Taking the guesswork out of selecting shafts (Part 1)

by Tom Wishon

In nearly 40 years of golf equipment design and research work, I think it is fair to say that the shaft is the least understood component of the golf club. Since I have engaged in serious shaft research since 1990, and from that have learned a lot about shaft design, performance and fitting, I would like to help clear some things up and share some facts about shafts and what you need to know to pick the best shaft for YOUR swing.

I will do my best to make all of this understandable without stressing everyone's attention span. But there is a lot to explain about this subject so I will separate this into three parts with some time in between each thread to allow you to digest it and ask questions.

How Can Golfers TRULY Compare Shafts to Know their Real Performance Differences?

Below is a typical "specification chart" from a major shaft company. I have removed the names because it is not my intent to criticize a specific shaft maker. It is simply my desire to show you how the typical information provided about shafts will not allow golfers to know what they really need to know about shafts to be able to make an informed buying decision.

Model	Flex	Trim Code	Butt Dia.	Tip Dia.	Weight	Length	Torque	Parallel Tip Section	Bend Point
50	R	F	0.605	0.335	49g	46"	5.4	3.0"	Mid
50	S	F	0.610	0.335	52g	46"	4.8	3.0"	Mid
50	X	F	0.615	0.335	54g	46"	4.2	3.0"	Mid
50	TX	F	0.615	0.335	54g	46"	3.8	3.0"	Mid
70	S	F	0.605	0.335	72g	46"	3.2	3.0"	Mid
70	X	F	0.610	0.335	75g	46"	2.9	3.0"	Mid
70	TX	F	0.610	0.335	75g	46"	2.5	3.0"	Mid

Plain and simple, the information in this chart cannot tell a golfer how any of these shafts truly perform, much less how they actually compare in stiffness to any other the shaft. The Flex? There are no standards for exactly how stiff any of the flex letter codes are. Charts like this provide no quantitative measurements of exactly how stiff any shaft might be.

In fact the ONLY bits of information on a typical chart like this which can be helpful are the WEIGHT and the TORQUE. The Butt and Tip Diameter? These are fine for knowing what the hosel bore of the

clubhead needs to be to easily accept the shaft and to know how to install the grip to obtain a desired size. The Parallel Tip section? That simply tells you if you cut more than 2” off the tip, it’s not likely to fit all the way into any normal hosel with a 0.335” bore. The Bend Point? Sorry, but the term bend point is not relevant because with terms like “high”, “mid”, or “low”, it has always been way too generic. WHERE EXACTLY IS a mid bend point? And how does this mid bend point compare to some other company’s mid or low or high bend point?

Recently I have seen a couple of other shaft companies begin to offer a form of QUANTITATIVE stiffness measurements for their shafts. Here’s an example:

					Stiffness Profile					
Flex	Weight	Torque	Launch	Butt OD	Butt	Mid	Tip	Parallel	Tip OD	Length
6A	64 g	5.0	Medium	0.615 "	242	6.2	24	4.0"	0.335 "	46 "
6R	66 g	3.0	Medium	0.615 "	257	6.9	25	4.0"	0.335 "	46 "
6R	65 g	4.0	Medium	0.615 "	257	6.9	25	4.0"	0.335 "	46 "
6R	65 g	5.0	Medium	0.615 "	256	6.9	25	4.0"	0.335 "	46 "
6S	67 g	3.0	Medium	0.615 "	270	7.4	27	4.0"	0.335 "	46 "
6S	66 g	4.0	Medium	0.615 "	270	7.4	27	4.0"	0.335 "	46 "
6S	66 g	5.0	Medium	0.615 "	269	7.4	27	4.0"	0.335 "	46 "

This shaft company offers a series of “Stiffness Profile” measurements for the Butt, Mid and Tip sections of their shafts. That’s a start but the problem is, this company only offers these Stiffness Profile measurements for their own shafts. This is somewhat reasonable for comparing the various shaft models and flexes within this one company, but what if you have some other company’s shaft in your driver, or you wish to compare these shafts to some other company’s shafts? And if you have never hit one of these shafts, how stiff or flexible are any of these measurements in the first place? These rudimentary Stiffness Profile measurements do not allow the depth and scope of stiffness information to allow you to make a valid shaft fitting decision.

You might look at the Butt Stiffness number and say, “That’s a frequency measurement and I know how stiff a 270cpm shaft plays.” Yes, that Butt Stiffness number is a frequency measurement. But the problem is you have no idea how these butt frequency measurements were obtained. What length of the butt was clamped? How heavy was the tip weight? Is this 270cpm frequency the same as a 270cpm shaft that you played? Again, there are no standards in the golf industry for shaft frequency measurement so you have no idea if a measurement of say, 270cpm from this company is equivalent to a measurement of 255cpm or 265cpm or whatever cpm using one of the many other types of shaft frequency measurement.

What makes all this even more “exciting” or I should say, challenging, is the fact the industry is now populated with many shafts which are VERY expensive. Do you really want to GUESS whether that $300 shaft is right for you, or would you like to have a more definitive way to help make that decision?

Is there a Better Way to Compare Shaft Stiffness?

Ever since I began to perform quantitative measurements on shafts, I knew we needed a way to be able to see and compare the stiffness of as many shafts as possible, and do it over their entire length. That way clubmakers and golfers could have a tangible way to compare the complete full length stiffness design of shafts to each other. The performance and the bending feel of any shaft are products of its stiffness design over its entire length. Not just the butt, not just the tip, but the whole length of the shaft. There are almost an infinite number of ways the stiffness of a shaft can be created over its entire length.

In 2005, we arrived on a reasonably simple method to perform full length comparative stiffness measurements for golf shafts. From this we created a software program that would house and display the data from our shaft stiffness comparison methodology. We made the first version of the software available to clubmakers in 2006. Two times each year we ask the shaft companies to send us multiples of each of their new shaft models and flexes so we can keep adding shafts to the software data base.

At present we have well over 2,000 different wood, hybrid and iron shafts in the TWGT Shaft Bend Profile software. We charge a one-time fee of $129.50 for the software because the expense to have it programmed and maintained is not insignificant. It also takes us quite a number of hours to acquire, test and input the new shaft data into the software two times each year. You can find more information about this on my site, which is linked in my bio.

