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eTECHREPORT

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What Golfers Should Expect from Shafts that Offer Differences in Launch

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Important Realizations About Fitting Driver Loft to Achieve Maximum Distance

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Shaft Design Analysis – Using the new TWGT Bend Profile Analysis to Show Performance Differences in Shafts

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MOI Matching of Clubs Now a Reality

Excerpts from emails received from clubmakers who are using the new TWGT MOI Matching System in their custom clubmaking work... [continues below]

What Golfers Should Expect from Shafts that Offer Differences in Launch

It has always been fascinating to me how clubheads, shafts and grips tend to follow waves of design trends. In fact, you can literally write a history of the golf equipment business just by referring to these trends. Over the past 25 years we have evolved through the “metal wood era,” the “low torque shaft era,” the “oversize metal wood era,” the “superlight graphite shaft era,” the “titanium driver era,” and now the “shafts with different launch performance era.”

Actually, shafts designed to launch the ball at different trajectories have been around for decades – the shaft industry used to call them “low bend point,” “mid-bend point,” and “high bend point” types of shafts. What is different today is that some shaft designers have learned how to manipulate the way that the flex of the ENTIRE shaft is distributed over its length to be able to allow the shaft to expand its range in trajectory in a way that is quite different than what was possible when the shaft industry only dealt in flight as a manner of bend point.

Just like all areas of golf equipment design, there are shafts that truly are designed to deliver different flight profiles and there are shafts that are said to do so. What makes it difficult to know what shafts do and do not deliver the maximum in trajectory differences is the fact that it is the golf swing mechanics of the golfer that really determine whether a launch profile shaft can deliver the trajectory for which it is designed.

Fitting golfers into shafts which deliver a different trajectory is truly an area of clubfitting that requires the clubmaker to know a little about how the shaft bends during the swing, as well as how different swing movements affect the shaft’s ability to bend as designed and deliver or not deliver the designed trajectory for the shot.

The fundamentally sound golf swing involves a number of movements that many golfers simply have not learned, or which they may not have the ability to execute. Golfers who possess the following DOWNSWING fundamentals will definitely be able to see trajectory differences in shafts which are PROPERLY designed to deliver such flight differences.

- The ability to begin the downswing with a movement of the shoulders or hips rather than just with the arms.
- The ability to rotate the body (TURN) through the impact area with the arms ‘connected’ to the torso as it turns through the ball. If the arms operate independently of the body in the downswing, flight differences of the shaft will be less visible.
- The ability to restrain the wrist-cock from unhinging until at least a point that is slightly above the level of the waist to below the waist. If the golfer immediately unhinges the wrist-cock at the start of the downswing, virtually all shaft designs will hit the ball on the same trajectory.
- The ability to prevent the lead wrist (left wrist for a RH golfer/right wrist for a LH golfer) from “breaking down” BEFORE impact with the ball. If the lead wrist hinges FORWARD before impact, again, virtually all shaft designs will hit the ball on the same trajectory... high!

Therefore, when you work with golfers who come to your for clubfitting, if they possess these previous swing mechanics, it will be possible for you to affect a change in their trajectory through the selection of the shaft and its launch design. Always keep in mind that the loft of the clubhead will have much more of a visible effect on trajectory than will the shaft.

If the golfer hits the ball on a very low-to-low trajectory and you believe that a higher trajectory will improve their potential for more distance, increasing trajectory through a loft increase MUST be your first priority, with the shaft's contribution second. If the golfer hits the ball on a medium trajectory and a higher launch angle would be beneficial, here becomes the first point where you may have the option to elevate the shot pattern with the shaft before you employ an increase in loft – but ONLY if the golfer's present shaft is either too stiff overall, or too stiff in the tip half of the shaft. If the golfer hits the ball with a medium trajectory using a more flexible shaft or a more tip flexible shaft in their current driver, then the loft increase of the clubhead will be more advisable as the manner for enhancing the launch angle and increasing trajectory.

There is one very good reason for trying to evaluate if a beneficial increase in trajectory for a golfer should be sought from the shaft first before increasing the loft of the clubhead. IF THE GOLFER POSSESSES AT LEAST THE MINIMUM SWING MECHANICS TO ALLOW THE BENDING OF THE SHAFT TO PERFORM AS DESIGNED, BEING ABLE TO KEEP THE LOFT LOWER WHILE GAINING THE INCREASE IN TRAJECTORY FROM THE SHAFT WILL ALLOW THE BALL TO LAUNCH AT A HIGHER VELOCITY. This is because ball speed is so much a product of the loft of the clubhead – the lower the loft, the higher the ball speed will be for ANY golfer. The higher the ball speed, the greater the distance – but ONLY if the proper launch angle can be achieved with that lower loft by proper fitting of the shaft.

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Important Realizations About Fitting Driver Loft to Achieve Maximum Distance

The vast majority of golfers do not generate a high enough launch angle with their present driver to maximize their potential for distance. In fact, a sweeping statement can almost be made that any golfer with a swing speed of 90 mph or less who is currently using a driver of 10 degrees or less is missing out on the chance of being able to increase their distance off the tee by not moving to a higher loft with the driver.

