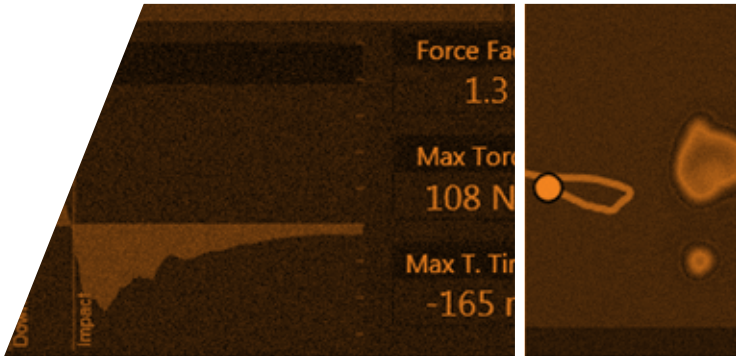
DATA GUIDE
3D MOTION PLATE



swingcatalyst

User guide 3D Motion Plate 2015

CONTENTS

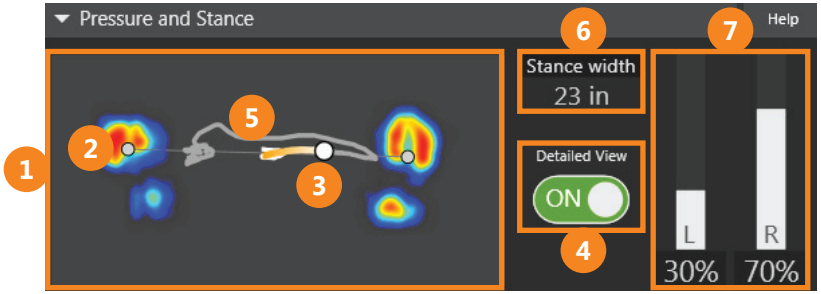
INTRODUCTION

The Swing Catalyst 3D Motion Plate is a patented combination of a highly advanced pressure plate and a 6 component force plate.

This guide aims to provide an overview of the data obtained from the 3D Motion Plate and some insight into what you should look for when interpreting your results. If you find yourself unfamiliar with any of the expressions used, or simply want more detailed information that might help you in your analysis, please visit the Swing Catalyst Learning Center online (www.swingcatalyst.com/learning-center) for definitions and articles.

To gain full value of the information provided by the Swing Catalyst software, we recommend setting the bookmarks (start of takeaway, top of backswing, impact) properly. Please refer to our software user guide for information on how to set the bookmarks.

PART 1: PRESSURE DATA

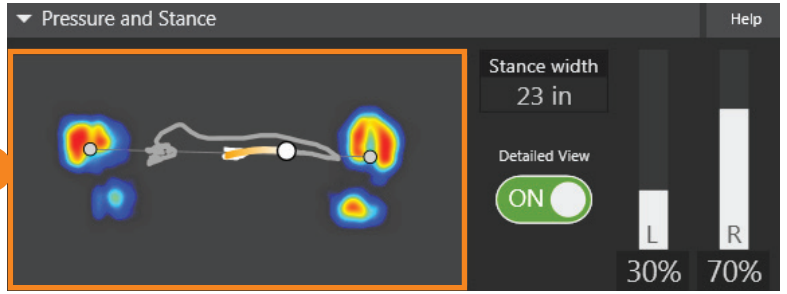


The top layer of the Swing Catalyst 3D Motion Plate consists of more than 2000 high-resolution sensors that measure the pressure applied to the ground by the golfer. This pressure plate provides information on center of pressure, stance width, and pressure distribution between the feet. This information can be seen in the Pressure and Stance data box in the Swing Catalyst software:

1. 3D Motion Plate surface area
2. Footprints
3. Center of pressure (CoP)
4. Detailed view
5. CoP trace
6. Stance width
7. Pressure distribution

