WILLIAMS®
FORM ENGINEERING CORP.

High Capacity Concrete Anchor Systems

100 YEARS

No. 223u1

Using Williams Products

Readers of this catalog should independently verify the efficiency of any Williams products for the purpose intended by the user. The suitability of Williams products will depend upon field conditions, fabrications and user specifications which must be investigated and controlled by the user or its representatives. What follows are some suggestions for proper use of Williams products.

Proper Use is the Key

Williams Form Engineering Corporation provides a limited warranty on all of its products, as set forth in its quotations, acknowledgements and invoices furnished to each customer in connection with the sale of those products. Not withstanding this limited warranty, you should be aware that Williams products are intended for use by qualified and experienced workers. Serious accidents may result from misuse or improper supervision or inspection. Carefully field test any use not strictly conforming to normal practice before general adoption of the application. Carefully evaluate the product application, determine safe working loads and control all field conditions to prevent unsafe load applications. All safety factors shown are approximate, and in no case should they be exceeded.

IMPROPER USE OR INSTALLATION MAY RESULT IN SERIOUS INJURY OR DEATH. IF YOU HAVE THE SLIGHTEST DOUBT CONCERNING PROPER USE OR INSTALLATION, PLEASE CONSULT WITH OUR ENGINEERING DEPARTMENT.

You are Responsible for Any Modifications or Substitutions

Do not weld any casting, unless in the opinion of a qualified engineer such weld is in a no load, non-critical area. Welding causes carbides and extreme brittleness near the weld point, and destroys nearly all load value. Any welding or modifications to Williams products are the responsibility of the user, and as set forth in its limited warranty, Williams Form Engineering Corporation makes no representations or warranties concerning products altered, welded, bent or modified by others.

Many Williams products are manufactured, supplied and or designed as a system. Hence, we cannot guarantee that components from systems supplied by other manufacturers are interchangeable with our products. For best results, all parts of a system should consist of Williams products. From time to time, Williams Form Engineering Corporation may change product designs, safe working load ratings and product dimensions without prior notice to users. For the most current information concerning Williams products, please contact our engineering department, one of our technical representatives or see our web site.

Ongoing Inspection and Replacement are Essential

Each user should periodically inspect bolts and working hardware for wear and discard worn parts. Bent bolts, and bolts used at loads exceeding advertised yield strength should be discarded and replaced. A comprehensive inspection and replacement program should be instituted and followed, so that all bolts will be replaced after a predetermined number of uses, regardless of the apparent condition of the bolt.

All lifting hardware units displayed in this catalog are subject to wear, misuse, overloading, corrosion, deformation and other factors which may affect their safe working load. They should be regularly inspected to see if they may be used at the rated safe working load or removed from service. Frequency of inspection is dependent upon frequency and period of use, environment and other factors, and is best determined by an experienced user taking into account the actual conditions under which the hardware is used.

Ordering Procedure and Warranties

This catalog is intended to provide potential purchasers and users with general information about products offered by Williams Form Engineering Corporation. Prices, specifications, product descriptions and catalog items are subject to modification without prior notice. Any person desiring further information about products offered by Williams Form Engineering Corporation may contact the company or its authorized representatives. In appropriate cases, Williams will provide quotations for possible orders.

Because the contents of this catalog are intended for general information purposes, they are subject to change without notice. Any warranties for Williams products shall be governed by Williams quotations, acknowledgements and invoices furnished to customers in connection with the sale of Williams products, as these documents contain more detail than this catalog. Williams Form Engineering Corporation disclaims all other warranties for its products, expressed or implied, including IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, which might otherwise arise from the contents of this catalog.

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Technical Assistance

Let Williams help save you thousands of dollars in start up costs by acting as an on-site advisor during your anchor bolt installation.

Our technician will work directly with your superintendent and crews to see they are prepared in terms of equipment needs, material coordination, and efficient installation procedures to yield the best productivity possible.

Our technicians are trained in most types of anchoring conditions and can often trim days off the bolting schedule by recommending efficient procedures. Technicians may also prove to be very beneficial in consulting with the design engineer to propose any last minute design changes to accommodate field conditions. Even the simplest anchoring job could have delays for an inexperienced crew. Take advantage of our expertise and be prepared to keep your project on schedule.

*Advance notification is requested. Contact your nearest Williams Representative for fee schedules.

Types of Concrete Anchors

When to Use Williams

For decades Williams Form Engineering Corp. has gained a world-wide reputation as the one source that contractors, designers, and owners consistently turn to in solving their most complex needs for high capacity concrete anchors.

Williams supplies post-installed mechanical and chemical high capacity concrete anchors as well as cast-in-place anchors depending on application need and design parameters. You can count on Williams for your next project whether it's a retro fit need such as vibratory restraint, seismic upgrade or new construction projects such as bridges, buildings or power plants.

Mechanical Anchors

Williams mechanical anchors are often used when a post-installed prestressed anchor is needed to resist heavy or vibratory loading. Each anchor is prestressed (proof-loaded) to a load that does not exceed the published yield strength of the anchor rod. A "locked-in" prestress load provides a test to verify the holding capacity and also will protect the anchor against fatigue from cyclical loading situations. In addition, many of Williams mechanical anchors can be cement grouted to provide corrosion protection and also to help lock in the prestress load. Williams' mechanical anchors have been used for foundation repair, structural supports, seismic upgrades, bridge applications, building applications, power plants and equipment mounting anchors.

Bonded Anchors

Williams Form Engineering offers the best in epoxy concrete anchoring. Epoxy dowels are ideal for static loads, shear loads or applications that require close spacing and edge distances. Unlike mechanical anchors, epoxy anchors do not exert the lateral stress that a mechanical anchor would along a concrete drill hole surface. Epoxy anchors are capable of reaching high bond-stress values in relatively fast cure times.

Williams also supplies cement grout-bond, post-installed anchor systems. These anchors are less sensitive to temperature and cement grout can be pumped more ideally for longer length anchor embedments. Cement grout also offers an excellent barrier against corrosion.

Ultrabond HS-1CC

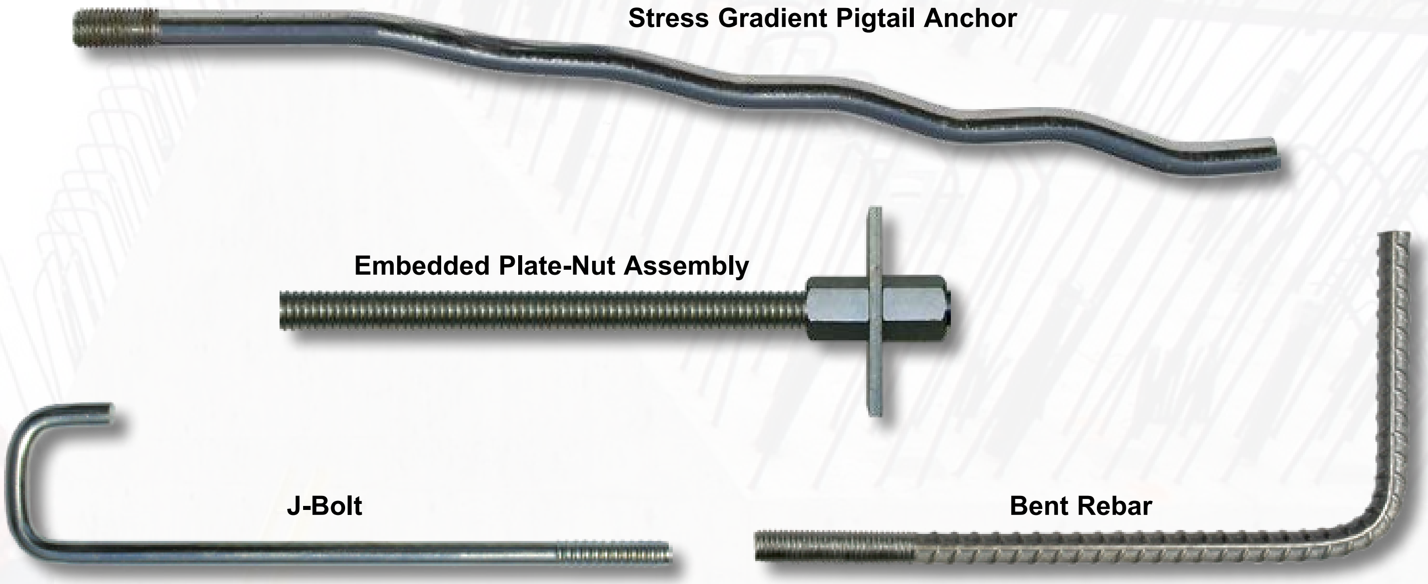
US Spec RA Grout

Wil-X Cement Grout

Types of Concrete Anchors

Cast-in-Place Anchors

Williams manufactures cast-in-place anchors with threaded bars up to 3-1/2” in diameter and stock lengths up to 50 feet. Williams can customize an anchor system for virtually any cast-in-place application. Williams can supply threaded bar with an embedded plate-nut assembly, Stress Gradient Pigtail Anchors, headed anchor studs and customized J, U and L bolts. Contact our engineering department for details not shown in this catalog.



Concrete Anchor Design

Concrete Anchor Design Models

In the past, Williams recommended the use of ACI 349 appendix B which utilized a “45° Cone Method” for designing concrete anchor systems. ACI 318 now has concrete breakout design methodology that was developed from the Concrete Capacity Design (CCD) Method. This applies to anchor diameters not exceeding 2-inches, and tensile embedments not exceeding 25-inches in depth. The CCD Method is an adaption of the κ Method and is considered to be accurate, easy to apply and capable of extension into irregular geometries. The κ Method defines the breakout strength calculations and the prism angle is approximately 35-degrees. The CCD Method predicts the load capacity of a single anchor or group of anchors, using a basic equation for tension and shear for a single anchor in cracked concrete. These load capacities are multiplied by modification factors that account for the number of anchors, edge distance, spacing, eccentricity and absence of cracking. The size and embedment depth limitations are based on the current range of test data and Williams recommends that designers use models that they are most comfortable with for anchor diameters greater than 2-inches in diameter and embedments exceeding 25-inches.

Concrete Anchor Testing

Williams has performed anchor tests spanning many years. Williams current capabilities allows testing deep embedded anchors in most configurations. Most deep embedded anchor testing has been conducted at Williams facilities.

Williams has supplied deep embedded concrete anchors for over 50 years and has gathered a vast amount of on-site testing, in house testing, and job experience related to the performance of large diameter concrete anchor products. Concrete anchor testing per ACI 355.2 is cost prohibitive for anchors in excess of 2-inches in diameter, as the space, concrete mass, equipment and experience are often not available. Please contact your Williams representative for guidance on deep embedded anchor systems.

ACI 318 - Anchoring to Concrete

Example of the ACI - Anchoring to Concrete - Post-Installed Anchors. Note: The following information is meant only as a quick reference. The reader should refer to ACI 318 Chapter 17 for complete information.

1) Definitions

A_{se} = Effective cross-sectional area of the anchor

f_{ya} = Yield stress of anchor bar

f_{uta} = Shall be taken as 125,000 psi or $1.9*f_{ya}$, whichever is less

h_{ef} = Anchor embedment depth

A_{Nco} = $9*h_{ef}^2$ = Maximum theoretical area of concrete available for breakout capacity at a given embedment depth Equation 17.4.2.1c

A_{Nc} = See R17.4.2.1, as breakout is dependent on concrete geometry, edge distance and group considerations (see page 15 this manual for additional information)

k_c = 17 for post-installed anchors and 24 for cast-in anchors

f_c = Compressive Strength of Concrete

Ψ_c = Modification factor for anchors located in a region of a concrete member where analysis indicates no cracking at service load levels = 1.25 for cast-in anchors and 1.40 for post-installed anchors

Ψ_{ec} = Modification factor for anchor groups loaded eccentrically in tension (shall not be taken greater than 1.0) Equations 17.4.2.4 (tension) and 17.5.2.5 (shear)

Ψ_{ed} = Modification factor for edge effects for single anchors or anchor groups loaded in tension Equations 17.4.2.5a and 17.4.2.5b (tension) and 17.5.2.6a and 17.5.2.6d (shear)

Ψ_{cp} = Modification factor for post-installed anchors designed for uncracked concrete, without supplementary reinforcement to control splitting - Equation 17.4.2.7a and 17.4.2.7b

Ψ_h = $\sqrt{\frac{(1.5*c_{a1})}{h_a}}$ Modification factor for anchors located in a concrete member where ($h_a < 1.5*c_{a1}$)

A_{Vc} = See R17.5.2.1b, projected area of single and group anchor based on concrete geometry, edge distance and group considerations

c_{a1} = Distance from center of the anchor to open face of concrete

A_{Vco} = $4.5*(c_{a1})^2$ Maximum theoretical area of concrete available for shear breakout at a given embedment depth Equation R17.5.2.1a

d_a = Anchor diameter

ACI 318 - Anchoring to Concrete

2) Anchor(s) in Tension

$N_{sa} = A_{se} * f_{uta}$ — Anchor nominal tensile strength - 17.4.1.2

$N_{cb} = \frac{A_{Nc}}{A_{Nco}} * \Psi_{ed} * \Psi_{c} * \Psi_{cp} * N_b$ — Single anchor breakout strength - 17.4.2.1a

$N_{cbg} = \frac{A_{Nc}}{A_{Nco}} * \Psi_{ec} * \Psi_{ed} * \Psi_{c} * \Psi_{cp} * N_b$ — Anchor group breakout strength - 17.4.2.1b

$N_b = k_c * \sqrt{f_c} * h_{ef}^{1.5}$ — Basic breakout strength of a single anchor in tension in cracked concrete 17.4.2.2a

3) Anchor(s) in Shear

$V_{sa} = 0.6 * A_{se} * f_{uta}$ — Anchor nominal shear strength - 17.5.1.2b

$V_{cb} = \frac{A_{Vc}}{A_{Vco}} * \Psi_{ed} * \Psi_{c} * \Psi_{h} * V_b$ — Single anchor shear strength - 17.5.2.1a

$V_{cbg} = \frac{A_{Vc}}{A_{Vco}} * \Psi_{ec} * \Psi_{ed} * \Psi_{c} * \Psi_{h} * V_b$ — Group anchor shear strength - 17.5.2.1b

V.b shall be the least of the follow two equations:

$V_b = \left[7 * \left(\frac{l_e}{d_a}\right)^{0.2} * \sqrt{d_a}\right] * \sqrt{f_c} * c_{a1}^{1.5}$ — Basic breakout strength of a single anchor in shear in cracked concrete 17.5.2.2a

OR

$V_b = 9 * \sqrt{f_c} * c_{a1}^{1.5}$ — 17.5.2.2b

$l_e = h_{ef}$ — for anchors with constant stiffness over the full length of the embedded section, such as post-installed anchors with a tubular shell from the top of the expansion shell to the top of concrete

$l_e = 2 * d_a$ — for torque-controlled expansion anchors with annular space between the drill hole wall and anchor rod from the top of the expanded cone and shell

$(l_e \leq 8 * d_a)$ — in all cases

$V_{cp} = k_{cp} * N_{cp}$ — $N_{cp} = N_{cb}$ Single Anchor Pryout Strength - 17.5.3.1a

$V_{cpg} = k_{cpg} * N_{cpg}$ — $N_{cpg} = N_{cbg}$ Group Anchor Pryout Strength - 17.5.3.1b

$\frac{N_{ua}}{\Phi N_n} + \frac{V_{ua}}{\Phi V_n} \leq 1.2$ — Interaction of tensile and shear forces - 17.6.3

Prestressed Concrete Anchors

Prestressed concrete anchors are often used for resisting cyclic or dynamic loading caused by wind or seismic events. They are also used to limit or restrict structural movement due to anchor steel elongation. Common applications for prestressed concrete anchors are tower anchoring, foundation repair, and heavy machinery tie down. Non-tensioned anchors or passive dowels are often used for temporary support, resisting shear loads, static loading, or for applications with low consequences of failure.

The prestressing of a concrete anchor is done by one of two methods. The preferred and most accurate way to prestress an anchor is to use a hollow ram hydraulic jack which couples directly to the end of the anchor with a pull rod assembly. The jack frame typically bears against the steel plate while the hydraulic ram transfers a direct tension load to the anchor. When the prestress load is reached, the anchor nut is turned tightly against the anchor bearing plate, and the load from the jack is released. The anchor nut prevents the steel from relaxing back to its original length, therefore, the anchor has been prestressed. Once the anchor is put into service, additional elongation in the anchor rod only occurs if the applied load exceeds the prestress load.

The second method of prestressing is to use a torque tension method. This is accomplished by simply turning the anchor nut against the anchor bearing plate with a torque wrench. By using a “torque tension relationship” provided by Williams, the installer can correlate the torque reading to a corresponding anchor tension load. Although not as accurate as direct tensioning, it is often used for fast, economical installations in areas where hydraulic jacks would be cumbersome or difficult to utilize. Torque tensioning is recommended to be done using a high-pressure lubricant on the anchor threads and under the hex nut to reduce frictional resistance.

Benefits of a Prestressed Anchor

Pre-tested - By prestressing an anchor, each bolt is essentially “pre-tested”, assuring it will hold its design load prior to final construction.

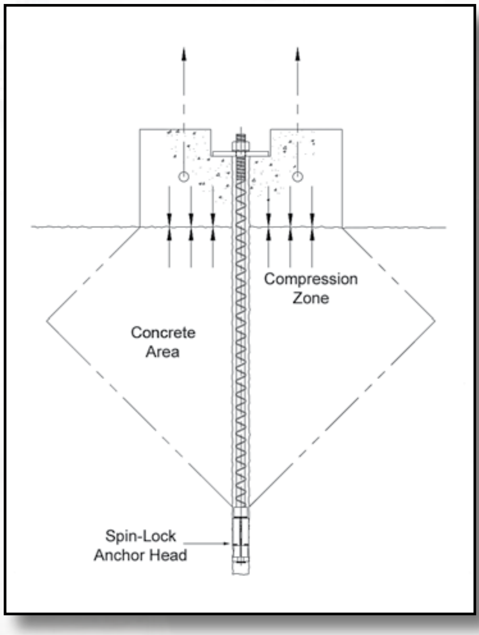
Eliminate Fatigue Stress - Fatigue failure is minimized since the service load must exceed the prestressed load of the bolt to cause additional steel elongation. Therefore, the periodic stretching and relaxing that causes fatigue failure is eliminated.

Eliminate Uplift - Prestressing can eliminate a “floating” condition of a foundation due to the natural hydraulic pressures or uplift loads caused by wind or other overturning moments.

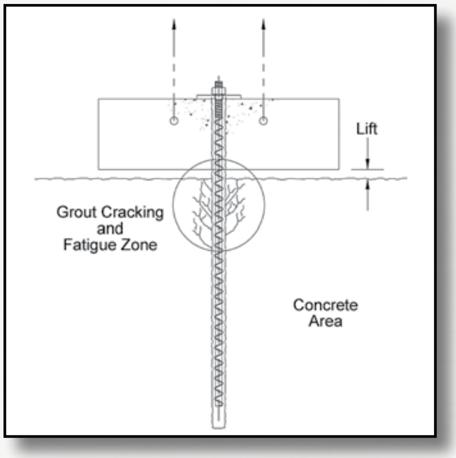
Negligible Bond Stress Relief - In cases where the concrete anchor free-stress length is grouted after prestress, the grout hardens around the deformations of the bar and bonds to the concrete in the drill hole to help prevent stress relief in the bolt.

Corrosion Protection - A prestressed concrete anchor will not elongate through the grout column in the free-stressing length. Elongation breaks down and cracks the grout, opening the door to corrosion and eventual failure. This is a common problem with passive or “non-tensioned” concrete dowels.

Prestressed Bolt



Dowel Bolt



Non-Tensioned Dowels May Produce the Following Effects:

Not Pre-Tensioned - Any application of load onto the bolt will cause the grout to crack in the first several inches of drill hole depth.

Floating Condition - Allows floating of foundation or uplift of the structure due to steel elongation.

Possible Fatigue Failure - Bolt can stretch and relax as the load varies.

Possible Corrosion Problem - Bolt elongation will crack protective grout cover.

Not Pre-Tested - The anchor holding capacity is not verified.

With a non-tensioned dowel, anchorage starts at the surface and actually breaks down and cracks the grout as the load transfers deeper along the length of the bolt. Over time the total anchorage may be lost due to these recurring grout breakdowns.

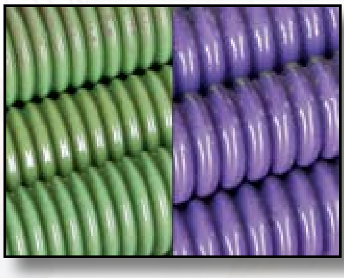
Corrosion Protection

Stainless Steel

Stainless steel can be specified for use with most of Williams anchors (except for Spin-Lock mechanical anchors). Williams can supply anchor rods and components in grades of 304 and 316 for use in highly corrosive environments. Stainless steel is the best means of corrosion protection available from Williams Form Engineering, however, steel strengths are often reduced and anchor prices are increased. When specifying stainless steel make sure to specify the steel grade and make note of the change in strengths from different stainless steel grades. Some stainless steel types require longer lead times.

Electro Zinc Plating

Zinc plating is a process which deposits a thin layer of zinc over the steel. It is different from galvanizing because zinc plating is an electro-chemical process and not a dip in molten zinc. The advantages of zinc plating over galvanizing are control over zinc thickness and smoother surfaces. The zinc protects the steel as a sacrificial coating. If the coating is damaged, the sacrificial action continues as long as any zinc remains in the immediate area. Electro zinc plating should be done in accordance with ASTM B633 Type II. Commercial zinc plating is commonly 0.0001 inches to 0.0005 inches in thickness and does not require oversized tapped components.



Epoxy Coating

Fusion bonded epoxy coating of steel bars to help prevent corrosion has been successfully employed in many applications because of the chemical stability of epoxy resins. Epoxy coated bars and fasteners should be done in accordance with ASTM A775 or ASTM A934. Epoxy coated bars and components are subject to damage if dragged on the ground or mishandled. Heavy plates and nuts are often galvanized even though the bar may be epoxy coated since they are difficult to protect against abrasion in the field. Epoxy coating patch kits are often used in the field for repairing nicked or scratched epoxy surfaces.

Hot Dip Galvanizing

Zinc serves as a sacrificial metal corroding preferentially to the steel. Galvanized bars have excellent bond characteristics to grout or concrete and do not require as much care in handling as epoxy coated bars. However, galvanization of anchor rods is more expensive than epoxy coating and often has greater lead time. Hot dip galvanizing bars and fasteners should be done in accordance with ASTM A153. Typical galvanized coating thickness for steel bars and components is between 3 and 4 mils. 150 KSI high strength steel bars shall require special cleaning procedures to avoid problems associated with hydrogen embrittlement in compliance with ASTM A143.

Cement Grout

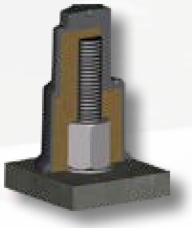
A contributing layer of corrosion protection for prestressed concrete anchors is complete encapsulation in cement grout of the steel tendon from the base of the concrete anchor to the anchorage. Portland cement grouts are alkaline in nature, render encased steel into a passive state, and eliminate any contact with the steel to air or water. Intelligent design, followed by thorough grouting operations performed by trained technicians provides a competent layer of corrosion protection for Williams prestressed concrete anchors. Cement grout should not be considered a contributing means of corrosion protection if used with a passive concrete anchor application as the grout will be prone to cracking when elongation occurs due to the dynamic loading of the passive anchor.

Williams recommends a portland cement based, shrinkage compensated, or expansive grout as the cement grout corrosion protection for prestressed concrete anchor applications. Grout should be injected after prestress forces are locked off by the use of grout tubes, de-air holes, or grout attachments to fill the remaining drill hole annulus around Williams concrete anchors.

End Caps

Williams offers several different types of end caps to provide corrosion protection at otherwise exposed anchor ends. Most often the caps are packed with corrosion inhibiting grease. Caps made from steel are used in exposed impact areas.

Screw-on Fiber Reinforced Nylon Cap

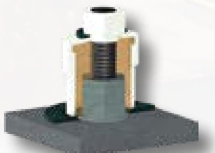


Steel Tube welded on Flange with Threaded Screw Connections

Steel Tube with Jam Nut

Screw-on PVC Cap

Slip-on PVC Cap w/ Plastic Nut



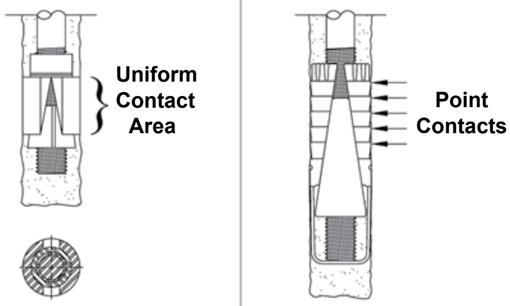
Introduction

Williams Spin-Lock anchors were first used in the 1950's for rock/roof bolting in projects such as NORAD and Australia's Snowy Mountain Power Facility. Since then many engineers, contractors and owners have recognized the advantages of the Spin-Lock anchor system as a high capacity concrete anchor. Spin-Locks have been used successfully on rocket launch pads, nuclear power plants, large dams and spillways, tower anchors, roller coasters and several other applications requiring high capacity and dynamic load resistant concrete anchor systems. Williams Spin-Lock anchors provide the advantages of immediate anchorage, prestressing/post-tension abilities, anchorage redundancy (mechanical anchorage with a grout bond), custom manufacturing, and the highest capacities of any production mechanical anchor available today.

To comply with the need for anchors which can be used in a variety of applications with a wide range of loading capabilities… Williams has developed a complete family of concrete anchor bolts with a simple and efficient system of installation. Williams also offers a line of rental equipment for installing, testing and grouting of Spin-Lock high capacity concrete anchors.

Before proceeding with your next project, consult with a design agency familiar with Williams anchor systems, or contact your nearest Williams representative. Williams would be pleased to recommend an ideal system to meet the needs of your next application.

Comparison Proves

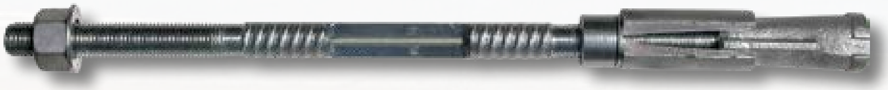
Williams Spin-Lock Anchor	Serrated Anchor by Others
	
Expansion shell receives full bearing support from solid 300° cone design.	Quartered cone design leaves expansion shell unsupported at adjacent gaps. Shell can collapse under high stress.

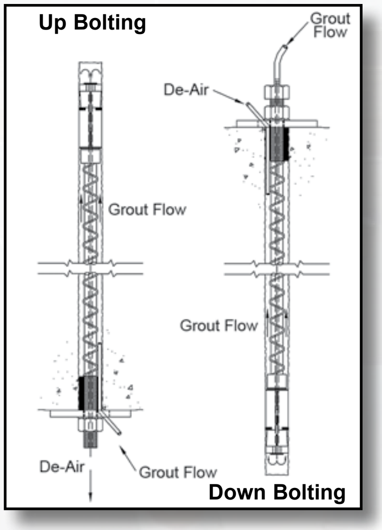
Spin-Lock Advantages

- **The mechanical head allows for a prestressed anchor which prevents anchor fatigue failure in cyclic or dynamic loading applications.**
- **Anchors can be custom manufactured or mechanically coupled to any length.**
- **Each anchor is tested to the desired working load.**
- **Anchors can be grouted providing redundant anchorage, corrosion protection and the grout helps to lock in prestress values.**
- **The mechanical head provides a full 300° bearing area and opens parallel to the drill hole, avoiding point loading.**
- **Anchors can be designed continuously threaded for field adaptation.**
- **Williams has testing equipment and personnel that can work with an engineer for designs with unique applications, locations or patterns.**
- **A selection of anchor bars is available to fit nearly every design.**
- **Williams Form can recommend several installation contractors in the area of the anchor installation.**
- **High degree of dependability allows a factor of safety in accordance with ACI 318.**
- **The Spin-Lock has been used in construction for over 50 years.**

R1H & R7S Spin-Lock Concrete Anchors

R1H High Grade Hollow-Core Anchor **ASTM A615 Deformation Pattern**





Prestressable • Positive Grouting • Permanent

Through years of development Williams has produced and patented the Prestressable, Hollow-Core, Groutable Spin-Lock Concrete Anchoring Systems. The hollow-core allows the anchor to always be grouted from the lowest gravitational point. In an up-bolting situation, the grout is pumped in through the plastic grout tube and begins to fill the drill hole from the plate. The grout rises until the entire hole is filled and the grout returns through the hollow bar. In down grouting situations, the grout is pumped through the hollow bar and starts at the bottom of the hole. Grout rises and returns through the de-air tube when the hole is filled. Improperly or incomplete grouted anchors are subjected to relaxation and corrosion. Because the Spin-Lock head assembly provides 300° perimeter expansion anchorage and develops the full strength of the rod, the hollow-core concrete anchor may be prestressed to the desired load and tested prior to grouting. Unfortunately, the Hollow-Core rebar is not available from a domestic source.

