

The logo for Maine Drilling & Blasting features the company name in a bold, serif font. A vertical red bar is positioned to the left of the text, partially overlapping the letter 'M'.

To: Mike Garn – Schultz Construction
From: Peter Marcotte, Maine Drilling & Blasting
Date: May 21, 2014
RE: Rock bolt Installation Submittal for Bridge 16 - Rochester, VT

Mike,

We have enclosed the proposed material and installation procedure for the 4 Rock Anchors at the Rochester, VT – Bridge 16 Project. The materials herein are an Alternate Anchorage System which will best suit the schedule for the project. The system meets the corrosion protection and capacity of the anchor described in the plans and specs.

We urge timely review so that the material can be procured, with any galvanized product the lead times are 4-6 weeks minimum.

Index

- Anchor Materials and Typical Detail
- Installation Procedure
- Grout Materials and Equipment
- Anchor Testing Logs and Equipment
- Installation Logs
- Federal Highway Administration remarks on Development of an Unbonded Length for Hollow core anchors, courtesy of Williams Form Engineering.

We look forward to working with your team. Please contact us with any questions.

Sincerely,

Maine Drilling & Blasting

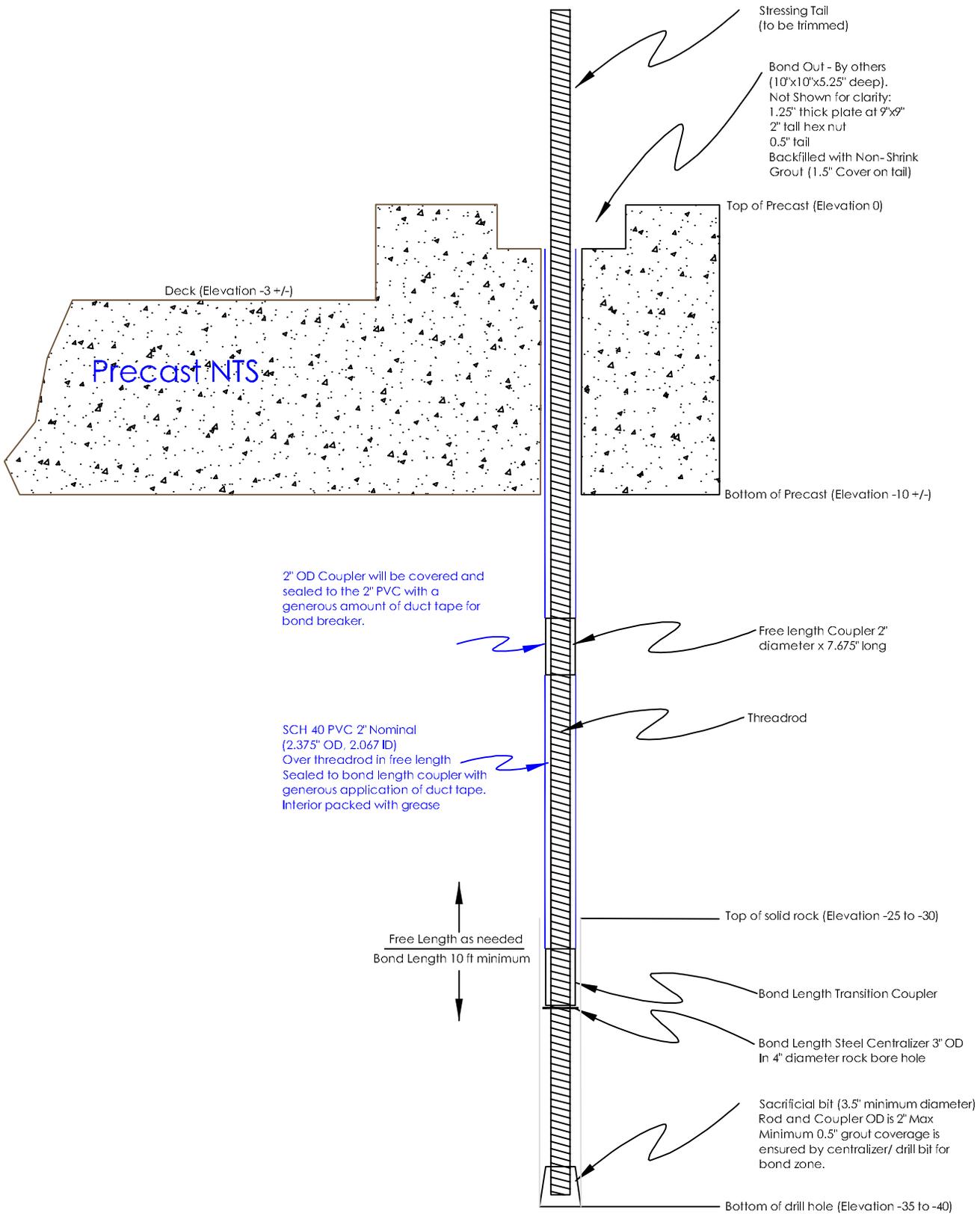
A handwritten signature in black ink, appearing to read 'Peter Marcotte', is written over a faint, larger version of the signature.

Peter Marcotte
Project Engineer

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Anchor Materials & Typical Detail



Stressing Tail
(to be trimmed)

Bond Out - By others
(10'x10'x5.25" deep).
Not Shown for clarity:
1.25" thick plate at 9'x9"
2" tall hex nut
0.5" tail
Backfilled with Non-Shrink
Grout (1.5' Cover on tail)

Top of Precast (Elevation 0)

Deck (Elevation -3 +/-)

Precast NTS

Bottom of Precast (Elevation -10 +/-)

2" OD Coupler will be covered and
sealed to the 2" PVC with a
generous amount of duct tape for
bond breaker.

Free length Coupler 2"
diameter x 7.675' long

Threadrod

SCH 40 PVC 2' Nominal
(2.375" OD, 2.067" ID)
Over Threadrod in free length
Sealed to bond length coupler with
generous application of duct tape.
Interior packed with grease

Free Length as needed
Bond Length 10 ft minimum

Top of solid rock (Elevation -25 to -30)

Bond Length Transition Coupler

Bond Length Steel Centralizer 3" OD
In 4" diameter rock bore hole

Sacrificial bit (3.5" minimum diameter)
Rod and Coupler OD is 2" Max
Minimum 0.5" grout coverage is
ensured by centralizer/ drill bit for
bond zone.

Bottom of drill hole (Elevation -35 to -40)



Bridge 16 - Rochester, VT

Typical Anchor Sketch

DATE: May 21 2014

SCALE: NTS



Hollow Bar Anchor System

Geo-Drill Injection Anchor System

The Williams Geo-Drill Injection Anchor System is today's solution for a fast and efficient anchoring system into virtually any type of soil. The system has historically been known as a "self-drilling anchoring" because the hollow fully-threaded bar serves as both the drill string and the grouted anchor, thus installation is performed in a single operation. The sacrificial drill bit is threaded onto the end of the Geo-Drill bar and left in place following drilling. The drilling fluid (air, water, or grout) is introduced through the hollow bar and allows the spoils to flush from the borehole.

The Geo-Drill System is particularly suitable for soils that do not allow for open-hole drilling (i.e. granular soils that are collapsible in nature). In such cases, drilling with a grout fluid serves the purpose of flushing spoils from the borehole and prevents looser, surrounding material from collapsing due to the higher relative density of the grout. Williams Geo-Drill Injection Anchor System should be considered on any project requiring fast production that would otherwise need to involve a casing system in order to maintain borehole stability.



Advantages of the Williams Geo-Drill Injection Anchor System

- **Fully Domestic System.**
- Fast, single-step anchoring system with simple equipment.
- Eliminates the need for a cased borehole in collapsing soils.
- Efficient installation since drilling and grouting can be performed in a single operation, saving both time and money.
- Continuously drilling and grouting under high pressure causes the grout to permeate into looser soils and creates a bulb-effect for increased bond capacity.
- Suitable for working in limited space and areas of difficult access.
- Multiple ranges of drill bits suitable for most soil conditions.
- Installed with standard track drill (top hammer) or hand-held drilling equipment, eliminating the need for larger casing rigs.
- Continuously threaded bar pattern can be cut and coupled anywhere along its length.
- Available in 10 or 20' lengths.
- Corrosion protection systems available upon request.
- FHWA approved for use as a micro pile.
- Domestic material available upon special request.

Thread rod is Hot Dip Galvanized per ASTM A123 & A153 (per spec)

B7X Geo-Drill Bar

Bar Diameter	Minimum Net Area Through Threads	Minimum Ultimate Strength	Minimum Yield Strength	Nominal Weight	Average Inner Diameter	Part Number
32 mm (1-1/4")	0.556 in ² (359 mm ²)	58.4 kips (260 kN)	47.2 kips (210 kN)	2.1 lbs/ft (3.1 Kg/M)	0.787" (20.0 mm)	B7X1-32
32X mm (1-1/4")	0.776 in ² (501 mm ²)	81.5 kips (363 kN)	66.0 kips (294 kN)	2.7 lbs/ft (4.0 Kg/M)	0.626" (15.9 mm)	B7X1-32X
38 mm (1-1/2")	1.067 in ² (688 mm ²)	112 kips (498 kN)	90.7 kips (404 kN)	3.76 lbs/ft (5.6 Kg/M)	0.830" (21.1 mm)	B7X1-38
51 mm (2")	1.795 in ² (1158 mm ²)	188 kips (837 kN)	152 kips (677 kN)	6.26 lbs/ft (9.3 Kg/M)	1.187" (30.1 mm)	B7X1-51
76 mm (3")	3.880 in ² (2503 mm ²)	407 kips (1811 kN)	329 kips (1466 kN)	13.79 lbs/ft (20.5 Kg/M)	1.890" (48.0 mm)	B7X1-76

Threaded Bar Profile

The Injection Bar is a high strength, impact resistant heavy wall steel tubing conforming to ASTM A519 or A513 and is continuously threaded over its entire length with a heavy duty left hand thread/deformation pattern. The steel tubing provides maximum flow with minimum resistance during high pressure flushing and grouting operations. The thread form (similar for all diameters) is a unique Williams feature that provides a lower thread pitch angle to provide easier coupling disengagement without "locking up", than conventional rope threads during drilling operations. This thread form provides more surface area and thread/deformations per unit length for superior bond capabilities over that of competitive drill steel thread forms. The bar's thread/deformation pattern has also shown to exceed the bond characteristics of ASTM A615 reinforcing steel. The lower thread angle allows the installed anchor to be torque-tensioned for fast tie back installations. The Geo-Drill Injection Anchor system is available with enhanced corrosion protection with hot-dip galvanized/epoxy coated bars and components. Installation adapters for the Geo-Drill Injection Anchors are available for all drill rigs.



Accessories

Couplings

The Geo-Drill Injection Anchor Couplings have a unique tapered center stop which seals the Injection Bar connection to prevent grout leakage during simultaneous grouting and drilling operations. The internal stop design also assures a full positive thread connection in both Injection Bar ends while providing a matching end bearing between bars that reduces percussion energy loss to the drill bit. The couplings are machined from ASTM A29 grade C1045 high strength steel to provide 100% ultimate tensile or compression strength capacity of the installed anchorage. The coupling OD is tapered on both ends to allow drill cuttings and grout displacement during drilling while the ID has internal chamfers to assist alignment and connection of the bars.



B7X2 Stop-Type Coupling - ASTM A29

Nominal Bar Diameter	Outside Diameter	Overall Length	Part Number
32 mm (1-1/4")	1-5/8" (41.3 mm)	6-1/4" (159 mm)	B7X2-32
38 mm (1-1/2")	2" (50.8 mm)	7-5/8" (194 mm)	B7X2-38
51 mm (2")	2-5/8" (66.7 mm)	8-1/2" (216 mm)	B7X2-51
76 mm (3")	3-7/8" (98.4 mm)	9-7/8" (251 mm)	B7X2-76

Couplers, Hex Nut are Hot Dip Galvanized per ASTM A123 & A153 (per spec)
Plate is 9"x9"x1.25" thick, is also Galvanized and is A36 material

Hex Nuts

The Hex Nuts designed exclusively for the Geo-Drill Injection Anchor system are a full 100% ultimate tension or compression strength component. They are manufactured from a high strength steel complying with ASTM A108.



