GENERAL INFORMATION

POWER-BOLT®+

Heavy Duty Sleeve Anchor

PRODUCT DESCRIPTION

The Power-Bolt+ anchor is a torque controlled, heavy duty sleeve style anchor which is designed for consistent performance in cracked and uncracked concrete. Suitable base materials include normal-weight concrete and lightweight concrete. The anchor is manufactured with a zinc plated carbon steel bolt, sleeve, cone and expansion clip. The Power-Bolt+ has a low profile finished hex head and a full size thick bearing sleeve to provide increased capacity in shear connections.

GENERAL APPLICATIONS AND USES

- Structural connections, i.e., beam and column anchorage
- Cracked concrete / tension zone applications
- Seismic Attachments (SDC A - F)
- Conveyors and Material Handling
- Base Plates and Racking
- Guards, Bumpers and Barriers
- Mounting Machinery

FEATURES AND BENEFITS

+ Consistent performance in high and low strength concrete
+ Anchor design allows for follow-up expansion after setting under tensile loading
+ Drill bit size is the same as the nominal anchor diameter
+ Anchor can be installed through standard fixture holes
+ Length ID code and identifying marking stamped on head of each anchor
+ High shear load capacity
+ Low profile finished hex bolt head
+ DEWALT dust removal drilling system (with HEPA dust extractor) can be used for an OSHA 1926.1153 Table 1 compliant solution

APPROVALS AND LISTINGS

- International Code Council, Evaluation Service (ICC-ES), ESR-3260 for cracked and uncracked concrete; code complaint with the 2021 IBC/IRC, 2018 IBC/IRC, 2015 IBC/IRC and 2012 IBC/IRC
- Tested in accordance with ACI 355.2/ASTM E488 and ICC-ES AC193 for use in structural concrete under the design provisions of ACI 318 (-19 or -14) Chapter 17 or ACI 318-11 Appendix D
- Evaluated and qualified by an accredited independent testing laboratory for recognition in cracked and uncracked concrete including seismic and wind loading (anchor category 1 for 1/2" to 3/4" sizes)
- City of Los Angeles, LABC Supplement (within ESR-3260)

GUIDE SPECIFICATIONS

CSI Divisions: 03 16 00 - Concrete Anchoring and 05 05 19 - Post-Installed Concrete Anchors
Expansion anchors shall be Power-Bolt+ as supplied by DEWALT, Towson, MD. Anchors shall be installed in accordance with published instructions and the Authority Having Jurisdiction.

SECTION CONTENTS

POWER-BOLT+ ASSEMBLY

HEAD STYLES

- Finished Hex Head

ANCHOR MATERIALS

- Zinc plated carbon steel bolt, washer, cone, sleeve, and expansion clip; assembled with a plastic compression ring and retainer nut

ANCHOR SIZE RANGE (TYP.)

- 1/4" through 3/4" diameters

SUITABLE BASE MATERIALS

- Normal-weight concrete
- Lightweight concrete

TENSION ZONE CRACKED CONCRETE
SEISMIC REGION QUALIFICATION
CODE LISTED ICC-ES ESR-3260 CONCRETE
DDA DEWALT DESIGN ASSIST
DUST X+ ANCHOR INSTALLATION SYSTEM

MATERIAL SPECIFICATIONS

Anchor Component	Carbon Steel Hex Head
Internal bolt	SAE Grade 8 equivalent ($f_y \geq 130{,}000$ psi)
Washer	Carbon steel, ASTM F844; meets dimensional requirements of ANSI B18.22.2, Type A Plain
Extension sleeve	Carbon Steel
Expansion clip	Carbon steel
Compression ring / Retention nut	Engineered plastic (Nylon)
Zinc plating	ASTM B633, SC1, Type III (Fe/Zn 5) – Mild service condition

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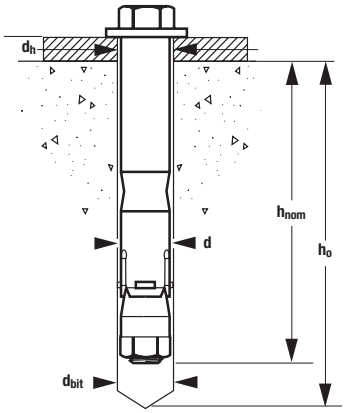
INSTALLATION SPECIFICATIONS

Power-Bolt+ Anchor Installation Specifications

Anchor Property/Setting Information	Notation	Units	Nominal Anchor Diameter (in.)				
			1/4	3/8	1/2	5/8	3/4
Anchor outside diameter	d	in. (mm)	0.250 (6.4)	0.375 (9.5)	0.500 (12.7)	0.625 (15.9)	0.750 (19.1)
Internal Bolt Diameter (UNC)	-	in. (mm)	#8 (4)	1/4 (6.4)	3/8 (9.5)	7/16 (11.1)	9/16 (14.3)
Nominal drill bit diameter (ANSI)	d_{bit}	in.	1/4	3/8	1/2	5/8	3/4
Minimum diameter of hole clearance in fixture	d_h	in. (mm)	5/16 (8)	7/16 (11)	9/16 (14)	11/16 (17)	13/16 (21)
Minimum nominal embedment depth	h_{nom}	in. (mm)	1-1/4 (32)	1-5/8 (41)	2-1/2 (64)	2-3/4 (70)	3 (76.2)
Minimum hole depth	h_o	in. (mm)	h_{nom} + 1/4 (6)		h_{nom} + 3/8 (10)	h_{nom} + 1/2 (13)	
Minimum member thickness	h_{min}	in. (mm)	3-1/2 (89)	4-1/2 (114)	5 (127)	6-1/2 (165)	7 (178)
Minimum edge distance	c_{min}	in. (mm)	1-3/4 (44)	2-3/4 (70)	3-1/4 (83)	4-1/2 (114)	6 (152)
Minimum spacing distance	s_{min}	in. (mm)	2 (51)	3-1/2 (89)	4-1/2 (114)	6 (152)	5 (127)
Installation torque	T_{inst}	ft.-lbf. (N-m)	4 (5)	20 (27)	40 (54)	60 (81)	110 (149)
Torque wrench/socket size	-	in.	3/8	1/2	5/8	3/4	15/16
Bolt Head Height	-	in. (mm)	1/8 (3)	13/64 (5)	9/32 (7)	5/16 (8)	3/8 (10)
Washer O.D.	-	in.	7/16	47/64	1	1-1/4	1-15/32

See Strength Design Information for installation specifications in strict accordance with ICC-ES ESR-3260.



