

Foresight Sports Europe Launch Monitor Guide



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Section 1

Launch monitors - an introduction

This guide will cover everything you need to know about golf launch monitors, from the different types of launch monitors to the specific data points that they measure. We will also look at the different ways a launch monitor can be used and how it can improve your game or assist with coaching and fitting.

Launch monitors have been a part of the golf industry for well over two decades. As the technology has become more advanced and user-friendly, they have soared in popularity, especially within the commercial side of the industry for club-fitting and coaching. In the more recent past, launch monitors have become increasingly popular with consumers looking to improve their golf at home or at the driving range.

Today, there are a variety of launch monitors available that provide data and measure golf performance in different ways. But, in general, they are all trying to provide crucial feedback about the flight of the golf ball and the delivery of the golf club. For coaching, fitting, professional tours and for home users of all abilities, launch monitors are proving to be a vital asset to fully understand each aspect of a golfers' game.

Learn more about the award-winning range of Foresight Sports launch monitors

[Click here](#)



What is a launch monitor?

A golf launch monitor is a piece of technology that is designed to measure the golf ball and in some cases the golf club, as accurately as possible.

The early launch monitors were used almost exclusively by manufacturers for the development of golf clubs, focusing heavily on the driver. The goal was simply to create the best combination of speed, launch angle and spin to generate distance.



2010



2017



2022

As the golf club manufacturing and fitting process became more sophisticated, launch monitors started to grow in popularity among PGA professionals who recognised the advantages of monitoring their swings. Golf retailers even began using them to provide consumers with the correct golf clubs for their individual requirements.

The next stage for launch monitors was to provide reliable golf club and club face feedback. This information provides coaches with an incredible tool to give players a complete analysis of their swing, and an understanding of why the ball flies a certain way. The introduction of launch monitors for golf coaching has been proven to increase the rate and longevity of a player's improvements.

The continued development of launch monitor software allowed golf coaches to begin teaching lessons indoors in golf simulators. Offering indoor practise, coaching and club-fitting completely revolutionises the ability of a golf business to trade all year round without losing revenue in the winter months.

Now, with many years of experience and advancement, launch monitors have become an integral part of almost every aspect of the industry, including fitting, coaching, gap testing, short game, putting, practice, and benchmarking.

What are launch monitors trying to do?

The primary goal of a launch monitor is to provide crucial feedback about the ball launch conditions immediately after impact, and the ball flight created from those launch conditions.

The launch conditions can be thought of as how the ball is moving immediately after impact. Those launch conditions are: speed, spin (back and side), horizontal launch angle and vertical launch angle.



To fully appreciate the job of a launch monitor, it's important to understand that the value of the launch conditions are at their highest immediately after impact. As soon as the ball has left the club face, all the launch conditions are continually reducing or slowing. Immediately after impact, the launch conditions are almost entirely unaffected by any external / downrange factors; they are also the only factors of the ball flight that the golfer and golf club are directly, and solely, responsible for.

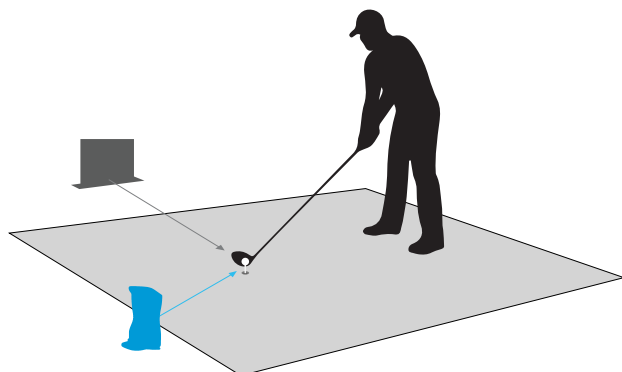
It is crucial for the launch monitor to be able to measure those data points as soon after impact as possible. Arguably, accurately knowing the launch conditions is more valuable to the golfer than just knowing how far the ball has gone. This is because the golfer has sole control over the launch conditions, whereas external conditions, such as wind, could impact ball distance. These should also be the data points that a coach or fitter focuses on, as they are what the golfer and golf club can actually control.

