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.

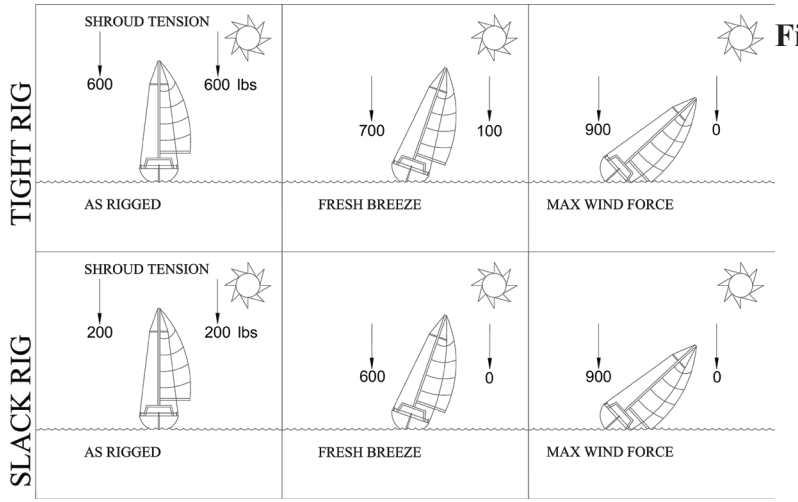

Fig. B

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

LOOS & CO. INC. CABLEWARE® DIVISION

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Rev. 02/21/13
INST-07

LOOS & CO. INC. CABLEWARE® DIVISION

"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.

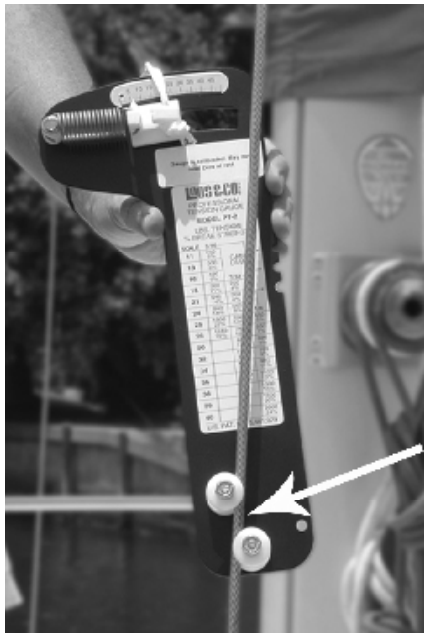

Fig .1

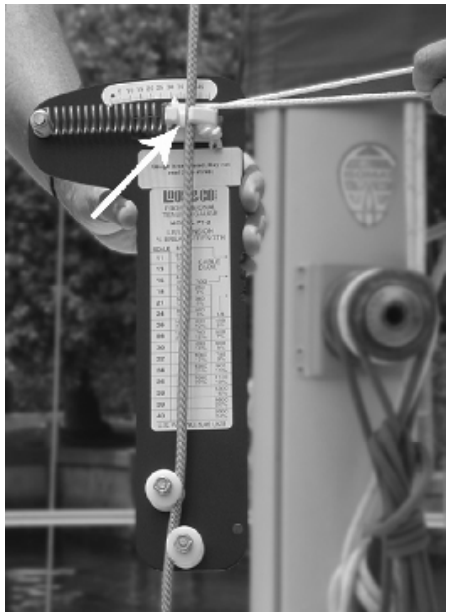

Fig. 2

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.

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.

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 APPRORIATE 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 EXTEDED USE, ROTATE NYLON SPOOLS 45°.

Additional Scale Readings
KGS. TENSION

	CALIBRATION PLATE MODEL PT-1 METRIC			CALIBRATION PLATE MODEL PT-2 METRIC			CALIBRATION PLATE MODEL PT-3 METRIC			
Scale	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

	CALIBRATION PLATE MODEL PT-1			CALIBRATION PLATE MODEL PT-2			CALIBRATION PLATE MODEL PT-3			
SCALE	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