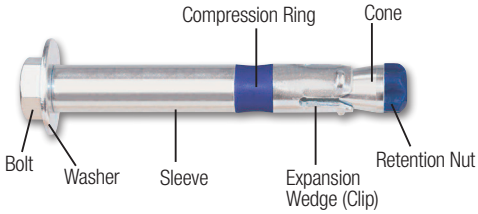
Head Marking

Legend

'PB+' Symbol = Power-Bolt+ Strength Design Compliant (see ordering information)

Letter Code = Length Identification Mark

Power-Bolt+ Anchor Assembly



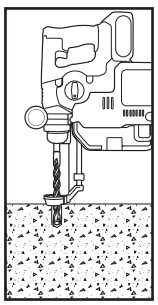
Length Identification

Mark	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
From	1-1/2"	2"	2-1/2"	3"	3-1/2"	4"	4-1/2"	5"	5-1/2"	6"	6-1/2"	7"	7-1/2"	8"	8-1/2"	9"	9-1/2"	10"
Up to but not including	2"	2-1/2"	3"	3-1/2"	4"	4-1/2"	5"	5-1/2"	6"	6-1/2"	7"	7-1/2"	8"	8-1/2"	9"	9-1/2"	10"	11"

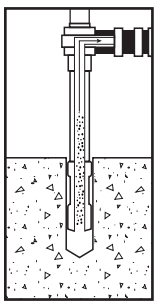
Length identification mark indicates the length of the anchor measured from under the washer to the end of the anchor.

INSTALLATION INSTRUCTIONS

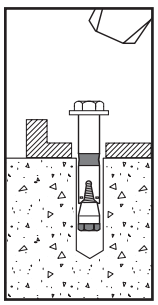
Installation Instructions for Power-Bolt+ Anchor



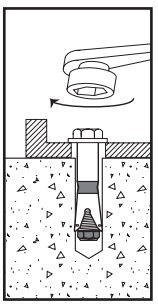
Step 1
Using the proper drill bit size, drill a hole into the base material to the required depth. The tolerances of the drill bit used should meet the requirements of ANSI Standard B212.15.



Step 2
Remove dust and debris from the hole during drilling (e.g. dust extractor, hollow bit) or following drilling (e.g. suction, forced air) to extract loose particles created by drilling. Ensure the cone is snug and uniformly under the expansion wedge (clip) with the clip fingers overlapping the anchor cone, prior to installation using the retention nut (see photo below).



Step 3
Drive anchor through the fixture into the hole. Be sure the anchor is driven to the minimum required embedment depth, h_{nom} .



Step 4
Tighten the anchor with a torque wrench by applying the required installation torque, T_{inst}.

PERFORMANCE DATA (ASD)

Ultimate Load Capacities for Power-Bolt+ in Normal-Weight Concrete[1,2]

