VERMONT

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Date June 24, 2016

CCS Constructors, Inc.
138 Munson Avenue
Morrisville, VT 05661

Project Name: New Haven BRF 0183(1)

Structure Identification: TH 2, Bridge 10

The Revised Drilled Shaft Means and Methods Submittal associated with Item 900.640 Special Provision (Drilled Shaft in Earth)(8-FT) has been reviewed and is being returned herewith.

All sheets are approved.

Sincerely,

Todd A. Sumner, P.E.
Structures Project Manager

Cc. *Bob Suckert*, Resident Engineer
Chris Williams, Regional Construction Engineer
Jim Wild, VAOT Composite Materials Engineer
Callie Ewald, VTrans Geotechnical Engineer
Bob Klinefelter, Construction Structures Engineer

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Vermont Agency of Transportation

HUB

Foundation Co., Inc.

Drilled Shafts
Means and Methods Submittal
River Road Bridge Replacement Project
BRF 0183(1)
New Haven, VT

Prepared for: CCS Constructors Inc.
Prepared by: Hub Foundation Co. Inc.
Date: June 16, 2016
Rev. 3

H U B FOUNDATION CO., INC.

139 BILLERICA ROAD 1-978-456-2387

CHELMSFORD, MA. 01824 1-978-456-9201 FAX

Submittal

PROJECT: Drilled Shafts
River Road Bridge Replacement Project
BRF 0183(1)
New Haven, VT

Table of Contents

Section 1

Name and Experience of Superintendents and Operators

Depending on the scheduled start time, Hub anticipates that one of the following Superintendents and one of the following Operating Engineers will perform the work at this project. Should it become necessary to change key personnel from those listed, appropriate information will be provided to the Resident Engineer.

All of Hub Foundation's Superintendents, Foremen, and Equipment Operators have a minimum of 5 years drilling experience in varied conditions on sites throughout New England, Upstate New York, Pennsylvania, and Washington, DC. Most have significantly longer careers in the drilling industry either with Hub Foundation Co. or other drilling contractors. Their experiences cover almost every conceivable drilling condition that can be encountered in the diverse geologies of the New England region. Each is capable of providing reliable drilling expertise for installation of the drilled shaft for the River Road Bridge Replacement Project.

Gregory W. Maxwell
General Superintendent

Experience:

1990-1994	Graduate of Tufts University, Class of 1994 Part time Laborer and Foreman for Hub Foundation
1994-Present	Foreman and General Superintendent for Hub Foundation Union member since 1990

Job Specific Training: Geology courses at Tufts University
OSHA 40 Hour Hazardous Materials School
OSHA 8 Hour Confined Entry Course
Osterberg Seminar on Testing by Load Cell
ADSC National Slurry School
ADSC Supervisory Course
ADSC Anchor and Minipile School
NETTCP Certified Drilled Shaft Inspector

Completed Projects: - Emergency Access, Florida, MA

- Route 2 Widening, Lincoln, MA
- Quincy Concourse Bridge, Quincy, MA
- C01A3, C14B1, C14A2, C14C4, C17A2, C19E1, C17A1, C01A7, C19B8, C14C2, C17A6, C21C2, C19BA, Central Artery, Boston, MA
    - Responsible for rigging and picking points for lifting a 60 ton drill rig out of SNE tunnel on C17E1
    - Responsible for rigging and setting 110' I-beams along the expressway for SOE on C17A6
- Bridge Reconstruction, Waterbury, CT
- Decking over East Milton Square, Milton, MA
- Route 202 Bridge over B & M Tracks, Templeton, MA
- Drilled 4' diameter shafts between two in service B & M tracks for Route 63 Bridge, Montague, MA
- Multiple Contracts for Route 146, Millbury, MA
    - Drilled 4', 5' and 6' diameter fully cased holes up to 90' deep using a specialized casing oscillator
- Route 27 Bridge over Amtrak, Acton, MA
- Pine Street Bridge over Conrail, Grafton, MA
- Mobil Oil platform support, East Boston, MA
    - Drilling from a barge in a tidal creek and being required to abandon partially completed holes while oil tankers unloaded in extreme safety environment
- Troy Parking Garage, Troy, NY
- Green Line Modernization, Boston, MA
- 155 Portland Street
- Super Wick-Wells, Hingham, MA
- Memorial Bridge, Portsmouth, NH
- Sagamore Creek Bridge Replacement, Portsmouth NH

Jeffrey F. Maxwell
Vice President and Superintendent

Experience:

1987-1992	Graduate of Tufts University, Class of 1992 Part time Laborer and Foreman for Hub Foundation
1992-Present	Foreman and General Superintendent for Hub Foundation
1999-Present	Vice President for Hub Foundation Union member since 1987

Job Specific Training:

BS in Geologic Sciences at Tufts University
OSHA 40 Hour Hazardous Materials School
OSHA 8 Hour Confined Entry Course
Osterberg Seminar on Testing by Load Cell
ADSC National Slurry School
ADSC Supervisory Course
ADSC Anchor and Minipile School
NETTCP Certified Drilled Shaft Inspector

Completed Projects:

- Emergency Access, Florida, MA
- Route 2 Widening, Lincoln, MA
- Quincy Concourse Bridge, Quincy, MA
- C01A3, C14B1, C14A2, C14C4, C17A2, C19E1, C17A1, C01A7, C19B8, C14C2, C17A6, C21C2, C19BA, Central Artery, Boston, MA
    - Gilmore Bridge Access Ramps, Hub was responsible for rigging and setting 4' diameter rebar cages 120' long, in one piece, between train tracks and I-93
- Decking over East Milton Square, Milton, MA
- Route 202 Bridge over B & M Tracks, Templeton, MA
- MBTA Green Line Modernization, Boston, MA
- Emerson College, Boston, MA
- Hale Street Bridge Reconstruction, Lowell, MA
- Sound Barrier Wall, Exton, PA
- Logan Airport Terminal E, done at night while maintaining pedestrian access at all times, Boston, MA
- Logan Airport Roadways with 8' and 9' diameter shafts, 220' deep with concrete pours of over 400 cubic yards
- Manulife Financial Building, Boston, MA
- Rte 1 over Harris and High St, Dedham, MA
- MVP Medical Office Building, Schenectady, NY
- Revere Street Bridge, low overhead drilling, Revere, MA
- Harvard University, Blackstone Tunnel, Cambridge, MA
- Secant pile wall for the Truman School, New Haven, CT
- Brosnihan Sq., Hurley Square and other various Rte 146 and I-290 rebuilding, Worcester, MA
- NStar Plant Relocation, Beverly, MA
- Mt. Vernon St. Bridge Replacement, Newport City, VT
- Sagamore Creek Bridge Replacement, Portsmouth NH

Steve Ling
Operating Engineer

Experience:

1981-1992	Borggaard -Mechanic
1995-2001	Metro West Tunnel - Mechanic
2001-2003	Boston Sand & Gravel - Plant Operator/Plant Mechanic
2006-Present	Hub Foundation Co., Inc – Equipment Operator
1981-Present	Member of Operating Engineers Local 4

Training:

ACI certified/concrete testing
MCID, concrete testing
Mass Hoisting License, Grades 1A, 2A, and 4A
OSHA 10 Hour Safety Certification
ICS/ Diesel Mechanic Course
MBCR Roadway Worker Protection

Past Projects:

- Central Artery/Tunnel Project, Boston, South Station, Trevi-Icos' grouting operation.
- Metro West Tunnel, Mechanic responsible for the maintenance of the conveyer.
- Boston Sand and Gravel, Boston, MA, plant operator and mechanic for various mixes for various projects over two year span.
- Revere Sewer Outflow, Revere, MA, construction of a 36" sewer line into the ocean

Hub Foundation Co. Projects:

- Rte. 63 Bridge over the Millers River, Erving/Montague, MA. - drilled 4' dia. shafts for new bridge piers.
- Taylor Street Bridge over Rte. 2 Littleton, MA. - drilled 4' dia. shafts for bridge pier in median of active highway.
- Interstate 290 and Rte146 Bridge Replacements, Worcester MA - drilled 4', 5' and 6' dia. shafts for new bridges (piers and abutments).
- Nashua River Bridge, Clinton, MA. - drilled 4' dia. shafts from existing bridge deck for new bridge piers.
- Revere Street Bridge over the MBTA, Revere, MA. - drilled shafts in active commuter rail right of way.
- Fairmont Corridor Bridge Replacement, Dorchester, MA. - drilled 5' dia. shafts adjacent to active commuter rail for new bridge abutments.
- Braintree Light Plant, Braintree, MA. - drilled 6' dia. shafts in active electrical substation.
- Bridge Over Interstate 93, Salem NH. - drilled shafts adjacent to active highway for bridge piers.
- Sound Barrier Foundations, Lynnfield, MA. - drilled 3' dia shafts for soundwall foundations working from breakdown lane of Interstate 95.
- Quincy Sound Barrier, Quincy, MA. - drilled 2'-6 dia shafts for soundwall along active commuter rail line
- Hospital Road Bridge, Harvard, MA. - drilled 4'dia. shafts for new bridge abutments working from false-work.
- High St. and Harris St. Bridge Replacement, Dedham, MA. – drilled 5, 6 and 7 ft diameter dia. shafts for bridge abutments

Section 2

Catalogue Data for Equipment

The primary piece of drilling equipment will be a Soilmec R930 hydraulic drill rig. We have enclosed data on the R930 in Appendix A.

We are also enclosing copies of catalogue cuts showing drill tooling. Our tooling consists of heavy duty earth augers, drilling buckets, rock augers and core barrels. The earth augers and drilling buckets generally use ESCO T-18 and T-25 teeth. The rock augers generally use Kennametal C-21 tungsten carbide tipped teeth and the rock augers use Kennametal C-31 and C-41 teeth. It is anticipated that most of the drilling for this project will use plain water as the drilling fluid. When drilling under fluids we will use typically use drilling buckets for removal of soil. Catalog cuts of typical drilling tools are included in Appendix B.

For pumping of fluids back to a storage tank we will use a Gorman-Rupp self-priming centrifugal pump. Pumping slurry (if used) to the shaft will be accomplished by gravity feed or by using a Wilden diaphragm pump. Catalog cuts of the self-priming pump and Wilden diaphragm pump are included in Appendix A.

We plan on installing casing by spinning and crowding the casing with the drill rig and/or by using a vibratory hammer. Catalog cuts on the vibratory hammer are included in Appendix A. Casing will be left in place.

Information pertaining to a crane to be used to install and extract casing; unload, lift and set the rebar cage; and service the drill rig, will be provided by the General Contractor separately from this submittal.

Note: Equipment may be modified or substituted depending on field conditions. Modifications will be submitted to the Resident Engineer for approval prior to being implemented.

Note: The drawings for the tooling shown in Appendix B are to be interpreted for conceptual use only. Hub Foundation's manufacturer produces tooling for Hub exclusively in the New England market and all of the tooling is built to our exact specifications and other custom requirements. Drawings will not be made available.

Section 3

Catalogue Data for Slurry

It is anticipated that drilling fluid will be required to stabilize the excavation below the bottom of the casing. It is our intent to use polymer slurry which will be introduced to the hole after the casing is driven to the desired embedment depth. The slurry to be used will be manufactured by Matrix Construction Products (877) 791-0893. Information for and Matrix polymer slurries are included in Appendix C. A slurry technician from the slurry manufacturer will be on site for a minimum of 3 days.

Polymer slurry will meet the following parameters unless otherwise required by the specific manufacturer:

1. Density in excavation will be 63 to 64 lbs. per cubic foot.
2. Viscosity of slurry in excavation will be a minimum of *32* seconds using the Marsh funnel method. The maximum viscosity will be *135* seconds. Mixing at the slurry plant may be thicker to allow for slurry degradation during the drilling of the hole.
3. Ph of slurry in the excavation will be 8 to 11.5.
4. Dwell time in the mixer will be 15 minutes.
5. Sand content will be less than 1% measured 12 inches *and* 10 ft. above the bottom of the hole immediately prior to placing reinforcing or concrete.
6. The slurry level will be held a minimum of 5' above groundwater table/river level during drilling and until concrete placement is started.

Drilling fluid will be topped off to an approximate height of 5' above the groundwater/river level at the end of the day. If drilling fluid loss is consistent in any given area, a float shut-off device will be installed to maintain the level.

Desanding equipment is not required for polymer slurries. Sand size particles drop out of the slurry quickly and are removed by the cleanout bucket.

The polymer slurry will be batched in mixing tank which uses a splash plate to introduce the powdered slurry into a stream of water and bubblers (air) to agitate the slurry to thoroughly mix it. It will then be transferred to the shaft or storage tanks for later use depending on need.

Drilling fluid will be returned to storage tanks as the hole is poured.

A slurry sampler is shown in Appendix A.

Section 4
Drilled Shaft Installation Procedure

1. Casing will be advanced to Elevation +177, approximately 13 ft. into the gravelly silty sand layer (top of stratum approx. 60 ft. below mudline) by driving with a vibratory hammer and/or by spinning and crowding with the drill rig. The casing will be 8'-3" OD x 0.750" (nominal) wall thickness. Casing will be new or used (at our option) meeting the requirements of ASTM A252 Gr 2 (or better) and left in place. It is anticipated that one field splice will be required. The splice will be adequate to allow installation of the casing to the desired depth and will not be tested. During construction of the shaft the top of the casing will be left at Elevation *+277*. The elevation of the work platform will be set at Elevation *+260* according to the General Contractor.

2. Once the casing has been advanced to the desired embedment into the gravelly silty sand layer, the soils within the casing will be drilled out using earth augers, drilling buckets, or rock augers as needed.

3. In the event the casing is not able to be advanced to the desired embedment into the gravelly silty sand layer due to soil friction, the casing will be cleaned out approximately

to the tip of casing and soil below the casing loosened, but not removed. The casing will then be advanced again. If an obstruction is found below the casing, it will be removed as discussed in Section 9. Plumbness of the casing will be checked with a level every 10' during the installation of the casing.

4. Once the casing has been cleaned out, excavation of the remainder of the shaft to the design tip elevation will be completed under drilling fluid using earth augers, drilling buckets, and rock augers as needed to advance the hole. During excavation, the plumbness of the kelly bar will be monitored with built in spirit levels.

5. Once the excavation has been advanced to the design depth, the bottom of the shaft will be cleaned with a cleanout bucket. Once cleaned, the shaft will be inspected (with Owner's Representative) to verify the depth and cleanliness with a weighted tape.

6. Once the shaft has been inspected and determined to be of the appropriate depth and cleanliness the reinforcing cage will be installed with crosshole sonic testing access tubes attached (see Section 11).

7. Concrete will be placed by tremie placement methods using tremie pipe or concrete pump (see Section 12). During placement of concrete, the displaced water or slurry will be pumped back to a storage tank.

8. The concrete in the shaft will be overpoured by a minimum of 2', to allow for any contaminated concrete to rise above the top of shaft elevation.

9. Poor quality concrete, concrete, and/or laitance above the cutoff grade (El. 241) will be *removed by chipping* as soon as possible after the completion of the placement.

10. The permanent casing will be *initially be cut to approximately Elevation +253 (just above river level) to allow the GC to place the pier column cage and 2nd lift of the drilled shaft followed by construction of the 6 ft. dia. pier column. The General Contractor will provide water control to allow the cut to final grade (Elevation +249) which will be made following construction of the pier column.* Casing will be cut using an oxy/acetylene torch.

Section 5

Excavation Procedures

1. Excavation of the overburden will be performed by rotary drilling using a heavy duty earth auger, drilling bucket, and/or rock auger.

2. After introduction of drilling fluid or encountering groundwater, granular material will generally be removed with a drilling bucket. Cohesive material may be removed with either an earth auger or a drilling bucket. Hard drilling may require the use of a rock auger to loosen soil before removal with the bucket.

3. Obstruction removal may require the use of a rock auger and/or a core barrel. When obstructions are encountered, the Engineer (or his/her designee) will be notified to verify an obstruction has been encountered and so that pay quantities can be determined.

4. While drilling, Hub will maintain the drilling fluid at least five feet above anticipated piezometric head level or as needed to assure shaft stability.

5. Shaft layout will be provided by the General Contractor's survey team.

6. In the event of a sudden loss of drilling fluid, loss of slurry stabilization properties, or sudden ground loss around the shaft during drilling, drilling will immediately stop and one or more of the following actions will occur as needed: the casing will be advanced to seal the hole; the hole will be backfilled with drilling spoils; slurry viscosity will be increased; the hole will be backfilled with lean mix concrete.

Section 6

Spoil Handling

Spoils handling, transport, disposal, and management of any temporary stockpiling sites will be by others. Hub will spin drilled material off the augers or dump them from drilling buckets onto the working platform next to the drill rig for removal by others.

Section 7

Out of Tolerance

If the hole is discovered to be out of tolerance, Hub will attempt to straighten the hole with a core barrel working on the "high" side of the hole. If the hole is out of tolerance due to an obstruction, the obstruction will be removed or a portion cored through. If we are unable to straighten the hole, the portion of the hole that is obstructed, will be backfilled with lean-mix (or flowable fill) and the hole re-drilled after the mix has setup.

Section 8

Sloping Rock Surfaces

Not applicable to this project.

Section 9

Removal of Obstructions

Hub will have a core barrel and rock auger on site to allow us to drill through boulders or other similar obstructions. Given the likelihood of groundwater or drilling fluid in the excavation it is not anticipated that downhole entry for the removal of obstructions will be utilized. However, should a decision be made to attempt to remove an obstruction by downhole entry, the excavation shall be fully cased to the obstruction level and water intrusion shall be under control before downhole entry procedures will be undertaken.

In the event that an obstruction is encountered requiring excavation below the bottom of the casing, water or polymer slurry will be introduced into the hole, as needed, to maintain hole stability below the bottom of the casing.

We will notify the Engineer when obstructions are encountered and assist in measuring elevations of top and bottom of obstructions to determine pay quantities.

Section 10

Shaft Inspection Procedure

Shaft inspection will be performed by Hub Foundation in conjunction with the Owner's Representative. Shaft approval will be by the Owner's Representative. Hub will notify the Engineer (or his/her designee) at the completion of a shaft or when any unusual or unanticipated geologic conditions are encountered. Hub will assist the Engineer in taking measurements as requested.

Shaft cleanliness will be determined by dropping a weighted tape to the bottom of the hole and sounding the bottom.

A sample drilled shaft log is shown in Appendix D.

Section 11

Lifting, Placing and Securing Cages

Hub will place the cage in the shaft using a service crane provided by the General Contractor. The cage, with CSL tubes attached, will be lifted by the service crane and, if necessary, the drill rig to hold the bottom of the cage during tripping up (upending of the cage for insertion into the casing). The cage will be spliced over the hole using mechanical couplers as indicated by the rebar cage shop drawing (submitted under separate cover). The cage will be suspended from the permanent casing using angle iron (or other materials) and secured prior to placement of the concrete. Spacers will be attached to the rebar cage to keep it centered in the hole.

The cage will be furnished in two pieces and spliced over the hole. The cage will be hoisted using the service crane. Endless round slings will be used to pick the lower section of the cage which will be lowered into and suspended in the hole using angle iron sitting on the permanent casing. The top section will be hoisted and the cage spliced. The entire length of the cage will be picked up slightly to allow removal of the angle iron supports and the cage lowered to the bottom of the excavation. Prior to hoisting, sacrificial bars will be cable clipped to the top section of the cage to allow the cage to be suspended/secured in the hole using angle iron supported on the permanent casing. Centralizers will be attached either prior to hoisting or during installation of the cage (or a combination thereof).

Section 12

Concrete Placement

A Concrete mix design will be submitted under separate cover.