R1H Structural Properties

Yield Stress	Ultimate Stress	Elongation in 2" (51 mm)	Reduction of Area
91 KSI (627 MPa)	124 KSI (854 MPa)	15% min	40% min

Diameter & Threads per Inch	Yield Strength (fy)	Ultimate Strength (fu)	Drill Hole Diameter (1)	Type Head Assembly	Torque (ft-lbs) To Expand Shell (2)	Torque (ft-lbs) On Nut for Tension (3)	Minimum Embedment (3000 PSI - f'c) (5)	Minimum Embedment (6500 PSI - f'c) (5)	Part Number
1" - 8 (25 mm)	48.6 kips (216 kN)	66.3 kips (294 kN)	1-3/4" (44 mm)	C 14	250 ft-lbs (450*)	400 ft-lbs	17" (432 mm)	13" (330 mm)	R1H08C14
1-3/8" - 8 (35 mm)	101 kips (451 kN)	138 kips (615 kN)	2-1/2" (65 mm)	B 20	750 ft-lbs (1200*)	Note (4)	28" (711 mm)	21" (533 mm)	R1H11B20
2" - 6 (51 mm)	221 kips (982 kN)	301 kips (1338 kN)	3-1/2" (89 mm)	C 28	1000 ft-lbs (2000*)	Note (4)	46" (1168 mm)	36" (914 mm)	R1H16C28

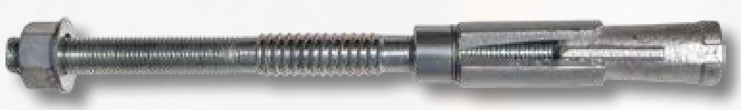
See notes at bottom

R7S 150 KSI Spin-Lock Concrete Anchor **ASTM A722**

The R7S Spin-Lock Concrete Anchor incorporates a high strength post-tension steel giving the designer the highest strength to anchor diameter ratio available for use with the Spin-Lock head assembly.

R7S Structural Properties

Yield Stress	Ultimate Stress	Elongation in 20 Bar Dia.	Reduction of Area
120 KSI (827 MPa)	150 KSI (1034 MPa)	4% min	20% min



Diameter & Threads per Inch	Yield Strength (fy)	Ultimate Strength (fu)	Drill Hole Diameter (1)	Type Head Assembly	Torque (ft-lbs) To Expand Shell (2)	Torque (ft-lbs) On Nut for Tension (3)	Minimum Embedment (3000 PSI - f'c) (5)	Minimum Embedment (6500 PSI - f'c) (5)	Part Number
1" - 8 (25 mm)	72.7 kips (324 kN)	90.9 kips (404 kN)	1-3/4" (44 mm)	C 14	500 ft-lbs (650*)	680 ft-lbs	17" (432 mm)	13" (330 mm)	R7S08C14
1-1/4" - 7 (32 mm)	116 kips (517 kN)	145 kips (646 kN)	2-1/2" (64 mm)	B 20	750 ft-lbs (1200*)	Note (4)	23" (584 mm)	18" (457 mm)	R7S10B20
1-1/2" - 6 (38 mm)	169 kips (750 kN)	210 kips (937 kN)	3" (76 mm)	B 24	1000 ft-lbs (1700*)	Note (4)	30" (762 mm)	23" (584 mm)	R7S12B24
1-7/8" - 8 (48 mm)	289 kips (1286 kN)	362 kips (1609 kN)	3-1/2" (89 mm)	C 28	1000 ft-lbs (2000*)	Note (4)	43" (1092 mm)	33" (838 mm)	R7S15C28

(*) Do not exceed these numbers
(1) Care should be taken to drill a straight and properly sized hole.
(2) More torque may be required on long anchors or if the head assembly is next to rebar. Consult your Williams Representative for more specific details.
(3) Torque value listed will achieve approximate load of 50% of the anchor ultimate strength, and is based on the torque tension curves on page 51.
(4) Stress to desired tensile load using a hollow ram hydraulic jack. Consult your Williams Representative.
(5) Full ultimate strength of anchor can be achieved at listed embedment depth, provided there are no edge or spacing effects on the anchor.

- Spin-Locks come standard with 12" of threaded area. Other lengths available upon request.
- WILLIAMS reserves the right to ship full length or coupled units as necessary.
- For Spin-Lock Accessories see page 41.

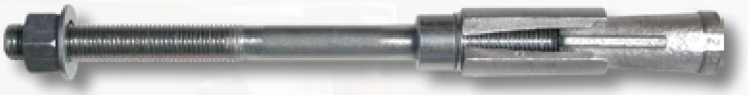
R1S & R1J Spin-Lock Concrete Anchors

R1S High Tensile Spin-Lock Concrete Anchor ASTM A108 Grade C1045

Williams R1S Spin-Lock Concrete Anchor utilizes an ASTM A108 Grade C1045 steel which provides high strength capacity and has the advantage of utilizing a more common steel for greater availability.

R1S Structural Properties

Diameter Range	Yield Stress	Ultimate Stress	Elongation in 2” Gauge Length	Reduction of Area
1/2” to 1” (13 to 25 mm)	92 KSI (634 MPa)	120 KSI (827 MPa)	11% min	20% min
1-1/8” and up (29 mm)	81 KSI (558 MPa)	105 KSI (723 MPa)	11% min	20% min



Meets strength of ASTM A325

Diameter & Threads per Inch	Yield Strength (fy)	Ultimate Strength (fu)	Drill Hole Diameter (1)	Type Head Assembly	Torque (ft-lbs)		Minimum Embedment (3000 PSI - f’c) (5)	Minimum Embedment (6500 PSI - f’c) (5)	Part Number
					To Expand Shell (2)	On Nut for Tension (3)			
1/2” - 13 (13 mm)	13 kips (57.8 kN)	17 kips (75.6 kN)	1-1/4” (32 mm)	A 10	50 ft-lbs (70*)	85 ft-lbs	7” (178 mm)	5” (127 mm)	R1S04A10
5/8” - 11 (16 mm)	20.8 kips (92.5 kN)	27.1 kips (121 kN)	1-1/4” (32 mm)	A 10	125 ft-lbs (250*)	125 ft-lbs	9” (229 mm)	7” (178 mm)	R1S05A10
3/4” - 10 (19 mm)	30.7 kips (137 kN)	40 kips (178 kN)	1-3/4” (44 mm)	C 14	210 ft-lbs (250*)	210 ft-lbs	11” (279 mm)	9” (229 mm)	R1S06C14
7/8” - 9 (22 mm)	42.5 kips (189 kN)	55.4 kips (246 kN)	1-3/4” (44 mm)	C 14	390 ft-lbs (410*)	390 ft-lbs	14” (356 mm)	11” (279 mm)	R1S07C14
1” - 8 (25 mm)	55.7 kips (248 kN)	72.7 kips (323 kN)	1-3/4” (44 mm)	C 14	500 ft-lbs (600*)	550 ft-lbs	17” (432 mm)	13” (330 mm)	R1S08C14
1-1/8” - 7 (29 mm)	61.8 kips (275 kN)	80.1 kips (356 kN)	2-1/4” (57 mm)	C 18	550 ft-lbs (600*)	770 ft-lbs	18” (457 mm)	14” (356 mm)	R1S09C18
1-1/4” - 7 (32 mm)	78.4 kips (349 kN)	102 kips (452 kN)	2-1/4” (57 mm)	C 18	750 ft-lbs (1200*)	1000 ft-lbs	21” (533 mm)	16” (406 mm)	R1S10C18
1-3/8” - 8 (35 mm)	99.8 kips (444 kN)	129 kips (576 kN)	2-1/2” (64 mm)	B 20	750 ft-lbs (1600*)	Note (4)	24” (610 mm)	19” (483 mm)	R1S11B20
1-1/2” - 6 (38 mm)	114 kips (506 kN)	148 kips (656 kN)	3” (76 mm)	B 24	1000 ft-lbs (1700*)	Note (4)	27” (686 mm)	21” (533 mm)	R1S12B24
2” - 6 (51 mm)	215 kips (955 kN)	278 kips (1238 kN)	3-1/2” (89 mm)	C 28	1000 ft-lbs (2000*)	Note (4)	40” (1016 mm)	31” (787 mm)	R1S16C28

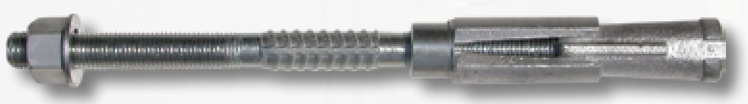
See notes on bottom of page 13

R1J Solid Rebar Spin-Lock Concrete Anchor ASTM A615

The R1J Spin-Lock Concrete Anchor uses an ASTM Grade 60 material for the anchor rod which is generally less expensive than other Spin-Lock anchors which incorporate higher strength steels.

R1J Structural Properties

Diameter Range	Yield Stress	Ultimate Stress	Elongation in 8” Gauge Length
1/2” to 1” (13 to 25 mm)	60 KSI (413 MPa)	80 KSI (552 MPa)	7% min
1-1/8” and up (29 mm)	60 KSI (413 MPa)	80 KSI (552 MPa)	9% min



Diameter & Threads per Inch	Yield Strength (fy)	Ultimate Strength (fu)	Drill Hole Diameter (1)	Type Head Assembly	Torque (ft-lbs)		Minimum Embedment (3000 PSI - f’c) (5)	Minimum Embedment (6500 PSI - f’c) (5)	Part Number
					To Expand Shell (2)	On Nut for Tension (3)			
1/2” - 13 (13 mm)	8.5 kips (37.9 kN)	11.3 kips (50.5 kN)	1-1/4” (32 mm)	A 10	50 ft-lbs (50*)	60 ft-lbs	6” (152 mm)	5” (127 mm)	R1J04A10
5/8” - 11 (16 mm)	13.5 kips (60 kN)	18.1 kips (80.4 kN)	1-1/4” (32 mm)	A 10	100 ft-lbs (100*)	110 ft-lbs	8” (203 mm)	6” (152 mm)	R1J05A10
3/4” - 10 (19 mm)	20.0 kips (89.1 kN)	26.7 kips (119 kN)	1-3/4” (44 mm)	C 14	165 ft-lbs (165*)	175 ft-lbs	10” (254 mm)	8” (203 mm)	R1J06C14
7/8” - 9 (22 mm)	27.7 kips (123 kN)	37.0 kips (164 kN)	1-3/4” (44 mm)	C 14	265 ft-lbs (265*)	290 ft-lbs	12” (305 mm)	9” (229 mm)	R1J07C14
1” - 8 (25 mm)	36.3 kips (161 kN)	48.5 kips (216 kN)	1-3/4” (44 mm)	C 14	400 ft-lbs (400*)	420 ft-lbs	14” (356 mm)	11” (279 mm)	R1J08C14
1-1/8” - 7 (29 mm)	45.8 kips (204 kN)	61.0 kips (271 kN)	2-1/4” (57 mm)	C 18	450 ft-lbs (550*)	610 ft-lbs	16” (406 mm)	13” (330 mm)	R1J09C18
1-1/4” - 7 (32 mm)	58.1 kips (259 kN)	77.5 kips (345 kN)	2-1/4” (57 mm)	C 18	750 ft-lbs (750*)	810 ft-lbs	19” (483 mm)	15” (381 mm)	R1J10C18
1-3/8” - 8 (35 mm)	74 kips (329 kN)	98.6 kips (439 kN)	2-1/2” (64 mm)	B 20	750 ft-lbs (1000*)	Note (4)	23” (584 mm)	18” (457 mm)	R1J11B20
1-3/4” - 6 (38 mm) *	110 kips (489 kN)	149 kips (663 kN)	3” (76 mm)	B 24	1000 ft-lbs (1700*)	Note (4)	31” (787 mm)	24” (610 mm)	R1J14B24

* 1-3/4” diameter is made from 400W rebar from Canada. See additional notes on bottom of page 13

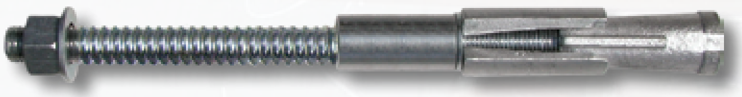
B7S & R1V Spin-Lock Concrete Anchors

B7S Coil All-Thread Spin-Lock Concrete Anchor **ASTM A108 Grade C1045**

Williams B7S Coil All-Thread Spin-Lock Concrete Anchor utilizes an ASTM A108 Grade C1045 steel which provides high strength capacity and has the advantage of utilizing a more common steel for greater availability.

B7S Structural Properties

Diameter Range	Yield Stress	Ultimate Stress	Elongation in 2" Gauge Length	Reduction of Area
1/2" to 1" (13 to 25 mm)	92 KSI (634 MPa)	120 KSI (827 MPa)	11% min	20% min
1-1/8" and up (29 mm)	81 KSI (558 MPa)	105 KSI (723 MPa)	11% min	20% min



Meets strength of ASTM A325

Diameter & Threads per Inch	Yield Strength (fy)	Ultimate Strength (fu)	Drill Hole Diameter (1)	Type Head Assembly	Torque (ft-lbs)		Minimum Embedment (3000 PSI - f'c) (5)	Minimum Embedment (6500 PSI - f'c) (5)	Part Number
					To Expand Shell (2)	On Nut for Tension (3)			
1/2" - 13 (13 mm)	13 kips (57.8 kN)	17 kips (75.6 kN)	1-1/4" (32 mm)	A 10	50 ft-lbs (70*)	85 ft-lbs	7" (178 mm)	5" (127 mm)	B7S04A10
5/8" - 11 (16 mm)	20.8 kips (92.5 kN)	27.1 kips (121 kN)	1-1/4" (32 mm)	A 10	125 ft-lbs (250*)	125 ft-lbs	9" (229 mm)	7" (178 mm)	B7S05A10
3/4" - 10 (19 mm)	30.7 kips (137 kN)	40.0 kips (178 kN)	1-3/4" (44 mm)	C 14	210 ft-lbs (250*)	210 ft-lbs	11" (279 mm)	9" (229 mm)	B7S06C14
7/8" - 9 (22 mm)	42.5 kips (189 kN)	55.4 kips (246 kN)	1-3/4" (44 mm)	C 14	390 ft-lbs (410*)	390 ft-lbs	14" (356 mm)	11" (279 mm)	B7S07C14
1" - 8 (25 mm)	55.7 kips (248 kN)	72.7 kips (323 kN)	1-3/4" (44 mm)	C 14	500 ft-lbs (600*)	550 ft-lbs	17" (432 mm)	13" (330 mm)	B7S08C14
1-1/8" - 7 (29 mm)	61.8 kips (275 kN)	80.1 kips (356 kN)	2-1/4" (57 mm)	C 18	550 ft-lbs (600*)	770 ft-lbs	18" (457 mm)	14" (356 mm)	B7S09C18
1-1/4" - 7 (32 mm)	78.5 kips (349 kN)	102 kips (452 kN)	2-1/4" (57 mm)	C 18	750 ft-lbs (1200*)	1000 ft-lbs	21" (533 mm)	16" (406 mm)	B7S10C18
1-1/2" - 6 (38 mm)	114 kips (506 kN)	148 kips (656 kN)	3" (76 mm)	B 24	1000 ft-lbs (1700*)	Note (4)	27" (686 mm)	21" (533 mm)	B7S12B24

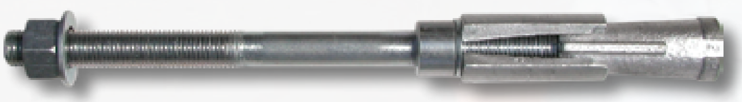
See notes at bottom

R1V High Impact Spin-Lock Concrete Anchor **ASTM A193 Grade B7**

The R1V Spin-Lock Concrete Anchor is often specified for applications in extreme cold temperatures or if the anchor may be exposed to impact loading.

R1V Structural Properties

Yield Stress	Ultimate Stress	Elongation in 4 Bar Dia.	Reduction of Area	Charpy at -40° F (-40° C)
105 KSI (723 MPa)	125 KSI (861 MPa)	16% min	50% min	20 ft-lbs (27 Joules)



Diameter & Threads per Inch	Yield Strength (fy)	Ultimate Strength (fu)	Drill Hole Diameter (1)	Type Head Assembly	Torque (ft-lbs)		Minimum Embedment (3000 PSI - f'c) (5)	Minimum Embedment (6500 PSI - f'c) (5)	Part Number
					To Expand Shell (2)	On Nut for Tension (3)			
1/2" - 13 (13 mm)	14.9 kips (66.3 kN)	17.8 kips (79.0 kN)	1-1/4" (32 mm)	A 10	50 ft-lbs (50*)	85 ft-lbs	8" (203 mm)	6" (152 mm)	R1V04A10
3/4" - 10 (19 mm)	35.1 kips (156 kN)	41.8 kips (186 kN)	1-3/4" (44 mm)	C 14	210 ft-lbs (250*)	250 ft-lbs	13" (330 mm)	10" (254 mm)	R1V06C14
1" - 8 (25 mm)	63.6 kips (284 kN)	75.8 kips (337 kN)	1-3/4" (44 mm)	C 14	500 ft-lbs (600*)	550 ft-lbs	19" (483 mm)	15" (381 mm)	R1V08C14
1-1/4" - 7 (32 mm)	102 kips (453 kN)	121 kips (538 kN)	2-1/4" (57 mm)	C 18	750 ft-lbs (1600*)	1000 ft-lbs	26" (660 mm)	20" (508 mm)	R1V10C18
1-3/8" - 8 (35 mm)	129 kips (576 kN)	154 kips (685 kN)	2-1/2" (64 mm)	B 20	750 ft-lbs (1600*)	Note (4)	30" (762 mm)	23" (584 mm)	R1V11B20
1-1/2" - 6 (38 mm)	148 kips (656 kN)	176 kips (781 kN)	3" (76 mm)	B 24	1000 ft-lbs (1700*)	Note (4)	33" (838 mm)	25" (635 mm)	R1V12B24
1-3/4" - 5 (45 mm)	200 kips (887 kN)	238 kips (1056 kN)	3" (76 mm)	B 24	1000 ft-lbs (1700*)	Note (4)	40" (1016 mm)	31" (787 mm)	R1V14B24
2" - 6 (51 mm)	278 kips (1238 kN)	331 kips (1473 kN)	3-1/2" (89 mm)	C 28	1000 ft-lbs (4000*)	Note (4)	50" (1270 mm)	39" (991 mm)	R1V16C28

(*) Do not exceed these numbers
(1) Care should be taken to drill a straight and properly sized hole.
(2) More torque may be required on long anchors or if the head assembly is next to rebar. Consult your Williams Representative for more specific details.
(3) Torque value listed will achieve approximate load of 50% of the anchor ultimate strength, and is based on the torque tension curves on page 51.
(4) Stress to desired tensile load using a hollow ram hydraulic jack. Consult your Williams Representative.
(5) Full ultimate strength of anchor can be achieved at listed embedment depth, provided there are no edge or spacing effects on the anchor.

- Spin-Locks come standard with 12" of threaded area. Other lengths available upon request.
- WILLIAMS reserves the right to ship full length or coupled units as necessary.
- For Spin-Lock Accessories see page 41.

Design Considerations

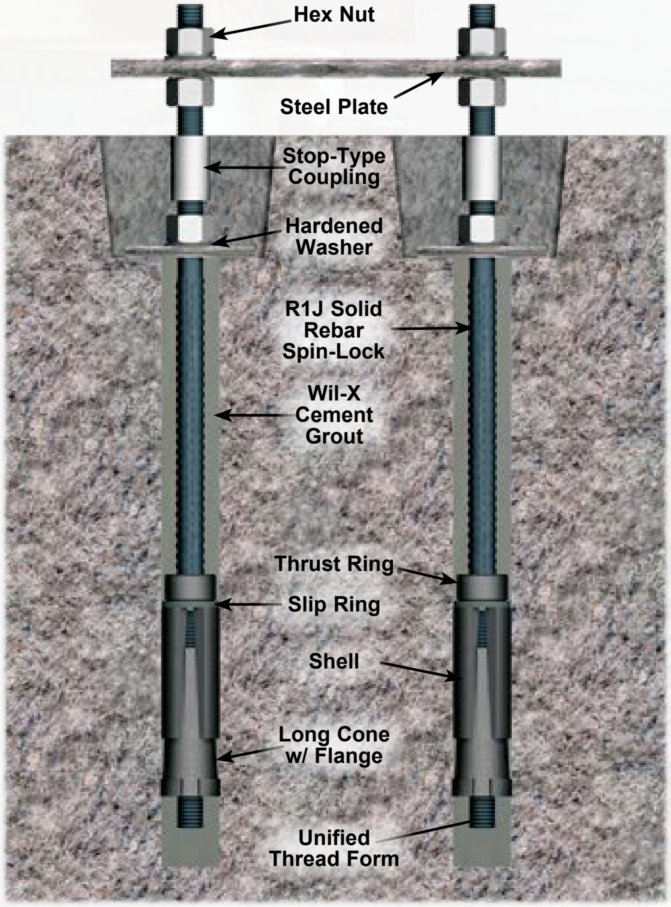
For several decades Engineers have based their Spin-Lock designs on the 45° cone method that was presented in ACI 349 Appendix B (1985). With recent changes in the ACI publication relating to concrete anchors in ACI 318: Anchoring to Concrete, a standardized method of analyzing concrete anchors has been established. This is the recommended method of analyzing anchor capacities, embedment depths, concrete breakout capacities and more for tension, shear, and combined loading scenarios.

At times, job conditions may dictate the necessity to place adjacent anchors closer than the minimum spacing (S) shown in the following table. When reduced spacing is desired it is then recommended to install the anchors by staggering the embedment depths or by installing the anchors at equivalent depths while ensuring confining pressures are placed on either side of a single anchor before stressing the anchors. This is accomplished by setting the mechanical head on the anchors on either side of the anchor being prestressed. When staggering the anchors, adjacent anchors should be staggered as shown in the illustration below. After the deepest anchors have been drilled, installed, grouted, and the grout has cured; adjacent anchors can be drilled and installed. This procedure would allow for (S) values to be reduced by half without the danger of fracture between holes during installation.

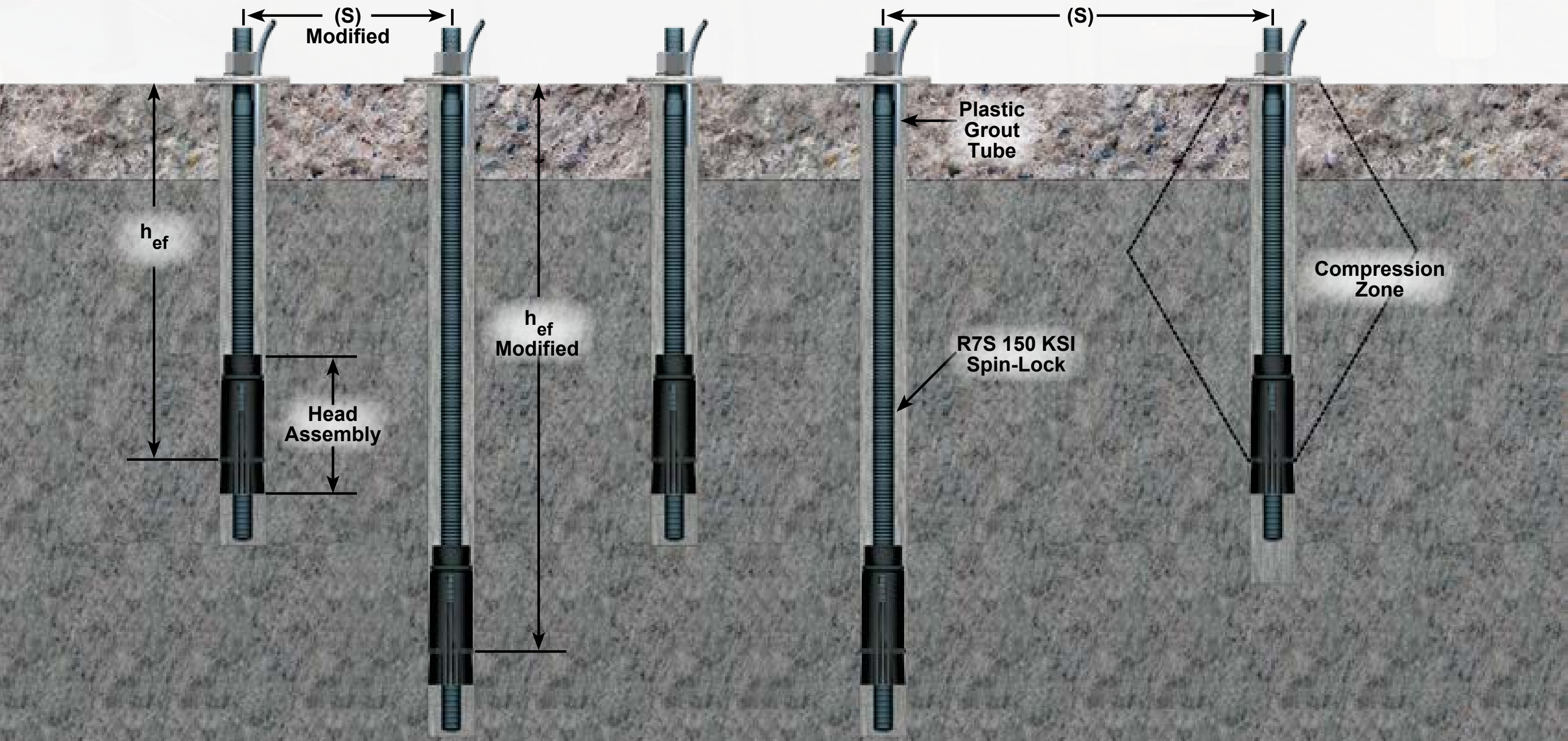
The ideal spacing is large enough to prevent blow out from anchor hole to anchor hole, and to develop the full combined anchor capacities. Based on the 35° cone method in ACI 318, the center to center spacing to develop the full shear cone should be 3 times the recommended embedment depth. Closely spaced anchors can be designed with a deeper embedment than what is listed in order to develop the combined anchor capacities.

For best results Williams Spin-Lock anchors should be used in high strength reinforced concrete.

Prestressed Anchors for Tower or Column Supports



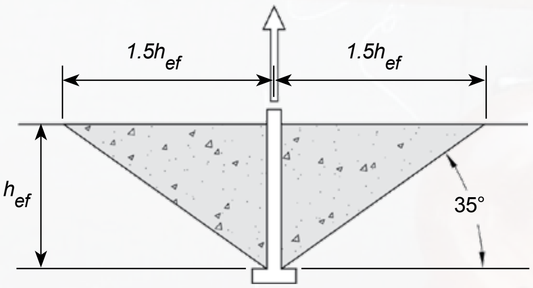
Prestressing New Concrete to Old Concrete



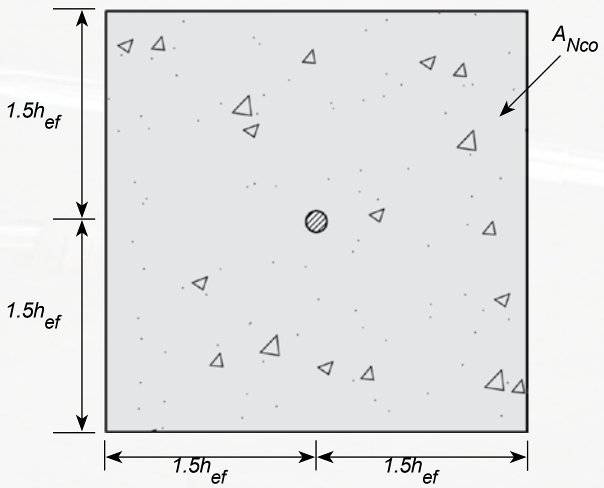
Design Considerations

Anchor embedment depths below are derived by calculation from ACI 318. Shorter embedment depths, edge distances and center to center spacing are possible if anchor design loads don't reach the ultimate strength of the anchor. Embedments depths to achieve ductile steel failure are reflected in the table below.

