CLUBMATE GOLF AUSTRALIA
GOLF CLUB COMPONENTS

eTECHREPORT

July 2004 eTECHreport - Welcome!

- The 949G/Ti has arrived! – if you haven't already, visit the description page here.
- A tour through the TWGT Trajectory Software is now online.
- The TWGT Forum continues to thrive. .

- **TWGT Robot Report**

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- **New Models Now Available**

  It may have been the singer Neil Young who coined the term, “Rust Never Sleeps”, and neither do we at TWGT when it comes to increasing our design options for clubmakers! [continues below]

- **949G/Ti Released and Proving Performance**

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- **TWGT Promotional and Instructional Videos Coming Soon**

  We have the technology! TWGT is pleased to announce that we have acquired the capability to begin producing our own video presentations. [continues below]

- **TWGT Inks Deal to Write Consumer Book Promoting Clubmaking**

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- **Clubheads Have More than One Different MOI Measurement that’s Important**

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TWGT Robot Report

CAD drawing of the TWGT Testing Robot

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In early June, I met with the graduate engineering students at Northern Arizona University to go over the final design of the new TWGT Testing Robot. The students took on the challenge of designing a totally new testing robot for TWGT to fulfill their Capstone Senior Engineering requirement for graduation.

Seven student engineers, four specializing in the mechanical engineering tasks, and three in the electrical and computer engineering side of the project comprised the full design team tackling the complex project of creating the TWGT hitting robot. The team was supervised by the advisor to the NAU engineering department whose role it was to offer input and professional direction for each aspect of the robot design.

The meeting to present and discuss the final design of the robot prior to construction of the working prototype consisted of myself, the lead students for both the mechanical and electrical/computer engineering teams, and NAU’s engineering department advisor. During the meeting we went over gigabytes of computer design and modeling files, looking at each aspect of the mechanical design of the robot from the platform to the complex function of the arm. The robot’s arm is the most unique element in the design. I was pleased to see the students were successful in

engineering the robot's arm to be able to change its Moment of Inertia during the downswing. No other robot does that, which is a critical par of replicating how a human swings the club on the downswing.

In the human swing, when we unhinge the wrist-cock on the downswing, the moment the angle between the arms and the club begins to unhinge, the arms begin to slow down and lose acceleration while the club speeds up. TWGT's robot will accomplish the same action through the use of a new multi-processor servo-motor which will receive its power commands from the custom Visual Basic computer operation program that will run the entire robot and all of its actions. At the meeting, the action of the arm and variable wrist-cock release was shown as well as the operation of the servo-motor and all of the electronic parts that will drive the robot.

The only aspect of the design that we chose to re-create was the action of the rotation of the wrist on the downswing. Initially the students had felt this should be variable to simulate the fact that some golfers leave the face open or rotate it closed at impact, so they had designed the pronation to be controlled by a second, smaller servo-motor. This double servo-motor design was proving to be overly complex to program in concert with the main servo driving the arm for different swing speeds, so there was concern about whether this could be a problem in programming the operating code.

Fortunately, I finally had a decent idea to contribute to the meeting when I told them the easiest way to simulate impact, in which the golfer left the face open or rotated it closed, was simply to adjust the position of the club in the robot's grip holding fixture! After everyone had one of those good laughs prompted by "paralysis from over-analysis," it was agreed that the pronation action would be re-designed to be mechanical in its operation.

Next step for the TWGT robot will be to build the Visual Basic operation program and use a far more robust engineering dynamics software package recently made available to the lead mechanical engineering student to model and re-analyze all of the mechanical parts to be sure of their ability to perform properly and withstand all possible stress of operation up to a maximum swing speed of 130mph. After that, the construction of the robot prototype will commence to enable real world testing to determine if any final design adjustments need to be made. Thus while the timing for completion is going to be a little later than what had been initially planned, everything is definitely a "go" with TWGT's project to complete a totally new more human-like hit testing robot!

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New Models Now Available

It may have been the singer Neil Young who coined the term, "Rust Never Sleeps", and neither do we at TWGT when it comes to increasing our design options for clubmakers! This month we are pleased to introduce a number of new clubhead models to allow clubmakers to further fit and build custom made clubs to help their golfers play better and enjoy the game more. All of these new TWGT models are arriving in Australia around the 10th of August. Contact us to pre-order yours today!

