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The complete stringer: From Stringer to 'Racquet Tuner'

When you focus on the player's preferences, type of play and personal characteristics, you'll step up your business.

By Fred Timmer

What is the difference between a stringer and a racquet tuner?

- A good stringer masters the technical skills of stringing. He is able to use all the necessary tricks to string all kinds of racquets.
- A racquet tuner is able to adjust the string job to the type of play and possible arm injuries of the player. He knows which string to use and at what tension every string should be used to obtain the best possible combination of string qualities and string bed stiffness for every individual player, man, woman, or child.

A serious racquet tuner uses a stiffness tester to test if his "product" meets the desired string bed stiffness.

Such a stiffness tester measures the overall stiffness of the string bed. Mechanical testers apply a certain force on the string bed and measure the deflection. Electronic stiffness testers generate the natural vibration of the string bed, and calculate the string bed stiffness from there.

Stringing on stiffness means that the stringer aims at that value that the player actually feels when he plays with the string bed. The stringing tension is only a set tension on a certain machine and the final result is influenced by the quality of the machine, the stringer and the type of string that is used.

What items does a racquet tuner need to fulfill his task in the best possible way:

- He needs a system to analyze the player so that he can advise him about string bed stiffness and type of string. The system should consider the type of play, his or her preference, possible arm injuries, and the age of the player.
- He needs a string classification system so that he is able to choose a string with the right playing characteristic for that certain player. It is nearly impossible for stringers to find the optimal string in a market with a huge number of strings of all different kinds without a classification.
- To obtain a certain stiffness in the racquet the stringer needs to know what tension he needs on his stringing machine so that he obtains the desired stiffness. He needs a system that converts the desired stiffness into stringing tension, based on the size of the racquet and the string bed density.
- Every stringer should know the correlation between his way of stringing on his machine and the resulting string bed stiffness in kg/cm.
- To be able "to string on stiffness" the stringer needs a stringing machine that offers a certain minimum accuracy of +/- 5% of the desired string bed stiffness.

The business-importance of being a racquet tuner

There is a saying "A stringer is good until the player finds a better one" which means that no stringer can allow himself to stay "only" a stringer. As soon as a more dedicated stringer is discovered by the players business can go down. Of course mouth-to-mouth publicity can also be used in one's favor, like "famous" Dutch stringer Arie showed once.

Arie learned about the formulas Stringway developed that could be used to calculate the tensions for racquets of different size and also learned that the tensions should go down considerably to obtain maximum playability.

Arie told his customers that he would string free of charge according to his personal advise, the players only were asked to pay when they were satisfied. His business grew rapidly because the players really felt that his advise offered them much more comfort and ease of play, compared to the much higher tensions that were used then (in 1995).

The graphic below shows all the aspects which a racquet tuner needs to know and items that he needs to carry out his task at maximum quality. The result of his knowledge, skill and professional equipment will be a satisfied customer who keeps coming back to him.

This series — 'from stringer to racquet tuner'

In this series we will deal with all aspects that have to do with "tuning a string job". The basis will be the player with his or her preferences, type of play, age and possible arm injuries.

This installment will cover the classification of strings for different types of players.

Future installments will cover:

- String bed stiffness and ways to check it.
- The right stiffness for different players.
- How to string as accurately as possible.
- Stringing "on stiffness" instead of on tension.

Chapter 1 — What string for whom? The string is the unknown quality

The importance of elongation

There is a huge amount of strings on the market today and it is quite difficult for stringers to find the best strings for different types of players. To make things worse, string manufacturers do not advertise the most important specification of their strings - elongation. It is like offering a car without telling how many seats are inside.

In the old days there was a saying that was frequently used to describe a new string; "this string plays like gut". Manufacturers tried to copy the gut string because that was believed to be the best playing string.

When a player hits a ball he feels the way that the string stretches and how it accelerates the ball in the opposite direction. These properties depend entirely on the elongation of the string.

It is impossible to copy the playability of gut strings, because it seems impossible to copy their elongation quality. Perhaps that is the reason that string manufacturers did not like to tell the elongation specs of their strings, it would tell the world that the new strings are not as good as gut after all.

