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## FOCUS: Smash Factor

In the analysis of a golf shot, “smash factor” is referred to increasingly in the golfing community. This in-depth interview with Fredrik Tuxen – CTO at ISG and the inventor of TrackMan™ – touches upon the relevance, measurement, and maximization of smash factor.

### What is the smash factor?

The smash factor is the ratio between ball speed and club head speed.

$$\text{SMASH FACTOR} = \frac{\text{BALL SPEED}}{\text{CLUB HEAD SPEED}}$$

### What does smash factor tell a golfer about a shot?

As a parameter, it is an expression of the player’s ability to generate ball speed based on a given club speed. Technically, the smash factor says a lot about the centeredness of impact and the solidity of the shot - there is a strong correlation between the degree of centeredness at impact and the obtained smash factor.

### How important is smash factor as a launch parameter?

It is very important – and to be honest, it is much more important than many think. Especially for those amateurs that try to swing too hard at the ball. By trying to achieve a high club speed, they lose control and don’t obtain a solid, centered impact, resulting in a relatively low smash factor, far from what is optimal. When working with TrackMan™, the amateur and the pro should focus a lot more on ball speed and the smash factor in order to improve their ball striking. This is the reason why we have deliberately taken club speed away from the first page on the TrackMan™ screen and moved it down to page 3. We want players to focus on what is really significant to improve in their swing.

Let me give you an example. With a club speed of 100 mph and a smash factor of 1.40, the ball speed is 140 mph. But if the golfer could obtain a smash factor of 1.48 with a more controlled swing having a lower club speed of 98 mph, the ball speed would be increased to 145 mph – i.e. an additional 5 mph ball speed by swinging slower. Since 1 more mph ball speed (all other things equal) will generate 2 more yards carry, an extra 10 yards is added to the drive in this case by swinging with more control! Further, the more controlled swing will most likely have a very positive effect on dispersion.

### What is the highest smash factor you can obtain?

The laws of physics do put some limitations on what is possible.

Even though you may impact the ball dead-center on the club face, so the ball departs on a line that goes directly through the Center of Gravity (CoG) of the club head, there are 3 more factors that determine the maximum obtainable smash factor:

- 1) coefficient of restitution between club and ball (COR),
- 2) the SPIN LOFT – the angle between club face orientation and club head direction (see TrackMan™ newsletter #1 and #2), and
- 3) the mass ratio between ball weight and club head weight.

The equation below shows the maximum obtainable smash factor assuming a dead-center hit:

$$\text{SMASH FACTOR} \approx (1 + \text{COR}) \frac{\cos(\text{SPIN LOFT})}{1 + \frac{\text{BALL MASS}}{\text{CLUB HEAD MASS}}}$$

For the coefficient of restitution, USGA and The R&A have limited golf clubs and balls to a maximum COR of 0.83.

While the spin loft could theoretically be 0 deg, it is impractical since this would mean something like a 0 deg lofted driver with a zero flex shaft producing 0 rpm of spin! The lowest realistic spin loft for a driver is around 8 deg.

As for the ball, the maximum allowed mass is 45.93 g, with no lower limit. However, it turns out that almost all golf balls have a mass above 45 g since the heavier weight makes the ball slow down less during flight (due to air resistance). For the club head mass, there are small variations among drivers. They typically range from 197 to 201 g, with tour pros using 202-207 g. The heaviest driver head I have heard about is 212 g.

By inserting realistic numbers in the equation above for maximizing the smash factor (COR 0.83, SPIN LOFT 8 deg, mass ratio 45/212), the highest realistic smash factor is 1.494.

A word of caution, before you start putting lead tape on your driver to make it heavier, that the heavier the club head the harder it is to generate club head speed. Maximum ball speed for a 45 inch driver is obtained for most people with a club head weight around 200 g. See “Search for The Perfect Swing” by Cochran and Stobbs for a study on how the club head speed varies with club head weight.

### What is a good smash factor?

This depends highly on what club you are looking at and what ball type you are playing. For a driver with a premium ball, as an amateur, your smash factor should be above 1.42 and if you have elite ambitions, you should not be below 1.47. Tour pros should aim for nothing less than 1.48 as a minimum.

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## FOCUS: Smash Factor (continued)

But do note that if you are hitting the very common high durability range balls the effective COR can easily be as low as 0.73 which will limit the smash factor realistically to about 1.41!

### How much does the smash factor vary from club to club?

By using the equation above and assuming standard loft as being the SPIN LOFT and average male club head weights, the theoretical optimal smash factor throughout the set is shown in Table 1. For illustration, the corresponding club head speed and ball speed is shown where the club head speed has been scaled to match the average for the PGA TOUR.

CLUB	CLUB SPEED [mph]	SPIN LOFT [deg]	BALL SPEED [mph]	SMASH FACTOR $\square$
Driver	112.6	10.0	167.9	1.49
3 wood	107.0	15.0	158.4	1.48
5 wood	103.0	21.0	149.6	1.45
3 iron	97.8	21.0	142.1	1.45
4 iron	95.8	23.5	137.2	1.43
5 iron	94.3	26.0	132.4	1.40
6 iron	92.3	29.0	126.7	1.37
7 iron	90.0	33.0	119.2	1.33
8 iron	86.8	37.0	111.0	1.28
9 iron	85.3	41.0	103.3	1.21
PW	83.2	46.0	93.7	1.13
SW	80.7	56.0	75.1	0.93

**Table 1:** Optimal smash factor from spin loft. Assuming premium ball being used.

The results in Table 1 agree very well with our observations of male and female tour pros for longer irons and woods. Some examples are presented in Table 2.

