

Concrete  
Forming Systems

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Bridge Deck Forming  
and Hanging Systems

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Reinforcing  
Bar Supports

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Concrete  
Anchoring Systems

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Precast Concrete  
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ACROW-RICHMOND

THE HIDDEN STRENGTH™

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LA FORCE CACHÉE

# ROCK ANCHORING AND BOLT SYSTEMS

# ROD SERIES ANCHORS EQUIPMENT INSTALLATION



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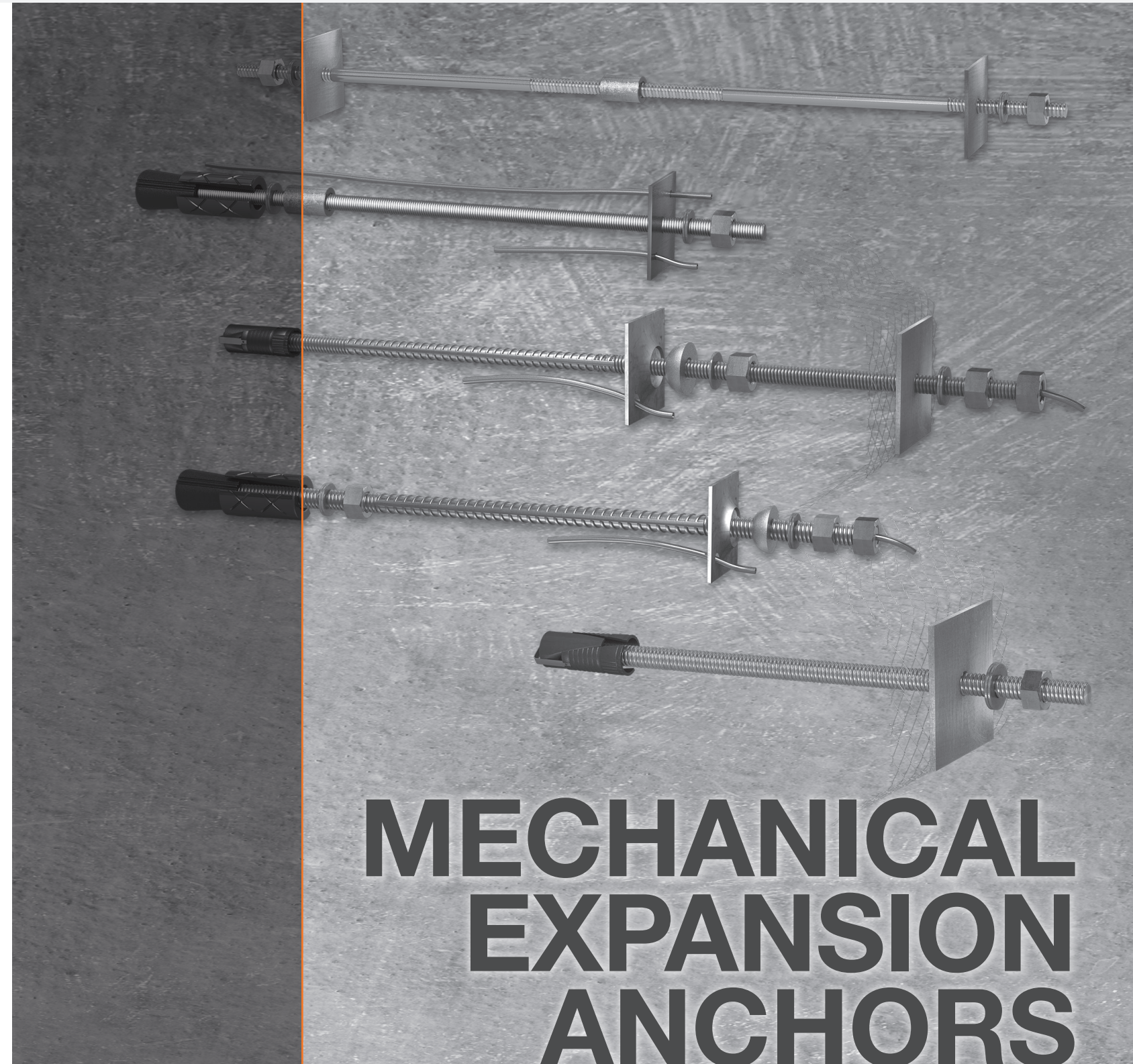
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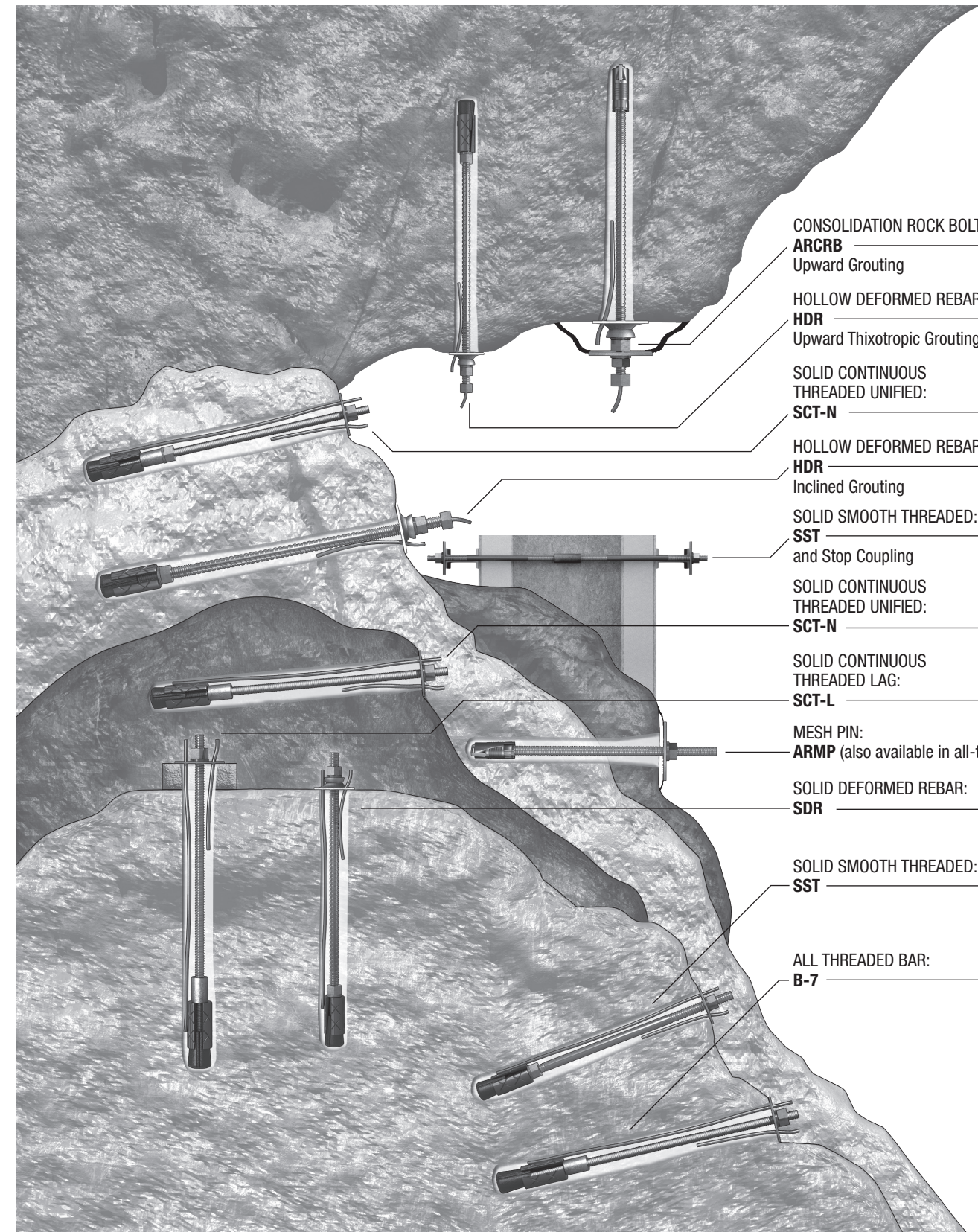
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# MECHANICAL EXPANSION ANCHORS

## Rock Bolt Anchoring Systems



CONSOLIDATION ROCK BOLT:  
**ARCRB**  
Upward Grouting

HOLLOW DEFORMED REBAR:  
**HDR**  
Upward Thixotropic Grouting

SOLID CONTINUOUS  
THREADED UNIFIED:  
**SCT-N**

HOLLOW DEFORMED REBAR:  
**HDR**  
Inclined Grouting

SOLID SMOOTH THREADED:  
**SST**  
and Stop Coupling

SOLID CONTINUOUS  
THREADED UNIFIED:  
**SCT-N**

SOLID CONTINUOUS  
THREADED LAG:  
**SCT-L**

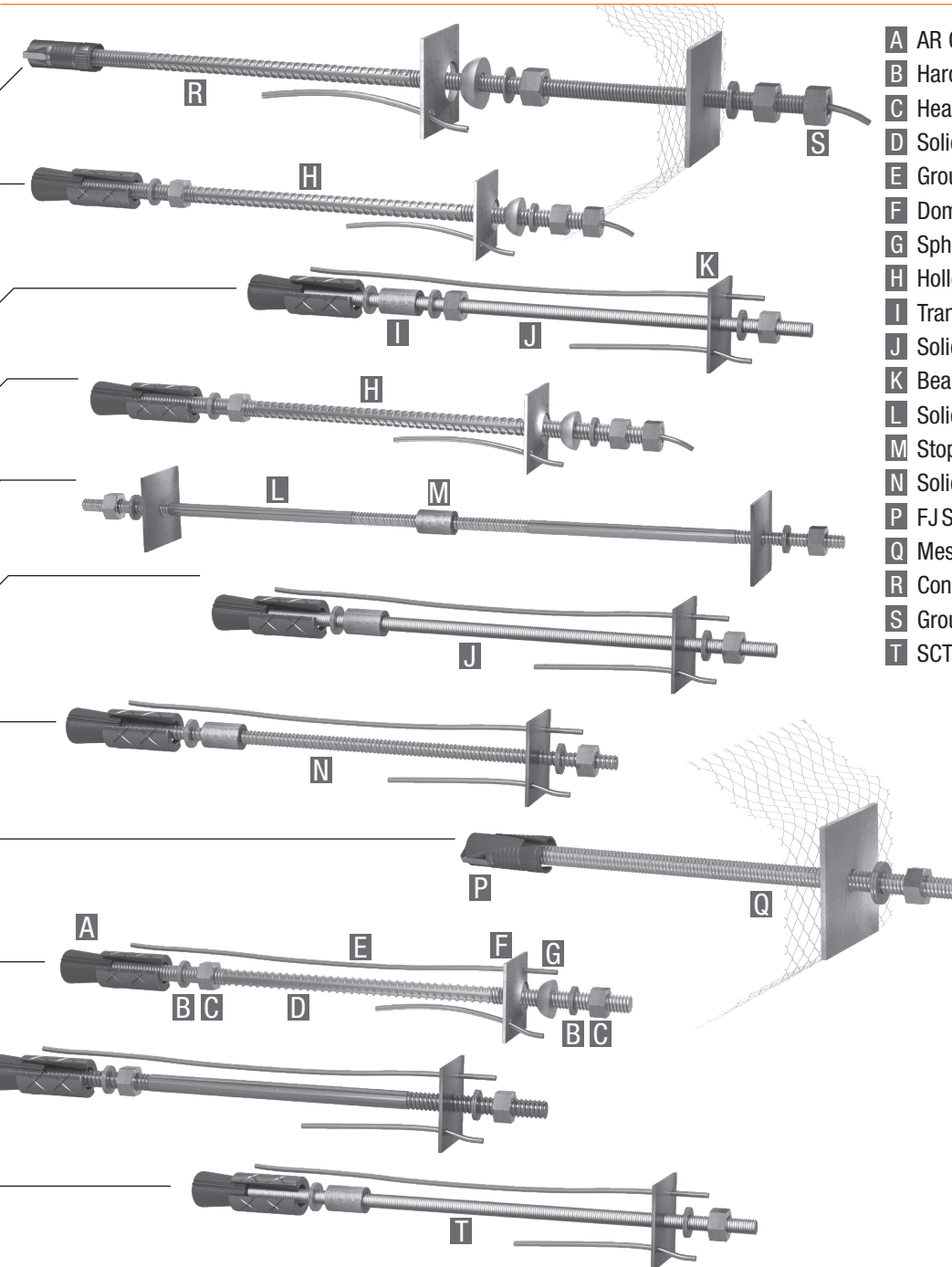
MESH PIN:  
**ARMP** (also available in all-thread)

SOLID DEFORMED REBAR:  
**SDR**

SOLID SMOOTH THREADED:  
**SST**

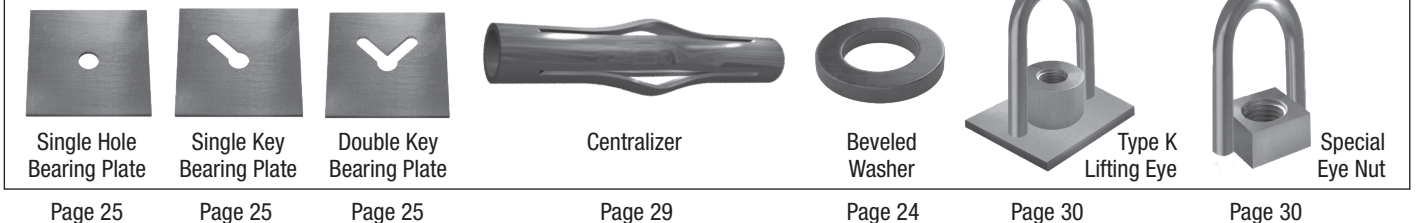
ALL THREADED BAR:  
**B-7**

## Rock Bolt Anchoring Systems



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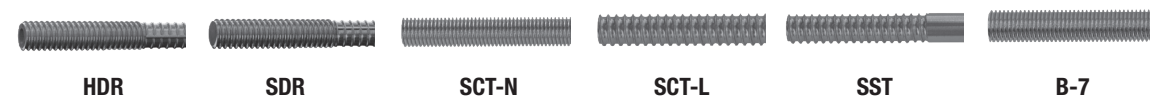
**Additional hardware options.**



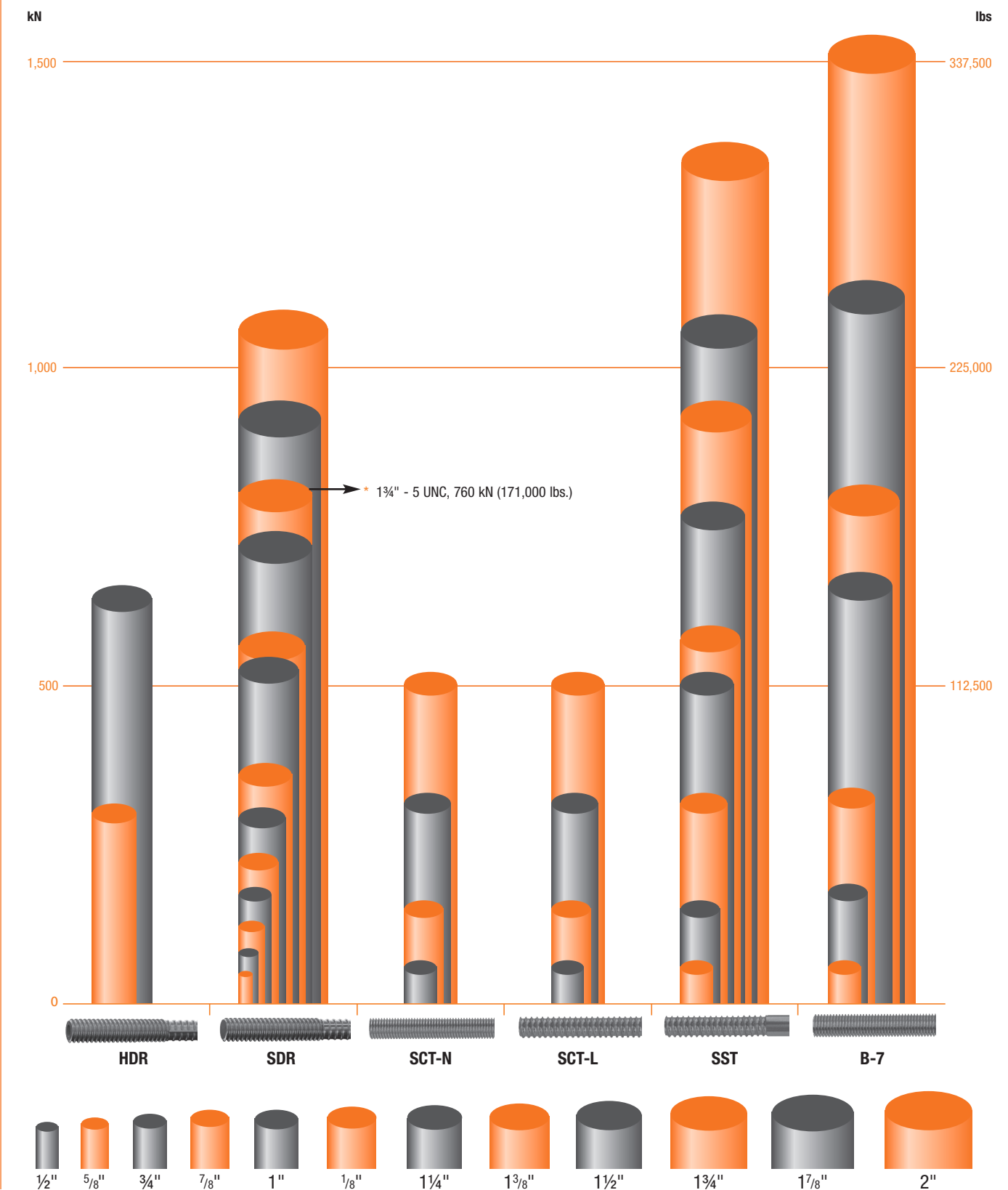
Single Hole Bearing Plate Page 25    Single Key Bearing Plate Page 25    Double Key Bearing Plate Page 25    Centralizer Page 29    Beveled Washer Page 24    Type K Lifting Eye Page 30    Special Eye Nut Page 30