It is assumed that the concrete will require placement by the tremie method due to the likely presence of groundwater or drilling fluid in the shaft. Concrete will be placed by the tremie

method utilizing either 10” diameter tremie pipe or concrete pump with minimum 4” diameter discharge. A cut sheet of the tremie pipe is included in Appendix A.

The tremie method consists of placing concrete at the bottom of the shaft under water or drilling fluid using either a minimum 4 inch diameter concrete pump discharge or a ten inch diameter tremie pipe, placed in the center of the shaft. As the concrete is placed it displaces the fluid in the shaft which is pumped back to a holding tank. A “rabbit” (*either foam or vermiculite plug)* will be used between the concrete and the water or drilling fluid to prevent contamination of the concrete. The tremie pipe and hopper will be supported on the top of the casing.

As the concrete is poured, portions of the tremie pipe will be removed. The tremie pipe will always be embedded a minimum of 10’ into the concrete. Concrete will be over-poured a minimum of 2 feet to provide good concrete at final grade. The over-pour will be removed by chipping to final grade using jackhammers and/or chipping guns.

Should it become necessary to reinsert the tremie pipe, the foreman will probably be fired, a watertight flap will be attached to the bottom of the tremie string and the tremie pipe reinserted a minimum of 5 ft. into the previously placed concrete. Concrete will be introduced into the tremie pipe and the pipe lifted approximately 1 foot to open the flap and start the flow of concrete.

Should an emergency construction joint be required, the shaft will be dewatered and the top of the concrete chipped down to good concrete and roughened. A bonding agent will be applied to the cold joint and the remainder of the concrete will be placed in the dry. This procedure is only possible within the limits of the permanent casing. Should an emergency construction joint be required below the limits of the permanent casing, the shaft will have to be re-drilled.

CSL Tubes will be filled with non-shrink grout. Grout will be placed using tremie methods. Information on the non-shrink grout will be provided in a separate/future submittal.

CSL tubes will be filled with water prior to concreting of the shaft.

Section 13

Corporate Experience

In 1966 Francis Maxwell founded Hub Foundation Co., Inc.; his son Jim Maxwell took over management of the company in 1981. Jeff and Greg Maxwell joined Hub after graduating from Tufts University in the 1990s. They are presently managing jobs and are poised to take over the company in the future. Hub has completed more than 1100 contracts in the New England and NY area under diverse and difficult conditions.

Hub has capabilities to install drilled shafts ranging in size from 18” inches up to 12 ft. in diameter through soils and into underlying bedrock. Hub also has capabilities to install drilled in soldier piles, drilled mini-piles, secant piles, steel sheet piling, tiebacks, rock anchors, soil nails, and helical piles.

Hub owns 12 hydraulic crawler mounted drill rigs of various sizes to allow us to handle a variety of projects from small to large. Hub also owns a 220-ton capacity Liebherr HS895 lattice boom crane with built in hydraulics, 35 ton single part line pull and full computer monitoring; two Mantis 77 ton capacity hydraulic crawler cranes; an Ape King Kong vibratory hammer capable of vibrating up to 12’ diameter casing; a high frequency variable moment vibratory hammer; two

ICE vibratory hammers; a Volvo 150 loader; and a Komatsu PW 220 rubber tired backhoe. Our Soilmec SR-100 is one of the largest hydraulic drill rigs made and is capable of drilling shafts up to 12' in diameter and 230' deep. Our three Soilmec 930's and our SR-90 can drill shafts up to ten feet in diameter and 220' deep. Other equipment is available for various sizes of shafts 18 inches in diameter and larger.

Hub also owns several minipile drill rigs and tieback rigs, including small electric minipile drill rigs capable of work inside existing structures. Hub has the capability to install drilled minipiles, tiebacks, soil nails, rock anchors, and helical piles.

Hub also owns a significant inventory of drilling tools, slurry plant equipment and drilling accessories. We fabricate many of our own drill tools at our shop.

For more information on Hub Foundation Co., Inc. look us up on our website, www.hubfoundation.com, or contact our office at 978.456.2387.

Some Completed projects

Logan Airport, Boston, MA: Hub has been involved in multiple contracts at Logan Airport over the past few years. Our work has included running the night shift and maintaining pedestrian access to Terminal E at all times while drilling and pouring operations were ongoing. Hub also drilled 8' and 9' diameter shafts up to 220 feet deep for the viaduct shafts. The pours were continual and comprised more than 400 cubic yards of concrete. Contractor: Modern Continental and Flatiron, Flatiron Address: 18 Logan Way, Boston, MA, 02127, Ph: 617.567.4038

Emerson College, Boston, MA**:** Hub had a 100' x 100' site to drill 17 four foot diameter 90' to 140' deep shafts and nine soldier piles and had to enter through a 12 foot wide alley. Contractor: Lee Kennedy Address: 1792 Dorchester Ave, Boston, MA, 02124, Ph: 617.825.6930.

CA/T Utility relocation for the new Central Artery placed in downtown Boston. We have been active on C01A3, C14B1, C14A2, C14C4, C17A2, C19E1, C17A1, C01A7, C19B8, C14C2, C17A6, C19E6, C21C2, and C19BA. We have drilled and placed soldier piles in low headroom situations, under the existing Central Artery, and in high traffic areas such as Kneeland Street. We have also performed night shift work on Causeway Street. Once drilling was completed C19E1, we were required to lift the Soilmec 312, a 40-ton drill rig, with a 200-ton crane. On the C14B1 project we were responsible for rigging and setting four-foot diameter rebar cages 120 feet long, in one piece, between live train tracks and I-93 without disrupting vehicular or train traffic. On C19BA we were contracted to drill 6' and 8' diameter shafts with permanent casing. Contractors: The Middlesex Corp., Daniel O'Connell's Sons, The Laxfield Corp., McCourt Construction Co., J. F. White Contract Corp., Modern Continental Construction Co., Modern's Address: 600 Memorial Drive, Cambridge, MA, 02139 Ph: 617.864.6300. (2 current projects)

399 Boylston Street: Picking up precast concrete piles 130 feet long in a downtown area on a site 70' by 200', while maintaining pedestrian and vehicular traffic. Contractor: George B. H. Macomber Company, Address: One Design Center Place Boston, MA 02210 Ph: 617.965.7300.

53 State Street, Boston, MA: Installing a soldier beam and lagging system in the midst of old streets and utilities to an excavated depth of 30 feet. After the excavation was complete we turned and drove piles in the hole while a six story façade, left for historical purposes, reminded us that an unplanned move could topple the wall over with disastrous consequences. Contractor: Kiewit Eastern and Gilbane Building, Address: 2310 Washington Street, Newton Lower Falls, MA, 02462, Ph: 617.965.7300.

Lechmere Galleria, Cambridge, MA: Installing 3,000 lineal feet of permanent sheeting and jacked raker system, for an excavation up to 40 feet deep. Immediately adjacent to our work was a new building, which had footings 15 feet above the excavation. The site filled in a portion of the Charles River and had to be dewatered. Contractor: Beaver Builders, Address: 1 Wells Ave, Newton Center, MA 02459, Ph: 617.965.9600.

Route 2 Widening, Lincoln, MA: Hub designed and drilled 41 soldier piles to facilitate the widening of Route 2 near an environmentally sensitive area. The beams varied from 23' to 39' in length and were placed through fill up to 25 feet deep. The till consisted of boulders, some of which were larger than the 4'6" diameter casing. A cantilever design allowed traffic to run unimpeded next to a cut as deep as 19 feet. This was done without installing tiebacks, which would have cut into an existing gas main, or bracing, which would have been destructive to the wetlands. Design by James C. Schrock, P.E., Contractor: G. Conway, Inc., Address: 500 Main St., Charlestown, MA, Ph: 617.242.2151.

Groton Submarine Base: The Navy required a new dock in an area where there was little material over rock. In order to secure the dock and fender system we installed 123 18" and 20" piles, which were predrilled with a down hole hammer as much as 25 feet into granite. All of the piles were placed within a ¾ inch tolerance for a precast deck system to be installed. Contractor: The Middlesex Corp., Address: One Spectacle Pond Road, Littleton, MA 01460, Ph: 978.742.4400.

Reconstruction of Rte 146, Millbury and Worcester, MA: We have drilled four-, five-, and six-foot diameter shafts up to 90 feet deep with rock sockets up to eight feet deep into hard schist. The shafts were to support a series of ten bridges over the Blackstone River and the P & W Railroad. Much of the work required fully cased shafts, which was installed using a two-meter casing oscillator to eliminate vibration settlement in loose sands. Contractor: Roads Corp., Address 241 Treble Cove Road, Billerica, MA 01862, Ph: 978.663.9700.

East Milton Square, Milton, MA: Our contract required us to install 42" diameter shafts on 20' centers along the median strip. Phase one holes supported a temporary bridge constructed to carry traffic over the SE Expressway while new bridges were constructed in phase two. This was an extremely tight site requiring planning and coordination between the state, GC and Hub. While on this site there was an Osterberg Load Cell Test to a total capacity of about 6,147 tons. Testing was performed by Loadtest Inc. Contractor: The Middlesex Corp., Address: One Spectacle Pond Road, Littleton, MA, 01460, Ph: 978.742.4400.

Mobil Oil, Boston, MA: An earth retention system was needed to stabilize a granite seawall, which was moving due to a slope failure. The new system had to be installed without any vibration. Hub installed 51" casing in a tangent pile system using a casing oscillator, which was mounted on false work driven under a previous contract. We drilled 50' holes through a dense glacial till containing cobbles and boulders, from a barge in a tidal creek with limited access to an active pier. Hub had to abandon partially completed holes while oil tankers unloaded in an extreme safety environment. The work was performed on a time and material basis because of numerous interruptions. Contractor: Mobil Oil Corp., 1.888.662.4599.

Mohawk Valley Physicians Office Building and Parking Garage, Schenectady, NY: Hub drilled 80 three-, four-, and five-foot diameter shafts, up to 160' deep. Two Osterberg tests showed that the till could support very high loads, saving the owner over $200,000 by reducing the size and socket depth of the shafts. Contractor: BBL Construction Services, Address: 302 Washington Ave Extension, Albany, NY 12203, Ph: 518.452.5200.

Secant Pile Wall, New Haven, CT: 2003-2004 Hub is drilling a series of over 300 shafts as a secant pile wall for the City of New Haven water department to create a retaining wall for a 5 million gallon rain water runoff overflow reservoir. Hub is using both a Liebherr 225 and a Soilmec 930 to create the secant pile wall. The Liebherr uses a Continuous Flight Auger system, which allows for a 60 foot shaft to be drilled and cased at once. Contractor: Remedial Construction Services ph: 281.664.1114.

Sheridan Hollow Parking Garage, Albany NY: Hub drilled 115 three- to five-foot diameter shafts on a steeply sloping job site. Our 200-ton Liebherr 895 greatly simplified the project with its reach and line pull. Our Soilmec R-930 and R-518 rigs drilled holes up to 100 feet deep through clay and till to support a seven-story parking garage. Turner Construction, 54 State Street, Albany, NY, 518.432.0277.

Blackfan Research Center, Boston, MA: Hub is installing 8' and 10' diameter drilled shafts in a limited space job in a very busy area of Boston. East Coast Slurry, 145 Island Street, Stoughton, MA, 781.344.5700.

500 Atlantic Avenue, Boston, MA**:** Joint venture with East Coast Slurry to place the foundation for a hotel around the existing Central Artery Tunnel and air filtration stack. Drilling is took place in very tight, downtown conditions through many existing wood piles. Bovis Lend Lease, 99 Chauncy Street, Boston, MA 02111, Ph: 617.598.4300

Memorial Bridge, Portsmouth NH: Installation of 3 ft and 5 ft diameter shafts and 9 5/8" diameter mini-piles in Portsmouth Harbor. Shafts were drilled from trestles through overburden soils into the underlying bedrock. Rock socket depths for the drilled shafts varied between 6'-6 to 8'-6. Minipiles were drilled through the existing main span piers to depths of approximately 100 ft with 25 ft deep rock socket. Archer Western Contractors LLC, 45 Shawmut Road, Canton, MA 02021, Ph 781.793.9988

Appendix A

Drill Rig/Equipment Data

R-930

Rotary idraulica

Hydraulic rotary rig

SOILMEC

R-930

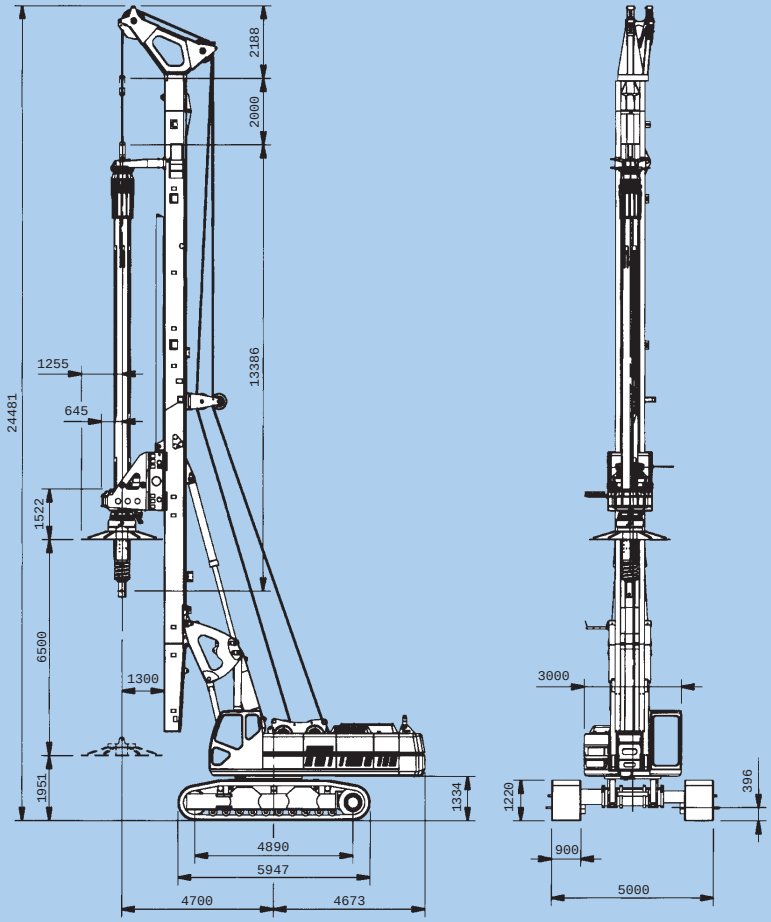
PALI GRANDE DIAMETRO
LARGE DIAMETER PILES

Le attrezzature di perforazione **serie R-930** su carro base **SOILMEC** sono progettate per eseguire i seguenti lavori:

- **pali trivellati a secco o con fluidi di perforazione;**
- **pali trivellati con l'infissione ed estrazione di tubi di rivestimento con o senza morsa;**
- **pali ad elica continua;**
- **pali a circolazione inversa;**
- **pali secanti con doppia testa.**

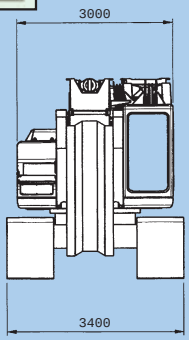
Le caratteristiche qualificanti della **R-930** sono:

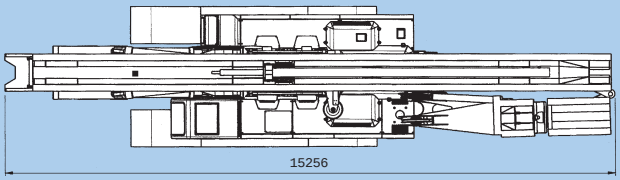
- **classe macchina 100 t;**
- **completamente automontante;**
- **possibilità di intubaggio con testa di rotazione;**
- **moderna strumentazione;**
- **affidabilità e sicurezza.**



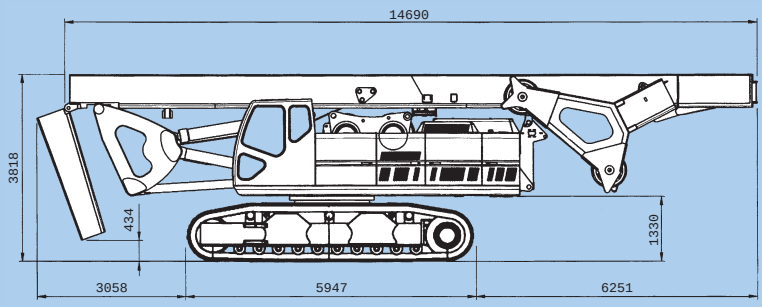
Sistema di Qualità Certificato
Certified Quality System

Dal 1990 la Soilmec si è uniformata alle normative previste dal sistema di Qualità ISO 9001/UNI 29001.
In 1990 Soilmec was awarded the certification of its own Quality System to ISO 9001/UNI 29001 series standards



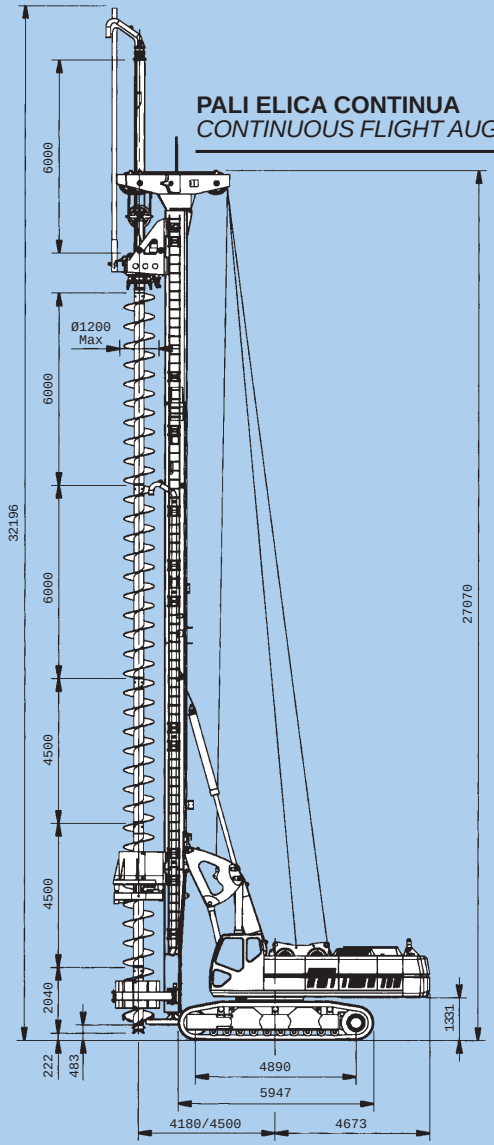


KELLY BAR / *KELLY BAR*		
Diametro max palo *Max pile diameter*	mm	**2500 / 3000** (1)
Max Profondità palo *Max pile depth*	m	**76,5**