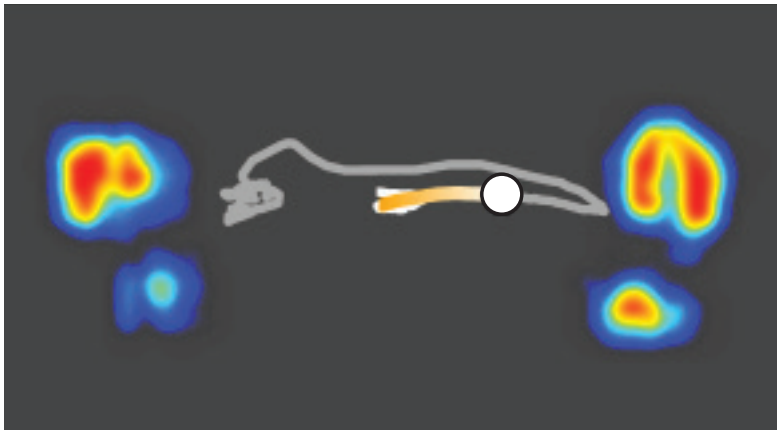
All pressure data is fully synchronized with the video images.

3D MOTION PLATE SURFACE AREA



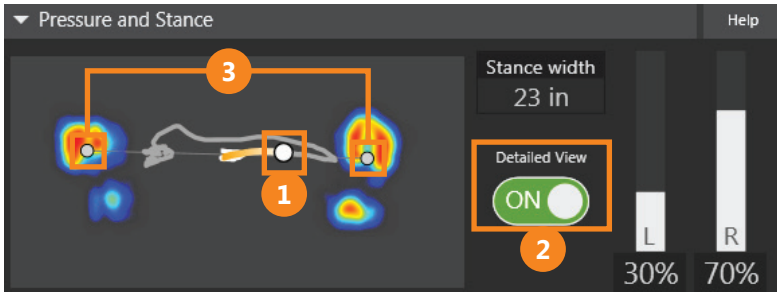
1. The grey area represents the surface area of the 3D Motion Plate.
2. 3D Motion Plate.

FOOTPRINTS



The colored footprints on the left side of the box indicate the contact that is present between the shoes and the plate. Different amounts of pressure are shown by different colors, with blue representing the least pressure and red the most.

CoP & DETAILED VIEW

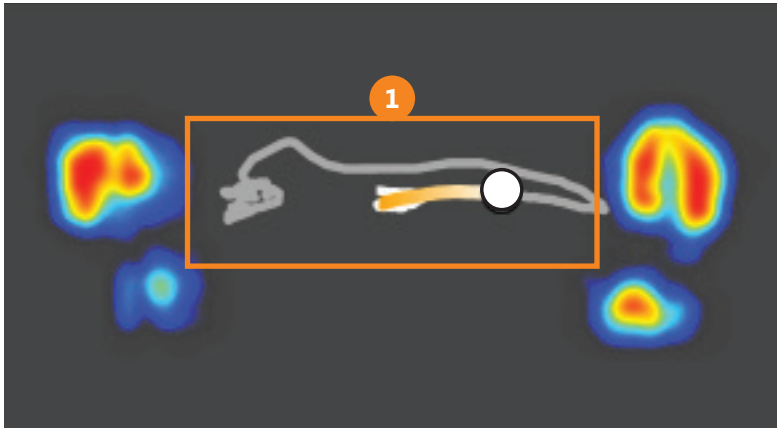


The white circle indicates the position of the CoP, which is affected by the pressure distribution. For example, movement of the CoP toward the lead foot indicates a relative increase in pressure at the lead foot.

By turning on the *Detailed view* option, individual CoP markers for each foot are activated. The smaller, grey circles indicate the position of the CoP under each foot. Between the two markers, a thin, straight line shows where the CoP of one foot is positioned relative to the other foot.

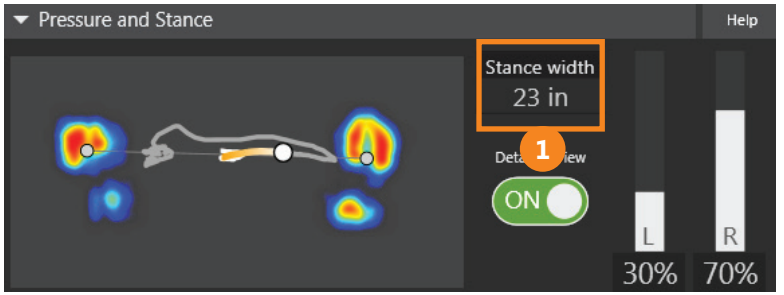
1. CoP
2. Turn on/off Detailed view
3. Individual CoP markers

CoP TRACE



1 The movement pattern of the CoP throughout the swing is traced with a grey line. If the bookmarks are set, the grey line will change color to white/orange as the CoP moves along the trace as the video is scrolled forward.

