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Legacy report on the 1997 Uniform Building Code™, the 2000 International Building Code® and the 2000 International Residential Code®

DIVISION: 05—METALS
Section: 05090—Metal Fastenings

DIVISION: 03—CONCRETE
Section: 03151—Concrete Anchoring

POWERS POWDER-ACTUATED FASTENERS, CEILING CLIP ASSEMBLIES AND SILL PLATE ANCHORAGE

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1.0 SUBJECT

Powers Powder-actuated Fasteners, Ceiling Clip Assemblies and Sill Plate Anchorage.

2.0 DESCRIPTION

2.1 General:

The Powers Powder-actuated Fasteners, Ceiling Clip Assemblies and Sill Plate Anchorage are low-velocity powder-actuated fasteners for use in normal-weight concrete, lightweight concrete, and steel base materials. They are available in a variety of shapes and assemblies with several diameters and lengths. Shapes include headed pins with smooth shanks, headed pins with knurled shanks, and threaded studs. See Figure 1 for examples. Manufactured from AISI 1062 modified steel, these fasteners are austempered to a Rockwell C hardness of 53 to 55. The fasteners are zinc-plated to a minimum thickness of 0.0002 inch (0.005 mm). The plating must conform to ASTM B 695, Class 5, Type 1. The Powers fasteners have a minimum bending yield stress, Fby, of 236,000 psi (1626 MPa).

The 0.300-inch-head drive pin and 8-millimeter-head drive pin are also sold by Max Co., Ltd., and are labeled as Powerlite 0.300-inch-head drive pin and Powerlite 8-millimeter-head drive pin. Recognition of Powerlite pins is limited to Tables 1, 3 and 6 of this report.

Assemblies include premounted flutes, washers and angles. Flutes are formed from flexible vinyl. Washers, angles and clips are produced from 0.075-inch-thick (1.9 mm) zinc-plated steel having a minimum 0.00015-inch-thick (0.0038 mm) plating. The steel must be commercial quality with a Rockwell hardness from 45 to 60. Typical assemblies are illustrated in Figure 2.

Fasteners may be designed for structural connections using allowable loads described in Section 2.3. Fasteners may also be used to connect sill plates to foundations in accordance with Section 2.4. Section 2.4 provides equivalence to 1/2-inch-diameter (12.7 mm) bolts described in Section 1806.6 of the 1997 Uniform Building Code™ (UBC), Section 2308.6 of the 2000 International Building Code® (IBC) and Section R403.1.6 of the 2000 International Residential Code® (IRC).

2.2 Installation:

The installation of fasteners into concrete and steel requires a Powers powder-actuated fastening tool or other power-actuated tool as recommended by Powers Fasteners, Inc. Installation is limited to dry, interior environments. The fastener size, minimum embedment, minimum spacing, and edge and end distances shall comply with Tables 1 through 6.

2.3 Allowable Loads:

2.3.1 Concrete or Steel Base Material: The allowable shear and tension (pullout) values for fasteners driven into concrete or steel are set forth in Tables 1 through 6. Earthquake load resistance is beyond the scope of this report, except as permitted in Section 2.4. The stress increases described in Section 1612.3 of the UBC and Section 1605.3 of the IBC are not allowed for wind loads acting alone or when combined with vertical loads. No increase will be allowed for vertical loads acting alone. Allowable loads for fasteners subjected to combined shear and tension loads may be calculated by the following equation:

(Ps/Pt) + (Vs/Vt) ≤ 1

where:

- Ps = Applied service tension load, pounds (N).
Pt = Allowable service tension load, pounds (N).
Vs = Applied service shear load, pounds (N).
Vt = Allowable service shear load, pounds (N).

*Revised November 1, 2004

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2.3.2 Wood to Steel or Concrete: Lateral design values determined in accordance with Section 2318 of the UBC and Section 2306.1 of the IBC, and presented in tables referenced in Section 2318 of the UBC and Section 2306.1 of the IBC, are permitted with Powers fasteners of equal or greater diameters. The wood element is the side member.

2.4 Sill Plate to Foundation Connections:

2.4.1 General: Attachment of wood sill plates to the perimeter of concrete is allowed under the following conditions:

1. No cold joint exists, between the slab and foundation, below the plate.
2. No plate is installed on slabs supported by concrete-block foundation walls.

