G5 Adhesive

2009 IBC Compliant ICC-ES Report No. 1137

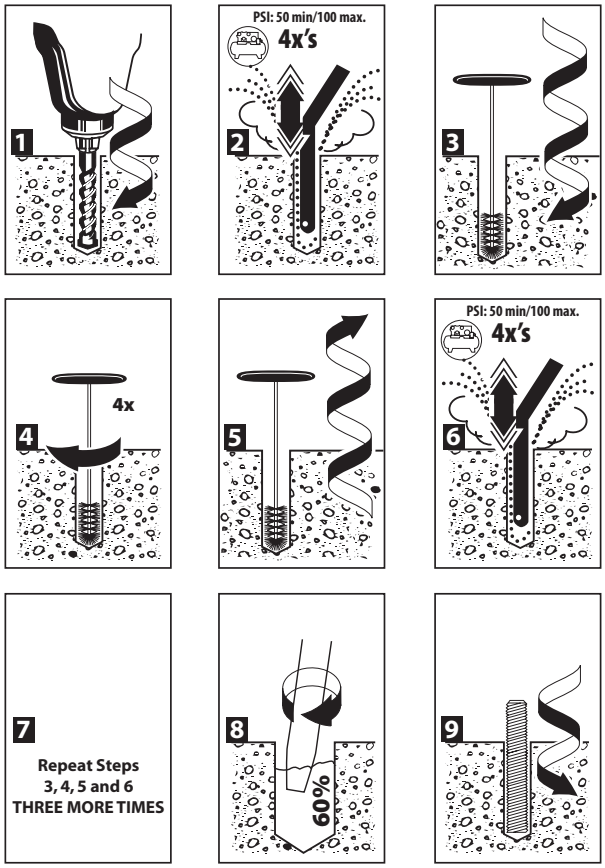
High Strength Epoxy tested with accordance with ICC-ES AC308

The epoxy resin and hardener are completely mixed as they are dispensed from the dual cartridge through a static mixing nozzle, directly into the anchor hole.

Compliant with 2009 IBC. Category 1 performance rating. For use in uncracked, cracked concrete and seismic applications

MADE IN USA

INSTALLATION STEPS



FORMULATED FOR HOT OR WARM WEATHER

- Fire rated: tested up to 4hrs FRP
- High strength Epoxy
- 15 minute nozzle life at 70° degrees F.

RECOGNIZED WORLDWIDE
Tested BS476 4 Hrs FRP

International Standard Fire Resistance Performance

NON-OFFENSIVE ODOR

- Virtually odorless, can be used indoors

NSF®
Certified to ANSI/NSF 61

Curing Times

BASE MATERIAL (F°/C°)	WORKING TIME	FULL CURE TIME
110°/ 43°	9 minutes	24 hours
90°/ 32°	9 minutes	24 hours
70°/ 20°	15 minutes	24 hours

APPROVALS/LISTINGS

ICC Evaluation Service, Inc.– No. ESR 1137

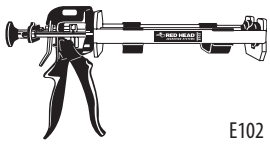
DOT Approvals

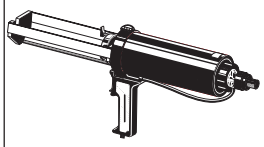
COLA RR-25270

Florida Building Code Approved

NSF Standard 61 Certified for Drinking Water Components

G5–22 fl. oz. Ordering Information

PART NUMBER	DESCRIPTION	BOX QTY
 G5-22	G5 Adhesive, 22 Fl. Oz. Cartridge	6
 E55	Mixing Nozzle for G5-22 Cartridge Nozzle diameter fits 3/8" to 5/8" holes (overall length of nozzle 14")	24
 E102	Hand Dispenser for G5-22 Cartridges Dispenses both 18 oz. and 22 oz. Cartridges	1

PART NUMBER	DESCRIPTION	BOX QTY
 E202	Pneumatic Tool for G5-22 Cartridge	1

Refer to page 49 for ordering information on brushes , hole plugs, and extension tubing for deep holes.

ESTIMATING TABLE

G5 22 Fluid Ounce Cartridge — Number of Anchoring Installations Per Cartridge* Using Reinforcing Bar with G5 Adhesive in Concrete