Nominal Anchor Diameter d in.	Minimum Embed. Depth in. (mm) h_{nom}	Minimum Concrete Compressive Strength									
		f'c = 2,500 psi (17.3 MPa)		f'c = 3,000 psi (20.7 MPa)		f'c = 4,000 psi (27.6 MPa)		f'c = 6,000 psi (41.4 MPa)		f'c = 8,000 psi (55.2 MPa)	
		Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
1/4	1-1/4 (32)	1,245 (5.5)	1,670 (7.4)	1,260 (5.6)	1,670 (7.4)	1,290 (5.7)	1,670 (7.4)	1,345 (6.0)	1,670 (7.4)	1,397 (6.2)	1,670 (7.4)
	1-3/4 (44)	1,740 (7.7)	1,670 (7.4)	1,905 (8.5)	1,670 (7.4)	1,945 (8.7)	1,670 (7.4)	1,945 (8.7)	1,670 (7.4)	1,945 (8.7)	1,670 (7.4)
3/8	1-5/8 (41)	1,420 (6.3)	2,420 (10.8)	1,555 (6.9)	2,460 (10.9)	1,795 (8.0)	2,460 (10.9)	2,105 (9.4)	2,470 (11.0)	2,430 (10.8)	2,810 (12.5)
	2 (51)	2,740 (12.2)	3,990 (17.7)	3,000 (13.3)	3,990 (17.7)	3,465 (15.4)	3,990 (17.7)	4,140 (18.4)	3,990 (17.7)	4,425 (19.7)	3,990 (17.7)
	2-3/4 (70)	4,130 (18.4)	3,990 (17.7)	4,425 (19.7)	3,990 (17.7)	4,425 (19.7)	3,990 (17.7)	4,425 (19.7)	3,990 (17.7)	4,425 (19.7)	3,990 (17.7)
1/2	2-1/2 (64)	3,880 (17.3)	7,420 (33.0)	4,250 (18.9)	8,030 (35.7)	4,905 (21.8)	8,030 (35.7)	5,150 (22.9)	8,030 (35.7)	5,518 (24.5)	8,030 (35.7)
	3 (76)	5,190 (23.1)	8,030 (35.7)	5,685 (25.3)	8,030 (35.7)	6,560 (29.2)	8,030 (35.7)	7,985 (35.5)	8,030 (35.7)	9,065 (40.3)	8,030 (35.7)
	3-1/4 (83)	7,120 (31.7)	8,030 (35.7)	7,660 (34.1)	8,030 (35.7)	8,645 (38.5)	8,030 (35.7)	9,400 (41.8)	8,030 (35.7)	10,835 (48.2)	8,030 (35.7)
5/8	2-3/4 (70)	4,745 (21.1)	9,975 (44.4)	5,195 (23.1)	10,930 (48.6)	6,000 (26.7)	12,620 (56.1)	6,845 (30.4)	13,155 (58.5)	7,200 (32.0)	13,155 (58.5)
	3-1/2 (89)	6,995 (31.1)	9,975 (44.4)	7,660 (34.1)	10,930 (48.6)	8,845 (39.3)	12,620 (56.1)	11,325 (50.4)	13,155 (58.5)	12,900 (57.4)	13,155 (58.5)
	3-3/4 (95)	8,710 (38.7)	12,015 (53.4)	9,545 (42.5)	14,320 (63.7)	11,020 (49.0)	16,535 (73.6)	12,820 (57.0)	18,250 (81.2)	14,800 (65.8)	18,250 (81.2)
3/4	3 (76)	5,655 (25.2)	10,950 (48.7)	6,195 (27.6)	11,995 (53.4)	7,155 (31.8)	13,850 (61.6)	8,385 (37.3)	18,510 (82.3)	9,685 (43.1)	21,370 (95.1)
	4-3/8 (111)	10,870 (48.4)	18,635 (82.9)	11,910 (53.0)	20,415 (90.8)	13,750 (61.2)	23,575 (104.9)	14,705 (65.4)	23,575 (104.9)	16,975 (75.5)	23,575 (104.9)
	7 (178)	18,145 (80.7)	24,290 (108.0)	19,880 (88.4)	24,290 (108.0)	22,955 (102.1)	24,290 (108.0)	28,445 (126.5)	24,290 (108.0)	29,863 (132.8)	24,290 (108.0)

1. The tabulated load values are applicable to single anchors installed in uncracked concrete with no edge or spacing considerations. Concrete compressive strength must be at the specified minimum at the time of installation.
2. Ultimate load capacities must reduced by a minimum safety factor of 4.0 or greater to determine allowable working loads.

Allowable Load Capacities for Power-Bolt+ in Normal-Weight Concrete[1,2,3]

Nominal Anchor Diameter d in.	Minimum Embed. Depth in. (mm) h_{nom}	Minimum Concrete Compressive Strength									
		f'c = 2,500 psi (17.3 MPa)		f'c = 3,000 psi (20.7 MPa)		f'c = 4,000 psi (27.6 MPa)		f'c = 6,000 psi (41.4 MPa)		f'c = 8,000 psi (55.2 MPa)	
		Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
1/4	1-1/4 (32)	310 (1.4)	420 (1.9)	315 (1.4)	420 (1.9)	325 (1.4)	420 (1.9)	335 (1.5)	420 (1.9)	350 (1.6)	420 (1.9)
	1-3/4 (44)	435 (1.9)	420 (1.9)	475 (2.1)	420 (1.9)	485 (2.2)	420 (1.9)	485 (2.2)	420 (1.9)	485 (2.2)	420 (1.9)
3/8	1-5/8 (41)	355 (1.6)	605 (2.7)	390 (1.7)	615 (2.7)	450 (2.0)	615 (2.7)	525 (2.3)	620 (2.8)	610 (2.7)	705 (3.1)
	2 (51)	685 (3.0)	1,000 (4.4)	750 (3.3)	1,000 (4.4)	865 (3.8)	1,000 (4.4)	1,035 (4.6)	1,000 (4.4)	1,105 (4.9)	1,000 (4.4)
	2-3/4 (70)	1,035 (4.6)	1,000 (4.4)	1,105 (4.9)	1,000 (4.4)	1,105 (4.9)	1,000 (4.4)	1,105 (4.9)	1,000 (4.4)	1,105 (4.9)	1,000 (4.4)
1/2	2-1/2 (64)	970 (4.3)	1,855 (8.3)	1,065 (4.7)	2,010 (8.9)	1,225 (5.4)	2,010 (8.9)	1,290 (5.7)	2,010 (8.9)	1,380 (6.1)	2,010 (8.9)
	3 (76)	1,300 (5.8)	2,010 (8.9)	1,420 (6.3)	2,010 (8.9)	1,640 (7.3)	2,010 (8.9)	1,995 (8.9)	2,010 (8.9)	2,265 (10.1)	2,010 (8.9)
	3-1/4 (83)	1,780 (7.9)	2,010 (8.9)	1,915 (8.5)	2,010 (8.9)	2,160 (9.6)	2,010 (8.9)	2,350 (10.5)	2,010 (8.9)	2,710 (12.1)	2,010 (8.9)
5/8	2-3/4 (70)	1,185 (5.3)	2,495 (11.1)	1,300 (5.8)	2,735 (12.2)	1,500 (6.7)	3,155 (14.0)	1,710 (7.6)	3,290 (14.6)	1,800 (8.0)	3,290 (14.6)
	3-1/2 (89)	1,750 (7.8)	2,495 (11.1)	1,915 (8.5)	2,735 (12.2)	2,210 (9.8)	3,155 (14.0)	2,830 (12.6)	3,290 (14.6)	3,225 (14.3)	3,290 (14.6)
	3-3/4 (95)	2,180 (9.7)	3,005 (13.4)	2,385 (10.6)	3,580 (15.9)	2,755 (12.3)	4,135 (18.4)	3,205 (14.3)	4,565 (20.3)	3,700 (16.5)	4,565 (20.3)
3/4	3 (76)	1,415 (6.3)	2,740 (12.2)	1,550 (6.9)	3,000 (13.3)	1,790 (8.0)	3,465 (15.4)	2,095 (9.3)	4,630 (20.6)	2,420 (10.8)	5,345 (23.8)
	4-3/8 (111)	2,720 (12.1)	4,660 (20.7)	2,980 (13.3)	5,105 (22.7)	3,440 (15.3)	5,895 (26.2)	3,675 (16.3)	5,895 (26.2)	4,245 (18.9)	5,895 (26.2)
	7 (178)	4,535 (20.2)	6,075 (27.0)	4,970 (22.1)	6,075 (27.0)	5,740 (25.5)	6,075 (27.0)	7,110 (31.6)	6,075 (27.0)	7,465 (33.2)	6,075 (27.0)

