

An Introduction to Manta Ray and Stingray Earth Anchors



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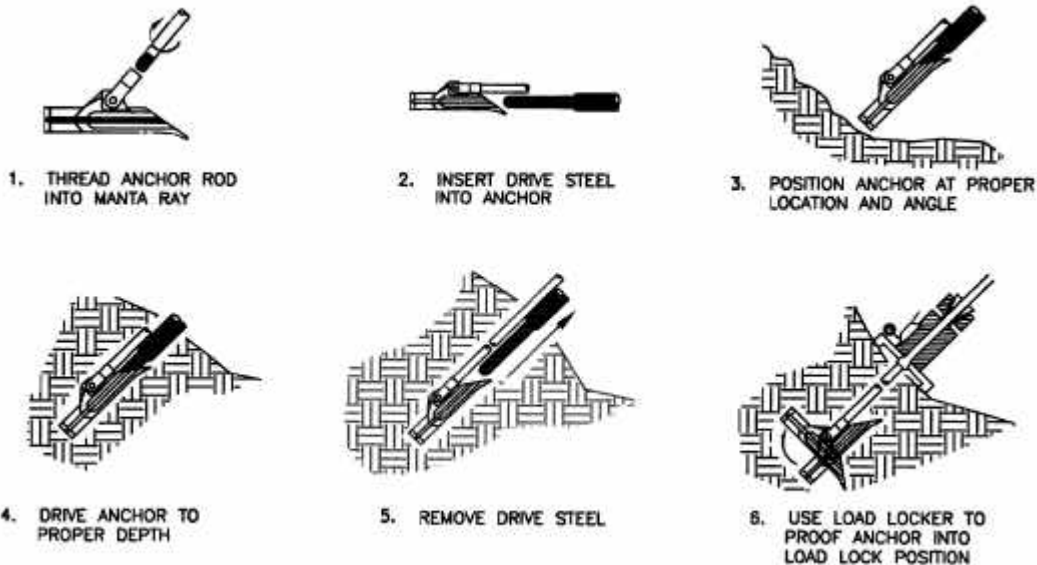
1) INTRODUCTION

Manta Ray and Stingray earth anchors are driven tipping plate soil anchors for reaction of tensile loads. Manta Ray anchors have ultimate capacities up to 20 tons, and Stingray anchors have ultimate capacities up to 50 tons. After driving the anchor to the required depth, the driving tool (called drive steel) is removed. The anchor is then tipped and proof tested with Foresight's Anchor Locking Kit from its edgewise-driving position to present its bearing area to the soil. This is called "load locking", and provides an immediate proof test of each anchor.

2) THE UNFAIR ADVANTAGE

Manta Ray and Stingray anchors offer many significant advantages:

- ❖ Fast, easy installation
- ❖ Immediate proof test results
- ❖ No grout
- ❖ Inexpensive installation equipment
- ❖ Environmentally friendly
- ❖ No excavation required
- ❖ Superior Holding Capacity
- ❖ Anchors for a wide range of soils & applications



3) MANTA RAY AND STINGRAY BASIC SIZES

Basic Anchor	Installation Depth		Ultimate Strength		Yield Strength		Anchor Weight		Bearing Area	
	Feet	Meters	Kips	kN	Kips	kN	Lbs	kg	Sq. in.	cm
Manta Ray MR-SR	7-30	2-10	40	178	30	133	21	9.5	142	916
Manta Ray MR-1	7-30	2-10	40	178	30	133	12	5.4	71	458
Manta Ray MR-2	7-30	2-10	40	178	30	133	10	4.5	41	265
Manta Ray MR-3	7-20	2-6	20	89	16	72	6	2.7	34	219
Stingray SR-1	15-50	5-15	100	445	75	334	47	21	115	740
Stingray SR-2	15-50	5-15	100	445	75	334	66	30	250	1613
Stingray SR-3	15-50	5-15	100	445	75	334	77	35	375	2419

4) INSTALLATION METHODS

Vehicle Mounted Breakers or Compactors:

Boom mounted demolitions or compactions are very effective for driving Manta Ray and Stingray anchors. This method requires a special tool in the breaker or a socket welded to the bottom of the compactor to hold the drive steel. Skid Steer Loaders, Loader-Backhoes or Excavators work well. 4,000 to 16,000 lb. Vehicles with 250 to 500 foot-pound pavement breakers are best for Manta Rays, and 16,000 to 30,000 lb. Vehicles with 500 to 1,000 foot-pound pavement breakers are best for Stingrays. Breaker tools and vibro sockets are available from Foresight Products.



