

ANCHOR RODES are selected for maximum load and shock absorption

The anchor or mooring rode, as well as the anchor itself, should be selected with careful consideration of specific conditions and maximum anticipated loads.

Let us consider first the function of an anchor rode beyond that of connecting the boat to the anchor. First, the rode should lead from the anchor horizontally, or parallel with the boat anchor, even when under strain. Any lead upward from the anchor, the amount of loss decreases holding power, the amount of loss depends upon the angle and the type of anchor. A Danforth® lightweight type anchor suffers less. Secondly, the rode should prevent sudden shock loads due to possible wave action or surge, as discussed previously. It is possible to design the rode properly; heavy chain, nylon line, long scope, and mooring buoys are the elements often employed in this respect. The merits of various rode should be known before proceeding further.

NYLON is highly desirable because its working elasticity is 15% to 25%, or 2½ to 4½ times the elasticity of manila. It resists most rot and decay. It often protects itself from serious chafing by forming a protective layer of fuzz at the outside. It should be protected by chafing gear, however, where it goes through chocks or across sharp edges, and also protected from bottom chafe or cutting by using a length of chain next to the anchor.

Nylon costs about four times as much as manila per pound, but it must be remembered that a smaller diameter offers equal strength as a larger manila line; on this basis, nylon costs only about 1½ times as much as manila, and ordinarily lasts much longer. In our opinion, its advantages make it well worth its price. In using nylon, however,

watch the following: seizings must be made so they will not slip; thimbles should be tightly spliced so that they will not drop out when the line is stretched; one more tuck should be taken in splicing nylon than manila, also each strand must be kept twisted; keep shaded when possible, as the ultra violet in sunlight eventually damages the surface fibers. This damage is negligible in larger lines.

CHAIN is an excellent material for an anchor rode because its weight causes a catenary curve which absorbs shock loads and also lowers the angle of pull at the anchor. Chain is heavy, to be sure, but no matter how much chain you have out, you never have to lift more at one time than the length from the bottom vertically to the deck.

WIRE ROPE is light in weight for its strength, and can be stowed neatly on a drum. However, rust and corrosion are serious problems. Usually, its light weight does not provide sufficient catenary for shock absorption.

MANILA rope is in common use on lighter anchors, and is easy to handle, light in weight, comparatively inexpensive, and capable of enough stretch to absorb some shock load. On the debit side, it deteriorates quickly if not cared for, and is subject to chafe on both the bottom and at the boat.

The following simple formulae, derived from catenary equations, are most helpful in determining tensions, weights, lengths of rode, comparative merits, etc., in varying situations. The formulae on the left will give you a rode that leads horizontally away from the anchor when under the assumed load. For comparison, the formulae on the right will give you a rode that will lead upward at an 8° angle with the bottom:

Formulae for a horizontal lead

1. $T = T_0 + wd$
2. $T_0 = \sqrt{T^2 - T_1^2}$
3. $l = \frac{T_0}{w}$

Where: T = Maximum tension in line in lbs.

T_0 = Horizontal load in lbs.

T_1 = Vertical load in lbs.

d = Depth of water in feet (Include possible hurricane depth plus maximum possible wave heights)

w = Weight of rode in lbs. per foot underwater (See tables at bottom of page)

l = Length of rode in feet.

If we assume a horizontal load of 2000 lbs., 50 ft. of water, and ½" BBB chain, we get the following results: (The figure 2.57 lbs. for chain is obtained by multiplying the weight of 1 ft. of chain in air, 2.95 lbs., by 87%, which is the weight of steel in water as compared to air. Both figures are taken from tables at the bottom of this page.)