B7X3 Hex Nuts - ASTM A108 or A29

Nominal Bar Diameter	Across Flats	Thickness	Part Number
32 mm (1-1/4")	1-3/4" (44.5 mm)	1-3/4" (44.5 mm)	B7X3-32
38 mm (1-1/2")	2" (50.8 mm)	2" (50.8 mm)	B7X3-38
51 mm (2")	3" (76.2 mm)	2-1/2" (63.5 mm)	B7X3-51
76 mm (3")	4" (102 mm)	4-1/4" (108 mm)	B7X3-76

R9F Hardened Washers - ASTM F436

Nominal Bar Dia.	Outside Diameter	Inside Diameter	Thickness	Part Number
32 mm (1-1/4")	2-1/2" (63.5 mm)	1-3/8" (34.9 mm)	5/32" (3.97 mm)	R9F-10-436
38 mm (1-1/2")	3" (76.2 mm)	1-5/8" (41.3 mm)	5/32" (3.97 mm)	R9F-12-436
51 mm (2")	3-3/4" (95.3 mm)	2-1/8" (54.0 mm)	7/32" (5.56 mm)	R9F-16-436
76 mm (3")	5-1/2" (140 mm)	3-1/8" (79.4 mm)	9/32" (7.14 mm)	R9F-24-436

R8M Beveled Washers - ASTM A47 or ASTM A519

Nominal Bar Dia.	Degree of Bevel	Outside Diameter	Inside Diameter	Maximum Thickness	Minimum Thickness	Part Number
32 mm (1-1/4")	15°	2-13/16" (71.4 mm)	1-5/16" (33.3 mm)	1" (25.4 mm)	5/16" (7.9 mm)	R8M-09S
38 mm (1-1/2")	15°	3-3/8" (87.7 mm)	1-9/16" (39.7 mm)	1-15/64" (31.4 mm)	3/8" (9.7 mm)	R8M-12S
51 mm (2")	15°	4" (102 mm)	2-1/4" (57.2 mm)	1-37/64" (39.9 mm)	1/2" (12.7 mm)	R8M-16B7X
76 mm (3")	15°	6" (152 mm)	3-1/2" (88.9 mm)	2-7/64" (53.6 mm)	1/2" (12.7 mm)	R8M-24B7X

Beveled washers must be used in conjunction with hardened washer.



Centralizers

The bar can be centralized in the drill hole on 10' centers by attaching a steel centralizer in front of the coupling during the drilling operation. Available plain or hot dip galvanized to ASTM A123. State drill hole diameter and bar size when ordering.

Bearing Plates

Williams provides a large selection of bearing plates for the Geo-Drill Injection Anchors in ASTM A36 in Grade 36 or ASTM A572 Grade 50 steel. The bearing plate holes can be round for standard embedment applications or slotted for angled Injection Anchors installed through steel walers or in contact with a rock slope. We manufacture plates to any size specifications required by the project or Williams can design a bearing plate for your specific application.



Accessories

B7XB Drill Bits



HC Drill Bit

Hardened cross cut drill bit, suitable for the majority of applications including narrow bands of soft rock.

Soil Types: Fills and Medium Dense Gravels



CC Drill Bit

Tungsten carbide cross-cut drill bit. Excellent choice for majority of granular soils with mixed hard formations.

Soil Types: Fills, Gravels, Shale & Seamy Rock Formations.



SB Drill Bit

Two stage cross cut drill bit, suitable for loose ground and fills.

Soil Types: Sand, Clay and Medium Dense Clays



CB Drill Bit

Tungsten carbide hemispherical button drill bit for moderately strong to strong rock, boulders and rubble.

Rock Types: Mudstone, Limestone, and Granite



GB Drill Bit

Offset face cross cut drill bit suitable for drilling in cobbles with silt and gravel as well as sedimentary bedrock material.

Nominal Bar Diameter	Available Drill Bit Diameters				
	HC	CC	SB	CB	GB
32 mm (1-1/4")	2" (51 mm)	2" (51 mm)			
	2-1/2" (65 mm)	2-1/2" (65 mm)			
	3" (76 mm)	3" (76 mm)	4" (100 mm)	2" (51 mm)	4" (100 mm)
	3-1/2" (89 mm)	3-1/2" (89 mm)			
38 mm (1-1/2")	4" (100 mm)	4" (100 mm)			
	2-1/2" (65 mm)	2-1/2" (65 mm)	5" (127 mm)		
	3" (76 mm)	3" (76 mm)		3" (76 mm)	4" (100 mm)
	3-1/2" (89 mm)	3-1/2" (89 mm)	6" (150 mm)		
51 mm (2")		3" (76 mm)			
		3-1/2" (90 mm)	8" (203 mm)	4" (100 mm)	5" (127 mm)
		4" (100 mm)			
76 mm (3")		5" (125 mm)			
		6" (150 mm)	10" (254 mm)		
		7" (175 mm)			

Applications

Soil Nails

Soil Nails are non-tensioned, in-situ reinforcement for the stability of excavations and embankments in top-down construction. The Williams Geo-Drill Injection Anchor System is an ideal choice for soil nailing in difficult soils as it offers high installation rates. Hollow bar elements have been used as an approved permanent soil nail on selected DOT projects and are currently under an FHWA evaluation study which would make them generally accepted for use as a permanent soil nail.

Prestressed Ground Anchors

Williams Geo-Drill Injection Bar Anchors can be used as a choice for pre-tensioned anchors in loose or collapsing soils without the need for a casing. A free length must be installed onto the anchor if the project specifications call for a pretension load to be applied from the bond length. Please consult with a Williams specialist for suggestions to properly attach a free length sleeve. Note to Designer: Consult with Williams for an appropriate level of corrosion protection if prestressed ground anchors are intended to be used for a permanent application.

Micro Piles

Williams Geo-Drill Injection Bar offer an excellent choice for micro piles in difficult ground conditions where open-hole drilling isn't possible. The continuously threaded bar profile lends itself perfectly for restricted headroom applications because the bar can be cut and coupled at any length. The FHWA has approved hollow bar anchors for permanent use in micro pile applications.

Tunnel Spiles and Forepoling

The Geo-Drill Injection Anchor System are often used for spiling in NATM tunneling. Spiles are continuously drilled and grouted pre-support reinforcement to enable the heading of a tunnel to advance without the risk of falling debris. The anchors can also be used as face stabilization of portals.

Limitations of System

In general, Williams recommends using the Geo-Drill Injection Anchor System in difficult soils that do not allow for open-hole drilling. Ground conditions featuring large voids or the presence of underground water are generally not suitable for a drilled and grouted hollow bar. In hard rock, conventional DTH (Down the Hole Hammers) in open-hole drilling offer a more efficient alternative. In all such cases, Williams offers solutions in their complete line of solid bar anchor systems and multi-strand tendon systems.

Project Photos



Project: Queens Crossing
Contractor: Urban Foundation
Location: New York, NY



Project: Heartland Corridor Clearance Improvement
Contractor: Johnson Western Gunite
Location: Radford, VA



Project: Reno Retrack Project
Contractor: Condon Johnson
Location: Reno, NV



Project: Private Residence
Contractor: B&Y Construction
Location: Aspen, CO



Project: Hana Highway
Contractor: Prometheus Construction
Location: Maui, HI



Project: North & East Telluride
Contractor: Mays Construction Specialties
Location: Telluride, CO



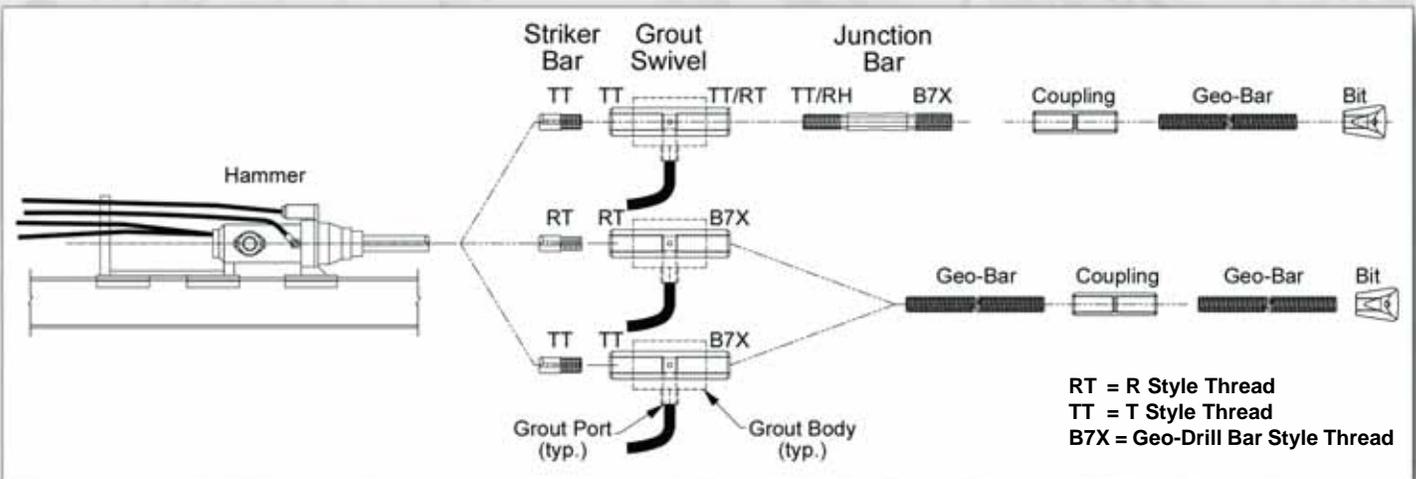
Installation

The Williams Geo-Drill Injection Anchor System is optimally used in poor or very poor ground conditions ranging from inconsistent fill, boulders, rubble and weathered rock to sand and gravel. Generally the system is installed with rotary percussive drilling and continuous grouting. The thickness of grout can be varied depending on susceptibility of the borehole to collapse, however a grout mixture of 0.4 water to cement ratio is recommended in poor, collapsible soils to ensure a high enough density to support the annulus. In all cases, a final grout mixture of 0.40 w/c should be used for adequate in-situ structural capacity. Williams recommends mixing the grout in a colloidal (shear type) mixer, so once pumped, the fine grout particles are fully able to disperse into the small voids of the surrounding soil. This well mixed grout exits the side ports of the drill bit under pressure to flush and remove the softer parts of the soil while penetrating into the firmer material for increased bond capacity. Williams recommends to partially withdraw each fully drilled section up the drill mast prior to attaching new sections, this way the drilling can begin in a plunging type action to even further improve grout penetration. Utilizing proper drilling and grouting techniques is important as the system would generally fail between the soil/anchor interface, not the grout/anchor interface.

In all cases the hollow bar system should be drilled slow enough to ensure rotation through the soil as opposed to excessive percussion and feed pressure with limited rotation. Such practice will provide the formation of a true borehole with consistent grout cover. Grouting pressure should be sufficient to maintain circulation at all times with a small amount of grout return visible at the mouth of the borehole. Normal drilling rotation is in the range of 40 and 100 RPM.

Drill Rigs

The preferred method of installation for the Williams Geo-Drill Injection Anchor System is rotary percussion drilling, as this method offers good directional stability and high rates of production. Hand-held drill rigs can be used to install 32 mm (1-1/4") bars. Hand-held equipment works best when used in conjunction with a jackleg or within a slideframe arrangement.



