

Benefits of Correct Rigging Tension

Contrary to popular thought, a slack rig is more punishing on a hull than a properly adjusted, tight rig. Insufficient tension will not reduce the loads transmitted in the hull. Slack rigging will punish the spar and rigging needlessly by allowing excessive movement, chafe and shock loading. Modern fiberglass hulls should not be damaged by a properly adjusted, tight rig.

Figure B lists the rigging tension under different conditions for a typical boat with a properly tuned rig and with a slack rig. It will be noted that the maximum load is the same. However, for properly tuned rig the leeward shrouds will not go slack under normal sailing conditions.

The lateral stiffness of the mast and the fore and aft stiffness of the spreaders is reduced by a factor of 2 when the leeward shrouds go slack. This important structural characteristic is not generally recognized.

Rigging tension is becoming more important as a result of the trend toward the use of mast bend to control mainsail shape under different wind conditions. Mast bend will also affect the shape and trim of the jib, since mast adjustment generally affects forestay tension. The expert skipper will benefit by maintaining consistent rigging tension while developing the optimum sail shape and sailing tactics.

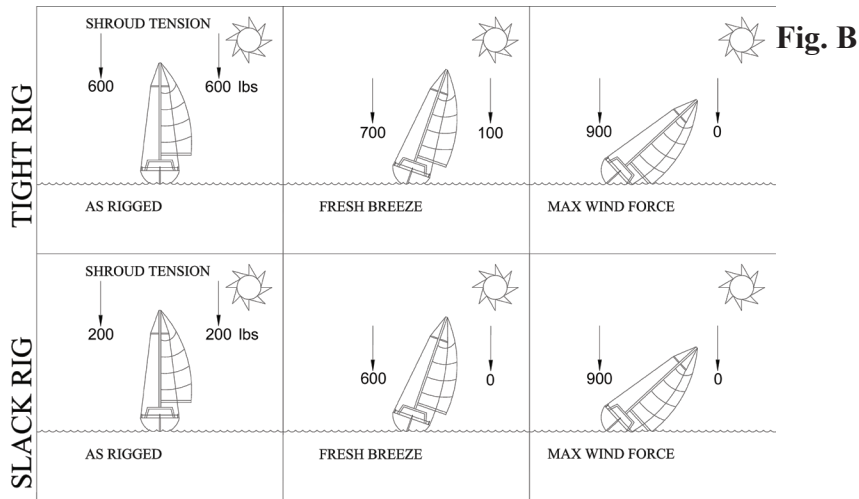


Fig. B

Orders and requests for this "LOOS Tension Gauge" should be sent to:



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"PROFESSIONAL MODEL"

The LOOS "Professional Model" tension gauge is designed to provide an accurate measurement of the tension in rigging wire and other types of cable used in recreational and industrial applications. It is particularly used for accurate and repeatable tuning of a sailboat's standing rigging.

- Model PT-1 Cable size 3/32", 1/8", 5/32"
- Model PT-1M Cable size 2.5mm, 3mm, 4mm
- Model PT-2 Cable size 3/16", 7/32", 1/4"
- Model PT-2M Cable size 5mm, 6mm, 7mm
- Model PT-3 Cable size 1/4", 9/32", 5/16", 3/8"
- Model PT-3M Cable size 7mm, 8mm, 9mm, 10mm



Each model covers a tension range of approximately 5% to 25% of the breaking strength of the wire and is designed and tested to provide an accuracy of plus or minus 3% at mid-range.

The "Professional Model" tension gauges will provide an increase in accuracy and convenience of use when compared to our popular standard gauges, Model A and B. The gauge may be hooked on the wire and will remain in position while the tension is adjusted.

U.S. Patent No. 5,461,929

How To Measure

1. Hold the gauge with the left hand and place the cable between the two nylon spools as shown in Figure 1.

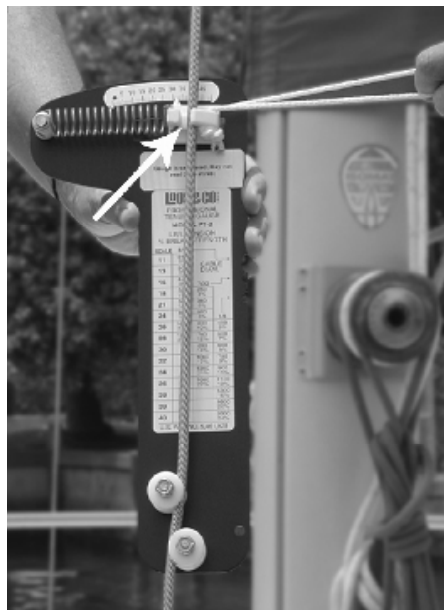


Fig. 2

3. Release the lanyard to assure accurate readings make sure that the slider moves freely in the frame slot and does not bind, move frame back and forth to center it.

