

GENERAL INFORMATION

POWER-BOLT+ (PB+)

Heavy Duty Sleeve Anchor

PRODUCT DESCRIPTION

The Power-Bolt+ (PB+) 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 sand-lightweight concrete. The anchor is manufactured with a zinc plated carbon steel bolt, sleeve, cone and expansion clip. The PB+ has a low profile finished hex head.

GENERAL APPLICATIONS AND USES

- Structural connections, i.e., beam and column anchorage
- Safety-related attachments and tension zone applications
- Interior applications / low level corrosion environment
- Heavy duty applications

FEATURES AND BENEFITS

- + Consistent performance in high and low strength concrete
- + Nominal drill bit size is the same as the anchor diameter
- + Anchor can be installed through standard fixture holes
- + Length ID code and identifying marking stamped on head of each anchor
- + Anchor design allows for follow-up expansion after setting under tensile loading
- + High shear load capacity

APPROVALS AND LISTINGS

- International Code Council, Evaluation Service (ICC-ES), ESR-3260 for cracked and uncracked concrete - 1/2" and 5/8" diameters (3/4" pending)
- Code compliant with 2012 IBC, 2012 IRC, 2009 IBC, 2009 IRC, 2006 IBC, and 2006, IRC.
- Tested in accordance with ACI 355.2 and ICC-ES AC193 (including ASTM E 488) for use in structural concrete under the design provisions of ACI 318 (Strength Design method using Appendix D)
- Evaluated and qualified by an accredited independent testing laboratory for recognition in cracked and uncracked concrete including seismic and wind loading (Category 1 anchors), 1/2" and 5/8" diameters. (3/4" pending)

GUIDE SPECIFICATIONS

CSI Divisions: 03 16 00 - Concrete Anchoring and 05 05 19 - Post Installed Concrete Anchors
Expansion anchors shall be Power-Bolt+ (PB+) as supplied by Powers Fasteners, Inc., Brewster, NY. Anchors shall be installed in accordance with published instructions and the Authority Having Jurisdiction.

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POWER-BOLT+ (PB+) 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" diameter through 3/4" diameter

SUITABLE BASE MATERIALS

- Normal-weight concrete
- Sand-lightweight concrete



This Product Available In



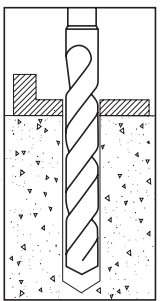
Powers Design Assist
 Real Time Anchor Design Software
www.powersdesignassist.com

MATERIAL SPECIFICATIONS

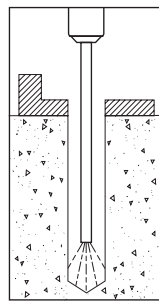
Anchor component	Specification
Bolt	Medium carbon steel (Grade 8 equivalent)
Washer	Conforms to ASTM F844
Cone	AISI C1035-C1040
Expansion Clip	AISI C1045-C1050
Metal Sleeve	Medium carbon steel tubing (seamless)
Compression Ring & Retainer Nut	Engineered plastic
Plating	Zinc plating according to ASTM B 633, SC1 Type III (Fe/Zn 5). Minimum plating requirements for Mild Service Condition.

INSTALLATION INSTRUCTIONS

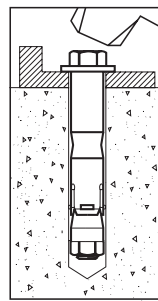
Installation Instructions for Power-Bolt+ (PB+) Anchor



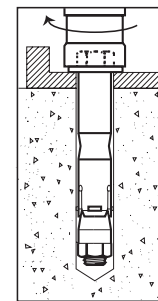
Step 1
Using the proper drill bit size, drill a hole into the base material to the required depth. The tolerances of the drill bit used should meet the requirements of ANSI Standard B212.15.



Step 2
Remove dust and debris from the hole using a hand pump, compressed air or a vacuum. 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} .