Grout-Swivel System for Rig Installation

For simultaneous drilling and grouting installations a grout-swivel system is required. The grout-swivel consists of a Grout Body and Grout Shank. The Grout Shank fits within the Grout Body and contains grout inlet ports. One end of the shank attaches to the striker bar while the other end attaches to the hollow bar anchor. The Grout Body contains an inlet pipe to allow grout to enter into the shank and down the hollow bar. The body remains stationary while the shank spins with the rotary action of the drill. To hold the body into position and prevent spinning with the rotary action of the drill, it is necessary to attach a locator frame from the body to the drifter.

We recommend water or grout flush (not air) be used with the grout-swivel system. In all cases, grease should be applied to the grout-swivel system prior to use.

Junction Bar

When using a grout shank with a T or R type thread, Williams recommends the use of a Junction Bar to transition between the Grout Shank and the Geo-Drill Bar. Coming out the anchor end of the Junction Bar would either be a Geo-Drill Coupling or Coupling Adapter. All disengagement during drilling to add sections or move to another anchor location would be done from below the Junction Bar and not at the Grout Shank, thus prolonging the life of the Grout Swivel.

Coupling Adapter

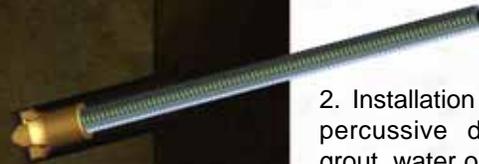
A Coupling Adapter is a machined and case hardened adapter, which is usually located just below the drill hammer and is used to connect the striker bar to the hollow bar. Sizes are available in any striker bar thread type to connect to any Geo-Drill Bar size. Generally a Coupling Adapter would be used in place of a grout-swivel during an air flush installation.



Installation



1. Williams Geo-Drill Injection Anchor set into position for installation.



2. Installation begins with rotary percussive drilling and either grout, water or air flushing.



3. Once the first 10 foot section is installed, drilling stops long enough to add the second section.



4. Raise the anchor high enough to get visible evidence of flush return from the mouth of the bore hole and begin drilling again in a normal fashion.



5. Add sections in the manner noted in step four until anchor reaches final depth. Completely flush all drilling grout and debris with competent compressive strength grout.



Strand Accessories

Centralizers - CEN

Centralizers are placed over the strand anchor assembly to maintain the minimum required 0.5" distance between the assembled anchor bundle and the drill hole wall. Depending on the anchor type and orientation, there are a wide variety of centralizers available for every application. State drill hole size for ordering.



Heavy Duty Plastic Grout Tube

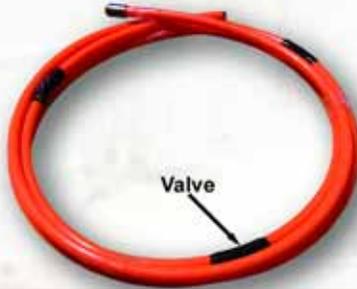
Furnished in product lengths or in rolls.



O.D.	I.D.	Part No.
3/8" (9.5 mm)	1/4" (6.4 mm)	T3P03002
1/2" (12.7 mm)	3/8" (9.5 mm)	T3P04003
5/8" (15.9 mm)	1/2" (12.7 mm)	T3P05004
3/4" (19.1 mm)	5/8" (15.9 mm)	T3906005
1" Nom. (25.4 mm)	3/4" Nom. (19.1 mm)	T3P06

Post-Grout Tube

Williams will provide post-grout tubes for anchors bonded in weak rock or soil upon request. Williams supplies flexible Post-Grout Tube with bursting strengths of 1000 psi, as well as PVC Post-Grout Tube with bursting strengths of 900 psi. The Post-Grout Tube length and valve placement are adjustable and can be specified at the time of order. Drill hole diameter should be a 1" minimum clearance to accommodate Post-Grout Tube.



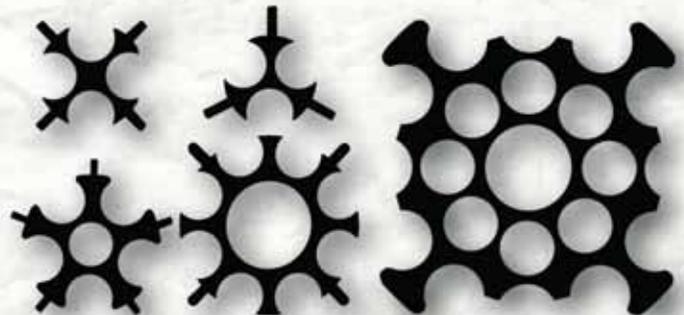
Corrosion Inhibiting Grease or Wax Gel

Williams corrosion inhibiting compounds can be placed in the free stressing areas, in the end caps, and trumpet areas. Each are of an organic compound with either a grease or wax gel base. They provide the appropriate polar moisture displacement and have corrosion inhibiting additives with self-healing properties. They can be pumped or applied manually. Corrosion inhibiting compounds stay permanently viscous, chemically stable and non-reactive with the prestressing steel, duct materials or grout. Both compounds meet PTI standards for Corrosion Inhibiting Coating.



Spacers - RSPS

Strand spacers are provided in the anchor bond zone to separate the strand and provide for the minimum required grout cover around each strand for corrosion protection and bond strength development. The strand spacers are normally located 1-2 feet above the bottom of the anchor and at the top of the bond zone. The intermediate strand spacers are typically placed at a distance of 5-10 feet, center to center along the bond zone between the top and bottom spacer.



Corrugated Duct - R75

Williams utilizes corrugated duct that complies with the required wall thickness (0.060" nominal) as specified by the Post-Tensioning Institute's *Recommendations for Prestressed Rock and Soil Anchors*.



Heat Shrink Tubing

Provides a corrosion protected seal when connecting or repairing smooth and corrugated segments.

Corrosion Protection Coatings

Optional coatings for steel end caps, bearing plates with trumpet and anchor heads are available for additional corrosion protection as required by the designer. Coating specifications are as follows:

- Electro Zinc Plating:** ASTM B633 (wedge plates)
- Hot Dip Galvanizing:** ASTM A153 (bearing plates/trumpets and steel end caps)
- Epoxy Coating:** ASTM A775 (bearing plates/trumpets and steel end caps)

Product Data Sheet

No. 17007 - 05/13

COLD GALVANIZE COATING 93% ZINC RICH

AEROSOL CARB VOC < 80% / MIR ≤ 1.90, BULK < 500 G/L

PRODUCT NUMBERS:

7007 - 13 OZ. NET WT. AEROSOL

Product number 7007 plus letter designation is as follows:

P = 1/2 pint; Q = 4 one-quart cans; G = 1 one-gallon can (not sold in fives or drums due to weight)

I. GENERAL DESCRIPTION

Description: Crown's premium Cold Galvanize Coating 93% Zinc Rich provides corrosion protection to ferrous metal surfaces; first as a long-lived coating of practically pure Zinc comparable to that obtained by galvanization and second, through sacrificial anodization. Both aerosol and bulk use metallic zinc dust that is 97% pure, which leaves 93% zinc in the dry film. The zinc fuses to metal substrates for protection equal to or better than hot-dipped galvanizing. This protection becomes effective when the surface is scratched, broken, or corrupted. With the presence of moisture the Zinc coating will corrode while continuing to protect the metal it covers.

Benefits: Meets multiple performance requirements of ASTM, MIL, and DOD specifications (see "Specifications"). Acceptable as a coating in federally inspected meat and poultry plants for application to structural surfaces or surfaces where there is a possibility of incidental food contact. It acts as both a metallic primer and single coat for iron, steel, and their welds. It may be the final protective coating or it may be top coated with Aervoe's DTM water-based Rust Proofing paint.

Application: Use on damaged galvanized surfaces, structural steel, automobiles, guard rails, bridges, TV and radio towers, welded joints, storage tanks, signs and sign posts, equipment (farming, mining & construction, power plant, railroad, offshore, etc.), gutters, pipelines, transformers, and corrugated metal buildings. Ideal for industrial type applications in the aviation, marine, petroleum and manufacturing fields.

Directions: Apply directly to metal or galvanized surfaces that are free of loose rust, heavy mill scale, old paint, grease, moisture, and other contaminants. Clean severely rusted areas with a wire brush to remove loose scale. For best results, use at temperatures between 64° and 86°F (18° to 30°C). Drying may be accelerated by applying heat.

Notice: Zinc is a dense material which will settle on the bottom of the container. This product is formulated to resist hard settling (where zinc is dry, clumped together and will not remix). However, soft settling (the

zinc sinks to the bottom but remains wet, no clumping, & will remix) is natural for this product and can occur from road vibration during transportation or while sitting on the shelf. **Aerosol application:** align spray head with black mark on valve rim to insure complete evacuation of contents. Vigorously shake can for 2 minutes after hearing rattle of agitator ball (ball should release in 10 to 30 seconds), and intermittently (1 to 2 seconds) during use. Apply from a distance of 10 to 12 inches. Spray in light, sweeping strokes to avoid run and sags. The preferred application method is to apply a coating of 3-4 mils, wet thickness in one application. One coat will be satisfactory. A second coat may be applied to maximize the protection (refer to the recoat schedule). Whenever you must set the aerosol can aside for more than 2 minutes or are ready to store the can, then invert the can and spray for two seconds to clear dip tube, valve and tip to prevent zinc from drying in those areas and clogging the can. **Bulk application:** mix contents thoroughly (paint shaker or electric drill with metal paint stirrer) and scrape bottom and sides. Contents may be applied full-strength without thinning. If using in conventional spray equipment, use a minimum pressure of 40 psi. If thinning, do not add thinner directly to the contents; pour contents into separate container and thin as necessary with mineral spirits or vm&p naphtha. Check local VOC regulations / air quality standards prior to thinning as the use of either solvent will increase the VOC content. Invert stored bulk containers occasionally to keep solids in suspension.

Limitations: Please refer to the Safety Data Sheets for specific information on material hazards, etc. Do not apply at temperatures below 40°F (4°C), or if rain is imminent within 6 hours of application. Galvanizing products have a limited shelf life; use them within 12 months from the date of manufacture (guarantee is for 6 months from date of purchase and 12 months from date of manufacture). The bulk product has special conditions related to storage. In bulk form, the user must be aware of possible gas formation which could distort the container and affect storage stability. Containers should be stored in a cool dry place.

Packaging:

Aerosol:	Cans (211x604)	13 net wt. (369 g)	8.6 fl. oz. (255 ml)
	Case (12/case):	14 lbs. (6.4 kg)	0.47 CF (0.013 CM)
Bulk:	1 case of 12 half-pints (mt. rd.)	21 lbs. (9.5 kg)	0.33 CF (0.009 CM)
	1 case of 4 quarts (mt. rd.)	26 lbs. (11.8 kg)	0.29 CF (0.008 CM)
	1 case of 1 gallon (mt. rd.)	25 lbs. (11.3 kg)	0.31 CF (0.009 CM)

II. CHARACTERISTICS & PROPERTIES

Specifications: Meets specification MIL-P-21035B (par. 3.3.1, 3.3.2, & 3.3.3) and performance requirements of MIL-P-46105(MR) (par. 3.2, 3.3.1, 3.5.8, 4.4.5), DOD-P-21035A (par. 3.1, 3.2, 3.5.3, 3.5.6, 4.4.3, 6.1, & 6.5), and MIL-P26915 as a lead-free, zinc dust primer for steel surfaces. Meets ASTM B-117 salt spray (2000 hrs) and ASTM A 780. Meets SSPC 20 paint specifications. Bulk product meets National Architectural Coatings VOC emissions standards of 500 g/L and aerosol meets CARB requirements.