As much as we would like, there is no possible way we can include EVERY shaft in the industry in the software's data base. We have to rely on the shaft companies to send us the multiple samples of each of their shafts to measure because we simply cannot afford to actually buy all of the shafts. We also cannot obtain the OEM stock shafts because the OEM companies will simply not allow anyone to have their raw shafts for any measurement work like this. We do have some OEM stock shafts in the data base which come from "pulls" from OEM clubs that we can measure. But we do try to put as many shafts as we can into the data base so that clubmakers and golfers can better compare the relative stiffness of shafts.

To date more than 600 different clubmakers now use the TWGT Shaft Bend Profile software in their shaft fitting. This use by the clubmakers has also provided "in the field" verification that the measurements of the shafts do indeed provide a valid representation of the performance and even the bending feel of the shafts in the data base. The shaft fitting comparisons made with the data in the TWGT Shaft Bend Profile software is most definitely valid for predicting the performance and feel of a shaft.

How Does the Bend Profile Data Explain the Performance and Differences Between Shafts?

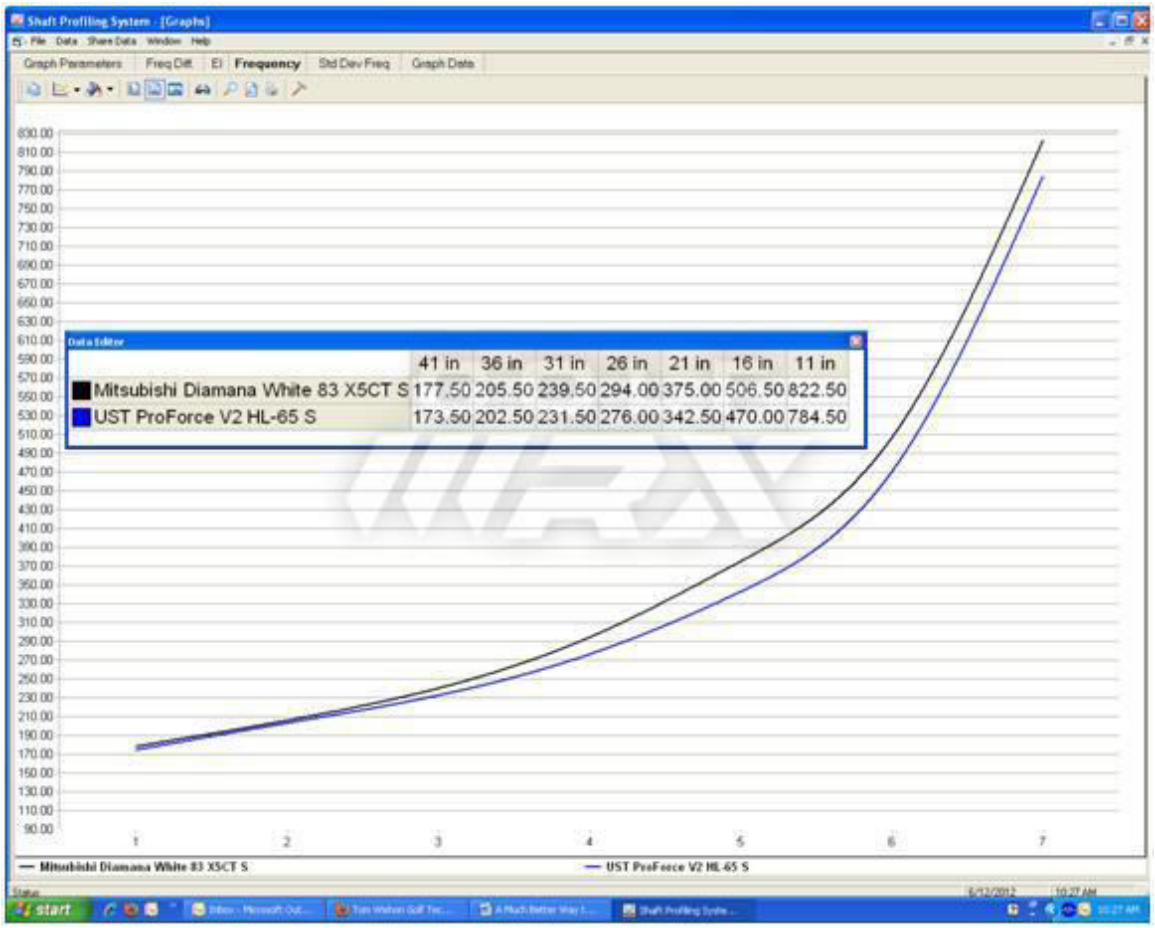
Some of you have seen graphs from the TWGT Bend Profile software that I have posted to answer a question here and there about shafts. For those of you who have not seen this, following is a basic screen image from the software showing a comparison of the relative stiffness design of two shafts – I just randomly chose to use the Diamana White 83 X5CT S flex and the UST ProForce V2 HL65 S flex to

start the explanation.

You see 7 columns in the data box. These show WHERE on the shafts we do the stiffness measurements. Starting at 11” up from the tip, the measurements then are made at 5” spaced positions up from the tip end of each shaft, ending at 41” up from the tip. Because iron and hybrid shafts are shorter in raw length, their measurements run from 11” up to 36” up from the tip end of the shafts.

Measurements are done with a 454 gram weight attached to the tip of the shaft using a specially designed frequency analyzer that measures the shaft oscillations using two separate load cells and two separate strain gauges. Each shaft is tested at the same exact place on the shaft, using the same exact test methodology. This ensures the data is comparable from shaft to shaft to shaft in the data base of the software.

Let’s take a look at an example graph and data chart:



The 41”, 36” and 31” measurements represent the butt section, the 31”, 26” and 21” the center section and the 21”, 16” and 11” measurements represent the tip section of the shaft (yes there is an overlap). When companies design different flexes of a shaft, each different letter flex version is ordained chiefly by the stiffness measurements of the 41 to 21 inch positions (butt to center to upper tip) of the shaft. Tip

section differences on shafts do not play a significant of a role in the overall flex design (swing speed rating) of a shaft as do the butt to center to upper tip sections. The tip section design of a shaft is chiefly designed to create differences in the launch angle, trajectory and spin rate among shafts within the same flex.

