2,905	2,905	2,905	2,905	2,905	3,775
	4 1/2	3,875	3,875	3,875	3,875	3,875	3,875	3,775
	7 1/2	6,460	6,460	6,460	6,460	6,460	6,460	3,775
1/2	4 1/2	5,165	5,165	5,165	5,165	5,165	5,165	6,915
	6	6,890	6,890	6,890	6,890	6,890	6,890	6,915
	10	11,485	11,485	11,485	11,485	11,485	11,485	6,915
5/8	5 5/8	7,370	8,070	8,075	8,075	8,075	8,075	11,015
	7 1/2	10,765	10,765	10,765	10,765	10,765	10,765	11,015
	12 1/2	17,945	17,945	17,945	17,945	17,945	17,945	11,015
3/4	6 3/4	9,685	10,610	10,975	10,975	10,975	10,975	15,365
	9	14,635	14,635	14,635	14,635	14,635	14,635	16,305
	15	24,395	24,395	24,395	24,395	24,395	24,395	16,305
7/8	7 7/8	12,210	13,375	14,940	14,940	14,940	14,940	20,915
	10 1/2	18,795	19,920	19,920	19,920	19,920	19,920	22,505
	17 1/2	33,200	33,200	33,200	33,200	33,200	33,200	22,505
1	9	14,915	16,340	18,865	19,515	19,515	19,515	27,320
	12	22,965	25,155	26,020	26,020	26,020	26,020	29,525
	20	43,365	43,365	43,365	43,365	43,365	43,365	29,525
1 1/4	11 1/4	20,845	22,835	26,370	29,480	32,295	33,285	46,600
	15	32,095	35,160	40,600	44,380	44,380	44,380	47,240
	25	69,060	73,970	73,970	73,970	73,970	73,970	47,240

1. Tabulated values are for estimation purposes only and should not be used for design (please use our free TruSpec anchorage design software at www.ITW-redhead.com)
2. Tabulated values represent strength design per ACI 318 for a single anchor in adequate concrete thickness, not near an edge nor adjacent anchorage, and not for sustained loading.
3. Bond strengths are for dry, cracked concrete with periodic inspection
4. Bond strengths are for Temperature Range A (maximum long term temperature of 110F, maximum short term temperature of 142F).

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Tension (lbf) and Shear (lbf) in 4000 psi Cracked Concrete by Threaded Rod Type[1,2,3,4]

ANCHOR DIAMETER (in.)	EMBEDMENT DEPTH (in.)	ASTM A193 B7 THREAD ROD		CARBON STEEL A36		STAINLESS STEEL F593	
		TENSION (lbf)	SHEAR (lbf)	TENSION (lbf)	SHEAR (lbf)	TENSION (lbf)	SHEAR (lbf)
3/8	3 3/8	2,905	3,775	3,375	1,755	4,785	2,280
	4 1/2	3,875	3,775	3,375	1,755	4,785	2,280
	7 1/2	6,460	3,775	3,375	1,755	4,785	2,280
1/2	4 1/2	5,165	6,915	6,170	3,210	8,760	4,040
	6	6,890	6,915	6,170	3,210	8,760	4,040
	10	11,485	6,915	6,170	3,210	8,760	4,040
5/8	5 5/8	8,075	11,015	9,830	5,115	13,160	6,440
	7 1/2	10,765	11,015	9,830	5,115	13,955	6,440
	12 1/2	17,945	11,015	9,830	5,115	13,955	6,440
3/4	6 3/4	10,975	15,365	14,550	7,565	16,500	7,610
	9	14,635	16,305	14,550	7,565	16,500	7,610
	15	24,395	16,305	14,550	7,565	16,500	7,610
7/8	7 7/8	14,940	20,915	20,085	10,445	21,800	10,530
	10 1/2	19,920	22,505	20,085	10,445	22,820	10,530
	17 1/2	33,200	22,505	20,085	10,445	22,820	10,530
1	9	19,515	27,320	26,345	13,700	26,635	13,815
	12	26,020	29,525	26,345	13,700	29,935	13,815
	20	43,365	29,525	26,345	13,700	29,935	13,815
1 1/4	11 1/4	33,285	46,600	37,225	21,920	37,225	22,090
	15	44,380	47,240	42,155	21,920	47,865	22,090
	25	73,970	47,240	42,155	21,920	47,865	22,090

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2. Tabulated values represent strength design per ACI 318 for a single anchor in adequate concrete thickness, not near an edge nor adjacent anchorage, and not for sustained loading.
3. Bond strengths are for dry, cracked concrete with periodic inspection
4. Bond strengths are for Temperature Range A (maximum long term temperature of 110F, maximum short term temperature of 142F).

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Tension (lbf) and Shear (lbf) in Uncracked Concrete with ASTM A615 Grade 60 Reinforcing Bar[1,2,3,4]

ANCHOR DIAMETER # Rebar	EMBEDMENT DEPTH (in.)	TENSION (lbf) 2500 psi	3000 psi	4000 psi	5000 psi	6000 psi	7000-8000 psi	SHEAR (lbf) 2500-8000 psi
#3	3 3/8	4,835	5,295	6,110	6,110	6,110	6,110	3,560
	4 1/2	6,435	6,435	6,435	6,435	6,435	6,435	3,560
	7 1/2	4,835	6,435	6,435	6,435	6,435	6,435	3,560
#4	4 1/2	7,445	8,155	9,415	10,450	10,450	10,450	6,480
	6	11,460	11,700	11,700	11,700	11,700	11,700	6,480
	10	11,700	11,700	11,700	11,700	11,700	11,700	6,480
#5	5 5/8	10,405	11,395	13,160	14,715	15,650	15,650	10,040
	7 1/2	16,020	17,550	18,135	18,135	18,135	18,135	10,040
	12 1/2	18,135	18,135	18,135	18,135	18,135	18,135	10,040
#6	6 3/4	13,675	14,980	17,300	18,235	18,235	18,235	14,255
	9	21,060	23,070	24,315	24,315	24,315	24,315	14,255
	15	25,740	25,740	25,740	25,740	25,740	25,740	14,255
#7	7 7/8	17,235	18,880	21,800	23,690	23,690	23,690	19,440
	10 1/2	26,535	29,070	31,590	31,590	31,590	31,590	19,440
	17 1/2	35,100	35,100	35,100	35,100	35,100	35,100	19,440
#8	9	21,060	23,070	26,635	29,465	29,465	29,465	25,595
	12	32,420	35,515	39,290	39,290	39,290	39,290	25,595
	20	46,215	46,215	46,215	46,215	46,215	46,215	25,595
#9	10 1/8	25,130	27,525	31,785	35,525	35,525	35,525	32,400
	13 1/2	38,690	42,380	47,365	47,365	47,365	47,365	32,400
	22 1/2	58,500	58,500	58,500	58,500	58,500	58,500	32,400
#10	11 1/4	29,430	32,240	37,225	41,620	42,210	42,210	41,145
	15	45,310	49,635	56,285	56,285	56,285	56,285	41,145
	25	74,295	74,295	74,295	74,295	74,295	74,295	41,145

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2. Tabulated values represent strength design per ACI 318 for a single anchor in adequate concrete thickness, not near an edge nor adjacent anchorage, and not for sustained loading.
3. Bond strengths are for dry, uncracked concrete with periodic inspection
4. Bond strengths are for Temperature Range A (maximum long term temperature of 110F, maximum short term temperature of 142F).

STRENGTH DESIGN

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Tension (lbf) and Shear (lbf) in Cracked Concrete with ASTM A615 Grade 60 Reinforcing Bar [1,2,3,4]

ANCHOR DIAMETER # Rebar	EMBEDMENT DEPTH (in.)	TENSION (lbf) 2500 psi	3000 psi	4000 psi	5000 psi	6000 psi	7000-8000 psi	SHEAR (lbf) 2500-8000 psi
#3	3 3/8	2,825	2,905	2,905	2,905	2,905	3,560	3,560
	4 1/2	3,875	3,875	3,875	3,875	3,875	3,560	3,560
	7 1/2	6,435	6,435	6,435	6,435	6,435	3,560	3,560
#4	4 1/2	5,165	5,165	5,165	5,165	5,165	6,480	6,480
	6	6,890	6,890	6,890	6,890	6,890	6,480	6,480
	10	11,485	11,485	11,485	11,485	11,485	6,480	6,480
#5	5 5/8	7,370	7,965	7,965	7,965	7,965	10,040	10,040
	7 1/2	10,620	10,620	10,620	10,620	10,620	10,040	10,040
	12 1/2	17,705	17,705	17,705	17,705	17,705	10,040	10,040
#6	6 3/4	9,685	10,405	10,405	10,405	10,405	14,255	14,255
	9	13,875	13,875	13,875	13,875	13,875	14,255	14,255
	15	23,130	23,130	23,130	23,130	23,130	14,255	14,255
#7	7 7/8	12,210	13,375	13,570	13,570	13,570	19,000	19,440
	10 1/2	18,095	18,095	18,095	18,095	18,095	19,440	19,440
	17 1/2	30,160	30,160	30,160	30,160	30,160	19,440	19,440
#8	9	14,915	16,340	16,950	16,950	16,950	23,730	25,595
	12	22,600	22,600	22,600	22,600	22,600	25,595	25,595
	20	37,665	37,665	37,665	37,665	37,665	25,595	25,595
#9	10 1/8	17,800	19,495	20,465	20,465	20,465	28,655	32,400
	13 1/2	27,290	27,290	27,290	27,290	27,290	32,400	32,400
	22 1/2	45,485	45,485	45,485	45,485	45,485	32,400	32,400
#10	11 1/4	20,845	22,835	26,370	26,660	26,660	37,325	41,145
	15	32,095	35,160	35,545	35,545	35,545	41,145	41,145
	25	59,245	59,245	59,245	59,245	59,245	41,145	41,145

1. Tabulated values are for estimation purposes only and should not be used for design (please use our free TruSpec anchorage design software at www.ITW-redhead.com)
2. Tabulated values represent strength design per ACI 318 for a single anchor in adequate concrete thickness, not near an edge nor adjacent anchorage, and not for sustained loading.
3. Bond strengths are for dry, cracked concrete with periodic inspection
4. Bond strengths are for Temperature Range A (maximum long term temperature of 110F, maximum short term temperature of 142F).

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Grout-filled Concrete Block: Allowable Tension and Shear Loads based on Steel Design Information for U.S. Customary Unit Threaded Rod [1, 2, 3]

Anchor Diameter (in.)	Tension (lb)			Shear (lb)		
	ASTM A307 F_u = 60 ksi	ASTM A193 Grade B7 F_u = 125 ksi	ASTM F593 SS 304 F_u = 100 ksi	ASTM A307 F_u = 60 ksi	ASTM A193 Grade B7 F_u = 125 ksi	ASTM F593 SS 304 F_u = 100 ksi
3/8	2,185	4,555	3,645	1,125	2,345	1,875
1/2	3,885	8,100	6,480	2,000	4,170	3,335
5/8	6,075	12,655	10,125	3,130	6,520	5,215
3/4	8,750	18,225	12,390	4,505	9,390	6,385

For SI: 1 inch = 25.4mm, 1 lbf = 4.45N, 1ft-lbf = 1.356 N-M, 1 psi = 0.006895 MPa

1. Allowable load used in the design must be the lesser of bond values and tabulated steel element values.
2. Allowable tension and shear loads for threaded rods to resist short term loads, such as wind or seismic, must be calculated in accordance with Section 4.1 as applicable.
3. Allowable steel loads are based on allowable tension and shear stresses equal to 0.33X F_u and 0.17xF_u, respectively.

MASONRY DESIGN

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Grout-filled Concrete Block: Allowable Tension Loads for Threaded Rod [1, 2, 3, 4, 7, 9, 10, 11, 12]

Threaded Rod Size (in.)	Minimum Embedment (inches)	Load at s_{cr} and c_{cr} (lb)	Spacing[5]			Edge Distance[6]		
			Critical s_{cr} (inches)	Minimum s_{min} (inches)	Load reduction factor for s_{min} [8]	Critical c_{cr} (inches)	Minimum c_{min} (inches)	Load reduction factor for c_{min} [8]
3/8	3 3/8	945	13.5	4	1.00	12	4	0.87
1/2	4 1/2	1,395	18	4	0.50	20	4	0.68
5/8	5 5/8	1,825	22.5	4	0.50	20	4	0.68
3/4	6 3/4	2,085	27	4	0.50	20	4	0.68

For SI: 1 inch = 25.4mm, 1 lbf = 0.0044kN, 1 ksi = 6.894 MPa
See footnotes below

MASONRY DESIGN

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Grout-filled Concrete Block: Allowable Shear Loads for Threaded Rod [1, 2, 3, 4, 7, 9, 10, 11, 12]

Threaded Rod Size (in.)	Minimum Embedment (inches)	Load at *scr* and c_{cr} ⊥ to edge (lb)	Spacing[5]			Edge Distance[6]		
			Critical s_{cr} (inches)	Minimum s_{min} (inches)	Load reduction factor for s_{min} [8]	Critical c_{cr} (inches)	Minimum c_{min} (inches)	Load reduction factor for c_{min} [8]
3/8	3 3/8	825	13.5	4	0.50	12	4	0.87
1/2	4 1/2	1,560	18	4	0.50	20	4	0.56
5/8	5 5/8	2,680	22.5	4	0.50	20	4	0.30
3/4	6 3/4	3,180	27	4	0.50	20	4	0.27

For SI: 1 inch = 25.4mm, 1 lbf = 0.0044kN, 1 ksi = 6.894 MPa

1. All values are for anchors installed in fully grouted concrete masonry with minimum masonry strength of 1500 psi (10.3 MPa). Concrete masonry units must be light-, medium, or normal-weight conforming to ASTM C 90. Allowable loads have been calculated using a safety factor of 5.0.
3. Anchors may be installed in any location in the face of the masonry wall (cell, web, bed joint).
4. A maximum of two anchors may be installed in a single masonry cell in accordance with the spacing and edge or end distance requirements. Embedment is measured from the outside surface of the concrete masonry unit to the embedded end of the anchor.
5. The critical spacing distance, scr, is the anchor spacing where full load values in the table may be used. The minimum spacing distance, smin, is the minimum anchor spacing for which values are available and installation is permitted. Spacing distance is measured from the centerline to centerline between two anchors.
6. The critical edge or end distance, ccr, is the distance where full load values in the table may be used. The minimum edge or end distance, cmin, is the minimum distance for which values are available and installation is permitted. Edge or end distance is measured from anchor centerline to the closest unrestrained edge.
7. The tabulated values are applicable for anchors in the ends of grout-filled concrete masonry units where minimum edge distances are maintained.
8. Load values for anchors installed less than scr and ccr must be multiplied by the appropriate load reduction factor based on actual spacing (s) or edge distance (c). Load factors are multiplicative; both spacing and edge reduction factors must be considered.
9. Linear interpolation of load values between minimum spacing (smin) and critical spacing (scr) and between minimum edge or end distance (cmin) and critical edge or end distance (ccr) is permitted.
10. Concrete masonry width (wall thickness) must be equal to or greater than 1.5 times the anchor embedment depth (e.g. 3/8-inch- and 1/2-inch-diameter anchors are permitted in minimum nominally 6-inch-thick concrete masonry). The 5/8- and 3/4-inch-diameter anchors must be installed in minimum nominally 8-inch-thick concrete masonry.
11. Allowable loads must be the lesser of the adjusted masonry or bond values tabulated above and the steel strength values.
12. Tabulated allowable bond loads must be adjusted for increased in-service base material temperatures.

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Grout-filled Concrete Block: Allowable Tension and Shear Loads Based on Steel Strength for Rebar [1, 2, 3]

Rebar Size	Tension (lb)	Shear (lb)
	ASTM A615, Grade 60	ASTM A615, Grade 60
#3	3,270	1,685
#4	5,940	3,060
#5	9,205	4,745
#6	13,070	6,730

For SI: 1 inch = 25.4mm, 1 lbf = 4.45N, 1ft-lbf = 1.356 N-M, 1 psi = 0.006895 MPa

1. Allowable load used in the design must be the lesser of bond values and tabulated steel element values.
2. Allowable tension and shear loads for threaded rods to resist short term loads, such as wind or seismic, must be calculated in accordance with Section 4.1 as applicable.
3. Allowable steel loads are based on allowable tension and shear stresses equal to 0.33X F_u and 0.17xF_u, respectively.

