WILLIAMS®
FORM ENGINEERING CORP.

High Capacity Concrete Anchor Systems

For Over 85 Years

No. 211u

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 representative 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.

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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.

Different 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 a vibratory restraint, seismic upgrade, or a need for a new project such as a bridge or power plant.

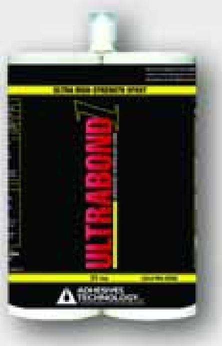
Mechanical Anchors

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) typically to a 2:1 safety factor based on the anchor's ultimate tensile strength. 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, bridge applications and countless other situations that demand a high degree of structural safety.

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 1

Ultrabond 2

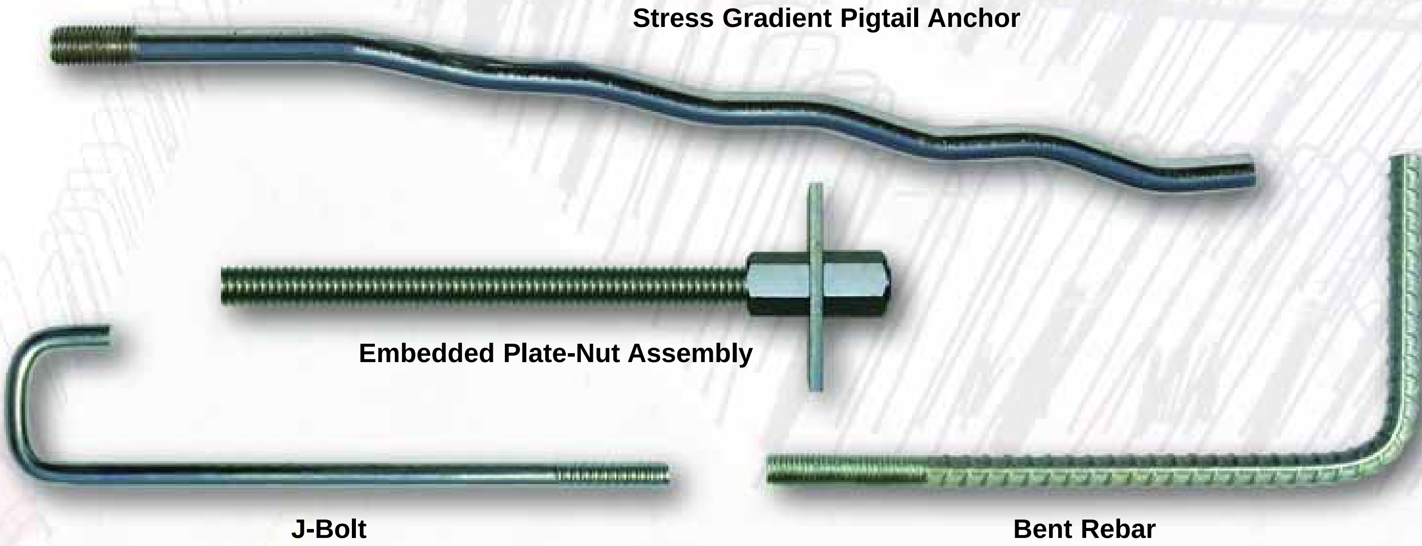
5-Star Cement Grout

Wil-X Cement Grout

Different 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 has recommended the use of ACI 349 appendix B which utilized a "45˚ cone method" for designing concrete anchor bolt systems. A new model is presently available in ACI 318 appendix D, however the database used to generate this new model was primarily derived from test data that included anchors up to 1" in diameter. For larger diameter anchors 1" and greater, the method shown in ACI 318 appendix D does not have a time tested record to demonstrate the effectiveness of its current equations. Some adjustment factors to the concrete breakout equation would need to be applied for anchors larger than 1" diameter in the future as the anchor test database increases to accommodate deep embedded anchors. The model presented in ACI 318 appendix D when used for large diameter anchors (diameters between 1" and 2") would typically be more conservative than the "45˚ cone method", but it may also be restrictive. Williams recommends designers use the models they are most comfortable with for deep embedded anchors and consult Williams Concrete Anchor Division for test data that may be useful.

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 is done 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 anchor products. Some tests described in codes, such as ACI 318 Appendix D and ACI 355.2, are cost prohibitive for large diameter anchors. These tests were primarily written for small diameter anchors and recent findings have shown the economic impracticality for large anchor systems. The space, concrete mass, equipment and experience are often not available for some of the testing required by ACI 355.2 as it currently pertains to large diameter anchors. ACI has recently organized a task group to study the economic problems related to testing large anchors in concrete. Please contact the Concrete Anchor Division at Williams Form for guidance on deep embedded anchor systems.

Example of the ACI 45° Cone Design Method

Note: The following information is meant only as a quick reference. The reader should refer to ACI 355.1R-91 and ACI 349 Appendix B, 1985 for complete information.

Excerpts from "State of the Art Report on Anchoring to Concrete" ACI 355.1R-91

(3.2.3.2) When the embedment of an anchor or group of anchors is insufficient to develop the tensile strength of the anchor steel, a pullout cone failure of the concrete is the principal failure mode. When the spacing of anchors or location of an edge interferes with the development of the full cone strength of an anchor, its capacity will be reduced.

In ACI 349 Appendix B, (ACI committee 349, 1985) the angle of the failure cone of headed and expansion anchors is assumed as 45-degrees.

The following formulas have been developed to describe behavior of headed studs, expansion, and undercut anchors.

Anchor Tension Load

Concrete Cone Failure (3.2.3.2)

ACI 349 Appendix B, limits the tensile capacity of cone failure of an anchor or group of anchors, to a uniform stress on the stress cone surface of the anchors.

$$Fu = 4\phi(\sqrt{f'c})A \qquad (3.2)$$

ϕ = Strength reduction factor
= .85 for uncracked concrete
= .65 in zone of potential cracking
A = The summation of the projected areas of individual stress cones minus the areas of overlap and of any area, or areas, cut off by intersecting edges (in^2)
Fu = Tensile capacity of the concrete cone (lbs.)
$f'c$ = Concrete Compressive strength (psi)

Minimum Edge Distance (3.2.3.2)

With respect to the minimum edge distance, tests reported a direct relationship between anchor load and side cone failure. The equation below is a more correct design boundry for the edge distance for headed anchors.

$$m = Fut\sqrt{\frac{3500}{f'c}}\frac{1}{10} \qquad (3.6)$$

Fut = ASTM - specified tensile strength of the anchor bolt (kips)
m = Minimum edge distance (in.)
$f'c$ = Concrete Compressive strength (psi)

Side Cone Bursting (3.2.3.2)

The average failure load for a side cone (bursting) failure is given as:

$$Fu = 15m\sqrt{\frac{f'c}{3500}} \qquad (3.7)$$

m = Actual edge distance (in.)
Fu = Failure load of side cone bursting (kips)
$f'c$ = Concrete Compressive strength (psi)

Splitting Failure (3.2.3.2)

With respect to minimum edge distance, the following criteria is proposed to preclude splitting failure occurring at a load lower than the capacity of the concrete cone failure or pullout. This equation is valid for anchor spacing S ≥ 2 in.

$$m = D(11.4 - .9(ld)) \qquad (3.21)$$

m = Minimum edge distance (in.)
D = Anchor bolt diameter (in.)
ld = Embedment depth to the bottom of the anchor (in.)

Example of the ACI 45° Cone Design Method

Anchor Shear Loading

Steel Failure (3.2.5.1)

Steel failure usually occurs after relatively large displacements and is most common for deep embedments, lower strength steels and large edge distances. The failure load depends on the steel area and the steel strength and given by:

$$Fu = N(As)(fut) \qquad (3.22)$$

N = Where the factor N takes account of the steel "shear" strength and has the range .6 to .7
As = Tensile stress area (in^2)
fut = Ultimate tensile strength (psi)
Fu = Ultimate shear strength of steel (lbs.)

Edge Failure (3.2.5.2.1)

For all types of anchors loaded in shear toward an adjacent, free edge and exhibiting a concrete failure, the failure load is influenced by the concrete tensile strength, the edge distance m and the stiffness of the anchor. Another influencing factor is the embedment depth. The Failure surface has conical shape that may radiate from the embedded end of the anchor for shallow embedments or from the upper part of the anchorage for deep embedments.

ACI 349 appendix B, Commentary gave a design shear strength of:

$$Vu = 2\vartheta\sqrt{f'c}(\pi)(m^2) \qquad (3.23)$$

ϑ = .85
$f'c$ = Concrete Compressive strength (psi)
m = Distance from anchor to free edge (in.)
π = 3.14
Vu = Concrete shear breakout capacity (lbs.)

Minimum Edge Distance Shear (3.2.5.2.1)

ACI 349, Appendix B further recommends a minimum side cover or edge distance m required to preclude edge failures, be calculated by:

$$m = D\sqrt{\frac{Fut}{7.5\sqrt{f'c}}} \qquad (3.24)$$

D = Anchor diameter (in.)
Fut = Anchor ultimate tensile load (lbs.)
$f'c$ = Concrete Compressive strength (psi)
m = Minimum edge distance for shear loading (in.)

Critical Spacing (3.2.5.2.1)

Calculating the failure load of single fastenings situated in a corner or in narrow members. Klinger, Mendonca, and Malik (1982) recommend a critical (minimum) edge spacing of:

$$m \geq D\sqrt{\frac{Fut}{8\vartheta c\sqrt{f'c}}} \qquad (3.29)$$

ϑc = .9
m = Critical minimum edge spacing (in)
D = Anchor diameter (in)
Fut = ASTM - specified tensile strength of the anchor bolt (kips)
$f'c$ = Concrete Compressive strength (psi)

Combined Tension and Shear (3.2.5.2.2)

The behavior of anchors under combined tension and shear loading lies in between the behavior under tension or shear loading, and for a given depth of embedment, is dependent on the angle of the loading.

To calculate the failure load under combined tension one approach is the straight-line function.

$$(Ta/Tu) + (Va/Vu) \leq 1.0 \qquad (3.32)$$

Ta, Va = Applied tensile and shear load, respectively
Tu, Vu = Ultimate tensile and shear load, respectively

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.

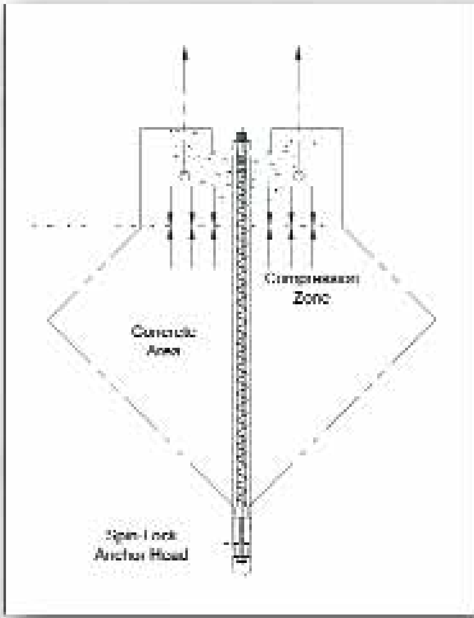
Eliminate Fatigue Stress - Fatigue failure is minimized since the service load must exceed the prestressed load of the bolt to cause additional steel elongation. Therefore, the periodic stretching and relaxing that causes fatigue failure is eliminated.

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.

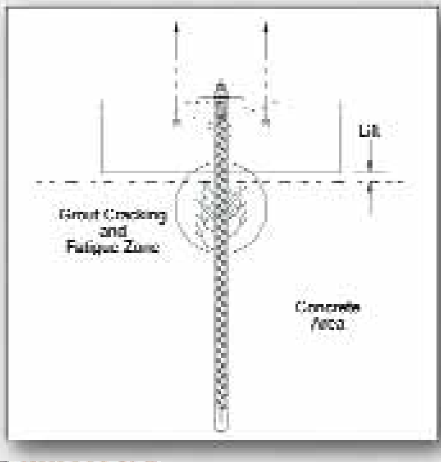
Negligible Bond Stress Relief - In cases where the concrete anchor free-stress length is grouted after prestress, the grout hardens around the deformations of the bar and bonds to the concrete in the drill hole to help prevent stress relief in the bolt.

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.

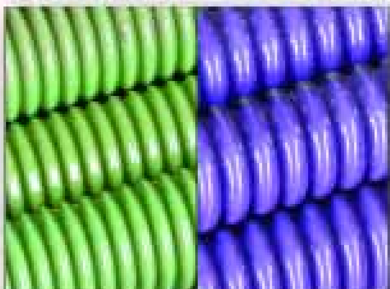
Corrosion Protection

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. Coating thickness is generally specified between 7 to 12 mils. Epoxy coated bars and fasteners 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 large heavy components 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. Epoxy Coating is used strictly on Williams Cast-in-Place, Wil-Bond Epoxy or cement grouted anchors. Not recommended for fine thread forms.

Hot Dip Galvanizing

Zinc metal used in the galvanizing process provides a barrier between the steel substrate and the corrosive elements in its surroundings. The zinc coating sacrifices itself slowly by galvanic action to protect the base 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 anchors rods is generally more expensive than epoxy coating and often has greater lead time. Hot dip galvanized bars and fasteners should be done in accordance with ASTM A153. Hot dip galvanized coating thickness for steel bars and the components is between 3 and 4 mils. **150 KSI high strength steel bars should always be mechanically cleaned (never acid washed) to avoid problems associated with hydrogen embrittlement.** Hot Dip Galvanizing can be used on Williams Spin-Locks, cast-in-place anchors, epoxy and cement grout anchors. Oversized tapped hex nuts should be used with hot dip galvanized bars.

End Caps

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

Fiber Reinforced Nylon Cap

Steel Tube welded on Flange with Threaded Screw Connections

Steel Tube with Jam Nut

Slip-On PVC Cap with Plastic Nut

Screw-On PVC Cap

Introduction

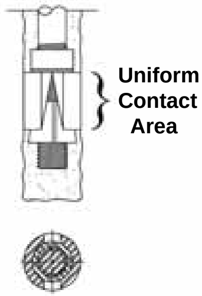
Williams Spin-Lock anchors were first used in the 1950's for rock/roof bolting in projects such as NORAD and Australia's Snowy Mountain Power Facility. Since then many engineers, contractors and owners have recognized the advantages of the Spin-Lock anchor system as a high capacity concrete anchor. Spin-Locks 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.

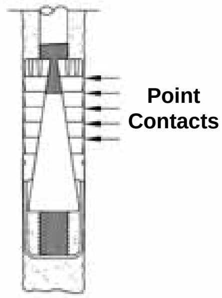
Comparison Proves

Williams Spin-Lock Anchor



Expansion shell receives full bearing support from solid 300° cone design.

Serrated Anchor by Others



Quartered cone design leaves expansion shell unsupported at adjacent gaps. Shell can collapse under high stress.

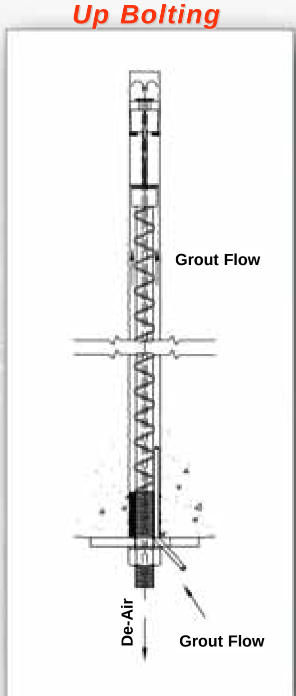
Spin-Lock Advantages

- **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 are 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 personal 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 for a 2:1 safety factor.**
- **The Spin-Lock has been used in construction for over 50 years.**

R1H Hollow-Core Spin-Lock Concrete Anchor

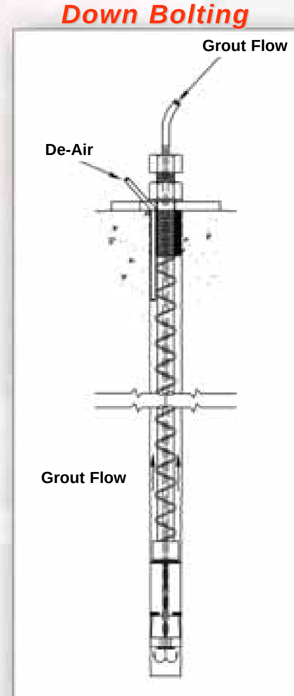
Prestressable • Positive Grouting • Permanent

Up Bolting



Though 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 300º 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.

Down Bolting



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.

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

Dia & Threads per In.	Recomm. Design Load at Approx. 2:1 Safety Factor	Maximum Working Load to Yield	Average Ultimate Strength	Ultimate Shear Strength	Drill Hole Dia. (1)	Type Head Ass’y	Torque Ft.-Lbs.		Embedment Depth in 3000 PSI Concrete (4)	Part Number
							To Expand Shell (2)	On Nut for Tension		
1” - 8 (25 mm)	33 kips (147 kN)	47 kips (209 kN)	66 kips (294 kN)	39.6 kips (176 kN)	1-3/4” (44 mm)	B 14	250 ft.-lbs. (450*)	400	15” (381 mm)	R1H08B14
1-3/8” - 8 (35 mm)	69 kips (307 kN)	100 kips (445 kN)	138 kips (614 kN)	82.8 kips (368 kN)	2-1/2” (65 mm)	B 20	750 ft.-lbs. (1200*)	Note (3)	23” (584 mm)	R1H11B20
2” - 6 (51 mm)	150 kips (667 kN)	219 kips (974 kN)	300 kips (1334 kN)	180 kips (801 kN)	3-1/2” (89 mm)	C 28	1000 ft.-lbs. (2000*)	Note (3)	34” (864 mm)	R1H16C28

NOTES:
(*) 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) Stress to desired tensile load using a hollow ram hydraulic jack. Consult your Williams Representative.
(4) Full ultimate strength of anchor can be achieved at listed embedment depth, provided there are no edge or spacing effects on the anchor.
(5) WILLIAMS reserves the right to ship full length or coupled units as necessary.
(6) All above torque values are used for clean, dry (un-greased) threads. For greased thread torque values, contact your local Williams representative.

R1S / B7S / R1V Spin-Lock Concrete Anchors

R1S U.N. Thread Form Bar

B7S All-Thread Coil Bar

R1S / B7S Structural Properties

Yield Stress	Ultimate Stress	Elongation in 2" (51 mm)	Reduction of Area
90 / 81 KSI (621 / 558 MPa)	120 / 105 KSI (827 / 723 MPa)	11%	20% min.

Meets strength of ASTM A325

R1S / B7S High Tensile Spin-Lock Concrete Anchor - ASTM A108 / C1045

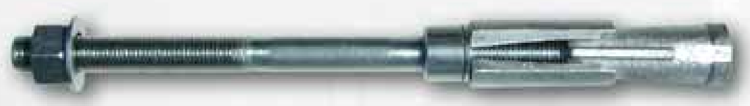
Williams R1S / B7S Spin-Lock Concrete Anchor utilizes a C-1045 steel which provides high strength capacity and has the advantage of utilizing a more common steel for greater availability.

Dia & Threads per In.	Recomm. Design Load at Approx. 2:1 Safety Factor	Maximum Working Load to Yield	Average Ultimate Strength	Ultimate Shear Strength	Drill Hole Dia. (1)	Type Head Ass'y	Torque Ft.-Lbs. To Expand Shell (2)	Torque Ft.-Lbs. On Nut for Tension	Embedment Depth in 3000 PSI Concrete (4)	Part Number
1/2" - 13 (12 mm)	8.53 kips (37.9 kN)	13.1 kips (58.1 kN)	17.1 kips (75.8 kN)	10.2 kips (45.5 kN)	1-1/4" (32 mm)	A 10	50 ft.-lbs. (70*)	85	7" (178 mm)	R1S04A10
5/8" - 11 (16 mm)	13.6 kips (60.3 kN)	20.8 kips (92.5 kN)	27.1 kips (120.6 kN)	16.3 kips (72.4 kN)	1-1/4" (32 mm)	A 10	125 ft.-lbs. (250*)	125	8" (203 mm)	R1S05A10
3/4" - 10 (20 mm)	20.1 kips (89.2 kN)	30.7 kips (137 kN)	40.1 kips (178 kN)	24.1 kips (107 kN)	1-3/4" (44 mm)	C 14	210 ft.-lbs. (250*)	210	11" (279 mm)	R1S06C14
7/8" - 9 (22 mm)	27.7 kips (123 kN)	42.5 kips (189 kN)	55.4 kips (246 kN)	33.2 kips (148 kN)	1-3/4" (44 mm)	C 14	390 ft.-lbs. (410*)	390	14" (356 mm)	R1S07C14
1" - 8 (25 mm)	36.4 kips (162 kN)	55.8 kips (248 kN)	72.7 kips (323 kN)	43.6 kips (194 kN)	1-3/4" (44 mm)	C 14	500 ft.-lbs. (600*)	550	16" (406 mm)	R1S08C14
1-1/8" - 7 (29 mm)	40.5 kips (180 kN)	62 kips (284 kN)	81 kips (360 kN)	48.6 kips (216 kN)	2-1/4" (57 mm)	C 18	550 ft.-lbs. (600*)	770	17" (432 mm)	R1S09C18
1-1/4" - 7 (32 mm)	51 kips (254 kN)	79 kips (381 kN)	102 kips (508 kN)	61.2 kips (305 kN)	2-1/4" (57 mm)	C 18	750 ft.-lbs. (1200*)	1000	20" (508 mm)	R1S10C18
1-3/8" - 8 (35 mm)	65 kips (289 kN)	100 kips (445 kN)	130 kips (578 kN)	78 kips (347 kN)	2-1/2" (64 mm)	B 20	750 ft.-lbs. (1600*)	Note (3)	22" (559 mm)	R1S11B20
1-1/2" - 6 (38 mm)	73.5 kips (327 kN)	113 kips (503 kN)	147 kips (654 kN)	88.2 kips (392 kN)	3" (76 mm)	B 24	1000 ft.-lbs. (1700*)	Note (3)	23" (584 mm)	R1S12B24
2" - 6 (51 mm)	139 kips (657 kN)	215 kips (1080 kN)	279 kips (1313 kN)	167.4 kips (788 kN)	3-1/2" (89 mm)	C 28	1000 ft.-lbs. (2000*)	Note (3)	34" (864 mm)	R1S16C28

See Notes on bottom of page 13.

R1V Structural Properties

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



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.

Dia & Threads per In.	Recomm. Design Load at Approx. 2:1 Safety Factor	Maximum Working Load to Yield	Average Ultimate Strength	Ultimate Shear Strength	Drill Hole Dia. (1)	Type Head Ass'y	Torque Ft.-Lbs. To Expand Shell (2)	Torque Ft.-Lbs. On Nut for Tension	Embedment Depth in 3000 PSI Concrete (4)	Part Number
1/2" - 13 (12 mm)	9 kips (40 kN)	15 kips (66.7 kN)	18 kips (80 kN)	10.8 kips (48 kN)	1-1/4" (32 mm)	A 10	50 ft.-lbs. (50*)	85	7" (178 mm)	R1V04A10
3/4" - 10 (20 mm)	21 kips (93.3 kN)	36 kips (160 kN)	42 kips (187 kN)	25.2 kips (112 kN)	1-3/4" (44 mm)	C 14	210 ft.-lbs. (250*)	250	12" (305 mm)	R1V06C14
1" - 8 (25 mm)	38 kips (169 kN)	64 kips (285 kN)	76 kips (338 kN)	45.6 kips (203 kN)	1-3/4" (44 mm)	C 14	500 ft.-lbs. (600*)	550	16" (406 mm)	R1V08C14
1-1/4" - 7 (32 mm)	61 kips (273 kN)	102 kips (454 kN)	122 kips (543 kN)	73 kips (326 kN)	2-1/4" (57 mm)	C 18	750 ft.-lbs. (1600*)	1000	22" (559 mm)	R1V10C18
1-3/8" - 8 (35 mm)	77.5 kips (344 kN)	129 kips (573 kN)	154 kips (684 kN)	92.4 kips (411 kN)	2-1/2" (64 mm)	B 20	750 ft.-lbs. (1600*)	Note (3)	24" (610 mm)	R1V11B20
1-1/2" - 6 (38 mm)	88 kips (391 kN)	148 kips (658 kN)	176 kips (783 kN)	106 kips (470 kN)	3" (76 mm)	B 24	1000 ft.-lbs. (1700*)	Note (3)	26" (660 mm)	R1V12B24
1-3/4" - 5 (45 mm)	119 kips (443 kN)	199 kips (885 kN)	237 kips (1054 kN)	142 kips (632 kN)	3" (76 mm)	B 24	1000 ft.-lbs. (1700*)	Note (3)	29" (737 mm)	R1V14B24
2" - 6 (51 mm)	165 kips (733 kN)	278 kips (1236 kN)	330 kips (1467 kN)	198 kips (880 kN)	3-1/2" (89 mm)	C 28	1000 ft.-lbs. (2000*)	Note (3)	35" (889 mm)	R1V16C28

See Notes on bottom of page 13.

