Spike® *Pre-Expanded Anchor*

PRODUCT DESCRIPTION

The Spike anchor, one-piece, vibration resistant anchor for use in concrete block or stone. Several head styles, including tamperfroof versions and anchor materials are available. The Spike anchor is formed with an "s" shaped configuration at the working end of the anchor to create an expansion mechanism. Since the anchor is pre-expanded, there is no secondary tightening operation required which greatly reduces the overall cost of an anchor installation.

GENERAL APPLICATIONS AND USES

- Tamper-proof Applications
- Exterior Applications
- Cable Trays and Strut
- Pipe Hanging
- Metal Track Attachments
- Concrete Formwork
- For roofing applications see the Roofing Spike product information

FEATURES AND BENEFITS

+ Pre-expanded anchor design allows for easy installation
+ Mushroom and flat head Spike anchors are tamper-proof
+ Forming Spike, which is removable, can be used for temporary installations
+ Pipe and Tie-wire Spike is an easy to install alternative to direct fastening

APPROVALS AND LISTINGS

Factory Mutual Research Corporation (FM Approvals) – J.I. ON5A1.AH, 3/8" diameter Pipe Spike *Pipe hanger components for Automatic Sprikler Systems.*
Tested in accordance with ASTM E488 and AC01 criteria

GUIDE SPECIFICATIONS

CSI Divisions: *03151-Concrete Anchoring, 04081-Masonry Anchorage* and *05090-Metal Fastenings.* Pre-expanded anchors shall be Spike as supplied by Powers Fasteners, Inc., Brewster, NY.

MATERIAL SPECIFICATIONS

Carbon Steel (Mushroom Head, Flat Head, Pipe, Tie-Wire and Forming Spike)

Anchor Component	Component Material
Anchor Body	AISI 1038 Carbon Steel
Zinc Plating	ASTM B633, SC1, Type III (Fe/Zn 5)

Stainless Steel (Mushroom Head)

Anchor Component	Component Material
Anchor Body	Type 316L Stainless Steel

SECTION CONTENTS Page No.

Mushroom Head Spike

Flat Head Spike

Pipe Spike

Tie-Wire Spike

Forming Spike

HEAD STYLES

Mushroom Head
Flat Head
Pipe
Tie-Wire
Forming

ANCHOR MATERIALS

Zinc Plated Carbon Steel
Type 316 Stainless Steel

ANCHOR SIZE RANGE (TYP.)

3/16" diameter to 1/2" diameter

SUITABLE BASE MATERIALS

Normal-Weight Concrete
Structural Lightweight Concrete
Grouted Concrete Masonry (CMU)

INSTALLATION SPECIFICATIONS

Mushroom Head Carbon Steel Spike

Dimension	Nominal Anchor Size, *d*			
	3/16"	1/4"	3/8"	1/2"
ANSI Drill Bit Size, d_{bit} (in.)	3/16	1/4	3/8	1/2
Fixture Clearance Hole, d_h (in.)	1/4	5/16	7/16	9/16
Head Height (in.)	7/64	7/64	7/32	1/4
Head Size, O.D. (in.)	7/16	1/2	3/4	1

Mushroom Head Stainless Steel Spike

Dimension	Nominal Anchor Size, *d*		
	3/16"	1/4"	3/8"
ANSI Drill Bit Size, d_{bit} (in.)	3/16	1/4	3/8
Fixture Clearance Hole, d_h (in.)	1/4	5/16	7/16
Head Height (in.)	7/64	7/64	7/32
Head Size, O.D. (in.)	7/16	1/2	3/4

Flat Head Spike (80°– 82° Head)

Dimension	Nominal Anchor Size, *d*	
	3/16"	1/4"
ANSI Drill Bit Size, d_{bit} (in.)	3/16	1/4
Fixture Clearance Hole, d_h (in.)	1/4	5/16
Head Height (in.)	7/64	9/64
Head Size, O.D. (in.)	3/8	1/2

Pipe Spike

Dimension	Nominal Anchor Size, *d*	
	1/4"	3/8"
ANSI Drill Bit Size, d_{bit} (in.)	3/16	1/4
UNC Thread Size	1/4-20	3/8-16
Head Height (in.)	1/2	5/8
Head Size, O.D. (in.)	13/32	35/64

Tie-Wire Spike

Dimension	Nominal Anchor Size, *d*	
	3/16"	1/4"
ANSI Drill Bit Size, d_{bit} (in.)	3/16	1/4
Tie-Wire Hole (in.)	3/16	9/32
Head Height (in.)	37/64	41/64
Head Width (in.)	9/64 x 7/16	3/16 x 9/16

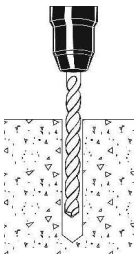
Forming Spike

Dimension	Nominal Anchor Size, *d*	
	3/16"	1/4"
ANSI Drill Bit Size, d_{bit} (in.)	3/16	1/4
Fixture Clearance Hole, d_h (in.)	1/4	5/16
Head Height (in.)	9/16	9/16
Head Size, O.D. (in.)	13/32	1/2

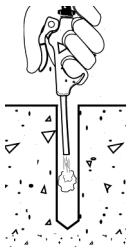
INSTALLATION SPECIFICATIONS

Mushroom/Flat Head Version

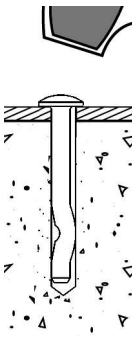
Using the proper diameter bit, drill a hole into the base material to a depth of at least 1/2" or one anchor diameter deeper than the embedment required.
The tolerances of the drill bit used must meet the requirements of ANSI Standard B212.15



Blow the hole clean of dust and other material.

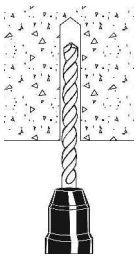


Drive the anchor through the fixture into the anchor hole until the head is firmly seated against the fixture. Be sure the anchor is driven to the required embedment depth.



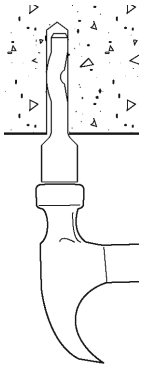
Pipe Spike Version

Using the proper diameter bit, drill a hole into the base material to a depth of at least 1/2" or one anchor diameter deeper than the embedment required.
The tolerances of the drill bit used must meet the requirements of ANSI Standard B212.15



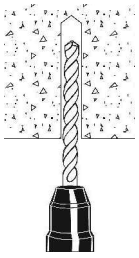
Blow the hole clean of dust and other material.

