DUCKBILL®
EARTH ANCHORS

DUCKBILL® ENGINEERED EARTH ANCHOR SYSTEMS

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INSTALLATION GUIDELINES

INTRODUCTION >>>

This guide serves to aid suppliers and installers of DUCKBILL® Earth Anchors about installation methods and techniques. DUCKBILL is offered in 4 Aluminum alloy anchor models and 3 galvanized ductile iron anchor models (for very hard / rocky soils). The anchors range in holding capacities in normal soil from 300 to 5000 lbs. (135 kg to 2250 kg) The DUCKBILL Earth Anchor has been developed to function in the total range of soils. Its design allows the installer much greater flexibility than other anchors offer. Installation details, tools and special soil conditions will be covered and should answer any questions that may arise. DUCKBILL anchoring systems offer an economic, lightweight solution to nearly any anchoring situation, big or small.

THE DUCKBILL PRINCIPLE

The DUCKBILL Anchor works very much like a toggle bolt. The anchor body is driven into the soil with a re-useable drive steel (drive rod). Once the anchor body is placed to the proper depth the drive steel is removed. A backward pull on the cable then rotates the anchor body in the ground until it is perpendicular to the cable. This is called anchor-locking the anchor. Because the DUCKBILL is driven into the earth, it is actually compacting the soil around it, not disturbing it. As the anchor is anchor-locked it cuts through the compacted soil into undisturbed soil and further compacts the soil above the anchor. As the soil above the anchor is compacted from below it forms an inverted cone of compact soil. This is called a cone of resistance. One of the most important features of the DUCKBILL anchoring concept is the ability to proof-test the anchor during normal installation. The anchor locking operation can be a proof-test of the anchor. By measuring the force required to anchor-lock the anchor the installer knows the actual holding capacity of the installation.

SOILS

Anchor holding capacity will vary in the different classes of soils. More capacity can be expected in the numerically lower classes and less capacity in the higher number classes. Knowing the type of soil does not always mean that the class is known. For example, a clay material can have a class ranging from 4 to 8 depending on whether the material is very stiff to hard or soft to very soft. Water content will affect classification. Similarly, cohesion-less soils such as sands and gravels have a wide range depending upon the density or compactness of the material.

There are various ways of testing soils. A torque probe is the best for quick classification in the field. Core samples are the best for detailed classification but are expensive and take time to obtain the test results. Generally resistance to driving the DUCKBILL is a good “seat of the pants” indicator of soil class. Stiff resistance will normally result in positive anchoring. If the anchor drives very easily, the soil is soft and steps should be taken to assure adequate capacity such as using a larger DUCKBILL Anchor. Keep in mind that simple anchor-locking will verify the capacity of the anchor in any soil class. This is recommended when a specific holding capacity is required.

SOILS >>>

Class	Description	Probe Value
1	Solid Bedrock	Over 600 in./lbs
2	Dense Clay; Compact Gravel Dense Fine Sand; Laminated Rock; Slate; Schist; Sand Stone	500-600 in./lbs
3	Shale; Broken Bedrock; Hardpan; Compact Gravel Clay Mixtures	400-500 in./lbs
4	Gravel; Compact Gravel and Sand; Claypen	300-400 in./lbs
5	Medium-Firm Clay; Loose Standarad Gravel; Compact Coarse Sand	200-300 in./lbs
6	Medium-Firm Clay; Loose Coarse Sand; Clayey Silt; Compact Fine Sand	100-200 in./lbs
7	Fill; Loose Fine Sand; Wet Clays; Silt	100 in./lbs
8	Swamp Marsh; Saturated Silty; Humus	Under 100 in./lbs

HOLDING CAPACITY >>>

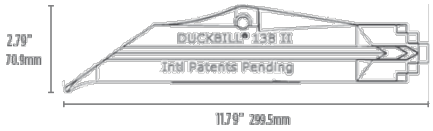
	Model 40-DB1	Model 68-DB1	Model 88-DB1	Model 138-DB1
Capacity (Per Anchor)	300 lbs (1.33 kN) in normal soil	1,100 lbs (4.89 kN) in normal soil	3,000 lbs (13.39 kN) in normal soil	5,000 lbs (22.24 kN) in normal soil
Wire Rope Length	20 in (0.51 m)	2 ½ ft (0.76 m)	3 ½ ft (1.07 m)	5 ft (1.52 m)
Galvanized Wire Rope	1/16 in (1.6 mm) 7 x 7 GAC	1/8 in (3.2 mm) 7 x 7 GAC	¼ in (6.4 mm) 7 x 19 GAC	5/16 in (7.9 mm) 7 x 19 GAC
Wire Rope Breaking Strength	480 lbs (2.14 kN)	1,700 lbs (7.56 kN)	7,000 lbs (31.13 kN)	9,800 lbs (43.59 kN)
Anchor Weight	1.0 oz (28 gm)	4.5 oz (128 gm)	14 oz (397 gm)	2.5 lbs (1.1 kg)
Standard Case & Weight	50 units at 3.7 lbs (1.7 kg)	24 units at 7 lbs (3.2 kg)	12 units at 11 lbs (5.0 kg)	12 units at 32 lbs (14.5 kg)

The anchors are rated in an average (class 5) soil condition. Again, higher capacities can be expected in harder soils and lower capacities in softer soils. The rating is mainly useful as a reference for anchor selection. Proof-loading is the only way to insure the exact capacity of each installation. This is true for all anchors on the market today.

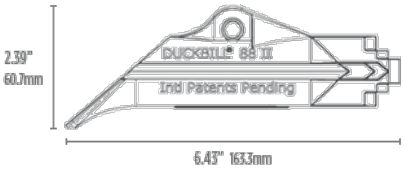
INSTALLATION >>>

The first step in any installation is to select the proper anchor for the job. Keep in mind the maximum load expected and add a reasonable safety factor.