1. Allowable load capacities listed are calculated using an applied safety factor of 4.0.
2. Tabulated load values are for anchors installed in uncracked concrete. Concrete compressive strength must be at the specified minimum at the time of installation.
3. Allowable load capacities are multiplied by reduction factors when anchor spacing or edge distances are less than critical distances.

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Load Adjustment Factors for Normal-Weight Concrete

Spacing Reduction Factors - Tension (F_{NS})

Diameter (in)		1/4	3/8	1/2	5/8	3/4
Nominal Embedment h_{nom} (in)		1-1/4	2	2-1/2	2-3/4	3
Minimum Spacing s_{min} (in)		2	3-1/2	4-1/2	6	5
Spacing Distance (inches)	2	0.78	-	-	-	-
	2-1/2	0.82	-	-	-	-
	3	0.87	-	-	-	-
	3-1/2	0.91	0.80	-	-	-
	4	0.96	0.83	-	-	-
	4-1/2	1.00	0.86	0.83	-	-
	5	1.00	0.89	0.85	-	0.77
	5-1/2	1.00	0.92	0.88	-	0.79
	6	1.00	0.95	0.91	0.85	0.81
	6-1/2	1.00	0.98	0.93	0.87	0.83
	7	1.00	1.00	0.96	0.90	0.85
	7-1/2	1.00	1.00	0.98	0.92	0.87
	8	1.00	1.00	1.00	0.95	0.89
	8-1/2	1.00	1.00	1.00	0.97	0.92
	9	1.00	1.00	1.00	1.00	0.94
	9-1/2	1.00	1.00	1.00	1.00	0.96
	10	1.00	1.00	1.00	1.00	0.98
	10-1/2	1.00	1.00	1.00	1.00	1.00

Edge Distance Reduction Factors - Tension (F_{NC})

Diameter (in)		1/4	3/8	1/2	5/8	3/4
Nominal Embedment h_{nom} (in)		1-1/4	2	2-1/2	2-3/4	3
Minimum Edge Distance c_{min} (in)		1-3/4	2-3/4	3-1/4	4-1/2	6
Edge Distance (inches)	1-3/4	0.39	-	-	-	-
	2	0.44	-	-	-	-
	2-1/2	0.56	-	-	-	-
	3	0.67	0.46	-	-	-
	3-1/4	0.72	0.50	0.41	-	-
	3-1/2	0.78	0.54	0.44	-	-
	4	0.89	0.62	0.50	-	-
	4-1/2	1.00	0.69	0.56	0.75	-
	5	1.00	0.77	0.63	0.83	-
	5-1/2	1.00	0.85	0.69	0.92	-
	6	1.00	0.92	0.75	1.00	0.75
	6-1/2	1.00	1.00	0.81	1.00	0.81
	7	1.00	1.00	0.88	1.00	0.88
	7-1/2	1.00	1.00	0.94	1.00	0.94
	8	1.00	1.00	1.00	1.00	1.00

Spacing Reduction Factors - Shear (F_{VS})

Diameter (in)		1/4	3/8	1/2	5/8	3/4
Nominal Embedment h_{nom} (in)		1-1/4	2	2-1/2	2-3/4	3
Minimum Spacing s_{min} (in)		2	3-1/2	4-1/2	6	5
Spacing Distance (inches)	2	0.86	-	-	-	-
	2-1/2	0.89	-	-	-	-
	3	0.92	-	-	-	-
	3-1/2	0.94	0.88	-	-	-
	4	0.97	0.90	-	-	-
	4-1/2	1.00	0.91	0.89	-	-
	5	1.00	0.93	0.91	-	0.84
	5-1/2	1.00	0.95	0.93	-	0.86
	6	1.00	0.97	0.94	0.89	0.87
	6-1/2	1.00	0.99	0.96	0.91	0.88
	7	1.00	1.00	0.97	0.93	0.90
	7-1/2	1.00	1.00	0.99	0.94	0.91
	8	1.00	1.00	1.00	0.96	0.93
	8-1/2	1.00	1.00	1.00	0.98	0.94
	9	1.00	1.00	1.00	1.00	0.96
	9-1/2	1.00	1.00	1.00	1.00	0.97
	10	1.00	1.00	1.00	1.00	0.99
	10-1/2	1.00	1.00	1.00	1.00	1.00

Edge Distance Reduction Factors - Shear (F_{VC})