CLUB	OPTIMAL from SPIN LOFT	PGA #1	PGA #2	PGA #3	LPGA #1	LPGA #2
Driver	1.49	1.50	1.48	1.48	1.49	1.49
3 wood	1.48	1.47		1.47	1.48	1.48
5 wood	1.45				1.48	1.48
3 iron	1.45	1.40	1.40		1.48	
4 iron	1.43	1.40	1.40	1.46	1.48	1.46
5 iron	1.40	1.38	1.39	1.45	1.44	1.42
6 iron	1.37	1.36	1.38	1.41	1.44	1.40
7 iron	1.33	1.32	1.34	1.40	1.39	1.35
8 iron	1.28	1.28	1.31	1.37	1.35	1.34
9 iron	1.21	1.22	1.26	1.34	1.30	1.27
PW	1.13	1.19	1.21	1.28	1.27	1.21
SW	0.93			1.14		
<hr/>						
Club Speed 5 iron		98.4	94.9	93.9	82.1	78.0
Club Speed Driver		109.8	107.6	114.8	94.6	91.2

**Table 2:** Smash factor of PGA and LPGA players.

In general, both the PGA and LPGA players seem to be right at the optimal smash factor - and sometimes actually slightly above. In particular on the shorter irons, the pros are achieving a higher smash factor than what is reasonably expected from the club loft. The likely explanation for these high smash factors is that the spin loft is actually lower than the club loft which will be the case if the ball is impacted with the hands leading the club head.

Another interesting observation in Table 2 is that LPGA players seem to generate higher smash factors for the longer irons in particular. A possible explanation for this is that there is a small increase in club/ball COR at lower club head speeds. Also the ladies tend to use more cavity back type of clubs which has slightly higher COR and slightly lower loft than corresponding blade type which is preferred by most PGA Tour players.

### Have you come across any smash factors on the pro scene that stand out, positive or negative?

One thing I have found very remarkable is how consistently the tour pros are able to produce smash factors of 1.48 and above with their drivers.

One of the biggest concrete surprises I have had was when we had the Danish European Tour player Mads Vibe-Hastrup in front of TrackMan™ with his driver.

Mads initially had a smash factor of 1.42 (110 mph club head speed, 156 mph ball speed)! Interestingly enough, he was launching the ball at 14 degrees with a spin rate of 2500 rpm, so if you only looked at the ball speed, launch angle and spin rate, the data would look very close to optimal. But by measuring club head speed and ball speed independently, thus having a fully measured smash factor result, we could immediately see that something was very far from optimal.

It turned out that Mads was hitting significantly down on the ball and impacted the ball high on the club face, slightly towards the heel. As you can read elsewhere in this newsletter, Mads achieved the 1.48-1.49 smash factor with a significant distance increase in return for his hard work on TrackMan™.

Another surprise was LPGA player Natalie Gulbis during Wendy's 3-Tour Challenge in 2007 (see also newsletter #2). She was consistently getting smash factors around 1.42. So despite her very nice positive attack angle, she was at this event losing about 12 yards carry compared to her potential.

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# FOCUS: Smash Factor (continued)

## How does TrackMan™ actually measure smash factor?

While the calculation of smash factor is simply the ratio between ball speed and club head speed, there are some details that are worth noticing. The ball speed is very well defined, and TrackMan™ measures the ball speed directly within 0.1 mph.

However, with the club head speed things are not quite as simple. It might be a surprise to many golfers, but the club head speed actually varies significantly depending on where on the club face you are looking. On average there is a 14% difference between heel and toe speed. This means that if you have 100 mph club head speed in the center of the club face, the speed of the heel will be around 93 mph and the toe 107 mph. This is primarily due to two things: 1) the further distance from grip to the toe of the club compared to the grip to heel 2) the rotation of the club head during the downswing. Likewise, the club head speed low on the club face is higher than high on the club face.

TrackMan™ always refers to the club head speed at the center of the club face, but because of around a 3/8 inch uncertainty of the location of the radar reflection point on the back of the club face, this leads to an accuracy of the club head speed measurement of the TrackMan™ of ±1 mph with reference to the center of the club face.

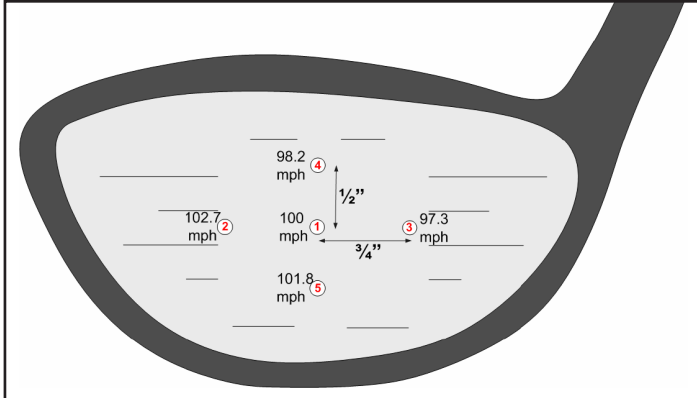


Figure 1: Typical club head speed variation across the club face.

