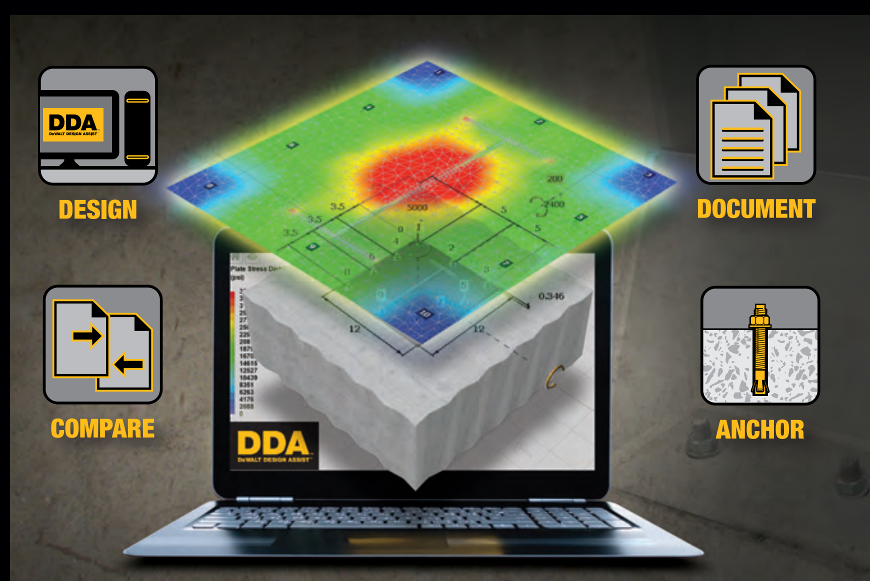
DEWALT

ANCHORS & FASTENERS



SPECIFICATIONS | DESIGN TABLES | SOFTWARE | APPROVALS

TECHNICAL GUIDE

FOR DESIGN PROFESSIONALS

3RD EDITION

DEWALT®

ANCHORS & FASTENERS

HEAVY DUTY UNDERCUT ANCHORS

PART OF AN OSHA COMPLIANT™ 1926.1153 SYSTEM

DDA DEWALT DESIGN ASSIST™

CODE LISTED
ICC-ES ESR-4810
CONCRETE

CCU+™ CRITICAL CONNECTION UNDERCUT ANCHORING SYSTEM

When critical mechanical anchor connections are required, consider the DEWALT® Critical Connection Undercut (CCU+™). The 3/8", 1/2", 5/8" and 3/4" diameter CCU+™ anchor range combine with Hollow Stop and Undercutting Bits, 60V MAX* rotary hammers and HEPA dust extractors for an OSHA Table 1 compliant cordless system. CCU+ anchors are available in 3 steel grades and are all 100% Made in the USA for Buy America construction projects.

ANCHORS MADE IN THE USA

* System is compliant to the Exposure Control Methods described in Table 1 of 29 CFR 1926.1153 when outlined components are operating and maintained in accordance to manufacturer's instructions.

TECHNICAL GUIDE
FOR DESIGN PROFESSIONALS

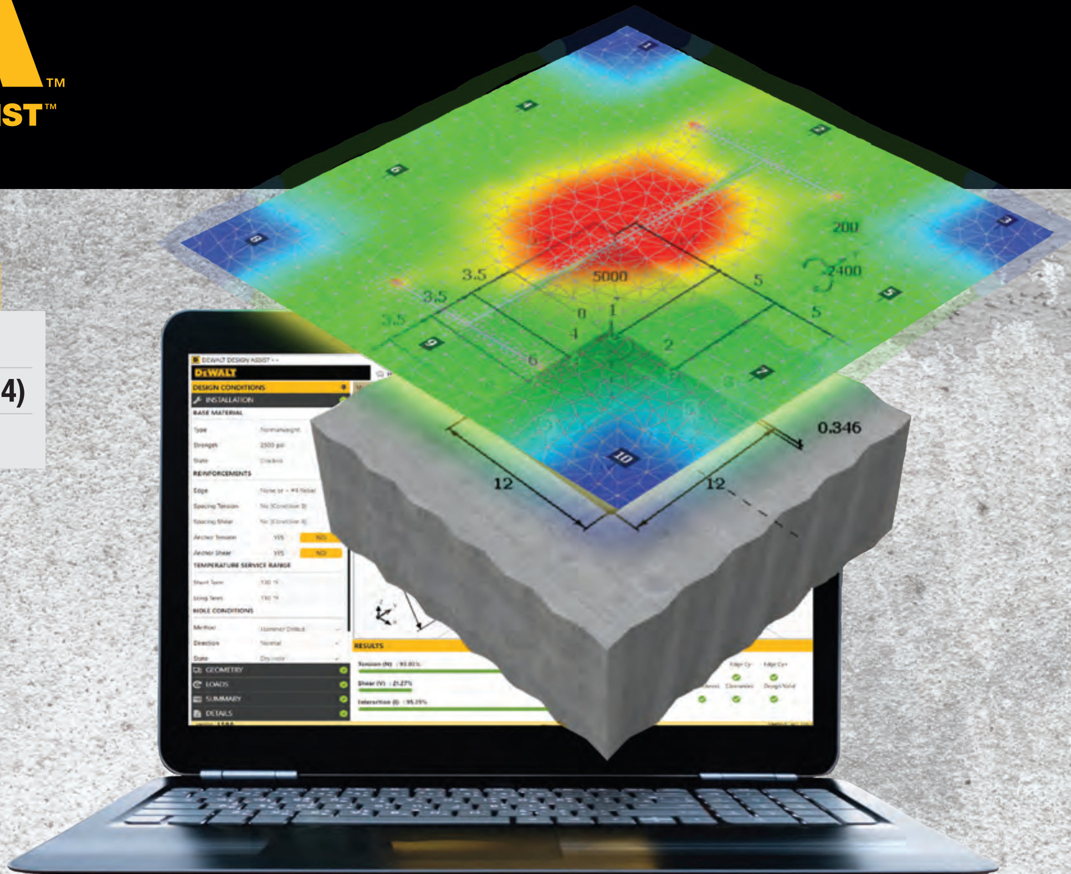
3RD EDITION

DEWALT®

ANCHORS & FASTENERS

DDA™

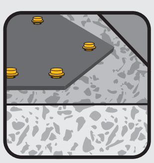
DEWALT DESIGN ASSIST™



CODE COMPLIANCES

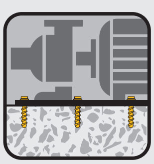
- ☑ ACI 318 (-19, -14)
- ☑ CSA A23.3 (-19, -14)
- ☑ ASCE 7 (-16, -10)

KEY FEATURES AND BENEFITS



Base Plate Anchorage

The standard tool to use when considering anchorage to concrete, allows complete geometric flexibility with the anchor patterns or base plate shape. Designs are calculated to be compliant with the latest major published design criteria and use products that have been independently tested and qualified by approval bodies for performance.

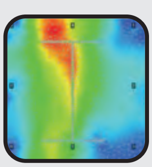


Equipment Anchorage

Further extending the functionality of base plate designs, you can now leverage this tool to model wind and seismic forces acting on equipment and resolve optimal anchorage solutions in accordance with ASCE 7.

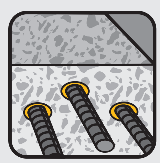
Anchorage to Deck Members

Into the floor or overhead, this functionality considers the unique designs where anchoring to concrete deck members is required. Various considerations are taken into account for the multiple cast-in or post-installed products DEWALT has to offer in this composite base material.



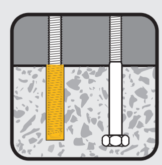
Base Plate Thickness Tool

Using finite element analysis, this tool discretizes the baseplate into elements to calculate and check the thickness to determine when the plate is sufficiently rigid. A heat map is generated to highlight the distribution of the stresses on the plate.



Post-Installed Rebar Design

Enables the design of post-installed rebar connections and rebar development length applications for specifically qualified adhesive systems in accordance with ACI 318 Chapter 12 and Chapter 25.



Anchor Comparisons

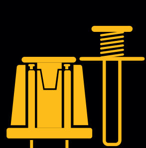
Comparisons of anchors can occur in several ways within DEWALT Design Assist. For a broad analysis, quickly calculate and filter the entire anchor library with a click of a button. To take a more detailed look, use the Anchor Comparison Tool to quickly see differences across anchor types, sizes and brands. It can help to intelligently and effectively select the best product for your design.

Independently Verified

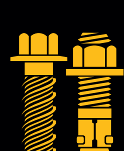
To provide the best possible design aid DEWALT has partnered with leading engineering firms for the development of the core calculation logic. In addition to extensive internal software testing, various design scenarios were independently validated to ensure accuracy and precision.

Versatility

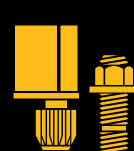
Adaptable approach in DDA allows designer to choose between pre-defined or customized load combinations. In addition, the advanced interaction of tension and shear forces feature allows designer to choose to optimize between trilinear (1.2) option and traditional (5/3) approach.



MEP Inserts



Mechanical

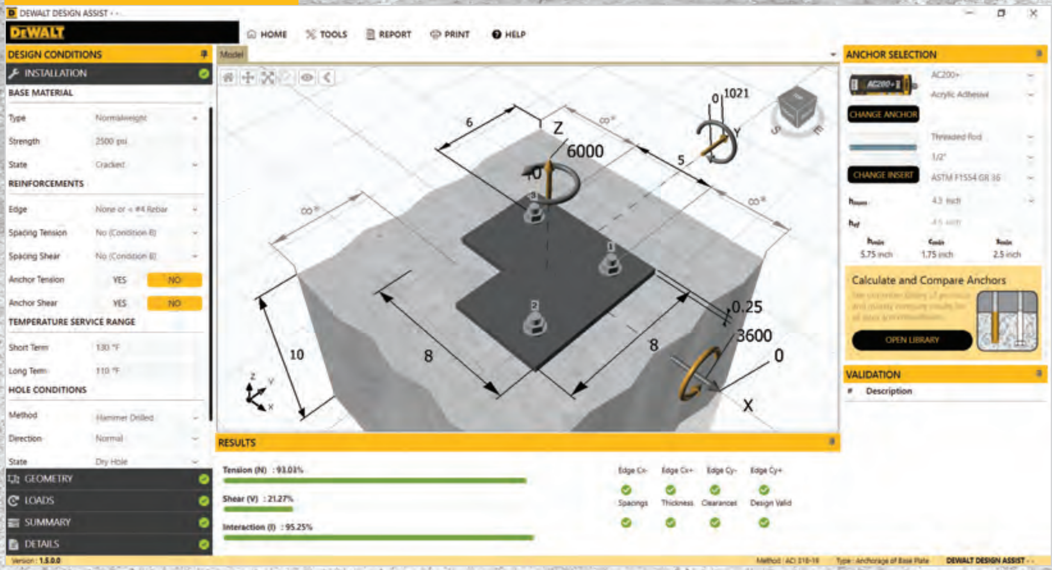


Adhesives

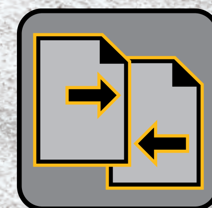
Cast-In-Place

STRUCTURAL ANCHORING DESIGN SOFTWARE

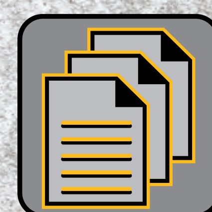
3D INTERACTIVE UI



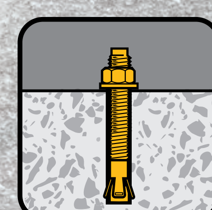
DESIGN



COMPARE



DOCUMENT



ANCHOR

PRODUCT COMPARISON

Anchor Image			
Anchor Name	CCU+	Pure110+	Headed Heavy Hex Bolt
Anchor Material	Undercut Anchor	Epoxy Adhesive	Headed Bolt
Approval	ICC-ES ESR-4810	ICC-ES ESR-3298	- -
Issued	Jun,2021	Jul,2021	-
Diameter (in)	1/2"	1/2"	1/2"
Embedment,hnom (in)	5.375	5.375	5.375
Hmin (in)	7	6.625	2.25
Cmin (in)	3	2.5	0.75
Smin (in)	3.75	2.5	2
Design Valid	Satisfied	Satisfied	Satisfied
Tension	80.960%	81.000%	81.000%
Shear	7.470 %	6.230 %	6.230 %
Interaction	80.960 %	81.000 %	81.000 %

DOWNLOAD THE FULL SUITE AT DEWALT.COM/DDA

DEWALT®

ANCHORS & FASTENERS

SELECTION GUIDE

DEWALT®

ANCHORS & FASTENERS

Product	Substrate								Approvals and Listing							Recognition			Size Range		Features			
	Normal-Weight Concrete	Lightweight Concrete	Cracked Concrete	Concrete Over Metal Deck	Grout Filled CMU	Hollow CMU	Unreinforced Masonry	Clay Brick	ICC-ES Report (ESR No.)	City of Los Angeles Supplement	Florida Building Codes Supplement	Miami-Dade County Approved	UL Listed	FM Approved	NSF Listed	Seismic Recognition	High Wind Recognition	Post-Installed Rebar Connections	Nominal Anchor Diameter	Reinforcing Bar Size	DEWALT Design Assist Software	DUSTX+ Installation System	Made in the USA	DOT Listings
ADHESIVE ANCHORING SYSTEMS																								
Pure110+® High Strength Epoxy Anchoring System	✔	✔	✔		✔	✔			3298	✔	✔				✔	✔	✔	✔	3/8 to 1-1/4	#3 to #11	✔	✔	✔	✔
Pure50+™ Epoxy Anchoring System	✔	✔	✔						3576	✔	✔				✔	✔	✔		3/8 to 1-1/4	#3 to #10	✔	✔	✔	✔
AC200+™ High Strength Acrylic Anchoring System	✔	✔	✔						4027	✔	✔				✔	✔	✔	✔	3/8 to 1-1/4	#3 to #10	✔	✔		✔
AC100+ Gold® Vinylester Adhesive Anchoring System	✔	✔	✔		✔	✔	✔	✔	2582 3200 4105	✔	✔				✔	✔	✔		3/8 to 1-1/4	#3 to #10	✔	✔		✔
EXPANSION ANCHORS																								
Power-Stud®+ SD1 Carbon Steel Wedge-Anchor	✔	✔	✔	✔	✔				2818 2966	✔	✔		✔	✔		✔	✔		1/4 to 1-1/4		✔	✔		
Power-Stud®+ SD2 High Performance Carbon Steel Wedge-Anchor	✔	✔	✔	✔	✔				2502	✔	✔		✔	✔		✔	✔		3/8 to 3/4		✔	✔		
Power-Stud®+ SD4 304 Stainless Steel Wedge-Anchor	✔	✔	✔		✔				2502	✔	✔					✔	✔		1/4 to 3/4		✔	✔	✔[1]	
Power-Stud®+ SD6 316 Stainless Steel Wedge-Anchor	✔	✔	✔		✔				2502	✔	✔					✔	✔		1/4 to 3/4		✔	✔	✔[1]	
Power-Stud® HD5 Hot-Dip Galvanized Wedge Expansion Anchor	✔	✔	✔		✔												✔		3/8 to 3/4			✔		
SCREW ANCHORS																								
Screw-Bolt+™ High Performance Screw Anchor	✔	✔	✔	✔	✔			✔	3889 4042	✔	✔					✔	✔		1/4 to 3/4		✔	✔		
316 Stainless Steel Wedge-Bolt™ Screw Anchor	✔	✔			✔												✔		1/4 to 1/2			✔		
UltraCon®+ Concrete Screw Anchor	✔	✔		✔	✔	✔		✔	3068 3196 3213 3042	✔	✔	✔					✔		3/16 and 1/4		✔	✔		
UltraCon® Concrete and Masonry Fasteners	✔	✔			✔	✔					✔	✔					✔		5/16			✔		
UltraCon® SS4 410 SS Concrete and Masonry Fasteners	✔				✔	✔					✔	✔					✔		1/4			✔		
Crete-Flex® 410 SS Concrete and Masonry Fasteners	✔				✔	✔					✔	✔					✔		3/16 and #14			✔		
Aggre-Gator® 300 SS Bi-Metal Concrete and Masonry Fasteners	✔				✔	✔		✔			✔	✔					✔		1/4			✔		
SPECIALTY ANCHORS																								
CCU+™ Heavy Duty Undercut Anchor	✔	✔	✔	✔					4810	✔	✔					✔	✔		3/8 to 3/4		✔	✔	✔	✔
Power-Bolt®+ Heavy Duty Sleeve Anchor	✔	✔	✔	✔					3260	✔						✔	✔		1/4 to 3/4		✔	✔		
MEP THREADED ROD HANGING ANCHORS																								
Snake+® Rod Hanger / Screw Anchor	✔	✔	✔	✔					2272	✔	✔			✔		✔	✔		1/4 to 1/2		✔	✔		
Hangermate®+ Rod Hanging Anchor	✔	✔	✔	✔					3889	✔	✔			✔		✔	✔		1/4 to 1/2		✔	✔		
Mini-Undercut+™ Rod Hanger for PT Slabs and Hollow Core Plank	✔	✔	✔	✔					3912	✔	✔					✔	✔		3/8		✔	✔		
CAST IN PLACE ANCHORS																								
Bang-It®+ Metal deck cast in place anchor	✔	✔	✔	✔					3657	✔	✔		✔	✔		✔	✔		1/4 to 3/4		✔			
Wood-Knocker®II+ Cast-in-Place Anchor for Forms	✔	✔	✔	✔					3657	✔	✔		✔	✔		✔	✔		1/4 to 3/4		✔			
Pan-Knocker®II+ Cast-in-Place Concrete Insert Anchor	✔	✔	✔	✔					3657	✔	✔		✔	✔		✔	✔		1/4 to 3/4		✔			
DDI+™ (Deck Insert) Metal Deck Cast In Place Anchor	✔	✔	✔	✔					3958	✔	✔		✔	✔		✔	✔		3/8 to 7/8		✔			

For technical support please contact a DEWALT Product & Code Expert at 800-524-3244 or visit our website at www.DEWALT.com

1. Domestically produced Power-Stud SD4/SD6 available by special order. See Ordering Information for product availability and details.

TABLE OF CONTENTS

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

MECHANICAL ANCHORS

Power-Stud®

The Power-Stud anchor is a fully threaded, torque-controlled, wedge expansion anchor designed for use in uncracked concrete and grout-filled masonry. It is available in 304 and 316 stainless steel.

Power-Bolt®

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.

Lok-Bolt AS®

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.

Smart-DI

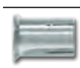
The Smart DI is an all-steel, machine bolt anchor available in carbon steel. It can be used in solid concrete, hard stone, and solid block base materials. The Smart DI is specifically designed to be easier to fully set during installation as a benefit to the user.

Steel Dropin™

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, including lightweight concrete and concrete-filled steel deck members. The anchors can also be considered for hard stone and solid block base materials.

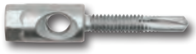
Hollow-Set Dropin™

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.



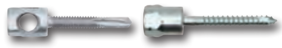
Mini Dropin™

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.



Suspender®

The Suspender is a one-piece screw anchor designed for overhead MEP applications. The Suspender features heads that are both end-tapped and cross-tapped to permit in-line or side mounting of threaded rod to concrete, steel, or wood substrates.



Hangermate® Rod Hangers for Steel, and Wood

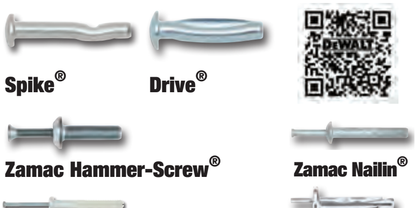
The Hangermate for Steel and Wood is a one-piece screw anchor designed for anchoring threaded rod into steel or wood base materials for overhead suspended MEP applications.

BOLT AND SHIELD ANCHORS

Double™ **Lag Shield™** **Calk-In™**

Bolt and shield anchors comprise a group of anchors that are particularly suited for substrates of questionable strength or consistence such as stone or weak masonry.

IMPACT, NAIL AND PIN ANCHORS



Spike® **Drive®** **Zamac Hammer-Screw®** **Zamac Nailin®** **Nylon Nailin®** **Heli-Pin™** **Safe-T Pin™**

Impact, Nail and Pin anchors comprise a group of anchors will well-known names, such as Spike, or Zamac Nailin. These anchors are function well for light and medium duty loads and have tamper-proof features among the many head styles and types.

LIGHT DUTY ANCHORS

Toggle-Bolt **Wall Dog®** **Strap-Toggle™** **Zip-Toggle®** **Polly™** **Zip-It®** **Pop-Toggle™** **Poly-Toggle®** **Sharkie™** **Bantam Plug** **Fluted Plastic Anchor**

Light duty anchors comprise a group of anchors that are well suited for wall board anchoring and general purpose fastening into solid substrates.

CHEMICAL ADHESIVES

Hammer-Capsule®

The Hammer-Capsule system consists of a self contained, single use, two-part glass capsule into which threaded anchor rod or reinforcing bars can be directly driven without the need for a chisel point or spinning action.

AC50™

AC50 is a two-component, adhesive anchoring system. The system includes injection adhesive in plastic cartridges, mixing nozzles, dispensing tools and hole cleaning equipment. The AC50 is designed for bonding threaded rod and reinforcing bar hardware into drilled holes in solid concrete base materials.

EXPANSION FOAMS

PowerFoam™ TriggerFoam Pro

PowerFoam and TriggerFoam are single component moisture curing polyurethane expanding foam used for insulation, through wall penetrations and fire blocking available in a variety formulations depending on use.

ADHESIVE SEALANT

PowerStick™

Powerstick is a single-component adhesive sealant with excellent bond characteristics and adhesive properties for general purpose use on most construction materials

ADHESIVE ACCESSORIES

Adhesive Accessories include dispensing and cleaning tools, mixing nozzles as well as screen tubes and piston plugs various installation scenarios

DUST EXTRACTORS

Dust extractors provided the necessary airflow for drilling, hammering, and grinding and are OSHA-compliant (1926.1153) for dust control with 99% or greater filter efficiency.

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

CORDLESS CONCRETE NAILER (CCN)

20V MAX* Cordless Concrete Nailer System

The 20V MAX* Cordless Concrete Nailer is a battery operated combustion-free nailer system designed for commercial framing and track installation into concrete and steel. The system can also install mechanical clips, lathing, installation and more.

For 20V MAX Maximum initial battery voltage measured without a workload is 20 volts. Nominal voltage is 18.

GAS ACTUATED FASTENING

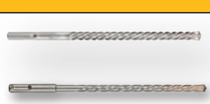
Trak-It® C5 System

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.

ROTARY HAMMERS

Rotary Hammers are available in cordless and corded platforms with SDS-Max, SDS-Plus, and spline shank styles for maximum flexibility in jobsite drilling.

CONCRETE AND MASONRY DRILL BITS



DEWALT's high performance carbide offering includes both standard and hollow versions. Hollow Drill Bits extract dust while drilling for an OSHA Table 1 compliant dust control solution when used with DEWALT dust extractors.

POWDER ACTUATED DIRECT FASTENING

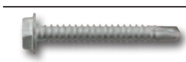
Powder-Actuated Fastening System

This system provides a cost-effective method of attaching members and fixtures in applications without pre-drilling holes. This family of products provides users with optimum performance in fastening to concrete, concrete over steel deck, masonry, and structural steel.

METAL CONSTRUCTION SCREWS

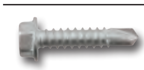
Drilit®

Drilit self-drilling fasteners eliminate separate drilling and tapping operations for faster, more economical installations.



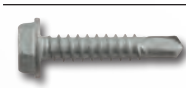
Dril-Flex®

Dril-Flex Structural Drill Screws are dual heat treated self-drilling tapping screws that provide the strength, ductility and resistance to embrittlement required for critical applications.



Bi-Flex®

Bi-Flex structural screws are bi-metal self-drilling tapping screws that provide the corrosion resistance of 300 series stainless steel and the efficiency of drill screws. Bi-Flex screws are suitable for use in both steel and aluminum.

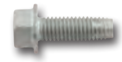


Alumi-Flex®

Alumi-Flex structural drill screws are 300 series (18-8) stainless steel self-drilling tapping screws that are used for fastening to aluminum when corrosion resistance and galvanic reaction are a primary concern.

Architectural Roof Clip Fasteners

Architectural Roof Clip Fasteners offer a low-profile head design for wood and steel applications.

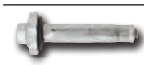


Tap-Flex®

Tap-Flex Thread-Forming Structural Screws are thread-forming, dual heat treated self-tapping fasteners that provide the strength, ductility, and resistance to embrittlement failures required in critical curtain wall and dissimilar metal applications.

Tap-Fast®

TapFast fasteners are high-performance fasteners designed specifically for attaching light gauge metal panels (18 ga. max.) to wood frame structures.



Fab-Lok®

Vibration, either from inside or outside a building, can make ordinary fasteners loosen and back out. Fab-Lok fasteners combine a screw and a slotted aluminum sleeve to provide resistance to loosening in high-stress and high-vibration environments.

PanelMate®

PanelMate is a family of screw anchors available in both internally and externally threaded variations. Originally designed for installing hurricane panels, these versatile anchors can be used wherever 1/4"-20 threaded hardware needs to be attached to concrete, masonry or wood.

Vent-All®

Vent-All explosion venting fasteners, a series of FMapproved collapsible washers on stainless steel fasteners, are designed to minimize injury and destruction of property from explosions caused by agricultural or industrial operations.

IMPACT WRENCHES

DEWALT offers a wide range of cordless and corded impact wrenches for jobsite anchoring applications.

TORQUE WRENCHES

When exact torque requirements are needed for proper anchor installation per the specifications and drawings, DEWALT calibrated torque wrenches get the job done.

DISCLAIMER FOR RECOMMENDATIONS, INFORMATION AND USE OF DATA

OUR PRODUCTS: The recommendations, information and data contained in this technical guide and on the Site are put together with the greatest care and accuracy possible. They are based on principles, equations and safety factors set out in the technical documentation of DEWALT, that are believed to be true and correct at the time of publication on October 1, 2022. The information and data is subject to change after such date as DEWALT reserves the right to change the designs, materials and specifications of the products on the Site without notice.

It is the responsibility of the design professional to ensure that suitable product is selected, properly designed and used in the intended application. This includes that the selected product and its use is compliant with applicable building codes and other legal requirements and will satisfy durability and performance criteria and margins of safety which the design professional determine are applicable. The products must be used, handled, applied and installed strictly in accordance with all current instructions for use published by DEWALT.

The performance data in the technical guide and on the Site are the result of the evaluation of tests conducted under laboratory conditions. It is the responsibility of the designer and installer in charge to consider the project conditions and to ensure the performance date set forth on the Site is applicable to the actual conditions. In particular the base materials and environmental conditions must be checked prior to installation. In case of doubt, contact the technical support of DEWALT.

DISCLAIMER OF WARRANTIES AND LIMITATION OF LIABILITY: OUR EXPRESS WARRANTIES ARE LIMITED TO THOSE SPECIFIED WITH EACH PRODUCT. TO THE FULL EXTENT PERMISSIBLE BY APPLICABLE LAW, WE DISCLAIM ALL IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT WILL WE BE LIABLE TO ANY PARTY FOR ANY DAMAGES OF ANY KIND ARISING FROM THE USE OF THIS SITE OR FROM ANY INFORMATION, CONTENT, MATERIALS (INCLUDING SOFTWARE) OR SERVICES INCLUDED ON OR OTHERWISE MADE AVAILABLE TO YOU, INCLUDING, BUT NOT LIMITED TO, DIRECT, INDIRECT, INCIDENTAL, PUNITIVE, AND CONSEQUENTIAL DAMAGES, LOST PROFITS OR REVENUES, COSTS OF REPLACEMENT, BUSINESS INTERRUPTIONS, LOSS OF DATA OR DAMAGES RESULTING FROM USE OF OR RELIANCE ON THE INFORMATION PRESENT, EVEN IF STANLEY BLACK & DECKER IS EXPRESSLY ADVISED ABOUT THE POSSIBILITY OF SUCH DAMAGES, UNLESS OTHERWISE SPECIFIED IN WRITING. CERTAIN STATE LAWS DO NOT ALLOW LIMITATIONS ON IMPLIED WARRANTIES OR THE EXCLUSION OR LIMITATION OF CERTAIN DAMAGES. IF THESE LAWS APPLY TO YOU, SOME OR ALL OF THE ABOVE DISCLAIMERS, EXCLUSIONS, OR LIMITATIONS MAY NOT APPLY TO YOU, AND YOU MIGHT HAVE ADDITIONAL RIGHTS. FURTHER, STANLEY BLACK & DECKER SHALL HAVE NO LIABILITY WITH RESPECT TO CHANGES IN THE DESIGN, MATERIALS AND SPECIFICATIONS IN THE PRODUCTS, NOR WITH RESPECT TO ANY PRODUCT WHICH HAS BEEN MODIFIED OR INSTALLED IMPROPERLY, REGARDLESS OF ANY SPECIFIC INSTRUCTIONS TO THE INSTALLER. THE RESPONSIBLE DESIGNER AND INSTALLER SHALL HOLD STANLEY BLACK & DECKER HARMLESS FROM AND AGAINST ANY AND ALL CLAIMED LOSS OR DAMAGE OCCASIONED, IN WHOLE OR IN PART, BY ANY MODIFIED PRODUCTS OR DEVIATIONS IN PRODUCT INSTALLATION PROCEDURES.

LEGAL NOTICE FOR NEW JERSEY RESIDENTS: Under the New Jersey Truth-in-Consumer Contract, Warranty and Notice ACT (“TCCWNA”), N.J.S.A. 56:12-14 et seq., consumers may not be offered any written contract which includes any provision that violates any clearly established legal right of a consumer, or responsibility of a seller, as established by state or federal law. In addition, under the TCCWNA, no consumer contract may state that any of its provisions are or may be void, unenforceable or inapplicable in some jurisdictions without specifying which provisions are or are not void, unenforceable or inapplicable in New Jersey. Therefore, the following provisions of these Terms shall not be applicable to New Jersey residents: (1) in the Disclaimer of Warranties and Limitation of Liability section, (a) the provision concerning limiting our liability for any loss or damage is not applicable to New Jersey residents to the extent we were negligent or have breached our obligation to you, and (b) the provision concerning the exclusion or limitation of certain damages is not applicable to New Jersey residents with respect to punitive damages, loss of data, and loss of or damage to property; and (c) the provision concerning the indemnification by you is not applicable to New Jersey residents unless you were negligent or have breached these requirements.

ANCHORING AND FASTENING SYSTEMS

FOR CONCRETE AND MASONRY

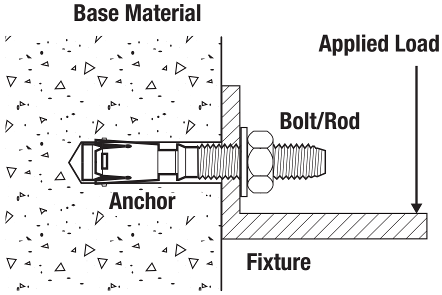
SECTION CONTENTS

INTRODUCTION

A wide variety of post-installed anchors, cast-in place anchors and fastening systems are available. In construction, these products are commonly 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, and direct fastening technologies (e.g. powder actuated, cordless battery actuated, gas actuated). 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.

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 in certain applications 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 A615 and A706.

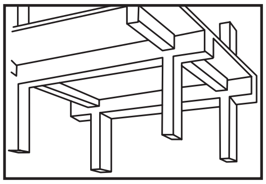
The design and construction requirements for reinforced concrete buildings and structures in the United States are published by the American Concrete Institute (ACI) in document ACI 318, Building Code Requirements for Structural Concrete.

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 C150. 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 C33 for normal-weight concrete.

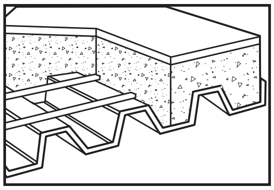
The aggregate used in normal-weight concrete ranges in weight from 135 to 165 pcf. For lightweight concrete, the aggregate such as that manufactured from expanded shale, slate, clay, or slag has a weight range of 55 to 75 pcf as listed in ASTM C330. The unit weight for normal-weight concrete ranges from 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. 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. Typically, 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 C31. The cylinders are broken according to ASTM C39 at specified time intervals, and the resulting strength is calculated and reported in psi.

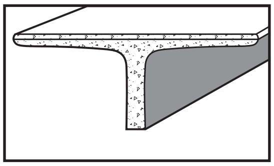
Examples of common construction methods in which reinforced concrete is used are shown in the following figures:



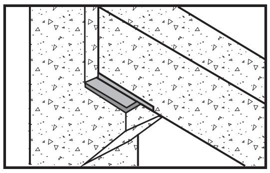
POURED IN PLACE CONCRETE USING A FORM SYSTEM



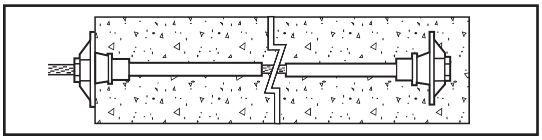
COMPOSITE SLABS POURED OVER STEEL DECK



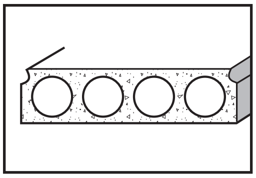
PRECAST TEES



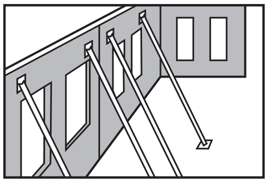
PRECAST BEAMS AND COLUMNS



POST-TENSIONED SLABS AND BEAMS



PRECAST PLANK



TILT-UP WALL PANELS

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.

Unless otherwise noted (e.g. qualification tests in cracked concrete), the tests to determine load capacities listed in this guide were conducted in unreinforced test locations/members. This was done to provide baseline data which is usable regardless of the possible benefit of reinforcement.

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 unless specific site testing is conducted to the satisfaction of the design professional responsible for the project. 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 adhesive anchor 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.

MASONRY MATERIALS

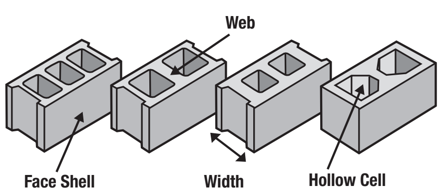
The strength of masonry walls is typically less than that of concrete and the consistency of masonry materials can vary on a regional basis. To form a wall, individual masonry units are bonded together with a cement mortar. A vertical row is called a course and a horizontal row is called a wythe. The 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 generally 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 and engagewith 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 fasteners in critical applications or where specific data is not available. 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)

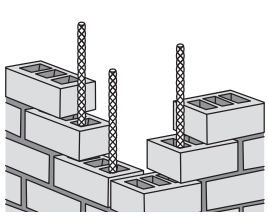
Masonry block is found in a variety of sizes and shapes depending upon the age and location of a building. Both hollow and solid styles which can be classified as load-bearing or non-load bearing are used. Load-bearing block, known as a concrete masonry unit (CMU) is generally suitable for anchoring or fastening. ASTM C90 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 C90. 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.

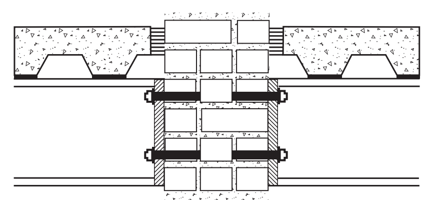


GROUT-FILLED CONCRETE MASONRY

Experience has shown that the consistency of grout-filled block can vary and voided areas are often present a problem. Therefore, job site tests are recommended to determine actual load capacities for fasteners in critical applications or where specific data is not available. 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. Unless otherwise noted, the load capacities listed in this guide were conducted in unreinforced test locations/members to provide baseline data which is usable regardless of the possible benefit of reinforcement unless otherwise noted.

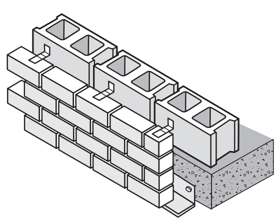
Brick

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

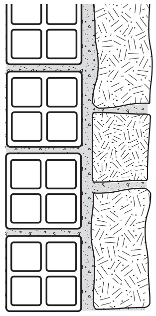
Brick is produced as a solid masonry unit or with cores during extrusion. The cores (also known as weep holes) reduce the weight of the brick and help it to lay better. ASTM C652 describes hollow brick masonry units. Hollow brick is defined as having a cross sectional bearing area which is less than 75% of the gross area of the brick measured in the same plane. ASTM C62 describes solid building brick while C216 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.



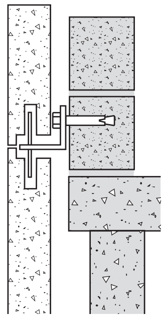
Note: Brick cores can often create a problem when attempting to install traditional anchors because of the cavities. In this case, an alternative anchor, such as an adhesive anchor could be considered. Also, brick is generally not suitable for power-actuated fasteners.

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

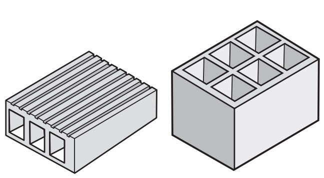
Generally, anchors installed in softer material such as limestone or sandstone will have capacities similar to those obtained in 2,000 psi concrete. In harder stone such as granite or marble, the capacities will be similar to 4,000 or 6,000 psi concrete. Job site tests are recommended because of the wide variation in the strengths of natural stone. ASTM C119 describes dimensional stone for use in building construction. Specifications for individual stone types include C503 for marble, C568 for limestone, C615 for granite, and C616 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 C119 describes dimensional stone for use in building construction. Specifications for individual stone types include C503 for marble, C568 for limestone, C615 for granite, and C616 for quartz-based material.

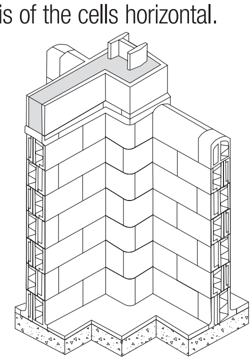
Note: Stone is not generally considered a suitable base material for power-actuated fasteners.

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



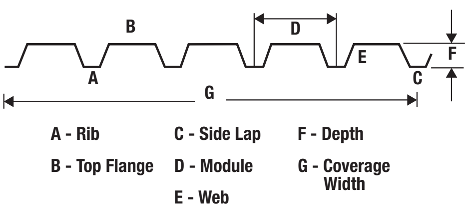
STRUCTURAL CLAY PARTITION

Structural clay tile units can be used to form a load bearing wall and as a veneer or facade. ASTM C34 describes structural clay tile for load bearing walls. Structural clay facing tile is described in ASTM C212. For non-load bearing applications, ASTM C56 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 A525 in various thicknesses. The following diagram shows a typical steel deck cross section.



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 A611 and A446. 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 gauge 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 and 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

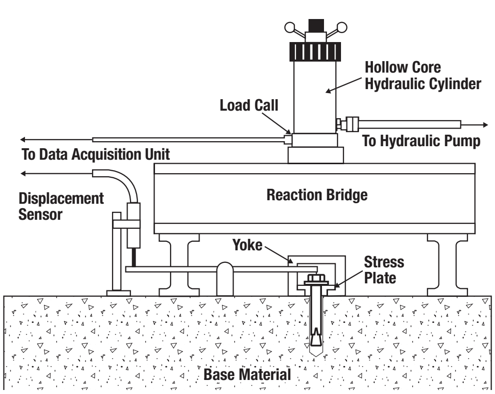
The general test data for anchors and fasteners published in this guide was developed according to the following standards (as applicable): *ASTM E488, Standard Test Methods for Strength of Anchors in Concrete; ASTM E1190, Standard Test Methods for Strength of Power-Actuated Fasteners Installed in Structural 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 can be 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 15 to 20% for concrete or masonry base materials respectively).

EVALUATION OF TEST DATA (SD)

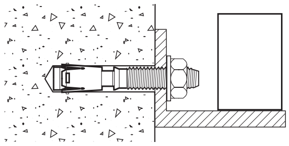
Strength Design for anchors in concrete for structural and non-structural connections is becoming more the norm as the International Building Code (IBC) has been adopted and accepted in most jurisdictions within the United States; Canada is also following closely with the National Building Code of Canada (NBC). This method applies reduction factors to characteristic values determined from comprehensive qualification testing requirements and assessment which results in factored design capacities. 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 Chapter 17. 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.

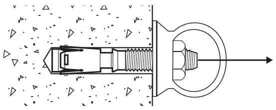
STATIC LOADS

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.



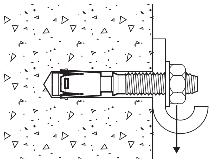
Tension Load

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



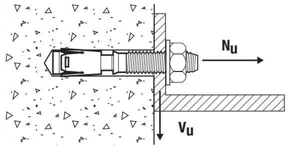
Shear Load

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

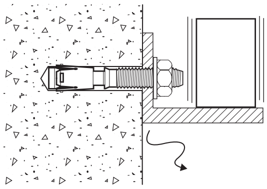
One often overlooked result of static load is bending. It is frequently necessary to place shims or spacers between the fixture and the material for alignment or leveling. When this occurs, it is often the strength of the anchor material or bolt material that determines the capacity of the connection. 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 bending load should be calculated by a design professional based on the material. 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 which can be, approximated by 1/2 to 1 anchor diameter.

DYNAMIC AND SHOCK LOADS

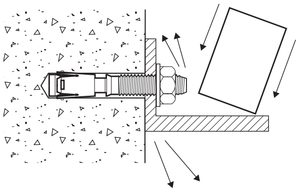
Dynamic Loads

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.



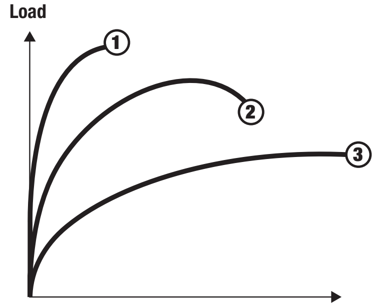
Standard industry practice with regard to safety factors varies depending upon the frequency and intensity of the load. However, safety factors for dynamic or shock load conditions may require 10:1 or higher. Determination of the appropriate safety factor should be made by the design professional in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

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 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 steel anchor rod. A heavy duty undercut anchor may also exhibit this type of behavior and can also provide ductility often needed in design for critical connections, including loads due to earthquakes.

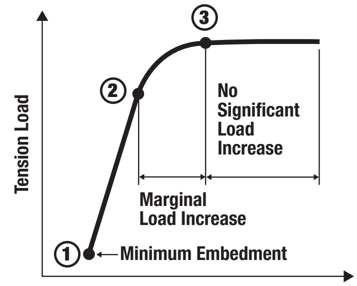
Typical performance of a torque controlled anchor is shown in Curve (2). Displacement begins to occur after the initial preload in the anchor has been exceeded until the ultimate load capacity is achieved.

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 significantly 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 setting (e.g. applying torque). 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 and as noted in the load tables in specific product sections.

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 anchors may reach the capacity of the bond strength, the steel anchor rod material, or the capacity of the base material. For applications requiring installation at embedment depths between those published, linear interpolation can be considered (see information in specific product sections). The following diagram shows an illustration of tension performance of a mechanical anchor installed in concrete as embedment increases.

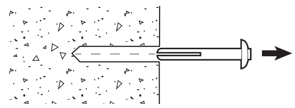


MODES OF FAILURE

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

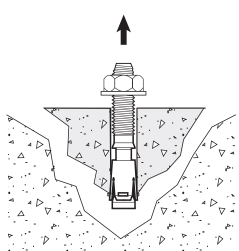
Anchor Pullout

This type of failure occurs when the applied load is greater than the friction or engagement 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.



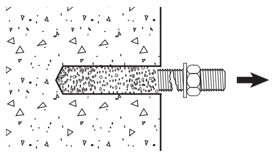
Base Material Failure

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 can be pulled, usually for anchors installed at a relatively 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.



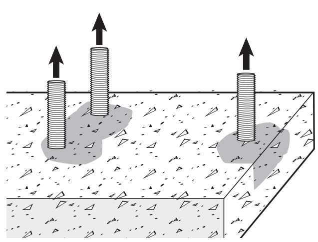
As the embedment of some anchor styles is increased to six diameters or beyond, the concrete can sustain the applied compression force and the load capacity of the anchor will increase up to a point at which either the capacity of the expansion mechanism or the bond is reached. In masonry, part of the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

Anchor Material Failure



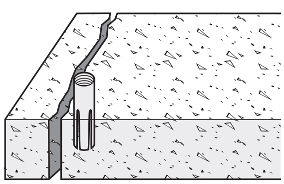
A failure of the anchor body or rod will occur when the applied load exceeds the strength of the material from which the anchor is manufactured. For mechanical anchors, this usually occurs for anchors which are embedded deep enough to develop the full strength of the expansion mechanism and the base 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 applied. This is especially important in unreinforced base materials and for cases such as groups of anchors near the corner of a concrete or masonry member. The critical dimensions include the thickness and the width of the base material.

ANCHOR PRELOAD

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 significant 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.

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 offers several of adhesive anchoring systems that have been independently tested and qualified to meet or exceed the creep requirements of ACI 355.4, ICC-ES AC308 and AC58 (see information in specific 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 in assemblies (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 during manufacture 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 and/or critical components manufactured from a material with a melting point of less than 1000°F are not normally recommended for overhead applications due to fire considerations (e.g. Zamac Nailin anchor bodies). 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 bright' 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 B633, 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 B695, 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, B695. ASTM A153, 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. Stalgard®)

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 Stalgard® (formerly known as Perma-Seal™). When a component is coated with Stalgard, 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 Stalgard 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 B117 shows that the Stalgard 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 304 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.

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.

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.

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. The age of the base material as well as strength and hardness will affect drilling speed, drill bit wear, and drill bit life. 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 commonly 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 hollow drill bits and a HEPA vacuum (e.g. DustX+), compressed air, 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 taken when using adhesives for anchoring. The drilled hole should be thoroughly cleaned with suitable equipment to ensure that a proper bond is developed. See specific product information concerning suitability of specific conditions like installations in submerged environments.

Mechanical and adhesive anchors should not be installed in holes drilled with diamond tipped core bits unless specific testing has been conducted to verify performance. A diamond tipped core bit drills a hole which creates smoother walls which can cause some anchor types to slip and perform poorly.

FIXTURE 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 choosing the diameter of the hole to be formed in a fixture, consideration should be given so the resulting fixture hole selected allows for proper anchor installation as applicable.

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 clearance hole required is the anchor diameter plus 1/16". For sizes 1" and larger, the clearance hole is the anchor diameter plus 1/8". This clearance hole should be adjusted to allow for any coating applied to the fixture.

In contrast, in the case a larger than necessary fixture hole is considered for the selected anchor, the design professional should verify how the oversized fixture hole will transfer shear, as applicable. A common approach in construction using anchor bolts is to utilize oversized washers to increase the shear bearing area.

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

OVERSIZED DRILLED 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. However, some products have undergone specific qualification testing for use in oversized holes (see information in specific 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/conditions and product, oversizing the drilled hole can have an effect on performance. Site testing should be considered if product specific testing is not available from the anchor supplier to evaluate any possible effects. As in all applications, the design professional responsible for the installation should determine the drill hole size to be used based on the anchor selected and relevant requirements of the connection.

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

CORE DRILLED HOLES

Unless otherwise noted, the performance values for DEWALT 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 information in specific 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 requirements of the connection.

Note: Unless specific qualification testing or specific project testing has been conducted, it is not recommended to install 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 influence of in-service temperature including elevated temperature and freeze-thaw effects, reference the information in the specific product 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 drilled hole. If this occurs, the adhesive may not properly bond to the walls of the drilled hole. A torch should normally not be used because it carbonates the concrete on the walls of the drilled hole creating a residual dust. Job site tests are recommended where a torch is used to dry the drilled hole prior to anchor installation.

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

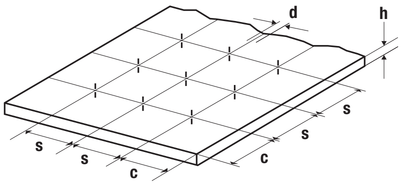
$$(F_{allow} = F_m \;/\; \Omega)$$

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 Chapter 17 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) for mechanical anchors and ACI 355.4 (ICC-ES AC308) for adhesive anchors, including consideration of cracked and uncracked concrete. 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 tension and shear, the combination of loads is typically 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 tested and qualified with ACI 355.2 or ACI 355.4, the parabolic interaction equation (shown previously) may also be considered for combined loading conditions.

For anchors that are designed using ACI 318 Chapter 17 it is possible to convert design strengths to allowable loads using the following approach from ICC-ES AC193 and AC308:

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

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 associated product evaluation reports 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 in concrete is given in CSA A23.3. In principle, the limit state design method for anchorage to concrete follows strength design provisions but utilizes different strength reduction factors. Post-installed anchors qualified 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.

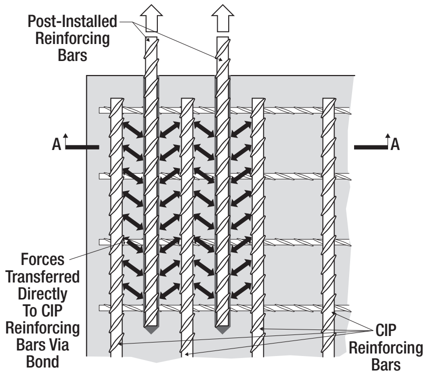
Anchors to be used for seismic loads will not be fully loaded in place until an earthquake occurs. Standard test methods have been developed to provide a methodology to simulate seismic load cycles in order to obtain statistical data for the performance of anchors in such conditions. In shear, anchors 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 Chapter 17 or CSA A23.3, as applicable.

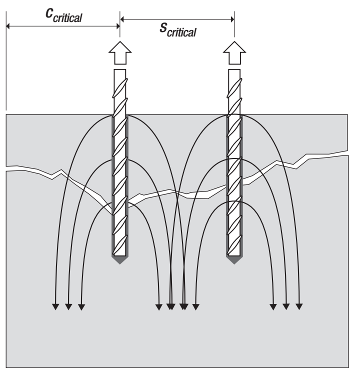
POST-INSTALLED REBAR CONNECTIONS

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 considered 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 ACI 318 Chapter 17 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: ANCHORAGE TO CONCRETE IN ACCORDANCE WITH ACI 318

The following is a reference tool for the design of anchors into concrete using ACI 318 (-19 or -14) Chapter 17 and ACI 318-11 Appendix D.

In general, the following steps should be considered when determining the controlling design strength (i.e. factored resistance, factored nominal strength) of the anchor system:

In all cases, the anchor system must be designed as follows:

$\phi N_n \geq N_{ua}$ (Tension Check)

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

- For mechanical expansion and screw anchors, ϕN_n is the lowest design strength in tension of an anchor or group of anchors as determined from consideration of steel strength, concrete breakout strength or pullout strength; ϕN_{sa}, ϕN_{cb}, ϕN_{cbg}, or ϕN_{pn}.
- For adhesive anchors, ϕN_n is the lowest design strength in tension of an anchor or group of anchors as determined from consideration of steel strength, concrete breakout strength or bond strength; ϕN_{sa}, ϕN_{cb}, ϕN_{cbg}, ϕN_a or ϕN_{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.

- For cast-in anchors, ϕN_n is the lowest design strength in tension of an anchor or group of anchors as determined from consideration of steel strength, concrete breakout strength, side-face blowout strength or pullout strength; ϕN_{sa}, ϕN_{cb}, ϕN_{cbg}, ϕN_{sb}, ϕN_{sbg}, or ϕN_{pn}. (side-face blowout strength failure mode not pictured)

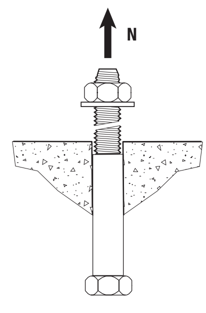
$\phi V_n \geq V_{ua}$ (Shear Check)

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

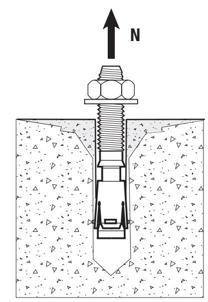
- For mechanical expansion and screw anchors, ϕV_n is the lowest design strength in shear of an anchor or group of anchors as determined from consideration of steel strength, concrete breakout strength or pryout strength; ϕV_{sa}, ϕV_{cb}, ϕV_{cbg}, ϕV_{cp}, or ϕV_{cpg}.
- For adhesive anchors, ϕV_n is the lowest design strength in shear of an anchor or group of anchors as determined from consideration of steel strength, concrete breakout strength or pryout strength; ϕV_{sa}, ϕV_{cb}, ϕV_{cbg}, ϕV_{cp} or ϕV_{cpg}.
- For cast-in anchors, ϕV_n is the lowest design strength in shear of an anchor or group of anchors as determined from consideration of steel strength, concrete breakout strength or pryout strength; ϕV_{sa}, ϕV_{cb}, ϕV_{cbg}, ϕV_{cp}, or ϕV_{cpg}.

For anchors loaded in both tension and shear, the combination of loads must also be considered using the interaction equation(s) from ACI 318.

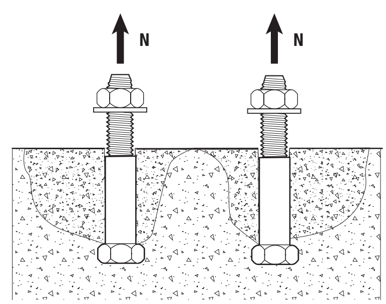
Failure modes:



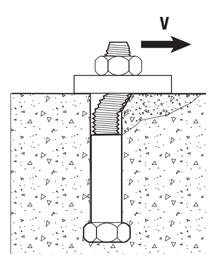
STEEL FAILURE



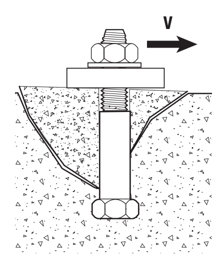
PULLOUT



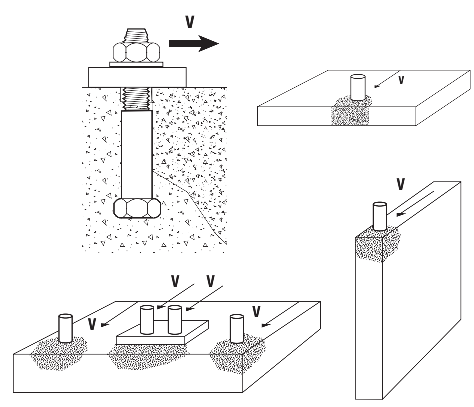
CONCRETE BREAKOUT (TENSION)



STEEL FAILURE PROCEEDED BY CONCRETE SPALL



CONCRETE PRYOUT FOR ANCHORS FAR FROM A FREE EDGE



CONCRETE BREAKOUT (SHEAR)

FIELD TECHNICAL SUPPORT

DEWALT
ANCHORS & FASTENERS

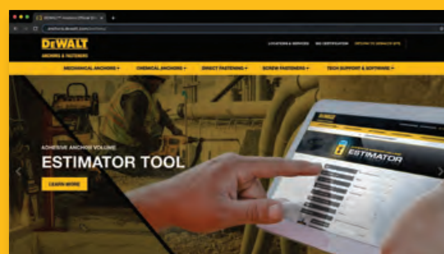
TRAINING PRESENTATIONS

ANCHORING 101 – BACK TO BASICS

Understanding the basics of post installed anchoring codes and DEWALT product offering

WEBSITE RESOURCES & DEWALT TECHNICAL SUPPORT

A comprehensive review of the DEWALT Anchoring & Fastening website content, Field Technical support offerings



SUBMITTAL TRAINING

Understanding the submittal process, where to find the relevant anchoring information in the project documents and a demonstration on creating an effective and detailed submittal

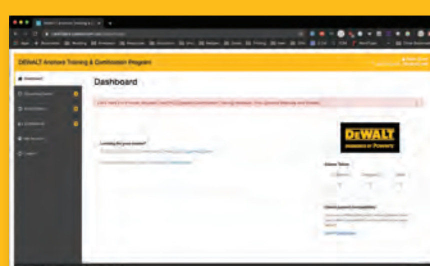
PRODUCT KNOWLEDGE, TRAINING, CERTIFICATIONS

ANCHOR INSTALLATION

"Manufacturer's Training" available for all of DEWALT Post Installed and Cast In Place Anchoring solutions

POWDER ACTUATED TOOL TRAINING AND CERTIFICATION

In accordance with current OSHA Standards



DEWALT ADHESIVE ANCHOR INSTALLER CERTIFICATION

In accordance with current ACI 318 recommendations

FIELD TECHNICAL SUPPORT

DEWALT
ANCHORS & FASTENERS

TECHNICAL TRAINING FOR PROFESSIONAL DEVELOPMENT, CONTINUING EDUCATION FOR ENGINEERS

Hangers and Bracing

Non-structural anchorage for gravity hangers and seismic bracing with review of prescriptive and design codes for MEP and Fire Protection Applications. Includes current ASCE 7 & ACI 318 requirements.

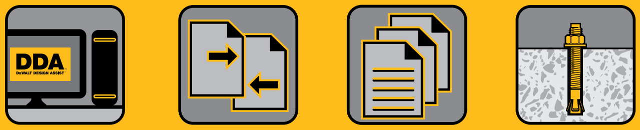
(1.0 Contact Hour)

NCSEA
DIAMOND REVIEW·CONTINUING EDUCATION

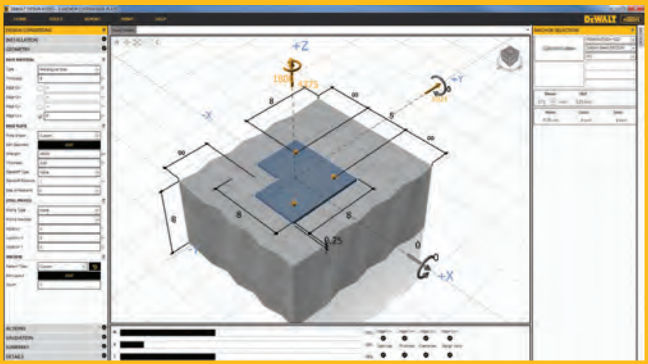
DEWALT Design Assist (DDA)

Detailed overview of DDA software functionality and key features such as custom anchor layout, load combinations, comparative anchor design, equipment anchorage and post-installed rebar design in accordance with ACI 318.

(1.0 Contact Hour)



DESIGN COMPARE DOCUMENT ANCHOR



Hands-On Anchor Training

Discuss anchors specified for commercial construction from the perspectives of design, installation, and inspection. Attendees install anchors in a concrete block (pre-drilled, office friendly). This presentation is ideal for those who have not had an opportunity to install anchors or observe anchor installation at a jobsite.

(1.5 Contact Hours)

Technical sessions are conducted by DEWALT Field Engineers in an office or jobsite environment and are accredited by NCSEA for professional development.

ADHESIVE ANCHORING SYSTEMS

ADHESIVE ANCHORS SELECTION GUIDE

Chemistry	Product	Base Material								Nominal Anchor Size													Hole Drill Method*		Hole Condition				Install Temps (Guide)			Approvals and Listings
		Concrete	Lightweight Concrete	Grout-filled Concrete Masonry	Hollow Concrete Masonry	Solid Brick	Hollow Brick	Stone	Structural Clay Tile	1/4"	3/8" (#3)	1/2" (#4 or 10M)	5/8" (#5 or 15M)	3/4" (#6 or 20M)	7/8" (#7)	1" (#8 or 25M)	1-1/8" (#9)	1-1/4" (#10 or 30M)	1-3/8" (#11 or 35M)	1-1/2"	1-3/4" (#14 or 45M)	2"	Hammer-drill	Core-drill	Dry	Wet or Water-filled	Underwater	Oversize	Cold Climate	Moderate Climate	Hot Climate	Building Code / Jurisdiction Recognition
FAST CURE ACRYLICS (HYBRID / ESTER BASE CHEMISTRY)	AC200+™	●	●	●	○	○	○	○		○	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	○	○	●	●	○	ICC-ES ESR-4027 IBC, NBC, City of LA, FBC, NSF, LEED, ASTM C881, DOT
	AC100+ Gold®	●	●	●	●	●	●	○	○		●	●	●	●	●	●	●	●	○	○			●		●	●			●	●	○	ICC-ES ESR-2582 ESR-3200, ESR-4105 IBC, NBC, City of LA, FBC, NSF, LEED, ASTM C881, DOT
STANDARD CURE EPOXIES (EPOXY BASE CHEMISTRY)	Pure110+®	●	●	●	●	○	○	○		○	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	ICC-ES ESR-3298 IBC, NBC, City of LA, FBC, NSF, LEED, ASTM C881, DOT
	Pure50+™	●	●	○		○		○			●	●	●	●	●	●	●	●	○	○			●	○	●	●		●		●	●	ICC-ES ESR-3576 IBC, FBC, NSF, LEED, ASTM C881, DOT

● Suitable ○ May be Suitable

*Hammer-drill, i.e. rotary impact drills or rock drills with a carbide drill bit (including hollow drill bits); core-drill i.e. core-drill with a diamond core-drill bit.

GENERAL INFORMATION

AC200+™

Acrylic Injection Adhesive Anchoring System and Post-Installed Reinforcing Bar Connections

PRODUCT DESCRIPTION

The AC200+ is a two-component, high strength adhesive anchoring system. The system includes injection adhesive in plastic cartridges, mixing nozzles, dispensing tools and hole cleaning equipment. AC200+ is designed for bonding threaded rod and reinforcing bar hardware into drilled holes in concrete base materials and for post-installed reinforcing bar connections (rebar development).

GENERAL APPLICATIONS AND USES

- High strength anchoring: bonding threaded rod and reinforcing bar into hardened concrete
- Rebar development length connections in concrete up to 60d embedments
- Evaluated for installation and use in dry and wet concrete (including water-filled holes)
- Can be installed in a wide range of base material temperatures
- Cracked and uncracked concrete conditions as well as wind and seismic loading (SDC A - F)
- Oversized hammer-drilled holes in concrete, for short term loading only (see www.DEWALT.com)
- Can also be used to fill large cracks and abandoned holes in concrete and masonry

FEATURES AND BENEFITS

+ Fast curing system which can be applied in structural applications as low as 14ºF (-10ºC)
+ Evaluated and recognized for freeze/thaw performance
+ Can be used in a wide range of embedments in low and high strength concrete
+ Cartridge design allows for multiple uses using extra mixing nozzles
+ Mixing nozzles proportion adhesive and provide simple delivery method into drilled holes
+ Evaluated and recognized for long term and short term loading (see performance tables)
+ Rated for in-service temperatures of up to 320ºF (160ºC)

APPROVALS AND LISTINGS

- International Code Council, Evaluation Service (ICC-ES) ESR-4027 for cracked and uncracked concrete
- Code Compliant with the International Building Code/International Residential Code: 2021 IBC/IRC, 2018 IBC/IRC, 2015 IBC/IRC, and 2012 IBC/IRC
- Tested in accordance with ACI 355.4, ASTM E488, and ICC-ES AC308 for use in structural concrete with design according to ACI 318 (-19 & -14), Chapter 17 and ACI 318-11 Appendix D
- Evaluated and qualified by an accredited independent testing laboratory for recognition in cracked and uncracked concrete including static, wind and seismic loading
- Tested and qualified for use in post-installed rebar connections and rebar development length applications in accordance with ICC-ES AC308 Table 3.8 and ACI 318 Chapter 12 and Chapter 25
- City of Los Angeles, LABC and LARC Supplement (within ESR-4027)
- Florida Building Code, FBC Supplement including HVHZ (within ESR-4027)
- Compliant with NSF/ANSI 61 for drinking water system components - health effects
- Compliant to California DPH for VOC emissions and South Coast AQMD for VOC content (LEED v4.1)
- Conforms to requirements of ASTM C881 including C882 and AASHTO M235, Types I, II, IV and V, Grade 3, Class A and conforms to requirements of ASTM C881 Types I and IV, Grade 3, Class B.
- Department of Transportation listings - see www.DEWALT.com or contact transportation agency

GUIDE SPECIFICATIONS

CSI Divisions: 03 16 00 - Concrete Anchors, and 05 05 19 Post-Installed Concrete Anchors. Adhesive anchoring system shall be AC200+ as supplied by DEWALT, Towson, MD. Anchors shall be installed in accordance with published instructions and requirements of the Authority Having Jurisdiction.

TENSION ZONE CRACKED CONCRETE | SEISMIC REGION QUALIFICATION | NSF | CODE LISTED ICC-ES ESR-4027 CONCRETE | DDA DEWALT DESIGN ASSIST | DUST X+ ANCHOR INSTALLATION SYSTEM

SECTION CONTENTS

AC200+ ADHESIVE IN CARTRIDGE
(STANDARD THREADED ROD AND REBAR STEEL SUPPLIED BY OTHERS)

PACKAGING (10:1 MIX RATIO)

Coaxial Cartridge

- 9.5 fl. oz. (280 mL or 17 in³)
- 14 fl. oz. (420 mL or 25.5 in³)

Dual Cartridge (side-by-side)

- 28 fl. oz. (825 mL or 50 in³)

STORAGE LIFE & CONDITIONS

Eighteen months in a dry, dark environment with temperature ranging from 41°F to 77°F (5°C to 25°C)

ANCHOR SIZE RANGE (TYPICAL)

- 3/8" to 1-1/4" diameter threaded rod
- No. 3 to No. 10 reinforcing bar (rebar)
- 10M to 30M reinforcing bar (CA rebar)

SUITABLE BASE MATERIALS

- Normal-weight concrete
- Lightweight concrete

PERMISSIBLE INSTALLATION CONDITIONS (ADHESIVE)

- Dry concrete
- Water-saturated concrete (wet)
- Water-filled holes (flooded)

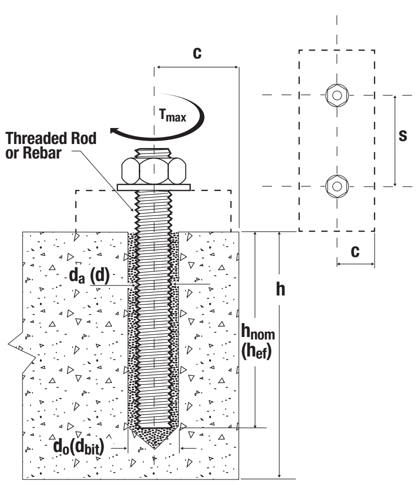
INSTALLATION SPECIFICATIONS

Installation Specifications for Threaded Rod and Reinforcing Bar

Dimension/Property	Notation	Units	Nominal Anchor Size																
Threaded Rod (in.)	-	-	3/8	-		1/2	-	5/8	-	-	3/4	-	7/8	-	1	-	-	1-1/4	-
Reinforcing Bar (No.)	-	-	-	#3	10M	-	#4	-	#5	15M	#6	20M	#7	25M	#8	#9	30M	-	#10
Nominal anchor diameter	d_a (d)	in. (mm)	0.375 (9.5)		0.445 (11.3)	0.500 (12.7)		0.625 (15.9)		0.630 (16.0)	0.750 (19.1)	0.768 (19.5)	0.875 (22.2)	0.992 (25.2)	1.000 (25.4)	1.125 (28.6)	1.177 (29.9)	1.250 (31.8)	
Nominal drill bit size (ANSI)	d_o [d_{bit}]	in.	7/16	1/2	9/16	9/16	5/8	11/16	3/4	3/4	7/8	1	1	1-1/4	1-1/8	1-3/8	1-1/2	1-3/8	1-1/2
Minimum embedment[1,2]	$h_{ef,min}$	in. (mm)	2-3/8 (60)		2.8 (70)	2-3/4 (70)		3-1/8 (79)		3.1 (79)	3-1/2 (43)	3.5 (43)	3-1/2 (89)	3.9 (100)	4 (102)	4-1/2 (114)	4.7 (120)	5 (127)	
Maximum embedment[1,2]	$h_{ef,max}$	in. (mm)	7-1/2 (191)		8.9 (225)	10 (254)		12-1/2 (318)		12.6 (320)	15 (381)	15.4 (390)	17-1/2 (445)	19.8 (505)	20 (508)	22-1/2 (572)	23.5 (600)	25 (635)	
Minimum concrete member thickness	h_{min}	in. (mm)	h_{ef} + 1-1/4 (h_{ef} + 30)					$h_{ef} + 2d_o$											
Min. spacing distance	s_{min}	in. (mm)	1-7/8 (48)		2 (50)	2-1/2 (62)		3 (76)		3.2 (80)	3-5/8 (92)	3.9 (100)	4-1/4 (108)	4.9 (125)	4-3/4 (121)	5-1/4 (133)	5.9 (150)	5-7/8 (149)	
Min. edge distance (Up to 100% T_{max})	c_{min}	in. (mm)	1-5/8 (41)		1.7 (43)	1-3/4 (44)		2 (51)		2.2 (55)	2-3/8 (60)	2-3/8 (60)	2-1/2 (64)	2.7 (70)	2-3/4 (70)	3 (75)	3 (75)	3-1/4 (80)	
Maximum Torque[3]	T_{max}	ft-lbs (N-m)	15 [4] (20)		-	30 (41)		44 (60)		-	66 (90)	66 (90)	96 (130)	-	147 (199)	185 (251)	-	221 (300)	
Min. edge distance, reduced[5,6] (45% T_{max})	$c_{min,red}$	in (mm)	-		-	-		1-3/4 (45)		1-3/4 (45)	1-3/4 (45)	1-3/4 (45)	1-3/4 (45)	1-3/4 (45)	1-3/4 (45)	2-3/4 (70)	2-3/4 (70)	2-3/4 (70)	

1. Embedment range qualified for use with the anchor design provisions of ACI 318 (-19 and -14) Ch. 17 or ACI 318-11 Appendix D as applicable, ICC-ES AC308, and ESR-4027.
2. For rebar development lengths with embedments up to 60d, see the table for Installation Parameters for Common Post-installed Reinforcing Bar Connections.
3. Torque may not be applied to the anchors until the full cure time of the adhesive has been achieved.
4. For ASTM A36/F1554 Grade 36 carbon steel threaded rods with 3/8-inch-diameter, T_{max} = 11 ft.-lbs.
5. For installations below the minimum edge distance, c_{min}, down to the reduced minimum edge distance, $c_{min,red}$, the reduced maximum toque is 0.45*T_{max}.
6. For installations below the minimum edge distance, c_{min}, down to the reduced minimum edge distance, $c_{min,red}$, the minimum anchor spacing, s_{min} is 5d_a.

Detail of Steel Hardware Elements used with Injection Adhesive System



Nomenclature

d_a (d) = Diameter of anchor
d_o (d_{bit}) = Diameter of drilled hole
h = Base material thickness
h_{nom} (h_{ef}) = Embedment depth
s = Spacing of anchors
c = Edge distance
T_{max} = Maximum torque

Common Threaded Rod and Deformed Reinforcing Bar Material Properties

Steel Description (General)	Steel Specification	Nominal Anchor Size	Minimum Ultimate Strength f_u psi (MPa)	Minimum Yield Strength f_y psi (MPa)
Carbon Rod	ASTM A36 or F1554, Grade 36	3/8" through 1-1/4"	58,000 (400)	36,000 (250)
	ASTM F1554 Grade 55		75,000 (517)	55,000 (380)
	ASTM A193 Grade B7 or ASTM F1554 Grade 105		125,000 (860)	105,000 (724)
	ASTM A449	3/8" through 1"	120,000 (828)	92,000 (635)
		1-1/4"	105,000 (720)	81,000 (560)
	ASTM F568M Class 5.8	3/4" through 1-1/4"	72,500 (500)	58,000 (400)
Stainless Rod (Alloy 304 / 316)	ASTM F593 CW1	3/8" through 5/8"	100,000 (690)	65,000 (450)
	ASTM F593 CW2	3/4" through 1-1/4"	85,000 (590)	45,000 (310)
	ASTM A193/A193M Grade B8/B8M2, Class 2B	3/8" through 1-1/4"	95,000 (655)	75,000 (515)
Reinforcing Bar	ASTM A615, A767 Grade 75	#3 through #10	100,000 (690)	75,000 (517)
	ASTM A615, A767, A996 Grade 60	#3 through #10	90,000 (620)	60,000 (414)
	ASTM A706, A767 Grade 60		80,000 (550)	60,000 (414)
	ASTM A615 Grade 40	#3 through #6	60,000 (415)	40,000 (275)
Metric Reinforcing Bar (CA)	CAN/CSA G30.18, Grade 400	10M through 30M	78,300 (540)	58,000 (400)

Tabulated material properties are provided for reference; other steel hardware elements may also be considered such as and ASTM A706 Grade 80 reinforcing bars.

STRENGTH DESIGN INFORMATION

Steel Tension and Shear Design for Threaded Rod in Normal Weight Concrete

CODE LISTED ICC-ES ESR-4027

STRENGTH DESIGN TABLES

Design Information		Symbol	Units	Nominal Rod Diameter[1] (inch)						
				3/8	1/2	5/8	3/4	7/8	1	1-1/4
Threaded rod nominal outside diameter		d	inch (mm)	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)
Threaded rod effective cross-sectional area		A_{se}	inch² (mm²)	0.0775 (50)	0.1419 (92)	0.2260 (146)	0.3345 (216)	0.4617 (298)	0.6057 (391)	0.9691 (625)
ASTM A36 and ASTM F1554 Grade 36	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lbf (kN)	4,495 (20.0)	8,230 (36.6)	13,110 (58.3)	19,400 (86.3)	26,780 (119.1)	35,130 (156.3)	56,210 (250.0)
		V_{sa}	lbf (kN)	2,695 (12.0)	4,940 (22.0)	7,860 (35.0)	11,640 (51.8)	16,070 (71.4)	21,080 (93.8)	33,725 (150.0)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.60						
	Strength reduction factor for tension[2]	ϕ	-	0.75						
	Strength reduction factor for shear[2]	ϕ	-	0.65						
ASTM F1554 Grade 55	Nominal strength as governed by steel strength(for a single anchor)	N_{sa}	lbf (kN)	5,810 (25.9)	10,640 (47.3)	16,950 (75.4)	25,085 (111.6)	34,625 (154.0)	45,425 (202.0)	72,680 (323.3)
		V_{sa}	lbf (kN)	3,485 (15.5)	6,385 (28.4)	10,170 (45.2)	15,050 (67.0)	20,775 (92.4)	27,255 (121.2)	43,610 (194.0)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.60						
	Strength reduction factor for tension[2]	ϕ	-	0.75						
	Strength reduction factor for shear[2]	ϕ	-	0.65						
ASTM A193 Grade B7 and ASTM F1554 Grade 105	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lbf (kN)	9,685 (43.1)	17,735 (78.9)	28,250 (125.7)	41,810 (186.0)	57,710 (256.7)	75,710 (336.8)	121,135 (538.8)
		V_{sa}	lbf (kN)	5,815 (25.9)	10,640 (7.3)	16,950 (75.4)	25,085 (111.6)	34,625 (154.0)	45,425 (202.1)	72,680 (323.3)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.60						
	Strength reduction factor for tension[2]	ϕ	-	0.75						
	Strength reduction factor for shear[2]	ϕ	-	0.65						
ASTM A449	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lbf (kN)	9,300 (41.4)	17,025 (75.7)	27,120 (120.6)	40,140 (178.5)	55,905 (248.7)	72,685 (323.3)	101,755 (452.6)
		V_{sa}	lbf (kN)	5,580 (24.8)	10,215 (45.4)	16,270 (72.4)	24,085 (107.1)	33,540 (149.2)	43,610 (194.0)	61,050 (271.6)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.60						
	Strength reduction factor for tension[2]	ϕ	-	0.75						
	Strength reduction factor for shear[2]	ϕ	-	0.65						
ASTM F568M Class 5.8	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lbf (kN)	5,620 (25.0)	10,290 (45.8)	16,385 (72.9)	24,250 (107.9)	33,475 (148.9)	43,915 (195.4)	70,260 (312.5)
		V_{sa}	lbf (kN)	3,370 (15.0)	6,175 (27.5)	9,830 (43.7)	14,550 (64.7)	20,085 (89.3)	26,350 (117.2)	42,155 (187.5)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.60						
	Strength reduction factor for tension[2]	ϕ	-	0.65						
	Strength reduction factor for shear[2]	ϕ	-	0.60						
ASTM F593 CW Stainless (Types 304 and 316)	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lbf (kN)	7,750 (34.5)	14,190 (63.1)	22,600 (100.5)	28,430 (126.5)	39,245 (174.6)	51,485 (229.0)	82,370 (366.4)
		V_{sa}	lbf (kN)	4,650 (20.7)	8,515 (37.9)	13,560 (60.3)	17,060 (75.9)	23,545 (104.7)	30,890 (137.4)	49,425 (219.8)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.60						
	Strength reduction factor for tension[2]	ϕ	-	0.65						
	Strength reduction factor for shear[2]	ϕ	-	0.60						
ASTM A193 Grade B8/B8M2, Class 2B Stainless (Types 304 and 316)	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lbf (kN)	7,365 (32.8)	13,480 (60.0)	21,470 (95.5)	31,775 (141.3)	43,860 (195.1)	57,545 (256.0)	92,065 (409.5)
		V_{sa}	lbf (kN)	4,420 (19.7)	8,085 (36.0)	12,880 (57.3)	19,065 (84.8)	26,315 (117.1)	34,525 (153.6)	55,240 (245.7)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.60						
	Strength reduction factor for tension[2]	ϕ	-	0.75						
	Strength reduction factor for shear[2]	ϕ	-	0.65						

For SI: 1 inch = 25.4 mm, 1 lbf = 4.448 N. For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf.

1. Values provided for steel element material types are based on minimum specified strengths and calculated in accordance with ACI 318-19 Eq. 17.6.1.2 and Eq. 17.7.1.2(b) or ACI 318-14 Eq. 17.4.1.2 and Eq. 17.5.1.2b or ACI 318-11 Eq. (D-2) and Eq. (D-29), as applicable, except where noted. Nuts and washers must be appropriate for the rod. Nuts must have specified proof load stresses equal to or greater than the minimum tensile strength of the specified threaded rod.
2. The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318 (-19 or -14) 5.3 or ACI 318-11 9.2, as applicable, are used in accordance with ACI 318-19 Section 17.5.3 or 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 D.4.4.

Steel Tension and Shear Design for Reinforcing Bars in Normal Weight Concrete

CODE LISTED
ICC-ES ESR-4027

Design Information		Symbol	Units	Nominal Reinforcing Bar Size (Rebar)[1]							
				No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10
Rebar nominal outside diameter		d	inch (mm)	0.375 (9.5)	0.500 (12.7)	0.625 (15.9)	0.750 (19.1)	0.875 (22.2)	1.000 (25.4)	1.125 (28.7)	1.250 (32.3)
Rebar effective cross-sectional area		A_{se}	inch² (mm²)	0.110 (71.0)	0.200 (129.0)	0.310 (200.0)	0.440 (283.9)	0.600 (387.1)	0.790 (509.7)	1.000 (645.2)	1.270 (819.4)
ASTM A615 Grade 75	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lbf (kN)	11,000 (48.9)	20,000 (89.0)	31,000 (137.9)	44,000 (195.7)	60,000 (266.9)	79,000 (351.4)	100,000 (444.8)	127,000 (564.9)
		V_{sa}	lbf (kN)	6,600 (29.4)	12,000 (53.4)	18,600 (82.7)	26,400 (117.4)	36,000 (160.1)	47,400 (210.8)	60,000 (266.9)	76,200 (338.9)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.65							
	Strength reduction factor for tension[3]	ϕ	-	0.65							
	Strength reduction factor for shear[3]	ϕ	-	0.60							
ASTM A615, A767, A996 Grade 60	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lbf (kN)	9,900 (44.0)	18,000 (80.1)	27,900 (124.1)	39,600 (176.1)	54,000 (240.2)	71,100 (316.3)	90,000 (400.3)	114,300 (508.4)
		V_{sa}	lbf (kN)	5,940 (26.4)	10,800 (48.0)	16,740 (74.5)	23,760 (105.7)	32,400 (144.1)	42,660 (189.8)	54,000 (240.2)	68,580 (305.0)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.65							
	Strength reduction factor for tension[2]	ϕ	-	0.65							
	Strength reduction factor for shear[2]	ϕ	-	0.60							
ASTM A706 Grade 60	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lbf (kN)	8,800 (39.1)	16,000 (71.2)	24,800 (110.3)	35,200 (156.6)	48,000 (213.5)	63,200 (281.1)	80,000 (355.9)	101,600 (452.0)
		V_{sa}	lbf (kN)	5,280 (23.5)	9,600 (42.7)	14,880 (66.2)	21,120 (94.0)	28,800 (128.1)	37,920 (168.7)	48,000 (213.5)	60,960 (271.2)
	Reduction factor for seismic shear	$\alpha_{V,seis}$		0.65							
	Strength reduction factor for tension[2]	ϕ	-	0.75							
	Strength reduction factor for shear[2]	ϕ	-	0.65							
ASTM A 615 Grade 40	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lbf (kN)	6,600 (29.4)	12,000 (53.4)	18,600 (82.7)	26,400 (117.4)	In accordance with ASTM A615, Grade 40 bars are furnished only in sizes No. 3 through No. 6			
		V_{sa}	lbf (kN)	3,960 (17.6)	7,200 (32.0)	11,160 (49.6)	15,840 (70.5)				
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.65							
	Strength reduction factor for tension[2]	ϕ	-	0.65							
	Strength reduction factor for shear[2]	ϕ	-	0.60							

For SI: 1 inch = 25.4 mm, 1 lbf = 4.448 N. For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf.

1. Values provided for reinforcing bar material types based on minimum specified strengths and calculated in accordance with ACI 318-19 Eq. 17.6.1.2 and Eq. 17.7.1.2(b) or ACI 318-19 Eq. 17.6.1.2 and Eq. 17.5.1.2b or ACI 318-11 Eq. (D-2) and Eq. (D-29), as applicable.
2. The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318 (-14 & -19) 5.3 or ACI 318-11 9.2, as applicable, are used in accordance with ACI 318-19 17.5.3, ACI 318-14, 17.3.3 or ACI 318-11 D.4.3, as applicable. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318 D.4.4.

Design Information		Symbol	Units	Nominal Reinforcing Bar Size (Rebar)[1]				
				10M	15M	20M	25M	30M
Reinforcing bar O.D.		d	mm (in.)	11.4 (0.445)	16.0 (0.630)	19.5 (0.768)	25.2 (0.992)	29.9 (1.177)
Reinforcing bar effective cross-sectional area		A_{se}	mm² (inch²)	100.3 (0.155)	201.1 (0.312)	298.6 (0.463	498.8 (0.773)	702.2 (1.088)
CAN/CSA G30.18 Grade 400	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	kN (lb)	54.0 (12,175)	108.5 (24,410)	161.5 (36,255)	270.0 (60,550)	380.0 (85,240)
		V_{sa}	kN (lb)	32.5 (7,305)	65.0 (14,645)	97.0 (21,755)	161.5 (36,330)	227.5 (51,145)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.65				
	Strength reduction factor for tension[2]	ϕ	-	0.65				
	Strength reduction factor for shear[2]	ϕ	-	0.60				

1. Values provided for common bar material types based on specified strengths and calculated in accordance with ACI 318-19 Eq. 17.6.1.2 and Eq. 17.7.1.2(b) or ACI 318-14 Eq. 17.4.1.2 and Eq. 17.5.1.2b or ACI 318-11 Eq. (D-2) and Eq. (D-29), as applicable.
2. The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318 (-19 or -14) 5.3 or ACI 318-11 9.2, as applicable, as set forth in ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are used. 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 D.4.4.

Concrete Breakout Design Information for Threaded Rod and in Holes Drilled with a Hammer Drill and Carbide Bit[1]

CODE LISTED ICC-ES ESR-4027

Design Information	Symbol	Units	Nominal Rod Diameter (inch)						
			3/8	1/2	5/8	3/4	7/8	1	1-1/4
Effectiveness factor for cracked concrete	$k_{c,cr}$	- (SI)	17 (7.1)						
Effectiveness factor for uncracked concrete	$k_{c,uncr}$	- (SI)	24 (10.0)						
Minimum embedment	$h_{ef,min}$	inch (mm)	2-3/8 (60)	2-3/4 (70)	3-1/8 (79)	3-1/2 (89)	3-1/2 (89)	4 (102)	5 (127)
Maximum embedment	$h_{ef,max}$	inch (mm)	7-1/2 (191)	10 (254)	12-1/2 (318)	15 (381)	17-1/2 (445)	20 (508)	25 (635)
Minimum anchor spacing	s_{min}	inch (mm)	1-7/8 (48)	2-1/2 (64)	3-1/8 (79)	3-5/8 (90)	4-1/8 (105)	4-3/4 (120)	5-7/8 (150)
Minimum edge distance[2]	c_{min}	inch (mm)	1-5/8 (41)	1-3/4 (44)	2 (51)	2-3/8 (60)	2-1/2 (64)	2-3/4 (70)	3-1/4 (80)
Minimum edge distance, reduced[2] (45% T_{max})	$c_{min,red}$	inch (mm)	-	-	1-3/4 (44)	1-3/4 (44)	1-3/4 (44)	1-3/4 (44)	2-3/4 (70)
Minimum member thickness	h_{min}	inch (mm)	h_{ef} + 1-1/4 (h_{ef} + 30)		$h_{ef} + 2d_o$ where d_o is hole diameter;				
Critical edge distance—splitting (for uncracked concrete only)[3]	c_{ac}	inch | mm	$c_{ac} = h_{ef} \cdot (\frac{\tau_{uncr}}{1160})^{0.4} \cdot [3.1\text{-}0.7 \frac{h}{h_{ef}}]$ | $c_{ac} = h_{ef} \cdot (\frac{\tau_{uncr}}{8})^{0.4} \cdot [3.1\text{-}0.7 \frac{h}{h_{ef}}]$						
Strength reduction factor for tension, concrete failure modes, Condition B[4]	ϕ	-	0.65						
Strength reduction factor for shear, concrete failure modes, Condition B[4]	ϕ	-	0.70						

For SI: 1 inch = 25.4 mm, 1 lbf = 4.448 N. For pound-inch units: 1 mm = 0.03937 inch, 1 N = 0.2248 lbf.

1. Additional setting information is described in the installation instructions.
2. For installation between the minimum edge distance, c_{min}, and the reduced minimum edge distance, $c_{min,red}$, the maximum torque applied must be reduced (multiplied) by a factor of 0.45.
3. $\tau_{k,uncr}$ need not be taken as greater than: $\tau_{k,uncr} = \frac{k_{uncr} \bullet \sqrt{h_{ef} \bullet f'c}}{\pi \bullet d}$ and $\frac{h}{h_{ef}}$ need not be taken as larger than 2.4.
4. Condition A requires supplemental reinforcement, while Condition B applies where supplemental reinforcement is not provided or where pryout governs, as set forth in ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318 (-19 or -14) 5.3 or ACI 318-11 9.2, as applicable, are used in accordance with ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318 D.4.4.

Bond Strength Design Information for Threaded Rod in Holes Drilled with a Hammer Drill and Carbide Bit[1]

CODE LISTED ICC-ES ESR-4027

Design Information		Symbol	Units	Nominal Rod Diameter (inch)						
				3/8	1/2	5/8	3/4	7/8	1	1-1/4
Minimum embedment		$h_{ef,min}$	inch (mm)	2-3/8 (60)	2-3/4 (70)	3-1/8 (79)	3-1/2 (89)	3-1/2 (89)	4 (102)	5 (127)
Maximum embedment		$h_{ef,max}$	inch (mm)	7-1/2 (191)	10 (254)	12-1/2 (318)	15 (381)	17-1/2 (445)	20 (508)	25 (635)
Temperature Range A 122°F (50°C) Maximum Long-Term Service Temperature; 176°F (80°C) Maximum Short-Term Service Temperature[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (N/mm^2)	1,041 (7.2)	1,041 (7.2)	1,111 (7.7)	1,219 (8.4)	1,212 (8.4)	1,206 (8.3)	1,146 (7.9)
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (N/mm^2)	2,601 (17.9)	2,415 (16.7)	2,262 (15.6)	2,142 (14.8)	2,054 (14.2)	2,000 (13.8)	1,990 (13.7)
Temperature Range B 161°F (72°C) Maximum Long-Term Service Temperature; 248°F (120°C) Maximum Short-Term Service Temperature[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (N/mm^2)	905 (6.2)	906 (6.2)	966 (6.7)	1060 (7.3)	1054 (7.3)	1049 (7.2)	997 (6.9)
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (N/mm^2)	2,263 (15.6)	2,101 (14.5)	1,968 (13.6)	1,863 (12.8)	1,787 (12.3)	1,740 (12.0)	1732 (11.9)
Temperature Range C 212°F (100°C) Maximum Long-Term Service Temperature; 320°F (160°C) Maximum Short-Term Service Temperature[2,3]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (N/mm^2)	652 (4.5)	653 (4.5)	696 (4.8)	764 (5.3)	760 (5.2)	756 (5.2)	719 (5.0)
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (N/mm^2)	1631 (11.2)	1514 (10.4)	1418 (9.8)	1343 (9.3)	1288 (8.9)	1254 (8.6)	1248 (8.6)
Dry concrete	Anchor Category	-	-	1						
	Strength reduction factor	ϕ_d	-	0.65						
Water-saturated concrete	Anchor Category	-	-	2						
	Strength reduction factor	ϕ_{ws}	-	0.55						
Water-filled holes	Anchor Category	-	-	3						
	Strength reduction factor	ϕ_{wf}	-	0.45						
Reduction factor for seismic tension[9]		$\alpha_{N,seis}$	-	0.95						

For SI: 1 inch = 25.4 mm, 1 psi = 0.006894 MPa. For pound-inch units: 1 mm = 0.03937 inch, 1 MPa = 145.0 psi.

1. Bond strength values correspond to a normal-weight concrete compressive strength f'c = 2,500 psi (17.2 MPa). For concrete compressive strength, f'c between 2,500 psi and 8,000 psi (17.2 MPa and 55.2 MPa), the tabulated characteristic bond strength may be increased by a factor of $(f'c / 2{,}500)^{0.10}$ [For SI: $(f'c / 17.2)^{0.10}$].
2. Short-term elevated concrete base material service temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling. Long-term elevated concrete base material service temperatures are roughly constant over significant periods of time.
3. Characteristic bond strengths are for sustained loads including dead and live loads. For load combinations consisting of short-term loads only, such as wind, bond strengths may be increased by 23 percent for the temperature range C.

Concrete Breakout Design Information for Reinforcing Bars in Holes Drilled with a Hammer Drill and Carbide Bit[1]

CODE LISTED ICC-ES ESR-4027

Design Information	Symbol	Units	Nominal Bar Size (US Customary)							
			#3	#4	#5	#6	#7	#8	#9	#10
Effectiveness factor for cracked concrete	$k_{c,cr}$	- (SI)	17 (7.1)							
Effectiveness factor for uncracked concrete	$k_{c,uncr}$	- (SI)	24 (10.0)							
Minimum embedment	$h_{ef,min}$	inch (mm)	2-3/8 (60)	2-3/4 (70)	3-1/8 (79)	3-1/2 (89)	3-1/2 (89)	4 (102)	4-1/2 (114)	5 (127)
Maximum embedment	$h_{ef,max}$	inch (mm)	7-1/2 (191)	10 (254)	12-1/2 (318)	15 (381)	17-1/2 (445)	20 (508)	22-1/2 (572)	25 (635)
Minimum anchor spacing	s_{min}	inch (mm)	1-7/8 (48)	2-1/2 (64)	3 (79)	3-5/8 (92)	4-1/4 (105)	4-3/4 (120)	5-1/4 (133)	5-7/8 (150)
Minimum edge distance[2]	c_{min}	inch (mm)	1-5/8 (41)	1-3/4 (44)	2 (51)	2-3/8 (60)	2-1/2 (64)	2-3/4 (70)	3 (75)	3-1/4 (80)
Minimum edge distance, reduced[2] (45% T_{max})	$c_{min,red}$	inch (mm)	-	-	1-3/4 (44)	1-3/4 (44)	1-3/4 (44)	1-3/4 (44)	2-3/4 (70)	2-3/4 (70)
Minimum member thickness	h_{min}	inch (mm)	h_{ef} + 1-1/4 (h_{ef} + 30)		$h_{ef} + 2d_o$ where d_o is hole diameter;					
Critical edge distance—splitting (for uncracked concrete only)[3]	c_{ac}	inch | mm	$c_{ac} = h_{ef} \cdot \left(\frac{\tau_{uncr}}{1160}\right)^{0.4} \cdot \left[3.1-0.7\frac{h}{h_{ef}}\right]$ | $c_{ac} = h_{ef} \cdot \left(\frac{\tau_{uncr}}{8}\right)^{0.4} \cdot \left[3.1-0.7\frac{h}{h_{ef}}\right]$							
Strength reduction factor for tension, concrete failure modes, Condition B[4]	ϕ	-	0.65							
Strength reduction factor for shear, concrete failure modes, Condition B[4]	ϕ	-	0.70							

For SI: 1 inch = 25.4 mm, 1 lbf = 4.448 N. For pound-inch units: 1 mm = 0.03937 inch, 1 N = 0.2248 lbf.

1. Additional setting information is described in the installation instructions.
2. For installation between the minimum edge distance, c_{min}, and the reduced minimum edge distance, $c_{min,red}$, the maximum torque applied must be reduced (multiplied) by a factor of 0.45.
3. $\tau_{k,uncr}$ need not be taken as greater than: $\tau_{k,uncr} = \frac{k_{uncr} \cdot \sqrt{h_{ef} \cdot f'c}}{\pi \cdot d}$ and $\frac{h}{h_{ef}}$ need not be taken as larger than 2.4.
4. Condition A requires supplemental reinforcement, while Condition B applies where supplemental reinforcement is not provided or where pryout governs, as set forth in ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318 (-19 or -14) 5.3 or ACI 318-11 9.2, as applicable, are used in accordance with ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318 D.4.4.

Bond Strength Design Information for Reinforcing Bars in Holes Drilled with a Hammer Drill and Carbide Bit[1]

CODE LISTED ICC-ES ESR-4027

Design Information		Symbol	Units	Nominal Bar Size (US Customary)							
				#3	#4	#5	#6	#7	#8	#9	#10
Minimum embedment		$h_{ef,min}$	inch (mm)	2-3/8 (60.0)	2-3/4 (70.0)	3-1/8 (79.0)	3-1/2 (89.0)	3-1/2 (89.0)	4 (102.0)	4-1/2 (114.0)	5 (127.0)
Maximum embedment		$h_{ef,max}$	inch (mm)	7-1/2 (191.0)	10 (254.0)	12-1/2 (318.0)	15 (381.0)	17-1/2 (445.0)	20 (508.0)	22-1/2 (572.0)	25 (635.0)
Temperature Range A 122°F (50°C) Maximum Long-Term Service Temperature; 176°F (80°C) Maximum Short-Term Service Temperature[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (N/mm^2)	1,088 (7.5)	1,053 (7.3)	1,128 (7.8)	1,169 (8.1)	1,174 (8.1)	1,156 (8.0)	1,141 (7.9)	1,164 (8.0)
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (N/mm^2)	2,200 (15.2)	2,101 (14.5)	2,028 (14.0)	1,969 (13.6)	1,921 (13.2)	1,881 (13.0)	1,846 (12.7)	1,815 (12.5)
Temperature Range B 161°F (72°C) Maximum Long-Term Service Temperature; 248°F (120°C) Maximum Short-Term Service Temperature[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (N/mm^2)	947 (6.5)	916 (6.3)	982 (6.8)	1,017 (7.0)	1,021 (7.0)	1,006 (6.9)	993 (6.8)	1,012 (7.0)
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (N/mm^2)	1,914 (13.2)	1,828 (12.6)	1,764 (12.2)	1,713 (11.8)	1,672 (11.5)	1,636 (11.3)	1,616 (11.1)	1,579 (10.9)
Temperature Range C 212°F (100°C) Maximum Long-Term Service Temperature; 320°F (160°C) Maximum Short-Term Service Temperature[2,3]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (N/mm^2)	682 (4.7)	660 (4.6)	707 (4.9)	733 (5.1)	736 (5.1)	725 (5.0)	715 (4.9)	730 (5.0)
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (N/mm^2)	1,379 (9.5)	1,317 (9.1)	1,271 (8.8)	1,235 (8.5)	1,205 (8.3)	1,179 (8.1)	1,157 (8.0)	1,138 (7.8)
Dry concrete	Anchor Category	-	-	1							
	Strength reduction factor	ϕ_d	-	0.65							
Water-saturated concrete	Anchor Category	-	-	2							
	Strength reduction factor	ϕ_{ws}	-	0.55							
Water-filled holes	Anchor Category	-	-	3							
	Strength reduction factor	ϕ_{wf}	-	0.45							
Reduction factor for seismic tension[9]		$\alpha_{N,seis}$	-	0.95		1.00					

For SI: 1 inch = 25.4 mm, 1 psi = 0.006894 MPa. For pound-inch units: 1 mm = 0.03937 inch, 1 MPa = 145.0 psi.

1. Bond strength values correspond to a normal-weight concrete compressive strength f'c = 2,500 psi (17.2 MPa). For concrete compressive strength, f'c between 2,500 psi and 8,000 psi (17.2 MPa and 55.2 MPa), the tabulated characteristic bond strength may be increased by a factor of $(f'c / 2{,}500)^{0.10}$ [For SI: $(f'c / 17.2)^{0.10}$].
2. Short-term elevated concrete base material service temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling. Long-term elevated concrete base material service temperatures are roughly constant over significant periods of time.
3. Characteristic bond strengths are for sustained loads including dead and live loads. For load combinations consisting of short-term loads only, such as wind, bond strengths may be increased by 23 percent for the temperature range C.

Concrete Breakout Design Information for Metric Reinforcing Bars in Holes Drilled with a Hammer Drill and Carbide Bit[1]

CODE LISTED
ICC-ES ESR-4027

Design Information	Symbol	Units	Nominal Bar Size (CA)				
			10M	15M	20M	25M	30M
Effectiveness factor for cracked concrete	$k_{c,cr}$	SI (-)	7 (17)				
Effectiveness factor for uncracked concrete	$k_{c,uncr}$	SI (-)	10 (24)				
Minimum embedment	$h_{ef,min}$	mm (in.)	70 (2.8)	80 (3.1)	90 (3.5)	100 (3.9)	120 (4.7)
Maximum embedment	$h_{ef,max}$	mm (in.)	225 (8.9)	320 (12.6)	390 (15.4)	505 (19.8)	600 (23.5)
Minimum anchor spacing	s_{min}	mm (in.)	55 (2-1/2)	80 (3-1/8)	95 (3-3/4)	120 (4-5/8)	150 (5-7/8)
Minimum edge distance[2]	c_{min}	mm (in.)	40 (1-3/4)	50 (2)	60 (2-3/8)	70 (2-3/4)	85 (3-1/8)
Minimum edge distance, reduced[2] (45% T_{max})	$c_{min,red}$	mm (in.)	-	40 (1-3/4)	40 (1-3/4)	40 (1-3/4)	70 (2-3/4)
Minimum member thickness	h_{min}	mm (in.)	h_{ef} + 1-1/4 (h_{ef} + 30)		$h_{ef} + 2d_o$ where d_o is hole diameter;		
Critical edge distance—splitting (for uncracked concrete only)[3]	c_{ac}	inch | mm	$c_{ac} = h_{ef} \cdot (\frac{\tau_{uncr}}{1160})^{0.4} \cdot [3.1-0.7 \frac{h}{h_{ef}}]$ | $c_{ac} = h_{ef} \cdot (\frac{\tau_{uncr}}{8})^{0.4} \cdot [3.1-0.7 \frac{h}{h_{ef}}]$				
Strength reduction factor for tension, concrete failure modes, Condition B[4]	ϕ	-	0.65				
Strength reduction factor for shear, concrete failure modes, Condition B[4]	ϕ	-	0.70				

For SI: 1 inch = 25.4 mm, 1 lbf = 4.448 N. For pound-inch units: 1 mm = 0.03937 inch, 1 N = 0.2248 lbf.

1. Additional setting information is described in the installation instructions.
2. For installation between the minimum edge distance, c_{min}, and the reduced minimum edge distance, $c_{min,red}$, the maximum torque applied must be reduced (multiplied) by a factor of 0.45.
3. $\tau_{k,uncr}$ need not be taken as greater than: $\tau_{k,uncr} = \frac{k_{uncr} \bullet \sqrt{h_{ef} \bullet f'c}}{\pi \bullet d}$ and $\frac{h}{h_{ef}}$ need not be taken as larger than 2.4.
4. Condition A requires supplemental reinforcement, while Condition B applies where supplemental reinforcement is not provided or where pryout governs, as set forth in ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318 (-19 or -14) 5.3 or ACI 318-11 9.2, as applicable, are used in accordance with ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318 D.4.4.

Bond Strength Design Information for Metric Reinforcing Bars in Holes Drilled with a Hammer Drill and Carbide Bit[1]

CODE LISTED
ICC-ES ESR-4027

Design Information		Symbol	Units	Nominal Bar Size (CA)				
				10M	15M	20M	25M	30M
Minimum embedment		$h_{ef,min}$	mm (in.)	70 (2.8)	80 (3.1)	90 (3.5)	100 (3.9)	120 (4.7)
Maximum embedment		$h_{ef,max}$	mm (in.)	225 (8.9)	320 (12.6)	390 (15.4)	505 (19.8)	600 (23.5)
Temperature Range A 122°F (50°C) Maximum Long-Term Service Temperature; 176°F (80°C) Maximum Short-Term Service Temperature[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	N/mm² (psi)	7.2 (1,041)	7.5 (1,087)	7.2 (1,045)	6.7 (965)	6.3 (915)
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	N/mm² (psi)	14.5 (2,110)	13.2 (1,916)	12.5 (1,814)	11.7 (1,690)	11.1 (1,612)
Temperature Range B 161°F (72°C) Maximum Long-Term Service Temperature; 248°F (120°C) Maximum Short-Term Service Temperature[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	N/mm² (psi)	6.2 (906)	6.5 (946)	6.3 (909)	5.8 (840)	5.5 (796)
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	N/mm² (psi)	12.7 (1,836)	11.5 (1,667)	10.9 (1,578)	10.1 (1,470)	9.7 (1,402)
Temperature Range C 212°F (100°C) Maximum Long-Term Service Temperature; 320°F (160°C) Maximum Short-Term Service Temperature[2,3]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	N/mm² (psi)	5.6 (806)	5.8 (841)	5.6 (809)	5.2 (747)	4.9 (708)
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	N/mm² (psi)	9.1 (1,633)	8.3 (1,201)	7.8 (1,137)	7.3 (1,059)	7.0 (1,010)
Dry concrete	Anchor Category	-	-	1				
	Strength reduction factor	ϕ_d	-	0.65				
Water-saturated concrete	Anchor Category	-	-	2				
	Strength reduction factor	ϕ_{ws}	-	0.55				
Water-filled holes	Anchor Category	-	-	3				
	Strength reduction factor	ϕ_{wf}	-	0.45				
Reduction factor for seismic tension[9]		$\alpha_{N,seis}$	-	0.95		1.00		

For SI: 1 inch = 25.4 mm, 1 psi = 0.006894 MPa. For pound-inch units: 1 mm = 0.03937 inch, 1 MPa = 145.0 psi.

1. Bond strength values correspond to a normal-weight concrete compressive strength f'c = 2,500 psi (17.2 MPa). For concrete compressive strength, f'c between 2,500 psi and 8,000 psi (17.2 MPa and 55.2 MPa), the tabulated characteristic bond strength may be increased by a factor of $(f'c / 2{,}500)^{0.10}$ [For SI: $(f'c / 17.2)^{0.10}$].
2. Short-term elevated concrete base material service temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling. Long-term elevated concrete base material service temperatures are roughly constant over significant periods of time.
3. Characteristic bond strengths are for sustained loads including dead and live loads. For load combinations consisting of short-term loads only, such as wind, bond strengths may be increased by 23 percent for the temperature range C.

DESIGN STRENGTH TABLES (SD)

Tension and Shear Design Strength for Threaded Rod Installed in Uncracked Concrete (Bond or Concrete Strength) Drilled with a Hammer-Drill and Carbide Bit in a Dry Hole Condition Temperature Range A: 122°F (50°C) Maximum Long-Term Service Temperature; 176°F (80°C) Maximum Short-Term Service Temperature[1,2,3,4,5,6,7,8,9,10,11]

STRENGTH DESIGN SD TABLES

Nominal Rod Size (in.)	Embed. Depth hef (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_{cb} or ϕN_{a} Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_{a} Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_{a} Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_{a} Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_{a} Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)
3/8	2-3/8	2,855	2,570	3,125	2,920	3,610	3,575	4,425	4,745	5,105	5,500
	3	4,055	4,010	4,440	4,555	5,125	5,570	6,280	7,400	6,710	8,775
	4-1/2	7,445	7,935	8,155	9,015	9,395	11,015	9,785	13,710	10,070	16,015
	7-1/2	14,940	18,190	15,215	20,070	15,655	23,445	16,305	29,180	16,780	34,085
1/2	2-3/4	3,555	3,305	3,895	3,755	4,500	4,590	5,510	6,095	6,365	7,455
	4	6,240	6,700	6,835	7,610	7,895	9,310	9,665	12,365	11,080	15,080
	6	11,465	13,235	12,560	15,035	14,500	18,390	16,150	23,515	16,620	27,470
	10	24,660	31,215	25,110	34,445	25,845	40,235	26,915	50,085	27,700	58,500
5/8	3-1/8	4,310	4,120	4,720	4,680	5,450	5,720	6,675	7,600	7,710	9,295
	5	8,720	9,985	9,555	11,345	11,030	13,875	13,510	18,430	15,600	22,540
	7-1/2	16,020	19,725	17,550	22,410	20,265	27,410	23,635	35,695	24,325	41,695
	12-1/2	34,470	46,550	36,750	52,320	37,825	61,110	39,390	76,070	40,540	87,310
3/4	3-1/2	5,105	5,015	5,595	5,700	6,460	6,970	7,910	9,255	9,135	11,320
	6	11,465	13,595	12,560	15,445	14,500	18,895	17,760	25,095	20,505	30,695
	9	21,060	26,855	23,070	30,510	26,640	37,320	32,225	49,325	33,165	57,615
	15	45,315	63,370	49,640	72,000	51,575	84,420	53,710	105,080	55,280	119,060
7/8	3-1/2	5,105	4,930	5,595	5,605	6,460	6,855	7,910	9,100	9,135	11,130
	7	14,445	16,605	15,825	18,865	18,275	23,075	22,380	30,650	25,840	37,485
	10-1/2	26,540	32,800	29,070	37,265	33,570	45,580	41,115	60,540	43,290	71,360
	17-1/2	57,100	77,405	62,550	87,940	67,315	104,575	70,100	130,170	72,150	152,045
1	4	6,240	6,115	6,835	6,945	7,895	8,495	9,665	11,280	11,160	13,800
	8	17,650	19,750	19,335	22,435	22,325	27,440	27,340	36,450	31,570	44,580
	12	32,425	39,005	35,520	44,315	41,015	54,200	50,230	71,990	55,055	86,235
	20	69,765	92,055	76,425	104,585	85,610	126,375	89,155	157,310	91,755	183,745
1-1/4	5	8,720	8,170	9,555	9,285	11,030	11,355	13,510	15,085	15,600	18,450
	10	24,665	26,380	27,020	29,975	31,200	36,660	38,210	48,690	44,125	59,555
	15	45,315	52,110	49,640	59,200	57,320	72,410	70,200	96,175	81,060	117,630
	25	97,500	122,990	106,805	139,730	123,330	170,905	138,610	219,325	142,655	256,185

- Concrete Breakout Strength - Bond Strength/Pryout Strength

1. Tabular values are provided for illustration and are applicable for single anchors installed in uncracked 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 according to ACI 318 (-19 or -14) Ch.17 and ICC-ES AC308. The load level corresponding to the failure mode listed [Concrete breakout strength, bond strength/pryout strength] must be checked against the tabulated steel strength of the corresponding threaded rod or rebar size and type, the lowest load level controls.
3. Strength reduction factors (ϕ) for concrete breakout strength are based on ACI 318 (-19 or -14) Section 5.3 for load combinations. Condition B was assumed.
4. Strength reduction factors (ϕ) for bond strength are determined from reliability testing and qualification in accordance with ICC-ES AC308 and are tabulated in this product information and in ESR-4027.
5. Tabular values are permitted for static loads only, seismic loading is not considered with these tables. Periodic special inspection must be performed where required by code, see ESR-4027 for applicable information.
6. For anchors subjected to tension resulting from sustained loading a supplemental check must be performed according to ACI 318-19 17.5.2.2 or ACI 318-14 17.3.1.2.
7. For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318 (-19 or -14) Ch.17.
8. Interpolation is not permitted to be used with the tabular values. For intermediate base material compressive strengths, please see ACI 318 (-19 or -14) Ch.17, ICC-ES AC308 and information included in this product supplement. For other design conditions including seismic considerations please see ACI 318 (-19 or -14) Ch.17 and ICC-ES AC308 and ESR-4027.
9. Long term concrete temperatures are roughly constant over significant periods of time. Short-term elevated temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.
10. The tabulated design strengths may be converted to allowable stress design values. Divide by conversion factor calculated as a weighted average of the load factors for the controlling load combination.
11. For other installation conditions such as water-saturated concrete or water-filled hole applications, see the associated strength reduction factors (ϕ) for bond strength in the determination of controlling design strength values, as applicable.

Tension and Shear Design Strength in Threaded Rod Installed in Cracked Concrete (Bond or Concrete Strength) Drilled with a Hammer-Drill and Carbide Bit in a Dry Hole Condition Temperature Range A: 122°F (50°C) Maximum Long-Term Service Temperature; 176°F (80°C) Maximum Short-Term Service Temperature[1,2,3,4,5,6,7,8,9,10,11,12]

STRENGTH DESIGN SD TABLES

Nominal Rod Size (in.)	Embed. Depth hef (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_{cb} or ϕN_{a} Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_{a} Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_{a} Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_{a} Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_{a} Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)
3/8	2-3/8	1,895	1,835	1,930	2,075	1,985	2,135	2,065	2,225	2,125	2,290
	3	2,390	2,865	2,435	3,255	2,505	3,980	2,610	5,285	2,685	5,785
	4-1/2	3,585	5,665	3,655	6,440	3,760	7,865	3,915	8,435	4,030	8,680
	7-1/2	5,980	12,875	6,090	13,115	6,265	13,495	6,525	14,055	6,715	14,465
1/2	2-3/4	2,520	2,360	2,760	2,680	3,065	3,280	3,190	4,355	3,285	5,325
	4	4,250	4,785	4,330	5,435	4,455	6,650	4,640	8,830	4,775	10,285
	6	6,375	9,455	6,495	10,740	6,685	13,135	6,960	14,990	7,165	15,430
	10	10,630	22,300	10,825	23,315	11,140	23,995	11,600	24,985	11,940	25,715
5/8	3-1/8	3,050	2,940	3,345	3,340	3,860	4,085	4,730	5,430	4,980	6,640
	5	6,175	7,135	6,765	8,105	7,430	9,910	7,740	13,165	7,965	16,100
	7-1/2	10,635	14,090	10,830	16,005	11,145	19,575	11,610	25,000	11,945	25,730
	12-1/2	17,725	33,250	18,050	37,370	18,575	40,010	19,345	41,670	19,910	42,885
3/4	3-1/2	3,620	3,580	3,965	4,070	4,575	4,980	5,605	6,610	6,470	8,085
	6	8,120	9,710	8,895	11,035	10,270	13,495	12,225	17,925	12,585	21,925
	9	14,920	19,185	16,340	21,795	17,610	26,655	18,340	35,230	18,875	40,655
	15	28,005	45,265	28,520	51,425	29,350	60,300	30,565	65,835	31,460	67,755
7/8	3-1/2	3,620	3,525	3,965	4,000	4,575	4,895	5,605	6,500	6,470	7,950
	7	10,230	11,860	11,210	13,475	12,945	16,485	15,850	21,895	17,030	26,775
	10-1/2	18,800	23,430	20,590	26,620	23,780	32,555	24,820	43,240	25,545	50,970
	17-1/2	37,900	55,290	38,595	62,815	39,720	74,695	41,365	89,095	42,570	91,695
1	4	4,420	4,365	4,840	4,960	5,590	6,065	6,845	8,060	7,905	9,855
	8	12,500	14,105	13,695	16,025	15,815	19,600	19,365	26,035	22,130	31,845
	12	22,965	27,860	25,160	31,655	29,050	38,715	32,255	51,425	33,200	61,595
	20	49,255	65,755	50,160	74,705	51,625	90,270	53,760	112,365	55,330	119,170
1-1/4	5	6,175	5,835	6,765	6,630	7,815	8,110	9,570	10,775	11,050	13,175
	10	17,470	18,845	19,140	21,410	22,100	26,185	27,065	34,780	31,255	42,540
	15	32,095	37,220	35,160	42,285	40,600	51,720	47,895	68,695	49,290	84,020
	25	69,060	87,850	74,475	99,810	76,650	122,075	79,820	156,660	82,150	176,940

☐ - Concrete Breakout Strength ☐ - Bond Strength/Pryout Strength

1. Tabular values are provided for illustration and are applicable for single anchors installed in cracked 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 according to ACI 318 (-19 or -14) Ch.17 and ICC-ES AC308. The load level corresponding to the failure mode listed [Concrete breakout strength, bond strength/pryout strength] must be checked against the tabulated steel strength of the corresponding threaded rod or rebar size and type, the lowest load level controls.
3. Strength reduction factors (ϕ) for concrete breakout strength are based on ACI 318 (-19 or -14) Section 5.3 for load combinations. Condition B was assumed.
4. Strength reduction factors (ϕ) for bond strength are determined from reliability testing and qualification in accordance with ICC-ES AC308 and are tabulated in this product information and in ESR-4027.
5. Tabular values are permitted for static loads only, seismic loading is not considered with these tables. Periodic special inspection must be performed where required by code, see ESR-4027 for applicable information.
6. For anchors subjected to tension resulting from sustained loading a supplemental check must be performed according to ACI 318-19 17.5.2.2 or ACI 318-14 17.3.1.2.
7. For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318 (-19 or -14) Ch.17.
8. Interpolation is not permitted to be used with the tabular values. For intermediate base material compressive strengths, please see ACI 318 (-19 or -14) Ch.17, ICC-ES AC308 and information included in this product supplement. For other design conditions including seismic considerations please see ACI 318 (-19 or -14) Ch.17 and ICC-ES AC308 and ESR-4027.
9. Long term concrete temperatures are roughly constant over significant periods of time. Short-term elevated temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.
10. The tabulated design strengths may be converted to allowable stress design values. Divide by conversion factor calculated as a weighted average of the load factors for the controlling load combination.
11. For seismic design in accordance with ACI 318, the tabulated tension design strengths in cracked concrete for concrete breakout and bond strength must be multiplied by a factor of 0.75. In the determination of the tension design strength values in cracked concrete, the bond strength requires an additional reduction factor applied for seismic tension ($\alpha_{N,seis}$), where seismic design is applicable.
12. For other installation conditions such as water-saturated concrete or water-filled hole applications, see the associated strength reduction factors (ϕ) for bond strength in the determination of controlling design strength values, as applicable.

Tension and Shear Design Strength for Reinforcing Bar Installed in Uncracked Concrete (Bond or Concrete Strength) Drilled with a Hammer-Drill and Carbide Bit in a Dry Hole Condition Temperature Range A: 122°F (50°C) Maximum Long-Term Service Temperature; 176°F (80°C) Maximum Short-Term Service Temperature[1,2,3,4,5,6,7,8,9,10,11]

STRENGTH DESIGN SD TABLES

Nominal Rod Size (in.)	Embed. Depth hef (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_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)
#3	2-3/8	2,855	2,570	3,125	2,920	3,610	3,575	4,365	4,705	4,495	4,840
	3	4,055	4,010	4,440	4,555	5,125	5,570	5,515	7,025	5,675	8,205
	4-1/2	7,445	7,935	7,720	8,820	7,945	10,300	8,275	12,820	8,515	14,975
	7-1/2	12,635	17,010	12,870	18,770	13,245	21,925	13,790	27,290	14,195	30,570
#4	2-3/4	3,555	3,305	3,895	3,755	4,500	4,590	5,510	6,095	6,365	7,455
	4	6,240	6,700	6,835	7,610	7,895	9,310	9,365	12,210	9,640	14,260
	6	11,465	13,235	12,560	15,035	13,490	17,870	14,050	22,240	14,460	25,980
	10	21,450	29,525	21,845	32,580	22,485	38,055	23,415	47,370	24,100	51,905
#5	3-1/8	4,310	4,120	4,720	4,680	5,450	5,725	6,675	7,600	7,710	9,295
	5	8,720	10,005	9,555	11,365	11,030	13,900	13,510	18,465	14,540	21,955
	7-1/2	16,020	19,760	17,550	22,450	20,265	27,460	21,190	34,235	21,805	39,985
	12-1/2	32,355	45,455	32,950	50,155	33,910	58,585	35,315	72,925	36,345	78,280
#6	3-1/2	5,105	5,015	5,595	5,700	6,460	6,970	7,910	9,255	9,135	11,320
	6	11,465	13,595	12,560	15,445	14,500	18,895	17,760	25,095	20,325	30,585
	9	21,060	26,855	23,070	30,510	26,640	37,320	29,625	47,690	30,490	55,705
	15	45,235	63,325	46,065	69,880	47,410	81,620	49,370	101,600	50,815	109,445
#7	3-1/2	5,105	4,930	5,595	5,605	6,460	6,855	7,910	9,100	9,135	11,130
	7	14,445	16,605	15,825	18,865	18,275	23,075	22,380	30,650	25,840	37,485
	10-1/2	26,540	32,800	29,070	37,265	33,570	45,580	39,340	59,480	40,485	69,475
	17-1/2	57,100	77,405	61,170	87,160	62,960	101,810	65,565	126,730	67,475	145,335
#8	4	6,240	6,115	6,835	6,945	7,895	8,495	9,665	11,280	11,160	13,800
	8	17,650	19,750	19,335	22,435	22,325	27,440	27,340	36,450	31,570	44,580
	12	32,425	39,005	35,520	44,315	41,015	54,200	50,230	71,990	51,780	84,145
	20	69,765	92,055	76,425	104,585	80,520	123,310	83,850	153,495	86,295	179,295
#9	4-1/2	7,445	7,110	8,155	8,080	9,420	9,880	11,535	13,125	13,320	16,055
	9	21,060	23,055	23,070	26,190	26,640	32,035	32,625	42,550	37,675	52,040
	13-1/2	38,690	45,540	42,380	51,740	48,940	63,280	59,940	84,050	64,315	99,830
	22-1/2	83,245	107,440	91,190	122,065	100,010	146,245	104,150	182,045	107,190	212,640
#10	5	8,720	8,160	9,555	9,270	11,030	11,335	13,510	15,060	15,600	18,420
	10	24,665	26,430	27,020	30,025	31,200	36,725	38,210	48,780	44,125	59,660
	15	45,315	52,205	49,640	59,310	57,320	72,545	70,200	96,350	78,065	116,085
	25	97,500	123,170	106,805	139,935	121,395	170,075	126,420	211,705	130,110	247,285

■ - Concrete Breakout Strength ■ - Bond Strength/Pryout Strength

1. Tabular values are provided for illustration and are applicable for single anchors installed in uncracked 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 according to ACI 318 (-19 or -14) Ch.17 and ICC-ES AC308. The load level corresponding to the failure mode listed [Concrete breakout strength, bond strength/ pryout strength] must be checked against the tabulated steel strength of the corresponding threaded rod or rebar size and type, the lowest load level controls.
3. Strength reduction factors (ϕ) for concrete breakout strength are based on ACI 318 (-19 or -14) Section 5.3 for load combinations. Condition B was assumed.
4. Strength reduction factors (ϕ) for bond strength are determined from reliability testing and qualification in accordance with ICC-ES AC308 and are tabulated in this product information and in ESR-4027.
5. Tabular values are permitted for static loads only, seismic loading is not considered with these tables. Periodic special inspection must be performed where required by code, see ESR-4027 for applicable information.
6. For anchors subjected to tension resulting from sustained loading a supplemental check must be performed according to ACI 318-19 17.5.2.2 or ACI 318-14 17.3.1.2.
7. For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318 (-19 or -14) Ch.17.
8. Interpolation is not permitted to be used with the tabular values. For intermediate base material compressive strengths, please see ACI 318 (-19 or -14) Ch.17, ICC-ES AC308 and information included in this product supplement. For other design conditions including seismic considerations please see ACI 318 (-19 or -14) Ch.17 and ICC-ES AC308 and ESR-4027.
9. Long term concrete temperatures are roughly constant over significant periods of time. Short-term elevated temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.
10. The tabulated design strengths may be converted to allowable stress design values. Divide by conversion factor calculated as a weighted average of the load factors for the controlling load combination.
11. For other installation conditions such as water-saturated concrete or water-filled hole applications, see the associated strength reduction factors (ϕ) for bond strength in the determination of controlling design strength values, as applicable.

Tension and Shear Design Strength for Reinforcing Bar Installed in Cracked Concrete (Bond or Concrete Strength)
Drilled with a Hammer-Drill and Carbide Bit in a Dry Hole Condition
Temperature Range A: 122°F (50°C) Maximum Long-Term Service Temperature; 176°F (80°C) Maximum Short-Term Service Temperature[1,2,3,4,5,6,7,8,9,10,11,12]

STRENGTH DESIGN SD TABLES

Nominal Rod Size (in.)	Embed. Depth hef (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_{cb} or ϕN_{a} Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_{a} Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_{a} Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_{a} Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_{a} Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)
#3	2-3/8	1,980	1,835	2,015	2,085	2,075	2,235	2,160	2,325	2,225	2,395
	3	2,500	2,865	2,545	3,255	2,620	3,980	2,730	5,020	2,810	5,860
	4-1/2	3,750	5,665	3,820	6,300	3,930	7,355	4,090	8,815	4,210	9,070
	7-1/2	6,250	12,150	6,365	13,405	6,550	14,105	6,820	14,690	7,020	15,120
#4	2-3/4	2,520	2,360	2,760	2,680	3,100	3,280	3,225	4,355	3,320	5,325
	4	4,300	4,785	4,380	5,435	4,505	6,650	4,695	8,720	4,830	10,185
	6	6,450	9,455	6,570	10,740	6,760	12,765	7,040	15,165	7,245	15,610
	10	10,750	21,090	10,950	23,270	11,270	24,270	11,735	25,275	12,075	26,015
#5	3-1/8	3,050	2,940	3,345	3,340	3,860	4,090	4,730	5,430	5,055	6,640
	5	6,175	7,145	6,765	8,120	7,545	9,930	7,855	13,190	8,085	15,680
	7-1/2	10,795	14,115	10,995	16,035	11,315	19,615	11,785	24,455	12,130	26,125
	12-1/2	17,995	32,465	18,325	35,825	18,860	40,625	19,640	42,305	20,215	43,540
#6	3-1/2	3,620	3,580	3,965	4,070	4,575	4,980	5,605	6,610	6,470	8,085
	6	8,120	9,710	8,895	11,035	10,270	13,495	11,725	17,925	12,065	21,845
	9	14,920	19,185	16,340	21,795	16,890	26,655	17,585	34,065	18,100	38,985
	15	26,855	45,235	27,350	49,915	28,150	58,300	29,310	63,135	30,170	64,975
#7	3-1/2	3,620	3,525	3,965	4,000	4,575	4,895	5,605	6,500	6,470	7,950
	7	10,230	11,860	11,210	13,475	12,945	16,485	15,850	21,895	16,495	26,775
	10-1/2	18,800	23,430	20,590	26,620	23,085	32,555	24,040	42,485	24,745	49,625
	17-1/2	36,710	55,290	37,385	62,260	38,475	72,720	40,070	86,300	41,240	88,820
#8	4	4,420	4,365	4,840	4,960	5,590	6,065	6,845	8,060	7,905	9,855
	8	12,500	14,105	13,695	16,025	15,815	19,600	19,365	26,035	21,215	31,845
	12	22,965	27,860	25,160	31,655	29,050	38,715	30,920	51,425	31,820	60,105
	20	47,210	65,755	48,080	74,705	49,485	88,080	51,530	109,640	53,035	114,230
#9	4-1/2	5,275	5,080	5,780	5,770	6,670	7,060	8,170	9,375	9,435	11,465
	9	14,920	16,465	16,340	18,710	18,870	22,880	23,110	30,390	26,500	37,170
	13-1/2	27,405	32,530	30,020	36,955	34,665	45,200	38,625	60,035	39,750	71,305
	22-1/2	58,965	76,740	60,060	87,190	61,815	104,460	64,375	130,030	66,250	142,695
#10	5	6,175	5,830	6,765	6,620	7,815	8,100	9,570	10,755	11,050	13,155
	10	17,470	18,880	19,140	21,445	22,100	26,230	27,065	34,840	31,255	42,615
	15	32,095	37,290	35,160	42,365	40,600	51,815	48,645	68,825	50,065	82,920
	25	69,060	87,980	75,645	99,955	77,855	121,485	81,075	151,220	83,440	176,635

■ - Concrete Breakout Strength ■ - Bond Strength/Pryout Strength

1. Tabular values are provided for illustration and are applicable for single anchors installed in cracked 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 according to ACI 318 (-19 or -14) Ch.17 and ICC-ES AC308. The load level corresponding to the failure mode listed [Concrete breakout strength, bond strength/ pryout strength] must be checked against the tabulated steel strength of the corresponding threaded rod or rebar size and type, the lowest load level controls.
3. Strength reduction factors (ϕ) for concrete breakout strength are based onACI 318 (-19 or -14) Section 5.3 for load combinations. Condition B was assumed.
4. Strength reduction factors (ϕ) for bond strength are determined from reliability testing and qualification in accordance with ICC-ES AC308 and are tabulated in this product information and in ESR-4027.
5. Tabular values are permitted for static loads only, seismic loading is not considered with these tables. Periodic special inspection must be performed where required by code, see ESR-4027 for applicable information.
6. For anchors subjected to tension resulting from sustained loading a supplemental check must be performed according to ACI 318-19 17.5.2.2 or ACI 318-14 17.3.1.2.
7. For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318 (-19 or -14) Ch.17.
8. Interpolation is not permitted to be used with the tabular values. For intermediate base material compressive strengths, please see ACI 318 (-19 or -14) Ch.17, ICC-ES AC308 and information included in this product supplement. For other design conditions including seismic considerations please see ACI 318 (-19 or -14) Ch.17 and ICC-ES AC308 and ESR-4027.
9. Long term concrete temperatures are roughly constant over significant periods of time. Short-term elevated temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.
10. The tabulated design strengths may be converted to allowable stress design values. Divide by conversion factor calculated as a weighted average of the load factors for the controlling load combination.
11. For seismic design in accordance with ACI 318, the tabulated tension design strengths in cracked concrete for concrete breakout and bond strength must be multiplied by a factor of 0.75. In the determination of the tension design strength values in cracked concrete, the bond strength requires an additional reduction factor applied for seismic tension ($\alpha_{N,seis}$), where seismic design is applicable.
12. For other installation conditions such as water-saturated concrete or water-filled hole applications, see the associated strength reduction factors (ϕ) for bond strength in the determination of controlling design strength values, as applicable.

Tension and Shear Design Strength for Reinforcing Bar Installed in Uncracked Concrete (Bond or Concrete Strength) Drilled with a Hammer-Drill and Carbide Bit in a Dry Hole Condition Temperature Range A: 122°F (50°C) Maximum Long-Term Service Temperature; 176°F (80°C) Maximum Short-Term Service Temperature[1,2,3,4,5,6,7,8,9,10,11]

STRENGTH DESIGN SD TABLES

Nominal Rebar Size	Embed. Depth h_{ef} in. (mm)	Minimum Concrete Compressive Strength									
		f'c = 2,500 psi (17.2 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)	
		ϕN_{cb} or ϕN_{a} Tension lbs. (MPa)	ϕV_{cb} or ϕV_{cp} Shear lbs. (MPa)	ϕN_{cb} or ϕN_{a} Tension lbs. (MPa)	ϕV_{cb} or ϕV_{cp} Shear lbs. (MPa)	ϕN_{cb} or ϕN_{a} Tension lbs. (MPa)	ϕV_{cb} or ϕV_{cp} Shear lbs. (MPa)	ϕN_{cb} or ϕN_{a} Tension lbs. (MPa)	ϕV_{cb} or ϕV_{cp} Shear lbs. (MPa)	ϕN_{cb} or ϕN_{a} Tension lbs. (MPa)	ϕV_{cb} or ϕV_{cp} Shear lbs. (MPa)
10M	2.4 (61)	2,900 (12.9)	2,580 (11.5)	3,175 (14.1)	2,930 (13.0)	3,670 (16.3)	3,585 (15.9)	4,495 (20.0)	4,760 (21.2)	5,170 (23.0)	5,550 (24.7)
	3.6 (90)	5,235 (23.3)	5,440 (24.2)	5,735 (25.5)	6,180 (27.5)	6,625 (29.5)	7,560 (33.6)	7,445 (33.1)	9,370 (41.7)	7,665 (34.1)	10,820 (48.1)
	5.3 (136)	9,620 (42.8)	10,755 (47.8)	10,420 (46.4)	12,075 (53.7)	10,725 (47.7)	13,940 (62.0)	11,170 (49.7)	17,075 (76.0)	11,495 (51.1)	19,715 (87.7)
	7.5 (191)	14,375 (63.9)	18,220 (81.0)	14,640 (65.1)	19,960 (88.8)	15,070 (67.0)	23,045 (102.5)	15,690 (69.8)	28,225 (125.6)	16,150 (71.8)	32,595 (145.0)
15M	3.1 (79)	4,255 (18.9)	4,050 (18.0)	4,665 (20.8)	4,600 (20.5)	5,385 (24.0)	5,625 (25.0)	6,595 (29.3)	7,475 (33.3)	7,615 (33.9)	9,140 (40.7)
	5.0 (128)	8,825 (39.3)	10,105 (44.9)	9,665 (43.0)	11,480 (51.1)	11,160 (49.6)	14,045 (62.5)	13,555 (60.3)	17,950 (79.8)	13,950 (62.1)	20,725 (92.2)
	7.6 (192)	16,210 (72.1)	19,960 (88.8)	17,760 (79.0)	22,680 (100.9)	19,525 (86.9)	26,695 (118.7)	20,335 (90.5)	32,695 (145.4)	20,930 (93.1)	37,750 (167.9)
	12.6 (320)	31,050 (138.1)	44,995 (200.1)	31,620 (140.7)	49,290 (219.3)	32,545 (144.8)	56,915 (253.2)	33,890 (150.8)	69,705 (310.1)	34,880 (155.2)	75,125 (334.2)
20M	3.5 (89)	5,105 (22.7)	4,995 (22.2)	5,595 (24.9)	5,675 (25.2)	6,460 (28.7)	6,945 (30.9)	7,910 (35.2)	9,220 (41.0)	9,135 (40.6)	11,280 (50.2)
	6.1 (156)	11,870 (52.8)	14,045 (62.5)	13,005 (57.8)	15,955 (71.0)	15,015 (66.8)	19,515 (86.8)	18,390 (81.8)	25,390 (112.9)	19,620 (87.3)	29,320 (130.4)
	9.2 (234)	21,810 (97.0)	27,750 (123.4)	23,890 (106.3)	31,525 (140.2)	27,460 (122.1)	37,770 (168.0)	28,595 (127.2)	46,260 (205.8)	29,430 (130.9)	53,415 (237.6)
	15.4 (390)	43,665 (194.2)	63,590 (282.9)	44,470 (197.8)	69,660 (309.9)	45,765 (203.6)	80,435 (357.8)	47,660 (212.0)	98,515 (438.2)	49,050 (218.2)	105,650 (470.0)
25M	3.9 (99)	6,005 (26.7)	5,855 (26.0)	6,580 (29.3)	6,650 (29.6)	7,600 (33.8)	8,135 (36.2)	9,305 (41.4)	10,805 (48.1)	10,745 (47.8)	13,215 (58.8)
	7.9 (202)	17,440 (77.6)	19,590 (87.1)	19,105 (85.0)	22,255 (99.0)	22,060 (98.1)	27,220 (121.1)	27,020 (120.2)	36,155 (160.8)	30,525 (135.8)	41,845 (186.1)
	11.9 (302)	32,040 (142.5)	38,700 (172.1)	35,100 (156.1)	43,970 (195.6)	40,530 (180.3)	53,780 (239.2)	44,490 (197.9)	66,015 (293.6)	45,790 (203.7)	76,230 (339.1)
	19.8 (504)	67,940 (302.2)	90,755 (403.7)	69,190 (307.8)	99,420 (442.2)	71,205 (316.7)	114,800 (510.7)	74,155 (329.9)	140,600 (625.4)	76,320 (339.5)	162,350 (722.2)
30M	4.7 (119)	7,950 (35.4)	7,510 (33.4)	8,705 (38.7)	8,530 (37.9)	10,055 (44.7)	10,435 (46.4)	12,315 (54.8)	13,860 (61.7)	14,215 (63.2)	16,950 (75.4)
	9.4 (239)	22,540 (100.3)	24,470 (108.8)	24,695 (109.8)	27,805 (123.7)	28,515 (126.8)	34,005 (151.3)	34,920 (155.3)	45,165 (200.9)	40,325 (179.4)	53,080 (236.1)
	14.1 (359)	41,410 (184.2)	48,350 (215.1)	45,365 (201.8)	54,930 (244.3)	52,380 (233.0)	67,185 (298.9)	59,745 (265.8)	83,745 (372.5)	61,490 (273.5)	96,700 (430.1)
	23.5 (598)	89,105 (396.4)	114,045 (507.3)	92,910 (413.3)	126,110 (561.0)	95,620 (425.3)	145,620 (647.8)	99,575 (442.9)	178,350 (793.3)	102,480 (455.9)	205,940 (916.1)

□ - Concrete Breakout Strength □ - Bond Strength/Pryout Strength

1. Tabular values are provided for illustration and are applicable for single anchors installed in cracked 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 according to ACI 318 (-19 or -14) Ch.17 and ICC-ES AC308. The load level corresponding to the failure mode listed [Concrete breakout strength, bond strength/pryout strength] must be checked against the tabulated steel strength of the corresponding threaded rod or rebar size and type, the lowest load level controls.
3. Strength reduction factors (ϕ) for concrete breakout strength are based on ACI 318 (-19 or -14) Section 5.3 for load combinations. Condition B was assumed.
4. Strength reduction factors (ϕ) for bond strength are determined from reliability testing and qualification in accordance with ICC-ES AC308 and are tabulated in this product information and in ESR-4027.
5. Tabular values are permitted for static loads only, seismic loading is not considered with these tables. Periodic special inspection must be performed where required by code, see ESR-4027 for applicable information.
6. For anchors subjected to tension resulting from sustained loading a supplemental check must be performed according to ACI 318-19 17.5.2.2 or ACI 318-14 17.3.1.2.
7. For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318 (-19 or -14) Ch.17.
8. Interpolation is not permitted to be used with the tabular values. For intermediate base material compressive strengths, please see ACI 318 (-19 or -14) Ch.17, ICC-ES AC308 and information included in this product supplement. For other design conditions including seismic considerations please see ACI 318 (-19 or -14) Ch.17 and ICC-ES AC308 and ESR-4027.
9. Long term concrete temperatures are roughly constant over significant periods of time. Short-term elevated temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.
10. The tabulated design strengths may be converted to allowable stress design values. Divide by conversion factor calculated as a weighted average of the load factors for the controlling load combination.
11. For other installation conditions such as water-saturated concrete or water-filled hole applications, see the associated strength reduction factors (ϕ) for bond strength in the determination of controlling design strength values, as applicable.