Diameter (in)		1/4	3/8	1/2	5/8	3/4
Nominal Embedment h_{nom} (in)		1-1/4	2	2-1/2	2-3/4	3
Minimum Edge Distance c_{min} (in)		1-3/4	2-3/4	3-1/4	4-1/2	6
Edge Distance (inches)	1-3/4	0.39	-	-	-	-
	2	0.44	-	-	-	-
	2-1/2	0.56	-	-	-	-
	3	0.67	0.44	-	-	-
	3-1/4	0.72	0.48	0.41	-	-
	3-1/2	0.78	0.52	0.44	-	-
	4	0.89	0.59	0.51	-	-
	4-1/2	1.00	0.67	0.57	0.50	-
	5	1.00	0.74	0.63	0.56	-
	5-1/2	1.00	0.81	0.70	0.61	-
	6	1.00	0.89	0.76	0.67	0.57
	6-1/2	1.00	0.96	0.83	0.72	0.62
	7	1.00	1.00	0.89	0.78	0.67
	7-1/2	1.00	1.00	0.95	0.83	0.71
	8	1.00	1.00	1.00	0.89	0.76
	8-1/2	1.00	1.00	1.00	0.94	0.81
	9	1.00	1.00	1.00	1.00	0.86
	9-1/2	1.00	1.00	1.00	1.00	0.90
	10	1.00	1.00	1.00	1.00	0.95
	10-1/2	1.00	1.00	1.00	1.00	1.00

STRENGTH DESIGN INFORMATION

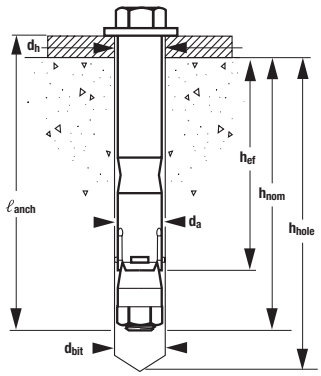
Power-Bolt+ Anchor Installation Specifications in Concrete and Supplemental Information [1]

Anchor Property/Setting Information		Notation	Units	Nominal Anchor Diameter (in.)			
				1/2	5/8	3/4	
Anchor outside diameter		d_a	in. (mm)	0.500 (12.7)	0.625 (15.9)	0.750 (19.1)	
Internal bolt diameter (UNC)		-	in. (mm)	3/8 (9.5)	7/16 (11.1)	9/16 (14.3)	
Minimum diameter of hole clearance in fixture		d_h	in. (mm)	9/16 (14.3)	11/16 (17.5)	13/16 (21.6)	
Nominal drill bit diameter (ANSI)		d_{bit}	in.	1/2	5/8	3/4	
Minimum nominal embedment depth		h_{nom}	in. (mm)	3-1/4 (83)	3-3/4 (95)	4-3/8 (111)	
Effective embedment		h_{ef}	in. (mm)	2-5/8 (67)	3 (76)	3-1/2 (89)	
Minimum hole depth		h_{hole}	in. (mm)	3-3/4 (95)	4-1/4 (108)	5 (127)	
Minimum member thickness		h_{min}	in. (mm)	5 (127)	6-1/2 (165)	7 (178)	
Minimum overall anchor length[2]		ℓ_{anch}	in. (mm)	3-1/2 (89)	4 (102)	4-1/2 (114)	
Minimum edge distance		c_{min}	in. (mm)	3-1/4 (83)	4-1/2 (114)	6 (152)	8 (203)
Minimum spacing distance		s_{min}	in. (mm)	4-1/2 (114)	6 (152)	6 (152)	5 (127)
Installation torque		T_{inst}	ft.-lbf. (N-m)	40 (54)	60 (81)	110 (149)	
Bolt Head Height		-	in. (mm)	9/32 (7.1)	5/16 (7.9)	3/8 (9.6)	
Torque wrench/socket size		-	in.	5/8	3/4	15/16	
Washer O.D.		-	in.	1	1-1/4	1-15/32	
Minimum specified yield strength		f_y	psi (N/mm^2)	130,000 (896)	130,000 (896)	130,000 (896)	
Minimum specified ultimate tensile strength[8]		f_{uta}	psi (N/mm^2)	150,000 (1,034)	150,000 (1,034)	150,000 (1,034)	
Effective tensile stress area (internal bolt threads)		$A_{se,N}$	in^2 (mm^2)	0.0775 (50)	0.1063 (68.6)	0.1820 (117.4)	
Effective shear stress area (internal bolt shank)		$A_{se,V}$	in^2 (mm^2)	0.1069 (69)	0.1452 (93.7)	0.2410 (153.0)	
Mean axial stiffness[4]	Uncracked concrete	β_{uncr}	lbf/in. (kN/mm)	366,000 (63)	871,000 (150)	256,000 (44)	
	Cracked concrete	β_{cr}	lbf/in. (kN/mm)	64,000 (11)	94,000 (16)	27,000 (5)	

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

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318 (-19 or -14) Chapter 17 or ACI 318-11 Appendix D.
2. The listed minimum overall anchor length is based on anchor sizes available at the time of publication compared with the requirements for the minimum nominal embedment depth and fixture attachment. The actual minimum anchor length must be determined by the taking the selected nominal embedment depth (e.g. required to obtain desired load capacity) and adding the thickness of the fixture, including any spacers or shims.
3. The maximum fixture thickness, t_{max} for selected anchors can be determined by taking the length of the selected anchor and subtracting the nominal embedment into the base material.
4. Mean values shown, actual stiffness varies considerably depending on concrete strength, loading and geometry of application.