Section through failure cone

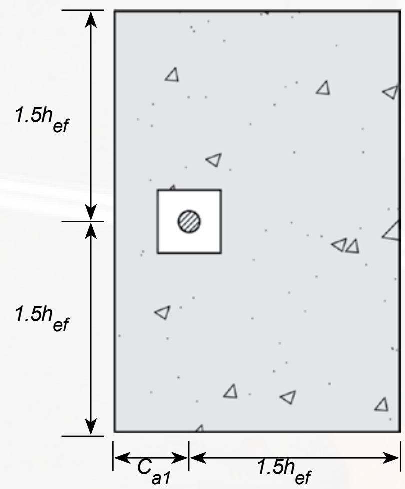


$A_{Nco} = 9*h_{ef}^2$



$A_{Nc} = (c_{ef}+1.5h_{ef})(2*1.5h_{ef})$

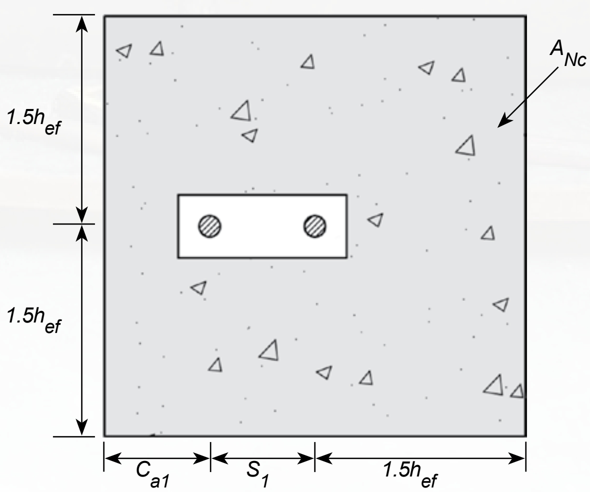
if: $c_{a1}<1.5h_{ef}$



$A_{Nc} = (c_{a1}+s_1+1.5h_{ef})(2*1.5h_{ef})$

if: $c_{a1}< 1.5h_{ef}$

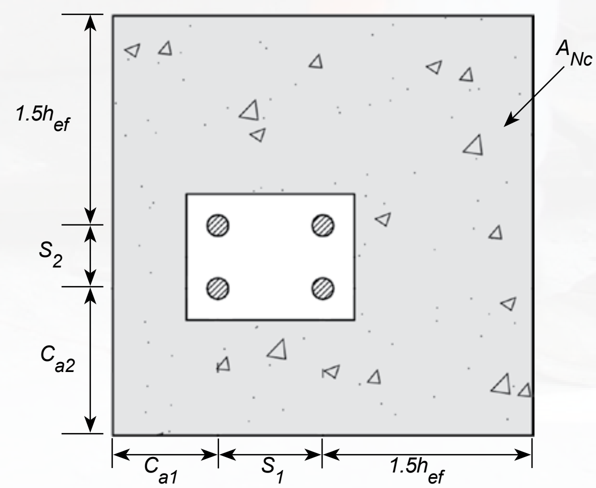
and: $s_1< 3h_{ef}$



$A_{Nc} = (c_{a1}+ s_1+1.5h_{ef})(c_{a2}+s_2+1.5h_{ef})$

if: c_{a1} and $c_{a2} < 1.5h_{ef}$

and: s_1 and $s_2 < 3h_{ef}$

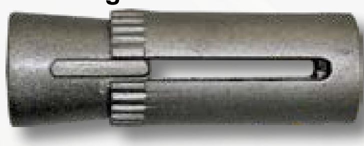


Spin-Lock Head Assemblies

The Williams Spin-Lock anchor assembly gives full 300° bearing area. The smooth shell design allows for maximum shell to concrete contact and eliminates "point of contact" created by serrated designs. The cone design supports the shell 300°, thereby eliminating any possible collapse of the shell under high load conditions. The thrust ring stop in front of the shell prevents any possible rebound of the expanded shell down the cone if subjected to impact loading. The Williams Spin-Lock anchor has been field proven on the world's largest projects to far exceed in tension capacity any other production mechanical anchor on the market.

Type A
Short Shell & Cone

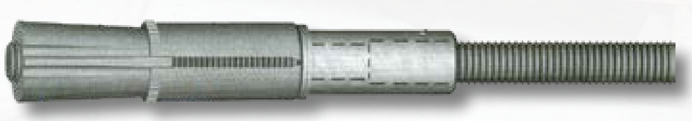
Type B
Long Shell & Cone



Type C
Long Shell & Cone w/ Flange

Head Assembly	Drill Hole Diameter	Diameter & Threads per Inch	Cone		Shell		Thrust Ring		Slip Rings	Overall Assembly Length
			Length	Part No.	Length	Part No.	Diameter	Thickness		
A10	1-1/4" (32 mm)	1/2" - 13 NC (13 mm)	1-7/8" (48 mm)	SC-114-4	1-7/8" (48 mm)	SS-114	1-1/8" (29 mm)	9/16" (14 mm)	1/16" (1.6 mm)	4-7/16" (112 mm)
		5/8" - 11 NC (16 mm)	1-7/8" (48 mm)	SC-114-5	1-7/8" (48 mm)	SS-114	1-1/8" (29 mm)	9/16" (14 mm)	1/16" (1.6 mm)	4-7/16" (112 mm)
B20	2-1/2" (65 mm)	1-1/4" - 7 NC (32 mm)	4" (102 mm)	LC-250	4" (102 mm)	LS-250	2-1/8" (54 mm)	1-1/4" (32 mm)	9/64" (3.6 mm)	9-1/2" (241 mm)
		1-3/8" - 8 NC (35 mm)	4" (102 mm)	LC-250	4" (102 mm)	LS-250	2-1/8" (54 mm)	1-3/8" (35 mm)	9/64" (3.6 mm)	9-5/8" (244 mm)
B24	3" (76 mm)	1-1/2" - 6 NC (38 mm)	5-1/2" (140 mm)	LC-300	5-1/2" (140 mm)	LS-300	2-3/4" (70 mm)	1-1/2" (38 mm)	5/32" (4 mm)	12-7/8" (325 mm)
		1-3/4" - 5 NC (45 mm)	5-1/2" (140 mm)	LC-300	5-1/2" (140 mm)	LS-300	2-3/4" (70 mm)	1-3/4" (45 mm)	1/8" (3 mm)	13" (330 mm)
C14	1-3/4" (44 mm)	3/4" - 10 NC (19 mm)	4-1/4" (108 mm)	LCF-175-6	3-3/4" (95 mm)	LS-175	1-5/8" (41 mm)	3/4" (19 mm)	1/16" (1.6 mm)	9-3/8" (238 mm)
		7/8" - 9 NC (22 mm)	4-1/4" (108 mm)	LCF-175-7	3-3/4" (95 mm)	LS-175	1-5/8" (41 mm)	1" (25 mm)	1/16" (1.6 mm)	9-1/2" (241 mm)
		1" - 8 NC (25 mm)	4-1/4" (108 mm)	LCF-175-8	3-3/4" (95 mm)	LS-175	1-5/8" (41 mm)	1-1/4" (32 mm)	1/16" (1.6 mm)	9-5/8" (244 mm)
C18	2-1/4" (57 mm)	1-1/8" - 7 NC (30 mm)	4-7/8" (124 mm)	LCF-225-9	4" (102 mm)	LS-225	2" (51 mm)	1-1/4" (32 mm)	1/16" (1.6 mm)	10-1/4" (260 mm)
		1-1/4" - 7 NC (32 mm)	4-7/8" (124 mm)	LCF-225-10	4" (102 mm)	LS-225	2" (51 mm)	1-3/8" (35 mm)	1/16" (1.6 mm)	10-1/4" (260 mm)
C28	3-1/2" (89 mm)	1-7/8" - 8 UN (48 mm)	7" (178 mm)	LCF-350-16	6" (152 mm)	LS-350	2-7/8" (73 mm)	1-7/8" (48 mm)	1/8" (3.2 mm)	15-1/8" (384 mm)
		2" - 6 UN (51 mm)	7" (178 mm)	LCF-350-16	6" (152 mm)	LS-350	2-7/8" (73 mm)	2" (51 mm)	1/8" (3.2 mm)	15-1/4" (387 mm)

Coupled Head Assemblies



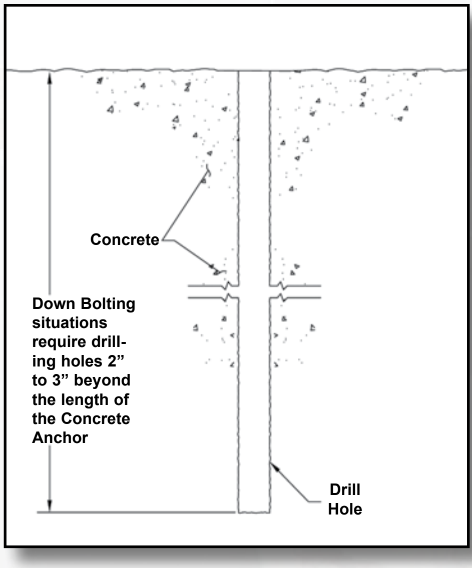
Williams can manufacture Spin-Lock Anchor systems with the use of a transition coupling, which allows the anchor to be designed with a continuously workable thread-form. This is advantageous when the anchor length may need to be adjusted in the field due to variable site conditions. The transition coupling engages a continuously threaded U.N. bar into the head assembly and the All-Thread Bar (typically Grade 75 & Grade 80 All-Thread Rebar or 150 KSI All-Thread-Bar) is attached to the other end of the coupling.

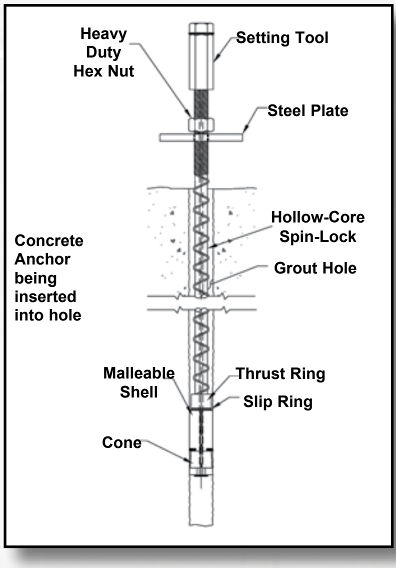
Installation

Step 1: Drilling

Use Hammer Drill or Core Drill

Care should be taken to ensure an accurate diameter and the drilled hole is as perpendicular to the concrete surface as possible. The hole depth should be drilled 2” to 3” deeper than the anchor embedment depth. Clean the drill hole by blowing air at the bottom of the hole to remove debris.



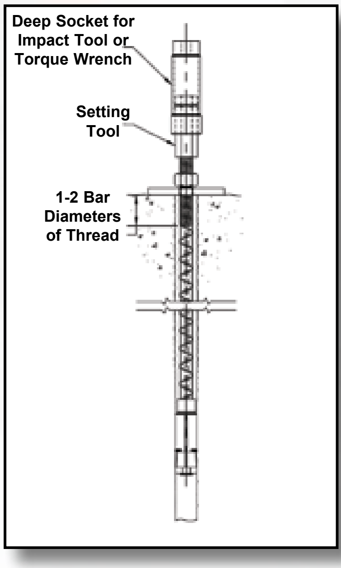


Step 2: Anchor Placement

Place the nut, washer, bevel washers (if required), and plate on the anchor. Insert the anchor into the hole to correct anchor embedment depth. If the anchor becomes stuck in the hole, attach the setting tool to the end of the anchor and drive it into the hole with a hammer. If the anchor slides into the hole extremely loose, remove the anchor from the hole. Pre-expand the anchor head 1/2 revolution or until it fits snugly into the drill hole.

Step 3: Setting the Anchor

Before placing the setting tool on the anchor, it should be inspected to ensure both sections are turned tightly together and the washers are greased. Install setting tool fully onto the exposed threaded end of the anchor. Initially torque the anchor with an impact gun. This action migrates the cone into the shell, thus expanding the mechanical anchor into the concrete. The final torque can be checked and adjusted with a manual or hydraulic torque wrench. Remove the setting tool by restraining the lower section while rotating its upper section counter-clockwise until the setting tool is loose.



Installation

Step 4a: Testing the Anchor

Method A: Tensioning with a Test Jack

Place the jack and frame over the anchor and attach the test rod and couplings to the anchor. Make sure the coupling is fully engaged. Attach the test nut and test plate over the test rod on top of the jack. Test the anchor by tensioning the jack to the required test load (usually half of the ultimate strength) but never to exceed the advertised yield strength of the anchor. Adjust the jack to the required final tension and lock in the final prestress load. This is done by tightening the concrete anchor hex nut with a knocker wrench (through the frame opening) until a slight reduction is noticed on the jack gauge. The full prestress load will be transferred to the anchor bolt once the tension in the test jack has been released and test components removed.

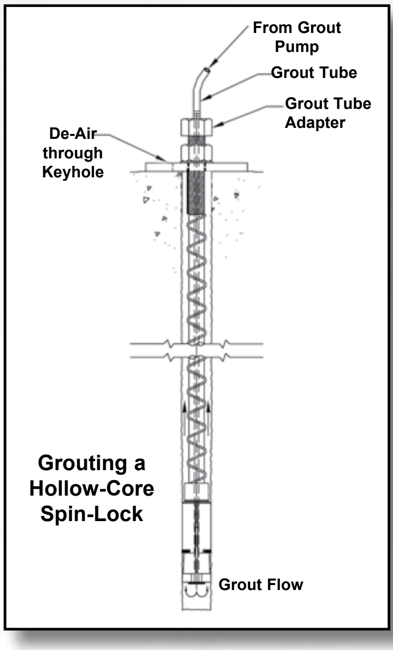
Step 4b: Testing the Anchor

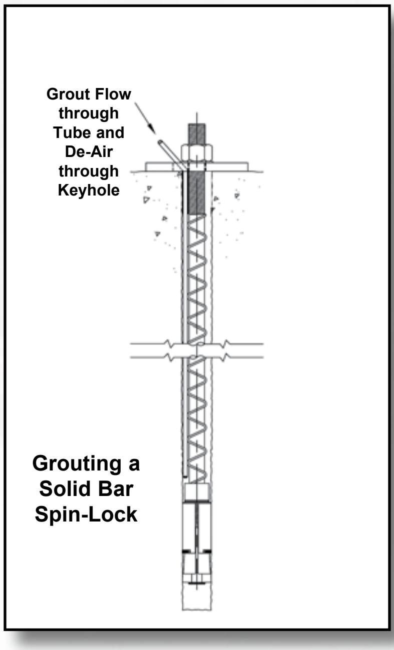
Method B: Testing by Torque Tensioning

Tension the anchor by torquing the hex nut with a torque wrench. To obtain the advertised tensile working load, see the "Torque On Nut" column on the Spin-Lock Anchor charts listed on pages 11-13. For other desired loads, see the torque tension graphs shown on pages 50 & 51. **Please Note:** The torque/tension relationship is not as accurate as direct tensioning with a hydraulic jack and should not be used where critical tension loads need to be verified.

Step 5: Grouting the Anchor

When Grouting the anchor, always grout from the lowest gravitational point. Continue grouting until a steady stream of pure grout is seen coming out around the bearing plate or grout tube, and/or from the de-air tube. For solid anchors, a separate grout tube must be placed in the drill hole (through an opening in the bearing plate) as deep as possible before grouting. Down-grouting of Hollow Core Spin-Locks can be simply grouted through the hollow core by attaching a grout tube adapter to the outer end of the tensioned anchor and grouting. When the grouting is complete, all air and standing water has been removed from the drill hole by displacement.





Williams offers a field installation advising service to aid contractors in the initial installation process of installing all types of concrete anchors. A Williams "Spin-Lock Anchor Installation Video" is available on our YouTube Channel. Contact your Williams sales representative for details.

Project Photos

Project: Woodrow Wilson Bridge
Contractor: American Bridge
Location: Washington DC

Project: Marine Terminal
Contractor: Toledo Caisson
Location: Toledo, OH

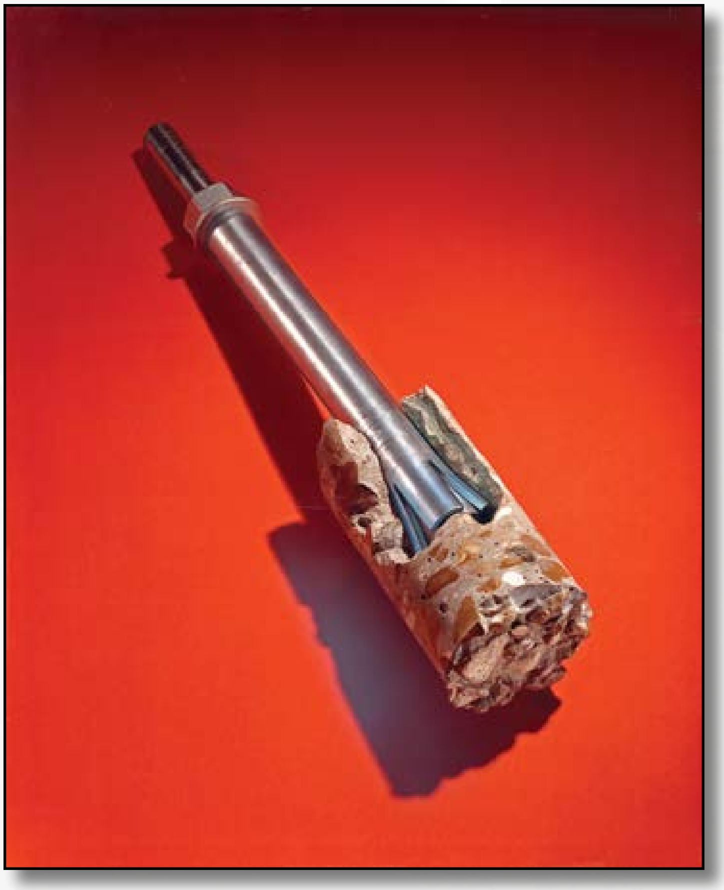
Project: Chicago Elevated Train
Contractor: Kiewit
Location: Chicago, IL

Project: Long Beach Cruise Terminal
Designer: CH2M Hill
Contractor WW Stevenson
Location: Long Beach, CA

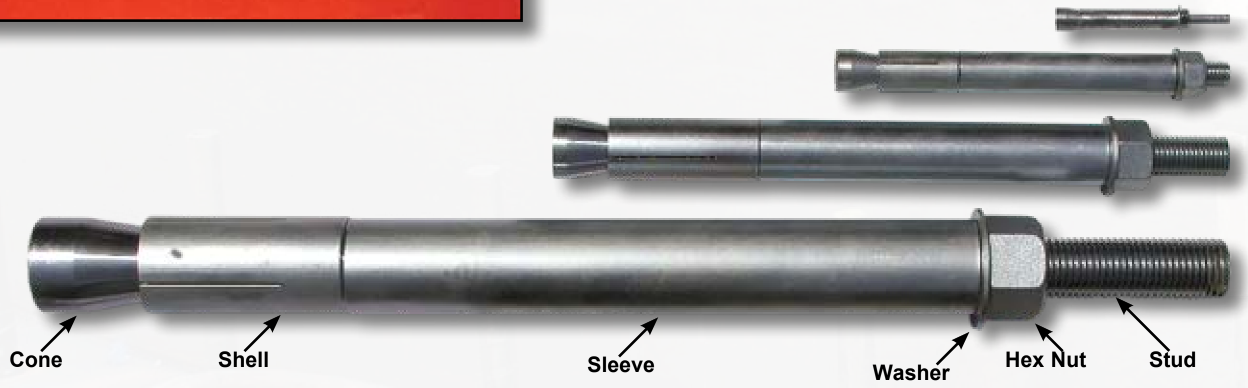
Project Name: Repairs to Deep Draft Wharf, Fac. 4028
Contractor: Black Construction Corporation
Location: Diego Garcia, British Indian Ocean Territory

Project: Tennessee DOT Cantilever Sign Retrofit
Contractor: Thompson & Thompson
Location: Throughout Tennessee

S-9 Undercut Concrete Anchor



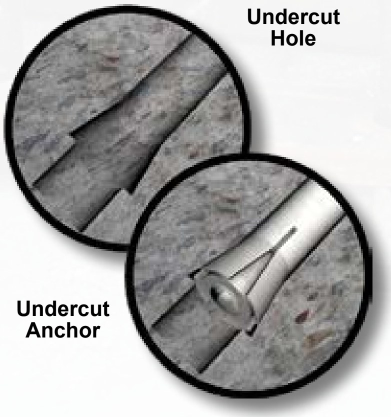
Williams S-9 Undercut Bearing Anchor was designed to eliminate the direct lateral stress found in the setting of conventional anchors and to bring its characteristics closer to those of cast-in-place anchors. Through the use of Williams undercutting tool, along with Williams undercut anchor, the conical shape of the anchor fits into the conical cut of the hole. This produces a positive expansion anchoring system that develops the tensile capacity of the bolt without slip or concrete failure. Because the anchor head is larger than the drill hole size, a properly embedded anchor will consistently develop 100% of the ASTM A193 Grade B7 bolting material.



Advantages of Williams Undercut Anchors

Cyclic Loading in Cracked Concrete

In situations where the diameter of the hole is increased due to changes caused by nature, the S-9 Undercut Bearing Anchor withstands cyclic loads in the cracked concrete member because the undercut of the hole is much larger than the top of the hole.



High Levels of Preload

Williams high strength stud bolt is threaded the total length of the bar to provide uniform stress throughout the bolt. When combined with Williams undercut head assembly the product is an anchor which will retain a much higher preload than a standard friction anchor.

Vibratory Loads

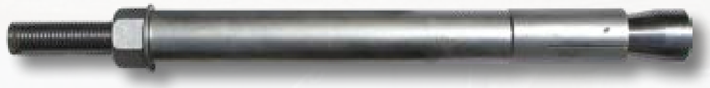
Throughout the destructive testing on Williams undercut anchor there has been consistent ductile failure on the stud bolt demonstrating a high reliability of safety. Therefore the S-9 Undercut anchor may be used safely with vibration equipment and piping.

S-9 Undercut Anchor Data

S-9 Undercut Concrete Anchor ASTM A193 Grade B7

Structural Properties

Yield Stress	Ultimate Stress	Elongation in 20 Bar Dia.	Reduction of Area	Charpy at -40° F (-40° C)
105 KSI (723 MPa)	125 KSI (861 MPa)	16% min	50% min	20 ft-lbs (27 Joules)



Diameter & Threads per Inch	Yield Strength (fy)	Ultimate Strength (fu)	Drill Hole Diameter (1)	Minimum Embedment (3000 PSI - f'c) (2)	Minimum Embedment (6500 PSI - f'c) (2)	Part Number
3/8" - 16 (9.5 mm)	8.14 kips (36.2 kN)	9.69 kips (43.1 kN)	7/8" (22 mm)	5" (127 mm)	4" (102 mm)	S9T-03
1/2" - 13 (13 mm)	14.9 kips (66.3 kN)	17.7 kips (78.9 kN)	7/8" (22 mm)	8" (204 mm)	6" (153 mm)	S9T-04
5/8" - 11 (16 mm)	23.7 kips (105 kN)	28.2 kips (125 kN)	1-1/8" (29 mm)	10" (254 mm)	8" (204 mm)	S9T-05
3/4" - 10 (19 mm)	35.1 kips (156 kN)	41.8 kips (186 kN)	1-1/8" (29 mm)	13" (331 mm)	10" (254 mm)	S9T-06
1" - 8 (25 mm)	63.6 kips (283 kN)	75.8 kips (337 kN)	1-5/8" (41 mm)	19" (483 mm)	15" (381 mm)	S9T-08
1-1/4" - 7 (32 mm)	102 kips (453 kN)	121 kips (539 kN)	2" (51 mm)	26" (661 mm)	20" (508 mm)	S9T-10
1-1/2" - 6 (38 mm)	148 kips (656 kN)	176 kips (781 kN)	2-1/2" (64 mm)	33" (839 mm)	25" (635 mm)	S9T-12

(1) Care should be taken to drill a straight and properly sized hole.
(2) Full ultimate strength of anchor can be achieved at listed embedment depth, provided there are no edge or spacing effects on the anchor.

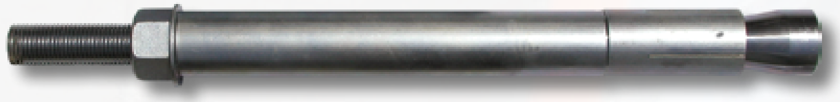
Stainless S-9 Undercut Anchor Data

Presented below are four different stainless steel options for the S-9 Undercut Concrete Anchor. Generally, the Stainless 304 B8 Class 1 and the Stainless 316 B8M Class I S-9 Undercut Concrete Anchors are the least expensive and most readily available of the Stainless Steels. The Stainless 304 B8 Class II S-9 boasts the highest strength among the Stainless Steels, while the 316 B8M Class II S-9 provides the combination of high strength and the highest level of corrosion resistance.

Stainless S-9 Undercut Concrete Anchor ASTM A193 304 B8 & 316 B8M Class I

Structural Properties

Yield Stress	Ultimate Stress	Elongation in 4 Bar Dia.	Reduction of Area
30 KSI (207 MPa)	75 KSI (517 MPa)	30% min	50% min



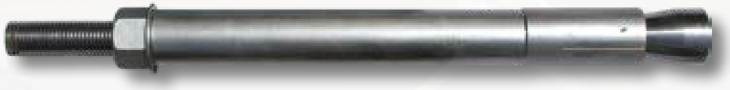
Diameter & Threads per Inch	Yield Strength (fy)	Ultimate Strength (fu)	Drill Hole Diameter (1)	Minimum Embedment (3000 PSI - f'c) (2)	Minimum Embedment (6500 PSI - f'c) (2)	Part Number
3/8" - 16 (9.5 mm)	2.32 kips (10.3 kN)	5.81 kips (25.8 kN)	7/8" (22 mm)	4" (102 mm)	3" (77 mm)	S9T-03-S4 S9T-03-S6
1/2" - 13 (13 mm)	4.26 kips (18.9 kN)	10.6 kips (47.3 kN)	7/8" (22 mm)	5" (127 mm)	4" (102 mm)	S9T-04-S4 S9T-04-S6
5/8" - 11 (16 mm)	6.78 kips (30.2 kN)	16.9 kips (75.2 kN)	1-1/8" (29 mm)	7" (178 mm)	6" (153 mm)	S9T-05-S4 S9T-05-S6
3/4" - 10 (19 mm)	10.0 kips (44.6 kN)	25.1 kips (111 kN)	1-1/8" (29 mm)	9" (229 mm)	7" (178 mm)	S9T-06-S4 S9T-06-S6
1" - 8 (25 mm)	18.2 kips (80.9 kN)	45.5 kips (202 kN)	1-5/8" (41 mm)	14" (356 mm)	11" (280 mm)	S9T-08-S4 S9T-08-S6
1-1/4" - 7 (32 mm)	29.1 kips (129 kN)	72.7 kips (323 kN)	2" (51 mm)	18" (458 mm)	14" (356 mm)	S9T-10-S4 S9T-10-S6
1-1/2" - 6 (38 mm)	42.2 kips (188 kN)	105 kips (469 kN)	2-1/2" (64 mm)	23" (585 mm)	18" (458 mm)	S9T-12-S4 S9T-12-S6

(1) Care should be taken to drill a straight and properly sized hole.
(2) Full ultimate strength of anchor can be achieved at listed embedment depth, provided there are no edge or spacing effects on the anchor.

Stainless S-9 Anchor Data

304 Stainless S-9 Undercut Concrete Anchor

ASTM A193 304 B8 Class II



Structural Properties

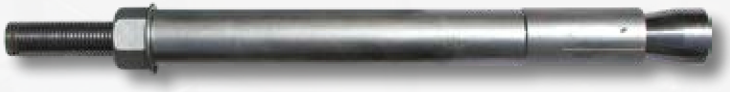
Diameter Range	Yield Stress	Ultimate Stress	Elongation in 4 Bar Dia.	Reduction of Area
3/8” to 3/4” (9.5 to 19 mm)	100 KSI (690 MPa)	125 KSI (862 MPa)	12% min	35% min
1” (25 mm)	80 KSI (552 MPa)	115 KSI (793 MPa)	15% min	35% min
1-1/4” (32 mm)	65 KSI (448 MPa)	105 KSI (724 MPa)	20% min	35% min
1-1/2” (38 mm)	50 KSI (375 MPa)	100 KSI (670 MPa)	28% min	45% min

Diameter & Threads per Inch	Yield Strength (fy)	Ultimate Strength (fu)	Drill Hole Diameter (1)	Minimum Embedment (3000 PSI - f’c) (2)	Minimum Embedment (6500 PSI - f’c) (2)	Part Number
3/8” - 16 (9.5 mm)	7.75 kips (34.5 kN)	9.69 kips (43.1 kN)	7/8” (22 mm)	5” (127 mm)	4” (102 mm)	S9T-03-S42
1/2” - 13 (13 mm)	14.2 kips (63.1 kN)	17.7 kips (78.9 kN)	7/8” (22 mm)	8” (204 mm)	6” (153 mm)	S9T-04-S42
5/8” - 11 (16 mm)	22.6 kips (101 kN)	28.2 kips (126 kN)	1-1/8” (29 mm)	10” (254 mm)	8” (204 mm)	S9T-05-S42
3/4” - 10 (19 mm)	33.4 kips (149 kN)	41.8 kips (186 kN)	1-1/8” (29 mm)	13” (331 mm)	10” (254 mm)	S9T-06-S42
1” - 8 (25 mm)	48.4 kips (215 kN)	69.7 kips (310 kN)	1-5/8” (41 mm)	18” (458 mm)	14” (356 mm)	S9T-08-S42
1-1/4” - 7 (32 mm)	63.0 kips (280 kN)	102 kips (453 kN)	2” (51 mm)	23” (585 mm)	18” (458 mm)	S9T-10-S42
1-1/2” - 6 (38 mm)	70.2 kips (312 kN)	141 kips (625 kN)	2-1/2” (64 mm)	28” (712 mm)	22” (559 mm)	S9T-12-S42

(1) Care should be taken to drill a straight and properly sized hole.
(2) Full ultimate strength of anchor can be achieved at listed embedment depth, provided there are no edge or spacing effects on the anchor.