While the potential is there to become a hero to millions of golfers, the question all clubmakers have to answer is "How do I know how much loft each golfer needs to optimize their driver play?" And a good question it is, because ultimately, the golfer's swing mechanics are THE important detail when it comes to making the decision of what loft for which golfer will bring more distance, or whether it will even be possible to help the golfer in the first place.

Some months ago, we discussed the swing characteristic called the 'Angle of Attack'. The A of A describes the angle at which the clubhead arrives at impact – downward (hitting the ball with the clubhead still moving at a downward angle), level with the ground, or upward (hitting the ball on the upswing). If the golfer has a downward A of A and hits the ball low, they will need a more substantial increase in loft to offset the downward A of A and generate the proper launch angle for maximum distance. To contrast, if the golfer hits the ball rather high already from an upward A of A, the recommendation to achieve the proper launch angle may actually be a driver with LESS loft! Without knowing the golfer's angle of attack, and without knowing what the launch angle will be for any

given loft angle with that angle of attack, clubmakers are simply guessing when they wish to recommend the optimal driver loft angle for any golfer.

If you are very serious about your clubmaking, there is no doubt today that you can achieve a decent return on the investment in a good launch monitor. Not only will a launch monitor offer the information you need to know to make the best fitting decisions for maximizing distance, and accuracy, but when you put the word out in your area that you have such a sophisticated fitting tool in your shop, it can act as a drawing card to bring more golfers to your shop.

Without a launch monitor, all is definitely not lost. The alternative is to use our Launch Angle Gauge to obtain launch angle measurements from the golfers, with the TWGT Trajectory and Ball Flight Software to input the data from your golfers to be able to know what driver loft will deliver the most distance. On one hand, you can look at this as a "shameless commercial plug" on my part to offer these products, but seriously, the combination of these two items in the absence of a launch monitor WILL allow you to ensure an accurate fitting for the driver loft. The investment of $129 can easily be made back in the sale of just one driver, not to mention the boost in image the use of these fitting tools can bring when you show your golfers how they are used to maximize their distance off the tee.

Here's how it works. First, determine the golfer's angle of attack using the Launch Angle Gauge. After the golfer hits a few balls to warm up, have them hit a series of shots with a driver of known loft and note the average launch angle from the point of contact of the ball on the Gauge hanging in the hitting net. Teaching by example, the following chart shows how you determine the angle of attack for a number of different possible test driver lofts:

Test Driver Loft	If Launch Angle is this A of A is 0 degrees	If Launch angle is this, A of A is +1 degrees	If Launch angle is this, A of A is +2 degrees	If Launch angle is this, A of A is +3 degrees	If Launch angle is this, A of A is -1 degrees	If Launch angle is this, A of A is -2 degrees	If Launch angle is this, A of A is -3 degrees
8	7.1	8.1	9.1	10.1	6.1	5.1	4.1
9	8.0	9.0	10.0	11.0	7.0	8.0	9.0
10	8.8	9.8	10.8	11.8	7.8	6.8	5.8
11	9.6	10.6	11.6	12.6	8.6	7.6	6.6
12	10.4	11.4	12.4	13.4	9.4	8.4	7.4

*(+) values of the Angle of Attack indicate an UPWARD A of A. A (-) value indicates a LEVEL A of A