R1J / R7S Spin-Lock Concrete Anchors

R1J Structural Properties

Yield Stress	Ultimate Stress	Elongation in 8" (203 mm)
60 KSI (413 MPa)	90 KSI (621 MPa)	#6-#8 - 7% min. #9 & Larger - 9% min.

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.

Dia & Threads per In.	Recomm. Design Load at Approx. 2:1 Safety Factor	Maximum Working Load to Yield	Average Ultimate Strength	Ultimate Shear Strength	Drill Hole Dia. (1)	Type Head Ass'y	Torque Ft.-Lbs.		Embedment Depth in 3000 PSI Concrete (4)	Part Number
							To Expand Shell (2)	On Nut for Tension		
1/2" - 13 (12 mm)	6.35 kips (28.2 kN)	8.5 kips (37.7 kN)	12.7 kips (56.5 kN)	7.62 kips (33.9 kN)	1-1/4" (32 mm)	A 10	50 ft.-lbs. (50*)	60	7" (178 mm)	R1J04A10
5/8" - 11 (16 mm)	10.2 kips (45.2 kN)	13.5 kips (60.1 kN)	20.3 kips (90.3 kN)	12.2 kips (54.2 kN)	1-1/4" (32 mm)	A 10	100 ft.-lbs. (100*)	110	8" (203 mm)	R1J05A10
3/4" - 10 (20 mm)	15 kips (66.7 kN)	20 kips (88.9 kN)	30 kips (134 kN)	18 kips (80.1 kN)	1-3/4" (44 mm)	C 14	165 ft.-lbs. (165*)	175	10" (254 mm)	R1J06C14
7/8" - 9 (22 mm)	20.7 kips (92.1 kN)	27 kips (120 kN)	41.5 kips (185 kN)	24.9 kips (111 kN)	1-3/4" (44 mm)	C 14	265 ft.-lbs. (265*)	290	12" (305 mm)	R1J07C14
1" - 8 (25 mm)	27 kips (120 kN)	36 kips (160 kN)	54 kips (240 kN)	32.4 kips (144 kN)	1-3/4" (44 mm)	C 14	400 ft.-lbs. (400*)	420	14" (356 mm)	R1J08C14
1-1/8" - 7 (29 mm)	34 kips (151 kN)	45 kips (200 kN)	68 kips (303 kN)	40.8 kips (182 kN)	2-1/4" (57 mm)	C 18	450 ft.-lbs. (550*)	610	16" (406 mm)	R1J09C18
1-1/4" - 7 (32 mm)	43.5 kips (194 kN)	58 kips (258 kN)	87 kips (387 kN)	52.2 kips (232 kN)	2-1/4" (57 mm)	C 18	750 ft.-lbs. (750*)	810	18" (457 mm)	R1J10C18
1-3/8" - 8 (35 mm)	55 kips (245 kN)	73 kips (325 kN)	110 kips (489 kN)	66 kips (294 kN)	2-1/2" (64 mm)	B 20	750 ft.-lbs. (1000*)	Note (3)	22" (559 mm)	R1J11B20
1-3/4" - 6 (38 mm)	85.5 kips (380 kN)	114 kips (507 kN)	171 kips (761 kN)	103 kips (456 kN)	3" (76 mm)	B 24	1000 ft.-lbs. (1700*)	Note (3)	26" (660 mm)	R1J14B24
2" - 6 (51 mm)	119 kips (529 kN)	159 kips (707 kN)	238 kips (1058 kN)	143 kips (635 kN)	3-1/2" (89 mm)	C 28	1000 ft.-lbs. (2000*)	Note (3)	34" (864 mm)	R1J16C28

See Notes at bottom

R7S Structural Properties

Yield Stress	Ultimate Stress	Elongation in 20 Bar Dia.	Reduction of Area
127.7 KSI (880 MPa)	150 KSI (1034 MPa)	4% min.	20% min.

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.

Dia & Threads per In.	Recomm. Design Load at Approx. 2:1 Safety Factor	Maximum Working Load to Yield	Average Ultimate Strength	Ultimate Shear Strength	Drill Hole Dia. (1)	Type Head Ass'y	Torque Ft.-Lbs.		Embedment Depth in 3000 PSI Concrete (4)	Part Number
							To Expand Shell (2)	On Nut for Tension		
1" - 8 (25 mm)	45 kips (200 kN)	72 kips (320 kN)	90 kips (400 kN)	54 kips (240 kN)	1-3/4" (44 mm)	C 14	500 ft.-lbs. (650*)	680	18" (457 mm)	R7S08C14
1-1/4" - 7 (32 mm)	72.5 kips (322 kN)	116 kips (516 kN)	145 kips (649 kN)	87 kips (389 kN)	2-1/2" (64 mm)	B 20	750 ft.-lbs. (1200*)	Note (3)	23" (584 mm)	R7S10B20
1-1/2" - 6 (38 mm)	105 kips (467 kN)	168 kips (747 kN)	210 kips (932 kN)	126 kips (559 kN)	3" (76 mm)	B 24	1000 ft.-lbs. (1700*)	Note (3)	26" (660 mm)	R7S12B24
1-7/8" - 8 (48 mm)	180 kips (799 kN)	289 kips (1284 kN)	360 kips (1598 kN)	216 kips (959 kN)	3-1/2" (89 mm)	C 28	1000 ft.-lbs. (2000*)	Note (3)	36" (914 mm)	R7S15C28

NOTES:
(*) 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) Stress to desired tensile load using a hollow ram hydraulic jack. Consult your Williams Representative.
(4) Full ultimate strength of anchor can be achieved at listed embedment depth, provided there are no edge or spacing effects on the anchor.
(5) WILLIAMS reserves the right to ship full length or coupled units as necessary.
(6) All above torque values are used for clean, dry (un-greased) threads. For greased thread torque values, contact your local Williams representative.

Design Considerations for Spin-Locks

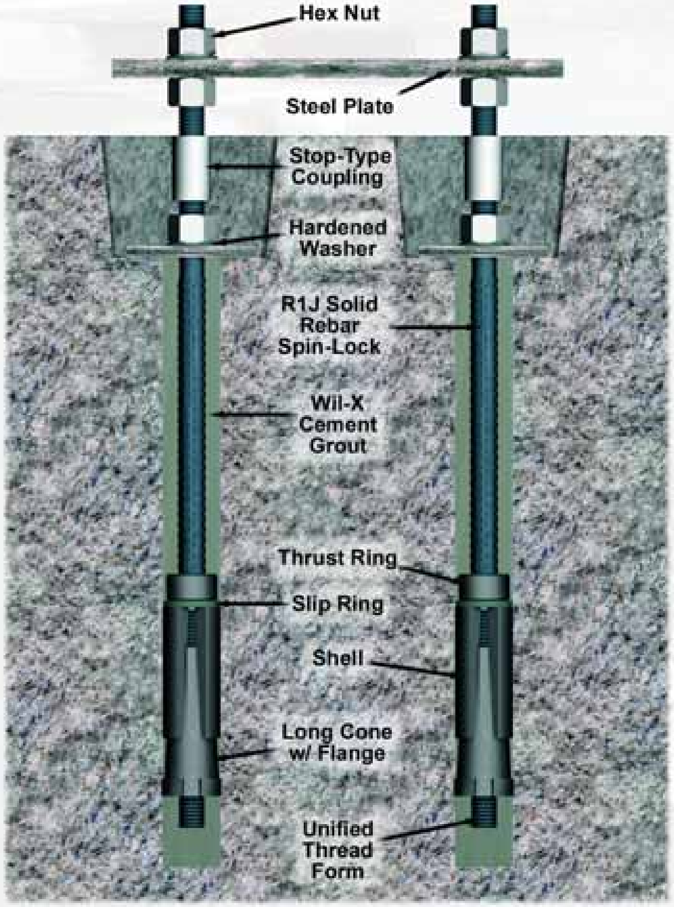
For several decades Engineers have successfully based their Spin-lock designs on the 45˚ cone method that was presented in ACI 349 Appendix B (1985). This method has worked effectively for Spin-Locks when used in nuclear power plants, rocket launch pads, machinery tie downs, foundation repair anchors and many more applications.

At times, job conditions may dictate the necessity to place adjacent anchors closer than the minimum spacings (S) shown in the following table. When reduced spacing is desired it is then recommended to install the anchors by staggering the embedment depths. 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; the 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.

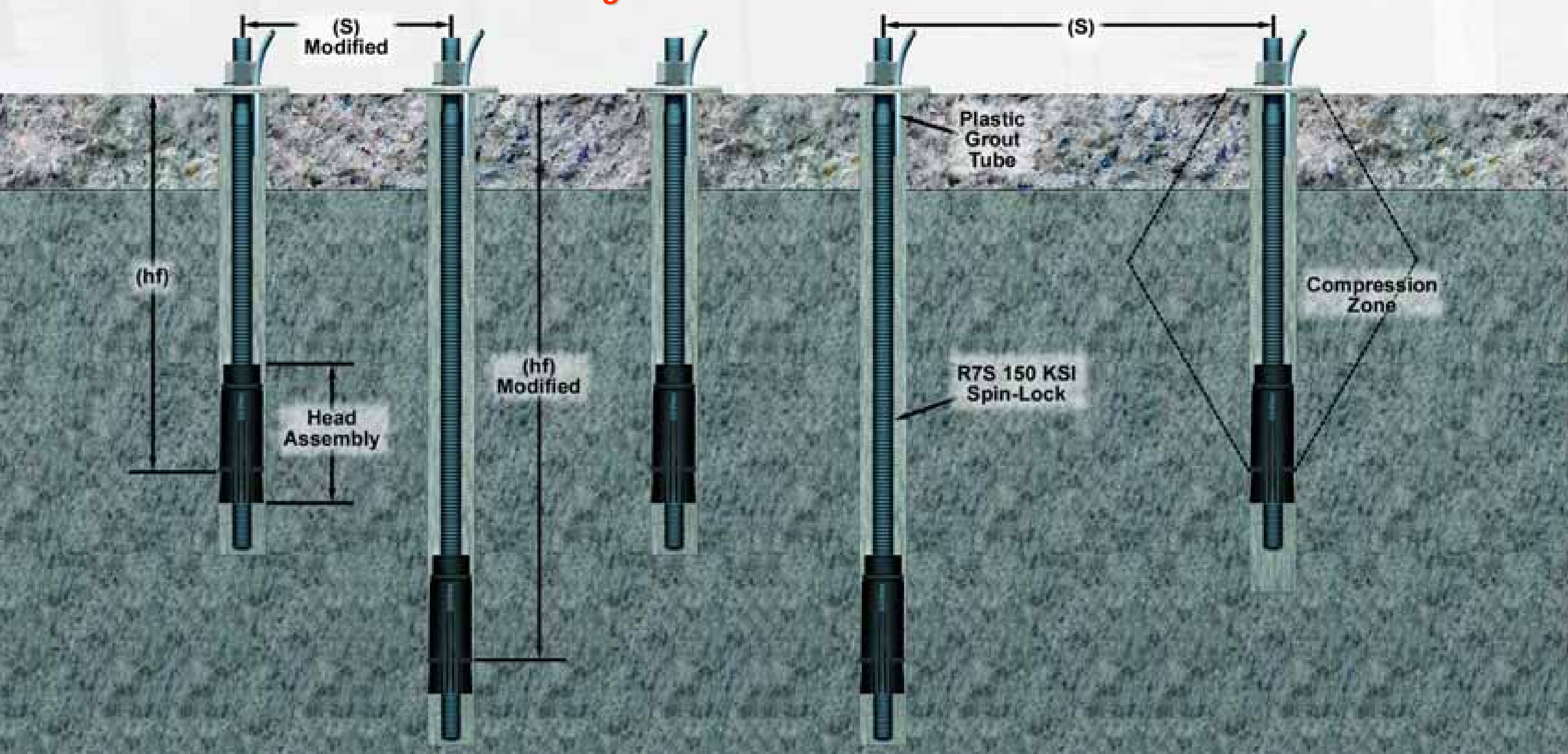
The ideal spacings are large enough to prevent blow out from anchor hole to anchor hole, but not to develop the full combined anchor capacities. Based on the 45˚ cone method in ACI 349 Appendix B (1985), the center to center spacing to develop the full shear cone should be 2 times the recommended embedment depth. Closely spaced anchors can be designed with a deeper embedment than what is listed in order to develop the combined anchor capacities.

Adequate safety factors should always be applied based on site and design conditions. 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 for Spin-Locks

Edge distance (E) may be reduced from the following chart if special care is taken during installation, working loads are reduced, or heavy reinforcement is present in the side wall of the concrete. Williams has performed testing that gives the designer a basic idea of what concrete failure loads to expect in non-reinforced concrete for reduced edge distances. These numbers are not recommendations, they are simply meant to be used as a reference. The designer should compare the numbers below that are based on tests, to numbers determined from the design models of ACI 349 appendix B and/or values from ACI 318 Appendix D. Call the Williams Concrete Anchor Division for additional test info.

Spin-Lock Concrete Anchors - Minimum Spacing & Edge Distances

Head Assembly	Anchor Type	Anchor Diameter	Minimum Embedment	Minimum Spacing to Prevent Hole to Hole Blowout Failure (S)	Minimum Recommended Edge Distance (E)	Average Ultimate Strength	Concrete Failure Loads			
							7 Bar ø from the Edge (Test)	10 Bar ø from the Edge (Test)	14 Bar ø from the Edge (Test)	18 Bar ø from the Edge (Test)
A10	R1S	1/2" (12 mm)	7" (178 mm)	6" (152 mm)	8" (203 mm)	17.1 kips (75.8 kN)	15 kips (67 kN)	17 kips (75.8 kN)	(1)	(1)
		5/8" (16 mm)	8" (203 mm)	7-1/2" (191 mm)	9" (229 mm)	27.1 kips (121 kN)	15 kips (67 kN)	19 kips (84.5 kN)	22 kips (98 kN)	N.A.
	R1V	1/2" (12 mm)	7" (178 mm)	6" (152 mm)	8" (203 mm)	18 kips (80 kN)	15 kips (67 kN)	(1)	(1)	(1)
	R1J	1/2" (12 mm)	7" (178 mm)	6" (152 mm)	8" (203 mm)	12.7 kips (56.5 kN)	15 kips (67 kN)	(1)	(1)	(1)
		5/8" (16 mm)	8" (203 mm)	7-1/2" (191 mm)	9" (229 mm)	20.3 kips (90.3 kN)	15 kips (67 kN)	19 kips (84.5 kN)	20 kips (89 kN)	(1)
B14	R1H	1" (25 mm)	14" (356 mm)	12" (305 mm)	15" (381 mm)	66 kips (294 kN)	35 kips (156 mm)	66 kips (294 kN)	(1)	(1)
	R1J	3/4" (20 mm)	10" (254 mm)	9" (229 mm)	11" (279 mm)	30 kips (134 kN)	18 kips (80 kN)	30 kips (134 kN)	(1)	(1)
		7/8" (22 mm)	12" (305 mm)	10-1/2" (227 mm)	14" (356 mm)	41.5 kips (185 kN)	18 kips (80 kN)	41.5 kips (185 kN)	(1)	(1)
		1" (25 mm)	15" (381 mm)	12" (305 mm)	15" (381 mm)	54 kips (240 kN)	35 kips (156 mm)	54 kips (240 kN)	(1)	(1)
B20	R1H	1-3/8" (35 mm)	24" (610 mm)	16-1/2" (419 mm)	22" (559 mm)	138 kips (614 kN)	N.A.	90 kips (400 kN)	102 kips (454 kN)	N.A.
	R1V	1-3/8" (35 mm)	24" (610 mm)	16-1/2" (419 mm)	22" (559 mm)	154 kips (684 kN)	N.A.	90 kips (400 kN)	102 kips (454 kN)	N.A.
	R1J	1-3/8" (35 mm)	22" (559 mm)	16-1/2" (419 mm)	22" (559 mm)	110 kips (489 kN)	N.A.	90 kips (400 kN)	102 kips (454 kN)	(1)
	R7S	1-1/4" (32 mm)	18" (457 mm)	15" (381 mm)	20" (508 mm)	145 kips (649 kN)	82 kips (365 kN)	87 kips (387 kN)	N.A.	N.A.
B24	R7S	1-1/2" (38 mm)	26" (662 mm)	19-1/2" (495 mm)	27" (686 mm)	210 kips (932 kN)	N.A.	90 kips (400 kN)	102 kips (454 kN)	208 kips (925 kN)
C14	R1S	3/4" (20 mm)	12" (305 mm)	9" (229 mm)	11" (279 mm)	40.1 kips (178 kN)	33 kips (147 kN)	42 kips (187 kN)	(1)	(1)
		7/8" (22 mm)	14" (356 mm)	10-1/2" (267 mm)	14" (356 mm)	55.4 (246 kN)	33 kips (147 kN)	42 kips (187 kN)	(1)	(1)
		1" (25 mm)	16" (406 mm)	12" (305 mm)	15" (381 mm)	72.7 kips (323 kN)	55 kips (245 kN)	67 kips (298 kN)	(1)	(1)
	R1V	3/4" (20 mm)	11" (279 mm)	9" (229 mm)	11" (279 mm)	42 kips (187 kN)	33 kips (147 kN)	42 kips (187 kN)	(1)	(1)
		1" (25 mm)	16" (406 mm)	12" (305 mm)	15" (381 mm)	76 kips (338 kN)	55 kips (245 kN)	67 kips (298 kN)	N.A.	N.A.
	R7S	1" (25 mm)	18" (457 mm)	13" (330 mm)	17" (432 mm)	90 kips (400 kN)	55 kips (245 kN)	67 kips (298 kN)	91 kips (405 kN)	(1)
C18	R1S	1-1/4" (32 mm)	20" (508 mm)	15" (381 mm)	20" (508 mm)	102 kips (508 kN)	82 kips (365 kN)	92 kips (409 kN)	102 kips (454 kN)	(1)
	R1J	1-1/8" (30 mm)	16" (406 mm)	13-1/2" (343 mm)	18" (457 mm)	68 kips (303 kN)	N.A.	68 kips (302 kN)	(1)	(1)
		1-1/4" (32 mm)	23" (584 mm)	16" (406 mm)	22" (559 mm)	87 kips (387 kN)	82 kips (365 kN)	92 kips (409 kN)	(1)	(1)
C28	R1H	2" (51 mm)	33" (838 mm)	24" (610 mm)	32" (813 mm)	300 kips (1334 kN)	N.A.	180 kips (801 kN)	283 kips (1259 kN)	300 kips (1334 kN)
	R1V	2" (51 mm)	35" (889 mm)	24" (610 mm)	32" (813 mm)	330 kips (1467 kN)	N.A.	180 kips (801 kN)	283 kips (1259 kN)	330 kips (1468 kN)
	R7S	1-7/8" (48 mm)	36" (914 mm)	24" (610 mm)	35" (889 mm)	360 kips (1598 kN)	N.A.	180 kips (801 kN)	283 kips (1259 kN)	330 kips (1468 kN)

(1) Ultimate Strength of the steel was reached.
(N.A.) No test data is available
Concrete compressive strengths were between 3000-4500 psi with the exception of the C28 tests which were performed in high strength 5000 psi concrete.
All tests were performed in unreinforced concrete.

Spin-Lock Head Assembly

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

Head Assembly	Drill Hole Dia.	Bolt Dia. & Thread Form	Standard Cone Length & Part Num.	Standard MAL Shell Length & Part Num.	Overall Assy. Length
A10	1-1/4” (32 mm)	1/2” - 13 NC (12 mm)	1-7/8” SC-114-4	1-7/8” SS-114	4-1/4” (108 mm)
		5/8” - 11 NC (16 mm)	1-7/8” SC-114-5		

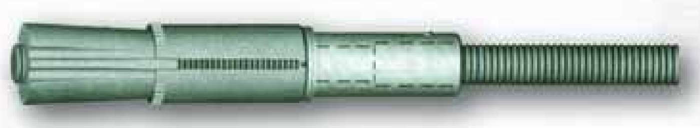
Type B - Long Shell & Cone

Head Assembly	Drill Hole Dia.	Bolt Dia. & Thread Form	Long Cone Length & Part Num.	Long MAL Shell Length & Part Num.	Overall Assy. Length
B14	1-3/4” (44 mm)	1” - 8 NC (25 mm)	3-3/4” LC-158-8	3-3/4” LS-175	8-1/4” (210 mm)
B20	2-1/2” (65 mm)	1-1/4” - 7 NC (32 mm)	4” LC-250	4” LS-250	9-3/8” (238 mm)
		1-3/8” - 8 NC (35 mm)			9-1/2” (241 mm)
B24	3” (76 mm)	1-1/2” - 6 NC (38 mm)	5-1/2” LC-300	5-1/2” LS-300	12-5/8” (321 mm)
		1-3/4” - 5 NC (45 mm)			12-7/8” (327 mm)

Type C - Long Shell & Cone with Flange

Head Assembly	Drill Hole Dia.	Bolt Dia. & Thread Form	Long Cone w/ Flange Length & Part Num.	Long MAL Shell Length & Part Num.	Overall Assy. Length
C14	1-3/4” (44 mm)	3/4” - 10 NC (20 mm)	4-1/4” LCF-175-6	3-3/4” LS-175	9” (229 mm)
		7/8” - 9 NC (22 mm)	4-1/4” LCF-175-7		9-1/16” (230 mm)
		1” - 8 NC (25 mm)	4-1/4” LCF-175-8		9-3/16” (233 mm)
C18	2-1/4” (57 mm)	1-1/8” - 7 NC (30 mm)	4-7/8” LCF-225-9	4” LS-225	10” (254 mm)
		1-1/4” - 7 NC (32 mm)	4-7/8” LCF-225-10		10-1/4” (260 mm)
C28	3-1/2” (89 mm)	1-7/8” - 8 UN (48 mm)	7” LCF-350-16	6” LS-350	15” (381 mm)
		2” - 6 UN (51 mm)			15-1/8” (384 mm)

Coupled Head Assemblies



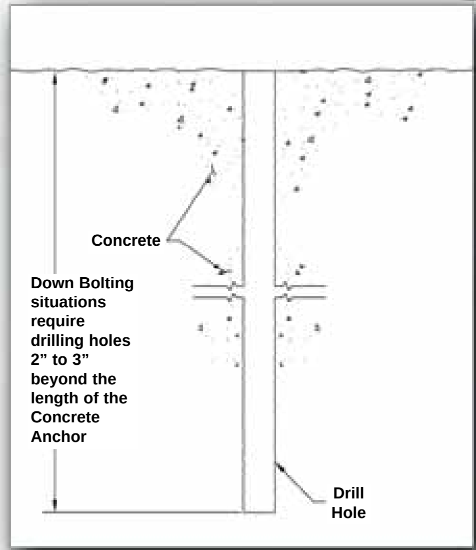
Williams can manufacture Spin-Lock Anchor systems with the use of a transition coupling, which allows the anchor to be designed with a continuously workable thread-form. This is advantageous when the anchor length may need to be adjusted in the field due to variable site conditions. The transition coupling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

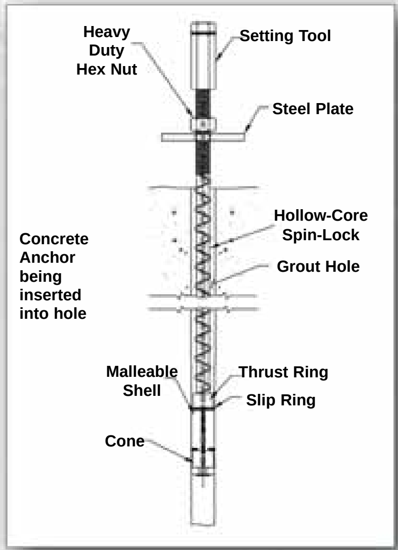
Spin-Lock Installation

Step 1: Drilling

Use Hammer Drill
or Core Drill

Care should be taken to insure 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.