Appearance:

Gloss at 60°	< 5	
Class	Metallic	
Coverage:.....	Aerosol	Bulk
Theoretical (at 1 mil dry)	24 sq. ft./can.....	870 sq. ft./gallon
Practical (at 1/2 mil dry).....	48 sq. ft./can.....	1740 sq. ft./gallon

Drying Schedule (at 77° F [25° C], 50% Humidity at 1 mil dry):

To touch.....	15 min.....	15 to 20 min.
To handle.....	30 min.....	1 hr.
To recoat	Before 1 hr. or after 24 hrs.	Before 1 hr. or after 48 hrs.
Full cure	24 hrs.	48 hrs.

Performance and Chemical Properties:

Weight per gallon	17 lbs.....	23 lbs.
Specific gravity.....	2.03	2.76
Viscosity		90 to 100 Ku
Flammability: Label marking	Extremely flammable.....	SP
Flash point.....	< 0° F (-18° C).....	101° F (38° C) T.C.C.
Operating temperature range.....	50° to 90° F (10° to 32° C)	50° to 90° F (10° to 32° C)
Percent solids by weight	60%	85%
Percent solids by volume	20%	45%
Percent pigment by volume.....	12%	30%
Dry Film Weight.....	93% zinc dust.....	93% zinc dust
	7% resin	7% resin
CARB VOC (zinc rich primers).....	< 80%.....	< 500 g/L
CARB MIR (Metallic Coating).....	< 1.90	
Interior durability.....	Excellent.....	Excellent
Exterior durability	Excellent.....	Excellent
Temperature resistance.....	150° F (65° C)	150° F (65° C)
Color fastness	Excellent.....	Excellent
Adhesion (ASTM D3359).....	Fair	Very Good
Salt spray corrosion (ASTM B117).....	2000 hrs.	2000 hrs.
Mineral Spirits resistance.....	Fair	Fair
Gasoline resistance.....	Poor.....	Good
Motor Oil resistance	Good.....	Good
Pencil hardness (ASTM D3363).....	< 2B	< 2B

Base Materials:

Resin system.....	Acrylic.....	Epoxy Ester
Solvents (top two)	VM&P Naphtha, MEK.....	Petroleum Distillate
Propellant.....	Hydrocarbon	

III. SHIPPING, STORAGE AND HEALTH

	Aerosol	Bulk
UN number.....	UN1950	UN1263
Proper Shipping Description	Aerosols.....	Paint
Hazard Class.....	2.1	3
Packing Group	N/A.....	III
Limited Quantity	Yes.....	Container size determines applicability
Warehouse storage level number	NFPA 30B Level 1.....	Flammable liquid class 1-C
Storage temperature	32° to 120°F (0° to 49°C).....	32° to 120°F (0° to 49°C)
Shelf life	6-12 months.....	6-12 months
HMIS ratings		
Health	2	2
Fire.....	4	2
Reactivity	1	1

IV. MISCELLANEOUS

Contains no Ozone Depleting Substances (O.D.S.)

V. WARRANTY

1-year performance warranty on all products from date of purchase. Report to home office or local Aervoe representative for examination. Because Seller cannot control Buyer's handling or use of product, Seller makes no warranty expressed or implied when not used or stored in accordance with directions. Seller shall not be liable for cost of labor, incidental or consequential damages, and this warranty is limited to replacement of product or credit of purchase.

Installation Procedure

Anchor Assembly

- Anchor typical detail is enclosed for reference. The galvanized thread rod will be furnished in 10 foot minimum lengths. The 2” nominal diameter free stressing sleeves will be installed at the factory by the anchor manufacturer. Lengths will be added as the drill progresses and couplers will be treated as detailed in the typical detail enclosed.

Anchor Installation

- At the option of the MD&B, the hole may be predrilled with conventional drill steel and rock bit advanced by the percussion drill rig. Predrilling will determine the elevation of rock for material staging and serve as pre-bore/flush of overburden between the precast and the ledge surface. This will minimize the overburden drill spoils which have to be managed in the bond out during the anchor installation, predrill any significant boulder obstructions in the overburden, enhance the ability for migrating grout flush.
- The Anchor will be installed using the percussion drill rig in accordance with the manufacturer’s recommendations, Williams Form, which are enclosed in the materials section of this submittal.
- Grouting will be primarily during the drill process. If clean grout is not returned at the top of the hole (to bond-out grade) via pumping bond grout through the anchor the following will be completed.
 - If return is not achieved by a reasonable attempt (2 times the theoretical after making final embedment depth), the hole will be topped off from the top of the hole via lancing a grout tube to the bottom of the precast to ensure any displaced material at the precast/subgrade interface is backfilled with bond grout.
- After the anchor placement is complete, the bond out will be cleaned of debris. A skim coat of stiff mix bond grout will be placed on bearing surface as needed. The PVC stressing length will be trimmed as needed and the plate will be installed.
- The bond grout will cure for minimum 3 days or as break determine prior to anchor testing.

Anchor Testing

- Information on the stressing equipment is enclosed in this submittal.
- All anchors will be proof tested.
- There will be no sacrificial test anchor.
- Testing will be in accordance with the specifications.
- A Sample test log is included, a Design Load and Lock off load (if any) is requested to construct the final test log.

Completion

- Upon acceptance of the anchor testing the anchor will be trimmed as shown in the typical detail. The cut end will be cleaned and a cold galvanize product will be applied to the cut end (product cut sheet in Anchor Materials section). The bond out will be back filled with non-shrink grout (product cut sheet in Grout Materials section).

Installation Logs

- Drilling Logs & Grouting Logs will be completed, logs are included in this submittal

Grout Materials & Grouting Equipment

Bond Grout Mix:

- The mixture of grout is 5 gallons of water to 94 # (1 bag) of Portland Type I / II cement and 8 oz. of FX-32. The ad-mixture FX-32 Catalytic Agent will be used to reduce cure time.
- Sample breaks on this mix are enclosed.

Non Shrink Grout:

- The mixture will be the recommended plastic/flow able mix.

OPTIMUM

CONSTRUCTION LAYOUT - MATERIALS TESTING

P.O. Box 439 • 195 Gosselin Drive • Derby, Vermont 05829
Office: 802-766-2434 • E-mail: optimum.test@yahoo.com

Report of Grout Cubes Compressive Strength

Project Name: Kingdom Community Wind

Project Number: 1116-316

Client: Brian Holmes

Client Contract #:

General Contractor: Reed & Reed, Inc
Woolwich, Maine

SAMPLE BOND GROUT BREAKS OF MD&B
PROPOSED MIX

PLACEMENT INFORMATION

Date Cast: 6/28/2012

Placement Location: T-13 Rock Anchor Grout

Grout Type: Portland Type I/II w/ FX-32 Catalytic agent

Mix Design: 5 Gal. water / 94 lb bag with 8 oz of FX-32

Strength Requirements: Minimum 3000 PSI @ 7 Days

TEST RESULTS

Mark	Date Tested	Age (Days)	Cube Dimensions		Total Load (lbs.)	Unit Load (psi)
			D1 (in)	D2 (in)		
A	7/5/2012	7	2.01	1.99	29700	7425
B	7/5/2012	7	1.96	2.00	30290	7727
C	7/26/2012	28	2.00	2.02	36240	8970
D	7/26/2012	28	2.01	1.99	36430	9108

Remarks:

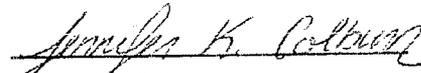
Bond Grout



P.O. Box 191, U.S. Route 1 • Thomaston, Maine 04861 • 207-594-5555

MILL TEST RESULTS Laboratory at Thomaston, Maine	Date: January, 2011 Cement Type: I/II Silo Numbers: 20, 24, 27 & 30
---	---

CHEMICAL DATA	Percent	PHYSICAL DATA	
Silicon Dioxide.....	20.3	Specific Surface.....	377
Aluminum Dioxide.....	4.3	Blaine (sq m /kg)	
Ferric Oxide.....	3.0	(Per ASTM C 204)	
Calcium Oxide.....	61.7	Percent Passing 325 Mesh	98.3
Magnesium Oxide.....	3.6	(Per ASTM C 430)	
Sulphur Trioxide.....	3.7	Compressive Strength (psi)	
Loss on Ignition.....	1.2	(Per ASTM C 109)	
Insoluble Residue.....	0.4	1 day.....	2390
Tricalcium Silicate.....	53	3 day.....	3980
Dicalcium Silicate.....	18	7 day.....	4730
Tricalcium Aluminate.....	6	28 day.....	
Sodium Oxide.....	0.3	Vicat Setting Time	
Potassium Oxide.....	1.3	(Per ASTM C 191)	
Equivalent Alkalies.....	1.2	Initial (min.).....	115
(Chemical Analysis all per ASTM C 114)		Final (min.).....	205
		Air Content (%).....	7.7
		(Per ASTM C 185)	
		Autoclave Expansion (%).....	0.17
		(Per ASTM C 151)	
		Expansion in water (%).....	0.010
		(Per ASTM C 1038)	
		Heat of Hydration (%).....	80
		(Per ASTM C186)	

Certified by:

 Jennifer K. Colburn

We hereby certify that this cement complies with current ASTM C 150, AASHTO M-85 and CSA-A3001 Type GU specifications.

Testing was completed by Brian Secord and/or Richard Erickson
 This mill test report is generated for silos produced in the calendar month prior to the date upon this report.



FX-32 Catalytic Agent

DESCRIPTION:

FX-32 Catalytic Agent is a high range water reducing admixture for Portland cement based materials. **FX-32 CA** is available in liquid or powder forms and meets the performance requirements of ASTM C 494 Type F admixtures. A water reduction, in concrete and grout up to 25% can be achieved at a normal level of workability **FX-32** provides excellent workability of plastic concrete, superior later-age strength and improved finishability, **FX-32** produces high-early strength, scale resistant concrete or grout even with low cement mixes.

ADVANTAGES:

- Reduces water demand of Portland cement mixes.
- Retards initial set, depending on dosage used from 1/2 to 1 hour when compared to control mix. It is capable of producing structural concrete in 24 hours.
- Increases density and lowers chloride and other chemical intrusion.
- Increases bond of new concrete or mortar to old.
- Resists attack by water with an altered pH condition or salt spray when used in marine environment or on bridge decks.
- Lower water content reduces shrinkage by 25% to 40%.

WHERE TO USE:

In concrete: For use where corrosion resistance is an important design consideration, and where the level of chloride or chemical intrusion is needed to be kept to its lowest possible levels.

In grout: To increase fluidity, strength, density and bond. Bridge decks, tie backs, underpinning precast concrete, parking decks, and on-grade highway patching are examples of where **FX-32CA** has been successfully employed.

PHYSICAL PROPERTIES:

FX-32CA contains no calcium chloride, salts, foaming agents or sugar.

If air-entrained concrete or mortars are desired, trial mixes should be run to establish the amount of air-entraining agent required and the compatibility of the cement used (do not use Type II cement or Type I modified, unless trial mixes have established their compatibility). Usually, 1 to 2.5 liquid ounces of a vinsol resin type air-entraining agent such as **FX-340** is recommended.

APPLICATION:

FX-32 CA Liquid - Use 16 to 32 ounces of **FX-32 CA** per 100 lbs of cement, depending upon design requirements.

FX-32 CA Powder - Use 1/2 to 1 lb per 100 lbs of cement, depending upon design requirements.

Mix designs can be provided by Fox Industries.

MIXING:

16 fluid ounces of **FX-32 CA** per 100 lbs of cement will retard the initial set of concrete or mortar approximately 1/2 to 1 hour at 70°F, while reducing water requirements for a given slump by 15% to 25%.

PACKAGING:

FX-32 CA liquid is packaged in 5 gallon pails or 55-gallon drums.

FX-32 CA powder is packaged 33 pounds in a 5 gallon pail.

SHELF LIFE:

One year

LIMITATIONS:

Prevent liquid from freezing. Keep powder dry. Avoid extreme heat (above 120°F) in storage.