316 Stainless S-9 Undercut Concrete Anchor

ASTM A193 316 B8M Class II



Structural Properties

Diameter Range	Yield Stress	Ultimate Stress	Elongation in 4 Bar Dia.	Reduction of Area
3/8” to 3/4” (9.5 to 19 mm)	96 KSI (662 MPa)	110 KSI (759 MPa)	15% min	45% min
1” (25 mm)	80 KSI (552 MPa)	100 KSI (670 MPa)	20% min	45% min
1-1/4” (32 mm)	65 KSI (448 MPa)	95 KSI (655 MPa)	25% min	45% min
1-1/2” (38 mm)	50 KSI (375 MPa)	90 KSI (621 MPa)	30% min	45% min

Diameter & Threads per Inch	Yield Strength (fy)	Ultimate Strength (fu)	Drill Hole Diameter (1)	Minimum Embedment (3000 PSI - f’c) (2)	Minimum Embedment (6500 PSI - f’c) (2)	Part Number
3/8” - 16 (9.5 mm)	7.44 kips (33.1 kN)	8.53 kips (37.9 kN)	7/8” (22 mm)	5” (127 mm)	4” (102 mm)	S9T-03-S62
1/2” - 13 (13 mm)	13.6 kips (60.6 kN)	15.6 kips (69.4 kN)	7/8” (22 mm)	7” (178 mm)	5” (127 mm)	S9T-04-S62
5/8” - 11 (16 mm)	21.7 kips (96.5 kN)	24.9 kips (110 kN)	1-1/8” (29 mm)	9” (229 mm)	7” (178 mm)	S9T-05-S62
3/4” - 10 (19 mm)	32.1 kips (143 kN)	36.7 kips (163 kN)	1-1/8” (29 mm)	12” (305 mm)	9” (229 mm)	S9T-06-S62
1” - 8 (25 mm)	48.5 kips (216 kN)	60.6 kips (269 kN)	1-5/8” (41 mm)	16” (407 mm)	13” (331 mm)	S9T-08-S62
1-1/4” - 7 (32 mm)	63.0 kips (280 kN)	92.0 kips (409 kN)	2” (51 mm)	22” (559 mm)	17” (432 mm)	S9T-10-S62
1-1/2” - 6 (38 mm)	70.2 kips (312 kN)	126 kips (562 kN)	2-1/2” (64 mm)	26” (660 mm)	21” (534 mm)	S9T-12-S62

(1) Care should be taken to drill a straight and properly sized hole.
(2) Full ultimate strength of anchor can be achieved at listed embedment depth, provided there are no edge or spacing effects on the anchor.

Installation

S9U Undercutting Tool

This tool is required for undercutting the holes to accommodate the S-9 Undercut Anchor. Designed to be attached to concrete coring equipment and apparatus with water flushing capabilities. Specifications available on request. **Special length undercut tools can be manufactured upon request.**

Typical Undercut Tools in Stock

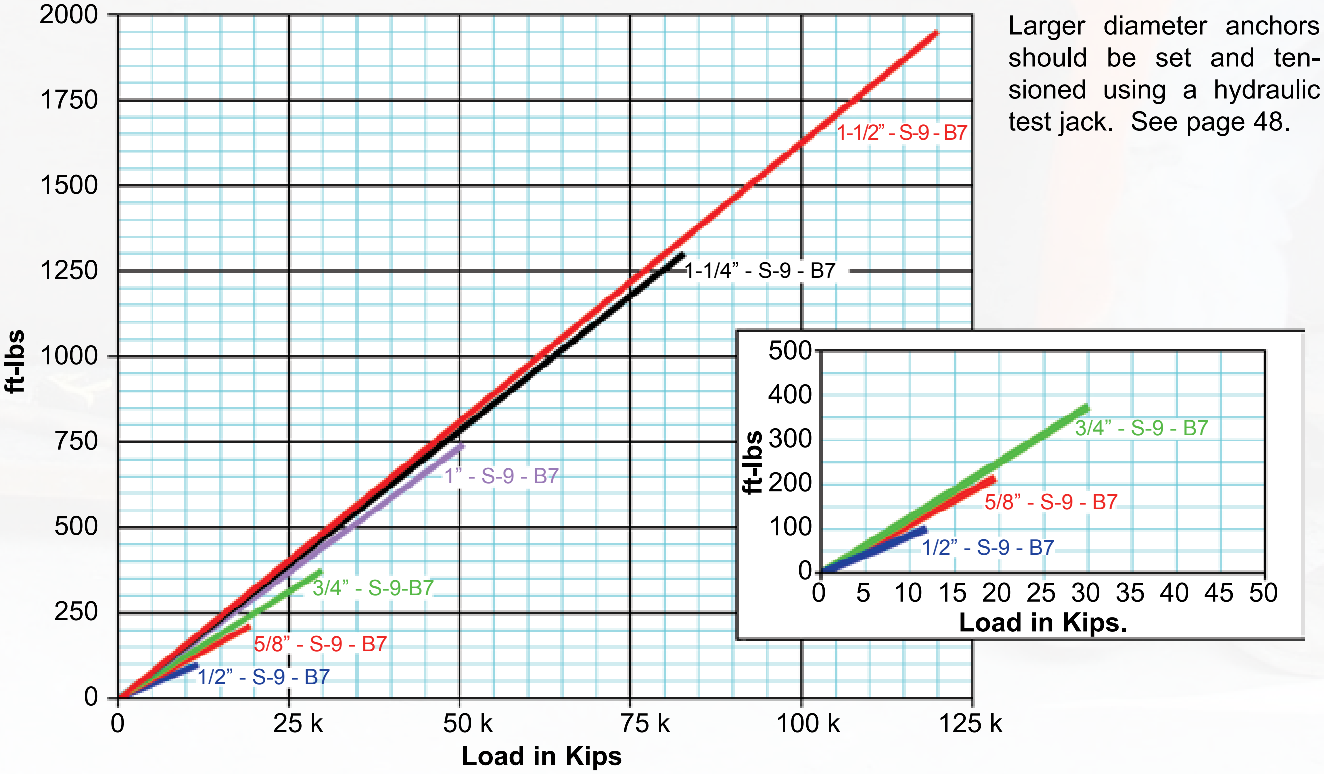
Bar Diameter	Standard Embedment Range	Part Number
3/8" - 16 NC (9.5 mm)	Up to 6-1/2" (165 mm)	S9U-04H
1/2" - 13 UNC (13 mm)	Up to 8" (203 mm)	S9U-04H
5/8" - 11 UNC (16 mm)	Up to 10" (254 mm)	S9U-06H
3/4" - 10 UNC (19 mm)	Up to 12-1/4" (311 mm)	S9U-06H
1" - 8 UNC (25 mm)	Up to 15-1/2" (394 mm)	S9U-08H
1-1/4" - 7 UNC (32 mm)	Up to 21" (533 mm)	S9U-10H
1-1/2" - 6 NC (38 mm)	Up to 27-1/2" (699 mm)	S9U-12H

Undercut Anchor Setting Chart

Bar Diameter	Cone Migration into Shell	Distance per Revolution	Revolutions Required to Set Cone to Shell
3/8" - 16 UNC (9.5 mm)	0.60" (15 mm)	0.063" (1.59 mm)	9 to 11
1/2" - 13 UNC (13 mm)	0.72" (18 mm)	0.077" (1.95 mm)	9 to 11
5/8" - 11 UNC (16 mm)	1.1" (28 mm)	0.091" (2.31 mm)	12 to 14
3/4" - 10 UNC (19 mm)	1.2" (30 mm)	0.100" (2.54 mm)	11 to 13
1" - 8 UNC (25 mm)	1.2" (30 mm)	0.125" (3.18 mm)	9 to 11
1-1/4" - 7 UNC (32 mm)	1.6" (41 mm)	0.143" (3.63 mm)	11 to 13
1-1/2" - 6 NC (38 mm)	3.0" (76 mm)	0.167" (4.23 mm)	18 to 20

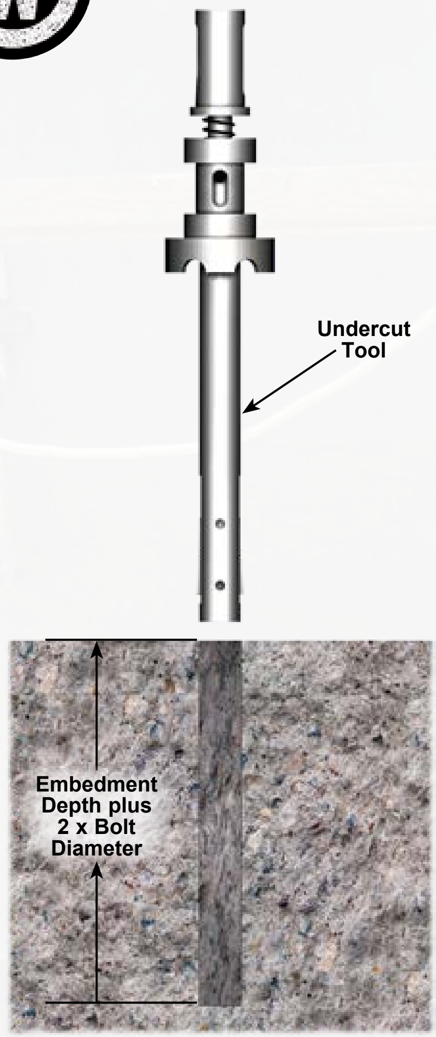
A193 Grade B7 Bar - Torque Tension Chart

All data based on greased (MolyKoat Gn) threads and surfaces. Torque tension relationships shown should be used as a guide. Actual tension can vary significantly, and should be verified in the field. If accurate tension is required, Williams recommends tensioning using a hydraulic ram.



Larger diameter anchors should be set and tensioned using a hydraulic test jack. See page 48.

Installation

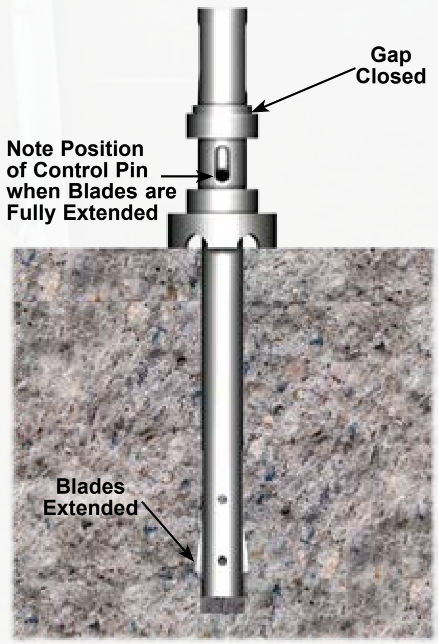


Step 1

Before starting the undercutting procedure, be sure the hole is drilled to the proper diameter and depth (Embedment Depth + (2 x bolt diameter)). Attach the undercutting tool to the core drill and be sure there is an adequate flow of water through the tool.

Step 2

Insert the tool into the hole until the bearing stop contacts the concrete.

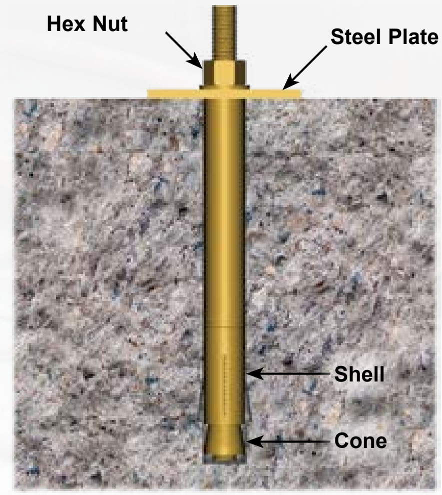


Step 3

Turn the core drill handle downward with slow even motion until the cutter blades are fully extended. The cutter blades are fully extended when the gap at the top between the innershaft and outerhousing make contact.

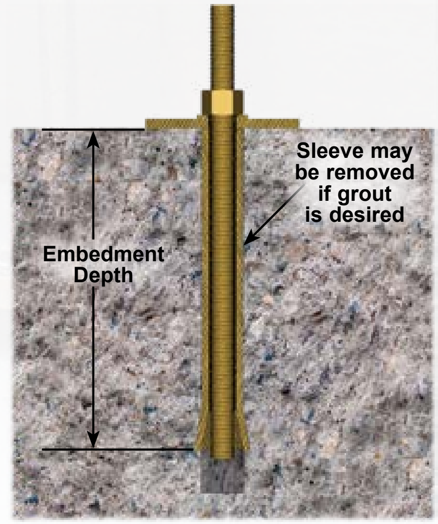
Step 4

Conical shape is undercut with Williams Undercutting Tool attachment.



Step 5

Anchor and sleeve are inserted into hole.

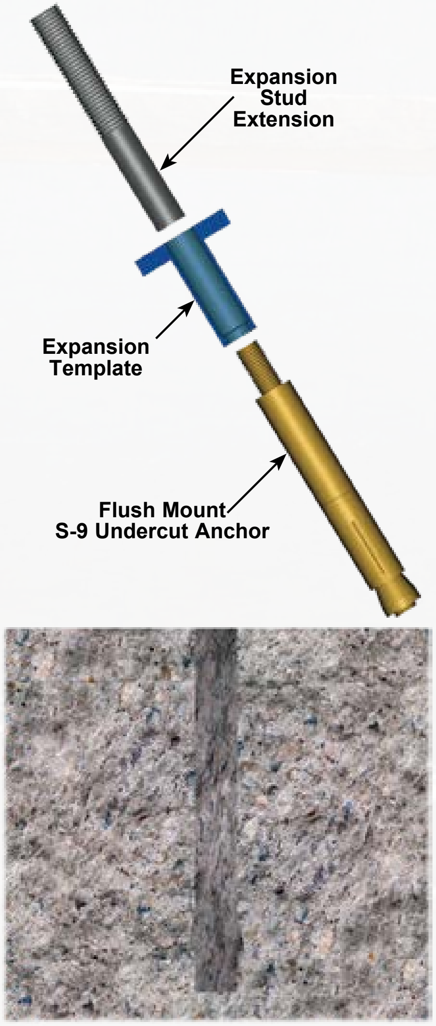


Step 6

Anchor is jacked or torqued to draw the cone up into the shell, therefore opening the shell into the undercut hole.

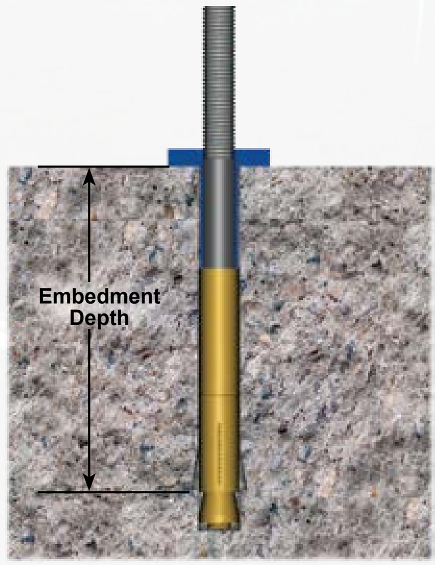
Flush Mount Anchor Installation

Williams also offers a flush mount S-9 Undercut Bearing Anchor that carries all the advantages of the standard S-9 , but adds the ease of installing in special conditions such as heavy machinery or large weldments. After hole is undercut, proceed as shown below in steps 1-5.



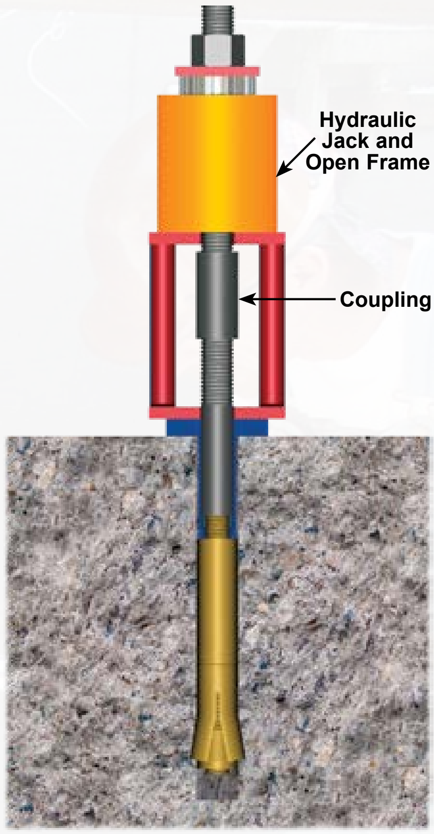
Step 1

Attach expansion template and stud extension to anchor. Check for proper anchor embedment by measuring assembled set-up.



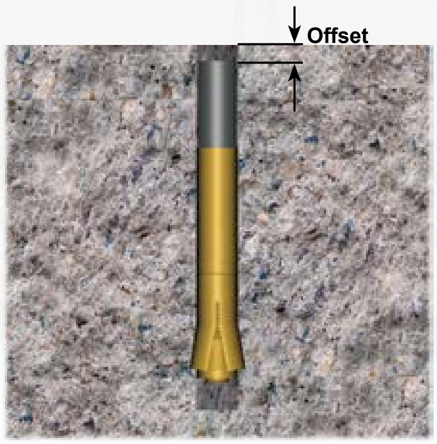
Step 2

Insert anchor set-up assembly into drill hole. Set embedment to include expansion template. Template allows clearance for S-9 flush mount coupling.



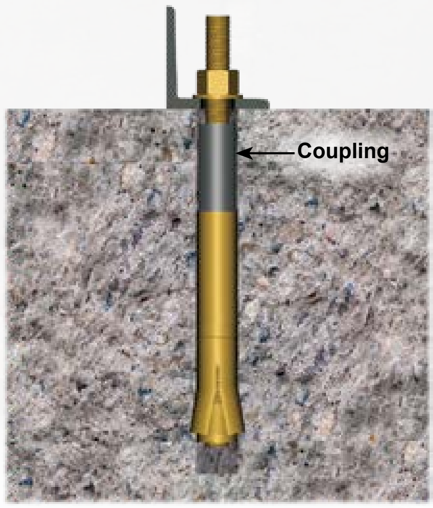
Step 3

Attach test coupling and test rod of center hole test jack to stud extension. Tension to set anchor head to load specified for anchor.



Step 4

Remove ram and setting tools and install couple to offset per the following chart. Anchor installation is complete and ready for attachments.



Step 5

After stud rods, bolts, washers or assemblies are installed, torque hex nut to required tension or tension with hydraulic jack to working load.

S-9 Flush Mount Undercut Concrete Anchor Data

Anchor Size	Minimum Embed.	Offset	Coupling	
			Dia.	Length
3/8” (9.5 mm)	4-1/8” (105 mm)	3/8” (9.5 mm)	3/4” (19 mm)	2-1/4” (57 mm)
1/2” (13 mm)	6” (152 mm)	3/8” (9.5 mm)	3/4” (19 mm)	2-1/4” (57 mm)
5/8” (16 mm)	7-1/2” (191 mm)	3/8” (9.5 mm)	1” (25 mm)	3” (76 mm)
3/4” (19 mm)	9-1/4” (235 mm)	1/2” (13 mm)	1-1/16” (27 mm)	3” (76 mm)
1” (25 mm)	12-1/2” (318 mm)	5/8” (16 mm)	1-1/2” (38 mm)	4-1/4” (108 mm)
1-1/4” (32 mm)	16” (406 mm)	3/4” (19 mm)	1-7/8” (48 mm)	5-5/8” (143 mm)
1-1/2” (38 mm)	21-1/2” (546 mm)	1” (25 mm)	2-1/4” (57 mm)	8-5/8” (219 mm)

*For larger stainless diameters these dimensions may vary.

Project Photos

Project: Bridge River 1 Stoplog
Contractor: BC Hydro
Location: Shalath, BC

Project: Popps Ferry Bridge Rehab
Contractor: Coastal Marine Contractors
Location: Biloxi, MS

Project: Seismic Retrofit TDOT
Contractor: St. Louis Bridge
Location: Tennessee

Project: Pineview Dam
Contractor: Cal Wadsworth
Location: Ogden River, UT

Project: San Vicente Dam Raising
Contractor: Barnard Construction
Location: San Diego, CA

Project: Aircraft Tether Tie Down
Contractor: AEI Inc.
Location: Singapore

S-7 Reusable Concrete Anchor

The S-7 anchor consists of a reliable torque controlled expansion anchor assembly similar to the Spin-Lock, however the S-7 drill hole diameter is the same size as the anchor stud diameter. This non-grouted anchor system is easy for contractors to install and the fast setting procedure saves time and money on important anchor installations. S-7 anchors are ideal for conditions that do not require cement grout as a corrosion protection barrier and are generally specified as a multi-purpose product with re-usable capabilities. The head assembly boasts a full 300° bearing area. S-7 anchors come complete with outer hex nut and washer. Zinc plating for corrosion protection is standard up to 1” diameter bolts and optional on larger sizes. Anchors are also available in stainless up to 1” in diameter.

S-7 Advantages

- Smaller drill holes
- Removable outer stud for reuse
- Field proven expansion anchor
- Convenient patching after removal
- Prestressable
- Anchor outer studs & heads can be purchased separately

S-7 Reusable Concrete Anchor Studs

S-7 anchors are available with a variety of removable outer studs for special applications.

Type A - Typical for outer stud diameters over 1”.

Type B - For applications where a recessed, tapped hole is required. Type B anchors are usually flush with the concrete surface and installed with a special Williams setting tool.

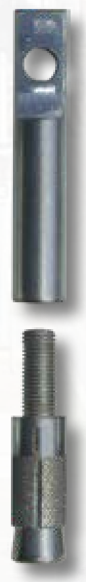
Type C - For stringing cable or wire though the anchor end. This anchor is often used for wire hangers or guy type anchorages.

Type D - Typical for outer stud diameters of 1” or smaller. Outer stud end has flats which allow for easy anchor removal.

Type A

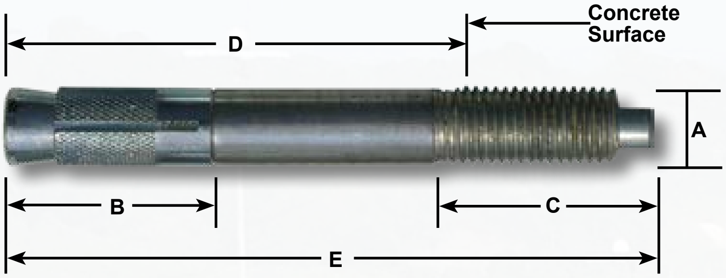
Type B

Type C



Type D

Anchor Data



S-7 Reusable Concrete Anchor

Standard Carbon Steel Grade

Diameter & Threads per Inch (A)	Ultimate Strength Inner Stud (fu)	Ultimate Strength Outer Stud (fu)	Nominal Shear Strength of Outer Thread (Vsa)	Torque (ft-lbs)		Minimum Embedment (3000 PSI - f'c) (2) (D)	Minimum Embedment (6500 PSI - f'c) (2) (D)	Cone & Shell Length (B)	Exterior Thread Length (C)	Part Number
				To Expand Shell	On Nut for Tension					
1/2" - 13 (13 mm)	6.28 kips (28.0 kN)	9.93 kips (44 kN)	5.96 kips (26.5 kN)	15	30	4-1/2" (114 mm)	3-1/2" (89 mm)	1-1/4" (32 mm)	1-1/2" (38 mm)	S7T-04
3/4" - 10 (19 mm)	17.0 kips (75.7 kN)	23.4 kips (104 kN)	14 kips (62.3 kN)	70	100	7-3/4" (197 mm)	6" (153 mm)	1-3/4" (45 mm)	1-7/8" (48 mm)	S7T-06
1" - 8 (25 mm)	27.1 kips (121 kN)	42.4 kips (189 kN)	25.4 kips (113 kN)	85	200	8-1/2" (216 mm)	6-1/2" (165 mm)	2-9/16" (65 mm)	2-1/2" (64 mm)	S7T-08
1-1/4" - 7 (32 mm)	27.1 kips (121 kN)	67.8 kips (302 kN)	40.7 kips (181 kN)	125	240	8-1/2" (216 mm)	6-1/2" (165 mm)	3-1/4" (83 mm)	3-1/4" (83 mm)	S7T-10
1-3/4" - 5 (45 mm)	72.7 kips (323 kN)	133 kips (592 kN)	79.8 kips (355 kN)	500	900	16-1/2" (419 mm)	12-3/4" (324 mm)	6-1/4" (159 mm)	4" (102 mm)	S7T-14
2" - 6 (51 mm)	102 kips (454 kN)	175 kips (778 kN)	105 kips (467 kN)	500	1,500	20-1/2" (521 mm)	16" (406 mm)	6-3/4" (171 mm)	4" (102 mm)	S7T-16

(1) Use the lesser strength of the outer or inner stud capacity for anchor structural capacity in design.
(2) Full ultimate strength of anchor can be achieved at listed embedment depth, provided there are no edge or spacing effects on the anchor.
(3) For Type C anchor applications, please contact your Williams representative to determine the capacity of the cable hole.

Stainless S-7 Reusable Concrete Anchor

ASTM A193 304 B8 Class 1

Diameter & Threads per Inch (A)	Ultimate Strength Inner Stud (fu)	Ultimate Strength Outer Stud (fu)	Nominal Shear Strength of Outer Thread (Vsa)	Torque (ft-lbs)		Minimum Embedment (3000 PSI - f'c) (2) (D)	Minimum Embedment (6500 PSI - f'c) (2) (D)	Cone & Shell Length (B)	Exterior Thread Length (C)	Part Number
				To Expand Shell	On Nut for Tension					
1/2" - 13 (13 mm)	3.93 kips (17.5 kN)	10.6 kips (47.3 kN)	6.38 kips (28.4 kN)	10	10	3" (77 mm)	2" (51 mm)	1-1/4" (32 mm)	1-1/2" (38 mm)	S7U-3041-04
3/4" - 10 (19 mm)	10.6 kips (47.2 kN)	25 kips (111 kN)	15 kips (66.7 kN)	50	60	5" (127 mm)	4" (102 mm)	1-3/4" (45 mm)	1-3/4" (45 mm)	S7U-3041-06
1" - 8 (25 mm)	17.0 kips (75.6 kN)	45.5 kips (202 kN)	27.3 kips (121 kN)	75	170	7" (178 mm)	6" (153 mm)	2-9/16" (65 mm)	2-1/2" (64 mm)	S7U-3041-08

(1) Use the lesser strength of the outer or inner stud capacity for anchor structural capacity in design.
(2) Full ultimate strength of anchor can be achieved at listed embedment depth, provided there are no edge or spacing effects on the anchor.
(3) For Type C anchor applications, please contact your Williams representative to determine the capacity of the cable hole.

Type "B" S-7 Anchor

Shear through hex headed Grade 8 bolt

Outer Stud Diameter	Inner Stud Diameter & Pitch	Nominal Shear Strength of Grade 8 Bolt (Vsa)
1/2" (13 mm)	5/16" - 18 (8 mm)	3.93 kips (17.5 kN)
3/4" (19 mm)	1/2" - 13 (13 mm)	10.6 kips (47 kN)
1" (25 mm)	5/8" - 11 (16 mm)	17 kips (75.6 kN)
1-1/4" (32 mm)	5/8" - 11 (16 mm)	17 kips (75.6 kN)
1-3/4" (45 mm)	1" - 8 (25 mm)	45.5 kips (202 kN)
2" (51 mm)	1-1/4" - 7 (32 mm)	72.6 kips (323 kN)

Design Considerations

Williams has listed recommended embedment depths that are minimum values for ductile steel failure design in 3000 psi and 6500 psi concrete; respectively, in accordance with ACI 318 on page 28. Embedment depths will need to increase according to the values determined from anchor design models when spacing requirements are less than the values listed below (S). A reduction in anchor capacity should be used if the concrete thickness does not allow for deep er embedments, as concrete breakout strength would control the design. When placing anchors that require a smaller edge distance (E) than what is recommended in the table below, the designer should be aware of a reduction in anchor capacity, as side face blowout strength would control the design.

S-7 Reusable Anchor - Minimum Spacing & Edge Distance

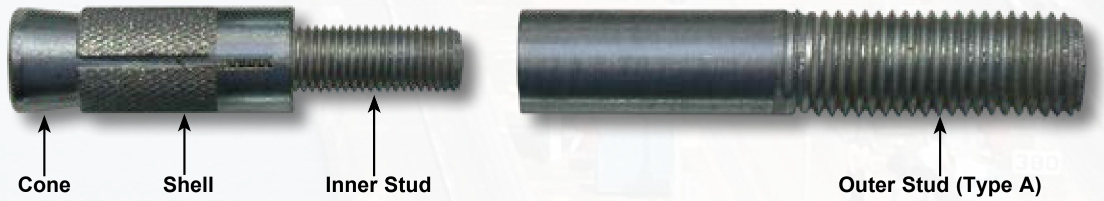
Outer Stud Diameter	Center to Center Spacing for Full Strength with no reduction (S) (3000 PSI Concrete)	Center to Center Spacing for Full Strength with no reduction (S) (6500 PSI Concrete)	Minimum Recommended Edge Distance (E) (3000 PSI Concrete)	Minimum Recommended Edge Distance (E) (6500 PSI Concrete)
1/2" - 13 (13 mm)	14" (356 mm)	11" (279 mm)	7" (178 mm)	5-1/2" (140 mm)
3/4" - 10 (19 mm)	24" (610 mm)	18" (457 mm)	12" (305 mm)	9" (229 mm)
1" - 8 (25 mm)	26" (660 mm)	20" (508 mm)	13" (330 mm)	10" (254 mm)
1-1/4" - 7 (32 mm)	26" (660 mm)	20" (508 mm)	13" (330 mm)	10" (254 mm)
1-3/4" - 5 (45 mm)	50" (1270 mm)	39" (991 mm)	25" (635 mm)	19-1/2" (495 mm)
2" - 6 (51 mm)	62" (1575 mm)	48" (1219 mm)	31" (787 mm)	24" (610 mm)

(1) Center to center spacing (S) is based on minimum embedment depth (h.ef), multiplied by 3, per ACI 318 for 3000 and 6500 psi concrete, respectively.
(2) Edge Distance (E) is based on minimum embedment depth (h.ef), multiplied by 1.5, per ACI 318 for 3000 and 6500 psi concrete, respectively. Values shown apply only to standard carbon steel grade S-7 anchors.