Tension and Shear Design Strength for Reinforcing Bar Installed in Cracked Concrete (Bond or Concrete Strength) Drilled with a Hammer-Drill and Carbide Bit in a Dry Hole Condition Temperature Range A: 122°F (50°C) Maximum Long-Term Service Temperature; 176°F (80°C) Maximum Short-Term Service Temperature[1,2,3,4,5,6,7,8,9,10,11,12]

Nominal Rebar Size	Embed. Depth h_{ef} in. (mm)	Minimum Concrete Compressive Strength									
		f'c = 2,500 psi (17.2 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)	
		ϕN_{cb} or ϕN_a Tension lbs. (MPa)	ϕV_{cb} or ϕV_{cp} Shear lbs. (MPa)	ϕN_{cb} or ϕN_a Tension lbs. (MPa)	ϕV_{cb} or ϕV_{cp} Shear lbs. (MPa)	ϕN_{cb} or ϕN_a Tension lbs. (MPa)	ϕV_{cb} or ϕV_{cp} Shear lbs. (MPa)	ϕN_{cb} or ϕN_a Tension lbs. (MPa)	ϕV_{cb} or ϕV_{cp} Shear lbs. (MPa)	ϕN_{cb} or ϕN_a Tension lbs. (MPa)	ϕV_{cb} or ϕV_{cp} Shear lbs. (MPa)
10M	2.4 (61)	2,055 (9.1)	1,670 (7.4)	2,250 (10.0)	1,830 (8.1)	2,600 (11.6)	2,115 (9.4)	3,180 (14.1)	2,590 (11.5)	3,675 (16.3)	2,990 (13.3)
	3.6 (90)	3,710 (16.5)	3,255 (14.5)	4,065 (18.1)	3,565 (15.9)	4,690 (20.9)	4,120 (18.3)	5,745 (25.6)	5,045 (22.4)	6,635 (29.5)	5,825 (25.9)
	5.3 (136)	6,815 (30.3)	5,935 (26.4)	7,465 (33.2)	6,500 (28.9)	8,620 (38.3)	7,505 (33.4)	10,560 (47.0)	9,195 (40.9)	11,495 (51.1)	10,615 (47.2)
	7.5 (191)	11,350 (50.5)	9,810 (43.6)	12,430 (55.3)	10,745 (47.8)	14,355 (63.9)	12,410 (55.2)	15,690 (69.8)	15,200 (67.6)	16,150 (71.8)	17,550 (78.1)
15M	3.1 (79)	3,015 (13.4)	2,890 (12.9)	3,305 (14.7)	3,190 (14.2)	3,815 (17.0)	3,685 (16.4)	4,670 (20.8)	4,515 (20.1)	5,395 (24.0)	5,210 (23.2)
	5.0 (128)	6,250 (27.8)	6,595 (29.3)	6,845 (30.4)	7,225 (32.1)	7,905 (35.2)	8,345 (37.1)	9,685 (43.1)	10,220 (45.5)	11,180 (49.7)	11,800 (52.5)
	7.6 (192)	11,480 (51.1)	12,015 (53.4)	12,580 (56.0)	13,165 (58.6)	14,525 (64.6)	15,200 (67.6)	17,790 (79.1)	18,615 (82.8)	20,540 (91.4)	21,495 (95.6)
	12.6 (320)	24,705 (109.9)	25,620 (114.0)	27,065 (120.4)	28,065 (124.8)	31,250 (139.0)	32,405 (144.1)	33,890 (150.8)	39,690 (176.5)	34,880 (155.2)	45,830 (203.9)
20M	3.5 (89)	3,620 (16.1)	3,570 (15.9)	3,965 (17.6)	4,055 (18.0)	4,575 (20.4)	4,730 (21.0)	5,605 (24.9)	5,790 (25.8)	6,470 (28.8)	6,685 (29.7)
	6.1 (156)	8,410 (37.4)	9,390 (41.8)	9,210 (41.0)	10,285 (45.7)	10,635 (47.3)	11,875 (52.8)	13,030 (58.0)	14,545 (64.7)	15,045 (66.9)	16,795 (74.7)
	9.2 (234)	15,450 (68.7)	17,105 (76.1)	16,925 (75.3)	18,740 (83.4)	19,540 (86.9)	21,640 (96.3)	23,935 (106.5)	26,500 (117.9)	27,635 (122.9)	30,600 (136.1)
	15.4 (390)	33,240 (147.9)	36,430 (162.0)	36,415 (162.0)	39,905 (177.5)	42,045 (187.0)	46,080 (205.0)	47,660 (212.0)	56,435 (251.0)	49,050 (218.2)	65,165 (289.9)
25M	3.9 (99)	4,255 (18.9)	4,180 (18.6)	4,660 (20.7)	4,750 (21.1)	5,385 (24.0)	5,810 (25.8)	6,590 (29.3)	7,125 (31.7)	7,610 (33.9)	8,230 (36.6)
	7.9 (202)	12,355 (55.0)	13,355 (59.4)	13,535 (60.2)	14,630 (65.1)	15,625 (69.5)	16,890 (75.1)	19,140 (85.1)	20,685 (92.0)	22,100 (98.3)	23,890 (106.3)
	11.9 (302)	22,695 (101.0)	24,325 (108.2)	24,865 (110.6)	26,650 (118.5)	28,710 (127.7)	30,770 (136.9)	35,160 (156.4)	37,685 (167.6)	40,600 (180.6)	43,515 (193.6)
	19.8 (504)	48,835 (217.2)	51,810 (230.5)	53,495 (238.0)	56,755 (252.5)	61,770 (274.8)	65,535 (291.5)	74,155 (329.9)	80,260 (357.0)	76,320 (339.5)	92,680 (412.3)
30M	4.7 (119)	5,630 (25.0)	5,365 (23.9)	6,165 (27.4)	6,095 (27.1)	7,120 (31.7)	7,455 (33.2)	8,720 (38.8)	9,230 (41.1)	10,070 (44.8)	10,660 (47.4)
	9.4 (239)	15,965 (71.0)	16,900 (75.2)	17,490 (77.8)	18,510 (82.3)	20,195 (89.8)	21,375 (95.1)	24,735 (110.0)	26,180 (116.5)	28,565 (127.1)	30,230 (134.5)
	14.1 (359)	29,335 (130.5)	30,785 (136.9)	32,135 (142.9)	33,725 (150.0)	37,105 (165.1)	38,940 (173.2)	45,445 (202.1)	47,690 (212.1)	52,475 (233.4)	55,070 (245.0)
	23.5 (598)	63,115 (280.7)	65,565 (291.6)	69,140 (307.6)	71,820 (319.5)	79,835 (355.1)	82,930 (368.9)	97,780 (434.9)	101,570 (451.8)	102,480 (455.9)	117,280 (521.7)

- Concrete Breakout Strength   - Bond Strength/Pryout Strength

1. Tabular values are provided for illustration and are applicable for single anchors installed in cracked 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 according to ACI 318 (-19 or -14) Ch.17 and ICC-ES AC308. The load level corresponding to the failure mode listed [Concrete breakout strength, bond strength/pryout strength] must be checked against the tabulated steel strength of the corresponding threaded rod or rebar size and type, the lowest load level controls.
3. Strength reduction factors (ϕ) for concrete breakout strength are based on ACI 318 (-19 or -14) Section 5.3 for load combinations. Condition B was assumed.
4. Strength reduction factors (ϕ) for bond strength are determined from reliability testing and qualification in accordance with ICC-ES AC308 and are tabulated in this product information and in ESR-4027.
5. Tabular values are permitted for static loads only, seismic loading is not considered with these tables. Periodic special inspection must be performed where required by code, see ESR-4027 for applicable information.
6. For anchors subjected to tension resulting from sustained loading a supplemental check must be performed according to ACI 318-19 17.5.2.2 or ACI 318-14 17.3.1.2.
7. For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318 (-19 or -14) Ch.17.
8. Interpolation is not permitted to be used with the tabular values. For intermediate base material compressive strengths, please see ACI 318 (-19 or -14) Ch.17, ICC-ES AC308 and information included in this product supplement. For other design conditions including seismic considerations please see ACI 318 (-19 or -14) Ch.17 and ICC-ES AC308 and ESR-4027.
9. Long term concrete temperatures are roughly constant over significant periods of time. Short-term elevated temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.
10. The tabulated design strengths may be converted to allowable stress design values. Divide by conversion factor calculated as a weighted average of the load factors for the controlling load combination.
11. For seismic design in accordance with ACI 318, the tabulated tension design strengths in cracked concrete for concrete breakout and bond strength must be multiplied by a factor of 0.75. In the determination of the tension design strength values in cracked concrete, the bond strength requires an additional reduction factor applied for seismic tension ($\alpha_{N,seis}$), where seismic design is applicable.
12. For other installation conditions such as water-saturated concrete or water-filled hole applications, see the associated strength reduction factors (ϕ) for bond strength in the determination of controlling design strength values, as applicable.

Tension Design of Steel Elements (Steel Strength)[1,2]

Steel Elements - Threaded Rod and Reinforcing Bar												
Nominal Rod/Rebar Size	ASTM A36 and ASTM F1554 Grade 36	ASTM F1554 Grade 55	ASTM A193 Grade B7 and ASTM F1554 Grade 105	ASTM A449	ASTM F568M Class 5.8	ASTM F593 CW Stainless (Types 304 and 316)	ASTM A193 Grade B8/B8M2, Class 2B Stainless (Types 304 and 316)	ASTM A615 Grade 75 Rebar	ASTM A615 Grade 60 Rebar	ASTM A706 Grade 60 Rebar	ASTM A615 Grade 40 Rebar	CAN/CSA G30.18 Grade 400
	ϕN_{sa} Tension lbs	ϕN_{sa} Tension lbs	ϕN_{sa} Tension lbs	ϕN_{sa} Tension lbs	ϕN_{sa} Tension lbs	ϕN_{sa} Tension lbs	ϕN_{sa} Tension lbs	ϕN_{sa} Tension lbs	ϕN_{sa} Tension lbs	ϕN_{sa} Tension lbs	ϕN_{sa} Tension lbs	ϕN_{sa} Tension lbs (kN)
3/8" or #3	3,370	4,360	7,265	6,975	3,655	5,040	5,525	7,150	6,435	6,600	4,290	-
10M	-	-	-	-	-	-	-	-	-	-	-	7,915 (35.2)
1/2" or #4	6,175	7,980	13,300	12,770	6,690	9,225	10,110	13,000	11,700	12,000	7,800	-
5/8" or #5	9,835	12,715	21,190	20,340	10,650	14,690	16,105	21,150	18,135	18,600	12,090	-
15M	-	-	-	-	-	-	-	-	-	-	-	15,870 (70.6)
3/4" or #6	14,550	18,815	31,360	30,105	15,765	18,480	23,830	28,600	25,740	26,400	17,160	-
20M	-	-	-	-	-	-	-	-	-	-	-	23,560 (104.8)
7/8" or #7	20,085	25,970	43,285	41,930	21,760	25,510	32,895	39,000	35,100	36,000	-	-
25M	-	-	-	-	-	-	-	-	-	-	-	39,360 (175.1)
1" or #8	26,350	34,070	56,785	54,515	28,545	33,465	43,160	51,350	46,215	47,400	-	-
#9	-	-	-	-	-	-	-	65,000	58,500	60,000	-	-
30M	-	-	-	-	-	-	-	-	-	-	-	55,410 (246.5)
1-1/4" or #10	42,160	54,510	90,850	76,315	45,670	53,540	69,050	82,550	74,295	76,200	-	-

■ - Steel Strength

1. Steel tensile design strength according to ACI 318 Ch.17, $\phi N_{sa} = \phi \cdot A_{se,N} \cdot f_{uta}$.
2. The tabulated steel design strength in tension must be checked against the bond strength/concrete capacity design strength to determine the controlling failure mode, the lowest load level controls.

Shear Design of Steel Elements (Steel Strength)[1,2,3]

Steel Elements - Threaded Rod and Reinforcing Bar												
Nominal Rod/Rebar Size	ASTM A36 and ASTM F1554 Grade 36	ASTM F1554 Grade 55	ASTM A193 Grade B7 and ASTM F1554 Grade 105	ASTM A449	ASTM F568M Class 5.8	ASTM F593 CW Stainless (Types 304 and 316)	ASTM A193 Grade B8/B8M2, Class 2B Stainless (Types 304 and 316)	ASTM A615 Grade 75 Rebar	ASTM A615 Grade 60 Rebar	ASTM A706 Grade 60 Rebar	ASTM A615 Grade 40 Rebar	CAN/CSA G30.18 Grade 400
	ϕV_{sa} Shear lbs	ϕV_{sa} Shear lbs	ϕV_{sa} Shear lbs	ϕV_{sa} Shear lbs	ϕV_{sa} Shear lbs	ϕV_{sa} Shear lbs	ϕV_{sa} Shear lbs	ϕV_{sa} Shear lbs	ϕV_{sa} Shear lbs	ϕV_{sa} Shear lbs	ϕV_{sa} Shear lbs	ϕV_{sa} Shear lbs (kN)
3/8" or #3	1,755	2,265	3,775	3,625	2,020	2,790	2,870	3,960	3,565	3,430	2,375	-
10M	-	-	-	-	-	-	-	-	-	-	-	4,385 (19.5)
1/2" or #4	3,210	4,150	3,915	6,640	3,705	5,110	5,255	7,200	6,480	6,240	4,320	-
5/8" or #5	5,115	6,610	11,020	10,575	2,900	8,135	8,375	11,160	10,045	9,670	6,695	-
15M	-	-	-	-	-	-	-	-	-	-	-	8,790 (39.1)
3/4" or #6	7,565	9,785	16,305	15,655	8,730	10,235	12,390	15,840	14,255	13,730	9,505	-
20M	-	-	-	-	-	-	-	-	-	-	-	13,050 (58.0)
7/8" or #7	10,445	13,505	22,505	21,805	12,050	14,130	17,105	21,600	19,440	18,720	-	-
25M	-	-	-	-	-	-	-	-	-	-	-	21,800 (97.0)
1" or #8	13,700	17,715	29,525	28,345	15,810	18,535	22,445	28,440	25,595	24,650	-	-
#9	-	-	-	-	-	-	-	36,000	32,400	31,200	-	-
30M	-	-	-	-	-	-	-	-	-	-	-	30,685 (136.5)
1-1/4" or #10	21,920	28,345	47,250	39,685	25,295	25,295	35,905	45,720	41,150	39,625	-	-

■ - Steel Strength

1. Steel shear design strength according to ACI 318 Ch.17, $\phi V_{sa} = \phi \cdot 0.60 \cdot A_{se,V} \cdot f_{uta}$.
2. The tabulated steel design strength in shear must be checked against the bond strength/concrete capacity design strength to determine the controlling failure mode, the lowest load level controls.
3. In the determination of the shear design strength values in cracked concrete, the steel strength requires an additional reduction factor applied for seismic shear ($\alpha_{V,seis}$), where seismic design is applicable.

POST-INSTALLED REBAR DEVELOPMENT LENGTH TABLES

Development Lengths for Common Reinforcing Bar Connections[1,2,3,6]

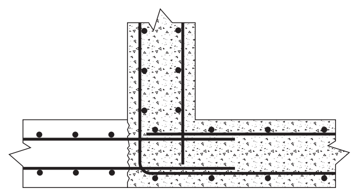
Design Information	Symbol	Reference Standard	Units	Nominal Rebar Size (US)							
				#3	#4	#5	#6	#7	#8	#9	#10
Nominal rebar diameter	d_b	ASTM A615/A706, Grade 60 (f_y = 60 ksi)	in. (mm)	0.375 (9.5)	0.5 (12.7)	0.625 (15.9)	0.75 (19.1)	0.875 (22.2)	1 (25.4)	1.128 (28.6)	1.27 (32.3)
Nominal rebar area	A_b		in² (mm²)	0.11 (71)	0.2 (127)	0.31 (198)	0.44 (285)	0.6 (388)	0.79 (507)	1 (645)	1.27 (817)
Development length in f'c = 2,500 psi concrete[4,5]	l_d	ACI 318-19 25.4.2.4, ACI 318-14 25.4.2.3 or ACI 318-11 12.2.3 as applicable	in. (mm)	12 (305)	14.4 (366)	18 (457)	21.6 (549)	31.5 (800)	36 (914)	40.6 (1031)	45.7 (1161)
Development length in f'c = 3,000 psi concrete[4,5]			in. (mm)	12 (305)	13.1 (334)	16.4 (417)	19.7 (501)	28.8 (730)	32.9 (835)	37.1 (942)	41.7 (1060)
Development length in f'c = 4,000 psi concrete[4,5]			in. (mm)	12 (305)	12 (305)	14.2 (361)	17.1 (434)	24.9 (633)	28.5 (723)	32.1 (815)	36.2 (920)
Development length in f'c = 6,000 psi concrete[4,5]			in. (mm)	12 (305)	12 (305)	12 (305)	13.9 (354)	20.3 (516)	23.2 (590)	26.2 (666)	29.5 (750)
Development length in f'c = 8,000 psi concrete[4,5]			in. (mm)	12 (305)	12 (305)	12 (305)	12.1 (307)	17.6 (443)	20.1 (511)	22.7 (577)	25.6 (649)

Design Information	Symbol	Reference Standard	Units	Nominal Rebar Size (CA)				
				10M	15M	20M	25M	30M
Nominal rebar diameter	d_b	CSA G30.18 Grade 400 (f_y = 58 ksi)	mm (in.)	11.3 (0.445)	16.0 (0.630)	19.5 (0.768)	25.2 (0.992)	29.9 (1.177)
Nominal rebar area	A_b		mm² (in²)	100 (0.16)	200 (0.31)	300 (0.46)	500 (0.77)	700 (1.09)
Development length in f'c = 2,500 psi concrete[4,6]	l_d	ACI 318-19 25.4.2.4, ACI 318-14 25.4.2.3 or ACI 318-11 12.2.3 as applicable	mm (in.)	315 (12.4)	445 (17.5)	678 (26.7)	876 (34.5)	1041 (41.0)
Development length in f'c = 3,000 psi concrete[4,6]			mm (in.)	305 (12.0)	407 (16.0)	620 (24.4)	800 (31.5)	950 (37.4)
Development length in f'c = 4,000 psi concrete[4,6]			mm (in.)	305 (12.0)	353 (13.9)	536 (21.1)	693 (27.3)	823 (32.4)
Development length in f'c = 6,000 psi concrete[4,6]			mm (in.)	305 (12.0)	305 (12.0)	438 (17.3)	566 (22.3)	672 (26.4)
Development length in f'c = 8,000 psi concrete[4,6]			mm (in.)	305 (12.0)	305 (12.0)	379 (14.9)	490 (19.3)	582 (22.9)

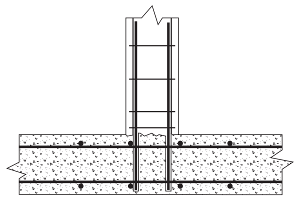
For SI: 1 inch = 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa; for pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi.

1. Calculated development lengths in accordance with ACI 318-19 25.4.2.4, ACI 318-14 25.4.2.3 or ACI 318-11 12.2.3, as applicable, for reinforcing bars are valid for static, wind, and earthquake loads.
2. Calculated development lengths in SDC C through F must comply with ACI 318 (-19 or -14) Chapter 18 or ACI 318-11 Chapter 21, as applicable.
3. For Class B splices, minimum length of lap for tension lap splices is $1.3*l_d$ in accordance with ACI 318 (-19 or -14) 25.5.2 and ACI 318-11 12.15.1, as applicable.
4. For lightweight concrete, $\lambda = 0.75$; therefore multiply development lengths by 1.33 (increase development length by 33 percent), unless the provisions of ACI 318-19 25.4.2.5, ACI 318-14 25.4.2.4 or ACI 318-11 12.2.4 (d), as applicable, are met to permit alternate values of λ (e.g for sand-lightweight concrete, $\lambda = 0.85$; therefore multiply development lengths by 1.18). Refer to ACI 318 (-19 or -14) 19.2.4 or ACI 318-11 8.6.1, as applicable.
5. $\left(\frac{c_b + K_{tr}}{d_b}\right) = 2.5$, $\psi_t = 1.0$, $\psi_e = 1.0$, $\psi_s = 0.8$ for $d_b \le$ #6, and $d_b <= 19$ mm, 1.0 for $d_b >$ #6 and $d_b > 19$ mm. Refer to ACI 318-19 17.4.2.5, ACI 318-14 25.4.2.4 or ACI 318-11 12.2.4, as applicable.
6. Calculations may be performed for other steel grades and concrete compressive strengths per ACI 318 (-19 or -14) Chapter 25 or ACI 318-11 Chapter 12, as applicable.

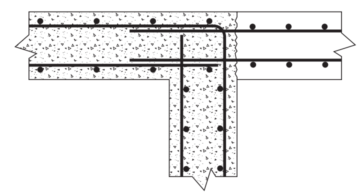
Examples of Development Length Application Details for Post-Installed Reinforcing Bar Connections Provided for Illustration



Tension Lap Splice with Existing Reinforcement for Footing and Foundation Extensions

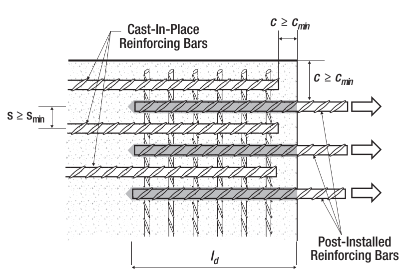


Tension Development of Column, Cap or Wall Dowels



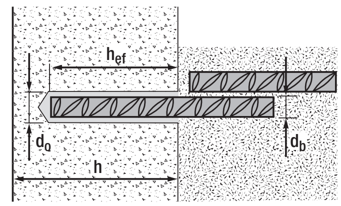
Tension Lap Splice with Existing Flexural Reinforcement For Slab and Beam Extensions

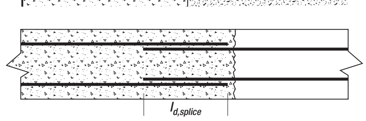
Installation Detail for Post-Installed Reinforcing Bar Connection



Development Length

c = edge distance
s = spacing





d_b = nominal bar diameter
d_0 = nominal hole diameter
h_{ef} = effective embedment
h = member thickness

Installation Parameters for Common Post-Installed Reinforcing Bar Connections

Parameter	Symbol	Units	Nominal Rebar Size (US)							
			#3	#4	#5	#6	#7	#8	#9	#10
Nominal hole diameter[1]	d_o	in.	1/2	5/8	3/4	7/8	1	1-1/8 I 1-1/4	1-3/8	1-1/2
Effective embedment	h_{ef}	in.	Up to 22-1/2	Up to 30	Up to 37-1/2	Up to 45	Up to 52-1/2	Up to 60	Up to 67-1/2	Up to 75

Parameter	Symbol	Units	Nominal Rebar Size (CA)				
			10M	15M	20M	25M	30M
Nominal hole diameter[1]	d_o	in.	9/16	3/4	1	1-1/4	1-1/2
Effective embedment	h_{ef}	mm	Up to 680	Up to 960	Up to 1170	Up to 1510	Up to 1795

For SI: 1 inch = 25.4 mm,; for pound-inch units: 1 mm = 0.03937 inches.

1. For any case, it must be possible for the reinforcing bar (rebar) to be inserted into the cleaned hole without resistance.
2. Consideration should be given regarding the commercial availability of carbide drill bits (including hollow drill bits), as applicable, with lengths necessary to achieve effective embedments for post-installed reinforcing bar connections.

Hole Cleaning Tools and Accessories for Post-Installed Rebar Connections[1,2,3,4,5,6,7]

Rebar Size	Drill Bit Size (inch)	Brush Size (inch)	Brush Length (inches)	Wire Brush (Cat. No.)	Plug Size (inch)	Piston Plug (Cat. No.)
No. 3	1/2	1/2	6	PFC1671010	-	-
10M	9/16	9/16	6	PFC1671150	-	-
No. 4	5/8	5/8	6	PFC1671200	5/8	PFC1691510
No. 5	3/4	3/4	6	PFC1671250	3/4	PFC1691520
15M	3/4	3/4	6	PFC1671250	3/4	PFC1691520
No. 6	7/8	7/8	6	PFC1671300	7/8	PFC1691530
20M	1	1	6	PFC1671350	1	PFC1691540
No. 7	1	1	6	PFC1671350	1	PFC1691540
25M	1-1/4	1-1/4	6	PFC1671450	1-1/4	PFC1691555
No. 8	1-1/8	1-1/8	6	PFC1671425	1-1/8	PFC1691550
	1-1/4	1-1/4	6	PFC1671450	1-1/4	PFC1691555
No. 9	1-3/8	1-3/8	6	PFC1671450	1-3/8	PFC1691560
30M	1-1/2	1-1/2	6	PFC1671500	1-1/2	PFC1691570
No. 10	1-1/2	1-1/2	6	PFC1671500	1-1/2	PFC1691570

1. If the DEWALT DustX+ extraction system is used to automatically clean the holes during drilling, standard hole cleaning (brushing and blowing following drilling) is not required.
2. Holes may be drilled with hammer-drill, i.e. rotary impact drills or rock drills with a carbide drill bit (including hollow bits).
3. For any case, it must be possible for the reinforcing bar to be inserted into the cleaned drill hole without resistance.
4. A brush extension (Cat.#PFC1671820) must be used with a steel wire brush for holes drilled deeper than the listed brush length.
5. Brush adaptors for power tool connections are available for SDS (Cat.#PFC1671830).
6. A flexible extension tube (Cat.#08297-PWR) or flexible extension hose (Cat.#PFC1640600) or equivalent approved by DEWALT must be used if the bottom or back of the anchor hole is not reached with the mixing nozzle only.
7. All overhead (i.e upwardly inclined) installations require the use of piston plugs during where one is tabulated together with the anchor size (see table). All horizontal installations require the use of piston plugs where the embedment depth is greater than 10 inches and the drill bit size is larger than 5/8-inch. A flexible extension tube (Cat.#08297-PWR) or flexible extension hose (Cat.#PFC1640600) or equivalent approved by DEWALT must be used with piston plugs.


Wire Brush


Brush Extension


SDS Adapter


Premium Piston Plug

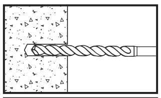
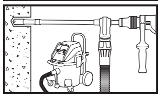

Compressed Air Nozzle


DustX+™ System
(hollow bits with HEPA dust extraction)

DUST X+™ ANCHOR INSTALLATION SYSTEM

INSTALLATION INSTRUCTIONS (SOLID BASE MATERIALS)

DRILLING

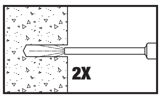
1- Drill a hole into the base material with rotary hammer drill (i.e. percussion drill) and a carbide drill bit to the size and embedment required by the selected steel hardware element (reference installation specifications for threaded rod and reinforcing bar). The tolerances of the carbide drill bits, including hollow bits, must meet ANSI Standard B212.15.

- Precaution: Use suitable eye and skin protection. Avoid inhalation of dust during drilling and/or removal.
- Note! In case of standing water in the drilled hole (flooded hole condition), all the water has to be removed from the hole (e.g. vacuum, compressed air, etc.) prior to cleaning.

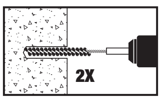
Drilling in dry base material is recommended when using hollow drill bits (vacuum must be on).

GO TO STEP 3 FOR HOLES DRILLED WITH DUSTX+™ EXTRACTION SYSTEM (NO FURTHER HOLE CLEANING IS REQUIRED); OTHERWISE GO TO STEP 2A FOR HOLE CLEANING INSTRUCTIONS.

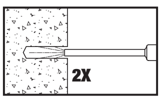
HOLE CLEANING



2a- Starting from the bottom or back of the anchor hole, blow the hole clean with compressed air (min. 90 psi / 6 bar) a minimum of two times (2x). If the back of the drilled hole is not reached an extension shall be used.

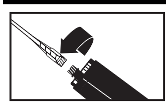


2b- Determine brush diameter (see hole cleaning equipment selection table) for the drilled hole and brush the hole by hand or attach the brush with adaptor to a rotary drill tool or battery screw gun. Brush the hole with the selected wire brush a minimum of two times (2x). A brush extension (supplied by DEWALT) must be used for drill hole depth > 6" (150mm). The wire brush diameter must be checked periodically during use. The brush should resist insertion into the drilled hole, if not, the brush is too small and must be replaced with proper brush diameter (i.e. new wire brush).



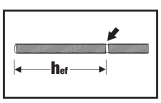
2c- Finally blow the hole clean again with compressed air (min. 90 psi / 6 bar) a minimum of two times (2x). If the back of the drilled hole is not reached an extension shall be used. When finished the hole should be clean and free of dust, debris, ice, grease, oil or other foreign material.

PREPARING

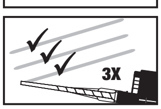


3- Check adhesive expiration date on cartridge label. Do not use expired product. Review Safety Data Sheet (SDS) before use. Cartridge temperature must be between 41°F - 104°F (5°C - 40°C) when in use; except for installations in base material temperatures between 14ºF and 23ºF (-10ºC and -5ºC) the cartridge adhesive temperature must be conditioned to 50ºF (10ºC) minimum.. Review published working and cure times. Consideration should be given to the reduced gel (working) time of the adhesive in warm temperatures. For permitted range of the base material temperature, see published gel and curing times.

- Attach a supplied mixing nozzle to the cartridge. Unless otherwise noted do not modify the mixer in any way and make sure the mixing element is inside the nozzle. Load the cartridge into the correct dispensing tool.
- Note: Always use a new mixing nozzle with new cartridge of adhesive and also for all work interruptions exceeding the published gel (working) time of the adhesive.



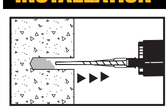
4- Prior to inserting the anchor rod or rebar into the filled drilled hole, the position of the embedment depth has to be marked on the anchor. Verify anchor element is straight and free of surface damage.



5- Adhesives must be properly mixed to achieve published properties. For new cartridges and nozzles, prior to dispensing adhesive into the drilled hole, separately dispense at least three full strokes of adhesive through the mixing nozzle until the adhesive is a consistent **GRAY** color.

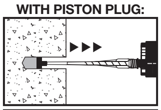
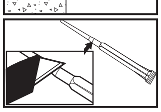
- Review and note the published working and cure times (reference gel time and curing time table) prior to injection of the mixed adhesive into the cleaned anchor hole.

INSTALLATION



6- Fill the cleaned hole approximately two-thirds full with mixed adhesive starting from the bottom or back of the anchor hole. Slowly withdraw the mixing nozzle as the hole fills to avoid creating air pockets or voids. A plastic extension tube (Cat# 08281-PWR or 08297-PWR) or equivalent approved by DEWALT must be used with the mixing nozzle if the bottom or back of the anchor hole is not reached with the mixing nozzle (see reference tables for installation).

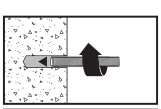
WITH PISTON PLUG:

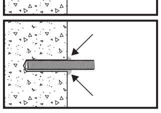
Note! Piston plugs (see hole cleaning equipment selection table) must be used with and attached to the mixing nozzle and extension tube for:

- Overhead installations and installations between horizontal and overhead in concrete with anchors larger than 1/2", #4 and 10M.
- All installations with drill hole depth > 10" (250mm)
- Insert piston plug to the back of the drilled hole and inject as described in the method above. During installation the piston plug will be naturally extruded from the drilled hole by the adhesive pressure.
- In the case that flexible tubing is used (Cat. #PFC1640600), the mixing nozzle may be trimmed at the preforation on the front port before attachment of the tubing. Verify the mixing element is inside the nozzle before use.

Attention! Do not install anchors overhead or upwardly inclined without installation hardware supplied by DEWALT and also receiving proper training and/or certification. Contact DEWALT for details prior to use, as applicable.

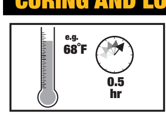


7- The anchor should be free of dirt, grease, oil or other foreign material. Push clean threaded rod or reinforcing bar into the anchor hole while turning slightly to ensure positive distribution of the adhesive until the embedment depth is reached. Observe the gel (working) time.



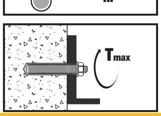
8- Ensure that the anchor element is installed to the specific embedment depth. Adhesive must completely fill the annular gap at the concrete surface. Following installation of the anchor element, remove excess adhesive. Protect the anchor element threads from fouling with adhesive. For all installations the anchor element must be restrained from movement throughout the specified curing period (as necessary) through the use of temporary wedges, external supports, or other methods. Minor adjustment to the position of the anchor element may be performed during the gel (working) time only.

CURING AND LOADING



9- Allow the adhesive anchor to cure to the specified full curing time prior to applying any load (reference gel time and curing time table).

- Do not disturb, torque or load the anchor until it is fully cured.

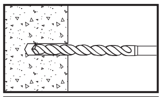
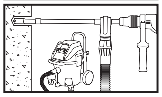


10- After full curing of the adhesive anchor, a fixture can be installed to the anchor and tightened up to the maximum torque (reference installation specifications for threaded rod and reinforcing bar table) by using a calibrated torque wrench.

- Note! Take care not to exceed the maximum torque for the selected anchor.

INSTALLATION INSTRUCTIONS POST-INSTALLED FOR REBAR CONNECTIONS

HAMMER DRILLING

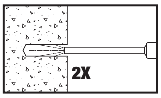
1- Drill a hole into the base material with rotary hammer drill (i.e. percussion drill) and a carbide drill bit to the size and embedment required by the selected steel hardware element (reference installation specifications for threaded rod and reinforcing bar). The tolerances of the carbide drill bits, including hollow bits, must meet ANSI Standard B212.15.

- Precaution: Use suitable eye and skin protection. Avoid inhalation of dust during drilling and/or removal.
- Note! In case of standing water in the drilled hole (flooded hole condition), all the water has to be removed from the hole (e.g. vacuum, compressed air, etc.) prior to cleaning.

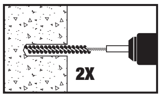
Drilling in dry base materials is recommended when using hollow drill bits (vacuum must be on).

GO TO STEP 3 FOR HOLES DRILLED WITH DUSTX+™ EXTRACTION SYSTEM (NO FURTHER HOLE CLEANING IS REQUIRED); OTHERWISE GO TO STEP 2A FOR HOLE CLEANING INSTRUCTIONS.

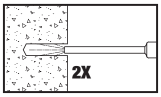
HOLE CLEANING



2a- Starting from the bottom or back of the drilled hole, blow the hole clean a minimum of two times (2x). Use a compressed air nozzle (min. 90 psi) for all sizes of reinforcing bar (rebar).

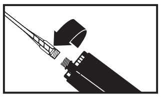


2b- Determine brush diameter (see hole cleaning accessories for post-installed rebar selection table) for the drilled hole and brush the hole by hand or attach the brush with adaptor to a rotary drill tool or battery screw gun. Brush the hole with the selected wire brush a minimum of two times (2x). A brush extension (supplied by DEWALT) must be used for drill hole depth > 6" (150mm). The wire brush diameter must be checked periodically during use. The brush should resist insertion into the drilled hole, if not, the brush is too small and must be replaced with proper brush diameter (i.e. new wire brush).



2c- Repeat Step 2a again by blowing the hole clean a minimum of two times (2x).
When finished the hole should be clean and free of dust, debris, oil or other foreign material.

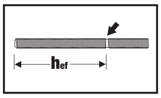
PREPARING



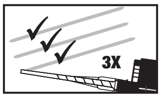
3- Check adhesive expiration date on cartridge label. Do not use expired product. Review Safety Data Sheet (SDS) before use. Review published gel (working) and cure times. Cartridge adhesive temperature must be between 41°F - 104°F (5°C - 40°C) when in use; except for installations in base material temperatures between 14ºF and 23ºF (-10ºC and -5ºC) the cartridge adhesive temperature must be conditioned to 50ºF (10ºC) minimum.

Note: Consideration should be given to the reduced gel (working) time of the adhesive in warm temperatures. For the permitted range of the base material temperature see published gel and cure times.
Attach a supplied mixing nozzle to the cartridge. Unless otherwise noted do not modify the mixer in any way and make sure the mixing element is inside the nozzle. Load the cartridge into the correct dispensing tool.

- Note: Always use a new mixing nozzle with new cartridge of adhesive and also for all work interruptions exceeding the published gel (working) time of the adhesive.

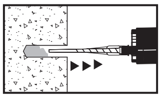


4- Prior to inserting the rebar into the filled drilled hole, the position of the embedment depth has to be marked on the anchor.
Verify anchor element is straight and free of surface damage.

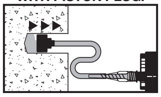


5- Adhesive must be properly mixed to achieve published properties. Prior to dispensing adhesive into the drilled hole, separately dispense at least three full strokes of adhesive through the mixing nozzle until the adhesive is a consistent **GRAY** color.
Review and note the published gel (working) and cure times prior to injection of the mixed adhesive into the cleaned anchor hole.

INSTALLATION



WITH PISTON PLUG:

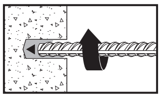


6- Fill the cleaned hole approximately two-thirds full with mixed adhesive starting from the bottom or back of the anchor hole. Slowly withdraw the mixing nozzle as the hole fills to avoid creating air pockets or voids. A flexible extension tube (Cat.# 08297-PWR) or flexible extension hose (Cat.# PFC1640600) or equivalent approved by DEWALT must be used with the mixing nozzle if the bottom or back of the anchor hole is not reached with the mixing nozzle (see reference tables for installation). (see hole cleaning tools and accessories for post-installed rebar table).

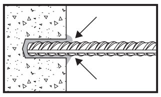
Note! Piston plugs must be used with and attached to mixing nozzle and extension tube for overhead (i.e. upwardly inclined) installations and horizontal installations with rebar sizes larger than #4 and 10M. Insert piston plug to the back of the drilled hole and inject as described in the method above. During injection of the adhesive the piston plug will be naturally extruded from the drilled hole by the adhesive pressure.

- In the case that flexible tubing is used (Cat. #PFC1640600), the mixing nozzle may be trimmed at the preforation on the front port before attachment of the tubing. Verify the mixing element is inside the nozzle before use.

Attention! Do not install anchors overhead or upwardly inclined without installation hardware supplied by DEWALT and also receiving proper training and/or certification. Contact DEWALT for details prior to use, as applicable.

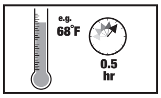


7- The reinforcing bar should be free of dirt, grease, oil or other foreign material. Push clean rebar into the anchor hole while turning slightly to ensure positive distribution of the adhesive until the embedment depth is reached. Observe the gel (working) time.



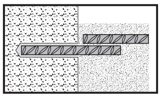
8- Ensure that the anchor element is installed to the specific embedment depth. Adhesive must completely fill the annular gap at the concrete surface. Following installation of the anchor element, remove excess adhesive. Protect the anchor element threads from fouling with adhesive. For all installations the anchor element must be restrained from movement throughout the specified curing period (as necessary) through the use of temporary wedges, external supports, or other methods. Minor adjustment to the position of the anchor element may be performed during the gel (working) time only.

CURING AND LOADING



9- Allow the adhesive anchor to cure to the specified full curing time prior to applying any load (reference gel time and curing time table).

- Do not disturb, torque or load the anchor until it is fully cured.



10- After full curing of the rebar connection, new concrete can be poured (placed) to the installed rebar connection.

REFERENCE INSTALLATION TABLES

Gel (working) Time and Curing Table

Temperature of base material	Gel (working) time	Full curing time
14°F (-10°C) to 22°F (-6°C)	60 minutes	24 hours
23°F (-5°C) to 31°F (-1°C)	50 minutes	5 hours
32°F (0°C) to 40°F (4°C)	25 minutes	3.5 hours
41°F (5°C) to 49°F (9°C)	15 minutes	2 hours
50°F (10°C) to 58°F (14°C)	10 minutes	1 hour
59°F (15°C) to 67°F (19°C)	6 minutes	40 minutes
68°F (20°C) to 85°F (29°C)	3 minutes	30 minutes
86°F (30°C) to 104°F (40°C)	2 minutes	30 minutes

Linear interpolation for intermediate base material temperature is possible.

Cartridge temperature must be between 41ºF (5ºC) and 104ºF (40ºC) when in use; except for installations in base material temperatures between 14ºF and 23ºF (-10ºC and -5ºC) the cartridge temperature must be conditioned to 50ºF (10ºC) minimum.

Wire Brush Selection Table for AC200+ Adhesive Anchors[1,2,3]

Nominal Wire Brush Size (inch)	ANSI Drill Bit Diameter (inch)	Brush Length (inches)	Steel Wire Brush[1,2] (Cat. #)	Blowout Tool
7/16	7/16	6	PFC1671050	Compressed air nozzle only, Cat #08292-PWR (min. 90 psi)
1/2	1/2	6	PFC1671100	
9/16	9/16	6	PFC1671150	
5/8	5/8	6	PFC1671200	
11/16	11/16	6	PFC1671225	
3/4	3/4	6	PFC1671250	
7/8	7/8	6	PFC1671300	
1	1	6	PFC1671350	
1-1/8	1-1/8	6	PFC1671400	
1-1/4	1-1/4	6	PFC1671450	
1-3/8	1-3/8	6	PFC1671450	
1-1/2	1-1/2	6	PFC1671500	

1. An SDS-plus adaptor (Cat. #PFC1671830) is required to attach a steel wire brush to hammer drill. For hand brushing, attach manual brush wood handle (Cat. #PFC1671000) to the steel brush.
2. A brush extension (Cat. #PFC1671820) must be used with a steel wire brush for holes drilled deeper than the listed brush length.
3. If the DEWALT DustX+ extraction system is used to automatically clean holes during drilling, standard hole cleaning (i.e. brushing and removing dust/debris following drilling) is not required.

Piston Plug Selection Table for Adhesive Anchors[1,2,3,4]

Plug Size (inch)	ANSI Drill Bit Diameter (inch)	Piston Plug (Cat. #)	Premium Piston Plug (Cat. #)
11/16	11/16	08258-PWR	PFC1691515
3/4	3/4	08259-PWR	PFC1691520
7/8	7/8	08300-PWR	PFC1691530
1	1	08301-PWR	PFC1691540
1-1/8	1-1/8	08303-PWR	PFC1691550
1-1/4	1-1/4	08307-PWR	PFC1691555
1-3/8	1-3/8	08305-PWR	PFC1691560
1-1/2	1-1/2	08309-PWR	PFC1691570
1-3/4	1-3/4	-	PFC1691580
2	2	-	PFC1691590
2-3/16	2-3/16	-	PFC1691600

1. All overhead or upwardly inclined installations require the use of piston plugs where one is tabulated together with the anchor size.
2. All installations require the use of piston plugs where the embedment depth is greater than 10 inches and drill bit size is larger than 5/8-inch.
3. The use of piston plugs is also recommended for underwater installations where one is tabulated together with the anchor size.
4. A flexible plastic extension tube (Cat. #08281-PWR or #08297-PWR) or equivalent approved by DEWALT must be used with piston plugs.

ORDERING INFORMATION

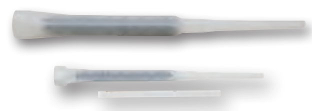
AC200+ Cartridges (10:1 mix ratio)

Cat. No.	Description	Pack Qty.	Std. Ctn.	Pallet
PFC1271050	AC200+ 9.5 fl. oz. Quick-Shot	12	36	648
PFC1271110	AC200+ 14 fl. oz. coaxial cartridge	-	12	540
PFC1271150	AC200+ 28 fl. oz. dual cartridge	-	8	240

An AC200+ mixing nozzle is packaged with each cartridge.
AC200+ mixing nozzles must be used to ensure complete and proper mixing of the adhesive.

Cartridge System Mixing Nozzles

Cat. No.	Description	Pack Qty.	Std. Ctn.
PFC1641600	Mixing nozzle (with 8" extension)	2	24
08281-PWR	Mixing nozzle extension, 8" long	2	24
08297-PWR	Mixing nozzle extension, 20" long	1	12



Dispensing Tools for Injection Adhesive

Cat. No.	Description	Pack Qty.	Std. Ctn.
08437-PWR	Manual caulking gun for Quick-Shot	1	12
DCE560D1	Cordless 20v battery powered dispensing tool for Quick-Shot	1	-
08414-PWR	14 fl. oz. Standard metal manual tool	1	-
08494-PWR	28 fl. oz. Standard metal manual tool	1	-
08496-PWR	28 fl. oz. High performance pneumatic tool	1	-
DCE595D1	28 fl. oz. cordless 20v battery powered dispensing tool	1	-

Hole Cleaning Tools and Accessories

Cat No.	Description	Pack Qty.
PFC1671050	Premium Wire brush for 7/16" ANSI hole, 6" length	1
PFC1671100	Premium Wire brush for 1/2" ANSI hole, 6" length	1
PFC1671150	Premium Wire brush for 9/16" ANSI hole, 6" length	1
PFC1671200	Premium Wire brush for 5/8" ANSI hole, 6" length	1
PFC1671225	Premium Wire brush for 11/16" ANSI hole, 6" length	1
PFC1671250	Premium Wire brush for 3/4" ANSI hole, 6" length	1
PFC1671300	Premium Wire brush for 7/8" ANSI hole, 6" length	1
PFC1671350	Premium Wire brush for 1" ANSI hole, 6" length	1
PFC1671400	Premium Wire brush for 1-1/8" ANSI hole, 6" length	1
PFC1671450	Premium Wire brush for 1-1/4" and 1-3/8" ANSI hole, 6" length	1
PFC1671500	Premium Wire brush for 1-1/2" ANSI hole, 6" length	1
PFC1671830	SDS-plus adapter for premium steel brushes	1
PFC1671000	Premium manual brush wood handle	1
PFC1671820	Premium steel brush extension, 12" length	1
08292-PWR	Air compressor nozzle with extension, 18" length	1
Std. Wire Brushes for Large Diameter Holes		
08299-PWR	Std. Wire brush for 1-3/4" ANSI hole, 11" length	1
08271-PWR	Std. Wire brush for 2" ANSI hole, 11" length	1
08272-PWR	Std. Wire brush for 2-3/16" ANSI hole, 11" length	1
08282-PWR	Std. steel brush extension, 12" length	1
08283-PWR	SDS-Plus adaptor for Std. steel brushes	1

Piston Plugs for Adhesive Anchors

Cat No.	Description	ANSI Drill Bit Dia.	Pack Qty.
08258-PWR	11/16" Plug	11/16"	10
08259-PWR	3/4" Plug	3/4"	10
08300-PWR	7/8" Plug	7/8"	10
08301-PWR	1" Plug	1"	10
08303-PWR	1-1/8" Plug	1-1/8"	10
08307-PWR	1-1/4" Plug	1-1/4	10
08305-PWR	1-3/8" Plug	1-3/8"	10
08309-PWR	1-1/2" Plug	1-1/2"	10

Piston Plugs for Post-Installed Rebar Connections

Cat. No.	Description	ANSI Drill Bit Dia.	Pack Qty.
PFC1691510	5/8" Plug	5/8"	1
PFC1691515	11/16" Plug	11/16"	1
PFC1691520	3/4" Plug	3/4"	1
PFC1691530	7/8" Plug	7/8"	1
PFC1691540	1" Plug	1"	1
PFC1691550	1-1/8" Plug	1-1/8"	1
PFC1691555	1-1/4" Plug	1-1/4"	1
PFC1691560	1-3/8" Plug	1-3/8"	1
PFC1691570	1-1/2" Plug	1-1/2"	1
PFC1691580	1-3/4" Plug	1-3/4"	1
PFC1691590	2" Plug	2"	1
PFC1691600	2-3/16" Plug	2-3/16"	1

SDS Max 4-Cutter Carbide Drill Bits

Cat. No.	Diameter	Usable Length	Overall Length
DW5806	5/8"	8"	13-1/2"
DW5809	5/8"	16"	21-1/2"
DW5807	5/8"	31"	36"
DW5808	11/16"	16"	21-1/2"
DW5810	3/4"	8"	13-1/2"
DW5812	3/4"	16"	21-1/2"
DW5813	3/4"	31"	36"
DW5814	13/16"	16"	21-1/2"
DW5815	7/8"	8"	13-1/2"
DW5816	7/8"	16"	21-1/2"
DW5851	7/8"	31"	36"
DW5817	27/32"	16"	21-1/2"
DW5818	1"	8"	13-1/2"
DW5819	1"	16"	22-1/2"
DW5852	1"	24"	29"
DW5820	1"	31"	36"
DW5821	1-1/8"	10"	15"
DW5822	1-1/8"	18"	22-1/2"
DW5853	1-1/8"	24"	29"
DW5854	1-1/8"	31"	36"
DW5824	1-1/4"	10"	15"
DW5825	1-1/4"	18"	22-1/2"

SDS+ Full Head Carbide Drill Bits

Cat. No.	Diameter	Usable Length	Overall Length
DW5502	3/16"	2"	4-1/2"
DW5503	3/16"	4"	6-1/2"
DW5504	3/16"	5"	8-1/2"
DW5506	3/16"	10"	12"
DW5512	7/32"	8"	10"
DW5517	1/4"	4"	6"
DW5518	1/4"	6"	8-1/2"
DW55200	1/4"	10"	12"
DW5521	1/4"	12"	14"
DW5524	5/16"	4"	6"
DW5526	5916"	10"	12"
DW5527	3/8"	4"	6-1/2"
DW5529	3/8"	8"	10"
DW55300	3/8"	10"	12"
DW5531	3/8"	16"	18"
DW5537	1/2"	4"	6"
DW5538	1/2"	8"	10-1/2"
DW5539	1/2"	10"	12"
DW5540	1/2"	16"	18"

SDS+ 4-Cutter Carbide Drill Bits

Cat. No.	Diameter	Usable Length	Overall Length
DW5471	5/8"	8"	10"
DW5472	5/8"	16"	18"
DW5474	3/4"	8"	10"
DW5475	3/4"	16"	18"
DW5477	7/8"	8"	10"
DW5478	7/8"	16"	18"
DW5479	1"	8"	10"
DW5480	1"	16"	18"
DW5481	1-1/8"	8"	10"
DW5482	1-1/8"	6"	18"

Dust Extraction

Cat. No.	Description
DWV012	10 Gallon Wet/Dry Hepa/Rrp Dust Extractor DWV9402 Fleece bag (5 pack) for DEWALT dust extractors DWV9316 Replacement Anti-Static Hose DWV9320 Replacement HEPA Filter Set (Type 1)
DWH050K	Dust Extraction with two interchangeable drilling heads
DCB1800M3T1	1800 Watt Portable Power Station & Parallel Battery Charger with (3) 20V Max* 5Ah Batteries and (1) 60V Max* Flexvolt® Battery

Hollow Drill Bits

Shank	Cat. No.	Diameter	Overall Length	Usable Length	Recommended Hammer
SDS+	DWA54012	1/2"	14-1/2"	9-3/4"	DCH133 / DCH273 / DCH293
	DWA54916	9/16"	14-1/2"	9-3/4"	DCH133 / DCH273 / DCH293
	DWA54058	5/8"	14-1/2"	9-3/4"	DCH133 / DCH273 / DCH293
	DWA54034	3/4"	14-1/2"	9-3/4"	DCH133 / DCH273 / DCH293
SDS Max	DWA58058	5/8"	23-5/8"	15-3/4"	DCH481 / D25603K
	DWA58958	5/8"	47-1/4"	39-3/8"	DCH481 / D25603K
	DWA58116	11/16"	24-3/4"	15-3/4"	DCH481 / D25603K
	DWA58034	3/4"	23-5/8"	15-3/4"	DCH481 / D25603K
	DWA58934	3/4"	47-1/4"	39-3/8"	DCH481 / D25603K
	DWA58078	7/8"	23-5/8"	15-3/4"	DCH481 / D25603K
	DWA58001	1"	23-5/8"	15-3/4"	DCH481 / D25603K
	DWA58901	1"	47-1/4"	39-3/8"	DCH481 / D25603K
	DWA58118	1-1/8"	23-5/8"	15-3/4"	DCH481 / D25603K
	DWA58918	1-1/8"	47-1/4"	39-3/8"	DCH481 / D25603K
	DWA58115	1-1/4"	23-5/8"	15-3/4"	DCH481 / D25603K
	DWA58114	1-1/4"	47-1/4"	39-3/8"	DCH481 / D25603K
	DWA58138	1-3/8"	47-1/4"	39-3/8"	DCH481 / D25603K
	DWA58112	1-1/2"	47-1/4"	39-3/8"	DCH481 / D25603K

DUST X+™
ANCHOR INSTALLATION SYSTEM

GENERAL INFORMATION

AC100+ GOLD®

Vinylester Injection Adhesive Anchoring System

PRODUCT DESCRIPTION

The AC100+ Gold is a two-component vinylester adhesive anchoring system. The system includes injection adhesive in plastic cartridges, mixing nozzles, dispensing tools and hole cleaning equipment. The adhesive is designed for bonding threaded rod and reinforcing bar elements into drilled holes in concrete and masonry base materials. It can be considered for use in solid base materials as well as hollow base materials with screen tubes.

GENERAL APPLICATIONS AND USES

- Bonding threaded rod and reinforcing bar into hardened concrete and masonry
- Evaluated for use in dry and water-saturated concrete (including water filled holes)
- Suitable to resist loads in cracked or uncracked concrete base materials
- Adhesive system can be installed in a wide range of base material temperatures; qualified for structural applications in concrete and masonry as low as 14ºF (-10ºC)
- Qualified for seismic (earthquake) and wind loading (SDC A - F)

FEATURES AND BENEFITS

+ Designed for use with threaded rod and reinforcing bar hardware elements
+ Consistent performance in low and high strength concrete
+ Evaluated and recognized for freeze/thaw performance
+ Evaluated and recognized for a range of embedments
+ Versatile low odor formula with optimized cure time
+ Evaluated and recognized for long term and short term loading (see performance tables)
+ Mixing nozzles proportion adhesive and provide simple delivery method into drilled holes
+ Cartridge design allows for multiple uses using extra mixing nozzles
+ Universal product for concrete and masonry (hollow and solid base materials)

APPROVALS AND LISTINGS

- International Code Council, Evaluation Service (ICC-ES) ESR-2582 for concrete
- International Code Council, Evaluation Service (ICC-ES) ESR-3200 for masonry
- International Code Council, Evaluation Service (ICC-ES) ESR-4105 for Unreinforced Masonry (URM)
- Code compliant with the 2021 IBC/IRC, 2018 IBC/IRC, 2015 IBC/IRC and 2012 IBC/IRC
- Tested in accordance with ASTM E488 / ACI 355.4 and ICC-ES AC308 for use in structural concrete with design according to ACI 318 (-19 & -14) Chapter 17 and ACI 318 Appendix D
- Tested in accordance with ICC-ES AC58 and ICC-ES AC60 for use in masonry walls
- Compliant with NSF/ANSI Standard 61 for drinking water system components – health effects
- Compliant to California DPH for VOC emissions and South Coast AQMD for VOC content (LEED v4.1)
- Conforms to requirements of ASTM C881 including C882 and AASHTO M235, Types I, II, IV and V, Grade 3, Class A and conforms to requirements of ASTM C881 Types I and IV, Grade 3, Class B
- Department of Transportation listings – see www.DEWALT.com or contact transportation agency

GUIDE SPECIFICATIONS

CSI Divisions: 03 16 00 - Concrete Anchors, 04 05 19.16 - Masonry Anchors and 05 05 19 - Post-Installed Concrete Anchors. Adhesive anchoring system shall be AC100+ Gold as supplied by DEWALT, Towson, MD. Anchors shall be installed in accordance with published instructions and requirements of the Authority Having Jurisdiction.

TENSION ZONE CRACKED CONCRETE | SEISMIC REGION QUALIFICATION | NSF | CODE LISTED ICC-ES ESR-2582 CONCRETE | CODE LISTED ICC-ES ESR-3200 MASONRY | CODE LISTED ICC-ES ESR-4105 URM | DDA DEWALT DESIGN ASSIST

SECTION CONTENTS

AC100+ GOLD ADHESIVE IN CARTRIDGE
(STANDARD THREADED ROD AND REBAR STEEL SUPPLIED BY OTHERS)

PACKAGING (10:1 MIX RATIO)

Coaxial / Foil Cartridge

- 9.5 fl. oz. (280 mL or 17.1 in³)
- 14 fl. oz. (420 mL or 25.6 in³)

Dual Cartridge (side-by-side)

- 28 fl. oz. (825 mL or 50.3 in³)

STORAGE LIFE & CONDITIONS

Eighteen months in a dry, dark environment with temperature ranging from 32°F and 86°F (-0°C to 30°C)

ANCHOR SIZE RANGE (TYPICAL)

- 3/8" to 1-1/4" diameter threaded rod
- No. 3 to No. 10 reinforcing bar

SUITABLE BASE MATERIALS

- Normal-weight concrete
- Lightweight concrete
- Grouted concrete masonry (CMU)
- Hollow concrete masonry (CMU)
- Hollow core concrete
- Brick masonry
- Unreinforced Masonry (URM Walls)

PERMISSIBLE INSTALLATION CONDITIONS (ADHESIVE)

- Dry concrete
- Water-saturated concrete (wet)
- Water-filled holes (flooded)

INSTALLATION SPECIFICATIONS

Installation Table for AC100+ Gold (Solid Concrete Base Materials)

Parameter	Symbol	Units	Fractional Nominal Rod Diameter (Inch) / Reinforcing Bar Size									
			3/8 or #3	1/2	#4	5/8 or #5	3/4 or #6	7/8 or #7	1 or #8	#9	1-1/4	#10
Threaded rod outside diameter	d_a (d)	inch (mm)	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)	-
Rebar nominal outside diameter	d_a (d)	inch (mm)	0.375 (9.5)	0.500 (12.7)		0.625 (15.9)	0.750 (19.1)	0.875 (22.2)	1.000 (25.4)	1.125 (28.7)	-	1.250 (31.8)
Nominal drill bit size (ANSI)[6]	d_o (d_{bit})	inch	7/16	9/16	5/8	11/16 or 3/4	7/8	1	1-1/8	1-3/8	1-3/8	1-1/2
Minimum embedment[1]	$h_{ef,min}$	inch (mm)	2-3/8 (60)	2-3/4 (70)		3-1/8 (79)	3-1/2 (89)	3-1/2 (89)	4 (102)	4-1/2 (114)	5 (127)	5 (127)
Maximum embedment[1]	$h_{ef,max}$	inch (mm)	4-1/2 (114)	6 (152)		7-1/2 (191)	9 (229)	10-1/2 (267)	12 (305)	13-1/2 (343)	15 (381)	15 (381)
Minimum member thickness	h_{min}	inch (mm)	h_{ef} + 1-1/4 (h_{ef} + 30)			$h_{ef} + 2d_o$						
Minimum anchor spacing	s_{min}	inch (mm)	1-7/8 (48)	2-1/2 (64)		3-1/8 (79)	3-3/4 (95)	4-3/8 (111)	5 (127)	5-5/8 (143)	6-1/4 (159)	6-1/4 (159)
Minimum edge distance (up to 100% T_{max})	c_{min}	inch (mm)	1-7/8 (48)	2-1/2 (64)		3-1/8 (79)	3-3/4 (95)	4-3/8 (111)	5 (127)	5-5/8 (143)	6-1/4 (159)	6-1/4 (159)
Max. rod torque[2]	T_{max}	ft-lbs	15	33		60	105	125	165	-	280	-
Minimum edge distance, reduced[4,5]	$c_{min,red}$	inch (mm)	1-3/4 (45)	1-3/4 (45)		1-3/4 (45)	1-3/4 (45)	1-3/4 (45)	1-3/4 (45)	2-3/4 (70)	2-3/4 (70)	2-3/4 (70)
Max. torque[2,3] (low strength rods)	$T_{max,ls\text{-}rod}$	ft-lbs	7	20		40	60	100	165	-	280	-

For pound-inch units: 1 mm = 0.03937 inch, 1 N-m = 0.7375 ft-lbf. For SI: 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m.

5. Embedment range qualified for use with the design provisions of ACI 318 (-19 and -14) Chapter 17 or ACI 318-11 Appendix D as applicable and ICC-ES AC308, and ESR-2582.
6. Torque may not be applied to the anchors until the full cure time of the adhesive has been achieved.
7. These torque values apply to ASTM A36 / F1554 Grade 36 carbon steel threaded rods and ASTM A193 Grade B8/B8M (Class 1) stainless steel threaded rods.
8. For installation below the minimum edge distance, c_{min}, down to the reduced minimum edge distance, $c_{min,red}$, the reduced maximum torque is 0.45*T_{max}.
9. For installations down to the reduced minimum edge distance, $c_{min,red}$, the minimum anchor spacing, s_{min}, is 5d_a.
10. The listed drill bit sizes are also applicable to installations into grouted concrete masonry.

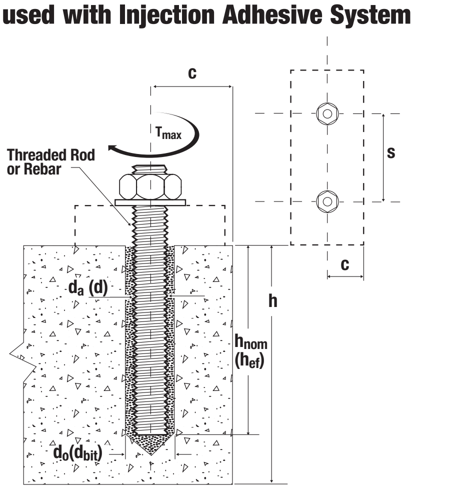
Installation Table for AC100+ Gold (Hollow Base Material with Screen Tube)

Parameter	Symbol	Units	Nominal Tube Size - Stainless Steel						Nominal Tube Size - Plastic		
Nominal threaded rod size	-	in.	1/4	3/8	1/2	5/8	3/4		3/8	1/2	5/8
Nominal threaded rod diameter	d	in.	0.250	0.375	0.500	0.625	0.750		0.375	0.500	0.625
Reinforcing bar size	-	No.	-	-	#3	#4	#5	#6	-	-	-
Nominal rebar diameter	d	in.	-	-	0.375	0.500	0.625	0.750	-	-	-
Nominal screen tube diameter	-	in.	1/4	3/8	1/2	5/8	3/4	15/16	3/8	1/2	5/8
Nominal drill bit size (ANSI)	d_{bit}	in.	3/8	1/2	5/8	3/4	7/8	1	9/16	3/4	7/8
Maximum torque[1]	T_{max}	ft-lbs	3	6	10	10	10	10	5	8	8

1. Torque may not be applied to the anchors until the full cure time of the adhesive has been achieved.

For Unreinforced Masonry (URM Walls) see separate installation details and information in these tech pages for 'Retrofit Bolt Anchors in URM Walls'.

Detail of Steel Hardware Elements used with Injection Adhesive System



Nomenclature

d_a (d) = Diameter of anchor
d_o (d_{bit}) = Diameter of drilled hole
h = Base material thickness
h_{nom} (h_{ef}) = Embedment depth
s = Spacing of anchors
c = Edge distance
T_{max} = Maximum torque

Threaded Rod and Deformed Reinforcing Bar Material Properties

Steel Description (General)	Steel Specification (ASTM)	Nominal Anchor Size (inch/No.)	Minimum Yield Strength, f_y (psi)	Minimum Ultimate Strength, f_u (psi)
Carbon rod	ASTM A36 and F1554 Grade 36	3/8 through 1-1/4	36,000	58,000
	ASTM F1554 Grade 55	3/8 through 1-1/4	55,000	75,000
	ASTM A449	3/8 through 1	92,000	120,000
		1-1/4	81,000	105,000
	ASTM A193 Grade B7 and F1554 Grade 105	3/8 through 1-1/4	105,000	125,000
Stainless rod (Alloy 304/316)	ASTM F593 Condition CW	3/8 through 5/8	65,000	100,000
		3/4 through 1-1/4	45,000	85,000
	ASTM A193 Grade B8/B8M, Class 1	3/8 through 1-1/4	30,000	75,000
	ASTM A193 Grade B8/B8M2, Class 2B	3/8 through 1-1/4	75,000	95,000
Reinforcing Bar	ASTM A615, A767, Grade 75	#3 through #10	75,000	100,000
	ASTM A615, A767, Grade 60	#3 through #10	60,000	90,000
	ASTM A706, A767, Grade 60	#3 through #10	60,000	80,000
	ASTM A615, A767, Grade 40	#3 through #6	40,000	60,000

Tabulated material properties are provided for reference; other steel hardware elements may also be considered such as ASTM A706 Grade 80 reinforcing bars.

PERFORMANCE DATA (ASD)

Ultimate and Allowable Load Capacities for AC100+ Gold Installed into Normal Weight Concrete with Threaded Rod and Reinforcing Bar (based on bond strength/concrete capacity)[1,2,3,4,5,6]

Nominal Rod Diameter or Rebar Size d in. or No.	Minimum Embedment Depth h_{nom} in.	Minimum Concrete Compressive Strength							
		f'c = 3,000 psi		f'c = 4,000 psi		f'c = 5,000 psi		f'c = 6,000 psi	
		Ultimate Tension Load Capacity lbs (kN)	Allowable Tension Load Capacity lbs (kN)	Ultimate Tension Load Capacity lbs (kN)	Allowable Tension Load Capacity lbs (kN)	Ultimate Tension Load Capacity lbs (kN)	Allowable Tension Load Capacity lbs (kN)	Ultimate Tension Load Capacity lbs (kN)	Allowable Tension Load Capacity lbs (kN)
3/8 or #3	2-3/8	4,840 (21.5)	1,210 (5.4)	5,040 (22.4)	1,260 (5.6)	5,180 (23.0)	1,295 (5.8)	5,320 (23.7)	1,330 (5.9)
	3-1/2	7,140 (31.8)	1,785 (7.9)	7,420 (33.0)	1,855 (8.3)	7,640 (34.0)	1,910 (8.5)	7,820 (34.8)	1,955 (8.7)
	4-1/2	9,180 (40.8)	2,295 (10.2)	9,540 (42.4)	2,385 (10.6)	9,820 (43.7)	2,455 (10.9)	10,060 (44.7)	2,515 (11.2)
1/2 or #4	2-3/4	7,980 (35.5)	1,995 (8.9)	8,280 (36.8)	2,070 (9.2)	8,540 (38.0)	2,135 (9.5)	8,740 (38.9)	2,185 (9.7)
	4-3/8	12,720 (56.6)	3,180 (14.1)	13,200 (58.7)	3,300 (14.7)	13,580 (60.4)	3,395 (15.1)	13,900 (61.8)	3,475 (15.5)
	6	17,420 (77.5)	4,355 (19.4)	18,100 (80.5)	4,525 (20.1)	18,620 (82.8)	4,655 (20.7)	19,080 (84.9)	4,770 (21.2)
5/8 or #5	3-1/8	11,220 (49.9)	2,805 (12.5)	11,660 (51.9)	2,915 (13.0)	12,000 (53.4)	3,000 (13.3)	12,300 (54.7)	3,075 (13.7)
	5-1/4	19,200 (85.4)	4,800 (21.4)	19,960 (88.8)	4,990 (22.2)	20,540 (91.4)	5,135 (22.8)	21,020 (93.5)	5,255 (23.4)
	7-1/2	27,660 (123.0)	6,915 (30.8)	28,720 (127.8)	7,180 (31.9)	29,560 (131.5)	7,390 (32.9)	30,280 (134.7)	7,570 (33.7)
3/4 or #6	3-1/2	13,320 (59.3)	3,330 (14.8)	13,820 (61.5)	3,455 (15.4)	14,220 (63.3)	3,555 (15.8)	14,560 (64.8)	3,640 (16.2)
	6-1/4	26,880 (119.6)	6,720 (29.9)	27,900 (124.1)	6,975 (31.0)	28,720 (127.8)	7,180 (31.9)	29,420 (130.9)	7,355 (32.7)
	9	40,440 (179.9)	10,110 (45.0)	42,000 (186.8)	10,500 (46.7)	43,220 (192.3)	10,805 (48.1)	44,260 (196.9)	11,065 (49.2)
7/8 or #7	3-1/2	13,320 (59.3)	3,330 (14.8)	13,820 (61.5)	3,455 (15.4)	14,220 (63.3)	3,555 (15.8)	14,560 (64.8)	3,640 (16.2)
	7	36,680 (163.2)	9,170 (40.8)	38,080 (169.4)	9,520 (42.3)	39,200 (174.4)	9,800 (43.6)	40,140 (178.6)	10,035 (44.6)
	10-1/2	60,040 (267.1)	15,010 (66.8)	62,340 (277.3)	15,585 (69.3)	64,180 (285.5)	16,045 (71.4)	65,700 (292.2)	16,425 (73.1)
1 or #8	4	16,260 (72.3)	4,065 (18.1)	16,880 (75.1)	4,220 (18.8)	17,380 (77.3)	4,345 (19.3)	17,800 (79.2)	4,450 (19.8)
	8	46,540 (207.0)	11,635 (51.8)	48,300 (214.8)	12,075 (53.7)	49,740 (221.3)	12,435 (55.3)	50,920 (226.5)	12,730 (56.6)
	12	76,820 (341.7)	19,205 (85.4)	79,740 (354.7)	19,935 (88.7)	82,080 (365.1)	20,520 (91.3)	84,060 (373.9)	21,015 (93.5)
1-1/4 or #10	5	22,740 (101.2)	5,685 (25.3)	23,600 (105.0)	5,900 (26.2)	24,300 (108.1)	6,075 (27.0)	24,880 (110.7)	6,220 (27.7)
	10	65,880 (293.0)	16,470 (73.3)	68,400 (304.3)	17,100 (76.1)	70,420 (313.2)	17,605 (78.3)	72,100 (320.7)	18,025 (80.2)
	15	93,775 (417.1)	23,445 (104.3)	97,350 (433.1)	24,340 (108.3)	100,225 (445.8)	25,055 (111.5)	102,615 (456.5)	25,655 (114.1)

1. Allowable load capacities listed are calculated using an applied safety factor of 4.0 which includes an assessment of freezing/thawing conditions and sensitivity to sustained loads (i.e. creep resistance). Consideration of safety factors of 10 or higher may be necessary depending on the application, such as life safety or overhead.
2. Linear interpolation may be used to determine allowable loads for intermediate embedments and compressive strengths.
3. The tabulated load values are applicable to single anchors installed at critical edge and spacing distances of 3 times embedment and where the minimum member thickness is the greater of [h_{nom} + 1-1/4] and [h_{nom} + $2d_{bit}$].
4. The tabulated load values are applicable for dry uncracked concrete installed into holes drilled with a hammer drill and an ANSI carbide drill bit. Installations into saturated (wet) concrete or water-filled holes require a reduction in capacity for tabulated values of 15 percent or 50 percent, respectively.
5. Adhesives experience reductions in capacity at elevated temperatures. See the In-Service Temperature chart for allowable loads capacity reduction factors.
6. Allowable bond strength/concrete capacity must be checked against allowable steel strength to determine the controlling allowable load. Allowable shear capacity is controlled by allowable steel strength for the given conditions.

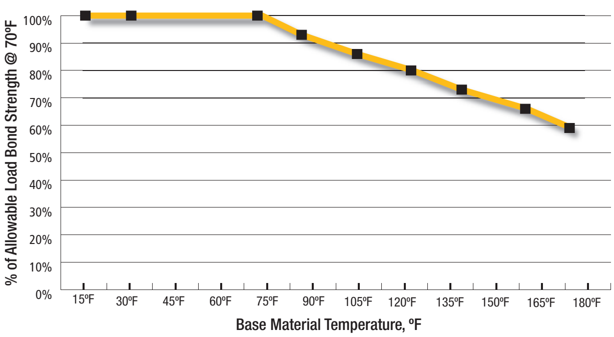
Allowable Load Capacities for Threaded Rod and Reinforcing Bar (Based on Steel Strength)[1,2,3,4]

Nominal Rod Diameter or Rebar Size (in. or No.)	Steel Elements - Threaded Rod and Reinforcing Bar																	
	A36 or F1554, Grade 36		A36 or F1554, Grade 55		A193, Grade B7 or F1554, Grade 105		F593, CW (SS)		ASTM A615 Grade 40 Rebar		ASTM A615 Grade 60 Rebar		ASTM A706 Grade 60 Rebar		ASTM A615 Grade 75 Rebar		ASTM A706 Grade 80 Rebar	
	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)	Tension lbs. (kN)	Shear lbs (kN)	Tension lbs. (kN)	Shear lbs (kN)	Tension lbs. (kN)	Shear lbs (kN)
3/8 or #3	2,115 (9.4)	1,090 (4.8)	2,735 (12.2)	1,410 (6.3)	4,555 (20.3)	2,345 (10.4)	3,645 (16.2)	1,880 (8.4)	2,210 (9.8)	1,125 (5.0)	2,650 (11.8)	1,690 (7.5)	2,650 (11.8)	1,500 (6.7)	2,650 (11.8)	1,875 (8.3)	2,650 (11.8)	1,875 (8.3)
1/2 or #4	3,760 (16.7)	1,935 (8.6)	4,860 (21.6)	2,505 (11.1)	8,100 (36.0)	4,170 (18.5)	6,480 (28.8)	3,340 (14.9)	3,925 (17.5)	2,005 (8.9)	4,710 (21.0)	3,005 (13.4)	4,710 (21.0)	2,670 (11.9)	4,710 (21.0)	3,335 (14.8)	4,710 (21.0)	3,335 (14.8)
5/8 or #5	5,870 (26.1)	3,025 (13.5)	7,595 (33.8)	3,910 (17.4)	12,655 (56.3)	6,520 (29.0)	10,125 (45.0)	5,215 (23.2)	6,135 (27.3)	3,130 (13.9)	7,365 (32.8)	4,695 (20.9)	7,365 (32.8)	4,170 (18.5)	7,365 (32.8)	5,215 (23.2)	7,365 (32.8)	5,215 (23.2)
3/4 or #6	8,455 (37.6)	4,355 (19.4)	10,935 (48.6)	5,635 (25.1)	18,225 (81.1)	9,390 (41.8)	12,390 (55.1)	6,385 (28.4)	8,835 (39.3)	4,505 (20.0)	10,605 (47.2)	6,760 (30.1)	10,605 (47.2)	6,010 (26.7)	10,605 (47.2)	7,510 (33.4)	10,605 (47.2)	7,510 (33.4)
7/8 or #7	11,510 (51.2)	5,930 (26.4)	14,885 (66.2)	7,665 (34.1)	24,805 (110.3)	12,780 (56.8)	16,865 (75.0)	8,690 (38.7)	-	-	14,430 (64.2)	9,200 (40.9)	14,430 (64.2)	8,180 (36.4)	14,430 (64.2)	10,220 (45.5)	14,430 (64.2)	10,220 (45.5)
1 or #8	15,035 (66.9)	7,745 (34.5)	19,440 (86.5)	10,015 (44.5)	32,400 (144.1)	16,690 (74.2)	22,030 (98.0)	11,350 (50.5)	-	-	18,850 (83.8)	12,015 (53.4)	18,850 (83.8)	10,680 (47.5)	18,850 (83.8)	13,350 (59.4)	18,850 (83.8)	13,350 (59.4)
#9	-	-	-	-	-	-	-	-	-	-	23,985 (106.7)	15,290 (68.0)	23,985 (106.7)	13,590 (60.5)	23,985 (106.7)	16,990 (75.6)	23,985 (106.7)	16,990 (75.6)
1-1/4	23,490 (104.5)	12,100 (53.8)	30,375 (135.1)	15,645 (69.6)	50,620 (225.2)	26,080 (116.0)	34,425 (153.1)	17,735 (78.9)	-	-	-	-	-	-	-	-	-	-
#10	-	-	-	-	-	-	-	-	-	-	30,405 (135.2)	19,380 (86.2)	30,405 (135.2)	17,230 (76.6)	30,405 (135.2)	21,535 (95.8)	30,405 (135.2)	21,535 (95.8)

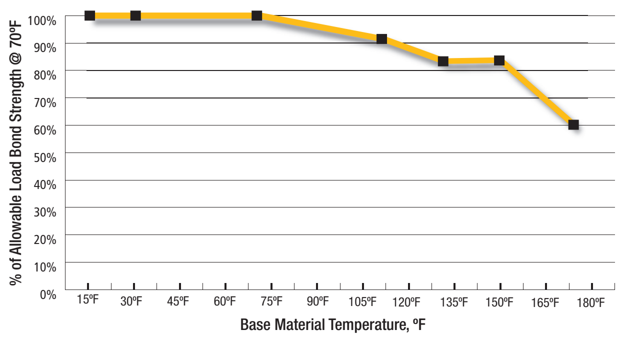
1. AISC defined steel strength (ASD) for threaded rod: Tensile = 0.33 • F_u • A_{nom}, Shear = 0.17 • F_u • A_{nom}
2. For reinforcing bars: The allowable steel tensile strength is based on 20 ksi for Grade 40 and 24 ksi for Grade 60 and higher, applied to the cross sectional area of the bar; allowable steel shear strength = 0.17 • F_u • A_{nom}
3. Allowable load capacities are calculated for the steel element type. Consideration of applying additional safety factors may be necessary depending on the application, such as life safety or overhead.
4. Allowable steel strength in tension must be checked against allowable bond strength/concrete capacity in tension to determine the controlling allowable load.

In-Service Temperature Chart For Allowable Load Capacities

Concrete Base Materials



Masonry Units

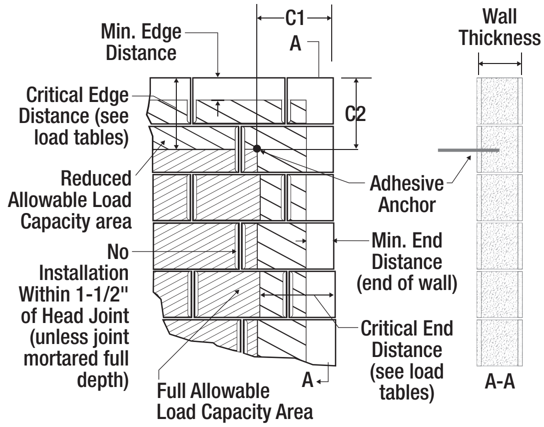


Allowable Load Capacities for Threaded Rod Installed with AC100+ Gold into Grout-Filled Concrete Masonry (Based on Bond Strength/Masonry Strength)[1,2,3,7,9,12]

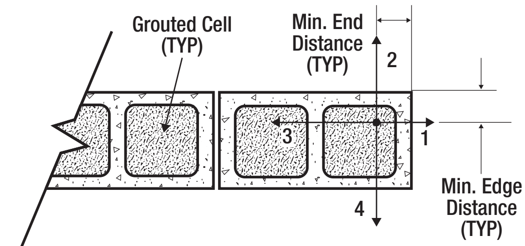
Anchor Diameter d inch	Minimum Embedment h_{nom} inch	Critical Spacing Distance s_{cr} inch	Minimum Edge Distance c_{min} inch	Minimum End Distance c_{min} inch	Tension Load lbs	Direction of Shear Loading	Shear Load lbs
Anchor Installed Into Grouted Masonry Wall Faces[4,5,6,8,10,11,13]							
3/8	3	6	3	3	615	Towards Edge/End	275
			3	3		Away From Edge/End	340
			3	4	735	Any	490
			12	12	960	Any	855
1/2	4	8	3	3	720	Towards Edge/End	430
			3	3		Away From Edge/End	1320
			4	4	960	Any	655
			12	12		Towards Edge/End	1430
			12	12		Away From Edge/End	1760
			7-3/4 (Bed Joint)	3	935	Load To Edge	460
5/8	5	10	3	3	710	Towards Edge/End	460
			3	3		Away From Edge/End	1410
			12	12	1095	Towards Edge/End	1530
			12	12		Away From Edge/End	1880
			7-3/4 (Bed Joint)	3	1030	Load To Edge	590
3/4	6	12	4	4	755	Towards Edge/End	630
			4	4		Away From Edge/End	1450
			12	12	1160	Towards Edge/End	1570
			12	12		Away From Edge/End	1930
			7-3/4 (Bed Joint)	4	945	Load To Edge	565
Anchor Installed Into Tops of Grouted Masonry Walls[14,15]							
Anchor Diameter d inch	**Minimum Embedment h_{nom} inch**	**Minimum Spacing Distance**	**Minimum Edge Distance c_{min} inch**	**Minimum End Distance c_{min} inch**	**Tension Load lbs**	**Direction of Shear Loading**	**Shear Load lbs**
1/2	2-3/4		1-3/4	4	595	Any	300
	4	1 anchor per cell		3	520	Load To Edge	190
	4			3		Load To End	300
	10	1 anchor per block		10-1/2	1670	Load To Edge	190
	10			10-1/2		Load To End	300
5/8	5	1 anchor per cell		3	745	Load To Edge	240
	5			3		Load To End	300
	12-1/2	1 anchor per block	1-3/4	10-1/2	2095	Load To Edge	240
	12-1/2			10-1/2		Load To End	300
3/4	6	1 anchor per cell		4	1260	Load To Edge	410
	6			4		Load To End	490

1. Tabulated load values are for anchors installed in nominal 8-inch wide (203 mm) Grade N, Type II, lightweight, medium-weight or normal-weight grout filled concrete masonry units with a minimum masonry strength, f'm, of 1,500 psi (10.3 MPa) conforming to ASTM C90. If the specified compressive strength of the masonry, f'm, is 2,000 psi (13.8 MPa) minimum the tabulated values may be increased by 4 percent (multiplied by 1.04).
2. Allowable bond or masonry strengths in tension and shear are calculated using a safety factor of 5.0 and must be checked against the allowable tension and shear capacities for threaded rod based on steel strength to determine the controlling factor. See allowable load table based on steel strength.
3. Embedment is measured from the outside surface of the concrete masonry unit to the embedded end of the anchor.
4. Anchors may be installed in the grouted cells, cell webs and bed joints not closer than 1-1/2-inch from the vertical mortar joint (head joint) provided the minimum edge and end distances are maintained. Anchors may be placed in the head joint if the vertical joint is mortared full-depth.
5. A maximum of two anchors may be installed in a single masonry cell in accordance with the spacing and edge or end distance requirements.
6. The critical spacing, s_{cr}, for use with the anchor values shown in this table is 16 anchor diameters. The critical spacing, s_{cr}, distance is the distance where the full load values in the table may be used. The minimum spacing distance, s_{min}, is the minimum anchor spacing for which values are available and installation is permitted. For 3/8-inch diameter anchors, the spacing may be reduced to 8 anchor diameters when using a tension reduction factor of 0.70 and a shear reduction factor of 0.45. For 1/2-inch and 5/8-inch diameter anchors, the spacing may be reduced to 8 anchor diameters when using a tension reduction factor of 0.85 and a shear reduction factor of 0.45. For 3/4-inch diameter anchors, the spacing may be reduced to 8 anchor diameters when using a tension reduction factor of 1.00 and a shear reduction factor of 0.45.
7. Spacing distance is measured from the centerline to centerline between two anchors.
8. The minimum edge or end distance, c_{min}, is the minimum distance for which values are available and installation is permitted.
9. Edge or end distance is measured from anchor centerline to the closest unrestrained edge.
10. Linear interpolation of load values between the minimum spacing, s_{min}, and critical spacing, s_{cr}, distances and between minimum edge or end distance, c_{min} is permitted.
11. The tabulated values are applicable for anchors in the ends of grout-filled concrete masonry units where minimum edge and end distances are maintained.
12. The tabulated values must be adjusted for increased in-service base material temperatures in accordance with the In-Service Temperature chart, as applicable.
13. Concrete masonry width (wall thickness) must be equal to or greater than 1.5 times the anchor embedment depth (e.g. 3/8-inch and 1/2-inch diameter anchors are permitted in nominally 6-inch-thick concrete masonry). The 5/8-inch and 3/4-inch diameter anchors must be installed in minimum nominally 8-inch-thck concrete masonry.
14. Anchors must be installed into the grouted cell; anchors are not permitted to be installed in a head joint, flange or web of the concrete masonry unit.
15. Allowable shear loads parallel or perpendicular to the edge of a masonry wall may be applied in or out of plane.

AC100+ Gold Adhesive Anchors Installed into Grouted Concrete Masonry Wall

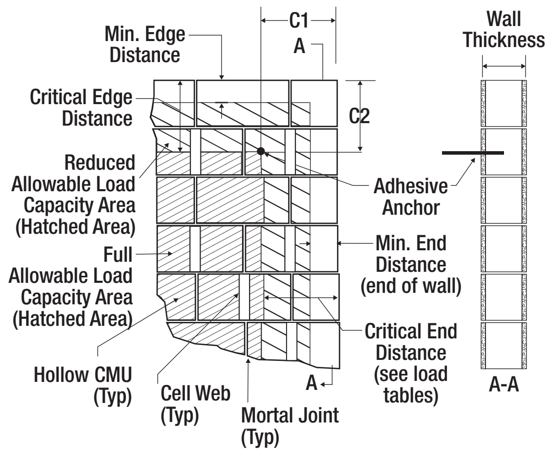


AC100+ Gold Adhesive Anchors Installed into Top of Grouted Concrete Masonry Wall

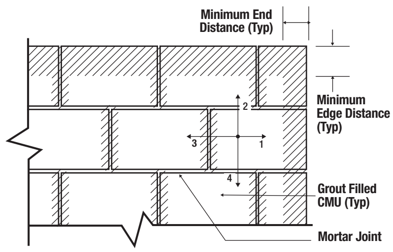


1. Shear load parallel to Edge and perpendicular to End
2. Shear load parallel to End and perpendicular to Edge
3. Shear load parallel to Edge and perpendicular away from End
4. Shear load parallel to End and perpendicular to opposite Edge

AC100+ Gold Adhesive Anchors Installed into Hollow Concrete Masonry Wall



Direction of Shear Loading in Relation to Edge and End of Masonry Wall



1. Shear load parallel to Edge and perpendicular to End
2. Shear load parallel to End and perpendicular to Edge
3. Shear load parallel to Edge and perpendicular away from End
4. Shear load parallel to End and perpendicular away from Edge

Allowable Load Capacities for Threaded Rod Installed with AC100+ Gold into Hollow Concrete Masonry Walls with Stainless Steel and Plastic Screen Tubes[1,2,3,4,5,6,7,8,9,10,11,12,13]

Anchor Diameter d inch	Screen Tube type	Minimum Embedment h_{nom} inch	Critical Spacing Distance s_{cr} inch	Minimum Edge Distance c_{min} inch	Minimum End Distance c_{min} inch	Allowable Load		
						Tension Load lbs	Direction of Shear Loading	Shear Load lbs
1/4	Stainless Steel	1-1/4	4	1-1/2	1-1/2	280	Towards Edge/End	140
				1-1/2	1-1/2		Away From Edge/End	235
				3	3	350	Towards Edge/End	275
				3	3		Away From Edge/End	465
3/8	Stainless Steel	1-1/4	6	1-7/8	1-7/8	320	Towards Edge/End	145
				1-7/8	1-7/8		Away From Edge/End	245
				3-3/4	3-3/4	400	Towards Edge/End	290
				3-3/4	3-3/4		Away From Edge/End	490
	Plastic	1-1/4	1 anchor per cell	3	3	140	Towards Edge/End	235
1/2	Stainless Steel	1-1/4	8	3-3/4	3-3/4	380	Towards Edge/End	215
				3-3/4	3-3/4		Away From Edge/End	365
				11-1/4	11-1/4	400	Towards Edge/End	430
				11-1/4	11-1/4		Away From Edge/End	730
	Plastic	1-1/4	1 anchor per cell	3	3	150	Towards Edge/End	215
5/8	Stainless Steel	1-1/4	8	3-3/4	3-3/4	380	Towards Edge/End	215
				3-3/4	3-3/4		Away From Edge/End	365
				11-1/4	11-1/4	400	Towards Edge/End	430
				11-1/4	11-1/4		Away From Edge/End	730
	Plastic	1-1/4	1 anchor per cell	3	3	150	Towards Edge/End	215
3/4	Stainless Steel	1-1/4	8	3-3/4	3-3/4	380	Towards Edge/End	215
				3-3/4	3-3/4		Away From Edge/End	365
				11-1/4	11-1/4	400	Towards Edge/End	430
				11-1/4	11-1/4		Away From Edge/End	730

1. Tabulated load values are for anchors installed in hollow concrete masonry with minimum masonry strength, f'm, of 1,500 psi (10.3 MPa). Concrete masonry units must be lightweight, medium-weight or normal-weight conforming to ASTM C90. Allowable loads have been calculated using a safety factor of 5.0.
2. Anchors must be installed into the hollow cell; anchors are not permitted to be installed in a mortar joint, flange or web of the concrete masonry unit.
3. A maximum of two anchor may be installed in a single masonry cell in accordance with the spacing and edge distance requirements, except as noted in the table.
4. Embedment is measured from the outside surface of the concrete masonry unit to the embedded end of the anchor.
5. Edge or end distance is measured from anchor centerline to the closest unrestrained edge of the CMU block.
6. The critical spacing, s_{cr}, for use with the anchor values shown in this table is 16 anchor diameters, except as noted in the table. The critical spacing, s_{cr}, distance is the distance where the full load values in the table may be used. The minimum spacing distance, s_{min}, is the minimum anchor spacing for which values are available and installation is permitted. The spacing may be reduced to 8 anchor diameters by multiplying the tension load value by a reduction factor of 0.60 and multiplying the shear load value by a reduction factor of 0.45.
7. Spacing distance is measured from the centerline to centerline between two anchors.
8. Linear interpolation of load values between the minimum spacing, s_{min}, and critical spacing, s_{cr}, distances and between minimum edge or end distance, c_{min}, is permitted if applicable.
9. Concrete masonry width (wall thickness) may be minimum nominal 6-inch-thick provided the minimum embedment (i.e. face shell thickness) is maintained.
10. The tabulated values are applicable for anchors in the ends of hollow concrete masonry units where minimum face shell thickness, minimum edge and end distances are maintained.
11. Anchors are recognized to resist dead, live and wind loads.
12. Allowable loads must be the lesser of the adjusted masonry or bond values tabulated above and the steel strength values.
13. The tabulated values must be adjusted for increased in-service base material temperatures in accordance with the In-Service Temperature chart, as applicable.

Ultimate and Allowable Load Capacities for AC100+ Gold into Precast Hollow Core Concrete with Threaded Rod and Stainless Steel Screen Tubes[1,2,3,4,5,6,7]

Anchor Diameter d in.	Drill Bit Diameter d_{bit} in.	Minimum Embedment h_{nom} in. (mm)	Minimum End Distance in. (mm)	Minimum Edge Distance in. (mm)	Ultimate Load		Allowable Load	
					Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
1/4	3/8	1-1/2 (38)	4 (102)	4 (102)	900 (4.0)	1,550 (6.9)	180 (0.8)	310 (1.4)
3/8	1/2	1-1/2 (38)	6 (152)	6 (152)	1,975 (8.8)	3,650 (16.2)	395 (1.8)	730 (3.2)
1/2	5/8	1-1/2 (38)	8 (203)	8 (203)	4,400 (19.6)	5,875 (26.1)	880 (3.9)	1,175 (5.2)

1. Tabulated load values are for anchors installed in precast hollow core concrete with minimum strength, f'm, of 5,000 psi (34.5 MPa). Allowable loads have been calculated using a safety factor of 5.0. The allowable load capacities may be increased by a factor of $(f'_c / 5000)^{0.13}$ for concrete compressive strength between 5,000 psi and 8000 psi.
2. Anchors must be installed into the hollow core; anchors are not permitted to be installed in a cell web of the hollow core concrete member.
3. Embedment is measured from the outside surface of the concrete masonry unit to the embedded end of the anchor.
4. Edge or end distance is measured from anchor centerline to the closest unrestrained edge of the concrete member.
5. The tabulated values are for anchors installed at a minimum of 16 anchor diameters on center for 100 percent capacity. Spacing distance is measured from the centerline to centerline between two anchors.
6. Allowable loads must be the lesser of the adjusted masonry or bond values tabulated above and the steel strength values.
7. The tabulated values must be adjusted for increased in-service base material temperatures in accordance with the In-Service Temperature chart, as applicable.

Ultimate and Allowable Load Capacities for Threaded Rod Installed with AC100+ Gold into Brick Masonry Walls[1,2,3,4]

Anchor Diameter d in.	Drill Diameter d_{bit} in.	Minimum Embedment h_{nom} in. (mm)	Minimum End Distance in. (mm)	Minimum Edge Distance in. (mm)	Ultimate Load		Allowable Load	
					Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
Anchors Installed into the Face of Brick Masonry Walls								
3/8	1/2	3-1/2 (89)	2-1/2 (64)	2-1/2 (64)	3,600 (16.0)	4,505 (20.0)	720 (3.2)	900 (4.0)
		3-1/2 (89)	6 (152)	6 (152)	5,845 (26.0)	4,580 (20.4)	1,170 (5.2)	915 (4.1)
		6 (152)	6 (152)	6 (152)	10,420 (46.4)	4,580 (20.4)	2,085 (9.3)	915 (4.1)
1/2	5/8	6 (152)	8 (203)	8 (203)	11,500 (51.2)	9,300 (41.4)	2,300 (10.2)	1,860 (8.3)
5/8	3/4	3-1/8 (79)	9-1/2 (241)	9-1/2 (241)	4,715 (21.0)	7,700 (34.3)	945 (4.2)	1,540 (6.6)
		6 (152)	9-1/2 (241)	9-1/2 (241)	9,925 (44.2)	7,700 (34.3)	1,985 (8.8)	1,540 (6.6)
Anchors Installed into the Top of Brick Masonry Walls								
3/8	1/2	3-1/2 (89)	2-1/2 (64)	2-1/2 (64)	3,665 (16.3)	2,435 (10.8)	735 (3.3)	485 (2.2)

1. Tabulated load values are for anchors installed in minimum 2 wythe, Grade SW, solid clay brick masonry conforming to ASTM C 62. Mortar and minimum mortar strength must meet Type N, S or M.
2. Allowable loads are calculated using an applied safety factor or 5.0. Consideration of safety factors of 10 or higher may be necessary depending on the application, such as life safety.
3. Allowable loads apply to installations in the face of brick or mortar joint. The tabulated values are for anchors installed at a minimum of 16 anchor diameters on center for 100 percent capacity.
4. The tabulated values must be adjusted for increased in-service base material temperatures in accordance with the In-Service Temperature chart, as applicable.

Allowable Load Capacities AC100+ Gold with for Threaded Rods and Reinforcing Bars or Rebar Dowel Installed in Unreinforced Masonry Walls with Stainless Steel Screen Tubes[1,2] (Retrofit Bolt Anchors in URM Walls with Low Minimum Mortar Strengths)

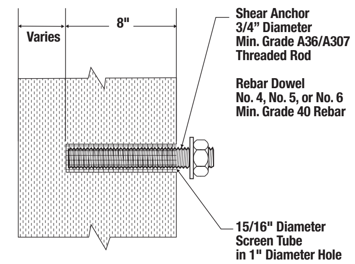


Figure 1

Shear Anchor – Configuration A (See Figure 1)

Rod Dia. or Rebar Size d in.	Minimum Embed. h_{nom} in. (mm)	Minimum Wall Thickness in. (mm)	Allowable Tension lbs. (kN)	Allowable Shear lbs. (kN)
3/4	8 (203)	13 (330)	See note 3	1,000 (4.5)
No. 4	8 (203)	13 (330)	See note 3	500 (2.3)
No. 5	8 (203)	13 (330)	See note 3	750 (3.4)
No. 6	8 (203)	13 (330)	See note 3	1,000 (4.5)

1. Allowable load values are applicable only where in-place shear tests indicate minimum mortar strength of 35 psi net.
2. The anchors installed in unreinforced brick walls are limited to resisting seismic or wind loads only.
3. Tension loading for these anchors is outside the scope of ICC-ES ESR-4105 and AC60.

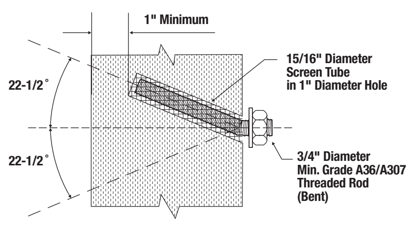


Figure 2

22-1/2° Combination Anchor – Configuration B (See Figure 2)

Rod Dia. d in.	Minimum Embed. h_{nom} in. (mm)	Minimum Wall Thickness in. (mm)	Allowable Tension lbs. (kN)	Allowable Shear lbs. (kN)
3/4	Within 1 inch (25mm) of opposite wall surface	13 (330)	1,200 (5.4)	1,000 (4.5)

1. Allowable load values are applicable only where in-place shear tests indicate minimum mortar strength of 35 psi net.
2. The anchors installed in unreinforced brick walls are limited to resisting seismic or wind loads only.

Anchor Description	Minimum Vertical Spacing in.	Minimum Horizontal Spacing in.	Minimum Edge Distance in.
Shear Anchor - Configuration A (See Figure 1)	16	16	16
22-1/2° Combination Anchor - Configuration B (See Figure 2)	16	16	16

STRENGTH DESIGN INFORMATION

Steel Tension and Shear Design for Threaded Rod in Normal Weight Concrete

CODE LISTED
ICC-ES ESR-2582

STRENGTH DESIGN TABLES

Design Information		Symbol	Units	Nominal Rod Diameter[1] (inch)						
				3/8	1/2	5/8	3/4	7/8	1	1-1/4
Threaded rod nominal outside diameter		d_a	inch (mm)	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)
Threaded rod effective cross-sectional area		A_{se}	inch² (mm²)	0.0775 (50)	0.1419 (92)	0.2260 (146)	0.3345 (216)	0.4617 (298)	0.6057 (391)	0.9691 (625)
ASTM A36 and ASTM F1554 Grade 36	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lbf (kN)	4,495 (20.0)	8,230 (36.6)	13,110 (58.3)	19,400 (86.3)	26,780 (119.1)	35,130 (156.3)	56,210 (250.0)
		V_{sa}	lbf (kN)	2,695 (12.0)	4,940 (22.0)	7,860 (35.0)	11,640 (51.8)	16,070 (71.4)	21,080 (93.8)	33,725 (150.0)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.80	0.80	0.80	0.80	0.80	0.80	0.80
	Strength reduction factor for tension[2]	ϕ	-	0.75						
	Strength reduction factor for shear[2]	ϕ	-	0.65						
ASTM F1554 Grade 55	Nominal strength as governed by steel strength(for a single anchor)	N_{sa}	lbf (kN)	5,810 (25.9)	10,640 (47.3)	16,950 (75.4)	25,085 (111.6)	34,625 (154.0)	45,425 (202.0)	72,680 (323.3)
		v_{sa}	lbf (kN)	3,485 (15.5)	6,385 (28.4)	10,170 (45.2)	15,050 (67.0)	20,775 (92.4)	27,255 (121.2)	43,610 (194.0)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.80	0.80	0.80	0.80	0.80	0.80	0.80
	Strength reduction factor for tension[2]	ϕ	-	0.75						
	Strength reduction factor for shear[2]	ϕ	-	0.65						
ASTM A193 Grade B7 and ASTM F1554 Grade 105	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lbf (kN)	9,685 (43.1)	17,735 (78.9)	28,250 (125.7)	41,810 (186.0)	57,710 (256.7)	75,710 (336.8)	121,135 (538.8)
		V_{sa}	lbf (kN)	5,815 (25.9)	10,640 (7.3)	16,950 (75.4)	25,085 (111.6)	34,625 (154.0)	45,425 (202.1)	72,680 (323.3)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.80	0.80	0.80	0.80	0.80	0.80	0.80
	Strength reduction factor for tension[2]	ϕ	-	0.75						
	Strength reduction factor for shear[2]	ϕ	-	0.65						
ASTM A449	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lbf (kN)	9,300 (41.4)	17,025 (75.7)	27,120 (120.6)	40,140 (178.5)	55,905 (248.7)	72,685 (323.3)	101,755 (452.6)
		V_{sa}	lbf (kN)	5,580 (24.8)	10,215 (45.4)	16,270 (72.4)	24,085 (107.1)	33,540 (149.2)	43,610 (194.0)	61,050 (271.6)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.80	0.80	0.80	0.80	0.80	0.80	0.80
	Strength reduction factor for tension[2]	ϕ	-	0.75						
	Strength reduction factor for shear[2]	ϕ	-	0.65						
ASTM F593 CW Stainless (Types 304 and 316)	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lbf (kN)	7,750 (34.5)	14,190 (63.1)	22,600 (100.5)	28,430 (126.5)	39,245 (174.6)	51,485 (229.0)	82,370 (366.4)
		V_{sa}	lbf (kN)	4,650 (20.7)	8,515 (37.9)	13,560 (60.3)	17,060 (75.9)	23,545 (104.7)	30,890 (137.4)	49,425 (219.8)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.70	0.70	0.80	0.80	0.80	0.80	0.80
	Strength reduction factor for tension[3]	ϕ	-	0.65						
	Strength reduction factor for shear[3]	ϕ	-	0.60						
ASTM A193 Grade B8/B8M, Class 1 Stainless (Types 304 and 316)	Nominal strength as governed by steel strength (for a single anchor)[4]	N_{sa}	lbf (kN)	4,420 (19.7)	8,090 (36.0)	12,880 (57.3)	19,065 (84.8)	26,315 (117.1)	34,525 (153.6)	55,240 (245.7)
		V_{sa}	lbf (kN)	2,650 (11.8)	4,855 (21.6)	7,730 (34.4)	11,440 (50.9)	15,790 (70.2)	20,715 (92.1)	33,145 (147.4)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.70	0.70	0.80	0.80	0.80	0.80	0.80
	Strength reduction factor for tension[2]	ϕ	-	0.75						
	Strength reduction factor for shear[2]	ϕ	-	0.65						
ASTM A193 Grade B8/ B8M2, Class 2B Stainless (Types 304 and 316)	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lbf (kN)	7,365 (32.8)	13,480 (60.0)	21,470 (95.5)	31,775 (141.3)	43,860 (195.1)	57,545 (256.0)	92,065 (409.5)
		V_{sa}	lbf (kN)	4,420 (19.7)	8,085 (36.0)	12,880 (57.3)	19,065 (84.8)	26,315 (117.1)	34,525 (153.6)	55,240 (245.7)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.70	0.70	0.80	0.80	0.80	0.80	0.80
	Strength reduction factor for tension[2]	ϕ	-	0.75						
	Strength reduction factor for shear[2]	ϕ	-	0.65						

For SI: 1 inch = 25.4 mm, 1 lbf = 4.448 N. For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf.

1. Values provided for steel element material types are based on minimum specified strengths and calculated in accordance with ACI 318-19 Eq. 17.6.1.2 and Eq. 17.7.1.2(b), ACI 318-14 Eq. 17.4.1.2 and Eq. 17.5.1.2b or ACI 318-11 Eq. (D-2) and Eq. (D-29), as applicable, except where noted. Nuts and washers must be appropriate for the rod. Nuts must have specified proof load stresses equal to or greater than the minimum tensile strength of the specified threaded rod.
2. The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318 (-19 or -14) 5.3 or ACI 318-11 9.2, as applicable, are used in accordance with ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318 D.4.4. Values correspond to ductile steel elements.
3. The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318 (-19 or -14) 5.3 or ACI 318-11 9.2, as applicable, are used in accordance with ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318 D.4.4. Values correspond to brittle steel elements
4. In accordance with ACI 318-19 Eq. 17.6.1.2 and Eq. 17.7.1.2(b), ACI 318-14 17.4.1.2 and 17.5.1.2 or ACI 318-11 D.5.1.2 and D.6.1.2, as applicable, the calculated values for nominal tension and shear strength for ASTM A193 Grade B8/B8M Class 1 stainless steel threaded rods are based on limiting the specified tensile strength of the anchor steel to $1.9f_y$ or 57,000 psi (393 MPa).

Steel Tension and Shear Design for Reinforcing Bars in Normal Weight Concrete

CODE LISTED
ICC-ES ESR-2582

STRENGTH DESIGN TABLES

Design Information		Symbol	Units	Nominal Reinforcing Bar Size (Rebar)[1]							
				No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10
Rebar nominal outside diameter		d_a	inch (mm)	0.375 (9.5)	0.500 (12.7)	0.625 (15.9)	0.750 (19.1)	0.875 (22.2)	1.000 (25.4)	1.125 (28.7)	1.250 (32.3)
Rebar effective cross-sectional area		A_{se}	$inch^2$ (mm^2)	0.110 (71.0)	0.200 (129.0)	0.310 (200.0)	0.440 (283.9)	0.600 (387.1)	0.790 (509.7)	1.000 (645.2)	1.270 (819.4)
ASTM A615 Grade 75	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lbf (kN)	11,000 (48.9)	20,000 (89.0)	31,000 (137.9)	44,000 (195.7)	60,000 (266.9)	79,000 (351.4)	100,000 (444.8)	127,000 (564.9)
		V_{sa}	lbf (kN)	6,600 (29.4)	12,000 (53.4)	18,600 (82.7)	26,400 (117.4)	36,000 (160.1)	47,400 (210.8)	60,000 (266.9)	76,200 (338.9)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.70	0.70	0.80	0.80	0.80	0.80	0.80	0.80
	Strength reduction factor for tension[3]	ϕ	-	0.65							
	Strength reduction factor for shear[3]	ϕ	-	0.60							
ASTM A615 Grade 60	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lbf (kN)	9,900 (44.0)	18,000 (80.1)	27,900 (124.1)	39,600 (176.1)	54,000 (240.2)	71,100 (316.3)	90,000 (400.3)	114,300 (508.4)
		V_{sa}	lbf (kN)	5,940 (26.4)	10,800 (48.0)	16,740 (74.5)	23,760 (105.7)	32,400 (144.1)	42,660 (189.8)	54,000 (240.2)	68,580 (305.0)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.70	0.70	0.80	0.80	0.80	0.80	0.80	0.80
	Strength reduction factor for tension[3]	ϕ	-	0.65							
	Strength reduction factor for shear[3]	ϕ	-	0.60							
ASTM A706 Grade 60	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lbf (kN)	8,800 (39.1)	16,000 (71.2)	24,800 (110.3)	35,200 (156.6)	48,000 (213.5)	63,200 (281.1)	80,000 (355.9)	101,600 (452.0)
		V_{sa}	lbf (kN)	5,280 (23.5)	9,600 (42.7)	14,880 (66.2)	21,120 (94.0)	28,800 (128.1)	37,920 (168.7)	48,000 (213.5)	60,960 (271.2)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.70	0.70	0.80	0.80	0.80	0.80	0.80	0.80
	Strength reduction factor for tension[2]	ϕ	-	0.75							
	Strength reduction factor for shear[2]	ϕ	-	0.65							
ASTM A615 Grade 40	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lbf (kN)	6,600 (29.4)	12,000 (53.4)	18,600 (82.7)	26,400 (117.4)	In accordance with ASTM A 615, Grade 40 bars are furnished only in sizes No. 3 through No. 6			
		V_{sa}	lbf (kN)	3,960 (17.6)	7,200 (32.0)	11,160 (49.6)	15,840 (70.5)				
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.70	0.70	0.80	0.80				
	Strength reduction factor for tension[3]	ϕ	-	0.65							
	Strength reduction factor for shear[3]	ϕ	-	0.60							

1. Values provided for reinforcing bar material types based on minimum specified strengths and calculated in accordance with ACI 318-19 Eq. 17.6.1.2 and Eq. 17.7.1.2(b), ACI 318-14 Eq. 17.4.1.2 and Eq. 17.5.1.2b or ACI 318-11 Eq. (D-2) and Eq. (D-29), as applicable.
2. The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318 (-19 or -14) 5.3 or ACI 318-11 9.2, as applicable, are used in accordance with ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318 D.4.4. Values correspond to ductile steel elements. In accordance with ACI 318-19 17.10.5.3(a)(vi), ACI 318-14 17.2.3.4.3(a)(vi) or ACI 318-11 D.3.3.4.3(a)6, as applicable, deformed reinforcing bars meeting this specification used as ductile steel elements to resist earthquake effects shall be limited to reinforcing bars satisfying the requirements of ACI 318-19 20.2.2, ACI 318-14 20.2.2.4 and 20.2.2.5 or ACI 318-11 21.1.5.2 (a) and (b), as applicable.
3. The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318 (-19 or -14) 5.3 or ACI 318-11 9.2, as applicable, are used in accordance with ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318 D.4.4. Values correspond to brittle steel elements.

Concrete Breakout Design Information for Threaded Rod and Reinforcing Bars

CODE LISTED ICC-ES ESR-2582

Design Information	Symbol	Units	Nominal Rod Diameter (inch) / Reinforcing Bar Size							
			3/8 or #3	1/2 or #4	5/8 or #5	3/4 or #6	7/8 or #7	1 or #8	#9	1-1/4 or #10
Effectiveness factor for cracked concrete	$k_{c,cr}$	- (SI)	Not Applicable	17 (7.1)						
Effectiveness factor for uncracked concrete	$k_{c,uncr}$	- (SI)	24 (10.0)							
Minimum embedment	$h_{ef,min}$	inch (mm)	2-3/8 (60)	2-3/4 (70)	3-1/8 (79)	3-1/2 (89)	3-1/2 (89)	4 (102)	4-1/2 (114)	5 (127)
Maximum embedment	$h_{ef,max}$	inch (mm)	4-1/2 (114)	6 (152)	7-1/2 (191)	9 (229)	10-1/2 (267)	12 (305)	13-1/2 (343)	15 (381)
Minimum anchor spacing	s_{min}	inch (mm)	1-7/8 (48)	2-1/2 (64)	3-1/8 (79)	3-3/4 (95)	4-3/8 (111)	5 (127)	5-5/8 (143)	6-1/4 (159)
Minimum edge distance[2]	c_{min}	inch (mm)	5*d* where *d* is nominal outside diameter of the anchor							
Minimum edge distance, reduced[2] (45% T_{max})	$c_{min,red}$	inch (mm)	1-3/4 (45)	1-3/4 (45)	1-3/4 (45)	1-3/4 (45)	1-3/4 (45)	1-3/4 (45)	2-3/4 (70)	2-3/4 (70)
Minimum member thickness	h_{min}	inch (mm)	h_{ef} + 1-1/4 (h_{ef} + 30)		$h_{ef} + 2d_o$ where d_o is hole diameter;					
Critical edge distance—splitting (for uncracked concrete only)[3]	c_{ac}	inch	$c_{ac} = h_{ef} \cdot (\frac{\tau_{uncr}}{1160})^{0.4} \cdot [3.1\text{-}0.7 \frac{h}{h_{ef}}]$							
		(mm)	$c_{ac} = h_{ef} \cdot (\frac{\tau_{uncr}}{8})^{0.4} \cdot [3.1\text{-}0.7 \frac{h}{h_{ef}}]$							
Strength reduction factor for tension, concrete failure modes, Condition B[4]	ϕ	-	0.65							
Strength reduction factor for shear, concrete failure modes, Condition B[4]	ϕ	-	0.70							

For SI: 1 inch = 25.4 mm, 1 lbf = 4.448 N. For pound-inch units: 1 mm = 0.03937 inch, 1 N = 0.2248 lbf.

1. Additional setting information is described in the installation instructions.
2. For installation between the minimum edge distance, c_{min}, and the reduced minimum edge distance, $c_{min,red}$, the maximum torque applied must be reduced (multiplied) by a factor of 0.45.
3. $\tau_{k,uncr}$ need not be taken as greater than: $\tau_{k,uncr} = \frac{k_{uncr} \bullet \sqrt{h_{ef} \bullet f'c}}{\pi \bullet d}$ and $\frac{h}{h_{ef}}$ need not be taken as larger than 2.4.
4. Condition A requires supplemental reinforcement, while Condition B applies where supplemental reinforcement is not provided or where pryout governs, as set forth in ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318 (-19 or -14) 5.3 or ACI 318-11 9.2, as applicable, are used in accordance with ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318 D.4.4.

Bond Strength Design Information for Threaded Rods

Design Information		Symbol	Units	Nominal Rod Diameter (Inch) / Reinforcing Bar Size						
				3/8	1/2	5/8	3/4	7/8	1	1-1/4
Minimum embedment		$h_{ef,min}$	inch (mm)	2-3/8 (60)	2-3/4 (70)	3-1/8 (79)	3-1/2 (89)	3-1/2 (89)	4 (102)	5 (127)
Maximum embedment		$h_{ef,max}$	inch (mm)	4-1/2 (114)	6 (152)	7-1/2 (191)	9 (229)	10-1/2 (267)	12 (305)	15 (381)
Temperature Range A 122°F (50°C) Maximum Long-Term Service Temperature; 176°F (80°C) Maximum Short-Term Service Temperature[3,4]	Characteristic bond strength in cracked concrete[4,7]	$\tau_{k,cr}$	psi (N/mm²)	Not Applicable	498 (3.4)	519 (3.6)	519 (3.6)	519 (3.6)	519 (3.6)	525 (3.6)
	Characteristic bond strength in uncracked concrete[4,8]	$\tau_{k,uncr}$	psi (N/mm²)	823 (5.7)	823 (5.7)	823 (5.7)	823 (5.7)	823 (5.7)	743 (5.1)	588 (4.1)
									Not applicable in water-filled hole installation condition	
Temperature Range B 162°F (72°C) Maximum Long-Term Service Temperature; 248°F (120°C) Maximum Short-Term Service Temperature[3,4]	Characteristic bond strength in cracked concrete[4,7]	$\tau_{k,cr}$	psi (N/mm²)	Not Applicable	245 (1.7)	255 (1.8)	255 (1.8)	255 (1.8)	255 (1.8)	255 (1.8)
	Characteristic bond strength in uncracked concrete[4,8]	$\tau_{k,uncr}$	psi (N/mm²)	405 (2.8)	405 (2.8)	405 (2.8)	405 (2.8)	405 (2.8)	366 (2.5)	Not Applicable
								Not applicable in water-filled hole installation condition		
Permissible installation conditions[6]	Dry concrete	Anchor Category	-	1						
		ϕ_d	-	0.65						
	Water-saturated concrete	Anchor Category	-	2						
		ϕ_{ws}	-	0.55						
	Water-filled hole (flooded)	Anchor Category	-	3						
		ϕ_{wf}	-	0.45						
		κ_{wf}		0.78				0.70	0.69	0.67
Reduction factor for seismic tension		$\alpha_{N,seis}$	-	0.95						

For SI: 1 inch = 25.4 mm, 1 psi = 0.006894 MPa. For pound-inch units: 1 mm = 0.03937 inch, 1 MPa = 145.0 psi.

1. Bond strength values correspond to a normal-weight concrete compressive strength f'c = 2,500 psi (17.2 MPa). For concrete compressive strength, f'c between 2,500 psi and 8,000 psi (17.2 MPa and 55.2 MPa), the tabulated characteristic bond strength may be increased by a factor of $(f'c / 2{,}500)^{0.13}$ [For SI: $(f'c / 17.2)^{0.13}$].
2. The modification factor for bond strength of adhesive anchors in lightweight concrete shall be taken as given in ACI 318-19 17.2.4.1, ACI 318-14 17.2.6 where applicable.
3. Long-term and short-term temperatures meet the requirements of Section 8.5 of ACI 355.4 and Table 9.1, Temperature Category A.
4. Short-term base material service temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling. Long-term base material service temperatures are roughly constant over significant periods of time.
5. Characteristic bond strengths are for sustained loads including dead and live loads. Characteristic bond strengths are also applicable to short-term loading. For load combinations consisting of short-term loads only such as wind and seismic, bond strengths may be increased by 43 percent for Temperature Range A and 122 percent for Temperature Range B.
6. Permissible installation conditions include dry concrete, water-saturated concrete and water-filled holes. Water-filled holes include applications in dry or water-saturated concrete where the drilled holes contain standing water at the time of anchor installation.
7. For structures assigned to Seismic Design Categories C, D, E or F, the tabulated bond strength values for cracked concrete must be adjusted by an additional reduction factor, $\alpha_{N,seis}$, as given in this table.
8. Bond strength values for uncracked concrete are applicable for structures assigned to Seismic Design Categories A and B only.

Bond Strength Design Information for Reinforcing Bar

Design Information		Symbol	Units	Nominal Rod Diameter (Inch) / Reinforcing Bar Size							
				#3	#4	#5	#6	#7	#8	#9	#10
Minimum embedment		$h_{ef,min}$	inch (mm)	2-3/8 (60)	2-3/4 (70)	3-1/8 (79)	3-1/2 (89)	3-1/2 (89)	4 (102)	4-1/2 (114)	5 (127)
Maximum embedment		$h_{ef,max}$	inch (mm)	4-1/2 (114)	6 (152)	7-1/2 (191)	9 (229)	10-1/2 (267)	12 (305)	13-1/2 (343)	15 (381)
Temperature Range A 122°F (50°C) Maximum Long-Term Service Temperature; 176°F (80°C) Maximum Short-Term Service Temperature[3,4]	Characteristic bond strength in cracked concrete[4,7]	$\tau_{k,cr}$	psi (N/mm²)	Not Applicable	331 (2.3)	345 (2.4)	345 (2.4)	345 (2.4)	345 (2.4)	349 (2.4)	349 (2.4)
	Characteristic bond strength in uncracked concrete[4,8]	$\tau_{k,uncr}$	psi (N/mm²)	823 (5.7)	823 (5.7)	823 (5.7)	823 (5.7)	823 (5.7)	743 (5.1) Not applicable in water-filled hole installation condition	655 (4.5)	588 (4.1)
Temperature Range B 162°F (72°C) Maximum Long-Term Service Temperature; 248°F (120°C) Maximum Short-Term Service Temperature[3,4]	Characteristic bond strength in cracked concrete[4,7]	$\tau_{k,cr}$	psi (N/mm²)	Not Applicable	163 (1.1)	170 (1.2)	170 (1.2)	170 (1.2)	170 (1.2)	170 (1.2)	170 (1.2)
	Characteristic bond strength in uncracked concrete[4,8]	$\tau_{k,uncr}$	psi (N/mm²)	405 (2.8)	405 (2.8)	405 (2.8)	405 (2.8)	405 (2.8) Not applicable in water-filled hole installation condition	366 (2.5)	329 (2.3)	Not Applicable
Permissible installation conditions[6]	Dry concrete	Anchor Category	-	1							
		ϕ_d	-	0.65							
	Water-saturated concrete	Anchor Category	-	2							
		ϕ_{ws}	-	0.55							
	Water-filled hole (flooded)	Anchor Category	-	3							
		ϕ_{wf}	-	0.45							
		κ_{wf}		0.78				0.70	0.69	0.68	0.67
Reduction factor for seismic tension		$\alpha_{N,seis}$	-	1.0							

For SI: 1 inch = 25.4 mm, 1 psi = 0.006894 MPa. For pound-inch units: 1 mm = 0.03937 inch, 1 MPa = 145.0 psi.

1. Bond strength values correspond to a normal-weight concrete compressive strength f'c = 2,500 psi (17.2 MPa). For concrete compressive strength, f'c between 2,500 psi and 8,000 psi (17.2 MPa and 55.2 MPa), the tabulated characteristic bond strength may be increased by a factor of $(f'c / 2{,}500)^{0.13}$ [For SI: $(f'c / 17.2)^{0.13}$].
2. The modification factor for bond strength of adhesive anchors in lightweight concrete shall be taken as given in ACI 318-19 17.2.4.1, ACI 318-14 17.2.6 where applicable.
3. Long-term and short-term temperatures meet the requirements of Section 8.5 of ACI 355.4 and Table 9.1, Temperature Category A.
4. Short-term base material service temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling. Long-term base material service temperatures are roughly constant over significant periods of time.
5. Characteristic bond strengths are for sustained loads including dead and live loads. Characteristic bond strengths are also applicable to short-term loading. For load combinations consisting of short-term loads only such as wind and seismic, bond strengths may be increased by 43 percent for Temperature Range A and 122 percent for Temperature Range B.
6. Permissible installation conditions include dry concrete, water-saturated concrete and water-filled holes. Water-filled holes include applications in dry or water-saturated concrete where the drilled holes contain standing water at the time of anchor installation.
7. For structures assigned to Seismic Design Categories C, D, E or F, the tabulated bond strength values for cracked concrete must be adjusted by an additional reduction factor, $\alpha_{N,seis}$, as given in this table.
8. Bond strength values for uncracked concrete are applicable for structures assigned to Seismic Design Categories A and B only.

DESIGN STRENGTH TABLES (SD)

Tension and Shear Design Strength for Threaded Rod and Reinforcing Bar Installed in Uncracked Concrete (Bond or Concrete Strength) Drilled with a Hammer-Drill and Carbide Bit in a Dry Hole Condition 122°F (50°C) Maximum Long-Term Service Temperature; 176°F (80°C) Maximum Short-Term Service Temperature[1,2,3,4,5,6,7,8,9,10,11]

Nominal Rod/Rebar Size (in. or #)	Embed. Depth h_{ef} (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_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)
3/8 or #3	2-3/8	1,495	1,610	1,535	1,650	1,590	1,715	1,675	1,805	1,740	1,875
	3	1,890	2,955	1,935	3,270	2,010	3,830	2,120	4,565	2,200	4,735
	4-1/2	2,835	5,395	2,905	5,965	3,015	6,495	3,180	6,845	3,300	7,105
1/2 or #4	2-3/4	2,310	2,780	2,365	3,075	2,455	3,605	2,590	4,505	2,690	5,280
	4	3,360	5,230	3,440	5,785	3,575	6,780	3,765	8,110	3,910	8,420
	6	5,040	9,530	5,165	10,540	5,360	11,545	5,650	12,170	5,865	12,630
5/8 or #5	3-1/8	3,280	3,695	3,360	4,085	3,490	4,785	3,680	5,990	3,820	7,020
	5	5,250	8,155	5,380	9,015	5,585	10,565	5,885	12,675	6,110	13,160
	7-1/2	7,880	14,850	8,065	16,420	8,375	18,035	8,825	19,015	9,165	19,735
3/4 or #6	3-1/2	4,285	4,730	4,380	5,230	4,535	6,130	4,760	7,670	4,925	8,990
	6	7,565	11,515	7,745	12,730	8,040	14,925	8,475	18,250	8,795	18,950
	9	11,345	20,970	11,615	23,190	12,060	25,975	12,710	27,380	13,195	28,420
7/8 or #7	3-1/2	4,370	4,930	4,475	5,470	4,635	6,410	4,865	8,020	5,040	9,400
	7	10,295	14,500	10,540	16,035	10,940	18,795	11,535	23,510	11,975	25,790
	10-1/2	15,440	26,410	15,810	29,210	16,415	34,235	17,300	37,265	17,960	38,685
1 or #8	4	5,210	6,045	5,325	6,685	5,515	7,835	5,795	9,800	6,000	11,490
	8	12,140	17,000	12,430	18,800	12,905	22,040	13,600	27,565	14,120	30,410
	12	18,205	30,965	18,645	34,245	19,355	40,140	20,400	43,940	21,180	45,615
#9	5	5,795	6,845	5,925	7,570	6,135	8,875	6,445	11,100	6,670	13,010
	10	13,545	19,320	13,865	21,365	14,395	25,045	15,175	31,325	15,755	33,930
	15	20,315	35,195	20,800	38,920	21,595	45,620	22,760	49,025	23,630	50,895
1-1/4	5	6,575	7,695	6,720	8,510	6,955	9,975	7,305	12,480	7,565	14,625
	10	15,010	21,630	15,370	23,920	15,955	28,035	16,820	35,065	17,460	37,605
	15	22,515	39,390	23,055	43,560	23,930	51,060	25,225	54,335	26,190	56,405
#10	5	6,490	7,685	6,635	8,495	6,870	9,960	7,215	12,455	7,470	14,600
	10	15,010	21,665	15,370	23,960	15,955	28,085	16,820	35,130	17,460	37,605
	15	22,515	39,465	23,055	43,640	23,930	51,155	25,225	54,335	26,190	56,405

□ - Concrete Breakout Strength □ - Bond Strength/Pryout Strength

1. Tabular values are provided for illustration and are applicable for single anchors installed in uncracked 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 according to ACI 318 (-19 or -14), Ch.17 and ICC-ES AC308. The load level corresponding to the failure mode listed [Concrete breakout strength, bond strength/pryout strength] must be checked against the tabulated steel strength of the corresponding threaded rod or rebar size and type, the lowest load level controls.
3. Strength reduction factors (ϕ) for concrete breakout strength are based onACI 318 (-19 or -14) 5.3 for load combinations. Condition B was assumed.
4. Strength reduction factors (ϕ) for bond strength are determined from reliability testing and qualification in accordance with ICC-ES AC308 and are tabulated in this product information and in ESR-2582.
5. Tabular values are permitted for static loads only, seismic loading is not considered with these tables. Periodic special inspection must be performed where required by code, see ESR-2582 for applicable information.
6. For anchors subjected to tension resulting from sustained loading a supplemental check must be performed according to ACI 318 -19 17.5.2.2, ACI 318-14 17.3.1.2.
7. For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318 (-19 or -14), Ch.17.
8. Interpolation is not permitted to be used with the tabular values. For intermediate base material compressive strengths, please see ACI 318 (-19 or -14), Ch.17, ICC-ES AC308 and information included in this product supplement. For other design conditions including seismic considerations please see ACI 318 (-19 or -14), Ch.17 and ICC-ES AC308 and ESR-2582.
9. Long term concrete temperatures are roughly constant over significant periods of time. Short-term elevated temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.
10. The tabulated design strengths may be converted to allowable stress design values. Divide by conversion factor calculated as a weighted average of the load factors for the controlling load combination.
11. For other installation conditions such as water-saturated concrete or water-filled hole applications, see the associated strength reduction factors (ϕ) for bond strength in the determination of controlling design strength values, as applicable.

Tension and Shear Design Strength for Threaded Rod Installed in Cracked Concrete (Bond or Concrete Strength) Drilled with a Hammer-Drill and Carbide Bit in a Dry Hole Condition 122°F (50°C) Maximum Long-Term ServiceTemperature; 176°F (80°C) Maximum Short-Term Service Temperature[1,2,3,4,5,6,7,8,9,10,11,12]

Nominal Rod/Rebar Size (in.)	Embed. Depth h_{ef} (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_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)
1/2	2-3/4	1,400	1,985	1,430	2,195	1,485	2,575	1,565	3,220	1,625	3,505
	4	2,035	3,735	2,085	4,130	2,160	4,655	2,280	4,910	2,365	5,095
	6	3,050	6,570	3,125	6,730	3,245	6,985	3,420	7,365	3,550	7,645
5/8	3-1/8	2,070	2,640	2,120	2,915	2,200	3,420	2,320	4,275	2,410	5,015
	5	3,310	5,825	3,390	6,440	3,520	7,550	3,710	7,995	3,855	8,300
	7-1/2	4,970	10,605	5,085	10,955	5,280	11,375	5,565	11,990	5,780	12,445
3/4	3-1/2	2,705	3,380	2,760	3,735	2,860	4,380	3,000	5,480	3,105	6,420
	6	4,770	8,225	4,885	9,095	5,070	10,660	5,345	11,510	5,550	11,950
	9	7,155	14,980	7,325	15,780	7,605	16,380	8,015	17,265	8,320	17,925
7/8	3-1/2	2,755	3,525	2,820	3,910	2,920	4,580	3,070	5,730	3,180	6,715
	7	6,490	10,360	6,645	11,455	6,900	13,425	7,275	15,665	7,550	16,265
	10-1/2	9,735	18,865	9,970	20,865	10,350	22,295	10,910	23,500	11,325	24,395
1	4	3,640	4,320	3,720	4,775	3,855	5,595	4,045	7,000	4,190	8,205
	8	8,480	12,145	8,680	13,430	9,015	15,740	9,500	19,690	9,865	21,240
	12	12,720	22,120	13,025	24,460	13,520	28,670	14,250	30,695	14,795	31,865
1-1/4	5	5,870	5,495	6,000	6,080	6,210	7,125	6,525	8,915	6,755	10,445
	10	13,400	15,450	13,720	17,085	14,245	20,025	15,015	25,050	15,590	29,360
	15	20,100	28,135	20,585	31,115	21,370	36,470	22,525	45,620	23,385	50,365

☐ - Concrete Breakout Strength ☐ - Bond Strength/Pryout Strength

1. Tabular values are provided for illustration and are applicable for single anchors installed in cracked 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 according to ACI 318 (-19 or -14) Ch.17 and ICC-ES AC308. The load level corresponding to the failure mode listed [Concrete breakout strength, bond strength/ pryout strength] must be checked against the tabulated steel strength of the corresponding threaded rod or rebar size and type, the lowest load level controls.
3. Strength reduction factors (ϕ) for concrete breakout strength are based on ACI 318 (-19 or -14) Section 5.3 for load combinations. Condition B was assumed.
4. Strength reduction factors (ϕ) for bond strength are determined from reliability testing and qualification in accordance with ICC-ES AC308 and are tabulated in this product information and in ESR-2582.
5. Tabular values are permitted for static loads only, seismic loading is not considered with these tables. Periodic special inspection must be performed where required by code, see ESR-2582 for applicable information.
6. For anchors subjected to tension resulting from sustained loading a supplemental check must be performed according to ACI 318 -19 17.5.2.2, ACI 318-14 17.3.1.2.
7. For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318 (-19 or -14) Ch.17.
8. Interpolation is not permitted to be used with the tabular values. For intermediate base material compressive strengths, please see ACI 318 (-19 or -14) Ch.17, ICC-ES AC308 and information included in this product supplement. For other design conditions including seismic considerations please see ACI 318 (-19 or -14) Ch.17 and ICC-ES AC308 and ESR-2582.
9. Long term concrete temperatures are roughly constant over significant periods of time. Short-term elevated temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.
10. The tabulated design strengths may be converted to allowable stress design values. Divide by conversion factor calculated as a weighted average of the load factors for the controlling load combination.
11. For seismic design in accordance with ACI 318, the tabulated tension design strengths in cracked concrete for concrete breakout and bond strength must be multiplied by a factor of 0.75. In the determination of the tension design strength values in cracked concrete, the bond strength requires an additional reduction factor applied for seismic tension ($\alpha_{N,seis}$), where seismic design is applicable.
12. For other installation conditions such as water-saturated concrete or water-filled hole applications, see the associated strength reduction factors (ϕ) for bond strength in the determination of controlling design strength values, as applicable.

Tension and Shear Design Strength for Reinforcing Bar Installed in Cracked Concrete (Bond or Concrete Strength) Drilled with a Hammer-Drill and Carbide Bit in a Dry Hole Condition 122°F (50°C) Maximum Long-Term Service Temperature; 176°F (80°C) Maximum Short-Term Service Temperature[1,2,3,4,5,6,7,8,9,10,11,12]

Nominal Rod/Rebar Size (#)	Embed. Depth h_{ef} (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_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)
#4	2-3/4	930	1,985	950	2,050	990	2,130	1,040	2,245	1,080	2,330
	4	1,350	2,910	1,385	2,980	1,435	3,095	1,515	3,265	1,575	3,385
	6	2,030	4,365	2,075	4,470	2,155	4,645	2,270	4,895	2,360	5,080
#5	3-1/8	1,375	2,640	1,410	2,915	1,465	3,150	1,540	3,320	1,600	3,445
	5	2,200	4,740	2,255	4,855	2,340	5,040	2,465	5,315	2,560	5,515
	7-1/2	3,300	7,115	3,380	7,285	3,510	7,560	3,700	7,970	3,840	8,275
#6	3-1/2	1,795	3,380	1,835	3,735	1,900	4,095	1,995	4,300	2,065	4,450
	6	3,170	6,830	3,245	6,990	3,370	7,260	3,550	7,650	3,690	7,945
	9	4,755	10,240	4,870	10,490	5,055	10,890	5,330	11,475	5,530	11,915
#7	3-1/2	1,830	3,525	1,875	3,910	1,945	4,185	2,040	4,395	2,110	4,550
	7	4,315	9,295	4,420	9,515	4,585	9,880	4,835	10,415	5,020	10,810
	10-1/2	6,475	13,940	6,630	14,275	6,880	14,820	7,255	15,620	7,530	16,215
#8	4	2,420	4,320	2,475	4,775	2,560	5,515	2,690	5,795	2,785	6,000
	8	5,635	12,140	5,770	12,430	5,990	12,905	6,315	13,600	6,555	14,120
	12	8,455	18,210	8,655	18,645	8,985	19,355	9,475	20,405	9,835	21,180
#9	5	3,090	4,890	3,155	5,410	3,270	6,340	3,435	7,395	3,555	7,655
	10	7,215	13,800	7,390	15,260	7,670	16,520	8,085	17,415	8,395	18,080
	15	10,825	23,315	11,085	23,870	11,505	24,780	12,130	26,125	12,590	27,120
#10	5	3,855	5,490	3,940	6,070	4,080	7,115	4,280	8,900	4,435	9,550
	10	8,910	15,475	9,120	17,115	9,470	20,060	9,980	21,500	10,365	22,320
	15	13,365	28,190	13,685	29,470	14,205	30,595	14,975	32,250	15,545	33,480

☐ - Concrete Breakout Strength ☐ - Bond Strength/Pryout Strength

1. Tabular values are provided for illustration and are applicable for single anchors installed in cracked 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 according to ACI 318 (-19 or -14) Ch.17 and ICC-ES AC308. The load level corresponding to the failure mode listed [Concrete breakout strength, bond strength/pryout strength] must be checked against the tabulated steel strength of the corresponding threaded rod or rebar size and type, the lowest load level controls.
3. Strength reduction factors (ϕ) for concrete breakout strength are based on ACI 318 (-19 or -14) Section 5.3 for load combinations. Condition B was assumed.
4. Strength reduction factors (ϕ) for bond strength are determined from reliability testing and qualification in accordance with ICC-ES AC308 and are tabulated in this product information and in ESR-2582.
5. Tabular values are permitted for static loads only, seismic loading is not considered with these tables. Periodic special inspection must be performed where required by code, see ESR-2582 for applicable information.
6. For anchors subjected to tension resulting from sustained loading a supplemental check must be performed according to ACI 318 -19 17.5.2.2, ACI 318-14 17.3.1.2.
7. For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318 (-19 or -14) Ch.17.
8. Interpolation is not permitted to be used with the tabular values. For intermediate base material compressive strengths, please see ACI 318 (-19 or -14) Ch.17, ICC-ES AC308 and information included in this product supplement. For other design conditions including seismic considerations please see ACI 318 (-19 or -14) Ch.17 and ICC-ES AC308 and ESR-2582.
9. Long term concrete temperatures are roughly constant over significant periods of time. Short-term elevated temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.
10. The tabulated design strengths may be converted to allowable stress design values. Divide by conversion factor calculated as a weighted average of the load factors for the controlling load combination.
11. For seismic design in accordance with ACI 318, the tabulated tension design strengths in cracked concrete for concrete breakout and bond strength must be multiplied by a factor of 0.75. In the determination of the tension design strength values in cracked concrete, the bond strength requires an additional reduction factor applied for seismic tension ($\alpha_{N,seis}$), where seismic design is applicable.
12. For other installation conditions such as water-saturated concrete or water-filled hole applications, see the associated strength reduction factors (ϕ) for bond strength in the determination of controlling design strength values, as applicable.