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Grout-filled Concrete Block: Allowable Tension Loads for Rebar [1, 2, 3, 4, 7, 9, 10, 11, 12]

Rebar Size	Minimum Embedment (inches)	Load at s_{cr} and c_{cr} (lb)	Spacing[5]			Edge Distance[6]		
			Critical s_{cr} (inches)	Minimum s_{min} (inches)	Load reduction factor for s_{min} [8]	Critical c_{cr} (inches)	Minimum c_{min} (inches)	Load reduction factor for c_{min} [8]
#3	3 ⅜	785	13.5	4	1.00	12	4	0.87
#4	4 ½	1,355	18	4	0.50	20	4	0.68
#5	5 ⅝	2,060	22.5	4	0.50	20	4	0.68
#6	6 ¾	2,415	27	4	0.50	20	4	0.68

For SI: 1 inch = 25.4mm, 1 lbf = 0.0044kN, 1 ksi = 6.894 MPa
See footnotes below

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Grout-filled Concrete Block: Allowable Shear Loads for Threaded Rebar [1, 2, 3, 4, 7, 9, 10, 11, 12]

Rebar Size	Minimum Embedment (inches)	Load at s_{cr} and c_{cr} ⊥ to edge (lb)	Spacing[5]			Edge Distance[6]		
			Critical s_{cr} (inches)	Minimum s_{min} (inches)	Load reduction factor for s_{min} [8]	Critical c_{cr} (inches)	Minimum c_{min} (inches)	Load reduction factor for c_{min} [8]
#3	3 ⅜	1,230	13.5	4	0.50	12	4	
#4	4 ½	2,340	18	4	0.50	12	4	
#5	5 ⅝	3,600	22.5	4	0.50	20	4	
#6	6 ¾	3,685	27	4	0.50	20	4	

For SI: 1 inch = 25.4 mm; 1 lbf = 0.0044 kN, 1 ksi = 6.894 MPa.

1. All values are for anchors installed in fully grouted concrete masonry with minimum masonry strength of 1500 psi (10.3 MPa). Concrete masonry units must be light-, medium, or normal-weight conforming to ASTM C 90. Allowable loads have been calculated using a safety factor of 5.0.
3. Anchors may be installed in any location in the face of the masonry wall (cell, web, bed joint).
4. A maximum of two anchors may be installed in a single masonry cell in accordance with the spacing and edge or end distance requirements. Embedment is measured from the outside surface of the concrete masonry unit to the embedded end of the anchor.
5. The critical spacing distance, s_{cr}, is the anchor spacing where full load values in the table may be used. The minimum spacing distance, s_{min}, is the minimum anchor spacing for which values are available and installation is permitted. Spacing distance is measured from the centerline to centerline between two anchors.
6. The critical edge or end distance, c_{cr}, is the distance where full load values in the table may be used. The minimum edge or end distance, c_{min}, is the minimum distance for which values are available and installation is permitted. Edge or end distance is measured from anchor centerline to the closest unrestrained edge.
7. The tabulated values are applicable for anchors in the ends of grout-filled concrete masonry units where minimum edge distances are maintained.
8. Load values for anchors installed less than s_{cr} and c_{cr} must be multiplied by the appropriate load reduction factor based on actual spacing (s) or edge distance (c). Load factors are multiplicative; both spacing and edge reduction factors must be considered.
9. Linear interpolation of load values between minimum spacing (s_{min}) and critical spacing (s_{cr}) and between minimum edge or end distance (c_{min}) and critical edge or end distance (c_{cr}) is permitted.
10. Concrete masonry width (wall thickness) must be equal to or greater than 1.5 times the anchor embedment depth (e.g. No. 3 and No. 4 reinforcing bars are permitted in minimum nominally 6-inch-thick concrete masonry). No. 5 and No. 6 reinforcing bars must be installed in minimum nominally 8-inch-thick concrete masonry.
11. Allowable loads must be the lesser of the adjusted masonry or bond values tabulated above and the steel strength values.
12. Tabulated allowable bond loads must be adjusted for increased in-service base material temperatures.

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ICC-ES Evaluation Report

ESR-4046

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This report is subject to renewal September 2022.

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

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

REPORT HOLDER:

ITW RED HEAD

EVALUATION SUBJECT:

ITW RED HEAD C6+ ADHESIVE ANCHORING SYSTEM FOR CRACKED AND UNCRACKED CONCRETE

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2015, 2012, 2009, 2006 and 2003 *International Building Code®* (IBC)
- 2015, 2012, 2009, 2006 and 2003 *International Residential Code®* (IRC)

For evaluation for compliance with codes adopted by the Los Angeles Department of Building and Safety (LADBS), see ESR-4046 LABC and LARC Supplement.

Property evaluated:

Structural

2.0 USES

Adhesive anchors installed using the Red Head C6+ Adhesive Anchoring System are post-installed adhesive anchors used to resist static, wind or earthquake (for use in structures assigned to Seismic Design Categories A through F) tension and shear loads in cracked and uncracked normalweight concrete, having a specified compressive strength, f'_c, of 2500 psi to 8,500 psi (17.2 MPa to 58.6 MPa).

The anchoring system complies with requirements for anchors as described in Section 1901.3 of the 2015 IBC, Section 1909 of the 2012 IBC and is an alternative to cast-in-place anchors described in Section 1908 of the 2012 IBC, and Sections 1911 and 1912 of the 2009 and 2006 IBC, and Sections 1912 and 1913 of the 2003 IBC. The adhesive anchoring system may also be used where an engineered design is submitted in accordance with Section R301.1.3 of the IRC.

3.0 DESCRIPTION

3.1 General:

The Red Head C6+ Adhesive Anchoring System consists of a two-component, high-strength, structural adhesive, an anchor element (a continuously threaded steel rod or a deformed steel reinforcing bar) installed in normalweight concrete, hole cleaning equipment, adhesive dispensing tools, and installation accessories. The primary components of the Red Head C6+ Adhesive Anchoring System supplied by the report holder are shown in Figure 1 of this report.

The manufacturer's printed installation instructions (MPII) are included with the adhesive packaging and are replicated in Figure 3 of this report.

3.2 Materials:

3.2.1 Red Head C6+ Adhesive: The primary component of the Red Head C6+ Adhesive Anchoring System is a two-part epoxy packaged in a dual-chamber cartridge at a volumetric ratio of 2:1. The cartridge is available in 30-ounce (side-by-side) or 15-ounce (side-by-side) sizes. The adhesive components are dispensed through a static mixing nozzle, supplied by ITW, which is attached to the cartridge. The original, unopened cartridge has a shelf life of 24 months, as indicated by the "best used by" date stamped onto the cartridge, when stored in a cool (50°F to 77°F), dry, ventilated area and in accordance with Figure 3.

3.2.2 Hole Cleaning Equipment and Installation Accessories: Hole cleaning equipment consists of wire brushes, as shown in Figures 1 and 3, and a compressed air nozzle with extension. Installation accessories include static mixing nozzles, extension tubing, piston plugs, and hole plugs as shown in Figures 1 and 3

3.2.3 Dispensing Tools: Red Head C6+ Adhesive must be dispensed with manual or pneumatic or battery-operated dispensing tools provided by ITW Red Head, as shown in Figure 1.

3.2.4 Anchor Elements:

3.2.4.1 Steel Threaded Rods: The continuously threaded steel rods must range from $^3/_8$ inch through $1^1/_4$ inches (9.5 mm through 31.75 mm) in diameter. Carbon steel threaded rods must comply with either ASTM A36 [minimum f_{uta} = 58,000 psi (400 MPa)] or ASTM A193,

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Grade B7 [minimum f_{uta} = 125,000 psi (860 MPa)]. Stainless steel threaded rods must comply with ASTM F593 (Alloy Type 300, CW1 and CW2) [minimum f_{uta} = 95,000 psi (655 MPa) for CW1, and f_{uta} =80,000 psi (552 MPa) for CW2]. Table 1 provides steel design information for the steel threaded rods. Carbon steel threaded rods must be furnished with a minimum 0.0002-inch-thick (5 μm) zinc electroplated coating complying with ASTM B633 SC1 or must be hot-dipped galvanized complying with ASTM A153, Class C or D. Steel grades, types of materials (carbon steel or stainless steel) and sizes of the washers and nuts must match the corresponding threaded rods. Threaded steel rods must be straight and free from indentations or other defects along their length.

3.2.4.2 Steel Reinforcing Bars: Steel reinforcing bars must be deformed reinforcing bars as described in Table 5 of this report. The embedded portions of reinforcing bars must be straight, and free of mill scale, rust, mud, oil, and other coatings that may impair the bond with the adhesive. Reinforcing bars must not be bent after installation, except as set forth in ACI 318-14 Section 26.6.3.1 (b) or ACI 318-11 Section 7.3.2, as applicable, with the additional condition that the bars must be bent cold, and heating of reinforcing bars to facilitate field bending is not permitted.

3.2.4.3 Ductility of Anchor Elements: In accordance with ACI 318-14 Section 2.3 or ACI 318-11 Appendix D Section D.1, as applicable, in order for a steel anchor element to be considered ductile, the tested elongation of the steel element must be at least 14 percent and reduction of area must be at least 30 percent. Steel elements with a tested elongation of less than 14 percent or a reduction of area of less than 30 percent, or both, are considered brittle. Strength reduction factors, ϕ, in Table 1 for ASTM A36 and ASTM A193 B7 steel threaded rods are applicable to ductile steel elements; values in Table 1 for ASTM F593 steel threaded rod are applicable to brittle steel elements; values in Table 5 for ASTM A615 Grade 60 steel reinforcing bars are applicable to brittle steel elements. Where values are nonconforming or unstated, the steel must be considered brittle.

3.3 Concrete:

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

4.0 DESIGN AND INSTALLATION

4.1 Strength Design:

4.1.1 General: The design strength of adhesive anchors under the 2015 IBC, as well as the 2015 IRC must be determined in accordance with ACI 318-14 and this report. The design strength of adhesive anchors under the 2012, 2009, 2006 and 2003 IBC, as well as the 2012, 2009, 2006 and 2003 IRC, must be determined in accordance with ACI 318-11 and this report.

A design example in accordance with the 2012 IBC based on ACI 318-11 is provided in Figure 2 of this report.

Design parameters are based on ACI 318-14 for use with the 2015 IBC, and the ACI 318-11 for use with the 2012, 2009, 2006 and 2003 IBC unless noted otherwise in this report. In keeping consistent with ACI 318 notation style, the word “Section” does not precede ACI 318 Section numbers in Sections 4 and 5 of this report.

The strength design of adhesive anchors must comply with ACI 318-14 17.3.1 or ACI 318-11 D.4.1, as applicable, except as required in ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable. Design parameters are provided in Tables 1 through 6. Strength reduction factors, ϕ, as given in ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, must be used for load combinations calculated in accordance with Section 1605.2 of the IBC or ACI 318-14 5.3 or ACI 318-11 9.2, as applicable. Strength reduction factors, ϕ, as described in ACI 318-11 D.4.4, must be used for load combinations calculated in accordance with ACI 318-11 Appendix C.

4.1.2 Static Steel Strength in Tension: The nominal static steel strength of a single anchor in tension, N_{sa}, in accordance with ACI 318-14 17.4.1.2 or ACI 318-11 D.5.1.2, as applicable, and the associated strength reduction factors, ϕ, in accordance with ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are given in Tables 1 and 5 of this report for the anchor element types included in this report.

4.1.3 Static Concrete Breakout Strength in Tension: The nominal static concrete breakout strength of a single anchor or group of anchors in tension, N_{cb} or N_{cbg}, must be calculated in accordance with ACI 318-14 17.4.2 or ACI 318-11 D.5.2, as applicable, with the following addition:

The basic concrete breakout strength of a single anchor in tension, N_b, must be calculated in accordance with ACI 318-14 17.4.2.2 or ACI 318-11 D.5.2.2, as applicable, using the values of $k_{c,cr,}$ and $k_{c,uncr}$ as described in Tables 2 and 6 of this report. Where analysis indicates no cracking in accordance with ACI 318-14 17.4.2.6 or ACI 318-11 D.5.2.6, as applicable, N_b must be calculated using $k_{c,\ uncr}$ and $\Psi_{c,N}$ = 1.0. For anchors in lightweight concrete see ACI 318-14 17.2.6 or ACI 318-11 D.3.6, as applicable. The value of f'_c used for calculation must be limited to 8,000 psi (55 MPa) in accordance with ACI 318-14 17.2.7 or ACI 318-11 D.3.7, as applicable. Additional information for the determination of nominal bond strength in tension is given in Section 4.1.4 of this report.

4.1.4 Static Bond Strength in Tension: The nominal static bond strength of a single adhesive anchor or group of adhesive anchors in tension, N_a or N_{ag}, must be calculated in accordance with ACI 318-14 17.4.5 or ACI 318-11 D.5.5, as applicable. Bond strength values are a function of whether the concrete is cracked or uncracked, the concrete temperature range, the installation conditions (dry or water-saturated concrete, water-filled holes, or submerged), and the level of inspection provided. The resulting characteristic bond strength must be multiplied by the associated strength reduction factor ϕ_{nn} as follows:

CONCRETE TYPE	PERMISSIBLE INSTALLATION CONDITIONS	BOND STRENGTH	ASSOCIATED STRENGTH REDUCTION FACTOR
Uncracked	Dry	τ_{uncr}	ϕ_d
	Water-saturated	τ_{uncr}	ϕ_{ws}
	Water-filled holes	τ_{uncr}	ϕ_{wf}
	Submerged	τ_{uncr}	ϕ_{sub}
Cracked	Dry	τ_{cr}	ϕ_d
	Water-saturated	τ_{cr}	ϕ_{ws}
	Water-filled holes	τ_{cr}	ϕ_{wf}
	Submerged	τ_{cr}	ϕ_{sub}

Strength reduction factors for determination of the bond strength are given in Tables 3, 4, 7 and 8 of this report.

4.1.5 Static Steel Strength in Shear: The nominal static strength of a single anchor in shear as governed by the steel, V_{sa}, in accordance with ACI 318-14 17.5.1.2 or ACI 318-11 D.6.1.2, as applicable, and strength reduction factors, ϕ, in accordance with ACI 318-14 17.2.3 or ACI 318-11 D.4.3, as applicable are given in Tables 1 and 5 of this report for the anchor element types included in this report.

4.1.6 Static Concrete Breakout Strength in Shear: The nominal concrete breakout strength of a single anchor or group of anchors in shear, V_{cb} or V_{cbg}, must be calculated in accordance with ACI 318-14 17.5.2 or ACI 318-11 D.6.2, as applicable, based on information given in Table 2 and Table 6 of this report. The basic concrete breakout strength of a single anchor in shear, V_b, must be calculated in accordance with ACI 318-14 17.5.2.2 or ACI 318-11 D.6.2.2, as applicable, using the values of d given in this report in lieu of d_a (2015, 2012 and 2009 IBC), d_o (2006 IBC). In addition, h_{ef} must be substituted for ℓ_e. In no case shall ℓ_e exceed 8d. The value of f'_c must be limited to a maximum value of 8,000 psi (55 MPa) in accordance with ACI 318-14 17.2.7 or ACI 318-11 D.3.7, as applicable.

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

4.1.8 Interaction of Tensile and Shear Forces: For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318-14 17.6 or ACI 318-11 D.7, as applicable.

4.1.9 Minimum Member Thickness, h_{min}, Anchor Spacing, s_{min}, and Edge Distance, c_{min}: In lieu of ACI 318-14 17.7.1 and 17.7.3 or ACI 318-11 D.8.1 and D.8.3, as applicable, values of s_{min} and c_{min}, as given in Table 2 and Table 6 of this report, must be observed for adhesive anchor design and installation. The minimum member thicknesses h_{min}, as given in Table 2 and Table 6 of this report must be observed for adhesive anchor design and installation. For adhesive anchors that will remain untorqued, ACI 318-14 17.7.4 or ACI 318-11 D.8.4, as applicable, applies.

4.1.10 Critical Edge Distance c_{ac} and $\psi_{cp,Na}$: The modification factor $\psi_{cp,Na}$, must be determined in accordance with ACI 318-14 17.4.5.5 or ACI 318-11 D.5.5.5, as applicable, except as noted below:

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

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

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

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

where

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

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

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

4.1.11 Design Strength in Seismic Design Categories C, D, E and F: In structures assigned to Seismic Design Category C, D, E or F under the IBC or IRC, anchors must be designed in accordance with ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable, except as described below. Modifications to ACI 318-14 17.2.3 shall be applied under Section 1905.1.8 of the 2015 IBC. For the 2012 IBC, Section 1905.1.9 shall be omitted. The nominal steel shear strength, V_{sa}, must be adjusted by $\alpha_{V,seis}$ as given in Tables 1 and 5 for the anchor element types included in this report. The nominal bond strength $\tau_{\kappa;cr}$ must be adjusted by $\alpha_{N,seis}$, as given in Tables 3, 4, 7 and 8 of this report.