Let me give you an example of how this affects your smash factor measurement: Let us assume a club head speed of 100 mph (in the center of the club face) with a dead center ball impact producing 148 mph ball speed. This should theoretically give a smash factor of 1.48. However, due to the uncertainty of the exact location of the club head speed reading of the TrackMan™, the smash factor might be measured somewhere between 148/101 and 148/99 (1.465 to 1.495).

Let us then take the other case where the ball is impacted at the 5 different locations indicated on the club face above but having the club delivered with the same speed and spin loft to the ball (Figure 1). The club head measured by the TrackMan™ is independent on

where on the club face the ball is impacted, so this will be 100 mph for all the 5 different impact locations. In the table below, an example of a realistic variation of the COR variation across the club face has been used. Maximum ball speed is obtained with impact 3/4 of an inch towards the toe despite the lower COR of 0.81 at this point on the club face.

IMPACT	CLUB SPEED [mph]	COR	BALL SPEED [mph]	TrackMan SMASH FACTOR	Theoretical SMASH FACTOR
1 CENTER	100.0	0.83	148.0	1.480	1.480
2 1/4" TOE	102.7	0.81	150.3	1.503	1.463
3 1/4" HEEL	97.3	0.81	142.4	1.424	1.463
4 1/2" HIGH	98.2	0.82	144.5	1.445	1.471
5 1/2" LOW	101.8	0.82	149.8	1.498	1.471

Table 3: Smash factor variation across club face. Assuming no club head rotation due to off-center hits.

If the smash factor was calculated from straight theory (last column in table 3): ball speed divided with the club head speed at point of impact, the smash factor producing the highest 150.3 mph ball speed would come out as 1.463.

Since ball speed (together with launch angle and spin rate) is what matters for the ball flight, by using the center of the club face as reference for the club head speed measurement, maximizing your TrackMan™ smash factor means also maximizing your ball speed for a given physical strength.

This means that in the case the ball is impacted towards the toe (higher club head speed) but still with a high COR and no loss of energy due to twisting of the club head during impact, the theoretical maximum smash factor might be 1.48, but the TrackMan™ smash factor could come out higher.

## Are there more smash factor discoveries left to make?

We have so far spent most of our time looking at smash factors for drivers. We have now started looking at smash factors for irons. The tour pros seem to generate a slightly higher smash factor with their irons, especially the shorter ones, than what you would expect from the loft of the club. So we are currently analyzing the tour pros' club delivery – in particular attack angle and dynamic loft to understand more precisely what the world's best ball strikers are doing. The results of this will be very valuable for both fitting and instruction.

## Soren Kjeldsen - A Tour Pro With A TrackMan™ Edge

European Tour top profile and Ryder Cup contender, Soren Kjeldsen, was an early TrackMan™ adopter. The product fitted him instantly like a glove and has given him significant yield – and he did not have to wait long for it...

Soren Kjeldsen is one of the pioneers among tour pros working with TrackMan™ – actually, the Dane was one of the very first tour pros to purchase one. TrackMan™ News caught up with Soren right after the Malaysian Open, asking him to look back on the long-term investment decision he made in August 2006.

“At the time of purchase, I had tested TrackMan™ extensively and I had quickly realized what great value it contained. It was just so good. I had already a fundamental competitive edge in my wedge game but I wanted to do more to enhance this edge. Furthermore, I was always looking for something that could make my practice a bit sharper regarding distance control. When I had tried out TrackMan™, I was completely sold. I was also testing some drivers at that time, and in that area too, TrackMan™ was indispensable. I like going into details and being precise, so in a way this product suited my profile perfectly. The purchase decision for TrackMan™ was not a challenging one for me... I could simply not afford not to own a TrackMan™”.

Kjeldsen is known as a very hard-working tour pro with a strong will, having worked himself up the ladder on the professional tours. However, he also finds inspiration in the gaming side of the product.

“Working with a TrackMan™ makes practicing more fun. All of us tour pros work hard to be able to do what we do to begin with, so anything that helps and boosts one’s practice while making it more fun has a double positive effect. In this context, TrackMan™ definitely added something new to my practice”.

### Rapid return on investment

Having purchased his TrackMan™, Soren went into hard core practice mode with his new (working) tool, and concrete results were almost instantaneous. A month after the investment was made, Soren finished T4 at the Omega European Masters on the difficult Crans-sur-Sierre course, and he followed that performance with two more top 10 finishes (T8 in the Alfred Dunhill Links Championship and T6 in the Mallorca Classic).