New PCF model Black Cobalt finished wedges

- After working with a number of firms to develop and test a new dark finish for wedges, we are very excited to introduce the new PCF Black Cobalt wedges.
- Available in 52° gap wedge, 56° sand wedge and 60° lob wedge in RH.
- Loft, lie, sole angle and headweight specifications are the same as the current PCF mirror Ni/Cr finished wedges.
- PCF Black Cobalt wedges are precision investment cast for specification accuracy from very soft HRB80 stainless steel, then vacuum chemical treated to create the beautiful Black Cobalt finish.

New 321-5 iron hybrid

- If you have been one of the many clubmakers to build and be amazed at the ease of play and superior performance of the new 321Li Hybrid ironheads, you'll be sure to welcome the addition of the 5-iron head to the line. If you have not yet tried the 321 hybrids, you are missing the absolute best true long iron replacement design in the entire golf industry.
- 321-5 iron designed with 28° loft, 60° lie, 254g headweight, bulge 20", roll 0" flat.
- .335" bore designed to work with the GI-335 graphite long iron shaft, or the Series 5 Steel 335 shaft. These specially designed and custom trimmed shafts are one of the real secrets behind the incredible launch and distance performance of the 321 hybrid long ironheads.
- Investment cast from 17-4 stainless with extra thick rear wall design to move the CG farther back from the face for higher launch angle.

New 939H Iron Additions

- 939H is TWGT's full set of matched hybrid and conventional irons that truly looks like a blended set of irons. New this summer to join the 939H family are the 2-pc hollow design #6-iron and AW gap wedge options.
- 939-6H allows clubmakers to extend the total game improvement 2-pc hollow construction all the way to the 6-iron. Most players looking for

game improvement help with stronger loft irons do not hit the loft of modern 6-irons as well as they do the 7- to the wedges. With the addition of the 6-iron in the same hybrid construction design as the #2, 3, 4, and 5 irons in the 939 set, clubmakers will be able to offer players a wider range of performance in the set. 939-6H has the same specifications as the solid conventional cavity back #6 currently available in the 939 set.

- 939-AW narrows the distance gap between today's typical PW and SW lofts. Cavity back, one-piece investment cast design with 52° loft, 64° lie, 284g headweight and 2mm offset hosel.

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949G/Ti Released and Proving Performance

If you'll forgive me for repeating myself, I'll say once again, "all good things take time." And this statement certainly applies to the new 949G/Ti driver that TWGT finally completed and began shipping. Final model testing and early reports from clubmakers has really made me feel good that the extra time I took to keep adjusting the production tooling and pushing the Center of Gravity (CG) farther back from the face was definitely worth it. I am so pleased that I had the opportunity to design the industry's first graphite + metal hollow body driver way back in 1995 because the experience definitely taught both me and our production foundry how to create the design so that it actually lived up to its design concept and performed as intended.

The whole reason for creating a woodhead in which heavier metal is replaced by light graphite composite is to allow a greater movement of weight around the head and therefore position the CG in a more extreme location inside the head than what is possible in an all-metal head design. In the case of the 949, my express goal was to push the CG farther back in the head than any other driver – this would allow the use of less loft on the face to achieve a higher launch angle. Thus if a large portion of the launch angle could come from the CG position and not simply the loft, the loft could be reduced slightly to keep the ball velocity from dropping. The result is a launch angle similar to that from other 12 degree drivers, but with a ball velocity commensurate with other 10.5 loft designs. The best of both worlds in other words!

We were able to design the 949 so that it performs as designed and still offers great feel and a favorable sound that is closer to an all-Ti driver without the dead sound of a graphite head. This was done through small metal braces inside the head, which prevents the impact vibrations from the face from being muted by the graphite.

In addition, the 949 becomes the second driver design line to incorporate TWGT's unique GRT face design. GRT, or Graduated Roll Technology is one of the reasons the 515 drivers have received incredible reviews from clubmakers and golfers this year. By eliminating the vertical roll radius curvature of the bottom of the face, the loft of the 949G/Ti is the same 10.5 degrees over the bottom 55% of the face. This ensures a much higher launch angle for low face hits than all other drivers that are made with typical full face roll curvature.