STANCE WIDTH



1 The stance width is measured as the distance between the centers of the respective feet.

PRESSURE DISTRIBUTION

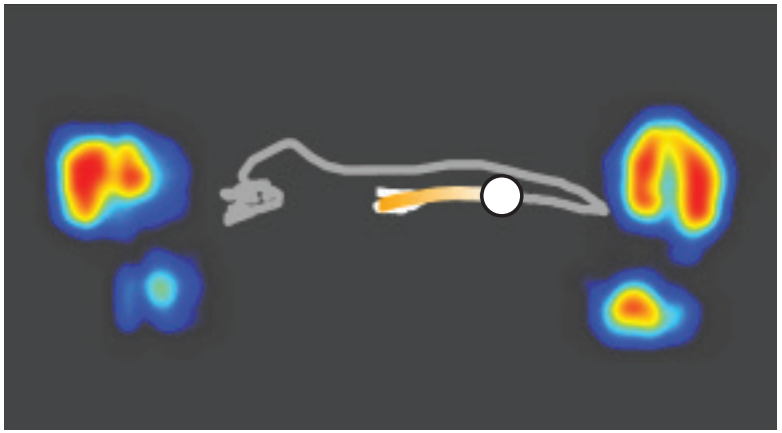
1 The white/grey bars on the right side of the box show how the total pressure is distributed between the two feet. In other words, it is a measure of how much the golfer is pushing down on one foot compared to the other. This is used to see where the golfer is exerting force on the ground.

The pressure distribution determines the lateral position of the CoP. For example, leaning more on one foot will cause the CoP to move toward it. This represents a pressure shift, and is seen as increased and decreased values in the pressure distribution bars and the CoP moving left and right.

PART 2: WHAT SHOULD YOU LOOK FOR? (PRESSURE)

The pressure plate component of the Swing Catalyst 3D Motion Plate provides a basis for analyzing the pressure exerted on the ground by the golfer during the golf swing, showing data that can reveal issues related to balance or pressure shift that may affect the swing.

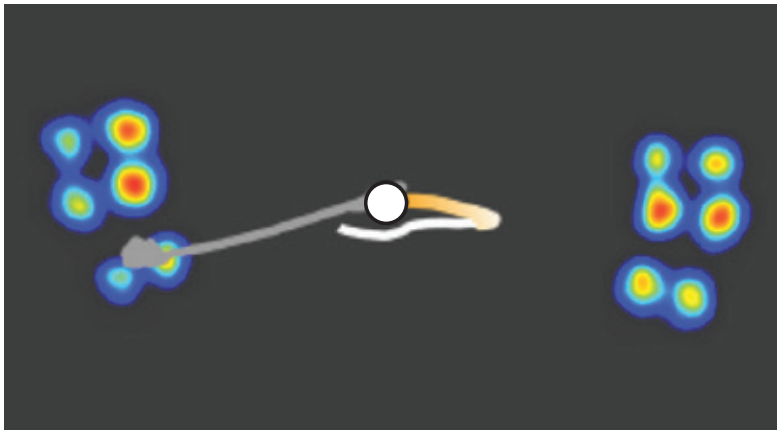
PRESSURE COLORING



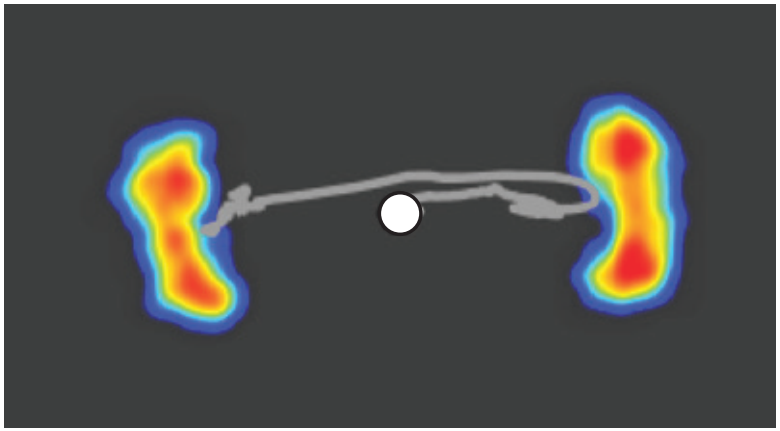
Pressure coloring will reveal tendencies to lean on specific parts of the foot during the swing. This is most obvious when there are differences between the heel and forefoot or between the inside and outside of the foot. Tendencies to lift parts of the foot off the ground are revealed by a lack of pressure coloring.