“TrackMan™ just had a massive effect on these performances, especially in Switzerland, on a course I had always disliked. As I understood after the tournament, my main problem had been the feeling of uncertainty in the high altitude. I did not know exactly how far the ball was flying - the standard estimation among the players that “it flies approximately 10% longer” did simply not work for me and my brain. So the first thing I did was to zoom in on “Find Your Distance” and went through my whole bag which took me a



Photo: www.sorenkjeldsen.com

“ The purchase decision for TrackMan™ was not a challenging one for me... I could simply not afford not to own a TrackMan™. ”

Soren Kjeldsen

full day, noting a great number of yardages. Then I knew exactly how far the ball was flying in that (high) altitude, and I had some new but correct yardages to assist me. I no longer had the enormous uncertainty, not knowing how far the ball flew.

I had 3 top 10s in a row, and TrackMan™ was a decisive factor in that run of form, but Switzerland was special as TrackMan™ helped me to a mega success experience, solving a problem for me on a very tricky, non-favourable course.

You know, a lot of my colleagues come and ask me, “What does your TrackMan™ cost? Oh, that much..?”. Then I tell them that I picked up a EUR 85,000 prize money cheque in Switzerland the first week I used it seriously in a tournament, meaning the cost of the TrackMan™ and a lot more were covered week 1. That is normally a sufficient answer”.

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### Tour pros who own a TrackMan™

- Darren Clarke
- Ian Poulter
- Niclas Fasth
- Steve Lowery
- Graeme McDowell
- Jeff Quinney
- Robert-Jan Derksen
- Soren Kjeldsen
- Mark Wilson
- Marcel Siem
- Martin Kaymer
- David Howell

## Soren Kjeldsen - A Tour Pro With A TrackMan™ Edge (continued)

### Focus on wedge game

Soren uses his TrackMan™ extensively in practice, depending on where his game and focus are at the given moment. "The great thing is that there are so many parameters to address, and there are always some that are more important than others given the situation and the status of my game. I can still find new ways to use it. To be honest, I use my TrackMan™ a lot but I constantly get many new ideas about further use of it".

Yet, there is no doubt as to the area in which he uses his TrackMan™ most and finds the greatest value of the product. "I have profited mostly from TrackMan™ in my wedge game. I use my TrackMan™ every day in my wedge game as I practice wedge training for one hour, every day, all year round. I use very much time with this, not only practicing distances, but also playing small games with myself hitting shorter distances. I have a very good feeling with my TrackMan™. It's not as if I can say on the first wedge shot that it flies 118 yards, but after 5-10 shots - the conditions vary somewhat due to the grass, heat, humidity and other factors - I am no more than a yard wrong when I say how long it is. Furthermore, when I change my wedges, the TrackMan™ is very valuable as I can monitor the spin, making sure that the new wedges spin as much as I want them to but also that the old wedges spin enough to stay in the bag.

The wedge game has always been a force of mine, and I think this part of the game is somewhat overlooked on the European Tour, but TrackMan™ has just made me even sharper and enhanced this edge of mine. I hit my wedges closer to the pin than ever before, there is no doubt about that".

In his amateur years and in the early years on the European Tour, Soren was not among the longest hitters with the driver. His approach shots were significantly longer than the ones his competitors sent away at the greens. However, with hard technical and physical work Soren has reduced this distance gap, and TrackMan™ is helping him close it out.

"I remember when I played with a Great Big Bertha II, my ball speed with the driver was only around 155-156 mph so I shifted to a Callaway FT-3 with which I went to 158-159 mph. Through hard training, I tested a lot of small things – e.g. how to increase ball speed while maintaining the stability in the ball strike. Getting constant feedback on the changes I tried out was key here, and step by step I took my ball speed to 166 mph (around Tour average) which is my standard now in practice.

Confirming that the work with the longest club in the bag is paying dividends and has given Soren more confidence with the Callaway tool, he was T7 in Driving Distance in Malaysia "Even if only a few holes were measured, I know for a fact that not many were hitting it further than me in Malaysia".



Photo: www.sorenkjeldsen.com

“ Working with a TrackMan™ makes practicing more fun...so anything that helps and boosts one's practice while making it more fun has a double positive effect. ”

**Soren Kjeldsen**

### Secrets staying with Soren

When asked how he works specifically with his TrackMan™ and which games he plays to make his practice more motivating and rewarding, the reply is candid but limited, "I have my own ways with TrackMan™ - small secrets it has taken a lot of time to develop, trying to structure my practice optimally and covering every corner of my game. I cannot just serve that to my competitors, they will have to sort this out themselves".

Soren is likely to get more "TrackMan™ colleagues" out there on the tours in the years to come as he experiences a vastly increasing interest in the product, the TrackMan™ trend is strong. "Yet, to many it seems a bit strange that you roll your computer around, and as they haven't really tried working with it, they have trouble imagining how easy and user-friendly TrackMan™ is. People ask me how long it takes to set it up and are surprised by the "1 minute" answer. Furthermore, many players say, "I know very well how far I hit my wedges". Well, we are all different but that does not work for me. Many are not minded for this kind of product - well, that just gives me an edge over them. I wish TrackMan™ all possible success in the market place but given how good the product is, it would not hurt me at all if not everybody out there had one", Soren says with a smile.

After TrackMan™ News talked to Soren, he went directly to the WGC-CA Championship at Doral and finished 11 in a field that does not get tougher. The impressive performance will help Soren fulfill his objective to reach the top 50 on the Official World Golf Ranking - as will TrackMan™.