8 oz dose per 94# bag is typical, see recent breaks

FOR INDUSTRIAL USE ONLY. KEEP AWAY FROM CHILDREN. UPDATED 5/29/2013

ChemGrout[®]

1 of the 2 pumps which may be used

CG-550 Rugged Series

Combines ease of operation and low maintenance to provide the ultimate in performance.

**CG550/030/A
Air Powered**



**CG550/030/GHES
Gas/Hydraulic**



**CG555/030/GHES
Gas/Hydraulic**



Single operator system – 45 gallon (170 liter) mixing tank, large holding hopper and centrally located controls allow a single operator to mix, transfer and pump for continuous production.

Efficiently mixes and pumps most pre-packed non-shrink grouts and repair mortars. Materials include bentonites, cement/sand and most slurry products.

Outputs to 16 gpm (60 lpm), 400 psi (27 bar).

Power options include air, electric/hydraulic, hydraulic, gas/hydraulic and diesel/hydraulic.

Pump completely disassembles with only a hammer for fast and thorough cleaning.

ChemGrout[®]

Widest Selection of Grouting Equipment in the World

**CG-030
Rapid U-clip
Disassembly**



The Rugged Series features a single acting, variable speed 3" piston pump that provides the versatility to handle materials ranging from fluid slurries to heavily sanded grouts. Materials commonly used with the CG-030 include cement slurries, sanded cement mixes, bentonite mixes (with or without sand), most repair mortars, high-strength non-shrink grouts and self-leveling products.

The CG-030 is engineered for ease of operation and low cost maintenance. The unique staple lock construction holds all working components together allowing parts to be easily accessed for cleaning and maintenance.

The large capacity hopper is mounted above the suction housing, enabling a new batch to be mixed while the first is being pumped. This helps to provide a consistent "non-stop" discharge of material, virtually eliminating the clogging of tremmie lines.

Specifications

CG030 Skid - Power	Max. Output/Pressure	Required	Weight	Size
Air	16 gpm (60 lpm), 400 psi (27 bar)	100 cfm, 100 psi	310 lbs	64" x 31" x 29"
Hydraulic	14 gpm (53 lpm), 400 psi (27 bar)	9 gpm, 2000 psi	290 lbs	64" x 31" x 29"

CG550/030 Skid Power	Max. Output/Pressure	Required	Weight	Size
Air	16 gpm (60 lpm), 400 psi (27 bar)	150 cfm, 100 psi	490 lbs	66" x 31" x 56"
Hydraulic	14 gpm (53 lpm), 400 psi (27 bar)	2 Supplies each of 9gpm, 2000 psi	450 lbs	66" x 31" x 56"
Electric/Hydraulic	14 gpm (53 lpm), 400 psi (27 bar)	*3 Phase	955 lbs	84" x 34" x 56"
Gas/Hydraulic, Electric Start	14 gpm (53 lpm), 400 psi (27 bar)	Self-Contained	955 lbs	84" x 34" x 56"
Diesel/Hydraulic	14 gpm (53 lpm), 400 psi (27 bar)	Self-Contained	1050 lbs	84" x 34" x 56"

CG555/030 Trailer - Pwr	Max. Output/Pressure	Required	Weight	Size
Gas/Hydraulic	14 gpm (53 lpm), 400 psi (27 bar)	Self-Contained	1400 lbs	110" x 60" x 70"
Diesel/Hydraulic	14 gpm (53 lpm), 400 psi (27 bar)	Self-Contained	1495 lbs	110" x 60" x 70"

* Several Voltages Available

**CG-030
Piston
Pump Skid
Mounted**



Complete grouting systems combine the CG-030 piston pump with a high efficiency paddle mixer to provide a continuous output of material. Both mixer and pump are equipped with their own variable speed control.

The large 45-gallon mix tank features specially designed blades and baffles that develop a high shearing action, insuring rapid and thorough mixing. After mixing, the material is transferred to a holding hopper through a slide gate designed to handle the most difficult materials. Holding hoppers are available in 15-gallon (57 liter) or 30-gallon (113 liter) sizes and are matched based on material flow.

The compact, skid mounted CG-550/030 is available in either air or hydraulic power. Hydraulic power units with either a gasoline/diesel engine or an electric motor can also be mounted on a separate skid. The trailer mounted CG-555 is a fully integrated system combining mixer, pump and power system, all in a single road worthy package.

Accessories

Grout Hose. Equipped with quick disconnect fittings. Available in 25 and 50 foot lengths.



Water Meters. Available in manual or automatic. Accurately measures the water for each batch.



Diaphragm Protected Pressure Gauge.



Mechanical Surface Packer. Equipped with shut-off valve and a quick disconnect fitting.

Applications include:

Soil nails, tiebacks, earth anchors, cable & rock bolts, foundation stabilization, soil compaction, pavement undersealing, slabjacking, slab raising, underwater foundations, piers, deep well casing, well sealing, abandonment and geothermal.

ChemGrout®

Widest Selection of Grouting Equipment in the World

2 of the 2 pumps which may be used

ChemGrout[®]

CG-500 Versatile Series

The CG-500 Series are balanced systems that enable high volume production and continuous mixing for a broad range of applications.

CG500/2C6/A
Air Powered



Specially designed mix tank provides high shearing action for thorough and complete particle wetting, producing superior grout.

For grouting tunnels, shafts, dams, mines, void filling, tiebacks, piling encasements, rock grouting & wells.

Mixes & pumps neat cement or cement/sand grouts. Mixing & pumping all on one skid for fast mobilization.

Maximum output 20 gpm (76 lpm). Maximum pressure 174 psi (12 Bar), optional 261 psi (18 Bar).

Two 70 gallon (265 liter) mixing tanks & a 15 gallon (57 liter) holding hopper allows continuous production.

Power options include air, hydraulic, electric/hydraulic gas/hydraulic & diesel/hydraulic.

ChemGrout[®]

Widest Selection of Grouting Equipment in the World

Versatile Series – High Output, Continuous Operation

Highly versatile, the CG-500 handles a broad range of grouting applications including tunnels, shafts, dams, plant maintenance and geotechnical works. The unique twin mix tank design permits continuous pumping as each tank alternates feeding the hopper. This non-stop pumping process maximizes the batching of materials such as neat cement, sand/cement, and most commercial pre-bagged grouts.

Two high-capacity 70-gallon mixing tanks, pump, and 15-gallon holding hopper are all mounted on a single skid for quick, easy set-up and immediate operation. The holding hopper includes an internal auger that keeps the material thoroughly mixed while supplying the pump.

The open throat grout pump features a non-pulsating positive displacement rotor-stator that provides a constant discharge of materials. This progressing cavity pump is variable speed with an output of up to 20 gpm with a standard maximum pressure of 174 psi (261 psi optional).



CG-500GH
Gas/Hydraulic

Specifications

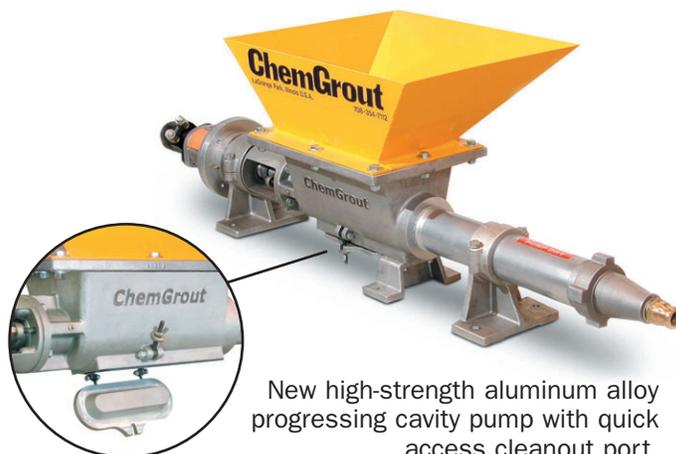
CG500 Pump	2C6	3C6
Pump	open throat, non pulsating	
Maximum Output	20 gpm (76 lpm)	
Maximum Pressure	174 psi (12 Bar)	261 psi (18 Bar)

CG500 Power	Required	Weight	Size
Air	250 cfm, 100 psi	1100 lbs	88L X 34W X 58H
Hydraulic	12 gpm, 1200 psi	1050 lbs	88L X 34W X 58H
Electric/Hydraulic	*3 Phase only	1550 lbs	88L X 34W X 58H
Gas/Hydraulic	Self contained	1425 lbs	88L X 34W X 58H
Diesel/Hydraulic	Self contained	1625 lbs	100L X 34WX 58H

* Several voltages available

Industries

Tunneling	Well Drilling	Geotechnical
Construction	Mining	Municipal
Restoration	Highway	



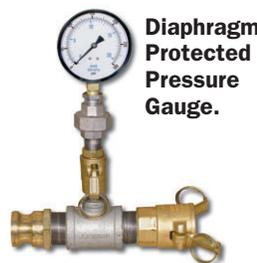
New high-strength aluminum alloy progressing cavity pump with quick access cleanout port.

Accessories

Grout Hose. Equipped with quick disconnect fittings. Available in 25 and 50 foot lengths.



Water Meters. Available in manual or automatic. Accurately measures the water for each batch.



Diaphragm Protected Pressure Gauge.



Mechanical Surface Packer. Equipped with shut-off valve and a quick disconnect fitting.

Applications include:

Soil compaction, rock grouting, void-filling, waterproofing, soil anchors, cable bolts, rock bolts, well encasements, contact grouting, well abandonment, marine/underwater, post tensioning, precast, machine base installation, self-leveling floor underlayments, slab undersealing and slabjacking.

ChemGrout®

Widest Selection of Grouting Equipment in the World

Harris Construction Grout

Non Shrink Bond Out backfill
grout

50 lb. Bag

Non-shrink, Non-metallic grout

DESCRIPTION

Harris Construction Grout is a non-shrink, non-metallic multipurpose cement-based grout. Harris Construction Grout is formulated for a wide variety of grouting applications, from damp pack to flowable through a controlled, positive expansion.

USE

Recommended applications include grouting of pump and equipment based column base plates, anchor bolts, pre-cast and tilt-up walls.

FEATURES / BENEFITS

- Controlled positive expansion for maximum effective bearing
- Non-metallic / non-corrosive
- Pourable / pumpable versatility
- Excellent freeze / thaw resistance
- Can be extended with pea stone for deep applications

SPECIFICATIONS / COMPLIANCES

Corp of Engineers CRD-C-621 Grade A, B & C
ASTM C-1107. Grade A, B & C

APPLICATION

Preparation: Remove all dirt, oil, and loose or foreign material. Any metal in contact with grout must be free of rust, oil, grease, and other foreign matter which would limit bond. Concrete surface must be sound and roughened to insure proper bonding. Prior to placing grout, surface should be saturated for a minimum period of four hours and preferably for twenty-four hours. Remove all excess water before placement of grout. Bolts, base plates and equipment must be secure and rigid before placement of grout.

Forms: Allow for the continuous placement of grout. Provisions for venting to avoid air entrapment must be made. Placing from one side, provide a 45° angle in the forms to a height suitable to provide a head of grout during placement. On all sides, provide a minimum 1" (2.54 cm) horizontal clearance between the base plate and forms. Forms should be at least 1" (2.54 cm) higher than the bottom of the base plate.

APPLICATION (cont.)

Mixing: Small quantities of grout may be hand mixed in a concrete mixing pan until lump free. For large quantities and continuous pours, mix using a mortar mixer with rubber tipped blades or appropriate grout pump for a minimum of 5 minutes. Start with minimum water requirements.

Always add water to mixer first, then slowly add powder. Use only the amount of water required for the desired placement consistency. Mix in two steps: Add 2/3 of the water, add grout, after partial mixing add the remaining 1/3 of the water for desired consistency. Thoroughly mix total quantity for an additional 2 to 3 minutes. Do not mix more than can be placed in 30 minutes. Test data and recommended water amounts are based on laboratory conditions. Actual field results may vary based on jobsite conditions.