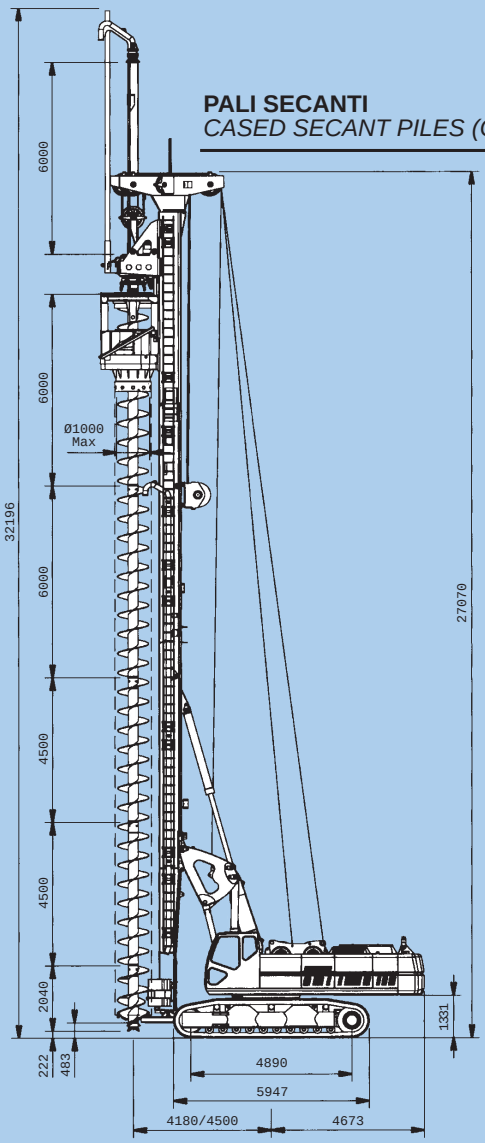


PESI e DIMENSIONI / *WEIGHTS and DIMENSIONS*		
Larghezza in trasporto *Transport width*	mm	**3400 / 3000** (2)
Altezza in trasporto *Transport width*	mm	**3560 / 3200** (2)
Peso in ordine di lavoro *Operating weight*	ton	**100 - 105**
Peso in trasporto, min. *Minimum transport weight*	ton	**45** (3)

PALI ELICA CONTINUA
CONTINUOUS FLIGHT AUGER (CFA)



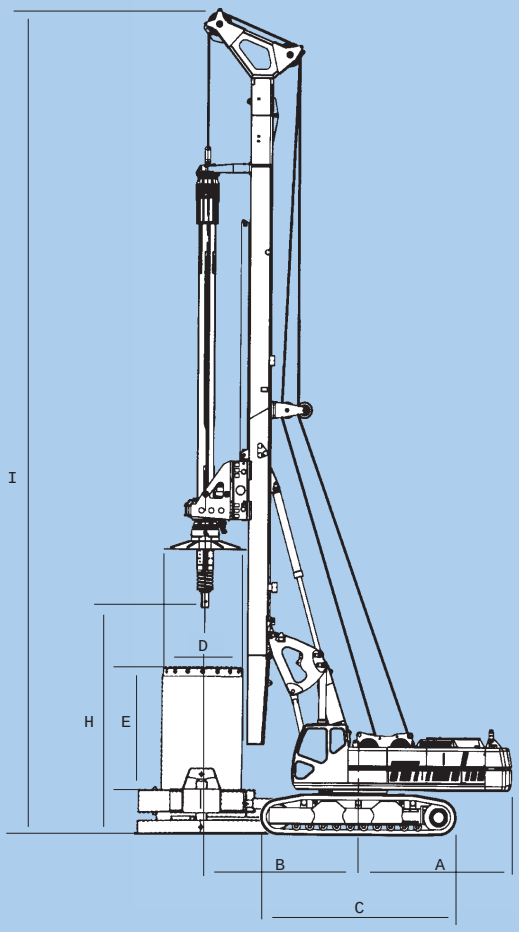
PALI SECANTI
CASED SECANT PILES (CSP)



ELICA CONTINUA / *CONTINUOUS FLIGHT AUGER*		
Diametro max palo *Max. pile diameter*	mm	**1200**
Max profondità palo *Max. pile depth*	m	**28.6**
Max profondità con pulitore *Max. pile depth w. auger cleaner*	m	**27**
Forza di estrazione *Extraction force*	kN	**1160**

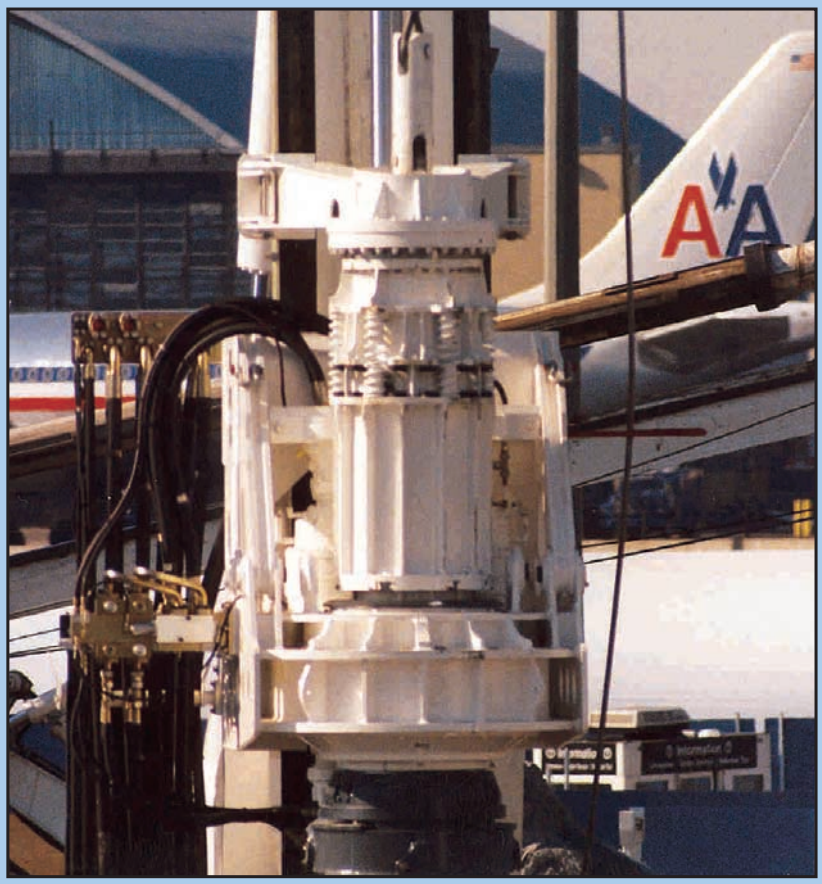
PALI SECANTI / *CASED SECANT PILES*		
Diametro max palo *Max. pile diameter*	mm	**1000**
Max profondità palo *Max. pile depth*	m	**25**
Max profondità intubato *Max. cased depth*	m	**18.5**
Tiro/spinta di estrazione *Casing pull-up down*	kN	**320**
Coppia 2ª rotary **(32 MPa)** *2nd rotary torque*	kNm	**305** @ 4.8 rpm
Velocità max intubaggio *Max casing speed*	rpm	**9.7**

(1) Con / Senza piede antenna. *With / Without bottom mast section.*
(2) Con / Senza cingolato. *With / Without tracks.*
(3) Senza cingoli, zavorra, rotary, kelly, testata con carrucole, prolunga antenna.
Tracks, counterweight, rotary, bottom & top mast section, sheave head removed.



A	**Raggio di rotazione torretta** *Tail/swing radius*	mm	**4670**
B	**Asse di rotazione - asse di scavo** *Radius of front end*	mm	**4700**
C	**Lunghezza totale cingolo** *Track total length*	mm	**5950**
D	**Diameatro max con morsa** *Max diameter with casing oscillator*	mm	**2500**
D	**Diametro max.*** *Max diameter **	mm	**3000**
E	**Altezza max tubo colonna** *Max length of casing element*	mm	**6000**
H	**Altezza attacco utensile da terra** *Tool connection height from ground level*		vedi tabella aste *see kelly table*
I	**Altezza totale macchina** *Machine total height*	mm	**24500**

*** si può ottenere smontando la parte inferiore del mast**
may be obtained by removing the lower mast element



ASTE A FRIZIONE Ø 483
KELLY FRICTION Ø 483

n° elementi *n° elements*	lungh. *length*	profondità *depth*	peso *weight*	H
4x	10,5 m	37,0 m	7000 kg	9900 mm
4x	11,5 m	41,0 m	7500 kg	8800 mm
4x	13,5 m	49,5 m	8500 kg	6760 mm
4x	15,5 m	57,5 m	9500 kg	4770 mm
4x	16,5 m	61,0 m	10000 kg	3860 mm
5x	10,5 m	46,0 m	7600 kg	9900 mm
5x	11,5 m	51,5 m	8300 kg	8800 mm
5x	13,5 m	62,0 m	9600 kg	6760 mm
5x	15,5 m	72,0 m	10900 kg	4770 mm
5x	16,5 m	76,5 m	11500 kg	3860 mm

ASTE A BLOCCAGGIO MECCANICO Ø 483
KELLY MECHANICAL LOCKING Ø 483

n° elementi *n° elements*	lungh. *length*	profondità *depth*	peso *weight*	H
4x	10,5 m	37,0 m	7000 kg	9900 mm
4x	11,5 m	41,0 m	7500 kg	8800 mm
4x	13,5 m	49,0 m	8500 kg	6760 mm
4x	15,5 m	57,0 m	9500 kg	4770 mm
4x	16,5 m	61,0 m	10000 kg	3860 mm

La misura standard per il quadro attacco utensili è 200 x 200
Standard dimension of tool connection is 200 x 200 mm

SOTTOCARRO CINGOLATO / *UNDERCARRIAGE*		
Lunghezza totale *Overall length*	mm	**5950**
Larghezza pattini *Track shoe width*	mm	**900**
Larghezza totale, aperto *Overall width (retracted side frames)*	mm	**5000**
Larghezza totale, chiuso *Overall width (extented side frames)*	mm	**3400**
Pressione al suolo *Ground pressure*	MPa	**0,01**
MOTORE DIESEL / *DIESEL ENGINE **		
Marca / Modello *Make and model*		**Deutz BF8M1015C**
Potenza massima *Power rating*	kW (HP)	**364** (488) @ 2200 rpm
POMPE IDRAULICHE / *HYDRAULIC PUMPS*		
Portata pompe principali *Main pumps*	lt/min	2 x **380**
Taratura idraulica *Hydr. power setting*	kW (HP)	**247** (331)
Pressione massima di utilizzo *Max working pressure*	MPa	**35**
ARGANO PRINCIPALE / *MAIN WINCH*		**Controlled Descent**
Tiro nominale in 1° strato *1st layer nominal line pull*	kN	**290**
Velocità massima in 1° strato *1st layer nominal rope speed*	m/min	**82**
Diametro fune *Rope diameter*	mm	**30**
ARGANO SECONDARIO / *SERVICE WINCH*	**Controlled Descent (SW-140)**	**Free Fall (SF-140)**
Tiro nominale in 1° strato *1st layer nominal line pull*	kN	**140**
Velocità massima in 1° strato *1st layer nominal rope speed*	m/min	**87**
Diametro fune *Rope diameter*	mm	**26**
TAVOLA ROTARY / *ROTARY TABLE*		
Coppia massima (35 MPa) *Maximum torque (35 MPa)*	kNm	**305**
Velocità di scarico *Spin off speed*	rpm	**117**
Velocità max. perforazione *Maximum drilling speed*	rpm	**27.1**
Forza max. spinta / estrazione *Max pull / push force*	kN	**318 / 322** **sul casing** / *on casing*
Forza max. in spinta sul kelly *Max force pull on kelly*	kN	**153**
Corsa cilindro di pull-down *Pull down cylinder stroke*	mm	**6500**

* **Conforme alle norme sulle emissioni dei diesel industriali** / *Nonroad diesel exhaust regulations compliance* (EU - **97/68/CE**, U.S.A. - **EPA**; California - **CARB**.)

*The **R-930** drilling rig mounted on **SOILMEC** base carrier has been specially designed to perform the following applications:*

- ***bored piles with or without drilling fluid;***
- ***casing with rotary head or by the use of an oscillator;***
- ***continous flight auger piles (C.F.A);***
- ***bored piles by reverse circulation;***
- ***secant piles with double head (C.S.P.).***

*The main features of **R-930** are the followings:*

- ***a 100 ton class machine;***
- ***completely self-erecting;***
- ***casing can be installed by means of a rotary head;***
- ***sophisticated instrumentation;***
- ***reliability and safety.***

Tutti i dati tecnici sono da considerare indicativi.
La SOILMEC si riserva la facoltà di modificarli opportunamente.

All technical data are purely indicative and subject to change without notice.

12/99 - Impianti / Il Digitale • Stampa: Litot

SOILMEC
Drilling and Foundation Equipment
5819 via Dismano - 47023 **Cesena** (FC) - Italy
Tel. +39-0547-319111 Fax +39-0547-318548
http://**www.soilmec.it**
e-mail: **soilmec@soilmec.it**

APE Model 400 Vibratory Driver Extractor

The Worlds Largest Provider of Foundation Construction Equipment

SPECIFICATIONS	DATA
Eccentric Moment	11,500 in-lbs (132.49 kgm)
Drive Force	320 tons (2,847 kN)
Frequency Maximum (VPM)	0 - 1,400 vpm
Max Line Pull	234 tons (2,082 kN)
Bare Hammer Weight w/o Clamp	31,570 lbs (14,320 kg)
Throat Width	33.00 in (84 cm)
Length	141.00 in (358 cm)
Height w/o Clamp	88.50 in (225 cm)

APE Model 1050 Power Unit

SPECIFICATIONS	DATA
Engine Type	Caterpillar C27 Tier II
Horse Power	1,050 HP (772 kW)
Drive Pressure	0 - 4,800 psi (331 bar)
Drive Flow	294 gpm (1,113 lpm)
Clamp Pressure	4,800 psi (69,618 bar)
Clamp Flow	10 gpm (3 lpm)
Engine Speed	2,100 rpm
Weight	22,500 lbs (10,206 kg)
Length	186 in (472 cm)
Width	87 in (221 cm)
Height	103 in (260 cm)
Hydraulic Reservoir	Consult Factory
Fuel Capacity	Consult Factory

Specifications may vary due to site conditions, specific hammer conditions or product set up.
Specifications may change without notice.
Consult the factory for details on any specific product (800) 248-8498.

Specification Data | **Sec. 45** | PAGE 1460 | Apr. 20, 1992

ACE

Self Priming Centrifugal Pump

Diesel Engine Driven

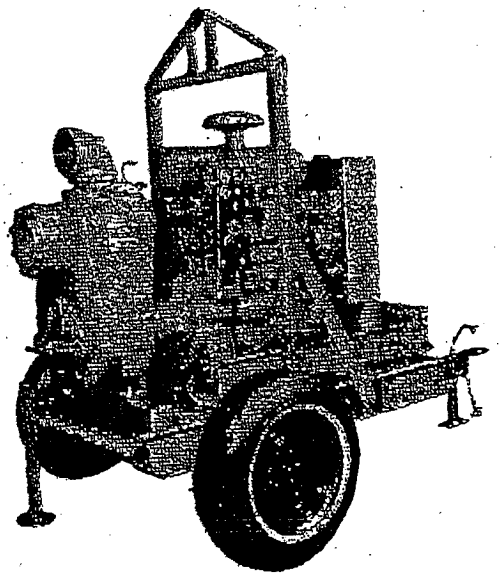
Model 16C2-4039D *and* 16C20-4039D

Size 6" x 6"

CERTIFIED PERFORMANCE CONTRACTOR PUMP DESIGN CPD

70 MT

Total Head		CAPACITY OF PUMP IN U.S. GALLONS PER MINUTE AT CONTINUOUS PERFORMANCE				
P.S.I.	Feet					
64	147	420	420	420	420	420
54	125	615	875	930	939	930
43.5	100	660	945	1170	1340	1350
33	75	685	960	1195	1425	1515
22	50	695	960	1205	1455	1565
Suction lift		25'	20'	15'	10'	5'



PUMP SPECIFICATIONS

Size: 6" [152,4 mm] x 6" [152,4 mm] N.P.T.-Female
Casing: Gray Iron No. 30
(Maximum Operating Pressure 130 psi. [896 kPa])
Impeller: Open Type, Two Vanes, Ductile Iron No. 60-40-18
(Handles 3" [76,2 mm] Dia. Spherical Solids)
Impeller Shaft: Alloy Steel No. 4140
Wear Plate; Replaceable: Steel No. 1018
Cover Plate; Removable: Gray Iron No. 30 (47 lbs. [21.3 kg.])
Intermediate Bracket: Gray Iron No. 30
Seal Plate: Gray Iron No. 30
Seal: **(Model 16C2-4039D Only)**
Double Grease-Lubricated with Spring Loaded Grease Cup.
Sintered Bronze Stationary Seal Seats. Rotating Faces Are Steel.
Maximum Temperature of Liquid Pumped, 110°F [43°C]
Maximum Suction Pressure 10 Pounds Per Square Inch [69 kPa].
Seal: **(Model 16C20-4039D Only)**
Mechanical Oil-Lubricated Double Floating Self-Aligning.
Rotating and Stationary Faces are Tungsten Titanium Carbide.
Stationary Seat is Stainless Steel No. 316. Elastomers are Viton.
Cage and Spring are Stainless Steel No. 18-8. Maximum
Temperature of Liquid Pumped is 160°F [71°C]*
** Consult factory for applications with liquids in excess of temperature indicated.*
Seal Liner: Bronze No. C83600 **(Model 16C2-4039D Only)**
Shaft Sleeve: Alloy Steel No. 4130 **(Model 16C20-4039D Only)**
Flap Valve: Neoprene with Steel Reinforcing
Radial Bearing: Open Ball
Thrust Bearing: Open Double Ball
Bearing Lubrication: Oil
Flanges: Gray Iron No. 30
Gaskets: Resistant Synthetic Rubber & Cork; Vegetable Fiber; Compressed Synthetic Fibers; Teflon
Hardware: Standard Plated Steel

Standard Equipment:
Hoisting Bail
Skid Base
90° Discharge Elbow
Strainer
Oil Level Sight Gauge

Optional Equipment:
2 Wheel Truck Assy with Pneumatic Tires, P235/75R15
Battery
Over the Road Trailer (Meets D.O.T. Requirements)

ENGINE SPECIFICATIONS

Model: John Deere 4039D
Type: Four Cylinder, Four Cycle, Liquid Cooled Diesel Engine
Displacement: 239 Cu. In. [3.9 L]
Governor: Mechanical
Lubrication: Forced Circulation
Air Cleaner: Dry Type
Oil Reservoir: 9 U.S. Quarts [8.5 L]
Fuel Tank: 38.9 U.S. Gallons [147.2 L]
Operating Time; Full Load: 12.5 Hours
Starter: 12 Volt Electric

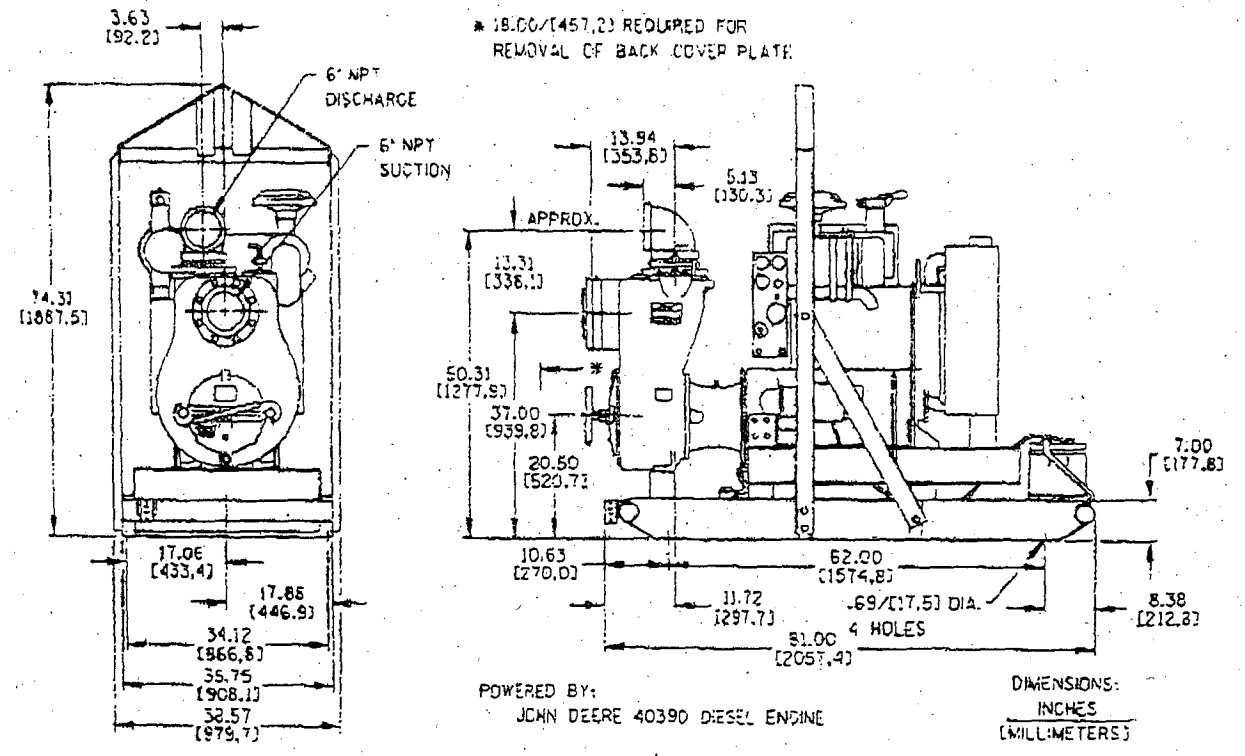
Standard Features:
Safety Shut Down Switches for Low Oil Pressure and High Coolant Temperature,
Instrument Panel with Temp. Gauge, Oil pressure Gauge, Ammeter, Hourmeter & Tachometer.
Muffler with Guard and Weather Cap.