Drive the anchor into the hole until the head is firmly seated against the base material. Be sure the anchor is driven to the required embedment depth.

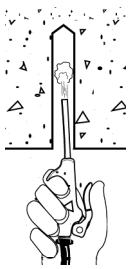


Tie-Wire Version

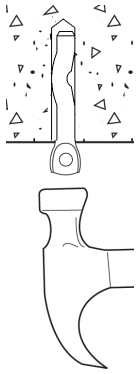
Using the proper diameter bit, drill a hole into the base material to a depth of at least 1/2" or one anchor diameter deeper than the embedment required.
The tolerances of the drill bit used must meet the requirements of ANSI Standard B212.15



Blow the hole clean of dust and other material.l.

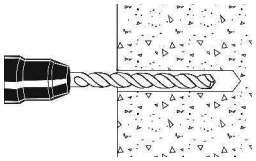


Drive the anchor into the hole until the head is firmly seated against the base material. Be sure the anchor is driven to the required embedment depth.

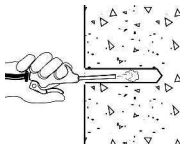


Forming Spike Version

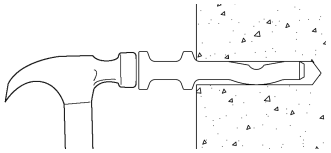
Using the proper diameter bit, drill a hole into the base material to a depth of at least 1/2" or one anchor diameter deeper than the embedment required.
The tolerances of the drill bit used must meet the requirements of ANSI Standard B212.15



Blow the hole clean of dust and other material.



Drive the anchor through the fixture into the anchor hole until the head is firmly seated against the fixture. Be sure the anchor is driven to the required embedment depth.



PERFORMANCE DATA

Ultimate Load Capacities for Carbon Steel Spike in Normal-Weight Concrete[1]

Anchor Diameter *d* in. (mm)	Minimum Embedment Depth h_v in. (mm)	Minimum Concrete Compressive Strength (f'_c)							
		2,000 psi (13.8 MPa)		**3,000 psi** (20.7 MPa)		**4,000 psi** (27.6 MPa)		**5,000 psi** (34.5 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)
3/16 (4.8)	7/8 (22.2)	520 (2.3)	1,080 (4.9)	760 (3.4)	1,270 (5.7)	860 (3.9)	1,310 (5.9)	890 (4.0)	1,350 (6.1)
	1 (25.4)	540 (2.4)	1,230 (5.5)	820 (3.7)	1,725 (7.8)	980 (4.4)	1,860 (8.4)	995 (4.5)	1,860 (8.4)
	1 1/4 (31.8)	780 (3.5)	1,800 (8.1)	1,000 (4.5)	2,000 (9.0)	1,260 (5.7)	2,155 (9.7)	1,520 (6.8)	2,310 (10.4)
1/4 (6.4)	7/8 (22.2)	680 (3.1)	1,405 (6.3)	820 (3.7)	1,630 (7.3)	945 (4.3)	1,870 (8.4)	1,010 (4.5)	2,110 (9.5)
	1 (25.4)	720 (3.2)	1,585 (7.1)	975 (4.4)	1,965 (8.8)	1,135 (5.1)	2,160 (9.7)	1,185 (5.3)	2,360 (10.6)
	1 1/4 (31.8)	830 (3.7)	1,815 (8.2)	1,100 (4.9)	2,020 (9.1)	1,210 (5.4)	2,220 (10.0)	1,320 (5.9)	2,585 (11.6)
3/8 (9.5)	1 3/4 (44.5)	1,785 (8.0)	3,645 (16.4)	2,120 (9.5)	4,480 (20.2)	2,630 (11.8)	5,025 (22.6)	2,875 (12.9)	5,075 (22.8)
1/2 (12.7)	2 1/2 (63.5)	3,215 (14.5)	5,345 (24.1)	3,620 (16.3)	8,460 (38.1)	4,015 (18.1)	10,320 (46.4)	4,410 (19.8)	10,860 (48.9)

1. Ultimate load capacities should be reduced by a minimum safety factor of 4.0 or greater to determine the allowable working load. Consideration of safety factors of 10 or higher may be necessary depending on the application, such as life safety or overhead.

Allowable Load Capacities for Carbon Steel Spike in Normal-Weight Concrete[1,2]

Anchor Diameter *d* in. (mm)	Minimum Embedment Depth h_v in. (mm)	Minimum Concrete Compressive Strength (f'_c)							
		2,000 psi (13.8 MPa)		**3,000 psi** (20.7 MPa)		**4,000 psi** (27.6 MPa)		**5,000 psi** (34.5 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)
3/16 (4.8)	7/8 (22.2)	130 (0.6)	270 (1.2)	190 (0.9)	320 (1.4)	215 (1.0)	330 (1.5)	225 (1.0)	340 (1.5)
	1 (25.4)	135 (0.6)	310 (1.4)	205 (0.9)	430 (1.9)	245 (1.1)	465 (2.1)	250 (1.1)	465 (2.1)
	1 1/4 (31.8)	195 (0.9)	450 (2.0)	250 (1.1)	500 (2.3)	315 (1.4)	540 (2.4)	380 (1.7)	580 (2.6)
1/4 (6.4)	7/8 (22.2)	170 (0.8)	350 (1.6)	205 (0.9)	410 (1.8)	235 (1.1)	470 (2.1)	255 (1.1)	530 (2.4)
	1 (25.4)	180 (0.8)	395 (1.8)	245 (1.1)	490 (2.2)	285 (1.3)	540 (2.4)	295 (1.3)	590 (2.7)
	1 1/4 (31.8)	210 (0.9)	455 (2.0)	275 (1.2)	505 (2.3)	300 (1.3)	555 (2.5)	330 (1.5)	645 (2.9)
3/8 (9.5)	1 3/4 (44.5)	445 (2.0)	910 (4.1)	530 (2.4)	1,120 (5.0)	660 (3.0)	1,255 (5.6)	720 (3.2)	1,270 (5.7)
1/2 (12.7)	2 1/2 (63.5)	805 (3.6)	1,335 (6.0)	905 (4.1)	2,115 (9.5)	1,005 (4.5)	2,580 (11.6)	1,105 (5.0)	2,715 (12.2)

1. Allowable load capacities are calculated using an applied safety factor of 4.0. Consideration of safety factors of 10 or higher may be necessary depending on the application, such as life safety or overhead.
2. Linear interpolation may be used to determine allowable loads for intermediate embedments and compressive strengths.