As an exception to ACI 318-11 D.3.3.4.2: Anchors designed to resist wall out-of-plane forces with design strengths equal to or greater than the force determined in accordance with ASCE 7 Equation 12.11-1 or 12.14-10 shall be deemed to satisfy ACI 318-11 D.3.3.4.3(d).

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

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

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

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

   1.2. The maximum anchor nominal diameter is $^5/_8$ inch (16 mm).

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

   1.4. Anchor bolts are located a minimum of $1^3/_4$ inches (45 mm) from the edge of the concrete parallel to the length of the wood sill plate.

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

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

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

   2.1. The maximum anchor nominal diameter is $^5/_8$ inch (16 mm).

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

   2.3. Anchors are located a minimum of $1^3/_4$ inches

(45 mm) from the edge of the concrete parallel to the length of the track.

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

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

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

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

4.2 Allowable Stress Design:

4.2.1 General: For adhesive anchors designed using load combinations in accordance with IBC Section 1605.3 (Allowable Stress Design), allowable loads shall be established using Eq. (4-2) or Eq. (4-3):

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

and

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

where

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

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

ϕN_n = Lowest design strength of an anchor or anchor group in tension as determined in accordance with ACI 318-14 Chapter 17 and 2015 IBC Section 1905.1.8, ACI 318-11 Appendix D, ACI 318-08 Appendix D and 2009 IBC Sections 1908.1.9 and 1908.1.10, ACI 318-05 Appendix D and 2006 IBC Section 1908.1.16, and Section 4.1 of this report, as applicable.

ϕV_n = Lowest design strength of an anchor or anchor group in shear as determined in accordance with ACI 318-14 Chapter 17 and 2015 IBC Section 1905.1.8, ACI 318-11 Appendix D, ACI 318-08 Appendix D and 2009 IBC Sections 1908.1.9 and 1908.1.10, ACI 318-05 Appendix D and 2006 IBC Section 1908.1.16, and Section 4.1 of this report, as applicable.

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

Limits on edge distance, anchor spacing and member thickness described in this report must apply.

Example calculations for derivation of $T_{allowable,ASD}$ are provided in Figure 2 and Table 9.

4.2.2 Interaction of tensile and shear forces: In lieu of ACI 318-14 17.6.1, 17.6.2 and 17.6.3 or ACI 318-11 D.7.1, D.7.2 and D.7.3, as applicable, interaction must be calculated as follows:

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

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

For all other cases:

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

4.3 Installation:

Installation parameters are illustrated in Figure 3 of this report. Installation must be in accordance with ACI 318-14 17.8.1 and 17.8.2 or ACI 318-11 D.9.1 and D.9.2, as applicable. Adhesive anchor locations must comply with this report and the plans and specifications approved by the code official. Use of the Red Head C6+ Adhesive Anchoring System must conform to the manufacturer's printed installation instructions included in each unit package, as provided in Figure 3 of this report.

The adhesive anchors may be used for floor (vertically down), wall (horizontal) and overhead applications. Horizontal and overhead applications are to be used with the $^3/_8$-inch (9.5 mm) through $1^1/_4$-inch-diameter (31 mm) threaded rods and reinforcing bars. For the $^3/_8$-inch diameter (9.5 mm) and $^1/_2$-inch diameter (12 mm), the adhesive may be injected directly to the bottom/back of the hole using extension tubing or nozzle. The $^5/_8$-inch (16 mm) through $1^1/_4$-inch (31 mm) diameter threaded rod and reinforcing bars must be installed with a Red Head piston plug.

4.4 Special Inspection:

4.4.1 General: Installations may be made under continuous special inspection or periodic special inspection, as determined by the registered design professional. Tables 3, 4, 7 and Table 8 of this report provide strength reduction factors, ϕ, corresponding to the type of inspection provided.

Continuous special inspection of adhesive anchors installed in horizontal or upwardly inclined orientations to resist sustained tension loads shall be performed in accordance with ACI 318-14 17.8.2.4 or ACI 318-11 D.9.2.4, as applicable.

Under the IBC, additional requirements as set forth in Section 1705.1.1 and Table 1705.3 of the 2015 or 2012 IBC, and Sections 1705, 1706 or 1707 of the 2009, 2006, and 2003 IBC must be observed, where applicable.

4.4.2 Continuous Special Inspection: Installations made under continuous special inspection with an on-site proof loading program must be performed in accordance with Section 1705.1.1 and Table 1705.3 of the 2015 and 2012 IBC, Sections 1704.4 and 1704.15 and Table 1704.4 of the 2009 IBC, or Section 1704.13 of the 2006 and 2003 IBC, whereby continuous special inspection is defined in Section 1702.1 of the IBC, and this report. The special inspector must be on the jobsite continuously during anchor installation to verify anchor type, adhesive expiration date, anchor dimensions, concrete type, concrete compressive strength, hole dimensions, hole cleaning procedures, anchor spacing, edge distances, concrete thickness, anchor embedment, tightening torque, and adherence to the manufacturers printed installation instructions.

The proof loading program must be established by the registered design professional. As a minimum, the following requirements must be addressed in the proof loading program:

1. Frequency of proof loading based on anchor type, diameter, and embedment.
2. Proof loads by anchor type, diameter, embedment, and location.
3. Acceptable displacements at proof load.

4. Remedial action in the event of a failure to achieve proof load, or excessive displacement.

Unless otherwise directed by the registered design professional, proof loads must be applied as confined tension tests. Proof load levels must not exceed the lesser of 67 percent of the load corresponding to the nominal bond strength as calculated from the characteristic bond stress for uncracked concrete modified for edge effects and concrete properties, or 80 percent of the minimum specified anchor element yield strength ($A_{se,N} \cdot f_{ya}$). The proof load shall be maintained at the required load level for a minimum of 10 seconds.

4.4.3 Periodic Special Inspection: Periodic special inspection must be performed where required in accordance with Section 1705.1.1 and Table 1705.3 of the 2015 and 2012 IBC, Section 1704.15 and Table 1704.4 of the 2009 IBC, or Section 1704.13 of the 2006, and 2003 IBC, whereby periodic special inspection is defined in Section 1702.1 of the IBC and this report. The special inspector must be on the jobsite initially during anchor installation to verify anchor type, anchor dimensions, concrete type, concrete compressive strength, hole dimensions, hole cleaning procedures, anchor spacing, edge distances, concrete thickness, anchor embedment, tightening torque, and adherence to the manufacturer's printed installation instructions. The special inspector must verify the initial installations of each type and size of adhesive anchor by construction personnel on the site. Subsequent installations of the same anchor type and size

by the same construction personnel are permitted to be performed in the absence of the special inspector. Any change in the anchor product being installed or the personnel performing the installation requires an initial inspection. For ongoing installations over an extended period, the special inspector must make regular inspections to confirm correct handling and installation of the product.

4.5 Compliance with NSF/ANSI Standard 61:

The Red Head C6+ Adhesive Anchoring System complies with the requirements of NSF/ANSI Standard 61, as referenced in Section 605 of the 2009 and 2006 *International Plumbing Code*® (IPC). Certified for use at a maximum surface area to volume ratio of 0.0005 square inches per liter in a tank. An NSF/ANSI Standard 61 listing is provided by NSF International.

5.0 CONDITIONS OF USE

Adhesive anchors installed using the Red Head C6+ Adhesive Anchoring System described in this report comply with or are a suitable alternative to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 The Red Head C6+ adhesive anchors must be installed in accordance with the manufacturer's printed installation instructions, as included with the adhesive packaging and reproduced in Figure 3 of this report.

5.2 The adhesive anchors must be installed in cracked and uncracked normalweight concrete having a specified compressive strength of f'_c = 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa).

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

5.4 The concrete shall have attained its minimum design strength prior to installation of the adhesive anchors.

5.5 Adhesive anchors must be installed in concrete base materials in holes predrilled in accordance with the instructions provided in Figure 3 of this report, using a carbide-tipped masonry drill bit manufactured within the range of the maximum and minimum drill-tip dimensions of ANSI B212.15-1994, or a diamond core drill bit, as listed in Figure 3.

5.6 Loads applied to the adhesive anchors must be adjusted in accordance with Section 1605.2 of the IBC for strength design and in accordance with Section 1605.3 of the IBC for allowable stress design.

5.7 Red Head C6+ adhesive anchors are recognized for use in resisting short- and long-term loads, including wind and earthquake loads, subject to the conditions of this report.

5.8 In structures assigned to Seismic Design Category C, D, E or F under the IBC or IRC, anchor strength must comply with the requirements of Section 4.1.11 of this report.

5.9 Red Head C6+ Adhesive Anchors are permitted to be installed in concrete that is cracked or that may be expected to crack during the service life of the anchor, subject to the conditions of this report.

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

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

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

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

5.14 Adhesive anchors are not permitted to support fire-resistive construction. Where not otherwise prohibited by the code, adhesive anchors are permitted for installation in fire-resistive construction provided at least one of the following conditions is fulfilled:

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

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

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

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

5.18 Steel anchoring elements in contact with preservative-treated and fire-retardant-treated wood must be of zinc-coated carbon steel or stainless steel. The minimum coating weights for zinc-coated steel must comply with ASTM A153.

5.19 Special inspection must be provided in accordance with Section 4.4 of this report. Continuous special inspection for anchors installed in horizontal or upwardly inclined orientations to resist sustained tension loads must be provided in accordance with Section 4.4 of this report.

5.20 Installation of adhesive anchors in horizontal or upwardly inclined orientations to resist sustained tension loads shall be performed by personnel certified by an applicable certification program in accordance with ACI 318-14 17.8.2.2 or 17.8.2.3; or ACI 318-11 D.9.2.2 or D.9.2.3, as applicable.

5.21 Red Head C6+ Adhesive Anchors may be used to resist tension and shear forces for floor (vertically down), wall (horizontal) and overhead installations with concrete temperatures between 50°F and 110°F. Horizontal and overhead applications are to be used with the $^{3}/_{8}$-inch- (9.5 mm) through $1^{1}/_{4}$-inch-diameter (31 mm) threaded rods and reinforcing bars. The adhesive must be injected directly to the back end of the hole using extension tubing (E916-6) for the ½-inch-diameter anchors, and extension tubing (E25-6) for the $^{3}/_{8}$-inch-diameter anchors. The $^{5}/_{8}$-inch- (16 mm) through $1^{1}/_{4}$-inch-diameter (31 mm) threaded rod and reinforcing bars must be installed with a Red Head piston plug. See the MPII in Figure 3 of this report for temperature and installation requirements.

5.22 The Red Head C6+ Adhesive Anchoring System may not be used for applications where the concrete temperature can rise from 40°F (or less) to 80°F (or higher) within a 12-hour period. Such applications may include but are not limited to anchorage of building facade systems and other applications subject to direct sun exposure.

5.23 Red Head C6+ Adhesive is manufactured under a quality-control program with inspections by ICC-ES.

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Post-installed Adhesive Anchors in Concrete Elements (AC308), dated October 2016, which incorporates requirements in ACI 355.4-11.

7.0 IDENTIFICATION

7.1 Read Head C6+ Adhesive is identified by labels on the adhesive cartridges bearing the adhesive manufacturer's name (ITW Commercial Construction North America) and address (Glendale Heights, Illinois), the product name (Red Head C6+), best-used-by expiration date, and the evaluation report number (ESR-4046).

7.2 The report holder's contact information is the following:

ITW RED HEAD
700 HIGH GROVE BOULEVARD
GLENDALE HEIGHTS, ILLINOIS 60139
(800) 848-5611
www.itw-redhead.com
techsupport@itwccna.com

FIGURE 1—RED HEAD C6+ ADHESIVE CARTRIDGES, DISPENSING TOOLS, MIXING NOZZLES, HOLE CLEANING BRUSHES AND HOLE PLUGS

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

CHARACTERISTIC		SYMBOL	UNITS	NOMINAL ROD DIAMETER (inch)						
				$^3/_8$	$^1/_2$	$^5/_8$	$^3/_4$	$^7/_8$	1	$1^1/_4$
Threaded rod effective cross-sectional area		A_{se}	inch²	0.078	0.142	0.226	0.335	0.462	0.606	0.969
Carbon Steel A36	Nominal steel strength in tension	N_{sa}	lb	4,500	8,230	13,110	19,400	26,780	35,130	56,210
	Nominal steel strength in shear	V_{sa}	lb	2,700	4,940	7,870	11,640	16,070	21,080	33,730
	Strength reduction factor for tension, steel failure mode	ϕ	-	0.75	0.75	0.75	0.75	0.75	0.75	0.75
	Strength reduction factor for shear, steel failure mode[1]	ϕ	-	0.65	0.65	0.65	0.65	0.65	0.65	0.65
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.70	0.70	0.70	0.70	0.70	0.70	0.70
Carbon Steel A193 B7	Nominal steel strength in tension	N_{sa}	lb	9,690	17,740	28,250	41,810	57,710	75,710	121,140
	Nominal steel strength in shear	V_{sa}	lb	5,810	10,640	16,950	25,090	34,630	45,430	72,680
	Strength reduction factor for tension, steel failure mode	ϕ	-	0.75	0.75	0.75	0.75	0.75	0.75	0.75
	Strength reduction factor for shear, steel failure mode[1]	ϕ	-	0.65	0.65	0.65	0.65	0.65	0.65	0.65
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.70	0.70	0.70	0.70	0.70	0.70	0.70
Stainless Steel F593	F593 CW1 nominal steel strength in tension	N_{sa}	lb	7,365	13,480	21,470	-	-	-	-
	F593 CW1 nominal steel strength in shear	V_{sa}	lb	3,680	6,740	10,735	-	-	-	-
	F593 CW2 nominal steel strength in tension	N_{sa}	lb	-	-	-	25,385	35,110	46,055	73,645
	F593 CW2 nominal steel strength in shear	V_{sa}	lb	-	-	-	12,690	17,555	23,030	36,820
	Strength reduction factor for tension, steel failure mode[1]	ϕ	-	0.65	0.65	0.65	0.65	0.65	0.65	0.65
	Strength reduction factor for shear, steel failure mode	ϕ	-	0.60	0.60	0.60	0.60	0.60	0.60	0.60
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.70	0.70	0.70	0.70	0.70	0.70	0.70

For **SI:** 1 inch = 25.4mm, 1 lbf = 4.45N, 1ft-lbf = 1.356 N-M, 1 psi = 0.006895 MPa.

[1]The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318-14 5.3 or ACI 318-11 9.2 are used. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4.

TABLE 2—CONCRETE BREAKOUT DESIGN INFORMATION FOR U.S. CUSTOMARY UNIT STEEL THREADED ROD (1)

CHARACTERISTIC	SYMBOL	UNITS	NOMINAL ROD DIAMETER (inch)						
			$^3/_8$	$^1/_2$	$^5/_8$	$^3/_4$	$^7/_8$	1	$1^1/_4$
Effectiveness factor for uncracked concrete	k_{uncr}	-	24	24	24	24	24	24	24
Effectiveness factor for cracked concrete	k_{cr}	-	17	17	17	17	17	17	17
Minimum concrete thickness	h_{min}	in.	$h_{ef} + 1^1/_4$		$h_{ef} + 2d_o$				
Anchor embedment depth - minimum	$h_{ef,min}$	in.	$1^1/_2$	2	$2^1/_2$	3	$3^1/_2$	4	5
Minimum spacing	s_{min}	in.	$^{15}/_{16}$	$1^1/_2$	$2^1/_2$	3	$3^1/_2$	4	5
Minimum edge distance	c_{min}	in.	$^{15}/_{16}$	$1^1/_2$	$2^1/_2$	3	$3^1/_2$	4	5
Critical edge distance	c_{ac}	in.	See Section 4.1.10 of this report						
Strength reduction factor for tension, concrete failure mode[1]	ϕ	Cond. B	0.65	0.65	0.65	0.65	0.65	0.65	0.65
Strength reduction factor for shear, concrete failure mode[1]	ϕ	Cond. B	0.70	0.70	0.70	0.70	0.70	0.70	0.70

For **SI:** 1 inch = 25.4mm, 1 lbf = 4.45N, 1ft-lbf = 1.356 N-M, 1 psi = 0.006895 MPa.