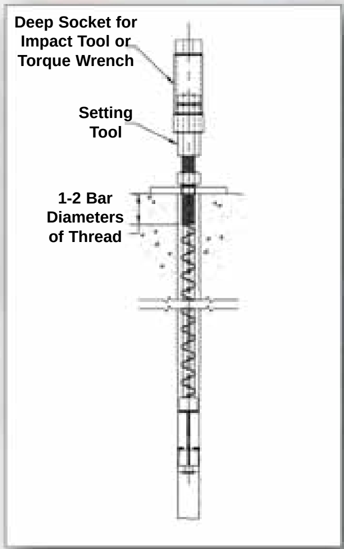


Step 2: Anchor Placement

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 insure 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.



Spin-Lock 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.

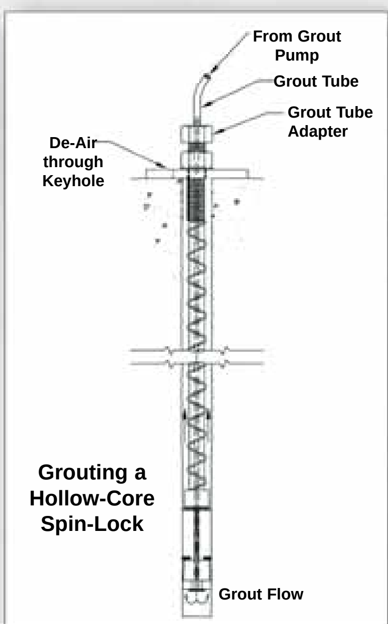
Step 4b: Testing the Anchor

Method B: Testing by Torque Tensioning

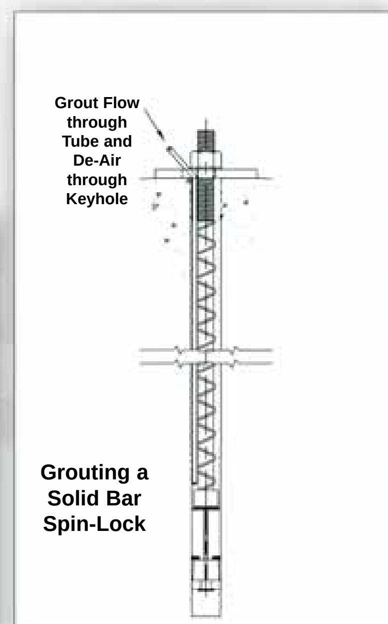
Tension the anchor by torquing the hex nut with a torque wrench. To obtain the advertised tensile working load, see the "Torque On Nut" column on the Spin-Lock Anchor charts listed on pages 11-13. For other desired loads, see the torque tension graphs shown on pages 50 & 51. **Please Note:** The torque/tension 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.



Grouting a Hollow-Core Spin-Lock



Grouting a Solid Bar Spin-Lock

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 also available upon request. Contact your Williams sales representative for details.

Spin-Lock Anchor 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: Cape Canaveral Launch Site
Contractor: Bechtel National
Location: Cape Canaveral, FL

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

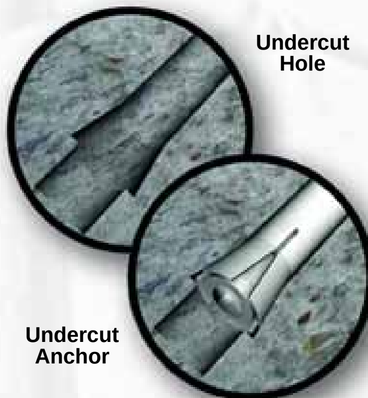
S-9 Undercut Concrete Anchor

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 (See pages 6 & 7 for common failure modes)

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 Concrete Anchor - ASTM A193 Grade B7

Bar Diameter	Drill Hole Diameter	Minimum Ultimate Strength (FpuA) (2)	Minimum Yield Strength	Allowable Tension .5 (FpuA)	Allowable Simple Shear .17 (FpuA) (1)	Yield Stress	Ultimate Stress	Elongation in 20 Bar Diameters	Reduction of Area	Part Number
1/4" - 20 UNC (6.4 mm)	5/8" (16 mm)	3.98 kips (17.7 kN)	3.34 kips (14.9 kN)	1.99 kips (8.92 kN)	0.677 kips (3.01 kN)	105 KSI (723 mPa)	125 KSI (861 mPa)	16%	50%	S9T-02
3/8" - 16 UNC (10 mm)	7/8" (22 mm)	9.69 kips (43.1 kN)	8.14 kips (36.2 kN)	4.84 kips (21.5 kN)	1.65 kips (7.34 kN)	105 KSI (723 mPa)	125 KSI (861 mPa)	16%	50%	S9T-03
1/2" - 13 UNC (12 mm)	7/8" (22 mm)	17.7 kips (78.9 kN)	14.9. kips (66.3 kN)	8.85 kips (39.4 kN)	3.01 kips (13.4 kN)	105 KSI (723 mPa)	125 KSI (861 mPa)	16%	50%	S9T-04
5/8" - 11 UNC (16 mm)	1-1/8" (29 mm)	28.2 kips (125 kN)	23.7 kips (105 kN)	14.5 kips (64.5 kN)	4.93 kips (22.0 kN)	105 KSI (723 mPa)	125 KSI (861 mPa)	16%	50%	S9T-05
3/4" - 10 UNC (20 mm)	1-1/8" (29 mm)	41.8 kips (187 kN)	35.1 kips (156 kN)	20.9 kips (93.6 kN)	7.11 kips (31.6 kN)	105 KSI (723 mPa)	125 KSI (861 mPa)	16%	50%	S9T-06
1" - 8 UNC (25 mm)	1-5/8" (41 mm)	75.8 kips (337 kN)	63.6 kips (283 kN)	37.9 kips (168 kN)	12.9 kips (57.4 kN)	105 KSI (723 mPa)	125 KSI (861 mPa)	16%	50%	S9T-08
1-1/4" - 7 UNC (32 mm)	2" (51 mm)	121 kips (539 kN)	102 kips (453 kN)	60.6 kips (269 kN)	20.6 kips (91.6 kN)	105 KSI (723 mPa)	125 KSI (861 mPa)	16%	50%	S9T-10
1-1/2" - 6 NC (38 mm)	2-1/2" (64 mm)	176 kips (781 kN)	148 kips (656 kN)	87.8 kips (390 kN)	29.9 kips (133 kN)	105 KSI (723 mPa)	125 KSI (861 mPa)	16%	50%	S9T-12

These loads are valid where embedment is sufficient to assure steel failure; that is concrete shear cone strength is greater than steel strength.
(1) Allowable Simple Shear load per AISC Table 1-D.
(2) Minimum ultimate static tension values based on physicals of ASTM A193 Grade B7 bolting material having 125,000 PSI minimum ultimate strength.

Stainless Steel Grade S-9 Undercut Anchor

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 most protection from corrosion.

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

Bar Diameter	Drill Hole Diameter	Minimum Ultimate Strength (FpuA)	Minimum Yield Strength	Allowable Tension .6 (FyA)	Allowable Simple Shear .17 (FpuA) (1)	Yield Stress	Ultimate Stress	Elongation in 4 Bar Diameters	Reduction of Area	Partial Part Number
1/4" - 20 UNC (6.4 mm)	5/8" (16 mm)	2.39 kips (10.6 kN)	0.95 kips (4.2 kN)	0.570 kips (2.54 kN)	0.405 kips (1.81 kN)	30 KSI (207 mPa)	75 KSI (517 mPa)	30%	50%	S9T-02-S4 S9T-02-S6
3/8" - 16 NC (10 mm)	7/8" (22 mm)	5.81 kips (25.8 kN)	2.32 kips (10.3 kN)	1.39 kips (6.18 kN)	0.988 kips (4.39 kN)	30 KSI (207 mPa)	75 KSI (517 mPa)	30%	50%	S9T-03-S4 S9T-03-S6
1/2" - 13 UNC (12 mm)	7/8" (22 mm)	10.6 kips (47.3 kN)	4.26 kips (18.9 kN)	2.56 kips (11.5 kN)	1.81 kips (8.05 kN)	30 KSI (207 mPa)	75 KSI (517 mPa)	30%	50%	S9T-04-S4 S9T-04-S6
5/8" - 11 UNC (16 mm)	1-1/8" (29 mm)	16.9 kips (75.4 kN)	6.78 kips (30.2 kN)	4.07 kips (18.1 kN)	2.88 kips (12.8 kN)	30 KSI (207 mPa)	75 KSI (517 mPa)	30%	50%	S9T-05-S4 S9T-05-S6
3/4" - 10 UNC (20 mm)	1-1/8" (29 mm)	25.1 kips (111 kN)	10.0 kips (44.6 kN)	6.00 kips (26.7 kN)	4.26 kips (18.9 kN)	30 KSI (207 mPa)	75 KSI (517 mPa)	30%	50%	S9T-06-S4 S9T-06-S6
1" - 8 UNC (25 mm)	1-5/8" (41 mm)	45.5 kips (202 kN)	18.2 kips (80.9 kN)	10.9 kips (48.5 kN)	7.73 kips (34.6 kN)	30 KSI (207 mPa)	75 KSI (517 mPa)	30%	50%	S9T-08-S4 S9T-08-S6
1-1/4" - 7 UNC (32 mm)	2" (51 mm)	72.7 kips (323 kN)	29.1 kips (129 kN)	17.5 kips (77.8 kN)	12.4 kips (55.0 kN)	30 KSI (207 mPa)	75 KSI (517 mPa)	30%	50%	S9T-10-S4 S9T-10-S6
1-1/2" - 6 NC (38 mm)	2-1/2" (64 mm)	105 kips (469 kN)	42.2 kips (188 kN)	25.3 kips (112 kN)	17.9 kips (79.5 kN)	30 KSI (207 mPa)	75 KSI (517 mPa)	30%	50%	S9T-12-S4 S9T-12-S6

See notes at bottom

Stainless S-9 Undercut Concrete Anchor - ASTM A193 304 B8 Class II

Bar Diameter	Drill Hole Diameter	Minimum Ultimate Strength (FpuA)	Minimum Yield Strength	Allowable Tension .6 (FyA)	Allowable Simple Shear .17 (FpuA) (1)	Yield Stress	Ultimate Stress	Elongation in 4 Bar Diameters	Reduction of Area	Partial Part Number
1/4" - 20 UNC (6.4 mm)	5/8" (16 mm)	3.98 kips (17.7 kN)	3.18 kips (14.1 kN)	1.91 kips (8.50 kN)	0.670 kips (2.98 kN)	100 KSI (690 mPa)	125 KSI (862 mPa)	12%	35%	S9T-02-S42
023/8" - 16 NC (10 mm)	7/8" (22 mm)	9.69 kips (43.1 kN)	7.75 kips (34.5 kN)	4.65 kips (20.7 kN)	1.65 kips (7.33 kN)	100 KSI (690 mPa)	125 KSI (862 mPa)	12%	35%	S9T-03-S42
1/2" - 13 UNC (12 mm)	7/8" (22 mm)	17.7 kips (78.9 kN)	14.2 kips (63.1 kN)	8.52 kips (37.9 kN)	3.01 kips (13.4 kN)	100 KSI (690 mPa)	125 KSI (862 mPa)	12%	35%	S9T-04-S42
5/8" - 11 UNC (16 mm)	1-1/8" (29 mm)	28.2 kips (126 kN)	22.6 kips (101 kN)	13.6 kips (60.5 kN)	4.79 kips (21.3 kN)	100 KSI (690 mPa)	125 KSI (862 mPa)	12%	35%	S9T-05-S42
3/4" - 10 UNC (20 mm)	1-1/8" (29 mm)	41.8 kips (186 kN)	33.4 kips (149 kN)	20.0 kips (88.96 kN)	7.10 kips (31.6 kN)	100 KSI (690 mPa)	125 KSI (862 mPa)	12%	35%	S9T-06-S42
1" - 8 UNC (25 mm)	1-5/8" (41 mm)	69.7 kips (310 kN)	48.4 kips (215 kN)	29.0 kips (129 kN)	11.8 kips (52.9 kN)	80 KSI (552 mPa)	115 KSI (793 mPa)	15%	35%	S9T-08-S42
1-1/4" - 7 UNC (32 mm)	2" (51 mm)	102 kips (453 kN)	63.0 kips (280 kN)	37.8 kips (167 kN)	17.3 kips (77.5 kN)	65 KSI (448 mPa)	105 KSI (724 mPa)	20%	35%	S9T-10-S42
1-1/2" - 6 NC (38 mm)	2-1/2" (64 mm)	141 kips (625 kN)	70.2 kips (312 kN)	42.1 kips (187 kN)	25.1 kips (112 kN)	50 KSI (375 mPa)	100 KSI (670 mPa)	28%	45%	S9T-12-S42

See notes at bottom

Stainless S-9 Undercut Concrete Anchor - ASTM A193 316 B8M Class II

Bar Diameter	Drill Hole Diameter	Minimum Ultimate Strength (FpuA)	Minimum Yield Strength	Allowable Tension .6 (FyA)	Allowable Simple Shear .17 (FpuA) (1)	Yield Stress	Ultimate Stress	Elongation in 4 Bar Diameters	Reduction of Area	Partial Part Number
1/4" - 20 UNC (6.4 mm)	5/8" (16 mm)	3.50 kips (15.6 kN)	3.05 kips (13.6 kN)	1.83 kips (8.14 kN)	0.595 kips (2.65 kN)	96 KSI (662 mPa)	110 KSI (759 mPa)	15%	45%	S9T-02-S62
3/8" - 16 NC (10 mm)	7/8" (22 mm)	8.53 kips (37.9 kN)	7.44 kips (33.1 kN)	4.46 kips (20.0 kN)	1.45 kips (6.45 kN)	96 KSI (662 mPa)	110 KSI (759 mPa)	15%	45%	S9T-03-S62
1/2" - 13 UNC (12 mm)	7/8" (22 mm)	15.6 kips (69.4 kN)	13.6 kips (60.6 kN)	8.16 kips (36.3 kN)	2.65 kips (11.8 kN)	96 KSI (662 mPa)	110 KSI (759 mPa)	15%	45%	S9T-04-S62
5/8" - 11 UNC (16 mm)	1-1/8" (29 mm)	24.9 kips (110 kN)	21.7 kips (96.5 kN)	13.0 kips (57.8 kN)	4.23 kips (18.8 kN)	96 KSI (662 mPa)	110 KSI (759 mPa)	15%	45%	S9T-05-S62
3/4" - 10 UNC (20 mm)	1-1/8" (29 mm)	36.7 kips (163 kN)	32.1 kips (143 kN)	19.3 kips (85.8 kN)	6.24 kips (27.8 kN)	96 KSI (662 mPa)	110 KSI (759 mPa)	15%	45%	S9T-06-S62
1" - 8 UNC (25 mm)	1-5/8" (41 mm)	60.6 kips (269 kN)	48.5 kips (216 kN)	29.1 kips (129 kN)	10.3 kips (45.8 kN)	80 KSI (552 mPa)	100 KSI (670 mPa)	20%	45%	S9T-08-S62
1-1/4" - 7 UNC (32 mm)	2" (51 mm)	92.0 kips (409 kN)	63.0 kips (280 kN)	37.8 kips (168 kN)	15.8 kips (70.3 kN)	65 KSI (448 mPa)	95 KSI (655 mPa)	25%	45%	S9T-10-S62
1-1/2" - 6 NC (38 mm)	2-1/2" (64 mm)	126 kips (562 kN)	70.2 kips (312 kN)	42.1 kips (187 kN)	21.5 kips (95.6 kN)	50 KSI (375 mPa)	90 KSI (621 mPa)	30%	45%	S9T-12-S62

These loads are valid where embedment is sufficient to assure steel failure; that is concrete shear cone strength is greater than steel strength.
(1) Allowable Simple Shear load per AISC Table 1-D.

S-9 Undercut Anchor Design Considerations

Williams has listed recommended embedment depths that are minimum values for ductile steel failure design in 3000 psi concrete. 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 deeper embedments. Appropriate reduction factors can be calculated from industry design models. When placing anchors that require a smaller edge distance than what is recommended in the table below, the designer should be aware of a reduction in anchor capacity. Table information below can be used as a reference when reduced edge distance is a factor in anchor design. The values for reduced edge distance are based on tests in 3000 to 4000 psi non-reinforced concrete and should only be used as a reference in combination with reduction values calculated from industry design models.

Grade B7 S-9 Undercut Concrete Anchors - Minimum Spacing & Edge Distances

Bar Diameter	Anchor Length	Flush Mount Anchor Length	Embedment Depth	Attachment Thickness	Center to Center Spacing for Full Strength with no Reduction (S)	Minimum Recommended Edge Distance (E)	Minimum Ultimate Strength	Concrete Failure Loads		
								4 Bar ø from the Edge (Test)	6 Bar ø from the Edge (Test)	8 Bar ø from the Edge (Test)
1/4" (6 mm)	4-1/2" (114 mm)	-	3" (76 mm)	1" (26 mm)	6" (152 mm)	3" (76 mm)	3.98 kips (17.7 kN)	N.A.	N.A.	N.A.
3/8" (9.5 mm)	6" (152 mm)	3-3/4" (95 mm)	3-1/2" * (89 mm)	1" (26 mm)	7" (178 mm)	5" (127 mm)	9.69 kips (43.1 kN)	N.A.	N.A.	N.A.
	8" (203 mm)	-	3-1/2" (89 mm)	3" (76 mm)						
	11" (279 mm)	-	6-1/2" (165 mm)	3" (76 mm)						
1/2" (13 mm)	8" (203 mm)	5-5/8" (143 mm)	6" (152 mm)	1" (26 mm)	12" (305 mm)	6" (152 mm)	17.7 kips (78.9 kN)	4 kips (17.9 kN)	8 kips (35.6 kN)	16 kips (71.2 kN)
	10" (254 mm)	-	6" (152 mm)	3" (76 mm)						
	12" (305 mm)	-	8" (203 mm)	3" (76 mm)						
5/8" (16 mm)	10" (254 mm)	7-1/8" (181 mm)	7-1/2" (191 mm)	1" (26 mm)	15" (381 mm)	8" (203 mm)	28.2 kips (125 kN)	16 kips (71.2 kN)	29 kips (129 kN)	N.A.
	12" (305 mm)	-	7-1/2" (191 mm)	3" (76 mm)						
	15" (381 mm)	-	10" (254 mm)	3" (76 mm)						
3/4" (19 mm)	13" (330 mm)	8-3/4" (222 mm)	9-1/4" (235 mm)	2" (51 mm)	18-1/2" (470 mm)	11" (279 mm)	41.8 kips (187 kN)	20 kips (89 kN)	34 kips (151 kN)	41 kips (182 kN)
	16" (406 mm)	-	9-1/4" (235 mm)	5" (127 mm)						
	19" (483 mm)	-	12-1/4" (311 mm)	5" (127 mm)						
1" (26 mm)	17" (432 mm)	11-7/8" (302 mm)	12-1/2" (318 mm)	2" (51 mm)	25" (635 mm)	14" (356 mm)	75.8 kips (337 kN)	25 kips (111 kN)	50 kips (222 kN)	N.A.
	20" (508 mm)	-	12-1/2" (318 mm)	5" (127 mm)						
	23" (584 mm)	-	15-1/2" (394 mm)	5" (127 mm)						
1-1/4" (32 mm)	21" (533 mm)	15-1/4" (387 mm)	16" (406 mm)	2" (51 mm)	32" (813 mm)	18" (457 mm)	121 kips (539 kN)	50 kips (222 kN)	90 kips (400 kN)	107 kips (476 kN)
	25" (635 mm)	-	16" (406 mm)	6" (152 mm)						
	30" (762 mm)	-	21" (533 mm)	6" (152 mm)						
1-1/2" (38 mm)	31" (787 mm)	20-1/2" (520 mm)	21-1/2" (546 mm)	2" (51 mm)	43" (1092 mm)	23" (584 mm)	176 kips (781 kN)	N.A.	N.A.	N.A.

(N.A.) No test data available
Standard sizes are shown, special lengths available on request.
Tests were performed on A193 Grade B7 products and values will be conservative for Stainless Steel S-9 Anchors.
Concrete compressive strengths were between 3000-4000 psi unreinforced concrete.
Anchor embedment depth will vary with respect to anchor spacing.
Flush mount anchor length Includes coupling.
Attachment thickness for flush mount by others. Attachment bolt length or stud rod length are as required.
(*) 4-1/8" minimum embedment for flush mount.

S-9 Undercut 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

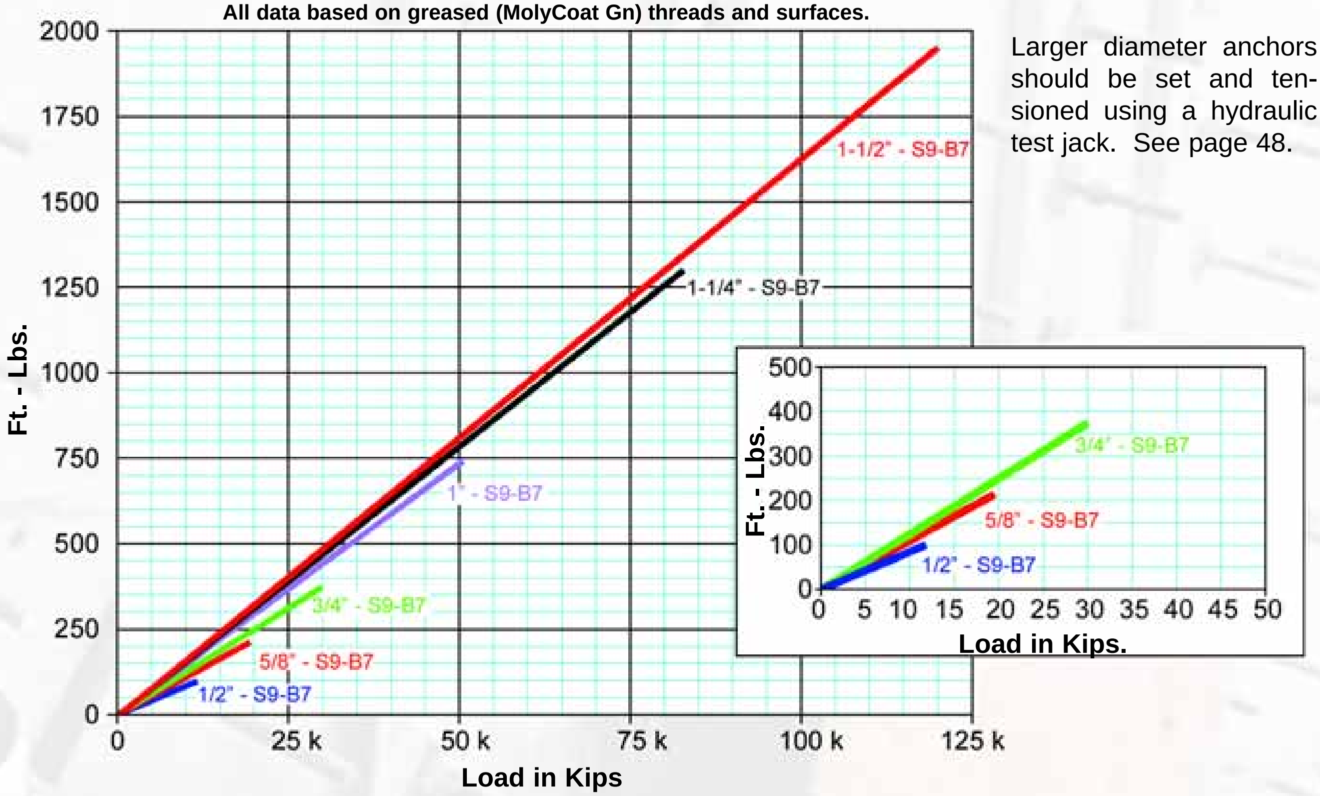
Bar Diameter	Standard Embedment Range	Part Number
1/4" - 20 UNC (6.4 mm)	Up to 5" (127 mm)	S9U-02H
3/8" - 16 NC (10 mm)	Up to 6-1/2" (165 mm)	S9U-04H
1/2" - 13 UNC (12 mm)	Up to 8" (203 mm)	S9U-04H
5/8" - 11 UNC (16 mm)	Up to 10" (254 mm)	S9U-06H
3/4" - 10 UNC (20 mm)	Up to 12-1/4" (311 mm)	S9U-06H
1" - 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

Torque Setting Chart

Bar Diameter	Cone Migration into Shell	Distance per Revolution	Revolutions Required to Set Cone to Shell
1/4" - 20 UNC (6.4 mm)	0.4140" (10.52 mm)	0.0500" (1.27 mm)	8 to 10
3/8" - 16 UNC (10 mm)	0.6040" (15.34 mm)	0.0625" (1.59 mm)	9 to 11
1/2" - 13 UNC (12 mm)	0.7191" (18.27 mm)	0.0769" (1.95 mm)	9 to 11
5/8" - 11 UNC (16 mm)	1.097" (27.86 mm)	0.0909" (2.31 mm)	12 to 14
3/4" - 10 UNC (20 mm)	1.189" (30.20 mm)	0.1000" (2.54 mm)	11 to 13
1" - 8 UNC (25 mm)	1.174" (29.82 mm)	0.1250" (3.18 mm)	9 to 11
1-1/4" - 7 UNC (32 mm)	1.622" (41.20 mm)	0.1428" (3.63 mm)	11 to 13
1-1/2" - 6 NC (38 mm)	3.044" (77.32 mm)	0.1667" (4.23 mm)	18 to 20

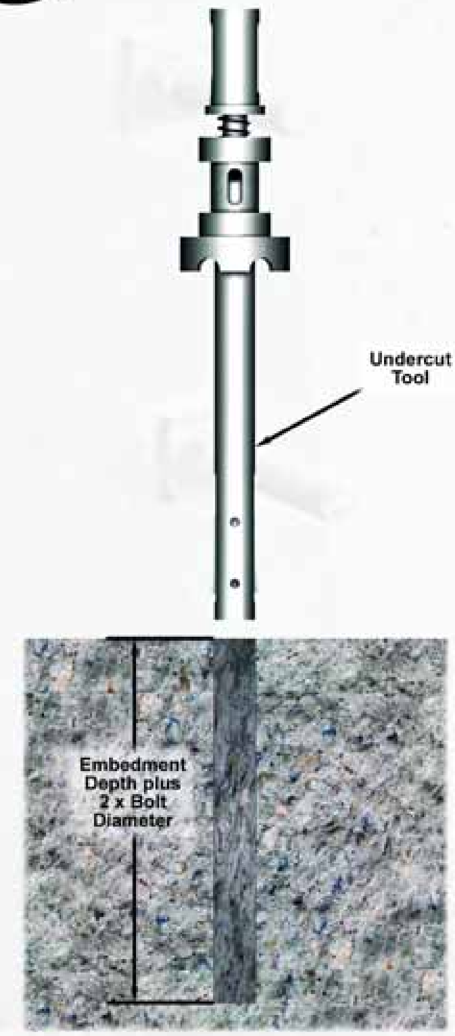
S9T - A-193 B7 Bar - Torque Tension Chart

All data based on greased (MolyCoat Gn) threads and surfaces.