2.4.2 UBC: These sill-plate connections are intended to satisfy the requirements of Section 1806.6 of the UBC, Section 2308.6 of the IBC and Section R403.1.6 of the IRC. Usage is limited to Seismic Zones 0, 1, 2 and 3, and areas with basic wind speeds up to 80 mph (129 km/h). The allowable fastener spacings for attachment of wood plates to concrete footings or slabs are set forth in Table 6.

For sill plate connections in Seismic Zone 4 and 90 mph (145 km/h) and greater basic wind speed areas, an engineering design using allowable loads described in Tables 1 and 3 is required.

2.4.3 IBC: These sill-plate connections are intended to satisfy the requirements of Section 2308.6 of the IBC. Usage is limited to Seismic Design Categories A, B, or C, and areas with basic wind speeds up to 100 mph (161 km/h) (3-second gusts). The allowable fastener spacings for attachment of wood plates to concrete footings or slabs are set forth in Table 6.

For sill plates in Seismic Design Category D or E and having 105 mph (169 km/hr) 3-second-gust and greater basic wind speeds, an engineering design, using allowable loads described in Tables 1 and 3, is required.

2.4.4 IRC: These sill plate connections are intended to satisfy the requirements of Section R403.1.6 of the IRC. Usage is limited to Seismic Design Categories A, B, and C

and areas with basic wind speeds up to 100 mph (161 km/hr). The allowable fastener spacings for attachment of wood plates to concrete footings or slabs are set forth in Table 6.

2.5 Identification:

The fasteners are identified by a label on the packaging that notes the company name (Powers Fasteners, Inc., or Max Co., Ltd.), the catalog number and the fastener size.

3.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Interim Criteria for Power-driven Fasteners in Concrete, Steel and Masonry Elements (AC70), dated September 1995.

4.0 FINDINGS

The Powers Powder-actuated Fastening Systems described in this report comply with the 1997 Uniform Building Code™, the 2000 International Building Code® and the 2000 International Residential Code®, subject to the following conditions:

- 4.1 Fasteners are manufactured and identified in accordance with this report.
- 4.2 Fasteners are installed in accordance with this report and Powers Fasteners, Inc., instructions.
- 4.3 Allowable loads are in accordance with Section 2.3 of this report. Calculations proving that the applied loads are less than the maximum allowable loads described in this report must be submitted to the building official for approval.
- 4.4 Fastener attachment of wood plates to foundations complies with Section 2.4 of this report.
- 4.5 Minimum concrete thickness is three times the fastener embedment into the concrete.
- 4.6 Earthquake load resistance is beyond the scope of this report, except as permitted in Section 2.4.

This report is subject to re-examination in two years.

TABLE 1—ALLOWABLE SERVICE TENSION AND SHEAR VALUES, FOR POWDER-ACTUATED FASTENERS IN NORMAL-WEIGHT CONCRETE^{1,2,3,4,5} (pounds)

FASTENER DESCRIPTION	SHANK DIAMETER (inch)	EMBEDMENT DEPTH (inches)	$f'_c = 2,000$ psi		$f'_c = 3,000$ psi		$f'_c = 4,000$ psi		$f'_c = 5,000$ psi	
			Tension	Shear	Tension	Shear	Tension	Shear	Tension	Shear
0.300-inch-head drive pin 8-millimeter-head drive pin 1/4-inch—20 threaded stud	0.145	5/8	25	45	60	95	45	95	25	95
		3/4	60	95	95	125	95	125	100	125
		1	100	140	130	155	155	155	180	200
		1 1/4	110	155	155	165	195	165	235	200
		1 1/2	115	175	180	175	235	175	290	200
3/8-inch-head drive pin	0.172	1 1/4	135	225	145	240	200	260	200	260
		1 1/2	185	280	230	305	230	305	230	305
3/8-inch—16 threaded stud	0.205	1	95	135	80	135	160	110	160	110
		1 1/4	170	220	165	220	200	320	200	320
		1 3/8	230	275	275	325	295	395	295	395

See Table 3 for footnotes.