Power-Bolt+ Anchor Detail



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Tension Design information for Power-Bolt+ Anchor in Concrete

CODE LISTED
ICC-ES ESR-3260

Design Characteristic	Notation	Units	Nominal Anchor Diameter		
			1/2	5/8	3/4
Anchor category	1,2 or 3	-	1	1	1
Nominal embedment depth	h_{nom}	in. (mm)	3-1/4 (83)	3-3/4 (95)	4-3/8 (111)
Effective embedment	h_{ef}	in. (mm)	2.625 (67)	3.00 (76)	3.50 (89)
STEEL STRENGTH IN TENSION (ACI 318-19 17.6.1, ACI 318-14 17.4.1 or ACI 318-11 D.5.1)[4]					
Steel strength in tension	N_{sa}	lb (kN)	9,685 (43.1)	13,285 (59.1)	27,300 (121.4)
Reduction factor for steel strength[3]	ϕ	-	0.75		0.65
CONCRETE BREAKOUT STRENGTH IN TENSION (ACI 318-19 17.6.2, ACI 318-14 17.4.2 or ACI 318-11 D.5.2)[7]					
Effectiveness factor for uncracked concrete	k_{ucr}	-	27	27	24
Effectiveness factor for cracked concrete	k_{cr}	-	17	17	17
Modification factor for cracked and uncracked concrete[5]	$\psi_{c,N}$	-	1.0	1.0	1.0
Critical edge distance (uncracked concrete only)	c_{ac}	in. (mm)	8 (203)	6 (152)	8 (203)
Reduction factor for concrete breakout strength[4]	ϕ	-	0.65 (Condition B)		
PULLOUT STRENGTH IN TENSION (ACI 318-19 17.6.3, ACI 318-14 17.4.3 or ACI 318-11 D.5.3)[7]					
Characteristic pullout strength, uncracked concrete (2,500 psi)	$N_{p,uncr}$	lb (kN)	Not Applicable[6]	Not Applicable[6]	Not Applicable[6]
Characteristic pullout strength, cracked concrete (2,500 psi)	$N_{p,cr}$	lb (kN)	Not Applicable[6]	Not Applicable[6]	Not Applicable[6]
Reduction factor for pullout strength	ϕ	-	0.65 (Condition B)		
PULLOUT STRENGTH IN TENSION FOR SEISMIC APPLICATIONS (ACI 318-19 17.10.3, ACI 318-14 17.2.3.3 or ACI 318-11 D.3.3.3)[7]					
Characteristic pullout strength, seismic (2,500 psi)	$N_{p,eq}$	lb (kN)	Not Applicable[6]	Not Applicable[6]	Not Applicable[6]
Reduction factor for pullout strength	ϕ	-	0.65 (Condition B)		

For SI: 1 inch = 25.4 mm; 1 ksi = 6.894 N/mm²; 1 lbf = 0.0044 kN.

1. The data in this table is intended to be used with the design provisions of ACI 318 (-19 or -14) Chapter 17 or ACI 318-11 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-19 17.10, ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable, shall apply.
2. Installation must comply with the manufacturer's published installation instructions.
3. The tabulated value of ϕ for steel strength applies when the load combinations of Section 1605.2 of the IBC, ACI 318 (-19 or -14) Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ for steel strength must be determined in accordance with ACI 318-11 D.4.3. The anchors are ductile steel elements as defined in ACI 318 (-19 or -14) 2.3 or ACI 318-11 D.1, as applicable, except for the 3/4-inch-diameter, which is considered a brittle steel element for the purposes of design.
4. The tabulated value of ϕ for concrete breakout strength applies when both the load combinations of Section 1605.2 of the IBC, ACI 318 (-19 or -14) Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used and the requirements of ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, for Condition B are satisfied. If the load combinations of Section 1605.2 of the IBC, ACI 318 (-19 or -14) Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used and the requirements of ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, for Condition A are satisfied, the appropriate value of ϕ for concrete breakout strength must be determined in accordance with ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ for concrete breakout strength must be determined in accordance with ACI 318-11 D.4.4.
5. For all design cases use $\Psi_{c,N} = 1.0$. The appropriate effectiveness factor for cracked concrete (k_{cr}) or uncracked concrete (k_{uncr}) must be used.
6. Pullout strength does not control design and does not need to be calculated for indicated size and embedment.
7. Anchors are permitted to be used in lightweight concrete provided the modification factor λ_a equal to 0.8λ is applied to all values of $\sqrt{f'_c}$ affecting N_n and V_n. λ shall be determined in accordance with the corresponding version of ACI 318.
8. In accordance with ACI 318-19 17.6.1.2 and Eq. 17.6.1.1, ACI 318-14 17.4.1.2 and Eq. 17.4.1.2 or ACI 318-11 D.5.1.2 and Eq. D-2, as applicable, the nominal steel strength in tension is calculated using a limited value of f_{uta} of 125 ksi.

Shear Design information for Power-Bolt+ Anchor in Concrete

CODE LISTED
ICC-ES ESR-3260

Design Characteristic	Notation	Units	Nominal Anchor Diameter		
			1/2	5/8	3/4
Anchor category	1, 2 or 3	-	1	1	1
Nominal embedment depth	h_{nom}	in. (mm)	3-1/4 (83)	3-3/4 (95)	4-3/8 (111)
Effective embedment	h_{ef}	in (mm)	2.625 (675)	3.000 (76)	3.500 (89)
STEEL STRENGTH IN SHEAR (ACI 318-19 17.7.1, ACI 318-14 17.5.1 or ACI 318-11 D.6.1)					
Steel strength in shear[6]	V_{sa}	lb (kN)	6,005 (26.7)	13,415 (59.7)	14,820 (65.9)
Reduction factor for steel strength[3]	ϕ	-	0.65		0.60
STEEL STRENGTH IN SHEAR FOR SEISMIC APPLICATIONS (ACI 318-19 17.10.1, ACI 318-14 17.2.3.3 or ACI 318-11 D.3.3.3)					
Steel strength in shear, seismic[8]	$V_{sa,\ eq}$	lb (kN)	4,565 (20.3)	7,425 (33.0)	14,820 (65.9)
Reduction factor for steel strength in shear for seismic[3]	ϕ	-	0.65		0.60
CONCRETE BREAKOUT STRENGTH IN SHEAR (ACI 318-19 17.7.2, ACI 318-14 17.5.2 or ACI 318-11 D.6.2)[7]					
Load bearing length of anchor	ℓ_e	in (mm)	1.00 (25)	1.25 (32)	1.50 (38)
Nominal anchor diameter	d_a	in (mm)	0.500 (12.7)	0.625 (15.9)	0.750 (19.1)
Reduction factor for concrete breakout[4]	ϕ	-	0.70 (Condition B)		
PRYOUT STRENGTH IN SHEAR (ACI 318-19 17.7.3, ACI 318-14 17.2.3.3 or ACI 318-11 D.6.3)[7]					
Coefficient for pryout strength	k_{cp}	-	2.0	2.0	2.0
Reduction factor for pryout strength[5]	ϕ	-	0.70 (Condition B)		