If the launch conditions are measured immediately after impact, and assuming there are no additional downrange conditions present (i.e. wind / rain / change in elevation) then the flight and landing point of the golf ball can be determined. The better a launch monitor can measure launch conditions, the more accurately it will be able to predict the resultant ball flight and carry distance.

In addition to the golf ball, the more advanced launch monitors are also able to measure golf club data. The data provided depends on the launch monitor and the way it measures, but the majority will provide data such as club speed, club path, angle of attack and face angle. A crucial component of club data is knowing the impact location of the ball on the club face, as that has huge implications on the ball flight.

Section 2

Launch monitors – different types of launch monitors



CAMERA-BASED TECHNOLOGY

Positioned to capture and measure all critical ball and club data at the point of impact

RADAR TECHNOLOGY

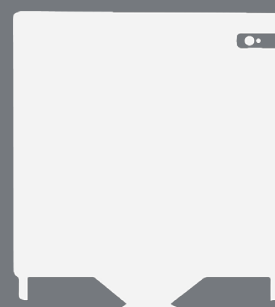
Positioned behind the golfer, with no direct view of the club face or ball impact location

There is a large variety of launch monitor brands on the market ranging in cost, reliability, accuracy, and depth of data provided. Almost all makes and models will either be a camera-based launch monitor or a doppler radar-based launch monitor.

The camera or the doppler radar element is what the launch monitor is using to measure the golf ball to try and determine the launch conditions. Camera and radar launch monitors essentially use opposite methods to provide the data. Each measurement method has different strengths and weaknesses, depending on how and where they are used or which part of the game or golf swing they are measuring.



Camera-based launch monitors



Radar-based launch monitors

Camera-based launch monitors

Camera-based launch monitors work by taking pictures of the golf ball as it moves through the monitor's launch window. The number and quality of images taken will vary between different launch monitors.

All camera-based or optical launch monitors will take multiple images (from 2 up to 200+) of the golf ball, usually from a position opposite and slightly in front (towards the target) of the golfer at address. The images will then be compared to measure how the ball is moving immediately after impact.

Camera-based launch monitors process launch information through a ball-flight model to show the flight that the launch conditions would have caused. The quality and quantity of the images, and the launch monitor's ability to extract the necessary measurements, will determine how accurately the launch monitor can report the launch conditions and the resultant ball flight.

An important strength of a camera-based launch monitor is that it can take direct measurements of the launch conditions, it can tell the golfer exactly how their technique is affecting the golf ball, without interference from downrange conditions. This is known as closed data.



Camera-based launch monitors

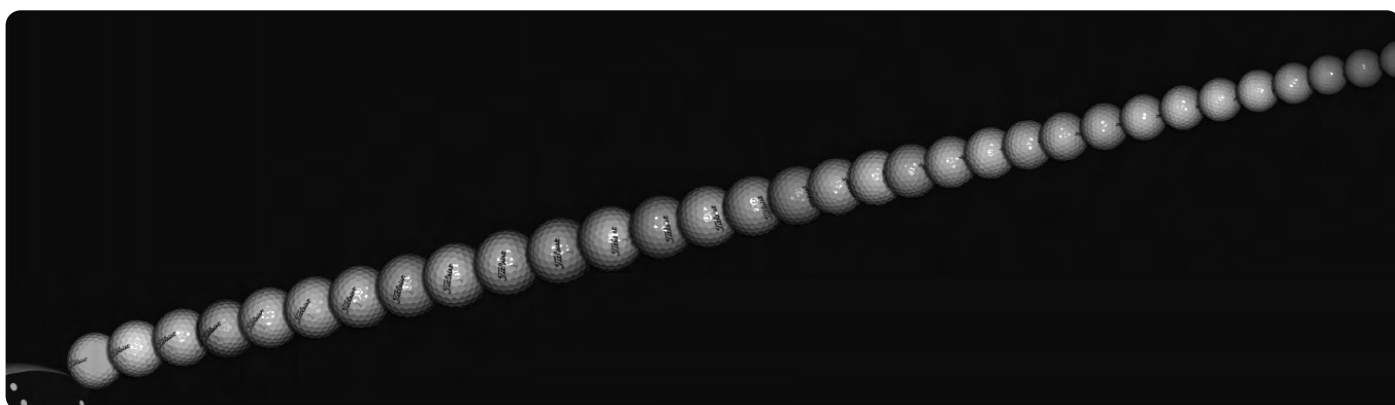
The Foresight Sports GCQuad uses four ultra-high-speed cameras to take up to 200 images of the golf ball within the first 30cm of ball flight. Taking the images from four different perspectives allows the GCQuad launch monitor to produce a 3D picture of the golf ball's movement, while the high-resolution cameras allow the system to clearly see the dimple pattern of the golf ball. This is a vital component when trying to measure spin. The onboard computer will then compare each image to the next, and using a method called spherical correlation, it will measure how the dimple pattern is rotating throughout the image set.