Concrete Breaker on Skid Steer



Vibro on Backhoe

Rock Drills:

Top Hammer or down-the-hole hammer rock drills are very effective for installation of Manta Ray and Stingray anchors. For hard soil or weak rock installations, the drill can be used to drill a pilot hole. Foresight can provide striker bar adapters for these types of drills. Rock drilling steel can also be modified to drive Manta Rays and Stingrays.



Top Hammer Rock Drill



Down Hole Hammer

Manual Installation:

In some applications, Manta Ray anchors are driven into the soil with a 90 lb. pavement breaker and coupled drive steel. Pneumatic or hydraulic breakers are acceptable, but a 90 lb. weight class breaker is necessary. Manual installation of Stingray anchors is not recommended.



5) INSTALLATION EQUIPMENT

Drive Steel:

Drive steel and accessories are available from Foresight Products for all Manta Ray and Stingray anchors in basic lengths of 3 feet, 6 feet, and 8 feet. Multiple sections are coupled together with specialized couplers to achieve the required depth of installation. Manta Ray and Stingray drive steel are not interchangeable.

Load Locking Kits

For Manta Ray, the LL-1 is a 10-ton fast acting jack with an 8-inch stroke. The direct reading gauge and rod gripping jaws make load locking easy and quick. For high capacity Stingrays, the LL-40 is a 20-ton jack with a 10-inch stroke. The base and jack are self-aligning to the actual installed angle of the anchor. Both kits require open center hydraulic flow of 2 to 8 gallons per minute and a maximum pressure of 2,000 psi. A power supply is not included with these load-locking kits, it must be provided separately. Foresight Products models GPU18-8 or GPU-2 are suitable for the LL-1. GPU18-8 is required for the LL-40.



LL-1 for Manta Ray

For Stingray, the SR-LLK is a 60-ton double acting jack with a 10-inch stroke, which includes a hydraulic power supply. It is available in two models, one for tower guy anchors and one for retaining wall tieback anchors.



SR-LLK for Stingray

6) COMPOSITION AND MATERIALS

Manta Ray and Stingray anchors are made of hot dip galvanized ductile iron. Structurally compatible anchor rods and end terminations for guy line or retaining structures are available for all anchor models. Manta Ray anchors use Continuous Thread Bar (CTB) and Stingray anchors use Solid Core Rod (SCR). Some models of Manta Ray anchors are available in Stainless Steel.

7) TECHNICAL PERFORMANCE ISSUES

Manta Ray and Stingray anchors are tensile anchors designed to work well in soils with SPT blow counts (N) from 7 to 50. The smaller anchor models are used in harder soils or where lower loads are required. Larger anchors are used in softer soils. In harder soils, the installed capacity is limited by the ultimate strength of the anchor. In softer soils, it is limited by the soil strength. Soils with blow counts of 35 to 50 and higher, often require the installer to drill a 4-inch diameter pilot hole for Manta Ray or a 6-inch pilot hole for Stingray prior to installation in order to achieve an efficient installation time.

Although they are not intended for installation in rock, some models can be successfully installed into rock formations with low Rock Quality Designation (RQD). Typically, a pilot hole is required for these installations, but sometimes anchors can be simply driven into weathered, layered, decomposing rock.

Manta Ray and Stingray anchors are designed to react tensile loads along the axis of the anchor rod. They are not designed to react compressive, lateral, or shear loads, however, they can be made to do so by the addition of grout, which will increase the holding capacity, sometimes very significantly.

The increase is dependant upon the grout length and soil type. Both the CTB and SCR exceed the deformation characteristics of ASTM 615 rebar.

For retaining structures, Manta Ray anchors should be installed a minimum of 6 feet behind the failure plane after proof testing. Stingray anchors should be installed a minimum of 10 feet behind the failure plane after proof testing. A minimum overburden of 4 feet must be maintained for Manta Ray anchors and 7 feet for Stingray anchors.

Manta Ray and Stingray anchors can be proof tested up to 90% of yield strength. Working loads are typically between 50% and 90% of the proof test value.

8) TECHNICAL SERVICES

Limited technical services are available to help select anchors and anchoring methods, installation training, and support. Soil boring logs with USCS soil classification and SPT blow counts are required to predict anchor performance. Please contact your Manta Ray distributor or Foresight Products directly. Per diem and other charges for on-site services may apply.

