TECHNICAL GUIDE FOR THE DESIGN PROFESSIONAL

1ST EDITION

Anchoring and Fastening Systems

DEWALT®

ENGINEERED BY Powers™

STRUCTURAL ANCHOR SELECTION GUIDE

ADHESIVE ANCHORS

Product	Description	Anchor Diameter	ICC-ES Approvals: Concrete	Cracked Concrete	Seismic	Post-Installed Rebar	Concrete-filled Metal Deck	Grouted Masonry	Ungrouted Masonry	UL Listing	FM Approval	Capacity	Cost	Similar Product
Pure110+®	1-to-1 and 3-to-1 Cartridge - Epoxy Anchor	3/8" - 1-1/4" #3 - #10 Rebar	ICC ES ESR-3298	ICC ES ESR-3298	ICC ES ESR-3298	ICC ES ESR-3298						lbs lbs lbs	$$$	RE 500 V3
Pure50+™	1-to-1 Cartridge - Epoxy Anchor	3/8" - 1-1/4" #3 - #10 Rebar	ICC ES ESR-3576	ICC ES ESR-3576	ICC ES ESR-3576							lbs lbs	$$	RE 500 SD RE 100
AC200+	10-to-1 Cartridge Hybrid Anchor	3/8" - 1-1/4" #3 - #10 Rebar	ICC ES ESR-4027	ICC ES ESR-4027	ICC ES ESR-4027							lbs lbs lbs	$$$	HY 200
AC100+ Gold®	10-to-1 Cartridge - Vinylester Anchor	3/8" - 1-1/4" #3 - #10 Rebar	ICC ES ESR-2582	ICC ES ESR-2582	ICC ES ESR-2582			ICC ES ESR-3200	ICC ES ESR-3200			lbs lbs	$$	HY 100 HY 70

EXPANSION ANCHORS

Product	Description	Anchor Diameter	Concrete	Cracked Concrete	Seismic	Post-Installed Rebar	Concrete-filled Metal Deck	Grouted Masonry	Ungrouted Masonry	UL Listing	FM Approval	Capacity	Cost	Similar Product
Power-Stud®+ SD1	Carbon Steel Wedge-Anchor	1/4" - 1-1/4"	ICC ES ESR-2818	ICC ES ESR-2818	ICC ES ESR-2818		ICC ES ESR-2818	ICC ES ESR-2966		UL File No. EX1289	FM APPROVED File No. 3059197	lbs lbs	$	Kwik Bolt 3 (KB3) KBV-TZ
Power-Stud®+ SD2	High Performance Carbon Steel Wedge-Anchor	3/8" - 3/4"	ICC ES ESR-2502	ICC ES ESR-2502	ICC ES ESR-2502		ICC ES ESR-2502			UL File No. EX1289	FM APPROVED File No. 3059197	lbs lbs lbs	$$	Kwik Bolt TZ
Power-Stud®+ SD4	304 Stainless Steel Wedge-Anchor	1/4" - 3/4"	ICC ES ESR-2502	ICC ES ESR-2502	ICC ES ESR-2502							lbs lbs lbs	$$$	Kwik Bolt 3 (KB3) / KB TZ SS
Power-Stud®+ SD6	316 Stainless Steel Wedge-Anchor	1/4" - 3/4"	ICC ES ESR-2502	ICC ES ESR-2502	ICC ES ESR-2502							lbs lbs lbs	$$$$	Kwik Bolt 3 (KB3) / KB TZ SS

SCREW ANCHORS

Product	Description	Anchor Diameter	Concrete	Cracked Concrete	Seismic	Post-Installed Rebar	Concrete-filled Metal Deck	Grouted Masonry	Ungrouted Masonry	UL Listing	FM Approval	Capacity	Cost	Similar Product
Screw-Bolt+™	High Performance Screw Anchor	1/4" - 3/4" (CS and MG)	ICC ES ESR-3889	ICC ES ESR-3889	ICC ES ESR-3889		ICC ES ESR-3889					lbs lbs lbs	$$$	KH-EZ
Wedge-Bolt®+	Screw Anchor	1/4" - 3/4" (CS) 3/8" - 3/4" (MG)	ICC ES ESR-2526	ICC ES ESR-2526	ICC ES ESR-2526		ICC ES ESR-2526	ICC ES ESR-1678				lbs lbs	$$$	Kwik HUS / HUS-EZ

SPECIALITY ANCHORS

Product	Description	Anchor Diameter	Concrete	Cracked Concrete	Seismic	Post-Installed Rebar	Concrete-filled Metal Deck	Grouted Masonry	Ungrouted Masonry	UL Listing	FM Approval	Capacity	Cost	Similar Product
Atomic+ Undercut®	Undercut Anchor	5/8" - 1-1/8" (Rod size 3/8" - 3/4")	ICC ES ESR-3067	ICC ES ESR-3067	ICC ES ESR-3067							lbs lbs lbs lbs	$$$$	HDA Undercut
Power-Bolt®+	Heavy Duty Sleeve Anchor	1/4" - 3/4" (CS) 1/4" - 1/2" (SS)	ICC ES ESR-3260	ICC ES ESR-3260	ICC ES ESR-3260							lbs lbs	$$$	HSL-3

MEP HANGER ANCHORS

Product	Description	Anchor Diameter	Concrete	Cracked Concrete	Seismic	Post-Installed Rebar	Concrete-filled Metal Deck	Grouted Masonry	Ungrouted Masonry	UL Listing	FM Approval	Capacity	Cost	Similar Product
Snake+®	Rod Hanger / Screw Anchor	1/4" - 1/2"	ICC ES ESR-2272	ICC ES ESR-2272	ICC ES ESR-2272		ICC ES ESR-2272				FM APPROVED File No. 3059197	lbs lbs	$$	No Similar Product
Hangermate®+ (Concrete)	Rod Hanging Anchor	1/4" - 3/8"	ICC ES ESR-3889	ICC ES ESR-3889	ICC ES ESR-3889		ICC ES ESR-3889				FM APPROVED File No. 3059197	lbs lbs	$$	KH-EZI
Vertigo®+ (Concrete)	Rod Hanger / Screw Anchor	1/4" - 1/2"	ICC ES ESR-2526	ICC ES ESR-2526	ICC ES ESR-2526		ICC ES ESR-2526				FM APPROVED File No. 3059197	lbs lbs	$$	KH-EZI Hilti HUS-EZ I
Mini-Undercut™	Rod Hanger / Screw Anchor	3/8"	ICC ES ESR-3912	ICC ES ESR-3912	ICC ES ESR-3912						FM APPROVED File No. 3059197	lbs lbs	$$	No Similar Product
Bang-It+®	Speciality Cast-In-Place	1/4" - 3/4"			ICC ES ESR-3657		ICC ES ESR-3657			UL File No. EX1289	FM APPROVED File No. 3059197	lbs lbs	$$	HCI-MD KCS-MD
Wood-Knocker+® II	Speciality Cast-In-Place	1/4" - 3/4"	ICC ES ESR-3657	ICC ES ESR-3657	ICC ES ESR-3657					UL File No. EX1289	FM APPROVED File No. 3059197	lbs lbs	$$	HCI-WF KCS-WF
DDI+™ (Deck Insert)	Thread Insert for Composite Steel Deck	3/8" - 3/4"			ICC ES ESR-3958		ICC ES ESR-3958			UL File No. EX1289	FM APPROVED File No. 3059197	lbs lbs	$$	No Similar Product

ICC ES Indicates a Code Listed Product

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STRUCTURAL DESIGN SOFTWARE

Powers Design Assist®

- Free anchor calculation design software with user-friendly interface
- Model and see results with real-time 3D graphics and dynamic results
- Concrete anchor calculations according to ACI 318, CSA A23.3 and ETAG
- Detailed output and printout of results with code section references
- NOW INCLUDES DEWALT ANCHORS

- Design For Anchors In Deck
- Custom Anchor Design
- Simple And Detailed Output
- Legacy Codes
- Seismic Design

MOST CODE COMPLIANT ANCHORS IN THIS TECH GUIDE ARE INCLUDED THE PDA SOFTWARE!

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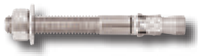
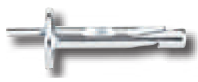
MECHANICAL ANCHORS



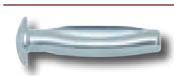
Domestic Wedge Anchor

A threaded, torque-controlled, carbon steel or stainless steel wedge expansion anchor for consistent performance in concrete. Base materials: normal-weight and sand-lightweight concrete. Carbon steel body and expansion clip or a stainless steel body and expansion clip. Nut and washer included.



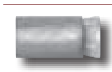
Safe-T Pin

All-steel nail anchor designed for use in a variety of applications and as an improved alternative to traditional zamac nailin anchors where overhead use in not recommended. Pre-drill holes in solid base materials such as concrete, grouted block, brick and stone. Cracked concrete applications where designed for redundant fastening.



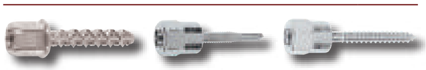
DRIVE®

A one piece tamper-proof, pre-expanded anchor available in carbon steel for use in concrete and stone. Tie-Wire Drive anchors are used for suspended ceiling applications. The flat head (counter-sunk) style is suited for wood-to-concrete anchoring.



Calk-In™

A pre-assembled precision cast calking type machine bolt anchor which can be used in concrete, block, brick or stone. Antimonial lead alloy calking sleeve and Zamac alloy internally-threaded expander cone.



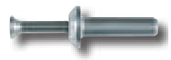
Vertigo Rod Hangers for Concrete, Steel, and Wood

A one-piece, all steel threaded fastening system for suspending steel threaded rod vertically overhead in pipe hanging, fire protection, electrical conduit and cable-tray applications. Base materials: steel bar joists/beams, wood frame columns/beams, as well as concrete ceilings, beams/columns.

Heli-Pin™

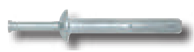
A stainless steel anchor tie to stabilize brick and masonry walls and repair cracks in brick veneers. Use in concrete and masonry, wood and steel studs.

MECHANICAL ANCHORS



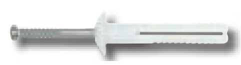
Zamac Hammer-Screw®

A one-step drive anchor with a Phillips head screw for concrete, block, brick or stone. Corrosion resistant Zamac alloy body and a carbon or stainless steel drive screw.



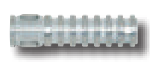
Zamac Nailin®

A tamper-proof nail drive anchor wth a Zamac alloy body. Carbon or stainless steel nail. Used in concrete, block, brick or stone. Not recommended for applications overhead.



Nylon Nailin®

A pin drive anchor with an engineered nylon body and carbon and stainless steel nails. Used in concrete, block, or brick. Not recommended for applications overhead.



Lag Shield™

A screw style anchor for use with lag bolts. Use in concrete and the mortar joints of block or brick walls. Zamac alloy. Short Lag Shields - harder masonry materials to reduce drill time. Long Lag Shields - soft/weak masonry to increase strength.

Single™

A machine bolt anchor designed for concrete, and some block, brick or stone base materials. Consists of a pre-assembled set of expansion shields and an Zamac alloy expander cone.

Double

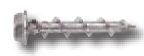
A dual expansion machine bolt anchor particularly suited for materials of questionable strength. Used in solid concrete and some block, brick and stone base materials.

ADHESIVE ANCHORS

Hammer-Capsule®

Glass capsule anchor system. Threaded anchor rod or reinforcing bars driven directly; no need for a chisel point or spinning action. For the installation of 3/8" through 1" diameter threaded rod or reinforcing bar in solid concrete and masonry.

LIGHT DUTY ANCHORS

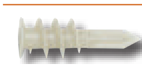


Wall Dog®

All steel, one piece, threaded fastener used to fasten fixtures directly into drywall. Variety of head styles.

Scru-Lead™

For sheet metal or wood screws in concrete, block or brick. Lead alloy. For light duty applications where holding power is not a critical factor. Not to be used overhead.



Zip-It®

A one piece self-drilling anchor for hollow gypsum wallboard and light duty loads. Engineered nylon or Zamac alloy. Use No. 6 or No. 8 screw in 3/8" to 1" wallboard. Zip-It® Jr. is engineered nylon used with a No. 6 screw in 3/8" to 5/8" wallboard.

Strap-Toggle™

A pre-assembled anchor consisting of a carbon steel wing and a locking cap/ratchet leg assembly of molded engineered plastic. Installs through a smaller hole than traditional toggles. Does not require a fixture or screw to set.

Bantam Plug

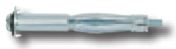
A plastic anchor for use with lightweight fixtures and a sheet metal or wood screw. For light duty static applications. Not to be used overhead.

FOR MORE INFORMATION VISIT WWW.DEWALT.COM OR REFER TO DEWALT BUYERS GUIDE

LIGHT DUTY ANCHORS

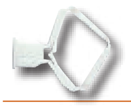
Pop-Toggle™

Hollow wall anchors for static applications requiring light to medium load performance. Pre-drill 5/16" diameter hole. Not for use overhead or applications where holding values are critical.



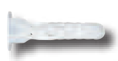
Polly

A sleeve type hollow wall anchor designed for use in base materials such as plaster, wallboard, concrete block, hollow tile or plywood.



Poly-Toggle®

A screw actuated hollow wall anchor for paneling, wallboard and solid masonry available in 6 sizes to match the most common wall thicknesses. For light duty static applications where holding power is not a critical factor.

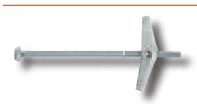


Sharkie

The screw extrudes the anchor polymer into the wall under pressure, molding the anchor exactly to the surface of the hole. The forces supported by the screw are transmitted outwardly 360° for greater holding power.

Zinc Zip Toggle®

A self drilling hollow gypsum wallboard anchor for superior performance without the need to pre-drill holes. Comes with No. 6 x 2" screws.



Toggle-Bolt

A spring wing type hollow wall anchor for block & wallboard. Machine screw and spring wing toggle assembly. 1/8"x 2" to 1/2" x 6". Combo round, flat, mushroom, tie-wire or slotted hex head styles.

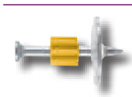
POWDER ACTUATED FASTENING

Tools

0.27 Caliber Strip Tools	- P3600, P3500, PA3500, Sniper Pole Tool
0.25 Caliber Strip Tool	- P35s
0.22 Caliber Single Shot Tools	- P2201, P1000, T1000

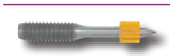
.300 Head Drive Pins

Permanently fastens fixtures to concrete, some types of concrete block, and A36 or A572 structural steel. 0.145" diameter shank in various lengths, and a specially designed point to allow proper penetration into typical base materials. Knurled shank designs are available to increase performance in steel base materials.



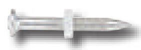
.300 Head Drive Pins With Washers

To provide resistance to pullover, these pins are available with pre-assembled 14 gage (0.075") metal washers in various diameters. Resistance to pullover is increased by the additional bearing surface provided by the washer. The insulation washer has a thickness of 0.035".



Threaded Studs

Threaded studs are available in 1/4"- 20 and 3/8"-16 thread diameters with a variety of thread and shank lengths for use in concrete, some types of concrete block, and A36 or A572 structural steel. For applications where it may be desirable to remove the fixture or where shimming may be required.



CSI Pins

Provide premium performance in concrete and steel base materials. Manufactured with a 0.157" diameter shank in various lengths and with a spiral knurling for consistent optimized performance in concrete and steel (including I-Beams).

Ceiling Clip Assemblies

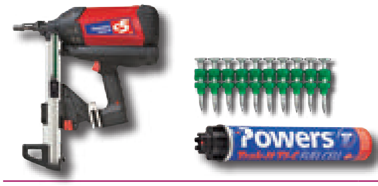
For acoustical applications and suspended ceiling systems or light fixtures. Several styles of angled clips are pre-mounted onto pins.

POWDER ACTUATED FASTENING

Loads

Single Shot Loads	- 0.22 Caliber, 0.25 Caliber, 0.27 Caliber
Strip Shot Loads	- 0.25 Caliber, 0.27 Caliber

GAS ACTUATED FASTENING



Trak-It® C5 System

Fuel injected cordless concrete pin nailer; the lightest and smallest tool in its class. Power output at 105 Joules, shoots into even the hardest concrete. Pin styles: 0.102 & 0.145 diameter, short tapered, concrete, steel and spiral knurled, up to 1-1/2" length.

ANCHORING AND FASTENING SYSTEMS

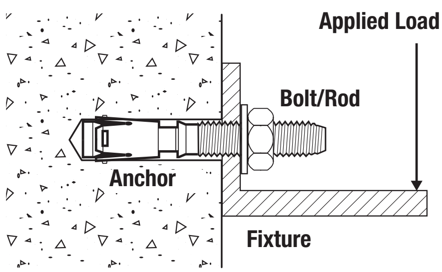
SECTION CONTENTS

INTRODUCTION

A wide variety of post-installed anchors, cast-in place anchors and fastening systems are available. In construction, these products are normally installed into concrete, masonry and steel base materials. This includes but is not limited to mechanical expansion and screw anchors, adhesive anchoring systems, self-drilling screws, powder-actuated fastening and gas fastening technologies. Although the variety of choice provides the user with the opportunity to select the best product for a specific application, it also makes the selection process more difficult. For this reason, the load capacities and other criteria (e.g. material, finish) used to determine the type, size, and number of anchors or fasteners to be used for any given application need to be taken into consideration. As in all applications, the load capacity and other criteria used to determine an anchoring system's suitability should be reviewed and verified by the design professional responsible for the actual product installation. The following is intended to guide the user of this information toward an anchor or fastening system that is best suited for the application.

FASTENED ASSEMBLY

Before selection can take place, several factors should be considered and reviewed to determine their effect on the application including the key components of the fastened assembly. The following diagram shows a typical fastened assembly using an post-installed anchor:



Some critical items to consider in the selection of a product include the following:

1. Base material (e.g. type and strength) in which the anchor or fastener will be installed.
2. Load level and type of loads applied to the fixture or material to be fastened.
3. Anchor or fastener material and the bolt / threaded rod in the assembly (e.g. internally threaded anchors) as applicable
4. Installation procedures including the method of drilling, hole preparation, and installation tool used.
5. Dimensions of the base material including the material thickness, anchor or fastener spacing, and edge distance.
6. Effects of corrosion and service environment.

BASE MATERIALS

The materials used in building construction vary widely. Although fastening can occur in many materials, the base materials are often the weak link in the assembly design. The base material is a critical factor in the selection of an anchor or fastener because it must be able to sustain the applied loads. Base material strength can vary widely, and is a key factor in the performance of an anchor or fastener. Generally, products installed in dense concrete and stone can withstand far greater stress than those installed in softer materials such as lightweight concrete, block, or brick. The following sections provide a descriptive summary of typical base materials for reference purposes. Refer to the individual product sections for details on suitable base materials. Individual standards, national/local codes and the authority having jurisdiction should also be considered.

CONCRETE

Reinforced concrete is formed using concrete meeting a certain compressive strength combined with reinforcing steel (rebar). The function of the concrete is to resist compressive forces while the reinforcing steel resists the tensile forces. Two primary characteristics of concrete are workability and strength. Fresh concrete must have the proper consistency or workability to enable it to be properly placed. Hardened concrete must be able to achieve the specified performance factors including the required compressive strength. The design and construction requirements for reinforced concrete buildings are published by the American Concrete Institute (ACI) in document ACI 318, Building Code Requirements for Structural Concrete.

Steel reinforcement such as deformed reinforcing bars or welded wire fabric are placed in the forms prior to the pouring of concrete to resist tensile forces in the base material. For prestressed or post-tensioned concrete construction, bars, wire, or strands may be used as the reinforcement. Smooth dowel bars are also used primarily to resist shear loads. Steel reinforcement should not be drilled/cored through without authorization from the design professional responsible for the project. Dimensions, deformation requirements and strengths of standard deformed reinforcing bars (e.g. Grade 60) are most common according to ASTM A 615 and A 706.

Concrete is a mixture of aggregate, cement, water, and additives. Its strength is achieved through the hydration of the cement component (usually Portland) which is used to bind the aggregate together. The type of cement used depends on the requirements of the structure into which the concrete will be placed. The requirements and standards specifications are outlined in ASTM C 150. A concrete mix design consists of both fine and coarse aggregates. Fine aggregate is usually particles of sand less than 3/16-inch in diameter while the coarse aggregate is crushed stone or gravel greater than 3/16-inch in diameter as outlined in ASTM C 33 for normal-weight concrete.

The aggregate used in normal-weight concrete ranges in weight from 135 to 165 pcf. For lightweight concrete, the aggregate such as that manufactured from expanded shale, slate, clay, or slag has a weight range of 55 to 75 pcf as listed in ASTM C 330. The unit weight for normal-weight concrete ranges from 145 to 155 pcf while lightweight concrete ranges from 100 to 115 pcf. Lightweight concrete is used where it is desirable to decrease the weight of the building structure. It also has better fire resistance than normal-weight concrete. Precast autoclaved aerated concrete (AAC) describes another lightweight concrete building material which is mainly available in block form.

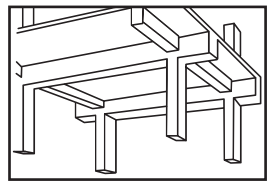
Admixtures are specified in a mix design to modify the concrete, either for placement characteristics or hardened properties. Air entraining admixtures which disperse tiny air bubbles throughout the concrete mix help to improve the freeze thaw resistance and increase workability. Examples of other admixtures are superplasticizers, which allow a reduction in the quantity of mixing water for much lower water-cement ratios, or products which accelerate or slow down the curing of the concrete. While the type of cement, aggregate, and admixtures have an impact on the compressive strength of the concrete, the water-cement ratio is the primary factor affecting the strength. As the water-cement ratio decreases, the compressive strength of the concrete increases. In order to determine the compressive strength of concrete, test specimens are formed in cylinders according to ASTM C 31. The cylinders are broken according to ASTM C 39 at specified time intervals, and the resulting strength is calculated and reported in psi.

The age of concrete as well as strength and hardness of the aggregate will affect drilling speed, drill bit wear, and drill bit life. Anchors or fasteners installed in lightweight concrete have load capacities which are approximately 40% less than those installed in normal-weight concrete. Job site tests are recommended if specific data is not available for this base material for a given product.

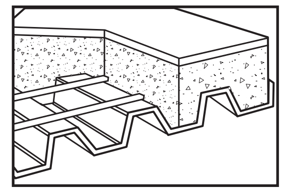
The load capacities listed in this guide were conducted in unreinforced test members to provide baseline data which is usable regardless of the possible benefit of reinforcement unless otherwise noted.

The load capacities for installations in normal-weight and lightweight concrete listed in this guide are for concrete which has achieved its designated 28 day compressive strength. Concrete is considered at early strength or 'green' if less than 21 days old which can have an effect on performance of anchors and fasteners. It is recommended that anchors and fasteners not be made in concrete which has cured for less than 7 days. For concrete that has not cured at least 21 days, expected load capacities for metal anchors and fasteners would correlate to the actual compressive strength of the base material at the time of installation. For use of adhesive anchors in concrete that has not cured at least 21 days, site testing should be considered if product specific testing is not available from the supplier to evaluate any possible effects. Job site tests are recommended for installations in concrete where the material strength or condition is unknown or questionable.

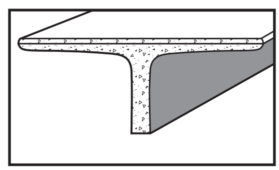
Examples of common construction methods in which concrete is used are shown in the following figures:



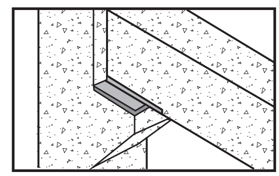
POURED IN PLACE CONCRETE USING A FORM SYSTEM



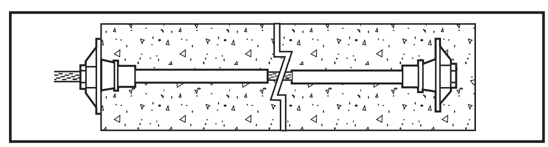
COMPOSITE SLABS POURED OVER STEEL DECK



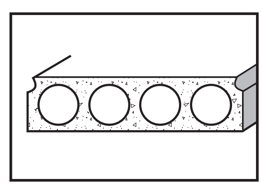
PRECAST TEES



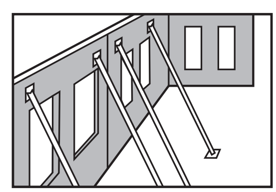
PRECAST BEAMS AND COLUMNS



POST-TENSIONED SLABS AND BEAMS



PRECAST PLANK



TILT-UP WALL PANELS

MASONRY MATERIALS

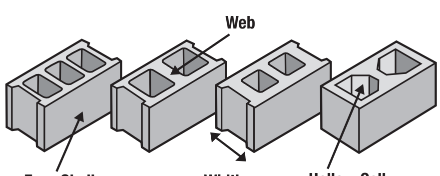
The strength of masonry walls is typically less than that of concrete and the consistency of masonry materials can vary on a regional basis. To form a wall, individual masonry units are bonded together with a cement mortar. A vertical row is called a course and a horizontal row is called a wythe. The strength of the mortar is often the critical factor in this type of base material assembly and typically limits anchor product performance. Generally, anchors or fasteners may be installed in the horizontal mortar joint or directly into most types of masonry units. The vertical mortar joint should be avoided since this joint location is typically not fully mortared.

Note: Hollow base materials require special care as the anchor or fastener must be properly sized to coincide with the wall thickness or selected to properly expand in the void (e.g. toggle and sleeve type anchors). When using anchors in these materials, spalling can occur during the drilling process prior to installation, further decreasing the wall thickness. Manufacturers of hollow base materials often specify a maximum load that can be applied to the material. Since the strength of masonry materials varies widely, job site tests are recommended to determine actual load capacities for critical applications or where specific data is not available for this base material or base material location for a given product. In field testing, products should be installed and loaded to simulate the actual placement. The reaction bridge used should span the joint or unit to provide an unrestrained test.

Concrete Block (CMU)

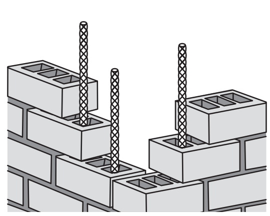
Masonry block is found in a variety of sizes and shapes depending upon the age and location of a building. Both hollow and solid styles which can be classified as load-bearing or non-load bearing are used. Load-bearing block, known as a concrete masonry unit (CMU) is generally suitable for anchoring or fastening. ASTM C 90 describes hollow and solid load-bearing concrete masonry units made from portland cement, water, and mineral aggregates which are available in normal, medium and lightweight blocks. One of the critical factors contributing to the strength of a masonry wall is the type of mortar used to bond the masonry units together. Mortar is made from a mixture of cement, very fine aggregate, and water.

Typical shapes for concrete masonry units are shown in the following diagrams. The term "face shell" refers to the outside face of the block while the term "web" refers to the interior portions between the hollow cells.



TYPICAL CMU SHAPES

Typical minimum dimensions for the face shell and web thickness are given in ASTM C 90. The minimum compressive strength from the ASTM specification is 1,900 psi. Typical dimensions are nominally 8" x 8" x 16" with a minimum face shell thickness of 1-1/4" to 1-1/2". The difference between hollow and solid block is based on the cross sectional bearing area of the block. Solid block is defined as having a cross sectional bearing area which is not less than 75% of the gross area of the block measured in the same plane. To provide greater resistance to lateral loads, concrete masonry units are often strengthened with steel reinforcing bars. In this case, hollow units are grout filled to allow them to act together with the reinforcing bars.

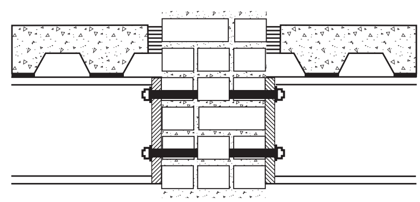


GROUT-FILLED CONCRETE MASONRY

Experience has shown that the consistency of grout-filled block can vary and voided areas are often present a problem. Therefore, job site job site tests are recommended to determine actual load capacities for critical applications or where specific data is not available for this base material or base material location for a given product. In this, guide load capacities are published for some products installed in the face shell of hollow load-bearing concrete masonry units and at various embedments into grout filled units. The load capacities listed in this guide were conducted in unreinforced test members to provide baseline data which is usable regardless of the possible benefit of reinforcement unless otherwise noted.

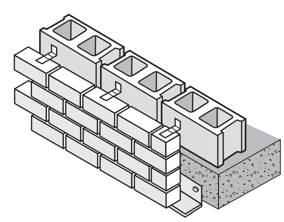
Brick

Brick units are found in a variety of shapes, sizes, and strengths depending upon the age and location of a building. Brick is manufactured from clay or shale which is extruded / wire-cut, machine molded, or handmade to shape then hardened through a firing process. Brick can be used to form a load bearing wall or used as a veneer or facade.



TYPICAL BRICK BEARING WALL

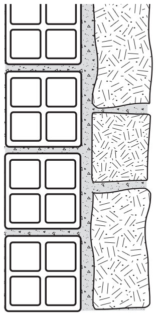
Brick is produced as a solid masonry unit or with cores during extrusion. The cores (also known as weep holes) reduce the weight of the brick and help it to lay better. ASTM C 652 describes hollow brick masonry units. Hollow brick is defined as having a cross sectional bearing area which is less than 75% of the gross area of the brick measured in the same plane. ASTM C 62 describes solid building brick while C 216 describes solid facing brick. To provide greater resistance to lateral loads, walls are often strengthened with steel rod and wire reinforcing. When brick is used as a building facade, it is important to properly tie it to the backup wall and structure which is often done using anchors manufactured from a corrosion-resistant material such as stainless steel.



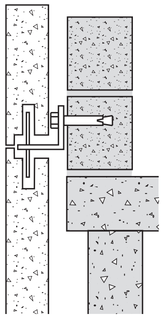
Note: Brick cores can often create a problem when attempting to install traditional anchors because of the cavities. In this case, an alternative anchor, such as an adhesive anchor could be considered. Also, brick is generally not suitable for power-actuated fasteners.

Stone

Natural stone is available in a variety of types, colors, and textures for use in many building applications. The strength and the quality of stone can vary dramatically from each stone quarry and for different geological locations. Naturally occurring rock which has been fabricated to a specific size and shape is referred to as dimension stone. Dimension stone units can be used to form a load bearing wall and as a veneer or façade.



STONE WITH TILE BACKUP



STONE FACADE

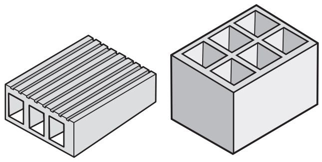
Generally, anchors installed in softer material such as limestone or sandstone will have capacities similar to those obtained in 2,000 psi concrete. In harder stone such as granite or marble, the capacities will be similar to 4,000 or 6,000 psi concrete. Job site tests are recommended because of the wide variation in the strengths of natural stone. ASTM C 119 describes dimensional stone for use in building construction. Specifications for individual stone types include C 503 for marble, C 568 for limestone, C 615 for granite, and C 616 for quartz-based material.

When stone is used as a building facade, it is important that the stone be properly tied to the backup wall using anchors manufactured from a corrosion-resistant material such as stainless steel. ASTM C 119 describes dimensional stone for use in building construction. Specifications for individual stone types include C 503 for marble, C 568 for limestone, C 615 for granite, and C 616 for quartz-based material.

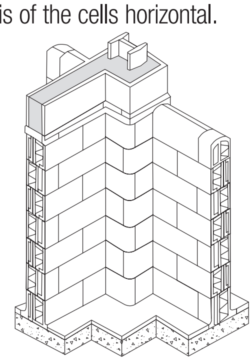
Note: Stone is not generally considered a suitable base material for power-actuated fasteners.

Structural Clay Tile

Structural clay tile units are found in a variety of shapes, sizes, and strengths for use primarily in walls. The tile units are manufactured from clay, shale, or fire clay which is extruded to shape then hardened through a firing process. During the extrusion process, several continuous cells or hollow spaces are formed within the exterior shell of the tile. The typical thickness of the outer shell is 3/4" with a 1/2" thick interior web. End-construction tile is designed to be placed in a wall with the axis of the cells vertical while side-construction tile is placed with the axis of the cells horizontal.



TYPICAL CLAY TILE SHAPES



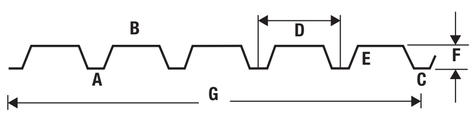
STRUCTURAL CLAY PARTITION

Structural clay tile units can be used to form a load bearing wall and as a veneer or facade. ASTM C 34 describes structural clay tile for load bearing walls. Structural clay facing tile is described in ASTM C 212. For non-load bearing applications, ASTM C 56 describes structural clay tile used primarily for partitions. This type of tile is sometimes referred to as architectural terra cotta although this term is more appropriately applied to ornamental building units.

Note: These materials present a problem when attempting to install anchors and fasteners because the relatively thin walls cannot sustain the high stresses applied by typical anchors. For light duty loads, a hollow wall anchor which opens behind the face shell may be used (e.g. toggle bolts). For heavier loading, an adhesive anchor installed using a screen tube inserted through the face shell and interior web is suggested. Since the strength and condition of these materials can vary, job site tests are recommended. Structural clay tile is not a suitable base material for power-actuated fasteners.

Steel Deck

Steel deck is available in many configurations for use as a floor deck (both composite and non-composite) or a roof deck. It is usually cold formed from steel sheet to provide the combination of deck type, depth, and gage (thickness) to meet the application requirements. A rib shape, formed in various depths and sizes, adds strength in flexure depending upon the length of span. Steel deck may be supplied uncoated, painted, or zinc coated according to ASTM A 525 in various thicknesses. The following diagram shows a typical steel deck cross section.



A - Rib
B - Top Flange
C - Side Lap
D - Module
E - Web
F - Depth
G - Coverage Width

Industry standards for the design, manufacture and use of steel deck are provided by the Steel Deck Institute (SDI). Material requirements are also listed in ASTM A 611 and A 446. The yield strength of the steel deck typically varies from 25,000 to 80,000 psi, depending on the grade. Steel deck is commonly specified by a decimal thickness but often also correlated to a gage number.

Steel floor deck used for composite construction with concrete fill has typical rib depths of 1-1/2", 2", and 3" with deeper depths available. This type of deck is normally manufactured to a minimum yield strength of 33,000 psi. Non-composite steel form deck is used as a permanent form for concrete slabs with rib depths ranging from 1/2" to 2". For steel roof deck, the ribs are classified as narrow, intermediate, or wide with a 1-1/2" minimum depth spaced at 6" on center. Deep rib deck with a 3" minimum depth with ribs spaced at 8" on center is also available. Other types of steel decking include acoustical sound absorbing floor or roof decks, long span roof decks, and cellular roof decks.

TESTING AND DATA FUNDAMENTALS

The fundamentals of anchor and fastener design include the determination calculation of design load capacities based on laboratory test data conducted to simulate typical field conditions. This guide provides published design load capacities for anchors and fasteners installed in concrete and masonry units along with other appropriate base materials.

TEST PROCEDURES AND CRITERIA

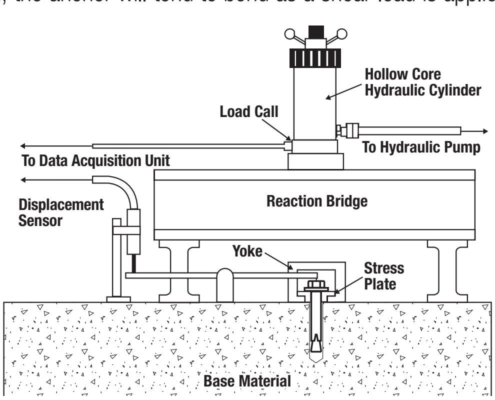
The general test data for anchors and fasteners published in this guide was developed according to the following standards (as applicable): *ASTM E 488, Standard Test Methods for Strength of Anchors in Concrete; ASTM E 1190, Standard Test Methods for Strength of Power-Actuated Fasteners Installed in Structural Members; ACI 355.2, Qualification of Post-Installed Mechanical Anchors in Concrete; ACI 355.4, Qualification of Post-Installed Adhesive Anchors in Concrete; ICC-ES AC01, Expansion Anchors in Masonry Elements; ICC-ES AC58, Adhesive Anchors in Masonry Elements; ICC-ES AC70, Power-actuated Fasteners Driven into Concrete, Steel and Masonry Elements; ICC-ES AC193, Mechanical Anchors in Concrete Elements; ICC-ES AC308, Post-installed Adhesive Anchors in Concrete Elements; ICC-ES AC446, Headed Cast-in Specialty Inserts in Concrete.*

TENSION AND SHEAR TEST DATA

Tension test data is sometimes referred to as pullout or tensile test data. A typical hydraulic test assembly used to perform an unconfined tension test on an anchor is illustrated. A similar assembly is used for testing other fasteners (e.g. power-actuated), however, deflection may not be measured unless specified by the prevailing criteria.

The test equipment frame is designed to support the hydraulic test unit and span the test area so that reaction loading does not influence the test results. However, in some cases a confined testing setup is more desirable depending on the product and test purpose (e.g. isolating bond strength of adhesive anchors, proof loading).

In a shear test, the test load is applied perpendicular to the anchor across the cross-section of the product body. This type of loading is also applied typically using a hydraulic equipment test setup. When a shear load is applied to an anchor, the anchor body resists the applied load by placing a bearing stress against the base material. In addition, the anchor will tend to bend as a shear load is applied.



TYPICAL STATIC TENSION TEST ASSEMBLY

and as the base material begins to crush. The applied load will actually be resisted by a combination of the bearing strength of the base material and the tension capacity of the anchor.

During testing, load is gradually applied to the anchor by a hydraulic cylinder while the displacement is measured using an electronic displacement sensor. The load is measured by a hollow core load cell and the resulting performance is recorded by a data acquisition unit. Loading is continued until the ultimate (failure) load is achieved. The ultimate load capacity is recorded and normally associated with a typical failure mode.

EVALUATION OF TEST DATA (ASD)

Two primary methods of evaluating test data to determine the suitable working loads for anchors in concrete and masonry are currently used. The first and still most common, because of its long history and relative ease of use, is the application of a global safety factor which is used in conjunction with allowable stress design (ASD). Using this method, an appropriate safety factor is applied to the average ultimate load obtained from testing to establish an allowable load:

Allowable load = Ultimate load / Safety Factor

Safety factors are used and assumed to account for field variations which may differ from the testing conditions in the laboratory. Typical minimum safety factors established by industry are 4:1 for concrete and 5:1 for masonry materials. Actual safety factors to be used should be determined by the design professional responsible for the product application and installation, based on the governing building code and after examining all influencing factors.

A second method which is used less frequently, but sometimes used as an alternative to applying straight safety factors is a statistical method in which the allowable working loads are based in part on the coefficient of variation (COV) obtained during testing. In most cases, the results obtained using the safety factor method are similar to those obtained when using the statistical method unless COV values are very high (e.g greater than 20%).

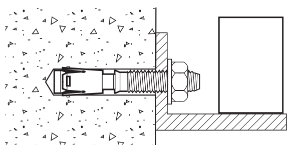
EVALUATION OF TEST DATA (SD)

Strength Design for anchors in concrete for structural and non-structural connections are becoming more the norm as the International Building Code (IBC) has been adopted and accepted in most jurisdictions within the United States. This method incorporates reduction factors to characteristic values determined from comprehensive qualification testing requirements. Specific details of the procedure to properly evaluate such data can be found in ACI 355.2 and ACI 355.4. These requirements provide consideration for anchor behavior and different types of failure modes. Strength Design as it applies to anchorage to concrete is detailed in ACI 318 Appendix D (Chapter 17 for ACI 318-14 and later editions). This method is referenced directly by the IBC and is recommended where applicable.

APPLIED LOADS

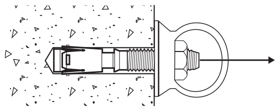
The type of load and the manner in which it is applied by the fixture or other attachment is a principle consideration in the selection of an anchor. Applied loads can be generically described as static, dynamic, or shock. Some anchor types are suitable for use with static loads only, while others can be subjected to dynamic or shock loads. The suitability of an anchor for a specific application should be determined by a qualified design professional responsible for the product installation.

STATIC LOADS



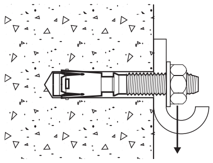
These are non-moving, constant loads such as those produced by an interior sign, cabinet, equipment, or other. A typical static load could be a combination of the dead load (weight of fixture) and the live load a fixture must support. Basic static load conditions are tension, shear, or a combination of both. To determine the allowable static working load, the industry practice is to reduce the ultimate load capacity of an anchor by a minimum safety factor. In cases of combined load, other reduction factors may be required.

Tension Load



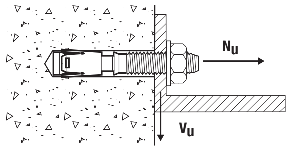
A tension load is applied directly in line with the axis of the anchor.

Shear Load



A shear load is applied perpendicularly across the anchor directly at the surface of the base material.

Combined Load



Most anchor installations are subjected to a combination of shear and tension loads.

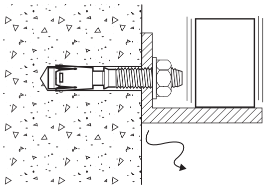
BENDING LOAD

One often overlooked result of static load is bending. It is frequently necessary to place shims or spacers between the fixture and the material for alignment or leveling. When this occurs, it is often the strength of the anchor material or bolt material that determines the capacity of the connection. The load is applied at a distance from the surface of the base material creating a lever-type action on the anchor. Typical examples of this type of loading are the installation of windows using plastic horse shoe shims or machinery installations with shims below the base plate. In loading such as this, it is often the physical strength of the anchor material, not the tension and shear load capacities, that limit the strength of the anchorage.

The allowable bending load should be calculated by a design professional based on the material from which an anchor is manufactured. In concrete or masonry materials, the bending arm used in the calculation should be increased to allow for spalling around the top of the anchor hole, approximated by 1/2 to 1 anchor diameter.

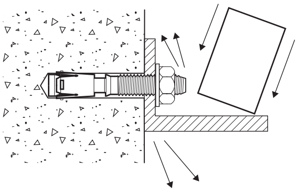
DYNAMIC AND SHOCK LOADS

Dynamic Loads



Dynamic loads are intermittent and varying loads such as those imposed by central air conditioning units, manufacturing machinery or earthquakes. They are normally the alternating or pulsating loads associated with vibration.

Shock Loads



Shock loads are instantaneous, periodic loads of high intensity such as those applied by an automobile striking a guard rail support or a truck hitting a dock bumper.

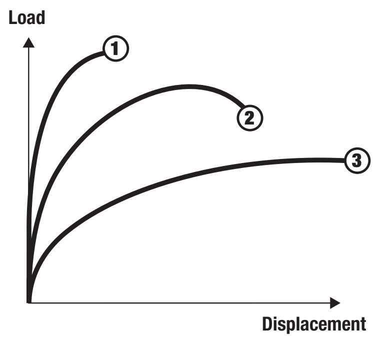
Standard industry practice with regard to safety factors varies depending upon the frequency and intensity of the load. However, safety factors for dynamic or shock load conditions may require 10:1 or higher. Determination of the appropriate safety factor should be made by the design professional in charge of the project and application.

ANCHOR BEHAVIOR AND MATERIAL

The selection and specification of an anchor requires an understanding of basic anchor behavior or performance. A variety of performance attributes can be expected depending upon the type or style of anchor.

DISPLACEMENT

As an anchor is loaded to its ultimate (failure) load capacity, displacement or movement of the anchor relative to the base material will occur. The amount of displacement will be affected by the anchor preload, the anchor material strength, the design of the expansion mechanism, and the strength of the base material. Typical load versus displacement curves are shown in the following diagram for three anchor types.



Curve (1) shows the typical performance of an adhesive type anchor. These anchors normally exhibit elastic behavior up to the ultimate load capacity. Performance will vary depending upon the type of adhesive used, the base material strength, and the strength of the anchor rod. A deformation controlled anchor such as a dropin anchor may also exhibit this type of behavior although the ultimate load capacity will normally be much less than that of an adhesive anchor. The compression force developed by a dropin is usually very high when compared to a torque controlled anchor resulting in low displacement characteristics.

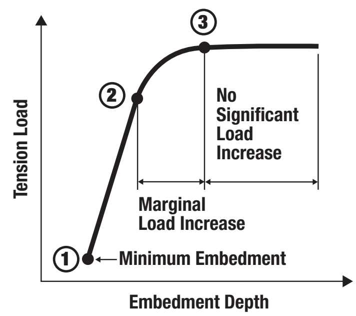
Typical performance of a torque controlled anchor is shown in Curve (2). Displacement begins to occur after the initial preload in the anchor has been exceeded until the ultimate load capacity is achieved.

Anchors for use in light duty applications often exhibit the behavior shown in Curve (3). Once the working load has been exceeded, the anchor begins to displace or stretch until failure occurs.

DEPTH OF EMBEDMENT

The depth of embedment published for each anchor in the load capacity charts is critical to achieving the expected load capacities. This nominal depth is measured from the surface of the base material to the bottom of the anchor. For mechanical expansion anchors, this would be the depth measured to the bottom of the anchor prior to actuation. For each anchor type, a minimum embedment depth is specified. This depth is typically the minimum required for proper anchor installation and reliable functioning. In some masonry materials, the minimum depth may be decreased depending upon the anchor style as noted in the load tables.

The load capacity of some anchor types will increase with deeper embedments. For anchors which exhibit this behavior, multiple embedment depths and the corresponding load capacity are listed. As the embedment depth is increased, the load capacity will increase up to a transition point. This point is usually the maximum embedment depth listed. At this point, mechanical anchors may experience material failure or localized failure of the base material around the expansion mechanism. Adhesive type anchors may reach the capacity of the bond, the anchor rod material, or the capacity of the base material. For applications requiring installation at embedment depths between those published, linear interpolation is permitted. The following diagram shows the typical performance of a mechanical anchor installed in concrete.

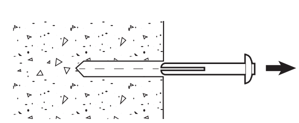


MODES OF FAILURE

As an anchor is loaded to its ultimate capacity, the following modes of failure can occur.

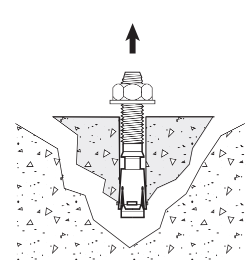
Anchor Pullout

This type of failure occurs when the applied load is greater than the friction or compressive force developed between the anchor body and the base material. The anchor is unable to fully transfer the load to develop the strength of the base material. For adhesive anchors, this can occur with products which have a low bond strength or have been installed in a poorly prepared anchor hole.



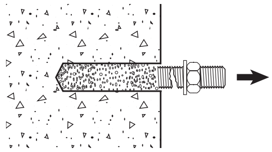
Base Material Failure

When the applied load is greater than the strength of the base material, the material pulls out or fails. In concrete, a shear prism/cone will be pulled, usually for anchors installed at a shallow depth. The angle of the shear prism/cone has been assumed to be 35-45°, however, this can vary slightly depending upon the anchor style and embedment depth.



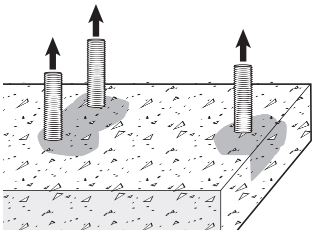
As the embedment of some anchor styles is increased to six diameters or beyond, the concrete can sustain the applied compression force and the load capacity of the anchor will increase up to a point at which either the capacity of the expansion mechanism or the bond is reached. In masonry, part of the individual unit may be pulled from the wall, especially in cases where the strength of the mortar may be low.

Anchor Material Failure



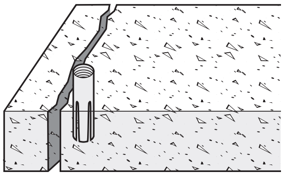
A failure of the anchor body or rod will occur when the applied load exceeds the strength of the material from which the anchor is manufactured. For mechanical anchors, this usually occurs for anchors which are embedded deep enough to develop the full strength of the expansion mechanism and the base material. For adhesive anchors, this will occur when the base material and bond strength of the adhesive is greater than the strength of the anchor rod.

Spacing or Edge Failure



The spacing and edge distance of installed anchors will affect the mode of failure along with the resulting ultimate load capacity. Anchors which are spaced close together will have a compound influence on the base material resulting in lower individual ultimate load capacities. For anchors installed close to an unsupported edge, the load capacity will be affected by both the direction of the load and the distance from the edge. As load is applied, a concrete cone type of failure will occur. This can be caused by the compressive forces generated by the expansion mechanism or by the stresses created by the applied load.

Base Material Splitting



Concrete and masonry units must be of sufficient size to prevent cracking or splitting during anchor installation and as load is applied (for both unreinforced and reinforced base materials). The critical dimensions include the thickness and the width of the base material.

ANCHOR PRELOAD AND TORQUE

Anchor preload is developed by the setting action in a displacement controlled anchor or the tightening of a bolt/nut in a torque controlled anchor. When a load is applied to an anchor, significant displacement will not occur until the preload in the anchor has been exceeded. The amount of preload normally does not have any effect on ultimate load capacity provided the anchor is properly set.

By tightening a torque controlled anchor a particular number of turns or to a specific torque level, the anchor is initially preloaded. This action will reduce the overall displacement of the anchor and normally ensures that elastic behavior will occur in the working load range (but should not be counted on where cracking of the concrete may occur, e.g. seismic event). A preload may also be applied to achieve a clamping force between the fixture and the base material. The diagram below shows the effect of preload on the performance characteristics of two wedge anchor samples.

LONG TERM BEHAVIOR

Various additional influences may need consideration for the proper long term behavior of an anchoring or fastening system. These important considerations include but are not limited to effects of concrete state (uncracked, cracked), earthquake loading, fatigue, freezing/thawing effects, sustained loading (i.e. creep), elevated temperature, fire, corrosion and/or chemical resistance.

DEWALT current offering of adhesive anchoring systems have been independently tested and qualified to meet or exceed the creep requirements of ACI 355.4, ICC-ES AC308 and AC58. Product specific information can be found in individual product sections.

ANCHOR MATERIAL SELECTION

The material from which an anchor is manufactured is generally capable of sustaining the published tension and shear loads. However, other conditions such as bending loads should be checked. In certain loading situations, the material strength may be the weak link. Bolts, threaded rods or other materials (e.g. steel inserts, rod couplers) used in conjunction with an anchor should be capable of sustaining the applied load and should be installed to the minimum recommended thread engagement. For reference purposes, the minimum expected mechanical properties of commonly used carbon steel and stainless steel materials are listed in various standards. The typical standards used are for externally threaded parts as assigned by the Society of Automotive Engineers (SAE), Industrial Fasteners Institute (IFI), American Iron and Steel Institute (AISI) or the American Society for Testing and Materials (ASTM). Variations in strength will occur due to heat treating, strain hardening, or cold working. Consult the individual standards for details.

In addition to the load capability of the material, an anchor should be manufactured from material which is compatible with its intended use. For example, anchors manufactured from a material with a melting point of less than 1000°F are not normally recommended for overhead applications due to fire considerations unless specific fire rating tests have been performed. Special materials may be required for corrosive environments and connections involving dissimilar metals which have potential for galvanic reaction.

CORROSION RESISTANCE

The corrosive environment in which an anchor or fastener will be installed should be considered. Corrosion can be described broadly as the destruction of a material due to chemical or electrochemical reactions based upon the application environment. Industry estimates of the annual cost of corrosion place it in the billions of dollars. The subject of corrosion is very complex and knowledge is constantly being gained based on industry experience. Chemical and electrochemical corrosion are described in the following two sections to provide a basic understanding of the process

CHEMICAL CORROSION

Direct chemical attack occurs when an anchor or fastener is immersed in the corrosive substance, typically a liquid or a gas. For example, an anchor used to restrain equipment in a water treatment tank would have to be made from a material which would be resistant to chlorine or other corrosive liquids present. This type of corrosion can also occur when a stone facade is attached to a backup wall. Mild acids can be formed in the wall cavity due to reaction of condensation with the attached stone. The product selected would have to be resistant to the type of acid formed.

ELECTROCHEMICAL CORROSION

All metals have an electrical potential which has been measured through research and ranked into an electromotive force series. When two metals of different electric potential are brought into contact in the presence of an electrolyte(e.g. water), the metal with the lower potential (least noble) will form the anode while the metal with the higher potential (most noble) will form the cathode.

As current flows from the anode to the cathode, a chemical reaction will take place. The metal forming the anode will corrode and will deposit a layer of material on the metal forming the cathode. As the electric potential between two dissimilar metals increases, the stronger the current flow and corresponding rate of corrosion. The rate of corrosion will also be influenced by the conductivity of the electrolyte.

+ Corroded End (Anodic or least noble)
Magnesium
Magnesium alloys
Zinc
Aluminum 1100
Cadmium
Aluminum 2024-T4
Steel or Iron
Cast Iron
Chromium-iron (active)
Ni-Resist cast iron
Type 304 Stainless (active)
Type 316 Stainless (active)
Lead tin solders
Lead
Tin
Nickel (active)
Inconel nickel-chromium alloy (active)
Hastelloy Alloy C (active)
Brasses
Copper
Bronzes
Copper-nickel alloys
Monel nickel-copper alloy
Silver solder
Nickel (passive)
Inconel nickel-chromium alloy (passive)
Chromium-iron (passive)
Type 304 Stainless (passive)
Type 316 Stainless (passive)
Hastelloy Alloy C (passive)
Silver
Titanium
Graphite
Gold
Platinum
- Protected End (Cathodic or most noble)

Galvanic Series

In order to provide a more practical approach to understanding the electromotive force series, testing was conducted on commercial alloys and metals in sea water to develop a chart called the Galvanic Series. One of the reasons sea water was used as the electrolyte was because it has a high conductivity rate. The above chart lists a representative sample of dissimilar metals and indicates their relative potential for galvanic corrosion. When two dissimilar metals are in contact (coupled) in the presence of a conductive solution or electrolyte (i.e. water) electric current flows from the less noble (anodic) metal to the more noble (cathodic) metal. In any couple, the less noble metal is more active and corrodes while the more noble metal is galvanically protected.

To prevent galvanic corrosion, the following precautions can be used:

1. Use the same or similar metals in an assembly. Select metals which are close together in the Galvanic Series.
2. When dissimilar metals are connected in the presence of a conductive solution, separate them with dielectric materials such as insulation, a sealing washer, or a coating. Coatings should be kept in good repair to prevent accelerated attack at any imperfection.
3. Avoid combinations where the area of the less noble material is relatively small. It is good practice to use anchors or fasteners made from a metal which is more noble than that of the material being fastened.

In critical applications, testing should be conducted to simulate actual conditions. Other types of electrochemical corrosion such as stress corrosion may need to be considered depending upon the application. In all cases, it is important to evaluate the application, materials and the service environment to make a proper selection.

COATINGS AND PLATINGS

A variety of coatings and platings are offered by industry to resist various extremes of corrosion. A plating metal which is less noble (lower electric potential) than the base metal it is designed to protect is usually selected. When subjected to an electrochemical reaction, the plating will corrode or sacrifice while the base metal remains protected. Once the plating has been reduced significantly, the base material will then begin to corrode. If a plating metal which is more noble is selected, the base metal would begin to corrode immediately if the plating is damaged.

Zinc Plating and Coatings

For carbon steel anchors and fasteners, zinc is one of the most common plating materials used because it can be applied in a broad thickness range and because it is less noble than carbon steel. Zinc may be applied by electroplating, mechanical methods, or hot dip galvanizing.

The following table shows the typical mean corrosion rate of zinc based on data compiled by ASTM. Theoretically, the life expectancy of a zinc plating would be the thickness of the plating divided by the corrosion rate. These values are provided for reference and should only be used as a guide since actual performance will vary with local conditions.

Atmosphere	Mean Corrosion Rate
Industrial	5.6 microns (0.00022") per year
Urban non-industrial or marine	1.5 microns (0.00006") per year
Suburban	1.3 microns (0.00005") per year
Rural	0.8 microns (0.00003") per year
Indoors	Considerably less than 0.5 microns (0.00002") per year
Note: Reproduced from ASTM; the mean corrosion rate given pertains to zinc only and does not include a corrosion rate when zinc is passivated or in contact with other materials.	

The standard zinc plating used on carbon steel anchors is applied using electroplating (often called 'commercial' zinc). The anchor components are immersed in a water based solution containing a zinc compound. An electrical current is then induced into the solution causing the zinc to precipitate out, depositing it onto the components. DEWALT carbon steel anchors are typically electroplated according to ASTM B 633, SC1, Type III . SC1 signifies Service Condition 1 which is for a mild environment with an average coating thickness of 5 microns (0.0002"). This condition is also classified as Fe/Zn 5. Type III indicates that a supplementary clear chromate treatment is applied over the zinc plating. Prior to applying the chromate treatment, heat treated products which are electroplated are normally baked to provide relief from any hydrogen trapped in the granular matrix and/or acid-free cleaning processes are used to ensure hydrogen is not introduced during production and manufacture.

Note: Hardened fasteners such as carbon steel concrete screws and power-actuated fasteners are designed to be used in a non-corrosive atmosphere unless application specific corrosion testing has been performed. To reduce the possibility of the embrittlement of a heat treated part, a mechanically applied zinc meeting the requirements of ASTM B 695, Class 5 is used. Class 5 signifies an average minimum coating thickness of 5 microns (0.0002").

Zinc platings or coatings are often described using the term “galvanized”. Another zinc coating which is available on some carbon steel anchors is mechanically applied (e.g. mechanical galvanized). To apply this coating, the anchor components and glass beads are placed in a chamber on an agitating machine. As the chamber is agitated, powdered zinc compound is gradually added allowing the glass beads to pound the zinc onto the surface of the anchor components. Carbon steel products which are coated using this method are mechanically galvanized according to ASTM, B 695. ASTM A 153, Type C describes the requirements for applying a zinc coating using a hot dip method. According to this specification, the anchor components are placed in a bath of molten zinc for a specified time to allow a metallurgical reaction which bonds the zinc to the steel surface.

Barrier Coatings (e.g. Perma-Seal)

To provide increased protection from the effects of corrosion on smaller diameter anchors and fasteners used in some industrial applications, proprietary coatings have been developed. Some of these coatings have shown to provide better resistance to corrosion and abrasion than traditional zinc electroplating or mechanical galvanizing. Coatings of this type are often called barrier coatings because they seal the part as opposed to zinc platings which are sacrificial.

One of these barrier coatings is called Perma-Seal™. When a component is coated with Perma-Seal, a zinc enriched base is first applied to the surface followed by a proprietary process during which a polymer based paint is bonded over the base coat. This creates a finish which is resistant to the environments such as those created by the high saline (salt) content of most insulation boards, and the acids which are produced by ponded water in many built-up or single ply roofing systems

Coatings of this type are typically tested according to DIN Standard 50018, 2.0S, which is a test method referred to as a Kesternich Test. As a measure of corrosion resistance when using this test method, Factory Mutual Standard 4470 (now FM Global) establishes an allowable surface corrosion (red rust) limit of 15% of the surface area after 15 cycles of exposure. The Perma-Seal coating with undamaged coating surface exceeds this requirement withstanding 30 cycles of exposure with less than 15% surface corrosion (red rust). Additional testing conducted in a salt spray chamber according to ASTM B 117 shows that the Perma-Seal coating with undamaged coating surface can withstand over 1,000 hours of exposure with less than 5% surface corrosion. The coating has also been tested to ICC-ES AC257, *Acceptance Criteria for Corrosion-resistant Fasteners and Evaluation of Corrosion Effect of Wood Treatment Chemicals*.

In all cases, it is important to evaluate the application and the service environment to make a proper selection. The suitability of an anchor for a specific application should be determined by a qualified design professional responsible for the product installation.

Note: Environmental, application and other factors can affect the service life of anchors and fasteners. Current test standards for corrosion resistance do not enable test results to be directly correlated into expected service life; as such, it is impossible to accurately predict the service life of a specific installation.

CORROSION RESISTANT MATERIALS

In addition to coatings and platings, a variety of other anchor and fastener materials are available which provide varying degrees of corrosion resistance.

Stainless Steel

Stainless steels were originally named according to their chromium and nickel content. Chromium-nickel alloys are known as 300 series stainless steels while chromium alloys are 400 series. Stainless steels develop their resistance to corrosion by forming a thin, self healing, passive film of chromium oxide on their surface.

The most common for fastener applications are produced from 300 series stainless steels. These are austenitic alloys which are nonmagnetic and are not heat treatable, although they can be annealed. Anchors made from 300 series stainless steel can exhibit very slight magnetic properties due to the manufacturing process. In order to achieve higher tensile strengths, this series of stainless must be cold worked. For some components, a minimum yield strength is specified based on the work hardening which occurs during the cold forming process. In the industry, the term 18-8 is still used to generically describe the 300 series of alloys, especially Types 302, 303, and 304. Type 303 is used where machinability is required for products. This type of stainless steel has a higher sulfur content than Type 304 which reduces drag on cutting tools, especially when forming internal threads.

Type 304 and 304 Cu (302 HQ) stainless steels are used to cold form anchor components. This type of stainless steel is one of the most widely specified. It is commonly used outdoors in a nonmarine environment and for applications in the food processing industry. For more severe corrosive environments, Type 316 stainless steel is available. Type 316 has a higher nickel content than Type 304 and the addition of molybdenum. This provides increased resistance to pitting caused by chlorides (salts) and corrosive attack by sulfurous acids such as those used in the paper industry.

Note: The use of Type 316 stainless steel in environments where pitting and stress corrosion is likely (e.g. chloride/chlorine environments) should be avoided due to the possibility of sudden failure without visual warning.

INSTALLATION GUIDELINES

As with any building component, proper installation is the key to a successful application once a fastener has been designed and properly selected.

DRILLED HOLE (POST-INSTALLED ANCHORS)

A properly drilled hole is a critical factor both for ease of installation and optimum anchor performance. The anchors selected and the drill bits to be used should be specified as part of the total anchoring system. Most DEWALT anchors are designed to be installed in holes drilled with carbide tipped bits meeting the requirements of the American National Standards Institute (ANSI) Standard B212.15 unless otherwise specified. If alternate bit types are used, the tip tolerance should be within the ANSI range unless otherwise permitted. The following table lists the nominal drill bit diameter along with the tolerance range established by ANSI for the carbide tip.

Nominal Drill	ANSI Standard	Nominal Drill	ANSI Standard
1/8"	0.134 - 0.140"	11/16"	0.713 - 0.723"
5/32"	0.165 - 0.171"	3/4"	0.775 - 0.787"
11/64"	0.181- 0.187"	27/32"	0.869- 0.881"
3/16"	0.198 - 0.206"	7/8"	0.905 - 0.917"
7/32"	0.229 - 0.237"	15/16"	0.968 - 0.980"
1/4"	0.260 - 0.268"	1"	1.030 - 1.042"
9/32"	0.296 - 0.304"	1-1/8"	1.160 - 1.175"
5/16"	0.327- 0.335"	1-1/4"	1.285 - 1.300"
3/8"	0.390 - 0.398"	1-3/8"	1.410 - 1.425"
7/16"	0.458 - 0.468"	1-1/2"	1.535 - 1.550"
1/2"	0.520 - 0.530"	1-5/8"	1.655 - 1.675"
9/16"	0.582 - 0.592"	1-3/4"	1.772 - 1.792"
5/8"	0.650 - 0.660"	2"	2.008 - 2.028"

When drilling an anchor hole using a carbide tipped bit, the rotary hammer or hammer drill used transfers impact energy to the bit which forms the hole primarily due to a chiseling action. This action forms an anchor hole which has roughened walls. Mechanical anchors should not be installed in holes drilled with diamond tipped core bits unless testing has been conducted to verify performance. Adhesive anchors should also be tested. A diamond tipped bit drills a hole which has very smooth walls which can cause some anchor types to slip and fail prematurely. Smooth walls should generally be roughened and cleaned.

During the drilling operation, bit wear should be monitored to ensure that the carbide tip does not wear below the following limits to ensure proper anchor functioning. This is especially important when using mechanical anchors (including screw anchors). Generally, mechanical anchors can be installed in holes drilled with bits which have worn, but are still in the acceptable range. This depends on the base material, so this information should be used as a guide.

Nominal Drill	Lower Wear	Nominal Drill	Lower Wear
3/16"	0.190"	5/8"	0.639"
1/4"	0.252"	3/4"	0.764"
5/16"	0.319"	7/8"	0.897"
3/8"	0.381"	1"	1.022"
1/2"	0.510"	1-1/4"	1.270"

Anchor holes should be drilled to the proper depth which is based on the anchor style. The recommended drilling depth is listed in the installation instructions for the individual products. Anchor holes should be thoroughly cleaned prior to installation of the anchor unless otherwise noted. This procedure is easily accomplished using compressed air, pump or a vacuum with an extension. Dust and other debris must be removed from the hole to allow an anchor to be installed to the required embedment and to ensure that the expansion, engagement and/or bond can be properly actuated. Extra care must be be taken when using adhesives. The drilled hole should be thoughly cleaned, including brushing and blowing of the anchor hole with suitable equipment to ensure that a proper bond is developed. See specific product information concerning suitability of installations in wet or submerged environments.

ANCHOR ALIGNMENT

Anchors should be installed perpendicular to the surface of the base material. Within the industry, +/- 6° is typically used as the permissible deviation from perpendicular. If anchors are installed beyond this point, calculations to ensure that a bending load has not been created may need to be performed. Job site tests may be required to determine actual load capacities if anchors are not installed perpendicular to the surface of the base material.

CLEARANCE HOLES

Post-installed anchors of fractional sizes are designed to be installed in holes drilled in concrete and masonry base materials with carbide tipped drill bits meeting the requirements of ANSI B212.15 as listed in the previous section unless otherwise noted. The actual hole diameter drilled in the base material using an ANSI Standard carbide tipped bit is larger than the nominal diameter. For example, a 1/2" nominal diameter drill bit has an actual O.D. of 0.520" to 0.530". When selecting the diameter of the hole to be pre-drilled in a fixture, the diameter of the hole selected should allow for proper anchor installation.

For through fixture installations (e.g. through-bolting), it is necessary to pre-drill or punch a minimum clearance hole in the fixture which is large enough to allow the carbide tipped bit and the anchor to pass through. For example, through-bolting with mechanical wedge anchors require a pre-drilled hole in the fixture which is large enough for the expansion mechanism to be driven through. Normally, for mechanical expansion anchor sizes up to 7/8", the minimum clearance hole required is the anchor diameter plus 1/16". For sizes 1" and larger, the minimum clearance hole is the anchor diameter plus 1/8". This clearance hole should be adjusted to allow for any coating applied to the fixture.

As in all applications, the design professional responsible for the installation should determine the clearance hole to be used.

OVERSIZED HOLES (ADHESIVE ANCHORS)

Unless otherwise noted, the performance values for DEWALT adhesive anchor systems are based upon testing of anchors installed in holes drilled with carbide-tipped bits typically with either 1/16-inch or 1/8-inch greater than the nominal diameter of the steel anchor element (see specific information contained in product sections). Some cases may warrant the consideration of oversizing the drilled holes (e.g. due to placement issues, construction adjustments). Depending upon the application and conditions, oversizing the drilled hole can have an effect on performance. Site testing should be considered if product specific testing is not available from the supplier to evaluate any possible effects.

As in all applications, the design professional responsible for the installation should determine the clearance hole to be used based on the anchor selected and relevant code requirements.

Note: It is not recommended to install mechanical anchors in oversized holes.

CORE DRILLED HOLES (ADHESIVE ANCHORS)

Unless otherwise noted, the performance values for DEWALT adhesive anchor systems are generally based upon testing of anchors installed in holes drilled with carbide-tipped bits. However, some products have undergone specific qualification testing for use in core drilled holes (see specific information contained in product sections).

As in all applications, the design professional responsible for the installation should determine the clearance hole to be used based on the anchor selected and relevant code requirements.

Note: Unless otherwise noted, it is not recommended to install mechanical anchors in core drilled holes.

TEMPERATURE (ADHESIVE ANCHORS)

The product installation temperature and base material temperature can have an effect on performance of adhesive anchors. The selected product must be suitable for the application and installation conditions. It is recommended that the product be conditioned and installed in accordance with published instructions for best results. For in-service temperature and freeze-thaw effects, reference the information contained in the specific product information sections.

Note: When adhesive anchors are installed in concrete which is in the freezing range, frost or ice can form on the walls of the anchor hole. If this occurs, injection type adhesives may not properly bond to the walls of the anchor hole. Spin-in type capsule systems which scrape the walls of the anchor hole during installation are less sensitive to this. A torch should normally not be used because it carbonates the concrete on the walls of the anchor hole creating a residual dust. Job site tests are recommended where a torch is used to dry the anchor hole.

INSTALLATION TORQUE

Certain anchor styles, sometimes referred to as torque controlled anchors, are actuated by tightening a bolt or nut. For typical field installations, especially where it is not practical to measure the torque, the commonly suggested tightening procedure for such anchors is to apply 3 to 5 turns to the head of the bolt or nut from the finger tight position or to within the maximum guide torque range. This is usually sufficient to initially expand the anchors and is standard industry practice. In some cases, it may be desirable to specify an installation torque for an anchor or a maximum torque as in the case for adhesive anchors.

The frictional characteristics which govern the torque-tension relationship for an anchor will vary depending upon the anchor type and the base material. Other factors which may affect the relationship are the effects of fixture coatings or platings, lubrication of the anchor components due to the use of sealants around the anchor hole, and the anchor material. DEWALT publishes guide installation torque values for anchors that are actuated by tightening a bolt or nut. These values are based on standard product installations, and with the exception of torque-controlled expansion anchors which have a specified value based on testing, should be used as a guideline since performance may vary depending upon the application. For other anchor types such as adhesive anchors, a maximum torque may be published for use as a guide to prevent overloading when applying a clamping force to a fixture.

Note: These values may have to be reduced for installations in hollow and/or masonry materials. Suggested allowable torque range values are also provided in the product sections.

TEST TORQUE

To establish application specific installation torque values, a job site test is recommended. A typical procedure includes the following: Install the anchor duplicating the actual application. Using a torque wrench, apply the recommended number of full turns from the finger tight position. The number of turns may vary depending upon the base material strength. Upon completion of the final turn, record the torque reading from the wrench. This should be performed on a minimum sample of 5 anchors averaging the results to establish an installation torque range. Care should be taken by the design professional responsible for the installation to consider the material strength and composition of the anchor so that the tests do not damage the anchor or cause undue damage to the test location.

Should anchor failures occur during this job site test procedure, average ultimate torque values should be compared to published torque recommendations and an appropriate factor of safety should be applied (typically in the range of 2 to 2.5) subject to the design professional and/or building official as applicable.

If previously installed anchors are to be inspected with a torque wrench, it should be noted that anchors experience a relaxation of preload which begins immediately after tightening due to creep within the concrete or masonry material. The torque value measured after installation is typically 50% of that initially applied to set the anchor.

DESIGN CRITERIA

ALLOWABLE STRESS DESIGN (ASD)

The historical standards established by industry for anchoring and fastening is to reduce the ultimate load (i.e. mean average) capacity by a minimum safety factor depending upon the type of base material and governing construction code to calculate the allowable working load.

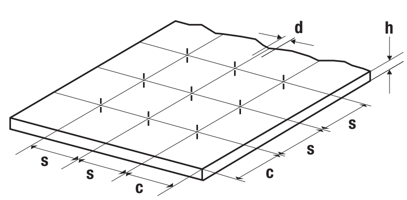
Allowable load = Ultimate load / Safety Factor

For example, a post-installed mechanical anchor which has an average ultimate tension load capacity in solid normal-weight concrete of 12,000 pounds for a given set of conditions would have a maximum allowable working load anchor of 3,000 pounds when utilizing a safety factor of 4 to 1. Connections such as overhead applications and/or involving dynamic loading, shock loads, fatigue loading, corrosion and fire considerations may require higher safety factors depending on product, base material and conditions. The allowable loads are recommendations, however, and local construction codes should be consulted to determine the required safety factors and design methodology. For adhesive anchors, both the strength of the adhesive at in-service temperature and the steel anchor element must also be considered (the lower of the strengths must govern). As in all applications, the actual safety factors and design load capacities used should be reviewed and verified by a design professional responsible for the actual product installation.

In allowable stress design (ASD), the design professional must design the anchorage so that the service loads do not exceed the allowable loads for a given anchor or anchor group (where T = tension and V = shear):

$$T_{service} \leq T_{allowable} \qquad V_{service} \leq V_{allowable}$$

The design professional must take the allowable load from the relevant published data and adjust the allowable load for all applicable design parameters for the anchor. This includes but is not limited to center-to-center spacing distance, edge distance and base material in-service temperature, as applicable.



d - Anchor Size **c - Edge Distance**
s - Spacing **h - Base Material Thickness**

Applicable load-adjustment factors for the anchors for the design conditions must be applied cumulatively. See the applicable product information for the product specific load adjustment factors and guidance for the use of linear interpolation for geometric conditions, where applicable.

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

$$\left(\frac{N_u}{N_n}\right)+\left(\frac{V_u}{V_n}\right)\leq 1 \quad \text{OR} \quad \left(\frac{N_u}{N_n}\right)^{\frac{5}{3}}+\left(\frac{V_u}{V_n}\right)^{\frac{5}{3}}\leq 1$$

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

[Straight Line and Parabolic Interaction Equations]

The straight line equation is typically given as default; the parabolic equation is applicable where testing has been performed to qualify the use of this parabolic interaction relationship.

STRENGTH DESIGN (SD)

For Strength Design, also known as LRFD, the design professional must design the anchorage so that the required strength (i.e. factored load) does not exceed the lowest design strength of the anchor or anchor group in concrete (considering all possible failure modes):

$$N_{ua} \leq \phi N_n \qquad V_{ua} \leq \phi V_n$$

Calculations are performed in accordance with the design provisions of ACI 318 Appendix D (Chapter 17 for ACI 318-14 and later editions) for cast-in-place, mechanical and adhesive anchors. The characteristic strengths and design data for post-installed anchors are derived from comprehensive independent testing and assessment in accordance with ACI 355.2 (ICC-ES AC193) and ACI 355.4 (ICC-ES AC308). Characteristic strengths are 5% fractile strengths calculated from the average ultimate load and associated coefficient of variation from test results. The 5% fractile strength is defined as the characteristic strength for which there is a 90% confidence that there is a 95% probability of the actual strength exceeding the characteristic strength.

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

$$\left(\frac{N_{ua}}{\phi N_n}\right)+\left(\frac{V_{ua}}{\phi V_n}\right)\leq 1.2$$

N_{ua} = Factored Tensile Applied to an Anchor or Group of Anchors
N_n = Nominal Strength in Tension
V_{ua} = Factored Shear Load Applied to an Anchor or Group of Anchors
V_n = Nominal Strength in Shear
ϕ = Strength Reduction Factor

For anchors that are designed using ACI 318 Appendix D (Chapter 17 for ACI 318-14 and later editions) it is possible to convert design strengths (i.e. Nn or Vn) to allowable loads using the following approach from ICC-ES AC193 and AC308:

$$T_{allowable,\,ASD} \text{ and } V_{allowable,\,ASD} = \frac{\phi N_n}{\alpha} \text{ and } \frac{\phi V_n}{\alpha}$$

Where:

$T_{allowable,\,ASD}$ = Allowable Tension Load
$V_{allowable,\,ASD}$ = Allowable Shear Load

α = Conversion factor calculated as a weighted average of the load factors for the controlling load combination. In addition, the conversion factor, α, shall include all applicable factors to account for non-ductile failure modes and required over-strength. For consideration of complete details, consult the individual product sections and approvals or contact DEWALT.

LIMIT STATE DESIGN

Much like Strength Design, the philosophy of Limit State Design method is to see that the structure remains fit for use throughout its designed life by remaining within the acceptable limit of safety and serviceability requirements based on the risks involved. The limit state design method for anchor design is given in CSA A23.3 Annex D. In principle, the limit state design method for anchorage to concrete follows strength design provisions but utilizes different strength reduction factors. Post-installed anchors qualfied for use with this design method are subject to comprehensive independent testing and assessment in accordance with ACI 355.2 (ICC-ES AC193) and ACI 355.4 (ICC-ES AC308) to determine characteristic strengths and design data.

ANCHORS FOR USE IN SEISMIC DESIGN

Seismic design as based on the building codes require that building structures resist the effects of ground motion induced by an earthquake. Each structure is assigned to a seismic design category/ zone based on the location of the building site as referenced in the building codes.

Seismic design is complex as it considers several influencing factors such as site geology and soil characteristics, building occupancy categories, building configuration, structural systems, and lateral forces. Lateral forces are critical because of an earthquakes tendency to shake the building structure from side to side.

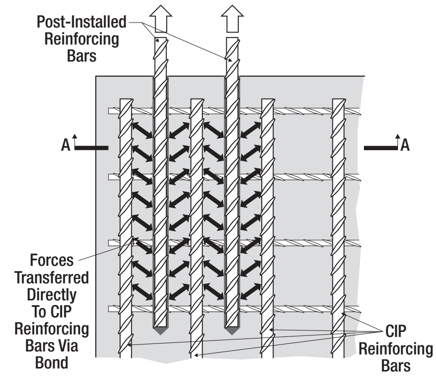
Anchors to be used for seismic loads will not be fully loaded in place until an earthquake occurs. Standard test methods have been developed to provide a methodology to simulate seismic load cycles in order to obtain statistical data for the performance of anchors in such conditions. In shear, anchors are tested and are subjected to alternating load applications. Internationally recognized assessment criteria is utilized for evaluating the performance of post-installed anchors when subjected to such simulated seismic loading.

The criteria used as conditions of acceptance for seismic performance of anchors is based on independent testing according to ACI qualification and ICC-ES acceptance criteria. Anchors qualified for seismic applications must have evidence of performance in cracked concrete in accordance with these standards. For seismic design, anchors in concrete must be designed following Strength Design provisions of ACI 318 Appendix D (or Chapter 17 for ACI 318-14 and later editions) or CSA A23.3, as applicable.

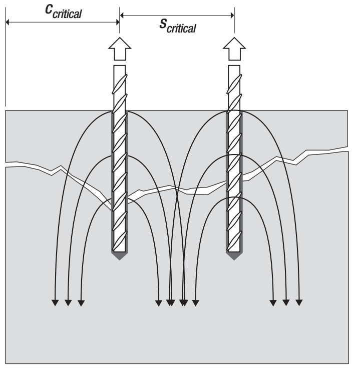
POST-INSTALLED REBAR CONNECTIONS

Post-installed rebar connections can also be designed according to the principles of reinforced concrete design (e.g. ACI 318) to provide development of non-contact bar splices. These connections utilize rebars installed and bonded into drilled holes in hardened concrete with a tested and qualified structural injection adhesive. Testing and qualification of the structural injection adhesive is conducted and evaluated specifically for this application (e.g. in accordance with ICC-ES AC308). The post-installed rebars are assessed and shown to provide equivalent bond strength and basic tensile behavior to cast-in reinforcement for the purposes of design and construction.

Although post-installed rebars behave like cast-in reinforcement, other influences of reinforced concrete design should also be considered such as fire, as applicable. Utilizing proper design and installation practices, the post-installed rebar connections in the structure can be assumed to be monolithic (i.e. uniform structural member).



Post-installed Reinforcing Bar Designed As A Lap Splice



Reinforcing Dowels Designed Using Anchor Theory

Situations where the concrete needs to take up tensile loads from the anchorage or in cases where rebars are designed to carry shear loads, the design should be according to anchor design principles as given in Appendix D (or Chapter 17 for ACI 318-14 and later editions) or CSA A23.3, as applicable. Unlike in anchor applications, reinforcement design is normally done to achieve yielding of the steel, often in nested groups, in order to obtain ductile behavior of the structure with good serviceability.

SD REFERENCE GUIDE - STRENGTH DESIGN OF ANCHORAGE TO CONCRETE ACI 318-11 APPENDIX D AND ACI 318-14 (CHAPTER 17)

The following is a reference tool for the design of post-installed anchors into concrete using ACI 318-11 and ACI 318-14.

The following steps should be considered when determining the controlling design strength (factored resistance) of the anchor system:

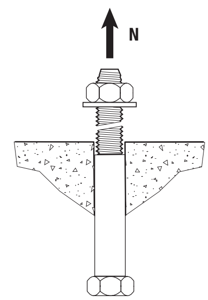
<table>
<tr><th>In all cases, the anchor system must be designed as follows:</th><th>Failure modes:</th></tr>
<tr><td>

Ø$N_n \geq N_{ua}$

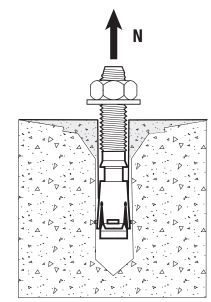
where ØN_n is the lowest design strength in tension from all appropriate failure modes;

- For mechanical expansion and screw anchors, ØN_n is the lowest design strength in tension of an anchor or group of anchors as determined from consideration of ØN_{sa}, ØN_{cb}, ØN_{cbg}, (or ØN_{pn}).
- For adhesive anchors, ØN_n is the lowest design strength in tension of an anchor or group of anchors as determined from consideration of ØN_{sa}, ØN_{cb}, ØN_{cbg}, ØN_a (or ØN_{ag}). *(bond strength failure mode not pictured)*
- A supplemental design check and an additional strength reduction is required for adhesive anchors subjected to sustained tensile loads or load combinations with a sustained load component.

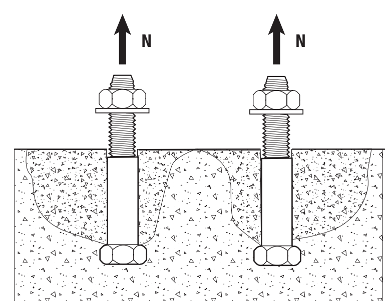
</td><td>



STEEL FAILURE



PULLOUT



CONCRETE BREAKOUT

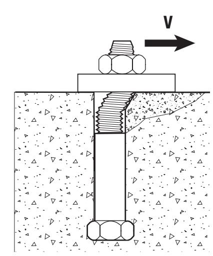
</td></tr>
<tr><td>

Ø$V_n \geq V_{ua}$

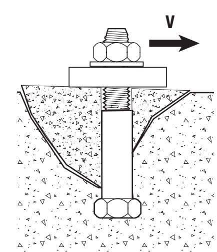
where ØV_n is the lowest design strength in shear from all appropriate failure modes;

- For mechanical expansion and screw anchors, ØV_n is the lowest design strength in shear of an anchor or group of anchors as determined from consideration of ØV_{sa}, ØV_{cb}, ØV_{cbg}, ØV_{cp}, (or ØV_{cpg}).
- For adhesive anchors, ØV_n is the lowest design strength in shear of an anchor or group of anchors as determined from consideration of ØV_{sa}, ØV_{cb}, ØV_{cbg}, ØV_{cp} (or ØV_{cpg}).

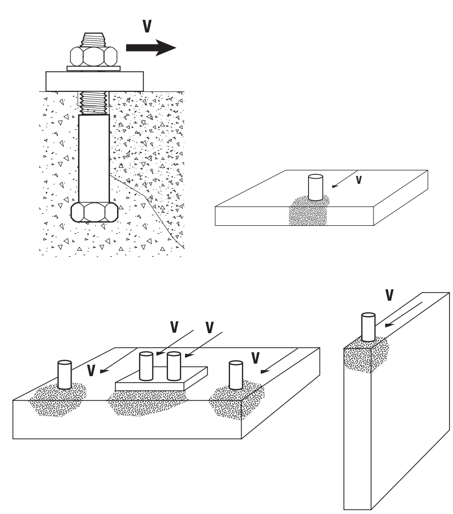
</td><td>



STEEL FAILURE PROCEEDED BY CONCRETE SPALL



CONCRETE PRYOUT FOR ANCHORS FAR FROM A FREE EDGE



CONCRETE BREAKOUT

</td></tr>
</table>

DUST CONTROL DRILLING SYSTEMS

Table 1 of 29 CFR 1926.1153, part of the OSHA Silica Dust Rule published in March, 2016 details requirements for handheld drills used during the installation process of post-installed anchors. The requirements for each part of this system are:

Tool

1. Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions

Accessories and Shrouds

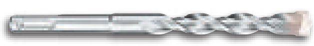
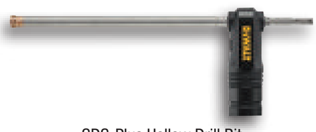
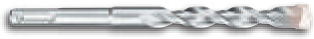
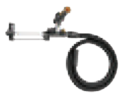
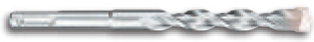
1. Use drill equipped with commercially available shroud or cowling with dust collection system

Dust Extractor

1. Dust collector must provide the air flow recommended by the tool manufacturer, or greater, and have a filter with 99% or greater efficiency
2. Cleaning holes requires a vacuum with a HEPA filter
3. Dust collector must have a filter cleaning mechanism

The DEWALT systems outlined in the table are examples of compliant methods used to drill the hole as required in published installation instructions.

DEWALT OSHA 29 CFR 1926.1153 Table 1 Compliant Drilling Systems

Tool	Accessories and Shrouds	Dust Extractor
SDS-Max Drills		
 Cordless	 SDS-Max Hollow Drill Bit	 Dust Extractor
 Corded	  SDS-Max With Shroud	
SDS-Plus Drills		
 Cordless	 SDS-Plus Bit	 Cordless Dust Extractor
	 SDS-Plus Hollow Drill Bit	 Dust Extractor
 Corded	  SDS-Plus With Telescope	
	  SDS-Plus With Shroud	

Mechanical anchors are available in many variations and choices and can usually be loaded immediately after installation which may be an advantage in many applications. Steel mechanical anchors also generally have a greater resistance to the effects of elevated temperature when compared with adhesives such as ester based resins or epoxies. Mechanical anchors can also be described by their style (e.g. undercut, expansion, screw, etc.).

Undercut anchors

Undercut anchors expand at the bottom of the drilled hole similar to a compression type anchor except that the actual diameter of the expanded area is wider than the drilled hole, undercutting the base material similar to a dove tail slot. Anchors of this type require a secondary drilling operation to form the undercut at the bottom of the drilled hole. During installation, as the expansion mechanism undercuts the base material, it forms a large bearing area which can transfer greater load to the base material.

Expansion anchors

Expansion anchors can be used to describe the majority of concrete and masonry anchors. Anchors of this type are designed with an expansion mechanism that compresses against the base material.

The expansion mechanism may be a sleeve, slotted shell, slotted stud, or wedge assembly which is actuated by a tapered cone, tapered plug, nail, bolt, or screw depending upon the anchor style. The compression of the expansion mechanism against the wall of the drilled hole allows the anchor to transfer the load to the base material. Anchors which are expanded by tightening a bolt or nut are considered to be torque controlled while those that are actuated by driving a nail or plug are considered to be deformation controlled. A deformation controlled anchor can develop a higher initial compression force when compared to a torque controlled anchor. Compression anchors may also be pre-expanded and/or used in conjuction with a drive nail. The expansion mechanism on an anchor of this style is actuated as it is compressed during the driving operation into the anchor hole.

Screw anchors

Screw anchors develop their load capacity by tapping into and creating an interlock between the anchor and the base material. In the most common systems, an undersized hole is drilled into the base material. As the anchor is driven in, a keying/friction force is developed between the shank of the anchor and the base material. This type of anchor can be suitable for sustaining light to heavy duty loads depending on the anchor design.

CATEGORY CONTENTS

		Base Material											Anchor Diameter										Head Style									Coating/Material							
		Concrete	Lightweight Concrete	Hollow Core Plank	Grout-filled Concrete Masonry	Hollow Concrete Masonry	Solid Brick	Hollow Brick	Stone	Structural Clay Tile	Wood	Steel	3/16"	1/4"	5/16"	3/8"	1/2"	5/8"	3/4"	7/8"	1" (24mm)	1-1/4" (28mm)	Finished Hex Head	Hex Head	Round/Acorn Head	Flat Head (Countersunk)	Mushroom Head	Removable	Tie-Wire Head	Tamperproof	Internal Thread	Coated/Plated Carbon Steel	Galvanized Carbon Steel	Type 303/304 Stainless Steel	Type 316 Stainless Steel	Type 410 Stainless Steel	Perma-Seal Coated	Nylon/Plastic	Code Recognition
	Atomic+ Undercut®	●	●													●	●	●	●					●								●			●				ICC-ES ESR 3067
Expansion Anchors	Power-Stud®+ SD1	●	●		●				○					●		●	●	●	●	●	●	●		●					●			●							ICC-ES ESR-2818 & 2966
Expansion Anchors	Power-Stud®+ SD2	●	●		●				○							●	●	●	●					●								●							ICC-ES ESR-2502
Expansion Anchors	Power-Stud®+ SD4/SD6	●	●		●				○					●		●	●	●	●					●										●	●				ICC-ES ESR 2502
Expansion Anchors	Power-Stud® HD5	●	●		●											●	●	●	●														●						
Expansion Anchors	PB-PRO™	●	○																		●	●	●									●							
Expansion Anchors	Power-Bolt®+	●	●		○				○					●		●	●	●	●				●					●				●							ICC-ES ESR-3260
Expansion Anchors	Power-Bolt®	●	●	○	●	●	●	○	○							●	●	●					●			●		●				●		●					
Expansion Anchors	Lok-Bolt AS®	●	○	○	●	●	●	○	○					●	●	●	●	●	●					●	●	●			●		●	●		●					
Screw Anchors	Screw-Bolt+™	●	●	○	●	○	●							●		●	●	●	●				●					●				●	●						ICC-ES ESR-3889
Screw Anchors	316 Stainless Steel Wedge-Bolt™	●			●		●							●		●	●						●					●							●				
Screw Anchors	Snake+®	●	●											●		●	●											●			●	●							ICC-ES ESR-2272
Drop-in Anchors	Smart DI™	●	○						○					●		●	●														●	●							
Drop-in Anchors	Steel Dropin™	●	●						○					●		●	●	●	●												●	●		●	●				
Drop-in Anchors	Mini Dropin™	●	●	●	○				○					●		●	●														●	●							
Drop-in Anchors	Hollow-Set Dropin™	●	○	●	●	●	●	○	○					●	●	●	●	●													●	●		●					
Rod Hanging System	Hangermate®+	●	●	○										●		●												●			●	●							ICC-ES ESR-3889
Rod Hanging System	Mini-Undercut+™	●		●												●															●	●							ICC-ES ESR-3912
Rod Hanging System	Wood-Knocker II+®	●	●											●		●	●	●	●												●	●						●	ICC-ES ESR-3657
Rod Hanging System	Bang-it+®	●	●											●		●	●	●	●												●	●						●	ICC-ES ESR-3657
Rod Hanging System	DDI+™	●	●													●	●	●	●	●												●							ICC-ES ESR-3958

● Suitable ○ May be Suitable

GENERAL INFORMATION

ATOMIC+ UNDERCUT®

Heavy Duty Undercut Anchor

PRODUCT DESCRIPTION

The Atomic+ Undercut anchor is designed for applications in cracked and uncracked concrete. The anchors are is available in standard ASTM A 36 steel, high strength ASTM A 193 Grade B7 steel and Type 316 stainless steel designations.

The Type 316 stainless steel version can be considered for exterior use and industrial applications where a high level of corrosion resistance is required.

The Atomic+ Undercut anchor is installed into a pre-drilled hole which has been enlarged at the bottom in the shape of a reversed cone using the DEWALT undercut drill bit. The result is an anchor which transfers load mainly through bearing, and unlike a typical expansion anchor is not dependent upon friction between the expansion sleeve and the concrete. Due to the use of a thick walled expansion sleeve, the load is distributed to a large area which can provide ductile behavior of the anchor even at relatively shallow embedments.

GENERAL APPLICATIONS AND USES

- Structural connections, beam and column anchorage
- Safety related attachments
- Tension zone applications
- Heavy duty loading
- Pipe supports, strut & base mounts
- Suspended equipment
- Seismic and wind loading

FEATURE AND BENEFITS

+ Consistent performance in high and low strength concrete
+ Anchors available for standard pre-set installations and for through bolt applications
+ Length ID code and identifying marking stamped on head of each anchor
+ Load transfers to concrete through bearing, not friction, behaves like a cast in place bolt
+ Bearing load transfer allows for closer spacing and edge distances
+ Can be designed for predictable ductile steel performance
+ Undercut created in seconds with durable undercutting tool

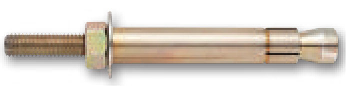
APPROVALS AND LISTINGS

- International Code Council, Evaluation Service (ICC-ES), ESR-3067
  Code compliant with the 2015 IBC, 2015 IRC, 2012 IBC, 2012 IRC, 2009 IBC, 2009 IRC, 2006 IBC, and 2006 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 318-14 Chapter 17 or ACI 318-11/08 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)

GUIDE SPECIFICATIONS

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

SECTION CONTENTS



ATOMIC+ UNDERCUT ASSEMBLY

THREAD VERSION

- UNC threaded stud

ANCHOR MATERIALS

- Carbon Steel
- High Strength Carbon Steel
- Type 316 Stainless Steel

ANCHOR SIZE RANGE (TYP.)

- 3/8" through 3/4" diameter

SUITABLE BASE MATERIALS

- Normal-weight concrete
- Sand-lightweight concrete

TENSION ZONE CRACKED CONCRETE

SEISMIC REGION QUALIFICATION

CODE LISTED
ICC-ES ESR-3067
CONCRETE

MATERIAL SPECIFICATIONS

Anchor component	Anchor Designation		
	Standard ASTM A 36	High Strength ASTM A 193 Grade B7	Type 316 Stainless Steel
Threaded Rod	ASTM A 36	ASTM A 193 Grade B7	Type 316 Stainless Steel ASTM A193 Grade B8 Class 1
Expansion Coupling	ASTM A 108 12L14	ASTM A 108 12L14	Type 316 Stainless Steel
Expansion/Spacer Sleeve	ASTM A 513 Type 5	ASTM A 513 Type 5	Type 316 Stainless Steel
Hex Nuts	Carbon Steel, ASTM A 563, Grade A		Type 316 Stainless Steel, ASTM A 563, Grade A
Washer	Carbon Steel, ASTM A 844; Meets dimensional requirments of ANSI B18. 2.22.2, Type A Plain		Type 316 Stainless Steel, ASTM F 844, meets dimensional requirements of ANSI B18,22.2, Type A
Plating	Zinc Plating according to ASTM B 633, SC1, (Fe/Zn 5) Minimum plating requirement for Mild Service Condition		N/A

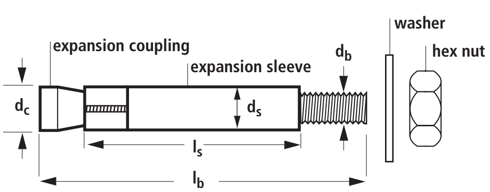
High strength type 316 Stainless Steel anchors also available. Contact Powers Fasteners for details.
Stainless steel anchors with anchor rod designation ASTM A193 Grade B8 Class 1 have the same dimensional characteristics of carbon steel anchors with anchor rod designation ASTM A 36.

ANCHOR SPECIFICATIONS

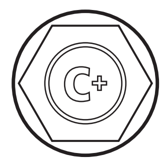
Dimensional Characteristics Table for Atomic+ Undercut

Anchor Designation	Anchor Type	Anchor Rod ASTM Designation	Rod Diameter, d_b (inch)	Anchor Length, l_b (inches)	Sleeve Length, l_s (inches)	Sleeve Diameter, d_s (inch)	Expansion Coupling Diameter d_c (inch)	Max. Fixture Thickness, t (inches)
03100SD	Standard	A 36	3/8	5-1/2	2-3/4	5/8	5/8	1-3/4
03102SD	Through bolt (TB)	A 36	3/8	5-1/2	4-1/2	5/8	5/8	1-3/4
03600SD	Standard	Type 316 SS	3/8	5-1/2	2-3/4	5/8	5/8	1-3/4
03602SD	Through bolt (TB)	Type 316 SS	3/8	5-1/2	4-1/2	5/8	5/8	1-3/4
03104SD	Standard	A 193, Grade B7	3/8	6-3/4	4	5/8	5/8	1-3/4
03106SD	Through bolt (TB)	A 193, Grade B7	3/8	6-3/4	5-3/4	5/8	5/8	1-3/4
03108SD	Standard	A 36	1/2	7	4	3/4	3/4	1-3/4
03110SD	Through bolt (TB)	A 36	1/2	7	5-3/4	3/4	3/4	1-3/4
03608SD	Standard	Type 316 SS	1/2	7	4	3/4	3/4	1-3/4
03610SD	Through bolt (TB)	Type 316 SS	1/2	7	5-3/4	3/4	3/4	1-3/4
03112SD	Standard	A 193, Grade B7	1/2	8	5	3/4	3/4	1-3/4
03114SD	Through bolt (TB)	A 193, Grade B7	1/2	8	6-3/4	3/4	3/4	1-3/4
03116SD	Standard	A 193, Grade B7	1/2	9-3/4	6-3/4	3/4	3/4	1-3/4
03118SD	Through bolt (TB)	A 193, Grade B7	1/2	9-3/4	8-1/2	3/4	3/4	1-3/4
03120SD	Standard	A 36	5/8	7-3/4	4-1/2	1	1	1-3/4
03122SD	Through bolt (TB)	A 36	5/8	7-3/4	6-1/4	1	1	1-3/4
03620SD	Standard	Type 316 SS	5/8	7-3/4	4-1/2	1	1	1-3/4
03622SD	Through bolt (TB)	Type 316 SS	5/8	7-3/4	6-1/4	1	1	1-3/4
03124SD	Standard	A 193, Grade B7	5/8	10-3/4	7-1/2	1	1	1-3/4
03126SD	Through bolt (TB)	A 193, Grade B7	5/8	10-3/4	9-1/4	1	1	1-3/4
03128SD	Standard	A 193, Grade B7	5/8	12-1/4	9	1	1	1-3/4
03130SD	Through bolt (TB)	A 193, Grade B7	5/8	12-1/4	10-3/4	1	1	1-3/4
03132SD	Standard	A 36	3/4	8-5/8	5	1-1/8	1-1/8	1-3/4
03134SD	Through bolt (TB)	A 36	3/4	8-5/8	6-3/4	1-1/8	1-1/8	1-3/4
03632SD	Standard	Type 316 SS	3/4	8-5/8	5	1-1/8	1-1/8	1-3/4
03634SD	Through bolt (TB)	Type 316 SS	3/4	8-5/8	6-3/4	1-1/8	1-1/8	1-3/4
03136SD	Standard	A 193, Grade B7	3/4	13-5/8	10	1-1/8	1-1/8	1-3/4
03138SD	Through bolt (TB)	A 193, Grade B7	3/4	13-5/8	11-3/4	1-1/8	1-1/8	1-3/4

Atomic+ Undercut Anchor Detail



Head Marking



Legend
Letter Code = Length Identification Mark
'+' Symbol = Strength Design Compliant Anchor (see ordering information)

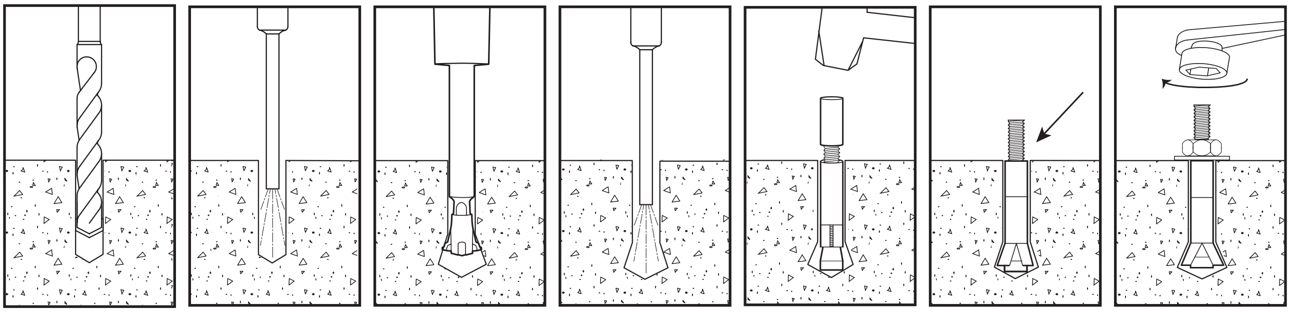
Length Identification

Mark	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
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"	11"	12"
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"	12"	13"

Length identification mark indicates overall length of anchor.