## Rod Size and Ultimate Tensile Strength

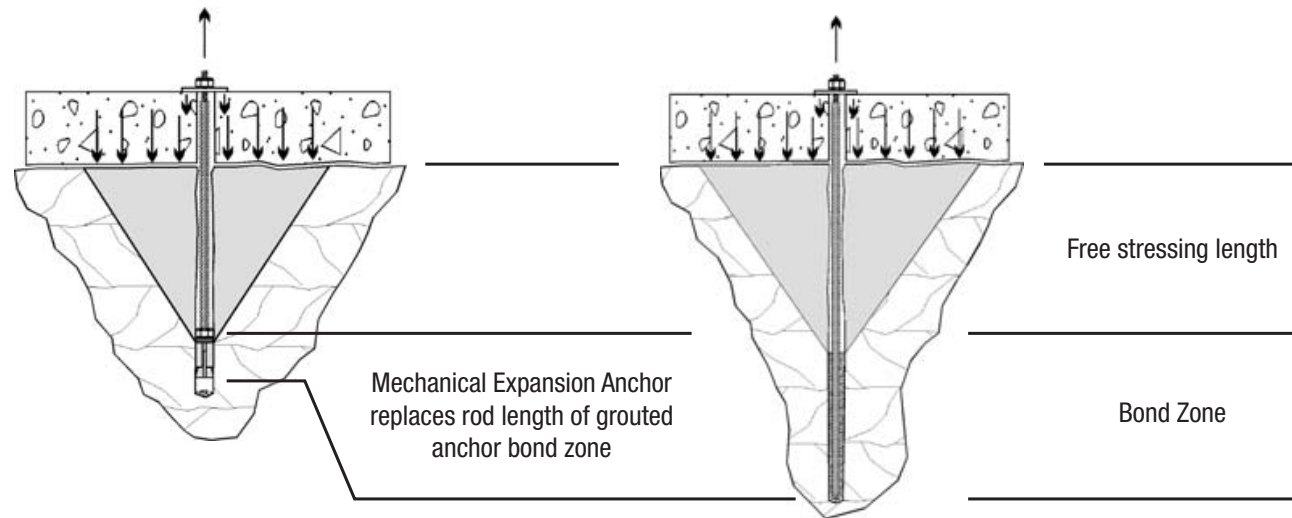
Thread Diameter - TPI	HDR	SDR	SCT-N	SCT-L	SST	B-7
1/2" - 13 UNC		56 kN (12,700 lbs.)	80 kN (18,000 lbs.)	80 kN (18,000 lbs.)	80 kN (18,000 lbs.)	80 kN (18,000 lbs.)
5/8" - 11 UNC		90 kN (20,300 lbs.)				
3/4" - 10 UNC		133 kN	169 kN (38,000 lbs.)	169 kN (38,000 lbs.)	169 kN (38,000 lbs.)	186 kN (42,000 lbs.)
7/8" - 9 UNC		185 kN (41,850 lbs.)				
1" - 8 UN	320 kN (72,000 lbs.)	242 kN (54,500 lbs.)	334 kN (75,000 lbs.)	334 kN (75,000 lbs.)	334 kN (75,000 lbs.)	337 kN (76,000 lbs.)
1 1/8" - 8 UN		314 kN (70,600 lbs.)				
1 1/4" - 8 UN		387 kN (87,200 lbs.)	534 kN (120,000 lbs.)	534 kN (120,000 lbs.)	534 kN (120,000 lbs.)	
1 3/8" - 8 UN	663 kN (149,000 lbs.)	547 kN (123,000 lbs.)			600 kN (135,000 lbs.)	684 kN (154,000 lbs.)
1 1/2" - 8 UN		596 kN (134,000 lbs.)			796 kN (179,000 lbs.)	828 kN (186,500 lbs.)
*1 3/4" - 5 UNC		760 kN (171,000 lbs.)			1,100 kN (249,000 lbs.)	1,155 kN (260,000 lbs.)
1 3/4" - 8 UN		833 kN (216,900 lbs.)				
1 7/8" - 8 UN		964 kN (216,900 lbs.)				
2" - 8 UN		1,109 kN (249,300 lbs.)			1,370 kN (310,000 lbs.)	1,539 kN (346,000 lbs.)



## Rod Size and Ultimate Tensile Strength

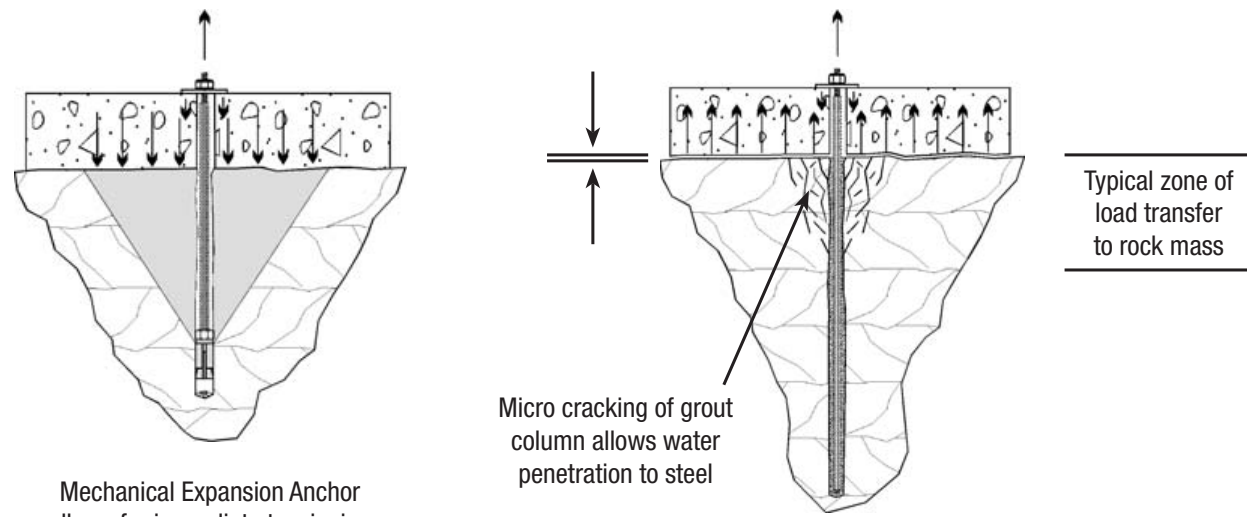


## Mechanical Expansion Anchor Principles



**Prestressed Mechanical Expansion Anchor**

**Prestressed Grouted Anchor**



Mechanical Expansion Anchor allows for immediate tensioning

**Prestressed Rod with Mechanical Expansion Anchor**

**Embedded Dowel**

Micro cracking of grout column allows water penetration to steel

Typical zone of load transfer to rock mass

## Mechanical Expansion Anchor Principles

ROCK CONDITION	GOUGE ZONE CRUSHED/SHATTERED	CONCRETE	RQD 50%	BLOCKY	SOLID/MASSIVE RQD 100%
ROCK QUALITY	Very Poor Rock	Poor Rock	Fair Rock	Good Rock	Very Good Rock
STRENGTH	Very Low Strength	Low Strength	Medium Strength	High Strength	Very High Strength
UNIAXIAL COMPRESSIVE STRENGTH	Less than 25 MPa	25 to 50 MPa	50 to 100 MPa	100 to 200 MPa	Greater than 200 MPa

Acceptable Range of AR Shell Series

The above table indicates acceptable ranges of rock quality for which an engineer should consider using mechanical anchors. Mechanical anchors offer immediate compression between rock and shell anchor and therefore, allow for immediate prestressing. Anchors should be fully grouted for permanent applications. Cement grout protects against bolt corrosion and transfers load to the rock mass or concrete. Mechanical expansion anchors automatically center the bolt at the bottom of drilled hole.

## AR Cone Shell Expansion Anchors

The AR Cone Shell Expansion Anchors are designed to develop the full tensile capacities of the Rod Series offered in this manual. Mechanical anchors are activated immediately. This feature is of major benefit to the installation of prestressed anchors. Saving the time associated with cement grout bonded zone anchorages. The patented AR Cone Shell design has a “Ridge-Groove” system that allows each size anchor to operate to the holding capacity of the high strength rods in the widest possible variety of rock conditions.

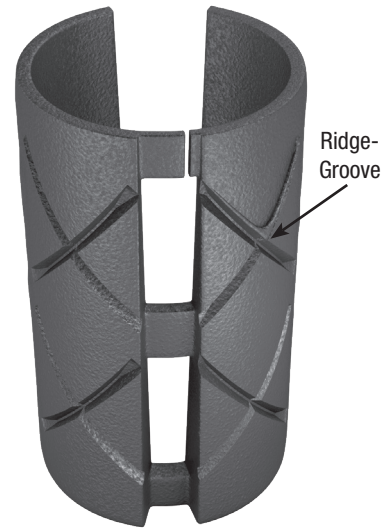
The wide application range is possible due to the combination of a large smooth surface contact area between the shell and drill hole wall as a result of carefully chosen shell length and drill hole diameters and the spacing and orientation of Ridge-Groove system.

Loads are transferred to the rock by putting the rock in compression on the smooth areas of the shell and the ridges are stress raisers to activate the shear strength of the rock. The grooves that follow the ridges allow rock points to be activated in shear without crushing and in the case of extremely hard rock, a place for the ridge metal to translate as full compression between rock and shell is achieved by rotating the anchor rod.

The approximate 45° orientation of ridges allows for both antirotational effect of the shell in the hole when setting the anchor and the vertical holding capacity of the anchor to be maximized.

AR Cones are offered with Channels through the shell which allows for passage of grout past the anchorage contact zone. The Cones are tapped through their entire length to accept the various rods available from AR. The 8UN thread series is used for all rods, couplings and anchors 25 mm (1”) and greater in thread diameter. Rock classification systems are numerous and include some subjective criteria. A relative scale of the acceptable range of use of (AR) Mechanical Expansion Anchors is presented in Table CS1 on page 5.

Always use good engineering practice when designing and installing rockbolts.



AR SHELL



AR CONE  
PATENTED

FEATURES	BENEFITS
Anchors are set from surface by rotation of rod.	Outer threaded end of rod does not change in elevation when setting anchor. Minimal deflection when tensioning.
A tapped cone expands shell against the drill hole wall as the anchor rod is rotated.	Immediate verification of anchor holding capacity without waiting for grouts to cure.
Versatile one-size anchor assembly for each drill hole diameter.	Allows for simplicity of design of rock bolt.
Smooth cylinder shell with 45 degree “Ridge-Groove” shell design.	Greatest shell to rock stress distribution of any mechanical expansion anchor on the market. Ridge-Groove orientation gives anchor an anti-rotation aspect as well as enhanced performance in the vertical direction.

## AR Cone Shell Expansion Anchors

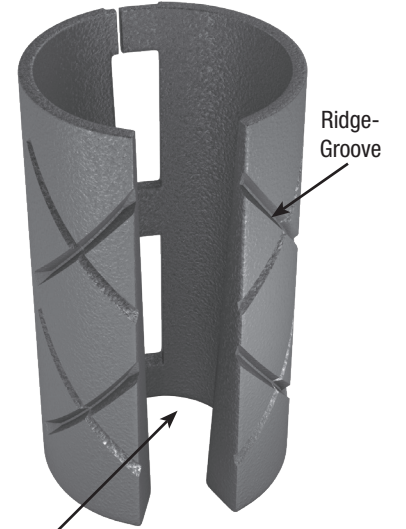
TABLE CS2 CONE & SHELL EXPANSION ANCHORS

Shell Product Number	Cone Product Number	Rod Type	Thread Diameter 8 - TPI	Drill Hole Diameter	Cone Length	Shell Length
AR45	AR4512-L*	SCT-L	½” 6 LAG	45 mm (1¾”)	65 mm (2½”)	76 mm (3”)
	AR4512-N	SDR/SST/SCT-N	½” 13UNC			
	AR-4516-N	SDR	5/8” 11UNC			
	AR4520-L*	SCT-L	¾” 4.5 LAG			
	AR4520-N	SDR/SST/SCT-N	¾” 10UNC			
	AR4522-N	SDR	7/8” 9UNC			
AR50	AR5025	HDR/SDR/SST/SCT-N-SA	1” 8UN	51 mm (2”)	70 mm (2¾”)	90 mm (3½”)
	AR5029	SDR	1 1/8” 8UN			
AR55	AR5525-N	HDR/SDR/SST/SCT-N	1” 8UN	57 mm (2¼”)	70 mm (2¾”)	90 mm (3½”)
	AR5529-N	SDR	1 1/8” 8UN			
AR65	AR6525-L*	SCT-L	1” 3.5 LAG	65 mm (2½”)	90 mm (3½”)	100 mm (4”)
	AR6525-N	HDR/SDR/SST/SCT-N	1” 8UN			
	AR6529-N	SDR	1 1/8” 8UN			
	AR6532-L*	SCT-L	1¼” 3.5 LAG			
	AR6532-N	SDR/SST/SCT-N	1¼” 8UN			
	AR6535-N	HDR/SDR/SST	1 3/8” 8UN			
AR76	AR7635-N	HDR/SDR/SST	1 3/8” 8UN	76 mm (3”)	100 mm (4”)	130 mm (5”)
	AR7638-N	SDR/SST	1½” 8UN			
	AR7645-N	SDR	1¾” 5UN			
AR90	AR9045-N	SST	1¾” 8UN	90 mm (3½”)	130 mm (5”)	150 mm (6”)
	AR9048-N	SDR	1 7/8” 8UN			
	AR9050-N	HDR/SDR/SST	2” 8UN			

\*Hole diameters of the cone-shell anchors shown permit the use of stop couplings with grout tubes in the SDR, SST, SCT-L and SCT-N series. Finished drilled hole diameters vary depending on rock type, quality and method of drilling employed.

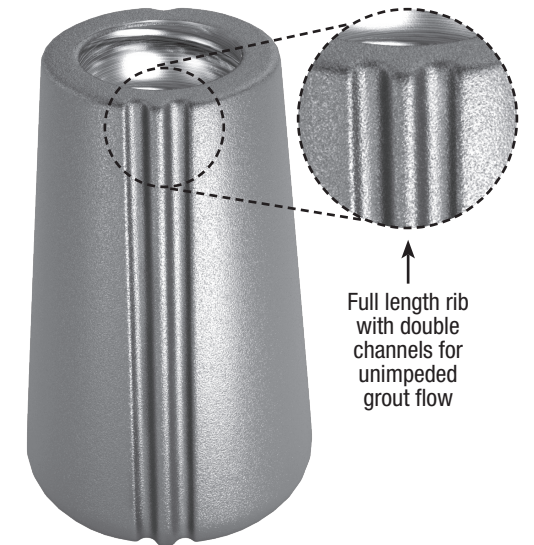
\*\*Couplings cannot be used with the modified cone shell anchor AR4525-M due to the hole diameter.