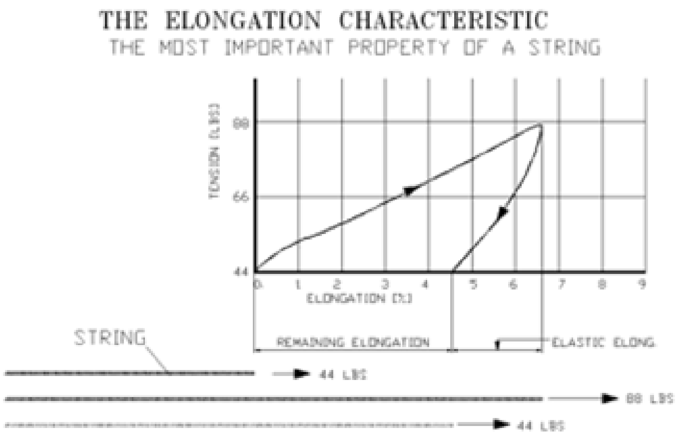
The elongation measurement of a string shows the most important quality of a string, it shows what the player will feel on ball impact and also gives some insight on the durability of a string. Also, elongation of a string affects the loss of tension during stringing and play.

Measuring elongation

The answers to many questions about strings come from testing their elongation. It is quite easy to measure the elongation character of strings. A stringer can actually perform a simple test on his stringing machine. But, with more scientific equipment, a complete graph can be created.

Figure 1 shows the elongation graph of a string. Creating a graph like this requires special equipment that cannot be found in most shops. As the string being tested is pulled through a range of tensions, the special equipment constantly measures the length of the string and converts it to a percent of elongation. The horizontal axis shows the elongation of the string in %, the vertical axis shows the tension in pounds.

Figure 1



The string is tensioned from 44 pounds to 88 pounds while the elongation is measured. After reaching 88 pounds the tension is lowered to 44 pounds again. The speed of pulling is low (1 to 2 pounds/second) so that all the elongation in the string can be developed.

The graph shows the following figures:

- The total elongation of the string from 44 to 88 pounds is 6.7%.
- About 2% of the elongation has "sprung back" after lowering the tension to 44 pounds, this is the elastic elongation, the actual elasticity of the string.
- After reaching 44 pounds the string is 4.6% longer than when the string started the test, this is the elongation that did not recover. It stays in the string after the first pull, this is the remaining elongation.

To show the qualities during play the test must be done from the lowest stringing tension upwards:

When this string is tested again the elongation will be much less because the remaining elongation that has developed during the first pull will not develop again.

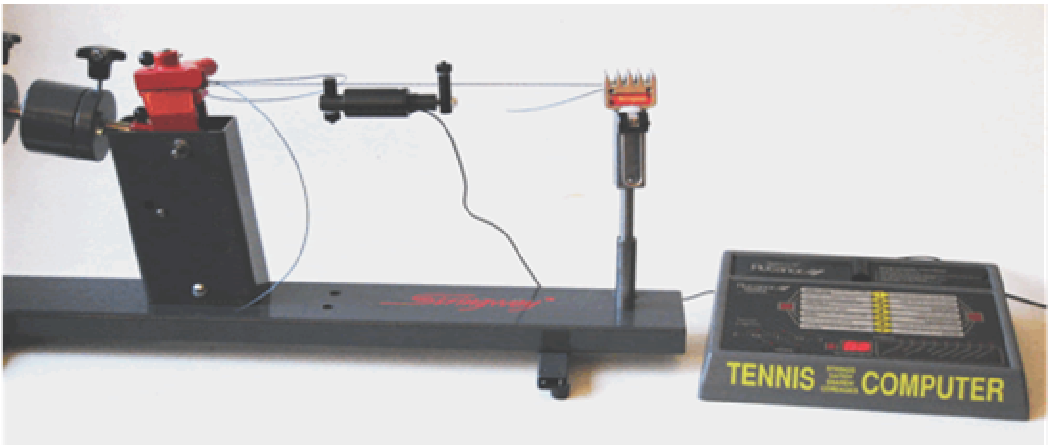
The graph shows that there is a certain amount of elongation for each tension in the string.

Simplified elongation test — 5 point test

It is not necessary to measure a complete graph to obtain the major elongation figures of a string. One can also do a 5 point-test. Tension the string to 44 pounds and make 2 marks on the string 10 cm apart (this is point 1). Then, change the tension from 44 to 66 and measure the distance between the marks (this is point 2). Then change the tension to 88 and measure the distance between the marks (this is point 3). Then change the tension back to 66 and measure the distance between the marks (this is point 4). Finally, change the tension back to 44 and measure the distance between the marks (this is point 5). Measure the length of string between the marks at each tension and calculate the different elongations with these results. It is important to measure the elongation at 66 and 88 because it can show the difference in character of a string in the lower and higher tension range. Many monofilament strings show a completely different character at higher tensions compared to the lower tensions.