PERFORMANCE DATA

Ultimate Load Capacities for Stainless Steel Spike in Normal-Weight Concrete[1]

Anchor Diameter *d* in. (mm)	Minimum Embedment Depth h_v in. (mm)	Minimum Concrete Compressive Strength (f'_c)							
		2,000 psi (13.8 MPa)		**3,000 psi** (20.7 MPa)		**4,000 psi** (27.6 MPa)		**5,000 psi** (34.5 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)
3/16 (4.8)	7/8 (22.2)	490 (2.2)	920 (4.1)	715 (3.2)	1,155 (5.2)	850 (3.8)	1,220 (5.5)	875 (3.9)	1,290 (5.8)
	1 (25.4)	500 (2.3)	1,175 (5.3)	810 (3.6)	1,650 (7.4)	975 (4.4)	1,740 (7.8)	985 (4.4)	1,830 (8.2)
	1 1/4 (31.8)	740 (3.3)	1,735 (7.8)	970 (4.4)	1,930 (8.7)	1,160 (5.2)	2,040 (9.2)	1,420 (6.4)	2,150 (9.7)
1/4 (6.4)	7/8 (22.2)	635 (2.9)	1,350 (6.1)	790 (3.6)	1,570 (7.1)	880 (4.0)	1,785 (8.0)	980 (4.4)	2,000 (9.0)
	1 (25.4)	670 (3.0)	1,565 (7.0)	970 (4.4)	1,845 (8.3)	1,045 (4.7)	2,095 (9.4)	1,120 (5.0)	2,250 (10.1)
	1 1/4 (31.8)	795 (3.6)	1,765 (7.9)	1,080 (4.9)	1,965 (8.8)	1,175 (5.2)	2,145 (9.7)	1,280 (5.7)	2,325 (10.5)
3/8 (9.5)	1 3/4 (44.5)	1,575 (7.1)	3,155 (14.2)	1,990 (9.0)	3,880 (17.5)	2,420 (10.9)	4,150 (18.7)	2,570 (11.6)	4,425 (19.9)

1. Ultimate load capacities should be reduced by a minimum safety factor of 4.0 or greater to determine the allowable working load. Consideration of safety factors of 10 or higher may be necessary depending on the application, such as life safety or overhead.

Allowable Load Capacities for Stainless Steel Spike in Normal-Weight Concrete[1,2]

Anchor Diameter *d* in. (mm)	Minimum Embedment Depth h_v in. (mm)	Minimum Concrete Compressive Strength (f'_c)							
		2,000 psi (13.8 MPa)		**3,000 psi** (20.7 MPa)		**4,000 psi** (27.6 MPa)		**5,000 psi** (34.5 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)
3/16 (4.8)	7/8 (22.2)	125 (0.6)	230 (1.0)	180 (0.8)	290 (1.3)	215 (1.0)	305 (1.4)	220 (1.0)	325 (1.5)
	1 (25.4)	125 (0.6)	295 (1.3)	205 (0.9)	415 (1.9)	245 (1.1)	435 (2.0)	245 (1.1)	460 (2.1)
	1 1/4 (31.8)	185 (0.8)	435 (2.0)	245 (1.1)	485 (2.2)	290 (1.3)	510 (2.3)	355 (1.6)	540 (2.4)
1/4 (6.4)	7/8 (22.2)	160 (0.7)	340 (1.5)	200 (0.9)	395 (1.8)	220 (1.0)	445 (2.0)	245 (1.1)	500 (2.3)
	1 (25.4)	170 (0.8)	390 (1.8)	245 (1.1)	460 (2.1)	260 (1.2)	525 (2.4)	280 (1.3)	565 (2.5)
	1 1/4 (31.8)	200 (0.9)	440 (2.0)	270 (1.2)	490 (2.2)	295 (1.3)	535 (2.4)	320 (1.4)	580 (2.6)
3/8 (9.5)	1 3/4 (44.5)	395 (1.8)	790 (3.6)	500 (2.3)	970 (4.4)	605 (2.7)	1,040 (4.7)	645 (2.9)	1,105 (5.0)

1. Allowable load capacities are calculated using an applied safety factor of 4.0. Consideration of safety factors of 10 or higher may be necessary depending on the application, such as life safety or overhead.
2. Linear interpolation may be used to determine allowable loads for intermediate embedments and compressive strengths.

PERFORMANCE DATA

Ultimate Load Capacities for Carbon Steel Pipe Spike in Normal-Weight Concrete[1]

Anchor Dia. d in. (mm)	Drill Bit Dia. d_{bit} in.	Minimum Embed. Depth h_v in. (mm)	Minimum Concrete Compressive Strength (f'_c)							
			2,000 psi (13.8 MPa)		**3,000 psi** (20.7 MPa)		**4,000 psi** (27.6 MPa)		**5,000 psi** (34.5 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)
1/4 (6.4)	3/16	1 1/4 (31.8)	780 (3.5)	975 (4.4)	1,260 (5.7)	975 (4.4)	1,260 (5.7)	975 (4.4)	1,260 (5.7)	975 (4.4)
3/8 (9.5)	1/4	1 3/4 (44.5)	1,100 (5.0)	1,815 (8.2)	1,660 (7.5)	2,020 (9.1)	2,000 (9.0)	2,100 (9.5)	2,000 (9.0)	2,180 (9.8)

1. Ultimate load capacities should be reduced by a minimum safety factor of 4.0 or greater to determine the allowable working load. Consideration of safety factors of 10 or higher may be necessary depending on the application, such as life safety or overhead.

Allowable Load Capacities for Carbon Steel Pipe Spike in Normal-Weight Concrete[1,2]

Anchor Dia. d in. (mm)	Drill Bit Dia. d_{bit} in.	Minimum Embed. Depth h_v in. (mm)	Minimum Concrete Compressive Strength (f'_c)							
			2,000 psi (13.8 MPa)		**3,000 psi** (20.7 MPa)		**4,000 psi** (27.6 MPa)		**5,000 psi** (34.5 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)
1/4 (6.4)	3/16	1 1/4 (31.8)	195 (0.9)	245 (1.1)	315 (1.4)	245 (1.1)	315 (1.4)	245 (1.1)	315 (1.4)	245 (1.1)
3/8 (9.5)	1/4	1 3/4 (44.5)	275 (1.2)	455 (2.0)	415 (1.9)	505 (2.3)	500 (2.3)	525 (2.4)	500 (2.3)	545 (2.5)

1. Allowable load capacities are calculated using an applied safety factor of 4.0. Consideration of safety factors of 10 or higher may be necessary depending on the application, such as life safety or overhead.
2. Linear interpolation may be used to determine allowable loads for intermediate compressive strengths.