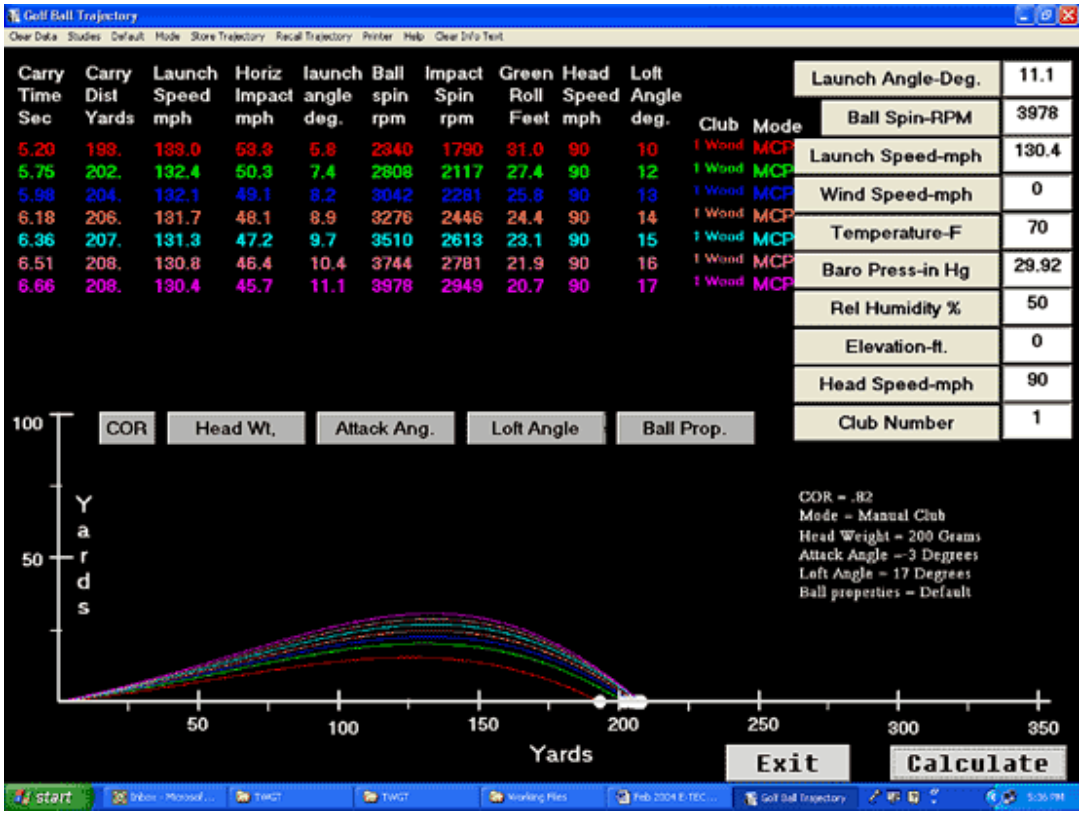
* Golfer Angle of Attack may be greater than +3 degrees and lower than -3 degrees. This chart only lists examples for teaching how the A of A is related to the Launch Angle for any given loft of a driver. For example, if the golfer shows a Launch Angle of 15 degrees using an 11 degree test driver, the A of A would be +5.4 degrees. Or if the golfer shows a Launch Angle of 5 degrees using a 12 degree loft test driver, the A of A would be -5.4 degrees

Keep in mind that regardless of the swing speed of the golfer, the launch angle will always be the same for any given clubhead loft and angle of attack in the swing. It is a myth that launch angle changes as clubhead speed changes. The apex trajectory of the shot may be different due to the fact backspin will increase as swing speed increases for the golfer, but the launch angle will always be the same for any given clubhead loft and angle of attack in the swing.

On the next page, we'll go through a few examples of driver loft fitting recommendations for golfers with different swing speeds and different angle of attack in their swing.

Example 1

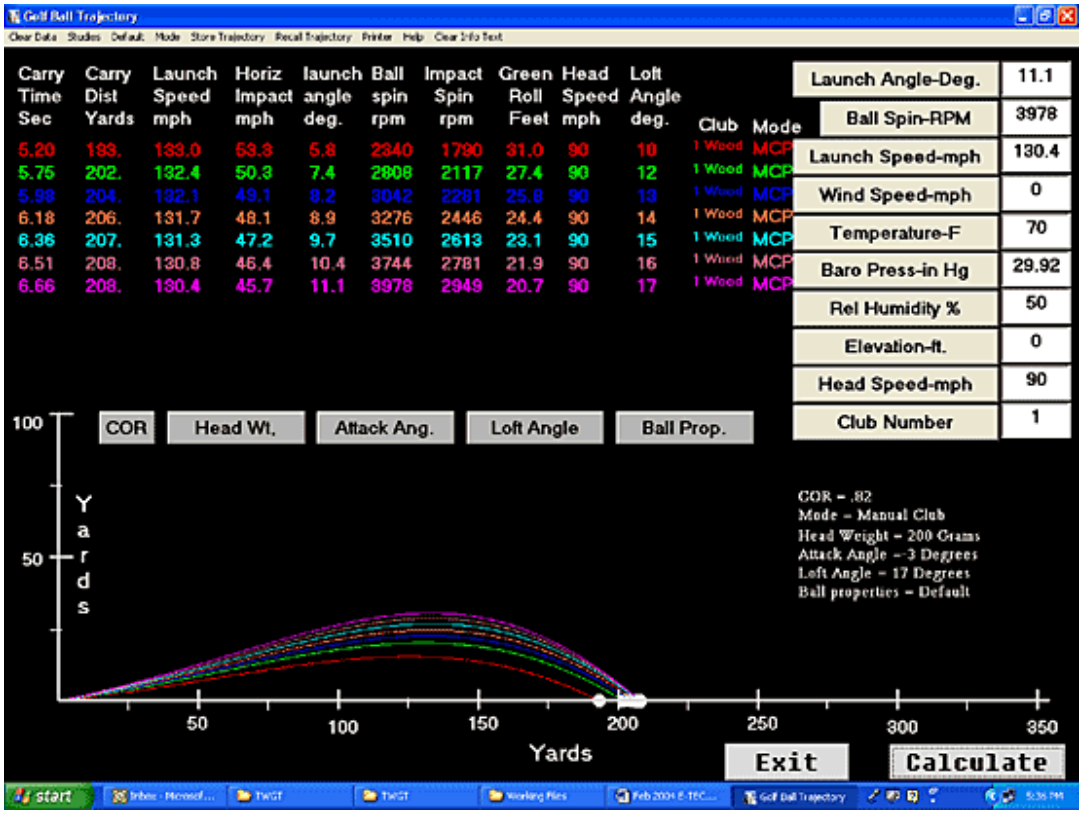
Golfer of 90 mph swing speed with a -3 angle of attack due to a swing move of "going over the top" and swinging down from outside to inside on the swing path.