Also, lubricate the slider slot frequently with silicone lubricant. Read the needle position on the scale. Refer to the calibration table to obtain correct tension in the cable. The gauge can be left on the wire for “hands free” adjusting of the cable.

Note.

An extra 1/4” inch hole is provided in the frame of the instrument for an attachment of a short lanyard and snap hook (not furnished) for securing the gauge to the cable. This will prevent loss of the instrument if it becomes inadvertently detached.

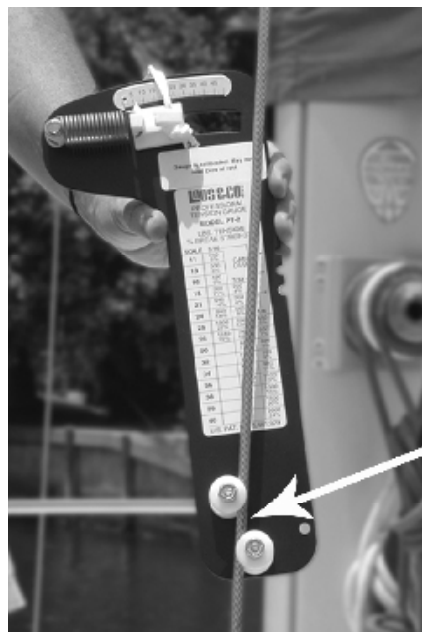


Fig. 1

2. With the right hand pull the lanyard and extend the spring until the hook on the nylon slider can be hooked on the cable as shown in Figure 2.

WHEN NO SPECIFIC REQUIREMENTS ARE PROVIDED BY THE SAILMAKER, THE FOLLOWING GENERAL COMMENTS WILL PROVIDE A BASIS FOR A RATIONAL PROCEDURE FOR TUNING THE RIG.

Forestay Tension - Masthead Rig On the masthead rig it's almost always advantageous to set the forestay tension as high as possible within the limits of structural strength. Generally, it's possible to use 15% of the breaking strength of the cable. Thus, a forestay tension of 1,000 lbs. is a reasonable place to start with a 7/32” diam., 302 / 304 1x19 stainless steel cable.

Backstay tension would, of course, have to be adjusted to maintain a straight mast with the desired forestay tension. Since the backstay makes a greater angle to the mast, the backstay tension will be lower than the forestay tension.

NOTE! ROLLER FURLING CAN ONLY BE SET BY BACK STAY TENSION.

Forestay Tension - Fractional Rig In a fractional rig the forestay does not go all the way to the masthead and forestay tension cannot be directly balanced by tension in the backstay. Therefore, some mast bend is generally accepted and the mainsail is cut to fit the bend. A forestay tension of at least 15% of the cable strength is desirable. However, if this results in excessive mast bend it will be necessary to back off a bit. On some fractional rigs, diamond shrouds are used to reduce mast bend.

Upper and Lower Shroud Tension - Masthead Rig There is a simple criterion for shroud tension. The initial rigging tension should be high enough that the leeward shrouds do not go slack when sailing close-hauled in a reasonably brisk breeze. The proper value for your boat can be found by a few trial runs under sail. Once the correct tension is known, the gauge can be used to maintain the value.

For many boat designs a shroud tension of 10% to 12% of the breaking strength of the cable is adequate. Thus, for 7/32”, 302 / 304 1x19 stainless steel cable, the upper and lower shrouds would be set to 600 to 700 lbs. tension. On some rigs it may be desirable to carry more tension in the uppers than in the lowers.

Upper and Lower Shroud Tension - Fractional Rig For most fractional rigs the correct shroud tension is the same as that for a masthead rig, i.e., a tension setting that will keep the leeward shrouds from going slack. However there is one exception. On certain fractional rigs, the upper and lower shrouds lead to chainplates that are aft of the mast. The spreader is swept back. For such a rig most of the forestay tension is balanced by the upper shrouds. A shroud tension of approximately 20 % of the cable strength may be required to achieve the desired forestay tension. Never exceed 25% of the cable breaking strength. (Refer to the breaking strength chart Table 1.)