NOTE: All thread products require a stud adaptor with anchor assembly.



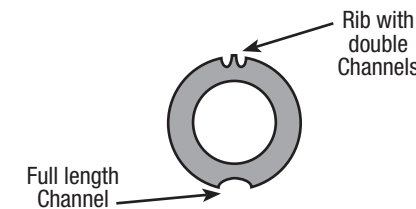
Full length Slot to fit Rib and allow uninterrupted grout flow (note “Rib-Groove” texture circumvents Shell)

AR SHELL Slot Side

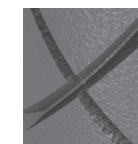


Full length rib with double channels for unimpeded grout flow

AR CONE Rib Side



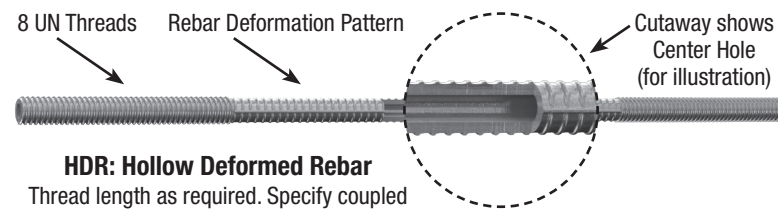
AR CONE Top View



Ridges and Grooves on Shell Contact Surface

## Hollow Deformed Rebar (HDR)

Originally developed by engineers working on the Snowy Mountain Hydro Electric project in Australia for permanent corrosion protected rock anchors. Hollow core steel guarantees an uninterrupted passage for grout from the surface to the distal end of the drill hole. May be used for supplying or returning grout as orientation dictates. Portland cement based grouts provide a pH environment which renders the steel rod protected from the corrosive effects of oxidation. The process of pumping fluid cement grout with a hollow core rod will provide complete encapsulation of the steel in the drill hole as well as consolidating cracks and fissures of the rock strata. Major benefits are obtained when producing long bolts or in poor ground conditions with heavily fractured zones and water infiltration problems.



**HDR: Hollow Deformed Rebar**  
Thread length as required. Specify coupled lengths if bolt greater than 6.2m (20 ft)



**HDR-25 Shipping Assembly**  
Complete with an AR6525 coneshell anchor



**HDR Site Assembly**  
Ready for insertion into drilled hole

AR High Strength ASTM-A615  
NOTE: To activate AR Mechanical Expansion Anchors apply steady torque (not impact) until anchor rod stops rotating or maximum allowable applied torque value is reached. Fully support hex nut, do not cause bending. DO NOT exceed maximum allowable applied torque. Torsional shear failure at root of threads may occur. Recommended minimum Safe Working (Design) Load is 2 to 1 against ultimate.

TABLE CS3 HDR TECHNICAL INFORMATION

PRODUCT NUMBER	HDR BAR DIAMETER	THREAD DIAMETER - TPI	EFFECTIVE TENSILE STRESS AREA	MAX. WORKING LOAD TO YIELD	ULTIMATE TENSILE STRENGTH	MECHANICAL ANCHOR ASSEMBLY	DRILL HOLE DIAMETER	RECOMMENDED ALLOWABLE APPLIED TORQUE*
HDR25	25 mm	(1" - 8UN)	339 sq. mm (0.526 sq. in.)	200 kN (52,600 lbs)	320 kN (72,000 lbs)	AR4525-M**	45 mm (1 3/4")	675 Nm (500 ft-lbs)
						AR5025-N	51 mm (2")	
						AR6525-N	65 mm (2 1/2")	
HDR35	35 mm (1 3/8")	(1 3/8" - 8UN)	702 sq. mm (1.089 sq. in.)	484 kN (108,900 lbs)	663 kN (149,000 lbs)	AR5535-N	57 mm (2 1/4")	2,000 Nm (1,500 ft-lbs)
						AR6535-N	65 mm (2 1/2")	
						AR7635-N	76 mm (3")	

NOTE: HDR bolts are made from high strength steel alloy with a minimum elongation of 15% in a 2 inch gauge length. Good engineering practice must be utilized so that the nut is fully supported by the base plate and bending is not induced at the root of the threads.

\*\* Couplings cannot be used with the modified cone shell anchor AR4525-M due to the hole diameter

## Hollow Deformed Rebar (HDR)

### Applications

Hollow Deformed Reinforcing Bars allow positive grouting to distal end of drill hole through difficult conditions such as fracture zones and over long lengths. This produces a permanent corrosion protected anchor.

### Vertical Downward

For vertically downward orientations expansive cement grout is pumped to bottom of drill hole and fully encapsulates rebar while consolidation grouting of strata takes place.

### Inclined Horizontal

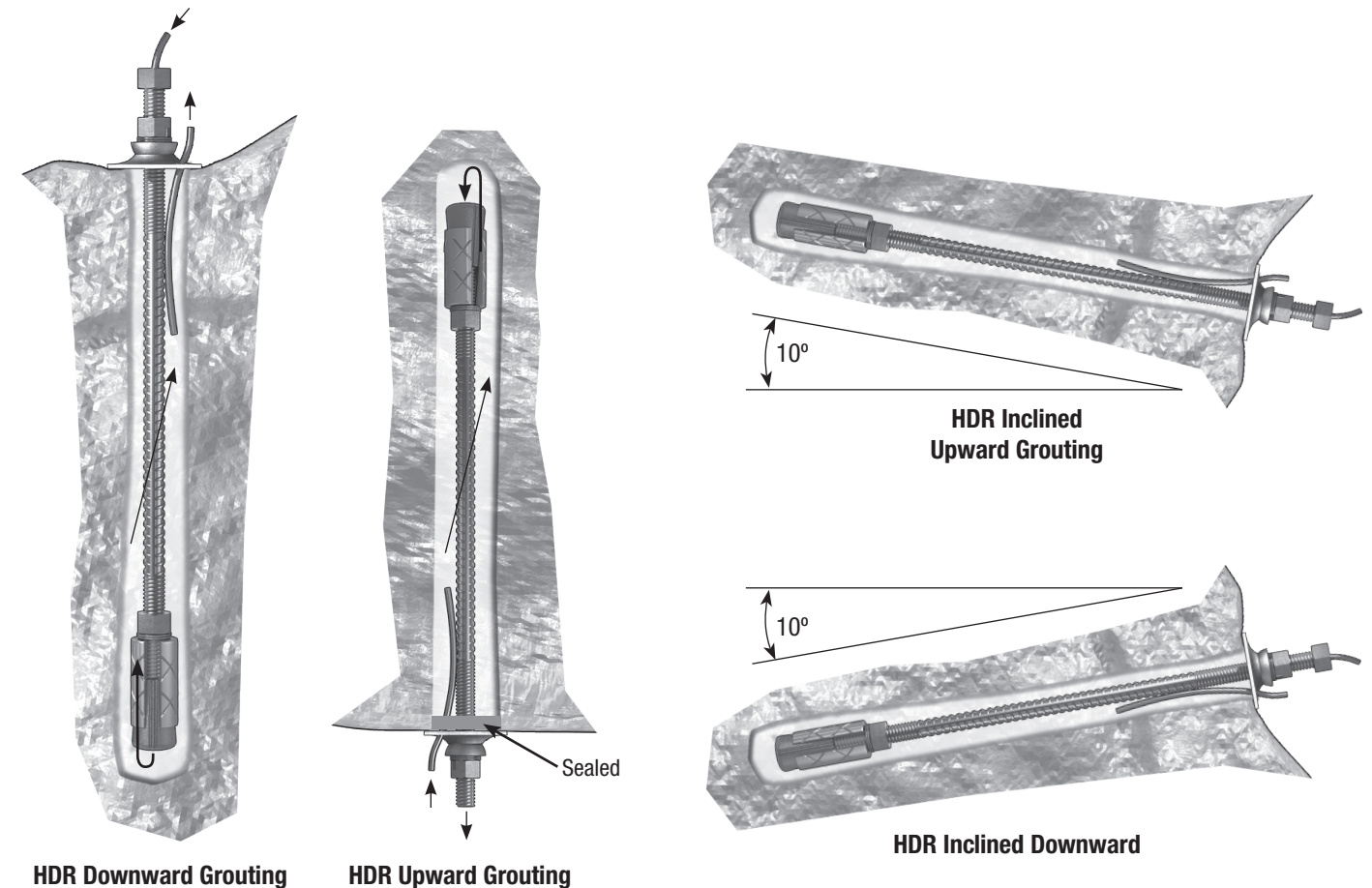
Horizontal applications inclined by 10° either up or down to facilitate grout pumping. Pump grout according to whether inclined up or down in accordance with up or down grouting procedures.

### Vertical Upward

Fluid grouts can be pumped in the annular space around bolt.

### Thixotropic Grouting

Thixotropic grouts can be pumped through the hollow core of the bolt and return through vent. Neat expansive cement grouts of a 0.3 to 1 water/cement ratio can be pumped. Pumping is performed with thixotropic grout pump-mixers available from AR.



HDR Downward Grouting

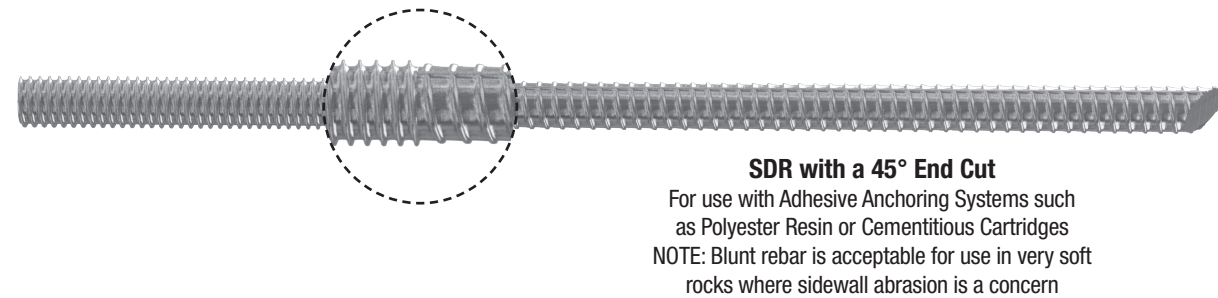
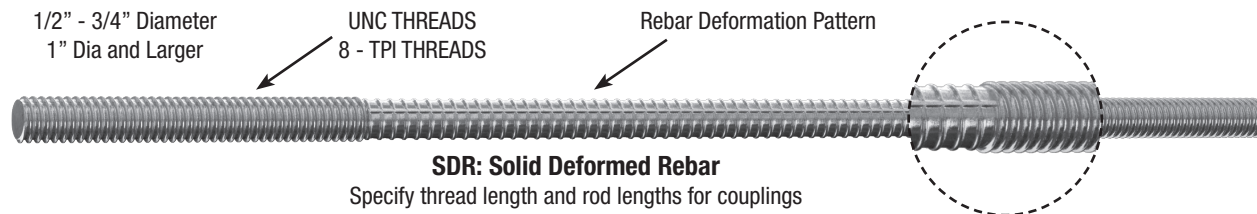
HDR Upward Grouting

HDR Inclined Downward

HDR Inclined Upward Grouting

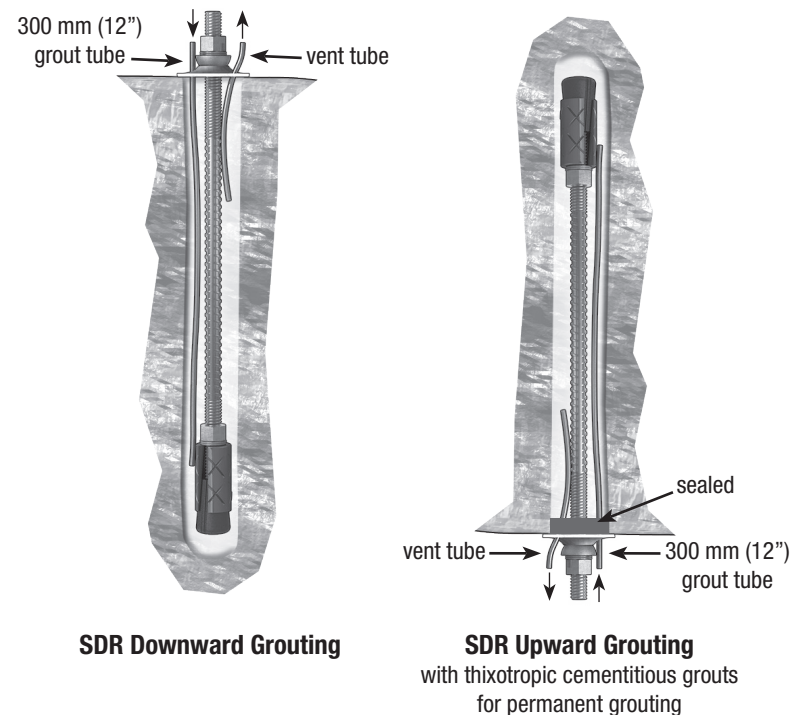
## Solid Deformed Rebar (SDR)

Made from reinforcing that meets CSA standard G30.18 M-92 and ASTM 615. An economical, medium strength rod used for tie downs, and rock reinforcement. Use AR Expansion cone shell anchor series for blind hole and prestressed rebar anchor applications. Use 2 tubes for complete grouting. One tube pumps grout to the back of the borehole and the other acts as a vent. The grouting tube is affixed to the rod to a point just above the anchor and the vent tube just passes through the plate to the drilled hole.



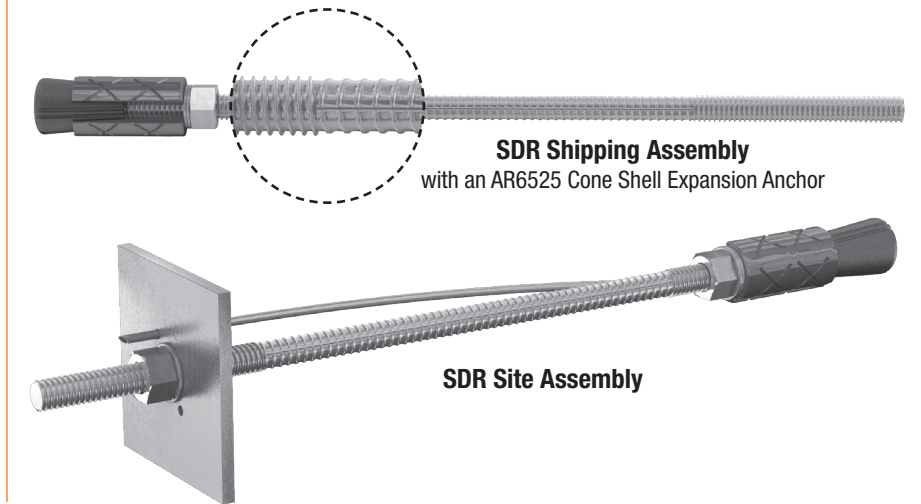
## SOLID DEFORMED REBAR (SDR) APPLICATIONS

Two tubes are utilized when pumping fluid cementitious grouts in vertically downward or near horizontal orientations. Pumping vertically upwards is best achieved by using a hollow deformed rebar. Thixotropic grouts may be used by pumping through a tube to the back of the drill hole.



## Solid Deformed Rebar (SDR)

NOTE: To activate AR Mechanical Expansion Anchors apply steady torque (not impact) until anchor rod stops rotating or maximum allowable applied torque value is reached. Anchor rods can be hot dipped galvanized, full length or partial. DO NOT EXCEED MAXIMUM ALLOWABLE APPLIED TORQUE. TORSIONAL SHEAR FAILURE AT ROOT OF THREADS MAY OCCUR. Recommended minimum Safe Working (Design) Load is 2 to 1 against ultimate.