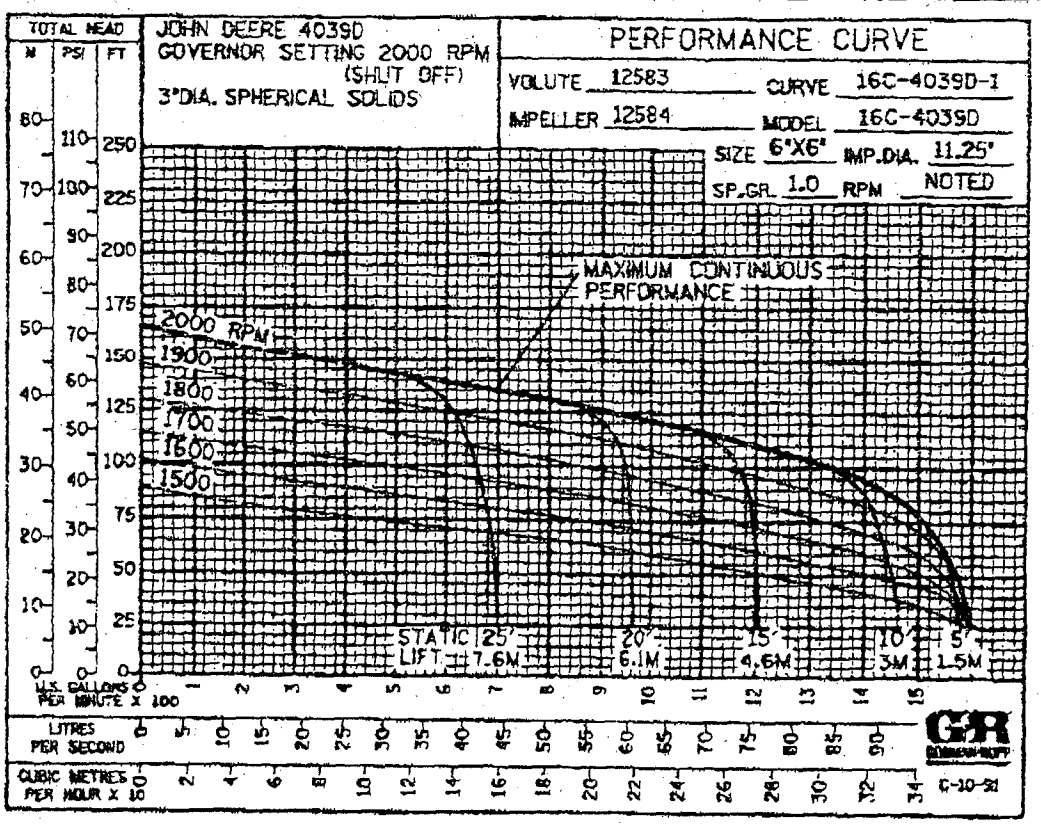
JOHN DEERE PUBLISHED PERFORMANCE:
Max. Cont. B.H.P. 71 @ 2200 RPM
Max. Dyn. B.H.P. 80 @ 2500 RPM

WARNING
DO NOT USE IN EXPLOSIVE ATMOSPHERE OR FOR PUMPING VOLATILE FLAMMABLE LIQUIDS

THE GORMAN-RUPP COMPANY • MANSFIELD, OHIO
GORMAN-RUPP OF CANADA LIMITED • ST. THOMAS, ONTARIO, CANADA
Printed in U.S.A.

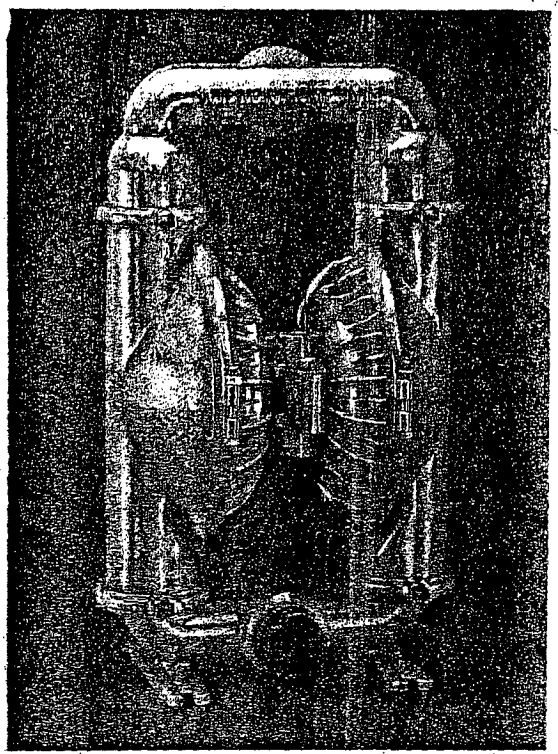
Specification Data	OVERALL DIMENSIONS and WEIGHTS APPROXIMATE		SKID BASE	2-WHEEL
SECTION 45, PAGE 1460		NET WEIGHT:	2482 LBS. [1126 KG.]	2756 LBS. [1259 KG.]
		SHIPPING WEIGHT:	2582 LBS. [1171 KG.]	2756 LBS. [1250 KG.]
		EXPORT CRATE:	156 CU. FT. [4.4 CU. M.]	174 CU. FT. [4.9 CU. M.]



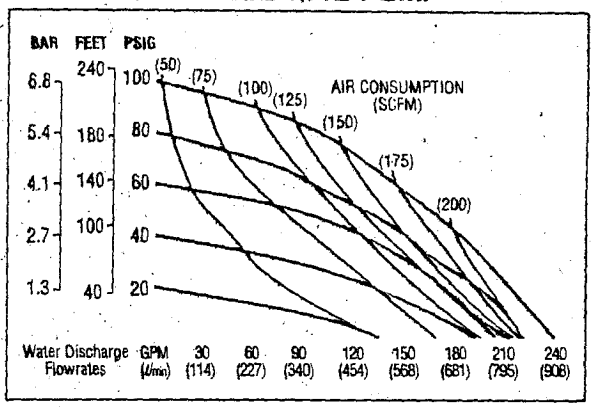


THE GORMAN-RUPP COMPANY • MANSFIELD, OHIO
GORMAN-RUPP OF CANADA LIMITED • ST. THOMAS, ONTARIO, CANADA
Printed in U.S.A.

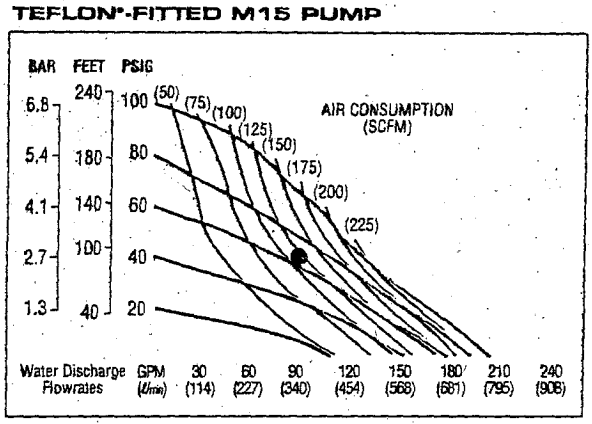
M15 METAL PUMP



RUBBER/TPE-FITTED M15 PUMP



TEFLON®-FITTED M15 PUMP



M15 Metal Pump Flows up to 240 G.P.M.

Maximum pump operating pressures should not exceed 125 psig (8.62 Bar).

Volumes indicated on charts were determined by actually pumping water into calibrated tanks.

Example:

To pump 90 gpm against a discharge head of 40 psig requires 65 psig and 125 scfm air consumption. (See dot on Teflon-fitted chart.)

SPECIFICATIONS

Materials of Construction, Wetted Housings

(Water Chambers, Inlet/Discharge Manifolds)

MATERIAL	SHP. WT.	MATERIAL	SHP. WT.
Aluminum	110 lbs.	316 Stainless Steel	165 lbs.
Hastelloy C	218 lbs.	Cast Iron	181 lbs.

Materials of Construction, Non-Wetted Housings

DESCRIPTION	MATERIAL
Center Block	Aluminum or Aluminum, Nickel-Plated or Stainless Steel or Polypropylene
Air Chambers	Aluminum or Aluminum, Nickel-Plated or Stainless Steel or Cast Iron
Air Valve	Brass or Brass, Nickel-Plated or Stainless Steel

Suction Lift Capability

DRY LIFT	PRIMED LIFT
17' (5.18m)	25' (7.62m)

The above figures represent rubber-fitted pump capabilities. Consult your distributor for TPE and/or Teflon®-fitted pump data.

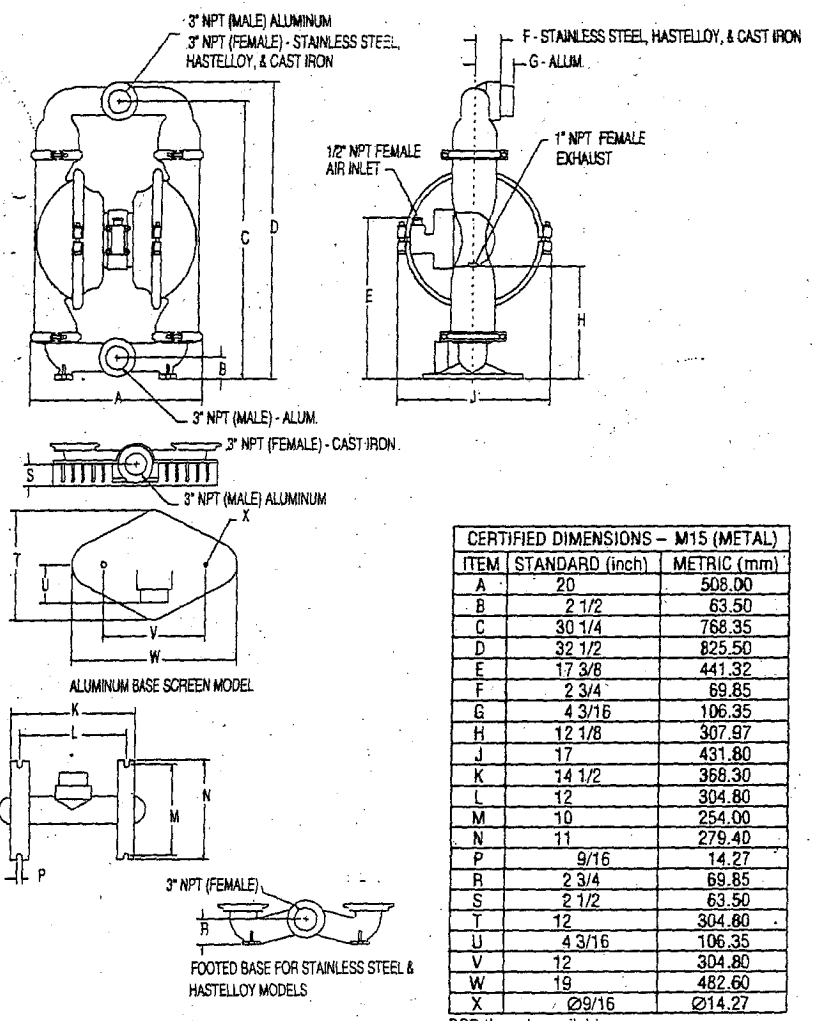
Maximum Diameter Solids

⅜" (9.52mm) Diameter

Elastomer Options

MATERIAL	TEMPERATURE LIMITS
Polyurethane	+10 (–12.2) to +150 (65.6) F° (C°)
Neoprene	0 (–17.8) to +200 (93.3) F° (C°)
Buna-N	+10 (–12.2) to +180 (82.2) F° (C°)
Nordel	–60 (–51.1) to +280 (137.8) F° (C°)
Viton	–40 (–40.0) to +350 (176.7) F° (C°)
Saniflex™	–20 (–28.9) to +220 (104.4) F° (C°)
Teflon®	+40 (4.4) to +220 (104.4) F° (C°)
Wil-Flex™	–40 (–40.0) to +225 (107.2) F° (C°)

DIMENSIONAL DRAWING



CERTIFIED DIMENSIONS – M15 (METAL)		
ITEM	STANDARD (inch)	METRIC (mm)
A	20	508.00
B	2 1/2	63.50
C	30 1/4	768.35
D	32 1/2	825.50
E	17 3/8	441.32
F	2 3/4	69.85
G	4 3/16	106.35
H	12 1/8	307.97
J	17	431.80
K	14 1/2	368.30
L	12	304.80
M	10	254.00
N	11	279.40
P	9/16	14.27
R	2 3/4	69.85
S	2 1/2	63.50
T	12	304.80
U	4 3/16	106.35
V	12	304.80
W	19	482.60
X	Ø9/16	Ø14.27

BSP threads available.

PUMP DYNAMICS

The Wilden diaphragm pump is an air-operated, positive displacement, self-priming pump. These drawings show the flow pattern through the pump upon its initial stroke. It is assumed the pump has not been primed prior to its initial stroke.

FIGURE 1 The air valve directs pressurized air to the back side of diaphragm A. The compressed air is applied directly to the liquid column separated by elastomeric diaphragms. The diaphragm acts as a separation membrane between the compressed air and the liquid. Driving the diaphragm with air instead of the shaft balances the load and removes mechanical stress from the diaphragm, dramatically extending diaphragm life. The compressed air moves the diaphragm away from the center block of the pump. The opposite diaphragm is pulled in by the shaft connected to the pressurized diaphragm. Diaphragm B is now on its air exhaust stroke; air behind the diaphragm has been forced out to atmosphere through the exhaust port of the pump. The movement of diaphragm B toward the center block of the pump creates a vacuum within chamber B. Atmospheric pressure forces fluid into the inlet manifold forcing the inlet valve ball off its seat. Liquid is free to move past the inlet valve ball and fill the liquid chamber.

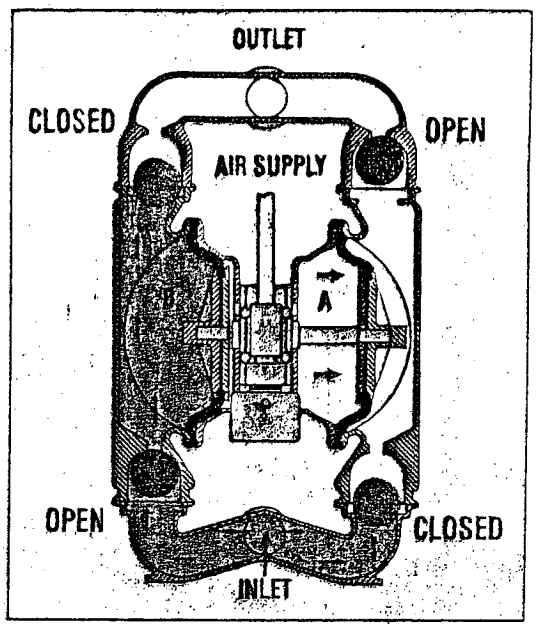


FIGURE 1

FIGURE 2 When the pressurized diaphragm, diaphragm A, reaches the limit of its discharge stroke, the air valve redirects pressurized air to the back side of diaphragm B. The pressurized air forces diaphragm B away from the center block while pulling diaphragm A to the center block. Diaphragm B is now on its liquid discharge stroke. Diaphragm B forces the inlet valve ball onto its seat due to the hydraulic forces developed. These same hydraulic forces lift the discharge valve ball off its seat, while the opposite discharge valve ball is forced onto its seat, forcing fluid to flow through the pump discharge. The movement of diaphragm A to the center block of the pump creates a vacuum within liquid chamber A. Atmospheric pressure forces fluid into the inlet manifold of the pump. The inlet valve ball is forced off its seat allowing the fluid being transferred to fill the liquid chamber.

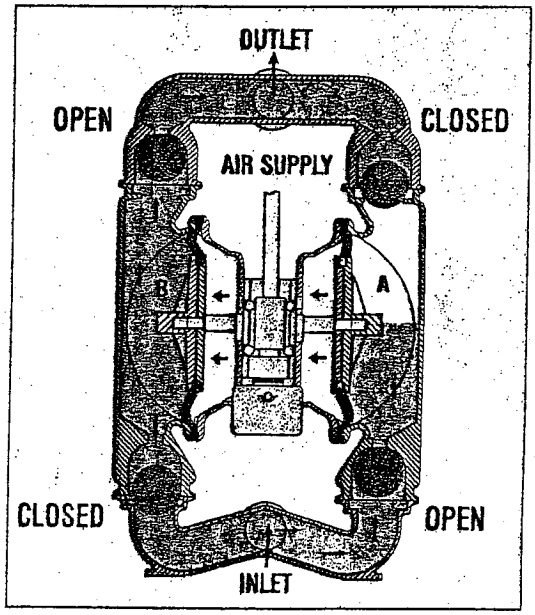


FIGURE 2

FIGURE 3 Upon completion of the stroke, the air valve again redirects air to the back side of diaphragm A, and starts diaphragm B on its air exhaust stroke. As the pump reaches its original starting point, each diaphragm has gone through one air exhaust or one fluid discharge stroke. This constitutes one complete pumping cycle. The pump may take several cycles to become completely primed depending on the conditions of the application.