To verify our claim for more rear located CG, TWGT recently performed a measurement of the CG location of three of the industry's leading graphite and titanium driver designs. In addition, we also measured the CG on each of these three companies' all-Titanium driver heads of the same loft angle to investigate the difference between these companies' all-Ti and Graphite/Ti drivers. Following is that information:

TWGT Analysis of all-Ti vs. Graphite + Ti Driver Designs

Company	Model	Construction	Loft	Face Height	Face to Back	Vertical CG	Face to Back CG
Callaway	Fusion	Graphite + Ti	10	54mm	95.5mm	33.4mm	38.8mm
	Great Big Bertha II	all Ti	10	56mm	94mm	33.2mm	33.7mm
Mizuno	MP-001	Graphite + Ti	10	52.5mm	99.5mm	33.6mm	34.9mm
	Blue Rage	All Ti	10	52.5mm	96mm	33.2mm	34.0mm
Yonex	Cyberstar PowerBrid	Graphite + Ti	10.5	58mm	98mm	33.3mm	31mm
	V-Mass 400	All Ti	10.5	58mm	100mm	35.6mm	34mm
Wishon	949G/Ti	Graphite + Ti	10.5	55.5mm	97mm	33.5mm	43mm
	919CCG-380cc	Ti + Copper	10.5	57mm	104mm	35mm	38mm
	915CFE-360cc	All Ti	11	51mm	102mm	34.5mm	33mm

TWGT believes the reason for creating a graphite + titanium driver design is to use the opportunity to re-position weight in the head to make the graphite + titanium driver different in performance than an all-titanium design. One of the best ways to determine that is by comparing the vertical and the face-to-back locations of the Center of Gravity. If you look at the CG measurement data for some of the golf industry's all-titanium and graphite + titanium driver designs, you can see that only TWGT and Callaway have created their graphite + titanium drivers to have a more rear located CG than their all-titanium drivers. Mizuno's graphite + titanium model MP001 and all-titanium Blue Rage drivers have virtually the same CG locations, while in the case of the two versions of driver designs from Yonex, the company's all-titanium driver actually has a more rear located CG than their graphite + titanium design!

At TWGT we work very hard to create a different type of performance for each model we design. If you look at the CG locations for three of our popular driver models, you can see that the face-to-back CG location changes by 5mm between each model. Thus each model has a little different performance offering. In addition, we were able to move the face-to-back CG location of our graphite + titanium 949G/Ti 4.2mm farther back than the Callaway Fusion.

The other drivers measured in this comparison are manufactured to high standards of production by high quality foundries. It is not TWGT's intent to infer anything from this comparison other than to show design differences between drivers of similar construction. We take our work as original equipment designers very seriously at TWGT. We believe strongly that our models are conceived and designed with specific performance intent, and that we work hard to create designs that offer differences in performance and do perform as we intend. In sharing this information, we are pleased that the 949G/Ti is another solid, high quality TWGT design that if fit properly, will definitely benefit the golfer.

Visit the 949G/Ti page for details

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TWGT Promotional and Instructional Videos Coming Soon

We have the technology! TWGT is pleased to announce that we have acquired the capability to begin producing our own video presentations. This month we began work on marketing and instructional videos that will be made available to clubmakers in both VHS and DVD format to provide more information to improve your clubmaking skills and knowledge. In addition, we also have the in-house ability to compress and offer video information on our clubmaker and consumer web sites primarily for visitors with broadband internet access, or a ton of patience.

The first video project will be created as an addition to the TWGT Marketing Kit. The video is intended for serious clubmakers illustrating the quality of custom made clubs built from quality components. We are well aware that many consumers believe that OEM standard made clubs are superior to custom fit clubs built from components. Such beliefs come primarily from the large OEM's multi-million dollar marketing and player endorsement programs. We know that such beliefs are difficult for you to overcome on your own, so we're using our experience in golf equipment manufacturing and design to bring forth facts in a positive manner intended to better inform consumers of the truths about golf club design, production, fitting and performance.

We are committed to helping you in every way possible to increase your equipment knowledge, all for one simple reason: we truly believe and know that the best set of clubs any golfer will ever have is not a set of standard made clubs "bought off the rack"; they will be a set of clubs that are custom fit and built from high quality components. To get that message to golfers and convince them where they will find the best clubs for their game will always be a major focus of our company.