[1]The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318-14 5.3 or ACI 318-11 9.2 are used and the requirements of ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, for Condition B are met. 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 for Condition B.

TABLE 3—RED HEAD C6+ ADHESIVE ANCHOR BOND STRENGTH DESIGN INFORMATION FOR U.S. CUSTOMARY UNIT STEEL THREADED ROD INSTALLED IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT [1,5]

CHARACTERISTIC		SYMBOL	UNITS	NOMINAL ROD DIAMETER (inch)						
				$^3/_8$	$^1/_2$	$^5/_8$	$^3/_4$	$^7/_8$	1	$1^1/_4$
Anchor embedment depth - minimum		h_{ef}	in.	$1^1/_2$	2	$2^1/_2$	3	$3^1/_2$	4	5
Anchor embedment depth - maximum		h_{ef}	in.	$7^1/_2$	10	$12^1/_2$	15	$17^1/_2$	20	25
Temperature Range A[2]	Characteristic Bond Strength for Uncracked Concrete	$\tau_{k,uncr}$	psi	2,470	2,390	2,315	2,240	2,160	2,085	1,930
	Characteristic Bond Strength for Cracked Concrete	$\tau_{k,cr}$	psi	1,125	1,125	1,125	1,255	1,255	1,255	1,370
Temperature Range B[3,4]	Characteristic Bond Strength for Uncracked Concrete	$\tau_{k,uncr}$	psi	2,110	2,040	1,975	1,910	1,845	1,780	1,645
	Characteristic Bond Strength for Cracked Concrete	$\tau_{k,cr}$	psi	960	960	960	1,070	1,070	1,070	1,170
Continuous Inspection	Strength Reduction Factor - Dry Concrete	$\phi_{dry,ci}$	-	0.65	0.65	0.65	0.65	0.65	0.65	0.65
	Strength Reduction Factor – Water-Saturated Concrete	$\phi_{sat,ci}$	-	0.65	0.65	0.65	0.65	0.65	0.65	0.65
	Strength Reduction Factor - Water-Filled Holes	$\phi_{wf,ci}$	-	0.65	0.65	0.65	0.65	0.65	0.65	0.65
	Strength Reduction Factor - Submerged Concrete	$\phi_{sub,ci}$	-	0.65	0.65	0.55	0.55	0.55	0.55	0.55
Periodic Inspection	Strength Reduction Factor - Dry Concrete	$\phi_{dry,pi}$	-	0.65	0.65	0.65	0.55	0.55	0.55	0.55
	Strength Reduction Factor – Water-Saturated Concrete	$\phi_{sat,pi}$	-	0.65	0.65	0.65	0.55	0.55	0.55	0.65
	Strength Reduction Factor - Water-Filled Holes	$\phi_{wf,pi}$	-	0.55	0.55	0.55	0.55	0.55	0.55	0.55
	Strength Reduction Factor - Submerged Concrete	$\phi_{sub,pi}$	-	0.55	0.65	0.55	0.45	0.45	0.45	0.45
Submerged Installation Reduction Factor		$\alpha_{N,sub}$	-	1.00	1.00	1.00	1.00	1.00	0.81	1.00
Reduction factor for seismic tension		$\alpha_{N,seis}$	-	0.95	0.98	0.96	0.96	0.94	0.94	0.94

For **SI:** 1 inch = 25.4mm, 1 lbf = 4.45N, 1ft-lbf = 1.356 N-M, 1 psi = 0.006895 MPa.

[1]Bond strength values correspond to concrete compressive strengths ranging from 2,500 psi to 8,000.
[2]Temperature range A: Maximum short term temperature of 142°F and maximum long term temperature of 110°F.
[3]Temperature range B: Maximum short term temperature of 165°F and maximum long term temperature of 110°F.
[4]For load combinations consisting of only short-term loads, such as wind or seismic loads, bond strengths may be increased by 4 percent for Temperature Range B.
[5]For structures assigned to IBC or IRC Seismic Design Category C, D, E, or F, bond strength values must be multiplied by $\alpha_{N,seis}$.

TABLE 4—RED HEAD C6+ ADHESIVE ANCHOR BOND STRENGTH DESIGN INFORMATION FOR U.S. CUSTOMARY UNIT STEEL THREADED ROD INSTALLED IN HOLES CORE DRILLED WITH A DIAMOND CORE BIT[1,5]

CHARACTERISTIC		SYMBOL	UNITS	NOMINAL ROD DIAMETER (inch)						
				$^3/_8$	$^1/_2$	$^5/_8$	$^3/_4$	$^7/_8$	1	$1^1/_4$
Anchor embedment depth - minimum		h_{ef}	in.	$1^1/_2$	2	$2^1/_2$	3	$3^1/_2$	4	5
Anchor embedment depth - maximum		h_{ef}	in.	$7^1/_2$	10	$12^1/_2$	15	$17^1/_2$	20	25
Temperature Range A[2]	Characteristic Bond Strength for Uncracked Concrete	$\tau_{k,uncr}$	psi	1,935	1,750	1,590	1,460	1,360	1,285	1,225
	Characteristic Bond Strength for Cracked Concrete	$\tau_{k,cr}$	psi	1,010	1,010	1,010	1,030	975	965	1,030
Temperature Range B[3,4]	Characteristic Bond Strength for Uncracked Concrete	$\tau_{k,uncr}$	psi	1,650	1,490	1,355	1,245	1,160	1,100	1,045
	Characteristic Bond Strength for Cracked Concrete	$\tau_{k,cr}$	psi	860	860	860	880	835	825	880
Continuous Inspection	Strength Reduction Factor - Dry Concrete	$\phi_{dry,ci}$	-	0.65	0.65	0.65	0.65	0.65	0.65	0.65
	Strength Reduction Factor – Water-Saturated Concrete	$\phi_{sat,ci}$	-	0.65	0.65	0.65	0.65	0.65	0.65	0.65
	Strength Reduction Factor - Water-Filled Holes	$\phi_{wf,ci}$	-	0.65	0.65	0.65	0.65	0.65	0.65	0.65
	Strength Reduction Factor - Submerged Concrete	$\phi_{sub,ci}$	-	0.65	0.65	0.65	0.65	0.65	0.65	0.65
Periodic Inspection	Strength Reduction Factor - Dry Concrete	$\phi_{dry,pi}$	-	0.65	0.65	0.65	0.55	0.55	0.55	0.65
	Strength Reduction Factor – Water-Saturated Concrete	$\phi_{sat,pi}$	-	0.65	0.65	0.65	0.65	0.65	0.65	0.65
	Strength Reduction Factor - Water-Filled Holes	$\phi_{wf,pi}$	-	0.65	0.65	0.65	0.55	0.55	0.55	0.65
	Strength Reduction Factor - Submerged Concrete	$\phi_{sub,pi}$	-	0.65	0.65	0.65	0.55	0.65	0.65	0.65
Submerged Installation Reduction Factor		$\alpha_{N,sub}$	-	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Reduction factor for seismic tension		$\alpha_{N,seis}$	-	0.95	0.98	0.96	0.96	0.94	0.94	0.94

For **SI:** 1 inch = 25.4mm, 1 lbf = 4.45N, 1ft-lbf = 1.356 N-M, 1 psi = 0.006895 MPa.

[1]Bond strength values correspond to concrete compressive strengths ranging from 2,500 psi to 8,000 psi.
[2]Temperature range A: Maximum short term temperature of 142°F and maximum long term temperature of 110°F.
[3]Temperature range B: Maximum short term temperature of 165°F and maximum long term temperature of 110°F.
[4]For load combinations consisting of only short-term loads, such as wind or seismic loads, bond strengths may be increased by 4 percent for Temperature Range B.
[5]For structures assigned to IBC or IRC Seismic Design Category C, D, E, or F, bond strength values must be multiplied by $\alpha_{N,seis}$.

TABLE 5—STEEL DESIGN INFORMATION FOR U.S. CUSTOMARY UNIT STEEL REINFORCING BARS (1)

CHARACTERISTIC		SYMBOL	UNITS	NOMINAL ROD DIAMETER (inch)							
				No. 3	**No. 4**	**No. 5**	**No. 6**	**No. 7**	**No. 8**	**No. 9**	**No. 10**
Nominal bar diameter		***d***	in.	$^3/_8$	$^1/_2$	$^5/_8$	$^3/_4$	$^7/_8$	1	$1^1/_8$	$1^1/_4$
Reinforcing bar effective cross-sectional area		A_{se}	inch²	0.11	0.2	0.31	0.44	0.6	0.79	1.00	1.27
ASTM 615 Grade 60	Nominal steel strength in tension	N_{sa}	lb	9,900	18,000	27,900	39,600	54,000	71,100	90,000	114,300
	Nominal steel strength in shear	V_{sa}	lb	5,940	10,800	16,740	23,760	32,400	42,660	54,000	68,580
	Strength reduction factor for tension, steel failure mode	ϕ	-	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
	Strength reduction factor for shear, steel failure mode[1]	ϕ	-	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.91	0.91	0.91	0.90	0.90	0.71	0.71	0.71

For **SI:** 1 inch = 25.4mm, 1 lbf = 4.45N, 1ft-lbf = 1.356 N-M, 1 psi = 0.006895 MPa.

[1]The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318-14 5.3 or ACI 318-11 9.2 are used. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4.

TABLE 6—CONCRETE BREAKOUT DESIGN INFORMATION FOR U.S. CUSTOMARY UNIT STEEL REINFORCING BARS (1,2)

CHARACTERISTIC	SYMBOL	UNITS	NOMINAL ROD DIAMETER (inch)							
			No. 3	**No. 4**	**No. 5**	**No. 6**	**No. 7**	**No. 8**	**No. 9**	**No. 10**
Effectiveness factor for uncracked concrete	k_{uncr}	-	24	24	24	24	24	24	24	24
Effectiveness factor for cracked concrete	k_{cr}	-	17	17	17	17	17	17	17	17
Minimum concrete thickness	h_{min}	in.	$h_{ef} + 1^1/_4$			$h_{ef} + 2d_o$				
Anchor embedment depth - minimum	$h_{ef,min}$	in.	$1^1/_2$	2	$2^1/_2$	3	$3^1/_2$	4	$4^1/_2$	5
Minimum spacing	s_{min}	in.	$^{15}/_{16}$	$1^1/_2$	$2^1/_2$	3	$3^1/_2$	4	$4^1/_2$	5
Minimum edge distance	c_{min}	in.	$^{15}/_{16}$	$1^1/_2$	$2^1/_2$	3	$3^1/_2$	4	$4^1/_2$	5
Critical edge distance	c_{ac}	in.		See Section 4.1.10 of this report						
Strength reduction factor for tension, concrete failure mode[1]	ϕ	Cond. B	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
Strength reduction factor for shear, concrete failure mode[1]	ϕ	Cond. B	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70

For **SI:** 1 inch = 25.4mm, 1 lbf = 4.45N, 1ft-lbf = 1.356 N-M, 1 psi = 0.006895 MPa.

[1]The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318-14 5.3 or ACI 318-11 9.2 are used and the requirements of ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, for Condition B are met. 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 for Condition B.
[2]The value of f'_c used for calculation must be limited to maximum 8,000 psi (55 MPa) in accordance with ACI 318-14 17.2.7 or ACI 318-11 D.3.7, as applicable.

TABLE 7—RED HEAD C6+ ADHESIVE ANCHOR BOND STRENGTH DESIGN INFORMATION FOR U.S. CUSTOMARY UNIT STEEL REINFORCING BARS INSTALLED IN HOLES PREPARED WITH A HAMMER DRILL AND CARBIDE BIT [1,5]

CHARACTERISTIC		SYMBOL	UNITS	NOMINAL ROD DIAMETER (inch)							
				No. 3	**No. 4**	**No. 5**	**No. 6**	**No. 7**	**No. 8**	**No. 9**	**No. 10**
Anchor embedment depth - minimum		h_{ef}	in.	$1^1/_2$	2	$2^1/_2$	3	$3^1/_2$	4	$4^1/_2$	5
Anchor embedment depth - maximum		h_{ef}	in.	$7^1/_2$	10	$12^1/_2$	15	$17^1/_2$	20	$22^1/_2$	25
Temperature Range A[2]	Characteristic Bond Strength for Uncracked Concrete	$\tau_{k,uncr}$	psi	2,365	2,275	2,180	2,085	1,990	1,895	1,805	1,710
	Characteristic Bond Strength for Cracked Concrete	$\tau_{k,cr}$	psi	1,125	1,125	1,110	1,190	1,140	1,090	1,040	1,080
Temperature Range B[3,4]	Characteristic Bond Strength for Uncracked Concrete	$\tau_{k,uncr}$	psi	2,020	1,940	1,860	1,780	1,700	1,620	1,540	1,460
	Characteristic Bond Strength for Cracked Concrete	$\tau_{k,cr}$	psi	960	960	945	1,015	975	930	890	925
Continuous Inspection	Strength Reduction Factor - Dry Concrete	$\phi_{dry,ci}$	-	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
	Strength Reduction Factor – Water-Saturated Concrete	$\phi_{sat,ci}$	-	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
	Strength Reduction Factor - Water-Filled Holes	$\phi_{wf,ci}$	-	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
	Strength Reduction Factor - Submerged Concrete	$\phi_{sub,aci}$	-	0.65	0.65	0.65	0.55	0.55	0.55	0.55	0.55
Periodic Inspection	Strength Reduction Factor - Dry Concrete	$\phi_{dry,pi}$	-	0.65	0.65	0.65	0.55	0.55	0.55	0.55	0.55
	Strength Reduction Factor – Water-Saturated Concrete	$\phi_{sat,pi}$	-	0.65	0.65	0.65	0.55	0.55	0.55	0.55	0.65
	Strength Reduction Factor - Water-Filled Holes	$\phi_{wf,pi}$	-	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
	Strength Reduction Factor - Submerged Concrete	$\phi_{sub,pi}$	-	0.55	0.65	0.55	0.45	0.45	0.45	0.45	0.45
Submerged Installation Reduction Factor		$\alpha_{N,sub}$	-	1.00	1.00	1.00	1.00	1.00	0.81	0.81	1.00
Reduction factor for seismic tension		$\alpha_{N,seis}$	-	0.88	0.88	0.88	0.84	0.84	0.84	0.84	0.95

For **SI:** 1 inch = 25.4mm, 1 lbf = 4.45N, 1ft-lbf = 1.356 N-M, 1 psi = 0.006895 MPa.

[1]Bond strength values correspond to concrete compressive strengths ranging from 2,500 psi to 8,000.
[2]Temperature range A: Maximum short term temperature of 142°F and maximum long term temperature of 110°F.
[3]Temperature range B: Maximum short term temperature of 165°F and maximum long term temperature of 110°F.
[4]For load combinations consisting of only short-term loads, such as wind or seismic loads, bond strengths may be increased by 4 percent for Temperature Range B.
[5]For structures assigned to IBC or IRC Seismic Design Category C, D, E, or F, bond strength values must be multiplied by $\alpha_{N,seis}$.