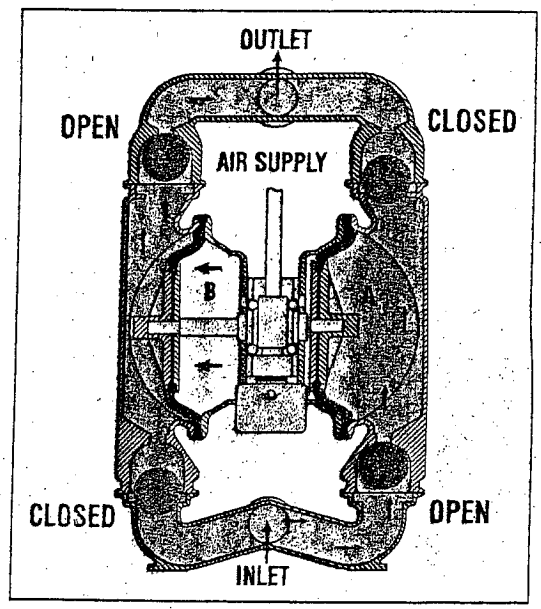
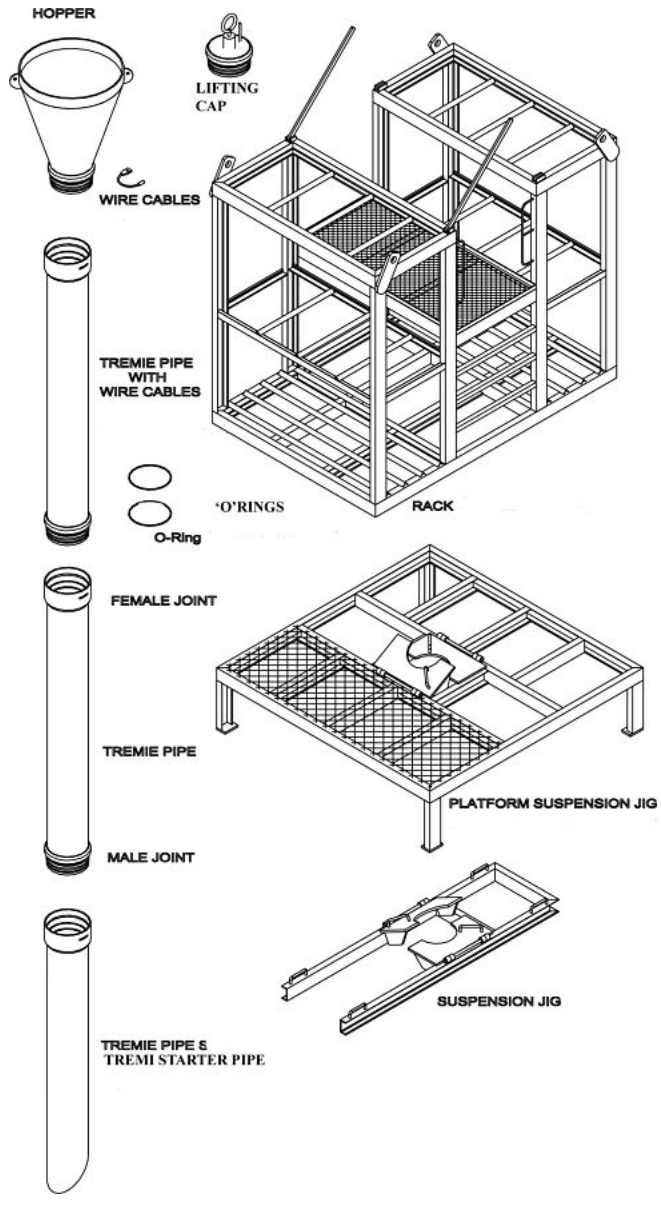


FIGURE 3

Tremie Pipes

In the Tremie Concrete pouring method, Concrete is placed below water / ground level though a pipe, the lower end of which is kept immersed in fresh concrete so that the rising concrete from the bottom displaces the water / Bentonite without washing out the cement content. Tremie can also be used as a noun to refer to the hopper and drop pipe used to place the concrete underwater / below ground level.



Concrete Placement
Three issues are critical to the placement of concrete under water or slurry:
• A delivery method must be used that keeps the concrete separated from the water or slurry and prevents intermixing.
• The concrete must maintain a high slump to completely fill the shaft and flow easily around the reinforcing steel.
• The top of the shaft must be thoroughly flushed at completion of the pour.

TECHNICAL DATA

SAMPLE BAILER

DOUBLE BALL DISCRETE DEPTH COLLECTION

DESCRIPTION

SAMPLE BAILER has a second ball check located at the top that permits the bailer to secure a sample from a specific depth without influence from the slurry above. Meets contract specifications for collecting slurry samples for testing physical drilling slurry properties.

RECOMMENDED USE

Tie the suspension cord to the bailer hook. Lower the bailer slowly down the borehole to the desired depth. Yank up on the SAMPLE BAILER allowing the SAMPLE BAILER to collect a sample, and then raise the bailer gently to the surface to maintain sample integrity. Empty the SAMPLE BAILER contents into a sample bottle.

ADVANTAGES

- Collects slurry samples accurately
- Meets specification to collect slurry samples from different depths
- Large enough to collect slurry for all the required tests
- Used to collect samples for specified physical properties of drilling slurry density, sand content, pH, and viscosity

CHARACTERISTICS

The white PVC re-usable sample bailers are designed to retrieve a sample from specific depths. The threaded all PVC construction and the removable top and bottom valves make cleaning quick and easy.

PACKAGING

3” white PVC threaded SAMPLE BAILER 3.500 O.D. x 24” long.

2870 Forbs Avenue, Hoffman Estates, IL 60192
847.851.1800 | 800.527.9948 | cetco.com/dpg

BARBOOT®

DRILLED SHAFT REBAR SUPPORT

WHY USE IT?

In order to support the entire rebar cage vertically within the drilled shaft and provide proper clearance between the rebar reinforcement and the earthen surface at the bottom of the shaft. The encapsulation of the ends of the vertical rebar provides added corrosion protection.

BARBOOT

A simple and economical method of supporting and spacing vertical cage reinforcement at the base of drilled shafts.

APPLICATIONS

- Bridge Foundations
- Building Foundations
- Retaining Wall Foundations
- Street Light Foundations
- High Mast Foundations
- Transmission Line Foundations
- Sub-station Foundations
- Tower Foundations
- Slurry Walls

ADVANTAGES

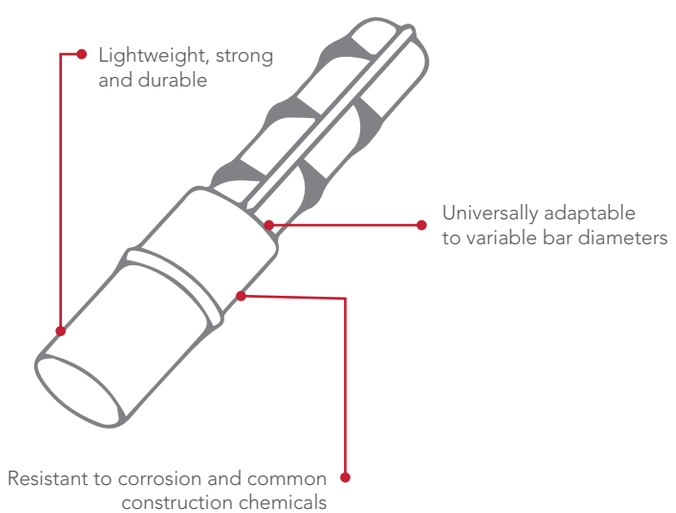
- Saves time and money
- Easy installation
- Universally adaptable to variable size bar diameters (one size fits all)
- Self-locking
- Lightweight, yet strong and durable
- Engineered with the contractor in mind
- Made of high-density plastic, resistant to corrosion, and chemicals common to construction
- Economical to use
- Indefinite shelf-life and easily stored

CONSTRUCTION BENEFITS

- Protects from bar end corrosion.
- Ensures that the bar reinforcement is properly spaced and supported within the confines of the drilled shaft or excavation.
- Provides quality assurance of the contractor's performance for the engineer and owner.

BARBOOT MINIMUM PLACEMENT RECOMMENDATIONS

- Equally space boots around bottom of the cage
- Use one Barboot per 1500 lbs. of steel cage weight; minimum of one Barboot every other vertical bar

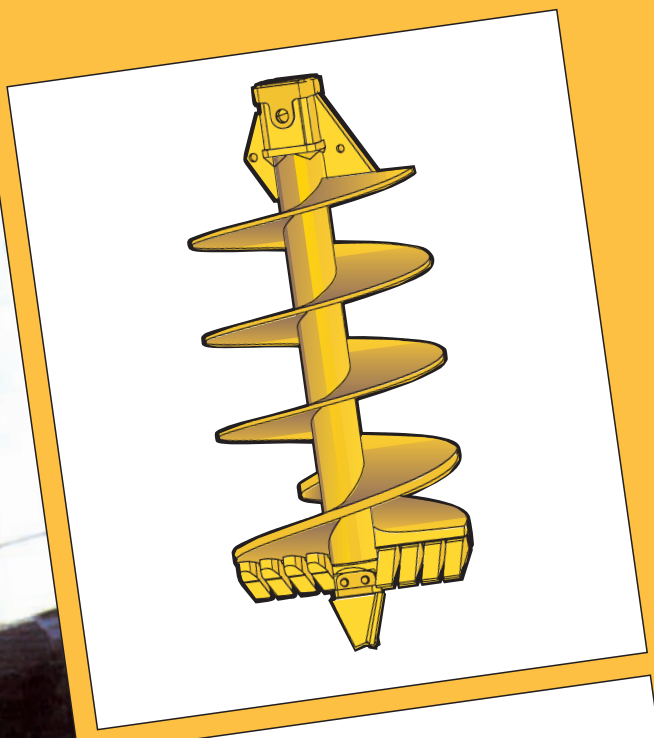


Appendix B

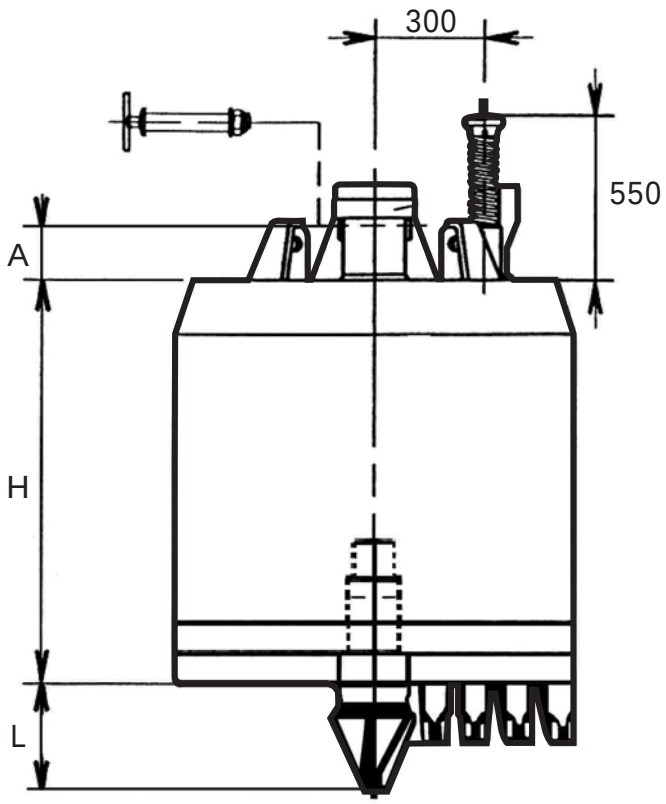
Drilling Tools

Rotary Drilling Rig

Utensili
Drilling Tools

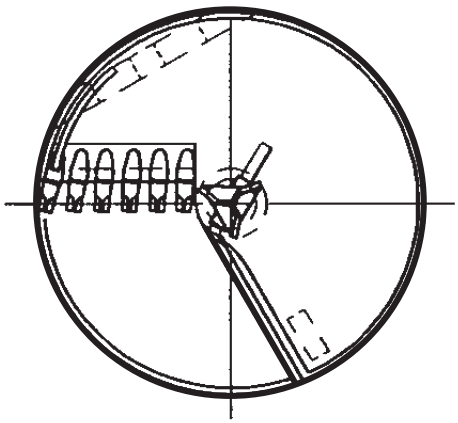


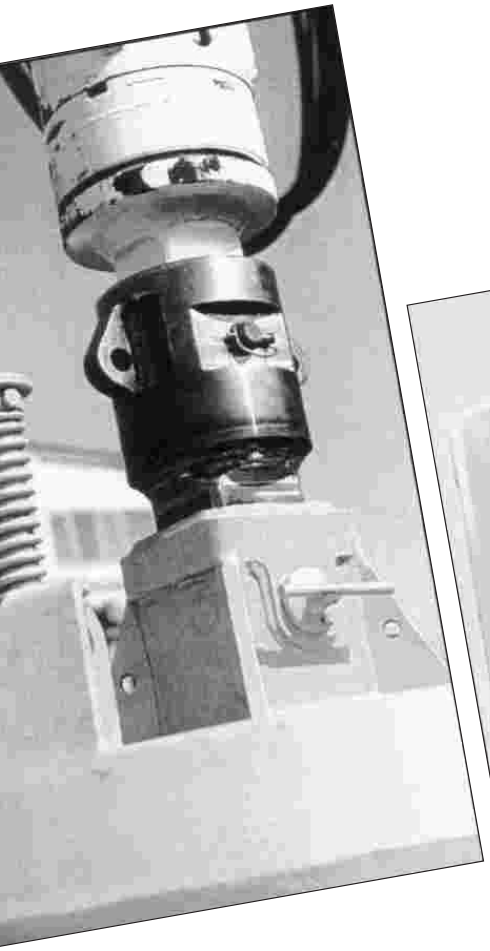
SOILMEC

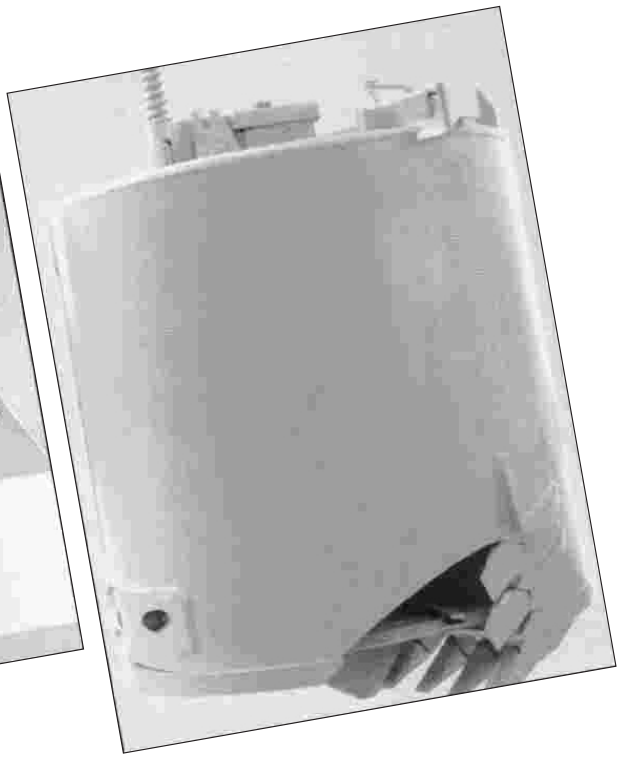


a fondo rotante

with guillotine type closing bottom







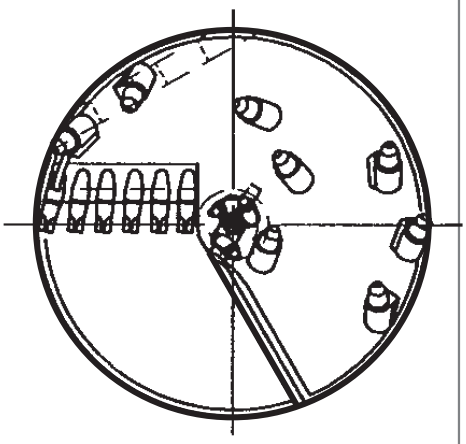
HD/R serie *series*

Ø scavo *excavation*	Peso indicativo *approx. weight*	Lungh. (H) *length*
mm	kg	mm
800	**1020**	**1250**
900	**1150**	**1250**
1000	**1300**	**1250**
1100	**1420**	**1250**
1200	**1580**	**1250**
1300	**1700**	**1250**
1400	**1810**	**1250**
1500	**1900**	**1350**
1600	**2000**	**1350**
1700	**2180**	**1350**
1800	**2480**	**1350**
1900	**2600**	**1350**
2000	**2720**	**1350**
2100	**-**	**1350**
2200	**-**	**1350**

N.B. Altri diametri a richiesta
Other dimensions upon request

a fondo rotante per roccia, variante a denti misti

with guillotine type closing bottom for rock, mixed teeth type



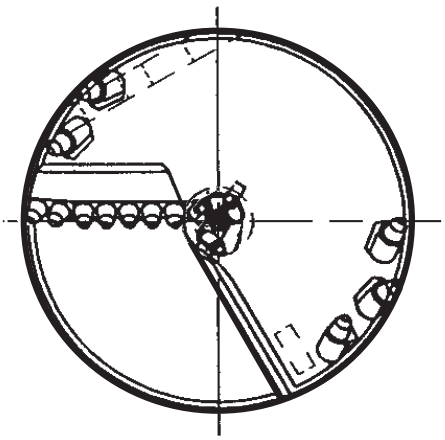
HK/R serie *series* ②

Ø scavo *excavation*	Peso indicativo *approx. weight*	Lungh. (H) *length*
mm	kg	mm
800	**1000**	**1200**
900	**1030**	**1200**
1000	**1280**	**1200**
1100	**1390**	**1200**
1200	**1550**	**1200**
1300	**1670**	**1200**
1400	**1780**	**1200**
1500	**1860**	**1300**
1600	**1960**	**1300**
1700	**2140**	**1300**
1800	**2430**	**1300**
1900	**2550**	**1300**
2000	**2670**	**1300**
2100	**-**	**1300**
2200	**-**	**1300**

N.B. Altri diametri a richiesta
Other dimensions upon request

a fondo rotante per roccia, variante a picchi

with guillotine type closing bottom for rock, bit type



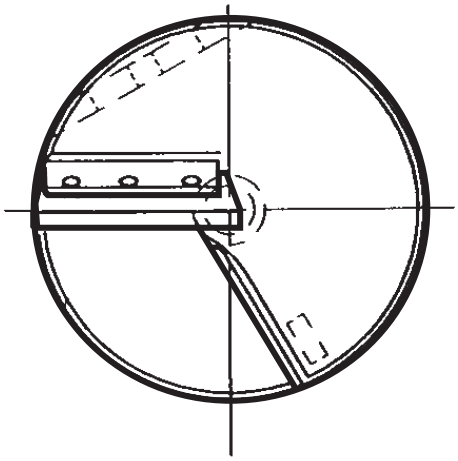
RK/R serie *series* ③

Ø scavo *excavation*	Peso indicativo *approx. weight*	Lungh. (H) *length*
mm	kg	mm
800	**960**	**1250**
900	**990**	**1250**
1000	**1260**	**1250**
1100	**1370**	**1250**
1200	**1520**	**1250**
1300	**1630**	**1250**
1400	**1750**	**1250**
1500	**1850**	**1350**
1600	**1950**	**1350**
1700	**2130**	**1350**
1800	**2400**	**1350**
1900	**2500**	**1350**
2000	**2640**	**1350**
2100	**-**	**1350**
2200	**-**	**1350**

N.B. Altri diametri a richiesta
Other dimensions upon request

a fondo rotante, pulitore di fondo

with guillotine type closing bottom and bottom cleaner



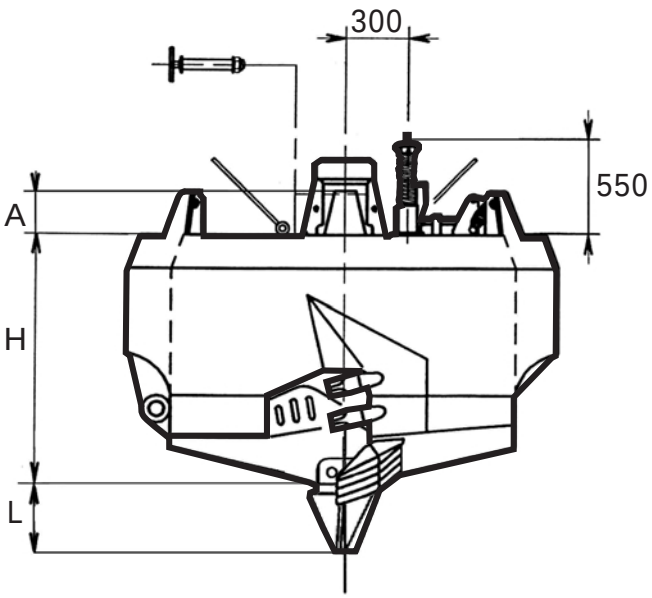
CL/R serie *series* ④

Ø scavo *excavation*	Peso indicativo *approx. weight*	Lungh. (H) *length*
mm	kg	mm
800	**950**	**1250**
900	**980**	**1250**
1000	**1250**	**1250**
1100	**1350**	**1250**
1200	**1500**	**1250**
1300	**1610**	**1250**
1400	**1720**	**1250**
1500	**1800**	**1350**
1600	**1900**	**1350**
1700	**2080**	**1350**
1800	**2360**	**1350**
1900	**2460**	**1350**
2000	**2580**	**1350**
2100	**-**	**1350**
2200	**-**	**1350**