Materials

The Williams S-7 Reusable Concrete Anchor is offered in diameters ranging from 1/2"-13 UN thru 2"-6 UN and a choice of materials including ASTM A108 standard commercial grade carbon steel and ASTM A193 Grade B8 Type 304 stainless steels in anchor sizes up to 1" diameter. The anchors shall be complete with stud, cone, and expansion shell.

1. Anchor assembly for S-7 consists of:
   a. An anchor stud complying with ASTM A108 for carbon steel and ASTM A193 Grade B8 Type 304 for stainless steel.
   b. A Williams cone in threaded engagement with the inner end of the anchor stud complying with ASTM A 29 for carbon steel and ASTM A193 Grade B8 Type 304 for stainless steel. The cone shall have an exterior conical surface continuous in cross section to deliver bearing pressure radially with respect to the axis of the anchor bar.
   c. A Williams slotted expansion shell with an inner surface bearing on the cone, the outer surface initially of cylindrical curvature. The steel complies with ASTM A108 for carbon steel and ASTM A193 Grade B8 Type 304 for stainless steel.
2. The S9Z Setting Tool is required for installation of S-7 Reusable Concrete Anchors.

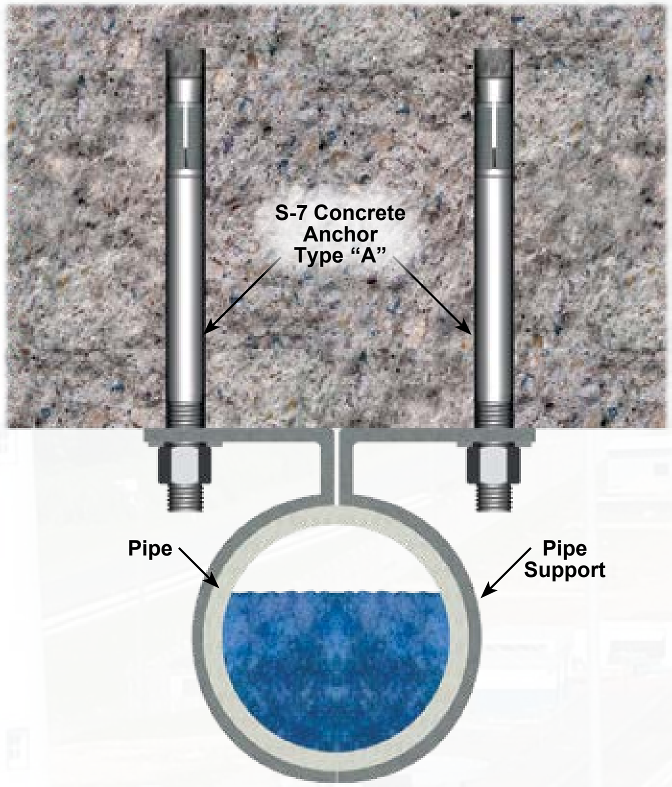


Williams S-7 anchors are specially designed with a cone that threads into the bottom of the anchor stud. This threaded portion at the bottom of the anchor governs the ultimate tensile capacity of the system, which explains why the tensile loads are lower than Williams Spin-Lock anchor systems. However, shear loading at the base plate is resisted by the full diameter of the anchor stud rather than the smaller threaded diameter at the cone/stud interface. The picture above illustrates this point. This process is necessary to provide the user with a reusable detachable anchor stud. The outer stud diameter dictates the shear strength of the anchor, while the inner stud diameter dictates the anchor tensile strength.

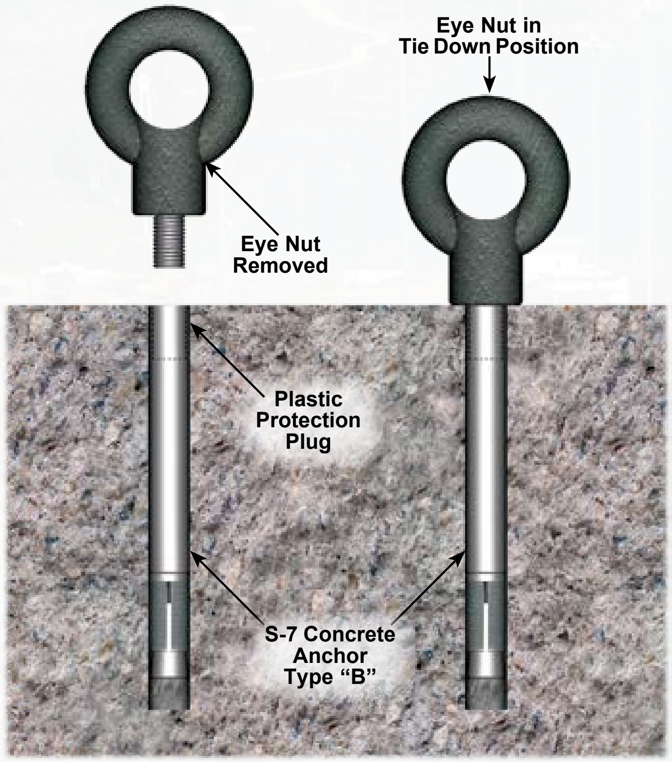
Applications

The S-7's unique design allows the hole to be drilled and the bolt to be placed through an existing plate, tower base or machine base when required. In a temporary bolting situation, the outer portion of the bolt may be removed and discarded or reused once the anchor is no longer needed. Since it is unnecessary to pull out or burn off unwanted anchors, patching operations are quick and clean.

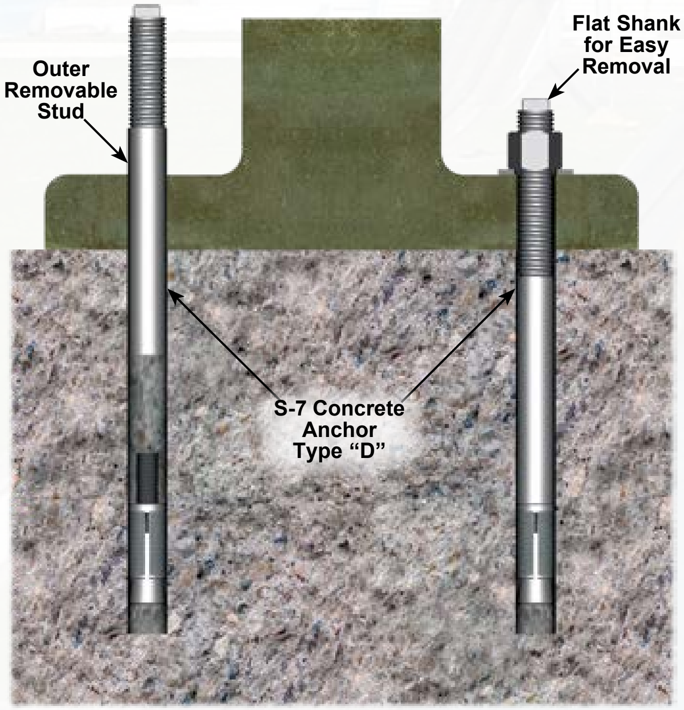
Pipe Supports or Electrical Tray Hangers



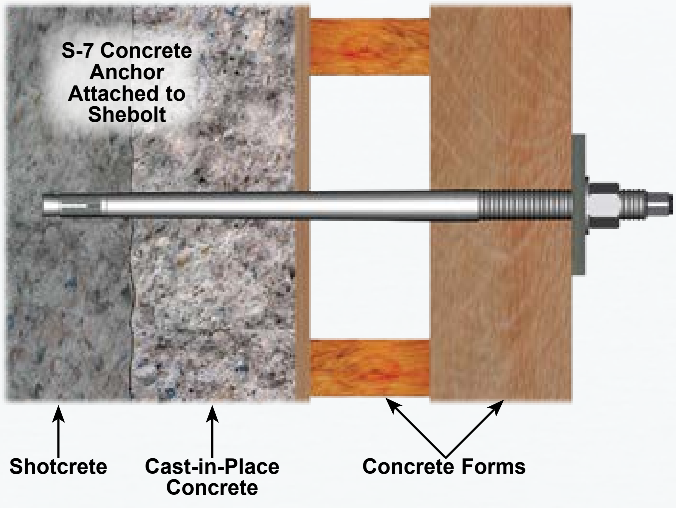
Temporary Tie Down Anchors for Aircraft & Inflatable Structure Covers



Removable Machinery Anchor



S-7 Form Tie



Installation

Step 1
Drill hole diameter to equal nominal bolt diameter. Holes in concrete should be two times the bolt diameter deeper than the embedment length.

Step 2
Install setting tool on S-7 anchor and tap with hammer into hole. If the anchor goes into the hole extremely loose, remove the anchor from the hole. Pre-expand the anchor head one half revolution or until it fits snugly into the drill hole.

Step 3
Torque the anchor bolt clockwise to indicated ft-lbs for expanding the anchor head.

Step 4
Remove setting tool. If the setting tool does not immediately remove, use a wrench to back off hex bolt in the setting tool. Install plate, washer, and nut.

Step 5
Torque nut to indicated ft.-lb. for pretension. The stud portion of the S-7 may be removed and reattached when required.

S9Z S-7 Setting Tool

Bar Diameter	Part Number
1/2”	S9Z-004
3/4”	S9Z-006
1”	S9Z-008
1-1/4”	S6Z-OH-010
1-3/4”	S6Z-OH-014
2”	S6Z-OH-016

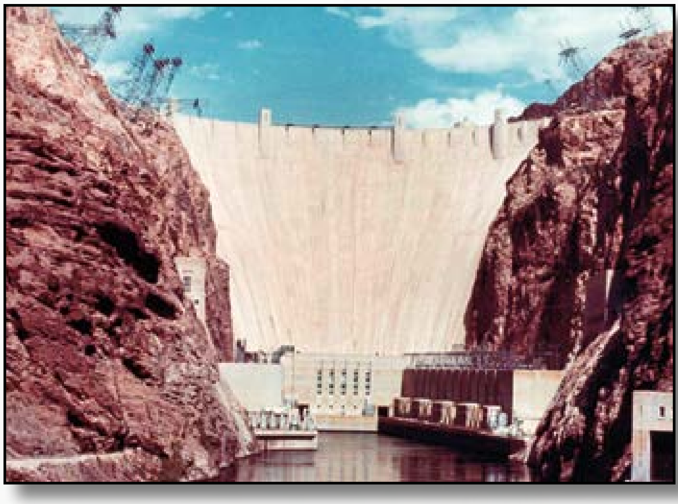
Included with each full box of anchors up to 1” in diameter. For anchors above 1” in diameter, use S6Z Spin-Lock Setting Tool.

Demonstration of S-7 Removable Use

Project Photos

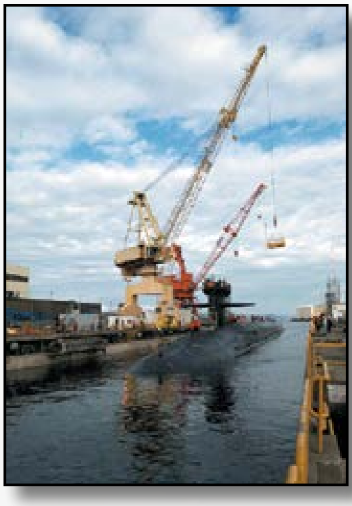
Project: CSX Concrete Removal
Contractor: Fenton Rigging
Location: Benton Harbor, MI

Project: CSX Concrete Removal
Contractor: Fenton Rigging
Location: Benton Harbor, MI



Project: Hoover Dam Spillway Repair
Contractor: Frontier Kemper Construction Co.
Location: Las Vegas, NV

Project: S-7 Installation Testing
Location: Grand Rapids, MI



Project: Navy Ship Yard Fender Repair
Location: Bangor, WA

Project: Panama Canal Rehab
Contractor: Panama Commission
Location: Panama Canal, Panama

Epoxy Anchor System

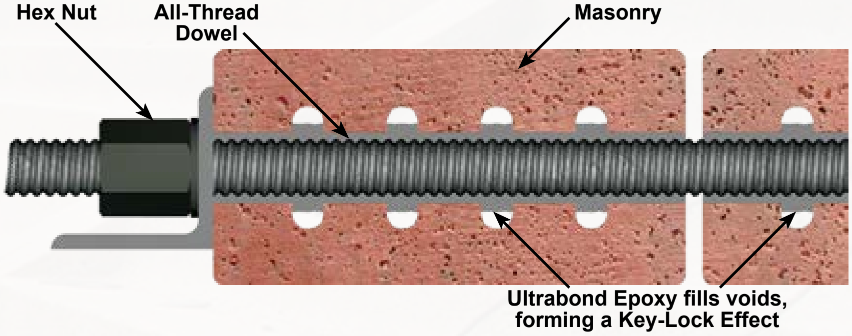
When are Epoxy Concrete Anchors used?

- Epoxy is ideal **for passive dowels or anchors without sustained loading conditions**; however, when high capacity anchors are to be prestressed, the designer should consider Williams Spin-Lock mechanical anchors.
- Use Williams epoxy anchors **for concrete anchors loaded in shear.**

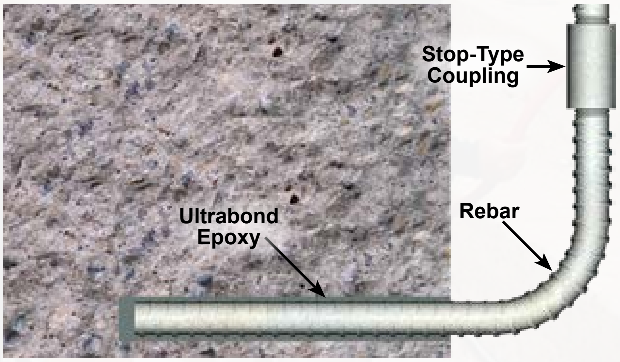
Applications

- Concrete Foundation Repair
- Seismic Retro-Fit
- Machinery Anchoring
- Anchors for Rail Systems
- Underwater Doweling
- Concrete Dock Repair and Construction
- Anchors subject to large shear loads
- Bridge Pier Reinforcement
- Pier Cap Repairs
- Dam Refacement
- General Plant Maintenance
- Column Anchors
- Light Poles

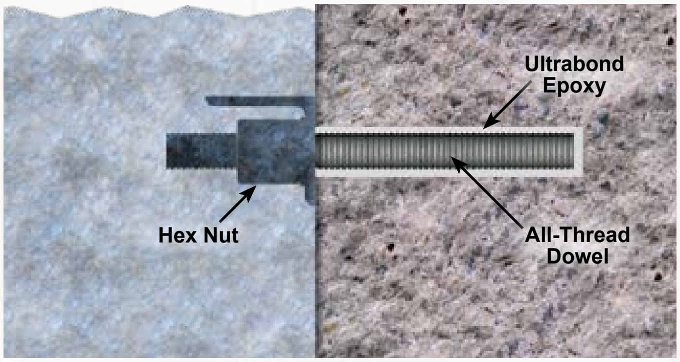
Typical Masonry Application



Rebar Extensions



Underwater Locations



Ultrabond HS-1CC

Ultrabond HS-1CC is IBC/IRC code compliant (ESR 4094), nationally DOT approved or pending, and the first anchoring system for cracked and uncracked concrete that's available in both cartridge and bulk dispensing options. With the highest short-term elevated temperature resistance of any approved epoxy, Ultrabond HS-1CC has a convenient 1:1 mix ratio for easier application. It's also NSF61 approved and made in the USA.

Ultrabond HYB-2CC

For cracked and uncracked concrete, new Ultrabond HYB-2CC is IBC approved (ESR 4535) for application in temperatures down to 23°F. And for jobs where a quick cure rate is required, it will cure completely in 30 minutes at 70°F. Approved for use in dry, damp and water-filled holes, Ultrabond HYB-2CC features a higher creep resistance and a longer shelf life. When you need a high strength hybrid anchoring adhesive that's approved for multiple anchor types - including fractional and metric threaded rod & rebar - choose Ultrabond HYB-2CC.

Ultrabond 1

DOT Approved - Over 20 years of trusted performance

Tried and true for more than 20 years, Ultrabond 1 is NTPEP compliant, offering substantial load capacity and a convenient 1:1 mix ratio. Made in the USA, Ultrabond 1 has numerous DOT approvals. Available in a variety of cartridge sizes and bulk containers.

Ultrabond 2

Extended working time for warmer weather

Much like Ultrabond 1 with a convenient 1:1 mix ratio and a variety of cartridge sizes and bulk containers, but with the added benefit of delayed set for extended working time.

Ultrabond Comparison

Epoxy Type	Strength (Scale 1-5)	Cure Speed (Scale 1-5)	Install Temperature
Ultrabond HS-1CC	5	3	38-125° F
Ultrabond HYB-2CC	5	5	23-104° F
Ultrabond 1	3	2	40-110° F
Ultrabond 2	2	1	40-110° F

All-Thread Bar Data

Williams All-Thread-Bars are used with the Ultrabond adhesive for unmatched anchoring versatility and capacities. The Ultrabond adhesive provides a molecular bond to the substrate while coating and protecting the embedded dowel. Epoxy Adhesive concrete anchors should be designed utilizing methods in Chapter 17 of the latest edition of ACI 318. Bars can be ordered cut to length or in stock lengths up to 50 feet for job-site cutting. Williams offers hex nuts, plates and washers with each anchor bar. Williams recommends epoxy anchors to only be specified as passive (non-prestressed) anchors.
Williams bars should never be torch cut.

R61 Grade 75 & Grade 80 All-Thread Rebar - ASTM A615

Bar Diameter	Minimum Net Area Thru Threads	Minimum Ultimate Strength	Grade 75 Minimum Yield Strength	Grade 80 Minimum Yield Strength	Approximate Thread Major Diameter	Recommended Hole Diameter	Maximum Recommended Embedment Depth (1)	Quantity of Ultrabond per Hole (2)
#6 - 3/4" (19 mm)	0.44 in^2 (284 mm^2)	44 kips (196 kN)	33 kips (147 kN)	35 kips (156 kN)	7/8" (22 mm)	1" (25 mm)	15" (381 mm)	2.9 oz (5.2 in^3)
#7 - 7/8" (22 mm)	0.60 in^2 (387 mm^2)	60 kips (267 kN)	45 kips (200 kN)	48 kips (214 kN)	1" (25 mm)	1-1/8" (29 mm)	17-1/2" (445 mm)	3.8 oz (6.9 in^3)
#8 - 1" (25 mm)	0.79 in^2 (510 mm^2)	79 kips (351 kN)	59 kips (264 kN)	63 kips (280 kN)	1-1/8" (28 mm)	1-1/4" (32 mm)	20" (508 mm)	4.9 oz (8.8 in^3)
#9 - 1-1/8" (28 mm)	1.00 in^2 (645 mm^2)	100 kips (445 kN)	75 kips (334 kN)	80 kips (356 kN)	1-1/4" (32 mm)	1-3/8" (35 mm)	22-1/2" (572 mm)	6.1 oz (11 in^3)
#10 - 1-1/4" (32 mm)	1.27 in^2 (819 mm^2)	127 kips (565 kN)	95 kips (424 kN)	102 kips (454 kN)	1-3/8" (35 mm)	1-5/8" (41 mm)	25" (635 mm)	11.8 oz (21.2 in^3)
#11 - 1-3/8" (35 mm)	1.56 in^2 (1006 mm^2)	156 kips (694 kN)	117 kips (521 kN)	125 kips (556 kN)	1-1/2" (38 mm)	1-3/4" (45 mm)	27-1/2" (699 mm)	14 oz (25.3 in^3)
#14 - 1-3/4" (45 mm)	2.25 in^2 (1452 mm^2)	225 kips (1001 kN)	169 kips (750 kN)	180 kips (801 kN)	1-7/8" (48 mm)	2-1/8" (55 mm)	35" (889 mm)	22.2 oz (40 in^3)
#18 - 2-1/4" (55 mm)	4.00 in^2 (2581 mm^2)	400 kips (1780 kN)	300 kips (1335 kN)	320 kips (1423 kN)	2-7/16" (62 mm)	2-3/4" (70 mm)	45" (1143 mm)	49 oz (88.4 in^3)

B8V High Impact Bar - Grade B7 - ASTM A193

Bar Diameter & Pitch	Minimum Net Area Thru Threads	Minimum Ultimate Strength	Minimum Yield Strength	Approximate Thread Major Diameter	Recommended Hole Diameter	Maximum Recommended Embedment Depth (1)	Quantity of Ultrabond per Hole (2)
1/2" - 13 UNC (13 mm)	0.142 in^2 (91.6 mm^2)	17.8 kips (79.0 kN)	14.9 kips (66.3 kN)	1/2" (13 mm)	9/16" (14.3 mm)	10" (254 mm)	0.3 oz (0.5 in^3)
5/8" - 11 UNC (16 mm)	0.226 in^2 (146 mm^2)	28.3 kips (126 kN)	23.7 kips (106 kN)	5/8" (16 mm)	3/4" (19 mm)	12-1/2" (318 mm)	0.9 oz (1.7 in^3)
3/4" - 10 UNC (19 mm)	0.334 in^2 (215 mm^2)	41.8 kips (186 kN)	35.0 kips (156 kN)	3/4" (19 mm)	7/8" (22 mm)	15" (381 mm)	1.3 oz (2.4 in^3)
7/8" - 9 UNC (22 mm)	0.462 in^2 (298 mm^2)	57.8 kips (257 kN)	48.5 kips (216 kN)	7/8" (22 mm)	1" (25 mm)	17-1/2" (445 mm)	1.8 oz (3.2 in^3)
1" - 8 UNC (25 mm)	0.606 in^2 (391 mm^2)	75.8 kips (337 kN)	63.6 kips (283 kN)	1" (25 mm)	1-1/8" (29 mm)	20" (508 mm)	2.3 oz (4.2 in^3)
1-1/8" - 7 UNC (29 mm)	0.763 in^2 (492 mm^2)	95.4 kips (424 kN)	80.1 kips (356 kN)	1-1/8" (28 mm)	1-1/4" (32 mm)	22-1/2" (572 mm)	2.9 oz (5.3 in^3)
1-1/4" - 7 UNC (32 mm)	0.969 in^2 (625 mm^2)	121 kips (539 kN)	102 kips (453 kN)	1-1/4" (32 mm)	1-3/8" (35 mm)	25" (635 mm)	3.6 oz (6.5 in^3)
1-3/8" - 8 UN (35 mm)	1.23 in^2 (794 mm^2)	154 kips (684 kN)	129 kips (575 kN)	1-3/8" (35 mm)	1-5/8" (41 mm)	27-1/2" (699 mm)	9 oz (16.2 in^3)
1-1/2" - 6 UNC (38 mm)	1.41 in^2 (909 mm^2)	176 kips (784 kN)	148 kips (658 kN)	1-1/2" (38 mm)	1-3/4" (45 mm)	30" (762 mm)	10.6 oz (19.2 in^3)
1-3/4" - 5 UNC (45 mm)	1.90 in^2 (1226 mm^2)	238 kips (1056 kN)	200 kips (887 kN)	1-3/4" (45 mm)	2" (51 mm)	35" (889 mm)	14.3 oz (25.8 in^3)
2" - 6 UN (51 mm)	2.65 in^2 (1710 mm^2)	331 kips (1473 kN)	278 kips (1237 kN)	2" (51 mm)	2-1/4" (57 mm)	40" (1016 mm)	18.5 oz (33.4 in^3)

1) Recommend embedment depths are based on ACI 318-14, Section 17.3.2.3 with Maximum embedment depth not to exceed 20 bar diameters. Greater embedments depths may be considered provided each anchor is tested to verify adequate bond strength.
2) Volumes are based on the Maximum Recommended Embedment Depth and the recommended drill hole diameter. For different embedment depths, the volume can be estimated by linear interpolation.
* Bars larger than 1-1/4" are not included within ESR-4094 for Ultrabond HS-1CC or ESR-4535 for Ultrabond HYB-2CC.

Installation

Job-Site Preparation and Work Flow

These installation procedures provide a general idea of proper epoxy adhesive anchor installation. However, to achieve the desired results and capacities, it is important to follow the preparation and installation instructions as detailed in the most current Manufacturer's Printed Installation Instruction (MPII) included in the product packaging.

Manual Epoxy Dispenser
(A Pneumatic Epoxy Dispenser is available for the 53 oz cartridge.

The "HP" Mixing Nozzle breaks off to accommodate varying hole diameters and depths.

Dual Cartridge Anchoring & Doweling Into Concrete

1. Drill hole to proper diameter and depth. Blow out dust from the bottom of the hole. Brush the hole with a nylon brush. Blow out dust again. The hole should be dry and clean of dust and debris.

2. Insert cartridge into the gun with label side down. This allows you to see how much material is left in the cartridge.

3. Remove plastic band and black caps from the cartridge. Dispense a small amount of epoxy into a disposable container until you get an even flow of black and white material.

4. Thread nozzle onto cartridge, making sure the nozzle, and cartridge assembly are secure. Dispense enough epoxy into a disposable container, until the color becomes a consistent gray with no streaks.

5. Dispense the material from the bottom of the hole. Fill approximately 1/4 of the hole depth while slowly withdrawing the nozzle.

6. Insert the threaded bar or rebar to the bottom of the hole while turning bar into epoxy. The threaded bar or rebar should be free of dirt, grease, oil, or other foreign materials. Do not disturb or bolt-up until minimum bolt-up time has passed.

Project Photos

Project: Atlantis Systems Flight Simulator
Contractor: Rianna Contracting Ltd.
Location: Brampton, ON

Project: Ohio River Bridge - East End
Contractor: Walsh Construction
Location: Louisville, KY

Project: Foundation Upgrade
Contractor: JBS Energy Solutions
Location: Mountaineer, WV

Project: Foundation Upgrade
Contractor: JBS Energy Solutions
Location: Mountaineer, WV

Project: Cannelton Hydro
Contractor: Walsh Construction
Location: Hawesville, KY

Project: Popps Ferry Bridge Rehab
Contractor: Coastal Marine Contractors
Location: Biloxi, MS

Sledge Drive Mechanical Ancors

Quick, simple anchor designed to develop the full strength of the bar. Recommended for short anchors in rock or concrete. Available with 1-5/8" menter aluminum expansion shell. In temporary situations, bar may be removed and used again. Williams can supply custom length steel drive pipes at your request.

Stee Type	Bar Diameter	Maximum Factored Design Load	Ultimate Strength (fu)	Drill Hole	Minimum Embedment (3000 PSI - f'c)	Minimum Embedment (6500 PSI - f'c)	Part Number B8S Cone / Shell (B7S Cone / Shell)
B1S Smooth Rod B7S All-Thread Coil Rod B8S All-Thread N.C. Rod	3/8" (9.5 mm)	7.8 kips (32.7 kN)	9.8 kips (43.6 kN)	1-5/8" (41 mm)	5" (127 mm)	4" (102 mm)	R4M03RB0 / R4A13 (R4MC3RB0 / R4A13)
	1/2" (13 mm)	13.5 kips (60.0 kN)	18 kips (80.1 kN)	1-5/8" (41 mm)	8" (204 mm)	6" (153 mm)	R4M04RB0 / R4A13 (R4MC4RB0 / R4A13)
	5/8" (16 mm)	16.8 kips (74.7 kN)	22.5 kips (100 kN)	1-5/8" (41 mm)	9" (229 mm)	7" (178 mm)	R4M05RB0 / R4A13 (R4MC5RB0 / R4A13)
	3/4" (19 mm)	27.0 kips (120 kN)	36 kips (160 kN)	1-5/8" (41 mm)	12" (305 mm)	9" (229 mm)	R4M06RAC / R4A13 (R4MC6RAC / R4A13)
	7/8" (22 mm)	43.5 kips (193 kN)	58 kips (258 kN)	1-5/8" (41 mm)	16" (407 mm)	12" (305 mm)	R4M07RAC / R4A13 (R4MC7RAC / R4A13)
R50 Grade 60 All-Thread Rebar	#4 - 1/2" (13 mm)	12 kips (53.3 kN)	16 kips (71.2 kN)	1-5/8" (41 mm)	8" (204 mm)	6" (153 mm)	R4MG4RAC / R4A13
	#5 - 5/8" (16 mm)	19.2 kips (85.4 kN)	26 kips (114 kN)	1-5/8" (41 mm)	10" (254 mm)	8" (204 mm)	R4MG5RAC / R4A13
R61 Grade 75 & Grade 80 All-Thread Rebar	#6 - 3/4" (19 mm)	33.0 kips (146 kN)	44 kips (196 kN)	1-5/8" (41 mm)	13" (331 mm)	10" (254 mm)	R4MG6RAC / R4A13

(1) Minimum embedment depths reflect values for ductile steel failure in accordance with ACI 318 for 3000 and 6500 PSI concrete, respectively.
(2) Sledge drive anchor minimum spacing shall be the minimum embedment depth (h.ef) multiplied by 3 in accordance with ACI 318 for 3000 and 6500 PSI concrete, respectively.
(3) Sledge drive anchor minimum edge distance shall be the minimum embedment depth (h.ef) multiplied by 1.5 in accordance with ACI 318 for 3000 and 6500 PSI concrete, respectively.