TABLE 8—RED HEAD C6+ ADHESIVE ANCHOR BOND STRENGTH DESIGN INFORMATION FOR U.S. CUSTOMARY UNIT STEEL REINFORCING BARS INSTALLED IN HOLES CORE DRILLED WITH A DIAMOND CORE BIT [1,5]

CHARACTERISTIC		SYMBOL	UNITS	NOMINAL ROD DIAMETER (inch)							
				No. 3	**No. 4**	**No. 5**	**No. 6**	**No. 7**	**No. 8**	**No. 9**	**No. 10**
Anchor embedment depth - minimum		h_{ef}	in.	$1^1/_2$	2	$2^1/_2$	3	$3^1/_2$	4	$4^1/_2$	5
Anchor embedment depth - maximum		h_{ef}	in.	$7^1/_2$	10	$12^1/_2$	15	$17^1/_2$	20	$22^1/_2$	25
Temperature Range A[2]	Characteristic Bond Strength for Uncracked Concrete	$\tau_{k,uncr}$	psi	1,855	1,660	1,495	1,360	1,255	1,170	1,145	1,085
	Characteristic Bond Strength for Cracked Concrete	$\tau_{k,cr}$	psi	1,010	1,010	995	975	885	840	800	815
Temperature Range B[3,4]	Characteristic Bond Strength for Uncracked Concrete	$\tau_{k,uncr}$	psi	1,585	1,420	1,280	1,160	1,070	1,000	980	930
	Characteristic Bond Strength for Cracked Concrete	$\tau_{k,cr}$	psi	860	860	850	835	755	715	685	695
Continuous Inspection	Strength Reduction Factor - Dry Concrete	$\phi_{dry,ci}$	-	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
	Strength Reduction Factor – Water-Saturated Concrete	$\phi_{sat,ci}$	-	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
	Strength Reduction Factor - Water-Filled Holes	$\phi_{wf,ci}$	-	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
	Strength Reduction Factor - Submerged Concrete	$\phi_{sub,aci}$	-	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
Periodic Inspection	Strength Reduction Factor - Dry Concrete	$\phi_{dry,pi}$	-	0.65	0.65	0.65	0.55	0.55	0.55	0.55	0.65
	Strength Reduction Factor – Water-Saturated Concrete	$\phi_{sat,pi}$	-	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
	Strength Reduction Factor - Water-Filled Holes	$\phi_{wf,pi}$	-	0.65	0.65	0.65	0.55	0.55	0.55	0.55	0.65
	Strength Reduction Factor - Submerged Concrete	$\phi_{sub,pi}$	-	0.65	0.65	0.65	0.55	0.65	0.65	0.65	0.65
Submerged Installation Reduction Factor		$\alpha_{N,sub}$	-	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Reduction factor for seismic tension		$\alpha_{N,seis}$	-	0.88	0.88	0.88	0.84	0.84	0.84	0.84	0.95

For **SI:** 1 inch = 25.4mm, 1 lbf = 4.45N, 1ft-lbf = 1.356 N-M, 1 psi = 0.006895 MPa.

[1]Bond strength values correspond to concrete compressive strengths ranging from 2,500 psi to 8,000 psi.
[2]Temperature range A: Maximum short term temperature of 142°F and maximum long term temperature of 110°F.
[3]Temperature range B: Maximum short term temperature of 165°F and maximum long term temperature of 110°F.
[4]For load combinations consisting of only short-term loads, such as wind or seismic loads, bond strengths may be increased by 4 percent for Temperature Range B.
[5]For structures assigned to IBC or IRC Seismic Design Category C, D, E, or F, bond strength values must be multiplied by $\alpha_{N,seis}$.

TABLE 9—EXAMPLE RED HEAD C6+ ADHESIVE ANCHOR ALLOWABLE STRESS DESIGN VALUES (ASD) FOR ILLUSTRATIVE PURPOSES

Anchor Diameter (d)	Min/Max Embedment Depth, h_{ef} (in)	Char. Bond Strength $\tau_{k,uncr}$ (psi)	Allowable Tension Load (lb) 2500psi- 8000psi	Controlling Failure Mode
$^3/_8$	$2^3/_8$	2,470	1,929	Concrete
	$7^1/_2$		4,910	Steel
$^1/_2$	$2^3/_4$	2,390	2,403	Concrete
	10		8,990	Steel
$^5/_8$	$3^1/_8$	2,315	2,911	Concrete
	$12^1/_2$		14,315	Steel
$^3/_4$	$3^1/_2$	2,240	3,451	Concrete
	15		21,185	Steel
$^7/_8$	$3^1/_2$	2,160	3,451	Concrete
	$17^1/_2$		29,245	Steel
1	4	2,085	4,216	Concrete
	20		38,365	Steel
$1^1/_4$	5	1,930	5,892	Concrete
	25		61,390	Steel

For **SI:** 1 inch = 25.4mm, 1 lbf = 4.45N, 1ft-lbf = 1.356 N-M, 1 psi = 0.006895 MPa.

This table was developed based on the following conditions:
[1]Single anchor with static tension only, A193 Grade B7 threaded rod
[2]Vertical downward installation direction
[3]Inspection regimen = Periodic
[4]Installation temperature = 50°F to 110°F
[5]Long term temperature = 110°F
[6]Short term temperature = 142°F
[7]Dry hole condition (carbide drilled hole)
[8]Embedment = hef (min/max for each diameter)
[9]Concrete determined to remain uncracked for the life of the anchorage
[10]Load combinations from ACI 318-11 Section 9.2 (no seismic loading)
[11]30% dead load and 70% live load, controlling load combination 1.2D + 1.6L
[12]Calculation of weighted average for α = 0.3*1.2 + 0.7*1.6 = 1.48
[13]f'_c = 2,500 psi (normalweight concrete)
[14]$c_{a1} = c_{a2} \geq c_{ac}$
[15]$h \geq h_{min}$

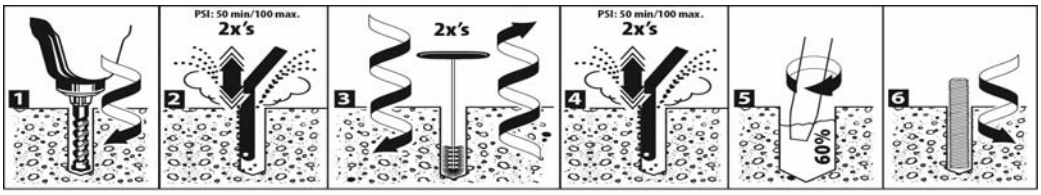
Illustrative Procedure to Calculate Allowable Stress Design Tension Value:
Red Head C6+ Adhesive Anchor $^1/_2$-inch diameter, using an embedment of $4^1/_2$ inches, assuming the conditions given in Table 9 (for use with the 2012 IBC, based on ACI 318-11 Appendix D). Applied tension load, N_{ua} = 4,000 lbs.

	PROCEDURE	***CALCULATION***
Step 1	Calculate steel strength of a single anchor in tension per ACI 318-11 D.5.1.2 and Table 1 of this report.	ϕN_{sa} = 0.75*17,740 = 13,305 lbs steel strength
Step 2	Calculate concrete breakout strength of a single anchor in tension per ACI 318-11 D.5.2 and Table 2 of this report.	$N_b = k_{c,uncr} * \lambda_a \sqrt{f'_c}\ h_{ef}^{1.5} = 24 * \sqrt{2{,}500} * 4.5^{1.5}$ N_b = 11,455 lbs $\phi N_{cb} = \phi\ A_{NC}/A_{NC0}\ \psi_{ed,N}\ \psi_{c,N}\ \psi_{cp,N}\ N_b$ ϕN_{cb} = 0.65*1.0*1.0*1.0*1.0*11,455 ϕN_{cb} = 7,446 lbs concrete breakout strength
Step 3	Calculate bond strength of a single anchor in tension per ACI 318-11 D.5.5 and Table 3 of this report.	$N_{ba} = * \lambda_a \tau_{k,uncr}\ \pi d h_{ef}$ N_{ba} = 1.0*2,390`*3.14*0.5*4.5 N_{ba} = 16,885 lbs $\phi N_a = \phi\ A_{Na}/A_{Na0}\ \psi_{ed,Na}\ \psi_{cp,Na}\ N_{ao}$ ϕN_a = 0.65*1.0*1.0*1.0*16,885 ϕN_a = 10,975 lbs bond strength
Step 4	Determine compliance with required anchor strength per ACI 318-11 D.4.1.	ϕN_{sa} = 13,305 lbs > N_{ua} = 4,000 lbs ϕN_{cb} = 7,446 lbs > N_{ua} = 4,000 lbs ϕN_a = 10,975 lbs > N_{ua} = 4,000 lbs
Step 5	Calculate allowable stress design conversion factor for loading condition per ACI 318-11 Section 9.2.	α = 1.2*D* + 1.6*L* = 1.2(0.3) + 1.6(0.7) = 1.48
Step 6	Calculate allowable stress design value per Section 4.2 of this report.	$T_{allowable,ASD} = \phi\ N_n / \alpha$ = 7,446 lbs/1.48 $T_{allowable,ASD}$ = 3,270 lbs allowable stress design

FIGURE 2—EXAMPLE DESIGN CALCULATION

RED HEAD C6+ ADHESIVE ANCHOR INSTALLATION INSTRUCTION

Hammer Drilling Installation



* Water-saturated concrete, water-filled holes and submerged concrete applications require 4x's air, 4x's brushing and 4x's air

1) ▪ Use a rotary hammer drill with a carbide drill bit complying to ANSI B212.15-1994 tolerance requirements or a core drill with diamond core bit. Drill hole to the required embedment depth. See attached table for drill bit specifications and min/maximum embedment depths.
▪ Installations may be used with maximum 1-1/4" diameter rods/rebar for floor, wall and overhead applications.
▪ Per construction specification, adhere to minimum spacing, minimum edge distance, and minimum member thickness.

2) ▪ For dry holes, oscillate a clean air nozzle in and out of the dry hole two times, for a total of two seconds, starting at the bottom of the hole with contaminant-free compressed air, exhausting hole until visually clean (i.e., no dust, debris, etc.)
▪ For water-saturated concrete and water-filled hole applications, oscillate a clean air nozzle in and out of the damp, water-filled or submerged hole four times, for a total of four seconds, starting at the bottom of the hole with contaminant-free compressed air, exhausting hole until visually clean (i.e., no dust, debris, etc.)
▪ If required, use an extension on the end of the air nozzle to reach the bottom of the hole.
▪ For core drilled holes, flush the hole twice with water, starting from the back of the hole using water line pressure.

3) ▪ Select an appropriately sized Red Head brush for the anchor diameter. Brush must be checked for wear before use. See attached table for brush specifications, including minimum diameter.
▪ Insert the brush into the hole with a clockwise motion. For every ½" forward advancement, complete one full turn until bottom of hole is reached. For faster and more suitable cleaning, attach the brush to a drill.
▪ Using a clockwise motion, for every full turn of the brush, pull the brush ½" out of the hole.
▪ For dry holes, twist/spin the brush two times in/out of the hole.
▪ For water-saturated concrete and water-filled hole applications, twist/spin the brush four times in/out of the hole.
▪ If required, use a wire brush extension (part nos. ESDS-38 or EHAN-38) to reach the bottom of the hole.
▪ Air clean the dust off the brush to prevent clogging of the brush.
▪ For core drilled holes, twist/spin the brush two times in/out of the hole.

4) ▪ For dry holes, oscillate a clean air nozzle in and out of the dry hole two times, for a total of two seconds, starting at the bottom of the hole with contaminant-free compressed air, exhausting hole until visually clean (i.e., no dust, debris, etc.)
▪ For water-saturated concrete and water-filled hole applications, oscillate a clean air nozzle in and out of the damp, water-filled or submerged hole four times, for a total of four seconds, starting at the bottom of the hole with contaminant-free compressed air, exhausting hole until visually clean (i.e., no dust, debris, etc.)
▪ For core drilled holes, flush the hole twice with water, starting from the back of the hole using water line pressure. Remove any remaining water in the hole using compressed air.

5) ▪ Review the Safety Data Sheet (SDS) before use.
▪ Check the "Use By" date on the cartridge and that the cartridge has been stored out of direct sunlight.
▪ Review the gel time/cure time chart, based on the temperature at time of installation, to determine tool, cartridge and nozzle requirements.
▪ Assemble the Red Head supplied cartridge and nozzle. Do not modify or remove mixing elements in nozzle.
▪ If nozzle does not reach the bottom of the hole, use Red Head E25-6 extension tubing (0.44" O.D.) positioned on the end of nozzle or use the S75EXT (nozzle extension) on the end of the S75 nozzle.
▪Place the assembly into a hand injection tool or a pneumatic injection tool.
▪ Dispense mixed adhesive outside of hole until uniform color is achieved.
▪ During installations, concrete must be between 50 and 110 degrees F, or artificially maintained.
▪ Insert the nozzle to the bottom of the hole and inject the adhesive at an angle, leaving the nozzle tip always slightly below the fill level.
▪ In a slow circular direction, work the adhesive into the sides of the hole, filling slowly to ensure proper adhesive distribution, until the hole is approximately 60% filled.
▪ For holes that contain water, keep injecting the adhesive below the water to displace the water upward.

HORIZONTAL AND OVERHEAD INJECTION OF ADHESIVE:
▪ For 3/8" and 1/2" diameter anchors installed horizontal and overhead, the adhesive may be injected directly to the back end of the hole using required Red Head E916-6 extension tubing (0.56" O.D.) for the ½" diameter anchors and Red Head E25-6 extension tubing (0.44" O.D.) for the 3/8" diameter anchors.

▪ For 5/8" diameter rod (#5 rebar) and larger anchors installed horizontal and overhead, assemble Red Head E916-6 extension tubing (0.56" O.D.) and appropriate sized piston plug on end of tubing:
PL-5834 for $^5/_8$" & ¾" diameter rod (No. 5 and No. 6 rebar)
PL-7810 for $^7/_8$" & 1" diameter rod (No. 7 and No. 8 rebar)
PL-1250 for 1-$^1/_4$" diameter rod (No. 9 and No. 10 rebar)

▪ The use of the Red Head pneumatic tool may be required for larger diameter anchor and/or deeper embedment installations at temperatures up to 110 degrees F.

6) ▪ Immediately insert the oil, rust and scale free rod/rebar assembly to the required embedment depth, using a counterclockwise motion to ensure proper adhesive distribution.
▪ The anchor rod/rebar must be marked with the required embedment depth.
▪ For wall (horizontal) and overhead installations with concrete or adhesive over 70 degrees F, the anchor rod/rebar must be marked with the required embedment depth and assembled with a Red Head hole plug positioned on the rod/rebar at the required embedment depth.
▪ After installing the anchor, the gap between the rod and the concrete must be completely filled with adhesive. The adhesive must fill voids, crevices and uniformly coat the rod and concrete.
▪ After installation, do not disturb the anchor until the full cure time has elapsed. Overhead installations must be supported until full cure time has elapsed.
▪ Adhesive must be fully cured before applying any load or torque. Do not over torque the anchor as this could adversely affect its performance.

Core Drilling Installation

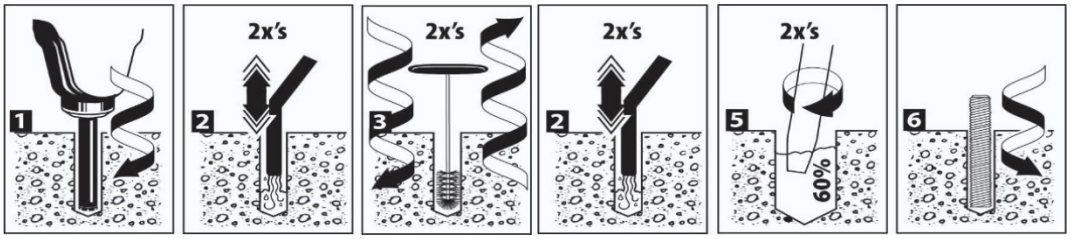


FIGURE 3—RED HEAD C6+ ADHESIVE INSTALLATION INSTRUCTIONS

SPECIFICATIONS FOR INSTALLATION OF RED HEAD C6+ ADHESIVE ANCHORS IN CONCRETE

FOR INSTALLATION USING U.S. CUSTOMARY UNIT STEEL THREADED ROD

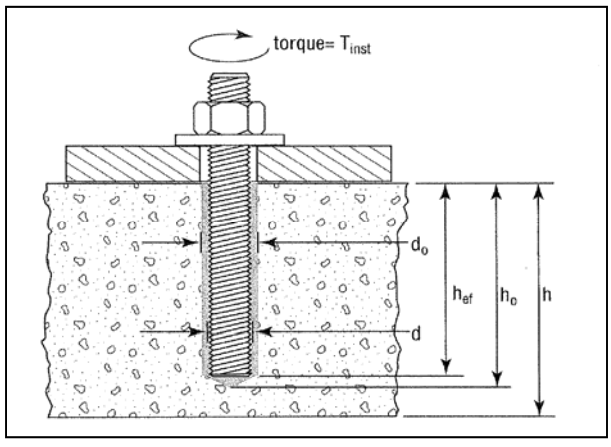
CHARACTERISTIC	SYMBOL	UNITS	NOMINAL ROD DIAMETER (inch)						
			3/8	1/2	5/8	3/4	7/8	1	1 1/4
Nominal carbide bit/diameter core bit diameter	-	in.	7/16	9/16	3/4	7/8	1	1 1/8	1 3/8
Anchor embedment depth - minimum	$h_{ef,\ min}$	in.	2 3/8	2 3/4	3 1/8	3 1/2	3 1/2	4	5
Anchor embedment depth - maximum	$h_{ef,\ max}$	in.	7 1/2	10	12 1/2	15	17 1/2	20	25
Minimum spacing	s_{min}	in.	15/16	1 1/2	2 1/2	3	3 1/2	4	5
Minimum edge distance	c_{min}	in.	15/16	1 1/2	2 1/2	3	3 1/2	4	5
Minimum concrete thickness	h_{min}	in.	h_{ef} + 1 1/4		h_{ef} + 2d_o				
Maximum tightening torque for pretension clamping	T_{inst}	ft lb	9	16	47	70	90	110	370

FOR INSTALLATION USING U.S. CUSTOMARY UNIT STEEL REINFORCING BARS

CHARACTERISTIC	SYMBOL	UNITS	NOMINAL REBAR DIAMETER (inch)							
			No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10
Nominal carbide bit/diameter core bit diameter	-	in.	7/16	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8
Anchor embedment depth - minimum	$h_{ef,\ min}$	in.	2 3/8	2 3/4	3 1/8	3 1/2	3 1/2	4	4 1/2	5
Anchor embedment depth - maximum	$h_{ef,\ max}$	in.	7 1/2	10	12 1/2	15	17 1/2	20	22 1/2	25
Minimum spacing	s_{min}	in.	15/16	1 1/2	2 1/2	3	3 1/2	4	4 1/2	5
Minimum edge distance	c_{min}	in.	15/16	1 1/2	2 1/2	3	3 1/2	4	4 1/2	5
Minimum concrete thickness	h_{min}	in.	h_{ef} + 1 1/4			h_{ef} + 2d_o				

For **SI:** 1 inch = 25.4mm, 1 lbf = 4.45N, 1ft-lbf = 1.356N-m, 1psi = 0.006895MPa.