For SI: 1 inch = 25.4 mm; 1 ksi = 6.894 N/mm²; 1 lbf = 0.0044 kN.

1. The data in this table is intended to be used with the design provisions of ACI 318 (-19 or -14) Chapter 17 or ACI 318-11 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-19 17.10, ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable, shall apply.
2. Installation must comply with the manufacturer's published installation instructions.
3. The tabulated value of ϕ for steel strength applies when the load combinations of Section 1605.2 of the IBC, ACI 318 (-19 or -14) Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ for steel strength must be determined in accordance with ACI 318-11 D.4.3. The anchors are ductile steel elements as defined inACI 318 (-19 or -14) 2.3 or ACI 318-11 D.1, as applicable, except for the 3/4-inch-diameter which is considered a brittle steel element for the purposes of design.
4. The tabulated value of ϕ for concrete breakout strength applies when both the load combinations of Section 1605.2 of the IBC, ACI 318 (-19 or -14) Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used and the requirements of ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, for Condition B are satisfied. If the load combinations of Section 1605.2 of the IBC, ACI 318 (-19 or -14) Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used and the requirements of ACI 318-19 Section 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, for Condition A are satisfied, the appropriate value of ϕ for concrete breakout strength must be determined in accordance with ACI 318-19 Section 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ for concrete breakout strength must be determined in accordance with ACI 318-11 D.4.4.
5. The tabulated value of for pryout strength applies if the load combinations of Section 1605.2 of the IBC, ACI 318 (-19 or -14) Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ for pryout strength must be determined in accordance with ACI 318-11 D.4.4, for condition B.
6. Tabulated values for steel strength in shear must be used for design. The tabulated values for the shear stress area are listed conservatively and the results for the steel strength will be more conservative when using ACI 318-19 Section 17.7.1.2 and Eq. 17.7.1.2a, ACI 318-14 Eq. 17.5.1.2b or ACI 318-11 Eq. D-29, as applicable.
7. Anchors are permitted to be used in lightweight concrete provided the modification factor λ_a equal to 0.8λ is applied to all values of $\sqrt{f'c}$ affecting N_n and V_n. λ shall be determined in accordance with the corresponding version of ACI 318.
8. Tabulated values for steel strength in shear are for seismic applications and based on test results in accordance with ACI 355.2, Section 9.6.

DESIGN STRENGTH TABLES (SD)

Tension and Shear Design Strengths for Power-Bolt+ in Cracked Concrete[1,2,3,4,5,6,7,8]

Nominal Anchor Diameter (in.)	Nominal Embed. h_{nom} (in.)	Minimum Concrete Compressive Strength									
		f'c = 2,500 psi		f'c = 3,000 psi		f'c = 4,000 psi		f'c = 6,000 psi		f'c = 8,000 psi	
		ϕNn Tension (lbs.)	ϕVn Shear (lbs.)	ϕNn Tension (lbs.)	ϕVn Shear (lbs.)	ϕNn Tension (lbs.)	ϕVn Shear (lbs.)	ϕNn Tension (lbs.)	ϕVn Shear (lbs.)	ϕNn Tension (lbs.)	ϕVn Shear (lbs.)
1/2	3-1/4	2,350	3,905	2,575	3,905	2,970	3,905	3,640	3,905	4,205	3,905
5/8	3-3/4	2,870	5,105	3,145	5,590	3,630	6,460	4,450	7,910	5,135	8,720
3/4	4-3/8	3,620	7,740	3,965	8,475	4,575	8,890	5,605	8,890	6,470	8,890

- Concrete Breakout Strength Controls - Steel Strength Controls

Tension and Shear Design Strengths for Power-Bolt+ in Uncracked Concrete[1,2,3,4,5,6,7]

Nominal Anchor Diameter (in.)	Nominal Embed. h_{nom} (in.)	Minimum Concrete Compressive Strength, f'c (psi)									
		f'c = 2,500 psi		f'c = 3,000 psi		f'c = 4,000 psi		f'c = 6,000 psi		f'c = 8,000 psi	
		ϕNn Tension (lbs.)	ϕVn Shear (lbs.)	ϕNn Tension (lbs.)	ϕVn Shear (lbs.)	ϕNn Tension (lbs.)	ϕVn Shear (lbs.)	ϕNn Tension (lbs.)	ϕVn Shear (lbs.)	ϕNn Tension (lbs.)	ϕVn Shear (lbs.)
1/2	3-1/4	3,730	3,905	4,090	3,905	4,720	3,905	5,780	3,905	6,675	3,905
5/8	3-3/4	4,560	7,145	4,995	7,830	5,770	8,720	7,065	8,720	8,155	8,720
3/4	4-3/8	5,105	8,890	5,595	8,890	6,460	8,890	7,910	8,890	9,135	8,890

- Concrete Breakout Strength Controls - Steel Strength Controls

1- Tabular values are provided for illustration and are applicable for single anchors installed in normal-weight concrete with minimum slab thickness, $h_a = 1.5*h_{min}$, and with the following conditions:
   - c_{a1} is greater than or equal to 1.5 times the critical edge distance, c_{ac} (table values based on $c_{a1} = 1.5*c_{ac}$).
   - c_{a2} is greater than or equal to 1.5 times c_{a1}.