This process means that the GCQuad is incredibly accurate at not only measuring the ball speed and launch angles (both horizontal and vertical), but also at providing a direct measurement of the spin rate and the spin axis. The GCQuad also has the added strength of an on-board barometer and thermometer; this means it can use real-time air pressure and temperature in its ball flight model to provide the most reliable ball flight information.

Some launch monitors, as we've already indicated, may measure the golf club in addition to the golf ball. However, the club head speed that some launch monitors show is just a prediction based on an expected smash-factor determined by the club you've specified to the system.

The GCQuad - regarded as the industry-leading launch monitor for club data measurement - measures club data from either 1 or 4 small reflective stickers (known as fiducials). These are stuck on the club face in specific locations to create a face outline plane that the launch monitor can track.

The GCQuad is positioned just in front of the golf ball, to the side of the golfer. From there, the cameras can look back towards the approach of the golf club, allowing it to take direct images of the face itself. From this position, the GCQuad can also measure the exact impact point of the golf ball on the club face.





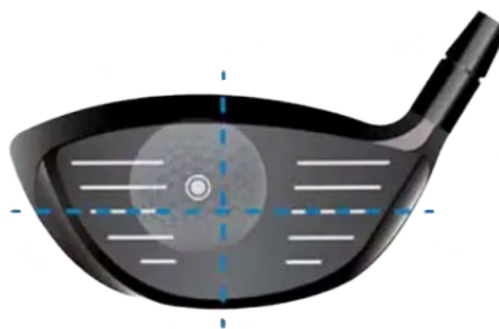
Camera-based launch monitors

The real strength of a camera-based launch monitor is that all the measurements of the launch conditions are direct measurements, not calculations. This means that they are able to produce the same reliable results whether they are used inside and outside.

Something that a camera-based launch monitor isn't able to tell the golfer is how the golf ball was impacted by downrange conditions. For example, if there was a strong wind or heavy rain, the launch monitor would tell you where the golf ball would have gone in still conditions, not where it actually went in the current conditions.

Similarly, a golf course's natural hills and slopes will impact how far the ball travels once it hits the ground. However, a launch monitor will tell you how far the ball has travelled as if the course was completely flat.

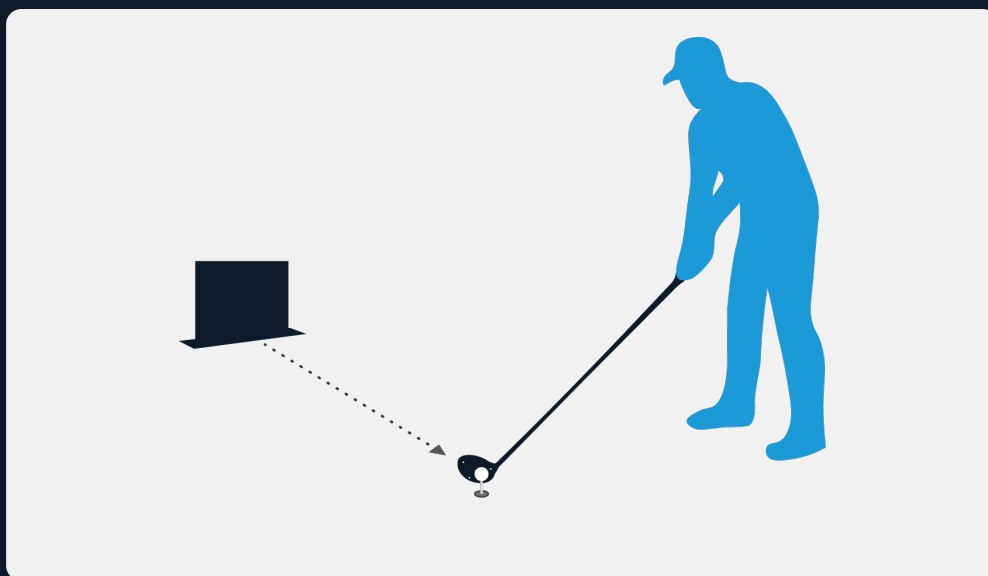
Some golfers may see that as a strength or a weakness, depending on how they want to use the launch monitor. However, the simulation software does allow the user to create windy conditions to see the effect of the weather on the ball.