In the above example as modeled on our Trajectory and Ball Flight software, the -3 downward angle of attack of this golfer is seen from the launch angle of 5.8 degrees from a driver head with a 10 degree loft. Study the lines of data across the top of the screen and note the carry distance as the driver loft is increased from 10 to 17 degrees. Here is an example to show how a 90 mph golfer with a slight downward angle of attack can increase distance by 14-15 yards by changing to a 15-16 degree loft driver. Next let's take a look at a golfer with the same 90 mph swing speed, but who swings with an upward angle of attack.

Example 2

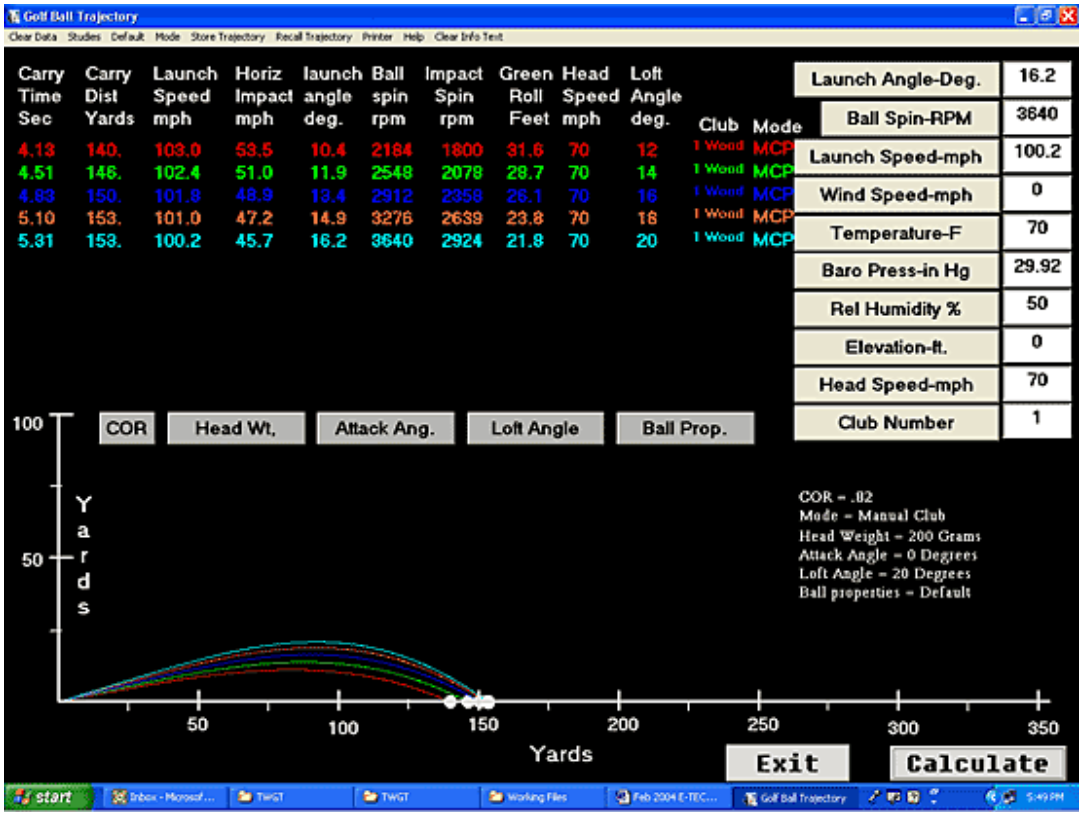
Golfer of 90 mph swing speed with a +3 degree angle of attack due to a swing move of “unhinging the wrists early” on the downswing.