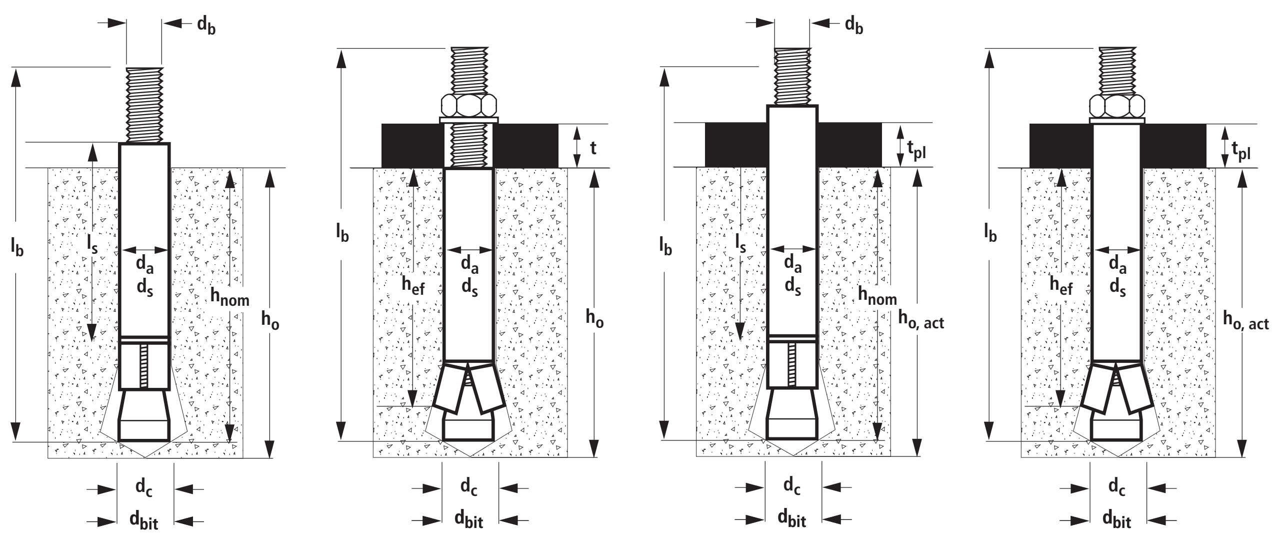
INSTALLATION INSTRUCTIONS

Installation Instructions for Atomic+ Undercut Anchors



1. Drill the hole to proper depth and diameter per specifications using rotohammer and stop drill.
2. Remove dust and debris from the hole during drilling (e.g. dust extractor) or following drilling (e.g. suction, forced air) to extract loose particles created by drilling.
3. Insert the undercut bit and start the rotohammer. Undercutting is complete when the stopper sleeve is fully compressed (gap closed)
4. Clean the hole using a blow-out bulb or compressed air.
5. Insert anchor into hole. Place setting sleeve over anchor and drive the expansion sleeve over the expansion coupling.
6. Verify that the setting mark is visible on the theaded rod above the sleeve.
7. Apply proper torque; Do not exceed maximum torque.

Atomic+ Undercut Anchor Detail (before and after application of setting sleeve and attachment)



Before | After
Standard Type (Pre-set Version)

Before | After
Through Bolt Type

Axial Stiffness Values, β, for Atomic+ Undercut Anchors in Normal-Weight Concrete[1]

Concrete State	Notation	Units	Nominal Anchor Size / Rod Diameter (inch)			
			3/8	1/2	5/8	3/4
Uncracked concrete	β_{min}	10^3 lbf/in (kN/mm)	131 (23)			
	β_m	10^3 lbf/in (kN/mm)	930 (163)			
	β_{max}	10^3 lbf/in (kN/mm)	1,444 (253)			
Cracked concrete	β_{min}	10^3 lbf/in (kN/mm)	91 (16)			
	β_m	10^3 lbf/in (kN/mm)	394 (69)			
	β_{max}	10^3 lbf/in (kN/mm)	1,724 (302)			

1. Valid for anchors with high strength threaded rod (A 193 Grade B7). For anchors with low strength threaed rod (A 36) values must be multiplied by 0.7.

INSTALLATION SPECIFICATIONS

Installation Specifications for Atomic+ Undercut Anchors

Anchor Property/Setting Information		Notation	Units	Nominal Anchor Diameter									
				3/8 inch		1/2 inch			5/8 inch			3/4 inch	
Outside anchor diameter		d_a[d_o][3]	in. (mm)	0.625 (15.9)		0.750 (19.1)			1.000 (25.4)			1.125 (28.6)	
Minimum diameter of hole clearance in fixture[2]		d_h	in. (mm)	7/16 (11.1)		9/16 (14.3)			11/16 (17.5)			13/16 (20.6)	
Anchor rod designation		ASTM	-	A36	A193 Gr. B7	A36	A193 Grade B7		A36	A193 Grade B7		A36	A193 Gr. B7
Minimum nominal embedment depth		h_{nom}	in. (mm)	3-1/8 (79)	4-3/8 (111)	4-1/4 (108)	5-1/4 (133)	7 (178)	5 (127)	8 (203)	9-1/2 (241)	5-7/8 (149)	10-7/8 (276)
Effective embedment		h_{ef}	in. (mm)	2-3/4 (68)	4 (102)	4 (102)	5 (127)	6-3/4 (171)	4-1/2 (114)	7-1/2 (190)	9 (229)	5 (127)	10 (254)
Minimum hole depth[1]		h_o	in. (mm)	3-1/8 (79)	4-3/8 (111)	4-1/4 (108)	5-1/4 (133)	7 (178)	5 (127)	8 (204)	9-1/2 (241)	5-7/8 (149)	10-7/8 (276)
Minimum concrete member thickness	For h_{min1}		in. (mm)	5-1/2 (140)	8 (204)	8 (204)	10 (254)	13-1/2 (343)	9 (229)	15 (381)	18 (457)	10 (254)	20 (508)
	$c_{ac,1} \geq$		in. (mm)	4-1/8 (105)	6 (152)	6 (152)	7-1/2 (190)	10-1/8 (257)	6-3/4 (171)	11-1/4 (256)	13-1/2 (343)	7-1/2 (190)	15 (381)
	For h_{min2}		in. (mm)	4-3/8 (111)	6 (152)	6 (152)	7-1/2 (190)	10-1/8 (257)	6-3/4 (171)	11-1/4 (256)	13-1/2 (343)	7-1/2 (190)	15 (381)
	$c_{ac,2} \geq$		in. (mm)	5-1/2 (140)	10-1/4 (260)	9-1/4 (235)	13 (330)	20-1/4 (514)	9-1/2 (241)	21 (533)	27 (686)	10-1/2 (267)	30 (762)
Minimum edge distance		c_{min}	in. (mm)	2-1/4 (57)	3-1/4 (82)	3-1/4 (82)	4 (102)	5-3/8 (86)	3-5/8 (92)	6 (152)	7-1/4 (184)	4 (102)	8 (204)
Minimum spacing distance		s_{min}	in. (mm)	2-3/4 (70)	4 (102)	4 (102)	5 (127)	6-3/4 (171)	4-1/2 (114)	7-1/2 (190)	9 (229)	5 (127)	10 (254)
Maximum thickness of fixture		t	in. (mm)	1-3/4 (44)		1-3/4 (44)			1-3/4 (44)			1-3/4 (44)	
Maximum torque		T_{inst}	ft.-lbf.	26		44			60			133	
Torque wrench / socket size		-	in.	9/16		3/4			15/16			1-1/8	
Nut Height		-	in.	21/64		7/16			35/64			41/64	
Stop Drill Bit													
Nominal stop drill bit diameter		d_{bit}	in.	5/8 ANSI		3/4 ANSI			1 ANSI			1-1/8 ANSI	
Stop drill bit for anchor installation		-	-	3220SD	3221SD	3222SD	3223SD	3224SD	3225SD	3226SD	3227SD	3228SD	3229SD
Drilled hole depth of stop bit[1]		-	-	3-1/8	4-3/8	4-1/4	5-1/4	7	5	8	9-1/2	5-7/8	10-7/8
Stop drill bit shank type		-	-	SDS		SDS			SDS-Max			SDS-Max	
Undercut Drill Bit													
Nominal undercut drill bit diameter		d_{uc}	in.	5/8		3/4			1			1-1/8	
Undercut drill bit designation		-	-	3200SD		3201SD			3202SD			3203SD	
Maximum depth of hole for undercut drill bit		-	in. (mm)	9 (229)		10-1/4 (260)			12-1/4 (311)			13-1/2 (343)	
Undercut drill bit shank type		-	-	SDS		SDS			SDS-Max			SDS-Max	
Required impact drill energy		-	ft.-lbf.	1.6		2.5			3.2			4.0	
Setting Sleeve													
Recommended setting sleeve		-	-	3210SD		3211SD			3212SD			3213SD	

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

1. For through bolt applications, the actual hole depth is given by the minimum hole depth plus the maximum thickness of fixture less the thickness of the actual part(s) being fastened to the base material ($h_{o,act} = h_o + t - t_{pl}$).
2. For through bolt applications the minimum diameter of hole clearance in fixture is 1/16-inch larger than the nominal outside anchor diameter.
3. The notation in brackets is for the 2006 IBC.

PERFORMANCE DATA

Tension and Shear Design Information For Atomic+ Undercut Anchor in Concrete (For use with load combinations taken from ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2)[1]

Anchor Property / Setting Information	Notation	Units	Nominal Anchor Diameter									
			3/8 inch		1/2 inch			5/8 inch			3/4 inch	
Anchor category	1,2 or 3	-	1									
Outside anchor diameter	$d_a[d_o]$[8]	in. (mm)	0.625 (15.9)		0.750 (19.1)			1.000 (25.4)			1.125 (28.6)	
Effective embedment	h_{ef}	in. (mm)	2-3/4 (68)	4 (102)	4 (102)	5 (127)	6-3/4 (171)	4-1/2 (114)	7-1/2 (190)	9 (229)	5 (127)	10 (254)
STEEL STRENGTH IN TENSION AND SHEAR[3]												
Tensile stress area of anchor rod steel	A_{se}	in.² (mm²)	0.0775 (50)		0.1419 (91)			0.2260 (146)			0.3345 (216)	
ASTM A36 ($f_y \geq$ 36 ksi) ASTM A193 Grade B7 ($f_y \geq$ 105 ksi): Minimum specified yield strength of anchor rod[10]	f_y	ksi (N/mm²)	36 (248)	105 (723)	36 (248)	105 (723)	105 (723)	36 (248)	105 (723)	105 (723)	36 (248)	105 (723)
ASTM A36 / A193 B7: Minimum specified ultimate tensile strength of anchor rod[10]	f_{uta}	ksi (N/mm²)	58 (400)	125 (860)	58 (400)	125 (860)	125 (860)	58 (400)	125 (860)	125 (860)	58 (400)	125 (860)
ASTM A36 / A193 B7: Steel strength in tension, static[10]	N_{sa}	lb (kN)	4,495 (20.1)	9,685 (43.2)	8,230 (36.7)	17,735 (79.1)	17,735 (79.1)	13,100 (58.5)	28,250 (126.1)	28,250 (126.1)	19,400 (86.3)	41,810 (186.0)
ASTM A36 / A193 B7: Steel strength in shear, static[9,10]	V_{sa}	lb (kN)	2,245 (10.0)	4,885 (21.7)	4,110 (18.4)	8,855 (39.5)	8,855 (39.5)	6,560 (29.3)	14,110 (63.0)	14,110 (63.0)	9,685 (43.2)	20,875 (93.2)
ASTM A36 / A193 B7: Steel strength in shear, seismic[9,10]	V_{eq}	lb (kN)	2,245 (10.0)	4,885 (21.7)	4,110 (18.4)	8,855 (39.5)	8,855 (39.5)	6,560 (29.3)	14,110 (63.0)	14,110 (63.0)	9,685 (43.2)	20,875 (93.2)
ASTM A193 Grade B8, Class 1 ($f_y \geq$ 30 ksi): Minimum specified yield strength of anchor rod (Type 316 stainless steel anchor)	$f_{y,ss}$	ksi (N/mm²)	30 (205)	-	30 (205)	-	-	30 (205)	-	-	30 (205)	-
ASTM A193 B8 Cl. 1: Minimum specified ultimate tensile strength of anchor rod (Type 316 stainless steel anchor)	$f_{uta,ss}$	ksi (N/mm²)	75 (515)	-	75 (515)	-	-	75 (515)	-	-	75 (515)	-
ASTM A193 B8 Cl. 1: Steel strength in tension, static (Type 316 stainless steel anchor)[11]	$N_{sa,ss}$	lb (kN)	4,415 (19.6)	-	8,085 (36.0)	-	-	12,880 (57.3)	-	-	19,065 (84.8)	-
ASTM A193 B8 Cl. 1: Steel strength in shear, static (Type 316 stainless steel anchor)[11]	$V_{sa,ss}$	lb (kN)	2,650 (11.8)	-	4,850 (21.6)	-	-	7,725 (34.4)	-	-	11,440 (50.9)	-
Reduction factor for steel strength in tension[2]	ϕ	-	0.75									
Reduction factor for steel strength in shear[2]	ϕ	-	0.65									
CONCRETE BREAKOUT STRENGTH IN TENSION AND SHEAR[7]												
Effectiveness factor for uncracked concrete	k_{uncr}	-	30		30			30			30	
Effectiveness factor for cracked concrete	k_{cr}	-	24		24			24			24	
Modification factor for cracked and uncracked concrete[4]	$\Psi_{c,N}$	-	1.0 (See note 4)		1.0 (See note 4)			1.0 (See note 4)			1.0 (See note 4)	
Reduction factor for concrete breakout strength in tension[2]	ϕ	-	0.65 (Condition B)									
Reduction factor for concrete breakout strength in shear[2]	ϕ	-	0.70 (Condition B)									
PULLOUT STRENGTH IN TENSION[7]												
Characteristic pullout strength, uncracked concrete (2,500 psi)[5]	$N_{p,uncr}$	lb (kN)	See note 6		See note 6			See note 6			See note 6	
Characteristic pullout strength, cracked concrete (2,500 psi)[5]	$N_{p,cr}$	lb (kN)	See note 6	9,000 (40.2)	See note 6	11,500 (51.3)		See note 6	15,000 (67.0)		See note 6	22,000 (98.2)
Characteristic pullout strength, seismic (2,500 psi)[5,10]	N_{eq}	lb (kN)	See note 6	9,000 (40.2)	See note 6	11,500 (51.3)		See note 6	15,000 (67.0)		See note 6	22,000 (98.2)
Reduction factor for pullout strength[2]	ϕ	-	0.65 (Condition B)									
PRYOUT STRENGTH IN SHEAR[7]												
Coefficient for pryout strength	k_{cp}	-	2.0		2.0			2.0			2.0	
Reduction factor for pryout strength[2]	ϕ	-	0.70 (Condition B)									

For SI: 1 inch = 25.4 mm, 1 ksi = 6.895 MPa (N/mm²), 1 lbf = 0.0044 kN, 1 in² = 645 mm².

1. The data in this table is intended to be used with the design provisions of ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable, shall apply.
2. All values of ϕ were determined from the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable. If the load combinations of ACI 318-11 Appendix C are used, then the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4. For reinforcement that meets ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable, requirements for Condition A, see ACI 318-14 17.3.3(c) or ACI 318-11 D.4.3(c), as applicable, for the appropriate ϕ factor when the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used.
3. Anchors are considered a ductile steel element as defined by ACI 318-14 2.3 or ACI 318-11 D.1, as applicable.
4. For all design cases $\Psi_{c,N}$ =1.0. The appropriate effectiveness factor for cracked concrete (k_{cr}) or uncracked concrete (k_{uncr}) must be used.
5. For all design cases $\Psi_{c,P}$ =1.0. For concrete compressive strength greater than 2,500 psi N_{pn} = (pullout strength from table)*(specified concrete compressive strength/2,500)$^{0.5}$. For concrete over steel deck the value of 2,500 must be replaced with the value of 3,000.
6. Pullout strength does not control design of indicated anchors. Do not calculate pullout strength for indicated anchor 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. The notation in brackets is for the 2006 IBC.
9. Shear strength values are based on standard (pre-set) installation, and must be used for both standard (pre-set) and through-bolt installations.
10. Only applicable to carbon steel anchors
11. Calculated using $f_{uta,ss}$ = 57 ksi (1.9fy) in accordance with ACI 318-14 Chapter 17 or ACI 318-11 Appendix D.

FACTORED DESIGN STRENGTH (ϕN_N AND ϕV_N) CALCULATED IN ACCORDANCE WITH ACI 318-14 CHAPTER 17:

1- Tabular values are provided for illustration and are applicable for single anchors installed in normal-weight concrete with minimum slab thickness, $h_a = h_{min2}$, 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}.

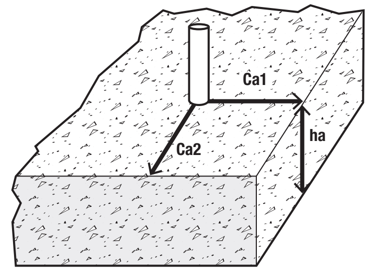
2- Calculations were performed according to ACI 318-14 Chapter 17. The load level corresponding to the controlling failure mode is listed. (e.g. For tension: steel, concrete breakout and pullout; For shear: steel, concrete breakout and pryout). Furthermore, the capacities for concrete breakout strength in tension and pryout strength in shear are calculated using the effective embedment values, hef, 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 318-14 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 318-14 Chapter 17.

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



Tension and Shear Design Strength for Carbon Steel Atomic+ Undercut in Cracked Concrete

STRENGTH DESIGN TABLES

Nominal Anchor Size (in.)	Nominal Embed. h_{nom} (in.)	Anchor Rod Designation (ASTM)	Minimum Concrete Compressive Strength, f'c (psi)									
			2,500		3,000		4,000		6,000		8,000	
			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.)
3/8	3-1/8	A 36	3,370	1,460	3,370	1,460	3,370	1,460	3,370	1,460	3,370	1,460
3/8	4-3/8	A 193, Gr. B7	5,850	3,175	6,410	3,175	7,265	3,175	7,265	3,175	7,265	3,175
1/2	4-1/4	A 36	6,175	2,670	6,175	2,670	6,175	2,670	6,175	2,670	6,175	2,670
1/2	5-1/4	A 193, Gr. B7	7,475	5,755	8,190	5,755	9,455	5,755	11,580	5,755	13,300	5,755
1/2	7	A 193, Gr. B7	7,475	5,755	8,190	5,755	9,455	5,755	11,580	5,755	13,300	5,755
5/8	5	A 36	7,445	4,265	8,155	4,265	9,420	4,265	9,825	4,265	9,825	4,265
5/8	8	A 193, Gr. B7	9,750	9,170	10,680	9,170	12,335	9,170	15,105	9,170	17,440	9,170
5/8	9-1/2	A 193, Gr. B7	9,750	9,170	10,680	9,170	12,335	9,170	15,105	9,170	17,440	9,170
3/4	5-7/8	A 36	8,720	6,410	9,555	6,410	11,030	6,410	13,510	6,410	14,550	6,410
3/4	10-7/8	A 193, Gr. B7	14,300	13,570	15,665	13,570	18,090	13,570	22,155	13,570	25,580	13,570

- Anchor Pullout/Pryout Strength Controls - Concrete Breakout Strength Controls - Steel Strength Controls

Tension and Shear Design Strength for Carbon Steel Atomic+ Undercut in Uncracked Concrete

Nominal Anchor Size (in.)	Nominal Embed. h_{nom} (in.)	Anchor Rod Designation (ASTM)	Minimum Concrete Compressive Strength, f'c (psi)									
			2,500		3,000		4,000		6,000		8,000	
			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.)
3/8	3-1/8	A 36	3,370	1,460	3,370	1,460	3,370	1,460	3,370	1,460	3,370	1,460
3/8	4-3/8	A 193, Gr. B7	7,265	3,175	7,265	3,175	7,265	3,175	7,265	3,175	7,265	3,175
1/2	4-1/4	A 36	6,175	2,670	6,175	2,670	6,175	2,670	6,175	2,670	6,175	2,670
1/2	5-1/4	A 193, Gr. B7	10,900	5,755	11,940	5,755	13,300	5,755	13,300	5,755	13,300	5,755
1/2	7	A 193, Gr. B7	13,300	5,755	13,300	5,755	13,300	5,755	13,300	5,755	13,300	5,755
5/8	5	A 36	9,305	4,265	9,825	4,265	9,825	4,265	9,825	4,265	9,825	4,265
5/8	8	A 193, Gr. B7	20,025	9,170	21,190	9,170	21,190	9,170	21,190	9,170	21,190	9,170
5/8	9-1/2	A 193, Gr. B7	21,190	9,170	21,190	9,170	21,190	9,170	21,190	9,170	21,190	9,170
3/4	5-7/8	A 36	10,900	6,410	11,940	6,410	13,790	6,410	14,550	6,410	14,550	6,410
3/4	10-7/8	A 193, Gr. B7	30,830	13,570	31,360	13,570	31,360	13,570	31,360	13,570	31,360	13,570

- Anchor Pullout/Pryout Strength Controls - Concrete Breakout Strength Controls - Steel Strength Controls

FACTORED DESIGN STRENGTH (ϕN_N AND ϕV_N) CALCULATED IN ACCORDANCE WITH ACI 318-14 CHAPTER 17:

1- Tabular values are provided for illustration and are applicable for single anchors installed in normal-weight concrete with minimum slab thickness, $h_a = h_{min2}$, 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}.

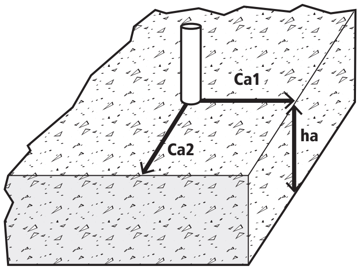
2- Calculations were performed according to ACI 318-14 Chapter 17. The load level corresponding to the controlling failure mode is listed. (e.g. For tension: steel, concrete breakout and pullout; For shear: steel, concrete breakout and pryout). Furthermore, the capacities for concrete breakout strength in tension and pryout strength in shear are calculated using the effective embedment values, hef, 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 318-14 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 318-14 Chapter 17.

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



Tension and Shear Factored Design Strength for Stainless Steel Atomic+ Undercut Anchor in Cracked Concrete

STRENGTH DESIGN SD TABLES

Nominal Anchor Size (in.)	Nominal Embed. h_{nom} (in.)	Anchor Rod Designation (ASTM)	Minimum Concrete Compressive Strength, f'c (psi)									
			2,500		3,000		4,000		6,000		8,000	
			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.)
3/8	3-1/8	A 193, Gr. B8 Class 1	3,310	1,725	3,310	1,725	3,310	1,725	3,310	1,725	3,310	1,725
1/2	4-1/4	A 193, Gr. B8 Class 1	6,065	3,155	6,065	3,155	6,065	3,155	6,065	3,155	6,065	3,155
5/8	5	A 193, Gr. B8 Class 1	7,445	5,020	8,155	5,020	9,420	5,020	9,660	5,020	9,660	5,020
3/4	5-7/8	A 193, Gr. B8 Class 1	8,720	7,425	9,555	7,425	11,030	7,425	13,510	7,425	14,275	7,425

Tension and Shear Factored Design Strength for Stainless Steel Atomic+ Undercut Anchor in Uncracked Concrete

Nominal Anchor Size (in.)	Nominal Embed. h_{nom} (in.)	Anchor Rod Designation (ASTM)	Minimum Concrete Compressive Strength, f'c (psi)									
			2,500		3,000		4,000		6,000		8,000	
			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.)
3/8	3-1/8	A 193, Gr. B8 Class 1	3,310	1,725	3,310	1,725	3,310	1,725	3,310	1,725	3,310	1,725
1/2	4-1/4	A 193, Gr. B8 Class 1	6,065	3,155	6,065	3,155	6,065	3,155	6,065	3,155	6,065	3,155
5/8	5	A 193, Gr. B8 Class 1	9,305	5,020	9,660	5,020	9,660	5,020	9,660	5,020	9,660	5,020
3/4	5-7/8	A 193, Gr. B8 Class 1	10,900	7,425	11,940	7,425	13,790	7,425	14,275	7,425	14,275	7,425

- Anchor Pullout/Pryout Strength Controls - Concrete Breakout Strength Controls - Steel Strength Controls

Converted Allowable Loads for Carbon Steel Atomic+ Undercut in Cracked Concrete[1,2]

Nominal Anchor Diameter (in.)	Nominal Embed. h_{nom} (in.)	Anchor Rod Designation (ASTM)	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	
			$T_{allowable,ASD}$ Tension (lbs.)	$V_{allowable,ASD}$ Shear (lbs.)	$T_{allowable,ASD}$ Tension (lbs.)	$V_{allowable,ASD}$ Shear (lbs.)	$T_{allowable,ASD}$ Tension (lbs.)	$V_{allowable,ASD}$ Shear (lbs.)	$T_{allowable,ASD}$ Tension (lbs.)	$V_{allowable,ASD}$ Shear (lbs.)	$T_{allowable,ASD}$ Tension (lbs.)	$V_{allowable,ASD}$ Shear (lbs.)
3/8	3-1/8	A 36	2,405	1,045	2,405	1,045	2,405	1,045	2,405	1,045	2,405	1,045
	4-3/8	A 193, Gr. B7	4,180	2,270	4,580	2,270	5,190	2,270	5,190	2,270	5,190	2,270
1/2	4-1/4	A 36	4,410	1,905	4,410	1,905	4,410	1,905	4,410	1,905	4,410	1,905
	5-1/4	A 193, Gr. B7	5,340	4,110	5,850	4,110	6,755	4,110	8,270	4,110	9,500	4,110
	7	A 193, Gr. B7	5,340	4,110	5,850	4,110	6,755	4,110	8,270	4,110	9,500	4,110
5/8	5	A 36	5,320	3,045	5,825	3,045	6,730	3,045	7,020	3,045	7,020	3,045
	8	A 193, Gr. B7	6,965	6,550	7,630	6,550	8,810	6,550	10,790	6,550	12,455	6,550
	9-1/2	A 193, Gr. B7	6,965	6,550	7,630	6,550	8,810	6,550	10,790	6,550	12,455	6,550
3/4	5-7/8	A 36	6,230	4,580	6,825	4,580	7,880	4,580	9,650	4,580	10,395	4,580
	10-7/8	A 193, Gr. B7	10,215	9,695	11,190	9,695	12,920	9,695	15,825	9,695	18,270	9,695

1. Allowable load values are calculated using a conversion factor, α, from Factored Design Strengths and conditions shown on the previous page.
2. Tabulated allowable load values assume 50% dead load and 50% live load, with controlling load combination 1.2D + 1.6L. Calculated weighted average for the conversion factor α : 1.2(0.5) + 1.6(0.5) = 1.4.

Converted Allowable Loads for Carbon Steel Atomic+ Undercut in Uncracked Concrete[1,2]

Nominal Anchor Diameter (in.)	Nominal Embed. h_{nom} (in.)	Anchor Rod Designation (ASTM)	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	
			$T_{allowable,ASD}$ Tension (lbs.)	$V_{allowable,ASD}$ Shear (lbs.)	$T_{allowable,ASD}$ Tension (lbs.)	$V_{allowable,ASD}$ Shear (lbs.)	$T_{allowable,ASD}$ Tension (lbs.)	$V_{allowable,ASD}$ Shear (lbs.)	$T_{allowable,ASD}$ Tension (lbs.)	$V_{allowable,ASD}$ Shear (lbs.)	$T_{allowable,ASD}$ Tension (lbs.)	$V_{allowable,ASD}$ Shear (lbs.)
3/8	3-1/8	A 36	2,405	1,045	2,405	1,045	2,405	1,045	2,405	1,045	2,405	1,045
	4-3/8	A 193, Gr. B7	5,190	2,270	5,190	2,270	5,190	2,270	5,190	2,270	5,190	2,270
1/2	4-1/4	A 36	4,410	1,905	4,410	1,905	4,410	1,905	4,410	1,905	4,410	1,905
	5-1/4	A 193, Gr. B7	7,785	4,110	8,530	4,110	9,500	4,110	9,500	4,110	9,500	4,110
	7	A 193, Gr. B7	9,500	4,110	9,500	4,110	9,500	4,110	9,500	4,110	9,500	4,110
5/8	5	A 36	6,645	3,045	7,020	3,045	7,020	3,045	7,020	3,045	7,020	3,045
	8	A 193, Gr. B7	14,305	6,550	15,135	6,550	15,135	6,550	15,135	6,550	15,135	6,550
	9-1/2	A 193, Gr. B7	15,135	6,550	15,135	6,550	15,135	6,550	15,135	6,550	15,135	6,550
3/4	5-7/8	A 36	7,785	4,580	8,530	4,580	9,850	4,580	10,395	4,580	10,395	4,580
	10-7/8	A 193, Gr. B7	22,020	9,695	22,400	9,695	22,400	9,695	22,400	9,695	22,400	9,695

1. Allowable load values are calculated using a conversion factor, α, from Factored Design Strengths and conditions shown on the previous page.
2. Tabulated allowable load values assume 50% dead load and 50% live load, with controlling load combination 1.2D + 1.6L. Calculated weighted average for the conversion factor α : 1.2(0.5) + 1.6(0.5) = 1.4.

Converted Allowable Loads for Stainless Steel Atomic+ Undercut in Cracked Concrete[1,2]

Nominal Anchor Diameter (in.)	Nominal Embed. h_{nom} (in.)	Anchor Rod Designation (ASTM)	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	
			$T_{allowable,ASD}$ Tension (lbs.)	$V_{allowable,ASD}$ Shear (lbs.)	$T_{allowable,ASD}$ Tension (lbs.)	$V_{allowable,ASD}$ Shear (lbs.)	$T_{allowable,ASD}$ Tension (lbs.)	$V_{allowable,ASD}$ Shear (lbs.)	$T_{allowable,ASD}$ Tension (lbs.)	$V_{allowable,ASD}$ Shear (lbs.)	$T_{allowable,ASD}$ Tension (lbs.)	$V_{allowable,ASD}$ Shear (lbs.)
3/8	3-1/8	A 193, Gr. B8 Class 1	2,365	1,230	2,365	1,230	2,365	1,230	2,365	1,230	2,365	1,230
1/2	4-1/4	A 193, Gr. B8 Class 1	4,330	2,255	4,330	2,255	4,330	2,255	4,330	2,255	4,330	2,255
5/8	5	A 193, Gr. B8 Class 1	5,320	3,585	5,825	3,585	6,730	3,585	6,900	3,585	6,900	3,585
3/4	5-7/8	A 193, Gr. B8 Class 1	6,230	5,200	6,825	5,310	7,880	5,310	9,650	5,310	10,215	5,310

1. Allowable load values are calculated using a conversion factor, α, from Factored Design Strengths and conditions shown on the previous page.
2. Tabulated allowable load values assume 50% dead load and 50% live load, with controlling load combination 1.2D + 1.6L. Calculated weighted average for the conversion factor α : 1.2(0.5) + 1.6(0.5) = 1.4.

Converted Allowable Loads for Stainless Steel Atomic+ Undercut in Uncracked Concrete[1,2]

Nominal Anchor Diameter (in.)	Nominal Embed. h_{nom} (in.)	Anchor Rod Designation (ASTM)	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	
			$T_{allowable,ASD}$ Tension (lbs.)	$V_{allowable,ASD}$ Shear (lbs.)	$T_{allowable,ASD}$ Tension (lbs.)	$V_{allowable,ASD}$ Shear (lbs.)	$T_{allowable,ASD}$ Tension (lbs.)	$V_{allowable,ASD}$ Shear (lbs.)	$T_{allowable,ASD}$ Tension (lbs.)	$V_{allowable,ASD}$ Shear (lbs.)	$T_{allowable,ASD}$ Tension (lbs.)	$V_{allowable,ASD}$ Shear (lbs.)
3/8	3-1/8	A 193, Gr. B8 Class 1	2,365	1,230	2,365	1,230	2,365	1,230	2,365	1,230	2,365	1,230
1/2	4-1/4	A 193, Gr. B8 Class 1	4,330	2,255	4,330	2,255	4,330	2,255	4,330	2,255	4,330	2,255
5/8	5	A 193, Gr. B8 Class 1	6,645	3,585	6,900	3,585	6,900	3,585	6,900	3,585	6,900	3,585
3/4	5-7/8	A 193, Gr. B8 Class 1	7,785	5,310	8,530	5,310	9,850	5,310	10,215	5,310	10,215	5,310

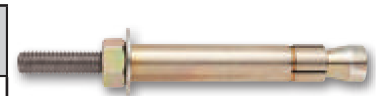
1. Allowable load values are calculated using a conversion factor, α, from Factored Design Strengths and conditions shown on the previous page.
2. Tabulated allowable load values assume 50% dead load and 50% live load, with controlling load combination 1.2D + 1.6L. Calculated weighted average for the conversion factor α : 1.2(0.5) + 1.6(0.5) = 1.4.

ORDERING INFORMATION

Atomic+ Undercut Anchor A 36 Steel

Cat. No.	Nominal Anchor Diameter	Anchor Outside Diameter	Overall Length	Required Undercut Bit (Cat. No.)	Recommended Stop Bit (Cat. No.)	Anchor Type	Std. Box
03100SD	3/8"	5/8"	5-1/2"	03200SD	03220SD	Standard	20
03102SD	3/8"	5/8"	5-1/2"		*	Through bolt	20
03108SD	1/2"	3/4"	7"	03201SD	03222SD	Standard	15
03110SD	1/2"	3/4"	7"		*	Through bolt	15
03120SD	5/8"	1"	7-3/4"	03202SD	03225SD	Standard	10
03122SD	5/8"	1"	7-3/4"		*	Through bolt	10
03132SD	3/4"	1-1/8"	8-5/8"	03203SD	03228SD	Standard	8
03134SD	3/4"	1-1/8"	8-5/8"		*	Through bolt	8

For availability of all anchors lengths please contact DEWALT.
*Contact DEWALT for appropriate drilling method and hardware.



Atomic+ Undercut Anchor High Strength A 193, Grade B7 Steel

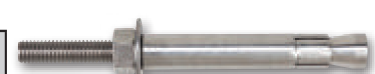
Cat. No.	Nominal Anchor Diameter	Anchor Outside Diameter	Overall Length	Required Undercut Bit (Cat. No.)	Recommended Stop Bit (Cat. No.)	Anchor Type	Std. Box
03104SD	3/8"	5/8"	6-3/4"	03200SD	03221SD	Standard	20
03106SD	3/8"	5/8"	6-3/4"		*	Through bolt	20
03112SD	1/2"	3/4"	8"	03201SD	03223SD	Standard	15
03114SD	1/2"	3/4"	8"		*	Through bolt	15
03116SD	1/2"	3/4"	9-3/4"		03224SD	Standard	15
03118SD	1/2"	3/4"	9-3/4"		*	Through bolt	15
03124SD	5/8"	1"	10-3/4"	03202SD	03226SD	Standard	10
03126SD	5/8"	1"	10-3/4"		*	Through bolt	10
03128SD	5/8"	1"	12-1/4"		03227SD	Standard	10
03130SD	5/8"	1"	12-1/4"		*	Through bolt	10
03136SD	3/4"	1-1/8"	13-5/8"	03203SD	03229SD	Standard	8
03138SD	3/4"	1-1/8"	13-5/8"		*	Through bolt	8

For availability of all anchors lengths please contact DEWALT.
*Contact DEWALT for appropriate drilling method and hardware.

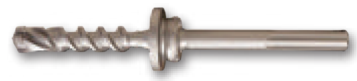
Atomic+ Undercut Anchor Type 316 Stainless Steel, ASTM A 193 Grade B8, Class 1

Cat. No.	Nominal Anchor Diameter	Anchor Outside Diameter	Overall Length	Required Undercut Bit (Cat. No.)	Recommended Stop Bit (Cat. No.)	Anchor Type	Std. Box
03600SD	3/8"	5/8"	5-1/2"	03200SD	03220SD	Standard	20
03602SD	3/8"	5/8"	5-1/2"		*	Through bolt	20
03608SD	1/2"	3/4"	7"	03201SD	03222SD	Standard	15
03610SD	1/2"	3/4"	7"		*	Through bolt	15
03620SD	5/8"	1"	7-3/4"	03202SD	03225SD	Standard	10
03622SD	5/8"	1"	7-3/4"		*	Through bolt	10
03632SD	3/4"	1-1/8"	8-5/8"	03203SD	03228SD	Standard	8
03634SD	3/4"	1-1/8"	8-5/8"		*	Through bolt	8

For availability of all anchors lengths please contact DEWALT.
*Contact DEWALT for appropriate drilling method and hardware.
High Strength Type 316 Stainless Steel anchors also available,
*Contact DEWALT for details.



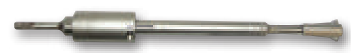
Stop Drill Bits



Cat. No.	Nominal Stop Drill Bit Diameter	Corresponding Nominal Anchor Diameter	Max. Drill Depth	Shank Type	Std. Tube
03220SD	5/8	3/8	3-1/8"	SDS	1
03221SD	5/8	3/8	4-3/8"	SDS	1
03222SD	3/4	1/2	4-1/4"	SDS	1
03223SD	3/4	1/2	5-1/4"	SDS	1
03224SD	3/4	1/2	7"	SDS	1
03225SD	1	5/8	5"	SDS-Max	1
03226SD	1	5/8	8"	SDS-Max	1
03227SD	1	5/8	9-1/2"	SDS-Max	1
03228SD	1-1/8	3/4	5-13/16"	SDS-Max	1
03229SD	1-1/8	3/4	10-13/16"	SDS-Max	1

The Stop Drill Bit creates a drill hole to the proper depth for standard installations of the Atomic+ Undercut anchor
(For through bolt applications please contact DEWALT for appropriate drilling method and hardware).

Undercut Drill Bits



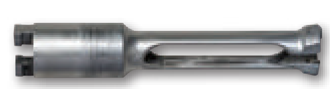
Cat. No.	Nominal Undercut Drill Bit Diameter	Corresponding Nominal Anchor Diameter	Maximum Depth of Hole	Shank Type	Std. Tube
03200SD	5/8	3/8	9"	SDS	1
03201SD	3/4	1/2	10-1/4"	SDS	1
03202SD	1	5/8	12-1/4"	SDS-Max	1
03203SD	1-1/8	3/4	13-1/2"	SDS-Max	1

The Undercut Drill Bit has a unique design that enlarges the bottom of the drill hole creating a reverse cone sized to receive the Atomic+ Undercut anchor.

Setting Sleeve for Undercut Anchors

Cat.. No.	Corresponding Nominal Anchor Diameter	Std. Box
03210SD	3/8	1
03211SD	1/2	1
03218SD	5/8	1
03213SD	3/4	1

Replacement Blade Assemblies for Undercut Drill Bit



Cat.. No.	Description	Std. Tube
03205SD	Atomic+ (3/8") Cutter Blade - 5/8"	1
03206SD	Atomic+ (1/2") Cutter Blade - 3/4"	1
03208SD	Atomic+ (5/8") Cutter Blade - 1"	1
03209SD	Atomic+ (3/4") Cutter Blade - 1-1/8"	1

Replacement Bow Jaws for Undercut Drill Bit

Cat.. No.	Description	Std. Tube
03212SD	3/8" Bow Jaw for 5/8" Hole	1
03215SD	1/2" Bow Jaw for 3/4" Hole	1
03216SD	5/8" Bow Jaw for 1" Hole	1
03217SD	3/4" Bow Jaw for 1-1/8" Hole	1

GENERAL INFORMATION

POWER-STUD®+ SD1

Wedge Expansion Anchor

PRODUCT DESCRIPTION

The Power-Stud+ SD1 anchor is a fully threaded, torque-controlled, wedge expansion anchor which is designed for consistent performance in cracked and uncracked concrete. Suitable base materials include normal-weight concrete, sand-lightweight concrete, concrete over steel deck, and grouted concrete masonry. The anchor is manufactured with a zinc plated carbon steel body and expansion clip for premium performance. Nut and washer are included.

GENERAL APPLICATIONS AND USES

- Structural connections, i.e., beam and column anchorage
- Safety-related attachments
- Interior applications / low level corrosion environment
- Tension zone applications, i.e., cable trays and strut, pipe supports, fire sprinklers
- Seismic and wind loading

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

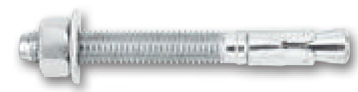
APPROVALS AND LISTINGS

- International Code Council, Evaluation Service (ICC-ES), ESR-2818 for cracked and uncracked concrete
- International Code Council, Evaluation Service (ICC-ES), ESR-2966 for masonry
- Code compliant with the 2015 IBC, 2015 IRC, 2012 IBC, 2012 IRC, 2009 IBC, and 2009 IRC
- Tested in accordance with ACI 355.2/ASTM E 488 and ICC-ES AC193 for use in structural concrete under the design provisions of ACI 318-14 Chapter 17 or ACI 318-11/08 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)
- Tested in accordance with ICC-ES AC01 for use in Masonry
- Underwriters Laboratories (UL Listed) - File No. EX1289, see listing for sizes

GUIDE SPECIFICATIONS

CSI Divisions: 03 16 00 - Concrete Anchors, 04 05 19.16 - Masonry Anchors and 05 05 19 - Post-Installed Concrete Anchors. Expansion anchors shall be Power-Stud+ SD1 as supplied by DEWALT, Towson, MD. Anchors shall be installed in accordance with published instructions and the Authority Having Jurisdiction.

SECTION CONTENTS



POWER-STUD+ SD1 ASSEMBLY

THREAD VERSION

- UNC threaded stud

ANCHOR MATERIALS

- Zinc plated carbon steel body with expansion clip, nut and washer

ANCHOR SIZE RANGE (TYP.)

- 1/4" diameter through 1-1/4" diameter

SUITABLE BASE MATERIALS

- Normal-weight concrete
- Structural sand-lightweight concrete
- Concrete over steel deck
- Grouted concrete masonry (CMU)

TENSION ZONE CRACKED CONCRETE

SEISMIC REGION QUALIFICATION

CODE LISTED ICC-ES ESR-2818 CONCRETE

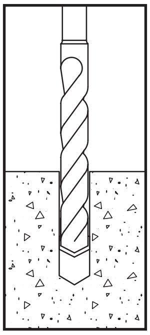
CODE LISTED ICC-ES ESR-2966 MASONRY

MATERIAL SPECIFICATIONS

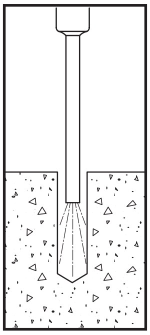
Anchor component	Specification
Anchor Body	Medium carbon steel
Hex nut	Carbon steel, ASTM A 563, Grade A
Washer	Carbon Steel, ASTM F 844; meets dimensional requirements of ANSI B18.22.2. Type A Plain
Expansion wedge (clip)	Carbon Steel
Plating	Zinc plating according to ASTM B 633, SC1 Type III (Fe/Zn 5). Minimum plating requirements for Mild Service Condition.

INSTALLATION INSTRUCTIONS

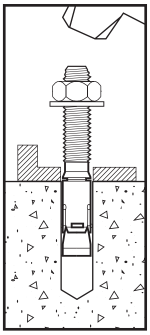
Installation Instructions for Power-Stud+ SD1



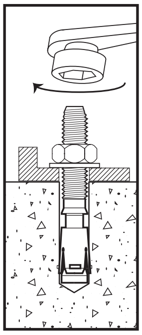
Step 1
Using the proper drill bit size, drill a hole into the base material to the required depth. The tolerances of the drill bit used should meet the requirements of ANSI Standard B212.15.



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.

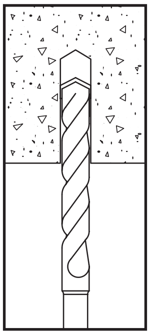


Step 3
Position the washer on the anchor and thread on the nut. If installing through a fixture, drive the anchor through the fixture into the hole. Be sure the anchor is driven to the minimum required embedment depth, h_{nom}.

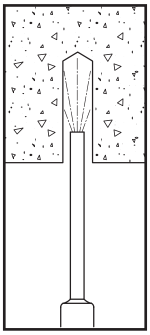


Step 4
Tighten the anchor with a torque wrench by applying the required installation torque, T_{inst}. Note: The threaded stud will draw up during tightening of the nut; the expansion wedge (clip) remains in original position.

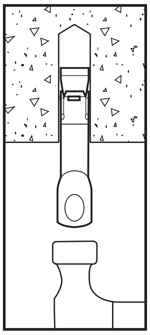
Installation Instructions for Power-Stud+ SD1 Tie Wire Version



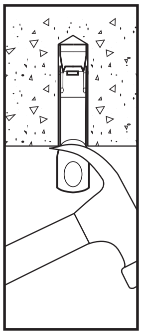
Step 1
Using the proper drill bit size, drill a hole into the base material to the required depth. The tolerances of the drill bit used should meet the requirements of ANSI Standard B212.15.



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.

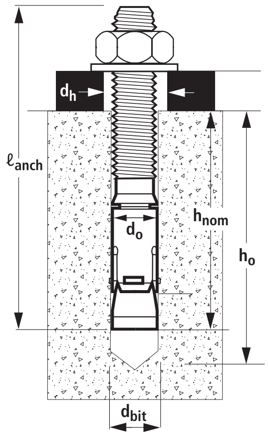


Step 3
Drive the anchor into the hole until the head is firmly seated against the base material. Be sure the anchor is driven to the required embedment depth.

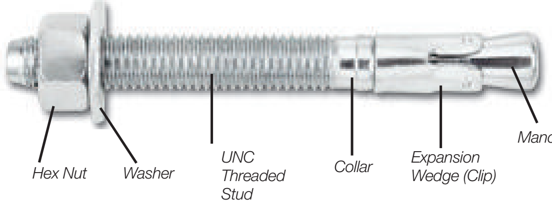


Step 4
Set the anchor with a prying action using a claw hammer.

Power-Stud+ SD1 Anchor Detail



Power-Stud+ SD1 Anchor Assembly



Head Marking

Legend

Letter Code = Length Identification Mark

'+' Symbol = Strength Design Compliant Anchor (see ordering information)

Number Code = Carbon Steel Body and Carbon Steel Expansion Clip (not on 1/4" diameter anchors)

Length Identification

Mark	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
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"	11"	12"
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"	12"	13"

Length identification mark indicates overall length of anchor.

REFERENCE DATA (ASD)

Installation Specifications for Power-Stud+ SD1 in Concrete[1,2]

Anchor Property/ Setting Information	Notation	Units	Nominal Anchor Diameter							
			1/4	3/8	1/2	5/8	3/4	7/8	1	1-1/4
Anchor diameter	d_o	in. (mm)	0.250 (6.4)	0.375 (9.5)	0.500 (12.7)	0.625 (15.9)	0.750 (19.1)	0.875 (22.2)	1.000 (25.4)	1.250 (31.8)
Minimum diameter of hole clearance in fixture	d_h	in. (mm)	5/16 (7.5)	7/16 (11.1)	9/16 (14.3)	11/16 (17.5)	13/16 (20.6)	1 (25.4)	1-1/8 (28.6)	1-3/8 (34.9)
Nominal drill bit diameter	d_{bit}	in.	1/4" ANSI	3/8" ANSI	1/2" ANSI	5/8" ANSI	3/4" ANSI	7/8" ANSI	1" ANSI	1-1/4" ANSI
Minimum nominal embedment depth	h_{nom}	in. (mm)	1-1/8 (29)	1-5/8 (41)	2-1/4 (57)	2-3/4 (70)	3-3/8 (86)	4-1/2 (114)	4-1/2 (114)	6-1/2 (165)
Minimum hole depth	h_o	in. (mm)	1-1/4 (48)	1-3/4 (44)	2-1/2 (64)	3-1/8 (79)	3-5/8 (92)	4-7/8 (122)	4-7/8 (122)	7-1/4 (184)
Installation torque	T_{inst}	ft.-lbf. (N-m)	4 (5)	20 (27)	40 (54)	80 (108)	110 (149)	175 (237)	225 (305)	375 (508)
Torque wrench/ socket size	-	in.	7/16	9/16	3/4	15/16	1-1/8	1-5/16	1-1/2	1-7/8
Nut height	-	In.	7/32	21/64	7/16	35/64	41/64	3/4	55/64	1-1/16

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

1. The minimum base material thickness should be $1.5h_{nom}$ or 3", whichever is greater.
2. See Performance Data in Concrete for additional embedment depths.

Ultimate Load Capacities for Power-Stud+ SD1 in Normal-Weight Concrete[1,2]

Nominal Anchor Diameter in.	Minimum Embedment Depth in. (mm)	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)	
		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	1-1/8 (28)	1,320 (5.9)	1,160 (5.2)	1,435 (6.4)	1,255 (5.6)	1,660 (7.4)	1,255 (5.6)	-	-
	1-3/4 (44)	2,775 (12.4)	1,255 (5.6)	2,775 (12.4)	1,255 (5.6)	2,775 (12.4)	1,255 (5.6)	2,775 (12.4)	1,255 (5.6)
3/8	1-5/8 (41)	2,240 (10.9)	2,320 (10.3)	2,685 (12)	2,540 (11.3)	3,100 (13.8)	2,540 (11.3)	-	-
	2-3/8 (60)	3,485 (15.5)	2,540 (11.3)	3,815 (17)	2,540 (11.3)	4,410 (19.6)	2,540 (11.3)	5,400 (24)	2,540 (11.3)
1/2	2-1/4 (57)	3,800 (16.9)	3,840 (17.1)	4,155 (18.5)	4,195 (18.7)	4,800 (21.4)	4,195 (18.7)	-	-
	2-1/2 (64)	3,910 (17.4)	4,195 (18.7)	4,285 (19.1)	4,195 (18.7)	4,950 (22)	4,195 (18.7)	6,060 (27)	4,195 (18.7)
	3-3/4 (95)	7,955 (35.4)	4,195 (18.7)	8,715 (38.8)	4,195 (18.7)	10,065 (44.8)	4,195 (18.7)	12,325 (54.8)	4,195 (18.7)
5/8	2-3/4 (70)	4,960 (22.1)	6,220 (27.7)	5,440 (24.3)	6,815 (30.3)	6,285 (28)	6,815 (30.3)	-	-
	3-3/8 (86)	6,625 (29.5)	6,815 (30.3)	7,260 (32.3)	6,815 (30.3)	8,380 (37.3)	6,815 (30.3)	10,265 (45.7)	6,815 (30.3)
	4-5/8 (117)	11,260 (50.1)	6,815 (30.3)	12,335 (54.9)	6,815 (30.3)	14,245 (63.4)	6,815 (30.3)	14,465 (65.7)	6,815 (30.3)
3/4	3-3/8 (86)	7,180 (31.9)	11,480 (51.5)	7,860 (32.2)	12,580 (56.0)	9,075 (40.5)	12,580 (56.0)	-	-
	4 (102)	9,530 (42.4)	12,580 (56.0)	10,440 (46.5)	12,580 (56.0)	12,060 (53.6)	12,580 (56.0)	14,770 (65.7)	12,580 (56.0)
	5-5/8 (143)	17,670 (78.6)	12,580 (56.0)	19,355 (86.1)	12,580 (56.0)	22,350 (99.4)	12,580 (56.0)	25,065 (111.5)	12,580 (56.0)
7/8	3-7/8 (98)	9,120 (40.6)	10,680 (47.5)	10,005 (44.5)	11,690 (52.0)	11,555 (51.4)	11,690 (52.0)	-	-
	4-1/2 (114)	11,320 (50.4)	11,690 (52.0)	12,405 (55.2)	11,690 (52.0)	15,125 (67.3)	11,690 (52.0)	19,470 (86.6)	11,690 (52.0)
1	4-1/2 (114)	12,400 (55.2)	19,320 (85.9)	13,580 (60.4)	21,155 (94.1)	15,680 (69.7)	21,155 (94.1)	-	-
	5-1/2 (140)	16,535 (73.6)	21,155 (94.1)	18,115 (80.6)	21,155 (94.1)	20,915 (93)	21,155 (94.1)	25,615 (114)	21,155 (94.1)
	8 (203)	19,640 (87.4)	21,155 (94.1)	21,530 (95.8)	21,155 (94.1)	24,865 (110.6)	21,155 (94.1)	-	-
1-1/4	5-1/2 (140)	18,520 (82.5)	26,560 (118.1)	20,275 (90.9)	29,105 (129.4)	23,410 (105.0)	29,105 (129.4)	-	-
	6-1/2 (165)	22,485 (100.0)	29,105 (129.4)	24,630 (109.6)	29,105 (129.4)	28,440 (126.5)	29,105 (129.4)	37,360 (166.2)	29,105 (129.4)

1. Tabulated load values are for 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 be reduced by a minimum safety factor of 4.0 or greater to determine allowable working loads.

Allowable Load Capacities for Power-Stud+ SD1 in Normal-Weight Concrete[1,2,3,4]

Nominal Anchor Diameter (in.)	Minimum Embedment Depth in. (mm)	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)	
		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	1-1/8 (28)	330 (1.5)	290 (1.3)	360 (1.6)	315 (1.4)	415 (1.8)	315 (1.4)	-	-
	1-3/4 (44)	695 (3.1)	315 (1.4)	695 (3.1)	315 (1.4)	695 (3.1)	315 (1.4)	695 (3.1)	315 (1.4)
3/8	1-5/8 (41)	610 (2.7)	580 (2.6)	670 (3.0)	635 (2.8)	775 (3.4)	635 (2.8)	-	-
	2-3/8 (60)	870 (3.9)	635 (2.8)	955 (4.2)	635 (2.8)	1,105 (4.9)	635 (2.8)	1,350 (6.0)	635 (2.8)
1/2	2-1/4 (57)	950 (4.2)	960 (4.3)	1,040 (4.6)	1,050 (4.7)	1,200 (5.3)	1,050 (4.7)	-	-
	2-1/2 (64)	980 (4.4)	1,050 (4.7)	1,070 (4.8)	1,050 (4.7)	1,240 (5.5)	1,050 (4.7)	1,515 (6.7)	1,050 (4.7)
	3-3/4 (95)	1,990 (8.9)	1,050 (4.7)	2,180 (9.7)	1,050 (4.7)	2,515 (11.2)	1,050 (4.7)	3,080 (13.7)	1,050 (4.7)
5/8	2-3/4 (70)	1,240 (5.5)	1,555 (6.9)	1,360 (6.0)	1,705 (7.6)	1,570 (7.0)	1,705 (7.6)	-	-
	3-3/8 (86)	1,655 (7.4)	1,705 (7.6)	1,815 (8.1)	1,705 (7.6)	2,095 (9.3)	1,705 (7.6)	2,565 (11.4)	1,705 (7.6)
	4-5/8 (117)	2,815 (12.5)	1,705 (7.6)	3,085 (13.7)	1,705 (7.6)	3,560 (15.8)	1,705 (7.6)	3,615 (16.1)	1,705 (7.6)
3/4	3-3/8 (86)	1,795 (8.0)	2,870 (12.8)	1,965 (8.7)	3,145 (14.0)	2,270 (10.1)	3,145 (14.0)	-	-
	4 (102)	2,385 (10.6)	3,145 (14.0)	2,610 (11.6)	3,145 (14.0)	3,015 (13.4)	3,145 (14.0)	3,620 (16.1)	3,145 (14.0)
	5-5/8 (143)	4,420 (19.7)	3,145 (14.0)	4,840 (21.5)	3,145 (14.0)	5,590 (24.9)	3,145 (14.0)	6,265 (27.9)	3,145 (14.0)
7/8	3-7/8 (98)	2,280 (10.1)	2,670 (11.9)	2,500 (11.1)	2,925 (13.0)	2,890 (12.9)	2,925 (13.0)	-	-
	4-1/2 (114)	2,830 (12.6)	2,925 (13.0)	3,100 (13.8)	2,925 (13.0)	3,780 (16.8)	2,925 (13.0)	4,870 (21.7)	2,925 (13.0)
1	4-1/2 (114)	3,100 (13.8)	4,830 (21.5)	3,395 (15.1)	5,290 (23.5)	3,920 (17.4)	5,290 (23.5)	-	-
	5-1/2 (140)	4,135 (18.4)	5,290 (23.5)	4,530 (20.2)	5,290 (23.5)	5,230 (23.3)	5,290 (23.5)	6,405 (28.5)	5,290 (23.5)
	8 (203)	4,910 (21.8)	5,290 (23.5)	5,380 (23.9)	5,290 (23.5)	6,215 (27.6)	5,290 (23.5)	-	-
1-1/4	5-1/2 (140)	4,630 (20.6)	6,640 (29.5)	5,070 (22.6)	7,275 (32.4)	5,850 (26.0)	7,275 (32.4)	-	-
	6-1/2 (165)	5,620 (25.0)	7,275 (32.4)	6,160 (27.4)	7,275 (32.4)	7,110 (31.6)	7,275 (32.4)	9,340 (41.5)	7,275 (32.4)

1. Tabulated load values are for anchors installed in concrete. Concrete compressive strength must be at the minimum at the time of installation.
2. Allowable load capacities are calculated using an applied safety factor of 4.0.
3. Allowable load capacities must be multiplied by reduction factors when anchor spacing or edge distances are less than critical distances.
4. Linear interpolation may be used to determine allowable loads for intermediate embedments and compressive strengths.

Spacing Distance and Edge Distance Tension (F_{NS}, F_{NC}) Adjustment Factors for Normal-Weight Concrete

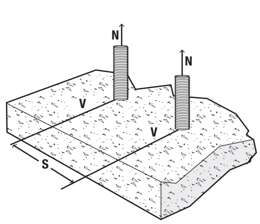
	Dia. (in)	1/4	3/8	1/2	1/2	5/8	5/8	3/4	3/4	7/8	1	1-1/4
	h_{nom} (in.)	1-3/4	2-3/8	2-1/2	3-3/4	3-3/8	4-5/8	4	5-5/8	4-1/2	5-1/2	6-1/2
	s_{min} (in.)	2-1/4	3-1/2	4-1/2	5	6	4-1/4	6	6-1/2	6-1/2	8	8
Spacing Distance (inches)	2	-	-	-	-	-	-	-	-	-	-	-
	2-1/4	0.78	-	-	-	-	-	-	-	-	-	-
	2-1/2	0.80	-	-	-	-	-	-	-	-	-	-
	2-3/4	0.83	-	-	-	-	-	-	-	-	-	-
	3	0.85	-	-	-	-	-	-	-	-	-	-
	3-1/2	0.90	0.84	-	-	-	-	-	-	-	-	-
	4	0.95	0.87	-	-	-	-	-	-	-	-	-
	4-1/4	0.98	0.89	-	-	-	0.72	-	-	-	-	-
	4-1/2	1.00	0.90	0.91	-	-	0.73	-	-	-	-	-
	5	1.00	0.94	0.94	0.79	-	0.75	-	-	-	-	-
	5-1/2	1.00	0.97	0.97	0.81	-	0.77	-	-	-	-	-
	6	1.00	1.00	1.00	0.83	0.88	0.79	0.87	-	-	-	-
	6-1/2	1.00	1.00	1.00	0.86	0.90	0.80	0.89	0.79	0.85	-	-
	7	1.00	1.00	1.00	0.88	0.93	0.82	0.91	0.81	0.87	-	-
	7-1/2	1.00	1.00	1.00	0.90	0.96	0.84	0.93	0.82	0.89	-	-
	8	1.00	1.00	1.00	0.92	0.99	0.86	0.95	0.83	0.91	0.84	0.82
	8-1/2	1.00	1.00	1.00	0.94	1.00	0.88	0.97	0.85	0.93	0.85	0.83
	9	1.00	1.00	1.00	0.97	1.00	0.89	0.99	0.86	0.94	0.87	0.84
	9-1/2	1.00	1.00	1.00	0.99	1.00	0.91	1.00	0.87	0.96	0.89	0.85
	10	1.00	1.00	1.00	1.00	1.00	0.93	1.00	0.89	0.98	0.90	0.86
	10-1/2	1.00	1.00	1.00	1.00	1.00	0.95	1.00	0.90	1.00	0.92	0.87
	11	1.00	1.00	1.00	1.00	1.00	0.96	1.00	0.91	1.00	0.93	0.88
	11-1/2	1.00	1.00	1.00	1.00	1.00	0.98	1.00	0.93	1.00	0.95	0.90
	12	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.94	1.00	0.96	0.91
	12-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	0.98	0.92
	13	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97	1.00	1.00	0.93
	13-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	1.00	1.00	0.94
	14	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00	1.00	0.95
	14-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96
	15	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97
	15-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99
	16	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

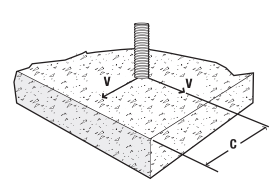
	Dia. (in)	1/4	3/8	1/2	1/2	5/8	5/8	3/4	3/4	7/8	1	1-1/4
	h_{nom} (in.)	1-3/4	2-3/8	2-1/2	3-3/4	3-3/8	4-5/8	4	5-5/8	4-1/2	5-1/2	6-1/2
	c_{ac} (in.)	3-1/2	6-1/2	8	8	6	10	11	16	11-1/2	12	20
	c_{min} (in.)	1-3/4	2-1/4	3-1/4	2-3/4	5-1/2	4-1/4	5	6	7	8	8
Edge Distance (inches)	1-3/4	0.50	-	-	-	-	-	-	-	-	-	-
	2	0.57	-	-	-	-	-	-	-	-	-	-
	2-1/4	0.64	0.35	-	-	-	-	-	-	-	-	-
	2-1/2	0.71	0.38	-	-	-	-	-	-	-	-	-
	2-3/4	0.79	0.42	-	0.34	-	-	-	-	-	-	-
	3	0.86	0.46	-	0.38	-	-	-	-	-	-	-
	3-1/4	0.93	0.50	0.41	0.41	-	-	-	-	-	-	-
	3-1/2	1.00	0.54	0.44	0.44	-	-	-	-	-	-	-
	4	1.00	0.62	0.50	0.50	-	-	-	-	-	-	-
	4-1/4	1.00	0.65	0.53	0.53	-	0.43	-	-	-	-	-
	4-1/2	1.00	0.69	0.56	0.56	-	0.45	-	-	-	-	-
	5	1.00	0.77	0.63	0.63	-	0.50	0.45	-	-	-	-
	5-1/2	1.00	0.85	0.69	0.69	0.92	0.55	0.50	-	-	-	-
	6	1.00	0.92	0.75	0.75	1.00	0.60	0.55	0.38	-	-	-
	6-1/2	1.00	1.00	0.81	0.81	1.00	0.65	0.59	0.41	-	-	-
	7	1.00	1.00	0.88	0.88	1.00	0.70	0.64	0.44	0.61	-	-
	7-1/2	1.00	1.00	0.94	0.94	1.00	0.75	0.68	0.47	0.65	-	-
	8	1.00	1.00	1.00	1.00	1.00	0.80	0.73	0.50	0.70	0.67	0.40
	8-1/2	1.00	1.00	1.00	1.00	1.00	0.85	0.77	0.53	0.74	0.71	0.43
	9	1.00	1.00	1.00	1.00	1.00	0.90	0.82	0.56	0.78	0.75	0.45
	9-1/2	1.00	1.00	1.00	1.00	1.00	0.95	0.86	0.59	0.83	0.79	0.48
	10	1.00	1.00	1.00	1.00	1.00	1.00	0.91	0.63	0.87	0.83	0.50
	10-1/2	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.66	0.91	0.88	0.53
	11	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.69	0.96	0.92	0.55
	11-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.72	1.00	0.96	0.58
	12	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.75	1.00	1.00	0.60
	12-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.78	1.00	1.00	0.63
	13	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.81	1.00	1.00	0.65
	13-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.84	1.00	1.00	0.68
	14	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.88	1.00	1.00	0.70
	14-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.91	1.00	1.00	0.73
	15	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.94	1.00	1.00	0.75
	15-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97	1.00	1.00	0.78
	16	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.80
	16-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.83
	17	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.85
	17-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.88
	18	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.90
	18-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.93
	19	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95
	19-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98
	20	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Spacing Distance and Edge Distance Shear (F_{VS}, F_{VC}) Adjustment Factors for Normal-Weight Concrete

Dia. (in)	1/4	3/8	1/2	1/2	5/8	5/8	3/4	3/4	7/8	1	1-1/4
h_{nom} (in.)	1-3/4	2-3/8	2-1/2	3-3/4	3-3/8	4-5/8	4	5-5/8	4-1/2	5-1/2	6-1/2
s_{min} (in.)	2-1/4	3-1/2	4-1/2	5	6	4-1/4	6	6-1/2	6-1/2	8	8
Spacing Distance (inches)											
2-1/4	0.85	-	-	-	-	-	-	-	-	-	-
2-1/2	0.87	-	-	-	-	-	-	-	-	-	-
2-3/4	0.88	-	-	-	-	-	-	-	-	-	-
3	0.90	-	-	-	-	-	-	-	-	-	-
3-1/2	0.93	0.90	-	-	-	-	-	-	-	-	-
4	0.97	0.92	-	-	-	-	-	-	-	-	-
4-1/4	0.98	0.93	-	-	-	0.82	-	-	-	-	-
4-1/2	1.00	0.94	0.95	-	-	0.82	-	-	-	-	-
5	1.00	0.96	0.97	0.86	-	0.83	-	-	-	-	-
5-1/2	1.00	0.98	0.98	0.87	-	0.85	-	-	-	-	-
6	1.00	1.00	1.00	0.89	0.91	0.86	0.92	-	-	-	-
6-1/2	1.00	1.00	1.00	0.90	0.93	0.87	0.93	0.88	0.91	-	-
7	1.00	1.00	1.00	0.92	0.95	0.88	0.94	0.88	0.92	-	-
7-1/2	1.00	1.00	1.00	0.93	0.97	0.89	0.96	0.89	0.93	-	-
8	1.00	1.00	1.00	0.95	0.99	0.90	0.97	0.90	0.94	0.90	0.89
8-1/2	1.00	1.00	1.00	0.96	1.00	0.92	0.98	0.91	0.96	0.91	0.90
9	1.00	1.00	1.00	0.98	1.00	0.93	0.99	0.92	0.97	0.92	0.91
9-1/2	1.00	1.00	1.00	0.99	1.00	0.94	1.00	0.92	0.98	0.93	0.91
10	1.00	1.00	1.00	1.00	1.00	0.95	1.00	0.93	0.99	0.94	0.92
10-1/2	1.00	1.00	1.00	1.00	1.00	0.96	1.00	0.94	1.00	0.95	0.93
11	1.00	1.00	1.00	1.00	1.00	0.98	1.00	0.95	1.00	0.96	0.93
11-1/2	1.00	1.00	1.00	1.00	1.00	0.99	1.00	0.96	1.00	0.97	0.94
12	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96	1.00	0.98	0.95
12-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97	1.00	0.99	0.95
13	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	1.00	1.00	0.96
13-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00	1.00	0.97
14	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97
14-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98
15	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99
15-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99
16	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Dia. (in)	1/4	3/8	1/2	1/2	5/8	5/8	3/4	3/4	7/8	1	1-1/4
h_{nom} (in.)	1-3/4	2-3/8	2-1/2	3-3/4	3-3/8	4-5/8	4	5-5/8	4-1/2	5-1/2	6-1/2
c_{min} (in.)	1-3/4	2-1/4	3-1/4	2-3/4	5-1/2	4-1/4	5	6	7	8	8
Edge Distance (inches)											
1-3/4	0.39	-	-	-	-	-	-	-	-	-	-
2	0.44	-	-	-	-	-	-	-	-	-	-
2-1/4	0.50	0.38	-	-	-	-	-	-	-	-	-
2-1/2	0.56	0.42	-	-	-	-	-	-	-	-	-
2-3/4	0.61	0.46	-	0.28	-	-	-	-	-	-	-
3	0.67	0.50	-	0.31	-	-	-	-	-	-	-
3-1/4	0.72	0.54	0.54	0.33	-	-	-	-	-	-	-
3-1/2	0.78	0.58	0.58	0.36	-	-	-	-	-	-	-
4	0.89	0.67	0.67	0.41	-	-	-	-	-	-	-
4-1/4	0.94	0.71	0.71	0.44	-	0.35	-	-	-	-	-
4-1/2	1.00	0.75	0.75	0.46	-	0.38	-	-	-	-	-
5	1.00	0.83	0.83	0.51	-	0.42	0.53	-	-	-	-
5-1/2	1.00	0.92	0.92	0.56	0.67	0.46	0.59	-	-	-	-
6	1.00	1.00	1.00	0.62	0.73	0.50	0.64	0.42	-	-	-
6-1/2	1.00	1.00	1.00	0.67	0.79	0.54	0.69	0.46	-	-	-
7	1.00	1.00	1.00	0.72	0.85	0.58	0.75	0.49	0.67	-	-
7-1/2	1.00	1.00	1.00	0.77	0.91	0.63	0.80	0.53	0.71	-	-
8	1.00	1.00	1.00	0.82	0.97	0.67	0.85	0.56	0.76	0.61	0.50
8-1/2	1.00	1.00	1.00	0.87	1.00	0.71	0.91	0.60	0.81	0.65	0.53
9	1.00	1.00	1.00	0.92	1.00	0.75	0.96	0.63	0.86	0.69	0.56
9-1/2	1.00	1.00	1.00	0.97	1.00	0.79	1.00	0.67	0.90	0.72	0.59
10	1.00	1.00	1.00	1.00	1.00	0.83	1.00	0.70	0.95	0.76	0.62
10-1/2	1.00	1.00	1.00	1.00	1.00	0.88	1.00	0.74	1.00	0.80	0.65
11	1.00	1.00	1.00	1.00	1.00	0.92	1.00	0.77	1.00	0.84	0.68
11-1/2	1.00	1.00	1.00	1.00	1.00	0.96	1.00	0.81	1.00	0.88	0.71
12	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.84	1.00	0.91	0.74
12-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.88	1.00	0.95	0.78
13	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.91	1.00	0.99	0.81
13-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.84
14	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	1.00	1.00	0.87
14-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.90
15	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.93
15-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96
16	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99
16-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

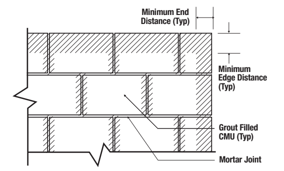




Ultimate and Allowable Load Capacities in Tension for Power-Stud+ SD1 in Grout Filled Concrete Masonry Wall Faces[1,2,3,4,5,6,7]

CODE LISTED
ICC-ES ESR-2966

Nominal Anchor Diameter in.	Nominal Drill Bit Diameter in.	Min. Embed. Depth in. (mm)	Min. Edge Distance in. (mm)	Min. End Distance in. (mm)	Installation Torque T_{inst} ft-lbf (N-m)	Grout-Filled Concrete Masonry			
						f'm = 1,500 psi		f'm = 2,000 psi	
						Ultimate Load Tension lbs. (kN)	Allowable Load Tension lbs. (kN)	Ultimate Load Tension lbs. (kN)	Allowable Load Tension lbs. (kN)
3/8	3/8 ANSI	2-3/8 (60.3)	4 (101.6)	4 (101.6)	20 (27)	2,225 (10.0)	445 (2.0)	2,670 (12.0)	535 (2.4)
1/2	1/2 ANSI	2-1/2 (63.5)	4 (101.6)	4 (101.6)	40 (54)	2,650 (11.9)	530 (2.4)	3,180 (14.3)	635 (2.9)
5/8	5/8 ANSI	3-3/8 (85.7)	4 (101.6)	4 (101.6)	50 (68)	3,525 (15.9)	705 (3.2)	4,230 (19.0)	845 (3.8)
3/4	3/4 ANSI	3-3/8 (85.7)	12 (304.8)	12 (304.8)	80 (108)	7,575 (33.7)	1,515 (6.7)	8,175 (36.4)	1,635 (7.3)
			20 (508.0)	20 (508.0)	80 (108)	7,575 (33.7)	1,515 (6.7)	8,175 (36.4)	1,635 (7.3)
		4-3/4 (120.7)	12 (304.8)	12 (304.8)	80 (108)	7,580 (34.1)	1,515 (6.8)	8,755 (39.4)	1,750 (7.9)



Wall Face
Permissible Anchor Locations
(Un-hatched Area)

1. Tabulated load values for 3/8", 1/2" and 5/8" diameter anchors are installed in minimum 6" wide, Grade N, Type II, lightweight, medium-weight or normal-weight concrete masonry units conforming to ASTM C 90. Mortar must be minimum Type N. Masonry compressive strength must be at specified minimum at the time of installation.
2. Tabulated load values for 3/4" diameter anchors are installed in minimum 8" wide, Grade N, Type II, lightweight, medium-weight or normal-weight concrete masonry units conforming to ASTM C 90. Mortar must be minimum Type N. Masonry compressive strength must be at specified minimum at the time of installation.
3. Allowable load capacities listed are calculated using an applied safety factor of 5.0.
4. The tabulated values are applicable for anchors installed into grouted masonry wall faces at a critical spacing distance, s_{cr}, between anchors of 16 times the anchor diameter. The spacing distance between two anchors may be reduced to minimum distance, s_{min}, of 8 times the anchor diameter provided the allowable tension loads are multiplied by a reduction factor 0.80 and allowable shear loads are multiplied by a reduction factor of 0.90. Linear interpolation for calculation of allowable loads may be used for intermediate anchor spacing distances.
5. Anchors may be installed in the grouted cells and in cell webs and bed joints not closer than 1-3/8" from head joints. The minimum edge and end distances must also be maintained.
6. Allowable tension values for anchors installed into bed joints of grouted masonry wall faces with a minimum of 12" edge distance and end distance may be increased by 20 percent for the 1/2-inch diameter and 10 percent for the 5/8-inch diameter.
7. 3/4 inch diameter anchor not included in ICC-ES ESR-2966.

Ultimate and Allowable Load Capacities in Shear for Power-Stud+ SD1 in Grout Filled Concrete Masonry Wall Faces[1,2,3,4,5,6]

CODE LISTED
ICC-ES ESR-2966

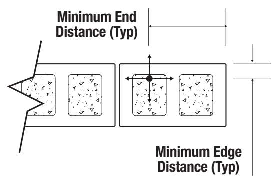
Nominal Anchor Diameter in.	Nominal Drill Bit Diameter in.	Min. Embed. Depth in. (mm)	Min. Edge Distance in. (mm)	Min. End Distance in. (mm)	Direction of Loading	Installation Torque T_{inst} ft-lbf (N-m)	Grout-Filled Concrete Masonry			
							f'm = 1,500 psi		f'm = 2,000 psi	
							Ultimate Load Shear lbs. (kN)	Allowable Load Shear lbs. (kN)	Ultimate Load Shear lbs. (kN)	Allowable Load Shear lbs. (kN)
3/8	3/8 ANSI	2-3/8 (60.3)	4 (101.6)	4 (101.6)	Perpendicular or parallel to wall edge or end	20 (27)	2,975 (13.4)	595 (2.7)	3,570 (16.1)	715 (3.2)
1/2	1/2 ANSI	2-1/2 (63.5)	4 (101.6)	12 (304.8)	Perpendicular or parallel to wall edge or end	40 (54)	2,800 (12.6)	560 (2.5)	3,360 (15.1)	670 (3.0)
			12 (304.8)	4 (101.6)	Parallel to wall end		4,025 (18.1)	805 (3.6)	4,830 (21.7)	965 (4.3)
			4 (101.6)	12 (304.8)	Parallel to wall edge					
5/8	5/8 ANSI	3-3/8 (85.7)	4 (101.6)	4 (101.6)	Perpendicular or parallel to wall edge or end	50 (68)	3,425 (15.4)	685 (3.1)	4,110 (18.5)	820 (3.7)
			12 (304.8)	4 (101.6)	Parallel to wall end		5,325 (24.0)	1,065 (4.8)	6,390 (28.8)	1,280 (5.8)
			4 (101.6)	12 (304.8)	Parallel to wall edge					
3/4	3/4 ANSI	3-3/8 (85.7)	12 (304.8)	12 (304.8)	Perpendicular or parallel to wall edge or end	80 (108)	8,850 (39.4)	1,770 (7.9)	9,375 (41.7)	1,875 (8.3)
			20 (508.0)	20 (508.0)			10,200 (45.4)	2,040 (9.1)	10,800 (48.0)	2,160 (9.6)
		4-3/4 (120.7)	12 (304.8)	12 (304.8)			12,735 (56.7)	2,545 (11.3)	12,735 (56.7)	2,545 (11.3)

1. Tabulated load values for 3/8", 1/2" and 5/8" diameter anchors are installed in minimum 6" wide, Grade N, Type II, lightweight, medium-weight or normal-weight concrete masonry units conforming to ASTM C 90. Mortar must be minimum Type N. Masonry compressive strength must be at specified minimum at the time of installation.
2. Tabulated load values for 3/4" diameter anchors are installed in minimum 8" wide, Grade N, Type II, lightweight, medium-weight or normal-weight concrete masonry units conforming to ASTM C 90. Mortar must be minimum Type N. Masonry compressive strength must be at specified minimum at the time of installation.
3. Allowable load capacities listed are calculated using an applied safety factor of 5.0.
4. The tabulated values are applicable for anchors installed into grouted masonry wall faces at a critical spacing distance, s_{cr}, between anchors of 16 times the anchor diameter. The spacing distance between two anchors may be reduced to minimum distance, s_{min}, of 8 times the anchor diameter provided the allowable tension loads are multiplied by a reduction factor 0.80 and allowable shear loads are multiplied by a reduction factor of 0.90. Linear interpolation for calculation of allowable loads may be used for intermediate anchor spacing distances.
5. Anchors may be installed in the grouted cells and in cell webs and bed joints not closer than 1-3/8" from head joints. The minimum edge and end distances must also be maintained.
6. 3/4 inch diameter anchor not included in ICC-ES ESR-2966.

Ultimate and Allowable Load Capacities in Tension for Power-Stud+ SD1 in Grout Filled Concrete Masonry Wall Tops[1,2,3,4]

CODE LISTED ICC-ES ESR-2966 ALLOWABLE STRESS DESIGN ASD

Nominal Anchor Diameter in.	Nominal Drill Bit Diameter in.	Minimum Embed. Depth in. (mm)	Min. Edge Distance in. (mm)	Min. End Distance in. (mm)	Installation Torque T_{inst} ft-lbf (N-m)	Grout-Filled Concrete Masonry			
						f'm = 1,500 psi		f'm = 2,000 psi	
						Ultimate Load Tension lbs. (kN)	Allowable Load Tension lbs. (kN)	Ultimate Load Tension lbs. (kN)	Allowable Load Tension lbs. (kN)
3/8	3/8 ANSI	2-3/8 (60.3)	1-3/4 (44.5)	12 (304.8)	20 (27)	1,475 (6.6)	295 (1.3)	1,770 (8.0)	355 (1.6)
1/2	1/2 ANSI	2-1/2 (63.5)	2-1/4 (57.1)		40 (54)	2,225 (9.9)	445 (2.0)	2,575 (11.5)	515 (2.3)
		5 (127)				3,425 (15.4)	685 (3.1)	4,110 (18.5)	820 (3.7)
5/8	5/8 ANSI	3-3/8 (85.7)			50 (68)	3,825 (17.2)	765 (3.4)	4,590 (20.7)	920 (4.1)



Top of Wall

1. Tabulated load values are for anchors installed in minimum 8-inch wide, minimum Grade N, Type II, lightweight, medium-weight or normal-weight concrete masonry units conforming to ASTM C 90. Mortar must be minimum Type N. Masonry compressive strength must be at the specified minimum at the time of installation.
2. Allowable load capacities listed are calculated using and applied safety factor of 5.0. Consideration of safety factors of 10 or higher may be necessary depending upon the application such as life safety.
3. Anchors must be installed in the grouted cells and the minimum edge and end distances must be maintained.
4. The tabulated values are applicable for anchors installed in top of grouted masonry walls at a critical spacing distance, s_{cr}, between anchors of 16 times the anchor diameter.

Ultimate and Allowable Load Capacities in Shear for Power-Stud+ SD1 in Grout Filled Concrete Masonry Wall Tops[1,2,3,4]

CODE LISTED ICC-ES ESR-2966 ALLOWABLE STRESS DESIGN ASD

Nominal Anchor Diameter in.	Nominal Drill Bit Diameter in.	Minimum Embed. Depth in. (mm)	Min. Edge Distance in. (mm)	Min. End Distance in. (mm)	Direction of Loading	Installation Torque T_{inst} ft-lbf (N-m)	Grout-Filled Concrete Masonry			
							f'm = 1,500 psi		f'm = 2,000 psi	
							Ultimate Load Shear lbs. (kN)	Allowable Load Shear lbs. (kN)	Ultimate Load Shear lbs. (kN)	Allowable Load Shear lbs. (kN)
3/8	3/8 ANSI	2-3/8 (60.3)	1-3/4 (44.5)	12 (304.8)	Perpendicular to wall toward minimum edge	20 (27)	1,150 (5.2)	230 (1.0)	1,380 (6.2)	275 (1.2)
					Parallel to wall edge		2,425 (10.9)	485 (2.2)	2,910 (13.1)	580 (2.6)
1/2	1/2 ANSI	2-1/2 (63.5)	2-1/4 (57.1)	12 (304.8)	Any	40 (54)	1,150 (5.2)	230 (1.0)	1,380 (6.2)	275 (1.2)
		5 (127)			Perpendicular to wall toward minimum edge		1,400 (6.3)	280 (1.3)	1,680 (7.6)	325 (1.5)
					Parallel to wall edge		2,825 12.7	565 (2.5)	3,390 (15.3)	680 (3.1)
5/8	5/8 ANSI	3-3/8 (85.7)	2-1/4 (57.1)	12 (304.8)	Any	50 (68)	1,150 (5.2)	230 (1.0)	1,380 (6.2)	275 (1.2)
		6-1/4 (158.8)			Perpendicular to wall toward minimum edge		1,700 (7.7)	340 (1.5)	2,040 (9.2)	410 (1.8)
					Parallel to wall edge		3,525 (15.9)	705 (3.2)	4,230 (19.0)	845 (3.8)

1. Tabulated load values are for anchors installed in minimum 6-inch wide, minimum Grade N, Type II, lightweight, medium-weight or normal-weight concrete masonry units conforming to ASTM C 90. Mortar must be minimum Type N. Masonry compressive strength must be at the specified minimum at the time of installation.
2. Allowable load capacities listed are calculated using an applied safety factor of 5.0. Consideration of safety factors of 10 or higher may be necessary depending upon the application such as life safety.
3. Anchors must be installed in the grouted cells and the minimum edge and end distances must be maintained.
4. The tabulated values are applicable for anchors installed in top of grouted masonry walls at a critical spacing distance, s_{cr}, between anchors of 16 times the anchor diameter.

STRENGTH DESIGN (SD)

Power-Stud+ SD1 Anchor Installation Specifications in Concrete[1]

CODE LISTED ICC-ES ESR-2818

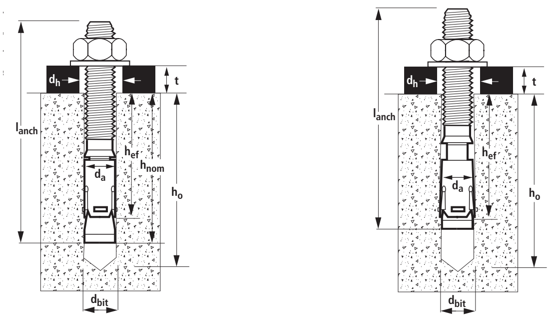
STRENGTH DESIGN SD TABLES

Anchor Property / Setting Information	Notation	Units	Nominal Anchor Diameter															
			1/4 inch	3/8 inch			1/2 inch				5/8 inch			3/4 inch		7/8 inch	1 inch	1-1/4 inch
Anchor diameter	d_a	in. (mm)	0.250 (6.4)	0.375 (9.5)			0.500 (12.7)				0.625 (15.9)			0.750 (19.1)		0.875 (22.2)	1.000 (25.4)	1.250 (31.8)
Minimum diameter of hole clearance in fixture	d_h	in. (mm)	5/16 (7.5)	7/16 (11.1)			9/16 (14.3)				11/16 (17.5)			13/16 (20.6)		1 (25.4)	1-1/8 (28.6)	1-3/8 (34.9)
Nominal drill bit diameter	d_{bit}	in.	1/4 ANSI	3/8 ANSI			1/2 ANSI				5/8 ANSI			3/4 ANSI		7/8 ANSI	1 ANSI	1-1/4 ANSI
Nominal embedment depth	h_{nom}	in. (mm)	1-3/4 (44)	2-3/8 (60)			2-1/2 (64)		3-3/4 (95)		3-3/8 (86)		4-5/8 (117)	4 (102)	5-5/8 (143)	4-1/2 (114)	5-1/2 (140)	6-1/2 (165)
Effective embedment depth	h_{ef}	in. (mm)	1.50 (38)	2.00 (51)			2.00 (51)		3.25 (83)		2.75 (70)		4.00 (102)	3.125 (79)	4.75 (114)	3.50 (89)	4.375 (111)	5.375 (137)
Minimum hole depth	h_{hole}	in. (mm)	1-7/8 (48)	2-1/2 (64)			2-3/4 (70)		4 (102)		3-3/4 (95)		5 (127)	4-1/4 (108)	5-7/8 (149)	4-7/8 (124)	5-7/8 (149)	7-1/4 (184)
Minimum overall anchor length[2]	ℓ_{anch}	in. (mm)	2-1/4 (57)	3 (76)			3-3/4 (95)		4-1/2 (114)		4-1/2 (114)		6 (152)	5-1/2 (140)	7 (178)	8 (203)	9 (229)	9 (229)
Installation torque[6]	T_{inst}	ft.-lbf. (N-m)	4 (5)	20 (27)			40 (54)				80 (108)			110 (149)		175 (237)	225 (305)	375 (508)
Torque wrench/socket size	-	in.	7/16	9/16			3/4				15/16			1-1/8		1-5/16	1-1/2	1-7/8
Nut height	-	in.	7/32	21/64			7/16				35/64			41/64		3/4	55/64	1-1/16
Anchors Installed in Concrete Construction																		
Minimum member thickness	h_{min}	in. (mm)	3-1/4 (83)	3-3/4 (95)		4 (102)	4 (102)		6 (152)		6 (152)		7 (178)	6 (152)	10 (254)	10 (254)	10 (254)	12 (305)
Minimum edge distance	c_{min}	in. (mm)	1-3/4 (45)	6 (152)	2-3/4 (70)	2-1/4 (57)	6 (152)	3-1/4 (95)	4 (102)	2-3/4 (70)	6 (152)	5-1/2 (140)	4-1/4 (108)	5 (127)	6 (152)	7` (178)	8 (203)	8 (203)
Minimum spacing distance	s_{min}	in. (mm)	2-1/4 (57)	3-1/2 (89)	9 (229)	3-3/4 (95)	4-1/2 (114)	10 (254)	5 (127)	6 (152)	6 (152)	11 (270)	4-1/4 (108)	6 (152)	6-1/2 (165)	6-1/2 (165)	8 (203)	8 (203)
Critical edge distance (uncracked concrete only)	c_{ac}	in. (mm)	3-1/2 (89)	6-1/2 (165)			8 (203)		8 (203)		6 (152)		10 (254)	11 (279)	16 (406)	11-1/2 (292)	12 (305)	20 (508)
Anchors Installed in the Topside of Concrete-filled Steel Deck Assemblies[3,4]																		
Minimum member topping thickness	$h_{min,deck}$	in. (mm)	3-1/4 (83)	3-1/4 (83)			3-1/4 (83)		See note 3		See note 3			See note 3		See note 3	See note 3	See note 3
Minimum edge distance	$c_{min,deck,top}$	in. (mm)	1-3/4 (45)	2-3/4 (70)			4-1/2 (114)											
Minimum spacing distance	$s_{min,deck,top}$	in. (mm)	2-1/4 (57)	4 (102)			6-1/2 (165)											
Critical edge distance (uncracked concrete only)	$c_{ac,deck,top}$	in. (mm)	3-1/2 (89)	6-1/2 (165)			6 (152)											
Anchors Installed Through the Soffit of Steel Deck Assemblies into Concrete[5]																		
Minimum member topping thickness (see detail in Figure 2A)	$h_{min,deck}$	in. (mm)	Not Applicable	3-1/4 (95)			3-1/4 (95)				3-1/4 (95)			3-1/4 (95)		Not Applicable	Not Applicable	Not Applicable
Minimum edge distance, lower flute (see detail in Figure 2A)	c_{min}	in. (mm)		1-1/4 (32)			1-1/4 (32)				1-1/4 (32)			1-1/4 (32)				
Minimum axial spacing distance along flute (see detail in Figure 2A)	s_{min}	in. (mm)		6-3/4 (171)			6-3/4 (171)		9-3/4 (248)		8-1/4 (210		12 (305)	9-3/8 (238)	14-1/4 (362)			
Minimum member topping thickness (see detail in Figure 2B)	$h_{min,deck}$	in. (mm)		2-1/4 (57)			2-1/4 (57)				Not Applicable			Not Applicable		Not Applicable	Not Applicable	Not Applicable
Minimum edge distance, lower flute (see detail in Figure 2B)	c_{min}	in. (mm)		3/4 (19)			3/4 (19)											
Minimum axial spacing distance along flute (see detail in Figure 2B)	s_{min}	in. (mm)		6 (152)			6 (152)		9-3/4 (248)									

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

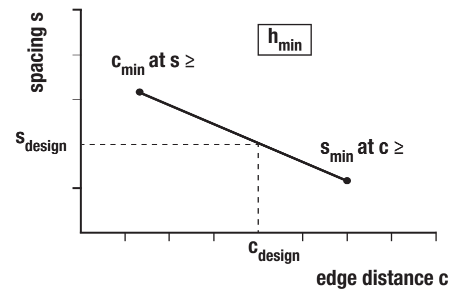
1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable.
2. The listed minimum overall anchor length is based on anchor sizes commercially available at the time of publication compared with the requirements to achieve the minimum nominal embedment depth, nut height and washer thickness, and consideration of a possible fixture attachment.
3. The 1/4 -inch-diameter (6.4 mm) anchors may be installed in the topside of uncracked concrete-filled steel deck assemblies where concrete thickness above the upper flute meets the minimum member thicknesses specified in this table. The 3/8 -inch (9.5 mm) through 1-1/4 -inch-diameter (31.8 mm) anchors may be installed in the topside of cracked and uncracked concrete-filled steel deck assemblies where concrete thickness above the upper flute meets the minimum member thicknesses specified in this table under Anchors Installed in Concrete Construction.
4. For installations in the topside of concrete-filled steel deck assemblies, see the installation detail in Figure 1.
5. For installations through the soffit of steel deck assemblies into concrete, see the installation details in Figures 2A and 2B. In accordance with the figures, anchors shall have an axial spacing along the flute equal to the greater of $3h_{ef}$ or 1.5 times the flute width.
6. For installation of 5/8 -inch diameter anchors through the soffit of the steel deck into concrete, the installation torque is 50 ft.-lbf. For installation of 3/4-inch-diameter anchors through the soffit of the steel deck into concrete, installation torque is 80 ft.-lbf.

Power-Stud+ SD1 Anchor Detail



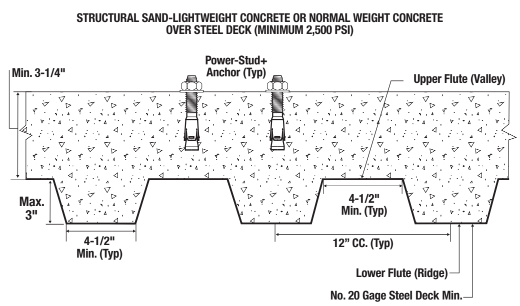
Application of Installation Torque

Interpolation of Minimum Edge Distance and Anchor Spacing



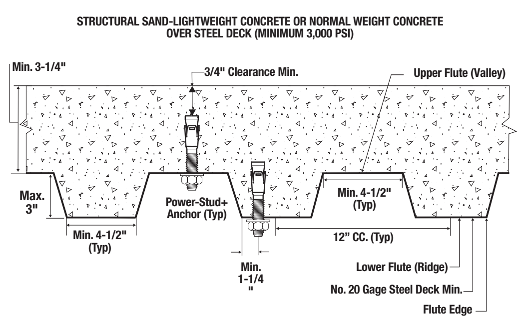
This interpolation applies to the cases when two sets of minimum edge distances, c_{min}, and minimum spacing distances, s_{min}, are given in the SD Installation Specifications for Concrete table for a given anchor diameter under the same effective embedment depth, h_{ef}, and corresponding minimum member thickness, h_{min}.

Figure 1 - Power-Stud+ SD1 Installation Detail for Anchors in the Topside Of Concrete Filled Steel Deck Floor and Roof Assemblies (See Dimensional Profile Requirements)



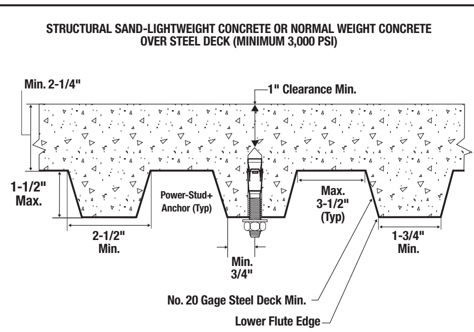
Anchors may be placed in the topside of steel deck profiles in accordance with Figure 1 provided the minimum member topping thickness, minimum spacing distance and minimum edge distance are satisfied as given in Installation Specifications.

Figure 2A - Power-Stud+ SD1 Installation Detail for Anchors in the Soffit Of Concrete Over Steel Deck Floor and Roof Assemblies (See Dimensional Profile Requirements)



Anchors may be placed in the upper flute or lower flute of the steel deck profiles in accordance with Figure 2A provided the minimum hole clearance is satisfied. Anchors in the lower flute of Figure 2A profiles may be installed with a maximum 1-inch offset in either direction from the center of the flute. The offset distance may be increased proportionally for profiles with lower flute widths greater than those shown provided the minimum lower flute edge distance is also satisfied. In addition, the anchors must have an axial spacing along the flute equal to the greater of $3h_{ef}$ or 1.5 times the flute width.

Figure 2B - Power-Stud+ SD1 Installation Detail for Anchors in the Soffit Of Concrete Over Steel Deck Floor and Roof Assemblies (See Dimensional Profile Requirements)



Anchors may be placed in the lower flute of the steel deck profiles in accordance with Figure 2B provided the minimum hole clearance is satisfied. Anchors in the lower flute of Figure 2B profiles may be installed with a maximum 1/8-inch offset in either direction from the center of the flute. The offset distance may be increased proportionally for profiles with lower flute widths greater than those shown provided the minimum lower flute edge distance is also satisfied. In addition, the anchors must have an axial spacing along the flute equal to the greater of $3h_{ef}$ or 1.5 times the flute width. Anchors may be placed in the upper flute of the steel deck profiles in accordance with Figure 2B provided the concrete thickness above the upper flute is minimum 3-1/4-inch and a minimum hole clearance of 3/4-inch is satisfied.

Tension Design Information for Power-Stud+ SD1 Anchor in Concrete (For use with load combinations taken from ACI 318-14, Section 5.3 or ACI 318-11, Section 9.2)[1,2]

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ICC-ES ESR-2818

STRENGTH DESIGN TABLES SD

Design Characteristic	Notation	Units	Nominal Anchor Diameter										
			1/4 inch	3/8 inch	1/2 inch		5/8 inch		3/4 inch		7/8 inch	1 inch	1-1/4 inch
Anchor category	1, 2 or 3	-	1	1	1		1		1		1	1	1
STEEL STRENGTH IN TENSION[4]													
Minimum specified yield strength	f_{ya}	ksi (N/mm²)	88.0 (606)	88.0 (606)	80.0 (551)		80.0 (551)		64.0 (441)		58.0 (400)	58.0 (400)	58.0 (400)
Minimum specified ultimate tensile strength (neck)	f_{uta}[12]	ksi (N/mm²)	110.0 (758)	110.0 (758)	100.0 (689)		100.0 (689)		80.0 (552)		75.0 (517)	75.0 (517)	75.0 (517)
Effective tensile stress area (neck)	$A_{se,N}$	in² (mm²)	0.0220 (14.2)	0.0531 (34.3)	0.1018 (65.7)		0.1626 (104.9)		0.2376 (150.9)		0.327 (207.5)	0.430 (273.1)	0.762 (484)
Steel strength in tension[4]	N_{sa}[12]	lb (kN)	2,255 (10.0)	5,455 (24.3)	9,080 (40.4)		14,465 (64.3)		19,000 (84.5)		24,500 (109.0)	32,250 (143.5)	56,200 (250)
Reduction factor for steel strength[3]	ϕ	-	0.75										
CONCRETE BREAKOUT STRENGTH IN TENSION[8]													
Effective embedment depth	h_{ef}	in. (mm)	1.50 (38)	2.00 (51)	2.00 (51)	3.25 (83)	2.75 (70)	4.00 (102)	3.125 (79)	4.75 (114)	3.50 (89)	4.375 (111)	5.375 (137)
Effectiveness factor for uncracked concrete	k_{uncr}	-	24	24	24		24		24	24	24	24	27
Effectiveness factor for cracked concrete	k_{cr}	-	Not Applicable	17	17		17		21	17	21	24	24
Modification factor for cracked and uncracked concrete[5]	$\Psi_{c,N}$[12]	-	1.0	1.0	1.0		1.0		1.0		1.0	1.0	1.0
Critical edge distance (uncracked concrete only)	c_{ac}	in. (mm)	See Installation Specifications										
Reduction factor for concrete breakout strength[3]	ϕ	-	0.65 (Condition B)										
PULLOUT STRENGTH IN TENSION (NON SEISMIC-APPLICATIONS)[8,9]													
Characteristic pullout strength, uncracked concrete (2,500 psi)[6]	$N_{p,uncr}$	lb (kN)	See note 7	2,865 (12.8)	3,220 (14.3)	5,530 (24.6)	See note 7	See note 7	See note 7		See note 7	See note 7	See note 7
Characteristic pullout strength, cracked concrete (2,500 psi)[6]	$N_{p,cr}$	lb (kN)	Not Applicable	2,035 (9.1)	See note 7	2,505 (11.2)	See note 7	4,450 (19.8)	See note 7		See note 7	See note 7	11,350 (50.5)
Reduction factor for pullout strength[3]	ϕ	-	0.65 (Condition B)										
PULLOUT STRENGTH IN TENSION FOR SEISMIC APPLICATIONS[8,9]													
Characteristic pullout strength, seismic (2,500 psi)[6,10]	$N_{p,eq}$[12]	lb (kN)	Not Applicable	2,035 (9.1)	See note 7	2,505 (11.2)	See note 7	4,450 (19.8)	See note 7		See note 7	See note 7	11,350 (50.5)
Reduction factor for pullout strength, seismic[3]	ϕ	-	0.65 (Condition B)										
PULLOUT STRENGTH IN TENSION FOR ANCHORS INSTALLED THROUGH THE SOFFIT OF SAND-LIGHTWEIGHT AND NORMAL-WEIGHT CONCRETE OVER STEEL DECK													
Characteristic pullout strength, uncracked concrete over steel deck(Figure 2A)[6,11]	$N_{p,deck,uncr}$	lb (kN)	Not Applicable	1,940 (8.6)	3,205 (14.2)		2,795 (12.4)		3,230 (14.4)		Not Applicable	Not Applicable	Not Applicable
Characteristic pullout strength, cracked concrete over steel deck (Figure 2A)[6,11]	$N_{p,deck,cr}$	lb (kN)	Not Applicable	1,375 (6.1)	2,390 (10.6)		1,980 (8.8)		2,825 (12.4)		Not Applicable	Not Applicable	Not Applicable
Characteristic pullout strength, cracked concrete over steel deck, seismic (Figure 2A)[6,11]	$N_{p,deck,eq}$	lb (kN)	Not Applicable	1,375 (6.1)	2,390 (10.6)		1,980 (8.8)		2,825 (12.4)		Not Applicable	Not Applicable	Not Applicable
Characteristic pullout strength, uncracked concrete over steel deck (Figure 2B)[6,11]	$N_{p,deck,uncr}$	lb (kN)	Not Applicable	1,665 (7.4)	1,900 (8.5)		Not Applicable		Not Applicable		Not Applicable	Not Applicable	Not Applicable
Characteristic pullout strength, cracked concrete over steel deck (Figure 2B)[6,11]	$N_{p,deck,cr}$	lb (kN)	Not Applicable	1,180 (5.2)	1,420 (6.3)		Not Applicable		Not Applicable		Not Applicable	Not Applicable	Not Applicable
Characteristic pullout strength, cracked concrete over steel deck, seismic (Figure 2B)[6,11]	$N_{p,deck,eq}$	lb (kN)	Not Applicable	1,180 (5.2)	1,420 (6.3)		Not Applicable		Not Applicable		Not Applicable	Not Applicable	Not Applicable
Reduction factor for pullout strength, steel deck[3]	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 318-14 Chapter 17 or ACI 318 -11 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable, must apply.
2. Installation must comply with published instructions and details.
3. All values of ϕ apply to the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable. If the load combinations of ACI 318-11 Appendix C are used, then the appropriate value of ϕ must be determined in accordance with ACI 318-11 D4.4. For reinforcement that meets ACI 318-14 Chapter 17 or ACI 318-11 Appendix D requirements for Condition A, see ACI 318-14 17.3.3(c) or ACI 318-11 D.4.3(c), as applicable, for the appropriate ϕ factor when the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used.
4. The Power-Stud+ SD1 is considered a ductile steel element as defined by ACI 318-14 2.3 or ACI 318-11 D.1, as applicable. Tabulated values for steel strength in tension are based on test results per ACI 355.2 and must be used for design.
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. For all design cases use $\Psi_{c,P}$ = 1.0. For concrete compressive strength greater than 2,500 psi N_{pn} = (pullout strength from table)*(specified concrete compressive strength/2,500)$^{0.5}$. For concrete over steel deck the value of 2,500 must be replaced with the value of 3,000.
7. Pullout strength does not control design of indicated anchors. Do not calculate pullout strength for indicated anchor size and embedment.
8. 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.
9. For anchors in the topside of concrete-filled steel deck assemblies, see Figure 1.
10. Tabulated values for characteristic pullout strength in tension are for seismic applications and based on test results in accordance with ACI 355.2, Section 9.5.
11. Values for $N_{p,deck}$ are for sand-lightweight concrete (f'c, min = 3,000 psi) and additional lightweight concrete reduction factors need not be applied. In addition, evaluation for the concrete breakout capacity in accordance with ACI 318-14 17.4.2 or ACI 318-11 D.5.2, as applicable, is not required for anchors installed in the deck soffit (flute).