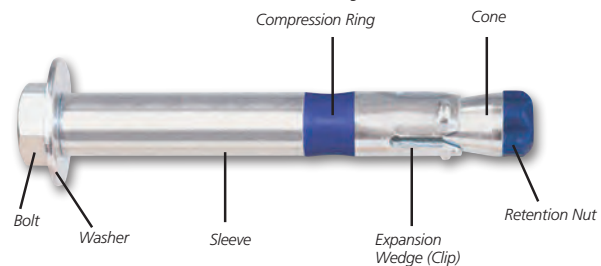
Step 4
Tighten the anchor with a torque wrench by applying the required installation torque, T_{inst} .

Head Marking



Legend
'PB+' Symbol = Power-Bolt+ Strength Design Compliant (see ordering information)
Letter Code = Length Identification Mark

Power-Bolt+ (PB+) 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 overall length of anchor.

MECHANICAL ANCHORS

POWER-BOLT+ (PB+)
Heavy Duty Sleeve Anchor

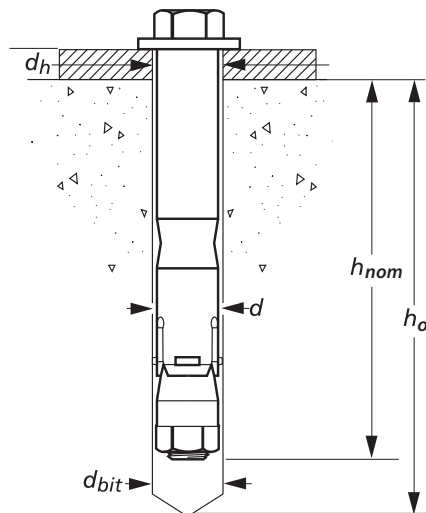
INSTALLATION SPECIFICATIONS

Power-Bolt+ (PB+) 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	d _{bit}	in. (mm)	1/4 ANSI	3/8 ANSI	1/2 ANSI	5/8 ANSI	3/4 ANSI
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)	2 (51)	2-1/2 (64)	2-3/4 (70)	3 (76.2)
Minimum hole depth	h _o	in. (mm)	1-1/2 (38)	2-1/4 (57)	3 (76)	3-1/4 (83)	3-5/8 (92)
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)	6 (152)
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)

Power-Bolt+ (PB+) Anchor Detail



MECHANICAL ANCHORS

POWER-BOLT+ (PB+)

Heavy Duty Sleeve Anchor

REFERENCE PERFORMANCE DATA

Ultimate Load Capacities for Power-Bolt+ (PB+) in Normal-Weight Concrete¹



Nominal Anchor Diameter d in.	Minimum Nominal Embed. Depth in. (mm) h _{nom}	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	
		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	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.

MECHANICAL ANCHORS

POWER-BOLT+ (PB+)
Heavy Duty Sleeve Anchor

ALLOWABLE STRESS DESIGN (ASD) PERFORMANCE DATA

Allowable Load Capacities for Power-Bolt+ (PB+) in Normal-Weight Concrete^{1,2,3}



Nominal Anchor Diameter d in.	Minimum Nominal Embed. Depth in. (mm) h _{nom}	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	
		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	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. Consideration of safety factors of 10 or higher may be necessary depending on the applications, such as life safety or overhead.
2. Tabulated load values are for anchors installed in 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.

MECHANICAL ANCHORS

POWER-BOLT+ (PB+)

Heavy Duty Sleeve Anchor

ALLOWABLE STRESS DESIGN (ASD) DESIGN CRITERIA



MECHANICAL ANCHORS

POWER-BOLT+ (PB+)
Heavy Duty Sleeve Anchor

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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+ (PB+) Anchor Installation Specifications¹