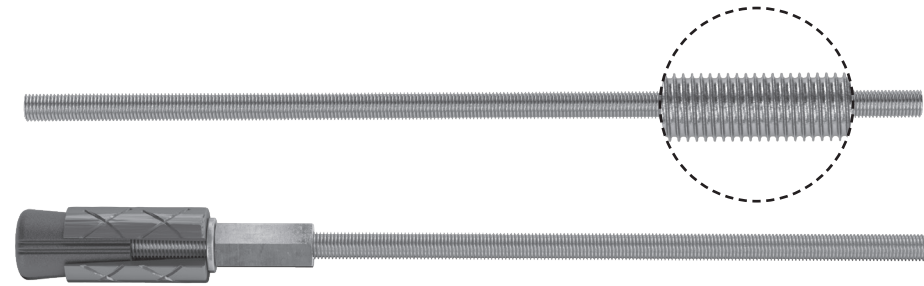
PRODUCT NUMBER	SDR BAR SIZE	THREAD DIAMETER - TPI	EFFECTIVE TENSILE STRESS AREA	GRADE 400 MPa		MECHANICAL ANCHOR ASSEMBLY	DRILL HOLE DIAMETER	RECOMMENDED ALLOWABLE APPLIED TORQUE*
				MAX. WORKING LOAD TO YIELD	ULTIMATE TENSILE STRENGTH			
SDR-12	15M	1/2" - 13UNC	92 sq. mm (0.1419 sq. in.)	36 kN (8,200 lbs)	56 kN (12,700 lbs)	AR4512-N	45 mm (1 3/4")	70 Nm (50 ft-lbs)
SDR-16	15M	5/8" - 11UNC	145 sq. mm (0.226 sq. in.)	60 kN (13,500 lbs)	90 kN (20,300 lbs)	AR4516-N	45 mm (1 3/4")	110 Nm (80 ft-lbs)
SDR-20	20M	3/4" - 10UNC	215 sq. mm (0.334 sq. in.)	86 kN (19,400 lbs)	133 kN (30,000 lbs)	AR4520-N	45 mm (1 3/4")	230 Nm (170 ft-lbs)
SDR-22	25M	7/8" - 9UNC	297 sq. mm (0.462 sq. in.)	123 kN (27,700 lbs)	185 kN (41,580 lbs)	AR4522-N	45 mm (1 3/4")	360 Nm (265 ft-lbs)
SDR-25	25M	1" - 8UN	391 sq. mm (0.606 sq. in.)	156 kN (35,200 lbs)	242 kN (54,500 lbs)	AR4525-M*	45 mm (1 3/4")	550 Nm (400 ft-lbs)
						AR5025-N	51 mm (2")	
						AR5525-N	57 mm (2 1/4")	
						AR6525-N	65 mm (2 1/2")	
SDR-29	30M	1 1/8" - 8UN	512 sq. mm	203 kN	314 kN	AR5029-N	57 mm (2 1/4")	825 Nm (600 ft-lbs)
						AR6529-N	65 mm (2 1/2")	
SDR-32	35M	1 1/8" - 8UN	645 sq. mm (1.000 sq. in.)	203 kN (58,100 lbs.)	387 kN (87,200 lbs)	AR5529-N	57 mm (2 1/4")	1,015 Nm (750 ft-lbs)
						AR6532-N	65 mm (2 1/2")	
SDR-35	35M	1 3/8" - 8UN	796 sq. mm (1.233 sq. in.)	325 kN (73,000 lbs)	493 kN (110,000 lbs)	AR5535-N	57 mm (2 1/4")	1,100 Nm (800 ft-lbs)
						AR6535-N	65 mm (2 1/2")	
						AR7635-N	76 mm (3")	
SDR-38	45M	1 1/2" - 8UN	963 sq. mm (1.492 sq. in.)	395 kN (89,000 lbs)	596 kN (134,000 lbs)	AR7638-N	76 mm (3")	1,650 Nm (1,200 ft-lbs)
						AR7645-N	90 mm (3 1/2")	
SDR-45	45M	1 3/4" - 5UN	1225 sq. mm (1.900 sq. in.)	501 kN (112,800 lbs)	760 kN (171,000 lbs)	AR7645-N	90 mm (3 1/2")	2,000 Nm (1,500 ft-lbs)
	55M	1 3/4" - 8UN	1342 sq. mm (2.080 sq. in.)	536 kN (120,600 lbs)	833 kN (187,200 lbs)	AR9045-N	90 mm (3 1/2")	
SDR-48	55M	1 7/8" - 8UN	1555 sq. mm (2.410 sq. in.)	643 kN (144,600 lbs)	964 kN (216,900 lbs)	AR9048-N	90 mm (3 1/2")	3,300 Nm (2,450 ft-lbs)
SDR-55	55M	2" - 8UN	1787 sq. mm (2.770 sq. in.)	716 kN (160,900 lbs)	1,109 kN (249,300 lbs)	AR9050-N	90 mm (3 1/2")	4,000 Nm (3,000 ft-lbs)

\* Couplings cannot be used with the modified Cone Shell AR4525-M, AR5025-N due to the hole diameter.



## Solid Continuous Threaded Unified (SCT-N)

Available in 8-UN thread forms for thread sizes 25mm (1") and over. UNC thread forms for thread sizes less than 25 mm (1"). Material is a ductile carbon steel. SCT-N utilizes both the AR and bail mechanical expansion anchors. May also be used in bail anchor applications. Suitable for field cutting to any length.



**SCT-N Shipping Assembly**  
with an AR Cone Shell.

PRODUCT NUMBER	SDR BAR SIZE	THREAD DIAMETER - TPI	EFFECTIVE TENSILE STRESS AREA	MAX. WORKING LOAD TO YIELD	ULTIMATE TENSILE STRENGTH	MECHANICAL ANCHOR ASSEMBLY	DRILL HOLE DIAMETER	RECOMMENDED ALLOWABLE APPLIED TORQUE*
SCT-N-12	15 mm (1/2")	1/2" - 13UNC	92 sq. mm (0.1419 sq. in.)	57 kN (13,200 lbs.)	80 kN (18,000 lbs)	AR4512-N-SA	45 mm (1 3/4")	95 Nm (70 ft-lbs)
SCT-N-20	19 mm (3/4")	3/4" - 10UNC	215 sq. mm (0.334 sq. in.)	133 kN (30,000 lbs.)	169 kN (38,000 lbs)	AR4520-N-SA	45 mm (1 3/4")	340 Nm (250 ft-lbs)
SCT-N-25	25 mm (1")	1" - 8UN	391 sq. mm (0.606 sq. in.)	266 kN (60,000 lbs.)	334 kN (75,000 lbs)	AR5025-N	45 mm (1 3/4")	810 Nm (600 ft-lbs)
						AR5525-N-SA	57 mm (2 1/4")	
						AR6525-N-SA	65 mm (2 1/2")	
SCT-N-32	32 mm (1 1/4")	1 1/4" - 8UN	645 sq. mm (1.000 sq. in.)	203 kN (90,000 lbs.)	534 kN (120,000 lbs)	AR5532-N	57 mm (2 1/4")	1,625 Nm (1,200 ft-lbs)
						AR6529-N	65 mm (2 1/2")	

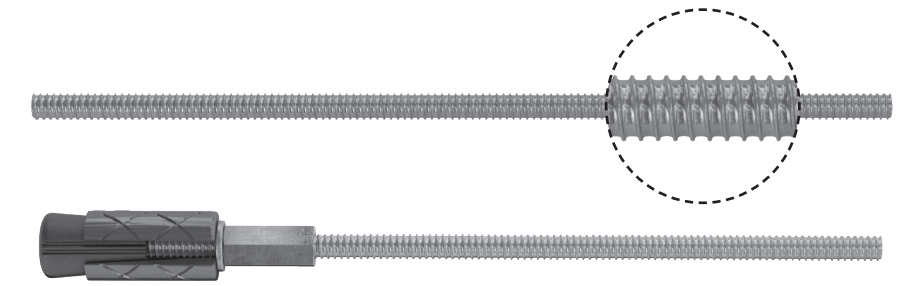
Electro plated or hot dipped galvanized available.

\*Consult AR for mechanical anchor assembly requirements.

NOTE: To activate AR Mechanical Expansion Anchors apply steady torque (not impact) until maximum allowable applied torque value is reached. DO NOT EXCEED MAXIMUM ALLOWABLE APPLIED TORQUE. TORSIONAL SHEAR FAILURE AT ROOT OF THREADS MAY OCCUR. Recommended minimum Safe Working (Design) Load is 2 to 1 against ultimate.

## Solid Continuous Threaded Lag (SCT-L)

Lag stud bolts of the same carbon steel as the SCT and SST series SCT-L Shipping Assembly with AR cone shell anchor Ready for protective storage sleeve utilizes both AR and bail mechanical expansion anchor series. Also used in through bolting applications without mechanical anchors. Suitable for field cutting to any length. The lag stud thread form is typically used with concrete forming hardware. Use AR mechanical cone shell anchors to provide maximum holding power with minimum rod deflection.



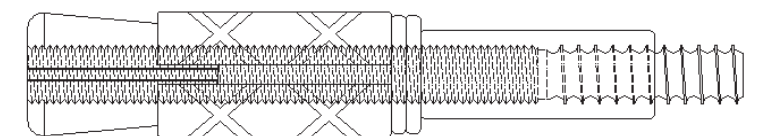
**SCT-L Shipping Assembly**  
with AR cone shell anchor  
Ready for protective storage sleeve

PRODUCT NUMBER	SDR BAR SIZE	THREAD DIAMETER - TPI	EFFECTIVE TENSILE STRESS AREA	MAX. WORKING LOAD TO YIELD	ULTIMATE TENSILE STRENGTH	MECHANICAL ANCHOR ASSEMBLY	DRILL HOLE DIAMETER	RECOMMENDED ALLOWABLE APPLIED TORQUE*
SCT-L-12	13 mm (1/2")	1/2" - 6 LAG	90 sq. mm (0.139 sq. in.)	57 kN (13,000 lbs)	80 kN (18,000 lbs)	AR4512-L-SA	45 mm (1 3/4")	95 Nm (70 ft-lbs)
SCT-L-20	19 mm (3/4")	3/4" - 4.5 LAG	198 sq. mm (0.307 sq. in.)	133 kN (30,000 lbs)	169 kN (38,000 lbs)	AR4520-L-SA	45 mm (1 3/4")	340 Nm (250 ft-lbs)
SCT-L-25	25 mm (1")	1" - 3.5 LAG	349 sq. mm (0.541 sq. in.)	266 kN (60,000 lbs)	334 kN (75,000 lbs)	AR5023-L-SA	45 mm (1 3/4")	810 Nm (600 ft-lbs)
						AR5525-L-SA	57 mm (2 1/4")	
						AR6525-L-SA	65 mm (2 1/2")	
SCT-L-32	32 mm (1 1/4")	1 1/4" - 3.5 LAG	591 sq. mm (0.916 sq. in.)	400 kN (90,000 lbs)	534 kN (90,000 lbs)	AR5532-L-SA	57 mm (2 1/4")	1,625 Nm (1,200 ft-lbs)
						AR6529-N	65 mm (2 1/2")	

NOTE: To activate AR Mechanical Expansion Anchors apply steady torque (not impact) until maximum allowable applied torque value is reached. DO NOT EXCEED MAXIMUM ALLOWABLE APPLIED TORQUE. TORSIONAL SHEAR FAILURE AT ROOT OF THREADS MAY OCCUR. Recommended minimum Safe Working (Design) Load is 2 to 1 against ultimate.

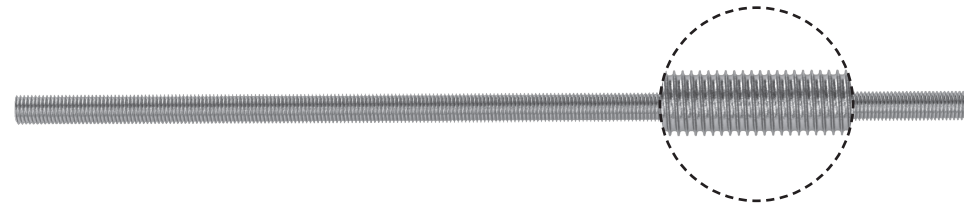
## AR Anchor with Stud Assembly for SCT-L ROD Series

The AR Anchor with Stud Assembly comes with a transition coupler to provide the AR mechanical cone shell anchors the ability to be used with all thread rods such as lagstud, a coil or rope thread, SCT-N, SST, B7 for single sided forming or rock bolting applications.



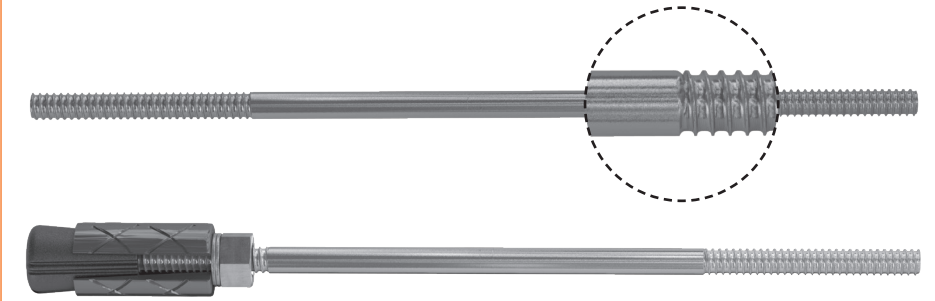
## SCT-N-B7 All Thread Bar

AR SCT-N-B7 All Thread Bar products are manufactured from heat treated alloy steel in conformance to ASTM A193 using a roll thread process. The AR SCT-N-B7 products are commonly used in high pressure and extreme service requirements are a consideration in cold temperature. AR SCT-N-B7 all thread products can be supplied with a AR Anchor using a stud assembly or Bail Anchor.



## Solid Smooth Threaded (SST)

For High Strength (structural) bolting applications. Solid Smooth Cold Drawn high tensile carbon steel for assurance of quality. Cold Rolled threaded with the 8UN thread series for sizes 25 mm (1") & greater originally developed for high pressure bolting installations. Standard UNC thread series for sizes less than 25 mm (1"). Suitable for use with AR mechanical expansion anchors for prestressed and blind hole bolting applications. Also available in all diameters of specified rods with thread lengths at each end for tiethrough applications.



**SST Shipping Assembly**  
with AR Cone Shell anchor ready  
for protective storage sleeve

### Mechanical Properties of ASTM A193 B7

#### STRAIN GAUGE LOAD CELLS STANDARD DIMENSIONS

Diameter	Tensile (Psi)	Yield (Psi)	Elongation	Reduction	Hardness
Up to 63 mm (2½")	125,000	105,000	16	50	35 HRC max.
63 mm (2½") to 100 mm (4")	115,000	95,000	16	50	33 HRC max.