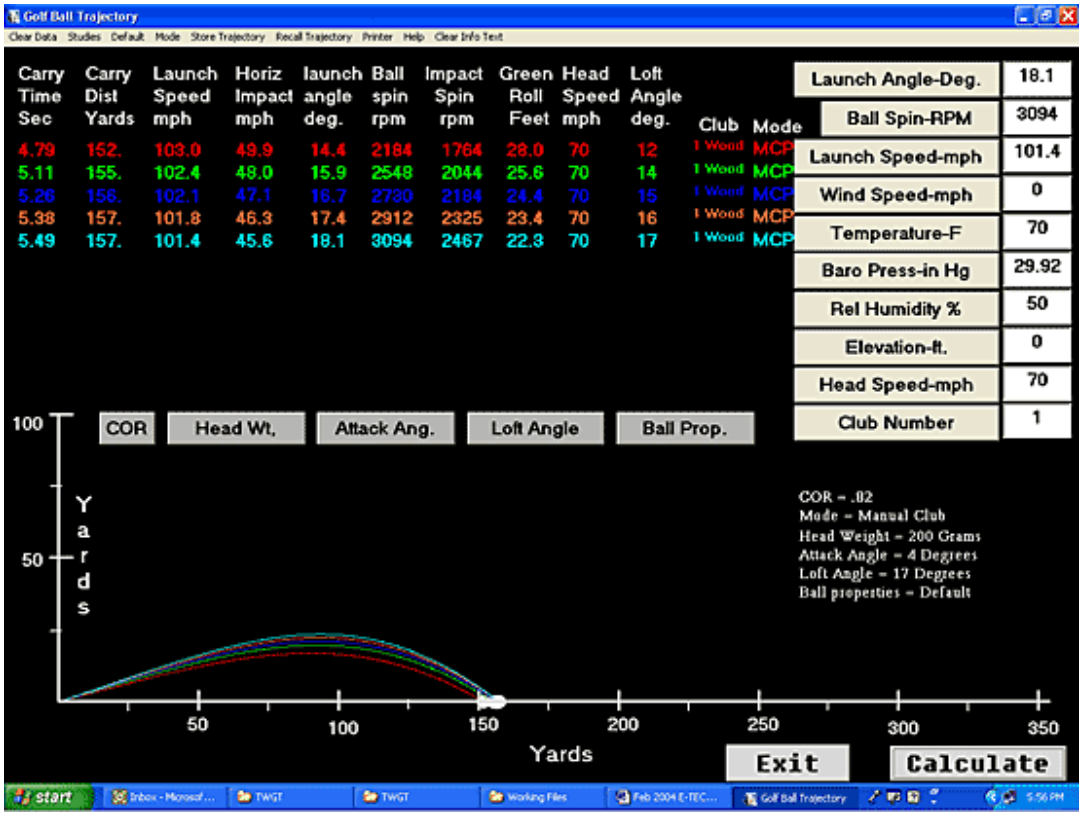
Note that for the same swing speed of 90 mph, the golfer with a more upward angle of attack to the ball will achieve optimal distance with a driver loft of 12-13 degrees. Without the capability to determine the golfer’s angle of attack and model their shot outcome with different driver lofts, you can see how easy it would be to make a mistake by guessing at the loft based only on the golfer’s swing speed and end up not helping the golfer maximize their potential.

Example 3

A Senior or Lady golfer with a 70 mph swing speed and a 0 degree or level angle of attack which comes from swinging mostly with the arms and sweeping the ball on all shots.



Here is a perfect example of how a player with little strength who swings mostly with the arms will have no business playing with a driver or even a 3-wood to maximize their distance potential. For this golfer, the “driver” should be a fairway woodhead with 17-18 degrees of loft that would be built to a length and headweight that would allow them to not drop their swing speed under 70 mph. Now let’s take a look at a golfer of the same swing speed, but who un-hinges the wrists early and flexes the wrists forward before impact, thus hitting the ball well on the upswing and creating an upward angle of attack to the ball.



With only the difference of hitting the ball on the upswing with a +4 degree angle of attack, a golfer with the same 70 mph swing speed would be optimized for maximum distance off the tee with a driver of 15-16 degrees loft, or with a 3-wood head of the same loft angle. Whether the optimal tee shot club is made with a driver or a 3w in such a case would be determined by the assembled length with which the golfer could still retain their highest swing speed. The bottom line is that squeezing all possible distance from a golfer's swing is a task that cannot simply be accomplished by guessing at the proper specifications of the club. Tools do exist that will help you make the right decisions for your golfers. When you realize that you do need to use these types of fitting aids, we at TWGT are always going to be here to help you use them as accurately as possible because if you make the right fitting decisions, your golfers are going to be very pleased and word of your work will travel from there.