## TWGT - True Custom Club Design And Fitting

Tom Wishon Golf Technology  
Durango, Colorado



www.WishonGolf.com

Tom Wishon Golf Technology (TWGT) is recognized as one of the world's leading companies in custom club making design technology. In this interview, Wishon talks about the current custom club making trend and how TrackMan™ fits into it.

After 22 years in the component club making industry and leading the research and design departments for the world's largest distributors, Tom Wishon and his wife established TWGT in 2003.

Based in Durango, Colorado – a small mountain town with 15,000 permanent residents and three golf courses - TWGT has set out to develop and offer state-of-the-art club making technology in golf club design and custom club fitting technology to club makers around the world. Extensive engineering and design experience are behind the company's own club head, shaft, and grip designs, as well as club making technology products.

The size of any club maker's business is not a qualification for doing business with TWGT, but all customers are screened in order to ensure that all TWGT accounts will uphold high quality standards of true custom club making.

"We simply want to ensure that any golfer who puts their trust in a custom club maker will walk away with a positive feeling about the fitting experience and the best set of clubs he has ever played", Tom Wishon defines one of the missions of TWGT.

Tom Wishon has written literally hundreds of technical articles for key golf and club making publications around the world and has authored nine books on club making, shaft fitting and research, and custom club fitting. Two of them, *The Search for the Perfect Golf Club*, and *The Search for the Perfect Driver*, were chosen as successive winners of the Book of the Year for 2005-2006 and 2006-2007 by the International Network of Golf. Further, Wishon served for 13 years as a member of the technical advisory panel of Golf Digest magazine and is the Technical Advisor to PGA Tour Partners, the official magazine of the PGA Tour.

In his career, Tom Wishon has been recognized for creating sophisticated, industry-acclaimed designs for club heads, shafts, grips and club making/club fitting tools and technology products. He is credited with more than 50 golf industry design technology firsts and is still the only designer from the custom club making industry to have created models which have been used to win on



“ Due to the unique radar technology, TrackMan™ data are so much better than the output from competing products so we can simply not tell customers that if they use this other monitor, they will be okay. ”

**Tom Wishon**

*Founder of Tom Wishon Golf Technology*

the PGA TOUR, Champions Tour and in Ryder Cup competition. He has designed custom clubs for Scott Verplank, Bruce Lietzke, Ben Crenshaw, and has the honor of creating the last set of custom clubs used in competition by the late Payne Stewart.

### TrackMan™ brought accuracy above all

As a living club making institution, Tom Wishon is very well positioned to assess the impact of TrackMan™ as a technological asset in the golf world, e.g. in club making and fitting. He looks back a few years in time and analyzes TrackMan™'s entry into the industry.

"TrackMan™ came as a surprise at the time it hit the golf industry. We had come to a point where we were aware that we had to live with the imperfection of the existing launch monitors. The alternative was to go out and build a single prototype, and that was not likely to happen. I owned and used other launch monitors, but people then told me about TrackMan™, "Prepare to get rid of your other launch monitors, Tom, this may be as good as we think it is". I'm glad I did.

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## TWGT - True Custom Club Design And Fitting (continued)

We then met Fredrik Tuxen at the Byron Nelson Classic in Dallas, and Fredrik was also kind enough to travel to Durango to demonstrate it further to us. Immediately upon seeing the product in action, we asked him when he could ship us one - we wanted it as soon as possible”.

For a small company like TWGT, the USD 25,000 investment in something that was basically a tool in R&D and specific product development was a major step, also given the fact that unlike club fitters, TWGT was investing in a tool to enhance their R&D, and not looking at charging golfers for the use of the TrackMan™. Yet, there are no regrets today as the investment has been profitable in various ways. And Tom Wishon is very clear as regards TrackMan™’s major contribution to the golf industry.

“Accuracy above all. For instance, with the other 5-6 launch monitors I had experience with prior to TrackMan™, you never knew whether the spin read-out was accurate or not – that was something you were always very doubtful of. When TrackMan™ came along, it was able to read the ball all the way down range to landing, no competing products had come close to being able to do that. To those of us who were used to the other launch monitors, TrackMan™ was pretty spectacular.

With TrackMan™ we could suddenly trust that the numbers we got from our test data were correct, meaning that we felt a lot better making conclusions based on these data. Yet, that was just the beginning. Then came all the capability adding software updates where we’ve received so many new and valuable parameters on the golf club delivery, completely distancing TrackMan™ from anything else I had ever used”.

### TrackMan™ detects design differences

As regards the value TrackMan™ has brought TGWT, the effect has mostly been on the quality of the test data when developing new club head designs and performing club fitting research, “We help club makers get the right components to make better fitting conclusions to make better recommendations to their customers. In this context, one very important thing is that with TrackMan™ we can now see even very small, genuine differences in testing. Earlier, if there was a difference between tests of a specific design, we did not know where that change came from. By measuring things a lot more accurately, we can now detect and understand smaller differences, and we can tell whether it’s a significant change/difference or not - that is very important when designing new prototypes. With TrackMan™ we make more accurate designs and expand our fitting knowledge, in general, and hereby we also create high value to our customers in the process of creating great golf clubs”.