Ultimate Load Capacities for Carbon Steel Tie-Wire Spike in Normal-Weight Concrete[1]

Anchor Diameter d in. (mm)	Minimum Embedment Depth h_v in. (mm)	Minimum Concrete Compressive Strength (f'_c)					
		3,000 psi (20.7 MPa)		**4,000 psi** (27.6 MPa)		**5,000 psi** (34.5 MPa)	
		Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
3/16 (4.8)	1 1/8 (28.6)	975 (4.4)	950 (4.3)	1,050 (4.7)	950 (4.3)	1,120 (5.0)	950 (4.3)
1/4 (6.4)	1 1/8 (28.6)	1,075 (4.8)	1,310 (5.9)	1,150 (5.2)	1,310 (5.9)	1,230 (5.5)	1,310 (5.9)

1. Ultimate load capacities should be reduced by a minimum safety factor of 4.0 or greater to determine the allowable working load. Consideration of safety factors of 10 or higher may be necessary depending on the application, such as life safety or overhead.

Allowable Load Capacities for Carbon Steel Tie-Wire Spike in Normal-Weight Concrete[1,2]

Anchor Diameter d in. (mm)	Minimum Embedment Depth h_v in. (mm)	Minimum Concrete Compressive Strength (f'_c)					
		3,000 psi (20.7 MPa)		**4,000 psi** (27.6 MPa)		**5,000 psi** (34.5 MPa)	
		Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
3/16 (4.8)	1 1/8 (28.6)	245 (1.1)	240 (1.1)	265 (1.2)	240 (1.1)	280 (1.3)	240 (1.1)
1/4 (6.4)	1 1/8 (28.6)	270 (1.2)	330 (1.5)	290 (1.3)	330 (1.5)	310 (1.4)	330 (1.5)

1. Allowable load capacities are calculated using an applied safety factor of 4.0. Consideration of safety factors of 10 or higher may be necessary depending on the application, such as life safety or overhead.
2. Linear interpolation may be used to determine allowable loads for intermediate compressive strengths.

(c)

PERFORMANCE DATA

Ultimate Load Capacities for Carbon Steel Forming Spike in Normal-Weight Concrete[1]

Anchor Diameter d in. (mm)	Minimum Embed. Depth h_v in. (mm)	Minimum Concrete Compressive Strength (f'_c)							
		2,000 psi (13.8 MPa)		**3,000 psi** (20.7 MPa)		**4,000 psi** (27.6 MPa)		**5,000 psi** (34.5 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)
3/16 (4.8)	1 1/4 (31.8)	780 (3.5)	1,800 (8.1)	1,000 (4.5)	2,000 (9.0)	1,260 (5.7)	2,155 (9.7)	1,260 (5.7)	2,310 (10.4)
1/4 (6.4)	1 1/4 (31.8)	830 (3.7)	1,815 (8.2)	1,200 (5.4)	2,020 (9.1)	1,410 (6.3)	2,220 (10.0)	1,410 (6.3)	2,585 (11.6)

1. Ultimate load capacities should be reduced by a minimum safety factor of 4.0 or greater to determine the allowable working load. Consideration of safety factors of 10 or higher may be necessary depending on the application, such as life safety or overhead.

Allowable Load Capacities for Carbon Steel Forming Spike in Normal-Weight Concrete[1,2]

Anchor Diameter d in. (mm)	Minimum Embed. Depth h_v in. (mm)	Minimum Concrete Compressive Strength (f'_c)							
		2,000 psi (13.8 MPa)		**3,000 psi** (20.7 MPa)		**4,000 psi** (27.6 MPa)		**5,000 psi** (34.5 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)
3/16 (4.8)	1 1/4 (31.8)	195 (0.9)	450 (2.0)	250 (1.1)	500 (2.3)	315 (1.4)	540 (2.4)	315 (1.4)	580 (2.6)
1/4 (6.4)	1 1/4 (31.8)	210 (0.9)	455 (2.0)	300 (1.4)	505 (2.3)	355 (1.6)	555 (2.5)	355 (1.6)	645 (2.9)

1. Allowable load capacities are calculated using an applied safety factor of 4.0. Consideration of safety factors of 10 or higher may be necessary depending on the application, such as life safety or overhead.
2. Linear interpolation may be used to determine allowable loads for intermediate compressive strengths.

Ultimate Load Capacities for Spike in Structural Lightweight Concrete[1,2]

Anchor Diameter d in. (mm)	Minimum Embed. Depth h_v in. (mm)	Minimum Concrete Compressive Strength (f'_c)					
		3,000 psi (20.7 MPa)		**4,000 psi** (27.6 MPa)		**5,000 psi** (34.5 MPa)	
		Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
3/16 (4.8)	1 1/4 (31.8)	440 (2.0)	1,280 (5.8)	400 (1.8)	1,280 (5.8)	380 (1.7)	1,280 (5.8)
1/4 (6.4)	1 1/4 (31.8)	480 (2.2)	1,720 (7.7)	440 (2.0)	1,720 (7.7)	400 (1.8)	1,720 (7.7)
3/8 (9.5)	1 3/4 (44.5)	1,140 (5.1)	3,000 (13.5)	960 (4.3)	3,000 (13.5)	800 (3.6)	3,000 (13.5)
1/2 (12.7)	2 1/2 (63.5)	1,860 (8.4)	6,440 (29.0)	1,860 (8.4)	6,440 (29.0)	1,860 (8.4)	6,440 (29.0)

1. Tabulated load values are applicable to carbon and stainless steel anchors.
2. The values listed above are ultimate load capacities which should be reduced by a minimum safety factor of 4.0 or greater to determine the allowable working load. Consideration of safety factors of 10 or higher may be necessary depending on the application, such as life safety or overhead.