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

S-9 Undercut Anchor Installation

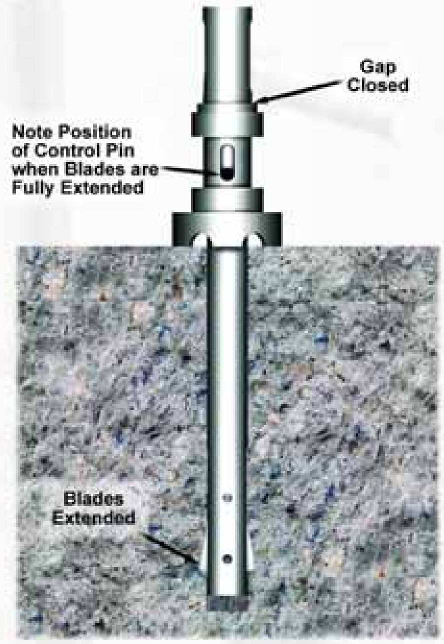


Step 1

Before starting the undercutting procedure, be sure the hole is drilled to the proper diameter and depth (2 x bolt dia.). 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.

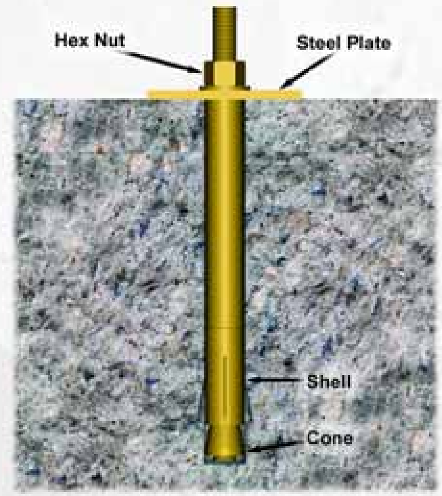


Step 3

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.

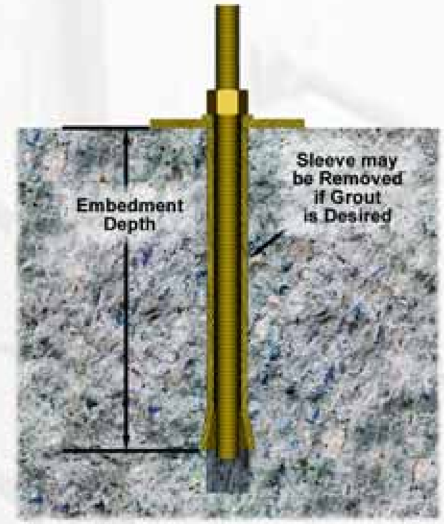
Step 4

Conical shape is undercut with Williams Undercutting Tool attachment.



Step 5

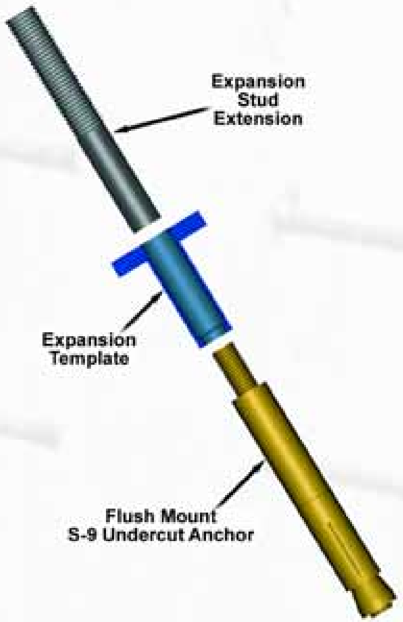
Anchor and sleeve are inserted into hole.



Step 6

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

S-9 Undercut Flush Mount Anchor Installation



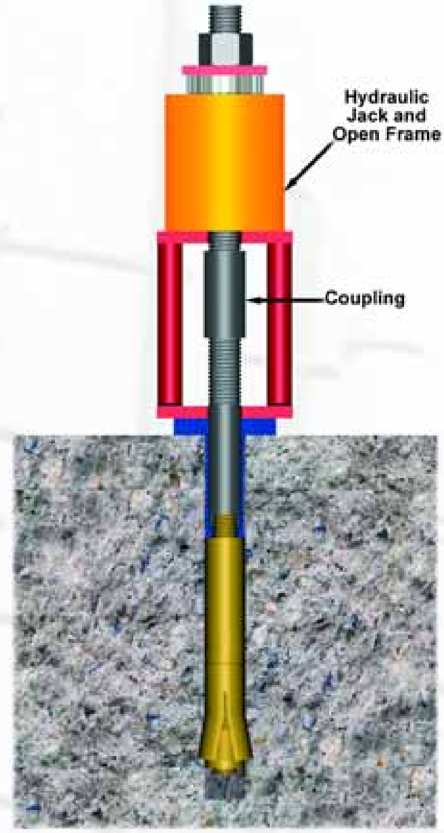
Williams also offers a flush mount S-9 Undercut Bearing Anchor that carries all the advantages of the standard S-9 , but adds the ease of installing in special conditions such as heavy machinery or large weldments. Refer to S-9 Undercut Anchor Installation (page 24) for instructions on undercutting the drill hole, steps 1-4. 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.

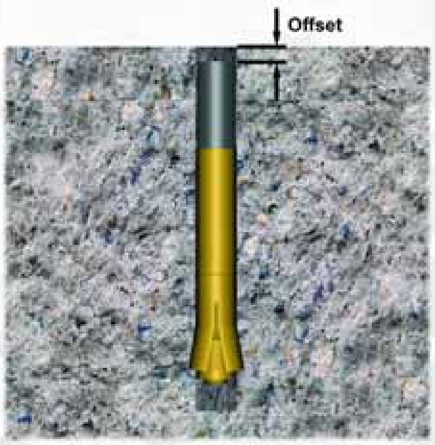
Step 2

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



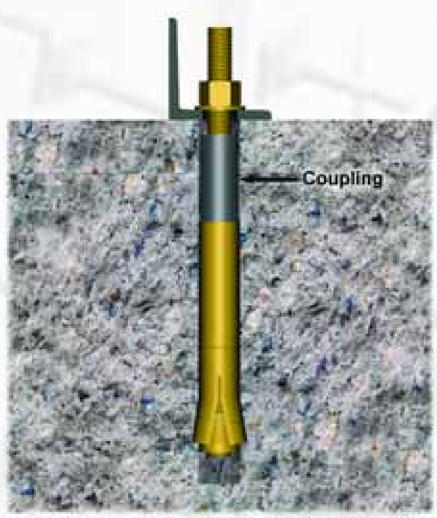
Step 3

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

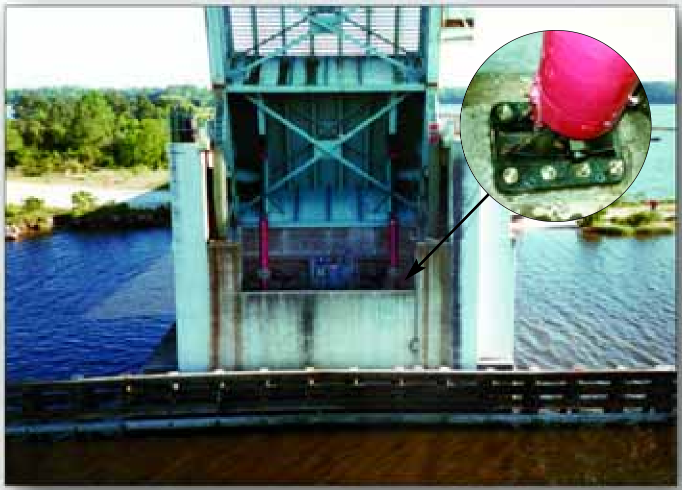
After stud rods, bolts, washers or assemblies are installed, torque hex nut to required tension or tension with hydraulic jack to working load.

S-9 Flush Mount Undercut Concrete Anchor Data

Anchor Size	Minimum Embed.	Offset	Coupling	
			Dia.	Length
3/8" (10 mm)	4-1/8" (105 mm)	3/8" (10 mm)	3/4" (20 mm)	2-1/4" (57 mm)
1/2" (12 mm)	6" (152 mm)	3/8" (10 mm)	3/4" (20 mm)	2-1/4" (57 mm)
5/8" (16 mm)	7-1/2" (191 mm)	3/8" (10 mm)	1" (25 mm)	3" (76 mm)
3/4" (20 mm)	9-1/4" (235 mm)	1/2" (12 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" (20 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)

S-9 and S-7 Anchor Project Photos

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



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

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

S-7 Reusable Anchor System

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”.

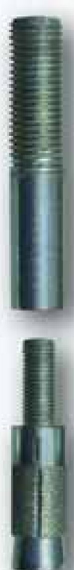
Type B - For applications where a recessed, tapped hole is required. Type B anchors are usually flush with the concrete surface and installed with a special Williams setting tool.

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

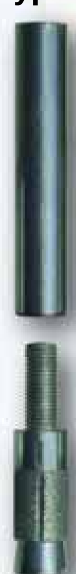
Type D - Typical for outer stud diameters of 1” or smaller. Outer stud end has flats which allow for easy anchor removal.

Type E - When type A, B, C or D anchor studs are removed, a type E stud can be used as a temporary hole plug. The outer stud end has a notch to fit a flat head screwdriver.

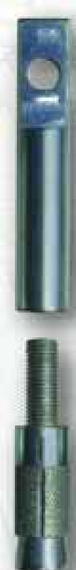
Type A



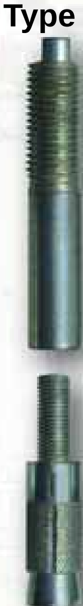
Type B



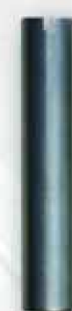
Type C



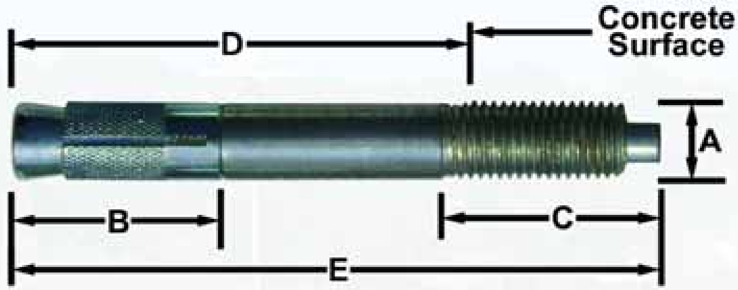
Type D



Type E



S-7 Reusable Anchor System



S-7 Reusable Concrete Anchor - Standard Carbon Steel Grade

Outer Stud Diameter (A)	Maximum Allowable Working Load in Tension (1)	Ultimate Strength	Allowable Shear of Outer Thread	Torque Ft.-Lbs.		Minimum Embedment in 3000 PSI Concrete (D)	Cone & Shell Length (B)	Exterior Thread Length (C)	Overall Length (E)	Standard Style Part Number
				To Expand Shell	On Nut for Tension					
1/2" - 13 (12 mm)	3.13 kips (14.0 kN)	6.25 kips (27.8 kN)	1.6 kips (7.1 kN)	15	30	3-3/4" (95 mm)	1-1/4" (32 mm)	1-1/2" (38 mm)	*4-1/4" - (108 mm) 5-1/2" - (140 mm) 7" - (178 mm)	S7T-04
3/4" - 10 (20 mm)	8.5 kips (37.8 kN)	17 kips (75.6 kN)	3.9 kips (17.3 kN)	70	100	5-1/4" (133 mm)	1-3/4" (45 mm)	1-3/4" (45 mm)	*5-3/4" - (146 mm) 7" - (178 mm) 8-1/2" - (216 mm) 10" - (254 mm)	S7T-06
1" - 8 (25 mm)	11.25 kips (50 kN)	22.5 kips (100 kN)	7.2 kips (32.0 kN)	85	200	7-1/4" (184 mm)	2-9/16" (65 mm)	2-1/2" (64 mm)	*7-3/4" - (197 mm) 9" - (229 mm) 12" - (305 mm)	S7T-08
1-1/4" - 7 (32 mm)	11.25 kips (50 kN)	22.5 kips (100 kN)	11.5 kips (51.1 kN)	125	240	7-3/4" (197 mm)	3-1/4" (83 mm)	3-1/4" (83 mm)	*9" - (229 mm) 12" - (305 mm)	S7T-10
1-3/4" - 5 (45 mm)	37.5 kips (167 kN)	75 kips (334 kN)	22.6 kips (101 kN)	500	900	12-1/2" (318 mm)	6-1/4" (159 mm)	4" (102 mm)	*15" - (381 mm) 18" - (457 mm)	S7T-14
2" - 6 (51 mm)	60 kips (267 kN)	120 kips (534 kN)	31.5 kips (140 kN)	500	1,500	16" (406 mm)	6-3/4" (171 mm)	4" (102 mm)	*18" - (457 mm) 24" - (610 mm)	S7T-16

(1) Maximum recommended working load is based on 1/2 of ultimate strength.
* Recommended for type B only, to achieve full embedment.

Stainless S-7 Reusable Concrete Anchor - ASTM A193 (304) B8 Class 1

Outer Stud Diameter (A)	Maximum Allowable Working Load in Tension (1)	Ultimate Strength	Allowable Shear of Outer Thread	Torque Ft.-Lbs.		Minimum Embedment in 3000 PSI Concrete (D)	Cone & Shell Length (B)	Exterior Thread Length (C)	E Overall Length	Standard Style Part Number
				To Expand Shell	On Nut for Tension					
1/2" - 13 (12 mm)	.943 kips (4.2 kN)	3.93 kips (17.5 kN)	1.81 kips (8.0 kN)	10	10	3-3/4" (95 mm)	1-1/4" (32 mm)	1-1/2" (38 mm)	*4-1/4" - (108 mm) 5-1/2" - (140 mm) 7" - (178 mm)	S7U-3041-04
3/4" - 10 (20 mm)	2.55 kips (11.4 kN)	10.64 kips (47.3 kN)	4.26 kips (18.9 kN)	50	60	5-1/4" (133 mm)	1-3/4" (45 mm)	1-3/4" (45 mm)	*5-3/4" - (146 mm) 7" - (178 mm) 8-1/2" - (216 mm) 10" - (254 mm)	S7U-3041-06
1" - 8 (25 mm)	4.07 kips (18.1 kN)	16.95 kips (75.4 kN)	7.73 kips (34.4 kN)	75	170	7-1/4" (184 mm)	2-9/16" (65 mm)	2-1/2" (64 mm)	*7-3/4" - (197 mm) 9" - (229 mm) 12" - (305 mm)	S7U-3041-08

(1) Maximum recommended working load is based on .6 of yield strength.
* Recommended for type B only, to achieve full embedment.

S-7 Design Considerations

Williams has listed recommended embedment depths that are minimum values for ductile steel failure design in 3000 psi concrete. 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 deeper embedments. Appropriate reduction factors can be calculated from industry design models. When placing anchors that require a smaller edge distance than what is recommended in the table below, the designer should be aware of a reduction in anchor capacity. Table information below can be used as a reference when reduced edge distance is a factor in anchor design. The values for reduced edge distance are based on tests in 3000 to 4000 psi non-reinforced concrete and should only be used as a reference in combination with reduction values calculated from industry design models.

S-7 Reusable Anchor - Minimum Spacing & Edge Distance

Outer Stud Diameter	Minimum Embedment in 3000 PSI Concrete	Center to Center Spacing for Full Strength with no Reduction (S)	Minimum Recommended Edge Distance (E)	Minimum Ultimate Strength of Inner Stud	Concrete Failure Loads	
					4 Bar ø from the Edge (Test)	6 Bar ø from the Edge (Test)
1/2" - 13 (12 mm)	3-3/4" (95 mm)	7-1/2" (191 mm)	5" (127 mm)	6.25 kips (27.8 kN)	4 kips (18 kN)	6.2 kips (31 kN)
3/4" - 10 (20 mm)	5-1/4" (133 mm)	10-1/2" (267 mm)	5-3/4" (146 mm)	17 kips (75.6 kN)	11 kips (49 kN)	17 kips (76 kN)
1" - 8 (25 mm)	7-1/4" (184 mm)	14-1/2" (368 mm)	9" (229 mm)	22.5 kips (100 kN)	15 kips (67 kN)	22 kips (98 kN)
1-1/4" - 7 (32 mm)	7-3/4" (197 mm)	15-1/2" (394 mm)	12-1/2" (318 mm)	22.5 kips (100 kN)	19 kips (85 kN)	21 kips (93 kN)
1-3/4" - 5 (45 mm)	12-1/2" (318 mm)	25" (635 mm)	16" (406 mm)	75 kips (334 kN)	18 kips (80 kN)	23 kips (102 kN)
2" - 6 (51 mm)	16" (406 mm)	32" (813 mm)	21" (533 mm)	135 kips (600 kN)	N.A.	N.A.

(N.A.) No test data available
Recommended safe edge distance to be at least 10 bar diameters.
Concrete compressive strengths were between 3000-4000 psi unreinforced concrete.

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.

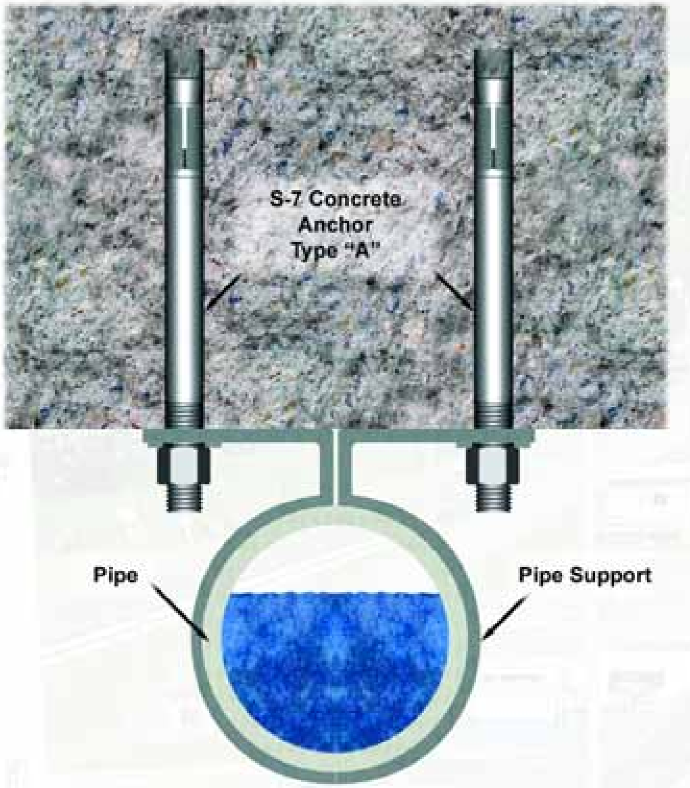
1. Anchor assembly for S-7 consists of:
   a. An anchor stud complying with ASTM A108 for carbon steel and ASTM A193 Grade B8 Type 304 for stainless steel.
   b. A Williams cone in threaded engagement with the inner end of the anchor stud complying with ASTM A 29 for carbon steel and ASTM A193 Grade 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 S97 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.

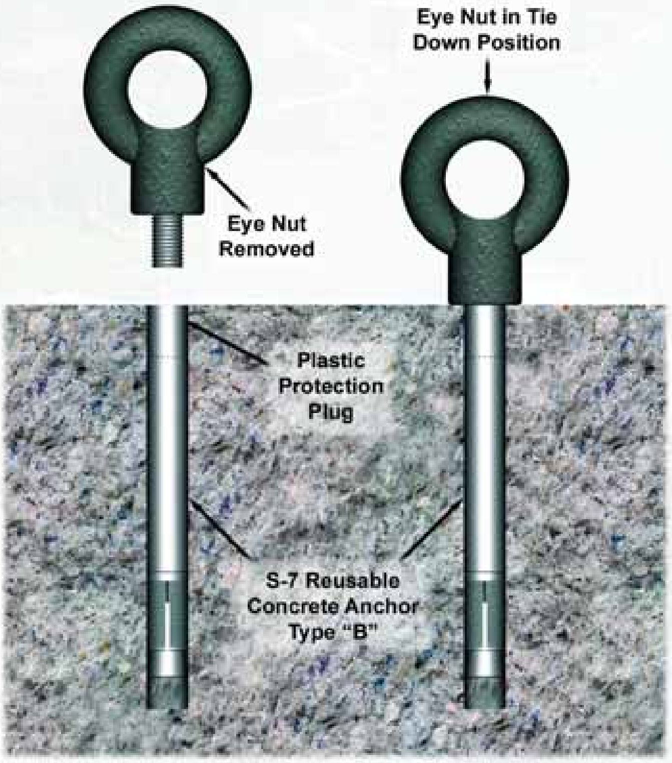
S-7 Anchor Applications

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.