Plastic/Dry Pack 55 lbs grout 6.93-7.54 pints (3.28-3.57 liters)	Flowable 55 lbs grout 7.54-8.52 pints (3.57-4.03 liters)	Fluid 55 lbs grout 8.52-9.18 pints (4.03-4.34 liters)
---	---	--

Placing: Place continuously and quickly. Start from one side to avoid air trapment. Be sure grout fills spaces and remains in contact with plate. DO NOT VIBRATE. A minimum of 1" (2.48 cm) vertical clearance should be maintained for base plate grouting applications. Thinner vertical clearances may require the use of another type of grout.

Curing: Immediately cover with clean, wet rags (do not use burlap) and keep moist until final set. After final set, remove rags and apply an ASTM-C-309 curing com-

A.H. Harris & Sons, Inc.[®]



CONSTRUCTION SUPPLIES

Since 1916

367 Alumni Road | Newington, CT 06111
www.ahharris.com | (860) 665-9494

APPLICATION (cont.)

TYPICAL PERFORMANCE DATA

	Plastic	Flowable	Fluid
Water / 50 lb.	6.30-6.85 pints	6.85-7.75 pints	7.75-8.35 pints
Compressive Strength			
	Plastic	Flowable	Fluid
1 day	4,000 psi	3,100 psi	2,100 psi
3 days	5,500 psi	5,000 psi	4,000 psi
7 days	8,100 psi	6,900 psi	5,100 psi
28 days	10,200 psi	8,400 psi	7,000 psi
Expansion Percentage			
	Plastic	Flowable	Fluid
1 day	0.07	0.03	0.03
3 days	0.07	0.03	0.02
14 days	0.07	0.03	0.02
28 days	0.07	0.03	0.02

Note: the data shown is based on controlled laboratory testing. Reasonable variation from test results shown can be expected. Field and laboratory testing should be controlled on the basis of the desired placing consistency, rather than strictly on water content.

pound, such as Harris Emulsion Kurseal 309.

Special Conditions:

Deep application: Pre-washed and graded 3/8" (1 cm) pea gravel must be used in applications thicker than 3" (7.62 cm) as follows:

- 3"-5" (7.62-12.7 cm): Add 25% of 3/8" (1 cm) pea gravel per 50 lb bag of grout.
 - 5" (12.7 cm) and over: Add 50% of 3/8" (1 cm) pea gravel per 50 lb bag of grout.
- Place in 6" lifts with proper reinforcement

Hot weather conditions: Provide shade for area to be grouted. Use cool or chilled mixing water. Protect grout from direct sun exposure for up to 24 hours after grouting. The maximum temperature (ambient and substrate) for grouting is 85°F (29°C). The maximum grout temperature should not exceed 80°F (27°C). For additional information, refer to ACI 305 (Recommended Practices for Hot Weather Concreting).

Cold weather conditions: Raise the temperature of the area to be grouted with space heaters or steam. Warm the mixing water. Cover and insulate the grout to retain warmth. The minimum temperature (ambient, substrate, and grout) for grouting is 40°F (5°C). For additional information, refer to ACI 306 (Recommended Practices for Cold Weather Concreting).

PACKAGING / YIELD

50 lb (22.7Kg) multiple plastic lined bag will yield approximately 0.45 cu. ft. in a fluid condition.
50% by weight extension (25 lbs) of 3/8" pea stone will yield approximately 0.59 cu. ft.

LIMITATIONS / PRECAUTIONS

DO NOT place at temperatures below 40°F (5°C) or if the temperature is expected to fall below 40°F (5°C) in the next twenty four hour period. At low temperatures, water requirement should be field tested.

When nearby equipment causes vibration of the grout, such equipment should be shut down for a period of 24 hours (at 73°F (23°C)). DO NOT mix over 5 minutes. DO NOT over water; this can cause bleeding or separation. DO NOT retemper. DO NOT add cement, sand, aggregate, or admixtures.

Avoid hazards by following all precautions found in the Material Safety Data Sheets (MSDS), product labels, and technical literature

SHELF LIFE / STORAGE

Harris Construction Grout should be stored in a cool, dry interior area. At no time should material be exposed to high moisture, rain, or snow conditions. When stored in the original, tightly closed container, the shelf life is one year from the date of manufacture.

TECHNICAL SERVICES

For assistance, contact technical services at:
860-665-9494
www.ahharris.com

24 HOUR EMERGENCY CONTACT:

CHEMTREC - 800-424-9300

WARRANTY

NOTICE-READ CAREFULLY CONDITIONS OF SALE

A.H. Harris offers this product for sale subject to and limited by the warranty which may only be varied by written agreement of a duly authorized corporate officer of A.H. Harris. No other representative of or for A.H. Harris is authorized to grant any warranty or to waive limitation of liability set forth below.

WARRANTY LIMITATION

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INHERENT RISK

Purchaser assumes all risk associated with the use or application of the product.

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Anchor Testing Logs & Testing Equipment

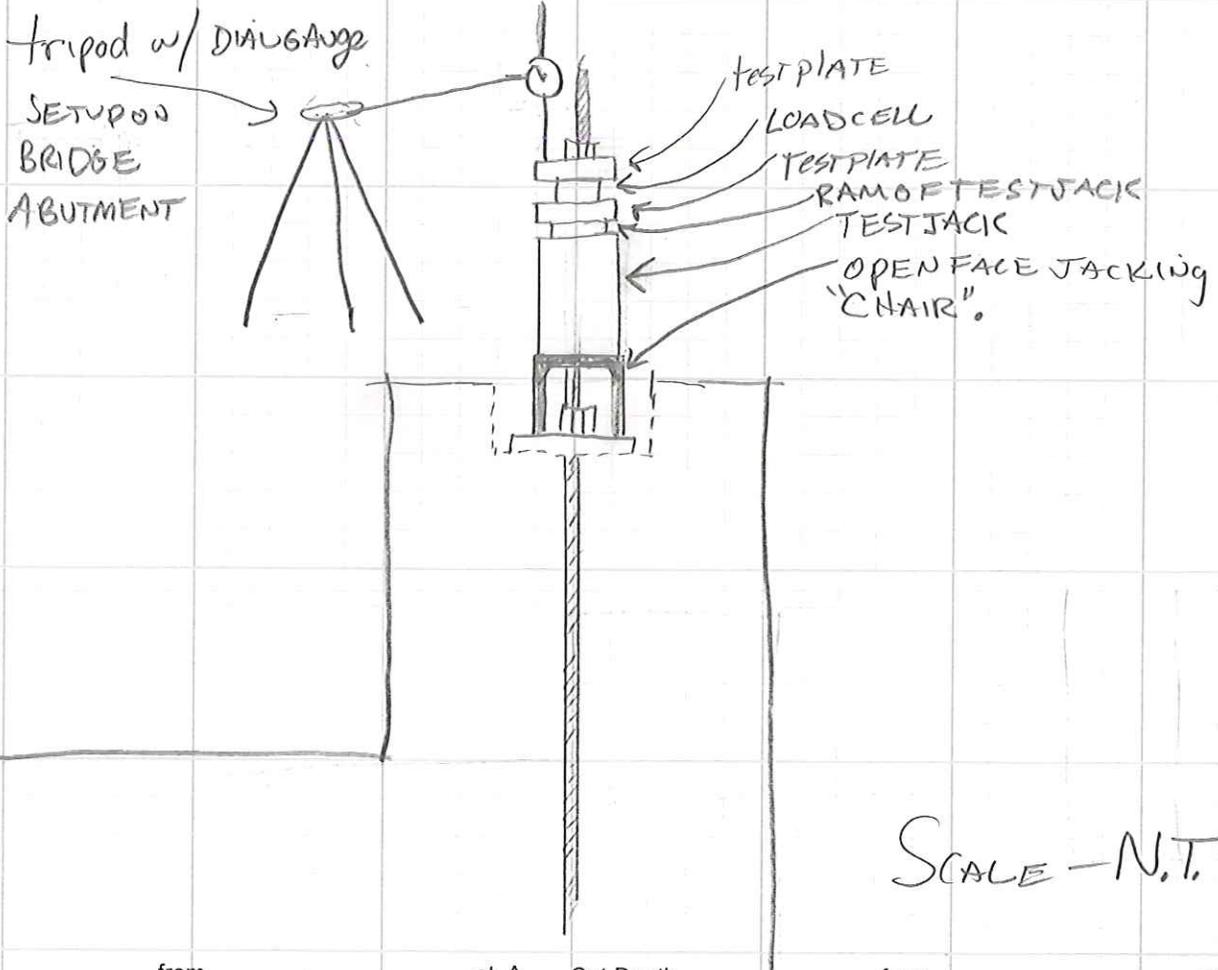
CUSTOMER	
PROJECT	
LOCATION	DATE
SCALE	JOB#
	MANAGER

Maine Drilling & Blasting

ATTACHMENT B

AGREED PLAN OF AREA TO BE BLASTED

TEST ANCHOR - DIAGRAM
ROCHESTER, VT - BRIDGE 16



SCALE - N.T.S.

Cut Depth _____ from _____ at A

Cut Depth _____ from _____ at B

Cut Depth _____ from _____ at C

Cut Depth _____ from _____ at D

Cut Depth _____ from _____ at E

Cut Depth _____ from _____ at F

Customer Signature

Subcontractor Signature

DATE: _____

OPERATOR: _____

Provide Anchor Location Sketch w/ numbering

*Gauge PSI for Reference use Load Cell for Actual

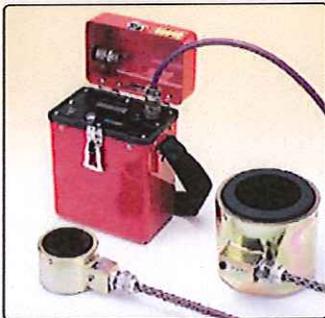
% LOAD	LOAD (lbs)	GAUGE (psi)*	STARRETT READING (Inches)			
			Bolt 1	Bolt 2	Bolt 3	Bolt 4
AL	TBD	TBD				
.25 DL	TBD	TBD				
.50 DL	TBD	TBD				
.75 DL	TBD	TBD				
1.00 DL	TBD	TBD				
1.20 DL	TBD	TBD				
1.33 DL	TBD	TBD				
CREEP TEST						
1 minute						
2 minutes						
3 minutes						
4 minutes						
5 minutes						
6 minutes						
10 minutes						
IF CHANGE FROM 1 TO 10 MIN > 0.040 INCH CONTINUED CREEP TEST						
20 minutes						
30 minutes						
40 minutes						
50 minutes						
60 minutes						
LOCK-OFF						
AL	TBD	TBD				
	TBD	TBD				
FINAL LIFT (psi)						

Requesting a Design Load and any lock off load

A similar Load Cell will be sized for the Test load once the test load is furnished by the Engineer. The cut sheets and calibration data will be submitted for the final selected unit at least 7 days prior to work start.

Applications

- Monitoring loads in tie-backs and rock bolts in the walls of excavations
- Monitoring long-term loads in concrete dam tie-downs
- Monitoring loads in steel arch tunnel supports
- Monitoring loads in cross lot struts
- Measurement of loads during pile testing



• Model 3000 Load Cells with the Model GK-501 Readout Box.



• Model GK-403 Readout Box for use with the Model 4900 Load Cells.



• Model 4900 Vibrating Wire Load Cells.

Operating Principle

The Geokon Model 4900 Load Cell consists of a cylinder of high-strength steel with 3-6 vibrating wire strain sensors arranged to measure the compression of the cylinder under load. The cylindrical shape allows the load cell to be used with tie-backs and rock bolts.

The readings from the individual sensors are averaged and used in conjunction with a calibration factor, supplied with the load cell, to calculate the applied loads.