Tension Design of Steel Elements (Steel Strength)[1,2]

Nominal Rod/Rebar Size (in. or No.)	Steel Elements - Threaded Rod and Reinforcing Bar									
	ASTM A36 and ASTM F1554 Grade 36	ASTM F1554 Grade 55	ASTM A193 Grade B7 and ASTM F1554 Grade 105	ASTM F593 CW Stainless (Types 304 and 316)	ASTM A193 Grade B8/ B8M, Class 1 Stainless (Types 304 and 316)	ASTM A193 Grade B8/ B8M2, Class 2B Stainless (Types 304 and 316)	ASTM A615 Grade 75 Rebar	ASTM A615 Grade 60 Rebar	ASTM A706 Grade 60 Rebar	ASTM A615 Grade 40 Rebar
	ϕN_{sa} Tension (lbs.)	ϕN_{sa} Tension (lbs.)	ϕN_{sa} Tension (lbs.)	ϕN_{sa} Tension (lbs.)	ϕN_{sa} Tension (lbs.)	ϕN_{sa} Tension (lbs.)	ϕN_{sa} Tension (lbs.)	ϕN_{sa} Tension (lbs.)	ϕN_{sa} Tension (lbs.)	ϕN_{sa} Tension (lbs.)
3/8 or #3	3,370	4,360	7,265	5,040	3,315	5,525	7,150	6,435	6,600	4,290
1/2 or #4	6,175	7,980	13,300	9,225	6,070	10,110	13,000	11,700	12,000	7,800
5/8 or #5	9,835	12,715	21,190	14,690	9,660	16,105	20,150	18,135	18,600	12,090
3/4 or #6	14,550	18,815	31,360	18,480	14,300	23,830	28,600	25,740	26,400	17,160
7/8 or #7	20,085	25,970	43,285	25,510	19,735	32,895	39,000	35,100	36,000	-
1 or #8	26,350	34,070	56,785	33,465	25,895	43,160	51,350	46,215	47,400	-
#9	-	-	-	-	-	-	65,000	58,500	60,000	-
1-1/4 or #10	42,160	54,510	90,850	53,540	41,430	69,050	82,550	74,295	76,200	-

■ - Steel Strength

1. Steel tensile design strength according to ACI 318 (-19 or -14) Ch.17 or ACI 318 Appendix D, $\phi N_{sa} = \phi \bullet A_{se,N} \bullet f_{uta}$.
2. The tabulated steel design strength in tension must be checked against the bond strength/concrete capacity design strength to determine the controlling failure mode, the lowest load level controls.

Shear Design of Steel Elements (Steel Strength)[1,2,3]

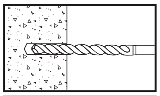
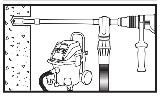
Nominal Rod/Rebar Size (in. or No.)	Steel Elements - Threaded Rod and Reinforcing Bar									
	ASTM A36 and ASTM F1554 Grade 36	ASTM F1554 Grade 55	ASTM A193 Grade B7 and ASTM F1554 Grade 105	ASTM F593 CW Stainless (Types 304 and 316)	ASTM A193 Grade B8/ B8M, Class 1 Stainless (Types 304 and 316)	ASTM A193 Grade B8/ B8M2, Class 2B Stainless (Types 304 and 316)	ASTM A615 Grade 75 Rebar	ASTM A615 Grade 60 Rebar	ASTM A706 Grade 60 Rebar	ASTM A615 Grade 40 Rebar
	ϕV_{sa} Shear (lbs.)	ϕV_{sa} Shear (lbs.)	ϕV_{sa} Shear (lbs.)	ϕV_{sa} Shear (lbs.)	ϕV_{sa} Shear (lbs.)	ϕV_{sa} Shear (lbs.)	ϕV_{sa} Shear (lbs.)	ϕV_{sa} Shear (lbs.)	ϕV_{sa} Shear (lbs.)	ϕV_{sa} Shear (lbs.)
3/8 or #3	1,755	2,265	3,775	2,790	1,725	2,870	3,960	3,565	3,430	2,375
1/2 or #4	3,210	4,150	6,915	5,110	3,155	5,255	7,200	6,480	6,240	4,320
5/8 or #5	5,115	6,610	11,020	8,135	5,025	8,375	11,160	10,045	9,670	6,695
3/4 or #6	7,565	9,785	16,305	10,235	7,435	12,390	15,840	14,255	13,730	9,505
7/8 or #7	10,445	13,505	22,505	14,130	10,265	17,105	21,600	19,440	18,720	-
1 or #8	13,700	17,715	29,525	18,535	13,465	22,445	28,440	25,595	24,650	-
#9	-	-	-	-	-	-	36,000	32,400	31,200	-
1-1/4 or #10	21,920	28,345	47,240	29,655	21,545	35,905	45,720	41,150	39,625	-

■ - Steel Strength

1. Steel shear design strength according to ACI 318 (-19 or -14) Ch.17 or ACI 318 Appendix D, $\phi V_{sa} = \phi \bullet 0.60 \bullet A_{se,V} \bullet f_{uta}$.
2. The tabulated steel design strength in shear must be checked against the bond strength/concrete capacity design strength to determine the controlling failure mode, the lowest load level controls.
3. In the determination of the shear design strength values in cracked concrete, the steel strength requires an additional reduction factor applied for seismic shear ($\alpha_{V,seis}$), where seismic design is applicable.

INSTALLATION INSTRUCTIONS (SOLID BASE MATERIALS)

DRILLING

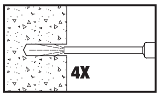



1- Drill a hole into the base material with rotary hammer drill (i.e. percussion drill) and a carbide drill bit to the size and embedment required by the selected steel hardware element (reference installation specifications for threaded rod and reinforcing bar). The tolerances of the carbide drill bits, including hollow bits, must meet ANSI Standard B212.15.

- Precaution: Use suitable eye and skin protection. Avoid inhalation of dust during drilling and/or removal (see optional dust extraction equipment supplied by DEWALT to minimize dust emission).
- Note! In case of standing water in the drilled hole (flooded hole condition), all the water has to be removed from the hole (e.g. vacuum, compressed air, etc.) prior to cleaning.
- Drilling in dry base material is recommended when using hollow drill bits (vacuum must be on).

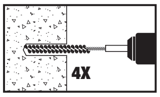
GO TO STEP 3 FOR HOLES DRILLED WITH DUSTX+™ DRILLING AND CLEANING SYSTEM; OTHERWISE GO TO STEP 2A.

HOLE CLEANING



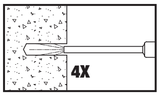
2a- Starting from the bottom or back of the anchor hole, blow the hole clean using a compressed air nozzle (min. 90 psi) or a hand pump (min. volume 25 fl. oz.) supplied by DEWALT) a minimum of four times (4x).

- Use a compressed air nozzle or a hand pump for anchor rod diameters 3/8" to 3/4" or reinforcing bar (rebar) sizes #3 to #6.
- Use a compressed air nozzle for anchor rod diameter 7/8" to 1-1/4" and rebar sizes #7 to #10. Do not use a hand pump for these sizes.



2b- Determine wire brush diameter (see installation specifications) and attach the brush with adaptor to a rotary drill tool or battery screwgun. Brush the hole with the selected wire brush a minimum of four times (4x). A brush extension (supplied by DEWALT) should be used for holes drilled deeper than the listed brush length.

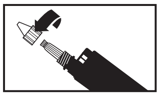
- Note! The wire brush diameter should be checked periodically during use. The brush should resist insertion into the drilled hole and come into contact with the sides of the drilled hole. If not the brush is too small and must be replaced.



2c- Finally, blow the hole clean again using a compressed air nozzle (min. 90 psi) or a hand pump (min. volume 25 fl.oz.) supplied by DEWALT a minimum of four times (4x).

- Use a compressed air nozzle or a hand pump for anchor rod diameters 3/8" to 3/4" or reinforcing bar (rebar) sizes #3 to #6.
- Use a compressed air nozzle for anchor rod diameters 7/8" to 1-1/4" and rebar sizes #7 to #10. Do not use a hand pump for these sizes.
- When finished the hole should be clean and free of dust, debris, ice, grease, oil or other foreign material.

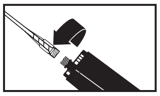
PREPARING



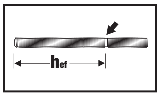
3- Check adhesive expiration date on cartridge label. Do not use expired product. Review Safety Data Sheet (SDS) before use. Cartridge temperature must be between 23°F - 95°F (-5°C - 35°C) when in use unless otherwise noted. Review gel (working) and cure time table. Consideration should be given to the reduced gel (working) time of the adhesive in warm temperatures.

- Remove cap from cartridge.

- **ATTENTION! 8478SDF-PWR ONLY:** If foil is present: cut across below the metal ring to open the foil.

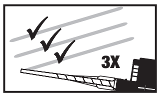


- Attach a supplied mixing nozzle to the cartridge. Unless otherwise noted do not modify the mixer in any way. Make sure the mixing element is inside the nozzle. Load the cartridge into the correct dispensing tool.
- Note! Use a new mixing nozzle with new cartridges of adhesive and also for all work interruptions exceeding the published gel (working) time of the adhesive.



4- Prior to inserting the anchor rod or rebar into the drilled hole, the position of the embedment depth has to be marked on the anchor.

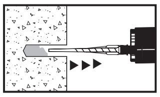
- Verify anchor element is straight and free of surface damage.



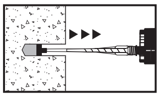
5- Adhesive must be properly mixed to achieve published properties. For new cartridges and nozzles, prior to dispensing adhesive into the drilled hole, separately dispense at least three full strokes of adhesive through the mixing nozzle until the adhesive is a consistent **GRAY** color.

- Unless otherwise noted, do not attach a used nozzle when changing to a new cartridge.
- Review and note the published working and cure times (see gel time and curing time table) prior to injection of the mixed adhesive into the cleaned anchor hole.

INSTALLATION

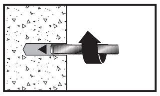


WITH PISTON PLUG:

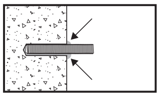


6- Fill the cleaned hole approximately two-thirds full with mixed adhesive starting from the bottom or back of the anchor hole. Slowly withdraw the mixing nozzle as the hole fills to avoid creating air pockets or voids. If the bottom or back of the anchor hole is not reached with the mixing nozzle only, a plastic extension tube supplied by DEWALT must be used with the mixing nozzle (see reference tables for installation).

- Piston plugs must be used with and attached to mixing nozzle and extension tube for overhead (i.e. upwardly inclined) installations and horizontal installations with anchor sizes as indicated in the piston plug selection table. Insert piston plug to the back of the drilled hole and inject as described in the method above. During installation the piston plug will be naturally extruded from the drilled hole by the adhesive pressure.
- Attention! Do not install anchors overhead without proper training and installation hardware provided by DEWALT. Contact DEWALT for details.

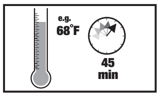


7- The anchor should be free of dirt, grease, oil or other foreign material. Push clean threaded rod or reinforcing bar into the anchor hole while turning slightly to ensure positive distribution of the adhesive until the embedment depth is reached. Observe the gel (working) time.



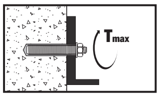
8- Be sure the rod or rebar is fully seated at the bottom of the hole to the specified embedment. Adhesive must completely fill the annular gap between the anchor and the base material. Protect exposed anchor threads from fouling with adhesive. For all installations the anchor must be restrained from movement throughout the specified curing period (as necessary) where necessary through the use of temporary wedges, external supports, or other methods. Minor adjustments to the position of the anchor element may be performed during the gel (working) time only.

CURING AND LOADING



9- Allow the adhesive anchor to cure to the specified full curing time prior to applying any load (reference gel time and curing time table).

- Do not disturb, torque or load the anchor until it is fully cured.

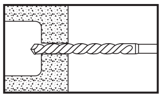


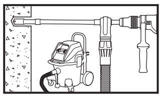
10- After full curing of the adhesive anchor, a fixture can be installed to the anchor and tightened up to the maximum torque (reference gel time and curing table) by using a calibrated torque wrench.

- Note! Take care not to exceed the maximum torque for the selected anchor.

INSTALLATION INSTRUCTIONS (UNREINFORCED MASONRY [URM WALLS] AND HOLLOW BASE MATERIALS)

DRILLING



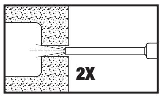


1- Drill a hole into the base material with a rotary drill tool to the size and embedment required by the selected screen tube size and steel anchor element (see installation specifications for threaded rod in hollow base material with screen tube supplied by DEWALT). Holes drilled in hollow concrete masonry units may be drilled with a rotary hammer-drill. The tolerances of the drill bit, including hollow drill bits, must meet the requirements of ANSI B212.15.

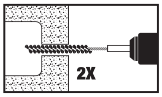
- Precaution: Wear suitable eye and skin protection. Avoid inhalation of dust during drilling and/or removal (see dust extraction by DEWALT to minimize dust emission).
- Drilling in dry base materials is recommended when using hollow drill bits (vacuum must be on).

GO TO STEP 3 FOR HOLES DRILLED WITH DUSTX+™ DRILLING AND CLEANING SYSTEM; OTHERWISE GO TO STEP 2.

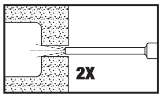
HOLE CLEANING (BLOW 2X, BRUSH 2X, BLOW 2X)



2- Starting from the bottom or back of the anchor hole, blow the hole clean with a hand pump with min. volume 25 fl.oz. supplied by DEWALT (Cat #08280-PWR) or compressed air nozzle a minimum of two times (2x).

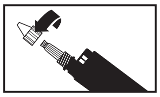


- Determine the wire brush diameter (see installation specifications) and attach the brush with adaptor to a rotary drill tool or battery screw gun. Brush the hole with the selected wire brush a minimum of two times (2x). A brush extension supplied by DEWALT (Cat. #08282-PWR) should be used for holes drilled deeper than the listed brush length.
- Note! The wire brush should be checked periodically during use. The brush should resist insertion into the drilled hole and come into contact with the sides of the drilled hole. If not the brush is too small and must be replaced.



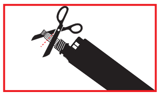
- Finally, blow the hole clean again a minimum of two times (2x)
- When finished the hole should be clean and free of dust, debris, ice, grease, oil or other foreign material.

PREPARING

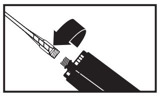


3- Check adhesive expiration date on cartridge label. Do not use expired product. Review Safety Data Sheet (SDS) before use. Cartridge temperature must be between 23°F - 95°F (-5°C - 35°C) when in use unless otherwise noted. Review gel (working) and cure time table. Consideration should be given to the reduced gel (working) time of the adhesive in warm temperatures.

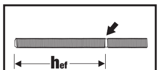
- Remove cap from cartridge.



- **ATTENTION! 8478SDF-PWR ONLY:** If foil is present: cut across below the metal ring to open the foil.

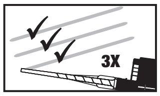


- Attach a supplied mixing nozzle to the cartridge. Unless otherwise noted do not modify the mixer in any way. Make sure the mixing element is inside the nozzle. Load the cartridge into the correct dispensing tool.
- Note! Use a new mixing nozzle with new cartridges of adhesive and also for all work interruptions exceeding the published gel (working) time of the adhesive.



4- Prior to inserting the anchor rod or rebar into the drilled hole, the position of the embedment depth has to be marked on the anchor.

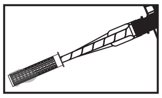
- Verify anchor element is straight and free of surface damage.



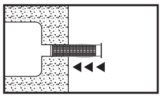
5- Adhesive must be properly mixed to achieve published properties. For new cartridges and nozzles, prior to dispensing adhesive into the drilled hole, separately dispense at least three full strokes of adhesive through the mixing nozzle until the adhesive is a consistent **GRAY** color.

- Unless otherwise noted, do not attach a used nozzle when changing to a new cartridge.
- Review and note the published working and cure times (see gel time and curing time table) prior to injection of the mixed adhesive into the cleaned anchor hole.

INSTALLATION

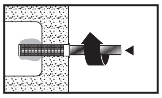


6- Select a screen tube of suitable length supplied by DEWALT. Fill the screen tube full with adhesive starting from the bottom or back of the tube. Slowly withdraw the mixing nozzle as the screen fills to avoid creating air pockets or voids. A plastic extension tube must be used with the mixing nozzle if the back of the screen tube cannot be reached (see reference tables for installation).



7- Insert the screen tube filled with adhesive into the cleaned anchor hole. Inject additional adhesive into the screen tube as necessary to ensure the screen tube is completely filled.

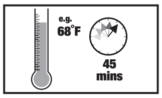
- Note! Overfilling the screen tube is acceptable but not required.



8- Prior to inserting the anchor rod into the screen tube inspect it to ensure that it is free of dirt, grease, oil or other foreign material.

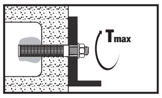
- Push the threaded rod into the screen tube while turning slightly to ensure positive distribution of the adhesive until back of the tube is reached.
- Note: In cases where the drilled hole size is larger than specified due to rotary drilling (e.g. an elongated opening), the annular space between the screen tube and the hole at the base material surface must be filled with adhesive.

CURING AND FIXTURE



9- Allow the adhesive anchor to cure to the specified full curing time prior to applying any load.

- Do not disturb, torque or load the anchor until it is fully cured (see gel time and curing time table).



10- After full curing of the adhesive anchor, a fixture can be installed to the anchor and tightened up to the maximum torque (see installation specifications for threaded rod in hollow base material) by using a calibrated torque wrench.

- Note! Take care not to exceed the maximum torque for the selected anchor.

REFERENCE INSTALLATION TABLES

Gel (working) Time and Curing Table

Temperature of Base Material		Gel (working) Time	Full Curing Time
˚F	˚C		
14	-10	90 minutes	24 hours
23	-5	90 minutes	14 hours
32	0	45 minutes	7 hours
41	5	25 minutes	2 hours
50	10	15 minutes	90 minutes
68	20	6 minutes	45 minutes
86	30	4 minutes	25 minutes
95	35	2 minutes	20 minutes
104	40	1.5 minutes	15 minutes

The gel (working) times listed for 32˚F to 95˚F are also applicable for the temperature of the adhesive and use of mixing nozzes during installation.
For installations in base material temperatures between 14˚F and 23˚F (-10ºC and -5ºC) the cartridge temperature must be conditioned to between 68˚F and 95˚F (20˚C - 35˚C).

Wire Brush Selection Table for AC100+ Gold[1,2]

Nominal Wire Brush Size (inch)	ANSI Drill Bit Diameter (inch)	Brush Length (inches)	Steel Wire Brush (Cat. #)	Blowout Tool
Solid Base Material				
7/16	7/16	7	08284-PWR	Hand-pump (Cat #08280-PWR) or compressed air nozzle
9/16	9/16	7	08285-PWR	
5/8	5/8	7	08275-PWR	
11/16	11/16	9	08286-PWR	
3/4	3/4	9	08278-PWR	
7/8	7/8	9	08287-PWR	
1	1	11	08288-PWR	Compressed air nozzle only
1-1/8	1-1/8	11	08289-PWR	
1-3/8	1-3/8	11	08290-PWR	
1-1/2	1-1/2	11	08291-PWR	
Hollow Base Material (with Screen Tube)				
3/8	3/8 (SS screen)	7	08284-PWR	Hand pump (Cat# 08280-PWR) or compressed air nozzle
1/2	1/2 (SS screen)	7	08284-PWR	
9/16	9/16 (plastic screen)	7	08285-PWR	
5/8	5/8 (SS screen)	7	08275-PWR	
3/4	3/4 (plastic screen)	9	08278-PWR	
3/4	3/4 (SS screen)	9	08278-PWR	
7/8	7/8 (plastic screen)	9	08287-PWR	
7/8	7/8 (SS screen)	9	08287-PWR	
1	1 (SS screen)	11	08288-PWR	

1. An SDS-plus adaptor (Cat. #08283-PWR) or Jacobs chuck style adaptor (Cat. #08296-PWR) is available to attach a steel wire brush to the drill tool.
2. A brush extension (Cat. #08282-PWR) must be used for holes drilled deeper than the listed brush length.

For Retrofit Bolt Anchors in URM Walls, including separate installation details, see the table in this tech section entitled "Allowable Load Capacities for AC100+ Gold with Threaded Rods and Reinforcing Bars or Rebar Dowel Installed in Unreinforced Masonry Walls with Stainless Steel Screen Tubes"

Piston Plug Selection Table for Adhesive Anchors[1,2,3,4]

Drill Bit Diameter (inch)	Plug Size (inch)	Piston Plug (Cat. #)	Premium Piston Plug (Cat. #)
11/16	11/16	08258-PWR	PFC1691515
3/4	3/4	08259-PWR	PFC1691520
7/8	7/8	08300-PWR	PFC1691530
1	1	08301-PWR	PFC1691540
1-1/8	1-1/8	08303-PWR	PFC1691550
1-1/4	1-1/4	08307-PWR	PFC1691555
1-3/8	1-3/8	08305-PWR	PFC1691560
1-1/2	1-1/2	08309-PWR	PFC1691570
1-3/4	1-3/4	-	PFC1691580
2	2	-	PFC1691590
2-3/16	2-3/16	-	PFC1691600

1. All overhead or upwardly inclined installations require the use of piston plugs where one is tabulated together with the anchor size.
2. All horizontal installations require the use of piston plugs where the embedment depth is greater than 8 inches and the drill bit size is larger than 5/8-inch.
3. The use of piston plugs is also recommended for underwater installations where one is tabulated together with the anchor size.
4. A flexible plastic extension tube (Cat. #08281-PWR or #08297-PWR) or equivalent approved by DEWALT must be used with piston plugs.

ORDERING INFORMATION

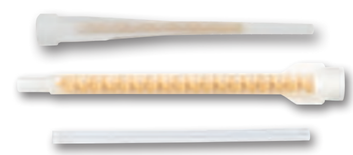
AC100+ Gold Cartridges (10:1 mix ratio)

Cat. No.	Description	Pack Qty.	Std. Carton	Pallet
8478SD-PWR	AC100+ Gold 9.5 fl. oz. Quick-Shot	12	36	648
8478SDF-PWR	AC100+ Gold 9.5 fl. oz. Quick-Shot Foil	12	36	648
8578SD-PWR	AC100+ Gold 14 fl. oz. coaxial cartridge	-	12	540
8490SD-PWR	AC100+ Gold 28 fl. oz. dual cartridge	-	8	240

An AC100+ Gold mixing nozzle is packaged with each cartridge.
AC100+ Gold mixing nozzles must be used to ensure complete and proper mixing of the adhesive.

Cartridge System Mixing Nozzles

Cat. No.	Description	Pack Qty.	Carton Qty.
08293-PWR	Mixing nozzle for AC100+ Gold	2	24
08294-PWR	Long mixing nozzle (with an 8" extension) for AC100+ Gold	2	24
08281-PWR	Mixing nozzle extension, 8" long	2	24
08297-PWR	Flexible extension tubing, 20" long	12	36



Dispensing Tools for Injection Adhesive

Cat. No.	Description	Pack Qty.
08437-PWR	Manual caulking gun for Quick-Shot	1
DCE560D1	Quick-Shot 20v battery powered caulking gun	1
08414-PW	14 fl. oz. standard metal manual tool	1
08494-PWR	AC100+ Gold 28 oz. std. metal manual tool	1
08496-PWR	28 oz. pneumatic tool	1
DCE595D1	28 oz. 20v battery powered dispensing tool	1

Hole Cleaning Tools and Accessories

Cat. No.	Description	Pack Qty.
08284-PWR	Wire brush for 7/16" or 1/2" ANSI hole, 7" length	1
08285-PWR	Wire brush for 9/16" ANSI hole, 7" length	1
08275-PWR	Wire brush for 5/8" ANSI hole, 7" length	1
08286-PWR	Wire brush for 11/16" ANSI hole, 9" length	1
08278-PWR	Wire brush for 3/4" ANSI hole, 9" length	1
08287-PWR	Wire brush for 7/8" ANSI hole, 9" length	1
08288-PWR	Wire brush for 1" ANSI hole, 11" length	1
08289-PWR	Wire brush for 1-1/8" ANSI hole, 11" length	1
08276-PWR	Wire brush for 1-1/4" ANSI hole, 11" length	1
08290-PWR	Wire brush for 1-3/8" ANSI hole, 11" length	1
08291-PWR	Wire brush for 1-1/2" ANSI hole, 11" length	1
08299-PWR	Wire brush for 1-3/4" ANSI hole, 11" length	1
08271-PWR	Wire brush for 2" ANSI hole, 11" length	1
08272-PWR	Wire brush for 2-3/16" ANSI hole, 11" length	1
08283-PWR	SDS-plus adapter for steel brushes	1
08296-PWR	Standard drill adapter for steel brushes (e.g. Jacobs Chuck)	1
08282-PWR	Steel brush extension, 12" length	1
08280-PWR	Hand pump/dust blower (25 fl. oz. clylinder volume)	1
08292-PWR	Air compressor nozzle with extension, 18" length	1

Premium Piston Plugs

Cat. No.	Description	ANSI Drill Bit Dia.	Pack Qty.
PFC1691510	5/8" Plug	5/8"	1
PFC1691515	11/16" Plug	11/16"	1
PFC1691520	3/4" Plug	3/4"	1
PFC1691530	7/8" Plug	7/8"	1
PFC1691540	1" Plug	1"	1
PFC1691550	1-1/8" Plug	1-1/8"	1
PFC1691555	1-1/4" Plug	1-1/4"	1
PFC1691560	1-3/8" Plug	1-3/8"	1
PFC1691570	1-1/2" Plug	1-1/2"	1
PFC1691580	1-3/4" Plug	1-3/4"	1
PFC1691590	2" Plug	2"	1
PFC1691600	2-3/16" Plug	2-3/16"	1

Stainless Steel Screen Tubes

Cat. No.	Description	Drill Bit Dia.	Pack Qty.
07960-PWR	1/4" x 2" Screen Tube	3/8"	25
07862-PWR	1/4" x 6" Screen Tube*	3/8"	25
07864-PWR	1/4" x 8"Screen Tube*	3/8"	25
07856-PWR	3/8" x 2" Screen Tube	1/2"	25
07961-PWR	3/8" x 3-1/2" Screen Tube	1/2"	25
07962-PWR	3/8" x 6" Screen Tube*	1/2"	25
07963-PWR	3/8" x 8" Screen Tube*	1/2"	25
07964-PWR	3/8" x 10" Screen Tube*	1/2"	25
07959-PWR	3/8" x 12" Screen Tube*	1/2"	25
07857-PWR	1/2" x 2" Screen Tube	5/8"	25
07965-PWR	1/2" x 3-1/2" Screen Tube	5/8"	25
07966-PWR	1/2" x 6" Screen Tube	5/8"	25
07967-PWR	1/2" x 8" Screen Tube*	5/8"	25
07968-PWR	1/2" x 10" Screen Tube*	5/8"	25
07858-PWR	5/8" x 2" Screen Tube	3/4"	25
07969-PWR	5/8" x 4-1/2" Screen Tube	3/4"	20
07970-PWR	5/8" x 6" Screen Tube	3/4"	20
07971-PWR	5/8" x 8" Screen Tube	3/4"	20
07972-PWR	5/8" x 10" Screen Tube	3/4"	20
07859-PWR	3/4" x 2" Screen Tube	7/8"	25
07973-PWR	3/4" x 6 Screen Tube	7/8"	10
07977-PWR	3/4" x 8 Screen Tube	7/8"	10
07974-PWR	3/4" x 10 Screen Tube	7/8"	10
07975-PWR	3/4" x 13 Screen Tube	7/8"	10
07978-PWR	3/4" x 17 Screen Tube	7/8"	10
07855-PWR	15/16" x 2" Screen Tube	1"	25
07865-PWR	15/16" x 8" Screen Tube	1"	10
07867-PWR	15/16" x 13" Screen Tube	1"	10
07869-PWR	15/16" x 17" Screen Tube	1"	10

Screen tubes are made from a 300 series stainless steel. The nominal diameter of the screen listed indicates the matching rod diameter (except for the 15/16" screen tubes).
15/16" screen tubes can accept 3/4" diameter threaded rods and #4, #5 or #6 reinforcing bars for unreinforced masonry wall applications (URM).
*Includes extension tubing.

Piston Plugs for Adhesive Anchors

Cat. No.	Description	Drill Bit Dia.	Pack Qty.	Carton Qty.
08304-PWR	5/8" Plug	5/8"	10	100
08258-PWR	11/16" Plug	11/16"	10	100
08259-PWR	3/4" Plug	3/4"	10	100
08300-PWR	7/8" Plug	7/8"	10	100
08301-PWR	1" Plug	1"	10	100
08303-PWR	1-1/8" Plug	1-1/8"	10	100
08305-PWR	1-3/8" Plug	1-3/8"	10	100
08307-PWR	1-1/4" Plug	1-1/4"	10	100
08309-PWR	1-1/2" Plug	1-1/2"	10	100

A plastic extension tube (Cat# 08281-PWR or 08297-PWR) or equivalent approved by DEWALT must be used with piston plugs.

Plastic Screen Tubes

Cat. No.	Description	Drill Bit Dia.	Pack Qty.
08310-PWR	3/8" x 3-1/2" Plastic Screen	9/16"	25
08311-PWR	3/8" x 6" Plastic Screen	9/16"	25
08313-PWR	3/8" x 8" Plastic Screen	9/16"	25
08315-PWR	1/2" x 3-1/2" Plastic Screen	3/4"	25
08317-PWR	1/2" x 6" Plastic Screen	3/4"	25
08321-PWR	5/8" x 6" Plastic Screen	7/8"	25
08323-PWR	3/4" x 6" Plastic Screen	1"	10

The nominal diameter of the screen listed indicates the matching rod diameter.

SDS+ Full Head Carbide Drill Bits

Cat. No.	Diameter	Usable Length	Overall Length
DW5527	3/8"	4"	6-1/2"
DW5529	3/8"	8"	10"
DW55300	3/8"	10"	12"
DW5531	3/8"	16"	18"
DW5537	1/2"	4"	6"
DW5538	1/2"	8"	10-1/2"
DW5539	1/2"	10"	12"
DW5540	1/2"	16"	18"

SDS Max 4-Cutter Carbide Drill Bits

Cat. No.	Diameter	Usable Length	Overall Length
DW5806	5/8"	8"	13-1/2"
DW5809	5/8"	16"	21-1/2"
DW5807	5/8"	31"	36"
DW5808	11/16"	16"	21-1/2"
DW5810	3/4"	8"	13-1/2"
DW5812	3/4"	16"	21-1/2"
DW5813	3/4"	31"	36"
DW5814	13/16"	16"	21-1/2"
DW5815	7/8"	8"	13-1/2"
DW5816	7/8"	16"	21-1/2"
DW5851	7/8"	31"	36"
DW5818	1"	8"	13-1/2"
DW5819	1"	16"	22-1/2"
DW5852	1"	24"	29"
DW5820	1"	31"	36"
DW5821	1-1/8"	10"	15"
DW5822	1-1/8"	18"	22-1/2"
DW5853	1-1/8"	24"	29"
DW5854	1-1/8"	31"	36"
DW5824	1-1/4"	10"	15"
DW5825	1-1/4"	18"	22-1/2"

SDS+ 4-Cutter Carbide Drill Bits

Cat. No.	Diameter	Usable Length	Overall Length
DW5471	5/8"	8"	10"
DW5472	5/8"	16"	18"
DW5474	3/4"	8"	10"
DW5475	3/4"	16"	18"
DW5477	7/8"	8"	10"
DW5478	7/8"	16"	18"
DW5479	1"	8"	10"
DW5480	1"	16"	18"
DW5481	1-1/8"	8"	10"
DW5482	1-1/8"	6"	18"

Dust Extraction

Cat. No.	Description
DWV012	10 Gallon Wet/Dry Hepa/Rrp Dust Extractor DWV9402 Fleece bag (5 pack) for DEWALT dust extractors DWV9316 Replacement Anti-Static Hose DWV9320 Replacement HEPA Filter Set (Type 1)
DWH050K	Dust Extraction with two interchangeable drilling heads
DCB1800B	1800 Watt Portable Power Station & Parallel Battery Charger Bare Unit

Hollow Drill Bits

Shank	Cat. No.	Diameter	Overall Length	Usable Length	Recommended Hammer
SDS+	DWA54012	1/2"	14-1/2"	9-3/4"	DCH133 / DCH273 / DCH293
	DWA54916	9/16"	14-1/2"	9-3/4"	DCH133 / DCH273 / DCH293
	DWA54058	5/8"	14-1/2"	9-3/4"	DCH133 / DCH273 / DCH293
	DWA54034	3/4"	14-1/2"	9-3/4"	DCH133 / DCH273 / DCH293
SDS Max	DWA58058	5/8"	23-5/8"	15-3/4"	DCH481 / D25603K
	DWA58958	5/8"	47-1/4"	39-3/8"	DCH481 / D25603K
	DWA58116	11/16"	24-3/4"	15-3/4"	DCH481 / D25603K
	DWA58034	3/4"	23-5/8"	15-3/4"	DCH481 / D25603K
	DWA58934	3/4"	47-1/4"	39-3/8"	DCH481 / D25603K
	DWA58078	7/8"	23-5/8"	15-3/4"	DCH481 / D25603K
	DWA58001	1"	23-5/8"	15-3/4"	DCH481 / D25603K
	DWA58901	1"	47-1/4"	39-3/8"	DCH481 / D25603K
	DWA58118	1-1/8"	23-5/8"	15-3/4"	DCH481 / D25603K
	DWA58918	1-1/8"	47-1/4"	39-3/8"	DCH481 / D25603K
	DWA58115	1-1/4"	23-5/8"	15-3/4"	DCH481 / D25603K
	DWA58114	1-1/4"	47-1/4"	39-3/8"	DCH481 / D25603K
	DWA58138	1-3/8"	47-1/4"	39-3/8"	DCH481 / D25603K
	DWA58112	1-1/2"	47-1/4"	39-3/8"	DCH481 / D25603K

DUSTX+
ANCHOR INSTALLATION SYSTEM

GENERAL INFORMATION

PURE110+®

Epoxy Injection Adhesive Anchoring System and Post-Installed Reinforcing Bar Connections

PRODUCT DESCRIPTION

The Pure110+ is a two-component, high strength adhesive anchoring system. The system includes injection adhesive in plastic cartridges, mixing nozzles, dispensing tools and hole cleaning equipment. Pure110+ is designed for bonding threaded rod and reinforcing bar hardware into drilled holes in concrete base materials and for post-installed reinforcing bar connections (rebar development).

GENERAL APPLICATIONS AND USES

- Bonding threaded rod and reinforcing bar into hardened concrete
- Rebar development length connections in concrete up to 60d embedments
- Evaluated for installation and use in dry and wet holes, including water filled and submerged
- Can be installed in a broad range of base material temperatures with good working times
- Cracked and uncracked concrete conditions as well as wind and seismic loading (SDC A - F)
- Can be considered for anchoring into core drilled holes in concrete (see www.DEWALT.com)
- Oversized hammer-drilled holes in concrete, for short term loading only (see www.DEWALT.com)

FEATURES AND BENEFITS

+ Standard curing system which offers good working times even in warm temperatures
+ Evaluated and recognized for freeze/thaw performance
+ Cartridge design allows for multiple uses using extra mixing nozzles
+ Mixing nozzles proportion adhesive and provide simple delivery method into drilled holes
+ Evaluated and recognized for long term and short term loading (see performance tables)
+ Same bond strength at room temperature and at 110ºF (43ºC)

APPROVALS AND LISTINGS

- International Code Council, Evaluation Service (ICC-ES) ESR-3298 for cracked and uncracked concrete
- Code Compliant with 2021 IBC/IRC, 2018 IBC/IRC, 2015 IBC/IRC and 2012 IBC/IRC
- Tested in accordance with ACI 355.4/ASTM E488, and ICC-ES AC308 for use in structural concrete with design according to ACI 318 (-19 & -14) Chapter 17 and ACI 318 Appendix D
- Tested and qualified for use in post-installed reinforcing bar connections and rebar development length applications in accordance with ICC-ES AC308, Table 3.8 and ACI 318 Chapter 12 and Chapter 25
- Evaluated and qualified by an accredited independent testing laboratory for recognition in cracked and uncracked concrete including static, wind and seismic loading
- City of Los Angeles, LABC and LARC Supplement (within ESR-3298)
- Florida Building Code, FBC Supplement including HVHZ (within ESR-3298)
- Compliant with NSF/ANSI/CAN 61 for drinking water system components - health effects
- Also classified as lead free in accordance with NSF/ANSI/CAN 372
- Compliant to California DPH for VOC emissions and South Coast AQMD for VOC content (LEED v4.1)
- Conforms to requirements of ASTM C881 including C882 and AASHTO M235, Types I, II, IV and V, Grade 3, Classes B & C (also meets Type III except for elongation)
- Department of Transportation listings – see www.DEWALT.com or contact transportation agency

GUIDE SPECIFICATIONS

CSI Divisions: 03 16 00 - Concrete Anchors, 04 05 19.16 Masonry Anchors and 05 05 19 Post-Installed Concrete Anchors. Adhesive anchoring system shall be Pure110+ as supplied by DEWALT, Towson, MD. Anchors shall be installed in accordance with published instructions and requirements of the Authority Having Jurisdiction.

TENSION ZONE CRACKED CONCRETE · SEISMIC REGION QUALIFICATION · C US · CODE LISTED ICC-ES ESR-3298 CONCRETE · DDA DEWALT DESIGN ASSIST · DUSTX+ ANCHOR INSTALLATION SYSTEM

SECTION CONTENTS

PURE110+ ADHESIVE IN CARTRIDGE
(STANDARD THREADED ROD AND REBAR STEEL SUPPLIED BY OTHERS)

PACKAGING (1:1 MIX RATIO)

Coaxial Cartridge

- 9 fl. oz. (265 ml or 16 in³)

Dual Cartridge (side-by-side)

- 20.5 fl. oz. (610 ml or 37 in³)
- 50.5 fl. oz. (1500 ml or 91.5 in³)

STORAGE LIFE & CONDITIONS

Dual cartridge: Two years
Coaxial cartridge: Eighteen months
Store in a dry, dark environment with temperature ranging from 41°F to 86°F (5°C to 30°C)

ANCHOR SIZE RANGE (TYPICAL)

- 3/8" to 1-1/4" diameter threaded rod
- No. 3 to No. 11 reinforcing bar (rebar)

SUITABLE BASE MATERIALS

- Normal-weight concrete
- Lightweight concrete
- Grouted Concrete Masonry
- Hollow Concrete Masonry

PERMISSIBLE INSTALLATION CONDITIONS (ADHESIVE)

- Dry concrete
- Water-saturated concrete (wet)
- Water-filled holes (flooded)
- Underwater concrete (submerged)

INSTALLATION SPECIFICATIONS

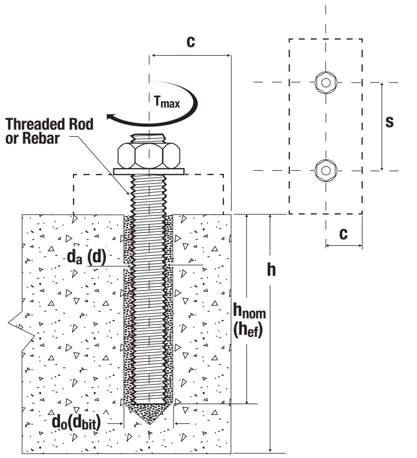
Installation Specifications for Threaded Rod and Reinforcing Bar

Parameter	Symbol	Units	Fractional Nominal Rod Diameter (Inch) / Reinforcing Bar Size (No.)									
			3/8 or #3	1/2	#4	5/8 or #5	3/4 or #6	7/8 or #7	1 or #8	#9	1-1/4	#10
Threaded rod outside diameter	d_a (d)	inch (mm)	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)	-
Rebar nominal outside diameter	d_a (d)	inch (mm)	0.375 (9.5)	0.500 (12.7)		0.625 (15.9)	0.750 (19.1)	0.875 (22.2)	1.000 (25.4)	1.125 (28.7)	-	1.250 (31.8)
Nominal drill bit diameter (ANSI)	d_o (d_{bit})	inch	7/16	9/16	5/8	11/16 or 3/4	7/8	1	1-1/8	1-3/8	1-3/8	1-1/2
Minimum embedment[1,6]	$h_{ef,min}$	inch (mm)	2-3/8 (60)	2-3/4 (70)		3-1/8 (79)	3-1/2 (89)	3-1/2 (89)	4 (102)	4-1/2 (114)	5 (127)	5 (127)
Maximum embedment[1,6]	$h_{ef,max}$	inch (mm)	7-1/2 (191)	10 (254)		12-1/2 (318)	15 (381)	17-1/2 (445)	20 (508)	22-1/2 (572)	25 (635)	25 (635)
Minimum member thickness	h_{min}	inch (mm)	h_{ef} + 1-1/4 (h_{ef} + 30)			$h_{ef} + 2d_o$						
Minimum anchor spacing	s_{min}	inch (mm)	1-7/8 (48)	2-1/2 (64)		3-1/8 (79)	3-3/4 (95)	4-3/8 (111)	5 (127)	5-5/8 (143)	6-1/4 (159)	6-1/4 (159)
Minimum edge distance (up to 100% T_{max})	c_{min}	inch (mm)	1-7/8 (48)	2-1/2 (64)		3-1/8 (79)	3-3/4 (95)	4-3/8 (111)	5 (127)	5-5/8 (143)	6-1/4 (159)	6-1/4 (159)
Max. torque[2]	T_{max}	ft-lbs (N-m)	15 (20)	30 (41)		60 (81)	105 (142)	125 (169)	165 (221)	200 (280)	280 (379)	280 (379)
Max. torque[2,3] (low strength rods)	$T_{max,ls\text{-}rod}$	ft-lbs (N-m)	7 (9)	20 (27)		40 (54)	60 (81)	100 (136)	165 (223)	-	280 (379)	-
Min. edge distance, reduced[4,5] (45% T_{max})	$c_{min,red}$	inch (mm)	1-3/4 (45)	1-3/4 (45)		1-3/4 (45)	1-3/4 (45)	1-3/4 (45)	1-3/4 (45)	2-3/4 (70)	2-3/4 (70)	2-3/4 (70)

For pound-inch units: 1 mm = 0.03937 inch, 1 N-m = 0.7375 ft-lbf. For SI: 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m.

1. Embedment range qualified for use with the anchoring design provisions of ACI 318 (-19 & -14) or ACI 318 Appendix D as applicable, ICC-ES AC308, Section 4.2 and ESR-3298.
2. Torque may not be applied to the anchors until the full cure time of the adhesive has been achieved.
3. These torque values apply to ASTM A36 / F1554 Grade 36 carbon steel threaded rods; and ASTM A193 Grade B8/B8M (Class 1) stainless steel threaded rods.
4. For installations below the minimum edge distance, c_{min}, down to the reduced minimum edge distance, $c_{min,red}$, the reduced maximum torque is 0.45*T_{max}.
5. For installations below the minimum edge distance, c_{min}, and down to the reduced minimum edge distance, $c_{min,red}$, the minimum anchor spacing, s_{min} is $5d_a$.
6. For rebar development lengths with embedments up to 60d, see the table for Installation Parameters for Common Post-installed Reinforcing Bar Connections.

Detail of Steel Hardware Elements used with Injection Adhesive System



Nomenclature

d_a (d) = Diameter of anchor
d_o (d_{bit}) = Diameter of drilled hole
h = Base material thickness
h_{nom} (h_{ef}) = Embedment depth
s = Spacing of anchors
c = Edge distance
T_{max} = Maximum torque

Threaded Rod and Deformed Reinforcing Bar Material Properties

Steel Description (General)	Steel Specification (ASTM)	Nominal Anchor Size (inch/No.)	Minimum Yield Strength, f_y (psi)	Minimum Ultimate Strength, f_u (psi)
Carbon rod	A36 or F1554 Grade 36	3/8 through 1-1/4	36,000	58,000
	F1554 Grade 55		55,000	75,000
	A449	3/8 through 1	92,000	120,000
		1-1/4	81,000	105,000
	A193, Grade B7 or F1554 Grade 105	3/8 through 1-1/4	105,000	125,000
	F568M Class 5.8	3/4 through 1-1/4	58,000	72,500
Stainless rod	F593 Condition CW	3/8 through 5/8	65,000	100,000
		3/4 through 1-1/4	45,000	85,000
	A193/193M Grade B8/B8M, Class 1	3/8 through 1-1/4	30,000	75,000
	A193/A193M Grade B8/B8M2, Class 2B	3/8 through 1-1/4	75,000	95,000
Reinforcing Bar	A615, A767, Grade 40	#3 through #6	40,000	60,000
	A615, A767, Grade 60	#3 through #10	60,000	90,000
	A706, A767, Grade 60		60,000	80,000
	A615, A767, Grade 75	#3 through #10	75,000	100,000
	A706, A767, Grade 80	#3 through #10	80,000	100,000

Tabulated material properties are provided for reference; other steel hardware elements may also be considered.

PERFORMANCE DATA (ASD)

Ultimate and Allowable Load Capacities for Pure110+ Installed with Threaded Rod into Normal Weight Concrete (based on bond strength/concrete capacity)[1,2,3,4,5,6]

Rod Diameter d in.	Drill Bit Diameter d_{bit} in.	Minimum Embedment Depth h_{nom} in. (mm)	Minimum Concrete Compressive Strength					
			f'c = 2,500 psi (17.2 MPa)		f'c = 3,000 psi (20.7 MPa)		f'c = 4,000 psi (27.6 MPa)	
			Ultimate Tension Load Capacity lbs. (kN)	Allowable Tension Load Capacity lbs. (kN)	Ultimate Tension Load Capacity lbs. (kN)	Allowable Tension Load Capacity lbs. (kN)	Ultimate Tension Load Capacity lbs. (kN)	Allowable Tension Load Capacity lbs. (kN)
3/8	7/16	3-3/8 (86)	10,015 (44.6)	2,505 (11.1)	10,445 (46.5)	2,610 (11.6)	10,445 (46.5)	2,610 (11.6)
1/2	9/16	4-1/2 (114)	16,755 (74.5)	4,190 (18.6)	17,470 (77.7)	4,370 (19.4)	20,225 (90.0)	5,055 (22.5)
5/8	11/16 or 3/4	5-5/8 (143)	22,375 (99.5)	5,595 (24.9)	23,335 (103.8)	5,835 (26.0)	28,600 (127.2)	7,150 (31.8)
3/4	7/8	6-3/4 (172)	34,765 (154.6)	8,690 (38.7)	36,255 (161.3)	9,065 (40.3)	40,930 (182.1)	10,235 (45.5)
7/8	1	7-7/8 (200)	44,375 (197.4)	11,095 (49.4)	46,275 (205.8)	11,570 (51.5)	52,920 (235.4)	13,230 (58.8)
1	1-1/8	9 (229)	54,675 (243.2)	13,670 (60.8)	57,015 (253.6)	14,255 (63.4)	65,835 (292.9)	16,460 (74.2)
		10 (254)	74,265 (330.5)	18,565 (82.6)	77,445 (344.5)	19,360 (86.1)	82,745 (368.1)	20,685 (92.0)
1-1/4	1-3/8	11-1/4 (286)	88,110 (391.9)	22,030 (98.0)	91,885 (408.7)	22,970 (102.2)	98,170 (436.7)	24,545 (109.2)
1-1/2	1-3/4	13-1/2 (343)	121,521 (540.6)	30,380 (135.1)	126,725 (563.7)	31,680 (140.9)	135,390 (602.3)	33,850 (150.6)

1. Allowable load capacities listed are calculated using an applied safety factor of 4.0 which includes an assessment of freezing/thawing conditions and sensitivity to sustained loads (i.e. creep resistance). Consideration of safety factors of 10 or higher may be necessary depending on the application, such as life safety or overhead.
2. Linear interpolation may be used to determine allowable loads for intermediate embedments and compressive strengths.
3. The tabulated load values are applicable to single anchors installed at critical edge and spacing distances of 3 times the embedment depth and where the minimum member thickness is the greater of [h_{nom} + 1-1/4"] and [h_{nom} + $2d_{bit}$].
4. The tabulated load values are applicable for dry uncracked concrete installed into holes drilled with a hammer drill and an ANSI carbide drill bit. Installations in water-saturated concrete (wet) or in water-filled holes (flooded) require a 15% reduction in capacity. Installations in underwater concrete (submerged) require a 30% reduction in capacity.
5. Adhesives experience reductions in capacity at elevated temperatures. See the in-service temperature chart for allowable load capacity reduction factors.
6. Allowable bond strength/concrete capacity must be checked against allowable steel strength in tension to determine the controlling allowable load. Allowable shear capacity is controlled by allowable steel strength for the given conditions.

Ultimate and Allowable Load Capacities for Pure110+ Installed with Reinforcing Bar into Normal Weight Concrete (based on bond strength/concrete capacity)[1,2,3,4,5,6]

Bar Size d No.	Drill Bit Diameter d_{bit} in.	Minimum Embedment Depth h_{nom} in. (mm)	Minimum Concrete Compressive Strength					
			f'c = 2,500 psi (17.2 MPa)		f'c = 3,000 psi (20.7 MPa)		f'c = 4,000 psi (27.6 MPa)	
			Ultimate Tension Load Capacity lbs. (kN)	Allowable Tension Load Capacity lbs. (kN)	Ultimate Tension Load Capacity lbs. (kN)	Allowable Tension Load Capacity lbs. (kN)	Ultimate Tension Load Capacity lbs. (kN)	Allowable Tension Load Capacity lbs. (kN)
#3	7/16	3-3/8 (86)	10,695 (47.6)	2,675 (11.9)	11,155 (49.6)	2,790 (12.4)	11,155 (49.6)	2,790 (12.4)
#4	9/16	4-1/2 (114)	17,005 (75.6)	4,250 (18.9)	17,735 (78.9)	4,435 (19.7)	19,200 (85.4)	4,800 (21.4)
#5	11/16 or 3/4	4 (102)	16,055 (71.4)	4,015 (17.9)	16,740 (74.5)	4,185 (18.6)	16,910 (75.2)	4,230 (18.8)
		5-5/8 (143)	22,460 (99.9)	5,615 (25.0)	23,420 (104.2)	5,855 (26.0)	25,705 (114.3)	6,425 (28.6)
#6	7/8	6-3/4 (172)	32,860 (146.2)	8,215 (36.5)	34,266 (152.4)	8,565 (38.1)	40,775 (181.4)	10,195 (45.3)
#7	1	7-7/8 (200)	39,520 (175.8)	9,880 (44.0)	41,210 (183.3)	10,305 (45.8)	44,030 (195.9)	11,010 (49.0)
#8	1-1/8	9 (229)	52,875 (235.2)	13,220 (58.8)	55,140 (245.3)	13,785 (61.3)	63,670 (283.2)	15,920 (70.8)
#9	1-3/8	10-1/8 (257)	61,275 (272.6)	15,320 (68.1)	63,900 (284.3)	15,975 (71.1)	68,270 (303.7)	17,070 (75.9)
#10	1-1/2	11-1/4 (286)	77,425 (344.4)	19,355 (86.1)	80,740 (359.2)	20,185 (89.8)	86,265 (383.7)	21,565 (95.9)
#11	1-3/4	12-3/8 (314)	95,680 (425.6)	23,920 (106.4)	99,755 (443.8)	24,945 (111.0)	106,595 (474.2)	26,650 (118.5)

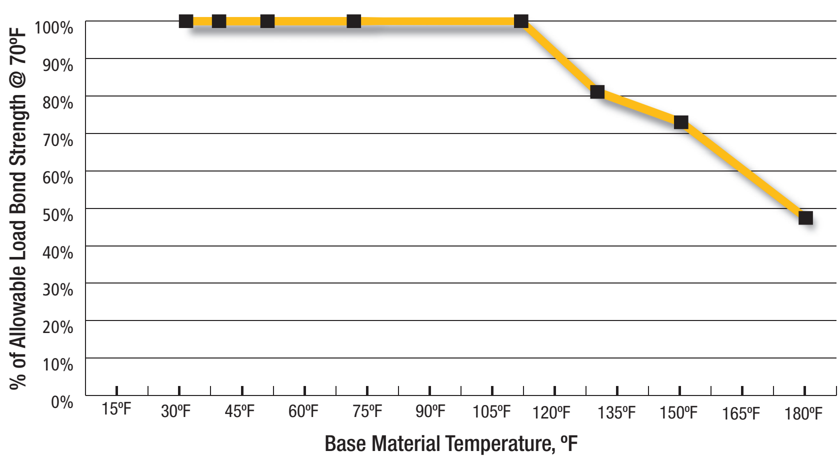
1. Allowable load capacities listed are calculated using an applied safety factor of 4.0 which includes an assessment of freezing/thawing conditions and sensitivity to sustained loads (i.e. creep resistance). Consideration of safety factors of 10 or higher may be necessary depending on the application, such as life safety or overhead.
2. Linear interpolation may be used to determine allowable loads for intermediate embedments and compressive strengths.
3. The tabulated load values are applicable to single anchors installed at critical edge and spacing distances of 3 times the embedment depth and where the minimum member thickness is the greater of [h_{nom} + 1-1/4"] and [$h_{nom} + 2d_{bit}$].
4. The tabulated load values are applicable for dry uncracked concrete installed into holes drilled with a hammer drill and an ANSI carbide drill bit. Installations in water-saturated concrete (wet) or in water-filled holes (flooded) require a 15% reduction in capacity. Installations in underwater concrete (submerged) require a 30% reduction in capacity.
5. Adhesives experience reductions in capacity at elevated temperatures. See the in-service temperature chart for allowable load capacity reduction factors.
6. Allowable bond strength/concrete capacity must be checked against allowable steel strength in tension to determine the controlling allowable load. Allowable shear capacity is controlled by allowable steel strength for the given conditions.

Allowable Load Capacities for Threaded Rod and Reinforcing Bar (Based on Steel Strength)[1,2,3,4]

Nominal Rod Diameter or Rebar Size (in. or No.)	Steel Elements - Threaded Rod and Reinforcing Bar																	
	A36 or F1554, Grade 36		A36 or F1554, Grade 55		A 193, Grade B7 or F1554, Grade 105		F 593, CW (SS)		ASTM A615 Grade 40 Rebar		ASTM A615 Grade 60 Rebar		ASTM A706 Grade 60 Rebar		ASTM A615 Grade 75 Rebar		ASTM A706 Grade 80 Rebar	
	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)	Tension lbs. (kN)	Shear lbs (kN)	Tension lbs. (kN)	Shear lbs (kN)	Tension lbs. (kN)	Shear lbs (kN)
3/8 or #3	2,115 (9.4)	1,090 (4.8)	2,735 (12.2)	1,410 (6.3)	4,555 (20.3)	2,345 (10.4)	3,645 (16.2)	1,880 (8.4)	2,210 (9.8)	1,125 (5.0)	2,650 (11.8)	1,690 (7.5)	2,650 (11.8)	1,500 (6.7)	2,650 (11.8)	1,875 (8.3)	2,650 (11.8)	1,875 (8.3)
1/2 or #4	3,760 (16.7)	1,935 (8.6)	4,860 (21.6)	2,505 (11.1)	8,100 (36.0)	4,170 (18.5)	6,480 (28.8)	3,340 (14.9)	3,925 (17.5)	2,005 (8.9)	4,710 (21.0)	3,005 (13.4)	4,710 (21.0)	2,670 (11.9)	4,710 (21.0)	3,335 (14.8)	4,710 (21.0)	3,335 (14.8)
5/8 or #5	5,870 (26.1)	3,025 (13.5)	7,595 (33.8)	3,910 (17.4)	12,655 (56.3)	6,520 (29.0)	10,125 (45.0)	5,215 (23.2)	6,135 (27.3)	3,130 (13.9)	7,365 (32.8)	4,695 (20.9)	7,365 (32.8)	4,170 (18.5)	7,365 (32.8)	5,215 (23.2)	7,365 (32.8)	5,215 (23.2)
3/4 or #6	8,455 (37.6)	4,355 (19.4)	10,935 (48.6)	5,635 (25.1)	18,225 (81.1)	9,390 (41.8)	12,390 (55.1)	6,385 (28.4)	8,835 (39.3)	4,505 (20.0)	10,605 (47.2)	6,760 (30.1)	10,605 (47.2)	6,010 (26.7)	10,605 (47.2)	7,510 (33.4)	10,605 (47.2)	7,510 (33.4)
7/8 or #7	11,510 (51.2)	5,930 (26.4)	14,885 (66.2)	7,665 (34.1)	24,805 (110.3)	12,780 (56.8)	16,865 (75.0)	8,690 (38.7)	-	-	14,430 (64.2)	9,200 (40.9)	14,430 (64.2)	8,180 (36.4)	14,430 (64.2)	10,220 (45.5)	14,430 (64.2)	10,220 (45.5)
1 or #8	15,035 (66.9)	7,745 (34.5)	19,440 (86.5)	10,015 (44.5)	32,400 (144.1)	16,690 (74.2)	22,030 (98.0)	11,350 (50.5)	-	-	18,850 (83.8)	12,015 (53.4)	18,850 (83.8)	10,680 (47.5)	18,850 (83.8)	13,350 (59.4)	18,850 (83.8)	13,350 (59.4)
#9	-	-	-	-	-	-	-	-	-	-	23,985 (106.7)	15,290 (68.0)	23,985 (106.7)	13,590 (60.5)	23,985 (106.7)	16,990 (75.6)	23,985 (106.7)	16,990 (75.6)
1-1/4	23,490 (104.5)	12,100 (53.8)	30,375 (135.1)	15,645 (69.6)	50,620 (225.2)	26,080 (116.0)	34,425 (153.1)	17,735 (78.9)	-	-	-	-	-	-	-	-	-	-
#10	-	-	-	-	-	-	-	-	-	-	30,405 (135.2)	19,380 (86.2)	30,405 (135.2)	17,230 (76.6)	30,405 (135.2)	21,535 (95.8)	30,405 (135.2)	21,535 (95.8)
1-1/2	33,805 (150.4)	17,415 (77.5)	43,715 (194.5)	22,520 (100.2)	72,860 (324.1)	37,530 (166.9)	49,540 (220.4)	25,520 (113.5)	-	-	-	-	-	-	-	-	-	-
#11	-	-	-	-	-	-	-	-	-	-	37,440 (166.5)	23,868 (106.2)	37,440 (166.5)	21,216 (94.4)	37,440 (166.5)	26,520 (118.0)	37,440 (166.5)	26,520 (118.0)

1. AISC defined steel strength (ASD) for threaded rod: Tensile = 0.33 • F_u • A_{nom}, Shear = 0.17 • F_u • A_{nom}
2. For reinforcing bars: The allowable steel tensile strength is based on 20 ksi for Grade 40 and 24 ksi for Grade 60 and higher, applied to the cross sectional area of the bar; allowable steel shear strength = 0.17 • F_u • A_{nom}
3. Allowable load capacities are calculated for the steel element type. Consideration of applying additional safety factors may be necessary depending on the application, such as life safety or overhead.
4. Allowable steel strength in tension must be checked against allowable bond strength/concrete capacity in tension to determine the controlling allowable load.

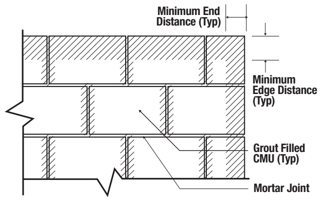
In-Service Temperature Chart For Allowable Load Capacities



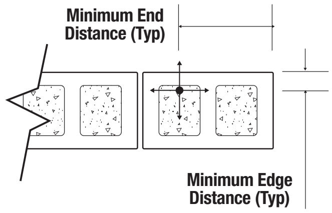
Ultimate and Allowable Load Capacities for Threaded Rod Installed with Pure110+ into Grout-Filled Masonry[1,2,3,4,5,7]

Anchor Installed Into Grouted Masonry Wall Faces								
Nominal Diameter d in.	Nominal Drill Bit d_{bit} Diameter in.	Minimum Embed. h_{nom} in. (mm)	Minimum End Distance in. (mm)	Minimum Edge Distance in. (mm)	Ultimate Load		Allowable Load	
					Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
3/8	7/16	3 (76)	12 (305)	12 (305)	6,005 (26.7)	5,200 (23.1)	1,200 (5.3)	1,040 (4.6)
1/2	9/16	4 (102)	12 (305)	12 (305)	8,650 (38.5)	8,845 (39.3)	1,730 (7.7)	1,770 (7.9)
5/8	11/16	5 (127)	12 (305)	12 (305)	12,840 (57.1)	8,430 (37.5)	2,570 (11.4)	1,685 (7.5)
3/4	7/8	6 (153)	20 (508)	20 (508)	19,560 (87.0)	12,685 (56.4)	3,910 (17.4)	2,540 (11.3)
Anchor Installed in the Tops of Grouted Masonry Walls[6]								
Nominal Diameter d in.	Nominal Drill Bit d_{bit} Diameter in.	Minimum Embed. h_{nom} in. (mm)	Minimum End Distance in. (mm)	Minimum Edge Distance in. (mm)	Ultimate Load		Allowable Load	
					Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
1/2	9/16	4 (102)	4 (102)	1-3/4 (45)	5,135 (22.8)	1,750 (7.8)	1,030 (4.6)	350 (1.6)
5/8	11/16	5 (127)	4 (102)	2-3/4 (70)	5,360 (23.6)	3,130 (13.9)	1,070 (4.8)	625 (2.8)

1. Tabulated load values are for 3/8" and 1/2" diameter anchors installed in minimum 6" wide, Grade N, Type II, lightweight concrete masonry units conforming to ASTM C90 that have reached the minimum designated ultimate compressive strength at the time of installation (f'm ≥ 1,500 psi). Grout must have a minimum compressive strength of 2,000 psi. Mortar and minimum mortar strength must be Types M, S or N.
2. Tabulated load values are for 5/8" and 3/4" diameter anchors installed in 8" wide, Grade N, Type II, lightweight concrete masonry units conforming to ASTM C90 that have reached the minimum designated ultimate compressive strength at the time of installation (f'm ≥ 1,500 psi). Grout must have a minimum compressive strength of 2,000 psi. Mortar and minimum mortar strength must be Types M, S or N.
3. Anchors must be installed in grouted cells and the minimum edge and end distances must be maintained.
4. Allowable load capacities listed are calculated using an applied safety factor of 5.0 and must be checked against the allowable tension and shear capacities for threaded rod based on steel strength to determine the controlling allowable load.
5. The tabulated values are applicable for anchors installed into grouted masonry wall faces and masonry wall tops at a critical spacing distance, s_{cr}, between anchors of 3 times the embedment depth. Minimum spacing distance for anchors installed into grouted masonry wall faces may be reduced to 1.5 times embedment depth provided the tabulated allowable tension load values are multiplied by a reduction factor of 0.65 and the allowable shear load values are multiplied by a reduction factor of 0.50. Linear interpolation may be used to determine values for intermediate spacing distances.
6. Anchor installations into tops of grouted masonry walls are limited to one per masonry cell.
7. The tabulated values must be adjusted for increased in-service base material temperatures in accordance with the In-Service Temperature chart, as applicable.



Wall Face
Permissible Anchor Locations
(Un-hatched Area)



Top of Wall

Ultimate and Allowable Load Capacities for Threaded Rod Installed with Pure110+ into Hollow Concrete Masonry Walls with Plastic Screen Tubes[1,2,3,4,5]

Nominal Anchor Diameter / Screen Tube Size in.	Nominal Drill Bit Diameter d_{bit} in.	Minimum End Distance in. (mm)	Minimum Edge Distance in. (mm)	ASTM C90 Block	Ultimate Load		Allowable Load	
					Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
3/8	9/16	3-3/4 (95)	3-3/4 (95)	Lightweight	790 (3.5)	900 (4.0)	160 (0.7)	180 (0.8)
1/2	5/8	3-3/4 (95)	3-3/4 (95)	Lightweight	1,255 (5.6)	1,350 (6.0)	250 (1.1)	270 (1.2)
5/8	3/4	3-3/4 (95)	3-3/4 (95)	Normal-weight[4]	1,545 (6.9)	1,675 (7.5)	310 (1.4)	335 (1.5)
3/4	1	3-3/4 (95)	3-3/4 (95)	Normal-weight[4]	1,545 (6.9)	1,675 (7.5)	310 (1.4)	335 (1.5)

1. Tabulated load values are for anchors installed in minimum 8" wide, Grade N, Type II, lightweight or normal weight concrete masonry units conforming to ASTM C 90 that have reached a designated ultimate compressive strength at the time of installation (f'm ≥ 1,500 psi). Mortar and minimum mortar strength must meet Type N, S or M.
2. Allowable loads 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. Anchor spacing is limited to one per masonry cell.
4. The tabulated load values are applicable to normal-weight concrete masonry units with a minimum face shell thickness of 1-1/2 inches.
5. The tabulated values must be adjusted for increased in-service base material temperatures in accordance with the In-Service Temperature chart, as applicable.

STRENGTH DESIGN INFORMATION

Steel Tension and Shear Design for Threaded Rod in Normal Weight Concrete

CODE LISTED ICC-ES ESR-3298

Design Information		Symbol	Units	Nominal Rod Diameter[1] (inch)						
				3/8	1/2	5/8	3/4	7/8	1	1-1/4
Threaded rod nominal outside diameter		d	inch (mm)	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)
Threaded rod effective cross-sectional area		A_{se}	inch² (mm²)	0.0775 (50)	0.1419 (92)	0.2260 (146)	0.3345 (216)	0.4617 (298)	0.6057 (391)	0.9691 (625)
ASTM A36 and ASTM F1554 Grade 36	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lbf (kN)	4,495 (20.0)	8,230 (36.6)	13,110 (58.3)	19,400 (86.3)	26,780 (119.1)	35,130 (156.3)	56,210 (250.0)
		V_{sa}	lbf (kN)	2,695 (12.0)	4,940 (22.0)	7,860 (35.0)	11,640 (51.8)	16,070 (71.4)	21,080 (93.8)	33,725 (150.0)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.80	0.80	0.80	0.80	0.80	0.80	0.80
	Strength reduction factor for tension[2]	ϕ	-	0.75						
	Strength reduction factor for shear[2]	ϕ	-	0.65						
ASTM F1554 Grade 55	Nominal strength as governed by steel strength(for a single anchor)	N_{sa}	lbf (kN)	5,810 (25.9)	10,640 (47.3)	16,950 (75.4)	25,085 (111.6)	34,625 (154.0)	45,425 (202.0)	72,680 (323.3)
		V_{sa}	lbf (kN)	3,485 (15.5)	6,385 (28.4)	10,170 (45.2)	15,050 (67.0)	20,775 (92.4)	27,255 (121.2)	43,610 (194.0)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.80	0.80	0.80	0.80	0.80	0.80	0.80
	Strength reduction factor for tension[2]	ϕ	-	0.75						
	Strength reduction factor for shear[2]	ϕ	-	0.65						
ASTM A193 Grade B7 and ASTM F1554 Grade 105	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lbf (kN)	9,685 (43.1)	17,735 (78.9)	28,250 (125.7)	41,810 (186.0)	57,710 (256.7)	75,710 (336.8)	121,135 (538.8)
		V_{sa}	lbf (kN)	5,815 (25.9)	10,640 (7.3)	16,950 (75.4)	25,085 (111.6)	34,625 (154.0)	45,425 (202.1)	72,680 (323.3)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.80	0.80	0.80	0.80	0.80	0.80	0.80
	Strength reduction factor for tension[2]	ϕ	-	0.75						
	Strength reduction factor for shear[2]	ϕ	-	0.65						
ASTM A449	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lbf (kN)	9,300 (41.4)	17,025 (75.7)	27,120 (120.6)	40,140 (178.5)	55,905 (248.7)	72,685 (323.3)	101,755 (452.6)
		V_{sa}	lbf (kN)	5,580 (24.8)	10,215 (45.4)	16,270 (72.4)	24,085 (107.1)	33,540 (149.2)	43,610 (194.0)	61,050 (271.6)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.80	0.80	0.80	0.80	0.80	0.80	0.80
	Strength reduction factor for tension[2]	ϕ	-	0.75						
	Strength reduction factor for shear[2]	ϕ	-	0.65						
ISO 898-1 Class 5.8	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lbf (kN)	5,620 (25.0)	10,290 (45.8)	16,385 (72.9)	24,250 (107.9)	33,475 (148.9)	43,915 (195.4)	-[5]
		V_{sa}	lbf (kN)	3,370 (15.0)	6,175 (27.5)	9,830 (43.7)	14,550 (64.7)	20,085 (89.3)	26,350 (117.2)	-[5]
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.80	0.80	0.80	0.80	0.80	0.80	-[5]
	Strength reduction factor for tension[3]	ϕ	-	0.65						
	Strength reduction factor for shear[3]	ϕ	-	0.60						
ASTM F593 CW Stainless (Types 304 and 316)	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lbf (kN)	7,750 (34.5)	14,190 (63.1)	22,600 (100.5)	28,430 (126.5)	39,245 (174.6)	51,485 (229.0)	82,370 (366.4)
		V_{sa}	lbf (kN)	4,650 (20.7)	8,515 (37.9)	13,560 (60.3)	17,060 (75.9)	23,545 (104.7)	30,890 (137.4)	49,425 (219.8)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.70	0.70	0.80	0.80	0.80	0.80	0.80
	Strength reduction factor for tension[3]	ϕ	-	0.65						
	Strength reduction factor for shear[3]	ϕ	-	0.60						
ASTM A193 Grade B8/B8M, Class 1 Stainless (Types 304 and 316)	Nominal strength as governed by steel strength (for a single anchor)[4]	N_{sa}	lbf (kN)	4,420 (19.7)	8,090 (36.0)	12,880 (57.3)	19,065 (84.8)	26,315 (117.1)	34,525 (153.6)	55,240 (245.7)
		V_{sa}	lbf (kN)	2,650 (11.8)	4,855 (21.6)	7,730 (34.4)	11,440 (50.9)	15,790 (70.2)	20,715 (92.1)	33,145 (147.4)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.70	0.70	0.80	0.80	0.80	0.80	0.80
	Strength reduction factor for tension[2]	ϕ	-	0.75						
	Strength reduction factor for shear[2]	ϕ	-	0.65						
ASTM A193 Grade B8/ B8M2, Class 2B Stainless (Types 304 and 316)	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lbf (kN)	7,365 (32.8)	13,480 (60.0)	21,470 (95.5)	31,775 (141.3)	43,860 (195.1)	57,545 (256.0)	92,065 (409.5)
		V_{sa}	lbf (kN)	4,420 (19.7)	8,085 (36.0)	12,880 (57.3)	19,065 (84.8)	26,315 (117.1)	34,525 (153.6)	55,240 (245.7)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.70	0.70	0.80	0.80	0.80	0.80	0.80
	Strength reduction factor for tension[2]	ϕ	-	0.75						
	Strength reduction factor for shear[2]	ϕ	-	0.65						

For SI: 1 inch = 25.4 mm, 1 lbf = 4.448 N. For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf.

1. Values provided for steel element material types are based on minimum specified strengths and calculated in accordance with ACI 318-19 Eq. 17.6.1.2 and Eq. 17.7.1.2(b) or ACI 318-14 Eq. 17.4.1.2 and Eq. 17.5.1.2b or ACI 318-11 Eq. (D-2) and Eq. (D-29), as applicable, except where noted. Nuts and washers must be appropriate for the rod. Nuts must have specified proof load stresses equal to or greater than the minimum tensile strength of the specified threaded rod.
2. The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318 (-19 or -14) 5.3 or ACI 318-11 9.2, as applicable, are used in accordance with ACI 318-19 Section 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318 D.4.4. Values correspond to ductile steel elements.
3. The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318 (-19 or -14) 5.3 or ACI 318-11 9.2, as applicable, are used in accordance with ACI 318-19 Section 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318 D.4.4. Values correspond to brittle steel elements
4. In accordance with ACI 318-19 Eq. 17.6.1.2 and Eq. 17.7.1.2(b), ACI 318-14 17.4.1.2 and 17.5.1.2 or ACI 318-11 D.5.1.2 and D.6.1.2, as applicable, the calculated values for nominal tension and shear strength for ASTM A193 Grade B8/B8M Class 1 stainless steel threaded rods are based on limiting the specified tensile strength of the anchor steel to $1.9f_y$ or 57,000 psi (393 MPa).
5. The referenced standard includes rod diameters up to and including 1-inch (24 mm).

Steel Tension and Shear Design for Reinforcing Bars in Normal Weight Concrete

CODE LISTED
ICC-ES ESR-3298

Design Information		Symbol	Units	Nominal Reinforcing Bar Size (Rebar)[1]							
				No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10
Rebar nominal outside diameter		d	inch (mm)	0.375 (9.5)	0.500 (12.7)	0.625 (15.9)	0.750 (19.1)	0.875 (22.2)	1.000 (25.4)	1.125 (28.7)	1.250 (32.3)
Rebar effective cross-sectional area		A_{se}	inch² (mm²)	0.110 (71.0)	0.200 (129.0)	0.310 (200.0)	0.440 (283.9)	0.600 (387.1)	0.790 (509.7)	1.000 (645.2)	1.270 (819.4)
ASTM A615 Grade 75	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lbf (kN)	11,000 (48.9)	20,000 (89.0)	31,000 (137.9)	44,000 (195.7)	60,000 (266.9)	79,000 (351.4)	100,000 (444.8)	127,000 (564.9)
		V_{sa}	lbf (kN)	6,600 (29.4)	12,000 (53.4)	18,600 (82.7)	26,400 (117.4)	36,000 (160.1)	47,400 (210.8)	60,000 (266.9)	76,200 (338.9)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.70	0.70	0.80	0.80	0.80	0.80	0.80	0.80
	Strength reduction factor for tension[3]	ϕ	-	0.65							
	Strength reduction factor for shear[3]	ϕ	-	0.60							
ASTM A615 Grade 60	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lbf (kN)	9,900 (44.0)	18,000 (80.1)	27,900 (124.1)	39,600 (176.1)	54,000 (240.2)	71,100 (316.3)	90,000 (400.3)	114,300 (508.4)
		V_{sa}	lbf (kN)	5,940 (26.4)	10,800 (48.0)	16,740 (74.5)	23,760 (105.7)	32,400 (144.1)	42,660 (189.8)	54,000 (240.2)	68,580 (305.0)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.70	0.70	0.80	0.80	0.80	0.80	0.80	0.80
	Strength reduction factor for tension[3]	ϕ	-	0.65							
	Strength reduction factor for shear[3]	ϕ	-	0.60							
ASTM A706 Grade 60	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lbf (kN)	8,800 (39.1)	16,000 (71.2)	24,800 (110.3)	35,200 (156.6)	48,000 (213.5)	63,200 (281.1)	80,000 (355.9)	101,600 (452.0)
		V_{sa}	lbf (kN)	5,280 (23.5)	9,600 (42.7)	14,880 (66.2)	21,120 (94.0)	28,800 (128.1)	37,920 (168.7)	48,000 (213.5)	60,960 (271.2)
	Reduction factor for seismic shear	$\alpha_{V,seis}$		0.70	0.70	0.80	0.80	0.80	0.80	0.80	0.80
	Strength reduction factor for tension[2]	ϕ	-	0.75							
	Strength reduction factor for shear[2]	ϕ	-	0.65							
ASTM A615 Grade 40	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lbf (kN)	6,600 (29.4)	12,000 (53.4)	18,600 (82.7)	26,400 (117.4)	In accordance with ASTM A 615, Grade 40 bars are furnished only in sizes No. 3 through No. 6			
		V_{sa}	lbf (kN)	3,960 (17.6)	7,200 (32.0)	11,160 (49.6)	15,840 (70.5)				
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.70	0.70	0.80	0.80				
	Strength reduction factor for tension[3]	ϕ	-	0.65							
	Strength reduction factor for shear[3]	ϕ	-	0.60							

For SI: 1 inch = 25.4 mm, 1 lbf = 4.448 N. For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf.

1. Values provided for reinforcing bar material types based on minimum specified strengths and calculated in accordance with ACI 318-19 Eq. 17.6.1.2 and Eq. 17.7.1.2(b), ACI 318-14 Eq. 17.4.1.2 and Eq. 17.5.1.2b or ACI 318-11 Eq. (D-2) and Eq. (D-29), as applicable.
2. The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318 (-19 or -14) 5.3 or ACI 318-11 9.2, as applicable, are used in accordance with ACI 318-19 Section 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318 D.4.4. Values correspond to ductile steel elements. In accordance with ACI 318-14 17.2.3.4.3(a)(vi) or ACI 318-11 D.3.3.4.3(a)6, as applicable, deformed reinforcing bars meeting this specification used as ductile steel elements to resist earthquake effects shall be limited to reinforcing bars satisfying the requirements of ACI 318-14 20.2.2.4 and 20.2.2.5 or ACI 318-11 21.1.5.2 (a) and (b), as applicable.
3. The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318 (-19 or -14) 5.3, or ACI 318-11 9.2, as applicable, are used in accordance with ACI 318-19 Section 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318 D.4.4. Values correspond to brittle steel elements.

Concrete Breakout Design Information for Threaded Rod and Reinforcing Bars

CODE LISTED ICC-ES ESR-3298

Design Information	Symbol	Units	Nominal Rod Diameter (inch) / Reinforcing Bar Size							
			3/8 or #3	1/2 or #4	5/8 or #5	3/4 or #6	7/8 or #7	1 or #8	#9	1-1/4 or #10
Effectiveness factor for cracked concrete	$k_{c,cr}$	- (SI)	17 (7.1)							
Effectiveness factor for uncracked concrete	$k_{c,uncr}$	- (SI)	24 (10.0)							
Minimum embedment	$h_{ef,min}$	inch (mm)	2-3/8 (60)	2-3/4 (70)	3-1/8 (79)	3-1/2 (89)	3-1/2 (89)	4 (102)	4-1/2 (114)	5 (127)
Maximum embedment	$h_{ef,max}$	inch (mm)	7-1/2 (191)	10 (254)	12-1/2 (318)	15 (381)	17-1/2 (445)	20 (508)	22-1/2 (572)	25 (635)
Minimum anchor spacing	s_{min}	inch (mm)	1-7/8 (48)	2-1/2 (64)	3-1/8 (79)	3-3/4 (95)	4-3/8 (111)	5 (127)	5-5/8 (143)	6-1/4 (159)
Minimum edge distance[2]	c_{min}	inch (mm)	5*d* where *d* is nominal outside diameter of the anchor							
Minimum edge distance, reduced[2] (45% T_{max})	$c_{min,red}$	inch (mm)	1-3/4 (45)	1-3/4 (45)	1-3/4 (45)	1-3/4 (45)	1-3/4 (45)	1-3/4 (45)	2-3/4 (70)	2-3/4 (70)
Minimum member thickness	h_{min}	inch (mm)	h_{ef} + 1-1/4 (h_{ef} + 30)	$h_{ef} + 2d_o$ where d_o is hole diameter;						
Critical edge distance—splitting (for uncracked concrete only)[3]	c_{ac}	inch	$c_{ac} = h_{ef} \cdot (\frac{\tau_{uncr}}{1160})^{0.4} \cdot [3.1 - 0.7 \frac{h}{h_{ef}}]$							
		(mm)	$c_{ac} = h_{ef} \cdot (\frac{\tau_{uncr}}{8})^{0.4} \cdot [3.1 - 0.7 \frac{h}{h_{ef}}]$							
Strength reduction factor for tension, concrete failure modes, Condition B[4]	ϕ	-	0.65							
Strength reduction factor for shear, concrete failure modes, Condition B[4]	ϕ	-	0.70							

For SI: 1 inch = 25.4 mm, 1 lbf = 4.448 N. For pound-inch units: 1 mm = 0.03937 inch, 1 N = 0.2248 lbf.

1. Additional setting information is described in the installation instructions.
2. For installation between the minimum edge distance, c_{min}, and the reduced minimum edge distance, $c_{min,red}$, the maximum torque applied must be reduced (multiplied) by a factor of 0.45.
3. $\tau_{k,uncr}$ need not be taken as greater than: $\tau_{k,uncr} = \frac{k_{uncr} \cdot \sqrt{h_{ef} \cdot f'_c}}{\pi \cdot d}$ and $\frac{h}{h_{ef}}$ need not be taken as larger than 2.4.
4. Condition A requires supplemental reinforcement, while Condition B applies where supplemental reinforcement is not provided or where pryout governs, as set forth in ACI 318-19 Section 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318 (-19 or -14) 5.3 or ACI 318-11 9.2, as applicable, are used in accordance with ACI 318-19 Section 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318 D.4.4.

Bond Strength Design Information for Threaded Rods and Reinforcing Bars[1,2]

CODE LISTED
ICC-ES ESR-3298

Design Information		Symbol	Units	Nominal Rod Diameter (inch)						
				3/8	1/2	5/8	3/4	7/8	1	1-1/4
Minimum embedment		$h_{ef,min}$	inch (mm)	2-3/8 (60)	2-3/4 (70)	3-1/8 (79)	3-1/2 (89)	3-1/2 (89)	4 (102)	5 (127)
Maximum embedment		$h_{ef,max}$	inch (mm)	7-1/2 (191)	10 (254)	12-1/2 (318)	15 (381)	17-1/2 (445)	20 (508)	25 (635)
110°F (43°C) Maximum Long-Term Service Temperature; 140°F (60°C) Maximum Short-Term Service Temperature[3,5]	Characteristic bond strength in cracked concrete[6,9]	$\tau_{k,cr}$	psi (N/mm²)	1,206 (8.3)	1,206 (8.3)	1,206 (8.3)	1,206 (8.3)	1,206 (8.3)	1,206 (8.3)	1,206 (8.3)
	Characteristic bond strength in uncracked concrete[6,8]	$\tau_{k,uncr}$	psi (N/mm²)	1,829 (12.6)	1,738 (12.0)	1,671 (11.5)	1,617 (11.1)	1,567 (10.8)	1,538 (10.6)	1,479 (10.2)
110°F (43°C) Maximum Long-Term Service Temperature; 176°F (80°C) Maximum Short-Term Service Temperature[4,5]	Characteristic bond strength in cracked concrete[6,9]	$\tau_{k,cr}$	psi (N/mm²)	882 (6.1)	882 (6.1)	882 (6.1)	882 (6.1)	882 (6.1)	882 (6.1)	882 (6.1)
	Characteristic bond strength in uncracked concrete[6,8]	$\tau_{k,uncr}$	psi (N/mm²)	1,334 (9.2)	1,262 (8.7)	1,218 (8.4)	1,175 (8.1)	1,146 (7.9)	1,117 (7.7)	1,073 (7.4)

Design Information		Symbol	Units	Nominal Bar Size							
				#3	#4	#5	#6	#7	#8	#9	#10
Minimum embedment		$h_{ef,min}$	inch (mm)	2-3/8 (60.0)	2-3/4 (70.0)	3-1/8 (79.0)	3-1/2 (89.0)	3-1/2 (89.0)	4 (102.0)	4-1/2 (114.0)	5 (127.0)
Maximum embedment		$h_{ef,max}$	inch (mm)	7-1/2 (191.0)	10 (254.0)	12-1/2 (318.0)	15 (381.0)	17-1/2 (445.0)	20 (508.0)	22-1/2 (572.0)	25 (635.0)
110°F (43°C) Maximum Long-Term Service Temperature; 140°F (60°C) Maximum Short-Term Service Temperature[3,5]	Characteristic bond strength in cracked concrete[6,9]	$\tau_{k,cr}$	psi (N/mm²)	1,206 (8.3)	1,170 (8.1)	1,122 (7.7)	1,122 (7.7)	1,122 (7.7)	1,122 (7.7)	1,122 (7.7)	1,122 (7.7)
	Characteristic bond strength in uncracked concrete[6,8]	$\tau_{k,uncr}$	psi (N/mm²)	1,829 (12.6)	1,738 (12.0)	1,671 (11.5)	1,617 (11.1)	1,567 (10.8)	1,538 (10.6)	1,507 (10.4)	1,479 (10.2)
110°F (43°C) Maximum Long-Term Service Temperature; 176°F (80°C) Maximum Short-Term Service Temperature[4,5]	Characteristic bond strength in cracked concrete[6,9]	$\tau_{k,cr}$	psi (N/mm²)	882 (6.1)	848 (5.8)	814 (5.6)	814 (5.6)	814 (5.6)	814 (5.6)	814 (5.6)	814 (5.6)
	Characteristic bond strength in uncracked concrete[6,8]	$\tau_{k,uncr}$	psi (N/mm²)	1,334 (9.2)	1,262 (8.7)	1,218 (8.4)	1,175 (8.1)	1,146 (7.9)	1,117 (7.7)	1,102 (7.6)	1,073 (7.4)
Permissible installation conditions[7]	Dry concrete	Anchor Category		1							
		ϕ_d		0.65							
	Water-saturated concrete, or Water-filled hole (flooded)	Anchor Category		2							
		ϕ_{ws}, ϕ_{wf}		0.55							
	Underwater (submerged)	Anchor Category		2				3			
		ϕ_{uw}		0.55				0.45			
Reduction factor for seismic tension[9]		$\alpha_{N,seis}$		1.0							

For SI: 1 inch = 25.4 mm, 1 psi = 0.006894 MPa. For pound-inch units: 1 mm = 0.03937 inch, 1 MPa = 145.0 psi.

1. Bond strength values correspond to a normal-weight concrete compressive strength f'c = 2,500 psi (17.2 MPa). For concrete compressive strength, f'c between 2,500 psi and 8,000 psi (17.2 MPa and 55.2 MPa), the tabulated characteristic bond strength may be increased by a factor of $(f'c / 2{,}500)^{0.23}$ [For SI: $(f'c / 17.2)^{0.23}$].
2. The modification factor for bond strength of adhesive anchors in lightweight concrete shall be taken as given in ACI 318-19 17.2.4.1, ACI 318-14 17.2.6 or ACI 318-11 D.3.6, as applicable, where applicable.
3. The maximum short-term service temperature may be increased to 162°F (72°C) provided characteristic bond strengths are reduced by 3 percent. Long-term and short-term temperatures meet the requirements of Section 8.5 of ACI 355.4 and Table 8.1, Temperature Category B.
4. Long-term and short-term temperatures meet the requirements of Section 8.5 of ACI 355.4 and Table 8.1, Temperature Category A.
5. Short-term base material service temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling. Long-term elevated concrete base material service temperatures are roughly constant over significant periods of time.
6. Characteristic bond strengths are for sustained loads including dead and live loads. Characteristic bond strengths are also applicable to short-term loading.
7. Permissible installation conditions include dry concrete, water-saturated concrete, water-filled holes and underwater (submerged) applications. Water-filled holes include applications in dry or water-saturated concrete where the drilled holes contain standing water at the time of anchor installation.
8. Bond strength values for uncracked concrete are applicable for structures assigned to Seismic Design Categories A and B only.
9. For structures assigned to Seismic Design Categories C, D, E or F, the tabulated bond strength values for cracked concrete do not require an additional reduction factor applied for seismic tension ($\alpha_{N,seis}$ = 1.0), where seismic design is applicable.

DESIGN STRENGTH TABLES (SD)

Tension and Shear Design Strength for Threaded Rod Installed in Uncracked Concrete (Bond or Concrete Strength) Drilled with a Hammer-Drill and Carbide Bit in a Dry Hole Condition 110°F (43°C) Maximum Long-Term Service Temperature; 140°F (60°C) Maximum Short-Term Service Temperature[1,2,3,4,5,6,7,8,9,10,11]

Nominal Rod/Rebar Size (in.)	Embed. Depth h_{ef} (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_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)
3/8	2-3/8	2,855	2,570	3,125	2,920	3,610	3,575	4,070	4,380	4,345	4,680
	3	4,055	4,010	4,380	4,530	4,680	5,370	5,140	6,830	5,490	8,095
	4-1/2	6,305	7,420	6,575	8,270	7,020	9,805	7,710	12,465	8,235	14,775
	7-1/2	10,505	15,800	10,955	17,600	11,705	20,865	12,845	26,530	13,725	29,565
1/2	2-3/4	3,555	3,305	3,895	3,755	4,500	4,590	5,510	6,095	6,365	7,455
	4	6,240	6,700	6,835	7,610	7,895	9,310	8,680	11,845	9,275	14,045
	6	10,645	12,850	11,105	14,315	11,865	16,970	13,020	21,575	13,915	25,585
	10	17,745	27,370	18,505	30,485	19,770	36,150	21,705	45,955	23,190	49,945
5/8	3-1/8	4,310	4,120	4,720	4,680	5,450	5,725	6,675	7,600	7,710	9,295
	5	8,720	10,005	9,555	11,365	11,030	13,900	13,040	18,205	13,935	21,585
	7-1/2	15,995	19,745	16,680	22,000	17,820	26,080	19,565	33,160	20,900	39,315
	12-1/2	26,660	42,065	27,800	46,860	29,700	55,560	32,605	70,225	34,835	75,030
3/4	3-1/2	5,105	5,015	5,595	5,700	6,460	6,970	7,910	9,255	9,135	11,320
	6	11,465	13,595	12,560	15,445	14,500	18,895	17,760	25,095	19,415	30,030
	9	21,060	26,855	23,070	30,510	24,835	36,285	27,260	46,130	29,125	54,695
	15	37,145	58,530	38,740	65,200	41,390	77,305	45,435	97,855	48,540	104,550
7/8	3-1/2	5,105	4,930	5,595	5,605	6,460	6,855	7,910	9,100	9,135	11,130
	7	14,445	16,605	15,825	18,865	18,275	23,075	22,380	30,650	25,610	37,355
	10-1/2	26,540	32,800	29,070	37,265	32,755	45,135	35,955	57,380	38,415	68,035
	17-1/2	49,000	72,810	51,095	81,105	54,590	96,165	59,930	122,255	64,025	137,905
1	4	6,240	6,115	6,835	6,945	7,895	8,495	9,665	11,280	11,160	13,800
	8	17,650	19,750	19,335	22,435	22,325	27,440	27,340	36,450	31,570	44,580
	12	32,425	39,005	35,520	44,315	41,015	54,200	46,095	69,560	49,250	82,475
	20	62,815	88,270	65,505	98,330	69,985	116,585	76,825	148,215	82,080	175,735
1-1/4	5	8,720	8,170	9,555	9,285	11,030	11,355	13,510	15,085	15,600	18,450
	10	24,665	26,380	27,020	29,975	31,200	36,660	38,210	48,690	44,125	59,555
	15	45,315	52,110	49,640	59,200	57,320	72,410	69,260	95,655	74,000	113,420
	25	94,380	121,400	98,420	135,235	105,155	160,345	115,435	203,845	123,330	241,695

☐ - Concrete Breakout Strength ☐ - Bond Strength/Pryout Strength

1. Tabular values are provided for illustration and are applicable for single anchors installed in uncracked 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 according to ACI 318 (-19 or -14) Ch. 17 and ICC-ES AC308. The load level corresponding to the failure mode listed [Concrete breakout strength, bond strength/pryout strength] must be checked against the tabulated steel strength of the corresponding threaded rod or rebar size and type, the lowest load level controls.
3. Strength reduction factors (ϕ) for concrete breakout strength are based on ACI 318 (-19 or -14) Section 5.3 for load combinations. Condition B was assumed.
4. Strength reduction factors (ϕ) for bond strength are determined from reliability testing and qualification in accordance with ICC-ES AC308 and are tabulated in this product information and in ESR-3298.
5. Tabular values are permitted for static loads only, seismic loading is not considered with these tables. Periodic special inspection must be performed where required by code, see ESR-3298 for applicable information.
6. For anchors subjected to tension resulting from sustained loading a supplemental check must be performed according to ACI 318 -19 17.5.2.2, or ACI 318-14 17.3.1.2.
7. For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318 (-19 or -14) Ch. 17.
8. Interpolation is not permitted to be used with the tabular values. For intermediate base material compressive strengths, please see ACI 318 (-19 or -14) Ch. 17, ICC-ES AC308 and information included in this product supplement. For other design conditions including seismic considerations please see ACI 318 (-19 or -14) Ch. 17 and ICC-ES AC308 and ESR-3298.
9. Long term concrete temperatures are roughly constant over significant periods of time. Short-term elevated temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.
10. The tabulated design strengths may be converted to allowable stress design values. Divide by conversion factor calculated as a weighted average of the load factors for the controlling load combination.
11. For other installation conditions such as water-saturated concrete, water-filled holes or underwater applications, see the associated strength reduction factors (ϕ) for bond strength in the determination of controlling design strength values, as applicable.

Tension and Shear Design Strength for Threaded Rod Installed in Cracked Concrete (Bond or Concrete Strength) Drilled with a Hammer-Drill and Carbide Bit in a Dry Hole Condition 110°F (43°C) Maximum Long-Term Service Temperature; 140°F (60°C) Maximum Short-Term Service Temperature[1,2,3,4,5,6,7,8,9,10,11,12]

Nominal Rod/Rebar Size (in. or #)	Embed. Depth h_{ef} (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_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)
3/8	2-3/8	2,020	1,835	2,215	2,085	2,445	2,555	2,685	2,890	2,865	3,085
	3	2,770	2,865	2,890	3,235	3,085	3,835	3,390	4,875	3,620	5,785
	4-1/2	4,155	5,300	4,335	5,905	4,630	7,005	5,085	8,900	5,430	10,555
	7-1/2	6,925	11,285	7,225	12,570	7,715	14,905	8,470	18,245	9,050	19,495
1/2	2-3/4	2,520	2,360	2,760	2,680	3,185	3,280	3,905	4,355	4,425	5,325
	4	4,420	4,785	4,840	5,435	5,490	6,650	6,025	8,460	6,435	10,030
	6	7,390	9,180	7,705	10,225	8,230	12,125	9,035	15,410	9,655	18,275
	10	12,315	19,550	12,840	21,775	13,720	25,820	15,060	32,435	16,090	34,655
5/8	3-1/8	3,050	2,940	3,345	3,340	3,860	4,090	4,730	5,430	5,460	6,640
	5	6,175	7,145	6,765	8,120	7,815	9,930	9,415	13,005	10,055	15,415
	7-1/2	11,350	14,105	12,040	15,715	12,860	18,630	14,120	23,685	15,085	28,080
	12-1/2	19,240	30,045	20,065	33,470	21,435	39,685	23,530	50,455	25,140	54,150
3/4	3-1/2	3,620	3,580	3,965	4,070	4,575	4,980	5,605	6,610	6,470	8,085
	6	8,120	9,710	8,895	11,035	10,270	13,495	12,580	17,925	14,480	21,450
	9	14,920	19,185	16,340	21,795	18,520	25,920	20,330	32,950	21,720	39,070
	15	27,705	41,805	28,890	46,570	30,870	55,220	33,885	70,200	36,205	77,975
7/8	3-1/2	3,620	3,525	3,965	4,000	4,575	4,895	5,605	6,500	6,470	7,950
	7	10,230	11,860	11,210	13,475	12,945	16,485	15,850	21,895	18,305	26,680
	10-1/2	18,800	23,430	20,590	26,620	23,780	32,240	27,675	40,985	29,565	48,595
	17-1/2	37,710	52,005	39,325	57,935	42,015	68,690	46,120	87,325	49,275	103,540
1	4	4,420	4,365	4,840	4,960	5,590	6,065	6,845	8,060	7,905	9,855
	8	12,500	14,105	13,695	16,025	15,815	19,600	19,365	26,035	22,365	31,845
	12	22,965	27,860	25,160	31,655	29,050	38,715	35,580	49,685	38,615	58,910
	20	49,255	63,050	51,365	70,235	54,875	83,275	60,240	105,870	64,360	125,525
1-1/4	5	6,175	5,835	6,765	6,630	7,815	8,110	9,570	10,775	11,050	13,175
	10	17,470	18,845	19,140	21,410	22,100	26,185	27,065	34,780	31,255	42,540
	15	32,095	37,220	35,160	42,285	40,600	51,720	49,725	68,325	57,415	81,015
	25	69,060	86,715	75,655	96,595	85,745	114,530	94,125	145,605	100,565	172,640

☐ - Concrete Breakout Strength ☐ - Bond Strength/Pryout Strength

1. Tabular values are provided for illustration and are applicable for single anchors installed in cracked 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 according toACI 318 (-19 or -14) Ch. 17 and ICC-ES AC308. The load level corresponding to the failure mode listed [Concrete breakout strength, bond strength/pryout strength] must be checked against the tabulated steel strength of the corresponding threaded rod or rebar size and type, the lowest load level controls.
3. Strength reduction factors (ϕ) for concrete breakout strength are based on ACI 318 (-19 or -14) 5.3 for load combinations. Condition B was assumed.
4. Strength reduction factors (ϕ) for bond strength are determined from reliability testing and qualification in accordance with ICC-ES AC308 and are tabulated in this product information and in ESR-3298.
5. Tabular values are permitted for static loads only, seismic loading is not considered with these tables. Periodic special inspection must be performed where required by code, see ESR-3298 for applicable information.
6. For anchors subjected to tension resulting from sustained loading a supplemental check must be performed according to ACI 318 -19 17.5.2.2, ACI 318-14 17.3.1.2.
7. For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318 (-19 or -14) Ch. 17.
8. Interpolation is not permitted to be used with the tabular values. For intermediate base material compressive strengths, please see ACI 318 (-19 or -14) Ch. 17, ICC-ES AC308 and information included in this product supplement. For other design conditions including seismic considerations please see ACI 318 (-19 or -14) Ch. 17 and ICC-ES AC308 and ESR-3298.
9. Long term concrete temperatures are roughly constant over significant periods of time. Short-term elevated temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.
10. The tabulated design strengths may be converted to allowable stress design values. Divide by conversion factor calculated as a weighted average of the load factors for the controlling load combination.
11. For seismic design in accordance with ACI 318, the tabulated tension design strengths in cracked concrete for concrete breakout and bond strength must be multiplied by a factor of 0.75. In the determination of the tension design strength values in cracked concrete, the bond strength does not require an additional reduction factor applied for seismic tension ($\alpha_{N,seis}$ = 1.0), where seismic design is applicable.
12. For other installation conditions such as water-saturated concrete, water-filled holes or underwater applications, see the associated strength reduction factors (ϕ) for bond strength in the determination of controlling design strength values, as applicable.

Tension and Shear Design Strength for Reinforcing Bar Installed in Uncracked Concrete (Bond or Concrete Strength)
Drilled with a Hammer-Drill and Carbide Bit in a Dry Hole Condition
110°F (43°C) Maximum Long-Term Service Temperature; 140°F (60°C) Maximum Short-Term Service Temperature[1,2,3,4,5,6,7,8,9,10,11]

Nominal Rod/Rebar Size (#)	Embed. Depth h_{ef} (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_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)
#3	2-3/8	2,855	2,570	3,125	2,920	3,610	3,575	4,070	4,380	4,345	4,680
	3	4,055	4,010	4,380	4,530	4,680	5,370	5,140	6,830	5,490	8,095
	4-1/2	6,305	7,420	6,575	8,270	7,020	9,805	7,710	12,465	8,235	14,775
	7-1/2	10,505	15,800	10,955	17,600	11,705	20,865	12,845	26,530	13,725	29,565
#4	2-3/4	3,555	3,305	3,895	3,755	4,500	4,590	5,510	6,095	6,365	7,455
	4	6,240	6,700	6,835	7,610	7,895	9,310	8,680	11,845	9,275	14,045
	6	10,645	12,850	11,105	14,315	11,865	16,970	13,020	21,575	13,915	25,585
	10	17,745	27,370	18,505	30,485	19,770	36,150	21,705	45,955	23,190	49,945
#5	3-1/8	4,310	4,120	4,720	4,680	5,450	5,725	6,675	7,600	7,710	9,295
	5	8,720	10,005	9,555	11,365	11,030	13,900	13,040	18,205	13,935	21,585
	7-1/2	15,995	19,745	16,680	22,000	17,820	26,080	19,565	33,160	20,900	39,315
	12-1/2	26,660	42,065	27,800	46,860	29,700	55,560	32,605	70,225	34,835	75,030
#6	3-1/2	5,105	5,015	5,595	5,700	6,460	6,970	7,910	9,255	9,135	11,320
	6	11,465	13,595	12,560	15,445	14,500	18,895	17,760	25,095	19,415	30,030
	9	21,060	26,855	23,070	30,510	24,835	36,285	27,260	46,130	29,125	54,695
	15	37,145	58,530	38,740	65,200	41,390	77,305	45,435	97,855	48,540	104,550
#7	3-1/2	5,105	4,930	5,595	5,605	6,460	6,855	7,910	9,100	9,135	11,130
	7	14,445	16,605	15,825	18,865	18,275	23,075	22,380	30,650	25,610	37,355
	10-1/2	26,540	32,800	29,070	37,265	32,755	45,135	35,955	57,380	38,415	68,035
	17-1/2	49,000	72,810	51,095	81,105	54,590	96,165	59,930	122,255	64,025	137,905
#8	4	6,240	6,115	6,835	6,945	7,895	8,495	9,665	11,280	11,160	13,800
	8	17,650	19,750	19,335	22,435	22,325	27,440	27,340	36,450	31,570	44,580
	12	32,425	39,005	35,520	44,315	41,015	54,200	46,095	69,560	49,250	82,475
	20	62,815	88,270	65,505	98,330	69,985	116,585	76,825	148,215	82,080	175,735
#9	4-1/2	7,445	7,110	8,155	8,080	9,420	9,880	11,535	13,125	13,320	16,055
	9	21,060	23,055	23,070	26,190	26,640	32,035	32,625	42,550	37,675	52,040
	13-1/2	38,690	45,540	42,380	51,740	48,940	63,280	57,165	82,475	61,075	97,785
	22-1/2	77,895	104,620	81,230	116,545	86,790	138,185	95,270	175,670	101,790	208,290
#10	5	8,720	8,160	9,555	9,270	11,030	11,335	13,510	15,060	15,600	18,420
	10	24,665	26,430	27,020	30,025	31,200	36,725	38,210	48,780	44,125	59,660
	15	45,315	52,205	49,640	59,310	57,320	72,545	69,260	95,835	74,000	113,625
	25	94,380	121,580	98,420	135,435	105,155	160,580	115,435	204,145	123,330	242,050

☐ - Concrete Breakout Strength ☐ - Bond Strength/Pryout Strength

1. Tabular values are provided for illustration and are applicable for single anchors installed in uncracked 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 according to ACI 318 (-19 or -14) Ch. 17 and ICC-ES AC308. The load level corresponding to the failure mode listed [Concrete breakout strength, bond strength/pryout strength] must be checked against the tabulated steel strength of the corresponding threaded rod or rebar size and type, the lowest load level controls.
3. Strength reduction factors (ϕ) for concrete breakout strength are based on ACI 318 (-19 or -14) 5.3 for load combinations. Condition B was assumed.
4. Strength reduction factors (ϕ) for bond strength are determined from reliability testing and qualification in accordance with ICC-ES AC308 and are tabulated in this product information and in ESR-3298.
5. Tabular values are permitted for static loads only, seismic loading is not considered with these tables. Periodic special inspection must be performed where required by code, see ESR-3298 for applicable information.
6. For anchors subjected to tension resulting from sustained loading a supplemental check must be performed according to ACI 318 -19 17.5.2.2, ACI 318-14 17.3.1.2.
7. For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318 (-19 or -14) Ch. 17.
8. Interpolation is not permitted to be used with the tabular values. For intermediate base material compressive strengths, please see ACI 318 (-19 or -14) Ch. 17, ICC-ES AC308 and information included in this product supplement. For other design conditions including seismic considerations please see ACI 318 (-19 or -14) Ch. 17 and ICC-ES AC308 and ESR-3298.
9. Long term concrete temperatures are roughly constant over significant periods of time. Short-term elevated temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.
10. The tabulated design strengths may be converted to allowable stress design values. Divide by conversion factor calculated as a weighted average of the load factors for the controlling load combination.
11. For other installation conditions such as water-saturated concrete, water-filled holes or underwater applications, see the associated strength reduction factors (ϕ) for bond strength in the determination of controlling design strength values, as applicable.

Tension and Shear Design Strength for Reinforcing Bar Installed in Cracked Concrete (Bond or Concrete Strength)
Drilled with a Hammer-Drill and Carbide Bit in a Dry Hole Condition
110°F (43°C) Maximum Long-Term Service Temperature; 140°F (60°C) Maximum Short-Term Service Temperature[1,2,3,4,5,6,7,8,9,10,11,12]

Nominal Rod/Rebar Size (#)	Embed. Depth h_{ef} (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_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)
#3	2-3/8	2,020	1,835	2,215	2,085	2,445	2,555	2,685	2,890	2,865	3,085
	3	2,770	2,865	2,890	3,235	3,085	3,835	3,390	4,875	3,620	5,785
	4-1/2	4,155	5,300	4,335	5,905	4,630	7,005	5,085	8,900	5,430	10,555
	7-1/2	6,925	11,285	7,225	12,570	7,715	14,905	8,470	18,245	9,050	19,495
#4	2-3/4	2,520	2,360	2,760	2,680	3,185	3,280	3,905	4,355	4,295	5,325
	4	4,420	4,785	4,840	5,435	5,325	6,650	5,845	8,460	6,245	10,030
	6	7,170	9,180	7,475	10,225	7,985	12,125	8,765	15,410	9,365	18,275
	10	11,945	19,550	12,455	21,775	13,310	25,820	14,610	31,470	15,610	33,620
#5	3-1/8	3,050	2,940	3,345	3,340	3,860	4,090	4,730	5,430	5,380	6,640
	5	6,175	7,145	6,765	8,120	7,815	9,930	8,755	13,005	9,355	15,415
	7-1/2	10,740	14,105	11,200	15,715	11,965	18,630	13,135	23,685	14,035	28,080
	12-1/2	17,900	30,045	18,665	33,470	19,945	39,685	21,890	47,155	23,390	50,380
#6	3-1/2	3,620	3,580	3,965	4,070	4,575	4,980	5,605	6,610	6,470	8,085
	6	8,120	9,710	8,895	11,035	10,270	13,495	12,580	17,925	13,475	21,450
	9	14,920	19,185	16,130	21,795	17,230	25,920	18,915	32,950	20,210	39,070
	15	25,775	41,805	26,880	46,570	28,720	55,220	31,525	67,900	33,680	72,545
#7	3-1/2	3,620	3,525	3,965	4,000	4,575	4,895	5,605	6,500	6,470	7,950
	7	10,230	11,860	11,210	13,475	12,945	16,485	15,850	21,895	18,305	26,680
	10-1/2	18,800	23,430	20,590	26,620	23,455	32,240	25,745	40,985	27,505	48,595
	17-1/2	35,085	52,005	36,585	57,935	39,090	68,690	42,910	87,325	45,845	98,740
#8	4	4,420	4,365	4,840	4,960	5,590	6,065	6,845	8,060	7,905	9,855
	8	12,500	14,105	13,695	16,025	15,815	19,600	19,365	26,035	22,365	31,845
	12	22,965	27,860	25,160	31,655	29,050	38,715	33,625	49,685	35,925	58,910
	20	45,825	63,050	47,785	70,235	51,055	83,275	56,045	105,870	59,880	125,525
#9	4-1/2	5,275	5,080	5,780	5,770	6,670	7,060	8,170	9,375	9,435	11,465
	9	14,920	16,465	16,340	18,710	18,870	22,880	23,110	30,390	26,685	37,170
	13-1/2	27,405	32,530	30,020	36,955	34,665	45,200	42,455	58,910	45,470	69,845
	22-1/2	57,995	74,730	60,480	83,245	64,615	98,700	70,930	125,480	75,785	148,775
#10	5	6,175	5,830	6,765	6,620	7,815	8,100	9,570	10,755	11,050	13,155
	10	17,470	18,880	19,140	21,445	22,100	26,230	27,065	34,840	31,255	42,615
	15	32,095	37,290	35,160	42,365	40,600	51,815	49,725	68,455	56,135	81,160
	25	69,060	86,840	74,665	96,740	79,775	114,700	87,570	145,820	93,560	172,890

☐ - Concrete Breakout Strength ☐ - Bond Strength/Pryout Strength

1. Tabular values are provided for illustration and are applicable for single anchors installed in cracked 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 according to ACI 318 (-19 or -14) Ch. 17 and ICC-ES AC308. The load level corresponding to the failure mode listed [Concrete breakout strength, bond strength/pryout strength] must be checked against the tabulated steel strength of the corresponding threaded rod or rebar size and type, the lowest load level controls.
3. Strength reduction factors (ϕ) for concrete breakout strength are based on ACI 318 (-19 or -14) 5.3 for load combinations. Condition B was assumed.
4. Strength reduction factors (ϕ) for bond strength are determined from reliability testing and qualification in accordance with ICC-ES AC308 and are tabulated in this product information and in ESR-3298.
5. Tabular values are permitted for static loads only, seismic loading is not considered with these tables. Periodic special inspection must be performed where required by code, see ESR-3298 for applicable information.
6. For anchors subjected to tension resulting from sustained loading a supplemental check must be performed according to ACI 318 -19 17.5.2.2, ACI 318-14 17.3.1.2.
7. For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318 (-19 or -14) Ch. 17.
8. Interpolation is not permitted to be used with the tabular values. For intermediate base material compressive strengths, please see ACI 318 (-19 or -14) Ch. 17, ICC-ES AC308 and information included in this product supplement. For other design conditions including seismic considerations please see ACI 318 (-19 or -14) Ch. 17 and ICC-ES AC308 and ESR-3298.
9. Long term concrete temperatures are roughly constant over significant periods of time. Short-term elevated temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.
10. The tabulated design strengths may be converted to allowable stress design values. Divide by conversion factor calculated as a weighted average of the load factors for the controlling load combination.
11. For seismic design in accordance with ACI 318, the tabulated tension design strengths in cracked concrete for breakout and bond strength must be multiplied by a factor of 0.75. In the determination of the tension design strength values in cracked concrete, the bond strength does not require an additional reduction factor applied for seismic tension ($\alpha_{N,seis} = 1.0$), where seismic design is applicable.
12. For other installation conditions such as water-saturated concrete, water-filled holes or underwater applications, see the associated strength reduction factors (ϕ) for bond strength in the determination of controlling design strength values, as applicable.

Tension Design of Steel Elements (Steel Strength)[1,2]

Nominal Rod/Rebar Size (in. or No.)	Steel Elements - Threaded Rod and Reinforcing Bar											
	ASTM A36 and ASTM F1554 Grade 36	ASTM F1554 Grade 55	ASTM A193 Grade B7 and ASTM F1554 Grade 105	ASTM A449	ASTM F568M Class 5.8 and ISO 898-1 Class 5.8	ASTM F593 CW Stainless (Types 304 and 316)	ASTM A193 Grade B8/B8M, Class 1 Stainless (Types 304 and 316)	ASTM A193 Grade B8/ B8M2, Class 2B Stainless (Types 304 and 316)	ASTM A615 Grade 75 Rebar	ASTM A615 Grade 60 Rebar	ASTM A706 Grade 60 Rebar	ASTM A615 Grade 40 Rebar
	$ØN_{sa}$ Tension (lbs.)	$ØN_{sa}$ Tension (lbs.)	$ØN_{sa}$ Tension (lbs.)	$ØN_{sa}$ Tension (lbs.)	$ØN_{sa}$ Tension (lbs.)	$ØN_{sa}$ Tension (lbs.)	$ØN_{sa}$ Tension (lbs.)	$ØN_{sa}$ Tension (lbs.)	$ØN_{sa}$ Tension (lbs.)	$ØN_{sa}$ Tension (lbs.)	$ØN_{sa}$ Tension (lbs.)	$ØN_{sa}$ Tension (lbs.)
3/8 or #3	3,370	4,360	7,265	6,975	3,655	5,040	3,315	5,525	7,150	6,435	6,600	4,290
1/2 or #4	6,175	7,980	13,300	12,770	6,690	9,225	6,070	10,110	13,000	11,700	12,000	7,800
5/8 or #5	9,835	12,715	21,190	20,340	10,650	14,690	9,660	16,105	20,150	18,135	18,600	12,090
3/4 or #6	14,550	18,815	31,360	30,105	15,765	18,480	14,300	23,830	28,600	25,740	26,400	17,160
7/8 or #7	20,085	25,970	43,285	41,930	21,760	25,510	19,735	32,895	39,000	35,100	36,000	-
1 or #8	26,350	34,070	56,785	54,515	28,545	33,465	25,895	43,160	51,350	46,215	47,400	-
#9	-	-	-	-	-	-	-	-	65,000	58,500	60,000	-
1-1/4 or #10	42,160	54,510	90,850	76,315	-	53,540	41,430	69,050	82,550	74,295	76,200	-

■ - Steel Strength

1. Steel tensile design strength according to ACI 318 (-19 or -14) Ch. 17 and ACI 318 Appendix D, $\phi N_{sa} = \phi \bullet A_{se,N} \bullet f_{uta}$.
2. The tabulated steel design strength in tension must be checked against the bond strength/concrete capacity design strength to determine the controlling failure mode, the lowest load level controls.

Shear Design of Steel Elements (Steel Strength)[1,2,3]

Nominal Rod/Rebar Size (in. or No.)	Steel Elements - Threaded Rod and Reinforcing Bar											
	ASTM A36 and ASTM F1554 Grade 36	ASTM F1554 Grade 55	ASTM A193 Grade B7 and ASTM F1554 Grade 105	ASTM A449	ASTM F568M Class 5.8 and ISO 898-1 Class 5.8	ASTM F593 CW Stainless (Types 304 and 316)	ASTM A193 Grade B8/B8M, Class 1 Stainless (Types 304 and 316)	ASTM A193 Grade B8/ B8M2, Class 2B Stainless (Types 304 and 316)	ASTM A615 Grade 75 Rebar	ASTM A615 Grade 60 Rebar	ASTM A706 Grade 60 Rebar	ASTM A615 Grade 40 Rebar
	$ØV_{sa}$ Shear (lbs.)	$ØV_{sa}$ Shear (lbs.)	$ØV_{sa}$ Shear (lbs.)	$ØV_{sa}$ Shear (lbs.)	$ØV_{sa}$ Shear (lbs.)	$ØV_{sa}$ Shear (lbs.)	$ØV_{sa}$ Shear (lbs.)	$ØV_{sa}$ Shear (lbs.)	$ØV_{sa}$ Shear (lbs.)	$ØV_{sa}$ Shear (lbs.)	$ØV_{sa}$ Shear (lbs.)	$ØV_{sa}$ Shear (lbs.)
3/8 or #3	1,755	2,265	3,775	3,625	2,025	2,790	1,725	2,870	3,960	3,565	3,430	2,375
1/2 or #4	3,210	4,150	6,915	6,640	3,705	5,110	3,155	5,255	7,200	6,480	6,240	4,320
5/8 or #5	5,115	6,610	11,020	10,575	5,900	8,135	5,025	8,375	11,160	10,045	9,670	6,695
3/4 or #6	7,565	9,785	16,305	15,655	8,730	10,235	7,435	12,390	15,840	14,255	13,730	9,505
7/8 or #7	10,445	13,505	22,505	21,805	12,050	14,130	10,265	17,105	21,600	19,440	18,720	-
1 or #8	13,700	17,715	29,525	28,345	15,810	18,535	13,465	22,445	28,440	25,595	24,650	-
#9	-	-	-	-	-	-	-	-	36,000	32,400	31,200	-
1-1/4 or #10	21,920	28,345	47,240	39,685	-	29,655	21,545	35,905	45,720	41,150	39,625	-

■ - Steel Strength

1. Steel shear design strength according to ACI 318 (-19 or -14) Ch. 17 and ACI 318 Appendix D, $\phi V_{sa} = \phi \bullet 0.60 \bullet A_{se,V} \bullet f_{uta}$.
2. The tabulated steel design strength in shear must be checked against the bond strength/concrete capacity design strength to determine the controlling failure mode, the lowest load level controls.
3. In the determination of the shear design strength values in cracked concrete, the steel strength requires an additional reduction factor applied for seismic shear ($\alpha_{V,seis}$), where seismic design is applicable.

POST-INSTALLED REBAR DEVELOPMENT LENGTH TABLES

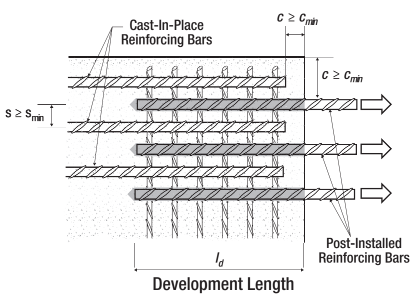
Development Lengths for Common Reinforcing Bar Connections[1,2,3,6]

Design Information	Symbol	Reference Standard	Units	Nominal Rebar Size (US)								
				#3	#4	#5	#6	#7	#8	#9	#10	#11
Nominal rebar diameter	d_b	ASTM A615/A706, Grade 60 (f_y = 60 ksi)	in. (mm)	0.375 (9.5)	0.5 (12.7)	0.625 (15.9)	0.75 (19.1)	0.875 (22.2)	1 (25.4)	1.128 (28.6)	1.27 (32.3)	1.41 (35.8)
Nominal rebar area	A_b		in² (mm²)	0.11 (71)	0.2 (127)	0.31 (198)	0.44 (285)	0.6 (388)	0.79 (507)	1 (645)	1.27 (817)	1.56 (1006)
Development length in f'c = 2,500 psi concrete[4,5]	l_d	ACI 318-19 25.4.2.4, ACI 318-14 25.4.2.3 or ACI 318-11 12.2.3 as applicable	in. (mm)	12 (305)	14.4 (366)	18 (457)	21.6 (549)	31.5 (800)	36 (914)	40.6 (1031)	45.7 (1161)	50.8 (1290)
Development length in f'c = 3,000 psi concrete[4,5]			in. (mm)	12 (305)	13.1 (334)	16.4 (417)	19.7 (501)	28.8 (730)	32.9 (835)	37.1 (942)	41.7 (1060)	46.3 (1177)
Development length in f'c = 4,000 psi concrete[4,5]			in. (mm)	12 (305)	12 (305)	14.2 (361)	17.1 (434)	24.9 (633)	28.5 (723)	32.1 (815)	36.2 (920)	40.1 (1019)
Development length in f'c = 6,000 psi concrete[4,5]			in. (mm)	12 (305)	12 (305)	12 (305)	13.9 (354)	20.3 (516)	23.2 (590)	26.2 (666)	29.5 (750)	32.8 (832)
Development length in f'c = 8,000 psi concrete[4,5]			in. (mm)	12 (305)	12 (305)	12 (305)	12.1 (307)	17.6 (443)	20.1 (511)	22.7 (577)	25.6 (649)	28.4 (721)

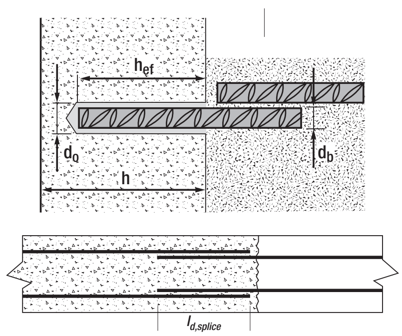
For SI: 1 inch = 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa; for pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi.

1. Calculated development lengths in accordance with ACI 318 -19 25.4.2.4, ACI 318-14 25.4.2.3 or ACI 318-11 12.2.3, as applicable, for reinforcing bars are valid for static, wind, and earthquake loads.
2. Calculated development lengths in SDC C through F must comply with ACI 318 (-19 or -14) Chapter 18 or ACI 318-11 Chapter 21, as applicable.
3. For Class B splices, minimum length of lap for tension lap splices is 1.3*l_d in accordance withACI 318 (-19 OR -14) 25.5.2 and ACI 318-11 12.15.1, as applicable.
4. For lightweight concrete, λ = 0.75; therefore multiply development lengths by 1.33 (increase development length by 33 percent), unless the provisions of ACI 318-19 25.4.2.5, ACI 318-14 25.4.2.4 or ACI 318-11 12.2.4 (d), as applicable, are met to permit alternate values of λ (e.g for sand-lightweight concrete, λ = 0.85; therefore multiply development lengths by 1.18). Refer to ACI 318-14 19.2.4 or ACI 318-11 8.6.1, as applicable.
5. $\left(\frac{c_b + K_{tr}}{d_b}\right) = 2.5$, $\psi_t=1.0$, $\psi_e=1.0$, $\psi_s=0.8$ for $d_b \le$ #6,1.0 for $d_b >$ #6. Refer to ACI 318-19 25.4.2.5, ACI 318-14 25.4.2.4 or ACI 318-11 12.2.4, as applicable.
6. Calculations may be performed for other steel grades and concrete compressive strengths per ACI 318 (-19 or -14) Chapter 25 or ACI 318-11 Chapter 12, as applicable.

Installation Detail for Post-Installed Reinforcing Bar Connection

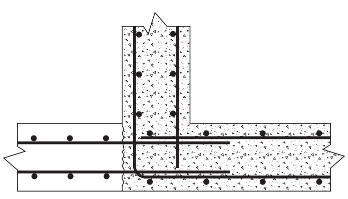


c = edge distance
s = spacing

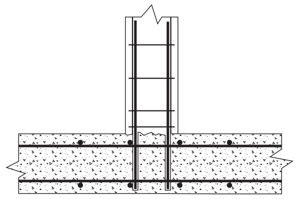


d_b = nominal bar diameter
d_0 = nominal hole diameter
h_{ef} = effective embedment
h = member thickness

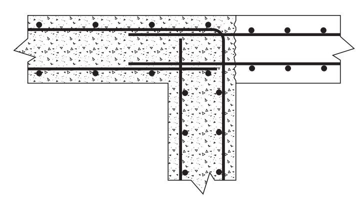
Examples of Development Length Application Details for Post-Installed Reinforcing Bar Connections Provided for Illustration



Tension Lap Splice with Existing Reinforcement for Footing and Foundation Extensions



Tension Development of Column, Cap or Wall Dowels



Tension Lap Splice with Existing Flexural Reinforcement For Slab and Beam Extensions

ADHESIVES

PURE110+® Epoxy Injection Adhesive Anchoring System

Installation Parameters for Common Post-Installed Reinforcing Bar Connections[2,3]

Parameter	Symbol	Units	Nominal Rebar Size (US)								
			#3	#4	#5	#6	#7	#8	#9	#10	#11
Nominal hole diameter[1]	d_o	in.	7/16	5/8	3/4	7/8	1	1-1/8	1-3/8	1-1/2	1-3/4
Effective embedment	h_{ef}	in.	Up to 7-1/2	Up to 10	Up to 12-1/2	Up to 15	Up to 17-1/2	Up to 20	Up to 22-1/2	Up to 25	Up to 27-1/2
Nominal hole diameter[1]	d_o	in.	1/2	5/8	3/4	1	1-1/8	1-1/4	1-3/8	1-1/2	1-3/4
Effective embedment	h_{ef}	in.	Up to 22-1/2	Up to 30	Up to 37-1/2	Up to 45	Up to 52-1/2	Up to 60	Up to 67-1/2	Up to 75	Up to 82-1/2

For SI: 1 inch = 25.4 mm,; for pound-inch units: 1 mm = 0.03937 inches.

1. For any case, it must be possible for the reinforcing bar (rebar) to be inserted into the cleaned hole without resistance.
2. Consideration should be given regarding the commercial availability of carbide drill bits (including hollow drill bits) and diamond core bits, as applicable, with lengths necessary to achieve effective embedments for post-installed reinforcing bar connections.
3. For fractional reinforcing bars where the effective embedment is listed for two nominal hole diameters, either nominal hole diameter may be used.

Hole Cleaning Tools and Accessories for Post-Installed Rebar Connections[1,2,3,4,5,6,7]

Rebar Size (No.)	Drill Bit Size (inch)	Brush Size (inch)	Brush Length (inches)	Wire Brush (Cat. No.)	Plug Size (inch)	Piston Plug (Cat. No.)
3	7/16	7/16	7	08284-PWR	-	-
	1/2	1/2	7	08285-PWR	-	-
4	5/8	5/8	7	08275-PWR	-	-
5	3/4	3/4	9	08278-PWR	3/4	PFC1691520
6	7/8	7/8	9	08287-PWR	7/8	PFC1691530
	1	1	11	08288-PWR	1	PFC1691540
7	1	1	11	08288-PWR	1	PFC1691540
	1-1/8	1-1/8	11	08289-PWR	1-1/8	PFC1691550
8	1-1/8	1-1/8	11	08289-PWR	1-1/8	PFC1691550
	1-1/4	1-1/4	11	08290-PWR	1-1/4	PFC1691555
9	1-3/8	1-3/8	11	08290-PWR	1-3/8	PFC1691560
10	1-1/2	1-1/2	11	08291-PWR	1-1/2	PFC1691570
11	1-3/4	1-3/4	11	08299-PWR	1-3/4	PFC1691580

1. If the DEWALT DustX+ extraction system is used to automatically clean the holes during drilling, standard hole cleaning (brushing and blowing following drilling) is not required.
2. Holes may be drilled with hammer-drill, i.e. rotary impact drills or rock drills with a carbide drill bit (including hollow bits) or core-drill, i.e. core drill with a diamond core drill bit.
3. For any case, it must be possible for the reinforcing bar to be inserted into the cleaned hole without resistance.
4. A brush extension (Cat.#08282-PWR) must be used with a steel wire brush for holes drilled deeper than the listed brush length.
5. Brush adaptors for power tool connections are available for drill chuck (Cat.#08296-PWR) and SDS (Cat.#08283-PWR).
6. A flexible extension tube (Cat.#08297-PWR) or flexible extension hose (Cat.#PFC1640600) or equivalent approved by DEWALT must be used if the bottom or back of the anchor hole is not reached with the mixing nozzle only.
7. All overhead (i.e upwardly inclined) installations require the use of piston plugs during where one is tabulated together with the anchor size (see table). All horizontal installations require the use of piston plugs where the embedment depth is greater than 8 inches and the drill bit size is larger than 5/8-inch. A flexible extension tube (Cat.#08297-PWR) or flexible extension hose (Cat.#PFC1640600) or equivalent approved by DEWALT must be used with piston plugs.

Wire Brush

Brush Extension

Drill Chuck Adapter

SDS Adapter

Premium Piston Plug

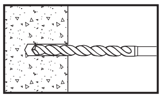
Compressed Air Nozzle

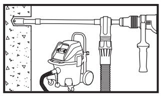
DustX+™ System
(hollow bits with HEPA dust extraction)

DUST X+ ANCHOR INSTALLATION SYSTEM

INSTALLATION INSTRUCTIONS FOR ADHESIVE ANCHORS (SOLID BASE MATERIALS)

DRILLING





1- Drill a hole into the base material with rotary hammer drill (i.e. percussion drill) and a carbide drill bit to the size and embedment required by the selected steel hardware element (reference installation specifications for threaded rod and reinforcing bar). The tolerances of the carbide drill bits, including hollow bits, must meet ANSI Standard B212.15.

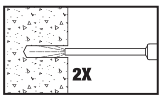
- Precaution: Use suitable eye and skin protection. Avoid inhalation of dust during drilling and/or removal.
- Note! In case of standing water in the drilled hole (flooded hole condition), all the water has to be removed from the hole (e.g. vacuum, compressed air, etc.) prior to cleaning.

Drilling in dry base materials is recommended when using hollow drill bits (vacuum must be on).

GO TO STEP 3 FOR HOLES DRILLED WITH DUSTX+™ EXTRACTION SYSTEM (NO FURTHER HOLE CLEANING IS REQUIRED). OTHERWISE GO TO STEP 2A FOR HOLE CLEANING INSTRUCTIONS.

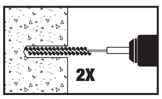
IN THE CASE OF AN UNDERWATER (SUBMERGED) INSTALLATION CONDITION GO TO STEP 2UW-I FOR SEPARATE SPECIFIC HOLE CLEANING INSTRUCTIONS.

HOLE CLEANING DRY OR WET/WATER-SATURATED HOLES (BLOW 2X, BRUSH 2X, BLOW 2X)



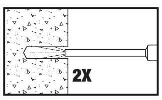
2a- Starting from the bottom or back of the drilled anchor hole, blow the hole clean a minimum of two times (2x).

- Use a compressed air nozzle (min. 90 psi) for all sizes of anchor rod and reinforcing bar (rebar).



2b- Determine wire brush diameter (see hole cleaning equipment selection table) for the drilled hole and attach the brush with adaptor to a rotary drill tool or battery screw gun. Brush the hole with the selected wire brush a minimum of two times (2x).
A brush extension (supplied by DEWALT) must be used for holes drilled deeper than the listed brush length.

- The wire brush diameter must be checked periodically during use. The brush should resist insertion into the drilled hole, if not, the brush is too small and must be replaced with proper brush diameter (i.e. new wire brush).

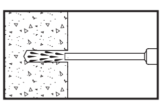


2c- Repeat Step 2a again by blowing the hole clean a minimum of two times (2x).

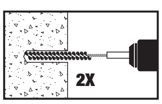
- When finished the hole should be clean and free of dust, debris, ice, grease, oil or other foreign material.

NEXT GO TO STEP 3.

HOLE CLEANING UNDERWATER INSTALLATION (FLUSH, BRUSH 2X, FLUSH)

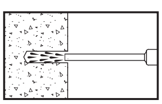


2uw-i- Starting from the bottom or back of the drilled anchor hole, rinse/flush the hole clean with air/water (air/water line pressure) until clear water comes out.



2uw-ii- Determine brush diameter (see hole cleaning equipment selection table) for the drilled hole and attach the brush with adaptor to a rotary drill tool. Brush the hole with the selected wire brush a minimum of two times (2x). A brush extension (supplied by DEWALT) must be used for holes drilled deeper than the listed brush length.

- The wire brush diameter must be checked periodically during use. The brush should resist insertion into the drilled hole, if not, the brush is too small and must be replaced with proper brush diameter (i.e. new wire brush).

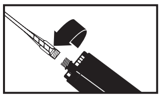


2uw-iii- Repeat Step 2a again by rinse/flushing the hole clean with air/water.

- When finished the hole should be clean and free of dust, debris, ice, grease, oil or other foreign material.

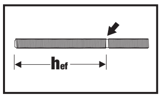
NEXT GO TO STEP 3.

PREPARING

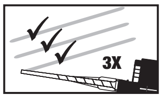


3- Check adhesive expiration date on cartridge label. Do not use expired product. Review Safety Data Sheet (SDS) before use. Cartridge temperature must be between 50°F - 110°F (10°C - 43°C) when in use; for overhead applications cartridge temperature must be between 50ºF - 90ºF (10ºC - 32ºC) when in use. For best experience, suggested minimum cartridge adhesive temperature is 68ºF (20ºC) when in use. Review published gel (working) and cure times. Consideration should be given to the reduced gel (working) time of the adhesive in warm temperatures. For permitted range of the base material temperature, see published gel and curing times.

- Attach a supplied mixing nozzle to the cartridge. Unless otherwise noted do not modify the mixer in any way and make sure the mixing element is inside the nozzle. Load the cartridge into the correct dispensing tool.
- Note: Unless otherwise noted, use a new mixing nozzle with new cartridge of adhesive and also for all work interruptions exceeding the published gel (working) time of the adhesive.



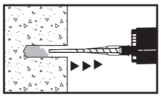
4- Prior to inserting the anchor rod or rebar into the drilled hole, the position of the embedment depth has to be marked on the anchor. Verify anchor element is straight and free of surface damage.



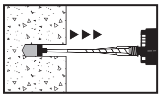
5- Adhesives must be properly mixed to achieve published properties. For new cartridges and nozzles, prior to dispensing adhesive into the drilled hole, separately dispense at least three full strokes of adhesive through the mixing nozzle until the adhesive is a consistent **RED** color.

- Review and note the published gel (working) and cure times (reference gel time and curing time table) prior to injection of the mixed adhesive into the cleaned anchor hole.

INSTALLATION



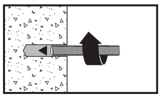
WITH PISTON PLUG:



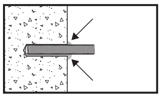
6- Fill the cleaned hole approximately two-thirds full with mixed adhesive starting from the bottom or back of the anchor hole. Slowly withdraw the mixing nozzle as the hole fills to avoid creating air pockets or voids. A plastic extension tube (Cat# 08281-PWR or 08297-PWR) or equivalent approved by DEWALT must be used with the mixing nozzle if the bottom or back of the anchor hole is not reached with the mixing nozzle only.

- Note: Piston plugs (see installation specifications) must be used with and attached to the mixing nozzle and extension tube for overhead (i.e. upwardly inclined) installations and horizontal installations in concrete where the embedment depth is greater than 8 inches and the drill bit size is larger than 5/8-inch. Insert piston plug to the back of the drilled hole and inject as described in the method above. During injection of the adhesive the piston plug will be naturally extruded from the drilled hole by the adhesive pressure.
- The use of piston plugs is also recommended for underwater installations where the drill bit size is larger than 5/8-inch.