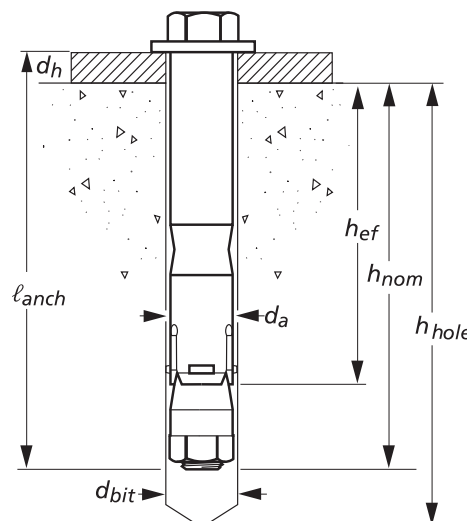


Anchor Property/Setting Information	Notation	Units	Nominal Anchor Diameter (in.)		
			1/2	5/8	3/4
Anchor outside diameter	d_a [d_o] ²	in. (mm)	0.500 (12.7)	0.625 (15.9)	0.750 (19.1)
Internal bolt diameter (UNC)	-	in. (mm)	3/8 (9.5)	7/16 (11.1)	9/16 (14.3)
Minimum diameter of hole clearance in fixture	d_h	in. (mm)	9/16 (14.3)	11/16 (17.5)	
Nominal drill bit diameter	d_{bit}	in. ANSI	1/2 ANSI	5/8 ANSI	3/4 ANSI
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)	5-1/4 (133)
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)
Critical edge distance	c_{ac}	in. (mm)	8 (203)	6 (152)	8 (203)
Installation torque	T_{inst}	ft.-lbf. (N-m)	40 (54)	60 (81)	110 (149)
Bolt Head Height	-	in. (mm)	1/4 (7.1)	5/16 (7.9)	3/8 (9.6)
Torque wrench/socket size	-	in.	5/8	3/4	15/16

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 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.
3. The notation in brackets is for the 2006 IBC.

Power-Bolt+ (PB+) Anchor Detail





**Tension Design information for Power-Bolt+ (PB+) Anchor in Concrete
(for use with load combinations taken from ACI 318, Section 9.2)^{1,2}**

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)
STEEL STRENGTH IN TENSION³					
Minimum specified yield strength	f_y	ksi (N/mm ²)	130 (896)	130 (896)	130 (896)
Minimum specified ultimate tensile strength ⁹	f_{uta}^{10}	ksi (N/mm ²)	150 (1034)	150 (1034)	150 (1034)
Effective tensile stress area (threads)	$A_{se, N}$ [A_{se}^{11}]	in ² (mm ²)	0.0775 (50)	0.1063 (68.6)	0.1820 (116)
Steel strength in tension	N_{sa}^{10}	lb (kN)	9,685 (43.1)	13,285 (59.1)	27,300 (121.4)
Reduction factor for steel strength ³	ϕ	-	0.75		
CONCRETE BREAKOUT STRENGTH IN TENSION⁸					
Effective embedment	h_{ef}	in. (mm)	2.625 (67)	3.000 (76)	3.500 (89)
Effectiveness factor for uncracked concrete	k_{ucr}	-	27	27	24
Effectiveness factor for cracked concrete	k_{cr}	-	17	17	21
Modification factor for cracked and uncracked concrete ⁵	$\Psi_{c,N}^{10}$	-	1.0	1.0	1.0
Critical edge distance (uncracked concrete)	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 (NON-SEISMIC APPLICATIONS)⁸					
Characteristic pullout strength, uncracked concrete (2,500 psi) ⁶	$N_{p,ucr}$	lb (kN)	Not Applicable ⁷	Not Applicable ⁷	Not Applicable ⁷
Characteristic pullout strength, cracked concrete (2,500 psi) ⁶	$N_{p,cr}$	lb (kN)	Not Applicable ⁷	Not Applicable ⁷	Not Applicable ⁷
Reduction factor for pullout strength	ϕ	-	0.65 (Condition B)		
PULLOUT STRENGTH IN TENSION FOR SEISMIC APPLICATIONS⁸					
Characteristic pullout strength, seismic (2,500 psi) ⁶	N_{eq}^9	lb (kN)	Not Applicable ⁷	Not Applicable ⁷	Not Applicable ⁷
Reduction factor for pullout strength	ϕ	-	0.65 (Condition B)		