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TWGT Inks Deal to Write Consumer Book Promoting Clubmaking

TWGT is committed to getting the word out to consumers that the best set of clubs you will ever get is a set YOU fit and build using our high quality and high performance clubhead, shaft and grip designs. In February, Tom Wishon was asked to be the Technical Advisor and write a monthly equipment article for the PGA of America's official web site, www.pga.com. In March, TWGT created the component clubmaking industry's only consumer web site, www.twgolftech.com, to help inform consumers that your skills and commitment in custom clubmaking will provide you with the best equipment.

This month, we're very proud to tell you about another project that is certain to get the word out. Ann Arbor Press has asked Tom Wishon and writer/clubmaker Tom Grundner to co-write a new book that Ann Arbor Press will promote and distribute that will educate consumers about the performance of golf equipment and tell the truth about custom built vs. standard OEM off the rack clubs. Ann Arbor Press is the sports book division of Sleeping Bear Press, the sole distributor for the Harry Potter books in the US.

That means that in time for the Christmas holiday season, Tom's new consumer golf equipment book will be offered for sale by every major retail bookselling chain in the US, as well as all major internet bookselling companies.

I have always wanted to write a book that would tell the story about real golf club performance and be able to educate consumer golfers about the differences between OEM clubs bought standard, off-the-rack and the custom clubs that clubmakers create. The fact that Ann Arbor Press expressed a similar interest and contacted me to do the project is a

fantastic break for custom clubmaking because they have the clout to get the book into major bookselling outlets nationwide.

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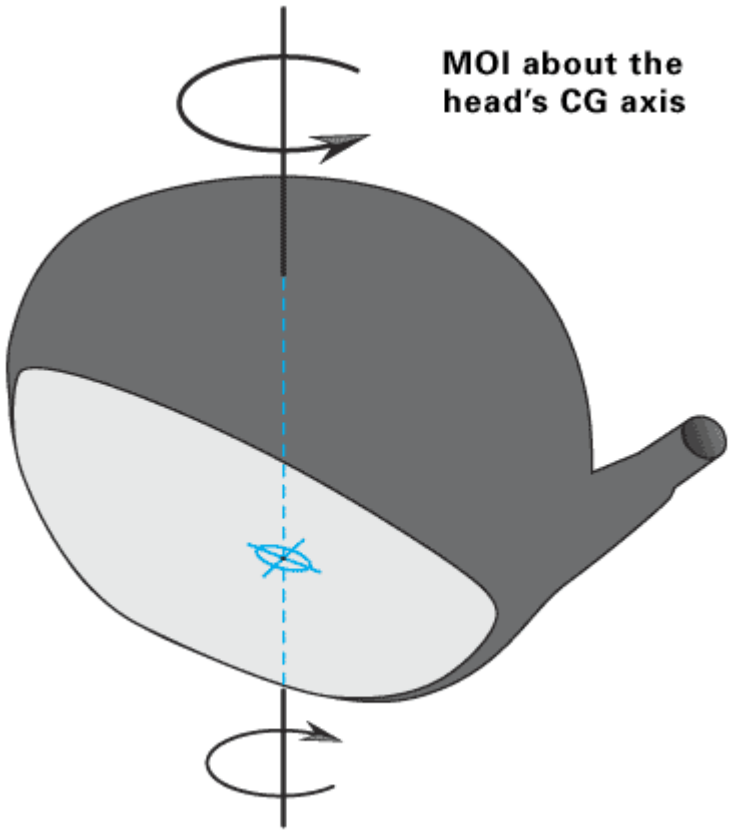
Clubheads Have More than One Different MOI Measurement that's Important

Moment of Inertia (MOI) as it relates to golf club performance can be a very confusing subject. In a golf club, we can look at MOI for the whole assembled club and we can look at MOI individually for the head, shaft and grip of the club. But for now, let's forget the MOI of the assembled club and focus only on the MOI of the clubhead itself. As you know, MOI is a parameter that offers an indication of the clubhead's resistance to twisting. However, when you talk about a resistance to twisting, you have to define an axis of rotation, because twisting can only occur around an axis. For an indication of real clubhead performance, you have to look at the MOI of the head about its own center of gravity (CG), but you also have to look at the head's MOI about the axis of the shaft bore. Both MOI's of the clubhead are equally important to performance.