“ With TrackMan™ we make more accurate designs and expand our fitting knowledge, in general, and hereby we also create high value to our customers in the process of creating great golf clubs. ”

**Tom Wishon**

*Founder of Tom Wishon Golf Technology*

According to Tom Wishon, a second significant advantage is TrackMan™’s contribution to the image of his company, “We definitely tell our customers that we use TrackMan™ and that we use it a lot, that’s a marketing edge. To my knowledge, I believe we still are the only company in the custom club making side of the golf industry to use TrackMan™ in our R&D work. In that sense, TrackMan™ helps us market our company as a serious, knowledge-strong component club making vendor in the very high end of the industry”.

Many of TWGT’s customers ask for recommendations on launch monitors. The majority of the customers are small 1-man-businesses with limited resources but a strong need for accurate data, making a launch monitor purchase a substantial issue to consider.

“Due to the unique radar technology, TrackMan™ data are so much better than the output from competing products so we can simply not tell customers that if they use this other monitor, they will be okay. So instead we say, “Go to the bank and get a loan and get a TrackMan™. If you go out and promote it, you’ll make money eventually and you’ll be amazed what it can do”. Our customers can tell their golfers, “Okay, with 92 mph club speed and a 3 degree downward attack angle, you need a driver with these specifications”, making their sales effort stronger than before”.

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## TWGT - True Custom Club Design And Fitting (continued)

### The custom club making trend will grow

One of the causes nearest Tom Wishon's heart is for the average golfer to find the perfect golf club for him/her – a journey that his company tries to motivate and help.

“Every golfer should have custom fit clubs, that's the way it has to be. There is a myth out there that only good amateur golfers and pros can benefit from custom fitting – that is very wrong. The higher the handicap of the golfer, the bigger the room for improvement with custom fit clubs. I can drop an 18 handicapper 4-5 shots over night, but a 6 handicapper, I can maybe only drop 1 or 2 shots. Part of the explanation is that the higher handicapper usually doesn't have the athletic ability to adjust to what doesn't fit him. When the average golfer knows about the improvement he can make, this trend will really take off. He could get an instant improvement. We're slowly creating a tiny demand for custom fitting but the potential is enormous. The market will be receptive to professional custom fitting if it is explained to the golfer in understandable terms what needs to be changed in his golf club to make his game better...and my books confirm that”.

Tom Wishon and his colleagues mostly write about fitting issues with club makers as the target group. Yet, 3 years ago, he finally got to write a book for regular golfers, *The Search for the Perfect Golf Club*. “Maybe not a best seller novel, but it did sell more than 50,000 copies, indicating that there is an interest out there among the golfers. Our record of phone calls and e-mails proves that a high percentage of the people who read the book actually go out and find a club fitter and get fit. And we get many calls and e-mails from golfers who want to fly in to Durango, Colorado to get fit by us. That is a nice sign as well”.

### Increasing contact with European club pros

Last October, Tom Wishon was asked to speak at the PGAs of Europe Teaching & Coaching Conference (TCC) in Malmo, Sweden, where 500 pros from all over the world were present. He talked one-on-one with a lot of them, and many of them signaled that they had lost the ability to sell golf clubs. “Internationally, the retail stores and the Internet are such dominating players in selling clubs off the shelves. In the USA, 90% of all the premium brand golf clubs are sold by giant retail stores and Internet sites. When discussing with the European club pros, it was very easy to convince them that club fitting is better for golfers. And in the clubs where there were a great number of potential customers, it would make sense to buy a TrackMan™ to get their golfers to become more interested in how different clubs perform for them”.

TWGT will work more with European club pros in the years to come. For example, a shorter version of Tom's *The Search for the Perfect Golf Club* book titled, *12 Myths That Could Wreck Your*



“ Every golfer should have custom fit clubs, that's the way it has to be. There is a myth out there that only good amateur golfers and pros can benefit from custom fitting – that is very wrong. ”

**Tom Wishon**

*Founder of Tom Wishon Golf Technology*

*Golf Game*, is presently published in French, Dutch and Spanish, and will be available before the end of 2008 in Swedish, German and Polish. In this way, TWGT will assist the development of the custom fitting trend in Europe.

According to Tom Wishon, TrackMan™ and its accurate data are helping this trend develop. One example of this is collected in his home mountains.

“In Durango, the head pro of the Dalton Ranch Golf Club had heard that we had a TrackMan™ and came swiftly to us. We only had to put him on it for 5 minutes before he said, “This is unbelievable!” Soon, his club members wanted to know their numbers and now they are frequently at our R&D center being fitted on our TrackMan™. We didn't even push this, allowing the pro to book 5 fitting sessions per week. With our help and TrackMan™'s assistance, this pro sold more clubs last year than he had done in the 14 previous years he had been at the golf club. TrackMan™ had a tremendous effect in this sales boost – and with 15,000 people, Durango is not even a golf town! We built our R&D center so that we could do our own research and product development. But now I have to consider hiring a person for handling the fitting activities in the research center, as I feel the demand is there”.

## TrackMan™ Paper Delivered During The WSCG-V

At the heart of TrackMan™ technology is radar science, and with respect to the product and its industry leader position, Fredrik Tuxen delivered a paper based on TrackMan™ data for the Fifth World Scientific Congress of Golf.