Attention! Do not install anchors overhead or upwardly inclined without installation hardware supplied by the DEWALT and also receiving proper training and/or certification. Contact DEWALT for details prior to use, as applicable.

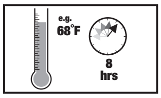


7- The anchor should be free of dirt, grease, oil or other foreign material. Push clean threaded rod or reinforcing bar into the anchor hole while turning slightly to ensure positive distribution of the adhesive until the embedment depth is reached. Observe the gel (working) time.



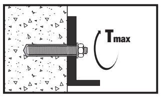
8- Ensure that the anchor element is installed to the specific embedment depth. Adhesive must completely fill the annular gap at the concrete surface. Following installation of the anchor element, remove excess adhesive. Protect the anchor element threads from fouling with adhesive. For all installations the anchor element must be restrained from movement throughout the specified curing period, (as necessary) through the use of temporary wedges, external supports, or other methods. Minor adjustment to the position of the anchor element may be performed during the gel (working) time only.

CURING AND LOADING



9- Allow the adhesive anchor to cure to the specified full curing time prior to applying any load (reference gel time and curing time table).

- Do not disturb, torque or load the anchor until it is fully cured.

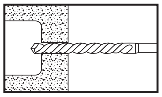


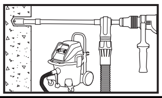
10- After full curing of the adhesive anchor, a fixture can be installed to the anchor and tightened up to the maximum torque (reference gel time and curing table) by using a calibrated torque wrench.

- Note! Take care not to exceed the maximum torque for the selected anchor.

INSTALLATION INSTRUCTIONS FOR ADHESIVE ANCHORS (HOLLOW BASE MATERIALS)

DRILLING



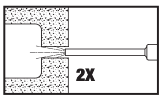


1- Drill a hole into the base material with a rotary drill tool to the size and embedment for the required screen size (see installation specifications for threaded rod in hollow concrete base material with screen tube supplied by DEWALT). Holes drilled in hollow concrete masonry units may be drilled with a rotary hammer-drill. The tolerances of the drill bit used should meet the requirements of ANSI B212.15.

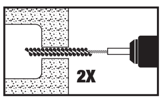
- Precaution: Wear suitable eye and skin protection. Avoid inhalation of dust during drilling and/or removal.

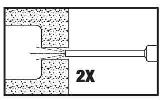
Drilling in dry base materials is recommended when using hollow drill bits (vacuum must be on).

HOLE CLEANING (BLOW 2X, BRUSH 2X, BLOW 2X)



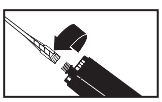
2- Starting from the bottom or back of the anchor hole, blow the hole clean with a hand pump (min. volume 25 fl.oz. supplied by DEWALT) or compressed air nozzle a minimum of two times (2x).





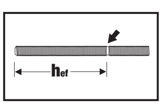
- Determine the wire brush diameter (see installation specifications) and attach the brush with adaptor to a rotary drill tool or battery screw gun. Brush the hole with the selected wire brush a minimum of two times (2x). A brush extension should be used for holes drilled deeper than the listed brush length.
- The wire brush should be checked periodically during use. The brush should resist insertion into the drilled hole and come into contact with the sides of the drilled hole. If not the brush is too small and must be replaced.
- Finally, blow the hole clean again a minimum of two times (2x)
- When finished the hole should be clean and free of dust, debris, ice, grease, oil or other foreign material.

PREPARING

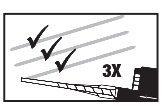


3- Check adhesive expiration date on cartridge label. Do not use expired product. Review Safety Data Sheet (SDS) before use. Cartridge temperature must be between 50°F - 110°F (10°C - 43°C) when in use. For best experience, suggested minimum cartridge adhesive temperature is 68°F (20°C) when in use. Review gel (working) time and curing time table. Consideration should be given to the reduced gel (working) time of the adhesive in warm temperatures.

- Attach a supplied mixing nozzle to the cartridge. Unless otherwise noted do not modify the mixer in any way and make sure the mixing element is inside the nozzle. Load the cartridge into the correct dispensing tool.
- Note: Unless otherwise noted, use a new mixing nozzle with new cartridges of adhesive and also for all work interruptions exceeding the published working time of the adhesive.



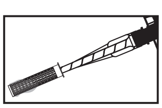
4- Prior to inserting the anchor rod into the filled screen tube, the position of the embedment depth has to be marked on the anchor. Verify anchor element is straight and free of surface damage.



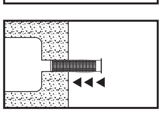
5- Adhesive must be properly mixed to achieve published properties. Prior to dispensing adhesive into the drilled hole, separately dispense at least three full strokes of adhesive through the mixing nozzle until the adhesive is a consistent RED color. Do not attach a used nozzle when changing to a new cartridge.

- Review and note the published working and cure times (see gel time and curing time table) prior to injection of the mixed adhesive into the screen tube.

INSTALLATION

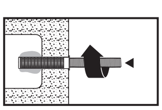


6- Select a screen tube of suitable length (supplied by DEWALT). Fill the screen tube full with adhesive starting from the bottom or back of the tube. Slowly withdraw the mixing nozzle as the screen fills to avoid creating air pockets or voids. A plastic extension tube (Cat# 08281-PWR or 08297-PWR) or equivalent approved by DEWALT must be used with the mixing nozzle if the bottom or back of the screen tube is not reached with the mixing nozzle only.



7- Insert the screen tube filled with adhesive into the cleaned anchor hole.

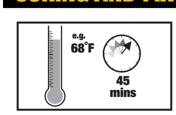
- Note: Overfilling the screen tube is acceptable but not required.



8- Prior to inserting the anchor rod into the screen tube inspect it to ensure that it is free of dirt, grease, oil or other foreign material.

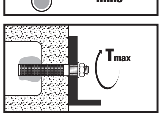
- Push the threaded rod into the screen tube while turning slightly to ensure positive distribution of the adhesive until back of the tube is reached.
- Note: In cases where the drilled hole size is larger than specified due to rotary drilling (e.g. an elongated opening), the annular space between the screen tube and the hole at the base material surface must be filled with adhesive.

CURING AND FIXTURE



9- Allow the adhesive anchor to cure to the specified full curing time prior to applying any load.

- Do not disturb, torque or load the anchor until it is fully cured (see gel time and curing time table).



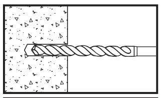
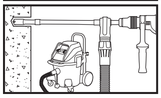
10- After full curing of the adhesive anchor, a fixture can be installed to the anchor and tightened up to the maximum torque (see installation specifications for threaded rod in hollow base material) by using a calibrated torque wrench.

- Note! Take care not to exceed the maximum torque for the selected anchor.

INSTALLATION INSTRUCTIONS FOR POST-INSTALLED REBAR CONNECTIONS

HAMMER DRILLING

DRILLING

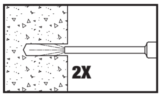
1- Drill a hole into the base material with rotary hammer drill (i.e. percussion drill) and a carbide drill bit to the size and embedment required by the selected steel hardware element (reference installation specifications for threaded rod and reinforcing bar). The tolerances of the carbide drill bits, including hollow bits, must meet ANSI Standard B212.15.

- Precaution: Use suitable eye and skin protection. Avoid inhalation of dust during drilling and/or removal.
- Note! In case of standing water in the drilled hole (flooded hole condition), all the water has to be removed from the hole (e.g. vacuum, compressed air, etc.) prior to cleaning.

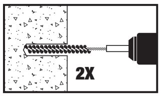
Drilling in dry base materials is recommended when using hollow drill bits (vacuum must be on).

GO TO STEP 3 FOR HOLES DRILLED WITH DUSTX+™ EXTRACTION SYSTEM (NO FURTHER HOLE CLEANING IS REQUIRED). OTHERWISE GO TO STEP 2A FOR HOLE CLEANING INSTRUCTIONS.

HOLE CLEANING DRY OR WET HOLES (BLOW 2X, BRUSH 2X, BLOW 2X)

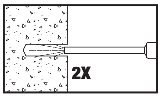


2a- Starting from the bottom or back of the drilled hole, blow the hole clean a minimum of two times (2x). Use a compressed air nozzle (min. 90 psi) for all sizes of reinforcing bar (rebar).



2b- Determine brush diameter (see hole cleaning accessories for post-installed rebar selection table) for the drilled hole and brush the hole by hand or attach the brush with adaptor to a rotary drill tool or battery screw gun. Brush the hole with the selected wire brush a minimum of two times (2x).

- A brush extension (supplied by DEWALT) must be used for drill hole depth than the listed brush length. The wire brush diameter must be checked periodically during use; The brush should resist insertion into the drilled hole, if not the brush is too small and must be replaced with the proper brush diameter (i.e. new wire brush).



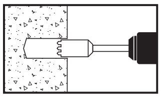
2c- Repeat Step 2a again by blowing the hole clean a minimum of two times (2x).

When finished the hole should be clean and free of dust, debris, oil or other foreign material.

NEXT GO TO STEP 3.

CORE DRILLING

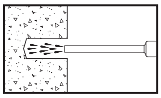
DRILLING



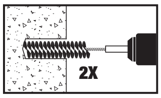
1- Drill a hole into the base material with a core drill tool to the size and embedment required by the selected steel hardware element

Precaution: Use suitable eye and skin protection. Avoid inhalation of dust during drilling and/or removal.

HOLE CLEANING (RINSE, BRUSH 2X, RINSE, BLOW 2X)

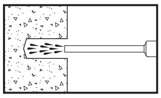


2a- Starting from the bottom or back of the drilled hole, rinse/flush the hole clean with air/water (air/water line pressure) until clear water comes out.

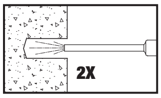


2b- Determine brush diameter (see hole cleaning accessories for post-installed rebar selection table) for drilled hole and attach the brush with adaptor to a rotary drill tool or battery screw gun. Brush the hole with the selected wire brush a minimum of two times (2x).

- A brush extension (supplied by DEWALT) must be used for holes drilled deeper than the listed brush length. The wire brush diameter must be checked periodically during use The brush should resist insertion into the drilled hole, if not the brush is small and must be replaced with the proper brush diameter (i.e. new wire brush).

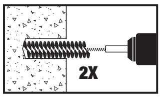


2c- Repeat Step 2a by rinse/flush the hole clean with water.

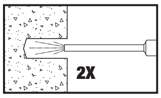


2d- Starting from the bottom or back of the drilled anchor hole, blow the hole clean a minimum if two times (2x). Use a compressed air nozzle (min. 90 psi) for all sizes of anchor rod and reinforcing bar (rebar)

When finished the hole should be clean and free of water, debris, oil or other foreign material.



2e- Repeat Step 2b again by brushing the hole with a wire brush a minimum if two times (2x).

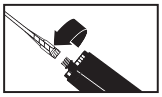


2f- Repeat Step 2d again by blowing the hole clean a minimum if two times (2x).

When finished the hole should be clean and free of water, debris, oil or other foreign material.

NEXT GO TO STEP 3.

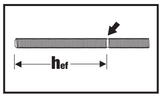
PREPARING



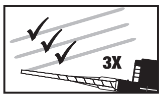
3- Check adhesive expiration date on cartridge label. Do not use expired product. Review Safety Data Sheet (SDS) before use. Review published gel (working) and cure times. Cartridge adhesive temperature must be between 50°F - 110°F (10°C - 43°C) when in use; except for overhead applications cartridge adhesive temperature must be between 50°F - 90°F (10°C - 32°C) when in use. For best experience, the suggested minimum cartridge adhesive temperature is 68°F (20°C) when in use. Consideration should be given to the reduced gel (working) time of the adhesive in warm temperatures. For the permitted range of the base material temperature see published gel and cure times.

Attach a supplied mixing nozzle to the cartridge. Unless otherwise noted do not modify the mixer in any way and make sure the mixing element is inside the nozzle. Load the cartridge into the correct dispensing tool.

- Note: Unless otherwise noted, use a new mixing nozzle with new cartridge of adhesive and also for all work interruptions exceeding the published gel (working) time of the adhesive.



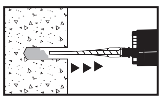
4- Prior to inserting the rebar into the filled drilled hole, the position of the embedment depth has to be marked on the anchor. Verify anchor element is straight and free of surface damage.



5- Adhesive must be properly mixed to achieve published properties. Prior to dispensing adhesive into the drilled hole, separately dispense at least three full strokes of adhesive through the mixing nozzle until the adhesive is a consistent **RED** color.

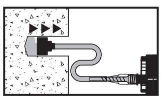
Review and note the published gel (working) and cure times prior to injection of the mixed adhesive into the cleaned anchor hole.

INSTALLATION



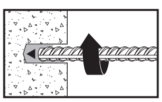
6- Fill the cleaned hole approximately two-thirds full with mixed adhesive starting from the bottom or back of the anchor hole. Slowly withdraw the mixing nozzle as the hole fills to avoid creating air pockets or voids. A flexible extension tube (Cat.# 08297-PWR) or flexible extension hose (Cat.# PFC1640600) or equivalent approved by DEWALT must be used with the mixing nozzle if the bottom or back of the anchor hole is not reached with the mixing nozzle only (see hole cleaning tools and accessories for post-installed rebar table).

WITH PISTON PLUG:

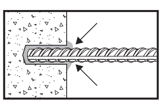


Note: Piston plugs must be used with and attached to mixing nozzle and extension tube for overhead (i.e. upwardly inclined) installations and horizontal installations with rebar sizes where the embedment depth is greater than 8 inches and the drill bit size is larger than 5/8-inch.
Insert piston plug to the back of the drilled hole and inject as described in the method above. During injection of the adhesive the piston plug will be naturally extruded from the drilled hole by the adhesive pressure.

Attention! Do not install anchors overhead or upwardly inclined without installation hardware supplied by DEWALT and also receiving proper training and/or certification. Contact DEWALT for details prior to use, as applicable.

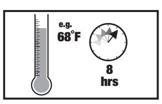


7- The reinforcing bar should be free of dirt, grease, oil or other foreign material. Push clean rebar into the anchor hole while turning slightly to ensure positive distribution of the adhesive until the embedment depth is reached. Observe the gel (working) time.



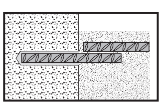
8- Ensure that the reinforcing bar is installed to the specified embedment depth. Adhesive must completely fill the annular gap at the concrete surface. Following installation of the rebar, remove excess adhesive. For all installations the rebar must be restrained from movement throughout the specified curing period, (as necessary) through the use of temporary wedges, external supports, or other methods. Minor adjustments to the position of the rebar may be performed during the gel (working) time only.

CURING AND LOADING



9- Allow the adhesive anchor to cure to the specified full curing time prior to applying any load (reference gel time and curing time table).

- Note! Do not disturb, torque or load the anchor until it is fully cured.



10- After full curing of the rebar connection, new concrete can be poured (placed) to the installed rebar connection.

REFERENCE INSTALLATION TABLES

Gel (working) Time and Curing Table

Temperature of base material		Gel (working) time	Full curing time
°F	°C		
41	5	120 minutes	48 hours
50	10	90 minutes	24 hours
68	20	25 minutes	8 hours
86	30	20 minutes	6 hours
95	35	15 minutes	6 hours
104	40	12 minutes	4 hours
110	43	10 minutes	4 hours

Linear interpolation for intermediate base material temperature is possible.

Cartridge adhesive temperature must be between 50°F - 110°F (10°C - 43°C) when in use; for overhead applications cartridge adhesive temperature must be between 50°F - 90°F (10°C - 32°C) when in use. For best adhesive dispensing experience, suggested minimum cartridge adhesive temperature is 68°F (20°C) when in use.

Wire Brush Selection Table for Pure110+ Adhesive Anchors[1,2,3]

Drill Bit Diameter[1] (inch)	Nominal Wire Brush Size (inch)	Brush Length (inches)	Steel Wire Brush[2,3] (Cat. #)	Blowout Tool
Solid Base Material				
7/16	7/16	7	08284-PWR	Compressed air nozzle only, Cat #8292-PWR (min. 90 psi)
9/16	9/16	7	08285-PWR	
5/8	5/8	7	08275-PWR	
11/16	11/16	9	08286-PWR	
3/4		9	08278-PWR	
7/8	7/8	9	08287-PWR	
1	1	11	08288-PWR	
1-1/8	1-1/8	11	08289-PWR	
1-3/8	1-3/8	11	08290-PWR	
1-1/2	1-1/2	11	08291-PWR	
Hollow Base Material (with plastic screen tube)				
9/16 (3/8 screen tube)	9/16	7	08285-PWR	Compressed air nozzle only, Cat #8292-PWR (min. 90 psi)
3/4 (1/2 screen tube)	3/4	9	08278-PWR	
7/8 (5/8 screen tube)	7/8	9	08287-PWR	
1 (3/4 screen tube)	1	11	08288-PWR	

1. An SDS-plus adaptor (Cat. #08283-PWR) or Jacobs chuck style adaptor (Cat. #08296-PWR) is required to attach a steel wire brush to the drill tool.
2. A brush extension (Cat. #08282-PWR) must be used with a steel wire brush for holes drilled deeper than the listed brush length.
3. If the DEWALT DustX+ extraction system is used to automatically clean holes during drilling, standard hole cleaning (i.e. brushing and removing dust/debris following drilling) is not required.

Piston Plug Selection Table for Adhesive Anchors[1,2,3,4]

Drill Bit Diameter (inch)	Plug Size (inch)	Piston Plug (Cat. #)	Premium Piston Plug (Cat. #)
Solid Base Materials			
11/16	11/16	08258-PWR	PFC1691515
3/4	3/4	08259-PWR	PFC1691520
7/8	7/8	08300-PWR	PFC1691530
1	1	08301-PWR	PFC1691540
1-1/8	1-1/8	08303-PWR	PFC1691550
1-1/4	1-1/4	08307-PWR	PFC1691555
1-3/8	1-3/8	08305-PWR	PFC1691560
1-1/2	1-1/2	08309-PWR	PFC1691570
1-3/4	1-3/4	-	PFC1691580
2	2	-	PFC1691590
2-3/16	2-3/16	-	PFC1691600

1. All overhead or upwardly inclined installations require the use of piston plugs where one is tabulated together with the anchor size.
2. All horizontal installations require the use of piston plugs where the embedment depth is greater than 8 inches and the drill bit size is larger than 5/8-inch.
3. The use of piston plugs is also recommended for underwater installations where one is tabulated together with the anchor size.
4. A flexible plastic extension tube (Cat. #08281-PWR or #08297-PWR) or equivalent approved by DEWALT must be used with piston plugs.

ORDERING INFORMATION

Pure110+ Cartridges (1:1 mix ratio)

Cat. No.	Description	Pack Qty.	Pallet Qty.
08310SD-PWR	Pure110+ 9 fl. oz. Quick-Shot cartridge	12	432
08321SD-PWR	Pure110+ 20.5 fl. oz. dual cartridge	12	540
08351SD-PWR	Pure110+ 50.5 fl. oz. dual cartridge	5	135
A mixing nozzle is packaged with each cartridge. Pure110+ mixing nozzles must be used to ensure complete and proper mixing of the adhesive.			

Cartridge System Mixing Nozzles and Nozzle Extensions

Cat. No.	Description	Pack Qty.	Carton Qty.
PFC1641600	Mixing nozzle (with 8" extension) for Pure110+ Quick-Shot	2	24
08609-PWR	High flow mixing nozzle (with 8" extension) for Pure110+ dual cartridge	2	24
08281-PWR	Mixing nozzle extension, 8" long	2	24
08297-PWR	Mixing nozzle extension, 20" long	1	12
PFC1640600	Flexible Extension Hose, 25 ft.	1	12

Dispensing Tools for Injection Adhesive

Cat. No.	Description	Pack Qty.	Carton Qty.
08437-PWR	Manual caulking gun for Quick-Shot cartridge	1	12
DCE560D1	Cordless 20v Battery powered dispensing tool for Quick-Shot	1	-
08409-PWR	20.5 fl. oz. Standard metal manual tool	1	10
DCE591D1	20.5 fl. oz. cordless 20v Battery powered dispensing tool	1	-
08459-PWR	20.5 fl. oz. Pneumatic tool	1	-
08438-PWR	50.5 fl. oz. Pneumatic tool	1	-

Hole Cleaning Tools and Accessories

Cat. No.	Description	Pack Qty.
08284-PWR	Wire brush for 7/16" or 1/2" hole, 7" length	1
08285-PWR	Wire brush for 9/16" hole, 7" length	1
08275-PWR	Wire brush for 5/8" hole, 7" length	1
08286-PWR	Wire brush for 11/16" hole, 9" length	1
08278-PWR	Wire brush for 3/4" hole, 9" length	1
08287-PWR	Wire brush for 7/8" hole, 9" length	1
08288-PWR	Wire brush for 1" hole, 11" length	1
08289-PWR	Wire brush for 1-1/8" hole, 11" length	1
08276-PWR	Wire brush for 1-1/4" hole, 11" length	1
08290-PWR	Wire brush for 1-3/8" hole, 11" length	1
08291-PWR	Wire brush for 1-1/2" hole, 11" length	1
08273-PWR	Wire brush for 1-5/8" hole, 11" length	1
08299-PWR	Wire brush for 1-3/4" hole, 11" length	1
08271-PWR	Wire brush for 2" hole, 11" length	1
08272-PWR	Wire brush for 2-3/16" hole, 11" length	1
08283-PWR	SDS-plus adapter for steel brushes	1
08296-PWR	Standard drill adapter for steel brushes (e.g. Jacobs Chuck)	1
08282-PWR	Steel brush extension, 12" length	1
08292-PWR	Air compressor nozzle with extension, 18" length	1

Piston Plugs for Adhesive Anchors

Cat. No.	Description	ANSI Drill Bit Dia.	Pack Qty.
08258-PWR	11/16" Plug	11/16"	10
08259-PWR	3/4" Plug	3/4"	10
08300-PWR	7/8" Plug	7/8"	10
08301-PWR	1" Plug	1"	10
08303-PWR	1-1/8" Plug	1-1/8"	10
08305-PWR	1-3/8" Plug	1-3/8"	10
08309-PWR	1-1/2" Plug	1-1/2"	10

Piston Plugs for Post-Installed Rebar Connections

Cat. No.	Description	ANSI Drill Bit Dia.	Pack Qty.
PFC1691510	5/8" Plug	5/8"	1
PFC1691515	11/16" Plug	11/16"	1
PFC1691520	3/4" Plug	3/4"	1
PFC1691530	7/8" Plug	7/8"	1
PFC1691540	1" Plug	1"	1
PFC1691550	1-1/8" Plug	1-1/8"	1
PFC1691555	1-1/4" Plug	1-1/4"	1
PFC1691560	1-3/8" Plug	1-3/8"	1
PFC1691570	1-1/2" Plug	1-1/2"	1
PFC1691580	1-3/4" Plug	1-3/4"	1
PFC1691590	2" Plug	2"	1
PFC1691600	2-3/16" Plug	2-3/16"	1

Plastic Screen Tubes

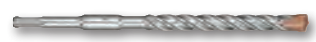
Cat. No.	Description	ANSI Drill Diameter	Pack Qty.
08310-PWR	3/8" x 3-1/2" Plastic Screen	9/16"	25
08311-PWR	3/8" x 6" Plastic Screen	9/16"	25
08313-PWR	3/8" x 8" Plastic Screen	9/16"	25
08315-PWR	1/2" x 3-1/2" Plastic Screen	3/4"	25
08317-PWR	1/2" x 6" Plastic Screen	3/4"	25
08321-PWR	5/8" x 6" Plastic Screen	7/8"	25
08323-PWR	3/4" x 6" Plastic Screen	1"	10

SDS Max 4-Cutter Carbide Drill Bits

Cat. No.	Diameter	Usable Length	Overall Length
DW5806	5/8"	8"	13-1/2"
DW5809	5/8"	16"	21-1/2"
DW5807	5/8"	31"	36"
DW5808	11/16"	16"	21-1/2"
DW5810	3/4"	8"	13-1/2"
DW5812	3/4"	16"	21-1/2"
DW5813	3/4"	31"	36"
DW5814	13/16"	16"	21-1/2"
DW5815	7/8"	8"	13-1/2"
DW5816	7/8"	16"	21-1/2"
DW5851	7/8"	31"	36"
DW5817	27/32"	16"	21-1/2"
DW5818	1"	8"	13-1/2"
DW5819	1"	16"	22-1/2"
DW5852	1"	24"	29"
DW5820	1"	31"	36"
DW5821	1-1/8"	10"	15"
DW5822	1-1/8"	18"	22-1/2"
DW5853	1-1/8"	24"	29"
DW5854	1-1/8"	31"	36"
DW5824	1-1/4"	10"	15"
DW5825	1-1/4"	18"	22-1/2"

SDS+ Full Head Carbide Drill Bits

Cat. No.	Diameter	Usable Length	Overall Length
DW5502	3/16"	2"	4-1/2"
DW5503	3/16"	4"	6-1/2"
DW5504	3/16"	5"	8-1/2"
DW5506	3/16"	10"	12"
DW5512	7/32"	8"	10"
DW5517	1/4"	4"	6"
DW5518	1/4"	6"	8-1/2"
DW55200	1/4"	10"	12"
DW5521	1/4"	12"	14"
DW5524	5/16"	4"	6"
DW5526	5/16"	10"	12"
DW5527	3/8"	4"	6-1/2"
DW5529	3/8"	8"	10"
DW55300	3/8"	10"	12"
DW5531	3/8"	16"	18"
DW5537	1/2"	4"	6"
DW5538	1/2"	8"	10-1/2"
DW5539	1/2"	10"	12"
DW5540	1/2"	16"	18"



SDS+ 4-Cutter Carbide Drill Bits

Cat. No.	Diameter	Usable Length	Overall Length
DW5471	5/8"	8"	10"
DW5472	5/8"	16"	18"
DW5474	3/4"	8"	10"
DW5475	3/4"	16"	18"
DW5477	7/8"	8"	10"
DW5478	7/8"	16"	18"
DW5479	1"	8"	10"
DW5480	1"	16"	18"
DW5481	1-1/8"	8"	10"
DW5482	1-1/8"	6"	18"

Dust Extraction

Cat. No.	Description
DWV012	10 Gallon Wet/Dry Hepa/Rrp Dust Extractor DWV9402 Fleece bag (5 pack) for DEWALT dust extractors DWV9316 Replacement Anti-Static Hose DWV9320 Replacement HEPA Filter Set (Type 1)
DWH050K	Dust Extraction with two interchangeable drilling heads
DCB1800B	1800 Watt Portable Power Station & Parallel Battery Charger Bare Unit

Hollow Drill Bits

Shank	Cat. No.	Diameter	Overall Length	Usable Length	Recommended Hammer
SDS+	DWA54012	1/2"	14-1/2"	9-3/4"	DCH133 / DCH273 / DCH293
	DWA54916	9/16"	14-1/2"	9-3/4"	DCH133 / DCH273 / DCH293
	DWA54058	5/8"	14-1/2"	9-3/4"	DCH133 / DCH273 / DCH293
	DWA54034	3/4"	14-1/2"	9-3/4"	DCH133 / DCH273 / DCH293
SDS Max	DWA58058	5/8"	23-5/8"	15-3/4"	DCH481 / D25603K
	DWA58958	5/8"	47-1/4"	39-3/8"	DCH481 / D25603K
	DWA58116	11/16"	24-3/4"	15-3/4"	DCH481 / D25603K
	DWA58034	3/4"	23-5/8"	15-3/4"	DCH481 / D25603K
	DWA58934	3/4"	47-1/4"	39-3/8"	DCH481 / D25603K
	DWA58078	7/8"	23-5/8"	15-3/4"	DCH481 / D25603K
	DWA58001	1"	23-5/8"	15-3/4"	DCH481 / D25603K
	DWA58901	1"	47-1/4"	39-3/8"	DCH481 / D25603K
	DWA58118	1-1/8"	23-5/8"	15-3/4"	DCH481 / D25603K
	DWA58918	1-1/8"	47-1/4"	39-3/8"	DCH481 / D25603K
	DWA58115	1-1/4"	23-5/8"	15-3/4"	DCH481 / D25603K
	DWA58114	1-1/4"	47-1/4"	39-3/8"	DCH481 / D25603K
	DWA58138	1-3/8"	47-1/4"	39-3/8"	DCH481 / D25603K
	DWA58112	1-1/2"	47-1/4"	39-3/8"	DCH481 / D25603K

DUSTX+™
ANCHOR INSTALLATION SYSTEM

GENERAL INFORMATION

PURE50+™

Epoxy Injection Adhesive Anchoring System

PRODUCT DESCRIPTION

The Pure50+ is a two-component adhesive anchoring system. The system includes injection adhesive in plastic cartridges, mixing nozzles, dispensing tools and hole cleaning equipment. Pure50+ epoxy is designed for bonding threaded rod and reinforcing bar hardware into drilled holes in solid concrete base materials. It can also be considered for bonding together cured concrete and masonry materials together as well as filling large cracks and abandoned holes.

GENERAL APPLICATIONS AND USES

- Bonding and anchoring threaded rod and reinforcing bar into hardened concrete
- Evaluated for installation and use in dry and wet holes, including water-filled holes
- Can be installed in a wide range of base material temperatures with good working times
- Cracked and uncracked concrete conditions as well as seismic and wind loading (SDC A - F)

FEATURES AND BENEFITS

+ Designed for use with threaded rod and reinforcing bar hardware elements
+ Evaluated and recognized for freeze/thaw performance
+ Cartridge design allows for multiple uses using extra mixing nozzles
+ Mixing nozzles proportion adhesive and provide simple delivery method into drilled holes
+ Evaluated and recognized for long term and short term loading (see performance tables)
+ Oversized hammer-drilled holes in concrete, for short term loading only (see www.DEWALT.com)

APPROVALS AND LISTINGS

- International Code Council, Evaluation Service (ICC-ES) ESR-3576 for cracked and uncracked concrete
- Code Compliant with the 2021 IBC/IRC, 2018 IBC/IRC, 2015 IBC/IRC and 2012 IBC/IRC
- Tested in accordance with ACI 355.4/ASTM E488, and ICC-ES AC308 for use in structural concrete with designs according to ACI 318 (-19 & -14) Chapter 17 and ACI 318 Appendix D
- Evaluated and qualified by an accredited independent testing laboratory for recognition in cracked and uncracked concrete including seismic and wind loading
- Florida Building Code, FBC Supplement including HVHZ (within ESR-3576)
- Compliant with NSF/ANSI/CAN Standard 61 for drinking water system components - health effects
- Also classified as lead free in accordance with NSF/ANSI/CAN 372
- Compliant with California DPH for VOC emissions and South Coast AQMD for VOC content (LEED v4.1)
- Conforms to requirements of ASTM C881 including C882 and AASHTO M235, Types I, II, IV and V, Grade 3, Classes B & C (also meets Type III except for elongation)
- Department of Transportation listings - see www.DEWALT.com or contact transportation agency

GUIDE SPECIFICATIONS

CSI Divisions: 03 16 00 - Concrete Anchors. and 05 05 19 - Post-Installed Concrete Anchors. Adhesive anchoring system shall be Pure50+ as supplied by DEWALT, Towson, MD. Anchors shall be installed in accordance with published instructions and requirements of the Authority Having Jurisdiction.

TENSION ZONE CRACKED CONCRETE · SEISMIC REGION QUALIFICATION · C US · CODE LISTED ICC-ES ESR-3576 CONCRETE · DDA DEWALT DESIGN ASSIST™ · DUSTX+™ ANCHOR INSTALLATION SYSTEM

SECTION CONTENTS

PURE110+ ADHESIVE IN CARTRIDGE
(STANDARD THREADED ROD AND REBAR STEEL SUPPLIED BY OTHERS)

PACKAGING (1:1 MIX RATIO)

Coaxial Cartridge

- 9 fl. oz. ((265 mL or 16 in³))

Dual Cartridge (side-by-side)

- 20.5 fl. oz. (610 mL or 37 in³)
- 50.5 fl. oz. (1500 mL or 91.5 in³)

STORAGE LIFE & CONDITIONS

Dual cartridge: Two years
Coaxial cartridge: Eighteen months
Store in a dry, dark environment with temperature ranging from 41°F to 86°F (5°C to 30°C)

ANCHOR SIZE RANGE (TYPICAL)

- 3/8" to 1-1/4" diameter threaded rod
- No. 3 to No. 10 reinforcing bar (rebar)

SUITABLE BASE MATERIALS

- Normal-weight Concrete
- Lightweight Concrete

PERMISSIBLE INSTALLATION CONDITIONS (ADHESIVE)

- Dry Concrete
- Water Saturated Concrete
- Water-Filled Holes (flooded)

INSTALLATION SPECIFICATIONS

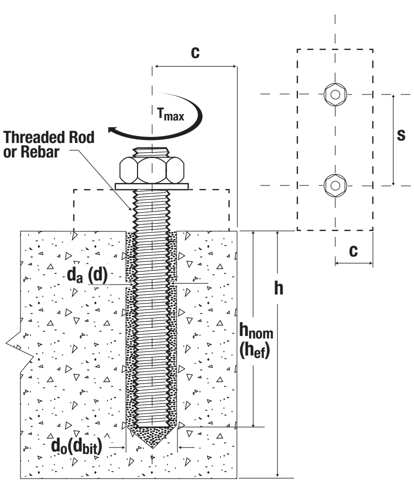
Installation Specifications for Threaded Rod and Reinforcing Bar

Parameter	Symbol	Units	Fractional Nominal Rod Diameter (Inch) / Reinforcing Bar Size									
			3/8 or #3	1/2	#4	5/8 or #5	3/4 or #6	7/8 or #7	1 or #8	#9	1-1/4	#10
Threaded rod outside diameter	d_a (d)	inch (mm)	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)	-
Rebar nominal outside diameter	d_a (d)	inch (mm)	0.375 (9.5)	0.500 (12.7)		0.625 (15.9)	0.750 (19.1)	0.875 (22.2)	1.000 (25.4)	1.125 (28.7)	-	1.250 (31.8)
Nominal drill bit size (ANSI)	d_o (d_{bit})	inch	7/16	9/16	5/8	11/16 or 3/4	7/8	1	1-1/8	1-3/8	1-3/8	1-1/2
Minimum embedment[1]	$h_{ef,min}$	inch (mm)	2-3/8 (60)	2-3/4 (70)		3-1/8 (79)	3-1/2 (89)	3-1/2 (89)	4 (102)	4-1/2 (114)	5 (127)	5 (127)
Maximum embedment[1]	$h_{ef,max}$	inch (mm)	7-1/2 (191)	10 (254)		12-1/2 (318)	15 (381)	17-1/2 (445)	20 (508)	22-1/2 (572)	25 (635)	25 (635)
Minimum member thickness	h_{min}	inch (mm)	h_{ef} + 1-1/4 (h_{ef} + 30)			$h_{ef} + 2d_o$						
Minimum anchor spacing	s_{min}	inch (mm)	1-7/8 (48)	2-1/2 (64)		3-1/8 (79)	3-3/4 (95)	4-3/8 (111)	5 (127)	5-5/8 (143)	6-1/4 (159)	6-1/4 (159)
Minimum edge distance (up to 100% T_{max})	c_{min}	inch (mm)	1-7/8 (48)	2-1/2 (64)		3-1/8 (79)	3-3/4 (95)	4-3/8 (111)	5 (127)	5-5/8 (143)	6-1/4 (159)	6-1/4 (159)
Max. torque[2]	T_{max}	ft-lbs (N-m)	15 (20)	30 (41)		60 (81)	105 (142)	125 (169)	165 (221)	200 (280)	280 (379)	280 (379)
Max. torque[2,3] (low strength rods)	$T_{max,ls\text{-}rod}$	ft-lbs (N-m)	5 (9)	20 (27)		40 (54)	60 (81)	100 (136)	165 (223)	-	280 (379)	-
Min. edge distance, reduced[4,5] (up to 45% T_{max})	$c_{min,red}$	inch (mm)	1-3/4 (45)	1-3/4 (45)		1-3/4 (45)	1-3/4 (45)	1-3/4 (45)	1-3/4 (45)	2-3/4 (70)	2-3/4 (70)	2-3/4 (70)

For pound-inch units: 1 mm = 0.03937 inch, 1 N-m = 0.7375 ft-lbf. For SI: 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m.

1. Embedment range for use with the design provisions of 318 (-19 & -14) or ACI 318 Appendix D as applicable, ICC-ES AC308, Section 4.2 and ESR-3576.
2. Torque may not be applied to the anchors until the full cure time of the adhesive has been achieved.
3. These torque values apply to ASTM A36 / F1554 Grade 36 carbon steel threaded rods; and ASTM A193 Grade B8/B8M (Class 1) stainless steel threaded rods.
4. For installations below the minimum edge distance, c_{min}, and the reduced minimum edge distance, $c_{min,red}$, the reduced maximum torque is 0.45*T_{max}.
5. For installations below the minimum edge distance, c_{min}, down to the reduced minimum edge distance, $c_{min,red}$, the minimum anchor spacing, s_{min} is $5d_a$.

Detail of Steel Hardware Elements used with Injection Adhesive System



Nomenclature

d_a (d) = Diameter of anchor
d_o (d_{bit}) = Diameter of drilled hole
h = Base material thickness
h_{nom} (h_{ef}) = Embedment depth
s = Spacing of anchors
c = Edge distance
T_{max} = Maximum torque

Threaded Rod and Deformed Reinforcing Bar Material Properties

Steel Description (General)	Steel Specification (ASTM)	Nominal Anchor Size (inch/No.)	Minimum Yield Strength, f_y (psi)	Minimum Ultimate Strength, f_u (psi)
Carbon rod	A36 or F1554 Grade 36	3/8 through 1-1/4	36,000	58,000
	F1554 Grade 55		55,000	75,000
	A449	3/8 through 1	92,000	120,000
		1-1/4	81,000	105,000
	A193, Grade B7 or F1554, Grade 105	3/8 through 1-1/4	105,000	125.0
	F568M Class 5.8	3/4 through 1-1/4	58,000	72,500
Stainless rod	F593 Condition CW	3/8 through 5/8	65,000	100,000
		3/4 through 1-1/4	45,000	85,000
	A193/193M Grade B8/B8M, Class 1	3/8 through 1-1/4	30,000	75,000
	A193/A193M Grade B8/B8M2, Class 2B	3/8 through 1-1/4	75,000	95,000
Reinforcing Bar	A615, A767, Grade 40	#3 through #6	40,000	60,000
	A615, A767, Grade 60	#3 through #10	60,000	90,000
	A706, A767, Grade 60		60,000	80,000
	A615, A767, Grade 75	#3 through #10	75,000	100,000
	A706, A767, Grade 80	#3 through #10	80,000	100,000

Tabulated material properties are provided for reference; other steel hardware elements may also be considered.

PERFORMANCE DATA (ASD)

Ultimate and Allowable Load Capacities for Pure50+ Installed with Threaded Rod into Normal-Weight Concrete (based on bond strength/concrete capacity)[1,2,3,4,5,6]

Rod Diameter d (in.)	Drill Diameter d_{bit} (in.)	Minimum Embedment Depth h_{nom} (in.)	Minimum Concrete Compressive Strength					
			f'c = 2,500 psi		f'c = 3,000 psi		f'c = 4,000 psi	
			Ultimate Tension Load Capacity (lbs.)	Allowable Tension Load Capacity (lbs.)	Ultimate Tension Load Capacity (lbs.)	Allowable Tension Load Capacity (lbs.)	Ultimate Tension Load Capacity (lbs.)	Allowable Tension Load Capacity (lbs.)
3/8	7/16	3-3/8	9,515	2,380	9,925	2,480	9,925	2,480
1/2	9/16	4-1/2	15,750	3,940	16,420	4,110	19,010	4,750
5/8	11/16 or 3/4	5-5/8	21,930	5,485	22,870	5,720	28,030	7,005
3/4	7/8	6-3/4	31,985	7,995	33,355	8,340	37,655	9,415
7/8	1	7-7/8	40,380	10,095	42,110	10,530	48,155	12,040
1	1-1/8	9	50,300	12,575	52,455	13,115	60,570	15,145
		10	66,840	16,710	69,700	17,425	74,470	18,615
1-1/4	1-3/8	11-1/4	81,060	20,270	84,535	21,130	90,315	22,580
1-1/2	1-3/4	13-1/2	110,585	27,645	115,320	28,830	123,205	30,805

1. Allowable load capacities listed are calculated using an applied safety factor of 4.0 which includes an assessment of freezing/thawing conditions and sensitivity to sustained loads (i.e. creep resistance). Consideration of safety factors of 10 or higher may be necessary depending on the application, such as life safety or overhead.
2. Linear interpolation may be used to determine allowable loads for intermediate embedments and compressive strengths.
3. The tabulated load values are applicable to single anchors installed at critical edge and spacing distances of 3 times embedment and where the minimum member thickness is greater of [h_{nom} + 1-1/4"] and [h_{nom} + $2d_{bit}$].
4. The tabulated load values are for applicable for dry uncracked concrete in holes must be drilled with a hammer drill and an ANSI carbide drill bit. Installations in water saturated (wet) concrete or in water-filled holes (flooded) require a 15% reduction in capacity.
5. Adhesives experience reductions in capacity at elevated temperatures. See the in-service temperature chart for allowable load capacity reduction factors.
6. Allowable bond strength/concrete capacity must be checked against allowable steel strength in tension to determine the controlling allowable load. Allowable shear capacity is controlled by allowable steel strength for the given conditions.

Ultimate and Allowable Load Capacities for Pure50+ Installed with Reinforcing Bar into Normal-Weight Concrete (based on bond strength/concrete capacity)[1,2,3,4,5,6]

Bar Size d No.	Drill Diameter d_{bit} (in.)	Minimum Embedment Depth h_{nom} (in.)	Minimum Concrete Compressive Strength					
			f'c = 2,500 psi		f'c = 3,000 psi		f'c = 4,000 psi	
			Ultimate Tension Load Capacity (lbs.)	Allowable Tension Load Capacity (lbs.)	Ultimate Tension Load Capacity (lbs.)	Allowable Tension Load Capacity (lbs.)	Ultimate Tension Load Capacity (lbs.)	Allowable Tension Load Capacity (lbs.)
#3	7/16	3-3/8	9,730	2,435	10,150	2,540	10,150	2,540
#4	9/16	4-1/2	16,155	4,040	16,850	4,215	18,240	4,560
#5	11/16 or 3/4	4	15,735	3,935	16,405	4,100	16,570	4,145
		5-5/8	22,010	5,505	22,950	5,740	25,190	6,295
#6	7/8	6-3/4	30,890	7,720	32,210	8,050	38,330	9,585
#7	1	7-7/8	37,545	9,385	39,150	9,790	41,830	10,460
#8	1-1/8	9	50,230	12,560	52,385	13,095	60,485	15,125
#9	1-3/8	10-1/8	59,435	14,860	61,985	15,495	66,220	16,560
#10	1-1/2	11-1/4	74,330	18,580	77,510	19,380	82,815	20,700
#11	1-3/4	12-3/8	90,895	22,725	94,765	23,700	101,265	25,320

1. Allowable load capacities listed are calculated using an applied safety factor of 4.0 which includes an assessment of freezing/thawing conditions and sensitivity to sustained loads (i.e. creep resistance).. Consideration of safety factors of 10 or higher may be necessary depending on the application, such as life safety or overhead.
2. Linear interpolation may be used to determine allowable loads for intermediate embedments and compressive strengths.
3. The tabulated load values are applicable to single anchors installed at critical edge and spacing distances of 3 times embedment and where the minimum member thickness is greater of [h_{nom} + 1-1/4"] and [h_{nom} + $2d_{bit}$].
4. The tabulated load values are for applicable for dry uncracked concrete in holes must be drilled with a hammer drill and an ANSI carbide drill bit. Installations in water saturated (wet) concrete or in water-filled holes (flooded) require a 15% reduction in capacity.
5. Adhesives experience reductions in capacity at elevated temperatures. See the in-service temperature chart for allowable load capacity reduction factors.
6. Allowable bond strength/concrete capacity must be checked against allowable steel strength in tension to determine the controlling allowable load. Allowable shear capacity is controlled by allowable steel strength for the given conditions.

Allowable Load Capacities for Pure50+ Installed with Threaded Rod into Normal-Weight Concrete with 1-3/4" Edge Distance (Based on Bond Strength / Concrete Capacity)[1,2,3,4,5,6]

Nominal Anchor Diameter d (in.)	Minimum Embedment Depth h_{nom} (in.)	Minimum Concrete Compressive Strength - f'c (psi)					
		2,500 psi		3,000 psi		4,000 psi	
		Allowable Tension Load Capacity (lbs.)	Allowable Shear Load Capacity (lbs.)	Allowable Tension Load Capacity (lbs.)	Allowable Shear Load Capacity (lbs.)	Allowable Tension Load Capacity (lbs.)	Allowable Shear Load Capacity (lbs.)
3/8	3-3/8	1,615	1,800	1,675	1,800	1,775	1,800
1/2	4-1/2	2,405	2,480	2,495	2,480	2,645	2,480
5/8	5-5/8	2,900	3,195	3,010	3,195	3,190	3,195
3/4	6-3/4	3,100	2,590	3,215	2,590	3,405	2,590

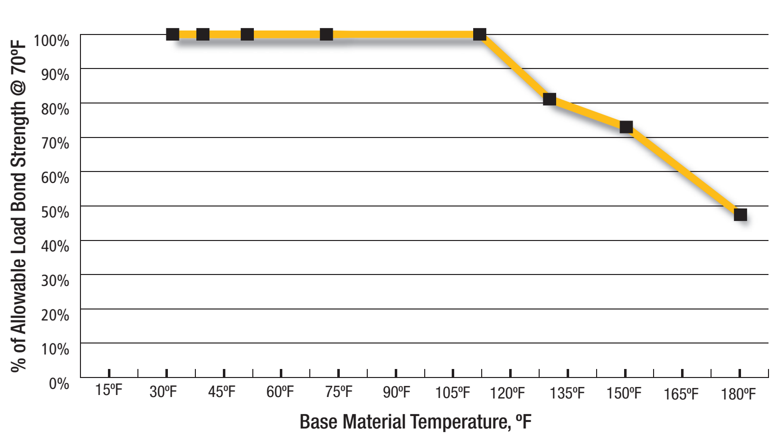
1. Allowable load capacities listed are calculated using an applied safety factor of 4.0 which includes an assessment of freezing/thawing conditions and sensitivity to sustained loads (i.e. creep resistance). Consideration of safety factors of 10 or higher may be necessary depending on the application, such as life safety or overhead.
2. Linear interpolation may be used to determine allowable loads for intermediate compressive strengths..
3. The tabulated load values are applicable to single anchors at critical spacing distance of 3 times embedment where the minimum member thickness is greater of [h_{nom} + 1-1/4"] and [h_{nom} + $2d_{bit}$].
4. The tabulated load values are for applicable for dry uncracked concrete in holes must be drilled with a hammer drill and an ANSI carbide drill bit. Installations in water-saturated concrete (wet) or in water-filled holes (flooded) require a 15% reduction in capacity.
5. Adhesives experience reductions in capacity at elevated temperatures. See the in-service temperature chart for allowable load capacity reduction factors.
6. Allowable bond strength/concrete capacity must be checked against allowable steel strength in tension to determine the controlling allowable load.

Allowable Load Capacities for Threaded Rod and Reinforcing Bar (Based on Steel Strength)[1,2,3,4]

Nominal Rod Diameter or Rebar Size (in. or No.)	Steel Elements - Threaded Rod and Reinforcing Bar																	
	A36 or F1554, Grade 36		A36 or F1554, Grade 55		A 193, Grade B7 or F1554, Grade 105		F 593, CW (SS)		ASTM A615 Grade 40 Rebar		ASTM A615 Grade 60 Rebar		ASTM A706 Grade 60 Rebar		ASTM A615 Grade 75 Rebar		ASTM A706 Grade 80 Rebar	
	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.	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 or #3	2,115	1,090	2,735	1,410	4,555	2,345	3,645	1,880	2,210	1,125	2,650	1,690	2,650	1,500	2,650	1,875	2,650	1,875
1/2 or #4	3,760	1,935	4,860	2,505	8,100	4,170	6,480	3,340	3,925	2,005	4,710	3,005	4,710	2,670	4,710	3,335	4,710	3,335
5/8 or #5	5,870	3,025	7,595	3,910	12,655	6,520	10,125	5,215	6,135	3,130	7,365	4,695	7,365	4,170	7,365	5,215	7,365	5,215
3/4 or #6	8,455	4,355	10,935	5,635	18,225	9,390	12,390	6,385	8,835	4,505	10,605	6,760	10,605	6,010	10,605	7,510	10,605	7,510
7/8 or #7	11,510	5,930	14,885	7,665	24,805	12,780	16,865	8,690	-	-	14,430	9,200	14,430	8,180	14,430	10,220	14,430	10,220
1 or #8	15,035	7,745	19,440	10,015	32,400	16,690	22,030	11,350	-	-	18,850	12,015	18,850	10,680	18,850	13,350	18,850	13,350
#9	-	-	-	-	-	-	-	-	-	-	23,985	15,290	23,985	13,590	23,985	16,990	23,985	16,990
1-1/4	23,490	12,100	30,375	15,645	50,620	26,080	34,425	17,735	-	-	-	-	-	-	-	-	-	-
#10	-	-	-	-	-	-	-	-	-	-	30,405	19,380	30,405	17,230	30,405	21,535	30,405	21,535

1. AISC defined steel strength (ASD) for threaded rod: Tensile = 0.33 • F_u • A_{nom}, Shear = 0.17 • F_u • A_{nom}
2. For reinforcing bars: The allowable steel tensile strength is based on 20 ksi for Grade 40 and 24 ksi for Grade 60 and higher, applied to the cross sectional area of the bar; allowable steel shear strength = 0.17 • F_u • A_{nom}
3. Allowable load capacities are calculated for the steel element type. Consideration of applying additional safety factors may be necessary depending on the application, such as life safety or overhead.
4. Allowable steel strength in tension must be checked against allowable bond strength/concrete capacity in tension to determine the controlling allowable load.

In-Service Temperature Chart For Allowable Load Capacities



STRENGTH DESIGN INFORMATION

Steel Tension and Shear Design for Threaded Rod in Normal Weight Concrete

CODE LISTED ICC-ES ESR-3576

Design Information		Symbol	Units	Nominal Rod Diameter[1] (inch) 3/8	1/2	5/8	3/4	7/8	1	1-1/4
Threaded rod nominal outside diameter		d	inch (mm)	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)
Threaded rod effective cross-sectional area		A_{se}	inch² (mm²)	0.0775 (50)	0.1419 (92)	0.2260 (146)	0.3345 (216)	0.4617 (298)	0.6057 (391)	0.9691 (625)
ASTM A36 and ASTM F1554 Grade 36	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lbf (kN)	4,495 (20.0)	8,230 (36.6)	13,110 (58.3)	19,400 (86.3)	26,780 (119.1)	35,130 (156.3)	56,210 (250.0)
		V_{sa}	lbf (kN)	2,695 (12.0)	4,940 (22.0)	7,860 (35.0)	11,640 (51.8)	16,070 (71.4)	21,080 (93.8)	33,725 (150.0)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.80	0.80	0.80	0.80	0.80	0.80	0.80
	Strength reduction factor for tension[2]	ϕ	-	0.75						
	Strength reduction factor for shear[2]	ϕ	-	0.65						
ASTM F1554 Grade 55	Nominal strength as governed by steel strength(for a single anchor)	N_{sa}	lbf (kN)	5,810 (25.9)	10,640 (47.3)	16,950 (75.4)	25,085 (111.6)	34,625 (154.0)	45,425 (202.0)	72,680 (323.3)
		V_{sa}	lbf (kN)	3,485 (15.5)	6,385 (28.4)	10,170 (45.2)	15,050 (67.0)	20,775 (92.4)	27,255 (121.2)	43,610 (194.0)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.80	0.80	0.80	0.80	0.80	0.80	0.80
	Strength reduction factor for tension[2]	ϕ	-	0.75						
	Strength reduction factor for shear[2]	ϕ	-	0.65						
ASTM A193 Grade B7 and ASTM F1554 Grade 105	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lbf (kN)	9,685 (43.1)	17,735 (78.9)	28,250 (125.7)	41,810 (186.0)	57,710 (256.7)	75,710 (336.8)	121,135 (538.8)
		V_{sa}	lbf (kN)	5,815 (25.9)	10,640 (7.3)	16,950 (75.4)	25,085 (111.6)	34,625 (154.0)	45,425 (202.1)	72,680 (323.3)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.80	0.80	0.80	0.80	0.80	0.80	0.80
	Strength reduction factor for tension[2]	ϕ	-	0.75						
	Strength reduction factor for shear[2]	ϕ	-	0.65						
ASTM A449	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lbf (kN)	9,300 (41.4)	17,025 (75.7)	27,120 (120.6)	40,140 (178.5)	55,905 (248.7)	72,685 (323.3)	101,755 (452.6)
		V_{sa}	lbf (kN)	5,580 (24.8)	10,215 (45.4)	16,270 (72.4)	24,085 (107.1)	33,540 (149.2)	43,610 (194.0)	61,050 (271.6)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.80	0.80	0.80	0.80	0.80	0.80	0.80
	Strength reduction factor for tension[2]	ϕ	-	0.75						
	Strength reduction factor for shear[2]	ϕ	-	0.65						
ASTM F568 Class 5.8 (ISO 898-1)	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lbf (kN)	5,620 (25.0)	10,290 (45.8)	16,385 (72.9)	24,250 (107.9)	33,475 (148.9)	43,915 (195.4)	-[5]
		V_{sa}	lbf (kN)	3,370 (15.0)	6,175 (27.5)	9,830 (43.7)	14,550 (64.7)	20,085 (89.3)	26,350 (117.2)	-[5]
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.80	0.80	0.80	0.80	0.80	0.80	-[5]
	Strength reduction factor for tension[3]	ϕ	-	0.65						
	Strength reduction factor for shear[3]	ϕ	-	0.60						
ASTM F593 CW Stainless (Types 304 and 316)	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lbf (kN)	7,750 (34.5)	14,190 (63.1)	22,600 (100.5)	28,430 (126.5)	39,245 (174.6)	51,485 (229.0)	82,370 (366.4)
		V_{sa}	lbf (kN)	4,650 (20.7)	8,515 (37.9)	13,560 (60.3)	17,060 (75.9)	23,545 (104.7)	30,890 (137.4)	49,425 (219.8)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.70	0.70	0.80	0.80	0.80	0.80	0.80
	Strength reduction factor for tension[3]	ϕ	-	0.65						
	Strength reduction factor for shear[3]	ϕ	-	0.60						
ASTM A193 Grade B8/B8M, Class 1 Stainless (Types 304 and 316)	Nominal strength as governed by steel strength (for a single anchor)[4]	N_{sa}	lbf (kN)	4,420 (19.7)	8,090 (36.0)	12,880 (57.3)	19,065 (84.8)	26,315 (117.1)	34,525 (153.6)	55,240 (245.7)
		V_{sa}	lbf (kN)	2,650 (11.8)	4,855 (21.6)	7,730 (34.4)	11,440 (50.9)	15,790 (70.2)	20,715 (92.1)	33,145 (147.4)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.70	0.70	0.80	0.80	0.80	0.80	0.80
	Strength reduction factor for tension[2]	ϕ	-	0.75						
	Strength reduction factor for shear[2]	ϕ	-	0.65						
ASTM A193 Grade B8/ B8M2, Class 2B Stainless (Types 304 and 316)	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lbf (kN)	7,365 (32.8)	13,480 (60.0)	21,470 (95.5)	31,775 (141.3)	43,860 (195.1)	57,545 (256.0)	92,065 (409.5)
		V_{sa}	lbf (kN)	4,420 (19.7)	8,085 (36.0)	12,880 (57.3)	19,065 (84.8)	26,315 (117.1)	34,525 (153.6)	55,240 (245.7)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.70	0.70	0.80	0.80	0.80	0.80	0.80
	Strength reduction factor for tension[2]	ϕ	-	0.75						
	Strength reduction factor for shear[2]	ϕ	-	0.65						

For SI: 1 inch = 25.4 mm, 1 lbf = 4.448 N. For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf.

1. Values provided for steel element material types are based on minimum specified strengths and calculated in accordance with ACI 318-19 Eq. 17.6.1.2 and Eq. 17.7.1.2(b), ACI 318-14 Eq. 17.4.1.2 and Eq. 17.5.1.2b or ACI 318-11 Eq. (D-2) and Eq. (D-29), as applicable, except where noted. Nuts and washers must be appropriate for the rod. Nuts must have specified proof load stresses equal to or greater than the minimum tensile strength of the specified threaded rod.
2. The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318 (-19 or -14) 5.3 or ACI 318-11 9.2, as applicable, are used in accordance with ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318 D.4.4. Values correspond to ductile steel elements.
3. The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318 (-19 or -14) 5.3 or ACI 318-11 9.2, as applicable, are used in accordance with ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318 D.4.4. Values correspond to brittle steel elements
4. In accordance with ACI 318-19 Eq. 17.6.1.2 and Eq. 17.7.1.2(b), ACI 318-14 17.4.1.2 and 17.5.1.2 or ACI 318-11 D.5.1.2 and D.6.1.2, as applicable, the calculated values for nominal tension and shear strength for ASTM A193 Grade B8/B8M Class 1 stainless steel threaded rods are based on limiting the specified tensile strength of the anchor steel to 1.9fy or 57,000 psi (393 MPa).
5. The referenced standard includes rod diameters up to and including 1-inch (24 mm).

Steel Tension and Shear Design for Reinforcing Bars in Normal Weight Concrete

CODE LISTED ICC-ES ESR-3576

STRENGTH DESIGN TABLES SD

Design Information		Symbol	Units	Nominal Reinforcing Bar Size (Rebar)[1]							
				No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10
Rebar nominal outside diameter		d	inch (mm)	0.375 (9.5)	0.500 (12.7)	0.625 (15.9)	0.750 (19.1)	0.875 (22.2)	1.000 (25.4)	1.125 (28.7)	1.250 (32.3)
Rebar effective cross-sectional area		A_{se}	inch² (mm²)	0.110 (71.0)	0.200 (129.0)	0.310 (200.0)	0.440 (283.9)	0.600 (387.1)	0.790 (509.7)	1.000 (645.2)	1.270 (819.4)
ASTM A615 Grade 75	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lbf (kN)	11,000 (48.9)	20,000 (89.0)	31,000 (137.9)	44,000 (195.7)	60,000 (266.9)	79,000 (351.4)	100,000 (444.8)	127,000 (564.9)
		V_{sa}	lbf (kN)	6,600 (29.4)	12,000 (53.4)	18,600 (82.7)	26,400 (117.4)	36,000 (160.1)	47,400 (210.8)	60,000 (266.9)	76,200 (338.9)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.70	0.70	0.80	0.80	0.80	0.80	0.80	0.80
	Strength reduction factor for tension[3]	ϕ	-	0.65							
	Strength reduction factor for shear[3]	ϕ	-	0.60							
ASTM A615 Grade 60	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lbf (kN)	9,900 (44.0)	18,000 (80.1)	27,900 (124.1)	39,600 (176.1)	54,000 (240.2)	71,100 (316.3)	90,000 (400.3)	114,300 (508.4)
		V_{sa}	lbf (kN)	5,940 (26.4)	10,800 (48.0)	16,740 (74.5)	23,760 (105.7)	32,400 (144.1)	42,660 (189.8)	54,000 (240.2)	68,580 (305.0)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.70	0.70	0.80	0.80	0.80	0.80	0.80	0.80
	Strength reduction factor for tension[3]	ϕ	-	0.65							
	Strength reduction factor for shear[3]	ϕ	-	0.60							
ASTM A706 Grade 60	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lbf (kN)	8,800 (39.1)	16,000 (71.2)	24,800 (110.3)	35,200 (156.6)	48,000 (213.5)	63,200 (281.1)	80,000 (355.9)	101,600 (452.0)
		V_{sa}	lbf (kN)	5,280 (23.5)	9,600 (42.7)	14,880 (66.2)	21,120 (94.0)	28,800 (128.1)	37,920 (168.7)	48,000 (213.5)	60,960 (271.2)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.70	0.70	0.80	0.80	0.80	0.80	0.80	0.80
	Strength reduction factor for tension[2]	ϕ	-	0.75							
	Strength reduction factor for shear[2]	ϕ	-	0.65							
ASTM A615 Grade 40	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lbf (kN)	6,600 (29.4)	12,000 (53.4)	18,600 (82.7)	26,400 (117.4)	In accordance with ASTM A615, Grade 40 bars are furnished only in sizes No. 3 through No. 6			
		V_{sa}	lbf (kN)	3,960 (17.6)	7,200 (32.0)	11,160 (49.6)	15,840 (70.5)				
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.70	0.70	0.80	0.80				
	Strength reduction factor for tension[3]	ϕ	-	0.65							
	Strength reduction factor for shear[3]	ϕ	-	0.60							

For SI: 1 inch = 25.4 mm, 1 lbf = 4.448 N. For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf.

1. Values provided for reinforcing bar material types based on minimum specified strengths and calculated in accordance with ACI 318-19 Eq. 17.6.1.2 and Eq. 17.7.1.2(b), ACI 318-14 Eq. 17.4.1.2 and Eq. 17.5.1.2b or ACI 318-11 Eq. (D-2) and Eq. (D-29), as applicable.
2. The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318 (-19 or -14) 5.3 or ACI 318-11 9.2, as applicable, are used in accordance with ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318 D.4.4. Values correspond to ductile steel elements. In accordance with ACI 318-19 17.10.5.3(a)(vi), ACI 318-14 17.2.3.4.3(a)(vi) or ACI 318-11 D.3.3.4.3(a)6, as applicable, deformed reinforcing bars meeting this specification used as ductile steel elements to resist earthquake effects shall be limited to reinforcing bars satisfying the requirements of ACI 318-19 20.2.2, ACI 318-14 20.2.2.4 and 20.2.2.5 or ACI 318-11 21.1.5.2 (a) and (b), as applicable.
3. The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318 (-19 or -14) 5.3 or ACI 318-11 9.2, as applicable, are used in accordance with ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318 D.4.4. Values correspond to brittle steel elements.

Concrete Breakout Design Information for Threaded Rod and Reinforcing Bars

CODE LISTED
ICC-ES ESR-3576

Design Information	Symbol	Units	Nominal Rod Diameter (inch) / Reinforcing Bar Size							
			3/8 or #3	1/2 or #4	5/8 or #5	3/4 or #6	7/8 or #7	1 or #8	#9	1-1/4 or #10
Effectiveness factor for cracked concrete	$k_{c,cr}$	- (SI)	17 (7.1)							
Effectiveness factor for uncracked concrete	$k_{c,uncr}$	- (SI)	24 (10.0)							
Minimum embedment	$h_{ef,min}$	inch (mm)	2-3/8 (60)	2-3/4 (70)	3-1/8 (79)	3-1/2 (89)	3-1/2 (89)	4 (102)	4-1/2 (114)	5 (127)
Maximum embedment	$h_{ef,max}$	inch (mm)	7-1/2 (191)	10 (254)	12-1/2 (318)	15 (381)	17-1/2 (445)	20 (508)	22-1/2 (572)	25 (635)
Minimum anchor spacing	s_{min}	inch (mm)	1-7/8 (48)	2-1/2 (64)	3-1/8 (79)	3-3/4 (95)	4-3/8 (111)	5 (127)	5-5/8 (143)	6-1/4 (159)
Minimum edge distance[2]	c_{min}	inch (mm)	5*d* where *d* is nominal outside diameter of the anchor							
Minimum edge distance, reduced[2] (45% T_{max})	$c_{min,red}$	inch (mm)	1-3/4 (45)	1-3/4 (45)	1-3/4 (45)	1-3/4 (45)	1-3/4 (45)	1-3/4 (45)	2-3/4 (70)	2-3/4 (70)
Minimum member thickness	h_{min}	inch (mm)	h_{ef} + 1-1/4 (h_{ef} + 30)	$h_{ef} + 2d_o$ where d_o is hole diameter;						
Critical edge distance—splitting (for uncracked concrete only)[3]	c_{ac}	inch	$c_{ac} = h_{ef} \cdot (\frac{\tau_{uncr}}{1160})^{0.4} \cdot [3.1-0.7 \frac{h}{h_{ef}}]$							
		(mm)	$c_{ac} = h_{ef} \cdot (\frac{\tau_{uncr}}{8})^{0.4} \cdot [3.1-0.7 \frac{h}{h_{ef}}]$							
Strength reduction factor for tension, concrete failure modes, Condition B[4]	ϕ	-	0.65							
Strength reduction factor for shear, concrete failure modes, Condition B[4]	ϕ	-	0.70							

For SI: 1 inch = 25.4 mm, 1 lbf = 4.448 N. For pound-inch units: 1 mm = 0.03937 inch, 1 N = 0.2248 lbf.

1. Additional setting information is described in the installation instructions.
2. For installation between the minimum edge distance, c_{min}, and the reduced minimum edge distance, $c_{min,red}$, the maximum torque applied must be reduced (multiplied) by a factor of 0.45.
3. $\tau_{k,uncr}$ need not be taken as greater than: $\tau_{k,uncr} = \frac{k_{uncr} \cdot \sqrt{h_{ef} \cdot f'_c}}{\pi \cdot d}$ and $\frac{h}{h_{ef}}$ need not be taken as larger than 2.4.
4. Condition A requires supplemental reinforcement, while Condition B applies where supplemental reinforcement is not provided or where pryout governs, as set forth in ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318 (-19 or -14) 5.3 or ACI 318-11 9.2, as applicable, are used in accordance with ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318 D.4.4.

Bond Strength Design Information for Threaded Rods and Reinforcing Bars

Design Information		Symbol	Units	Nominal Rod Diameter (inch) / Reinforcing Bar Size							
				3/8 or #3	1/2 or #4	5/8 or #5	3/4 or #6	7/8 or #7	1 or #8	#9	1-1/4 or #10
Minimum embedment		$h_{ef,min}$	inch (mm)	2-3/8 (60)	2-3/4 (70)	3-1/8 (79)	3-1/2 (89)	3-1/2 (89)	4 (102)	4-1/2 (114)	5 (127)
Maximum embedment		$h_{ef,max}$	inch (mm)	7-1/2 (191)	10 (254)	12-1/2 (318)	15 (381)	17-1/2 (445)	20 (508)	22-1/2 (572)	25 (635)
110°F (43°C) Maximum Long-Term Service Temperature; 140°F (60°C) Maximum Short-Term Service Temperature[3,5]	Characteristic bond strength in cracked concrete[6,9]	$\tau_{k,cr}$	psi (N/mm²)	684 (4.7)	658 (4.5)	632 (4.4)	608 (4.2)	585 (4.0)	562 (3.9)	562 (3.9)	562 (3.9)
	Characteristic bond strength in uncracked concrete[6,8]	$\tau_{k,uncr}$	psi (N/mm²)	1,444 (10.0)	1,389 (9.6)	1,335 (9.2)	1,283 (8.8)	1,234 (8.5)	1,184 (8.2)	1,184 (8.2)	1,184 (8.2)
110°F (43°C) Maximum Long-Term Service Temperature; 176°F (80°C) Maximum Short-Term Service Temperature[4,5]	Characteristic bond strength in cracked concrete[6,9]	$\tau_{k,cr}$	psi (N/mm²)	475 (3.3)	457 (3.2)	439 (3.0)	422 (2.9)	406 (2.8)	390 (2.7)	390 (2.7)	390 (2.7)
	Characteristic bond strength in uncracked concrete[6,8]	$\tau_{k,uncr}$	psi (N/mm²)	1,024 (7.1)	985 (6.8)	947 (6.5)	910 (6.3)	875 (6.0)	840 (5.8)	840 (5.8)	840 (5.8)
Permissible Installation Conditions[7]	Dry concrete	Anchor Category	-	1							
		ϕ_d	-	0.65							
	Water-saturated concrete or Water-filled hole (flooded)	Anchor Category	-	2							
		ϕ_{ws}, ϕ_{wf},	-	0.55							
Reduction factor for seismic tension[9]		$\alpha_{N,seis}$	-	1.0							

For SI: 1 inch = 25.4 mm, 1 psi = 0.006894 MPa. For pound-inch units: 1 mm = 0.03937 inch, 1 MPa = 145.0 psi.

1. Bond strength values correspond to a normal-weight concrete compressive strength f'c = 2,500 psi (17.2 MPa). For concrete compressive strength, f'c between 2,500 psi and 8,000 psi (17.2 MPa and 55.2 MPa), the tabulated characteristic bond strength may be increased by a factor of $(f'c / 2,500)^{0.23}$ [For SI: $(f'c / 17.2)^{0.23}$]. See Section 4.1.4 of this report for bond strength determination.
2. The modification factor for bond strength of adhesive anchors in lightweight concrete shall be taken as given in ACI 318-19 17.2.4.1, or ACI 318-14 17.2.6 where applicable.
3. The maximum short-term service temperature may be increased to 162°F (72°C) provided characteristic bond strengths are reduced by 3 percent. Long-term and short-term temperatures meet the requirements of Section 8.5 of ACI 355.4 and Table 8.1, Temperature Category B.
4. Long-term and short-term temperatures meet the requirements of Section 8.5 of ACI 355.4 and Table 8.1, Temperature Category A.
5. Short-term base material service temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling. Long-term base material service temperatures are roughly constant over significant periods of time.
6. Characteristic bond strengths are for sustained loads including dead and live loads. Characteristic bond strengths are also applicable to short-term loading.
7. Permissible installation conditions include dry concrete, water-saturated concrete, and water-filled holes. Water-filled holes include applications in dry or water-saturated concrete where the drilled holes contain standing water at the time of anchor installation.
8. Bond strength values for uncracked concrete are applicable for structures assigned to Seismic Design Categories A and B only.
9. For structures assigned to Seismic Design Categories C, D, E or F, the tabulated bond strength values for cracked concrete do not require an additional reduction factor applied for seismic tension ($\alpha_{N,seis}$ = 1.0), where seismic design is applicable.

DESIGN STRENGTH TABLES (SD)

Tension and Shear Design Strength Installed in Uncracked Concrete (Bond or Concrete Strength) Drilled with a Hammer-Drill and Carbide Bit in a Dry Hole Condition 110°F (43°C) Maximum Long-Term Service Temperature; 140°F (60°C) Maximum Short-Term Service Temperature[1,2,3,4,5,6,7,8,9,10,11]

STRENGTH DESIGN SD TABLES

Nominal Rod/Rebar Size (in. or #)	Embed. Depth h_{ef} (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_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)
3/8 or #3	2-3/8	2,625	2,490	2,740	2,770	2,925	3,150	3,210	3,460	3,430	3,695
	3	3,315	3,700	3,460	4,120	3,695	4,885	4,055	6,210	4,335	7,365
	4-1/2	4,975	6,755	5,190	7,525	5,545	8,920	6,085	11,340	6,500	13,445
	7-1/2	8,295	14,375	8,650	16,010	9,240	18,985	10,145	21,845	10,835	23,340
1/2 or #4	2-3/4	3,555	3,305	3,895	3,755	4,345	4,525	4,770	5,755	5,095	6,825
	4	5,675	6,450	5,915	7,185	6,320	8,520	6,940	10,830	7,415	12,840
	6	8,510	11,750	8,875	13,085	9,480	15,515	10,405	19,725	11,120	23,390
	10	14,180	25,020	14,790	27,875	15,800	33,050	17,345	37,360	18,530	39,915
5/8 or #5	3-1/8	4,310	4,120	4,720	4,680	5,450	5,720	6,430	7,525	6,835	8,920
	5	8,520	9,895	8,885	11,020	9,490	13,065	10,420	16,610	11,130	19,695
	7-1/2	12,780	18,020	13,325	20,070	14,235	23,800	15,630	30,255	16,700	35,870
	12-1/2	21,300	38,395	22,210	42,775	23,730	50,715	26,050	56,105	27,830	59,940
3/4 or #6	3-1/2	5,105	5,015	5,595	5,700	6,460	6,970	7,635	9,255	8,265	11,245
	6	11,465	13,595	12,295	15,315	13,135	18,160	14,420	23,090	15,405	27,375
	9	17,685	25,045	18,440	27,900	19,705	33,080	21,630	42,050	23,110	49,775
	15	29,475	53,355	30,735	59,435	32,840	70,470	36,050	77,645	38,515	82,955
7/8 or #7	3-1/2	5,105	4,930	5,595	5,605	6,460	6,855	7,350	9,100	7,975	11,130
	7	14,445	16,605	15,825	18,865	17,195	22,525	18,875	28,635	20,170	33,950
	10-1/2	23,150	31,060	24,145	34,595	25,795	41,020	28,315	52,150	30,250	61,830
	17-1/2	38,585	66,175	40,240	73,715	42,990	87,400	47,195	101,645	50,420	108,600
1 or #8	4	6,240	6,115	6,835	6,945	7,895	8,495	9,190	11,280	9,980	13,800
	8	17,650	19,750	19,335	22,435	21,550	27,055	23,655	34,395	25,275	40,785
	12	29,015	37,310	30,255	41,560	32,325	49,280	35,485	62,650	37,910	74,280
	20	48,355	79,500	50,425	88,560	53,875	105,005	59,140	127,380	63,185	136,095
#9	4-1/2	7,445	7,110	8,155	8,080	9,420	9,880	11,335	13,125	12,300	16,055
	9	21,060	23,055	23,070	26,190	26,640	32,035	29,940	41,110	31,990	48,745
	13-1/2	36,720	44,600	38,290	49,680	40,910	58,905	44,910	74,885	47,985	88,790
	22-1/2	61,200	94,995	63,820	105,825	68,185	125,475	74,850	159,515	79,970	172,245
1-1/4	5	8,720	8,170	9,555	9,285	11,030	11,355	13,510	15,085	15,190	18,450
	10	24,665	26,380	27,020	29,975	31,200	36,660	36,965	48,050	39,490	56,970
	15	45,315	52,110	47,275	58,060	50,510	68,835	55,445	87,515	59,240	103,760
	25	75,555	111,065	78,790	123,720	84,180	146,695	92,410	186,490	98,730	212,650
#10	5	8,720	8,160	9,555	9,270	11,030	11,335	13,510	15,060	15,020	18,420
	10	24,665	26,430	27,020	30,025	31,200	36,725	36,965	48,135	39,490	57,070
	15	45,315	52,205	47,275	58,165	50,510	68,965	55,445	87,675	59,240	103,955
	25	75,555	111,225	78,790	123,905	84,180	146,910	92,410	186,765	98,730	212,650

- Concrete Breakout Strength - Bond Strength/Pryout Strength

1. Tabular values are provided for illustration and are applicable for single anchors installed in uncracked 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 according to ACI 318 (-19 or -14) Ch. 17 and ICC-ES AC308. The load level corresponding to the failure mode listed [Concrete breakout strength, bond strength/ pryout strength] must be checked against the tabulated steel strength of the corresponding threaded rod or rebar size and type, the lowest load level controls.
3. Strength reduction factors (ϕ) for concrete breakout strength are based on ACI 318 (-19 or -14) 5.3 for load combinations. Condition B was assumed.
4. Strength reduction factors (ϕ) for bond strength are determined from reliability testing and qualification in accordance with ICC-ES AC308 and are tabulated in this product information and in ESR-3576.
5. Tabular values are permitted for static loads only, seismic loading is not considered with these tables. Periodic special inspection must be performed where required by code, see ESR-3576 for applicable information.
6. For anchors subjected to tension resulting from sustained loading a supplemental check must be performed according to ACI 318 -19 17.5.2.2, or ACI 318-14 17.3.1.2.
7. For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318 (-19 or -14) Ch. 17.
8. Interpolation is not permitted to be used with the tabular values. For intermediate base material compressive strengths, please see ACI 318 (-19 or -14) Ch. 17, ICC-ES AC308 and information included in this product supplement. For other design conditions including seismic considerations please see ACI 318 (-19 or -14) Ch. 17 and ICC-ES AC308 and ESR-3576.
9. Long term concrete temperatures are roughly constant over significant periods of time. Short-term elevated temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.
10. The tabulated design strengths may be converted to allowable stress design values. Divide by conversion factor calculated as a weighted average of the load factors for the controlling load combination.
11. For other installation conditions such as water-saturated concrete or water-filled holes, see the associated strength reduction factors (ϕ) for bond strength in the determination of controlling design strength values, as applicable.

Tension and Shear Design Strength Installed in Cracked Concrete (Bond or Concrete Strength) Drilled with a Hammer-Drill and Carbide Bit in a Dry Hole Condition 110°F (43°C) Maximum Long-Term Service Temperature; 140°F (60°C) Maximum Short-Term Service Temperature[1,2,3,4,5,6,7,8,9,10,11,12]

STRENGTH DESIGN SD TABLES

Nominal Rod/Rebar Size (in. or #)	Embed. Depth h_{ef} (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_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)
3/8 or #3	2-3/8	1,245	1,340	1,295	1,395	1,385	1,495	1,520	1,640	1,625	1,750
	3	1,570	2,645	1,640	2,945	1,750	3,490	1,920	4,140	2,055	4,425
	4-1/2	2,355	4,825	2,460	5,295	2,625	5,655	2,885	6,210	3,080	6,635
	7-1/2	3,930	8,460	4,095	8,825	4,375	9,425	4,805	10,350	5,135	11,055
1/2 or #4	2-3/4	1,850	2,360	1,925	2,680	2,060	3,235	2,260	4,110	2,415	4,875
	4	2,685	4,605	2,800	5,130	2,995	6,085	3,285	7,080	3,510	7,565
	6	4,030	8,390	4,205	9,055	4,490	9,675	4,930	10,620	5,265	11,345
	10	6,720	14,470	7,005	15,090	7,485	16,120	8,215	17,700	8,780	18,910
5/8 or #5	3-1/8	2,365	2,940	2,500	3,340	2,720	4,085	3,045	5,375	3,235	6,375
	5	4,035	7,065	4,205	7,870	4,495	9,335	4,935	10,625	5,270	11,350
	7-1/2	6,050	12,870	6,310	13,590	6,740	14,515	7,400	15,935	7,905	17,025
	12-1/2	10,085	21,715	10,515	22,645	11,235	24,195	12,330	26,560	13,175	28,375
3/4 or #6	3-1/2	2,805	3,580	2,955	4,070	3,215	4,980	3,620	6,610	3,920	8,035
	6	5,585	9,710	5,825	10,940	6,225	12,970	6,835	14,720	7,300	15,725
	9	8,380	17,890	8,740	18,825	9,335	20,110	10,250	22,075	10,950	23,585
	15	13,970	30,085	14,565	31,370	15,560	33,520	17,085	36,795	18,250	39,310
7/8 or #7	3-1/2	2,720	3,525	2,860	4,000	3,105	4,895	3,485	6,500	3,780	7,950
	7	7,315	11,860	7,630	13,475	8,150	16,090	8,950	19,275	9,560	20,595
	10-1/2	10,975	22,185	11,445	24,650	12,230	26,340	13,425	28,910	14,340	30,890
	17-1/2	18,290	39,400	19,075	41,085	20,380	43,895	22,370	48,185	23,905	51,485
1 or #8	4	3,405	4,365	3,585	4,960	3,890	6,065	4,365	8,060	4,735	9,855
	8	9,180	14,105	9,575	16,025	10,230	19,325	11,230	24,185	11,995	25,840
	12	13,770	26,650	14,360	29,685	15,345	33,050	16,845	36,280	17,995	38,760
	20	22,950	49,435	23,935	51,555	25,575	55,080	28,070	60,465	29,995	64,600
#9	4-1/2	4,205	5,080	4,425	5,770	4,800	7,060	5,380	9,375	5,840	11,465
	9	11,620	16,465	12,115	18,710	12,945	22,880	14,210	29,365	15,185	32,705
	13-1/2	17,430	31,855	18,175	35,485	19,420	41,825	21,315	45,915	22,775	49,055
	22-1/2	29,050	62,570	30,295	65,245	32,365	69,710	35,530	76,525	37,960	81,760
1-1/4	5	5,190	5,835	5,465	6,630	5,925	8,110	6,645	10,775	7,210	13,175
	10	14,345	18,845	14,960	21,410	15,985	26,185	17,545	34,320	18,745	40,375
	15	21,520	37,220	22,440	41,470	23,975	49,170	26,320	56,685	28,120	60,560
	25	35,865	77,245	37,400	80,550	39,955	86,060	43,865	94,475	46,865	100,935
#10	5	5,135	5,830	5,405	6,620	5,860	8,100	6,570	10,755	7,130	13,155
	10	14,345	18,880	14,960	21,445	15,985	26,230	17,545	34,380	18,745	40,375
	15	21,520	37,290	22,440	41,545	23,975	49,260	26,320	56,685	28,120	60,560
	25	35,865	77,245	37,400	80,550	39,955	86,060	43,865	94,475	46,865	100,935

☐ - Concrete Breakout Strength ☐ - Bond Strength/Pryout Strength

1. Tabular values are provided for illustration and are applicable for single anchors installed in cracked 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 according to ACI 318 (-19 or -14) Ch. 17 and ICC-ES AC308. The load level corresponding to the failure mode listed [Concrete breakout strength, bond strength/ pryout strength] must be checked against the tabulated steel strength of the corresponding threaded rod or rebar size and type, the lowest load level controls.
3. Strength reduction factors (ϕ) for concrete breakout strength are based on ACI 318 (-19 or -14) 5.3 for load combinations. Condition B was assumed.
4. Strength reduction factors (ϕ) for bond strength are determined from reliability testing and qualification in accordance with ICC-ES AC308 and are tabulated in this product information and in ESR-3576.
5. Tabular values are permitted for static loads only, seismic loading is not considered with these tables. Periodic special inspection must be performed where required by code, see ESR-3576 for applicable information.
6. For anchors subjected to tension resulting from sustained loading a supplemental check must be performed according to ACI 318 -19 17.5.2.2 or ACI 318-14 17.3.1.2.
7. For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318-14 Ch.17.
8. Interpolation is not permitted to be used with the tabular values. For intermediate base material compressive strengths, please see ACI 318 (-19 or -14) Ch. 17, ICC-ES AC308 and information included in this product supplement. For other design conditions including seismic considerations please see ACI 318 (-19 or -14) Ch. 17 and ICC-ES AC308 and ESR-3576.
9. Long term concrete temperatures are roughly constant over significant periods of time. Short-term elevated temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.
10. The tabulated design strengths may be converted to allowable stress design values. Divide by conversion factor calculated as a weighted average of the load factors for the controlling load combination.
11. For seismic design in accordance with ACI 318, the tabulated tension design strengths in cracked concrete for concrete breakout and bond strength must be multiplied by a factor of 0.75. In the determination of the tension design strength values in cracked concrete, the bond strength does not require an additional reduction factor applied for seismic tension ($\alpha_{N,seis} = 1.0$), where seismic design is applicable.
12. For other installation conditions such as water-saturated concrete or water-filled holes, see the associated strength reduction factors (ϕ) for bond strength in the determination of controlling design strength values, as applicable.

Tension Design of Steel Elements (Steel Strength)[1,2]

Nominal Rod/Rebar Size (in. or No.)	Steel Elements - Threaded Rod and Reinforcing Bar											
	ASTM A36 and ASTM F1554 Grade 36	ASTM F1554 Grade 55	ASTM A193 Grade B7 and ASTM F1554 Grade 105	ASTM A449	ASTM F568M Class 5.8 and ISO 898-1 Class 5.8	ASTM F593 CW Stainless (Types 304 and 316)	ASTM A193 Grade B8/B8M, Class 1 Stainless (Types 304 and 316)	ASTM A193 Grade B8/ B8M2, Class 2B Stainless (Types 304 and 316)	ASTM A615 Grade 75 Rebar	ASTM A615 Grade 60 Rebar	ASTM A706 Grade 60 Rebar	ASTM A615 Grade 40 Rebar
	ϕN_{sa} Tension (lbs.)	ϕN_{sa} Tension (lbs.)	ϕN_{sa} Tension (lbs.)	ϕN_{sa} Tension (lbs.)	ϕN_{sa} Tension (lbs.)	ϕN_{sa} Tension (lbs.)	ϕN_{sa} Tension (lbs.)	ϕN_{sa} Tension (lbs.)	ϕN_{sa} Tension (lbs.)	ϕN_{sa} Tension (lbs.)	ϕN_{sa} Tension (lbs.)	ϕN_{sa} Tension (lbs.)
3/8 or #3	3,370	4,360	7,265	6,975	3,655	5,040	3,315	5,525	7,150	6,435	6,600	4,290
1/2 or #4	6,175	7,980	13,300	12,770	6,690	9,225	6,070	10,110	13,000	11,700	12,000	7,800
5/8 or #5	9,835	12,715	21,190	20,340	10,650	14,690	9,660	16,105	20,150	18,135	18,600	12,090
3/4 or #6	14,550	18,815	31,360	30,105	15,765	18,480	14,300	23,830	28,600	25,740	26,400	17,160
7/8 or #7	20,085	25,970	43,285	41,930	21,760	25,510	19,735	32,895	39,000	35,100	36,000	-
1 or #8	26,350	34,070	56,785	54,515	28,545	33,465	25,895	43,160	51,350	46,215	47,400	-
#9	-	-	-	-	-	-	-	-	65,000	58,500	60,000	-
1-1/4 or #10	42,160	54,510	90,850	76,315	-	53,540	41,430	69,050	82,550	74,295	76,200	-

■ - Steel Strength

1. Steel tensile design strength according to ACI 318 (-19 or -14) Ch. 17 and ACI 318 Appendix D, $\phi N_{sa} = \phi \bullet A_{se,N} \bullet f_{uta}$.
2. The tabulated steel design strength in tension must be checked against the bond strength/concrete capacity design strength to determine the controlling failure mode, the lowest load level controls.

Shear Design of Steel Elements (Steel Strength)[1,2,3]

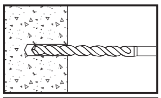
Nominal Rod/Rebar Size (in. or No.)	Steel Elements - Threaded Rod and Reinforcing Bar											
	ASTM A36 and ASTM F1554 Grade 36	ASTM F1554 Grade 55	ASTM A193 Grade B7 and ASTM F1554 Grade 105	ASTM A449	ASTM F568M Class 5.8 and ISO 898-1 Class 5.8	ASTM F593 CW Stainless (Types 304 and 316)	ASTM A193 Grade B8/B8M, Class 1 Stainless (Types 304 and 316)	ASTM A193 Grade B8/ B8M2, Class 2B Stainless (Types 304 and 316)	ASTM A615 Grade 75 Rebar	ASTM A615 Grade 60 Rebar	ASTM A706 Grade 60 Rebar	ASTM A615 Grade 40 Rebar
	ϕV_{sa} Shear (lbs.)	ϕV_{sa} Shear (lbs.)	ϕV_{sa} Shear (lbs.)	ϕV_{sa} Shear (lbs.)	ϕV_{sa} Shear (lbs.)	ϕV_{sa} Shear (lbs.)	ϕV_{sa} Shear (lbs.)	ϕV_{sa} Shear (lbs.)	ϕV_{sa} Shear (lbs.)	ϕV_{sa} Shear (lbs.)	ϕV_{sa} Shear (lbs.)	ϕV_{sa} Shear (lbs.)
3/8 or #3	1,755	2,265	3,775	3,625	2,025	2,790	1,725	2,870	3,960	3,565	3,430	2,375
1/2 or #4	3,210	4,150	6,915	6,640	3,705	5,110	3,155	5,255	7,200	6,480	6,240	4,320
5/8 or #5	5,115	6,610	11,020	10,575	5,900	8,135	5,025	8,375	11,160	10,045	9,670	6,695
3/4 or #6	7,565	9,785	16,305	15,655	8,730	10,235	7,435	12,390	15,840	14,255	13,730	9,505
7/8 or #7	10,445	13,505	22,505	21,805	12,050	14,130	10,265	17,105	21,600	19,440	18,720	-
1 or #8	13,700	17,715	29,525	28,345	15,810	18,535	13,465	22,445	28,440	25,595	24,650	-
#9	-	-	-	-	-	-	-	-	36,000	32,400	31,200	-
1-1/4 or #10	21,920	28,345	47,240	39,685	-	29,655	21,545	35,905	45,720	41,150	39,625	-

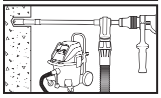
■ - Steel Strength

1. Steel shear design strength according to ACI 318 (-19 or -14) Ch. 17 and ACI 318 Appendix D, $\phi V_{sa} = \phi \bullet 0.60 \bullet A_{se,V} \bullet f_{uta}$.
2. The tabulated steel design strength in shear must be checked against the bond strength/concrete capacity design strength to determine the controlling failure mode, the lowest load level controls.
3. In the determination of the shear design strength values in cracked concrete, the steel strength requires an additional reduction factor applied for seismic shear ($\alpha_{V,seis}$), where seismic design is applicable.

INSTALLATION INSTRUCTIONS (SOLID BASE MATERIALS)

DRILLING





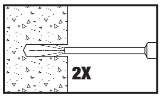
1- Drill a hole into the base material with rotary hammer drill (i.e. percussion drill) and a carbide drill bit to the size and embedment required by the selected steel hardware element (reference installation specifications for threaded rod and reinforcing bar). The tolerances of the carbide drill bits, including hollow bits, must meet ANSI Standard B212.15.

- Precaution: Use suitable eye and skin protection. Avoid inhalation of dust during drilling and/or removal.
- Note! In case of standing water in the drilled hole (flooded hole condition), all the water has to be removed from the hole (e.g. vacuum, compressed air, etc.) prior to cleaning.

Drilling in dry base materials is recommended when using hollow drill bits (vacuum must be on).

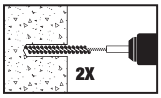
GO TO STEP 3 FOR HOLES DRILLED WITH DUSTX+™ EXTRACTION SYSTEM (NO FURTHER HOLE CLEANING IS REQUIRED). OTHERWISE GO TO STEP 2A FOR HOLE CLEANING INSTRUCTIONS.

HOLE CLEANING (BLOW 2X, BRUSH 2X, BLOW 2X)

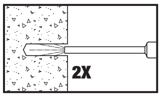


2a- Starting from the bottom or back of the drilled anchor hole, blow the hole clean a minimum of two times (2x).

- Use a compressed air nozzle (min. 90 psi) for all sizes of anchor rod and reinforcing bar (rebar).



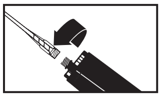
2b- Determine wire brush diameter (see installation specifications) for the drilled hole and attach the brush with adaptor to a rotary drill tool or battery screw gun. Brush the hole with the selected wire brush a minimum of two times (2x). A brush extension (supplied by DEWALT) must be used for holes drilled deeper than the listed brush length. The wire brush diameter must be checked periodically during use. The brush should resist insertion into the drilled hole, if it does not come into contact with the sides of the drilled hole, the brush is too small and must be replaced.



2c- Repeat Step 2a again by blowing the hole clean a minimum of two times (2x).

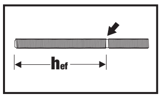
- When finished the hole should be clean and free of dust, debris, ice, grease, oil or other foreign material.

PREPARING

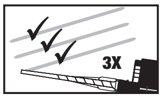


3- Check adhesive expiration date on cartridge label. Do not use expired product. Review Safety Data Sheet (SDS) before use. Cartridge temperature must be between 50°F - 104°F (10°C - 40°C) when in use; for overhead applications cartridge temperature must be between 50ºF - 90ºF (10ºC - 30ºC). Review published working and cure times. Consideration should be given to the reduced gel (working) time of the adhesive in warm temperatures. For permitted range of the base material temperature, see published gel and curing times.

- Attach a supplied mixing nozzle to the cartridge. Unless otherwise noted do not modify the mixer in any way and make sure the mixing element is inside the nozzle. Load the cartridge into the correct dispensing tool.
- Note: Unless otherwise noted use a new mixing nozzle with new cartridge of adhesive and also for all work interruptions exceeding the published gel (working) time of the adhesive.



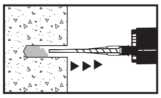
4- Prior to inserting the anchor rod or rebar into the filled bore hole, the position of the embedment depth has to be marked on the anchor. Verify anchor element is straight and free of surface damage.



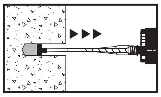
5- Adhesives must be properly mixed to achieve published properties. For new cartridges and nozzles, prior to dispensing adhesive into the drilled hole, separately dispense at least three full strokes of adhesive through the mixing nozzle until the adhesive is a consistent **GRAY** color.

- Review and note the published working and cure times (reference gel time and curing time table) prior to injection of the mixed adhesive into the cleaned anchor hole.

INSTALLATION



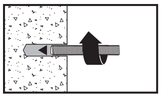
WITH PISTON PLUG:



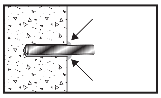
6- Fill the cleaned hole approximately two-thirds full with mixed adhesive starting from the bottom or back of the anchor hole. Slowly withdraw the mixing nozzle as the hole fills to avoid creating air pockets or voids. A plastic extension tube (Cat# 08281-PWR or 08297-PWR) or equivalent approved by DEWALT must be used with the mixing nozzle if the bottom or back of the anchor hole is not reached with the mixing nozzle only.

- Note! Piston plugs (see adhesive piston plug table) must be used with and attached to the mixing nozzle and extension tube for horizontal installations where embedment is greater than 8 inches and where the drilled hole diameter is larger than 5/8-inch. Insert piston plug to the back of the drilled hole and inject as described in the method above. During installation the piston plug will be naturally extruded from the drilled hole by the adhesive pressure.

Attention! Do not install anchors overhead without proper training and installation hardware provided by the DEWALT. Contact DEWALT for details prior to use.

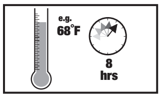


7- The anchor should be free of dirt, grease, oil or other foreign material. Push clean threaded rod or reinforcing bar into the anchor hole while turning slightly to ensure positive distribution of the adhesive until the embedment depth is reached. Observe the gel (working) time.



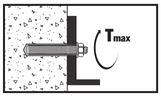
8- Ensure that the anchor element is installed to the specific embedment depth. Adhesive must completely fill the annular gap at the concrete surface. Following installation of the anchor element, remove excess adhesive. Protect the anchor element threads from fouling with adhesive. For all installations the anchor element must be restrained from movement throughout the specified curing period (as necessary) through the use of temporary wedges, external supports, or other methods. Minor adjustment to the position of the anchor element may be performed during the gel time only.

CURING AND LOADING



9- Allow the adhesive anchor to cure to the specified full curing time prior to applying any load (reference gel time and curing time table).

- Do not disturb, torque or load the anchor until it is fully cured.



10- After full curing of the adhesive anchor, a fixture can be installed to the anchor and tightened up to the maximum torque (reference gel time and curing table) by using a calibrated torque wrench.

- Note: Take care not to exceed the maximum torque for the selected anchor.

REFERENCE INSTALLATION TABLES

Gel (working) Time and Curing Table[1,2]

Temperature of base material		Gel (working) time	Full curing time
°F	°C		
50	10	90 minutes	24 hours
68	20	25 minutes	8 hours
86	30	20 minutes	6 hours
95	35	15 minutes	6 hours
104	40	12 minutes	4 hours

1. Linear interpolation for intermediate base material temperature is possible.
2. Cartridge adhesive temperature must be between 50°F - 110°F (10°C - 43°C) when in use; for overhead applications cartridge adhesive temperature must be between 50°F - 90°F (10°C - 32°C) when in use. For best adhesive dispensing experience, suggested minimum cartridge adhesive temperature is 68°F (20°C) when in use

Wire Brush Selection Table for Pure50+ Adhesive Anchors[1,2,3]

ANSI Drill Bit Diameter[1] (inch)	Nominal Wire Brush Size (inch)	Brush Length (inches)	Steel Wire Brush[2,3] (Cat. #)	Blowout Tool
7/16	7/16	7	08284-PWR	Compressed air nozzle only, Cat #08292-PWR (min. 90 psi)
9/16	9/16	7	08285-PWR	
5/8	5/8	7	08275-PWR	
11/16	11/16	9	08286-PWR	
3/4		9	08278-PWR	
7/8	7/8	9	08287-PWR	
1	1	11	08288-PWR	
1-1/8	1-1/8	11	08289-PWR	
1-3/8	1-3/8	11	08290-PWR	
1-1/2	1-1/2	11	08291-PWR	

1. An SDS-plus adaptor (Cat. #08283-PWR) or Jacobs chuck style adaptor (Cat. #08296-PWR) is required to attach a steel wire brush to the drill tool.
2. A brush extension (Cat. #08282-PWR) must be used with a steel wire brush for holes drilled deeper than the listed brush length.
3. If the DEWALT DustX+ extraction system is used to automatically clean the holes during drilling, standard hole cleaning (i.e. brushing and removing dust/debris following drilling) is not required.

Piston Plug Selection Table for Adhesive Anchors[1,2,3,4]

Drill Bit Diameter (inch)	Plug Size (inch)	Piston Plug (Cat. #)	Premium Piston Plug (Cat. #)
11/16	11/16	08258-PWR	PFC1691515
3/4	3/4	08259-PWR	PFC1691520
7/8	7/8	08300-PWR	PFC1691530
1	1	08301-PWR	PFC1691540
1-1/8	1-1/8	08303-PWR	PFC1691550
1-1/4	1-1/4	08307-PWR	PFC1691555
1-3/8	1-3/8	08305-PWR	PFC1691560
1-1/2	1-1/2	08309-PWR	PFC1691570
1-3/4	1-3/4	-	PFC1691580
2	2	-	PFC1691590
2-3/16	2-3/16	-	PFC1691600

1. All overhead installations require the use of piston plugs where one is tabulated together with the anchor size.
2. All horizontal installations require the use of piston plugs where the embedment depth is greater than 8 inches and the drill bit size is larger than 5/8-inch.
3. The use of piston plugs is also recommended for underwater installations where one is tabulated together with the anchor size.
4. A flexible plastic extension tube (Cat. #08281-PWR or #08297-PWR) or equivalent approved by DEWALT must be used with piston plugs.

ORDERING INFORMATION

Pure50+ Cartridges

Cat. No.	Description	Pack Qty.	Pallet Qty
08600-PWR	Pure50+ 9 fl. oz Quick-Shot cartridge	12	432
08605-PWR	Pure50+ 20.5 fl. oz. cartridge	12	540
08651-PWR	Pure50+ 50.5 fl. oz. cartridge	5	135
A Pure50+ mixing nozzle is packaged with each cartridge. Pure50+ mixing nozzles must be used to ensure complete and proper mixing of the adhesive.			

Cartridge System Mixing Nozzles

Cat. No.	Description	Pack Qty.	Carton Qty.
PFC1641600	Mixing nozzle (with 8" extension) for Pure50+ Quick-Shot	1	12
08294-PWR	Mixing nozzle (with 8" extension)	2	24
08609-PWR	High flow mixing nozzle (with 8" extension)	2	24
08281-PWR	Mixing nozzle extension, 8" long	2	24
08297-PWR	Mixing nozzle extension, 20" long	1	12

Dispensing Tools for Injection Adhesive

Cat. No.	Description	Pack Qty.	Carton Qty.
08437-PWR	Manual caulking gun for Quick-Shot	1	12
DCE560D1	Quik-Shot 20v Battery powered dispensing tool	1	-
08409-PWR	20.5 fl. oz. Standard metal manual tool	1	10
DCE591D1	20.5 fl. oz. 20v Battery powered dispensing tool	1	-
08459-PWR	20.5 fl. oz. Pneumatic tool	1	-
08438-PWR	50.5 fl. oz. Pneumatic tool	1	-

Hole Cleaning Tools and Accessories

Cat. No.	Description	Pack Qty.
08284-PWR	Wire brush for 7/16" or 1/2" ANSI hole, 7" length	1
08285-PWR	Wire brush for 9/16" ANSI hole, 7" length	1
08275-PWR	Wire brush for 5/8" ANSI hole, 7" length	1
08286-PWR	Wire brush for 11/16" ANSI hole, 9" length	1
08278-PWR	Wire brush for 3/4" ANSI hole, 9" length	1
08287-PWR	Wire brush for 7/8" ANSI hole, 9" length	1
08288-PWR	Wire brush for 1" ANSI hole, 11" length	1
08289-PWR	Wire brush for 1-1/8" ANSI hole, 11" length	1
08276-PWR	Wire brush for 1-1/4" ANSI hole, 11" length	1
08290-PWR	Wire brush for 1-3/8" h ANSI ole, 11" length	1
08291-PWR	Wire brush for 1-1/2" ANSI hole, 11" length	1
08273-PWR	Wire brush for 1-5/8" ANSI hole, 11" length	1
08299-PWR	Wire brush for 1-3/4" ANSI hole, 11" length	1
08271-PWR	Wire brush for 2" ANSI hole, 11" length	1
08272-PWR	Wire brush for 2-3/16" ANSI hole, 11" length	1
08283-PWR	SDS-plus adapter for steel brushes	1
08296-PWR	Standard drill adapter for steel brushes (e.g. Jacobs Chuck)	1
08282-PWR	Steel brush extension, 12" length	1
08292-PWR	Air compressor nozzle with extension, 18" length	1

Piston Plugs for Adhesive Anchors

Cat. No.	Description	ANSI Drill Bit Dia.	Pack Qty.
08258-PWR	11/16" Plug	11/16"	10
08259-PWR	3/4" Plug	3/4"	10
08300-PWR	7/8" Plug	7/8"	10
08301-PWR	1" Plug	1"	10
08303-PWR	1-1/8" Plug	1-1/8"	10
08305-PWR	1-3/8" Plug	1-3/8"	10
08309-PWR	1-1/2" Plug	1-1/2"	10

Premium Piston Plugs

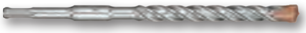
Cat. No.	Description	ANSI Drill Bit Dia.	Pack Qty.
PFC1691510	5/8" Plug	5/8"	1
PFC1691515	11/16" Plug	11/16"	1
PFC1691520	3/4" Plug	3/4"	1
PFC1691530	7/8" Plug	7/8"	1
PFC1691540	1" Plug	1"	1
PFC1691550	1-1/8" Plug	1-1/8"	1
PFC1691555	1-1/4" Plug	1-1/4"	1
PFC1691560	1-3/8" Plug	1-3/8"	1
PFC1691570	1-1/2" Plug	1-1/2"	1
PFC1691580	1-3/4" Plug	1-3/4"	1
PFC1691590	2" Plug	2"	1
PFC1691600	2-3/16" Plug	2-3/16"	1

SDS Max 4-Cutter Carbide Drill Bits

Cat. No.	Diameter	Usable Length	Overall Length
DW5806	5/8"	8"	13-1/2"
DW5809	5/8"	16"	21-1/2"
DW5807	5/8"	31"	36"
DW5808	11/16"	16"	21-1/2"
DW5810	3/4"	8"	13-1/2"
DW5812	3/4"	16"	21-1/2"
DW5813	3/4"	31"	36"
DW5814	13/16"	16"	21-1/2"
DW5815	7/8"	8"	13-1/2"
DW5816	7/8"	16"	21-1/2"
DW5851	7/8"	31"	36"
DW5817	27/32"	16"	21-1/2"
DW5818	1"	8"	13-1/2"
DW5819	1"	16"	22-1/2"
DW5852	1"	24"	29"
DW5820	1"	31"	36"
DW5821	1-1/8"	10"	15"
DW5822	1-1/8"	18"	22-1/2"
DW5853	1-1/8"	24"	29"
DW5854	1-1/8"	31"	36"
DW5824	1-1/4"	10"	15"
DW5825	1-1/4"	18"	22-1/2"

SDS+ Full Head Carbide Drill Bits

Cat. No.	Diameter	Usable Length	Overall Length
DW5502	3/16"	2"	4-1/2"
DW5503	3/16"	4"	6-1/2"
DW5504	3/16"	5"	8-1/2"
DW5506	3/16"	10"	12"
DW5512	7/32"	8"	10"
DW5517	1/4"	4"	6"
DW5518	1/4"	6"	8-1/2"
DW55200	1/4"	10"	12"
DW5521	1/4"	12"	14"
DW5524	5/16"	4"	6"
DW5526	5916"	10"	12"
DW5527	3/8"	4"	6-1/2"
DW5529	3/8"	8"	10"
DW55300	3/8"	10"	12"
DW5531	3/8"	16"	18"
DW5537	1/2"	4"	6"
DW5538	1/2"	8"	10-1/2"
DW5539	1/2"	10"	12"
DW5540	1/2"	16"	18"



SDS+ 4-Cutter Carbide Drill Bits

Cat. No.	Diameter	Usable Length	Overall Length
DW5471	5/8"	8"	10"
DW5472	5/8"	16"	18"
DW5474	3/4"	8"	10"
DW5475	3/4"	16"	18"
DW5477	7/8"	8"	10"
DW5478	7/8"	16"	18"
DW5479	1"	8"	10"
DW5480	1"	16"	18"
DW5481	1-1/8"	8"	10"
DW5482	1-1/8"	6"	18"

Dust Extraction

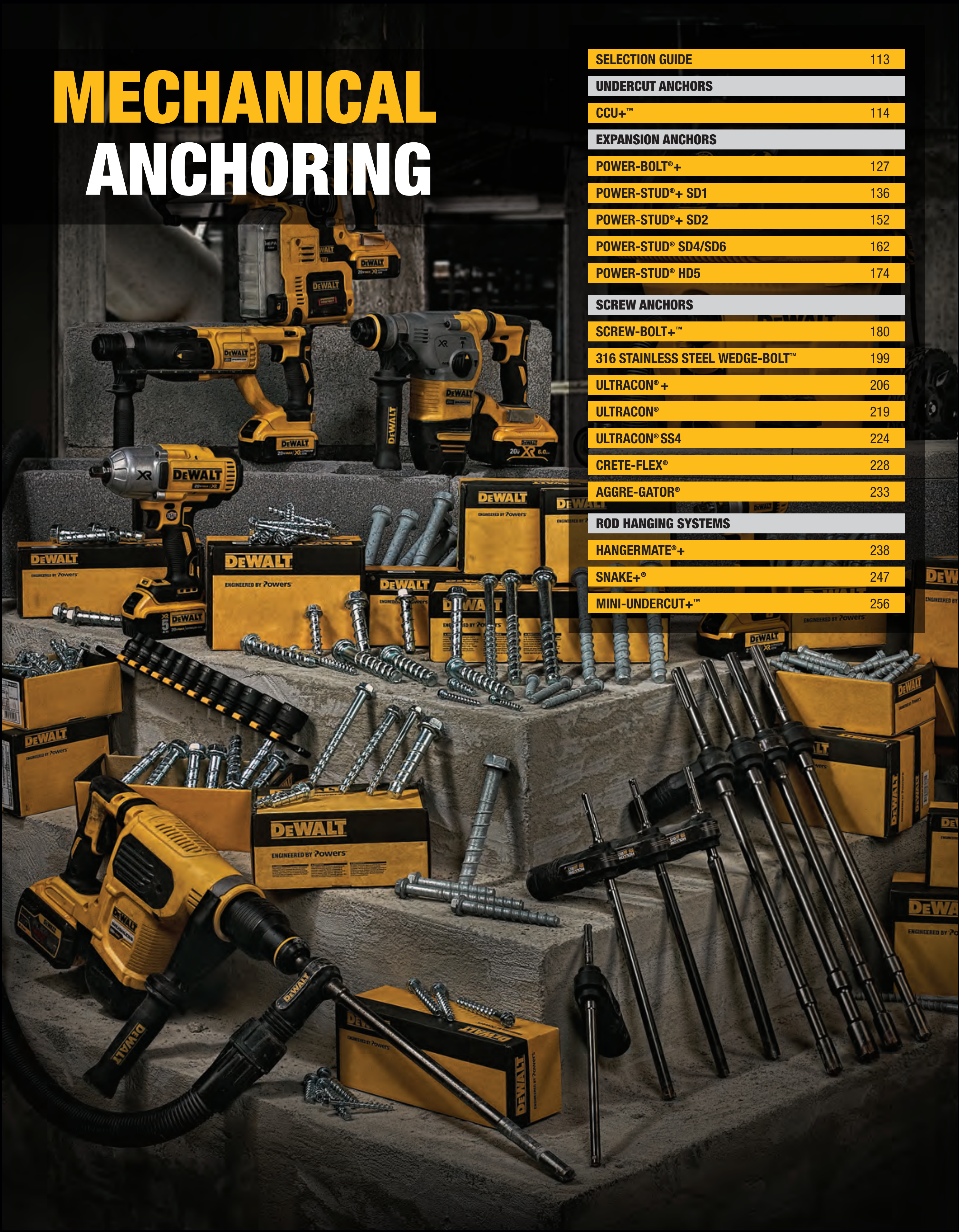
Cat. No.	Description
DWV012	10 Gallon Wet/Dry Hepa/Rrp Dust Extractor DWV9402 Fleece bag (5 pack) for DEWALT dust extractors DWV9316 Replacement Anti-Static Hose DWV9320 Replacement HEPA Filter Set (Type 1)
DWH050K	Dust Extraction with two interchangeable drilling heads
DCB1800B	1800 Watt Portable Power Station & Parallel Battery Charger Bare Unit

Hollow Drill Bits

Shank	Cat. No.	Diameter	Overall Length	Usable Length	Recommended Hammer
SDS+	DWA54012	1/2"	14-1/2"	9-3/4"	DCH133 / DCH273 / DCH293
	DWA54916	9/16"	14-1/2"	9-3/4"	DCH133 / DCH273 / DCH293
	DWA54058	5/8"	14-1/2"	9-3/4"	DCH133 / DCH273 / DCH293
	DWA54034	3/4"	14-1/2"	9-3/4"	DCH133 / DCH273 / DCH293
SDS Max	DWA58058	5/8"	23-5/8"	15-3/4"	DCH481 / D25603K
	DWA58958	5/8"	47-1/4"	39-3/8"	DCH481 / D25603K
	DWA58116	11/16"	24-3/4"	15-3/4"	DCH481 / D25603K
	DWA58034	3/4"	23-5/8"	15-3/4"	DCH481 / D25603K
	DWA58934	3/4"	47-1/4"	39-3/8"	DCH481 / D25603K
	DWA58078	7/8"	23-5/8"	15-3/4"	DCH481 / D25603K
	DWA58001	1"	23-5/8"	15-3/4"	DCH481 / D25603K
	DWA58901	1"	47-1/4"	39-3/8"	DCH481 / D25603K
	DWA58118	1-1/8"	23-5/8"	15-3/4"	DCH481 / D25603K
	DWA58918	1-1/8"	47-1/4"	39-3/8"	DCH481 / D25603K
	DWA58115	1-1/4"	23-5/8"	15-3/4"	DCH481 / D25603K
	DWA58114	1-1/4"	47-1/4"	39-3/8"	DCH481 / D25603K
	DWA58138	1-3/8"	47-1/4"	39-3/8"	DCH481 / D25603K
	DWA58112	1-1/2"	47-1/4"	39-3/8"	DCH481 / D25603K

DUSTX+™ ANCHOR INSTALLATION SYSTEM

MECHANICAL ANCHORING



		Base Material										Anchor Diameter										Head Style						Coating/Material						Approvals and Listings
		Concrete	Lightweight Concrete	Hollow Core Plank	Grout-filled Concrete Masonry	Hollow Concrete Masonry	Solid Brick	Hollow Brick	Stone	Structural Clay Tile	Wood	3/16"	1/4"	5/16"	3/8"	1/2"	5/8"	3/4"	7/8"	1"	1-1/4"	Finished Hex Head	Hex Head	Flat Head (Countersunk)	Removable	Tie-Wire Head	Internal Thread	Coated/Plated Carbon Steel	Galvanized Carbon Steel	Type 303/304 Stainless Steel	Type 316 Stainless Steel	Type 410 Stainless Steel	Stalgard Coated Steel	Building Code / Jurisdiction Recognition
UNDERCUT ANCHORS	CCU+™	●	●												●	●	●	●					●					●			●			ICC-ES ESR-4810 IBC, City of LA, FBC
EXPANSION ANCHORS	Power-Bolt®+	●	●		○				○				●		●	●	●	●				●			○			●						ICC-ES ESR-3260 IBC, City of LA
EXPANSION ANCHORS	Power-Stud®+ SD1	●	●		●				○				●		●	●	●	●	●	●	●		●			●		●						ICC-ES ESR-2818 & 2966 IBC, NBC, City of LA, FBC, FM, UL
EXPANSION ANCHORS	Power-Stud®+ SD2	●	●		●				○						●	●	●	●					●					●						ICC-ES ESR-2502 IBC, NBC, City of LA, FBC, FM, UL
EXPANSION ANCHORS	Power-Stud®+ SD4/SD6	●	●		●				○				●		●	●	●	●					●							●	●			ICC-ES ESR-2502 IBC, NBC, City of LA, FBC
EXPANSION ANCHORS	Power-Stud® HD5	●	●		●				○						●	●	●	●					●						●					
SCREW ANCHORS	Screw-Bolt+™	●	●	○	●	○	●		○				●		●	●	●	●				●		●	●			●	●					ICC-ES ESR-3889 IBC, City of LA, FBC
SCREW ANCHORS	316 Stainless Steel Wedge-Bolt™	●	●		●		●		○				●		●	●						●			●						●			
SCREW ANCHORS	UltraCon®+	●	●	○	●	●	●	○			●	●	●									●		●	●			●					●	ICC-ES ESR-3068 IBC, City of LA, FBC Miami-Dade County
SCREW ANCHORS	UltraCon®	●	●			●	●				●			●								●		●	●			●					●	Miami-Dade County
SCREW ANCHORS	UltraCon® SS4	●	○		●	●							●									●		●	●							●	●	Miami-Dade County
SCREW ANCHORS	Crete-Flex®	●			●	●						●	●									●		●	●							●	●	Miami-Dade County
SCREW ANCHORS	Aggre-Gator®	●	○		●	○	●	○			●		●									●		●	●					●			●	Miami-Dade County
ROD HANGING SYSTEMS	HangerMate®+	●	●	●	○								●		●	●											●	●						ICC-ES ESR-3889 IBC, City of LA, FBC, FM
ROD HANGING SYSTEMS	Snake+®	●	●		○								●		●	●											●	●						ICC-ES ESR-2772 IBC, City of LA, FBC, FM
ROD HANGING SYSTEMS	Mini-Undercut+™	●	●											●													●	●						ICC-ES ESR-3912 IBC, City of LA, FBC

● Suitable ○ May be Suitable

GENERAL INFORMATION

CCU+™

Critical Connection Undercut Anchoring System

PRODUCT DESCRIPTION

The DEWALT Critical Connection Undercut (CCU+™) anchor is a post-installed structural anchor designed for static, dynamic and seismic loading in the tension zone of both cracked and uncracked concrete. The high capacity CCU+™ anchor can be loaded immediately following installation and is available in zinc plated ASTM A36 (F1554 Grade 36) mild carbon steel and ASTM A193 Grade B7 high strength carbon steel. For exterior applications or where high corrosion resistance is required, the CCU+™ is also available in ASTM A193 Grade 8BM, Class 2 high strength 316 stainless steel.

CCU+ anchors are installed into a fixed depth hole with a cone-shaped cavity at the bottom which is created in a secondary drilling operation using a specialty undercut drill bit supplied by DEWALT. The result is bottom-bearing post-installed anchor which keys into the base material with minimal expansive forces allowing for close edge distance and anchor spacing, similar to a cast-in-place headed stud. The heavy-wall expansion sleeve contributes to load transfer and improved shear capacities particularly for the thrubolt version.

GENERAL APPLICATIONS AND USES

- Structural connections (e.g. beam, column)
- Safety related fastening and assemblies
- Bridge, tunnel and port structure attachments
- Water and wastewater treatment facility units
- Vessel, tank and containment wall anchorage
- Power generation plant / hydro dam anchors
- Industrial machine and equipment mounts
- Utility system bracing, hangers and supports
- Barriers, guards, fencing and railing
- Retrofit anchors for cast-in anchor bolts
- Tension zone / cracked concrete
- Seismic attachments (SDC A - F)

FEATURE AND BENEFITS

+ Load transfers to concrete through bearing not friction (similar to cast-in headed bolts)
+ Provides positive mechanical interlock into base material
+ Consistent predictable behavior and exceptional load capacities
+ Robust design minimizes anchor displacement under load
+ Anchor bearing area is more than two-and-a-half times the net tensile area of the anchor rod
+ Anchor rods can be designed for stretch length and ductile steel behavior for seismic loading
+ Close edge distance, anchor spacing, and slab thickness due to low expansive forces
+ Thrubolt version provides significant increase in shear capacities and variable fixture thickness
+ Length ID code and material ID marking stamped on head of each anchor
+ Undercut cavity is created in seconds with durable undercutting tool
+ DEWALT dust removal drilling system (with HEPA dust extractor) can be used for an OSHA 1926.1153 Table 1 compliant solution
+ CCU+ undercut anchors made in USA at time of publication; product certifications available by request (anchors@DEWALT.com)

APPROVALS AND LISTINGS

- International Code Council, Evaluation Service (ICC-ES), ESR-4810 for cracked and uncracked concrete
- Code compliant with the 2021 IBC/IRC, 2018 IBC/IRC, 2015 IBC/IRC and 2012 IBC/IRC
- Tested in accordance with ACI 355.2/ASTM E488 and ICC-ES AC193 for use in structural concrete under the design provisions of ACI 318 (-19 and -14) Chapter 17 or ACI 318-11 Appendix D
- Evaluated and qualified by an accredited independent testing laboratory for recognition in cracked and uncracked concrete including seismic and wind loading (anchor category 1 for all sizes)
- City of Los Angeles, LABC Supplement (within ESR-4810)
- Florida Building Code, FBC Supplement including HVHZ (within ESR-4810)

GUIDE SPECIFICATIONS

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

SECTION CONTENTS

CCU+ UNDERCUT PRESET (PS)

CCU+ UNDERCUT THRUBOLT (TB)

THREAD VERSION

- UNC threaded stud (anchor rod)

ANCHOR SIZE RANGE (TYP.)

- 3/8" through 3/4" diameters (anchor rod diameter)

ANCHOR MATERIAL TYPE

- Zinc Plated Carbon Steel
- 316 Stainless Steel

ANCHOR VERSIONS

- Preset (PS)
- Thrubolt (TB)

SUITABLE BASE MATERIALS

- Normal-weight concrete
- Lightweight concrete

TENSION ZONE CRACKED CONCRETE
SEISMIC REGION QUALIFICATION

CODE LISTED
ICC-ES ESR-4810
CONCRETE

DDA
DEWALT DESIGN ASSIST™

DUST X+™
ANCHOR INSTALLATION SYSTEM

MATERIAL SPECIFICATIONS

Anchor Component	Anchor Designation / Material	
	Mild Carbon Steel I High Strength Carbon Steel	High Strength Stainless Steel
Anchor Rod (Threaded Rod)	ASTM A36 (F1554, Grade 36) I ASTM A193, Grade B7	ASTM A193, Grade B8M, Class 2 (316 SS)
Expansion Sleeve	Carbon Steel	AISI 316 SS
Expansion Cone	Carbon Steel	AISI 316 SS
Heavy Hex Nut	ASTM A563, Grade C	ASTM A194, Grade 8M (S1)
Washer	ASTM F844; Meets ANSI/ASME B18.22.1, Type A plain (wide)	AISI 316 SS; meets ANSI/ASME B18.22.1, Type A plain (wide)
Plating (carbon steel components)	Zinc plating, ASTM B633, SC1 (Fe/Zn 5); min. plating requirement for Mild Service Condition	Not applicable

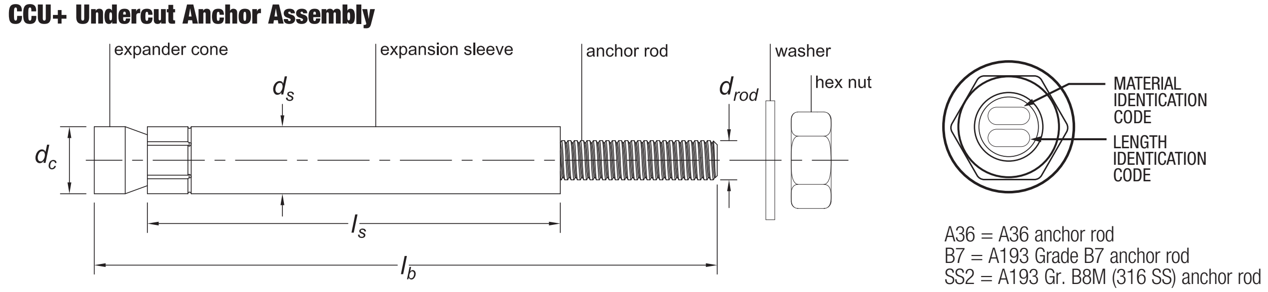
ANCHOR SPECIFICATIONS

CCU+ Undercut Anchor Nominal Dimensional Characteristics[1,2,3]

Anchor Description, Nominal Size and Length (in.)	Anchor Rod Designation (ASTM)	Anchor Version	Rod Diameter, d_{rod} (in.)	Anchor Length, l_b (in.)	Expansion Sleeve		Expander Cone Dia., d_c (in.)	Max. Fixture Thickness, t_{max} (in.)
					Length, l_s (in.)	Diameter d_s (in.)		
3/8 x 6	ASTM A36 or A193, Grade B7	Preset (PS)	3/8	6	4	11/16	11/16	7/8
		Thrubolt (TB)			4-7/8			
	A193, Grade B8M (316 SS)	Preset (PS)	3/8	6	4	11/16	11/16	7/8
		Thrubolt (TB)			4-7/8			
1/2 x 7-1/2	ASTM A36 or A193, Grade B7	Preset (PS)	1/2	7-1/2	5	13/16	13/16	1-1/4
		Thrubolt (TB)			6-1/4			
	A193, Grade B8M (316 SS)	Preset (PS)	1/2	7-1/2	5	13/16	13/16	1-1/4
		Thrubolt (TB)			6-1/4			
1/2 x 8-1/4	ASTM A36 or A193, Grade B7	Preset (PS)	1/2	8-1/4	5	13/16	13/16	2
		Thrubolt (TB)			7			
	A193, Grade B8M (316 SS)	Preset (PS)	1/2	8-1/4	5	13/16	13/16	2
		Thrubolt (TB)			7			
5/8 x 10-3/4	ASTM A36 or A193, Grade B7	Preset (PS)	5/8	10-3/4	7-1/2	1	1	1-5/8
		Thrubolt (TB)			9-1/8			
	A193, Grade B8M (316 SS)	Preset (PS)	5/8	10-3/4	7-1/2	1	1	1-5/8
		Thrubolt (TB)			9-1/8			
5/8 x 11-1/2	ASTM A36 or A193, Grade B7	Preset (PS)	5/8	11-1/2	7-1/2	1	1	2-3/8
		Thrubolt (TB)			9-7/8			
	A193, Grade B8M (316 SS)	Preset (PS)	5/8	11-1/2	7-1/2	1	1	2-3/8
		Thrubolt (TB)			9-7/8			
3/4 x 14	ASTM A36 or A193, Grade B7	Preset (PS)	3/4	14	10	1-1/4	1-1/4	2
		Thrubolt (TB)			12			
	A193, Grade B8M (316 SS)	Preset (PS)	3/4	14	10	1-1/4	1-1/4	2
		Thrubolt (TB)			12			
3/4 x 16	ASTM A36 or A193, Grade B7	Preset (PS)	3/4	16	10	1-1/4	1-1/4	4
		Thrubolt (TB)			14			
	A193, Grade B8M (316 SS)	Preset (PS)	3/4	16	10	1-1/4	1-1/4	4
		Thrubolt (TB)			14			

1. Preset anchors are designed so the top of the expansion sleeve is approximately flush with the base material after setting. Thrubolt anchors are designed so the expansion sleeve can be set through and can engage the fixture. See CCU+ undercut anchor detail and installation specifications.
2. Anchor rod (threaded rod) conforming to ASTM F1554, Grade 105 is strength equivalent to the tabulated ASTM A193, Grade B7 designation.
3. The listed anchor lengths are based on the anchor sizes commercially available at the time of publication; custom lengths can be produced by request. Custom length anchors not long enough to meet the minimum embedment requirements are outside the scope of ICC-ES ESR-4810.

CCU+ Undercut Anchor Assembly

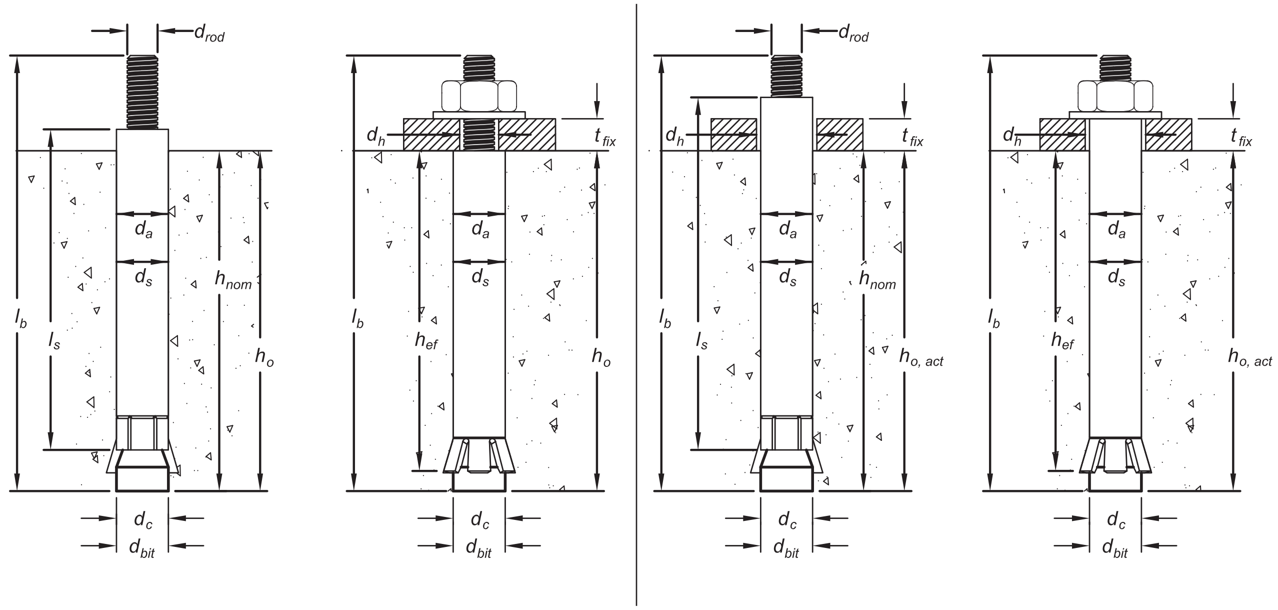


Anchor Length Code Identification System

Length ID marking on anchor rod head		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
Anchor Length. l_b (inches)	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	13	14	15	16
	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	14	15	16	17

INSTALLATION SPECIFICATIONS

CCU+ Undercut Anchor Detail



Before Setting | After Setting

Preset (PS)

Before Setting | After Setting

Thrubolt (TB)

CCU+ Undercut Anchor Installation Specifications and Supplemental Information

Anchor Property/ Setting Information	Notation	Units	Nominal Anchor Size / Rod Diameter, d_{rod}											
			3/8 inch			1/2 inch			5/8 inch			3/4 inch		
Anchor Rod Designation	ASTM	-	A36	A193, Gr. B7	A193, Gr. B8M (316 SS)	A36	A193, Gr. B7	A193, Gr. B8M (316 SS)	A36	A193, Gr. B7	A193, Gr. B8M (316 SS)	A36	A193, Gr. B7	A193, Gr. B8M (316 SS)
Outside anchor diameter / expansion sleeve diameter	d_a / d_s	in. (mm)	0.6875 (17.5)			0.8125 (20.6)			1.000 (25.4)			1.25 (31.8)		
Nominal drill bit diameter (ANSI)	d_{bit}	in.	11/16			13/16			1			1-1/4		
Nominal embedment depth[1]	h_{nom}	in. (mm)	4-1/4 (108)			5-3/8 (137)			8 (203)			10-5/8 (270)		
Effective embedment	h_{ef}	in. (mm)	4 (102)			5 (127)			7-1/2 (191)			10 (254)		
Minimum hole depth, preset version (see note 2 for thrubolt version)	h_o	in. (mm)	4-1/4 (108)			5-3/8 (137)			8 (203)			10-5/8 (270)		
Min. concrete member thickness, preset version (see note 3 for thrubolt version)	h_{min}	in. (mm)	6 (152)			7 (178)			9-1/2 (241)			12 (305)		
Minimum edge distance	c_{min}	in. (mm)	2-1/2 (64)			3 (76)			4-1/2 (114)			6 (152)		
Minimum spacing distance	s_{min}	in. (mm)	3 (76)			3-3/4 (95)			5-5/8 (143)			7-1/2 (191)		
Minimum diameter of clearance hole in fixture – Preset (PS) Version	d_h	in. (mm)	7/16 (11.1)			9/16 (14.3)			11/16 (17.5)			13/16 (20.6)		
Minimum diameter of clearance hole in fixture – Thrubolt (TB) Version	d_h	in. (mm)	3/4 (19.1)			7/8 (22.2)			1-1/8 (28.6)			1-3/8 (34.9)		
Maximum thickness of fixture	t_{max}	in.	See nominal dimensional characteristics table (this is dependent on the selected anchor)											
Installation torque	T_{inst}	ft.-lbf. (N-m)	11 (15)	37 (50)		29 (40)	70 (95)		70 (95)	118 (160)		118 (160)	221 (300)	
Torque wrench / socket size	-	in.	11/16			7/8			1-1/16			1-1/4		
Nut height	-	in.	23/64			31/64			39/64			47/64		
Washer O.D.	-	in.	1			1-3/8			1-3/4			2		
Effective tensile stress area (anchor rod)	A_{se}	in.² (mm²)	0.078 (50)			0.142 (91)			0.226 (146)			0.334 (215)		
Minimum specified ultimate strength[4]	f_{uta}	psi (N/mm²)	58,000 (400)	125,000 (860)	120,000 (827)	58,000 (400)	125,000 (860)	110,000 (758)	58,000 (400)	125,000 (860)	110,000 (758)	58,000 (400)	125,000 (860)	110,000 (758)
Minimum specified yield strength	f_{ya}	psi (N/mm²)	36,000 (248)	105,000 (723)	95,000 (655)	36,000 (248)	105,000 (723)	95,000 (655)	36,000 (248)	105,000 (723)	95,000 (655)	36,000 (248)	105,000 (723)	95,000 (655)
Strength length of the anchor rod[5]	-	in.	h_{nom} - 11/16 + t_{fix}			h_{nom} - 13/16 + t_{fix}			h_{nom} - 1 + t_{fix}			h_{nom} - 1-1/4 + t_{fix}		
Mean axial stiffness[6] – Uncracked concrete	β_{uncr}	lbf/in.	595,000			1,705,000			356,000			446,000		
Mean axial stiffness[6] – cracked concrete	β_{cr}	lbf/in.	398,000			744,000			445,000			354,000		

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 and equal to the hole depth.
2. For thrubolt applications the actual hole depth, $h_{o,act}$ is dependent on the actual fixture thickness, t_{fix}. Actual hole depth for thrubolts is determined by taking the minimum hole depth plus the maximum thickness of fixture for the selected anchor less the actual fixture thickness being fastened to the base material ($h_{o,act} = h_o + t_{max} - t_{fix}$).
3. For thrubolt applications the minimum concrete member thickness, $h_{min,act}$ is dependent on the actual fixture thickness, t_{fix}. Minimum concrete member thickness for thrubolts is determined by taking the minimum concrete member thickness plus the maximum thickness of fixture for the selected anchor less the actual fixture thickness being fastened to the base material ($h_{min,act} = h_{min} + t_{max} - t_{fix}$).
4. The anchor rod for the 3/8-inch stainless steel anchors is manufactured with a minimum specified ultimate strength of 120 ksi (827 N/mm²).
5. For CCU+ undercut anchors, the anchor rod, d_{rod} replaces the outside anchor diameter, d_a (i.e. expansion sleeve diameter, d_s) for determination of stretch length and stretch length ratio. Stretch lengths of the anchor rod (threaded rod) in anchor assemblies for embedments listed are greater than eight anchor rod diameters, $8d_{rod}$ which meets the prescriptive requirements as given in ACI 318-19 17.10.5.3(a), ACI 318-14 17.2.3.4.3(a) and ACI 318-11 D.3.3.4.3(a).
6. Mean values shown, actual stiffness varies considerably depending on concrete strength, loading and geometry of application.

CCU+ Undercut Anchor Installation Accessories and Tools[1,2]

Nominal Anchor Size	Nominal Hole Diameter	Anchor Version	Primary Bit			Undercut Bit		Rotary Hammer Drill	Setting Sleeves	
			HSB	HB	Conventional	HUCB	UCB		Powered	Manual
3/8"	11/16"	Preset (PS)	DFX11380 (SDS-Plus)	DWA54116 (SDS-Plus)	DW5808 4-Cutter (SDS-Max)	DFX21380 (SDS-Plus)	DFX21381 (SDS-Plus)	DCH416 or D25416 (SDS-Plus)	DFX313825 (SDS-Plus)	DFX313805
		Thrubolt (TB)	-							
1/2"	13/16"	Preset (PS)	DFX11120 (SDS-Plus)	DWA54316 (SDS-Plus)	DW5814 4-Cutter (SDS-Max)	DFX21120 (SDS-Plus)	DFX21121 (SDS-Plus)	DCH416 or D25416 (SDS-Plus)	DFX311230 (SDS-Plus)	DFX311210
		Thrubolt (TB)	-							
5/8"	1"	Preset (PS)	DFX11580 (SDS-Max)	DWA58001 (SDS-Max)	DW5852 4-Cutter (SDS-Max)	DFX21580* (SDS-Plus)	DFX21581* (SDS-Plus)	DCH614 or D25614 (SDS-Max)	DFX315835 (SDS-Max)	DFX315815
		Thrubolt (TB)	-							
3/4"	1-1/4"	Preset (PS)	DFX11340 (SDS-Max)	DWA58115 (SDS-Max)	DW5855 4-Cutter (SDS-Max)	DFX21340 (SDS-Max)	DFX21341 (SDS-Max)	DCH614 or D25614 (SDS-Max)	DFX313440 (SDS-Max)	DFX313420
		Thrubolt (TB)	-							

*For rotary hammer drill connector options, designated drill bits can be considered for use with a DW5891 SDS-Max to SDS-Plus adapter.