Shear Design Information for Power-Stud+ SD1 Anchor in Concrete (For use with load combinations taken from ACI 318-14, Section 5.3 or ACI 318-11, Section 9.2)[1,2]

CODE LISTED
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STRENGTH DESIGN SD TABLES

Design Characteristic	Notation	Units	Nominal Anchor Diameter										
			1/4 inch	3/8 inch	1/2 inch		5/8 inch		3/4 inch		7/8 inch	1 inch	1-1/4 inch
Anchor category	1, 2 or 3	-	1	1	1		1		1		1	1	1
STEEL STRENGTH IN SHEAR[4]													
Minimum specified yield strength (threads)	f_{ya}	ksi (N/mm^2)	70.0 (482)	80.0 (552)	70.4 (485)		70.4 (485)		64.0 (441)		58.0 (400)	58.0 (400)	58.0 (400)
Minimum specified ultimate strength (threads)	f_{uta}	ksi (N/mm^2)	88.0 (606)	100.0 (689)	88.0 (607)		88.0 (607)		80.0 (552)		75.0 (517)	75.0 (517)	75.0 (517)
Effective tensile stress area (threads)	$A_{se,V}$	in^2 (mm^2)	0.0318 (20.5)	0.0775 (50.0)	0.1419 (91.5)		0.2260 (145.8)		0.3345 (212.4)		0.462 (293.4)	0.6060 (384.8)	0.969 (615)
Steel strength in shear[5]	V_{sa}	lb (kN)	925 (4.1)	2,990 (13.3)	4,620 (20.6)		9,030 (40.2)		10,640 (47.3)	11,655 (54.8)	8,820 (39.2)	10,935 (48.6)	17,750 (79.0)
Reduction factor for steel strength[3]	ϕ	-	0.65										
CONCRETE BREAKOUT STRENGTH IN SHEAR[6,7]													
Load bearing length of anchor (h_{ef} or $8d_o$, whichever is less)	ℓ_e	in. (mm)	1.50 (38)	2.00 (51)	2.00 (51)	3.25 (83)	2.75 (70)	4.00 (102)	3.125 (79)	4.75 (114)	3.50 (88.9)	4.375 (111)	5.375 (137)
Nominal anchor diameter	d_a	in. (mm)	0.250 (6.4)	0.375 (9.5)	0.500 (12.7)		0.625 (15.9)		0.750 (19.1)		0.875 (22.2)	1.000 (25.4)	1.25 (31.8)
Reduction factor for concrete breakout[3]	ϕ	-	0.70 (Condition B)										
PRYOUT STRENGTH IN SHEAR[6,7]													
Coefficient for pryout strength (1.0 for $h_{ef} < 2.5$ in., 2.0 for $h_{ef} \geq 2.5$ in.)	k_{cp}	-	1.0	1.0	1.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Effective embedment	h_{ef}	in. (mm)	1.50 (38)	2.00 (51)	2.00 (51)	3.25 (83)	2.75 (70)	4.00 (102)	3.125 (79)	4.75 (114)	3.50 (88.9)	4.375 (111)	5.375 (137)
Reduction factor for pryout strength[3]	ϕ	-	0.70 (Condition B)										
STEEL STRENGTH IN SHEAR FOR SEISMIC APPLICATIONS													
Steel strength in shear, seismic[8]	$V_{sa,eq}$	lb (kN)	N/A	2,440 (10.9)	3,960 (17.6)		6,000 (26.7)		8,580 (38.2)	9,635 (42.9)	8,820 (39.2)	9,845 (43.8)	17,750 (79.0)
Reduction factor for steel strength in shear for seismic[3]	ϕ	-	0.65										
STEEL STRENGTH IN SHEAR FOR FOR ANCHORS INSTALLED THROUGH THE SOFFIT OF SAND-LIGHTWEIGHT AND NORMAL-WEIGHT CONCRETE OVER STEEL DECK[9,10]													
Steel strength in shear, concrete over steel deck (Figure 2A)[9]	$V_{sa,deck}$	lb (kN)	Not Applicable	2,120 (9.4)	2,290 (10.2)		3,710 (16.5)		5,505 (24.5)		Not Applicable	Not Applicable	Not Applicable
Steel strength in shear, concrete over steel deck, seismic (Figure 2A)[9]	$V_{sa,deck,eq}$	lb (kN)		2,120 (9.4)	2,290 (10.2)		3,710 (16.5)		4,570 (20.3)				
Steel strength in shear, concrete over steel deck (Figure 2B)[9]	$V_{sa,deck}$	lb (kN)		2,120 (9.4)	2,785 (12.4)		Not Applicable		Not Applicable				
Steel strength in shear, concrete over steel deck, seismic (Figure 2B)[9]	$V_{sa,deck,eq}$	lb (kN)		2,120 (9.4)	2,785 (12.4)								
Reduction factor for steel strength in shear, steel deck[3]	ϕ	-	0.65										

For SI: 1 inch = 25.4 mm; 1 ksi = 6.894 N/mm^2; 1 lbf = 0.0044 kN.

1. The data in this table is intended to be used with the design provisions of ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable, must apply.
2. Installation must comply with published instructions and details.
3. All values of ϕ were determined from the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2. If the load combinations of ACI 318-11 Appendix C are used, then the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4. For reinforcement that meets ACI 318-14 Chapter 17 or ACI 318-11 Appendix D requirements for Condition A, see ACI 318-14 17.3.3(c) or ACI 318-11 D.4.3(c), as applicable, for the appropriate ϕ factor when the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used.
4. The Power-Stud+ SD1 is considered a ductile steel element as defined by ACI 318-14 2.3 or ACI 318-11 D.1, as applicable.
5. Tabulated values for steel strength in shear must be used for design. These tabulated values are lower than calculated results using equation D-20 in ACI 318-08.
6. 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.
7. For anchors in the topside of concrete-filled steel deck assemblies, see Figure 1.
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.
9. Tabulated values for $V_{sa,deck}$ and $V_{sa,deck,eq}$ are for sand-lightweight concrete (f'c, min = 3,000 psi); additional lightweight concrete reduction factors need not be applied. In addition, evaluation for the concrete breakout capacity in accordance with ACI 318-14 17.5.2 or ACI 318-11 D.6.2, as applicable, and the pryout capacity in accordance with ACI 318-14 17.5.3 or ACI 318-11 D.6.3, as applicable, are not required for anchors installed in the deck soffit (flute).
10. Shear loads for anchors installed through steel deck into concrete may be applied in any direction.

STRENGTH DESIGN PERFORMANCE DATA

Factored design strength ϕN_n and ϕV_n
Calculated in accordance with ACI 318-14 Chapter 17
Compliant with the International Building Code

Tension and Shear Design Strengths for Power-Stud+ SD1 in Cracked Concrete[1-6]

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.)
1/4	1-3/4	-	-	-	-	-	-	-	-	-	-
3/8	2-3/8	1,325	1,685	1,450	1,845	1,675	1,945	2,050	1,945	2,365	1,945
1/2	2-1/2	1,565	1,685	1,710	1,845	1,975	2,130	2,420	2,605	2,795	3,005
	3-3/4	1,630	3,005	1,785	3,005	2,060	3,005	2,520	3,005	2,915	3,005
5/8	3-3/8	2,520	3,125	2,760	3,425	3,185	3,955	3,905	4,845	4,505	5,590
	4-5/8	2,895	5,870	3,170	5,870	3,660	5,870	4,480	5,870	5,175	5,870
3/4	4	3,770	6,210	4,130	6,800	4,770	6,915	5,840	6,915	6,735	6,915
	5-5/8	5,720	7,575	6,265	7,575	7,235	7,575	8,860	7,575	10,230	7,575
7/8	4-1/2	4,470	5,735	4,895	5,735	5,655	5,735	6,925	5,735	7,995	5,735
1	5-1/2	7,140	7,110	7,820	7,110	9,030	7,110	11,060	7,110	12,770	7,110
1-1/4	6-1/2	7,380	11,540	8,080	11,540	9,330	11,540	11,430	11,540	13,195	11,540

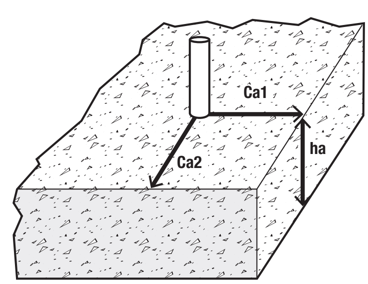
□ - Anchor Pullout/Pryout Strength Controls □ - Concrete Breakout Strength Controls ■ - Steel Strength Controls

Tension and Shear Design Strengths for Power-Stud+ SD1 in Uncracked Concrete[1-6]

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.)
1/4	1-3/4	1,435	600	1,570	600	1,690	600	1,690	600	1,690	600
3/8	2-3/8	1,860	1,945	2,040	1,945	2,335	1,945	2,885	1,945	3,330	1,945
1/2	2-1/2	2,095	2,375	2,295	2,605	2,645	3,005	3,240	3,005	3,745	3,005
	3-3/4	3,595	3,005	3,940	3,005	4,545	3,005	5,570	3,005	6,430	3,005
5/8	3-3/8	3,555	4,375	3,895	4,795	4,500	5,535	5,510	5,870	6,365	5,870
	4-5/8	6,240	5,870	6,835	5,870	7,895	5,870	9,665	5,870	10,850	5,870
3/4	4	4,310	6,915	4,720	6,915	5,450	6,915	6,675	6,915	7,710	6,915
	5-5/8	8,075	7,575	8,845	7,575	10,215	7,575	12,510	7,575	14,250	7,575
7/8	4-1/2	5,105	5,735	5,595	5,735	6,460	5,735	7,910	5,735	9,135	5,735
1	5-1/2	7,140	7,110	7,820	7,110	9,030	7,110	11,060	7,110	12,770	7,110
1-1/4	6-1/2	10,935	11,540	11,980	11,540	13,830	11,540	16,940	11,540	19,560	11,540

□ - Anchor Pullout/Pryout Strength Controls □ - Concrete Breakout Strength Controls ■ - Steel Strength Controls

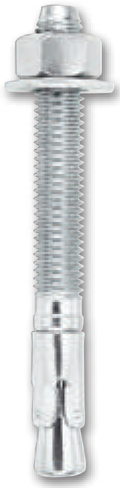
1- Tabular values are provided for illustration and are applicable for single anchors installed in normal-weight concrete with minimum slab thickness, $h_a = h_{min}$, and with the following conditions:
   - c_{a1} is greater than or equal to the critical edge distance, c_{ac} (table values based on $c_{a1} = c_{ac}$).
   - c_{a2} is greater than or equal to 1.5 times c_{a1}.
2- Calculations were performed according to ACI 318-14 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 318-14 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 318-14 Chapter 17.
6- Interpolation is not permitted to be used with the tabular values. For intermediate base material compressive strengths please see ACI 318-14 Chapter 17. For other design conditions including seismic considerations please see ACI 318-14 Chapter 17.



ORDERING INFORMATION

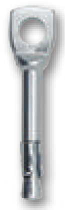
Power-Stud+ SD1 (Carbon Steel Body and Expansion Clip)

Cat. No.	Anchor Size	Thread Length	Box Qty.	Carton Qty.	Wt./100 (lbs.)	ANSI Carbide Drill Bit Cat. No.		
						Full Head Carbide SDS-Plus	Carbide SDS-Plus	Carbide SDS-Max
7400SD1	1/4" x 1-3/4"	3/4"	100	600	3	DW5517	DW5416	-
7402SD1	1/4" x 2-1/4"	1-1/4"	100	600	4	DW5517	DW5417	-
7404SD1	1/4" x 3-1/4"	2-1/4"	100	600	5	DW5517	DW5417	-
7410SD1	3/8" x 2-1/4"	7/8"	50	300	8	DW5527	DW5427	-
7412SD1	3/8" x 2-3/4"	1-3/8"	50	300	9	DW5527	DW5427	-
7413SD1	3/8" x 3"	1-5/8"	50	300	10	DW5527	DW5427	-
7414SD1	3/8" x 3-1/2"	2-1/8"	50	300	12	DW5527	DW5427	-
7415SD1	3/8" x 3-3/4"	2-3/8"	50	300	13	DW5527	DW5427	-
7416SD1	3/8" x 5"	3-5/8"	50	300	15	DW55300	DW5429	-
7417SD1	3/8" x 7"	5-5/8"	50	300	21	DW55300	DW5429	-
7420SD1	1/2" x 2-3/4"	1"	50	200	19	DW5537	DW5437	DW5803
7422SD1	1/2" x 3-3/4"	2"	50	200	23	DW5537	DW5437	DW5803
7423SD1	1/2" x 4-1/2"	2-3/4"	50	200	27	DW5539	DW5438	DW5803
7424SD1	1/2" x 5-1/2"	3-3/4"	50	150	30	DW5539	DW5438	DW5803
7426SD1	1/2" x 7"	5-1/4"	25	100	38	DW5539	DW5438	DW5803
7427SD1	1/2" x 8-1/2"	6-3/4"	25	100	44	DW5539	DW5439	DW5804
7428SD1	1/2" x 10"	8-1/4"	25	100	53	DW5539	DW5439	DW5804
7430SD1	5/8" x 3-1/2"	1-1/2"	25	100	37	-	DW5446	DW5806
7432SD1	5/8" x 4-1/2"	2-1/2"	25	100	43	-	DW5446	DW5806
7433SD1	5/8" x 5"	3"	25	100	47	-	DW5446	DW5806
7434SD1	5/8" x 6"	4"	25	75	53	-	DW5446	DW5806
7436SD1	5/8" x 7"	5"	25	75	60	-	DW5447	DW5806
7438SD1	5/8" x 8-1/2"	6-1/2"	25	50	70	-	DW5447	DW5809
7439SD1	5/8" x 10"	8"	25	75	87	-	DW5447	DW5809
7440SD1	3/4" x 4-1/4"	1-3/4"	20	60	63	-	DW5453	DW5810
7441SD1	3/4" x 4-3/4"	2-1/4"	20	60	68	-	DW5453	DW5810
7442SD1	3/4" x 5-1/2"	3"	20	60	76	-	DW5453	DW5810
7444SD1	3/4" x 6-1/4"	3-3/4"	20	60	83	-	DW5455	DW5810
7446SD1	3/4" x 7"	4-1/2"	20	60	91	-	DW5455	DW5810
7448SD1	3/4" x 8-1/2"	6"	10	40	107	-	DW5455	DW5812
7449SD1	3/4" x 10"	7-1/2"	10	30	123	-	DW5455	DW5812
7451SD1	3/4" x 12"	9-1/2"	10	30	144	-	DW5456	DW5812
7450SD1	7/8" x 6"	2-3/4"	10	20	128	-	-	DW5815
7452SD1	7/8" x 8"	4-3/4"	10	40	161	-	-	DW5815
7454SD1	7/8" x 10"	6-3/4"	10	30	187	-	-	DW5816
7461SD1	1" x 6"	2-3/8"	10	30	168	-	-	DW5818
7463SD1	1" x 9"	5-3/8"	10	30	234	-	-	DW5819
7465SD1	1" x 12"	8-3/8"	5	15	307	-	-	DW5819
7473SD1	1-1/4" x 9"	4-3/4"	5	15	374	-	-	DW5820
7475SD1	1-1/4" x 12"	7-3/4"	5	15	476	-	-	DW5825



Tie Wire Power-Stud+ SD1 (Carbon Steel Body and Expansion clip)

Cat. No.	Anchor Size	Thread Length	Box Qty.	Carton Qty.	Wt./100 (lbs.)
7409SD1	1/4" x 2"	N/A	100	500	3



Installation Accessories

Cat. No.	Description	Box Qty
08280	Hand pump / dust blower	1

Shaded catalog numbers denote sizes which are less than the minimum standard anchor length for strength design.

The published size includes the diameter and the overall length of the anchor.

All anchors are packaged with nuts and washers (not including tie wire version).
See the DEWALT website or Buyers Guide for additional information on carbide drill bits.

GENERAL INFORMATION

POWER-STUD® +SD2

High Performance Wedge Expansion Anchor

PRODUCT DESCRIPTION

The Power-Stud+ SD2 anchor is a fully threaded, torque-controlled, wedge expansion anchor which is designed for consistent performance in cracked and uncracked concrete. Suitable base materials include normal-weight concrete, sand-lightweight concrete and concrete over steel deck. The anchor is manufactured with a zinc plated carbon steel body and stainless steel expansion clip for premium performance.

GENERAL APPLICATIONS AND USES

- Structural connections, i.e., beam and column anchorage
- Utility and safety-related attachments
- Interior applications / low level corrosion environment
- Tension zone applications, i.e., cable trays and strut, pipe supports, fire sprinklers
- Seismic and wind loading
- Medium to heavy duty purposes

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

APPROVALS AND LISTINGS

- International Code Council, Evaluation Service (ICC-ES), ESR-2502 for cracked and uncracked concrete
- Code Compliant with the 2015, IBC, 2015 IRC, 2012 IBC, 2012 IRC, 2009 IBC, and 2009 IRC
- Tested in accordance with ACI 355.2 and ICC-ES AC193 for use in structural concrete under the design provisions of ACI 318-14 Chapter 17 or ACI 318-11/08 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)
- FM Global (Factory Mutual) - File No. 3033795, 3/8" and 1/2" diameters
  Pipe hanger components for automatic sprinkler systems
- Underwriters Laboratories (UL Listed) - File No. EX1289 - See listing

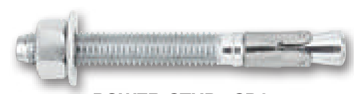
GUIDE SPECIFICATIONS

CSI Divisions: 03 16 00 - Concrete Anchors, 04 05 19.16 - Masonry Anchors and 05 05 09 - Post-Installed Concrete Anchors. Expansion anchors shall be Power-Stud+ SD2 as supplied by DEWALT, Towson, MD. Anchors shall be installed in accordance with published instructions and the Authority Having Jurisdiction.

MATERIAL SPECIFICATIONS

Anchor component	Specification
Anchor Body	Medium carbon steel
Hex nut	Carbon steel, ASTM A 563, Grade A
Washer	Carbon Steel, ASTM F 844; meets dimensional requirements of ANSI B18.22.2. Type A Plain
Expansion wedge (clip)	Type 316 Stainless Steel
Plating (anchor body, nut and washer)	Zinc plating according to ASTM B 633, SC1 Type III (Fe/Zn 5). Minimum plating requirements for Mild Service Condition.

SECTION CONTENTS



POWER-STUD+ SD2
ASSEMBLY

THREAD VERSION

- UNC threaded stud

ANCHOR MATERIALS

- Zinc plated carbon steel body with stainless steel expansion clip, zinc plated carbon steel nut and washer

ANCHOR SIZE RANGE (TYP.)

- 3/8" diameter through 3/4" diameter

SUITABLE BASE MATERIALS

- Normal-weight concrete
- Sand-lightweight concrete
- Concrete over steel deck
- Grouted-filled concrete masonry (CMU)

TENSION ZONE CRACKED CONCRETE

SEISMIC REGION QUALIFICATION

CODE LISTED
ICC-ES ESR-2502
CONCRETE

INSTALLATION SPECIFICATIONS

Installation Table for Power-Stud+ SD2[4]

Anchor Property/ Setting Information	Notation	Units	Nominal Anchor Size 3/8"	1/2"				5/8"			3/4"	
Anchor diameter	d_a	in. (mm)	0.375 (9.5)	0.500 (12.7)				0.625 (15.9)			0.750 (19.1)	
Minimum diameter of hole clearance in fixture	d_h	in. (mm)	7/16 (11.1)	9/16 (14.3)				11/16 (17.5)			13/16 (20.6)	
Nominal drill bit diameter	d_{bit}	in.	3/8 ANSI	1/2 ANSI				5/8 ANSI			3/4 ANSI	
Minimum nominal embedment depth[1]	h_{nom}	in. (mm)	2-3/8 (60)	2-1/2 (64)		3-3/4 (95)		3-7/8 (98)	4-7/8 (124)		4-1/2 (114)	5-3/4 (146)
Effective embedment	h_{ef}	in. (mm)	2 (51)	2 (51)		3-1/4 (83)		3-1/4 (83)	4-1/4 (108)		3-3/4 (95)	5 (127)
Minimum hole depth[2]	h_o	in. (mm)	2-5/8 (67)	2-3/4 (70)		4 (102)		4-1/4 (108)	5-1/4 (133)		5 (127)	6-1/4 (159)
Minimum concrete member thickness	h_{min}	in. (mm)	4 (102)	4-1/2 (114)	6 (152)	5-3/4 (146)	5-3/4 (146)	5-3/4 (146)	6-1/2 (165)	8 (203)	7 (178)	10 (254)
Minimum overall anchor length[3]	ℓ_{anch}	in. (mm)	3 (76.2)	3-3/4 (95)		4-1/2 (114)		4-3/4 (121)	6 (152)		5-1/2 (140)	7 (178)
Minimum edge distance[2]	c_{min}	in. (mm)	2-1/2 (63.5)	4 (102)	2-3/4 (70)	4 (102)	2-3/4 (70)	4-1/4 (108)	4-1/4 (108)		5 (127)	4-1/2 (114)
Minimum spacing distance[2]	s_{min}	in. (mm)	3-1/2 (88.9)	6 (152)	6 (152)	4 (102)	6 (152)	4-1/4 (108)	4-1/4 (108)		6 (152)	6 (152)
Critical edge distance[2]	c_{ac}	in. (mm)	6-1/2 (165.1)	8 (203)		10 (254)		8 (203)	15-3/4 (400)	10 (254)	12 (305)	12 (305)
Installation torque	T_{inst}	ft.-lb. (N-m)	20 (27)	40 (54)				60 (81)			110 (149)	
Torque wrench socket size	-	in.	9/16	3/4				15/16			1-1/8	
Nut height	-	in.	21/64	7/16				35/64			41/64	

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

1. The embedment depth, h_{nom}, is measured from the outside surface of the concrete member to the embedded end of the anchor prior to tightening.
2. For installations through the soffit of steel deck into concrete see the installation details in Figure A, B, and C. In addition, anchors shall have an axial spacing along the flute equal to the greater of $3h_{ef}$ or 1.5 times the flute width. The hole diameter in the steel deck must not exceed the hole diameter in the concrete by more than 1/8-inch (3.2 mm).
3. The listed minimum overall anchor length is based on anchor sizes commercially available at the time of publication compared with the requirements to achieve the minimum nominal embedment depth and possible fixture attachment.
4. The anchors may be installed in the topside of concrete-filled steel deck floor and roof assemblies in accordance with the installation specifications and design information provided the concrete thickness above the upper flute meets the minimum thicknesses specified in the tables; see Setting Information for Installation on the Top of Concrete-Filled Steel Deck Assemblies table and installation detail D.

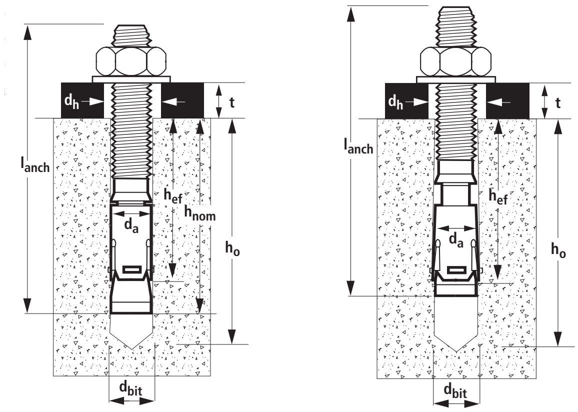
Anchor Setting Information for Installation on the Top of Concrete-Filled Steel Deck Assemblies[3,4]

Anchor Property/ Setting Information	Notation	Units	Nominal Anchor Size (inch) 3/8"		1/2"	
Nominal drill bit diameter	d_{bit}	in.	3/8 ANSI		1/2 ANSI	
Minimum nominal embedment depth[1]	h_{nom}	in. (mm)	2-3/8 (60)		2-1/2 (64)	
Effective embedment	h_{ef}	in. (mm)	2.00 (51)		2.00 (51)	
Minimum concrete member thickness[2]	$h_{min,deck}$	in. (mm)	2-1/2 (64)		2-1/2 (64)	
Critical edge distance	$c_{ac,deck,top}$	in. (mm)	8 (203)		9 (229)	
Minimum edge distance	$c_{min,deck,top}$	in. (mm)	4 (102)	2-3/4 (70)	4 (102)	8 (203
Minimum spacing distance	$s_{min,deck,top}$	in. (mm)	3-1/2 (89)	6 (152)	8 (203)	4 (102)
Minimum hole depth	h_o	in. (mm)	2-1/2 (64)		2-1/2 (64)	
Installation torque	T_{inst}	ft.-lb. (N-m)	20 (27)		40 (54)	
Torque wrench socket size	-	in.	9/16		3/4	
Nut height	-	in.	21/64		7/16	

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

1. The embedment depth, h_{nom}, is measured from the outside surface of the concrete member to the embedded end of the anchor prior to tightening.
2. The anchors may be installed in the topside of concrete-filled steel deck floor and roof assemblies provided the concrete thickness above the upper flute meets the minimum thicknesses specified in this table. Minimum concrete member thickness refers to the concrete thickness above the upper flute (topping thickness). See Installation Detail D.
3. For all other anchor diameters and embedment depths, refer to the installation table for applicable values of h_{min}, c_{min} and s_{min}.
4. Design capacities shall be based on calculations according to values in Tension and Shear Design Information for Anchors in Concrete tables.

Power-Stud+ SD2 Anchor Detail



Before　　After

Head Marking

Legend

Letter Code = Length Identification Mark

'+' Symbol = Strength Design Compliant Anchor

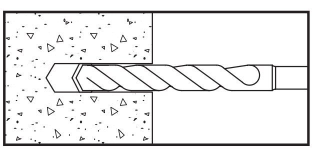
Number Code = Carbon Steel Body and Stainless Steel Expansion Clip

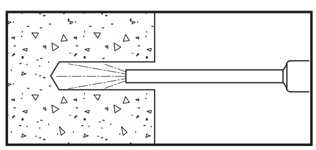
Length Identification

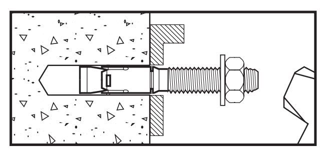
Mark	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
From	1-1/2"	2"	2-1/2"	3"	3-1/2"	4"	4-1/2"	5"	5-1/2"	6"	6-1/2"	7"	7-1/2"	8"	8-1/2"	9"
Up to but not including	2"	2-1/2"	3"	3-1/2"	4"	4-1/2"	5"	5-1/2"	6"	6-1/2"	7"	7-1/2"	8"	8-1/2"	9"	9-1/2"
Length identification mark indicates overall length of anchor.																

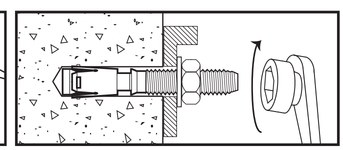
INSTALLATION INSTRUCTIONS

Installation Instructions for Power-Stud+ SD2









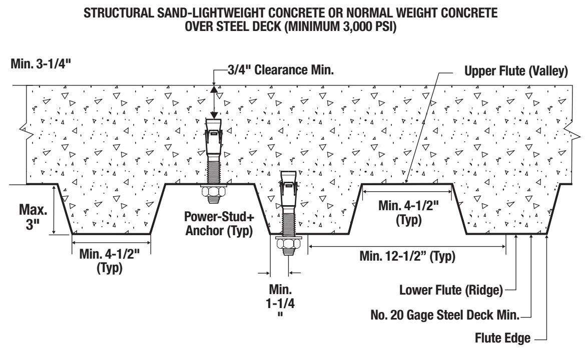
Step 1
Using the proper drill bit size, drill a hole into the base material to the required depth. The tolerances of the drill bit used should meet the requirements of ANSI Standard B212.15.

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.

Step 3
Position the washer on the anchor and thread on the nut. If installing through a fixture, drive the anchor through the fixture into the hole. Be sure the anchor is driven to the minimum required embedment depth, h_{nom}.

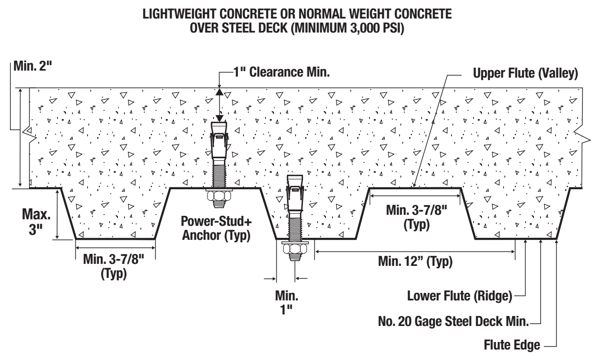
Step 4
Tighten the anchor with a torque wrench by applying the required installation torque, T_{inst}.

Installation Detail A: Power-Stud+ SD2 Installed in the Soffit of Concrete over Steel Deck Floor and Roof Assemblies (see dimensional profile requirements)[1]



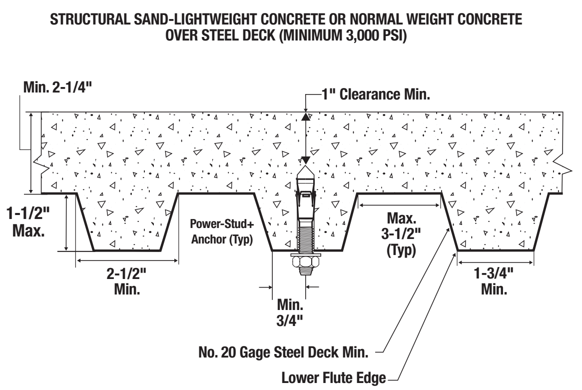
1. Anchors may be placed in the upper flute or lower flute of the steel deck profiles in accordance with installation Detail A provided the minimum hole clearance is satisfied. Anchors in the lower flute of installation Detail A profiles may be installed with a maximum 1-inch offset in either direction from the center of the flute. The offset distance may be increased proportionally for profiles with lower flute widths greater than those shown provided the minimum lower flute edge distance is also satisfied.

Installation Detail B: Power-Stud+ SD2 Installed in the Soffit of Concrete Over Steel Deck Floor and Roof Assemblies (see dimensional profile requirements)[1]



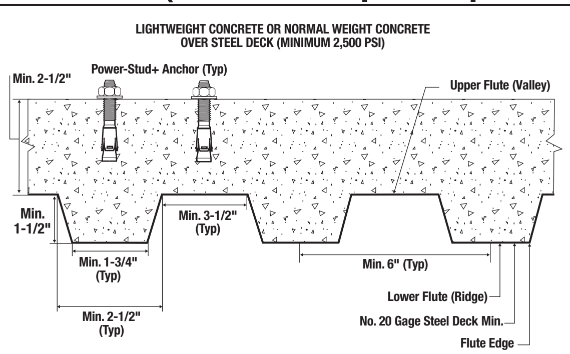
1. Anchors may be placed in the upper flute or lower flute of the steel deck profiles in accordance with Detail B provided the minimum hole clearance is satisfied. Anchors in the lower flute of Detail B profiles may be installed with a maximum 15/16 -inch offset in either direction from the center of the flute. The offset distance may be increased proportionally for profiles with lower flute widths greater than those shown provided the minimum lower flute edge distance is also satisfied.

Installation Detail C: Power-Stud+ SD2 Installed in the Soffit of Concrete over Steel Deck Floor and Roof Assemblies (See Dimensional Profile Requirements)[1,2]



1. Anchors may be placed in the lower flute of the steel deck profiles in accordance with installation Detail C provided the minimum hole clearance is satisfied. Anchors in the lower flute of installation Detail C profiles may be installed with a maximum 1/8-inch offset in either direction from the center of the flute. The offset distance may be increased proportionally for profiles with lower flute widths greater than those shown provided the minimum lower flute edge distance is also satisfied.
2. Anchors may be placed in the upper flute of the steel deck profiles in accordance with installation Detail C provided the concrete thickness above the upper flute is minimum 3-1/4-inch and a minimum hole clearance of 3/4-inch is satisfied.

Installation Detail D: Installation Detail for Anchors in the Top of Concrete Over Steel Deck Floor and Roof Assemblies (see dimensional profile requirements)[1,2]



1. Anchors may be placed in the top side of concrete over steel deck profiles in accordance with Detail D provided the minimum concrete thickness above the upper flute (topping thickness) is as illustrated and the minimum spacing distance and minimum edge distances are satisfied as given in Setting Information for Installation on the Top of Concrete-Filled Steel Deck Assemblies Table.
2. For anchors installed in the top of concrete over steel deck profiles with concrete thickness above the upper flute (topping thickness) greater than or equal to the minimum concrete member thicknesses specified in Installation Table for the Power-Stud+ SD2, the minimum spacing distance and minimum edge distances may be used from this table, as applicable.

PERFORMANCE DATA

Tension Design Information[1,2,12]

CODE LISTED ICC-ES ESR-2502 — STRENGTH DESIGN TABLES

Design Characteristic	Notation	Units	Nominal Anchor Diameter (inch) 3/8	1/2		5/8		3/4	
Anchor category	1,2 or 3	-	1	1		1		1	
STEEL STRENGTH IN TENSION (ACI 318-14 17.4.1 or ACI 318-11 D.5.1)[4]									
Minimum specified yield strength (neck)	f_y	ksi (N/mm²)	96.0 (662)	85.0 (586)		85.0 (586)		70.0 (483)	
Minimum specified ultimate tensile strength (neck)	f_{uta}	ksi (N/mm²)	120.0 (827)	106.0 (731)		106.0 (731)		90.0 (620)	
Effective tensile stress area (neck)	$A_{se,N}$	in² (mm²)	0.0552 (35.6)	0.1007 (65.0)		0.1619 (104.5)		0.2359 (153.2)	
Steel strength in tension[5]	N_{sa}	lb (kN)	6,625 (29.4)	10,445 (46.5)		13,080 (58.2)		21,230 (94.4)	
Reduction factor for steel strength[3]	ϕ	-	0.75						
CONCRETE BREAKOUT STRENGTH IN TENSION (ACI 318-14 17.4.2 or ACI 318-11 D.5.2)[8]									
Effective embedment	h_{ef}	in. (mm)	2.00 (51)	2.00 (51)	3.25 (83)	3.25 (83)	4.25 (108)	3.75 (95)	5.00 (127)
Effectiveness factor for uncracked concrete	k_{ucr}	-	24	24		24		24	
Effectiveness factor for cracked concrete	k_{cr}	-	17	17		17		17	
Modification factor for cracked and uncracked concrete[6]	$\psi_{c,N}$	-	1.0 See note 5	1.0 See note 6		1.0 See note 6		1.0 See note 6	
Critical edge distance	c_{ac}	in. (mm)	See Installation Table						
Reduction factor for concrete breakout strength[3]	ϕ	-	0.65 (Condition B)						
PULLOUT STRENGTH IN TENSION (ACI 318-14 17.4.3 or ACI 318-11 D.5.3)[9]									
Characteristic pullout strength, uncracked concrete (2,500 psi)[7]	$N_{p,uncr}$	lb (kN)	2,775 (12.3)	See note 8	6,615 (29.4)	See note 8	See note 8	See note 8	See note 8
Characteristic pullout strength, cracked concrete (2,500 psi)[7]	$N_{p,cr}$	lb (kN)	2,165 (9.6)	See note 8	4,375 (19.5)	See note 8	See note 8	See note 8	7,795 (35.1)
Reduction factor for pullout strength[3]	ϕ	-	0.65 (Condition B)						
PULLOUT STRENGTH IN TENSION FOR SEISMIC APPLICATIONS (ACI 318-14 17.2.3.3 or ACI 318-11 D.5.3.3.3)[9]									
Characteristic pullout strength, seismic (2,500 psi)[7,10]	$N_{p,eq}$	lb (kN)	2,165 (9.6)	See note 8	4,375 (19.5)	See note 8	See note 8	See note 8	7,795 (35.1)
Reduction factor for pullout strength[3]	ϕ	-	0.65 (Condition B)						
Mean axial stiffness values service load range[11] — Uncracked concrete	β	lbf/in (kN/mm)	865,000 (151)	717,00 (126)		569,000 (100)		420,000 (74)	
Mean axial stiffness values service load range[11] — Cracked concrete	β	lbf/in (kN/mm)	49,500 (9)	57,000 (10)		64,500 (11)		72,000 (13)	

1. The data in this table is intended to be used with the design provisions of ACI 318-14 Chapter 17 or ACI 318 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-14 17.2.3 or ACI 318 D.3.3, as applicable, shall apply.
2. Installation must comply with published instructions and details.
3. All values of ϕ were determined from the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable. If the load combinations of ACI 318-11 Appendix C are used, then the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4. For reinforcement that meets ACI 318-14 Chapter 17 or ACI 318 Appendix D, as applicable, requirements for Condition A, see ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, for the appropriate ϕ factor when the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used.
4. The Power-Stud+ SD2 is considered a ductile steel element in tension as defined by ACI 318-14 2.3 or ACI 318 D.1, as applicable.
5. Tabulated values for steel strength in tension are based on test results per ACI 355.2 and must be used for design in lieu of calculation.
6. For all design cases use $\psi_{c,N} = 1.0$. Select appropriate effectiveness factor for cracked concrete (k_{cr}) or uncracked concrete (k_{uncr}).
7. For all design cases use $\psi_{c,P} = 1.0$. For concrete compressive strength greater than 2,500 psi, N_{pn} = (pullout strength value from table)*(specified concrete compressive strength/2500)^n. For concrete over steel deck the value of 2500 must be replaced with the value of 3000.
   For all anchors n = 1/2 with the exception of the 3/8" anchor size for cracked concrete where n = 1/3.
8. Pullout strength does not control design of indicated anchors. Do not calculate pullout strength for indicated anchor size and embedment.
9. Anchors are permitted to be used in sand-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.
10. Tabulated values for characteristic pullout strength in tension for seismic applications are based on test results per ACI 355.2, Section 9.5.
11. Mean values shown; actual stiffness varies considerable depending on concrete strength, loading and geometry of application.
12. Anchors are permitted for use in concrete-filled steel deck floor and roof assemblies; see installation details A, B, C and D.

Shear Design Information[1,2,8]

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Design Characteristic	Notation	Units	Nominal Anchor Diameter (inch)						
			3/8	1/2		5/8		3/4	
Anchor category	1,2 or 3	-	1	1		1		1	
STEEL STRENGTH IN SHEAR (ACI 318-14 17.5.1 or ACI 318-11 D.6.1)[4]									
Minimum specified yield strength (threads)	f_y	ksi (N/mm²)	76.8 (530)	68.0 (469)		68.0 (469)		56.0 (386)	
Minimum specified ultimate tensile strength (threads)	f_{uta}	ksi (N/mm²)	100.0 (690)	88.0 (607)		88.0 (607)		80.0 (551)	
Effective tensile stress area (threads)	$A_{se,V}$	in² (mm²)	0.0775 (50.0)	0.1419 (65.7)		0.2260 (104.9)		0.3345 (215.8)	
Steel strength in shear[5]	V_{sa}	lb (kN)	3,115 (13.9)	4,815 (21.4)		10,170 (45.2)		12,610 (56.1)	
Reduction factor for steel strength[3]	ϕ	-	0.65						
CONCRETE BREAKOUT STRENGTH IN SHEAR (ACI 318-14 17.5.2 or ACI 318-11 D.6.2)[6]									
Load bearing length of anchor (h_{ef} or $8d_o$, whichever is less)	ℓ_e	in. (mm)	2.00 (51)	2.00 (51)	3.25 (83)	3.25 (83)	4.25 (108)	3.75 (95)	5.00 (127)
Reduction factor for concrete breakout strength[3]	ϕ	-	0.70 (Condition B)						
PRYOUT STRENGTH IN SHEAR (ACI 318-14 17.5.3 or ACI 318-11 D.6.3)[6]									
Coefficient for pryout strength 1.0 for $h_{ef} < 2.5$ in., 2.0 for $h_{ef} \geq 2.5$ in.	k_{cp}	-	1.0	1.0	2.0	2.0	2.0	2.0	2.0
Effective Embedment	h_{ef}	in. (mm)	2.00 (51)	2.00 (51)	3.25 (83)	3.25 (83)	4.25 (108)	3.75 (95)	5.00 (127)
Reduction factor for pullout strength[3]	ϕ	-	0.70 (Condition B)						
STEEL STRENGTH IN SHEAR FOR SEISMIC APPLICATIONS (ACI 318-14 17.2.3.3 or ACI 318-11 D.3.3.3)									
Steel Strength in shear, seismic[7]	$V_{sa,eq}$	lb (kN)	2,460 (11.0)	4,815 (21.4)		6,770 (30.1)		8,060 (35.9)	
Reduction factor for pullout strength[3]	ϕ	-	0.65 (Condition B)						

1. The data in this table is intended to be used with the design provisions of ACI 318-14 Chapter 17 or ACI 318 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-14 17.2.3 or ACI 318 D.3.3 shall apply, as applicable.
2. Installation must comply with published instructions and details.
3. All values of ϕ were determined from the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3 or ACI 318 Section 9.2. If the load combinations of ACI 318-11 Appendix C are used, then the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4. For reinforcement that meets ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable, requirements for Condition A, see ACI 318-14 17.3.3 or ACI 318-11 D.4.3, for the appropriate ϕ factor when the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3 or ACI 318 Section 9.2 are used.
4. The Power-Stud+ SD2 is considered a ductile steel element as defined by ACI 318-14 2.3 or ACI 318-11 D.1, as applicable.
5. Reported values for steel strength in shear are based on test results per ACI 355.2, Section 9.4 and shall be used for design.
6. Anchors are permitted to be used in sand-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.
7. Reported values for steel strength in shear for seismic applications are based on test results per ACI 355.2, Section 9.6.
8. Anchors are permitted for use in concrete-filled steel deck floor and roof assemblies; see installation details A, B, C and D.

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STRENGTH DESIGN TABLES

Tension and Shear Design Data for Power-Stud+ SD2 Anchors in the Soffit of Concrete-Filled Steel Deck Assemblies[1,2,7]

Design Characteristics		Notation	Units	Nominal Anchor Size (inch)					
				0.375	0.5		0.625		0.75
Anchor Category		1, 2 or 3	-	1	1		1		1
Effective Embedment		h_{ef}	in. (mm)	2.00 (51)	2.00 (51)	3.25 (83)	3.25 (83)	4.25 (108)	3.75 (95)
Minimum Nominal Embedment Depth		h_{nom}	in. (mm)	2-3/8 (60)	2-1/2 (64)	3-3/4 (83)	3-7/8 (98)	4-7/8 (124)	4-1/2 (114)
Minimum Hole Depth		h_o	in. (mm)	2-5/8 (67)	2-3/4 (70)	4 (102)	4-1/4 (108)	5-1/4 (133)	5 (27)
PULLOUT STRENGTH IN TENSION FOR ANCHORS IN SOFFIT OF SAND LIGHTWEIGHT AND NORMAL-WEIGHT CONCRETE OVER STEEL DECK[1]									
According to Detail A 4-1/2-inch-wide deck flute	Characteristic pullout strength, uncracked concrete over steel deck[2]	$N_{p,deck,uncr}$	lbf (kN)	1,855 (8.3)	2,065 (9.2)	3,930 (17.5)	4,665 (20.8)	7,365 (32.8)	4,900 (21.8)
	Characteristic pullout strength, cracked concrete over steel deck[2,3]	$N_{p,deck,cr}$	lbf (kN)	1,445 (6.4)	1,465 (6.5)	2,600 (11.6)	3,305 (14.7)	5,215 (23.2)	3,470 (15.4)
According to Detail B 3-7/8-inch-wide deck flute	Characteristic pullout strength, uncracked concrete over steel deck[2]	$N_{p,deck,uncr}$	lbf (kN)	2,235 (9.9)	2,785 (12.4)	5,600 (24.9)	4,480 (19.9)	7,265 (32.3)	Not Applicable
	Characteristic pullout strength, cracked concrete over steel deck[2,3]	$N_{p,deck,cr}$	lbf (kN)	1,745 (7.8)	1,975 (8.8)	3,695 (16.4)	3,175 (14.1)	5,145 (22.9)	Not Applicable
According to Detail C 1-3/4-inch-wide deck flute	Characteristic pullout strength, uncracked concrete over steel deck[2]	$N_{p,deck,uncr}$	lbf (kN)	1,600 (7.1)	2,025 (9.0)	Not Applicable	Not Applicable	Not Applicable	Not Applicable
	Characteristic pullout strength, cracked concrete over steel deck[2,3]	$N_{p,deck,cr}$	lbf (kN)	1,250 (5.6)	1,435 (6.4)	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Reduction factor for pullout strength[6]		ϕ	-	0.65					
STEEL STRENGTH IN SHEAR FOR ANCHORS IN SOFFIT OF SAND-LIGHTWEIGHT AND NORMAL WEIGHT CONCRETE OVER STEEL DECK[4,5]									
According to Detail A 4-1/2-inch-wide deck flute	Steel strength in shear, concrete over steel deck	$V_{sa,deck}$	lbf (kN)	2,170 (9.7)	3,815 (17.0)	5,040 (22.4)	4,015 (17.9)	6,670 (29.7)	4,325 (19.2)
	Steel strength in shear, seismic, concrete over steel deck	$V_{sa,deck,eq}$	lbf (kN)	1,715 (7.6)	3,815 (17.0)	5,040 (22.4)	2,675 (11.9)	4,445 (19.8)	2,820 (12.5)
According to Detail B 3-7/8-inch-wide deck flute	Steel strength in shear, concrete over steel deck	$V_{sa,deck}$	lbf (kN)	3,040 (13.5)	2,675 (11.9)	4,930 (21.9)	Not Applicable	Not Applicable	Not Applicable
	Steel strength in shear, seismic, concrete over steel deck	$V_{sa,deck,eq}$	lbf (kN)	2,400 (10.6)	2,675 (11.9)	4,930 (21.9)	Not Applicable	Not Applicable	Not Applicable
According to Detail C 1-3/4-inch-wide deck flute	Steel strength in shear, concrete over steel deck	$V_{sa,deck}$	lbf (kN)	2,170 (9.7)	2,880 (12.8)	Not Applicable	Not Applicable	Not Applicable	Not Applicable
	Steel strength in shear, seismic, concrete over steel deck	$V_{sa,deck,eq}$	lbf (kN)	1,715 (7.6)	2,880 (12.8)	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Reduction factor for steel strength in shear, concrete over steel deck[6]		ϕ	-	0.65					

1. For all design cases $\Psi_{c,P}$ = 1.0. For concrete compressive strength greater than 3,000 psi, N_{pn}=(pullout strength value from table) * (specified concrete compressive strength/2500)^n. For all anchors n=1/2 with exception of the 3/8-inch-diameter anchor size, where n=1/3.
2. Values for $N_{p,deck}$ are for sand-lightweight concrete ($f'_{c,min}$ = 3,000 psi) and additional lightweight concrete reduction factors need not be applied. In addition, evaluation for the concrete breakout capacity in accordance with ACI 318-14 17.4.2 or ACI 318 D.5.2, as applicable, is not required for anchors installed in the deck soffit (flute).
3. Values for $N_{p,deck,cr}$ are applicable for seismic loading.
4. Shear loads for anchors installed through steel deck into concrete may be applied in any direction.
5. Values for $V_{sa,deck}$ and $V_{sa,deck,eq}$ are for sand-lightweight concrete ($f'_{c,min}$ = 3,000 psi) and additional lightweight concrete reduction factors need not be applied. In addition, evaluation for the concrete breakout capacity in accordance with ACI 318-14 17.5.2 or ACI 318 D.6.2, as applicable and the pryout capacity in accordance with ACI 318-14 17.5.3 or ACI 318-11 D.6.3, as applicable, is not required for anchors installed in the deck soffit (flute).
6. All values of ϕ were determined from the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable. If the load combinations of ACI 318-11 Appendix C are used, then the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4.
7. Anchors shall have an axial spacing along the flute soffit equal to the greater of $3h_{ef}$ or 1.5 times the flute width.

Factored Design Strength (ϕN_n and ϕV_n) Calculated in Accordance with ACI 318-14 Chapter 17:

1- 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}.

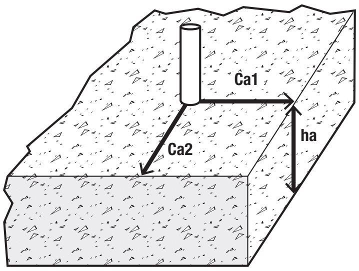
2- Calculations were performed according to ACI 318-18 Chapter 17. The load level corresponding to the controlling failure mode is listed. (e.g. For tension: steel, concrete breakout and pullout; For shear: steel, concrete breakout and pryout). Furthermore, the capacities for concrete breakout strength 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 318-14 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 318-14 Chapter 17.

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



Tension and Shear Design Strengths for Power-Stud+ SD2 in Cracked Concrete

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.)
3/8	2-3/8	1,405	1,685	1,495	1,845	1,645	2,025	1,885	2,025	2,075	2,025
1/2	2-1/2	1,565	1,685	1,710	1,845	1,975	2,130	2,420	2,605	2,795	3,010
	3-3/4	2,845	3,130	3,115	3,130	3,595	3,130	4,405	3,130	5,085	3,130
5/8	3-7/8	3,235	4,220	3,545	4,620	4,095	5,335	5,015	6,535	5,790	6,610
	4-7/8	4,840	6,610	5,305	6,610	6,125	6,610	7,500	6,610	8,660	6,610
3/4	4-1/2	4,010	7,590	4,395	8,195	5,075	8,195	6,215	8,195	7,175	8,195
	5-3/4	5,065	8,195	5,550	8,195	6,410	8,195	7,850	8,195	9,065	8,195

□ - Anchor Pullout/Pryout Strength Controls □ - Concrete Breakout Strength Controls ■ - Steel Strength Controls

Tension and Shear Design Strengths for Power-Stud+ SD2 in Uncracked Concrete

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.)
3/8	2-3/8	1,805	2,025	1,975	2,025	2,280	2,025	2,795	2,025	3,225	2,025
1/2	2-1/2	2,205	2,375	2,415	2,605	2,790	3,005	3,420	3,130	3,945	3,130
	3-3/4	4,300	3,130	4,710	3,130	5,440	3,130	6,660	3,130	7,690	3,130
5/8	3-7/8	4,570	5,905	5,005	6,470	5,780	6,610	7,080	6,610	8,175	6,610
	4-7/8	6,835	6,610	7,485	6,610	8,645	6,610	9,810	6,610	9,810	6,610
3/4	4-1/2	5,665	8,195	6,205	8,195	7,165	8,195	8,775	8,195	10,130	8,195
	5-3/4	8,720	8,195	9,555	8,195	11,030	8,195	13,510	8,195	15,600	8,195

□ - Anchor Pullout/Pryout Strength Controls □ - Concrete Breakout Strength Controls ■ - Steel Strength Controls

Factored design strengths may be converted to allowable loads using an appropriate conversion factor, α, for the controlling load combination.
See ICC-ES ESR-2502 or contact DEWALT for more information regarding the procedure to convert factored design strengths to allowable loads.

Converted Allowable Loads for Power-Stud+ SD2 in Cracked Concrete[1,2]

Nominal Anchor Size (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	
		$T_{allowable,ASD}$ Tension (lbs.)	$V_{allowable,ASD}$ Shear (lbs.)	$T_{allowable,ASD}$ Tension (lbs.)	$V_{allowable,ASD}$ Shear (lbs.)	$T_{allowable,ASD}$ Tension (lbs.)	$V_{allowable,ASD}$ Shear (lbs.)	$T_{allowable,ASD}$ Tension (lbs.)	$V_{allowable,ASD}$ Shear (lbs.)	$T_{allowable,ASD}$ Tension (lbs.)	$V_{allowable,ASD}$ Shear (lbs.)
3/8	2-3/8	1,005	1,205	1,070	1,320	1,175	1,445	1,345	1,445	1,480	1,445
1/2	2-1/2	1,120	1,205	1,220	1,320	1,410	1,520	1,730	1,860	1,995	2,150
	3-3/4	2,030	2,235	2,225	2,235	2,570	2,235	3,145	2,235	3,630	2,235
5/8	3-7/8	2,310	3,015	2,530	3,300	2,925	3,810	3,580	4,670	4,135	4,720
	4-7/8	3,455	4,720	3,790	4,720	4,375	4,720	5,355	4,720	6,185	4,720
3/4	4-1/2	2,865	5,420	3,140	5,855	3,625	5,855	4,440	5,855	5,125	5,855
	5-3/4	3,620	5,855	3,965	5,855	4,580	5,855	5,605	5,855	6,475	5,855

1. Allowable load values are calculated using a conversion factor, α, from Factored Design Strengths and conditions shown on the previous page.
2. Tabulated allowable load values assume 50% dead load and 50% live load, with controlling load combination 1.2D + 1.6L. Calculated weighted average for the conversion factor, α : 1.2(0.5) + 1.6(0.5) = 1.4.

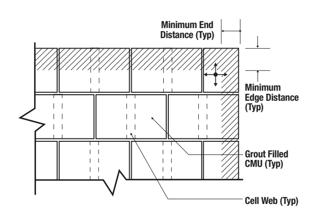
Converted Allowable Loads for Power-Stud+ SD2 in Uncracked Concrete[1,2]

Nominal Anchor Size (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	
		$T_{allowable,ASD}$ Tension (lbs.)	$V_{allowable,ASD}$ Shear (lbs.)	$T_{allowable,ASD}$ Tension (lbs.)	$V_{allowable,ASD}$ Shear (lbs.)	$T_{allowable,ASD}$ Tension (lbs.)	$V_{allowable,ASD}$ Shear (lbs.)	$T_{allowable,ASD}$ Tension (lbs.)	$V_{allowable,ASD}$ Shear (lbs.)	$T_{allowable,ASD}$ Tension (lbs.)	$V_{allowable,ASD}$ Shear (lbs.)
3/8	2-3/8	1,290	1,445	1,410	1,445	1,630	1,445	1,995	1,445	2,305	1,445
1/2	2-1/2	1,575	1,695	1,725	1,860	1,995	2,145	2,445	2,235	2,820	2,235
	3-3/4	3,070	2,235	3,365	2,235	3,885	2,235	4,755	2,235	5,495	2,235
5/8	3-7/8	3,265	4,220	3,575	4,620	4,130	4,720	5,055	4,720	5,840	4,720
	4-7/8	4,880	4,720	5,345	4,720	6,175	4,720	7,005	4,720	7,005	4,720
3/4	4-1/2	4,045	5,855	4,430	5,855	5,120	5,855	6,270	5,855	7,235	5,855
	5-3/4	6,230	5,855	6,825	5,855	7,880	5,855	9,650	5,855	11,145	5,855

1. Allowable load values are calculated using a conversion factor, α, from Factored Design Strengths and conditions shown on the previous page.
2. Tabulated allowable load values assume 50% dead load and 50% live load, with controlling load combination 1.2D + 1.6L. Calculated weighted average for the conversion factor, α : 1.2(0.5) + 1.6(0.5) = 1.4.

Ultimate and Allowable Load Capacities for Power-Stud+ SD2 in Grouted Filled Concrete Masonry[1,2,3]

Nominal Anchor Size in. (mm)	Minimum Embedment Depth (mm)	Installation Location[3]	Minimum Masonry Compressive Strength, f'm = 1,500 psi (10.4 MPa)			
			Ultimate Load Tension lbs. (kN)	Allowable Load Tension lbs. (kN)	Ultimate Load Shear lbs. (kN)	Allowable Load Shear lbs. (kN)
3/8 (9.5)	2-1/2 (50.8)	Wall Face/End Min. 2-1/2" Edge and End Distances	1,670 (7.4)	335 (1.5)	2,075 (9.2)	415 (1.8)
1/2 (12.7)	2-1/2 (50.8)	Wall Face/End Min. 3" Edge and End Distances	2,295 (10.2)	460 (2.0)	1,310 (5.8)	260 (1.2)
	3-3/4 (95.3)	Top of Wall Min. 1-3/4" Edge and 4" Edge Distances	3,320 (14.8)	665 (3.0)	1,140 (5.1)	230 (1.0)



Face Shell Permissible Anchor Locations
(Un-hatched Area / Through Face Shell)

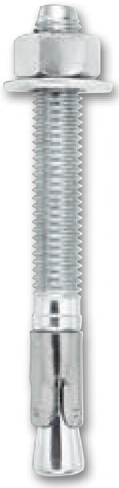
1. Tabulated load values are for anchors installed in minimum 6-inch wide, minimum Grade N, Type II, lightweight, medium-weight or normal-weight concrete masonry units conforming to ASTM C 90. Mortar must be minimum Type N. Masonry compressive strength must be at the specified minimum at the time of installation.
2. Allowable load capacities listed are calculated using and applied safety factor of 5.0. Consideration of safety factors of 10 or higher may be necessary depending upon the application such as life safety.
3. Anchor installations into grouted masonry walls are limited to one per masonry cell.

ORDERING INFORMATION

Power-Stud+ SD2 (Carbon Steel Body with Stainless Steel Expansion Clip)

Cat. No.	Anchor Size	Thread Length	Box Qty.	Carton Qty.	Wt./100 (lbs.)	ANSI Carbide Drill Bit Cat. No.		
						Full Head Carbide SDS-Plus	Carbide SDS-Plus	Carbide SDS-Max
7413SD2	3/8" x 3"	1-3/4"	50	300	10	DW5527	DW5427	-
7414SD2	3/8" x 3-1/2"	2-1/4"	50	300	12	DW5527	DW5427	-
7415SD2	3/8" x 3-3/4"	2-1/2"	50	300	13	DW5527	DW5427	-
7416SD2	3/8" x 5"	3-3/4"	50	300	16	DW55300	DW5429	-
7422SD2	1/2" x 3-3/4"	2-1/8"	50	200	23	DW5537	DW5437	DW5803
7423SD2	1/2" x 4-1/2"	2-7/8"	50	200	28	DW5539	DW5438	DW5803
7424SD2	1/2" x 5-1/2"	3-7/8"	50	150	32	DW5539	DW5438	DW5803
7426SD2	1/2" x 7"	5-3/8"	25	100	44	DW5539	DW5438	DW5803
7427SD2	1/2" x 8-1/2"	6-7/8"	25	100	46	DW5539	DW5439	DW5804
7435SD2	5/8" x 4-3/4"	2-7/8"	25	100	52	-	DW5446	DW5806
7433SD2	5/8" x 5"	3-1/8"	25	50	57	-	DW5446	DW5806
7434SD2	5/8" x 6"	4-1/8"	25	75	64	-	DW5446	DW5806
7436SD2	5/8" x 7"	5-1/8"	25	75	72	-	DW5447	DW5806
7438SD2	5/8" x 8-1/2"	6-5/8"	25	75	84	-	DW5447	DW5809
7442SD2	3/4" x 5-1/2"	3-1/4"	20	60	88	-	DW5453	DW5810
7444SD2	3/4" x 6-1/4"	4"	20	60	90	-	DW5455	DW5810
7446SD2	3/4" x 7"	4-3/4"	20	60	95	-	DW5455	DW5810
7448SD2	3/4" x 8-1/2"	6-1/4"	10	40	95	-	DW5455	DW5812

The published size includes the diameter and the overall length of the anchor.
All anchors are packaged with nuts and washers.



Installation Accessories

Cat. No.	Description	Box Qty
08280	Hand pump / dust blower	1

GENERAL INFORMATION

POWER-STUD®+ SD4/SD6

Stainless Steel Wedge Expansion Anchors

PRODUCT DESCRIPTION

The Power-Stud+ SD4 and Power-Stud+ SD6 anchors are fully threaded, torque-controlled, stainless steel wedge expansion anchors which are designed for consistent performance in cracked and uncracked concrete. Suitable base materials are normal-weight, sand-lightweight concrete, and grouted concrete masonry (CMU). The anchor is manufactured with a stainless steel body and expansion clip. Nut and washer are included.

GENERAL APPLICATIONS AND USES

- Structural connections, i.e., beam and column anchorage
- Safety-related and common attachments
- Interior and exterior applications
- Tension zone applications, i.e., cable trays and strut, pipe supports, fire sprinklers

FEATURES AND BENEFITS

+ Knurled mandrel design provides consistent performance in cracked concrete and helps prevent galling during service life.
+ Nominal drill bit size is the same as the anchor diameter
+ Anchor can be installed through standard clearance 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
+ Corrosion resistant stainless steel anchors
+ Domestically manufactured by request, call for details

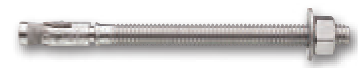
APPROVALS AND LISTINGS

- International Code Council Evaluation Service (ICC-ES), ESR-2502 for cracked and uncracked concrete
- Code compliant with the 2015 IBC, 2015 IRC, 2012 IBC, 2012 IRC, 2009 IBC, and 2009 IRC
- Tested in accordance with ACI 355.2/ASTM E 488 and ICC-ES AC193 for use in structural concrete under the design provisions of ACI 318-14 Chapter 17 or ACI 318-11/08 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)

GUIDE SPECIFICATIONS

CSI Divisions: 03 16 00-Concrete Anchors, 04 05 19.16 - Masonry Anchors and 05 05 19 Post-Installed Concrete Anchors. Expansion anchors shall be Power-Stud+ SD4 and Power-Stud+ SD6 as supplied by DEWALT, Towson, MD. Anchors shall be installed in accordance with published instructions and the Authority Having Jurisdiction.

SECTION CONTENTS



POWER-STUD+ STAINLESS STEEL ASSEMBLY

THREAD VERSION

- UNC threaded stud

ANCHOR MATERIALS

- Stainless steel body and expansion clip, nut and washer

ANCHOR SIZE RANGE (TYP.)

- 1/4" diameter through 3/4" diameter

SUITABLE BASE MATERIALS

- Normal-weight concrete
- Structural sand-lightweight
- Grouted Concrete Masonry (CMU)

TENSION ZONE CRACKED CONCRETE

SEISMIC REGION QUALIFICATION

CODE LISTED
ICC-ES ESR-2502
CONCRETE

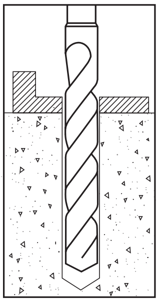
MATERIAL SPECIFICATIONS

Anchor component	Specification	
	SD4[1]	SD6[1]
Anchor body	Type 304 Stainless Steel	Type 316 Stainless Steel
Washer	300 Series Stainless Steel	Type 316 Stainless Steel
Hex Nut	Type 316 Stainless Steel	
Expansion wedge (clip)	Type 316 Stainless Steel	

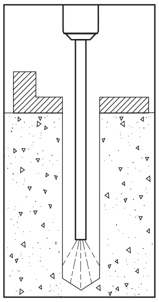
1. Domestically manufactured anchors are available upon request (see ordering information for details).

INSTALLATION INSTRUCTIONS

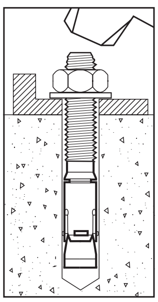
Installation Instructions for Power-Stud+ SD4 and Power-Stud+ SD6



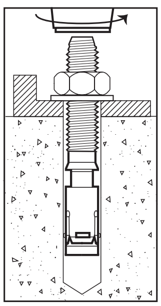
Step 1
Using the proper drill bit size, drill a hole into the base material to the required depth. The tolerances of the drill bit used should meet the requirements of ANSI Standard B212.15.



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.



Step 3
Position the supplied washer on the anchor and thread on the supplied nut. If installing through a fixture, drive the anchor through the fixture into the hole. Be sure the anchor is driven to the minimum required embedment depth.



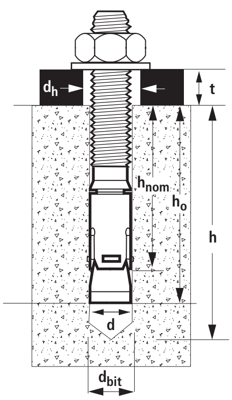
Step 4
Tighten the anchor with a torque wrench by applying the required installation torque, T_{inst}.

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"

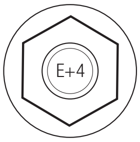
Length identification mark indicates overall length of anchor.

Anchor Detail



Nomenclature
- d = Diameter of anchor
- d_{bit} = Diameter of drill bit
- d_h = Diameter of fixture clearance hole
- h = Base material thickness. The minimum value of h should be $1.5h_{nom}$ or 3" whichever is greater
- h_{nom} = Minimum embedment depth

Head Marking



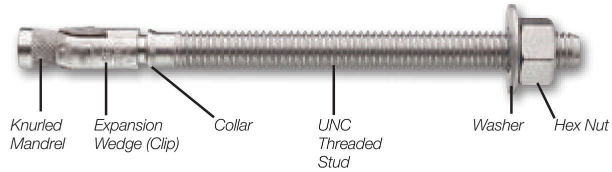
Legend

Letter Code = Length Identification Mark

'+' Symbol = Strength Design Compliant Anchor (see ordering information, symbol not on 1/4" diameter anchors)

Number Code = Stainless Steel Body Type (4 or 6)

Anchor Assembly



REFERENCE DATA (ASD)

Installation Specifications Table for Power-Stud+ SD4 and Power-Stud+ SD6 in Concrete

Anchor Property/Setting Information	Notation	Units	Nominal Anchor Diameter (inch)				
			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)
Nominal drill bit diameter	d_{bit}	in.	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 (7.9)	7/16 (11.1)	9/16 (14.3)	11/16 (17.5)	13/16 (20.6)
Minimum embedment depth	h_{nom}	in. (mm)	1-1/8 (29)	1-3/8 (41)	1-7/8 (48)	2-1/2 (64)	3-3/8 (86)
Minimum hole depth	h_o	in. (mm)	1-1/4 (32)	1-1/2 (38)	2 (51)	2-5/8 (67)	3-1/2 (89)
Installation torque	T_{inst}	ft.-lbf. (N-m)	6 (8)	25 (34)	40 (54)	60 (81)	110 (149)
Torque wrench/socket size	-	in.	7/16	9/16	3/4	15/16	1-1/8
Nut height	-	in.	7/32	21/64	7/16	35/64	41/64

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

Ultimate Load Capacities for Power-Stud+ SD4 and Power-Stud+ SD6 in Normal-Weight Concrete[1,2]

Nominal Anchor Diameter in.	Minimum Embedment Depth h_{nom} in. (mm)	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	1-1/8 (29)	1,095 (4.9)	2,135 (9.5)	1,200 (5.3)	2,135 (9.5)	1,390 (6.2)	2,135 (9.5)	1,455 (6.5)	2,135 (9.5)	1,680 (7.5)	2,135 (9.5)
	1-3/4 (44)	1,890 (8.4)	2,135 (9.5)	2,070 (9.2)	2,135 (9.5)	2,390 (10.6)	2,135 (9.5)	2,480 (11.0)	2,135 (9.5)	2,480 (11.0)	2,135 (9.5)
3/8	1-3/8 (41)	1,530 (6.8)	2,745 (12.2)	1,680 (7.5)	2,745 (12.2)	1,940 (8.6)	2,745 (12.2)	2,520 (11.2)	2,745 (12.2)	2,910 (12.9)	2,745 (12.2)
	1-7/8 (48)	2,790 (12.4)	2,745 (12.2)	3,060 (13.6)	2,745 (12.2)	3,530 (15.7)	2,745 (12.2)	4,195 (18.7)	2,745 (12.2)	4,840 (21.5)	2,745 (12.2)
	3 (76)	4,700 (20.9)	2,745 (12.2)	4,895 (21.8)	2,745 (12.2)	4,895 (21.8)	2,745 (12.2)	4,895 (21.8)	2,745 (12.2)	4,895 (21.8)	2,745 (12.2)
1/2	1-7/8 (48)	2,745 (12.2)	5,090 (22.6)	3,010 (13.4)	5,090 (22.6)	3,475 (15.5)	5,090 (22.6)	4,525 (20.1)	5,090 (22.6)	5,230 (23.3)	5,090 (22.6)
	2-3/8 (60)	5,370 (23.9)	5,090 (22.6)	5,880 (26.2)	5,090 (22.6)	6,790 (30.2)	5,090 (22.6)	6,790 (30.2)	5,090 (22.6)	7,845 (34.9)	5,090 (22.6)
	3-3/4 (95)	8,840 (39.3)	5,090 (22.6)	9,300 (41.4)	5,090 (22.6)	9,300 (41.4)	5,090 (22.6)	9,300 (41.4)	5,090 (22.6)	9,300 (41.4)	5,090 (22.6)
5/8	2-1/2 (64)	5,015 (22.3)	9,230 (41.1)	5,495 (24.4)	9,230 (41.1)	6,345 (28.2)	9,230 (41.1)	7,250 (32.2)	9,230 (41.1)	8,370 (37.2)	9,230 (41.1)
	3-1/4 (83)	6,760 (30.1)	9,230 (41.1)	7,405 (32.9)	9,230 (41.1)	8,560 (38.1)	9,230 (41.1)	9,615 (42.8)	9,230 (41.1)	11,105 (49.4)	9,230 (41.1)
	4-3/4 (121)	10,550 (46.9)	9,230 (41.1)	11,555 (51.4)	9,230 (41.1)	13,345 (59.4)	9,230 (41.1)	14,560 (64.8)	9,230 (41.1)	14,560 (64.8)	9,230 (41.1)
3/4	3-3/8 (86)	6,695 (29.8)	11,255 (50.1)	7,330 (32.6)	12,625 (56.2)	8,465 (37.7)	14,580 (64.9)	9,705 (43.2)	15,440 (68.7)	11,210 (49.9)	15,440 (68.7)
	4-1/2 (114)	10,800 (48.0)	15,440 (68.7)	11,830 (52.6)	15,440 (68.7)	13,575 (60.4)	15,440 (68.7)	17,110 (76.1)	15,440 (68.7)	19,760 (87.9)	15,440 (68.7)
	5-5/8 (143)	11,730 (52.2)	15,440 (68.7)	12,850 (57.2)	15,440 (68.7)	13,575 (60.4)	15,440 (68.7)	19,710 (87.7)	15,440 (68.7)	21,705 (96.5)	15,440 (68.7)

1. Tabulated load values are for 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 be reduced by a minimum safety factor of 4.0 or greater to determine allowable working loads.

Allowable Load Capacities for Power-Stud+ SD4 and Power-Stud+ SD6 in Normal-Weight Concrete[1,2,3,4]

ALLOWABLE STRESS DESIGN ASD

Nominal Anchor Diameter in.	Minimum Embedment Depth h_{nom} in. (mm)	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	1-1/8 (28)	275 (1.2)	535 (2.4)	300 (1.3)	535 (2.4)	350 (1.6)	535 (2.4)	365 (1.6)	535 (2.4)	420 (1.9)	535 (2.4)
	1-3/4 (44)	475 (2.1)	535 (2.4)	520 (2.3)	535 (2.4)	600 (2.7)	535 (2.4)	620 (2.8)	535 (2.4)	620 (2.8)	535 (2.4)
3/8	1-3/8 (41)	385 (1.7)	685 (3.0)	420 (1.9)	685 (3.0)	485 (2.2)	685 (3.0)	630 (2.8)	685 (3.0)	730 (3.2)	685 (3.0)
	1-7/8 (60)	700 (3.1)	685 (3.0)	765 (3.4)	685 (3.0)	885 (3.9)	685 (3.0)	1,050 (4.7)	685 (3.0)	1,210 (5.4)	685 (3.0)
	3 (60)	1,175 (5.2)	685 (3.0)	1,225 (5.4)	685 (3.0)	1,225 (5.4)	685 (3.0)	1,225 (5.4)	685 (3.0)	1,225 (5.4)	685 (3.0)
1/2	1-7/8 (57)	685 (3.0)	1,275 (5.7)	755 (3.4)	1,275 (5.7)	870 (3.9)	1,275 (5.7)	1,130 (5.0)	1,275 (5.7)	1,310 (5.8)	1,275 (5.7)
	2-3/8 (64)	1,345 (6.0)	1,275 (5.7)	1,470 (6.5)	1,275 (5.7)	1,700 (7.6)	1,275 (5.7)	1,700 (7.6)	1,275 (5.7)	1,960 (8.7)	1,275 (5.7)
	3-3/4 (95)	2,210 (9.8)	1,275 (5.7)	2,325 (10.3)	1,275 (5.7)	2,325 (10.3)	1,275 (5.7)	2,325 (10.3)	1,275 (5.7)	2,325 (10.3)	1,275 (5.7)
5/8	2-1/2 (70)	1,255 (5.6)	2,310 (10.3)	1,375 (6.1)	2,310 (10.3)	1,585 (7.1)	2,310 (10.3)	1,815 (8.1)	2,310 (10.3)	2,095 (9.3)	2,310 (10.3)
	3-1/4 (86)	1,690 (7.5)	2,310 (10.3)	1,850 (8.2)	2,310 (10.3)	2,140 (9.5)	2,310 (10.3)	2,405 (10.7)	2,310 (10.3)	2,775 (12.3)	2,310 (10.3)
	4-3/4 (117)	2,640 (11.7)	2,310 (10.3)	2,890 (12.9)	2,310 (10.3)	3,335 (14.8)	2,310 (10.3)	3,640 (16.2)	2,310 (10.3)	3,640 (16.2)	2,310 (10.3)
3/4	3-3/8 (86)	1,675 (7.5)	2,815 (12.5)	1,835 (8.2)	3,155 (14.0)	2,115 (9.4)	3,645 (16.2)	2,425 (10.8)	3,860 (17.2)	2,805 (12.5)	3,860 (17.2)
	4-1/2 (114)	2,700 (12.0)	3,860 (17.2)	2,960 (13.2)	3,860 (17.2)	3,395 (15.1)	3,860 (17.2)	4,280 (19.0)	3,860 (17.2)	4,940 (22.0)	3,860 (17.2)
	5-5/8 (143)	2,935 (13.1)	3,860 (17.2)	3,215 (14.3)	3,860 (17.2)	3,395 (15.1)	3,860 (17.2)	4,930 (21.9)	3,860 (17.2)	5,425 (24.1)	3,860 (17.2)

1. Tabulated load values are for anchors installed in uncracked concrete. Concrete compressive strength must be at the specified minimum at the time of installation.
2. Allowable load capacities listed are calculated using and applied safety factor of 4.0.
3. Allowable load capacities must be multiplied by reduction factors when anchor spacing or edge distances are less than critical distances.
4. Linear interpolation may be used to determine allowable loads for intermediate embedments and compressive strengths.

SPACING DISTANCE AND EDGE DISTANCE ADJUSTMENT FACTORS FOR NORMAL WEIGHT CONCRETE - TENSION (F_{NS}, F_{NC})

Spacing Reduction Factors - Tension (F_{NS})

Diameter (in)	1/4	3/8	1/2	5/8	3/4
Nominal Embed. h_{nom} (in)	1-3/4	1-7/8	2-1/2	3-1/4	4-1/2
Minimum Spacing, s_{min} (in)	2	3	3	5	5
Spacing Distance (inches)					
1-3/4	-	-	-	-	-
2	0.79	-	-	-	-
2-1/4	0.81	-	-	-	-
2-1/2	0.83	-	-	-	-
2-3/4	0.85	-	-	-	-
3	0.87	0.87	0.82	-	-
3-1/2	0.91	0.91	0.85	-	-
4	0.96	0.96	0.88	-	-
4-1/2	1.00	1.00	0.91	-	-
5	1.00	1.00	0.94	0.85	0.76
5-1/2	1.00	1.00	0.97	0.87	0.78
6	1.00	1.00	1.00	0.90	0.80
6-1/2	1.00	1.00	1.00	0.92	0.82
7	1.00	1.00	1.00	0.94	0.84
7-1/2	1.00	1.00	1.00	0.97	0.86
8	1.00	1.00	1.00	0.99	0.87
8-1/4	1.00	1.00	1.00	1.00	0.88
8-1/2	1.00	1.00	1.00	1.00	0.89
9	1.00	1.00	1.00	1.00	0.91
9-1/2	1.00	1.00	1.00	1.00	0.93
10	1.00	1.00	1.00	1.00	0.95
10-1/2	1.00	1.00	1.00	1.00	0.97
11	1.00	1.00	1.00	1.00	0.99
11-1/4	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 Embed. h_{nom} (in)	1-3/4	1-7/8	2-1/2	3-1/4	4-1/2
Critical Edge Distance, c_{ac} (in)	5	5	7-1/2	9-1/2	9
Min. Edge Distance, c_{min} (in)	1-3/4	3	3	4-1/2	5
Edge Distance (inches)					
1-1/2	-	-	-	-	-
1-3/4	0.35	-	-	-	-
2	0.40	-	-	-	-
2-1/4	0.45	-	-	-	-
2-1/2	0.50	-	-	-	-
2-3/4	0.55	-	-	-	-
3	0.60	0.60	0.40	-	-
3-1/2	0.70	0.70	0.47	-	-
4	0.80	0.80	0.53	-	-
4-1/2	0.90	0.90	0.60	0.47	-
5	1.00	1.00	0.67	0.53	0.56
5-1/2	1.00	1.00	0.73	0.58	0.61
6	1.00	1.00	0.80	0.63	0.67
6-1/2	1.00	1.00	0.87	0.68	0.72
7	1.00	1.00	0.93	0.74	0.78
7-1/2	1.00	1.00	1.00	0.79	0.83
8	1.00	1.00	1.00	0.84	0.89
8-1/2	1.00	1.00	1.00	0.89	0.94
9	1.00	1.00	1.00	0.95	1.00
9-1/2	1.00	1.00	1.00	1.00	1.00

SPACING DISTANCE AND EDGE DISTANCE ADJUSTMENT FACTORS FOR NORMAL WEIGHT CONCRETE - SHEAR (F_{VS}, F_{VC})

Spacing Reduction Factors - Shear (F_{VS})

Diameter (in)	1/4	3/8	1/2	5/8	3/4
Nominal Embed. h_{nom} (in)	1-3/4	1-7/8	2-1/2	3-1/4	4-1/2
Minimum Spacing, s_{min} (in)	2	3	3	5	5
Spacing Distance (inches)					
1-3/4	-	-	-	-	-
2	0.87	-	-	-	-
2-1/4	0.88	-	-	-	-
2-1/2	0.90	-	-	-	-
2-3/4	0.91	-	-	-	-
3	0.92	0.92	0.89	-	-
3-1/2	0.95	0.95	0.91	-	-
4	0.97	0.97	0.93	-	-
4-1/2	1.00	1.00	0.95	-	-
5	1.00	1.00	0.96	0.91	0.84
5-1/2	1.00	1.00	0.98	0.93	0.85
6	1.00	1.00	1.00	0.94	0.86
6-1/2	1.00	1.00	1.00	0.95	0.88
7	1.00	1.00	1.00	0.97	0.89
7-1/2	1.00	1.00	1.00	0.98	0.90
8	1.00	1.00	1.00	0.99	0.92
8-1/4	1.00	1.00	1.00	1.00	0.92
8-1/2	1.00	1.00	1.00	1.00	0.93
9	1.00	1.00	1.00	1.00	0.94
9-1/2	1.00	1.00	1.00	1.00	0.95
10	1.00	1.00	1.00	1.00	0.97
10-1/2	1.00	1.00	1.00	1.00	0.98
11	1.00	1.00	1.00	1.00	0.99
11-1/4	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 Embed. h_{nom} (in)	1-3/4	1-7/8	2-1/2	3-1/4	4-1/2
Min. Edge Distance, c_{min} (in)	1-3/4	3	3	4-1/2	5
Edge Distance (inches)					
1-1/2	-	-	-	-	-
1-3/4	0.39	-	-	-	-
2	0.44	-	-	-	-
2-1/4	0.50	-	-	-	-
2-1/2	0.56	-	-	-	-
2-3/4	0.61	-	-	-	-
3	0.67	0.67	0.50	-	-
3-1/2	0.78	0.78	0.58	-	-
4	0.89	0.89	0.67	-	-
4-1/2	1.00	1.00	0.75	0.55	-
5	1.00	1.00	0.83	0.61	0.44
5-1/2	1.00	1.00	0.92	0.67	0.49
6	1.00	1.00	1.00	0.73	0.53
6-1/2	1.00	1.00	1.00	0.79	0.58
7	1.00	1.00	1.00	0.85	0.62
7-1/2	1.00	1.00	1.00	0.91	0.67
8	1.00	1.00	1.00	0.97	0.71
8-1/4	1.00	1.00	1.00	1.00	0.73
8-1/2	1.00	1.00	1.00	1.00	0.76
9	1.00	1.00	1.00	1.00	0.80
9-1/2	1.00	1.00	1.00	1.00	0.84
10	1.00	1.00	1.00	1.00	0.89
10-1/2	1.00	1.00	1.00	1.00	0.93
11	1.00	1.00	1.00	1.00	0.98
11-1/4	1.00	1.00	1.00	1.00	1.00

PERFORMANCE DATA

Ultimate Load Capacities for Power-Stud+ SD4 and Power-Stud+ SD6 installed into the Face of Grout Filled Concrete Masonry[1,2]

Nominal Anchor Diameter in.	Minimum Embedment h_{nom} in. (mm)	Minimum Edge Distance in. (mm)	Minimum End Distance in. (mm)	Ultimate Tension Load lb (kN)	Direction of Shear Loading	Ultimate Shear Load lb (kN)
1/2	2-3/8 (60)	3 (76.2)	3 (76.2)	1,695 (7.5)	Any	2,080 (9.3)
		12 (304.8)	12 (304.8)	2,425 (10.8)	Any	4,905 (21.8)
5/8	3-1/4 (83)	12 (304.8)	12 (304.8)	5,565 (24.8)	Any	7,944 (35.3)

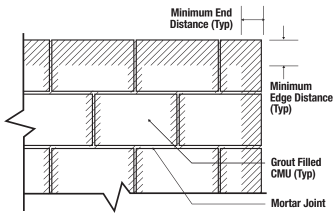
1. Tabulated load values are for anchors installed in minimum 8 inch wide, minimum Grade N, Type II, normal-weight concrete masonry units conforming to ASTM C 90. Mortar must be minimum Type N. Masonry compressive strength must be at the specified minimum at the time of installation.
2. Ultimate load capacities must be reduced by a minimum safety factor of 5.0 or greater to determine allowable working loads.

Allowable Load Capacities for Power-Stud+ SD4 and Power-Stud+ SD6 installed into the Face of Grout Filled Concrete Masonry[1,2,3,4,5]

ALLOWABLE STRESS DESIGN ASD

Nominal Anchor Diameter in.	Minimum Embedment h_{nom} in. (mm)	Minimum Edge Distance in. (mm)	Minimum End Distance in. (mm)	Allowable Tension Load lb (kN)	Direction of Shear Loading	Allowable Shear Load lb (kN)
1/2	2-3/8 (60)	3 (76.2)	3 (76.2)	340 (1.5)	Any	415 (1.8)
		12 (304.8)	12 (304.8)	485 (2.2)	Any	980 (4.4)
5/8	3-1/4 (83)	12 (304.8)	12 (304.8)	1,115 (5.0)	Any	1,590 (7.1)

1. Tabulated load values are for anchors installed in minimum 8 inch wide, minimum Grade N, Type II, normal-weight concrete masonry units conforming to ASTM C 90. Mortar must be minimum Type N. Masonry compressive strength must be at the specified minimum at the time of installation.
2. Allowable load capacities listed are calculated using an applied safety factor of 5.0. Consideration of safety factors of 10 or higher may be necessary depending upon the application such as life safety.
3. The tabulated values are applicable for anchors installed in grouted masonry wall faces at a critical spacing distance, s_{cr}, between anchors of 16 times the anchor diameter. The spacing distance between two anchors may be reduced to a minimum distance, s_{min}, of 8 times the anchor diameter provided the allowable tension loads are multiplied a reduction factor of 0.80 and allowable shear loads are multiplied by a reduction factor of 0.90. Linear interpolation for calculation of allowable loads may be used for intermediate anchor spacing distances.
4. Anchors may be installed in the grouted cells and in cell webs and bed joints not closer than 1-3/8" from head joints. The minimum edge and end distances must also be maintained.
5. Allowable tension values for anchors installed into bed joints of grouted masonry wall faces with a minimum of 12" edge and end distance may be increased by 20 percent for the 1/2-inch diameter and 10 percent for the 5/8-inch diameter.



Wall Face
Permissible Anchor Locations
(Un-hatched Area)

STRENGTH DESIGN (SD)

Strength Design Installation Table for Power-Stud+ SD4 and Power-Stud+ SD6[1,4]

CODE LISTED
ICC-ES ESR-2502

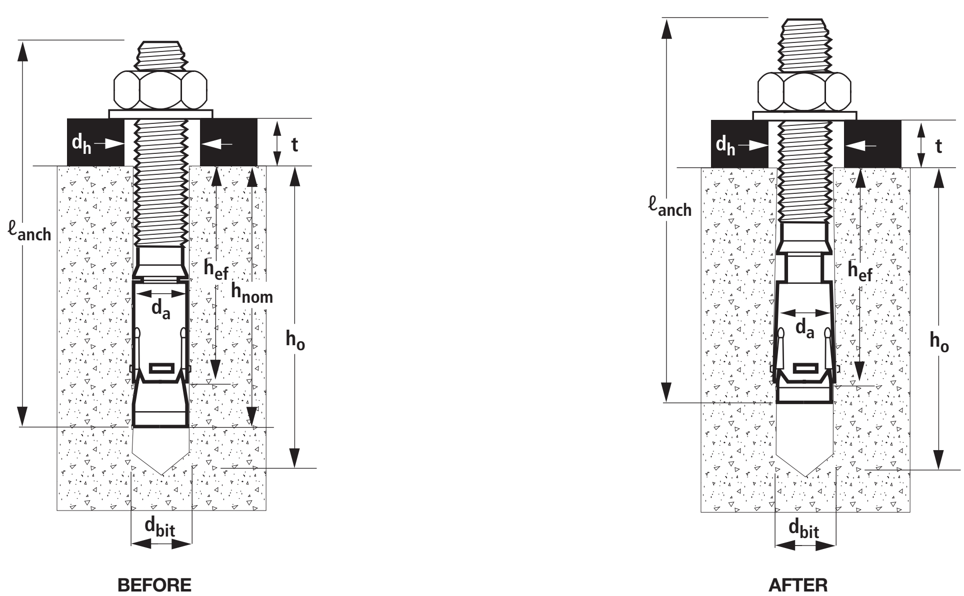
STRENGTH DESIGN SD TABLES

Anchor Property/Setting Information	Notation	Units	Nominal Anchor Diameter 1/4	3/8		1/2		5/8		3/4	
Anchor outside diameter	d_a	in. (mm)	0.250 (6.4)	0.375 (9.5)		0.500 (12.7)		0.625 (15.9)		0.750 (19.1)	
Minimum diameter of hole clearance in fixture	d_h	in. (mm)	5/16 (7.9)	7/16 (11.1)		9/16 (14.3)		11/16 (17.5)		13/16 (20.6)	
Nominal drill bit diameter	d_{bit}	in.	1/4 ANSI	3/8 ANSI		1/2 ANSI		5/8 ANSI		3/4 ANSI	
Minimum nominal embedment depth[2]	h_{nom}	in. (mm)	1-3/4 (44)	1-7/8 (48)		2-1/2 (64)		3-1/4 (83)		4-1/2 (114)	
Effective embedment	h_{ef}	in. (mm)	1.50 (38)	1.50 (38)		2.00 (51)		2.75 (70)		3-3/4 (95)	
Minimum hole depth	h_o	in. (mm)	1-7/8 (48)	2 (51)		2-5/8 (67)		3-1/2 (89)		4-3/4 (121)	
Minimum member thickness	h_{min}	in. (mm)	3-1/4 (83)	3-1/4 (83)	4 (102)	4 (102)		5 (127)		6 (152)	
Minimum overall anchor length[3]	ℓ_{anch}	in. (mm)	2-1/4 (57)	2-3/4 (70)		3-3/4 (95)		4-1/2 (114)		5-1/2 (140)	
Minimum edge distance	c_{min}	in. (mm)	1-3/4 (44)	3 (76)	3-1/2 (89)	6 (152)	3 (76)	4-1/2 (114)	8-1/2 (216)	5 (127)	9 (229)
Minimum spacing distance	s_{min}	in. (mm)	2 (51)	5-1/2 (140)	3 (76)	3 (76)	6 (152)	8-1/2 (216)	5 (127)	9 (229)	5 (127)
Critical edge distance	c_{ac}	in. (mm)	5 (127)	5 (127)		7-1/2 (191)		9-1/2 (241)		9 (229)	
Installation torque	T_{inst}	ft.-lbf. (N-m)	6 (8)	25 (34)		40 (54)		60 (81)		110 (149)	
Torque wrench/socket size	-	in.	7/16	9/16		3/4		15/16		1-1/8	
Nut height	-	in.	7/32	21/64		7/16		35/64		41/64	

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 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable.
2. The embedment depth, h_{nom}, is measured from the outside surface of the concrete member to the embedded end of the anchor prior to tightening.
3. The listed minimum overall anchor length is based on anchor sizes commercially available at the time of publication compared with the requirements to achieve the minimum nominal embedment depth and possible fixture attachment.
4. The anchors may be installed in the topside of concrete-filled steel deck floor and roof assemblies in accordance with the following: the 1/4-inch diameter anchors must be installed in uncracked normal-weight or sand-lightweight concrete; 3/8-inch to 3/4-inch diameter anchors must be installed in cracked and uncracked normal-weight or sand-lightweight concrete over steel deck having a minimum specified compressive strength, f'c, of 3,000 psi (20.7 MPa) provided the concrete thickness above the upper flute meets the minimum thickness specified in this table.

Power-Stud+ SD4 and Power-Stud+ SD6 Anchor Detail



Application of Installation Torque

Tension Design Information for Power-Stud+ SD4 and Power-Stud+ SD6 Anchors in Concrete (For use with load combinations taken from ACI 318-14, Section 5.3 or ACI 318-11, Section 9.2)[1,8]

CODE LISTED
ICC-ES ESR-2502

Design Characteristic		Notation	Units	Nominal Anchor Diameter 1/4	3/8	1/2	5/8	3/4
Anchor category		1,2 or 3	-	1	1	1	1	1
Nominal embedment depth		h_{nom}	in.	1-3/4	1-7/8	2-3/8	3-1/4	4-1/2
STEEL STRENGTH IN TENSION (ACI 318-14 17.4.1 or ACI 318-11 D.5.1)								
Minimum specified yield strength (neck		f_y	ksi (N/mm²)	60 (414)	60 (414)	60 (414)	60 (414)	60 (414)
Minimum specified ultimate tensile strength (neck)		f_{uta}	ksi (N/mm²)	90 (621)	90 (621)	90 (621)	90 (621)	90 (621)
Effective tensile stress area (neck)		$A_{se,N}$	in² (mm²)	0.0249 (16.1)	0.0530 (34.2)	0.1020 (65.8)	0.1630 (105.2)	0.2380 (151)
Steel strength in tension		N_{sa}	lb (kN)	2,240 (10.0)	4,780 (21.3)	9,160 (40.8)	14,635 (65.1)	21,380 (95.1)
Reduction factor for steel strength[2,3]		ϕ	-	0.75				
CONCRETE BREAKOUT STRENGTH IN TENSION (ACI 318-14 17.4.2 or ACI 318-11 D.5.2)[8]								
Effective embedment		h_{ef}	in. (mm)	1.50 (38)	1.50 (38)	2.00 (51)	2.75 (70)	3.75 (95)
Effectiveness factor for uncracked concrete		k_{uncr}	-	24	24	24	24	24
Effectiveness factor for cracked concrete		k_{cr}	-	Not Applicable	17	21	21	21
Modification factor for cracked and uncracked concrete		$\psi_{c,N}$	-	1.0 See Note 5	1.0 See Note 5	1.0 See Note 5	1.0 See Note 5	1.0 See Note 5
Critical edge distance (uncracked concrete only)		c_{ac}	in. (mm)	5 (127)	5 (127)	7-1/2 (191)	9-1/2 (241)	9 (229)
Reduction factor for concrete breakout strength[4]		ϕ	-	0.65 (Condition B)				
PULLOUT STRENGTH IN TENSION (ACI 318-14 17.4.3 or ACI 318-11 D.5.3)[8]								
Characteristic pullout strength, uncracked concrete (2,500 psi)[5]		$N_{p,uncr}$	lb (kN)	1,510 (6.7)	See Note 7	See Note 7	See Note 7	8,520 (37.8)
Characteristic pullout strength, cracked concrete (2,500 psi)[5]		$N_{p,cr}$	lb (kN)	Not Applicable	See Note 7	See Note 7	See Note 7	See Note 7
Reduction factor for pullout strength[3]		ϕ	-	0.65 (Condition B)				
PULLOUT STRENGTH IN TENSION FOR SEISMIC APPLICATIONS (ACI 318-14 17.2.3.3 or ACI 318-11 D.3.3.3)[8]								
Characteristic pullout strength, seismic (2,500 psi)[6,9]		$N_{p,eq}$	lb (kN)	Not Applicable	1,645 (7.3)	See Note 7	See Note 7	See Note 7
Reduction factor for pullout strength[4]		ϕ	-	0.65 (Condition B)				
Mean axial stiffnes values for service load range	Uncracked concrete	β	lbf/in (kN/mm)	171,400 (30,060)	490,000 (86,000)	459,000 (80,500)	234,000 (41,000)	395,000 (69,300)
	Cracked concrete	β	lbf/in (kN/mm)	Not Applicable	228,000 (40,000)	392,000 (68,800)	193,000 (33,800)	76,600 (13,400)

For SI: 1 inch = 25.4 mm; 1 ft-lbf = 1.356 N-m; 1 ksi = 6.894 N/mm²; 1 lb = 0.0044 kN.

1. The data in this table is intended to be used with the design provisions of ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable, shall apply.
2. The tabulated value of ϕ for steel strength applies when the load combinations of Section 1605.2 of the IBC, ACI 318-14 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.4.4.
3. The anchors are ductile steel elements as defined in ACI 318-14 2.3 or ACI 318-11 D.1, as applicable.
4. The tabulated value of ϕ for concrete breakout strength and pullout strength applies when both the load combinations of Section 1605.2 of the IBC, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used and the requirements of ACI 318-14 17.3.3 or ACI 318-11 D.4.3, for Condition B are satisfied. If the load combinations of Section 1605.2 of the IBC ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used and the requirements of ACI 318-14 17.3.3 or ACI 318-11 D.4.3, for Condition A are satisfied, the appropriate value of ϕ for concrete breakout strength and pullout strength must be determined in accordance with ACI 318-14 17.3.3 or ACI 318-11 D.4.3. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ for concrete breakout strength and pullout strength must be determined in accordance with ACI 318-11 D.4.4.
5. For all design cases $\psi_{c,N}$ =1.0. The appropriate effectiveness factor for cracked concrete (k_{cr}) or uncracked concrete (k_{uncr}) must be used.
6. For all design cases $\psi_{c,P}$ =1.0. For concrete compressive strength greater than 2,500 psi, N_{pn} = (pullout strength value from table)*(specified concrete compressive strength/2,500)$^{0.5}$.
7. Pullout strength does not control design of indicated anchors. Do not calculate pullout strength for indicated anchor size and embedment.
8. 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.
9. Tabulated values for characteristic pullout strength in tension are for seismic applications and are based on test results per ACI 355.2, Section 9.5.
10. Actual stiffness of the mean value varies depending on concrete strength, loading and geometry of application.