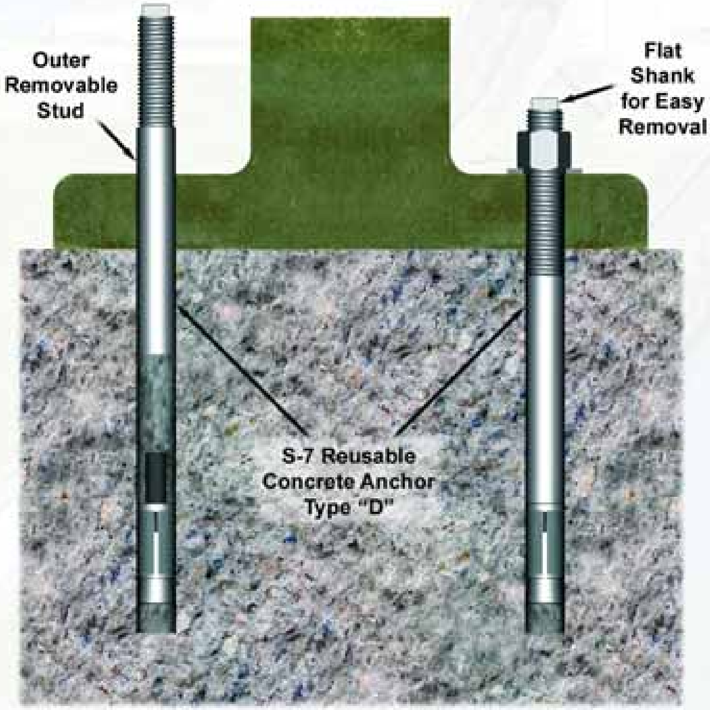
Pipe Supports or Electrical Tray Hangers



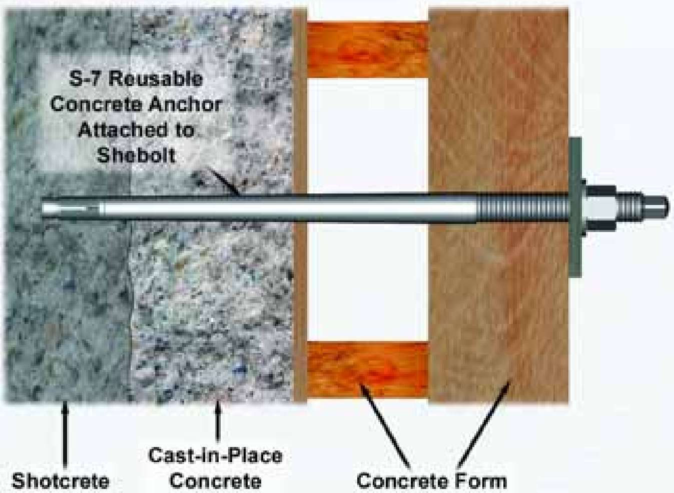
Temporary Tie Down Anchors for Aircraft & Inflatable Structure Covers



Removable Machinery Anchor



S-7 Form Tie



S-7 Reusable Anchor 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.-lb. 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.

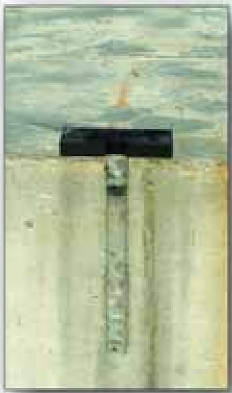
Step 5
Torque nut to indicated ft.-lb. for pretension. The stud portion of the S-7 may be removed and reattached when required.

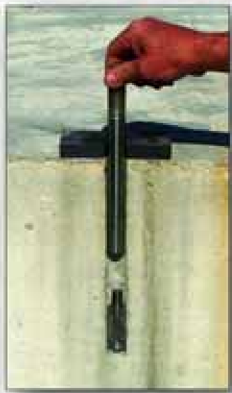
S9Z S-7 Setting Tool

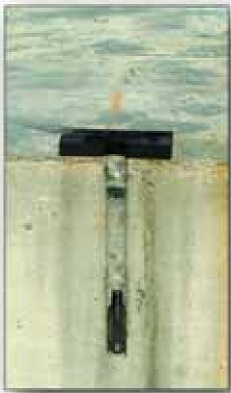
Bar Diameter	Part Number
1/2"	S9Z-004
3/4"	S9Z-006
1"	S9Z-008
1-1/4"	S6Z-OH-010
1-3/4"	S6Z-OH-014
2"	S6Z-OH-016

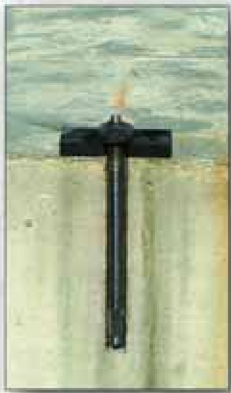
Included with each full box of anchors up to 1" in diameter. For anchors above 1" in diameter, use S6Z Spin-Lock Setting Tool.

Demonstration of S-7 Removable Use









Sledge Drive Anchors

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” diamenter 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	Recommended Safe Working Load to 2:1 Safety Factor	Average Ultimate Strength	Drill Hole	Embedment Depth		Minimum Edge Distance		Part Number B8S Cone / Shell (B7S Cone / Shell)
					3000 PSI Concrete	5000 PSI Concrete	3000 PSI Concrete	5000 PSI Concrete	
B1S Smooth Rod B7S All-Thread Coil Rod B8S All-Thread N.C. Rod	3/8" (10 mm)	4.9 kips (21.8 kN)	9.8 kips (43.6 kN)	1-5/8" (41 mm)	6” (152 mm)	5” (127 mm)	4.8” (122 mm)	4.2” (107 mm)	R4M03RB0 / R4A13 (R4MC3RB0 / R4A13)
	1/2" (12 mm)	9 kips (40.0 kN)	18 kips (80.1 kN)	1-5/8" (41 mm)	7” (178 mm)	6” (152 mm)	6.4” (163 mm)	5.6” (142 mm)	R4M04RB0 / R4A13 (R4MC4RB0 / R4A13)
	5/8" (16 mm)	11.3 kips (40.0 kN)	22.5 kips (100 kN)	1-5/8" (41 mm)	8” (203 mm)	7” (178 mm)	7.7” (196 mm)	6.7” (170 mm)	R4M05RB0 / R4A13 (R4MC5RB0 / R4A13)
	3/4" (20 mm)	18 kips (80.0 kN)	36 kips (160 kN)	1-5/8" (41 mm)	10” (254 mm)	9” (228 mm)	9.2” (234 mm)	8.1” (206 mm)	R4M06RAC / R4A13 (R4MC6RAC / R4A13)
	7/8" (22 mm)	29 kips (129 kN)	58 kips (258 kN)	1-5/8" (41 mm)	12” (305 mm)	11” (279 mm)	11.4” (290 mm)	10” (254 mm)	R4M07RAC / R4A13 (R4MC7RAC / R4A13)
R50 Grade 60 All-Thread Rebar	#4 - 1/2" (12 mm)	9 kips (40 kN)	18 kips (80.1 kN)	1-5/8" (41 mm)	7” (178 mm)	6” (152 mm)	6.4” (163 mm)	5.6” (142 mm)	R4MG4RAC / R4A13
	#5 - 5/8" (16 mm)	13.8 kips (62 kN)	27.9 kips (124 kN)	1-5/8" (41 mm)	9” (228 mm)	8” (203 mm)	8” (203 mm)	7” (178 mm)	R4MG5RAC / R4A13
R61 Grade 75 All-Thread Rebar	#6 - 3/4" (20 mm)	22 kips (97.9 kN)	44 kips (196 kN)	1-5/8" (41 mm)	11” (279 mm)	10” (254 mm)	10” (254 mm)	9” (228 mm)	R4MG6RAC / R4A13

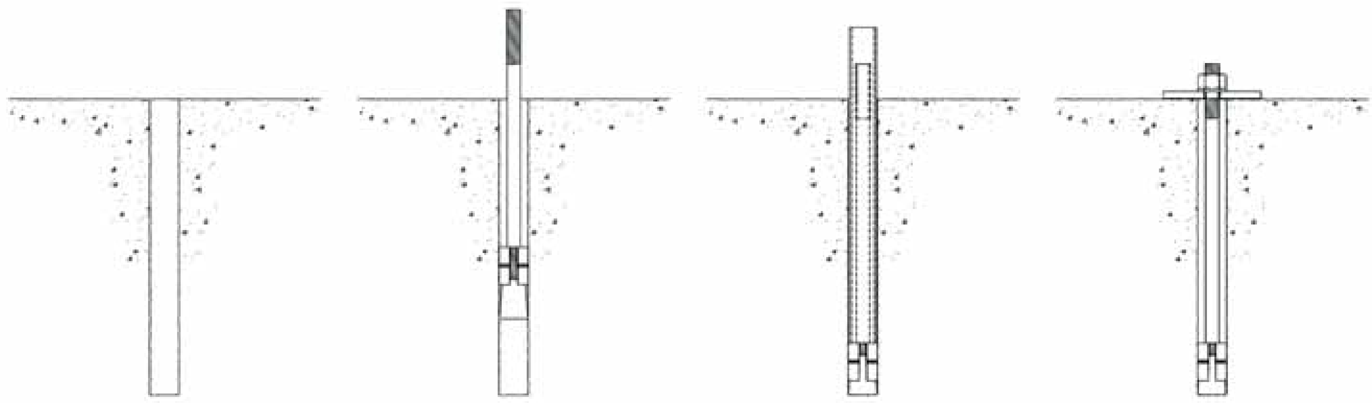
Sledge Drive Anchor Installation

Drill hole to prescribed diameter 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 pre-stressed or pre-tested.



Epoxy Anchor System

When are Epoxy Concrete Anchors used?

- Epoxy concrete anchors are an excellent alternate to Williams high capacity mechanical anchors **when applications require close anchor spacing and small edge distances.** Mechanical anchors require greater spacings and edge distances because of the lateral pressure placed on the drill hole due to anchor expansion. This expansion pressure is reduced with epoxy anchor systems.
- Epoxy is ideal **for passive dowels or anchors without a prestress load,** 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

Approvals and Listings

ICC (formerly ICBO) ER Evaluation Report #4996
State DOT's

Ultrabond products meet the new ICC AC58 Acceptance Criteria for Adhesive Anchors in Concrete and Masonry Elements. This testing criteria was developed at the request of ICC and engineers throughout the United States in order to evaluate the long term performance and durability of various epoxy systems under real world conditions.

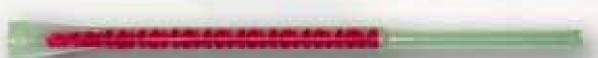
Ultrabond 1
22 oz. Cartridge

Ultrabond 1
53 oz. Cartridge

Ultrabond 2
22 oz. Cartridge

Ultrabond 2
53 oz. Cartridge

Grade 75 All-Thread Rebar



Mixing Nozzle

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

Ultrabond Epoxy Technical Information

Shelf Life	28 Months
Storage	Room Temperature out of direct sunlight
Application Temperature Range*	35° - 115° F
Color	Resin - White
	Hardener - Black
	Mixed - Concrete Grey
Viscosity	Resin - 330,000 cps
	Hardener - 150,000 cps

The Ultrabond Epoxy Anchor System is a two component 100% solids, high aspect ceramic blend amine-based epoxy. It is a solvent free, high strength, high modulus, moisture insensitive, non-sag epoxy system.

*Temperature application range or product information range refers to the temperature range that the product is recommended for use. The product will need to be warmed prior to use at temperatures below 70° F.

Ultrabond 1 Properties

Gel Time (60g @ 75° F)	20 minutes
Cure Time (60g @ 75° F)	4 hours
Final Cure (60g @ 75° F)	24 hours
Water Absorption - 24 hrs	0.40%
Linear Shrinkage	0.003 cm/cm
Compressive Yield Strength - 7 days	9,880 psi
Compressive Modulus Strength - 7 days	191,280 psi
Tensile Strength - 7 days	6,790 psi
Elongation at Break - 7 days	1.9%
Heat Deflection Temperature	134˚ F (57˚ C)
Bond Strength - 2 days	1,100 psi
Bond Strength - 14 days	1,640 psi

Ultrabond 2 Properties

Gel Time (60g @ 75° F)	25 minutes
Cure Time (60g @ 75° F)	10 hours
Final Cure (60g @ 75° F)	48 hours
Water Absorption - 24 hrs	0.40%
Linear Shrinkage	0.002 cm/cm
Compressive Yield Strength - 7 days	10,850 psi
Compressive Modulus Strength - 7 days	210,800 psi
Tensile Strength - 7 days	7,190 psi
Elongation at Break - 7 days	1.9%
Heat Deflection Temperature	135˚ F (57˚ C)
Bond Strength - 2 days	1,280 psi
Bond Strength - 14 days	1,740 psi

Ultrabond 1 Temp vs Bolt-Up Times

Temperature	Bolt-Up Time*	Final Cure Time*
95˚ F (35˚ C)	3 Hrs.	20 Hrs.
80˚ F (27˚ C)	4 Hrs.	24 Hrs.
65˚ F (18˚ C)	8 Hrs.	42 Hrs.
50˚ F (10˚ C)	16 Hrs.	56 Hrs.
35˚ F (2˚ C)	24 Hrs.	72 Hrs.

Ultrabond 2 Temp vs Bolt-Up Times

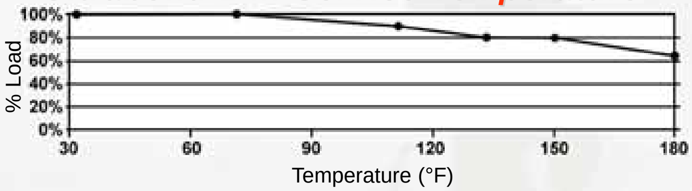
Temperature	Bolt-Up Time*	Final Cure Time*
95˚ F (35˚ C)	8 Hrs.	44 Hrs.
80˚ F (27˚ C)	10 Hrs.	48 Hrs.
65˚ F (18˚ C)	20 Hrs.	72 Hrs.
50˚ F (10˚ C)	24 Hrs.	96 Hrs.
35˚ F (2˚ C)	48 Hrs.	144 Hrs.

*Bolt-Up Time and Final Cure Time is based off the lowest substrate temperature experienced during the curing. Therefore, if the lowest temperature experience by the substrate is 50˚ F (10˚ C), then it will take 56 hours for Ultrabond 1 to cure.

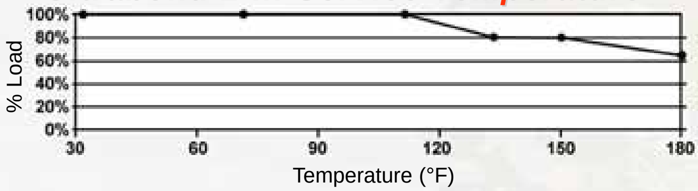
AC58 Test Criteria - The International Code Council (ICC) developed this adhesive test criteria because they recognized the necessity for engineers and contractors to be able to distinguish between poor, medium and high quality adhesives. The long term durability of the adhesive, in a variety of service conditions, is of particular importance. We are proud to say Ultrabond demonstrates superiority and easily passes all of the service condition tests. The following data substantiates Ultra-Bond's exceptional performance.

In-Service Temperature - Test shows the strength of the anchoring systems in elevated temperatures. The following charts show the strength of Ultrabond 1 & 2 load values versus temperature.

Ultrabond 1 In-Service Temperature



Ultrabond 2 In-Service Temperature



Creep - This test simulates epoxy performance for 30 to 50 years of service life. Ultrabond 1 passed this test with a 10,500 lbs. tensile load on a 1/2" diameter anchor.

Dampness - This test shows the hole may be damp during installation. Therefore, if the construction site is exposed to a damp environment, Ultrabond can be used without compromising the strength (rain, rivers, lakes, water treatment plants, ect.).

Seismic - This test shows the anchor system can withstand seismic activity, wind loading, and cyclic loading. Both Ultra-Bond products passed this test with a 10,000 lbs. tensile load on a 1/2" diameter anchor.

Freezing & Thawing - This test shows the anchor can withstand freezing and thawing climates. This is very important in environments that experience an annual winter that goes below freezing.

Epoxy Anchor Bar Strength Charts

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. The epoxy distributes the transmitted load from the dowel into the concrete over the entire surface of the anchor hole. Since the epoxy is stronger than the concrete, the ultimate anchor load will be limited only by the concrete or capacity of the steel. Bars can be ordered cut to length or in stock lengths up to 50 feet for job-site cutting. The 360° thread provides unmatched epoxy to bar bond. Williams offers hex nuts, plates and washers with each anchor bar. Working loads should be based on a 4:1 safety factor from bar ultimate strength. Listed anchor embedment depth based on 3,000 PSI concrete. Williams recommends epoxy dowels to only be specified as passive (non-prestressed) anchors. **Williams bars should never be torch cut.**

R71 150 KSI All-Thread-Bar - ASTM A722-98

Bar Diameter	Minimum Ultimate Strength	Minimum Yield Strength	Working Load (4:1 SF)	Approx. Thread Major Dia.	Recommended Embedment	Quantity of Ultrabond per Hole	Recommended Hole Diameter
1" (26 mm)	127.5 kips (567 kN)	102 kips (454 kN)	31 kips (137 kN)	1-1/8" (28.6 mm)	25" (630 mm)	4.5 oz (8.2 in^3)	1-1/4" (32 mm)
1-1/4" (32 mm)	187.5 kips (834 kN)	150 kips (667 kN)	46 kips (201 kN)	1-7/16" (36.5 mm)	29" (730 mm)	11.9 oz (21.5 in^3)	1-5/8" (41 mm)
1-3/8" (36 mm)	237 kips (1054 kN)	190 kips (843 kN)	59 kips (255 kN)	1-9/16" (39.7 mm)	33" (840 mm)	13.3 oz (23.9 in^3)	1-3/4" (45 mm)
1-3/4" (45 mm)	400 kips (1779 kN)	320 kips (1423 kN)	100 kips (430 kN)	2" (50.8 mm)	44" (1100 mm)	32.5 oz (58.7 in^3)	2-1/4" (57 mm)

R61 Grade 75 All-Thread Rebar - ASTM A615

Bar Designation Nominal Dia.	Minimum Ultimate Strength	Minimum Yield Strength	Working Load (4:1 SF)	Approx. Thread Major Dia.	Recommended Embedment	Quantity of Ultrabond per Hole	Recommended Hole Diameter
#6 - 3/4" (20 mm)	44 kips (196 kN)	33 kips (147 kN)	11 kips (48 kN)	7/8" (22.2 mm)	12" (310 mm)	2.4 oz (4.4 in^3)	1" (26 mm)
#7 - 7/8" (22 mm)	60 kips (267 kN)	45 kips (200 kN)	15 kips (66 kN)	1" (25.4 mm)	15" (270 mm)	3.4 oz (6.2 in^3)	1-1/8" (28 mm)
#8 - 1" (25 mm)	79 kips (351 kN)	59.3 kips (264 kN)	19 kips (87 kN)	1-1/8" (28.6 mm)	17" (430 mm)	4.4 oz (7.9 in^3)	1-1/4" (32 mm)
#9 - 1-1/8" (28 mm)	100 kips (445 kN)	75 kips (334 kN)	25 kips (111 kN)	1-1/4" (31.8 mm)	20" (490 mm)	5.4 oz (9.5 in^3)	1-3/8" (35 mm)
#10 - 1-1/4" (32 mm)	127 kips (565 kN)	95.3 kips (424 kN)	31 kips (141 kN)	1-3/8" (34.9 mm)	21" (540 mm)	10.4 oz (18.8 in^3)	1-5/8" (41 mm)
#11 - 1-3/8" (35 mm)	156 kips (694 kN)	117 kips (521 kN)	39 kips (173 kN)	1-1/2" (38.1 mm)	24" (610 mm)	12.0 oz (21.7 in^3)	1-3/4" (45 mm)
#14 - 1-3/4" (45 mm)	225 kips (1001 kN)	168.7 kips (750 kN)	56 kips (250 kN)	1-7/8" (47.6 mm)	29" (730 mm)	21.4 oz (38.7 in^3)	2-1/8" (55 mm)
#18 - 2-1/4" (55 mm)	400 kips (1779 kN)	300 kips (1335 kN)	100 kips (444 kN)	2-7/16" (61.9 mm)	39" (980 mm)	43.1 oz (77.9 in^3)	2-3/4" (70 mm)

B8V High Impact Bar - ASTM A193 - Grade B7

Bar Diameter	Minimum Ultimate Strength	Minimum Yield Strength	Working Load (4:1 SF)	Approx. Thread Major Dia.	Recommended Embedment	Quantity of Ultrabond per Hole	Recommended Hole Diameter
1/2" - 13 UNC (12 mm)	18 kips (80 kN)	15 kips (66.7 kN)	4.5 kips (20.0 kN)	1/2" (13 mm)	4-1/2" (114 mm)	0.2 oz (0.3 in^3)	9/16" (14.3 mm)
5/8" - 11 UNC (16 mm)	29 kips (129 kN)	24 kips (108 kN)	7.25 kips (32.2 kN)	5/8" (16 mm)	5-5/8" (143 mm)	0.55 oz (1 in^3)	3/4" (20 mm)
3/4" - 10 UNC (20 mm)	42 kips (187 kN)	36 kips (160 kN)	10.25 kips (45.6 kN)	3/4" (20 mm)	6-3/4" (171 mm)	0.71 oz (1.3 in^3)	7/8" (22 mm)
7/8" - 9 UNC (22 mm)	58 kips (258 kN)	49 kips (218 kN)	14.5 kips (64.5 kN)	7/8" (22 mm)	16" (406 mm)	2.0 oz (3.7 in^3)	1" (25 mm)
1" - 8 UNC (25 mm)	76 kips (338 kN)	64 kips (285 kN)	19 kips (84.5 kN)	1" (25 mm)	20" (508 mm)	2.8 oz (5.2 in^3)	1-1/8" (29 mm)
1-1/8" - 7 UNC (29 mm)	96 kips (427 kN)	81 kips (360 kN)	24 kips (107 kN)	1-1/8" (28 mm)	22" (559 mm)	3.5 oz 6.4 in^3)	1-1/4" (32 mm)
1-1/4" - 7 UNC (32 mm)	122 kips (543 kN)	102 kips (454 kN)	30.5 kips (136 kN)	1-1/4" (32 mm)	25" (635 mm)	4.5 oz (8.3 in^3)	1-3/8" (35 mm)
1-3/8" - 8 UN (35 mm)	154 kips (684 kN)	129 kips (573 kN)	38.5 kips (171 kN)	1-3/8" (35 mm)	28" (711 mm)	11.0 oz (20.2 in^3)	1-5/8" (41 mm)
1-1/2" - 6 NC (38 mm)	176 kips (783 kN)	148 kips (658 kN)	44 kips (197 kN)	1-1/2" (38 mm)	29" (737 mm)	12.5 oz (23.0 in^3)	1-3/4" (45 mm)
1-3/4" - 5 UNC (45 mm)	237 kips (1054 kN)	199 kips (885 kN)	59.3 kips (264 kN)	1-3/4" (45 mm)	34" (864 mm)	17.1 oz (31.3 in^3)	2" (51 mm)
2" - 6 UN (51 mm)	330 kips (1467 kN)	278 kips (1236 kN)	82.5 kips (367 kN)	2" (51 mm)	43" (1092 mm)	24.4 oz (44.8 in^3)	2-1/4" (57 mm)

Epoxy Anchor Design Considerations

Ultrabond adhesive is a two component 100% solid, high aspect ceramic blend epoxy. They consist of a resin and a curing agent Adhesive anchors are often used because of fast curing times compared to cement based grouts. The Ultrabond adhesive, after being properly mixed through the mixing nozzle, experiences an exothermic reaction which forms a polymer matrix bonding to the surrounding concrete. The bond generated by the Ultrabond adhesive is accomplished through a dual action of chemically adhering to the concrete and by interlocking with drill hole surface deformations. When designing adhesive anchor systems the engineer should be aware of four potential failure modes; ductile steel failure, concrete breakout, bond failure between the adhesive and the steel threads and bond failure between the concrete and epoxy interface. Presently the anchor industry is absent of a formal design code for adhesive anchors, however the designer can consider the following equations for assistance.

Uniform Bond Stress Model

$$N = \tau(\pi)(d)hef$$

N = Bond Strength (lbs)
τ = Bond Stress (based on cure times at 70° F)
= 1600 psi in 14 days - ASTM C882
= 1100 psi in 2 days - ASTM C882
π = 3.14
d = Drill Hole Diameter (in.)
hef = Anchor Embedment Depth (in.)