### Mechanical Properties of ASTM A193 B7

PRODUCT NUMBER	SCT-N-B7 DIAMETER	THREAD DIAMETER - TPI	EFFECTIVE TENSILE STRESS AREA	MAX. WORKING LOAD TO YIELD	ULTIMATE TENSILE STRENGTH	MECHANICAL ANCHOR ASSEMBLY	DRILL HOLE DIAMETER	RECOMMENDED ALLOWABLE APPLIED TORQUE*
SCT-N-B7-12	13 mm (½")	13 UNC	92 sq. mm (0.1419 sq. in.)	66.6 kN (15,000 lbs)	80 kN (18,000 lbs)	AR4512-N-SA	45 mm (1¾")	95 Nm (70 ft-lbs)
SCT-N-B7-20	20 mm (¾")	10 UNC	215 sq. mm (0.334 sq. in.)	160 kN (36,000 lbs)	169 kN (42,000 lbs)	AR4520-N-SA	45 mm (1¾")	340 Nm (250 ft-lbs)
SCT-N-B7-25	25 mm (1")	8 UN	391 sq. mm (0.606 sq. in.)	285 kN (64,000 lbs)	337 kN (76,000 lbs)	AR4525-M-SA	65 mm (1¾")	810 Nm (600 ft-lbs)
						AR5025-N-SA		
						AR5525-N-SA	57 mm (2¼")	
						AR6525-N-SA	65 mm (2½")	
SCT-N-B7-32	32 mm (1¼")	8 UN	645 sq. mm (1.000 sq. in.)	467 kN (105,000 lbs)	556 kN (125,000 lbs)	AR6532-N-SA	65 mm (2½")	1,625 Nm (1,200 ft-lbs)
SCT-N-B7 - 35	35 mm (1 3/8")	8 UN	796 sq mm (1.233 sq. in.)	573 kN (129,000 lbs)	684 kN (154,000 lbs)	AR6535-N-SA	57 mm (2¼")	2,170 Nm (1,600 ft-lbs)
						AR7635-N-SA	76 mm (3")	
SCT-N-B7-38	38 mm (1½")	8 UN	963 sq. mm (1.492 sq. in.)	695 kN (156,660 lbs)	828 kN (186,500 lbs)	AR7638-N-SA	76 mm (3")	2,700 Nm (2,000 ft-lbs)
SCT-N-B7-45	45 mm (1¾")	8 UN	1,342 sq. mm (2.080 sq. in.)	970 kN (218,400 lbs)	1,155 kN (260,000 lbs)	AR9045-N-SA	90 mm (3½")	4,067 Nm (3,000 ft-lbs)
SCT-N-B7 - 50	50 mm (2")	8 UN	1,787 sq. mm (2.770 sq. in.)	1,293 kN (290,850 lbs)	1,539 kN (346,000 lbs)	AR9050-N-SA	90 mm (3½")	6,100 Nm (4,500 ft-lbs)

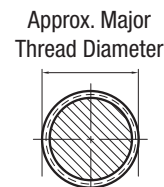
### TABLE CS7 SST TECHNICAL INFORMATION

PRODUCT NUMBER	SST ROD DIAMETER	THREAD DIAMETER - TPI	EFFECTIVE TENSILE STRESS AREA	MAX. WORKING LOAD TO YIELD	ULTIMATE TENSILE STRENGTH	MECHANICAL ANCHOR ASSEMBLY	DRILL HOLE DIAMETER	RECOMMENDED ALLOWABLE APPLIED TORQUE
SST-12	11 mm (7/16")	½" - 13 UNC	92 sq. mm (0.1419 sq. in.)	57 kN (13,000 lbs)	80 kN (18,000 lbs)	AR4512-N	45 mm (1¾")	95 Nm (70 ft-lbs)
SST-20	18 mm (11/16")	¾" - 10 UNC	215 sq. mm (0.334 sq. in.)	133 kN (30,000 lbs)	169 kN (38,000 lbs)	AR4520-N	45 mm (1¾")	340 Nm (250 ft-lbs)
SST-25	24 mm (15/16")	1" - 8 UN	391 sq. mm (0.606 sq. in.)	266 kN (60,000 lbs)	334 kN (75,000 lbs)	AR4525-M	65 mm (1¾")	810 Nm (600 ft-lbs)
						AR5025-N		
						AR5525-N	57 mm (2¼")	
						AR6525-N	65 mm (2½")	
SST-32	30 mm (1 3/16")	1¼" - 8 UN	645 sq. mm (1.000 sq. in.)	400 kN (90,000 lbs)	534 kN (120,000 lbs)	AR5532-N	57 mm (2¼")	1,625 Nm (1,200 ft-lbs)
						AR6532-N	65 mm (2½")	
SST-35	33 mm (1 5/16")	1 3/8" - 8 UN	796 sq mm (1.233 sq. in.)	489 kN (110,000 lbs)	600 kN (135,000 lbs)	AR5535-N	65 mm (2½")	2,170 Nm (1,600 ft-lbs)
						AR6535-N	57 mm (2¼")	
						AR7635-N	76 mm (3")	
SST-38	37 mm (1 7/16")	1½" - 8 UN	963 sq. mm (1.492 sq. in.)	596 kN (134,000 lbs)	796 kN (179,000 lbs)	AR7638-N	76 mm (3")	2,700 Nm (2,000 ft-lbs)
SST-45	43 mm (1 11/16")	1¾" - 8 UN	1,342 sq. mm (2.080 sq. in.)	830 kN (187,000 lbs)	1,100 kN (249,000 lbs)	AR9045-N	90 mm (3½")	4,067 Nm (3,000 ft-lbs)
SST-50	49 mm (1 15/16")	2" - 8 UN	1,787 sq. mm (2.770 sq. in.)	1,150 kN (260,000 lbs)	1,370 kN (310,000 lbs)	AR9050-N	90 mm (3½")	6,100 Nm (4,500 ft-lbs)

NOTE: To activate AR Mechanical Expansion Anchors apply steady torque (not impact) until maximum allowable applied torque value is reached. DO NOT EXCEED MAXIMUM ALLOWABLE APPLIED TORQUE. TORSIONAL SHEAR FAILURE AT ROOT OF THREADS MAY OCCUR. Recommended minimum Safe Working (Design) Load is 2 to 1 against ultimate.

## All Thread Bar

AR All Thread Bars conform to ASTM A722 and ACI 318. The deformation complies with ASTM A615. All Thread Bars are available in grade 60, 75, 95 and 150 to satisfy requirements for tyback, reinforcing connections and rock bolting. All Thread Bars can be supplied as plain, hot dipped galvanized or epoxy coated. Consult the AR Technical Department for available bar diameters.



**Cold Rolled Threaded Bar – Grade 75 – ASTM A 615**

Bar Designation	Nominal Diameter in (mm)	Min. Net Area Thru Threads / in <sup>2</sup> (mm <sup>2</sup> )	Min. Ultimate Strength / kips (kN)	Min. Yield Strength kips (kN)	Nominal Weight lbs/ft (kg/m)	Approx. Major Thread Diameter / in (mm)	Thread Orientation	Max. Length ft (m)
#8	1 (25)	0.790 (510.0)	79 (351.4)	59.3 (263.8)	2.70 (4.0)	1 1/8 (28.5)	Left Hand	60 (18.3)
#9	1 1/8 (28)	1.000 (645.0)	100 (444.8)	75 (333.6)	3.40 (5.1)	1 1/4 (32.0)	Left Hand	60 (18.3)
#10	1 1/4 (32)	1.270 (819.0)	127 (564.9)	95.3 (423.9)	4.30 (6.4)	1 3/8 (35.0)	Left Hand	60 (18.3)
#11	1 3/8 (35)	1.560 (1006.0)	156 (694.0)	117 (520.5)	5.30 (7.9)	1 1/2 (38.1)	Left Hand	60 (18.3)
#14	1 3/4 (45)	2.250 (1452.0)	225 (1000.9)	168.7 (750.4)	7.65 (11.4)	1 7/8 (47.6)	Right Hand	60 (18.3)
#18	2 1/4 (55)	4.000 (2581.0)	400 (1779.4)	300 (1334.5)	13.60 (20.2)	2 2/3 (70.0)	Right Hand	60 (18.3)
#20	2 1/2 (64)	4.910 (3168.0)	491 (2184.0)	368 (1637.0)	16.69 (24.8)	2 3/4 (70.0)	Right Hand	60 (18.3)
#24	3 (76)	7.070 (4417.0)	707 (3142.0)	530 (2356.0)	24.10 (35.9)	3 1/4 (82.6)	Right Hand	60 (18.3)
#28	3 1/2 (89)	9.610 (6200.0)	960 (4274.0)	720 (3206.0)	32.70 (48.7)	3 3/4 (95.3)	Right Hand	60 (18.3)

Cold rolled threaded bars to conform to the physical and chemical requirements of ASTM A 615 Grade 75 ksi  
“Standard Specification for Deformed Carbon Steel Bars for Concrete Reinforcement”



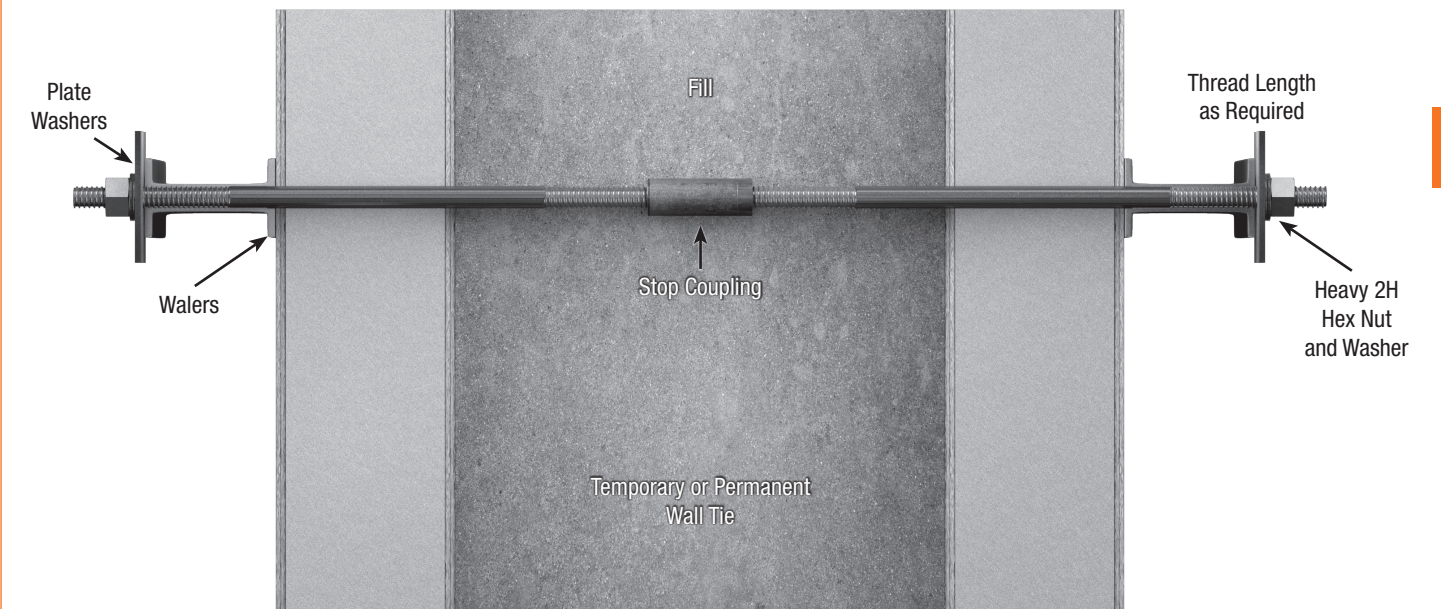
**Cold Rolled Threaded Bar – Grade 150 – ASTM A 722**

Nominal Diameter in (mm)	Min. Net Area Thru Threads in <sup>2</sup> (mm <sup>2</sup> )	Min. Ultimate Strength kips (kN)	Min. Yield Strength kips (kN)	Nominal Weight lbs/ft (kg/m)	Approx. Major Thread Diameter in (mm)	Thread Orientation	Max. Length ft (m)
1 (26)	0.850 (549)	128 (567.0)	59.3 (263.8)	2.70 (4.0)	1 1/8 (28.5)	Left Hand	60 (18.3)
1 1/4 (32)	1.250 (807)	188 (834.0)	75 (333.6)	3.40 (5.1)	1 1/4 (32.0)	Left Hand	60 (18.3)
1 3/8 (36)	1.580 (1019)	237 (1054.0)	95.3 (423.9)	4.30 (6.4)	1 3/8 (35.0)	Left Hand	60 (18.3)
1 3/4 (46)	2.600 (1664.0)	400 (1779.0)	117 (520.5)	5.30 (7.9)	1 1/2 (38.1)	Left Hand	60 (18.3)
2 1/4 (57)	4.000 (2581.0)	600 (2669.0)	168.7 (750.4)	7.65 (11.4)	1 7/8 (47.6)	Right Hand	60 (18.3)
2 1/2 (65)	5.190 (3350.0)	778 (3457.0)	300 (1334.5)	13.60 (20.2)	2 2/3 (70.0)	Right Hand	60 (18.3)
3 (75)	7.060 (4169.0)	1059 (3457.0)	847 (3766)	24.0 (35.7)	3 1/4 (82.6)	Left Hand	50 (15.2)

1 inch to 1 3/8 inch diameter, ASTM A 722; 1 3/4 inch to 3 inch diameter bar manufactured in accordance with ASTM A 722 physical and chemical requirements. \*Additional lengths available upon request.

## Through Wall Ty Bar

All AR bar products in this publication can be considered for Through Wall Ty applications. AR Standard Deform Bar (SDR) Continuous Threaded Lag (SCT-L) and our Solid Smooth Threaded (SST) products provide a wide range of economical solutions for tie back requirements. Refer to SDR, SCT-L or SST for material selection. AR engineered approach provides an innovative method to achieve the full working load requirement. When design loads exceed published values, consult the AR Technical Department.



## AR Corrosion Protection Products

AR provides a wide range of corrosion protection systems and sealants. They include sealants, profiling mastics and tapes. Consult the AR Technical Department for application recommendations and details.

## FJ Series Rock Anchors



FJ Series Rock Anchor Assembly

Double leaf bail-type anchors are suitable for light to moderate load applications up to a 35mm (1 3/8") 8UN thread size.

Anchors are positioned by inserting to final depth and using a moderate torque at 20 ft-lbs. (hand tight) to pre-expand anchors.

Final fit-up is achieved by tensioning the anchor rod against the bearing plate. Available in Lag and UN/UNC series threads as shown.



Type D33 FJ Series Rock Anchor

TABLE CS8: FJ SERIES TECHNICAL INFORMATION

PRODUCT NUMBER	THREAD DIAMETER - TPI	DRILL HOLE DIAMETER	SHELL LENGTH	WEDGE LENGTH	NON-SEIZURE LOAD*					
D2-L-12	1/2" - 6 LAG	35 mm (1 3/8")	65 mm (2 1/2")	80 mm (3 1/8")	60 kN (13,500 lbs)					
D51-L-20	3/4" - 4.5 LAG	45 mm (1 3/4")	75 mm (3")	80 mm (3 1/8")	133 kN (30,000 lbs)					
D51-L-25	1" - 3.5 LAG	45 mm (1 3/4")	75 mm (3")	80 mm (3 1/8")	162 kN (36,500 lbs)					
D20-N-20	3/4" - 10 UNC	50 mm (2")	100 mm (4")	98 mm (3 7/8")	178 kN (40,000 lbs)					
D20-N-25	1" - 8 UN	50 mm (2")	100 mm (4")	98 mm (3 7/8")	222 kN (50,000 lbs)					
D33-N-32	1 1/4" - 8 UN	65 mm (2 1/2")	100 mm (4")	98 mm (3 7/8")	311 kN (70,000 lbs)					
D33-N-35	1 3/8" - 8 UN	65 mm (2 1/2")	100 mm (4")	98 mm (3 7/8") </tr <tr> <td>D51-N-25</td> <td>1" - 8 UN</td> <td>45 mm (1 3/4")</td> <td>75 mm (3")</td> <td>80 mm (3 1/8")</td> <td>162 kN (36,500 lbs)</td> </tr>	D51-N-25	1" - 8 UN	45 mm (1 3/4")	75 mm (3")	80 mm (3 1/8")	162 kN (36,500 lbs)
D51-N-25	1" - 8 UN	45 mm (1 3/4")	75 mm (3")	80 mm (3 1/8")	162 kN (36,500 lbs)					

\*Non-Seizure Load: The load at which the mine roof support anchor can be taken to, while in compression, without thread seizure.