N.B. Altri diametri a richiesta
Other dimensions upon request

alta capacità di carico,
terreni compatti

high load capacity, hard soil



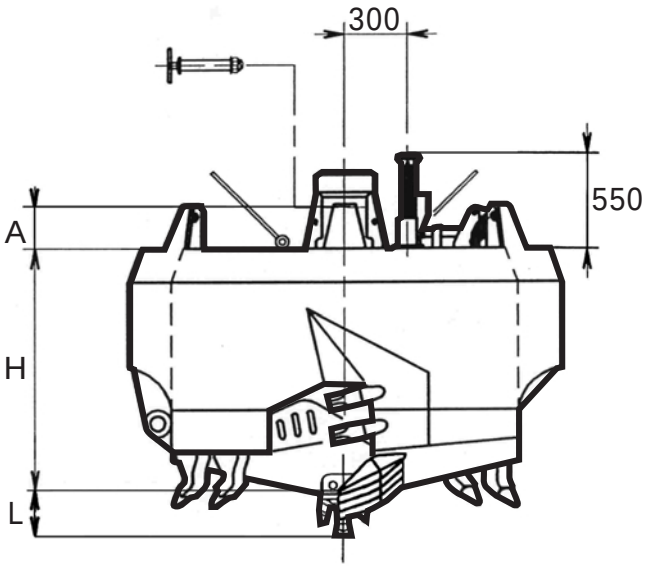
HD serie *series* ⑤

Ø scavo *excavation*	Peso indicativo *approx. weight*	Lungh. (H) *length*
mm	kg	mm
800	**870**	**1400**
900	**960**	**1400**
1000	**1100**	**1400**
1100	**1200**	**1400**
1200	**1340**	**1400**
1300	**1440**	**1400**
1400	**1540**	**1400**
1500	**1610**	**1500**
1600	**1700**	**1500**
1700	**1850**	**1500**
1800	**2100**	**1500**
1900	**2200**	**1500**
2000	**2300**	**1500**
2100	**-**	**1500**
2200	**-**	**1500**

N.B. Altri diametri a richiesta
Other dimensions upon request

alta capacità di carico, da roccia,
singolo principio

high load capacity, for rock, single start

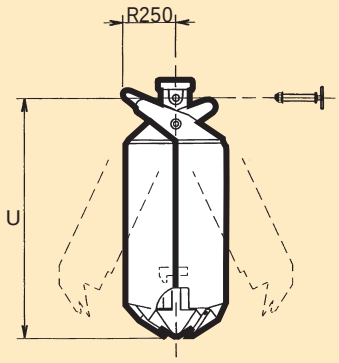


RK serie *series* ⑥

Ø scavo *excavation*	Peso indicativo *approx. weight*	Lungh. (H) *length*
mm	kg	mm
800	**900**	**1400**
900	**1000**	**1400**
1000	**1150**	**1400**
1100	**1250**	**1400**
1200	**1400**	**1400**
1300	**1500**	**1400**
1400	**1600**	**1400**
1500	**1700**	**1500**
1600	**1800**	**1500**
1700	**1950**	**1500**
1800	**2200**	**1500**
1900	**2350**	**1500**
2000	**2450**	**1500**
2100	**-**	**1500**
2200	**-**	**1500**

N.B. Altri diametri a richiesta
Other dimensions upon request

Bucket speciali / *Special Buckets*



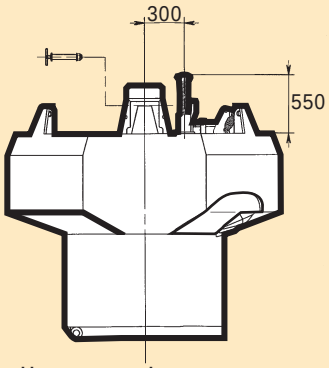
a corpo apribile,
per piccoli diametri

butterfly bucket for small diameter

SB serie *series* ⑦/⑧

Ø scavo *excavation*	Peso indicativo *approx. weight*	Lungh. (U) *length*
mm	kg	mm
500	**315**	**1450**
600	**365**	**1450**
700	**450**	**1450**

N.B. Altri diametri a richiesta
Other dimensions upon request



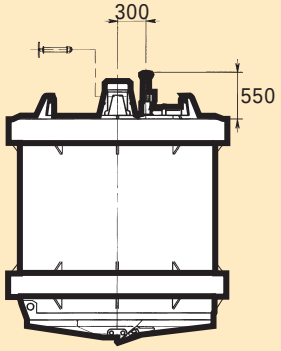
allargatori
a due diametri

two dimension reamers

DD serie *series* ⑨

Ø scavo preforo *pre-hole excavation*	Ø scavo *excavation*
mm	mm
1200	**1500**
1200	**1600**
1200	**1700**
1200	**1800**
1200	**1900**
1200	**2000**
1200	**2100**
1200	**2200**
1800	**2300**
1800	**2400**
1800	**2500**
1800	**2600**
1800	**2700**
1800	**2800**
1800	**2900**
1800	**3000**

N.B. Altri diametri a richiesta
Other dimensions upon request



a fondo rotante, **fasce di centraggio per diam. medio grandi**

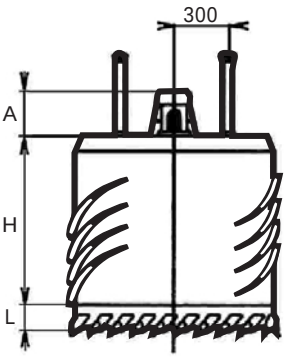
with guillotine type closing bottom, centering device for medium large diameters

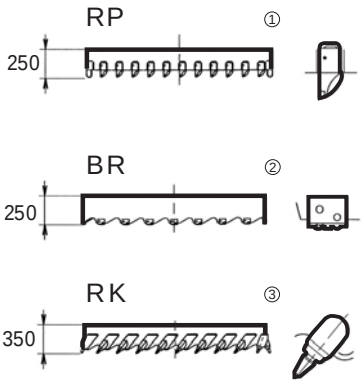
OF serie *series* ⑩

Tipo Bucket *Bucket Type*	Ø scavo *excavation*
	mm
1500	**1500**
1600	**1600**
1700	**1700**
1800	**1800**
1900	**1900**
2000	**2000**
2100	**2100**
2200	**2200**
2300	**2300**
2400	**2400**
2500	**2500**

N.B. Altri diametri a richiesta
Other dimensions upon request

Carotieri / *Core barrels*





con denti tipo RIPPER
with teeth ripper type

RP a corona
RP cutting ring type

Ø scavo *excavation*	Peso indicativo *approx. weight*	Lungh. (H) *length*
mm	kg	mm
800	**490**	**1150**
900	**570**	**1150**
1000	**660**	**1150**
1100	**760**	**1150**
1200	**900**	**1150**
1300	**950**	**1150**
1400	**1050**	**1200**
1500	**1260**	**1200**
1600	**1500**	**1200**
1700	**1730**	**1200**
1800	**1950**	**1200**

con denti a placchette abrasive
with teeth with abrasive plates

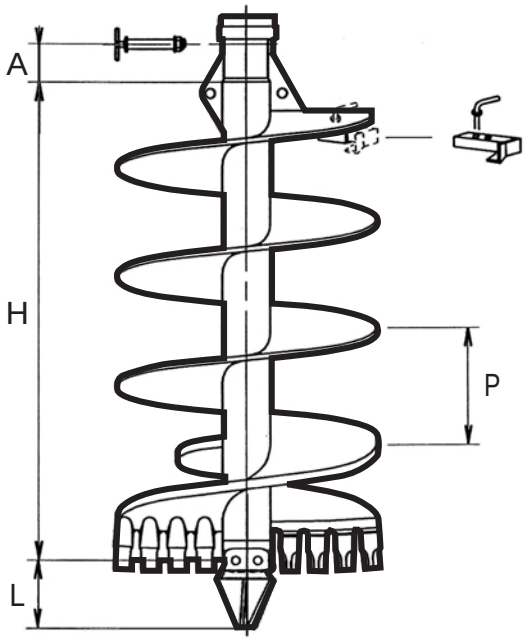
BR a corona
BR cutting ring type

Ø scavo *excavation*	Peso indicativo *approx. weight*	Lungh. (H) *length*
mm	kg	mm
600	**350**	**1150**
700	**430**	**1150**
800	**480**	**1150**
900	**560**	**1150**
1000	**650**	**1150**
1100	**750**	**1150**
1200	**890**	**1150**
1300	**940**	**1150**
1400	**1050**	**1200**
1500	**1250**	**1200**
1600	**1490**	**1200**
1700	**1730**	**1200**
1800	**1850**	**1200**
1900	**-**	**1200**
2000	**-**	**1200**

con picchi
with bits

RK a corona
BR cutting ring type

Ø scavo *excavation*	Peso indicativo *approx. weight*	Lungh. (H) *length*
mm	kg	mm
600	**380**	**1150**
700	**460**	**1150**
800	**520**	**1150**
900	**600**	**1150**
1000	**700**	**1150**
1100	**810**	**1150**
1200	**950**	**1150**
1300	**1000**	**1150**
1400	**1100**	**1200**
1500	**1320**	**1200**
1600	**1560**	**1200**
1700	**1800**	**1200**
1800	**2050**	**1200**
1900	**-**	**1200**
2000	**-**	**1200**



alta capacità di carico per terreni compatti

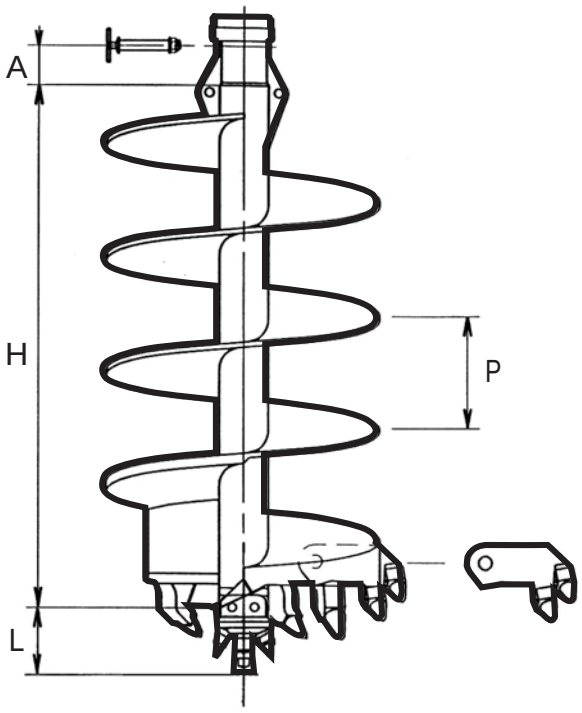
high load capacity for hard soil

HD/H serie *series* ①

Ø scavo *excavation*	Passo Elica (P) *Pitch*	Peso indicativo *approx. weight*	Lungh. (H) *length*
mm (*)	mm	kg	mm
400 (600)	300	200	1800
500 (700)	300	290	1800
600 (800)	350	350	1700
700 (900)	350	500	1700
800 (1000)	400	600	1900
900 (1100)	400	700	1900
1000 (1200)	400	740	1900
1100 (1300)	450	800	2100
1200 (1400)	450	930	2100
1300 (1500)	500	1100	1900
1400 (1600)	500	1250	1900
1500 (1700)	500	-	1900
1600 (1800)	550	-	2000
1700 (1900)	550	-	2000
1800 (2000)	550	-	2000

(*)con allargatore superiore
with upper reamer

N.B. Altri diametri a richiesta
Other dimensions upon request



alta capacità di carico da roccia, singolo principio

high load capacity for rock, single start

HK/H serie *series* ②

Ø scavo *excavation*	Passo Elica (P) *Pitch*	Peso indicativo *approx. weight*	Lungh. (H) *length*
mm (*)	mm	kg	mm
400	300	230	1800
500	300	320	1800
600 (700)	350	520	1700
700 (800)	350	650	1700
800 (900)	400	750	1900
900 (1000)	400	850	1900
1000 (1100)	400	980	1900
1100 (1200)	450	1130	2100
1200 (1300)	450	1130	2100
1300 (1400)	500	1510	2050
1400 (1500)	500	1740	1850
1500 (1600)	500	2000	1850
1600 (1700)	550	-	2000
1700 (1800)	550	-	2000

(*)con allargatore inferiore
with lower reamer

N.B. Altri diametri a richiesta
Other dimensions upon request

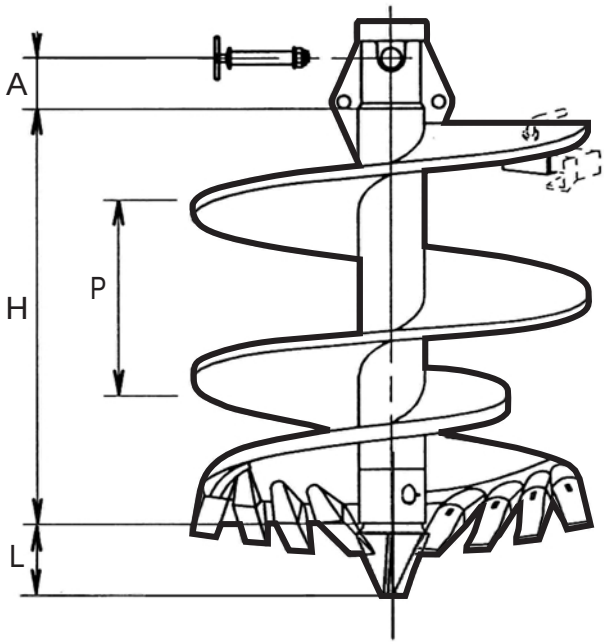
tradizionale per terreni compatti
traditional type for hard soils

HD serie *series*

Ø scavo *excavation*	Passo Elica (P) *Pitch*	Peso indicativo *approx. weight*	Lungh. (H) *length*
mm (*)	mm	kg	mm
800 (1000)	400	450	1050
900 (1100)	400	480	1050
1000 (1200)	400	520	1050
1100 (1300)	500	610	1050
1200 (1400)	500	750	1050
1300 (1500)	500	840	1050
1400 (1600)	500	880	1050
1500 (1700)	500	940	1050
1600 (1800)	600	1050	1200
1700 (1900)	600	1100	1200
1800 (2000)	600	1230	1200

(*)con allargatore superiore
with upper reamer

N.B. Altri diametri a richiesta
Other dimensions upon request

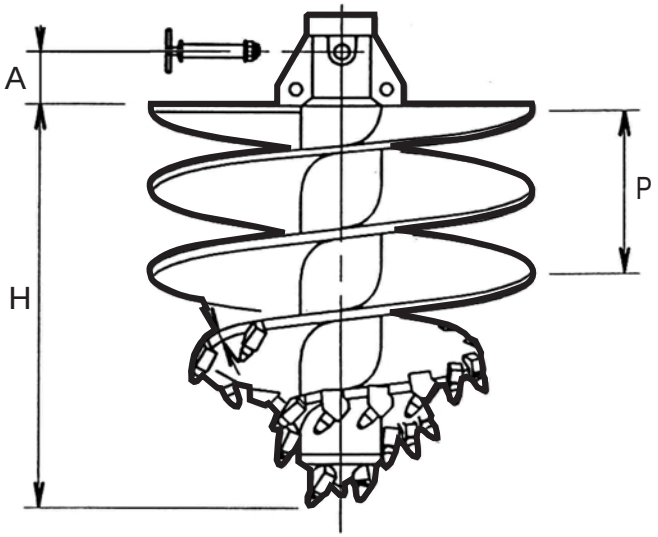


tradizionale da roccia
traditional type for rock

RK serie *series*

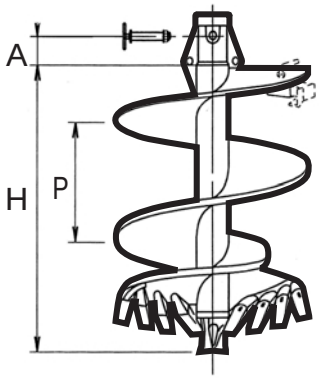
Ø scavo *excavation*	Passo Elica (P) *Pitch*	Peso indicativo *approx. weight*	Lungh. (H) *length*
mm	mm	kg	mm
400	300	225	850
500	300	240	850
600	400	250	1050
700	400	300	1050
800	400	360	1050
900	400	450	1050
1000	500	560	1250
1100	550	640	1250
1200	550	750	1250
1300	500	860	1250
1400	500	970	1250
1500	500	1090	1250
1600	500	1240	1250
1700	500	1400	1250
1800	500	1580	1250

N.B. Altri diametri a richiesta
Other dimensions upon request



tradizionale economica per terreni facili, piccoli diametri
cheap traditional type for loose soils, small diameters

LD serie *series*



Ø scavo *excavation*	Passo Elica (P) *Pitch*	Peso indicativo *approx. weight*	Lungh. (H) *length*
mm (*)	mm	kg	mm
400 (600)	300	200	1250
500 (700)	300	280	1350
600 (800)	300	305	1350
700 (900)	400	360	1450

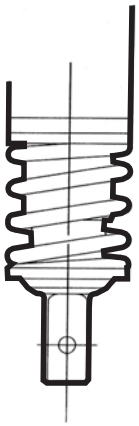
(*)con allargatore superiore
with upper reamer

Adattatori Asta-Utensili / *Adaptors*

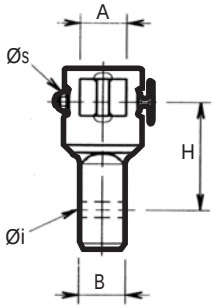
Tipo AXB *AXB Type*	H (mm)	Øs (mm)	Øi (mm)	Peso/*Weight* (kg)
175 x 130	335	54	41	150
175 x 150	365	54	52	165
175 x 200	400	54	62	175
150 x 130	320	52	41	125
150 x 175	231	52	54	140
150 x 200	250	52	62	155
130 x 150	350	41	52	110
130 x 175	400	41	54	145
130 x 200	435	41	62	125
200 x 150	400	70	52	220
200 x 175	-	-	-	-
200 x 130	-	-	-	-