Shear Design Information for Power-Stud+ SD4 and Power-Stud+ SD6 Anchors in Concrete (For use with load combinations taken from ACI 318-14, Section 5.3 or ACI 318-11, Section 9.2)[1,7]

CODE LISTED
ICC-ES ESR-2502

Design Characteristic	Notation	Units	Nominal Anchor Diameter				
			1/4	3/8	1/2	5/8	3/4
Anchor category	1, 2 or 3	-	1	1	1	1	1
Nominal embedment depth	h_{nom}	in.	1-3/4	1-7/8	2-3/8	3-1/4	4-1/2
STEEL STRENGTH IN SHEAR (ACI 318-14 17.5.1 or ACI 318-11 D.6.1)[4]							
Minimum specified yield strength (threads)	f_y	ksi (N/mm²)	60 (414)	60 (414)	60 (414)	60 (414)	60 (414)
Minimum specified ultimate strength (threads)	f_{uta}	ksi (N/mm²)	90 (621)	90 (621)	90 (621)	90 (621)	90 (621)
Effective tensile stress area (threads)	$A_{se,V}$ [A_{se}][8]	in² (mm²)	0.0318 (20.5)	0.078 (50.3)	0.142 (91.6)	0.226 (145.8)	0.334 (212)
Steel strength in shear[6]	V_{sa}	lb (kN)	1,115 (5.0)	1,470 (6.6)	3,170 (14.3)	7,455 (33.6)	11,955 (53.2)
Reduction factor for steel strength[2,3]	ϕ	-	0.65				
CONCRETE BREAKOUT STRENGTH IN SHEAR (ACI 318-14 17.5.2 or ACI 318-11 D.6.2)							
Load bearing length of anchor (h_{ef} or $8d_a$, whichever is less)	ℓ_e	in. (mm)	1.50 (38.1)	1.50 (38.1)	2.00 (50.8)	2.75 (69.9)	3.75 (95)
Nominal anchor diameter	d_a	in. (mm)	0.250 (6.4)	0.375 (9.5)	0.500 (12.7)	0.625 (15.9)	0.750 (19.1)
Reduction factor for concrete breakout[4]	ϕ	-	0.70 (Condition B)				
CONCRETE PRYOUT STRENGTH IN SHEAR (ACI 318-14 17.2.3.3 or ACI 318-11 D.6.3)							
Coefficient for pryout strength (1.0 for h_{ef} < 2.5 in., 2.0 for $h_{ef} \geq$ 2.5 in.)	k_{cp}	-	1.0	1.0	1.0	2.0	2.0
Effective embedment	h_{ef}	in. (mm)	1.50 (38.1)	1.50 (38.1)	2.00 (50.8)	2.75 (69.9)	3.75 (95)
Reduction factor for pryout strength[5]	ϕ	-	0.70 (Condition B)				
STEEL STRENGTH IN SHEAR FOR SEISMIC APPLICATIONS (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)	Not Applicable	1,305 (5.9)	2,765 (12.3)	5,240 (23.3)	7,745 (34.5)
Reduction factor for steel strength in shear for seismic[2]	ϕ	-	0.65				

For SI: 1 inch = 25.4 mm; 1 ft-lbf = 1.356 N-m; 1 ksi = 6.894 N/mm²; 1 lb = 0.0044 kN.

1. The data in this table is intended to be used with the design provisions of ACI 318-14 Chapter or ACI 318-11 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable, shall apply.
2. The tabulated value of ϕ for steel strength applies when the load combinations of Section 1605.2 of the IBC, ACI 318-14 Section 5.3 or ACI 318-11Section 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.4.4.
3. The anchors are ductile steel elements as defined in ACI 318-14 2.3 or ACI 318-11 D.1, as applicable.
4. The tabulated value of ϕ for concrete breakout strength applies when both the load combinations of Section 1605.2 of the IBC, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used and the requirements of ACI 318-14 17.3.3 or ACI 318-11 D.4.3, for Condition B are satisfied. If the load combinations of Section 1605.2 of the IBC, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used and the requirements of ACI 318-14 14.3.3 or ACI 318-11 D.4.3, for Condition A are satisfied, the appropriate value of ϕ for concrete breakout strength must be determined in accordance with 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 318-14 5.3 or ACI 318-11 Section 9.2 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, Condition B.
6. Tabulated values for steel strength in shear must be used for design.
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 are based on test results per ACI 355.2, Section 9.6.

STRENGTH DESIGN PERFORMANCE DATA

Factored design strength ϕN_n and ϕV_n
Calculated in accordance with ACI 318-14 Chapter 17
Compliant with the International Building Code

Tension and Shear Design Strengths Installed in Cracked Concrete[1-6]

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_{sa}, ϕN_{cb} or ϕN_{cp} Tension (lbs.)	ϕV_{sa}, ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{sa}, ϕN_{cb} or ϕN_{cp} Tension (lbs.)	ϕV_{sa}, ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{sa}, ϕN_{cb} or ϕN_{cp} Tension (lbs.)	ϕV_{sa}, ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{sa}, ϕN_{cb} or ϕN_{cp} Tension (lbs.)	ϕV_{sa}, ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{sa}, ϕN_{cb} or ϕN_{cp} Tension (lbs.)	ϕV_{sa}, ϕV_{cb} or ϕV_{cp} Shear (lbs.)
1/4	-	-	-	-	-	-	-	-	-	-	-
3/8	1-7/8	1,015	955	1,110	955	1,285	955	1,570	955	1,815	955
1/2	2-1/2	1,930	2,060	2,115	2,060	2,440	2,060	2,990	2,060	3,455	2,060
5/8	3-1/4	3,110	4,520	3,410	4,845	3,935	4,845	4,820	4,845	5,570	4,845
3/4	4-1/2	4,955	5,270	5,430	5,770	6,270	6,665	7,680	7,770	8,865	7,770

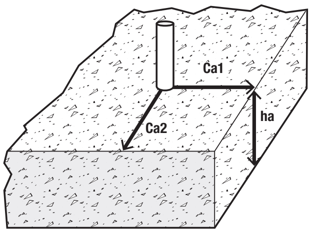
□ - Anchor Pullout/Pryout Strength Controls □ - Concrete Breakout Strength Controls ■ - Steel Strength Controls

Tension and Shear Design Strengths Installed in Uncracked Concrete[1-6]

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_{sa}, ϕN_{cb} or ϕN_{cp} Tension (lbs.)	ϕV_{sa}, ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{sa}, ϕN_{cb} or ϕN_{cp} Tension (lbs.)	ϕV_{sa}, ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{sa}, ϕN_{cb} or ϕN_{cp} Tension (lbs.)	ϕV_{sa}, ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{sa}, ϕN_{cb} or ϕN_{cp} Tension (lbs.)	ϕV_{sa}, ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{sa}, ϕN_{cb} or ϕN_{cp} Tension (lbs.)	ϕV_{sa}, ϕV_{cb} or ϕV_{cp} Shear (lbs.)
1/4	1-3/4	980	725	1,075	725	1,240	725	1,520	725	1,680	725
3/8	1-7/8	1,435	955	1,570	955	1,815	955	2,220	955	2,565	955
1/2	2-1/2	2,205	2,060	2,415	2,060	2,790	2,060	3,420	2,060	3,945	2,060
5/8	3-1/4	3,555	4,845	3,895	4,845	4,500	4,845	5,510	4,845	6,365	4,845
3/4	4-1/2	5,540	7,375	6,065	7,770	7,005	7,770	8,580	7,770	9,905	7,770

□ - Anchor Pullout/Pryout Strength Controls □ - 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, $h_a = h_{min}$, 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}.
2- Calculations were performed according to ACI 318-14 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 318-14 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 318-14 Chapter 17.
6- Interpolation is not permitted to be used with the tabular values. For intermediate base material compressive strengths please see ACI 318-14 Chapter 17. For other design conditions including seismic considerations please see ACI 318-14 Chapter 17.



ORDERING INFORMATION

Power-Stud+ SD4 (Type 304 Stainless Steel Body)

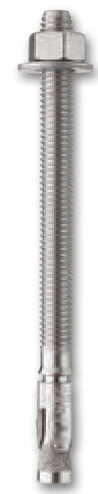
Cat. No.	Anchor Size	Thread Length	Box Qty.	Carton Qty.	ANSI Carbide Drill Bit Cat. No.		
					Full Head Carbide SDS-Plus	Carbide SDS-Plus	Carbide SDS-Max
7300SD4	1/4" x 1-3/4"	3/4"	100	600	DW5517	DW5416	-
7302SD4	1/4" x 2-1/4"	1-1/4"	100	600	DW5517	DW5417	-
7304SD4	1/4" x 3-1/4"	2-1/4"	100	600	DW5517	DW5417	-
7313SD4	3/8" x 3"	1-5/8"	50	300	DW5527	DW5427	-
7315SD4	3/8" x 3-3/4"	2-3/8"	50	300	DW5527	DW5427	-
7316SD4	3/8" x 5"	3-5/8"	50	300	DW55300	DW5429	-
7322SD4	1/2" x 3-3/4"	2"	50	200	DW5537	DW5437	DW5803
7323SD4	1/2" x 4-1/2"	2-3/4"	50	200	DW5539	DW5438	DW5803
7324SD4	1/2" x 5-1/2"	3-3/4"	50	150	DW5539	DW5438	DW5803
7326SD4	1/2" x 7"	5-1/4"	25	100	DW5539	DW5438	DW5803
7333SD4	5/8" x 5"	3"	25	100	-	DW5439	DW5806
7334SD4	5/8" x 6"	4"	25	75	-	DW5439	DW5806
7338SD4	5/8" x 8-1/2"	6-1/2"	25	50	-	DW5447	DW5809
7342SD4	3/4" X 5-1/2"	3-1/8"	20	60	-	DW5453	DW5810
7348SD4	3/4" X 8-1/2"	6-1/8"	10	40	-	DW5455	DW5812

Power-Stud+ SD4 and Power-Stud+ SD6 anchors can be domestically manufactured (assembled in the USA with foreign and domestic components) and are available for special order only. Call for details.

Shaded catalog numbers denote sizes which are less than the minimum standard anchor length for strength design.

The published size includes the diameter and the overall length of the anchor.

All anchors are packaged with nuts and washers.



Power-Stud+ SD6 (Type 316 Stainless Steel Body)

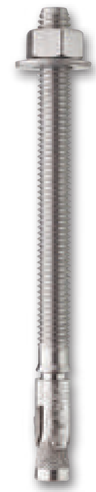
Cat. No.	Anchor Size	Thread Length	Box Qty.	Carton Qty.	ANSI Carbide Drill Bit Cat. No.		
					Full Head Carbide SDS-Plus	Carbide SDS-Plus	Carbide SDS-Max
7600SD6	1/4" x 1-3/4"	3/4"	100	600	DW5517	DW5416	-
7602SD6	1/4" x 2-1/4"	1-1/4"	100	600	DW5517	DW5417	-
7604SD6	1/4" x 3-1/4"	2-1/4"	100	600	DW5517	DW5417	-
7610SD6	3/8" x 2-1/4"	7/8"	50	300	DW5527	DW5427	-
7612SD6	3/8" x 2-3/4"	1-3/8"	50	300	DW5527	DW5427	-
7613SD6	3/8" x 3"	1-5/8"	50	300	DW5527	DW5427	-
7614SD6	3/8" x 3-1/2"	2-1/8"	50	300	DW5527	DW5427	-
7615SD6	3/8" x 3-3/4"	2-3/8"	50	300	DW5527	DW5427	-
7616SD6	3/8" x 5"	3-5/8"	50	300	DW55300	DW5429	-
7617SD6	3/8" x 7"	5-5/8"	50	200	DW55300	DW5429	-
7620SD6	1/2" x 2-3/4"	1"	50	200	DW5537	DW5437	DW5803
7622SD6	1/2" x 3-3/4"	2"	50	200	DW5537	DW5437	DW5803
7623SD6	1/2" x 4-1/2"	2-3/4"	50	200	DW5539	DW5438	DW5803
7624SD6	1/2" x 5-1/2"	3-3/4"	50	100	DW5539	DW5438	DW5803
7626SD6	1/2" x 7"	5-1/4"	25	100	DW5539	DW5438	DW5803
7630SD6	5/8" x 3-1/2"	1-1/2"	25	100	-	DW5446	DW5806
7632SD6	5/8" x 4-1/2"	2-1/2"	25	100	-	DW5446	DW5806
7633SD6	5/8" x 5"	3"	25	100	-	DW5446	DW5806
7634SD6	5/8" x 6"	4"	25	75	-	DW5446	DW5806
7636SD6	5/8" x 7"	5"	25	75	-	DW5447	DW5806
7638SD6	5/8" x 8-1/2"	6-1/2"	25	50	-	DW5447	DW5809
7640SD6	3/4" X 4-1/4"	1-7/8"	20	60	-	DW5453	DW5810
7641SD6	3/4" X 4-3/4"	2-3/8"	20	60	-	DW5453	DW5810
7642SD6	3/4" X 5-1/2"	3-1/8"	20	60	-	DW5453	DW5810
7644SD6	3/4" X 6-1/4"	3-7/8"	20	60	-	DW5455	DW5810
7646SD6	3/4" X 7"	4-5/8"	20	60	-	DW5455	DW5810
7648SD6	3/4" X 8-1/2"	6-1/8"	10	40	-	DW5455	DW5812

Power-Stud+ SD4 and Power-Stud+ SD6 anchors can be domestically manufactured (assembled in the USA with foreign and domestic components) and are available for special order only. Call for details.

Shaded catalog numbers denote sizes which are less than the minimum standard anchor length for strength design.

The published size includes the diameter and the overall length of the anchor.

All anchors are packaged with nuts and washers.



Installation Accessories

Cat. No.	Description	Box Qty
08280	Hand pump / dust blower	1

MECHANICAL ANCHORS

POWER-STUD® HD5
Hot-Dip Galvanized Wedge Expansion Anchor

GENERAL INFORMATION

POWER-STUD® HD5

Hot-Dip Galvanized Wedge Expansion Anchor

PRODUCT DESCRIPTION

The Power-Stud HD5 anchor is a fully threaded, torque-controlled, wedge expansion anchor. Suitable base materials include normal-weight concrete, sand-lightweight concrete and grouted concrete masonry. The anchor is manufactured with a hot-dip galvanized carbon steel body and stainless steel expansion clip. Nut and washer are included.

GENERAL APPLICATIONS AND USES

- Racking and Shelving
- Material Handling
- Support Ledgers
- Storage Facilities
- Fencing
- Repairs
- Maintenance
- Retrofits

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

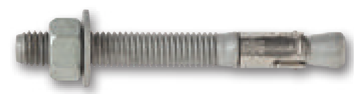
GUIDE SPECIFICATIONS

CSI Divisions: 03 16 00 - Concrete Anchors, 04 05 19.16 - Masonry Anchors and 05 05 19 Post - Installed Concrete Anchors. Expansion Anchors shall be Power-Stud HD5 as supplied by DeWALT, Towson, MD. Anchors shall be installed in accordance with published instructions and the Authority Having Jurisdiction.

MATERIAL SPECIFICATIONS

Anchor Component	Specification
Anchor body	Medium carbon steel
Hex Nut	Carbon steel, ASTM A 563, Grade A
Washer	Carbon steel ASTM F 844; meets dimensional requirements of ANSI B18.22.2, Type A plain
Expansion wedge (clip)	Type 304 Stainless Steel
Plating (Anchor, body, nut, washer)	Zinc Galvanized According to ASTM A 153 Class C or D

SECTION CONTENTS



POWER-STUD HD5 ASSEMBLY

THREAD VERSION

- UNC Threaded Stud

ANCHOR MATERIALS

- Hot-dip galvanized carbon steel body, stainless steel expansion clip, hot-dip galvanized nut and washer

ROD/ANCHOR SIZE RANGE (TYP.)

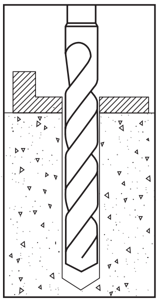
- 3/8" diameter through 3/4" diameter

SUITABLE BASE MATERIALS

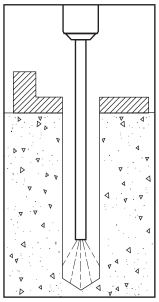
- Normal-weight concrete
- Sand-lightweight concrete
- Grouted concrete masonry

INSTALLATION INSTRUCTIONS

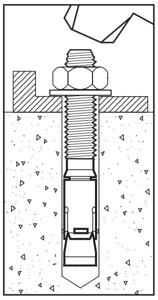
Installation Instructions for Power-Stud HD5



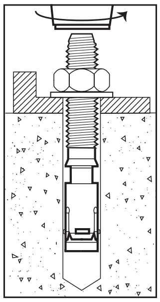
Step 1
Using the proper drill bit size, drill a hole into the base material to the required depth. The tolerances of the drill bit used should meet the requirements of ANSI Standard B212.15.



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.

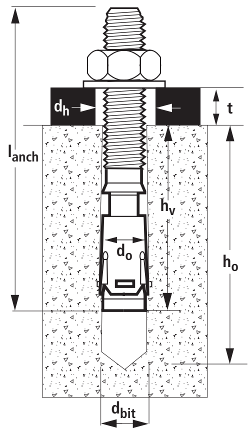


Step 3
Position the washer on the anchor and thread on the nut. If installing through a fixture, drive the anchor through the fixture into the hole. Be sure the anchor is driven to the minimum required embedment depth, h_v.



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

Anchor Specifications



Length Identification

Mark	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
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"
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"

Length identification mark indicates overall length of anchor.

REFERENCE DATA (ASD)

Installation Specification for Power-Stud HD5 in Concrete

Anchor Property/ Setting Information	Notation	Units	Nominal Anchor Diameter (inch)									
			3/8		1/2			5/8			3/4	
Anchor outside diameter	d	in. (mm)	0.375 (9.525)		0.500 (12.7)			0.625 (15.9)			0.750 (19.05)	
Minimum diameter of hole clearance in fixture	d_h	in. (mm)	7/16 (11.1)		9/16 (14.3)			11/16 (17.5)			13/16 (20.6)	
Nominal drill bit diameter	d_{bit}	in. (mm)	3/8 ANSI		1/2 ANSI			5/8 ANSI			3/4 ANSI	
Minimum nominal embedment depth	h_v	in. (mm)	1-3/4 (44)	2-3/8 (60)	2 (51)	2-1/2 (64)	3-3/4 (95)	2-3/8 (60)	3-3/8 (86)	4-5/8 (117)	3-3/8 (66)	5 (127)
Minimum hole depth	h_o	in. (mm)	2 (51)	2-5/8 (67)	2-1/2 (64)	3 (76)	4-1/4 (108)	2-7/8 (73)	3-7/8 (98)	5-1/8 (130)	3-7/8 (98)	5-1/2 (140)
Minimum member thickness	h_{min}	in. (mm)	3-1/4 (83)	4 (102)	4 (102)	5 (127)	6 (152)	5 (127)	6 (152)	7 (178)	6 (152)	10 (254)
Minimum overall anchor length[1]	ℓ_{anch}	in. (mm)	3 (76)	3 (76)	2-3/4 (70)	3-3/4 (95)	4-1/2 (114)	3-1/2 (89)	5 (127)	6 (152)	4-3/4 (121)	5-1/2 (140)
Minimum edge distance	c_{min}	in. (mm)	3 (76)	2-1/4 (57)	4 (102)	5-1/4 (133)	4 (102)	4-1/4 (108)	5-1/2 (140)	4-1/4 (108)	5 (127)	4-1/2 (114)
Minimum spacing distance	s_{min}	in. (mm)	5-1/4 (133)	3-3/4 (95)	6 (152)	7-1/4 (184)	5 (127)	7-1/8 (181)	10-1/8 (257)	4-1/4 (108)	9 (229)	6 (152)
Critical edge distance	c_{ac}	in. (mm)	5 (127)	6-1/2 (165)	8 (203)	8-1/2 (216)	8 (203)	8 (203)	6 (152)	10 (254)	5 (127)	12 (305)
Installation torque (Normal-weight concrete)	T_{inst}	ft.-lbf. (N-m)	20 (27)		40 (54)			60 (81)			110 (149)	
Installation torque (Grout Filled CMU)	T_{inst}	ft.-lbf. (N-m)	20 (27)		40 (54)			50 (68)			80 (108)	
Torque wrench/socket size	-	in.	9/16		3/4			15/16			1-1/8	
Nut height	-	in.	21/64		7/16			35/64			41/64	

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

1. 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.

Ultimate Load Capacities for Power-Stud HD5 in Normal-Weight Concrete[1,2]

Nominal Anchor Diameter (in.)	Minimum Embedment Depth (in.)	Minimum Concrete Compressive Strength - f'c (psi)									
		2,500 psi		3,000 psi		4,000 psi		6,000 psi		8,000 psi	
		Tension (lbs)	Shear (lbs)	Tension (lbs)	Shear (lbs)	Tension (lbs)	Shear (lbs)	Tension (lbs)	Shear (lbs)	Tension (lbs)	Shear (lbs)
3/8	1-3/4	2,470	3,925	2,710	3,925	3,130	3,925	3,220	3,925	3,715	3,925
	2-3/8	3,620	3,925	3,965	3,925	4,580	3,925	5,470	3,925	6,320	3,925
1/2	2	2,690	4,195	2,950	4,195	3,405	4,195	4,170	4,195	4,815	4,195
	2-1/2	4,140	4,195	4,540	4,195	5,240	4,195	6,415	4,195	7,410	4,195
	3-3/4	8,580	4,195	9,400	4,195	10,300	4,195	10,300	4,195	10,300	4,195
5/8	2-1/2	4,115	6,815	4,505	6,815	5,200	6,815	6,370	6,815	7,355	6,815
	3-3/8	7,305	6,815	8,000	6,815	9,240	6,815	11,315	6,815	13,065	6,815
	4-5/8	11,715	6,815	12,830	6,815	14,815	6,815	16,400	6,815	16,400	6,815
3/4	3-3/8	7,080	11,570	7,750	11,570	8,955	11,570	12,125	11,570	14,000	11,570
	5	16,965	11,570	18,580	11,570	21,330	11,570	21,330	11,570	21,330	11,570

1. 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 be reduced by a minimum safety factor of 4.0 or greater to determine allowable working load.

ALLOWABLE STRESS ASD DESIGN

Allowable Load Capacities for Power-Stud HD5 in Normal-Weight Concrete[1]

Nominal Anchor Diameter (in.)	Minimum Embedment Depth (in.)	Minimum Concrete Compressive Strength - f'c (psi)									
		2,500 psi		3,000 psi		4,000 psi		6,000 psi		8,000 psi	
		Tension (lbs)	Shear (lbs)	Tension (lbs)	Shear (lbs)	Tension (lbs)	Shear (lbs)	Tension (lbs)	Shear (lbs)	Tension (lbs)	Shear (lbs)
3/8	1-3/4	620	980	680	980	785	980	805	980	930	980
	2-3/8	905	980	990	980	1,145	980	1,370	980	1,580	980
1/2	2	675	1,050	740	1,050	850	1,050	1,045	1,050	1,205	1,050
	2-1/2	1,035	1,050	1,135	1,050	1,310	1,050	1,605	1,050	1,855	1,050
	3-3/4	2,145	1,050	2,350	1,050	2,575	1,050	2,575	1,050	2,575	1,050
5/8	2-1/2	1,030	1,705	1,125	1,705	1,300	1,705	1,595	1,705	1,840	1,705
	3-3/8	1,825	1,705	2,000	1,705	2,310	1,705	2,830	1,705	3,265	1,705
	4-5/8	2,930	1,705	3,210	1,705	3,705	1,705	4,100	1,705	4,100	1,705
3/4	3-3/8	1,770	2,895	1,940	2,895	2,240	2,895	3,030	2,895	3,500	2,895
	5	4,240	2,895	4,645	2,895	5,335	2,895	5,335	2,895	5,335	2,895

1. Allowable load capacities listed are calculated using and applied safety factor of 4.0.
2. Allowable load capacities are multiplied by reduction factors when anchor spacing or edge distances are less than critical distances.

Spacing Distance and Edge Distance Tension (F_{NS}, F_{NC}) Adjustment Factors for Normal-Weight Concrete

Spacing Distance - Tension (F_{NS})

Diameter, d (in)	3/8	3/8	1/2	1/2	1/2	5/8	5/8	5/8	3/4	3/4
Minimum Embedment, h_v (in)	1-3/4	2-3/8	2	2-1/2	3-3/4	2-3/8	3-3/8	4-5/8	3-3/8	5
Minimum Spacing, s_{min} (in)	5-1/4	3-3/4	6	7-1/4	5	7-1/8	10-1/8	4-1/4	9	6
Spacing Distance (inches)										
3-3/4	-	0.80	-	-	-	-	-	-	-	-
4	-	0.82	-	-	-	-	-	-	-	-
4-1/4	-	0.83	-	-	-	-	-	0.69	-	-
4-1/2	-	0.85	-	-	-	-	-	0.70	-	-
5	-	0.88	-	-	0.75	-	-	0.71	-	-
5-1/2	1.00	0.91	-	-	0.77	-	-	0.73	-	-
6	1.00	0.93	1.00	-	0.79	-	-	0.74	-	0.74
6-1/2	1.00	0.96	1.00	-	0.81	-	-	0.76	-	0.75
7	1.00	0.99	1.00	-	0.83	-	-	0.78	-	0.77
7-1/4	1.00	1.00	1.00	0.99	0.84	-	-	0.78	-	0.78
7-1/2	1.00	1.00	1.00	1.00	0.85	1.00	-	0.79	-	0.78
8	1.00	1.00	1.00	1.00	0.87	1.00	-	0.81	-	0.80
8-1/2	1.00	1.00	1.00	1.00	0.89	1.00	-	0.83	-	0.81
9	1.00	1.00	1.00	1.00	0.91	1.00	-	0.84	0.94	0.83
9-1/2	1.00	1.00	1.00	1.00	0.93	1.00	-	0.86	0.97	0.84
10	1.00	1.00	1.00	1.00	0.95	1.00	-	0.87	0.99	0.86
10-1/2	1.00	1.00	1.00	1.00	0.97	1.00	1.00	0.89	1.00	0.87
11	1.00	1.00	1.00	1.00	0.99	1.00	1.00	0.91	1.00	0.88
11-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.92	1.00	0.90
12	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.94	1.00	0.91
12-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96	1.00	0.93
13	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97	1.00	0.94
13-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00	0.96
14	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97
14-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99
15	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Edge Distance - Tension (F_{NC})

Diameter, d (in)	3/8	3/8	1/2	1/2	1/2	5/8	5/8	5/8	3/4	3/4
Minimum Embedmend, h_v (in)	1-3/4	2-3/8	2	2-1/2	3-3/4	2-3/8	3-3/8	4-5/8	3-3/8	5
Minimum Edge Distance, c_{min} (in)	3	2-1/4	4	5-1/4	4	4-1/4	5-1/2	4-1/4	5	4-1/2
Edge Distance (inches)										
2-1/4	-	0.35	-	-	-	-	-	-	-	-
2-1/2	-	0.38	-	-	-	-	-	-	-	-
3	0.60	0.46	-	-	-	-	-	-	-	-
3-1/2	0.70	0.54	-	-	-	-	-	-	-	-
4	0.80	0.62	0.50	-	0.50	-	-	-	-	-
4-1/4	0.85	0.65	0.53	-	0.53	0.53	-	0.43	-	-
4-1/2	0.90	0.69	0.56	-	0.56	0.56	-	0.45	-	0.38
5	1.00	0.77	0.63	-	0.63	0.63	-	0.50	1.00	0.42
5-1/4	1.00	0.81	0.66	0.62	0.66	0.66	-	0.53	1.00	0.44
5-1/2	1.00	0.85	0.69	0.65	0.69	0.69	0.92	0.55	1.00	0.46
6	1.00	0.92	0.75	0.71	0.75	0.75	1.00	0.60	1.00	0.50
6-1/2	1.00	1.00	0.81	0.76	0.81	0.81	1.00	0.65	1.00	0.54
7	1.00	1.00	0.88	0.82	0.88	0.88	1.00	0.70	1.00	0.58
7-1/2	1.00	1.00	0.94	0.88	0.94	0.94	1.00	0.75	1.00	0.63
8	1.00	1.00	1.00	0.94	1.00	1.00	1.00	0.80	1.00	0.67
8-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.85	1.00	0.71
9	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.90	1.00	0.75
9-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	0.79
10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.83
10-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.88
11	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.92
11-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96
12	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Spacing Distance Shear (F_{VS}) Adjustment Factors for Normal-Weight Concrete

Spacing Distance - Shear (F_{VS})											
Diameter, d (in)		3/8	3/8	1/2	1/2	1/2	5/8	5/8	5/8	3/4	3/4
Minimum Embedment, h_v (in)		1-3/4	2-3/8	2	2-1/2	3-3/4	2-3/8	3-3/8	4-5/8	3-3/8	5
Minimum Spacing, s_{min} (in)		5-1/4	3-3/4	6	7-1/4	5	7-1/8	11	4-1/4	9	6
Spacing Distance (inches)	3-3/4	-	0.87	-	-	-	-	-	-	-	-
	4	-	0.88	-	-	-	-	-	-	-	-
	4-1/4	-	0.89	-	-	-	-	-	0.78	-	-
	4-1/2	-	0.90	-	-	-	-	-	0.79	-	-
	5	-	0.92	-	-	0.82	-	-	0.80	-	-
	5-1/2	1.00	0.94	-	-	0.84	-	-	0.81	-	-
	6	1.00	0.96	1.00	-	0.85	-	-	0.82	-	0.82
	6-1/2	1.00	0.98	1.00	-	0.87	-	-	0.83	-	0.83
	7	1.00	1.00	1.00	-	0.88	-	-	0.84	-	0.84
	7-1/2	1.00	1.00	1.00	1.00	0.89	1.00	-	0.85	-	0.85
	8	1.00	1.00	1.00	1.00	0.91	1.00	-	0.87	-	0.86
	8-1/2	1.00	1.00	1.00	1.00	0.92	1.00	-	0.88	-	0.87
	9	1.00	1.00	1.00	1.00	0.94	1.00	-	0.89	0.96	0.88
	9-1/2	1.00	1.00	1.00	1.00	0.95	1.00	-	0.90	0.98	0.89
	10	1.00	1.00	1.00	1.00	0.96	1.00	-	0.91	1.00	0.90
	10-1/2	1.00	1.00	1.00	1.00	0.98	1.00	-	0.92	1.00	0.91
	11	1.00	1.00	1.00	1.00	0.99	1.00	1.00	0.93	1.00	0.92
	11-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	0.93
	12	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96	1.00	0.94
	12-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97	1.00	0.95
	13	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	1.00	0.96
	13-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00	0.97
	14	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98
	14-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99
	15	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Edge Distance Shear (F_{VC}) Adjustment Factors for Normal-Weight Concrete

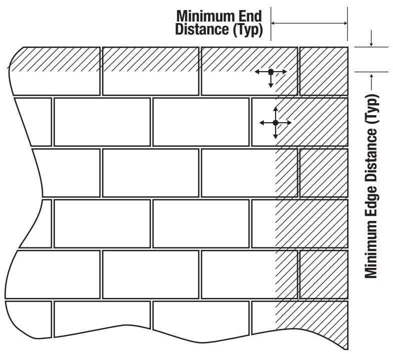
Edge Distance - Shear (F_{VC})											
Diameter, d (in)		3/8	3/8	1/2	1/2	1/2	5/8	5/8	5/8	3/4	3/4
Minimum Embedment, h_v (in)		1-3/4	2-3/8	2	2-1/2	3-3/4	2-3/8	3-3/8	4-5/8	3-3/8	5
Minimum Edge Distance, c_{min} (in)		5	6-1/2	6	8-1/2	8	7-1/8	6	10	5	12
Edge Distance (inches)	5	0.95	-	-	-	-	-	-	-	0.49	-
	5-1/2	1.00	-	-	-	-	-	-	-	0.54	-
	6	1.00	-	1.00	-	-	-	0.59	-	0.59	-
	6-1/2	1.00	0.91	1.00	-	-	-	0.64	-	0.64	-
	7	1.00	0.98	1.00	-	-	-	0.69	-	0.69	-
	7-1/2	1.00	1.00	1.00	-	-	1.00	0.74	-	0.74	-
	8	1.00	1.00	1.00	-	0.71	1.00	0.79	-	0.79	-
	8-1/2	1.00	1.00	1.00	1.00	0.76	1.00	0.84	-	0.84	-
	9	1.00	1.00	1.00	1.00	0.80	1.00	0.89	-	0.89	-
	9-1/2	1.00	1.00	1.00	1.00	0.84	1.00	0.94	-	0.94	-
	10	1.00	1.00	1.00	1.00	0.89	1.00	0.99	0.72	0.99	-
	10-1/2	1.00	1.00	1.00	1.00	0.93	1.00	1.00	0.76	1.00	-
	11	1.00	1.00	1.00	1.00	0.98	1.00	1.00	0.79	1.00	-
	11-1/4	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.81	1.00	-
	11-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.83	1.00	-
	12	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.86	1.00	0.80
	12-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.90	1.00	0.83
	13	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.94	1.00	0.87
	13-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97	1.00	0.90
	14	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.93
	14-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97
	15	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

MASONRY PERFORMANCE DATA

Ultimate and Allowable Load Capacities for Power-Stud HD5 in Grout - Filled Concrete Masonry[1,2,3]

Anchor Diameter d in.	Minimum Embed. h_v in. (mm)	Nominal Drill Bit Diameter in.	Minimum Edge Distance in. (mm)	Minimum End Distance in. (mm)	Ultimate Loads		Allowable Loads	
					Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
3/8	1-1/2 (38.1)	3/8 ANSI	4 (102)	4 (102)	1,185 (5.3)	1,340 (6.0)	235 (1.0)	270 (1.2)
1/2	2 (50.8)	1/2 ANSI	4 (102)	4 (102)	1,670 (7.4)	2,110 (9.4)	335 (1.5)	420 (1.9)
			12 (305)	12 (305)	1,860 (8.3)	2,560 (11.4)	370 (1.6)	510 (2.3)
5/8	2-3/8 (60.3)	5/8 ANSI	4 (102)	4 (102)	2,155 (9.6)	2,110 (9.4)	430 (1.9)	420 (1.9)
			12 (305)	12 (305)	2,850 (12.7)	5,225 (23.2)	570 (2.5)	1,045 (4.6)
3/4	3-3/8 (85.7)	3/4 ANSI	12 (305)	12 (305)	5,660 (25.2)	8,115 (36.1)	1,130 (5.0)	1,625 (7.2)
			20 (508)	20 (508)	5,660 (25.2)	9,360 (41.6)	1,130 (5.0)	1,870 (8.3)

1. Tabulated load values are for anchors installed in minimum 6-inch wide, Grade N, Type II, lightweight concrete masonry units conforming to ASTM C 90 that have reached the minimum designated ultimate compressive strength at the time of installation ($f'm \geq 1{,}500$ psi).
2. Allowable load capacities listed are calculated using an applied safety factor of 5.0. Consideration of safety factors of 10 or higher may be necessary depending on the application, such as life safety.
3. The tabulated values are for anchors installed at a minimum spacing of 16 anchor diameters on center for 100 percent capacity. Spacing distances may be reduced to 8 anchor diameters on center provided the capacities are reduced by 50 percent. Linear interpolation may be used for intermediate spacing. Anchors with 3/4-inch diameter are limited to one anchor per cell.



ORDERING INFORMATION

Power-Stud HD5 (Carbon Steel Body and Stainless Steel Expansion Clip)

Cat. No.	Anchor Size	Thread Length	Box Qty.	Carton Qty.	Wt/100 (lbs.)	ANSI Carbide Drill Bit Cat. No.		
						Full Head Carbide SDS-Plus	Carbide SDS-Plus	Carbide SDS-Max
7713HD5	3/8" x 3"	1-1/2"	50	300	10	DW5527	DW5427	-
7715HD5	3/8" x 3-3/4"	2-3/8"	50	300	13	DW5527	DW5427	-
7716HD5	3/8" x 5"	3-1/2"	50	300	15	DW55300	DW5429	-
7717HD5	3/8" x 7"	5-1/2"	50	200	21	DW55300	DW5429	-
7720HD5	1/2" x 2-3/4"	1"	50	200	21	DW5537	DW5437	DW5803
7722HD5	1/2" x 3-3/4"	2"	50	200	19	DW5537	DW5437	DW5803
7723HD5	1/2" x 4-1/2"	2-3/4"	50	200	23	DW5539	DW5438	DW5803
7724HD5	1/2" x 5-1/2"	3-3/4"	50	150	27	DW5539	DW5438	DW5803
7726HD5	1/2" x 7"	5-1/4"	25	100	30	DW5539	DW5438	DW5803
7730HD5	5/8" x 3-1/2"	1-1/2"	25	100	44	-	DW5446	DW5806
7733HD5	5/8" x 5"	3"	25	100	43	-	DW5446	DW5806
7734HD5	5/8" x 6"	4"	25	75	47	-	DW5446	DW5806
7738HD5	5/8" x 8-1/2"	6-1/2"	25	50	60	-	DW5447	DW5809
7741HD5	3/4" x 4-3/4"	2-1/4"	20	60	68	-	DW5453	DW5810
7742HD5	3/4" x 5-1/2"	3"	20	60	76	-	DW5453	DW5810
7746HD5	3/4" x 7"	4-1/2"	20	60	92	-	DW5455	DW5810
7748HD5	3/4" x 8-1/2"	6"	10	40	107	-	DW5455	DW5812

The published size includes the diameter and the overall length of the anchor.
All anchors are packaged with nuts and washers.

Installation Accessories

Cat. No.	Description	Box Qty
08280	Hand pump / dust blower	1

GENERAL INFORMATION

PB-PRO™

Heavy Duty Sleeve Anchor

PRODUCT DESCRIPTION

The PB-PRO is a large diameter torque controlled, heavy duty sleeve anchor designed for concrete applications. Suitable base materials included normal-weight concrete. The anchor is manufactured with a zinc plated carbon steel bolt, sleeve, cone and expansion clip and plastic compression ring. The PB-PRO 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
+ High shear load capacity
+ Patented plastic retainer nut prevents loosening components during transport as well as spinning in the drill hole
+ Compression zone in sleeve clamps fixture to the base material

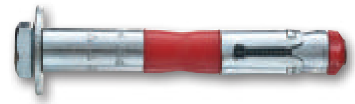
APPROVALS AND LISTINGS

- Tested in accordance with ASTM E488

GUIDE SPECIFICATIONS

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

SECTION CONTENTS



PB-PRO 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

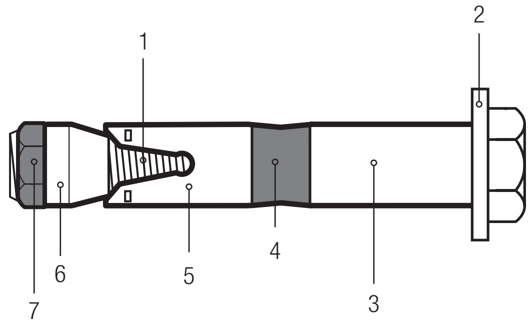
ANCHOR SIZE RANGE (TYP.)

- 16mm through 20mm

SUITABLE BASE MATERIALS

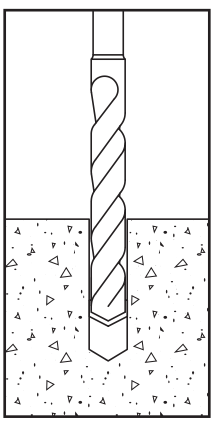
- Normal-weight concrete

MATERIAL SPECIFICATION

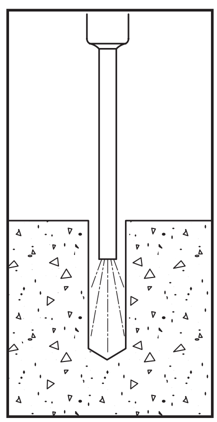


Part No.	Designation	Material	Protection
1	Threaded bolt	Medium Carbon Steel (Grade 8.8)	Zinc plated (5 µm)
2	Washer	Steel Property class 8.8 acc. to EN ISO 7093	Zinc plated (5 µm)
3	Distance sleeve	Medium Carbon Steel	Zinc plated (5 µm)
4	Compression ring	Plastic (HDPE)	-
5	Expansion sleeve	Medium Carbon Steel	Zinc plated (5 µm)
6	Cone nut	Medium Carbon Steel	Zinc plated (5 µm)
7	Retainer nut	Plastic (HDPE)	-

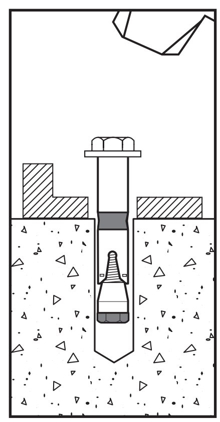
INSTALLATION INSTRUCTIONS



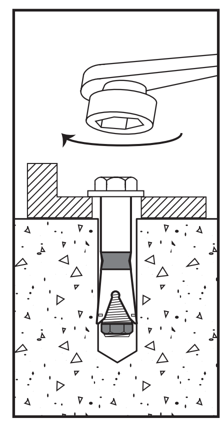
1. Using the proper drill bit size, drill a hole into the base material to the required depth.



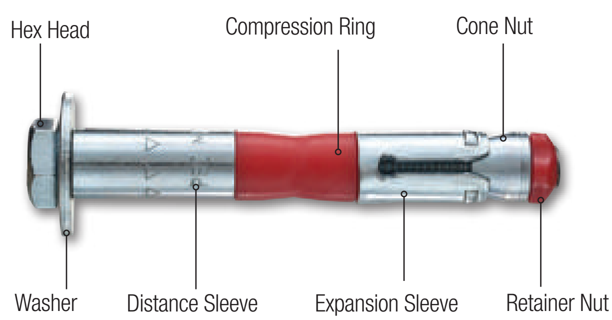
2. Remove dust and debris from the hole during drilling (e.g. dust extractor, hollow bit) or following drilling (e.g. suction, forced air) to extract loose particles created by drilling.



3. Drive the anchor into the hole through the fixture at least to the minimum required embedment depth.



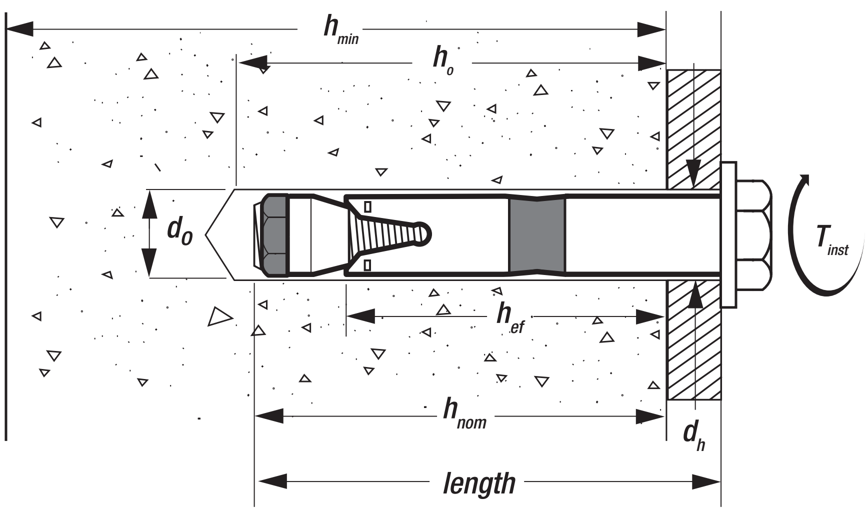
4. Tighten the anchor with a torque wrench by applying the required installation torque Tinst.



INSTALLATION INFORMATION

INSTALLATION DATA

Description	Notation	Unit	PB-PRO	
			M16	M20
Anchor diameter	d	mm (in)	24 (0.94)	28 (1.10)
Head Height	-	mm (in)	10.0 (0.39)	12.5 (0.49)
Washer Outter Diameter	-	mm (in)	50 (1.97)	60 (236)
Internal bolt diameter	-	mm (in)	16 (0.63)	20 (0.79)
Minimum Specified Yield Strength	f_y	MPa (ksi)	640 (92.8)	640 (92.8)
Minimum Specified Ultimate Steel Strength	f_{uta}	MPa (ksi)	800 (116)	800 (116)
Nominal drill bit diameter	d_{bit}	mm (in)	24 (0.94)	28 (1.10)
Diameter of hole clearance in fixture	d_h	mm (in)	26 (1.02)	31 (1.22)
Minimum Nominal Embedment Depth	h_{nom}	mm (in)	128 (5.04)	160 (6.30)
Effective embedment depth	h_{ef}	mm (in)	100 (3.94)	125 (4.92)
Minimum hole depth	h_o	mm (in)	155 (6.10)	180 (7.09)
Minimum member thickness	h_{min}	mm (in)	200 (7.87)	250 (9.84)
Minimum spacing	s_{min}	mm (in)	130 (5.12)	140 (5.51)
Corresponding edge distance at s_{min}	for c ≥	mm (in)	240 (9.45)	300 (11.81)
Minimum edge distance	c_{min}	mm (in)	140 (5.51)	140 (5.51)
Corresponding spacing at c_{min}	for s ≥	mm (in)	230 (9.06)	300 (11.81)
Installation torque	T_{inst}	Nm (ft-lb)	130 (96)	200 (148)
Torque wrench socket size	-	mm	24	28



PERFORMANCE DATA

Ultimate Load Capacities for PB-PRO in Normal-Weight Concrete[1,2]

Nominal Anchor Diameter d mm	Minimum Nominal Embed. Depth mm (in)	Minimum Concrete Compressive Strength									
		2,500 psi		3,000 psi		4,000 psi		6,000 psi		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)
M16	128 (5.04)	9,135 (40.9)	16,505 (74.0)	10,005 (44.8)	18,080 (81.0)	11,555 (51.8)	20,880 (93.6)	14,145 (63.4)	24,600 (110.3)	16,337 (73.2)	24,600 (110.3)
M20	160 (6.30)	11,515 (51.6)	21,780 (97.6)	12,615 (56.5)	23,860 (106.9)	14,565 (65.3)	27,555 (123.5)	17,840 (80.0)	31,280 (140.2)	20,600 (92.3)	31,280 (140.2)

1. Tabulated load values are for anchors installed in concrete. Concrete compressive strength must be at the specified minimum at the time of installation.
2. Ultimate load capacities must be reduced by a minimum safety factor of 4.0 or greater to determine allowable working load. Consideration of safety factors of 10 or higher may be necessary depending upon the application such as life safety or overhead.

Allowable Load Capacities for PB-PRO in Normal-Weight Concrete[1,2,3]

ALLOWABLE STRESS DESIGN ASD

Nominal Anchor Diameter d mm	Minimum Nominal Embed. Depth mm (in)	Minimum Concrete Compressive Strength									
		2,500 psi		3,000 psi		4,000 psi		6,000 psi		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)
M16	128 (5.04)	2,285 (10.2)	4,125 (18.5)	2,500 (11.2)	4,520 (20.3)	2,890 (13.0)	5,220 (23.4)	3,535 (15.8)	6,150 (27.6)	4,085 (18.3)	6,150 (27.6)
M20	160 (6.30)	2,880 (12.9)	5,445 (24.4)	3,155 (14.1)	5,965 (26.7)	3,640 (16.3)	6,890 (30.9)	4,460 (20.0)	7,820 (35.1)	5,150 (23.1)	7,820 (35.1)

1. Allowable load capacities listed are calculated using and applied safety factor of 4.0. Consideration of safety factors of 10 or higher may be necessary depending upon the application such as life safety or overhead.
2. Allowable load capacities are multiplied by reduction factors when anchor spacing or edge distances are less than critical distances.
3. Linear interpolation may be used to determine allowable loads for intermediate embedments and compressive strengths.

Spacing Reduction Factors - Tension (F_{NS})

Nominal Anchor Size		M16	M20
Minimum Spacing s_{min} (mm)		130	140
Nominal Embedment h_{nom} (mm)		128	160
Spacing Distance (mm)	130	0.84	-
	140	0.85	0.80
	150	0.87	0.81
	175	0.91	0.84
	200	0.95	0.87
	225	0.99	0.90
	250	1.00	0.94
	275	1.00	0.97
	300	1.00	1.00

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

Nominal Anchor Size		M16	M20
Minimum Edge Distance c_{min} (mm)		140	140
Nominal Embedment h_{nom} (mm)		128	160
Edge Distance (mm)	140	0.58	-
	150	0.63	0.50
	160	0.67	0.53
	175	0.73	0.58
	200	0.83	0.67
	225	0.94	0.75
	250	1.00	0.83
	275	1.00	0.92
	300	1.00	1.00

Spacing Reduction Factors - Shear (F_{VS})

Nominal Anchor Size		M16	M20
Minimum Spacing s_{min} (mm)		130	140
Nominal Embedment h_{nom} (mm)		128	160
Spacing Distance (mm)	130	0.86	-
	140	0.87	0.84
	150	0.88	0.85
	175	0.90	0.87
	200	0.92	0.88
	225	0.94	0.90
	250	0.96	0.92
	275	0.98	0.93
	300	1.00	0.95
	325	1.00	0.97
	350	1.00	0.98
	375	1.00	1.00

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

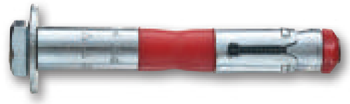
Nominal Anchor Size		M16	M20
Minimum Edge Distance c_{min} (mm)		140	140
Nominal Embedment h_{nom} (mm)		128	160
Edge Distance (mm)	140	0.47	0.37
	150	0.50	0.40
	160	0.53	0.43
	175	0.58	0.47
	200	0.67	0.53
	225	0.75	0.60
	250	0.83	0.67
	275	0.92	0.73
	300	1.00	0.80
	325	1.00	0.87
	350	1.00	0.93
	375	1.00	1.00

ORDERING INFORMATION

Carbon Steel Hex Head PB-PRO

Cat No.	Size (Diameter x Length)	Drill Dia	Length*	Std Box	Std Ctn
PFM1220650	PB-PRO 24-M16 x 148mm	24mm	148mm	5	20
PFM1220700	PB-PRO 24-M16 x 178mm	24mm	178mm	5	20
PFM1220750	PB-PRO 28-M20 x 170mm	28mm	170mm	5	15
PFM1220800	PB-PRO 28-M20 x 190mm	28mm	190mm	5	10
PFM1220850	PB-PRO 28-M20 x 220mm	28mm	220mm	5	10

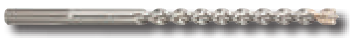
*Length measured from underneath the washer to the end of the anchor.



PB-PRO ACCESSORIES

Metric Drill Bits
SDS-MAX Carbide Drill Bits – 4 Cutter

Cat No.	Size	Drill Dia	Length	Useable Length	Std. Tube
PPA1330220	M24x340x200	24mm	340mm	200mm	1
PPA1330290	M28x380x250	28mm	380mm	250mm	1



Installation Accessories

Cat. No.	Description	Box Qty
08280	Hand pump / dust blower	1

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 sand-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.

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

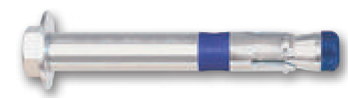
APPROVALS AND LISTINGS

- International Code Council, Evaluation Service (ICC-ES), ESR-3260 for cracked and uncracked concrete - 1/2", 5/8" and 3/4" diameters
- Code compliant with 2015 IBC, 2015 IRC, 2012 IBC, 2012 IRC, 2009 IBC, and 2009 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 318-14 Chapter 17 or ACI 318-11/08 (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", 5/8" and 3/4" diameters

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" diameter through 3/4" diameter

SUITABLE BASE MATERIALS

- Normal-weight concrete
- Sand-lightweight concrete

TENSION ZONE CRACKED CONCRETE

SEISMIC REGION QUALIFICATION

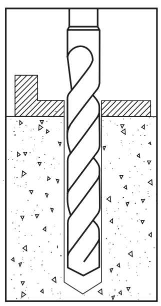
CODE LISTED
ICC-ES ESR-3260
CONCRETE

MATERIAL SPECIFICATIONS

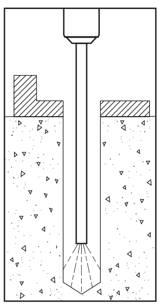
Anchor component	Specification
Bolt	Medium carbon steel (Grade 8 equivalent)
Washer	Conforms to ASTM F844
Cone	AISI C1035-C1040
Expansion Clip	AISI C1045-C1050
Metal Sleeve	Medium carbon steel tubing (seamless)
Compression Ring & Retainer Nut	Engineered plastic
Plating	Zinc plating according to ASTM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

INSTALLATION INSTRUCTIONS

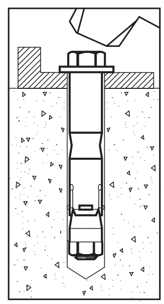
Installation Instructions for Power-Bolt+ Anchor



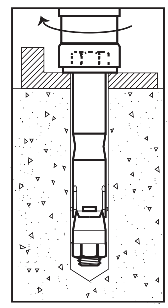
Step 1
Using the proper drill bit size, drill a hole into the base material to the required depth. The tolerances of the drill bit used should meet the requirements of ANSI Standard B212.15.



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}.

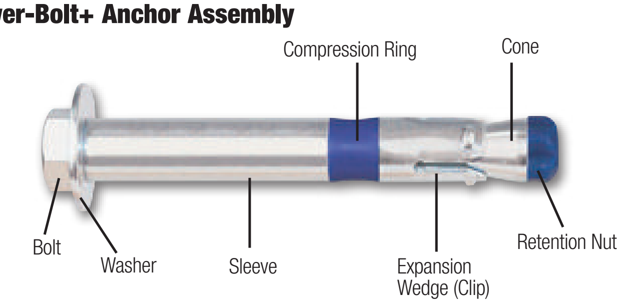
Head Marking

Legend

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

Letter Code = Length Identification Mark

Power-Bolt+ Anchor Assembly



Length Identification

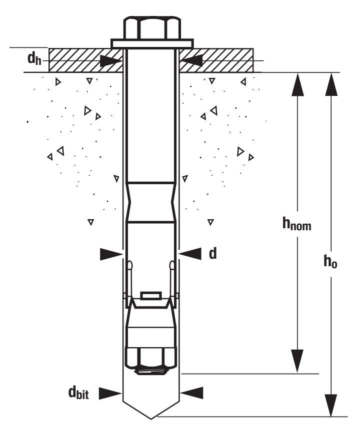
Mark	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
From	1-1/2"	2"	2-1/2"	3"	3-1/2"	4"	4-1/2"	5"	5-1/2"	6"	6-1/2"	7"	7-1/2"	8"	8-1/2"	9"	9-1/2"	10"
Up to but not including	2"	2-1/2"	3"	3-1/2"	4"	4-1/2"	5"	5-1/2"	6"	6-1/2"	7"	7-1/2"	8"	8-1/2"	9"	9-1/2"	10"	11"
Length identification mark indicates overall length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

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	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)	1-5/8 (41)	2-1/2 (64)	2-3/4 (70)	3 (76.2)
Minimum hole depth	h_o	in. (mm)	1-1/2 (38)	1-7/8 (48)	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+ Anchor Detail



REFERENCE PERFORMANCE DATA

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. 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.

ALLOWABLE STRESS DESIGN (ASD) DESIGN CRITERIA

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

CODE LISTED
ICC-ES ESR-3260

STRENGTH DESIGN TABLES SD

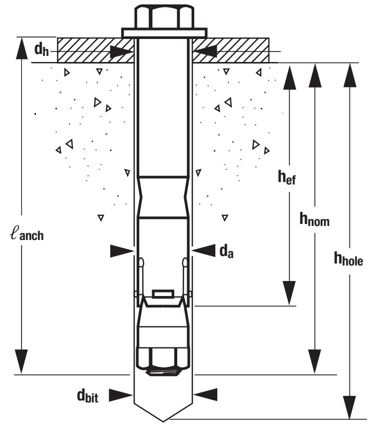
Power-Bolt+ Anchor Installation Specifications[1]

Anchor Property/Setting Information	Notation	Units	Norminal 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	d_{bit}	in.	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)	9/32 (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 318-14 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.

Power-Bolt+ Anchor Detail



Tension Design information for Power-Bolt+ Anchor in Concrete (for use with load combinations taken form ACI 318-14, Section 5.3 or ACI 318-11, Section 9.2)[1,2]

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)
STEEL STRENGTH IN TENSION[4]					
Minimum specified yield strength	f_y	ksi (N/mm²)	130 (896)	130 (896)	130 (896)
Minimum specified ultimate tensile strength[8]	f_{uta}	ksi (N/mm²)	150 (1,034)	150 (1,034)	150 (1,034)
Effective tensile stress area (threads)	$A_{se,N}$	in² (mm²)	0.0775 (50)	0.1063 (68.6)	0.1820 (117.4)
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[7]					
Effective embedment	h_{ef}	in. (mm)	2.625 (67)	3.000 (76)	3.500 (89)
Effectiveness factor for uncracked concrete	k_{ucr}	-	27 (11.3)	27 (11.3)	24 (10.0)
Effectiveness factor for cracked concrete	k_{cr}	-	17 (7.1)	17 (7.1)	17 (7.1)
Modification factor for cracked and uncracked concrete[5]	$\psi_{c,N}$	-	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)[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[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 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of 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 318-14 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 318-14 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 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used and the requirements of 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 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used and the requirements of 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 318-14 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.
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 318-14 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.

Mean Axial Stiffness Values, β, for Power-Bolt+ Anchors in Normal-Weight Concrete[1]

Concrete State	Units	Nominal Anchor Diameter		
		1/2 inch	5/8 inch	3/4 inch
Uncracked concrete	10^3 lbf/in. (kN/mm)	366 (63)	871 (150)	256 (44)
Cracked concrete	10^3 lbf/in. (kN/mm)	64 (11)	94 (16)	27 (5)

1. Mean values shown; actual stiffness varies considerably depending on concrete strength, loading and geometry of application.

Shear Design information for Power-Bolt+ Anchor in Concrete (For use with load combinations taken from ACI 318-14, Section 5.3 or ACI 318-11, Section 9.2)[1,2]

CODE LISTED
ICC-ES ESR-3260

STRENGTH DESIGN SD TABLES

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/mm²)	130 (896)	130 (896)	130 (896)
Minimum specified ultimate strength	f_{uta}	ksi (N/mm²)	150 (1,034)	150 (1,034)	150 (1,034)
Effective shear stress area	$A_{se,v}$	in² (mm²)	0.1069 (69.0)	0.1452 (93.7)	0.2410 (153)
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
CONCRETE BREAKOUT STRENGTH IN SHEAR[7]					
Load bearing length of anchor	ℓ_e	in (mm)	1.00 (25)	1.25 (32)	1.50 (51)
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[7]					
Coefficient for pryout strength (1.0 for h_{ef} < 2.5 in., 2.0 for h_{ef} ≥ 2.5 in.)	k_{cp}	-	2.0	2.0	2.0
Effective embedment	h_{ef}	in (mm)	2.625 (68)	3.000 (76)	3.500 (89)
Reduction factor for pryout strength[5]	ϕ	-	0.70 (Condition B)		
STEEL STRENGTH IN SHEAR FOR SEISMIC APPLICATIONS					
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

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 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of 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 318-14 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 318-14 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 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used and the requirements of 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 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used and the requirements of 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 318-14 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 318-14 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 318-14 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.

STRENGTH DESIGN PERFORMANCE DATA

Factored design strength ΦNn and ΦVn
Calculated in accordance with ACI 318-14 Chapter 17
Tested to the International Building Code

STRENGTH DESIGN SD TABLES

Tension and Shear Design Strengths for Power-Bolt+ 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	
		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	2,905	2,575	3,185	2,970	3,675	3,640	3,905	4,205	3,905
5/8	3-3/4	2,870	2,780	3,145	3,045	3,630	3,515	4,450	4,305	5,135	4,970
3/4	4-3/8	3,620	4,210	3,965	4,615	4,575	5,330	5,605	6,525	6,470	7,535

■ - Concrete Breakout Strength Controls ■ - Steel Strength Controls

Tension and Shear Design Strengths for Power-Bolt+ 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	
		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	3,890	4,995	4,260	5,770	4,920	7,065	6,025	8,155	6,960
3/4	4-3/8	5,105	5,895	5,595	6,460	6,460	7,460	7,910	8,690	9,135	8,690

■ - 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, $h_a = h_{min}$, 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}.

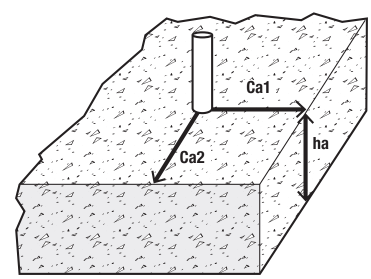
2- Calculations were performed according to ACI 318-14- Chapter 17. The load level corresponding to the controlling failure mode is listed. (e.g. For tension: steel, concrete breakout and pullout; For shear: steel, concrete breakout and pryout). Furthermore, the capacities for concrete breakout strength 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 318-14 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 318-14- Chapter 17.

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



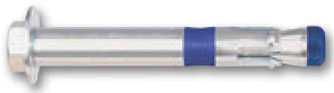
ORDERING INFORMATION

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
6911SD	3/8" x 1-7/8"	1/4"	50	300
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 4-1/2"	1-1/2"	10	60
6954SD	3/4" x 5-1/4"	7/8"	10	60
6956SD	3/4" x 7-1/4"	2-7/8"	10	40
6957SD	3/4" x 8-1/4"	3-7/8"	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
08280	Hand pump / dust blower	1

MECHANICAL ANCHORS

POWER-BOLT®+
Heavy Duty Sleeve Anchor

GENERAL INFORMATION

POWER-BOLT®

Heavy-Duty Sleeve Anchor

PRODUCT DESCRIPTION

The Power-Bolt anchor, is a heavy duty sleeve style, self-locking anchor which is vibration resistant and removable. It is available with a finished hex head or flat head with a hex key insert and can be used in concrete, block, brick, or stone.

Expansion occurs at two locations within the drilled hole. First, the cone is pulled into the large triple-tined expansion sleeve, developing a mid-level, compression force. Further turning causes the threaded bolt to advance into the threads of the expander cone, forcing its four sections outward. This action engages the base material deep in the anchor hole, greatly increasing the holding power of the Power-Bolt. The bolt and cone remain locked together which prevents loosening under vibratory conditions.

The Power-Bolt is also designed to draw the fixture into full bearing against the base material through the action of its flexible compression ring. As the anchor is being tightened, the compression ring will crush if necessary to tightly secure the fixture against the face of the base material.

The internal bolt of the Power-Bolt is removable and reusable in the same anchor sleeve making it suitable for applications such as mounting machinery which may need to be removed for service and for temporary applications such as heavy duty form work.

GENERAL APPLICATIONS AND USES

- Column Base Plates and Mechanical Equipment
- Dock Bumpers and Support Ledgers
- Racking and Railing Attachments

FEATURE AND BENEFITS

+ High load capacity
+ Two-level expansion mechanism
+ Internal high strength bolt is removable and reusable
+ Compression zone in sleeve clamps fixture to the base material
+ Low profile finished head design

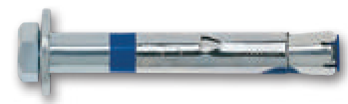
APPROVALS AND LISTINGS

- Tested in accordance with ASTM E488 and AC01 criteria

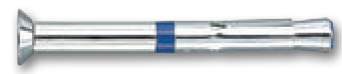
GUIDE SPECIFICATIONS

CSI Divisions: 03 16 00 - Concrete Anchors, 04 05 19.16 - Masonry Anchors, and 05 05 19 - Post-Installed Concrete Anchors. Expansion anchors shall be Power-Bolt as supplied by DEWALT, Towson, MD.

SECTION CONTENTS



HEX HEAD
POWER-BOLT ASSEMBLY



FLAT HEAD
POWER-BOLT ASSEMBLY

HEAD STYLES

- Finished Hex Head
- Flat Head

ANCHOR MATERIALS

- Zinc Plated Carbon Steel (Flat Head)
- Type 304 Stainless Steel (Hex Head)

ANCHOR SIZE RANGE (TYP.)

- 1/4" diameter through 5/8" diameter

SUITABLE BASE MATERIALS

- Normal-weight concrete
- Lightweight concrete
- Grouted Concrete Masonry (CMU)
- Hollow CMU
- Brick Masonry
- Stone

INSTALLATION SPECIFICATIONS

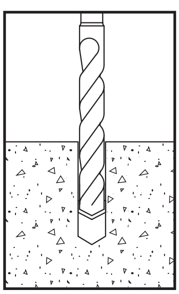
Carbon Steel Flat Head Power-Bolt (80°–82° head)

Dimension	Anchor Diameter, d		
	3/8"	1/2"	5/8"
ANSI Drill Bit Size, d_{bit} (in.)	3/8	1/2	5/8
Fixture Clearance Hole, d_h (in.)	7/16	9/16	11/16
Internal Bolt Size (UNC)	5/16-18	3/8-16	1/2-13
Head Height (in.)	15/64	1/4	21/64
Head Diameter, d_{hd} (in.)	3/4	7/8	1-1/8
Allen Wrench Size (in.)	7/32	5/16	3/8
Max Bolt Torque, T_{max} (ft-lbs)	25	45	100

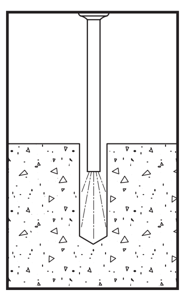
Stainless Steel Hex Head Power-Bolt

Dimension	Anchor Diameter, d		
	1/4"	3/8"	1/2"
ANSI Drill Bit Size, d_{bit} (in.)	1/4	3/8	1/2
Fixture Clearance Hole, d_h (in.)	5/16	7/16	9/16
Internal Bolt Size (UNC)	10-24	5/16-18	3/8-16
Head Height (in.)	7/64	13/64	15/64
Washer O.D., d_w (in.)	1/2	13/16	1
Wrench Size (in.)	5/16	1/2	9/16
Max Bolt Torque, T_{max} (ft-lbs)	3	12	25

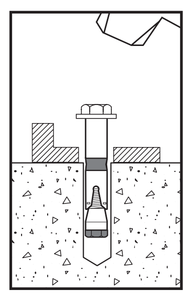
Installation Procedure



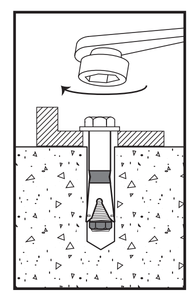
Using the proper diameter bit, drill a hole into the base material to a depth of at least 1/2" or one anchor diameter deeper than the embedment required. The tolerances of the drill bit used must meet the requirements of ANSI Standard B212.15.



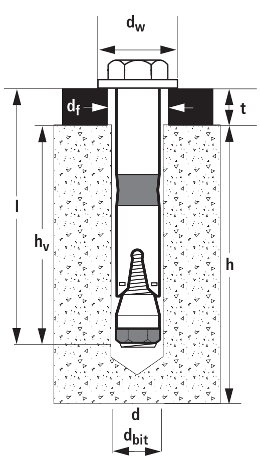
Remove dust and debris from the hole during drilling (e.g. dust extractor, hollow bit) or following drilling (e.g. suction, forced air) to extract loose particles created by drilling. Do not modify the anchor or advance the bolt in the anchor assembly prior to installation.

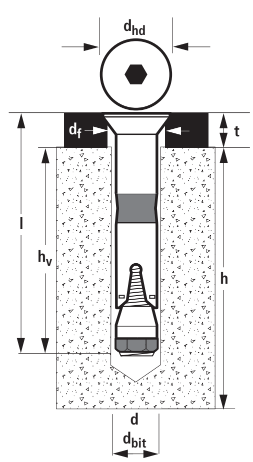


Drive the anchor through the fixture into the anchor hole until the bolt head is firmly seated against the fixture. Be sure the anchor is driven to the required embedment depth.



Tighten the anchor by turning the head 3 to 4 turns past finger tight.





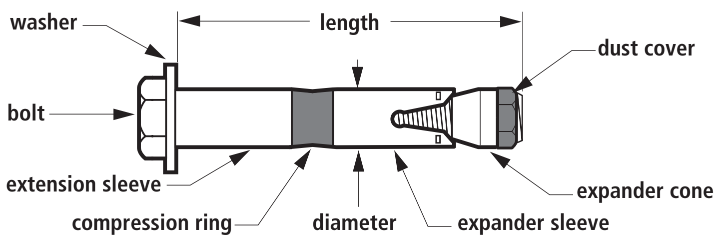
Nomenclature

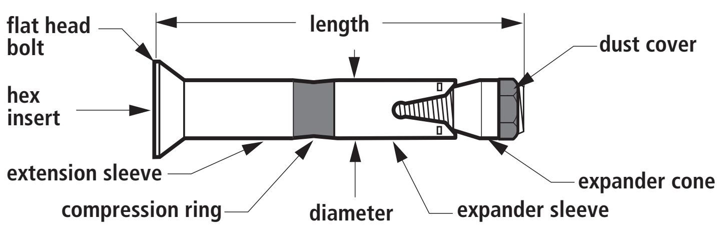
- d = Diameter of anchor
- d_{bit} = Diameter of drill bit
- d_h = Diameter of fixture clearance hole
- d_{hd} = Flat Head of Diameter
- d_w = Diameter of washer
- h = Base material thickness. The minimum value of h should be $1.5h_v$ or 3" whichever is greater
- h_v = Minimum embedment depth
- l = Overall length of anchor
- t = Fixture thickness

MATERIAL SPECIFICATIONS

Anchor Component	Carbon Steel Flat Head	Stainless Steel Hex Head
Internal Bolt	SAE Grade 5	**Type 304 SS
Washer	N/A	Type 18-8 SS
Expander Sleeve	AISI 1010	Type 304 SS
Extension Sleeve	AISI 1010	Type 304 SS
Expander Cone	AISI 12L14	Type 303 SS
Compression Ring	Nylon	Nylon
Dust Cap	Nylon	Nylon
Zinc Plating	ASTM B 633, SC1, Type III (Fe/Zn 5) – Mild Service Condition	N/A

** Manufactured with a minimum yield strength of 65,000 psi.
Stainless steel anchor components are passivated. The stainless steel expander cone is zinc plated.





Length Identification (Threaded Version)

Mark	♦	■	A	B	C	D	E	F	G	H	I
From	1/2"	1"	1-1/2"	2"	2-1/2"	3"	3-1/2"	4"	4-1/2"	5"	5-1/2"
Up to but not including	1"	1-1/2"	2"	2-1/2"	3"	3-1/2"	4"	4-1/2"	5"	5-1/2"	6"

PERFORMANCE DATA

Ultimate Load Capacities for Carbon and Stainless Steel Power-Bolt in Normal-Weight Concrete[1,2]

Anchor Diameter d in.	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)		6,000 psi (41.4 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	1-1/4 (31.8)	945 (4.2)	1655 (7.4)	1105 (4.9)	1680 (7.5)	1265 (5.6)	1705 (7.6)	1330 (5.9)	1705 (7.6)
	1-3/4 (44.5)	1120 (5.0)	1655 (7.4)	1240 (5.5)	1845 (8.2)	1360 (6.0)	2030 (9.0)	1490 (6.6)	2030 (9.0)
	2-1/2 (63.5)	1505 (6.7)	1655 (7.4)	1550 (6.9)	2185 (9.7)	1600 (7.1)	2710 (12.1)	1680 (7.5)	2710 (12.1)
3/8	2 (50.8)	3,500 (15.8)	3,985 (17.9)	4,045 (18.2)	5,205 (23.4)	4,585 (20.6)	6,425 (28.9)	5,915 (26.6)	7,440 (33.5)
	2-1/2 (63.5)	3,800 (17.1)	4,380 (19.7)	4,330 (19.5)	5,770 (26.0)	4,855 (21.8)	7,160 (32.2)	6,665 (30.0)	7,960 (35.8)
	3-1/2 (88.9)	4,395 (19.8)	4,980 (22.4)	5,195 (23.4)	6,815 (30.7)	5,995 (27.0)	8,650 (38.9)	7,150 (32.2)	8,650 (38.9)
1/2	2-1/2 (63.5)	4,900 (22.1)	6,840 (30.8)	5,710 (25.7)	7,535 (33.9)	6,520 (29.3)	8,225 (37.0)	7,320 (32.9)	8,225 (37.0)
	3-1/2 (88.9)	6,140 (27.6)	8,540 (38.4)	7,590 (34.2)	9,200 (41.4)	9,040 (40.7)	9,860 (44.4)	9,890 (44.5)	10,780 (48.5)
	5 (127.0)	7,260 (32.7)	10,140 (45.6)	8,480 (38.2)	11,230 (50.5)	9,700 (43.7)	12,320 (55.4)	10,935 (49.2)	12,315 (55.4)
5/8	2-3/4 (69.9)	5,360 (24.1)	7,970 (35.9)	6,535 (29.4)	9,970 (44.9)	7,705 (34.7)	11,970 (53.9)	8,490 (38.2)	11,970 (53.9)
	4 (101.6)	6,460 (29.1)	10,860 (48.9)	8,210 (36.9)	12,710 (57.2)	9,960 (44.8)	14,560 (65.5)	13,110 (59.0)	15,900 (71.6)

1. Tabulated load values are for anchors installed in concrete. Concrete compressive strength must be at the specified minimum at the time of installation.
2. Ultimate load capacities must be reduced by a minimum safety factor of 4.0 or greater to determine allowable working load. Consideration of safety factors of 10 or higher may be necessary depending upon the application such as life safety or overhead.

Allowable Load Capacities for Carbon and Stainless Steel Power-Bolt in Normal-Weight Concrete[1,2,3]

Anchor Diameter d in.	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)		6,000 psi (41.4 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	1-1/4 (31.8)	235 (1.0)	415 (1.8)	275 (1.2)	420 (1.9)	315 (1.4)	425 (1.9)	335 (1.5)	425 (1.9)
	1-3/4 (44.5)	280 (1.2)	415 (1.8)	310 (1.4)	460 (2.0)	340 (1.5)	510 (2.3)	375 (1.7)	510 (2.3)
	2-1/2 (63.5)	375 (1.7)	415 (1.8)	390 (1.7)	545 (2.4)	400 (1.8)	680 (3.0)	420 (1.9)	680 (3.0)
3/8	2 (50.8)	875 (3.9)	995 (4.5)	1,010 (4.5)	1,300 (5.9)	1,145 (5.2)	1,605 (7.2)	1,480 (6.7)	1,860 (8.4)
	2-1/2 (63.5)	950 (4.3)	1,095 (4.9)	1,080 (4.9)	1,445 (6.5)	1,215 (5.5)	1,790 (8.1)	1,665 (7.5)	1,990 (9.0)
	3-1/2 (88.9)	1,100 (5.0)	1,245 (5.6)	1,300 (5.9)	1,705 (7.7)	1,500 (6.8)	2,165 (9.7)	1,790 (8.1)	2,165 (9.7)
1/2	2-1/2 (63.5)	1,225 (5.5)	1,710 (7.7)	1,430 (6.4)	1,885 (8.5)	1,630 (7.3)	2,055 (9.2)	1,830 (8.2)	2,055 (9.2)
	3-1/2 (88.9)	1,535 (6.9)	2,135 (9.6)	1,900 (8.6)	2,300 (10.4)	2,260 (10.2)	2,465 (11.1)	2,470 (11.1)	2,695 (12.1)
	5 (127.0)	1,815 (8.2)	2,535 (11.4)	2,120 (9.5)	2,810 (12.6)	2,425 (10.9)	3,080 (13.9)	2,735 (12.3)	3,080 (13.9)
5/8	2-3/4 (69.9)	1,340 (6.0)	1,995 (9.0)	1,635 (7.4)	2,495 (11.2)	1,925 (8.7)	2,995 (13.5)	2,125 (9.6)	2,995 (13.5)
	4 (101.6)	1,615 (7.3)	2,715 (12.2)	2,055 (9.2)	3,180 (14.3)	2,490 (11.2)	3,640 (16.4)	3,275 (14.7)	3,975 (17.9)

1. Allowable load capacities listed are calculated using and applied safety factor of 4.0. Consideration of safety factors of 10 or higher may be necessary depending upon the application such as life safety or overhead.
2. Allowable load capacities are multiplied by reduction when anchor spacing or edge distances are less than critical distances.
3. Linear interpolation may be used to determine allowable loads for intermediate embedments and compressive strengths.

Ultimate and Allowable Load Capacities for Carbon and Stainless Steel Power-Bolt in Structural Lightweight Concrete[1,2,3]

Anchor Diameter d in.	Minimum Embedment Depth h_v in. (mm)	Minimum Concrete Compressive Strength (f´c)							
		3,000 psi (20.7 MPa)				5,000 psi (34.5 MPa)			
		Ultimate Load		Allowable Load		Ultimate Load		Allowable Load	
		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 (31.8)	1,000 (4.5)	1,520 (6.8)	250 (1.1)	380 (1.7)	1,320 (5.9)	1,520 (6.8)	330 (1.5)	380 (1.7)
	2 (50.8)	1,510 (6.8)	1,540 (6.9)	380 (1.7)	385 (1.7)	–	–	–	–
3/8	2 (50.8)	2,160 (9.7)	2,780 (12.5)	540 (2.4)	695 (3.1)	3,240 (14.6)	2,780 (12.5)	810 (3.6)	695 (3.1)
	3-1/2 (88.9)	4,200 (18.9)	4,980 (22.4)	1,050 (4.7)	1,245 (5.6)	–	–	–	–
1/2	2-1/2 (63.5)	3,680 (16.6)	4,615 (20.8)	920 (4.1)	1,155 (5.2)	4,920 (22.1)	4,615 (20.8)	1,230 (5.5)	1,155 (5.2)
	5 (127.0)	5,540 (24.9)	8,730 (39.3)	1,385 (6.2)	2,185 (9.8)	–	–	–	–
5/8	2-3/4 (69.9)	3,120 (14.0)	6,840 (30.8)	780 (3.5)	1,710 (7.7)	5,240 (23.6)	6,840 (30.8)	1,310 (5.9)	1,710 (7.7)

1. Tabulated load values are for anchors installed in sand-lightweight concrete. Concrete compressive strength must be at the specified minimum at the time of installation.
2. Allowable load capacities listed are calculated using and applied safety factor of 4.0. Consideration of safety factors of 10 or higher may be necessary depending upon the application such as life safety or overhead.
3. Linear interpolation may be used to determine ultimate and allowable loads for intermediate embedments and compressive strengths.

Ultimate and Allowable Load Capacities for Carbon and Stainless Steel Power-Bolt Installed Through Steel Deck into Structural Lightweight Concrete[1,2,3,4]

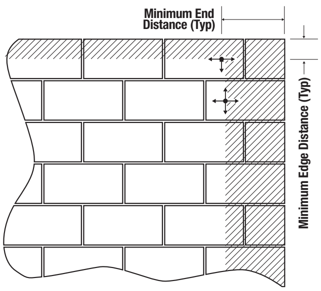
Anchor Diameter d in.	Minimum Embedment Depth h_v in. (mm)	Lightweight Concrete over minimum 20 Gage Metal Deck, f´c ≥ 3,000 (20.7 MPa)							
		Minimum 1-1/2" Wide Deck				Minimum 4-1/2" Wide Deck			
		Ultimate Load		Allowable Load		Ultimate Load		Allowable Load	
		Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
1/4	1-1/4 (31.8)	720 (3.2)	2,360 (10.6)	180 (0.8)	590 (2.7)	920 (4.1)	2,360 (10.6)	230 (1.0)	590 (2.7)
3/8	2 (50.8)	720 (3.2)	2,740 (12.3)	180 (0.8)	685 (3.1)	1,840 (8.3)	2,740 (12.3)	460 (2.1)	685 (3.1)
1/2	2-1/2 (63.5)	1,640 (7.4)	2,740 (12.3)	410 (1.8)	685 (3.1)	2,000 (9.0)	4,400 (19.8)	500 (2.3)	1,100 (5.0)
5/8	2-3/4 (88.9)	–	–	–	–	2,000 (9.0)	4,440 (20.0)	500 (2.3)	1,110 (5.0)

1. Tabulated load values are for anchors installed in sand-lightweight concrete over steel deck. Concrete compressive strength must be at the specified minimum at the time of installation.
2. Allowable load capacities listed are calculated using and applied safety factor of 4.0. Consideration of safety factors of 10 or higher may be necessary depending upon the application such as life safety or overhead.
3. Tabulated load values are for anchors installed in the center of the flute. Spacing distances shall be in accordance with the spacing table for lightweight concrete.
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 Power-Bolt in Grout-Filled Concrete Masonry[1,2,3,4]

Anchor Diameter d in.	Minimum Embed. Depth h_v in. (mm)	Minimum Edge Distance in. (mm)	Minimum End Distance in. (mm)	f´m ≥ 1,500 psi (10.4 MPa)			
				Ultimate Load		Allowable Load	
				Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
1/4	1-1/8 (28.6)	3-3/4 (95.3)	3-3/4 (95.3)	1,215 (5.5)	1,185 (5.3)	245 (1.1)	235 (1.1)
	2-1/2 (63.5)	5-1/4 (133.4)	3-3/4 (95.3)	1,760 (7.9)	1,185 (5.3)	350 (1.6)	235 (1.1)
3/8	2 (50.8)	5-5/8 (142.9)	5-5/8 (142.9)	1,985 (8.9)	3,065 (13.8)	395 (1.8)	615 (2.8)
	3-1/2 (88.9)	7-7/8 (200.0)	5-5/8 (142.9)	2,120 (9.5)	3,065 (13.8)	425 (1.9)	615 (2.8)
1/2	2-1/2 (63.5)	7-1/2 (190.5)	7-1/2 (190.5)	2,435 (11.0)	5,650 (25.4)	485 (2.2)	1,130 (5.1)
	4 (101.6)	10-1/2 (266.7)	7-1/2 (190.5)	2,690 (12.1)	5,650 (25.4)	540 (2.4)	1,130 (5.1)
5/8	2-3/4 (69.9)	9-3/8 (238.1)	9-3/8 (238.1)	2,560 (11.5)	9,000 (40.5)	510 (2.3)	1,800 (8.1)
	5 (127.0)	13-1/8 (333.4)	9-3/8 (238.1)	2,975 (13.4)	9,000 (40.5)	595 (2.7)	1,800 (8.1)

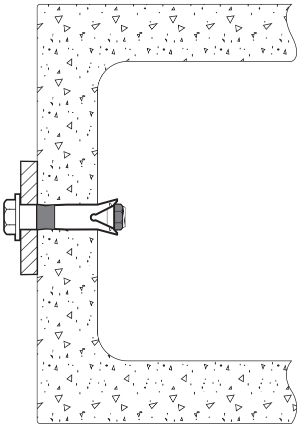
1. Tabulated load values are for carbon steel and stainless steel anchors installed in minimum 6-inch wide, minimum Grade N, Type II, lightweight, medium-weight or normal-weight concrete masonry units conforming to ASTM C 90. Mortar must be minimum Type N. Masonry cells may be grouted. Masonry compressive strength must be at the specified minimum at the time of installation (f'm ≥ 1,500 psi).
2. Allowable load capacities listed are calculated using and applied safety factor of 5.0. Consideration of safety factors of 10 or higher may be necessary depending upon the application such as life safety or overhead.
3. Linear interpolation may be used to determine ultimate and allowable loads for intermediate embedment depths.
4. The tabulated values are for anchors installed at a minimum of 12 anchor diameters on center for 100 percent capacity. Spacing distances may be reduced to 6 anchor diameters on center provided the capacities are reduced by 50 percent. Linear interpolation may be used for intermediate spacing.



Ultimate and Allowable Load Capacities for Power-Bolt in Hollow Concrete Masonry[1,2,3,4,5]

Anchor Diameter d in.	Minimum Embed. Depth h_v in. (mm)	Minimum Edge Distance in. (mm)	Minimum End Distance in. (mm)	f´m ≥ 1,500 psi (10.4 MPa)			
				Ultimate Load		Allowable Load	
				Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
1/4	7/8 (22.2)	3-3/4 (95.3)	3-3/4 (95.3)	600 (2.7)	765 (3.4)	120 (0.5)	155 (0.7)
	1-1/4 (31.8)	3-3/4 (95.3)	8 (203.2)	825 (3.7)	1,055 (4.8)	165 (0.7)	210 (0.9)
	1-1/2 (38.1)	3-3/4 (95.3)	12 (304.8)	1,130 (5.1)	1,230 (5.5)	225 (1.0)	245 (1.1)
3/8	1-1/4 (31.8)	12 (304.8)	8 (203.2)	1,360 (6.1)	2,150 (9.7)	270 (1.2)	430 (1.9)
	1-1/2 (38.1)	12 (304.8)	12 (304.8)	1,470 (6.6)	2,600 (11.7)	295 (1.3)	520 (2.3)
1/2	1-1/4 (31.8)	12 (304.8)	8 (203.2)	2,560 (11.5)	2,150 (9.7)	590 (2.4)	430 (1.9)
	1-1/2 (38.1)	12 (304.8)	12 (304.8)	2,560 (11.5)	3,385 (15.2)	510 (2.3)	675 (3.0)

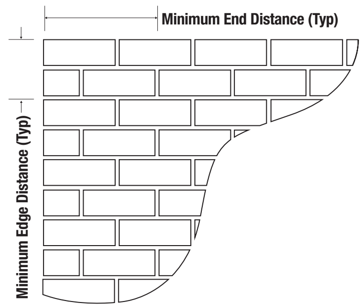
1. Tabulated load values are for carbon steel and stainless steel anchors installed in minimum 6-inch wide, minimum Grade N, Type II, lightweight, medium-weight or normal-weight concrete masonry units conforming to ASTM C 90. Mortar must be minimum Type N. Masonry cells may be grouted. Masonry compressive strength must be at the specified minimum at the time of installation (f'm ≥ 1,500 psi).
2. Allowable load capacities listed are calculated using and applied safety factor of 5.0. Consideration of safety factors of 10 or higher may be necessary depending upon the application such as life safety or overhead.
3. Linear interpolation may be used to determine ultimate and allowable loads for intermediate embedment depths.
4. The tabulated values are for anchors installed at a minimum of 16 anchor diameters on center for 100 percent capacity. Spacing distances may be reduced to 8 anchor diameters on center provided the capacities are reduced by 50 percent. Linear interpolation may be used for intermediate spacing.
5. A suitable anchor length must be selected which included consideration of fixture to engage the base material at the minimum embedment depth when anchoring into hollow concrete masonry.
(e.g. attachment thickness + embedment + one half inch = suitable anchor length)



Ultimate and Allowable Load Capacities for Power-Bolt in Clay Brick Masonry[1,2,3]

Anchor Dia. d in.	Min. Embed. Depth h_v in. (mm)	Min. Edge Distance	Min. End Distance	Min. Spacing Distance	Structural Brick Masonry f´m ≥ 1,500 psi (10.4 MPa)			
					Ultimate Load		Allowable Load	
					Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
1/4	7/8 (22.2)	8 (203.2)	4 (101.6)	6 (152.4)	1,090 (4.9)	1,160 (5.2)	220 (1.0)	230 (1.0)
	1-1/2 (38.1)				1,455 (6.6)	1,265 (5.7)	290 (1.3)	255 (1.1)
3/8	2 (50.8)	12 (304.8)	6 (152.4)	8 (203.2)	2,015 (9.1)	3,655 (16.5)	405 (1.8)	730 (3.3)
1/2	2-1/2 (63.5)		8 (203.2)	10 (254.0)	3,110 (14.0)	4,585 (20.6)	620 (2.8)	915 (4.1)
5/8	2-3/4 (69.9)	16 (406.4)	10 (254.0)	12 (304.8)	4,535 (20.4)	5,470 (24.6)	905 (4.1)	1,095 (4.9)

1. Tabulated load values are for anchors installed in multiple wythe, minimum Grade SW, solid clay brick masonry walls conforming to ASTM C 62. Mortar must be minimum Type N. Masonry compressive strength must be at the specified minimum at the time of installation (f'm ≥ 1,500 psi).
2. Allowable load capacities listed are calculated using and applied safety factor of 5.0. Consideration of safety factors of 10 or higher may be necessary depending upon the application such as life safety or overhead.
3. Spacing between anchors may be reduced to half the listed distances provided the capacities are reduced by 50 percent. Linear interpolation may be used for intermediate spacing.



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[1]

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	$s_{cr} = 2.0h_v$	$F_{Ns} = F_{Vs} = 1.0$	$s_{min} = h_v$	$F_{Ns} = F_{Vs} = 0.50$
Edge Distance (c)	Tension	$c_{cr} = 12d$	$F_{Nc} = 1.0$	$c_{min} = 5d$	$F_{Nc} = 0.70$
	Shear	$c_{cr} = 12d$	$F_{Vc} = 1.0$	$c_{min} = 5d$	$F_{Vc} = 0.35$

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	$s_{cr} = 2.0h_v$	$F_{Ns} = F_{Vs} = 1.0$	$s_{min} = h_v$	$F_{Ns} = F_{Vs} = 0.50$
Edge Distance (c)	Tension	$c_{cr} = 12d$	$F_{Nc} = 1.0$	$c_{min} = 5d$	$F_{Nc} = 0.80$
	Shear	$c_{cr} = 12d$	$F_{Vc} = 1.0$	$c_{min} = 5d$	$F_{Vc} = 0.40$

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.

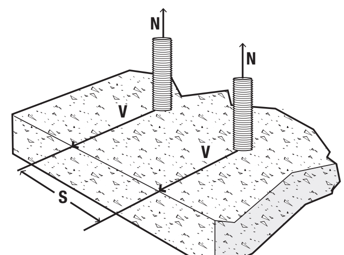
Load Adjustment Factors for Normal-Weight Concrete

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

Dia. (in.)	1/4			3/8			1/2			5/8		
h_v (in.)	1-1/4	1-3/4	2-1/2	2	2-1/2	3-1/2	2-1/2	3-1/2	5	2-3/4	4	6
s_{cr} (in.)	2-1/2	3-1/2	5	4	5	7	5	7	10	5-1/2	8	12
s_{min} (in.)	1-1/4	1-3/4	2-1/2	2	2-1/2	3-1/2	2-1/2	3-1/2	5	2-3/4	4	6
Spacing, s (inches)												
1-1/4	0.50	-	-	-	-	-	-	-	-	-	-	-
1-3/4	0.70	0.50	-	-	-	-	-	-	-	-		-
2	0.80	0.57	-	0.50	-	-	-	-	-	-	-	-
2-1/2	1.00	0.71	0.50	0.63	0.50	-	0.50	-	-	-	-	-
2-3/4	1.00	0.79	0.55	0.69	0.55	-	0.55	-	-	0.50	-	-
3	1.00	0.86	0.60	0.75	0.60	-	0.60	-	-	0.55	-	-
3-1/2	1.00	1.00	0.70	0.88	0.70	0.50	0.70	0.50	-	0.64	-	-
4	1.00	1.00	0.80	1.00	0.80	0.57	0.80	0.57	-	0.73	0.50	-
4-1/2	1.00	1.00	0.90	1.00	0.90	0.64	0.90	0.64	-	0.82	0.56	-
5	1.00	1.00	1.00	1.00	1.00	0.71	1.00	0.71	0.50	0.91	0.63	-
5-1/2	1.00	1.00	1.00	1.00	1.00	0.79	1.00	0.79	0.55	1.00	0.69	-
6	1.00	1.00	1.00	1.00	1.00	0.86	1.00	0.86	0.60	1.00	0.75	0.50
7	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.70	1.00	0.88	0.58
8	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.80	1.00	1.00	0.67
9	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.90	1.00	1.00	0.75
10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.83
12	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
14	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Notes: For anchors loaded in tension and shear, the critical spacing (s_{cr}) is equal to 2 embedment depths ($2h_v$) 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.

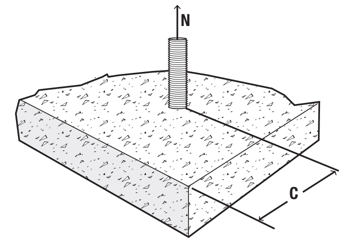


Edge Distance, Tension (F_{NC})

Dia. (in.)	1/4	3/8	1/2	5/8
c_{cr} (in.)	3	4-1/2	6	7-1/2
c_{min} (in.)	1-1/4	1-7/8	2-1/2	3-1/8
Edge Distance, c (inches)				
1-1/4	0.70	-	-	-
1-5/8	0.76	-	-	-
1-7/8	0.81	0.70	-	-
2	0.83	0.71	-	-
2-1/2	0.91	0.77	0.70	-
3	1.00	0.83	0.74	-
3-1/8	1.00	0.84	0.75	0.70
3-3/4	1.00	0.91	0.81	0.74
4	1.00	0.94	0.83	0.76
4-1/2	1.00	1.00	0.87	0.79
5	1.00	1.00	0.91	0.83
6	1.00	1.00	1.00	0.90
6-1/4	1.00	1.00	1.00	0.91
7	1.00	1.00	1.00	0.97
7-1/2	1.00	1.00	1.00	1.00
8	1.00	1.00	1.00	1.00
9	1.00	1.00	1.00	1.00

Notes: For anchors loaded in tension, the critical edge distance (c_{cr}) is equal to 12 anchor diameters (12d) 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 70% of load.

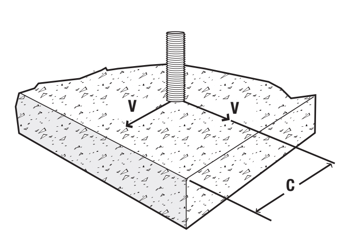


Edge Distance, Shear (F_{VC})

Dia. (in.)	1/4	3/8	1/2	5/8
c_{cr} (in.)	3	4-1/2	6	7-1/2
c_{min} (in.)	1-1/4	1-7/8	2-1/2	3-1/8
Edge Distance, c (inches)				
1-1/4	0.35	-	-	-
1-5/8	0.49	-	-	-
1-7/8	0.58	0.35	-	-
2	0.63	0.38	-	-
2-1/2	0.81	0.50	0.35	-
3	1.00	0.63	0.44	-
3-1/8	1.00	0.66	0.47	0.35
3-3/4	1.00	0.81	0.58	0.44
4	1.00	0.88	0.63	0.48
4-1/2	1.00	1.00	0.72	0.55
5	1.00	1.00	0.81	0.63
6	1.00	1.00	1.00	0.78
6-1/4	1.00	1.00	1.00	0.81
7	1.00	1.00	1.00	0.93
7-1/2	1.00	1.00	1.00	1.00
8	1.00	1.00	1.00	1.00
9	1.00	1.00	1.00	1.00

Notes: For anchors loaded in shear, the critical edge distance (c_{cr}) is equal to 12 anchor diameters (12d) 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 35% of load.

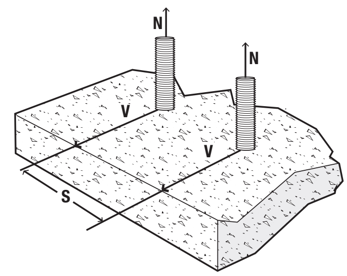


Load Adjustment Factors for Lightweight Concrete

Spacing, Tension (F_{NS}) & Shear (F_{VS})												
Dia. (in.)	**1/4**			**3/8**			**1/2**			**5/8**		
h_v (in.)	**1-1/4**	**1-3/4**	**2-1/2**	**2**	**2-1/2**	**3-1/2**	**2-1/2**	**3-1/2**	**5**	**2-3/4**	**4**	**6**
s_{cr} (in.)	**2-1/2**	**3-1/2**	**5**	**4**	**5**	**7**	**5**	**7**	**10**	**5-1/2**	**8**	**12**
s_{min} (in.)	**1-1/4**	**1-3/4**	**2-1/2**	**2**	**2-1/2**	**3-1/2**	**2-1/2**	**3-1/2**	**5**	**2-3/4**	**4**	**6**
Spacing, s (inches) 1-1/4	0.50	-	-	-	-	-	-	-	-	-	-	-
1-3/4	0.70	0.50	-	-	-	-	-	-	-	-	-	-
2	0.80	0.57	-	0.50	-	-	-	-	-	-	-	-
2-1/2	1.00	0.71	0.50	0.63	0.50	-	0.50	-	-	-	-	-
2-3/4	1.00	0.79	0.55	0.69	0.55	-	0.55	-	-	0.50	-	-
3	1.00	0.86	0.60	0.75	0.60	-	0.60	-	-	0.55	-	-
3-1/2	1.00	1.00	0.70	0.88	0.70	0.50	0.70	0.50	-	0.64	-	-
4	1.00	1.00	0.80	1.00	0.80	0.57	0.80	0.57	-	0.73	0.50	-
4-1/2	1.00	1.00	0.90	1.00	0.90	0.64	0.90	0.64	-	0.82	0.56	-
5	1.00	1.00	1.00	1.00	1.00	0.71	1.00	0.71	0.50	0.91	0.63	-
5-1/2	1.00	1.00	1.00	1.00	1.00	0.79	1.00	0.79	0.55	1.00	0.69	-
6	1.00	1.00	1.00	1.00	1.00	0.86	1.00	0.86	0.60	1.00	0.75	0.50
7	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.70	1.00	0.88	0.58
8	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.80	1.00	1.00	0.67
9	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.90	1.00	1.00	0.75
10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.83
12	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
14	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

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

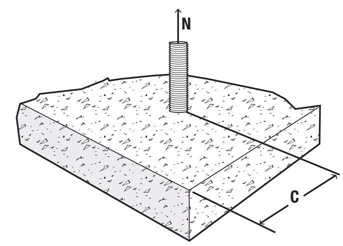
Minimum spacing (s_{min}) is equal to 1 embedment depth (h_v) at which the anchor achieves 50% of load.



Edge Distance, Tension (F_{NC})				
Dia. (in.)	**1/4**	**3/8**	**1/2**	**5/8**
c_{cr} (in.)	**3**	**4-1/2**	**6**	**7-1/2**
c_{min} (in.)	**1-1/4**	**1-7/8**	**2-1/2**	**3-1/8**
Edge Distance, c (inches) 1-1/4	0.80	-	-	-
1-5/8	0.84	-	-	-
1-7/8	0.87	0.80	-	-
2	0.89	0.81	-	-
2-1/2	0.94	0.85	0.80	-
3	1.00	0.89	0.83	-
3-1/8	1.00	0.90	0.84	0.80
3-3/4	1.00	0.94	0.87	0.83
4	1.00	0.96	0.89	0.84
4-1/2	1.00	1.00	0.91	0.86
5	1.00	1.00	0.94	0.89
6	1.00	1.00	1.00	0.93
6-1/4	1.00	1.00	1.00	0.94
7	1.00	1.00	1.00	0.98
7-1/2	1.00	1.00	1.00	1.00
8	1.00	1.00	1.00	1.00
9	1.00	1.00	1.00	1.00

Notes: For anchors loaded in tension, the critical edge distance (c_{cr}) is equal to 12 anchor diameters (12d) at which the anchor achieves 100% of load.

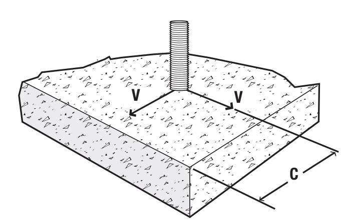
Minimum edge distance (c_{min}) is equal to 5 anchor diameters (5d) at which the anchor achieves 80% of load.



Edge Distance, Shear (F_{VC})				
Dia. (in.)	**1/4**	**3/8**	**1/2**	**5/8**
c_{cr} (in.)	**3**	**4-1/2**	**6**	**7-1/2**
c_{min} (in.)	**1-1/4**	**1-7/8**	**2-1/2**	**3-1/8**
Edge Distance, c (inches) 1-1/4	0.40	-	-	-
1-5/8	0.53	-	-	-
1-7/8	0.61	0.40	-	-
2	0.66	0.43	-	-
2-1/2	0.83	0.54	0.40	-
3	1.00	0.66	0.49	-
3-1/8	1.00	0.69	0.51	0.40
3-3/4	1.00	0.83	0.61	0.49
4	1.00	0.89	0.66	0.52
4-1/2	1.00	1.00	0.74	0.59
5	1.00	1.00	0.83	0.66
6	1.00	1.00	1.00	0.79
6-1/4	1.00	1.00	1.00	0.83
7	1.00	1.00	1.00	0.93
7-1/2	1.00	1.00	1.00	1.00
8	1.00	1.00	1.00	1.00
9	1.00	1.00	1.00	1.00

Notes: For anchors loaded in shear, the critical edge distance (c_{cr}) is equal to 12 anchor diameters (12d) 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 40% of load.