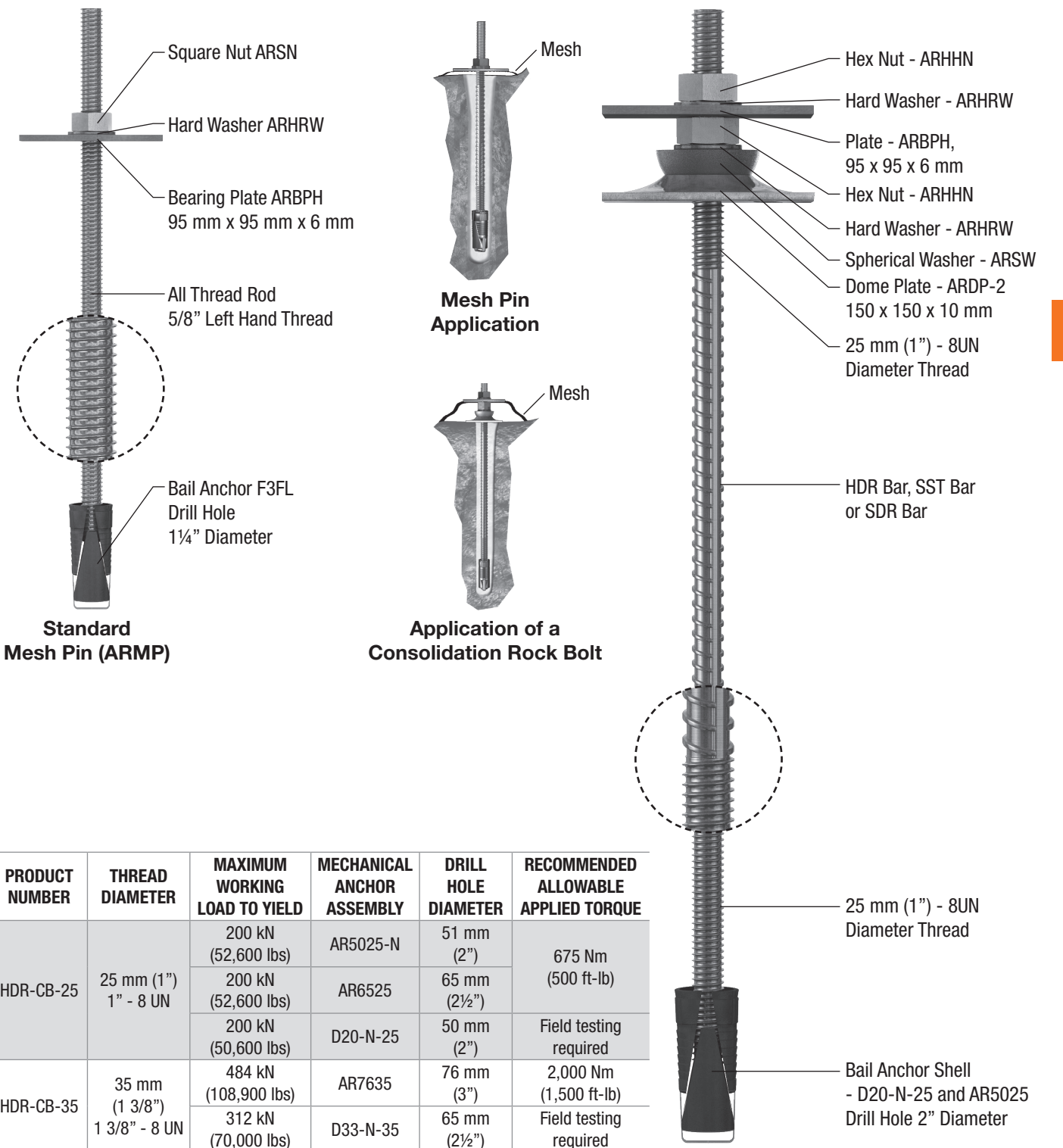


F2B - AR

THREAD DIAMETER - TPI	DRILL HOLE DIAMETER	SHELL LENGTH	WEDGE LENGTH	WEDGE PEARLITIC (P) OR MALLEABLE (M)	NON-SEIZURE LOAD (lbs)
5/8" UNC	(35mm) 1 3/8"	(73mm) 2 7/8"	(35mm) 1 3/8"	M	75.5 kN (17,000 lbs)
3/4" UNC	(35mm) 1 3/8"	(73mm) 2 7/8"	(35mm) 1 3/8"	P	133 kN (30,000 lbs)
1/2" LAG HT*	(35mm) 1 3/8"	(73mm) 2 7/8"	(35mm) 1 3/8"	M	80 kN (18,000 lbs)*
3/4" LAG HT*	(35mm) 1 3/8"	(73mm) 2 7/8"	(35mm) 1 3/8"	P	160 kN (36,000 lbs)*

HT\* Based upon testing using High Tensile Continuous Lag Threaded bar. Each application should be tested utilizing intended threaded bar.

## Consolidation Rock Bolt (ARCRB)



PRODUCT NUMBER	THREAD DIAMETER	MAXIMUM WORKING LOAD TO YIELD	MECHANICAL ANCHOR ASSEMBLY	DRILL HOLE DIAMETER	RECOMMENDED ALLOWABLE APPLIED TORQUE
HDR-CB-25	25 mm (1") 1" - 8 UN	200 kN (52,600 lbs)	AR5025-N	51 mm (2")	675 Nm (500 ft-lb)
		200 kN (52,600 lbs)	AR6525	65 mm (2 1/2")	
		200 kN (50,600 lbs)	D20-N-25	50 mm (2")	Field testing required
HDR-CB-35	35 mm (1 3/8") 1 3/8" - 8 UN	484 kN (108,900 lbs)	AR7635	76 mm (3")	2,000 Nm (1,500 ft-lb)
		312 kN (70,000 lbs)	D33-N-35	65 mm (2 1/2")	Field testing required

\*NOTE: Coupling of 1 1/2" O.D. to be used with D20-N-25 and AR5025 Anchor due to the hole diameter of 2"



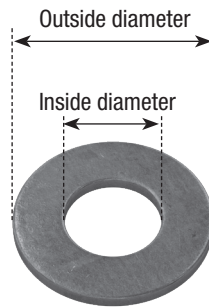
## Heavy Hex Nut (ARHHN)



ASTM A-194  
Grade 2H

ARHHN Thread Diameter - TPI	Height	Across Flats	Across Corners
1/2" 6 LAG	12.3 mm (31/64")	22 mm (7/8")	25 mm (1")
1/2" 13UNC	12.3 mm (31/64")	22 mm (7/8")	25 mm (1")
5/8" 11UNC	15.4 mm (39/64")	26.9 mm (11/16")	30.9 mm (17/32")
3/4" 4.5 LAG	18.7 mm (47/64")	32 mm (1 1/4")	37 mm (17/16")
3/4" 10UNC	18.7 mm (47/64")	32 mm (1 1/4")	37 mm (17/16")
7/8" 9UNC	21.8 mm (55/64")	36.5 mm (17/16")	42 mm (121/32")
1" 3.5 LAG	25 mm (63/64")	41 mm (15/8")	48 mm (17/8")
1" 8UN	25 mm (63/64")	41 mm (15/8")	48 mm (17/8")
1 1/8" 8UNC	25.4 mm (17/64")	46.0 mm (113/16")	53.2 mm (23/32")
1 1/4" 3.5 LAG	31 mm (17/32")	51 mm (2")	59 mm (25/16")
1 1/4" 8UN	31 mm (17/32")	51 mm (2")	59 mm (25/16")
1 3/8" 8UN	34.1 mm (111/32")	56 mm (23/16")	64 mm (2 1/2")
1 3/8" 8UN	34.1 mm (111/32")	56 mm (23/16")	64 mm (2 1/2")
1 1/2" 8UN	37.3 mm (115/32")	60 mm (23/8")	70 mm (2 3/4")
1 3/4" 5UN	43.7 mm (123/32")	70 mm (2 3/4")	81 mm (33/16")
1 3/4" 8UN	43.7 mm (123/32")	70 mm (2 3/4")	81 mm (33/16")
1 7/8" 8UN	46.8 mm (127/32")	74.6 mm (215/16")	86.1 mm (325/64")
2" 8UN	50 mm (131/32")	79 mm (31/8")	92 mm (35/8")

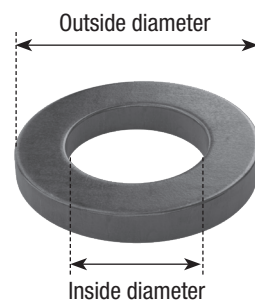
## Hardened Round Washer (ARHRW)



ASTM F-436

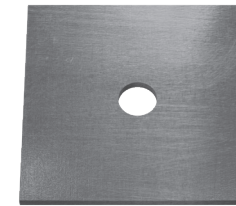
ARHRW Nominal Size	Thickness	Inside Diameter	Outside Diameter
1/2"	2 mm (3/32")	13 mm (17/32")	27 mm (11/16")
5/8"	3 mm (1/8")	17.4 mm (11/16")	33.3 mm (15/16")
3/4"	3 mm (1/8")	20 mm (13/16")	37 mm (115/32")
7/8"	4 mm (9/64")	23.8 mm (15/16")	44.4 mm (1 3/4")
1"	4 mm (9/64")	29 mm (11/8")	51 mm (2")
1 1/8"	4 mm (9/64")	31.7 mm (1 1/4")	57.1 mm (2 1/4")
1 1/4"	4 mm (9/64")	35 mm (13/8")	64 mm (2 1/2")
1 3/8"	4 mm (9/64")	38 mm (1 1/2")	70 mm (2 3/4")
1 1/2"	5 mm (13/64")	41 mm (15/8")	76 mm (3")
1 3/4"	5 mm (13/64")	48 mm (161/64")	89 mm (3 1/2")
2"	5 mm (13/64")	54 mm (21/8")	95 mm (3 3/4")

## Beveled Washer (ARBW)



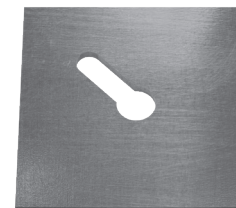
ARBW Nominal Size A	Inside Diameter B	Outside Diameter C	Minimum Thickness D	Minimum Thickness E	Width
1/2"	14 mm (0.56")	N/A	3 mm (0.12")	9 mm (0.34")	32 mm (1.25")
3/4"	21 mm (0.81")	N/A	5 mm (0.19")	11 mm (0.44")	32 mm (1.25")
1"	29 mm (1.16")	51 mm (2.00")	6 mm (0.25")	14 mm (0.55")	N/A
1 1/4"	39 mm (1.52")	66 mm (2.60")	7 mm (0.28")	16 mm (0.63")	N/A
1 3/8"	39 mm (1.52")	66 mm (2.60")	7 mm (0.28")	16 mm (0.63")	N/A
1 1/2"	39 mm (1.52")	66 mm (2.60")	7 mm (0.28")	16 mm (0.63")	N/A
1 3/4"	53 mm (2.10")	93 mm (3.67")	14 mm (0.54")	22 mm (0.86")	N/A
2"	53 mm (2.10")	93 mm (3.67")	14 mm (0.54")	22 mm (0.86")	N/A

## Single Hole Bearing Plate (ARBPH)



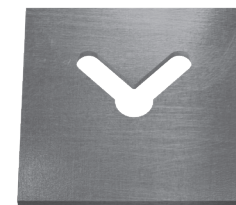
ARBPH Nominal Size	Width	Length	Across Corners
1/2"	95 mm (3 3/4")	95 mm (3 3/4")	6 mm (1/4")
3/4"	152 mm (6")	152 mm (6")	10 mm (3/8")
1"	203 mm (8")	203 mm (8")	10 mm (3/8")
1" Heavy	203 mm (8")	203 mm (8")	13 mm (1/2")
1 1/4"	203 mm (8")	203 mm (8")	13 mm (1/2")
1 3/8"	203 mm (8")	203 mm (8")	13 mm (1/2")
1 3/8" Heavy	203 mm (8")	203 mm (8")	19 mm (3/4")
1 1/2"	203 mm (8")	203 mm (8")	19 mm (3/4")
1 1/2" Heavy	229 mm (9")	229 mm (9")	25 mm (1")
1 3/4"	305 mm (12")	305 mm (12")	25 mm (1")
2"	305 mm (12")	305 mm (12")	25 mm (1")

## Single Key Bearing Plate (ARBP)



ARBP Nominal Size	Width	Length	Across Corners
1/2"	95 mm (3 3/4")	95 mm (3 3/4")	6 mm (1/4")
3/4"	152 mm (6")	152 mm (6")	10 mm (3/8")
1"	203 mm (8")	203 mm (8")	10 mm (3/8")
1" Heavy	203 mm (8")	203 mm (8")	13 mm (1/2")
1 1/4"	203 mm (8")	203 mm (8")	13 mm (1/2")
1 3/8"	203 mm (8")	203 mm (8")	13 mm (1/2")
1 3/8" Heavy	203 mm (8")	203 mm (8")	19 mm (3/4")
1 1/2"	203 mm (8")	203 mm (8")	19 mm (3/4")
1 1/2" Heavy	229 mm (9")	229 mm (9")	25 mm (1")
1 3/4"	305 mm (12")	305 mm (12")	25 mm (1")
2"	305 mm (12")	305 mm (12")	25 mm (1")

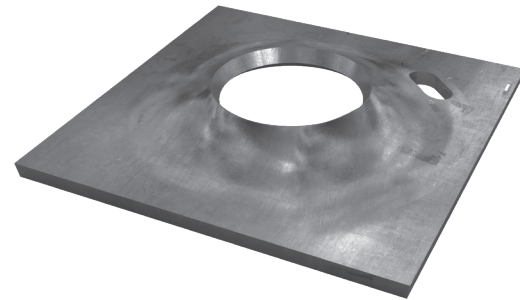
## Double Key Bearing Plate (ARBPD)



ARBPD Nominal Size	Width	Length	Across Corners
1/2"	95 mm (3 3/4")	95 mm (3 3/4")	6 mm (1/4")
3/4"	152 mm (6")	152 mm (6")	10 mm (3/8")
1"	203 mm (8")	203 mm (8")	10 mm (3/8")
1" Heavy	203 mm (8")	203 mm (8")	13 mm (1/2")
1 1/4"	203 mm (8")	203 mm (8")	13 mm (1/2")
1 3/8"	203 mm (8")	203 mm (8")	13 mm (1/2")
1 3/8" Heavy	203 mm (8")	203 mm (8")	19 mm (3/4")
1 1/2"	203 mm (8")	203 mm (8")	19 mm (3/4")
1 1/2" Heavy	229 mm (9")	229 mm (9")	25 mm (1")
1 3/4"	305 mm (12")	305 mm (12")	25 mm (1")
2"	305 mm (12")	305 mm (12")	25 mm (1")

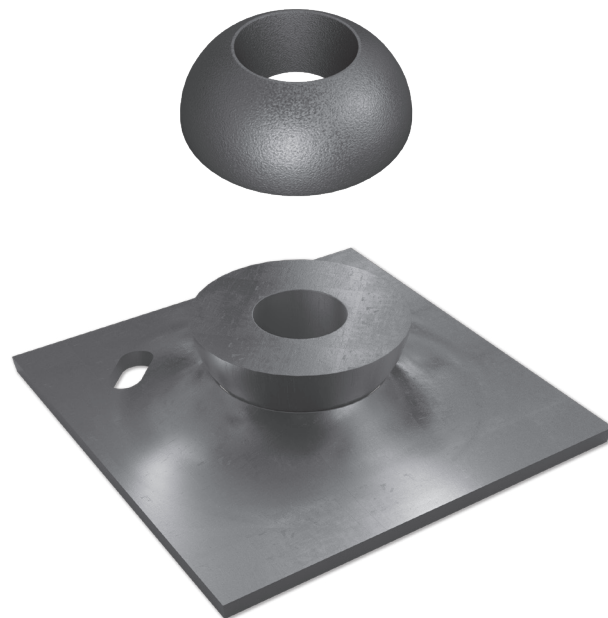
## 1" Dome Plate (ARDP-2)

The Dome Plate (ARDP-2) comes in a standard size of 10 mm x 150 mm x 150 mm (3/8" x 6" x 6").



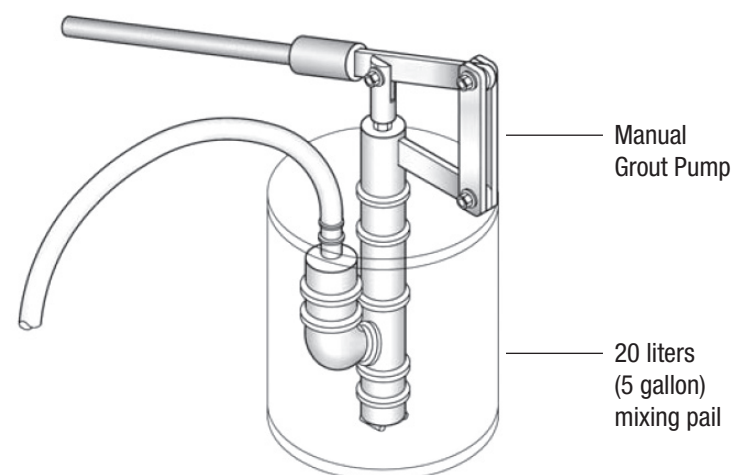
## 1" Spherical Washer (ARSW)

The Spherical Washer (ARSW) is designed to fit with the AR Dome Plate (ARDP-2). Maximum deflection angle 26°.



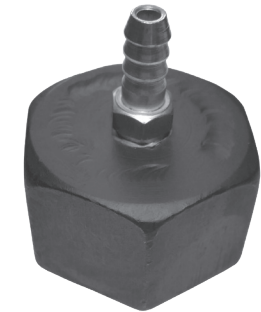
## Manual Grout Pump (ARMGP)

Pump Rate:  
0.256L/stroke (15.63 cu.in.)



## Grout Tube Adapter (ARGTA)

Grout Tube Adapter used with HDR Rod Series.



## Grout Tube (ARGT)

Outside Diameter	Inside Diameter	Quantity per roll
1/2"	3/8"	500 ft per roll
5/8"	1/2"	500 ft per roll
3/4"	5/8"	500 ft per roll



## Expansive Type Cement Grout (ARECG)

### Cementitious Pumpable Grouts for Anchoring

AR Expansive Type Cement Grout is to be used where net drying shrinkage is of concern. The material is a Portland cement based product without sand which has been tested to pump 10 m (32 feet) in a 9 mm (1/4") diameter hole at 280 kPa (40 PSI). Packaged in 22.7 kg (50 lbs) bag size.