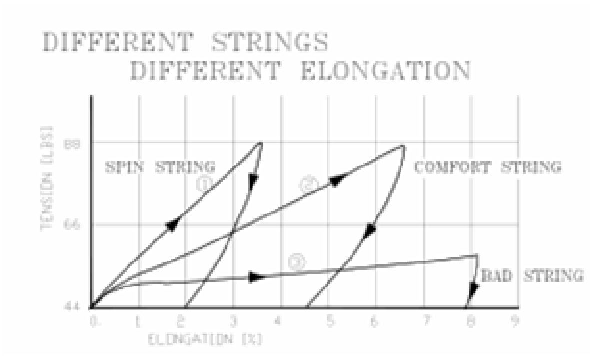
Figure 2 shows a simplified but very accurate test setup. The tension is generated by a Constant Pull drop weight system, which is very suitable because it is easy to raise and lower the tension accurately. In Figure 2, the elongation is measured with a linear potentiometer mounted inside the test tool, which is simply clamped to the tested string between the clamp and the tension head.

Figure 2



The display of the Tennis Computer shows the elongation figures, which are measured by the linear potentiometer. But, similar results can be achieved by making marks on the string and measuring the distance between them at each of the 5 tensions. To calculate the percent of elongation at each point, subtract the length of string at point 1 from the length of string at the current point and divide that number by the length at point 1. Take care that the test is done with an un-pulled piece of string because the results will be very different the second time the piece of string is tested.

To conduct this 5-point test, it is best to use a drop weight machine, but a good constant pull electronic machine can also be effective. It is not critical to use 66 and 88 pounds. But, it is important that two strings being compared are pulled to the same tensions.



Many different strings

Figure 3 shows different strings, which are in the market, a stiffer string suitable for spin play, a more comfortable string and a useless string with huge elongation but almost no elastic elongation at all.

Figure 3

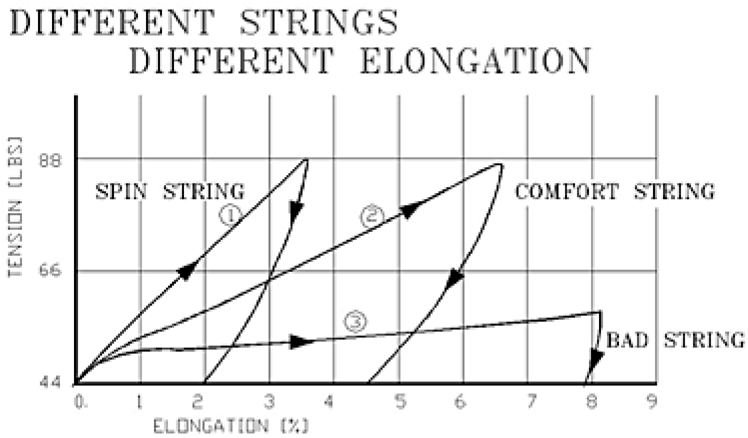


Figure 4 shows the elongations of some monofilament strings and figure 5 shows the elongations of a number of nylon multifilament strings.

The player also feels the stiffness of the string.

In addition to the elongation figures, the tables in Figure 4 and Figure 5 also show the stiffness of the strings in the blue column. The stiffness is shown in pounds/inch for a length of string of 320 mm.

The stiffness is calculated by dividing the total elongation from 44 to 66 pounds by the difference in tension (22 pounds).

Figure 4

Elongation>>	ELASTIC EL.		REMAINING EL.		TOTAL EL.		STIFFNESS
	[%]	[%]	[%]	[%]	[%]	El.inde:	lbs/in
Tension>>	44>66	44>88	44>66	44>88	44>88	el/tot	44>66
STRING							l=320 mm
Prof Supreme Power	0.8	1.2	3.6	6.7	7.9	0.15	40
Wilson Enduro Tour	0.7	1.1	3.6	6.1	7.2	0.15	41
Prof supreme power	0.6	1.1	2.9	5.7	6.8	0.16	50
Toro	0.6	0.9	2.0	5.8	6.7	0.13	67
Pros Pro Cygber power	0.8	1.2	1.5	4.3	5.5	0.22	76
MSV Focus Hex	0.7	1.1	0.6	3.2	4.3	0.26	134
Oehms black pearl	0.7	1.1	0.5	2.5	3.6	0.31	146
Babolat Pro Hurricane	0.6	0.9	0.6	2.6	3.5	0.26	146
Prof Dual Metal	0.6	1.0	0.2	1.8	2.8	0.36	218
Orkit Fluo qua	0.5	0.8	0.1	0.8	1.6	0.50	291