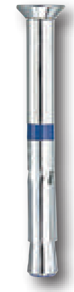


ORDERING INFORMATION

Carbon Steel Flat Head Power-Bolt

Cat.No.	Anchor Size	Drill Dia.	Min. Embed.	Std. Box	Std. Carton	Wt./100
6981	3/8" x 3-3/4"	3/8"	2"	50	300	14
6982	3/8" x 5"	3/8"	2"	50	300	17
6983	3/8" x 6"	3/8"	2"	50	300	20
6984	1/2" x 5"	1/2"	2-1/2"	25	150	26
6987	5/8" x 5-1/2"	5/8"	2-3/4"	15	90	57

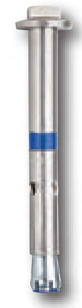
The published length is the overall length of the anchor.
The flat head Power-Bolt anchor has a hex key insert formed in the head of the bolt.
Each box contains an Allen wrench which matches the insert size.



Stainless Steel Hex Head Power-Bolt

Cat.No.	Anchor Size	Drill Dia.	Min. Embed.	Std. Box	Std. Carton	Wt./100
5902	1/4" x 1-3/4"	1/4"	1-1/4"	100	600	3
5906	1/4" x 3"	1/4"	1-1/4"	100	600	5
5910	3/8" x 2-1/4"	3/8"	2"	50	300	10
5914	3/8" x 3-1/2"	3/8"	2"	50	300	12
5916	3/8" x 4"	3/8"	2"	50	300	14
5930	1/2" x 2-3/4"	1/2"	2-1/2"	50	200	16
5934	1/2" x 4-3/4"	1/2"	2-1/2"	25	150	26

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



GENERAL INFORMATION

LOK-BOLT AS®

Sleeve Anchor

PRODUCT DESCRIPTION

The Lok-Bolt AS is an all-steel pre-assembled single unit sleeve anchor which is designed for use in concrete or masonry base materials. The anchors are available in multiple head styles for multiple applications and a finished appearance. Anchor extender sleeves can be added to create longer lengths.

GENERAL APPLICATIONS AND USES

- Door and window frame installations
- Masonry applications
- Electrical / Mechanical applications
- Mounting fixtures on walls
- General purpose anchoring

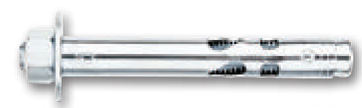
FEATURES AND BENEFITS

+ Variety of head styles, lengths and sizes
+ All steel component design
+ Preassembled anchor for immediate installation
+ Sleeve design keeps anchor centered in hole
+ Sleeve has 360° contact area for even stress distribution
+ Versatile – can be used for solid and hollow concrete or masonry applications
+ Designed to allow fixture to draw snug against the base material during tightening

GUIDE SPECIFICATIONS

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

SECTION CONTENTS



HEX HEAD

HEAD STYLES

- Hex Head
- Acorn Nut
- Round Head
- Combo Flat Head
- Threshold Flat Head
- Rod Hanger
- Tie-Wire

ANCHOR MATERIALS

- Zinc Plated Carbon Steel
- Type 304 Stainless Steel

ANCHOR SIZE RANGE (TYP.)

- 1/4" diameter through 3/4" diameter

SUITABLE BASE MATERIALS

- Normal-Weight Concrete
- Grouted Concrete Masonry (CMU)
- Hollow Concrete Masonry (CMU)
- Brick Masonry

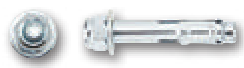
MATERIAL SPECIFICATIONS

Anchor Component	Carbon Steel Version	Stainless Steel Version
Plow-Bolt	AISI 1010/1018	Type 304 Stainless Steel
Expansion Sleeve	AISI 1010	Type 304 Stainless Steel
Extender	AISI 1010	N/A
Zinc Plating	ASTM B 633, SCI, Type III (Fe/Zn5)	N/A

INSTALLATION SPECIFICATIONS

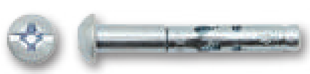
Acorn Nut and Hex Head Lok-Bolt AS

Dimension	Nominal Anchor Diameter, d					
	1/4"	5/16"	3/8"	1/2"	5/8"	3/4"
ANSI Drill Bit Size, d_{bit} (in.)	1/4	5/16	3/8	1/2	5/8	3/4
Fixture Clearance Hole, d_h (in.)	5/16	3/8	7/16	9/16	11/16	15/16
Plow Bolt Size (UNC)	10-24	1/4-20	5/16-18	3/8-16	1/2-13	5/8-11
Nut Height (in.)	3/16	7/32	17/64	21/64	7/16	35/64
Washer O.D., d_w (in.)	1/2	5/8	13/16	1	1-3/8	1-3/4
Wrench Size (in.)	3/8	7/16	1/2	9/16	3/4	15/16



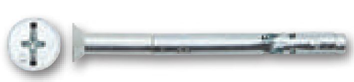
Round Head Lok-Bolt AS

Dimension	Nominal Anchor Diameter, d		
	1/4"	5/16"	3/8"
ANSI Drill Bit Size, d_{bit} (in.)	1/4	5/16	3/8
Fixture Clearance Hole, d_h (in.)	5/16	3/8	7/16
Plow Bolt Size (UNC)	10-24	1/4-20	5/16-18
Head Height (in.)	11/64	13/64	15/64
Head Width, d_{hd} (in.)	29/64	9/16	43/64
Phillips Driver Size	#3	#3	#4



Combo Flat Head Lok-Bolt AS

Dimension	Nominal Anchor Diameter, d		
	1/4"	5/16"	3/8"
ANSI Drill Bit Size, d_{bit} (in.)	1/4	5/16	3/8
Fixture Clearance Hole, d_h (in.)	5/16	3/8	7/16
Plow Bolt Size (UNC)	10-24	1/4-20	5/16-18
Head Height (in.)	5/32	3/16	15/64
Head Width, d_{hd} (in.)	1/2	5/8	3/4
Phillips Driver Size	#2	#3	#4



Rod Hanger Lok-Bolt AS

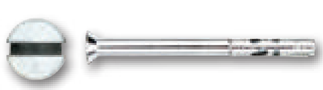
Dimension	Nominal Anchor Diameter, d		
	1/4"	5/16"	3/8"
ANSI Drill Bit Size, d_{bit} (in.)	5/16	3/8	1/2
Plow Bolt Size (UNC)	1/4-20	5/16-18	3/8-16
Coupling Height (in.)	7/8	1	1-1/4
Washer O.D., d_w (in.)	5/8	13/16	1
Coupling Wrench Size (in.)	3/8	1/2	11/16

Threshold Lok-Bolt AS

Dimension	Anchor Size, d
	1/4"
ANSI Drill Bit Size, d_{bit} (in.)	1/4
Fixture Clearance Hole, d_h (in.)	5/16
Plow Bolt Size (UNC)	10-24
Head Height (in.)	5/64
Head Width, d_{hd} (in.)	23/64

Tie-Wire Lok-Bolt AS

Dimension	Anchor Size, d
	5/16"
ANSI Drill Bit Size, d_{bit} (in.)	5/16
Fixture Clearance Hole, d_h (in.)	3/8
Plow Bolt Size (UNC)	1/4-20
Head Height (in.)	1-9/16
Head Width, d_{hd} (in.)	31/64

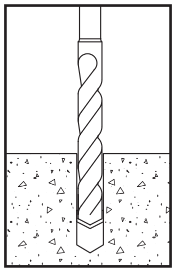


INSTALLATION INSTRUCTIONS

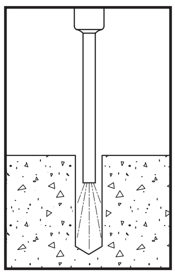
Hex/Acorn/Flat Head Round Versions

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

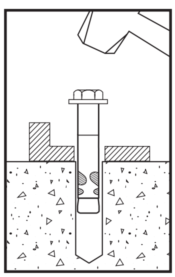


Remove dust and debris from the hole during drilling (e.g. dust extractor, hollow bit) or following drilling (e.g. suction, forced air) to extract loose particles created by drilling.

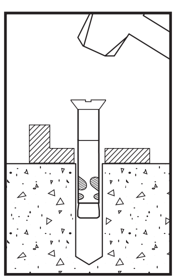


Hex Head/Acorn Nut
Position the washer on the anchor and thread on the nut.

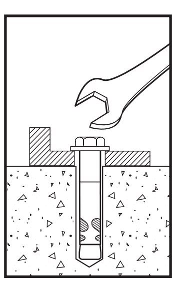
Drive the anchor through the fixture into the anchor hole until the nut and washer are firmly seated against the fixture. Be sure the anchor is driven to the required embedment depth.



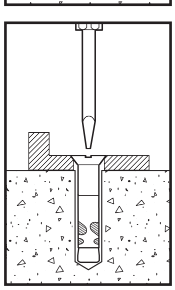
Flat Head/Round Head
Drive the anchor through the fixture until the anchor is firmly seated. Be sure the anchor is driven to the required embedment depth.



Hex Head/Acorn Nut
Tighten the anchor by turning the nut or head 3 to 5 turns past finger tight or by applying the guide installation torque from the finger tight position.



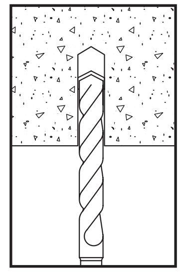
Flat Head/Round Head
Tighten the anchor by turning the head 3 to 5 turns past finger tight.



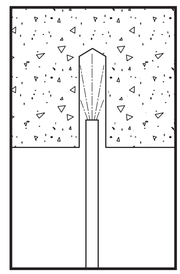
Rod Hanger Version

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.

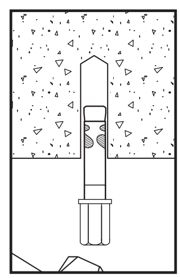
The tolerances of the drill bit used must meet the requirements of ANSI Standard B212.15



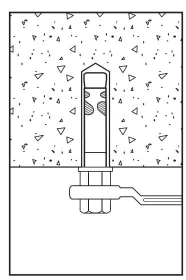
Remove dust and debris from the hole during drilling (e.g. dust extractor, hollow bit) or following drilling (e.g. suction, forced air) to extract loose particles created by drilling.



Drive the anchor into the hole until the anchor is at the required embedment depth.



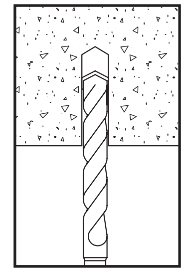
Tighten the coupler nut and washer up to the concrete surface and tighten the anchor by turning the nut 3 to 5 turns past finger tight or by applying the guide installation torque from the finger tight position.



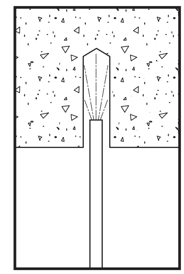
Tie-Wire Version

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.

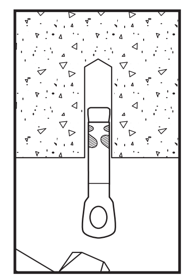
The tolerances of the drill bit used must meet the requirements of ANSI Standard B212.15



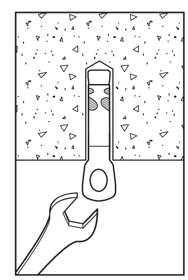
Remove dust and debris from the hole during drilling (e.g. dust extractor, hollow bit) or following drilling (e.g. suction, forced air) to extract loose particles created by drilling.



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.



Tighten the tie wire nut by turning the head 3 to 5 turns past finger tight or by applying the guide installation torque from the finger tight position.



PERFORMANCE DATA

Ultimate and Allowable Load Capacities for Carbon and Stainless Steel Lok-Bolt AS Anchors in Normal Weight Concrete[1,2,3,4]

Nominal Anchor Diameter d in.	Min. Embed. Depth h_v in.	Guide Installation Torque ft.-lbs.		Minimum Concrete Compressive Strength, f'c											
				3,000 psi				3,500 psi				4,000 psi			
				Ultimate		Allowable		Ultimate		Allowable		Ultimate		Allowable	
		Carbon	Stainless	Tension lbs.	Shear lbs.	Tension lbs.	Shear lbs.	Tension lbs.	Shear lbs.	Tension lbs.	Shear lbs.	Tension lbs.	Shear lbs.	Tension lbs.	Shear lbs.
1/4	1/2	2	-	225	1,000	55	250	240	1,000	60	250	260	1,000	65	250
	1	6	4	910	1,120	230	280	980	1,120	245	280	1,050	1,120	265	280
5/16	1	12	-	1,205	2,360	300	590	1,300	2,360	325	590	1,390	2,360	350	590
3/8	1-1/4	18	18	1,875	4,110	470	1,030	2,040	4,110	510	1,030	2,165	4,110	540	1,030
1/2	1-1/2	26	26	2,235	4,860	560	1,215	2,420	4,860	605	1,215	2,580	4,860	645	1,215
5/8	2	50	40	4,870	4,860	1,220	1,215	5,260	4,860	1,315	1,215	5,625	4,860	1,405	1,215
3/4	2-1/4	90	60	5,045	11,040	1,260	2,760	5,450	11,040	1,365	2,760	5,825	11,040	1,455	2,760

1. The ultimate load values listed above must 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.
2. 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 application, such as life safety or overhead.
3. Tabulated load values are for anchors installed at a minimum spacing distance between anchors and an edge distance of 12 times the anchor diameters.
4. The embedment depth is measured from the outside surface of the concrete member to the embedded end of the anchor prior to tightening.

Ultimate and Allowable Load Capacities for Carbon and Stainless Steel Lok-Bolt AS Anchors in Hollow or Solid Concrete Masonry[1,2,3,4,5]

Nominal Anchor Diameter d in.	Minimum Embed. Depth h_v in.	Guide Installation Torque ft.-lbs.	Minimum Edge Dist. in.	Minimum End Dist. in.	Ultimate Loads		Allowable Loads	
					Tension lbs.	Shear lbs.	Tension lbs.	Shear lbs.
1/4	1	4	3-3/4	4	800	1,140	160	225
5/16	1	8			905	1,570	180	310
3/8	1-1/4	15			1,100	1,570	220	310
1/2	1-1/2	18			1,525	1,570	305	310
5/8	1-1/2	30			2,250	1,770	450	355

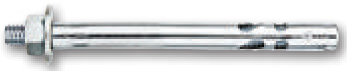
1. Tabulated load values are for anchors installed in minimum 6 inch wide, Grade N, Type II, normal-weight concrete masonry units conforming to ASTM C 90. Mortar must be minimum Type N, S, or M. Masonry prism compressive strength must be 1,500 psi minimum at time of installation.
2. Allowable load capacities listed are calculated using an applied 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. A suitable anchor length must be selected which includes consideration of a fixture to engage the base material at the minimum embedment depth when anchoring into hollow concrete masonry. (e.g. attachment thickness + face shell thickness embedment + one half inch = suitable anchor length)
4. The consistence of hollow concrete block masonry base material can vary greatly. Consideration of job site testing should be given to verify conformance of base materials and anchor performance in actual conditions.
5. The embedment depth is measured from the outside surface of the masonry member to the embedded end of the anchor prior to tightening.

Ultimate and Allowable Load Capacties for Carbon or Stainless Steel Lok-Bolt AS Anchors in Solid Clay Brick Masonry[1,2,3]

Nominal Anchor Diameter d in.	Minimum Embed. Depth h_v in.	Guide Installation Torque ft.-lbs.	Minimum Edge Dist. in.	Minimum End Dist. in.	f'm ≥ 1,500 psi (10.4 MPa)			
					Ultimate		Allowable	
					Tension lbs.	Shear lbs.	Tension lbs.	Shear lbs.
1/4	1	4	4	1-1/2	800	950	160	190
3/8	1-1/4	15	8	8	1,100	3,000	220	600
1/2	1-1/2	26	8	8	1,560	3,150	310	630
5/8	2	40	8	8	2,470	5,250	495	1,050

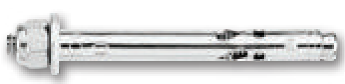
1. Tabulated load values are for anchors installed in Grade SW, multiple wythe solid clay brick masonry conforming to ASTM C 62.
2. Allowable load capacities listed are calculated using a safety factor of 5.0 or greater. Consideration of safety factors of 10 or higher may be necessary depending on the application, such as life safety.
3. The embedment depth is measured from the outside surface of the brick masonry member to the embedded end of the anchor prior to tightening.

ORDERING INFORMATION



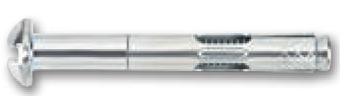
Hex Nut Lok-Bolt AS

Catalog Number		Size	Drill Dia.	Std. Box	Std. Ctn.
Carbon Steel	Stainless Steel				
5005S	-	5/16" x 1-1/2"	5/16"	100	1000
5010S	-	5/16" x 2-3/8"	5/16"	100	500
5015S	6152S	3/8" x 1-7/8"	3/8"	50	500
5020S	6153S	3/8" x 3"	3/8"	50	500
5022S	-	3/8" x 4"	3/8"	50	250
5025S	6156S	1/2" x 2-1/2"	1/2"	25	250
5030S	6157S	1/2" x 3"	1/2"	25	250
5034S	6160S	1/2" x 3-3/4"	1/2"	25	125
5033S	-	1/2" x 5-1/4"	1/2"	25	125
5032S	-	1/2" x 6"	1/2"	10	100
5035S	-	5/8" x 2-1/2"	5/8"	25	125
5038S	-	5/8" x 3"	5/8"	25	125
5040S	6164S	5/8" x 4-1/4"	5/8"	10	100
5045S	-	5/8" x 5-3/4"	5/8"	10	100
5050S	-	3/4" x 2-3/4"	3/4"	10	100
5055S	-	3/4" x 4-1/4"	3/4"	10	40
5060S	-	3/4" x 6-1/4"	3/4"	10	30
5065S	-	3/4" x 8-1/4"	3/4"	10	30
The published length is measured from below the washer to the end of the anchor					



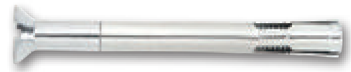
Acorn Nut Lok-Bolt AS

Catalog Number		Size	Drill Dia.	Std. Box	Std. Ctn.
Carbon Steel	Stainless Steel				
5125S	-	1/4" x 5/8"	1/4"	100	1000
5150S	6150S	1/4" x 1-3/8"	1/4"	100	1000
5175S	-	1/4" x 2-1/4"	1/4"	100	1000
The published length is measured from below the washer to the end of the anchor					



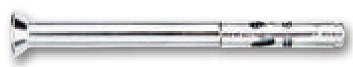
Round Head Lok-Bolt AS, Slotted

Catalog Number		Size	Drill Dia.	Std. Box	Std. Ctn.
Carbon Steel	Stainless Steel				
5205S	-	1/4" x 1-3/8"	1/4"	100	1000
5210S	6180S	1/4" x 2-1/4"	1/4"	100	1000
5215S	-	1/4" x 3"	1/4"	100	1000
5220S	-	1/4" x 3-3/4"	1/4"	100	1000
5225S	-	5/16" x 2-3/8"	5/16"	100	1000
5230S	-	5/16" x 3-3/8"	5/16"	100	500
5235S	-	3/8" x 2-3/4"	3/8"	50	500
5240S	-	3/8" x 3-3/4"	3/8"	50	250
The published length is measured from below the head to the end of the anchor					



Combo Flat Head Lok-Bolt AS

Catalog Number		Size	Drill Dia.	Std. Box	Std. Ctn.
Carbon Steel	Stainless Steel				
5305S	-	1/4" x 1-1/2"	1/4"	100	1000
5310S	6170S	1/4" x 2-1/4"	1/4"	100	1000
5315S	6172S	1/4" x 3"	1/4"	100	1000
5320S	-	1/4" x 4"	1/4"	100	500
5325S	-	1/4" x 5-1/4"	1/4"	100	500
5330S	-	5/16" x 2-1/2"	5/16"	100	1000
5340S	-	3/8" x 2-3/4"	3/8"	50	500
5345S	6174S	3/8" x 4"	3/8"	50	250
5350S	6175S	3/8" x 5"	3/8"	50	250
5360S	6176S	3/8" x 6"	3/8"	50	250
The published length is the overall length of the anchor					

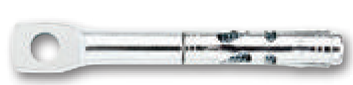


Threshold Flat Head Lok-Bolt AS

Cat #	Size	Drill Dia.	Std. Box	Std. Ctn.
5500S	1/4" x 2"	1/4"	100	1000
The published length is the overall length of the anchor				

Rod Hanger Lok-Bolt AS

Cat #	Size	Drill Dia.	Std. Box	Std. Ctn.
5810S	1/4" x 1-1/2"	5/16"	50	250
5815S	3/8" x 1-7/8"	3/8"	50	250
5825S	1/2" x 2-1/4"	1/2"	25	125
The published length is measured from below the washer to the end of the anchor				



Tie-Wire Lok-Bolt AS

Cat #	Size	Drill Dia.	Std. Box	Std. Ctn.
5700S	5/16" x 2-3/8"	5/16"	100	1000
The published length is measured from below the head to the end of the anchor				

Lok-Bolt AS Extenders

Cat #	Size	Drill Dia.	Std. Box	Std. Ctn.
5684S	3/8" x 1-1/4"	3/8"	50	500

GENERAL INFORMATION

SCREW-BOLT+™

High Performance Screw Anchor

PRODUCT DESCRIPTION

The Screw-Bolt+ anchor is a one piece, heavy duty screw anchor with a finished hex head. It is simple to install, easy to identify and fully removable. The patented thread design, designed for use with standard ANSI drill bits, reduces installation torque and enhances productivity. The steel threads along the anchor body tap into the hole during installation to provide keyed engagement and allow for reduced edge and spacing distances. The Screw-Bolt+ finish is available in bright zinc-plated and mechanically galvanized. Suitable base materials include normal-weight concrete, sand-lightweight concrete, concrete over steel deck, concrete masonry and solid clay brick.

GENERAL APPLICATIONS AND USES

- Racking, shelving and material handling
- Support ledgers and sill plate attachments
- Temporary attachments
- Glazing and window attachments
- Retrofits, repairs and maintenance
- Fencing and railing
- Seismic and wind loading

FEATURES AND BENEFITS

+ Designed for standard ANSI tolerance drill bits
+ Patented thread design offers low installation torque
+ Tough threads for tapping high strength concrete
+ Ratchet teeth on underside of hex washer head lock against the fixture
+ Can be installed closer to the edge than traditional expansion anchors
+ Fully removeable and reinstallable in same hole
+ Fast installation with powered impact wrench
+ Diameter, length and identifying marking stamped on head of each anchor
+ One-piece, finished head design

APPROVALS AND LISTINGS

- International Code Council, Evaluation Service (ICC-ES), ESR-3889 for concrete. Code compliant with 2015 IBC, 2015 IRC, 2012 IBC, 2012 IRC, 2009 IBC, and 2009 IRC.
- Tested in accordance with ACI 355.2 and ICC-ES AC193 for use in structural applications in concrete under the design provisions of ACI 318 (Strength Design Method)
- Evaluated and qualified by an accredited independent testing laboratory for recognition in cracked and uncracked concrete including seismic and wind loading (Category 1 anchors)
- Evaluated and qualified by an accredited independent testing laboratory for reliability against brittle failure, e.g. hydrogen embrittlement

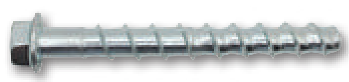
GUIDE SPECIFICATIONS

CSI Divisions: 03 16 00 - Concrete Anchors, 04 05 19.16 - Masonry Anchors and 05 05 19 - Post-Installed Concrete Anchors. Screw anchors shall be Screw-Bolt+ as supplied by DEWALT, Towson, MD. Anchors shall be installed in accordance with published instructions and the Authority Having Jurisdiction.

MATERIAL SPECIFICATIONS

Anchor component	Specification
Anchor Body and hex washer head	Case hardened low carbon steel
Plating Standard zinc plated or mechanically galvanized versions	Zinc plating according to ASTM B 633, SC1 Type III (Fe/Zn 5). Minimum plating requirements for Mild Service Condition.
	Mechanically Galvanized Zinc plating according to ASTM B 695, Class 55

SECTION CONTENTS



SCREW-BOLT+

HEAD STYLES

Hex Washer Head

ANCHOR MATERIALS

Zinc plated carbon steel or mechanically galvanized

ANCHOR SIZE RANGE (TYP.)

- 1/4" diameter through 3/4" diameter (see ordering information)

SUITABLE BASE MATERIALS

- Normal-weight concrete
- Sand-lightweight concrete
- Concrete over steel deck

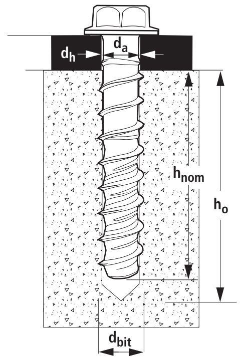
TENSION ZONE CRACKED CONCRETE

SEISMIC REGION QUALIFICATION

CODE LISTED
ICC-ES ESR-3889
CONCRETE

INSTALLATION SPECIFICATIONS

Screw-Bolt+ Anchor Detail

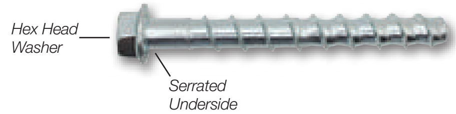


Nomenclature
d_a = Diameter of Anchor
d_{bit} = Diameter of Drill Bit
d_h = Diameter of Clearance Hole
h = Base Material Thickness. The value of h should be $1.5h_{nom}$ or 3", whichever is greater
h_{nom} = Minimum Nominal Embedment
h_o = Minimum Hole Depth

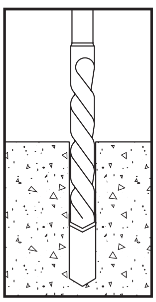
Hex Head Marking

Legend

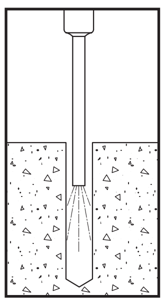
Diameter and Length Identification Mark



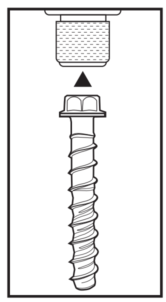
Installation Instructions for Screw-Bolt+



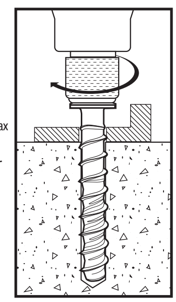
Step 1
Using the proper drill bit size, drill a hole into the base material to the required depth. The tolerances of the drill bit used should meet the requirements of ANSI standard B212.15



Step 2
Remove dust and debris from hole during drilling (e.g. dust extractor, hollow bit) or following drilling (e.g. suction, forced air) to extract loose particles created during drilling.



Step 3
Select a torque wrench or powered impact wrench and do not exceed the maximum torque, $T_{inst,max}$ or $T_{impact,max}$ respectively for the selected anchor diameter and embedment. Attach an appropriate sized hex socket/driver to the impact wrench. Mount the screw anchor head into the socket.



Step 4
Drive the anchor into the hole until the head of the anchor comes into contact with the fixture. The anchor must be snug after installation. Do not spin the hex socket off the anchor to disengage.

REFERENCE DATA (ASD)

Installation Specifications for Screw-Bolt+ in Concrete and Supplemental Information[2]

Anchor Property/Setting Information	Notation	Units	Nominal Anchor Diameter (inch)				
			1/4	3/8	1/2	5/8	3/4
Anchor outside diameter	d	in. (mm)	0.250 (6.35)	0.375 (9.53)	0.500 (12.70)	0.625 (15.88)	0.750 (19.05)
Nominal drill bit diameter	d_{bit}	in.	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)	3/8 (9.5)	1/2 (12.7)	5/8 (15.9)	3/4 (19.1)	7/8 (22.2)
Minimum embedment depth	h_{nom}	in. (mm)	1 (25)	1-1/2 (38)	1-3/4 (44)	2-1/2 (64)	2-1/2 (64)
Minimum hole depth	h_o	in. (mm)	1-3/8 (35)	1-7/8 (48)	2-1/8 (54)	2-7/8 (73)	2-7/8 (73)
Minimum member thickness[1]	h_{min}	in. (mm)	3 (76)	3 (76)	3 (76)	3-3/4 (95)	3-3/4 (95)
Minimum edge distance	c_{min}	in. (mm)	1-1/2 (38)	1-1/2 (38)	1-3/4 (44)	1-3/4 (44)	1-3/4 (44)
Minimum spacing	s_{min}	in. (mm)	1-1/2 (38)	2 (51)	2-3/4 (70)	2-3/4 (70)	3 (76)
Max Installation torque	$T_{inst,max}$	ft.-lbf. (N-m)	19 (26)	25 (34)	45 (61)	60 (81)	70 (95)
Max impact wrench power (torque)	$T_{impact,max}$	ft.-lbf. (N-m)	150 (203)	300 (407)	300 (407)	700 (950)	700 (950)
Impact wrench socket size	-	in.	7/16	9/16	3/4	15/16	1-1/8
Maximum head height	-	in.	21/64	3/8	31/64	37/64	43/64
Maximum washer diameter	-	in.	37/64	3/4	1-1/16	1-1/8	1-13/32
Effective tensile stress area (screw anchor body)	A_{se}	in^2 (mm^2)	0.045 (29.0)	0.094 (60.6)	0.176 (113.5)	0.274 (176.8)	0.399 (257.4)
Minimum specified ultimate strength	f_{uta}	ksi (N/mm^2)	100 (690)	92.5 (638)	115 (794)	95 (656)	95 (656)
Minimum specified yield strength	f_y	ksi (N/mm^2)	80 (552)	74 (511)	92 (635)	76 (524)	76 (524)

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

1. The minimum base material thickness shall be the greater of $1.5 \cdot h_{nom}$ or 3 inches.
2. See load capacities in normal weight concrete for additional embedment depths.

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

Nominal Anchor Diameter in.	Minimum Nominal Embedment Depth in. (mm)	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 (25)	1,325 (5.9)	1,660 (7.4)	1,400 (6.2)	1,755 (7.8)	1,530 (6.8)	1,910 (8.5)	1,725 (7.7)	2,080 (9.3)	1,725 (7.7)	2,080 (9.3)
	1-5/8 (41)	2,835 (12.6)	1,660 (7.4)	2,995 (13.3)	1,755 (7.8)	3,265 (14.5)	1,910 (8.5)	3,265 (14.5)	2,080 (9.3)	3,265 (14.5)	2,080 (9.3)
	2-1/2 (64)	3,650 (16.2)	2,025 (9.0)	3,855 (17.1)	2,140 (9.5)	4,200 (18.7)	2,335 (10.4)	4,270 (19.0)	2,545 (11.3)	4,270 (19.0)	2,545 (11.3)
3/8	1-1/2 (38)	2,630 (11.7)	3,550 (15.8)	2,880 (12.8)	3,890 (17.3)	3,330 (14.8)	4,490 (20.0)	4,075 (18.1)	5,500 (24.5)	4,075 (18.1)	6,355 (28.3)
	2 (51)	3,670 (16.3)	4,320 (19.2)	4,020 (17.9)	4,735 (21.1)	4,645 (20.7)	5,465 (24.3)	4,725 (21.0)	6,345 (28.2)	5,455 (24.3)	6,345 (28.2)
	3-1/4 (83)	7,420 (33.0)	6,325 (28.1)	8,130 (36.2)	6,930 (30.8)	9,065 (40.3)	8,000 (35.6)	9,065 (40.3)	8,565 (38.1)	10,350 (46.0)	8,565 (38.1)
	4-1/2 (114)	10,905 (48.5)	6,325 (28.1)	11,945 (53.1)	6,930 (30.8)	13,795 (61.4)	8,000 (35.6)	15,075 (67.1)	8,565 (38.1)	15,075 (67.1)	8,565 (38.1)
1/2	1-3/4 (44)	2,840 (12.6)	5,985 (26.6)	3,115 (13.9)	6,555 (29.2)	3,595 (16.0)	7,570 (33.7)	4,400 (19.6)	9,270 (41.2)	4,400 (19.6)	10,705 (47.6)
	2-1/2 (64)	6,680 (29.7)	8,035 (35.7)	7,320 (32.6)	8,800 (39.1)	8,450 (37.6)	10,160 (45.2)	8,450 (37.6)	11,545 (51.4)	8,450 (37.6)	11,545 (51.4)
	4-1/4 (108)	13,260 (59.0)	9,395 (41.8)	14,525 (64.6)	10,290 (45.8)	16,480 (73.3)	11,885 (52.9)	16,480 (73.3)	13,520 (60.1)	16,480 (73.3)	13,520 (60.1)
	5-1/2 (140)	15,730 (70.0)	9,395 (41.8)	17,235 (76.7)	10,290 (45.8)	19,900 (88.5)	11,885 (52.9)	21,310 (94.8)	13,520 (60.1)	21,310 (94.8)	13,520 (60.1)
5/8	2-1/2 (64)	5,735 (25.5)	10,615 (47.2)	6,285 (28.0)	11,630 (51.7)	7,255 (32.3)	13,425 (59.7)	8,885 (39.5)	16,445 (73.2)	8,885 (39.5)	17,170 (76.4)
	3-1/4 (83)	9,755 (43.4)	12,065 (53.7)	10,685 (47.5)	13,220 (58.8)	12,340 (54.9)	15,265 (67.9)	12,340 (54.9)	17,170 (76.4)	12,340 (54.9)	17,170 (76.4)
	5 (127)	14,455 (64.3)	13,675 (60.8)	15,830 (70.4)	14,980 (66.6)	18,280 (81.3)	17,295 (76.9)	19,295 (85.8)	19,485 (86.7)	22,280 (99.1)	19,485 (86.7)
	6-1/4 (159)	20,520 (91.3)	13,675 (60.8)	22,475 (100.0)	14,980 (66.6)	25,955 (115.5)	17,295 (76.9)	31,785 (141.4)	19,485 (86.7)	31,785 (141.4)	19,485 (86.7)
3/4	2-1/2 (64)	6,035 (26.8)	11,615 (51.7)	6,610 (29.4)	12,725 (56.6)	7,635 (34.0)	14,690 (65.3)	9,350 (41.6)	17,995 (80.0)	9,350 (41.6)	20,775 (92.4)
	4-1/4 (108)	11,900 (52.9)	17,055 (75.9)	13,035 (58.0)	18,685 (83.1)	15,050 (66.9)	21,575 (96.0)	17,745 (78.9)	24,270 (108.0)	20,490 (91.1)	24,270 (108.0)
	5 (127)	19,020 (84.6)	17,055 (75.9)	20,835 (92.7)	18,685 (83.1)	24,055 (107.0)	21,575 (96.0)	29,460 (131.0)	24,270 (108.0)	29,460 (131.0)	24,270 (108.0)
	6-1/4 (159)	20,495 (91.2)	17,055 (75.9)	22,450 (99.9)	18,685 (83.1)	25,920 (115.3)	21,575 (96.0)	31,750 (141.2)	24,270 (108.0)	31,750 (141.2)	24,270 (108.0)

1. Tabulated load values are for anchors installed in concrete. Concrete compressive strength must be at a minimum at the time of installation.
2. Ultimate load capacities must be reduced by a minimum safety factor of 4.0 or greater to determine allowable working load.

Allowable Load Capacities for Screw-Bolt+ in Normal-Weight Concrete[1,2,3,4]

Nominal Anchor Diameter in.	Minimum Nominal Embedment Depth in. (mm)	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 (25)	330 (1.5)	415 (1.8)	350 (1.6)	440 (2.0)	385 (1.7)	480 (2.1)	430 (1.9)	520 (2.3)	430 (1.9)	520 (2.3)
	1-5/8 (41)	710 (3.2)	415 (1.8)	750 (3.3)	440 (2.0)	815 (3.6)	480 (2.1)	815 (3.6)	520 (2.3)	815 (3.6)	520 (2.3)
	2-1/2 (64)	915 (4.1)	505 (2.2)	965 (4.3)	535 (2.4)	1,050 (4.7)	585 (2.6)	1,070 (4.8)	635 (2.8)	1,070 (4.8)	635 (2.8)
3/8	1-1/2 (38)	660 (2.9)	890 (4.0)	720 (3.2)	975 (4.3)	835 (3.7)	1,125 (5.0)	1,020 (4.5)	1,375 (6.1)	1,020 (4.5)	1,590 (7.1)
	2 (51)	920 (4.1)	1,080 (4.8)	1,005 (4.5)	1,185 (5.3)	1,160 (5.2)	1,365 (6.1)	1,180 (5.2)	1,585 (7.1)	1,365 (6.1)	1,585 (7.1)
	3-1/4 (83)	1,855 (8.3)	1,580 (7.0)	2,035 (9.1)	1,735 (7.7)	2,265 (10.1)	2,000 (8.9)	2,265 (10.1)	2,140 (9.5)	2,590 (11.5)	2,140 (9.5)
	4-1/2 (114)	2,725 (12.1)	1,580 (7.0)	2,985 (13.3)	1,735 (7.7)	3,450 (15.3)	2,000 (8.9)	3,770 (16.8)	2,140 (9.5)	3,770 (16.8)	2,140 (9.5)
1/2	1-3/4 (44)	710 (3.2)	1,495 (6.7)	780 (3.5)	1,640 (7.3)	900 (4.0)	1,895 (8.4)	1,100 (4.9)	2,320 (10.3)	1,100 (4.9)	2,675 (11.9)
	2-1/2 (64)	1,670 (7.4)	2,010 (8.9)	1,830 (8.1)	2,200 (9.8)	2,115 (9.4)	2,540 (11.3)	2,115 (9.4)	2,885 (12.8)	2,115 (9.4)	2,885 (12.8)
	4-1/4 (108)	3,315 (14.7)	2,350 (10.5)	3,630 (16.1)	2,575 (11.5)	4,120 (18.3)	2,970 (13.2)	4,120 (18.3)	3,380 (15.0)	4,120 (18.3)	3,380 (15.0)
	5-1/2 (140)	3,935 (17.5)	2,350 (10.5)	4,310 (19.2)	2,575 (11.5)	4,975 (22.1)	2,970 (13.2)	5,330 (23.7)	3,380 (15.0)	5,330 (23.7)	3,380 (15.0)
5/8	2-1/2 (64)	1,435 (6.4)	2,655 (11.8)	1,570 (7.0)	2,910 (12.9)	1,815 (8.1)	3,355 (14.9)	2,220 (9.9)	4,110 (18.3)	2,220 (9.9)	4,295 (19.1)
	3-1/4 (83)	2,440 (10.9)	3,015 (13.4)	2,670 (11.9)	3,305 (14.7)	3,085 (13.7)	3,815 (17.0)	3,085 (13.7)	4,295 (19.1)	3,085 (13.7)	4,295 (19.1)
	5 (127)	3,615 (16.1)	3,420 (15.2)	3,960 (17.6)	3,745 (16.7)	4,570 (20.3)	4,325 (19.2)	4,825 (21.5)	4,870 (21.7)	5,570 (24.8)	4,870 (21.7)
	6-1/4 (159)	5,130 (22.8)	3,420 (15.2)	5,620 (25.0)	3,745 (16.7)	6,490 (28.9)	4,325 (19.2)	7,945 (35.3)	4,870 (21.7)	7,945 (35.3)	4,870 (21.7)
3/4	2-1/2 (64)	1,510 (6.7)	2,905 (12.9)	1,655 (7.4)	3,180 (14.1)	1,910 (8.5)	3,675 (16.3)	2,340 (10.4)	4,500 (20.0)	2,340 (10.4)	5,195 (23.1)
	4-1/4 (108)	2,975 (13.2)	4,265 (19.0)	3,260 (14.5)	4,670 (20.8)	3,765 (16.7)	5,395 (24.0)	4,435 (19.7)	6,070 (27.0)	5,125 (22.8)	6,070 (27.0)
	5 (127)	4,755 (21.2)	4,265 (19.0)	5,210 (23.2)	4,670 (20.8)	6,015 (26.8)	5,395 (24.0)	7,365 (32.8)	6,070 (27.0)	7,365 (32.8)	6,070 (27.0)
	6-1/4 (159)	5,125 (22.8)	4,265 (19.0)	5,615 (25.0)	4,670 (20.8)	6,480 (28.8)	5,395 (24.0)	7,940 (35.3)	6,070 (27.0)	7,940 (35.3)	6,070 (27.0)

1. Tabulated load values are for anchors installed in concrete. Concrete compressive strength must be at the specified minimum at the time of installation.
2. Allowable load capacities are calculated using an applied safety factor 4.0.
3. Allowable load capacities must be multiplied by reduction factors when anchor spacing or edge distances are less than critical distances.
4. Linear interpolation may be used to determine allowable loads for intermediate embedments and compressive strengths.

LOAD ADJUSTMENT FACTORS FOR NORMAL-WEIGHT CONCRETE

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	1-5/8	2-1/2	1-1/2	2	3-1/4	4-1/2	1-3/4	2-1/2	4-1/4	5-1/2	2-1/2	3-1/4	5	6-1/4	2-1/2	4-1/4	5	6-1/4
Min. Edge Distance c_{min} (in)	1-1/2	1-1/2	1-1/2	1-1/2	1-1/2	1-1/2	1-1/2	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4
Edge Distance (inches) 1-1/2	1.00	0.77	0.64	0.85	0.74	0.59	0.55	-	-	-	-	-	-	-	-	-	-	-	-
1-3/4	1.00	0.83	0.67	0.93	0.79	0.62	0.57	0.87	0.71	0.58	0.54	0.73	0.65	0.56	0.53	0.73	0.59	0.56	0.53
2	1.00	0.88	0.71	1.00	0.84	0.65	0.59	0.94	0.76	0.60	0.56	0.78	0.68	0.58	0.54	0.78	0.61	0.58	0.54
2-1/4	1.00	0.94	0.75	1.00	0.89	0.68	0.61	1.00	0.80	0.63	0.57	0.82	0.71	0.60	0.56	0.82	0.63	0.60	0.56
2-1/2	1.00	1.00	0.78	1.00	0.95	0.71	0.63	1.00	0.84	0.65	0.59	0.87	0.75	0.62	0.57	0.87	0.66	0.62	0.57
2-3/4	1.00	1.00	0.82	1.00	1.00	0.74	0.65	1.00	0.88	0.67	0.61	0.91	0.78	0.64	0.59	0.91	0.68	0.64	0.59
3	1.00	1.00	0.86	1.00	1.00	0.77	0.67	1.00	0.92	0.69	0.62	0.96	0.81	0.66	0.60	0.96	0.70	0.66	0.60
3-1/2	1.00	1.00	0.93	1.00	1.00	0.83	0.71	1.00	1.00	0.74	0.65	1.00	0.87	0.69	0.63	1.00	0.75	0.69	0.63
4	1.00	1.00	1.00	1.00	1.00	0.88	0.75	1.00	1.00	0.78	0.69	1.00	0.94	0.73	0.66	1.00	0.79	0.73	0.66
4-1/2	1.00	1.00	1.00	1.00	1.00	0.94	0.79	1.00	1.00	0.82	0.72	1.00	1.00	0.77	0.69	1.00	0.84	0.77	0.69
5	1.00	1.00	1.00	1.00	1.00	1.00	0.84	1.00	1.00	0.87	0.75	1.00	1.00	0.81	0.72	1.00	0.89	0.81	0.72
5-1/2	1.00	1.00	1.00	1.00	1.00	1.00	0.88	1.00	1.00	0.91	0.79	1.00	1.00	0.85	0.75	1.00	0.93	0.85	0.75
6	1.00	1.00	1.00	1.00	1.00	1.00	0.92	1.00	1.00	0.96	0.82	1.00	1.00	0.89	0.78	1.00	0.98	0.89	0.78
6-1/2	1.00	1.00	1.00	1.00	1.00	1.00	0.96	1.00	1.00	1.00	0.85	1.00	1.00	0.92	0.81	1.00	1.00	0.92	0.81
7	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.88	1.00	1.00	0.96	0.84	1.00	1.00	0.96	0.84
7-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.92	1.00	1.00	1.00	0.87	1.00	1.00	1.00	0.87
8	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	1.00	0.90	1.00	1.00	1.00	0.90
8-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	1.00	1.00	1.00	0.93	1.00	1.00	1.00	0.93
9	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96	1.00	1.00	1.00	0.96
9-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00	1.00	1.00	0.99
10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Spacing Reduction Factors - Tension (F_{NS})

Diameter (in)	1/4			3/8				1/2				5/8				3/4			
Nominal Embedment h_{nom} (in)	1	1-5/8	2-1/2	1-1/2	2	3-1/4	4-1/2	1-3/4	2-1/2	4-1/4	5-1/2	2-1/2	3-1/4	5	6-1/4	2-1/2	4-1/4	5	6-1/4
Minimum Spacing s_{min} (in)	1-1/2	1-1/2	1-1/2	2	2	2	2	2-3/4	2-3/4	2-3/4	2-3/4	2-3/4	2-3/4	2-3/4	2-3/4	3	3	3	3
Spacing Distance (inches) 1-1/2	0.89	0.73	0.66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-3/4	0.94	0.77	0.68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	1.00	0.80	0.70	0.88	0.77	0.67	0.63	-	-	-	-	-	-	-	-	-	-	-	-
2-1/4	1.00	0.83	0.72	0.93	0.80	0.69	0.64	-	-	-	-	-	-	-	-	-	-	-	-
2-1/2	1.00	0.86	0.74	0.97	0.83	0.70	0.65	-	-	-	-	-	-	-	-	-	-	-	-
2-3/4	1.00	0.89	0.76	1.00	0.86	0.72	0.66	0.92	0.78	0.67	0.64	0.80	0.73	0.65	0.63	-	-	-	-
3	1.00	0.92	0.78	1.00	0.89	0.74	0.67	0.95	0.80	0.68	0.65	0.83	0.74	0.66	0.64	0.83	0.69	0.66	0.64
3-1/2	1.00	0.99	0.82	1.00	0.94	0.77	0.70	1.00	0.85	0.71	0.67	0.88	0.78	0.68	0.65	0.88	0.71	0.68	0.65
4	1.00	1.00	0.86	1.00	1.00	0.80	0.72	1.00	0.89	0.73	0.68	0.92	0.81	0.70	0.67	0.93	0.74	0.71	0.67
4-1/2	1.00	1.00	0.90	1.00	1.00	0.83	0.74	1.00	0.93	0.75	0.70	0.97	0.85	0.72	0.68	0.97	0.76	0.73	0.69
5	1.00	1.00	0.94	1.00	1.00	0.86	0.76	1.00	0.98	0.78	0.72	1.00	0.88	0.75	0.70	1.00	0.79	0.75	0.70
5-1/2	1.00	1.00	0.97	1.00	1.00	0.89	0.78	1.00	1.00	0.80	0.74	1.00	0.92	0.77	0.72	1.00	0.81	0.77	0.72
6	1.00	1.00	1.00	1.00	1.00	0.93	0.81	1.00	1.00	0.82	0.75	1.00	0.95	0.79	0.73	1.00	0.84	0.79	0.73
6-1/2	1.00	1.00	1.00	1.00	1.00	0.96	0.83	1.00	1.00	0.85	0.77	1.00	0.98	0.81	0.75	1.00	0.86	0.81	0.75
7	1.00	1.00	1.00	1.00	1.00	0.99	0.85	1.00	1.00	0.87	0.79	1.00	1.00	0.83	0.76	1.00	0.89	0.83	0.77
7-1/2	1.00	1.00	1.00	1.00	1.00	1.00	0.87	1.00	1.00	0.90	0.81	1.00	1.00	0.85	0.78	1.00	0.91	0.85	0.78
8	1.00	1.00	1.00	1.00	1.00	1.00	0.90	1.00	1.00	0.92	0.83	1.00	1.00	0.87	0.80	1.00	0.94	0.87	0.80
8-1/2	1.00	1.00	1.00	1.00	1.00	1.00	0.92	1.00	1.00	0.94	0.84	1.00	1.00	0.89	0.81	1.00	0.96	0.89	0.81
9	1.00	1.00	1.00	1.00	1.00	1.00	0.94	1.00	1.00	0.97	0.86	1.00	1.00	0.91	0.83	1.00	0.99	0.91	0.83
9-1/2	1.00	1.00	1.00	1.00	1.00	1.00	0.96	1.00	1.00	0.99	0.88	1.00	1.00	0.93	0.84	1.00	1.00	0.93	0.85
10	1.00	1.00	1.00	1.00	1.00	1.00	0.98	1.00	1.00	1.00	0.90	1.00	1.00	0.95	0.86	1.00	1.00	0.95	0.86
10-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.91	1.00	1.00	0.97	0.88	1.00	1.00	0.97	0.88
11	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.93	1.00	1.00	0.99	0.89	1.00	1.00	0.99	0.89
11-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	1.00	0.91	1.00	1.00	1.00	0.91
12	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97	1.00	1.00	1.00	0.92	1.00	1.00	1.00	0.93
13	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96	1.00	1.00	1.00	0.96
14	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00	1.00	1.00	0.99
15	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

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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	1-5/8	2-1/2	1-1/2	2	3-1/4	4-1/2	1-3/4	2-1/2	4-1/4	5-1/2	2-1/2	3-1/4	5	6-1/4	2-1/2	4-1/4	5	6-1/4
	Min. Edge Distance c_{min}(in)	1-1/2	1-1/2	1-1/2	1-1/2	1-1/2	1-1/2	1-1/2	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4
Edge Distance (inches)	1-1/2	0.58	0.63	0.59	0.40	0.37	0.31	0.32	-	-	-	-	-	-	-	-	-	-	-	-
	1-3/4	0.68	0.73	0.69	0.46	0.43	0.36	0.38	0.35	0.31	0.30	0.31	0.27	0.26	0.25	0.26	0.26	0.22	0.22	0.23
	2	0.78	0.84	0.78	0.53	0.49	0.41	0.43	0.41	0.35	0.35	0.36	0.30	0.29	0.29	0.30	0.30	0.25	0.26	0.27
	2-1/4	0.87	0.94	0.88	0.59	0.55	0.46	0.48	0.46	0.40	0.39	0.40	0.34	0.33	0.32	0.33	0.33	0.28	0.29	0.30
	2-1/2	0.97	1.00	0.98	0.66	0.61	0.51	0.54	0.51	0.44	0.43	0.45	0.38	0.36	0.36	0.37	0.37	0.31	0.32	0.33
	2-3/4	1.00	1.00	1.00	0.73	0.67	0.56	0.59	0.56	0.49	0.48	0.49	0.42	0.40	0.40	0.41	0.41	0.34	0.35	0.37
	3	1.00	1.00	1.00	0.79	0.73	0.61	0.64	0.61	0.53	0.52	0.54	0.46	0.44	0.43	0.45	0.44	0.38	0.39	0.40
	3-1/2	1.00	1.00	1.00	0.92	0.85	0.72	0.75	0.71	0.62	0.61	0.63	0.53	0.51	0.50	0.52	0.52	0.44	0.45	0.47
	4	1.00	1.00	1.00	1.00	0.97	0.82	0.86	0.81	0.71	0.69	0.72	0.61	0.58	0.57	0.59	0.59	0.50	0.51	0.53
	4-1/2	1.00	1.00	1.00	1.00	1.00	0.92	0.97	0.91	0.80	0.78	0.81	0.68	0.66	0.65	0.67	0.67	0.56	0.58	0.60
	5	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.89	0.87	0.90	0.76	0.73	0.72	0.74	0.74	0.63	0.64	0.66
	5-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97	0.95	0.99	0.84	0.80	0.79	0.82	0.82	0.69	0.71	0.73
	6	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.91	0.88	0.86	0.89	0.89	0.75	0.77	0.80
	6-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.95	0.93	0.97	0.96	0.81	0.84	0.86
	7	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.88	0.90	0.93
	7-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.94	0.96	1.00
	8	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	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	1-5/8	2-1/2	1-1/2	2	3-1/4	4-1/2	1-3/4	2-1/2	4-1/4	5-1/2	2-1/2	3-1/4	5	6-1/4	2-1/2	4-1/4	5	6-1/4
	Minimum Spacing s_{min} (in)	1-1/2	1-1/2	1-1/2	2	2	2	2	2-3/4	2-3/4	2-3/4	2-3/4	2-3/4	2-3/4	2-3/4	2-3/4	3	3	3	3
Spacing Distance (inches)	1-1/2	0.60	0.60	0.60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1-3/4	0.61	0.62	0.61	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	0.63	0.64	0.63	0.59	0.58	0.57	0.57	-	-	-	-	-	-	-	-	-	-	-	-
	2-1/4	0.65	0.66	0.65	0.60	0.59	0.58	0.58	-	-	-	-	-	-	-	-	-	-	-	-
	2-1/2	0.66	0.67	0.66	0.61	0.60	0.59	0.59	-	-	-	-	-	-	-	-	-	-	-	-
	2-3/4	0.68	0.69	0.68	0.62	0.61	0.59	0.60	0.59	0.58	0.58	0.58	0.57	0.57	0.57	0.57	-	-	-	-
	3	0.69	0.71	0.70	0.63	0.62	0.60	0.61	0.60	0.59	0.59	0.59	0.58	0.57	0.57	0.57	0.57	0.56	0.56	0.57
	3-1/2	0.73	0.74	0.73	0.65	0.64	0.62	0.63	0.62	0.60	0.60	0.60	0.59	0.59	0.58	0.59	0.59	0.57	0.57	0.58
	4	0.76	0.78	0.76	0.68	0.66	0.64	0.64	0.64	0.62	0.62	0.62	0.60	0.60	0.60	0.60	0.60	0.58	0.59	0.59
	4-1/2	0.79	0.81	0.79	0.70	0.68	0.65	0.66	0.65	0.63	0.63	0.63	0.61	0.61	0.61	0.61	0.61	0.59	0.60	0.60
	5	0.82	0.85	0.83	0.72	0.70	0.67	0.68	0.67	0.65	0.64	0.65	0.63	0.62	0.62	0.62	0.62	0.60	0.61	0.61
	5-1/2	0.86	0.88	0.86	0.74	0.72	0.69	0.70	0.69	0.66	0.66	0.66	0.64	0.63	0.63	0.64	0.64	0.61	0.62	0.62
	6	0.89	0.92	0.89	0.76	0.74	0.70	0.71	0.70	0.68	0.67	0.68	0.65	0.65	0.64	0.65	0.65	0.63	0.63	0.63
	6-1/2	0.92	0.95	0.92	0.79	0.76	0.72	0.73	0.72	0.69	0.69	0.69	0.66	0.66	0.66	0.66	0.66	0.64	0.64	0.64
	7	0.95	0.99	0.96	0.81	0.78	0.74	0.75	0.74	0.71	0.70	0.71	0.68	0.67	0.67	0.67	0.67	0.65	0.65	0.66
	7-1/2	0.99	1.00	0.99	0.83	0.80	0.76	0.77	0.75	0.72	0.72	0.72	0.69	0.68	0.68	0.69	0.69	0.66	0.66	0.67
	8	1.00	1.00	1.00	0.85	0.82	0.77	0.79	0.77	0.74	0.73	0.74	0.70	0.69	0.69	0.70	0.70	0.67	0.67	0.68
	9	1.00	1.00	1.00	0.90	0.87	0.81	0.82	0.80	0.77	0.76	0.77	0.73	0.72	0.72	0.72	0.72	0.69	0.69	0.70
	10	1.00	1.00	1.00	0.94	0.91	0.84	0.86	0.84	0.80	0.79	0.80	0.75	0.74	0.74	0.75	0.75	0.71	0.71	0.72
	11	1.00	1.00	1.00	0.98	0.95	0.87	0.89	0.87	0.82	0.82	0.83	0.78	0.77	0.76	0.77	0.77	0.73	0.74	0.74
	12	1.00	1.00	1.00	1.00	0.99	0.91	0.93	0.91	0.85	0.85	0.86	0.80	0.79	0.79	0.80	0.80	0.75	0.76	0.77
	13	1.00	1.00	1.00	1.00	1.00	0.94	0.96	0.94	0.88	0.88	0.89	0.83	0.82	0.81	0.82	0.82	0.77	0.78	0.79
	14	1.00	1.00	1.00	1.00	1.00	0.98	1.00	0.97	0.91	0.90	0.92	0.85	0.84	0.84	0.85	0.85	0.79	0.80	0.81
	15	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.94	0.93	0.95	0.88	0.86	0.86	0.87	0.87	0.81	0.82	0.83
	16	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97	0.96	0.98	0.91	0.89	0.88	0.90	0.90	0.83	0.84	0.85
	17	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00	0.93	0.91	0.91	0.92	0.92	0.86	0.86	0.88
	18	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96	0.94	0.93	0.95	0.94	0.88	0.89	0.90
	19	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	0.96	0.95	0.97	0.97	0.90	0.91	0.92
	20	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.98	1.00	0.99	0.92	0.93	0.94
	21	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.94	0.95	0.97
	22	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96	0.97	0.99
	23	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	0.99	1.00
	24	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Ultimate Load Capacities for Screw-Bolt+ in Normal-Weight Concrete at Minimum Edge[1,2]

Nominal Anchor Diameter d in.	Minimum Nominal Embedment Depth in. (mm)	Minimum Edge Distance in. (mm)	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)	
			Tension lbs (kN)	Shear lbs (kN)	Tension lbs (kN)	Shear lbs (kN)	Tension lbs (kN)	Shear lbs (kN)
1/4	1-5/8 (41)	1-1/2 (38)	2,060 (9.2)	1,300 (5.8)	2,260 (10.1)	1,420 (6.3)	2,600 (11.6)	1,640 (7.3)
	2-1/2 (64)		3,380 (15.0)	1,580 (7.0)	3,700 (16.5)	1,740 (7.7)	4,280 (19.0)	2,000 (8.9)
3/8	1-1/2 (38)	1-1/2 (38)	2,120 (9.4)	1,060 (4.7)	2,320 (10.3)	1,160 (5.2)	2,680 (11.9)	1,340 (6.0)
	2 (51)		2,600 (11.6)	1,560 (6.9)	2,840 (12.6)	1,700 (7.6)	3,280 (14.6)	1,960 (8.7)
	3-1/4 (83)		4,460 (19.8)	2,080 (9.3)	4,880 (21.7)	2,280 (10.1)	5,640 (25.1)	2,640 (11.7)
	4-1/2 (114)		7,680 (34.2)	2,080 (9.3)	8,420 (37.5)	2,280 (10.1)	9,720 (43.2)	2,640 (11.7)
1/2	1-3/4 (44)	1-3/4 (38)	2,840 (12.6)	2,040 (9.1)	3,115 (13.9)	2,220 (9.9)	3,595 (16.0)	2,580 (11.5)
	2-1/2 (64)		3,820 (17.0)	2,360 (10.5)	4,180 (18.6)	2,580 (11.5)	4,820 (21.4)	2,980 (13.3)
	4-1/4 (108)		6,860 (30.5)	3,280 (14.6)	7,520 (33.5)	3,580 (15.9)	8,680 (38.6)	4,140 (18.4)
	5-1/2 (140)		12,600 (56.0)	3,280 (14.6)	13,800 (61.4)	3,580 (15.9)	15,940 (70.9)	4,140 (18.4)
5/8	3-1/4 (83)	1-3/4 (44)	5,260 (23.4)	2,800 (12.5)	5,760 (25.6)	3,060 (13.6)	6,640 (29.5)	3,540 (15.7)
	5 (127)		8,360 (37.2)	3,660 (16.3)	9,160 (40.7)	4,020 (17.9)	10,580 (47.1)	4,640 (20.6)
	6-1/4 (159)		10,240 (45.5)	3,660 (16.3)	11,200 (49.8)	4,020 (17.9)	12,940 (57.6)	4,640 (20.6)
3/4	4-1/4 (108)	1-3/4 (44)	7,240 (32.2)	3,460 (15.4)	7,920 (35.2)	3,780 (16.8)	9,160 (40.7)	4,360 (19.4)
	5 (127)		9,140 (40.7)	3,460 (15.4)	10,020 (44.6)	3,780 (16.8)	11,560 (51.4)	4,360 (19.4)
	6-1/4 (159)		14,420 (64.1)	3,460 (15.4)	15,800 (70.3)	3,780 (16.8)	18,240 (81.1)	4,360 (19.4)

1. Tabulated load values are for anchors installed in concrete. Concrete compressive strength must be at the specified minimum at the time of installation.
2. Ultimate load capacities must be reduced by a minimum safety factor of 4.0 or greater to determine allowable working load.

Allowable Load Capacities for Screw-Bolt+ in Normal-Weight Concrete at Minimum Edge[1,2,3,4]

Nominal Anchor Diameter d in.	Minimum Nominal Embedment Depth in. (mm)	Minimum Edge Distance in. (mm)	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)	
			Tension lbs (kN)	Shear lbs (kN)	Tension lbs (kN)	Shear lbs (kN)	Tension lbs (kN)	Shear lbs (kN)
1/4	1-5/8 (41)	1-1/2 (38)	515 (2.3)	325 (1.4)	565 (2.5)	355 (1.6)	650 (2.9)	410 (1.8)
	2-1/2 (64)		845 (3.8)	395 (1.8)	925 (4.1)	435 (1.9)	1,070 (4.8)	500 (2.2)
3/8	1-1/2 (38)	1-1/2 (38)	530 (2.4)	265 (1.2)	580 (2.6)	290 (1.3)	670 (3.0)	335 (1.5)
	2 (51)		650 (2.9)	390 (1.7)	710 (3.2)	425 (1.9)	820 (3.6)	490 (2.2)
	3-1/4 (83)		1,115 (5.0)	520 (2.3)	1,220 (5.4)	570 (2.5)	1,410 (6.3)	660 (2.9)
	4-1/2 (114)		1,920 (8.5)	520 (2.3)	2,105 (9.4)	570 (2.5)	2,430 (10.8)	660 (2.9)
1/2	1-3/4 (44)	1-3/4 (38)	710 (3.2)	510 (2.3)	780 (3.5)	555 (2.5)	900 (4.0)	645 (2.9)
	2-1/2 (64)		955 (4.2)	590 (2.6)	1,045 (4.6)	645 (2.9)	1,205 (5.4)	745 (3.3)
	4-1/4 (108)		1,715 (7.6)	820 (3.6)	1,880 (8.4)	895 (4.0)	2,170 (9.7)	1,035 (4.6)
	5-1/2 (140)		3,150 (14.0)	820 (3.6)	3,450 (15.3)	895 (4.0)	3,985 (17.7)	1,035 (4.6)
5/8	3-1/4 (83)	1-3/4 (44)	1,315 (5.8)	700 (3.1)	1,440 (6.4)	765 (3.4)	1,660 (7.4)	885 (3.9)
	5 (127)		2,090 (9.3)	915 (4.1)	2,290 (10.2)	1,005 (4.5)	2,645 (11.8)	1,160 (5.2)
	6-1/4 (159)		2,560 (11.4)	915 (4.1)	2,800 (12.5)	1,005 (4.5)	3,235 (14.4)	1,160 (5.2)
3/4	4-1/4 (108)	1-3/4 (44)	1,810 (8.1)	865 (3.8)	1,980 (8.8)	945 (4.2)	2,290 (10.2)	1,090 (4.8)
	5 (127)		2,285 (10.2)	865 (3.8)	2,505 (11.1)	945 (4.2)	2,890 (12.9)	1,090 (4.8)
	6-1/4 (159)		3,605 (16.0)	865 (3.8)	3,950 (17.6)	945 (4.2)	4,560 (20.3)	1,090 (4.8)

1. Tabulated load values are for anchors installed in concrete. Concrete compressive strength must be at the specified minimum at the time of installation.
2. Allowable load capacities are calculated using an applied safety factor 4.0.
3. Allowable load capacities must be multiplied by reduction factors when anchor spacing or edge distances are less that critical distances.
4. Linear interpolation may be used to determine allowable loads for intermediate embedments and compressive strengths.

INSTALLATION SPECIFICATIONS

Screw-Bolt+ Installation Specifications in Concrete and Supplemental Information[1,2,3,4]

CODE LISTED
ICC-ES ESR-3889

STRENGTH DESIGN SD TABLES

Anchor Property/ Setting Information	Notation	Units	Nominal Anchor Diameter (inch)											
			1/4		3/8			1/2			5/8			3/4
Nominal anchor diameter	d_a	in. (mm)	0.250 (6.35)		0.375 (9.525)			0.500 (12.7)			0.625 (15.9)			0.750 (19.05)
Minimum diameter of hole clearance in fixture	d_h	in. (mm)	3/8 (9.5)		1/2 (12.7)			5/8 (15.9)			3/4 (19.1)			7/8 (22.2)
Nominal drill bit diameter	d_{bit}	in.	1/4 ANSI		3/8 ANSI			1/2 ANSI			5/8 ANSI			7/8 ANSI
Minimum nominal embedment depth[5]	h_{nom}	in. (mm)	1-5/8 (41)	2-1/2 (64)	2 (51)	2-1/2 (64)	3-1/4 (83)	2-1/2 (64)	3 (76)	4-1/4 (108)	3-1/4 (64)	4 (64)	5 (127)	4-1/4 (108)
Effective Embedment	h_{ef}	in. (mm)	1.20 (30)	1.94 (49)	1.33 (34)	1.75 (44)	2.39 (61)	1.75 (44)	2.17 (55)	3.23 (82)	2.24 (57)	2.88 (73)	3.73 (95)	3.08 (78)
Minimum hole depth	h_{hole}	in. (mm)	2 (51)	2-7/8 (73)	2-3/8 (60)	2-7/8 (73)	3-5/8 (92)	2-7/8 (73)	3-3/8 (86)	4-5/8 (117)	3-5/8 (92)	4-3/8 (111)	5-3/8 (137)	4-5/8 (117)
Minimum concrete member thickness	h_{min}	in. (mm)	3-1/4 (83)	4 (102)	3-1/2 (89)	4 (102)	5 (127)	4-1/2 (114)	5-1/4 (133)	6-3/4 (171)	5 (127)	6 (152)	7 (178)	6 (152)
Minimum edge distance[6]	c_{min}	in. (mm)	1-1/2 (38)		c_{min} = 1-1/2 (38) for $s_{min} \geq 3$ (76)			1-3/4 (44)			1-3/4 (44)			1-3/4 (44)
Minimum spacing distance[6]	s_{min}	in. (mm)	1-1/2 (38)		s_{min} = 2 (51) for $c_{min} \geq 2$ (51)			2-3/4 (70)			2-3/4 (70)			3 (76)
Critical edge distance	c_{ac}	in. (mm)	4.30 (109)	6.10 (155)	5.00 (127)	6.30 (160)	7.80 (198)	3.30 (84)	5.90 (150)	8.10 (206)	6.30 (160)	7.90 (201)	10.10 (257)	10.90 (277)
Minimum overall anchor length[7]	ℓ_{anch}	in. (mm)	1-3/4 (44)	3 (76)	2-1/2 (64)	3 (76)	4 (102)	3 (76)	4 (102)	5 (127)	4 (102)	5 (127)	6 (152)	5 (127)
Maximum Installation torque	$T_{inst,max}$	ft.-lbf. (N-m)	19 (26)	25 (34)	25 (34)	25 (34)	40 (54)	45 (61)	45 (61)	60 (81)	60 (81)			70 (95)
Maximum impact wrench power (torque)	$T_{impact,max}$	ft.-lbf (N-m).	150 (203)		300 (407)			300 (407)			700 (950)			700 (950)
Impact wrench socket size	-	in.	7/16		9/16			3/4			15/16			1-1/8
Maximum head height	-	in.	21/64		3/8			31/64			37/64			43/64
Maximum washer diameter	-	in.	37/64		3/4			1-1/16			1-1/8			1-13/32
Effective tensile stress area (screw anchor body)	A_{se}	in² (mm²)	0.045 (29.0)		0.094 (60.6)			0.176 (113.5)			0.274 (176.8)			0.399 (257.4)
Minimum specified ultimate strength	f_{uta}	ksi (N/mm²)	100 (690)		92.5 (638)			115 (794)			95 (656)			95 (656)
Minimum specified yield strength	f_y	ksi (N/mm²)	80 (552)		74 (511)			92 (635)			76 (524)			76 (524)
Mean axial stiffness[8]: Uncracked concrete	β_{uncr}	lbf/in (kN/mm)	1,252,000 (211)		1,157,000 (195)			1,014,000 (171)			919,000 (155)			1,028,000 (173)
Mean axial stiffness[8]: Cracked concrete	β_{cr}	lbf/in (kN/mm)	355,000 (60)		330,000 (56)			349,000 (59)			378,000 (64)			419,000 (71)

For SI: 1 inch = 25.4 mm; 1 ksi = 6.894 N/mm²; 1 ft-lb = 1.356 N-m; 1 lb = 0.0044 kN.

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable.
2. For installations in the topside of concrete-filled steel deck assemblies with minimum concrete member thickness, $h_{min,deck}$, of 2.5 inches above the upper flute (topping thickness). See the table for anchor setting information for installation on the top of concrete-filled steel deck assemblies and the top of concrete over steel deck installation detail.
3. For installations in the topside of concrete-filled steel deck assemblies with sand-lightweight concrete fill, the maximum installation torque, $T_{inst,max}$, is 18 ft.-lb.
4. For installations through the soffit of steel deck assemblies into concrete, see the design information table for installation in the soffit of concrete-filled steel deck assemblies and the installation details in the soffit of concrete over steel deck for the applicable steel deck profile. Tabulated minimum spacing values are based on anchors installed along the flute with axial spacing equal to the greater of $3h_{ef}$ or 1.5 times the flute width.
5. The embedment depth, h_{nom}, is measured from the outside surface of the concrete member to the embedded end of the anchor.
6. Additional combinations for minimum edge distance, c_{min}, and minimum spacing distance, s_{min}, may be derived by linear interpolation between the given boundary values for the 3/8-inch diameter anchors.
7. The listed minimum overall anchor length is based on the anchor sizes commercially available at the time of publication compared with the requirements to achieve the minimum nominal embedment depth, including consideration of a fixture attachment. The minimum nominal anchor length is measured from under the head to the tip of the anchor.
8. Mean values shown, actual stiffness varies considerably depending on concrete strength, loading and geometry of application.

Anchor Setting Information for Installation on the Top of Concrete-Filled Steel Deck Assemblies with Minimum Topping Thickness[1,2,3,4]

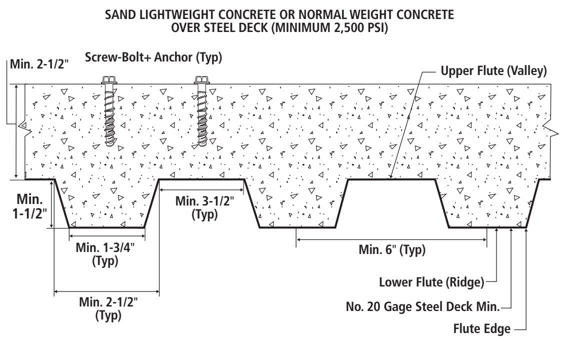
CODE LISTED
ICC-ES ESR-3889

Anchor Property / Setting Information	Notation	Units	Nominal Anchor Size (inch)			
			1/4		3/8	1/2
Nominal anchor diameter	d_a	in. (mm)	0.250 (6.4)		0.375 (9.5)	0.500 (12.7)
Minimum diameter of hole clearance in fixture	d_h	in. (mm)	3/8 (9.5)		1/2 (12.7)	5/8 (15.9)
Nominal drill bit diameter	d_{bit}	in.	1/4 ANSI		3/8 ANSI	1/2 ANSI
Minimum nominal embedment depth[5]	h_{nom}	in. (mm)	1-5/8 (41)	2-1/2 (64)	2 (51)	2-1/2 (64)
Effective embedment	h_{ef}	in. (mm)	1.20 (30)	1.94 (49)	1.33 (33)	1.75 (44)
Minimum hole depth	h_o	in. (mm)	2 (51)	2-1/2 (64)	2-3/8 (60)	2-1/2 (64)
Minimum concrete member thickness (topping thickness)	$h_{min,deck}$	in. (mm)	2-1/2 (64)	2-1/2 (64)	2-1/2 (64)	2-1/2 (64)
Minimum edge distance	$c_{min,deck,top}$	in. (mm)	1-1/2 (38)		2 (51)	2-1/2 (64)
Minimum spacing distance	$s_{min,deck,top}$	in. (mm)	1-1/2 (38)		2 (51)	2-1/2 (64)
Critical edge distance	$c_{ac,deck,top}$	in. (mm)	3 (76)	4 (102)	3.5 (89)	6 (152)
Minimum nominal anchor length[6]	ℓ_{anch}	in. (mm)	1-3/4 (44)	3 (76)	2-1/2 (64)	3 (76)
Maximum impact wrench power (torque)	$T_{impact,max}$	ft.-lb. (N-m)	150 (203)		300 (407)	300 (407)
Max. installation torque	$T_{inst,max}$	ft.-lb. (N-m)	18[7] (26)	25 (34)	25 (34)	45 (61)
Wrench socket size	-	in.	7/16		9/16	3/4
Max. head height	-	in.	21/64		3/8	31/64
Max. washer diameter	-	in.	37/64		3/4	1-1/16

For SI: 1 inch = 25.4 mm; 1 ksi = 6.894 N/mm²; 1 ft-lb = 1.356 N-m; 1 lb = 0.0044 kN.

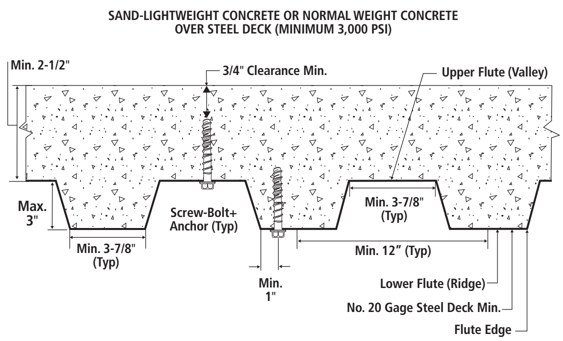
1. The anchors may be installed in the topside of concrete-filled steel deck floor and roof assemblies in accordance with this table, the anchor installation specifications in concrete table and the top of concrete over steel deck installation detail provided the concrete thickness above the upper flute meets the minimum thicknesses specified in this table. Minimum concrete member thickness, $h_{min,deck}$, refers to the concrete thickness above the upper flute (topping thickness). See the top of concrete over steel deck installation detail.
2. Applicable to the following conditions:
   For 1/4-inch-diameter anchors with 1-5/8-inch nominal embedment, 2-1/2-inch ≤ $h_{min,deck}$ < 3-1/4-inch.
   For 1/4-inch-diameter anchors with 2-1/2-inch nominal embedment, 2-1/2-inch ≤ $h_{min,deck}$ < 4-inch.
   For 3/8-inch-diameter anchors with 2-inch nominal embedment, 2-1/2-inch ≤ $h_{min,deck}$ < 3-1/2-inch.
   For 1/2-inch-diameter anchors with 2-1/2-inch nominal embedment, 2-1/2-inch ≤ $h_{min,deck}$ < 4-1/2-inch.
3. For all other anchor diameters and embedment depths, refer to the anchor installation specifications in concrete table for applicable values of h_{min}, c_{min} and s_{min}, which can be substituted for $h_{min,deck}$, $c_{min,deck,top}$ and $s_{min,deck,top}$, respectively.
4. Design capacities shall be based on calculations according to values in Tension Design Information and the Shear Design Information tables.
5. The embedment depth, h_{nom}, is measured from the outside surface of the concrete member to the embedded end of the anchor.
6. The listed minimum overall anchor length is based on the anchor sizes commercially available at the time of publication compared with the requirements to achieve the minimum nominal embedment depth, including consideration of a fixture attachment for hex head anchors. The minimum nominal anchor length is measured from under the head to the tip of the anchor.
7. For installations in the topside of concrete-filled steel deck assemblies with normal-weight concrete fill, a maximum installation torque, $T_{inst,max}$, of 19 ft.-lb is allowed.

Installation Detail for Anchors in the Top of Concrete Over Steel Deck Floor and Roof Assemblies with Minimum Topping Thickness (See Dimensional Profile Requirements)[1,2]



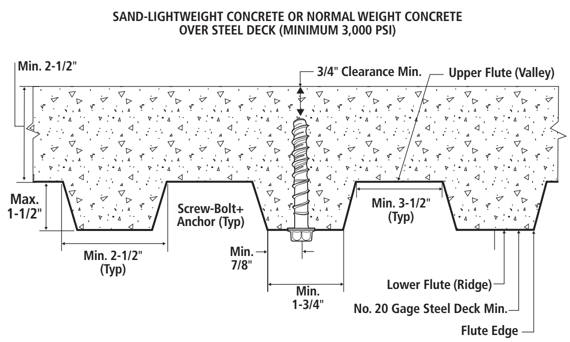
1. Anchors may be placed in the top side of concrete over steel deck profiles provided the minimum concrete thickness above the upper flute (topping thickness), minimum spacing distance and minimum edge distances are satisfied as given in Anchor Setting Information for Installation on the Top of Concrete-Filled Steel Deck Assemblies with Minimum Topping Thickness table.
2. For all other anchor diameters and embedment depths installed in the top of concrete over steel deck profiles with topping thickness greater than or equal to the minimum concrete member thicknesses given in the Installation Specifications in Concrete table, the minimum spacing distances and minimum edge distances must be used from the Installation Specifications in Concrete table, as applicable.

Screw-Bolt+ Installation Detail for Anchors in the Soffit of Concrete Over Steel Deck Floor and Roof Assemblies (See Dimensional Profile Requirements)[1,2,3]



1. Anchors may be placed in the upper flute or lower flute of concrete-filled steel deck profiles provided the minimum hole clearance of 3/4-inch is satisfied for the selected anchor. See the Tension and Shear Design information for Anchors Installed in the Soffit of Concrete-Filled Steel Deck Assemblies table.
2. Anchors in the lower flute may be installed with a maximum 15/16 -inch offset in either direction from the center of the flute. The offset distance may be increased proportionally for profiles with lower flute widths greater than those shown provided the minimum lower flute edge distance is also satisfied (e.g. 1-1/4 -inch offset for 4-1/2-inch wide flute).
3. See the Tension and Shear Design information for Anchors Installed in the Soffit of Concrete-Filled Steel Deck Assemblies table for design data.

Screw-Bolt+ Installation Detail for Anchors in the Soffit of Concrete Over Steel Deck Floor and Roof Assemblies (See Dimensional Profile Requirements)[1,2,3]



1. Anchors may be placed in the upper flute or lower flute of the concrete-filled steel deck profiles provided the minimum hole clearance of 3/4-inch is satisfied for the selected anchor. See the Tension and Shear Design information for Anchors Installed in the Soffit of Concrete-Filled Steel Deck Assemblies table.
2. Anchors in the lower flute may be installed in the center of the flute. An offset distance may be given proportionally for profiles with flute widths greater than those shown provided the minimum lower flute edge distance is also satisfied.
3. See the Tension and Shear Design information for Anchors Installed in the Soffit of Concrete-Filled Steel Deck Assemblies table for design data.

STRENGTH DESIGN (SD)

CODE LISTED
ICC-ES ESR-3889

Tension Design Information For Screw-Bolt+ Anchor In Concrete[1,2]

Design Characteristic	Notation	Units	Nominal Anchor Diameter											
			1/4		3/8			1/2			5/8			3/4
Anchor category	1, 2 or 3	-	1		1			1			1			1
Minimum nominal embedment depth	h_{nom}	in. (mm)	1-5/8 (41)	2-1/2 (64)	2 (51)	2-1/2 (64)	3-1/4 (83)	2-1/2 (64)	3 (76)	4-1/4 (108)	3-1/4 (64)	4 (64)	5 (127)	4-1/4 (108)
Steel Strength in Tension (ACI 318-14 17.4.1 or ACI 318-11 D.5.1)														
Steel strength in tension	N_{sa}[10]	lb (kN)	4,535 (20.2)		8,730 (38.8)			20,475 (91.1)			26,260 (116.8)			38,165 (169.8)
Reduction factor for steel strength[3,4]	ϕ	-	0.65											
Concrete Breakout Strength in Tension (ACI 318-14 17.4.2 or ACI 318-11 D.5.2)														
Effective embedment	h_{ef}	in. (mm)	1.20 (30)	1.94 (49)	1.33 (34)	1.75 (44)	2.39 (61)	1.75 (44)	2.17 (55)	3.23 (82)	2.24 (57)	2.88 (73)	3.73 (95)	3.08 (78)
Critical edge distance	c_{ac}	in. (mm)	4.30 (109)	6.10 (155)	5.00 (127)	6.30 (160)	7.80 (198)	3.30 (84)	5.90 (150)	8.10 (206)	6.30 (160)	7.90 (201)	10.10 (257)	10.90 (277)
Critical edge distance, topside of concrete-filled steel decks with minimum topping thickness[9]	$c_{ac,deck,top}$	in. (mm)	3.00 (76)	4.00 (102)	3.50 (89)	-[11]	-[11]	6.00 (152)	-[11]	-[11]	-[11]	-[11]	-[11]	-[11]
Effectiveness factor for uncracked concrete	k_{uncr}	-	27	24	30	24	24	30	24	24	30	24	24	27
Effectiveness factor for cracked concrete	k_{cr}	-	17		17			17			21			17
Modification factor for cracked and uncracked concrete[5]	$\Psi_{c,N}$	-	1.0		1.0			1.0			1.0			1.0
Reduction factor for concrete breakout strength[3]	ϕ	-	0.65 (Condition B)											
Pullout Strength in Tension (Non-Seismic Applications) (ACI 318-14 17.4.3 or ACI 318-11 D.5.3)														
Characteristic pullout strength, uncracked concrete (2,500 psi)[6,10]	$N_{p,uncr}$	lb (kN)	See Note 7		See Note 7			See Note 7			See Note 7			See Note 7
Characteristic pullout strength, cracked concrete (2,500 psi)[6,10]	$N_{p,cr}$	lb (kN)	765 (3.4)	1,415 (6.3)	See Note 7			1,645 (7.3)	2,515 (11.2)	4,700 (20.9)	3,080 (13.7)	4,720 (21.0)	6,900 (30.7)	See Note 7
Reduction factor for pullout strength[3]	ϕ	-	0.65 (Condition B)											
Pullout Strength in Tension for Seismic Applications (ACI 318-14 17.2.3.3 or ACI 318-11 D.3.3.3)														
Characteristic pullout strength, seismic (2,500 psi)[6,8,10]	N_{eq}	lb	360 (1.6)	1,170 (5.2)	900 (4.0)	1,645 (7.3)	2,765 (12.3)	1,645 (7.3)	2,515 (11.2)	4,700 (20.9)	1,910 (8.5)	2,445 (10.9)	3,370 (15.0)	4,085 (18.2)
Reduction factor for pullout strength[3]	ϕ	-	0.65 (Condition B)											

For SI: 1 inch = 25.4 mm; 1 ksi = 6.894 N/mm²; 1 ft-lb = 1.356 N-m; 1 lb = 0.0044 kN.

1. The data in this table is intended to be used with the design provisions of ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable, shall apply.
2. Installation must comply with published instructions and details.
3. All values of ϕ were determined from the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3, or ACI 318-11 Section 9.2. If the load combinations of ACI 318-11 Appendix C are used, then the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4. For reinforcement that complies with ACI 318-14 Chapter 17 or ACI 318-11 Appendix D requirements for Condition A, see ACI 318-14 17.3.3(c) or ACI 318-11 Section D.4.3(c), as applicable for the appropriate ϕ factor when the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2 are used.
4. The anchors are considered a brittle steel elements as defined by ACI 318-14 2.3 or ACI 318-11 D.1, as applicable.
5. Select the appropriate effectiveness factor for cracked concrete (k_{cr}) or uncracked concrete (k_{uncr}) and use $\Psi_{c,N} = 1.0$.
6. For all design cases $\Psi_{c,P} = 1.0$. The characteristic pullout strength, N_{pn}, for concrete compressive strengths greater than 2,500 psi for 1/4-inch-diameter anchors may be increased by multiplying the value in the table by $(f'c / 2{,}500)^{0.3}$ for psi or $(f'c / 17.2)^{0.3}$ for MPa. The characteristic pullout strength, N_{pn}, for concrete compressive strengths greater than 2,500 psi for 3/8-inch- to 3/4-inch-diameter anchors may be increased by multiplying the value in the table by $(f'c / 2{,}500)^{0.5}$ for psi or $(f'c / 17.2)^{0.5}$ for MPa.
7. Pullout strength does not control design of indicated anchors and does not need to be calculated for indicated anchor size and embedment.
8. Reported values for characteristic pullout strength in tension for seismic applications are based on test results per ACI 355.2, Section 9.5.Y
9. Anchors are permitted in the topside of concrete-filled steel deck assemblies in accordance with the Installation Detail for Anchors in the Top of Concrete Over Steel Deck Floor and Roof Assemblies with Minimum Topping Thickness.
10. Anchors are permitted to be used in lightweight concrete provided the modification factor λa equal to 0.8λ is applied to all values of f'c affecting N_n.
11. Tabulated critical edge distance values, $c_{ac,deck,top}$, are for anchors installed in the top of concrete over steel deck profiles with a minimum concrete thickness, $h_{min,deck}$, of 2.5 inches above the upper flute (topping thickness). For minimum topping thickness greater than or equal to the minimum concrete member thicknesses, h_{min}, given in the Installation Specifications table, the associated critical edge distance, c_{ac}, for indicated anchor diameters and embedment depths may be used in the calculation of $\Psi_{cp,N}$ as applicable.

Shear Design Information for Screw-Bolt+ Anchor in Concrete[1,2,7,8]

CODE LISTED
ICC-ES ESR-3889

Design Characteristic	Notation	Units	Nominal Anchor Diameter												
			1/4		3/8			1/2			5/8			3/4
Anchor category	1, 2 or 3	-	1		1			1			1			1
Minimum nominal embedment depth	h_{nom}	in. (mm)	1-5/8 (41)	2-1/2 (64)	2 (51)	2-1/2 (64)	3-1/4 (83)	2-1/2 (64)	3 (76)	4-1/4 (108)	3-1/4 (64)	4 (64)	5 (127)	4-1/4 (108)
Steel Strength in Shear (ACI 318-14 17.5.1 or ACI 318-11 D.6.1)															
Steel strength in shear[5]	V_{sa}	lb (kN)	1,635 (7.3)	2,040 (9.1)	3,465 (15.4)	3,465 (15.4)	4,345 (19.3)	8,860 (39.4)	8,860 (39.4)	11,175 (49.7)	12,310 (54.8)	12,310 (54.8)	15,585 (69.3)	19,260 (85.7)
Reduction factor for steel strength[3,4]	ϕ	-	0.60												
Steel Strength in Shear for Seismic Applications (ACI 318-14 17.2.3.3 or ACI 318-11 D.3.3.3)															
Steel strength in shear, seismic[6]	V_{eq}	lb (kN)	1,360 (6.1)	1,700 (7.7)	2,415 (10.9)	2,415 (10.9)	3,030 (13.6)	7,090 (31.9)	7,090 (31.9)	8,940 (40.2)	9,845 (44.3)	9,845 (44.3)	12,465 (56.1)	15,405 (69.3)
Reduction factor for steel strength in shear for seismic[3,4]	ϕ	-	0.60												
Concrete Breakout Strength in Shear (ACI 318-14 17.5.2 or ACI 318-11 D.6.2)															
Nominal anchor diameter	d_a	in. (mm)	0.250 (6.4)		0.375 (9.5)			0.500 (12.7)			0.625 (15.9)			0.750 (19.1)
Load bearing length of anchor	ℓ_e	in. (mm)	1.20 (30)	1.94 (49)	1.33 (34)	1.75 (44)	2.39 (61)	1.75 (44)	2.17 (55)	3.23 (82)	2.24 (57)	2.88 (73)	3.73 (95)	3.08 (78)
Reduction factor for concrete breakout[3]	ϕ	-	0.70 (Condition B)												
Pryout Strength in Shear (ACI 318-14 17.5.3 or ACI 318-11 D.6.3)															
Coefficient for pryout strength	k_{cp}	-	1	1	1	1	1	1	1	2	1	2	2	2
Effective embedment	h_{ef}	in. (mm)	1.20 (30)	1.94 (49)	1.33 (34)	1.75 (44)	2.39 (61)	1.75 (44)	2.17 (55)	3.23 (82)	2.24 (57)	2.88 (73)	3.73 (95)	3.08 (78)
Reduction factor for pryout strength[3]	ϕ	-	0.70 (Condition B)												

For SI: 1 inch = 25.4 mm; 1 ksi = 6.894 N/mm²; 1 ft-lb = 1.356 N-m; 1 lb = 0.0044 kN.

1. The data in this table is intended to be used with the design provisions of ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-17 17.2.3 or ACI 318-11 D.3.3, as applicable shall apply.
2. Installation must comply with published instructions and details.
3. All values of ϕ were determined from the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3, or ACI 318-11 Section 9.2. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 Section D.4.4. For reinforcement that complies with ACI 318-14 Chapter 17 or ACI 318-11 Appendix D requirements for Condition A, see ACI 318-14 17.3.3(c) or ACI 318-11 D.4.3(c), as applicable, for the appropriate ϕ factor when the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3, or ACI 318-11 Section 9.2 are used.
4. The anchors are considered a brittle steel elements as defined by ACI 318-14 2.3 or ACI 318-11 D.1.
5. Reported values for steel strength in shear are based on test results per ACI 355.2, Section 9.4 and must be used for design in lieu of the calculated results using equation 17.5.1.2(b) of ACI 318-14 or equation D-29 in ACI 318-11 D.6.1.2.
6. Reported values for steel strength in shear are for seismic applications and based on test results in accordance with ACI 355.2, Section 9.6 and must be used for design.
7. Anchors are permitted in the topside of concrete-filled steel deck assemblies in accordance with the Installation Detail for Anchors in the Top of Concrete Over Steel Deck Floor and Roof Assemblies with Minimum Topping Thickness.
8. Anchors are permitted to be used in lightweight concrete in provided the modification factor λa equal to 0.8λ is applied to all values of f'c affecting N_n.

Tension and Shear Design Information for Screw-Bolt+ Anchor in the Soffit (Through the Underside) of Concrete-Filled Steel Deck Assemblies[1,2,3,4,5,6]

CODE LISTED
ICC-ES ESR-3889

STRENGTH DESIGN TABLES SD

Anchor Property/Setting Information	Notation	Units	Nominal Anchor Diameter (inch)											
			1/4		3/8			1/2			5/8			3/4
Minimum nominal embedment depth	h_{nom}	in. (mm)	1-5/8 (41)	2-1/2 (64)	2 (51)	2-1/2 (64)	3-1/4 (83)	2-1/2 (64)	3 (76)	4-1/4 (108)	3-1/4 (64)	4 (64)	5 (127)	4-1/4 (108)
Effective Embedment	h_{ef}	in. (mm)	1.20 (30)	1.94 (49)	1.33 (34)	1.75 (44)	2.39 (61)	1.75 (44)	2.17 (55)	3.23 (82)	2.24 (57)	2.88 (73)	3.73 (95)	3.08 (78)
Minimum hole depth	h_o	in. (mm)	1-3/4 (44)	2-5/8 (67)	2-1/8 (54)	2-5/8 (67)	3-3/8 (86)	2-5/8 (67)	3-1/8 (79)	4-3/8 (111)	3-3/8 (86)	4-1/8 (10.5)	5-1/8 (130)	4-3/8 (111)
Anchors Installed Through the Soffit of Steel Deck Assemblies into Concrete (Minimum 3-7/8-inch-wide deck flute)														
Minimum concrete member thickness[7]	$h_{min,deck,total}$	in. (mm)	5-1/2 (140)	5-1/2 (140)	5-1/2 (140)	5-1/2 (140)	5-1/2 (140)	5-1/2 (140)	5-1/2 (140)	5-1/2 (140)	5-1/2 (140)	5-1/2 (140)	6-1/4 (159)	6-1/4 (159)
Characteristic pullout strength, uncracked concrete over steel deck, (3,000 psi)	$N_{p,deck,uncr}$	lb (kN)	1,430 (6.4)	2,555 (11.4)	2,275 (10.1)	2,655 (11.8)	3,235 (14.4)	2,600 (11.6)	3,555 (15.8)	5,975 (26.6)	2,610 (11.6)	4,150 (18.5)	6,195 (27.6)	6,085 (27.1)
Characteristic pullout strength, cracked concrete over steel deck, (3,000 psi)	$N_{p,deck,cr}$	lb (kN)	615 (2.7)	1,115 (5.0)	1,290 (5.7)	1,880 (8.4)	2,290 (10.2)	1,230 (5.5)	2,330 (10.4)	4,030 (17.9)	1,600 (7.1)	3,340 (14.9)	4,945 (22.0)	3,835 (17.1)
Characteristic pullout strength, cracked concrete over steel deck,seismic, (3,000 psi)	$N_{p,deck,eq}$	lb (kN)	290 (1.3)	920 (4.1)	890 (4.0)	1,570 (7.0)	2,015 (9.0)	1,230 (5.5)	2,330 (10.4)	4,030 (17.9)	990 (4.4)	1,730 (7.7)	2,415 (10.7)	3,410 (15.2)
Reduction factor for pullout strength[8]	ϕ	-	0.65											
Steel strength in shear, concrete over steel deck	$V_{sa,deck}$	lb (kN)	1,155 (5.1)	2,595 (11.5)	2,470 (11.0)	2,470 (11.0)	3,225 (14.3)	2,435 (10.8)	2,435 (10.8)	5,845 (26.0)	2,650 (11.8)	2,650 (11.8)	6,325 (28.1)	5,175 (23.0)
Steel strength in shear, concrete over steel deck, seismic	$V_{sa,deck,eq}$	lb (kN)	960 (4.3)	2,165 (9.6)	1,725 (7.7)	1,900 (8.5)	2,250 (10.0)	1,950 (8.7)	2,095 (9.3)	4,675 (20.8)	2,120 (9.4)	2,325 (10.3)	5,060 (22.5)	4,140 (18.4)
Reduction factor for steel strength in shear for concrete over steel deck[8]	ϕ	-	0.60											
Anchors Installed Through the Soffit of Steel Deck Assemblies into Concrete (Minimum 1-3/4-inch-wide deck flute)														
Minimum concrete member thickness[7]	$h_{min,deck,total}$	in. (mm)	4 (102)	4 (102)	4 (102)	4 (102)	4 (102)	4 (102)	N/A		N/A			N/A
Characteristic pullout strength, uncracked concrete over steel deck, (3,000 psi)	$N_{p,deck,uncr}$	lb (kN)	1,760 (7.8)	2,075 (9.2)	1,440 (6.4)	2,135 (9.5)	3,190 (14.2)	1,720 (7.7)	N/A		N/A			N/A
Characteristic pullout strength, cracked concrete over steel deck, (3,000 psi)	$N_{p,deck,cr}$	lb (kN)	760 (3.4)	910 (4.0)	815 (3.6)	1,510 (6.7)	2,260 (10.1)	1,280 (5.7)	N/A		N/A			N/A
Characteristic pullout strength, cracked concrete over steel deck,seismic, (3,000 psi)	$N_{p,deck,eq}$	lb (kN)	355 (1.6)	750 (3.3)	565 (2.5)	1,260 (5.6)	1,985 (8.8)	1,280 (5.7)	N/A		N/A			N/A
Reduction factor for pullout strength[8]	ϕ	-	0.65						N/A		N/A			N/A
Steel strength in shear, concrete over steel deck	$V_{sa,deck}$	lb (kN)	1,880 (8.4)	2,315 (10.3)	2,115 (9.4)	2,115 (9.4)	2,820 (12.5)	2,095 (9.3)	N/A		N/A			N/A
Steel strength in shear, concrete over steel deck, seismic	$V_{sa,deck,eq}$	lb (kN)	1,565 (7.0)	1,930 (8.6)	1,475 (6.6)	1,625 (7.2)	1,965 (8.7)	1,675 (7.5)	N/A		N/A			N/A
Reduction factor for steel strength in shear for concrete over steel deck[8]	ϕ	-	0.60		0.60			0.60	N/A		N/A			N/A

For SI: 1 inch = 25.4 mm; 1 ksi = 6.894 N/mm²; 1 ft-lb = 1.356 N-m; 1 lb = 0.0044 kN.

1. Installation must comply with published instructions and details.
2. Values for $N_{p,deck}$ and $N_{p,deck,cr}$ are for sand-lightweight concrete (f'c, min = 3,000 psi) and additional lightweight concrete reduction factors need not be applied. In addition, evaluation for the concrete breakout capacity in accordance with ACI 318-14 17.4.2 or ACI 318 D.5.2, as applicable, is not required for anchors installed in the deck soffit (through underside).
3. Values for $N_{p,deck,eq}$ are applicable for seismic loading and must be used in lieu of $N_{p,deck,cr}$.
4. For all design cases $\Psi_{c,P}$ = 1.0. The characteristic pullout strength, N_{pn}, for concrete compressive strengths greater than 3,000 psi for 1/4-inch-diameter anchors may be increased by multiplying the value in the table by $(f'c / 3{,}000)^{0.3}$ for psi or $(f'c / 17.2)^{0.3}$ for MPa. The characteristic pullout strength, N_{pn}, for concrete compressive strengths greater than 3,000 psi for 3/8-inch- to 3/4-inch-diameter anchors may be increased by multiplying the value in the table by $(f'c / 3{,}000)^{0.5}$ for psi or $(f'c / 17.2)^{0.5}$ for MPa.
5. Shear loads for anchors installed through steel deck into concrete may be applied in any direction.
6. Values of $V_{sa,deck}$ and $V_{sa,deck,eq}$ are for sand-lightweight concrete and additional lightweight concrete reduction factors need not be applied. In addition, evaluation for the concrete breakout capacity in accordance with ACI 318-14 17.5.2 or ACI 318-11 D.6.2, as applicable, and the pryout capacity in accordance with ACI 318-14 17.5.3 or ACI 318-11 D.6.3, as applicable, are not required for anchors installed in the soffit (through underside).
7. The minimum concrete member thickness, $h_{min,deck,total}$, is the minimum overall thickness of the concrete-filled steel deck (depth and topping thickness).
8. All values of ϕ were determined from the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3 or ACI 318 Section 9.2. If the load combinations of ACI 318 Appendix C are used, then the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4 (ACI 318-08).

FACTORED RESISTANCE STRENGTH ($ØN_n$ AND $ØV_n$) CALCULATED IN ACCORDANCE WITH ACI 318-14 CHAPTER 17:

1- 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}.

2- Calculations were performed according to ACI 318-14, 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.

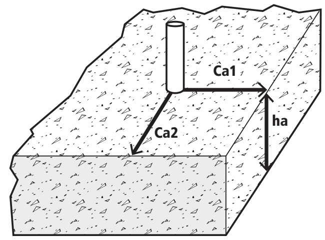
3- Strength reduction factors (ø) were based on ACI 318-14 Section 5.3 for load combinations. Condition B is assumed.

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 318-14, Chapter 17.