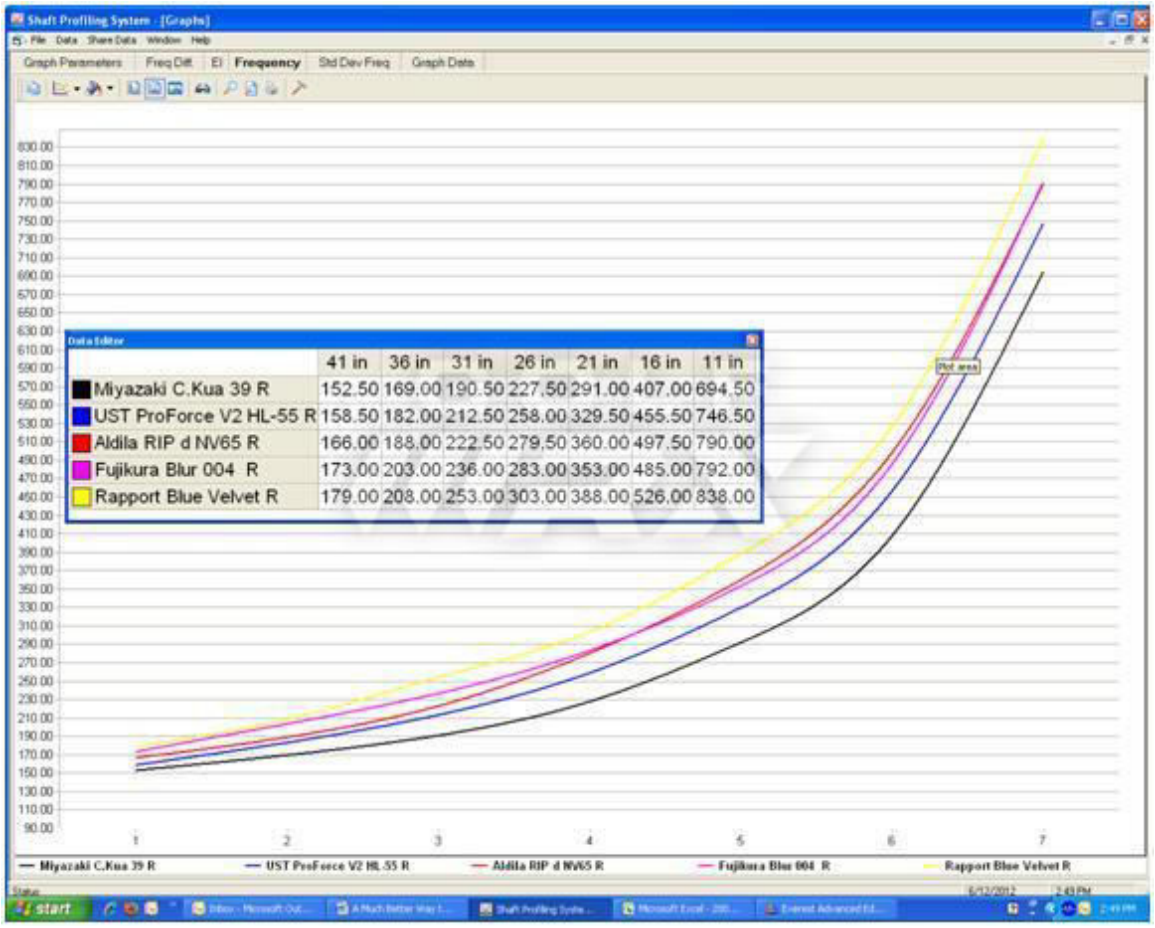
After significant research and study of the shaft data, we can make conclusions about how much of a difference in the stiffness measurements is significant or not. With so many shafts in the data base, we can also identify a basic relationship between a golfer's clubhead speed, the average bending force generated by that clubhead speed, and the overall stiffness design of a shaft. This is very important for being able to tell a golfer which shaft may be better suited to his clubhead speed. Therefore we can use the stiffness measurements of the 41" to 21" positions on the shaft to determine the swing speed rating of any shaft.

We can also determine how much of a measurement difference is significant or not with respect to stiffness in the butt, center and tip sections of the shafts.

- For example, at the start of the butt section as represented by the 41" measurement, a measurement difference of 8 to 10 cpm is approximately equivalent to one full letter flex difference.
- At the middle of the center section as represented by the 26" measurements, a difference of 12 to 15 cpm is equivalent to one full letter flex difference.
- In the middle of the tip section, represented by the 16" measurement, a difference of 30-40 cpm usually accounts for a visible difference in the launch angle, trajectory and spin rate of the shot.

There are no standards for how stiff any of the letter flex designations of shafts may be. How stiff IS an R flex, an S flex (or any of the other letter flexes)? How much variation is there among shafts of the same letter flex?

Below is data to show the low to high range in stiffness for all shafts for drivers and fwy woods in our data base that are marked as being a letter R flex shafts. These are listed from softest to stiffest, but all of these are made and marked by their respective companies to be an R flex shaft. Based on the measurements of the 41/36 for the butt section, you are looking at a range of FOUR FULL FLEXES. That means the R flex shafts in the golf industry actually exist within a range of 4 full flexes. The same is true for S flex shafts as well. Because there are far fewer L, A and X flex shafts the range in stiffness within these letter flex codes is not quite as wide as it is within the R and S flex shafts created by the golf industry. Here is the Bend Profile graph and data chart to illustrate the range in R flex shafts for woods that exist today.



Based on all of our research to associate a driver clubhead speed with the measurements for the 41, 36, 31, 26 positions of the butt and center of the shaft, here are the appropriate driver clubhead speed ratings for each of these above 5 different R flex shafts:

Miyazaki C.Kua 39 R – for a golfer with a driver clubhead speed of 55 to 65mph

UST ProForce V2 HL-55 R – for a golfer with a driver clubhead speed of 65 to 75mph

Aldila RIP'd NV65 R – for a golfer with a driver clubhead speed of 75 to 85mph

Fujikura Blue 004 R – for a golfer with a driver clubhead speed of 85 to 95mph

Rappor Blue Velvet R – for a golfer with a driver clubhead speed of 95 to 105mph

Therefore, you are looking at shafts in the golf industry which match up to a range in swing speed of 50 mph – yet ALL are marked and sold as R flex shafts.