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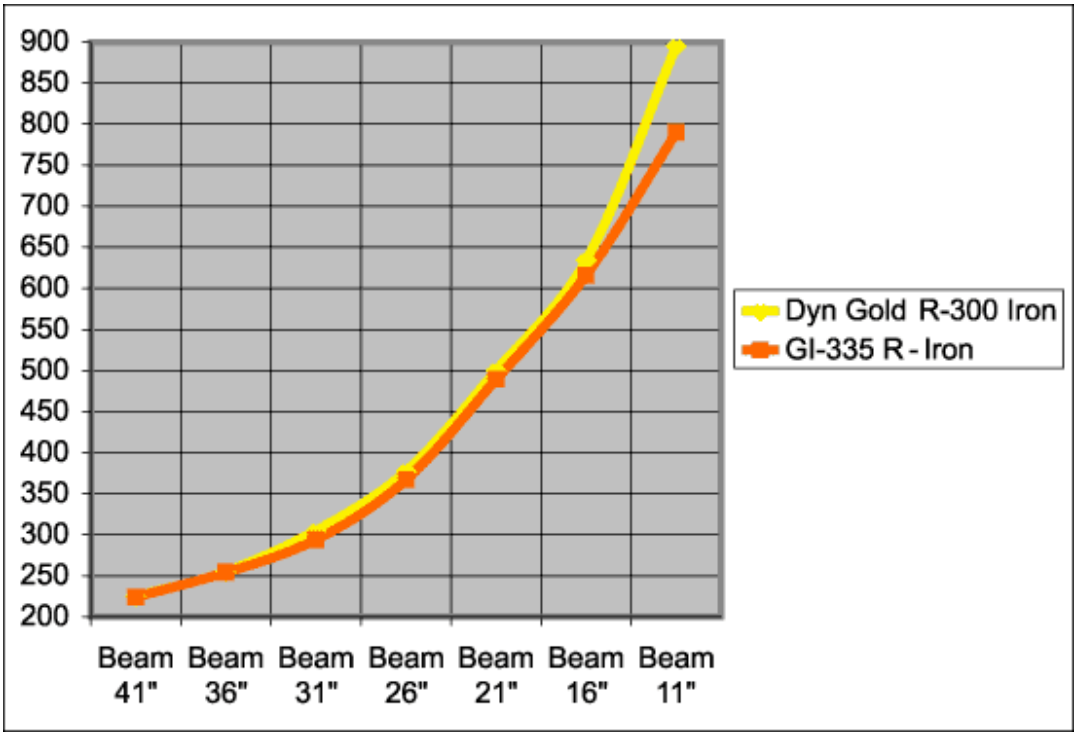
Shaft Design Analysis – Using TWGT Bend Profile Analysis to Show Performance Differences in Shafts

Many of you know that digging deeper and deeper into the world of shaft fitting and performance has been a primary, ongoing focus of mine for a long time. I also know that for the majority of you, the only area you lack confidence in your fitting is with the selection of the shaft for the golfers you serve. If you have not yet had an opportunity to read page 66 in our 2004 catalog, if you are interested in shaft fitting I really urge you to sit down

and take a moment to read a little of what direction we are headed in trying to dig deeper into the often confusing world of shaft fitting to provide you with a more quantitative way to select shafts for golfers. What I want to do in this discussion is to move on from the information on shaft design and analysis (view pdf file) to explain a few more points about how shaft bend profile analysis can help you understand more about the performance of shafts.

To better acquaint you with a TWGT bend profile graph, the two curved lines represent the stiffness as measured at 7 different points equally spaced along the length of the shaft. The shafts' bend profile measurements from butt to tip travel from left to right across the graph. When one shaft bend profile line is above the other shaft's bend profile line, that means in that area of the shaft, the bend profile is more stiff. Conversely, the lower line for any area on the shaft represents that area of the shaft being less stiff.



Now take a look at the bend profile curves for the Dynamic Gold R300 and the TWGT GI-335 R flex iron shafts. The first two measurements starting from the lower left corner of the graph show that the Dynamic Gold R3 and GI-335 R flex have the same stiffness in the first 10"+ of the butt section of each shaft. Then for the next 20" down from the butt, the GI-335 starts to become slightly less stiff than the same area of the Dynamic Gold R3 shaft. But then in the very tip end of the shafts, the GI-335 becomes much more flexible than the same area of the Dynamic Gold iron shaft.

My intent in the design of the GI-335 was to create an iron shaft that would display a visibly higher launch angle than conventional iron shafts, yet at the same time not end up feeling too whippy to the golfer. From this type of

bend profile analysis we felt that the way to accomplish this goal was to design the GI-335 so that a significant part of the butt section was the same stiffness that golfers were used to in their conventional iron shafts.

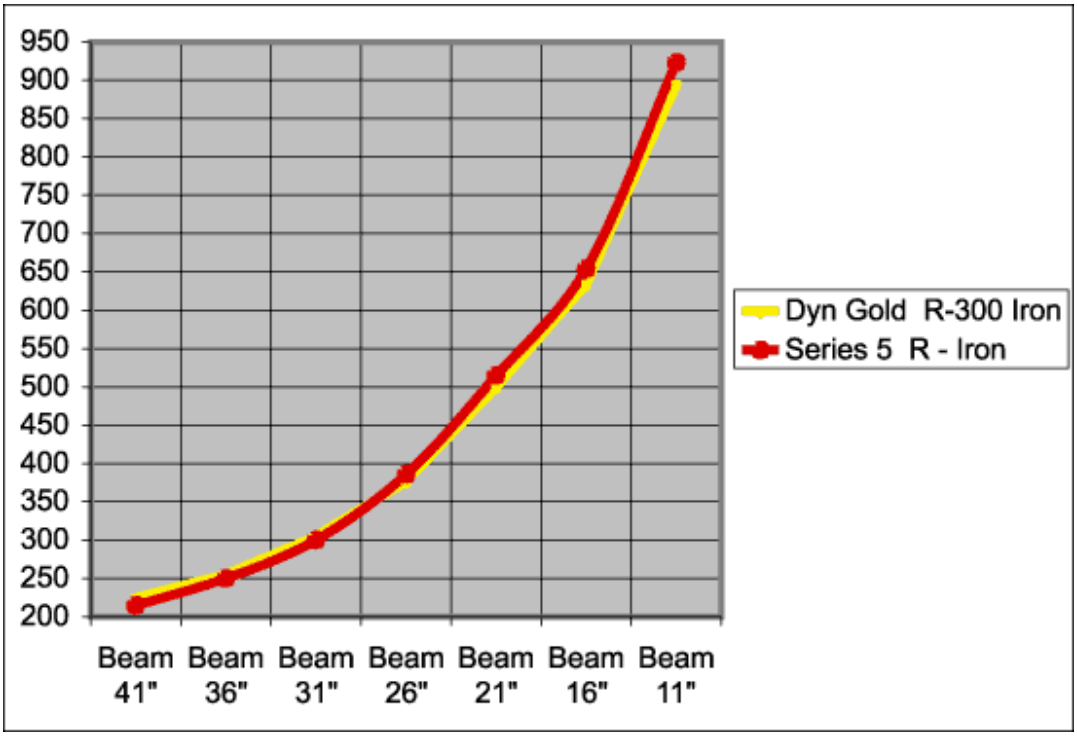
Next, we wanted to begin to create the capability of the GI-335 to be able to flex forward more just before impact with the ball, but not make that “unloading” of the shaft to be too drastic, which could have transmitted a feel of the shaft being too “whippy” to the golfer. Thus to accomplish this, we dropped the center section stiffness slightly over a long 20” section of the center area of the GI-335. And then in the tip area, we created the much more dramatic forward bending capability of the tip end of the GI-335 by changing the tip section diameter from the conventional .370” of all other parallel tip iron shafts to a smaller 0.335” diameter.