Allowable Load Capacities for Spike in Structural Lightweight Concrete[1,2,3]

Anchor Diameter d in. (mm)	Minimum Embed. Depth h_v in. (mm)	Minimum Concrete Compressive Strength (f'_c)					
		3,000 psi (20.7 MPa)		**4,000 psi** (27.6 MPa)		**5,000 psi** (34.5 MPa)	
		Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
3/16 (4.8)	1 1/4 (31.8)	110 (0.5)	320 (1.4)	100 (0.5)	320 (1.4)	95 (0.4)	320 (1.4)
1/4 (6.4)	1 1/4 (31.8)	120 (0.5)	430 (1.9)	110 (0.5)	430 (1.9)	100 (0.5)	430 (1.9)
3/8 (9.5)	1 3/4 (44.5)	285 (1.3)	750 (3.4)	240 (1.1)	750 (3.4)	200 (0.9)	750 (3.4)
1/2 (12.7)	2 1/2 (63.5)	465 (2.1)	1,610 (7.2)	465 (2.1)	1,610 (7.2)	465 (2.1)	1,610 (7.2)

1. Tabulated load values are applicable to carbon and stainless steel anchors.
2. Allowable load capacities are calculated using an applied safety factor of 4.0. Consideration of safety factors of 10 or higher may be necessary depending on the application, such as life safety or overhead.
3. Linear interpolation may be used to determine ultimate loads for intermediate compressive strengths.

(c)

PERFORMANCE DATA

Ultimate and Allowable Load Capacities for Carbon and Stainless Steel Spike Anchors Installed Through Metal Deck into Structural Lightweight Concrete[1,2,3,4]

Anchor Diameter d in. (mm)	Minimum Embedment Depth h_v in. (mm)	Lightweight Concrete Over Minimum 20 Ga. Steel Deck $f'_c \geq$ 3,000 psi (20.7 MPa)			
		Minimum 1-1/2" Wide Deck			
		Ultimate Load		Allowable Load	
		Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
3/16 (4.8)	1 1/4 (31.8)	560 (2.5)	2,000 (9.0)	140 (0.6)	500 (2.3)
1/4 (6.4)	1 1/4 (31.8)	560 (2.5)	2,000 (9.0)	140 (0.6)	500 (2.3)
3/8 (9.5)	1 3/4 (44.5)	600 (2.7)	2,620 (11.8)	150 (0.7)	655 (2.9)
1/2 (12.7)	2 1/2 (63.5)	1,120 (5.0)	3,020 (13.6)	280 (1.3)	755 (3.4)

1. The values listed above are ultimate and allowable load capacities for anchors installed in structural sand-lightweight concrete.
2. Allowable load capacities are calculated using a safety factor of 4.0. Consideration of safety factors of 10 or higher may be necessary depending on the application, such as life safety or overhead.
3. Spacing distances shall be in accordance with the spacing table for structural lightweight concrete listed in the Design Criteria section.
4. Anchors are permitted to be installed in the lower or upper flute of the steel deck provided the proper installation procedures are maintained.

Ultimate and Allowable Load Capacities for Carbon Steel and Stainless Steel Spike in Grouted Concrete Masonry[1,2,3,4]

Anchor Diameter d in. (mm)	Minimum Embedment Depth h_v in. (mm)	Normal-Weight CMU, $f'_m \geq$ 1,500 psi (10.4 MPa)							
		Ultimate Load				Allowable Load			
		Carbon Steel Spike		Stainless Steel Spike		Carbon Steel Spike		Stainless Steel Spike	
		Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
3/16 (4.8)	7/8 (22.2)	280 (1.3)	540 (2.4)	280 (1.3)	540 (2.4)	55 (0.2)	110 (0.5)	55 (0.2)	110 (0.5)
	1 (25.4)	410 (1.8)	590 (2.7)	310 (1.4)	590 (2.7)	80 (0.4)	120 (0.5)	60 (0.3)	120 (0.5)
	1 1/4 (31.8)	740 (3.3)	1,090 (4.9)	730 (3.3)	1,980 (8.9)	150 (0.7)	420 (1.9)	145 (0.7)	395 (1.8)
1/4 (6.4)	1 (25.4)	670 (3.0)	1,840 (8.3)	645 (2.9)	1,620 (7.3)	135 (0.6)	370 (1.7)	130 (0.6)	325 (1.5)
	1 1/4 (31.8)	800 (3.6)	2,100 (9.5)	770 (3.5)	1,890 (8.5)	160 (0.7)	420 (1.9)	155 (0.7)	380 (1.7)

1. Tabulated load values are for anchors installed into the face shell minimum 6-inch wide, Grade N, normal-weight concrete masonry units conforming to ASTM C 90. Mortar must be type N, S or M.
2. Allowable load capacities are calculated using a safety factor of 5.0. Consideration of safety factors of 10 or higher may be necessary depending on the application, such as life safety or overhead.
3. Linear interpolation may be used to determine allowable load capacities for intermediate embedments.
4. The tabulated values are for anchors installed at a minimum of 16 anchor diameters on center.

DESIGN CRITERIA (ALLOWABLE STRESS DESIGN)

Combined Loading

For anchors loaded in both shear and tension, the combination of loads should be proportioned as follows:

$$\left(\frac{N_u}{N_n}\right) + \left(\frac{V_u}{V_n}\right) \leq 1$$

Where: N_u = Applied Service Tension Load
N_n = Allowable Tension Load
V_u = Applied Service Shear Load
V_n = Allowable Shear Load

Load Adjustment Factors for Spacing and Edge Distances in Concrete

Anchor Installed in Normal-Weight Concrete					
Anchor Dimension	**Load Type**	**Critical Distance (Full Anchor Capacity)**	**Critical Load Factor**	**Minimum Distance (Reduced Capacity)**	**Minimum Load Factor**
Spacing (s)	Tension and Shear	$s_{cr} = 2.0h_v$	$F_{NS} = F_{VS} = 1.0$	$s_{min} = h_v$	$F_{N_S} = F_{V_S} = 0.50$
Edge Distance (c)	Tension	$c_{cr} = 14d$	$F_{NC} = 1.0$	$c_{min} = 5d$	$F_{N_C} = 0.80$
	Shear	$c_{cr} = 14d$	$F_{VC} = 1.0$	$c_{min} = 5d$	$F_{V_C} = 0.50$

Anchor Installed in Structural Lightweight Concrete					
Anchor Dimension	**Load Type**	**Critical Distance (Full Anchor Capacity)**	**Critical Load Factor**	**Minimum Distance (Reduced Capacity)**	**Minimum Load Factor**
Spacing (s)	Tension and Shear	$s_{cr} = 3.0h_v$	$F_{NS} = F_{VS} = 1.0$	$s_{min} = 1.5\ h_v$	$F_{N_S} = F_{V_S} = 0.50$
Edge Distance (c)	Tension	$c_{cr} = 14d$	$F_{NC} = 1.0$	$c_{min} = 7d$	$F_{N_C} = 0.80$
	Shear	$c_{cr} = 14d$	$F_{VC} = 1.0$	$c_{min} = 7d$	$F_{V_C} = 0.50$

1. Allowable load values found in the performance data tables are multiplied by reduction factors when anchor spacing or edge distances are less than critical distances. Linear interpolation is allowed for intermediate anchor spacing and edge distances between critical and minimum distances. When an anchor is affected by both reduced spacing and edge distance, the spacing and edge reduction factors must be combined (multiplied). Multiple reduction factors for anchor spacing and edge distance may be required depending on the anchor group configuration.