ANCHOR INSTALLATION



BRUSH, NOZZLE, EXTENSION TUBING AND PISTON PLUG SPECIFICATIONS

Anchor diameter (in) **(d)**	Brush Part No.	Minimum brush diameter (in)	Mixing nozzle	USE of extension tubing ONLY Part No	USE of Piston Plug with extension tubing Part Nos.
3/8	WB038	0.563	A24S or S55	E25-6	-
1/2	WB012	0.675	A24S or S55	E25-6	-
5/8	WB058	0.900	A24S or S55	-	PL-5834 E916-6
3/4	WB034	1.125	S55 or S75/S75EXT	-	PL-5834 E916-6
7/8	WB078	1.350	S55 or S75/S75EXT	-	PL-7810 E916-6
1 & 1 1/8	WB100	1.463	S55 or S75/S75EXT	-	PL-7810 E916-6
1 1/4	WB125	1.575	S55 or S75/S75EXT	-	PL-1250 E916-6

FIGURE 3—RED HEAD C6+ ADHESIVE INSTALLATION INSTRUCTIONS (Continued)

CURE TIMES AND GEL TIMES FOR RED HEAD C6+ ADHESIVE

Concrete Temperature (°F)[1]	Gel Time[2]	Cure Time[3]
110	10 minutes	2 hours
90	14 minutes	2.75 hours
70	16 minutes	6.5 hours
50	30 minutes	24 hours

For **SI:** t° (°F-32) X .555 = °C.

[1]Adhesive must be installed in concrete temperatures within the noted range or artificially maintained at the noted temperature.
[2]Gel time is the maximum time from the end of mixing to when the insertion of the anchor into the adhesive must be completed and is based upon the adhesive and concrete temperatures noted.
[3]Cure time is the minimum time from the end of gel time to when the anchor maybe torque or loaded. Anchors are to be undisturbed during the cure time.

FIGURE 3—RED HEAD C6+ ADHESIVE INSTALLATION INSTRUCTIONS (Continued)

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

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

REPORT HOLDER:

ITW RED HEAD

EVALUATION SUBJECT:

ITW RED HEAD C6+ ADHESIVE ANCHORING SYSTEM FOR CRACKED AND UNCRACKED CONCRETE

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that the ITW Red Head C6+ Adhesive Anchoring System for cracked and uncracked concrete, described in ICC-ES evaluation report ESR-4046, has also been evaluated for compliance with the codes noted below as adopted by the Los Angeles Department of Building and Safety (LADBS).

Applicable code editions:

- 2017 *City of Los Angeles Building Code* (LABC)
- 2017 *City of Los Angeles Residential Code* (LARC)

2.0 CONCLUSIONS

The ITW Red Head C6+ Adhesive Anchoring System for cracked and uncracked concrete, described in Sections 2.0 through 7.0 of the evaluation report ESR-4046, complies with LABC Chapter 19, and LARC, and is subjected to the conditions of use described in this supplement.

3.0 CONDITIONS OF USE

The ITW Red Head C6+ Adhesive Anchoring System described in this evaluation report must comply with all of the following conditions:

- All applicable sections in the evaluation report ESR-4046.
- The design, installation, conditions of use and identification of the anchoring system are in accordance with the 2015 *International Building Code®* (2015 IBC) provisions noted in the evaluation report ESR-4046.
- The design, installation and inspection are in accordance with additional requirements of LABC Chapters 16 and 17, as applicable.
- Under the LARC, an engineered design in accordance with LARC Section R301.1.3 must be submitted.
- The allowable and strength design values listed in the evaluation report and tables are for the connection of the adhesive anchors to the concrete. The connection between the adhesive anchors and the connected members shall be checked for capacity (which may govern).

This supplement expires concurrently with the evaluation report, reissued September 2021.

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

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

ITW RED HEAD

EVALUATION SUBJECT:

ITW RED HEAD C6+ ADHESIVE ANCHORING SYSTEM FOR CRACKED AND UNCRACKED CONCRETE

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that Red Head C6+ Adhesive Anchoring System for Cracked and Uncracked Concrete, described in ICC-ES evaluation report ESR-4046, has also been evaluated for compliance with the codes noted below.

Compliance with the following codes:

- 2014 *Florida Building Code—Building*
- 2014 *Florida Building Code—Residential*

2.0 PURPOSE OF THIS SUPPLEMENT

This supplement is issued to indicate that the Red Head C6+ Adhesive Anchoring System for Cracked and Uncracked Concrete described in Sections 2.0 through 7.0 of the evaluation report, ESR-4046, complies with the *Florida Building Code—Building* and the *Florida Building Code—Residential*, when designed and installed in accordance with the 2012 *International Building Code*® (IBC) provisions noted in the evaluation report under the following conditions:

- Design wind loads must be based on Section 1609 of the *Florida Building Code—Building* or Section 301.2.1.1 of the *Florida Building Code—Residential*, as applicable.
- Load combinations must be in accordance with Section 1605.2 or Section 1605.3 of the 2014 *Florida Building Code—Building*, as applicable.

Use of the Red Head C6+ Adhesive Anchoring System with stainless steel threaded rod materials has also been found to be in compliance with the High-Velocity Hurricane Zone provisions of the *Florida Building Code—Building* and the *Florida Building Code—Residential* when the following condition is met:

The design wind loads for use of the anchors in a High-Velocity Hurricane Zone are based on Section 1620 of the *Florida Building Code—Building.*

Use of the the Red Head C6+ Adhesive Anchoring System with carbon steel threaded rod materials and reinforcing bars for compliance with the High-velocity Hurricane Zone provisions of the *Florida Building Code—Building* and the *Florida Building Code—Residential* has not been evaluated and is outside the scope of this supplemental report.

For products falling under Florida Rule 9N-3, verification that the report holder's quality-assurance program is audited by a quality-assurance entity approved by the Florida Building Commission for the type of inspections being conducted is the responsibility of an approved validation entity (or the code official, when the report holder does not possess an approval by the Commission).

This supplement expires concurrently with the evaluation report, reissued September 2021.

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ICC-ES Evaluation Report

ESR-4109

Reissued September 2021

This report is subject to renewal September 2022.

DIVISION: 04 00 00—MASONRY
Section: 04 05 19.16—Masonry Anchors

REPORT HOLDER:

ITW RED HEAD

EVALUATION SUBJECT:

ITW RED HEAD C6+ ADHESIVE ANCHORING SYSTEMS IN MASONRY

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2015, 2012, 2009 and 2006 *International Building Code*® (IBC)
- 2015, 2012, 2009 and 2006 *International Residential Code*® (IRC)

For evaluation for compliance with codes adopted by the Los Angeles Department of Building and Safety (LADBS), see ESR-4109 LABC and LARC supplement.

Property evaluated:

Structural

2.0 USES

The Red Head C6+ Adhesive Anchoring Systems are used to anchor building components to fully grouted concrete masonry walls to resist static, wind or seismic forces, as noted in Section 4.0 of this report.

The Red Head C6+ Adhesive Anchoring Systems are an alternative to Section 2.1.4 of TMS 402/ACI 530/ASCE 5 as referenced in Section 2107 of the IBC. The anchoring system may also be used where an engineered design is submitted in accordance with Section R301.1.3 of the IRC.

3.0 DESCRIPTION

3.1 General:

Each Red Head C6+ Adhesive Anchoring System is comprised of Red Head A7+ two-component adhesive filled in cartridges, static mixing nozzles, dispensing tools, hole cleaning equipment and adhesive injection accessories, and steel anchor elements, which are continuously threaded steel rods or deformed steel reinforcing bars as described in Section 3.2.4. The primary components of the ITW Red Head C6+ Adhesive Anchoring Systems are shown in Figure 3 of this report.

The manufacturer's printed installation instructions (MPII) are included with the adhesive packaging and are replicated in Figure 4 of this report.

3.2 Materials:

3.2.1 Red Head C6+ Adhesive: The primary component of the Red Head C6+ Anchoring System is a two-part epoxy packaged in a dual-chamber cartridge at a volumetric ratio of 2:1. The cartridge is available in either 30-ounce (side-by-side) or 15-ounce (side-by-side) sizes as shown in Figure 3. The component is dispensed through a static mixing nozzle which attaches to the cartridge. The original, unopened cartridge has a shelf life of 24 months, as indicated by the "best used by" date stamped onto the cartridge, when stored in a cool, dry, ventilated area.

3.2.2 Hole Cleaning Equipment: Hole cleaning equipment consists of wire brushes, as shown in Figures 3 and 4, and a compressed air nozzle with extension.

3.2.3 Dispensing Tools: Red Head C6+ Adhesive must be dispensed with manual or pneumatic dispensing tools provided by ITW Red Head, as shown in Figure 3.

3.2.4 Steel Anchor Elements:

3.2.4.1 Threaded Steel Rods: The continuously threaded steel rods range from $^3/_8$ inch through $^3/_4$ inches (9.5 mm through 19 mm) in diameter. Carbon steel threaded rods must comply with either ASTM A36 [minimum f_{uta} = 58,000 psi (400 MPa)] or ASTM A193, Grade B7 [minimum f_{uta} = 125,000 psi (860 MPa)]. Stainless steel threaded rods must comply with ASTM F593 (Alloy Type 300, CW1 and CW2) [minimum f_{uta} = 95,000 psi (655 MPa) for CW1, and f_{uta} =80,000 psi (552 MPa) for CW2]. Table 2 notes steel design information for the threaded rods. Carbon steel threaded rods must be furnished with a minimum 0.0002-inch-thick (5 μm) zinc electroplated coating complying with ASTM B633 SC1 or must be hot-dipped galvanized complying with ASTM A153, Class C or D. Threaded steel rods must be straight and free from indentations or other defects along their length.

3.2.4.2 Steel Reinforcing Bars: Steel reinforcing bars must be deformed reinforcing bars as described in Table 5 of this report. The embedded portions of reinforcing bars must be straight, and free of mill scale, rust, mud, oil, and

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other coatings that may impair the bond with the adhesive.

3.3 Grouted-filled Concrete Masonry: The masonry must be fully grouted complying with Chapter 21 of the IBC. The compressive strength of masonry, f'_m, at 28 days must be a minimum of 1,500 psi (13.1 MPa). Fully grouted masonry walls must be constructed from the following:

3.3.1 Concrete Masonry Units (CMUs): Concrete masonry walls must be constructed from minimum nominal 8-inch-wide (203 mm) by 8-inches-high (203 mm) by 16-inches-long (406 mm), lightweight, medium-weight or normal-weight concrete masonry units (CMUs) conforming to ASTM C90.

3.3.2 Grout: Grout-filled concrete masonry units must be fully grouted with grout complying with Section 2103.3 of the 2015 IBC, Section 2103.13 of the 2012 IBC, Section 2103.12 of the 2009 and 2006 IBC, Section R606.2.11 of the 2015 IRC, or Section R609.1.1 of the 2012, 2009 and 2006 IRC, as applicable. Alternatively, the grout must have a minimum compressive strength, when tested in accordance with ASTM C1019, equal to its specified strength, but not less than 2,000 psi (13.8 MPa).

3.3.3 Mortar: Mortar must be Types M, S or N prepared in accordance with Section 2103.2.1 of the 2015 IBC, 2103.9 of the 2012 IBC, Section 2103.8 of the 2009 and 2006 IBC, Section R606.2.7 of the 2015 IRC, or Section R607.1 of the 2012, 2009 and 2006 IRC, as applicable.

4.0 DESIGN AND INSTALLATION

4.1 Strength Design:

4.1.1 General: The design load values for anchor systems described in this report are based on allowable stress design (ASD), as an alternative to TMS 402/ACI 530/ASCE 5 Section 8.1.3 (2013 edition) or Section 2.1.4 (2011 or 2008 editions) as referenced in Section 2107.1 of the IBC. For use under the IRC, an engineered design in accordance with R301.1.3 must be submitted to the code official. Allowable tension and shear loads for installation in grout-filled masonry walls are noted in Tables 3, 4, 6 and 7 of this report. The allowable tension and shear values in this report must be adjusted in accordance with Figure 1 for in-service base material temperatures in excess of 70°F (21°C). Allowable tension and shear loads based on steel strength for threaded rods are described in Table 2. Allowable tension and shear loads based on steel strength for reinforcing bars are described in Table 5.

Allowable stress design tension and shear load values given in Tables 3, 4, 6 and 7 may be used to resist short-term loads such as wind or seismic, in accordance with Section 5.5 and Table 1 of this report. The allowable tension and shear loads are for anchors installed in the area of the face of the grout-filled CMU wall (cell, web, bed joints, and head joints of walls constructed using open-ended blocks or head joint mortared full depth) and for resisting static, wind or earthquake loads.

Critical and minimum spacing and edge distance values, with appropriate reduction values, where applicable, are given in Tables 3, 4, 6 and 7.

4.1.2 Combined Loading: The allowable loads for anchor systems installed in masonry and subjected to combined tension and shear forces must be determined by the following equation:

$$\left(\frac{P_s}{P_t}\right)+\left(\frac{V_s}{V_t}\right)\le 1$$

where:

P_s = Applied service tension load (lbf or kN)

P_t = Allowable service tension load (lbf or kN)

V_s = Applied service shear load (lbf or kN)

V_t = Allowable service shear load (lbf or kN)

4.2 Installation:

4.2.1 General: Anchor systems must be installed in accordance with this report and the manufacturer's printed installation instructions (MPII) represented in Figure 4. The anchor must not be installed until the base material has reached its minimum designated compressive strength. The drill bit size, hole diameter, embedment depth, spacing, edge distance and base material must comply with the requirements of this report. Installation procedures and locations must be in accordance with Tables 3, 4, 6 and 7 as well as Figure 2 of this report, as applicable.

4.2.2 Installation in Grout-filled Concrete Masonry Wall: Anchor systems must be installed in grout-filled concrete masonry walls as specified in Tables 3, 4, 6 and 7. Installation requirements are tabulated for various threaded rod and rebar diameters in Figure 4. The minimum installation temperature is 50°F (10°C) for the adhesive and the masonry. Holes are drilled to predetermined depths using rotary hammer drills and carbide-tipped drill bits that comply with ANSI B212.15-1994. Holes must be cleaned from the back with compressed air and an air-nozzle extension. A wire brush is used to remove dust and debris from the hole, and this is followed by another cleaning with compressed air. A mixing nozzle is attached to the Red Head C6+ cartridge to ensure proper mixing of the adhesive from the dual-component system. Before application, the adhesive is pumped out of the nozzle until the material achieves a uniform dark-gray color. Holes may be dry or damp but must not contain any water at the time of installations. Holes are filled approximately 60% full with the mixed adhesive, and the threaded rods or reinforcing bars are inserted, with a rotating motion, to the back of the hole. The adhesive shall cure in accordance with Figure 4 before the placement of attachments.

4.3 Special Inspection:

Periodic special inspections are required in accordance with IBC Section 1704, and are also applicable for installations under the IRC.