Radar-based launch monitors

Doppler radar launch monitors, such as Flightscope or Trackman, work the opposite way from a camera-based launch monitor. They use radar to track the flight of the golf ball and then calculate the launch conditions that would have caused that flight.

The frequency and quality of the radar, combined with the complexity and accuracy of the algorithm used to calculate the launch conditions, will determine how reliable the data produced by the launch monitor is.



Radar has been used for object tracking for over 100 years and played a major role in WW2. In its simplest form, a doppler radar system sends out a radio frequency from its transmitter, this frequency then reflects off the object in question and returns to the receiver.

The time between the signal leaving the transmitter and arriving at the receiver allows the radar to calculate how far away the object is. Sending and receiving multiple signals means the radar can plot the positions of a moving object.

In the case of golf played outdoors, the radar system will transmit a signal downrange that tracks the flight of the golf ball as it sends a reflected radio wave back to the receiver. This allows the radar to plot the trajectory of the golf ball and produce a trace of the flight.

The internal computer within the launch monitor (or associated software) will then, from that tracked ball flight, try to calculate what set of launch conditions would have caused that particular ball flight and shot shape.

Radar-based launch monitors

A strength of a radar system is being able to show where, and how far, the golf ball has travelled for each shot. This is why we see them so often for shot-tracing on television coverage. However, using this method can cause issues when it comes to calculating the launch conditions as the golf ball has already travelled a significant distance before the radar has enough data points to calculate from.

Radar	vs	Camera
Radar technology		Photometric technology
Closed data		Open data
Placed behind golfer		Placed opposite golfer
Triangulates club head data		Measures exact club head data
Relies on estimations for indoor use		Works optimally indoors and outdoors

This means that downrange conditions, like wind, might have already affected or changed the flight of the golf ball. The resultant calculated launch conditions may therefore not be an accurate report of how the golfer's technique affected the ball's flight.

This is known as 'open data', unlike the closed data captured by a camera launch monitor. It is down to the individual golfer to decide if they would rather know how the external conditions affected their ball flight, or how their swing and club affected it.

Much like the camera launch monitors, some doppler radar systems can also measure club data. Early doppler radar launch monitors would simply track the movement of the back of the golf club in order to report parameters such as club speed, club path and angle of attack.

The issue with measuring a single point at the back of the golf club is that for a large club head, like a wood or driver, the projection of the club face would be different to the back. This would result in significant errors in the data produced.

In the example of a Trackman 4, the market leader for radar launch monitors, the system uses two radar transmitters of different frequencies - one to measure the club and the other to measure the ball.

The radar that is focusing on the golf club sends a high-frequency signal which hits the back and edges of the club head as it approaches the golf ball. By using a high-frequency signal the radar is able to produce a 'silhouette' of the shape outside of the club head. Producing this silhouette means that the radar can triangulate the centre of the club head, rather than the rear, reducing (although not eliminating) the error when measuring club data.

Radar-based launch monitors

The real challenge for the radar system and club data is that, from behind, there is no way of seeing the club face. In order to produce club face data, radar systems use the initial tracked club head data (e.g. path / angle of attack) combined with the calculated initial launch conditions, to try and calculate how that face was positioned during the impact interval.