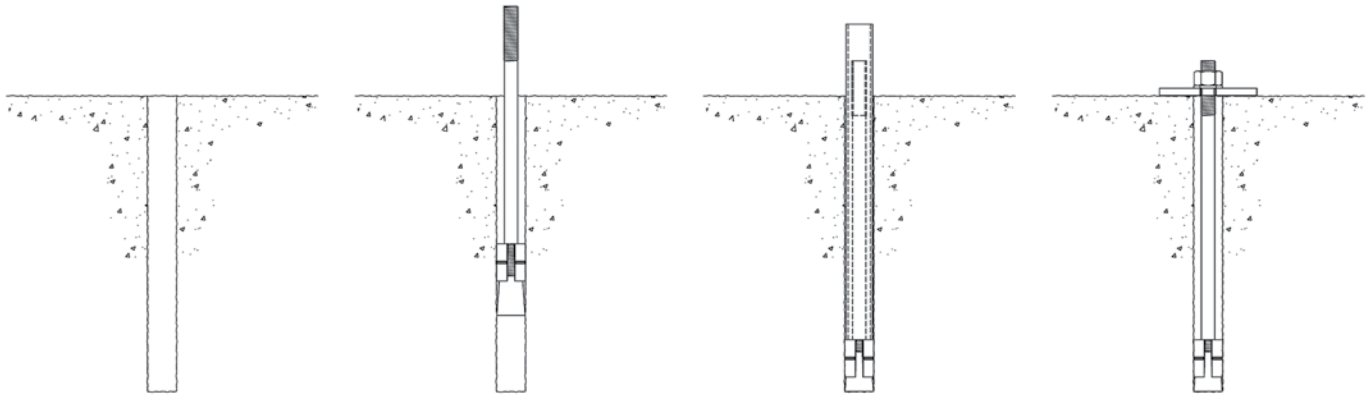
Sledge Drive Anchor Installation

Drill hole to prescribed meter and exact embedment depth for rock bolt.

Insert Sledge Drive Anchor to bottom of hole. Bolt may be tapped in place.

Place heavy wall pipe driver over bar and drive shell down over cone to expand anchor.

Attach item to be anchored or plate and nut. Anchor may be prestressed or pre-tested.

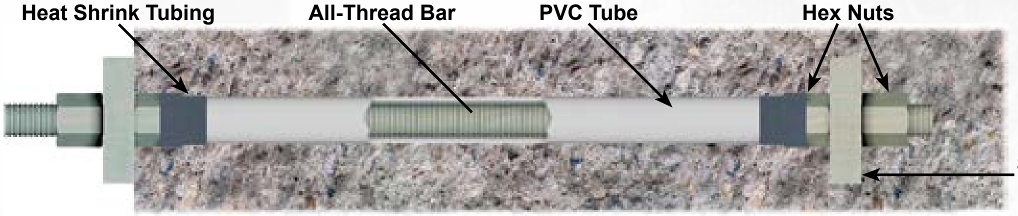


Cast-in-Place Anchors

Williams Form Engineering can supply a wide range of cast-in-place concrete anchor systems. Ranging from J, U and L-Bolts to a special post-tensionable anchor system that Williams has used on several high profile projects. Anchor design criterea for cast-in-place anchors can be found in ACI 318.

Cast-in-Place Post-Tensionable System

The system shown below allows the engineer to design an anchor system that can be cast-in-place and after the concrete sets, the anchor can be prestressed. The bond breaker provides a free stress length commonly used in post-tensioning systems. The free stress length helps to prevent load loss and concrete spalling that can eventually lead to corrosion problems or fatigue failure. After the anchor is prestressed, the inside of the sleeve can be grouted or it can be pre-greased with a corrosion inhibiting product prior to anchor placement. Bar strengths are listed on pages 42-45.



Project: Fjardaal Smelting Plant
Contractor: Bechtel Overseas Corp.
Location: Iceland

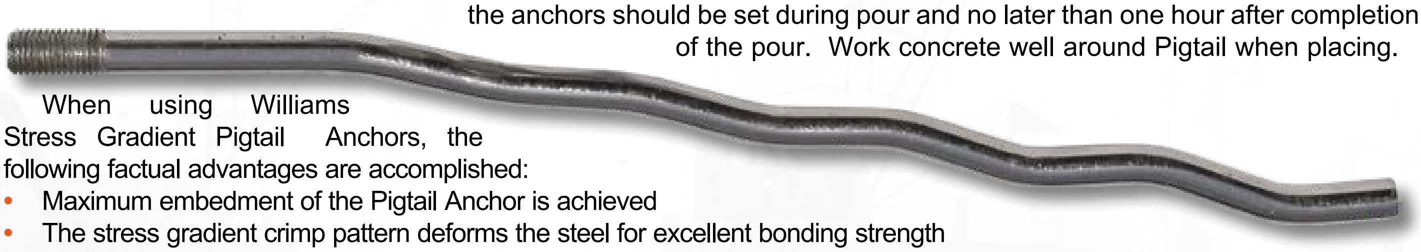
Project: London Lock & Dam Rehabilitation
Contractor: OCCI Inc.
Location: London, WV

Cast-in-Place Anchors

Stress Gradient Pigtail Anchor

Williams patented Stress Gradient Pigtail Anchor has a unique design, which gradually increases the depth of each crimp to develop a full length Pigtail anchor. The lesser crimps in front allow the Pigtail to elongate through the concrete thereby transferring stress over its entire length. The stress gradient anchor is a positive "non-slip" anchor, which may be placed within 3" of an edge even in low compression strength concrete.

Williams combines the extra strength of stress gradient Pigtail anchors with high tensile 120 KSI steel for more strength per pound than mild steel. A 1/2" high tensile bar will do the work of a 5/8" mild steel bar. Always remember the anchors should be set during pour and no later than one hour after completion of the pour. Work concrete well around Pigtail when placing.



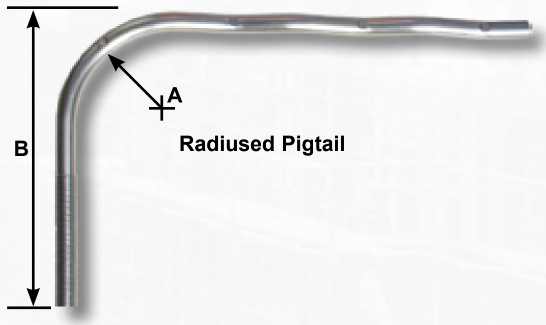
When using Williams Stress Gradient Pigtail Anchors, the following factual advantages are accomplished:

- Maximum embedment of the Pigtail Anchor is achieved
- The stress gradient crimp pattern deforms the steel for excellent bonding strength
- The high tensile steel offers high working loads with no welds which can limit strength.

B5S Stress Gradient Pigtail Anchor

ASTM A108 Grade C1045

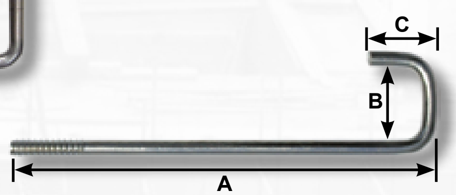
Standard Lengths		Radiused Lengths			Safe Working Load (2:1 SF)	Ultimate Strength
Diameter	Total Length	A	B	C Total Length		
3/8" - 8 NC (9.5 mm)	12" (305 mm)	4" (102 mm)	10" (254 mm)	22" (559 mm)	4.9 kips (21.8 kN)	9.8 kips (43.6 kN)
1/2" - 13 UNC (13 mm)	18" (457 mm)	4" (102 mm)	10" (254 mm)	24" (610 mm)	8.53 kips (37.9 kN)	17.1 kips (75.8 kN)
5/8" - 11 UNC (16 mm)	24" (610 mm)	6" (152 mm)	12" (305 mm)	30" (762 mm)	13.6 kips (60.3 kN)	27.1 kips (120.6 kN)
3/4" - 10 UNC (19 mm)	24" (610 mm)	6" (152 mm)	12" (305 mm)	30" (762 mm)	20.1 kips (89.2 kN)	40.1 kips (178 kN)
7/8" - 9 UNC (22 mm)	30" (762 mm)	8" (203 mm)	14" (356 mm)	36" (914 mm)	27.7 kips (123 kN)	55.4 kips (246 kN)
1" - 8 UNC (25 mm)	36" (914 mm)	8" (203 mm)	14" (356 mm)	42" (1067 mm)	36.4 kips (162 kN)	72.7 kips (323 kN)
1-1/8" - 7 UNC (29 mm)	36" (914 mm)	N.A.	N.A.	N.A.	40.5 kips (180 kN)	81 kips (360 kN)
1-1/4" - 7 UNC (32 mm)	42" (1067 mm)	N.A.	N.A.	N.A.	51 kips (254 kN)	102 kips (508 kN)
2" - 6 UN (51 mm)	72" (1829 mm)	N.A.	N.A.	N.A.	139 kips (657 kN)	279 kips (1313 kN)



Anchor data reflects results from in house testing and the cast-in-place anchors do not conform to the code requirement of ACI 318. Pigtail lengths shown are recommended for 3000 PSI concrete or better.

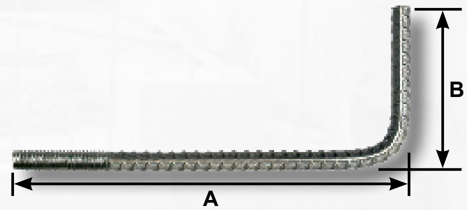
B3Z Column Anchor

Williams B3Z Column Anchor was designed for use in most general construction, specifically machine, column or utility pole anchoring. The two-piece feature gives this anchor the ability to be placed flush with the concrete, therefore, eliminating interference during concrete placement and finishing. The anchor stud can then be conveniently threaded into the replaced anchor assembly as needed. Williams Column Anchor studs and bars are fabricated from ASTM A108 Grade C1045 steel with a high tensile strength. Couplings are designed to exceed bar strengths. Anchors are available in most diameters. Plastic caps are provided to protect the threads during concrete pouring.



B4S J-Bolts

Round or square bottom J-bolts with most length and radius combinations available for a wide range of applications. Available in most diameters with coil or V-thread. To order, please specify diameter, A and B dimensions, thread type and length.

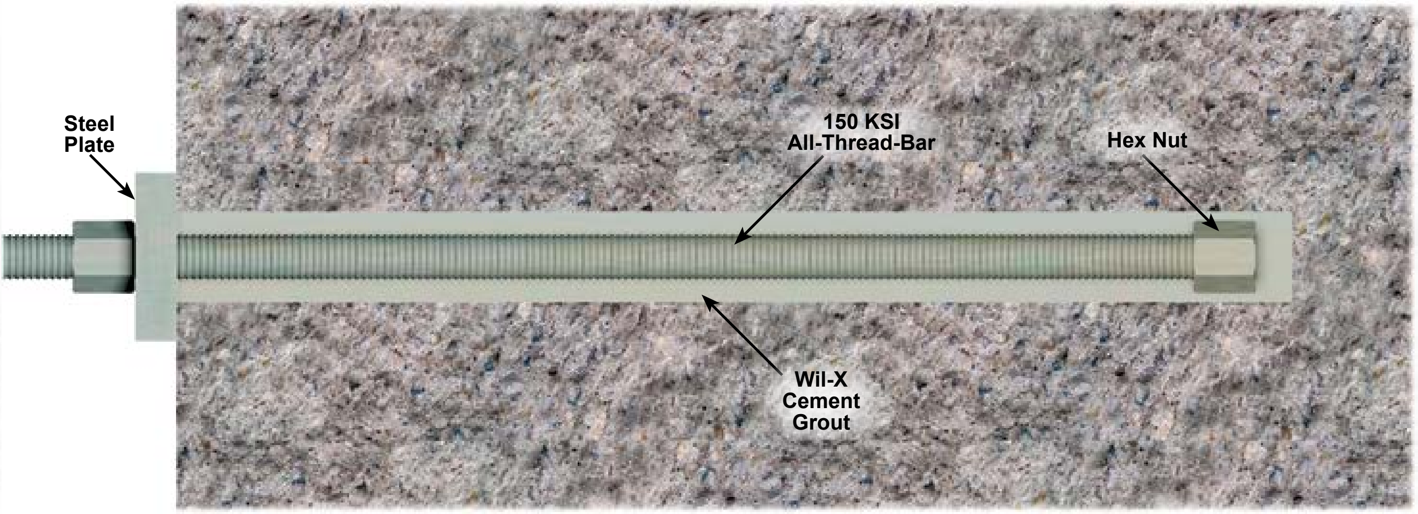


B3S L-Bolts

May be used as embedded anchor bolts. Available in most diameters with coil or V-thread. To order, please specify diameter, A and B dimensions, thread type and length.

Grout Bonded Concrete Anchors

Williams' grouted concrete anchors are post-installed bars utilizing a high strength grout for the bonding material. The advantage of using a grout versus and epoxy is cement grout does not break down in high heat areas and can be pumped into deep embedded holes easier than epoxy. The disadvantages are longer set times than epoxy and the bond stress may also be lower. Williams offers US Spec RA Grout (High Flow, Non-aggregate, Non-shrink grout) for cement grout bonded anchors. This product is manufactured by US Spec. Has excellent grout bond characteristics and quick set-up times. See page 47 for the RA Grout properties. Shown on the following pages are the various steels and corresponding hex nuts that are used for Williams Grout Bonded Concrete Anchors.



Grouted concrete anchors typically use a hex nut at the bottom of the anchor rod. This helps to assure that a failure will not occur at the grout to bar interface. The modes of failure that can be evaluated for a single grouted concrete anchor include, ductile steel failure, concrete breakout failure and bond failure. By setting the bar's ultimate steel strength equal to the concrete breakout strength, the designer can estimate a recommended embedment depth using industry design models. In addition bond failure can be checked by using a Uniform Bond Stress Model. Presently the anchor industry is absent of a formal design code for grouted anchors, however the designer can consider the following equations taken from *ACI 318-14 Chapter 17* for assistance.

Uniform Bond Stress Model

$$P_w = \tau_w * \pi * d * h_{ef}$$

P_w = Working Load (lbs)

τ_w = Working Bond Stress
5% of the concrete compressive strength, not to exceed 300 psi

π = 3.14

d = $1.5 * d_a$ Drill Hole diameter (in) - minimum is 1.5 times the bar diameter

h_{ef} = Anchor embedment depth (in)

Concrete Breakout Strength

$$N_{cb} = \frac{A_{Nc}}{A_{Nco}} * \Psi_{ed} * \Psi_c * \Psi_{cp} * N_b$$

Single anchor breakout strength - Equation 17.4.2.1a

$$N_{cbg} = \frac{A_{Nc}}{A_{Nco}} * \Psi_{ec} * \Psi_{ed} * \Psi_c * \Psi_{cp} * N_b$$

Anchor group breakout strength - Equation 17.4.2.1b

$$N_b = k_c * \sqrt{f_c} * h_{ef}^{1.5}$$

Basic breakout strength of a single anchor in tension in cracked concrete
Equation 17.4.2.2a

Note: Variables derived on pages 6 & 7

Note:
Williams recommends designing for ductile steel failure whenever possible. Steel strengths can be collected from the strength charts.

Fasteners for NC Threaded Bar

H1F Heavy Duty Hex Nuts

Bar Diameter	Across Flats	Across Corners	Thickness	Part Number
3/8” (9.5 mm)	11/16” (18 mm)	0.79” (20 mm)	23/64” (9 mm)	H1F-03
1/2” (13 mm)	7/8” (22 mm)	1.0” (26 mm)	31/64” (12 mm)	H1F-04
5/8” (16 mm)	1-1/16” (27 mm)	1.2” (31 mm)	39/64” (16 mm)	H1F-05
3/4” (19 mm)	1-1/4” (32 mm)	1.4” (37 mm)	47/64” (19 mm)	H1F-06
7/8” (22 mm)	1-7/16” (36.6 mm)	1.7” (42 mm)	55/64” (22 mm)	H1F-07
1” (25 mm)	1-5/8” (41 mm)	1.9” (48 mm)	63/64” (25 mm)	H1F-08
1-1/8” (29 mm)	1-13/16” (46 mm)	2.1” (53 mm)	1-7/64” (28 mm)	H1F-09
1-1/4” (32 mm)	2” (51 mm)	2.3” (59 mm)	1-7/32” (31 mm)	H1F-10
1-3/8” (36 mm)	2-3/16” (56 mm)	2.5” (64 mm)	1-11/32” (34 mm)	H1F-11
1-1/2” (38 mm)	2-3/8” (60 mm)	2.7” (70 mm)	1-15/32” (37 mm)	H1F-12
1-3/4” (43 mm)	2-3/4” (70 mm)	3.2” (81 mm)	1-23/32” (44 mm)	H1F-14
1-7/8” (48 mm)	2-15/16” (75 mm)	3.4” (86 mm)	1-27/32” (47 mm)	H1F-15
2” (51 mm)	3-1/8” (79 mm)	3.6” (92 mm)	1-31/32” (50 mm)	H1F-16
2-1/4” (57 mm)	3-1/2” (89 mm)	4.0” (103 mm)	2-1/4” (57 mm)	H1F-18

C2T Stop-Type & C2D Flange Couplings

Bar Diameter	Outside Diameter	Overall Length	Stop-Type Part Number	Flange Coupling	
				Flange Size	Part Number
3/8” (9.5 mm)	3/4” (19 mm)	1-1/2” (38 mm)	C2T-03	2” x 2” (51 x 51 mm)	C2D-03
1/2” (13 mm)	3/4” (19 mm)	1-1/2” (38 mm)	C2T-04	2” x 2” (51 x 51 mm)	C2D-04
5/8” (16 mm)	1” (25 mm)	1-3/4” (45 mm)	C2T-05	2” x 2” (51 x 51 mm)	C2D-05
3/4” (19 mm)	1-1/8” (29 mm)	2” (51 mm)	C2T-06	2” x 2” (51 x 51 mm)	C2D-06
7/8” (22 mm)	1-1/4” (32 mm)	2-1/4” (57 mm)	C2T-07	3” x 3” (76 x 76 mm)	C2D-07
1” (25 mm)	1-1/2” (38.1 mm)	3” (76 mm)	C2T-08	3” x 3” (76 x 76 mm)	C2D-08
1-1/8” (29 mm)	1-5/8” (41 mm)	3-1/2” (89 mm)	C2T-09	3” x 3” (76 x 76 mm)	C2D-09
1-1/4” (32 mm)	1-7/8” (48 mm)	3-3/4” (95 mm)	C2T-10	3” x 3” (76 x 76 mm)	C2D-10
1-3/8” (35 mm)	2-1/8” (54 mm)	4” (102 mm)	C2T-11	3” x 3” (76 x 76 mm)	C2D-11
1-1/2” (38 mm)	2-1/4” (57 mm)	5” (127 mm)	C2T-12	3” x 3” (76 x 76 mm)	C2D-12
1-3/4” (45 mm)	2-1/2” (64 mm)	5-1/2” (140 mm)	C2T-14	4” x 4” (102 x 102 mm)	C2D-14
1-7/8” (48 mm)	2-7/8” (73 mm)	6” (152 mm)	C2T-15	-	-
2” (51 mm)	3” (76 mm)	6” (152 mm)	C2T-16	-	-
2-1/4” (57 mm)	3-1/2” (89 mm)	8” (203 mm)	C2T-18	-	-

R9F Hardened Washers

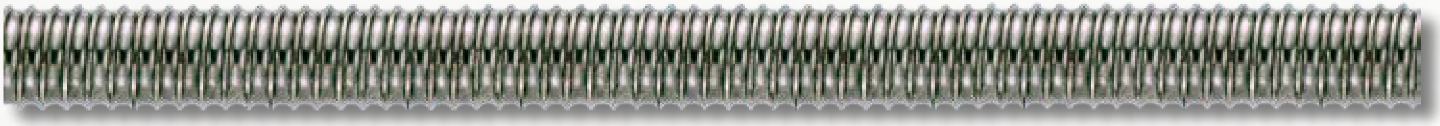
Bar Diameter	Outside Diameter	Inside Diameter	Thickness	Part Number
3/8” (9.5 mm)	1” (25 mm)	7/16” (11 mm)	5/64” (2 mm)	R9F-03-436
1/2” (13 mm)	1-1/16” (27 mm)	17/32” (14 mm)	9/64” (3.6 mm)	R9F-04-436
5/8” (16 mm)	1-5/16” (33 mm)	11/16” (17 mm)	9/64” (3.6 mm)	R9F-05-436
3/4” (19 mm)	1-7/16” (37 mm)	13/16” (21 mm)	9/64” (3.6 mm)	R9F-06-436
7/8” (22 mm)	1-3/4” (45 mm)	15/16” (24 mm)	5/32” (4 mm)	R9F-07-436
1” (25 mm)	2” (51 mm)	1-1/16” (29 mm)	5/32” (4 mm)	R9F-08-436
1-1/8” (29 mm)	2-1/4” (57 mm)	1-3/16” (30 mm)	5/32” (4 mm)	R9F-09-436
1-1/4” (32 mm)	2-1/2” (64 mm)	1-3/8” (35 mm)	5/32” (4 mm)	R9F-10-436
1-3/8” (36 mm)	2-3/4” (70 mm)	1-1/2” (38 mm)	5/32” (4 mm)	R9F-11-436
1-1/2” (38 mm)	3” (76 mm)	1-5/8” (41 mm)	5/32” (4 mm)	R9F-12-436
1-3/4” (43 mm)	3-3/8” (86 mm)	1-7/8” (48 mm)	7/32” (6 mm)	R9F-14-436
1-7/8” (48 mm)	3-3/4” (95 mm)	2-1/8” (54 mm)	7/32” (6 mm)	R9F-16-436
2” (51 mm)	3-3/4” (95 mm)	2-1/8” (54 mm)	7/32” (6 mm)	R9F-16-436
2-1/4” (57 mm)	4” (102 mm)	2-3/8” (60 mm)	9/32” (7 mm)	R9F-18-436

R8M Beveled Washers

Bar Diameter	Degree of Bevel	Outside Diameter	Inside Diameter	Maximum Thickness	Minimum Thickness	Part Number
3/8” (9.5 mm)	14°	1-1/4” (32 mm)	9/16” (14 mm)	7/16” (11 mm)	1/8” (3 mm)	R8M-03
1/2” (13 mm)	14°	1-1/4” (32 mm)	9/16” (14 mm)	7/16” (11 mm)	1/8” (3 mm)	R8M-04
5/8” (16 mm)	11°	1-9/16” (40 mm)	13/16” (21 mm)	1/2” (13 mm)	3/16” (5 mm)	R8M-06
3/4” (19 mm)	11°	1-9/16” (40 mm)	13/16” (21 mm)	1/2” (13 mm)	3/16” (5 mm)	R8M-06
7/8” (22 mm)	15°	2-1/16” (52 mm)	1” (25 mm)	3/4” (19 mm)	1/4” (6 mm)	R8M-08S
1” (25 mm)	15°	2-1/16” (52 mm)	1” (25 mm)	3/4” (19 mm)	1/4” (6 mm)	R8M-08S
1-1/8” (29 mm)	15°	2-13/16” (71 mm)	1-5/16” (33 mm)	1” (25 mm)	5/16” (8 mm)	R8M-09S
1-1/4” (32 mm)	15°	3-3/8” (86 mm)	1-9/16” (40 mm)	1-15/64” (31 mm)	3/8” (10 mm)	R8M-12S
1-3/8” (36 mm)	15°	3-3/8” (86 mm)	1-9/16” (40 mm)	1-15/64” (31 mm)	3/8” (10 mm)	R8M-12S
1-1/2” (38 mm)	15°	3-1/2” (89 mm)	1-3/4” (45 mm)	1-1/4” (32 mm)	3/8” (10 mm)	R8M-13S
1-3/4” (43 mm)	5°	3-9/16” (91 mm)	2-1/16” (52 mm)	13/16” (21 mm)	1/2” (13 mm)	R8M-16
1-7/8” (48 mm)	5°	3-9/16” (91 mm)	2-1/16” (52 mm)	13/16” (21 mm)	1/2” (13 mm)	R8M-16
2” (51 mm)	5°	3-9/16” (91 mm)	2-1/16” (52 mm)	13/16” (21 mm)	1/2” (13 mm)	R8M-16
2-1/4” (57 mm)	-	-	-	-	-	-

To achieve full strength of the nut, beveled washers must be used in conjunction with a hardened washer

150 KSI All-Thread-Bar



R71 150 KSI All-Thread-Bar

ASTM A722*

Nominal Bar Diameter & Pitch	Minimum Net Area Thru Threads	Minimum Ultimate Strength	Prestressing Force			Nominal Weight	Approx. Thread Major Dia.	Part Number
			$0.80 f_{pu} A$	$0.70 f_{pu} A$	$0.60 f_{pu} A$			
1" - 4 (26 mm)	0.85 in² (549 mm²)	128 kips (567 kN)	102 kips (454 kN)	89.3 kips (397 kN)	76.5 kips (340 kN)	3.09 lbs/ft (4.6 kg/m)	1-1/8" (29 mm)	R71-08
1-1/4" - 4 (32 mm)	1.25 in² (807 mm²)	188 kips (834 kN)	150 kips (667 kN)	131 kips (584 kN)	113 kips (500 kN)	4.51 lbs/ft (6.7 kg/m)	1-7/16" (37 mm)	R71-10
1-3/8" - 4 (36 mm)	1.58 in² (1019 mm²)	237 kips (1054 kN)	190 kips (843 kN)	166 kips (738 kN)	142 kips (633 kN)	5.71 lbs/ft (8.5 kg/m)	1-9/16" (40 mm)	R71-11
1-3/4" - 3-1/2 (46 mm)	2.60 in² (1664 mm²)	390 kips (1734 kN)	312 kips (1388 kN)	273 kips (1214 kN)	234 kips (1041 kN)	9.06 lbs/ft (13.5 kg/m)	2" (51 mm)	R71-14
2-1/4" - 3-1/2 (57 mm) *	4.08 in² (2632 mm²)	613 kips (2727 kN)	490 kips (2181 kN)	429 kips (1909 kN)	368 kips (1636 kN)	14.1 lbs/ft (20.8 kg/m)	2-1/2" (64 mm)	R71-18
2-1/2" - 3 (65 mm)	5.19 in² (3350 mm²)	778 kips (3457 kN)	622 kips (2766 kN)	545 kips (2422 kN)	467 kips (2074 kN)	18.2 lbs/ft (27.1 kg/m)	2-3/4" (70 mm)	R71-20
3" - 3 (75 mm)	6.85 in² (4419 mm²)	1027 kips (4568 kN)	822 kips (3656 kN)	719 kips (3198 kN)	616 kips (2740 kN)	24.1 lbs/ft (35.8 kg/m)	3-1/8" (80 mm)	R71-24

* The 2-1/4" diameter bar is not covered under ASTM A722.

- ACI 318-14, Section 17.5.1.2 indicates that the nominal shear strength of an anchor not exceed 0.60 x area of steel x the ultimate strength of the steel. Designers should utilize appropriate resistance factors for shear based on the condition of use.
- Per PTI recommendations for anchoring, anchors should be designed so that:
  - The design load is not more than 60% of the specified minimum tensile strength of the prestressing steel.
  - The lock-off load should not exceed 70% of the specified minimum tensile strength of the prestressing steel.
  - The maximum test load should not exceed 80% of the specified minimum tensile strength of the prestressing steel.
  - Maximum test load and maximum factored design load must not exceed the yield strength of ANY steel element.

Sizes

Williams 150 KSI bars are manufactured in 7 diameters from 1" (26 mm) through 3" (75 mm). All diameters are available in continuous lengths up to 50' (15.2 m).

Steel Quality

Williams 1" through 1-3/8" 150 KSI bars are smooth, hot rolled, high strength prestressing steel. The bars are cold-stressed and stress relieved in strict compliance with ASTM A722 and AASHTO M275 Highway Specifications. The 1-3/4" through 3" 150 KSI bars are made from alloy steel that is hot rolled, quenched and tempered to meet to the prescribed mechanical properties of ASTM A722.

Thorough inspection and traceability are carried out during all phases of manufacturing to assure the highest standards of quality.

Properties

Williams 150 KSI bars are high in strength yet ductile enough to exceed the specified elongation and reduction of area requirements. Selected heats can also pass the 135° supplemental bend test when required. Testing has shown Williams 150 KSI All-Thread-Bars to meet or exceed post tensioning bar and rock anchoring criteria as set by the Post Tensioning Institute including dynamic test requirements beyond 500,000 cycles of loading.

Williams 360° continuous thread deformation pattern has the ideal relative rib area configuration to provide excellent bond strength capability to grout or concrete, far better than traditional reinforcing deformation patterns.

Cutting (No Welding)

Williams 150 KSI All-Thread-Bar should not be subjected to the heat of a torch, welding or used as a ground. Field cutting should be done with an abrasive wheel or band saw.

Threads

All-Thread-Bars are cold rolled threaded to close tolerances under continuous monitoring procedures for quality control. Threads for Williams 150 KSI bar are specially designed with a rugged thread pitch wide enough to be fast under job site conditions and easy to assemble. They also have a smooth, wide, concentric, surface suitable for torque tensioning. This combination offers tremendous installation savings over inefficient, hot rolled, non-concentric thread forms. Threads are available in both right and left hand.

Williams All-Thread-Bars are threaded around the full circumference enabling the load transfer from the bar to the fasteners to occur efficiently without eccentric point loading. Williams fasteners easily meet the allowable load transfer limitations set forth by the Post Tensioning Institute. Williams 150 KSI All-Thread-Bars and fasteners are machined to tight tolerances for superior performance and mechanical lock. Precision machining greatly reduces concern of fastener loosening or detensioning. Williams 150 KSI bars exceed the deformation requirements of ASTM A722. Williams special thread deformation pattern projects ultra high relative rib area, much greater than conventional rebar. This provides for superior bond performance in concrete.

Tensile Strength & Working Loads

Williams 150 KSI bars are available with ultimate tensile strengths and working loads as displayed above. Safety factors and functional working loads are at the discretion of the project design engineer, however test loads should never exceed 80% of the published ultimate bar strength.