Based on normal weight concrete

Concrete Breakout Strength

A designer can estimate the concrete capacity using methods such as ACI 349-97 Appendix B or ACI 318-02 Appendix D. Example:

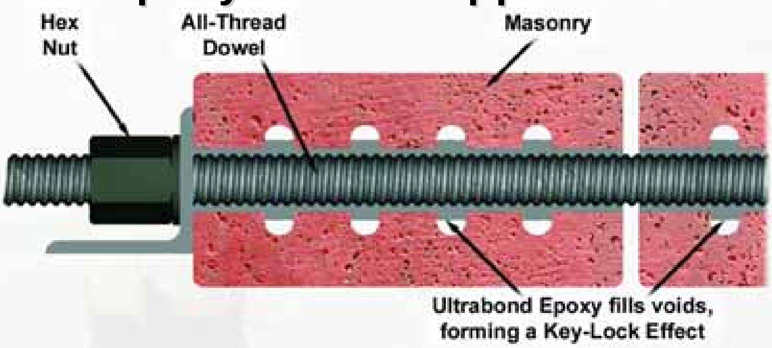
$$P = 4(Ac)\sqrt{fc'}$$

P = Concrete Capacity (lbs)
fc' = Concrete Compressive Strength (psi)
Ac = $\pi(hef)^2$ = Projected Cone Area (in^2)
hef = Anchor Embedment Depth (in)

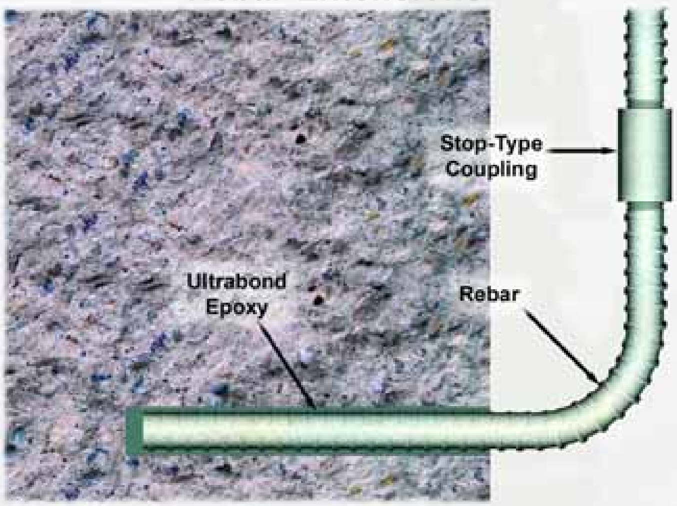
Williams recommends designing for ductile steel failure whenever possible. Steel strengths can be collected from the strength charts. The designer can verify concrete capacity and bond strengths from the equations listed above to determine which are the governing factors.

Epoxy Anchor Applications

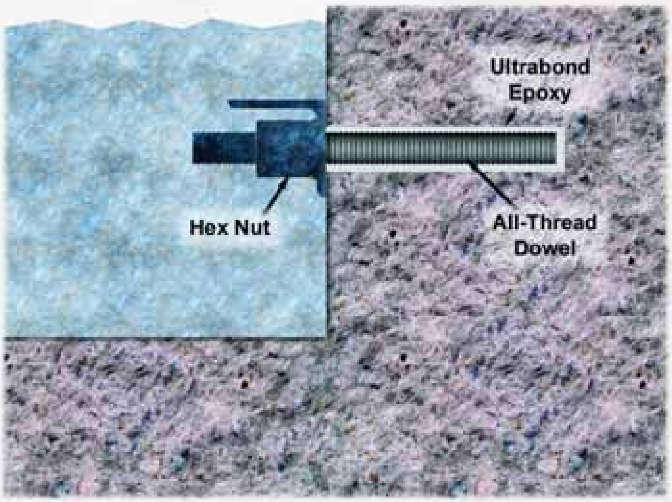
Typical Masonry Application



Rebar Extensions



Underwater Locations



Epoxy Anchor Installation

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

Job-Site Preparation and Work Flow

To achieve the desired results, carefully follow these procedures. *If installing anchors in extreme temperatures please call your local Williams representative.*

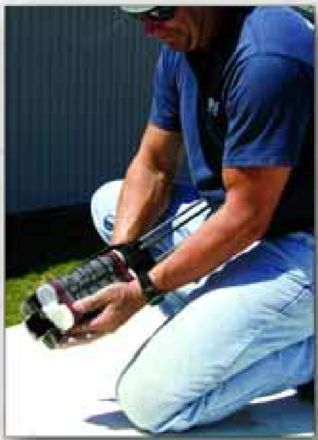
• Always be sure the holes are prepared in advance before starting a new cartridge. If possible, schedule dispensing to consume an entire cartridge at one time with no interruption of epoxy flow.

• To achieve maximum flow and reduce fatigue, break off the nozzle to the largest diameter that will fit into the hole or screen. If the hole is 5/8" diameter or larger, snap off the smaller diameter section before using.

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.

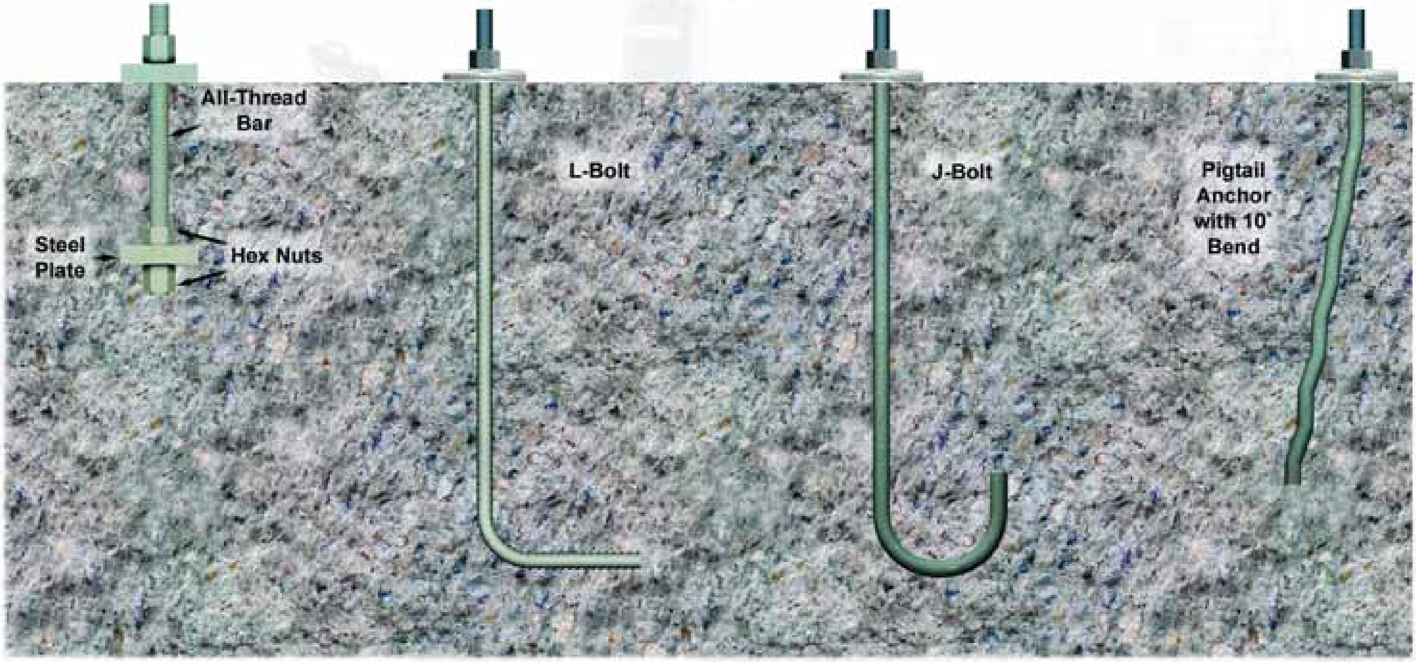
4. Thread nozzle onto cartridge, making sure the nozzle, and cartridge assembly are secure. Dispense enough epoxy into a disposable container, until the color becomes a consistent gray with no streaks.

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.

Cast-in-Place Concrete 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 Appendix D.



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 Concrete Anchors

B5S Stress Gradient Pigtail Anchor - C1045 Steel

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.

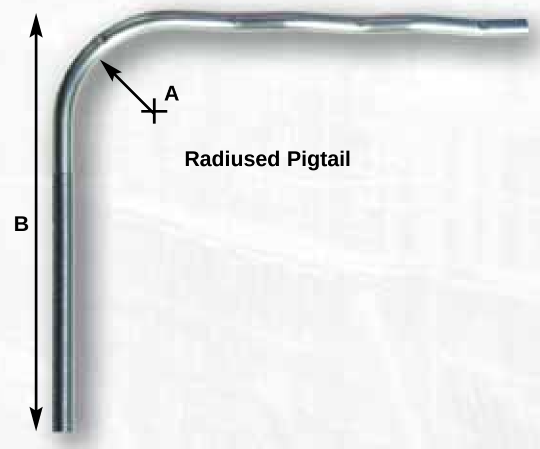
When using Williams Stress Gradient Pigtail Anchors, the following factual advantages are accomplished: 1) Maximum embedment of the Pigtail Anchor is achieved, 2) The stress gradient crimp pattern deforms the steel for excellent bonding strength, and 3) The high tensile steel offers high working loads with no welds which can limit strength.

B5S Stress Gradient Pigtail Anchor

Standard Lengths		Radiused Lengths			Safe Working Load (2:1 S.F.)	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 (12 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 (20 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)

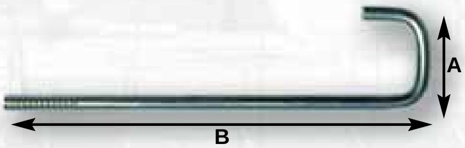
Pigtail lengths shown are recommended for 3000 PSI concrete or better. N.A. = Not Available

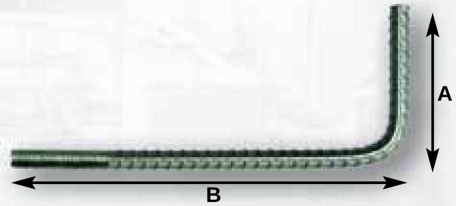
Pigtail lengths shown are recommended for 3000 PSI concrete or better. N.A. = Not Available



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 cold rolled C-1045 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

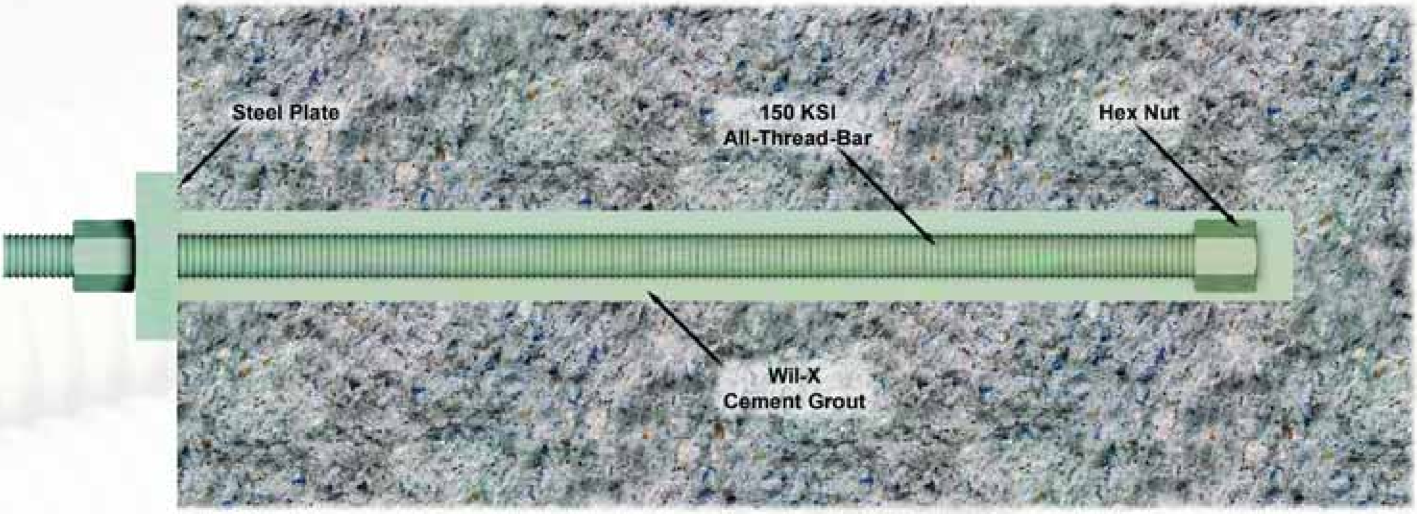
Round or square bottom J-bolts with most length and radius combinations available for a wide range of applications. Available in most diameters with coil or V-thread. To order, please specify diameter, A and B dimensions, thread type and length.

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 an 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 Five Star Special Grout 400 for cement grout bonded anchors. This product manufactured by Five Star has excellent grout bond characteristics and quick set-up times. See page 47 for the Five Star 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 for assistance.

Uniform Bond Stress Model

The Uniform Bond Stress Model has been used in some testing to demonstrate the bond behavior of adhesive and grouted anchor systems by assuming a bond stress that is uniform throughout the anchor systems embedment length. This model is used to calculate the overall tensile strength of the bond at the grout/concrete interface. The equation shown below only gives an estimate as bond stress values and concrete compressive strengths do not always give consistent anchor test pull results. Please call Williams Concrete Anchor Division for more information on bond stress.

$$N = \tau(\pi)(d)hef$$

N = Bond Strength (lbs)
τ = Bond Stress for fully cured Grout = 900 psi.**
π = 3.14
d = Drill Hole Diameter (in.) Note: Minimum 1.5 x bar diameter
hef = Anchor Embedment Depth (in.)

Concrete Breakout Strength

A designer can estimate the concrete capacity using methods such as ACI 349-97 Appendix B or ACI 318-02 Appendix D. Example:

$$P = 4(Ac)\sqrt{fc'}$$

P = Concrete Capacity (lbs)
fc' = Concrete Compressive Strength (psi)
Ac = $\pi(hef)^2$ = Projected Cone Area (in^2)
hef = Anchor Embedment Depth (in)

Notes:
Williams recommends designing for ductile steel failure whenever possible. Steel strengths can be collected from the strength charts.
** When Five Star Special Grout 400 Is used. Check with your grout manufacturer for ultimate bond strength values when using other grouts.

Anchor Accessories

H1F Heavy Duty Hex Nuts ASTM 194 Grade 2H

Bar Diameter	Across Flats	Across Corners	Thickness	Part Number
1/4" - 20 UNC (6.4 mm)	1/2" (12 mm)	.57" (14.5 mm)	15/64" (5.95 mm)	H1F-02
3/8" - 16 NC (10 mm)	11/16" (17.5 mm)	.794" (20.2 mm)	23/64" (9.1 mm)	H1F-03
1/2" - 13 UNC (12 mm)	7/8" (22.2 mm)	1.01" (25.7 mm)	31/64" (12.3 mm)	H1F-04
5/8" - 11 UNC (16 mm)	1-1/16" (27.0 mm)	1.227" (31.2 mm)	39/64" (15.5 mm)	H1F-05
3/4" - 10 UNC (19 mm)	1-1/4" (31.8 mm)	1.444" (36.7 mm)	47/64" (18.7 mm)	H1F-06
7/8" - 9 UNC (22 mm)	1-7/16" (36.6 mm)	1.66" (42.2 mm)	55/64" (21.8 mm)	H1F-07
1" - 8 UNC (25 mm)	1-5/8" (41.3 mm)	1.877" (47.7 mm)	63/64" (25.0 mm)	H1F-08
1-1/8" - 9 UNC (28 mm)	1-13/16" (46.0 mm)	2.093" (53.2 mm)	1-7/64" (28.2 mm)	H1F-09
1-1/4" - 7 UNC (32 mm)	2" (50.8 mm)	2.309" (58.6 mm)	1-7/32" (31.0 mm)	H1F-10
1-3/8" - 8 UN (35 mm)	2-3/16" (55.6 mm)	2.526" (64.2 mm)	1-11/32" (34.1 mm)	H1F-11
1-1/2" - 6 NC (38 mm)	2-3/8" (60.3 mm)	2.742" (69.6 mm)	1-15/32" (37.3 mm)	H1F-12
1-3/4" - 5 UNC (45 mm)	2-3/4" (69.9 mm)	3.175" (80.6 mm)	1-23/32" (43.7 mm)	H1F-14
1-7/8" - 8 UN (48 mm)	2-15/16" (74.6 mm)	3.392" (86.2 mm)	1-27/32" (46.8 mm)	H1F-15
2" - 6 UN (51 mm)	3-1/8" (79.4 mm)	3.608" (91.7 mm)	1-31/32" (50.0 mm)	H1F-16

Stop-Type & Flange Couplings ASTM A108

Bar Diameter	Outside Diameter	Overall Length	Flange Coupling	
			Flange Size	Part Number
1/4" (6.4 mm)	1/2" (12 mm)	7/8" (22 mm)	-	-
3/8" (10 mm)	3/4" (19 mm)	1-1/2" (38 mm)	2" x 2" (51 x 51 mm)	C2D-03
1/2" (12 mm)	3/4" (19 mm)	1-1/2" (38 mm)	2" x 2" (51 x 51 mm)	C2D-04
5/8" (16 mm)	1" (25 mm)	1-3/4" (45 mm)	2" x 2" (51 x 51 mm)	C2D-05
3/4" (19 mm)	1-1/8" (29 mm)	2" (51 mm)	2" x 2" (51 x 51 mm)	C2D-06
7/8" (22 mm)	1-1/4" (32 mm)	2-1/4" (57 mm)	3" x 3" (76 x 76 mm)	C2D-07
1" (25 mm)	1-1/2" (38 mm)	3" (76 mm)	3" x 3" (76 x 76 mm)	C2D-08
1-1/8" (28 mm)	1-5/8" (41 mm)	3-1/2" (89 mm)	3" x 3" (76 x 76 mm)	C2D-09
1-1/4" (32 mm)	1-7/8" (47 mm)	3-3/4" (95 mm)	3" x 3" (76 x 76 mm)	C2D-10
1-3/8" (35 mm)	2-1/8" (55 mm)	4" (102 mm)	3" x 3" (76 x 76 mm)	C2D-11
1-1/2" (38 mm)	2-1/4" (57 mm)	5" (127 mm)	3" x 3" (76 x 76 mm)	C2D-12
1-3/4" (45 mm)	2-1/2" (65 mm)	5-1/2" (140 mm)	4" x 4" (102 x 102 mm)	C2D-14
1-7/8" (48 mm)	2-7/8" (73 mm)	6" (152 mm)	-	-
2" (51 mm)	3" (76 mm)	6" (152 mm)	-	-

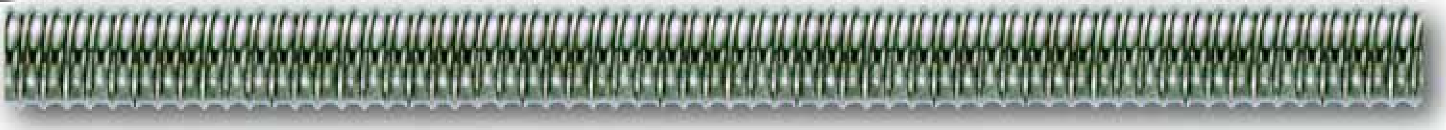
R9F Hardened Washers - ASTM F436

Bar Diameter	Outside Diameter	Inside Diameter	Thickness	Part Number
1/4" - 20 UNC (6.4 mm)	5/8" (16 mm)	9/32" (7.1 mm)	1/16" (1.58 mm)	R9F-02-436
3/8" - 16 NC (10 mm)	1" (25 mm)	7/16" (11 mm)	5/64" (2.0 mm)	R9F-03-436
1/2" - 13 UNC (12 mm)	1-3/8" (35 mm)	9/16" (14 mm)	9/64" (3.6 mm)	R9F-04-436
5/8" - 11 UNC (16 mm)	1-3/4" (45 mm)	11/16" (17 mm)	9/64" (3.6 mm)	R9F-05-436
3/4" - 10 UNC (19 mm)	1-15/32" (37 mm)	13/16" (21 mm)	9/64" (3.4 mm)	R9F-06-436
7/8" - 9 UNC (22 mm)	1-3/4" (45 mm)	15/16" (24 mm)	5/32" (3.4 mm)	R9F-07-436
1" - 8 UNC (25 mm)	2" (51 mm)	1-1/8" (28 mm)	5/32" (4.0 mm)	R9F-08-436
1-1/8" - 9 UNC (28 mm)	2-1/4" (57 mm)	1-1/4" (32 mm)	5/32" (4.0 mm)	R9F-09-436
1-1/4" - 7 UNC (32 mm)	2-1/4" (57 mm)	1-3/8" (35 mm)	5/32" (4.0 mm)	R9F-10-436
1-3/8" - 8 UN (35 mm)	2-3/4" (70 mm)	1-1/2" (38 mm)	5/32" (4.0 mm)	R9F-11-436
1-1/2" - 6 NC (38 mm)	3" (76 mm)	1-5/8" (41 mm)	5/32" (4.0 mm)	R9F-12-436
1-3/4" - 5 UNC (45 mm)	3-3/8" (86 mm)	1-7/8" (48 mm)	7/32" (5.6 mm)	R9F-14-436
1-7/8" - 8 UN (48 mm)	3-3/4" (95 mm)	2-1/8" (54 mm)	7/32" (5.6 mm)	R9F-16-436
2" - 6 UN (51 mm)	3-3/4" (95 mm)	2-1/8" (54 mm)	7/32" (5.6 mm)	R9F-16-436

R8M Beveled Washers - ASTM A47 or ASTM A536

Bar Diameter	Degree of Bevel	Outside Diameter	Inside Diameter	Maximum Thickness	Minimum Thickness	Part Number
1/4" (6.4 mm)	-	-	-	-	-	-
3/8" (10 mm)	14°	1-1/4" (32 mm)	9/16" (14 mm)	7/16" (11 mm)	1/8" (3 mm)	R8M-03
1/2" (12 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" (39.7 mm)	13/16" (20.6 mm)	1/2" (12.7 mm)	3/16" (4.8 mm)	R8M-06
3/4" (19 mm)	11°	1-9/16" (39.7 mm)	13/16" (20.6 mm)	1/2" (12.7 mm)	3/16" (4.8 mm)	R8M-06
7/8" (22 mm)	9°	2" (50.8 mm)	1-3/16" (30.2 mm)	9/16" (14.3 mm)	1/4" (6.4 mm)	R8M-09
1" (25 mm)	9°	2" (50.8 mm)	1-3/16" (30.2 mm)	9/16" (14.3 mm)	1/4" (6.4 mm)	R8M-09
1-1/8" (28 mm)	15°	2-13/16" (71.4 mm)	1-5/16" (33.3 mm)	1" (25 mm)	5/16" (7.9 mm)	R8M-09S
1-1/4" (32 mm)	15°	3-3/8" (85.7 mm)	1-9/16" (39.7 mm)	1-15/64" (43.9 mm)	3/8" (9.7 mm)	R8M-12S
1-3/8" (35 mm)	15°	3-3/8" (85.7 mm)	1-9/16" (39.7 mm)	1-15/64" (43.9 mm)	3/8" (9.7 mm)	R8M-12S
1-1/2" (38 mm)	5°	3-9/16" (90.5 mm)	2-1/16" (52.4 mm)	13/16" (20.6 mm)	1/2" (12.7 mm)	R8M-16
1-3/4" (45 mm)	5°	3-9/16" (90.5 mm)	2-1/16" (52.4 mm)	13/16" (20.6 mm)	1/2" (12.7 mm)	R8M-16
1-7/8" (48 mm)	5°	3-9/16" (90.5 mm)	2-1/16" (52.4 mm)	13/16" (20.6 mm)	1/2" (12.7 mm)	R8M-16
2" (51 mm)	5°	3-9/16" (90.5 mm)	2-1/16" (52.4 mm)	13/16" (20.6 mm)	1/2" (12.7 mm)	R8M-16

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 in^2 (549 mm^2)	127.5 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 in^2 (807 mm^2)	187.5 kips (834 kN)	150 kips (667 kN)	131 kips (584 kN)	113 kips (500 kN)	4.51 lbs./ft. (6.71 Kg/M)	1-7/16" (37 mm)	R71-10
1-3/8" - 4 (36 mm)	1.58 in^2 (1019 mm^2)	237 kips (1054 kN)	190 kips (843 kN)	166 kips (738 kN)	142 kips (633 kN)	5.71 lbs./ft. (8.50 Kg/M)	1-9/16" (40 mm)	R71-11
1-3/4" - 3-1/2 (46 mm)	2.60 in^2 (1664 mm^2)	400 kips (1779 kN)	320 kips (1423 kN)	280 kips (1245 kN)	240 kips (1068 kN)	9.06 lbs./ft. (13.5 Kg/M)	2" (51 mm)	R71-14
2-1/4" - 3-1/2 (57 mm) *	4.08 in^2 (2632 mm^2)	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 in^2 (3350 mm^2)	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) *	6.46 in^2 (4169 mm^2)	969 kips (4311 kN)	775 kips (3448 kN)	678 kips (3018 kN)	581 kips (2587 kN)	22.3 lbs./ft. (32.7 Kg/M)	3-3/64" (78 mm)	R71-24

* The 2-1/4" & 3" diameter bars are not covered under ASTM A722.