For example, if the radar saw a club face 4 degrees right, and a ball start direction of 2 degrees right, the radar would calculate that the face must have been 2 degrees closed to the club path.

The issue with this measurement technique is that it ignores different strike locations. So a heel or toe strike would be reflected by the radar system reporting an overly open, or overly closed club face. The same would be true for vertical launch angle and high or low impact points.

Using a radar launch monitor also raises an interesting question when it comes to indoor use. Unlike the camera launch monitors, a radar cannot simply rely on the same method to measure ball data indoors, because they do not have enough data points to reliably calculate the spin and spin-axis indoors.



Radar-based launch monitors

Using a radar launch monitor also raises an interesting question when it comes to indoor use. Unlike the camera launch monitors, a radar cannot simply rely on the same method to measure ball data indoors, because they do not have enough data points to reliably calculate the spin and spin-axis indoors.

When switched into indoor mode, a Trackman 4 will do a relatively good job of measuring the ball speed and the horizontal / vertical launch angles, but it has to rely on additional calculations to produce a spin and a spin-axis. Any time you see an italic number, it's showing how the system has estimated the value as it could not calculate it.

To calculate the spin-axis, a radar launch monitor will use a combination of the measured club data and the ball start direction to calculate the club face position, and from that calculation, will decipher how the golf ball would have spun. Once again, this series of calculations can be wildly distorted by off-centre strikes. This is the finding that led Jason MacNiven to switch over to a camera-based launch monitor for his club-fitting business.

Radar launch monitors have had great success when used outside and are regularly used to track data on the PGA Tour or at driving ranges. But it is important to understand how they calculate data when it comes to downrange conditions, the club face, and indoor use.



Section 3

Launch monitors – ball data launch conditions

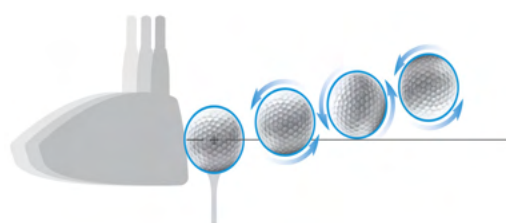
Ball Speed

Measuring the speed of the ball immediately after impact, measured in mph.



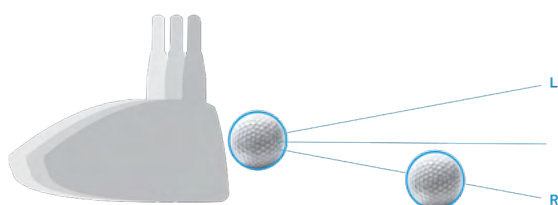
Spin (backspin)

The phenomenon of the ball rotating backwards towards the player after it has been hit.



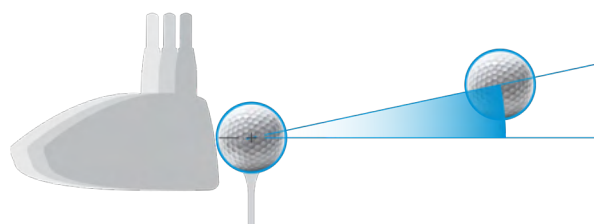
Horizontal Launch Angle

The initial horizontal direction of the golf ball, relative to the target line, measured in degrees.



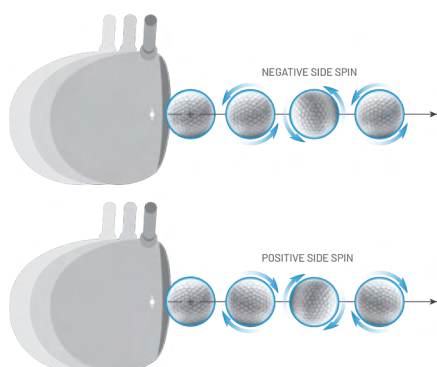
Vertical Launch Angle

The initial vertical direction of the golf ball, relative to the ground plane, measured in degrees.



Spin Axis (sidespin)

A spin axis is referring to the angle that the golf ball is spinning, causing the ball to curve in that same direction.