150 KSI All-Thread-Bar Accessories

Hex Nut

Round Collar Nut

All Couplings and Hex/Collar Nuts exceed 100% of the bar's published ultimate strength and couplings will meet ACI 318 Section 25.5.7.1 for mechanical rebar connections.

R73 Hex & R74 Collar Nuts

Bar Diameter	Across Flats	OD/Across Corners	Thickness	Part Number
1" (26 mm)	1-3/4" (44 mm)	2.0" (51 mm)	1-5/8" (41 mm)	R73-08
1-1/4" (32 mm)	2-1/4" (57 mm)	2.6" (66 mm)	1-7/8" (48 mm)	R73-10
1-3/8" (36 mm)	2-1/2" (64 mm)	2.9" (73 mm)	2-1/8" (54 mm)	R73-11
1-3/4" (46 mm)	3" (76 mm)	3.5" (88 mm)	3-1/2" (89 mm)	R73-14
2-1/4" (57 mm)	3-3/4" (95 mm)	4.3" (109 mm)	3-3/4" (95 mm)	R73-18
2-1/2" (65 mm)	4-1/4" (108 mm)	4.9" (124 mm)	3-3/4" (95 mm)	R73-20
3" * (75 mm)	4-1/2" (114 mm)	OD 5" (127 mm)	5-1/2" (140 mm)	R74-24

* Rounded Collar Nut

R72 Stop-Type Coupling

Bar Diameter	Outside Diameter	Overall Length	Part Number
1" (26 mm)	1-3/4" (44 mm)	4" (102 mm)	R72-08
1-1/4" (32 mm)	2-1/8" (54 mm)	4-1/2" (114 mm)	R72-10
1-3/8" (36 mm)	2-3/8" (60 mm)	5" (127 mm)	R72-11
1-3/4" (46 mm)	3" (76 mm)	8-1/2" (216 mm)	R72-14
2-1/4" (57 mm)	3-1/2" (89 mm)	8-1/2" (216 mm)	R72-18
2-1/2" (65 mm)	4-1/4" (108 mm)	8-5/8" (219 mm)	R72-20
3" (75 mm)	5" (127 mm)	11-7/8" (302 mm)	R72-24

R9F Hardened Washers

Bar Diameter	Outside Diameter	Inside Diameter	Thickness	Part Number
1" (26 mm)	2-1/4" (57 mm)	1-3/16" (30 mm)	5/32" (4 mm)	R9F-09-436
1-1/4" (32 mm)	2-3/4" (70 mm)	1-1/2" (38 mm)	5/32" (4 mm)	R9F-11-436
1-3/8" (36 mm)	3" (76 mm)	1-5/8" (41 mm)	5/32" (4 mm)	R9F-12-436
1-3/4" (46 mm)	3-3/4" (95 mm)	2-1/8" (54 mm)	7/32" (6 mm)	R9F-16-436
2-1/4" (57 mm)	4-1/2" (114 mm)	2-5/8" (67 mm)	9/32" (7 mm)	R9F-20-436
2-1/2" (65 mm)	5" (127 mm)	2-7/8" (73 mm)	9/32" (7 mm)	R9F-22-436
3" (75 mm)	6" (152 mm)	3-3/8" (86 mm)	9/32" (7 mm)	R9F-26-436

To achieve full strength of the system, hardened washers must be used with R73 hex nuts

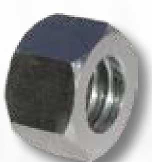
Provides up to 5˚ angle when used with a dished plate.

R88 Spherical Hex Nuts

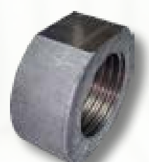
Bar Diameter	Across Flats	Thickness	Outside Dome	Part Number
1" (26 mm)	1-3/4" (44 mm)	2-1/4" (57 mm)	2-1/2" (64 mm)	R88-08
1-1/4" (32 mm)	2-1/4" (57 mm)	2-3/4" (70 mm)	3-1/8" (80 mm)	R88-10
1-3/8" (36 mm)	2-1/2" (64 mm)	3-1/4" (83 mm)	3-5/8" (90 mm)	R88-11
1-3/4" (46 mm)	3" (76 mm)	3-1/2" (89 mm)	4" (102 mm)	R88-14
2-1/4" * (57 mm)	3-3/4" (95 mm)	5-1/4" (133 mm)	5-1/2" (140 mm)	R73-18 R81-18
2-1/2" * (65 mm)	4-1/4" (108 mm)	5-1/2" (140 mm)	6" (152 mm)	R73-20 R81-20
3" ** (75 mm)	4-1/4" (108 mm)	7-1/2" (191 mm)	7" (178 mm)	R74-24 R81-24

* Standard Nut with Spherical Washer assembly

** Rounded Collar Nut with Spherical Washer assembly



Hex Jam Nut



Round Collar Jam Nut

Jam Nuts can not be substituted for full strength nuts. Larger diameters will be a rounded collar jam nut, with special order machined hex available.

R73/R74-JN Jam Nuts

Bar Diameter	Across Flats	OD/Across Corners	Thickness	Part Number
1" (26 mm)	1-3/4" (44 mm)	2.0" (51 mm)	0.41" (10 mm)	R73-08JN
1-1/4" * (32 mm)	1-7/8" (48 mm)	OD 2-1/8" (54 mm)	0.47" (12 mm)	R74-10JN
1-3/8" * (36 mm)	2-1/8" (54 mm)	OD 2-3/8" (60 mm)	0.53" (14 mm)	R74-11JN
1-3/4" * (46 mm)	2-3/4" (70 mm)	OD 3" (76 mm)	0.88" (22 mm)	R74-14JN
2-1/4" * (57 mm)	3-1/4" (83 mm)	OD 3-1/2" (89 mm)	0.94" (24 mm)	R74-18JN
2-1/2" * (65 mm)	4" (102 mm)	OD 4-1/4" (108 mm)	0.94" (24 mm)	R74-20JN
3" * (75 mm)	4-1/4" (108 mm)	OD 5" (127 mm)	2" (51 mm)	R74-24JN

*Round Collar Jam Nut

R8M Beveled Washers

Bar Diameter	Degree of Bevel	Outside Diameter	Inside Diameter	Maximum Thickness	Minimum Thickness	Part Number
1" (26 mm)	10°	2-27/32" (72 mm)	1-7/16" (37 mm)	7/8" (22 mm)	3/8" (10 mm)	R8M-08-150
1-1/4" (32 mm)	15°	3-3/8" (86 mm)	1-9/16" (40 mm)	1-15/64" (44 mm)	3/8" (10 mm)	R8M-12S
1-3/8" (36 mm)	15°	3-1/2" (89 mm)	1-3/4" (44 mm)	1-1/4" (32 mm)	3/8" (10 mm)	R8M-13S
1-3/4" (46 mm)	15°	5-1/4" (133 mm)	2-1/4" (57 mm)	1-5/8" (41 mm)	5/16" (8 mm)	R8M-16-150
2-1/4" (57 mm)	10°	6-1/2" (165 mm)	3" (76 mm)	1-7/8" (48 mm)	3/4" (19 mm)	R8M-18-150
2-1/2" (65 mm)	10°	7-1/2" (190 mm)	3-1/2" (89 mm)	2.31" (59 mm)	1" (25 mm)	R8M-20-150
3" (75 mm)	10°	8" (203 mm)	3-5/8" (92 mm)	2.43" (62 mm)	1" (25 mm)	R8M-24-150

To achieve full strength of the system, beveled washers must be used in conjunction with a hardened washer

Grade 75 & Grade 80 All-Thread Rebar

Threads

Williams All-Thread Rebar has a cold rolled, continuous, rounded course thread form. Williams special thread (deformation) pattern projects ultra high relative rib area at 3 times that of conventional rebar. This provides for superior bond performance in concrete. Because of the high thread pitch and the full 360 degree concentric thread form, Williams All-Thread Rebar should only bent under special provisions using larger bend diameters than typical ACI minimums. As an alternative to bending, Williams recommends use of a steel plate or a threaded terminator disc to reduce development length. Threads are available in both right and left hand. Grades up to 100 are available upon request.

Sizes

All-Thread Rebar is available in 12 diameters from #6 through #32. Diameters #6 to #24 are available in continuous lengths up to 50-foot, larger diameters up to 40-foot.

Welding

Welding of All-Thread Rebar should be approached with caution since no specific provisions have been included to enhance its weldability. Refer to ANSI/AWS D1.4 for proper selections and procedures.

R61 Grade 75 & Grade 80 All-Thread Rebar

ASTM A615*

Bar Designation & Pitch	Minimum Net Area Thru Threads	Minimum Ultimate Strength	Grade 75 Minimum Yield Strength	Grade 80 Minimum Yield Strength	Nominal Weight	Approx. Thread Major Diameter	Part Number
#6 - 5 (19 mm)	0.44 in^2 (284 mm^2)	44 kips (196 kN)	33 kips (147 kN)	35 kips (156 kN)	1.5 lbs/ft (2.4 kg/m)	7/8" (22 mm)	R61-06
#7 - 5 (22 mm)	0.60 in^2 (387 mm^2)	60 kips (267 kN)	45 kips (200 kN)	48 kips (214 kN)	2.0 lbs/ft (3.0 kg/m)	1" (25 mm)	R61-07
#8 - 3-1/2 (25 mm)	0.79 in^2 (510 mm^2)	79 kips (351 kN)	59 kips (264 kN)	63 kips (280 kN)	2.7 lbs/ft (3.9 kg/m)	1-1/8" (29 mm)	R61-08
#9 - 3-1/2 (29 mm)	1.00 in^2 (645 mm^2)	100 kips (445 kN)	75 kips (334 kN)	80 kips (356 kN)	3.4 lbs/ft (5.1 kg/m)	1-1/4" (32 mm)	R61-09
#10 - 3 (32 mm)	1.27 in^2 (819 mm^2)	127 kips (565 kN)	95 kips (424 kN)	102 kips (454 kN)	4.3 lbs/ft (5.5 kg/m)	1-3/8" (35 mm)	R61-10
#11 - 3 (36 mm)	1.56 in^2 (1006 mm^2)	156 kips (694 kN)	117 kips (521 kN)	125 kips (556 kN)	5.3 lbs/ft (7.9 kg/m)	1-1/2" (38 mm)	R61-11
#14 - 3 (43 mm)	2.25 in^2 (1452 mm^2)	225 kips (1001 kN)	169 kips (750 kN)	180 kips (801 kN)	7.65 lbs/ft (11.8 kg/m)	1-7/8" (48 mm)	R61-14
#18 - 3 (57 mm)	4.00 in^2 (2581 mm^2)	400 kips (1780 kN)	300 kips (1335 kN)	320 kips (1423 kN)	13.6 lbs/ft (19.6 kg/m)	2-7/16" (62 mm)	R61-18
#20 - 2-3/4 (64 mm)	4.91 in^2 (3168 mm^2)	491 kips (2184 kN)	368 kips (1637 kN)	393 kips (1748 kN)	16.7 lbs/ft (24.8 kg/m)	2-3/4" (70 mm)	R61-20
#24 - 2-3/4 (76 mm) *	6.82 in^2 (4400 mm^2)	682 kips (3034 kN)	512 kips (2277 kN)	546 kips (2429 kN)	24.0 lbs/ft (35.8 kg/m)	3-3/16" (81 mm)	R61-24
#28 - 2-3/4 (89 mm) *	9.61 in^2 (6200 mm^2)	961 kips (4274 kN)	720 kips (3206 kN)	769 kips (3421 kN)	32.7 lbs/ft (48.6 kg/m)	3-3/4" (95 mm)	R61-28
#32 - 2-3/4 (102 mm) *	12.56 in^2 (8103 mm^2)	1256 kips (5587 kN)	942 kips (4190 kN)	1004 kips (4466 kN)	43.0 lbs/ft (64.0 kg/m)	4-1/4" (108 mm)	R61-32

* Bars size #24 and larger are not covered under ASTM A615.
#32 Bar availability may be limited. Please contact Williams for specific lead times.

All Couplings and Hex/Collar Nuts exceed 100% of the bar's published ultimate strength and couplings will meet ACI 318 Section 25.5.7.1 for mechanical rebar connections.

Hex Nut

Round Collar Nut

R62 Stop-Type Couplings

Bar Desig. & Nominal Dia.	Outside Diameter	Overall Length	Part Number
#6 - 3/4" (19 mm)	1-1/4" (32 mm)	3-1/2" (89 mm)	R62-06
#7 - 7/8" (22 mm)	1-3/8" (35 mm)	4" (102 mm)	R62-07
#8 - 1" (25 mm)	1-5/8" (41 mm)	4-1/2" (114 mm)	R62-08
#9 - 1-1/8" (29 mm)	1-7/8" (48 mm)	5" (127 mm)	R62-09
#10 - 1-1/4" (32 mm)	2" (51 mm)	5-1/2" (140 mm)	R62-10
#11 - 1-3/8" (36 mm)	2-1/4" (57 mm)	6" (152 mm)	R62-11
#14 - 1-3/4" (43 mm)	2-7/8" (73 mm)	6" (152 mm)	R62-14
#18 - 2-1/4" (57 mm)	3-1/2" (89 mm)	7-1/8" (181 mm)	R62-18
#20 - 2-1/2" (64 mm)	4" (102 mm)	8" (203 mm)	R62-20
#24 - 3" (76 mm)	5" (127 mm)	9-3/4" (248 mm)	R62-24
#28 - 3-1/2" (89 mm)	5-1/2" (140 mm)	12" (305 mm)	R62-28
#32 - 4" (102 mm)	5-3/4" (146 mm)	15" (381 mm)	R62-32

Couplings are available as tap thru upon request

R63 Hex Nuts & R64 Collar Nuts

Bar Desig. & Nominal Dia.	Across Flats	OD/Across Corners	Thickness	Part Number
#6 - 3/4" (19 mm)	1-1/4" (32 mm)	1.44" (37 mm)	1-1/8" (29 mm)	R63-06
#7 - 7/8" (22 mm)	1-7/16" (37 mm)	1.66" (42 mm)	1-1/4" (32 mm)	R63-07
#8 - 1" (25 mm)	1-5/8" (41 mm)	1.88" (48 mm)	1-3/8" (35 mm)	R63-08
#9 - 1-1/8" (29 mm)	1-7/8" (48 mm)	2.17" (55 mm)	1-1/2" (38 mm)	R63-09
#10 - 1-1/4" (32 mm)	2" (51 mm)	2.31" (59 mm)	2" (51 mm)	R63-10
#11 - 1-3/8" (36 mm)	2-1/4" (57 mm)	2.60" (66 mm)	2-1/8" (54 mm)	R63-11
#14 - 1-3/4" (43 mm)	2-3/4" (70 mm)	3.18" (81 mm)	3" (76 mm)	R63-14
#18 - 2-1/4" (57 mm)	3-3/4" (95 mm)	4.33" (110 mm)	3-3/4" (95 mm)	R63-18
#20 - 2-1/2" (64 mm)	4" (102 mm)	4.62" (117 mm)	3-3/4" (95 mm)	R63-20
#24 - 3" (76 mm) *	4-1/2" (114 mm)	OD 5" (127 mm)	4-3/8" (111 mm)	R64-24
#28 - 3-1/2" (89 mm) *	5-1/2" (140 mm)	OD 6" (152 mm)	5-1/2" (140 mm)	R64-28
#32 - 4" (102 mm) *	5-3/4" (146 mm)	OD 6.25" (159 mm)	7" (178 mm)	R64-32

* Round Collar Nut

Grade 75 & Grade 80 Accessories

R81 Spherical Washers

Bar Desig. & Nominal Dia.	Thickness	Outside Dome	Part Number
#6 - 3/4" (19 mm)	35/64" (14 mm)	2" (51 mm)	R81-0675
#7 - 7/8" (22 mm)	39/64" (15 mm)	2-1/4" (57 mm)	R81-0775
#8 - 1" (25 mm)	5/8" (16 mm)	2-1/2" (64 mm)	R81-0875
#9 - 1-1/8" (29 mm)	3/4" (19 mm)	2-3/4" (70 mm)	R81-0975
#10 - 1-1/4" (32 mm)	53/64" (21 mm)	3" (76 mm)	R81-1075
#11 - 1-3/8" (36 mm)	29/32" (23 mm)	3-1/4" (83 mm)	R81-1175
#14 - 1-3/4" (43 mm)	1-7/64" (28 mm)	3-3/4" (95 mm)	R81-1475
#18 - 2-1/4" (57 mm)	1-13/32" (36 mm)	5" (127 mm)	R81-1875
#20 - 2-1/2" (64 mm)	1-1/2" (38 mm)	5-1/4" (133 mm)	R81-2075
#24 - 3" (76 mm)	1-7/8" (48 mm)	6-1/2" (165 mm)	R81-2475
#28 - 3-1/2" (89 mm)	1-1/2" (38 mm)	7" (178 mm)	R81-2875
#32 - 4" (102 mm)	-	-	-

Provides up to 5˚ angle when used with a dished plate.

R9F Hardened Washers

Bar Desig. & Nominal Dia.	Outside Diameter	Inside Diameter	Thickness	Part Number
#6 - 3/4" (19 mm)	1-3/4" (44 mm)	15/16" (24 mm)	5/32" (4 mm)	R9F-07-436
#7 - 7/8" (22 mm)	2" (51 mm)	1-1/16" (29 mm)	5/32" (4 mm)	R9F-08-436
#8 - 1" (25 mm)	2-1/4" (57 mm)	1-3/16" (30 mm)	5/32" (4 mm)	R9F-09-436
#9 - 1-1/8" (29 mm)	2-1/4" (57 mm)	1-3/16" (30 mm)	5/32" (4 mm)	R9F-09-436
#10 - 1-1/4" (32 mm)	2-1/2" (64 mm)	1-3/8" (35 mm)	5/32" (4 mm)	R9F-10-436
#11 - 1-3/8" (36 mm)	3" (76 mm)	1-5/8" (41 mm)	5/32" (4 mm)	R9F-12-436
#14 - 1-3/4" (43 mm)	3-3/8" (86 mm)	1-7/8" (48 mm)	7/32" (6 mm)	R9F-14-436
#18 - 2-1/4" (57 mm)	4-1/2" (114 mm)	2-5/8" (67 mm)	9/32" (7 mm)	R9F-20-436
#20 - 2-1/2" (64 mm)	5" (127 mm)	2-7/8" (73 mm)	9/32" (7 mm)	R9F-22-436
#24 - 3" (76 mm)	6" (142 mm)	3-3/8" (86 mm)	9/32" (7 mm)	R9F-26-436
#28 - 3-1/2" (89 mm)	7" (178 mm)	3-7/8" (98 mm)	9/32" (7 mm)	R9F-30-436
#32 - 4" (102 mm)	7-3/4" (197 mm)	4-3/8" (111 mm)	5/16" (8 mm)	R9F-34-436


Hex Jam Nut


Round Collar Jam Nut

Jam Nuts can not be substituted for full strength nuts. Larger diameters will be a rounded collar jam nut, with special order machined hex available.

R63/R64-JN Jam Nuts

Bar Desig. & Nominal Dia.	Across Flats	OD/Across Corners	Thickness	Part Number
#6 - 3/4" (19 mm)	1-1/4" (32 mm)	1.44" (37 mm)	9/16" (14 mm)	R63-06JN
#7 - 7/8" (22 mm)	1-7/16" (37 mm)	1.66" (42 mm)	5/8" (16 mm)	R63-07JN
#8 - 1" (25 mm)	1-5/8" (41 mm)	1.88" (48 mm)	11/16" (17 mm)	R63-08JN
#9 - 1-1/8" (29 mm)	1-7/8" (48 mm)	2.17" (55 mm)	3/4" (19 mm)	R63-09JN
#10 - 1-1/4" (32 mm)	2" (51 mm)	2.31" (59 mm)	15/16" (24 mm)	R63-10JN
#11 - 1-3/8" (36 mm)	2-1/4" (57 mm)	2.60" (66 mm)	1" (25 mm)	R63-11JN
#14 - 1-3/4" (43 mm) *	2-5/8" (67 mm)	OD 2.88" (73 mm)	1-3/16" (30 mm)	R64-14JN
#18 - 2-1/4" (57 mm) *	3-1/4" (83 mm)	OD 3.5" (89 mm)	1-11/16" (43 mm)	R64-18JN
#20 - 2-1/2" (64 mm) *	3-3/4" (95 mm)	OD 4" (102 mm)	1-11/16" (43 mm)	R64-20JN
#24 - 3" (76 mm) *	4-1/2" (114 mm)	OD 5" (127 mm)	2" (51 mm)	R64-24JN
#28 - 3-1/2" (89 mm) *	5" (127 mm)	OD 5.5" (140 mm)	2-1/4" (57 mm)	R64-28JN
#32 - 4" (102 mm) *	5-3/4" (146 mm)	OD 6.25" (159 mm)	2-1/2" (64 mm)	R64-32JN

*Round Collar Jam Nut

R8M Beveled Washers

Bar Desig. & Nominal Dia.	Degree of Bevel	Outside Diameter	Inside Diameter	Maximum Thickness	Minimum Thickness	Part Number
#6 - 3/4" (19 mm)	15°	2-1/16" (52 mm)	1" (25 mm)	3/4" (19 mm)	1/4" (6 mm)	R8M-08S
#7 - 7/8" (22 mm)	15°	2-1/16" (52 mm)	1" (25 mm)	3/4" (19 mm)	1/4" (6 mm)	R8M-08S
#8 - 1" (25 mm)	15°	2-13/16" (71 mm)	1-5/16" (33 mm)	1" (25 mm)	5/16" (8 mm)	R8M-09S
#9 - 1-1/8" (29 mm)	15°	2-13/16" (71 mm)	1-5/16" (33 mm)	1" (25 mm)	5/16" (8 mm)	R8M-09S
#10 - 1-1/4" (32 mm)	15°	3-3/8" (86 mm)	1-9/16" (40 mm)	1-15/64" (44 mm)	3/8" (10 mm)	R8M-12S
#11 - 1-3/8" (36 mm)	15°	3-1/2" (89 mm)	1-3/4" (44 mm)	1-1/4" (32 mm)	3/8" (10 mm)	R8M-13S
#14 - 1-3/4" (43 mm)	15°	4-1/2" (114 mm)	2-1/8" (54 mm)	1-5/8" (41 mm)	15/32" (12 mm)	R8M-14S
#18 - 2-1/4" (57 mm)	15°	5" (127 mm)	3" (76 mm)	1-5/8" (41 mm)	19/64" (8 mm)	R8M-18
#20 - 2-1/2" (64 mm)	10°	5-1/2" (140 mm)	3" (76 mm)	1-23/32" (44 mm)	3/4" (19 mm)	R8M-20
#24 - 3" (76 mm)	10°	7" (178 mm)	3-5/8" (92 mm)	2" (51 mm)	3/4" (19 mm)	R8M-24
#28 - 3-1/2" (89 mm)	10°	8" (203 mm)	4-1/4" (108 mm)	2-19/64" (58 mm)	7/8" (22 mm)	R8M-28
#32 - 4" (102 mm)	-	-	-	-	-	-

To achieve full strength of the system, beveled washers must be used in conjunction with a hardened washer

Plates, End Caps, Centralizers & Eye Nuts

Bearing Plates

Williams steel bearing plates are standard with a round hole for non-grouted ground anchors. Also available are dished plates for use with spherical hex nuts and keyhole plates which provide free access for grout tube entry. Bearing plates are customized for each application. Plate dimensions should be specified around the parameters of the project. In addition, corrosion protection should be considered along with specifying hole diameter and bar angle.

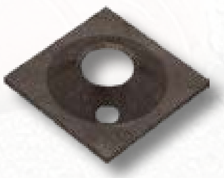
S1K - Round

R80 - Dished

S1K - Keyhole

S0K - Studded

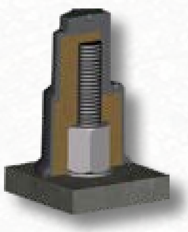
S2K - Domed



End Caps

Williams offers several different types of end caps to provide corrosion protection at otherwise exposed anchor ends. Most often the caps are packed with corrosion inhibiting grease. Caps made from steel are used in exposed impact areas.

Screw-on Fiber Reinforced Nylon Cap

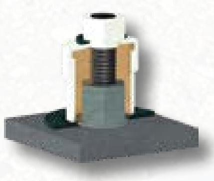


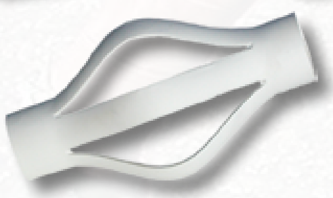
Steel Tube welded on Flange with Threaded Screw Connections

Steel Tube with Jam Nut

Screw-on PVC Cap

Slip-on PVC Cap w/ Plastic Nut





PVC Centralizer

The Williams PVC Centralizer is used to center the anchor assembly in the drill hole. They are usually spaced 10 to 15 feet along the bar. To order, specify drill hole diameter, bar size or the outer diameter of sleeve when used over bar.

Eye Nuts

Williams Eye Nuts may be used as lifting eyes for forms, concrete blocks, concrete cylinders, machinery or equipment. The large base on three of the models makes them excellent for anchoring guy wires. Safety factors and working loads based on the ultimate strength of the Eye Nuts should be determined for the specific application by the project design engineer.

E1N

E1N1C

E1N3

E1N4

Eye Nut Designation	Minimum Inside Width	Inside Height	Ring Diameter	Overall Height	Taps Available				SWL (3:1 FS) **	SWL (5:1 FS) **	Blank Part Number
					UNC & Coil Tie Rods	Grade 60 Grade 75	150 KSI All-Thread	B7X Hollow			
E1N * Cast Steel	1-1/2" (38 mm)	2-1/2" (64 mm)	7/8" (22 mm)	5-1/8" (130 mm)	1/2" to 1" (13 to 25 mm)	#4 to #8	-	-	23 kips (104 kN)	14 kips (62 kN)	E1M-00-E1N
E1N1C Forged Steel	2" (51 mm)	2-1/2" (64 mm)	1.15"Oval (29 mm)	5-1/2" (140 mm)	1" to 1-1/8" (25 to 29 mm)	#8 to #9	1" (26 mm)	32 mm	41 kips (182 kN)	25 kips (109 kN)	E1M-00-E1N1C
E1N3 Forged Steel	2" (51 mm)	3" (76 mm)	1-3/4" (45 mm)	8" (203 mm)	1-1/8" to 1-3/8" (29 to 35 mm)	#10 to #11	1" to 1-3/8" (26 to 36 mm)	38 mm	87 kips (386 kN)	52 kips (231 kN)	E1M-00-E1N3
E1N4 Forged Steel	2-1/2" (64 mm)	3-3/4" (95 mm)	2-3/16" (56 mm)	10" (254 mm)	1-3/4" to 2" (45 to 51 mm)	#14 to #18	1-3/4" (46 mm)	51 mm	137 kips (608 kN)	82 kips (365 kN)	E1M-00-E1N4
E1N4C Forged Steel	3" (76 mm)	5-3/4" (146 mm)	2" (51 mm)	11-1/2" (292 mm)	1-1/4" to 2" (32 to 51 mm)	#10 to #18	1-3/8" to 1-3/4" (36 to 46 mm)	51 mm	124 kips (550 kN)	74 kips (330 kN)	E1M-00-E1N4C
E1N5C * Forged Steel	4-1/4" (108 mm)	4-1/2" (114 mm)	2-5/8" (67 mm)	12" (305 mm)	-	#18 to #20	2-1/4" to 2-1/2" (57 to 65 mm)	76 mm	204 kips (907 kN)	122 kips (544 kN)	E1M-00-E1N5C

* Non-Domestic

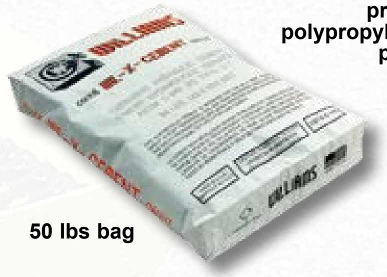
** SWL based on straight tension loading only. Angled loading should be considered with caution, as it will significantly reduce eyenut capacity. Contact your Williams representative for more information.

Grout & Grouting Accessories

S5Z WIL-X CEMENT GROUT

Conforms to ASTM C845 Type K

Wil-X is chemically compensated for shrinkage. It has a high bond value and is crack resistant for permanent installations. Wil-X can be used safely with most concrete admixtures. Wil-X grout will be thicker than a Portland cement grout with the same water to cement ratio. Therefore, use of a high-range water reducing admixture (super plasticizer) is recommended if grout will be pumped or if higher fluidity is desired. Because it is a cement-based grout, it is non-explosive and has a six-month shelf life when stored properly in a dry location and out of direct sunlight.



50 lbs bag

5 gallon, resealable, moisture proof, polypropylene pails

Compressive Strength
Wil-X Cement Grout & Water
(74° F Dry Environment)
0.44 w/c ratio

Time	PSI	MPa
1 Day	2,800	19.3
3 Days	6,400	44.1
7 Days	7,700	53.1
28 Days	9,500	65.5

Wil-X may be used to build up leveling pads by simply mixing with sand or pea gravel. This mixture should not be run through the grout pump.

Setting Time: Gilmore Needles (ASTM C266). Initial set 45 minutes; final set 10 hours.

Comparative compressive strength test in PSI (modified ASTM C109) Actual strengths as mixed according to Williams Instructions range from 6,000 to 9,500 PSI depending on water content. Copy of ASTM Modification available upon request.