Since pressure is a result of force, the pressure coloring of the footprint will be affected by movement (which is dependent on force).

FOOTPRINT SHAPE

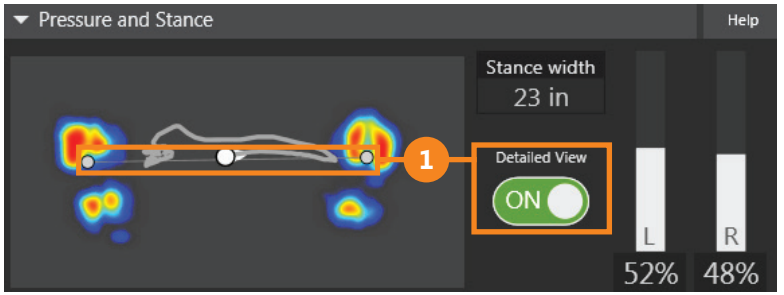


Since pressure is dependent on the area of ground contact, the footprint will be affected by the sole of the shoe that is worn (if no shoes are worn, the footprint will take the actual shape of the part of the foot that is in contact with the ground). For example, a cleated golf shoe will typically produce a footprint with specific points of high pressure where the cleats are located. This is because the force exerted on the ground by the golfer is spread over a small area, namely the cleats that are in contact with the ground. Note that wearing cleated shoes should not affect the pressure distribution between the lead foot and the trail foot.



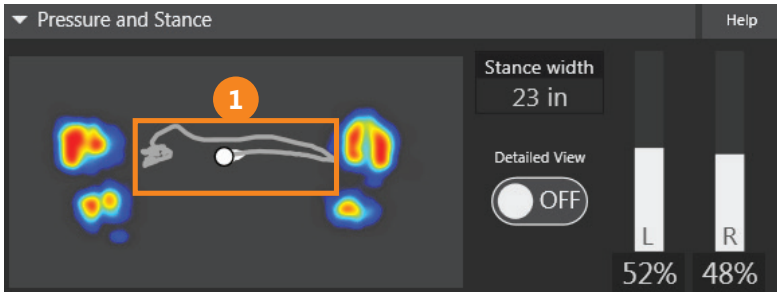
A flat-soled shoe, on the other hand, will typically show a more even distribution of pressure over the foot. This is because the force exerted on the ground by the golfer is spread over a larger area. In this case, specific points of high pressure will be more dependent on where under the foot the golfer exerts the most force on the ground.

CoP DETAILED VIEW



1 The *Detailed view* can be used to see if pressure is applied unevenly between the feet, by examining the straight line connecting the individual foot CoPs (two smaller, grey circles).