**TABLE 2—ALLOWABLE SERVICE TENSION AND SHEAR VALUES FOR POWDER-ACTUATED FASTENERS
IN NORMAL-WEIGHT CONCRETE^{1,2,3,4,5} (pounds)**

CEILING CLIPS—NORMAL-WEIGHT CONCRETE											
Fastener Description	Shank Diameter (inch)	Embedment Depth (inches)	$f'_c = 2,000$ psi			$f'_c = 3,000$ psi			$f'_c = 4,000$ psi		
			Tension	45°	Shear	Tension	45°	Shear	Tension	45°	Shear
Ceiling clips—standard	0.145	$\frac{3}{4}$ 1	40	35	65	65	65	105	70	70	145
			40	65	110	95	65	120	100	120	160
Ceiling clips—economy	0.145	$\frac{3}{4}$ 1	40	30	75	40	45	75	70	100	145
			40	40	120	40	80	150	100	120	150
Ceiling clips—ladd pin	0.152	$1\frac{1}{8}$	50	70	50	50	85	130	135	125	160

See Table 3 for footnotes

**TABLE 3—ALLOWABLE SERVICE TENSION AND SHEAR VALUES FOR POWDER-ACTUATED FASTENERS
IN LIGHTWEIGHT CONCRETE^{1,2,3,4,5} (pounds)**

FASTENER DESCRIPTION	SHANK DIAMETER (inch)	EMBEDMENT DEPTH (inches)	$f'_c = 3,000$ psi						$f'_c = 3,500$ psi					
			Directly into Concrete			Through Deck or Channel into Concrete			Directly into Concrete			Through Deck or Channel into Concrete		
			Tension	45°	Shear	Tension	45°	Shear	Tension	45°	Shear	Tension	45°	Shear
0.300-inch-head drive pin	0.145	1	70	—	125	65	—	170	75	—	135	70	—	185
8-millimeter-head drive pin		$1\frac{1}{2}$	130	—	180	105	—	175	140	—	195	115	—	190
$\frac{1}{4}$ -inch—20 threaded stud	0.145	$\frac{3}{4}$	70	—	35	35	—	160	75	—	40	40	—	175
		1	70	—	125	65	—	170	75	—	135	70	—	185
$\frac{3}{8}$ -inch-head drive pin	0.172	$1\frac{1}{4}$	65	—	195	35	—	225	70	—	210	40	—	245
		$1\frac{1}{2}$	155	—	205	105	—	240	165	—	220	115	—	260
$\frac{3}{8}$ -inch—16 threaded stud	0.205	1	70	—	130	45	—	165	75	—	140	50	—	180
		$1\frac{1}{4}$	170	—	265	85	—	225	185	—	285	90	—	245
Ceiling clips—standard	0.145	$\frac{3}{4}$	50	40	25	35	40	120	55	45	30	40	45	130
		1	60	40	80	45	70	120	65	45	85	50	75	130
Ceiling clips—economy	0.145	$\frac{3}{4}$	35	45	30	30	40	135	40	50	35	35	45	145
		1	55	90	115	55	45	135	60	95	125	60	50	145
Ceiling clips—ladd pin	0.152	$1\frac{1}{8}$	95	105	145	55	80	125	100	115	155	60	85	135

For SI: 1 inch = 25.4 mm, 1 psi = 6.89 kPa, 1 lbf = 4.45 N.

¹The fasteners must not be driven until the concrete has reached the designated minimum ultimate compressive strength. Minimum concrete thickness is three times the fastener embedment into the concrete.

²The allowable shear and tension values are for the fastener only. Wood or steel members connected to the fastener must be investigated separately in accordance with accepted design criteria.

³The stress increases described in Section 1612.3 of the UBC and Section 1605.3 of the IBC are not allowed for wind loads acting alone or when combined with other loads.

⁴The minimum spacing is 3 inches center-to-center and the minimum edge and end distances are 3 inches for installation in concrete.

⁵Earthquake load resistance is beyond the scope of this report, except as permitted in Section 2.4.

⁶Steel deck or channel must be minimum No. 20 gage [0.0359 inch (0.91 mm)] thick.

**TABLE 4—ALLOWABLE SERVICE TENSION AND SHEAR VALUES IN ASTM A 36 STEEL
FOR POWDER-ACTUATED FASTENERS^{1,2,3,4,5} (pounds)**

FASTENER DESCRIPTION	SHANK DIAMETER (inch)	SHANK TYPE	$\frac{1}{8}$ -INCH-THICK STEEL		$\frac{3}{16}$ -INCH-THICK STEEL		$\frac{1}{4}$ -INCH-THICK STEEL		$\frac{3}{8}$ -INCH-THICK STEEL	
			Tension	Shear	Tension	Shear	Tension	Shear	Tension	Shear
0.300-inch-head drive pin	0.145	Knurled	125	110	180	285	240	460	515	750
8-millimeter-head drive pin		Smooth	75	420	80	575	125	575	285	250
$\frac{1}{4}$ -inch—20 threaded stud	0.145	Knurled	125	445	180	450	240	460	515	750
$\frac{3}{8}$ -inch-head drive pin	0.172	Knurled	350	295	310	585	210	585	340	295
		Smooth	115	540	245	740	245	780	565	845
$\frac{3}{8}$ -inch—16 threaded stud	0.205	Knurled	—	—	200	960	265	1,615	—	—

For SI: 1 inch = 25.4 mm.