REBAR	DRILL HOLE DIA. INCHES	EMBEDMENT DEPTH IN INCHES (mm)														
		1 (25.4)	2 (50.8)	3 (76.2)	4 (101.6)	5 (127.0)	6 (152.4)	7 (177.8)	8 (203.2)	9 (228.6)	10 (254.0)	11 (279.4)	12 (304.8)	13 (330.2)	14 (355.6)	15 (381.0)
# 3	1/2	388.9	194.5	129.6	97.2	77.8	64.8	55.6	48.6	43.2	38.9	35.4	32.4	29.9	27.8	25.9
# 4	5/8	293.8	146.9	97.9	73.5	58.5	49.0	42.0	36.7	32.6	29.4	26.7	24.5	22.6	21.0	19.6
# 5	3/4	225.4	112.7	75.1	56.3	45.1	37.6	32.2	28.2	25.0	22.5	20.5	18.8	17.3	16.1	15.0
# 6	7/8	182.0	91.0	60.7	45.5	36.4	30.3	26.0	22.7	20.2	18.2	16.5	15.2	14.0	13.0	12.1
# 7	1-1/8	87.2	43.6	29.1	21.8	17.4	14.5	12.5	10.9	9.7	8.7	7.9	7.3	6.7	6.2	5.8
# 8	1-1/4	77.6	38.8	25.9	19.4	15.5	12.9	11.1	9.7	8.6	7.8	7.1	6.5	6.0	5.5	5.2
# 9	1-3/8	81.0	40.5	27.0	20.2	16.2	13.5	11.6	10.1	9.0	8.1	7.4	6.7	6.2	5.8	5.4
# 10	1-1/2	66.2	33.1	22.1	16.6	13.2	11.0	9.5	8.3	7.4	6.6	6.0	5.5	5.1	4.7	4.4
# 11	1-3/4	40.5	20.2	13.5	10.1	8.1	6.7	5.8	5.1	4.5	4.0	3.7	3.4	3.1	2.9	2.7

* The number of anchoring installations is based upon calculations of hole volumes using ANSI tolerance carbide tipped drill bits, the nominal areas of the reinforcing bars and the stress areas of the threaded rods. These estimates do not account for waste.
* Oversized holes acceptable but volume of adhesive will increase.

ESTIMATING TABLE

CLAMPING FORCE PROVIDED ON PAGE 25

G5 22 Fluid Ounce Cartridge — Number of Anchoring Installations Per Cartridge* Using Threaded Rod with G5 Adhesive in Concrete

ROD In. (mm)		DRILL HOLE DIA. INCHES	EMBEDMENT DEPTH IN INCHES (mm)													
			1 (25.4)	2 (50.8)	3 (76.2)	4 (101.6)	5 (127.0)	6 (152.4)	7 (177.8)	8 (203.2)	9 (228.6)	10 (254.0)	11 (279.4)	12 (304.8)	13 (330.2)	14 (355.6)	15 (381.0)
1/4	(6.4)	5/16	721.2	360.6	240.4	180.3	144.2	120.2	103.0	90.2	80.1	72.1	65.6	60.1	55.5	51.5	48.1
3/8	(9.5)	7/16	417.6	208.8	139.2	104.4	83.5	69.6	59.7	52.2	46.4	41.8	38.0	34.8	32.1	29.8	27.8
1/2	(12.7)	9/16	300.5	150.3	100.2	75.1	60.1	50.1	42.9	37.6	33.4	30.1	27.3	25.0	23.1	21.5	20.0
5/8	(15.9)	3/4	153.8	76.9	51.3	38.4	30.8	25.6	22.0	19.2	17.1	15.4	14.0	12.8	11.8	11.0	10.3
3/4	(19.1)	7/8	121.7	60.8	40.6	30.4	24.3	20.3	17.4	15.2	13.5	12.2	11.1	10.1	9.4	8.7	8.1
7/8	(22.2)	1	100.9	50.5	33.6	25.2	20.2	16.8	14.4	12.6	11.2	10.1	9.2	8.4	7.8	7.2	6.7
1	(25.4)	1-1/8	83.0	41.5	27.7	20.7	16.6	13.8	11.9	10.4	9.2	8.3	7.5	6.9	6.4	5.9	5.5
1-1/4	(31.8)	1-3/8	62.8	31.4	20.9	15.7	12.6	10.5	9.0	7.8	7.0	6.3	5.7	5.2	4.8	4.5	4.2

* The number of anchoring installations is based upon calculations of hole volumes using ANSI tolerance carbide tipped drill bits, the nominal areas of the reinforcing bars and the stress areas of the threaded rods. These estimates do not account for waste.
* Oversized holes acceptable but volume of adhesive will increase.

PACKAGING

1. Disposable, self-contained 22 ounce cartridge system capable of dispensing both epoxy components in the proper mixing ratio
2. Epoxy components dispensed through a static mixing nozzle that thoroughly mixes the material and places the epoxy at the base of the pre-drilled hole
3. Cartridge markings: Include manufacturer's name, batch number and best-used-by date, mix ratio by volume, ANSI hazard classification, and appropriate ANSI handling precautions

SUGGESTED SPECIFICATIONS

EPOXY ADHESIVE:

High Strength EPOXY ADHESIVE: USA Made, ARRA Certified

1. Odorless, two component resin and hardener, 100% solids (containing no solvents or VOC's), non-sag paste, insensitive to moisture, grey in color, extended working time, medium gel time for warm concrete.
2. Works in wet, damp, or submerged holes.
3. Compressive Strength, ASTM D695-02: 10,344 psi minimum.
4. Heat Deflection Temperature; 144°F minimum.
5. Shelf life: Best if used within 18 months.
6. Formulated for use in warmer concrete, solid grout-filled masonry, and solid brick.
7. Oversized and/or Core drilled holes permitted.
8. Fire-Resistance Performance of 4 Hours