- Effective cross sectional areas shown are as required by ASTM A722-07. Actual areas may exceed these values.
- ACI 355.1R section 3.2.5.1 indicates an ultimate strength in shear has a range of .6 to .7 of the ultimate tensile strength. Designers should provide adequate safety factors for safe shear strengths 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.

Sizes

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

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. 150 KSI bars meet or exceed the deformation requirements under ASTM A615 for concrete reinforcing bars. Williams special thread deformation pattern projects ultra high relative rib area, much greater than conventional rebar. This provides for superior bond performance in concrete.

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.

Steel Quality

Williams 1", 1-1/4", & 1-3/8" 150 KSI bars are smooth, hot rolled, high strength prestressing steel. The bars are cold-stressed and stress relieved to produce the above properties. The 1-3/4" through 3" 150 KSI bars are from an alloy based steel that is hot rolled, quenched-tempered and stress relieved. All bars are produced to the prescribed mechanical properties shown in ASTM A722-07.

Thorough inspection and traceability are carried out during all phases of manufacturing to assure the highest standards of quality. Mill certifications and certificates of conformance can be provided with each shipment as an assurance that the mechanical properties of Williams All-Thread-Bar are as shown.

Properties

Williams 150 KSI bars are manufactured in strict compliance with ASTM A722-07 and AASHTO M275 Highway Specifications. The prestressing steel is 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.

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

Collar

R73 Hex Nuts - ASTM A29

Bar Diameter	Across Flats	Across Corners	Thickness	Part Number
1" (26 mm)	1-3/4" (45 mm)	2.02" (51.3 mm)	2" (51 mm)	R73-08
1-1/4" (32 mm)	2-1/4" (57 mm)	2.60" (66.0 mm)	2-1/2" (64 mm)	R73-10
1-3/8" (36 mm)	2-1/2" (63.5 mm)	2.89" (73.4 mm)	2-3/4" (70 mm)	R73-11
1-3/4" (46 mm)	3" (76 mm)	3.46" (87.9 mm)	3-1/2" (89 mm)	R73-14
2-1/4" (57 mm)	3-1/2" (89 mm)	4" (102 mm)	4-1/4" (105 mm)	R73-18
2-1/2" (65 mm)	4-1/4" (108 mm)	4.91" (124.7 mm)	4-3/4" (120 mm)	R73-20
3" * (75 mm)	4-1/4" (108 mm)	5" (127 mm)	6-1/8" (156 mm)	R74-24

* Rounded collar nut with OD of 5" (127 mm).

R72 Stop-Type Coupling - ASTM A29, Grade C1045

Bar Diameter	Outside Diameter	Overall Length	Part Number
1" (26 mm)	1-3/4" (45 mm)	4-1/4" (108 mm)	R72-08
1-1/4" (32 mm)	2-1/8" (54 mm)	5-1/4" (133 mm)	R72-10
1-3/8" (36 mm)	2-3/8" (60 mm)	5-3/4" (146 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)	9" (229 mm)	R72-18
2-1/2" (65 mm)	4-1/4" (108 mm)	9-3/8" (238 mm)	R72-20
3" (75 mm)	5" (127 mm)	11-7/8" (302 mm)	R72-24

R9F Hardened Washers - ASTM F436

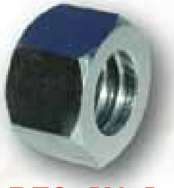
Bar Diameter	Outside Diameter	Inside Diameter	Thickness	Part Number
1" (26 mm)	2-1/4" (57 mm)	1-1/4" (32 mm)	5/32" (4.0 mm)	R9F-09-436
1-1/4" (32 mm)	2-3/4" (70 mm)	1-1/2" (38 mm)	5/32" (3.9 mm)	R9F-11-436
1-3/8" (36 mm)	3" (76 mm)	1-5/8" (41 mm)	5/32" (4.0 mm)	R9F-12-436
1-3/4" (46 mm)	3-3/4" (95 mm)	2-1/8" (54 mm)	7/32" (5.6 mm)	R9F-16-436
2-1/4" (57 mm)	4-1/2" (114 mm)	2-5/8" (67 mm)	9/32" (7.1 mm)	R9F-20-436
2-1/2" (65 mm)	5" (127 mm)	2-7/8" (73 mm)	9/32" (7.1 mm)	R9F-22-436
3" (75 mm)	6" (152 mm)	3-3/8" (86 mm)	5/16" (7.87 mm)	R9F-26-436

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

R88 Spherical Hex Nuts - ASTM A536

Bar Diameter	Across Flats	Thickness	Outside Dome	Part Number
1" (26 mm)	1-3/4" (45 mm)	2-1/4" (57 mm)	2-1/2" (63.5 mm)	R88-08
1-1/4" (32 mm)	2-1/4" (57 mm)	2-3/4" (70 mm)	3-1/8" (79.5 mm)	R88-10
1-3/8" (36 mm)	2-1/2" (63.5 mm)	3-1/4" (82.5 mm)	3-5/8" (90.2 mm)	R88-11
1-3/4" (46 mm)	3" (76 mm)	3-1/2" (89 mm)	4" (101.6 mm)	R88-14
2-1/4" * (57 mm)	3-1/2" (89 mm)	5-3/4" (146 mm)	5-1/2" (140 mm)	R73-18 R81-18
2-1/2" * (65 mm)	4-1/4" (108 mm)	6-1/2" (165 mm)	6" (152 mm)	R73-20 R81-20
3" ** (75 mm)	4-1/4" (108 mm)	8-1/8" (206 mm)	7" (178 mm)	R74-24 R81-24

* Requires a standard nut with spherical washer assembly.
** Requires rounded collar nut with spherical washer assembly.



These Jam Nuts can't be substitute for full strength nuts and can't be used on bars other than Williams 150 KSI All-Thread-Bars of the same diameter.

R73-JN Jam Nuts - ASTM A29, C1045

Bar Diameter	Across Flats	Thickness	Part Number
1" (26 mm)	1-3/4" (45 mm)	1/2" (12.7 mm)	R73-08JN
1-1/4" (32 mm)	2-1/4" (57 mm)	5/8" (15.9 mm)	R73-10JN
1-3/8" (36 mm)	2-1/2" (63.5 mm)	11/16" (17.5 mm)	R73-11JN
1-3/4" (46 mm)	3" (76 mm)	7/8" (22.2 mm)	R73-14JN
2-1/4" * (57 mm)	3-1/4" (83 mm)	1" (25 mm)	R73-18JN
2-1/2" (65 mm)	4" (102 mm)	1-3/16" (30.2 mm)	R73-20JN
3" * (75 mm)	4-1/2" (114 mm)	2" (51 mm)	R74-24JN

* Rounded collar nut

R8M Beveled Washers - ASTM A47 or ASTM A536

Bar Diameter	Degree of Bevel	Outside Diameter	Inside Diameter	Maximum Thickness	Minimum Thickness	Part Number
1" (26 mm)	10°	2-5/8" sq. (66.7 mm)	1-5/16" (33.3 mm)	13/16" (20.6 mm)	3/8" (9.5 mm)	R8M-08-150
1-1/4" * (32 mm)	15°	5-1/4" dia. (133.4 mm)	1-21/32" (41.9 mm)	1-41/64" (41.7 mm)	19/64" (7.5 mm)	R8M-10-150
1-3/8" * (36 mm)	15°	5-1/4" dia. (133.4 mm)	1-25/32" (45.2 mm)	1-41/64" (41.7 mm)	19/64" (7.5 mm)	R8M-11-150
1-3/4" (46 mm)	10°	5-1/2" dia. (137.7 mm)	2-1/2" (63.5 mm)	1-23/32" (43.6 mm)	3/4" (20 mm)	R8M-14-150
2-1/4" (57 mm)	10°	6-1/2" (165 mm)	3" (76 mm)	1-24/32" (47 mm)	3/4" (20 mm)	R8M-18-150
2-1/2" (65 mm)	10°	7-1/2" dia. (190.5 mm)	3-1/2" (88.9 mm)	2.31" (58.7 mm)	1" (26 mm)	R8M-20-150
3"* (75 mm)	10°	8" dia. (203 mm)	3-5/8" (92.1 mm)	2.43" (61.7 mm)	1" (26 mm)	R8M-24-150

* Additional USS Hardened Washer Required

Grade 75 All-Thread Rebar

Threads

Williams Grade 75 All-Thread Rebar has a cold rolled, continuous, rounded course thread form. Because of the full 360º concentric thread form, Williams All-Thread Rebar should only be bent under special provisions. 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. Threads are available in both right and left hand. Grade 80 is available upon request.

Sizes

All-Thread Rebar is available in 11 diameters from #6 (20 mm) through #28 (89 mm). Most diameters are available in continuous lengths up to 50' (15.2 m).

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 All-Thread Rebar - ASTM A615

Bar Designation Nominal Diameter & Pitch	Minimum Net Area Thru Threads	Minimum Ultimate Strength	Minimum Yield Strength	Nominal Weight	Approx. Thread Major Dia.	Part Number
#6 - 3/4" - 5 (20 mm)	0.44 in^2 (284 mm^2)	44 kips (196 kN)	33 kips (147 kN)	1.5 lbs./ft. (2.36 Kg/M)	7/8" (22 mm)	R61-06
#7 - 7/8" - 5 (22 mm)	0.60 in^2 (387 mm^2)	60 kips (267 kN)	45 kips (200 kN)	2.0 lbs./ft. (3.04 Kg/M)	1" (25 mm)	R61-07
#8 - 1" - 3-1/2 (25 mm)	0.79 in^2 (510 mm^2)	79 kips (351 kN)	59.3 kips (264 kN)	2.7 lbs./ft. (3.94 Kg/M)	1-1/8" (29 mm)	R61-08
#9 - 1-1/8" - 3-1/2 (28 mm)	1.00 in^2 (645 mm^2)	100 kips (445 kN)	75 kips (334 kN)	3.4 lbs./ft. (5.06 Kg/M)	1-1/4" (32 mm)	R61-09
#10 - 1-1/4" - 3 (32 mm)	1.27 in^2 (819 mm^2)	127 kips (565 kN)	95.3 kips (424 kN)	4.3 lbs./ft. (5.50 Kg/M)	1-3/8" (35 mm)	R61-10
#11 - 1-3/8" - 3 (35 mm)	1.56 in^2 (1006 mm^2)	156 kips (694 kN)	117 kips (521 kN)	5.3 lbs./ft. (7.85 Kg/M)	1-1/2" (38 mm)	R61-11
#14 - 1-3/4" - 3 (45 mm)	2.25 in^2 (1452 mm^2)	225 kips (1001 kN)	169 kips (750 kN)	7.65 lbs./ft. (11.8 Kg/M)	1-7/8" (48 mm)	R61-14
#18 - 2-1/4" - 2-3/4 (55 mm)	4.00 in^2 (2581 mm^2)	400 kips (1780 kN)	300 kips (1335 kN)	13.6 lbs./ft. (19.6 Kg/M)	2-7/16" (62 mm)	R61-18
#20 - 2-1/2" - 2-3/4 (64 mm)	4.91 in^2 (3168 mm^2)	491 kips (2184 kN)	368 kips (1637 kN)	16.7 lbs./ft. (24.8 Kg/M)	2-3/4" (70 mm)	R61-20
#24 - 3" - 2-3/4 (76 mm)	6.82 in^2 (4400 mm^2)	682 kips (3034 kN)	511 kips (2273 kN)	24.0 lbs./ft. (35.8 Kg/M)	3-3/16" (81 mm)	R61-24
#28 - 3-1/2" - 2-3/4 (89 mm)	9.61 in^2 (6200 mm^2)	960 kips (4274 kN)	720 kips (3206 kN)	32.7 lbs./ft. (48.6 Kg/M)	3-3/4" (95 mm)	R61-28

All Couplings and Hex Nuts exceed 100% of the bar's published ultimate strength and meet ACI 318 Section 12.14.3.2 for mechanical rebar connections.

Hex

Collar

R62 Stop-Type Coupling - ASTM A108

Bar Desig. & Nominal Dia.	Outside Diameter	Overall Length	Part Number
#6 - 3/4" (20 mm)	1-1/4" (31.8 mm)	3-1/2" (88.9 mm)	R62-06
#7 - 7/8" (22 mm)	1-3/8" (35.1 mm)	4" (101.6 mm)	R62-07
#8 - 1" (25 mm)	1-5/8" (41.4 mm)	4-1/2" (114.3 mm)	R62-08
#9 - 1-1/8" (28 mm)	1-7/8" (47.7 mm)	5" (127.0 mm)	R62-09
#10 - 1-1/4" (32 mm)	2" (50.8 mm)	5-1/2" (139.7 mm)	R62-10
#11 - 1-3/8" (35 mm)	2-1/4" (57.2 mm)	6" (152.4 mm)	R62-11
#14 - 1-3/4" (45 mm)	2-7/8" (73.0 mm)	7-7/8" (200 mm)	R62-14
#18 - 2-1/4" (55 mm)	3-1/2" (88.9 mm)	9-1/8" (233.0 mm)	R62-18
#20 - 2-1/2" (64 mm)	4" (101.6 mm)	9-1/2" (241.3 mm)	R62-20
#24 - 3" (76 mm)	5" (127 mm)	11-1/4" (286 mm)	R62-24
#28 - 3-1/2" (89 mm)	5-1/2" (140.0 mm)	12" (305 mm)	R62-28

R63 Hex Nut - ASTM A108

Bar Desig. & Nominal Dia.	Across Flats	Across Corners	Thickness	Part Number
#6 - 3/4" (20 mm)	1-1/4" (31.8 mm)	1.444" (36.7 mm)	1-5/8" (41.4 mm)	R63-06
#7 - 7/8" (22 mm)	1-7/16" (36.5 mm)	1.66" (42.2 mm)	1-3/4" (44.5 mm)	R63-07
#8 - 1" (25 mm)	1-5/8" (41.3 mm)	1.877" (47.7 mm)	2" (50.8 mm)	R63-08
#9 - 1-1/8" (28 mm)	1-7/8" (47.8 mm)	2.166" (55.0 mm)	2" (51 mm)	R63-09
#10 - 1-1/4" (32 mm)	2" (50.8 mm)	2.309" (58.6 mm)	2-3/16" (55.6 mm)	R63-10
#11 - 1-3/8" (35 mm)	2-1/4" (57.2 mm)	2.526" (64.2 mm)	2-13/32" (61.1 mm)	R63-11
#14 - 1-3/4" (45 mm)	2-3/4" (73.0 mm)	3.175" (80.6 mm)	3-1/4" (82.6 mm)	R63-14
#18 - 2-1/4" (55 mm)	3-1/2" (88.9 mm)	4.039" (102.6 mm)	3-1/2" (88.9 mm)	R63-18
#20 - 2-1/2" (64 mm)	4" (101.6 mm)	4.62" (117.3 mm)	4" (101.6 mm)	R63-20
*#24 - 3" (76 mm)	4-1/2" (114 mm)	O.D. 5" (127 mm)	5" (127 mm)	R64-24*
*#28 - 3-1/2" (89 mm)	5-1/2" (140 mm)	O.D. 6" (152 mm)	6" (142 mm)	R64-28*

* Round Collar Nut

Grade 75 All-Thread Rebar Accessories

R81 Spherical Washers - ASTM A536

Bar Desig. & Nominal Dia.	Thickness	Outside Dome	Part Number
#6 - 3/4" (20 mm)	35/64" (13.9 mm)	2" (51 mm)	R81-0675
#7 - 7/8" (22 mm)	39/64" (15.5 mm)	2-1/4" (57 mm)	R81-0775
#8 - 1" (25 mm)	5/8" (15.9 mm)	2-1/2" (64 mm)	R81-0875
#9 - 1-1/8" (28 mm)	3/4" (19.1 mm)	2-3/4" (70 mm)	R81-0975
#10 - 1-1/4" (32 mm)	53/64" (21.0 mm)	3" (76 mm)	R81-1075
#11 - 1-3/8" (35 mm)	29/32" (23.0 mm)	3-1/4" (83 mm)	R81-1175
#14 - 1-3/4" (45 mm)	1-7/64" (28.2 mm)	3-3/4" (95 mm)	R81-1475
#18 - 2-1/4" (55 mm)	1-13/32" (35.7 mm)	5" (127 mm)	R81-1875
#20 - 2-1/2" (64 mm)	1-1/2" (38.1 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" (38.1 mm)	7" (177.8 mm)	R81-2875

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

R9F Hardened Washers - ASTM F436

Bar Desig. & Nominal Dia.	Outside Diameter	Inside Diameter	Thickness	Part Number
#6 - 3/4" (20 mm)	1-3/4" (45 mm)	15/16" (24 mm)	5/32" (3.4 mm)	R9F-07-436
#7 - 7/8" (22 mm)	2" (51 mm)	1-1/8" (28 mm)	5/32" (4.0 mm)	R9F-08-436
#8 - 1" (25 mm)	2-1/4" (57 mm)	1-1/4" (32 mm)	5/32" (4.0 mm)	R9F-09-436
#9 - 1-1/8" (28 mm)	2-1/4" (57 mm)	1-1/4" (32 mm)	5/32" (4.0 mm)	R9F-09-436
#10 - 1-1/4" (32 mm)	2-1/4" (57 mm)	1-3/8" (35 mm)	5/32" (4.0 mm)	R9F-10-436
#11 - 1-3/8" (35 mm)	3" (76 mm)	1-5/8" (41 mm)	5/32" (4.0 mm)	R9F-12-436
#14 - 1-3/4" (45 mm)	3-3/8" (86 mm)	1-7/8" (48 mm)	9/32" (7.1 mm)	R9F-14-436
#18 - 2-1/4" (55 mm)	4-1/2" (114 mm)	2-5/8" (67 mm)	9/32" (7.1 mm)	R9F-20-436
#20 - 2-1/2" (64 mm)	5" (127 mm)	2-7/8" (73 mm)	9/32" (7.1 mm)	R9F-22-436
#24 - 3" (76 mm)	6" (142 mm)	3-3/8" (86 mm)	5/16" (7.9 mm)	R9F-24-436
#28 - 3-1/2" (89 mm)	7" (178 mm)	3-7/8" (98 mm)	5/16" (7.9 mm)	R9F-30-436

These Jam Nuts can not be substitute for full strength nuts and can not be used on bars other than Williams Grade 75 All-Thread Rebar of the same diameter.

R63-JN Jam Nuts - ASTM A108

Bar Desig. & Nominal Dia.	Across Flats	Thickness	Part Number
#6 - 3/4" (20 mm)	1-1/4" (32 mm)	13/16" (20.6 mm)	R63-06JN
#7 - 7/8" (22 mm)	1-7/16" (36.5 mm)	7/8" (22.2 mm)	R63-07JN
#8 - 1" (25 mm)	1-5/8" (41 mm)	1" (25 mm)	R63-08JN
#9 - 1-1/8" (28 mm)	1-7/8" (47.6 mm)	1" (25 mm)	R63-09JN
#10 - 1-1/4" (32 mm)	2" (51 mm)	1-3/16" (27.7 mm)	R63-10JN
#11 - 1-3/8" (35 mm)	2-1/4" (57 mm)	1-1/4" (31.8 mm)	R63-11JN
#14 - 1-3/4" (45 mm)	2-3/4" (70 mm)	1-5/8" (41.3 mm)	R63-14JN
#18 - 2-1/4" (55 mm)	3-1/2" (89 mm)	1-3/4" (44.5 mm)	R63-18JN
#20 - 2-1/2" (64 mm)	4" (102 mm)	2" (50.8 mm)	R63-20JN
*#24 - 3" (76 mm)	4-1/2" (114 mm)	2-1/4" (57 mm)	R64-24JN*
*#28 - 3-1/2" (89 mm)	5" (127 mm)	2-1/2" (63.5 mm)	R64-28JN*

*Round Collar Nut

R8M Beveled Washers - ASTM A47 or ASTM A536

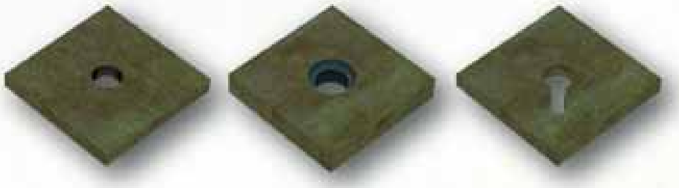
Bar Desig. & Nominal Dia.	Degree of Bevel	Outside Diameter	Inside Diameter	Maximum Thickness	Minimum Thickness	Part Number
#6 - 3/4" (20 mm)	9°	2" sq. (50.8 mm)	1" (25.4 mm)	17/32" (13.5 mm)	15/64" (6.1 mm)	R8M-07
#7 - 7/8" (22 mm)	9°	2" (50.8 mm)	1-3/16" (30.2 mm)	9/16" (14.3 mm)	1/4" (6.4 mm)	R8M-09
#8 - 1" (25 mm)	15°	2-13/16" (71.4 mm)	1-5/16" (33.3 mm)	1" (25.4 mm)	5/16" (7.9 mm)	R8M-09S
#9 - 1-1/8" (28 mm)	15°	2-13/16" (71.4 mm)	1-5/16" (33.3 mm)	1" (25.4 mm)	5/16" (7.9 mm)	R8M-09S
#10 - 1-1/4" (32 mm)	15°	3-3/8" (85.7 mm)	1-9/16" (39.7 mm)	1-15/64" (43.9 mm)	3/8" (9.7 mm)	R8M-12S
#11 - 1-3/8" (35 mm)	15°	3-1/2" (88.9 mm)	1-3/4" (44.5 mm)	1-1/4" (31.8 mm)	3/8" (9.7 mm)	R8M-13S
#14 - 1-3/4" (45 mm)	5°	3-9/16" (90.5 mm)	2-1/16" (52.4 mm)	13/16" (20.6 mm)	1/2" (12.7 mm)	R8M-16
#18 - 2-1/4" (55 mm)	15°	5" (127.0 mm)	3" (76.2 mm)	5/8" (41.4 mm)	19/64" (7.6 mm)	R8M-18
#20 - 2-1/2" (64 mm)	10°	5-1/2" (140 mm)	3" (76.2 mm)	1-23/32" (43.7 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

Anchor Accessories

Bearing Plates

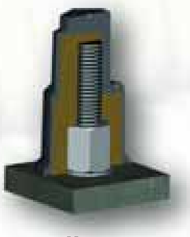
Williams steel bearing plates are standard with a round hole for non-grouted concrete anchors. Also available are dished plates for use with spherical hex nuts and keyhole plates which provide free access for grout tube entry. Bearing plates are customized for each application. Plate dimensions should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

S1K - Round **R80 - Dished** **S1K - Keyhole**



End Caps

Williams offers end caps produced from fiber reinforced nylon, steel or PVC to provide corrosion protection at otherwise exposed anchor ends. Most often the caps are packed with corrosion inhibiting wax or grease. Caps made from reinforced nylon and steel are used in exposed impact areas. The fiber reinforced nylon end cap meets the Florida DOT standards.



Fiber Reinforced Nylon Cap

Steel Tube welded on Flange with Threaded Screw Connections

Steel Tube with Jam Nut

Screw-On PVC Cap with Plastic Nut

Slip-On PVC Cap

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.