In testing with the shaft last summer, and confirmed by the clubmakers who have already used the GI-335 with a 321Li hybrid head or in conventional long/mid irons, we are really pleased that our use of bend profile analysis in the design of the GI-335 has really worked. The GI-335 offsets the more flexible low tip area with a conventional butt to center section stiffness so that the vast majority of golfers do not feel the GI-335 is flexible in feel. Yet the much greater forward bending capability of the lower tip section delivers a launch angle increase of over 4 degrees higher than the Dynamic Gold in the long irons.

If your golfer wants to use long to mid irons and struggles with hitting these clubs high enough to carry far and land softly on the green, bend profile analysis has shown its unique capability to assist us to create precisely that type of shaft for custom fitting. In addition, any golfer who hits the long and upper mid/irons ok, but is looking for a better carry distance with these clubs, as well as much better ability to stop these longer distance shots quickly on the green is also a very good candidate for the GI-335. Who is the GI-335 shaft not designed for? Because of the deviation of the tip end of the shaft to be much more flexible, if the golfer has a very aggressive downswing move combined with a very late release of the wrist-cock, these two swing actions will place a lot more bending force on the shaft which in turn could make the much more flexible tip section of the GI-335 feel too whippy to this type of golfer. Normally this type of golfer never has a problem with hitting the ball high enough, making them not a candidate for even considering the GI-335 in the first place.

Next I want to show you how bend profile analysis can show how a complete reversal of a shaft’s stiffness distribution design can work to create a shaft feel and performance that is different than what you may think, especially if you are still using a single measurement of butt section shaft frequency to make your conclusions about shaft stiffness for a golfer.

The following bend profile graph is created to compare the Dynamic Gold R300 and the Series 5 Steel R-flex iron shafts. Ever since the introduction of our own custom steel Series 5 design, clubmakers and their golfers have truly been amazed at the feel and performance of the Series 5 steel iron shafts. Comments like, “it is very ‘active’ and responsive,” “what a nice soft feel but yet sill snaps through the ball,” have been common from clubmakers who are frequently using the Series 5 when their fitting calls for a steel shaft in the irons.



The above bend profile comparison between the Dynamic Gold R3 and Series 5 R-flex shaft is a perfect example of two very important points of shaft fitting and design that can only be realized by bend profile analysis.

First, making flex decisions on the basis of a single butt frequency measurement of a shaft can be completely misleading. If you look at the butt section stiffness profile of the Dynamic Gold and Series 5 steel shafts, you see that the Dynamic Gold is 10cpm stiffer in the butt section. Thus if a clubmaker only uses a single frequency measurement of clamping the butt end of the shaft in their frequency analyzer, they would think that the Series 5 R flex is a full flex less than the Dynamic Gold R300. However, if you continue your study of the two shafts' bend profile curves, you will see that at a point 15" down from the butt, the bend profile curves cross, which indicates that in the center section of the shaft, the Series 5 becomes very slightly stiffer than the Dynamic Gold. Then continuing down to the tip section, it can be seen that the Series 5 becomes some 30+cpm stiffer than the Dynamic Gold. Thus the entire bend profile stiffness design of the Series 5 is somewhat opposite to the Dynamic Gold. Interestingly, as proven by real human testing and feedback from thousands of Series 5 shafts being used in custom fitting, the Series 5 exhibits a feel and performance that is "slightly soft over all but with a very responsive and crisp tip feel". In other words, golfers who have liked the feel and performance of the Dynamic Gold can easily be fit into a Series 5 steel and very much like its feel and performance.