PERFORMANCE TABLE

DRILL HOLE DIAMETERS PROVIDED ON PAGE 24

G5 Epoxy Adhesive — Average Ultimate Tension and Shear Loads[1,2,3] for Threaded Rod Installed in Solid Concrete

THREADED ROD DIA. In. (mm)	MAX. CLAMPING FORCE AFTER PROPER CURE Ft.-Lbs. (Nm)	EMBEDMENT CONCRETE In. (mm)	2000 PSI (13.8 MPa) CONCRETE		4000 PSI (27.6 MPa) CONCRETE	
			ULTIMATE TENSION Lbs. (kN)	ULTIMATE SHEAR Lbs. (kN)	ULTIMATE TENSION Lbs. (kN)	ULTIMATE SHEAR Lbs. (kN)
3/8 (9.5)	9 (12.2)	3-3/8 (85.7)	5,060 (22.5)	6,227 (27.7)	8,396 (37.3)	6,227 (27.7)
		4-1/2 (114.3)	6,465 (28.8)	6,227 (27.7)	10,490 (46.7)	6,227 (27.7)
1/2 (12.7)	16 (21.6)	4-1/2 (114.3)	10,484 (46.6)	12,016 (53.5)	13,476 (59.9)	12,016 (53.5)
		6 (152.4)	12,392 (55.1)	12,016 (53.5)	19,166 (85.3)	12,016 (53.5)
		7-1/2 (190.5)	N/A	12,016 (53.5)	20,572 (91.5)	12,016 (53.5)
5/8 (15.9)	47 (63.5)	5-5/8 (142.9)	14,634 (65.1)	17,547 (78.1)	20,880 (92.9)	17,547 (78.1)
		7-1/2 (190.5)	20,182 (89.8)	17,547 (78.1)	27,939 (124.3)	17,547 (78.1)
		9-3/8 (238.1)	N/A	17,547 (78.1)	32,249 (143.5)	17,547 (78.1)
3/4 (19.1)	90 (121.5)	6-3/4 (171.5)	18,966 (84.4)	24,918 (110.8)	29,019 (129.1)	24,918 (110.8)
		9 (228.6)	25,988 (115.6)	24,918 (110.8)	43,812 (194.9)	24,918 (110.8)
		11-1/4 (285.8)	N/A	24,918 (110.8)	47,927 (213.2)	24,918 (110.8)
1 (25.4)	276 (372.6)	9 (228.6)	43,804 (194.9)	43,648 (194.2)	53,531 (238.1)	43,648 (194.2)
		12 (304.8)	45,351 (201.6)	43,648 (194.2)	64,022 (284.8)	43,648 (194.2)
		15 (381.0)	N/A	43,648 (194.2)	82,547 (367.2)	43,648 (194.2)

1 Allowable working loads for the single installations under static loading should not exceed 25% (an industry standard) capacity or the allowable load of the anchor rod.

2 Ultimate load values in 2000 and 4000 psi stone aggregate concrete. Ultimate loads are indicated for the embedment shown in the Embedment in Concrete column. 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. (See page 27)

PERFORMANCE TABLE

DRILL HOLE DIAMETERS PROVIDED ON PAGE 24

G5 Epoxy Adhesive — Allowable Tension Loads[1] for Threaded Rod Installed in Solid Concrete

THREADED ROD DIA. In. (mm)	MIN. EMBEDMENT DEPTH In. (mm)	ALLOWABLE TENSION LOAD BASED ON EPOXY BOND STRENGTH		ALLOWABLE TENSION LOAD BASED ON STEEL STRENGTH		
		2000 PSI (13.8 MPa) CONCRETE Lbs. (kN)	4000 PSI (27.6 MPa) CONCRETE Lbs. (kN)	ASTM A307 (SAE 1018) Lbs. (kN)	ASTM A193 GR. B7 (SAE 4140) Lbs. (kN)	ASTM F593 AISI 304 SS Lbs. (kN)
3/8 (9.5)	3-3/8 (85.7)	1,265 (5.6)	2,092 (9.3)	2,080 (9.3)	4,340 (19.3)	3,995 (17.8)
	4-1/2 (114.3)	1,616 (7.2)	2,622 (11.7)	2,080 (9.3)	4,340 (19.3)	3,995(17.8)
1/2 (12.7)	4-1/2 (114.3)	3,004 (13.4)	3,369 (15.0)	3,730 (16.6)	7,780 (34.6)	7,155 (31.8)
	6 (152.4)	3,098 (13.8)	4,791 (21.3)	3,730 (16.6)	7,780 (34.6)	7,155 (31.8)
5/8 (15.9)	5-5/8 (142.9)	3,659 (16.3)	5,220 (23.2)	5,870 (26.1)	12,230 (54.4)	11,250 (50.0)
	7-1/2 (190.5)	5,046 (22.4)	6,985 (31.1)	5,870 (26.1)	12,230 (54.4)	11,250 (50.0)
3/4 (19.1)	6-3/4 (171.5)	4,742 (21.1)	7,255 (32.3)	8,490 (37.8)	17,690 (78.7)	14,860 (66.1)
	9 (228.6)	6,497 (28.9)	10,057 (44.7)	8,490 (37.8)	17,690 (78.7)	14,860 (66.1)
1 (25.4)	9 (228.6)	10,951 (48.7)	11,209 (49.9)	15,180 (67.5)	31,620 (140.6)	26,560 (118.1)
	12 (304.8)	11,338 (50.4)	15,923 (70.8)	15,180 (67.5)	31,620 (140.6)	26,560 (118.1)

