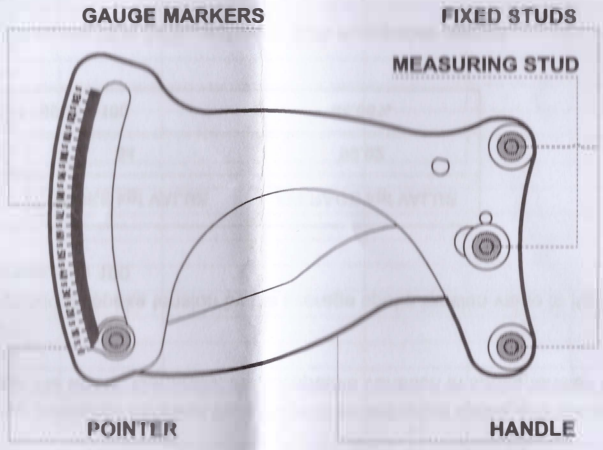
X TOOLS

SPOKE TENSION METER

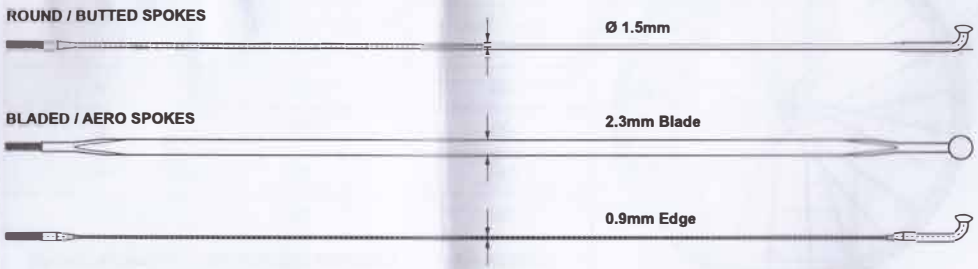


Strong and consistent spoke tension is essential for a stiff and durable wheel. The X-Tools Spoke Tension Meter provides a calibrated measurement of the spoke tension to help you get the best out of your wheel build.

Please consult your spoke and rim manufacturers recommended spoke tensions. As a general rule, the tension should be high enough to prevent slackness or flex when the wheel is in use.

MEASURING THE SPOKE DIMENSIONS

Use a gauge tool or a Vernier caliper to measure the gauge of the spoke. For butted spokes, measure the diameter of the spoke at the narrowest point. For bladed spokes, measure both the width and the edge of the blade.

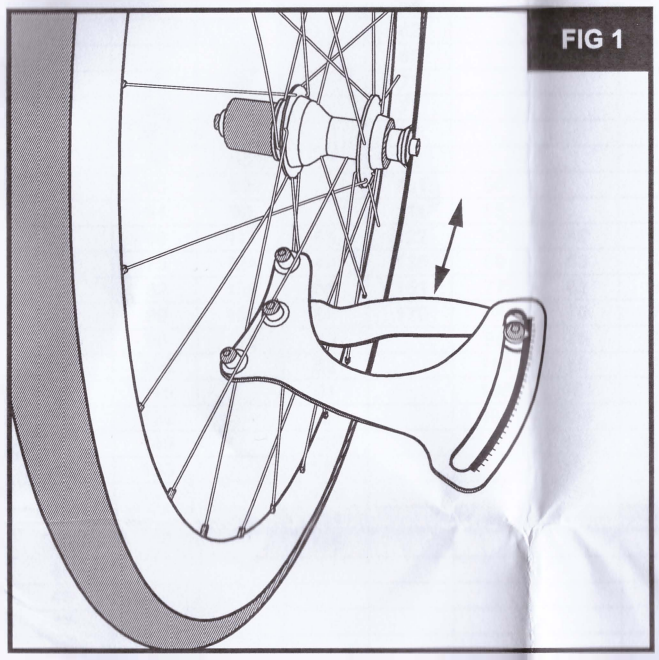


Make a note of the spoke dimensions, check the unit conversion table to ensure your spoke dimensions are listed.

If your spokes do not conform to the dimensions listed in the unit conversion table, it may not be possible to gain an accurate absolute tension value in kilograms/force. The X-Tools Spoke Tension Meter can still be used to measure the relative tensions of the spokes to help ensure the wheel is tensioned evenly.

MEASURING SPOKE TENSION

Mount the wheel in a truing jig. Mark the first spoke with a small strip of adhesive tape at the nipple for easy reference. Gently squeeze the handles of the tension meter, slot the spoke between the fixed studs and measuring stud [FIG 1]. For radial laced wheels, position the measuring stud at the mid point of the spoke. For wheels with crossed lacing patterns, position the measuring stud at the mid point between the rim and the cross. Ensure you measure the tension at the same point on each spoke.



Slowly release the handle and allow the measuring stud to rest fully on the spoke. Examine the measurement gauge and record the value indicated by the pointer. Repeat for each spoke on the same side of the wheel.

Please note: The spoke tensions on opposite sides of disc brake compatible wheels and geared rear wheels will not be the same. This is due to the differing spoke lengths and angles required to dish the rim centrally.