^{1,2,3,4,5}See corresponding footnotes to Table 5.

TABLE 5—ALLOWABLE SERVICE TENSION AND SHEAR VALUES IN ASTM A 36 STEEL FOR POWDER-ACTUATED FASTENERS WITH CEILING CLIPS^{1,2,3,4,5} (pounds)

FASTENER ASSEMBLY DESCRIPTION	SHANK DIAMETER (inch)	SHANK TYPE	1/8-INCH-THICK STEEL			3/16-INCH-THICK STEEL		
			Tension	45°	Shear	Tension	45°	Shear
Ceiling clips—standard	0.145	Smooth	205	215	220	220	215	220
Ceiling clips—economy	0.145	Smooth	190	255	245	210	255	245
Ceiling clips—ladd	0.152	Smooth	205	250	235	225	250	235

For **SI**: 1 inch = 25.4 mm, 1 lbf = 4.45 N.

¹To obtain the tabulated values, the entire pointed portion of the fastener must penetrate the steel.

²The allowable shear and tension values are for the fastener only. Wood or steel members connected must be investigated separately in accordance with accepted design criteria.

³The stress increases described in Section 1612.3 of the UBC and Section 1605.3 of the IBC are not allowed for wind loads acting alone or when combined with other loads.

⁴The minimum spacing is 1 1/2 inches center-to-center and the minimum edge and end distances are 1/2 inch for installations in ASTM A 36 steel.

⁵Earthquake load resistance is beyond the scope of this report, except as permitted in Section 2.4.

TABLE 6—SPACING REQUIREMENTS FOR FOUNDATION SILL PLATE ANCHORAGE TO NORMAL-WEIGHT CONCRETE

FASTENER DESCRIPTION	SHANK DIAMETER (inch)	EMBEDMENT DEPTH (inches)	MINIMUM LENGTH (inches)	SPACING ^{1,4,5,6,7} (feet)		
				Interior Shear Walls ^{3,5}	Interior Nonshear Walls ²	Exterior Shear Walls ^{3,5}
0.300-inch-head drive pin 8-millimeter-head drive pin	0.145	1 1/2	2 7/8	1.5	3	1.5
3/8-inch-head drive pin	0.172	1 1/2	3	2	4	2

For **SI**: 1 inch = 25.4 mm, 1 foot = 305 mm, 1 psi = 6.89 kPa, 1 pound per foot = 0.0146 N/m.

¹Spacings are based on the attachment of 2-inch-nominal-thickness wood at a 1 3/4-inch edge distance with a specific gravity of 0.5 or greater to concrete floor slabs or footings in accordance with Section 1806.6 of the UBC and Section 1805.6 of the IBC for maximum two-story buildings. For other species of lumber, the spacing of fasteners requires calculations complying with Chapter 23, Division III, of the UBC or Chapter 23, Section 2306, of the IBC.

²Walls must have fasteners placed 6 inches from ends of sill plates, with spacing between as noted above.

³Walls must have two fasteners placed 6 inches and 10 inches, respectively, from each end of sill plates, with maximum spacing between as shown in this table.

⁴Fasteners must not be driven until the concrete has reached a minimum compressive strength of 2,000 psi.

⁵Bearing walls have bracing in accordance with Section 2320.11.3 of the UBC, Section 2308.9.3 of the IBC, or Section R602.10 of the IRC. Interior and nonbearing partitions are assumed to be unbraced.

⁶Fasteners must not be used to attach shear walls having a unit shear exceeding 100 pounds per foot to other building elements.

⁷All fasteners must be installed with minimum 3/4-inch-diameter, No. 16 gage (0.0598 inch) steel washers. Fasteners must be installed a minimum of 1 3/4 inches from concrete edges.