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

2 Linear interpolation may be used for intermediate spacing and edge distances. (See page 27)

PERFORMANCE TABLE

DRILL HOLE DIAMETERS PROVIDED ON PAGE 24

G5 Epoxy Adhesive — Allowable Shear Loads[1,2] for Threaded Rod Installed in Solid Concrete

THREADED ROD DIA. In. (mm)	MIN. EMBEDMENT DEPTH In. (mm)	ALLOWABLE SHEAR LOAD BASED ON CONCRETE STRENGTH		ALLOWABLE SHEAR LOAD BASED ON STEEL STRENGTH		
		2000 PSI (13.8 MPa) CONCRETE Lbs. (kN)	4000 PSI (27.6 MPa) CONCRETE Lbs. (kN)	ASTM A307 (SAE 1018) Lbs. (kN)	ASTM A193 GR. B7 (SAE 4140) Lbs. (kN)	ASTM F593 AISI 304 SS Lbs. (kN)
3/8 (9.5)	3-3/8 (85.7)	1,557 (6.9)	1,557 (6.9)	1,040 (4.6)	2,170 (9.7)	1,995 (8.9)
1/2 (12.7)	4-1/2 (114.3)	3,004 (13.4)	3,004 (13.4)	1,870 (8.3)	3,895 (17.3)	3,585 (15.9)
5/8 (15.9)	5-5/8 (142.9)	4,387 (19.5)	4,387 (19.5)	2,940 (13.1)	6,125 (27.2)	5,635 (25.1)
3/4 (19.1)	6-3/4 (171.5)	6,230 (27.7)	6,230 (27.7)	4,250 (18.9)	8,855 (39.4)	7,440 (33.1)
1 (25.4)	9 (228.6)	10,912 (48.5)	10,912 (48.5)	7,590 (33.8)	15,810 (70.3)	13,285 (59.1)

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

2 Linear interpolation may be used for intermediate spacing and edge distances. (See page 27)

Combined Tension and Shear Loading—for G5 Adhesive Anchors

Allowable loads for anchors under tension and shear loading at the same time (combined loading) will be lower than the allowable loads for anchors subjected to 100% tension or 100% shear. Use the following equation to evaluate anchors in combined loading conditions:

$$\left(\frac{Na}{Ns}\right) + \left(\frac{Va}{Vs}\right) \leq 1$$

Na = Applied Service Tension Load

Ns = Allowable Tension Load

Va = Applied Service Shear Load

Vs = Allowable Shear Load

PERFORMANCE TABLE

DRILL HOLE DIAMETERS PROVIDED ON PAGE 24

G5 Epoxy Adhesive — Average Ultimate Tension Loads[1,2,3] for Reinforcing Bar Installed in Solid Concrete