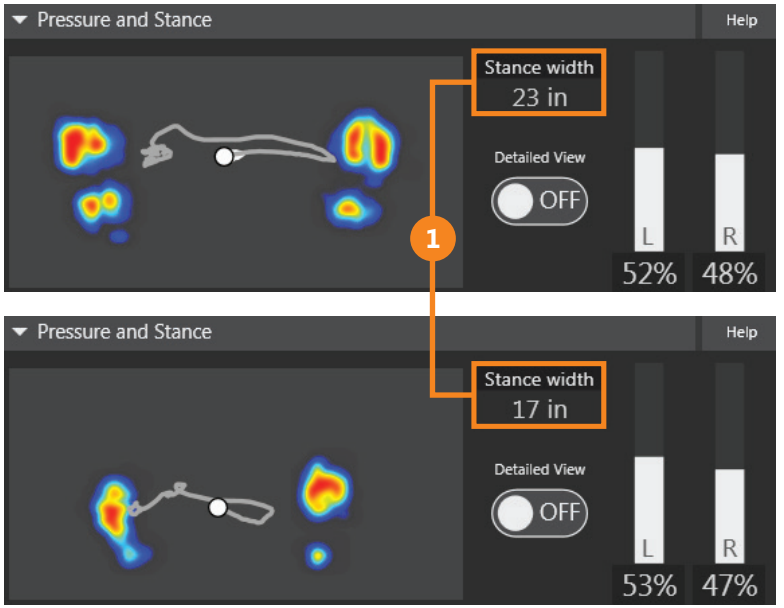
CoP TRACE



1 The CoP trace can reveal many different swing techniques. Common factors in successful swings are typically a smooth trace and that the trace is repeatable (for each individual player). Disturbances in the CoP trace, such as multiple rapid changes of direction, will usually indicate unnecessary or even detrimental movement. As an example, excessive CoP movement after follow-through can be a sign of imbalance.

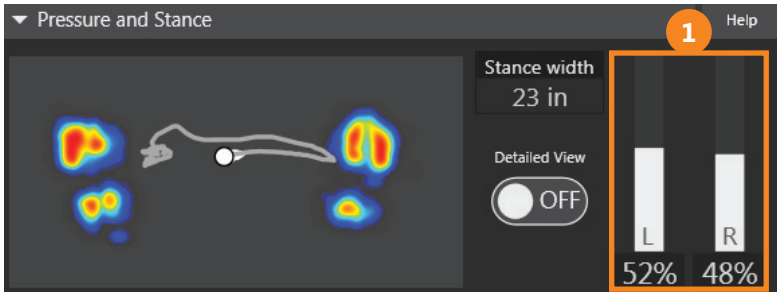
Most PGA Tour players perform a rapid, continuous pressure shift during the downswing, which is seen in a smooth and relatively straight line in the CoP trace from the trail foot to the lead foot (from right to left for a right-handed golfer).

STANCE WIDTH



1 A wider stance will allow for greater lateral movement of the CoP. Since the CoP is determined by the pressure at the feet, the absolute size of the CoP pattern is relative to the stance width. Note that a wider stance doesn't necessarily change the general shape of the CoP trace.

PRESSURE DISTRIBUTION

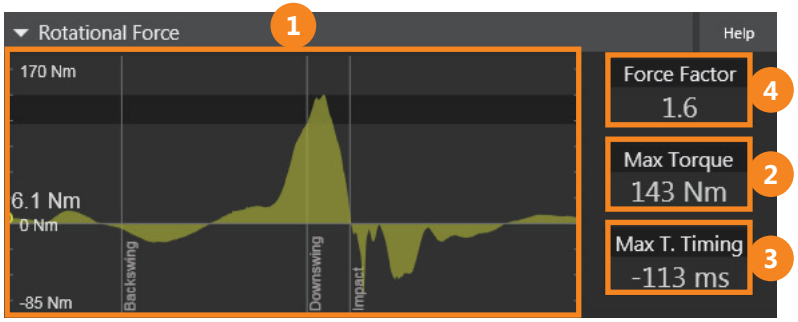


1 Similar to the CoP trace, the pressure distribution bars indicate if the golfer is predominantly exerting force on the ground at the lead foot or at the trail foot at different points during the swing. The changes in value of the pressure distribution bars over time represent pressure shift. With the exception of certain transition points in the swing, the pressure distribution is usually a good indicator of where the golfer's weight is placed.

PART 3: FORCE DATA

The bottom layer of the Swing Catalyst 3D Motion Plate is a 6 component force plate, measuring forces in three dimension and torques about three corresponding axes. The force plate component provides both graphical and numerical information on torque, vertical force, and horizontal force produced at the feet. This information can be seen in the various force data boxes in the Swing Catalyst software. All force data is fully synchronized with the video images.

ROTATIONAL FORCE



1. Torque graph
2. Max Torque
3. Max T. Timing
4. Force Factor

1 The torque graph on the left side of the box shows the rotational force the golfer is exerting on the ground about the vertical axis throughout the swing. Values above the baseline represent clockwise rotation (toward the trail foot for a right-handed golfer), while values below the baseline represent counter-clockwise rotation (toward the lead foot). Note that the graph shows the total torque resulting from both feet.