Figure 5

Elongation>>	ELASTIC EL.		REMAINING EL.		TOTAL EL.		STIFFNESS
	[%]	[%]	[%]	[%]	[%]	:l.index	lbs/in
Tension>>	44>66	44>88	44>66	44>88	44>88	el/tot	44>66
STRING							l=320 mm
Technifibre Duramix	1	1.6	1.5	2.9	4.5	0.36	70
Mailot Salvarez HT Ten:	1.1	1.8	0.7	2.1	3.9	0.46	97
MSV Multi g 10	1.1	1.8	0.8	1.9	3.7	0.49	92
Wilson Sensation	1	1.6	0.7	1.6	3.2	0.50	103
Technifibre Multifeel	1.0	1.7	0.6	1.4	3.1	0.55	109
Luxilon Luxifit	0.9	1.6	0.5	1.2	2.8	0.57	125
Prince Tournement	0.9	1.5	0.5	1.2	2.7	0.56	125
Kirschbaum Touch Titar	0.9	1.6	0.2	0.9	2.5	0.64	159
Head Fibergel	0.9	1.5	0.3	0.9	2.4	0.63	146
Gosen Micro	0.8	1.4	0.1	0.8	2.2	0.64	194

The figures show that:

- The difference in total elongation of the monofilament strings is huge, from 1.6 to 7.9 % (green column).
- The elasticity (yellow column) of all multifilaments is considerably higher than of any monofilament.
- There is a big difference in stiffness in both types of strings (blue column).
- The remaining elongation of many monofilaments over 66 pounds is huge. (difference between both white columns).

'Fast' strings and 'slow' strings

There is one more important item concerning the elongation of strings; there are fast strings and slow strings. With "fast" string it takes little time to develop all the elongation for a certain tension, with "slow" strings it takes much longer.

The elongation develops slower when there is a more friction inside the string, either between the filaments of the multifilament string or internally in the material of the monofilament string. A fast string (with a certain amount of elastic elongation) will give more power than a slower string with the same amount of elastic elongation. The speed of a string can be noticed on a stringing machine because a slow string needs more time before it will stop stretching at a given tension.

The meanings of the elongation figures

The meaning of the different types of elongation are:

- More elastic elongation:
  - More power, this is the actual elasticity of a string that generates the speed of the ball.
  - Better recovery after a spin stroke.
  - Better maintenance of the tension in the racquet.
- More remaining elongation:
  - More loss of tension during play.
- More total elongation:
  - Longer ball contact resulting in more comfort.
  - Worse durability, because the string will move up and down more with a spin stroke.

It is important to know that the behavior of any string strongly depends on the String bed stiffness in the racquet and the actual tension in the string in the racquet. The level of tension and stiffness can make or break the qualities of any string. The influence of String bed stiffness (tension) and string elongation will be described in a later chapter.

The "elongation" of a string during ball impact is easier to understand when the deflection of the string bed is divided in an inward and an outward movement:

During the inward movement of the ball into the string bed, the ball is actually caught by the strings.

- The amount of deflection depends fully on the string bed stiffness. The lower the string bed stiffness, the more deflection of the string bed. The amount of elongation of the string will grow progressively with the deflection of the string bed.
- Remaining and elastic elongation will be developed in the string during this movement and the tension in the string will rise. When the tension rises above the tension that it has ever reached before some remaining elongation will occur. Because the time of the impact is very short not all the remaining elongation belonging to this maximum tension will be developed. So the string needs a number of hits to develop all the elongation at a certain tension. Once the maximum tension during a hit does not rise anymore the loss of tension will decrease. This is why strings lose most of the tension during the first hour of play.
- The deflection will be smaller with a string with less total elongation, because the stiffness is higher. This results in a shorter dwell time (duration of contact) and a bigger "impact-force".

During the outward movement the ball will be "catapulted" away by the string bed.

- The amount of acceleration depends mainly on the elastic elongation of the string. The friction inside the string will have some influence on the power that a string offers. If there is more friction in the string there will be less power, the string will "spring back" slower.

The influence of elongation during stringing.

When stringers aim at a certain string bed stiffness ("stringing on stiffness"), it is important to know the influence of the properties of the string on the string bed stiffness after stringing. To string accurately means losing as little tension as possible.

Fast strings and slow strings

For every string, there is a fixed relation between the amount of elongation and the tension in the string. Depending on the friction inside the string construction or material certain strings can stretch very quickly and others need more time before all the elongation has developed in the string. When a stringer clamps a string before all the elongation has developed the string is still stretching behind the clamp and the string will lose tension. That is why there is a saying in the stringing world: "Fast stringers are soft stringers". The speed of stringing should depend upon the type of string, and if you want to string fast you have to use fast strings.

The elastic elongation maintains the tension

When you tension a rope between 2 walls it is nearly impossible to keep it tight, when the rope does not stretch. However, it is very easy to get a piece of elastic band tight. The elastic elongation of a string maintains the tension in the racquet. The final stiffness in the racquet will be lower with strings with less elastic elongation. The string bed stiffness with synthetic gut will be considerably higher than with any monofilament.