REINFORCING BAR In. (mm)	EMBEDMENT IN CONCRETE In. (mm)	2000 PSI (13.8 MPa) IN CONCRETE ULTIMATE TENSION Lbs. (kN)	4000 PSI (27.6 MPa) IN CONCRETE ULTIMATE TENSION Lbs. (kN) Lbs. (kN)	ULTIMATE TENSILE AND YIELD STRENGTH GRADE 60 REBAR	
				MINIMUM YIELD STRENGTH Lbs. (kN)	MINIMUM ULTIMATE TENSILE STRENGTH
# 3 (9.5)	3-3/8 (85.7)	7,480 (33.3)	8,090 (35.9)	6,600 (29.4)	9,900 (44.0)
	4-1/2 (114.3)	N/A	10,488 (46.6)	6,600 (29.4)	9,900 (44.0)
# 4 (12.7)	4-1/2 (114.3)	N/A	14,471 (64.4)	12,000 (53.4)	18,000 (80.1)
	6 (152.4)	11,235 (50.0)	20,396 (90.7)	12,000 (53.4)	18,000 (80.1)
# 5 (15.9)	5-5/8 (142.9)	N/A	21,273 (94.6)	18,600 (82.7)	27,900 (124.1)
	7-1/2 (190.5)	18,108 (80.6)	31,863 (141.7)	18,600 (82.7)	27,900 (124.1)
# 6 (19.1)	6-3/4 (171.5)	N/A	27,677 (123.1)	26,400 (117.4)	39,600 (176.2)
	9 (228.6)	29,338 (130.5)	47,879 (212.9)	26,400 (117.4)	39,600 (176.2)
# 7 (22.2)	7-7/8 (200.0)	N/A	43,905 (195.3)	36,000 (160.1)	54,000 (240.2)
	10-1/2 (266.7)	N/A	52,046 (231.5)	36,000 (160.1)	54,000 (240.2)
# 8 (25.4)	9 (228.6)	N/A	55,676 (247.7)	47,400 (210.9)	71,100 (316.3)
	12 (304.8)	48,000 (213.5)	77,358 (344.1)	47,400 (210.9)	71,100 (316.3)
# 9 (28.6)	10-1/8 (257.2)	N/A	62,443 (277.8)	60,000 (266.9)	90,000 (400.4)
	13-1/2 (342.9)	N/A	71,959 (320.1)	60,000 (266.9)	90,000 (400.4)
# 10 (31.8)	11-1/4 (285.8)	N/A	70,165 (312.1)	76,200 (339.0)	114,300 (508.5)
	15 (381.0)	N/A	78,545 (349.4)	76,200 (339.0)	114,300 (508.5)

1Allowable working loads for the single installations under static loading should not exceed 25% ultimate capacity or the allowable load of the anchor rod.

2Ultimate load values in 2000 and 4000 psi stone aggregate concrete. Ultimate loads are indicated for the embedment shown in the Embedment in Concrete column. Performance values are based on the use of minimum Grade 60 reinforcing bar. The use of lower strength rods will result in lower ultimate tension and shear loads.

3SHEAR 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.

G5 Epoxy Adhesive — Average Ultimate Tension Loads[1,2] for Threaded Rod Installed in Solid Concrete

THREADED ROD In. (mm)	HOLE DIAMETER In. (mm)	EMBEDMENT IN CONCRETE In. (mm)	≥ 3000 PSI (13.8 MPa) IN CONCRETE ULTIMATE TENSION Lbs. (kN)
1-1/2 (38.1)	1-3/4 (44.5)	13 (330.2)	100,250 (490.4)
		17 (431.8)	143,600 (638.8)
		19 (482.6)	150,000 (667.3)
2 (50.8)	2-1/4 (57.2)	16 (406.4)	150,000 (667.3)
		17 (431.8)	169,700 (754.9)

1 Allowable working loads for the single installations under static loading should not exceed 25% ultimate capacity or the allowable load of the anchor rod.

2 Ultimate load values are ≥3000 psi in stone aggregate concrete. Ultimate loads are indicated for the embedment shown in the Embedment in Concrete column. 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 loads. See chart below.

G5 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
Minimum Edge Distance—Tension	
70% Tension Load →	0.50 x Anchor Embedment
Critical Edge Distance—Shear	
100% Shear Load →	1.25 x Anchor Embedment
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
Minimum Spacing—Tension	
75% Tension Load →	0.75 x Anchor Embedment
Critical Spacing—Shear	
100% Shear Load →	1.50 x Anchor Embedment
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.

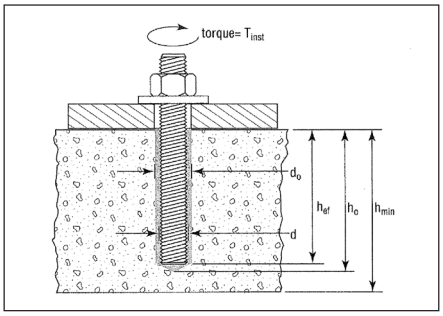
Strength Design Performance Values

SPECIFICATIONS AND DETAILS FOR INSTALLATION OF ANCHORS IN CONCRETE WITH EPCON G5 ADHESIVE

Characteristic	Symbol	Units	Threaded Rod Diameter (d)						
			3/8″	1/2″	5/8″	3/4″	7/8″	1″	1-1/4″
Nominal carbide bit diameter	d_o	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.	3-3/8	4-1/2	5-5/8	6-3/4	7-7/8	9	11-1/4
Minimum spacing	s_{min}	in.	15/16	1	2-1/2	6	3-1/2	4	5
Minimum edge distance	c_{min}	in.	15/16	1	2-1/2	6	3-1/2	4	5
Minimum concrete thickness	h_{min}	in.	$h_{ef} + 1\text{-}1/4$		$h_{ef} + 2d_o$				
Maximum tightening torque for pretension clamping	T_{inst}	ft lb	9	16	47	90	145	170	370

For SI: 1 inch= 25.4mm, 1 lbf = 4.45N, 1ft-lbf = 1.356N-m, 1psi = .006895MPa

ANCHOR INSTALLATION



BRUSH SPECIFICATIONS

Brush color	Part #	(d) Anchor diameter (in.)	(dr) Rebar	(d_o) Drill bit diameter (in.)	Minimum brush diameter (in.)
Grey	SB038	3/8	# 3	7/16	0.563
Brown	SB012	1/2	◆	9/16	0.675
Green	SB058	5/8	# 5	3/4	0.900
Yellow	SB034	3/4	# 6	7/8	1.125
Red	SB078	7/8	◆	1	1.350
Purple	SB010	1	# 7	1-1/8	1.463
Blue	SB125	1-1/4	◆	1-3/8	1.575

For SI: 1 inch= 25.4mm ◆ Available with lead time.