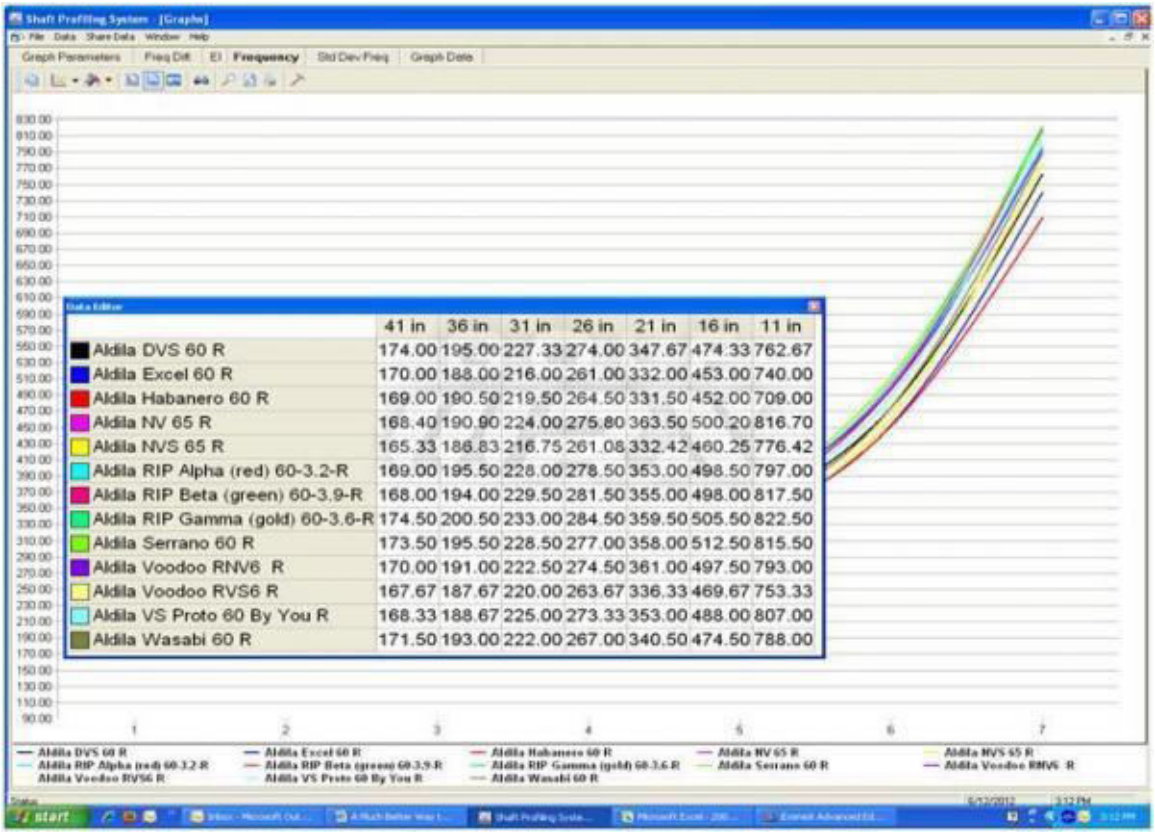
You may be prompted to comment, "this has to be the exception rather than the rule." If we take a look at the data base to search where the majority of R flex marked shafts lie with respect to their 41/36/31 inch butt section measurements, we find that the majority of R flex shafts exist within a range that represents a 20 to 30 mph difference in the clubhead speed rating for the shafts.

This is precisely why golfers sometimes buy a new club and its shaft doesn't feel as stiff or feels stiffer

than their previous shaft with the same letter flex.

Do all shafts of the same letter flex have the same butt to center section stiffness (same swing speed rating) within the same shaft company or the same golf club company?

Let's take a look at the R flex version of a number of different shaft models from one shaft manufacturing company. All are selected on the basis of being very close to the same shaft weight so they potentially could be considered for purchase by the same golfer.



	41 in	36 in	31 in	26 in	21 in	16 in	11 in
Aldila DVS 60 R	174.00	195.00	227.33	274.00	347.67	474.33	762.67
Aldila Excel 60 R	170.00	188.00	216.00	261.00	332.00	453.00	740.00
Aldila Habanero 60 R	169.00	190.50	219.50	264.50	331.50	452.00	709.00
Aldila NV 65 R	168.40	190.90	224.00	275.80	363.50	500.20	816.70
Aldila NVS 65 R	165.33	186.83	216.75	261.08	332.42	460.25	776.42
Aldila RIP Alpha (red) 60-3.2-R	169.00	195.50	228.00	278.50	353.00	498.50	797.00
Aldila RIP Beta (green) 60-3.9-R	168.00	194.00	229.50	281.50	355.00	498.00	817.50
Aldila RIP Gamma (gold) 60-3.6-R	174.50	200.50	233.00	284.50	359.50	505.50	822.50
Aldila Serrano 60 R	173.50	195.50	228.50	277.00	358.00	512.50	815.50
Aldila Voodoo RNV6 R	170.00	191.00	222.50	274.50	361.00	497.50	793.00
Aldila Voodoo RVS6 R	167.67	187.67	220.00	263.67	336.33	469.67	753.33
Aldila VS Proto 60 By You R	168.33	188.67	225.00	273.33	353.00	488.00	807.00
Aldila Wasabi 60 R	171.50	193.00	222.00	267.00	340.50	474.50	788.00

Let's be sure to first make something clear – We are NOT saying it is wrong for a company to make the same letter flex version of each different shaft model to be of a different stiffness design. That is their right as a company to determine the exact design of each flex for each shaft they make.

What we are saying is that it is very difficult for consumer golfers to know how to choose what shaft might best match their swing when the companies provide no empirical information like this to use for making quantitative comparisons of the different shafts.