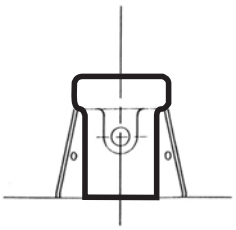
Aste telescopiche
Telescopic kelly

Ø 406
Ø 355
Ø 324
Ø 298



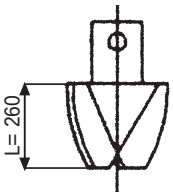
ADATTATORE
Adaptor



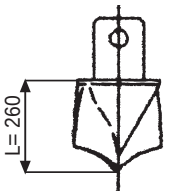


Attacco asta su utensile
Kelly box on tool

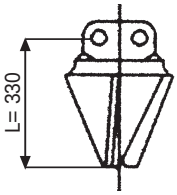
Punte pilota
Leading elements



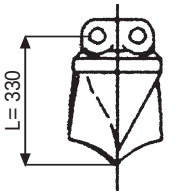
QD



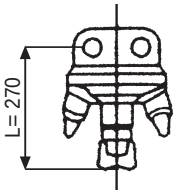
QH



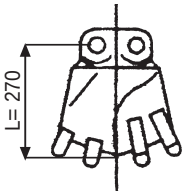
HD



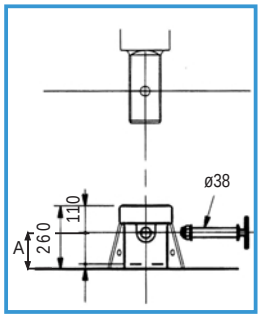
HH



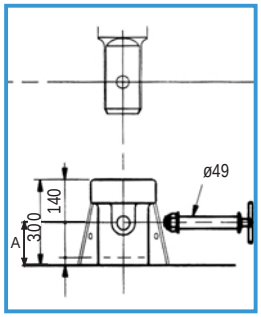
RK



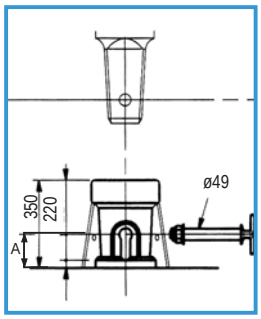
RP



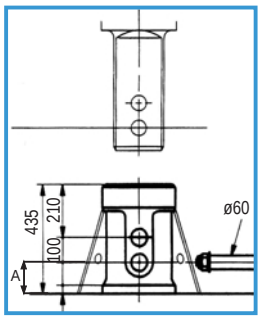
Attacco asta tipo *Kelly box type*	W (130 x130)
Coppia *Torque*	150 kNm
Peso Totale *Total weight*	40 kg
A =	150 mm
Ø Scavo Max *Max excavation diam.*	1800 mm



Attacco asta tipo *Kelly box type*	X (150 x150)
Coppia *Torque*	220 kNm
Peso Totale *Total weight*	65 kg
A =	160 mm



Attacco asta tipo *Kelly box type*	K (175x175)
Coppia *Torque*	360 kNm
Peso Totale *Total weight*	90 kg
A =	130 mm



Attacco asta tipo *Kelly box type*	Z (200 x200)
Coppia *Torque*	540 kNm
Peso Totale *Total weight*	140 kg
A =	125 mm
Ø Scavo Min *Min excavation diam.*	800 mm

Bucket / ***Bucket***

HD/R	a fondo rotante	*with guillotine type closing bottom*
HK/R	a fondo rotante per roccia, variante a denti misti	*with guillotine type closing bottom for rock, mixed teeth type*
RK/R	a fondo rotante per roccia, variante a picchi	*with guillotine type closing bottm for rock, bit type*
CL/R	a fondo rotante pulitore di fondo	*with guillotine type closing bottom and bottom cleaner*
HD	caricamento tradizionale (valvole di fondo)	*traditional loading system (bottom valve)*
RK	caricamento tradizionale (valvole di fondo); per roccia	*traditional loading system (bottom valve); for rock*
DD	allargatore a due diametri	*two dimension reamers*
OF	a fondo rotante, fasce di centraggio, diametri medio grandi	*with guillotine type closing bottom, centering device for medium large diameters*
SB	a corpo apribile, per piccoli diametri	*butterfly bucket for small diameter*

Trivelle / ***Augers***

HD/H	alta capacità di carico,terreni compatti	*high load capacity for hard soil*
HK/H	alta capacità di carico, da roccia, singolo principio	*high load capacity, single start*
HD	tradizionale, terreni compatti	*traditional type hard soils*
RK	tradizionale, da roccia	*traditional type for rock*
LD	tradizionale, economica, terreni facili,piccoli diametri	*cheap traditional type for loose soils, small diameters*

Carotieri / ***Core Barres***

RK	con picchi	*with bits*
RP	con denti tipo ripper	*with teeth ripper type*
BR	con denti a placchette abrasive	*with teeth with abrasive plates*

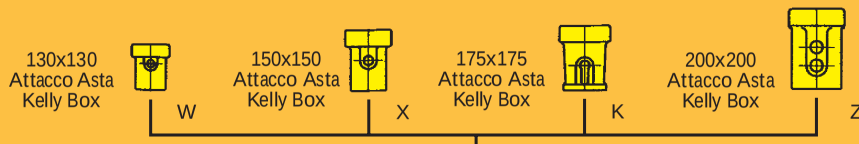
GRADO DI DUREZZA / *Hardness*

	Resistenza a compressione (Mpa) *Compressive Strength*		S Soft	M Medium	MH Medium Hard	H Hard	VH Very Hard
	min	max	0 10 20		30 40 50	60 70 80 90 100	110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300
Rocce magmatiche / *Igneous rock*							
Granito: Sienite / *Granite: syenite*	160	240					
Diorite: Gabbro / *Diorite: Gabbro*	170	300					
Porfido quarzifero Andesite / *Quarzitic porphyry Andexite*	180	>300					
Quarzo / *Quartz*	250	>300					
Rocce metamorfiche / *Metamorphics rock*							
Gneiss / *Gneiss*	160	280					
Anfiboliti / *Anphibolite*	170	280					
Scisti / *Schist/Shale*	0	10					
Rocce sedimentarie silicee / *Silceous sedimentary rock*							
Quarzite / *Quartzite*	150	300					
Arenaria quarzitica / *Quartzitic sandstones*	120	200					
Altre arenarie / *Other sandstones*	30	60					
Rocce sedimentarie calcaree / *Sedimentary Rock*							
Calcari e dolomie campatte e tanaci (inclusi i marmi) *Limestones and compacted dolomite (including marble)*	80	180					
Altri calcari (inclusi i cong. calcarei) *Other limestones (including calcareous conglomerates)*	20	90					
Travertino / *Gravertine*	20	60					
Rocce sedimentarie sciolte / *Sedimentary loose rocks*							
Limi e sabbie / *Siltand sand*	<5	10					
Marne e argille / *Marls and clay*	<5	30					

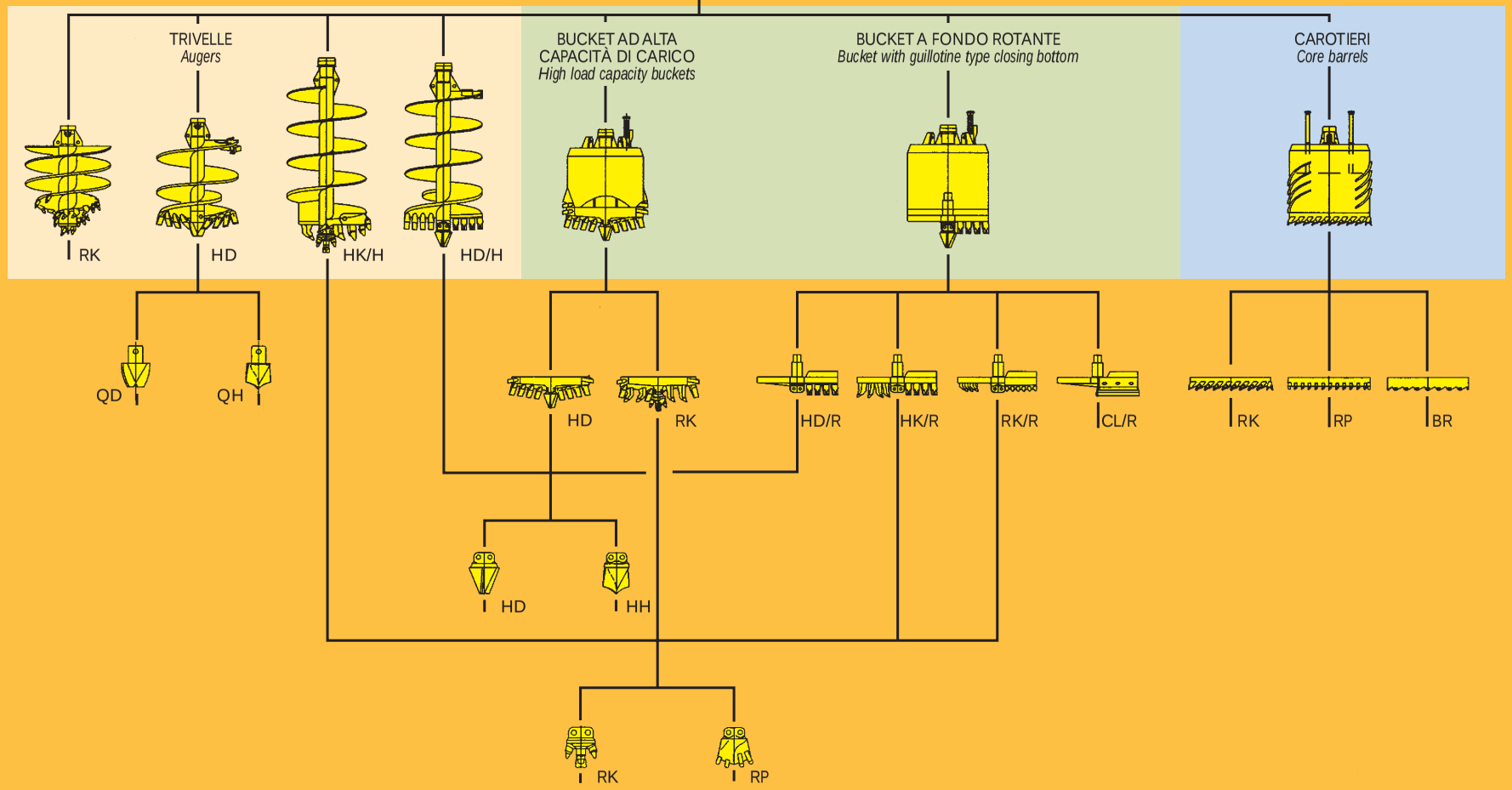
UTENSILI DI PERFORAZIONE / *Drilling tools*

BUCKET *Bucket*	HDR	
	HKR	
	RKR	
	CLR	
	HD	
	RK	
	DD	
	OF	
	SB	
TRIVELLE *Augers*	HDH	
	HKH	
	HD	
	RK	
	LD	
CAROTIERI *Core barrels*	RK	
	RP	
	BR	
UTENSILI SPECIALI / *Special tools*		

ATTACCO ASTA SU UTENSILE
Kelly box on tool



UTENSILI / *Drilling tools*



SOILMEC

Drilling and Foundation Equipment

5819, via Dismano - 47023 CESENA - ITALY
tel. 0547-319111 - telefax 0547-318548
E-mail:soilmec@soilmec.it

Impianti: Il Digitale - Tel. 0547/630808

02/99 - Stampa: Tipolitografia CILS, Cesena - Tel. 0547/28115

Appendix C

Polymer Slurry

BIG-FOOT®
POLYMER SLURRY

PRODUCT DATA SHEET

DRILLING FLUIDS ADDITIVES CHEMICALS

The BIG-FOOT® polymer slurry system is formulated to make a viscous slurry fluid to fortify the most challenging soil conditions. BIG-FOOT soil stabilizing polymer is an easy mixing, 100% active polymer packaged as a granular powder.

Due to its concentrated formula, small amounts of BIG-FOOT earth-reinforcing polymer mixed with fresh water builds high viscosity. BIG-FOOT is ideal for drilled shafts, mini-piles, slurry trenching, diaphragm walls, HDD, reverse circulation (RC) rotary drilling and tunneling.

Benefits of BIG-FOOT

- Stabilizes reactive clay and shale formations
- Mixes smoothly into flowing water with minor sheer
- Self-cleaning no solids equipment required
- Improves skin friction & end bearing capacity
- Non-gelling, even at high viscosities, facilitating settlement of fines and maintenance of a clean fluid
- Binds excavated sand & gravel soil for fast drilling and removal of spoils

TYPICAL PROPERTIES	
Appearance	White granular solid
pH (0.25% Solution)	8.5 to 9.0
Specific Gravity	1.00-1.01 (water= 1.0)
Bulk Density lb/ft^2	52
Odor	Odorless

MIXING DOSAGE: BIG-FOOT should be mixed at a minimum rate of 8 to 9 lb/1,000 gal of fresh water pretreated with M-BOOSTER®. For larger projects this should be done in a properly designed mixing tank.

SOIL FORMATION	BIG-FOOT® POLYMER MIX DOSAGE*			MARSH FUNNEL VISCOSITY
	lb/yd^3	lb/1,000 gal	kg/m^3	sec/qtr
Clay & Shale	0.8-1.0	4.0.-5.0	0.5-0.6	40-45
Silt & Fine-Medium Sand	1.2-1.25	6.0-6.5	0.7-0.75	50-55
Coarse Sand-Pea Gravel	1.4-1.6	7.0-8.0	0.8-0.9	60-70
Gravel-Cobble	1.7-2.0	9.0-10.0	1.1-1.2	75-95

* In application where brackish, salt or seawater contaminates slurry or is used as make-up water, BIG-FOOT dosage should be increased.

orders@matrixcp.com 877.591.3137 P 630.791.0893 C 630.730.7428 F 630.791.3459 matrixcp.com

MATRIX CONSTRUCTION PRODUCTS

BRANCH OFFICE
PO Box 9394
Naperville, IL 60567-0394

CORPORATE HEADQUARTERS
PO Box 1211
Englewood, CO 80150-1211

BIG-FOOT®
POLYMER SLURRY

PRODUCT DATA SHEET

DRILLING FLUIDS ADDITIVES CHEMICALS

MIXING FORMULA (IN ORDER OF ADDING:

1. **Prepare the make-up water** by adding M-BOOSTER at a concentration of 6 to 7 lbs/1,000 gal (0.7 to 0.8 kg/m^3) for a target pH of 9.0 to 10.0.
2. **Add BIG-FOOT polymer** through the same mixer at a dosage of 8.0 to 9.0 lb/1,000 gal (1.0 to 1.1 kg/m^3) of mix water depending on desired viscosity.
3. **Check slurry properties** as listed below and record time taken. Check slurry properties when each hole is completed and make required adjustments to bring slurry back into desirable property range.
4. **Once desired slurry properties are reached, the slurry is ready for use.**
5. **The slurry level should always be higher than the water table** or river level in the open-hole section to maintain a constant hydrostatic loading on excavation.
6. **Measure Marsh funnel viscosity.** Target viscosity should be in the range of 70 to 80 sec/qt.
7. **If Geology consists of gravels and sand with little or no fines add FORTIFY®** at a concentration of 5 to 6 lb/1,000 gal (0.6 to 0.7 kg/m^3) via MATRIX high shear mixer to promote enhanced rate of hydration and reduce the amount of un-yielded material (“fish eyes”).

On smaller projects or mobile projects, such as Transmission Line and Cell Towers, BIG-FOOT may be added at the excavation by sprinkling carefully into a stream of water directed into the excavation or an agitator mix tank.

Fanning the water stream over a sloping pan or across the blade of an auger facilitates lump-free mixing. If mixed directly in excavation, the tool should be reciprocated gently after product is added to distribute and homogenize the polymer. After completing the addition of BIG-FOOT into the excavation raise and lower the drilling tool from the top of the excavation to the bottom to assist in the proper distribution of the product.

For best results add 6-7-lb M-BOOSTER/1,000 gal of mix water for a pH of 9-10.

- Total chloride (salt) should be less than <1500 ppm (mg/L).
- Total hardness (calcium) less than <100 ppm.
- Total chlorine less than <50 ppm.

BREAK-DOWN: BIG-FOOT slurry can be chemically broken down using NEUTRALIZER®. This dry breaker when added into a slurry mixed with BIG-FOOT polymer at a dosage of 15 lb/3,500 gal will reduce the viscosity of the slurry preparing for disposal.

PACKAGING: BIG-FOOT dry polymer is packaged in 55 lb (25 kg) poly bags, 30 per pallet, and 35 lb (15.88 kg) plastic pails, 36 per pallet.

AVAILABILITY: BIG-FOOT dry polymer can be purchased through any MATRIX Construction Products Distributor. To place an order contact MATRIX Construction Products.

orders@matrixcp.com 877.591.3137 P 630.791.0893 C 630.730.7428 F 630.791.3459 matrixcp.com

MATRIX CONSTRUCTION PRODUCTS

BRANCH OFFICE
PO Box 9394
Naperville, IL 60567-0394

CORPORATE HEADQUARTERS
PO Box 1211
Englewood, CO 80150-1211

Appendix D

Sample Drilled Shaft Installation Logs

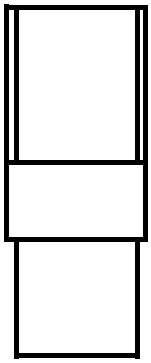
HUB Foundation Co., Inc.
139 Billerica Road
Chelmsford, MA 01824

Drilled Shaft Installation Report

Superintendent: _____
Date: _____
Job: _____
Shaft No: _____

Pour #: _____ GC: _____

Shaft Geometry	Design	As Built
Shaft Diameter		in
Rock Socket Diamater		in
Casing Diamater		in
Length of Rock Socket		ft
Shaft Depth		ft



	Elev.	Depth
Top of Casing		N/A
Top of Ground		
Gr. Water		
Top of Cage		
Top of Concrete		
Bot. of Casing		
Top of Till		
Top of Rock		
Bott of Shaft		

Installation	Date	Time
Excavation Started		
Excavation Completed		
Rock Socket Started		
Rock Socket Completed		
Obstruction Started		
Obstruction Completed		
Bottom Cleaning Completed		
Final Check of Bottom		
Cage Placed		
Concreting Started		
Concreting Completed		
Temporary Casing Removed		

Drilling Fluid Observations

Type of Drilling Fluid Used:

Slurry Testing				
Time	**pH**	**Viscosity**	**Sand %**	**Density**

Concrete Placement Inspected By: _____

Bottom Condition:

Deviation from Plan Loc'n:

Quantities	
Soil Excavation	
Rock	
Obstruction	
Concrete	
Flow Fill	

Tremie Start Length: _____
Hole Start Depth:

Theoretical Rises / 10 CY Truck	
Rise in Socket:	ft
Rise @ Shaft Diamater:	ft
Rise in Casing:	ft
Casing Wall Thickness:	in

Verticality checks

Depth	Results

Depth	Results

HUB Foundation Co., Inc.
139 Billerica Road
Chelmsford, MA 01824

Drilled Shaft Installation Report

Superintendent: _____
Date: _____
Job: _____

Pour #:

Shaft No: _____

Set #	Truck No.	Batch Time	Truck Vol (CY)	Volume (CY)	Start Time	Finish Time	Depth to Conc.*	Tremie Length	Tremie Removed*	Tremie in Conc.*	Actual Rise
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											
21											
22											
23											
24											
25											

*Datum per column are recorded after the truck is poured.