2- Calculations were performed according to ACI 318 (-19 or -14) Chapter 17. The load level corresponding to the controlling failure mode is listed. (e.g. For tension: steel, concrete breakout and pullout; For shear: steel, concrete breakout and pryout). Furthermore, the capacities for concrete breakout strength in tension and pryout strength in shear are calculated using the effective embedment values, h_{ef}, for the selected anchors as noted in the design information tables. Please also reference the installation specifications for more information.

3- Strength reduction factors (ø) were based on ACI 318 (-19 or -14) Section 5.3 for load combinations. Condition B is assumed.

4- Tabular values are permitted for static loads only, seismic loading is not considered with these tables.

5- For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318 (-19 or -14) Chapter 17.

6- Interpolation is not permitted to be used with the tabular values. For intermediate base material compressive strengths please see ACI 318 (-19 or -14) Chapter 17. For other design conditions including seismic considerations please see ACI 318 (-19 or -14) Chapter 17.

7- The tabulated design strengths may be converted to allowable stress design values. Divide by conversion factor calculated as a weighted average of the load factors for the controlling load combination.

8- For seismic design in accordance with ACI 318, the tabulated tension design strengths in cracked concrete for concrete breakout and pullout must be multiplied by a factor of 0.75.

ORDERING INFORMATION

Power-Bolt+ (Carbon Steel with Finished Hex Head)

Cat. No.	Anchor Size	Approximate Maximum Fixture Thickness	Pack Qty.	Carton Qty.	Suggested ANSI Carbide Drill Bit Cat. No.				
					Full Head SDS-Plus	SDS-Plus	SDS-Max	Hollow Bit SDS-Plus	Hollow Bit SDS-Max
6902SD-PWR	1/4" X 1-3/4"	1/2"	100	600	-	-	-	-	-
6906SD-PWR	1/4" X 3"	1-3/4"	100	600	-	-	-	-	-
6911SD-PWR	3/8" x 1-7/8"	1/4"	50	300	DW5527	DW5427	-	-	-
6910SD-PWR	3/8" X 2-1/4"	1/4"	50	300	DW5527	DW5427	-	-	-
6913SD-PWR	3/8" X 3"	1"	50	300	DW5527	DW5427	-	-	-
6914SD-PWR	3/8" X 3-1/2"	1-1/2"	50	300	DW5527	DW5427	-	-	-
6916SD-PWR	3/8" X 4"	2"	50	300	DW5527	DW5427	-	-	-
6930SD-PWR	1/2" x 2-3/4"	1/4"	50	200	DW5537	DW5429	DW5803	DWA54012	-
6932SD-PWR	1/2" x 3-1/2"	1/4"	50	200	DW5537	DW5429	DW5803	DWA54012	-
6934SD-PWR	1/2" x 4-3/4"	1-1/2"	25	150	DW5537	DW5429	DW5803	DWA54012	-
6936SD-PWR	1/2" x 5-3/4"	2-1/2"	25	150	DW5537	DW5429	DW5803	DWA54012	-
6940SD-PWR	5/8" x 3"	1/4"	20	120	-	DW5446	DW5806	DWA54058	DWA54058
6942SD-PWR	5/8" x 4"	1/4"	15	90	-	DW5446	DW5806	DWA54058	DWA54058
6944SD-PWR	5/8" x 5"	1-1/4"	15	90	-	DW5446	DW5806	DWA54058	DWA58058
6945SD-PWR	5/8" x 6"	2-1/4"	15	90	-	DW5446	DW5806	DWA54058	DWA58058
6947SD-PWR	5/8" x 8-1/2"	4-3/4"	10	40	-	DW5447	DW5809	DWA54058	DWA58058
6950SD-PWR	3/4" x 3-1/4"	1/4"	15	90	-	DW5453	DW5809	DWA54034	DWA54034
6952SD-PWR	3/4" x 4-1/2"	1/8"	10	60	-	DW5453	DW5809	DWA54034	DWA54034
6954SD-PWR	3/4" x 5-1/4"	7/8"	10	60	-	DW5453	DW5809	DWA54034	DWA54034
6956SD-PWR	3/4" x 7-1/4"	2-7/8"	10	40	-	DW5453	DW5809	DWA54034	DWA54034
6957SD-PWR	3/4" x 8-1/4"	3-7/8"	10	40	-	DW5455	DW5809	DWA54034	DWA54034

Shaded catalog numbers denote sizes which are too small or lengths less than the minimum standard anchor length for strength design. Anchors not long enough to meet the minimum nominal embedments published for strength design are outside the scope of ICC-ES ESR-3260.

The published size includes the diameter and the length. The length is measured from below the washer to the end of the anchor.

The tabulated maximum fixture thickness is provided for reference and based on published nominal embedment depths. The actual maximum fixture thickness for the anchor is determined by subtracting the required nominal embedment depth for the application from the published length.

To determine the actual minimum anchor length, select the nominal embedment depth needed (e.g. required to obtain desired load capacity). Then add the thickness of the fixture, including any spacers or shims, to the embedment depth.

Hollow drill bits must be used with a dust extraction vacuum (e.g. Cat. No. DW012).

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