DESIGN CRITERIA (ALLOWABLE STRESS DESIGN)

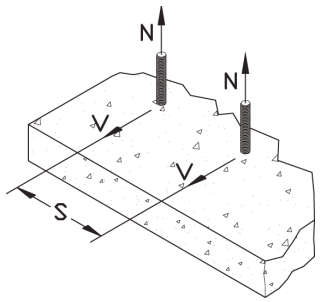
Load Adjustment Factors for Normal-Weight Concrete

Spacing, Tension (F_{NS}) & Shear (F_{VS})

Dia. (in.)		3/16			1/4			3/8	1/2
h_v (in.)		7/8	1	1 1/4	7/8	1	1 1/4	2 1/2	2 3/4
s_{cr} (in.)		1 3/4	2	2 1/2	1 3/4	2	2 1/2	5	5 1/2
s_{min} (in.)		7/8	1	1 1/4	7/8	1	1 1/4	2 1/2	2 3/4
Spacing, s (inches)	7/8	0.50			0.50				
	1	0.57	0.50		0.57	0.50			
	1 1/4	0.71	0.63	0.50	0.71	0.63	0.50		
	1 1/2	0.86	0.75	0.60	0.86	0.75	0.60		
	1 3/4	1.00	0.88	0.70	1.00	0.88	0.70		
	2		1.00	0.80		1.00	0.80		
	2 1/2			1.00			1.00	0.50	
	2 3/4							0.55	0.50
	3							0.60	0.55
	4							0.80	0.73
	5							1.00	0.91
	5 1/2								1.00

Notes: For anchors loaded in tension and shear, the critical spacing *(s_{cr})* is equal to 2 embedment depths ($2\,h_v$) at which the anchor achieves 100% of load.

Minimum spacing *(s_{min})* is equal to 1 embedment depth *(h_v)* at which the anchor achieves 50% of load.

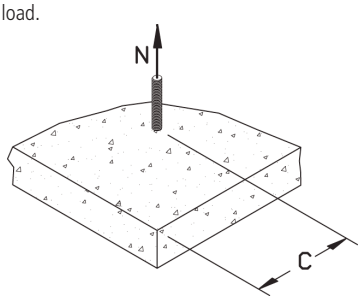


Edge Distance, Tension (F_{NC})

Dia. (in.)		3/16	1/4	3/8	1/2
c_{cr} (in.)		2 5/8	3 1/2	5 1/4	7
c_{min} (in.)		1	1 1/4	1 7/8	2 1/2
Edge Distance, c (inches)	1	0.50			
	1 1/4	0.59	0.50		
	1 7/8	0.78	0.64	0.50	
	2	0.81	0.67	0.52	
	2 1/2	0.96	0.78	0.59	0.50
	2 5/8	1.00	0.81	0.61	0.51
	3		0.89	0.67	0.56
	3 1/2		1.00	0.74	0.61
	4			0.81	0.67
	5			0.96	0.78
	5 1/4			1.00	0.81
	6				0.89
	7				1.00

Notes: For anchors loaded in tension, the critical edge distance *(c_{cr})* is equal to 14 anchor diameters ($14d$) at which the anchor achieves 100% of load.

Minimum edge distance *(c_{min})* is equal to 5 anchor diameters ($5d$) at which the anchor achieves 50% of load.

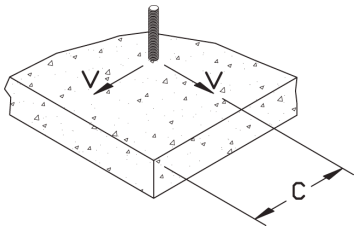


Edge Distance, Shear (F_{VC})

Dia. (in.)		3/16	1/4	3/8	1/2
c_{cr} (in.)		2 5/8	3 1/2	5 1/4	7
c_{min} (in.)		1	1 1/4	1 7/8	2 1/2
Edge Distance, c (inches)	1	0.25			
	1 1/4	0.39	0.25		
	1 7/8	0.67	0.46	0.25	
	2	0.72	0.50	0.28	
	2 1/2	0.94	0.67	0.39	0.25
	2 5/8	1.00	0.71	0.42	0.27
	3		0.83	0.50	0.33
	3 1/2		1.00	0.61	0.42
	4			0.72	0.50
	5			0.94	0.67
	5 1/4			1.00	0.71
	6				0.83
	7				1.00

Notes: For anchors loaded in shear, the critical edge distance *(c_{cr})* is equal to 14 anchor diameters ($14d$) at which the anchor achieves 100% of load.

Minimum edge distance *(c_{min})* is equal to 5 anchor diameters ($5d$) at which the anchor achieves 25% of load.