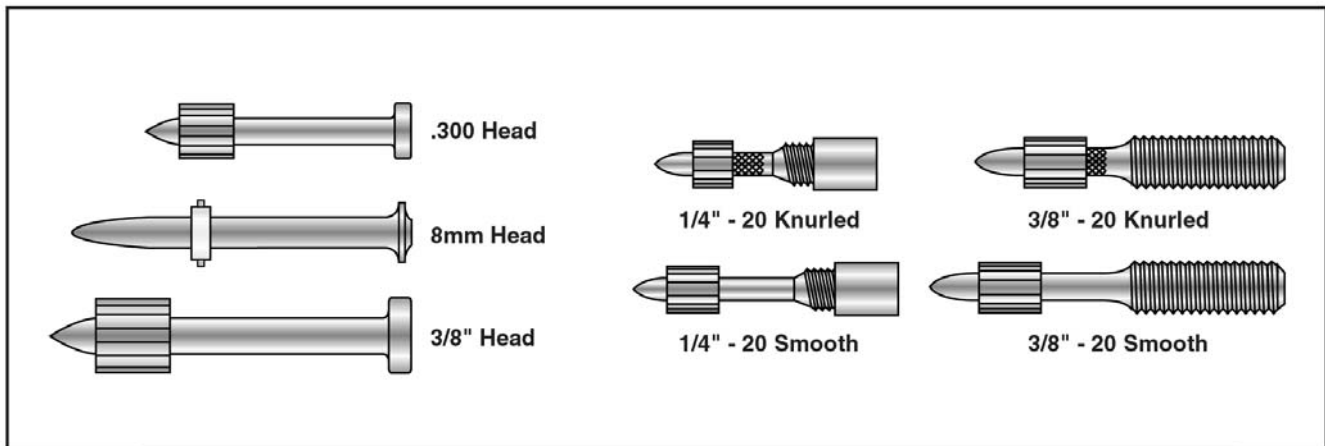


FIGURE 1—FASTENER SHAPES

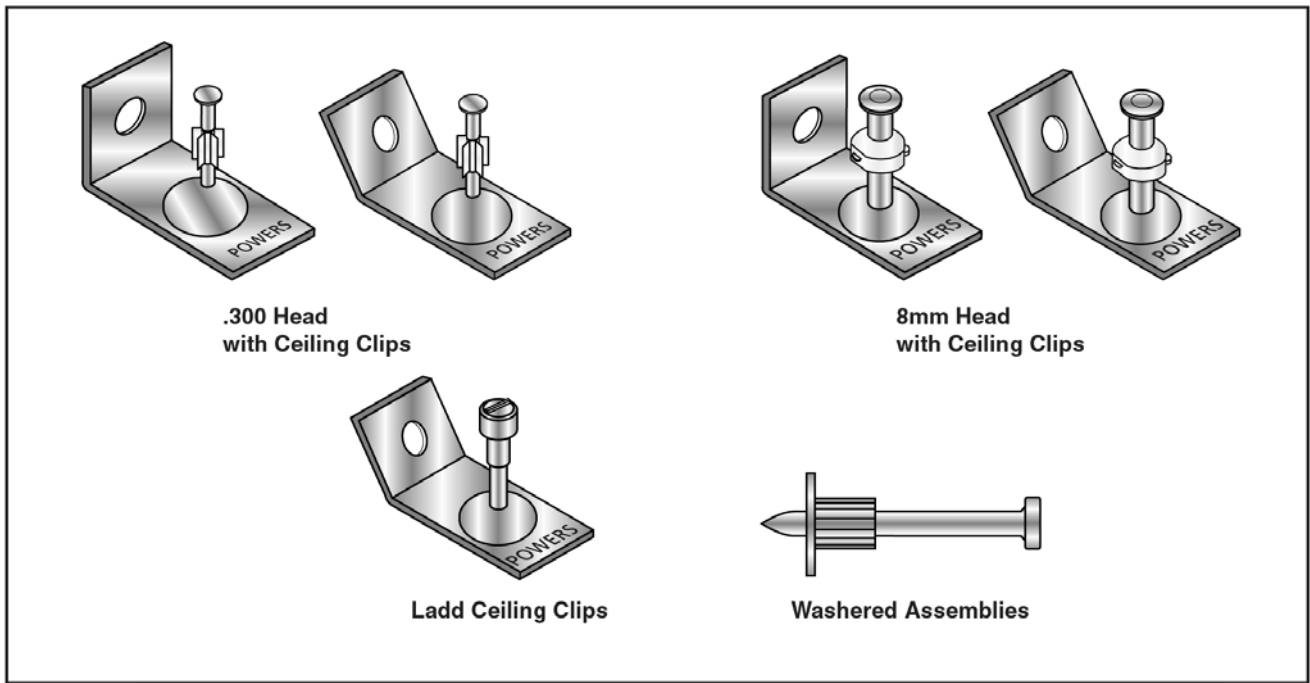


FIGURE 2—FASTENER ASSEMBLIES