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

STRENGTH DESIGN SD TABLES



Tension and Shear Design Strength Installed in Cracked Concrete

Nominal Anchor Diameter (in.)	Nominal Embed. Depth 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.)
1/4	1-5/8	495	780	525	855	575	980	645	980	705	980
	2-1/2	920	1,225	970	1,225	1,060	1,225	1,195	1,225	1,305	1,225
3/8	2	845	915	930	1,000	1,070	1,155	1,315	1,415	1,515	1,635
	2-1/2	1,280	1,375	1,400	1,510	1,620	1,740	1,980	2,080	2,290	2,080
	3-1/4	2,040	2,200	2,235	2,410	2,580	2,605	3,165	2,605	3,650	2,605
1/2	2-1/2	1,070	1,270	1,170	1,395	1,355	1,610	1,655	1,970	1,915	2,275
	3	1,635	1,900	1,790	2,085	2,070	2,405	2,535	2,945	2,925	3,400
	4-1/4	3,055	4,325	3,345	4,735	3,865	5,470	4,735	6,695	5,465	6,705
5/8	3-1/4	1,850	1,995	2,030	2,185	2,345	2,525	2,870	3,090	3,315	3,570
	4	2,700	4,155	2,960	4,550	3,415	5,255	4,185	6,435	4,830	7,385
	5	3,980	6,040	4,360	6,615	5,035	7,640	6,165	9,350	7,120	9,350
3/4	4-1/4	2,985	6,135	3,270	6,720	3,780	7,760	4,625	9,505	5,340	10,975

□ - Anchor Pullout/Pryout Strength Controls □ - Concrete Breakout Strength Controls ■ - Steel Strength Controls

Tension and Shear Design Strength Installed in Uncracked Concrete

Nominal Anchor Diameter (in.)	Nominal Embed. Depth 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.)
1/4	1-5/8	1,155	980	1,265	980	1,460	980	1,785	980	2,065	980
	2-1/2	2,110	1,225	2,310	1,225	2,665	1,225	2,950	1,225	2,950	1,225
3/8	2	1,495	1,610	1,640	1,765	1,890	2,035	2,315	2,080	2,675	2,080
	2-1/2	1,805	1,945	1,980	2,080	2,285	2,080	2,795	2,080	3,230	2,080
	3-1/4	2,880	2,605	3,155	2,605	3,645	2,605	4,465	2,605	5,155	2,605
1/2	2-1/2	2,255	1,780	2,475	1,950	2,855	2,255	3,495	2,760	4,040	3,185
	3	2,495	2,685	2,730	2,940	3,155	3,395	3,865	4,160	4,460	4,805
	4-1/4	4,530	6,050	4,960	6,630	5,725	6,705	7,015	6,705	8,100	6,705
5/8	3-1/4	3,270	3,520	3,580	3,855	4,135	4,455	5,065	5,455	5,845	6,295
	4	3,810	5,815	4,175	6,370	4,820	7,355	5,905	7,385	6,820	7,385
	5	5,620	8,455	6,155	9,265	7,110	9,350	8,705	9,350	10,050	9,350
3/4	4-1/4	4,745	8,590	5,195	9,410	6,000	10,865	7,350	11,555	8,485	11,555

□ - Anchor Pullout/Pryout Strength Controls □ - Concrete Breakout Strength Controls ■ - Steel Strength Controls

FACTORED RESISTANCE STRENGTH ($ØN_n$ AND $ØV_n$) CALCULATED IN ACCORDANCE WITH ACI 318-14, CHAPTER 17:

1- 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 $c_{a1} = c_{min}$).
   - c_{a2} is greater than or equal to 1.5 times c_{a1}.

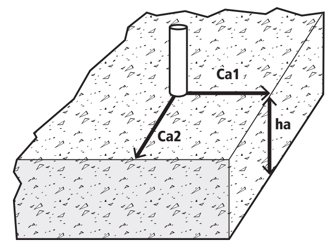
2- Calculations were performed according to ACI 318-14, Chapter 17. The load level corresponding to the controlling failure mode is listed. (e.g. For tension: steel, concrete breakout and pullout; For shear: steel, concrete breakout and pryout). Furthermore, the capacities for concrete breakout strength 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 318-14 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 318-14, Chapter 17.

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



Tension and Shear Design Strength at Minimum Edge Distance, c_{min} for Screw-Bolt+ in Cracked Concrete

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_{sn} Shear (lbs.)	ϕN_n Tension (lbs.)	ϕV_{sn} Shear (lbs.)	ϕN_n Tension (lbs.)	ϕV_{sn} Shear (lbs.)	ϕN_n Tension (lbs.)	ϕV_{sn} Shear (lbs.)	ϕN_n Tension (lbs.)	ϕV_{sn} Shear (lbs.)
1/4	1-5/8	495	370	525	405	575	470	645	575	705	660
	2-1/2	920	450	970	495	1,060	570	1,195	700	1,305	810
3/8	2	785	445	860	485	990	560	1,215	685	1,405	790
	2-1/2	1,115	500	1,220	550	1,410	635	1,725	775	1,995	895
	3-1/4	1,685	595	1,845	650	2,130	755	2,610	920	3,015	1,065
1/2	2-1/2	1,070	675	1,170	740	1,355	855	1,655	1,045	1,915	1,205
	3	1,520	760	1,665	835	1,925	960	2,355	1,180	2,720	1,360
	4-1/4	2,595	935	2,840	1,025	3,280	1,180	4,015	1,445	4,640	1,670
5/8	3-1/4	1,585	800	1,735	875	2,005	1,010	2,455	1,240	2,835	1,430
	4	2,220	920	2,430	1,010	2,805	1,165	3,435	1,425	3,970	1,645
	5	3,160	1,045	3,460	1,145	3,995	1,325	4,895	1,620	5,650	1,870
3/4	4-1/4	2,430	985	2,660	1,080	3,075	1,245	3,765	1,525	4,345	1,760

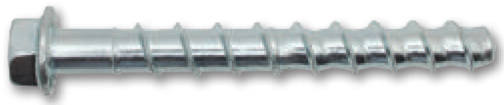
- Anchor Pullout/Pryout Strength Controls - Concrete Breakout Strength Controls - Steel Strength Controls

Tension and Shear Design Strength at Minimum Edge Distance, c_{min} for Screw-Bolt+ in Uncracked Concrete

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_{sn} Shear (lbs.)	ϕN_n Tension (lbs.)	ϕV_{sn} Shear (lbs.)	ϕN_n Tension (lbs.)	ϕV_{sn} Shear (lbs.)	ϕN_n Tension (lbs.)	ϕV_{sn} Shear (lbs.)	ϕN_n Tension (lbs.)	ϕV_{sn} Shear (lbs.)
1/4	1-5/8	460	495	505	540	580	625	710	765	820	885
	2-1/2	860	635	940	695	1,085	800	1,330	980	1,535	1,130
3/8	2	550	595	605	650	700	750	855	920	990	1,065
	2-1/2	655	700	720	765	830	885	1,015	1,085	1,175	1,250
	3-1/4	1,095	835	1,200	915	1,385	1,055	1,695	1,290	1,955	1,490
1/2	2-1/2	1,615	945	1,770	1,035	2,045	1,195	2,505	1,465	2,890	1,690
	3	1,185	1,065	1,300	1,165	1,500	1,345	1,835	1,650	2,120	1,905
	4-1/4	2,190	1,310	2,400	1,430	2,770	1,655	3,390	2,025	3,915	2,340
5/8	3-1/4	1,495	1,120	1,635	1,225	1,890	1,415	2,310	1,735	2,670	2,000
	4	1,715	1,290	1,875	1,410	2,165	1,630	2,655	1,995	3,065	2,305
	5	2,470	1,465	2,705	1,605	3,125	1,855	3,830	2,270	4,420	2,620
3/4	4-1/4	1,635	1,380	1,790	1,510	2,070	1,745	2,535	2,135	2,925	2,465

- Anchor Pullout/Pryout Strength Controls - Concrete Breakout Strength Controls - Steel Strength Controls

ORDERING INFORMATION



Screw-Bolt+

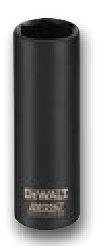
Cat. No. Zinc Plated	Cat. No. Galvanized	Anchor Size	Box Qty.	Ctn. Qty.	20V Max* SDS Plus Rotary Hammers: DCH273P2DH 1" L-Shape	20V Max* SDS Plus Rotary Hammers: DCH133M2 1" D-Handle	20V Max* SDS Plus Rotary Hammers: DCH293R2 1-1/8" L-Shape w/ E-Clutch	Flexvolt SDS Max: DCH481X2 1-9/16" w/ E-Clutch
					Carbide Bits			
PFM1411000	-	1/4" x 1-1/4"	100	600	DW5517	DW5417	DW5417	-
PFM1411020	-	1/4" x 1-3/4"	100	600	DW5517	DW5417	DW5417	-
PFM1411060	-	1/4" x 2-1/4"	100	600	DW5517	DW5417	DW5417	-
PFM1411080	-	1/4" x 2-5/8"	100	500	DW5517	DW5417	DW5417	-
PFM1411100	-	1/4" x 3"	100	500	DW5517	DW5417	DW5417	-
PFM1411160	-	3/8" x 1-3/4"	50	300	DW5527	DW5427	DW5427	-
PFM1411220	-	3/8" x 2-1/2"	50	300	DW5527	DW5427	DW5427	-
PFM1411240	PFM1461240	3/8" x 3"	50	250	DW5527	DW5427	DW5427	-
PFM1411280	PFM1461280	3/8" x 4"	50	250	DW5527	DW5427	DW5427	-
PFM1411300	PFM1461300	3/8" x 5"	50	250	DW5529	DW5429	DW5429	-
PFM1411320	PFM1461320	3/8" x 6"	50	150	DW5529	DW5429	DW5429	-
PFM1411340	-	1/2" x 2"	50	200	DW5537	DW5437	DW5437	-
PFM1411360	-	1/2" x 2-1/2"	50	200	DW5537	DW5437	DW5437	-
PFM1411380	-	1/2" x 3"	50	150	DW5537	DW5437	DW5437	-
PFM1411420	PFM1461420	1/2" x 4"	50	150	DW5537	DW5437	DW5437	-
PFM1411460	PFM1461460	1/2" x 5"	25	100	DW5538	DW5438	DW5438	-
PFM1411480	PFM1461480	1/2" x 6"	25	75	DW5538	DW5438	DW5438	-
PFM1411520	PFM1461520	1/2" x 8"	25	100	DW5538	DW5438	DW5438	-
PFM1411540	-	5/8" x 3"	25	100	DW5471	DW5446	DW5471	DW5806
PFM1411580	-	5/8" x 4"	25	100	DW5471	DW5446	DW5471	DW5806
PFM1411600	PFM1461600	5/8" x 5"	25	75	DW5471	DW5446	DW5471	DW5806
PFM1411640	PFM1461640	5/8" x 6"	25	75	DW5471	DW5446	DW5471	DW5806
PFM1411680	PFM1461680	5/8" x 8"	25	50	DW5471	DW5447	DW5471	DW5806
PFM1411700	-	3/4" x 3"	20	60	DW5474	DW5453	DW5474	DW5810
PFM1411720	-	3/4" x 4"	20	60	DW5474	DW5453	DW5474	DW5810
PFM1411760	-	3/4" x 5"	20	60	DW5474	DW5453	DW5474	DW5810
PFM1411800	PFM1461800	3/4" x 6"	20	60	DW5474	DW5453	DW5474	DW5810
PFM1411840	PFM1461850	3/4" x 8"	10	40	DW5474	DW5455	DW5474	DW5810
PFM1411880	-	3/4" x 10"	10	20	DW5475	DW5455	DW5475	DW5812

Shaded catalog numbers denote sizes which are less than the minimum standard anchor length for Strength Design.

The published size includes the diameter and length of the anchor measured from under the head.

- Optimum Tool Match
- Maximum Tool Match
- Not Recommended

Suggested Impact Wrench and Socket

Nominal Anchor Size	Socket Size	Impact Rated Socket		20V Max* Impact Wrenches	
1/4	7/16	DWMT74479B		DCF883L2 3/8" Impact Wrench	
3/8	9/16	DWMT75122B		DCF880M2 1/2" Impact Wrench	
1/2	3/4	DWMT75113B		DCF899P2 High Torque 1/2" (Use In Speed Setting #2)	
5/8	15/16	DWMT75104B			
3/4	1-1/8	DWMT75125B			

MECHANICAL ANCHORS

SCREW-BOLT+™
High Performance Screw Anchor

GENERAL INFORMATION

316 STAINLESS STEEL WEDGE-BOLT™

Screw Anchor

PRODUCT DESCRIPTION

The 316 Stainless Steel Wedge-Bolt anchor is a one piece, heavy duty screw anchor with a finished hex head. It is simple to install, easy to identify, fully removable and vibration resistant.
The Wedge-Bolt has many unique features and benefits that make it well suited for many applications, both indoors and out. Optimum performance is obtained using a combination of patented design concepts. The steel threads along the anchor body self tap into the hole during installation and provide positive keyed engagement. The benefit to the designer is higher load capacities, while the benefit to the user is ease of installation. The Wedge-Bolt can be installed with either a powered impact wrench or conventional hand socket.

316 Stainless Steel Wedge-Bolt screw anchors are designed to be used with a matched tolerance Wedge-Bit for optimum performance. The Wedge-Bolt works in fixture clearance holes that are 1/16" over nominal, which is typical of standard fixture holes used in steel fabrication.

Note: not suitable for chloride/chlorine environments.

GENERAL APPLICATIONS AND USES

- Interior and Exterior Applications
- Support Ledgers and Windows
- Railing and Fencing
- Storage Facilities
- Repairs & Retrofits
- Maintenance

FEATURES AND BENEFITS

+ High corrosion resistance of Type 316 stainless steel
+ Consistent performance in high and low strength concrete
+ Anchor can be installed through standard fixture holes
+ Diameter, length and identifying marking stamped on head of each anchor
+ Can be installed with an impact wrench or conventional hand socket
+ Fast installation and immediate loading minimizes downtime
+ Finished hex head provides attractive appearance and minimizes tripping hazard
+ Can be installed closer to the edge than traditional expansion anchors
+ Ratchet teeth on underside of hex washer head lock against the fixture
+ Removable

APPROVALS AND LISTINGS

- Tested in accordance with ASTM E488, AC106 criteria and AC193 criteria

GUIDE SPECIFICATIONS

CSI Divisions: 03 16 00 - Concrete Anchors, 04 05 19.16 - Masonry Anchors and 05 05 19 - Post-Installed Concrete Anchors. Screw anchors shall be 316 Stainless Steel Wedge-Bolt as supplied by DEWALT, Towson, MD. Anchors shall be installed in accordance with published instructions and the Authority Having Jurisdiction.

SECTION CONTENTS

316 STAINLESS STEEL WEDGE-BOLT

HEAD STYLES

- Stainless Steel Body and hex washer head

ANCHOR MATERIALS

- Type 316 Stainless Steel

ANCHOR SIZE RANGE (TYP.)

- 1/4" diameter through 1/2" diameter (see ordering information)

SUITABLE BASE MATERIALS

- Normal-weight concrete
- Grouted Concrete Masonry (CMU)
- Brick Masonry

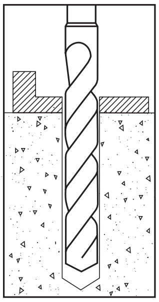
MATERIAL SPECIFICATIONS

Anchor component	Specification
Anchor Body and hex washer head	Type 316 Stainless Steel[1]

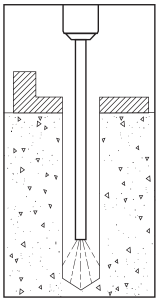
1. With sacrificial carbon steel drive tip and tapping threads.

INSTALLATION INSTRUCTIONS

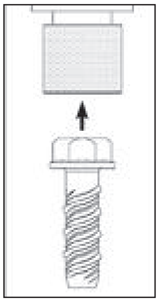
Installation Instructions for 316 Stainless Steel Wedge-Bolt



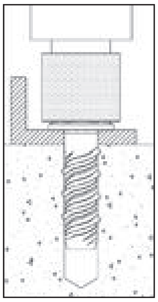
Step 1
Using the proper Wedge-bit size, drill a hole into the base material to the required depth. The tolerances of the Wedge-bit used must meet the requirements of the published Wedge-bit range.



Step 2
Remove dust and debris from the hole during drilling (e.g. dust extractor) or following drilling (e.g. suction, forced air) to extract loose particles created by drilling.

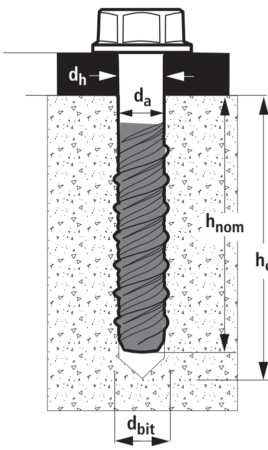


Step 3
Select a powered impact wrench that does not exceed the maximum torque, T_{screw}, for the selected anchor diameter. Attach an appropriate sized hex socket/driver to the impact wrench. Mount the screw anchor head into the socket.



Step 4
Drive the anchor through the fixture and into the hole until the head of the anchor comes into contact with the fixture. The anchor should be snug after installation. Do not spin the hex socket off the anchor to disengage.

316 Stainless Steel Wedge-Bolt Anchor Detail

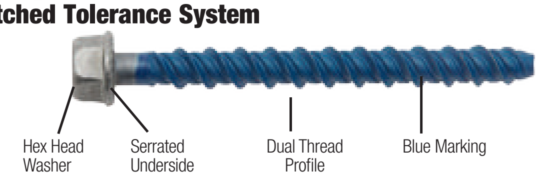


Nomenclature
d_a = Diameter of Anchor
d_{bit} = Diameter of Drill Bit
d_h = Diameter of Clearance Hole
h = Base Material Thickness. The value of h should be $1.5h_{nom}$ or 3", whichever is greater
h_{nom} = Minimum Nominal Embedment
h_o = Minimum Hole Depth

Hex Head Marking

Legend
Diameter, material, and length identification mark

Matched Tolerance System



BLUE WEDGE-BIT

Designed and tested as a system for consistency and reliability

REFERENCE DATA (ASD)

Installation Specifications for 316 Stainless Steel Wedge-Bolt in Concrete

Anchor Property / Setting Information	Notation	Units	Nominal Anchor Diameter		
			1/4	3/8	1/2
Anchor diameter	d_o	in. (mm)	0.250 (6.4)	0.375 (9.5)	0.500 (12.7)
Minimum diameter of hole clearance in fixture	d_h	in. (mm)	5/16 (7.9)	7/16 (11.1)	9/16 (14.3)
Nominal drill bit diameter	d_{bit}	in.	1/4 Wedge-Bit	3/8 Wedge-Bit	1/2 Wedge-Bit
Minimum nominal embedment depth	h_{nom}	in. (mm)	1-3/4 (44)	2 (51)	2-3/4 (70)
Minimum hole depth	h_o	in. (mm)	2 (51)	2-1/4 (57)	3 (77)
Minimum overall anchor length	ℓ_{anch}	in. (mm)	2 (51)	2-1/2 (64)	3 (76)
Maximum impact wrench power (torque)	T_{screw}	ft.-lbf. (N-m)	115 (156)	245 (332)	300 (407)
Torque wrench/socket size	-	in.	7/16	9/16	3/4
Head height	-	in.	7/32	21/64	7/16
Ultimate tensile strength	(UTS)	ksi	80	100	100
Approximate yield strength	(YS)	ksi	64	80	80

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

Ultimate Load Capacities for 316 Stainless Steel Wedge-Bolt in Normal-Weight Concrete[1,2]

Nominal Anchor Diameter in.	Minimum Embedment Depth, h_{nom} in. (mm)	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	1-3/4 (44)	890 (4.0)	1,385 (6.2)	975 (4.3)	1,520 (6.8)	1,130 (5.0)	1,755 (7.8)	1,440 (6.4)	2,560 (11.4)	1,440 (6.4)	2,850 (12.7)
	2-1/2 (64)	2,485 (11.1)	1,385 (6.2)	2,720 (12.1)	1,520 (6.8)	3,145 (14.0)	1,755 (7.8)	3,150 (14.0)	2,560 (11.4)	3,150 (14.0)	2,850 (12.7)
3/8	2 (51)	735 (3.3)	1,675 (7.5)	805 (3.6)	1,833 (8.2)	930 (4.1)	2,115 (9.4)	1,180 (5.2)	2,710 (12.1)	1,210 (5.4)	3,295 (14.7)
	2-1/2 (64)	1,515 (6.7)	1,675 (7.5)	1,655 (7.4)	1,833 (8.2)	1,915 (8.5)	2,115 (9.4)	2,130 (9.5)	2,710 (12.1)	2,180 (9.7)	3,295 (14.7)
	3-1/2 (89)	3,525 (15.7)	1,675 (7.5)	3,860 (17.2)	1,833 (8.2)	4,455 (19.8)	2,115 (9.4)	4,570 (20.3)	2,710 (12.1)	4,680 (20.8)	3,295 (14.7)
1/2	2-3/4 (70)	3,000 (13.3)	4,675 (20.8)	3,285 (14.6)	5,120 (22.8)	3,790 (16.9)	5,915 (26.3)	5,975 (26.6)	7,560 (33.6)	6,900 (30.7)	9,205 (40.9)
	3-1/2 (89)	3,830 (17.0)	5,205 (23.2)	4,195 (18.7)	5,700 (25.4)	4,845 (21.6)	6,590 (29.3)	6,800 (30.2)	7,390 (32.9)	7,855 (34.9)	8,995 (40.0)
	4-1/2 (114)	5,680 (25.3)	5,205 (23.2)	6,220 (27.7)	5,700 (25.4)	7,180 (31.9)	6,590 (29.3)	9,760 (43.4)	7,390 (32.9)	11,265 (50.1)	8,995 (40.0)

1. Tabulated load values are for anchors installed in concrete. Concrete compressive strength must be at a minumum at the time of installation.
2. Ultimate load capacities must be reduced by a minimum safety factor of 4.0 or greater to determine allowable working load.

Allowable Load Capacities for 316 Stainless Steel Wedge-Bolt in Normal-Weight Concrete[1,2,3,4]

Nominal Anchor Diameter in.	Minimum Embedment Depth, h_{nom} in. (mm)	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	1-3/4 (44)	225 (1.0)	345 (1.5)	245 (1.1)	380 (1.7)	285 (1.3)	440 (2.0)	360 (1.6)	640 (2.8)	360 (1.6)	715 (3.2)
	2-1/2 (64)	620 (2.8)	345 (1.5)	680 (3.0)	380 (1.7)	785 (3.5)	440 (2.0)	790 (3.5)	640 (2.8)	790 (3.5)	715 (3.2)
3/8	2 (51)	185 (0.8)	420 (1.9)	200 (0.9)	460 (2.0)	235 (1.0)	530 (2.4)	295 (1.3)	680 (3.0)	305 (1.4)	825 (3.7)
	2-1/2 (64)	380 (1.7)	420 (1.9)	415 (1.8)	460 (2.0)	480 (2.1)	530 (2.4)	535 (2.4)	680 (3.0)	545 (2.4)	825 (3.7)
	3-1/2 (89)	880 (3.9)	420 (1.9)	965 (4.3)	460 (2.0)	1,115 (5.0)	530 (2.4)	1,145 (5.1)	680 (3.0)	1,170 (5.2)	825 (3.7)
1/2	2-3/4 (70)	750 (3.3)	1,170 (5.2)	820 (3.6)	1,280 (5.7)	950 (4.2)	1,480 (6.6)	1,495 (6.7)	1,890 (8.4)	1,725 (7.7)	2,300 (10.2)
	3-1/2 (89)	960 (4.3)	1,300 (5.8)	1,050 (4.7)	1,425 (6.3)	1,210 (5.4)	1,650 (7.3)	1,700 (7.6)	1,850 (8.2)	1,965 (8.7)	2,250 (10.0)
	4-1/2 (114)	1,420 (6.3)	1,300 (5.8)	1,555 (6.9)	1,425 (6.3)	1,795 (8.0)	1,650 (7.3)	2,440 (10.9)	1,850 (8.2)	2,815 (12.5)	2,250 (10.0)

1. Tabulated load values are for anchors installed in concrete. Concrete compressive strength must be at a minimum at the time of installation.
2. Allowable load capacities are calculated using an applied safety factor of 4.0.
3. Allowable load capacities must be multiplied by reduction factors when anchor spacing or edge distances are less than critical distances.
4. Linear interpolation may be used to determine allowable loads for intermediate embedments and compressive strengths.

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[1]

Anchor Installed in Normal-Weight Concrete

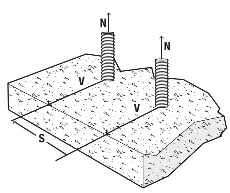
Anchor Dimension	Load Type	Critical Distance (Full Anchor Capacity)	Critical Load Factor	Minimum Distance (Reduced Capacity)	Minimum Load Factor
Spacing (s)	Tension	$s_{cr} = 12d$	$F_{NS} = 1.0$	$s_{min} = 4d$	$F_{NS} = 0.50$
	Shear	$s_{cr} = 12d$	$F_{VS} = 1.0$	$s_{min} = 4d$	$F_{VS} = 0.75$
Edge Distance (c)	Tension	$c_{cr} = 8d$	$F_{NC} = 1.0$	$c_{min} = 3d$	$F_{NC} = 0.70$
	Shear	$c_{cr} = 12d$	$F_{VC} = 1.0$	$c_{min} = 3d$	$F_{VC} = 0.15$

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.

LOAD ADJUSTMENT FACTORS FOR NORMAL-WEIGHT CONCRETE

Spacing, Tension (F_{NS})

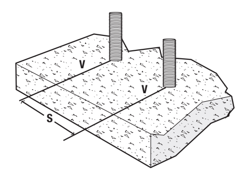
	Dia. (in.)	1/4	3/8	1/2
	s_{cr} (in.)	3	4-1/2	6
	s_{min} (in.)	1	1-1/2	2
Spacing, s (inches)	1	0.50	-	-
	1-1/2	0.63	0.50	-
	2	0.75	0.58	0.50
	2-1/2	0.88	0.67	0.56
	3	1.00	0.75	0.63
	4-1/2	1.00	1.00	0.81
	6	1.00	1.00	1.00



Notes: For anchors loaded in tension, the critical spacing (s_{cr}) is equal to 12 anchor diameters (12d) at which the anchor achieves 100% of load.
Minimum spacing (s_{min}) is equal to 4 anchor diameters (4d) at which the anchor achieves 50% of load.

Spacing, Shear (F_{VS})

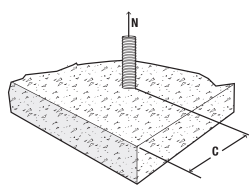
	Dia. (in.)	1/4	3/8	1/2
	s_{cr} (in.)	3	4-1/2	6
	s_{min} (in.)	1	1-1/2	2
Spacing, s (inches)	1	0.75	-	-
	1-1/2	0.81	0.75	-
	2	0.88	0.79	0.75
	2-1/2	0.91	0.83	0.78
	3	1.00	0.88	0.81
	4-1/2	1.00	1.00	0.91
	6	1.00	1.00	1.00



Notes: For anchors loaded in shear, the critical spacing (s_{cr}) is equal to 12 anchor diameters (12d) at which the anchor achieves 100% of load.
Minimum spacing (s_{min}) is equal to 4 anchor diameters (4d) at which the anchor achieves 75% of load.

Edge Distance, Tension (F_{NC})

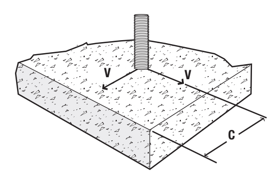
	Dia. (in.)	1/4	3/8	1/2
	c_{cr} (in.)	2	3	4
	c_{min} (in.)	3/4	1-1/8	1-1/2
Edge Distance, c (in.)	3/4	0.70	-	-
	1-1/8	0.79	0.70	-
	1-1/2	0.88	0.76	0.70
	1-7/8	0.97	0.82	0.75
	2	1.00	0.84	0.76
	2-1/4	1.00	0.88	0.79
	3	1.00	1.00	0.88
	4	1.00	1.00	1.00



Notes: For anchors loaded in tension, the critical edge distance (c_{cr}) is equal to 8 anchor diameters (8d) at which the anchor achieves 100% of load.
Minimum edge distance (c_{min}) is equal to 3 anchor diameters (3d) at which the anchor achieves 70% of load.

Edge Distance, Shear (F_{VC})

	Dia. (in.)	1/4	3/8	1/2
	c_{cr} (in.)	3	4-1/2	6
	c_{min} (in.)	3/4	1-1/8	1-1/2
Edge Distance, c (in.)	3/4	0.15	-	-
	1-1/8	0.29	0.15	-
	1-1/2	0.43	0.24	0.15
	1-7/8	0.58	0.34	0.22
	2-1/4	0.72	0.43	0.29
	3	1.00	0.62	0.43
	4-1/2	1.00	1.00	0.72
	6	1.00	1.00	1.00



Notes: For anchors loaded in shear, the critical edge distance (c_{cr}) is equal to 12 anchor diameters (12d) at which the anchor achieves 100% of load.
Minimum edge distance (c_{min}) is equal to 3 anchor diameters (3d) at which the anchor achieves 15% of load

MASONRY PERFORMANCE DATA

Ultimate Load Capacities for 316 Stainless Steel Wedge-Bolt installed into the Face or End of Grout Filled Concrete Masonry[1,2,3]

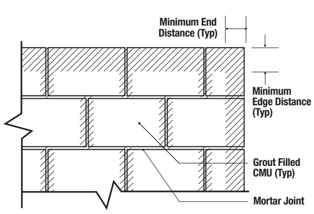
Nominal Anchor Diameter d in.	Minimum Embed. h_{nom} in. (mm)	Minimum Edge Distance in. (mm)	Minimum End Distance in. (mm)	Tension lbs. (kN)		Shear lbs. (kN)		
				f'm = 1,500 psi	f'm = 2,000 psi	Loading Direction	f'm = 1,500 psi	f'm = 2,000 psi
1/4	1-3/4 (44)	3-3/4 (95)	1-1/2 (38)	570 (2.5)	660 (2.9)	Perpendicular or parallel to wall edge or end	645 (2.9)	745 (3.3)
	2-1/4 (57)	3-3/4 (95)	1-1/2 (38)	1,145 (5.1)	1,325 (5.9)		910 (4.0)	1,050 (4.7)
3/8	2 (51)	3-3/4 (95)	1-1/2 (38)	1,535 (6.8)	1,775 (7.9)	Perpendicular or parallel to wall edge or end	775 (3.4)	895 (4.0)
	3 (76)	3-3/4 (95)	3-3/4 (95)	2,300 (10.2)	2,655 (11.8)	Perpendicular or parallel to wall edge or end	3,110 (13.8)	3,585 (15.9)
	3 (76)	3-3/4 (95)	11-1/4 (286)			Parallel to wall edge	3,325 (14.8)	3,835 (17.1)
1/2	2-3/4 (70)	3-3/4 (95)	1-3/4 (44)	1,330 (5.9)	1,535 (6.8)	Perpendicular or parallel to wall edge or end	2,050 (9.1)	2,365 (10.5)
	2-3/4 (70)	3-3/4 (95)	3-3/4 (95)				2,630 (11.7)	3,040 (13.5)
	4-1/2 (114)	3-3/4 (95)	11-1/4 (286)	4,680 (20.8)	5,400 (24.0)		2,630 (11.7)	3,040 (13.5)
	4-1/2 (114)	11-1/4 (286)	11-1/4 (286)				7,290 (32.4)	8,415 (37.4)

1. Tabulated load values are for anchors installed in minimum 8-inch wide, Grade N, Type II, normal-weight concrete masonry units conforming to ASTM C 90 that have reached the minimum designated ultimate strength at the time of installation (f'm ≥ 1,500 psi).
2. Ultimate load capacities must be reduced by a minimum safety factor of 5.0 or greater to determine allowable working load.
3. The tabulated load values are applicable for screw anchors installed at a critical spacing between screw anchors of 16 times the screws anchor diameter. Reduce the tabulated load capacities by 50 percent when anchors are installed at a minimum spacing between screw anchors of 8 times the screw anchor diameter. Linear interpolation may be used for intermediate spacing distances.

Allowable Load Capacities for 316 Stainless Steel Wedge-Bolt installed into the Face or End of Grout Filled Concrete Masonry[1,2,3,4,5]

ALLOWABLE STRESS DESIGN ASD

Nominal Anchor Diameter d in.	Minimum Embed. h_{nom} in. (mm)	Minimum Edge Distance in. (mm)	Minimum End Distance in. (mm)	Tension lbs. (kN)		Shear lbs. (kN)		
				f'm = 1,500 psi	f'm = 2,000 psi	Loading Direction	f'm = 1,500 psi	f'm = 2,000 psi
1/4	1-3/4 (44)	3-3/4 (95)	1-1/2 (38)	115 (0.5)	130 (0.6)	Perpendicular or parallel to wall edge or end	130 (0.6)	150 (0.7)
	2-1/4 (57)	3-3/4 (95)	1-1/2 (38)	230 (1.0)	265 (1.2)		180 (0.8)	210 (0.9)
3/8	2 (51)	3-3/4 (95)	1-1/2 (38)	305 (1.4)	355 (1.6)	Perpendicular or parallel to wall edge or end	155 (0.7)	180 (0.8)
	3 (76)	3-3/4 (95)	3-3/4 (95)	460 (2.0)	530 (2.4)	Perpendicular or parallel to wall edge or end	620 (2.8)	715 (3.2)
	3 (76)	3-3/4 (95)	11-1/4 (286)			Parallel to wall edge	665 (3.0)	765 (3.4)
1/2	2-3/4 (70)	3-3/4 (95)	1-3/4 (44)	265 (1.2)	305 (1.4)	Perpendicular or parallel to wall edge or end	410 (1.8)	475 (2.1)
	2-3/4 (70)	3-3/4 (95)	3-3/4 (95)				525 (2.3)	610 (2.7)
	4-1/2 (114)	3-3/4 (95)	11-1/4 (286)	935 (4.2)	1,080 (4.8)		525 (2.3)	610 (2.7)
	4-1/2 (114)	11-1/4 (286)	11-1/4 (286)				1,460 (6.5)	1,685 (7.5)



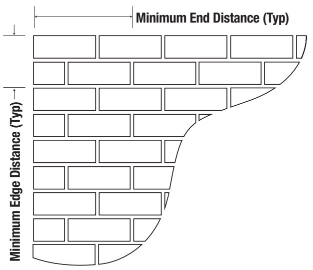
Wall Face
Permissible Anchor Locations
(Un-hatched Area)

1. Tabulated load values are for anchors installed in minimum 8-inch wide, Grade N, Type II, normal-weight concrete masonry units conforming to ASTM C 90 that have reached the minimum designated ultimate strength at the time of installation (f'm ≥ 1,500 psi).
2. Allowable load capacities are calculated using an applied safety factor of 5.0. Consideration of safety factors of 10 or higher may be necessary depending on the application, such as life safety.
3. Linear interpolation for allowable loads for anchors at intermediate embedment depths may be used.
4. For installation in 3,000 psi grout filled concrete masonry (f'm = 3,000 psi) the load capacity in 1,500 psi grout filled concrete masonry (f'm = 1,500) may be increased by 40% and the load capacity in 2,000 psi grout concrete masonry (f'm = 2,000 psi) may be increased by 22%.
5. The tabulated load values are applicable for screw anchors installed at a critical spacing between screw anchors of 16 times the screws anchor diameter. Reduce the tabulated load capacities by 50 percent when anchors are installed at a minimum spacing between screw anchors of 8 times the screw anchor diameter. Linear interpolation may be used for intermediate spacing distances.

Ultimate Load Capacities for 316 Stainless Steel Wedge-Bolt installed into Multiple Wythe Solid Clay Brick Masonry[1,2]

Nominal Anchor Diameter d in.	Minimum Nominal Embedment Depth h_{nom} in. (mm)	Minimum Edge Distance in. (mm)	Minimum End Distance in. (mm)	Minimum Spacing Distance in. (mm)	Tension lbs. (kN)	Shear lbs. (kN)
1/4	2-1/2 (63.5)	3-1/2 (88.9)	2-1/2 (63.5)	4 (101.6)	1,170 (5.2)	1,380 (6.1)
3/8	2-3/4 (69.9)	6 (152.4)	6 (152.4)	6 (152.4)	1,435 (6.4)	2,875 (12.8)
1/2	3-1/4 (82.6)	9-1/2 (241.3)	9-1/2 (241.3)	8 (203.2)	1,840 (8.2)	7,655 (34.1)

1. Tabulated load values are for anchors installed in minimum 2-wythe, minimum Grade SW, solid clay brick masonry walls conforming to ASTM C 62. Mortar must be minimum Type N. Masonry compressive strength must be at the specified minimum at the time of installation (f'm ≥ 1,500 psi).
2. Ultimate load capacities must be reduced by a minimum safety factor of 5.0 or greater to determine allowable working load.



Allowable Load Capacities for 316 Stainless Steel Wedge-Bolt installed into Multiple Wythe Solid Clay Brick Masonry[1,2]

Nominal Anchor Diameter d in.	Minimum Nominal Embedment Depth h_{nom} in. (mm)	Minimum Edge Distance in. (mm)	Minimum End Distance in. (mm)	Minimum Spacing Distance in. (mm)	Tension lbs. (kN)	Shear lbs. (kN)
1/4	2-1/2 (63.5)	3-1/2 (88.9)	2-1/2 (63.5)	4 (101.6)	235 (1.0)	275 (1.2)
3/8	2-3/4 (69.9)	6 (152.4)	6 (152.4)	6 (152.4)	285 (1.3)	575 (2.6)
1/2	3-1/4 (82.6)	9-1/2 (241.3)	9-1/2 (241.3)	8 (203.2)	370 (1.6)	1,530 (6.8)

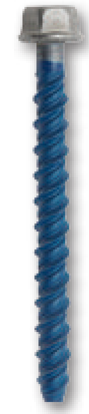
1. Tabulated load values are for anchors installed in minimum 2-wythe, minimum Grade SW, solid clay brick masonry walls conforming to ASTM C 62. Mortar must be minimum Type N. Masonry compressive strength must be at the specified minimum at the time of installation (f'm ≥ 1,500 psi).
2. Allowable load capacities listed are calculated using an applied safety factor of 5.0. Consideration of safety factors of 10 or higher may be used depending on the application, such as life safety.

ORDERING INFORMATION

316 Stainless Steel Wedge-Bolt

Cat. No.	Anchor Size	Thread Length (inc)	Box Qty.	Ctn. Qty.	Wt./100 (lbs)	Wedge-Bit Cat. No.			
						SDS-Plus	SDS-Max	Spline	Straight Shank
07870	1/4 x 2	1-3/4	100	600	3.94	01312	-	-	01370
07872	1/4 x 3	2-3/4	100	500	5.16	01314	-	-	01372
07876	1/4 x 4	2-3/4	100	500	6.56	01314	-	-	01372
07878	1/4 x 5	2-3/4	100	500	7.20	01315	-	-	-
07880	3/8 x 2-1/2	2-1/4	50	300	10.42	01316	-	-	01380
07882	3/8 x 3	2-1/4	50	250	11.96	01316	-	-	01380
07884	3/8 x 4	3-1/2	50	250	15.06	01316	-	-	01380
07886	3/8 x 5	3-1/2	50	250	17.92	01318	-	-	01384
07888	1/2 x 3	2-3/4	50	150	21.17	01320	01354	01340	01390
07890	1/2 x 4	2-3/4	50	150	25.87	01320	01354	01340	01390
07892	1/2 x 5	3-3/4	25	100	31.70	01322	01354	01340	01394
07894	1/2 x 6	3-3/4	25	75	36.73	01322	01354	01340	01394

The published size includes the diameter and length of the anchor measured from under the head to the tip.
*316 Stainless Steel Wedge-Bolt has a blue marking and must be installed with a matched tolerance Wedge-Bit.



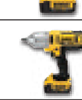
Wedge-Bit

Cat. No.	Wedge-Bit Description	Usable Length	Tube Qty.	Ctn. Qty.
01312	SDS 1/4" x 4"	2"	1	250
01314	SDS 1/4" x 6"	4"	1	100
01315	SDS 1/4" x 8"	6"	1	-
01316	SDS 3/8" x 6"	4"	1	200
01318	SDS 3/8" x 8"	6"	1	100
01332	SDS 3/8" x 12"	10"	1	50
01319	SDS 3/8" x 18"	16"	1	50
01320	SDS 1/2" x 6"	4"	1	150
01322	SDS 1/2" x 10"	8"	1	50
01334	SDS 1/2" x 12"	10"	1	50
01335	SDS 1/2" x 18"	16"	1	50
01340	Spline 1/2" x 13"	8"	1	20
01342	Spline 1/2" x 16"	11"	1	-
01354	SDS-Max 1/2" x 13"	8"	1	20
01370	HD Straight Shank 1/4" x 4"	2-3/4"	1	100
01372	HD Straight Shank 1/4" x 6"	4"	1	-
01380	HD Straight Shank 3/8" x 6"	4"	1	-
01384	HD Straight Shank 3/8" x 13"	11"	1	-
01390	HD Straight Shank 1/2" x 6"	4"	1	-
01394	HD Straight Shank 1/2" x 13"	11"	1	50

316 Stainless Steel Wedge-Bolt Screw Anchor Installation Accessories

Cat. No.	Description	Wt./100 (lbs)
08280	Hand pump / dust blower	1

Suggested Impact Wrench and Socket

Nominal Anchor Size	Socket Size	Impact Rated Socket		20V Max* Impact Wrenches	
1/4	7/16	DWMT74479B		DCF883L2 3/8" Impact Wrench	
3/8	9/16	DWMT75122B		DCF880M2 1/2" Impact Wrench	
1/2	3/4	DWMT75113B		DCF899P2 High Torque 1/2" (Use In Speed Setting #2)	

GENERAL INFORMATION

SNAKE+®

Internally Threaded Screw Anchor

PRODUCT DESCRIPTION

The Snake+ anchor is an internally threaded, self-tapping screw anchor designed for performance in cracked and uncracked concrete. Suitable base materials include normal-weight concrete, sand-lightweight concrete and concrete over steel deck. The Snake+ screw anchor is installed into a drilled hole with a power tool and a Snake+ setting tool. After installation a steel element is threaded into the anchor body.

GENERAL APPLICATIONS AND USES

- Suspending conduit, cable trays and strut
- Interior applications/low level corrosion environment
- Tension zone areas
- Pipe supports
- Seismic and wind loading applications
- Fire sprinklers
- Suspended lighting

FEATURE AND BENEFITS

+ Cracked concrete approved alternative to a dropin anchor
+ Designed for use in holes drilled with standard ANSI carbide drill bits
+ Anchor design allows for shallow embedment and mechanically interlocks with base material
+ Internally threaded anchor for easy adjustment and removability of threaded rod or bolt
+ Fast anchor installation with a powered impact wrench
+ Hammer not used for installation

APPROVALS AND LISTINGS

- International Code Council, Evaluation Service (ICC-ES), ESR-2272 for concrete. Code compliant with the 2015 IBC, 2015 IRC, 2012 IBC, 2012 IRC, 2009 IBC, 2009 IRC, 2006 IBC, and 2006 IRC.
- Tested in accordance with ACI 355.2 and ICC-ES AC193 for use in structural concrete under the design provisions of ACI 318-14 Chapter 17 or ACI 318-11/08 (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 anchor)
- Evaluated and qualified by an accredited independent testing laboratory for reliability against brittle failure, e.g. hydrogen embrittlement
- Evaluated and qualified by an accredited independent testing laboratory for supplemental recognition in redundant fastening applications
- FM Global (Factory Mutual) - File No. 3038104 (see report for sizes) www.approvalguide.com - Pipe hanger components for automatic sprinkler systems

GUIDE SPECIFICATIONS

CSI Divisions: 03 16 00 - Concrete Anchors and 05 05 09 - Post-Installed Concrete Anchors. Internally threaded anchors shall be Snake+ as supplied by DEWALT, Towson, MD. Anchors shall be installed in accordance with published instructions and the Authority Having Jurisdiction.

MATERIAL SPECIFICATIONS

Anchor Component	Specification
Anchor Body	Case hardened carbon steel
Plating	Zinc plating according to ASTM B633, SC1, Type III (Fe/Zn 5) Minimum plating requirements for Mild Service Condition

SECTION CONTENTS

SNAKE+

INTERNAL THREAD VERSION

- Unified coarse thread (UNC)

ANCHOR MATERIALS

- Zinc plated carbon steel body

ANCHOR SIZE RANGE (TYP.)

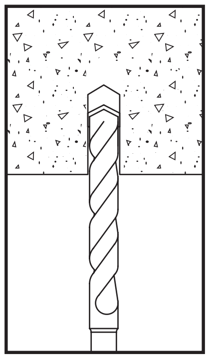
- 1/4", 3/8" and 1/2" diameters

SUITABLE BASE MATERIALS

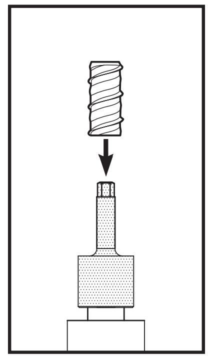
- Normal-weight concrete
- Sand-lightweight concrete
- Concrete over steel deck

CODE LISTED
ICC-ES ESR-2272
CONCRETE

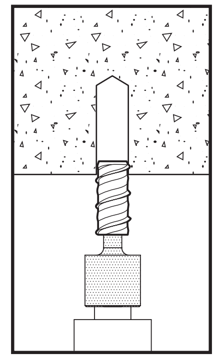
INSTALLATION INSTRUCTIONS



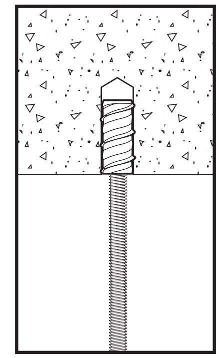
Step 1
Using the proper drill bit size, drill a hole into the base material to the required depth. The tolerances of the carbide drill bit used should meet the requirements of ANSI Standard B212.15.



Step 2
Select a powered impact wrench that does not exceed the maximum torque, T_{screw}, for the selected anchor diameter. Attach the Snake+ setting tool supplied by Powers Fasteners to the impact wrench. Mount the anchor onto the setting tool.

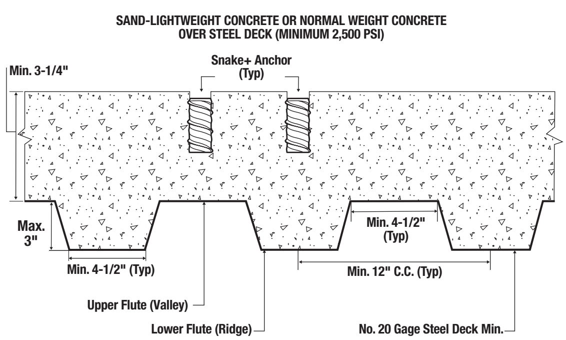


Step 3
Drive the anchor into the hole until the shoulder of the Snake+ setting tool comes into contact with the surface of the base material. Do not spin the setting tool off the anchor to disengage.



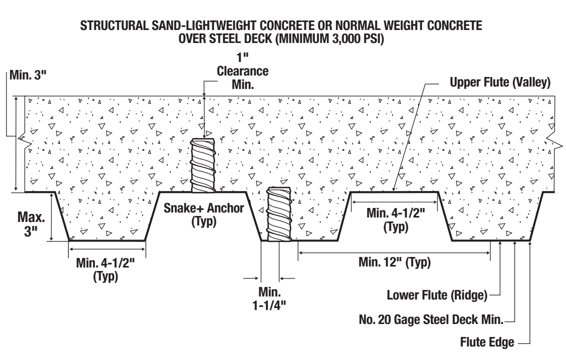
Step 4
Insert threaded rod or a bolt into the Snake+, taking care not to exceed the maximum specified tightening torque of the steel insert element, T_{max}. Minimum thread engagement should be at least one anchor diameter.

Installation Detail for Snake+ in the Topside of Concrete-Filled Steel Deck floor and Roof Assemblies[1]



1. 3/8-inch diameter anchors may be placed in the topside of steel deck profiles provided the minimum topping thickness, minimum spacing distance and minimum edge distance are satisfied as given in the installation information table.

Installation Detail for Snake+ Installed in the Soffit of Concrete over Steel Deck floor and Roof Assemblies[1]



1. Anchors may be placed in the upper flute or lower flute of the steel deck profiles provided in minimum hole clearance is satisfied. Anchors in the lower flute may be installed with a maximum 1-inch offset in either direction from the center of the flute. The offset distance may be increased proportionally for profiles with lower flute widths greater than those shown provided the minimum lower flute edge distance is also satisfied.

STRENGTH DESIGN (SD)

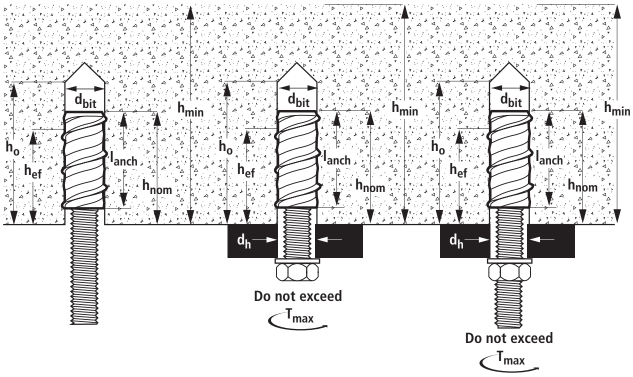
Installation Information for Snake+ Screw Anchor for Single Point Applications[1]

CODE LISTED
ICC-ES ESR-2272

Anchor Property/ Setting Information	Notation	Units	Nominal Anchor Size / Threaded Coupler Diameter (inch)		
			1/4	3/8	1/2
Nominal outside anchor diameter	$d_a(d_o)^3$	in. (mm)	0.375 (9.5)	0.500 (12.7)	0.750 (19.1)
Internal thread diameter (UNC)	d	in. (mm)	0.250 (6.4)	0.375 (9.5)	0.500 (12.7)
Minimum diameter of hole clearance in fixture for steel insert element (following anchor installation)	d_h	in.	5/16	7/16	9/16
Nominal drill bit diameter	d_{bit}	in.	3/8 ANSI	1/2 ANSI	3/4 ANSI
Minimum hole depth	h_o	in. (mm)	2 (51)	2 (51)	2-1/2 (64)
Overall anchor length	ℓ_{anch}	in. (mm)	1-1/4 (32)	1-1/4 (32)	1-11/16 (43)
Minimum nominal embedment depth[2]	h_{nom}	in. (mm)	1-5/8 (41)	1-5/8 (41)	2-3/16 (55)
Effective embedment	h_{ef}	in. (mm)	Not Applicable[4]	1.10 (28)	1.54 (39)
Maximum impact wrench power (torque)	T_{screw}	ft.-lb. (N-m)	120 (163)	345 (468)	345 (468)
Maximum tightening torque of steel insert element (threaded rod or bolt)	T_{max}	ft.-lb. (N-m)	4 (6)	8 (11)	36 (49)
Anchors Installed in Concrete Construction[2]					
Minimum member thickness[2]	h_{min}	in. (mm)	Not Applicable[4]	4 (102)	4 (102)
Critical edge distance[2]	c_{ac}	in. (mm)	Not Applicable[4]	3 (76)	4 (102)
Minimum edge distance[2]	c_{min}	in. (mm)	Not Applicable[4]	3 (76)	4 (102)
Minimum spacing distance[2]	s_{min}	in. (mm)	Not Applicable[4]	3 (76)	4 (102)
Anchors Installed in the Topside of Concrete-Filled Steel Deck Assemblies[5]					
Minimum member topping thickness	$h_{min,deck}$	in. (mm)	Not Applicable[4]	3-1/4 (83)	Not applicable
Critical edge distance	$c_{ac,deck,top}$	in. (mm)	Not Applicable[4]	3 (76)	Not applicable
Minimum edge distance	$c_{min,deck,top}$	in. (mm)	Not Applicable[4]	3 (76)	Not applicable
Minimum spacing distance	$s_{min,deck,top}$	in. (mm)	Not Applicable[4]	3 (76)	Not applicable

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable.
2. For installations through the soffit of steel deck into concrete, see installation detail. Anchors in the lower flute may be installed with a maximum 1-inch offset in either direction from center of the flute. In addition, anchors shall have an axial spacing along the flute equal to the greater of $3h_{ef}$ or 1.5 times the flute width.
3. The notation in parenthesis is for the 2006 IBC.
4. The 1/4-inch diameter anchor is limited to redundant fastening design only.
5. For 3/8-inch diameters installed in the topside of concrete-filled steel deck assemblies, steel installation detail.

Dimensional Sketch for Snake+ Screw Anchor Installed with Steel Insert Element



MECHANICAL ANCHORS

SNAKE+®
Internally Threaded Screw Anchor

PERFORMANCE DATA

Tension Design Information (For use with load combinations taken from ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2)[1,2]

CODE LISTED ICC-ES ESR-2272

STRENGTH DESIGN TABLES

Design Characteristic	Notation	Units		Nominal Anchor Diameter 3/8 inch	Nominal Anchor Diameter 1/2 inch
Anchor category	1,2 or 3	-		1	1
Nominal embedment depth	h_{nom}	in. (mm)		1-5/8 (41)	2-3/16 (55)
STEEL STRENGTH IN TENSION[4]					
Minimum specified yield strength of steel insert element	f_y	ksi (N/mm²)	ASTM A36	36.0 (248)	
			ASTM A193, Grade B7	105.0 (724)	-
Minimum specified ultimate strength of steel insert element	f_{uta}	ksi (N/mm²)	ASTM A36	58.0 (400)	
			ASTM A193, Grade B7	125.0 (862)	-
Effective tensile stress area of steel insert element	$A_{se,N}$ (A_{se})[10]	in² (mm²)		0.0775 (50)	0.1419 (92)
Steel strength in tension	N_{sa}	lb (kN)	ASTM A36	4.495 (20.0)	8,230 (37.0)
			ASTM A193, Grade B7	9,685 (43.1)	-
Reduction factor for steel strength[3]	ϕ	-		0.65	
CONCRETE BREAKOUT STRENGTH IN TENSION[8]					
Effective embedment	h_{ef}	in. (mm)		1.10 (28)	1.54 (39)
Effectiveness factor for uncracked concrete	k_{ucr}	-		24	30
Effectiveness factor for cracked concrete	k_{cr}	-		17	24
Modification factor for cracked and uncracked concrete[5]	$\psi_{c,N}$	-		Cracked concrete = 1.0 Uncracked concrete = 1.0	
Critical edge distance	c_{ac}	in. (mm)		3 (76)	4 (102)
Reduction factor for concrete breakout strength[3]	ϕ	-		Condition B = 0.65	
PULLOUT STRENGTH IN TENSION (NON-SEISMIC APPLICATIONS)[8]					
Characteristic pullout strength, uncracked concrete (2,500 psi)[6]	$N_{p,uncr}$	lb (kN)		See note 7	See note 7
Characteristic pullout strength, cracked concrete (2,500 psi)[6]	$N_{p,cr}$	lb (kN)		See note 7	1,665 (7.4)
Reduction factor for pullout strength[3]	ϕ	-		0.65 (Condition B)	
PULLOUT STRENGTH IN TENSION FOR SEISMIC APPLICATIONS[8]					
Characteristic pullout strength, seismic (2,500 psi)[6]	$N_{p,eq}$	lb (kN)		See note 7	1,665 (7.4)
Reduction factor for pullout strength[3]	ϕ	-		Condition B = 0.65	
PULLOUT STRENGTH IN TENSION FOR SOFFIT OF SAND-LIGHT WEIGHT AND NORMAL-WEIGHT CONCRETE OVER STEEL DECK					
Characteristic pullout strength, uncracked concrete over steel deck[6,9]	$N_{p,deck,uncr}$	lb (kN)		1,515 (6.7)	1,625 (7.2)
Characteristic pullout strength, cracked concrete over steel deck[6,9]	$N_{p,deck,cr}$	lb (kN)		1,075 (4.8)	1,300 (5.8)
Characteristic pullout strength, cracked concrete over steel deck, seismic[6,9]	$N_{p,deck,eq}$	lb (kN)		1,075 (4.8)	1,300 (5.8)
Reduction factor for pullout strength, concrete over steel deck[3]	ϕ	-		Condition B = 0.65	

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 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable, must apply.
2. Installation must comply with published instructions and details.
3. All values of ϕ were determined from the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2. If the load combinations ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4. For reinforcement that meets ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable, requirements for Condition A, see ACI 318-14 17.3.3(c) or ACI 318-11 D.4.3(c), as applicable, for the appropriate ϕ factor.
4. It is assumed that the threaded rod or bolt used with the Snake+ anchor is a ductile steel element with minimum specified properties as listed in the table or an equivalent steel element. The Snake+ anchor is considered a brittle steel element in tension as defined by ACI 318-14 2.3 or ACI 318-11D.1, as applicable. Tabulated values for steel strength in tension must be used for design.
5. For all design cases use $\psi_{c,N}$ = 1.0. The appropriate effectiveness factor for cracked concrete (k_{cr}) and uncracked concrete (k_{uncr}) must be used.
6. For all design cases use $\psi_{c,P}$ = 1.0. For concrete compressive strength greater than 2,500 psi, N_{pn} = (pullout strength from table)*(specified concrete compressive strength/2,500)$^{0.5}$. For concrete over steel deck the value of 2,500 must be replaced with the value of 3,000.
7. Pullout strength does not control design of indicated anchors. Do not calculate pullout strength for indicated anchor size and embedment.
8. 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. For anchors installed in the soffit of sand-lightweight concrete-filled steel deck and floor and roof assemblies, further reduction of the pullout values provided in not required.
9. Values for $N_{p,deck}$ are for sand-lightweight concrete (f'c,min = 3,000 psi) and additional lightweight concrete reduction factors need not be applied. In addition, evaluation for the concrete breakout capacity in accordance with ACI 318-14 17.4.2 or ACI 318-11 D.5.2, as applicable, is not required for anchors installed in the deck soffit (flute).
10. The notation in parenthesis is for the 2006 IBC.

Shear Design Information (For use with load combinations taken from ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2)[1,2]

CODE LISTED ICC-ES ESR-2272

Design Characteristic	Notation	Units		Nominal Anchor Diameter 3/8 inch	Nominal Anchor Diameter 1/2 inch
Anchor category	1,2 or 3	-		1	1
Nominal embedment depth	h_{nom}	in. (mm)		1-5/8 (41)	2-3/16 (55)
STEEL STRENGTH IN SHEAR[4]					
Steel strength in shear[5]	V_{sa}	lb (kN)	ASTM A36	770 (3.4)	1,995 (8.9)
			ASTM A193, Grade B7	1,655 (7.4)	-
Reduction factor for steel strength[3]	ϕ	-		0.60	
CONCRETE BREAKOUT STRENGTH IN SHEAR[6]					
Nominal outside anchor diameter	$d_a(d_o)$[10]	in. (mm)		0.500 (12.7)	0.750 (19.1)
Load bearing length of anchor (h_{ef} or $8d_o$, whichever is less)	ℓ_e	-		1.10 (28)	1.54 (39)
Reduction factor for concrete breakout strength[3]	ϕ	-		Condition B = 0.70	
PRYOUT STRENGTH IN SHEAR[6]					
Coefficient for pryout strength (1.0 for $h_{ef} < 2.5$ in, 2.0 for $h_{ef} \geq 2.5$ in.)	k_{cp}	-		1.0	1.0
Effective embedment	h_{ef}	in. (mm)		1.10 (28)	1.54 (39)
Reduction factor for pullout strength[3]	ϕ	-		Condition B = 0.70	
STEEL STRENGTH IN SHEAR FOR SEISMIC APPLICATIONS					
Steel strength in shear, seismic[7]	$V_{sa,eq}$	lb (kN)	ASTM A36	770 (3.4)	1,995 (8.9)
			ASTM A193, Grade B7	1,655 (7.4)	-
Reduction factor for pullout strength[3]	ϕ	-		Condition B = 0.60	
STEEL STRENGTH IN SHEAR FOR SOFFIT OF SAND-LIGHT WEIGHT AND NORMAL-WEIGHT CONCRETE OVER STEEL DECK[9]					
Steel strength in shear, concrete over steel deck[8]	$V_{sa,deck}$	lb (kN)	ASTM A36	770 (3.4)	1,995 (8.9)
			ASTM A193, Grade B7	1,655 (7.4)	-
Steel strength in shear, concrete over steel deck, seismic[8]	$V_{sa,deck,eq}$	lb (kN)	ASTM A36	770 (3)	1,995 (8.9)
			ASTM A193, Grade B7	1,665 (7.4)	-
Reduction factor for pullout strength[3]	ϕ	-		Condition B = 0.60	

For SI: 1 inch = 25.4 mm, 1 lbf = 0.0044 kN.

1. The data in this table is intended to be used with the design provisions of ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-14 17.2.3 or ACI 318-11 D.3.3 shall apply.
2. Installation must comply with published instructions and details.
3. All values of ϕ were determined from the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3, or ACI 318-11 Section 9.2, as applicable. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4. For reinforcement that meets ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable, requirements for Condition A, see ACI 318-14 17.3.3(c) or ACI 318-11 D.4.3(c), as applicable, for the appropriate ϕ factor.
4. It is assumed that the threaded rod or bolt used with the Snake+ anchor will be a ductile steel element as defined by ACI 318-14 2.3 or ACI 318-11 D.1, as applicable.
5. Tabulated values for steel strength in shear must be used for design. These tabulated values are lower than calculated results using equation 17.5.1.2b in ACI 318-14, D-29 in ACI 318-11, and ACI 318-14 17.5.1.2 or ACI 318-11 D.6.1.2, as applicable.
6. 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. For anchors installed in the soffit of sand-lightweight concrete-filled steel deck and floor and roof assemblies, further reduction of the pullout values provided in not required.
7. 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.
8. Tabulated values for $V_{sa,deck}$ are for sand-lightweight concrete (f'c,min = 3,000 psi) and additional lightweight concrete reduction factors need not be applied. In addition, evaluation for the concrete breakout capacity in accordance with ACI 318-14 17.5.2 or ACI 318-11 D.6.2, as applicable, and the pryout capacity in accordance with ACI 318-14 17.5.3 or ACI 318-11 D.6.3 are not required for anchors installed in the deck soffit (flute).
9. Shear loads for anchors installed through steel deck into concrete may be applied in any direction.
10. The notation in parenthesis is for the 2006 IBC.

Factored Design Strength ($ØN_n$ And $ØV_n$) Calculated In Accordance With ACI 318-14 Chapter 17:

1- 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}.

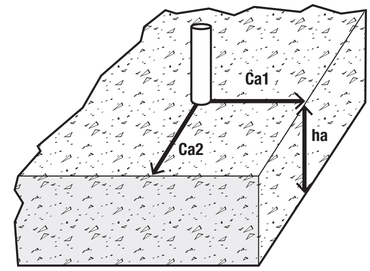
2- Calculations were performed according to ACI 318-14 Chapter 17. The load level corresponding to the controlling failure mode is listed. (e.g. For tension: steel, concrete breakout and pullout; For shear: steel, concrete breakout and pryout). Furthermore, the capacities for concrete breakout strength in tension and pryout strength in shear are calculated using the effective embedment values, hef, 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 318-14 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 318-14 Chapter 17.

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



Tension and Shear Design Strengths Installed in Cracked Concrete

Nominal Anchor Size (in.)	Nominal Embed. h_{nom} (in.)	Steel Insert Element (Threaded Rod or Bolt)	Minimum Concrete Compressive Strength, f'c (psi)									
			2,500		3,000		4,000		6,000		8,000	
			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.)
3/8	1-5/8	ASTM A36	635	500	700	500	805	500	985	500	1,140	500
		ASTM A193 Grade B7	635	685	700	750	805	870	985	1,065	1,140	1,075
1/2	2-3/16	ASTM A36	1,080	1,295	1,185	1,295	1,370	1,295	1,675	1,295	1,935	1,295

▢ - Anchor Pullout/Pryout Strength Controls ▢ - Concrete Breakout Strength Controls ■ - Steel Strength Controls

Tension and Shear Design Strengths Installed in Uncracked Concrete

Nominal Anchor Size (in.)	Nominal Embed. h_{nom} (in.)	Steel Insert Element (Threaded Rod or Bolt)	Minimum Concrete Compressive Strength, f'c (psi)									
			2,500		3,000		4,000		6,000		8,000	
			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.)
3/8	1-5/8	ASTM A36	900	500	985	500	1,140	500	1,395	500	1,610	500
		ASTM A193 Grade B7	900	970	985	1,060	1,140	1,075	1,395	1,075	1,610	1,075
1/2	2-3/16	ASTM A36	1,865	1,295	2,040	1,295	2,355	1,295	2,885	1,295	3,335	1,295

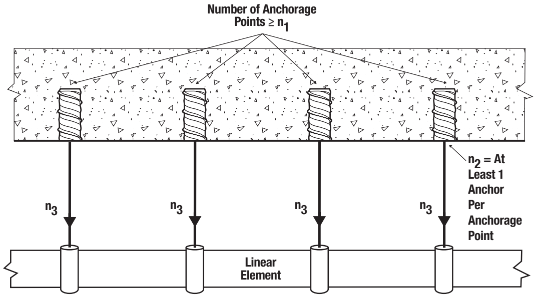
▢ - Anchor Pullout/Pryout Strength Controls ▢ - Concrete Breakout Strength Controls ■ - Steel Strength Controls

REDUNDANT FASTENING APPLICATIONS

For an anchoring system designed with redundancy, the load maintained by an anchor that experiences failure or excessive deflection can be transmitted to neighboring anchors without significant consequences to the fixture or remaining resistance of the anchoring system. In addition to the requirements for anchors, the fixture being attached shall be able to resist the forces acting on it assuming one of the fixing points is not carrying load. It is assumed that by adhering to the limits placed on n_1, n_2 and n_3 below, redundancy will be satisfied.

Anchors qualified for redundant applications may be designed for use in normal weight and sand-lightweight cracked and uncracked concrete. Concrete compressive strength of 2,500 psi shall be used for design. No increase in anchor capacity is permitted for concrete compressive strengths greater than 2,500 psi. The anchor installation is limited to concrete with a compressive strength of 8,500 psi or less.

Redundant applications shall be limited to structures assigned to Seismic Design Categories A or B only.
Redundant applications shall be limited to support of nonstructural elements.



Strength Design (Redundant Fastening):

For strength design, a redundant system is achieved by specifying and limiting the following variables

n_1 = the total number of anchorage points supporting the linear element

n_2 = number of anchors per anchorage point

n_3 = factored load at each anchorage point, lbs., using load combinations from IBC Section 1605.2.1 or ACI 318-14 Section 5.3 or ACI 318 (-11,-08,-05) Section 9.2.

Strength Design (SD)

Design values for use with strength design shall be established taking $\phi_{ra} \bullet F_{ra.}$

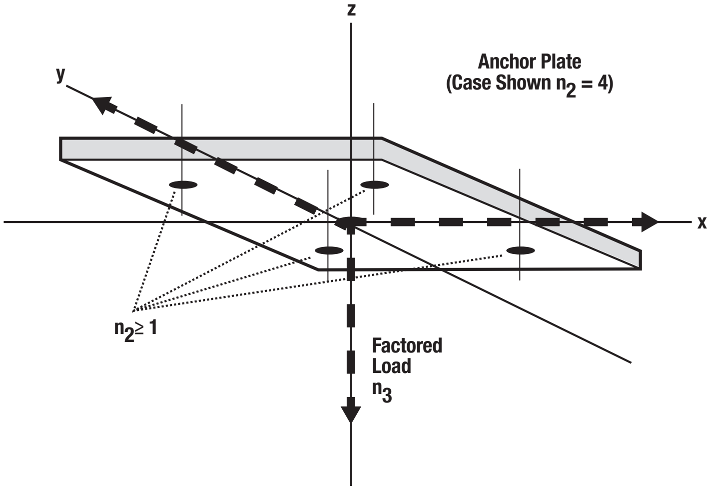
Allowable Stress Design (Redundant Fastening):

Design values for use with allowable stress design shall be established taking

$$R_d, ASD = \frac{\phi_{ra} \bullet F_{ra}}{\alpha}$$

Where α is the conversion factor calculated as the weighted average of the load factors from the controlling load combination. The conversion factor, α is equal to 1.4 assuming all dead load.

See redundant fastening design information table for Snake+ design resistance.



REDUNDANT FASTENING

Installation Information for Snake+ Screw Anchor in Redundant Fastening Applications

Anchor Property/ Setting Information	Notation	Units	Nominal Anchor Size / Threaded Coupler Diameter (inch)		
			1/4	3/8	1/2
Nominal drill bit diameter	d_{bit}	in.	3/8 ANSI	1/2 ANSI	3/4 ANSI
Nominal embedment depth	h_{nom}	in. (mm)	1-5/8 (41)	1-5/8 (41)	2-3/16 (55)
Effective embedment	h_{ef}	in. (mm)	1.10 (28)	1.10 (28)	1.54 (39)
Minimum hole depth	h_o	in. (mm)	2 (51)	2 (51)	2-1/2 (64)
Minimum concrete member thickness	h_{min}	in. (mm)	3 (76.2)	3 (76.2)	3 (76.2)
Overall anchor legnth	ℓ_{anch}	in. (mm)	1-1/4 (32)	1-1/4 (32)	1-11/16 (43)
Minimum edge distance, redundant fastening[1]	$c_{min} = c_{ac}$	in. (mm)	4 (102)	4 (102)	4 (102)
Minimum spacing distance, redundant fastening[1]	s_{min}	in. (mm)	8 (203)	8 (203)	8 (203)
Maximum tightening torque of steel insert element (threaded rod or bolt)	T_{max}	ft.-lb. (N-m)	4 (6)	8 (11)	36 (49)
Maximum impact wrench power (torque)	T_{screw}	ft.-lb. (N-m)	120 (163)	345 (468)	345 (468)

1. Tabulated minimum spacing and edge distances are applicable only for redundant fastening applications.

Redundant Fastening Design Information for Snake+ Anchors[1,2,3]

Anchor Property/ Setting Information	Notation	Units	Nominal Anchor Size					
			1/4"		3/8"		1/2"	
Anchor category	1,2 or 3	-	1		1		1	
Nominal embedment depth	h_{nom}	in. (mm)	1-5/8 (41)		1-5/8 (41)		2-3/16 (55)	
CHARACTERISTIC STRENGTH (RESISTANCE) INSTALLED IN CONCRETE[4,5]								
Resistance, cracked or uncracked concrete (2,500psi)	F_{ra}	lb (kN)	Number of anchorage points		Number of anchorage points		Number of anchorage points	
			$n_1 \geq 4$	$n_1 \geq 3$	$n_1 \geq 4$	$n_1 \geq 3$	$n_1 \geq 4$	$n_1 \geq 3$
			550 (2.5)	360 (1.6)	675 (3.0)	450 (2.0)	675 (3.0)	450 (2.0)
Strength reduction factor[3]	ϕ_{ra}	-	0.65					
CHARACTERISTIC STRENGTH (RESISTANCE) FOR SAND-LIGHTWEIGHT AND NORMAL WEIGHT CONCRETE OVER STEEL DECK[4,6]								
Resistance, cracked or uncracked concrete over steel deck (2,500 psi)	$F_{ra,deck}$	lb (kN)	Number of anchorage points		Number of anchorage points		Number of anchorage points	
			$n_1 \geq 4$	$n_1 \geq 3$	$n_1 \geq 4$	$n_1 \geq 3$	$n_1 \geq 4$	$n_1 \geq 3$
			550 (2.5)	360 (1.6)	675 (3.0)	450 (2.0)	675 (3.0)	450 (2.0)
Strength reduction factor[3]	ϕ_{ra}	-	0.65					

For SI: 1 inch = 25.4 mm, 1 lbf = 0.0044 kN.

1. The data in this table is intended to be used with the design provisions of Section 4.3 of this report; loads may be applied in tension, shear or any combination thereof.
2. Installation must comply with published instructions and this report.
3. All values of ϕ were determined from the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3 or ACI 318 (-11, -08, -05) Section 9.2, as applicable.
4. It is assumed that the threaded rod or bolt used with the Snake+ anchor has properties as listed in Tension Design Information table.
5. Anchors are permitted to be used in lightweight concrete provided the design strength $\phi_{ra} F_{ra}$ is multiplied by the modification factor λ_a. The modification factor λ_a is equal to 0.8λ, λ shall be determined in accordance with the corresponding version of ACI 318. For anchors installed in the soffit of sand-lightweight concrete-filled steel deck and floor and roof assemblies, further reduction of the pullout values provided in not required.
6. For installations through the soffit of steel deck into concrete see the installation detail. Anchors in the lower flute may be installed with a maximum 1-inch offset in either direction from center of the flute. In addition, anchors shall have an axial spacing along the flute equal to the greater of $3h_{ef}$ or 1.5 times the flute width.

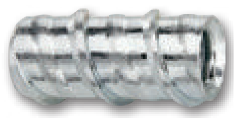
Ultimate Tension Load Capacities for Snake+ in Normal-Weight Uncracked Concrete[1,2,3,4]

Nominal Anchor Diameter in.	Minimum Embedment Depth in. (mm)	Minimum Concrete Compressive Strength					
		f'c = 2,500 psi (17.2 MPa)		f'c = 3,000 psi (20.7 MPa)		f'c = 6,000 psi (41.4 MPa)	
		Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
1/4	1-5/8 (41)	2,130 (9.5)	1,045 (4.6)	2,335 (10.4)	1,045 (4.6)	-	-
3/8	1-5/8 (41)	2,165 (9.7)	1,045 (4.6)	2,370 (10.6)	1,045 (4.6)	3,190 (14.2)	1,045 (4.6)
1/2	2-3/16 (55)	5,590 (24.9)	2,050 (9.1)	6,125 (27.3)	2,050 (9.1)	7,240 (32.0)	2,050 (9.1)

1. Tabulated load values are for anchors installed in concrete. Concrete compressive strength must be at the specified minimum at the time of installation.
2. Ultimate load capacities must be reduced by a minimum safety factor of 4.0 or greater to determine allowable working load.
3. The tabulated load values are applicable to single anchors in uncracked concrete installed at critical spacing distance between anchors and at critical edge distance.
4. Ultimate shear capacity is controlled by steel strength of ASTM A36 element (or equivalent).

ORDERING INFORMATION

Carbon Steel Snake+ Screw Anchor



Cat. No.	Anchor Size	Embedment	Internal Thread Depth	Std. Box[1]	Std. Ctn.
6400SD	1/4"	1-5/8"	11/32"	100	1,000
6401SD	3/8"	1-5/8"	23/32"	50	500
6403SD	1/2"	2-1/2"	15/16"	50	300

1. Each box comes with one free setting tool

Setting Tool for Snake+ Screw Anchor

Cat. No.	Anchor Size	Std. Ctn.
6402SD	1/4"	1
6407SD	3/8"	1
6404SD	1/2"	1

Suggested Impact Wrench

20V Max* Impact Wrenches	
DCF880M2 1/2" Impact Wrench	

GENERAL INFORMATION

SMART DI™

Internally Threaded Expansion Anchor

PRODUCT DESCRIPTION

The Smart DI is an all-steel, machine bolt anchor available in carbon steel. It can be used in solid concrete, hard stone, and solid block base materials. The Smart DI is specifically designed to be easier to fully set during installation as a benefit to the user.

GENERAL APPLICATIONS AND USES

- Suspending Conduit
- Fire Sprinkler
- Cable Trays and Strut
- Concrete Formwork
- Pipe Supports
- Suspended Lighting

FEATURES AND BENEFITS

+ Installs with reduced effort compared to traditional drop in style anchors
+ Can be installed using the manual setting tool or Smart DI system with a hammer-drill
+ Setting indicater makes identification of properly set anchors easy (when installed using the smart tool and smart bit)
+ Internally threaded anchor for easy bolt removability and service work
+ Anchor can be installed through standard fixture holes

TESTING, APPROVALS AND LISTINGS

- FM Global (Factory Mutual) - File No. 3059197 (see ordering information)
- Underwriters Laboratory (UL Listed) – File No. EX1289 (N) (see ordering information)

GUIDE SPECIFICATIONS

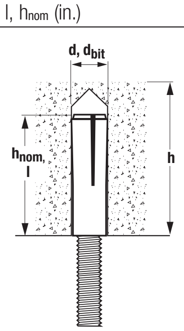
CSI Divisions: 03 16 00 - Concrete Anchors and 05 05 19 - Post-Installed Concrete Anchors. Dropin anchors shall be Smart DI as supplied by DEWALT, Towson, MD.

MATERIAL SPECIFICATIONS

Anchor component	Specification
Anchor Body	AISI 1008
Plug	AISI 1008
Zinc Plating	ASTM B 633, SC1 Type III (Fe/Zn 5)

INSTALLATION SPECIFICATIONS

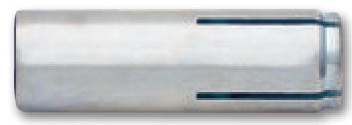
Anchor (Rod) Size	1/4"	3/8"	1/2"
Nominal Outside Diameter d (in.)	0.375	0.500	0.625
ANSI Drill Bit Size, d_{bit} (in.)	3/8	1/2	5/8
Maximum Tightening Torque, T_{max} (ft.-lbs.)	5	10	20
Thread Size (UNC)	1/4-20	3/8-16	1/2-13
Thread Depth (in.)	7/16	5/8	13/16
Anchor Length l, h_{nom} (in.)	1	1-9/16	2



Nomenclature

d = Diameter of anchor
d_{bit} = Diameter of drill bit
h = Base material thickness. The minimum value of h should be 3" min. except for 1/2" size where minimum value of h should be 4"
h_{nom} = Minimum embedment depth
l = Overall length of anchor

SECTION CONTENTS



SMART DI (DROP-IN)

THREAD VERSION

Coarse (UNC)

ANCHOR MATERIALS

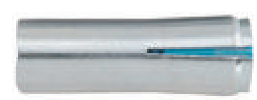
- Zinc Plated Carbon Steel

ROD/ANCHOR SIZE RANGE (TYP.)

- 1/4", 3/8" and 1/2" diameter (UNC)

SUITABLE BASE MATERIALS

- Normal-Weight Concrete



SMART DI DROP-IN

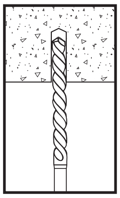
Anchor prior to installation

When properly set with Smart DI tool (system installation tool), anchor indicator will leave blue paint in recessed cavities. Note: Blue does not have to be removed from all four top surfaces to be fully set.

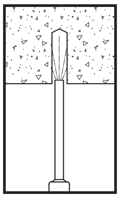
- Easier to Set
- More Expansion
- Expansion Indicator with a Smart DI System

INSTALLATION SPECIFICATIONS

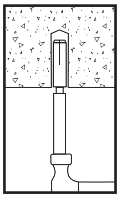
Manual Installation



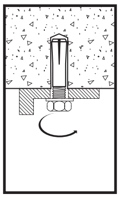
1. Drill a hole into the base material to the depth of embedment required. The tolerances of the drill bit used must meet the requirements of ANSI Standard B212.15. Use any ANSI Standard carbide drill bit.



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. Insert the anchor into the hole and, if necessary tap flush with surface.

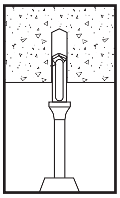


3. Using a DEWALT manual setting tool specifically, set the anchor by driving the tool with a sufficient number of hammer blows until the shoulder of the tool is seated against the anchor. Anchor will not hold allowable loads required if shoulder of DEWALT manual setting tool does not seat against anchor. Proper manual installation may not remove blue indicator paint.

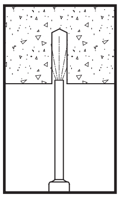


4. If using a fixture, position it, insert bolt and tighten so as not to exceed the maximum tightening torque. Most overhead applications utilize threaded rod. Minimum thread engagement should be at least one anchor diameter.

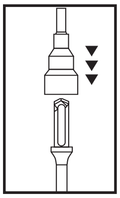
Smart DI System Installation



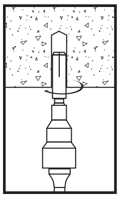
1. Drill a hole into the base material to the depth of embedment required using the appropriate DEWALT DI Stop Drill Bit. The tolerances of the drill bit used must meet the requirements of ANSI Standard B212.15. Standard installation with a DI Stop Drill Bit may result in the anchor being slightly subset from the surface. Minimum published embedment depths must be achieved by using the shoulder of the DI Stop Drill Bit as a guide.



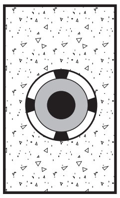
2. Remove dust and debris from the hole during drilling (e.g. dust extractor, hollow bit) or following drilling (e.g. suction, forced air) to extract loose particles created by drilling. Insert the anchor into the hole and, if necessary, tap flush with the surface.



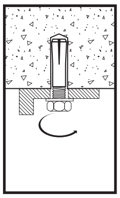
3. Slide the appropriate DEWALT DI Setting Tool over the DI Stop Drill Bit used to drill the hole and twist counterclockwise to lock the setting tool onto the bit. If tool does not fit snug onto bit it may be necessary to replace the internal rubber spring plug in the tool (see ordering information). Replacement kit sold separately.



4. Once attached, insert the tip of the setting tool into the Smart DI anchor and drive the internal plug fully using the rotation with hammer mode of the SDS+ drill (see table below for suggested tools).



5. For proper installation, the shoulder of the setting tool must come briefly in full contact with the Smart DI resulting in the blue indicator paint being removed from the raised top of the anchor. The paint will remain in the recessed portion of the top indicating full expansion.



6. If using a fixture, position it, insert the bolt and tighten so as not to exceed the maximum tightening torque. Most overhead applications utilize threaded rod. Minimum thread engagement should be at least one anchor diameter.

Recommended SDS+ Rotary Hammer Drill Specification for Smart DI Anchor (Drop-In) with Smart DI System Installation

Diameter	Concrete Compressive Strength (psi)	Rated Tool Impact Energy Suggested Range* (ft-lbs)	Recommended Rotary Hammer Tool Part Number
1/4"	2,500	1.3 - 2.6	DCH133M2, D25323K
	6,500	2.0 - 3.5	
3/8"	2,500	1.3 - 4.0	DCH293R2, D25263K
	6,500	2.1 - 4.0	
1/2"	2,500	2.0 - 4.0	DCH293R2, D25413K
	6,500	2.5 - 4.0	

* Local concrete conditions and rotary hammer impact efficiency vary greatly. Please verify that the tool impact energy is sufficient to fully set the internal plug of the Smart DI prior to using the system.

PERFORMANCE DATA

Ultimate and Allowable Load Capacities for Smart DI Anchor (Drop-In) in Normal-Weight Concrete[1,2,3,4,5]

Nom. Anchor Dia. d in.	Min. Embed. Depth in. (mm)	Minimum Concrete Compressive Strength - f'c (psi)															
		2,500				3,000				4,000				6,000			
		Tension		Shear		Tension		Shear		Tension		Shear		Tension		Shear	
		Ultimate lbs. (kN)	Allowable lbs. (kN)	Ultimate lbs. (kN)	Allowable lbs. (kN)	Ultimate lbs. (kN)	Allowable lbs. (kN)	Ultimate lbs. (kN)	Allowable lbs. (kN)	Ultimate lbs. (kN)	Allowable lbs. (kN)	Ultimate lbs. (kN)	Allowable lbs. (kN)	Ultimate lbs. (kN)	Allowable lbs. (kN)	Ultimate lbs. (kN)	Allowable lbs. (kN)
1/4	1 (25)	1,300 (5.8)	325 (1.4)	2,495 (11.1)	625 (2.8)	1,390 (6.2)	350 (1.6)	2,510 (11.2)	630 (2.8)	1,565 (7.0)	390 (1.7)	2,550 (11.3)	640 (2.8)	1,910 (8.5)	480 (2.1)	2,620 (11.7)	655 (2.9)
3/8	1-9/16 (40)	1,985 (8.6)	495 (2.2)	4,160 (18.5)	1,040 (4.6)	2,275 (10.1)	570 (2.5)	4,360 (19.4)	1,090 (4.6)	2,850 (12.7)	715 (3.2)	4,755 (21.2)	1,190 (5.3)	4,000 (17.5)	1,000 (4.4)	5,550 (24.7)	1,390 (5.2)
1/2	2 (51)	3,630 (16.1)	910 (4.0)	7,170 (31.9)	1,795 (8.0)	3,185 (14.2)	795 (3.5)	7,280 (32.4)	1,820 (8.1)	4,190 (18.6)	1,050 (4.7)	7,505 (33.4)	1,875 (8.3)	4,935 (22.0)	1,235 (8.3)	7,955 (35.4)	1,990 (8.9)

1. Tabulated load values are for anchors installed in concrete. Concrete compressive strength must be at the specified minimum at the time of installation.
2. Ultimate load capacities must be reduced by a minimum safety factor of 4.0 or greater to determine allowable working load.
3. Allowable load capacities listed are calculated using and applied safety factor of 4.0.
4. Linear interpolation may be used to determine allowable loads for intermediate compressive strengths.
5. Allowable load capacities are multiplied by reduction factors found in the Design Criteria section when anchor spacing or edge distances are less than critical distances.

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[1]

NOTE: 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.

LOAD ADJUSTMENT FACTORS FOR NORMAL-WEIGHT CONCRETE

Spacing Distance Adjustment Factors - Tension (F_{NS})

	Dia. (in)	1/4"	3/8"	1/2"
	h_v	1	1-9/16	2
	s_{cr}	3	4-1/2	6
	s_{min}	1-1/2	2-3/8	3
Spacing Distance (inches)	1/2	-	-	-
	1	-	-	-
	1-1/2	0.90	-	-
	2	0.94	-	-
	2-1/2	0.97	0.84	-
	3	1.00	0.87	0.85
	3-1/2	1.00	0.91	0.88
	4	1.00	0.95	0.90
	4-1/2	1.00	1.00	0.93
	5	1.00	1.00	0.95
	5-1/2	1.00	1.00	0.98
	6	1.00	1.00	1.00

Spacing Distance Adjustment Factors - Shear (F_{VS})

	Dia. (in)	1/4"	3/8"	1/2"
	h_v	1	1-9/16	2
	s_{cr}	3	5	6
	s_{min}	1-1/2	2-3/8	3
Spacing Distance (inches)	1/2	-	-	-
	1	-	-	-
	1-1/2	0.62	-	-
	2	0.75	-	-
	2-1/2	0.88	0.65	-
	3	1.00	0.73	0.62
	3-1/2	1.00	0.81	0.69
	4	1.00	0.89	0.75
	4-1/2	1.00	0.97	0.81
	5	1.00	1.00	0.88
	5-1/2	1.00	1.00	0.94
	6	1.00	1.00	1.00

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

	Dia. (in)	1/4"	3/8"	1/2"
	h_v	1	1-9/16	2
	c_{cr}	2	4-11/16	6
	c_{min}	2	3-1/8	4
Edge Distance (inches)	1/2	-	-	-
	1	-	-	-
	1-1/2	-	-	-
	2	1.00	-	-
	2-1/2	1.00	-	-
	3	1.00	-	-
	3-1/2	1.00	0.98	-
	4	1.00	0.99	0.93
	4-1/2	1.00	1.00	0.95
	5	1.00	1.00	0.97
	5-1/2	1.00	1.00	0.98
	6	1.00	1.00	1.00

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

	Dia. (in)	1/4"	3/8"	1/2"
	h_v	1	1-9/16	2
	c_{cr}	3	4-11/16	6
	c_{min}	2	3-1/8	4
Edge Distance (inches)	1/2	-	-	-
	1	-	-	-
	1-1/2	-	-	-
	2	0.87	-	-
	2-1/2	0.94	-	-
	3	1.00	-	-
	3-1/2	1.00	0.96	-
	4	1.00	0.98	0.91
	4-1/2	1.00	1.00	0.93
	5	1.00	1.00	0.95
	5-1/2	1.00	1.00	0.98
	6	1.00	1.00	1.00

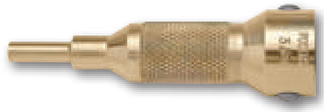
ORDERING INFORMATION

Smart DI Anchor (Drop-In) Carbon Steel Smooth Wall Dropin

Cat. No.	Rod/Anchor Size	Overall Length	Thread Depth	Std. Box	Std. Box	Wt./100	FM or UL
6304SD	1/4"	1"	7/16"	100	1,000	2	-
6306SD	3/8"	1-9/16"	5/8"	50	500	6	FM/UL
6308SD	1/2"	2"	13/16"	50	500	12	FM/UL

DI System Setting Tool

Cat. No.	00425SD	00427SD	00429SD
Rod/Anchor Size	1/4"	3/8"	1/2"
Pin Length	39/64"	61/64"	1-3/16"

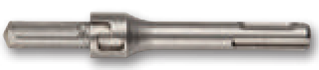


DI Tool Replacement Parts

Cat. No.	00426SD	00428SD	00430SD
Kit Contents	2 Guide Screws 1 Rubber Spring Plug	2 Guide Screws 1 Rubber Spring Plug	2 Guide Screws 1 Rubber Spring Plug
Fits Tool No.	00425SD	00427SD	00429SD

DI Stop Drill Bit

Cat. No.	00391SD	00397SD	00410SD
Description	Smart Bit for 1/4"	Smart Bit for 3/8"	Smart Bit for 1/2"
Bit Diameter	3/8"	1/2"	5/8"



Manual Setting Tools for Smart DI Anchor (Drop-In)

Cat. No.	6305	6307	6309
Rod/Anchor Size	1/4"	3/8"	1/2"
Pin Length	39/64"	61/64"	1-3/16"

Recommended Rotary Hammer Drills

Cat. No.	Description
DCH133M2	1" D-Handle SDS+ Brushless Rotary Hammer 20V Max
DCH293R2	1-1/8" SDS+ Brushless Rotary Hammer 3.5J w/ 6Ah Battery 20V Max
D25263K	1-1/8" SDS+ Rotary Hammer
D25323K	1" L-Shape SDS Rotary Hammer
D25413K	1-1/8" SDS Plus Rotary Hammer Kit





MECHANICAL ANCHORS

SMART DI™
Internally Threaded Expansion Anchor

GENERAL INFORMATION

STEEL DROPIN™

Internally Threaded Expansion Anchor

PRODUCT DESCRIPTION

The Steel Dropin is an all-steel, machine bolt anchor available in carbon steel and two types of stainless steel. It can be used in solid concrete, hard stone, and solid block base materials. A coil thread version for forming applications is also available.

GENERAL APPLICATIONS AND USES

- Suspending Conduit
- Fire Sprinkler
- Cable Trays and Strut
- Concrete Formwork
- Pipe Supports
- Suspended Lighting

FEATURES AND BENEFITS

+ Internally threaded anchor for easy bolt removability and service work
+ Flanged (lipped) version installs flush for easy inspection and standard embedment
+ Smooth wall dropin can be installed flush mounted or below the base material surface
+ Optionally available with a knurled body
+ Coil thread version accepts coil rod and typically used for concrete formwork applications

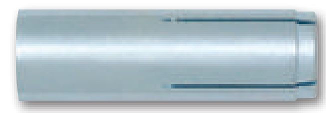
TESTING, APPROVALS AND LISTINGS

- Tested in accordance with ASTM 488 and AC01 criteria
- Underwriters Laboratory (UL Listed) – File No. EX1289 (N) (see ordering information)
- FM Approvals (Factory Mutual) – File No. 3059197

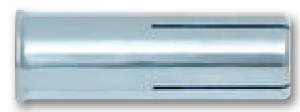
GUIDE SPECIFICATIONS

CSI Divisions: 03 16 00 - Concrete Anchors and 05 05 19 - Post-Installed Concrete Anchors. Dropin anchors shall be Steel Dropin as supplied by DEWALT, Towson, MD.

SECTION CONTENTS



SMOOTH WALL DROPIN



FLANGE (LIPPED) DROPIN

THREAD VERSION

- UNC Coarse Thread
- Coil Thread

ANCHOR MATERIALS

- Zinc Plated Carbon Steel
- 303 Stainless Steel (Domestic)
- 304 Stainless Steel
- 316 Stainless Steel

ROD/ANCHOR SIZE RANGE (TYP.)

- 1/4" to 3/4" diameter UNC Coarse Thread
- 1/2" and 3/4" diameter Coil Thread

SUITABLE BASE MATERIALS

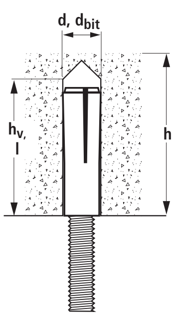
- Normal-weight Concrete
- Lightweight Concrete

MATERIAL SPECIFICATIONS

Anchor Component	Carbon Steel	Type 303 Stainless Steel	Type 316 Stainless Steel
Anchor Body	AISI 1008	Type 303/304 Stainless Steel	Type 316 Stainless Steel
Plug	AISI 1018	Type 303/304 Stainless Steel	Type 316 Stainless Steel
Zinc Plating	ASTM B633, SC1, Type III (Fe/Zn 5)	N/A	
Stainless steel anchor components are passivated.			

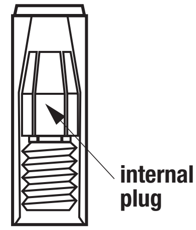
INSTALLATION SPECIFICATIONS

Anchor (Rod) Size	Rod/Anchor Diameter, d						
	1/4"	3/8"	1/2"	1/2" Coil Thread	5/8"	3/4"	3/4" Coil Thread
ANSI Drill Bit Size, d_{bit} (in.)	3/8	1/2	5/8	5/8	7/8	1	1
Maximum Tightening Torque, T_{max} (ft.-lbs.)	5	10	20	20	40	80	80
Thread Size (UNC)	1/4-20	3/8-16	1/2-13	1/2-6	5/8-11	3/4-10	3/4-41/2
Thread Depth (in.)	7/16	5/8	13/16	13/16	1-3/16	1-3/8	1-3/8
Flange Size (in.)	7/16	9/16	45/64	–	–	–	–
Anchor Length l, h_v (in.)	1	1-9/16	2	2	2-1/2	3-3/16	3-3/16



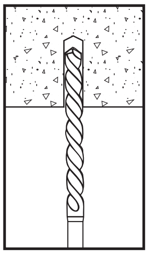
Nomenclature

d = Diameter of anchor
d_{bit} = Diameter of drill bit
h = Base material thickness. The minimum value of h should be $1.5h_v$ or 3" min. (whichever is greater)
h_v = Minimum embedment depth
l = Overall length of anchor
T_{max} = Maximum tightening torque

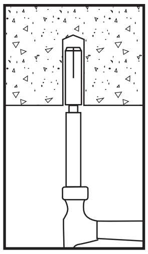


Installation Procedure

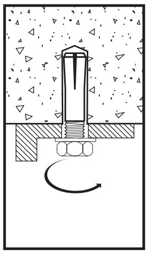
Drill a hole into the base material to the depth of embedment required. The tolerances of the drill bit used must meet the requirements of ANSI Standard B212.15. Do not over drill the hole unless the application calls for a subset anchor.



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. Insert the anchor into the hole and tap flush with surface. Using a DEWALT setting tool specifically, set the anchor by driving the tool with a sufficient number of hammer blows until the shoulder of the tool is seated against the anchor. Anchor will not hold allowable loads required if shoulder of DEWALT setting tool does not seat against anchor.



If using a fixture, position it, insert bolt and tighten. Most overhead applications utilize threaded rod. Minimum thread engagement should be at least one anchor diameter.



PERFORMANCE DATA

Ultimate and Allowable Load Capacities for Steel Dropin in Normal-Weight Concrete[1,2,3]

Rod/Anchor Diameter d in. (mm)	Minimum Embedment Depth in. (mm)	Tension						Shear	
		2,000 psi (13.8 MPa)		4,000 psi (27.6 MPa)		6,000 psi (41.4 MPa)		f'c ≥ 2000 psi (20.7 MPa)	
		Ultimate lbs. (kN)	Allowable lbs. (kN)	Ultimate lbs. (kN)	Allowable lbs. (kN)	Ultimate lbs. (kN)	Allowable lbs. (kN)	Ultimate lbs. (kN)	Allowable lbs. (kN)
1/4 (6.4)	1 (25.4)	1,140 (5.1)	285 (1.3)	1,985 (8.9)	495 (2.2)	2,080 (9.4)	520 (2.3)	2,120 (9.5)	530 (2.4)
3/8 (9.5)	1-9/16 (39.7)	2,180 (9.8)	545 (2.5)	4,180 (18.8)	1,045 (4.7)	4,950 (22.3)	1,240 (5.6)	4,585 (20.6)	1,145 (5.2)
1/2 (12.7)	2 (50.8)	4,105 (18.5)	1,025 (4.6)	5,760 (25.9)	1,440 (6.5)	6,585 (29.6)	1,645 (7.4)	6,400 (28.8)	1,600 (7.2)
5/8 (15.9)	2-1/2 (63.5)	4,665 (21.0)	1,165 (5.2)	7,440 (33.5)	1,860 (8.4)	10,920 (49.1)	2,730 (12.3)	12,380 (55.7)	3,095 (13.9)
3/4 (19.1)	3-3/16 (81.0)	8,580 (38.6)	2,145 (9.7)	9,405 (41.8)	2,350 (10.5)	11,300 (50.3)	2,825 (12.6)	15,680 (70.6)	3,920 (17.6)

1. Tabulated load values are applicable to carbon and stainless steel anchors.
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. Ultimate load capacities must be reduced by a minimum safety factor of 4.0 or greater to determine allowable working load.

Ultimate and Allowable Load Capacities for Steel Dropin in Lightweight Concrete[1,2,3,4]

Rod/Anchor Diameter d in. (mm)	Minimum Embedment Depth in. (mm)	Tension						Shear	
		2,000 psi (13.8 MPa)		4,000 psi (27.6 MPa)		6,000 psi (41.4 MPa)		f'c ≥ 2000 psi (20.7 MPa)	
		Ultimate lbs. (kN)	Allowable lbs. (kN)	Ultimate lbs. (kN)	Allowable lbs. (kN)	Ultimate lbs. (kN)	Allowable lbs. (kN)	Ultimate lbs. (kN)	Allowable lbs. (kN)
1/4 (6.4)	1 (25.4)	1,060 (4.8)	265 (1.2)	1,360 (6.1)	340 (1.5)	1,660 (7.5)	415 (1.9)	1,920 (8.6)	480 (2.2)
3/8 (9.5)	1-9/16 (39.7)	3,040 (13.7)	760 (3.4)	3,780 (17.0)	945 (4.3)	4,520 (20.3)	1,130 (5.1)	4,120 (18.5)	1,030 (4.6)
1/2 (12.7)	2 (50.8)	4,240 (19.1)	1,060 (4.8)	4,840 (21.8)	1,210 (5.4)	5,460 (24.6)	1,365 (6.1)	5,680 (25.6)	1,420 (6.4)
5/8 (15.9)	2-1/2 (63.5)	6,860 (30.9)	1,715 (7.7)	7,840 (35.3)	1,960 (8.8)	8,840 (39.8)	2,210 (9.9)	9,640 (43.4)	2,410 (10.8)
3/4 (19.1)	3-3/16 (81.0)	10,280 (45.7)	2,570 (11.4)	11,700 (52.7)	2,925 (13.0)	13,120 (59.0)	3,280 (14.6)	15,680 (70.6)	3,920 (17.9)

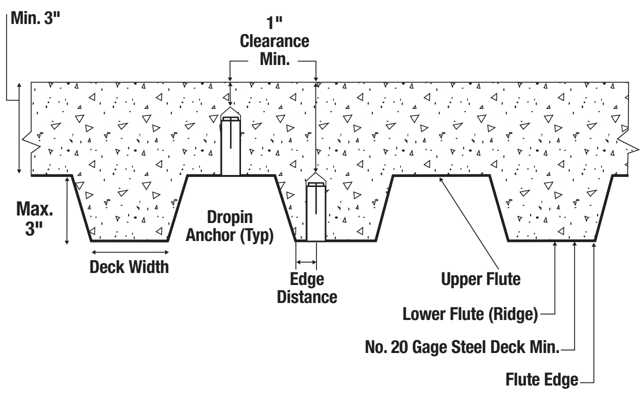
1. Tabulated load values are applicable to carbon and stainless steel anchors.
2. Tabulated load values are for anchors installed in concrete. Concrete compressive strength must be at the specified minimum at the time of installation.
3. Ultimate load capacities must be reduced by a minimum safety factor of 4.0 or greater to determine allowable working load.
4. Allowable load capacities are multiplied by reduction factors found in the Design Criteria section when anchor spacing or edge distances are less than critical distances.