Second pull less travel

When a string is tensioned for the second time the elongation is much less, because the remaining elongation has been developed in the first pull already. When stringing a stretchy string the travel of the tension system may be too small to reach the tension in one pull. Pull tension again without moving the clamp and the travel will often be ok then.

A lot of travel means a lot of elongation

When a string is tensioned the travel of the tensioner depends on the stiffness or total elongation of the string. When a string needs more travel it means that it is a string with a lower stiffness, so the stringer should know then if this string is suitable for a certain player or not. (As described above).

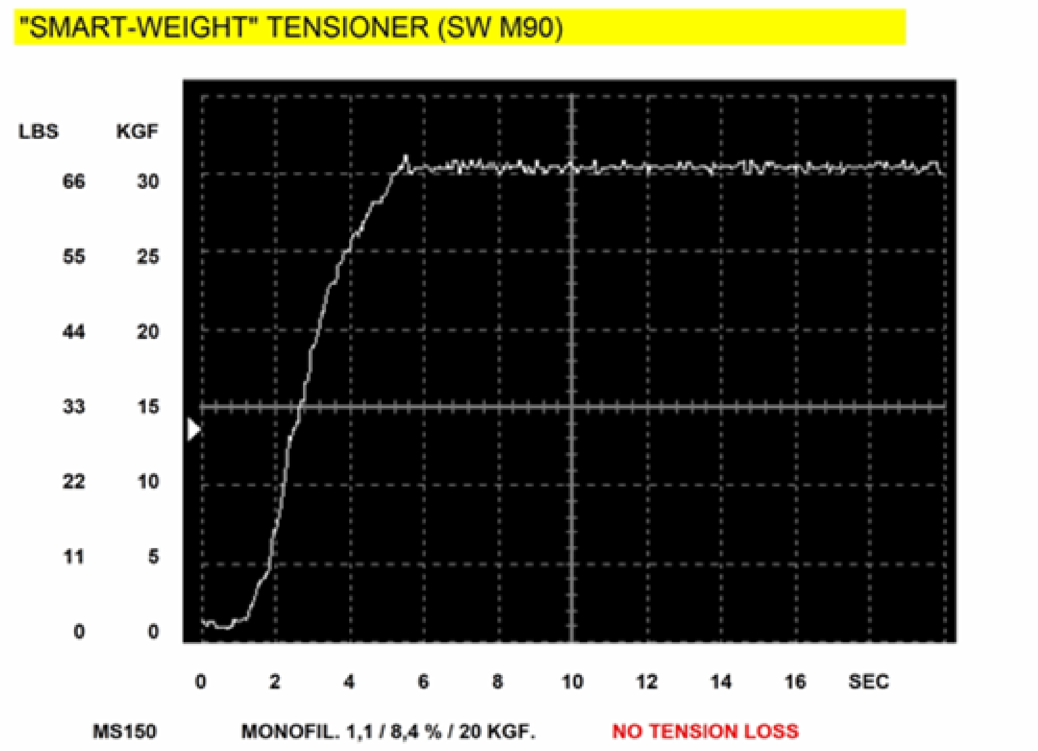
Machine prestretching creates a stiffer string with different playability

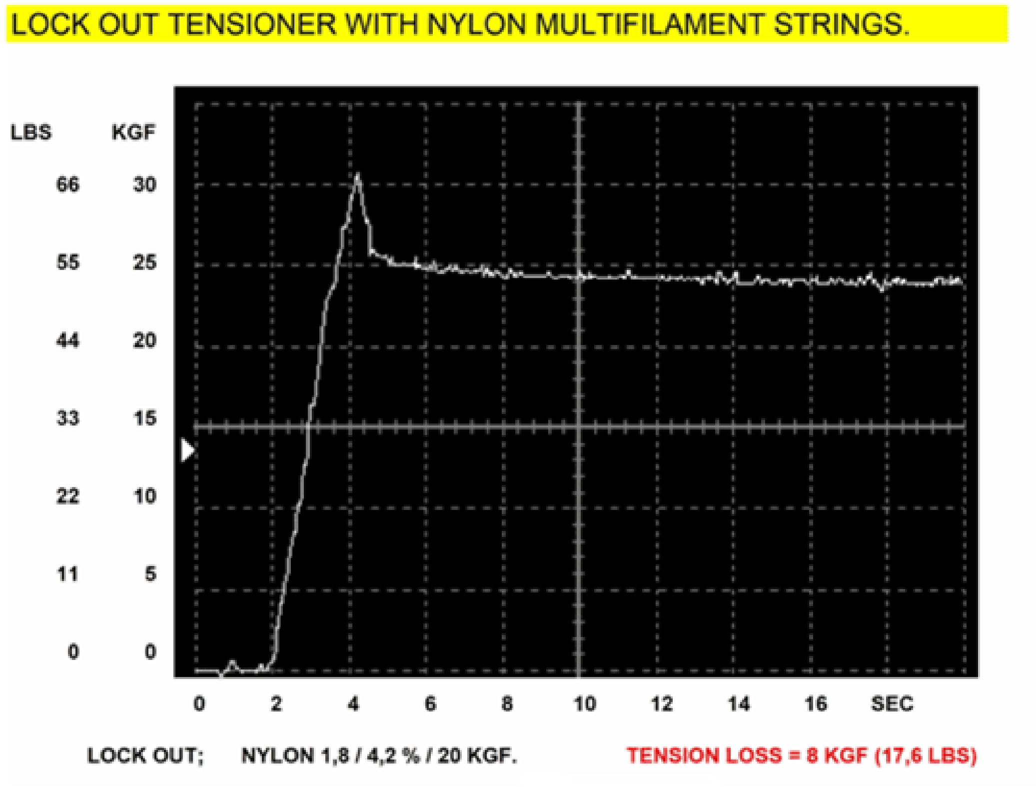
When a string is prestretched, the machine pulls higher then the reference tension before going back to the reference tension. This means that the remaining elongation has been pulled out of the string at a higher tension. The result is that the string is stiffer, offering less power, but the string also loses less tension.