The swing speed range for all these R flex shafts from Aldila ranges by 25 mph. At one end, the NVS 65-R is a shaft that would be rated for use by a golfer with a driver clubhead speed of 70-80mph. At the other end, the RIP Gamma 60-3.6-R is a shaft that would be rated for use by a golfer with a driver clubhead speed of 85-95mph. That means within all the R Flex shafts from Aldila, the clubhead speed rating for possible selection by a golfer can range by 25 mph – yet all are marked as being an R Flex shaft.

On top of this are definite differences in the TIP SECTION design of all these different R flex shafts. Within all the R Flex shafts from Aldila, we see shafts with a tip section design that ranges from the very tip-soft Habanero 60-R all the way up to the moderately tip stiff design of the RIP Gamma 60-3.6-R. If both these R flex shafts were hit by the same golfer, the Habanero would launch the ball approximately 3* higher and with an estimated 750 rpms more backspin than the RIP Gamma 60-3.6-R – yet again, both are marked as R flex shafts.

Once again, we must reiterate – WE ARE NOT SAYING THERE IS ANYTHING WRONG WITH THESE SHAFT DESIGNS nor are we criticizing anything about them. Each company is free to design their shafts as they see fit, for whichever golfer swing types they designate. However, how can any golfer really know the difference in the overall stiffness design of any of these shafts and from that, know anything about the performance difference between these shafts of the same flex without clear, quantitative comparative information?

Please understand that variation between the same letter flex of different shaft models goes on INTENTIONALLY with every shaft company in the golf industry. It is not specific to Aldila. I simply use them to illustrate that this does happen within each shaft manufacturing company. Without a clear, quantitative means to compare the stiffness design of shafts, consumer golfers are in the dark with respect to making accurate shaft buying and shaft fitting decisions.

(In part 2 we will discuss **How a golfer should select the right shaft for his/her swing**)

For those of you who made it this far, CONGRATULATIONS!! You ARE indeed interested in shafts. For those of you who didn't … well, true shaft knowledge can be a little beyond a normal realm of interest, I do admit that. I hope you all got something out of this, and there is more to come to help you know much more about how to determine the differences between shafts and how to turn that information into better shaft buying decision.

By the way, there are many custom clubmakers out there who can help you find the right shaft FAR more accurately than the ways you have been trying to pick the right shaft in the past. These clubmakers who study this stuff are worth knowing and can help you.

Wishon: Taking Shaft Fitting from Guessing to Specifics (Part 2)

Shafts do not perform the same way for all golfers. Shafts perform differently for different swing characteristics because different swing characteristics make shafts bend and twist differently. Most golfers are aware that their clubhead speed has relevance to what shaft they should play. But in addition to the clubhead speed, there are several other swing characteristics which determine how different

shafts can and do perform differently for different golfers.

Shafts are in essence, "dumb animals." There is absolutely NO magic to the performance of a shaft – they ONLY do what their owner's swing characteristics ordain them to do. For some golfers, there is some additional performance contribution from the center of gravity location inside the clubhead. However, there are a lot of different variations in how golfers swing the club with respect to the specific swing characteristics that dictate how a shaft will perform. The whole idea of analyzing the swing characteristics which are pertinent to shaft performance is to allow us to have a way to systematically ELIMINATE shafts from consideration for a golfer, so what is left would be a smaller, manageable number of shafts with which each golfer could play.

The KEY elements of the golf swing in shaft fitting are:

1. Clubhead Speed

The clubhead speed affords a basic, rudimentary, BEGINNING indication for the approximate overall amount of bending force a golfer may put on a shaft. However, it is very common for two golfers with the same clubhead speed to put totally different amounts of bending force on a shaft. It is also common for two golfers who put the same bending force on a shaft to have different clubhead speeds. This is why a good shaft fitter has to analyze other characteristics of the golf swing to get more of an idea of how much bending force the golfer is putting on the shaft for his/her swing speed, when that bending force is being applied to the shaft and where on the shaft is the most bending force being applied. Clubhead speed gives us a starting point to help us begin to narrow the choice of possible shafts for a golfer in the fitting process. But it only tells us a part of the story.

2. Downswing Transition Force

The force with which the golfer starts the downswing determines the initial bending force on the shaft. In other words, how much the shaft is initially "loaded" is chiefly determined by the golfer's transition force to start the downswing. Of two golfers with the same clubhead speed, the one with the stronger, more forceful transition will need a stiffer shaft (a shaft with a swing speed rating that is higher than the golfer's swing speed). Of two golfers with the same clubhead speed, the one with the smoother, passive transition will need a more flexible shaft (a shaft with a lower clubhead speed rating than the golfer's swing speed).

In addition, a golfer with a stronger transition typically is better fit into a HEAVIER weight shaft. A strong/forceful transition with a very light shaft can result in a swing tempo that gets too fast and too inconsistent, although it can be possible to use a higher than normal swingweight to allow a golfer with a strong transition to not get too quick when using a very light shaft.

3. Downswing Tempo/Downswing Aggressiveness

We said the transition force determines the INITIAL loading of the shaft. The downswing tempo determines how much that initial loading may change during the rest of the downswing before impact. Tests we have performed with special sensors on the shaft reveal that it is extremely rare for a golfer to increase the loading of the shaft during the downswing. It is not very common for a golfer to maintain the same load on the shaft during the downswing, either. Almost every golfer loads the shaft the most at the beginning of the downswing, after which the loading on the shaft begins to decrease from the moment the transition turns into the downswing.

A good shaft fitter will analyze the downswing tempo to estimate if the golfer is maintaining their initial loading of the shaft, slightly losing some of the loading or substantially losing it. In more recent research, we have come to the belief that the transition and tempo blend together in terms of the golfer's ability to put a bending force on the shaft and maintain it or not to the point of release. Hence the good shaft fitter will analyze the transition/tempo together in one overall observation to decide whether the golfer is an AGGRESSIVE HITTER, a SMOOTH SWINGER, somewhere in between or variations of each extreme. It really is not necessary to split the hair too fine on this evaluation. Good fitters chiefly think in terms of HITTER, SWINGER or AVERAGE when it comes to evaluating the effect of the transition/tempo on the golfer's ability to load the shaft.

How is the analysis of the golfer's transition/tempo used to help narrow down the shaft recommendation?