1. The listed anchor installation accessories and tools are based on DEWALT equipment commercially available at the time of publication.
2. CCU+ dust removal drill bits (e.g. HSB, HB, HUCB) are used with a vacuum dust extractor (e.g. DWV010, DWV012, DCV585).

CCU+ Dust Removal Drill Bits

Hollow Stop Bit (HSB)

Hollow Bit (HB)

Hollow Undercut Bit (HUCB)

CCU+ Customary Drill Bits

Conventional Bit

Undercut BIt (UCB)

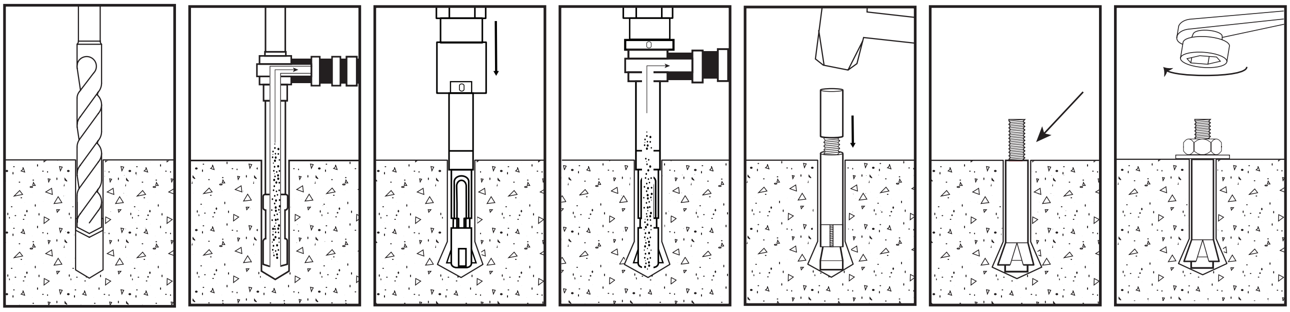
CCU+ Setting Sleeves

Powered Setting Sleeve

Manual Setting Sleeve

INSTALLATION INSTRUCTIONS

CCU+ Undercut Anchor Installation Instructions



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.
2. Remove dust and debris from the hole during drilling (e.g. hollow stop bit, hollow bit, dust extractor) or following drilling (e.g. suction, forced air) to extract loose particles created by drilling. Note: removing dust and debris after drilling is not required for overhead (ceiling) installations.
3. Insert the proper size undercut bit to the bottom of the hole. Start the rotary hammer (begin at a slow speed) and undercut the hole. Undercutting is complete when the stopper sleeve on the undercut bit is fully compressed (i.e. the gap is closed).
4. Remove dust and debris from the hole during undercutting (hollow undercut bit) or following undercutting (e.g. suction, forced air). Note: removing dust and debris after drilling is not required for overhead (ceiling) installations.
5. Insert anchor into the hole. Place setting sleeve over anchor rod and drive expansion sleeve over expander cone. Use the proper size powered setting sleeve or manual setting sleeve.
6. Verify that the setting mark is visible on the anchor rod (threaded rod) at or above the expansion sleeve.
7. Apply the proper installation torque to tighten the connection.

STRENGTH DESIGN INFORMATION

Design Information For Carbon Steel and Stainless Steel CCU+ Undercut Anchors[1,2,8]

Anchor Property / Setting Information	Notation	Units	3/8			1/2			5/8			3/4		
			Nominal Anchor Size / Rod Diameter, d_{rod} (in.)											
Anchor category	-	-	1			1			1			1		
Anchor rod designation	ASTM	-	A36	A193, Gr. B7	A193, Gr. B8M (316 SS)	A36	A193, Gr. B7	A193, Gr. B8M (316 SS)	A36	A193, Gr. B7	A193, Gr. B8M (316 SS)	A36	A193, Gr. B7	A193, Gr. B8M (316 SS)
Outside diameter of anchor	d_a	in. (mm)	0.6875 (17.5)			0.8125 (20.6)			1.000 (25.4)			1.25 (31.8)		
Nominal embedment depth	h_{nom}	in. (mm)	4-1/4 (108)			5-3/8 (137)			8 (203)			10-5/8 (270)		
Effective embedment depth	h_{ef}	in. (mm)	4 (102)			5 (127)			7-1/2 (190)			10 (254)		
STEEL STRENGTH IN TENSION (ACI 318-19 17.6.1, ACI 318-14 17.4.1 or ACI 318-11 D.5.1), STEEL STRENGTH IN SHEAR (ACI 318-19 17.7.1, ACI 318-14 17.5.1 or ACI 318-11 D.6.1), AND STEEL STRENGTH IN SHEAR FOR SEISMIC APPLICATIONS (ACI 318-19 17.10.3, ACI 318-14 17.2.3.3 or ACI 318-11 D.3.3.3)														
Steel strength in tension	N_{sa}	lb. (kN)	4,525 (20.1)	9,750 (43.4)	9,360 (41.6)	8,235 (36.6)	17,750 (79.0)	15,620 (69.5)	13,110 (58.3)	28,250 (125.7)	24,860 (110.6)	19,370 (86.2)	41,750 (185.7)	36,740 (163.4)
Reduction factor, steel strength in tension[3,4]	ϕ	-	0.75											
Preset (PS) – Steel strength in shear, static	V_{sa}	lb. (kN)	2,260 (10.1)	4,875 (21.7)	5,110 (22.7)	4,120 (18.3)	8,875 (39.5)	8,850 (39.4)	6,555 (29.1)	14,125 (62.8)	14,600 (64.9)	9,685 (43.1)	20,875 (92.9)	22,340 (99.4)
Preset (PS) – Steel strength in shear, seismic	$V_{sa,eq}$	lb. (kN)	1,585 (7.0)	4,390 (19.5)	4,600 (20.5)	2,885 (12.8)	7,990 (35.5)	8,145 (36.2)	4,590 (20.4)	12,715 (56.6)	13,140 (58.5)	6,780 (30.2)	18,790 (83.6)	20,105 (89.4)
Thrubolt (TB) – Steel strength in shear, static	V_{sa}	lb. (kN)	2,260 (10.1)	14,200 (63.2)	15,555 (79.2)	4,120 (18.3)	18,715 (83.3)	24,205 (107.7)	6,555 (29.1)	28,980 (128.9)	38,795 (172.6)	9,685 (43.1)	41,640 (185.2)	57,725 (256.9)
Thrubolt (TB) – Steel strength in shear, seismic	$V_{sa,eq}$	lb. (kN)	1,585 (7.0)	12,790 (56.9)	10,895 (48.5)	2,885 (12.8)	16,840 (74.9)	19,365 (86.1)	4,590 (20.4)	26,080 (116.0)	31,345 (139.4)	6,780 (30.2)	33,315 (148.2)	46,180 (205.4)
Reduction factor, steel strength in shear[3,4]	ϕ	-	0.65											
CONCRETE BREAKOUT STRENGTH IN TENSION (ACI 318-19 17.6.2, ACI 318-14 17.4.2 or ACI 318-11 D.5.2)														
Critical edge distance (uncracked concrete)[7]	c_{ac}	in. (mm)	6 (152)			7-1/2 (191)			11-1/4 (241)			15 (305)		
Effectiveness factor, uncracked concrete	k_{uncr}	-	30			30			30			30		
Effectiveness factor, cracked concrete	k_{cr}	-	24			24			24			24		
Modification factor for cracked and uncracked concrete[5]	$\psi_{c,N}$	-	1.0 (see note 5)			1.0 (see note 5)			1.0 (see note 5)			1.0 (see note 5)		
Reduction factor, concrete breakout strength in tension[4]	ϕ	-	0.65 (Condition B, no supplementary reinforcement) or 0.75 (Condition A, supplementary reinforcement present)											
PULLOUT STRENGTH IN TENSION (ACI 318-19 17.6.3, ACI 318-14 17.4.3 or ACI 318-11 D.5.3) AND PULLOUT STRENGTH IN TENSION FOR SEISMIC APPLICATIONS (ACI 318-19 17.10.3, ACI 318-14 17.2.3.3 or ACI 318-11 D.3.3.3)														
Characteristic pullout strength, uncracked concrete (2,500 psi)	$N_{p,uncr}$	lb. (kN)	See note 6			See note 6			See note 6			See note 6		
Characteristic pullout strength, cracked concrete (2,500 psi)	$N_{p,cr}$	lb. (kN)	See note 6			See note 6			See note 6			See note 6		
Characteristic pullout strength, seismic (2,500 psi)	$N_{p,eq}$	lb. (kN)	See note 6			See note 6			See note 6			See note 6		
Reduction factor, pullout strength in tension[4]	ϕ	-	0.65 (Condition B)											
CONCRETE BREAKOUT STRENGTH IN SHEAR (ACI 318-19 17.7.2, ACI 318-14 17.5.2 or ACI 318-11 D.6.2) AND PRYOUT STRENGTH IN SHEAR (ACI 318-19 17.7.3, ACI 318-14 17.5.3 or ACI 318-11 D.6.3)														
Load bearing length of anchor	ℓ_e	in. (mm)	4 (102)			5 (127)			7-1/2 (190)			10 (254)		
Coefficient for pryout strength	k_{cp}	-	2.0			2.0			2.0			2.0		
Reduction factor, concrete breakout strength in shear[4]	ϕ	-	0.70 (Condition B, no supplementary reinforcement) or 0.75 (Condition A, supplementary reinforcement present)											
Reduction factor, pryout strength in shear[4]	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 (-19 or -14) Chapter 17 or ACI 318-11 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-19 17.10, ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable, shall apply.
2. Installation must comply with manufacturer's printed installation instructions and details.
3. The anchors are considered ductile steel elements as defined by ACI 318 (-19 or -14) 2.3 or ACI 318-11 D.1, as applicable. See anchor installation specifications and supplemental information table for the determination of stretch length, as applicable.
4. The strength reduction factor applies when the load combinations from the IBC or ACI 318 are used and the requirements of ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are met. If the load combinations of ACI 318-11 Appendix C are used, the appropriate strength reduction factor must be determined in accordance with ACI 318-11 D.4.4. For installations where supplementary reinforcement is present, the strength reduction factors described in ACI 318-19 17.5.3, ACI 318-14 17.3.3(c) or ACI 318-11 D.4.3(c), as applicable, may be used for Condition A.
5. Select the appropriate effectiveness factor for cracked concrete (k_{cr}) or uncracked concrete (k_{uncr}) and use $\psi_{c,N} = 1.0$.
6. Pullout strength does not control design of indicated anchors and does not need to be calculated for indicated anchor size and embedment.
7. In lieu of ACI 318-19 17.6.2, ACI 318-14 17.4.2 or ACI 318-11 D.5.2, as applicable, the modification factor $\psi_{cp,N} = 1.0$ for all cases. In accordance with ACI 318-19 17.9.5, ACI 318-14 17.7.6 or ACI 318-11 D.8.6, as applicable, tension tests in accordance with ACI 355.2 have determined splitting failure under external load does not govern the resistance of the CCU+ undercut anchors, i.e. $c_{ac} = 1.5h_{ef}$. Therefore, this calculation is not required for design. For reference, values of c_{ac}, critical edge distance determined by $c_{ac} = 1.5h_{ef}$ are provided.
8. For the use of anchors in lightweight concrete, the modification factor λ_a equal to 1.0λ is applied to all values of $(f'_c)^{0.5}$ affecting N_n and V_n.
9. For ACI 318-19 (2021 IBC), ACI 318-14 (2018 and 2015 IBC), and ACI 318-11 (2012 IBC), λ shall be determined in accordance with the corresponding version of ACI 318: for sand-lightweight concrete, $\lambda = 0.85$; for all-lightweight concrete, $\lambda = 0.75$.

DESIGN STRENGTH TABLES (SD)

Tension and Shear Design Strengths for Carbon Steel CCU+ Preset Version (PS) Installed in Cracked Concrete[1,2,3,4,5,6,8]

Nominal Anchor Size / Rod Diameter (in.)	Nominal Embed. Depth hnom (in.)	Minimum Concrete Compressive Strength															
		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 Tens ion (lbs.)		ΦV_n Shear (lbs.)	
		A36	A193, Gr. B7	A36	A193, Gr. B7	A36	A193, Gr. B7	A36	A193, Gr. B7	A36	A193, Gr. B7	A36	A193, Gr. B7	A36	A193, Gr. B7	A36	A193, Gr. B7
3/8	4-1/4	3,395	6,835	1,470	3,170	3,395	7,315	1,470	3,170	3,395	7,315	1,470	3,170	3,395	7,315	1,470	3,170
1/2	5-3/8	6,175	9,555	2,680	5,770	6,175	11,030	2,680	5,770	6,175	13,315	2,680	5,770	6,175	13,315	2,680	5,770
5/8	8	9,835	17,550	4,260	9,180	9,835	20,265	4,260	9,180	9,835	21,190	4,260	9,180	9,835	21,190	4,260	9,180
3/4	10-5/8	14,530	27,020	6,295	13,570	14,530	31,200	6,295	13,570	14,530	31,315	6,295	13,570	14,530	31,315	6,295	13,570

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

Tension and Shear Design Strengths for Carbon Steel CCU+ Preset Version (PS) Installed in Uncracked Concrete[1,2,3,4,5,6,7]

Nominal Anchor Size / Rod Diameter (in.)	Nominal Embed. Depth hnom (in.)	Minimum Concrete Compressive Strength															
		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.)	
		A36	A193, Gr. B7	A36	A193, Gr. B7	A36	A193, Gr. B7	A36	A193, Gr. B7	A36	A193, Gr. B7	A36	A193, Gr. B7	A36	A193, Gr. B7	A36	A193, Gr. B7
3/8	4-1/4	3,395	7,315	1,470	3,170	3,395	7,315	1,470	3,170	3,395	7,315	1,470	3,170	3,395	7,315	1,470	3,170
1/2	5-3/8	6,175	11,940	2,680	5,770	6,175	13,315	2,680	5,770	6,175	13,315	2,680	5,770	6,175	13,315	2,680	5,770
5/8	8	9,835	21,190	4,260	9,180	9,835	21,190	4,260	9,180	9,835	21,190	4,260	9,180	9,835	21,190	4,260	9,180
3/4	10-5/8	14,530	31,315	6,295	13,570	14,530	31,315	6,295	13,570	14,530	31,315	6,295	13,570	14,530	31,315	6,295	13,570

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

Tension and Shear Design Strengths for Carbon Steel CCU+ Thrubolt Version (TB) Installed in Cracked Concrete[1,2,3,4,5,6,7,8]

Nominal Anchor Size / Rod Diameter (in.)	Nominal Embed. Depth hnom (in.)	Minimum Concrete Compressive Strength															
		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.)	
		A36	A193, Gr. B7	A36	A193, Gr. B7	A36	A193, Gr. B7	A36	A193, Gr. B7	A36	A193, Gr. B7	A36	A193, Gr. B7	A36	A193, Gr. B7	A36	A193, Gr. B7
3/8	4-1/4	3,395	6,835	1,470	4,650	3,395	7,315	1,470	5,370	3,395	7,315	1,470	6,580	3,395	7,315	1,470	7,595
1/2	5-3/8	6,175	9,555	2,680	6,845	6,175	11,030	2,680	7,905	6,175	13,315	2,680	9,685	6,175	13,315	2,680	11,180
5/8	8	9,835	17,550	4,260	11,965	9,835	20,265	4,260	13,815	9,835	21,190	4,260	16,920	9,835	21,190	4,260	18,835
3/4	10-5/8	14,530	27,020	6,295	17,930	14,530	31,200	6,295	20,705	14,530	31,315	6,295	25,355	14,530	31,315	6,295	27,065

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

Tension and Shear Design Strengths for Carbon Steel CCU+ Thrubolt Version (TB) Installed in Uncracked Concrete[1,2,3,4,5,6,7]

Nominal Anchor Size / Rod Diameter (in.)	Nominal Embed. Depth hnom (in.)	Minimum Concrete Compressive Strength															
		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.)	
		A36	A193, Gr. B7	A36	A193, Gr. B7	A36	A193, Gr. B7	A36	A193, Gr. B7	A36	A193, Gr. B7	A36	A193, Gr. B7	A36	A193, Gr. B7	A36	A193, Gr. B7
3/8	4-1/4	3,395	7,315	1,470	6,510	3,395	7,315	1,470	7,520	3,395	7,315	1,470	9,210	3,395	7,315	1,470	9,230
1/2	5-3/8	6,175	11,940	2,680	9,585	6,175	13,315	2,680	11,070	6,175	13,315	2,680	12,165	6,175	13,315	2,680	12,165
5/8	8	9,835	21,190	4,260	16,750	9,835	21,190	4,260	18,835	9,835	21,190	4,260	18,835	9,835	21,190	4,260	18,835
3/4	10-5/8	14,530	31,315	6,295	25,100	14,530	31,315	6,295	27,065	14,530	31,315	6,295	27,065	14,530	31,315	6,295	27,065

- 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, $h_a = 1.5*h_{min}$, and with the following conditions:
   - $c_{a1} \geq 1.5h_{ef}$
   - $c_{a2} \geq 1.5c_{a1}$.
2- Calculations were performed following methodology in ACI 318-19, Chapter 17. The load level corresponding to the failure mode 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 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) are in accordance with ACI 318-19 Section 17.5.3; it is assumed that supplementary reinforcement not present. Strength reduction factors for steel strength 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 318-19 Chapter 17, Section 17.8.
6- Interpolation is not permitted to be used with the tabular values. For intermediate base material compressive strengths, please see ACI 318-19 Chapter 17 and information contained in this product supplement. For other design conditions including seismic considerations please see ACI 318-19 Chapter 17.
7- The tabulated design strengths may be converted to allowable stress design values. Divide by conversion factor calculated as a weighted average of the load factors for the controlling load combination.
8- For seismic design in accordance with ACI 318, the tabulated tension design strengths in cracked concrete for concrete breakout must be multiplied by a factor of 0.75.

Tension and Shear Design Strengths for Stainless Steel CCU+ Preset Version (PS) Installed in Cracked Concrete[1,2,3,4,5,6,7,8]

Nominal Anchor Size / Rod Diameter (in.)	Nominal Embed. Depth hnom (in.)	Minimum Concrete Compressive Strength							
		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.)
		A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)
3/8	4-1/4	6,835	3,320	7,020	3,320	7,020	3,320	7,020	3,320
1/2	5-3/8	9,555	5,755	11,030	5,755	11,715	5,755	11,715	5,755
5/8	8	17,550	9,490	18,645	9,490	18,645	9,490	18,645	9,490
3/4	10-5/8	27,020	14,520	27,555	14,520	27,555	14,520	27,555	14,520

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

Tension and Shear Design Strengths for Stainless Steel CCU+ Preset Version (PS) Installed in Uncracked Concrete[1,2,3,4,5,6,7]

Nominal Anchor Size / Rod Diameter (in.)	Nominal Embed. Depth hnom (in.)	Minimum Concrete Compressive Strength							
		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.)
		A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)
3/8	4-1/4	7,020	3,320	7,020	3,320	7,020	3,320	7,020	3,320
1/2	5-3/8	11,715	5,755	11,715	5,755	11,715	5,755	11,715	5,755
5/8	8	18,645	9,490	18,645	9,490	18,645	9,490	18,645	9,490
3/4	10-5/8	27,555	14,520	27,555	14,520	27,555	14,520	27,555	14,520

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

Tension and Shear Design Strengths for Stainless Steel CCU+ Thrubolt Version (TB) Installed in Cracked Concrete[1,2,3,4,5,6,7,8]

Nominal Anchor Size / Rod Diameter (in.)	Nominal Embed. Depth hnom (in.)	Minimum Concrete Compressive Strength							
		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.)
		A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)
3/8	4-1/4	6,835	4,650	7,020	5,370	7,020	6,580	7,020	7,595
1/2	5-3/8	9,555	6,845	11,030	7,905	11,715	9,685	11,715	11,180
5/8	8	17,550	11,965	18,645	13,815	18,645	16,920	18,645	19,540
3/4	10-5/8	27,020	17,930	27,555	20,705	27,555	25,355	27,555	29,280

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

Tension and Shear Design Strengths for Stainless Steel CCU+ Thrubolt Version (TB) Installed in Uncracked Concrete[1,2,3,4,5,6,7]

Nominal Anchor Size / Rod Diameter (in.)	Nominal Embed. Depth hnom (in.)	Minimum Concrete Compressive Strength							
		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.)
		A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)
3/8	4-1/4	7,020	6,510	7,020	7,520	7,020	9,210	7,020	10,110
1/2	5-3/8	11,715	9,585	11,715	11,070	11,715	13,555	11,715	15,655
5/8	8	18,645	16,750	18,645	19,345	18,645	23,690	18,645	25,215
3/4	10-5/8	27,555	25,100	27,555	28,985	27,555	35,500	27,555	37,520

- 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, $h_a = 1.5*h_{min}$, and with the following conditions:
   - $c_{a1} \geq 1.5h_{ef}$
   - $c_{a2} \geq 1.5c_{a1}$.
2- Calculations were performed following methodology in ACI 318-19, Chapter 17. The load level corresponding to the failure mode 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 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) are in accordance with ACI 318-19 Section 17.5.3; it is assumed that supplementary reinforcement not present. Strength reduction factors for steel strength 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 318-19 Chapter 17, Section 17.8.
6- Interpolation is not permitted to be used with the tabular values. For intermediate base material compressive strengths, please see ACI 318-19 Chapter 17 and information contained in this product supplement. For other design conditions including seismic considerations please see ACI 318-19 Chapter 17.
7- The tabulated design strengths may be converted to allowable stress design values. Divide by conversion factor calculated as a weighted average of the load factors for the controlling load combination.
8- For seismic design in accordance with ACI 318, the tabulated tension design strengths in cracked concrete for concrete breakout must be multiplied by a factor of 0.75.

PERFORMANCE DATA (ASD)

Converted Allowable Loads for Carbon Steel CCU+ Preset Version (PS) Installed in Cracked Concrete[1,2]

Nominal Anchor Size / Rod Diameter (in.)	Nominal Embed. Depth h_{nom} (in.)	Minimum Concrete Compressive Strength															
		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.)	
		A36	A193, Gr. B7	A36	A193, Gr. B7	A36	A193, Gr. B7	A36	A193, Gr. B7	A36	A193, Gr. B7	A36	A193, Gr. B7	A36	A193, Gr. B7	A36	A193, Gr. B7
3/8	4-1/4	2,425	4,880	1,050	2,265	2,425	5,225	1,050	2,265	2,425	5,225	1,050	2,265	2,425	5,225	1,050	2,265
1/2	5-3/8	4,410	6,825	1,915	4,120	4,410	7,880	1,915	4,120	4,410	9,510	1,915	4,120	4,410	9,510	1,915	4,120
5/8	8	7,025	12,535	3,045	6,555	7,025	14,475	3,045	6,555	7,025	15,135	3,045	6,555	7,025	15,135	3,045	6,555
3/4	10-5/8	10,380	19,300	4,495	9,695	10,380	22,285	4,495	9,695	10,380	22,370	4,495	9,695	10,380	22,370	4,495	9,695

1. Allowable load values are calculated using a conversion factor, α, from the Factored Design Strength Tables and conditions shown previously.
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 CCU+ Preset Version (PS) Installed in Uncracked Concrete[1,2]

Nominal Anchor Size / Rod Diameter (in.)	Nominal Embed. Depth h_{nom} (in.)	Minimum Concrete Compressive Strength															
		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.)	
		A36	A193, Gr. B7	A36	A193, Gr. B7	A36	A193, Gr. B7	A36	A193, Gr. B7	A36	A193, Gr. B7	A36	A193, Gr. B7	A36	A193, Gr. B7	A36	A193, Gr. B7
3/8	4-1/4	2,425	5,225	1,050	2,265	2,425	5,225	1,050	2,265	2,425	5,225	1,050	2,265	2,425	5,225	1,050	2,265
1/2	5-3/8	4,410	8,530	1,915	4,120	4,410	9,510	1,915	4,120	4,410	9,510	1,915	4,120	4,410	9,510	1,915	4,120
5/8	8	7,025	15,135	3,045	6,555	7,025	15,135	3,045	6,555	7,025	15,135	3,045	6,555	7,025	15,135	3,045	6,555
3/4	10-5/8	10,380	22,370	4,495	9,695	10,380	22,370	4,495	9,695	10,380	22,370	4,495	9,695	10,380	22,370	4,495	9,695

1. Allowable load values are calculated using a conversion factor, α, from the Factored Design Strength Tables and conditions shown previously.
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 CCU+ Thrubolt Version (TB) Installed in Cracked Concrete[1,2]

Nominal Anchor Size / Rod Diameter (in.)	Nominal Embed. Depth h_{nom} (in.)	Minimum Concrete Compressive Strength															
		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.)	
		A36	A193, Gr. B7	A36	A193, Gr. B7	A36	A193, Gr. B7	A36	A193, Gr. B7	A36	A193, Gr. B7	A36	A193, Gr. B7	A36	A193, Gr. B7	A36	A193, Gr. B7
3/8	4-1/4	2,425	4,880	1,050	3,320	2,425	5,225	1,050	3,835	2,425	5,225	1,050	4,700	2,425	5,225	1,050	5,425
1/2	5-3/8	4,410	6,825	1,915	4,890	4,410	7,880	1,915	5,645	4,410	9,510	1,915	6,920	4,410	9,510	1,915	7,985
5/8	8	7,025	12,535	3,045	8,545	7,025	14,475	3,045	9,870	7,025	15,135	3,045	12,085	7,025	15,135	3,045	13,455
3/4	10-5/8	10,380	19,300	4,495	12,805	10,380	22,285	4,495	14,790	10,380	22,370	4,495	18,110	10,380	22,370	4,495	19,330

1. Allowable load values are calculated using a conversion factor, α, from the Factored Design Strength Tables and conditions shown previously.
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 CCU+ Thrubolt Version (TB) Installed in Uncracked Concrete[1,2]

Nominal Anchor Size / Rod Diameter (in.)	Nominal Embed. Depth h_{nom} (in.)	Minimum Concrete Compressive Strength															
		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.)	
		A36	A193, Gr. B7	A36	A193, Gr. B7	A36	A193, Gr. B7	A36	A193, Gr. B7	A36	A193, Gr. B7	A36	A193, Gr. B7	A36	A193, Gr. B7	A36	A193, Gr. B7
3/8	4-1/4	2,425	5,225	1,050	4,650	2,425	5,225	1,050	5,370	2,425	5,225	1,050	6,580	2,425	5,225	1,050	6,595
1/2	5-3/8	4,410	8,530	1,915	6,845	4,410	9,510	1,915	7,905	4,410	9,510	1,915	8,690	4,410	9,510	1,915	8,690
5/8	8	7,025	15,135	3,045	11,965	7,025	15,135	3,045	13,455	7,025	15,135	3,045	13,455	7,025	15,135	3,045	13,455
3/4	10-5/8	10,380	22,370	4,495	17,930	10,380	22,370	4,495	19,330	10,380	22,370	4,495	19,330	10,380	22,370	4,495	19,330

1. Allowable load values are calculated using a conversion factor, α, from the Factored Design Strength Tables and conditions shown previously.
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 CCU+ Preset Version (PS) Installed in Cracked Concrete[1,2]

Nominal Anchor Size / Rod Diameter (in.)	Nominal Embed. Depth h_{nom} (in.)	Minimum Concrete Compressive Strength							
		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.)
		A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)
3/8	4-1/4	4,880	2,370	5,015	2,370	5,015	2,370	5,015	2,370
1/2	5-3/8	6,825	4,110	7,880	4,110	8,370	4,110	8,370	4,110
5/8	8	12,535	6,780	13,320	6,780	13,320	6,780	13,320	6,780
3/4	10-5/8	19,300	10,370	19,680	10,370	19,680	10,370	19,680	10,370

1. Allowable load values are calculated using a conversion factor, α, from the Factored Design Strength Tables and conditions shown previously.
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 CCU+ Preset Version (PS) Installed in Uncracked Concrete[1,2]

Nominal Anchor Size / Rod Diameter (in.)	Nominal Embed. Depth h_{nom} (in.)	Minimum Concrete Compressive Strength							
		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.)
		A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)
3/8	4-1/4	5,015	2,370	5,015	2,370	5,015	2,370	5,015	2,370
1/2	5-3/8	8,370	4,110	8,370	4,110	8,370	4,110	8,370	4,110
5/8	8	13,320	6,780	13,320	6,780	13,320	6,780	13,320	6,780
3/4	10-5/8	19,680	10,370	19,680	10,370	19,680	10,370	19,680	10,370

1. Allowable load values are calculated using a conversion factor, α, from the Factored Design Strength Tables and conditions shown previously.
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 CCU+ Thrubolt Version (TB) Installed in Cracked Concrete[1,2]

Nominal Anchor Size / Rod Diameter (in.)	Nominal Embed. Depth h_{nom} (in.)	Minimum Concrete Compressive Strength							
		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.)
		A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)
3/8	4-1/4	4,880	3,320	5,015	3,835	5,015	4,700	5,015	5,425
1/2	5-3/8	6,825	4,890	7,880	5,645	8,370	6,920	8,370	7,985
5/8	8	12,535	8,545	13,320	9,870	13,320	12,085	13,320	13,955
3/4	10-5/8	19,300	12,805	19,680	14,790	19,680	18,110	19,680	20,915

1. Allowable load values are calculated using a conversion factor, α, from the Factored Design Strength Tables and conditions shown previously.
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 CCU+ Thrubolt Version (TB) Installed in Uncracked Concrete[1,2]

Nominal Anchor Size / Rod Diameter (in.)	Nominal Embed. Depth h_{nom} (in.)	Minimum Concrete Compressive Strength							
		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.)
		A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)	A193, Gr. B8M (316 SS)
3/8	4-1/4	5,015	4,650	5,015	5,370	5,015	6,580	5,015	7,220
1/2	5-3/8	8,370	6,845	8,370	7,905	8,370	9,680	8,370	11,180
5/8	8	13,320	11,965	13,320	13,820	13,320	16,920	13,320	18,010
3/4	10-5/8	19,680	17,930	19,680	20,705	19,680	25,355	19,680	26,800

1. Allowable load values are calculated using a conversion factor, α, from the Factored Design Strength Tables and conditions shown previously.
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

Carbon Steel CCU+ Undercut Anchors (ASTM A36 Anchor Rod)[1,2,3]

Cat. No.	Anchor Description, Nominal Size and Length (in.)	Anchor Version	Drill Hole Dia. (in.)	Max. Fixture Thickness, (in.)	Pack Qty.
DFM1311050	3/8 x 6	Preset (PS)	11/16	7/8	20
DFM1311550		Thrubolt (TB)			20
DFM1311100	1/2 x 7-1/2	Preset (PS)	13/16	1-1/4	12
DFM1311600		Thrubolt (TB)			12
DFM1311150	1/2 x 8-1/4	Preset (PS)	13/16	2	12
DFM1311650		Thrubolt (TB)			12
DFM1311200	5/8 x 10-3/4	Preset (PS)	1	1-5/8	10
DFM1311700		Thrubolt (TB)			10
DFM1311250	5/8 x 11-1/2	Preset (PS)	1	2-3/8	10
DFM1311750		Thrubolt (TB)			10
DFM1311300	3/4 x 14	Preset (PS)	1-1/4	2	6
DFM1311800		Thrubolt (TB)			6
DFM1311350	3/4 x 16	Preset (PS)	1-1/4	4	6
DFM1311850		Thrubolt (TB)			6


Carbon Steel CCU+ Undercut Anchors (ASTM A193, Grade B7 Anchor Rod)[1,2,3]

Cat. No.	Anchor Description, Nominal Size and Length (in.)	Anchor Version	Drill Hole Dia. (in.)	Max. Fixture Thickness, (in.)	Pack Qty.
DFM1371050	3/8 x 6	Preset (PS)	11/16	7/8	20
DFM1371550		Thrubolt (TB)			20
DFM1371100	1/2 x 7-1/2	Preset (PS)	13/16	1-1/4	12
DFM1371600		Thrubolt (TB)			12
DFM1371150	1/2 x 8-1/4	Preset (PS)	13/16	2	12
DFM1371650		Thrubolt (TB)			12
DFM1371200	5/8 x 10-3/4	Preset (PS)	1	1-5/8	10
DFM1371700		Thrubolt (TB)			10
DFM1371250	5/8 x 11-1/2	Preset (PS)	1	2-3/8	10
DFM1371750		Thrubolt (TB)			10
DFM1371300	3/4 x 14	Preset (PS)	1-1/4	2	6
DFM1371800		Thrubolt (TB)			6
DFM1371350	3/4 x 16	Preset (PS)	1-1/4	4	6
DFM1371850		Thrubolt (TB)			6


Stainless Steel CCU+ Undercut Anchors (ASTM A193, Grade B8M, Class 2 Anchor Rod - 316 SS)[1,2,3]

Cat. No.	Anchor Description, Nominal Size and Length (in.)	Anchor Version	Drill Hole Dia. (in.)	Max. Fixture Thickness, (in.)	Pack Qty.
DFM1361050	3/8 x 6	Preset (PS)	11/16	7/8	20
DFM1361550		Thrubolt (TB)			20
DFM1361100	1/2 x 7-1/2	Preset (PS)	13/16	1-1/4	12
DFM1361600		Thrubolt (TB)			12
DFM1361150	1/2 x 8-1/4	Preset (PS)	13/16	2	12
DFM1361650		Thrubolt (TB)			12
DFM1361200	5/8 x 10-3/4	Preset (PS)	1	1-5/8	10
DFM1361700		Thrubolt (TB)			10
DFM1361250	5/8 x 11-1/2	Preset (PS)	1	2-3/8	10
DFM1361750		Thrubolt (TB)			10
DFM1361300	3/4 x 14	Preset (PS)	1-1/4	2	6
DFM1361800		Thrubolt (TB)			6
DFM1361350	3/4 x 16	Preset (PS)	1-1/4	4	6
DFM1361850		Thrubolt (TB)			6


Notes for Anchor Ordering Information Tables:

1. Standard preset anchors are designed so the top of the expansion sleeve is approximately flush with the base material after setting. Thrubolt anchors are designed so the expansion sleeve can be set through and can engage the fixture. See CCU+ undercut anchor detail and installation specifications.
2. Undercut drill bits and setting sleeves are required for installation. See the available anchor installation accessories and tools commercially available from DEWALT at the time of publication.
3. The listed anchor lengths are based on the anchor sizes commercially available at the time of publication; custom lengths can be produced by request.

Setting Sleeves

Powered	Manual	Approximate Usable Sleeve Length, (in.)	Matching Nominal Anchor Size, (in.)	Pack Qty.
Cat. No.	Cat. No.			
DFX313825 (SDS-Plus)	-	2-3/4	3/8 (11/16 O.D.)	1
-	DFX313805	5		1
DFX311230 (SDS-Plus)	-	3-3/4	1/2 (13/16 O.D.)	1
-	DFX311210	5		1
DFX315835 (SDS-Max)	-	4-3/4	5/8 (1 O.D.)	1
-	DFX315815	5-1/4		1
DFX313440 (SDS-Max)	-	6-1/2	3/4 (1-1/4 O.D.)	1
-	DFX313420	7		1

Note: powered or manual setting sleeves are required for the installation of CCU+ undercut anchors; see installation instructions. Manual setting sleeves may be stacked to create longer usable setting sleeve lengths.
O.D. = outside diameter


Rotary Hammer Drills

Cat. No.	Nominal Drill Bit Diameter (in.)	Approximate Impact Energy (J)	Pack Qty.
DCH416 or D25416 (SDS-Plus)	11/16	4.5	1
	13/16		
DCH614 or D25614 (SDS-Max)	1	10.5	1
	1-1/4		

Drill Chuck Adapter

Cat. No.	Shank Type	Pack Qty.
DW5891	SDS-Max to SDS-Plus Adapter	1

Hollow Stop Bits (HSB)

Cat. No.	Nominal Drill Bit Diameter, (in.)	Max. Drilling Depth, (in.)	Shank Type	Pack Qty.
DFX11380	11/16	4-1/4	SDS-Plus	1
DFX11120	13/16	5-3/8	SDS-Plus	1
DFX11580	1	8	SDS-Max	1
DFX11340	1-1/4	10-5/8	SDS-Max	1

Stop drill bits create a drilled hole to the specified depth for standard preset version CCU+ Undercut anchors.
For thrubolt applications, see CCU+ undercut anchor detail and installation specifications.
HSB dust removal drill bits are used with a vacuum dust extractor (e.g. DWV010, DWV012, DCV585).

Hollow Bits (HB)

Cat. No.	Nominal Drill Bit Diameter, (in.)	Usable Length, (in.)	Shank Type	Pack Qty.
DWA54116	11/16	9-3/4	SDS-Plus	1
DWA54316	13/16	9-3/4	SDS-Plus	1
DWA58001	1	15-3/4	SDS-Max	1
DWA58115	1-1/4	15-3/4	SDS-Max	1

HB dust removal drill bits are used with a vacuum dust extractor (e.g. DWV010, DWV012, DCV585).

Conventional Bits (4-Cutter)

Cat. No.	Nominal Drill Bit Diameter, (in.)	Usable Length, (in.)	Shank Type	Pack Qty.
DW5808	11/16	16	SDS-Max	1
DW5814	13/16	16	SDS-Max	1
DW5852	1	24	SDS-Max	1
DW5855	1-1/4	24	SDS-Max	1

Hollow Undercut Bits (HUCB)

Cat. No.	Nominal Drill Bit Diameter, (in.)	Max. Hole Depth, (in.)	Shank Type	Pack Qty.
DFX21380	11/16	6	SDS-Plus	1
DFX21120	13/16	8	SDS-Plus	1
DFX21580*	1	11	SDS-Plus*	1
DFX21340	1-1/4	15-1/4	SDS-Max	1

*For rotary hammer drill connector options, a DW5891 SDS-Max to SDS-Plus adapter can be considered.
HUCB dust removal drill bits are used with a vacuum dust extractor (e.g. DWV010, DWV012, DCV585).
Note: HUCB or UCB are required for the installation of CCU+ undercut anchors; see installation instructions.

Undercut Bits (UCB)

Cat. No.	Nominal Drill Bit Diameter, (in.)	Max. Hole Depth, (in.)	Shank Type	Pack Qty.
DFX21381	11/16	6	SDS-Plus	1
DFX21121	13/16	8	SDS-Plus	1
DFX21581*	1	11	SDS-Plus*	1
DFX21341	1-1/4	15-1/4	SDS-Max	1

*For rotary hammer drill connector options, a DW5891 SDS-Max to SDS-Plus adapter can be considered.
Note: HUCB or UCB are required for the installation of CCU+ undercut anchors; see installation instructions.

Replacement Cutter Blades for Undercut Bits

Cat. No.	Nominal Drill Bit Diameter, (in.)	For Use With		Pack Qty.
		HUCB	UCB	
DFX213825	11/16	DFX21380	DFX21381	1
DFX211230	13/16	DFX21120	DFX21121	1
DFX215835	1	DFX21580	DFX21581	1
DFX213440	1-1/4	DFX21340	DFX21341	1

Replacement cutter blades can be used with both hollow undercut drill bits (HUCB) and undercut drill bits (UCB) as indicated.

Replacement Bow Jaws for Undercut Bits

Cat. No.	Nominal Drill Bit Diameter, (in.)	For Use With		Pack Qty.
		HUCB	UCB	
DFX213807	11/16	DFX21380	-	1
DFX213805		-	DFX21381	1
DFX211212	13/16	DFX21120	-	1
DFX211210		-	DFX21121	1
DFX215817	1	DFX21580	-	1
DFX215815		-	DFX21581	1
DFX213422	1-1/4	DFX21340	-	1
DFX213420		-	DFX21341	1

Vacuums

Cat. No.	Description	Pack Qty.
DWV010	8 Gallon HEPA/RRP Dust Extractor	1
DWV012	10 Gallon Wet/Dry HEPA/RRP Dust Extractor	1
DCV585	Flexvolt 60V Max Dust Extratcor (Tool only)	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 lightweight concrete. The anchor is manufactured with a zinc plated carbon steel bolt, sleeve, cone and expansion clip. The Power-Bolt+ has a low profile finished hex head and a full size thick bearing sleeve to provide increased capacity in shear connections.

GENERAL APPLICATIONS AND USES

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

FEATURES AND BENEFITS

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

APPROVALS AND LISTINGS

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

GUIDE SPECIFICATIONS

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

SECTION CONTENTS

POWER-BOLT+ ASSEMBLY

HEAD STYLES

- Finished Hex Head

ANCHOR MATERIALS

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

ANCHOR SIZE RANGE (TYP.)

- 1/4" through 3/4" diameters

SUITABLE BASE MATERIALS

- Normal-weight concrete
- Lightweight concrete

TENSION ZONE CRACKED CONCRETE

SEISMIC REGION QUALIFICATION

CODE LISTED
ICC-ES ESR-3260
CONCRETE

DDA
DEWALT DESIGN ASSIST™

DUSTX+™
ANCHOR INSTALLATION SYSTEM

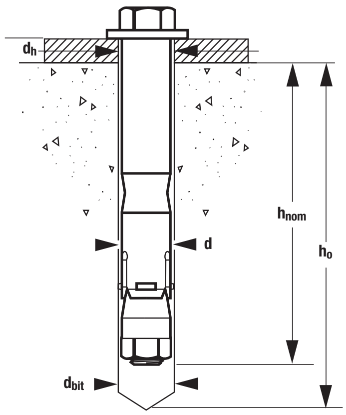
MATERIAL SPECIFICATIONS

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

INSTALLATION SPECIFICATIONS

Power-Bolt+ Anchor Installation Specifications

Anchor Property/Setting Information	Notation	Units	Nominal Anchor Diameter (in.)				
			1/4	3/8	1/2	5/8	3/4
Anchor outside diameter	d	in. (mm)	0.250 (6.4)	0.375 (9.5)	0.500 (12.7)	0.625 (15.9)	0.750 (19.1)
Internal Bolt Diameter (UNC)	-	in. (mm)	#8 (4)	1/4 (6.4)	3/8 (9.5)	7/16 (11.1)	9/16 (14.3)
Nominal drill bit diameter (ANSI)	d_{bit}	in.	1/4	3/8	1/2	5/8	3/4
Minimum diameter of hole clearance in fixture	d_h	in. (mm)	5/16 (8)	7/16 (11)	9/16 (14)	11/16 (17)	13/16 (21)
Minimum nominal embedment depth	h_{nom}	in. (mm)	1-1/4 (32)	1-5/8 (41)	2-1/2 (64)	2-3/4 (70)	3 (76.2)
Minimum hole depth	h_o	in. (mm)	h_{nom} + 1/4 (6)		h_{nom} + 3/8 (10)	h_{nom} + 1/2 (13)	
Minimum member thickness	h_{min}	in. (mm)	3-1/2 (89)	4-1/2 (114)	5 (127)	6-1/2 (165)	7 (178)
Minimum edge distance	c_{min}	in. (mm)	1-3/4 (44)	2-3/4 (70)	3-1/4 (83)	4-1/2 (114)	6 (152)
Minimum spacing distance	s_{min}	in. (mm)	2 (51)	3-1/2 (89)	4-1/2 (114)	6 (152)	5 (127)
Installation torque	T_{inst}	ft.-lbf. (N-m)	4 (5)	20 (27)	40 (54)	60 (81)	110 (149)
Torque wrench/socket size	-	in.	3/8	1/2	5/8	3/4	15/16
Bolt Head Height	-	in. (mm)	1/8 (3)	13/64 (5)	9/32 (7)	5/16 (8)	3/8 (10)
Washer O.D.	-	in.	7/16	47/64	1	1-1/4	1-15/32
See Strength Design Information for installation specifications in strict accordance with ICC-ES ESR-3260.							



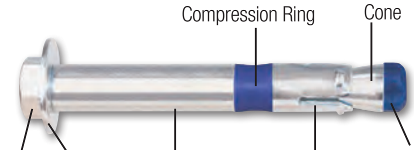
Head Marking

Legend

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

Letter Code = Length Identification Mark

Power-Bolt+ Anchor Assembly

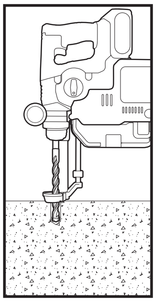


Length Identification

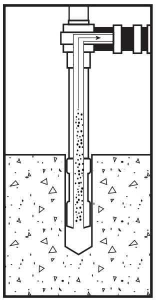
Mark	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
From	1-1/2"	2"	2-1/2"	3"	3-1/2"	4"	4-1/2"	5"	5-1/2"	6"	6-1/2"	7"	7-1/2"	8"	8-1/2"	9"	9-1/2"	10"
Up to but not including	2"	2-1/2"	3"	3-1/2"	4"	4-1/2"	5"	5-1/2"	6"	6-1/2"	7"	7-1/2"	8"	8-1/2"	9"	9-1/2"	10"	11"
Length identification mark indicates the length of the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

INSTALLATION INSTRUCTIONS

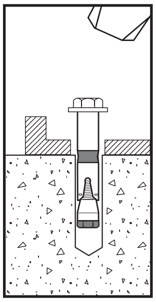
Installation Instructions for Power-Bolt+ Anchor



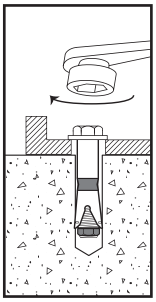
Step 1
Using the proper drill bit size, drill a hole into the base material to the required depth. The tolerances of the drill bit used should meet the requirements of ANSI Standard B212.15.



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



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



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

PERFORMANCE DATA (ASD)

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

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

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

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

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

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

Load Adjustment Factors for Normal-Weight Concrete

Spacing Reduction Factors - Tension (F_{NS})

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

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

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

Spacing Reduction Factors - Shear (F_{VS})

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

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

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

STRENGTH DESIGN INFORMATION

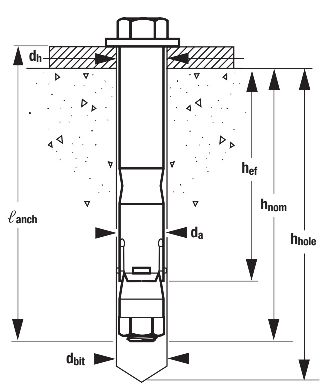
Power-Bolt+ Anchor Installation Specifications in Concrete and Supplemental Information [1]

Anchor Property/Setting Information		Notation	Units	Nominal Anchor Diameter (in.) 1/2	5/8	3/4
Anchor outside diameter		d_a	in. (mm)	0.500 (12.7)	0.625 (15.9)	0.750 (19.1)
Internal bolt diameter (UNC)		-	in. (mm)	3/8 (9.5)	7/16 (11.1)	9/16 (14.3)
Minimum diameter of hole clearance in fixture		d_h	in. (mm)	9/16 (14.3)	11/16 (17.5)	13/16 (21.6)
Nominal drill bit diameter (ANSI)		d_{bit}	in.	1/2	5/8	3/4
Minimum nominal embedment depth		h_{nom}	in. (mm)	3-1/4 (83)	3-3/4 (95)	4-3/8 (111)
Effective embedment		h_{ef}	in. (mm)	2-5/8 (67)	3 (76)	3-1/2 (89)
Minimum hole depth		h_{hole}	in. (mm)	3-3/4 (95)	4-1/4 (108)	5 (127)
Minimum member thickness		h_{min}	in. (mm)	5 (127)	6-1/2 (165)	7 (178)
Minimum overall anchor length[2]		ℓ_{anch}	in. (mm)	3-1/2 (89)	4 (102)	4-1/2 (114)
Minimum edge distance		c_{min}	in. (mm)	3-1/4 (83)	4-1/2 (114)	6 (152); 8 (203)
Minimum spacing distance		s_{min}	in. (mm)	4-1/2 (114)	6 (152)	6 (152); 5 (127)
Installation torque		T_{inst}	ft.-lbf. (N-m)	40 (54)	60 (81)	110 (149)
Bolt Head Height		-	in. (mm)	9/32 (7.1)	5/16 (7.9)	3/8 (9.6)
Torque wrench/socket size		-	in.	5/8	3/4	15/16
Washer O.D.		-	in.	1	1-1/4	1-15/32
Minimum specified yield strength		f_y	psi (N/mm²)	130,000 (896)	130,000 (896)	130,000 (896)
Minimum specified ultimate tensile strength[8]		f_{uta}	psi (N/mm²)	150,000 (1,034)	150,000 (1,034)	150,000 (1,034)
Effective tensile stress area (internal bolt threads)		$A_{se,N}$	in² (mm²)	0.0775 (50)	0.1063 (68.6)	0.1820 (117.4)
Effective shear stress area (internal bolt shank)		$A_{se,V}$	in² (mm²)	0.1069 (69)	0.1452 (93.7)	0.2410 (153.0)
Mean axial stiffness[4]	Uncracked concrete	β_{uncr}	lbf/in. (kN/mm)	366,000 (63)	871,000 (150)	256,000 (44)
	Cracked concrete	β_{cr}	lbf/in. (kN/mm)	64,000 (11)	94,000 (16)	27,000 (5)

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

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

Power-Bolt+ Anchor Detail



MECHANICAL ANCHORS

POWER-BOLT®+
Heavy Duty Sleeve Anchor

Tension Design information for Power-Bolt+ Anchor in Concrete

CODE LISTED ICC-ES ESR-3260

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

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

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

Shear Design information for Power-Bolt+ Anchor in Concrete

CODE LISTED
ICC-ES ESR-3260

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

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

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

DESIGN STRENGTH TABLES (SD)

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

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

■ - Concrete Breakout Strength Controls ■ - Steel Strength Controls

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

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

■ - Concrete Breakout Strength Controls ■ - Steel Strength Controls

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

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

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

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

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

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

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

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

ORDERING INFORMATION

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

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

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

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

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

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

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

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, 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
- Barriers and guards
- Fencing and railing
- Mezzanines and racking
- Tension zone applications, i.e., cable trays and strut, pipe supports, fire sprinklers
- Trapeze / overhead utilities
- Ledgers, angles and brackets
- Equipment anchorage
- Seismic and wind loading (SDC A - F)

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

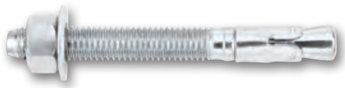
APPROVALS AND LISTINGS

- 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 2021 IBC/IRC, 2018 IBC/IRC, 2015 IBC/IRC, and 2012 IBC/IRC
- Tested in accordance with ACI 355.2/ASTM E488 and ICC-ES AC193 for use in structural concrete under the design provisions of ACI 318 (-19 or -14) Chapter 17 or ACI 318 Appendix D
- Evaluated and qualified by an accredited independent testing laboratory for recognition in cracked and uncracked concrete including seismic and wind loading (anchor Category 1)
- Tested in accordance with ASTM E488 and ICC-ES AC01 for use in masonry
- City of Los Angeles, LABC and LARC Supplement (within ESR-2818 and ESR-2966)
- Florida Building Code, FBC Supplement including HVHZ (within ESR-2818 and ESR-2966)
- Underwriters Laboratories (UL Listed) - File No. EX1289, see listing for sizes
- FM Approvals (Factory Mutual) – see FM Approval Guide 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
- Lightweight concrete
- Concrete over steel deck
- Grouted concrete masonry (CMU)

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 A563, Grade A
Washer	Carbon Steel, ASTM F844; meets dimensional requirements of ANSI B18.22.2, Type A Plain
Expansion wedge (clip)	Carbon Steel
Plating	Zinc plating according to ASTM B633, SC1 Type III (Fe/Zn 5) Minimum plating requirements for Mild Service Condition.
See Tension Design Information table for yield and ultimate strengths of the anchor body.	

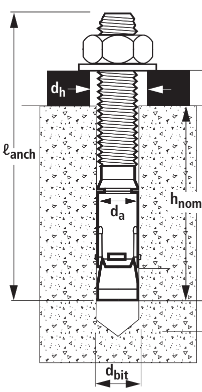
INSTALLATION SPECIFICATIONS

Installation Specifications for Power-Stud+ SD1 in Concrete[1,2,3]

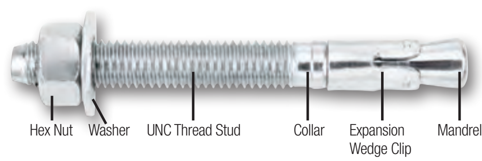
Anchor Property/ Setting Information	Notation	Units	Nominal Anchor Diameter							
			1/4	3/8	1/2	5/8	3/4	7/8	1	1-1/4
Anchor diameter	d_a (d)	in.	0.250	0.375	0.500	0.625	0.750	0.875	1.000	1.250
Minimum diameter of hole clearance in fixture	d_h	in.	5/16	7/16	9/16	11/16	13/16	1	1-1/8	1-3/8
Nominal drill bit diameter (ANSI)	d_{bit}	in.	1/4	3/8	1/2	5/8	3/4	7/8	1	1-1/4
Minimum nominal embedment depth[1]	h_{nom}	in.	1-1/8	1-5/8	2-1/4	2-3/4	3-3/8	3-7/8	4-1/2	5-1/2
Minimum hole depth	h_o	in.	h_{nom} + 1/8		h_{nom} + 1/4			h_{nom} + 3/8		h_{nom} + 1/2
Installation torque	T_{inst}	ft.-lbf.	4	20	40	80	110	175	225	375
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
Washer O.D.	-	in.	5/8	13/16	1-1/16	1-5/16	1-15/32	1-3/4	2	2-1/2

See Strength Design Information for installation specifications in strict accordance with ICC-ES ESR-2818.
1. See Performance Data tables for additional embedment depths.
2. The minimum base material thickness should be $1.5h_{nom}$ or 3", whichever is greater.

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

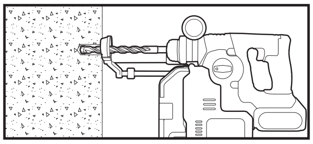
Length Identification

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"

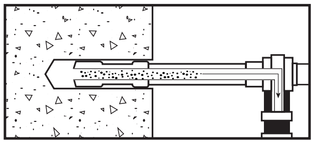
Length identification mark indicates overall length of anchor.

INSTALLATION INSTRUCTIONS

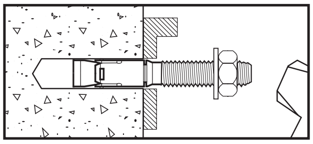
Installation Instructions for Power-Stud+ SD1



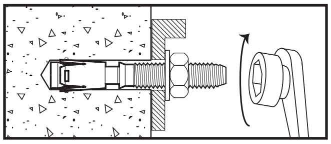
Step 1
Using the proper drill bit size, drill a hole into the base material to the required depth. The tolerances of the drill bit used should meet the requirements of ANSI Standard B212.15.



Step 2
Remove the 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.

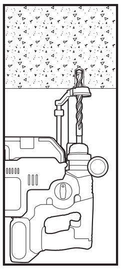


Step 3
Position the washer on the anchor and thread on the nut. If installing through a fixture, drive the anchor through the fixture into the hole. Be sure the anchor is driven to the minimum required embedment depth, h_{nom}.

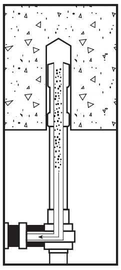


Step 4
Tighten the anchor with a torque wrench by applying the required installation torque, T_{inst}. Note: The threaded stud will draw up during tightening of the nut; the expansion wedge (clip) remains in original position.

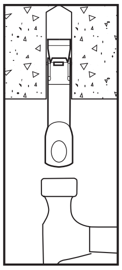
Installation Instructions for Power-Stud+ SD1 Tie Wire Version



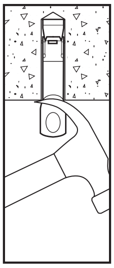
Step 1
Using the proper drill bit size, drill a hole into the base material to the required depth. The tolerances of the drill bit used should meet the requirements of ANSI Standard B212.15.



Step 2
Remove the 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
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.

PERFORMANCE DATA (ASD)

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

Nominal Anchor Diameter d 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)	
		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)	1,660 (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)	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)	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)	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)	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)	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)
	6-1/4 (159)	15,105 67.2)	15,795 (70.3)	16,545 (73.6)	17,305 (77.0)	19,105 (85.0)	19,980 (88.9)	19,105 (85.0)	19,980 (88.9)
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)	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)	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)	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[1,2,3,4,5]

ALLOWABLE STRESS DESIGN (ASD)

Nominal Anchor Diameter d (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)	
		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)	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)	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)	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)	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)	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)	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)
	6-1/4 (159)	3,775 (16.8)	3,950 (17.6)	4,135 (18.4)	4,325 (19.2)	4,775 (21.2)	4,995 (22.2)	4,775 (21.2)	4,995 (22.2)
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)	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)	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)	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 uncracked 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.
5. For lightweight concrete multiply tabulated allowable load values by a reduction factor of 0.60.

LOAD ADJUSTMENT FACTORS FOR NORMAL-WEIGHT CONCRETE

Spacing Reduction Factors - Tension (F_{NS})

Diameter (in)		1/4	1/4	3/8	3/8	1/2	1/2	1/2	5/8	5/8	5/8	3/4	3/4	3/4	7/8	7/8	7/8	1	1	1	1-1/4	1-1/4
Nominal Embedment h_{nom} (in)		1-1/8	1-3/4	1-5/8	2-3/8	2-1/4	2-1/2	3-3/4	2-3/4	3-3/8	4-5/8	3-3/8	4	5-5/8	3-7/8	4-1/2	6-1/4	4-1/2	5-1/2	8	5-1/2	6-1/2
Minimum Spacing s_{min} (in)		1-1/2	2-1/4	2-1/4	3-1/2	3	4-1/2	5	3-3/4	6	4-1/4	4-1/2	6	6-1/2	5-1/4	6-1/2	5-1/4	6	8	6	7-1/2	8
Spacing Distance (inches)	1-1/2	0.85	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1-3/4	0.88	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	0.92	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2-1/4	0.95	0.78	0.86	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2-1/2	0.98	0.80	0.88	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2-3/4	1.00	0.83	0.91	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3	1.00	0.85	0.93	-	0.85	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3-1/2	1.00	0.90	0.98	0.84	0.88	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	4	1.00	0.95	1.00	0.87	0.92	-	-	0.87	-	-	-	-	-	-	-	-	-	-	-	-	-
	4-1/4	1.00	0.98	1.00	0.89	0.93	-	-	0.88	-	0.72	-	-	-	-	-	-	-	-	-	-	-
	4-1/2	1.00	1.00	1.00	0.90	0.95	0.91	-	0.90	-	0.73	0.86	-	-	-	-	-	-	-	-	-	-
	5	1.00	1.00	1.00	0.94	0.98	0.94	0.79	0.92	-	0.75	0.88	-	-	-	-	-	-	-	-	-	-
	5-1/2	1.00	1.00	1.00	0.97	1.00	0.97	0.81	0.95	-	0.77	0.91	-	-	0.87	-	0.77	-	-	-	-	-
	6	1.00	1.00	1.00	1.00	1.00	1.00	0.83	0.98	0.88	0.79	0.93	0.87	-	0.89	-	0.78	0.86	-	0.75	-	-
	6-1/2	1.00	1.00	1.00	1.00	1.00	1.00	0.86	1.00	0.90	0.80	0.95	0.89	0.79	0.91	0.85	0.79	0.87	-	0.76	-	-
	7	1.00	1.00	1.00	1.00	1.00	1.00	0.88	1.00	0.93	0.82	0.98	0.91	0.81	0.93	0.87	0.80	0.89	-	0.77	-	-
	7-1/2	1.00	1.00	1.00	1.00	1.00	1.00	0.90	1.00	0.96	0.84	1.00	0.93	0.82	0.95	0.89	0.82	0.91	-	0.78	0.85	-
	8	1.00	1.00	1.00	1.00	1.00	1.00	0.92	1.00	0.99	0.86	1.00	0.95	0.83	0.97	0.91	0.83	0.93	0.84	0.78	0.86	0.82
	8-1/2	1.00	1.00	1.00	1.00	1.00	1.00	0.94	1.00	1.00	0.88	1.00	0.97	0.85	0.99	0.93	0.84	0.94	0.85	0.79	0.88	0.83
	9	1.00	1.00	1.00	1.00	1.00	1.00	0.97	1.00	1.00	0.89	1.00	0.99	0.86	1.00	0.94	0.85	0.96	0.87	0.80	0.89	0.84
	9-1/2	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00	1.00	0.91	1.00	1.00	0.87	1.00	0.96	0.86	0.98	0.89	0.81	0.90	0.85
	10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.93	1.00	1.00	0.89	1.00	0.98	0.87	1.00	0.90	0.82	0.92	0.86
	10-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.90	1.00	1.00	0.88	1.00	0.92	0.83	0.93	0.87
	11	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96	1.00	1.00	0.91	1.00	1.00	0.89	1.00	0.93	0.84	0.94	0.88
	11-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	1.00	1.00	0.93	1.00	1.00	0.90	1.00	0.95	0.84	0.96	0.90
	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	0.94	1.00	1.00	0.92	1.00	0.96	0.85	0.97	0.91
	12-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.93	1.00	0.98	0.86	0.98	0.92
	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	0.97	1.00	1.00	0.94	1.00	1.00	0.87	1.00	0.93
	13 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	0.98	1.00	1.00	0.95	1.00	1.00	0.88	1.00	0.94
	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	0.99	1.00	1.00	0.96	1.00	1.00	0.89	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	1.00	1.00	1.00	1.00	1.00	0.97	1.00	1.00	0.90	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	1.00	1.00	1.00	1.00	1.00	0.98	1.00	1.00	0.90	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	1.00	1.00	1.00	1.00	1.00	0.99	1.00	1.00	0.91	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	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.93	1.00	1.00
	16	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	0.92	1.00	1.00
	17	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	0.94	1.00	1.00
	17-1/2	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	1.00	1.00	0.95	1.00	1.00
	18	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	0.96	1.00	1.00
	18-1/2	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	1.00	1.00	0.96	1.00	1.00
	19	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	0.97	1.00	1.00
	19-1/2	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	1.00	1.00	0.98	1.00	1.00
	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	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00	1.00
	20-5/8	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	1.00	1.00

Spacing Reduction Factors - Shear (F_{VS})

Diameter (in)		1/4	1/4	3/8	3/8	1/2	1/2	1/2	5/8	5/8	5/8	3/4	3/4	3/4	7/8	7/8	7/8	1	1	1	1-1/4	1-1/4
Nominal Embedment h_{nom} (in)		1-1/8	1-3/4	1-5/8	2-3/8	2-1/4	2-1/2	3-3/4	2-3/4	3-3/8	4-5/8	3-3/8	4	5-5/8	3-7/8	4-1/2	6-1/4	4-1/2	5-1/2	8	5-1/2	6-1/2
Minimum Spacing s_{min} (in)		1-1/2	2-1/4	2-1/4	3-1/2	3	4-1/2	5	3-3/4	6	4-1/4	4-1/2	6	6-1/2	5-1/4	6-1/2	5-1/4	6	8	6	7-1/2	8
Spacing Distance (inches)	1-1/2	0.91	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1-3/4	0.93	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	0.95	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2-1/4	0.97	0.85	0.92	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2-1/2	0.99	0.87	0.93	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2-3/4	1.00	0.88	0.95	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3	1.00	0.90	0.96	-	0.91	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3-1/2	1.00	0.93	0.99	0.90	0.93	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	4	1.00	0.97	1.00	0.92	0.95	-	-	0.93	-	-	-	-	-	-	-	-	-	-	-	-	-
	4-1/4	1.00	0.98	1.00	0.93	0.96	-	-	0.93	-	0.82	-	-	-	-	-	-	-	-	-	-	-
	4-1/2	1.00	1.00	1.00	0.94	0.97	0.95	-	0.94	-	0.82	0.92	-	-	-	-	-	-	-	-	-	-
	5	1.00	1.00	1.00	0.96	0.99	0.97	0.86	0.96	-	0.83	0.93	-	-	-	-	-	-	-	-	-	-
	5-1/2	1.00	1.00	1.00	0.98	1.00	0.98	0.87	0.97	-	0.85	0.95	-	-	0.93	-	0.87	-	-	-	-	-
	6	1.00	1.00	1.00	1.00	1.00	1.00	0.89	0.99	0.91	0.86	0.96	0.92	-	0.94	-	0.88	0.92	-	0.86	-	-
	6-1/2	1.00	1.00	1.00	1.00	1.00	1.00	0.90	1.00	0.93	0.87	0.97	0.93	0.88	0.95	0.91	0.88	0.93	-	0.86	-	-
	7	1.00	1.00	1.00	1.00	1.00	1.00	0.92	1.00	0.95	0.88	0.99	0.94	0.88	0.96	0.92	0.89	0.94	-	0.87	-	-
	7-1/2	1.00	1.00	1.00	1.00	1.00	1.00	0.93	1.00	0.97	0.89	1.00	0.96	0.89	0.97	0.93	0.90	0.95	-	0.87	0.91	-
	8	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	0.99	0.90	1.00	0.97	0.90	0.99	0.94	0.90	0.96	0.90	0.88	0.92	0.89
	8-1/2	1.00	1.00	1.00	1.00	1.00	1.00	0.96	1.00	1.00	0.92	1.00	0.98	0.91	1.00	0.96	0.91	0.97	0.91	0.88	0.93	0.90
	9	1.00	1.00	1.00	1.00	1.00	1.00	0.98	1.00	1.00	0.93	1.00	0.99	0.92	1.00	0.97	0.91	0.98	0.92	0.89	0.94	0.91
	9-1/2	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00	1.00	0.94	1.00	1.00	0.92	1.00	0.98	0.92	0.99	0.93	0.89	0.94	0.91
	10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.93	1.00	0.99	0.93	1.00	0.94	0.90	0.95	0.92
	10-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96	1.00	1.00	0.94	1.00	1.00	0.93	1.00	0.95	0.90	0.96	0.93
	11	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	1.00	1.00	0.95	1.00	1.00	0.94	1.00	0.96	0.91	0.97	0.93
	11-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00	1.00	0.96	1.00	1.00	0.95	1.00	0.97	0.91	0.98	0.94
	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	0.96	1.00	1.00	0.95	1.00	0.98	0.92	0.98	0.95
	12-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97	1.00	1.00	0.96	1.00	0.99	0.92	0.99	0.95
	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	0.98	1.00	1.00	0.97	1.00	1.00	0.93	1.00	0.96
	13-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00	1.00	0.97	1.00	1.00	0.93	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	1.00	1.00	1.00	1.00	1.00	0.98	1.00	1.00	0.94	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	1.00	1.00	1.00	1.00	1.00	0.98	1.00	1.00	0.94	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	1.00	1.00	1.00	1.00	1.00	0.99	1.00	1.00	0.95	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	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	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	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96	1.00	1.00
	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	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96	1.00	1.00
	17	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	0.96	1.00	1.00
	17-1/2	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	1.00	1.00	0.97	1.00	1.00
	18	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	0.97	1.00	1.00
	18-1/2	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	1.00	1.00	0.98	1.00	1.00
	19	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	0.98	1.00	1.00
	19-1/2	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	1.00	1.00	0.99	1.00	1.00
	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	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00	1.00
	20-5/8	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	1.00	1.00

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

Diameter (in)	1/4	1/4	3/8	3/8	1/2	1/2	1/2	5/8	5/8	5/8	3/4	3/4	3/4	7/8	7/8	7/8	1	1	1	1-1/4	1-1/4
Nominal Embedment h_{nom} (in)	1-1/8	1-3/4	1-5/8	2-3/8	2-1/4	2-1/2	3-3/4	2-3/4	3-3/8	4-5/8	3-3/8	4	5-5/8	3-7/8	4-1/2	6-1/4	4-1/2	5-1/2	8	5-1/2	6-1/2
Min. Edge Distance c_{min} (in)	1-3/4	1-3/4	3	2-1/4	4	3-1/4	2-3/4	5	5-1/2	4-1/4	6	5	6	7	7	7	8	8	8	10	8
Edge Distance (inches)																					
1-3/4	0.50	0.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	0.57	0.57	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-1/4	0.64	0.64	-	0.35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-1/2	0.71	0.71	-	0.38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-3/4	0.79	0.79	-	0.42	-	-	0.34	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	0.86	0.86	0.60	0.46	-	-	0.38	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-1/4	0.93	0.93	0.65	0.50	-	0.41	0.41	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-1/2	1.00	1.00	0.70	0.54	-	0.44	0.44	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	1.00	1.00	0.80	0.62	0.57	0.50	0.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-1/4	1.00	1.00	0.85	0.65	0.61	0.53	0.53	-	-	0.43	-	-	-	-	-	-	-	-	-	-	-
4-1/2	1.00	1.00	0.90	0.69	0.64	0.56	0.56	-	-	0.45	-	-	-	-	-	-	-	-	-	-	-
5	1.00	1.00	1.00	0.77	0.71	0.63	0.63	0.59	-	0.50	-	0.45	-	-	-	-	-	-	-	-	-
5-1/2	1.00	1.00	1.00	0.85	0.79	0.69	0.69	0.65	0.92	0.55	-	0.50	-	-	-	-	-	-	-	-	-
6	1.00	1.00	1.00	0.92	0.86	0.75	0.75	0.71	1.00	0.60	0.60	0.55	0.38	-	-	-	-	-	-	-	-
6-1/2	1.00	1.00	1.00	1.00	0.93	0.81	0.81	0.76	1.00	0.65	0.65	0.59	0.41	-	-	-	-	-	-	-	-
7	1.00	1.00	1.00	1.00	1.00	0.88	0.88	0.82	1.00	0.70	0.70	0.64	0.44	0.61	0.61	0.33	-	-	-	-	-
7-1/2	1.00	1.00	1.00	1.00	1.00	0.94	0.94	0.88	1.00	0.75	0.75	0.68	0.47	0.65	0.65	0.36	-	-	-	-	-
8	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.94	1.00	0.80	0.80	0.73	0.50	0.70	0.70	0.38	0.59	0.67	0.29	-	0.40
8-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.85	0.85	0.77	0.53	0.74	0.74	0.40	0.63	0.71	0.31	-	0.43
9	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.90	0.90	0.82	0.56	0.78	0.78	0.43	0.67	0.75	0.33	-	0.45
9-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	0.86	0.59	0.83	0.83	0.45	0.70	0.79	0.35	-	0.48
10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.91	0.63	0.87	0.87	0.48	0.74	0.83	0.36	0.57	0.50
10-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.66	0.91	0.91	0.50	0.78	0.88	0.38	0.60	0.53
11	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.69	0.96	0.96	0.52	0.81	0.92	0.40	0.63	0.55
11-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.72	1.00	1.00	0.55	0.85	0.96	0.42	0.66	0.58
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	0.75	1.00	1.00	0.57	0.89	1.00	0.44	0.69	0.60
12-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.78	1.00	1.00	0.60	0.93	1.00	0.45	0.71	0.63
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	0.81	1.00	1.00	0.62	0.96	1.00	0.47	0.74	0.65
13-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.84	1.00	1.00	0.64	1.00	1.00	0.49	0.77	0.68
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	0.88	1.00	1.00	0.67	1.00	1.00	0.51	0.80	0.70
14-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.91	1.00	1.00	0.69	1.00	1.00	0.53	0.83	0.73
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	0.94	1.00	1.00	0.71	1.00	1.00	0.55	0.86	0.75
15-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97	1.00	1.00	0.74	1.00	1.00	0.56	0.89	0.78
16	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	0.76	1.00	1.00	0.58	0.91	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	1.00	1.00	1.00	1.00	1.00	0.79	1.00	1.00	0.60	0.94	0.83
17	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	0.81	1.00	1.00	0.62	0.97	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	1.00	1.00	1.00	1.00	1.00	0.83	1.00	1.00	0.64	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	1.00	1.00	1.00	1.00	1.00	0.86	1.00	1.00	0.65	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	1.00	1.00	1.00	1.00	1.00	0.88	1.00	1.00	0.67	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	1.00	1.00	1.00	1.00	1.00	0.90	1.00	1.00	0.69	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	1.00	1.00	1.00	1.00	1.00	0.93	1.00	1.00	0.71	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	1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.73	1.00	1.00
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	1.00	1.00	0.76	1.00	1.00
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	1.00	1.00	0.80	1.00	1.00
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	1.00	1.00	0.84	1.00	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	0.87	1.00	1.00
25	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	0.91	1.00	1.00
26	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	0.95	1.00	1.00
27	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	0.98	1.00	1.00
27-1/2	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	1.00	1.00	1.00	1.00	1.00

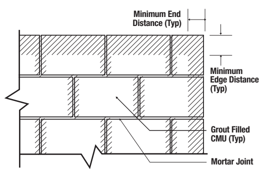
Edge Distance Reduction Factors - Shear (F_{VC})

	Diameter (in)	1/4	1/4	3/8	3/8	1/2	1/2	1/2	5/8	5/8	5/8	3/4	3/4	3/4	7/8	7/8	7/8	1	1	1	1-1/4	1 1/4
	Nominal Embedment h_{nom} (in)	1-1/8	1-3/4	1-5/8	2-3/8	2-1/4	2-1/2	3-3/4	2-3/4	3-3/8	4-5/8	3-3/8	4	5-5/8	3-7/8	4-1/2	6-1/4	4-1/2	5-1/2	8	5-1/2	6 1/2
	Min. Edge Distance c_{min} (in)	1-3/4	1-3/4	3	2-1/4	4	3-1/4	2-3/4	5	5-1/2	4-1/4	6	5	6	7	7	7	8	8	8	10	8
Edge Distance (inches)	1-3/4	0.67	0.39	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	0.76	0.44	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2-1/4	0.86	0.50	-	0.38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2-1/2	0.95	0.56	-	0.42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2-3/4	1.00	0.61	-	0.46	-	-	0.28	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3	1.00	0.67	0.80	0.50	-	-	0.31	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3-1/4	1.00	0.72	0.87	0.54	-	0.54	0.33	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3-1/2	1.00	0.78	0.93	0.58	-	0.58	0.36	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	4	1.00	0.89	1.00	0.67	0.76	0.67	0.41	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	4-1/4	1.00	0.94	1.00	0.71	0.81	0.71	0.44	-	-	0.35	-	-	-	-	-	-	-	-	-	-	-
	4-1/2	1.00	1.00	1.00	0.75	0.86	0.75	0.46	-	-	0.38	-	-	-	-	-	-	-	-	-	-	-
	5	1.00	1.00	1.00	0.83	0.95	0.83	0.51	0.78	-	0.42	-	0.53	-	-	-	-	-	-	-	-	-
	5-1/2	1.00	1.00	1.00	0.92	1.00	0.92	0.56	0.86	0.67	0.46	-	0.59	-	-	-	-	-	-	-	-	-
	6	1.00	1.00	1.00	1.00	1.00	1.00	0.62	0.94	0.73	0.50	0.80	0.64	0.42	-	-	-	-	-	-	-	-
	6-1/2	1.00	1.00	1.00	1.00	1.00	1.00	0.67	1.00	0.79	0.54	0.87	0.69	0.46	-	-	-	-	-	-	-	-
	7	1.00	1.00	1.00	1.00	1.00	1.00	0.72	1.00	0.85	0.58	0.93	0.75	0.49	0.81	0.67	0.44	-	-	-	-	-
	7-1/2	1.00	1.00	1.00	1.00	1.00	1.00	0.77	1.00	0.91	0.63	1.00	0.80	0.53	0.87	0.71	0.48	-	-	-	-	-
	8	1.00	1.00	1.00	1.00	1.00	1.00	0.82	1.00	0.97	0.67	1.00	0.85	0.56	0.93	0.76	0.51	0.79	0.61	0.39	-	0.50
	8-1/2	1.00	1.00	1.00	1.00	1.00	1.00	0.87	1.00	1.00	0.71	1.00	0.91	0.60	0.99	0.81	0.54	0.84	0.65	0.41	-	0.53
	9	1.00	1.00	1.00	1.00	1.00	1.00	0.92	1.00	1.00	0.75	1.00	0.96	0.63	1.00	0.86	0.57	0.89	0.69	0.44	-	0.56
	9-1/2	1.00	1.00	1.00	1.00	1.00	1.00	0.97	1.00	1.00	0.79	1.00	1.00	0.67	1.00	0.90	0.60	0.94	0.72	0.46	-	0.59
	10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.83	1.00	1.00	0.70	1.00	0.95	0.63	0.99	0.76	0.48	0.76	0.62
	10-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.88	1.00	1.00	0.74	1.00	1.00	0.67	1.00	0.80	0.51	0.80	0.65
	11	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.92	1.00	1.00	0.77	1.00	1.00	0.70	1.00	0.84	0.53	0.84	0.68
	11-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96	1.00	1.00	0.81	1.00	1.00	0.73	1.00	0.88	0.56	0.88	0.71
	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	0.84	1.00	1.00	0.76	1.00	0.91	0.58	0.91	0.74
	12-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.88	1.00	1.00	0.79	1.00	0.95	0.61	0.95	0.78
	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	0.91	1.00	1.00	0.83	1.00	0.99	0.63	0.99	0.81
	13-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.86	1.00	1.00	0.65	1.00	0.84
	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	0.98	1.00	1.00	0.89	1.00	1.00	0.68	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	1.00	1.00	1.00	1.00	1.00	0.92	1.00	1.00	0.70	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	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.73	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	1.00	1.00	1.00	1.00	1.00	0.98	1.00	1.00	0.75	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	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.78	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	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.80	1.00	1.00
	17	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	0.82	1.00	1.00
	17-1/2	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	1.00	1.00	0.85	1.00	1.00
	18	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	0.87	1.00	1.00
	18-1/2	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	1.00	1.00	0.90	1.00	1.00
	19	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	0.92	1.00	1.00
	19-1/2	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	1.00	1.00	0.95	1.00	1.00
	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	1.00	1.00	1.00	1.00	1.00	1.00	0.97	1.00	1.00
	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	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]

CODE LISTED
ICC-ES ESR-2966

Nominal Anchor Diameter d in.	Installation Torque T_{inst} ft-lbf (N-m)	Min. Embed. Depth h_{nom} in. (mm)	Min. Edge Distance in. (mm)	Min. End Distance in. (mm)	Grout-Filled Concrete Masonry f'm = 1,500 psi Ultimate Load Tension lbs. (kN)	Grout-Filled Concrete Masonry f'm = 1,500 psi Allowable Load Tension lbs. (kN)	Grout-Filled Concrete Masonry f'm = 2,000 psi Ultimate Load Tension lbs. (kN)	Grout-Filled Concrete Masonry f'm = 2,000 psi Allowable Load Tension lbs. (kN)
3/8	20 (27)	2-3/8 (60)	4 (102)	4 (102)	2,225 (10.0)	445 (2.0)	2,670 (12.0)	535 (2.4)
1/2	40 (54)	2-1/2 (64)	4 (102)	4 (102)	2,650 (11.9)	530 (2.4)	3,180 (14.3)	635 (2.9)
5/8	50 (68)	3-3/8 (86)	4 (102)	4 (102)	3,525 (15.9)	705 (3.2)	4,230 (19.0)	845 (3.8)
3/4	80 (108)	3-3/8 (86)	12 (305)	12 (305)	7,575 (33.7)	1,515 (6.7)	8,175 (36.4)	1,635 (7.3)
			20 (508)	20 (508)	7,575 (33.7)	1,515 (6.7)	8,175 (36.4)	1,635 (7.3)
		4-3/4 (121)	12 (305)	12 (305)	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 C90. Mortar must be Type N, S or M. 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 C90. Mortar must be Type N, S or M. 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.

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

CODE LISTED
ICC-ES ESR-2966

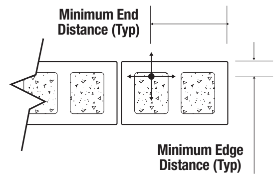
Nominal Anchor Diameter d in.	Installation Torque T_{inst} ft-lbf (N-m)	Min. Embed. Depth h_{nom} in. (mm)	Min. Edge Distance in. (mm)	Min. End Distance in. (mm)	Direction of Loading	Grout-Filled Concrete Masonry f'm = 1,500 psi Ultimate Load Shear lbs. (kN)	Grout-Filled Concrete Masonry f'm = 1,500 psi Allowable Load Shear lbs. (kN)	Grout-Filled Concrete Masonry f'm = 2,000 psi Ultimate Load Shear lbs. (kN)	Grout-Filled Concrete Masonry f'm = 2,000 psi Allowable Load Shear lbs. (kN)
3/8	20 (27)	2-3/8 (60)	4 (102)	4 (102)	Perpendicular or parallel to wall edge or end	2,975 (13.4)	595 (2.7)	3,570 (16.1)	715 (3.2)
1/2	40 (54)	2-1/2 (64)	4 (102)	12 (305)	Perpendicular or parallel to wall edge or end	2,800 (12.6)	560 (2.5)	3,360 (15.1)	670 (3.0)
			12 (305)	4 (102)	Parallel to wall end	4,025 (18.1)	805 (3.6)	4,830 (21.7)	965 (4.3)
			4 (102)	12 (305)	Parallel to wall edge				
5/8	50 (68)	3-3/8 (86)	4 (102)	4 (102)	Perpendicular or parallel to wall edge or end	3,425 (15.4)	685 (3.1)	4,110 (18.5)	820 (3.7)
			12 (305)	4 (102)	Parallel to wall end	5,325 (24.0)	1,065 (4.8)	6,390 (28.8)	1,280 (5.8)
			4 (102)	12 (305)	Parallel to wall edge				
3/4	80 (108)	3-3/8 (86)	12 (305)	12 (305)	Perpendicular or parallel to wall edge or end	8,850 (39.4)	1,770 (7.9)	9,375 (41.7)	1,875 (8.3)
			20 (508)	20 (508)		10,200 (45.4)	2,040 (9.1)	10,800 (48.0)	2,160 (9.6)
		4-3/4 (121)	12 (305)	12 (305)		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 C90. Mortar must be Type N, S or M. 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 C90. Mortar must be Type N, S or M. 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.

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

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

Nominal Anchor Diameter d in.	Installation Torque T_{inst} ft-lbf (N-m)	Minimum Embed. Depth h_{nom} in. (mm)	Min. Edge Distance in. (mm)	Min. End Distance in. (mm)	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	20 (27)	2-3/8 (60)	1-3/4 (45)	12 (305)	1,475 (6.6)	295 (1.3)	1,770 (8.0)	355 (1.6)
1/2	40 (54)	2-1/2 (64)	2-1/4 (57)		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	50 (68)	3-3/8 (86)	2-1/4 (57)		3,825 (17.2)	765 (3.4)	4,590 (20.7)	920 (4.1)
		6-1/4 (159)			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 C90. Mortar must be Type N, S or M. 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 the Tops of Concrete Masonry Walls[1,2,3,4]

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

Nominal Anchor Diameter d in.	Installation Torque T_{inst} ft-lbf (N-m)	Minimum Embed. Depth h_{nom} in. (mm)	Min. Edge Distance in. (mm)	Min. End Distance in. (mm)	Direction of Loading	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	20 (27)	2-3/8 (60)	1-3/4 (45)	12 (305)	Perpendicular to wall toward minimum edge	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	40 (54)	2-1/2 (64)	2-1/4 (57)	12 (305)	Any	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	50 (68)	3-3/8 (86)	2-1/4 (57)	12 (305)	Any	1,150 (5.2)	230 (1.0)	1,380 (6.2)	275 (1.2)
		6-1/4 (159)			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 C90. Mortar must be Type N, S or M. 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 INFORMATION

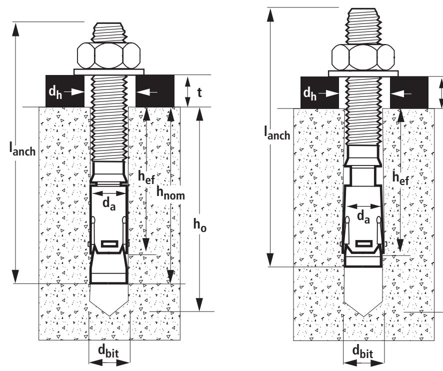
Power-Stud+ SD1 Anchor Installation Specifications in Concrete

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 (d)	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 (ANSI)	d_{bit}	in.	1/4	3/8			1/2				5/8			3/4		7/8	1	1-1/4
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 (178)
Minimum overall anchor length[2,7]	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)	6 (152)	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
Washer O.D.	-	in.	5/8	13/16			1-1/16				1-5/16			1-15/32		1-3/4	2	2-1/2
Anchors Installed in Concrete																		
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]																		
See Figure 2A: Minimum member topping thickness	$h_{min,deck}$	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
See Figure 2A: Minimum edge distance, lower flute	c_{min}	in. (mm)		1-1/4 (32)			1-1/4 (32)				1-1/4 (32)			1-1/4 (32)				
See Figure 2A: Minimum axial spacing distance along flute	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)			
See Figure 2B: Minimum member topping thickness	$h_{min,deck}$	in. (mm)		2-1/4 (57)			2-1/4 (57)				Not Applicable			Not Applicable		Not Applicable	Not Applicable	Not Applicable
See Figure 2B: Minimum edge distance, lower flute	c_{min}	in. (mm)		3/4 (19)			3/4 (19)											
See Figure 2B: Minimum axial spacing distance along flute	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 (-19 or -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.
7. Anchors with the following minimum lengths are also suitable for installations without a fixture or for use with cold-formed steel members provided the thickness of the fixture attachment does not exceed 20 gauge (0.036-inch base metal thickness):
   For 3/8-inch-diameter anchors with a 2-3/8-inch nominal embedment, 2-3/4-inch long anchors.
   For 3/4-inch-diameter anchors with a 4-inch nominal embedment, 4-3/4-inch long anchors.

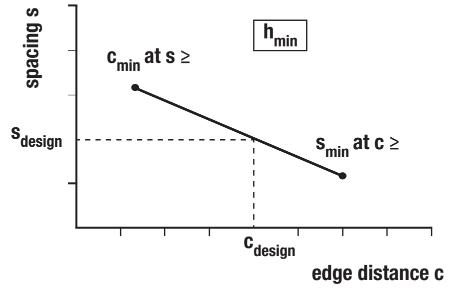
Power-Stud+ SD1 Anchor Detail



Before After

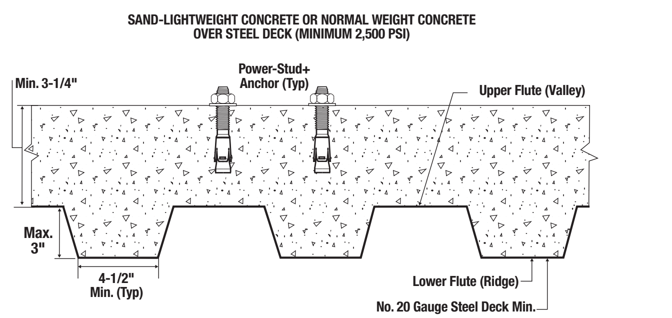
Application of Installation Torque

Interpolation of Minimum Edge Distance and Anchor Spacing



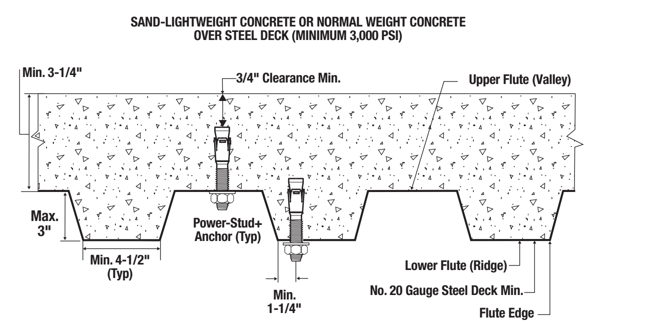
This interpolation applies to the cases when two sets of minimum edge distances, c_{min}, and minimum spacing distances, s_{min}, are given for a selected anchor diameter effective embedment depth, h_{ef}, and corresponding minimum member thickness, h_{min}.

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)



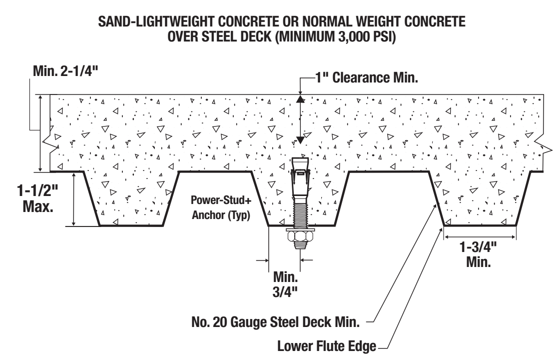
1. Anchors may be placed in the topside of steel deck profiles in accordance with Figure 1 provided the minimum member topping thickness, minimum spacing distance and minimum edge distance are satisfied as given in Installation Specifications.

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)



1. 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.
2. 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)



1. 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.
2. 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.
3. 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

CODE LISTED
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
Nominal embedment depth	h_{nom}	in. (mm)	1-3/4 (44)	1-3/4 (44)	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)
STEEL STRENGTH IN TENSION (ACI 318-19 17.6.1, ACI 318-14 17.4.1 or ACI 318-11 D.5.1)[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 (ACI 318-19 17.6.2, ACI 318-14 17.4.2 or ACI 318-11 D.5.2)[8]													
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]	$\Psi_{c,N}$	-	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 in concrete										
Reduction factor for concrete breakout strength[3]	ϕ	-	0.65 (Condition B)										
PULLOUT STRENGTH IN TENSION (ACI 318-19 17.6.3, ACI 318-14 17.4.3 or ACI 318-11 D.5.3)[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 (ACI 318-19 17.10.3, ACI 318-14 17.2.3.3 or ACI 318-11 D.3.3.3)[8,9]													
Characteristic pullout strength, seismic (2,500 psi)[6,10]	$N_{p,eq}$	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 (-19 or -14) Chapter 17 or ACI 318 -11 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-19 17.10, ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable, 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 (-19 or -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 (-19 or -14) Chapter 17 or ACI 318-11 Appendix D requirements for Condition A, see ACI 318-19 17.5.3, 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 (-19 or -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 (-19 or -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 in the denominator.
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 318-19 17.6.2, 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

CODE LISTED
ICC-ES ESR-2818

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
Nominal embedment depth	h_{nom}	in. (mm)	1-3/4 (44)	1-3/4 (44)	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	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)
STEEL STRENGTH IN SHEAR (ACI 318-19 17.7.1, ACI 318-14 17.5.1 or ACI 318-11 D.6.1)[4]													
Minimum specified yield strength (threads)	f_{ya}	ksi (N/mm²)	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/mm²)	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)	$A_{se,V}$	in² (mm²)	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										
STEEL STRENGTH IN SHEAR FOR SEISMIC APPLICATIONS (ACI 318-19 17.10.1, ACI 318-14 17.2.3.3 or ACI 318-11 D.3.3.3)													
Steel strength in shear, seismic[8]	$V_{sa,eq}$	lb (kN)	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										
CONCRETE BREAKOUT STRENGTH IN SHEAR (ACI 318-19 17.7.2, ACI 318-14 17.5.2 or ACI 318-11 D.6.2)[6,7]													
Load bearing length of anchor	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 (ACI 318-19 17.7.3, ACI 318-14 17.2.3.3 or ACI 318-11 D.6.3)[6,7]													
Coefficient for pryout strength	k_{cp}	-	1.0	1.0	1.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Reduction factor for pryout strength[3]	ϕ	-	0.70 (Condition B)										
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)	Not Applicable	2,120 (9.4)	2,290 (10.2)		3,710 (16.5)		4,570 (20.3)		Not Applicable	Not Applicable	Not Applicable
Steel strength in shear, concrete over steel deck (Figure 2B)[9]	$V_{sa,deck}$	lb (kN)	Not Applicable	2,120 (9.4)	2,785 (12.4)		Not Applicable		Not Applicable		Not Applicable	Not Applicable	Not Applicable
Steel strength in shear, concrete over steel deck, seismic (Figure 2B)[9]	$V_{sa,deck,eq}$	lb (kN)	Not Applicable	2,120 (9.4)	2,785 (12.4)		Not Applicable		Not Applicable		Not Applicable	Not Applicable	Not Applicable
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/mm²; 1 lbf = 0.0044 kN.

1. The data in this table is intended to be used with the design provisions of ACI 318 (-19 or -14) Chapter 17 or ACI 318-11 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-19 17.10, ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable, 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 (-19 or -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 (-19 or -14) Chapter 17 or ACI 318-11 Appendix D requirements for Condition A, see ACI 318-19 17.5.3, 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 byACI 318 (-19 or -14) 2.3 or ACI 318-11 D.1, as applicable.
5. Tabulated values for steel strength in shear must be used for design.
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 318-19 17.7.2, ACI 318-14 17.5.2 or ACI 318-11 D.6.2, as applicable, and the pryout capacity in accordance with ACI 318-19 17.7.3, 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.

DESIGN STRENGTH TABLES (SD)

Tension and Shear Design Strengths for Power-Stud+ SD1 in Cracked Concrete[1,2,3,4,5,6,7]

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.)
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[1,2,3,4,5,6]

Nominal Anchor Diameter (in.)	Nominal Embed. h_{nom} (in.)	Minimum Concrete Compressive Strength									
		f'_c = 2,500 psi		f'_c = 3,000 psi		f'_c = 4,000 psi		f'_c = 6,000 psi		f'_c = 8,000 psi	
		ϕN_n Tension (lbs.)	ϕV_n Shear (lbs.)	ϕN_n Tension (lbs.)	ϕV_n Shear (lbs.)	ϕN_n Tension (lbs.)	ϕV_n Shear (lbs.)	ϕN_n Tension (lbs.)	ϕV_n Shear (lbs.)	ϕN_n Tension (lbs.)	ϕV_n Shear (lbs.)
1/4	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 (-19 or -14) Chapter 17. The load level corresponding to the controlling failure mode is listed. (e.g. For tension: steel, concrete breakout and pullout; For shear: steel, concrete breakout and pryout). Furthermore, the capacities for concrete breakout strength in tension and pryout strength in shear are calculated using the effective embedment values, h_{ef}, for the selected anchors as noted in the design information tables. Please also reference the installation specifications for more information.

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

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

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

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

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

ORDERING INFORMATION

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

Cat. No.	Anchor Size	Approx. Thread Length	Pack Qty.	Carton Qty.	Suggested ANSI Carbide Drill Bit (Cat. No.)				
					Full Head SDS-Plus	SDS-Plus	SDS-Max	Hollow Bit SDS-Plus	Hollow Bit SDS-Max
7400SD1-PWR	1/4" x 1-3/4"	3/4"	100	600	DW5517	DW5416	-	-	-
7402SD1-PWR	1/4" x 2-1/4"	1-1/4"	100	600	DW5517	DW5417	-	-	-
7404SD1-PWR	1/4" x 3-1/4"	2-1/4"	100	600	DW5517	DW5417	-	-	-
7410SD1-PWR	3/8" x 2-1/4"	7/8"	50	300	DW5527	DW5427	-	-	-
7412SD1-PWR	3/8" x 2-3/4"	1-3/8"	50	300	DW5527	DW5427	-	-	-
7413SD1-PWR	3/8" x 3"	1-5/8"	50	300	DW5527	DW5427	-	-	-
7414SD1-PWR	3/8" x 3-1/2"	2-1/8"	50	300	DW5527	DW5427	-	-	-
7415SD1-PWR	3/8" x 3-3/4"	2-3/8"	50	300	DW5527	DW5427	-	-	-
7416SD1-PWR	3/8" x 5"	3-5/8"	50	300	DW55300	DW5429	-	-	-
7417SD1-PWR	3/8" x 7"	5-5/8"	50	300	DW55300	DW5429	-	-	-
7420SD1-PWR	1/2" x 2-3/4"	1"	50	200	DW5537	DW5437	DW5803	DWA54012	-
7422SD1-PWR	1/2" x 3-3/4"	2"	50	200	DW5537	DW5437	DW5803	DWA54012	-
7423SD1-PWR	1/2" x 4-1/2"	2-3/4"	50	200	DW5539	DW5438	DW5803	DWA54012	-
7424SD1-PWR	1/2" x 5-1/2"	3-3/4"	50	150	DW5539	DW5438	DW5803	DWA54012	-
7426SD1-PWR	1/2" x 7"	5-1/4"	25	100	DW5539	DW5438	DW5803	DWA54012	-
7427SD1-PWR	1/2" x 8-1/2"	6-3/4"	25	100	DW5539	DW5439	DW5804	DWA54012	-
7428SD1-PWR	1/2" x 10"	8-1/4"	25	100	DW5539	DW5439	DW5804	DWA54012	-
7430SD1-PWR	5/8" x 3-1/2"	1-1/2"	25	100	-	DW5446	DW5806	DWA54058	DWA54058
7432SD1-PWR	5/8" x 4-1/2"	2-1/2"	25	100	-	DW5446	DW5806	DWA54058	DWA54058
7433SD1-PWR	5/8" x 5"	3"	25	100	-	DW5446	DW5806	DWA54058	DWA54058
7434SD1-PWR	5/8" x 6"	4"	25	75	-	DW5446	DW5806	DWA54058	DWA54058
7436SD1-PWR	5/8" x 7"	5"	25	75	-	DW5447	DW5806	DWA54058	DWA54058
7438SD1-PWR	5/8" x 8-1/2"	6-1/2"	25	50	-	DW5447	DW5809	DWA54058	DWA54058
7439SD1-PWR	5/8" x 10"	8"	25	75	-	DW5447	DW5809	DWA54058	DWA54034
7440SD1-PWR	3/4" x 4-1/4"	1-3/4"	20	60	-	DW5453	DW5810	DWA54034	DWA54034
7441SD1-PWR	3/4" x 4-3/4"	2-1/4"	20	60	-	DW5453	DW5810	DWA54034	DWA54034
7442SD1-PWR	3/4" x 5-1/2"	3"	20	60	-	DW5453	DW5810	DWA54034	DWA54034
7444SD1-PWR	3/4" x 6-1/4"	3-3/4"	20	60	-	DW5455	DW5810	DWA54034	DWA54034
7446SD1-PWR	3/4" x 7"	4-1/2"	20	60	-	DW5455	DW5810	DWA54034	DWA54034
7448SD1-PWR	3/4" x 8-1/2"	6"	10	40	-	DW5455	DW5812	DWA54034	DWA54034
7449SD1-PWR	3/4" x 10"	7-1/2"	10	30	-	DW5455	DW5812	DWA54034	DWA54034
7451SD1-PWR	3/4" x 12"	9-1/2"	10	30	-	DW5456	DW5812	DWA54034	DWA54034
7450SD1-PWR	7/8" x 6"	2-3/4"	10	20	-	-	DW5815	-	DWA54078
7452SD1-PWR	7/8" x 8"	4-3/4"	10	40	-	-	DW5815	-	DWA54078
7454SD1-PWR	7/8" x 10"	6-3/4"	10	30	-	-	DW5816	-	DWA54078
7461SD1-PWR	1" x 6"	2-3/8"	10	30	-	-	DW5818	-	DWA58001
7463SD1-PWR	1" x 9"	5-3/8"	10	30	-	-	DW5819	-	DWA58001
7465SD1-PWR	1" x 12"	8-3/8"	5	15	-	-	DW5819	-	DWA58001
7473SD1-PWR	1-1/4" x 9"	4-3/4"	5	15	-	-	DW5820	-	-
7475SD1-PWR	1-1/4" x 12"	7-3/4"	5	15	-	-	DW5825	-	-

Shaded catalog numbers denote sizes which are less than the minimum standard anchor length for strength design. Anchors not long enough to meet the minimum nominal embedments published for strength design are outside the scope of ICC-ES ESR-2818.

The published size includes the diameter and the overall length of the anchor. Allow for fixture thickness (as applicable) plus one anchor diameter for the nut and washer thickness when selecting a length.

All anchors are packaged with nuts and washers.

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

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

Cat. No.	Anchor Size	Eyelet Hole Size	Pack Qty.	Carton Qty.
7409SD1-PWR	1/4" x 2"	9/32"	100	500

The Tie Wire Power-Stud+ is not listed in ICC-ES ESR-2818.

The minimum nominal embedment is 1-1/8" (see performance data in concrete).

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, 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
- Interior applications / low level corrosion environment
- Tension zone applications, i.e., safety-related attachments
- Seismic and wind loading (SDC A - F)
- Utility supports, e.g. pipe, strut, trapeze, bracing
- Equipment anchorage, angles, brackets and ledgers
- Barriers, guards and fencing
- Mezzanines, racking and railing

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 2021 IBC/IRC, 2018 IBC/IRC, 2015 IBC/IRC, and 2012 IBC/IRC
- Tested in accordance with ACI 355.2/ASTM E488 and ICC-ES AC193 for use in structural concrete under the design provisions of ACI 318 (-19 or -14) Chapter 17 or ACI 318 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)
- City of Los Angeles, LABC and LARC Supplement (within ESR-2502)
- Florida Building Code, FBC Supplement including HVHZ (within ESR-2502)
- FM Approvals (Factory Mutual) – see FM Approval Guide for sizes
- Underwriters Laboratory (UL Listed) – File No. EX1289 and VFXT7.EX1289, see listing for sizes

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 A563, Grade A
Washer	Carbon Steel, ASTM F844; meets dimensional requirements of ANSI B18.22.2. Type A Plain
Expansion wedge (clip)	316 Stainless Steel
Plating (anchor body, nut and washer)	Zinc plating according to ASTM B633, SC1 Type III (Fe/Zn 5) Minimum plating requirements for Mild Service Condition.
See Tension Design Information table for yield and ultimate strengths of the anchor body.	

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" through 3/4" diameters

SUITABLE BASE MATERIALS

- Normal-weight concrete
- 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

DDA DEWALT DESIGN ASSIST

DUST X+ ANCHOR INSTALLATION SYSTEM

INSTALLATION SPECIFICATIONS

Installation Table for Power-Stud+ SD2

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 (ANSI)	d_{bit}	in.	3/8	1/2				5/8			3/4	
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)	6-1/2 (165)	8 (203)	7 (178)	10 (254)
Minimum overall anchor length[3]	ℓ_{anch}	in.	3	3-3/4		4-1/2		4-3/4	6		5-1/2	7
Minimum edge distance[2]	c_{min}	in. (mm)	2-1/2 (64)	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 (89)	6 (152)	6 (152)	4 (102)	6 (152)	4-1/4 (108)	4-1/4 (108)		6 (152)	6 (152)
Critical edge distance[2] (uncracked concrete only)	c_{ac}	in. (mm)	6-1/2 (165)	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	
Washer O.D	-	in.	13/16	1-1/16				1-5/16			1-15/32	

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.
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.

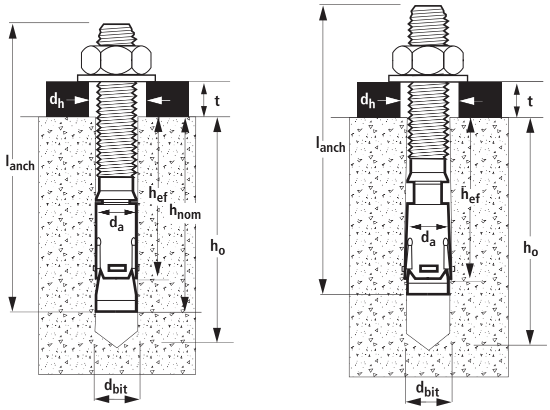
Anchor Setting Information for Installation on the Top of Concrete-Filled Steel Deck Assemblies[3,4]

Anchor Property/ Setting Information	Notation	Units	Nominal Anchor Size (inch)			
			3/8"		1/2"	
Nominal drill bit diameter (ANSI)	d_{bit}	in.	3/8		1/2	
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 for topside of concrete-filled steel deck assemblies with minimum topping thickness (uncracked concrete only)	$c_{ac,deck,top}$	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	
Washer O.D.	-	in.	13/16		1-1/16	

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 Design Information and Shear Design Information tables.

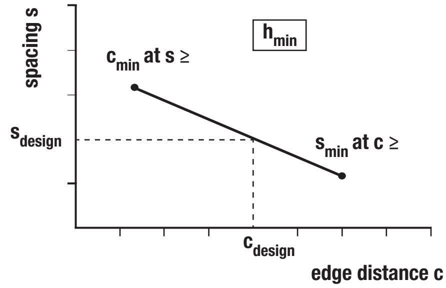
Power-Stud+ SD2 Anchor Detail



Before

After

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 for a selected anchor diameter effective embedment depth, h_{ef}, and corresponding minimum member thickness, h_{min}.

Head Marking

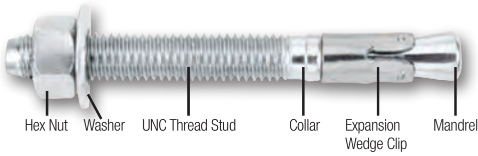
Legend

Letter Code = Length Identification Mark

'+' Symbol = Strength Design Compliant Anchor

Number Code 2 = Carbon Steel Body and Stainless Steel Expansion Clip

Power-Stud+ SD2 Anchor Assembly

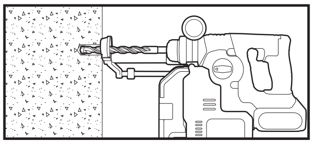


Length Identification

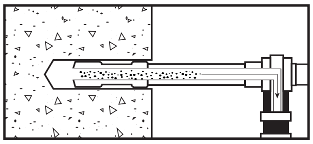
Mark	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
From	1-1/2"	2"	2-1/2"	3"	3-1/2"	4"	4-1/2"	5"	5-1/2"	6"	6-1/2"	7"	7-1/2"	8"	8-1/2"	9"
Up to but not including	2"	2-1/2"	3"	3-1/2"	4"	4-1/2"	5"	5-1/2"	6"	6-1/2"	7"	7-1/2"	8"	8-1/2"	9"	9-1/2"
Length identification mark indicates overall length of anchor.																

INSTALLATION INSTRUCTIONS

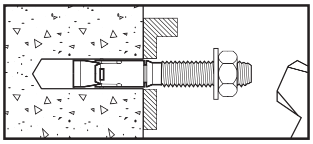
Installation Instructions for Power-Stud+ SD2



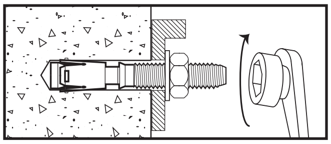
Step 1
Using the proper drill bit size, drill a hole into the base material to the required depth. The tolerances of the drill bit used should meet the requirements of ANSI Standard B212.15.



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.

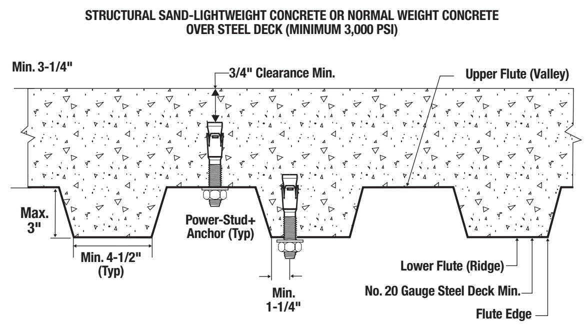


Step 3
Position the washer on the anchor and thread on the nut. If installing through a fixture, drive the anchor through the fixture into the hole. Be sure the anchor is driven to the minimum required embedment depth, h_{nom}.



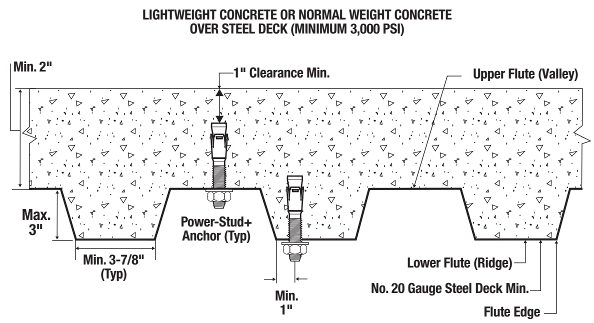
Step 4
Tighten the anchor with a torque wrench by applying the required installation torque, T_{inst}.

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



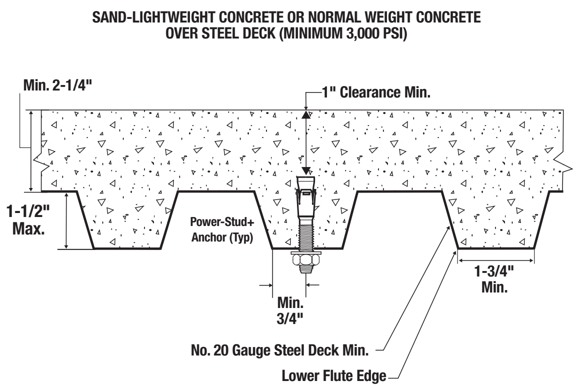
1. Anchors may be placed in the upper flute or lower flute of the steel deck profiles in accordance with installation Detail A provided the minimum hole clearance is satisfied. Anchors in the lower flute of installation Detail A profiles may be installed with a maximum 1-inch offset in either direction 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]



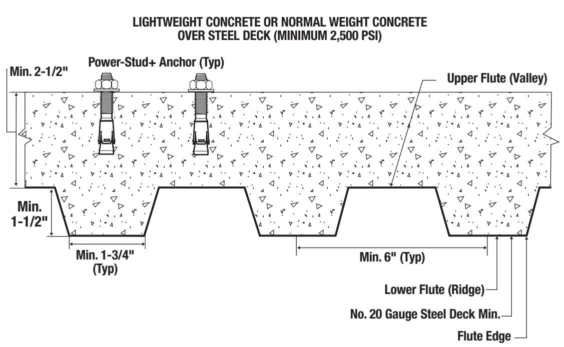
1. Anchors may be placed in the upper flute or lower flute of the steel deck profiles in accordance with Detail B provided the minimum hole clearance is satisfied. Anchors in the lower flute of Detail B profiles may be installed with a maximum 15/16 -inch offset in either direction from the center of 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.

STRENGTH DESIGN INFORMATION

Tension Design Information for Power-Stud+ SD2 in Concrete[1,2,12]

CODE LISTED
ICC-ES ESR-2502

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	
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)	2.00 (51)	2.00 (51)	3.25 (83)	3.25 (83)	4.25 (108)	3.75 (95)	5.00 (127)
STEEL STRENGTH IN TENSION (ACI 318-19 17.6.1, 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 318-19 17.6.2, ACI 318-14 17.4.2 or ACI 318-11 D.5.2)[8]									
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 6	1.0 See note 6		1.0 See note 6		1.0 See note 6	
Critical edge distance (uncracked concrete only)	c_{ac}	in. (mm)	See Installation Table						
Critical edge distance for topside of concrete-filled steel deck assemblies with minimum topping thickness (uncracked concrete only)	$c_{ac,deck,top}$	in. (mm)	See Anchor Setting Information Table for top of concrete-filled steel deck assemblies with minimum topping thickness						
Reduction factor for concrete breakout strength[3]	ϕ	-	0.65 (Condition B)						
PULLOUT STRENGTH IN TENSION (ACI 318-19 17.6.3, ACI 318-14 17.4.3 or ACI 318-11 D.5.3)[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 318-19 17.10.3, 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 (-19 or -14) Chapter 17 or ACI 318 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-19 17.10, ACI 318-14 17.2.3 or ACI 318 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 (-19 or -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 (-19 or -14) Chapter 17 or ACI 318 Appendix D, as applicable, requirements for Condition A, see ACI 318-19 17.5.3, 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 (-19 or -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 (-19 or -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 in the denominator.
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 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 for Power-Stud+ SD2 in Concrete[1,2,8]

CODE LISTED ICC-ES ESR-2502

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	
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)	2.00 (51)	2.00 (51)	3.25 (83)	3.25 (83)	4.25 (108)	3.75 (95)	5.00 (127)
STEEL STRENGTH IN SHEAR (ACI 318-19 17.7.1, ACI 318-14 17.5.1 or ACI 318-11 D.6.1)[4]									
Minimum specified yield strength (threads)	f_y	psi (N/mm²)	76,800 (530)	68,000 (469)		68,000 (469)		56,000 (386)	
Minimum specified ultimate tensile strength (threads)	f_{uta}	psi (N/mm²)	100,000 (690)	88,000 (607)		88,000 (607)		80,000 (551)	
Effective tensile stress area (threads)	$A_{se,V}$	in² (mm²)	0.0775 (50.0)	0.1419 (91.6)		0.2260 (145.8)		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						
STEEL STRENGTH IN SHEAR FOR SEISMIC APPLICATIONS (ACI 318-19 17.10.1, ACI 318-14 17.2.3.3 or ACI 318-11 D.3.3.3)									
Steel strength in shear, seismic[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 steel strength, seismic[3]	ϕ	-	0.65 (Condition B)						
CONCRETE BREAKOUT STRENGTH IN SHEAR (ACI 318-19 17.7.2, ACI 318-14 17.5.2 or ACI 318-11 D.6.2)[6]									
Load bearing length of anchor	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 318-19 17.7.3, ACI 318-14 17.5.3 or ACI 318-11 D.6.3)[6]									
Coefficient for pryout strength	k_{cp}	-	1.0	1.0	2.0	2.0	2.0	2.0	2.0
Reduction factor for pryout strength[3]	ϕ	-	0.70 (Condition B)						

1. The data in this table is intended to be used with the design provisions of ACI 318 (-19 or -14) Chapter 17 or ACI 318 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-19 17.10, ACI 318-14 17.2.3 or ACI 318 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 (-19 or -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 (-19 or -14) Chapter 17 or ACI 318-11 Appendix D, as applicable, requirements for Condition A, see ACI 318-19 17.5.3, 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 (-19 or -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 (-19 or -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.

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

CODE LISTED ICC-ES ESR-2502

STRENGTH DESIGN TABLES

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
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)
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 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]	$N_{p,deck,cr}$ ($N_{p,deck,eq}$)	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]	$N_{p,deck,cr}$ ($N_{p,deck,eq}$)	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]	$N_{p,deck,cr}$ ($N_{p,deck,eq}$)	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 318-19 17.6.2, 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 318-19 17.7.2, ACI 318-14 17.5.2 or ACI 318 D.6.2, as applicable and the pryout capacity in accordance with ACI 318-19 17.7.3, 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 (-19 or -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.

DESIGN STRENGTH TABLES (SD)

Tension and Shear Design Strengths for Power-Stud+ SD2 in Cracked Concrete[1,2,3,4,5,6,7,8]

Nominal Anchor Diameter (in.)	Nominal Embed. h_{nom} (in.)	Minimum Concrete Compressive Strength									
		f'c = 2,500 psi		f'c = 3,000 psi		f'c = 4,000 psi		f'c = 6,000 psi		f'c = 8,000 psi	
		ϕNn Tension (lbs.)	ϕVn Shear (lbs.)	ϕNn Tension (lbs.)	ϕVn Shear (lbs.)	ϕNn Tension (lbs.)	ϕVn Shear (lbs.)	ϕNn Tension (lbs.)	ϕVn Shear (lbs.)	ϕNn Tension (lbs.)	ϕVn Shear (lbs.)
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[1,2,3,4,5,6,7]

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

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

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

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

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

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

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

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

PERFORMANCE DATA (ASD)

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 Strength Tables and conditions shown previously.
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.

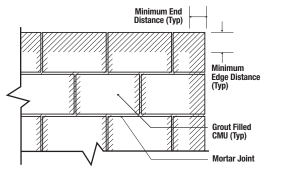
Converted Allowable Loads for Power-Stud+ SD2 in Uncracked Concrete[1,2]

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 Strength Tables and conditions shown previously.
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.	Installation Torque T_{inst} ft.-lb. (N-m)	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	20 (27)	2-1/2 (51)	Wall Face or 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	40 (54)	2-1/2 (51)	Wall Face or 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)	Top of Wall Min. 1-3/4" Edge and 4" End Distances	3,320 (14.8)	665 (3.0)	1,140 (5.1)	230 (1.0)



Wall Face Permissible Anchor Locations
(Un-hatched Area)

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 C90. Mortar must be Type N, S or M. 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. The tabulated values are for anchors installed at a minimum of 16 anchor diameters on center for 100 percent capacity.

ORDERING INFORMATION

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

Cat. No.	Anchor Size	Approx. Thread Length	Pack Qty.	Carton Qty.	Suggested ANSI Carbide Drill Bit Cat. No.				
					Full Head SDS-Plus	SDS-Plus	SDS-Max	Hollow Bit SDS-Plus	Hollow Bit SDS-Max
7413SD2-PWR	3/8" x 3"	1-3/4"	50	300	DW5527	DW5427	-	-	-
7414SD2-PWR	3/8" x 3-1/2"	2-1/4"	50	300	DW5527	DW5427	-	-	-
7415SD2-PWR	3/8" x 3-3/4"	2-1/2"	50	300	DW5527	DW5427	-	-	-
7416SD2-PWR	3/8" x 5"	3-3/4"	50	300	DW55300	DW5429	-	-	-
7422SD2-PWR	1/2" x 3-3/4"	2-1/8"	50	200	DW5537	DW5437	DW5803	DWA54012	-
7423SD2-PWR	1/2" x 4-1/2"	2-7/8"	50	200	DW5539	DW5438	DW5803	DWA54012	-
7424SD2-PWR	1/2" x 5-1/2"	3-7/8"	50	150	DW5539	DW5438	DW5803	DWA54012	-
7426SD2-PWR	1/2" x 7"	5-3/8"	25	100	DW5539	DW5438	DW5803	DWA54012	-
7427SD2-PWR	1/2" x 8-1/2"	6-7/8"	25	100	DW5539	DW5439	DW5804	DWA54012	-
7435SD2-PWR	5/8" x 4-3/4"	2-7/8"	25	100	-	DW5446	DW5806	DWA54058	DWA58058
7433SD2-PWR	5/8" x 5"	3-1/8"	25	50	-	DW5446	DW5806	DWA54058	DWA58001
7434SD2-PWR	5/8" x 6"	4-1/8"	25	75	-	DW5446	DW5806	DWA54058	DWA58001
7436SD2-PWR	5/8" x 7"	5-1/8"	25	75	-	DW5447	DW5806	DWA54058	DWA58001
7438SD2-PWR	5/8" x 8-1/2"	6-5/8"	25	75	-	DW5447	DW5809	DWA54058	DWA58001
7442SD2-PWR	3/4" x 5-1/2"	3-1/4"	20	60	-	DW5453	DW5810	DWA54074	DWA58034
7444SD2-PWR	3/4" x 6-1/4"	4"	20	60	-	DW5455	DW5810	DWA54074	DWA58034
7446SD2-PWR	3/4" x 7"	4-3/4"	20	60	-	DW5455	DW5810	DWA54074	DWA58034
7448SD2-PWR	3/4" x 8-1/2"	6-1/4"	10	40	-	DW5455	DW5812	DWA54074	DWA58034

The published size includes the diameter and the overall length of the anchor.
Allow for fixture thickness (as applicable) plus one anchor diameter for the nut and washer thickness when selecting a length.
All anchors are packaged with nuts and washers.
Hollow drill bits must be used with a dust extraction vacuum (e.g. Cat. No. DW012).

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 include normal-weight, 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
- Tension zone applications, i.e., safety-related attachments
- Seismic and wind loading (SDC A - F)
- Utility supports and bracing attachments
- Equipment anchorage, angles, brackets and ledgers
- Barriers, guards and fencing
- Mezzanines, racking and railing

FEATURES AND BENEFITS

+ Knurled mandrel provides consistent performance in cracked and uncracked concrete
+ Mandrel design 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
+ Domestically manufactured by request (see ordering information)

APPROVALS AND LISTINGS

- International Code Council Evaluation Service (ICC-ES), ESR-2502 for cracked and uncracked concrete
- Code compliant with the 2021 IBC/IRC, 2018 IBC/IRC, 2015 IBC/IRC, and 2012 IBC/IRC
- Tested in accordance with ACI 355.2/ASTM E488 and ICC-ES AC193 for use in structural concrete under the design provisions of ACI 318 (-19 or -14) Chapter 17 or ACI 318-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)
- City of Los Angeles, LABC and LARC Supplement (within ESR-2502)
- Florida Building Code, FBC Supplement including HVHZ (within ESR-2502)

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+ S4/SD6
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" through 3/4" diameters

SUITABLE BASE MATERIALS

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

TENSION ZONE CRACKED CONCRETE
SEISMIC REGION QUALIFICATION
CODE LISTED ICC-ES ESR-2502 CONCRETE
DDA DEWALT DESIGN ASSIST™
DUSTX+™ ANCHOR INSTALLATION SYSTEM

MATERIAL SPECIFICATIONS

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

See Tension Design Information table for yield and ultimate strengths of the anchor body).
1. Domestically manufactured anchors can be made available upon request (see ordering information).

INSTALLATION SPECIFICATIONS

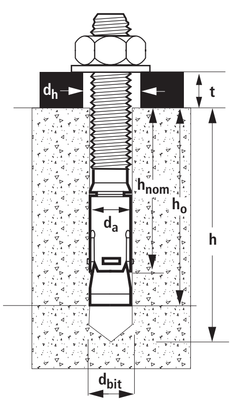
Installation Specifications Table for Power-Stud+ SD4 and Power-Stud+ SD6 in Concrete

Anchor Property/Setting Information	Notation	Units	Nominal Anchor Diameter (inch)				
			1/4	3/8	1/2	5/8	3/4
Anchor outside diameter	d_a (d)	in. (mm)	0.250 (6.4)	0.375 (9.5)	0.500 (12.7)	0.625 (15.9)	0.750 (19.1)
Thread Size (UNC)	-	in.	1/4-20	3/8-16	1/2-13	5/8-11	3/4-10
Nominal drill bit diameter (ANSI)	d_{bit}	in.	1/4	3/8	1/2	5/8	3/4
Minimum diameter of hole clearance in fixture	d_h	in. (mm)	5/16 (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.	h_{nom} + 1/8			h_{nom} + 1/4	
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
Washer O.D.	-	in.	5/8	13/16	1-1/16	1-5/16	1-15/32

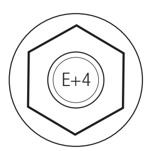
See Strength Design Information for installation specifications in strict accordance with ICC-ES ESR-2502.

1. The minimum base material thickness should be 1.5hnom or 3", whichever is greater.
2. See Performance Data tables for additional embedment depths.

Anchor Detail



Head Marking



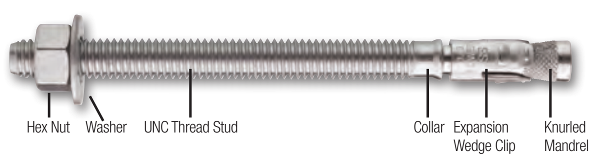
Legend

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



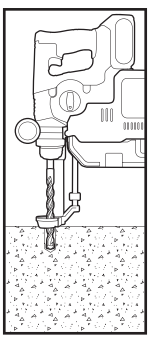
Length Identification

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"

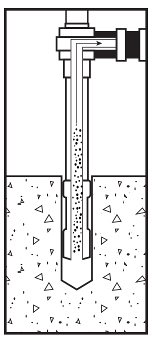
Length identification mark indicates overall length of anchor.

INSTALLATION INSTRUCTIONS

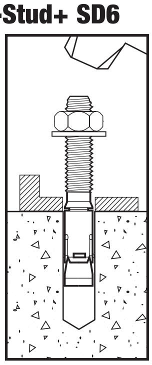
Installation Instructions for Power-Stud+ SD4 and Power-Stud+ SD6



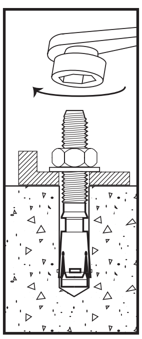
Step 1
Using the proper drill bit size, drill a hole into the base material to the required depth. The tolerances of the drill bit used should meet the requirements of ANSI Standard B212.15.



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}.

PERFORMANCE DATA (ASD)

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[1,2,3,4,5]

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.
5. For lightweight concrete multiply tabulated allowable load values by a reduction factor of 0.60.

Spacing Distance and Edge Distance Adjustment Factors for Normal Weight Concrete

Spacing Reduction Factors - Tension (F_{NS})

	Diameter (in)	1/4	1/4	3/8	3/8	3/8	1/2	1/2	1/2	5/8	5/8	5/8	3/4	3/4	3/4
	Nominal Embed. h_{nom} (in)	1-1/8	1-3/4	1-3/8	1-7/8	3	1-7/8	2-3/8	3-3/4	2-1/2	3-1/4	4-3/4	3-3/8	4-1/2	5-5/8
	Minimum Spacing, s_{min} (in)	1-1/2	2	2-1/4	3	3	3	3	3	3-3/4	5	5	4-1/2	5	5
Spacing Distance (inches)	1-1/2	0.85	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	0.92	0.79	-	-	-	-	-	-	-	-	-	-	-	-
	2-1/4	0.95	0.81	0.91	-	-	-	-	-	-	-	-	-	-	-
	2-1/2	0.98	0.83	0.94	-	-	-	-	-	-	-	-	-	-	-
	2-3/4	1.00	0.85	0.97	-	-	-	-	-	-	-	-	-	-	-
	3	1.00	0.87	1.00	0.87	0.78	0.88	0.82	0.75	-	-	-	-	-	-
	3-1/2	1.00	0.91	1.00	0.91	0.80	0.92	0.85	0.77	-	-	-	-	-	-
	4	1.00	0.96	1.00	0.96	0.83	0.96	0.88	0.79	0.88	-	-	-	-	-
	4-1/2	1.00	1.00	1.00	1.00	0.85	1.00	0.91	0.80	0.91	-	-	0.85	-	-
	5	1.00	1.00	1.00	1.00	0.87	1.00	0.94	0.82	0.94	0.85	0.79	0.87	0.76	0.77
	5-1/2	1.00	1.00	1.00	1.00	0.89	1.00	0.97	0.84	0.97	0.87	0.80	0.89	0.78	0.78
	6	1.00	1.00	1.00	1.00	0.92	1.00	1.00	0.86	1.00	0.90	0.81	0.92	0.80	0.79
	6-1/2	1.00	1.00	1.00	1.00	0.94	1.00	1.00	0.87	1.00	0.92	0.83	0.94	0.82	0.80
	7	1.00	1.00	1.00	1.00	0.96	1.00	1.00	0.89	1.00	0.94	0.84	0.96	0.84	0.82
	7-1/2	1.00	1.00	1.00	1.00	0.98	1.00	1.00	0.91	1.00	0.97	0.85	0.98	0.86	0.83
	8	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.93	1.00	0.99	0.87	1.00	0.87	0.84
	8-1/4	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.93	1.00	1.00	0.88	1.00	0.88	0.85
	8-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.94	1.00	1.00	0.88	1.00	0.89	0.85
	9	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96	1.00	1.00	0.90	1.00	0.91	0.86
	9-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	1.00	1.00	0.91	1.00	0.93	0.88
	10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.92	1.00	0.95	0.89
	11	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	0.99	0.91
	12	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	0.94
	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	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	0.98
	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

Spacing Reduction Factors - Shear (F_{VS})

	Diameter (in)	1/4	1/4	3/8	3/8	3/8	1/2	1/2	1/2	5/8	5/8	5/8	3/4	3/4	3/4
	Nominal Embed. h_{nom} (in)	1-1/8	1-3/4	1-3/8	1-7/8	3	1-7/8	2-3/8	3-3/4	2-1/2	3-1/4	4-3/4	3-3/8	4-1/2	5-5/8
	Minimum Spacing, s_{min} (in)	1-1/2	2	2-1/4	3	3	3	3	3	3-3/4	5	5	4-1/2	5	5
Spacing Distance (inches)	1 1/2	0.91	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	0.95	0.87	-	-	-	-	-	-	-	-	-	-	-	-
	2 1/4	0.97	0.88	0.95	-	-	-	-	-	-	-	-	-	-	-
	2 1/2	0.99	0.90	0.97	-	-	-	-	-	-	-	-	-	-	-
	2 3/4	1.00	0.91	0.98	-	-	-	-	-	-	-	-	-	-	-
	3	1.00	0.92	1.00	0.92	0.88	0.93	0.89	0.86	-	-	-	-	-	-
	3 1/2	1.00	0.95	1.00	0.95	0.89	0.96	0.91	0.87	-	-	-	-	-	-
	4	1.00	0.97	1.00	0.97	0.90	0.98	0.93	0.88	0.93	-	-	-	-	-
	4 1/2	1.00	1.00	1.00	1.00	0.91	1.00	0.95	0.89	0.95	-	-	0.91	-	-
	5	1.00	1.00	1.00	1.00	0.93	1.00	0.96	0.90	0.97	0.91	0.88	0.93	0.84	0.87
	5 1/2	1.00	1.00	1.00	1.00	0.94	1.00	0.98	0.91	0.98	0.93	0.89	0.94	0.85	0.88
	6	1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.92	1.00	0.94	0.89	0.95	0.86	0.88
	6 1/2	1.00	1.00	1.00	1.00	0.97	1.00	1.00	0.93	1.00	0.95	0.90	0.97	0.88	0.89
	7	1.00	1.00	1.00	1.00	0.98	1.00	1.00	0.94	1.00	0.97	0.91	0.98	0.89	0.90
	7 1/2	1.00	1.00	1.00	1.00	0.99	1.00	1.00	0.95	1.00	0.98	0.92	0.99	0.90	0.90
	8	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96	1.00	0.99	0.93	1.00	0.92	0.91
	8 1/4	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96	1.00	1.00	0.93	1.00	0.92	0.91
	8 1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97	1.00	1.00	0.93	1.00	0.93	0.92
	9	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	1.00	1.00	0.94	1.00	0.94	0.92
	9 1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00	1.00	0.95	1.00	0.95	0.93
	10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96	1.00	0.97	0.94
	10 1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96	1.00	0.98	0.94
	11	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97	1.00	0.99	0.95
	12	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	0.96
	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	0.98
	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	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

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

	Diameter (in)	1/4	1/4	3/8	3/8	3/8	1/2	1/2	1/2	5/8	5/8	5/8	3/4	3/4	3/4
	Nominal Embed. h_{nom} (in)	1-1/8	1-3/4	1-3/8	1-7/8	3	1-7/8	2-3/8	3-3/4	2-1/2	3-1/4	4-3/4	3-3/8	4-1/2	5-5/8
	Min. Edge Distance, c_{min} (in)	2	1-3/4	3-	3	3	4	3	4	5	4-1/2	5	6	5	6
Edge Distance (inches)	1-3/4	-	0.35	-	-	-	-	-	-	-	-	-	-	-	-
	2	0.57	0.40	-	-	-	-	-	-	-	-	-	-	-	-
	2-1/4	0.64	0.45	-	-	-	-	-	-	-	-	-	-	-	-
	2-1/2	0.71	0.50	-	-	-	-	-	-	-	-	-	-	-	-
	2-3/4	0.79	0.55	-	-	-	-	-	-	-	-	-	-	-	-
	3	0.86	0.60	0.75	0.60	0.29	-	0.40	-	-	-	-	-	-	-
	3-1/2	1.00	0.70	0.88	0.70	0.33	-	0.47	-	-	-	-	-	-	-
	4	1.00	0.80	1.00	0.80	0.38	0.67	0.53	0.30	-	-	-	-	-	-
	4-1/2	1.00	0.90	1.00	0.90	0.43	0.75	0.60	0.33	-	0.47	-	-	-	-
	5	1.00	1.00	1.00	1.00	0.48	0.83	0.67	0.37	0.63	0.53	0.29	-	0.56	-
	5-1/2	1.00	1.00	1.00	1.00	0.52	0.92	0.73	0.41	0.69	0.58	0.32	-	0.61	-
	6	1.00	1.00	1.00	1.00	0.57	1.00	0.80	0.44	0.75	0.63	0.35	0.57	0.67	0.31
	6-1/2	1.00	1.00	1.00	1.00	0.62	1.00	0.87	0.48	0.81	0.68	0.38	0.62	0.72	0.33
	7	1.00	1.00	1.00	1.00	0.67	1.00	0.93	0.52	0.88	0.74	0.41	0.67	0.78	0.36
	7-1/2	1.00	1.00	1.00	1.00	0.71	1.00	1.00	0.56	0.94	0.79	0.44	0.71	0.83	0.38
	8	1.00	1.00	1.00	1.00	0.76	1.00	1.00	0.59	1.00	0.84	0.47	0.76	0.89	0.41
	8-1/2	1.00	1.00	1.00	1.00	0.81	1.00	1.00	0.63	1.00	0.89	0.50	0.81	0.94	0.44
	9	1.00	1.00	1.00	1.00	0.86	1.00	1.00	0.67	1.00	0.95	0.53	0.86	1.00	0.46
	9-1/2	1.00	1.00	1.00	1.00	0.90	1.00	1.00	0.70	1.00	1.00	0.56	0.90	1.00	0.49
	10	1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.74	1.00	1.00	0.59	0.95	1.00	0.51
	10-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.78	1.00	1.00	0.62	1.00	1.00	0.54
	11	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.81	1.00	1.00	0.65	1.00	1.00	0.56
	12	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.89	1.00	1.00	0.71	1.00	1.00	0.62
	13	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96	1.00	1.00	0.76	1.00	1.00	0.67
	14	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.82	1.00	1.00	0.72
	15	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	0.77
	16	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.94	1.00	1.00	0.82
	17	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	0.87
	18	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	0.92
	19	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	0.97
	19-1/2	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

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

	Diameter (in)	1/4	1/4	3/8	3/8	3/8	1/2	1/2	1/2	5/8	5/8	5/8	3/4	3/4	3/4
	Nominal Embed. h_{nom} (in)	1-1/8	1-3/4	1-3/8	1-7/8	3	1-7/8	2-3/8	3-3/4	2-1/2	3-1/4	4-3/4	3-3/8	4-1/2	5-5/8
	Min. Edge Distance, c_{min} (in)	2	1-3/4	3-	3	3	4	3	4	5	4-1/2	5	6	5	6
Edge Distance (inches)	1-3/4	-	0.39	-	-	-	-	-	-	-	-	-	-	-	-
	2	0.76	0.44	-	-	-	-	-	-	-	-	-	-	-	-
	2-1/4	0.86	0.50	-	-	-	-	-	-	-	-	-	-	-	-
	2-1/2	0.95	0.56	-	-	-	-	-	-	-	-	-	-	-	-
	2-3/4	1.00	0.61	-	-	-	-	-	-	-	-	-	-	-	-
	3	1.00	0.67	1.00	0.67	0.38	-	0.50	-	-	-	-	-	-	-
	3-1/2	1.00	0.78	1.00	0.78	0.44	-	0.58	-	-	-	-	-	-	-
	4	1.00	0.89	1.00	0.89	0.51	0.89	0.67	0.40	-	-	-	-	-	-
	4-1/2	1.00	1.00	1.00	1.00	0.57	1.00	0.75	0.44	-	0.55	-	-	-	-
	5	1.00	1.00	1.00	1.00	0.63	1.00	0.83	0.49	0.83	0.61	0.39	-	0.44	-
	5-1/2	1.00	1.00	1.00	1.00	0.70	1.00	0.92	0.54	0.92	0.67	0.43	-	0.49	-
	6	1.00	1.00	1.00	1.00	0.76	1.00	1.00	0.59	1.00	0.73	0.47	0.76	0.53	0.41
	6-1/2	1.00	1.00	1.00	1.00	0.83	1.00	1.00	0.64	1.00	0.79	0.51	0.83	0.58	0.44
	7	1.00	1.00	1.00	1.00	0.89	1.00	1.00	0.69	1.00	0.85	0.55	0.89	0.62	0.48
	7-1/2	1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.74	1.00	0.91	0.59	0.95	0.67	0.51
	8	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.79	1.00	0.97	0.63	1.00	0.71	0.55
	8-1/4	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.81	1.00	1.00	0.65	1.00	0.73	0.56
	8-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.84	1.00	1.00	0.67	1.00	0.76	0.58
	9	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.89	1.00	1.00	0.71	1.00	0.80	0.62
	9-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.94	1.00	1.00	0.75	1.00	0.84	0.65
	10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00	1.00	0.78	1.00	0.89	0.68
	10-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.82	1.00	0.93	0.72
	11	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.86	1.00	0.98	0.75
	11-1/4	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	0.77
	12	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.94	1.00	1.00	0.82
	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	0.89
	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	0.96
	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

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

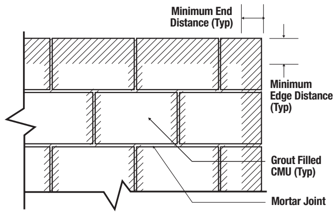
Nominal Anchor Diameter in.	Installation Torque, T_{inst} ft-lbf (N-m)	Minimum Embedment h_{nom} in. (mm)	Minimum Edge Distance in. (mm)	Minimum End Distance in. (mm)	Ultimate Tension Load lb (kN)	Direction of Shear Loading	Ultimate Shear Load lb (kN)
1/2	25 (34)	2-3/8 (60)	3 (76)	3 (76)	1,695 (7.5)	Any	2,080 (9.3)
			12 (305)	12 (305)	2,425 (10.8)	Any	4,905 (21.8)
		3-5/8 (92)	12 (305)	12 (305)	7,305 (32.5)	Any	9,315 (41.4)
5/8	40 (54)	3-1/4 (83)	12 (305)	12 (305)	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 C90. Mortar must be Type N, S or M. 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]

Nominal Anchor Diameter in.	Installation Torque, T_{inst} ft-lbf (N-m)	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	25 (34)	2-3/8 (60)	3 (76)	3 (76)	340 (1.5)	Any	415 (1.8)
			12 (305)	12 (305)	485 (2.2)	Any	980 (4.4)
		3-5/8 (92)	12 (305)	12 (305)	1,460 (6.5)	Any	1,865 (8.3)
5/8	40 (54)	3-1/4 (83)	12 (305)	12 (305)	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 C90. Mortar must be Type N, S or M. 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 INFORMATION

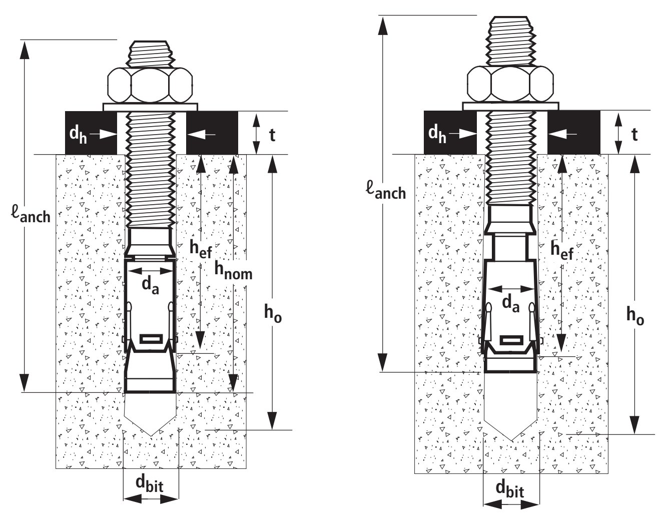
Installation Table for Power-Stud+ SD4 and Power-Stud+ SD6[1,4]

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)	
Thread Size (UNC)	-	in.	1/4-20	3/8-16		1/2-13		5/8-11		3/4-10	
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 (ANSI)	d_{bit}	in.	1/4	3/8		1/2		5/8		3/4	
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.	2-1/4	2-3/4		3-3/4		4-1/2		5-1/2	
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)
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	
Washer O.D.	-	in.	5/8	13/16		1-1/16		1-5/16		1-15/16	

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

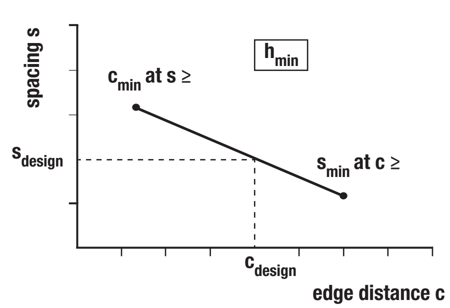
1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318 (-19 or -14) Chapter 17 or ACI 318-11 Appendix D, as applicable.
2. The embedment depth, h_{nom}, is measured from the outside surface of the concrete member to the embedded end of the anchor prior 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

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 for a selected anchor diameter effective embedment depth, h_{ef}, and corresponding minimum member thickness, h_{min}.