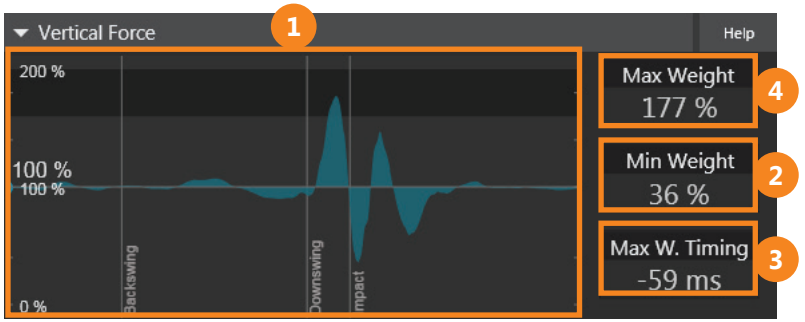
Based on the bookmarks, vertical lines indicate the backswing and downswing phases, as well as the point of impact. The magnitude of torque generated at a given point is indicated by the number next to the timeline marker. The dark horizontal area indicates the tour average (male, driver).

2 The Max Torque value on the right side of the box shows the magnitude of maximum torque achieved during the swing. In other words, it represents the maximum force the golfer produces by "twisting" against the ground.

3 The Max T. Timing value on the right side of the box shows the timing of maximum torque relative to impact, measured in milliseconds. A negative number indicates that maximum torque occurs prior to impact, while a positive number indicates that it occurs after impact.

4 The Force Factor value on the right side of the box represents a relative measure of the maximum torque, to allow for even comparisons between golfers. To obtain the Force Factor the maximum torque is normalized by body mass, meaning it is divided by body mass (in kilograms).

VERTICAL FORCE



1. Vertical Force graph
2. Max Weight
3. Min Weight
4. Max W. Timing

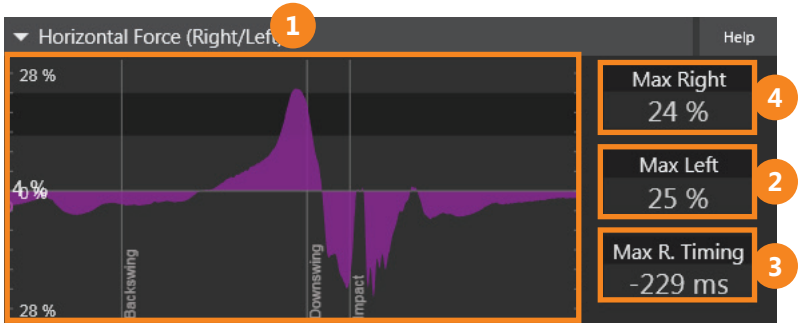
2. The vertical force graph shows the amount of force the golfer is exerting vertically downward on the ground throughout the swing, relative to body weight. Values above the baseline (100% body weight) represent vertical force greater than body weight, while values below the baseline represent vertical force lower than body weight.

   Based on the bookmarks, vertical lines indicate the backswing and downswing phases, as well as the point of impact. The magnitude of force at a given point is indicated by the number next to the timeline marker. The dark horizontal area indicates the tour average (male, driver).

3. The Max Weight and Min Weight values on the right side of the box show the magnitude of maximum and minimum vertical force achieved during the swing, relative to body weight.

4. The Max W. Timing value on the right side of the box shows the timing of maximum vertical force relative to impact, measured in milliseconds. A negative number indicates that maximum vertical force occurs prior to impact, while a positive number indicates that it occurs after impact.