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

- The data in this table is intended to be used with the design provisions of ACI 318 Appendix D; for anchors resisting seismic load combinations the additional requirements of ACI 318 D.3.3 must apply.
- Installation must comply with the manufacturer's published installation instructions.
- The tabulated value of ϕ for steel strength applies when the load combinations of Section 1605.2 of the IBC or ACI 318 Section 9.2 are used. If the load combinations of ACI 318 Appendix C are used, the appropriate value of ϕ for steel strength must be determined in accordance with ACI 318-11 D.4.3 (ACI 318-08 and -05 D.4.4). The anchors are ductile steel elements as defined in ACI 318 D.1.
- The tabulated value of ϕ for concrete breakout strength applies when both the load combinations of Section 1605.2 of the IBC or ACI 318 Section 9.2 are used and the requirements of ACI 318-11 D.4.3 (ACI 318-08 and -05 D.4.4) for Condition B are satisfied. If the load combinations of Section 1605.2 of the IBC or ACI 318 Section 9.2 are used and the requirements of ACI 318-11 D.4.3 (ACI 318-08 and -05 D.4.4) for Condition A are satisfied, the appropriate value of ϕ for concrete breakout strength must be determined in accordance with ACI 318-11 D.4.3 (ACI 318-08 and -05 D.4.4). If the load combinations of ACI 318 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 (ACI 318-08 and -05 D.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_{ucr}) must be used.
- For all design cases use $\Psi_{c,P} = 1.0$.
- Pullout strength will not control design of indicated anchors. Do not calculate pullout strength for indicated anchor size and embedment.
- Anchors are permitted to be used in sand-lightweight concrete provided that N_b and N_{pn} are multiplied by a factor of 0.60.
- In accordance with ACI 318 D.5.1.2 and Eq. (D-3) the nominal steel strength in tension is calculated using a limited value of f_{uta} of 125 ksi.
- For 2003 IBC, f_{uta} replaces f_{ut} ; N_{sa} replaces N_s ; $\Psi_{c,N}$ replaces Ψ_s ; and $N_{p,eq}$ replaces $N_{p,seis}$.
- The notation in brackets is for the 2006 IBC.

MECHANICAL ANCHORS
POWER-BOLT+ (PB+)
Heavy Duty Sleeve Anchor



**Shear Design information for Power-Bolt+ (PB+) Anchor in Concrete
(For use with load combinations taken from ACI 318, Section 9.2)^{1,2}**

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)
STEEL STRENGTH IN SHEAR					
Minimum specified yield strength	f_y	ksi (N/mm ²)	130 (896)	130 (896)	130 (896)
Minimum specified ultimate strength	f_{uts}^9	ksi (N/mm ²)	150 (1034)	150 (1034)	150 (1034)
Effective shear stress area	$A_{se,v}$ [A_{se}] ¹⁰	in ² (mm ²)	0.1069 (69.0)	0.1452 (93.7)	0.2410 (153)
Steel strength in shear ⁶	V_{sa}^9	lb (kN)	6,005 (26.7)	13,415 (59.7)	14,820 (65.9)
Reduction factor for steel strength ³	ϕ	-	0.65		
CONCRETE BREAKOUT STRENGTH IN SHEAR⁷					
Load bearing length of anchor (h_{ef} or $8d_a$, whichever is less)	ℓ_e^9	in (mm)	2.625 (67)	3.000 (76)	3.500 (89)
Nominal anchor diameter	d_a	in (mm)	0.500 (12.7)	0.625 (15.9)	0.750 (19.05)
Reduction factor for concrete breakout ⁴	ϕ	-	0.70 (Condition B)		
PRYOUT STRENGTH IN SHEAR⁷					
Coefficient for prout strength (1.0 for $h_{ef} < 2.5$ in., 2.0 for $h_{ef} \geq 2.5$ in.)	k_{cp}	-	2.0	2.0	2.0
Effective embedment	h_{ef}	in (mm)	2.625 (67.5)	3.000 (76)	3.500 (89)
Reduction factor for prout strength ⁵	ϕ	-	0.70 (Condition B)		
STEEL STRENGTH IN SHEAR FOR SEISMIC APPLICATIONS					
Steel strength in shear, seismic ⁸	$V_{sa, eq}^9$	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		