9) ULTIMATE HOLDING CAPACITY CHART

Soil Description	Blow Count	Stingray SR-3	Stingray SR-2	Stingray SR-1	Manta Ray MR-SR	Manta Ray MR-1	Manta Ray MR-2	Manta Ray MR-3
Dense fine compact sands, very hard silts or clays	45-60	100 (2,3)	79-89 (2,4)	58-65 (2,4)	40 (1,3)	36-40 (1,3,4)	21-28 (2,4)	17-20 (2,3,4)
Dense clays, sands and gravels, hard silts and clays	35-50	85-100 (2,3,4)	62-79 (4)	39-58 (4)	32-40 (2,3,4)	24-36 (2,4)	15-22 (2,4)	12-18 (2,4)
Medium dense sandy gravel stiff to hard silts and clays	24-40	63-90 (4)	46-66 (4)	29-41 (4)	24-34 (2,4)	18-20 (2,4)	12-18 (4)	9-14 (4)
Medium Dense Coarse sand and gravel, Stiff to Very stiff silts and clays	14-25	48-63 (4)	31-48 (4)	24-32 (4)	18-24 (4)	15-20 (4)	9-12 (4)	7-9 (4)
Loose to Medium Dense Fine to Coarse sand; Firm to Stiff clays and silts	7-14	37-48 (4)	27-36 (4)	16-24 (4)	14-18 (4)	10-15 (4)	7-10 (4)	5-8 (4)

Notes:

- 1) Drilled pilot hole required for efficient installation.
- 2) Ease of installation may be improved by drilling a pilot hole.
- 3) Holding capacity limited by ultimate strength of anchors.
- 4) Holding capacity limited by soil failure.
- 5) Not recommended in these soils.

10) GENERAL SPECIFICATION FOR MANTA RAY OR STINGRAY ANCHORS

1.0 Description

This work shall consist of furnishing, driving, proof testing and attaching of Manta Ray or Stingray Anchors at locations and finished embedment depths as shown on the plans, or as directed by the project engineer.

2.0 Work Included

- A) Furnishing and driving Manta Ray or Stingray Anchors as shown on the plans.
- B) Load Locking and Proof Testing the driven anchors.
- C) Furnishing and installing the hardware required attaching the anchors to the structure.

3.0 Definitions

- A) Manta Ray and Stingray Tieback Anchors – Impact or vibration driven tipping plate soil anchors for reaction of tensile loads.
- B) Anchor Rod – Galvanized threaded steel bar used to connect the Manta Ray or Stingray anchor head to the structure. Typically, the rod is a fully threaded bar of sufficient strength to be compatible with the strength of the Manta Ray or Stingray earth anchor head. This will provide an adequate structural safety factor compared to the proof test, lock-off, or working load.

4.0 Earth Anchors, Anchor Rods, and Attachment Hardware

- A) Earth anchors shall be as manufactured by Foresight Products, LLC of Commerce City, CO. or an engineer approved equivalent. Anchor model, rod size, embedment depth, and proof test requirement may vary with location as detailed on the project drawings.
- B) Anchor rods shall be a minimum of ¾” diameter steel for Manta Ray and 1” for Stingray and shall provide enough length to satisfy the specified minimum finished embedment length as shown on the project drawings.
- C) Attachment Hardware consisting of Washers, Beveled Washers, Steel Plates and Nuts or Eynenuts shall be compatible with the anchor rods in terms of fit, function and strength.

5.0 Materials

- A) Manta Ray and Stingray earth anchor heads are Hot Dip Galvanized Ductile Iron per ASTM A-123.
- B) Anchor rods and attachment hardware are Hot Dip Galvanized Steel per ASTM A-153.

6.0 Installation

- A) Manta Ray anchors must be driven to a depth that allows sufficient pull back allowance to meet the required minimum finished embedment length after proof testing. A good general rule is to allow for 3 feet of pull back. Choice of driving equipment is the responsibility of the contractor, but it is suggested that the contractor contact Foresight Products Engineering Department at 1-800-325-5360 for installation suggestions and required equipment.
- B) Manta Ray and Stingray anchors must be proof tested to the load specified on the project drawings with the Foresight LL-1, LL-45 or SR-LLK Load Locker or an engineer approved equivalent. After tipping the anchor to its “load locked” position, by one or more cycles of the Load Locker, a proof test must be performed as follows. Upon reaching the proof test load as specified on the project drawings, that load must be held for a period of 1 minute during which time the movement of the anchor rod shall not exceed 0.5”. The anchor must also meet the specified minimum embedment length after the proof test. If the anchor fails this proof test, the engineer must be notified. It is suggested that the contractor keep a record of the proof test loads achieved and final embedment lengths of each anchor.
- C) Remedies for a failed proof test load must be approved by the engineer, but in general include:
 - a) Decreased anchor spacing
 - b) Increased anchor embedment depth
 - c) Slightly different installation angle
 - d) Larger anchor head size
 - e) Addition of grout or other capacity enhancement material
 - f) Re-test after a period of 12 – 24 hours. History has shown an increase in capacity over time in the range of 5 – 10 percent.