WORKING TIMES AND CURE TIME FOR EPCON G5 ADHESIVE

Concrete Temp. (°F) [1,2]	Working Time (minutes) [3]	Cure Time (hours) [4]
70	15	24
90	9	24
110	9	24

For SI: t°(°F-32) X .555 = °C.

1 Adhesives must be installed in base material temperatures of 70°F to 110°F or artificially maintained.

2 Cartridge temperature should not differ significantly from the temperature of the base material.

3 Working time is the maximum time from the end of mixing to when the insertion of the anchor into the adhesive shall be completed.

4 Cure time is the minimum time from the end of working time to when the anchor may be torqued or loaded. Anchors are to be undisturbed during the cure time.

Strength Design Performance Values

TABLE 1: EPCON G5 ADHESIVE STEEL DESIGN INFORMATION FOR THREADED ROD

Characteristic		Symbol	Units	Anchor nominal diameter (d)						
				3/8″	1/2″	5/8″	3/4″	7/8″	1″	1-1/4″
Threaded rod effective cross-sectional area		A_{se}	inch^2	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	2,250	4,940	7,870	11,640	16,070	21,080	33,730
	Strength reduction factor for tension, steel failure mode[1]	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	4,845	10,640	16,950	25,090	34,630	45,430	72,680
	Strength reduction factor for tension, steel failure mode[1]	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	Nominal steel strength in tension	N_{sa}	lb	5,810	10,640	16,950	25,090	34,630	45,430	72,680
	Nominal steel strength in shear	V_{sa}	lb	2,905	6,390	10,170	15,050	20,780	27,260	43,610
	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[1]	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

1 The tabulated value of Φ applies when the load combinations of Section 1605.2.1 of the IBC, Section 1612.2.1 of the UBC, or ACI 318 Section 9.2 are used as set forth in ACI 318 D.4.4. If the load combinations of Section 1909.2 of the UBC or ACI 318 Appendix C are used, the appropriate value of Φ must be determined in accordance with ACI 318 D.4.5.

TABLE 2: EPCON G5 ADHESIVE CONCRETE BREAKOUT DESIGN INFORMATION

Characteristic	Symbol	Units	Nominal rod diameter, d (inch)						
			3/8″	1/2″	5/8″	3/4″	7/8″	1″	1-1/4″
Effectiveness factor for uncracked concrete	$k_{c,uncr}$	–	24	24	24	24	24	24	24
Effectiveness factor for cracked concrete	$k_{c,cr}$	–	17	17	17	17	17	17	17
Minimum concrete thickness[2]	h_{min}	in.	h_{ef} + 1-1/4		$h_{ef} + 2d_o$				
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.	3-3/8	4-1/2	5-5/8	6-3/4	7-7/8	9	11-1/4
Minimum spacing	s_{min}	in.	15/16	1	2-1/2	6	3-1/2	4	5
Minimum edge distance	c_{min}	in.	15/16	1	2-1/2	6	3-1/2	4	5
Critical edge distance	c_{ac}	in.	See Section 4.1.10 of the ESR-1137 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

1 The tabulated value of Φ applies when the load combinations of Section 1605.2.1 of the IBC, Section 1612.2.1 of the UBC, or ACI 318 Section 9.2 are used and the requirements of ACI 318 D.4.4(c) for Condition B are met. If the load combinations of Section 1909.2 of the UBC or ACI 318 Appendix C are used, the appropriate value of Φ must be determined in accordance with ACI 318 D.4.5 for Condition B.

2 d_o represents the nominal drill hole diameter.