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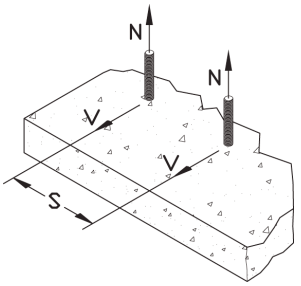
DESIGN CRITERIA (ALLOWABLE STRESS DESIGN)

Load Adjustment Factors for Structural Lightweight Concrete

Spacing, Tension (F_{NS}) & Shear (F_{VS})

Dia. (in.)		3/16			1/4			3/8	1/2
h_v (in.)		7/8	1	1 1/4	7/8	1	1 1/4	2 1/2	2 3/4
s_{cr} (in.)		2 5/8	3	3 3/4	2 5/8	3	3 3/4	7 1/2	8 1/4
s_{min} (in.)		1 3/8	1 1/2	1 7/8	1 3/8	1 1/2	1 7/8	3 3/4	4 1/8
Spacing, s (inches)	1 3/8	0.50			0.50				
	1 1/2	0.57	0.50		0.57	0.50			
	1 7/8	0.71	0.63	0.50	0.71	0.63	0.50		
	1 1/2	0.57	0.50	0.40	0.57	0.50	0.40		
	2 5/8	1.00	0.88	0.70	1.00	0.88	0.70		
	3		1.00	0.80		1.00	0.80		
	3 3/4			1.00			1.00	0.50	
	4							0.53	
	4 1/8							0.55	0.50
	5							0.67	0.61
	6							0.80	0.73
	7							0.93	0.85
	7 1/2							1.00	0.91
	8 1/4								1.00

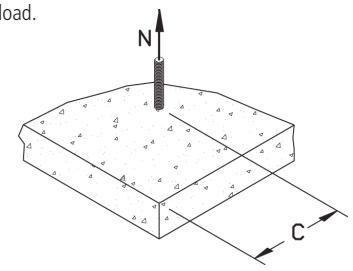
Notes: For anchors loaded in tension and shear, the critical spacing (s_{cr}) is equal to 3 embedment depths ($3h_v$) at which the anchor achieves 100% of load. Minimum spacing (s_{min}) is equal to 1.5 embedment depth ($1.5h_v$) at which the anchor achieves 50% of load.



Edge Distance, Tension (F_{NC})

Dia. (in.)		3/16	1/4	3/8	1/2
c_{cr} (in.)		2 5/8	3 1/2	5 1/4	7
c_{min} (in.)		1 3/8	1 3/4	2 5/8	3 1/2
Edge Distance, c (inches)	1 3/8	0.50			
	1 3/4	0.67	0.50		
	2	0.76	0.57		
	2 5/8	1.00	0.75	0.50	
	3		0.86	0.57	
	3 1/2		1.00	0.67	0.50
	4			0.76	0.57
	5			0.95	0.71
	5 1/4			1.00	0.75
	6				0.86
	7				1.00

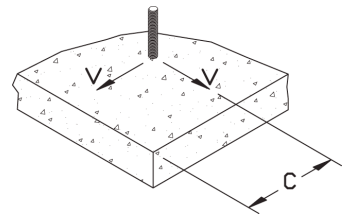
Notes: For anchors loaded in tension, the critical edge distance (c_{cr}) is equal to 14 anchor diameters ($14d$) at which the anchor achieves 100% of load. Minimum edge distance (c_{min}) is equal to 7 anchor diameters ($7d$) at which the anchor achieves 50% of load.



Edge Distance, Shear (F_{VC})

Dia. (in.)		3/16	1/4	3/8	1/2
c_{cr} (in.)		2 5/8	3 1/2	5 1/4	7
c_{min} (in.)		1 3/8	1 3/4	2 5/8	3 1/2
Edge Distance, c (inches)	1 3/8	0.40			
	1 3/4	0.60	0.40		
	2	0.71	0.49		
	2 5/8	1.00	0.70	0.40	
	3		0.83	0.49	
	3 1/2		1.00	0.60	0.40
	4			0.71	0.49
	5			0.94	0.66
	5 1/4			1.00	0.70
	6				0.83
	7				1.00

Notes: For anchors loaded in shear, the critical edge distance (c_{cr}) is equal to 14 anchor diameters ($14d$) at which the anchor achieves 100% of load. Minimum edge distance (c_{min}) is equal to 7 anchor diameters ($7d$) at which the anchor achieves 40% of load.



ORDERING INFORMATION

Mushroom Head Carbon Steel Spike (Tamperproof)

Cat. No.	Anchor Size	Drill Diameter	Min. Embed.	Std. Box	Std. Carton	Wt./100
5502	3/16" x 1"	3/16"	7/8"	100	1,000	1 1/4
5503	3/16" x 1 1/4"	3/16"	7/8"	100	1,000	1 1/2
5504	3/16" x 1 1/2"	3/16"	1 1/4"	100	1,000	1 3/4
5506	3/16" x 2"	3/16"	1 1/4"	100	1,000	2
5508	3/16" x 2 1/2"	3/16"	1 1/4"	100	1,000	2
5510	3/16" x 3"	3/16"	1 1/4"	100	1,000	2 1/2
5511	3/16" x 3 1/2"	3/16"	1 1/4"	100	1,000	3 1/2
5512	3/16" x 4"	3/16"	1 1/4"	100	500	4
5522	1/4" x 1"	1/4"	7/8"	100	1,000	1 1/2
5523	1/4" x 1 1/4"	1/4"	1"	100	1,000	2 1/4
5524	1/4" x 1 1/2"	1/4"	1 1/4"	100	1,000	2 1/2
5526	1/4" x 2"	1/4"	1 1/4"	100	1,000	3
5528	1/4" x 2 1/2"	1/4"	1 1/4"	100	1,000	4
5530	1/4" x 3"	1/4"	1 1/4"	100	1,000	4 1/2
5531	1/4" x 3 1/2"	1/4"	1 1/4"	100	1,000	4 1/2
5532	1/4" x 4"	1/4"	1 1/4"	100	1,000	5 1/2
5546	3/8" x 2"	3/8"	1 3/4"	25	250	7 1/2
5548	3/8" x 2 1/2"	3/8"	1 3/4"	25	250	9
5550	3/8" x 3"	3/8"	1 3/4"	25	250	10
5551	3/8" x 3 1/2"	3/8"	1 3/4"	25	250	11
5552	3/8″ x 4	3/8″	1 3/4″	25	250	11
5554	3/8″ x 5	3/8″	1 3/4″	25	250	11
5556	3/8″ x 6	3/8″	1 3/4″	25	250	11
5569	1/2″ x 2 3/4″	1/2″	2-1/2″	50	200	13
5571	1/2″ x 3 1/2″	1/2″	2-1/2″	50	150	13
5572	1/2″ x 4″	1/2″	2-1/2″	25	150	13
5574	1/2″ x 5″	1/2″	2-1/2″	25	150	13
5577	1/2″ x 6 1/2″	1/2″	2-1/2″	25	150	13

The published length is measured from below the head to the end of the anchor.