The more forceful and aggressive the golfer's transition/tempo, the more the shaft would be selected to have a swing speed rating that is a little higher than the actual swing speed of the golfer. Vice versa, the more passive, smooth and easy the golfer's transition/tempo, the more the shaft would be selected to have a swing speed rating that is a little lower than the actual swing speed of the golfer.

For example, let's say we have three golfers, each with a 100 mph clubhead speed. Golfer No. 1 has a short, three-quarter length backswing with a fast, forceful transition and an aggressive downswing. Golfer No. 2 has a normal backswing length with some sense of transition force and downswing aggressiveness but not nearly as much as Golfer No. 1. Golfer No. 3 has a smooth, rhythmic, almost passive transition and tempo that identifies him as far more of a "swinger" than a "hitter."

For basic fitting, Golfer No. 2 would be advised to look among shafts that have a 95-105 mph swing speed rating because his swing characteristics are putting an average amount of bending force on the shaft for his 100 mph clubhead speed.

Golfer No. 1 (strong/forceful transition and tempo) would be advised to look among shafts that would have a 100-110mph swing speed rating because his swing characteristics are "loading" the shaft more from him putting an ABOVE average amount of bending force on the shaft for his 100 mph clubhead speed. And Golfer No. 3 (smooth, passive transition and tempo) should choose from shafts that have a 90-100mph swing speed rating because his swing characteristics are "loading" the shaft much less for his speed and put a BELOW average amount of bending force on the shaft for his 100mph clubhead speed.

Three golfers in this example all had the same clubhead speed, yet each put a different bending force on the shaft. The more forceful and aggressive the transition/tempo, the higher the swing speed rating of the shaft should be in comparison to the golfer's clubhead speed. The more passive and smooth the transition/tempo, the lower the swing speed rating of the shaft should be in comparison to the golfer's

clubhead speed. And for the golfer with the average transition/tempo, the swing speed rating of the shaft should allow for the golfer's clubhead speed to be right in the middle of that range. Here's a little different way to look at this relationship of Clubhead Speed and Transition/Tempo versus the Bend Profile Stiffness measurements and the Swing Speed Rating for Shafts.

TWGT Bend Profile Stiffness Measurements

41	36	31	26	Shaft Swing Speed Range for a #1 Transition & Tempo	Shaft Swing Speed Range for a #2 Transition & Tempo	Shaft Swing Speed Range for a #3 Transition & Tempo
137	155	177	207	under 45	under 40	under 35
144	162	184	214	45 to 55	40 to 50	35 to 45
151	169	191	221	55 to 65	50 to 60	45 to 55
158	176	198	228	65 to 75	60 to 70	55 to 65
165	183	205	235	75 to 85	70 to 80	65 to 75
172	190	212	242	85 to 95	80 to 90	75 to 85
179	197	219	259	95 to 105	90 to 100	85 to 95
186	204	226	266	105 to 115	100 to 110	95 to 105
193	211	233	273	115 to 125	110 to 120	105 to 115
200	218	240	280	125 to 135	120 to 130	115 to 125
#1 Transition/Tempo = smooth, rhythmic, passive, not much sense of aggressiveness						
#2 Transition/Tempo = some sense of force during the downswing						
#3 Transition/Tempo = Forceful, aggressive, and definite sense of aggressiveness						

In short, as the golfer puts more bending force on the shaft due to his Transition and Tempo, the swing speed rating of the shaft needs to increase higher than the golfer's actual clubhead speed. And as the golfer puts less bending force on the shaft due to his Transition and Tempo, the swing speed rating of the shaft needs to decrease lower than the golfer's actual clubhead speed.

But what's next after finding the shafts which have a swing speed rating that corresponds to the golfer's clubhead speed and adjustments for the golfer's transition and tempo?

4. Point of Wrist-Cock Release During the Downswing

The key swing characteristic which good shaft fitters analyze to determine the correct TIP STIFFNESS design of the shaft for the golfer is the point the golfer unhinges their wrist cock release on the downswing. In swing mechanics terms, the action of unhinging the wrist cock angle is called the RELEASE.

The point when the golfer releases the club is what determines WHEN the shaft goes from being "loaded" to being "unloaded." The point when the golfer releases the club determines when the shaft moves from a "flexed back" position into a "flexed forward" position. The point of release also determines when the clubhead achieves its highest speed.

Once the golfer unhinges the wrist cock angle, the arms immediately begin to slow down while the clubhead speeds up. If the golfer releases the club too early, the clubhead reaches its highest speed well before it gets to the ball. With an early release, by the time the clubhead gets to the ball, the clubhead

speed has slowed down. This slowing down of the clubhead before impact even happens for golfers who release the club midway on the downswing – though not as much as with an early release.

The only golfers who achieve their highest clubhead speed right when the clubhead meets the ball are golfers with a late release. Hence this is another reason why a late release is such an important swing skill for golfers to achieve to be able to play to the best of their physical skills.

In shaft fitting terms, the later the golfer releases the club, the more tip stiff the shaft COULD be. And conversely, the earlier the golfer releases the club, the more tip flexible the shaft should be. Because the actual point of release can vary all the way from the start of the downswing to the very end, so too the tip stiffness design of the shaft is chosen to correspond. Early release = most tip flexible; Latest release = most tip stiff; Release in between early and very late = tip stiffness in between.

You can now start to see why we need to have quantitative stiffness measurements of shafts so we can choose the right level of stiffness for golfers with varying levels of transition/tempo force and different points of release. With only letters for flex and generic terms for tip stiffness or bend point, shaft fitting is little more than a trial-and-error guess.