Allowable Load Capacities for Steel Dropin in Lightweight Concrete over Steel Deck[1,2,3,4]

Rod/Anchor Diameter d in. (mm)	Minimum Embedment Depth h_v in. (mm)	Lightweight Concrete over Steel Deck, f´c ≥ 3,000 (20.7 MPa)							
		Minimum 1-1/2" Wide Deck				Minimum 4-1/2" Wide Deck			
		Ultimate Load		Allowable Load		Ultimate Load		Allowable Load	
		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)	1 (25.4)	400 (1.8)	2,040 (9.2)	100 (0.4)	510 (2.3)	760 (3.4)	2,040 (9.2)	190 (0.8)	510 (2.3)
3/8 (9.5)	1-9/16 (39.7)	600 (2.7)	2,760 (12.3)	150 (0.7)	690 (3.1)	960 (4.3)	2,760 (12.3)	240 (1.1)	690 (3.1)
1/2 (12.7)	2 (50.8)	-	-	-	-	2,740 (12.3)	5,560 (25.0)	685 (3.1)	1,390 (6.3)

1. Tabulated load values are for carbon steel and stainless steel anchors installed in sand-lightweight concrete over steel deck. Concrete compressive strength must be at the specified minimum at the time of installation.
2. Allowable load capacities listed are calculated using and applied safety factor of 4.0.
3. Tabulated load values are for anchors installed in the center of the flute. Spacing distances shall be in accordance with the spacing table for lightweight concrete listed in the Design Criteria.
4. Flute edge distance equals one-half the minimum deck width.
5. Anchors are permitted to be installed in the lower or upper flute of the metal deck provided the proper installation procedures are maintained.

SAND-LIGHTWEIGHT CONCRETE OR NORMAL WEIGHT CONCRETE
OVER STEEL DECK (MINIMUM 3,000 PSI)



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[1]

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	$s_{cr} = 3.0h_v$	$F_{NS} = F_{VS} = 1.0$	$s_{min} = 1.5h_v$	$F_{NS} = F_{VS} = 0.50$
Edge Distance (c)	Tension	$c_{cr} = 14d$	$F_{NC} = 1.0$	$c_{min} = 7d$	$F_{NC} = 0.90$
	Shear	$c_{cr} = 14d$	$F_{VC} = 1.0$	$c_{min} = 7d$	$F_{VC} = 0.50$

Anchor Installed in 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	$s_{cr} = 3.0h_v$	$F_{NS} = F_{VS} = 1.0$	$s_{min} = 1.5h_v$	$F_{NS} = F_{VS} = 0.50$
Edge Distance (c)	Tension	$c_{cr} = 14d$	$F_{NC} = 1.0$	$c_{min} = 7d$	$F_{NC} = 0.80$
	Shear	$c_{cr} = 14d$	$F_{VC} = 1.0$	$c_{min} = 7d$	$F_{VC} = 0.50$

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.

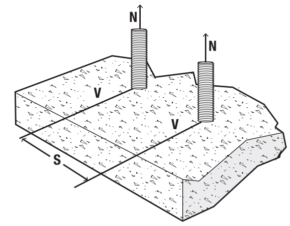
LOAD ADJUSTMENT FACTORS FOR NORMAL-WEIGHT AND LIGHTWEIGHT CONCRETE

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

	Dia. (in.)	1/4	3/8	1/2	5/8	3/4
	h_v (in.)	1	1-1/2	2	2-1/2	3
	s_{cr} (in.)	3	4-1/2	6	7-1/2	9
	s_{min} (in.)	1-1/2	2-1/4	3	3-3/4	4-1/2
Spacing Distance (inches)	1-1/2	0.50	-	-	-	-
	2-1/4	0.75	0.50	-	-	-
	3	1.00	0.67	0.50	-	-
	3-3/4	1.00	0.83	0.63	0.50	-
	4	1.00	0.89	0.67	0.53	-
	4-1/2	1.00	1.00	0.75	0.60	0.50
	5	1.00	1.00	0.83	0.67	0.56
	6	1.00	1.00	1.00	0.80	0.67
	7-1/2	1.00	1.00	1.00	1.00	0.83
	9	1.00	1.00	1.00	1.00	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 depths ($1.5h_v$) at which the anchor achieves 50% of load.

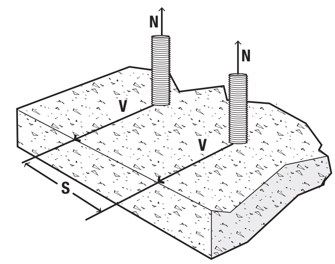


Edge Distance, Tension (F_{NC}) (Normal-Weight concrete only)

	Dia. (in.)	1/4	3/8	1/2	5/8	3/4
	c_{cr} (in.)	3-1/2	5-1/4	7	8-3/4	10-1/2
	c_{min} (in.)	1-3/4	2-5/8	3-1/2	4-3/8	5-1/4
Edge Distance, c (inches)	1-3/4	0.90	-	-	-	-
	2	0.91	-	-	-	-
	2-5/8	0.95	0.90	-	-	-
	3	0.97	0.91	-	-	-
	3-1/2	1.00	0.93	0.90	-	-
	4-3/8	1.00	0.97	0.93	0.90	-
	5-1/4	1.00	1.00	0.95	0.92	0.90
	6	1.00	1.00	0.97	0.94	0.91
	7	1.00	1.00	1.00	0.96	0.93
	8	1.00	1.00	1.00	0.98	0.95
	8-3/4	1.00	1.00	1.00	1.00	0.97
	10-1/2	1.00	1.00	1.00	1.00	1.00

Notes: For anchors loaded in tension, the critical edge (c_{cr}) is equal to 14 anchors 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 90% of load for normal-weight concrete and 80% of load for light-weight concrete.



Edge Distance, Tension (F_{NC}) (Lightweight concrete only)

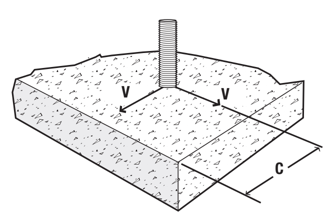
	Dia. (in.)	1/4	3/8	1/2	5/8	3/4
	c_{cr} (in.)	3-1/2	5-1/4	7	8-3/4	10-1/2
	c_{min} (in.)	1-3/4	2-5/8	3-1/2	4-3/8	5-1/4
Edge Distance, c (inches)	1-3/4	0.80	-	-	-	-
	2	0.83	-	-	-	-
	2-5/8	0.90	0.80	-	-	-
	3	0.94	0.83	-	-	-
	3-1/2	1.00	0.87	0.80	-	-
	4-3/8	1.00	0.93	0.85	0.80	-
	5-1/4	1.00	1.00	0.90	0.84	0.80
	6	1.00	1.00	0.94	0.87	0.83
	7	1.00	1.00	1.00	0.92	0.87
	8	1.00	1.00	1.00	0.97	0.90
	8-3/4	1.00	1.00	1.00	1.00	0.93
	10-1/2	1.00	1.00	1.00	1.00	1.00

Edge Distance, Shear (F_{VC})

	Dia. (in.)	1/4	3/8	1/2	5/8	3/4
	c_{cr} (in.)	3-1/2	5-1/4	7	8-3/4	10-1/2
	c_{min} (in.)	1-3/4	2-5/8	3-1/2	4-3/8	5-1/4
Edge Distance, c (inches)	1-3/4	0.50	-	-	-	-
	2	0.57	-	-	-	-
	2-5/8	0.75	0.50	-	-	-
	3	0.86	0.57	-	-	-
	3-1/2	1.00	0.67	0.50	-	-
	4-3/8	1.00	0.83	0.63	0.50	-
	5	1.00	0.95	0.71	0.57	-
	5-1/4	1.00	1.00	0.75	0.60	0.50
	6	1.00	1.00	0.86	0.69	0.57
	7	1.00	1.00	1.00	0.80	0.67
	8	1.00	1.00	1.00	0.91	0.76
	8-3/4	1.00	1.00	1.00	1.00	0.83
	10	1.00	1.00	1.00	1.00	0.95
	10-1/2	1.00	1.00	1.00	1.00	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.

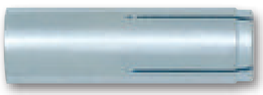
Minimum edge distance (c_{min}) is equal to 7 anchor diameters (7d) at which the anchor achieves 50% of load.



ORDERING INFORMATION

Carbon Steel Smooth Wall Dropin

Cat. No.	Domestic Cat. No.	Rod/Anchor Size	Overall Length	Thread Depth	Std. Box	Std. Carton	Wt./100
6304	6304USA	1/4"	1"	7/16"	100	1000	2
6306	6306USA	3/8"	1-9/16"	5/8"	50	500	6
6308	6308USA	1/2"	2"	13/16"	50	250	12
6320	6320USA	5/8"	2-1/2"	1-3/16"	25	125	32
6312	6312USA	3/4"	3-13/16"	1-3/8"	10	50	48

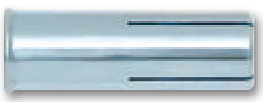


Carbon Steel Knurled Wall Dropin

Cat. No.	Rod/Anchor Size	Overall Length	Thread Depth	Std. Box	Std. Carton	Wt./100
6340	1/4"	1"	7/16"	100	1,000	2
6342	3/8"	1-9/16"	5/8"	50	500	6
6344	1/2"	2"	13/16"	50	250	12

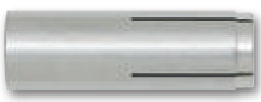
Carbon Steel Flanged Dropin (Lipped)

Cat. No.	Rod/Anchor Size	Overall Length	Thread Depth	Std. Box	Std. Carton	Wt./100
6324	1/4"	1"	7/16"	100	1,000	2
6326	3/8"	1-9/16"	5/8"	50	500	6
6328	1/2"	2"	13/16"	50	300	12



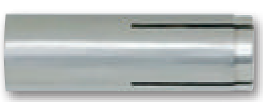
Type 300 Series Stainless Steel Dropin

Cat. No. (Type 304)	Domestic Cat. No. (Type 303)	Rod/Anchor Size	Overall Length	Thread Depth	Std. Box	Std. Carton	Wt./100
6204	6204USA	1/4"	1"	7/16"	100	1000	2
6206	6206USA	3/8"	1-9/16"	5/8"	50	500	6
6208	6208USA	1/2"	2"	13/16"	50	250	12
6210	6210USA	5/8"	2-1/2"	1-3/16"	25	125	32
6212	6212USA	3/4"	3-13/16"	1-3/8"	10	50	48



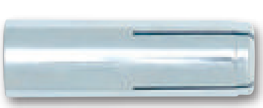
Type 316 Stainless Steel Dropin

Cat. No.	Domestic Cat. No.	Rod/Anchor Size	Overall Length	Thread Depth	Std. Box	Std. Carton	Wt./100
6224	6224USA	1/4"	1"	7/16"	100	1000	2
6226	6226USA	3/8"	1-9/16"	5/8"	50	500	6
6228	6228USA	1/2"	2"	13/16"	50	250	12
6230	6230USA	5/8"	2-1/2"	1-3/16"	25	125	32
6232	6232USA	3/4"	3-13/16"	1-3/8"	10	50	48



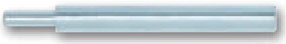
Carbon Steel Coil Thread Dropin

Cat. No.	Rod/Anchor Size	Overall Length	Thread Depth	Std. Box	Std. Carton	Wt./100
6330	1/2"	2"	13/16"	50	300	12
6332	3/4"	3-3/16"	1-3/8"	10	50	48



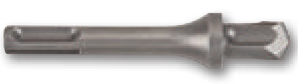
Setting Tools for Steel Dropin

Cat. No.	6305	6307	6309	6311	6313
Rod/Anchor Size	1/4"	3/8"	1/2"	5/8"	3/4"
Pin Length	39/64"	61/64"	1-3/16"	1-5/16"	1-61/64"



Accu-Bit™ Drill Stop for Steel Dropin

Cat. No.	Rod/Anchor Size	Drill Depth	Std. Box
DWA5493	1/2" Accu-Bit for 3/8" Steel Dropin	1-13/16"	1
DWA5495	5/8" Accu-Bit for 1/2" Steel Dropin	2-3/8"	1



GENERAL INFORMATION

MINI DROPIN™

Internally Threaded Expansion Anchor

PRODUCT DESCRIPTION

The Mini Dropin is a carbon steel machine bolt anchor for use in shallow embedment applications. In addition to solid concrete and precast hollow core plank, it can be used in post-tensioned concrete slabs and concrete pours over steel deck.

GENERAL APPLICATIONS AND USES

- Suspending Conduit
- Fire Sprinkler
- Cable Trays and Strut
- Utilities
- Pipe Supports
- Suspended Lighting

FEATURES AND BENEFITS

+ Internally threaded anchor for easy bolt removability and service work
+ Ideal for precast hollow core plank and post-tensioned concrete slabs
+ Lip provides flush installation and consistent embedment
+ Manual setting tool scores flange when set to verify proper expansion depth

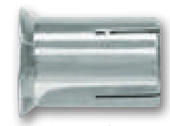
APPROVALS AND LISTINGS

- Tested in accordance with ASTM E 488 and AC01 criteria
- Factory Mutual Research Corporation (FM Approvals) – File No. 3059197
  See listing for applicable sizes - www.fmglobal.com

GUIDE SPECIFICATIONS

CSI Divisions: 03 16 00 - Concrete Anchors and 05 05 19 - Post-Installed Concrete Anchors. Anchors shall be Mini Dropin anchors as supplied by DEWALT, Towson, MD.

SECTION CONTENTS



MINI DROPIN

THREAD VERSION

- UNC Thread

ANCHOR MATERIALS

- Zinc Plated Carbon Steel

ROD/ANCHOR SIZE RANGE (TYP.)

- 1/4" diameter to 1/2" diameter

SUITABLE BASE MATERIALS

- Normal-weight Concrete
- Lightweight Concrete
- Precast Hollow Core Plank
- Concrete Over Steel Deck

MATERIAL AND INSTALLATION SPECIFICATIONS

Material Specification

Anchor Component	Carbon Steel
Anchor Body	SAE 1009
Plug	SAE 1009
Zinc Plating	ASTM B633, SC1, Type III (Fe/Zn 5)

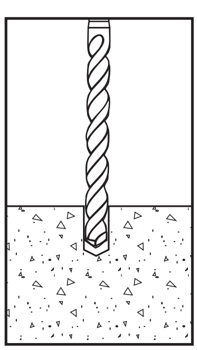
Installation Specification

Dimension	Rod/Anchor Diameter, d		
	1/4"	3/8"	1/2"
ANSI Drill Bit Size d_{bit} (in.)	3/8	1/2	5/8
Maximum Tightening Torque, T_{max}, (ft-lbs)	3	5	10
Thread Size (UNC)	1/4-20	3/8-16	1/2-13
Thread Depth (in.)	3/8	13/32	5/8
Overall Anchor Length (in.)	5/8	3/4	1

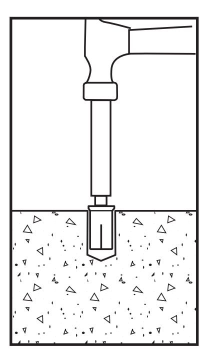
INSTALLATION PROCEDURES

Drill a hole into the base material to the depth of embedment required. The tolerances of the drill bit used must meet the requirements of ANSI Standard B212.15.

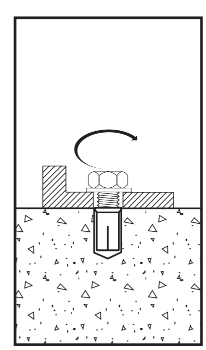
In post-tensioned concrete slabs, take care to avoid drilling into the post-tensioned cables.



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. Insert the anchor into the hole and tap flush with surface. Using a DEWALT setting tool specifically, set the anchor by driving the tool with a sufficient number of hammer blows until the shoulder of the tool is seated against the anchor. Anchor will not hold allowable loads required if shoulder of DEWALT setting tool does not seat against anchor.



If using a fixture, position it, insert bolt and tighten. Most overhead applications utilize threaded rod. Minimum thread engagement should be at least one anchor diameter.



PERFORMANCE DATA

Ultimate Load Capacities for Mini Dropin in Normal-Weight Concrete[1,2]

Rod/Anchor Size 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)		6,000 psi (41.4 MPa)	
		Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
1/4 (6.4)	5/8 (15.9)	1,100 (6.3)	1,260 (5.7)	1,150 (5.1)	1,650 (7.4)	1,200 (5.3)	1,650 (7.4)
3/8 (9.5)	3/4 (19.1)	1,980 (8.9)	2,700 (12.2)	2,120 (9.5)	4,220 (19.0)	2,270 (10.2	4,220 (19.0)
1/2 (12.7)	1 (25.4)	3,360 (15.1)	4,400 (19.8)	3,360 (15.1)	4,875 (21.9)	3,750 (16.9)	4,875 (21.9)

1. Tabulated load values are for anchors installed in concrete. Concrete compressive strength must be at the specified minimum at the time of installation.
2. Ultimate load capacities must be reduced by a minimum safety factor of 4.0 or greater to determine allowable working load.

ALLOWABLE STRESS DESIGN ASD

Allowable Load Capacities for Mini Dropin in Normal-Weight Concrete[1,2]

Rod/Anchor Size 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)		6,000 psi (41.4 MPa)	
		Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
1/4 (6.4)	5/8 (15.9)	275 (1.2)	315 (1.4)	285 (1.3)	415 (1.9)	300 (1.3)	415 (1.9)
3/8 (9.5)	3/4 (19.1)	495 (2.2)	675 (3.0)	530 (2.4)	1,055 (4.7)	570 (2.6)	1,055 (4.7)
1/2 (12.7)	1 (25.4)	840 (3.8)	1,100 (5.0)	840 (3.8)	1,220 (5.5)	940 (4.2)	1,220 (5.5)

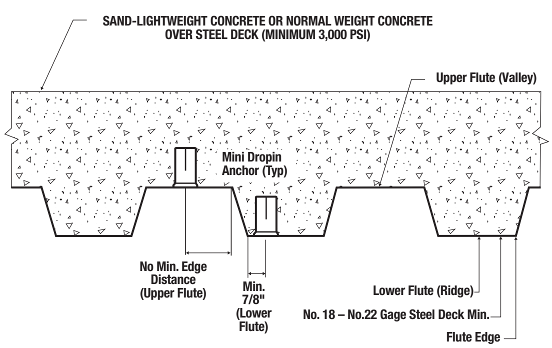
1. Allowable load capacities listed are calculated using and applied safety factor of 4.0.
2. Linear interpolation may be used to determine allowable loads for intermediate compressive strengths.

ALLOWABLE STRESS DESIGN ASD

Ultimate and Allowable Load Capacities for Mini Dropin Installed Through Steel Deck into Lightweight Concrete[1,2,3]

Rod/Anchor Size d in. (mm)	Minimum Embed. Depth h_v in. (mm)	Lightweight Concrete Over Min. 20 Ga. Steel Deck. f´c ≥ 3,000 psi (20.7 MPa)			
		Minimum 1-3/4" Wide Deck			
		Ultimate Load		Allowable Load	
		Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
1/4 (6.4)	5/8 (15.9)	740 (3.3)	1,880 (8.5)	185 (0.8)	470 (2.1)
3/8 (9.5)	3/4 (19.1)	880 (4.0)	2,040 (9.2)	220 (1.0)	510 (2.3)
1/2 (12.7)	1 (25.4)	1,380 (6.2)	2,120 (9.5)	345 (1.6)	530 (2.4)

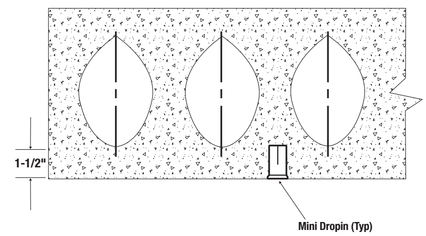
1. The metal deck shall be No. 22 gage to No. 18 gage thick steel [0.030-inch to 0.047-inch base metal thickness (0.75 mm to 1.20 mm)].
2. Allowable load capacities listed are calculated using and applied safety factor of 4.0.
3. Tabulated load values are for anchors installed with a minimum edge distance of 7/8" when installed through the lower flute. Anchors installed through the upper flute may be in any location provided the proper installation procedures are maintained.



Ultimate and Allowable Load Capacities for Mini Dropin in Precast Hollow Core Concrete Plank[1,2]

Rod/ Anchor Size d in. (mm)	Minimum Embed. Depth h_v in. (mm)	Minimum Spacing in. (mm)	Minimum Edge Distance in. (mm)	Min. Concrete Compressive Strength f´c ≥ 5,000 psi (34.5 MPa)			
				Ultimate Load		Allowable Load	
				Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
1/4 (6.4)	5/8 (15.9)	3 (76.2)	3 (76.2)	1,400 (6.2)	1,840 (8.3)	350 (1.6)	460 (2.1)
3/8 (9.5)	3/4 (19.1)	4-1/2 (114)	4-1/2 (114)	2,600 (11.7)	3,400 (15.3)	650 (2.9)	850 (3.8)
1/2 (12.7)	1 (25.4)	6 (152.4)	6 (152.4)	2,600 (11.7)	3,540 (15.9)	650 (2.9)	885 (4.0)

1. Tabulated load values are for anchors installed in concrete. Concrete compressive strength must be at the specified minimum at the time of installation.
2. Allowable load capacities listed are calculated using and applied safety factor of 4.0.



DESIGN CRITERIA (ALLOWABLE STRESS DESIGN)

Combined Loading

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

$$\left(\frac{Nu}{Nn}\right) + \left(\frac{Vu}{Vn}\right) \leq 1$$

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 DISTANCE[1,2,3]

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	$s_{cr} = 3.0h_v$	$F_{NC} = F_{VC} = 1.0$	$s_{min} = 1.5h_v$	$F_{NS} = F_{VS} = 0.50$
Edge Distance (c)	Tension	$c_{cr} = 12d$	$F_{NC} = F_{VC} = 1.0$	$c_{min} = 6d$	$F_{NC} = 0.90$
	Shear[1]	$c_{cr} = 12d$	$F_{NC} = F_{VC} = 1.0$	$c_{min} = 6d$	$F_{VC} = 0.75$

1. Allowable loads for anchors loaded in shear parallel to the edge have no load factor $F_{Vc} = 1.0$ when installed at minimum edge distances.
2. 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.

Anchor Installed in Through Steel Deck 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	$s_{cr} = 3.0h_v$	$F_{Ns} = F_{Vs} = 1.0$	$s_{min} = 1.5h_v$	$F_{NS} = F_{VS} = 0.50$

3. Allowable load values found in the performance data tables are multiplied by reduction factors when anchor spacing is less than critical distances. Linear interpolation is allowed for intermediate anchor spacing between critical and minimum distances. Multiple reduction factors for anchor spacing may be required depending on the anchor group configuration.

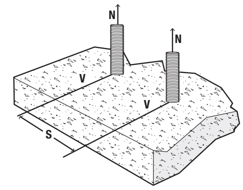
LOAD ADJUSTMENT FACTORS FOR NORMAL-WEIGHT AND LIGHTWEIGHT CONCRETE

Spacing, Tension (F_{NS}) & Shear (F_{VS}) (Normal-weight & Lightweight Concrete over deck)

Dia. (in.)		1/4	3/8	1/2
h_v (in.)		5/8	3/4	1
s_{cr} (in.)		1-7/8	2-1/4	3
s_{min} (in.)		1	1-1/8	1-1/2
Spacing, s (in.)	1	0.50	-	-
	1-1/8	0.60	0.50	-
	1-1/2	0.80	0.67	0.50
	1-7/8	1.00	0.83	0.63
	2	1.00	0.89	0.67
	2-1/4	1.00	1.00	0.75
	2-1/2	1.00	1.00	0.83
	3	1.00	1.00	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 depths ($1.5h_v$) at which the anchor achieves 50% of load.

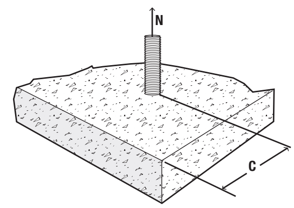


Edge Distance, Tension (F_{NC}) (Normal-weight concrete only)

Dia. (in.)		1/4	3/8	1/2
c_{cr} (in.)		3	4-1/2	6
c_{min} (in.)		1-1/2	2-1/4	3
Edge Distance, c (in.)	1-1/2	0.90	-	-
	2	0.93	-	-
	2-1/4	0.95	0.90	-
	2-1/2	0.97	0.91	-
	3	1.00	0.93	0.90
	4	1.00	0.98	0.93
	4-1/2	1.00	1.00	0.95
	5	1.00	1.00	0.97
	6	1.00	1.00	1.00

Notes: For anchors loaded in tension, the critical edge distance (c_{cr}) is equal to 12 anchor diameters (12d) at which the anchor achieves 100% of load.

Minimum edge distance (c_{min}) is equal to 6 anchor diameters (6d) at which the anchor achieves 90% of load.

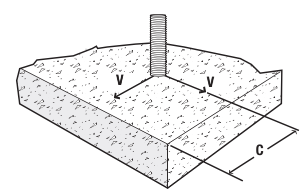


Edge Distance, Shear (F_{VC}) (Normal-weight concrete only)

Dia. (in.)		1/4	3/8	1/2
c_{cr} (in.)		3	4-1/2	6
c_{min} (in.)		1-1/2	2-1/4	3
Edge Distance, c (in.)	1-1/2	0.75	-	-
	2	0.83	-	-
	2-1/4	0.88	0.75	-
	2-1/2	0.92	0.78	-
	3	1.00	0.83	0.75
	4	1.00	0.94	0.83
	4-1/2	1.00	1.00	0.88
	5	1.00	1.00	0.92
	6	1.00	1.00	1.00

Notes: For anchors loaded in shear, the critical edge distance (c_{cr}) is equal to 12 anchor diameters (12d) at which the anchor achieves 100% of load.

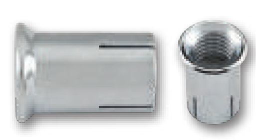
Minimum edge distance (c_{min}) is equal to 6 anchor diameters (6d) at which the anchor achieves 75% of load.



ORDERING INFORMATION

Carbon Steel Mini Dropin

Cat No.	Rod/Anchor Dia.	Drill Diameter	Overall Length	Standard Box	Standard Ctn.
6335	1/4"	3/8"	5/8"	100	1,000
6322	3/8"	1/2"	3/4"	100	1,000
6337	1/2"	5/8"	1"	50	250

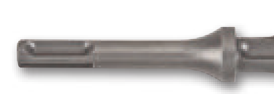


Setting Tool for Mini Dropin

Cat No.	Mini Dropin Size	Standard Box	Standard Carton
6336	1/4"	1	50
6323	3/8"	1	50
6338	1/2"	1	50

Accu-Bit™ Drill Stop for Mini Dropin

Cat No.	Rod/Anchor Size	Drill Depth	Standard Box
DWA5491	3/8" Accu-Bit for 1/4" Mini Dropin	7/8"	1
DWA5492	1/2" Accu-Bit for 3/8" Mini Dropin	15/16"	1
DWA5494	5/8" Accu-Bit for 1/2" Mini Dropin	1-13/32"	1



GENERAL INFORMATION

HOLLOW-SET DROPIN™

Internally Threaded Expansion Anchor

PRODUCT DESCRIPTION

The Hollow-Set Dropin anchor is designed for anchoring in hollow base materials such as hollow concrete block and precast hollow core plank. It can also be used in solid base materials. Concrete masonry blocks often have a maximum outer wall thickness of 1-1/2". During the drilling process, spalling on the back side of the wall often decreases the wall thickness, leaving only 1" or less for anchoring. The Hollow-Set Dropin is designed to perform in this environment, where most conventional style anchors will not function properly.

GENERAL APPLICATIONS AND USES

- Anchoring to Concrete Block
- Fastening to Precast Hollow Core Plank
- Suspending Conduit
- Fire Sprinkler
- Cable Trays and Strut
- Suspended Lighting
- Pipe Supports
- Removable Anchorage

FEATURE AND BENEFITS

+ Internally threaded anchor for easy bolt removability and service work
+ Unique expansion design allows for anchoring in thin-walled base materials
+ Versatile setting options allows for hollow or solid base materials
+ Tested in accordance with ASTM E488 and AC01 criteria

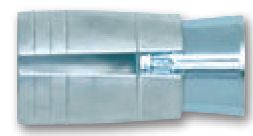
APPROVALS AND LISTINGS

- Underwriters Laboratories (UL) File EX 1289 (Hanger, Pipe): See listing for sizes.

GUIDE SPECIFICATIONS

CSI Divisions: 03 16 00 - Concrete Anchors, 04 05 19.16 - Masonry Anchors and 05 05 19 - Post-Installed Concrete Anchors. Dropin anchors shall be Hollow-Set Dropin as supplied by DEWALT, Towson, MD.

SECTION CONTENTS



HOLLOW-SET DROPIN

ANCHOR MATERIALS

- Zamac Alloy Anchor Body with:
  - Carbon Steel Cone or
  - Type 304 Stainless Steel Cone

ROD/ANCHOR SIZE RANGE (TYP.)

- 1/4" through 5/8" diameters

SUITABLE BASE MATERIALS

- Normal-Weight Concrete
- Precast Hollow Core Plank
- Hollow or Grout Filled Concrete Masonry (CMU)
- Brick Masonry

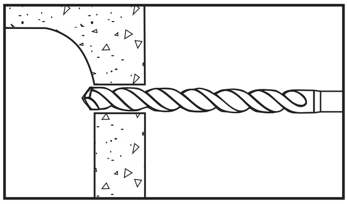
MATERIAL SPECIFICATIONS

Anchor Component	Carbon Steel	Stainless Steel
Anchor Body	Zamac Alloy	Zamac Alloy
Cone	AISI C 1008	Type 304 Stainless Steel
Plating (Cone)	ASTM B633, SC1, Type III (Fe/Zn 5)	N/A

INSTALLATION SPECIFICATIONS

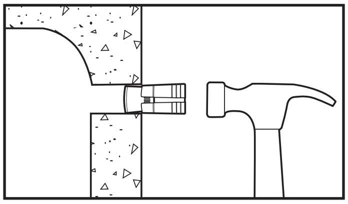
Dimension	Rod/Anchor Diameter, d				
	1/4"	5/16"	3/8"	1/2"	5/8"
ANSI Drill Bit Size, d_{bit} (in.)	3/8	5/8	5/8	3/4	1
Maximum Tightening Torque, T_{max} (ft.-lbs)	3-4	5-7	8-10	15-20	30-40
Thread Size (UNC)	1/4-20	5/16-18	3/8-16	1/2-13	5/8-11
Overall Anchor Length (in.)	7/8	1-5/16	1-5/16	1-3/4	2
Sleeve Length (in.)	5/8	15/16	15/16	1-1/4	1-1/2
Thread Length In Cone (in.)	3/8	5/8	5/8	3/4	1

INSTALLATION INSTRUCTIONS FOR HOLLOW BASE MATERIALS

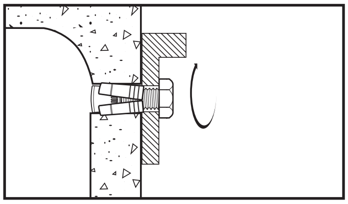


In hollow base materials, drill through into the cell or void. The tolerances of the drill bit used must meet the requirements of ANSI Standard B212.15.

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.

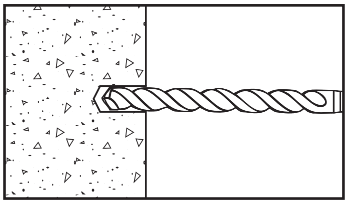


Do not expand the anchor prior to installation. Insert cone end and tap flush to surface.



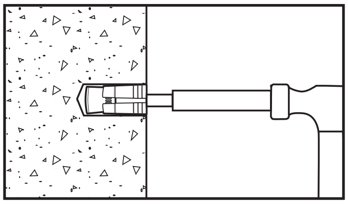
Position fixture, insert bolt and tighten. The bolt should engage a minimum of 2/3 of the anchor threads. The anchor can also be expanded using a Hollow-Set Tool. (If Hollow-Set Tool is used, thread anchor onto tool prior to tapping into anchor hole. When flush with surface, turn tool clockwise to tighten. Release tool from set anchor by turning counterclockwise. Fixture can then be attached).

INSTALLATION INSTRUCTIONS FOR SOLID BASE MATERIALS



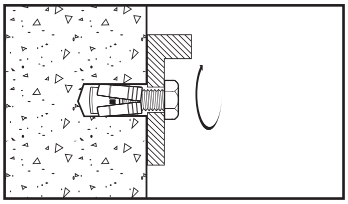
Drill a hole into the base material to the required embedment depth. The tolerances of the drill bit used must meet the requirements of ANSI Standard B212.15.

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.



Insert the anchor into the hole. Position the setting tool in the anchor.

Using the Solid Tool, set the anchor by driving the Zamac sleeve over the cone using several sharp hammer blows.



Be sure the anchor is at the required embedment depth, so that anchor threads do not protrude above the surface of the base material. Position the fixture, insert bolt or threaded rod and tighten.

PERFORMANCE DATA

Ultimate and Allowable Load Capacities for Hollow-Set Dropin in Normal-Weight Concrete[1,2,3,4]

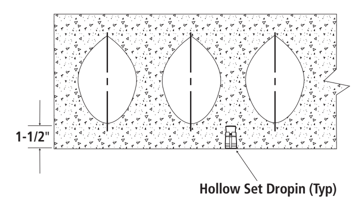
Rod/ Anchor Diameter d in. (mm)	Minimum Embed Depth h_v in. (mm)	Drill Bit Diameter ANSI in.	Minimum Concrete Compressive Strength, f 'c											
			2,000 psi				4,000 psi				6,000 psi			
			Tension		Shear		Tension		Shear		Tension		Shear	
			Ultimate lbs. (kN)	Allowable lbs. (kN)	Ultimate lbs. (kN)	Allowable lbs. (kN)	Ultimate lbs. (kN)	Allowable lbs. (kN)	Ultimate lbs. (kN)	Allowable lbs. (kN)	Ultimate lbs. (kN)	Allowable lbs. (kN)	Ultimate lbs. (kN)	Allowable lbs. (kN)
1/4 (6.4)	3/4 (19)	3/8	760 (3.4)	150 (0.7)	1,200 (5.3)	240 (1.1)	1,140 (5.1)	230 (1.0)	1,200 (5.3)	240 (1.1)	1,440 (6.4)	290 (1.3)	1,200 (5.3)	240 (1.1)
	7/8 (22)		880 (3.9)	175 (0.8)	1,440 (6.4)	290 (1.3)	1,145 (5.1)	230 (1.0)	1,440 (6.4)	290 (1.3)	2,045 (9.1)	410 (1.8)	1,440 (6.4)	290 (1.3)
5/16 (6.4)	1 (25)	5/8	1,120 (5.0)	225 (1.0)	1,980 (8.8)	395 (1.8)	1,680 (7.5)	335 (1.5)	1,980 (8.8)	395 (1.8)	2,200 (9.8)	440 (2.0)	1,980 (8.8)	395 (1.8)
	1-1/2 (38)		2,205 (9.8)	440 (2.0)	2,740 (12.2)	550 (2.4)	2,775 (12.3)	555 (2.5)	2,740 (12.2)	550 (2.4)	4,825 (21.5)	965 (4.3)	2,740 (12.2)	550 (2.4)
3/8 (9.5)	1 (25)	5/8	1,370 (6.1)	275 (1.2)	2,550 (11.3)	510 (2.3)	2,070 (9.2)	415 (1.8)	2,550 (11.3)	510 (2.3)	2,290 (10.2)	460 (2.0)	2,550 (11.3)	510 (2.3)
	1-1/2 (38)		2,445 (10.9)	490 (2.2)	3,145 (14.0)	630 (2.8)	2,800 (12.5)	560 (2.5)	3,145 (14.0)	630 (2.8)	5,085 (22.6)	1,015 (4.5)	3,145 (14.0)	630 (2.8)
1/2 (12.7)	1-1/2 (38)	3/4	2,140 (9.5)	430 (1.9)	4,020 (17.9)	805 (3.6)	4,025 (17.9)	805 (3.6)	4,020 (17.9)	805 (3.6)	7,285 (32.4)	1,455 (6.5)	4,020 (17.9)	805 (3.6)
	2 (51)		2,780 (12.4)	555 (2.5)	4,020 (17.9)	805 (3.6)	4,375 (19.5)	875 (3.9)	4,020 (17.9)	805 (3.6)	9,455 (42.1)	1,890 (8.4)	4,020 (17.9)	805 (3.6)
5/8 (15.9)	2-1/4 (57)	1	5,725 (25.5)	1,145 (5.1)	6,400 (28.5)	1,280 (5.7)	9,410 (41.9)	1,880 (8.4)	6,400 (28.5)	1,280 (5.7)	10,500 (46.7)	2,100 (9.3)	6,400 (28.5)	1,280 (5.7)

1. Tabulated load values are applicable to anchors with carbon and stainless steel cones.
2. Allowable load capacities listed are calculated using an applied safety factor of 4.0. Consideration of safety factors of 20 or higher may be necessary depending on the application, such as life safety, overhead and in sustained tensile loading applications.
3. Linear interpolation may be used to determine allowable loads for anchors at intermediate embedment depths and compressive strengths.
4. The tabulated load values are applicable to single anchors installed at critical edge and spacing distances. Allowable load capacities are multiplied by reduction factors when anchor spacing or edge distances are less than critical distances.

Ultimate and Allowable Load Capacities for Hollow-Set Dropin in Hollow Core Plank[1,2,3]

Rod/ Anchor Diameter d in. (mm)	Minimum Embedment Depth h_v in. (mm)	Drill Bit Diameter ANSI in.	Minimum Concrete Compressive Strength f´c ≥ 5,000 psi (34.5 MPa)			
			Ultimate Load		Allowable Load	
			Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
1/4 (6.4)	7/8 (22.2)	3/8	1,190 (5.4)	1,440 (6.5)	300 (1.4)	360 (1.6)
5/16 (7.9)	1 (25.4)	5/8	2,280 (10.3)	2,740 (12.3)	570 (2.6)	685 (3.1)
3/8 (9.5)	1 (25.4)	5/8	2,525 (11.4)	2,740 (12.3)	630 (2.8)	685 (3.1)
	1-1/2 (38.1)	5/8	3,620 (16.3)	3,145 (14.2)	905 (4.1)	785 (3.5)
1/2 (12.7)	1-1/4 (31.8)	3/4	5,420 (24.4)	5,580 (25.1)	1,355 (6.1)	1,395 (6.3)
5/8 (15.9)	1-1/2 (38.1)	1	6,560 (29.2)	8,320 (37.4)	1,640 (7.3)	2,080 (9.4)

1. Tabulated load values are applicable to anchors with carbon and stainless steel cones and set with sleeve flush to surface of the plank and with setting tool for solid base materials.
2. Allowable load capacities listed are calculated using and applied safety factor of 4.0. Consideration of safety factors of 20 or higher may be necessary depending upon the application such as life safety, overhead and in sustained tensile loading applications.
3. Minimum spacing distance must not be less than eight anchor diameters (8d).



Ultimate and Allowable Load Capacities for Hollow-Set Dropin in Hollow Concrete Masonry[1,2,3,4,5,6,7]

Rod/Anchor Diameter d in.	Minimum Embedment Depth hv in.	Drill Bit Diameter ANSI in.	Min. Edge Distance in. (mm)	Min. End Distance in. (mm)	f'm = 1,500 psi			
					Ultimate Load		Allowable Load	
					Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
1/4	7/8* (22.2)	3/8	3-3/4 (95)	3-3/4 (95)	530 (2.4)	785 (3.5)	105 (0.5)	155 (0.7)
5/16	1* (25.4)	5/8	3-3/4 (95)	3-3/4 (95)	1,035 (4.6)	920 (4.1)	205 (0.9)	185 (0.8)
3/8	1* (25.4)	5/8	3-3/4 (95)	3-3/4 (95)	1,225 (5.4)	1,175 (5.2)	245 (1.1)	235 (1.0)
1/2	1-1/4* (31.8)	3/4	3-3/4 (95)	3-3/4 (95)	1,520 (6.8)	1,240 (5.5)	305 (1.4)	250 (1.1)
	1-1/4* (31.8)	3/4	11-1/4 (286)	11-1/4 (286)	1,520 (6.8)	1,825 (8.1)	305 (1.4)	365 (1.6)
5/8	1-1/2* (38.1)	1	11-1/4 (286)	11-1/4 (286)	1,790 (8.0)	1,870 (8.3)	360 (1.6)	375 (1.7)

1. Tabulated load values are applicable to anchors with carbon and stainless steel cones.
2. Tabulated load values for anchors are installed in minimum 6" wide, minimum Grade N, Type II, lightweight, medium-weight or normal-weight concrete masonry units conforming to ASTM C 90. Mortar must be minimum Type N. Masonry cells may be grouted. Masonry compressive strength must be at specified minimum at the time of installation.
3. Allowable load capacities listed are calculated using an applied safety factor of 5.0. Consideration of safety factors of 20 or higher may be necessary depending upon the application such as life safety, and in sustained tensile loading applications.
4. Allowable shear load values may be increased by 100% (multiplied by 2.0) provided the applied shear loads are not loaded toward the wall edge and end.
5. The tabulated values are applicable for anchors installed into grouted masonry wall faces or ends of block ends provided minimum edge and end distances are maintained.
6. The tabulated values are applicable to single anchors. Two anchors may be installed in the same cell provided the spacing distance between the anchors is a minimum of six diameters (6d) and the allowable loads are reduced by 50%.
7. Anchors were installed with sleeve flush to block surface and with setting tool for hollow base materials. Embedment is measured from the surface of the base material.

*Minimum face shell thickness must be minimum 1.25-inch-thick for 1/2-inch-diameter anchors and minimum 1.5-inch-thick for 5/8-inch diameter anchors.

Ultimate and Allowable Load Capacities for Hollow-Set Dropin in Solid Clay Brick Masonry[1,2,3,4]

Rod/ Anchor Diameter d in. (mm)	Minimum Embed. Depth h_v in. (mm)	Drill Bit Diameter ANSI in.	Minimum Edge Distance in. (mm)	Minimum End Distance in. (mm)	f´m ≥ 1,500 psi (10.4 MPa)			
					Ultimate Load		Allowable Load	
					Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
1/4 (6.4)	7/8 (22.2)	3/8	6 (152.4)	8 (203.2)	880 (4.0)	1,640 (7.4)	175 (0.8)	330 (1.5)
5/16 (9.5)	1-1/4 (31.8)	5/8	8 (203.2)		1,460 (6.6)	2,230 (10.0)	290 (1.3)	445 (2.0)
3/8 (12.7)	1-1/4 (31.8)	5/8	8 (203.2)		1,860 (8.4)	2,980 (13.4)	370 (1.7)	595 (2.7)
1/2 (15.9)	1-1/2 (38.1)	3/4	10 (254.0)		3,240 (14.6)	4,230 (19.0)	650 (2.9)	845 (3.8)
5/8 (19.1)	2-1/4 (57.2)	1	12 (304.8)		4,680 (21.1)	6,420 (28.9)	935 (4.2)	1,605 (7.2)

1. Tabulated load values are for anchors with carbon or stainless steel cones.
2. Tabulated load values are for anchors installed in multiple wythe, minimum Grade SW, solid clay brick masonry walls conforming to ASTM C 62. Mortar must be minimum Type N. Masonry compressive strength must be at the specified minimum at the time of installation (f'm ≥ 1,500 psi).
3. Allowable load capacities listed are calculated using and applied safety factor of 5.0. Consideration of safety factors of 20 or higher may be necessary depending upon the application such as life safety, and in sustained tensile loading applications.
4. The tabulated values are for anchors installed at a minimum of 16 anchor diameters on center for 100 percent capacity. Spacing distances may be reduced to 8 anchor diameters on center provided the capacities are reduced by 50 percent. Linear interpolation may be used for intermediate spacing.

DESIGN CRITERIA (ALLOWABLE STRESS DESIGN)

Combined Loading

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

$$\left(\frac{Nu}{Nn}\right) + \left(\frac{Vu}{Vn}\right) \leq 1$$

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[1]

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	$s_{cr} = 3.0h_v$	$F_{NS} = F_{VS} = 1.0$	$s_{min} = 1.5h_v$	$F_{NS} = F_{VS} = 0.50$
Edge Distance (c)	Tension	$c_{cr} = 14d$	$F_{NC} = 1.0$	$c_{min} = 8d$	$F_{NC} = 0.80$
	Shear	$c_{cr} = 14d$	$F_{VC} = 1.0$	$c_{min} = 8d$	$F_{VC} = 0.50$

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.

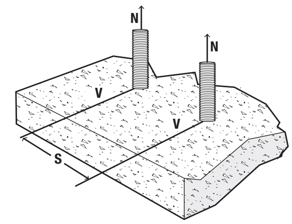
LOAD ADJUSTMENT FACTORS FOR NORMAL-WEIGHT CONCRETE

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

	Dia. (in.)	1/4	5/16	3/8	1/2	5/8
	h_v (in.)	7/8	1-1/2	1-1/2	2	2-1/4
	s_{cr} (in.)	2-5/8	4-1/2	4-1/2	6	6-3/4
	s_{min} (in.)	1-3/8	2-1/4	2-1/4	3	3-3/8
Spacing, s (inches)	1-3/8	0.50	-	-	-	-
	2-1/4	0.86	0.50	0.50	-	-
	2-5/8	1.00	0.58	0.58	-	-
	3	1.00	0.67	0.67	0.50	-
	3-3/8	1.00	0.75	0.75	0.56	0.50
	4	1.00	0.89	0.89	0.67	0.59
	4-1/2	1.00	1.00	1.00	0.75	0.67
	5	1.00	1.00	1.00	0.83	0.74
	6	1.00	1.00	1.00	1.00	0.89
	6-3/4	1.00	1.00	1.00	1.00	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 depths ($1.5h_v$) at which the anchor achieves 50% of load.

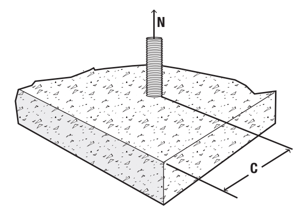


Edge Distance, Tension (F_{NC})

	Dia. (in.)	1/4	5/16	3/8	1/2	5/8
	c_{cr} (in.)	3-1/2	4-3/8	5-1/4	7	8-3/4
	c_{min} (in.)	2	2-1/2	3	4	5
Edge Distance, c (inches)	2	0.80	-	-	-	-
	2-1/2	0.87	0.80	-	-	-
	3	0.93	0.85	0.80	-	-
	3-1/2	1.00	0.91	0.84	-	-
	4	1.00	0.96	0.89	0.80	-
	4-3/8	1.00	1.00	0.92	0.83	-
	5	1.00	1.00	0.98	0.87	0.80
	5-1/4	1.00	1.00	1.00	0.88	0.81
	6	1.00	1.00	1.00	0.93	0.85
	7	1.00	1.00	1.00	1.00	0.91
	8	1.00	1.00	1.00	1.00	0.96
	8-3/4	1.00	1.00	1.00	1.00	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 8 anchor diameters (8d) at which the anchor achieves 80% of load.

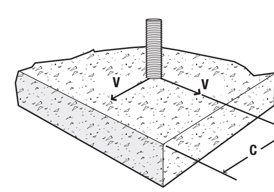


Edge Distance, Shear (F_{VC})

	Dia. (in.)	1/4	5/16	3/8	1/2	5/8
	c_{cr} (in.)	3-1/2	4-3/8	5-1/4	7	8-3/4
	c_{min} (in.)	2	2-1/2	3	4	5
Edge Distance, c (inches)	2	0.50	-	-	-	-
	2-1/2	0.67	0.50	-	-	-
	3	0.83	0.63	0.50	-	-
	3-1/2	1.00	0.77	0.61	-	-
	4	1.00	0.90	0.72	0.50	-
	4-3/8	1.00	1.00	0.81	0.56	-
	5	1.00	1.00	0.94	0.67	0.50
	5-1/4	1.00	1.00	1.00	0.71	0.53
	6	1.00	1.00	1.00	0.83	0.63
	7	1.00	1.00	1.00	1.00	0.77
	8	1.00	1.00	1.00	1.00	0.90
	8-3/4	1.00	1.00	1.00	1.00	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.

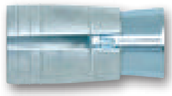
Minimum edge distance (c_{min}) is equal to 8 anchor diameters (8d) at which the anchor achieves 50% of load.



ORDERING INFORMATION

Hollow-Set Dropin with Carbon Steel Cone

Catalog Number	Rod/Anchor Diameter	Drill Diameter	Overall Length	Sleeve Length	Std. Box	Std. Ctn.	Wt./ 100
9320	1/4"	3/8"	7/8"	5/8"	100	1,000	1-3/4
9330	5/16"	5/8"	1-5/16"	15/16"	50	500	5-1/2
9340	3/8"	5/8"	1-5/16"	15/16"	50	300	5-1/2
9350	1/2"	3/4"	1-3/4"	1-1/4"	50	250	9-1/2
9360	5/8"	1"	2"	1-1/2"	25	125	21



Hollow-Set Dropin with Stainless Steel Cone

Catalog Number	Rod/Anchor Diameter	Drill Diameter	Overall Length	Sleeve Length	Std. Box	Std. Ctn.	Wt./ 100
9420	1/4"	3/8"	7/8"	5/8"	100	1,000	1-3/4
9440	3/8"	5/8"	1-5/16"	15/16"	100	500	5-1/2

Setting Tool for Solid Base Materials

Catalog Number	Size	Standard Box	Standard Carton
9322	1/4"	1	1
9342	5/16" and 3/8"	1	1
9352	1/2"	1	1
9362	5/8"	1	1

Setting Tool for Hollow Base Materials*

Catalog Number	Size	Standard Box	Standard Carton
9323	1/4"	1	1
9333	5/16"	1	1
9343	3/8"	1	1
9353	1/2"	1	1
9363	5/8"	1	1

* Hollow set tool for hollow block and clay brick masonry base materials.

GENERAL INFORMATION

CONCRETE HANGERMATE®+

Rod Hanging Anchor

PRODUCT DESCRIPTION

The Hangermate®+ concrete screw is a one piece, steel anchor designed for rod hanging applications such as fire protection systems, ventilation systems, electrical conduit, pipe hanging and cable trays. Tested and qualified for use in cracked concrete and seismic conditions. The concrete Hangermate®+ requires a 1/4" ANSI masonry bit for installation, accepts 1/4" and 3/8" diameter threaded rods and is also available in a 3/8" male thread version.

GENERAL APPLICATIONS AND USES

- Fire Sprinkler Pipes
- Ventilation Systems
- Cable Trays
- Suspended Ceilings
- Overhead Utilities
- Lighting Systems

FEATURES AND BENEFITS

+ Installs with standard ¼-inch ANSI drill bit
+ Faster installation resulting in labor savings
+ Patented thread design offers low installation torque
+ Tough threads for tapping high strength concrete

APPROVALS AND LISTINGS

- International Code Council, Evaluation Service (ICC-ES). ESR-3889 code compliant with the 2015 IBC/IRC, 2012 IBC/IRC, and 2009 IBC/IRC.
- FM Approvals (FM) - (see listing for applicable sizes and types).
- Tested in accordance with ACI 355.2/ASTM E 488 and ICC-ES AC193 for use in structural concrete under the design provisions of ACI 318-14, Chapter 17 and ACI-318-11/08 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)
- Evaluated and qualified by an accredited independent testing laboratory for reliability against brittle failure, e.g. hydrogen embrittlement.

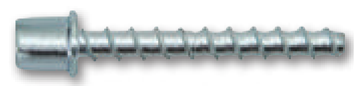
GUIDE SPECIFICATIONS

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

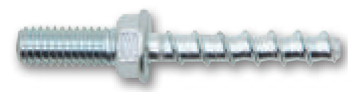
MATERIAL SPECIFICATIONS

Anchor component	Specification
Anchor Body	Case hardened low carbon steel
Plating	Zinc plating according to ASTM B 633, SC1 Type III (Fe/Zn 5). Minimum plating requirements for Mild Service Condition.

SECTION CONTENTS



CONCRETE HANGERMATE+ (INTERNALLY THREADED COUPLER HEAD)



CONCRETE HANGERMATE+ (EXTERNAL THREAD - STUD HEAD)

THREAD VERSION

- Unified Coarse Thread (UNC)

ANCHOR MATERIALS

- Zinc Plated Carbon Steel

ANCHOR SIZE RANGE (TYP.)

- 1/4" and 3/8" diameter (Threaded Heads)

SUITABLE BASE MATERIALS

- Normal-weight concrete
- Sand-lightweight concrete
- Concrete over steel deck

TENSION ZONE CRACKED CONCRETE

SEISMIC REGION QUALIFICATION

CODE LISTED
ICC-ES ESR-3889
CONCRETE

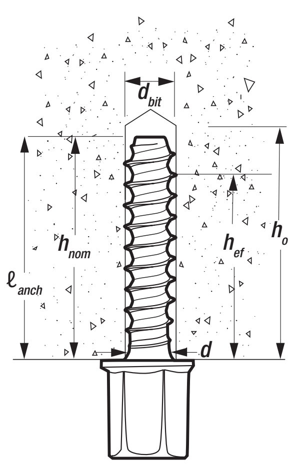
INSTALLATION SPECIFICATIONS

Installation Specifications for Hangermate+ in Concrete and Supplementary Information

Anchor Property/Setting Information		Notation	Units	Nominal Anchor Diameter (inch)	
				1/4	
Anchor outside diameter		d	in. (mm)	0.250 (6.35)	
Nominal drill bit diameter		d_{bit}	in. (mm)	1/4 ANSI	
Minimum embedment depth		h_{nom}	in. (mm)	1-5/8 (41)	2-1/2 (64)
Minimum hole depth		h_o	in. (mm)	2 (51)	2-7/8 (73)
Minimum member thickness		h_{min}	in. (mm)	3-1/4 (83)	4 (102)
Minimum edge distance		c_{min}	in. (mm)	1-1/2 (38)	
Minimum spacing		s_{min}	in. (mm)	1-1/2 (38)	
Max. Installation torque		$T_{inst,max}$	ft.-lbf. (N-m)	19 (26)	
Max impact wrench power (torque)		$T_{impact,max}$	ft.-lbf. (N-m)	150 (203)	
Internal Threaded Head	Wrench socket size	1/4 thread	in.	3/8	-
		3/8 thread		1/2	
	Maximum head height	1/4 thread	in.	33/64	-
		3/8 thread		43/64	
	Maximum washer diameter	1/4 thread	in.	1/2	-
		3/8 thread		21/32	
Externally Threaded Head	Wrench socket size	3/8 thread	in.	1/2	
	Maximum head height			1-3/16	
	Maximum washer diameter			21/32	
Effective tensile stress area (screw anchor body)		A_{se}	in.^{2} (mm^2)	0.045 (29.0)	
Minimum specified ultimate strength		f_{uta}	ksi (N/mm^2)	100 (690)	
Minimum specified yield strength		f_y	ksi (N/mm^2)	80 (552)	

For SI: 1 inch = 25.4 mm; 1 ksi = 6.894 N/mm²; 1 ft-lb = 1.356 N-m; 1 lb = 0.0044 kN.

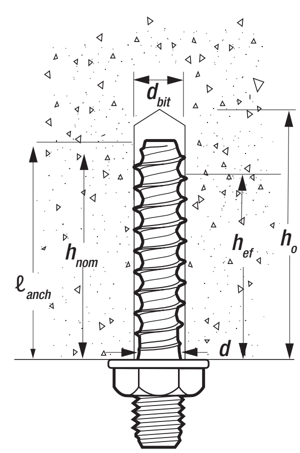
Hangermate+ Anchor Detail in Concrete



Internally Threaded

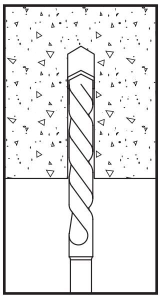
Nomenclature

d = Diameter of Anchor
d_{bit} = Diameter of Drill Bit
h_{nom} = Minimum Nominal Embedment
h_{ef} = Effective Embedment
h_o = Minimum Hole Depth
ℓ_{anch} = Nominal Anchor Length

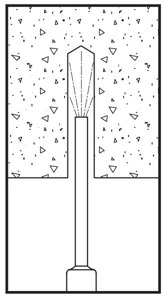


External Thread

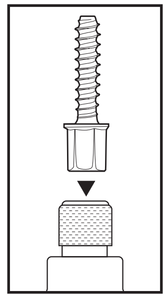
INSTALLATION INSTRUCTIONS



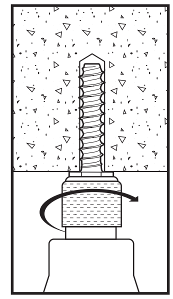
Step 1
Using the proper drill bit size, drill a hole into the base material to the required depth. The tolerances of the drill bit used should meet the requirements of ANSI Standard B212.15.



Step 2
Remove dust and debris from hole during drilling (e.g. dust extractor, hollow bit) or following drilling (e.g. suction, forced air) to extract loose particles created during drilling.

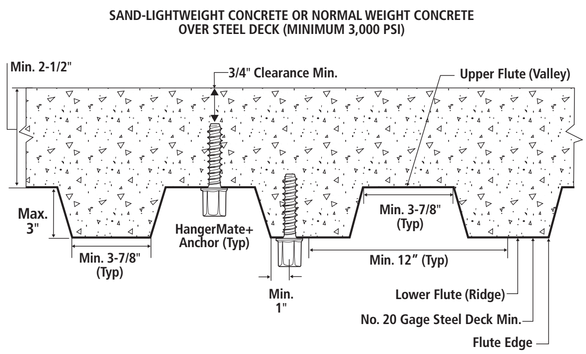


Step 3
Select a powered impact wrench or torque wrench and do not exceed the maximum torque, $T_{impact,max}$ or $T_{inst,max}$, repectively, for the selected anchor diameter and embedment (See Table 1). Attach an appropriate sized hex socket to the wrench. Mount the screw anchor head into the socket.



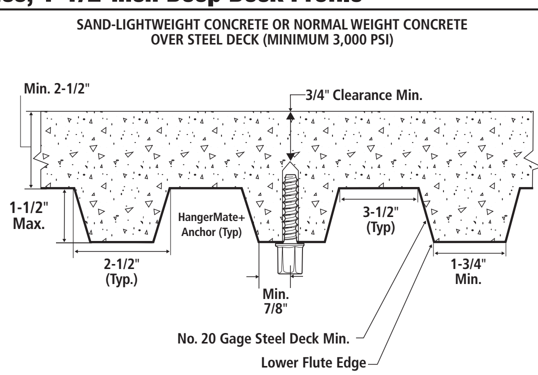
Step 4
Drive the anchor with an impact wrench or torque wrench through the fixture and into the hole until the head of the anchor comes into contact with the member surface. Do not spin the hex socket off the anchor to disengage. Insert threaded rod or threaded bolt element into Hangermate+.

Hangermate+ Installation Detail for Screw Anchors in the Soffit of Concrete over Steel Deck Floor and Roof Assemblies, 3-inch Deep Deck Profile[1,2,3]



1. Anchors may be placed in the upper flute or lower flute of the concrete-filled steel deck profiles provided the minimum hole clearance of 3/4-inch is satisfied for the selected anchor. See the Tension and Shear Design information for Anchors Installed in the Soffit of Concrete-Filled Steel Deck Assemblies table.
2. Anchors in the lower flute may be installed with a maximum 15/16-inch offset in either directions from the center of the flute. The offset distance may be increased proportionally for profiles with lower flute widths greater than those shown provided the minimum lower flute edge distance is also satisfied. (e.g. 1-1/4-inch offset for 4-1/2-inch wide flute).
3. See the Tension and Shear Design information for Anchors Installed in the Soffit of Concrete-Filled Steel Deck Assemblies table for design data.

Hangermate+ Installation Detail for Screw Anchors in the Soffit of Concrete over Steel Deck Floor and Roof Assemblies, 1-1/2-inch Deep Deck Profile[1,2,3]



1. Anchors may be placed in the upper flute or lower flute of the concrete-filled steel deck profiles provided the minimum hole clearance of 3/4-inch is satisfied for the selected anchor. See the Tension and Shear Design information for Anchors Installed in the Soffit of Concrete-Filled Steel Deck Assemblies table.
2. Anchors in the lower flute may be installed in the center of the flute. An offset distance may be given proportionally for profiles with flute widths greater than those shown provided the minimum lower flute edge distance is also satisfied.
3. See the Tension and Shear Design information for Anchors Installed in the Soffit of Concrete-Filled Steel Deck Assemblies table for design data.

REFERENCE DATA (ASD)

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

Nominal Anchor Diameter in.	Minimum Nominal Embedment Depth in. (mm)	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 (1/4 Thread)	1-5/8 (41)	2,835 (12.6)	1,485 (6.6)	2,995 (13.3)	1,525 (6.8)	3,265 (14.5)	1,525 (6.8)	3,265 (14.5)	1,525 (6.8)	3,265 (14.5)	1,525 (6.8)
1/4 (3/8 Thread)	1-5/8 (41)	2,835 (12.6)	2,035 (9.1)	2,995 (13.3)	2,090 (9.3)	3,265 (14.5)	2,090 (9.3)	3,265 (14.5)	2,090 (9.3)	3,265 (14.5)	2,090 (9.3)
	2-1/2 (64)	3,650 (16.2)	2,035 (9.1)	3,855 (17.1)	2,090 (9.3)	4,200 (18.7)	2,090 (9.3)	4,270 (19.0)	2,090 (9.3)	4,270 (19.0)	2,090 (9.3)

1. Tabulated load values are for anchors installed in concrete. Concrete compressive strength must be at a minimum at the time of installation.
2. Ultimate load capacities must be reduced by a minimum safety factor of 4.0 or greater to determine allowable working load.

Allowable Load Capacities for Hangermate+ in Normal-Weight Concrete[1,2,3,4]

ASD ALLOWABLE STRESS DESIGN

Nominal Anchor Diameter in.	Minimum Nominal Embedment Depth in. (mm)	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 (1/4 Thread)	1-5/8 (41)	710 (3.2)	370 (1.6)	750 (3.3)	380 (1.7)	815 (3.6)	380 (1.7)	815 (3.6)	380 (1.7)	815 (3.6)	380 (1.7)
1/4 (3/8 Thread)	1-5/8 (41)	710 (3.2)	510 (2.3)	750 (3.3)	525 (2.3)	815 (3.6)	525 (2.3)	815 (3.6)	525 (2.3)	815 (3.6)	525 (2.3)
	2-1/2 (64)	915 (4.1)	510 (2.3)	965 (4.3)	525 (2.3)	1,050 (4.7)	525 (2.3)	1,070 (4.8)	525 (2.3)	1,070 (4.8)	525 (2.3)

1. Tabulated load values are for anchors installed in concrete. Concrete compressive strength must be at the specified minimum at the time of installation.
2. Allowable load capacities are calculated using an applied safety factor 4.0.
3. Allowable load capacities must be multiplied by reduction factors when anchor spacing or edge distances are less than critical distances.
4. Linear interpolation may be used to determine allowable loads for intermediate embedments and compressive strengths.

Edge Distance - Tension (F_{NC})

Diameter (in)		1/4		
Thread Diameter		1/4"	3/8"	3/8"
Nominal Embedment, h_{nom} (in)		1-5/8	1-5/8	2-1/2
Minimum Edge Distance, c_{min} (in)		1-1/2	1-1/2	1-1/2
Edge Distance (inches)	1-1/2	0.77	0.77	0.64
	1-3/4	0.83	0.83	0.67
	2	0.88	0.88	0.71
	2-1/4	0.94	0.94	0.75
	2-1/2	1.00	1.00	0.78
	2-3/4	1.00	1.00	0.82
	3	1.00	1.00	0.86
	3-1/2	1.00	1.00	0.93
	4	1.00	1.00	1.00

Spacing - Tension (F_{NS})

Diameter (in)		1/4		
Thread Diameter		1-5/8	1-5/8	2-1/2
Nominal Embedment, h_{nom} (in)		1-1/5	1-1/5	2
Minimum Spacing, s_{min} (in)		3-3/5	3-3/5	5-5/6
Spacing Distance (inches)	1-1/2	0.77	0.77	0.68
	1-3/4	0.80	0.80	0.70
	2	0.83	0.83	0.72
	2-1/4	0.86	0.86	0.74
	2-1/2	0.89	0.89	0.76
	2-3/4	0.92	0.92	0.78
	3	0.99	0.99	0.82
	3-1/2	1.00	1.00	0.86
	4	1.00	1.00	0.90
	4-1/2	1.00	1.00	0.94
	5	1.00	1.00	0.97
	5-1/2	1.00	1.00	1.00
	6	1.00	1.00	1.00

Edge Distance - Shear (F_{VC})

Diameter (in)		1/4		
Thread Diameter		1/4"	3/8"	3/8"
Nominal Embedment, h_{nom} (in)		1-5/8	1-5/8	2-1/2
Minimum Edge Distance, c_{min} (in)		1-1/2	1-1/2	1-1/2
Edge Distance (inches)	1-1/2	0.68	0.55	0.59
	1-3/4	0.79	0.64	0.68
	2	0.90	0.73	0.78
	2-1/4	1.00	0.82	0.88
	2-1/2	1.00	0.92	0.98
	2-3/4	1.00	1.00	1.00

Spacing - Shear (F_{VS})

Diameter (in)		1/4		
Thread Diameter		1/4"	3/8"	3/8"
Nominal Embedment, h_{nom} (in)		1-5/8	1-5/8	2-1/2
Minimum Spacing, s_{min} (in)		1-1/2	1-1/2	1-1/2
Spacing Distance (inches)	1-1/2	0.61	0.59	0.60
	1-3/4	0.63	0.61	0.61
	2	0.65	0.62	0.63
	2-1/4	0.67	0.64	0.65
	2-1/2	0.69	0.65	0.66
	2-3/4	0.71	0.67	0.68
	3	0.73	0.68	0.70
	3-1/2	0.76	0.71	0.73
	4	0.80	0.74	0.76
	4-1/2	0.84	0.77	0.79
	5	0.88	0.81	0.83
	5-1/2	0.91	0.84	0.86
	6	0.95	0.87	0.89
	6-1/2	0.99	0.90	0.92
	7	1.00	0.93	0.96
	7-1/2	1.00	0.96	0.99
	8	1.00	0.99	1.00
	9	1.00	1.00	1.00

PERFORMANCE DATA (SD)

Hangermate+ Installation Specifications in Concrete and Supplemental Information[1,2]

CODE LISTED
ICC-ES ESR-3889

STRENGTH DESIGN SD TABLES

Anchor Property/Setting Information		Notation	Units	Nominal Anchor Diameter (inch)	
				1/4	
Nominal anchor diameter		d_a	in. (mm)	0.250 (6.4)	
Nominal drill bit diameter		d_{bit}	in.	1/4 ANSI	
Minimum nominal embedment depth[3]		h_{nom}	in. (mm)	1-5/8 (41)	2-1/2 (64)
Effective Embedment		h_{ef}	in. (mm)	1.20 (30)	1.94 (49)
Minimum hole depth		h_o	in. (mm)	2 (51)	2-7/8 (73)
Minimum concrete member thickness		h_{min}	in. (mm)	3-1/4 (83)	4 (102)
Minimum edge distance		c_{min}	in. (mm)	1-1/2 (38)	
Minimum spacing distance		s_{min}	in. (mm)	1-1/2 (38)	
Critical edge distance		c_{ac}	in. (mm)	4.30 (109)	6.10 (155)
Minimum nominal anchor length[4]		ℓ_{anch}	in. (mm)	1-5/8 (41)	2-1/2 (64)
Max Installation torque		$T_{inst,max}$	ft.-lb. (N-m)	19 (26)	25 (34)
Maximum impact wrench power (torque)		$T_{impact,max}$	ft.-lb. (N-m)	150 (203)	
Internal Threaded Head	Wrench socket size	1/4" thread	in.	3/8	-
		3/8" thread		1/2	
	Maximum head height	1/4" thread	in.	33/64	-
		3/8" thread		43/64	
	Maximum washer diameter	1/4" thread	in.	1/2	-
		3/8" thread		21/32	
Externally Threaded Head	Wrench socket size	3/8" thread	in.	1/2	
	Maximum head height			1-3/16	
	Maximum washer diameter			21/32	
Effective tensile stress area (screw anchor body)		A_{se}	in² (mm²)	0.045 (29.0)	
Minimum specified ultimate strength		f_{uta}	ksi (N/mm²)	100 (690)	
Minimum specified yield strength		f_y	ksi (N/mm²)	80 (552)	
Mean axial stiffness[5]	Uncracked concrete	β_{uncr}	lbf/in (kN/mm)	1,381,000 (242)	
	Cracked concrete	β_{cr}	lbf/in (kN/mm)	318,000 (56)	

For SI: 1 inch = 25.4 mm; 1 ksi = 6.894 N/mm²; 1 ft-lb = 1.356 N-m; 1 lb = 0.0044 kN.

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable.
2. For installations through the soffit of steel deck assemblies into concrete, see the design information table for installation in the soffit of concrete-filled steel deck assemblies and the installation details in the soffit of concrete over steel deck for the applicable steel deck profile. Tabulated minimum spacing values are based on anchors installed along the flute with axial spacing equal to the greater of $3h_{ef}$ or 1.5 times the flute width.
3. The embedment depth, h_{nom}, is measured from the outside surface of the concrete member to the embedded end of the anchor.
4. The listed minimum overall anchor length is based on the anchor sizes commercially available at the time of publication compared with the requirements to achieve the minimum nominal embedment depth, including consideration of a fixture attachment. The minimum nominal anchor length is measured from under the head to the tip of the anchor.
5. Mean values shown, actual stiffness varies considerably depending on concrete strength, loading and geometry of application.

Tension Design Information for Hangermate+ Anchor is in Concrete[1,2]

CODE LISTED ICC-ES ESR-3889

Design Characteristic	Notation	Units	Nominal Anchor Diameter	
			1/4	
Anchor category	1, 2 or 3	-	1	
Minimum nominal embedment depth	h_{nom}	in. (mm)	1-5/8 (41)	2-1/2 (64)
Steel Strength in Tension (ACI 318-14 17.4.1 or ACI 318-11 D.5.1)				
Steel strength in tension	N_{sa}[10]	lb (kN)	4,535 (20.2)	
Reduction factor for steel strength[3,4]	ϕ	-	0.65	
Concrete Breakout Strength in Tension (ACI 318-14 17.4.2 or ACI 318-11 D.5.2)				
Effective embedment	h_{ef}	in. (mm)	1.20 (30)	1.94 (49)
Critical edge distance	c_{ac}	in. (mm)	4.30 (109)	6.10 (155)
Effectiveness factor for uncracked concrete	k_{uncr}	-	27	24
Effectiveness factor for cracked concrete	k_{cr}	-	17	
Modification factor for cracked and uncracked concrete[5]	$\Psi_{c,N}$	-	1.0	
Reduction factor for concrete breakout strength[3]	ϕ	-	0.65 (Condition B)	
Pullout Strength in Tension (Non-Seismic Applications) (ACI 318-14 17.4.3 or ACI 318-11 D.5.3)				
Characteristic pullout strength, uncracked concrete (2,500 psi)[6,9]	$N_{p,uncr}$	lb (kN)	See Note 7	
Characteristic pullout strength, cracked concrete (2,500 psi)[6,9]	$N_{p,cr}$	lb (kN)	765 (3.4)	1,415 (6.3)
Reduction factor for pullout strength[3]	ϕ	-	0.65 (Condition B)	
Pullout Strength in Tension for Seismic Applications (ACI 318-14 17.2.3.3 Or ACI 318-11 D.3.3.3)				
Characteristic pullout strength, seismic (2,500 psi)[6,8,9]	$N_{p,eq}$	lb (kN)	360 (1.6)	1,170 (5.2)
Reduction factor for pullout strength[3]	ϕ	-	0.65 (Condition B)	

For SI: 1 inch = 25.4 mm; 1 ksi = 6.894 N/mm²; 1 ft-lb = 1.356 N-m; 1 lb = 0.0044 kN.

1. The data in this table is intended to be used with the design provisions of ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable, shall apply.
2. Installation must comply with published instructions and details.
3. All values of ϕ were determined from the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3, or ACI 318-11 Section 9.2. If the load combinations of ACI 318-11 Appendix C are used, then the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4. For reinforcement that complies with ACI 318-14 Chapter 17 or ACI 318-11 Appendix D requirements for Condition A, see ACI 318-14 17.3.3(c) or ACI 318-11 Section D.4.3(c), as applicable for the appropriate ϕ factor when the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2 are used.
4. The anchors are considered a brittle steel elements as defined by ACI 318-14 2.3 or ACI 318-11 D.1, as applicable.
5. Select the appropriate effectiveness factor for cracked concrete (k_{cr}) or uncracked concrete (k_{uncr}) and use $\Psi_{c,N} = 1.0$.
6. For all design cases $\Psi_{c,P} = 1.0$. The characteristic pullout strength, N_{pn}, for concrete compressive strengths greater than 2,500 psi may be increased by multiplying the value in the table by $(f'c / 2{,}500)^{0.3}$ for psi or $(f'c / 17.2)^{0.3}$ for MPa.
7. Pullout strength does not control design of indicated anchors and does not need to be calculated for indicated anchor size and embedment.
8. Reported values for characteristic pullout strength in tension for seismic applications are based on test results per ACI 355.2, Section 9.5.
9. Anchors are permitted to be used in lightweight concrete provided the modification factor λa equal to 0.8λ is applied to all values of $\sqrt{f'c}$ affecting N_n.

CODE LISTED
ICC-ES ESR-3889

Shear Design Information for Hangermate+ Anchor in Concrete[1,2,7,8]

Design Characteristic	Notation	Units	Nominal Anchor Diameter		
			1/4		
Anchor category	1, 2 or 3	-	1	1	
Thread diameter	-	in.	1/4	3/8	
Minimum nominal embedment depth	h_{nom}	in. (mm)	1-5/8 (41)	1-5/8 (41)	2-1/2 (64)
Steel Strength in Shear (ACI 318-14 17.5.1 or ACI 318-11 D.6.1)					
Steel strength in shear[5]	V_{sa}	lb (kN)	860 (3.8)	1,545 (6.9)	1,545 (6.9)
Reduction factor for steel strength[3,4]	ϕ	-	0.60		
Steel Strength in Shear for Seismic Applications (ACI 318-14 17.2.3.3 or ACI 318-11 D.3.3.3)					
Steel strength in shear, seismic[6]	V_{eq}	lb (kN)	600 (2.7)	1,390 (6.2)	1,390 (6.2)
Reduction factor for steel strength in shear for seismic[3,4]	ϕ	-	0.60		
Concrete Breakout Strength in Shear (ACI 318-14 17.5.2 or ACI 318-11 D.6.2)					
Nominal anchor diameter	d_a	in. (mm)	0.250 (6.4)	0.250 (6.4)	
Load bearing length of anchor	ℓ_e	in. (mm)	1.20 (30)	1.20 (30)	1.94 (49)
Reduction factor for concrete breakout[3]	ϕ	-	0.70 (Condition B)		
Pryout Strength in Shear (ACI 318-14 17.5.3 or ACI 318-11 D.6.3)					
Coefficient for pryout strength	k_{cp}	-	1	1	1
Effective embedment	h_{ef}	in. (mm)	1.20 (30)	1.20 (30)	1.94 (49)
Reduction factor for pryout strength[3]	ϕ	-	0.70 (Condition B)		

For SI: 1 inch = 25.4 mm; 1 ksi = 6.894 N/mm²; 1 ft-lb = 1.356 N-m; 1 lb = 0.0044 kN.

1. The data in this table is intended to be used with the design provisions of ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-17 17.2.3 or ACI 318-11 D.3.3, as applicable shall apply.
2. Installation must comply with published instructions and details.
3. All values of ϕ were determined from the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3, or ACI 318-11 Section 9.2. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 Section D.4.4. For reinforcement that complies with ACI 318-14 Chapter 17 or ACI 318-11 Appendix D requirements for Condition A, see ACI 318-14 17.3.3(c) or ACI 318-11 D.4.3(c), as applicable, for the appropriate ϕ factor when the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3, or ACI 318-11 Section 9.2 are used.
4. The anchors are considered a brittle steel elements as defined by ACI 318-14 2.3 or ACI 318-11 D.1.
5. Reported values for steel strength in shear are based on test results per ACI 355.2, Section 9.4 and must be used for design in lieu of the calculated results using equation 17.5.1.2(b) of ACI 318-14 or equation D-29 in ACI 318-11 D.6.1.2.
6. Reported values for steel strength in shear are for seismic applications and based on test results in accordance with ACI 355.2, Section 9.6 and must be used for design.
7. Anchors are permitted to be used in lightweight concrete in provided the modification factor λa equal to 0.8λ is applied to all values of $\sqrt{f'c}$ affecting N_n.
8. Shear values are for threaded rod or steel inserts with an ultimate strength, $F_u \geq 125$ ksi; threaded rod or steel inserts with an F_u less than 125 ksi are allowed provided the steel strength shear values are multiplied by the ratio of F_u (ksi) of the steel insert and 125 ksi.

Tension and Shear Design Information for Hangermate+ Anchor in the Soffit (Through the Underside) of Concrete-Filled Steel Deck Assemblies[1,2,3,4,5,6,7]

CODE LISTED
ICC-ES ESR-3889

Anchor Property/Setting Information	Notation	Units	Nominal Anchor Size (inch)		
Anchor Category	1, 2 or 3	-	1	1	
Head Style	-	-	Threaded		
Thread Diameter	-	in.	1/4	3/8	
Minimum nominal embedment depth	h_{nom}	in. (mm)	1-5/8 (41)	1-5/8 (41)	2-1/2 (64)
Effective Embedment	h_{ef}	in. (mm)	1.20 (30)	1.20 (30)	1.94 (49)
Minimum hole depth	h_o	in. (mm)	1-3/4 (44)	1-3/4 (44)	2-5/8 (67)
Anchors Installed Through the Soffit of Steel Deck Assemblies into Concrete (Minimum 3-7/8-inch-wide deck flute)					
Minimum concrete member thickness[8]	$h_{min,deck,total}$	in. (mm)	5-1/2 (140)	5-1/2 (140)	
Characteristic pullout strength, uncracked concrete over steel deck, (3,000 psi)	$N_{p,deck,uncr}$	lb (kN)	1,430 (6.4)	1,430 (6.4)	
Characteristic pullout strength, cracked concrete over steel deck, (3,000 psi)	$N_{p,deck,cr}$	lb (kN)	615 (2.7)	615 (2.7)	
Characteristic pullout strength, cracked concrete over steel deck,seismic, (3,000 psi)	$N_{p,deck,eq}$	lb (kN)	290 (1.3)	290 (1.3)	
Reduction factor for pullout strength[9]	ϕ	-	0.65		
Steel strength in shear, concrete over steel deck	$V_{sa,deck}$	lb (kN)	1,485 (6.6)	2,740 (12.2)	
Steel strength in shear, concrete over steel deck, seismic	$V_{sa,deck,eq}$	lb (kN)	1,040 (4.6)	2,465 (11.0)	
Reduction factor for steel strength in shear for concrete over steel deck[9]	ϕ	-	0.60		
Anchors Installed Through the Soffit of Steel Deck Assemblies into Concrete (Minimum 1-3/4-inch-wide deck flute)					
Minimum concrete member thickness[8]	$h_{min,deck,total}$	in. (mm)	4 (102)	4 (102)	
Characteristic pullout strength, uncracked concrete over steel deck, (3,000 psi)	$N_{p,deck,uncr}$	lb (kN)	1,760 (7.8)	1,760 (7.8)	
Characteristic pullout strength, cracked concrete over steel deck, (3,000 psi)	$N_{p,deck,cr}$	lb (kN)	760 (3.4)	770 (3.4)	
Characteristic pullout strength, cracked concrete over steel deck,seismic, (3,000 psi)	$N_{p,deck,eq}$	lb (kN)	355 (1.6)	635 (2.8)	
Reduction factor for pullout strength[8]	ϕ	-	0.65		
Steel strength in shear, concrete over steel deck	$V_{sa,deck}$	lb (kN)	1,680 (7.5)	2,180 (9.7)	
Steel strength in shear, concrete over steel deck, seismic	$V_{sa,deck,eq}$	lb (kN)	1,175 (5.2)	1,960 (8.7)	
Reduction factor for steel strength in shear for concrete over steel deck[9]	ϕ	-	0.60		

For SI: 1 inch = 25.4 mm; 1 ksi = 6.894 N/mm²; 1 ft-lb = 1.356 N-m; 1 lb = 0.0044 kN.

1. Installation must comply with published instructions and details.
2. Values for $N_{p,deck}$ and $N_{p,deck,cr}$ are for sand-lightweight concrete (f'c, min = 3,000 psi) and additional lightweight concrete reduction factors need not be applied. In addition, evaluation for the concrete breakout capacity in accordance with ACI 318-14 17.4.2 or ACI 318 D.5.2, as applicable, is not required for anchors installed in the deck soffit (through underside).
3. Values for $N_{p,deck,eq}$ are applicable for seismic loading and must be used in lieu of $N_{p,deck,cr}$.
4. For all design cases $\Psi_{c,P}$ = 1.0. The characteristic pullout strength, N_{pn}, for concrete compressive strengths greater than 3,000 psi anchors may be increased by multiplying the value in the table by $(f'c / 3{,}000)^{0.3}$ for psi or $(f'c / 17.2)^{0.3}$ for MPa.
5. Shear loads for anchors installed through steel deck into concrete may be applied in any direction.
6. Values of $V_{sa,deck}$ and $V_{sa,deck,eq}$ are for sand-lightweight concrete and additional lightweight concrete reduction factors need not be applied. In addition, evaluation for the concrete breakout capacity in accordance with ACI 318-14 17.5.2 or ACI 318-11 D.6.2, as applicable, and the pryout capacity in accordance with ACI 318-14 17.5.3 or ACI 318-11 D.6.3, as applicable, are not required for anchors installed in the soffit (through underside).
7. Shear values are for threaded rod or steel inserts with an ultimate strength, $F_u \geq$ 125 ksi; threaded rod or steel inserts with an F_u less than 125 ksi are allowed provided the steel strength shear values are multiplied by the ratio of F_u (ksi) of the steel insert and 125 ksi.
8. The minimum concrete member thickness, $h_{min,deck,total}$, is the minimum overall thickness of the concrete-filled steel deck (depth and topping thickness).
9. All values of ϕ were determined from the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3 or ACI 318 Section 9.2. If the load combinations of ACI 318 Appendix C are used, then the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4 (ACI 318-08).

Factored Resistance Strength ($ØN_n$ And $ØV_n$) Calculated In Accordance With ACI 318-14 Chapter 17:

1- 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}.

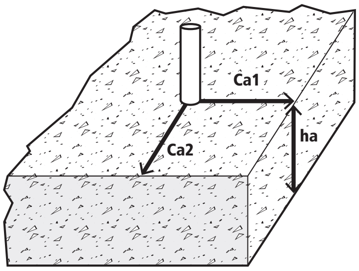
2- Calculations were performed according to ACI 318-14 Chapter 17. The load level corresponding to the controlling failure mode is listed. (e.g. For tension: steel, concrete breakout and pullout; For shear: steel, concrete breakout and pryout). Furthermore, the capacities for concrete breakout strength in tension and pryout strength in shear are calculated using the effective embedment values, hef, 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 318-14 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 318-14 Chapter 17.

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



Tension and Shear Design Strength Cracked Concrete

Nominal Anchor Diameter	Nominal Embed. Depth 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	
		øNn Tension (lbs.)	øVn Shear (lbs.)	øNn Tension (lbs.)	øVn Shear (lbs.)	øNn Tension (lbs.)	øVn Shear (lbs.)	øNn Tension (lbs.)	øVn Shear (lbs.)	øNn Tension (lbs.)	øVn Shear (lbs.)
1/4" (1/4" thread)	1-5/8	495	515	525	515	575	515	645	515	705	515
1/4" (3/8" thread)	1-5/8	495	780	525	855	575	925	645	925	705	925
	2-1/2	920	925	970	925	1,060	925	1,195	925	1,305	925

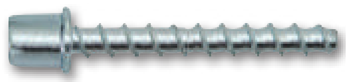
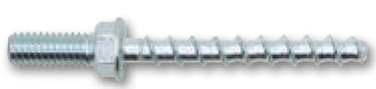
☐ - Anchor Pullout/Pryout Strength Controls ☐ - Concrete Breakout Strength Controls ■ - Steel Strength Controls

Tension and Shear Design Strength Uncracked Concrete

Nominal Anchor Diameter	Nominal Embed. Depth 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	
		øNn Tension (lbs.)	øVn Shear (lbs.)	øNn Tension (lbs.)	øVn Shear (lbs.)	øNn Tension (lbs.)	øVn Shear (lbs.)	øNn Tension (lbs.)	øVn Shear (lbs.)	øNn Tension (lbs.)	øVn Shear (lbs.)
1/4" (1/4" thread)	1-5/8	1,155	515	1,265	515	1,460	515	1,785	515	2,065	515
1/4" (3/8" thread)	1-5/8	1,155	925	1,265	925	1,460	925	1,785	925	2,065	925
	2-1/2	2,110	925	2,310	925	2,665	925	2,950	925	2,950	925

☐ - Anchor Pullout/Pryout Strength Controls ☐ - Concrete Breakout Strength Controls ■ - Steel Strength Controls

ORDERING INFORMATION

Catalog Number	Screw Size	Hang	Rod Size	Socket Size	Box Qty.	Ctn. Qty.	20V Max* SDS Plus Rotary Hammers			20V Max* Impact Wrench
							 DCH273P2DH 1" L-Shape	 DCH133M2 1" D-Handle	 DCH293R2 1-1/8" L-Shape w/ E-Clutch"	 DCF883L2 3/8" Impact Wrench
							Carbide Bits			Impact Rated Socket
										
Hangermate+ Internal Thread 										
PFM2211100	1/4" x 1-5/8"	Vertical	1/4"	3/8"	25	125	DW5517	DW5417	DW5417	DWMT19051B
PFM2211200	1/4" x 1-5/8"	Vertical	3/8"	1/2"	25	125	DW5517	DW5417	DW5417	DWMT19169B
PFM2211250	1/4" x 2-1/2"	Vertical	3/8"	1/2"	25	125	DW5517	DW5417	DW5417	DWMT19169B
Hangermate+ External Thread 										
PFM1421000	1/4" x 1-5/8"	Vertical	3/8"	1/2"	25	125	DW5517	DW5417	DW5417	DWMT19052B
PFM1421050	1/4" x 2-1/2"	Vertical	3/8"	1/2"	25	125	DW5517	DW5417	DW5417	DWMT19052B
The published size includes the diameter and length of the anchor measured from under the head.							▢ - Optimum Tool Match ▢ - Maximum Tool Match			

Zinc Economy Rod Coupling Nuts

Catalog Number	Coupler Size	Box Qty.	Ctn. Qty.
030007	3/8" - 16 x 1/2" x 1-1/8"	100	1000

Zinc Reducing Rod Coupling Nuts

Catalog Number	Coupler Size	Box Qty.	Ctn. Qty.
030016	3/8"-16 - 1/4"-20	50	1000
030017	1/2"-13 - 3/8"-16	50	500

GENERAL INFORMATION

MINI-UNDERCUT+™

Internally Threaded Undercut Anchor

PRODUCT DESCRIPTION

The Mini-Undercut+ anchor is an internally threaded, self-undercutting anchor designed for performance in cracked and uncracked concrete. Suitable base materials include post-tension concrete (PT slabs), hollow-core precast concrete, normal-weight concrete, sand-lightweight concrete and concrete over steel deck. The Mini-Undercut+ anchor is installed into a pre-drilled hole with a power tool and a setting tool. The result is an anchor which can provide consistent behavior at shallow embedments as low as 3/4 of an inch. After installation a steel element is threaded into the anchor body.

GENERAL APPLICATIONS AND USES

- Tension zones, seismic and wind loading applications
- Suspended Conduit
- Fire Sprinkler & pipe supports
- Cable Trays and Strut
- Suspended Lighting

FEATURE AND BENEFITS

+ Ideal for precast hollow-core plank and post-tensioned concrete slabs
+ Cracked concrete tested alternative to a mini dropin anchor
+ Redesigned ANSI carbide stop bit with enlarged shoulder for accurate depth
+ Anchor design allows for shallow embedment as low as 3/4 of an inch
+ Internally threaded anchor for easy adjustment and removability of threaded rod or bolt
+ Drill and drive the anchor with one tool for fast anchor installation

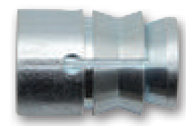
APPROVALS AND LISTINGS

- International Code Council, Evaluation Service (ICC-ES), ESR-3912 for Concrete and Hollow-Core precast slabs, Code Compliant with the 2015, IBC, 2015 IRC, 2012 IBC, 2012 IRC, 2009 IBC, and 2009 IRC.
- Qualified according to ACI 355.2 (including ASTM E 488) for use in concrete
- FM Approvals (Factory Mutual) – File No. J.I. 3059197

GUIDE SPECIFICATIONS

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

SECTION CONTENTS



MINI-UNDERCUT+

THREAD VERSION

- UNC Thread

ANCHOR MATERIALS

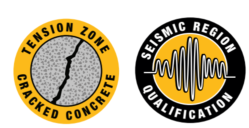
- Zinc plated carbon steel

ANCHOR SIZE RANGE (TYP.)

- 3/8"

SUITABLE BASE MATERIALS

- Post-Tension Concrete
- Precast Hollow-Core Plank
- Normal-weight concrete



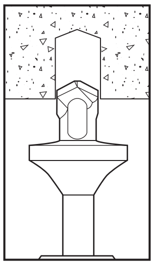
CODE LISTED
ICC-ES ESR-3912
CONCRETE

MECHANICAL ANCHORS

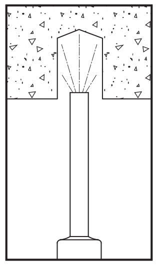
MINI-UNDERCUT+™
Internally Threaded Undercut Anchor

INSTALLATION INSTRUCTIONS

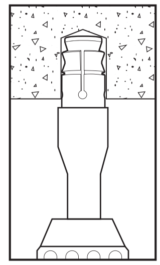
INSTALLATION PROCEDURE (USING SDS PLUS SYSTEM)



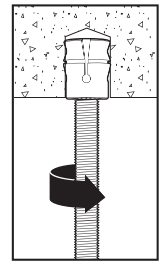
Using the required stop drill bit, drill a hole into the base material to the required depth using the shoulder of the drill bit as a guide. The tolerances of the drill bit used must meet the requirements of ANSI Standard B212.15.



Remove dust and debris from hole (e.g. suction, forced air) remove loose particles left from drilling.



Attach the required SDS setting tool to the hammer-drill. Mount the open end of the anchor onto the setting tool. Drive the anchor into the hole until the shoulder of the anchor is flush with the base material.



Insert threaded rod or bolt full depth into the Mini-Undercut+, taking care not to exceed the maximum tightening torque of the steel insert element, T_{max}.

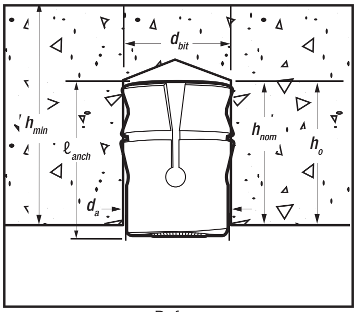
Installation Information for Mini-Undercut+ Anchor[1,2,3]

Anchor Property/Setting Information	Symbol	Units	Nominal Anchor Diameter (inch)
			3/8
Anchor outside diameter	d_a	in. (mm)	0.625 (15.9)
Internal thread diameter (UNC)	d	in. (mm)	3/8 (9.5)
Nominal drill bit diameter	d_{bit}	in. (mm)	5/8 ANSI
Minimum nominal embedment depth	h_{nom}	in. (mm)	3/4 (19)
Effective embedment depth	h_{ef}	in. (mm)	3/4 (19)
Hole depth	h_o	in. (mm)	3/4 (19)
Overall anchor length (before setting)	ℓ_{anch}	in. (mm)	15/16 (24)
Approximate tool impact power (hammer-drill)	-	J	2.1 to 2.8
Minimum diameter of hole clearance in fixture for steel insert element (following anchor installation)	d_h	in.	7/16
Minimum member thickness in normal-weight concrete	h_{min}	in. (mm)	2-1/2 (64)
Minimum cover thickness in hollow core concrete slabs (see Hollow-Core concrete figure)	$h_{min,core}$	in. (mm)	1-1/2 (38)
Critical edge distance	c_{ac}	in. (mm)	2-1/4 (57)
Minimum edge distance	c_{min}	in. (mm)	2-1/2 (64)
Minimum spacing distance	s_{min}	in. (mm)	2-3/4 (70)
Maximum installation torque	T_{max}	ft.-lb. (N-m)	5 (7)
Effective tensile stress area (undercut anchor body)	A_{se}	in.^{2} (mm^2)	0.044 (28.4)
Minimum specified ultimate strength	f_{uta}	psi (N/mm^2)	95,000 (655)
Minimum specified yield strength	f_{ya}	psi (N/mm^2)	76,000 (524)
Mean axial stiffness[4] – Uncracked concrete	β_{uncr}	lbf/in.	50,400
Mean axial stiffness[4] – Cracked concrete	β_{cr}	lbf/in.	29,120

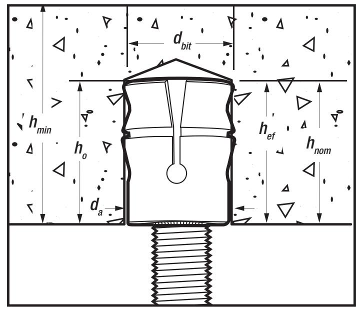
For SI: 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m.

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable.
2. For installation detail for anchors in hollow-core concrete slabs, see Hollow-Core concrete figure.
3. The embedment depth, h_{nom}, is measured from the outside surface of the concrete member to the embedded end of the anchor.
4. Mean values shown, actual stiffness varies considerably depending on concrete strength, loading and geometry of application.

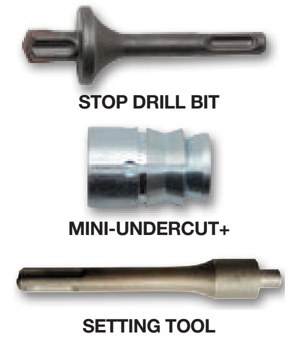
Mini-Undercut+ Anchor Detail



Before



After



Mini-Undercut+ Anchor Installed with Steel Insert Element

REFERENCE DATA (ASD)

Ultimate and Allowable Tension Load Capacities for Mini-Undercut+ in Normal-Weight Concrete[1,2,3]

Nominal Rod/ Anchor Diameter d in.	Minimum Nominal Embed. Depth in. (mm)	Minimum Concrete Compressive Strength							
		f'c = 3,000 psi (20.7 MPa)				f'c = 4,000 psi (27.6 MPa)			
		Ultimate		Allowable		Ultimate		Allowable	
		Tension lbs (kN)	Shear lbs (kN)	Tension lbs (kN)	Shear lbs (kN)	Tension lbs (kN)	Shear lbs (kN)	Tension lbs (kN)	Shear lbs (kN)
3/8	3/4 (19)	1,535 (6.8)	1,975 (8.8)	385 (1.7)	495 (2.2)	1,770 (7.9)	2,275 (10.1)	445 (2.0)	570 (2.5)

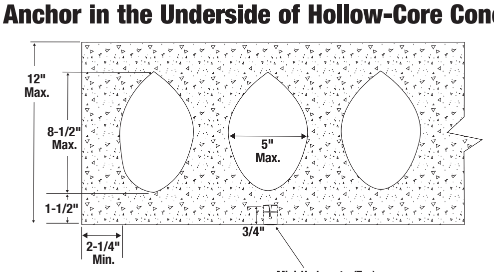
1. Tabulated load values are for anchors installed in concrete. Concrete compressive strength must be at the specified minimum at the time of installation.
2. Allowable load capacities are calculated using an applied safety factor 4.0.
3. Linear interpolation may be used to determine allowable loads for intermediate compressive strengths.

Ultimate and Allowable Tension Load Capacities for Mini-Undercut+ in Hollow-Core Plank[1,2,3]

Nominal Rod/ Anchor Diameter d in.	Minimum Nominal Embed. Depth in. (mm)	Minimum Concrete Compressive Strength											
		f'c = 5,000 psi (34.5 MPa)				f'c = 6,000 psi (41.4 MPa)				f'c = 8,000 psi (55.2 MPa)			
		Ultimate		Allowable		Ultimate		Allowable		Ultimate		Allowable	
		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)	Tension lbs (kN)	Shear lbs (kN)
3/8	3/4 (19)	1,855 (8.3)	2,590 (11.5)	465 (2.1)	650 (2.9)	2,035 (9.1)	2,835 (12.6)	510 (2.3)	710 (3.2)	2,345 (10.4)	3,275 (14.6)	585 (2.6)	820 (3.6)

1. Tabulated load values are for anchors installed in concrete. Concrete compressive strength must be at the specified minimum at the time of installation.
2. Allowable load capacities are calculated using an applied safety factor 4.0.
3. Linear interpolation may be used to determine allowable loads for intermediate compressive strengths.

Mini-Undercut+ Installed Detail for Anchor in the Underside of Hollow-Core Concrete slabs



STRENGTH DESIGN (SD)

Tension Design Information for Mini-Undercut+ Anchors in the Underside of Normal-weight Concrete and the Underside of Hollow-Core Concrete Slabs[1,2,3,4,5,6,7]

CODE LISTED ICC-ES ESR-3912

Design Characteristic	Notation	Units	Nominal Anchor Size / Threaded Rod Diameter (inch) 3/8
Anchor category	1, 2 or 3	-	1
Nominal embedment depth	h_{nom}	in. (mm)	3/4 (19)
Steel Strength In Tension (ACI 318-14 17.4.1 or ACI 318-11 D.5.1)			
Steel strength in tension	N_{sa}	lb (kN)	4,180 (18.6)
Reduction factor for steel strength	ϕ	-	0.65
Concrete Breakout Strength In Tension (ACI 318-14 17.4.2 or ACI 318-11 D.5.2)			
Effective embedment	h_{ef}	in. (mm)	3/4 (19)
Effectiveness factor for uncracked concrete	k_{uncr}	-	24
Effectiveness factor for cracked concrete	k_{cr}	-	17
Modification factor for cracked and uncracked concrete	$\Psi_{c,N}$	-	1.0 (see note 5)
Critical edge distance	c_{ac}	in. (mm)	2-1/4 (57)
Reduction factor, concrete breakout strength[3]	ϕ	-	0.40
Pullout Strength In Tension (ACI 318-14 17.4.3 or ACI 318-11 D.5.3)			
Pullout strength, uncracked concrete	$N_{p,uncr}$	lb (kN)	See note 7
Pullout strength, cracked concrete	$N_{p,cr}$	lb (kN)	455 (2.0)
Reduction factor, pullout strength	ϕ	-	0.40
Pullout Strength In Tension For Seismic Applications (ACI 318-14 17.2.3.3 or ACI 318-11 D.3.3.3)			
Characteristic pullout strength, seismic	$N_{p,eq}$	lb (kN)	410 (1.82)
Reduction factor, pullout strength, seismic	ϕ	-	0.40

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 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable, shall apply.
2. Installation must comply with manufacturer's published installation instructions and details.
3. All values of ϕ are applicable with the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3, or ACI 318-11 Section 9.2.
4. The threaded rod or bolt strength must also be checked, and the controlling value of ϕN_{sa} between the anchor and rod must be used for design.
5. Select the appropriate effectiveness factor for cracked concrete (k_{cr}) or uncracked concrete (k_{uncr}) and use $\psi_{c,N} = 1.0$.
6. The characteristic pullout strength for concrete compressive strengths greater than 2,500 psi for anchors may be increased by multiplying the value in the table by $(f'c / 2,500)^{0.5}$ for psi or $(f'c / 17.2)^{0.5}$. For hollow-core concrete slabs the characteristic pullout strength for concrete compressive strengths greater than 6,000 psi for anchors may be increased by multiplying the value in the table by $(f'c / 6,000)^{0.5}$ for psi or $(f'c / 41.4)^{0.5}$.
7. Reported values for characteristic pullout strength in tension for seismic applications are based on test results per ACI 355.2, Section 9.5.