Tension Design Information for Power-Stud+ SD4 and Power-Stud+ SD6 Anchors in Concrete[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
Effective embedment	h_{ef}	in. (mm)	1.50 (38)	1.50 (38)	2.00 (51)	2.75 (70)	3.75 (95)
STEEL STRENGTH IN TENSION (ACI 318-19 17.6.1, ACI 318-14 17.4.1 or ACI 318-11 D.5.1)							
Minimum specified yield strength (neck	f_y	psi (N/mm^2)	60,000 (414)	60,000 (414)	60,000 (414)	60,000 (414)	60,000 (414)
Minimum specified ultimate tensile strength (neck)	f_{uta}	psi (N/mm^2)	90,000 (621)	90,000 (621)	90,000 (621)	90,000 (621)	90,000 (621)
Effective tensile stress area (neck)	$A_{se,N}$	in^2 (mm^2)	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 318-19 17.6.2, ACI 318-14 17.4.2 or ACI 318-11 D.5.2)[8]							
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 318-19 17.6.3, 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 318-19 17.10.3, 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[10] – 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)
Mean axial stiffnes values for service load range[10] – 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/mm^2; 1 lb = 0.0044 kN.

1. The data in this table is intended to be used with the design provisions of ACI 318 (-19 or -14) Chapter 17 or ACI 318-11 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-19 17.10, ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable, shall apply.
2. The tabulated value of ϕ for steel strength applies when the load combinations of Section 1605.2 of the IBC, ACI 318 (-19 or -14) Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ for steel strength must be determined in accordance with ACI 318-11 D.4.4.
3. The anchors are ductile steel elements as defined in ACI 318 (-19 or -14) 2.3 or ACI 318-11 D.1, as applicable.
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 (-19 or -14) Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used and the requirements of ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, for Condition B are satisfied. If the load combinations of Section 1605.2 of the IBC, ACI 318 (-19 or -14) Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used and the requirements of ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, for Condition A are satisfied, the appropriate value of ϕ for concrete breakout strength and pullout strength must be determined in accordance with ACI 318-19 17.5.3, 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[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
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)
STEEL STRENGTH IN SHEAR (ACI 318-19 17.7.1, 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				
STEEL STRENGTH IN SHEAR FOR SEISMIC APPLICATIONS (ACI 318-19 17.10.1, ACI 318-14 17.2.3.3 or ACI 318-11 D.3.3.3)							
Steel strength in shear, seismic[8]	$V_{sa,eq}$	lb (kN)	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				
CONCRETE BREAKOUT STRENGTH IN SHEAR (ACI 318-19 17.7.2, ACI 318-14 17.5.2 or ACI 318-11 D.6.2)							
Load bearing length of anchor	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 318-19 17.7.3, ACI 318-14 17.2.3.3 or ACI 318-11 D.6.3)							
Coefficient for pryout strength	k_{cp}	-	1.0	1.0	1.0	2.0	2.0
Reduction factor for pryout strength[5]	ϕ	-	0.70 (Condition B)				

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 (-19 or -14) Chapter or ACI 318-11 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-19 17.10, ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable, shall apply.
2. The tabulated value of ϕ for steel strength applies when the load combinations of Section 1605.2 of the IBC, ACI 318 (-19 or -14) Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ for steel strength must be determined in accordance with ACI 318-11 D.4.4.
3. The anchors are ductile steel elements as defined in ACI 318 (-19 or -14) 2.3 or ACI 318-11 D.1, as applicable.
4. The tabulated value of ϕ for concrete breakout strength applies when both the load combinations of Section 1605.2 of the IBC, ACI 318 (-19 or -14) Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used and the requirements of ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, 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 318-19 17.5.3, 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 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ for concrete breakout strength must be determined in accordance with ACI 318-11 D.4.4.
5. The tabulated value of for pryout strength applies if the load combinations of Section 1605.2 of the IBC, ACI 318 (-19 or -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.

DESIGN STRENGTH TABLES (SD)

Tension and Shear Design Strengths Installed in Cracked Concrete[1,2,3,4,5,6,7,8]

Nominal Anchor Diameter (in.)	Nominal Embed. h_{nom} (in.)	Minimum Concrete Compressive Strength									
		f'c = 2,500 psi		f'c = 3,000 psi		f'c = 4,000 psi		f'c = 6,000 psi		f'c = 8,000 psi	
		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.)
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[1,2,3,4,5,6,7]

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

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

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

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

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

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

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

ORDERING INFORMATION

Power-Stud+ SD4 (Type 304 Stainless Steel Body) and Power-Stud+ SD6 (Type 316 Stainless Steel Body)

Cat. No.				Anchor Size	Approx. Thread Length	Pack Qty.	Ctn. Qty.	Suggested ANSI Carbide Drill Bit Cat. No.				
Type 304 SS		Type 316 SS						Full Head SDS-Plus	SDS-Plus	SDS-Max	Hollow Bit SDS-Plus	Hollow Bit SDS-Max
Standard	Domestic	Standard	Domestic									
7300SD4-PWR	-	7600SD6-PWR	-	1/4" x 1-3/4"	3/4"	100	600	DW5517	DW5416	-	-	-
7302SD4-PWR	-	7602SD6-PWR	-	1/4" x 2-1/4"	1-1/4"	100	600	DW5517	DW5417	-	-	-
7304SD4-PWR	7304SD4USA-PWR	7604SD6-PWR	7604SD6USA-PWR	1/4" x 3-1/4"	2-1/4"	100	600	DW5517	DW5417	-	-	-
-	7310SD4USA-PWR	7610SD6-PWR	7610SD6USA-PWR	3/8" x 2-1/4"	7/8"	50	300	DW5527	DW5427	-	-	-
-	7312SD4USA-PWR	7612SD6-PWR	7612SD6USA-PWR	3/8" x 2-3/4"	1-3/8"	50	300	DW5527	DW5427	-	-	-
7313SD4-PWR	7313SD4USA-PWR	7613SD6-PWR	7613SD6USA-PWR	3/8" x 3"	1-5/8"	50	300	DW5527	DW5427	-		
-	7314SD4USA-PWR	7614SD6-PWR	7614SD6USA-PWR	3/8" x 3-1/2"	2-1/8"	50	300	DW5527	DW5427	-	-	-
7315SD4-PWR	7315SD4USA-PWR	7615SD6-PWR	7615SD6USA-PWR	3/8" x 3-3/4"	2-3/8"	50	300	DW5527	DW5427	-	-	-
7316SD4-PWR	7316SD4USA-PWR	7616SD6-PWR	7616SD6USA-PWR	3/8" x 5"	3-5/8"	50	300	DW55300	DW5429	-	-	-
-	7317SD4USA-PWR	7617SD6-PWR	7617SD6USA-PWR	3/8" x 7"	5-5/8"	50	200	DW55300	DW5429	-	-	-
-	7320SD4USA-PWR	7620SD6-PWR	7620SD6USA-PWR	1/2" x 2-3/4"	1"	50	200	DW5537	DW5437	DW5803	DWA54012	-
7322SD4-PWR	7322SD4USA-PWR	7622SD6-PWR	7622SD6USA-PWR	1/2" x 3-3/4"	2"	50	200	DW5537	DW5437	DW5803	DWA54012	-
7323SD4-PWR	7323SD4USA-PWR	7623SD6-PWR	7623SD6USA-PWR	1/2" x 4-1/2"	2-3/4"	50	200	DW5539	DW5438	DW5803	DWA54012	-
7324SD4-PWR	7324SD4USA-PWR	7624SD6-PWR	7624SD6USA-PWR	1/2" x 5-1/2"	3-3/4"	50	150	DW5539	DW5438	DW5803	DWA54012	-
7326SD4-PWR	7326SD4USA-PWR	7626SD6-PWR	7626SD6USA-PWR	1/2" x 7"	5-1/4"	25	100	DW5539	DW5438	DW5803	DWA54012	-
-	7330SD4USA-PWR	7630SD6-PWR	7630SD6USA-PWR	5/8" x 3-1/2"	1-1/2"	25	100	-	DW5446	DW5806	DWA54058	DWA58058
-	7332SD4USA-PWR	7632SD6-PWR	7632SD6USA-PWR	5/8" x 4-1/2"	2-1/2"	25	100	-	DW5446	DW5806	DWA54058	DWA58058
7333SD4-PWR	7333SD4USA-PWR	7633SD6-PWR	7633SD6USA-PWR	5/8" x 5"	3"	25	100	-	DW5446	DW5806	DWA54058	DWA58058
7334SD4-PWR	7334SD4USA-PWR	7634SD6-PWR	7634SD6USA-PWR	5/8" x 6"	4"	25	75	-	DW5446	DW5806	DWA54058	DWA58058
-	7336SD4USA-PWR	7636SD6-PWR	7636SD6USA-PWR	5/8" x 7"	5"	25	75	-	DW5447	DW5806	DWA54058	DWA58058
7338SD4-PWR	7338SD4USA-PWR	7638SD6-PWR	7638SD6USA-PWR	5/8" x 8-1/2"	6-1/2"	25	50	-	DW5447	DW5809	DWA54058	DWA58058
-	7340SD4USA-PWR	7640SD6-PWR	7640SD6USA-PWR	3/4" X 4-1/4"	1-7/8"	20	60	-	DW5453	DW5810	DWA54034	DWA58034
-	7341SD4USA-PWR	7641SD6-PWR	7641SD6USA-PWR	3/4" X 4-3/4"	2-3/8"	20	60	-	DW5453	DW5810	DWA54034	DWA58034
7342SD4-PWR	7342SD4USA-PWR	7642SD6-PWR	7642SD6USA-PWR	3/4" X 5-1/2"	3-1/8"	20	60	-	DW5453	DW5810	DWA54034	DWA58034
-	7344SD4USA-PWR	7644SD6-PWR	7644SD6USA-PWR	3/4" X 6-1/4"	3-7/8"	20	60	-	DW5455	DW5810	DWA54034	DWA58034
-	7346SD4USA-PWR	7646SD6-PWR	7646SD6USA-PWR	3/4" X 7"	4-5/8"	20	60	-	DW5455	DW5810	DWA54034	DWA58034
7348SD4-PWR	7348SD4USA-PWR	7648SD6-PWR	7648SD6USA-PWR	3/4" X 8-1/2"	6-1/8"	10	40	-	DW5455	DW5812	DWA54034	DWA58034
-	7349SD4USA-PWR	7649SD6-PWR	-	3/4" x 10"	7-5/8"	10	40	-	DW5455	DW5812	DWA54034	DWA58034

Domestically manufactured Power-Stud+ SD4 and Power-Stud+ SD6 anchors are made to order. Contact DEWALT for additional details.

The published size includes the diameter and the overall length of the anchor. Allow for fixture thickness (as applicable) plus one anchor diameter for the nut and washer when selecting a length.

All anchors are packaged with nuts and washers.

Shaded catalog numbers denote sizes which are less than the minimum standard anchor length for strength design. Anchors not long enough to meet the minimum nominal embedments published for strength design are outside the scope of ICC-ES ESR-2502.

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

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, 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

- Barriers and Guards
- Posts and Railing
- 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
+ Hot-dip galvanized fasteners generally meet requirements for common exterior applications
+ HDG coating is compliant for contact with pressure-treated wood

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.

SECTION CONTENTS

POWER-STUD HD5 ASSEMBLY

THREAD VERSION

- Threaded Stud (UNC)

ANCHOR MATERIALS

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

ROD/ANCHOR SIZE RANGE (TYP.)

- 3/8" through 3/4" diameters

SUITABLE BASE MATERIALS

- Normal-weight concrete
- Lightweight concrete
- Grouted concrete masonry (CMU)

MATERIAL SPECIFICATIONS

Anchor Component	Specification
Anchor body	Medium carbon steel
Hex Nut	Carbon steel, ASTM A563, Grade A
Washer	Carbon steel ASTM F844; meets dimensional requirements of ANSI B18.22.2, Type A plain
Expansion wedge (clip)	304 Stainless Steel
Plating (anchor, body, nut, washer)	Zinc Galvanized According to ASTM A153 Class C or D

INSTALLATION SPECIFICATIONS

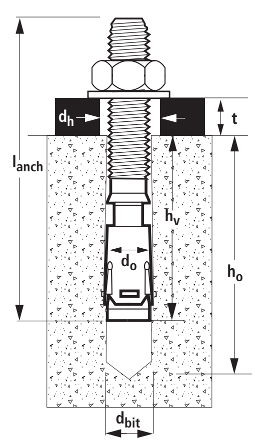
Installation Specifications for Power-Stud HD5 in Concrete

Anchor Property/ Setting Information	Notation	Units	Nominal Anchor Diameter (inch)									
			3/8		1/2			5/8			3/4	
Anchor outside diameter	d	in.	0.375		0.500			0.625			0.750	
Minimum diameter of hole clearance in fixture	d_h	in.	7/16		9/16			11/16			13/16	
Nominal drill bit diameter (ANSI)	d_{bit}	in.	3/8		1/2			5/8			3/4	
Minimum nominal embedment depth	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 hole depth	h_o	in.	2	2-5/8	2-1/4	2-3/4	4	2-3/4	3-3/4	5	3-3/4	5-3/8
Minimum member thickness	h_{min}	in.	3-1/4	4	4	5	6	5	6	7	6	8
Minimum overall anchor length[1]	ℓ_{anch}	in.	3	3	2-3/4	3-3/4	4-1/2	3-1/2	5	6	4-3/4	5-1/2
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
Minimum spacing distance	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
Installation torque (Normal-weight concrete)	T_{inst}	ft.-lbf.	20		40			60			110	
Installation torque (Grout-filled CMU)	T_{inst}	ft.-lbf.	20		40			50			80	
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	
Effective tensile stress area	A_{se}	in.²	0.078		0.142			0.226			0.334	
Minimum specified ultimate strength	f_{uta}	psi	88,000		80,000			80,000			72,000	
Minimum specified yield strength	f_{ya}	psi	70,400		64,000			64,000			57,600	

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.

Anchor Detail



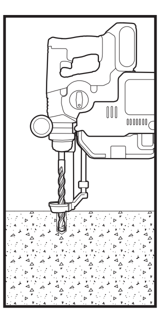
Length Identification

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"

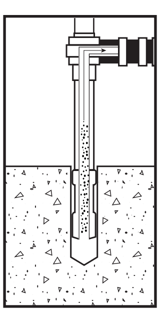
Length identification mark indicates overall length of anchor.

INSTALLATION INSTRUCTIONS

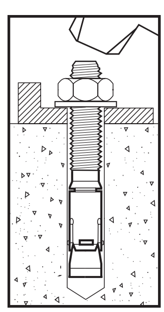
Installation Instructions for Power-Stud HD5



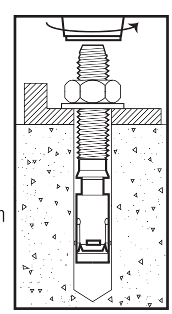
Step 1
Using the proper drill bit size, drill a hole into the base material to the required depth. The tolerances of the drill bit used should meet the requirements of ANSI Standard B212.15.



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}.

PERFORMANCE DATA (ASD)

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		3,965		4,580		5,470		6,320	
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		4,540		5,240		6,415		7,410	
	3-3/4	8,580		9,400		10,300		10,300		10,300	
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		8,000		9,240		11,315		13,065	
	4-5/8	11,715		12,830		14,815		16,400		16,400	
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		18,580		21,330		21,330		21,330	

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 Load Capacities for Power-Stud HD5 in Normal-Weight Concrete[1,2,3,4,5]

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		990		1,145		1,370		1,580	
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		1,135		1,310		1,605		1,855	
	3-3/4	2,145		2,350		2,575		2,575		2,575	
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		2,000		2,310		2,830		3,265	
	4-5/8	2,930		3,210		3,705		4,100		4,100	
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		4,645		5,335		5,335		5,335	

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 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.
5. For lightweight concrete multiply tabulated allowable load values by a reduction factor of 0.60.

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

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 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)		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

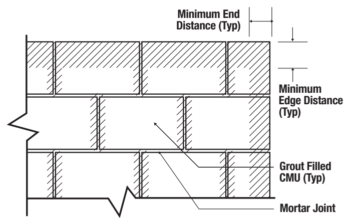
Edge Distance Shear (F_{VC}) Adjustment Factors for Normal-Weight Concrete

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

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.	Minimum Edge Distance in.	Minimum End Distance in.	Ultimate Loads		Allowable Loads	
				Tension lbs.	Shear lbs.	Tension lbs.	Shear lbs.
3/8	1-1/2	4	4	1,185	1,340	235	270
1/2	2	4	4	1,670	2,110	335	420
		12	12	1,860	2,560	370	510
5/8	2-3/8	4	4	2,155	2,110	430	420
		12	12	2,850	5,225	570	1,045
3/4	3-3/8	12	12	5,660	8,115	1,130	1,625
		20	20	5,660	9,360	1,130	1,870

1. Tabulated load values are for anchors installed in minimum 6" wide, Grade N, Type II, lightweight, medium-weight or normal-weight concrete masonry units conforming to ASTM C90. Mortar must be minimum Type N. Masonry compressive strength must be at specified minimum at the time of installation.
2. Allowable load capacities listed are calculated using an applied safety factor of 5.0.
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.



Wall Face
Permissible Anchor Locations
(Un-hatched Area)

ORDERING INFORMATION

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

Cat. No.	Anchor Size	Thread Length	Pack Qty.	Carton Qty.	Suggested ANSI Carbide Drill Bit				
					Full Head SDS-Plus	SDS-Plus	SDS-Max	Hollow Bit SDS-Plus	Hollow Bit SDS-Max
7713HD5-PWR	3/8" x 3"	1-1/2"	50	300	DW5527	DW5427	-	-	-
7715HD5-PWR	3/8" x 3-3/4"	2-3/8"	50	300	DW5527	DW5427	-	-	-
7716HD5-PWR	3/8" x 5"	3-1/2"	50	300	DW55300	DW5429	-	-	-
7717HD5-PWR	3/8" x 7"	5-1/2"	50	200	DW55300	DW5429	-	-	-
7720HD5-PWR	1/2" x 2-3/4"	1"	50	200	DW5537	DW5437	DW5803	DWA54012	-
7722HD5-PWR	1/2" x 3-3/4"	2"	50	200	DW5537	DW5437	DW5803	DWA54012	-
7723HD5-PWR	1/2" x 4-1/2"	2-3/4"	50	200	DW5539	DW5438	DW5803	DWA54012	-
7724HD5-PWR	1/2" x 5-1/2"	3-3/4"	50	150	DW5539	DW5438	DW5803	DWA54012	-
7726HD5-PWR	1/2" x 7"	5-1/4"	25	100	DW5539	DW5438	DW5803	DWA54012	-
7730HD5-PWR	5/8" x 3-1/2"	1-1/2"	25	100	-	DW5446	DW5806	DWA54058	DWA58058
7733HD5-PWR	5/8" x 5"	3"	25	100	-	DW5446	DW5806	DWA54058	DWA58058
7734HD5-PWR	5/8" x 6"	4"	25	75	-	DW5446	DW5806	DWA54058	DWA58058
7738HD5-PWR	5/8" x 8-1/2"	6-1/2"	25	50	-	DW5447	DW5809	DWA54058	DWA58058
7741HD5-PWR	3/4" x 4-3/4"	2-1/4"	20	60	-	DW5453	DW5810	DWA54034	DWA58034
7742HD5-PWR	3/4" x 5-1/2"	3"	20	60	-	DW5453	DW5810	DWA54034	DWA58034
7746HD5-PWR	3/4" x 7"	4-1/2"	20	60	-	DW5455	DW5810	DWA54034	DWA58034
7748HD5-PWR	3/4" x 8-1/2"	6"	10	40	-	DW5455	DW5812	DWA54034	DWA58034

The published size includes the diameter and the overall length of the anchor.
Allow for fixture thickness plus one anchor diameter for the nut and washer thickness when selecting a length.
All anchors are packaged with nuts and washers.
Hollow drill bits must be used with a dust extraction vacuum (e.g. DW012).

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 or flat head (countersunk). Suitable base materials include normal-weight concrete, sand-lightweight concrete, concrete over steel deck, concrete masonry and solid clay brick. 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+ is available as bright zinc-plated or mechanically galvanized plating.

GENERAL APPLICATIONS AND USES

- Racking, shelving and material handling
- Support ledgers and sill plate attachments
- Barriers, guards and temporary supports
- Glazing and window attachments
- Retrofits, repairs and maintenance
- Fencing, railing and stair stringers
- Cracked and uncracked concrete
- Seismic and wind loading (SDC A - F)

FEATURES AND BENEFITS

+ Designed for standard ANSI tolerance drill bits
+ Patented thread design offers toughened threads for tapping high strength concrete
+ Low installation torque in concrete and masonry
+ Universal product for concrete and grouted/solid masonry
+ Ratchet teeth on underside of hex washer head lock against the fixture
+ Can be installed closer to a free edge than traditional expansion anchors
+ Fully removable and reinstallable in same hole (see www.DEWALT.com)
+ Fast installation with powered impact wrench, but can also be installed manually
+ 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
- International Code Council, Evaluation Service (ICC-ES), ESR-4042 for masonry
- Code Compliant with the International Building Code/International Residential Code: 2021 IBC/IRC, 2018 IBC/IRC, 2015 IBC/IRC, and 2012 IBC/IRC
- Tested in accordance with ACI 355.2, ASTM E488 and ICC-ES AC193 for use in structural 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 (anchor Category 1)
- Evaluated and qualified by an accredited independent testing laboratory for sensitivity and reliability against brittle failure, e.g. hydrogen embrittlement

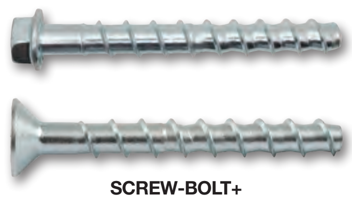
GUIDE SPECIFICATIONS

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 carbon steel
Plating	Standard zinc plated version	Zinc plating according to ASTM B633, SC1 Type III (Fe/Zn 5). Minimum plating requirements for Mild Service Condition
	Mechanically galvanized version	Mechanically Galvanized Zinc plating according to ASTM B695, Class 55

SECTION CONTENTS



SCREW-BOLT+

HEAD STYLES

- Hex Washer Head or Flat Head

ANCHOR MATERIALS

- Zinc plated carbon steel or mechanically galvanized plating

ANCHOR SIZE RANGE (TYP.)

- 1/4" through 3/4" diameters

SUITABLE BASE MATERIALS

- Normal-weight concrete
- Lightweight concrete
- Concrete over steel deck
- Grouted Concrete Masonry (CMU)
- Brick Masonry

TENSION ZONE CRACKED CONCRETE

SEISMIC REGION QUALIFICATION

CODE LISTED ICC-ES ESR-3889 CONCRETE

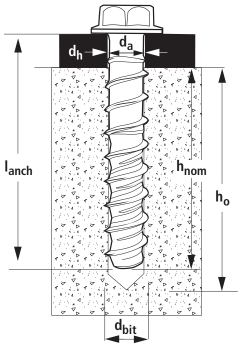
CODE LISTED ICC-ES ESR-4042 MASONRY

DDA DEWALT DESIGN ASSIST™

DUSTX+™ ANCHOR INSTALLATION SYSTEM

INSTALLATION SPECIFICATIONS

Screw-Bolt+ Anchor Detail



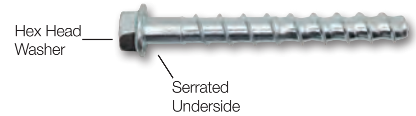
Nomenclature

- d_a = Diameter of Anchor
- d_{bit} = Diameter of Drill Bit
- d_h = Diameter of Clearance Hole
- h = Base Material Thickness.
- h_{nom} = Minimum Nominal Embedment
- h_o = Minimum Hole Depth

Head Marking

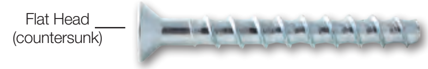
Legend

Diameter and Length Identification Mark



Legend

Diameter and Length Identification Mark



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

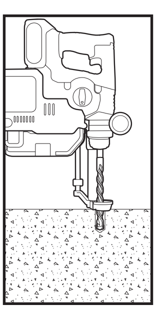
Anchor Property/ Setting Information	Notation	Units	Nominal Anchor Diameter (inch)				
			1/4	3/8	1/2	5/8	3/4
Anchor outside diameter	d_a (d)	in. (mm)	0.250 (6.4)	0.375 (9.5)	0.500 (12.7)	0.625 (15.9)	0.750 (19.1)
Nominal drill bit diameter (ANSI)	d_{bit}	in.	1/4	3/8	1/2	5/8	3/4
Minimum diameter of hole clearance in fixture	d_h	in. (mm)	11/32 (8.7)	1/2 (12.7)	5/8 (15.9)	3/4 (19.1)	7/8 (22.2)
Minimum embedment depth[1]	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)	h_{nom} + 3/8 (9.5)				
Minimum member thickness	h_{min}	in. (mm)	h_{nom} + 2 (51)				
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 manual 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)
Hex Head: Impact wrench socket size	-	in.	7/16	9/16	3/4	15/16	1-1/8
Hex Head: Maximum head height	-	in.	21/64	3/8	31/64	37/64	43/64
Hex Head: Maximum washer diameter	-	in.	37/64	3/4	1-1/16	1-1/8	1-13/32
Flat Head: Driver Size	-	in.	T-30	T-50	T-55	-	-
Flat Head: Max head height	-	in.	13/64	21/64	11/32	-	-
Flat Head: Max head diameter	-	in.	17/32	57/64	1	-	-
Flat Head: Countersunk angle	-	in.	82	82	82	-	-
Effective tensile stress area (screw anchor body)	A_{se}	in²	0.045	0.094	0.176	0.274	0.399
Minimum ultimate strength	f_{uta}	psi	100,000	105,000	115,000	95,000	95,000
Minimum yield strength	f_y	psi	80,000	84,000	92,000	76,000	76,000

See Strength Design Information for installation specifications in strict accordance with ICC-ES ESR-3889.

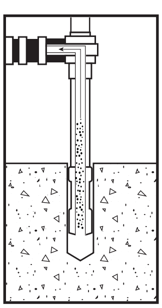
4. See load capacities for Screw-Bolt+ in normal weight concrete for additional nominal embedment depths.

INSTALLATION INSTRUCTIONS

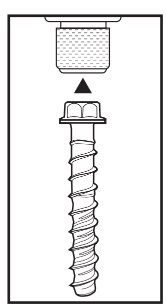
Installation Instructions for Screw-Bolt+ (Hex Head Version Illustrated, Flat Head Version Not Shown)



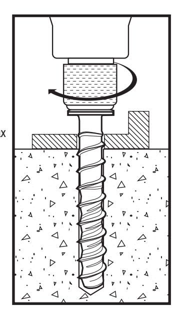
Step 1
Using the proper drill bit size, drill a hole into the base material to the required depth. The tolerances of the drill bit used should meet the requirements of ANSI standard B212.15



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.

PERFORMANCE DATA (ASD)

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)
	2-1/2 (64)	5,175 (23.0)	4,320 (19.2)	5,670 (25.2)	4,740 (21.1)	6,410 (28.5)	5,460 (24.3)	6,456 (28.7)	6,340 (28.2)	7,420 (33.0)	6,340 (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)
	3 (76)	8,560 (38.0)	8,040 (35.8)	9,375 (41.7)	8,800 (39.1)	10,750 (47.8)	10,160 (45.2)	10,750 (47.8)	11,540 (51.3)	10,750 (47.8)	11,540 (51.3)
	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)
	4 (102)	11,770 (52.4)	12,060 (53.6)	12,890 (57.3)	13,220 (58.8)	14,880 (66.2)	15,260 (67.9)	15,325 (68.2)	17,180 (76.4)	16,600 (73.8)	17,180 (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 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 Load Capacities for Screw-Bolt+ in Normal-Weight Concrete[1,2,3,4,5]

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)
	2-1/2 (64)	1,295 (5.8)	1,080 (4.8)	1,415 (6.3)	1,185 (5.3)	1,600 (7.1)	1,365 (6.1)	1,615 (7.2)	1,585 (7.1)	1,855 (8.3)	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)
	3 (76)	2,140 (9.5)	2,010 (8.9)	2,345 (10.4)	2,200 (9.8)	2,690 (11.9)	2,540 (11.3)	2,690 (11.9)	2,885 (12.8)	2,690 (11.9)	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)
	4 (102)	2,940 (13.1)	3,015 (13.4)	3,225 (14.3)	3,305 (14.7)	3,720 (16.5)	3,815 (16.9)	3,830 (17.0)	4,295 (19.1)	4,150 (18.5)	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 uncracked 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 of 4.0 to average ultimate load capacities.
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.
5. For lightweight concrete multiply tabulated allowable load values by a reduction factor of 0.60.

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

Allowable Screw-Bolt+ Tension and Shear Load Capacities Installed into the face of Grout-Filled Concrete Masonry Units[1,2,3,4,5,6,7,8,9]

CODE LISTED
ICC-ES ESR-4042

ALLOWABLE STRESS DESIGN ASD

Tension Load

Anchor Diameter, d in.	Minimum Embedment h_{nom} in. (mm)	Allowable Load at c_{cr} and s_{cr} lbs (kN)	Spacing Distance, s: Critical Distance, s_{cr} in. (mm)	Spacing Distance, s: Minimum Distance, s_{min} in. (mm)	Spacing Distance, s: Allowable Load Factor at s_{min}	Edge or End Distance, c_2 or c_1 (see Illustration of Screw-Bolt+ Installed into Grouted Concrete Masonry Wall detail): Critical Distance, c_{cr} in. (mm)	Edge or End Distance: Minimum Distance, c_{min} in. (mm)	Edge or End Distance: Allowable Load Factor at c_{min}
1/4	1-5/8 (41)	315 (1.4)	4 (102)	2 (51)	1.00 (no reduction)	3-3/4 (95)	1-1/4 (32)	0.60
	2-1/2 (64)	605 (2.7)						
3/8	2 (51)	450 (2.0)	6 (152)	3 (76)	1.00 (no reduction)	6 (152)	1-1/2 (38)	0.70
	3-1/4 (83)	1,085 (4.8)						
1/2	2-1/2 (64)	610 (2.7)	8 (203)	4 (102)	1.00 (no reduction)	8 (203)	2-5/8 (67)	0.75
	4-1/4 (108)	1,190 (5.3)						
5/8	3-1/4 (83)	880 (3.9)	10 (254)	4 (102)	1.00 (no reduction)	10 (254)	3-3/8 (88)	0.90
	5 (127)	1,270 (5.6)						
3/4	4 (102)	1,150 (5.1)	12 (305)	4 (102)	1.00 (no reduction)	12 (305)	4 (102)	1.00 (no reduction)
	6-1/4 (159)	1,355 (6.0)						

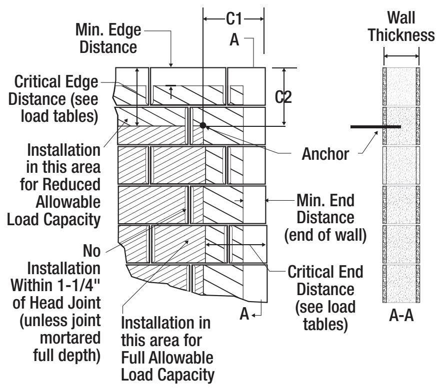
Shear Load

Anchor Diameter, d in.	Minimum Embedment h_{nom} in. (mm)	Allowable Load at c_{cr} and s_{cr} Direction 1 & 2 lbs[9] (kN)	Allowable Load at c_{cr} and s_{cr} Direction 3 & 4 lbs[9] (kN)	Spacing Distance, s: Critical Distance, s_{cr} in. (mm)	Spacing Distance, s: Minimum Distance, s_{min} in. (mm)	Spacing Distance, s: Allowable Load Factor at s_{min}	Edge or End Distance, c_2 or c_1 (see Illustration of Screw-Bolt+ Installed into Grouted Concrete Masonry Wall): Critical Distance, c_{cr} in. (mm)	Edge or End Distance: Minimum Distance, c_{min} in. (mm)	Allowable Load Factor at c_{min}: Load Perpendicular to Edge or End (Direction 1 & 2)[9]	Allowable Load Factor at c_{min}: Load Perpendicular to Edge or End (Direction 3 & 4)[9]
1/4	1-5/8 (41)	400 (1.8)	400 (1.8)	4 (102)	2 (51)	1.00 (no reduction)	3-3/4 (95)	1-1/4 (32)	0.35	1.00 (no reduction)
	2-1/2 (64)	505 (2.2)	505 (2.2)							
3/8	2 (51)	815 (3.6)	815 (3.6)	6 (152)	3 (76)	1.00 (no reduction)	6 (152)	1-1/2 (38)	0.27	1.00 (no reduction)
	3-1/4 (83)	935 (4.2)	935 (4.2)							
1/2	2-1/2 (64)	1,380 (6.1)	1,380 (6.1)	8 (203)	4 (102)	1.00 (no reduction)	8 (203)	2-5/8 (67)	0.20	1.00 (no reduction)
	4-1/4 (108)	2,180 (9.7)	2,180 (9.7)							
5/8	3-1/4 (83)	2,090 (9.3)	2,225 (9.9)	10 (254)	4 (102)	1.00 (no reduction)	10 (254)	3-3/8 (86)	0.23	1.00 (no reduction)
	5 (127)	2,640 (11.7)	2,640 (11.7)							
3/4	4 (102)	2,800 (12.5)	3,330 (14.8)	12 (305)	4 (102)	1.00 (no reduction)	12 (305)	4 (102)	0.25	1.00 (no reduction)
	6-1/4 (159)	3,100 (13.8)	3,685 (16.4)							

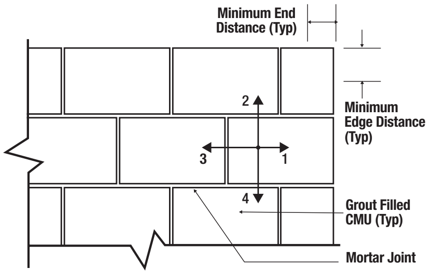
For SI: 1 inch = 25.4 mm; 1 lbs = 0.0044 kN, 1 psi = 0.006894 MPa.

1. All values are for anchors installed in fully grouted concrete masonry wall construction with materials meeting minimum compressive strength, f'm, of 1,500 psi (10.3 MPa). Concrete masonry units must be light-, medium, or normal-weight conforming to ASTM C90. Allowable loads are based on a safety factor of 5.0.
2. Anchors may be installed in any location in the face of the masonry wall (cell, web, bed joint) except within 1-1/4-inch from the of the vertical mortar joint (head joint), center-to-center, provided the minimum edge and end distances are maintained. Anchors may not be placed in the head joint unless the vertical joint is mortared full-depth.
3. A maximum of two anchors may be installed in a single masonry cell in accordance with the spacing and edge or end distance requirements. Embedment is measured from the outside surface of the concrete masonry unit to the embedded end of the anchor. See the figure for Illustration of Screw-Bolt+ Anchors Installed into Grouted Concrete Masonry Wall.
4. The critical spacing distance, s_{cr}, is the anchor spacing where full load values in the table may be used. The minimum spacing distance, s_{min}, is the minimum anchor spacing for which values are available and installation is permitted. Spacing distance is measured from the centerline to centerline between two anchors.
5. The critical edge or end distance, c_{cr}, is the distance where full load values in the table may be used. The minimum edge or end distance, c_{min}, is the minimum distance for which values are available and installation is permitted. Edge or end distance is measured from anchor centerline to the closest unrestrained edge.
6. The tabulated values are applicable for anchors installed into the ends of grout-filled concrete masonry units (e.g. wall opening) where minimum edge distances are maintained.
7. Load values for anchors installed less than s_{cr} and c_{cr} must be multiplied by the appropriate load reduction factor based on actual spacing (s) or edge distance (c). Load factors are multiplicative; both spacing and edge reduction factors must be considered.
8. Linear interpolation of load values between minimum spacing (s_{min}) and critical spacing (s_{cr}) and between minimum edge or end distance (c_{min}) and critical edge or end distance (c_{cr}) is permitted.
9. See the figure for Direction of Shear Loading in Relation to Edge and End of Masonry Wall figure for illustration of shear load directions.

Illustration of Screw-Bolt+ Anchors Installed into Grouted Concrete Masonry Wall



Direction of Shear Loading in Relation to Edge and End of Masonry Wall



1. Shear load perpendicular to End and parallel to Edge
2. Shear load perpendicular to Edge and parallel to End
3. Shear load parallel to Edge and perpendicular away from End
4. Shear load parallel to End and perpendicular to bottom of wall

Allowable Screw-Bolt+ Tension and Shear Load Capacities Installed into the Tops of Grout-Filled Concrete Masonry Units[1,2,3,4,5,6,7,8,9,10]

CODE LISTED
ICC-ES ESR-4042

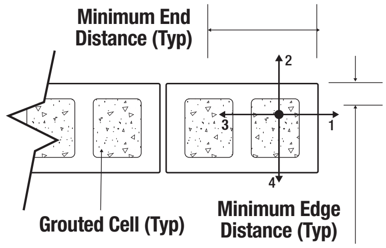
ALLOWABLE STRESS DESIGN ASD

Anchor Diameter d in.	Minimum Embedment h_{nom} in. (mm)	Minimum Spacing Distance in. (mm)	Minimum Edge Distance in. (mm)	Minimum End Distance in. (mm)	Tension Load lbs (kN)	Shear Load, lb (kN)	
						Load Perpendicular to Edge of Masonry Wall (II to end)	Load Parallel to Edge of Masonry Wall (⊥ to end)
1/4	2-1/2 (64)	1-1/2 (38)	1-1/2 (38)	4 (102)	410 (1.8)	185 (0.8)	185 (0.8)
		1-1/2 (38)	3-1/2 (89)	4 (102)	485 (2.2)	215 (1.0)	215 (1.0)
3/8	3-1/4 (83)	2 (51)	1-1/2 (38)	4 (102)	625 (2.8)	225 (1.0)	505 (2.2)
		2 (51)	3-1/2 (89)	6 (153)	625 (2.8)	560 (2.5)	560 (2.5)
1/2	4-1/4 (108)	8 (203) [see Note 4 for reduced minimum spacing distances]	1-3/4 (45)	8 (203)	810 (3.6)	255 (1.1)	580 (2.6)
			3-3/4 (95)		1,210 (5.4)	645 (2.9)	1,030 (4.6)
5/8	5 (127)	10 (254)	1-3/4 (45)	10 (254)	900 (4.0)	260 (1.2)	950 (4.2)
3/4	6-1/4 (159)	12 (301)	1-3/4 (45)	12 (305)	1,215 (5.4)	260 (1.2)	990 (4.4)

For SI: 1 inch = 25.4 mm; 1 lbs = 0.0044 kN, 1 psi = 0.006894 MPa.

1. All values are for anchors installed in fully grouted concrete masonry wall construction with materials meeting minimum compressive strength, f'm, of 1,500 psi (10.3 MPa). Concrete masonry units must be light-, medium, or normal-weight conforming to ASTM C90. Allowable loads are based on a safety factor of 5.0.
2. Anchors may be installed in any location in the top of the masonry wall except within 1-1/4-inch from the of the mortar joint (head joint), provided the minimum edge and end distances are maintained.
3. A maximum of two anchors may be installed in a single masonry cell in accordance with the spacing and edge or end distance requirements. Embedment is measured from the outside surface of the concrete masonry unit to the embedded end of the anchor. See figure for Screw-Bolt+ Anchors Installed into the Top of Grouted Concrete Masonry Wall.
4. Minimum spacing distance for 1/2-inch-diameter anchors shall be 8 inches and may be reduced to 2 inches provided the allowable load reduction factor of 0.40 is applied. Linear interpolation may be used to determine the reduction factor for intermediate anchor spacing distances between 8 inches and 2 inches.
5. Spacing distance is measured from the centerline to centerline between two anchors.
6. Linear interpolation may be used to for 1/4-inch and 3/8-inch-diameter anchors to determine allowable loads for edge distances between 3-1/2-inches and 1-1/2-inches.
7. Linear interpolation may be used to for 1/2-inch-diameter anchors to determine allowable loads for edge distances between 3-3/4-inches and 1-3/4-inches.
8. The edge and end distance is measured from the anchor centerline to the closest unrestrained edge and end of the CMU block, respectively. See figure for Screw-Bolt+ Anchors Installed into the Top of Grouted Concrete Masonry Wall.
9. Spacing distance is measured from the centerline to centerline between two anchors.
10. Allowable shear loads parallel and perpendicular to the edge of a masonry wall may be applied in or out of plane, respectively. See figure for Screw-Bolt+ Anchors Installed into the Top of Grouted Concrete Masonry Wall.

Screw-Bolt+ Anchors Installed into the Top of Grouted Concrete Masonry Wall



1. Shear load perpendicular to End and parallel to Edge
2. Shear load perpendicular to Edge and parallel to End
3. Shear load parallel to Edge and perpendicular away from End
4. Shear load parallel to End and perpendicular to bottom of wall

Allowable Screw-Bolt+ Tension and Shear Load Capacities Installed into the Face of Brick Masonry Walls[1,2,3,4,5,6,7,8]

Tension Load

Anchor Diameter, d in.	Minimum Embedment, h_{nom} in. (mm)	Allowable Load at c_{cr} and s_{cr} lbs (kN)	Spacing Distance, s: Critical Distance, s_{cr} in. (mm)	Spacing Distance, s: Minimum Distance, s_{min} in. (mm)	Spacing Distance, s: Allowable Load Factor at s_{min} in. (mm)	Edge or End Distance: Critical Distance, c_{cr} in. (mm)	Edge or End Distance: Minimum Distance, c_{min} in. (mm)	Edge or End Distance: Allowable Load Factor at c_{min}
1/4	1-5/8 (41)	550 (2.4)	4 (102)	2 (51)	0.60	3-3/4 (95)	1-1/4 (32)	0.25
	2-1/2 (64)	830 (3.7)						
3/8	2 (51)	905 (4.0)	6 (152)	3 (76)	0.60	6 (152)	1-1/2 (38)	0.50
	3-1/4 (82)	1,115 (5.0)						
1/2	2-1/2 (64)	1,015 (4.5)	8 (203)	4 (102)	0.60	8 (203)	2-5/8 (68)	0.50
	4-1/4 (108)	1,495 (6.7)						
5/8	3-1/4 (83)	1025 (4.6)	10 (254)	5 (127)	0.50	10 (254)	3-3/8 (86)	0.50
	5 (127)	2,015 (9.0)						
3/4	4 (102)	1,815 (8.1)	12 (305)	6 (152)	0.50	12 (305)	4 (102)	0.50
	6-1/4 (159)	2,400 (10.7)						

Shear Load

Anchor Diameter, d in.	Minimum Embedment, h_{nom} in. (mm)	Allowable Load at c_{cr} and s_{cr} lbs (kN)	Spacing Distance, s: Critical Distance, s_{cr} in. (mm)	Spacing Distance, s: Minimum Distance, s_{min} in. (mm)	Spacing Distance, s: Allowable Load Factor at s_{min} in. (mm)	Edge or End Distance: Critical Distance, c_{cr} in. (mm)	Edge or End Distance: Minimum Distance, c_{min} in. (mm)	Edge or End Distance: Allowable Load Factor at c_{min} Load Perpendicular to Edge or End
1/4	1-5/8 (41)	405 (1.8)	4 (102)	2 (51)	0.70	3-3/4 (95)	1-1/4 (32)	0.20
	2-1/2 (62)	520 (2.3)						
3/8	2 (51)	930 (4.1)	6 (152)	3 (76)	0.70	6 (152)	1-1/2 (39)	0.20
	3-1/4 (83)	1,030 (4.6)						
1/2	2-1/2 (64)	1,055 (4.7)	8 (203)	4 (102)	0.65	8 (203)	2-5/8 (67)	0.25
	4-1/4 (108)	1,075 (4.8)						
5/8	3-1/4 (83)	1,700 (7.6)	10 (254)	5 (127)	0.50	10 (254)	3-3/8 (86)	0.40
	5 (127)	1,980 (8.8)						
3/4	4 (102)	1,700 (7.6)	12 (305)	6 (152)	0.50	12 (305)	4 (102)	0.55
	6-1/4 (159)	2,030 (9.0)						

For SI: 1 inch = 25.4 mm; 1 lbs = 0.0044 kN, 1 psi = 0.006894 MPa.

1. All values are for anchors installed in minimum two-wythe, solid clay brick masonry walls conforming to ASTM C62, grade SW minimum. Mortar must be type N, S or M. The base material must have a minimum compressive strength, f'm, of 2,000 psi (13.8 MPa). Allowable loads are based on a safety factor of 5.0.
2. Anchors may be installed in any location in the face of the masonry wall, provided the minimum edge and end distances are maintained.
3. Embedment is measured from the outside surface of the concrete masonry unit to the embedded end of the anchor.
4. The critical spacing distance, s_{cr}, is the anchor spacing where full load values in the table may be used. The minimum spacing distance, s_{min}, is the minimum anchor spacing for which values are available and installation is permitted. Spacing distance is measured from the centerline to centerline between two anchors.
5. The critical edge or end distance, c_{cr}, is the distance where full load values in the table may be used. The minimum edge or end distance, c_{min}, is the minimum distance for which values are available and installation is permitted. Edge or end distance is measured from anchor centerline to the closest unrestrained edge.
6. The tabulated values are applicable for anchors installed into wall openings where minimum edge distances are maintained.
7. Load values for anchors installed less than s_{cr} and c_{cr} must be multiplied by the appropriate load reduction factor based on actual spacing (s) or edge distance (c). Load factors are multiplicative; both spacing and edge reduction factors must be considered.
8. Linear interpolation of load values between minimum spacing (s_{min}) and critical spacing (s_{cr}) and between minimum edge or end distance (c_{min}) and critical edge or end distance (c_{cr}) is permitted.

STRENGTH DESIGN INFORMATION

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

Anchor Property/ Setting Information	Notation	Units	Nominal Anchor Diameter (inch)											
			1/4		3/8			1/2			5/8			3/4
Head Style	-	-	Hex or Flat Head		Hex or Flat Head			Hex or Flat Head			Hex Head			Hex Head
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)
Minimum diameter of hole clearance in fixture[8]	d_h	in. (mm)	11/32 (8.7)		1/2 (12.7)			5/8 (15.9)			3/4 (19.1)			7/8 (22.2)
Drill bit diameter (ANSI)	d_{bit}	in.	1/4		3/8			1/2			5/8			3/4
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 (102)	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} ≥ 3 (76) s_{min} = 2 (51) for c_{min} ≥ 2 (51)			1-3/4 (44)			1-3/4 (44)			1-3/4 (44)
Minimum spacing distance[6]	s_{min}	in. (mm)	1-1/2 (38)					2-3/4 (70)			2-3/4 (70)			3 (76)
Minimum overall anchor length[7,9]	ℓ_{anch}	in.	1-3/4	2-5/8	2-1/2	3	4	3	4	5	4	5	6	5
Maximum manual 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)
Hex Head: Wrench socket size	-	in.	7/16		9/16			3/4			15/16			1-1/8
Hex Head: Maximum head height	-	in.	21/64		3/8			31/64			37/64			43/64
Hex Head: Max washer diameter	-	in.	37/64		3/4			1-1/16			1-1/8			1-13/32
Flat Head: Driver size	-	in.	T-30		T-50			T-55			-			-
Flat Head: Max head height	-	in.	13/64		21/64			11/32			-			-
Flat Head: Max head diameter	-	in.	17/32		57/64			1			-			-
Flat Head: Countersunk angle	-	in.	82		82			82			-			-
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)		105 (724)			115 (794)			95 (656)			95 (656)
Minimum specified yield strength	f_y	ksi (N/mm²)	80 (552)		84 (579)			92 (635)			76 (524)			76 (524)
Mean axial stiffness[9,10]: Uncracked concrete	β_{uncr}	lbf/in	1,252,000		1,157,000			1,014,000			919,000			1,028,000
Mean axial stiffness[9,10]: Cracked concrete	β_{cr}	lbf/in	355,000		330,000			349,000			378,000			419,000

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(-19 or -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. The minimum nominal length for hex head anchors is measured from under the head to the tip of the anchor, the minimum nominal length for flat head anchors is measured from the top of the head to the tip of the anchor.
8. The minimum diameter of fixture hole clearance is for the body of the anchor to pass through structural steel members; clearance holes may be 1/8-inch less than tabulated values (same as nominal drill bit diameter) provided the screw anchors are installed through light gauge cold-formed steel members or wood members.
9. Hex head anchors with the following minimum lengths are also suitable for use with cold-formed steel members provided the nominal thickness of the fixture attachments does not exceed 20 gauges (0.036-inch base metal thickness):
   For 3/8-inch-diameters anchors with 2-1/2-inch nominal embedment, 2-1/2-inch long anchors.
   For 1/2-inch-diameters anchors with 2-1/2-inch nominal embedment, 2-1/2-inch long anchors.
   For 1/2-inch-diameters anchors with 3-inch nominal embedment, 3-inch long anchors.
   For 5/8-inch-diameters anchors with 4-inch nominal embedment, 4-inch long anchors.
   For 5/8-inch-diameters anchors with 5-inch nominal embedment, 5-inch long anchors.
10. Mean values shown, actual stiffness varies considerably depending on concrete strength, loading and geometry of application.

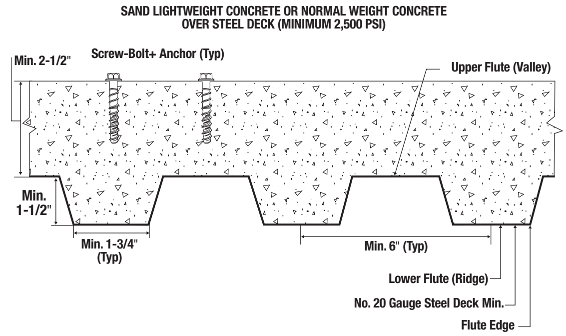
Anchor Setting Information for Installation on the Top of Concrete-Filled Steel Deck Assemblies with Minimum Topping Thickness[1,2,3,4]

Anchor Property / Setting Information	Notation	Units	Nominal Anchor Size (inch)			
			1/4		3/8	1/2
Head style	-	-	Hex Head or Flat Head		Hex Head or Flat Head	Hex Head or Flat Head
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[8]	d_h	in. (mm)	11/32 (8.7)		1/2 (12.7)	5/8 (15.9)
Nominal drill bit diameter (ANSI)	d_{bit}	in.	1/4		3/8	1/2
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)
Minimum nominal anchor length[6,9]	ℓ_{anch}	in.	1-3/4	2-5/8	2-1/2	3
Maximum impact wrench power (torque)	$T_{impact,max}$	ft.-lb. (N-m)	150 (203)		300 (407)	300 (407)
Max. manual installation torque	$T_{inst,max}$	ft.-lb. (N-m)	18[7] (26)	25 (34)	25 (34)	45 (61)
Hex Head: Wrench socket size	-	in.	7/16		9/16	3/4
Hex Head: Max. head height	-	in.	21/64		3/8	31/64
Hex Head: Max. washer diameter	-	in.	37/64		3/4	1-1/16
Flat Head: Driver Size	-	in.	T-30		T-50	T-55
Flat Head: Max head height	-	in.	13/64		21/64	11/32
Flat Head: Max head diameter	-	in.	17/32		57/64	1
Flat Head: Countersunk angle	-	in.	82		82	82

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.

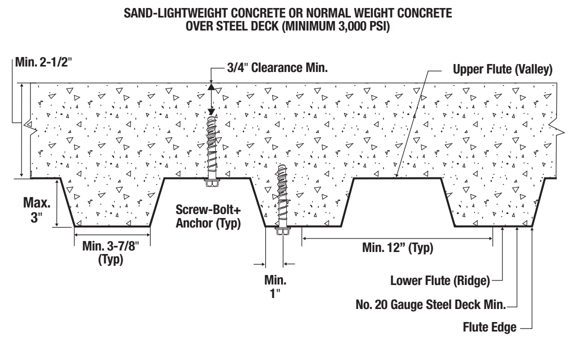
1. The anchors may be installed in the topside of concrete-filled steel deck floor and roof assemblies in accordance with this table, the anchor installation specifications in concrete table and the top of concrete over steel deck installation detail provided the concrete thickness above the upper flute 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. The minimum nominal length for hex head anchors is measured from under the head to the tip of the anchor, the minimum nominal length for flat head anchors is measured from the top of 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.
8. The minimum diameter of fixture hole clearance is for the body of the anchor to pass through structural steel members; clearance holes may be 1/8-inch less than tabulated values (same as nominal drill bit diameter) provided the screw anchors are installed through light gauge cold-formed steel members or wood members.
9. Hex head anchors with the following minimum lengths are also suitable for use with cold-formed steel members provided the nominal thickness of the fixture attachments does not exceed 20 gauges (0.036-inch base metal thickness):
   For 1/2-inch-diameters anchors with 2-1/2-inch nominal embedment, 2-1/2-inch long anchors.

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]



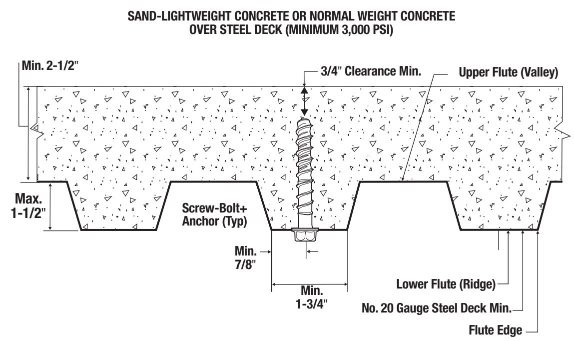
1. Anchors may be placed in the top side of concrete over steel deck profiles provided the minimum concrete thickness above the upper flute (topping thickness), minimum spacing distance and minimum edge distances are satisfied as given in Anchor Setting Information for Installation on the Top of Concrete-Filled 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.

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

CODE LISTED
ICC-ES ESR-3889

STRENGTH DESIGN SD TABLES

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)
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)
Steel Strength in Tension (ACI 318-19 17.6.1, 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 318-19 17.6.2, ACI 318-14 17.4.2 or ACI 318-11 D.5.2)														
Critical edge distance (uncracked concrete only)	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] (uncracked concrete only)	$c_{ac,deck,top}$	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 (ACI 318-19 17.6.3, 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 318-19 17.10.3, 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 (-19 or -14) Chapter 17 or ACI 318-11 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-19 17.10, ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable, shall apply.
2. Installation must comply with published instructions and details.
3. All values of ϕ were determined from the load combinations of IBC Section 1605.2, ACI 318 (-19 or -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 (-19 or -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 (-19 or -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 (-19 or -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

STRENGTH DESIGN SD TABLES

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)
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)
Steel Strength in Shear (ACI 318-19 17.7.1, ACI 318-14 17.5.1 or ACI 318-11 D.6.1)														
Steel strength in shear[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 318-19 17.10.1, 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 318-19 17.7.2, 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 318-19 17.7.3, 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
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 (-19 or -14) Chapter 17 or ACI 318-11 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-19 17.10, ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable shall apply.
2. Installation must comply with published instructions and details.
3. All values of ϕ were determined from the load combinations of IBC Section 1605.2, ACI 318 (-19 or -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 (-19 or -14) Chapter 17 or ACI 318-11 Appendix D requirements for Condition A, see ACI 318-19 17.5.3, 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 (-19 or -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 17.7.1.2b of ACI 318-19 or 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

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 318-19 17.6.2, 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 318-19 17.7.2, ACI 318-14 17.5.2 or ACI 318-11 D.6.2, as applicable, and the pryout capacity in accordance with ACI 318-19 17.7.3, 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 2021 IBC Section 1605.1 or 2018, 2015 and 2012 IBC 1605.2, ACI 318 (-19 or -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.

DESIGN STRENGTH TABLES (SD)

Tension and Shear Design Strength Installed in Cracked Concrete[1,2,3,4,5,6,7]

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	2,180	2,475	2,390	2,855	2,760	3,495	3,380	4,040	3,900
	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	6,705	4,960	6,705	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	7,125	4,175	7,385	4,820	7,385	5,905	7,385	6,820	7,385
	5	5,620	9,350	6,155	9,350	7,110	9,350	8,705	9,350	10,050	9,350
3/4	4-1/4	4,745	10,215	5,195	11,190	6,000	11,555	7,350	11,555	8,485	11,555

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

Tension and Shear Design Strength Installed in Uncracked Concrete[1,2,3,4,5,6]

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	1,375	1,170	1,510	1,355	1,740	1,655	2,135	1,915	2,465
	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	5,295	3,345	5,800	3,865	6,695	4,735	6,705	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	5,090	2,960	5,575	3,415	6,435	4,185	7,385	4,830	7,385
	5	3,980	7,400	4,360	8,105	5,035	9,350	6,165	9,350	7,120	9,350
3/4	4-1/4	2,985	6,430	3,270	7,045	3,780	8,135	4,625	9,965	5,340	11,505

- 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, $h_a = 1.5h_{min}$, 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 318-19, Chapter 17. The load level corresponding to the controlling failure mode is listed. (e.g. For tension: steel, concrete breakout and pullout; For shear: steel, concrete breakout and pryout). Furthermore, the capacities for concrete breakout strength in tension and pryout strength in shear are calculated using the effective embedment values, h_{ef}, for the selected anchors as noted in the design information tables. Please also reference the installation specifications for more information.

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

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

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

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

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

Tension and Shear Design Strength at Minimum Edge Distance, c_{min} for Screw-Bolt+ in Cracked Concrete[1,2,3,4,5,6,7]

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[1,2,3,4,5,6]

Nominal Anchor Diameter (in.)	Nominal Embed. h_{nom} (in.)	Minimum Concrete Compressive Strength									
		f'c = 2,500 psi		f'c = 3,000 psi		f'c = 4,000 psi		f'c = 6,000 psi		f'c = 8,000 psi	
		ϕN_n Tension (lbs.)	ϕV_{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

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

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

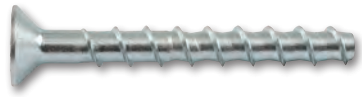
4- Tabular values are permitted for static loads only, seismic loading is not considered with these tables.

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

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

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

ORDERING INFORMATION

Screw-Bolt+

Cat. No. Hex Head Zinc Plated	Cat. No. Hex Head Galvanized	Cat. No. Flat Head Zinc Plated	Anchor Size	Approximate Thread Length	Box Qty.	Ctn. Qty.	20V Max* SDS Plus Rotary Hammers DCH273P2DH 1" L-Shape (Carbide Bits)	20V Max* SDS Plus Rotary Hammers DCH133M2 1" D-Handle (Carbide Bits)	20V Max* SDS Plus Rotary Hammers DCH293R2 1-1/8" L-Shape w/ E-Clutch (Carbide Bits)	Flexvolt SDS Max DCH481X2 1-9/16" w/ E-Clutch (Carbide Bits)
PFM1411000	-	-	1/4" x 1-1/4"	1-1/4"	100	600	DW5517	DW5417	DW5417	-
PFM1411020	-	-	1/4" x 1-3/4"	1-5/8"	100	600	DW5517	DW5417	DW5417	-
PFM1411060	-	-	1/4" x 2-1/4"	1-5/8"	100	600	DW5517	DW5417	DW5417	-
PFM1411080	-	-	1/4" x 2-5/8"	2-1/2"	100	500	DW5517	DW5417	DW5417	-
PFM1411100	-	PFM1411105	1/4" x 3"	2-1/2"	100	500	DW5517	DW5417	DW5417	-
PFM1411160	-	-	3/8" x 1-3/4"	1-3/4"	50	300	DW5527	DW5427	DW5427	-
PFM1411220	-	PFM1411225	3/8" x 2-1/2"	2"	50	300	DW5527	DW5427	DW5427	-
PFM1411240	PFM1461240	PFM1411245	3/8" x 3"	2"	50	250	DW5527	DW5427	DW5427	-
PFM1411280	PFM1461280	PFM1411285	3/8" x 4"	3-1/4"	50	250	DW5527	DW5427	DW5427	-
PFM1411300	PFM1461300	-	3/8" x 5"	3-1/4"	50	250	DW5529	DW5429	DW5429	-
PFM1411320	PFM1461320	-	3/8" x 6"	3-1/4"	50	150	DW5529	DW5429	DW5429	-
PFM1411340	-	-	1/2" x 2"	1-3/4"	50	200	DW5537	DW5437	DW5437	-
PFM1411360*	-	-	1/2" x 2-1/2"	2-1/2"	50	200	DW5537	DW5437	DW5437	-
PFM1411380	-	PFM1411385	1/2" x 3"	2-1/2"	50	150	DW5537	DW5437	DW5437	-
PFM1411420	PFM1461420	PFM1411425	1/2" x 4"	2-1/2"	50	150	DW5537	DW5437	DW5437	-
PFM1411460	PFM1461460	PFM1411465	1/2" x 5"	4-1/4"	25	100	DW5538	DW5438	DW5438	-
PFM1411480	PFM1461480	-	1/2" x 6"	4-1/4"	25	75	DW5538	DW5438	DW5438	-
PFM1411520	PFM1461520	-	1/2" x 8"	4-1/4"	25	100	DW5538	DW5438	DW5438	-
PFM1411540	-	-	5/8" x 3"	2-3/4"	25	100	DW5471	DW5446	DW5471	DW5806
PFM1411580	-	-	5/8" x 4"	3-1/4"	25	100	DW5471	DW5446	DW5471	DW5806
PFM1411600	PFM1461600	-	5/8" x 5"	5"	25	75	DW5471	DW5446	DW5471	DW5806
PFM1411640	PFM1461640	-	5/8" x 6"	5"	25	75	DW5471	DW5446	DW5471	DW5806
PFM1411680	PFM1461680	-	5/8" x 8"	5"	25	50	DW5471	DW5447	DW5471	DW5806
PFM1411700	-	-	3/4" x 3"	3"	20	60	DW5474	DW5453	DW5474	DW5810
PFM1411720	-	-	3/4" x 4"	3"	20	60	DW5474	DW5453	DW5474	DW5810
PFM1411760	-	-	3/4" x 5"	4-1/4"	20	60	DW5474	DW5453	DW5474	DW5810
PFM1411800	PFM1461800	-	3/4" x 6"	4-1/4"	20	60	DW5474	DW5453	DW5474	DW5810
PFM1411840	PFM1461850	-	3/4" x 8"	4-1/4"	10	40	DW5474	DW5455	DW5474	DW5810
PFM1411880	-	-	3/4" x 10"	4-1/4"	10	20	DW5475	DW5455	DW5475	DW5812

Shaded catalog numbers denote sizes which are less than the minimum standard anchor length for Strength Design. Anchors not long enough to meet the minimum nominal embedments published for strength design are outside the scope of ICC-ES ESR-3889.

Catalog numbers with an asterisk (*) denote sizes that meet the minimum anchor length requirement for strength design provided the fixture attachment does not exceed 0.036-inch (0.91mm) in thickness.

The selected anchor length should be long enough to accommodate the attachment thickness and achieve the minimum nominal embedment into the base material required for the application.

The published size includes the nominal diameter and length of the anchor. The length is measured from under the head for hex head parts and from the top of the head for flat head (countersunk) parts.

- Optimum Tool Match
- Maximum Tool Match
- Not Recommended

Impact Wrench Selection Guide

Anchor Setting Information	Nominal Anchor Diameter (Inch)									
	1/4"		3/8"		1/2"		5/8"		3/4"	
Max Impact Wrench Power	150 ft-lbs		300 ft-lbs		300 ft-lbs		700 ft-lbs		700 ft-lbs	
Suggested 20V Max Impact Wrench, Tool Setting / Speed and Cat. No.	FULL	SPEED 1	SPEED 1	SPEED 2	SPEED 1	SPEED 2	SPEED 2	SPEED 3	SPEED 2	SPEED 3
	DCF902	DCF921, DCF922, DCF923, DCF891, DCF892, DCF900	DCF911, DCF913, DCF900	DCF921, DCF922, DCF923, DCF891, DCF892	DCF911, DCF913, DCF900	DCF921, DCF922, DCF923, DCF891, DCF892	DCF900	DCF891, DCF892	DCF900	DCF891, DCF892

DEWALT Impact Wrenches









Cat. No.	DCF901	DCF903	DCF911	DCF913	DCF921	DCF922	DCF923	DCF891	DCF892
Anvil Size	3/8"	1/2"	3/8"	1/2"	1/2"	3/8"	1/2"	1/2"	1/2"
Anvil Type	Hog Ring	Hog Ring	Hog Ring	Hog Ring	Hog Ring	Detent	Hog Ring	Hog Ring	Detent
MAX Fastening Torque	Speed 1: 250 ft-lbs	Speed 1: 250 ft-lbs	Speed 1: 250 ft-lbs	Speed 1: 250 ft-lbs	Speed 1: 100 ft-lbs Speed 2: 300 ft-lbs	Speed 1: 100 ft-lbs Speed 2: 300 ft-lbs	Speed 1: 100 ft-lbs Speed 2: 300 ft-lbs	Speed 1: 100 ft-lbs. Speed 2: 300 ft-lbs. Speed 3: 600 ft-lbs	Speed 1: 100 ft-lbs. Speed 2: 300 ft-lbs. Speed 3: 600 ft-lbs

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, a fully removable.

The 316 Stainless Steel Wedge-Bolt has many unique features and benefits that make it well suited for many applications, both indoors and out. 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 316 Stainless Steel 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.

316 Stainless Steel Wedge-Bolt screw anchors are not recommended for immersion in or long term exposure to 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 size fixture holes in steel
+ 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 contact against the fixture
+ Removable

APPROVALS AND LISTINGS

- Tested in accordance with ASTM E488

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

- Hex washer head

ANCHOR MATERIALS

- Type 316 Stainless Steel

ANCHOR SIZE RANGE (TYP.)

- 1/4" to 1/2" diameters

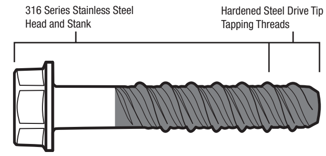
SUITABLE BASE MATERIALS

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

MATERIAL SPECIFICATIONS

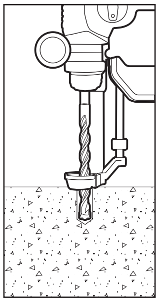
Anchor component	Specification
Anchor Body and hex washer head	Type 316 Stainless Steel[1]

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

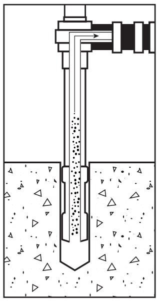


INSTALLATION INSTRUCTIONS

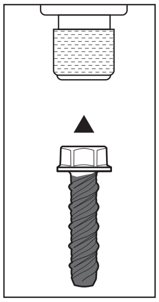
Installation Instructions for 316 Stainless Steel Wedge-Bolt



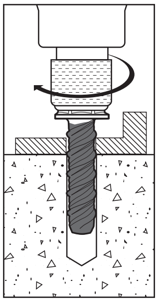
Step 1
Using the proper Wedge-bit size, drill a hole into the base material to the required depth. The tolerances of the Wedge-bit used must meet the requirements of the published Wedge-bit range.



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.

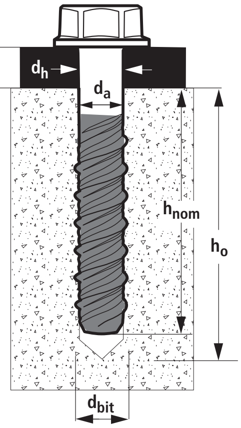


Step 3
Select a powered impact wrench that does not exceed the maximum torque, $T_{inst,max}$ or $T_{impact,max}$, for the selected anchor diameter. Attach an appropriate sized hex socket/driver to the impact wrench. Mount the screw anchor head into the socket.



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

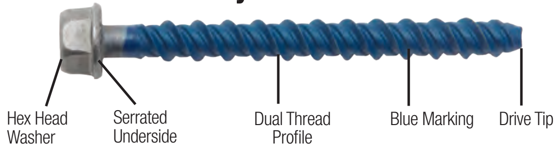


Nomenclature
- d_a = Diameter of Anchor
- d_{bit} = Diameter of Drill Bit
- d_h = Diameter of Clearance Hole
- h = Base Material Thickness. The value of h should be $1.5h_{nom}$ or 3", whichever is greater
- h_{nom} = Minimum Nominal Embedment
- h_o = Minimum Hole Depth

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

INSTALLATION SPECIFICATIONS

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_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)	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)
Max installation torque	$T_{inst,max}$	ft.-lbf. (N-m)	15 (20)	35 (47)	60 (81)
Max impact wrench power (torque)	$T_{impact,max}$	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
Nominal washer diameter	-	in.	37/64	3/4	1-1/16
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.

PERFORMANCE DATA (ASD)

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 uncracked normal weight 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 316 Stainless Steel Wedge-Bolt in Normal-Weight Concrete[1,2,3,4,5]

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 uncracked normal weight 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.
5. Allowable loads for lightweight concrete may be determined by multiplying the tabulated allowable load capacities for normal weight concrete by 0.60.

LOAD ADJUSTMENT FACTORS FOR SPACING AND EDGE DISTANCES[1]

Anchor Installed in Normal-Weight Concrete

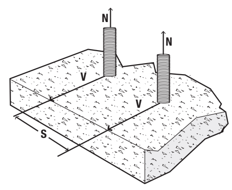
Anchor Dimension	Load Type	Critical Distance (Full Anchor Capacity)	Critical Load Factor	Minimum Distance (Reduced Capacity)	Minimum Load Factor
Spacing (s)	Tension	s_{cr} = 12d	F_{NS} = 1.0	s_{min} = 4d	F_{NS} = 0.50
	Shear	s_{cr} = 12d	F_{VS} = 1.0	s_{min} = 4d	F_{VS} = 0.75
Edge Distance (c)	Tension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

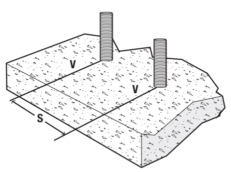
	Dia. (in.)	1/4	3/8	1/2
	s_{cr} (in.)	3	4-1/2	6
	s_{min} (in.)	1	1-1/2	2
Spacing, s (inches)	1	0.50	-	-
	1-1/2	0.63	0.50	-
	2	0.75	0.58	0.50
	2-1/2	0.88	0.67	0.56
	3	1.00	0.75	0.63
	4-1/2	1.00	1.00	0.81
	6	1.00	1.00	1.00



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})

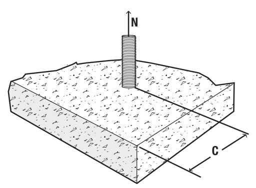
	Dia. (in.)	1/4	3/8	1/2
	s_{cr} (in.)	3	4-1/2	6
	s_{min} (in.)	1	1-1/2	2
Spacing, s (inches)	1	0.75	-	-
	1-1/2	0.81	0.75	-
	2	0.88	0.79	0.75
	2-1/2	0.91	0.83	0.78
	3	1.00	0.88	0.81
	4-1/2	1.00	1.00	0.91
	6	1.00	1.00	1.00



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})

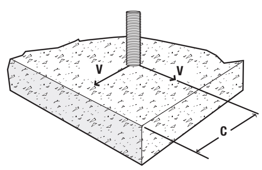
	Dia. (in.)	1/4	3/8	1/2
	c_{cr} (in.)	2	3	4
	c_{min} (in.)	3/4	1-1/8	1-1/2
Edge Distance, c (in.)	3/4	0.70	-	-
	1-1/8	0.79	0.70	-
	1-1/2	0.88	0.76	0.70
	1-7/8	0.97	0.82	0.75
	2	1.00	0.84	0.76
	2-1/4	1.00	0.88	0.79
	3	1.00	1.00	0.88
	4	1.00	1.00	1.00



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]

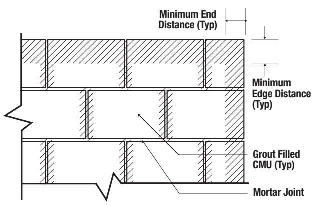
Nominal Anchor Diameter d in.	Minimum Embed. h_{nom} in. (mm)	Minimum Edge Distance in. (mm)	Minimum End Distance in. (mm)	Tension lbs. (kN)		Shear lbs. (kN)		
				f'm = 1,500 psi	f'm = 2,000 psi	Loading Direction	f'm = 1,500 psi	f'm = 2,000 psi
1/4	1-3/4 (44)	3-3/4 (95)	1-1/2 (38)	570 (2.5)	660 (2.9)	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)

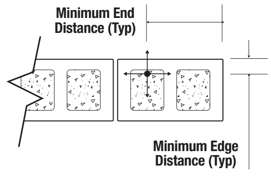


Wall Face
Permissible Anchor Locations
(Un-hatched Area)

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 and Allowable Load Capacities for 316 Stainless Steel Wedge-Bolt Installed in Grout Filled Concrete Masonry Wall Tops[1,2,3,4,5,6]

Nominal Anchor Diameter d in.	Minimum Nominal Embed. Depth h_{nom} in. (mm)	Minimum Edge Distance in. (mm)	Minimum End Distance in. (mm)	Minimum Spacing Distance in. (mm)	Ultimate Load		Allowable Load	
					Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
1/4	2-1/2 (64)	1-1/2 (38)	3 (76)	4 (102)	1,025 (4.6)	625 (2.8)	205 (0.9)	125 (0.6)
3/8	3 (76)	1-1/2 (38)	4 (102)	6 (152)	1,675 (7.5)	1,075 (4.8)	335 (1.5)	215 (1.0)
1/2	4-1/2 (114)	1-3/4 (44)	6 (152)	8 (203)	2,475 (11.0)	1,075 (4.8)	495 (2.2)	215 (1.0)

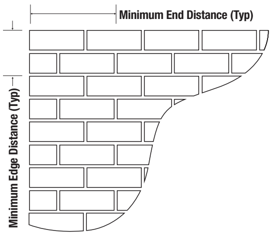


Top of Wall

1. All values are for anchors installed in fully grouted concrete masonry wall construction with materials meeting minimum compressive strength, f'm, of 1,500 psi (10.3 MPa). Concrete masonry units must be light-, medium, or normal-weight conforming to ASTM C90. Allowable loads are based on a safety factor of 5.0.
2. Anchors may be installed in any location in the top of the masonry wall except within 1-1/4-inch from the of the mortar joint (head joint), provided the minimum edge and end distances are maintained.
3. A maximum of two anchors may be installed in a single masonry cell in accordance with the spacing and edge or end distance requirements. Embedment is measured from the outside surface of the concrete masonry unit to the embedded end of the anchor.
4. Spacing distance is measured from the centerline to centerline between two anchors.
5. The edge and end distance is measured from the anchor centerline to the closest unrestrained edge and end of the CMU block, respectively.
6. Allowable shear loads may be applied in any direction.

Ultimate and Allowable Load Capacities for 316 Stainless Steel Wedge-Bolt Installed into Multiple Wythe Solid Clay Brick Masonry[1,2,3]

Nominal Anchor Diameter d in.	Minimum Nominal Embed. Depth h_{nom} in. (mm)	Minimum Edge Distance in. (mm)	Minimum End Distance in. (mm)	Minimum Spacing Distance in. (mm)	Ultimate Load		Allowable Load	
					Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
1/4	2-1/2 (64)	3-1/2 (89)	2-1/2 (64)	4 (102)	1,170 (5.2)	1,380 (6.1)	235 (1.0)	275 (1.2)
3/8	2-3/4 (70)	6 (152)	6 (152)	6 (152)	1,435 (6.4)	2,875 (12.8)	285 (1.3)	575 (2.6)
1/2	3-1/4 (83)	9-1/2 (241)	9-1/2 (241)	8 (203)	1,840 (8.2)	7,655 (34.1)	370 (1.6)	1,530 (6.8)



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 as 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.
3. 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 (in.)	Thread Length (in.)	Pack Qty.	Carton Qty.
07870-PWR	1/4 x 2	1-3/4	100	600
07872-PWR	1/4 x 3	2-3/4	100	500
07876-PWR	1/4 x 4	2-3/4	100	500
07878-PWR	1/4 x 5	2-3/4	100	500
07880-PWR	3/8 x 2-1/2	2-1/4	50	300
07882-PWR	3/8 x 3	2-1/4	50	250
07884-PWR	3/8 x 4	3-1/2	50	250
07886-PWR	3/8 x 5	3-1/2	50	250
07888-PWR	1/2 x 3	2-3/4	50	150
07890-PWR	1/2 x 4	2-3/4	50	150
07892-PWR	1/2 x 5	3-3/4	25	100
07894-PWR	1/2 x 6	3-3/4	25	75

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	Pack Qty.	Carton Qty.
01312-PWR	SDS 1/4" x 4"	2"	1	250
01314-PWR	SDS 1/4" x 6"	4"	1	100
01315-PWR	SDS 1/4" x 8"	6"	1	-
01316-PWR	SDS 3/8" x 6"	4"	1	200
01318-PWR	SDS 3/8" x 8"	6"	1	100
01332-PWR	SDS 3/8" x 12"	10"	1	50
01319-PWR	SDS 3/8" x 18"	16"	1	50
01320-PWR	SDS 1/2" x 6"	4"	1	150
01322-PWR	SDS 1/2" x 10"	8"	1	50
01334-PWR	SDS 1/2" x 12"	10"	1	50
01335-PWR	SDS 1/2" x 18"	16"	1	50
01340-PWR	Spline 1/2" x 13"	8"	1	20
01342-PWR	Spline 1/2" x 16"	11"	1	-
01354-PWR	SDS-Max 1/2" x 13"	8"	1	20
01370-PWR	HD Straight Shank 1/4" x 4"	2-3/4"	1	100
01372-PWR	HD Straight Shank 1/4" x 6"	4"	1	-
01380-PWR	HD Straight Shank 3/8" x 6"	4"	1	-
01384-PWR	HD Straight Shank 3/8" x 13"	11"	1	-
01390-PWR	HD Straight Shank 1/2" x 6"	4"	1	-
01394-PWR	HD Straight Shank 1/2" x 13"	11"	1	50

Suggested Impact Wrench and Socket

Nominal Anchor Size	Socket Size	Impact Rated Socket		20V Max* Impact Wrenches	
1/4"	7/16"	DW2285		DCF923GP2 3/8" ATOMIC Compact Impact Wrench with Hog Ring Anvil	
3/8"	9/16"	DW22872		DCF921GP2 1/2" ATOMIC Compact Impact Wrench with Hog Ring Anvil	
1/2"	3/4"	DW22902		DCF891P2 1/2" Mid-Range Impact Wrench with Hog Ring Anvil	

GENERAL INFORMATION

ULTRACON+®

Concrete Screw Anchor

PRODUCT DESCRIPTION

The UltraCon+ fastening system is a complete family of screw anchors for light to medium duty applications in concrete, masonry block, brick, and wood base materials. The UltraCon+ is fast and easy to install and provides a neat, finished appearance. The UltraCon+ screw anchor is engineered with matched tolerance drill bits and installation tools designed to meet the needs of the user and also provide optimum performance. The UltraCon+ features a gimlet point for self-drilling into wood base materials without pre-drilling.

The UltraCon+ screw anchor is available in carbon steel with a Stalgard coating in several colors. Head styles include a slotted hex washer head, Phillips flat head, Phillips Trimfit flat head and Hex flange head.

GENERAL APPLICATIONS AND USES

- Window and door frames
- Shutters and guards
- Lighting fixtures
- Thresholds
- Joint flashing
- Screened enclosures

FEATURES AND BENEFITS

+ Available in several head styles
+ Several colors and finishes to match application
+ Removable (reusable in wood)
+ Gimlet point for self drilling into wood
+ Does not exert expansion forces
+ No hole spotting required
+ Good corrosion protection with Stalgard coating
+ High-low thread design for greater stability and grip

APPROVALS AND LISTINGS

- International Code Council, Evaluation Service (ICC-ES), ESR-3068 for uncracked concrete, ESR-3196 for masonry, ESR-3042 for wood, and ESR-3213 for chemically treated lumber
- Code compliant with the International Building Code/International Residential Code: 2021 IBC/IRC, 2018 IBC/IRC, 2015 IBC/IRC, and 2012 IBC/IRC
- Tested in accordance with ACI ACI 355.2/ASTM E488 and ICC-ES AC193 for use in concrete, ICC-ES AC106 for use in masonry, ICC-ES AC233 for use in wood, and ICC-ES AC257 for use in pressure treated lumber
- Evaluated and qualified by an accredited independent testing laboratory for reliability against brittle failure, e.g. hydrogen embrittlement
- City of Los Angeles, LABC and LARC Supplement (within ICC-ES evaluation reports)
- Miami-Dade County Notice of Acceptance (NOA) No. 21-0113.01
- Florida Statewide Approval FL29080

GUIDE SPECIFICATIONS

CSI Divisions: 03 16 00 - Concrete Anchors, 04 05 19.16 - Masonry Anchors, 05 05 19 - Post-Installed Concrete Anchors and 06 05 23 - Wood, Plastic, and Composite Fastenings. Concrete Screw Anchors shall be UltraCon+ anchors as supplied by DEWALT, Towson, MD.

MATERIAL SPECIFICATIONS

Anchor Component	Specification
Anchor Body	Case hardened carbon steel
Coating/Plating/Finish	Stalgard® (various colors) 1000 hour rating for ASTM B117 salt spray test

SECTION CONTENTS

ULTRACON+

HEAD STYLES

- Slotted Hex Washer Head
- Hex Flange Head
- Phillips Flat Head
- TrimFit® Flat Head

ANCHOR MATERIALS

- Carbon Steel with Stalgard Coating

ANCHOR SIZE RANGE (TYP.)

- 3/16" and 1/4" diameters in various lengths

SUITABLE BASE MATERIALS

- Normal-weight Concrete
- Lightweight Concrete
- Grouted Concrete Masonry
- Hollow Concrete Masonry (CMU)
- Solid Brick Masonry
- Wood

CODE LISTED ICC-ES ESR-3068 UNCRACKED CONCRETE
CODE LISTED ICC-ES ESR-3196 MASONRY
CODE LISTED ICC-ES ESR-3042 WOOD-TO-WOOD
CODE LISTED ICC-ES ESR-3213 CHEMICALLY TREATED LUMBER
MIAMI-DADE COUNTY APPROVED
DDA DEWALT DESIGN ASSIST™

INSTALLATION SPECIFICATIONS

UltraCon+ Carbon Steel Hex Head

Dimension	Nominal Anchor Diameter, d	
	3/16"	1/4"
UltraCon+ Drill Bit Size, d_{bit} (in.)	5/32"	3/16"
Typ. Fixture Clearance Hole, d_h (in.)	1/4"	5/16"
Head Height (in.)	7/64"	9/64"
Hex Head Wrench/Socket Size	1/4"	5/16"
Washer O.D., d_w (in.)	11/32"	13/32"
Washer Thickness, (in.)	1/32"	1/32"

UltraCon+ Carbon Steel Flat Head

Dimension	Nominal Anchor Diameter, d	
	3/16"	1/4"
UltraCon+ Drill Bit Size, d_{bit} (in.)	5/32"	3/16"
Typ. Fixture Clearance Hole, d_h (in.)	1/4"	5/16"
Phillips Head O.D., (in.)	3/8"	1/2"
Phillips Head Height, (in.)	9/64"	3/16"
Phillips Bit Size (No.)	2	3

UltraCon+ Carbon Steel TrimFit Flat Head

Dimension	Nominal Anchor Diameter, d
	1/4"
UltraCon+ Drill Bit Size, d_{bit} (in.)	3/16"
Typ. Fixture Clearance Hole, d_h (in.)	3/8"
Phillips TrimFit Head O.D. (in.)	13/32
Phillips TrimFit Head Height (in.)	3/16"
Phillips Bit Size, (No.)	#3

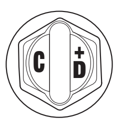
UltraCon+ Carbon Steel Hex Flange Head

Dimension	Nominal Anchor Diameter, d
	1/4"
UltraCon+ Drill Bit Size, d_{bit} (in.)	3/16"
Typ. Fixture Clearance Hole, d_h (in.)	5/16"
Head Height Including Flange, (in.)	15/64"
Hex Head Wrench/Socket Size, (in.)	5/16"
Washer O.D., (in.)	39/64"

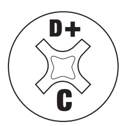
1. For minimum nominal embedment depths, h_{nom}, see the performance data tables. The minimum hole depth, h_o, is 1/4-inch more than the selected nominal embedment depth.
2. In light gauge steel material (0.036 / 20 gauge and thinner), the clearance hole can be the same diameter as the drill bit.
3. Pre-drilling is not required for UltraCon+ screw anchors into wood base materials (but can be considered).

Head Marking

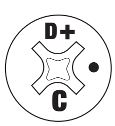
Hex Washer Head



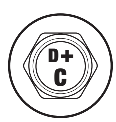
Philips Flat Head



TrimFit Flat Head

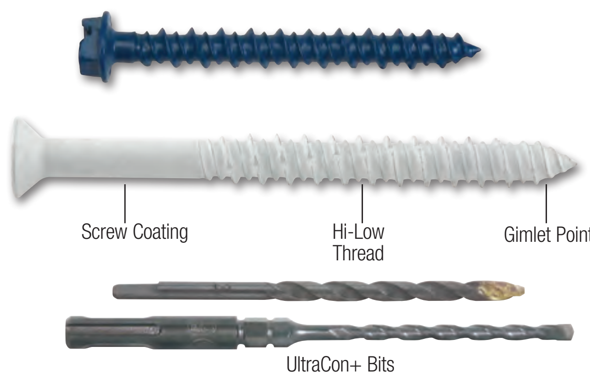


Hex Flange Head



Legend
'D' Marking = UltraCon+
'+' Symbol = Strength Design Compliant Anchor
'C' Mark = Length Identification Mark
'•' Mark = TrimFit Flat Head Identification

Matched Tolerance System



UltraCon+ Length Code Identification System

Length ID marking on head		□	A	B	C	D	E	F	G	H	I	J
Overall anchor length ℓ_{anch} (inches)	From	1"	1-1/2"	2"	2-1/2"	3"	3-1/2"	4"	4-1/2"	5"	5-1/2"	6"
	Up to but not including	1-1/2"	2"	2-1/2"	3"	3-1/2"	4"	4-1/2"	5"	5-1/2"	6"	6-1/2"

Installation Table for UltraCon+ in Concrete and Masonry[1,2]

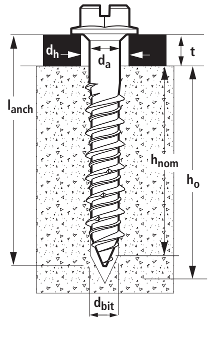
Anchor Property/Setting Information	Notation	Units	Nominal Anchor Size (in.)	
			3/16	1/4
Nominal anchor shank diameter	d_a	in.	0.145	0.185
Nominal drill bit diameter	d_{bit}	in.	5/32 UltraCon+ Bit	3/16 UltraCon+ Bit
UltraCon+ bit tolerance range	-	in.	0.170 to 0.176	0.202 to 0.206
Hex head socket size	-	in.	1/4	5/16
Phillips bit size (No.)	-	-	2	3
Maximum manual installation torque	$T_{inst,max}$	ft-lbs	3	5
Maximum powered installation torque	T_{screw}	ft-lbs	Not applicable using UltraCon+ installation socket tool	

1. For minimum nominal embedment depths, h_{nom}, see the performance data tables. The minimum hole depth, h_o, is 1/4-inch more than the selected nominal embedment depth.
2. See Strength Design Information for installation specifications in strict accordance with ICC-ES ESR-3068.

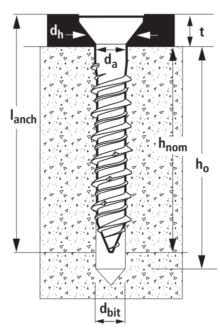
Installation Table for UltraCon+ in Wood

Anchor Property/Setting Information	Notation	Units	Nominal Anchor Size (in.)	
			3/16	1/4
Nominal anchor shank diameter	d_a	in.	0.145	0.185
Nominal drill bit diameter	d_{bit}	in.	Pre-drilling is not required for UltraCon+ into wood base materials (but can be considered)	
Hex head socket size	-	in.	1/4	5/16
Phillips bit size (No.)	-	-	2	3

UltraCon+ Anchor Detail



Hex Head



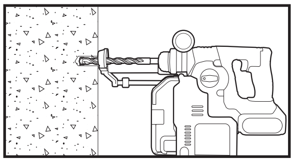
Flat Head

Nomenclature

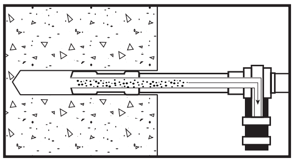
d_a = Diameter of anchor shank
d_{bit} = Diameter of drill bit
d_{ht} = Diameter of fixture clearance hole
h_{nom} = Minimum embedment depth
h = Base material thickness
the minimum value of h should be $1.5h_{nom}$ or 3" whichever is greater
h_o = Minimum hole depth

INSTALLATION INSTRUCTIONS

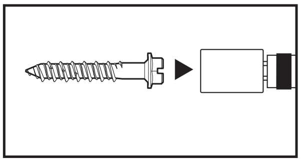
Installation Instruction for UltraCon+



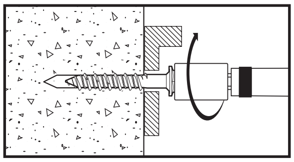
Step 1
Using the proper drill bit size, drill a hole into the base material to the required depth, h_o, which is a 1/4-inch deeper than the minimum embedment depth, h_{nom}.



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
Attach a UltraCon+ installation socket tool for the selected anchor size to a percussion drill and set the drill to rotary only mode. Mount the screw anchor head into the socket. For flat head versions a bit tip must be used with the socket tool.



Step 4
Place the point of the UltraCon+ through the fixture into the pre-drilled hole and drive the anchor in one steady continuous motion until it is fully seated at the proper embedment. The driver will automatically disengage from the head of the screw anchor.

PERFORMANCE DATA (ASD)

Ultimate and Allowable Load Capacities for UltraCon+ in Normal-Weight Concrete[1,2,3,4]

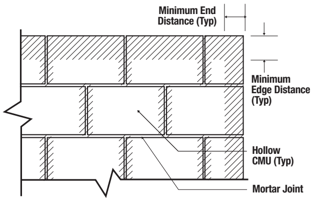
Nominal Anchor Diameter d in.	Minimum Embed. Depth h_{nom} in. (mm)	Minimum Edge Distance in. (mm)	Minimum Spacing in. (mm)	Minimum Concrete Compressive Strength											
				f'c = 2,500 psi (17.3 Mpa)				f'c = 3,000 psi (20.7 Mpa)				f'c = 4,000 psi (27.6 Mpa)			
				Ultimate		Allowable		Ultimate		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)
3/16	1-3/4 (44)	1 (25)	1 (25)	1,080 (4.8)	305 (1.3)	270 (1.2)	75 (0.3)	1,145 (5.0)	325 (1.4)	285 (1.3)	80 (0.4)	1,245 (5.5)	325 (1.4)	310 (1.4)	80 (0.4)
	1-3/4 (44)		1-1/8 (29)	1,190 (5.2)	305 (1.3)	295 (1.3)	75 (0.3)	1,255 (5.5)	325 (1.4)	315 (1.4)	80 (0.4)	1,370 (6.0)	325 (1.4)	340 (1.5)	80 (0.4)
	1-3/4 (44)		2-1/4 (57)	1,365 (6.0)	600 (2.6)	340 (1.5)	150 (0.7)	1,440 (6.3)	635 (2.8)	360 (1.6)	160 (0.7)	1,570 (6.9)	635 (2.8)	395 (1.7)	160 (0.7)
	1 (25)		3 (76)	580 (2.6)	435 (1.9)	145 (0.7)	110 (0.5)	615 (2.7)	460 (2.0)	155 (0.7)	115 (0.5)	670 (2.9)	460 (2.0)	170 (0.7)	115 (0.5)
	1-3/8 (35)			815 (3.6)	455 (2.0)	205 (0.9)	115 (0.5)	860 (3.8)	485 (2.1)	215 (1.0)	120 (0.5)	940 (4.1)	485 (2.1)	235 (1.0)	120 (0.5)
	1-3/4 (44)		3-3/8 (86)	1,365 (6.0)	600 (2.6)	340 (1.5)	150 (0.7)	1,440 (6.3)	635 (2.8)	360 (1.6)	160 (0.7)	1,570 (6.9)	635 (2.8)	395 (1.7)	160 (0.7)
	1-3/4 (44)	2-1/2 (64)	1-1/8 (29)	1,465 (6.4)	1,200 (5.3)	365 (1.6)	300 (1.3)	1,550 (6.8)	1,265 (5.6)	390 (1.7)	315 (1.4)	1,690 (7.4)	1,265 (5.6)	425 (1.9)	315 (1.4)
	1-3/4 (44)		2-1/4 (57)	1,465 (6.4)	1,200 (5.3)	365 (1.6)	300 (1.3)	1,550 (6.8)	1,265 (5.6)	390 (1.7)	315 (1.4)	1,690 (7.4)	1,265 (5.6)	425 (1.9)	315 (1.4)
	1 (25)		3 (76)	580 (2.6)	640 (2.8)	145 (0.7)	160 (0.7)	615 (2.7)	680 (3.0)	155 (0.7)	170 (0.8)	670 (2.9)	680 (3.0)	170 (0.7)	170 (0.8)
	1-3/8 (35)			1,220 (5.4)	735 (3.2)	305 (1.4)	185 (0.8)	1,290 (5.7)	775 (3.4)	325 (1.4)	195 (0.9)	1,405 (6.2)	775 (3.4)	350 (1.6)	195 (0.9)
	1-3/4 (44)		3-3/8 (86)	1,465 (6.4)	1,200 (5.3)	365 (1.6)	300 (1.3)	1,550 (6.8)	1,265 (5.6)	390 (1.7)	315 (1.4)	1,690 (7.4)	1,265 (5.6)	425 (1.9)	315 (1.4)
1/4	1-3/4 (44)	1 (25)	1 (25)	1,265 (5.6)	340 (1.5)	315 (1.4)	85 (0.4)	1,360 (6.0)	370 (1.6)	340 (1.5)	95 (0.4)	1,525 (6.7)	370 (1.6)	380 (1.7)	95 (0.4)
	1-3/4 (44)		1-1/2 (38)	1,265 (5.6)	385 (1.7)	315 (1.4)	95 (0.4)	1,325 (5.8)	415 (1.8)	340 (1.5)	105 (0.5)	1,525 (6.7)	415 (1.8)	380 (1.7)	105 (0.5)
	1-3/4 (44)		3 (76)	1,720 (7.6)	420 (1.8)	430 (1.9)	105 (0.5)	1,850 (8.1)	450 (2.0)	465 (2.0)	115 (0.5)	2,075 (9.1)	450 (2.0)	520 (2.3)	115 (0.5)
	1 (25)		4 (102)	770 (3.4)	495 (2.2)	195 (0.9)	125 (0.6)	830 (3.7)	530 (2.3)	210 (0.9)	135 (0.6)	930 (4.1)	530 (2.3)	235 (1.0)	135 (0.6)
	1-3/8 (35)			1,105 (4.9)	640 (2.8)	275 (1.2)	160 (0.7)	1,190 (5.2)	690 (3.0)	300 (1.3)	175 (0.8)	1,335 (5.9)	690 (3.0)	335 (1.5)	175 (0.8)
	1-3/4 (44)			1,975 (8.7)	645 (2.8)	495 (2.2)	160 (0.7)	2,120 (9.3)	690 (3.0)	530 (2.3)	175 (0.8)	2,380 (10.5)	690 (3.0)	595 (2.6)	175 (0.8)
	1-3/4 (44)	2-1/2 (64)	1-1/2 (38)	2,200 (9.7)	1,590 (7.0)	550 (2.4)	400 (1.8)	2,365 (10.4)	1,710 (7.5)	590 (2.6)	430 (1.9)	2,650 (11.7)	1,710 (7.5)	665 (2.9)	430 (1.9)
	1-3/4 (44)		3 (76)	2,200 (9.7)	1,635 (7.2)	550 (2.4)	410 (1.8)	2,365 (10.4)	1,755 (7.7)	590 (2.6)	440 (1.9)	2,650 (11.7)	1,755 (7.7)	665 (2.9)	440 (1.9)
	1 (25)		4 (102)	805 (3.5)	1,260 (5.6)	200 (0.9)	315 (1.4)	865 (3.8)	1,355 (6.0)	215 (1.0)	340 (1.5)	970 (4.3)	1,355 (6.0)	245 (1.1)	340 (1.5)
	1-3/8 (35)			1,755 (7.7)	1,635 (7.2)	440 (1.9)	410 (1.8)	1,885 (8.3)	1,755 (7.7)	470 (2.1)	440 (1.9)	2,115 (9.3)	1,755 (7.7)	530 (2.3)	440 (1.9)
	1-3/4 (45)			2,290 (10.1)	1,635 (7.2)	570 (2.5)	410 (1.8)	2,460 (10.8)	1,755 (7.7)	615 (2.7)	440 (1.9)	2,650 (11.7)	1755 (7.7)	665 (2.9)	440 (1.9)

1. Tabulated Ultimate 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 an applied safety factor of 4.0. Consideration of safety factors of 10 or higher may be necessary depending on the application, such as life safety or overhead.
3. Linear interpolation may be used to determine allowable loads for intermediate compressive strengths.
4. For lightweight concrete multiply tabulated allowable load values by a reduction factor of 0.60.

Ultimate and Allowable Load Capacities for UltraCon+ Anchors Installed in the Face of Hollow Concrete Masonry[1,2,3,4]

Nominal Anchor Diameter d in.	Minimum Embed. Depth h_{nom} in. (mm)	Minimum Edge Distance in. (mm)	Minimum End Distance in. (mm)	Minimum Spacing in. (mm)	Minimum ASTM C90 Block Type	Ultimate Load		Allowable Load	
						Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
3/16	1-1/4 (32)	1 (25)	2 (51)	1-1/2 (38)	Normal Weight	740 (3.3)	405 (1.8)	150 (0.7)	80 (0.4)
	1-1/4 (32)			3 (76)	Normal Weight	815 (3.6)	585 (2.6)	165 (0.7)	115 (0.5)
	1-1/4 (32)			6 (152)	Normal Weight	815 (3.6)	585 (2.6)	165 (0.7)	115 (0.5)
	1 (25)	2 (51)	2 (51)	1-1/2 (38)	Lightweight	300 (1.3)	460 (2.1)	55 (0.3)	90 (0.4)
	1 (25)			3 (76)	Lightweight	340 (1.5)	460 (2.1)	65 (0.3)	90 (0.4)
	1-1/4 (32)			1-1/2 (38)	Normal Weight	740 (3.3)	700 (3.1)	150 (0.7)	140 (0.6)
	1-1/4 (32)	2-1/2 (64)	2-1/2 (64)	1-1/8 (29)	Normal Weight	790 (3.5)	935 (4.1)	160 (0.7)	185 (0.8)
	1-1/4 (32)			2-1/4 (57)	Normal Weight	790 (3.5)	935 (4.1)	160 (0.7)	185 (0.8)
	1-1/4 (32)			6 (152)	Normal Weight	790 (3.5)	935 (4.1)	160 (0.7)	185 (0.8)
	1 (25)	3 (76)	3 (76)	1-1/2 (38)	Lightweight	385 (1.8)	670 (3.0)	80 (0.4)	135 (0.6)
	1 (25)			3 (76)	Lightweight	440 (2.0)	670 (3.0)	90 (0.4)	135 (0.6)
1/4	1-1/4 (32)	1 (25)	2 (51)	1-1/2 (38)	Normal Weight	725 (3.2)	475 (2.1)	145 (0.6)	95 (0.4)
	1-1/4 (32)			3 (76)	Normal Weight	940 (4.1)	800 (3.5)	190 (0.8)	160 (0.7)
	1-1/4 (32)			6 (152)	Normal Weight	725 (3.2)	690 (3.0)	145 (0.6)	140 (0.6)
	1 (25)	2 (51)	2 (51)	2 (51)	Lightweight	435 (1.9)	530 (2.4)	90 (0.4)	90 (0.4)
	1 (25)			4 (102)	Lightweight	495 (2.2)	530 (2.4)	100 (0.4)	90 (0.4)
	1-1/4 (32)			2 (51)	Normal Weight	760 (3.4)	740 (3.3)	150 (0.6)	150 (0.7)
	1-1/4 (32)			4 (102)	Normal Weight	950 (4.2)	740 (3.3)	190 (0.8)	150 (0.7)
	1-1/4 (32)	2-1/2 (64)	2-1/2 (64)	1-1/2 (38)	Normal Weight	800 (3.5)	1,220 (5.4)	160 (0.7)	245 (1.1)
	1-1/4 (32)			3 (76)	Normal Weight	880 (3.9)	1,450 (6.4)	175 (0.8)	290 (1.3)
	1-1/4 (32)			6 (152)	Normal Weight	880 (3.9)	1,450 (6.4)	175 (0.8)	290 (1.3)
	1 (25)	3 (76)	3 (76)	2 (51)	Lightweight	510 (2.3)	820 (3.6)	100 (0.4)	165 (0.7)
	1 (25)			4 (102)	Lightweight	580 (2.6)	820 (3.6)	115 (0.5)	165 (0.7)

1. Tabulated load values are for anchors installed in minimum 8-inch-wide, Type II, light weight or normal weight concrete masonry units conforming to ASTM C90 that have reached the minimum designated ultimate compressive strength at the time of installation (f'm ≥ 2,000 psi). Mortar must be Grade N,S or M..
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. Allowable shear loads into the face shell of a masonry wall may be applied in any direction.
4. The tabulated values are applicable for anchors installed into the ends of concrete masonry units (e.g. wall opening) where minimum edge distances are maintained

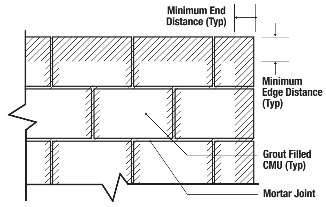


Wall Face
Permissible Anchor Locations
(Un-hatched Area)

Ultimate and Allowable Load Capacities for UltraCon+ Anchors Installed in the Face of Grout-Filled Concrete Masonry[1,2,3,4]

Nominal Anchor Diameter d	Minimum Embed. Depth h_{nom} in. (mm)	Minimum Edge Distance in. (mm)	Minimum End Distance in. (mm)	Minimum Spacing in. (mm)	Installation Location	Minimum ASTM C90 Block Type	Ultimate Load		Allowable Load	
							Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
3/16	1-3/4 (44)	1 (25)	2 (51)	1-1/2 (38)	Face	Normal Weight	510 (2.2)	435 (1.9)	100 (0.4)	85 (0.4)
	1-3/4 (44)			3-3/8 (86)	Face	Normal Weight	1,415 (6.2)	435 (1.9)	285 (1.2)	85 (0.4)
	2-1/4 (57)			4-1/2 (114)	Face	Normal Weight	2,080 (9.1)	755 (3.3)	415 (1.8)	150 (0.7)
	1-3/4 (44)	2-1/2 (64)	2-1/2 (64)	3-3/8 (86)	Face	Normal Weight	1,415 (6.2)	1,105 (4.9)	285 (1.2)	220 (1.0)
	1-3/4 (44)			3-9/16 (91)	Face	Normal Weight	1,485 (6.5)	1,260 (5.5)	295 (1.3)	250 (1.1)
	2-1/4 (57)			4-1/2 (114)	Face	Normal Weight	2,080 (9.1)	1,260 (5.5)	415 (1.8)	250 (1.1)
	1-1/2 (38)	8 (203)	3 (76)	3 (76)	Mortar Joint	Lightweight	625 (2.8)	660 (2.9)	125 (0.6)	130 (0.6)
	1-1/2 (38)	3 (76)	3 (76)	3 (76)	Face	Lightweight	410 (1.8)	600 (2.7)	80 (0.4)	120 (0.5)
1/4	1-3/4 (44)	1 (25)	2 (51)	1-1/2 (38)	Face	Normal Weight	980 (4.3)	460 (2.0)	195 (0.9)	90 (0.4)
	1-3/4 (44)			4 (102)	Face	Normal Weight	1,855 (8.2)	1,045 (4.6)	370 (1.6)	210 (0.9)
	1-3/4 (44)	2-1/2 (64)	2-1/2 (64)	4 (102)	Face	Normal Weight	1,980 (8.7)	1,450 (6.4)	395 (1.7)	290 (1.3)
	2-1/4 (57)			4 (102)	Face	Normal Weight	3,135 (13.8)	1,440 (6.3)	625 (2.8)	290 (1.3)
	1-1/2 (38)	8 (203)	3 (76)	4 (102)	Mortar Joint	Lightweight	730 (3.3)	1,010 (4.5)	145 (0.7)	200 (0.9)
	1-1/2 (38)	3 (76)	3 (76)	4 (102)	Face	Lightweight	650 (2.9)	1,010 (4.5)	130 (0.6)	200 (0.9)

1. Tabulated load values for anchors installed in lightweight concrete masonry units are based on minimum 6-inch-wide, Type II block conforming to ASTM C90 that have reached the minimum designated ultimate compressive strength at the time of installation (f'm ≥ 1,500 psi). Mortar must be Grade N, S or M.
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. Allowable shear loads into the face shell of a masonry wall may be applied in any direction
4. The tabulated values are applicable for anchors installed into the ends of concrete masonry units (e.g. wall opening) where minimum edge distances are maintained.



Wall Face
Permissible Anchor Locations
(Un-hatched Area)

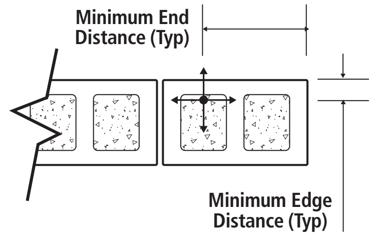
MECHANICAL ANCHORS

ULTRACON+®
Concrete Screw Anchor

Ultimate and Allowable Load Capacities for UltraCon+ Anchors Installed into the Tops of Grout Filled Concrete Masonry Walls[1,2,3]

Nominal Anchor Diameter d in.	Minimum Embed. h_{nom} in. (mm)	Minimum Edge Distance in. (mm)	Minimum End Distance in. (mm)	Minimum ASTM C90 Block Type	Ultimate Loads		Allowable Loads	
					Tension lbs (kN)	Shear lbs (kN)	Tension lbs (kN)	Shear lbs (kN)
3/16	1-1/2 (38)	1-1/2 (38)	3 (76)	Lightweight	450 (2.0)	510 (2.3)	90 (0.4)	100 (0.5)
1/4	1-1/2 (38)	1-1/2 (38)	3 (76)	Lightweight	825 (3.7)	780 (3.5)	165 (0.7)	155 (0.7)

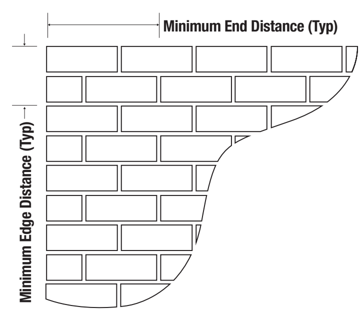
1. Tabulated load values are for 3/16-inch and 1/4-inch anchors installed in minimum 6-inch-wide, Type II, light weight concrete masonry units conforming to ASTM C90 that have reached the minimum designated ultimate compressive strength at the time of installation (f'm ≥ 1,500 psi). Mortar must be Grade N, S or M.
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. The tabulated values are applicable to anchors installed at a critical spacing between anchors of 16 times the anchor diameter.



Allowable Load Capacities for UltraCon+ Anchors Installed in Clay Brick Masonry[1,2,3,4,5]

Nominal Anchor Diameter d in.	Minimum Embed. h_v in. (mm)	Minimum Edge Distance in. (mm)	Minimum End Distance in. (mm)	Installation Location	Tension lbs. (kN)	Shear lbs. (kN)
3/16	1-1/2 (38)	1-3/4 (45)	1-3/4 (45)	Face	380 (1.7)	165 (0.7)
				Mortar Joint	300 (1.3)	190 (0.8)
1/4				Face	605 (2.7)	270 (1.2)
				Mortar Joint	200 (0.9)	155 (0.7)

1. Tabulated load values are for anchors installed in multiple wythe, minimum Grade SW, solid clay brick masonry walls conforming to ASTM C62. Mortar must be Type N, S or M. 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 necessary depending upon the application such as lifesafety or overhead.
3. Allowable shear loads into the face or mortar joint of the brick masonry wall may be applied in any direction.
4. The tabulated values are applicable for anchors installed at a critical spacing between anchors of 12 times the anchor diameter.
5. The tabulated values are applicable for anchors installed into the ends of masonry walls (e.g. wall opening) where minimum edge distances are maintained.



Average Withdrawal Capacity and Average Bending Yield Moment of UltraCon+ in Wood[1,2]

Nominal Anchor Diameter d in.	Minimum Embed. h_v in. (mm)	Minimum Edge Distance in. (mm)	Withdrawal Capacity[1] lbs. (kN)	
			DFL	SYP
3/16	1 (25)	1-3/4 (45)	540 (2.4)	-
	1-1/2 (38)	1-3/4 (45)	820 (3.7)	-
1/4	1 (25)	1-3/4 (45)	680 (3.0)	260 (1.6)
	1-1/2 (38)	1-3/4 (45)	1,050 (4.7)	735 (3.3)

1. Ultimate load capacities are based on laboratory tests and must be reduced by a minimum safety factor of 3.0 or greater to determine allowable working load.
2. Tests in Douglas-Fir Larch (DFL) with minimum Specific Gravity of 0.42 and tests in Southern Yellow Pine (SYP) with minimum Specific Gravity of 0.55; screws oriented tangential to wood grain.

STRENGTH DESIGN INFORMATION

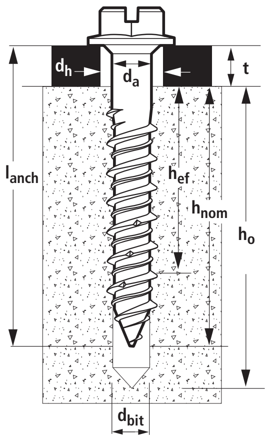
Installation Table for UltraCon+ in Concrete[1]

Anchor Property/Setting Information	Notation	Units	3/16	1/4
Nominal anchor shank diameter	d_a	in. (mm)	0.145 (3.7)	0.185 (4.7)
Nominal drill bit diameter	d_{bit}	in. (mm)	5/32 UltraCon+ Bit	3/16 UltraCon+ Bit
UltraCon+ bit tolerance range	-	in.	0.170 to 0.176	0.202 to 0.206
Minimum nominal embedment depth	h_{nom}	in. (mm)	1-3/4 (44)	1-3/4 (44)
Effective embedment	h_{ef}	in. (mm)	1.23 (31)	1.23 (31)
Minimum hole depth	h_{hole}	in. (mm)	h_{nom} + 1/4 (6)	h_{nom} + 1/4 (6)
Minimum concrete member thickness	h_{min}	in. (mm)	3-1/4 (83)	3-1/4 (83)
Minimum overall anchor length[2]	ℓ_{anch}	in. (mm)	2-1/4 (57)	2-1/4 (57)
Minimum edge distance	c_{min}	in. (mm)	1-3/4 (44)	1-3/4 (44)
Minimum spacing distance	s_{min}	in. (mm)	1 (25)	2 (51)
Maximum manual installation torque	$T_{inst,max}$	ft-lbs	3	5
Maximum powered installation torque	T_{screw}	ft-lbs	Not applicable using UltraCon+ installation socket tool	
Phillips bit size (No.)	-	-	2	3

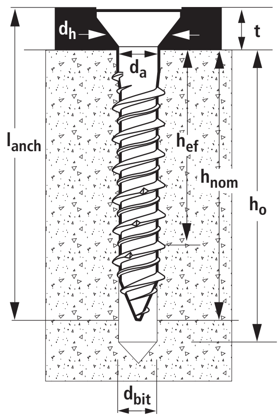
For SI: 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m.

1. The Information presented in this table is to be used in conjunction with the design criteria of ACI 318 (-19 and -14) Chapter 17 or ACI 318-11 Appendix D, as applicable.
2. The minimum overall anchor length for the hex head versions can be 1.75-inch (44 mm) provided the fixture does not exceed 0.036-inch (0.91mm) in thickness.

UltraCon+ Anchor Detail



Hex Head



Flat Head

Tension Design Information for UltraCon+ Anchor in Concrete[1,2]

CODE LISTED
ICC-ES ESR-3068

Design Characteristic	Notation	Units	Nominal Anchor Size (Inch)	
			3/16	1/4
Anchor category	1,2 or 3	-	1	1
Nominal embedment depth	h_{nom}	in. (mm)	1-3/4 (44)	1-3/4 (44)
Effective embedment	h_{ef}	in. (mm)	1.23 (31.2)	1.23 (31.2)
STEEL STRENGTH IN TENSION (ACI 318-19 17.6.1, ACI 318-14 17.4.1 or ACI 318-11 D.5.1)[4]				
Minimum specified ultimate tensile strength (neck)	f_{uta}	psi (N/mm²)	100,000 (689)	100,000 (689)
Effective tensile stress area (neck)	$A_{se,N}$	in² (mm²)	0.0162 (10.4)	0.0268 (17.3)
Steel strength in tension[8]	N_{sa}	lb (kN)	1,620 (7.2)	2,680 (12.0)
Reduction factor for steel strength[3]	ϕ	-	0.65	
CONCRETE BREAKOUT STRENGTH IN TENSION (ACI 318-19 17.6.2, ACI 318-14 17.4.2 or ACI 318-11 D.5.2)[7]				
Effectiveness factor for concrete breakout	k_{uncr}	-	24	24
Modification factor for cracked and uncracked concrete[5]	$\Psi_{c,N}$	-	1.0 See note 5	1.0 See note 5
Critical edge distance (uncracked concrete only)	c_{ac}	in. (mm)	3 (76)	3 (76)
Reduction factor for concrete breakout strength[3]	ϕ	-	0.65 (Condition B)	
PULLOUT STRENGTH IN TENSION (ACI 318-19 17.6.3, ACI 318-14 17.4.3 or ACI 318-11 D.5.3)[7]				
Characteristic pullout strength, uncracked concrete (2,500 psi)[6]	$N_{p,uncr}$	lb (kN)	635 (2.8)	940 (4.2)
Reduction factor for pullout strength[3]	ϕ	-	0.65 (Condition B)	

For SI: 1 inch = 25.4 mm, 1 ksi = 6.895 N/mm², 1 lbf = 0.0044 kN.

1. The data in this table is intended to be used with the design provisions of ACI 318 (-19 and -14) Chapter 17 or ACI 318-11 Appendix D, 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 (-19 and -14) Section 5.2 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 (-19 and -14) Chapter 17 or ACI 318-11 Appendix D, as applicable, requirements for Condition A, see ACI 318 (-19 and -14) 17.3.3 or ACI 318-11 D. 4.3, as applicable, for the appropriate ϕ factor.
4. The UltraCon+ anchor is considered a brittle steel element as defined by ACI 318-14 2.3 or ACI 318-11 D.1, as applicable.
5. For all design cases use $\Psi_{c,N} = 1.0$. The appropriate effectiveness factor for uncracked concrete (k_{uncr}) must be used.
6. For all design cases use $\Psi_{c,P} = 1.0$. For the calculation of $N_{p,uncr}$, the nominal pullout strength can be adjusted by calculation according to:
   $N_{pn,f'c} = N_{p,uncr}\left(\frac{f'c}{2{,}500}\right)^n$ (lbs, psi), $N_{pn,f'c} = N_{p,uncr}\left(\frac{f'c}{17.2}\right)^n$ (N,MPa)
   Where f'c is the specified concrete compressive strength and whereby the exponent $n = 0.3$ for the 3/16-inch-diameter anchors, $n = 0.4$ for 1/4-inch-diameter anchors.
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 tension must be used for design.

Shear Design Information for UltraCon+ Anchor in Concrete[1,2]

CODE LISTED
ICC-ES ESR-3068

Design Characteristic	Notation	Units	Nominal Anchor Diameter	
			3/16"	1/4"
Anchor category	1, 2 or 3	-	1	1
Nominal embedment depth	h_{nom}	in. (mm)	1-3/4 (44)	1-3/4 (44)
Effective embedment	h_{ef}	in. (mm)	1.23 (31.2)	1.23 (31.2)
STEEL STRENGTH IN SHEAR (ACI 318-19 17.7.1, ACI 318-14 17.5.1 or ACI 318-11 D.6.1)[4]				
Steel strength in shear[5]	V_{sa}	lb (kN)	810 (3.6)	1,180 (5.3)
Reduction factor for steel strength[3]	ϕ	-	0.60	
CONCRETE BREAKOUT STRENGTH IN SHEAR (ACI 318-19 17.7.2, ACI 318-14 17.5.2 or ACI 318-11 D.6.2)[6]				
Load bearing length of anchor	ℓ_e	in. (mm)	1.23 (32)	1.23 (32)
Nominal anchor diameter	d_a	in. (mm)	0.145 (3.7)	0.185 (4.7)
Reduction factor for concrete breakout[3]	ϕ	-	0.70 (Condition B)	
PRYOUT STRENGTH IN SHEAR (ACI 318-19 17.7.3, ACI 318-14 17.2.3.3 or ACI 318-11 D.6.3)[6]				
Coefficient for pryout strength	k_{cp}	-	1.0	1.0
Reduction factor for pryout strength[3]	ϕ	-	0.70 (Condition B)	

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 (-19 and -14) Chapter 17 or ACI 318-11 Appendix D, 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 (-19 and -14) Section 5.2 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 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D. 4.3, as applicable, for the appropriate ϕ factor.
4. The UltraCon+ anchor is considered a brittle steel element as defined by ACI 318 (-19 and -14) 2.3 or ACI 318-11 D.1, as applicable.
5. Tabulated values for steel strength in shear must be used for design.
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.

DESIGN STRENGTH TABLES (SD)

Tension and Shear Design Strengths for UltraCon+ 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_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.)
3/16	1-3/4	415	485	435	485	475	485	535	485	585	485
1/4	1-3/4	610	710	655	710	735	710	865	710	975	710

■ - Steel Strength Controls ■ - Concrete Breakout Strength Controls ■ - Anchor Pullout/Pryout 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 (-19 and -14), Chapter 17. The load level corresponding to the controlling failure mode is listed. (e.g. For tension: steel, concrete breakout and pullout; For shear: steel, concrete breakout and pryout). Furthermore, the capacities for concrete breakout strength in tension and pryout strength in shear are calculated using the effective embedment values, h_{ef}, for the selected anchors as noted in the design information tables. Please also reference the installation specifications for more information.

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

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

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

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

ORDERING INFORMATION

Blue UltraCon+ Standard Pack

Cat. No.		Screw Size	Approximate Thread Length	Pack Qty.	Carton Qty.
HWH	PFH				
DFM12700	DFM12740	3/16" x 1-1/4"	1"	100	500
DFM12702 *	DFM12742	3/16" x 1-3/4"	1-1/2"	100	500
DFM12704	DFM12744	3/16" x 2-1/4"	1-7/8"	100	500
DFM12706	DFM12746	3/16" x 2-3/4"	1-7/8"	100	500
DFM12708	DFM12748	3/16" x 3-1/4"	1-7/8"	100	500
DFM12710	DFM12750	3/16" x 3-3/4"	1-7/8"	100	500
DFM12712	DFM12752	3/16" x 4"	1-7/8"	100	500
DFM12715	-	1/4" x 1"	1"	100	500
DFM12720	DFM12760	1/4" x 1-1/4"	1-1/2"	100	500
DFM12722 *	DFM12762	1/4" x 1-3/4"	1-7/8"	100	500
DFM12724	DFM12764	1/4" x 2-1/4"	1-7/8"	100	500
DFM12726	DFM12766	1/4" x 2-3/4"	1-7/8"	100	500
DFM12728	DFM12768	1/4" x 3-1/4"	1-7/8"	100	500
DFM12730	DFM12770	1/4" x 3-3/4"	1-7/8"	100	500
DFM12732	DFM12772	1/4" x 4"	1-7/8"	100	500
DFM12734	DFM12774	1/4" x 5"	1-7/8"	100	500
DFM12735	DFM12776	1/4" x 6"	1-7/8"	100	500

HWH = Hex Washer Head (slotted); PFH = Phillips Flat Head

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

* Catalog numbers with an asterisk denote sizes that meet the minimum anchor length requirement for strength design provided the fixture attachment does not exceed 0.036-inch (0.91mm) in thickness.

- Hex Washer Head and Hex Flange Head UltraCon+ anchors are measured from below the washer. Phillips Flat Head and TrimFit Flat Head UltraCon+ anchors are measured end to end.

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

Blue UltraCon+ Master Pack

Cat. No.		Screw Size	Approximate Thread Length	Pack Qty.
HWH	PFH			
DFM12700B	DFM12740B	3/16" x 1-1/4"	1"	5000
DFM12702B *	DFM12742B	3/16" x 1-3/4"	1-1/2"	3000
-	DFM12744B	3/16" x 2-1/4"	1-7/8"	2500
DFM12704B	-			2000
DFM12706B	DFM12746B	3/16" x 2-3/4"	1-7/8"	1500
DFM12708B	DFM12748B	3/16" x 3-1/4"	1-7/8"	1000
DFM12710B	DFM12750B	3/16" x 3-3/4"	1-7/8"	1000
DFM12712B	DFM12752B	3/16" x 4"	1-7/8"	1000
DFM12720B	-	1/4" x 1-1/4"	1"	2000
-	DFM12760B			2500
DFM12722B *	-	1/4" x 1-3/4"	1-1/2"	2000
-	DFM12762B			2500
DFM12724B	DFM12764B	1/4" x 2-1/4"	1-7/8"	1500
DFM12726B	DFM12766B	1/4" x 2-3/4"	1-7/8"	1000
DFM12728B	DFM12768B	1/4" x 3-1/4"	1-7/8"	1000
DFM12730B	DFM12770B	1/4" x 3-3/4"	1-7/8"	500
DFM12732B	DFM12772B	1/4" x 4"	1-7/8"	500
DFM12734B	-	1/4" x 5"	1-7/8"	500
DFM12735B	-	1/4" x 6"	1-7/8"	500

HWH = Hex Washer Head (slotted); PFH = Phillips Flat Head

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

* Catalog numbers with an asterisk denote sizes that meet the minimum anchor length requirement for strength design provided the fixture attachment does not exceed 0.036-inch (0.91mm) in thickness.

- Hex Washer Head and Hex Flange Head UltraCon+ anchors are measured from below the washer. Phillips Flat Head and TrimFit Flat Head UltraCon+ anchors are measured end to end.

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

Silver UltraCon+ Master Pack

Cat. No.				Screw Size	Approximate Thread Length	Pack Qty.
HWH	HFH	PFH	TFH			
-	-	DFM2ELG521	-	3/16" x 1-1/4"	1"	5000
-	-	DFM2ELG551	-	3/16" x 1-3/4"	1-1/2"	3000
-	-	DFM2ELG581	-	3/16" x 2-1/4"	1-7/8"	2500
-	-	DFM2ELG611	-	3/16" x 2-3/4"	1-7/8"	1500
-	-	DFM2ELG641	-	3/16" x 3-1/4"	1-7/8"	1000
-	-	DFM2ELG671	-	3/16" x 3-3/4"	1-7/8"	1000
DFM2ELG340	-	-	DFM2ELG770	1/4" x 1-1/4"	1"	2500
DFM2ELG341 *	-	-	DFM2ELG771	1/4" x 1-3/4"	1-1/2"	2000
-	DFM2ELC145	-	-			1500
DFM2ELG371	-	-	DFM2ELG801	1/4" x 2-1/4"	1-7/8"	1500
-	DFM2ELC151	-	-			1000
DFM2ELG401	DFM2ELC160	-	DFM2ELG831	1/4" x 2-3/4"	1-7/8"	1000
DFM2ELG431	DFM2ELC170	-	DFM2ELG861	1/4" x 3-1/4"	1-7/8"	1000
-	-	-	DFM2ELG891	1/4" x 3-3/4"	1-7/8"	500
-	-	-	DFM2ELG921	1/4" x 4"	1-7/8"	500

HWH = Hex Washer Head (slotted); HFH = Hex Flange Head; PFH = Phillips Flat Head; TFH = TrimFit Flat Head

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

* catalog numbers with an asterisk denote sizes that meet the minimum anchor length requirement for strength design provided the fixture attachment does not exceed 0.036-inch (0.91mm) in thickness.

- Hex Flange Head Anchors are not covered by ICC-ES ESR-3068, ESR-3196, or ESR-3042. TrimFit Flat Head Anchors are not covered by ICC-ES ESR-3042.
- Hex Washer Head and Hex Flange Head UltraCon+ anchors are measured from below the washer. Phillips Flat Head and TrimFit Flat Head UltraCon+ anchors are measured end to end.
- To select the proper minimum anchor length, determine the nominal embedment depth (e.g. required to obtain desired load capacity). Then add the thickness of the fixture, including any spacers or shims, to the embedment depth.

White UltraCon+ Master Pack

Cat. No.				Screw Size	Approximate Thread Length	Pack Qty.
HWH	HFH	PFH	TFH			
DFM2ELD200	-	DFM2ELD320	-	3/16" x 1-1/4"	1"	5000
DFM2ELD210 *	-	DFM2ELD330	-	3/16" x 1-3/4"	1-1/2"	3000
DFM2ELD220	-	DFM2ELD340	-	3/16" x 2-1/4"	1-7/8"	2500
DFM2ELD230	-	DFM2ELD350	-	3/16" x 2-3/4"	1-7/8"	1500
DFM2ELD240	-	DFM2ELD360	-	3/16" x 3-1/4"	1-7/8"	1000
-	-	DFM2ELD370	-	3/16" x 3-3/4"	1-7/8"	1000
DFM2ELD250	-	DFM2ELD385	-	1/4" x 1-1/4"	1"	2500
-	DFM2ELD270	-	-			2000
DFM2ELD195 *		DFM2ELD386	DFM2ELD400	1/4" x 1-3/4"	1-1/2"	2000
-	DFM2ELD275	-	-			1500
DFM2ELD205	-	DFM2ELD387	DFM2ELD410	1/4" x 2-1/4"	1-7/8"	1500
-	DFM2ELD285	-	-			1000
DFM2ELD215	DFM2ELD295	DFM2ELD388	DFM2ELD420	1/4" x 2-3/4"	1-7/8"	1000
DFM2ELD225	-	DFM2ELD389	DFM2ELD430	1/4" x 3-1/4"	1-7/8"	1000
-	DFM2ELD305	-	-			500
DFM2ELD235	-	-	DFM2ELD440	1/4" x 3-3/4"	1-7/8"	500
DFM2ELD245	-	-	DFM2ELD450	1/4" x 4"	1-7/8"	500
DFM2ELD255	-	-	-	1/4" x 5"	1-7/8"	500
DFM2ELD265	-	-	-	1/4" x 6"	1-7/8"	500

HWH = Hex Washer Head (slotted); HFH = Hex Flange Head; PFH = Phillips Flat Head; TFH = TrimFit Flat Head

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

* catalog numbers with an asterisk denote sizes that meet the minimum anchor length requirement for strength design provided the fixture attachment does not exceed 0.036-inch (0.91mm) in thickness.

- Hex Flange Head Anchors are not covered by ICC-ES ESR-3068, ESR-3196, or ESR-3042. TrimFit Flat Head Anchors are not covered by ICC-ES ESR-3042.
- Hex Washer Head and Hex Flange Head UltraCon+ anchors are measured from below the washer. Phillips Flat Head and TrimFit Flat Head UltraCon+ anchors are measured end to end.
- To select the proper minimum anchor length, determine the nominal embedment depth (e.g. required to obtain desired load capacity). Then add the thickness of the fixture, including any spacers or shims, to the embedment depth.

Bronze UltraCon+ Master Pack

Cat. No.			Screw Size	Approximate Thread Length	Pack Qty.
HWH	PFH	TFH			
-	DFM2ELG612	-	3/16" x 2-3/4"	1-7/8"	1500
-	-	DFM2ELG832	1/4" x 2-3/4"	1-7/8"	1000
-	-	DFM2ELG862	1/4" x 3-1/4"	1-7/8"	1000
-	-	DFM2ELG892	1/4" x 3-3/4"	1-7/8"	500
DFM2ELE465	-	-	1/4" x 4"	1-7/8"	500

HWH = Hex Washer Head (slotted); PFH = Phillips Flat Head; TFH = TrimFit Flat Head

- TrimFit Flat Head Anchors are not covered by ICC-ES ESR-3042.
- Hex Washer Head and Hex Flange Head UltraCon+ anchors are measured from below the washer. Phillips Flat Head and TrimFit Flat Head UltraCon+ anchors are measured end to end.
- To select the proper minimum anchor length, determine the nominal embedment depth (e.g. required to obtain desired load capacity). Then add the thickness of the fixture, including any spacers or shims, to the embedment depth.