Notes

AppendixE

Equipment/Site Layout Sketch

STA. 502+94.80
END ROADWAY
BEGIN BRIDGE

RETAIN EXISTING
SIGNS

TEMPORARY
IMPACT AREA
3169 SF

STA. 503+78.31
℄ PIER CAP

℄ BRG
ABUT. 2

STA.
END
RESUM

Service Crane

Approx. edge of
working platform

Drill Rig

Baker Tanks

Slurry Mixing
Tank

503+00
504+00
11+00
12+00

OHW
AER E&T
MH

REMOVE EXISTING
SIGN

GRAVEL DRIVE

STONE FILL
TYPE IV

EXISTING ROW

290' SPAN

25' R

NEW HAVE

HUB Foundation Co., Inc.
139 Billerica Road
Chelmsford, MA 01824

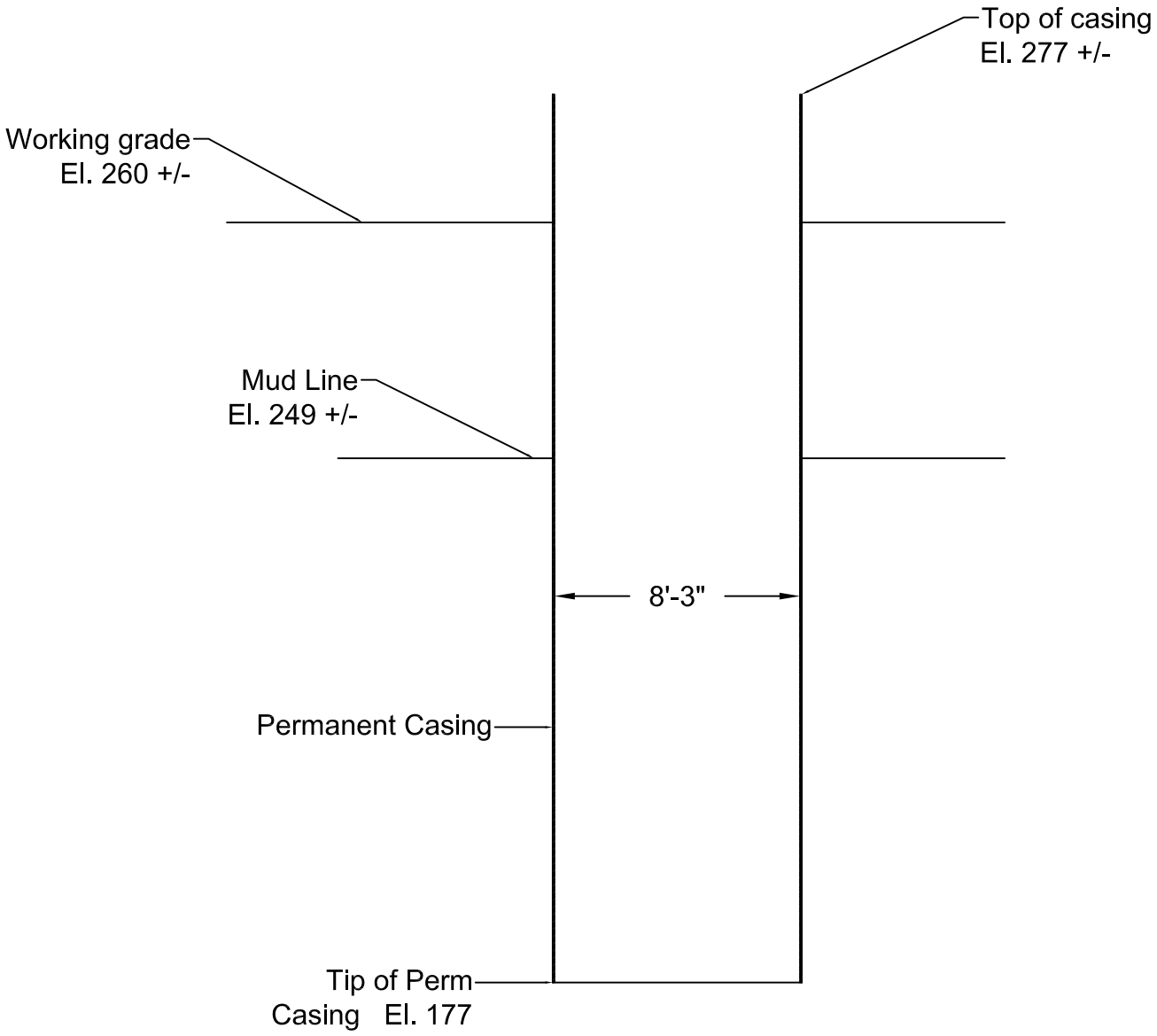
Equipment Layout
Replacement of Bridge #10
New Haven VT

DATE:	REV	SHEET
3/12/2016		
SCALE N.T.S		

Appendix F

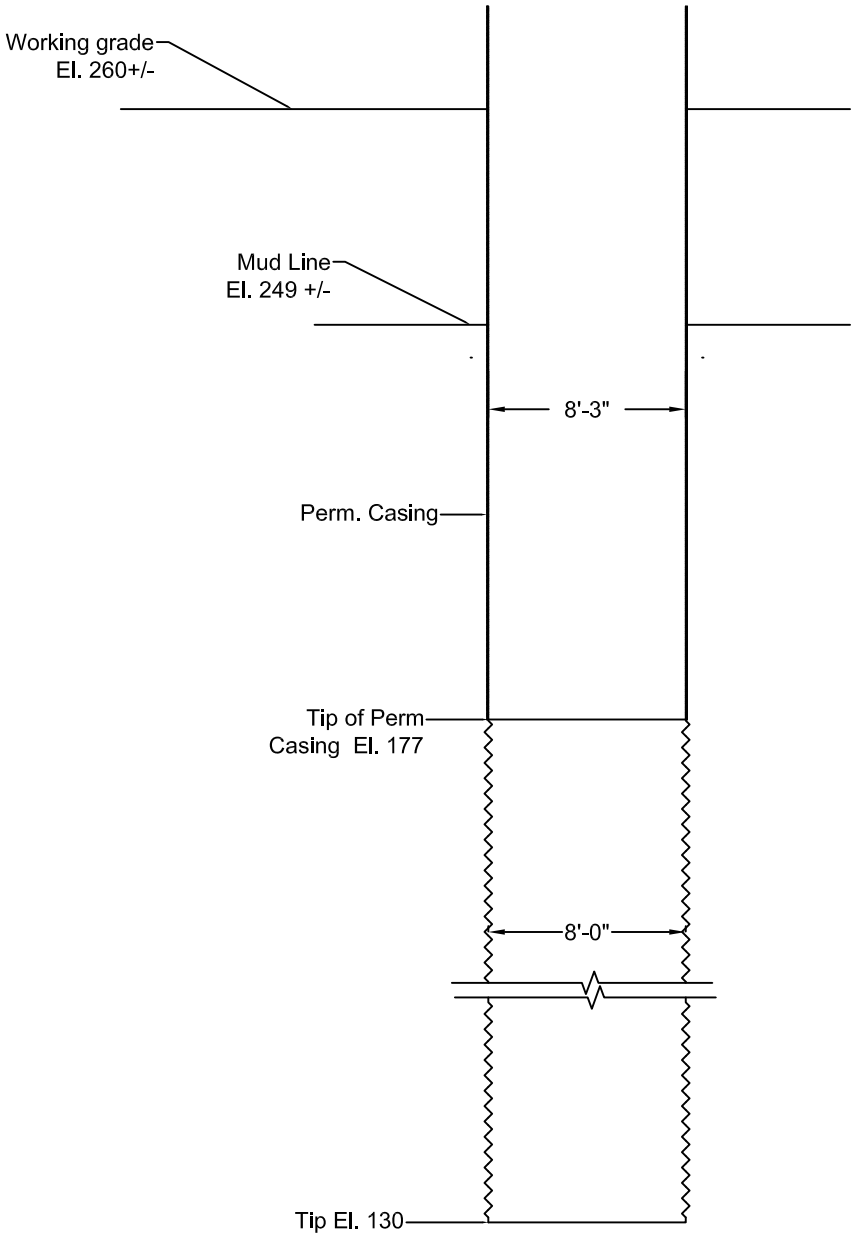
Drilled Shaft Installation Sequence

Step 1: Place 8'-3" Dia. x 100' permanent casing by driving with vibratory hammer then drill out to bottom of casing under slurry



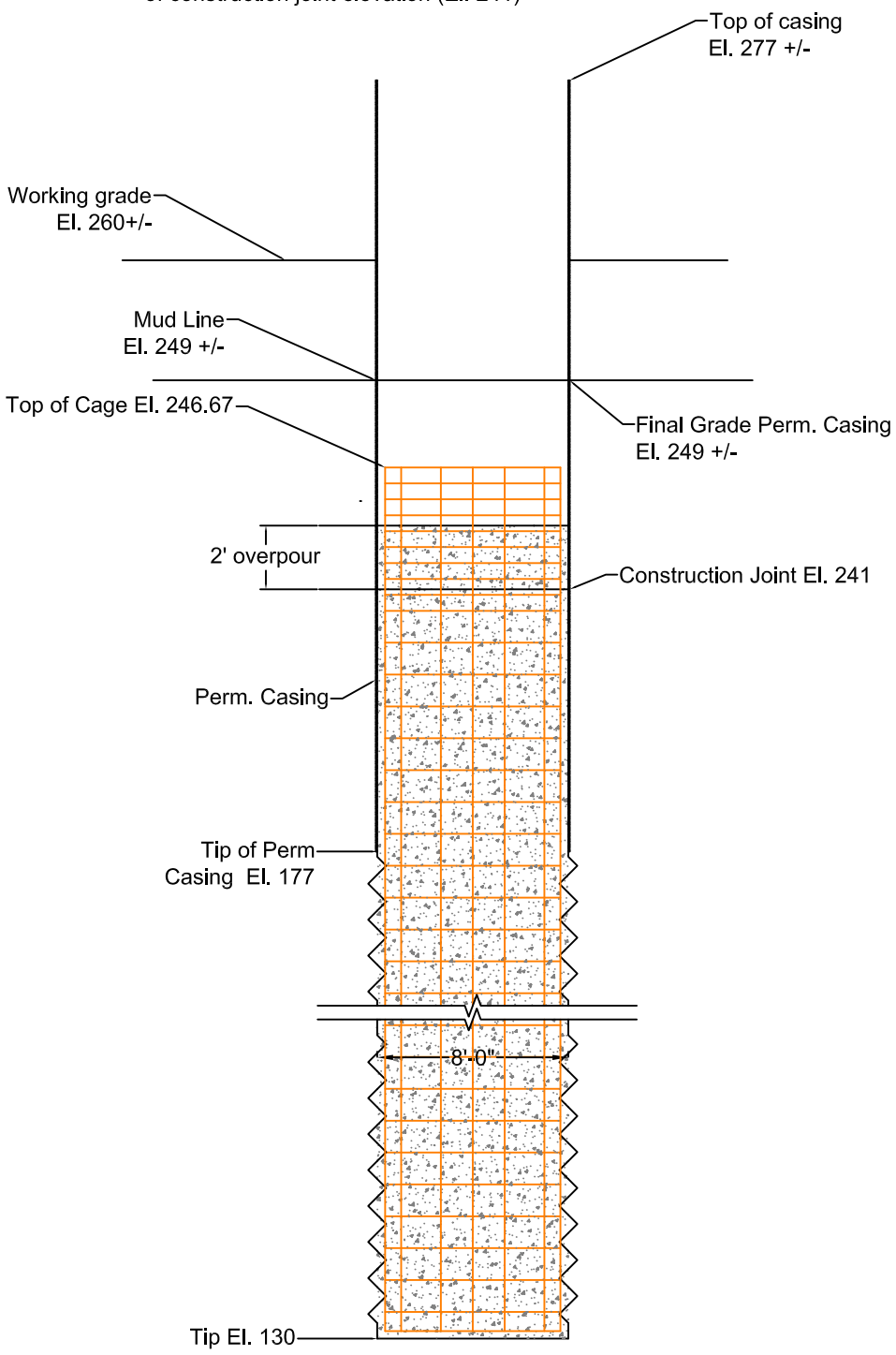
HUB Foundation Co 139 Billerica Road Chelmsford MA 01824	Drilled Shaft Installation Sequence River Road Bridge Replacement New Haven, VT	REV 1 May 31, 2016 DATE: 2/10/2016 SCALE: NTS SHEET 1 OF 5

Step 2: Continue drilling from bottom of casing to design tip elevation (El. 130) under slurry.



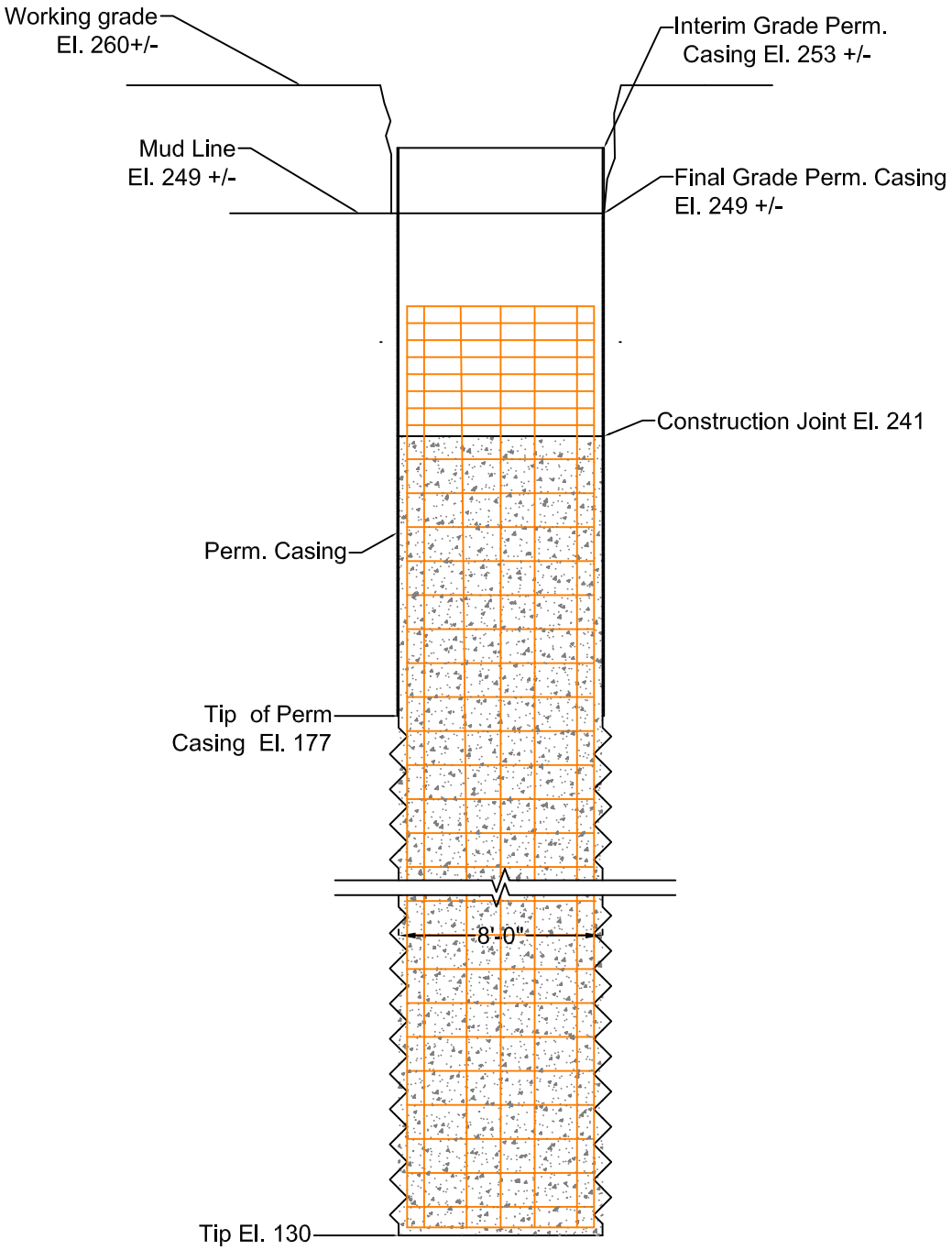
HUB Foundation Co 139 Billerica Road Chelmsford MA 01824	Drilled Shaft Installation Sequence River Road Bridge Replacement New Haven, VT	REV 1 May 31, 2016 DATE: 2/10/2016 SCALE: NTS SHEET 2 OF 5

Step 3: Clean out shaft and inspect. Place rebar cage and pour concrete to minimum 2 ft. above top of construction joint elevation (El. 241)



HUB Foundation Co 139 Billerica Road Chelmsford MA 01824	Drilled Shaft Installation Sequence River Road Bridge Replacement New Haven, VT	REV 1 May 31, 2016 DATE: 2/10/2016 SCALE: NTS SHEET 3 OF 5

Step 4: Remove over pour by chipping. Cut permanent casing to interim grade (El. 253+/-).



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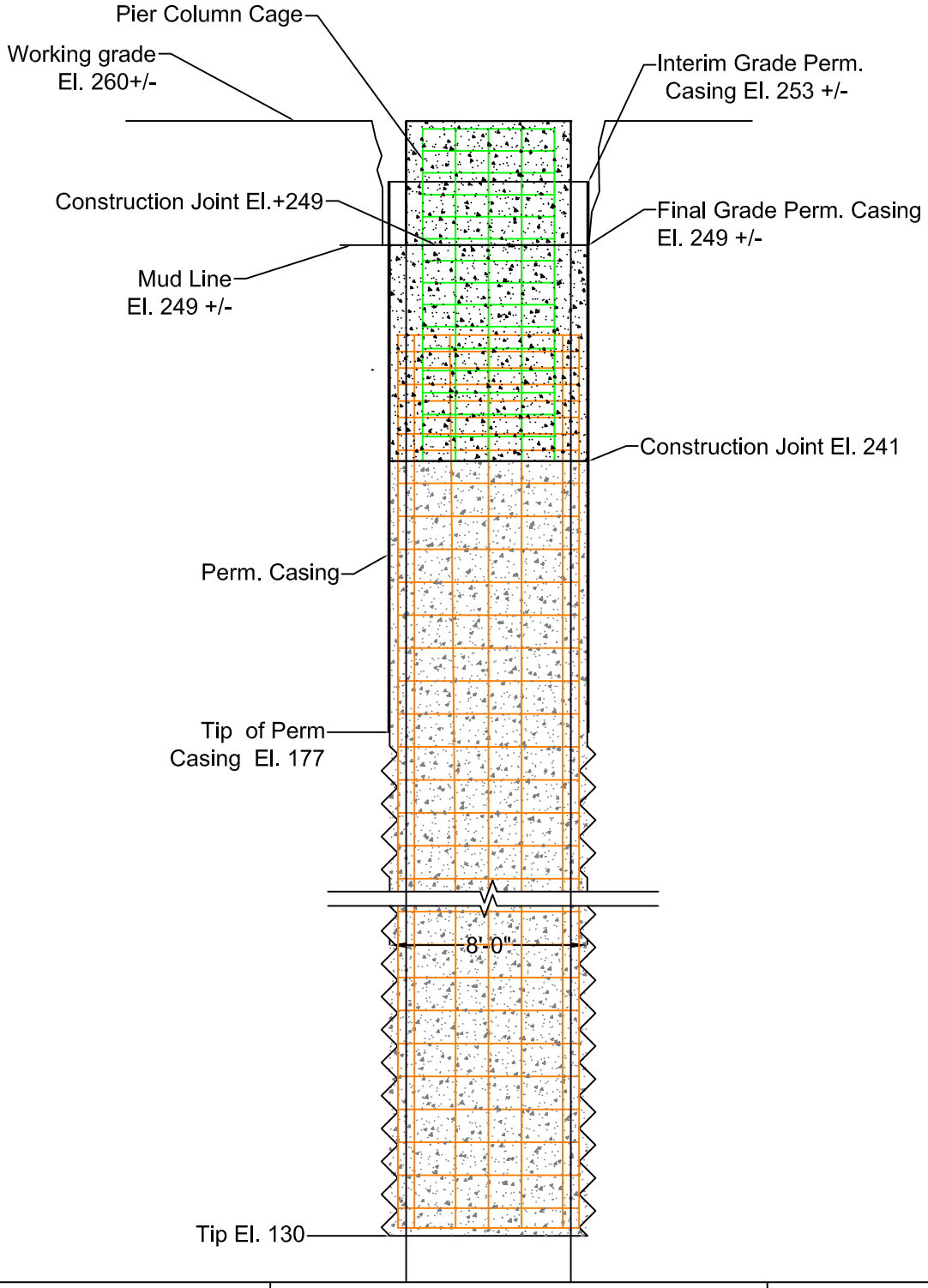
Step 5: GC to construct 2nd lift of drilled shaft to bottom of pier column (Elevation +241 to +249) and Pier Column. Cut permanent casing to final grade (El. +249).



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