The special inspector must be on the jobsite initially during anchor system installation to verify anchor element type, steel anchor dimensions, masonry type, masonry dimensions and compressive strength, drill bit size, steel anchor spacing, edge distances, embedment, and adherence to the manufacturer's printed installation instructions (MPII).

The special inspector must verify that the initial anchor system installations of each type and size are in compliance with this evaluation report and in accordance with the MPII.

Subsequent installations of the same anchor system type and size by the same construction personnel are permitted to be performed in the absence of the special inspector. Any change in the anchor product being installed or the personnel performing the installation requires an initial inspection. For ongoing installations over an extended period, the special inspector must make regular inspections to confirm correct handling and installation of the product.

5.0 CONDITIONS OF USE

The Red Head C6+ Adhesive Anchoring Systems described in this report comply with or are suitable

alternatives to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 The Red Head C6+ Adhesive anchor systems must be identified and installed in accordance with this report and the manufacturer's printed installation instructions (MPII), as included with the adhesive packaging and reproduced in Figure 4 of this report.

5.2 Anchor sizes, dimensions, and minimum embedment depths are as set forth in this report.

5.3 Red Head C6+ Adhesive Anchoring Systems described in Section 4.1.1 of this evaluation report are capable of resisting seismic and wind loads. When using the basic load combinations in accordance with IBC Section 1605.3.1, allowable loads must not be increased for wind or seismic loading. When using the alternative basic load combinations in 2009 and 2006 IBC Section 1605.3.2 that include seismic or wind loads, the allowable loads may be increased in accordance with Table 1, or the alternative basic load combinations may be decreased by the factors in Table 1, as applicable. For the 2015 and 2012 IBC, the allowable loads or load combinations must not be adjusted.

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

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

5.6 Anchor systems are not permitted to support fire-resistive construction. Where not otherwise prohibited by the code, anchor systems are permitted for installation in fire-resistive construction provided at least one of the following conditions is fulfilled:

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

5.7 Since an ICC-ES acceptance criteria for evaluating data to determine the performance of adhesive anchors in cracked masonry is unavailable at this time, the use of adhesive anchor systems is limited to installation in uncracked masonry. Cracking occurs when $f_t > f_r$ due to service loads or deformations.

5.8 The anchor systems may be installed in base materials having internal temperatures between 50°F (10°C) and 110°F (43°C) at the time of installation. Installation of Red Head C6+ adhesive systems in base materials having temperatures beyond this range is outside the scope of this report.

5.9 When anchor systems are located where the internal base material temperature may exceed 70°F (21°C), allowable tension and shear loads indicated in this report must be adjusted for in-service temperatures in accordance with Figure 1. The use of Red Head C6+ adhesive in base materials having internal temperatures exceeding 176°F (80°C) during service life is beyond the scope of this report.

5.10 Use of Red Head C6+ Adhesive in conjunction with uncoated, or zinc-electroplated carbon steel threaded rods must be limited to interior exposure. Use of the Red Head C6+ adhesive with stainless steel (AISI 304 or Type 316) anchors or hot-dipped galvanized anchors with zinc coating conforming to ASTM A153, Class C or D is permitted for exterior or damp environments.

5.11 The grout and mortar must have attained the minimum design strength prior to installation of the adhesive anchor systems.

5.12 Special inspection in accordance with Section 4.3 of this report must be provided for all anchor system installations.

5.13 Red Head C6+ Adhesive is manufactured under a quality-control program with inspections by ICC-ES.

6.0 EVIDENCE SUBMITTED

6.1 Data in accordance with the ICC-ES Acceptance Criteria for Adhesive Anchors in Masonry Elements (AC58), dated November 2015.

6.2 A quality control manual.

7.0 IDENTIFICATION

7.1 The Red Head C6+ Adhesive is identified by labels on the packaging indicating the manufacturer's name (ITW Commercial Construction North America) product name, material type, lot number traceable to production date, and the evaluation report number (ESR-4109). Steel threaded rods and deformed reinforcing bars must comply with Section 3.2.4 of this evaluation report and applicable specifications as set forth in Tables 2 and 5 of this evaluation report.

7.2 The report holder's contact information is the following:

ITW RED HEAD
700 HIGH GROVE BOULEVARD
GLENDALE HEIGHTS, ILLINOIS 60139
(800) 848-5611
www.itw-redhead.com
techsupport@itwccna.com

TABLE 1—ALTERNATIVE BASIC LOAD COMBINATION ADJUSTMENT FACTORS[1,2,3]

Steel Type	Modification Factors			
	Reductions for Alternate Basic Load Combinations		Increase Factor for Allowable Loads for Short-term Loading Conditions	
	Tension	Shear	Tension	Shear
Standard threaded rods	0.75	0.75	1.33	1.33
High-strength rods	0.75	1	1.33	1
Stainless steel rods	0.75	0.87	1.33	1.14
Steel reinforcing bars	0.75	0.75	1.33	1.33

[1]When using the basic load combinations in accordance with IBC Section 1605.3.1, allowable loads must not be increased for wind or seismic loading.
[2]The above modification factors are applicable under the 2009 or 2006 IBC only.
[3]When using the alternative basic load combinations in the 2009 or 2006 IBC Section 1605.3.2 that include wind or seismic loads, the allowable loads for anchors may be increased by the tabulated factors found in the right half of the table. Alternatively, the alternate basic load combinations may be reduced by multiplying them by the reduction factors found in the left half of the table. For example, for stainless steel rods in shear the alternate basic loads for wind or seismic may be multiplied by 0.87 for shear loading or divided by 1.14 (1/1.4 = 0.87), as applicable. For the 2015 and 2012 IBC, the allowable loads or load combination must not be adjusted.

TABLE 2—ALLOWABLE TENSION AND SHEAR LOADS BASED ON STEEL DESIGN INFORMATION FOR U.S. CUSTOMARY UNIT THREADED ROD[1,2,3]

Anchor Diameter (inches)	Tension (lb)			Shear (lb)		
	ASTM A307 F_u = 60 ksi	ASTM A193 Grade B7 F_u = 125 ksi	ASTM F593 SS 304 F_u = 100 ksi	ASTM A307 F_u = 60 ksi	ASTM A193 Grade B7 F_u = 125 ksi	ASTM F593 SS 304 F_u = 100 ksi
$^3/_8$	2,185	4,555	3,645	1,125	2,345	1,875
$^1/_2$	3,885	8,100	6,480	2,000	4,170	3,335
$^5/_8$	6,075	12,655	10,125	3,130	6,520	5,215
$^3/_4$	8,750	18,225	12,390	4,505	9,390	6,385

For **SI:** 1 inch = 25.4mm, 1 lbf = 4.45N, 1ft-lbf = 1.356 N-M, 1 psi = 0.006895 MPa.

[1]Allowable loads used in the design must be the lesser of bond values and tabulated steel element values.
[2]Allowable tension and shear loads for threaded rods to resist short term loads, such as wind or seismic, must be calculated in accordance with Section 4.1 as applicable.
[3]Allowable steel loads are based on allowable tension and shear stresses equal to 0.33X F_u and 0.17xF_u, respectively.

TABLE 3—ALLOWABLE RED HEAD C6+ ADHESIVE BOND TENSION LOADS FOR THREADED RODS INSTALLED INTO GROUT-FILLED CONCRETE MASONRY UNITS[1,2,3,4,7,9,10,11,12]

Threaded Rod Size	Minimum Embedment (inches)	Load at s_{cr} and c_{cr} (lb)	Spacing[5]			Edge Distance[6]		
			Critical, s_{cr} (inches)	Minimum, s_{min} (inches)	Load reduction factor for s_{min}[8]	Critical, c_{cr} (inches)	Minimum, c_{min} (inches)	Load reduction factor for c_{min}[8]
$^3/_8$	$3^3/_8$	945	13.5	4	1.00	12	4	0.87
$^1/_2$	$4^1/_2$	1,395	18	4	0.50	20	4	0.68
$^5/_8$	$5^5/_8$	1,825	22.5	4	0.50	20	4	0.68
$^3/_4$	$6^3/_4$	2,085	27	4	0.50	20	4	0.68

For **SI:** 1 inch = 25.4 mm; 1 lbf = 0.0044 kN, 1 ksi = 6.894 MPa. **(Refer to Table 4 for footnotes)**

TABLE 4—ALLOWABLE RED HEAD C6+ ADHESIVE BOND SHEAR LOADS FOR THREADED RODS INSTALLED INTO GROUT-FILLED CONCRETE MASONRY UNITS[1,2,3,4,7,9,10,11,12]

Threaded Rod Size	Minimum Embedment (inches)	Load at s_{cr} and c_{cr} ⊥ to edge (lb)	Spacing[5]			Edge Distance[6]		
			Critical, s_{cr} (inches)	Minimum, s_{min} (inches)	Load reduction factor for s_{min}[8]	Critical, c_{cr} (inches)	Minimum, c_{min} (inches)	Load reduction factor for c_{min}[8]
3/8	3 3/8	825	13.5	4	0.50	12	4	0.87
1/2	4 1/2	1,560	18	4	0.50	20	4	0.56
5/8	5 5/8	2,680	22.5	4	0.50	20	4	0.30
3/4	6 3/4	3,180	27	4	0.50	20	4	0.27

For **SI:** 1 inch = 25.4 mm; 1 lbf = 0.0044 kN, 1 ksi = 6.894 MPa.

(The following footnotes apply to both Tables 3 and 4)

[1]All values are for anchors installed in fully grouted concrete masonry with minimum masonry strength of 1500 psi (10.3 MPa). Concrete masonry units must be light-, medium-, or normal-weight conforming to ASTM C 90. Allowable loads have been calculated using a safety factor of 5.0.
[3]Anchors may be installed in any location in the face of the masonry wall (cell, web, bed joint) as shown in Figure 2.
[4]A maximum of two anchors may be installed in a single masonry cell in accordance with the spacing and edge or end distance requirements. Embedment is measured from the outside surface of the concrete masonry unit to the embedded end of the anchor. See Figure 2 of this report.
[5]The critical spacing distance, s_{cr}, is the anchor spacing where full load values in the table may be used. The minimum spacing distance, s_{min}, is the minimum anchor spacing for which values are available and installation is permitted. Spacing distance is measured from the centerline to centerline between two anchors.
[6]The critical edge or end distance, c_{cr}, is the distance where full load values in the table may be used. The minimum edge or end distance, c_{min}, is the minimum distance for which values are available and installation is permitted. Edge or end distance is measured from anchor centerline to the closest unrestrained edge.
[7]The tabulated values are applicable for anchors in the ends of grout-filled concrete masonry units where minimum edge distances are maintained.
[8]Load values for anchors installed less than s_{cr} and c_{cr} must be multiplied by the appropriate load reduction factor based on actual spacing (s) or edge distance (c). Load factors are multiplicative; both spacing and edge reduction factors must be considered.
[9]Linear interpolation of load values between minimum spacing (s_{min}) and critical spacing (s_{cr}) and between minimum edge or end distance (c_{min}) and critical edge or end distance (c_{cr}) is permitted.
[10]Concrete masonry width (wall thickness) must be equal to or greater than 1.5 times the anchor embedment depth (e.g. 3/8-inch- and 1/2-inch-diameter anchors are permitted in minimum nominally 6-inch-thick concrete masonry). The 5/8- and 3/4-inch-diameter anchors must be installed in minimum nominally 8-inch-thick concrete masonry.
[11]Allowable loads must be the lesser of the adjusted masonry or bond values tabulated above and the steel strength values given in Table 2.
[12]Tabulated allowable bond loads must be adjusted for increased in-service base material temperatures in accordance with Figure 1, as applicable.

TABLE 5—ALLOWABLE TENSION AND SHEAR LOADS BASED ON STEEL STRENGTH FOR REINFORCING BARS[1,2,3]

Rebar Size	Tension (lb)	Shear (lb)
	ASTM A615, Grade 60	ASTM A615, Grade 60
No. 3	3,270	1,685
No. 4	5,940	3,060
No. 5	9,205	4,745
No. 6	13,070	6,730

For **SI:** 1 inch = 25.4mm, 1 lbf = 4.45N, 1ft-lbf = 1.356 N-M, 1 psi = 0.006895 MPa.

[1]Allowable load used in the design must be the lesser of bond values and tabulated steel element values.
[2]Allowable tension and shear loads for threaded rods to resist short term loads, such as wind or seismic, must be calculated in accordance with Section 4.1 as applicable.
[3]Allowable steel loads are based on allowable tension and shear stresses equal to 0.33X F_u and 0.17xF_u, respectively.

TABLE 6—ALLOWABLE RED HEAD C6+ ADHESIVE BOND TENSION LOADS FOR REINFORCING BARS INSTALLED INTO GROUT-FILLED CONCRETE MASONRY UNITS[1,2,3,4,7,9,10,11,12]

Rebar Size	Minimum Embedment (inches)	Load at s_{cr} and c_{cr} (lb)	Spacing[5]			Edge Distance[6]		
			Critical, s_{cr} (inches)	Minimum, s_{min} (inches)	Load reduction factor for s_{min}[8]	Critical, c_{cr} (inches)	Minimum, c_{min} (inches)	Load reduction factor for c_{min}[8]
No. 3	3 3/8	785	13.5	4	1.00	12	4	0.87
No. 4	4 1/2	1,355	18	4	0.50	20	4	0.68
No. 5	5 5/8	2,060	22.5	4	0.50	20	4	0.68
No. 6	6 3/4	2,415	27	4	0.50	20	4	0.68

For **SI:** 1 inch = 25.4 mm; 1 lbf = 0.0044 kN, 1 ksi = 6.894 MPa. **(Refer to Table 7 for footnotes)**

TABLE 7—ALLOWABLE RED HEAD C6+ ADHESIVE BOND SHEAR LOADS FOR REINFORCING BARS INSTALLED INTO GROUT-FILLED CONCRETE MASONRY UNITS[1,2,3,4,7,9,10,11,12]

Rebar Size	Minimum Embedment (inches)	Load at s_{cr} and c_{cr} ⊥ to edge (lb)	Spacing[5]			Edge Distance[6]		
			Critical, s_{cr} (inches)	Minimum, s_{min} (inches)	Load reduction factor for s_{min}[8]	Critical, c_{cr} (inches)	Minimum, c_{min} (inches)	Load reduction factor for c_{min}[8]
No. 3	$3^3/_8$	1,230	13.5	4	0.50	12	4	0.73
No. 4	$4^1/_2$	2,340	18	4	0.50	12	4	0.37
No. 5	$5^5/_8$	3,600	22.5	4	0.50	20	4	0.27
No. 6	$6^3/_4$	3,685	27	4	0.50	20	4	0.22

For **SI:** 1 inch = 25.4 mm; 1 lbf = 0.0044 kN, 1 ksi = 6.894 MPa.

(The following footnotes apply to both Tables 6 and 7)

[1]All values are for anchors installed in fully grouted concrete masonry with minimum masonry strength of 1500 psi (10.3 MPa). Concrete masonry units must be light-, medium-, or normal-weight conforming to ASTM C 90. Allowable loads have been calculated using a safety factor of 5.0.
[3]Anchors may be installed in any location in the face of the masonry wall (cell, web, bed joint) as shown in figure 2.
[4]A maximum of two anchors may be installed in a single masonry cell in accordance with the spacing and edge or end distance requirements. Embedment is measured from the outside surface of the concrete masonry unit to the embedded end of the anchor. See Figure 2 of this report.
[5]The critical spacing distance, s_{cr}, is the anchor spacing where full load values in the table may be used. The minimum spacing distance, s_{min}, is the minimum anchor spacing for which values are available and installation is permitted. Spacing distance is measured from the centerline to centerline between two anchors.
[6]The critical edge or end distance, c_{cr}, is the distance where full load values in the table may be used. The minimum edge or end distance, c_{min}, is the minimum distance for which values are available and installation is permitted. Edge or end distance is measured from anchor centerline to the closest unrestrained edge.
[7]The tabulated values are applicable for anchors in the ends of grout-filled concrete masonry units where minimum edge distances are maintained.
[8]Load values for anchors installed less than s_{cr} and c_{cr} must be multiplied by the appropriate load reduction factor based on actual spacing (s) or edge distance (c). Load factors are multiplicative; both spacing and edge reduction factors must be considered.
[9]Linear interpolation of load values between minimum spacing (s_{min}) and critical spacing (s_{cr}) and between minimum edge or end distance (c_{min}) and critical edge or end distance (c_{cr}) is permitted.
[10]Concrete masonry width (wall thickness) must be equal to or greater than 1.5 times the anchor embedment depth (e.g. No. 3 and No. 4 reinforcing bars are permitted in minimum nominally 6-inch-thick concrete masonry). No. 5 and No. 6 reinforcing bars must be installed in minimum nominally 8-inch-thick concrete masonry.
[11]Allowable loads must be the lesser of the adjusted masonry or bond values tabulated above and the steel strength values given in Table 4.
[12]Tabulated allowable bond loads must be adjusted for increased in-service base material temperatures in accordance with Figure 1, as applicable.