Ball flight data

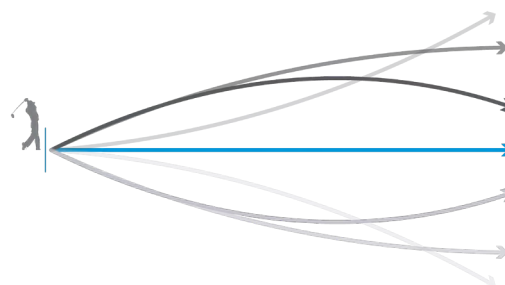
Carry Distance

The distance the golf ball travels before it makes any contact with the ground. The ball's first contact with the ground is where the carry distance is measured to.



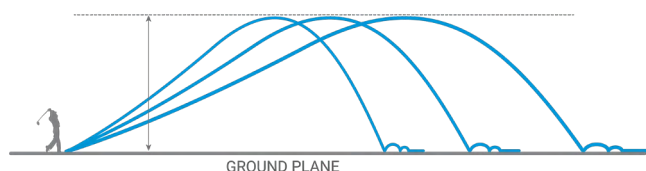
Curvature

The distance that the ball has moved either left or right of the intended target line.



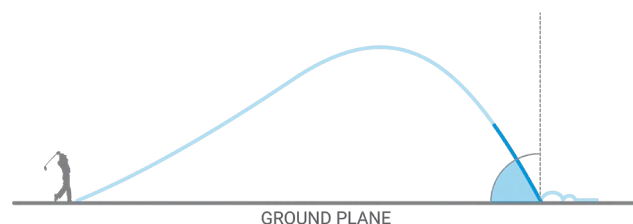
Peak Height

The tallest point that the ball reaches relative to the height where the ball was hit from.



Descent Angle

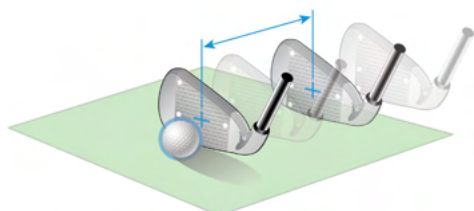
The angle that the golf ball approaches the ground, measured in degrees.



Club data

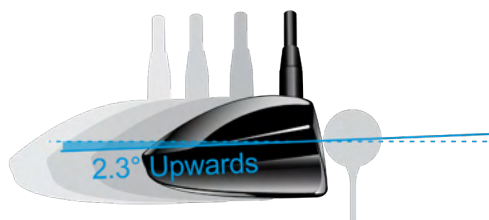
Club Speed

Measuring the speed of the ball immediately after impact, measured in mph.



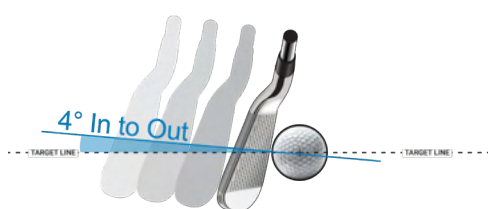
Angle of Attack

The initial horizontal direction of the golf ball, relative to the target line, measured in degrees.



Club Path

The initial vertical direction of the golf ball, relative to the ground plane, measured in degrees.



Delivered Lie

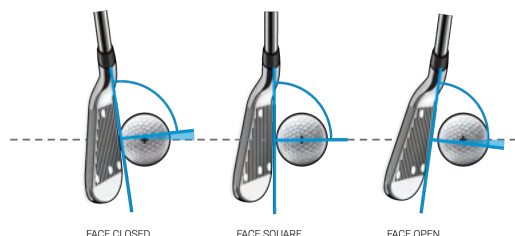
The phenomenon of the ball rotating backwards towards the player after it has been hit.



Club data

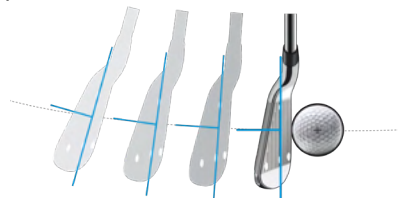
Face Angle

The phenomenon of the ball rotating backwards towards the player after it has been hit.