The Model 3000 has the same annular design, using high-strength steel or aluminum, but uses electrical resistance strain gages cemented to the outside of the annulus and connected together in a Wheatstone Bridge Circuit so that there is a single mV/V output. Remote sensing techniques are used to minimize cable effects.

Advantages and Limitations

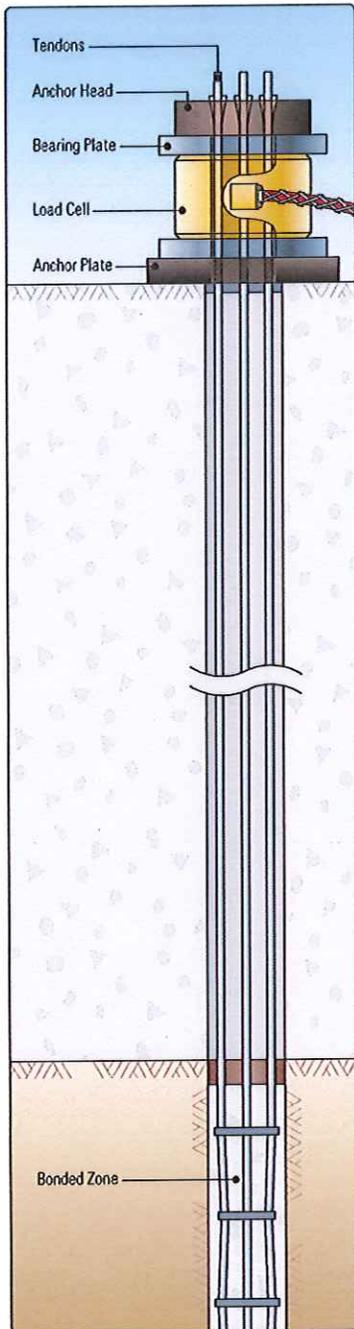
Vibrating wire load cells provide excellent long-term stability and can be used with long cables without adversely affecting the output frequency. They are water-proof and have low temperature coefficients. Vibrating

wire load cells have also been used successfully in high radiation environments.

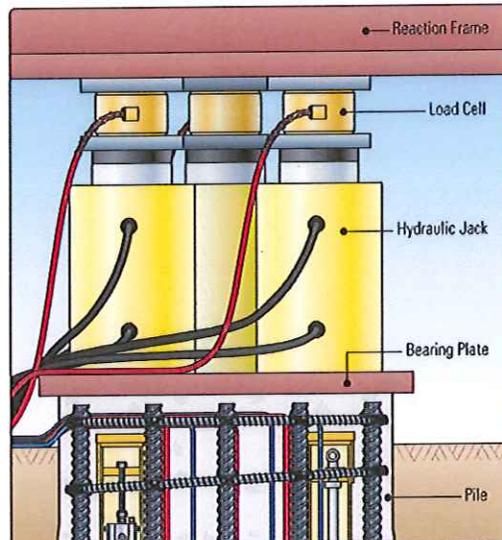
Eccentric loading is accounted for by averaging the readings from all the strain sensors.

Vibrating wire load cells are not able to measure dynamic loading and, although they are easily datalogged, the multiplicity of sensors requires a corresponding number of channels of the multiplexer. For dynamic applications it may be preferable to use the Model 3000 Load Cells.

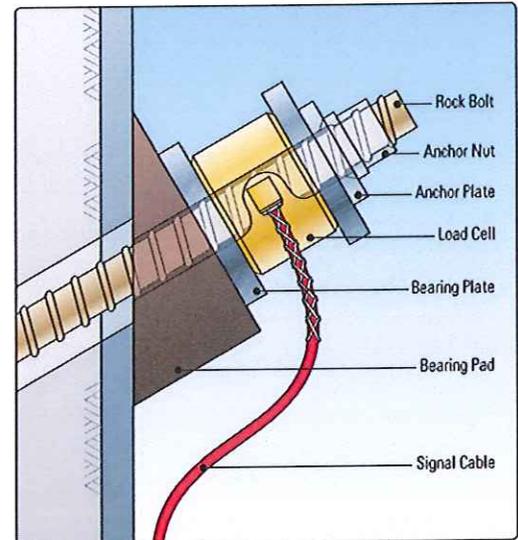
The calibration of annular shaped load cells is very dependent on the end loading conditions, i.e. on the flatness and thickness of the bearing surfaces and on any mismatch in size between the load cell and the hydraulic ram which could cause bearing plates to bend. Calibration variations of as much as 15% have been observed. For best accuracy, calibrations should be performed while duplicating or simulating actual field conditions.



● Model 4900 used in concrete dam tie-down.



● Load cells used in pile test.



● Load cell used to monitor performance of tie-back in excavation.

System Components

Signals from the load cell are transmitted to the readout location by means of a multi-conductor shielded cable, which may be armored for extra protection. Kellems grips prevent the cable from being pulled from the load cell. Larger size load cells are supplied with lifting lugs.

Readout of the Model 4900 Load Cells is by Model GK-401, GK-403 or Micro-10 Datalogger. Manual readout can be facilitated using a multi-channel switch box connected to the end of the cable. In the case of the GK-403 Readout Box, there is the option to use the Model GK-403-5 multiplexer which allows the GK-403 to automatically scan through all the vibrating wire sensors, average the readings, apply the calibration constant and display the load in engineering units. Readout of the Model 3000 Load Cells is by means of the Model GK-501 Readout Box.

To minimize eccentric and uneven loading, the use of the thick machined-flat bearing plates and centralizer bushings (where necessary) are recommended.

Bearing plates should be machined flat and large enough to totally cover the load bearing surface of the load cell. The thickness is related to the load cell/hydraulic jack

size mismatch: the greater the size disparity the thicker the bearing plate. Typical thickness ranges from 25 to 75 mm.

If the size of the tie-back or rock bolt is more than 30 mm smaller than the internal diameter of the load cell, then centralizer bushings are recommended.

Technical Specifications

	3000	4900
Rated Capacities ¹	100 to 10,000 kN	100 to 10,000 kN
Over Range ²	150% F.S.	150% F.S.
Resolution	0.025% F.S.	0.025% F.S.
Accuracy ³	±0.5% F.S.	±0.5% F.S.
Output	1.5 to 2.5 mV/V @ F.S.	1200-2800 Hz
Temperature Range	-20°C to +80°C	-20°C to +80°C
Cables	Multi-conductor shielded pairs with PVC outer jacket	
Internal Diameters ¹	solid, 25, 50, 75, 100, 125, 150, 200, 250 mm	

¹Other capacities and diameters available on request.

Calibrations that exceed Geokon's NIST traceable capacity of approximately 4500 kN are subcontracted to an accredited testing laboratory.

²With no calibration shift.

³Established under laboratory conditions. System accuracy depends on end loading conditions.



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Load Cell Readout Box

Applications

The Model GK-502 Load Cell Readout Box is designed to read Geokon's Model 3000 full bridge resistance strain gage type load cells. The rugged and reliable, user-friendly GK-502 features the following...

- Easy-to-use control panel
- Output displayed in engineering units
- 16x2 LCD display
- 10-pin load cell connector
- USB communications port
- Internal real-time clock
- Non-volatile memory
- Rechargeable battery
- Data storage capability
- Cold weather operation



• Model GK-502 Load Cell Readout Box.



• Close-up of the Model GK-502 Load Cell Readout Box control panel.

Operating Principle

The Model GK-502 Load Cell Readout Box is a portable battery powered instrument designed to read all full bridge resistance strain gage type load cells, including the Geokon Model 3000 Load Cells.

The readout incorporates a 12 Volt, 1.4 Ahr Sealed Lead Acid (SLA) battery, 16x2 graphic liquid crystal display (LCD) with backlight, membrane keypad, and battery charger circuit. Two side-mounted 10-pin, military style Bendix® connectors are provided; the first is used to connect the load cell, and the second is used for communications, via a USB connection (COM port), and for charging of the battery, via the battery charger.

The GK-502 supplies a precision 2.048 VDC excitation to the full bridge Load Cell and displays the output in Digits, mV, mV/V, or by entering a Gage Factor and Zero Reading, in engineering units (lbs, kg, kips, Tons, etc.).

An internal Real-Time Clock/Calendar (RTCC) and non-volatile memory allows storage for up to 999 time-stamped readings, which can be displayed via the LCD display, or downloaded to a computer via the COM port for further analysis.

The GK-502 is designed to read both 4-wire and 6-wire remote-sense full bridge load cells.

Power consumption of the GK-502 is very low (300 mW), and will allow continuous operation for up to 48 hours under normal conditions. Continuous battery monitoring is included to warn the user when the battery is low and requires recharging.



• Model GK-502 Load Cell Readout Box, showing load cell and communication connectors.



• Model GK-502 Load Cell Readout Box shown with the Model 3000 Electrical Resistance Load Cell.

Advantages and Limitations

The Model GK-502 is designed to be user-friendly with push button operation for all functions.

The display shows digits, mV, mV/V or engineering units.

Readings, including reading number, date and time, can be stored by pressing the "STORE" button.

To power off the GK-502, press the "ON/OFF" switch. Alternatively, the GK-502 will automatically shut off after five minutes of remaining idle.

Load cells are easily connected via the side-mounted 10-pin connector, or via the supplied patch cord with alligator clips.

Remote sense capabilities for added accuracy with long cable lengths.

Stored data can be downloaded through the 10-pin USB port for use in spreadsheet applications.

System Components

The Model GK-502 is supplied complete with battery charger, USB cable, USB driver (CD format), patch cord with alligator clips, for connection to load cell cables without 10-pin connectors, and manual.

Technical Specifications

Display Resolution	1 μ V (mV, mV/V); 1 digit (Dg); 1 lb (lbs.); 1 kg (kg); 0.01 kip (kips); 0.01 ton (tons); 0.01 metric ton (metric tons); 0.01 kN (kilonewton)
Accuracy	0.015% F.S. (max)
Range (S+S-)	± 16 mV ($\pm 31,250$ digits)
ADC	Differential 24 bit Sigma Delta
ADC Resolution	1.9 nV
Excitation Voltage/ ADC Reference	2.048 V (± 0.001 V) 3 ppm/ $^{\circ}$ C
Display	16 \times 2 graphic LCD with backlight
Connectors	<i>Bulkhead:</i> Bendix PTO2A-12-10S <i>Mating:</i> Bendix PY06A-12-10P(SR)
Operating Temperature	-30 to +50 $^{\circ}$ C
Power Requirements	12 VDC @ 22 mA (operation) 12 VDC @ 16 μ A (off)
AC Adaptor	120/230 VAC: 50-60 Hz, 18 VDC, 1.66 A
Battery	(<i>type</i>) Lead acid 12 volt, 1.4 Ahr (<i>operating time</i>) 48 hours
Materials	Aluminum case and lid
Weight	2.3 kg
L \times W \times H	165 \times 102 \times 216 mm



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gives the same reading as the GK-501. Alternatively the P3 can be set up to readout directly in engineering units – ponds, tons, kips, etc,