Note: Results based on a controlled laboratory environment. Jobsite results may vary.

US Spec RA Grout

Product Description

US Spec RA Grout consists of specialty blended cements and admixtures to provide maximum flow, shrinkage compensation and extended working times in an aggregate free formulation where clearances are minimal. RA Grout is non-metallic and non-corrosive. RA Grout has been specifically formulated to meet and exceed the testing requirements of **ASTM C1107** and US Army Corps of Engineers CRD C-621. When tested in accordance with ASTM C827 RA Grout yields a controlled positive expansion.

US SPEC RA Grout

Time	PSI	MPa
1 Day	4,500	31.02
7 Days	9,000	62.05
28 Days	12,000	82.73

Advantages

- Pumpable fluid grout for very tight clearances
- Non-bleeding
- Attains high compressive strengths at specified w/c ratios
- Extended working time for maximum pumping range
- Non-shrink from time of placement
- Thixotropic: High flow restored by agitation
- Encapsulates tendons, bolts or bars to protect from corrosion
- Consistent: Strict Quality Control testing and standards

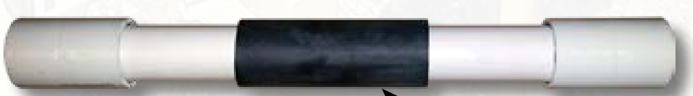
Packaging and Yield

US Spec RA Grout is packaged in heavy duty, polyethylene line backs containing 50 lbs (22.7 kg), yielding 0.53 cubic feet when 7.75 quarts of mixing water is used. Each pallet contains 48 bags of RA Grout.

Note: Results based on a controlled laboratory environment (see product data for details). Jobsite results may vary.

Mixing

Mix US Spec RA Grout to a uniform consistency in accordance with the manufacturer's instructions. Potable water containing no chlorides or other foreign substance shall be used. The water shall be accurately measured and placed in the mixer first. Start with 1.94 gallons of water per 50 lbs bag of US Spec RA Grout and mix continuously for 3-5 minutes before placing. If possible, the grout should be mixed continuously until placing is completed, but if this is not practical, a brief remixing prior to pumping or placement is adequate to overcome the effect of "thixotropic set". Do not use any other admixtures or additives.



Valve

Post-Grout Tube

Williams will provide post-grout tubes for anchors bonded in weak rock or soil upon request. The Williams supplied flexible or rigid post-grout tube has a bursting strength of 1000 psi. The post-grout tube length and valve placement are adjustable and can be specified at the time of order. There is no field assembly of the post grout tube, other than attaching it to the anchor as it is being installed down the drill hole. Drill hole diameter should be a 1" minimum clearance to accommodate Post-Grout Tube.

T3P Heavy Duty Plastic Grout Tube

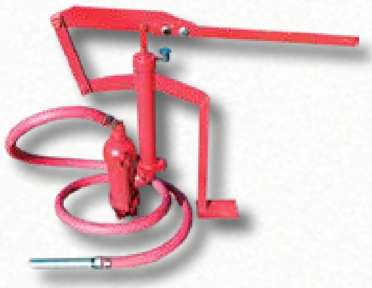
Furnished in product lengths for the rockbolts or in rolls.

O.D.	I.D.	Part No.
3/8" (9.5 mm)	1/4" (6.4 mm)	T3P03002
1/2" (12.7 mm)	3/8" (9.5 mm)	T3P04003
5/8" (15.9 mm)	1/2" (12.7 mm)	T3P05004
3/4" (19 mm)	5/8" (16 mm)	T3P06005
1" Nom. (25 mm)	3/4" Nom. (19 mm)	T3P06

T4Z Grout Tube Adapter

For down pressure grouting only when grout is forced through normal grout hole in the hollow rebar.

Grout Pumps & Hydraulic Jacks



T6Z-04 Hand Pump

Use of plasticizer is recommend with hand pumps.

Pump

Pump Type: 2 stroke, piston driven

Output/Pressure: 40 psi average, 80 psi max

Physical Specifications

Dimensions: 24-1/4"W x 30-3/4"H (35" w/ handle)

Weight: 60 lbs

T6Z-08 Air Pump

Pump

Output/Pressure: 8 gpm, 261 psi

Mixer

Mix Tank: 22 Gallon

Holding Hopper: 12 Gallon

Drive Power

Air: 175 CFM, 100 psi

Physical Specifications

Dimensions: 59"L x 30"W x 51"H

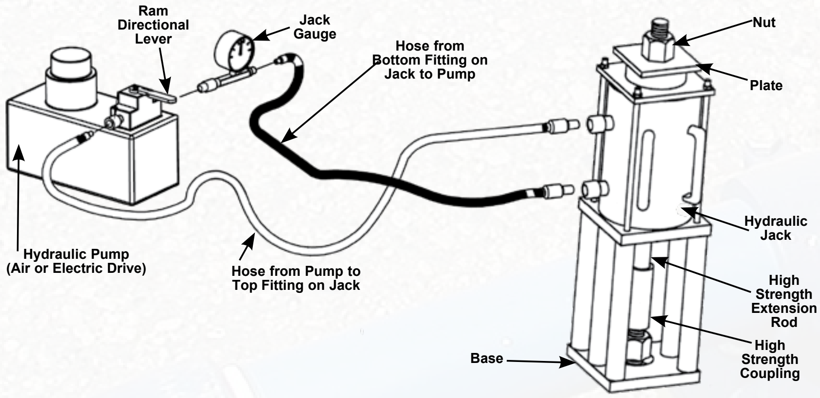
Weight: 575 lbs

Call your Williams representative for information on the full line of grout pumps and mixers.

Hydraulic Jacks

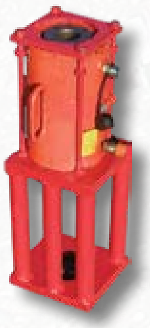
Tensioning By Jacking

Tensioning by jacking can be accomplished with the various capacity tensioning jacks shown below. Williams post tensioning jacks are designed to be especially helpful for recessed situations, while the T7Z Hydraulic Test Jacks are designed for open areas. Jacks are matched with electric or air pumps. Jacks may be purchased or rented as required. Rental equipment packages include ram on mounted stand, hoses, pull rod, gauges, power unit and knocker wrench for transferring the load from the jack to the anchor head.



T7Z Open Frame Hydraulic Jacks

Used for testing and prestressing All-Thread-Bars. Available with up to 5-1/8" center hole. Unit comes with ram, pump, gauge, hoses, jack stand, high strength coupling, high strength test rod, plate, hex nut and knocker wrench.



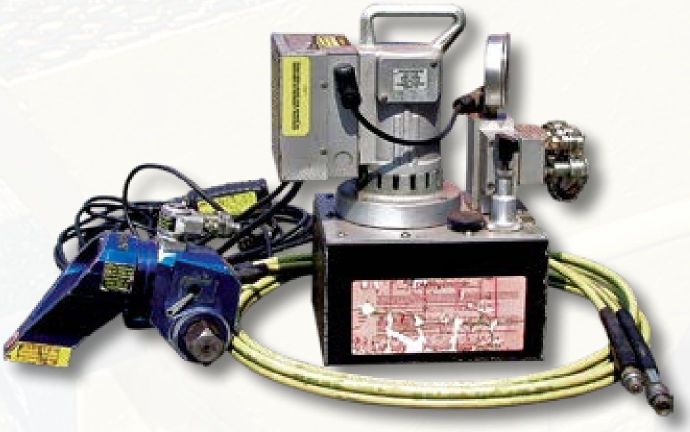
Jack Capacity	Pump Method	Ram Height	Base Size	Ram Travel	Minimum Total Ram & Frame Height	Maximum Test Rod Diameter	Ram Area	Approx. Total Ram & Frame Weight
10 tons (89 kN)	Hand Single Acting	5-5/16" (135 mm)	3" Diameter (76 mm)	2-1/2" (64 mm)	8-3/8" (213 mm)	3/4" (19 mm)	2.12 in² (14 cm²)	12 lbs (5.4 kg)
30 tons (267 kN)	Hand Double Acting	6-1/16" (154 mm)	8" x 8" (203 x 203 mm)	3" (76 mm)	19" (483 mm)	1-1/4" (32 mm)	5.89 in² (38 cm²)	80 lbs (36 kg)
60 tons (534 kN)	Hand, Air, or Electric Double Acting	9-1/2" (241 mm)	9" x 9" (228 x 228 mm)	5" (127 mm)	29" (737 mm)	2-1/8" (54 mm)	12.31 in² (79 cm²)	153 lbs (69 kg)
60 tons (534 kN)	Hand, Air, or Electric Double Acting	12-3/4" (324 mm)	9" x 9" (228 x 228 mm)	6-1/2" (165 mm)	32-1/4" (737 mm)	2-1/8" (54 mm)	12.73 in² (82 cm²)	173 lbs (78 kg)
100 tons (890 kN)	Air or Electric Double Acting	13-1/2" (343 mm)	9" x 9" (228 x 228 mm)	6" (152 mm)	29-1/8" (740 mm)	3-1/8" (79 mm)	20.63 in² (133 cm²)	198 lbs (87 kg)
100 tons (890 kN)	Air or Electric Double Acting	12-3/8" (314 mm)	9" x 9" (228 x 228 mm)	6" (152 mm)	28" (711 mm)	2" (51 mm)	20.03 in² (129 cm²)	192 lbs (87 kg)
200 tons (1779 kN)	Air or Electric Double Acting	12-1/4" (311 mm)	12" x 12" (305 x 305 mm)	8" (203 mm)	34" (864 mm)	4-1/16" (103 mm)	40.45 in² (261 cm²)	518 lbs (235 kg)
200 tons (1779 kN)	Air or Electric Double Acting	27-1/2" (699 mm)	12" x 12" (305 x 305 mm)	15" (381 mm)	49-1/4" (1250 mm)	4" (102 mm)	47.20 in² (303 cm²)	604 lbs (274 kg)
300 tons (2670 kN)	Electric Double Acting	27-1/2" (699 mm)	15" Dia. (381 mm)	15" (381 mm)	50-1/2" (1283 mm)	5-3/8" (137 mm)	78.5 in² (506 cm²)	1,400 lbs (635 kg)
400 tons (3558 kN)	Electric Double Acting	18-3/4" (476 mm)	15" Dia. (381 mm)	6" (152 mm)	45-3/4" (1162 mm)	4-1/4" (108 mm)	91.5 in² (590 cm²)	1,300 lbs (590 kg)

Torque Equipment

T8Z Hydraulic Torque Wrench

The hydraulic torque wrench is used for tensioning anchors in tight fitting locations where it would be difficult to use an hydraulic jack. The wrench is also recommended for use when setting the large diameter Spin-Lock anchors. The torque wrenches are light weight and can achieve a maximum of 7,400 ft-lbs. All Hydraulic Torque Wrenches have 1-1/2" square drive outputs.

Maximum Torque	Length	Height	Weight
5,590 ft-lbs (773 kg/M)	11.1" (279 mm)	4.5" (114 mm)	16.8 lbs (7.6 kg)
7,400 ft-lbs (1,023 kg/M)	10.7" (273 mm)	7" (178 mm)	19 lbs (11.3 kg)

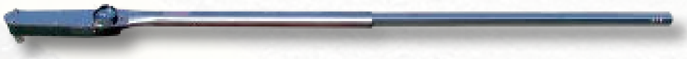


T8Z Torque Wrench

For applying torque to the anchor bolt when setting the anchor.

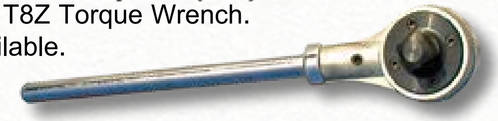
Capacity (ft-lbs)	Square Drive Size
100-600	3/4"
200-1,000	1"

Available with Ratchet Adapter



T8Z-04 Torque Multiplier (4:1)

For use with T8Z Torque Wrench. Other sizes available.

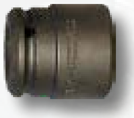


Size	Square Drive Input	Square Drive Output	Maximum Torque
GA 186	1"	1-1/2"	4,000 (ft-lbs)

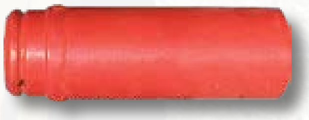
T1Z & T2Z Long Fitting Tool Adapters

For driving hex nuts and setting tools, typically with our Spin-Lock anchor systems. Works with torque wrench or impact gun.

Available with a 3/4", 1" and 1-1/2" square drive. Please specify square drive for compatibility with your equipment.



T2Z Regular Socket



T1Z Deep Socket

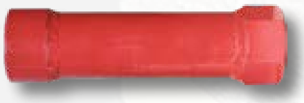
T9F Impact Tool

Lightweight air impact guns for applying torque to anchor bolts when setting or tensioning the anchor assembly.

Capacity (ft-lbs)	Square Drive Size	Size
1,700 - 2,000	1"	T9F-08
3,000 - 4,000	1-1/2"	T9F-12

K3F-26 Long Fitting Wrench Adapter

For applying torque to recessed rockbolt nuts that are under tension when using hydraulic jacks. Available in all rockbolt sizes.



S6Z Spin-Lock Setting Tool

This tool is required for torque setting the Spin-Lock anchors or for spinning rebars into resin cartridges without jamming or scoring the bolt threads. Special two piece design allows lower hex to be held in place while upper hex is loosened for easy removal.

Hardened steel allows for several reuses. Two piece design assures easy removal. Other thread forms are available for all Williams anchors.

Bolt Rod Diameter	Part Number
1/2"	S6Z-OH-004
5/8"	S6Z-OH-005
3/4"	S6Z-OH-006
7/8"	S6Z-OH-007
1"	S6Z-OH-008
1-1/8"	S6Z-OH-009
1-1/4"	S6Z-OH-010
1-3/8"	S6Z-OH-011
1-1/2"	S6Z-OH-012
1-3/4"	S6Z-OH-014
1-7/8"	S6Z-OH-015
2"	S6Z-OH-016

T3Z Hex Knocker Wrench

Hex knocker wrenches are used for safe hex nut adjustment inside of open frame jacks.

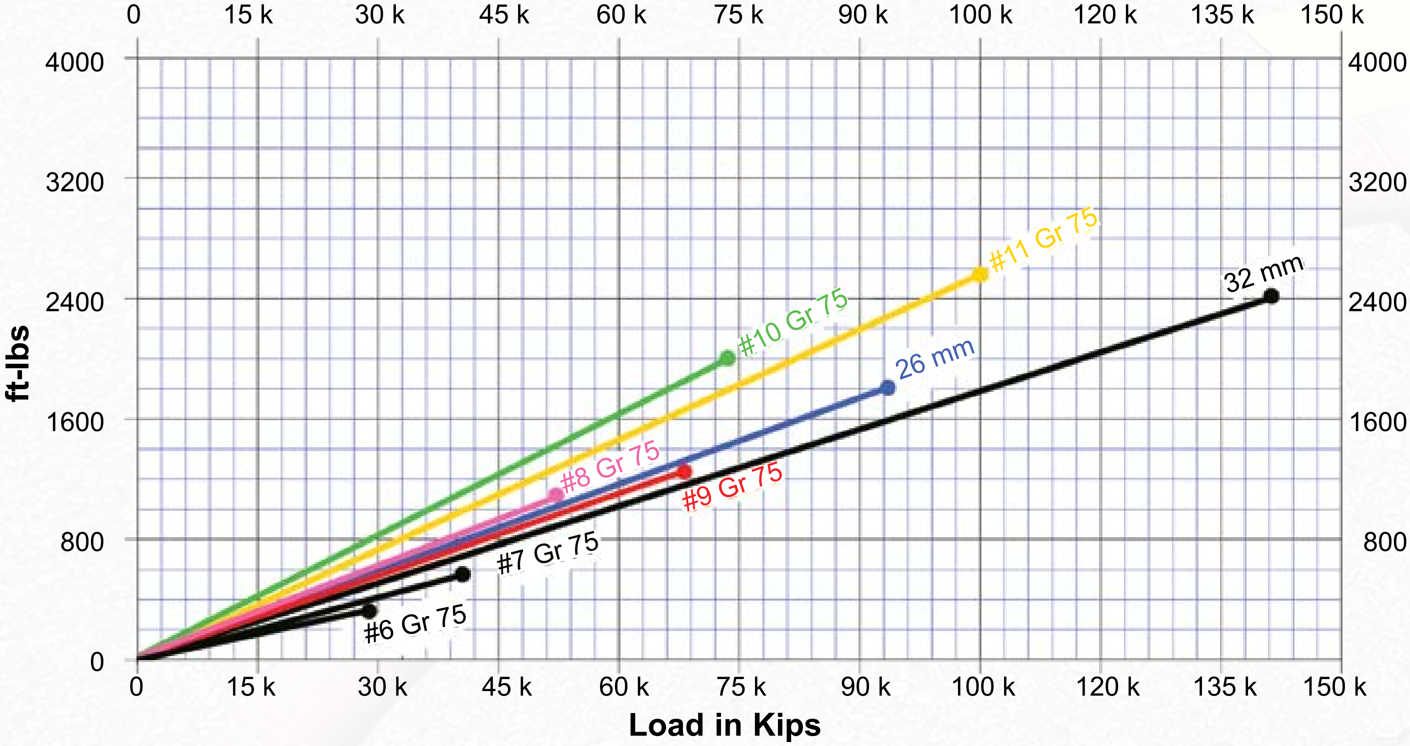
Spin Adapter

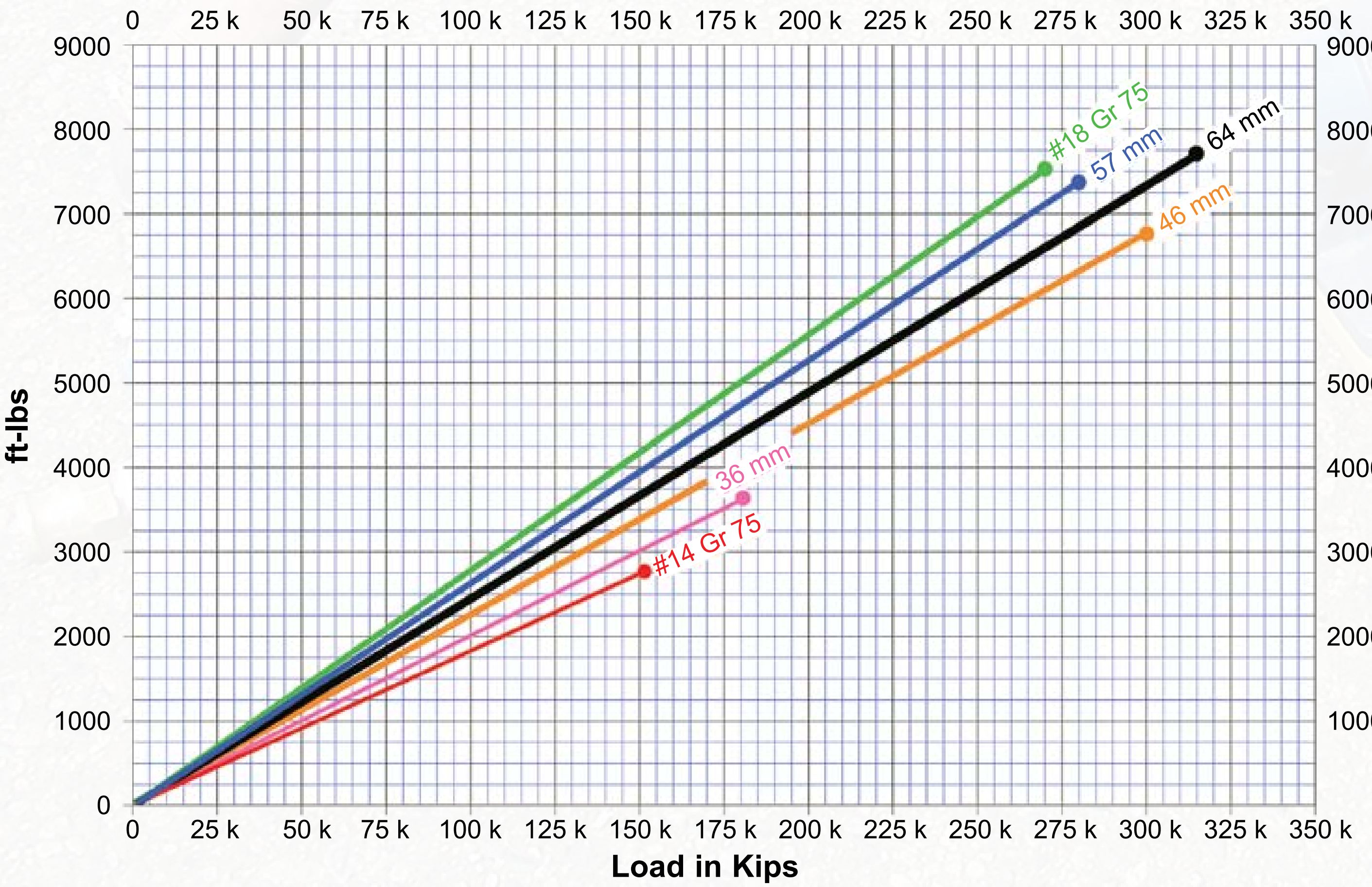
This tool provides a transition between the drill steel and the setting tool when the drilling equipment is used to spin the anchor bar through the resin cartridges. Adaptations to various drill steel types are available and must be specified when placing order.

All-Thread Bar Torque Tension Charts

R71 150 KSI All-Thread-Bar & R61 Grade 75 & Grade 80 All-Thread Rebar Torque Tension Chart

All data based on greased (MolyKoat GN) threads and surfaces. Torque-tension relationships should be used as a guide and are only applicable to uncoated (plain finish) bars. Actual tension can vary significantly, and should be verified in the field. If accurate tension is required, Williams recommends tensioning using a hydraulic ram.

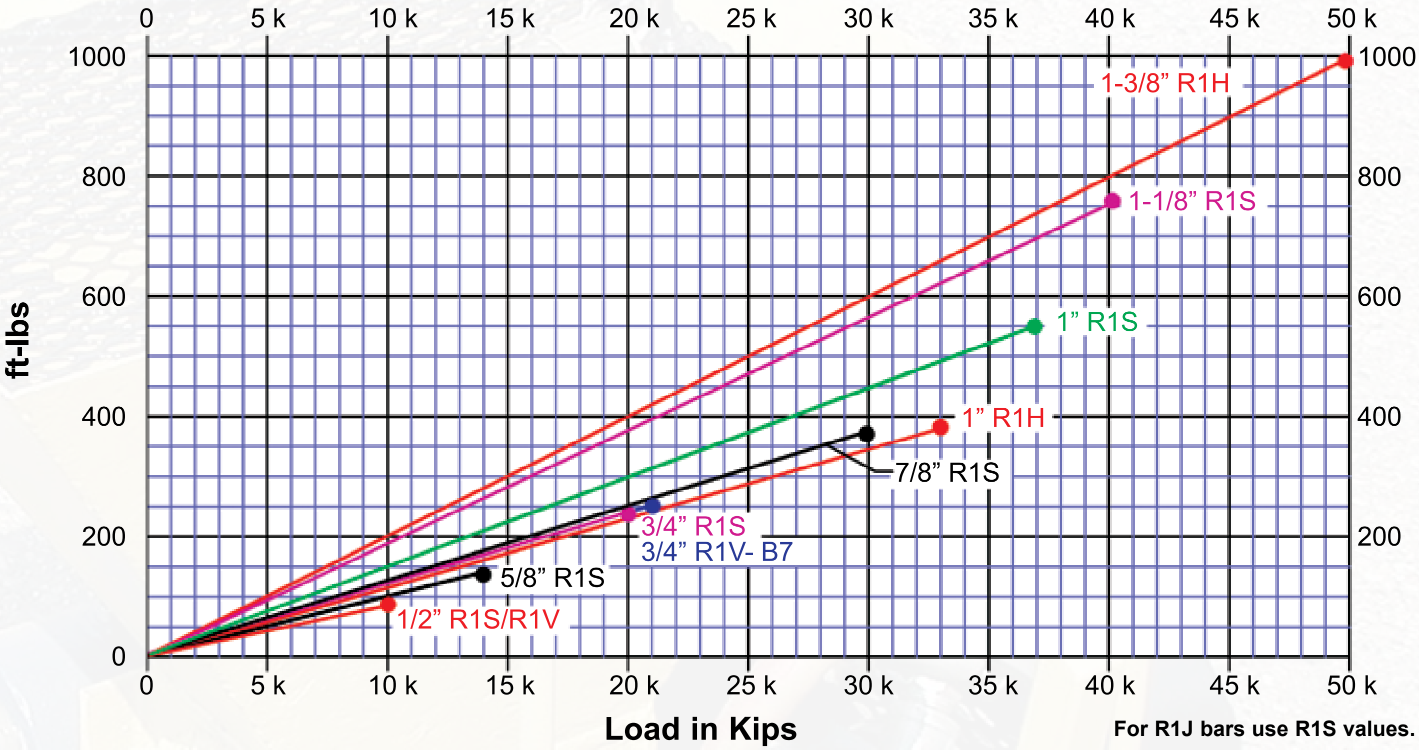




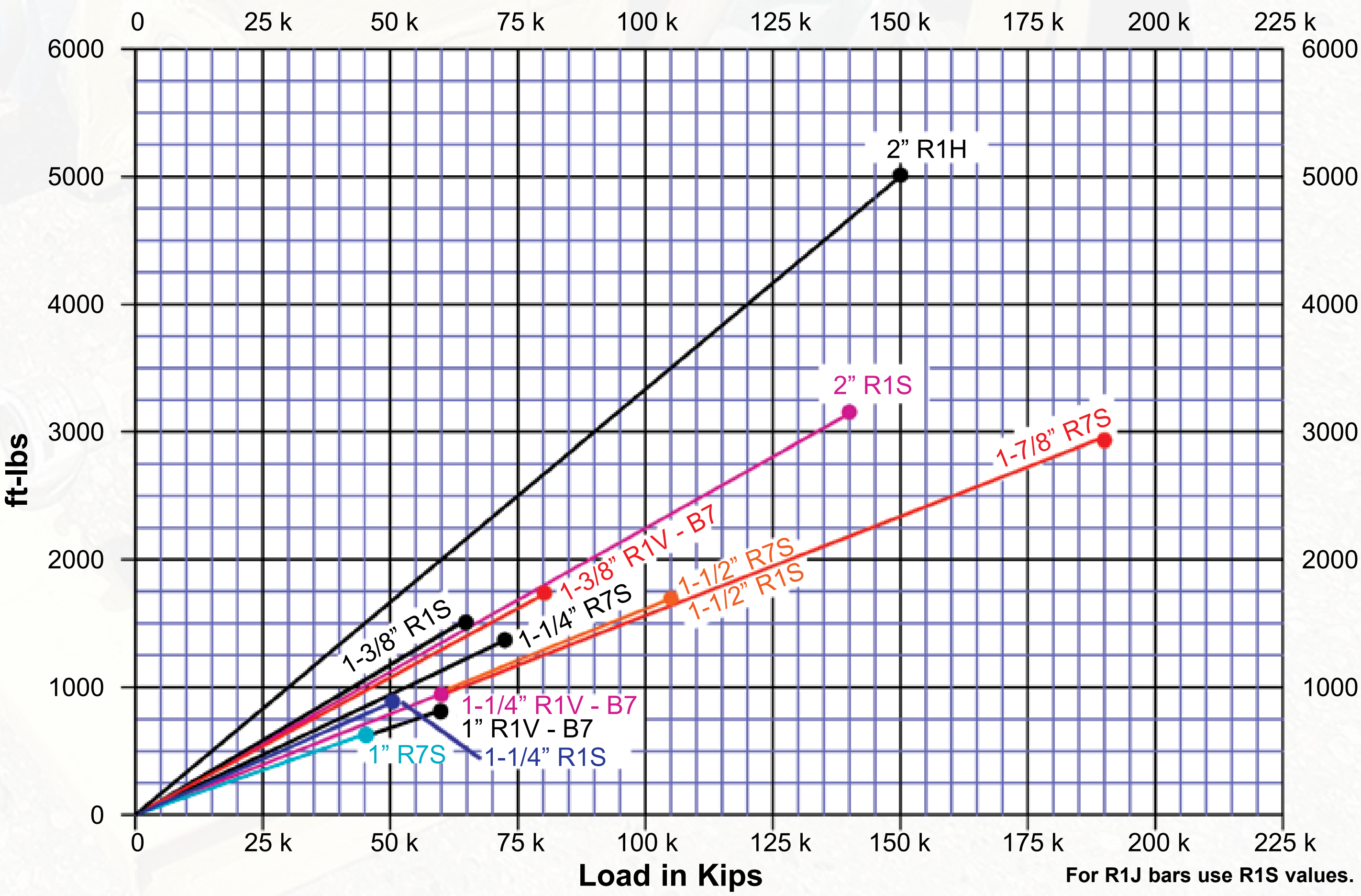
Spin-Lock Anchor Torque Tension Charts

R1H Hollow-Core, R1V High Impact, R1S High Tensile, R1J Solid Rebar & R7S 150 KSI Spin-Lock Torque Tension Chart

All data based on greased (MolyKoat GN) threads and surfaces. Torque-tension relationships should be used as a guide and are only applicable to uncoated (plain finish) bars. Actual tension can vary significantly, and should be verified in the field. If accurate tension is required, Williams recommends tensioning using a hydraulic ram.



For R1J bars use R1S values.



For R1J bars use R1S values.