Flat Head Carbon Steel Spike (Tamperproof)

Cat. No.	Anchor Size	Drill Diameter	Min. Embed.	Std. Box	Std. Carton	Wt./100
5608	3/16" x 2 1/2"	3/16"	1 1/4"	100	1,000	2
5610	3/16" x 3"	3/16"	1 1/4"	100	1,000	2 1/2
5612	3/16" x 4"	3/16"	1 1/4"	100	1,000	4
5624	1/4" x 1 1/2"	1/4"	1 1/4"	100	1,000	2 1/2
5626	1/4" x 2"	1/4"	1 1/4"	100	1,000	3
5628	1/4" x 2 1/2"	1/4"	1 1/4"	100	1,000	3 3/4
5630	1/4" x 3"	1/4"	1 1/4"	100	1,000	4 1/2
5631	1/4" x 3 1/2"	1/4"	1 1/4"	100	1,000	5
5632	1/4" x 4"	1/4"	1 1/4"	100	500	5 3/4

The published length is the overall length of the anchor.

ORDERING INFORMATION

Mushroom Head Type 316 Stainless Spike (Tamperproof)

Cat. No.	Anchor Size	Drill Diameter	Min. Embed.	Std. Box	Std. Carton	Wt./100
6602	3/16" x 1"	3/16"	7/8"	100	1,000	1 1/4
6603	3/16" x 1 1/4"	3/16"	7/8"	100	1,000	1 1/2
6604	3/16" x 1 1/2"	3/16"	7/8"	100	1,000	1 3/4
6606	3/16" x 2"	3/16"	7/8"	100	1,000	2
6623	1/4" x 1 1/4"	1/4"	7/8"	100	1,000	2 1/4
6624	1/4" x 1 1/2"	1/4"	7/8"	100	1,000	2 1/2
6626	1/4" x 2"	1/4"	7/8"	100	1,000	3
6628	1/4" x 2 1/2"	1/4"	7/8"	100	1,000	4
6630	1/4" x 3"	1/4"	7/8"	100	1,000	4 1/2
6646	3/8" x 2"	3/8"	7/8"	25	250	7 1/2
6648	3/8" x 2 1/2"	3/8"	1 3/4"	25	250	9
6650	3/8" x 3"	3/8"	1 3/4"	25	250	10

The published length is measured from below the head to the end of the anchor.

Pipe Spike

Cat. No.	Anchor Size	Drill Diameter	Min. Embed.	Std. Box	Std. Carton	Wt./100
3755	1/4"	3/16"	1 1/4"	100	1,000	4
3758	3/8"	1/4"	1 3/4"	50	500	6

Designed for rod hanging.

Tie-Wire Spike

Catalog Number	Anchor Size	Drill Diameter	Minimum Embed.	Tie Wire Hole Size	Standard Box	Standard Carton	Wt./100
3756	3/16"	3/16"	1 1/8"	3/16"	100	500	2
3759	1/4"	1/4"	1 1/8"	9/32"	100	500	2 1/2

Designed for suspended ceilings.

Forming Spike

Cat. No.	Anchor Size	Drill Diameter	Min. Embed.	Std. Box	Std. Carton	Wt./100
3795	3/16" x 1 1/2"	3/16"	1 1/4"	100	1,000	2 1/2
3796	3/16" x 2"	3/16"	1 1/4"	100	1,000	3
3797	3/16" x 2 3/4"	3/16"	1 1/4"	100	1,000	4
3794	1/4" x 2 3/4"	1/4"	1 1/4"	100	1,000	5

Designed for concrete forming. The published length is measured from below the head to the end of the anchor.

ORDERING INFORMATION

Spike Drivers

While the SPIKE anchor can easily be installed using a hammer, a specially designed series of drivers and manual tools provide a fast, easy to use method for installing SPIKE anchors into concrete and masonry materials. The tools allow the SPIKE anchor to be installed in confined areas and prevent damage to the fixture from stray hammer blows.

Catalog Number	Tool Description	Guide I.D.	Standard Box	Wt./100
3790	Spike Driver 1000	1/2"	1	1/4
3791	Spike Driver 2000	1/2"	1	1/4

The SPIKE Driver 1000 is a one piece tool with an SDS shank formed on one end and a retractable guide on the other. The driver is designed to fit directly into the chuck of an SDS rotary hammer drill to provide maximum impact energy for faster driving. Once the anchor hole is drilled, insert the SPIKE Driver 1000 into the chuck of the rotary hammer drill. Insert the tip of the SPIKE through the fixture into the anchor hole, then place the guide over the head of the SPIKE. Turn the rotary hammer on and drive the SPIKE until it is at the required embedment in the base material and seated flush against the fixture. As the SPIKE is driven into the base material, the guide retracts until the anchor is fully seated. This driver is normally used with a two person installation team where one installer is drilling the anchor holes while the other positions the fixture and sets the anchor.

The SPIKE Driver 2000 is a variation of the 1000 tool which is designed to be used in conjunction with a 3/16" x 4" or 1/4" x 4" SDS carbide tipped bit. The Driver has a recessed end which is slipped over the SDS bit on one end and a retractable guide on the other. Once the anchor hole is drilled, slip the SPIKE Driver 2000 over the 3/16" or 1/4" SDS bit. Drive the SPIKE anchor with the rotary hammer until it is seated flush against the fixture and at the required embedment in the base material. As the SPIKE is driven into the base material, the guide retracts until the anchor is fully seated. Once the SPIKE is installed,remove the driver from the SDS bit and drill the next anchor hole.

Pipe Spike Setting Tool

When installing the 3/8" Pipe SPIKE, this tool is designed to make driving easier. The tool has a guide tip on which the 3/8" Pipe SPIKE is mounted which helps to protect the internal threads during the driving operation. A large handle provides a convenient gripping area and a large bearing surface to accept the hammer blows. Simply position the 3/8" Pipe SPIKE on the tool and insert the tip of the anchor into the hole. Give the end of the handle several sharp hammer blows to drive the 3/8" Pipe SPIKE into the base material until it is at the required embedment.

Catalog Number	Tool Description	Tip O.D.	Standard Box	Wt./100
3760	Pipe Spike Setting Tool	5/16"	1	1

Spike Driver Selection Guide

Style	Size	1000	2000	Pipe
Mushroom	3/16"	X	X	
Mushroom	1/4"	X	X	
Flat Head	3/16"	X	X	
Flat Head	1/4"	X	X	
Pipe	1/4"	X	X	
Pipe	3/8"			X
Tie-Wire	3/16"	X	X	
Forming	3/16"	X	X	
Forming	1/4"	X	X	