NOTE! THE INTENDED USE OF THIS GAUGE IS TO BE USED ON 302 / 304 1X19 S.S. CABLE IN APPROPRIATE SIZES. IF USED ON CABLE TYPES, SIZES AND CONSTRUCTION YOUR READINGS WOULD BE CONSISTENT (REPEATABLE) BUT POUND TENSION VALUES WOULD DIFFER FROM THOSE LISTED ON THE LABEL. GAUGE MAY NOT READ “0” WHEN AT REST, AS THEY ARE CALIBRATED AT MID-RANGE OF TENSION.

NOTE! IF FLAT SPOTS APPEAR ON NYLON SPOOLS AFTER EXTENDED USE, ROTATE NYLON SPOOLS 45°.

ADDITIONAL SCALE READINGS KGS. TENSION

| Scale | CALIBRATION PLATE MODEL PT-1 METRIC | | | CALIBRATION PLATE MODEL PT-2 METRIC | | | CALIBRATION PLATE MODEL PT-3 METRIC | | | |
|-------|--|-----|-----|--|-----|-----|--|------|------|------|
| | 2.55mm | 3mm | 4mm | 5mm | 6mm | 7mm | 7mm | 8mm | 9mm | 10mm |
| 8 | 50 | | | | | | | | | |
| 9 | 54 | | | | | | | | | |
| 10 | 58 | | | | | | 300 | | | |
| 11 | 62 | | | 95 | | | 330 | | | |
| 12 | 66 | | | 110 | | | 360 | 200 | | |
| 13 | 70 | | | 120 | | | 400 | 220 | | |
| 14 | 75 | | | 140 | | | 440 | 240 | | |
| 15 | 82 | 70 | | 150 | | | 480 | 270 | | |
| 16 | 90 | 75 | | 170 | | | 515 | 300 | | |
| 17 | 100 | 82 | | 180 | | | 550 | 330 | | |
| 18 | 110 | 90 | | 200 | | | 590 | 360 | | |
| 19 | 120 | 100 | | 220 | | | 630 | 400 | | |
| 20 | 130 | 110 | | 240 | | | 680 | 430 | | |
| 21 | 140 | 120 | 70 | 260 | | | 730 | 460 | | |
| 22 | | 130 | 76 | 280 | 160 | | 790 | 500 | | |
| 23 | | 140 | 83 | 310 | 180 | | 840 | 540 | | |
| 24 | | 150 | 90 | 340 | 200 | | 900 | 590 | | |
| 25 | | 160 | 100 | 370 | 210 | | 1000 | 630 | 370 | |
| 26 | | 170 | 115 | 400 | 230 | | 1100 | 680 | 410 | |
| 27 | | 180 | 127 | 440 | 250 | | | 720 | 440 | |
| 28 | | 190 | 140 | 490 | 270 | | | 770 | 480 | |
| 29 | | 210 | 150 | 550 | 290 | | | 850 | 520 | |
| 30 | | 220 | 160 | 620 | 320 | 220 | | 920 | 560 | |
| 31 | | 235 | 170 | | 350 | 240 | | 1000 | 590 | |
| 32 | | 250 | 180 | | 380 | 270 | | 1100 | 630 | |
| 33 | | | 195 | | 420 | 290 | | 1240 | 700 | |
| 34 | | | 210 | | 460 | 320 | | 1400 | 750 | 400 |
| 35 | | | 225 | | 510 | 350 | | | 810 | 430 |
| 36 | | | 240 | | 570 | 370 | | | 870 | 460 |
| 37 | | | 260 | | 640 | 400 | | | 940 | 500 |
| 38 | | | 280 | | 730 | 440 | | | 1020 | 540 |
| 39 | | | 320 | | | 470 | | | 1100 | 590 |
| 40 | | | 360 | | | 510 | | | 1190 | 630 |
| 41 | | | | | | 550 | | | 1300 | 680 |
| 42 | | | | | | 620 | | | 1420 | 730 |
| 43 | | | | | | | | | 1600 | 790 |
| 44 | | | | | | | | | | 870 |
| 45 | | | | | | | | | | 940 |
| 46 | | | | | | | | | | 1000 |
| 47 | | | | | | | | | | 1090 |
| 48 | | | | | | | | | | 1180 |
| 49 | | | | | | | | | | 1270 |
| 50 | | | | | | | | | | 1360 |
| 51 | | | | | | | | | | 1500 |
| 52 | | | | | | | | | | 1640 |
| 53 | | | | | | | | | | 1800 |

SAFETY AND PERFORMANCE

SAFETY

The failure of a fitting, shroud or stay could damage your boat, buckle the mast or even cause personal injury. To avoid such failure of the cable and fittings from fatigue or shock loading, it is important to set up your standing rigging with the proper tension. Too little tension in the shroud will permit the leeward shroud to go slack, only to fetch up with a jolt when the boat rolls or pitches. A less common problem is excessive tension. This can cause permanent stretch to the cables and possibly damage the mast.