In addition to his duties as CTO at ISG, Fredrik Tuxen also finds time to carry out academic TrackMan™ work. One result of these theoretical endeavors was a paper submitted for the Fifth World Scientific Congress of Golf (WSCG-V) in March this year. The paper, entitled “*Optimization of Driving Distance – Importance of Determining the Attack Angle*” was approved for publication in the WSCG-V Golf and Science Book, and Fredrik presented the paper at the congress in the category “Equipment and Technology”.

The key findings of Fredrik’s paper are that while there is consensus in the golf community that optimal driving distance is obtained from a straight shot hit squarely in the center of the club face, there are, however, many variations in the recommendations for optimal vertical launch angle and spin rate for a given club head speed. By using TrackMan™ to measure the club delivery, ball launch data, and ball flight trajectory, the parameters to obtain optimum carry can be studied. As it turns out, the impact variables attack angle and club speed are essential in determining the optimal ball launch conditions for a given golfer in both club fitting and instruction.

Some of these findings were originally revealed in the previous edition of TrackMan™ News in an interview with Fredrik highlighting the importance of attack angle.

Having a paper approved by the WSCG-V has been an enriching experience for Fredrik and ISG. “We are very proud since this is fundamentally a great recognition of our product - without TrackMan™, none of these thoughts would have existed. It is very important that we participate in such theoretical forums to discuss new insight and share knowledge. To do that does require some openness, but we feel that we have an obligation to contribute given the impact of TrackMan™ and the fact that we are an industry leader in our field”, Fredrik says.

\* For further information, read Fredrik’s paper at the following link:  
<http://www.trackmangolf.com/newsletter/may08/OptimizationofDrivingDistance.pdf>

\* All approved papers can be read in the WSCG-V Golf and Science Book. The book and other items from the Congress can be purchased through the order form available on the following link:  
<http://golfscience.us/>  
The WSCG-VI will be held in 2012.

\* Tom Wishon was invited to WSCG-V as a Keynote Speaker. The video of his presentation, “Past, Present, and Future of Golf Club Technology” can be watched at the following link:  
[http://golfscience.us/index.php?option=com\\_wrapper&Itemid=60](http://golfscience.us/index.php?option=com_wrapper&Itemid=60)



“ We are very proud since this is fundamentally a great recognition of our product - without TrackMan™, none of these thoughts would have existed. It is very important that we participate in such theoretical forums in the golf community to discuss new insight and share knowledge. ”

**Fredrik Tuxen**  
*The inventor of TrackMan™*

## Special TrackMan™ 3.1 eCoach Version Launched Today

A special eCoach version of TrackMan 3.1 software was launched today. The application is free to download and use, making TrackMan™ content easier to access and understand for many in the golf community. The TrackMan™ 3.1 eCoach version, which features an in-built simulator, requires only the availability of a PC.

Although TrackMan™ is easy-to-use and quick to set up, the software features are quite comprehensive. Further, many customers have expressed their desire to learn more about TrackMan™ content. Therefore, this special 3.1 eCoach version was launched today to satisfy those requests, as well as provide TrackMan™ customers an efficient and cost effective way to learn the software on their schedule. The eCoach software assistant will teach you how to use the TrackMan™ more effectively and communicate what needs to be known about golf club delivery and ball flight as well as the relation between these two concepts.

With eCoach, TrackMan™ users will encounter a guide who will pop up with navigation instructions, reminders, and control questions as the user goes through the different parts of the TrackMan™ software. For example, when using "Target Selection", the guide will appear to instruct the user how to set the target precisely. The well-informed guide will not only facilitate the journey through the technical parameters but will also bring along new features and insights, enhancing the knowledge of the user by delivering, among other things, Tour averages for the various parameters.

The TrackMan™ 3.1 eCoach version is for PC use. The software is primarily intended for potential TrackMan™ customers but maybe existing TrackMan™ customers could also develop new knowledge and find support using eCoach.

For information on how to access the 3.1 eCoach version, please send an e-mail to: [sales@isg.dk](mailto:sales@isg.dk)



## Tour Pro Case: Increasing Driving Distance

**Open de Madrid 2007 winner, Mads Vibe-Hastrup, recently felt a need to increase his driving distance. With TrackMan™'s assistance, his data improved dramatically as he after one week's hard work gained more than 20 yards in driving distance in the two following tournaments on the European Tour.**

The start of the 2008 season on the European Tour had not exactly been what Mads Vibe-Hastrup had hoped for. Six missed cuts out of eight tournaments and no finishing position in the top 30. This was not the way he expected to build on his impressive first victory in the Open de Madrid in October 2007.

There were several things to work on in the swing, but the longest club was a key issue. "My driver had been far from optimal and had therefore brought a lot of uncertainty into my game. I was not hitting my driver the distance I felt I could, optimally", Mads explains.

Confirming the distance issue, he was 4th from the bottom (no 173) in the driving distance category on the European Tour with an average yardage around 271 yards.