UltraCon+ Drill Bits

Cat. No.	Description
DW5381	5/32" x 7" UltraCon+ SDS bit
DW5382	3/16 x 7" UltraCon+ SDS bit
DFX153255	5/32" x 5-1/2" UltraCon+ straight shank bit
DFX131645	3/16" x 4-1/2" UltraCon+ straight shank bit
DFX131675	3/16" x 7-1/2" UltraCon+ straight shank bit

Installation Kit

Cat. No.	Description
DW5366	UltraCon®+ Installation Kit includes: 5/32" and 3/16" UltraCon+ bit, 1/4" and 5/16" nutsetters, #2 and #3 Phillips bits, Phillips flat head adapter, percussion adapter, drive sleeve and 1/8" allen wrench

Rotary Hammers

Cat. No.	Description
DCH273	20V Max* XR Brushless 1" L-Shape SDS Plus Rotary Hammer
DCH133	20V Max* XR Brushless 1" D-Handle SDS Plus Rotary Hammer

Accessories

Cat. No.	Description
DWH303DH	Onboard Dust Extractor for 1" SDS Plus Hammers
DWH050	Large Hammer Dust Extraction - Hole Cleaning
DWH200	Dust Extraction Tube Kit with Hose

Dust Extractors

Cat. No.	Description
DCV585	Flexvolt® 60V Max* Dust Extractor
DVW010	8 Gallon Wet Dry Hepa/Rrp Dust Extractor
DWV012	10 Gallon Wet Dry Hepa/Rrp Dust Extractor
DWH161D1	20V Max* XR Brushless Universal Dust Extractor Kit

GENERAL INFORMATION

ULTRACON®

Concrete and Masonry Fasteners

PRODUCT DESCRIPTION

The UltraCon fastening system is a complete family of screw anchors for light to medium duty applications in concrete and masonry block base materials. UltraCon is available in 5/16" diameter which provides increased shear and tensile strength to meet the needs of more demanding applications. The UltraCon is fast and easy to install and provides a neat, finished appearance. The UltraCon screw anchor is available in carbon steel with a Stalgard coating in silver color that provides additional corrosion resistance.

GENERAL APPLICATIONS AND USES

- Window Frames
- Metal Door Frames
- Shelving and Racking
- Shutters and Guards
- Pipe Support
- Cable Trays

FEATURES AND BENEFITS

+ 5/16" diameter provides increased shear and tensile strength
+ Stalgard® coating provides 1000 hours of salt spray protection when tested in accordance with ASTM B117
+ Available in various head styles to fit the intended application
+ Installed with a standard ANSI bit

APPROVALS AND LISTINGS

- Tested in accordance with ASTM E488
- Miami-Dade County Notice of Acceptance (NOA) No. 21-0113.01
- Florida Statewide Product Approval FL29068.2

GUIDE SPECIFICATIONS

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

MATERIAL SPECIFICATIONS

Anchor Component	Specifications
Anchor Body	Case Hardened Carbon Steel
Coating/Plating/Finish	Stalgard® 1000 hour rating for ASTM B117 salt spray test

SECTION CONTENTS

ULTRACON

HEAD STYLES

- Hex Washer Head
- TrimFit® Hex Head
- Phillips Flat Head
- TrimFit® Flat Head
- Oversized Flat Head

ANCHOR MATERIALS

- Carbon Steel with Stalgard Coating

ANCHOR SIZE RANGE (TYP.)

- 5/16" diameter x 1-3/4" to 6" lengths

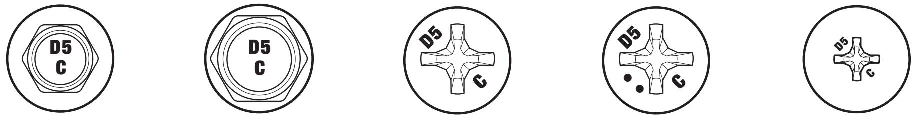
SUITABLE BASE MATERIALS

- Normal-weight Concrete
- Hollow Concrete Masonry (CMU)
- Grouted-Filled Concrete Masonry (CMU)
- Wood

INSTALLATION SPECIFICATIONS

UltraCon Identification

The head markings consist of a "D" for the DEWALT brand, the number "5" for the 5/16" diameter, and the length code. TrimFit flat head variations also include two dots.



Hex Washer Head (HWH) — TrimFit Hex Head (THH) — Phillips Flat Head (PFH) — TrimFit Flat Head (TFH) — Oversized Flat Head (OFH)

UltraCon Carbon Steel Hex Head[1,2]

Screw Property / Setting Information	Notation	Nominal Anchor Size				
		5/16" HWH	5/16" THH	5/16" PFH	5/16" TFH	5/16" OFH
Anchor Shank Diameter (in)	d_a	0.246	0.246	0.246	0.246	0.246
ANSI Drill Bit Size (in)	d_{bit}	1/4	1/4	1/4	1/4	1/4
Typ. Fixture Clearance hole (in)	d_h	3/8	3/8	3/8	3/8	3/8
Head Height (in.)	-	11/64	5/32	13/64	1/8	5/16
Head Width (in)	-	5/16	5/16	35/64	13/32	11/16
Washer O.D. (in)	-	35/64	7/16	N/A	N/A	N/A
Washer Thickness (in)	-	1/16	1/16	N/A	N/A	N/A
Hex Driver (in) / Phillips Driver	-	5/16	5/16	#3	#3	#3

HWH = Hex Washer Head; THH = TrmFit Hex Head; PFH = Phillips Flat Head, TFH = TrimFit Flat Head, OFH = Oversized Flat Head

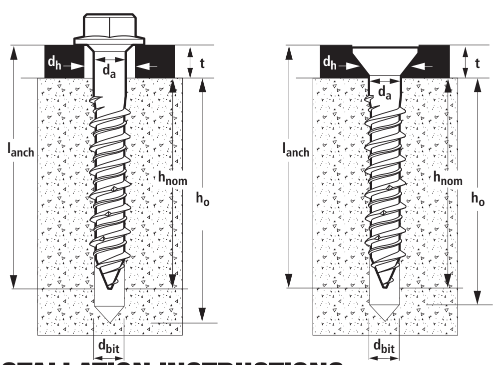
7. For minimum nominal embedment depths, h_{nom}, see the performance data tables. The minimum hole depth, h_o, is 1/4-inch more than the selected nominal embedment depth.
8. Pre-drilling is not required for UltraCon into wood (but can be considered).

UltraCon Length Code Identification System

Length ID marking on head		A	B	C	D	E	F	G	H
Overall anchor length ℓ_{anch} (inches)	From	1-1/2"	2"	2-1/2"	3-1/4"	3-1/2"	4"	4-1/2"	5-1/2"
	Up to but not including	2"	2-1/2"	3-1/4"	3-1/2"	4"	4-1/2"	5-1/2"	6-1/2"

Length identification mark indicates length of anchor measure from under the head for hex head UltraCon anchors and overall length for flat head UltraCon anchors.

Anchor Detail

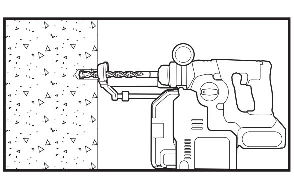


Nomenclature

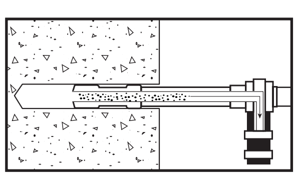
d_a = Diameter of anchor
d_{bit} = Diameter of drill bit
d_h = Diameter of fixture clearance hole
h_{nom} = Minimum embedment depth
h = Base material thickness
The minimum value of h should be $1.5h_{nom}$ or 3" whichever is greater
h_o = Minimum hole depth

INSTALLATION INSTRUCTIONS

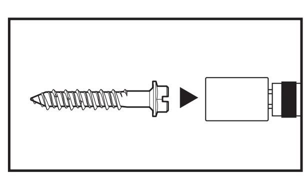
Installation Instruction for UltraCon



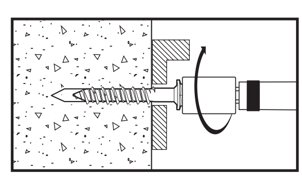
Step 1
Using the proper drill bit size, drill a hole into the base material to the required depth, h_o, which is a 1/4-inch deeper than the minimum embedment depth, h_{nom}.



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
Attach a UltraCon+ installation socket tool for the selected anchor size to a percussion drill and set the drill to rotary only mode. Mount the screw anchor head into the socket. For flat head versions a bit tip must be used with the socket tool.



Step 4
Place the point of the UltraCon through the fixture into the pre-drilled hole and drive the anchor in one steady continuous motion until it is fully seated at the proper embedment. The driver will automatically disengage from the head of the screw.

PERFORMANCE DATA

Ultimate Load Capacities for UltraCon in Normal-weight Concrete[1,2]

Nominal Anchor Diameter (in.)	Min. Embed. (in.)	Min. Edge Dist. (in.)	Min. Spacing (in.)	Minimum Concrete Compressive Stength			
				3000 psi		4000 psi	
				Tension (lbs.)	Shear (lbs.)	Tension (lbs.)	Shear (lbs.)
5/16	2	1-1/4	1-7/8	755	440	870	480
	2		3-3/4	1,070	440	1,235	480
	1		5	665	790	765	860
	1-3/4			1,940	1,215	2,240	1,320
	1	2-3/16	5	755	1,385	870	1,500
	1-3/4			2,215	2,900	2,560	3,140
	2	3-1/8	1-7/8	1,105	1,550	1,280	1,680
	2		3-3/4	1,680	2,620	1,940	2,840
	1		5	775	1,660	895	1,800
	1-3/4			2,435	3,140	2,815	3,400
	2			3,085	3,140	3,560	3,400

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. 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 and higher may be necessary depending upon the application such as life safety or overhead.

Allowable Load Capacities for UltraCon in Normal-weight Concrete[1]

Nominal Anchor Diameter (in.)	Min. Embed. (in.)	Min. Edge Dist. (in.)	Min. Spacing (in.)	Minimum Concrete Compressive Stength			
				3000 psi		4000 psi	
				Tension (lbs.)	Shear (lbs.)	Tension (lbs.)	Shear (lbs.)
5/16	2	1-1/4	1-7/8	185	110	215	120
	2		3-3/4	265	110	305	120
	1		5	165	195	190	215
	1-3/4			485	300	560	330
	1	2-3/16	5	185	345	215	375
	1-3/4			550	725	640	785
	2	3-1/8	1-7/8	275	385	320	420
	2		3-3/4	420	655	485	710
	1		5	190	415	220	450
	1-3/4			605	785	700	850
	2			770	785	890	850

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 application, such as life safety or overhead.

Ultimate Load Capacities for UltraCon in Hollow and Grout-Filled Concrete Masonry[1,2]

Nominal Anchor Diameter (in.)	Min. Embed. (in.)	Min. Edge Dist. (in.)	Min. Spacing (in.)	Hollow Block		Grouted-Filled Block	
				Tension (lbs.)	Shear (lbs.)	Tension (lbs.)	Shear (lbs.)
5/16	1-1/4	1-9/16	6	650	700	-	-
	1-3/4	2-1/2	5	-	-	1,150	1,850
	2-1/4			-	-	1,450	1,875
	1-1/4	3-1/8	1-7/8	650	875	-	-
	1-1/4		3-3/4	700	875	-	-
	1-1/4		6	1,125	1,450	-	-

1. Tabulated load values are for anchors installed in grout-filled concrete block conforming to ASTM C90.
2. Ultimate load capacities must be reduced by a minimum safety factor of 5.0 or greater to determine allowable working load. Consideration of safety factors of 10 and higher may be necessary depending upon the application such as life safety or overhead.

Allowable Load Capacities for UltraCon in Hollow and Grout-Filled Concrete Masonry[1]

ALLOWABLE STRESS DESIGN ASD

Nominal Anchor Diameter (in.)	Min. Embed. (in.)	Min. Edge Dist. (in.)	Min. Spacing (in.)	Hollow Block		Grouted-Filled Block	
				Tension (lbs.)	Shear (lbs.)	Tension (lbs.)	Shear (lbs.)
5/16	1-1/4	1-1/16	6	130	140	-	-
	1-3/4	2-1/2	5	-	-	230	370
	2-1/4			-	-	290	375
	1-1/4	3-1/8	1-7/8	130	175	-	-
	1-1/4		3-3/4	140	175	-	-
	1-1/4		6	225	290	-	-

1. 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.

Ultimate Load Capacities for UltraCon in Southern Yellow Pine[1,2]

Nominal Anchor Diameter (in.)	Min. Embed. (in.)	Min. Edge Dist. (in.)	Tension (lbs.)	Shear (lbs.)
5/16	1	1-9/16 (5d)	545	840
	1-1/2		1,450	1,150
	2		1,835	1,340

1. Ultimate load capacities are based on laboratory tests and must be reduced by a minimum safety factor of 3.0 or greater to determine allowable working load. Consideration of safety factors of 10 and higher may be necessary depending upon the application such as life safety or overhead.
2. Tests in Southern Yellow Pine with minimum Specific Gravity of 0.55; screw oriented tangential to wood grain.

ORDERING INFORMATION

UltraCon

Cat. No.					Screw Size	Pack Qty.	Carton Qty.
HWH	THH	PFH	TFH	OFH			
DFM5ELG481	DFM5ELG482	-	-	-	5/16" X 1-3/4"	1000	-
DFM5ELG486	DFM5ELG487	DFM5ELG941	DFM5ELG945	-	5/16" X 2-1/4"	1000	-
DFM5ELG491	DFM5ELG492	DFM5ELG948	DFM5ELG955	-	5/16" X 2-3/4"	500	-
-	-	-	-	DFM5ELG203	5/16" X 3"	50	250
DFM5ELG496	DFM5ELG497	DFM5ELG960	DFM5ELG965	-	5/16" X 3-1/4"	500	-
DFM5ELG501	DFM5ELG502	-	DFM5ELG972	-	5/16" X 3-3/4"	500	-
DFM5ELG506	-	DFM5ELG979	DFM5ELG976	-	5/16" X 4"	500	-
-	-	-	-	DFM5ELG204		50	250
DFM5ELG511	-	DFM5ELG992	DFM5ELG991	-	5/16" X 5"	250	-
-	-	-	-	DFM5ELG205		50	250
DFM5ELG516	-	DFM5ELG998	-	-	5/16" X 6"	250	-
-	-	-	-	DFM5ELG206		50	250

HWH = Hex Washer Head; THH = TrmFit Hex Head; PFH = Phillips Flat Head, TFH = TrimFit Flat Head, OFH = Oversized Flat Head
Hex Head UltraCon anchors are measured from below the washer while flat head UltraCon anchors are measured end to end.

To select the proper minimum anchor length, determine the embedment depth required to obtain the desired load capacity. Then add the thickness of the fixture, including any spacers or shims, to the embedment depth.

Approximate thread length for hex head parts (HWH & THH) is 2" except for 1-3/4" long hex head parts which have 1-1/2" of thread length.

Approximate thread length for flat head parts (PFH, TFH & OFH) is 1-3/4".

Drill Bits

Cat. No.	Description
DW5417	1/4" x 6" SDS Plus Drill Bit
DW5418	1/4" x 8-1/2" SDS Plus Drill Bit
DW5420	1/4" x 12" SDS Plus Drill Bit
DW5421	1/4" x 14" SDS Plus Drill Bit

Rotary Hammers

Cat. No.	Description
DCH273	20V Max* XR Brushless 1" L-Shape SDS Plus Rotary Hammer
DCH133	20V Max* XR Brushless 1" D-Handle SDS Plus Rotary Hammer

Accessories

Cat. No.	Description
DWH303DH	Onboard Dust Extractor for 1" SDS Plus Hammers
DWH050	Large Hammer Dust Extraction - Hole Cleaning
DWH200	Dust Extraction Tube Kit with Hose

Dust Extractors

Cat. No.	Description
DCV585	Flexvolt® 60V Max* Dust Extractor
DVW010	8 Gallon Wet Dry Hepa/Rrp Dust Extractor
DWV012	10 Gallon Wet Dry Hepa/Rrp Dust Extractor
DWH161D1	20V Max* XR Brushless Universal Dust Extractor Kit

GENERAL INFORMATION

ULTRACON® SS4

410 Stainless Steel Concrete and Masonry Fasteners

PRODUCT DESCRIPTION

The UltraCon SS4 anchor is a 410 stainless steel screw anchor for light to medium duty applications in concrete and masonry block base materials. The screw anchor is fast and easy to install and provides a neat, finished appearance. UltraCon SS4 anchors feature a Stalgard coating and provide enhanced corrosion resistance over carbon steel fasteners.

GENERAL APPLICATIONS AND USES

- Screen Enclosures
- Storm Shutters
- Light Duty Fixtures
- Light Duty Industrial Mounts

FEATURES AND BENEFITS

+ Special heat treatment to protect inherent corrosion resistance of the 410 stainless steel material
+ Stalgard coating provides 1000 hours of salt spray protection when tested in accordance with ASTM B117

APPROVALS AND LISTINGS

- Tested in accordance with ASTM E488
- Miami-Dade County Notice of Acceptance (NOA) No. 21-0201.08
- Florida Statewide Product Approval FL29068.1

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 UltraCon SS4 as supplied by DEWALT, Towson, MD. Concrete screw anchors shall be installed in accordance with published instructions and the Authority Having Jurisdiction.

MATERIAL SPECIFICATIONS

Anchor Component	Specification
Anchor Body	410 Stainless Steel
Coating/Plating/Finish	Stalgard® 1000 hour rating per ASTM B117 salt spray test
Note: 410 Stainless Steel fasteners in contact with aluminum and aluminum alloys is not recommended in accordance with AISI SS 502 / SSINA guidelines.	

SECTION CONTENTS

ULTRACON SS4

HEAD STYLES

- Hex Washer Head
- TrimFit® Flat Head

ANCHOR MATERIALS

- Type 410 Stainless Steel with Stalgard® Coating

ANCHOR SIZE RANGE

- 1/4" diameter x 1-1/4" to 6" lengths

SUITABLE BASE MATERIALS

- Normal-Weight Concrete
- Hollow Concrete Masonry (CMU)
- Grout-Filled Concrete Masonry (CMU)

INSTALLATION SPECIFICATIONS

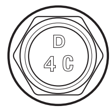
Anchor Property / Setting Information	Notation	Anchor Diameter, d_a	
		1/4" HEX	1/4" TFH
Anchor Shank Diameter (in)	d_a	0.193	0.193
Ultracon+ Drill Bit Size (in)	d_{bit}	3/16	3/16
Typ. Fixture Clearance hole (in)	d_h	5/16	5/16
Head Height (in)	-	9/64	3/16
Head Width (in)	-	5/16	13/32
Washer O.D. (in)	-	13/32	N/A
Washer Thickness (in)	-	1/32	N/A
Hex Driver (in) / Phillips Driver	-	5/16	#3

3. For minimum nominal embedment depths, h_{nom}, see the performance data tables. The minimum hole depth, h_o, is 1/4-inch more than the selected nominal embedment depth.

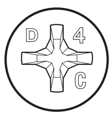
410 Stainless Steel UltraCon SS4 Identification

The head markings consist of a "D" for the DEWALT brand, the number "4" for the 410 series stainless steel classification, and the length code

Hex Washer Head



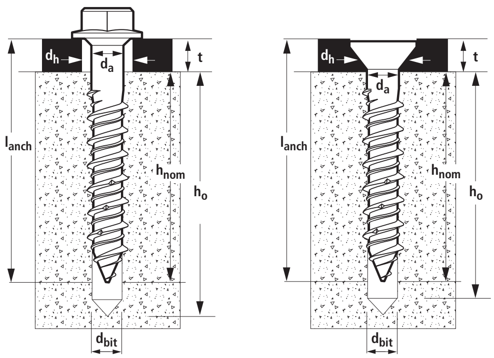
TrimFit Head



UltraCon SS4 Length Code Identification System

Length ID marking on head		□	A	B	C	D	E	F	G	H
Overall anchor length ℓ_{anch} (inches)	From	1"	1-1/2"	2"	2-1/2"	3"	3-1/2"	4"	4-1/2"	5-1/2"
	Up to but not including	1-1/2"	2"	2-1/2"	3"	3-1/2"	4"	4-1/2"	5-1/2"	6-1/2"

Anchor Detail

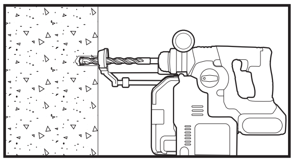


Nomenclature

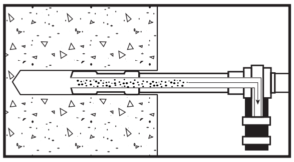
- d_a = Diameter of anchor
- d_{bit} = Diameter of drill bit
- d_h = Diameter of fixture clearance hole
- h_{nom} = Minimum embedment depth
- h = Base material thickness
  The minimum value of h should be $1.5h_{nom}$ or 3" whichever is greater
- h_o = Minimum hole depth

INSTALLATION INSTRUCTIONS

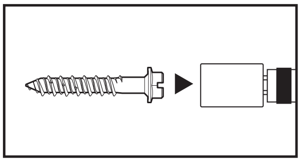
Installation Instruction for UltraCon SS4



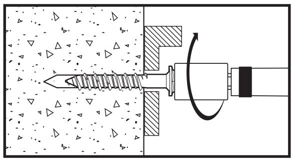
Step 1
Using the proper drill bit size, drill a hole into the base material to the required depth, h_o, which is a 1/4-inch deeper than the minimum embedment depth, h_{nom}.



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
Attach a UltraCon+ installation socket tool for the selected anchor size to a percussion drill and set the drill to rotary only mode. Mount the screw anchor head into the socket. For flat head versions a bit tip must be used with the socket tool.



Step 4
Place the point of the UltraCon SS4 through the fixture into the pre-drilled hole and drive the anchor in one steady continuous motion until it is fully seated at the proper embedment. The driver will automatically disengage from the head of the screw.

PERFORMANCE DATA

Ultimate Load Capacities for UltraCon SS4 in Normal-Weight Concrete[1]

Nominal Anchor Diameter	Min. Edge Dist. (in.)	Min. Spacing (in.)	Min. Embed. (in.)	Minimum Concrete Compressive Strength			
				2500 psi		3000 psi	
				Tension (lbs.)	Shear (lbs.)	Tension (lbs.)	Shear (lbs.)
1/4	1	1-1/2	1-1/2"	340	265	365	280
			1-3/4"	540	385	580	410
		3	1-1/2"	610	275	660	295
			1-3/4"	1235	510	1330	540
	2-1/2	1-1/2	1-1/2"	720	730	770	775
			1-3/4"	1275	1900	1375	2020
		3	1-1/2"	885	990	955	1050
			1-3/4"	1515	2200	1630	2335

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. 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 and higher may be necessary depending upon the application such as life safety or overhead.

Allowable Load Capacities for UltraCon SS4 in Normal-Weight Concrete[1]

Nominal Anchor Diameter	Min. Edge Dist. (in.)	Min. Spacing (in.)	Min. Embed. (in.)	Minimum Concrete Compressive Strength			
				2500 psi		3000 psi	
				Tension (lbs.)	Shear (lbs.)	Tension (lbs.)	Shear (lbs.)
1/4	1	1-1/2	1-1/2"	85	65	90	70
			1-3/4"	135	95	145	100
		3	1-1/2"	150	65	165	70
			1-3/4"	305	125	330	135
	2-1/2	1-1/2	1-1/2"	180	180	190	190
			1-3/4"	315	475	340	505
		3	1-1/2"	220	245	235	260
			1-3/4"	375	550	405	580

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 application, such as life safety or overhead.

Ultimate Load Capacities for UltraCon SS4 in Hollow and Grout-Filled Concrete Masonry[1,2]

Nominal Anchor Diameter (in.)	Min. Edge Dist. (in.)	Min. Spacing (in.)	Min. Embed. (in.)	Hollow Bock		Grout-Filled Block	
				Tension (lbs.)	Shear (lbs.)	Tension (lbs.)	Shear (lbs.)
1/4	1	1-1/2	1-1/4	530	220	685	280
			2	-	-	1090	280
		3	1-1/4	620	360	950	415
			2	-	-	1460	415
	2-1/2	1-1/2	1-1/4	530	445	1025	455
			2	-	-	1090	900
		3	1-1/4	620	615	1060	1000
			2	-	-	1930	1510

1. Tabulated load values are for anchors installed in grout-filled concrete block conforming to ASTM C90 with a minimum block compressive strength of 2000 psi and minimum grout compressive strength of 1625 psi.
2. Ultimate load capacities must be reduced by a minimum safety factor of 5.0 or greater to determine allowable working load. Consideration of safety factors of 10 and higher may be necessary depending upon the application such as life safety or overhead.

Allowable Load Capacities for UltraCon SS4 in Hollow and Grout-Filled Concrete Masonry[1]

Nominal Anchor Diameter (in.)	Min. Edge Dist. (in.)	Min. Spacing (in.)	Min. Embed. (in.)	Hollow Bock		Grout-Filled Block	
				Tension (lbs.)	Shear (lbs.)	Tension (lbs.)	Shear (lbs.)
1/4	1	1-1/2	1-1/4	105	40	135	55
			2	-	-	215	55
		3	1-1/4	120	70	190	80
			2	-	-	290	80
	2-1/2	1-1/2	1-1/4	105	85	205	90
			2	-	-	215	180
		3	1-1/4	120	120	210	200
			2	-	-	385	300

1. 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.

ORDERING INFORMATION

Silver Stalgard® UltraCon SS4

Cat. No.		Screw Size	Approximate Thread Length	Pack Qty.	Carton Qty.
HWH	TFH				
DFM4EUH310	DFM4EUF310	1/4" X 1-1/4"	1-1/8"	100	500
DFM4EUH315	DFM4EUF315	1/4" X 1-3/4"	1-5/8"	100	500
DFM4EUH325	DFM4EUF325	1/4" X 2-1/4"	1-7/8"	100	500
DFM4EUH335	DFM4EUF335	1/4" X 2-3/4"	1-7/8"	100	500
DFM4EUH345	DFM4EUF345	1/4" X 3-1/4"	1-7/8"	100	500
DFM4EUH355	DFM4EUF355	1/4" X 3-3/4"	1-7/8"	100	500
DFM4EUH365	DFM4EUF365	1/4" X 4"	1-7/8"	100	500
DFM4EUH375	-	1/4" X 5"	1-7/8"	100	500
DFM4EUH385	-	1/4" X 6"	1-7/8"	100	500

HWH = Hex Washer Head, TFH = TrimFit® Flat Head

Hex Head UltraCon SS4 Anchors are measured from below the washer while flat head UltraCon SS4 anchors are measured end to end. To select the proper minimum anchor length, determine the embedment depth required (e.g. required to obtain desired load capacity). Then add the thickness of the fixture, including any spacers or shims, to the embedment depth.

UltraCon+ Drill Bits

Cat. No.	Description
DW5382	3/16 x 7" UltraCon+ SDS bit

Installation Kit

Cat. No.	Description
DW5366	UltraCon®+ Installation Kit includes: 5/32" and 3/16" UltraCon+ bit, 1/4" and 5/16" nutsetters, #2 and #3 Phillips bits, Phillips flat head adapter, percussion adapter, drive sleeve and 1/8" allen wrench


Rotary Hammers

Cat. No.	Description
DCH273	20V Max* XR Brushless 1" L-Shape SDS Plus Rotary Hammer
DCH133	20V Max* XR Brushless 1" D-Handle SDS Plus Rotary Hammer
DCH172	ATOMIC 20V MAX 5/8 in. Brushless Cordless SDS Plus Rotary Hammer



Accessories

Cat. No.	Description
DWH303DH	Onboard Dust Extractor for 1" SDS Plus Hammers
DWH050	Large Hammer Dust Extraction - Hole Cleaning
DWH200	Dust Extraction Tube Kit with Hose



Dust Extractors

Cat. No.	Description
DCV585	Flexvolt® 60V Max* Dust Extractor
DVW010	8 Gallon Wet Dry Hepa/Rrp Dust Extractor
DWV012	10 Gallon Wet Dry Hepa/Rrp Dust Extractor
DWH161D1	20V Max* XR Brushless Universal Dust Extractor Kit



GENERAL INFORMATION

CRETE-FLEX®

410 Stainless Steel Concrete and Masonry Fasteners

PRODUCT DESCRIPTION

The Crete-Flex anchor is a 410 stainless steel screw anchor for light to medium duty applications in concrete and masonry block base materials. Crete-Flex anchors utilize more robust threads for enhanced thread engagement and “V” notches for efficient tapping. These features provide reduced installation torque and increased performance. Crete-Flex anchors feature a Stalgard coating and provide enhanced corrosion resistance over carbon steel fasteners.

GENERAL APPLICATIONS AND USES

- Window Frames
- Screens and Utilities
- Light Duty Industrial Applications
- Metal Door Frames
- Shutters and Guards
- Light Duty Fixtures

FEATURES AND BENEFITS

+ Special heat treament provides increased ductility and corrosison resistance
+ Larger-than-normal root diameters offers improved performance, including higher shear strengths
+ Stalgard® coating provides 1000 hours of salt spray resistance when tested in accordance with ASTM B117
+ Available in various head styles to fit the intended application

APPROVALS AND LISTINGS

- Tested in accordance with ASTM E488
- Miami-Dade County Notice of Acceptance (NOA) No. 21-0201.08
- Florida Statewide Product Approval FL29068.1

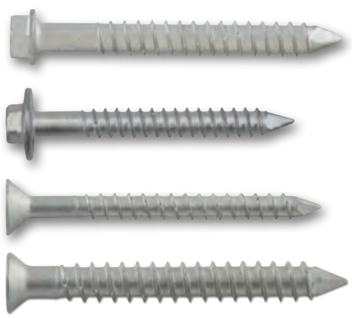
GUIDE SPECIFICATIONS

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 Crete-Flex as supplied by DEWALT, Towson, MD. Concrete screw anchors shall be installed in accordance with published instructions and the Authority Having Jurisdiction.

MATERIAL SPECIFICATIONS

Anchor Component	Specification
Anchor Body	410 Stainless Steel
Coating/Plating/Finish	Stalgard® (silver color) 1000 hour rating for ASTM B117 salt spray test

SECTION CONTENTS



CRETE-FLEX

HEAD STYLES

- Hex Washer Head
- Hex Flange Head
- Phillips Flat Head
- Phillips TrimFit® Flat Head

ANCHOR MATERIALS

- Type 410 Stainless Steel with Stalgard® Coating

ANCHOR SIZE RANGE

- 3/16" diameter x 1-1/4" to 3-1/4" lengths
- #14 diameter x 1-1/4" to 6" lengths

SUITABLE BASE MATERIALS

- Normal-weight Concrete
- Grouted Concrete Masonry
- Hollow Concrete Masonry (CMU)
- Wood

INSTALLATION SPECIFICATIONS

Crete-Flex 410 Stainless Steel Carbon Steel Hex Head[1,4]

Dimension	Nominal Anchor Diameter					
	3/16" HWH	3/16" PFH	#14 HWH	#14 HFH	#14 PFH	#14 TFH
Anchor Shank Diameter (in.)	0.160	0.160	0.215	0.215	0.215	0.215
Drill Bit Size[2] (in)	5/32 UltraCon+ Bit	5/32 UltraCon+ Bit	7/32 ANSI	7/32 ANSI	7/32 ANSI	7/32 ANSI
Typ. Fixture Clearance hole (in)	1/4	1/4	5/16	5/16	5/16	5/16
Head Height[3] (in.)	7/64	5/32	9/64	7/32	5/32	9/64
Head Width (in)	1/4	13/32	5/16	5/16	1/2	13/32
Washer O.D. (in)	11/32	N/A	13/32	5/8	N/A	N/A
Washer Thickness (in)	1/32	N/A	3/64	N/A	N/A	N/A
Hex Driver (in) / Phillips Driver	1/4	#3	5/16	5/16	#3	#3

HWH = Hex Washer Head, HFH = Hex Flange Head, PFH = Phillips Flat Head, TFH = TrimFit® Flat Head

1. For minimum nominal embedment depths, h_{nom}, see the performance data tables. The minimum hole depth, h_o, is 1/4-inch more than the selected nominal embedment depth.
2. 3/16-inch diameter Crete-Flex anchors require the use of a special tolerance UltraCon+ drill bit which have a tolerance range of 0.170" to 0.176".
3. Head Height of Hex Flange Head Anchors include the thickness of the flange.
4. Pre-drilling is not required for Crete-Flex into wood (but can be considered).

Crete-Flex Identification

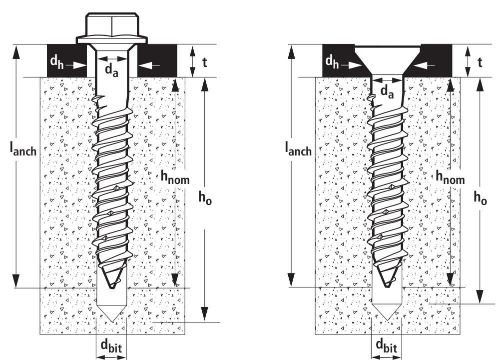
Hex Washer Head (HWH) Hex Flange Head (HFH) Phillips Flat Head (PFH) TrimFit Flat Head (TFH)

The head markings consist of a "D" for the DEWALT brand, the number "4" for the 410 series stainless steel classification, and the length code. TrimFit flat head variations also include a star

Crete-Flex Length Code Identification System

Length ID marking on head		□	A	B	C	D	E	F	G	H
Overall anchor length ℓ_{anch} (inches)	From	1"	1-1/2"	2"	2-1/2"	3-1/4"	3-1/2"	4"	4-1/2"	5-1/2"
	Up to but not including	1-1/2"	2"	2-1/2"	3-1/4"	3-1/2"	4"	4-1/2"	5-1/2"	6-1/2"

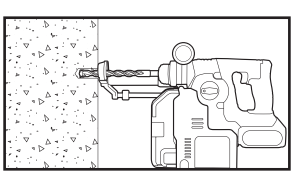
Anchor Detail



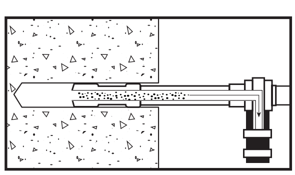
Nomenclature

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

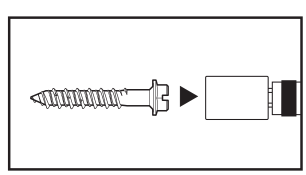
INSTALLATION INSTRUCTIONS



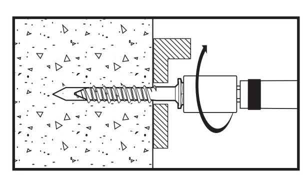
Step 1
Using the proper drill bit size, drill a hole into the base material to the required depth, h_o, which is a 1/4-inch deeper than the minimum embedment depth, h_{nom}.



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
Attach a UltraCon+ installation socket tool for the selected anchor size to a percussion drill and set the drill to rotary only mode. Mount the screw anchor head into the socket. For flat head versions a bit tip must be used with the socket tool.



Step 4
Place the point of the Crete-Flex through the fixture into the pre-drilled hole and drive the anchor in one steady continuous motion until it is fully seated at the proper embedment. The driver will automatically disengage from the head of the screw anchor.

PERFORMANCE DATA (ASD)

Ultimate Load Capacities for Crete-Flex in Normal-Weight Concrete[1,2]

Nominal Anchor Diameter	Min. Embed. (in.)	Min. Edge Dist. (in.)	Min. Spacing (in.)	Minimum Concrete Compressive Strength							
				2,000 psi		2,500 psi		3,000 psi		4,000 psi	
				Tension (lbs.)	Shear (lbs.)	Tension (lbs.)	Shear (lbs.)	Tension (lbs.)	Shear (lbs.)	Tension (lbs.)	Shear (lbs.)
3/16"	1-1/4	2-1/2	3	850	1,575	900	1,665	940	1,675	980	1,675
	1-1/2			1,200	1,800	1,265	1,900	1,325	1,915	1,380	1,915
	1-3/4			1,360	1,800	1,435	1,900	1,505	1,915	1,565	1,915
#14	1	1	6	535	445	575	480	610	500	645	500
	1	1-3/4		585	765	630	825	670	860	710	860
	1	2-1/2		675	945	725	1,015	775	1,060	815	1,060
	1-3/4	1	1-1/2	1,115	-	1,200	-	1,280	-	1,350	-
	1-3/4		3	1,115	635	1,200	680	1,280	710	1,350	710
	1-3/4		6	1,115	1,105	1,200	1,185	1,280	1,240	1,350	1,240
	1-3/4	1-3/4	6	1,165	1,600	1,250	1,720	1,330	1,800	1,405	1,800
	1-3/4	2-1/2	3	1,115	1,660	1,200	1,785	1,280	1,870	1,350	1,870
	1-3/4		6	1,165	2,295	1,250	2,470	1,330	2,580	1,405	2,580
	2	1	6	1,390	1,105	1,495	1,185	1,590	1,240	1,675	1,240
	2	1-3/4		1,520	1,600	1,635	1,720	1,740	1,800	1,835	1,800
	2	2-1/2		1,520	2,295	1,635	2,470	1,740	2,580	1,835	2,580

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. 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 and higher may be necessary depending upon the application such as life safety or overhead.

Allowable Load Capacities for Crete-Flex in Normal-Weight Concrete[1,2]

Nominal Anchor Diameter	Min. Embed. (in.)	Min. Edge Dist. (in.)	Min. Spacing (in.)	Minimum Concrete Compressive Strength							
				2,000 psi		2,500 psi		3,000 psi		4,000 psi	
				Tension (lbs.)	Shear (lbs.)	Tension (lbs.)	Shear (lbs.)	Tension (lbs.)	Shear (lbs.)	Tension (lbs.)	Shear (lbs.)
3/16"	1-1/4	2-1/2	3	215	395	225	415	235	420	245	420
	1-1/2			300	450	315	475	330	480	345	480
	1-3/4			340	450	360	475	375	480	390	480
#14	1	1	6	135	110	145	120	155	125	160	125
	1	1-3/4		145	190	160	205	170	215	180	215
	1	2-1/2		170	235	180	255	195	265	205	265
	1-3/4	1	1-1/2	280	-	300	-	320	-	340	-
	1-3/4		3	280	160	300	170	320	180	340	180
	1-3/4		6	280	275	300	295	320	310	340	310
	1-3/4	1-3/4	6	290	400	315	430	335	450	350	450
	1-3/4	2-1/2	3	280	415	300	445	320	470	340	470
	1-3/4		6	290	575	315	620	335	645	350	645
	2	1	6	350	275	375	295	400	310	420	310
	2	1-3/4		380	400	410	430	435	450	460	450
	2	2-1/2		380	575	410	620	435	645	460	645

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 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.

Ultimate and Allowable Load Capacities for Crete-Flex in Grouted and Hollow Concrete Masonry[1,2,3]

Nominal Anchor Diameter	Min. Embed. (in.)	Min. Edge Dist. (in.)	Min. Spacing (in.)	Ultimate Load		Allowable Load	
				Tension (lbs.)	Shear (lbs.)	Tension (lbs.)	Shear (lbs.)
3/16"	1-1/4	2-1/2	3	765	1305	155	260
#14	1-1/4	1	6	780	420	155	85
	1-1/4	1-3/4		1,160	1,320	230	265
	1-1/4	2-1/2	1-1/2	505	1,065	100	215
	1-1/4		3	505	1,235	100	245
	1-1/4		6	1,220	1,320	245	265
	1-5/8[3]	1	6	1,240	540	250	110

1. Tabulated load values are for anchors installed in minimum 8" wide, Type II, lightweight, medium-weight or normal-weight concrete masonry units conforming to ASTM C90. Mortar must be minimum Type N.
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. Tabulated load values for #14 screws with 1-5/8" embedment are applicable to grouted concrete masonry only.

Average Withdrawal Capacity Crete-Flex in Wood[1,2]

Nominal Anchor Diameter in.	Minimum Embedment in.	Minimum Edge Distance in.	Withdrawal Capacity lbs.
#14	1	1-3/4	260
	1-1/2	1-3/4	735

1. Ultimate load capacities are based on laboratory tests and must be reduced by a minimum safety factor of 3.0 or greater to determine allowable working load.
2. Tests in Southern Yellow Pine (SYP) with minimum Specific Gravity of 0.55; screws oriented tangential to wood grain.

ORDERING INFORMATION

Crete-Flex

Cat. No.				Screw Size	Approximate Thread Length	Pack Qty.	Carton Qty.
HWH	HFH	PFH	TFH				
DFM4EMH500	-	DFM4EMF610	-	3/16" X 1-1/4"	1"	100	500
DFM4EMH510	-	DFM4EMF620	-	3/16" X 1-3/4"	1-1/2"	100	500
DFM4EMH530	-	DFM4EMF630	-	3/16" X 2-1/4"	1-3/4"	100	500
DFM4EMH550	-	DFM4EMF640	-	3/16" X 2-3/4"	1-3/4"	100	500
-	-	DFM4EMF650	-	3/16" X 3-1/4"	1-3/4"	100	500
DFM4EMF310	-	DFM4EMF690	-	#14 X 1-1/4"	1"	100	500
DFM4EMF330	DFM4EMF340	DFM4EMF710	DFM4EMF510	#14 X 1-3/4"	1-1/2"	100	500
DFM4EMF350	DFM4EMF360	DFM4EMF730	DFM4EMF530	#14 X 2-1/4"	1-3/4"	100	500
DFM4EMF370	-	DFM4EMF750	DFM4EMF550	#14 X 2-3/4"	1-3/4"	100	500
DFM4EMF390	-	DFM4EMF770	-	#14 X 3-1/4"	1-3/4"	100	500
DFM4EMF410	-	DFM4EMF790	-	#14 X 3-3/4"	1-3/4"	100	500
DFM4EMF430	-	DFM4EMF810	-	#14 X 4"	1-3/4"	100	500
DFM4EMF450	-	DFM4EMF830	-	#14 X 5"	1-3/4"	100	500
DFM4EMF470	-	DFM4EMF850	-	#14 X 6"	1-3/4"	100	500

HWH = Hex Washer Head, HFH = Hex Flange Head, PFH = Phillips Flat Head, TFH = TrimFit® Flat Head

- One straight shank drill bit included in each standard box.
- Hex Washer Head and Hex Flange Head Crete-Flex anchors are measured from below the washer. Phillips Flat Head and TrimFit Flat head CreteFlex anchors are measured end to end. To select the proper minimum anchor length, determine the embedment depth (e.g. required to obtain desired load capacity), then add the thickness of the fixture, including any spacers or shims, to the embedment depth.

Drill Bits

Cat. No.	Description
DFX153255	5/32" x 5-1/2" UltraCon+ straight shank bit
DW5381	5/32" x 7" UltraCon+ SDS bit
DW5410	7/32" x 6" SDS Plus 2 Cutter Drill Bit
DW5412	7/32" x 10" SDS Plus 2 Cutter Drill Bit

Installation Kit

Cat. No.	Description
DW5366	UltraCon®+ Installation Kit includes: 5/32" and 3/16" UltraCon+ bit, 1/4" and 5/16" nutsetters, #2 and #3 Phillips bits, Phillipsflat head adapter, percussion adapter, drive sleeve and 1/8" allen wrench

Rotary Hammers

Cat. No.	Description
DCH273	20V Max* XR Brushless 1" L-Shape SDS Plus Rotary Hammer
DCH133	20V Max* XR Brushless 1" D-Handle SDS Plus Rotary Hammer

Accessories

Cat. No.	Description
DWH303DH	Onboard Dust Extractor for 1" SDS Plus Hammers
DWH050	Large Hammer Dust Extraction - Hole Cleaning
DWH200	Dust Extraction Tube Kit with Hose

Dust Extractors

Cat. No.	Description
DCV585	Flexvolt® 60V Max* Dust Extractor
DWV010	8 Gallon Wet Dry Hepa/Rrp Dust Extractor
DWV012	10 Gallon Wet Dry Hepa/Rrp Dust Extractor
DWH161D1	20V Max* XR Brushless Universal Dust Extractor Kit

GENERAL INFORMATION

AGGRE-GATOR®

300 Series Stainless Bi-Metal Concrete and Masonry Fasteners

PRODUCT DESCRIPTION

The Aggre-Gator anchor is a bi-metal screw anchor for light to medium duty applications in concrete and masonry block base materials. The Aggre-Gator is fast and easy to install and provides a neat, finished appearance. Aggre-Gator anchors provide excellent corrosion resistance in demanding applications, such as those in exposed environments.

GENERAL APPLICATIONS AND USES

- Mounts and clips
- Hurricane shutters
- Windows and screens
- Masonry facades (e.g. brick tie anchors)
- Aluminum enclosures
- Curtain wall and window wall support anchors
- Pressure-treated wood (e.g. ACQ)

FEATURES AND BENEFITS

+ High in-place value over life of structure
+ Good strength, performance and ductility
+ Stalgard GB coating creates greater galvanic compatibility in dissimilar metal applications involving aluminum
+ Anchor design and thread profile provides quick cutting during installation
+ Gimlet point allows for installation into wood without predrilling

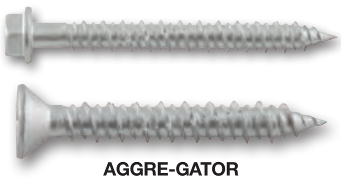
APPROVALS AND LISTINGS

- Tested in accordance with ASTM E488
- Miami-Dade County Notice of Acceptance (NOA) No. 21-0201.08
- Florida Statewide Product Approval FL29068.1

GUIDE SPECIFICATIONS

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

SECTION CONTENTS



AGGRE-GATOR

HEAD STYLES

- Hex Washer Head
- TrimFit® Flat Head

ANCHOR MATERIALS

- 300 series (18-8) stainless steel head and shank with hardened steel tapping threads and gimlet point
- Stalgard® GB coating (Galvanic Barrier)

ANCHOR SIZE RANGE

- 1/4" diameter x 1-1/4" to 4" lengths

SUITABLE BASE MATERIALS

- Normal-weight Concrete
- Hollow Concrete Masonry (CMU)
- Grout-Filled Concrete Masonry (CMU)
- Brick Masonry
- Wood

MIAMI-DADE COUNTY APPROVED

MATERIAL SPECIFICATIONS

Anchor Component	Specification
Anchor Head and Shank	300 series stainless steel
Tapping Threads and Gimlet Point	Hardened carbon steel
Coating/Plating/Finish	Stalgard® GB (silver color)

The tapping threads with gimlet point is approximately 1/2-inch in length.

INSTALLATION SPECIFICATIONS

Aggre-Gator Hex Head and Flat Head Screw Anchors[1,2]

Dimension	Nominal Anchor Diameter	
	1/4" HWH	1/4" TFH
Anchor Shank Diameter (in.)	0.189	0.189
Ultracon+ Drill Bit Size (in.)	3/16	3/16
UltraCon+ bit tolerance range (in.)	0.202 to 0.206	
Typ. Fixture Clearance hole (in.)	5/16	5/16
Head Height (in.)	9/64	3/16
Head Width (in.)	5/16	13/32
Washer O.D. (in.)	13/32	N/A
Washer Thickness (in.)	3/64	N/A
Hex Driver (in) / Phillips Driver Size	5/16	#3

HWH = Hex Washer Head, TFH = TrimFit Head

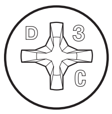
3. For minimum nominal embedment depths, h_{nom}, see the performance data tables. The minimum hole depth, h_o, is 1/4-inch more than the selected nominal embedment depth.
4. In light gauge steel material (.036" / 20 gauge and thinner), the clearance hole can be the same diameter as the drill bit.

300 Series Stainless Steel Aggre-Gator Identification

The head markings consist of a "D" for the DEWALT brand, the number "3" for the 300 series stainless steel classification, and the length code.

Hex Washer Head (HWH)

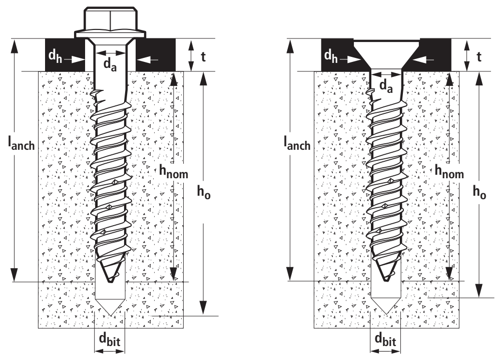
TrimFit® Head (TFH)



Aggre-Gator Length Code Identification System

Length ID marking on head		□	A	B	C	D	E	F
Overall anchor length ℓ_{anch} (inches)	From	1"	1-1/2"	2"	2-1/2"	3"	3-1/2"	4"
	Up to but not including	1-1/2"	2"	2-1/2"	3"	3-1/2"	4"	4-1/2"

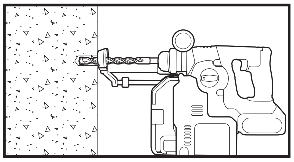
Anchor Detail



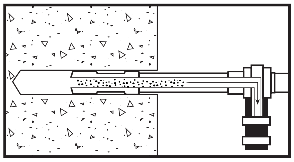
Nomenclature
d_a (d) = Diameter of anchor
d_{bit} = Diameter of drill bit
d_h = Diameter of fixture clearance hole
h_{nom} = Minimum embedment depth
h = Base material thickness
The minimum value of h should be $1.5h_{nom}$ or 3" whichever is greater
h_o = Minimum hole depth

INSTALLATION INSTRUCTIONS

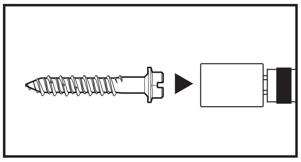
Installation Instructions for Aggre-Gator



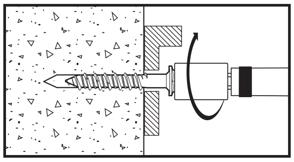
Step 1
Using the proper drill bit size, drill a hole into the base material to the required depth, h_o, which is a 1/4-inch deeper than the minimum embedment depth, h_{nom}.



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
Attach a Ultracon+ installation socket tool for the selected anchor size to a percussion drill and set the drill to rotary only mode. Mount the screw anchor head into the socket. For flat head versions a bit tip must be used with the socket tool.



Step 4
Place the point of the Aggre-Gator through the fixture into the pre-drilled hole and drive the anchor in one steady continuous motion until it is fully seated at the proper embedment. The driver will automatically disengage from the head of the screw.

PERFORMANCE DATA

Ultimate Load Capacities for Aggre-Gator in Normal-Weight Concrete[1,2]

Nominal Anchor Diameter	Min. Edge Dist. in.	Min. Spacing in.	Min. Embed. in.	Minimum Concrete Compressive Strength									
				2000 psi		2500 psi		3000 psi		3500 psi		4000 psi	
				Tension lbs.	Shear lbs.	Tension lbs.	Shear lbs.	Tension lbs.	Shear lbs.	Tension lbs.	Shear lbs.	Tension lbs.	Shear lbs.
1/4	1-1/4	3	1	450	-	495	-	955	-	1015	-	1070	-
			1-3/8	1105	-	1215	-	1215	-	1215	-	1270	-
			1-3/4	1125	-	1235	-	1235	-	1235	-	1270	-
	1-1/2	3	1	450	780	495	815	955	980	1015	1020	1070	1020
			1-3/8	1105	990	1215	1035	1215	1175	1215	1220	1270	1220
			1-3/4	1125	1170	1235	1220	1235	1220	1235	1220	1270	1220
	2-1/2	1-1/2	1	740	780	815	815	965	980	1030	1020	1085	1020
			1-3/8	960	990	1055	1035	1055	1175	1055	1220	1085	1220
			1-3/4	1220	1170	1340	1220	1340	1220	1340	1220	1380	1220
		3	1-1/2	-	765 [3]	-	800 [3]	-	-	-	-	-	-
			1-3/4	-	760 [4]	-	795 [4]	-	-	-	-	-	-
	3	1-1/2	1	740	865	815	900	965	900	1030	900	1085	900
			1-3/8	960	1580	1055	1650	1055	1965	1055	2040	1085	2040
			1-3/4	1220	1870	1340	1950	1340	1985	1340	2060	1380	2060

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. 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 and higher may be necessary depending upon the application such as life safety or overhead.
3. These shear values are for tests conducted with 1" x 4" nominal (3/4" max. thickness) treated southern yellow pine attached to concrete; the listed embedment is into the concrete.
4. These shear values are for tests conducted with 2" x 4" nominal (1-1/2" max. thickness) treated southern yellow pine attached to concrete; the listed embedment is into the concrete.

Allowable Load Capacities for Aggre-Gator in Normal-Weight Concrete[1,2]

ALLOWABLE STRESS DESIGN ASD

Nominal Anchor Diameter	Min. Edge Dist. in.	Min. Spacing in.	Min. Embed. in.	Minimum Concrete Compressive Strength									
				2000 psi		2500 psi		3000 psi		3500 psi		4000 psi	
				Tension lbs.	Shear lbs.	Tension lbs.	Shear lbs.	Tension lbs.	Shear lbs.	Tension lbs.	Shear lbs.	Tension lbs.	Shear lbs.
1/4	1-1/4	3	1	110	-	120	-	235	-	250	-	265	-
			1-3/8	275	-	300	-	300	-	300	-	315	-
			1-3/4	280	-	305	-	305	-	305	-	315	-
	1-1/2	3	1	110	195	120	200	235	245	250	255	265	255
			1-3/8	275	245	300	255	300	290	300	305	315	305
			1-3/4	280	290	305	305	305	305	305	305	315	305
	2-1/2	1-1/2	1	185	195	200	200	240	245	255	255	270	255
			1-3/8	240	245	260	255	260	290	260	305	270	305
			1-3/4	305	290	335	305	335	305	335	305	345	305
		3	1-1/2	-	190 [2]	-	200 [2]	-	-	-	-	-	-
			1-3/4	-	190 [3]	-	195 [3]	-	-	-	-	-	-
	3	1-1/2	1	185	215	200	225	240	225	255	225	270	225
			1-3/8	240	395	260	410	260	490	260	510	270	510
			1-3/4	305	465	335	485	335	495	335	515	345	515

1. Allowable load capacities listed are for uncracked concrete and calculated using an applied safety factor of 4.0. Consideration of safety factors of 10 or higher may be necessary depending on the application, such as life safety or overhead.
2. These shear values are for tests conducted with 1" x 4" nominal (3/4" max. thickness) treated southern yellow pine attached to concrete; the listed embedment is into the concrete.
3. These shear values are for tests conducted with 2" x 4" nominal (1-1/2" max. thickness) treated southern yellow pine attached to concrete; the listed embedment is into the concrete.

Ultimate Load Capacities for Aggre-Gator in Hollow and Grout-Filled Concrete Masonry[1,2]

Nominal Anchor Diameter in.	Min. Edge Dist. in.	Min. Spacing in.	Min. Embed. in.	Hollow Block		Grout-Filled Block	
				Tension lbs.	Shear lbs.	Tension lbs.	Shear lbs.
1/4	2	3	1-1/4	780	935	830	1035
			2	-	-	1625	2365
	4	1-1/2	1-1/4	-	-	745	1410
			2	-	-	2015	2385
	4	3	1-1/4	880	1055	-	-

1. Tabulated load values are for anchors installed in grout-filled concrete block conforming to ASTM C90.
2. Ultimate load capacities must be reduced by a minimum safety factor of 5.0 or greater to determine allowable working load. Consideration of safety factors of 10 and higher may be necessary depending upon the application such as life safety or overhead.

Allowable Load Capacities for Aggre-Gator in Hollow and Grout-Filled Concrete Masonry[1,2,3]

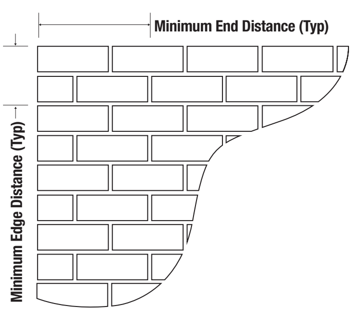
Nominal Anchor Diameter in.	Min. Edge Dist. in.	Min. Spacing in.	Min. Embed. in.	Hollow Block		Grout-Filled Block	
				Tension lbs.	Shear lbs.	Tension lbs.	Shear lbs.
1/4	2	3	1-1/4	155	185	165	205
			2	-	-	325	470
	4	1-1/2	1-1/4	-	-	145	280
			2	-	-	400	475
	4	3	1-1/4	175	210	-	-

1. Tabulated load values are for anchors installed in hollow or grout-filled concrete block conforming to ASTM C90. Mortar must be Type N, S or M. 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 necessary depending on the application, such as life safety or overhead.
3. The tabulated values are applicable for anchors installed into the ends of concrete masonry units (e.g. wall opening) where minimum edge distances are maintained.

Allowable Load Capacities for Aggre-Gator Anchors Installed in Clay Brick Masonry[1,2,3,4,5]

Nominal Anchor Diameter d in.	Minimum Embed. in.	Minimum Edge Distance in.	Minimum End Distance in.	Installation Location	Tension lbs.	Shear lbs.
1/4	1-1/2	1-1/8	1-3/4	Face	220	370
		2-1/2		Mortar Joint	320	360

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 Type N, S or M. 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 necessary depending upon the application such as life safety or overhead.
3. Allowable shear loads into the face or mortar joint of the brick masonry wall may be applied in any direction.
4. The tabulated values are applicable for anchors installed at a critical spacing between anchors of 12 times the nominal anchor diameter.
5. The tabulated values are applicable for anchors installed into the ends of masonry walls (e.g. wall opening) where minimum edge distances are maintained.



Ultimate Load Capacity for Aggre-Gator in Wood[1,2,3]

Nominal Anchor Diameter d in.	Minimum Embed. in.	Tension lbs.	Shear lbs.
1/4	1	205	435
	2	935	785

1. Pre-drilling is not required for this anchor into wood. (but can be considered).
2. Tabulated values are applicable for anchors installed at a minimum edge distance of 5 times the nominal anchor diameter.
3. Tested in stacked 2" x 4" (1-1/2" max. thickness) southern yellow pine; screws orientated tangential to wood grain.

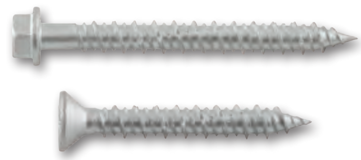
ORDERING INFORMATION

Silver Stalgard Aggre-Gator®

Cat. No.		Screw Size	Approximate Thread Length	Pack Qty.	Carton Qty.
HWH	TFH				
DFM3EML300	DFM3EMM300	1/4" X 1-1/4"	1-1/8"	50	300
DFM3EML315	DFM3EMM310	1/4" X 1-3/4"	1-5/8"	50	300
DFM3EML325	DFM3EMM320	1/4" X 2-1/4"	1-7/8"	50	300
DFM3EML335	DFM3EMM330	1/4" X 2-3/4"	1-7/8"	50	300
DFM3EML345	DFM3EMM340	1/4" X 3-1/4"	1-7/8"	50	300
DFM3EML365	DFM3EMM360	1/4" X 4"	1-7/8"	50	300

HWH = Hex Washer Head, TFH = TrimFit® Flat Head

Hex Head Aggre-Gator anchors are measured from below the washer while flat head Aggre-Gator anchors are measured end to end. To select the proper minimum anchor length, determine the embedment depth (e.g. required to obtain desired load capacity). Then add the thickness of the fixture, including any spacers or shims, to the embedment depth.



UltraCon+ Drill Bits

Cat. No.	Description
DW5381	5/32" x 7" UltraCon+ SDS bit
DW5382	3/16" x 7" UltraCon+ SDS bit
DFX153255	5/32" x 5-1/2" UltraCon+ straight shank bit
DFX131645	3/16" x 4-1/2" UltraCon+ straight shank bit
DFX131675	3/16" x 7-1/2" UltraCon+ straight shank bit

Installation Kit

Cat. No.	Description
DW5366	UltraCon®+ Installation Kit includes: 5/32" and 3/16" UltraCon+ bit, 1/4" and 5/16" nutsetters, #2 and #3 Phillips bits, Phillips flat head adapter, percussion adapter, drive sleeve and 1/8" allen wrench


Rotary Hammers

Cat. No.	Description
DCH273	20V Max* XR Brushless 1" L-Shape SDS Plus Rotary Hammer
DCH133	20V Max* XR Brushless 1" D-Handle SDS Plus Rotary Hammer


Accessories

Cat. No.	Description
DWH303DH	Onboard Dust Extractor for 1" SDS Plus Hammers
DWH050	Large Hammer Dust Extraction - Hole Cleaning
DWH200	Dust Extraction Tube Kit with Hose



Dust Extractors

Cat. No.	Description
DCV585	Flexvolt® 60V Max* Dust Extractor
DWV010	8 Gallon Wet Dry Hepa/Rrp Dust Extractor
DWV012	10 Gallon Wet Dry Hepa/Rrp Dust Extractor
DWH161D1	20V Max* XR Brushless Universal Dust Extractor Kit




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 ANSI masonry bits for installation, accepts 1/4", 3/8" or 1/2" diameter threaded rods. It is also available in a 3/8" male thread version.

GENERAL APPLICATIONS AND USES

- Fire Sprinkler Pipes
- Ventilation Systems
- Cable Trays
- Lighting Systems
- Suspended Ceilings
- Overhead Utilities
- Tension zone / cracked concrete
- Seismic qualification (SDC A – F)

FEATURES AND BENEFITS

+ Installs into holes drilled with a standard ANSI drill bit
+ Fast installation with power tools 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 for concrete; code compliant with the International Building Code/International Residential Code: 2021 IBC/IRC, 2018 IBC/IRC, 2015 IBC/IRC and 2012 IBC/IRC.
- Tested in accordance with ACI 355.2/ASTM E488 and ICC-ES AC193 for use in cracked and uncracked concrete and for use with the design provisions of ACI 318 (-19 and -14) Chapter 17 or ACI 318-11 Appendix D.
- Evaluated and qualified by an accredited independent testing laboratory for recognition in cracked and uncracked concrete including seismic and wind loading (anchor category 1)
- Evaluated and qualified by an accredited independent testing laboratory for reliability against brittle failure, e.g. hydrogen embrittlement.
- FM Approvals (Factory Mutual) - see approval for sizes.
- City of Los Angeles, LABC Supplement (within ESR-3889)
- Florida Building Code, FBC Supplement including HVHZ (within ESR-3889)

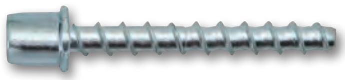
GUIDE SPECIFICATIONS

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.

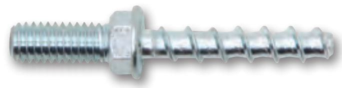
MATERIAL SPECIFICATIONS

Anchor component	Specification
Anchor Body	Case hardened low carbon steel
Plating	Zinc plating according to ASTM B633, 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", 3/8", and 1/2" diameter (threaded heads)

SUITABLE BASE MATERIALS

- Normal-weight concrete
- Lightweight concrete
- Concrete over steel deck
- Hollow core concrete

TENSION ZONE CRACKED CONCRETE

SEISMIC REGION QUALIFICATION

CODE LISTED ICC-ES ESR-3889 CONCRETE

DDA DEWALT DESIGN ASSIST™

INSTALLATION SPECIFICATIONS

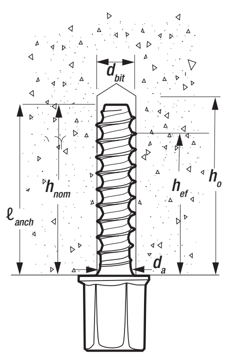
Installation Specifications for Hangermate+ in Concrete and Supplementary Information[1,2]

Anchor Property/Setting Information		Notation	Units	Nominal Anchor Diameter (inch)						
				1/4	3/8		3/8		3/8	1/2
Coupler thread size (UNC)		-	in.	1/4-20	3/8-16		3/8-16		3/8-16	1/2-13
Coupler head style		-	-	Internal Thread	Internal Thread		External Thread		Internal Thread	Internal Thread
Nominal anchor diameter (screw anchor body)		d_a	in. (mm)	0.250 (6.4)	0.250 (6.4)		0.250 (6.4)		0.375 (9.5)	0.375 (9.5)
Nominal drill bit diameter (ANSI)		d_{bit}	in.	1/4	1/4		1/4		3/8	3/8
Minimum nominal embedment depth[4]		h_{nom}	in. (mm)	1-5/8 (41)	1-5/8 (41)	2-1/2 (64)	1-5/8 (41)	2-1/2 (64)	2 (51)	2 (51)
Effective embedment		h_{ef}	in. (mm)	1.20 (30)	1.20 (30)	1.94 (49)	1.20 (30)	1.94 (49)	1.33 (33)	1.33 (33)
Minimum hole depth		h_o	in. (mm)	2 (51)	2 (51)	2-7/8 (73)	2 (51)	2-7/8 (73)	2-3/8 (60)	2-3/8 (60)
Minimum concrete member thickness		h_{min}	in. (mm)	3-1/4 (83)	3-1/4 (83)	4 (102)	3-1/4 (83)	4 (102)	3-1/2 (89)	3-1/2 (89)
Minimum edge distance[3]		c_{min}	in. (mm)	1-1/2 (38)	1-1/2 (38)		1-1/2 (38)		c_{min} = 1-1/2 (38) for $s_{min} \geq$ 3 (76);	c_{min} = 1-1/2 (38) for $s_{min} \geq$ 3 (76);
Minimum spacing distance[3]		s_{min}	in. (mm)	1-1/2 (38)	1-1/2 (38)		1-1/2 (38)		s_{min} = 2 (51) for $c_{min} \geq$ 2 (51)	s_{min} = 2 (51) for $c_{min} \geq$ 2 (51)
Nominal anchor length[6]		l_{anch}	in.	1-5/8	1-5/8	2-1/2	1-5/8	2-1/2	2	2
Maximum impact wrench power (torque)[1]		$T_{impact,max}$	ft.-lbf. (N-m)	150 (203)	150 (203)		150 (203)		300 (407)	300 (407)
Maximum manual installation torque		$T_{inst,max}$	ft.-lbf. (N-m)	19[3] (26)	19[3] (26)	25 (34)	19[3] (26)	25 (34)	25 (34)	25 (34)
Coupler Head	Wrench socket size	-	in.	3/8	1/2		1/2		1/2	11/16
	Max. head height	-	in.	33/64	43/64		1-3/16		43/64	53/64
	Max. washer diameter	-	in.	1/2	21/32		21/32		21/32	31/32
Effective tensile stress area (screw anchor body)		A_{se}	in.^{2} (mm^2)	0.045 (28.8)	0.045 (28.8)		0.045 (28.8)		0.094 (60.7)	0.094 (60.7)
Minimum specified ultimate strength		f_{uta}	psi (N/mm^2)	115,000 (793)	115,000 (793)		115,000 (793)		100,000 (690)	100,000 (690)
Minimum specified yield strength		f_y	psi (N/mm^2)	92,000 (634)	92,000 (634)		92,000 (634)		80,000 (552)	80,000 (552)
Mean axial Stiffness[7]	Uncracked concrete	β_{uncr}	lbf/in.	1,381,000	1,381,000		1,381,000		1,157,000	1,157,000
	Cracked concrete	β_{cr}	lbf/in.	318,000	318,000		318,000		330,000	330,000

For SI: 1 inch = 25.4 mm, 1 ft-lb = 1.356 N-m, 1 psi = 0.0069 N/mm² (MPa).

1. The information presented in this table is used in conjunction with the design criteria of ACI 318 (-19 or -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.
3. For installations into lightweight concrete, the max installation torque, $T_{inst,max}$, is 18 ft.-lb for nominal 1/4-inch-diameter anchors (screw anchor body diameter) with an 1-5/8-inch nominal embedment.
4. The embedment depth, h_{nom}, is measured from the outside surface of the concrete member to the embedded end of the anchor.
5. 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 nominal 3/8-inch-diameter anchors (screw anchor body diameter).
6. The listed anchor length is based on coupler head anchor sizes commercially available at the time of publication compared with the requirements to achieve the minimum nominal embedment depth. The nominal anchor length is measured from under the coupler head to the tip of the anchor.
7. Mean values shown, actual stiffness varies considerably depending on concrete strength, loading and geometry of application.

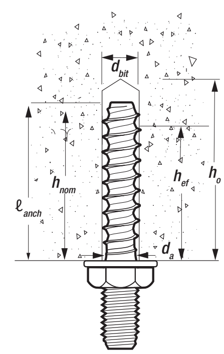
Hangermate+ Anchor Detail in Concrete



Internally Threaded Version

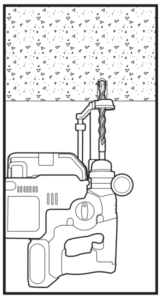
Nomenclature

- d_a = Anchor diameter (screw anchor body)
- 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

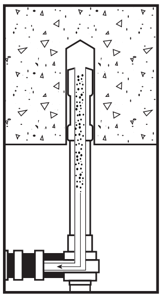


External Thread Version

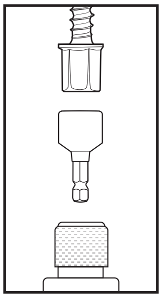
INSTALLATION INSTRUCTIONS



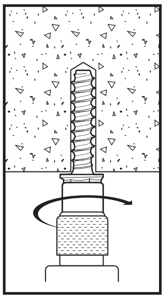
Step 1
Using the proper drill bit size, drill a hole into the base material to the required depth. The tolerances of the drill bit used should meet the requirements of ANSI Standard B212.15.



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.

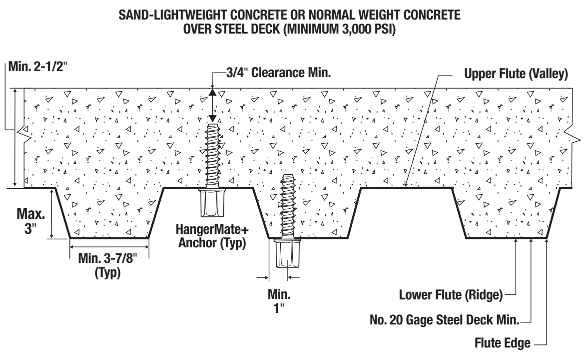


Step 3
Select a powered impact wrench or torque wrench and do not exceed the maximum torque, $T_{impact,max}$ or $T_{inst,max}$, repectively, for the selected anchor diameter and embedment (See Table 1). Attach an appropriate sized hex socket to the wrench. Mount the screw anchor head into the socket.



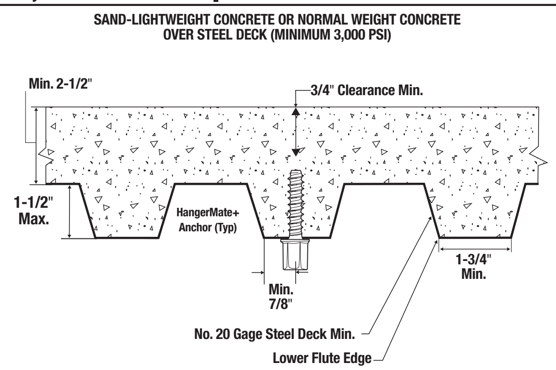
Step 4
Drive the anchor with an impact wrench or torque wrench through the fixture and into the hole until the head of the anchor comes into contact with the member surface. Do not spin the hex socket off the anchor to disengage. Insert threaded rod or threaded bolt element into Hangermate+.

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.

PERFORMANCE DATA (ASD)

Ultimate Load Capacities for Hangermate+ in Normal-Weight Concrete[1,2,3]

Nominal Anchor Size in.	Nominal Anchor Diameter (screw anchor body) 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	1-5/8 (41)	2,410 (10.7)	1,485 (6.6)	2,545 (11.3)	1,525 (6.8)	2,775 (12.3)	1,525 (6.8)	2,775 (12.3)	1,525 (6.8)	2,775 (12.3)	1,525 (6.8)
3/8	1/4	1-5/8 (41)	2,410 (10.7)	1,555 (6.9)	2,545 (11.3)	1,565 (7.0)	2,775 (12.3)	1,565 (7.0)	2,775 (12.3)	1,565 (7.0)	2,775 (12.3)	1,565 (7.0)
		2-1/2 (64)	3,650 (16.2)	1,555 (6.9)	3,855 (17.1)	1,565 (7.0)	4,200 (18.7)	1,565 (7.0)	4,270 (19.0)	1,565 (7.0)	4,270 (19.0)	1,565 (7.0)
3/8	3/8	2 (51)	3,670 (16.3)	1,985 (8.8)	4,020 (17.9)	2,010 (8.9)	4,645 (20.7)	2,010 (8.9)	4,725 (21.0)	2,010 (8.9)	5,455 (24.3)	2,010 (8.9)
1/2	3/8	2 (51)	3,670 (16.3)	2,970 (13.2)	4,020 (17.9)	2,990 (13.3)	4,645 (20.7)	2,990 (13.3)	4,725 (21.0)	2,990 (13.3)	5,455 (24.3)	2,990 (13.3)

1. Tabulated load values are for anchors installed in uncracked 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.
3. The tabulated capacities are for the Hangermate+ anchors which must be checked against the steel strength of the corresponding threaded rod or bolt size and type, the lowest load level controls.

Allowable Load Capacities for Hangermate+ in Normal-Weight Concrete[1,2,3,4,5,6]

Nominal Anchor Size in.	Nominal Anchor Diameter (screw anchor body) 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	1-5/8 (41)	605 (2.7)	370 (1.6)	635 (2.8)	380 (1.7)	695 (3.1)	380 (1.7)	695 (3.1)	380 (1.7)	695 (3.1)	380 (1.7)
3/8	1/4	1-5/8 (41)	605 (2.7)	390 (1.7)	635 (2.8)	390 (1.7)	695 (3.1)	390 (1.7)	695 (3.1)	390 (1.7)	695 (3.1)	390 (1.7)
		2-1/2 (64)	915 (4.1)	390 (1.7)	965 (4.3)	390 (1.7)	1,050 (4.7)	390 (1.7)	1,070 (4.8)	390 (1.7)	1,070 (4.8)	390 (1.7)
3/8	3/8	2 (51)	920 (4.1)	495 (2.2)	1,005 (4.5)	505 (2.2)	1,160 (5.2)	505 (2.2)	1,180 (5.2)	505 (2.2)	1,365 (6.1)	505 (2.2)
1/2	3/8	2 (51)	920 (4.1)	745 (3.3)	1,005 (4.5)	750 (3.3)	1,160 (5.2)	750 (3.3)	1,180 (5.2)	750 (3.3)	1,365 (6.1)	750 (3.3)

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 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.
5. For lightweight concrete, multiply the tabulated allowable load capacities by a reduction factor of 0.60.
6. The tabulated capacities are for the Hangermate+ anchors which must be checked against the steel strength of the corresponding threaded rod or bolt size and type, the lowest load level controls.

Allowable Load Capacities for Hangermate+ in Hollow-Core Concrete[1,2,3,4,5,6,7]

Nominal Anchor Size in.	Nominal Anchor Diameter (screw anchor body) in.	Minimum Nominal Embedment 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)	
			Tension lbs (kN)	Shear lbs (kN)	Tension lbs (kN)	Shear lbs (kN)	Tension lbs (kN)	Shear lbs (kN)
1/4	1/4	1-1/2 (41)	695 (3.1)	380 (1.7)	695 (3.1)	380 (1.7)	695 (3.1)	380 (1.7)
3/8	1/4	1-1/2 (41)	695 (3.1)	390 (1.7)	695 (3.1)	390 (1.7)	695 (3.1)	390 (1.7)

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 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.
5. Hollow core concrete must have a minimum cover thickness of 1-1/2" below the core locations. where anchors are installed. Care must be taken to prevent damage to prestressed cables in the hollow core concrete panel during drilling and installation.
6. Tabulated capacties are for PFM2211100, PFM2211200 and PFM1421000 Hangermate+, as applicable.
7. The tabulated capacities are for the Hangermate+ anchors which must be checked against the steel strength of the corresponding threaded rod or bolt size and type, the lowest load level controls.

LOAD ADJUSTMENT FACTORS FOR NORMAL-WEIGHT CONCRETE

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

Nominal Anchor Size (in)		1/4			3/8	1/2
Nominal Anchor Dia. (in) (Screw Anchor Body)		1/4	3/8	3/8	3/8	3/8
Nominal Embedment, h_{nom} (in)		1-5/8	1-5/8	2-1/2	2	2
Minimum Edge Distance, c_{min} (in)		1-1/2	1-1/2	1-1/2	1-1/2	1-1/2
Edge Distance (inches)	1-1/2	0.77	0.77	0.64	0.74	0.74
	1-3/4	0.83	0.83	0.67	0.79	0.79
	2	0.88	0.88	0.71	0.84	0.84
	2-1/4	0.94	0.94	0.75	0.89	0.89
	2-1/2	1.00	1.00	0.78	0.95	0.95
	2-3/4	1.00	1.00	0.82	1.00	1.00
	3	1.00	1.00	0.86	1.00	1.00
	3-1/2	1.00	1.00	0.93	1.00	1.00
	4	1.00	1.00	1.00	1.00	1.00

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

Nominal Anchor Size (in)		1/4			3/8	1/2
Nominal Anchor Dia. (in) (Screw Anchor Body)		1/4	3/8	3/8	3/8	3/8
Nominal Embedment, h_{nom} (in)		1-5/8	1-5/8	2-1/2	2	2
Minimum Edge Distance, c_{min} (in)		1-1/2	1-1/2	1-1/2	1-1/2	1-1/2
Edge Distance (inches)	1-1/2	0.68	0.66	0.70	0.61	0.47
	1-3/4	0.79	0.77	0.82	0.72	0.55
	2	0.90	0.88	0.93	0.82	0.63
	2-1/4	1.00	0.99	1.00	0.92	0.70
	2-1/2	1.00	1.00	1.00	1.00	0.78
	2-3/4	1.00	1.00	1.00	1.00	0.86
	3	1.00	1.00	1.00	1.00	0.94
	3-1/4	1.00	1.00	1.00	1.00	1.00

Spacing Reduction Factors - Tension (F_{NS})

Nominal Anchor Size (in)		1/4			3/8	1/2
Nominal Anchor Diameter (in) (Screw Anchor Body)		1/4	3/8	3/8	3/8	3/8
Nominal Embedment, h_{nom} (in)		1-5/8	1-5/8	2-1/2	2	2
Minimum Spacing, s_{min} (in)		1-1/2	1-1/2	1-1/2	2	2
Spacing Distance (inches)	1-1/2	0.73	0.73	0.66	-	-
	1-3/4	0.77	0.77	0.68	-	-
	2	0.80	0.80	0.70	0.77	0.77
	2-1/4	0.83	0.83	0.72	0.80	0.80
	2-1/2	0.86	0.86	0.74	0.83	0.83
	2-3/4	0.89	0.89	0.76	0.86	0.86
	3	0.92	0.92	0.78	0.89	0.89
	3-1/2	0.99	0.99	0.82	0.94	0.94
	4	1.00	1.00	0.86	1.00	1.00
	4-1/2	1.00	1.00	0.90	1.00	1.00
	5	1.00	1.00	0.94	1.00	1.00
	5-1/2	1.00	1.00	0.97	1.00	1.00
	6	1.00	1.00	1.00	1.00	1.00

Spacing Reduction Factors - Shear (F_{VS})

Nominal Anchor Size (in)		1/4			3/8	1/2
Nominal Anchor Diameter (in) (Screw Anchor Body)		1/4	3/8	3/8	3/8	3/8
Nominal Embedment, h_{nom} (in)		1-5/8	1-5/8	2-1/2	2	2
Minimum Spacing, s_{min} (in)		1-1/2	1-1/2	1-1/2	2	2
Spacing Distance (inches)	1-1/2	0.61	0.61	0.62	-	-
	1-3/4	0.63	0.63	0.64	-	-
	2	0.65	0.65	0.66	0.64	0.60
	2-1/4	0.67	0.66	0.68	0.65	0.62
	2-1/2	0.69	0.68	0.69	0.67	0.63
	2-3/4	0.71	0.70	0.71	0.69	0.64
	3	0.73	0.72	0.73	0.70	0.66
	3-1/2	0.76	0.76	0.77	0.74	0.68
	4	0.80	0.79	0.81	0.77	0.71
	4-1/2	0.84	0.83	0.85	0.81	0.73
	5	0.88	0.87	0.89	0.84	0.76
	5-1/2	0.91	0.90	0.93	0.88	0.79
	6	0.95	0.94	0.97	0.91	0.81
	6-1/2	0.99	0.98	1.00	0.94	0.84
	7	1.00	1.00	1.00	0.98	0.86
	7-1/2	1.00	1.00	1.00	1.00	0.89
	8	1.00	1.00	1.00	1.00	0.92
	9	1.00	1.00	1.00	1.00	0.97
	10	1.00	1.00	1.00	1.00	1.00

STRENGTH DESIGN INFORMATION

Tension and Shear Design Information for Hangermate+ Anchor is in Concrete[1,2,9,11,12]

CODE LISTED
ICC-ES ESR-3889

Design Characteristic	Notation	Units	Nominal Anchor Size (inch)						
			1/4	3/8		3/8		3/8	1/2
Anchor category	1, 2 or 3	-	1	1		1		1	1
Coupler thread size (UNC)	-		1/4- 20	3/8-16		3/8-16		3/8-16	1/2-13
Coupler head style	-		Internal Thread	Internal Thread		External Thread		Internal Thread	Internal Thread
Nominal anchor diameter (screw anchor body)	d_a	in. (mm)	0.250 (6.4)	0.250 (6.4)		0.250 (6.4)		0.375 (9.5)	0.375 (9.5)
Minimum nominal embedment depth[4]	h_{nom}	in. (mm)	1-5/8 (41)	1-5/8 (41)	2-1/2 (64)	1-5/8 (41)	2-1/2 (64)	2 (51)	2 (51)
Effective embedment	h_{ef}	in. (mm)	1.20 (30)	1.20 (30)	1.94 (49)	1.20 (30)	1.94 (49)	1.33 (33)	1.33 (33)
Steel Strength in Tension (ACI 318-19 17.6.1, ACI 318-14 17.4.1 or ACI 318-11 D.5.1)									
Steel strength in tension	N_{sa}	lb (kN)	4,535 (20.2)	4,535 (20.2)		4,535 (20.2)		8,730 (38.8)	8,730 (38.8)
Reduction factor for steel strength[3,4]	ϕ	-	0.65						
Concrete Breakout Strength in Tension (ACI 318-19 17.6.2, ACI 318-14 17.4.2 or ACI 318-11 D.5.2)									
Critical edge distance (uncracked concrete only)	c_{ac}	in. (mm)	4.3 (110)	4.3 (110)	6.1 (156)	4.3 (110)	6.1 (156)	5.0 (127)	5.0 (127)
Effectiveness factor for uncracked concrete	k_{uncr}	-	27	27	24	27	24	30	30
Effectiveness factor for cracked concrete	k_{cr}	-	17	17		17		17	17
Modification factor for cracked and uncracked concrete[5]	$\Psi_{c,N}$	-	1.0						
Reduction factor for concrete breakout strength[3]	ϕ	-	0.65						
Pullout Strength in Tension (Non-Seismic Applications) (ACI 318-19 17.6.3, 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	See Note 7		See Note 7		See Note 7	See Note 7
Characteristic pullout strength, cracked concrete (2,500 psi)[6,9]	$N_{p,cr}$	lb (kN)	765 (3.4)	765 (3.4)	1,415 (6.3)	765 (3.4)	1,415 (6.3)	See Note 7	See Note 7
Reduction factor for pullout strength[3]	ϕ	-	0.65						
Pullout Strength in Tension for Seismic Applications (ACI 318-19 17.10.3, ACI 318-14 17.2.3.3 Or ACI 318-11 D.3.3.3)									
Characteristic pullout strength, seismic (2,500 psi)[6,8,9]	$N_{p,eq}$	lb (kN)	360 (1.6)	360 (1.6)	1,170 (5.2)	360 (1.6)	1,170 (5.2)	900 (4.0)	900 (4.0)
Reduction factor for pullout strength[3]	ϕ	-	0.65						
Steel Strength in Shear (ACI 318-19 17.7.1, ACI 318-14 17.5.1 or ACI 318-11 D.6.1)									
Steel strength in shear[10]	V_{sa}	lb (kN)	800 (3.6)	1,360 (6.1)		1,360 (6.1)		1,295 (5.8)	1,295 (5.8)
Reduction factor for steel strength[3,4]	ϕ	-	0.60						
Steel Strength in Shear For Seismic Applications (ACI 318-19 17.10.3, ACI 318-14 17.2.3.3 or ACI 318-11 D.3.3.3)									
Steel strength in shear[10]	$V_{sa,eq}$	lb (kN)	600 (2.7)	695 (3.1)		695 (3.1)		800 (3.6)	800 (3.6)
Reduction factor for steel strength[3,4]	ϕ	-	0.60						
Concrete Breakout Strength in Shear (ACI 318-19 17.7.2, ACI 318-14 17.5.2 or ACI 318-11 D.6.2)									
Load bearing length of anchor	l_e	in. (mm)	1.20 (30)	1.20 (30)	1.94 (49)	1.20 (30)	1.94 (49)	1.33 (33)	1.33 (33)
Reduction factor for concrete breakout strength[3,4]	ϕ	-	0.70						
Pryout Strength in Shear (ACI 318-19 17.7.3, 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
Reduction factor for pryout strength[3,4]	ϕ	-	0.70						

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 (-19 or -14) Chapter 17 or ACI 318-11 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-14 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. The strength reduction factor applies when the load combinations from the IBC or ACI 318 are used and the requirements of ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are met. If the load combinations of ACI 318-11 Appendix C are used, the appropriate strength reduction factor must be determined in accordance with ACI 318-11 D.4.4.
4. The anchors are considered a brittle steel elements as defined by ACI 318 (-19 or -14) 2.3 or ACI 318-11 D.1.
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 1/4-inch-diameter anchors (screw anchor body diameter) 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 for concrete compressive strengths greater than 2,500 psi for 3/8-inch-diameter anchors (screw anchor body diameter) 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.
9. 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 17.7.1.2b in ACI 318-19, 17.5.1.2b in ACI 318-14 or equation D-29 in ACI 318-11 D.6.1.2.
10. Reported values for steel strength in shear are for seismic applications and based on tests in accordance with ACI 355.2, Section 9.6.
11. Anchors are permitted to be used in lightweight concrete in provided the modification factor λ_a equal to 0.8λ is applied to all values of $\sqrt{f'c}$ affecting N_n.
12. Hangermate+ shear values are for threaded rod or steel inserts with and 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[1,2,3,4,5,6,9]

CODE LISTED
ICC-ES ESR-3889

Design Characteristic	Notation	Units	Nominal Anchor Size (inch)						
			1/4	3/8		3/8		3/8	1/2
Anchor category	1, 2 or 3	-	1	1		1		1	1
Coupler thread size (UNC)	-	in.	1/4-20	3/8-16		3/8-16		3/8-16	1/2-13
Coupler head style	-	-	Internal Thread	Internal Thread		External Thread		Internal Thread	Internal Thread
Nominal anchor diameter (screw anchor body)	d_a	in. (mm)	0.250 (6.4)	0.250 (6.4)		0.250 (6.4)		0.375 (9.5)	0.375 (9.5)
Minimum nominal embedment depth[4]	h_{nom}	in. (mm)	1-5/8 (41)	1-5/8 (41)	2-1/2 (64)	1-5/8 (41)	2-1/2 (64)	2 (51)	2 (51)
Effective embedment	h_{ef}	in. (mm)	1.20 (30)	1.20 (30)	1.94 (49)	1.20 (30)	1.94 (49)	1.33 (33)	1.33 (33)
Hangermate+ Anchors Installed into Minimum 3-7/8-inch-wide Deck Flute (See Figure 6A)									
Minimum concrete member thickness[7]	$h_{min,deck,total}$	lb (kN)	5-1/2 (140)	5-1/2 (140)		5-1/2 (140)		5-1/2 (140)	5-1/2 (140)
Pullout strength, uncracked concrete (3,000 psi)	$N_{p,deck,uncr}$	lb (kN)	1,430 (6.4)	1,430 (6.4)	2,555 (11.4)	1,430 (6.4)	2,555 (11.4)	2,275 (10.1)	2,275 (10.1)
Pullout strength, cracked concrete (3,000 psi)	$N_{p,deck,cr}$	lb (kN)	615 (2.7)	615 (2.7)	1,115 (5.0)	615 (2.7)	1,115 (5.0)	1,290 (5.1)	1,290 (5.1)
Pullout strength, seismic (3,000 psi)	$N_{p,deck,eq}$	lb (kN)	290 (1.3)	290 (1.3)	920 (4.1)	290 (1.3)	920 (4.1)	890 (4.0)	890 (4.0)
Reduction factor for pullout strength[3,4]	ϕ	-	0.65						
Steel strength in shear	$V_{sa,deck}$	lb (kN)	1,205 (5.4)	1,205 (5.4)		1,205 (5.4)		1,360 (6.0)	1,360 (6.0)
Steel strength in shear, seismic	$V_{sa,deck,eq}$	lb (kN)	615 (2.7)	615 (2.7)		615 (2.7)		965 (4.3)	965 (4.3)
Reduction factor for steel strength[3,4]	ϕ	-	0.60						
Hangermate+ Anchors Installed into Minimum 1-3/4-inch-wide Deck Flute (See Figure 6B)									
Minimum concrete member thickness[7]	$h_{min,deck,total}$	lb (kN)	4 (102)	4 (102)		4 (102)		4 (102)	4 (102)
Pullout strength, uncracked concrete (3,000 psi)	$N_{p,deck,uncr}$	lb (kN)	1,430 (6.4)	1,430 (6.4)	2,075 (9.2)	1,430 (6.4)	2,075 (9.2)	1,440 (6.4)	1,440 (6.4)
Pullout strength, cracked concrete (3,000 psi)	$N_{p,deck,cr}$	lb (kN)	615 (2.7)	615 (2.7)	910 (4.0)	615 (2.7)	910 (4.0)	815 (3.6)	815 (3.6)
Pullout strength, seismic (3,000 psi)	$N_{p,deck,eq}$	lb (kN)	290 (1.3)	290 (1.3)	750 (3.3)	290 (1.3)	750 (3.3)	565 (2.5)	565 (2.5)
Reduction factor for pullout strength[8]	ϕ	-	0.65						
Steel strength in shear	$V_{sa,deck}$	lb (kN)	815 (3.6)	815 (3.6)		815 (3.6)		1,110 (4.9)	1,110 (4.9)
Steel strength in shear, seismic	$V_{sa,deck,eq}$	lb (kN)	415 (1.8)	415 (1.8)		415 (1.8)		790 (3.5)	790 (3.5)
Reduction factor for steel strength[8]	ϕ	-	0.60						

For SI: 1 inch = 25.4 mm, 1 ft-lb = 1.356 N-m, 1 psi = 0.0069 N/mm² (MPa).

1. Installation must comply with manufacturer's published installation 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 318-19 17.6.2, 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.
4. The characteristic pullout strength for concrete compressive strengths greater than 3,000 psi for 1/4-inch-diameter anchors (screw anchor body diameter) 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 for concrete compressive strengths greater than 3,000 psi for 3/8-inch-diameter anchors (screw anchor body diameter) 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. For all design cases $\Psi_{c,P} = 1.0$.
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 318-19 17.7.2, ACI 318-14 17.5.2 or ACI 318-11 D.6.2, as applicable, and the pryout capacity in accordance with ACI 318-19 17.7.2, 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, 318 (-19 or -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.
9. Hangermate+ shear values are for threaded rod or steel inserts with and 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.

DESIGN STRENGTH TABLES (SD)

Tension and Shear Design Strength Cracked Concrete[1,2,3,4,5,6,7,8]

Nominal Anchor Diameter			Nominal Embed. Depth h_{nom} (in.)	Effective Embed. Depth h_{ef} (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	
Coupler Thread Size (UNC)	Coupler Head Style	Screw Anchor Body			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 - 20	Internal Thread	1/4	1-5/8	1.20	495	515	525	515	575	515	645	515	705	515
3/8 - 16	Internal Thread	1/4	1-5/8	1.20	495	780	525	815	575	815	645	815	705	815
			2-1/2	1.94	920	815	970	815	1,060	815	1,195	815	1,305	815
3/8 - 16	External Thread	1/4	1-5/8	1.20	495	780	525	815	575	815	645	815	705	815
			2-1/2	1.94	920	815	970	815	1,060	815	1,195	815	1,305	815
3/8 - 16	Internal Thread	3/8	2	1.33	845	775	930	775	1,070	775	1,315	775	1,515	775
1/2 - 13	Internal Thread	3/8	2	1.33	845	915	930	1,000	1,070	1,140	1,315	1,140	1,515	1,140

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

Tension and Shear Design Strength Uncracked Concrete[1,2,3,4,5,6,7]

Nominal Anchor Diameter			Nominal Embed. Depth h_{nom} (in.)	Effective Embed. Depth h_{ef} (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	
Coupler Thread Size (UNC)	Coupler Head Style	Screw Anchor Body			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 - 20	Internal Thread	1/4	1-5/8	1.20	1,155	515	1,265	515	1,460	515	1,785	515	2,065	515
3/8 - 16	Internal Thread	1/4	1-5/8	1.20	1,155	815	1,265	815	1,460	815	1,785	815	2,065	815
			2-1/2	1.94	2,110	815	2,310	815	2,665	815	2,950	815	2,950	815
3/8 - 16	External Thread	1/4	1-5/8	1.20	1,155	815	1,265	815	1,460	815	1,785	815	2,065	815
			2-1/2	1.94	2,110	815	2,310	815	2,665	815	2,950	815	2,950	815
3/8 - 16	Internal Thread	3/8	2	1.33	1,495	775	1,640	775	1,890	775	2,315	775	2,675	775
1/2 - 13	Internal Thread	3/8	2	1.33	1,495	1,140	1,640	1,140	1,890	1,140	2,315	1,140	2,675	1,140

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

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

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

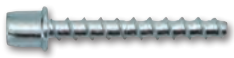
5- For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318 (-19 or -14) Chapter 17.

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

7- Hangermate+ shear values are for threaded rod or steel inserts with and 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- For seismic design in accordance with ACI 318, the tabulated tension design strengths in cracked concrete for concrete breakout and pullout strength must be multiplied by a factor of 0.75.

ORDERING INFORMATION

Catalog Number	Screw Size	Hang	Rod Size	Socket Size	Pack Qty.	Carton Qty.	Suggested Accessories	
							SDS+ Carbide Drill Bits	Hangermate+ Driver
Hangermate+ Internal Thread (UNC)								
PFM2211100	1/4" x 1-5/8"	Vertical	1/4"	3/8"	25	125	DW5517, DW5417	PFM1491050
PFM2211200	1/4" x 1-5/8"	Vertical	3/8"	1/2"	25	125	DW5517, DW5417	PFM1491100
PFM2211250	1/4" x 2-1/2"	Vertical	3/8"	1/2"	25	125	DW5517, DW5417	PFM1491100
PFM2211260	3/8" x 1-5/8"	Vertical	3/8"	1/2"	25	125	DW5527, DW5427	PFM1491100
PFM2211270	3/8" x 2"	Vertical	3/8"	1/2"	25	125	DW5527, DW5427	PFM1491100
PFM2211280	3/8" x 2"	Vertical	1/2"	11/16"	20	100	DW5527, DW5427	-
Hangermate+ External Thread (UNC)								
PFM1421000	1/4" x 1-5/8"	Vertical	3/8"	1/2"	25	125	DW5517, DW5417	DWMT19052B
PFM1421050	1/4" x 2-1/2"	Vertical	3/8"	1/2"	25	125	DW5517, DW5417	DWMT19052B

The published size includes the diameter and length of the anchor measured from under the head.
Shaded catalog numbers denote sizes which are less than the minimum standard anchor length for Strength Design.

Suggested Tools

20V Max* SDS+ Rotary Hammers

Option 1

 DCH172 ATOMIC™ 20V MAX* 5/8 in Brushless Cordless SDS Plus Rotary Hammer	 DWH200 Dust Extraction Tube Kit with Hose	 DWH161 20V MAX* Brushless Cordless Universal Dust Extractor

Option 2

 DCH273 20V MAX* XR 1" Brushless L-Shape Rotary Hammer	 DWH303 Onboard Dust Extractor for 1" SDS+ Rotary Hammer

Option 3

 DCH133 20V MAX* 1 in Brushless Cordless SDS PLUS D-Handle Rotary Hammer Kit	 DWH200 Dust Extraction Tube Kit with Hose	 DWH161 20V MAX* Brushless Cordless Universal Dust Extractor

20V Max* Impact Drivers

 DCF887 20V MAX* XR 1/4"3-Speed Impact Driver	 DCF850 Atomic 20V MAX* XR 1/4"3-Speed Impact Driver

20V Max* Impact Wrenches

 DCF921 Atomic 20V MAX* 1/2" Impact Wrench	 DCF923 Atomic 20V MAX* 3/8" Impact Wrench

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, 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 low level corrosion environment
- Tension zone / cracked concrete
- Seismic attachments (SDC A - F)
- Fire sprinklers and pipe supports
- 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 2021 IBC/IRC, 2018 IBC/IRC, 2015 IBC/IRC and 2012 IBC/IRC.
- Tested in accordance with ACI 355.2 and ICC-ES AC193 for use in concrete under the design provisions of ACI 318 (-19 and -14) Chapter 17 or ACI 318-11 (Appendix D)
- Evaluated and qualified by an accredited independent testing laboratory for recognition in cracked and uncracked concrete including seismic and wind loading (anchor Category 1)
- 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) - 3/8" diameter, see FM Approval Guide Pipe hanger components for automatic sprinkler systems

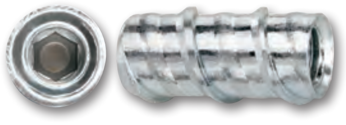
GUIDE SPECIFICATIONS

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
- Lightweight concrete
- Concrete over steel deck

TENSION ZONE CRACKED CONCRETE
SEISMIC REGION QUALIFICATION

CODE LISTED
ICC-ES ESR-2272
CONCRETE

DDA
DEWALT DESIGN ASSIST™

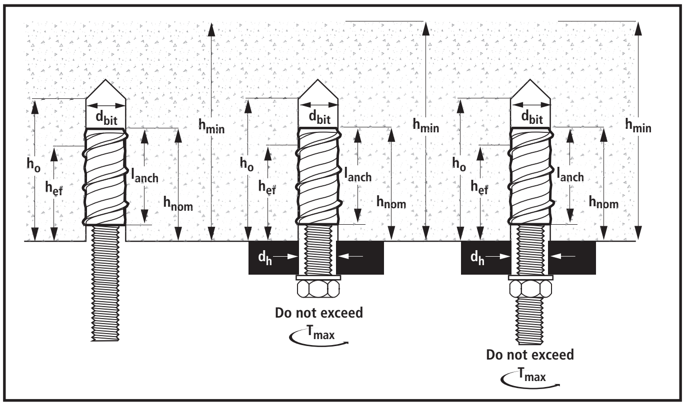
INSTALLATION SPECIFICATIONS

Installation Information for Snake+ Screw Anchor[1]

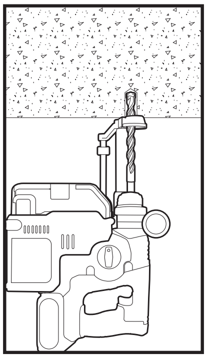
Anchor Property/ Setting Information	Notation	Units	Nominal Anchor Size / Threaded Coupler Diameter (inch)		
			1/4	3/8	1/2
Nominal outside anchor diameter	d_a	in. (mm)	0.375 (9.5)	0.500 (12.7)	0.750 (19.1)
Internal thread diameter (UNC)	d	in. (mm)	0.250 (6.4)	0.375 (9.5)	0.500 (12.7)
Minimum diameter 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 (ANSI)	d_{bit}	in.	3/8	1/2	3/4
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[3]	1.10 (28)	1.54 (39)
Max impact wrench power (torque)	T_{screw}	ft.-lb. (N-m)	120 (163)	345 (468)	345 (468)
Max tightening torque of steel insert element (threaded rod or bolt)	T_{max}	ft.-lb. (N-m)	4 (6)	8 (11)	36 (49)
Approximate internal thread depth	-	in.	11/32	23/32	15/16
Anchors Installed in Concrete Construction[2]					
Minimum member thickness[2]	h_{min}	in. (mm)	Not Applicable[3]	4 (102)	4 (102)
Minimum edge distance[2]	c_{min}	in. (mm)	Not Applicable[3]	3 (76)	4 (102)
Minimum spacing distance[2]	s_{min}	in. (mm)	Not Applicable[3]	3 (76)	4 (102)
Anchors Installed in the Topside of Concrete-Filled Steel Deck Assemblies[4]					
Minimum member topping thickness	$h_{min,deck}$	in. (mm)	Not Applicable[3]	3-1/4 (83)	-
Minimum edge distance	$c_{min,deck,top}$	in. (mm)	Not Applicable[3]	3 (76)	-
Minimum spacing distance	$s_{min,deck,top}$	in. (mm)	Not Applicable[3]	3 (76)	-

1. The information presented in this table is to be used in conjunction with the design criteria of 318 (-19 or -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 1/4-inch diameter anchor is limited to redundant fastening design only.
4. For 3/8-inch diameters installed in the topside of concrete-filled steel deck assemblies, steel installation detail.

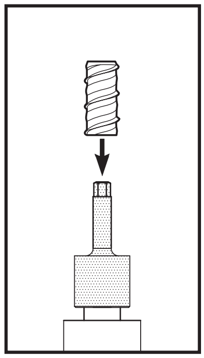
Dimensional Sketch for Snake+ Screw Anchor Installed with Steel Insert Element



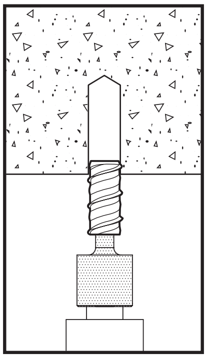
INSTALLATION INSTRUCTIONS



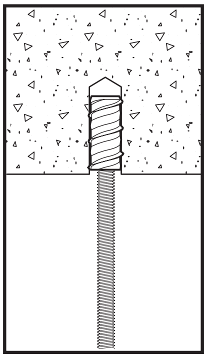
Step 1
Using the proper drill bit size, drill a hole into the base material to the required depth (e.g. dust extractor, hollow bit). The tolerances of the carbide drill bit used should meet the requirements of ANSI Standard B212.15.



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 DEWALT to the impact wrench. Mount the anchor onto the setting tool.

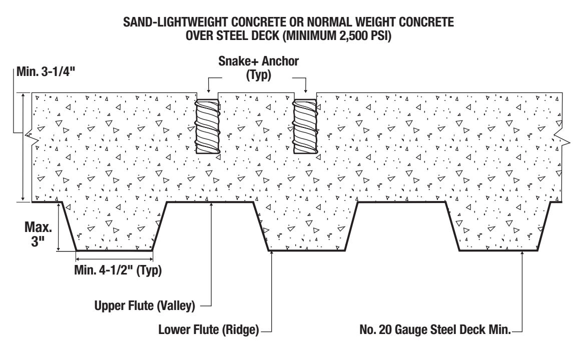


Step 3
Drive the anchor into the hole until the shoulder of the Snake+ setting tool comes into contact with the surface of the base material. Do not spin the setting tool off the anchor to disengage.



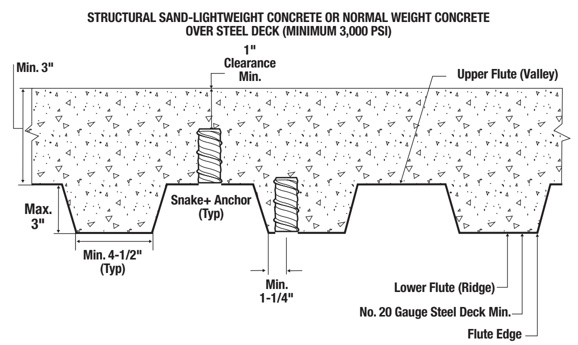
Step 4
Insert threaded rod or a bolt into the Snake+, taking care not to exceed the maximum specified tightening torque of the steel insert element, T_{max}. Minimum thread engagement should be at least one anchor diameter.

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 INFORMATION

Tension Design Information for Snake+ Anchors[1,2]

CODE LISTED ICC-ES ESR-2272

Design Characteristic	Notation	Units		Nominal Anchor Diameter	
				3/8 inch	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	$A_{se,N}$	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]	$\psi_{c,N}$	-		1.0	
Critical edge distance (uncracked concrete)	c_{ac}	in. (mm)		3 (76)	4 (102)
Critical edge distance, topside of concrete-filled steel decks with minimum topping thickness[10]	$c_{ac,deck,top}$	in. (mm)		3 (76)	-
Reduction factor for concrete breakout strength[3]	ϕ	-		Condition B = 0.65	
PULLOUT STRENGTH IN TENSION[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 (-19 and -14) Chapter 17 or ACI 318-11 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-19 17.10, ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable, 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 (-19 and -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 (-19 and -14) Chapter 17 or ACI 318-11 Appendix D, as applicable, requirements for Condition A, see ACI 318-19 17.5.3, 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 AACI 318 (-19 and -14) 2.3 or ACI 318-11 D.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 318-19 17.6.2, 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. 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..

Shear Design Information for Snake+ Anchors[1,2]

CODE LISTED
ICC-ES ESR-2272

Design Characteristic	Notation	Units		Nominal Anchor Diameter	
				3/8 inch	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	
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 steel strength[3]	ϕ	-		Condition B = 0.60	
CONCRETE BREAKOUT STRENGTH IN SHEAR[6]					
Nominal outside anchor diameter	d_a	in. (mm)		0.500 (12.7)	0.750 (19.1)
Load bearing length of anchor	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	k_{cp}	-		1.0	1.0
Effective embedment	h_{ef}	in. (mm)		1.10 (28)	1.54 (39)
Reduction factor for pryout strength[3]	ϕ	-		Condition B = 0.70	
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 steel strength, seismic[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 318-19 17.10, 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 (-19 and -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 (-19 and -14) Chapter 17 or ACI 318-11 Appendix D, as applicable, requirements for Condition A, see ACI 318-19 17.5.3, 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 (-19 and -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 17.7.1.2b in ACI 318-19 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 318-19 17.7.2, ACI 318-14 17.5.2 or ACI 318-11 D.6.2, as applicable, and the pryout capacity in accordance with ACI 318-19 17.7.3, 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.

DESIGN STRENGTH TABLES (SD)

Tension and Shear Design Strengths for Snake+ Anchors Installed in Cracked Concrete[1,2,3,4,5,6,7]

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 for Snake+ Anchors Installed in Uncracked Concrete[1,2,3,4,5,6]

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

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 318-19 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 318-19 Section 5.3 for load combinations. Condition B is assumed.

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

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

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

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

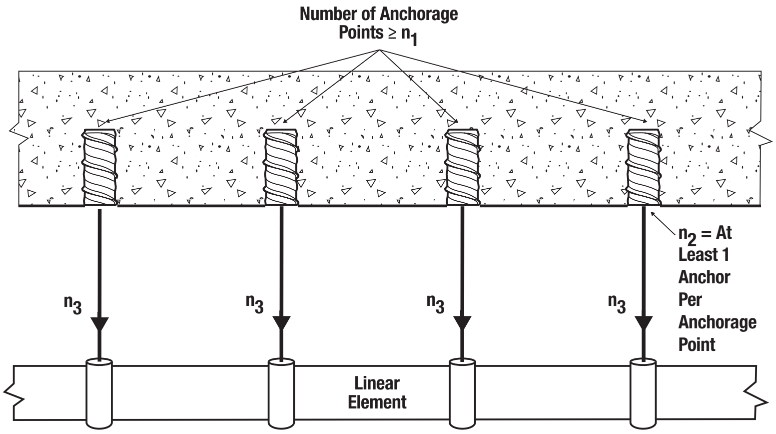
REDUNDANT FASTENING

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 (-19 and -14) Section 5.3 or ACI 318-11 Section 9.2.

Strength Design (SD)

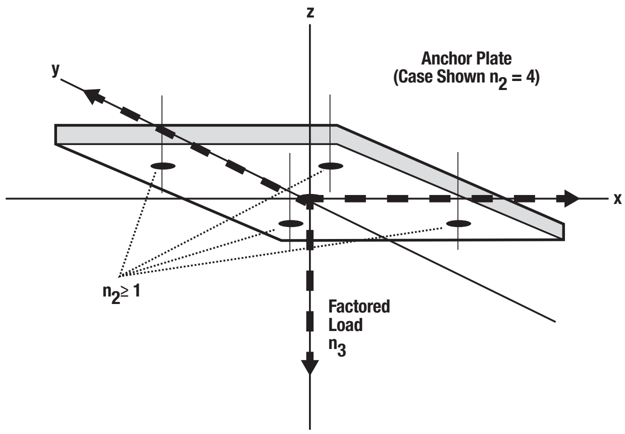
Design values for use with strength design shall be established taking $\phi_{ra} \bullet F_{ra}$. See redundant fastening design information table for Snake+ design resistance.

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. For example, the conversion factor, α is equal to 1.4 assuming all dead load.



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 (ANSI)	d_{bit}	in.	3/8	1/2	3/4
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)
Max impact wrench power (torque)	T_{screw}	ft.-lb. (N-m)	120 (163)	345 (468)	345 (468)
Max tightening torque of steel insert element (threaded rod or bolt)	T_{max}	ft.-lb. (N-m)	4 (6)	8 (11)	36 (49)
Approximate internal thread depth	-	in. (mm)	11/32	23/32	15/16

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 (-19 and -14) Section 5.3 or ACI 318 (-11) 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.

PERFORMANCE DATA (ASD)

Ultimate and Allowable Load Capacities for Snake+ in Normal-Weight Uncracked Concrete[1,2,3,4,5]

Nominal Anchor Diameter in.	Minimum Nominal 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 = 4,000 psi (20.7 MPa)				f'c = 6,000 psi (41.4 MPa)			
		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	1-5/8 (41)	2,130	535	1,045	260	2,335	585	1,045	260	2,335	585	1,045	260	-	-	-	-
		(9.5)	(2.4)	(4.6)	(1.2)	(10.4)	(2.6)	(4.6)	(1.2)	(10.4)	(2.6)	(4.6)	(1.2)				
3/8	1-5/8 (41)	2,165	540	1,860	465	2,370	595	1,860	465	2,735	685	1,860	465	3,190	800	1,860	465
		(9.6)	(2.4)	(8.3)	(2.1)	(10.5)	(2.6)	(8.3)	(2.1)	(12.2)	(3.0)	(8.3)	(2.1)	(14.2)	(3.6)	(8.3)	(2.1)
1/2	2-3/16 (55)	5,590	1,400	3,765	940	6,125	1,530	3,765	940	7,075	1,770	3,765	940	7,240	1,810	3,765	940
		(24.9)	(6.2)	(16.7)	(4.2)	(27.2)	(6.8)	(16.7)	(4.2)	(31.5)	(7.9)	(16.7)	(4.2)	(32.2)	(8.1)	(16.7)	(4.2)

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. Allowable load capacities listed are calculated using an applied safety factor of 4.0.
3. The tabulated load values are applicable to single anchors in uncracked concrete installed at critical spacing distance of three times embedment between anchors and at critical edge distance.
4. For lightweight concrete multiply tabulated allowable load values by a reduction factor of 0.60.
5. Ultimate shear capacity is based on tests conducted with ASTM A36 threaded elements (or equivalent).

ORDERING INFORMATION

Carbon Steel Snake+ Screw Anchor

Cat. No.	Nominal Anchor Size	Internal Thread Size (UNC)	Anchor Outside Diameter	Std. Pack	Std. Ctn.
6400SD-PWR	1/4"	1/4"-20	3/8"	100	1,000
6401SD-PWR	3/8"	3/8"-16	1/2"	50	500
6403SD-PWR	1/2"	1/2"-13	3/4"	50	300

1. Each box comes with one setting tool.

Setting Tool for Snake+ Screw Anchor

Cat. No.	Nominal Anchor Size	Std. Pack
6402SD-PWR	1/4"	1
6407SD-PWR	3/8"	1
6404SD-PWR	1/2"	1

Impact Wrench Selection Guide

Anchor Setting Information	Nominal Anchor Diameter (Inch)					
	1/4"		3/8"		1/2"	
Max Impact Wrench Power	120 ft-lbs		345 ft-lbs		345 ft-lbs	
Suggested 20V Max Impact Wrench, Tool Setting / Speed and Cat. No.	Full Speed	Speed 1	Speed 1	Speed 2	Speed 1	Speed 2
	DCF902	DCF921, DCF922, DCF923, DCF891, DCF892, DCF900	DCF911, DCF913, DCF900	DCF921, DCF922, DCF923, DCF891, DCF892	DCF911, DCF913, DCF900	DCF921, DCF922, DCF923, DCF891, DCF892

DEWALT Impact Wrenches









Cat. No.	DCF901	DCF903	DCF911	DCF913	DCF921	DCF922	DCF923	DCF891	DCF892
Anvil Size	3/8"	1/2"	3/8"	1/2"	1/2"	3/8"	1/2"	1/2"	1/2"
Anvil Type	Hog Ring	Hog Ring	Hog Ring	Hog Ring	Hog Ring	Detent	Hog Ring	Hog Ring	Detent
MAX Fastening Torque	Speed 1: 250 ft-lbs	Speed 1: 250 ft-lbs	Speed 1: 250 ft-lbs	Speed 1: 250 ft-lbs	Speed 1: 100 ft-lbs Speed 2: 300 ft-lbs	Speed 1: 100 ft-lbs Speed 2: 300 ft-lbs	Speed 1: 100 ft-lbs Speed 2: 300 ft-lbs	Speed 1: 100 ft-lbs. Speed 2: 300 ft-lbs. Speed 3: 600 ft-lbs	Speed 1: 100 ft-lbs. Speed 2: 300 ft-lbs. Speed 3: 600 ft-lbs

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 and lightweight concrete. The Mini-Undercut+ anchor is installed into a pre-drilled hole with a power tool and a setting tool. After installation a steel element is threaded into the anchor body. The result is an anchor which can provide consistent behavior at shallow embedments as low as 3/4 of an inch.

GENERAL APPLICATIONS AND USES

- Tension zone / cracked concrete
- Suspended Conduit
- Pipe supports
- Cable Trays and Strut
- Suspended Lighting
- Seismic attachments (SDC A - F)

FEATURE AND BENEFITS

+ Ideal for precast hollow-core plank and post-tensioned concrete slabs
+ Cracked concrete tested alternative to a mini dropin anchor
+ ANSI carbide stop bit with enlarged shoulder for accurate drill 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

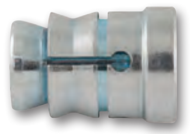
APPROVALS AND LISTINGS

- International Code Council, Evaluation Service (ICC-ES), ESR-3912 for Concrete and Hollow-Core precast slabs, code compliant with the International Building Code/International Residential Code: 2021 IBC/IRC, 2018 IBC/IRC, 2015 IBC/IRC and 2012 IBC/IRC
- Tested in accordance with ACI 355.2 (including ASTM E488) and ICC-ES AC193 for use in cracked and uncracked concrete under the design provisions of ACI 318 (-19 or -14) Chapter 17 or ACI 318-11 Appendix D
- Evaluated and qualified by an accredited independent testing laboratory for recognition in cracked and uncracked concrete including seismic and wind loading (anchor Category 1)

GUIDE SPECIFICATIONS

CSI Divisions: 03 16 00 - Concrete Anchoring and 05 05 19 - Post Installed Concrete Anchors. 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.)

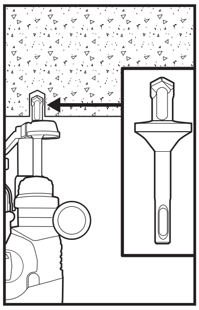
- 3/8" diameter (UNC)

SUITABLE BASE MATERIALS

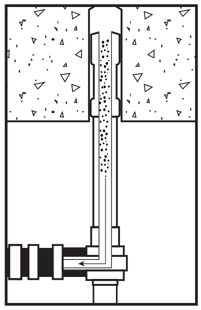
- Post-Tension Concrete
- Precast Hollow-Core Plank
- Normal-weight concrete
- Lightweight concrete

INSTALLATION INSTRUCTIONS

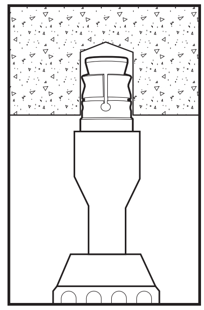
Installation Procedure (using SDS plus System)



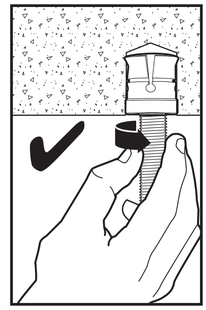
Using the required stop drill bit, drill a hole into the base material to the required depth using the shoulder of the drill bit as a guide. The tolerances of the drill bit used must meet the requirements of ANSI Standard B212.15.



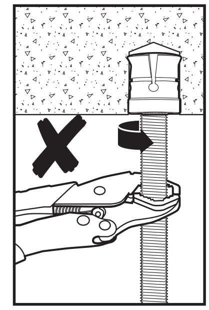
Remove dust and debris from the hole during drilling (e.g. dust extractor) or following drilling (e.g. suction forced air) to extract loose particles created by drilling.



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.



Thread the rod or bolt by hand until snug tight (minimum of 4 full rotations).



Do not further tighten with adjustable wrench or similar tool.

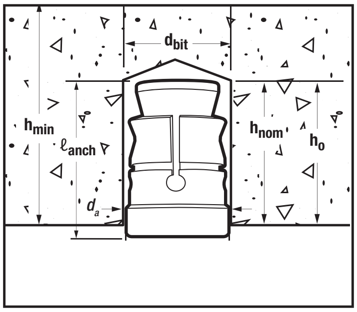
Installation Specifications for Mini-Undercut+ Anchor and Supplemental Information[1,2,3]

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 (ANSI)	d_{bit}	in.	5/8
Minimum nominal embedment depth	h_{nom}	in. (mm)	3/4 (19)
Effective embedment depth	h_{ef}		
Hole depth	h_o		
Overall anchor length (before setting)	ℓ_{anch}	in. (mm)	15/16 (24)
Approximate tool impact power (hammer-drill)	-	J	2.1 to 3.0
Minimum diameter of hole clearance in fixture for steel insert element (following anchor installation)	d_h	in.	7/16
Minimum member thickness in 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)
Minimum edge distance	c_{min}	in. (mm)	2-1/2 (64)
Minimum spacing distance	s_{min}	in. (mm)	3 (76)
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	95,000
Minimum specified yield strength	f_{ya}	psi	76,000
Mean axial stiffness[4] – Uncracked concrete	β_{uncr}	lbf/in.	50,400
Mean axial stiffness[4] – Cracked concrete	β_{cr}	lbf/in.	29,120

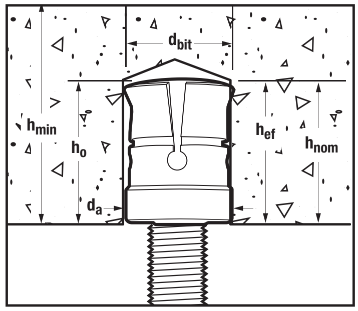
For SI: 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m.

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318 (-19 and -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

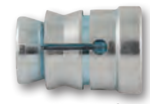


Before



After

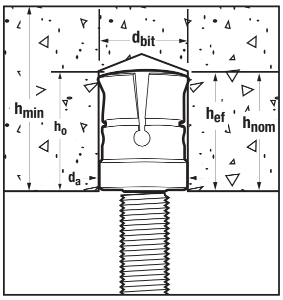
STOP DRILL BIT

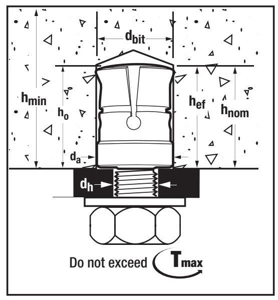


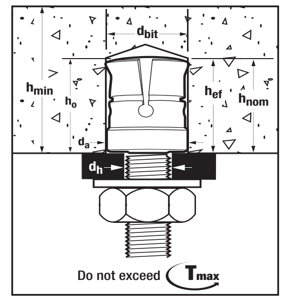
MINI-UNDERCUT+

SETTING TOOL

Mini-Undercut+ Anchor Installed with Steel Insert Element







REFERENCE DATA (ASD)

Ultimate and Allowable Tension Load Capacities for Mini-Undercut+ in Normal-Weight Concrete[1,2,3,4]

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)

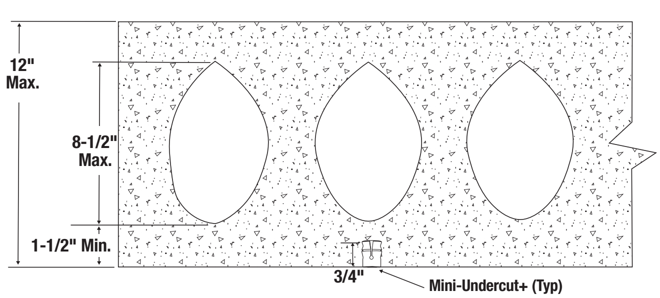
1. Tabulated load values are for anchors installed in uncracked concrete. Concrete compressive strength must be at the specified minimum at the time of installation.
2. Allowable load capacities are calculated using an applied safety factor of 4.0.
3. Linear interpolation may be used to determine allowable loads for intermediate compressive strengths.
4. For lightweight concrete, tabulated values must be multiplied by 0.60.

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 uncracked 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 of 4.0.
3. Linear interpolation may be used to determine allowable loads for intermediate compressive strengths.

Installation Detail: Mini-Undercut+ in the Underside of Hollow-Core Concrete Slabs



DESIGN INFORMATION

Tension Design Information for Mini-Undercut+ Anchors in the Underside of Concrete and the Underside of Hollow-Core Concrete Slabs[1,2,3,4,5,6,7,8,9]

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 318-19 17.6.1, 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 318-19 17.6.2, 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 (uncracked concrete only)	c_{ac}	in. (mm)	2.5 (64)
Reduction factor, concrete breakout strength[3]	ϕ	-	0.40
Pullout Strength In Tension (ACI 318-19 17.6.3, 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 318-19 17.10.3, ACI 318-14 17.2.3.3 or ACI 318-11 D.3.3.3)[8]			
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 (-19 and -14) Chapter 17 or ACI 318-11 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-19 17.10, ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable, shall apply.
2. Installation must comply with manufacturer's published installation instructions and details.
3. All values of ϕ are applicable with the load combinations of 2021 IBC Section 1605.1 or 2018, 2015 and 2012 IBC Section 1605.2, ACI 318 (-19 or -14) Section 5.3, or ACI 318-11 Section 9.2. For concrete failure modes, no increase for ACI 318-19 17.5.3 supplementary reinforcement present, ACI 318-14 17.3.3 Condition A or ACI 318-11 D.4.3 Condition A is permitted.
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 MPa. 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 $(f'c / 41.4)^{0.5}$ for MPa.
7. Pullout strength does not control the design of indicated anchors. Do not calculate pullout strength for the 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 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.

Shear Design Information for Mini-Undercut+ Anchors in the Underside of Concrete and the Underside of Hollow-Core Concrete Slabs[1,2,3,4,7]

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 Shear (ACI 318-19 17.7.1, ACI 318-14 17.5.1 or ACI 318-11 D.6.1)[5]			
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 318-19 17.10.3, ACI 318-14 17.2.3.3 or ACI 318-11 D.3.3.3)[6]			
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 318-19 17.7.2, 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 318-19 17.7.3, 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 (-19 and -14) Chapter 17 or ACI 318-11 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-19 17.10, ACI 318-17 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 2021 IBC Section 1605.1 or 2018, 2015 and 2012 IBC Section 1605.2, ACI 318 (-19 or -14) Section 5.3, or ACI 318-11 Section 9.2. For concrete failure modes, no increase for ACI 318-19 17.5.3 supplementary reinforcement present, ACI 318-14 17.3.3 Condition A or ACI 318-11 D.4.3 Condition A is permitted.
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 17.7.1.2b in ACI 318-19, 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.
7. 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.

Steel Design Information for Threaded Rod Elements Used with Mini-Undercut+ Anchors[1,2,3,4]

Design Information		Symbol	Units	3/8-inch
Threaded rod nominal outside diameter		d_{rod}	in.	0.375
Threaded rod effective cross-sectional area		A_{se}	in.^{2}	0.078
Nominal tension strength of threaded rod as governed by steel strength	ASTM A36 or F1554, Grade 36	$N_{sa,rod}$	lb	4,525
Nominal tension strength of threaded rod as governed by steel strength, seismic		$N_{sa,rod,eq}$	lb	4,525
Nominal shear strength of threaded rod as governed by steel strength	ASTM A36 or F1554, Grade 36	$V_{sa,rod}$	lb	2,695
Nominal shear strength of threaded rod as governed by steel strength, seismic		$V_{sa,rod,eq}$	lb	1,900

For SI: 1 inch = 25.4 mm, 1 pound = 0.00445 kN, 1 in^2 = 645.2 mm^2 For pound-inch unit: 1 mm = 0.03937 inches.

1. Values provided for steel element material types, or equivalent, based on minimum specified strengths; $N_{sa,rod}$ and $V_{sa,rod}$ calculated in accordance with ACI 318-19 Eq. 17.7.1.2a and 17.7.12b ACI 318-14 Eq. 17.5.1.2a and Eq. 17.5.1.2b or ACI 318-11 Eq. D-28 and Eq. D-29, respectively, as applicable. $V_{sa,rod,eq}$ must be taken as 0.7 $V_{sa,rod}$.
2. ϕN_{sa} shall be the lower of $\phi N_{sa,rod}$ or ϕN_{sa} for static steel strength in tension; for seismic loading $\phi N_{sa,eq}$ shall be the lower of $\phi N_{sa,rod,eq}$ or $\phi N_{sa,eq}$.
3. ϕV_{sa} shall be the lower of $\phi V_{sa,rod}$ or ϕV_{sa} for static steel strength in tension; for seismic loading $\phi V_{sa,eq}$ shall be the lower of $\phi V_{sa,rod,eq}$ or $\phi V_{sa,eq}$.
4. Strength reduction factor shall be taken from ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, for steel elements. Strength reduction factors for load combinations in accordance with ACI 318-19 and ACI 318-14 5.3 or ACI 318-11 9.2, as applicable, governed by steel strength of ductile steel elements shall be taken as 0.75 for tension and 0.65 for shear. The values of ϕ applies when the load combinations of 2021 IBC Section1605.1 or 2018, 2015 an d2012 Section 1605.2 of the IBC, ACI 318 (-19 or -14) 5.3 or ACI 318-11 9.2, as applicable, are used in accordance wtih ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable.

PERFORMANCE DATA (SD)

Factored Design Strength ($ØN_n$ And $ØV_n$) Calculated In Accordance With ACI 318-19 Chapter 17:

1- Tabular values are provided for illustration and are applicable for single anchors installed in normal-weight concrete with 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 $1.5c_{a1}$.

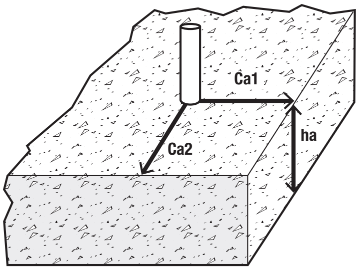
2- Calculations were performed following methodology in ACI 318-19, Chapter 17. The load level corresponding to the controlling failure mode is listed (e.g. For tension: steel, concrete breakout and pullout; For shear: steel, concrete breakout and pryout). Furthermore, the capacities for concrete breakout strength in tension and pryout 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- All values of ø are applicable with the load combinations of 2021 IBC Section 1605.1 or 2018, 2015 and 2012 IBC Section 1605.2, ACI 318 (-19 or -14) Section 5.3, or ACI 318-11 Section 9.2. For concrete failure modes, no increase for ACI 318-19 17.5.3 supplementary reinforcement present, ACI 318-14 17.3.3 Condition A or ACI 318-11 D.4.3 Condition A is permitted.

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 318-19 Chapter 17, Section 17.8.

6- Interpolation is not permitted to be used with the tabular values. For intermediate base material compressive strengths, please see ACI 318-19 Chapter 17 and information contained in this product supplement. For other design conditions including seismic considerations please see ACI 318-19 Chapter 17.



Tension and Shear Design Strengths 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	
		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	3/4	180	250	200	270	230	315	280	385	325	445

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

Tension and Shear Design Strengths Installed in Uncracked Concrete

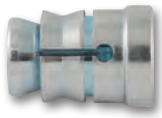
Nominal Anchor Diameter (in.)	Nominal Embed. Depth h_{nom} (in.)	Minimum Concrete Compressive Strength									
		f'c = 2,500 psi		f'c = 3,000 psi		f'c = 4,000 psi		f'c = 6,000 psi		f'c = 8,000 psi	
		ϕNn Tension (lbs.)	ϕVn Shear (lbs.)	ϕNn Tension (lbs.)	ϕVn Shear (lbs.)	ϕNn Tension (lbs.)	ϕVn Shear (lbs.)	ϕNn Tension (lbs.)	ϕVn Shear (lbs.)	ϕNn Tension (lbs.)	ϕVn Shear (lbs.)
3/8	3/4	310	350	340	385	395	445	485	545	560	590

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

ORDERING INFORMATION

Mini-Undercut+

Cat. No.	Anchor Size	Rod/Anchor Dia.	Outside Diameter	Overall Length	Pack 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.	Accu-Bit Size	Drill Diameter	Drill Depth	Pack Qty.
PPA2431720	5/8" x 3/4" Stop Drill Bit - PT Anchor	5/8"	3/4"	1

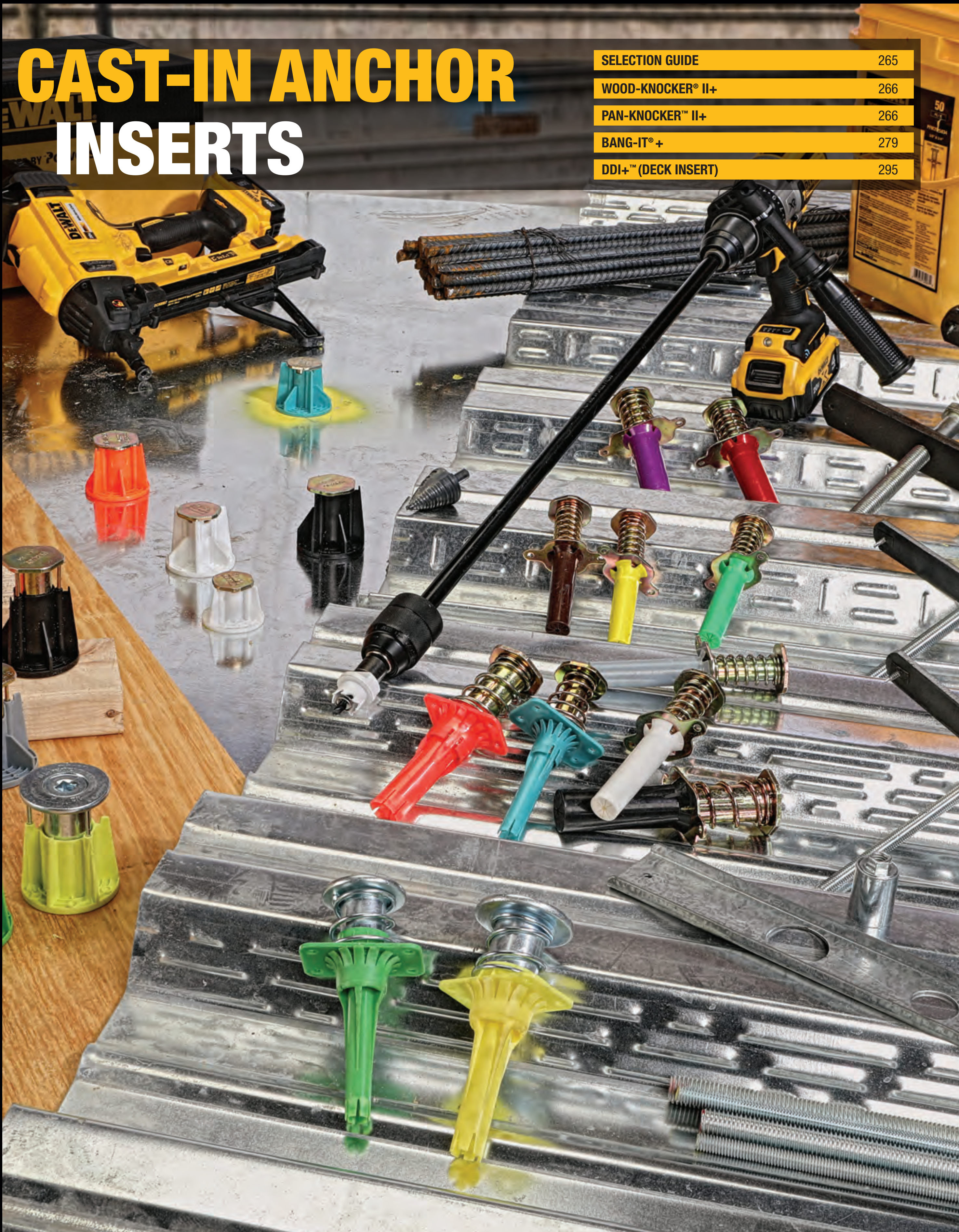
SDS Plus Setting Tool for DEWALT Mini-Undercut+

Cat. No.	SDS Plus Setting Tool Size	Rod/Anchor Dia.	Pack Qty.
PFM2101720	3/8" SDS+ Setting Tool - PT Anchor	3/8"	1

SDS PLUS 20v Max Rotary Hammer and Accessories

Cat. No.	Description	Pack Qty.
DWH003SBH*	Stop Bit Head Nozzle Kit	1
DWH002SBH*	Stop Bit Head Replacement 3-Pack	1
DCH273P2DHO*	20V MAX XR® Brushless 1" L-Shape SDS Plus Rotary Hammer Kit With On Board Dust Extractor	1
*ADD "DH" for On-Board Dust Extraction		

CAST-IN ANCHOR INSERTS



CAST-IN INSERT ANCHORS	Base Material				Anchor Diameter						Insert Style		Coating/ Material		Approvals and Listings
	Concrete	Lightweight Concrete	Wood Forms	Steel Forms	1/4"	3/8"	1/2"	5/8"	3/4"	7/8"	External Thread	Internal Thread	Coated/Plated Carbon Steel	Nylon/Plastic	Building Code / Jurisdiction Recognition
Wood-Knocker II+®	●	●	●		●	●	●	●	●			●	●	●	ICC-ES ESR-3657 IBC, NBC, City of LA, FBC, FM, UL
Pan-Knocker II+®	●	●		●	●	●	●	●	●			●	●	●	ICC-ES ESR-3657 IBC, NBC, City of LA, FBC, FM, UL
Bang-It+®	●	●		●	●	●	●	●	●			●	●	●	ICC-ES ESR-3657 IBC, NBC, City of LA, FBC, FM, UL
DDI+™	●	●		●		●	●	●	●	●	●		●		ICC-ES ESR-3958 IBC, City of LA, FBC, FM, UL

● Suitable ○ May be Suitable

GENERAL INFORMATION

WOOD-KNOCKER®II+ AND PAN-KNOCKER™II+

Concrete Inserts

PRODUCT DESCRIPTION

Wood-Knocker II+ and Pan-Knocker II+ concrete inserts are installed onto forms used to support newly poured concrete floor slabs, roof slabs or walls. The concrete inserts are specifically designed to provide hanger attachments for mechanical, electrical, plumbing (MEP) and fire protection.