PERFORMANCE

The actual set of sail under load is determined by the cut of the sail and the shape of the structure which supports the sail. Rigging tension plays an important part in determining the set of the sails.

When the boat has been tuned for peak performance, measure the cable tension should be recorded. The stainless steel used to make the rigging can stretch a little bit over time under high loading. Thus, marking turnbuckles, etc. cannot guarantee that subsequent adjustments will provide the desired tension. Only by gauging is it possible to repeat the initial tuning or improve it.

Limiting the sag of the forestay is perhaps the most important benefit to performance from having the proper rigging tension. Forestay sag permits the jib luff to fall off to leeward, tightening to leech and seriously degrading the performance to windward.

Tension in the upper and lower shrouds will influence the mast bend and set the mainsail. This is especially important on modern, fractional rigs where the mast bend is used to depower the sail in heavy winds.

If the shrouds are not set up with enough tension, the leeward shrouds will go slack when the boat is sailing to windward. This can result in fore and aft pumping of the mast in a head sea. This mast movement will change the shape of the mainsail and can cause performance loss as well as possible structural damage. **Specific tension requirements for your application must be obtained from the boat, mast, or sail manufacturer or the manufacturer of the product on which the cable is used.**

| Table 1 | | | |
|--|--------------------------|------------------|-----------------|
| 302 / 304 1 X 19 Stainless Steel Rigging Cable | | | |
| Diam., In. | Breaking Strength Pounds | Forestay* Pounds | Shrouds* Pounds |
| 3/32 | 1200 | 180 | 120 |
| 1/8 | 2100 | 320 | 240 |
| 5/32 | 3300 | 500 | 350 |
| 3/16 | 4700 | 750 | 500 |
| 7/32 | 6300 | 1000 | 700 |
| 1/4 | 8200 | 1300 | 850 |
| 9/32 | 10300 | 1600 | 1000 |
| 5/16 | 12500 | 2000 | 1300 |
| 3/8 | 17500 | 2750 | 1800 |

*Suggested initial settings.

How much Tension?

Table 1 recommends an initial tension setting, but there is no simple solution since the optimum rigging tension will be a function of the boat design, the rig (masthead or fractional, one or more spreaders, etc.), and even the cut of the sails. Many skippers use insufficient tension because of a fear of “breaking something.”

It should be noted that on America’s Cup contenders, where electronic state of the art tension instrumentation is available, the standing rigging is set as tight as is structurally feasible.

One Design Class Racing Sailboats

Most sailmakers who produce sails for the one design classes provide each purchaser with specific set of readings on the Loos Model A or Model B tension gauges for use when setting up the standing rigging. This assures that the sails will have the correct shape when the rig is under load.

For the convenience of sailors who wish to upgrade from our Model A or B gauges to the professional model (PT-1, PT-2, or PT-3) gauges we include below a conversion chart so that the same recommended tension can be obtained with the PT-1, PT-2 or PT-3 gauges as with the Model A or B gauges.

Scale Readings For Equal Tension

| MODEL A | MODEL PT-1 | | | MODEL B | MODEL PT-2 | | | MODEL PT-3 |
|---------|------------|-----|------|---------|------------|------|-----|------------|
| SCALE | 3/32 | 1/8 | 5/32 | SCALE | 3/16 | 7/32 | 1/4 | 9/32 |
| 5 | 6 | | | 10 | 11 | NA | NA | NA |
| 10 | 9 | | | 15 | 13 | | | |
| 15 | 12 | 14 | | 18 | 15 | | | |
| 20 | 16 | 16 | | 20 | 16 | 18 | | |
| 25 | 20 | 19 | | 22 | 18 | 20 | | |
| 28 | 23 | 21 | | 24 | 19 | 22 | | |
| 30 | | 22 | | 26 | 21 | 24 | | |
| 35 | | 27 | 25 | 28 | 23 | 25 | | |
| 38 | | 30 | 28 | 30 | 25 | 27 | 25 | |
| 40 | | 33 | 30 | 32 | 27 | 29 | 27 | |
| 42 | | | 33 | 34 | 29 | 31 | 29 | |
| 44 | | | 36 | 36 | | 33 | 31 | |
| 45 | | | 38 | 38 | | 36 | 33 | 6 |
| 46 | | | 39 | 39 | | 37 | 34 | 7 |
| 47 | | | 40 | 40 | | | 36 | 9 |
| | | | | 41 | | | 37 | 10 |
| | | | | 42 | | | 39 | 11 |
| | | | | 43 | | | 40 | 12 |
| | | | | 44 | | | | 14 |
| | | | | 45 | | | | 16 |
| | | | | 46 | | | | 18 |
| | | | | 47 | | | | 20 |
| | | | | 49 | | | | 25 |