Second, looking only at a tip frequency measurement and making conclusions about the feel and flight performance of a shaft can also be misleading. If you look at the tip section profiles of the Series 5 and Dynamic Gold, you see the tip section stiffness of the Series 5 is over 30cpm stiffer than the DG. In NO WAY is the frequency difference of the tip of any shaft the same as for the butt section of a shaft. A difference of 10 cpm in the butt section frequency between two shafts is equivalent to a 40-50cpm difference in the tip section frequency between two shafts. This is because the tip is so much smaller in diameter than the butt.

With the Series 5 being 10cpm softer in the butt section but 30cpm stiffer in the tip section, this “reversal” in the design between the two shafts has the ability to create a final stiffness feel for the Series 5 that is firm overall but with an active tip feel. Because of this type of “reversal” of the bending stiffness distribution between the Series 5 and the Dynamic Gold, the Series 5 would still satisfy the overall stiffness feel of a golfer fit with a DG, but because of the tip section design would hit the ball very slightly higher, and with slightly less of a tip firm feel.

We at TWGT realize that there is much, much more work to be done to keep comparing shaft bend profiles and cross-reference that with real fitting feedback from clubmakers and golfers so that more conclusions can be made which will guide clubmakers to more accurate shaft fitting recommendations. We plan to keep up the work and provide more information in our publications and web site over the course of this year and on into the future. But we are really excited because we do believe with this type of shaft to shaft comparison, it will be possible to do a better job of pinpointing shafts for players.

Important Initial Conclusions from Bend Profile Analysis:

1. In no way can a single measurement of butt frequency be used to describe the flex of a shaft, or used to determine if a shaft is “stiff enough” for a golfer. To do so would totally miss the potential for using a shaft that is designed with the center and tip section stiffness to offset a butt stiffness that is lower than what you might think indicates the “flex” of the whole shaft.

2. The difference in frequency measurements at the butt and tip ends of a shaft are totally different in their effect on stiffness and stiffness feel. While a 10-15cpm difference in the butt stiffness does indicate a full flex letter code change, it requires a 40-50cpm difference in the tip section frequency to indicate the same full flex level of stiffness change in the tip of the shaft. This is because the tip section is always far smaller in diameter than is the butt section of the shaft.

3. The same feel and flight performance can often be achieved through a complete reversal of stiffness distribution in a shaft. Again, this leads back into point number 1 – you cannot look separately at the butt or tip section stiffness alone and make conclusions about the performance of a shaft. You have to look at the entire shaft distribution of its stiffness before any conclusions can be made about a shaft’s performance for a golfer.

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MOI Matching of Clubs Now a Reality

Excerpts from emails received from clubmakers who are using the new TWGT MOI Matching System in their custom clubmaking work:

“I am falling in love with MOI. It can help so many golfers. I fitted my first pro last week and he is totally amazed.” Christopher Lynas – Lynas Golf Company

“The MOI program is amazing and I am just happy to have the access to the opportunity for MOI matching. I have been using it with much success. I have already completed about six sets, (including my own). The results are better than what I had experienced at Swing Sync in the early ‘90s.” CJ Ebel – Match Play of Pinehurst

Matching the swing feel of golf clubs by Moment of Inertia instead of swingweight is now possible with the completion of the TWGT MOI Matching System, and the clubmakers who have jumped in with both feet are finding the results quite amazing for their golfers.

We know that when we try to move any object, it resists our efforts according to its mass. If a mass is tied to the end of a string and rotated around, it offers a certain resistance to our efforts. If the string is lengthened, it is more difficult to make one revolution in the same time as before because the MOI of the entire ball and string as one object has been increased. Therefore, if we consider the object in our example to be a golf club, the MOI is a measurement of the golf club’s ability to resist our ability to rotate the golf club around our body.

The MOI of the golf club is the parameter that resists our efforts to swing and rotate the club around our body in the swing. A golf club that has a large MOI will require more effort to swing than a golf club that has a smaller MOI. The proper MOI of the golf club for the golfer thus has a direct bearing on the golfer’s strength, swing speed and the amount of control that the golfer has on the golf club when accelerating during the downswing to generate the energy potential needed to propel the golf ball. The energy potential of the golf swing can therefore be optimized by adjusting the MOI of the golf club to suit a particular golfer.

In MOI matching, it is critical to determine what exact MOI is best for each golfer. Because MOI can be unique for each golfer, this is why the major manufacturers of standard made golf clubs will never be able to offer their golf clubs in MOI matched form. Thus the potential for clubmakers to offer this unique fitting option to golfers that can truly improve EACH golfer’s performance can be quite significant to the future growth potential of their business. When the right MOI for the golfer is identified, the TWGT MOI Matching System will enable clubmakers to build golf clubs to a matched MOI so that all of the clubs in a set will require the same energy to swing. When this is done, the golfer should experience an improvement in consistency to strike the ball on-center a higher percentage of the time, which in turn will translate into greater distance and better accuracy overall.

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