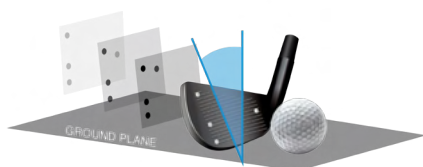
Closure Rate

The three-dimensional 'closing' of the club face immediately prior to impact, encompassing change in loft, lie and face angle, measured in degrees per second.



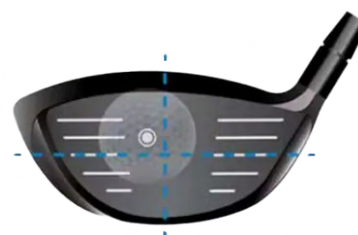
Delivered Loft

A spin axis is referring to the angle that the golf ball is spinning, causing the ball to curve in that same direction.



Impact point

The precise measurement of the contact point of the golf ball on the club face.





Section 4

Launch monitors - applications

Coaching

A launch monitor is a tool used by PGA professionals and golf coaches to speed up client improvement and track changes. When determining how the golfer is effecting the ball flight, the launch monitor, particularly one that measures the golf club, eliminates all uncertainty.

Golfers can observe and better grasp exactly what they are doing and how they may make an appropriate alteration to improve. This is helpful for both golf pros to drill straight into the potential concerns. As the data identifies specific areas for improvement and eliminates all guessing, PGA pros have discovered that a launch monitor leads to quick and long-lasting improvements among their customers.



Club fitting/testing

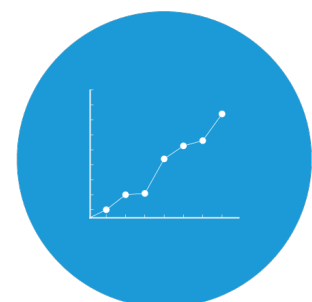
A launch monitor is becoming an essential tool for both club fitting and testing because it is the only real way to quantify the difference from one club to the next.

The launch monitor can show fractional differences in every aspect of ball flight meaning the fitter can truly dial into the best possible club set-up for that golfer. Without a launch monitor, the fitter would rely on watching ball flight, therefore estimating the best option - a launch monitor completely removes the guesswork.



Benchmarking

Benchmarking is a feature that can be used by either a golfer or a professional. Benchmarking is the process of measuring the golfer's numbers when playing well, this gives a benchmark for their 'good' swing. It means that when they are struggling, or their swing doesn't feel right they can compare back to their good swing and make the necessary changes. Once again, this is something that really cannot be done without a launch monitor.

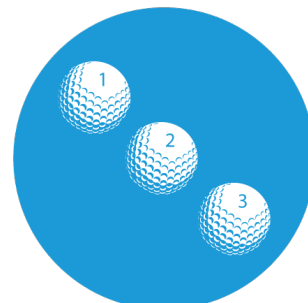


How can a launch monitor be used?

Ball fitting

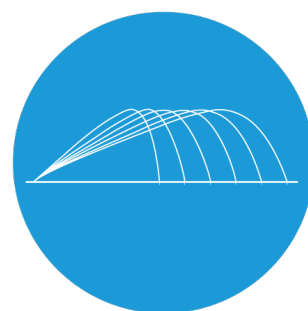
Ball fitting is still a relatively new application for launch monitors, although, without one, accurately fitting the best ball is nearly impossible. Much like with club fitting, the goal of a ball fitting is to dial in on the best possible golf ball for that player and their goals.

Some golf balls are better suited for hitting long distances while others might prefer more control. Without a launch monitor, it's near impossible to properly know the difference in performance from one ball to the next, using a launch monitor means that players and professionals can fully understand their optimal set-up.



Gap testing

Much like with club fitting, a launch monitor is the only way to truly gap test a golfer. A gap test is when the golfer hits shots with each of their clubs to measure the distance they hit with each club and understand the gaps between them, highlighting where additional clubs are required to fill the 'gap'. Gap testing is an underused tool in golf and a great potential revenue stream for a business with a launch monitor.



Numbers based practice

Many golfers spend hours of their time, and significant amounts of money, at driving ranges where they hit numerous golf balls with next-to-no feedback, and have no way to measure whether they are improving or not.