ADDITIONAL SCALE READINGS LBS. TENSION

| SCALE | CALIBRATION PLATE MODEL PT-1 | | | CALIBRATION PLATE MODEL PT-2 | | | CALIBRATION PLATE MODEL PT-3 | | | |
|-------|------------------------------|-----|------|------------------------------|------|------|------------------------------|------|------|------|
| | 3/32 | 1/8 | 5/32 | 3/16 | 7/32 | 1/4 | 1/4 | 9/32 | 5/16 | 3/8 |
| 5 | 70 | | | | | | 550 | | | |
| 6 | 80 | | | | | | 600 | | | |
| 7 | 90 | | | | | | 700 | | | |
| 8 | 100 | | | | | | 770 | 500 | | |
| 9 | 110 | | | | | | 830 | 550 | | |
| 10 | 125 | | | 180 | | | 900 | 600 | 320 | |
| 11 | 135 | | | 240 | | | 1000 | 650 | 380 | |
| 12 | 150 | 100 | | 270 | | | 1100 | 720 | 440 | |
| 13 | 160 | 110 | | 300 | | | 1200 | 780 | 500 | |
| 14 | 170 | 125 | | 330 | | | 1300 | 830 | 550 | |
| 15 | 185 | 135 | | 370 | | | 1400 | 900 | 600 | 200 |
| 16 | 200 | 150 | | 420 | | | 1500 | 1000 | 680 | 230 |
| 17 | 220 | 165 | | 450 | | | 1650 | 1080 | 740 | 270 |
| 18 | 240 | 180 | | 500 | | | 1800 | 1150 | 800 | 290 |
| 19 | 260 | 200 | | 540 | | | 2000 | 1220 | 870 | 330 |
| 20 | 280 | 220 | 140 | 590 | 320 | | | 1300 | 950 | 360 |
| 21 | 300 | 240 | 155 | 640 | 360 | | | 1420 | 1050 | 380 |
| 22 | | 260 | 170 | 700 | 410 | | | 1540 | 1130 | 420 |
| 23 | | 280 | 185 | 770 | 450 | 300 | | 1660 | 1210 | 480 |
| 24 | | 300 | 200 | 840 | 500 | 350 | | 1800 | 1300 | 530 |
| 25 | | 320 | 220 | 920 | 560 | 400 | | 1960 | 1400 | 570 |
| 26 | | 345 | 245 | 1030 | 630 | 450 | | 2130 | 1500 | 600 |
| 27 | | 370 | 265 | 1110 | 680 | 500 | | 2300 | 1600 | 650 |
| 28 | | 390 | 300 | 1240 | 740 | 550 | | 2500 | 1700 | 720 |
| 29 | | 420 | 320 | | 820 | 600 | | | 1850 | 800 |
| 30 | | 450 | 335 | | 890 | 660 | | | 2000 | 870 |
| 31 | | 475 | 360 | | 970 | 720 | | | 2200 | 930 |
| 32 | | 500 | 390 | | 1060 | 780 | | | 2400 | 1000 |
| 33 | | | 420 | | 1180 | 840 | | | 2700 | 1100 |
| 34 | | | 450 | | 1300 | 900 | | | 3000 | 1200 |
| 35 | | | 480 | | 1480 | 1000 | | | | 1300 |
| 36 | | | 520 | | 1680 | 1100 | | | | 1400 |
| 37 | | | 560 | | | 1200 | | | | 1500 |
| 38 | | | 610 | | | 1300 | | | | 1650 |
| 39 | | | 700 | | | 1600 | | | | 1770 |
| 40 | | | 800 | | | 2000 | | | | 1900 |
| 41 | | | | | | | | | | 2100 |
| 42 | | | | | | | | | | 2230 |
| 43 | | | | | | | | | | 2400 |
| 44 | | | | | | | | | | 2620 |
| 45 | | | | | | | | | | 2850 |
| 46 | | | | | | | | | | 3100 |
| 47 | | | | | | | | | | 3400 |
| 48 | | | | | | | | | | 3700 |
| 49 | | | | | | | | | | 4100 |
| 50 | | | | | | | | | | 4500 |