TABLE 3: EPCON G5 ADHESIVE ANCHOR BOND STRENGTH DESIGN INFORMATION[1]

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		$h_{ef,min}$	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.	3-3/8	4-1/2	5-5/8	6-3/4	7-7/8	9	11-1/4
Temperature Range A[2,4,5]	Characteristic Bond Strength for Uncracked Concrete	$\tau_{K,uncr}$	psi	1,620	1,620	1,620	1,620	1,620	1,620	1,620
	Characteristic Bond Strength for Cracked Concrete[6]	$\tau_{K,cr}$	psi	665	785	785	785	785	785	785
Temperature Range B[3,4,5]	Characteristic Bond Strength for Uncracked Concrete	$\tau_{K,uncr}$	psi	1,245	1,245	1,245	1,245	1,245	1,245	1,245
	Characteristic Bond Strength for Cracked Concrete[6]	$\tau_{K,cr}$	psi	510	605	605	605	605	605	605
Continuous Inspection	Strength Reduction Factor - Dry Concrete	$\Phi_{dry, ci}$	–	0.65	0.65	0.65	0.65	0.55	0.55	0.55
	Strength Reduction Factor - Saturated Concrete	$\Phi_{sat, ci}$	–	0.65	0.65	0.65	0.65	0.55	0.55	0.55
	Strength Reduction Factor - Water-Filled Holes	$\Phi_{wf, ci}$	–	0.65	0.65	0.65	0.65	0.55	0.55	0.55
	Strength Reduction Factor - Submerged Concrete	$\Phi_{sub, ci}$	–	0.65	0.65	0.65	0.65	0.55	0.55	0.55
Periodic Inspection	Strength Reduction Factor - Dry Concrete	$\Phi_{dry, ci}$	–	0.55	0.55	0.55	0.55	0.45	0.45	0.45
	Strength Reduction Factor - Saturated Concrete	$\Phi_{sat, ci}$	–	0.55	0.55	0.55	0.55	0.45	0.45	0.45
	Strength Reduction Factor - Water-Filled Holes	$\Phi_{wf, ci}$	–	0.55	0.55	0.55	0.55	0.45	0.45	0.45
	Strength Reduction Factor - Submerged Concrete	$\Phi_{sub, ci}$	–	0.55	0.55	0.55	0.55	0.45	0.45	0.45
Reduction factor for seismic tension		$\Phi_{N, seis}$	–	0.80						

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 strength range 2,500 psi to 8,500 psi.

2 Temperature range A: Maximum short term temperature of 110 degrees F and maximum long term temperature of 70 degrees F.

3 Temperature range B: Maximum short term temperature of 110 degrees F and maximum long term temperature of 110 degrees F.

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

5 For load combinations consisting of only short-term loads, such as wind or seismic loads, bond strengths may be increased by 5% for Temperature Range A and by 36% for Temperature Range B.

6 For structures assigned to IBC or IRC Seismic Design Category C, D, E, or F, or UBC Seismic Zone 2b, 3, or 4, bond strength values must be multiplied by $\alpha_{N,seis}$.

SEE TABLE ON ALLOWABLE STRESS DESIGN, ASD, USING LOW STRENGTH CARBON STEEL (A36) THREADED ROD ON NEXT PAGE.

Strength Design Performance Values

TABLE 4: STRENGTH DESIGN USING LOW STRENGTH CARBON STEEL (A36) THREADED ROD ◆ INSTALLED IN f′c = 2,500 PSI – 8,000 PSI UNCRACKED CONCRETE WITH EPCON G5 ADHESIVE

Anchor Diameter (d)	Embedment Depth, h_{ef} (in) (min./max)	* Characteristic Bond Strength τ_K, uncr (psi)	Allowable Tension Load LBS				
			2,500 PSI (Controlling Mode)	3,000 PSI (Controlling Mode)	4,000 PSI (Controlling Mode)	6,000 PSI (Controlling Mode)	8,000 PSI (Controlling Mode)
3/8	2-3/8	1,620	2,493 (BOND)	2,493 (BOND)	2,493 (BOND)	2,493 (BOND)	2,493 (BOND)
	3-3/8	1,620	3,375 (STEEL)	3,375 (STEEL)	3,375 (STEEL)	3,375 (STEEL)	3,375 (STEEL)
1/2	2-3/4	1,620	3,557 (CONCRETE)	3,849 (CONCRETE)	3,849 (BOND)	3,849 (BOND)	3,849 (BOND)
	4-1/2	1,620	6,173 (STEEL)	6,173 (STEEL)	6,173 (STEEL)	6,173 (STEEL)	6,173 (STEEL)
5/8	3-1/8	1,620	4,309 (CONCRETE)	4,720 (CONCRETE)	5,450 (CONCRETE)	5,467 (BOND)	5,467 (BOND)
	5-5/8	1,620	9,833 (STEEL)	9,833 (STEEL)	9,833 (STEEL)	9,833 (BOND)	9,833 (STEEL)
3/4	3-1/2	1,620	5,107 (CONCRETE)	5,595 (CONCRETE)	6,460 (CONCRETE)	7,348 (BOND)	7,348 (BOND)
	6-3/4	1,620	13,679 (CONCRETE)	14,171 (BOND)	14,171 (BOND)	14,171 (BOND)	14,171 (BOND)
7/8	3-1/2	1,620	5,107 (CONCRETE)	5,595 (CONCRETE)	6,460 (CONCRETE)	7,014 (BOND)	7,014 (BOND)
	7-7/8	1,620	15,781 (BOND)	15,781 (BOND)	15,781 (BOND)	15,781 (BOND)	15,781 (BOND)
1	4	1,620	6,240 (CONCRETE)	6,836 (CONCRETE)	7,893 (CONCRETE)	9,161 (BOND)	9,161 (BOND)
	9	1,620	20,612 (BOND)	20,612 (BOND)	20,612 (BOND)	20,612 (BOND)	20,612 (BOND)
1-1/4	5	1,620	8,721 (CONCRETE)	9,553 (CONCRETE)	11,031 (CONCRETE)	13,510 (CONCRETE)	14,314 (BOND)
	11-1/4	1,620	29,432 (CONCRETE)	32,206 (BOND)	32,206 (BOND)	32,206 (BOND)	32,206 (BOND)