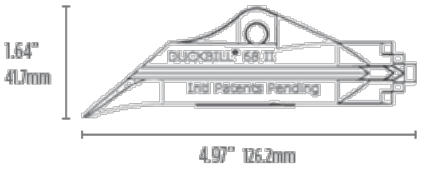
Aluminum Anchors



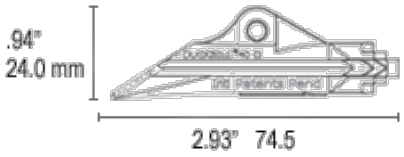
Model 138



Model 88

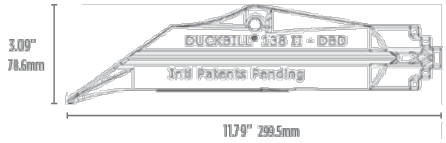


Model 68

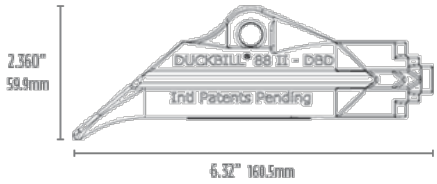


Model 40

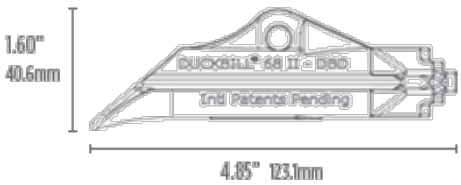
Galvanized Ductile Iron Anchors



Model 138-DI



Model 88-DI



Model 68-DI

DRIVING THE ANCHOR

The DUCKBILL® can be driven at any angle. In guy applications the angle of the installation should closely match the angle of the guy line. Start by inserting the drive steel into the anchor body. Use a sledgehammer, fence post driver or a power driven jack-hammer to drive the anchor to the proper depth. Fill hole made by anchor with soil. This will not allow water to seep down to the anchor.

MECHANICAL ANCHOR LOCKING

After the anchor has been driven to depth, the drive steel is retracted from the anchor. Pull back on the anchor cable to toggle the anchor into the perpendicular (anchor-locked) position. In average soils a rule of thumb is that the length of pull should equate to the length of the anchor. Movement will depend on soil; softer soils may require a longer distance than harder soils. For example: Model 88 anchor body measures 6” inches. A pull of 5-6” will rotate the anchor into a perpendicular position. Several methods are used to anchor lock the anchors.

HAND ANCHOR LOCKING

The smaller DUCKBILL models may be locked by hand. Insert the drive steel through the cable loop or wrap the cable around the drive steel to fashion a “T” handle. Pull on the drive steel to anchor-lock the anchor. A fulcrum is also very useful in locking anchors by hand. The DUCKBILL “hand hook” is also available.

JACKS

Ordinary automotive bumper jacks or handyman jacks work well on medium and larger sized anchors. By adding legs to the jack to form a tri-pod, angled pulls are achieved with greater ease.

JACKS

HYDRAULIC JACK

The LL-2 Anchor Locker is designed to load lock and test the full line of DUCKBILL Anchors. It is manually operated and has a maximum capacity of 8000 lbs. (36 kg).

NO MATTER WHAT METHOD IS USED, IT IS CRITICAL THAT THE ANCHOR BE PROPERLY LOCKED BEFORE TYING OFF THE OBJECT TO BE ANCHORED.

An anchor not properly locked prior to attaching will result in significant pull out before the anchor self locks. Obviously this is not desired.

Failure to install and lock the anchor at the correct angle will result in the anchor cable cutting through the soil until the angles equalize. This will cause slack in guy lines, also not desired.

SPECIAL SOILS CONSIDERATIONS >>>

SOFT SOILS

In areas where the soil proves to be softer than normal, steps should be taken to assure the capacity of the anchor. Proof-loading is especially useful in soft soils. Guesswork as to the capacity is eliminated. The installer will know immediately if the anchor point is adequate or if further steps are necessary. Backfilling and tamping the hole behind the anchor will yield somewhat higher capacity in most soft soils. Fill and tamp the hole in 3” lifts prior to anchor locking the anchor. Another option is to drive the anchor deeper in an effort to penetrate a harder layer of soil. Larger anchors may need to be placed to achieve the required load. As a last resort a number of anchors may be placed in a cluster and bridled together to form one point.

HARD SOILS AND ROCK

If excessive resistance to driving occurs it may be necessary to drill a hole for anchor placement. If the anchor stops moving and is subjected to excessive force (especially from power equipment) metal fatigue can occur and the anchor body can fracture. The DUCKBILL”’ Anchor may be placed in a pre-drilled hole in hard dirt or rocky material, and achieve very good results. Hand augers and gasoline or hydraulic powered earth drills can be used to form the hole. A gasoline powered breaker/drill is very useful due to the fact that it performs both drilling and driving operations.

CLEARANCE HOLE DIAMETERS & HARD SOIL PILOT HOLE DIAMETERS >>>

Installation of Duckbill Anchors in hard soils can be greatly helped by the use of a pilot hole. Typically, the pilot hole has no significant affect on the holding power of the anchor. There are many acceptable mehods of drilling pilot holes and many manufacturers of equipment to do so. Recommended hard soil pilot hold diameters and clearance hole diameters are charted below.

Model	Clearance Hole Diameter	Minimum Pilot Hole Diameter for Hard Soil
40-DB	1.0”	0.75”
68-DB	1.50”	1.25”
88-DB	2.25”	2.00”
138-DB	2.75”	2.50”