A lockout machine always pre-stretches the string, which means different playability

When a stringer aims at a certain SBS he needs more tension on a lockout tension unit then on a constant pull unit. The graphs in Figure 6 show the tension on a lockout machine and on a constant pull drop weight machine. On the lockout machine the string has been tensioned to about 67 pounds and the final tension is about 53 pounds. The string is actually pre-stretched to 67 pounds before finally stabilizing at 53 pounds. This means that a certain amount of the remaining elongation at 67 pounds has been developed and the string has become a stiffer string. The tension on the constant pull machine is never higher than the final tension in the string. In other words, if the final tension in the string should be 53 pounds, the tension will never exceed that tension on the constant pull machine, so the string offers more playability (comfort) then the string bed created on the lockout machine.

Figure 6





Drawback of the clamps causes more loss with stiffer strings

When the string is released by a tension unit, the clamp will move backwards under the load of the string, this is called drawback. Part of the drawback will recover at the next pull. The remaining drawback after the next pull causes loss of tension in the string. When you multiply the drawback and the stiffness of the string the result is the loss of tension. So the stiffer the string the more loss of tension is caused by the drawback of the clamp.

Other major specifications of strings

When strings should be selected for different types of players there are other properties, which play a part:

The breaking strength

When a string breaks at a higher tension the string can wear down further before it breaks, so a higher breaking strength raises the durability. Monofilament strings have a higher breaking strength than multifilament strings and Kevlar is very strong also. The difficulty with manufacturing multifilament strings is to divide the total force equally among the core and the smaller filaments around the core.

The wear-off resistance

The wear off resistance is a major factor in the durability of strings. When strings are used for spin play the main strings slide up and down all the time, resulting in a wear hole in the main strings at every crossing with a cross string. Monofilament or solid strings have the highest resistance against wear and soft-core strings wear very quickly especially after the shell has been cut through.

The diameter of strings

Most tennis strings are available in many gauges from 1.1 to 1.45 mm. It is important to understand that there is not much connection between the playability of strings and the diameter. The material and the construction of strings have a much larger influence on the playability then the diameter. Of course, thinner strings of a certain type usually stretch more than the thicker strings of that type.

The table in Figure 7 shows monofilament strings of two gauges, 1.25 and 1.3 mm. Only the material of these strings is different and the design is the same, all being monofilaments. Despite the fact that the diameter is the same, the stiffest string is nearly 4 times stiffer than the most stretchy string. The conclusion can be that the diameter of strings is a bad standard for playability.

When strings are classified for different players, the diameter can be used to select strings for certain racquets. Thinner strings can be used for high-density string patterns and stronger and thicker strings should be used for low-density patterns.