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

- The data in this table is intended to be used with the design provisions of ACI 318 Appendix D; for anchors resisting seismic load combinations the additional requirements of ACI 318 D.3.3 must apply.
- Installation must comply with the manufacturer's published installation instructions.
- The tabulated value of ϕ for steel strength applies when the load combinations of Section 1605.2 of the IBC or ACI 318 Section 9.2 are used. If the load combinations of ACI 318 Appendix C are used, the appropriate value of ϕ for steel strength must be determined in accordance with ACI 318-11 D.4.3 (ACI 318-08 and -05 D.4.4). The anchors are ductile steel elements as defined in ACI 318 D.1.
- The tabulated value of ϕ for concrete breakout strength applies when both the load combinations of Section 1605.2 of the IBC or ACI 318 Section 9.2 are used and the requirements of ACI 318-11 D.4.3 (ACI 318-08 and -05 D.4.4) for Condition B are satisfied. If the load combinations of Section 1605.2 of the IBC or ACI 318 Section 9.2 are used and the requirements of ACI 318-11 D.4.3 (ACI 318-08 and -05 D.4.4) for Condition A are satisfied, the appropriate value of ϕ for concrete breakout strength must be determined in accordance with ACI 318-11 D.4.3 (ACI 318-08 and -05 D.4.4). If the load combinations of ACI 318 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 (ACI 318-08 and -05 D.4.5).
- The tabulated value of ϕ for prout strength applies if the load combinations of Section 1605.2 of the IBC or ACI 318 Section 9.2 are used. If the load combinations of ACI 318 Appendix C are used, the appropriate value of ϕ for prout strength must be determined in accordance with ACI 318-11 D.4.4 (ACI 318-08 and -05 D.4.5), Condition B.
- 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 equation D-29 in ACI 318-11 (ACI 318-08 and -05, Eq. D-20).
- Anchors are permitted to be used in sand-lightweight concrete provided that V_b , V_p and V_{pb} are multiplied by a factor of 0.60.
- 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.
- For the 2003 IBC f_{ua} replaces f_{ut} ; V_{sa} replaces V_s ; ℓ_e replaces ℓ ; and V_{eq} replaces $V_{sa,seis}$.
- The notation in brackets is for the 2006 IBC.

MECHANICAL ANCHORS

POWER-BOLT+ (PB+)

Heavy Duty Sleeve Anchor



STRENGTH DESIGN PERFORMANCE DATA

Factored design strength ΦN_n and ΦV_n
Calculated in accordance with ACI 318 Appendix D
Tested to the International Building Code

Tension and Shear Design Strengths for Power-Bolt+ (PB+) in Cracked Concrete^{1,2,3,4,5,6}

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	
		ΦN_n Tension (lbs.)	ΦV_n Shear (lbs.)	ΦN_n Tension (lbs.)	ΦV_n Shear (lbs.)	ΦN_n Tension (lbs.)	ΦV_n Shear (lbs.)	ΦN_n Tension (lbs.)	ΦV_n Shear (lbs.)	ΦN_n Tension (lbs.)	ΦV_n Shear (lbs.)
1/2	3-1/4	2,350	3,525	2,575	3,860	2,970	3,905	3,640	3,905	4,205	3,905
5/8	3-3/4	2,870	3,310	3,145	3,625	3,630	4,190	4,450	5,130	5,135	5,920
3/4	4-3/8	4,470	4,990	4,895	5,465	5,655	6,310	6,925	7,730	7,995	8,925