For Horizontal Lead

1. $T = 2000 + 2.57 \times 50$
 $T = 2128$ lbs.
2. $T_0 = 727$ lbs.
3. $l = 283$ ft., or a ratio of 5.66 to 1

We have now obtained much useful information. We know the tension on the rode, the vertical pull down on the bow or the buoy and the length of rode necessary to accomplish our purpose. (NOTE: For safest mooring or anchoring, a buoy should be used to carry the bulk of the

Formulae for an 8° lead upward

1. $T = 1.01 T_0 + wd$
2. $T_0 = \sqrt{T^2 - T_1^2}$
3. $l = \frac{T_0}{w}$

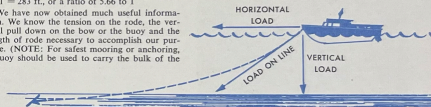
vertical load, leaving only a horizontal load on the bow of the boat as well as on the anchor.)

Now let us go further and see what would happen if we use 1" chain instead of ½" chain. Proceeding as before, we have:

For Horizontal Lead

1. $T = 2000 + 9.14 \times 50$
 $T = 2457$ lbs.
2. $T_0 = 1427$ lbs.
3. $l = 156$ ft., or a ratio of 3.12 to 1

A number of conclusions can be drawn from the above. It is obvious that we cannot make any flat statement about scope without knowing the kind of rode that is being used. Note that the use of 1" chain instead of ½" chain shortened the required scope from 283 ft. to 156 ft. (left column above); this fact is useful where anchorage area is limited. From the above, we see the value of using a buoy and pennant where possible instead of connecting the boat and anchor directly; note that the vertical load for ½" chain is 727 lbs. (left column), and this would materially decrease ability of the boat to lift its bow over waves. Working these formulae with rope and wire data will give a much more thorough understanding of what happens when various types of anchor rode are used.



NOTE:

Values in these tables are approximate, and vary with different brands and manufacturers. It is good practice to limit working loads to one-fifth the rated breaking strength of rope and wire rope, and they should be limited to one-half the proof test value to which chain is pre-stressed during manufacture.

Reduction of Rope Strength Due to Knots and Splices in Both

Manila and Nylon
Knots ... 40%-50% reduction
Splices ... 5%-15% reduction

WEIGHT OF VARIOUS MATERIALS IN WATER AS COMPARED TO AIR	APPROX. WEIGHT OF 100' IN AIR					ROPE Breaking Strength		CHAIN Proof Test		WIRE ROPE Breaking Strength				
	Diameter	Nylon Rope	Manila Rope	BBB Galv. Chain	6 x 19 Fiber Core Wire Rope	Nylon Yacht Rope	Manila Yacht Rope	BBB Gal. Coil Chain	High Strength Alloy Chain	Iron Wire Rope 6 x 19	Gal. Plow Steel Wire Rope 6 x 19 Fiber Core	Gal. Improved Plain Steel Wire Rope 6 x 19 Fiber Core	Stainless Steel Wire 1/8" IWC	Stainless Steel 7 x 19 Wire Rope
	1/4	1.7	1.9	76	10	1,800	650	2,700	6,500	2,200	4,300	5,000	.....	6,400
Nylon 11%	5/16	2.6	3.2	115	16	2,800	1,150	3,700	.....	3,200	6,700	7,700	.....	9,000
Concrete ... 58%	3/8	3.8	4.0	170	23	4,000	1,550	4,600	13,000	5,000	9,600	11,000	.....	12,000
Granite 62%	7/16	5.4	5.1	225	31	5,500	1,900	6,200	.....	6,400	13,000	15,000	16,300	.....
Steel 87%	1/2	7.1	6.5	295	40	7,100	2,900	8,200	22,000	8,400	17,000	19,000	22,800	.....
Lead 91%	9/16	8.3	8.5	350	51	8,300	3,800	10,200	.....	10,600	21,000	24,000	28,500	.....
	5/8	10.5	11.2	430	63	10,500	4,800	12,500	33,000	12,800	26,000	30,000	35,000	.....
	3/4	15.0	13.8	600	90	14,200	5,900	17,700	46,000	18,200	37,000	43,000	49,600	.....
	7/8	20.5	20.8	810	123	19,000	8,400	24,000	.....	21,400	50,000	58,000	66,500	.....
	1	27.0	25.2	1050	160	24,600	9,900	31,000	.....	28,000	66,000	75,000	85,400	.....

Manila varies with age, strain, dirt, and water absorption.