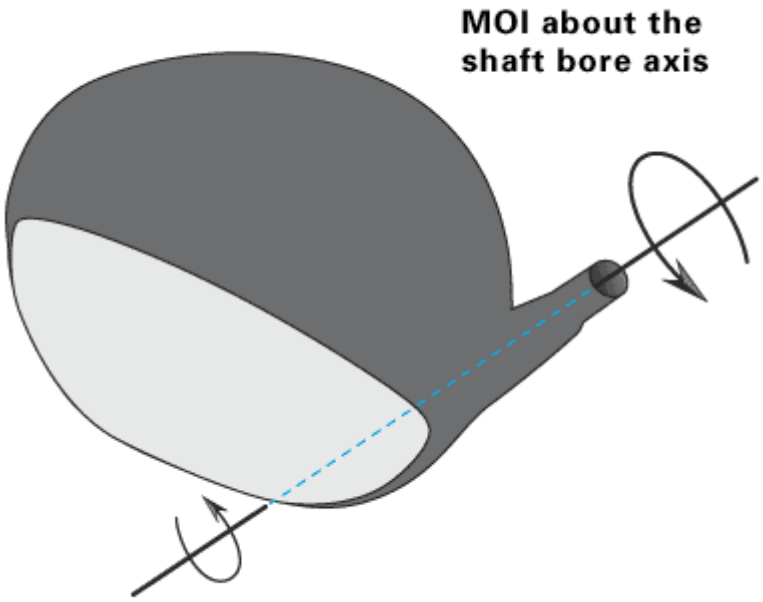


Most clubmakers and golfers interested in golf equipment technology think only about the MOI of the head about its CG. This is the MOI that determines how much energy the ball can lose when impact is made with the clubhead toward the toe or heel. Because there is always some energy loss when the ball is hit on the toe or heel side of the CG axis in the head, common sense says that the only golfers who should use a clubhead with a low MOI about the head's CG axis would be those players who never hit the ball toward the toe or heel! Since we know that applies to no golfer who ever played or will play the game, common sense says that all golfers should use a head with a high MOI about its CG axis, providing they can find the one that looks good in the playing position for confidence, and possesses loft, lie, sole angle, sole radius, etc specifications that match well with the way they play and swing the club. The higher the head MOI about its CG axis, the more distance could be retained for shots that are hit toward the toe or heel – well sort of.

From a real PRACTICAL sense, in ironhead and putter head design, once you create a moderately deep cavity on the back of the head with the weight removed re-distributed around the perimeter or toe/heel/rear of the iron or putter head, you have covered the majority of the possible distance-loss that most golfers will ever be able to SEE and

experience. Making the iron or putter head a little larger, designing the ironhead cavity deeper or the putter head with more heel/toe/rear weighting will increase the measurement of the head's MOI about its CG axis, but will not deliver a truly visible difference in off center hit success to the golfer.

But now let's shift to the other MOI of the head, the MOI that is measured about the axis of the shaft bore. The farther that the CG of the head is away from the shaft bore, the higher will be the MOI of the head about this axis of the shaft. A head with a high MOI about the shaft axis will be more difficult for the golfer to return to the square face position at impact. This is because during the backswing, we all rotate the clubhead open to achieve the proper position at the end of the backswing. On the downswing, we have to reverse that and rotate the head back again as we come back to the ball to hit the shot straight. The higher the MOI of the head about the axis of the shaft, the more resistance the head will have to the rotation of the face back to square. It is then possible for a head with a very high MOI about its own CG could also display a very high MOI about the shaft axis. If so, then the golfer could end up with a head that delivers less distance loss from an off center hit, but ends up hitting the ball out to the right in the rough or over the fence out of play.



People who slice/push the ball are better off with a head that has a low MOI about the shaft axis, while people who hook/pull the ball could be better off with a head that has a high MOI about the shaft axis. However, this design factor in a head has to be observed individually for each golfer. Of course too, this factor can be overcome/enhanced by the proper face angle in the woodhead model, or offset of the hosel in a wood or ironhead as well. A one degree CHANGE in woodhead face angle can represent a side-to-side movement of 5-7 yards in ball flight, while offset in the hosel design can allow just that split second of extra time before impact so the golfer can rotate the face just that little bit more back toward square and possibly keep the ball from hanging out to the push/slice side of the fairway.

Thus from a practical fitting standpoint (hmm, where have I heard that term before???) it is always best to think about the best face angle for the golfer's directional needs when fitting golfers with larger woodhead designs that typically have a higher MOI about the shaft axis.

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