Figure 7

	Elongation>>	ELASTIC EL.		REMAINING EL.		TOTAL EL.		STIFFNESS
Gauge		[%]	[%]	[%]	[%]	[%]	El.inde:	lbs/in
mm	Tension>>	44>66	44>88	44>66	44>88	44>88	el/tot	44>66
1.25	Speedstring Blacl Rev	0.7	1.2	3.4	6.4	7.6	0.16	43
1.25	Discho Iontec	0.6	0.9	1.6	3.6	4.5	0.20	79
1.25	MSV Hepta Twist	0.8	1.3	1.3	4.2	5.5	0.24	83
1.25	MSV Focus Evo	0.7	1.1	1.3	3.0	4.1	0.27	87
1.25	Babolat Pro Hurr -2	0.7	1.0	0.8	5.1	6.1	0.16	116
1.25	Babolat Pro Hurricane	0.7	1.0	0.7	5.0	6.0	0.17	125
1.25	Signum Hextreem	0.7	1.1	0.4	2.2	3.3	0.33	159
1.3	Prof Supreme Power	0.8	1.2	3.6	6.7	7.9	0.15	40
1.3	Wilson Enduro Tour	0.7	1.1	3.6	6.1	7.2	0.15	41
1.3	Toro	0.6	0.9	2.0	5.8	6.7	0.13	67
1.3	MSV Hepta Twist	0.7	1.1	1.6	3.7	4.8	0.23	76
1.3	MSV Evo Hex	0.5	0.9	1.0	2.5	3.4	0.26	116
1.3	Bab Pro Hur tour	0.6	1.0	0.8	1.7	2.7	0.37	125
1.3	Babolat Pro Hurricane	0.6	0.9	0.6	2.6	3.5	0.26	146

Classification of players

In order for a stringer to be able to tune the string bed to the type of player with the choice of the string and the stiffness of the string bed, he needs criterion to classify players and to classify the strings. This classification can be done based on the preferences of the player, how he or she hits the ball and if he or she has any arm injuries.

We can make the following division:

- LADY/ MAN
- COMFORT PLAY / POWERFUL PLAY
- WITH SPIN / WITHOUT SPIN
- ARM INJURY / NO INJURY
- UNDER 16 YEARS OLD / OVER 16 YEARS OLD

Classification of strings

When strings have to be classified for the different players, the following specifications can be used:

- The string elongation, influence as described above.

- The string stiffness, stiffer strings for durability and less power, more stretchy strings for more power and comfort.
- The breaking strength in the interest of high durability.
- The wear off resistance for high durability also.
- The diameter to adjust to the density of the string bed.
- The maximum stringing tension based on the remaining elongation.

Strings which lose a lot of tension at higher tensions can be the best for low tensions. These strings have much more remaining elongation from 66 to 88 pounds then below 66 pounds.

Based on these specs the strings can be classified in 4 classes:

C1 string for comfort players or players with arm injuries

A string for comfort play should stretch more for longer ball contact and have a good elasticity to supply the power. Durability is not important.

String: Total elongation more than 4% (44-88 pounds), good elasticity, durability unimportant.

Maximum stringing Tension: 60 pounds.

String bed stiffness: 28 - 34 kg/cm (dt value).

Tension: can be calculated from the stiffness when the size of the racquet and the number of strings is known.

C2 string for all-around players

This should be an all-around string with very good playability but stiffer than the S1 type. Durability is better then the C1 string.

String: Total elongation 3.3% to 4%, good elasticity, reasonable durability.

Maximum Tension: 65 pounds

String bed stiffness: 33 - 36 kg/cm (dt value)

Tension: can be calculated from the stiffness when the size of the racquet and the number of strings is known.

C3 string for spin players who prefer playability

This string combines good playability with good durability. It is stiffer than the C2 string and has a better wear off resistance.

String: Total elongation 2.8% to 3.2%, good durability.

Maximum Tension: 75 pounds

Stiffness: 36 - 38 kg/cm.

Tension: can be calculated from the stiffness when the size of the racquet and the number of strings is known.

C4 string for spin players who prefer durability

This string is for spin players who prefer maximum durability. It combines low elongation with maximum strength and a high wear off resistance.

String: Total elongation 2.0% – 2.8%, high durability. Poly strings or Kevlar/ nylon combination.