**TABLE CS9: Typical Compressive Strength**  
w/c 0.45 @ 78.6°F (26°C) moist cured.

Time	24 hours	7 days	28 days
Compressive Strength			
MPa	15.0	40.0	54.0
PSI	2,180	5,800	7,830

## Dispersion Stabilized Cement Grout (ARSCG)

AR Dispersion Stabilized Cement Grout is suitable for pumping into drilled holes when subjected to water flow as the grout gels immediately when pumping ceases. It will become fluid when pumping resumes. The thickening of the grout has the appearance of grout that has reached initial set. Dispersion Stabilized Cement Grout is a blend of high strength Portland Cement, water and high molecular-weight polymers. This combination allows the grout to have the strength gain and the alkali protection of cement particles in a stable polymer matrix. This matrix functions as a protective coating for the unhydrated cement particles, preventing water washout when the grout is in the plastic state. Available in a sulphate resistant formulation — ARSCG-S.

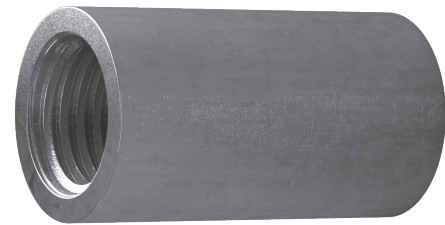
NOTE: Packaged in 22.7 kg (50 lbs) bag size, yields 13 litres (0.454 ft<sup>3</sup>).

**TABLE CS10: Typical Compressive Strength**  
w/c 0.45 @ 70°F (21°C) moist cured.

Time	16 hours	24 hours	7 days	28 days
Compressive Strength				
MPa	10.0	22.0	49.0	51.0
PSI	1,450	3,190	7,100	7,400

Setting time: 8 hours

## 1" Stop Coupler (ARSC)



FY 105 Ksi  
FU 125 Ksi

NOTE: Through Coupler  
available as a special order.

### ARSC Stop Coupler

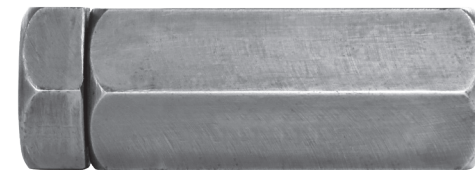
ARTC Thread Diameter - TPI	Overall Length	Outside Diameter	Tap Depth Each End
1/2" 6 LAG	51 mm (2")	29 mm (1 1/8")	19 mm (3/4")
3/4" 4.5 LAG	76 mm (3")	29 mm (1 1/8")	32 mm (1 1/4")
1" 3.5 LAG	102 mm (4")	51 mm (2")	44 mm (1 3/4")
1 1/4" 3.5 LAG	127 mm (5")	51 mm (2")	57 mm (2 1/4")
1/2" 13 UNC	51 mm (2")	29 mm (1 1/8")	19 mm (3/4")
5/8" 11 UNC	76 mm (3")	29 mm (1 1/8")	19 mm (3/4")
3/4" 10 UNC	76 mm (3")	28 mm (1 1/8")	32 mm (1 1/4")
7/8" 9 UN	76 mm (3")	51 mm (2")	19 mm (3/4")
1" 8 UN	76 mm (3")	38 mm (1 1/2")	32 mm (1 1/4")
1" 8 UN	76 mm (3")	51 mm (2")	32 mm (1 1/4")
1 1/8" 8 UN	102 mm (4")	51 mm (2")	44 mm (1 3/4")
1 1/4" 8 UN	102 mm (4")	51 mm (2")	44 mm (1 3/4")
1 3/8" 8 UN	102 mm (4")	64 mm (2 1/2")	44 mm (1 3/4")
1 1/2" 8 UN	152 mm (6")	64 mm (2 1/2")	70 mm (2 3/4")
1 3/4" 5UNC	152 mm (6")	76 mm (3")	70 mm (2 3/4")
1 3/4" 8 UN	152 mm (6")	76 mm (3")	70 mm (2 3/4")
1 7/8" 8 UN	152 mm (6")	76 mm (3")	70 mm (2 3/4")
2" 8 UN	152 mm (6")	76 mm (3")	70 mm (2 3/4")

### ARTC Transition Coupler

ARTC Thread Transition - TPI	Overall Length	Outside Diameter	Tap Depth Each End
1/2" - 13UNC to 1/2" - 6 LAG	89 mm (3 1/2")	29 mm (1 1/8")	38 mm (1 1/2")
3/4" - 10UNC to 3/4" - 4.5 LAG	89 mm (3 1/2")	29 mm (1 1/8")	38 mm (1 1/2")
1" - 8UN to 1" - 3.5 LAG	114 mm (4 1/2")	51 mm (2")	51 mm (2")
1 1/4" - 8UN to 1 1/4" - 3.5 LAG	140 mm (5 1/2")	51 mm (2")	64 mm (2 1/2")

## Spin Adaptors (ARSA)

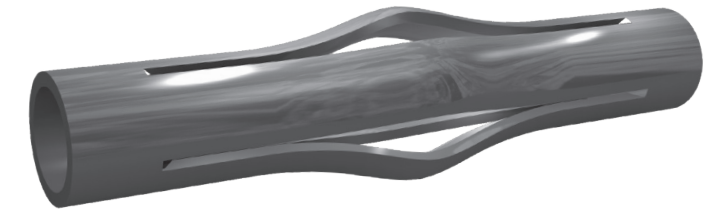
The ARSA Spin Adaptor allows rotation of rod to set anchor without damaging threads on rods.



Rod Type	Thread Diameter - TPI	Hex Stud & Nut Across Flats
SCT-L	1/2" 6 LAG	37 mm (1 1/2")
	3/4" 4.5 LAG	37 mm (1 1/2")
	1" 3.5 LAG	62 mm (2 1/2")
	1 1/4" 3.5 LAG	62 mm (2 1/2")
HDR/SDR/SST SCT-N/B-7	1/2" 13UNC	37 mm (1 1/2")
	5/8" 11UNC	37 mm (1 1/2")
	3/4" 10UNC	37 mm (1 1/2")
	7/8" 9UNC	62 mm (2 1/2")
	1" 8UN	62 mm (2 1/2")
	1 1/4" 8UN	62 mm (2 1/2")
	1 1/8" 8UN	62 mm (2 1/2")
	1 3/8" 8UN	83 mm (3 1/4")
	1 1/2" 8UN	83 mm (3 1/4")
	1 3/4" 8UN	83 mm (3 1/4")
	1 7/8" 8UN	83 mm (3 1/4")
	2" 8UN	83 mm (3 1/4")

## Centralizer (ARC)

The Centralizer is used to centre an anchor rod in a drilled hole when a mechanical anchor is not preset. To order, specify the drill hole diameter, the rod size or outer diameter of sleeve when used over bar.



### Dimension Tuyau en PVC - Schedule 40

Grandeur	Dia. Int.	Dia. Ext.	Mur	Lb / Pi.	PSI
1/8"	0.405	0.249	0.068	0.051	810
1/4"	0.540	0.344	0.088	0.086	780
3/8"	0.675	0.473	0.091	0.115	620
1/2"	0.840	0.602	0.109	0.170	600
3/4"	1.050	0.804	0.113	0.226	480
1"	1.315	1.029	0.133	0.333	450
1 1/4"	1.660	1.360	0.140	0.450	370
1 1/2"	1.900	1.590	0.145	0.537	330
2"	2.375	2.047	0.154	0.720	280
2 1/2"	2.875	2.445	0.203	1.136	300
3"	3.500	3.042	0.216	1.488	260
3 1/2"	4.000	3.521	0.226	1.789	240
4"	4.500	3.998	0.237	2.118	220
5"	5.563	5.016	0.258	2.874	190
6"	6.625	6.031	0.280	3.733	180
8"	8.625	7.942	0.322	5.619	160
10"	10.750	9.976	0.365	7.966	140
12"	12.750	11.889	0.406	10.534	130
14"	14.000	13.073	0.437	12.462	130
16"	16.000	14.940	0.500	16.286	130
18"	18.000	16.809	0.562	20.587	130
20"	20.000	18.743	0.593	24.183	120
24"	24.000	22.544	0.687	33.652	120

## Swivel/Pivot Lift Plate (ARSLP)

Swivel/Pivot Lift Plate allows for lifting and positioning of long heavy rock bolts by crane. Available for 3/4", 1", 1 1/4", and 1 1/2" diameters. Contact AR for others sizes.

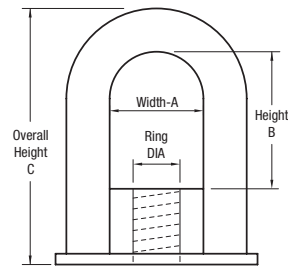




## Type K Lifting Eye

The AR Type K Lifting Eye consists of a ring, base and base plate welded together. Available in the size shown, the Type K Lifting Eye is designed for use with a single bolt to engage any single lifting insert.

Diameter mm (")	Ring Diameter	Straight Tension Ultimate Strength	90° Tension Ultimate Strength
13 mm (1/2")	20 mm (3/4")	80 kN (18,000 lbs*)	6.2 kN (1,400 lbs*)
20 mm (3/4")	20 mm (3/4")	150 kN (34,000 lbs*)	6.2 kN (1,400 lbs*)
25 mm (1")	25 mm (1")	333 kN (75,000 lbs*)	14.7 kN (3,326 lbs*)
32 mm (1 1/4")	32 mm (1 1/4")	422 kN (95,000 lbs*)	31 kN (6,975 lbs*)

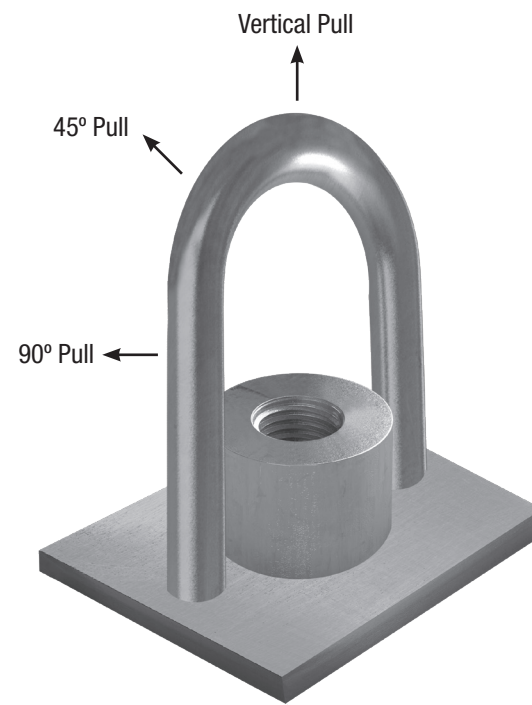


\*Recommended minimum Safe Working Load should be 4 to 1 against ultimate.

Refer to ASTM A 489 for load reduction calculation off vertical pull.

Not available in hot dip galvanized.

Diameter mm (")	Internal Thread	Width A	Width B	Width C
13 mm (1/2")	6 Lag	50 mm (2")	75 mm (3")	140 mm (5 1/2")
20 mm (3/4")	4.5 Lag	50 mm (2")	75 mm (3")	140 mm (5 1/2")
25 mm (1")	3.5 Lag	50 mm (2")	75 mm (3")	140 mm (5 1/2")
32 mm (1 1/4")	3.5 Lag	100 mm (2")	115 mm (4 1/2")	213 mm (8 3/8")



**APPROXIMATE SAFE  
WORKING LOAD  
4:1 Safety Factor**

## Special Eye Nut (AREN)

The AR Special Eye Nut consist of a wire ring welded to a left hand hex or square nut. The Special Eye Nut can be placed on a AR Mesh Pin or other threaded rod to support light loads in mining or tunneling applications.

Diameter Left Hand Nut	Ring Diameter	Straight Tension Ultimate Strength
5/8" Heavy Square Nut	25 mm (1")	23,000 lbs.
3/4" Heavy Square Nut	25 mm (1")	23,000 lbs.

\*Refer to ASTM A489 for load reduction calculation off vertical pull.

Other sizes and strengths available on request.



## Dial Indicator (ARDI)

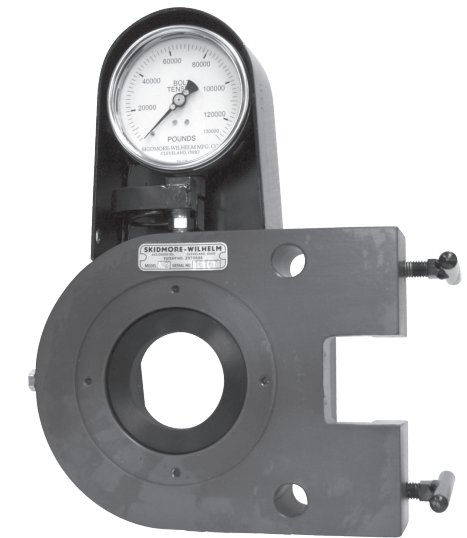
Dial Indicator with magnetic base.  
Measures bolt deflection to nearest 0.001 inch.

Number	Description	Applicable Stem Diameter
7010S	Magnetic Support	ø 6 mm, ø 8 mm*, ø 9.53 mm (3/8")



## Bolt Tension Calibrator

Lightweight design, 126,000 lb capacity - will do 1 1/4" A490 bolts. No need for dowel pins. Holes predrilled for torque reaction kits.



## Manual Torque Wrench

Robust construction gives accurate results, to  $\pm 4\%$ , even in arduous working conditions. The large break angle improves accuracy by reducing the possibility of over torquing. Cam control of the mechanism gives a controlled break which will not throw the operator off balance. Dual scaled, N.m and lbf.ft.



Model	Part No.		Range		Ratchet Diameter mm	Engagements per revolution	Length		Weight Kg
	3/4"	1"	N.m	lbf.ft			mm		
4AR	12007	12007.01	200 – 800	150 – 600	70	36	1250	6.4	

## Manual Torque Wrench Multiplier

The Manual Torque Wrench Multiplier with a 19mm (3/4") square drive input and 25 mm (1") square drive output has a mechanical advantage multiplier ratio of 5:1 and a capacity of 1694 Nm (1250 ft lbs.)



## Pneumatic Torque Wrench

The PTM-52 is engineered to be one of the lightest and fastest tools of its type on the market. The exceptionally compact 52 mm diameter gearbox means that the tool is well balanced, light weight and provides excellent access to bolts.



Model	Direction of Operation	Square Drive in	Part No.	Range		Free Speed rpm	Length "A" mm	Tool Weight Kg	Reaction Weight Kg
				N.m	lbf.ft				
PTM-52-500-F	Forward only	3/4	18100.F06	100-500	74-370	224	284	3.8	0.85
PTM-52-500-B	Bi-directional	3/4	18100.B06	100-500	74-370	224	333	4.1	0.85
PTM-52-800-F	Forward only	3/4	18101.F06	160-800	118-590	148	284	3.8	0.85
PTM-52-800-B	Bi-directional	3/4	18101.B06	160-800	118-590	148	333	4.1	0.85

NOTE: AR Pneumatic Torque Equipment comes complete with a Lubro Central Unit, reaction arm and required hex socket.

## Lubro Control Unit

The Lubro Control Unit filters, regulates and lubricates the supply of compressed air to the tool. Accompanies each Pneumatic Torque Wrench.



## Pneumatic Torquing Assembly

Pneumatic Torque Wrench and Lubro Control Unit shown assembled. Used with bolts 32mm or greater. Production bolting with many units possible. Refer to the Stressing Equipment table on page 36 of the Appendix for more information.

NOTE: Adequate reaction must be supplied with torque wrenches. Hex sockets are required to match spin adaptors used with particular rock bolts.



## AR Series Hydraulic Bolt Stressing Equipment

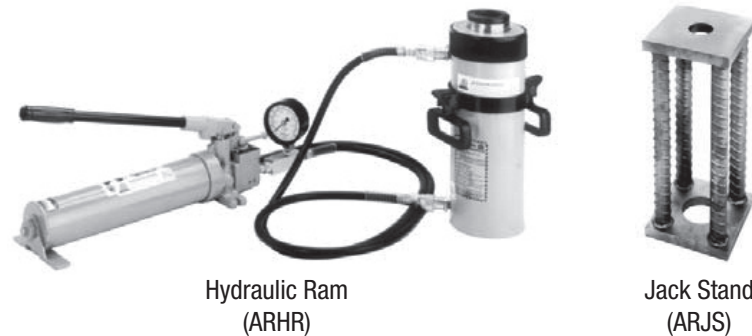
Hollow ram cylinders are used to prestress rock bolts. Calibrated hydraulic gauges gives true reading of axial tension applied to bolt. When used with AR Mechanical Expansion Cone and Shell anchors, setting the anchor and stressing are done immediately with no time required for setting of bonded anchors. Bolts are then grouted for permanent stress lockoff and corrosion protection. Stressing assembly consists of pump, gauge, ram hoses and standard jack stand that matches ram capacity. Stress rod hex nut and couplings required to stress bolts must be ordered as required.