Eye Nut Designation	Inside Width	Inside Height	Ring Diameter	Overall Height	Taps Available	Straight Tension Ultimate Strength	Blank Part Number
NEB 1 Ductile Iron	2" (51 mm)	2" (51 mm)	1-1/8" (29 mm)	5-1/8" (130 mm)	3/4"; 7/8"; 1"* (20; 22; 25 mm)	35 kips (156 kN)	E1M-00-001
NEB 50 Ductile Iron	3" (76 mm)	3' (76 mm)	1" (25 mm)	5-3/4" (146 mm)	1/2"; 3/4" (13; 20 mm)	26 kips (116 kN)	E1M-00-050
NEB 75R Ductile Iron	4" (102 mm)	5" (127 mm)	1" (25 mm)	7-3/4" (197 mm)	1/2"; 3/4" (13; 20 mm)	23 kips (102 kN)	E1M-00-75R
NEB 100 Ductile Iron	4" (102 mm)	4-1/2" (114 mm)	1-1/4" (32 mm)	8" (203 mm)	1"; 1-1/4"; 1-3/8"* (25; 32; 35 mm)	65 kips (289 kN)	E1M-00-100
NEB 200 Ductile Iron	5" (127 mm)	6" (152 mm)	2" (51 mm)	11" (274 mm)	1-3/8"; 2" (35; 51 mm)	150 kips (667 kN)	E1M-00-200
E1N Malleable	2" (51 mm)	2-1/2" (64 mm)	7/8" (22 mm)	5-1/8" (130 mm)	Grade 75 #6, #7, #8	70 kips (312 kN)	E1M-00-E1N
CCF 1 CCF 2 CCF 3 CCF 4 Steel	up to 4" (102 mm)	up to 6-1/4" (159 mm)	up to 1-1/2" (38 mm)	up to 8-1/2" (216 mm)	Grade 75 #6 through #18	up to 260 kips (1157 kN)	E1M-00-CCF1 E1M-00-CCF2 E1M-00-CCF3 E1M-00-CCF4

* 150 KSI All-Thread-Bar may not be used in 1" diameter for the NEB 1 or in 1-3/8" diameter for the NEB 100.

Grouting Accessories

S5Z WIL-X CEMENT GROUT

Conforms to ASTM C845-76 T

Wil-X is chemically compensated for shrinkage. It has a high bond value and is crack resistant for permanent installations. Because it is a cement-grout, it is non-explosive and has a long shelf life when kept dry.

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

Time	PSI	MPa
1 Day	3,200	22.2
3 Days	4,800	33.1
7 Days	6,700	46.2
28 Days	10,200	70.3

94 lbs. bag

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 10,200 PSI depending on water content. Copy of ASTM Modification available upon request.

5 gallon, resealable, moisture proof, polypropylene pails

Five Star Special Grout 400

Product Description

Five Star Special Grout 400 is a cement-based, nonmetallic, nonshrink, fluid grout that provides corrosion protection and is specifically formulated for grouting of anchor bolts. When tested in accordance with ASTM C827, Five Star Special Grout 400 shows positive expansion. Additional specifications available upon request.

Advantages

- Pumpable fluid grout for very tight clearances
- Nonbleeding
- Permanent filling of voids
- Extended working time
- Nonshrink from the time of placement
- Manufactures under strict quality control standards

Compressive Strength (73° F Dry Environment) 0.4 w/c Ratio

Time	PSI	MPa
1 Day	3,500	24.1
7 Days	7,000	48.3
28 Days	8,500	58.6

Packaging and Yield

Five Star Special Grout 400 is packaged in heavy-duty, polyethylene lined bags containing 49 lb (22 kg), yielding 0.50 cubic feet (14.2 liters).

Mixing

Mix Five Star Special Grout 400 to a uniform consistency in accordance with 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 at approximately 6 quarts of potable water per 49 lb bag. Mix to a flow of 9-20 seconds through a flow cone per ASTM C939 modified to PTI requirements. Add more water if necessary. Do not add more than 13 pints (13.5 lb) of water per 49 lb bag. Do not mix to a consistency that will cause segregation.

T3P Heavy Duty Plastic Grout Tube

Furnished in product lengths for the anchors or in rolls.

O.D.	I.D.
3/8" (9.5 mm)	1/4" (6.4 mm)
1/2" (12.7 mm)	3/8" (9.5 mm)
3/4" (19.1 mm)	5/8" (15.9 mm)

T4Z Grout Tube Adapter

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

Super Plasticizer

Plasticizer is available and is used as a water reducer for ease of pumping grout through tubes at lower water to cement ratios. Super Plasticizer can only be used with Wil-X Cement Grout.

Grout Pumps

T6Z-04 Manual Grout Pump

2 stroke position, piston driven pump. Pump cement grout only, no sand. Use of plasticizer is recommend with hand pumps.

Approximate size:	30-3/4" high
	24-1/4" wide
	35" high with handle
Weight:	60 lbs. (Dry weight)
Outlet capacity:	40 psi average,
	80 psi maximum

T6Z-08 Air Powered Grout Pump

Pumps cement grout only, no sand mixes. 32 Gallon Mixing Tank. Mixes up to 2 sacks of material at once and allows for grout to be pumped during mixing or mixed without pumping.

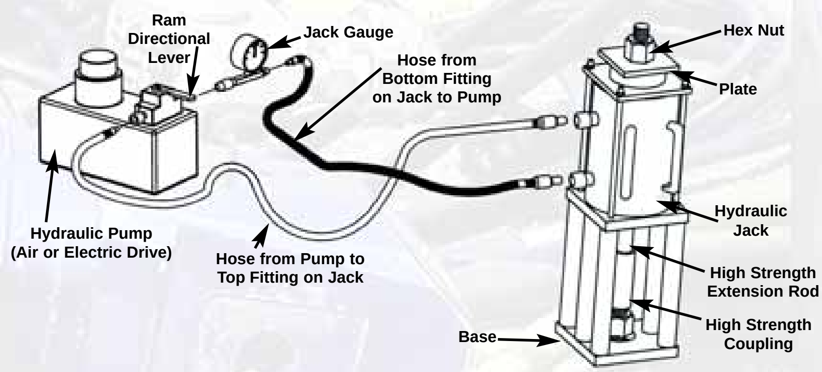
Weight:	560 lbs.
Dimension Size:	50" long
	30.5" wide
	52" high
Production Rate:	8 gallons per minute at 150 psi

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-Tread-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 m)	8-3/8" (213 mm)	3/4" (19 mm)	2.12 in^2 (1,368 mm^2)	12 lbs. (5.4 kg)
30 tons (267 kN)	Hand Single 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 in^2 (3,800 mm^2)	80 lbs. (36 kg)
60 tons (534 kN)	Hand, Air, or Electric Double Acting	9-1/2" (241 mm)	8" x 8" (203 x 203 mm)	5" (127 mm)	29" (737 mm)	2" (51 mm)	12.31 in^2 (7,942 mm^2)	153 lbs. (69 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 in^2 (12,923 mm^2)	192 lbs. (87 kg)
150 tons (1334 kN)	Air or Electric Double Acting	12-1/4" (311 mm)	12" x 12" (305 x 305 mm)	5" (127 mm)	32-1/4" (819 mm)	2-1/2" (64 mm)	30.1 in^2 (19,419 mm^2)	350 lbs. (159 kg)
200 tons (1779 kN)	Air or Electric Double Acting	16" (406 mm)	12" x 12" (305 x 305 mm)	8" (203 mm)	34" (864 mm)	4" (102 mm)	40.45 in^2 (26,097 mm^2)	518 lbs. (235 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 in^2 (50,645 mm^2)	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 in^2 (59,032 mm^2)	1,300 lbs. (590 kg)

Certification of gauge accuracy available on request prior to shipment only.

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)	11.11" (279 mm)	4.49" (114 mm)	16.75 lbs. (7.6 kg)
7,400 ft./lbs. (1,023 kg/M)	10.74" (273 mm)	7" (178 mm)	19 lbs. (11.3 kg)

T8Z Torque Wrench

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

Bolt Diameter	Square Drive Size	Capacity (ft. lbs.)
1/2"-1"	3/4"	100-600
*1-1/8"-2"	1"	200-1,000

*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.)

T9F Impact Tool

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

Size	Bolt Diameter	Square Drive Size	Capacity (ft. lbs.)
T9F-08	1" to 1-3/8"	1"	1,700 - 2,000
T9F-12	1-3/8" to 2"	1-1/2"	3,000 - 4,000

S9Z S-7 Setting Tool

Bolt Rod Diameter	Part Number
1/2"	S9Z-004
3/4"	S9Z-006
1"	S9Z-008

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

S6Z Spin-Lock Setting Tool

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

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

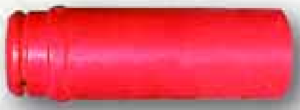
Hardened steel allows for several reuses. Two piece design assures easy removal.

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 1" or 1-1/2" square drive. Please specify square drive for compatibility with your equipment.

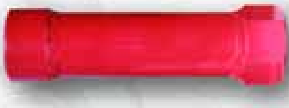
T2Z Regular Socket



T1Z Deep Socket

K3F-26 Long Fitting Wrench Adapter

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



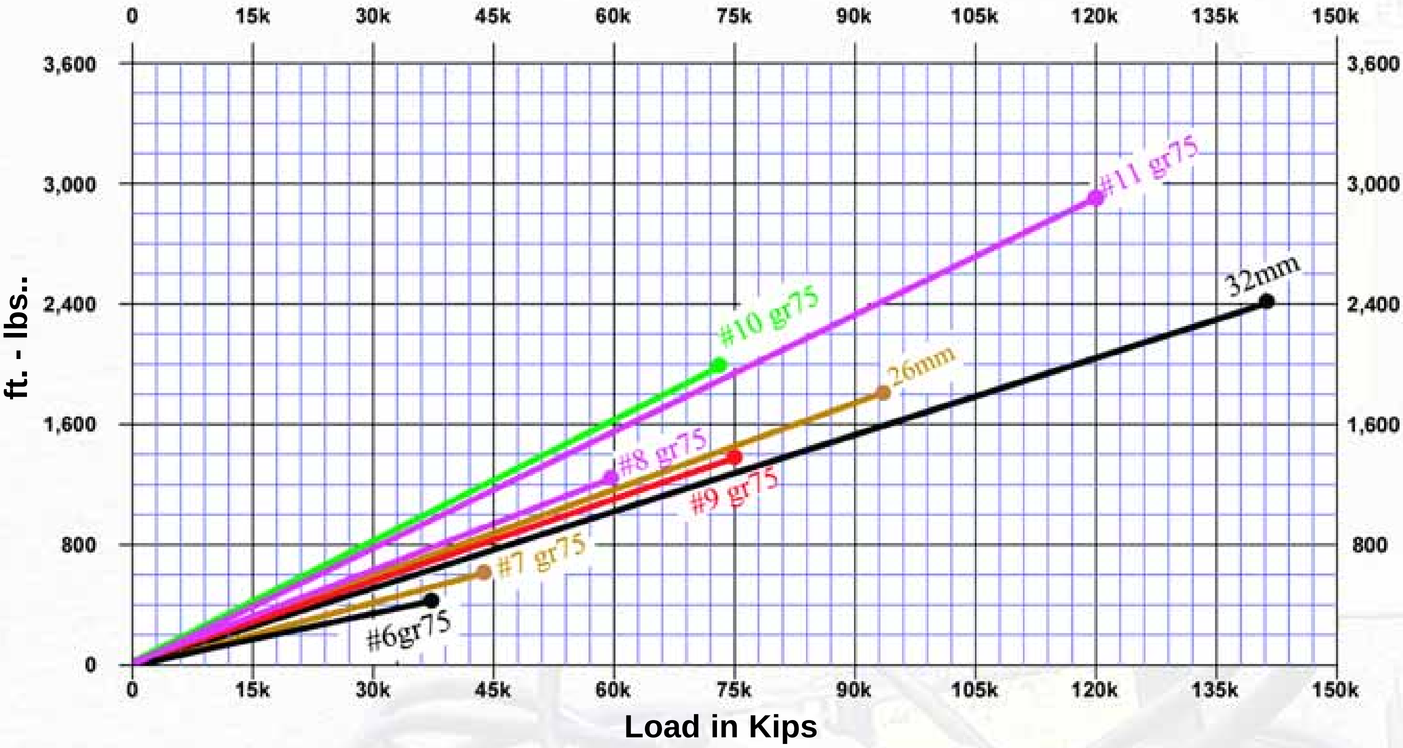
T3Z Hex Knocker Wrench

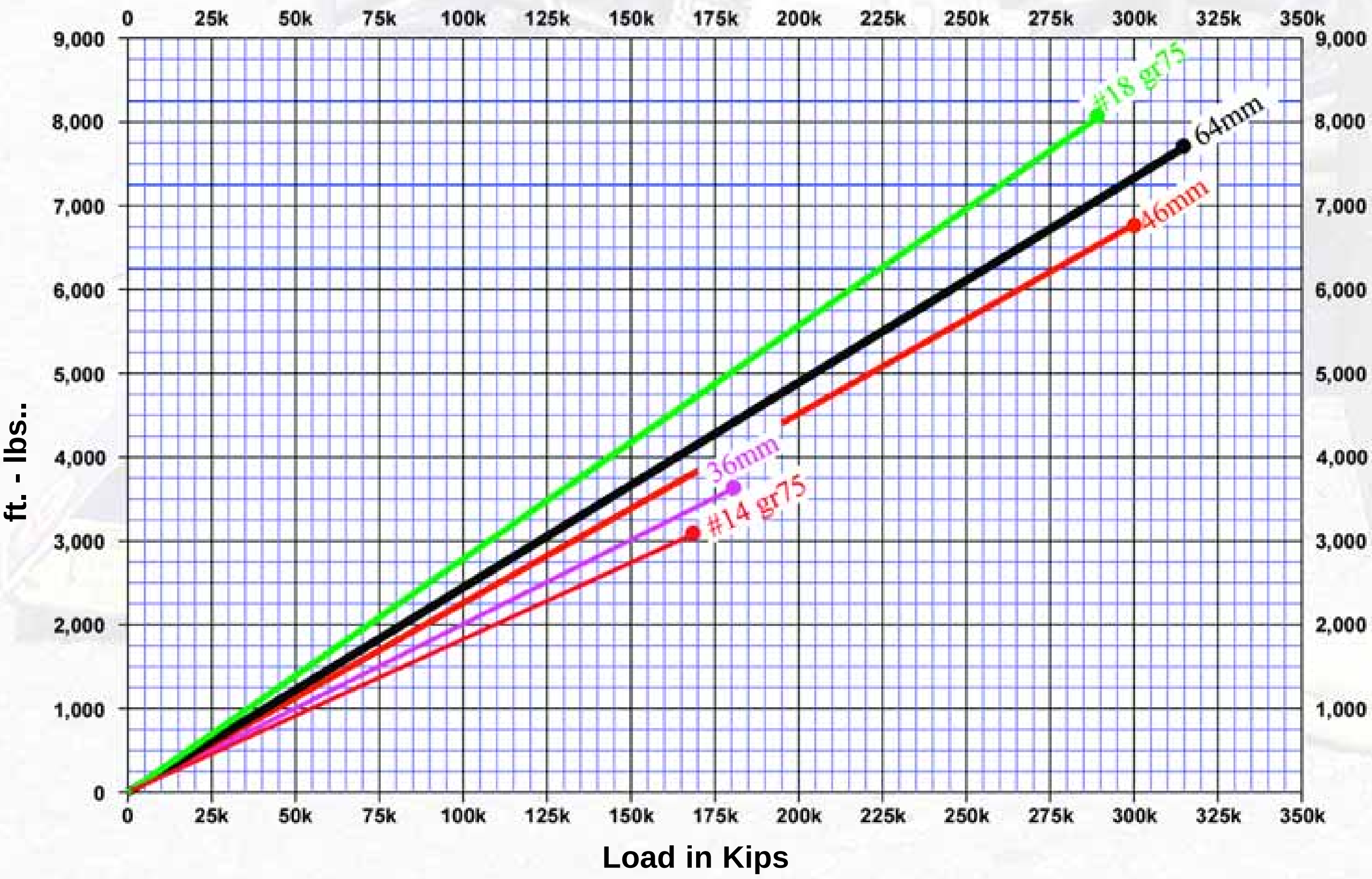
Hex knocker wrenches are used for safe hex nut adjustment inside of open frame jacks.

All-Thread Torque Tension Charts

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

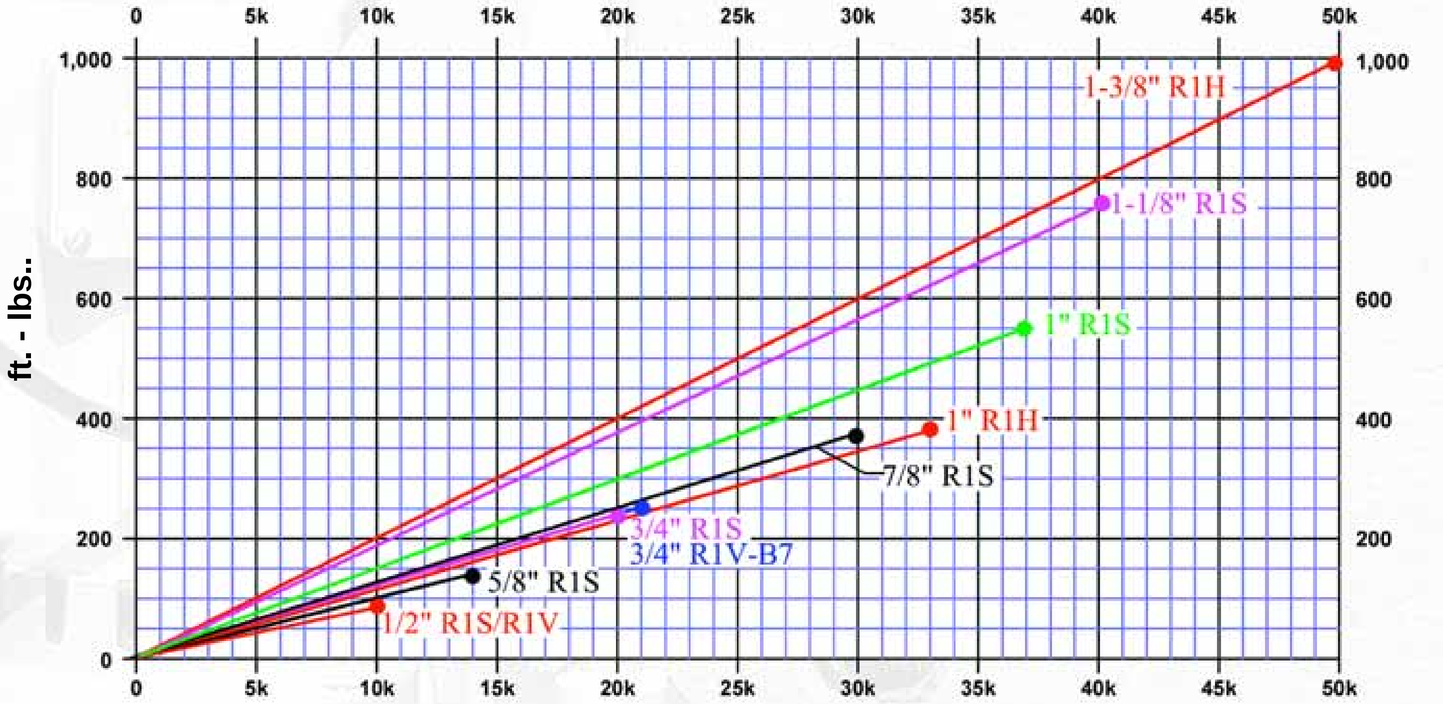
All data based on greased (MolyCoat Gn) threads and surfaces.



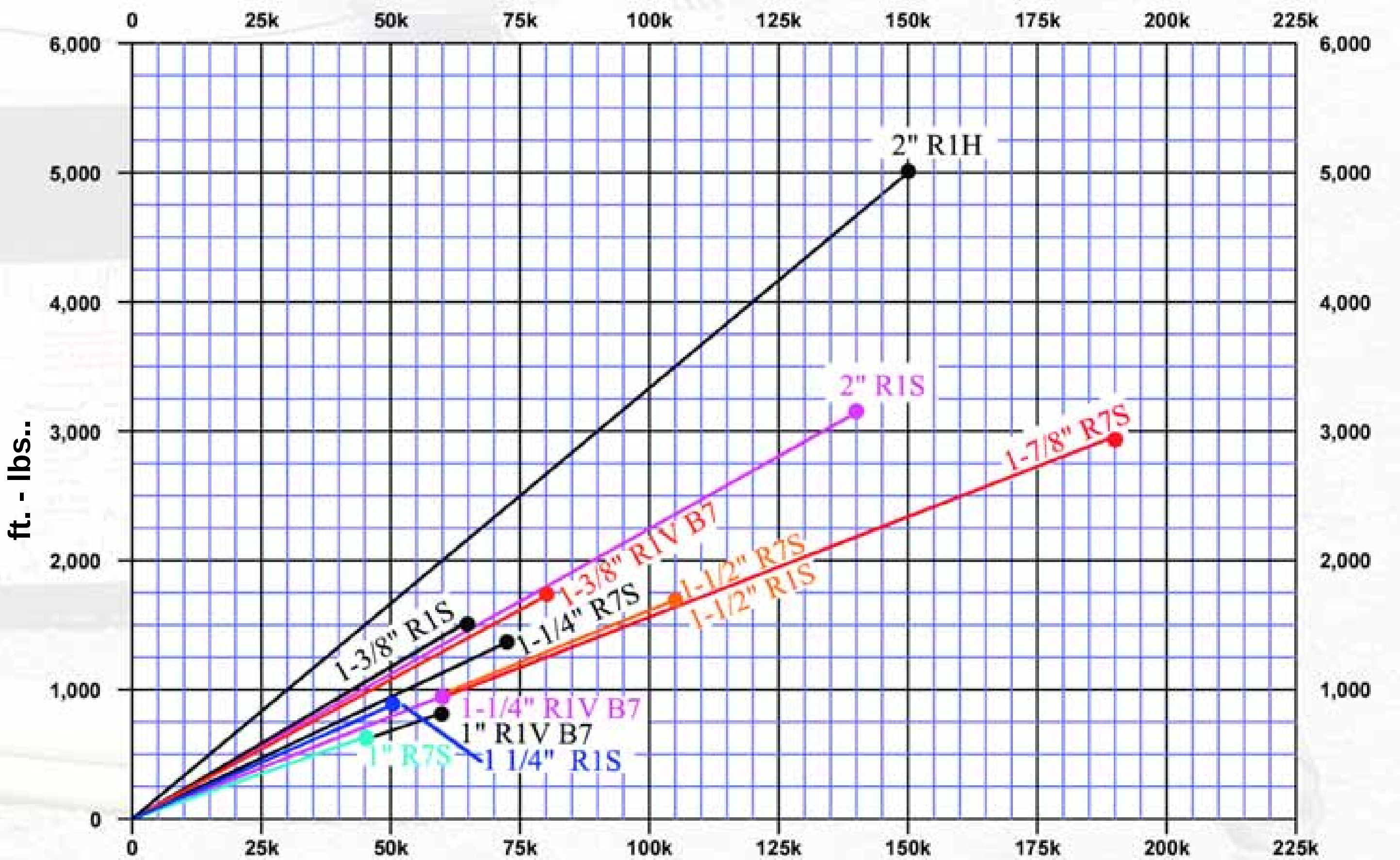


Spin-Lock Torque Tension Charts

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

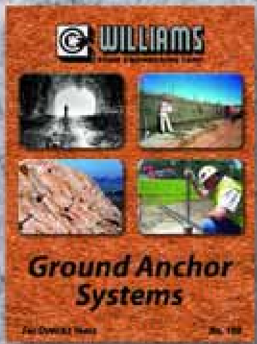


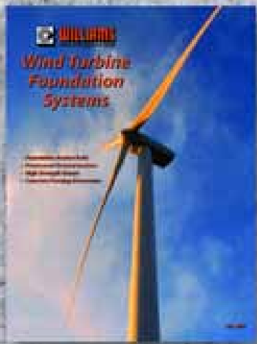
For R1J bars use R1S values.

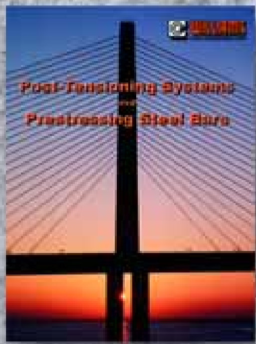


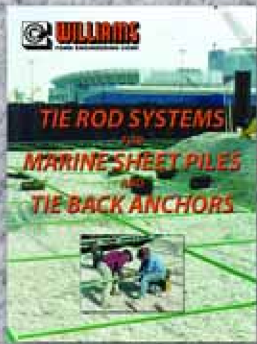
For R1J bars use R1S values.

Williams offers a full line of Ground Anchors, Concrete Anchors, Post-Tensioning Systems, and Concrete Forming Hardware Systems for whatever your needs may be.









Also available from Williams are *Rock & Soil Anchor Sample Specifications* and *High Capacity Concrete Anchor Sample Specifications*

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