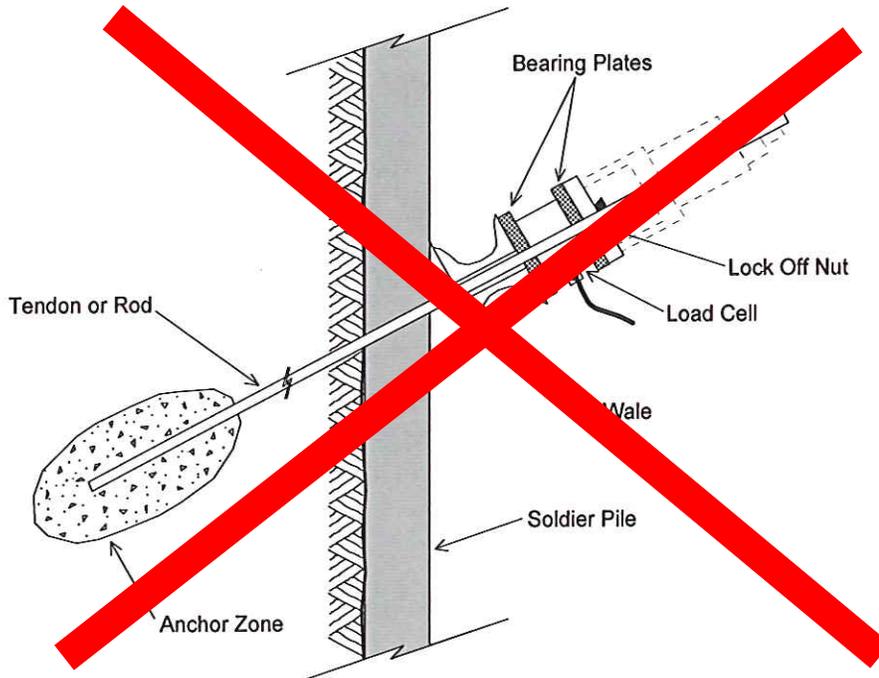


Figure 1 - Load Cells on Tiebacks for the Permanent Monitoring of Loads

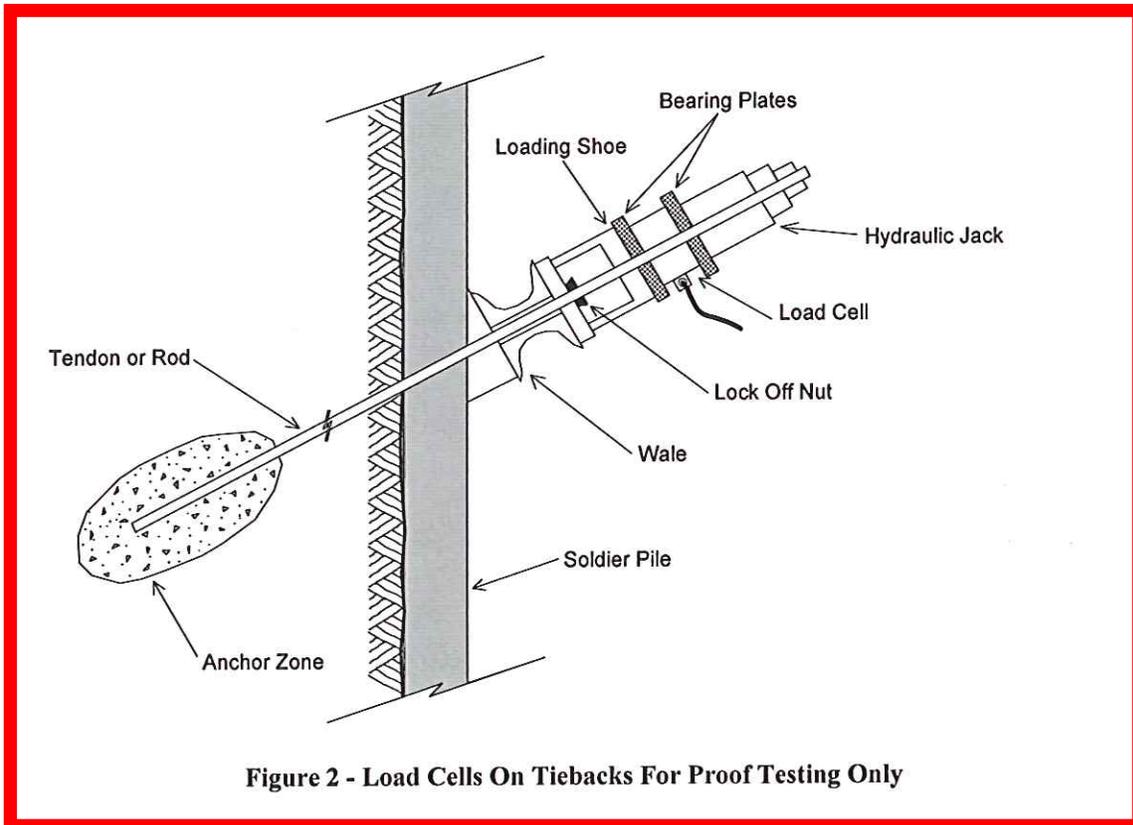


Figure 2 - Load Cells On Tiebacks For Proof Testing Only

A similar Load Cell will be sized for the Test load once the test load is furnished by the Engineer. The cut sheets and calibration data will be submitted for the final selected unit at least 7 days prior to work start.

Load Cell Calibration Report

Model Number: 3000-400-3

Calibration Date: July 12, 2013

Serial Number: 2539

Calibration Instruction: CI-3000

Max. Range (lbs): 400000

Cable Length: 25 feet

Initial Cycling Data

Technician: 

Load (lbs):	0	0	400000	0
Reading:	-110	-112	19518	-115

Calibration

Applied Load in lbs	Readings from GK-501 or GK-502 readout box				Linearity % Max Load	Polynomial Error (%FS)
	Cycle 1	Cycle 2	Average	Change		
0	-115	-118	-117		-0.88	-0.08
40000	1947	1929	1938	2055	-0.37	0.06
80000	3938	3943	3941	2003	-0.13	0.01
120000	5919	5921	5920	1979	-0.01	-0.09
160000	7923	7910	7917	1997	0.20	-0.02
200000	9885	9872	9879	1962	0.24	-0.05
240000	11856	11840	11848	1969	0.31	0.03
280000	13766	13790	13778	1930	0.18	-0.03
320000	15731	15723	15727	1949	0.15	0.09
360000	17659	17639	17649	1922	-0.02	0.13
400000	19502	19494	19498	1849	-0.57	-0.15
0	-115	-112	-114			

GK-501 or GK-502 Readout

Linear Gage Factor (G): 20.46 lbs/digit

Regression Zero (R₀):* 56

Polynomial Gage Factors: A: 0.00003728

B: 19.66

C: 1992

Polynomial, $L = AR_1^2 + BR_1 + C$

Full Scale mV/V: 4.904 mV/V

Calculate C by setting L=0 and R₁ = initial field zero reading in the polynomial equation

* Note: The above calibration uses a linear regression method. The Regression Zero Reading shown is ideal for straight line computation and does not usually agree with the actual no-load reading.

The above named instrument has been calibrated by comparison with standards traceable to the NIST, in compliance with ANSI Z540-1.

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RICHARD DUDGEON, INC.
1565 RAILROAD AVE. BRIDGEPORT, CT. 06605 TEL:203-336-4459 FAX:203-333-8417

PRESSURE GAUGE CERTIFICATION

CUSTOMER: MAINE DRILLING & BLASTING INC.

CUSTOMER'S ORDER NO. DUDGEON ORDER NO. ORDER DATE
VERBAL, PETE S13791 07/19/12

GAUGE SERIAL NO. CAPACITY
Z7005W4 6" DIA x 10,000 PSI

WE HEREBY CERTIFY THE ABOVE HYDRAULIC GAUGE HAVE BEEN TESTED AGAINST OUR HEISE DIGITAL PRESSURE INDICATOR, SERIAL NO. S7-9400 AND FOUND TO BE WITHIN A STANDARD ACCURACY (PLUS OR MINUS 1/2%) OF FULL SCALE. OUR TEST EQUIPMENT IS TRACEABLE TO THE NATIONAL BUREAU OF STANDARDS.

REFERENCE PRESSURE (PSI)	GAUGE READING (PSI)
0	50
1000	1000
2000	2000
3000	3000
4000	4000
5000	4975
6000	5975
7000	6950
8000	7950
9000	8950
10000	X

RICHARD DUDGEON, INC.

W. Noel
DATE: 7/19/12

Installation Log

Grouting and Placement Log



Project - Rochester, VT - Bridge 16

Foreman:

#1 -Grouting through Anchor (Drilling Phase)	Date:	Depth to rock (ft):	# Bags of Grout:	Bond length (ft):	Total Anchor Length (ft):
	Drilling Notes:		Grouting Notes:		
#1 Grouting From the Top (as neccessary)	# Bag of Grout:	Settlement Comments:			

#2 -Grouting through Anchor (Drilling Phase)	Date:	Depth to rock (ft):	# Bags of Grout:	Bond length (ft):	Total Anchor Length (ft):
	Drilling Notes:		Grouting Notes:		
#2 Grouting From the Top (as neccessary)	# Bag of Grout:	Settlement Comments:			

#3 -Grouting through Anchor (Drilling Phase)	Date:	Depth to rock (ft):	# Bags of Grout:	Bond length (ft):	Total Anchor Length (ft):
	Drilling Notes:		Grouting Notes:		
#3 Grouting From the Top (as neccessary)	# Bag of Grout:	Settlement Comments:			

#4 -Grouting through Anchor (Drilling Phase)	Date:	Depth to rock (ft):	# Bags of Grout:	Bond length (ft):	Total Anchor Length (ft):
	Drilling Notes:		Grouting Notes:		
#4 Grouting From the Top (as neccessary)	# Bag of Grout:	Settlement Comments:			



U.S. Department
of Transportation
**Federal Highway
Administration**

April 2006

Office of Bridge Technology
400 Seventh Street, SW
Washington, D.C. 20590

Publication No. Unassigned

Full Publication available:

[http://www.cflhd.gov/programs/techDevelopment/geotech/hollowcore/
Hollow_Core_Soil_Nails_SOP.pdf](http://www.cflhd.gov/programs/techDevelopment/geotech/hollowcore/Hollow_Core_Soil_Nails_SOP.pdf)

HOLLOW-CORE SOIL NAILS STATE-OF-THE-PRACTICE



CHAPTER 10. FIELD TESTING OF HOLLOW-CORE SOIL NAILS

The testing frequency and procedures for hollow-core soil nails do not vary from those for solid-bar nails described in FHWA (1996, 2003). However, as indicated in the previous chapter, development of the unbonded length for hollow-core soil nails is complicated by the basic requirement that the circulating grout must egress from the mouth of the drill hole. This continuous grout flushing through the drill hole mouth tends to bond the entire length of the nail. The testing is further complicated by the basic analytical model used to design soil nail walls.

Development of Unbonded Length

The procedure commonly used to achieve an unbonded length is pictorially shown in Figures 22 to 26. The procedure involves sliding a PVC tube over the nail before installation so that only the bonded length to be tested is exposed to the grout. The PVC tube must have an internal diameter larger than the outside diameter of the hollow-core bar but smaller than the outside diameter of the coupler. The ends of the PVC tube are duct-taped to prevent ingress of the grout in the annulus between the PVC tube and the hollow-core bar (see Figure 22). The PVC-outfitted hollow-core bar is then attached to the string of hollow-core bar already installed in the ground (see Figure 23). Once the string of hollow-core bars has reached its target depth and the entire nail length is flushed with the final grout as described earlier, the grout surrounding the installed nail is allowed to cure for at least three days. The duct tape at the end of the PVC tube at the mouth of the drill hole is then removed and the PVC tube is trimmed as necessary to permit attachment of the testing setup.

The PVC tube with the duct tape can be used on bar segments between couplers to develop an unbonded zone of the desired length. In this case, the coupler would still be bonded. However, since the exterior of the coupler is smooth (i.e., not threaded) and the coupler length is typically 150 to 229 mm (6 to 9-inches), the pullout resistance provided in the length of the coupler is insignificant compared to that in the bonded length.

The PVC tube technique breaks the grout-steel bond in the unbonded zone since there is no grout in the annulus between the PVC tube and the outside of the hollow-core soil nail. Because of the PVC tube's smooth exterior surface, the bond between the outside of the PVC tube and the grout is usually broken during the first or second increment of the design load. This is also true for the relatively smooth exterior surface of the coupler. Thus, it is often observed that the load deformation curve shows elastic movement less than 80% of the theoretical elongation up to the first or second increment of the test load which is typically 50% of the design load. This is not a reason for concern as long as the elastic criterion is satisfied at maximum test loads.