CODE LISTED
ICC-ES ESR-3912

Shear Design Information for Mini-Undercut+ Anchors in the Underside of Normal-weight Concrete and the Underside of Hollow-Core Concrete Slabs[1,2,3,4,5,6]

Design Characteristic	Notation	Units	Nominal Anchor Size / Threaded Rod Diameter (inch)
			3/8
Anchor category	1, 2 or 3	-	1
Nominal embedment depth	h_{nom}	in. (mm)	3/4 (19)
Steel Strength in Shear (ACI 318-14 17.5.1 or ACI 318-11 D.6.1)			
Steel strength in shear	V_{sa}	lb (kN)	985 (4.4)
Reduction factor, steel strength	ϕ	-	0.60
Steel Strength in Shear for Seismic (ACI 318-14 17.2.3.3 or ACI 318-11 D.3.3.3)			
Steel strength in shear, seismic	$V_{sa, eq}$	lb (kN)	895 (4.0)
Reduction factor, steel strength in shear, seismic	ϕ	-	0.60
Concrete Breakout Strength in Shear (ACI 318-14 17.5.2 or ACI 318-11 D.6.2)			
Load bearing length of anchor in shear	ℓ_e	in. (mm)	3/4 (19)
Nominal outside anchor diameter	d_a	in. (mm)	0.625 (15.9)
Reduction factor for concrete breakout strength	ϕ	-	0.45
Pryout Strength in Shear (ACI 318-14 17.5.3 or ACI 318-11 D.6.3)			
Coefficient for pryout strength	k_{cp}	-	1.0
Effective embedment	h_{ef}	in. (mm)	3/4 (19)
Reduction factor, pryout strength	ϕ	-	0.45

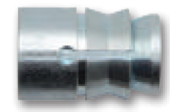
For SI: 1 inch = 25.4 mm, 1 lbf = 0.0044 kN.

1. The data in this table is intended to be used with the design provisions of ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-17 17.2.3 or ACI 318-11 D.3.3, as applicable shall apply
2. Installation must comply with manufacturer's published installation instructions and details.
3. All values of ϕ are applicable with the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3, or ACI 318-11 Section 9.2.
4. The strengths shown in the table are for the Mini-Undercut+ anchors only. Design professional is responsible for checking threaded rod strength in tension, shear, and combined tension and shear, as applicable.
5. Reported values for steel strength in shear are based on test results per ACI 355.2, Section 9.4 and must be used for design in lieu of the calculated results using equation 17.5.1.2b of ACI 318-14 or equation D-29 in ACI 318-11 D.6.1.2.
6. Reported values for steel strength in shear for the Mini-Undercut+ anchors are for seismic applications and based on test results in accordance with ACI 355.2, Section 9.6 and must be used for design.

ORDERING INFORMATION

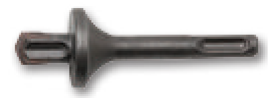
Mini-Undercut+

Cat. No.	Anchor Size	Rod/Anchor Dia.	Drill Diameter	Overall Length	Box Qty.	Ctn. Qty.
PFM2111820	3/8" x 3/4"	3/8"	5/8"	3/4"	100	600



Accu-Bit™ for DEWALT Mini-Undercut+

Cat. No.	Mini-Undercut+ Size	Rod/Anchor Dia.	Drill Diameter	Drill Depth	Std. Pack
PPA2431720	5/8" x 3/4" Stop Drill Bit - PT Anchor	3/8"	5/8"	3/4"	1



SDS Plus Setting Tool for DEWALT Mini-Undercut+

Cat. No.	Mini-Undercut+ Size	Rod/Anchor Dia.	Std. Pack
PFM2101720	3/8" SDS+ Setting Tool - PT Anchor	3/8"	1

Mini-Undercut+ Ordering Matrix

Description	Anchor Cat No.	Accu-Bit™ Cat. No.	SDS Plus Setting Tool Cat. No.	Recommended SDS Hammer-Tools (DEWALT)
3/8" x 3/4" Mini-Undercut+	PFM2111820	PPA2431720	PFM2101720	DCH273, DCH133, D25133, D25262

GENERAL INFORMATION

WOOD-KNOCKER® II+

Concrete Inserts

PRODUCT DESCRIPTION

Wood-Knocker II concrete inserts are specifically designed to provide hangar attachments for mechanical, electrical, plumbing (MEP) and fire protection.

Wood-Knocker II+ concrete inserts are installed onto wooden forms used to support newly poured concrete floor slabs, roof slabs or walls.

When the forms are stripped, the color-coded flange is visibly embedded in the concrete surface. The inserts allow the attachment of steel threaded rod or threaded bolts in sizes ranging from 1/4" to 3/4" in diameter, including a 3/8-1/2" multi insert. The hex impact plate offers resistance to rotation within the concrete as a steel threaded rod or threaded bolt is being installed.

GENERAL APPLICATIONS AND USES

- Hanging Pipe and Sprinkler Systems
- HVAC Ductwork and Strut Channels
- Suspending Trapeze and Cable Trays
- Mechanical Unit Overhead Utilities
- Conduit and Lighting System
- Seismic Loading and Cracked Concrete

FEATURES AND BENEFITS

+ Fast and simple to install, low installed cost
+ Color coded by size for simple identification
+ Wood-Knocker II+ can be installed in wood form pours only 3.5" thick
+ Hex head does not rotate when set
+ Insert design allows for full thread engagement
+ All sizes suitable for tension and shear loading

APPROVALS AND LISTINGS

- International Code Council, Evaluation Service (ICC-ES), ESR-3657 for concrete. Approved for seismic and wind loading (all diameters)
- Code compliant with the 2015 IBC, 2015 IRC, 2012 IBC, 2012 IRC, 2009 IBC, and 2009 IRC
- Tested in accordance with ASTM E 488 and ICC-ES AC446 for use in concrete under the design provisions of ACI 318 (Strength Design method)
- Evaluated and qualified by an accredited independent testing laboratory for recognition in cracked and uncracked concrete
- Underwriters Laboratories (UL Listed) - File No. EX1289, see listing for sizes. Also UL listed and recognized for use in air handling spaces.
- FM Approvals (Factory Mutual) – File No. J.I. 3059197

GUIDE SPECIFICATIONS

CSI Divisions: 03 15 19 - Cast-In Concrete Anchors and 03 16 00 - Concrete Anchors. Concrete inserts shall be Wood-Knocker II+ as supplied by DEWALT, Towson, MD.

SECTION CONTENTS

**WOOD-KNOCKER II+
WOOD FORM INSERT**

ANCHOR MATERIALS

- Carbon Steel and Engineered Plastic

ROD/ANCHOR SIZE RANGE (TYP.)

- 1/4" to 3/4" threaded rod for Wood-Knocker Concrete Inserts

SUITABLE BASE MATERIALS

- Normal-Weight Concrete
- Lightweight Concrete

TENSION ZONE CRACKED CONCRETE

SEISMIC REGION QUALIFICATION

CODE LISTED
ICC-ES ESR-3657
CONCRETE

MATERIAL SPECIFICATIONS

Wood-Knocker II+

Anchor Component	Component Material
Insert Body	AISI 1008 Carbon Steel or equivalent
Flange	Engineered Plastic
Zinc Plating	ASTM B 633 (Fe/Zn5) Min. plating requirements for mild service condition

Material Properties for Threaded Rod

Steel Description	Steel Specification (ASTM)	Rod Diameter (inch)	Minimum Yield Strength, f_y (ksi)	Minimum Ultimate Strength, f_u (ksi)
Standard carbon rod	A 36 or A 307, Grade C	1/4 to 3/4	36.0	58.0
High strength carbon rod	A 193, Grade B7	1/4 to 3/4	105.0	125.0

Allowable Steel Strength for Threaded Rod

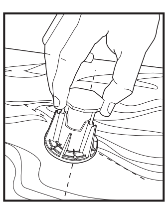
Anchor Diameter d in. (mm)	Nominal Area of Rod in.^{2} (mm^2)	Allowable Tension			Allowable Shear		
		ASTM A36 lbs. (kN)	ASTM A307 Grade C lbs. (kN)	ASTM A193 Grade B7 lbs. (kN)	ASTM A36 lbs. (kN)	ASTM A307 Grade C lbs. (kN)	ASTM A193 Grade B7 lbs. (kN)
1/4 (6.4)	0.0491 (1.2)	940 (4.2)	940 (4.2)	2,160 (9.7)	485 (2.2)	485 (2.2)	1,030 (4.6)
3/8 (9.5)	0.1104 (2.8)	2,115 (9.5)	2,115 (9.5)	4,375 (19.7)	1,090 (4.9)	1,090 (4.9)	2,255 (10.1)
1/2 (12.7)	0.1963 (5.0)	3,755 (16.9)	3,755 (16.9)	7,775 (35.0)	1,940 (8.7)	1,940 (8.7)	4,055 (18.2)
5/8 (15.9)	0.3068 (7.8)	5,870 (26.4)	5,870 (26.4)	12,150 (54.7)	3,025 (13.6)	3,025 (13.6)	6,260 (28.2)
3/4 (19.1)	0.4418 (11.2)	8,455 (38.0)	8,455 (38.0)	17,495 (78.7)	4,355 (19.6)	4,355 (19.6)	9,010 (40.5)

Allowable tension = f_u (A_{nom}) (0.33); Allowable shear = f_u (A_{nom}) (0.17)

INSTALLATION INSTRUCTIONS

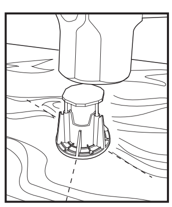
Installation Instructions for Wood-Knocker II+

Position



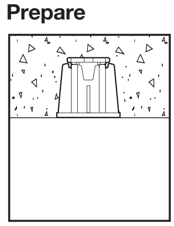
Step 1
Position insert on formwork plastic down.

Drive



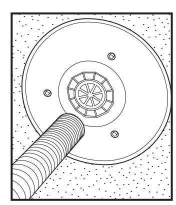
Step 2
Drive insert head down until head contacts plastic.

Prepare



Step 3
After formwork removal, remove nails as necessary(e.g. flush mounted fixtures).

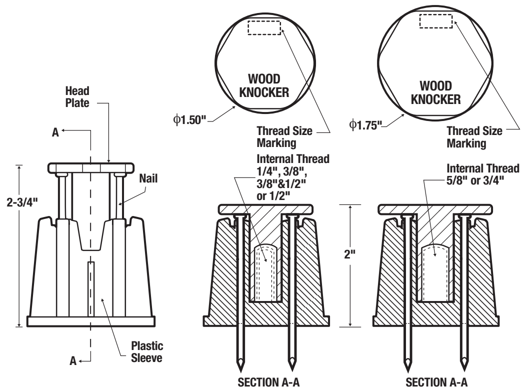
Attach



Step 4
After concrete pour and cure, install threaded steel element (rod/bolt) into the insert by firmly pushing threaded rod through plastic center to puncture thread seal. Attach fixture as applicable (e.g. seismic brace).

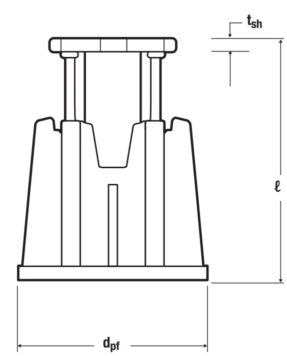
INSTALLATION SPECIFICATIONS

Wood-Knocker II+ Cast-In-Place Inserts for Form Pour Concrete



Wood-Knocker II+

Dimension	Notation	Nominal Rod/Anchor Size				
		1/4"	3/8"	1/2"	5/8"	3/4"
Insert Thread Length (in.)	-	3/8	5/8	11/16	15/16	1-1/8
Plastic Flange Dia. (in.)	d_{pf}	2-3/8	2-3/8	2-3/8	2-3/8	2-3/8
Plastic Flange Thickness (in.)	-	1/8	1/8	1/8	1/8	1/8
Thread Size, UNC	-	1/4-20	3/8-16	1/2-13	5/8-11	3/4-10
Overall Length, after setting (in.)	ℓ	2	2	2	2	2
Break-Off Nail Length (in.)	ℓ_n	3/4	3/4	3/4	3/4	3/4
Steel Flange Thickness (in.)	t_{sh}	1/8	1/8	1/8	1/8	1/8



REFERENCE DATA (ASD)

Ultimate and Allowable Load Capacities for Wood-Knocker II+ Inserts Installed in Normal-Weight Concrete[1,2,3]

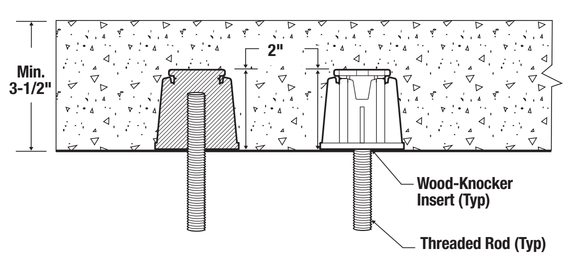
Rod/Insert Diameter d in. (mm)	Nominal Embedment Depth h_v in. (mm)	Insert Spacing in. (mm)	Edge Distance in. (mm)	Minimum Concrete Compressive Strength (f´c)							
				3,000 psi (20.7 MPa)				4,500 psi (31.1 MPa)			
				Ultimate Load		Allowable Load		Ultimate Load		Allowable Load	
				Tension lbs. (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)	2 (50.8)	6 (152)	6 (152)	3,720 (16.7)	1,490 (6.9)	1,240 (5.6)	495 (2.2)	4,250 (19.1)	1,610 (7.2)	1,415 (6.4)	535 (2.4)
3/8 (9.5)	2 (50.8)	6 (152)	6 (152)	4,820 (21.7)	5,330 (24.0)	1,605 (7.2)	1,775 (8.0)	7,190 (32.4)	5,620 (25.3)	2,395 (10.8)	1,875 (8.4)
1/2 (12.7)	2 (50.8)	6 (152)	6 (152)	4,820 (21.7)	7,400 (33.3)	1,605 (7.2)	2,465 (11.1)	7,190 (32.4)	8,590 (38.7)	2,395 (10.8)	2,865 (12.9)
5/8 (15.9)	2 (50.8)	6 (152)	6 (152)	4,650 (20.9)	11,360 (51.1)	1,550 (7.0)	3,785 (17.0)	7,350 (33.1)	13,010 (58.3)	2,450 (12.7)	4,335 (19.5)
3/4 (19.1)	2 (50.8)	6 (152)	6 (152)	4,650 (20.9)	11,360 (51.1)	1,550 (7.0)	3,785 (17.0)	7,350 (33.1)	14,590 (65.9)	2,450 (11.0)	4,865 (21.9)

1. Allowable load capacities listed are calculated using an applied safety factor of 3.0.
2. The allowable working load must be the lesser of the insert capacity or the steel strength of the threaded rod.
3. Linear interpolation may be used to determine ultimate loads for intermediate compressive strengths.

Ultimate and Allowable Load Capacities for Wood-Knocker II+ Inserts Installed in Sand-lightweight Concrete[1,2]

Rod/Insert Diameter d in. (mm)	Nominal Embedment Depth h_v in. (mm)	Insert Spacing in. (mm)	Edge Distance in. (mm)	f´c ≥ 3,000 psi (20.7 MPa)			
				Ultimate Load		Allowable Load	
				Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
1/4 (6.4)	2 (50.8)	6 (152)	6 (152)	3,570 (15.9)	1,380 (6.1)	1,190 (5.3)	460 (2.0)
3/8 (9.5)	2 (50.8)	6 (152)	6 (152)	4,270 (19.2)	5,280 (23.8)	1,425 (6.4)	1,760 (7.9)
1/2 (12.7)	2 (50.8)	6 (152)	6 (152)	4,270 (19.2)	7,180 (32.3)	1,425 (6.4)	2,395 (10.8)
5/8 (15.9)	2 (50.8)	6 (152)	6 (152)	4,600 (20.7)	7,590 (34.2)	1,535 (6.9)	2,530 (11.4)
3/4 (19.1)	2 (50.8)	6 (152)	6 (152)	4,600 (20.7)	7,590 (34.2)	1,535 (6.9)	2,530 (11.4)

1. Allowable load capacities listed are calculated using an applied safety factor of 3.0.
2. The allowable working load must be the lesser of the insert capacity or the steel strength of the threaded rod.
3. For 1/4", 3/8" and 1/2" Wood-Knocker II: When the inserts are spaced 3" center-to-center the inserts allowable tension capacity must be reduced by 25 percent and the allowable shear capacity reduced by 15 percent. When the inserts have a 3" edge distance the inserts allowable tension capacity does not require a reduction and the allowable shear capacity must be reduced by 40 percent.



STRENGTH DESIGN (SD)

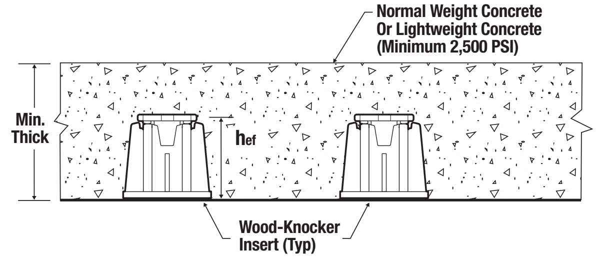
Wood-Knocker II+ Insert Design Information[1,2,3,4,5,6,7,8]

Design Information	Symbol	Units	1/4-inch	3/8-inch	1/2-inch	5/8-inch	3/4-inch
Insert O.D.	d_a (d_o)	in. (mm)	0.7 (18)	0.7 (18)	0.7 (18)	1.0 (25)	1.0 (25)
Insert head net bearing area	A_{brg}	in² (mm²)	1.20 (762)	1.20 (762)	1.20 (762)	1.30 (839)	1.30 (839)
Effective embedment depth	h_{ef}	in. (mm)	1.75 (45)	1.75 (45)	1.75 (45)	1.75 (45)	1.75 (45)
Minimum member thickness	h_{min}	-	3.5 (89)	3.5 (89)	3.5 (89)	3.5 (89)	3.5 (89)
Effectiveness factor for cracked concrete	k_c	- (SI)	24 (10)	24 (10)	24 (10)	24 (10)	24 (10)
Modification factor for tension strength in uncracked concrete	$\Psi_{c,N}$	-	1.25	1.25	1.25	1.25	1.25
Nominal tension strength of single insert as governed by steel strength	$N_{sa,insert}$	lb (kN)	10,270 (45.7)	10,270 (45.7)	9,005 (40.1)	12,685 (56.4)	12,685 (56.4)
Nominal tension strength of single insert as governed by steel strength, for seismic loading	$N_{sa,insert,eq}$	lb (kN)	10,270 (45.7)	10,270 (45.7)	9,005 (40.1)	12,685 (56.4)	12,685 (56.4)
Nominal steel shear strength of single insert	$V_{sa,insert}$	lb (kN)	7,180 (31.9)	7,180 (31.9)	7,180 (31.9)	9,075 (40.4)	9,075 (40.4)
Nominal steel shear strength of single insert, for seismic loading	$V_{sa,insert,eq}$	lb (kN)	7,180 (31.9)	7,180 (31.9)	7,180 (31.9)	9,075 (40.4)	9,075 (40.4)

For SI: 1 inch = 25.4 mm, 1 inch² = 635 mm², 1 pound = 0.00445 kN, 1 psi = 0.006895 MPa. For pound-inch unit: 1 mm = 0.03937 inches.

1. Concrete must have a compressive strength f'c of 2,500 psi minimum.
2. Design of headed cast-in specialty inserts shall be in accordance with the provisions of ACI 318 Appendix D for cast-in headed anchors.
3. Strength reduction factors for the inserts shall be taken from ACI 318-11 D.4.3 for cast-in headed anchors. Strength reduction factors for load combinations in accordance with ACI 318 Section 9.2 governed by steel strength of the insert shall be taken as 0.65 for tension and 0.60 for shear; values correspond to brittle steel elements. The value of ϕ applies when the load combinations of Section 1605.2 of the IBC or ACI 318 Section 9.2 are used in accordance with ACI 318 D.4.3. If the load combinations of ACI 318 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318 D.4.4.
4. The concrete tension strength of headed cast-in specialty inserts shall be calculated in accordance with ACI 318 Appendix D.
5. Insert O.D. is the outside diameter of the headed insert body.
6. Only the largest size of threaded rod or bolt for the 3/8 & 1/2 inch multi insert must be used for applications resisting shear loads.
7. Minimum spacing distance between anchors and minimum edge distance for cast-in Wood-Knocker anchors shall be in accordance with ACI 318 D.8.
8. The strengths shown in the table are for inserts only. Design professional is responsible for checking threaded rod or bolt strength in tension, shear, and combined tension and shear, as applicable. See Steel Design Information table for common threaded rod elements.

Wood-Knocker II+ Insert Installed in Soffit of Form Pour Concrete Floor and Roof Assemblies



1. Inserts may be placed in the upper flute or lower flute of the steel deck assembly. Inserts in the lower flute require a minimum 1.5" of concrete topping thickness (min. thick) from the top of the deck at the location of the installation. Upper flute installations require a minimum 3" topping thickness concrete (min. thick) from the top of the deck at the location of the installation.
2. Axial spacing for Bang-It inserts along the flute length shall be minimum $3h_{ef}$.
3. Upper flute Bang-It+ inserts are not subject to steel deck dimension limitations, or the minimum steel deck gauge limitations.
4. Inserts in the lower flute of 4-1/2-inch W-Deck may be installed with a maximum 1-1/8 -inch offset in either direction from the center of the flute. The offset distance may be increased for flute widths greater than those shown provided the minimum lower flute edge distance of 1-1/8 -inch is also satisfied.
5. Inserts in the lower flute of B-Deck may be installed with a maximum 1/8 -inch offset in either direction from the center of the flute. The offset distance may be increased for flute widths greater than those shown provided the minimum lower flute edge distance of 3/4 -inch is also satisfied.
6. Lower flute installations of B-Deck with flutes widths greater than 1-3/4 -inch are permitted.
7. Lower flute installations of B-Deck in flute depths greater than 1-1/2 -inch are permitted provided the minimum edge distance of 3/4 -inch is met and the minimum lower flute width is increased proportionally (e.g. applicable to a lower flute depth of 2-inch with a minimum lower flute width of 2-1/4 -inch).
8. Inserts in the lower flute of 3-7/8-inch W-Deck may be installed with a maximum 1-3/16 -inch offset in either direction from the center of the flute.

Specifications And Physical Properties Of Common Carbon Steel Threaded Rod Elements[1]

Threaded Rod Specification		Units	Min. Specified Ultimate Strength, F_{uta}	Min. Specified Yield Strength 0.2 Percent Offset, F_{ya}	$\frac{F_{uta}}{F_{ya}}$	Elongation Minimum Percent[5]	Reduction Of Area Min. Percent	Related Nut Specification[6]
Carbon Steel	ASTM A36/A36M[2] and F1554[3] Grade 36	psi (MPa)	58,000 (400)	36,000 (248)	1.61	23	40 (50 for A36)	ASTM A194 / A563 Grade A
	ASTM F1554[3] Grade 105	psi (MPa)	125,000 (862)	105,000 (724)	1.19	15	45	ASTM A194 / A563 Grade DH
	ASTM A193/A193M[4] Grade B7	psi (MPa)	125,000 (860)	105,000 (720)	1.19	16	50	

For SI: 1 inch = 25.4 mm, 1 psi = 0.006897 MPa. For pound-inch units: 1 mm = 0.03937 inch, 1 MPa = 145.0 psi.

1. Inserts may be used in conjunction with all grades of continuously threaded carbon steels (all-thread) that comply with code reference standards and that have thread characteristics comparable with ANSI B1.1 UNC Coarse Thread Series.
2. Standard Specification for Carbon Structural Steel.
3. Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
4. Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications.
5. Based on 2-inch (50 mm) gauge length except ASTM A193, which are based on a gauge length of 4d (d_{rod}).
6. Where nuts are applicable, nuts of other grades and style having specified proof load stress greater than the specified grade and style are also suitable.

Steel Design Information For Common Threaded Rod Elements Used With Concrete Inserts[1,2,3,4]

Design Information	Symbol	Units	1/4-inch	3/8-inch	1/2-inch	5/8-inch	3/4-inch
Threaded rod nominal outside diameter	d_{rod}	in. (mm)	0.250 (6.4)	0.375 (9.5)	0.500 (12.7)	0.625 (15.9)	0.750 (19.1)
Threaded rod effective cross-sectional area	A_{se}	in² (mm²)	0.032 (21)	0.078 (50)	0.142 (92)	0.226 (146)	0.335 (216)
Nominal tension strength of ASTM A36 threaded rod as governed by steel strength	$N_{sa,rod,A36}$	lb (kN)	1,855 (8.2)	4,525 (20.0)	8,235 (36.6)	13,110 (58.3)	19,430 (86.3)
Nominal seismic tension strength of ASTM A36 threaded rod as governed by steel strength	$N_{sa,rod,A36,eq}$	lb (kN)	1,855 (8.2)	4,525 (20.0)	8,235 (36.6)	13,110 (58.3)	19,430 (86.4)
Nominal tension strength of ASTM A193, Gr. B7 threaded rod as governed by steel strength	$N_{sa,rod,B7}$	lb (kN)	4,000 (17.7)	9,750 (43.1)	17,750 (78.9)	28,250 (125.7)	41,875 (186.0)
Nominal seismic tension strength of ASTM A193, Gr. B7 threaded rod as governed by steel strength	$N_{sa,rod,B7,eq}$	lb (kN)	4,000 (17.7)	9,750 (43.1)	17,750 (78.9)	28,250 (125.7)	41,875 (186.0)
Nominal shear strength of ASTM A36 threaded rod as governed by steel strength	$V_{sa,rod,A36}$	lb (kN)	1,115 (4.9)	2,715 (12.1)	4,940 (22.0)	7,865 (35.0)	11,660 (51.9)
Nominal seismic shear strength of ASTM A36 threaded rod as governed by steel strength	$V_{sa,rod,A36,eq}$	lb (kN)	780 (3.5)	1,900 (8.4)	3,460 (15.4)	5,505 (24.5)	8,160 (36.3)
Nominal shear strength of ASTM A193, Gr. B7 threaded rod as governed by steel strength	$V_{sa,rod,B7}$	lb (kN)	2,385 (10.6)	5,815 (25.9)	10,640 (7.3)	16,950 (75.4)	25,085 (111.6)
Nominal seismic shear strength of ASTM A193, Gr. B7 threaded rod as governed by steel strength	$V_{sa,rod,B7,eq}$	lb (kN)	1,680 (7.5)	4,095 (18.2)	7,455 (34.2)	11,865 (52.8)	17,590 (78.2)

For SI: 1 inch = 25.4 mm, 1 pound = 0.00445 kN, 1 in² = 645.2 mm². For pound-inch unit: 1 mm = 0.03937 inches.

1. Values provided for steel element material types based on minimum specified strengths and calculated in accordance with ACI 318-11 Eq. (D-2) and Eq. (D-29).
2. ϕN_{sa} shall be the lower of the $\phi N_{sa,rod}$ or $\phi N_{sa,insert}$ for static steel strength in tension; for seismic loading $\phi N_{sa,eq}$ shall be the lower of the $\phi N_{sa,rod,eq}$ or $\phi N_{sa,insert,eq}$.
3. ϕV_{sa} shall be the lower of the $\phi V_{sa,rod}$ or $\phi V_{sa,insert}$ for static steel strength in tension; for seismic loading $\phi V_{sa,eq}$ shall be the lower of the $\phi V_{sa,rod,eq}$ or $\phi V_{sa,insert,eq}$.
4. Strength reduction factors shall be taken from ACI 318-11 D.4.3 for steel elements. Strength reduction factors for load combinations in accordance with ACI 318 Section 9.2 governed by steel strength shall be taken as 0.75 for tension and 0.70 for shear for ductile steel elements; values correspond to ductile steel elements. The value of ϕ applies when the load combinations of Section 1605.2 of the IBC or ACI 318 Section 9.2 are used in accordance with ACI 318 D.4.3. If the load combinations of ACI 318 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318 D.4.4.

Tension and Shear Design Strengths for Wood-Knocker II+ Insert Installed in the Soffit of Form Poured Concrete and Roof Assemblies - Uncracked Concrete[1,2,3,4,5,6]

Nominal Anchor Diameter	Embed. Depth h_{ef} (in.)	Minimum Concrete Compressive Strength					
		f'c = 3,000 psi		f'c = 4,000 psi		f'c = 6,000 psi	
		ϕNn Tension (lbs.)	ϕVn Shear (lbs.)	ϕNn Tension (lbs.)	ϕVn Shear (lbs.)	ϕNn Tension (lbs.)	ϕVn Shear (lbs.)
1/4	1-3/4	2,665	2,420	3,075	2,795	3,765	3,425
3/8	1-3/4	2,665	2,420	3,075	2,795	3,765	3,425
1/2	1-3/4	2,665	2,420	3,075	2,795	3,765	3,425
5/8	1-3/4	2,665	2,665	3,075	3,075	3,765	3,765
3/4	1-3/4	2,665	2,665	3,075	3,075	3,765	3,765

☐ - Anchor Pullout/Pryout Strength Controls ☐ - Concrete Breakout Strength Controls ■ - Steel Strength Controls

Tension and Shear Design Strengths for Wood-Knocker II+ Insert Installed in the Soffit of Form Poured Concrete and Roof Assemblies - Cracked Concrete[1,2,3,4,5,6]

Nominal Anchor Diameter	Embed. Depth h_{ef} (in.)	Minimum Concrete Compressive Strength					
		f'c = 3,000 psi		f'c = 4,000 psi		f'c = 6,000 psi	
		ϕNn Tension (lbs.)	ϕVn Shear (lbs.)	ϕNn Tension (lbs.)	ϕVn Shear (lbs.)	ϕNn Tension (lbs.)	ϕVn Shear (lbs.)
1/4	1-3/4	2,130	1,730	2,460	2,000	3,015	2,445
3/8	1-3/4	2,130	1,730	2,460	2,000	3,015	2,445
1/2	1-3/4	2,130	1,730	2,460	2,000	3,015	2,445
5/8	1-3/4	2,130	2,130	2,460	2,460	3,015	3,015
3/4	1-3/4	2,130	2,130	2,460	2,460	3,015	3,015

☐ - Anchor Pullout/Pryout Strength Controls ☐ - 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, $h_a = h_{min}$, and with the following conditions:
   - c_{a1} is greater than or equal to the critical edge distance, c_{ac}.
   - c_{a2} is greater than or equal to 1.5 times c_{a1}.

2- Calculations were performed following methodology in ACI 318-11 Appendix D. The load level corresponding to the failure mode listed [steel strength of insert ($N_{sa,insert}$, $V_{sa,insert}$), concrete breakout strength, or pryout strength] must be checked against the tabulated steel strength of the corresponding threaded rod type, ($N_{sa,rod}$, $V_{sa,rod}$), the lowest load level controls.

3- Strength reduction factors (ø) for the inserts are based on ACI 318-11 D.4.3 for cast-in headed anchors. Condition B is assumed. Strength reduction factors for load combinations in accordance with ACI 318 Section 9.2 governed by steel strength of the insert are taken as 0.65 for tension and 0.60 for shear; values correspond to brittle steel elements.

4- Tabular values are permitted for short-term 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 318-11 Appendix D.

6- Interpolation is not permitted to be used with the tabular values. For intermediate base material compressive strengths please see ACI 318-11 Appendix D and information contained in this product supplement. For other design conditions including seismic considerations please see ACI 318-11 Appendix D.

Tension and Shear Design Strength of Steel Elements (Steel Strength)[1,2,3,4]

Nominal Rod Diameter (in. or No.)	Steel Elements - Threaded Rod			
	ASTM A36 and ASTM F1554 Grade 36		ASTM A193 Grade B7 and ASTM F1554 Grade 105	
	$\phi N_{sa,rod}$ Tension (lbs.)	$\phi V_{sa,rod}$ Shear (lbs.)	$\phi N_{sa,rod}$ Tension (lbs.)	$\phi V_{sa,rod}$ Shear (lbs.)
1/4	1,390	720	3,000	1,550
3/8	3,395	1,750	7,315	3,780
1/2	6,175	3,210	13,315	6,915
5/8	9,835	5,115	21,190	11,020
3/4	14,550	7,565	31,405	16,305

■ - Steel Strength Controls

1. Steel tensile design strength according to ACI 318 Appendix D, $\phi N_{sa} = \phi \bullet A_{se,N} \bullet f_{uta}$
2. The tabulated steel design strength in tension for the threaded rod must be checked against the design strength of the steel insert, concrete breakout and pullout design strength to determine the controlling failure mode, the lowest load level controls.
3. Steel shear design strength according to ACI 318 Appendix D, $\phi N_{sa} = \phi \bullet 0.60 \bullet A_{se,N} \bullet f_{uta}$
4. The tabulated steel design strength in shear for the threaded rod must be checked against the design strength of the steel insert, concrete breakout and pryout design strength to determine the controlling failure mode, the lowest load level controls

ORDERING INFORMATION

Wood-Knocker®II+ Form Insert (UNC)

Cat No.	Description	Color Code	Std. Box
PFM2521100	1/4" Wood-Knocker II+ Insert	Brown	100
PFM2521150	3/8" Wood-Knocker II+ Insert	Green	100
PFM2521200	1/2" Wood-Knocker II+ Insert	Yellow	100
PFM2521250	5/8" Wood-Knocker II+ Insert	Red	100
PFM2521300	3/4" Wood-Knocker II+ Insert	Purple	100
PFM2521350	3/8"-1/2" Wood-Knocker II+ Multi Insert	Gray	100
Threaded Inserts are color coded to easily identify location and diameter of the internally threaded coupling, allowing multiple trades on the same job to suspend their systems with various size steel threaded rods.			

Wood-Knocker®II+ Form Insert (UNC) with no nails

Cat No.	Description	Color Code	Std. Box
PFM2521100NN	1/4" Wood-Knocker II+ Insert with no nails	Brown	100
PFM2521150NN	3/8" Wood-Knocker II+ Insert with no nails	Green	100
PFM2521200NN	1/2" Wood-Knocker II+ Insert with no nails	Yellow	100
PFM2521250NN	5/8" Wood-Knocker II+ Insert with no nails	Red	100
PFM2521300NN	3/4" Wood-Knocker II+ Insert with no nails	Purple	100
PFM2521350NN	3/8-1/2" Wood-Knocker II+ Multi Insert with no nails	Gray	100
Wood-Knocker II+ Form Inserts with no nails must be screwed to the concrete form work (screws not included).			

GENERAL INFORMATION

BANG-IT®+

Concrete Inserts

PRODUCT DESCRIPTION

Bang-It+ concrete inserts are specifically designed to provide hangar attachments for mechanical, electrical, plumbing (MEP) and fire protection.

Bang-It+ concrete inserts are designed for installation in and through composite steel deck (i.e. "pan-deck") used to support newly poured concrete floors or roof slabs.

After installation, the protective sleeve of the insert protrudes below the surface of the deck. The sleeves are color coded by size and allow overhead attachment of steel threaded rod in sizes ranging from 1/4" to 3/4" in diameter, including a 3/8-1/2" multi insert. The sleeve prevents sprayed fireproofing material and acoustical dampening products from clogging the internal threads of the insert. It also prevents burying, masking or losing the insert location. A hex impact plate offers resistance to rotation within the concrete as a steel threaded rod is being installed.

GENERAL APPLICATIONS AND USES

- Hanging Pipe and Sprinkler Systems
- HVAC Ductwork and Strut Channels
- Suspending Trapeze and Cable Trays
- Mechanical Unit Overhead Utilities
- Conduit and Lighting System
- Seismic Loading and Cracked Concrete

FEATURES AND BENEFITS

+ Fast and simple to install, low installed cost
+ Color coded by size for simple identification
+ Bang-It+ can be installed in lower flute of steel deck as little as 1.5" topping thickness (see details)
+ Hex head does not rotate when set
+ Insert design allows for full thread engagement
+ All sizes suitable for tension and shear loading

APPROVALS AND LISTINGS

- International Code Council, Evaluation Service (ICC-ES), ESR-3657 for concrete. Approved for seismic and wind loading (all diameters)
- Code compliant with the 2015 IBC, 2015 IRC, 2012 IBC, 2012 IRC, 2009 IBC, and 2009 IRC
- Tested in accordance with ASTM E 488 and ICC-ES AC446 for use in concrete under the design provisions of ACI 318 (Strength Design method)
- Evaluated and qualified by an accredited independent testing laboratory for recognition in cracked and uncracked concrete
- Underwriters Laboratories (UL Listed) - File No. EX1289, see listing for sizes. Also UL listed and recognized for use in air handling spaces.
- FM Approvals (Factory Mutual) – File No. J.I. 3015153

GUIDE SPECIFICATIONS

CSI Divisions: 03 15 19 - Cast-In Concrete Anchors and 03 16 00 - Concrete Anchors. Concrete inserts shall be Bang-It+ as supplied by DEWALT, Towson, MD.

SECTION CONTENTS

BANG-IT+
STEEL DECK INSERT

ANCHOR MATERIALS

- Carbon Steel and Engineered Plastic

ROD/ANCHOR SIZE RANGE (TYP.)

- 1/4" to 3/4" threaded rod for Bang-It Concrete Inserts

SUITABLE BASE MATERIALS

- Normal-Weight Concrete
- Lightweight Concrete

CODE LISTED
ICC-ES ESR-3657
CONCRETE

MATERIAL SPECIFICATIONS

Bang-It+

Anchor Component	Component Material
Insert Body	AISI 1008 Carbon Steel or equivalent
Flange	AISI 1008 Carbon Steel or equivalent
Spring	Steel Music Wire
Protective Sleeve	Engineered Plastic
Zinc Plating	ASTM B 633 (Fe/Zn5) Min. Plating requirements for Mild Service Condition

Material Properties for Threaded Rod

Steel Description	Steel Specification (ASTM)	Rod Diameter (inch)	Minimum Yield Strength, f_y (ksi)	Minimum Ultimate Strength, f_u (ksi)
Standard carbon rod	A 36 or A 307, Grade C	1/4 to 3/4	36.0	58.0
High strength carbon rod	A 193, Grade B7	1/4 to 3/4	105.0	125.0

Allowable Steel Strength for Threaded Rod

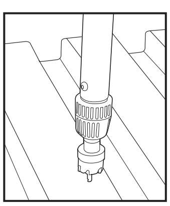
Anchor Diameter d in. (mm)	Nominal Area of Rod in.² (mm²)	Allowable Tension			Allowable Shear		
		ASTM A36 lbs. (kN)	ASTM A307 Grade C lbs. (kN)	ASTM A193 Grade B7 lbs. (kN)	ASTM A36 lbs. (kN)	ASTM A307 Grade C lbs. (kN)	ASTM A193 Grade B7 lbs. (kN)
1/4 (6.4)	0.0491 (1.2)	940 (4.2)	940 (4.2)	2,160 (9.7)	485 (2.2)	485 (2.2)	1,030 (4.6)
3/8 (9.5)	0.1104 (2.8)	2,115 (9.5)	2,115 (9.5)	4,375 (19.7)	1,090 (4.9)	1,090 (4.9)	2,255 (10.1)
1/2 (12.7)	0.1963 (5.0)	3,755 (16.9)	3,755 (16.9)	7,775 (35.0)	1,940 (8.7)	1,940 (8.7)	4,055 (18.2)
5/8 (15.9)	0.3068 (7.8)	5,870 (26.4)	5,870 (26.4)	12,150 (54.7)	3,025 (13.6)	3,025 (13.6)	6,260 (28.2)
3/4 (19.1)	0.4418 (11.2)	8,455 (38.0)	8,455 (38.0)	17,495 (78.7)	4,355 (19.6)	4,355 (19.6)	9,010 (40.5)

Allowable tension = f_u (A_{nom}) (0.33); Allowable shear = f_u (A_{nom}) (0.17)

INSTALLATION INSTRUCTIONS

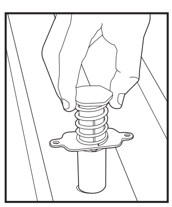
Installation Instructions for Bang-It+

Create Hole



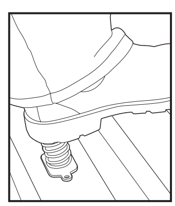
Step 1
Cut (e.g. drill/punch) a hole in the steel deck to the hole size required by the insert.

Position



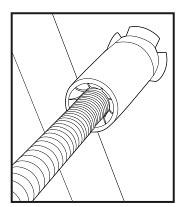
Step 2
Place the plastic sleeve of the insert through hole in steel deck.

Prepare



Step 3
Step on or impact the insert head to engage. Optionally, base plate of insert can also be screwed to steel deck.

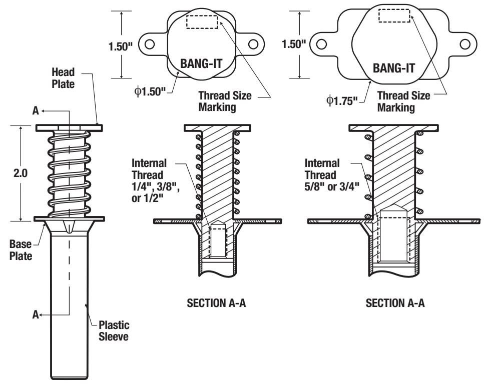
Attach



Step 4
After concrete pour and cure, install threaded steel element (rod/bolt) into the insert. Trim away for shear load application and attach fixture as applicable (e.g. seismic brace).

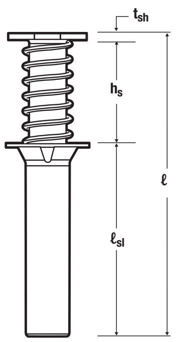
INSTALLATION SPECIFICATIONS

Bang-It+ Cast-In-Place Inserts for Concrete Filled Steel Deck Floor and Roof Assemblies



Bang-It+

Dimension	Notation	Nominal Rod/Anchor Size				
		1/4"	3/8"	1/2"	5/8"	3/4"
Metal Hole Saw Diameter (in.)	d_{bit}	13/16 or 7/8			1-3/16 or 1-1/4	
Metal Hole Saw Drilling Speed (rpm)	-	700-900	700-900	700-900	500-700	500-700
Height of Spring (in.)	h_s	1-7/8	1-7/8	1-7/8	1-7/8	1-7/8
Insert Thread Length (in.)	-	3/8	5/8	11/16	15/16	1-1/8
Length of Sleeve (in.)	ℓ_{sl}	3-3/8	3-3/8	3-3/8	3-3/8	3-3/8
Thread Size, UNC	-	1/4-20	3-3/8	1/2-13	5/8-11	3/4-10
Overall Length (in.)	ℓ	5-7/16	5-7/16	5-7/16	5-7/16	5-7/16
Steel Flange Thickness (in.)	t_{sh}	1/8	1/8	1/8	1/8	1/8



REFERENCE DATA (ASD)

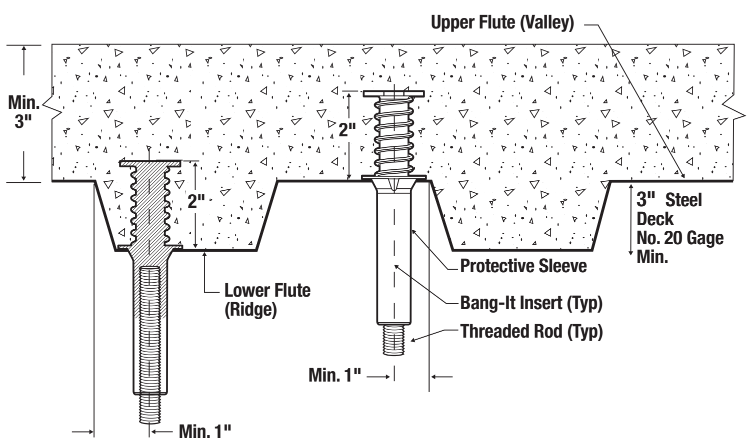
Ultimate and Allowable Load Capacities for Bang-It+ Inserts Installed in Sand-Lightweight Concrete or Normal Weight over Steel Deck[1,2,3]

Rod/Insert Diameter d in. (mm)	Nominal Embedment Depth h_v in. (mm)	Flute Location in Deck	Insert Spacing in. (mm)	End Distance in. (mm)	f´c ≥ 3,000 psi (20.7 MPa)			
					Ultimate Load		Allowable Load	
					Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
1/4 (6.4)	2 (50.8)	Upper	6 (152)	6 (152)	4,450 (20.0)	2,500 (11.3)	1,115 (5.0)	835 (3.8)
		Lower			3,320 (14.9)	2,500 (11.3)	830 (3.7)	625 (2.8)
3/8 (9.5)	2 (50.8)	Upper	6 (152)	6 (152)	5,750 (25.9)	3,350 (15.1)	1,915 (8.6)	1,115 (5.0)
		Lower			3,320 (14.9)	3,350 (15.1)	830 (3.7)	840 (3.8)
1/2 (12.7)	2 (50.8)	Upper	6 (152)	6 (152)	7,110 (32.0)	3,350 (15.1)	2,370 (10.7)	1,115 (5.0)
		Lower			3,320 (14.9)	3,350 (15.1)	830 (3.7)	840 (3.8)
5/8 (15.9)	2 (50.8)	Upper	6 (152)	6 (152)	8,810 (39.6)	3,350 (15.1)	2,935 (13.2)	1,115 (5.0)
		Lower	6 (152)		3,960 (17.8)	3,350 (15.1)	990 (4.5)	840 (3.8)
3/4 (19.1)	2 (50.8)	Upper	6 (152)	6 (152)	8,810 (39.6)	3,350 (15.1)	2,935 (13.2)	1,115 (5.0)
		Lower	6 (152)		3,960 (17.8)	3,350 (15.1)	990 (4.5)	840 (3.8)

1. Allowable load capacities listed are calculated using an applied safety factor of 3.0 for installations in the upper flute and 4.0 for installations in the lower flute.
2. The allowable working load must be the lesser of the insert capacity or the steel strength of the threaded rod.
3. For 1/4", 3/8" and 1/2" Bang-It Inserts:
   The allowable tension load for a single insert installed in the upper flute must be adjusted as follows for spacing less than 6 inches.
   When the insert are spaced 2" center-to-center across the flute the insert tension capacity must be reduced by 40 percent.
   When the insert are spaced 2" center-to-center along the flute the insert tension capacity must be reduced by 50 percent.

   The allowable tension load for a single insert installed into the lower flute must be adjusted as follows for spacing less than 6 inches.
   When the insert are spaced 2" center-to-center across the flute the insert tension capacity must be reduced by 30 percent.
   When the insert are spaced 2" center-to-center along the flute the insert tension capacity must be reduced by 35 percent.

SAND-LIGHTWEIGHT CONCRETE OR NORMAL WEIGHT CONCRETE OVER STEEL DECK (MINIMUM 3,000 PSI)



STRENGTH DESIGN (SD)

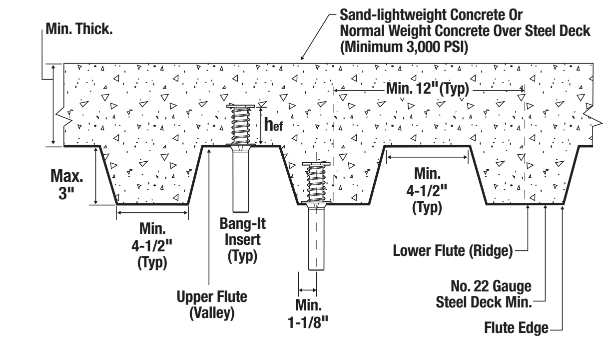
Bang-It+ Insert Design Information[1,2,3,4,5,6,7,8,9]

Design Information		Symbol	Units	1/4-inch	3/8-inch	1/2-inch	5/8-inch	3/4-inch
Insert O.D.		d_a (d_o)	in. (mm)	0.7 (18)	0.7 (18)	0.7 (18)	1.0 (25)	1.0 (25)
Insert head net bearing area		A_{brg}	in² (mm²)	1.20 (762)	1.20 (762)	1.20 (762)	1.30 (839)	1.30 (839)
Effective embedment depth		h_{ef}	in. (mm)	1.75 (45)	1.75 (45)	1.75 (45)	1.75 (45)	1.75 (45)
Minimum member thickness		h_{min}	-	See Deck Figures as applicable				
Minimum spacing and edge distances	Upper flute	s_{min}, c_{min}	-	See ACI 318 Section D.8.1 and D.8.2				
	Lower flute	s_{min}, c_{min}	-	See Deck Figures as applicable				
Effectiveness factor for cracked concrete		k_c	- (SI)	24 (10)	24 (10)	24 (10)	24 (10)	24 (10)
Modification factor for tension strength in uncracked concrete		$\Psi_{C,N}$	-	1.25	1.25	1.25	1.25	1.25
Nominal tension strength of single insert in tension as governed by steel strength (4-1/2" W-Deck, B-Deck, 3-7/8" W-Deck)		$N_{sa,insert}$	lb (kN)	10,440 (46.4)	10,440 (46.4)	8,850 (43.5)	11,985 (53.3)	11,985 (53.3)
Nominal tension strength of single insert in tension as governed by steel strength, for seismic loading (4-1/2" W-Deck, B-Deck, 3-7/8" W-Deck)		$N_{sa,insert,eq}$	lb (kN)	10,440 (46.4)	10,440 (46.4)	8,850 (43.5)	11,985 (53.3)	11,985 (53.3)
Nominal steel shear strength of single insert in the soffit of concrete on steel deck, (4-1/2" W-Deck)		$V_{sa,insert,deck}$	lb (kN)	2,280 (10.2)	2,280 (10.2)	2,280 (10.2)	3,075 (13.7)	3,075 (13.7)
Nominal steel shear strength of single insert in the soffit of concrete on steel deck, for seismic loading, (4-1/2" W-Deck)		$V_{sa,insert,deck,eq}$	lb (kN)	2,280 (10.2)	2,280 (10.2)	2,280 (10.2)	2,695 (12.0)	2,695 (12.0)
Nominal steel shear strength of single insert in the soffit of concrete on steel deck, (B-Deck, 3-7/8" W-Deck)		$V_{sa,insert,deck}$	lb (kN)	2,080 (10.2)	2,080 (10.2)	2,080 (10.2)	2,975 (13.2)	2,975 (13.2)
Nominal steel shear strength of single insert in the soffit of concrete on steel deck, for seismic loading, (B-Deck, 3-7/8" W-Deck)		$V_{sa,insert,deck,eq}$	lb (kN)	2,080 (10.2)	2,080 (10.2)	2,080 (10.2)	2,695 (12.0)	2,695 (12.0)

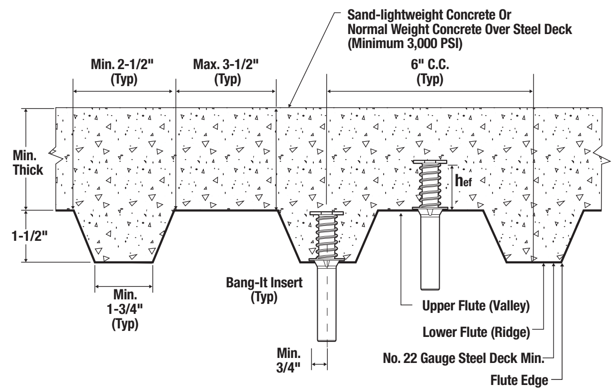
For SI: 1 inch = 25.4 mm, 1 inch² = 635 mm², 1 pound = 4.45 N, 1 psi = 0.006895 MPa. For pound-inch unit: 1 mm = 0.03937 inches.

1. Concrete must have a compressive strength f'c of 2,500 psi minimum.
2. Design of headed cast-in specialty inserts shall be in accordance with the provisions of ACI 318 Appendix D for cast-in headed anchors.
3. Strength reduction factors for the inserts shall be taken from ACI 318-11 D.4.3 for cast-in headed anchors. Strength reduction factors for load combinations in accordance with ACI 318 Section 9.2 governed by steel strength of the insert shall be taken as 0.65 for tension and 0.60 for shear; values correspond to brittle steel elements. The value of ϕ applies when the load combinations of Section 1605.2 of the IBC or ACI 318 Section 9.2 are used in accordance with ACI 318 D.4.3. If the load combinations of ACI 318 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318 D.4.4.
4. The concrete tension strength of headed cast-in specialty inserts in concrete filled steel deck assemblies shall be calculated in accordance with ACI 318 Appendix D and Deck Figures.
5. Insert O.D. is the outside diameter of the headed insert body.
6. Minimum spacing distance between anchors and minimum edge distances for cast-in Bang-It anchors shall be in accordance with Deck Figures, as applicable, and noted provisions.
7. Only the largest size of threaded rod or bolt for the 3/8 & 1/2 inch multi insert must be used for applications resisting shear loads.
8. The strengths shown in the table are for inserts only. Design professional is responsible for checking threaded rod strength in tension, shear, and combined tension and shear, as applicable. See Steel Design Information table for common threaded rod elements.
9. The tabulated insert strength values are applicable to installations in the lower flute or upper flute of the steel deck profiles; see Deck Figures.

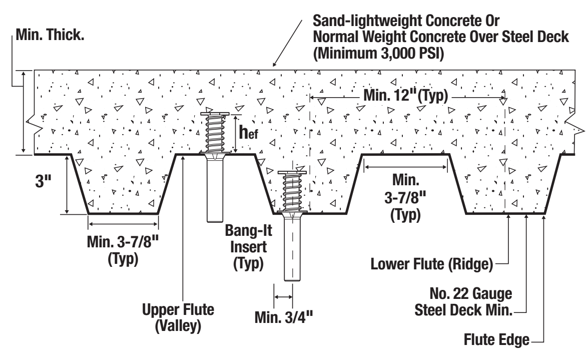
Bang-It+ Inserts Installed in Soffit of Concrete Filled Steel Deck Floor and Roof Assemblies, 4-1/2 -inch W-Deck[1,2,3,4]



Bang-It+ Inserts Installed in Soffit of Concrete Filled Steel Deck Floor and Roof Assemblies, B-Deck[1,2,3,4,5,6,7]



Bang-It+ Inserts Installed in Soffit of Concrete Filled Steel Deck Floor and Roof Assemblies, 3-7/8 -inch W-Deck[1,2,3,8]



1. Inserts may be placed in the upper flute or lower flute of the steel deck assembly. Inserts in the lower flute require a minimum 1.5" of concrete topping thickness (min. thick) from the top of the deck at the location of the installation. Upper flute installations require a minimum 3" topping thickness concrete (min. thick) from the top of the deck at the location of the installation.
2. Axial spacing for Bang-It inserts along the flute length shall be minimum $3h_{ef}$.
3. Upper flute Bang-It+ inserts are not subject to steel deck dimension limitations, or the minimum steel deck gauge limitations.
4. Inserts in the lower flute of 4-1/2-inch W-Deck may be installed with a maximum 1-1/8 -inch offset in either direction from the center of the flute. The offset distance may be increased for flute widths greater than those shown provided the minimum lower flute edge distance of 1-1/8 -inch is also satisfied.
5. Inserts in the lower flute of B-Deck may be installed with a maximum 1/8 -inch offset in either direction from the center of the flute. The offset distance may be increased for flute widths greater than those shown provided the minimum lower flute edge distance of 3/4 -inch is also satisfied.
6. Lower flute installations of B-Deck with flutes widths greater than 1-3/4 -inch are permitted.
7. Lower flute installations of B-Deck in flute depths greater than 1-1/2 -inch are permitted provided the minimum edge distance of 3/4 -inch is met and the minimum lower flute width is increased proportionally (e.g. applicable to a lower flute depth of 2-inch with a minimum lower flute width of 2-1/4 -inch).
8. Inserts in the lower flute of 3-7/8-inch W-Deck may be installed with a maximum 1-3/16 -inch offset in either direction from the center of the flute.

Specifications And Physical Properties Of Common Carbon Steel Threaded Rod Elements[1]

Threaded Rod Specification		Units	Min. Specified Ultimate Strength, F_{uta}	Min. Specified Yield Strength 0.2 Percent Offset, F_{ya}	F_{uta} — F_{ya}	Elongation Minimum Percent[5]	Reduction Of Area Min. Percent	Related Nut Specification[6]
Carbon Steel	ASTM A36/A36M[2] and F1554[3] Grade 36	psi (MPa)	58,000 (400)	36,000 (248)	1.61	23	40 (50 for A36)	ASTM A194 / A563 Grade A
	ASTM F1554[3] Grade 105	psi (MPa)	125,000 (862)	105,000 (724)	1.19	15	45	ASTM A194 / A563 Grade DH
	ASTM A193/A193M[4] Grade B7	psi (MPa)	125,000 (860)	105,000 (720)	1.19	16	50	

For SI: 1 inch = 25.4 mm, 1 psi = 0.006897 MPa. For pound-inch units: 1 mm = 0.03937 inch, 1 MPa = 145.0 psi.

1. Inserts may be used in conjunction with all grades of continuously threaded carbon steels (all-thread) that comply with code reference standards and that have thread characteristics comparable with ANSI B1.1 UNC Coarse Thread Series.
2. Standard Specification for Carbon Structural Steel.
3. Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
4. Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications.
5. Based on 2-inch (50 mm) gauge length except ASTM A193, which are based on a gauge length of 4d (d_{rod}).
6. Where nuts are applicable, nuts of other grades and style having specified proof load stress greater than the specified grade and style are also suitable.

Steel Design Information For Common Threaded Rod Elements Used With Concrete Inserts[1,2,3,4]

Design Information	Symbol	Units	1/4-inch	3/8-inch	1/2-inch	5/8-inch	3/4-inch
Threaded rod nominal outside diameter	d_{rod}	in. (mm)	0.250 (6.4)	0.375 (9.5)	0.500 (12.7)	0.625 (15.9)	0.750 (19.1)
Threaded rod effective cross-sectional area	A_{se}	in² (mm²)	0.032 (21)	0.078 (50)	0.142 (92)	0.226 (146)	0.335 (216)
Nominal tension strength of ASTM A36 threaded rod as governed by steel strength	$N_{sa,rod,A36}$	lb (kN)	1,855 (8.2)	4,525 (20.0)	8,235 (36.6)	13,110 (58.3)	19,430 (86.3)
Nominal seismic tension strength of ASTM A36 threaded rod as governed by steel strength	$N_{sa,rod,A36,eq}$	lb (kN)	1,855 (8.2)	4,525 (20.0)	8,235 (36.6)	13,110 (58.3)	19,430 (86.4)
Nominal tension strength of ASTM A193, Gr. B7 threaded rod as governed by steel strength	$N_{sa,rod,B7}$	lb (kN)	4,000 (17.7)	9,750 (43.1)	17,750 (78.9)	28,250 (125.7)	41,875 (186.0)
Nominal seismic tension strength of ASTM A193, Gr. B7 threaded rod as governed by steel strength	$N_{sa,rod,B7,eq}$	lb (kN)	4,000 (17.7)	9,750 (43.1)	17,750 (78.9)	28,250 (125.7)	41,875 (186.0)
Nominal shear strength of ASTM A36 threaded rod as governed by steel strength	$V_{sa,rod,A36}$	lb (kN)	1,115 (4.9)	2,715 (12.1)	4,940 (22.0)	7,865 (35.0)	11,660 (51.9)
Nominal seismic shear strength of ASTM A36 threaded rod as governed by steel strength	$V_{sa,rod,A36,eq}$	lb (kN)	780 (3.5)	1,900 (8.4)	3,460 (15.4)	5,505 (24.5)	8,160 (36.3)
Nominal shear strength of ASTM A193, Gr. B7 threaded rod as governed by steel strength	$V_{sa,rod,B7}$	lb (kN)	2,385 (10.6)	5,815 (25.9)	10,640 (7.3)	16,950 (75.4)	25,085 (111.6)
Nominal seismic shear strength of ASTM A193, Gr. B7 threaded rod as governed by steel strength	$V_{sa,rod,B7,eq}$	lb (kN)	1,680 (7.5)	4,095 (18.2)	7,455 (34.2)	11,865 (52.8)	17,590 (78.2)

For SI: 1 inch = 25.4 mm, 1 pound = 0.00445 kN, 1 in² = 645.2 mm². For pound-inch unit: 1 mm = 0.03937 inches.

1. Values provided for steel element material types based on minimum specified strengths and calculated in accordance with ACI 318-11 Eq. (D-2) and Eq. (D-29).
2. ϕN_{sa} shall be the lower of the $\phi N_{sa,rod}$ or $\phi N_{sa,insert}$ for static steel strength in tension; for seismic loading $\phi N_{sa,eq}$ shall be the lower of the $\phi N_{sa,rod,eq}$ or $\phi N_{sa,insert,eq}$.
3. ϕV_{sa} shall be the lower of the $\phi V_{sa,rod}$ or $\phi V_{sa,insert}$ for static steel strength in tension; for seismic loading $\phi V_{sa,eq}$ shall be the lower of the $\phi V_{sa,rod,eq}$ or $\phi V_{sa,insert,eq}$.
4. Strength reduction factors shall be taken from ACI 318-11 D.4.3 for steel elements. Strength reduction factors for load combinations in accordance with ACI 318 Section 9.2 governed by steel strength shall be taken as 0.75 for tension and 0.70 for shear for ductile steel elements; values correspond to ductile steel elements. The value of ϕ applies when the load combinations of Section 1605.2 of the IBC or ACI 318 Section 9.2 are used in accordance with ACI 318 D.4.3. If the load combinations of ACI 318 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318 D.4.4.

Tension and Shear Design Strengths for Bang-It+ Inserts Installed in the Soffit of Uncracked Concrete Filled Steel Deck Floor and Roof Assemblies[1,2,3,4,5,6]

Nominal Anchor Diameter	Embed. Depth h_{ef} (in.)	Minimum Concrete Compressive Strength f'c = 3,000 psi											
		4-1/2" W-Deck				B-Deck				3-7/8" W-Deck			
		Upper Flute		Lower Flute		Upper Flute		Lower Flute		Upper Flute		Lower Flute	
		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.)	ϕNn Tension (lbs.)	ϕVn Shear (lbs.)
1/4	1-3/4	2,665	1,370	1,340	1,370	2,265	1,250	595	1,250	2,265	1,250	1,145	1,250
3/8	1-3/4	2,665	1,370	1,340	1,370	2,265	1,250	595	1,250	2,265	1,250	1,145	1,250
1/2	1-3/4	2,665	1,370	1,340	1,370	2,265	1,250	595	1,250	2,265	1,250	1,145	1,250
5/8	1-3/4	2,665	1,845	1,340	1,845	2,265	1,785	595	1,785	2,265	1,785	1,145	1,785
3/4	1-3/4	2,665	1,845	1,340	1,845	2,265	1,785	595	1,785	2,265	1,785	1,145	1,785

☐ - Anchor Pullout/Pryout Strength Controls ☐ - Concrete Breakout Strength Controls ■ - Steel Strength Controls

Tension and Shear Design Strengths for Bang-It+ Inserts Installed in the Soffit of Cracked Concrete Filled Steel Deck Floor and Roof Assemblies[1,2,3,4,5,6]

Nominal Anchor Diameter	Embed. Depth h_{ef} (in.)	Minimum Concrete Compressive Strength f'c = 3,000 psi											
		4-1/2" W-Deck				B-Deck				3-7/8" W-Deck			
		Upper Flute		Lower Flute		Upper Flute		Lower Flute		Upper Flute		Lower Flute	
		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.)	ϕNn Tension (lbs.)	ϕVn Shear (lbs.)
1/4	1-3/4	1,810	1,370	1,070	1,370	1,810	1,250	475	1,250	1,810	1,250	915	1,250
3/8	1-3/4	1,810	1,370	1,070	1,370	1,810	1,250	475	1,250	1,810	1,250	915	1,250
1/2	1-3/4	1,810	1,370	1,070	1,370	1,810	1,250	475	1,250	1,810	1,250	915	1,250
5/8	1-3/4	1,810	1,845	1,070	1,845	1,810	1,785	475	1,785	1,810	1,785	915	1,785
3/4	1-3/4	1,810	1,845	1,070	1,845	1,810	1,785	475	1,785	1,810	1,785	915	1,785

☐ - Anchor Pullout/Pryout Strength Controls ☐ - Concrete Breakout Strength Controls ■ - Steel Strength Controls

1- Tabular values are provided for illustration and are applicable for single anchors installed in sand-lightweight 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}.
  - c_{a2} is greater than or equal to 1.5 times c_{a1}.

2- Calculations were performed following methodology in ACI 318-11 Appendix D. The load level corresponding to the failure mode listed [steel strength of insert ($N_{sa,insert}$, $V_{sa,insert}$), concrete breakout strength, or pryout strength] must be checked against the tabulated steel strength of the corresponding threaded rod type, ($N_{sa,rod}$, $V_{sa,rod}$), the lowest load level controls.

3- Strength reduction factors (ø) for the inserts are based on ACI 318-11 D.4.3 for cast-in headed anchors. Condition B is assumed. Strength reduction factors for load combinations in accordance with ACI 318 Section 9.2 governed by steel strength of the insert are taken as 0.65 for tension and 0.60 for shear; values correspond to brittle steel elements.

4- Tabular values are permitted for short-term 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 318-11 Appendix D.

6- Interpolation is not permitted to be used with the tabular values. For intermediate base material compressive strengths please see ACI 318-11 Appendix D and information contained in this product supplement. For other design conditions including seismic considerations please see ACI 318-11 Appendix D.

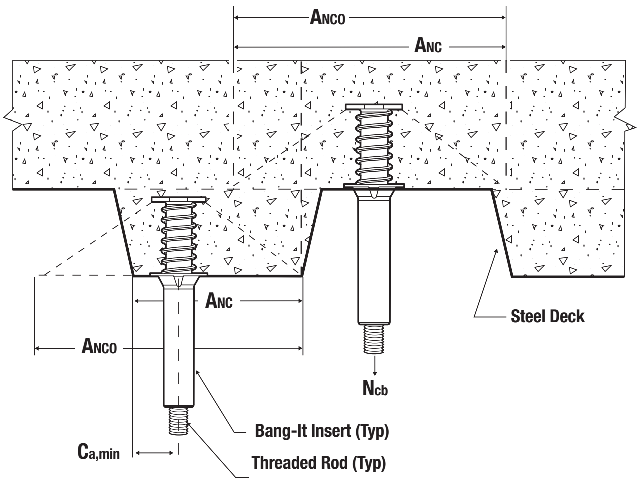
Tension and Shear Design Strength of Steel Elements (Steel Strength)[1,2,3,4]

Nominal Rod Diameter (in.)	Steel Elements - Threaded Rod			
	ASTM A36 and ASTM F1554 Grade 36		ASTM A193 Grade B7 and ASTM F1554 Grade 105	
	$\phi N_{sa,rod}$ Tension (lbs.)	$\phi V_{sa,rod}$ Shear (lbs.)	$\phi N_{sa,rod}$ Tension (lbs.)	$\phi V_{sa,rod}$ Shear (lbs.)
1/4	1,390	720	3,000	1,550
3/8	3,395	1,750	7,315	3,780
1/2	6,175	3,210	13,315	6,915
5/8	9,835	5,115	21,190	11,020
3/4	14,550	7,565	31,405	16,305

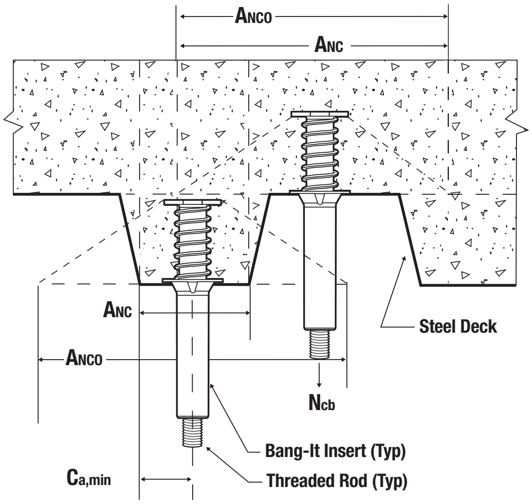
■ - Steel Strength Controls

1. Steel tensile design strength according to ACI 318 Appendix D, $\phi N_{sa} = \phi \bullet A_{se,N} \bullet f_{uta}$
2. The tabulated steel design strength in tension for the threaded rod must be checked against the design strength of the steel insert, concrete breakout and pullout design strength to determine the controlling failure mode, the lowest load level controls.
3. Steel shear design strength according to ACI 318 Appendix D, $\phi N_{sa} = \phi \bullet 0.60 \bullet A_{se,N} \bullet f_{uta}$
4. The tabulated steel design strength in shear for the threaded rod must be checked against the design strength of the steel insert, concrete breakout and pryout design strength to determine the controlling failure mode, the lowest load level controls.

Idealization of Concrete Filled Steel Decks for Determination of Concrete Breakout Strength in Accordance with ACI 318



Idealization of Standard Steel Deck Profiles



Idealization of B Deck Steel Deck Profiles

ORDERING INFORMATION

Bang-It®+ Deck Insert (UNC)

Cat.No.	Description	Color Code	Pre-Drilled Hole	Std. Box	Std. Pallet
7540	1/4" Bang-It+	Brown	13/16" or 7/8"	100	4,000
7542	3/8" Bang-It+	Green	13/16" or 7/8"	100	4,000
7544	1/2" Bang-It+	Yellow	13/16" or 7/8"	100	4,000
7546	5/8" Bang-It+	Red	1-3/16" or 1-1/4"	50	2,400
7548	3/4" Bang-It+	Purple	1-3/16" or 1-1/4"	50	2,400
7543	3/8-1/2" Bang-It+ Multi Insert	Gray	13/16" or 7/8"	100	4,000

Bang-It®+ Installation Accessories

Cat.No.	Description	Std. Box
7560	Bang-It Stand Up Pole tool	1
7562	13/16" Carbide Hole Saw for 1/4", 3/8" and 1/2" sizes	1
7564	1-3/16" Carbide Hole Saw for 5/8", 3/4" and 7/8" sizes	1
D180014IR	7/8" (22mm) Impact Ready® Hole Saw	1
D180020IR	1-1/4" (32mm) Impact Ready® Hole Saw	1
7566	Extra Carbide Hole Saw Center Bit	1
DWA1786IR	3/16" - 7/8" Impact Ready® Step Drill Bit	1
DWA1789IR	7/8" - 1-1/8" Impact Ready® Step Drill Bit	1
DCD980M2	20V Max* Lithium Ion Premium 3-Speed Drill/Driver Kit (4.0 Ah)	1
DWD220	1/2" VSR Pistol Grip Drill With E-Clutch Anti-Lock Control	1

Threaded Inserts are color coded to easily identify location and diameter of the internally threaded coupling, allowing multiple trades on the same job to suspend their systems with various size steel threaded rods.

GENERAL INFORMATION

DDI+™ (DECK INSERT)

Threaded Insert for Metal Deck

PRODUCT DESCRIPTION

The DDI+ (Deck Insert) is a concrete insert designed for installation in concrete-filled metal deck assemblies (i.e. “pan-deck”, “Q-deck”) applications. After installation, the threaded male hanger of the insert protrudes below the surface of the deck. The DDI+ comes in sizes ranging from 3/8" to 7/8" in diameter. The threaded bolt offers adjustability for precise height requirements and guarantees the minimum embedment depth. The longer "T" brace enables a variety of installation locations in across the deck.

GENERAL APPLICATIONS AND USES

- Seismic Loading and Cracked Concrete
- Hanging Pipe and Sprinkler Systems
- HVAC Ductwork and Strut Channels
- Suspending Trapeze and Cable Trays
- Mechanical Unit Overhead Utilities
- Conduit and Lighting System

FEATURE AND BENEFITS

+ Fast and simple to install, low installed cost
+ Pre-mounted self drilling screws for convenient installation
+ Fine-tuned thread length for guaranteed minimum embedment
+ Lengthened "T" brace for more flexible installation positions

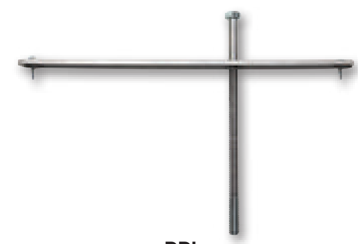
APPROVALS AND LISTINGS

- International Code Council, Evaluation Service (ICC-ES), ESR-3958 for concrete. Approved for seismic and wind loading
- Code compliant with the 2015 IBC, 2015 IRC, 2012 IBC, 2012 IRC, 2009 IBC, and 2009 IRC
- Underwriters Laboratories (UL Listed) - File No. EX1289, see listing for sizes.
- FM Approvals (Factory Mutual) – File No. J.I. 3059197

GUIDE SPECIFICATIONS

CSI Divisions: 03 15 19 - Cast-In Concrete Anchors and 03 16 00 - Concrete Anchors. Concrete inserts shall be DDI+ as supplied by DEWALT, Towson, MD.

SECTION CONTENTS



DDI+

THREAD VERSION

- UNC Thread

ANCHOR MATERIALS

Plain and zinc plated carbon steel

ANCHOR SIZE RANGE

- 3/8" diameter through 7/8" diameter

SUITABLE BASE MATERIALS

- Concrete or lightweight concrete over metal deck

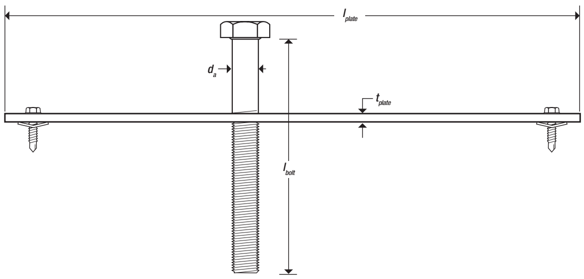
TENSION ZONE CRACKED CONCRETE

SEISMIC REGION QUALIFICATION

CODE LISTED
ICC-ES ESR-3958
CONCRETE

MATERIAL SPECIFICATIONS

Anchor Component	Component Material
Metal Plate	ASTM A1011 Carbon Steel or equivalent (plain)
Hex Head Bolt	ASTM A307 Grade A (zinc plated)



DDI+ Insert Detail

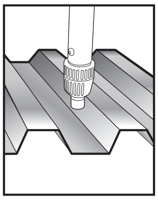
INSTALLATION SPECIFICATIONS

Dimension	Notation	Nominal Anchor Size				
		3/8"	1/2"	5/8"	3/4"	7/8"
Drill Bit Diameter	d_{bit}	7/16" or 1/2"	9/16" or 5/8"	11/16" or 3/4"	13/16" or 7/8"	15/16" or 1"
Overall Length of Metal Plate	in.	12	12	12	12	12
Approximate Thickness of Metal Plate	in.	3/16"	3/16"	3/16"	3/8"	3/8"
Overall Length of Hex Head Bolt	in.	8	8	8	8	8
Effective Embedment Depth	in.	1-1/2"	1-3/4"	2"	2-1/8"	2-1/16"
Nominal Embedment Depth	in.	1-3/4"	2"	2-3/8"	2-5/8"	2-5/8"

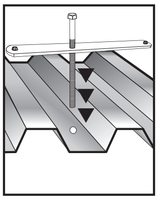
Dimension	Size:	Point Style	Drill Range	RPM (Max)
Self-Drilling Screw	8-18	#2	18 Gage Max	2500

INSTALLATION INSTRUCTIONS

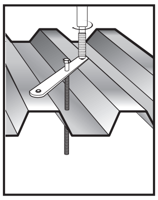
Cut (e.g. drill/punch) a hole in the steel deck to the hole size required by the threaded bolt of the insert.



Place the threaded bolt of the insert through the hole in the steel deck.



The metal plate of the insert must be on the top of the deck flutes. The metal plate can (optionally) be secured to the deck using the pre-assembled size drilling screws.



REFERENCE DATA (ASD)

Ultimate and Allowable Load Capacities for DDI+ (Deck Insert) Installed in the Soffit of Sand-lightweight or Normal Weight Concrete over Metal Deck Floor and Roof Assemblies[1,2,3,4]

Nominal Anchor Diameter	Nominal Embed. Depth h_{nom} (in.)	Min. Concrete Topping Thickness (in.)	Min. Insert Spacing (in.)	Min. End Distance (in.)	Normal-weight or Sand-lightweight concrete, f'c ≥ 3,000 psi											
					3-7/8 or 4-1/2 Wide Deck											
					Installed Over Upper Flute				Installed Over Flute Incline				Installed Over Lower Flute			
					Ultimate Load		Allowable Load		Ultimate Load		Allowable Load		Ultimate Load		Allowable Load	
					Tension lbs.	Shear lbs.	Tension lbs.	Shear lbs.	Tension lbs.	Shear lbs.	Tension lbs.	Shear lbs.	Tension lbs.	Shear lbs.	Tension lbs.	Shear lbs.
3/8	1-3/4	2	4-1/2	9	3,420	1,985	1,140	660	5,230	1,985	1,745	660	5,230	2,610	1,745	870
1/2	2	2-1/2	5-1/4	10-1/2	4,310	4,205	1,435	1,400	6,235	4,205	2,080	1,400	6,235	5,155	2,080	1,720
5/8	2-3/8	3-1/4	6	12	5,265	6,450	1,755	2,150	8,630	6,450	2,875	2,150	8,630	6,820	2,875	2,275
3/4	2-5/8	3-1/4	6-3/8	12-3/4	5,770	6,450	1,925	2,150	8,630	6,450	2,875	2,150	8,630	6,820	2,875	2,275
7/8	2-5/8	3-1/4	6-3/8	12-3/4	5,770	6,450	1,925	2,150	8,630	6,450	2,875	2,150	8,630	6,820	2,875	2,275

1. Allowable load capacities listed are calculated using an applied safety factor of 3.0
2. Nominal embedment depth is measured from the bottom of the insert plate to the top of the insert bolt head.
3. Insert spacing and end distances are measured from the centerline of the insert bolt head.
4. Shear loads may be applied in any direction. For inserts installed over the upper flute, if the shear load is parallel to the flute the tabulated allowable load values may be increased by 20 percent (multiplied by 1.2)

STRENGTH DESIGN (SD)

CODE LISTED
ICC-ES ESR-3958

STRENGTH DESIGN TABLES

DDI+ Insert Installation Information and Supplemental Information[1,2]

Design Information		Symbol	Units	3/8-inch	1/2-inch	5/8-inch
Nominal bolt diameter		d_a	in. (mm)	0.375 (9.5)	0.500 (12.7)	0.625 (15.9)
Overall length of insert bolt		ℓ_{bolt}	in (mm)	8 (203)	8 (203)	8 (203)
Drill bit diameter		d_{bit}	in.	7/16 or 1/2	9/16 or 5/8	11/16 or 3/4
Nominal overall length of insert plate		ℓ_{plate}	in.² (mm²)	12 (305)	12 (305)	12 (305)
Nominal width of insert plate		W_{plate}	in.² (mm²)	1-1/4 (32)	1-1/4 (32)	1-1/4 (32)
Approximate thickness of insert plate		t_{plate}	in. (mm)	3/16 (4.8)	3/16 (4.8)	3/16 (4.8)
Minimum nominal embedment depth	Over upper flute	$h_{nom\ (upperflute)}$	in. (mm)	1-3/4 (45)	2 (51)	2-3/8 (60)
	Over flute incline	$h_{nom\ (upperincline)}$	in. (mm)			
	Over lower flute	$h_{nom\ (lowerflute)}$	in. (mm)	4-3/4 (120)	5 (127)	5-3/8 (137)
Minimum effective embedment depth	Over upper flute	$h_{ef\ (upperflute)}$	in. (mm)	1.50 (38)	1.75 (45)	2.00 (51)
	Over flute incline	$h_{ef\ (upperincline)}$	in. (mm)			
	Over lower flute	$h_{ef\ (lowerflute)}$	in. (mm)	4.50 (114)	4.75 (121)	5.00 (127)
Minimum concrete member thickness (topping thickness)	Over upper flute	$h_{min\ (upperflute)}$	in. (mm)	2 (51)	2-1/2 (64)	3-1/4 (83)
	Over flute incline	$h_{min\ (upperincline)}$	in. (mm)			
	Over lower flute	$h_{min\ (lowerflute)}$	in. (mm)	2 (51)	2-1/2 (64)	3-1/4 (83)
Minimum flute edge distance (insert bolt)	Over upper flute	$c_{min,deck\ (upperflute)}$	in. (mm)	N/A	N/A	N/A
	Over flute incline	$c_{min,deck\ (upperincline)}$	in. (mm)			
	Over lower flute	$c_{min,deck\ (lowerflute)}$	in. (mm)	See Figure 3C	See Figure 3C	See Figure 3C
Minimum spacing distance (bolt spacing, center-to-center)	Over upper flute	$s_{min\ (upperflute)}$	in. (mm)	4-1/2 (114)	5-1/4 (133)	6 (152)
	Over flute incline	$s_{min\ (upperincline)}$	in. (mm)			
	Over lower flute	$s_{min\ (lowerflute)}$	in. (mm)	13-1/2 (343)	14-1/4 (362)	15 (381)
Minimum deck end distance	Over upper flute	$c_{min\ (upperflute)}$	in. (mm)	Specified cover requirements for reinforcement in accordance with ACI 318-14 17.7.2 or ACI 318-11 7.7, as applicable.		
	Over flute incline	$c_{min\ (upperincline)}$	in. (mm)			
	Over lower flute	$c_{min\ (lowerflute)}$	in. (mm)			
Effective tensile stress area (insert bolt)		A_{se}	in.² (mm²)	0.078 (50)	0.142 (92)	0.226 (146)
Insert head net bearing area		A_{brg}	in.² (mm²)	0.17 (110)	0.28 (181)	0.45 (290)
Minimum specified ultimate strength		f_{uta}	psi (N/mm²)	60,000 (400)		
Minimum specified yield strength		f_{ya}	psi (N/mm²)	36,000 (248)		

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

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable,
2. For installation detail for inserts in concrete-filled steel deck assemblies, see Figures A, B and C (i.e. over upper flute, over flute incline, over lower flute).

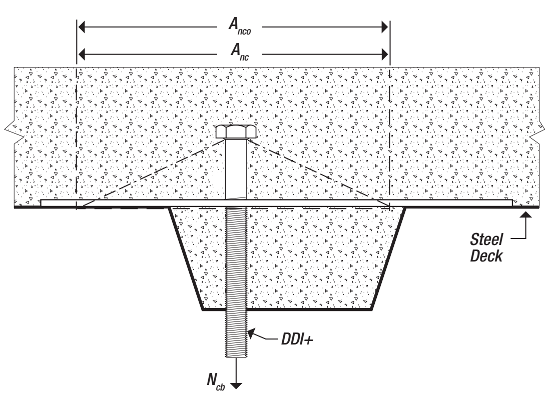
CODE LISTED
ICC-ES ESR-3958

DDI+ Insert Design Information[1,2,3,4,5,6]

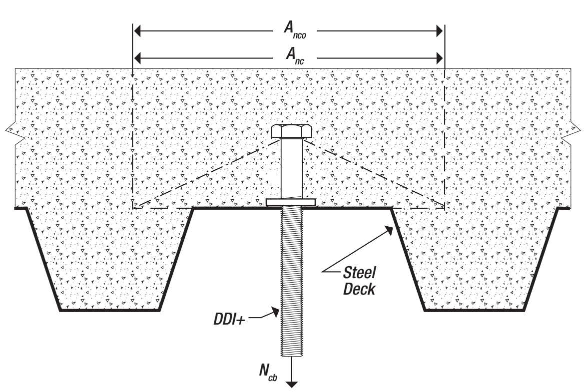
Design Information		Symbol	Units	3/8-inch	1/2-inch	5/8-inch
Insert O.D. (nominal bolt diameter)		d_a	in. (mm)	0.375 (9.5)	0.500 (12.7)	0.625 (15.9)
Insert head net bearing area		A_{brg}	in² (mm²)	0.17 (110)	0.28 (181)	0.45 (290)
Effective tensile stress area		A_{se}	in.² (mm²)	0.078 (50)	0.142 (92)	0.226 (146)
Effective embedment depth	Over upper flute	h_{ef} (upperflute)	in. (mm)	1.50 (38)	1.75 (45)	2.00 (51)
	Over flute incline	h_{ef} (fluteincline)	in. (mm)			
	Over lower flute	h_{ef} (lowerflute)	in. (mm)	4.50 (114)	4.75 (121)	5 (127)
Minimum concrete member thickness (topping thickness over upper flute)		h_{min}	in. (mm)	2.00 (51)	2.50 (64)	3.25 (83)
Minimum spacing and edge distance		s_{min}, c_{min}	in. (mm)	See Installation Information Table and Figures A, B and C		
Effectiveness factor for cracked concrete		k_c	- (SI)	24 (10)		
Modification factor for tension strength in uncracked concrete		$\Psi_{C,N}$	-	1.25		
According to Figures A, B or C	Nominal tension strength of single insert as governed by steel strength	$N_{sa,insert}$	lb (kN)	4,650 (20.7)	8,520 (37.9)	13,560 (60.3)
	Nominal tension strength of single insert as governed by steel strength, seismic	$N_{sa,insert,eq}$	lb (kN)			
According to Figure A (over upper flute)	Nominal steel shear strength of single insert in the soffit of concrete on steel deck	$V_{sa,insert,deck}$ (upperflute)	lb (kN)	2,280 (10.1)	4,260 (18.9)	7,245 (32.2)
	Nominal steel shear strength of single insert in the soffit of concrete on steel deck, seismic	$V_{sa,insert,deck,eq}$ (upperflute)	lb (kN)	1,825 (8.1)	3,410 (15.2)	
According to Figure B (over flute incline)	Nominal steel shear strength of single insert in the soffit of concrete on steel deck	$V_{sa,insert,deck}$ (fluteincline)	lb (kN)	1,310 (5.8)	3,410 (15.2)	5,240 (23.3)
	Nominal steel shear strength of single insert in the soffit of concrete on steel deck, seismic	$V_{sa,insert,deck,eq}$ (fluteincline)	lb (kN)	1,045 (4.6)	2,860 (12.7)	
According to Figure C (over lower flute)	Nominal steel shear strength of single insert in the soffit of concrete on steel deck	$V_{sa,insert,deck}$ (lowerflute)	lb (kN)	2,280 (10.1)	4,260 (18.9)	5,735 (25.5)
	Nominal steel shear strength of single insert in the soffit of concrete on steel deck, seismic	$V_{sa,insert,deck,eq}$ (lowerflute)	lb (kN)	2,015 (9.0)	3,410 (15.2)	

For SI: 1 inch = 25.4 mm, 1 pound = 4.45 N, 1 psi = 0.006895 MPa. For pound-inch unit: 1 mm = 0.03937 inches.

1. Concrete must have a compressive strength f 'c of 3,000 psi (20.7 MPa) minimum.
2. Design of headed cast-in specialty inserts shall be in accordance with the provisions of ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable, for cast-in headed anchors. Concrete breakout strength must also be in accordance with the Idealization of Concrete Filled Steel Decks Figure.
3. Strength reduction factors for the inserts shall be taken from ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, for cast-in headed anchors. Strength reduction factors for load combinations in accordance with ACI 318-14 5.3 or ACI 318-11 9.2, as applicable, governed by steel strength of the insert shall be taken as 0.75 for tension and 0.65 for shear; values correspond to ductile steel elements. The value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318-14 5.3 or ACI 318-11 9.2, as applicable, are used in accordance with 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 must be determined in accordance with ACI 318-11 D.4.4.
4. Insert O.D. is the nominal bolt diameter of the insert.
5. Minimum spacing distance between anchors and minimum edge distances for cast-in headed DDI+ inserts shall be in accordance with the Installation Information Table, Design Information Table, Figures A, B and C and noted provisions.
6. Shear loads for concrete inserts in concrete-filled steel deck assemblies may be applied in any direction (i.e. over upper flute, over flute incline, over lower flute).



Idealization of Steel Deck Profile (over lower flute)



Idealization of Steel Deck Profile (over upper flute or over flute incline)

Idealization of Concrete Filled Steel Decks for Determination of Concrete Breakout Strength in Accordance with ACI 318

Tension and Shear Design Strengths for DDI+ Inserts Installed in Uncracked Lightweight Concrete Filled Steel Deck Floor and Roof Assemblies[1,2,3,4,5,6]

Insert O.D. (Nominal Bolt Diameter) (in.)	Embed. Depth hef (in.)	Minimum Concrete Compressive Strength f'c = 3,000 psi					
		Upper Flute (Figure A)		Flute Incline (Figure B)		Lower Flute (Figure C)	
		ϕNn Tension (lbs.)	ϕVn Shear (lbs.)	ϕNn Tension (lbs.)	ϕVn Shear (lbs.)	ϕNn Tension (lbs.)	ϕVn Shear (lbs.)
3/8	1-3/4	1,795	1,480	1,795	850	1,795	1,480
1/2	1-3/4	2,265	2,770	2,265	2,215	2,265	2,770
5/8	1-3/4	2,765	4,710	2,765	3,405	2,765	3,730

- Anchor Pullout/Pryout Strength Controls - Concrete Breakout Strength Controls - Steel Strength Controls

Tension and Shear Design Strengths for DDI+ Inserts Installed in Cracked Lightweight Concrete Filled Steel Deck Floor and Roof Assemblies[1,2,3,4,5,6]

Insert O.D. (Nominal Bolt Diameter) (in.)	Embed. Depth hef (in.)	Minimum Concrete Compressive Strength f'c = 3,000 psi					
		Upper Flute (Figure A)		Flute Incline (Figure B)		Lower Flute (Figure C)	
		ϕNn Tension (lbs.)	ϕVn Shear (lbs.)	ϕNn Tension (lbs.)	ϕVn Shear (lbs.)	ϕNn Tension (lbs.)	ϕVn Shear (lbs.)
3/8	1 3/4	1,435	1,480	1,435	850	1,435	1,480
1/2	1 3/4	1,810	2,770	1,810	2,215	1,810	2,770
5/8	1 3/4	2,210	4,710	2,210	3,405	2,210	3,730

- Anchor Pullout/Pryout Strength Controls - Concrete Breakout Strength Controls - Steel Strength Controls

1- Tabular values are provided for illustration and are applicable for single anchors installed in sand-lightweight concrete with minimum member thickness (topping thickness), $h_a = h_{min}$, and with the following conditions:
   - For Upper Flute and Flute Incline: c_{a1} is greater than or equal to the critical edge distance, c_{ac}
   - For Lower Flute: c_{a1} is equal to the minimum lower flute edge distance

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

3- Strength reduction factors (ø) for the inserts are based on ACI 318-14 17.3.3 for cast-in headed anchors. Condition B is assumed. Strength reduction factors for load combinations in accordance with ACI 318-14 Section 5.3 governed by steel strength of the insert are taken as 0.75 for tension and 0.65 for shear; values correspond to ductile steel elements.

4- Tabular values are permitted for short-term 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 318-14 Chapter 17.

6- Interpolation is not permitted to be used with the tabular values. For intermediate base material compressive strengths, please see ACI 318-14 Chapter 17 and information contained in this product supplement. For other design conditions including seismic considerations please see ACI 318-14 Chapter 17.

Figure A

DDI+ Concrete Inserts Installed Through the Soffit of Concrete-Filled Steel Deck Floor and Roof Assemblies (Over Upper Flute)[1,2,3]

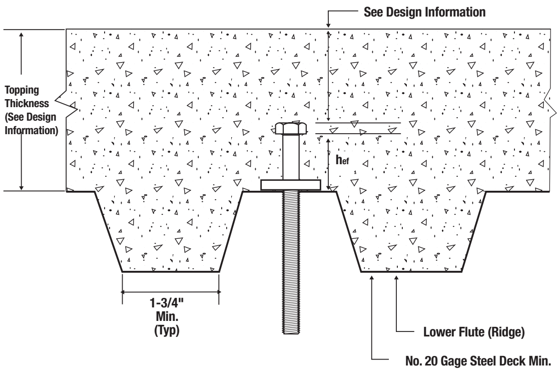


Figure B

DDI+ Concrete Inserts Installed Through the Soffit of Concrete-Filled Steel Deck Floor and Roof Assemblies (Over Flute Incline)[1,2,4]

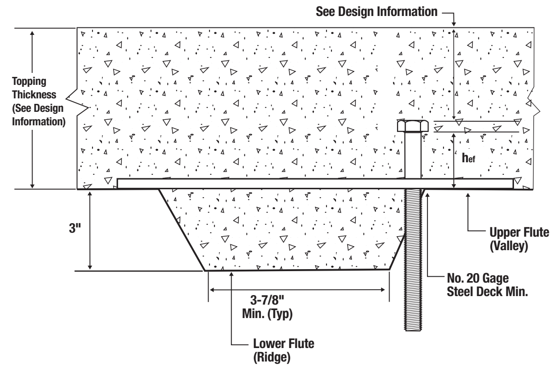
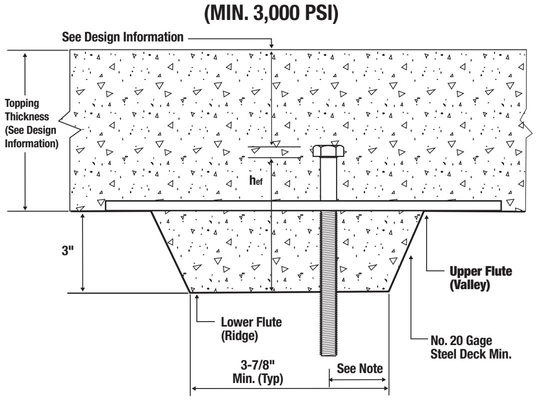


Figure C

DDI+ Concrete Inserts Installed Through the Soffit of Concrete-Filled Steel Deck Floor and Roof Assemblies (Over Lower Flute)[1,2,5]

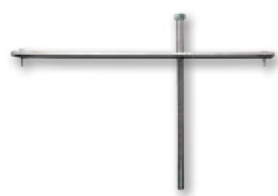


1. Installations require a minimum concrete member topping thickness from the top of the upper flute as given in the Design Information Table.
2. Inserts may be placed on the upper flute of the steel deck assembly; they may be installed anywhere across upper flute as follows:
   (Figure A) - Placed over the upper flute with threaded bolt installed through the upper flute or;
   (Figure B) - Placed over the upper flute spanning the lower flute with threaded bolt installed through the inclined section or;
   (Figure C) - Placed over the upper flute spanning the lower flute with threaded bolt installed through the lower flute.
3. Inserts over the upper flute with threaded bolt installed through the upper flute may be placed in any location and orientation that meets the minimum deck end distance requirements (see Design Information Table). The minimum deck end distance is measured from deck end to the centerline of the insert bolt.
4. Inserts over the upper flute spanning the lower flute with threaded bolt installed through the inclined section may be placed in any location and orientation that meets the minimum deck end distance requirements (see Design Information Table). The minimum deck end distance is measured from deck end to the centerline of the insert bolt.
5. Inserts over the upper flute spanning the lower flute with threaded bolt installed through the lower flute may be placed in any location that meets the minimum deck end distance and minimum lower flute edge distance requirements. The minimum deck end distance is measured from deck end to the centerline of the insert bolt. For lower flute widths of 3-7/8-inch, a maximum 1-inch centerline bolt offset in either direction from the center of the flute. The offset distance may be increased for flute widths greater than those shown provided the minimum lower flute edge distance of 15/16 -inch is also satisfied.

ORDERING INFORMATION

DDI+ (Deck Insert)

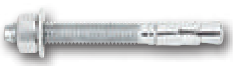
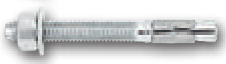
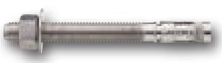
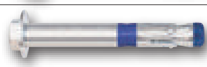
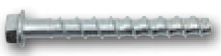
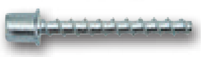
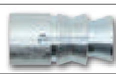
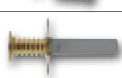
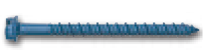
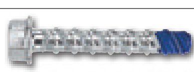
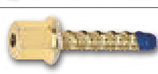
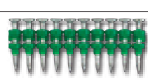
Cat. No.	Anchor Size	Rod/Anchor Dia.	Drill Diameter	Box Qty.
PFM2511100	3/8" Metal Deck Insert	3/8"	7/16" or 1/2"	20
PFM2511110	1/2" Metal Deck Insert	1/2"	9/16" or 5/8"	20
PFM2511120	5/8" Metal Deck Insert	5/8"	11/16" or 3/4"	20
PFM2511130	3/4" Metal Deck Insert	3/4"	13/16" or 7/8"	12
PFM2511140	7/8" Metal Deck Insert	7/8"	15/16" or 1"	12



Rod Coupling Nuts - Zinc

Cat. No.	Description	Rod/Anchor Dia.	Hex Diameter	Box Qty.	Ctn. Qty.
030007	3/8"-16 x 1/2" x 1-1/8"	3/8"	1/2"	100	1000
030009	1/2"-13 x 5/8" x 1-1/4"	1/2"	5/8"	50	500
030010	5/8"-13 x 13/16" x 2-1/8"	5/8"	13/16"	25	250
030011	3/4"-13 x 1" x 2-1/4"	3/4"	1"	25	250
030012	7/8"-13 x 1-1/4" x 2-1/2"	7/8"	1-1/4"	10	100

Building and Residential Code Complaint Product Solutions*

Product Picture	Product	Code Compliant Listing	Reference
	AC200+™	ICC-ES ESR-4027	Page 29
	Pure110+®	ICC-ES ESR-3298	Page 43
	AC100+ Gold®	ICC-ES ESR-2582 & ESR-3200	Page 68
	PE1000+®	ICC-ES ESR-2583	Page 91
	Pure50+®	ICC-ES ESR-3576	Page 110
	Atomic+ Undercut®	ICC-ES ESR-3067	Page 143
	Power-Stud®+ SD1	ICC-ES ESR-2818 & ESR-2966	Page 154
	Power-Stud®+ SD2	ICC-ES ESR-2502	Page 168
	Power-Stud®+ SD4/SD6	ICC-ES ESR-2502	Page 178
	Power-Bolt®+	ICC-ES ESR-3260	Page 202
	Screw-Bolt+™	ICC-ES ESR-3889	Page 227
	Snake+®	ICC-ES ESR-2272	Page 254
	Hangermate®+	ICC-ES ESR-3889	Page 280
	Mini-Undercut+™	ICC-ES ESR-3912	Page 291
	Wood-Knocker® II+	ICC-ES ESR-3657	Page 297
	Bang-It®+	ICC-ES ESR-3657	Page 305
	DDI+™	ICC-ES ESR-3958	Page 314
	Tapper+®	ICC-ES ESR-3068, ESR-3196 ICC-ES ESR-3042, ESR-3213	www.DEWALT.com
	Wedge-Bolt+	ICC-ES ESR-2526	www.DEWALT.com
	Vertigo®+	ICC-ES ESR-2526	www.DEWALT.com
	Woodworm+™	ICC-ES ESR-3164	www.DEWALT.com
	Trak-It® C4 and C5 Pins	ICC-ES ESR-3275	www.DEWALT.com
	Trak-It® Pins	ICC-ES ESR-2036	www.DEWALT.com
	Power-actuated Fasteners	ICC-ES ESR-2024	www.DEWALT.com
	TriggerFoam™ Pro	ICC-ES ESR-3263	www.DEWALT.com

*Evaluated by ICC-ES for Code Compliance with the 2015, 2012 and 2009 International Building Codes (IBC) and International Residential Codes (IRC)