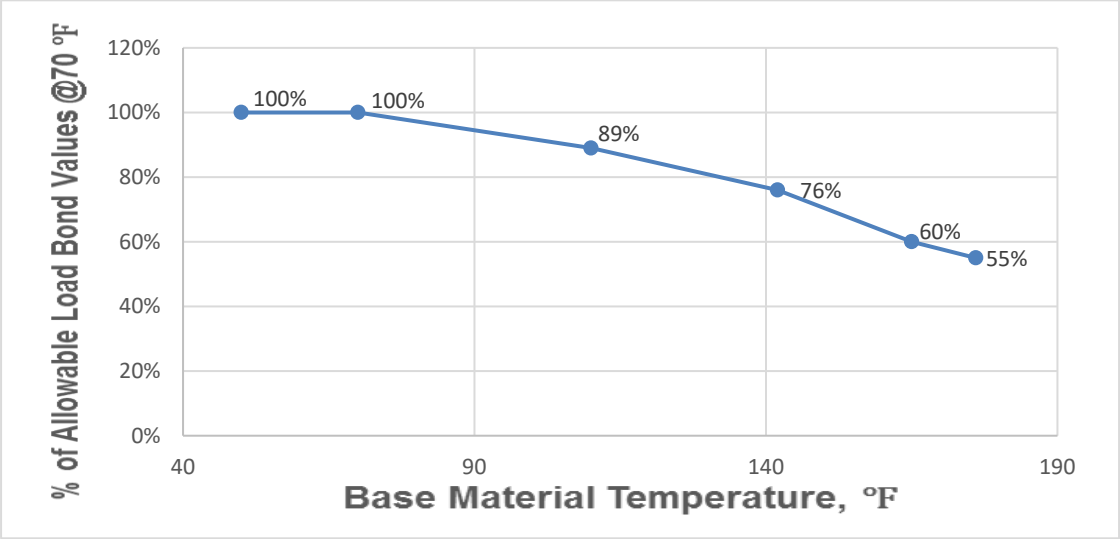


FIGURE 1—INFLUENCE OF BASE MATERIAL TEMPERATURE ON ALLOWABLE ADHESIVE BOND TENSION AND SHEAR LOADS FOR RED HEAD C6+ ADHESIVE ANCHORS INSTALLED INTO THE FACE OF CONCRETE MASONRY UNIT WALLS

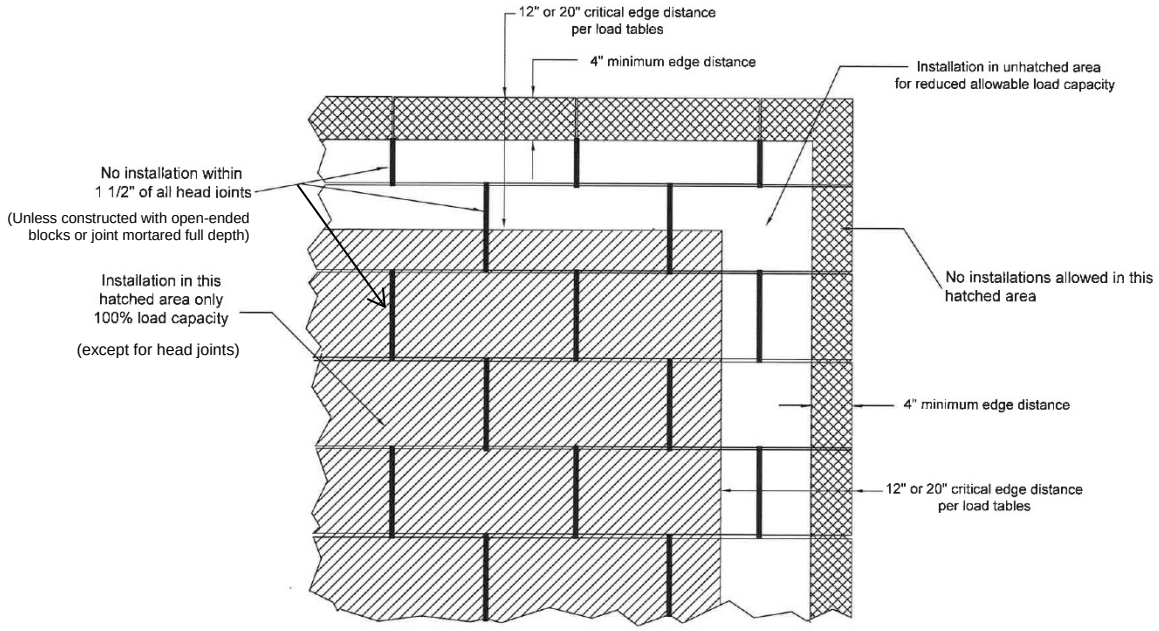


FIGURE 2—ILLUSTRATION OF PERMISSABLE LOCATIONS FOR RED HEAD C6+ ADHESIVE ANCHORS INSTALLED INTO THE FACE OF GROUTED CONCRETE MASONRY WALL (ELEVATION VIEW)

FIGURE 3—RED HEAD C6+ ADHESIVE CARTRIDGES, DISPENSING TOOLS, MIXING NOZZLES, HOLE CLEANING BRUSHES AND HOLE PLUGS

SPECIFICATIONS FOR INSTALLATION OF RED HEAD C6+ ADHESIVE ANCHORS

BRUSH AND CARBIDE DRILL BIT SPECIFICATIONS

Anchor diameter (in)	Carbide drill bit diameter (in)	Brush Part No.	Minimum brush diameter (in)
3/8 No. 3	7/16	WB-038	0.563
1/2 No. 4	9/16 for threaded rod 5/8 for rebar	WB-012	0.675
5/8 No. 5	3/4	WB-058	0.900
3/4 No. 6	7/8	WB-034	1.125

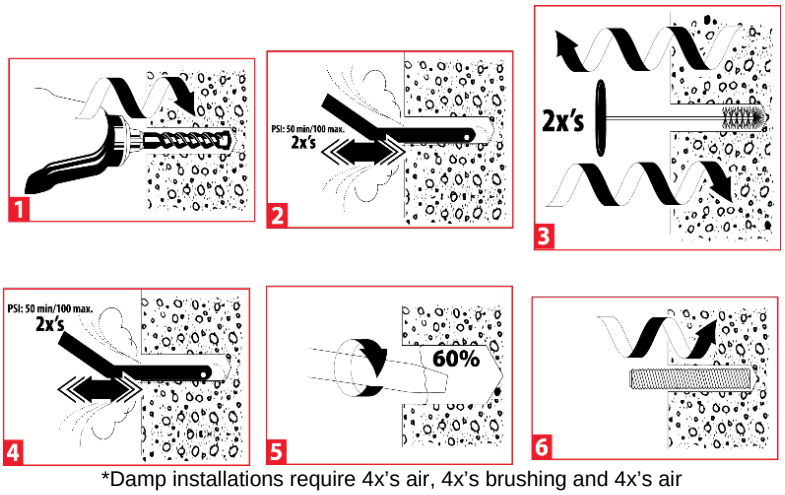
CURE TIMES AND GEL TIMES FOR RED HEAD C6+ ADHESIVE

Concrete Temperature (°F)[1]	Gel Time[2]	Cure Time[3]
110	10 minutes	2 hours
90	14 minutes	2-3/4 hours
70	16 minutes	6-1/2 hours
50	38 minutes	24 hours

For **SI:** t° (°F-32) X .555 = °C.

[1]Adhesive must be installed in concrete temperatures within the noted range or artificially maintained at the noted temperature.
[2]Gel time is the maximum time from the end of mixing to when the insertion of the anchor into the adhesive shall be completed and is based upon the adhesive and concrete temperatures noted.
[3]Cure time is the minimum time from the end of gel time to when the anchor may be torque or loaded. Anchors are to be undisturbed during the cure time.

FIGURE 4—RED HEAD C6+ ADHESIVE INSTALLATION INSTRUCTIONS



*Damp installations require 4x's air, 4x's brushing and 4x's air

1) ▪ Use a rotary hammer drill with a carbide drill bit complying to ANSI B212.15-1994 tolerance requirements. Drill hole to the required embedment depth. See attached table for drill bit specifications and embedment depths.
▪ Installations may be used with maximum $^{3}/_{4}$" diameter rods/rebar for masonry wall applications.
▪ Per construction specification, adhere to minimum spacing, minimum edge distance, and minimum wall thickness.

2) ▪ For dry holes, oscillate a clean air nozzle in and out of the dry hole two times, for a total of two seconds, starting at the bottom of the hole with contaminant-free compressed air, exhausting hole until visually clean (i.e., no dust, debris, etc.)
▪ For water-saturated applications, oscillate a clean air nozzle in and out of the damp hole four times, for a total of four seconds, starting at the bottom of the hole with contaminant-free compressed air, exhausting hole until visually clean (i.e., no dust, debris, etc.)
▪ If required, use an extension on the end of the air nozzle to reach the back of the hole.

3) ▪ Select an appropriately sized Red Head brush for the anchor diameter. Brush must be checked for wear before use. See attached table for brush specifications, including minimum diameter.
▪ Insert the brush into the hole with a clockwise motion. For every ½" forward advancement, complete one full turn until bottom of hole is reached. For faster and more suitable cleaning, attach the brush to a drill.
▪ Using a clockwise motion, for every full turn of the brush, pull the brush ½" out of the hole.
▪ For dry holes, twist/spin the brush two times in/out of the hole.
▪ For water-saturated applications, twist/spin the brush four times in/out of the hole.
▪ If required, use a wire brush extension (part nos. ESDS-38 or EHAN-38) to reach the bottom of the hole.
▪ Air clean the dust off the brush to prevent clogging of the brush.

4) ▪ For dry holes, oscillate a clean air nozzle in and out of the dry hole two times, for a total of two seconds, starting at the bottom of the hole with contaminant-free compressed air, exhausting hole until visually clean (i.e., no dust, debris, etc.)
▪ For water-saturated applications, oscillate a clean air nozzle in and out of the damp hole four times, for a total of four seconds, starting at the bottom of the hole with contaminant-free compressed air, exhausting hole until visually clean (i.e., no dust, debris, etc.)

5) ▪ Review the Safety Data Sheet (SDS) before use.
▪ Check the "Use By" date on the cartridge and that the cartridge has been stored in out of direct sunlight.
▪ Review the gel time/cure time chart, based on the temperature at time of installation, in order to determine tool, cartridge and nozzle requirements.
▪ Assemble the Red Head supplied cartridge and nozzle. Do not modify or remove mixing elements in nozzle.
▪Place the assembly into a hand injection tool or a pneumatic injection tool.
▪ Dispense mixed adhesive outside of hole until uniform color is achieved.
▪ During installations, masonry must be between 50 and 110 degrees F, or artificially maintained.
▪ Insert the nozzle to the bottom of the hole and inject the adhesive at an angle, leaving the nozzle tip always slightly below the fill level.
▪ In a slow circular direction, work the adhesive into the sides of the hole, filling slowly to ensure proper adhesive distribution, until the hole is approximately 60% filled.

6) ▪ Immediately insert the oil, rust and scale free rod/rebar assembly to the required embedment depth, using a counterclockwise motion to ensure proper adhesive distribution.
▪ The anchor rod/rebar must be marked with the required embedment depth.
▪ For installations with masonry or adhesive over 70 degrees F, the anchor rod/rebar must be marked with the required embedment depth and assembled with a Red Head hole plug positioned on the rod/rebar at the required embedment depth.
▪ After installing the anchor, the gap between the rod and the masonry must be completely filled with adhesive. The adhesive must fill voids, crevices and uniformly coat the rod and concrete.
▪ After installation, do not disturb the anchor until the full cure time has elapsed.
▪ Adhesive must be fully cured before applying any load or torque. Do not over torque the anchor as this could adversely affect its performance.

FIGURE 4—RED HEAD C6+ ADHESIVE INSTALLATION INSTRUCTIONS (Continued)

DIVISION: 04 00 00—MASONRY
Section: 04 05 19.16—Masonry Anchors

REPORT HOLDER:

ITW RED HEAD

EVALUATION SUBJECT:

ITW RED HEAD C6+ ADHESIVE ANCHORING SYSTEMS IN MASONRY

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that the ITW Red Head C6+ Adhesive Anchoring Systems in masonry, described in ICC-ES evaluation report ESR-4109, have also been evaluated for compliance with the codes noted below as adopted by the Los Angeles Department of Building and Safety (LADBS).

Applicable code editions:

- 2017 *City of Los Angeles Building Code* (LABC)
- 2017 *City of Los Angeles Residential Code* (LARC)

2.0 CONCLUSIONS

The ITW Red Head C6+ Adhesive Anchoring Systems in masonry, described in Sections 2.0 through 7.0 of the evaluation report ESR-4109, comply with LABC Chapter 21, and LARC, and are subjected to the conditions of use described in this supplement.

3.0 CONDITIONS OF USE

The ITW Red Head C6+ Adhesive Anchoring Systems described in this evaluation report must comply with all of the following conditions:

- All applicable sections in the evaluation report ESR-4109.
- The design, installation, conditions of use and identification of the anchor systems are in accordance with the 2015 *International Building Code*® (2015 IBC) provisions noted in the evaluation report ESR-4109.
- The design, installation and inspection are in accordance with additional requirements of LABC Chapters 16 and 17, and Section 2114, as applicable.
- Under the LARC, an engineered design in accordance with LARC Section R301.1.3 must be submitted.
- The allowable and strength design values listed in the evaluation report and tables are for the connection of the anchors to masonry. The connection between the anchors and the connected members shall be checked for capacity (which may govern).

This supplement expires concurrently with the evaluation report, reissued September 2021.

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DIVISION: 04 00 00—MASONRY
Section: 04 05 19.16—Masonry Anchors

REPORT HOLDER:

ITW RED HEAD

EVALUATION SUBJECT:

ITW RED HEAD C6+ ADHESIVE ANCHORING SYSTEMS IN MASONRY

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that the RED HEAD C6+ Adhesive Anchoring System in Masonry, described in ICC-ES evaluation report ESR-4109, has also been evaluated for compliance with the codes noted below.

Applicable code editions:

- 2014 *Florida Building Code—Building*
- 2014 *Florida Building Code—Residential*

2.0 CONCLUSIONS

The RED HEAD C6+ Adhesive Anchoring System in Masonry, described in Sections 2.0 through 7.0 of the evaluation report ESR-4109, complies with the *Florida Building Code—Building* and the *Florida Building Code—Residential*, provided the design and installation are in accordance with the 2012 *International Building Code*® (IBC) provisions noted in the evaluation report, and under the following conditions:

- Design wind loads must be based on Section 1609 of the *Florida Building Code—Building* or Section 301.2.1.1 of the *Florida Building Code—Residential*, as applicable.
- Load combinations must be in accordance with Section 1605.2 or Section 1605.3 of the *Florida Building Code—Building*, as applicable.

Use of the RED HEAD C6+ Adhesive Anchoring System with stainless steel threaded rod materials has also been found to be in compliance with the High-Velocity Hurricane Zone provisions of the *Florida Building Code—Building* and the *Florida Building Code—Residential*, when the following conditions are met:

- The design wind loads for use of the anchors in a High-Velocity Hurricane Zone are based on Section 1620 of the *Florida Building Code—Building*.

Use of RED HEAD C6+ Adhesive Anchoring System with carbon steel threaded rod materials for compliance with the High-velocity Hurricane Zone provisions of the *Florida Building Code—Building* and the *Florida Building Code—Residential* has not been evaluated, and is outside the scope of this supplemental report.

For products falling under Florida Rule 9N-3, verification that the report holder's quality-assurance program is audited by a quality-assurance entity approved by the Florida Building Commission for the type of inspections being conducted is the responsibility of an approved validation entity (or the code official, when the report holder does not possess an approval by the Commission).

This supplement expires concurrently with the evaluation report, reissued September 2021.

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