Mads and his swing coach, James Petts, therefore consulted TrackMan™ in an effort to detect and solve the main problems. On March 15, just 10 days before his entry in Open de Andalucia, Mads had his first shot analysis session with the driver. There were several negative signs: The first 10 shots revealed a very low average smash factor of 1.44 (club speed 108.4 mph/ball speed 156 mph). Further, his attack angle was -3.3 deg. Mads was not only hitting too much down on the ball, his ball impact was also clearly off center, hence the low smash factor.

Through various attempts to improve the data, Mads and his coach found out that he had to improve his angle of attack by coming into the ball on a flatter swing plane. Simultaneously, he also had to keep his back more towards the target going through the ball.

10 days of consistent, hard work on the TrackMan™ followed and 3 days before teeing off in competition at Aloha Golf Club, the numbers had changed dramatically. Testing on the range in Spain, Mads obtained an average club speed of 110.1 mph and an average ball speed of 164.5 (very close to Tour average). Further, his smash factor improved significantly to 1.49 and his attack angle improved to -0.2 degrees. As a result, his carry increased from 230 yds to more than 250 yds on many shots.

The positive effect on his driving distance in competition was also instant. Mads only played two rounds at Aloha but even after taking course conditions into account, his measured average yardage on two holes, 289 yds in Round 1 and 309.5 yds in Round 2\*, demonstrated tremendous improvement and reduced the distance of his approach shots significantly.



Photo: Claudia Dons

“ My driver had been far from optimal and had therefore brought a lot of uncertainty into my game. I was not hitting my driver the distance I felt I could, optimally. ”

**Mads Vibe-Hastrup**

During the following week at the Estoril Open, Mads had an average driving distance of 284.5 yds and hit a lot of fairways (43/52), stabilizing his driving game and leading to a T20 spot which was his best performance this year. Following the two tournaments, Mads went up 11 places (no 162) on the European Tour driving distance list.

Mads' work with the driver and his general swing changes are on-going, with TrackMan™ assisting him throughout the 2008 season. It remains to be seen where the newly acquired driving distance will take Mads the rest of the season.

\* In European Tour events, two drives are measured per round on holes chosen to counteract the effect of gradient or wind. The drives are measured at the point they come to rest regardless of whether they are on the fairway or not.

# Miscellaneous

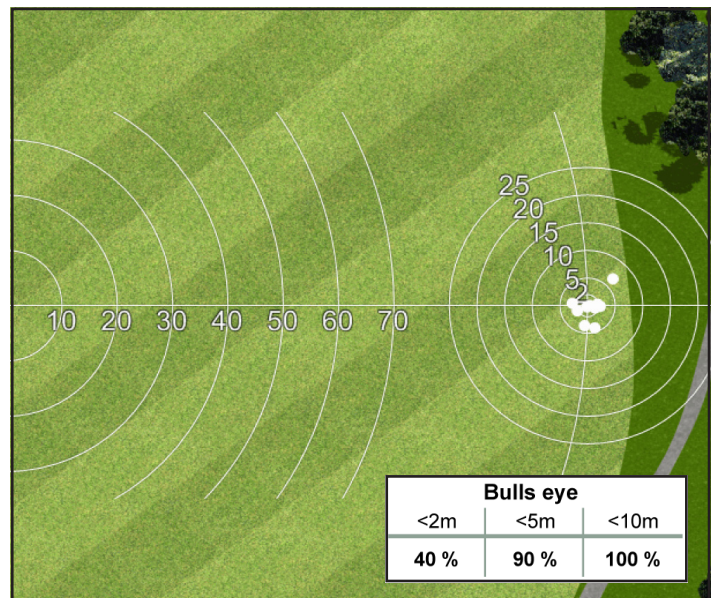
## Maarten Lafeber lands impressive new record in TrackMan™ approach shot test.

Dutch tour pro, Maarten Lafeber, carried out TrackMan™'s 105-meters Approach Test at Lake Nona, Florida, in April with the excellent score of 95 points out of 100 which is a new record from 105 meters.

With an average distance to the pin of 2.6 meters, Lafeber's 50 deg wedge looked to be one of the weapons behind his two top 10 finishes on the European Tour this season.



		LANDING				
Shot#	Mode	Club	Carry [m]	Side [m]	From Pin [m]	Points
<input type="checkbox"/>	1	Pro 50w	109.7	4.8L	6.7	8
<input type="checkbox"/>	2	Pro 50w	102.2	0.4L	2.8	9
<input type="checkbox"/>	3	Pro 50w	104.9	0.2R	0.2	10
<input type="checkbox"/>	4	Pro 50w	106.4	0.4R	1.4	10
<input type="checkbox"/>	5	Pro 50w	107.3	0.1R	2.3	10
<input type="checkbox"/>	6	Pro 50w	106.8	0.3L	1.8	10
<input type="checkbox"/>	7	Pro 50w	104.5	3.6R	3.7	9
<input type="checkbox"/>	8	Pro 50w	103.2	0.9R	2.1	10
<input type="checkbox"/>	9	Pro 50w	106.4	4.0R	4.2	9
<input type="checkbox"/>	10	Pro 50w	105.4	0.0L	0.4	10
<b>AVERAGE</b>			<b>105.7</b>	<b>0.4</b>	<b>2.6</b>	<b>95</b>



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