Below is a chart that offers some examples for how to combine the golfer's clubhead speed, transition/tempo evaluation and the golfer's point of release to narrow the choices for a suitably fit shaft:

Golfer's Clubhead Speed	+	Transition Rating	+	Downswing Tempo Rating	=	Golfer's Shaft Swing Speed Range	+	Point of Wrist-Cock Release	=	FINAL SHAFT RECOMMENDATION
90 mph	+	Smooth (1)	+	Smooth (1)	=	80 - 90 mph	+	Early (1)	=	80-90mph + Tip Flexible
90 mph	+	1	+	1	=	80 - 90 mph	+	Midway (2)	=	80-90mph + Tip Medium
90 mph	+	1	+	1	=	80 - 90 mph	+	Late (3)	=	80-90mph + Tip Firm
90 mph	+	Average (2)	+	Average (2)	=	85 - 95 mph	+	Early (1)	=	85-95mph + Tip Flexible
90 mph	+	2	+	2	=	85 - 95 mph	+	Midway (2)	=	85-95mph + Tip Medium
90 mph	+	2	+	2	=	85 - 95 mph	+	Late (3)	=	85-95mph + Tip Firm
90 mph	+	Forceful (3)	+	Aggressive (3)	=	90 - 100 mph	+	Early (1)	=	90-100mph + Tip Flexible
90 mph	+	3	+	3	=	90 - 100 mph	+	Midway (2)	=	90-100mph + Tip Medium
90 mph	+	3	+	3	=	90 - 100 mph	+	Late (3)	=	90-100mph + Tip Firm

5. The Qualitative Side of Shaft Fitting — The Golfer's Perception and Preference for the Shaft's BENDING FEEL

Talk about something that can throw a monkey wrench into all the logical things that we have taught so far about shaft flex/bend profile fitting! If you want to know why some golfers play well with shafts

which are “on paper” considered to be too stiff, too flexible, too tip stiff or too tip flexible for their clubhead speed, transition/tempo and point of release, this is the reason why.

If a golfer has developed a specific preference for a type of bending feel of the shaft during any point in the swing, that feel preference has to be THE GUIDING FACTOR in the shaft fitting process. During the fitting process, the smart, experienced clubfitter knows to interview the player and ask questions to assess the golfer’s level of perception for the bending feel of the shaft and whether they have acquired specific “likes and dislikes” for various aspects of the shaft’s bending feel during the swing.

The very best way to incorporate a golfer’s preference for shaft feel in the shaft fitting process is to have the golfer reveal specific shafts they have either liked or disliked in previous or current clubs. If these shaft models/flexes are searched in the Bend Profile Software we created, the stiffness measurements of those shafts can then be referenced against possible future shaft recommendations to determine if the new shaft selection may or may not satisfy the golfer’s shaft feel preferences.

One of the myths about shaft flex/bend profile performance is when someone states that this or that shaft is designed in a way that can actually increase the bending velocity of the shaft to offer a golfer a higher clubhead speed. This is impossible because of the physics of tube design and performance. However, it is very possible for a golfer to change to a different shaft flex/bend profile design and experience a measurable increase in clubhead speed.

How this happens is how the new shaft falls into the golfer’s preference for the bending feel of the shaft. Give a golfer a shaft that feels perfect in terms of how much it bends, when it bends and where it bends in relation to the golfer’s acquired preference for bending feel and that golfer will achieve his most free, most unrestricted and most fluid release through the ball. And it is from this – having a shaft that feels perfect in every way to the golfer – that they are able to achieve a higher clubhead speed.

On the other hand, put the golfer into a shaft that demonstrates a feeling of being too stiff or too flexible in some way compared to the golfer’s preference for bending feel and they most typically will begin to change their swing to make the shaft perform and feel as they prefer. Manipulating the swing means a lack of free motion, free unrestricted release and a lower clubhead speed with less swing consistency.

Again, to not have a truly quantitative way to analyze shafts, trying to turn a golfer’s feel preferences for the shaft into a valid new shaft recommendation becomes a trial and error process.

6. Putting It All Together

The higher the golfer’s clubhead speed, the more forceful/aggressive the transition and tempo, the later the release, the more the flex and the bend profile of the shaft become a contributor to the launch angle, trajectory and spin rate for the shot. The lower the clubhead speed, the more passive the transition and tempo, the earlier the release, the less important the shaft’s flex and bend profile are to performance. But for ALL golfers, the WEIGHT of the shaft is an important part of the shaft selection process.

The higher the golfer’s clubhead speed, the more forceful/aggressive the transition and tempo, and the later the release IN RELATION TO THE SWING SPEED RATING and TIP STIFFNESS OF THE SHAFT, the more the shaft can increase launch angle, trajectory and spin.

The shaft only just begins to contribute to launch angle, trajectory and spin in a gradual increasing manner as the golfer has a midway to later to very late release. Midway release, the flex and bend

profile begin to matter a little. Very late release, the stiffness design of the shaft matters a lot more. For golfers with an early to before midway release, the flex and bend profile of the shaft do virtually nothing to the launch angle, trajectory and spin of the shot. The shaft's WEIGHT becomes the only key shaft fitting factor for golfers with an early to before midway release.

The ONLY ways the shaft can lower launch angle, trajectory and spin is:

i. if the shaft is either more stiff overall than the golfer's previous/current shaft, OR,

ii. if the tip section of the shaft is more stiff than the tip section in the golfer's previous/current shaft.

Just because a shaft is said to be tip stiff will not reveal whether it is a lower spin shaft than what you play now. A shaft has to be more stiff overall and/or more tip stiff than what you play now to have any effect on lowering launch angle, trajectory and spin.

The golfer's preferences for a specific bending feel of the shaft overshadow the stiffness and bend profile fitting analysis compiled from the clubhead speed, transition/tempo and point of release. In all cases for all golfers, you do go through the stiffness and bend profile fitting analysis compiled from the clubhead speed, transition/tempo and point of release, but you listen hard and consider modifying the recommendation when the golfer says they have a specific preference for the bending feel of a shaft.

Facts about shafts — What they do (Part 3)

The Shaft Can Have an Effect on launch Angle, trajectory and spin rate. How much of an effect the shaft has on these shot parameters depends on the lateness of a golfer's release, their clubhead speed and how aggressive their downswing tempo is. In addition, how much the shaft can change launch angle, trajectory and spin for golfers who do have the swing characteristics to make the shaft perform depends completely on the overall stiffness and bend profile of the new shaft versus the golfer's previous shaft.

For those of you who have read some of my articles and posts on shafts, you have heard this part before. The shaft's effect on launch angle, trajectory and backspin only become visible as the golfer's release occurs later and later in the downswing. In addition, the shaft's effect on trajectory and spin progresses more and more as the golfer's clubhead speed and downswing aggressiveness/force increases.