ARTSR Product Number	Thread Diameter - TPI	ARJS Jack Stand Height	Rod Length
ARSTR-12-N	12 mm (1/2") 13 UNC	406 mm (16")	914 mm (3 ft.)
ARSTR-12-L	12 mm (1/2") 6 LAG	406 mm (16")	914 mm (3 ft.)
ARSTR-16-N	16 mm (5/8") 11 UNC	406 mm (16")	914 mm (3 ft.)
ARSTR-20-N	19 mm (3/4") 10 UNC	406 mm (16")	914 mm (3 ft.)
ARSTR-20-L	19 mm (3/4") 4.5 LAG	406 mm (16")	914 mm (3 ft.)
ARSTR-22-N	22 mm (7/8") 9 UNC	406 mm (16")	914 mm (3 ft.)
ARSTR-25-N	25 mm (1") 8 UN	610 mm (24")	914 mm (3 ft.)
ARSTR-25-L	25 mm (1") 3.5 LAG	610 mm (24")	914 mm (3 ft.)
ARSTR-29-N	28 mm (1-1/8") 8 UN	610 mm (24")	914 mm (3 ft.)
ARSTR-32-N	32 mm (1-1/4") 8 UN	610 mm (24")	914 mm (3 ft.)
ARSTR-32-L	32 mm (1-1/4") 3.5 LAG	610 mm (24")	914 mm (3 ft.)
ARSTR-35-N	35 mm (1-3/8") 8 UN	610 mm (24")	1,219 mm (4 ft.)
ARSTR-38-N	38 mm (1-1/2") 8 UN	610 mm (24")	1,219 mm (4 ft.)
ARSTR-45-N	45 mm (1-3/4") 5 UN	610 mm (24")	1,219 mm (4 ft.)
ARSTR-45-N	45 mm (1-3/4") 8 UN	610 mm (24")	1,219 mm (4 ft.)
ARSTR-48-N	48 mm (1-7/8") 8 UN	610 mm (24")	1,219 mm (4 ft.)
ARSTR-50-N	51 mm (2") 8 UN	610 mm (24")	1,219 mm (4 ft.)



ARSTR, ARJS and ARHR Complete Assembly

NOTE: AR Stressing Equipment assembly comes complete with hollow ram, hydraulic jack and pump as indicated, hoses and gauge with jack stand (flush mount) or stressing stool/long internal socket tube (for pocket mount) and stress rod assembly. Specify rock bolt thread form when ordering.



Hydraulic Ram (ARHR)

Jack Stand (ARJS)

Product Number	Capacity	Hollow Ram Diameter
ARHR-20	178 kN (40,000 lbs)	26.5 mm (1-3/64")
ARHR-30	267 kN (60,000 lbs)	32.9 mm (1-19/64")
ARHR-60	534 kN (120,000 lbs)	50.8 mm (2-3/32")
ARHR-100	890 kN (200,00 lbs)	79 mm (3-1/8")
ARHR-150	1,335 kN (300,000 lbs)	79 mm (3-1/8")

# APPENDIX



## Applied Torque

AR Rock Bolts	Applied Torque		Torque Wrench
HDR-25 Hollow Deformed Rebar	675 Nm	(500 ft.-lbs.)	PT-1500/PT-2
HDR-35 Hollow Deformed Rebar	2,000 Nm	(1,500 ft.-lbs.)	PT-5/PT-7
HDR-50 Hollow Deformed Rebar	5,400 Nm	(4,000 ft.-lbs.)	PT-7
SDR-12 Solid Deformed Rebar	70 Nm	(50 ft.-lbs.)	Manual
SDR-20 Solid Deformed Rebar	230 Nm	(170 ft.-lbs.)	Manual
SDR-25 Solid Deformed Rebar	550 Nm	(400 ft.-lbs.)	PT-1500
SDR-29 Solid Deformed Rebar	825 Nm	(600 ft.-lbs.)	PT-1500/PT-2
SDR-32 Solid Deformed Rebar	1,015 Nm	(750 ft.-lbs.)	PT-1500/PT2
SDR-35 Solid Deformed Rebar	1,100 Nm	(800 ft.-lbs.)	PT-1500/PT-2/PT-5
SDR-38 Solid Deformed Rebar	1,650 Nm	(1,200 ft.-lbs.)	PT-2/PT-5
SDR-45 Solid Deformed Rebar	2,000 Nm	(1,500 ft.-lbs.)	PT-5/PT-7
SDR-48 Solid Deformed Rebar	3,300 Nm	(2,450 ft.-lbs.)	PT-7
SDR-55 Solid Deformed Rebar	4,000 Nm	(3,000 ft.-lbs.)	PT-7
SCT-N-12 Solid Continuous Threaded Unified	95 Nm	(70 ft.-lbs.)	Manual
SCT-N-20 Solid Continuous Threaded Unified	340 Nm	(250 ft.-lbs.)	PT-1500
SCT-N-25 Solid Continuous Threaded Unified	810 Nm	(600 ft.-lbs.)	PT-1500/PT-2
SCT-N-32 Solid Continuous Threaded Unified	1,625 Nm	(1,200 ft.-lbs.)	PT-5
SCT-L-12 Solid Continuous Threaded Lag	95 Nm	(70 ft.-lbs.)	Manual
SCT-L-20 Solid Continuous Threaded Lag	340 Nm	(250 ft.-lbs.)	PT-1500
SCT-L-25 Solid Continuous Threaded Lag	810 Nm	(600 ft.-lbs.)	PT-1500/PT-2
SCT-L-32 Solid Continuous Threaded Lag	1,625 Nm	(1,200 ft.-lbs.)	PT-5
SCT-N-B7 All Thread Bar - 13	95 Nm	(70 ft.-lbs.)	Manual
SCT-N-B7 All Thread Bar - 20	340 Nm	(250 ft.-lbs.)	PT-1500
SCT-N-B7 All Thread Bar - 25	810 Nm	(600 ft.-lbs.)	PT-1500/PT-2
SCT-N-B7 All Thread Bar - 32	1,625 Nm	(1,200 ft.-lbs.)	PT-5
SCT-N-B7 All Thread Bar - 35	2,170 Nm	(1,600 ft.-lbs.)	PT-5/PT-7
SCT-N-B7 All Thread Bar - 38	2,700 Nm	(2,000 ft.-lbs.)	PT-5/PT-7
SCT-N-B7 All Thread Bar - 45	4,067 Nm	(3,000 ft.-lbs.)	PT-7
SCT-N-B7 All Thread Bar - 50	6,100 Nm	(4,500 ft.-lbs.)	PT-9
SST-12 Solid Smooth Threaded Ends	95 Nm	(70 ft.-lbs.)	Manual
SST-20 Solid Smooth Threaded Ends	340 Nm	(250 ft.-lbs.)	PT-1500
SST-25 Solid Smooth Threaded Ends	810 Nm	(600 ft.-lbs.)	PT-1500/PT-2
SST-32 Solid Smooth Threaded Ends	1,625 Nm	(1,200 ft.-lbs.)	PT-5
SST-35 Solid Smooth Threaded Ends	2,170 Nm	(1,600 ft.-lbs.)	PT-5/PT-7
SST-38 Solid Smooth Threaded Ends	2,700 Nm	(2,000 ft.-lbs.)	PT-5/PT-7
SST-45 Solid Smooth Threaded Ends	4,067 Nm	(3,000 ft.-lbs.)	PT-7
SST-50 Solid Smooth Threaded Ends	6,100 Nm	(4,500 ft.-lbs.)	PT-9

## Installation Instructions For AR Cone Shell Mechanical Expansion Anchors

### Hole Preparation

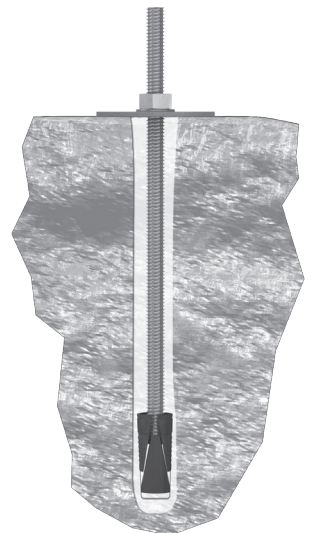
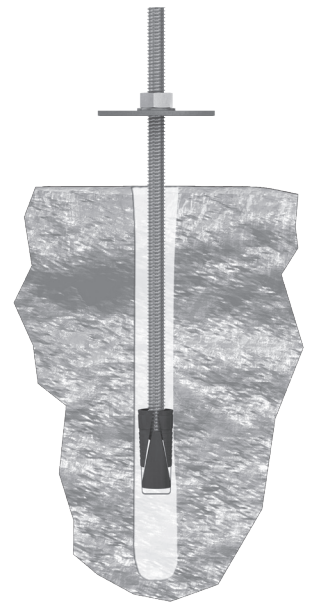
Mechanical expansion anchors require a hole drilled into the rock or concrete with attention paid to the length, diameter and straightness. Rotary percussion or diamond drills both provide acceptable drill hole surfaces for use with the AR series of cone shell expansion anchors. Particular attention must be paid to the diameter. Drill holes cannot be undersized. Drill hole diameter can be up to 10% oversized. Hole straightness must be maintained to allow passage of the mechanical anchor assembly as well as the overall length of the anchor rod over the entire length of the bolt. This is accomplished primarily with the attention of the driller to down pressure feed rate for a given rock type and the amount of wear in the drill steel and bit. Hole length should be in excess of the bolt length by 6 to 12 bolt diameters. This allows for larger pieces of rock dislodged during bolt insertion to be clear of the anchor at the final installation depth.

### Bolt Positioning

For vertically downwards oriented bolts the completely assembled units including the bearing plates should be lowered down the hole. The bolt must be centralized in the drilling hole during the installation procedure. Having the bearing plate with the hex nut and flat washer above the plate in place prior to lowering the unit downhole precludes the bolt from falling too far down an over drilled hole. Trying to pull vertically upwards on a mechanical expansion anchor already in a drill hole may begin to expand the shell against the drill hole wall and may not be possible.

Typically, the desired condition of drill hole diameter and anchor preset expansion will produce a snug but relatively easily inserted anchor down the length of the drill hole. In the event loose rock segments translate into hole and block the passage of the anchor, the outer end of the bolt may be struck with a hammer if the threads are protected with a nut or spin adaptor.

The ideal final elevation of the bolt should be when an equal length of thread exists both above and below the bearing plate. Under ideal conditions when the full torque required to expand the shell of the anchor assembly has been delivered to the anchor, tensioning the bolt will cause the anchor rod to extend only by the elastic deformation of the length of rod for a given axial tensile load. Practically, they may be further migration of the cone into the shell and some settling of the bearing plate as point load contacts between steel and rock crush to distribute final lock off loads. These effects will accumulate and may slightly raise the final elevation of the rock bolt. This does not mean that the anchor has slipped against the sides of the drill hole wall. The bolt cannot maintain a known prestress force unless the nut is capable of being in full contact with the bearing plate within the threaded length of the outer end of the bolt. To ensure full bearing between the underside of the hex nut and the bearing plate, a set of two beveled washers should be used\*. By swiveling the beveled washers against each other the angle may change from perpendicular to the axis of the bolt rod to 2X the angle of a single beveled washer. When mechanical expansion anchors are used in heavily fractured rock or in lengths greater than 5 or 6 meters, insertion into the hole is best achieved by providing an overdrilled diameter up to the last 30 bolt diameters of hole length above the anchor. This allows for uninterrupted passage of the anchor to just above the required anchor depth. Attention to all the previous details pertain to installing an anchor bolt vertically up for roof bolting with the exception of the possibility of losing a bolt downhole. The opposite is obviously true, and personnel or equipment must be able to push up on the bolt to achieve the desired destination.



## Setting Mechanical Expansion Anchors

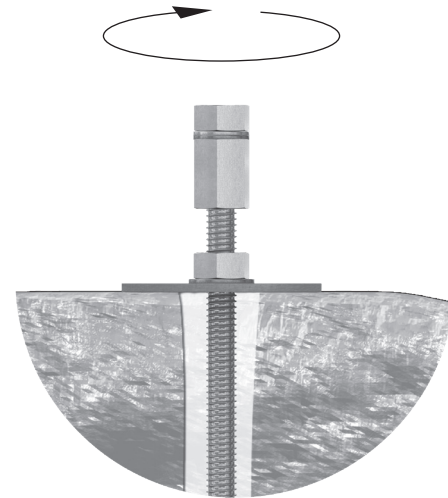
### Torquing

Once the rock bolt has been installed to the desired elevation the anchor Cone Shell assembly is set by applying torsion to the outer end of the rod. This is done by means of a 2 piece spin adaptor which threads onto the end of the rock bolt protecting the threads from damage. The spin adaptor is made from hex stock allowing it to be driven with a socket and restrained with a wrench when removing it after torquing the anchor. It is important not to allow the rod to counter rotate during tool removal as this can allow the anchor to loosen and slip under tension. The anchor is set by driving on the body of the spin adaptor and released by lifting the socket to continue driving in a right hand direction on the top bolt. The threads are left hand and the tool releases. Maintain an antirotational force on the body of the spin adapter, with a wrench, when releasing the top bolt.

AR bolts are threaded with right hand threads unless specially ordered left hand threads. This means that the anchors are set by rotating clockwise. Torque is applied by means of either manual or pneumatic powered wrenches. The outer end hex nut must be in an elevated position relative to the bearing plate so the rod is free to rotate while expanding the anchor.

The maximum torque values for each rod anchor assembly is listed in the application tables. This value is the safe capacity of the rod in torsion at the root of the threads. Exceeding these values could cause torsional shear failure!

Applied torque-induced tension values are known to be highly variable. (Note: Bail Anchor Series Anchors are set by tensioning the rod). Torque measuring equipment accuracy values should also be verified. AR recommends that the maximum torque be applied to a given rock bolt anchor installation until down hole rotation stops. This does not include the torsional spring of the rod. Rock bolts under 25 mm (1") in diameter may be installed with calibrated manual torque wrenches. For rock bolts 25 mm (1") and greater in diameter it is recommended to use Pneumo-hydraulic torque wrenches, available for sale or for rent from National Concrete Accessories.



## Tensioning Procedure For A Pretensioned Rock Bolt

### Stressing Equipment

The principle advantage of using a mechanical anchorage downhole is the ability to immediately tension the rod to a known value of prestress. This causes a reaction on the underside of the bearing plate putting the concrete and/or rock mass into compression. This zone of compression extends to the level of the expansion anchor.

The most reliable and accurate method of doing this is by coupling onto the rod and applying tension by means of a center-hole hydraulic jack. Access to the outer end hex nut of the rock bolt can be maintained by using either a ratcheting extension ram adapter or by means of a jack stand.

### Procedure

The ram of the centre hole jack is positioned directly over the rock bolt rod exposed through the bearing plate. Since most often the bolt end is not long enough to extend through the ram a coupling and an extension rod is required to give a threaded section above the top end of the ram. A bearing plate and beveled washers, or a spherical seated washer is passed over the rod and a hex nut is then threaded onto the extension rod allowing the vertical extension of the ram under pressure to tension the entire rockbolt rod to the elevation of the mechanical expansion anchor.

Pressure is applied by the hydraulic pump supplied. Manual pumps may be reliably used but for cost efficiency for "production" operations either an electric or pneumatic powered pump is available. Load should be applied in 6 to 10 equal increments with a minute or two between each increment. Extensive time delays are not required with cone shell as with cement grouted anchors which require microcracking to distribute the stress to the surrounding rock. Rod deflection measurements to verify mechanical anchor performance are optional as the mechanical anchors are not as variable as pumping cement grouts for a method of load transfer.

An often used value of design load for an anchor is 50% of the ultimate tensile capacity of the assembly. Where the bolts are required to carry a significant load, it is generally recommended that a tension of approximately 70% of the capacity of the bolt be installed initially. This provides a known load with a reserve in case of additional load being induced by displacements in the rock mass. Test values of 80% and lock off-transfer loads of 70% of ultimate are also typical.