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. The sturdy base and rib design minimizes the chance of inserts accidentally being hit out of place after attachment to the forms. The impact plate offers resistance to rotation within the concrete as a steel threaded rod or threaded bolt is being turned during installation.

A push-in thread version is also available which does not require turning the threaded rod or threaded bolt during installation which can be ideal for applications such as mounting prefabricated hardware and hanger assemblies.

GENERAL APPLICATIONS AND USES

- Hanging Pipe and Sprinkler Systems
- HVAC Ductwork and Strut Channels
- Suspending Trapeze and Cable Trays
- Cast-In Pre-installed Anchoring Points
- Distribution Systems / Utility Lines
- Conduit and Lighting Systems
- Cracked and Uncracked Concrete
- Seismic Qualification (SDC A - F)

FEATURES AND BENEFITS

+ Fast and simple to install, low installed cost
+ Sturdy base design resists inserts from being kicked over after placement
+ Color coded by size for simple identification, can be further marked by trade and/or utility
+ Inserts can be installed in form pours only 3.5" thick; low profile (LP) inserts can be installed in form pours only 2.5" thick (see installation details)
+ Suitable for seismic and wind loading (see design information)
+ Multi thread inserts allow for multiple diameters using the same part
+ All sizes of multi thread inserts have performance data for tension and shear loading
+ Push-In thread version does not require turning threaded rod elements during installation

APPROVALS AND LISTINGS

- International Code Council, Evaluation Service (ICC-ES), ESR-3657 for concrete
- Code compliant with the 2021 IBC/IRC, 2018 IBC/IRC, 2015 IBC/IRC, and 2012 IBC/IRC
- Tested in accordance with ASTM E488 and ICC-ES AC446 for use in cracked and uncracked concrete and with 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
- Underwriters Laboratories (UL Listed) - File No. EX1289 and VFXT7.EX1289, Also UL tested and recognized for use in air handling spaces (i.e. plenum rated locations)
- FM Approvals (Factory Mutual) – see FM Approval Guide

GUIDE SPECIFICATIONS

CSI Divisions: 03 15 19 - Cast-In Concrete Anchors and 03 16 00 - Concrete Anchors. Concrete inserts shall be Wood-Knocker II+ or Pan-Knocker II+ as supplied by DEWALT, Towson, MD. Anchors shall be installed in accordance with published instructions and the Authority Having Jurisdiction.

SECTION CONTENTS

WOOD-KNOCKER II+
FORM INSERT

PAN-KNOCKER II+
FORM INSERT
'NO NAIL' VERSION
OF WOOD-KNOCKER II+

WOOD-KNOCKER II+
FORM INSERT
PUSH-IN THREAD

PAN-KNOCKER II+
FORM INSERT
PUSH-IN THREAD

ANCHOR MATERIALS

- Carbon Steel and Engineered Plastic

ROD/ANCHOR SIZE RANGE (TYP.)

- 1/4" through 3/4" diameters (UNC)

INSERT VERSIONS

- Thread-In
- Push-In

SUITABLE BASE MATERIALS

- Normal-weight Concrete
- Lightweight Concrete

TENSION ZONE CRACKED CONCRETE

SEISMIC REGION QUALIFICATION

CODE LISTED
ICC-ES ESR-3657
CONCRETE

DDA
DEWALT DESIGN ASSIST™

MATERIAL SPECIFICATIONS

Wood-Knocker II+ and Pan-Knocker II+

Anchor Component	Component Material
Insert Body	AISI 1008 Carbon Steel or equivalent
Plastic sleeve	Engineered Plastic (polypropylene)
Zinc Plating (metal components)	ASTM B633 (Fe/Zn5) Min. plating requirements for mild service condition

Material Properties for Common Threaded Rods

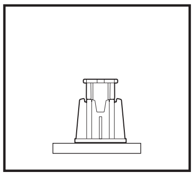
Description	Steel Specification (ASTM)	Threaded Rod Diameter (inch)	Minimum Yield Strength, f_y (ksi)	Minimum Ultimate Strength, f_u (ksi)
Standard Carbon Steel	A36 or ASTMF1554, Grade 36	1/4 to 3/4	36.0	58.0
High Strength Carbon Steel	A193, Grade B7	1/4 to 3/4	105.0	125.0

Inserts may be considered for use in conjunction with all grades of continuously threaded carbon steel (all-thread) that comply with code reference standards and that have thread characteristics comparable with ANSI B1.1 UNC Coarse Thread Series.

INSTALLATION INSTRUCTIONS

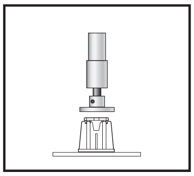
Installation Instructions for Wood-Knocker II+ Thread-In

POSITION



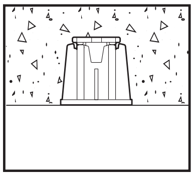
Step 1
Position insert on formwork plastic down.

DRIVE



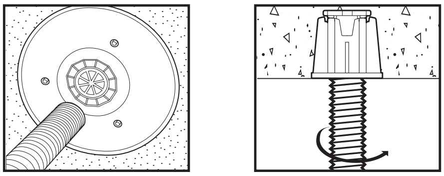
Step 2
Drive insert head down until head contacts plastic (e.g. Wood-Knocker installation tool, hammer).

PREPARE



Step 3
After formwork removal, remove nails as necessary (e.g. flush mounted fixtures).

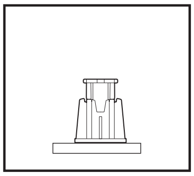
ATTACH



Step 4
Guide threaded rod/bolt through plastic thread seal cover. Turn until steel element fully threaded.
Attach fixtures as applicable.

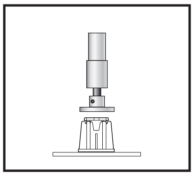
Installation Instructions for Wood-Knocker II+ Push-In

POSITION



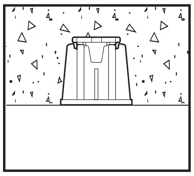
Step 1
Position insert on formwork plastic down.

DRIVE



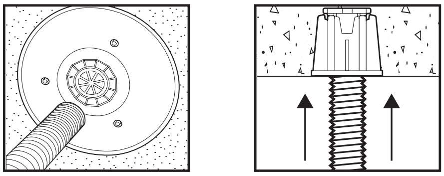
Step 2
Drive insert head down until head contacts plastic (e.g. Wood-Knocker installation tool, hammer).

PREPARE



Step 3
After formwork removal, remove nails as necessary (e.g. flush mounted fixtures).

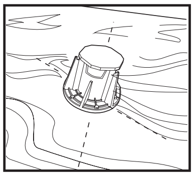
ATTACH



Step 4
Guide threaded rod/bolt through plastic thread seal cover. Push in until steel element is fully seated. Attach fixtures as applicable.

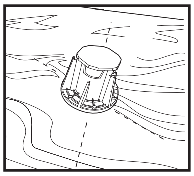
Installation Instructions for Pan-Knocker II+ Thread-In

POSITION



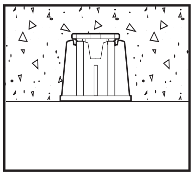
Step 1
Position insert on formwork plastic down.

MOUNT



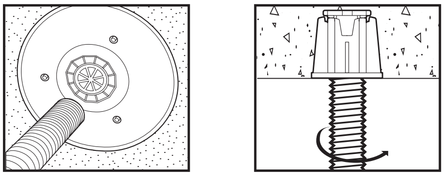
Step 2
Mount/secure insert to formwork through plastic base (e.g. with screws, pins).

PREPARE



Step 3
After formwork removal, remove pins or screws as necessary (e.g. flush mounted fixtures).

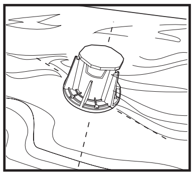
ATTACH



Step 4
Guide threaded rod/bolt through plastic thread seal cover. Turn until steel element fully threaded. Attach fixtures as applicable.

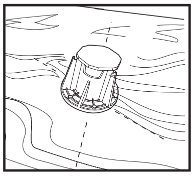
Installation Instructions for Pan-Knocker II+ Push-In

POSITION



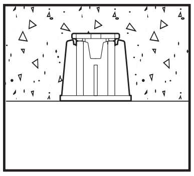
Step 1
Position insert on formwork plastic down.

MOUNT



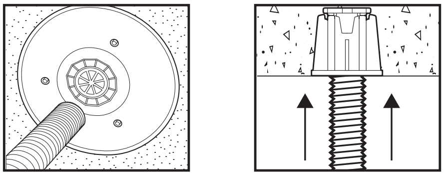
Step 2
Mount/secure insert to formwork through plastic base (e.g. with screws, pins).

PREPARE



Step 3
After formwork removal, remove pins or screws as necessary (e.g. flush mounted fixtures).

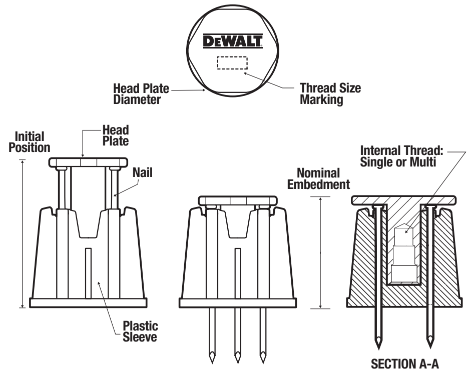
ATTACH



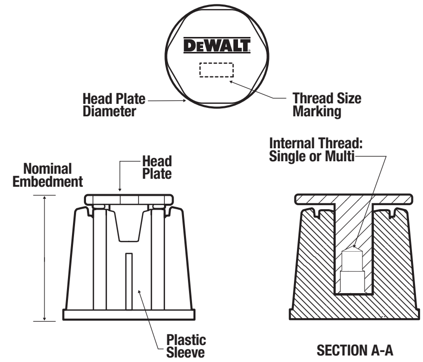
Step 4
Guide threaded rod/bolt through plastic thread seal cover. Push in until steel element is fully seated. Attach fixtures as applicable.

INSTALLATION SPECIFICATIONS

Wood-Knocker II+ Inserts for Form Pour Concrete



Pan-Knocker II+ Inserts for Form Pour Concrete



Installation Specifications for Wood-Knocker II+ and Pan-Knocker II+ Single Thread Inserts[1]

Insert Dimension / Property	Symbol	Units	Nominal Rod/Anchor Size						
			1/4" (LP)	3/8" (LP)	1/4"	3/8"	1/2"	5/8"	3/4"
Outside diameter of steel insert body	d_a	in. (mm)	0.5 (13)		0.7 (18)			1.0 (25)	
Insert head plate diameter	d_{hp}	in. (mm)	1.30 (33)		1.50 (38)			1.75 (45)	
Plastic sleeve diameter	d_s	in. (mm)	2 (51)		2-3/8 (60)			2-3/8 (60)	
Nominal embedment depth	h_{nom}	in. (mm)	1-1/2 (38)		2 (51)			2 (51)	
Effective embedment depth	h_{ef}	in. (mm)	1.25 (32)		1.75 (45)			1.75 (45)	
Minimum member thickness	h_{min}	in. (mm)	2-1/2 (64)		3-1/2 (89)			3-1/2 (89)	
Minimum spacing distance	s_{min}	in. (mm)	$4d_a$		$4d_a$			$4d_a$	
Minimum edge distance	c_{min}	in. (mm)	$0.5d_{hp}$ + 3/4 (19)		$0.5d_{hp}$ + 3/4 (19)			$0.5d_{hp}$ + 3/4 (19)	
Insert head plate thickness	t_{hp}	in. (mm)	1/8 (3)		1/8 (3)			1/8 (3)	
UNC internal thread size	-	TPI	1/4-20	3/8-16	1/4-20	3/8-16	1/2-13	5/8-11	3/4-10
Approx. internal thread length	-	in.	5/16	7/16	3/8	1/2	5/8	3/4	7/8
Approx. gap between plastic sleeve opening and start of internal thread, after setting	-	in.	5/16		3/8				

1. Inserts have internal thread size designations for coarse threads matching the nominal rod / anchor size.

Installation Specifications for Wood-Knocker II+ and Pan-Knocker II+ Multi Thread Inserts[1]

Insert Dimension / Property	Symbol	Units	Nominal Rod/Anchor Size													
			1/4" & 3/8" Multi (LP)		1/4" & 3/8" Multi		1/4" & 3/8" & 1/2" Multi			3/8" & 1/2" Multi		3/8" & 1/2" & 5/8" Multi			5/8" & 3/4" Multi	
Outside diameter of steel insert body	d_a	in. (mm)	0.5 (13)		0.7 (18)							1.0 (25)				
Insert head plate diameter	d_{hp}	in. (mm)	1.30 (33)		1.50 (38)							1.75 (45)				
Plastic sleeve diameter	d_s	in. (mm)	2 (51)		2-3/8 (60)							2-3/8 (60)				
Nominal embedment depth	h_{nom}	in. (mm)	1-1/2 (38)		2 (51)							2-3/8 (60)				
Effective embedment depth	h_{ef}	in. (mm)	1.25 (32)		1.75 (45)							2.25 (57)				
Minimum member thickness	h_{min}	in. (mm)	2-1/2 (64)		3-1/2 (89)							3-1/2 (89)				
Minimum spacing distance	s_{min}	in. (mm)	$4d_a$		$4d_a$							$4d_a$				
Minimum edge distance	c_{min}	in. (mm)	$0.5d_{hp}$ + 3/4 (19)		$0.5d_{hp}$ + 3/4 (19)							$0.5d_{hp}$ + 3/4 (19)				
Insert head plate thickness	t_{hp}	in. (mm)	1/8 (3)		1/8 (3)							1/8 (3)				
UNC internal thread size	-	TPI	1/4-20	3/8-16	1/4-20	3/8-16	1/4-20	3/8-16	1/2-13	3/8-16	1/2-13	3/8-16	1/2-13	5/8-11	5/8-11	3/4-10
Approx. internal thread length	-	in.	5/16	7/16	3/8	1/2	5/16	3/8	1/2	7/16	9/16	3/8	1/2	5/8	5/8	3/4
Approx. gap between plastic sleeve opening and start of internal thread, after setting	-	in.	7/8	5/16	1	5/16	1-7/16	15/16	5/16	1	5/16	1-11/16	1-1/16	5/16	1-3/16	5/16

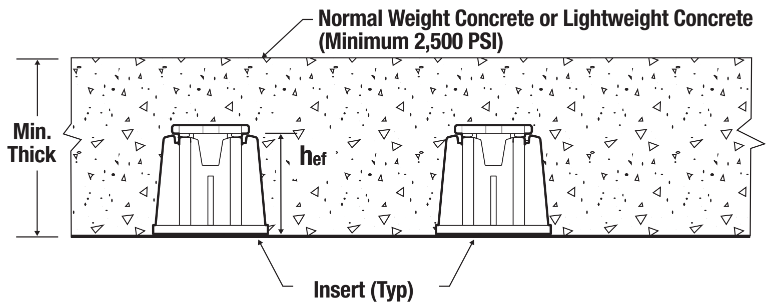
1. Inserts have internal thread size designations for coarse threads matching the nominal rod / anchor size.

Installation Specifications for Wood-Knocker II+ and Pan-Knocker II+ Push-In Thread Inserts[1]

Insert Dimension / Property	Symbol	Units	Nominal Rod/Anchor Size	
			3/8"	1/2"
Outside diameter of steel insert body	d_a	in. (mm)	1.0 (25)	1.125 (29)
Insert head plate diameter	d_{hp}	in. (mm)	1.9 (48)	2.2 (56)
Plastic sleeve diameter	d_s	in. (mm)	2-3/8 (60)	2-3/8 (60)
Nominal embedment depth	h_{nom}	in. (mm)	1-7/8 (48)	2-3/16 (56)
Effective embedment depth	h_{ef}	in. (mm)	1.7 (43)	2.0 (56)
Minimum member thickness	h_{min}	in. (mm)	3-1/2 (89)	3-1/2 (89)
Minimum spacing distance	s_{min}	in. (mm)	$4d_a$	$4d_a$
Minimum edge distance	c_{min}	in. (mm)	$0.5d_{hp}$ + 3/4 (19)	$0.5d_{hp}$ + 3/4 (19)
Insert head plate thickness	t_{hp}	in. (mm)	3/16 (5)	3/16 (5)
UNC internal thread size	-	TPI	3/8-16	1/2-13
Approx. internal thread length	-	in.	5/8	11/16
Approx. gap between plastic sleeve opening and start of internal thread, after setting	-	in.	3/4	7/8

1. Inserts have internal thread size designations for coarse threads matching the nominal rod / anchor size.

Wood-Knocker II+ and Pan-Knocker II+ Inserts Installed in Soffit of Form Pour Concrete Floor and Roof Members



PERFORMANCE DATA (ASD)

Allowable Design Values for Inserts in Uncracked Concrete (lbs)[1,2,3,4,5,6,7,8,9,10,11,12]

Load Type	Wood-Knocker II+ and Pan-Knocker II+ Single Thread Inserts							Wood-Knocker II+ and Pan-Knocker II+ Push-In Thread Inserts	
	1/4" (LP)	3/8" (LP)	1/4"	3/8"	1/2"	5/8"	3/4"	3/8"	1/2"
Tension	1,085	1,085	1,055	1,800	1,800	1,800	1,800	1,725	2,200
Shear	400	1,085	720	1,710	1,800	1,800	1,800	1,470	2,200

Load Type	Wood-Knocker II+ and Pan-Knocker II+ Multi Thread Inserts													
	1/4 & 3/8 Multi (LP)		1/4 & 3/8 Multi		1/4 & 3/8 & 1/2 Multi			3/8 & 1/2 Multi		3/8 & 1/2 & 5/8 Multi			5/8 & 3/4 Multi	
	1/4"	3/8"	1/4"	3/8"	1/4"	3/8"	1/2"	3/8"	1/2"	3/8"	1/2"	5/8"	5/8"	3/4"
Tension	1,085	1,085	1,355	1,800	1,555	1,800	1,800	1,800	1,800	2,625	2,625	2,625	2,625	2,625
Shear	400	1,085	370	1,710	720	1,710	1,800	1,410	1,800	1,510	2,625	2,625	2,625	2,625

Allowable Stress Design Values in tables for inserts are provided for illustration and applicable only when the following design assumptions are followed:

1. Concrete compressive strength, f'c = 3,000 psi given for normal weight concrete.
2. Single anchors with static loads and with installation in accordance with published instructions.
3. Concrete determined to remain uncracked for the life of the anchorage.
4. Load combinations from AACI 318 (-19 and -14)-14 5.3 or ACI 318-11 9.2, as applicable (no seismic loading considered).
5. 30% dead load and 70% live load, controlling load combination 1.2D + 1.6L.
6. Calculation of the weighted average for α = 1.2*0.3 + 1.6*0.7 = 1.48.
7. Assuming no edge distance influence ($c_{a1} \geq 1.5h_{ef}$) and no side-face blowout in tension.
8. Assuming no edge distance ($c_{a1} \geq 3h_{ef}$) or corner distance influence ($c_{a2} \geq 1.5c_{a1}$) in shear.
9. Shear loads may be applied in any direction.
10. $h \geq h_{min}$ according to ACI 318-19 17.9, ACI 318-14 17.7 or ACI 318-11 D.8, as applicable.
11. Values are for Condition B where supplementary reinforcement in accordance with ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, is not provided.
12. The allowable loads shown in the table are for the inserts only. The design professional is responsible for checking threaded rod strength in tension, shear and combined tension and shear, as applicable. For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318 (-19 and -14) Chapter 17 or ACI 318-11 Appendix D.

Allowable Design Values for Inserts in Cracked Concrete (lbs)[1,2,3,4,5,6,7,8,9,10,11,12]

Load Type	Wood-Knocker II+ and Pan-Knocker II+ Single Thread Inserts							Wood-Knocker II+ and Pan-Knocker II+ Push-In Thread Inserts	
	1/4" (LP)	3/8" (LP)	1/4"	3/8"	1/2"	5/8"	3/4"	3/8"	1/2"
Tension	870	870	1,440	1,440	1,440	1,440	1,440	1,380	1,760
Shear	400	870	720	1,440	1,440	1,440	1,440	1,380	1,760

Load Type	Wood-Knocker II+ and Pan-Knocker II+ Multi Thread Inserts													
	1/4 & 3/8 Multi (LP)		1/4 & 3/8 Multi		1/4 & 3/8 & 1/2 Multi			3/8 & 1/2 Multi		3/8 & 1/2 & 5/8 Multi			5/8 & 3/4 Multi	
	1/4"	3/8"	1/4"	3/8"	1/4"	3/8"	1/2"	3/8"	1/2"	3/8"	1/2"	5/8"	5/8"	3/4"
Tension	870	870	1,355	1,440	1,440	1,440	1,440	1,440	1,440	2,100	2,100	2,100	2,100	2,100
Shear	400	870	370	1,440	720	1,440	1,440	1,440	1,440	1,510	2,100	2,100	2,100	2,100

Allowable Stress Design Values in tables for inserts are for illustration and applicable only when the following design assumptions are followed:

1. Concrete compressive strength, f'c = 3,000 psi given for normal weight concrete.
2. Single anchors with static loads and with installation in accordance with published instructions.
3. Concrete determined to remain cracked for the life of the anchorage.
4. Load combinations from ACI 318 (-19 and -14) 5.3 or ACI 318-11 9.2, as applicable (no seismic loading considered).
5. 30% dead load and 70% live load, controlling load combination 1.2D + 1.6L.
6. Calculation of the weighted average for α = 1.2*0.3 + 1.6*0.7 = 1.48.
7. Assuming no edge distance influence ($c_{a1} \geq 1.5h_{ef}$) and no side-face blowout in tension.
8. Assuming no edge distance ($c_{a1} \geq 3h_{ef}$) or corner distance influence ($c_{a2} \geq 1.5c_{a1}$) in shear.
9. Shear loads may be applied in any direction.
10. $h \geq h_{min}$ according to ACI 318-19 17.9, ACI 318-14 17.7 or ACI 318-11 D.8, as applicable.
11. Values are for Condition B where supplementary reinforcement in accordance with ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, is not provided.
12. The allowable loads shown in the table are for the inserts only. The design professional is responsible for checking threaded rod strength in tension, shear and combined tension and shear, as applicable. For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318 (-19 and -14) Chapter 17 or ACI 318-11 Appendix D.

UL Listings and FM Approvals for Supporting Fire Protection Services & Automatic Sprinkler Systems

Listing/Approval	Wood-Knocker II+ and Pan-Knocker II+ Single Thread Inserts							Wood-Knocker II+ and Pan-Knocker II+ Push-In Thread Inserts	
	1/4" LP	3/8" LP	1/4"	3/8"	1/2"	5/8"	3/4"	3/8"	1/2"
UL Max. Pipe Size	N/A	4"	N/A	4"	8"	8"	8"	4"	8"
FM Max. Pipe Size	N/A	4"	N/A	4"	8"	-	-	4"	8"

Listing/Approval	Wood-Knocker II+ and Pan-Knocker II+ Multi Thread Inserts													
	1/4 & 3/8 Multi (LP)		1/4 & 3/8 Multi		1/4 & 3/8 & 1/2 Multi			3/8 & 1/2 Multi		3/8 & 1/2 & 5/8 Multi			5/8 & 3/4 Multi	
	1/4"	3/8"	1/4"	3/8"	1/4"	3/8"	1/2"	3/8"	1/2"	3/8"	1/2"	5/8"	5/8"	3/4"
UL Max. Pipe Size	N/A	4"	N/A	4"	N/A	4"	8"	4"	8"	4"	8"	12"	12"	12"
FM Max. Pipe Size	N/A	4"	N/A	4"	N/A	4"	8"	4"	8"	4"	8"	12"	12"	12"

Underwriters Laboratories (UL Listed) – File No. EX1289 and VFXT7.EX1289. Also UL tested and recognized for use in air handling spaces (i.e. plenum rated locations).

FM Approvals (Factory Mutual) – see FM Approval Guide.

STRENGTH DESIGN INFORMATION

Design Information For Wood Knocker II+ and Pan-Knocker II+ Single Thread Inserts[1,2,3,4,5]

Design Information / Insert Property	Symbol	Units	1/4" (LP)	3/8" (LP)	1/4"	3/8"	1/2"	5/8"	3/4"
Outside diameter of the steel insert body	d_a	in. (mm)	0.5 (13)		0.7 (18)			1.0 (25)	
Insert head net bearing area	A_{brg}	in² (mm²)	1.00 (645)		1.20 (762)			1.40 (903)	
Effective embedment depth	h_{ef}	in. (mm)	1.25 (32)		1.75 (45)			1.75 (45)	
STEEL STRENGTH IN TENSION (ACI 318-19 17.6.1, ACI 318-14 17.4.1 or ACI 318-11 Section D.5.1)									
Steel strength in tension of single insert	$N_{sa,insert}$	lb (kN)	3,545 (15.8)	6,535 (29.1)	3,545 (15.8)	9,005 (40.1)		12,685 (56.4)	
Steel strength in tension of single insert, seismic	$N_{sa,insert,eq}$	lb (kN)	3,545 (15.8)	6,535 (29.1)	3,545 (15.8)	9,005 (40.1)		12,685 (56.4)	
Reduction factor, steel strength in tension	ϕ	-	0.65		0.65			0.65	
CONCRETE BREAKOUT STRENGTH IN TENSION (ACI 318-19 17.6.2, ACI 318-14 17.4.2 or ACI 318-11 D.5.2)									
Effectiveness factor for cracked concrete	k_c	-	24 (for SI use a value of 10)						
Modification factor for uncracked concrete	$\Psi_{c,N}$	-	1.25						
Reduction factor, concrete strength in tension	ϕ	-	0.70						
STEEL STRENGTH IN SHEAR (ACI 318-19 17.7.1, ACI 318-14 17.5.1 or ACI 318-11 Section D.6.1)									
Steel strength in shear of single insert	$V_{sa,insert,deck}$	lb (kN)	985 (4.4)	2,835 (12.6)	1,775 (7.9)	4,220 (18.8)	7,180 (31.9)	9,075 (40.4)	
Steel strength in shear of single insert, seismic	$V_{sa,insert,eq,deck}$	lb (kN)	385 (1.7)	625 (2.8)	1,775 (7.9)	4,220 (18.8)	7,180 (31.9)	9,075 (40.4)	
Reduction factor, steel strength in shear	ϕ	-	0.60		0.60			0.60	
CONCRETE BREAKOUT STRENGTH IN SHEAR (ACI 318-19 17.7.2, ACI 318-14 17.5.2 or ACI 318-11 D.6.2) AND PRYOUT STRENGTH IN SHEAR (ACI 318-19 17.7.3, ACI 318-14 17.5.3 or ACI 318-11 D.6.3)									
Load bearing length of insert	l_e	in. (mm)	1.25 (32)		1.75 (45)			1.75 (45)	
Reduction factor, concrete strength in shear	ϕ	-	0.70		0.70			0.70	
Coefficient for pryout strength	k_{cp}	-	1		1			1	
Reduction factor, pryout strength in shear	ϕ	-	0.70		0.70			0.70	

1. Concrete must have a compressive strength f 'c of 2,500 psi minimum. Installation must comply with published instructions.
2. Design of headed cast-in specialty inserts shall be in accordance with the provisions of ACI 318 (-19 and -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 and steel deck figures, as applicable.
3. Strength reduction factors for the inserts shall be taken from ACI 318-19 17.5.3, 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 (-19 and -14) 5.3 or ACI 318-11 9.2, as applicable, governed by steel strength of the insert are tabulated. Strength reduction values correspond to brittle steel elements. The value of ϕ applies when the load combinations of 2021 IBC Section 1605.1 or 2018, 2015 and 2012 IBC 1605.2, ACI 318 (-19 or -14) Section 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. Minimum spacing distance between anchors and minimum edge distances for cast-in headed anchors shall be in accordance with ACI 318-19 17.9, ACI 318-14 17.7 or ACI 318-11 D.8, as applicable and the installation tables for the inserts.
5. 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 for common threaded rod elements.

Design Information for Wood Knocker II+ and Pan-Knocker II+ Multi Thread Inserts[2,3,4,5]

Design Information	Symbol	Units	1/4 & 3/8 Multi (LP)		1/4 & 3/8 Multi		1/4 & 3/8 & 1/2 Multi			3/8 & 1/2 Multi		3/8 & 1/2 & 5/8 Multi			5/8 & 3/4 Multi	
			1/4"	3/8"	1/4"	3/8"	1/4"	3/8"	1/2"	3/8"	1/2"	3/8"	1/2"	5/8"	5/8"	3/4"
Outside diameter of the steel insert body	d_a	in. (mm)	0.5 (13)		0.7 (18)							1.0 (25)				
Insert head net bearing area	A_{brg}	in² (mm²)	1.00 (645)		1.20 (762)							1.40 (903)				
Effective embedment depth	h_{ef}	in. (mm)	1.25 (32)		1.75 (45)							2.25 (57)				
STEEL STRENGTH IN TENSION (ACI 318-19 17.6.1, ACI 318-14 17.4.1 or ACI 318-11 Section D.5.1)																
Steel strength in tension of single insert	$N_{sa,insert}$	lb (kN)	3,545 (15.8)	6,535 (29.1)	3,085 (13.7)	9,005 (40.1)	3,545 (18.1)	7,515 (33.4)	9,005 (40.1)	9,005 (40.1)	9,005 (40.1)	8,630 (38.4)	16,610 (73.9)		17,100 (76.1)	
Steel strength in tension of single insert, seismic	$N_{sa,insert,eq}$	lb (kN)	3,545 (15.8)	6,535 (29.1)	3,085 (13.7)	9,005 (40.1)	3,545 (18.1)	7,515 (33.4)	9,005 (40.1)	9,005 (40.1)	9,005 (40.1)	8,630 (38.4)	16,610 (73.9)		17,100 (76.1)	
Reduction factor, steel strength in tension	ϕ	-	0.65		0.65							0.65				
CONCRETE BREAKOUT STRENGTH IN TENSION (ACI 318-19 17.6.2, ACI 318-14 17.4.2 or ACI 318-11 D.5.2)																
Effectiveness factor for cracked concrete	k_c	-	24 (for SI use a value of 10)													
Modification factor for uncracked concrete	$\Psi_{C,N}$	-	1.25													
Reduction factor, concrete strength in tension	ϕ	-	0.70													
STEEL STRENGTH IN SHEAR (ACI 318-19 17.7.1, ACI 318-14 17.5.1 or ACI 318-11 Section D.6.1)																
Steel strength in shear of single insert	$V_{sa,insert,deck}$	lb (kN)	985 (4.4)	2,835 (12.6)	910 (4.1)	4,220 (18.8)	1,775 (7.9)	4,220 (18.8)	7,180 (31.9)	3,475 (15.5)	7,180 (31.9)	3,720 (16.2)	9,410 (41.9)	10,570 (47.0	10,965 (48.8)	
Steel strength in shear of single insert, seismic	$V_{sa,insert,eq}$	lb (kN)	385 (1.7)	625 (2.8)	365 (1.6)	4,220 (18.8)	480 (2.1)	715 (3.2)	7,180 (31.9)	695 (3.1)	7,180 (31.9)	1,080 (4.8)	4,705 (20.9)	10,570 (47.0)	4,385 (19.1)	10,965 (48.8)
Reduction factor, steel strength in shear	ϕ	-	0.60		0.60							0.60				
CONCRETE BREAKOUT STRENGTH IN SHEAR (ACI 318-19 17.7.2, ACI 318-14 17.5.2 or ACI 318-11 D.6.2) AND PRYOUT STRENGTH IN SHEAR (ACI 318-19 17.7.3, ACI 318-14 17.5.3 or ACI 318-11 D.6.3)																
Load bearing length of insert	l_e	in. (mm)	1.25 (32)		1.75 (45)							2.25 (57)				
Reduction factor, concrete strength in shear	ϕ	-	0.70		0.70							0.70				
Coefficient for pryout strength	k_{cp}	-	1		1							1				
Reduction factor, pryout strength in shear	ϕ	-	0.70		0.70							0.70				

1. Concrete must have a compressive strength f 'c of 2,500 psi minimum. Installation must comply with published instructions.
2. Design of headed cast-in specialty inserts shall be in accordance with the provisions of ACI 318 (-19 and -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 and steel deck figures, as applicable.
3. Strength reduction factors for the inserts shall be taken from ACI 318-19 17.5.3, 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 (-19 and -14) 5.3 or ACI 318-11 9.2, as applicable, governed by steel strength of the insert are tabulated. Strength reduction values correspond to brittle steel elements. The value of ϕ applies when the load combinations of 2021 IBC Section 1605.1 or 2018, 2015 and 2012 IBC 1605.2, ACI 318 (-19 or -14) Section 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. Minimum spacing distance between anchors and minimum edge distances for cast-in headed anchors shall be in accordance with ACI 318-19 17.9, ACI 318-14 17.7 or ACI 318-11 D.8, as applicable and the installation tables for the inserts.
5. 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 for common threaded rod elements.

Design Information for Wood-Knocker II+ and Pan-Knocker II+ Push-In Thread Inserts[1,2,3,4,5]

Design Information	Symbol	Units	3/8"	1/2"
Outside diameter of the steel insert body	d_a	in. (mm)	1.0 (25)	1.125 (29)
Insert head plate net bearing area	A_{brg}	in^2 (mm^2)	2.0 (1290)	2.7 (1742)
Effective embedment depth	h_{ef}	in. (mm)	1.7 (43)	2.0 (51)
STEEL STRENGTH IN TENSION (ACI 318-19 17.6.1, ACI 318-14 17.4.1 or ACI 318-11 Section D.5.1)				
Steel strength in tension of single insert	$N_{sa,insert}$	lb (kN)	11,265 (50.1)	17,595 (78.3)
Steel strength in tension of single insert, seismic	$N_{sa,insert,eq}$	lb (kN)	11,265 (50.1)	17,595 (7.3)
Reduction factor, steel strength in tension	ϕ	-	0.65	
CONCRETE BREAKOUT STRENGTH IN TENSION (ACI 318-19 17.6.2, ACI 318-14 17.4.2 or ACI 318-11 D.5.2)				
Effectiveness factor for cracked concrete	k_c	-	24 (for SI use a value of 10)	
Modification factor for uncracked concrete	$\Psi_{C,N}$	-	1.25	
Reduction factor, concrete strength in tension	ϕ	-	0.70	
STEEL STRENGTH IN SHEAR (ACI 318-19 17.7.1, ACI 318-14 17.5.1 or ACI 318-11 Section D.6.1)				
Steel strength in shear of single insert	$V_{sa,insert,deck}$	lb (kN)	3,625 (16.1)	5,955 (26.5)
Steel strength in shear of single insert, seismic	$V_{sa,insert,eq}$	lb (kN)	3,625 (16.1)	5,955 (26.5)
Reduction factor, steel strength in shear	ϕ	-	0.60	
CONCRETE BREAKOUT STRENGTH IN SHEAR (ACI 318-19 17.7.2, ACI 318-14 17.5.2 or ACI 318-11 D.6.2) AND PRYOUT STRENGTH IN SHEAR (ACI 318-19 17.7.3, ACI 318-14 17.5.3 or ACI 318-11 D.6.3)				
Load bearing length of insert	l_e	in. (mm)	1.7 (43)	2.0 (51)
Reduction factor, concrete strength in shear	ϕ	-	0.70	
Coefficient for pryout strength	k_{cp}	-	1	
Reduction factor, pryout strength in shear	ϕ	-	0.70	

1. Concrete must have a compressive strength f 'c of 2,500 psi minimum. Installation must comply with published instructions.
2. Design of headed cast-in specialty inserts shall be in accordance with the provisions of ACI 318 (-19 and -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 and steel deck figures, as applicable.
3. Strength reduction factors for the inserts shall be taken from ACI 318-19 17.5.3, 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 (-19 and -14) 5.3 or ACI 318-11 9.2, as applicable, governed by steel strength of the insert are tabulated. Strength reduction values correspond to brittle steel elements. The value of ϕ applies when the load combinations of 2021 IBC Section 1605.1 or 2018, 2015 and 2012 IBC 1605.2, ACI 318 (-19 or -14) Section 5.3 or ACI 318-11 9.2, as applicable, are used in accordance with ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4.
4. Minimum spacing distance between anchors and minimum edge distances for cast-in headed anchors shall be in accordance with ACI 318-19 17.9, ACI 318-14 17.7 or ACI 318-11 D.8, as applicable and the installation tables for the inserts.
5. 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 for common threaded rod elements.

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[4]	Reduction Of Area Min. Percent	Related Nut Specification[5]
Carbon Steel	ASTM A36/A36M or ASTM F1554 Grade 36	psi (MPa)	58,000 (400)	36,000 (248)	1.61	23	40 (50 for A36)	ASTM A563 Gr. A or A194 Grade 2
	ASTM A193/A193M[3] Grade B7	psi (MPa)	125,000 (860)	105,000 (720)	1.19	16	50	ASTM A563 Gr. A or A194 Grade 2

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 Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications.
4. Based on 2-inch (50 mm) gauge length except for ASTM A36/A36M and ASTM A193, which are based on a gauge length of 4d (d_{rod}).
5. 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}	in^2 (mm^2)	0.032 (21)	0.078 (50)	0.142 (92)	0.226 (146)	0.335 (216)
Steel strength in tension of threaded rod	ASTM A36 or F1554, Grade 36	$N_{sa,rod,A36}$	lb (kN)	1,855 (8.2)	4,525 (20.0)	8,235 (36.6)	13,110 (58.3)	19,430 (86.3)
Steel strength in tension of threaded rod, seismic		$N_{sa,rod,eq,A36}$	lb (kN)	1,855 (8.2)	4,525 (20.0)	8,235 (36.6)	13,110 (58.3)	19,430 (86.4)
Steel strength in tension of threaded rod	ASTM A193, Gr. B7	$N_{sa,rod,B7}$	lb (kN)	4,000 (17.7)	9,750 (43.1)	17,750 (78.9)	28,250 (125.7)	41,875 (186.0)
Steel strength in tension of threaded rod, seismic		$N_{sa,rod,eq,B7}$	lb (kN)	4,000 (17.7)	9,750 (43.1)	17,750 (78.9)	28,250 (125.7)	41,875 (186.0)
Reduction factor, steel strength in tension		ϕ	-	0.75				
Steel strength in shear of threaded	ASTM A36 or F1554, Grade 36	$V_{sa,rod,A36}$	lb (kN)	1,115 (4.9)	2,715 (12.1)	4,940 (22.0)	7,865 (35.0)	11,660 (51.9)
Steel strength in shear of threaded rod, seismic		$V_{sa,rod,eq,A36}$	lb (kN)	780 (3.5)	1,900 (8.4)	3,460 (15.4)	5,505 (24.5)	8,160 (36.3)
Steel strength in shear of threaded rod	ASTM A193, Gr. B7	$V_{sa,rod,B7}$	lb (kN)	2,385 (10.6)	5,815 (25.9)	10,640 (7.3)	16,950 (75.4)	25,085 (111.6)
Steel strength in shear of threaded rod, seismic		$V_{sa,rod,eq,B7}$	lb (kN)	1,680 (7.5)	4,095 (18.2)	7,455 (34.2)	11,865 (52.8)	17,590 (78.2)
Reduction factor, steel strength in shear		ϕ	-	0.65				

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 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3 for steel elements. Condition B is assumed. Strength reduction factors for load combinations in accordance with ACI 318 (-19 and -14) Section 5.3 or ACI 318-11 Section 9.2 governed by steel strength of the threaded rod are taken as 0.75 for tension and 0.65 for shear; values correspond to ductile steel elements. The value of ø applies when the load combinations of 2021 IBC Section 1605.1 or 2018, 2015 and 2012 IBC 1605.2, ACI 318 (-19 or -14) Section 5.3 or ACI 318-11 Section 9.2 are used in accordance with ACI 318-19 17.5.3, 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, then the appropriate value of ø must be determined in accordance with ACI 318-11 D4.4.

DESIGN STRENGTH TABLES (SD)

Tension and Shear Design Strengths for Wood-Knocker II+ and Pan-Knocker II+ Single Thread Inserts Installed in Form Poured Concrete and Roof Members - Uncracked Concrete[1,2,3,4,5,6,7]

Nominal Anchor Diameter (in.)	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" (LP)	1-1/4	1,605	590	1,855	590	2,275	590
3/8" (LP)	1-1/4	1,605	1,235	1,855	1,425	2,275	1,700
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+ and Pan-Knocker II+ Single Thread Inserts Installed in Form Poured Concrete and Roof Members - Cracked Concrete[1,2,3,4,5,6,7,8]

Nominal Anchor Diameter (in.)	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" (LP)	1-1/4	1,285	590	1,485	590	1,820	590
3/8" (LP)	1-1/4	1,285	885	1,485	1,020	1,820	1,250
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:
- No edge distance influence ($c_{a1} \geq 1.5h_{ef}$) and no side-face blowout in tension.
- No edge distance ($c_{a1} \geq 3h_{ef}$) or corner distance influence ($c_{a2} \geq 1.5c_{a1}$) in shear.

2- Calculations were performed following methodology in ACI 318-19 17.5.3, ACI 318 (-19 and -14) Chapter 17 or 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 shall be taken from ACI 318-14 17.3.3 or 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 (-19 and -14) Section 5.3 or ACI 318-11 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 static loads only, seismic loading is not considered with these tables.

5- For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318 (-19 and -14) Chapter 17 or 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 (-19 and -14) Chapter 17 or ACI 318-11 Appendix D and information contained in this product supplement. For other design conditions including seismic considerations please see ACI 318 (-19 and -14) Chapter 17 or ACI 318-11 Appendix D.

7- For lightweight concrete, where concrete breakout or anchor pullout/pryout strength controls, the tabulated values must be multiplied by 0.85 for sand-lightweight and 0.75 for all-lightweight, as applicable.

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

Tension and Shear Design Strengths for Wood-Knocker II+ and Pan-Knocker II+ Multi Thread Inserts Installed in Form Poured Concrete and Roof Members - Uncracked Concrete[1,2,3,4,5,6,7]

Nominal Anchor Diameter (in.)	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" (1/4 - 3/8" Multi LP)	1-1/4	1,605	590	1,855	590	2,275	590
3/8" (1/4 - 3/8" Multi LP)	1-1/4	1,605	1,235	1,855	1,425	2,275	1,700
1/4" (1/4 - 3/8" Multi)	1-3/4	2,005	545	2,005	545	2,005	545
3/8" (1/4 - 3/8" Multi)	1-3/4	2,665	2,420	3,075	2,530	3,765	2,530
1/4" (1/4 - 3/8 - 1/2" Multi)	1-3/4	2,305	1,065	2,305	1,065	2,305	1,065
3/8" (1/4 - 3/8 - 1/2" Multi)	1-3/4	2,665	2,420	3,075	2,530	3,765	2,530
1/2" (1/4 - 3/8 - 1/2" Multi)	1-3/4	2,665	2,420	3,075	2,795	3,765	3,425
3/8" (3/8 - 1/2" Multi)	1-3/4	2,665	2,085	3,075	2,085	3,765	2,085
1/2" (3/8 - 1/2" Multi)	1-3/4	2,665	2,420	3,075	2,795	3,765	3,425
3/8" (3/8 - 1/2 - 5/8" Multi)	2-1/4	3,880	2,230	4,485	2,230	5,490	2,230
1/2" (3/8 - 1/2 - 5/8" Multi)	2-1/4	3,880	3,880	4,485	4,485	5,490	5,490
5/8" (3/8 - 1/2 - 5/8" Multi)	2-1/4	3,880	3,880	4,485	4,485	5,490	5,490
5/8" (5/8 - 3/4" Multi)	2-1/4	3,880	3,880	4,485	4,485	5,490	5,490
3/4" (5/8 - 3/4" Multi)	2-1/4	3,880	3,880	4,485	4,485	5,490	5,490

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

Tension and Shear Design Strengths for Wood-Knocker II+ and Pan-Knocker II+ Multi Thread Inserts Installed in Form Poured Concrete and Roof Members - Cracked Concrete[1,2,3,4,5,6,7,8]

Nominal Anchor Diameter (in.)	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" (1/4 - 3/8" Multi LP)	1-1/4	1,285	590	1,485	590	1,820	590
3/8" (1/4 - 3/8" Multi LP)	1-1/4	1,285	885	1,485	1,020	1,820	1,250
1/4" (1/4 - 3/8" Multi)	1-3/4	2,005	545	2,005	545	2,005	545
3/8" (1/4 - 3/8" Multi)	1-3/4	2,130	1,730	2,460	2,000	3,015	2,445
1/4" (1/4 - 3/8 - 1/2" Multi)	1-3/4	2,130	1,065	2,305	1,065	2,305	1,065
3/8" (1/4 - 3/8 - 1/2" Multi)	1-3/4	2,130	1,730	2,460	2,000	3,015	2,445
1/2" (1/4 - 3/8 - 1/2" Multi)	1-3/4	2,130	1,730	2,460	2,000	3,015	2,445
3/8" (3/8 - 1/2" Multi)	1-3/4	2,130	1,730	2,460	2,000	3,015	2,085
1/2" (3/8 - 1/2" Multi)	1-3/4	2,130	1,730	2,460	2,000	3,015	2,445
3/8" (3/8 - 1/2 - 5/8" Multi)	2-1/4	3,105	2,230	3,585	2,230	4,390	2,230
1/2" (3/8 - 1/2 - 5/8" Multi)	2-1/4	3,105	2,895	3,585	3,340	4,390	4,090
5/8" (3/8 - 1/2 - 5/8" Multi)	2-1/4	3,105	2,895	3,585	3,340	4,390	4,090
5/8" (5/8 - 3/4" Multi)	2-1/4	3,105	2,895	3,585	3,340	4,390	4,090
3/4" (5/8 - 3/4" Multi)	2-1/4	3,105	2,895	3,585	3,340	4,390	4,090

☐ - 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:
- No edge distance influence ($c_{a1} \geq 1.5h_{ef}$) and no side-face blowout in tension.
- No edge distance ($c_{a1} \geq 3h_{ef}$) or corner distance influence ($c_{a2} \geq 1.5c_{a1}$) in shear.

2- Calculations were performed following methodology in ACI 318 (-19 and -14) Chapter 17 or 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 shall be taken from ACI 318-19 17.5.3, ACI 318-14 17.3.3 or 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 (-19 and -14) Section 5.3 or ACI 318-11 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 static loads only, seismic loading is not considered with these tables.

5- For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318 (-19 and -14) Chapter 17 or 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 (-19 and -14) Chapter 17 or ACI 318-11 Appendix D and information contained in this product supplement. For other design conditions including seismic considerations please see ACI 318 (-19 and -14) Chapter 17 or ACI 318-11 Appendix D.

7- For lightweight concrete, where concrete breakout or anchor pullout/pryout strength controls, the tabulated values must be multiplied by 0.85 for sand-lightweight and 0.75 for all-lightweight, as applicable.

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

Tension and Shear Design Strengths for Wood-Knocker II+ and Pan-Knocker II+ Push-In Thread Inserts Installed in Form Poured Concrete and Roof Members - Uncracked Concrete[1,2,3,4,5,6,7]

Nominal Anchor Diameter (in.)	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.)
3/8" Push-In	1.70	2,550	2,175	2,945	2,175	3,605	2,175
1/2" Push-In	2.00	3,255	3,255	3,755	3,575	4,600	3,575

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

Tension and Shear Design Strengths for Wood-Knocker II+ and Pan-Knocker II+ Push-In Thread Inserts Installed in Form Poured Concrete and Roof Members - Cracked Concrete[1,2,3,4,5,6,7,8]

Nominal Anchor Diameter (in.)	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.)
3/8" Push-In	1.70	2,040	2,040	2,355	2,175	2,885	2,175
1/2" Push-In	2.00	2,605	2,605	3,005	3,005	3,680	3,575

■ - 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:
- No edge distance influence ($c_{a1} \geq 1.5h_{ef}$) and no side-face blowout in tension.
- No edge distance ($c_{a1} \geq 3h_{ef}$) or corner distance influence ($c_{a2} \geq 1.5c_{a1}$) in shear.

2- Calculations were performed following methodology in ACI 318 (-19 and -14) Chapter 17 or 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 shall be taken from ACI 318-19 17.5.3, ACI 318-14 17.3.3 or 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 (-19 and -14) Section 5.3 or ACI 318-11 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 (-19 and -14) Chapter 17 or 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 (-19 and -14) Chapter 17 or ACI 318-11 Appendix D and information contained in this product supplement. For other design conditions including seismic considerations please see ACI 318 (-19 and -14) Chapter 17 or ACI 318-11 Appendix D.

7- For lightweight concrete, where concrete breakout or anchor pullout/pryout strength controls, the tabulated values must be multiplied by 0.85 for sand-lightweight and 0.75 for all-lightweight, as applicable.

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

Tension and Shear Design Strength of Steel Elements (Steel Strength)[1,2,3,4]

Nominal Rod Diameter (in.)	Steel Elements - Threaded Rod			
	ASTM A36		ASTM A193 Grade B7	
	$\phi N_{sa,rod}$ 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 and ACI 318 Chapter 17, $\phi N_{sa} = \phi \bullet A_{se,N} \bullet f_{uta}$
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 and ACI 318 Chapter 17, $\phi V_{sa} = \phi \bullet 0.60 \bullet A_{se,N} \bullet f_{uta}$
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 internal thread)

Cat. No.	Description	Color Code	Pack Qty.
PFM2500014	1/4" Wood-Knocker II+ LP (Low Profile)	Brown	100
PFM2500038	3/8" Wood-Knocker II+ LP (Low Profile)	Green	100
PFM2521100	1/4" Wood-Knocker II+	Brown	100
PFM2521150	3/8" Wood-Knocker II+	Green	100
PFM2521200	1/2" Wood-Knocker II+	Yellow	100
PFM2521250	5/8" Wood-Knocker II+	Red	100
PFM2521300	3/4" Wood-Knocker II+	Purple	100
PFM2501438	1/4-3/8" Wood-Knocker II+ Multi LP (Low Profile)	White	100
PFM2521438	1/4-3/8" Wood-Knocker II+ Multi	White	100
PFM2521350	3/8-1/2" Wood-Knocker II+ Multi	Gray	100
PFM253143812	1/4-3/8-1/2" Wood-Knocker II+ Multi	Aqua	100
PFM253381258	3/8-1/2-5/8" Wood-Knocker II+ Multi	Orange	50
PFM2525834	5/8-3/4" Wood-Knocker II+ Multi	Black	50
PFM2610038	3/8" Wood-Knocker II+ Push-In Thread	Green	50
PFM2610012	1/2" Wood-Knocker II+ Push-In Thread	Yellow	50

Inserts are color coded to easily identify location, type and sizes of the internal diameters.



Wood-Knocker II+ Installation Accessories and Tools

Cat. No.	Description	Pack Qty.
PFM3612000	Wood-Knocker II+ Installation Tool	1
DWHT51439	16oz Steel Curve Claw Hammer	1

The Wood-Knocker II+ installation tool features a magnetic end to help hold the insert and assist in placement.

Pan-Knocker II+ Form Insert (UNC internal thread)

Cat. No.	Description	Color Code	Pack Qty.
PFM2501438NN	1/4-3/8" Pan-Knocker II+ Multi LP (Low Profile)	White	100
PFM253143812NN	1/4-3/8-1/2" Pan-Knocker II+ Multi	Aqua	100
PFM253381258NN	3/8-1/2-5/8" Pan-Knocker II+ Multi	Orange	100
PFM2525834NN	5/8-3/4" Pan-Knocker II+ Multi	Black	100
PFM2610038NN	3/8" Pan-Knocker II+ Push-In Thread	Green	50
PFM2610012NN	1/2" Pan-Knocker II+ Push-In Thread	Yellow	50

Pan-Knocker II+ form inserts must be mounted (e.g. screwed, pinned) to the form work. Fasteners are not included.


Pan-Knocker II+ Cordless Concrete Nailer Installation Tool and Pins

Cat. #	Description					Pack Qty.	Carton Qty.
DCN891P2	20V Max* Cordless Concrete Nailer Kit					1	-
Cat. #	Shank Dia. in.	Step Dia. in.	Length in.	Knurl (K)	Finish	Pack Qty.	Carton Qty.
DCN8907804	0.102"	0.088"	0.780"	Yes	Zinc	1000	6000

Fasteners have a head diameter of .250" and are zinc plated in accordance with ASTM B695, Class 5.


Pan-Knocker II+ Gas Fastening Nailer Installation Tool and Pins

Cat. #	Description					Pack Qty.	Carton Qty.
55142-PWR	Trak-It C5 Tool W/Deep Track (1-1/4" Pin)					1	-
Cat. #	Shank Dia. in.	Step Dia. in.	Length in.	Knurl (K)	Finish	Pack Qty.	Carton Qty.
55330-PWR	0.120"	0.102"	0.730"	Yes	Zinc	800	4000
55342-PWR	0.102"	0.088"	0.780"	Yes	Zinc	800	4000

Fasteners have a head diameter of .250" and are zinc plated in accordance with ASTM B695, Class 5.


Push-In Thread Couplers

Cat. No.	Description	Pack Qty.
PFM3613038	3/8"-16 Coupler Push-In Thread	20
PFM3613012	1/2"-13 Coupler Push-In Thread	20

Push-In couplers have one end that does not require turning threaded rod elements during installation which can be ideal for applications such as mounting prefabricated hardware and hanger assemblies.

GENERAL INFORMATION

BANG-IT®+

Concrete Inserts

PRODUCT DESCRIPTION

Bang-It+ concrete inserts are designed for installation in and through composite steel deck (i.e. "pan-deck") used to support newly poured concrete floor or roof slabs. The Bang-It+ concrete inserts are specifically designed to provide hangar attachments for mechanical, electrical, plumbing (MEP) and fire protection.

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. 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 turned during installation.

A push-in thread version is also available which does not require turning the threaded rod or threaded bolt during installation. which can be ideal for applications such as mounting prefabricated hardware and hanger assemblies.

GENERAL APPLICATIONS AND USES

- Hanging Pipe and Sprinkler Systems
- HVAC Ductwork and Strut Channels
- Suspending Trapeze and Cable Trays
- Mechanical Utility Lines
- Conduit and Lighting Systems
- Cracked and Uncracked Concrete

FEATURES AND BENEFITS

+ Fast and simple to install, low installed cost
+ Sturdy base design resists inserts from being kicked over after placement
+ Color coded by size for simple identification, can be further marked by trade and/or utility
+ Inserts can be installed in upper and lower steel deck profiles with limited concrete topping thickness (see installation details)
+ Suitable for seismic and wind loading (see design information)
+ Multi thread inserts allow for multiple diameters using the same part
+ All sizes of multi thread inserts rated for tension and shear loading
+ Push-In thread version does not require turning threaded rod elements during installation

APPROVALS AND LISTINGS

- International Code Council, Evaluation Service (ICC-ES), ESR-3657 for concrete-filled decks
- Code compliant with the 2021 IBC/IRC, 2018 IBC/IRC, 2015 IBC/IRC and 2012 IBC/IRC
- Tested in accordance with ASTM E488 and ICC-ES AC446 for use in cracked and uncracked concrete and with 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 as well as seismic and wind loading
- Underwriters Laboratories (UL Listed) - File No. EX1289 and VFXT7.EX1289, see listing for sizes Also UL listed and recognized for use in air handling spaces (i.e. plenum rated locations)
- FM Approvals (Factory Mutual) – see approval for sizes

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. Anchors shall be installed in accordance with published instructions and the Authority Having Jurisdiction.

SECTION CONTENTS

BANG-IT+
STEEL DECK INSERTS

BANG-IT+ PUSH-IN THREAD
STEEL DECK INSERT

ANCHOR MATERIALS

- Carbon Steel and Engineered Plastic

ROD/ANCHOR SIZE RANGE (TYP.)

- 1/4" through 3/4" threaded rod (UNC)

INSERT VERSIONS

- Single Thread (thread-in)
- Multi Thread (thread-in)
- Push-In Thread

SUITABLE BASE MATERIALS

- Normal-weight Concrete
- Lightweight Concrete

TENSION ZONE CRACKED CONCRETE
SEISMIC REGION QUALIFICATION
CODE LISTED
ICC-ES ESR-3657
CONCRETE
DDA
DEWALT DESIGN ASSIST™

MATERIAL SPECIFICATIONS

Bang-It+

Anchor Component	Component Material
Insert Body	AISI 1008 Carbon Steel or equivalent
Base Plate	AISI 1008 Carbon Steel or equivalent or Engineered Plastic (polypropylene)
Spring	Steel Music Wire
Protective Sleeve	Engineered Plastic (polypropylene)
Zinc Plating (metal components)	ASTM B633 (Fe/Zn5) Min. Plating requirements for Mild Service Condition

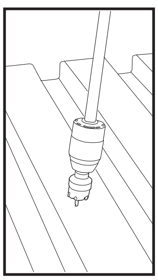
Material Properties for Common Threaded Rods

Description	Steel Specification (ASTM)	Threaded Rod Diameter (inch)	Minimum Yield Strength, f_y (ksi)	Minimum Ultimate Strength, f_u (ksi)
Standard Carbon Steel	A36 or F1554, Grade 36	1/4 to 3/4	36.0	58.0
High Strength Carbon Steel	A193, Grade B7	1/4 to 3/4	105.0	125.0

Inserts may be considered for use 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.

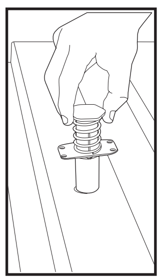
Installation Instructions for Bang-It+

CREATE HOLE



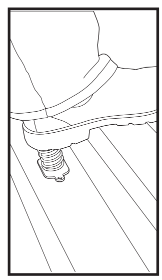
Step 1
Drill or punch a hole in the steel deck to hole size required (e.g. deck driller with hole saw or step bit).

POSITION



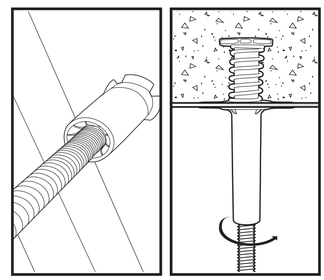
Step 2
Insert plastic sleeve through hole in steel deck.

MOUNT



Step 3
Step on or impact insert head to engage through deck. Option: base flange of insert can be attached.

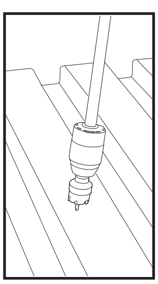
ATTACH



Step 4
Guide threaded rod or bolt through end of plastic sleeve into the insert. Turn until steel element fully threaded. Attach fixtures as applicable.

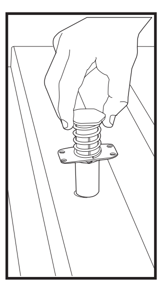
Installation Instructions for Bang-It+ Push-In

CREATE HOLE



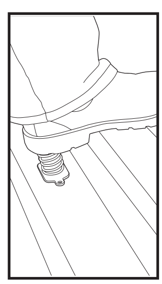
Step 1
Drill or punch a hole in the steel deck to hole size required (e.g. deck driller with hole saw or step bit).

POSITION



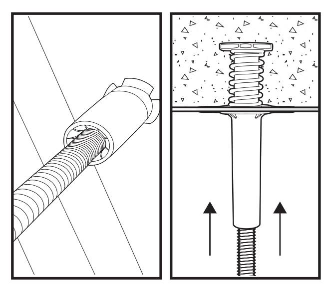
Step 2
Insert plastic sleeve through hole in steel deck.

MOUNT



Step 3
Step on or impact insert head to engage through deck. Option: base flange of insert can be attached to steel deck.

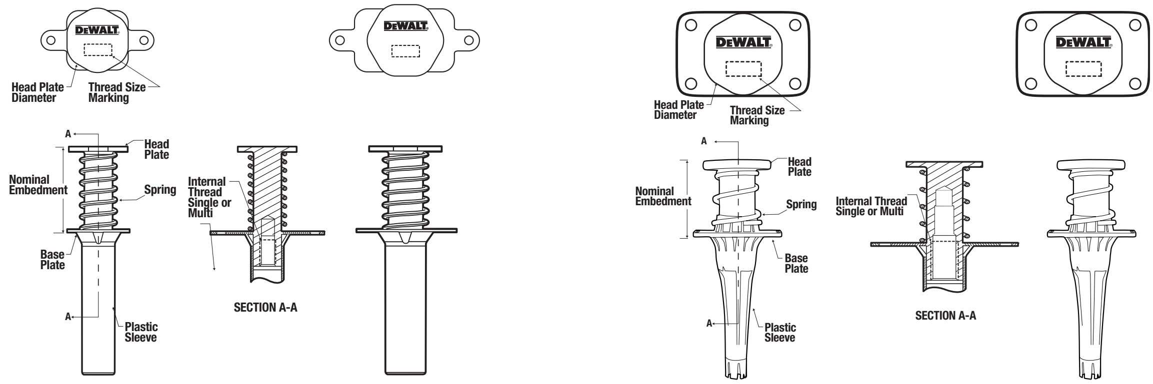
ATTACH



Step 4
Push threaded rod or bolt through end of plastic sleeve into the insert until steel element is fully seated. Attach fixtures as applicable.

INSTALLATION SPECIFICATIONS

Bang-It+ Cast-In-Place Inserts for Concrete Filled Steel Deck Floor and Roof Assemblies



Installation Specifications for Single Thread Bang-It+ Inserts[1,2]

Insert Dimension / Property	Symbol	Units	Nominal Rod/Anchor Size				
			1/4"	3/8"	1/2"	5/8"	3/4"
Outside diameter of steel insert body	d_a	in. (mm)	0.7 (18)			1.0 (25)	
Insert head plate diameter	d_{hp}	in. (mm)	1.50 (38)			1.75 (45)	
Plastic sleeve diameter	d_s	in. (mm)	27/32 (21)			1-7/32 (31)	
Suggested hole size in deck	d_{hole}	in. (mm)	7/8 (22)			1-1/4 (32)	
Base plate width	W_{bp}	in. (mm)	1-1/2 (38)			1-1/2 (38)	
Nominal embedment depth	h_{nom}	in. (mm)	2 (51)			2 (51)	
Effective embedment depth	h_{ef}	in. (mm)	1.75 (45)			1.75 (45)	
Minimum member thickness	h_{min}	in. (mm)	See steel deck figures, as applicable				
Minimum spacing distance	S_{min}	in. (mm)	$3h_{ef}$ for lower flute locations; $4d_a$ for upper flute locations				
Minimum edge distance	C_{min}	in. (mm)	See steel deck figures for lower flute edge distances; otherwise use $0.5d_{hp}$ + 3/4 (19)				
Insert head plate thickness	t_{hp}	in. (mm)	1/8 (3)			1/8 (3)	
Length of plastic sleeve	ℓ_s	in. (mm)	3-3/8 (86)			3-3/8 (86)	
UNC internal thread size	-	in. \ TPI	1/4-20	3/8-16	1/2-13	5/8-11	3/4-10
Approx. internal thread length	-	in.	3/8	1/2	5/8	3/4	7/8
Approx. space between base plate opening and start of internal thread, after setting*	-	in	-3/4			-3/4	

*A negative value indicates the internal threads of the insert start below (project through) the base plate.

5. Inserts have internal thread size designations for coarse threads matching the nominal rod / anchor size.
6. For installation specifications of Push-In inserts see the next page.

MECHANICAL ANCHORS

BANG-IT®+ Concrete Inserts

Installation Specifications for Multi Thread Bang-It+ Inserts[1]

Insert Dimension / Property	Symbol	Units	Nominal Rod/Anchor Size											
			1/4" & 3/8" Multi		1/4" & 3/8" & 1/2" Multi			3/8" & 1/2" Multi		3/8" & 1/2" & 5/8" Multi			5/8" & 3/4" Multi	
Outside diameter of the steel insert body	d_a	in. (mm)	0.7 (18)							1.0 (25)				
Insert head plate diameter	d_{hp}	in. (mm)	1.50 (38)							1.75 (45)				
Plastic sleeve diameter	d_s	in. (mm)	27/32 (21)							1-7/32 (32)				
Suggested hole size in deck	d_{hole}	in. (mm)	7/8 (22)							1-1/4 (32)				
Base plate width	W_{bp}	in. (mm)	1-1/2 (38)							1-1/2 (38)				
Nominal embedment depth	h_{nom}	in. (mm)	2 (51)							2-3/8 (60)				
Effective embedment depth	h_{ef}	in. (mm)	1.75 (45)							2.25 (57)				
Minimum member thickness	h_{min}	in. (mm)	See steel deck figures, as applicable											
Minimum spacing distance	s_{min}	in. (mm)	$3h_{ef}$ for lower flute locations; $4d_a$ for upper flute locations											
Minimum edge distance	c_{min}	in. (mm)	See steel deck figures for lower flute edge distances; otherwise use $0.5d_{hp}$ + 3/4 (19)											
Insert head plate thickness	t_{hp}	in. (mm)	1/8 (3)							1/8 (3)				
Length of plastic sleeve	ℓ_s	in. (mm)	3-3/8 (86)		3-1/2 (89)			3-3/8 (86)		3-1/2 (89)			3-3/8 (86)	
UNC internal thread size	-	in. \ TPI	1/4-20	3/8-16	1/4-20	3/8-16	1/2-13	3/8-16	1/2-13	3/8-16	1/2-13	5/8-11	5/8-11	3/4-10
Approx. internal thread length	-	in.	3/8	1/2	5/16	3/8	1/2	7/16	9/16	3/8	1/2	5/8	5/8	3/4
Approx. space between base plate opening and start of internal thread, after setting*	-	in	0	-3/4	3/4	0	-3/4	1/8	-3/4	1	1/4	-3/4	1/2	-3/4

*A negative value indicates the internal threads of the insert start below (project through) the base plate.

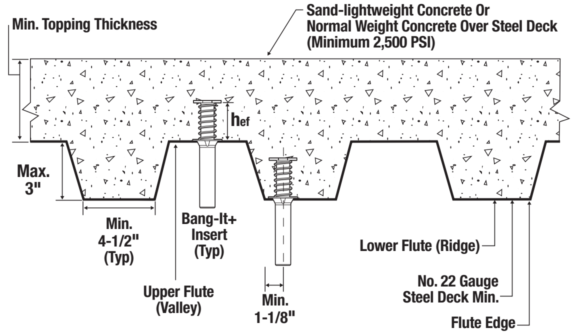
1. Inserts have internal thread size designations for coarse threads matching the nominal rod / anchor size.

Installation Specifications for Bang-It+ Push-In Inserts[1]

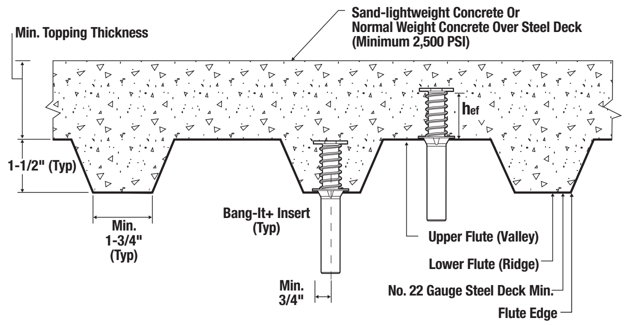
Insert Dimension / Property	Symbol	Units	Nominal Rod/Anchor Size	
			3/8"	1/2"
Outside diameter of the steel insert body	d_a	in. (mm)	1.0 (25)	1.125 (29)
Insert head plate diameter	d_{hp}	in. (mm)	1.9 (48)	2.2 (56)
Plastic sleeve diameter	d_s	in. (mm)	1-3/32 (28)	1-7/32 (31)
Suggested hole size in deck	d_{hole}	in. (mm)	1-1/4 (32)	1-1/4 (32)
Base plate width	W_{bp}	in. (mm)	1-1/2 (38)	1-1/2 (38)
Nominal embedment depth	h_{nom}	in. (mm)	1-11/16 (42)	1-7/8 (48)
Effective embedment depth	h_{ef}	in. (mm)	1.5 (38)	1.7 (43)
Minimum member thickness	h_{min}	in. (mm)	See steel deck figures, as applicable	
Minimum spacing distance	s_{min}	in. (mm)	$3h_{ef}$ for lower flute locations; $4d_a$ for upper flute locations	
Minimum edge distance	c_{min}	in. (mm)	See steel deck figures for lower flute edge distances; otherwise use $0.5d_{hp}$ + 3/4 (19)	
Insert head plate thickness	t_{hp}	in. (mm)	3/16 (5)	3/16 (5)
Length of plastic sleeve	ℓ_s	in. (mm)	3-1/2 (89)	3-1/2 (89)
UNC internal thread size	-	in. \ TPI	3/8-16	1/2-13
Approx. internal thread length	-	in.	5/8	11/16
Approx. space between base plate opening and start of internal thread, after setting	-	in	7/16	5/8

1. Inserts have internal thread size designations for coarse threads matching the nominal rod / anchor size.

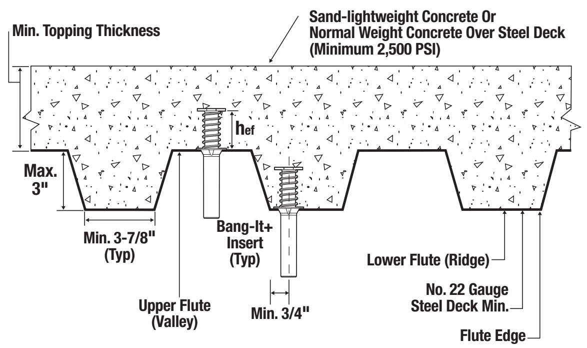
[A] Bang-It+ Inserts Installed in Soffit of Concrete Filled Steel Deck Floor and Roof Assemblies, 4-1/2 -inch W-Deck[1,2,3,4]



[B] Bang-It+ Inserts Installed in Soffit of Concrete Filled Steel Deck Floor and Roof Assemblies, B-Deck[1,2,3,5,6,7]



[C] Bang-It+ Inserts Installed in Soffit of Concrete Filled Steel Deck Floor and Roof Assemblies, 3-7/8 -inch W-Deck[1,2,3,8,9]



1. [A, B & C] 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 in Figures) from the top of the upper flute, except for the 3/8 & 1/2 & 5/8-inch multi insert and 5/8 & 3/4-inch multi insert which require a minimum of 2" of concrete topping thickness. Upper flute installations require a minimum 3" concrete topping thickness from the top of the upper flute.
2. [A, B & C] Axial spacing for inserts along the upper flute length shall be $4d_a$ minimum; axial spacing along the lower flute length shall be $3h_{ef}$ minimum.
3. [A, B & C] Upper flute Bang-It+ inserts are not subject to steel deck dimension limitations, or the minimum steel deck gauge limitations.
4. [A] 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. [B] 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. [B] Lower flute installations of B-Deck with flutes widths greater than 1-3/4 -inch are permitted.
7. [B] 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. [C] 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. 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.
9. [C] Inserts in upper flute may be installed anywhere across upper flute provided minimum edge distances are maintained; see insert design information tables, as applicable.

PERFORMANCE DATA (ASD)

Allowable Design Values for Inserts in Uncracked Concrete (lbs)[1,2,3,4,5,6,7,8,9,10,11,12]

Deck Profile Type	Load Type	Bang-It+ Single Thread Inserts										Bang-It+ Push-In Thread Inserts			
		1/4-inch		3/8-inch		1/2-inch		5/8-inch		3/4-inch		3/8-inch		1/2-inch	
		Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
Fig. A	Tension	1,530	1,090	1,530	1,090	1,530	1,090	1,530	1,090	1,530	1,090	1,215	910	1,465	1,055
	Shear	805	805	925	925	925	925	925	925	925	925	1,340	930	2,795	1,235
Fig. B	Tension	1,530	435	1,530	435	1,530	435	1,530	435	1,530	435	1,215	405	1,465	430
	Shear	730	730	845	845	845	845	1,205	1,205	1,205	1,205	1,340	930	2,795	1,035
Fig. C	Tension	1,530	985	1,530	985	1,530	985	1,530	985	1,530	985	1,215	810	1,465	945
	Shear	730	730	845	845	845	845	1,205	1,205	1,205	1,205	1,340	930	2,795	1,035

Deck Profile Type	Load Type	Bang-It+ Multi Thread Inserts													
		1/4 & 3/8 Multi				1/4 & 3/8 & 1/2 Multi						3/8 & 1/2 Multi			
		1/4-inch		3/8-inch		1/4-inch		3/8-inch		1/2-inch		3/8-inch		1/2-inch	
		Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
Fig. A	Tension	865	865	1,530	1,090	1,530	1,090	1,530	1,090	1,530	1,090	1,530	1,090	1,530	1,090
	Shear	675	470	925	925	675	515	1,435	840	1,690	840	965	845	1,690	925
Fig. B	Tension	865	435	1,530	435	1,530	435	1,530	435	1,530	435	1,530	435	1,530	435
	Shear	675	470	925	845	675	515	1,435	580	1,690	725	965	845	1,690	845
Fig. C	Tension	865	1,090	1,530	1,090	1,530	1,090	1,530	1,090	1,530	1,090	1,530	1,090	1,530	1,090
	Shear	675	470	925	845	675	515	1,435	580	1,690	725	965	845	1,690	845

Deck Profile Type	Load Type	Bang-It+ Multi Thread Inserts (Continued)									
		3/8 & 1/2 & 5/8 Multi						5/8 & 3/4 Multi			
		3/8-inch		1/2-inch		5/8-inch		5/8-inch		3/4-inch	
		Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
Fig. A	Tension	2,230	1,485	2,230	1,485	2,230	1,485	2,230	1,485	2,230	1,485
	Shear	1,975	1,020	3,280	1,020	3,280	1,020	2,280	1,235	2,625	1,235
Fig. B	Tension	2,230	495	2,230	495	2,230	495	2,230	495	2,230	495
	Shear	1,975	880	3,280	880	3,280	880	2,280	770	2,625	770
Fig. C	Tension	2,230	1,485	2,230	1,485	2,230	1,485	2,230	1,485	2,230	1,485
	Shear	1,975	880	3,280	880	3,280	880	2,280	770	2,625	770

Allowable Stress Design Values in tables for inserts are provided for illustration and applicable only when the following design assumptions are followed:

1. Concrete compressive strength, f'_c, 3000 psi for sand-lightweight concrete. For normalweight concrete, tabulated tension design values may be increased by 17 percent for the given conditions, except for 1/4-inch-diameters where no increase is permitted.
2. Single anchors with static loads; installation in upper and lower flute locations in concrete-filled steel deck in accordance with Figures A, B or C, as applicable.
3. Concrete determined to remain uncracked for the life of the anchorage.
4. Load combinations from ACI 318 (-19 or -14) 5.3 or ACI 318-11 9.2, as applicable (no seismic loading considered).
5. 30% dead load and 70% live load, controlling load combination 1.2D + 1.6L.
6. Calculation of the weighted average for $\alpha = 1.2*0.3 + 1.6*0.7 = 1.48$.
7. $h \geq h_{min}$ according to Figures A, B or C, as applicable.
8. Values are for Condition B where supplementary reinforcement in accordance with ACI 318-19 Section 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, is not provided.
9. Assuming no edge distance influence with $\Psi_{ed,N} = 1.0$ in tension for upper flute anchors.
10. Assuming no edge distance ($c_{a1} \geq 3h_{ef}$) or corner distance influence ($c_{a2} \geq 1.5c_{a1}$) for upper flute anchors in shear. Shear loads may be applied in any direction.
11. For lower flute anchors in accordance with Figure A, the near edge distance, $c_{a,min}$, is 1.125-inch. For lower flute anchors in accordance with Figure B, the near edge distance, $c_{a,min}$, is 0.75-inch. For lower flute anchors in accordance with Figure C, the near edge distance, $c_{a,min}$, is 0.75-inch.
12. The allowable loads shown in the table are for the inserts only. The design professional is responsible for checking threaded rod strength in tension, shear and combined tension and shear, as applicable. For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318 (-19 or -14) Chapter 17 or ACI 318-11 Appendix D, as applicable.

Allowable Design Values for Inserts in Cracked Concrete (lbs)[1,2,3,4,5,6,7,8,9,10,11,12]

Deck Profile Type	Load Type	Bang-It+ Single Thread Inserts										Bang-It+ Push-In Thread Inserts			
		1/4-inch		3/8-inch		1/2-inch		5/8-inch		3/4-inch		3/8-inch		1/2-inch	
		Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
Fig. A	Tension	1,225	875	1,225	875	1,225	875	1,225	875	1,225	875	970	730	1,170	845
	Shear	805	805	925	925	925	925	925	925	925	925	1,340	930	2,795	1,235
Fig. B	Tension	1,225	350	1,225	350	1,225	350	1,225	350	1,225	350	970	325	1,170	345
	Shear	730	730	845	845	845	845	1,205	1,205	1,205	1,205	1,340	930	2,795	1,035
Fig. C	Tension	1,225	785	1,225	785	1,225	785	1,225	785	1,225	785	970	645	1,170	760
	Shear	730	730	845	845	845	845	1,205	1,205	1,205	1,205	1,340	930	2,795	1,035

Deck Profile Type	Load Type	Bang-It+ Multi Thread Inserts													
		1/4 & 3/8 Multi				1/4 & 3/8 & 1/2 Multi						3/8 & 1/2 Multi			
		1/4-inch		3/8-inch		1/4-inch		3/8-inch		1/2-inch		3/8-inch		1/2-inch	
		Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
Fig. A	Tension	865	865	1,225	875	1,225	875	1,225	875	1,225	875	1,225	875	1,225	875
	Shear	675	470	925	925	675	515	1,435	840	1,690	840	965	845	1,690	925
Fig. B	Tension	865	350	1,225	350	1,225	350	1,225	350	1,225	350	1,225	350	1,225	350
	Shear	675	470	925	845	675	515	1,435	580	1,690	725	965	845	1,690	845
Fig. C	Tension	865	865	1,225	875	1,225	875	1,225	875	1,225	875	1,225	875	1,225	875
	Shear	675	470	925	845	675	515	1,435	580	1,690	725	965	845	1,690	845

Deck Profile Type	Load Type	Bang-It+ Multi Thread Inserts (Continued)									
		3/8 & 1/2 & 5/8 Multi						5/8 & 3/4 Multi			
		3/8-inch		1/2-inch		5/8-inch		5/8-inch		3/4-inch	
		Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
Fig. A	Tension	1,785	1,190	1,785	1,190	1,785	1,190	1,785	1,190	1,785	1,190
	Shear	1,975	1,020	3,280	1,020	3,280	1,020	2,280	1,235	2,625	1,235
Fig. B	Tension	1,785	395	1,785	395	1,785	395	1,785	395	1,785	395
	Shear	1,975	880	3,280	880	3,280	880	2,280	770	2,625	770
Fig. C	Tension	1,785	1,190	1,785	1,190	1,785	1,190	1,785	1,190	1,785	1,190
	Shear	1,975	880	3,280	880	3,280	880	2,280	770	2,625	770

1. Concrete compressive strength, f'_c = 3000 psi for sand-lightweight concrete. For normalweight concrete, tabulated tension design values may be increased by 17 percent for the given conditions, except for 1/4-inch-diameters where no increase is permitted.
2. Single anchors with static loads; installation in upper and lower flute locations in concrete-filled steel deck in accordance with Figures A, B or C, as applicable.
3. Concrete determined to be cracked for the life of the anchorage.
4. Load combinations from ACI 318 (-19 or -14) 5.3 or ACI 318-11 9.2, as applicable (no seismic loading considered).
5. 30% dead load and 70% live load, controlling load combination 1.2D + 1.6L.
6. Calculation of the weighted average for $\alpha = 1.2*0.3 + 1.6*0.7 = 1.48$.
7. $h \geq h_{min}$ according to Figures A, B or C, as applicable.
8. Values are for Condition B where supplementary reinforcement in accordance with ACI 318-19 Section 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, is not provided.
9. Assuming no edge distance influence with $\Psi_{ed,N} = 1.0$ in tension for upper flute anchors.
10. Assuming no edge distance ($c_{a1} \geq 3h_{ef}$) or corner distance influence ($c_{a2} \geq 1.5c_{a1}$) for upper flute anchors in shear. Shear loads may be applied in any direction.
11. For lower flute anchors in accordance with Figure A, the near edge distance, $c_{a,min}$, is 1.125-inch. For lower flute anchors in accordance with Figure B, the near edge distance, $c_{a,min}$, is 0.75-inch. For lower flute anchors in accordance with Figure C, the near edge distance, $c_{a,min}$, is 0.75-inch.
12. The allowable loads shown in the table are for the inserts only. The design professional is responsible for checking threaded rod strength in tension, shear and combined tension and shear, as applicable. For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318 (-19 or -14) Chapter 17 or ACI 318-11 Appendix D, as applicable.

UL Listings and FM Approvals for Supporting Fire Protection Services & Automatic Sprinkler Systems[1]

Listing/Approval	Bang-It+ Single Thread Inserts										Bang-It+ Push-In Inserts			
	1/4"		3/8"		1/2"		5/8"		3/4"		3/8"		1/2"	
	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
UL Max. Pipe Size	N/A	N/A	4"	4"	8"	8"	8"	8"	8"	8"	4"	4"	8"	8"
FM Max. Pipe Size	N/A	N/A	4"	4"	8"	8"	12"	-	12"	-	4"	4"	8"	8"

Listing/Approval	Bang-It+ Multi Thread Inserts													
	1/4 & 3/8 Multi				1/4 & 3/8 & 1/2 Multi						3/8 & 1/2 Multi			
	1/4"		3/8"		1/4"		3/8"		1/2"		3/8"		1/2"	
	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
UL Max. Pipe Size	N/A	N/A	4"	4"	N/A	N/A	4"	4"	8"	8"	4"	4"	8"	8"
FM Max. Pipe Size	N/A	N/A	4"	4"	N/A	N/A	4"	4"	8"	8"	4"	4"	8"	8"

Listing/Approval	Bang-It+ Multi Thread Inserts (Continued)									
	3/8 & 1/2 & 5/8 Multi						5/8 & 3/4 Multi			
	3/8"		1/2"		5/8"		5/8"		3/4"	
	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
UL Max. Pipe Size	4"	4"	8"	8"	10"	10"	10"	10"	10"	10"
FM Max. Pipe Size	4"	4"	8"	8"	12"	12"	12"	12"	12"	12"

Underwriters Laboratories (UL Listed) – File No. EX1289

FM Approvals (Factory Mutual)

1. Anchors with installation in upper and lower flute locations in concrete-filled steel deck in accordance with Figures A, B or C, as applicable.

STRENGTH DESIGN INFORMATION

Design Information for Bang-It+ Single Thread Inserts[1,2,3,4,5,6]

Design Information / Insert Property		Symbol	Units	1/4"	3/8"	1/2"	5/8"	3/4"
Outside diameter of the steel insert body		d_a	in. (mm)	0.7 (18)			1.0 (25)	
Insert head net bearing area		A_{brg}	in² (mm²)	1.20 (762)			1.40 (903)	
Effective embedment depth		h_{ef}	in. (mm)	1.75 (45)			1.75 (45)	
STEEL STRENGTH IN TENSION (ACI 318-19 17.6.1, ACI 318-14 17.4.1 or ACI 318-11 D.5.1)								
According to Figures A, B & C	Steel strength in tension of single insert	$N_{sa,insert}$	lb (kN)	3,955 (17.6)	9,480 (42.2)	9,850 (43.5)	11,985 (53.3)	
	Steel strength in tension of single insert, seismic	$N_{sa,insert,eq}$	lb (kN)	3,955 (17.6)	9,480 (42.2)	9,850 (43.5)	11,985 (53.3)	
Reduction factor, steel strength in tension		ϕ	-	0.65				
CONCRETE BREAKOUT STRENGTH IN TENSION (ACI 318-19 17.6.2, ACI 318-14 17.4.2 or ACI 318-11 D.5.2)								
Effectiveness factor for cracked concrete		k_c	-	24 (for SI use a value of 10)				
Modification factor for uncracked concrete		$\Psi_{C,N}$	-	1.25				
Reduction factor, concrete strength in tension		ϕ	-	0.70				
STEEL STRENGTH IN SHEAR (ACI 318-19 17.7.1, ACI 318-14 17.5.1 or ACI 318-11 D.6.1)								
According to Figure A	Steel strength in shear of single insert, in lower or upper flute	$V_{sa,insert,deck}$	lb (kN)	1,980 (8.8)	2,280 (10.1)		3,075 (13.7)	
	Steel strength in shear of single insert, seismic	$V_{sa,insert,eq,deck}$	lb (kN)	1,980 (8.8)	2,280 (10.1)		2,695 (12.0)	
According to Figures B & C	Steel strength in shear of single insert, in lower or upper flute	$V_{sa,insert,deck}$	lb (kN)	1,805 (8.0)	2,080 (9.3)		2,975 (13.2)	
	Steel strength in shear of single insert, seismic	$V_{sa,insert,eq,deck}$	lb (kN)	1,805 (8.0)	2,080 (9.3)		2,695 (12.0)	
Reduction factor, concrete strength in tension		ϕ	-	0.60				

1. Concrete must have a compressive strength f 'c of 2,500 psi minimum. Installation must comply with published instructions.
2. Design of headed cast-in specialty inserts shall be in accordance with the provisions of ACI 318 (-19 or -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 steel deck figures, as applicable.
3. Strength reduction factors for the inserts shall be taken from ACI 318-19 17.5.3, 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 (-19 or -14) 5.3 or ACI 318-11 9.2, as applicable, governed by steel strength of the insert are tabulated. Strength reduction values correspond to brittle steel elements. The value of ϕ applies when the load combinations of 2021 IBC Section 1605.1 or 2018, 2015 and 2012 IBC 1605.2, ACI 318 (-19 or -14) Section 5.3 or ACI 318-11 9.2, as applicable, are used in accordance with ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4.
4. Minimum spacing distance between anchors and minimum edge distances for cast-in headed anchors shall be in accordance with steel deck figures, as applicable and the installation tables for the inserts.
5. 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 for common threaded rod elements.
6. The tabulated seismic values for steel strength of the inserts are applicable to installations in the lower flute or upper flute of the indicated steel deck figures, as applicable.

Design Information for Bang-It+ Multi Thread Inserts[1,2,3,4,5,6]

Design Information		Symbol	Units	1/4 & 3/8 Multi		1/4 & 3/8 & 1/2 Multi			3/8 & 1/2 Multi		3/8 & 1/2 & 5/8 Multi			5/8 & 3/4 Multi	
				1/4"	3/8"	1/4"	3/8"	1/2"	3/8"	1/2"	3/8"	1/2"	5/8"	5/8"	3/4"
Outside diameter of the steel insert body		d_a	in. (mm)	0.7 (18)							1.0 (25)				
Insert head net bearing area		A_{brg}	in² (mm²)	1.20 (762)							1.40 (903)				
Effective embedment depth		h_{ef}	in. (mm)	1.75 (45)							1.75 (45)				
STEEL STRENGTH IN TENSION (ACI 318-19 17.6.1, ACI 318-14 17.4.1 or ACI 318-11 D.5.1)															
According to Figures A, B & C	Steel strength in tension of single insert	$N_{sa,insert}$	lb (kN)	1,965 (8.7)	9,480 (42.2)	3,545 (15.8)	8,565 (38.1)	9,850 (43.8)	9,480 (42.2)	9,850 (43.8)	11,485 (51.1)	17,365 (77.2)		20,805 (92.5)	
	Steel strength in tension of single insert, seismic	$N_{sa,insert,eq}$	lb (kN)	1,965 (8.7)	9,480 (42.2)	3,545 (15.8)	8,565 (38.1)	9,850 (43.8)	9,480 (42.2)	9,850 (43.8)	11,485 (51.1)	17,365 (77.2)		20,805 (92.5)	
Reduction factor, steel strength in tension		ϕ	-	0.65							0.65				
CONCRETE BREAKOUT STRENGTH IN TENSION (ACI 318-19 17.6.2, ACI 318-14 17.4.2 or ACI 318-11 D.5.2)															
Effectiveness factor for cracked concrete		k_c	-	24 (for SI use a value of 10)											
Modification factor for uncracked concrete		$\Psi_{C,N}$	-	1.25											
Reduction factor, concrete strength in tension		ϕ	-	0.70											
STEEL STRENGTH IN SHEAR (ACI 318-19 17.7.1, ACI 318-14 17.5.1 or ACI 318-11 D.6.1)															
According to Figure A	Steel strength in shear of single insert, in upper flute	$V_{sa,insert,deck}$	lb (kN)	1,670 (7.4)	2,280 (10.2)	1,670 (7.4)	3,545 (15.8)	4,165 (18.5)	2,375 (10.6)	4,165 (18.6)	4,875 (21.7)	8,090 (36.0)	8,090 (36.0)	5,620 (25.0)	6,475 (28.8)
	Steel strength in shear of single insert, in lower flute	$V_{sa,insert,deck}$	lb (kN)	1,165 (5.2)	2,280 (10.2)	1,275 (5.7)	2,070 (9.2)	2,070 (9.2)	2,080 (9.3)	2,280 (10.2)	2,515 (11.2)	2,515 (11.2)		3,045 (13.5)	
	Steel strength in shear of single insert, seismic	$V_{sa,insert,eq,deck}$	lb (kN)	395 (1.8)	2,280 (10.2)	395 (1.8)	1,435 (6.4)	1,790 (8.0)	2,080 (9.3)	2,280 (10.2)	2,175 (9.7)	2,175 (9.7)		1,905 (8.5)	
According to Figures B & C	Steel strength in shear of single insert, in upper flute	$V_{sa,insert,deck}$	lb (kN)	1,670 (7.4)	2,280 (10.2)	1,670 (7.4)	3,545 (15.8)	4,165 (18.5)	2,375 (10.6)	4,165 (18.5)	4,875 (21.7)	8,090 (36.0)	8,090 (36.0)	5,620 (25.0)	6,475 (28.8)
	Steel strength in shear of single insert, in lower flute	$V_{sa,insert,deck}$	lb (kN)	1,165 (5.2)	2,080 (9.3)	1,275 (5.7)	1,435 (6.4)	1,790 (8.0)	2,080 (9.3)	2,080 (9.3)	2,175 (9.7)	2,175 (9.7)		1,905 (8.5)	
	Steel strength in shear of single insert, seismic	$V_{sa,insert,eq,deck}$	lb (kN)	395 (1.8)	2,080 (9.3)	395 (1.8)	1,435 (6.4)	1,790 (8.0)	2,080 (9.3)	2,080 (9.3)	2,175 (9.7)	2,175 (9.7)0		1,905 (8.5)	
Reduction factor, concrete strength in tension		ϕ	-	0.60							0.60				

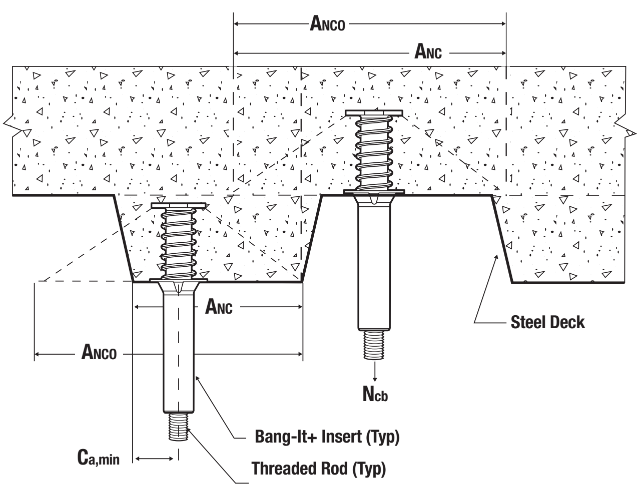
1. Concrete must have a compressive strength f 'c of 2,500 psi minimum. Installation must comply with published instructions.
2. Design of headed cast-in specialty inserts shall be in accordance with the provisions of ACI 318 (-19 or -14) Chapter 17 or ACI 318-11 Appendix D, as applicable, for cast-in headed anchors. Concrete breakout strength must also be in accordance with steel deck figures, as applicable.
3. Strength reduction factors for the inserts shall be taken from ACI 318-19 17.5.3, 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 (-19 or -14) 5.3 or ACI 318-11 9.2, as applicable, governed by steel strength of the insert are tabulated. Strength reduction values correspond to brittle steel elements. The value of ϕ applies when the load combinations of 2021 IBC Section 1605.1 or 2018, 2015 and 2012 IBC 1605.2, ACI 318 (-19 or -14) Section 5.3 or ACI 318-11 9.2, as applicable, are used in accordance with ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4.
4. Minimum spacing distance between anchors and minimum edge distances for cast-in headed anchors shall be in accordance with steel deck figures, as applicable and the installation tables for the inserts.
5. 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 for common threaded rod elements.
6. The tabulated seismic values for steel strength of the inserts are applicable to installations in the lower flute or upper flute of the indicated steel deck figures, as applicable.

Design Information for Bang-It+ Push-In Thread Inserts[1,2,3,4,5,6]

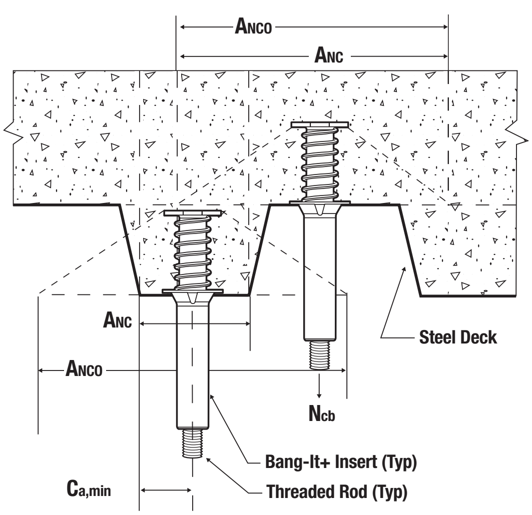
Design Information		Symbol	Units	1/4"	3/8"
Outside diameter of the steel insert body		d_a	in. (mm)	1.0 (25)	1.125 (29)
Insert head net bearing area		A_{brg}	in² (mm²)	2.0 (1290)	2.7 (1742)
Effective embedment depth		h_{ef}	in. (mm)	1.5 (38)	1.7 (43)
STEEL STRENGTH IN TENSION (ACI 318-19 17.6.1, ACI 318-14 17.4.1 or ACI 318-11 D.5.1)					
According to Figures A, B & C	Steel strength in tension of single insert	$N_{sa,insert}$	lb (kN)	11,265 (50.1)	17,595 (78.3)
	Steel strength in tension of single insert, seismic	$N_{sa,insert,eq}$	lb (kN)	11,265 (50.1)	17,595 (78.3)
Reduction factor, steel strength in tension		ϕ	-	0.65	
CONCRETE BREAKOUT STRENGTH IN TENSION (ACI 318-19 17.6.2, ACI 318-14 17.4.2 or ACI 318-11 D.5.2)					
Effectiveness factor for cracked concrete		k_c	-	24 (for SI use a value of 10)	
Modification factor for uncracked concrete		$\Psi_{C,N}$	-	1.25	
Reduction factor, concrete strength in tension		ϕ	-	0.70	
STEEL STRENGTH IN SHEAR (ACI 318-19 17.7.1, ACI 318-14 17.5.1 or ACI 318-11 D.6.1)					
According to Figure A	Steel strength in shear of single insert, in upper flute	$V_{sa,insert,deck}$	lb (kN)	3,305 (14.7)	6,900 (30.7)
	Steel strength in shear of single insert, in lower flute	$V_{sa,insert,deck}$	lb (kN)	2,295 (10.2)	3,045 (13.5)
	Steel strength in shear of single insert, seismic	$V_{sa,insert,eq,deck}$	lb (kN)	2,295 (10.2)	3,045 (13.5)
According to Figures B & C	Steel strength in shear of single insert, in upper flute	$V_{sa,insert,deck}$	lb (kN)	3,305 (14.7)	6,900 (30.7)
	Steel strength in shear of single insert, in lower flute	$V_{sa,insert,deck}$	lb (kN)	2,295 (10.2)	2,535 (11.3)
	Steel strength in shear of single insert, seismic	$V_{sa,insert,eq,deck}$	lb (kN)	2,295 (10.2)	2,535 (11.3)
Reduction factor, concrete strength in tension		ϕ	-	0.60	

1. Concrete must have a compressive strength f 'c of 2,500 psi minimum. Installation must comply with published instructions.
2. Design of headed cast-in specialty inserts shall be in accordance with the provisions of ACI 318 (-19 or -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 steel deck figures, as applicable.
3. Strength reduction factors for the inserts shall be taken from ACI 318-19 17.5.3, 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 (-19 or -14) 5.3 or ACI 318-11 9.2, as applicable, governed by steel strength of the insert are tabulated. Strength reduction values correspond to brittle steel elements. The value of ϕ applies when the load combinations of 2021 IBC Section 1605.1 or 2018, 2015 and 2012 IBC 1605.2, ACI 318 (-19 or -14) Section 5.3 or ACI 318-11 9.2, as applicable, are used in accordance with ACI 318-19 Section 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4.
4. Minimum spacing distance between anchors and minimum edge distances for cast-in headed anchors shall be in accordance with steel deck figures, as applicable and the installation tables for the inserts.
5. 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 for common threaded rod elements.
6. The tabulated seismic values for steel strength of the inserts are applicable to installations in the lower flute or upper flute of the indicated steel deck figures, as applicable..

Idealization of Concrete Filled Steel Decks for Determination of Concrete Breakout Strength in Accordance with ACI 318



Idealization of Standard 'W' Steel Deck Profiles



Idealization of 'B' Steel Deck Profiles

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[4]	Reduction Of Area Min. Percent	Related Nut Specification[5]
Carbon Steel	ASTM A36/A36M or ASTM F1554 Grade 36	psi (MPa)	58,000 (400)	36,000 (248)	1.61	23	40 (50 for A36)	ASTM A194 / A563 Grade A
	ASTM A193/A193M[3] Grade B7	psi (MPa)	125,000 (860)	105,000 (720)	1.19	16	50	ASTM A194 / A563 Grade DH

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 Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications.
4. Based on 2-inch (50 mm) gauge length except for ASTM A36/A36M and ASTM A193, which are based on a gauge length of 4d (d_{rod}).
5. 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)
Steel strength in tension of threaded rod	ASTM A36 or ASTM F1554, Grade 36	$N_{sa,rod,A36}$	lb (kN)	1,855 (8.2)	4,525 (20.0)	8,235 (36.6)	13,110 (58.3)	19,430 (86.3)
Steel strength in tension of threaded rod, seismic		$N_{sa,rod,eq,A36}$	lb (kN)	1,855 (8.2)	4,525 (20.0)	8,235 (36.6)	13,110 (58.3)	19,430 (86.4)
Steel strength in tension of threaded rod	ASTM A193, Gr. B7	$N_{sa,rod,B7}$	lb (kN)	4,000 (17.7)	9,750 (43.1)	17,750 (78.9)	28,250 (125.7)	41,875 (186.0)
Steel strength in tension of threaded rod, seismic		$N_{sa,rod,eq,B7}$	lb (kN)	4,000 (17.7)	9,750 (43.1)	17,750 (78.9)	28,250 (125.7)	41,875 (186.0)
Reduction factor, steel strength in tension		ϕ	-	0.75				
Steel strength in shear of threaded	ASTM A36 or ASTM F1554, Grade 36	$V_{sa,rod,A36}$	lb (kN)	1,115 (4.9)	2,715 (12.1)	4,940 (22.0)	7,865 (35.0)	11,660 (51.9)
Steel strength in shear of threaded rod, seismic		$V_{sa,rod,eq,A36}$	lb (kN)	780 (3.5)	1,900 (8.4)	3,460 (15.4)	5,505 (24.5)	8,160 (36.3)
Steel strength in shear of threaded rod	ASTM A193, Gr. B7	$V_{sa,rod,B7}$	lb (kN)	2,385 (10.6)	5,815 (25.9)	10,640 (7.3)	16,950 (75.4)	25,085 (111.6)
Steel strength in shear of threaded rod, seismic		$V_{sa,rod,eq,B7}$	lb (kN)	1,680 (7.5)	4,095 (18.2)	7,455 (34.2)	11,865 (52.8)	17,590 (78.2)
Reduction factor, steel strength in tension		ϕ	-	0.65				

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 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3 for steel elements. Condition B is assumed. Strength reduction factors for load combinations in accordance with ACI 318 (-19 or -14) Section 5.3 or ACI 318-11 Section 9.2 governed by steel strength of the threaded rod are taken as 0.75 for tension and 0.65 for shear; values correspond to ductile steel elements. The value of ø applies when the load combinations of IBC Section 1605.2, ACI 318 (-19 or -14) Section 5.3 or ACI 318-11 Section 9.2 are used in accordance with ACI 318-19 17.5.3, 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, then the appropriate value of ø must be determined in accordance with ACI 318-11 D4.4.

DESIGN STRENGTH TABLES (SD)

Tension and Shear Design Strengths for Bang-It+ Single Thread Inserts Installed in the Soffit of Uncracked Concrete Filled Steel Deck Floor and Roof Assemblies[1,2,3,4,5]

Nominal Anchor Diameter (in.)	Embed. Depth h_{ef} (in.)	Minimum Concrete Compressive Strength											
		f'c = 3,000 psi											
		4-1/2" W-Deck (Figure A)				B-Deck (Figure B)				3-7/8" W-Deck (Figure C)			
		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+ Single Thread Inserts Installed in the Soffit of Cracked Concrete Filled Steel Deck Floor and Roof Assemblies[1,2,3,4,5,6]

Nominal Anchor Diameter (in.)	Embed. Depth h_{ef} (in.)	Minimum Concrete Compressive Strength											
		f'c = 3,000 psi											
		4-1/2" W-Deck (Figure A)				B-Deck (Figure B)				3-7/8" W-Deck (Figure C)			
		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:
- No edge distance influence with $\Psi_{ed,N} = 1.0$ in tension for upper flute anchors. .
- No edge distance ($c_{a1} \geq 3h_{ef}$) or corner distance influence ($c_{a2} \geq 1.5c_{a1}$) for upper flute anchors in shear. Shear loads may be applied in any direction.

2- Calculations were performed following methodology in ACI 318 (19 or -14) Chapter 17 or 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 shall be taken from ACI 318-19 17.5.3, ACI 318-14 17.3.3 or 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 (19 or -14) Section 5.3 or ACI 318-11 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.Tabular values are permitted for short-term static loads only, seismic loading is not considered with these tables.

4- For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318 (19 or -14) Chapter 17 or ACI 318-11 Appendix D.

5- Interpolation is not permitted to be used with the tabular values. For intermediate base material compressive strengths please see ACI 318 (19 or -14) Chapter 17 or ACI 318-11 Appendix D and information contained in this product supplement. For other design conditions including seismic considerations please see ACI 318 (19 or -14) Chapter 17 or ACI 318-11 Appendix D.

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

Tension and Shear Design Strengths Installed for Bang-It+ Multi Thread Inserts Installed in the Soffit of Uncracked Concrete Filled Steel Deck Floor and Roof Assemblies[1,2,3,4,5]

Nominal Anchor Diameter (in.)	Embed. Depth hef (in.)	Minimum Concrete Compressive Strength											
		f'c = 3,000 psi											
		4-1/2" W-Deck (Figure A)				B-Deck (Figure B)				3-7/8" W-Deck (Figure C)			
		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" (1/4 - 3/8" Multi)	1-3/4	1,275	1,000	1,275	700	1,275	1,000	595	700	1,275	1,000	1,145	700
3/8" (1/4 - 3/8" Multi)	1-3/4	2,265	1,370	1,340	1,370	2,265	1,370	595	1,250	2,265	1,370	1,145	1,250
3/8" (3/8 - 1/2" Multi)	1-3/4	2,265	1,425	1,340	1,250	2,265	1,425	595	1,250	2,265	1,425	1,145	1,250
1/2" (3/8 - 1/2" Multi)	1-3/4	2,265	2,500	1,340	1,370	2,265	2,500	595	1,250	2,265	2,500	1,145	1,250
1/4" (1/4 - 3/8 - 1/2" Multi)	1-3/4	2,265	1,000	1,340	765	2,265	1,000	595	765	2,265	1,000	1,145	765
3/8" (1/4 - 3/8 - 1/2" Multi)	1-3/4	2,265	2,125	1,340	1,240	2,265	2,125	595	860	2,265	2,125	1,145	860
1/2" (1/4 - 3/8 - 1/2" Multi)	1-3/4	2,265	2,500	1,340	1,240	2,265	2,500	595	1,075	2,265	2,500	1,145	1,075
3/8" (3/8 - 1/2 - 5/8" Multi)	2-1/4	3,300	2,925	1,760	1,510	3,300	1,305	655	1,305	3,300	2,925	1,450	1,305
1/2" (3/8 - 1/2 - 5/8" Multi)	2-1/4	3,300	4,855	1,760	1,510	3,300	1,305	655	1,305	3,300	4,855	1,450	1,305
5/8" (3/8 - 1/2 - 5/8" Multi)	2-1/4	3,300	4,855	1,760	1,510	3,300	1,305	655	1,305	3,300	4,855	1,450	1,305
5/8" (5/8 - 3/4" Multi)	2-1/4	3,300	3,370	1,760	1,825	3,300	1,145	655	1,145	3,300	3,370	1,450	1,145
3/4" (5/8 - 3/4" Multi)	2-1/4	3,300	3,885	1,760	1,825	3,300	1,145	655	1,145	3,300	3,885	1,450	1,145

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

Tension and Shear Design Strengths Installed for Bang-It+ Multi Thread Inserts Installed in the Soffit of Cracked Concrete Filled Steel Deck Floor and Roof Assemblies[1,2,3,4,5,6]

Nominal Anchor Diameter (in.)	Embed. Depth hef (in.)	Minimum Concrete Compressive Strength											
		f'c = 3,000 psi											
		4-1/2" W-Deck (Figure A)				B-Deck (Figure B)				3-7/8" W-Deck (Figure C)			
		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" (1/4 - 3/8" Multi)	1-3/4	1,275	1,000	1,070	700	1,275	1,000	475	700	1,275	1,000	915	700
3/8" (1/4 - 3/8" Multi)	1-3/4	1,810	1,370	1,070	1,370	1,810	1,370	475	1,250	1,810	1,370	915	1,250
3/8" (3/8 - 1/2" Multi)	1-3/4	1,810	1,425	1,070	1,250	1,810	1,425	475	1,250	1,810	1,425	915	1,250
1/2" (3/8 - 1/2" Multi)	1-3/4	1,810	2,500	1,070	1,370	1,810	2,500	475	1,250	1,810	2,500	915	1,250
1/4" (1/4 - 3/8 - 1/2" Multi)	1-3/4	1,810	1,000	1,070	765	1,810	1,000	475	765	1,810	1,000	915	765
3/8" (1/4 - 3/8 - 1/2" Multi)	1-3/4	1,810	2,125	1,070	1,240	1,810	2,125	475	860	1,810	2,125	915	860
1/2" (1/4 - 3/8 - 1/2" Multi)	1-3/4	1,810	2,500	1,070	1,240	1,810	2,500	475	1,075	1,810	2,500	915	1,075
3/8" (3/8 - 1/2 - 5/8" Multi)	2-1/4	2,640	2,925	1,410	1,510	2,640	1,305	525	1,305	2,640	2,925	1,160	1,305
1/2" (3/8 - 1/2 - 5/8" Multi)	2-1/4	2,640	4,855	1,410	1,510	2,640	1,305	525	1,305	2,640	4,855	1,160	1,305
5/8" (3/8 - 1/2 - 5/8" Multi)	2-1/4	2,640	4,855	1,410	1,510	2,640	1,305	525	1,305	2,640	4,855	1,160	1,305
5/8" (5/8 - 3/4" Multi)	2-1/4	2,640	3,370	1,410	1,825	2,640	1,145	525	1,145	2,640	3,370	1,160	1,145
3/4" (5/8 - 3/4" Multi)	2-1/4	2,640	3,885	1,410	1,825	2,640	1,145	525	1,145	2,640	3,885	1,160	1,145

- 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:
 - No edge distance influence with $\Psi_{ed,N} = 1.0$ in tension for upper flute anchors. .
 - No edge distance ($c_{a1} \geq 3h_{ef}$) or corner distance influence ($c_{a2} \geq 1.5c_{a1}$) for upper flute anchors in shear. Shear loads may be applied in any direction.

2- Calculations were performed following methodology in ACI 318 (19 or -14) Chapter 17 or 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 shall be taken from ACI 318-19 17.5.3, ACI 318-14 17.3.3 or 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 (19 or -14) Section 5.3 or ACI 318-11 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.Tabular values are permitted for short-term static loads only, seismic loading is not considered with these tables.

4- For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318 (19 or -14) Chapter 17 or ACI 318-11 Appendix D.

5- Interpolation is not permitted to be used with the tabular values. For intermediate base material compressive strengths please see ACI 318 (19 or -14) Chapter 17 or ACI 318-11 Appendix D and information contained in this product supplement. For other design conditions including seismic considerations please see ACI 318 (19 or -14) Chapter 17 or ACI 318-11 Appendix D.

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

Tension and Shear Design Strengths Installed for Bang-It+ Push-In Thread Inserts Installed in the Soffit of Uncracked Concrete Filled Steel Deck Floor and Roof Assemblies[1,2,3,4,5]

Nominal Anchor Diameter (in.)	Embed. Depth hef (in.)	Minimum Concrete Compressive Strength f'c = 3,000 psi											
		4-1/2" W-Deck (Figure A)				B-Deck (Figure B)				3-7/8" W-Deck (Figure C)			
		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.)
Push-In 3/8"	1.50	1,795	1,985	1,145	1,375	1,795	1,375	560	1,375	1,795	1,985	960	1,375
Push-In 1/2"	1.70	2,165	4,140	1,300	1,825	2,165	1,520	585	1,520	2,165	4,140	1,105	1,520

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

Tension and Shear Design Strengths Installed for Bang-It+ Push-In Thread Inserts Installed in the Soffit of Cracked Concrete Filled Steel Deck Floor and Roof Assemblies[1,2,3,4,5,6]

Nominal Anchor Diameter (in.)	Embed. Depth hef (in.)	Minimum Concrete Compressive Strength f'c = 3,000 psi											
		4-1/2" W-Deck (Figure A)				B-Deck (Figure B)				3-7/8" W-Deck (Figure C)			
		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.)
Push-In 3/8"	1.50	1,435	1,985	915	1,375	1,435	1,375	445	1,375	1,435	1,985	765	1,375
Push-In 1/2"	1.70	1,735	4,140	1,040	1,825	1,735	1,520	470	1,520	1,735	4,140	885	1,520

□ - 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:
- No edge distance influence with $\Psi_{ed,N} = 1.0$ in tension for upper flute anchors. .
- No edge distance ($c_{a1} \geq 3h_{ef}$) or corner distance influence ($c_{a2} \geq 1.5c_{a1}$) for upper flute anchors in shear. Shear loads may be applied in any direction.

2- Calculations were performed following methodology in ACI 318 (19 or -14) Chapter 17 or 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 shall be taken from ACI 318-19 17.5.3, ACI 318-14 17.3.3 or 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 (19 or -14) Section 5.3 or ACI 318-11 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.Tabular values are permitted for short-term static loads only, seismic loading is not considered with these tables.

4- For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318 (19 or -14) Chapter 17 or ACI 318-11 Appendix D.

5- Interpolation is not permitted to be used with the tabular values. For intermediate base material compressive strengths please see ACI 318 (19 or -14) Chapter 17 or ACI 318-11 Appendix D and information contained in this product supplement. For other design conditions including seismic considerations please see ACI 318 (19 or -14) Chapter 17 or ACI 318-11 Appendix D.

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

Tension and Shear Design Strength of Steel Elements (Steel Strength)[1,2,3,4]

Nominal Rod Diameter (in.)	Steel Elements - Threaded Rod			
	ASTM A36		ASTM A193 Grade B7	
	$\phi N_{sa,rod}$ 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 318-11 Appendix D and ACI 318 (-19 or -14) Chapter 17, $\phi N_{sa} = \phi \bullet A_{se,N} \bullet f_{uta}$
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 318-11 Appendix D and ACI 318 (-19 or -14) Chapter 17, $\phi V_{sa} = \phi \bullet 0.60 \bullet A_{se,N} \bullet f_{uta}$
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

Bang-It®+ Steel Deck Insert (UNC internal thread)

Cat. No.	Description	Color Code	Suggested Hole Size in Steel Deck	Pack Qty.
07540-PWR	1/4" Bang-It+	Brown	7/8"	100
07542-PWR	3/8" Bang-It+	Green	7/8"	100
07544-PWR	1/2" Bang-It+	Yellow	7/8"	100
07546-PWR	5/8" Bang-It+	Red	1-1/4"	50
07548-PWR	3/4" Bang-It+	Purple	1-1/4"	50
PFM3521438	1/4-3/8" Bang-It+ Multi	White	7/8"	100
07543-PWR	3/8-1/2" Bang-It+ Multi	Gray	7/8"	100
PFM353143812	1/4-3/8-1/2" Bang-It+ Multi	Aqua	7/8"	50
PFM353381258	3/8-1/2-5/8" Bang-It+ Multi	Orange	1-1/4"	50
PFM3525834	5/8-3/4" Bang-It+ Multi	Black	1-1/4"	50
PFM3610038	3/8" Bang-It+ Push-In	Green	1-1/4"	50
PFM3610012	1/2" Bang-It+ Push-In	Yellow	1-1/4"	50

Inserts are color coded to easily identify location, type and sizes of the internal diameters.

Bang-It®+ Installation Accessories and Tools

Cat.No.	Description	Pack Qty.
DCD996P2	20V Max XR Lithium Ion Cordless Drill Driver Kit (5.0Ah)	1
PFM3611000	Bang-It+ Deck Driller Extension 28" (Use with 1/2" Drill Driver)	1
1779804	5L Arbor, 3/8" Solid Hex Shank	1
1779801	2L Arbor, 1/2" Solid Hex Shank	1
2009314CHC	Carbide Hole Cutter Bit 7/8" (use 5L Arbor, not included)	1
2009820CHC	Carbide Hole Cutter Bit 1-1/4" (use 2L Arbor, not included)	1
30912VB12	Vari-Bit Step Drill Bit 7/8", 1-1/8", 1-7/32", 1-1/4", 1-3/8"	1
PFM3613000	Bang-It+ Bridge Bar	20
PFM3613001	Bang-It+ Bridge Bar (packaged with screws)	20

Bang-It+ Bridge Bar nominal size is 2" wide x 12" long, 14 gauge thickness.

Push-In Thread Couplers

Cat. No.	Description	Pack Qty.
PFM3613038	3/8"-16 Coupler Push-In	20
PFM3613012	1/2"-13 Coupler Push-In	20

Push-In thread couplers have one end that does not require turning threaded rod elements during installation which can be ideal for applications such as mounting prefabricated hardware and hanger assemblies.

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"). 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 insert plate 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 Systems

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
+ Provides consistent uniform drop lengths below floor decks in every installation position

APPROVALS AND LISTINGS

- International Code Council, Evaluation Service (ICC-ES), ESR-3958 for concrete-filled metal decks
- Tested and qualified in accordance with ICC-ES AC446 for use in concrete-filled metal decks under the design provisions of ACI 318 (-19 or -14) Chapter 17 or ACI 318-11 (Appendix D)
- Code compliant with the 2021 IBC/IRC, 2018 IBC/IRC, 2015 IBC/IRC and 2012 IBC/IRC
- Underwriters Laboratories (UL Listed) - File No. EX1289, see listing for sizes
- FM Approvals (Factory Mutual) – see listing for sizes

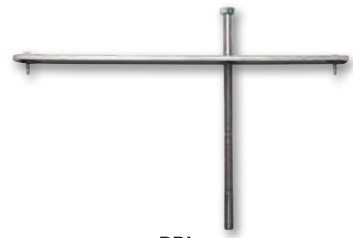
GUIDE SPECIFICATIONS

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. Anchor inserts shall be installed in accordance with published instructions and the Authority Having Jurisdiction.

MATERIAL SPECIFICATIONS

Anchor Component	Component Material
Metal Plate	ASTM A1011 Carbon Steel or equivalent (plain)
Hex Head Bolt	ASTM A307 Grade A (zinc plated)

SECTION CONTENTS



DDI+

THREAD VERSION

- UNC Thread

ANCHOR MATERIALS

Plain and zinc plated carbon steel

ANCHOR SIZE RANGE

- 3/8" through 7/8" diameters

SUITABLE BASE MATERIALS

- Normal-weight concrete or lightweight concrete filled metal deck assemblies

CODE LISTED
ICC-ES ESR-3958
CONCRETE

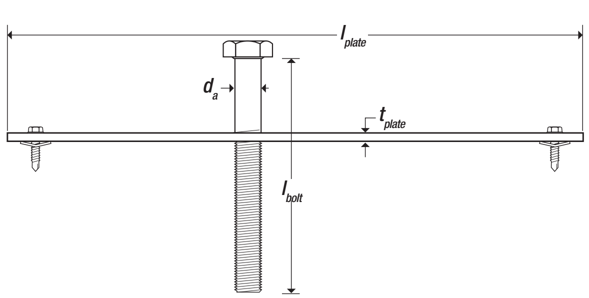
INSTALLATION SPECIFICATIONS

DDI+ Insert Installation Information and Supplemental Information[1,2]

Design Information		Notation	Units	3/8-inch	1/2-inch	5/8-inch	3/4-inch	7/8-inch
Nominal bolt diameter		d_a	in. (mm)	0.375 (9.5)	0.500 (12.7)	0.625 (15.9)	0.750 (19.1)	0.875 (22.2)
Bolt thread size (UNC)		-	in.	3/8-16	1/2-13	5/8-11	3/4-10	7/8-9
Length of insert bolt		ℓ_{bolt}	in (mm)	8 (203)	8 (203)	8 (203)	8 (203)	8 (203)
Typical drill bit diameter for deck		d_{bit}	in.	7/16 or 1/2	9/16 or 5/8	11/16 or 3/4	13/16 or 7/8	15/16 or 1
Nominal overall length of insert plate		ℓ_{plate}	in.² (mm²)	12 (305)	12 (305)	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)	2 (51)	2 (51)
Approximate thickness of insert plate		t_{plate}	in. (mm)	3/16 (4.8)	3/16 (4.8)	3/16 (4.8)	3/8 (9.5)	3/8 (9.5)
Minimum nominal embedment depth	Over upper flute	$h_{nom\ (upperflute)}$	in. (mm)	1-3/4 (45)	2 (51)	2-3/8 (60)	2-5/8 (67)	2-5/8 (67)
	Over flute incline	$h_{nom\ (upperincline)}$						
	Over lower flute	$h_{nom\ (lowerflute)}$						
Minimum effective embedment depth	Over upper flute	$h_{ef\ (upperflute)}$	in. (mm)	1.50 (38)	1.75 (45)	2.00 (51)	2.20 (56)	2.05 (52)
	Over flute incline	$h_{ef\ (upperincline)}$						
	Over lower flute	$h_{ef\ (lowerflute)}$						
Minimum concrete member thickness (topping thickness)	Over upper flute	$h_{min\ (upperflute)}$	in. (mm)	2 (51)	2-1/2 (64)	3 (76)	3-1/4 (83)	3-1/4 (83)
	Over flute incline	$h_{min\ (upperincline)}$						
	Over lower flute	$h_{min\ (lowerflute)}$						
Minimum flute edge distance (insert bolt)	Over upper flute	$c_{min,deck\ (upperflute)}$	in. (mm)	N/A	N/A	N/A	N/A	N/A
	Over flute incline	$c_{min,deck\ (upperincline)}$						
	Over lower flute	$c_{min,deck\ (lowerflute)}$	in. (mm)	See Figure C	See Figure C	See Figure C	See Figure C	See Figure C
Minimum spacing distance (bolt spacing, center-to-center)	Over upper flute	$s_{min\ (upperflute)}$	in. (mm)	1-1/2 (38)	2 (51)	2-1/2 (64)	3 (76)	3-1/2 (89)
	Over flute incline	$s_{min\ (upperincline)}$	in. (mm)	4-1/2 (114)	5-1/4 (133)	6 (152)	6-5/8 (168)	6-5/8 (168)
	Over lower flute	$s_{min\ (lowerflute)}$						
Minimum deck end distance	Over upper flute	$c_{min\ (upperflute)}$	in. (mm)	Specified cover requirements for reinforcement in accordance with AC318-19 17.9.2(a), ACI 318-14 17.7.2 or ACI 318-11 7.7, as applicable. 4d_a can be considered as a guideline if specified cover requirements are not provided and/or available.				
	Over flute incline	$c_{min\ (upperincline)}$						
	Over lower flute	$c_{min\ (lowerflute)}$						
Approx. Thread Projection (through 3-inch-deep deck)	Over Upper Flute	-	in.	6-1/4	6	5-5/8	5-3/8	5-3/8
	Over Lower Flute			3-1/4	3	2-5/8	2-3/8	2-3/8
Effective tensile stress area (insert bolt)		A_{se}	in.² (mm²)	0.078 (50)	0.142 (92)	0.226 (146)	0.335 (212)	0.462 (293)
Insert head net bearing area		A_{brg}	in.² (mm²)	0.17 (110)	0.28 (181)	0.45 (290)	0.65 (419)	0.89 (574)
Minimum specified ultimate strength		f_{uta}	psi (N/mm²)	60,000 (400)				
Minimum specified yield strength		f_{ya}	psi (N/mm²)	36,000 (248)				

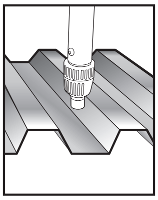
For SI: 1 inch = 25.4 mm, 1 ft-lb = 1.356 N-m
1. For installation detail for inserts in concrete-filled steel deck assemblies, see Figures A, B and C (i.e. over upper flute, over flute incline, over lower flute).
2. The insert plate is premouted with a #8-18 self-drilling screw with a #2 drill point (16 gauge max thickness).

DDI+ Insert Detail

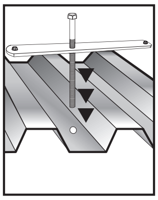


INSTALLATION INSTRUCTIONS

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 self-drilling screws.

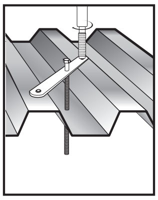


Figure A

DDI+ Concrete Inserts Installed Through the Soffit of Concrete-Filled Steel Deck Floor and Roof Assemblies (Over Upper Flute)[1,2,3]

SAND-LIGHTWEIGHT CONCRETE OR NORMAL-WEIGHT CONCRETE OVER STEEL DECK (MIN. 3,000 PSI)

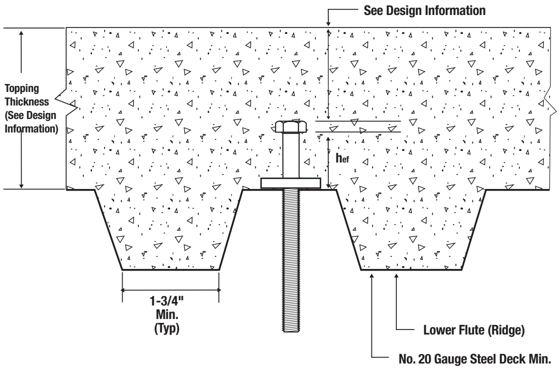


Figure B

DDI+ Concrete Inserts Installed Through the Soffit of Concrete-Filled Steel Deck Floor and Roof Assemblies (Over Flute Incline)[1,2,4]

SAND-LIGHTWEIGHT CONCRETE OR NORMAL-WEIGHT CONCRETE OVER STEEL DECK (MIN. 3,000 PSI)

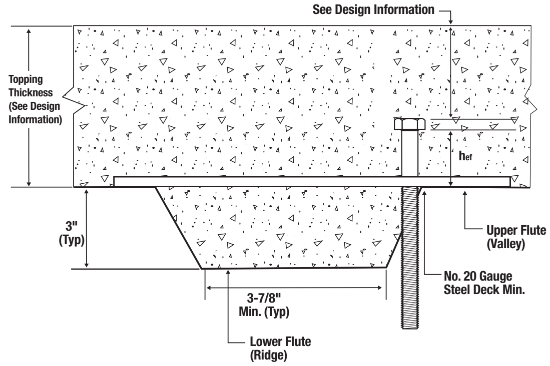
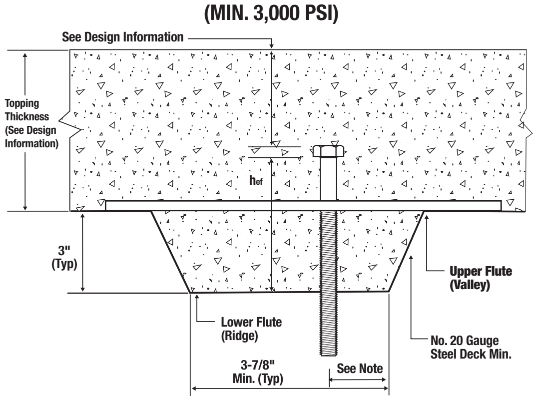


Figure C

DDI+ Concrete Inserts Installed Through the Soffit of Concrete-Filled Steel Deck Floor and Roof Assemblies (Over Lower Flute)[1,2,5]

SAND-LIGHTWEIGHT CONCRETE OR NORMAL-WEIGHT CONCRETE OVER STEEL DECK (MIN. 3,000 PSI)



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.

PERFORMANCE 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[1,2,3,4,5,6]

Nominal Anchor Diameter in.	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	6	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	7	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	6	8	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	8-3/4	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	8-3/4	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. Tabulated ultimate load values are for anchor inserts installed in uncracked concrete.
2. Allowable load capacities listed are calculated using an applied safety factor of 3.0
3. Nominal embedment depth is measured from the bottom of the insert plate to the top of the insert bolt head.
4. Insert spacing and end distances are measured from the centerline of the insert bolt head.
5. Shear loads may be applied in any direction.
6. For inserts installed over the upper flute and where shear loads act parallel to the flute, the tabulated allowable load valuesmay be increased by 20 percent (multiplied by 1.2).

UL Listings and FM Approvals for Supporting Fire Protection Services & Automatic Sprinkler Systems

Listing / Approval	DDI+ Threaded Concrete Inserts				
	3/8-inch	1/2-inch	5/8-inch	3/4-inch	7/8-inch
UL Max. Pipe Size	4"	8"	12"	12"	12"
FM Max. Pipe Size	4"	8"	12"	12"	-

Underwriters Laboratories (UL Listed) – File No. EX1289 and VFXT7.EX1289
FM Approvals (Factory Mutual)

STRENGTH DESIGN INFORMATION

CODE LISTED
ICC-ES ESR-3958

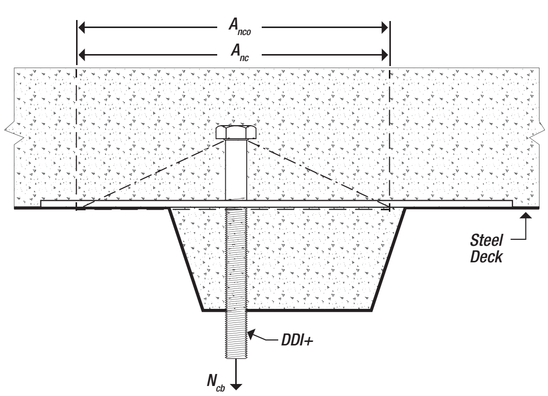
STRENGTH DESIGN TABLES SD

DDI+ Insert Design Information[1,2,3,4,5,6]

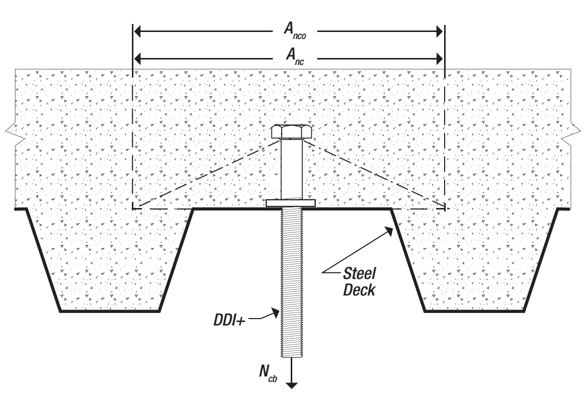
Design Information		Symbol	Units	3/8-inch	1/2-inch	5/8-inch
Insert O.D. (nominal bolt diameter)		d_a	in. (mm)	0.375 (9.5)	0.500 (12.7)	0.625 (15.9)
Insert head net bearing area		A_{brg}	in² (mm²)	0.17 (110)	0.28 (181)	0.45 (290)
Effective tensile stress area		A_{se}	in.² (mm²)	0.078 (50)	0.142 (92)	0.226 (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)				
	Over lower flute	h_{ef} (lowerflute)				
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 (-19 or -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 318-19 Section 17.5.3, 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 (-19 or -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 (-19 or -14) 5.3 or ACI 318-11 9.2, as applicable, are used in accordance with ACI 318-19 Section 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ 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 or over flute incline)



Idealization of Steel Deck Profile (over upper flute)

Idealization of Concrete Filled Steel Decks for Determination of Concrete Breakout Strength in Accordance with ACI 318

DESIGN STRENGTH TABLES (SD)

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 h_{ef} (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[1,2,3,4,5,6,7]

Insert O.D. (Nominal Bolt Diameter) (in.)	Embed. Depth h_{ef} (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 (-19 or -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 318-19 17.5.3, 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 (-19 and -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 static loads only, seismic loading is not considered with these tables.

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

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

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

Tension and Shear Design Strengths for DDI+ Inserts Installed in Uncracked Normal-Weight Concrete Filled Steel Deck and Roof Assemblies[1,2,3,4,5,6]

Insert O.D. (Nominal Bolt Diameter) (in.)	Embed. Depth h_{ef} (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	1-1/2	2,115	1,480	2,115	850	2,115	1,480
1/2	1-3/4	2,665	2,770	2,665	2,215	2,665	2,770
5/8	2	3,255	4,710	3,255	3,405	3,255	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 Normal-Weight Concrete Filled Steel Deck and Roof Assemblies[1,2,3,4,5,6,7]

Insert O.D. (Nominal Bolt Diameter) (in.)	Embed. Depth h_{ef} (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	1-1/2	1,690	1,480	1,690	850	1,690	1,480
1/2	1-3/4	2,130	2,770	2,130	2,215	2,130	2,770
5/8	2	2,605	4,710	2,605	3,405	2,605	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 normal-weight 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 (-19 or -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 318-19 17.5.3, 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 (-19 and -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 static loads only, seismic loading is not considered with these tables.

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

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

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

ORDERING INFORMATION

DDI+ (Deck Insert)

Cat. No.	Anchor Size	Rod/Anchor Dia.	Pack Qty.
PFM2511100	3/8" Metal Deck Insert	3/8"	20
PFM2511110	1/2" Metal Deck Insert	1/2"	20
PFM2511120	5/8" Metal Deck Insert	5/8"	20
PFM2511130	3/4" Metal Deck Insert	3/4"	12
PFM2511140	7/8" Metal Deck Insert	7/8"	12

DDI+ Installation Tools

Cat.No.	Description	Pack Qty.
DCD996P2	20V Max XR Lithium Ion Cordless Drill Driver Kit (5.0Ah)	1
PFM3611000	Deck Driller Extension 28" (Use with 1/2" Drill Driver)	1

Push-In Thread Couplers

Cat. No.	Description	Internal Thread Diameter	Pack Qty.
PFM3613038	3/8"-16 Coupler Push-In	3/8" to 3/8"	20
PFM3613012	1/2"-13 Coupler Push-In	1/2" to 1/2"	20
Push-In couplers have one end that does not require turning threaded rod elements during installation which can be ideal for applications such as mounting prefabricated hardware and hanger assemblies.			

DUST X+™

ANCHOR INSTALLATION SYSTEM

EXTRACTOR + ROTARY HAMMER + HOLLOW BIT + ANCHORS

OSHA COMPLIANT 1926.1153

DESIGNED TO FAST-TRACK ANCHOR INSTALLATION AND REDUCE DUST EXPOSURE.

Using the DEWALT Hollow Bit™ and dust extractor with SDS rotary hammers creates an OSHA-compliant (1926.1153) solution for dust control. The Hollow Bit™ simultaneously extracts dust to clean holes while drilling. For agility on the jobsite, go cordless with DEWALT's offering of battery-powered hammer drills, dust extractors and portable power stations.

DUST EXTRACTORS

DWV010 **8 Gallon HEPA/ RRP Dust Extractor**

DWV012 **10 Gallon Wet/Dry HEPA/RRP Dust Extractor**

DCV585 **60V MAX* Dust Extractor**

ROTARY HAMMERS

DCH416 **60V MAX* Brushless 1-1/4" SDS PLUS Rotary Hammer**

DCH614 **60V MAX* Brushless 1-3/4" SDS MAX Combination Rotary Hammer**

With respect to 60V MAX, Maximum initial battery voltage (measured without a workload) is 60 volts. Nominal voltage is 54.

DEWALT®

ANCHORS & FASTENERS

UP TO 70% TIME SAVINGS ON INITIAL HANGER PLACEMENT*

*vs. HangerWorks™ 2.0 Hanger Placement in Revit® Design Software

HangerWorks™ PRO

AUTOMATE HANGER PLACEMENT AND DESIGN FOR MEP SYSTEMS SUCH AS PIPE, DUCT, CONDUIT, AND CABLE TRAYS.

- PREFABRICATION SPOOLS
- AUTOMATED POINT LOADS & SEISMIC BRACING
- BILL OF MATERIALS
- FIELD LAYOUT POINTS
- CUSTOMIZABLE DESIGNS
- CLASH DETECTION
- ENGINEERING QUICK STAMPS

PLUG-IN FOR AUTODESK REVIT

GUARANTEED TOUGH.®

DEWALT®

ANCHORS & FASTENERS

VISIT **ANCHORS.DEWALT.COM** FOR:

DOWNLOADS | **TRAINING** | **SUPPORT** | **SOFTWARE**

ENGINEERING & PRODUCT SUPPORT
Call: 1-800-524-3244
Email: anchors@DEWALT.com

1-800-4 DEWALT®

www.DEWALT.com

DWTECHMAN22 10/22