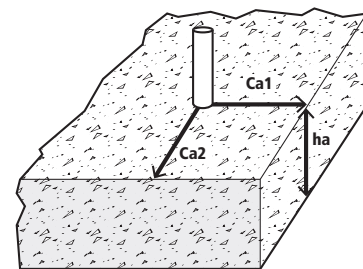
 - Concrete Breakout Strength Controls
 - Steel Strength Controls

Tension and Shear Design Strengths for Power-Bolt+ (PB+) in Uncracked Concrete^{1,2,3,4,5,6}

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	
		ΦN_n Tension (lbs.)	ΦV_n Shear (lbs.)	ΦN_n Tension (lbs.)	ΦV_n Shear (lbs.)	ΦN_n Tension (lbs.)	ΦV_n Shear (lbs.)	ΦN_n Tension (lbs.)	ΦV_n Shear (lbs.)	ΦN_n Tension (lbs.)	ΦV_n 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	4,635	4,995	5,076	5,770	5,865	7,065	7,180	8,155	8,290
3/4	4-3/8	5,105	6,985	5,595	7,655	6,460	8,835	7,910	9,410	9,135	9,410

 - Concrete Breakout Strength Controls
 - Steel Strength Controls

- Tabular values are provided for illustration and are applicable for single anchors installed in normal-weight concrete with minimum slab thickness, $h_a = h_{min}$, and with the following conditions:
 - C_{a1} is greater than or equal to the critical edge distance, C_{ac} (table values based on $C_{a1} = C_{ac}$).
 - C_{a2} is greater than or equal to 1.5 times C_{a1} .
- Calculations were performed according to ACI 318-11 Appendix D. 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.
- Strength reduction factors (ϕ) were based on ACI 318 Section 9.2 for load combinations. Condition B is assumed.
- Tabular values are permitted for static loads only, seismic loading is not considered with these tables.
- For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318 Appendix D.
- Interpolation is not permitted to be used with the tabular values. For intermediate base material compressive strengths please see ACI 318 Appendix D. For other design conditions including seismic considerations please see ACI 318 Appendix D.



ORDERING INFORMATION

Power-Bolt+ (Carbon Steel Finished Hex Head)

Cat. No.	Anchor Size	Maximum Fixture Thickness	Box Qty.	Carton Qty.
6902SD	1/4" X 1-3/4"	1/2"	100	600
6906SD	1/4" X 3"	1-3/4"	100	600
6910SD	3/8" X 2-1/4"	1/4"	50	300
6913SD	3/8" X 3"	1"	50	300
6914SD	3/8" X 3-1/2"	1-1/2"	50	300
6916SD	3/8" X 4"	2"	50	300
6930SD	1/2" x 2-3/4"	1/4"	50	200
6932SD	1/2" x 3-1/2"	1/4"	50	200
6934SD	1/2" x 4-3/4"	1-1/2"	25	150
6936SD	1/2" x 5-3/4"	2-1/2"	25	150
6940SD	5/8" x 3"	1/4"	20	120
6942SD	5/8" x 4"	1/4"	15	90
6944SD	5/8" x 5"	1-1/4"	15	90
6945SD	5/8" x 6"	2-1/4"	15	90
6947SD	5/8" x 8-1/2"	4-3/4"	10	40
6950SD	3/4" x 3-1/4"	1/4"	15	90
6952SD	3/4" x 4-1/4"	1-1/4"	10	60
6954SD	3/4" x 5-1/4"	2-1/4"	10	60
6956SD	3/4" x 7-1/4"	4-1/4"	10	40
6958SD	3/4" x 8-1/4"	5-1/4"	10	40



Shaded catalog numbers denote sizes which are less than the minimum standard anchor length for strength design or not included in ESR-3260.

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

Installation Accessories

Cat. No.	Description	Box Qty
08466	Adjustable torque wrench with 1/2" square drive (25 to 250 ft.-lbs.)	1
08280	Hand pump / dust blower	1