Maximum Tension: 75 pounds

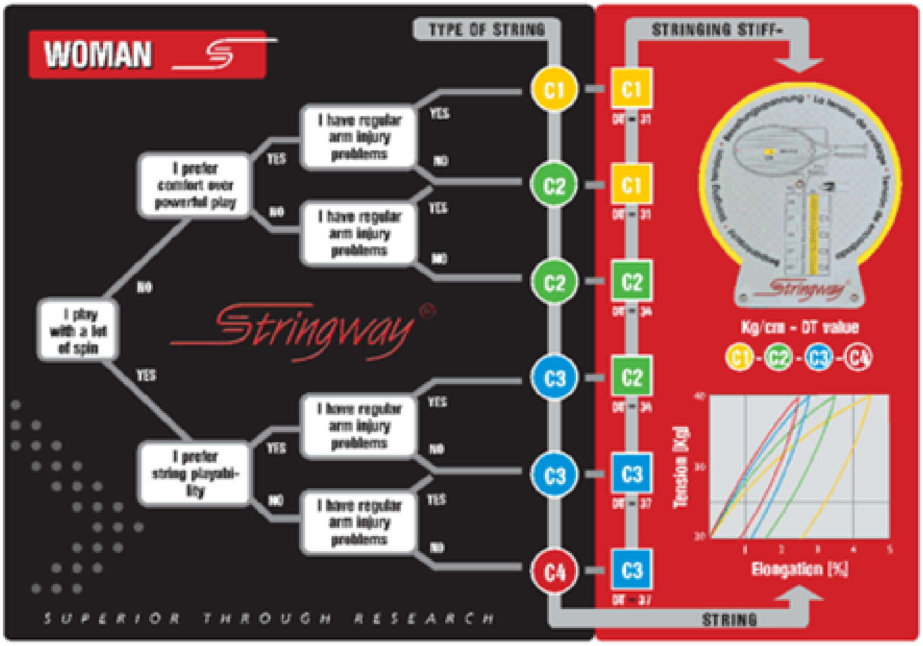
Stiffness: 38 – 40 kg/cm

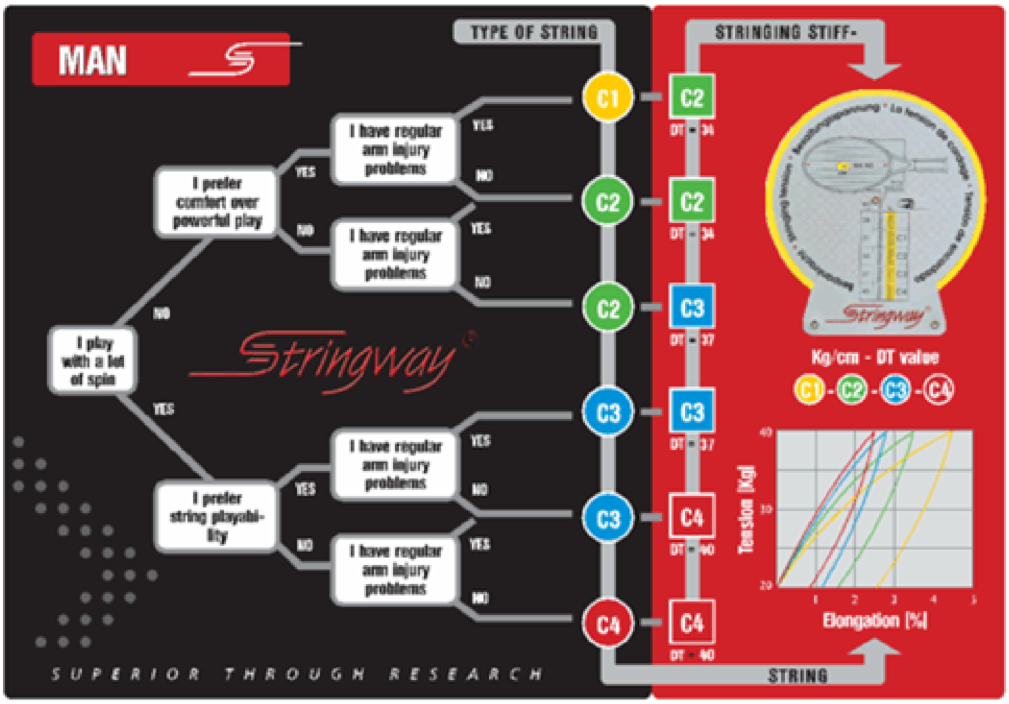
Tension: can be calculated from the stiffness when the size of the racquet and the number of strings is known.

Analyzing the players

The Stringway route map (as seen in Figure 8) is a system that helps to analyze players in order to choose the right string and string bed stiffness. The right string and stringing stiffness is selected based on the answers to the questions. The age of the player is not in this system but should play a role also. Young kids should play with a more comfortable string bed, comfort string at lower string bed stiffness, to prevent injuries and so that they learn to use the power out of the string bed. Lower the calculated stiffness by one stiffness class (3 kg/cm) for children under 16. Keep in mind that today’s pros play at relative low stiffnesses (Federer at 34 kg/cm) so that they can use the power of the string bed to lift the speed of their game.

Figure 8





The right side of the route map shows the string bed stiffness and the stringing tension for each category of player. The relation between the string bed stiffness and the stringing tension will be explained in a later chapter of this series.

In the next chapter of this series we will deal with string bed stiffness.

About the author

In 1982, Fred Timmer and his father started the Stringway business, based on the cross stringing tool that Timmer designed. A development engineer with the Dutch Nuclear Centre, Timmer has designed all Stringway products. He also has conducted research on the mechanics and properties of racquet strings, which has led to the development of the Tension Advisor (translator from string bed stiffness to stringing tensions), the Rucanor Tennis computer and the Stringlab. Since 2010, Timmer has worked on a string classification system with the USRSA and the Dutch racquet forum. You can reach him at stringway.fred@gmail.com.

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