Using a launch monitor not only means you can practise at home (with a golf simulator), it also means that the golfer knows exactly how their actions are causing the ball to fly. Practising in this way allows players to improve far more quickly and ensure their time is used much more valuably.



Testing the effect of water / rough / sand

Finally, a way that launch monitors are often used on the tour or by manufacturers is to test the effect of different conditions on the way the ball reacts. Water, long grass and sand can all drastically change the launch conditions of the golf ball when compared to a neutral environment.

Without a launch monitor there is no reliable way to properly understand the effect of these different conditions and therefore no way to understand how the player should treat them differently on the golf course.



How are launch monitors used in a simulator?

One of the single most common uses for a launch monitor is to power a golf simulator. The huge advantage, especially of a camera-based launch monitor, is that just about every single application for the launch monitor can be used inside and outside with the same accuracy and reliability.

In addition to that, a simulator also means you can play golf inside, practice on the course and the driving range, and compete in a wide variety of skills challenges all from the comfort of your home.

For a business in the golf industry, a golf simulator is a must-have; it means that the business can operate 12 months of the year without any interruption due to weather or a lack of daylight. Golf simulators also provide secondary revenue streams as members can hire them for course play or practice.

Overhead mounted launch monitors are able to track club and ball data with the same accuracy as ground-based launch monitors. However, from this elevated position, these launch monitors provide the opportunity to play football skill building games in the simulator.



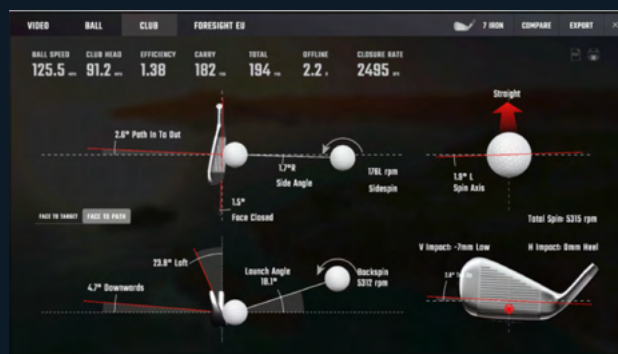
How is the launch monitor data displayed?



There are multiple ways to view the data produced by a launch monitor. Within a simulator, the data would usually be displayed on a laptop or PC, however, there are other ways it can be displayed.

Launch monitors such as the GCQuad or GC3 both have onboard display screens allowing the player, or coach / fitter, to instantly see the numbers from that shot. This ease of use is one reason that Foresight Sports has become the most used launch monitor seen on professional tours. When data is displayed in this way the shots are not recorded or stored within the unit.

Another way to display data is via a phone or tablet app, this combines the portability of a launch monitor with the storage and data analysis of computer software. Many launch monitor customers with use phone or tablet apps when practising on the range or on the course in order to review their data and keep a history of each session to look back on in the future.



What things should you be aware of when using a launch monitor?

Wet ball / club

A golf ball's initial launch circumstances and subsequent flight can be significantly altered by a wet ball or club face, so it is crucial to make sure they are both dry and clean, unless particular testing is being done to compare the effects of different ball and club conditions.

Distance from device

When considering the purchase of a launch monitor, especially for use in a simulator with limited space, customers should always be aware of the distance that the device needs to be from both the ball and the hitting screen.

When compared to a camera-based launch monitor, which can measure all launch circumstances within a few feet of ball flight, a radar-based launch monitor requires substantially more space in order to provide useful information.

Issues with foot spray

There are some golf launch monitor companies whose technology is not able to measure impact location. Some of these companies suggest the use of 'foot spray' (or an alternate face spray) to see where the ball has impacted the face. It's important to note that using foot spray can greatly affect how the ball flies, making it difficult to determine whether the spray or the strike itself caused a change in flight.

The best, and most reliable, way to measure the impact location is using a launch monitor that can directly measure the face of the golf club, such as the GCQuad or GC3.



You are also welcome to explore our PEAK online education platform. The training will help you understand how to read and interpret launch monitor data and let you hone in on target areas to improve your golf.



Discover PEAK