Golfers who unhinge the wrist cock early to midway in the downswing do NOT experience a difference in launch angle, trajectory or backspin from shafts of different flex and different bend profile. They do experience a difference in how solid or boardy the impact with the ball is. But as the release gets to midway on the downswing, and progressively a little later and later beyond midway in the downswing, the shaft begins to have a little more and more effect on launch angle, trajectory and spin.

The reason the shaft can have an effect on launch angle, trajectory and spin for later release players is because of the way the timing of the bending of the shaft can affect the dynamic loft of the clubhead at impact. When the golfer begins to unhinge their wrist cock angle on the downswing, the golfer's hands/arms begin to slow down while the club accelerates.

Yes, for EVERY golfer, once he or she unhinges the wrist cock angle, their arms slow down. Because the hands are holding the club while the arms are slowing down, the acceleration of the club begins to push the shaft against the resistance of the slowing arms/hands into a forward bend position.

The later the golfer's release, the more the forward bending of the shaft can arrive at impact in that forward bend position. For a midway release, the shaft only has a slight amount of forward bend by the time the clubhead gets to the ball. For an early to midway release, the forward bending of the shaft happens too soon, so that by the time the clubhead gets to the ball, the shaft has rebounded back to straight, thus not changing the dynamic loft of the clubhead at impact.

It is important to understand that two golfers can have the same launch angle but have totally different trajectories and backspin amounts from each other. If two golfers with different clubhead speeds have the same swing path, same angle of attack and same hand position at impact, the launch angle will be the same but the trajectory and spin rates will differ. The higher the clubhead speed of the golfer, the higher the trajectory and spin will be for any given launch angle.

How much can the shaft affect the launch angle and spin rate for those golfers who do have a later to very late release?

Two things control this. First, when a golfer uses a different shaft than he has been playing, the only way the shaft can change the launch angle and spin is if the new shaft is different in its overall stiffness design than the old shaft. Second, how much the shaft can affect launch angle and spin also depends on how flexible or stiff the shaft is in relation to the golfer's clubhead speed, transition and tempo force and point of release.

First, I see TONS of posts and questions in the GolfWRX forums that say something like:

> *"I need a recommendation for a good low-launching (or high-launching), low-spin shaft."*

Such a question is asked as if the golfer thinks that a shaft will demonstrate the same effect on launch angle and spin for every golfer who uses it.

While the shaft companies like to say their shafts are designed to have certain launch and spin characteristics, the truth is that a shaft can only offer a low or higher launch/spin if it is stiffer or more flexible THAN WHAT THE GOLFER USED BEFORE.

In other words, what is a low-launch and low-spin shaft for golfer A can be a high-launch and high-spin shaft for golfer B, and vice versa. FOR THE SAME SHAFT, the golfer with the higher clubhead speed, later release and more upward angle of attack is going to hit shots with a higher launch, higher trajectory and higher spin than will the golfer with a lower clubhead speed, earlier release and more downward angle of attack.

So, for golfers who are looking for a low-launch, low-spinning shaft, the only way you can find that is to:

- Know precisely what the overall stiffness and bend profile stiffness design is of the shaft you now play, and

- Know the overall stiffness and bend profile stiffness design of all other shafts so you can pick one that is stiffer overall and/or has a more stiff tip section design.

Shafts are dumb animals. They only do what their owner's swing forces them to do.

Second, if a late release golfer were to play with a soft L one day and a stiff X the next, without question the difference in launch angle, trajectory and spin would be very significant. But common sense says this isn't going to happen because each golfer should play a shaft that has its overall stiffness and bend profile properly matched to the golfer's unique combination of clubhead speed, transition/tempo force and point of wrist cock release.

Sure, some of us prefer to play a shaft that feels stiffer. Some of us like to play a shaft that feels a little more flexible. If a golfer has a preferred sense of bending feel for a shaft, without question, regardless of their clubhead speed, transition/tempo and point of release, their best shaft has to satisfy that bending feel preference or their swing tempo/timing/rhythm/release gets screwed up and becomes inconsistent.

But within shafts that reasonably fit a golfer's clubhead speed, transition/tempo and point of release, typically the maximum difference seen in launch angle from different shaft options is in the area of 2.5 to 3 degrees. As far as spin difference, that depends on the clubhead speed of the golfer. A shaft that launches the ball 2 degrees higher for a golfer with an 80 mph clubhead speed would typically increase spin by 350 to 400 rpms, while a shaft that launches the ball 2 degrees higher for a golfer with a 100 mph clubhead speed would typically increase spin by 500 to 600 rpms – that is, of course, given the same clubhead and same other assembly specs of the club.

So the bottom line is this – shafts can bring about changes in launch angle, trajectory and spin, but only for golfers with a later to late release, and only to the extent that their overall stiffness and bend profile are different from the shaft the golfer previously played.

If the golfer has developed a preferred sense of bending feel for the shaft, playing a shaft that satisfies that preferred bending feel will enable the golfer to achieve their highest clubhead speed. However, for such a golfer, playing a shaft that does NOT perfectly match their preferred bending feel will bring about a lower clubhead speed, worse accuracy and more off-center hits.

Here's a statement about shafts that I have heard a few times in my career:

> *"Different shaft designs can be designed with a higher tip velocity to allow the golfer to achieve a higher clubhead speed."*

That's not correct. As I said before, shafts are dumb animals. They ONLY do what the swing characteristics of their owners cause them to do. Whenever a golfer uses a shaft that has its weight, overall stiffness and bend profile well matched to the golfer's clubhead speed, transition/tempo, point of release AND preference for bending feel, that's when the golfer will achieve their highest clubhead speed. But this is only if the specs of length, loft, face angle, total weight, swing weight, and grip size are correctly fit to the golfer as well.

Give that same shaft to a different golfer with the same clubhead speed but a different combination of

transition/tempo, point of release and preference for bending feel and that same shaft will result in a lower clubhead speed with far worse performance for that golfer BECAUSE THE SHAFT DOES NOT FIT THE SWING CHARACTERISTICS OF THE OTHER GOLFER.

A shaft can only exhibit a high level of “tip velocity” for the golfers whose clubhead speed, transition/tempo, point of release AND preference for bending feel is perfectly matched to the weight, overall stiffness and bend profile of the shaft.