



GPS Deep Drilled Braced Monument Installation Driller Instructions

Overview

The deep drilled braced GPS monument (DDBM) is designed to create a highly rigid and immobile structure isolated from surface soil movement and cemented in place at depth. The monument consists of 5 legs (stainless steel pipes) placed into drilled holes, and welded together above the surface to create a “tripod” frame. Of the 5 legs, the center leg is vertical and the 4 other legs are installed at angles to brace the vertical leg.

The Plate Boundary Observatory (PBO) project will require the installation of at least 600 of these DDBM monuments throughout the Western US and Alaska. We hope to locate a small number of highly skilled contractors throughout the Western US and Alaska to install these monuments during the next five years. This scope of work is for a one-time installation project consisting of a small number (1-5) of these installations. This will allow us to evaluate the contractor for possible future work within PBO. Please provide a quote for services based upon the scope of work outlined below.

Material

Contractor to supply to the following material:

- 1) A sufficient amount of grout to fill 5-35 foot deep holes (4.5”-6” diameter) will be used. Contractor will assure the following:
 - a) Type I, II Portland cement and Class F Flyash shall be used for grout materials.
 - b) Flyash shall replace 10-15% of the volume of Portland cement.
 - c) Grout shall be proportioned to have a water to cementitious material ratio of 0.50.
 - d) If using pre-packaged grout, grout shall be 1118 Grout supplied by Surecrete, Seattle, WA, or an approved equal meeting these specifications. Grout 1119 should be used for applications when water is present in the hole.

- 2) Water sufficient to mix grout. Final mix should be consistency of a milk shake.

All other material will be supplied by UNAVCO.

Construction Procedure

Drilling/Casing/Pipe Placement

- 1) Drill rig type and size selection shall be determined by contractor such that equipment used is most suited to site geology and hole precision requirements.

- 2) UNAVCO shall provide to the contractor a summary of expected site conditions such as surface topography and subsurface material.



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- 3) Contractor shall drill 5 holes of 4.5” diameter to minimum depths of 35 ft.
 - a) Center hole shall be drilled at vertical orientation plus/minus 2 degrees.
 - b) Four angled holes shall be drilled at 35 degrees from vertical plus/minus 2.5 degrees.
- 4) Holes drilled at precise locations specified by UNAVCO engineering staff. Frequent measurement of hole inclination during drilling shall be made to ensure holes are drilled to exact specifications. The centerlines of all 5 holes shall intersect at a single point plus/minus 3”. This point of intersection shall be located 62” above the surface, at the center leg. On level ground, each of the 4 angled legs will enter the ground at 43.5” from the center leg.
- 5) All holes shall be drilled straight enough so that PVC casing can be installed in the top 15.5 ft of each hole, and that the steel pipe can be freely lowered, not forced, for its entire 35 ft length.
- 6) Hole depth is to be determined by actual measurement after drilling. If necessary, loose material may need to be removed from the bottom of the holes to achieve required depth.
- 7) 2.5” PVC casing (wrapped with insulation) shall be installed in upper 15.5 ft of each hole immediately after drilling. It may be necessary to use drill rig to push casing into hole.
- 8) Contractor shall assist UNAVCO staff in placement of steel piping immediately after drilling and casing installation. 1.25” schedule 40 steel pipe shall be installed inside casing in each hole to a depth of 32-38 ft.
- 9) A single 5 foot vertical hole shall be drilled for the equipment enclosure.
- 10) UNAVCO is responsible for siting and alignment.
- 11) Contractor shall assist in the clearing of cuttings from the hole, during the drilling operation.

Grout Installation

- 1) Contractor shall provide grouting material and water for mixing.
- 2) All five legs are to be cemented in place with expansive grout.
- 3) Contractor shall prepare the pumpable grout to a “milkshake” consistency. Jobsite conditions may affect actual quantities of water needed.
- 4) Following steel pipe installation, contractor shall pump grout down steel pipes until grout fills pipe and pipe-casing annulus, and is seen emerging from top of annulus. Due to small clearances within pipe and at pipe-casing annulus, high pressures may be encountered during grout placement.



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- 5) Contractor shall place grout such that no air bubbles are introduced. Ensuring a continuous flow of grout through pipe and back up through annulus requires proper grout handling, mixing, and pumping equipment and procedures.
- 6) Contractor shall neatly finish grout at surface of casing such that water will not puddle around monument legs.

Site Documentation and Cleanup

Contractor shall assist UNAVCO personnel in compiling site documentation including:

- 1) Depths of holes. All drilling documentation including drilled, measured, tamped, and shimmed pipe depths shall be recorded by contractor.
- 2) Grout information. Time of day, grout sack ID#, grout amount sifted, mixed, pumped, and lost shall all be monitored by contractor and reported to UNAVCO engineer for recording.
- 3) Contractor shall be responsible for removal of hazardous materials (i.e. hydraulic fluid, diesel fuel and/or contaminated soil) and debris. Site shall be left in suitable condition.
- 4) Contractor shall be responsible for containing and disposing of excess grouting material and debris such as cement bags, trash, and cigarette butts.
- 5) Contractor shall be responsible for leveling and raking of areas that were disturbed by drill rig and support vehicles at the site.

Miscellaneous

- 1) Contractor is responsible for hotel and per diem for the drilling crew.
- 2) Contractor shall assist UNAVCO personnel in any tasks related to GPS site installation such as pipe/coupling preparation, installation of pipe and insulation piping.
- 3) UNAVCO will mark for Underground Services Alert.
- 4) UNAVCO will provide maps, directions and relevant access information for drilling access.
- 5) Contractor's equipment and tools are the sole responsibility of the contractor. UNAVCO will not reimburse the contractor for any lost or damaged equipment.

All work shall be done to highest professional standards.