CONVERTING THE METER READINGS TO KILOGRAM-FORCE (kgf)

Locate the corresponding column for your spoke type and dimensions on the unit conversion table. Match your recorded readings to the kgf (Kilogram-force) values given for your spoke type/dimension. Eg. A round spoke with a 1.8mm diameter that gives a reading of 51 converts to 119 kgf tension. A Bladed Spoke with a 2.3mm width and 0.9mm edge that gives a reading of 32 converts to 122 kgf tension.

CALCULATING AVERAGE TENSION

For wheels with symmetrical hubs such as rim brake compatible front wheels, all of the spokes will be comparable.

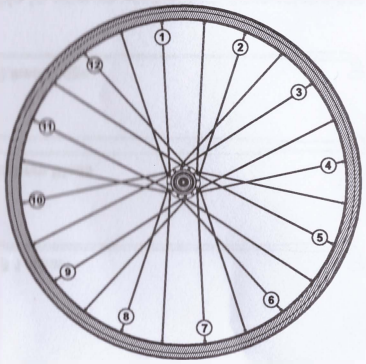
For hubs with asymmetrically spaced flanges such as disc brake compatible hubs and geared rear hubs, only the spokes on the same side of the wheel are comparable with one-another.

- Record the tension readings for all comparable spokes.
- Add the values together.
- Divide the total by the number of comparable spokes.
- Match the average recorded reading to the kgf value on the conversion table.

CALCULATING AVERAGE TENSION (continued)

EXAMPLE:
The drive side of a 24 spoke rear wheel (12 spokes). Spoke Type: Bladed Spoke with a 2.3mm width and 0.9mm edge.

SPOKE NUMBER	MEASURED READING	kgf VALUE
1	30	101
2	30	101
3	30	101
4	31	111
5	31	111
6	31	111
7	30	101
8	30	101
9	29	92
10	28	84
11	30	101
12	28	84
Average Spole Tension (Total kgf / 12)		**99.2 kgf**



CALCULATING RELATIVE TENSION

Relative tension is the difference between the tension of an individual spoke and the average tension of the comparable spokes in the wheel. Generally, the acceptable variation in spoke tension is plus or minus 20%.

- Divide the individual spoke tension by the average spoke tension value in Kg/f.
- Multiply the result by 100

SPOKE NUMBER	SPOKE kgf VALUE	AVERAGE kgf VALUE
10	84	99.92
Relative Tension (84 / 99.2) x 100		**84.06%**

The relative tension of spoke 10 is 84% ; within the 20% acceptable margin.

NB: The flange spacing of Modern 11 speed rear hubs is often very asymmetrical. The drive side of the wheel may feature shorter spokes at a steeper angle. The average tension of the drive side might be considerably higher than the non-drive side.

⚠ WARNING

- Cycling with improperly tensioned spokes can lead to wheelset failure and possible injury. If you have any doubts about your wheelset build, please consult a professional cycle mechanic.
- Do not exceed the maximum spoke tensions recommended by the spoke and rim manufacturers.
- Do not adjust the spring tension of the spoke tension meter, this has been carefully calibrated during manufacture.
- Store in a clean and dry environment.

ROUND / BUTTED SPOKES

MEASURED READING	SPOKE DIAMETER					
	Ø2.3	Ø2.0	Ø1.8	Ø1.7	Ø1.6	Ø1.5
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						
32						
33						44
34					43	47
35					46	50
36					50	53
37				43	54	56
38				47	58	61
39				51	62	67
40				55	68	74
41			40	60	75	82
42			45	65	81	91
43			49	70	90	101
44			55	76	98	112
45			62	85	109	124
46			70	94	119	137
47			79	103	136	152
48		41	89	113	151	169
49		45	99	124	167	
50		52	110	135		
51		59	119	151		
52		68	130	169		
53		77	145			
54		87	165			
55		100				
56		110				
57		124				
58		146				
59		170				
60	39					
61	46					
62	54					
63	62					
64	68					
65	78					
66	90					
67	106					
68	126					
69	145					
70	167		UNITS: kgf (Kilogram-force)			

BLADED / AERO SPOKES

MEASURED READING	SPOKE DIMENSIONS									
	2.0 x 1.25	2.0 x 0.9	2.8 x 1.3	2.3 x 0.9	3.3 x 1.0	2.3 x 1.2	3.2 X 1.0	2.0 X 0.95	1.7 X 0.9	4.6 X 1.0
21				51						
22				55						
23				58				50	49	
24				62				53	53	
25		44		66				59	58	
26	45	52		71				64	63	
27	48	62		77				70	68	
28	52	71		84				76	75	45
29	56	80		92				85	83	50
30	60	89		101	50			95	92	55
31	64	99		111	55			105	101	60
32	69	112	45	122	60	48	50	123	117	68
33	75	124	49	135	69	53	55	143	132	78
34	82	139	56	151	77	62	65	165	153	90
35	89	155	64	170	88	70	73		175	109
36	96	178	73		98	79	83			129
37	105		82		118	89	93			150
38	115		91		138	101	104			170
39	129		101		165	116	124			
40	145		115			133	145			
41	163		127			153	167			
42			139			169				
43			151							
44			170							
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69										
70							UNITS: kgf (Kilogram-force)			