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

1. Refer to Tables 1, 2 and 3 for steel, concrete and bond strength design information.
2. Bond strength reduction factors based on periodic inspection and dry, saturated, water-filled or submerged concrete conditions.

◆ Call 800-899-7890 for controlling modes and loads using stainless steel or higher strength threaded rod.

Procedure to calculate tension load for strength design – SD

Example: 1/2" diameter anchor with embedment depth of 4-1/2" installed in 4,000 psi concrete

1. Calculate steel strength – tension (per ACI 318 D.5.1.2)
   $\Phi N_{sa} = 0.75 * 8,230 = 6,173$ lbs
2. Calculate concrete breakout strength – tension
   $\Phi k_{uncr}\sqrt{2,500\text{ psi}}\ h_{ef}^{1.5} = 0.65 * 24 * \sqrt{2,500} * 4\text{-}1/2^{1.5}$
   $= 7,446$ lbs per ACI 318 D.5.2
   Normalize load for 4,000 psi concrete $= 7,446\sqrt{\frac{4,000}{2,500}} = 9,418$ lbs
3. Calculate bond strength – tension
   $\Phi * d * \pi * h_{ef} * \tau_{k,uncr} = 0.55 * 1/2 * 3.1415 * 4\text{-}1/2 * 1,620 = 6,298$ lbs (per equations D-16a, and D-16f of ESR-1137)
4. Controlling strength is 6,173 lbs (steel) – lowest load value amongst bond, concrete and steel controlling modes

Strength Design Load = 6,173 lbs

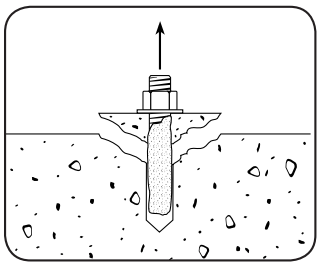
Procedure to calculate tension load for allowable stress design – ASD

1. Determine load combination and conversion factor.
   – Assume 30% dead load and 70% live load using load combination = 1.2D + 1.6L = 1.2 (0.3) + 1.6 (0.7) = 1.48 (per ACI318 Sect. 9.2)
2. Divide controlling strength (see strength design procedure - step 4) 6,173 lbs by the conversion factor of 1.48 = 6,173/1.48 = 4,171 lbs (steel)

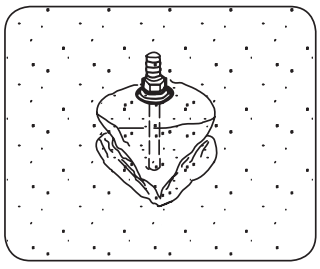
Allowable Strength Design Load = 4,171 lbs

Controlling Modes

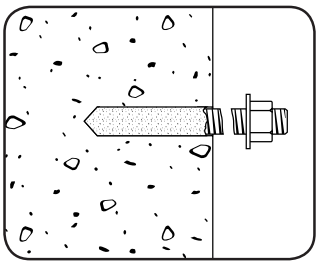
Bond



Concrete



Steel



G5 Chemical Resistance

G5 Chemical Resistance

	HIGH Anchors installed with G5 could be submerged in these materials.	MEDIUM Intermittent exposure or temporary submersion due to splash or spill.	LOW Exposure of G5 should be limited to splash and spill exposure followed by immediate cleanup.
Xylene	✔		
Gasoline	✔		
20% Caustic (NaOH)	✔		
Fresh Water	✔		
Salt Water	✔		
10% Sulfuric Acid (H_2SO_4)		✔	
3.5% Hydrochloric Acid (HCL)		✔	
9% Phosphoric Acid		✔	
Toluene		✔	
10% Nitric Acid		✔	
8.5% Ammonium Hydroxide		✔	
5% Bleach			✔
Acetone			✔
Glacial Acetic Acid			✔
Methanol			✔
Methylene Chloride			✔

Important Note: This chemical resistance table above only applies when G5 epoxy is used for installing anchors into concrete in a conventional manner with recommended hole sizes. Installation of the anchor must always be done in a drilled hole which is completely cleaned of all concrete dust and is dry. Exposure to solvents, chemical and water, as listed above, should occur only after the G5 epoxy has full cured.