HORIZONTAL FORCE (RIGHT/LEFT)



1. Horizontal Force (Right/Left) graph
2. Max Right
3. Max Left
4. Max R. Timing

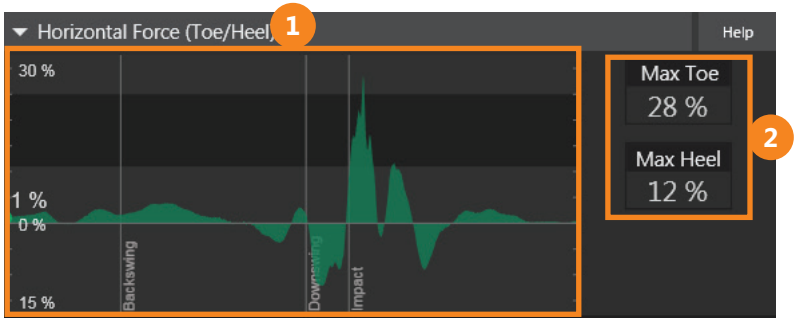
2. The horizontal force (right/left) graph shows the amount of force the golfer is exerting on the ground in the right or left direction throughout the swing, relative to body weight. Note that the graph shows the total force resulting from both feet, and thus represents the difference between the two directions regardless of their respective magnitudes. Values above the baseline (0% body weight) represent total force to the right (toward the trail foot for a right-handed golfer), while values below the baseline represent total force to the left (toward the lead foot).

   Based on the bookmarks, vertical lines indicate the backswing and downswing phases, as well as the point of impact. The magnitude of force at a given point is indicated by the number next to the timeline marker. The dark horizontal area indicates the tour average (male, driver).

3. The Max Right and Max Left values on the right side of the box show the magnitudes of maximum horizontal force toward the right and left achieved during the swing, relative to body weight.

4. The Max R. Timing value on the right side of the box shows the timing of maximum horizontal force toward the right relative to impact, measured in milliseconds. A negative number indicates that maximum horizontal force toward the right occurs prior to impact, while a positive number indicates that it occurs after impact.

HORIZONTAL FORCE (TOE/HEEL)



1. Horizontal Force (Toe/Heel) graph
2. Max Toe and Max Heel

1. The horizontal force (toe/heel) graph shows the amount of force the golfer is exerting on the ground in the toe or heel direction throughout the swing, relative to body weight. Note that the graph shows the total force resulting from both feet, and thus represents the difference between the two directions regardless of their respective magnitudes. Values above the baseline (0% body weight) represent total force toward the toes, while values below the baseline represent total force toward the heels.

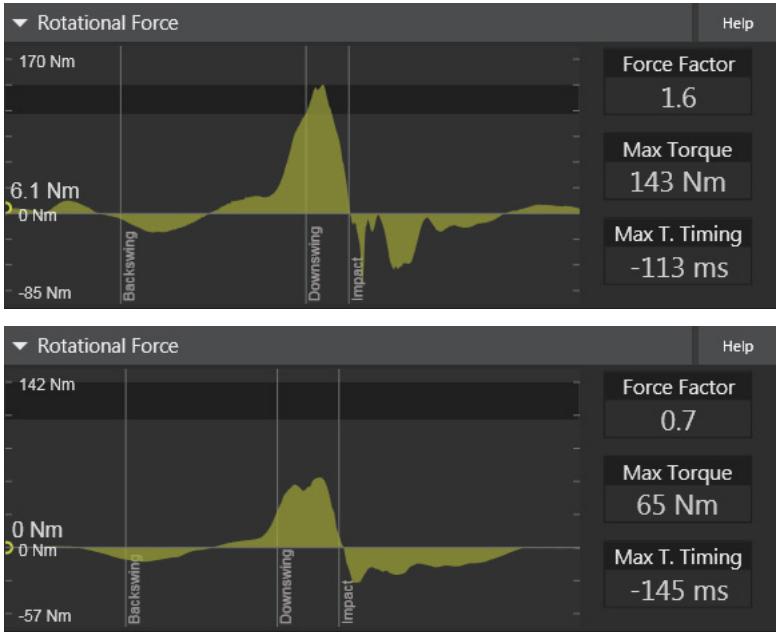
   Based on the bookmarks, vertical lines indicate the backswing and downswing phases, as well as the point of impact. The magnitude of force at a given point is indicated by the number next to the timeline marker. The dark horizontal area indicates the tour average (male, driver).

2. The Max Toe and Max Heel values on the right side of the box show the magnitudes of maximum horizontal force toward the toes and heels achieved during the swing, relative to body weight.

PART 4: FORCES: WHAT SHOULD YOU LOOK FOR?

The force plate component of the Swing Catalyst 3D Motion Plate provides a basis for analyzing the force production in the golf swing, showing data that can reveal issues related to magnitude or timing of force that may affect the swing.

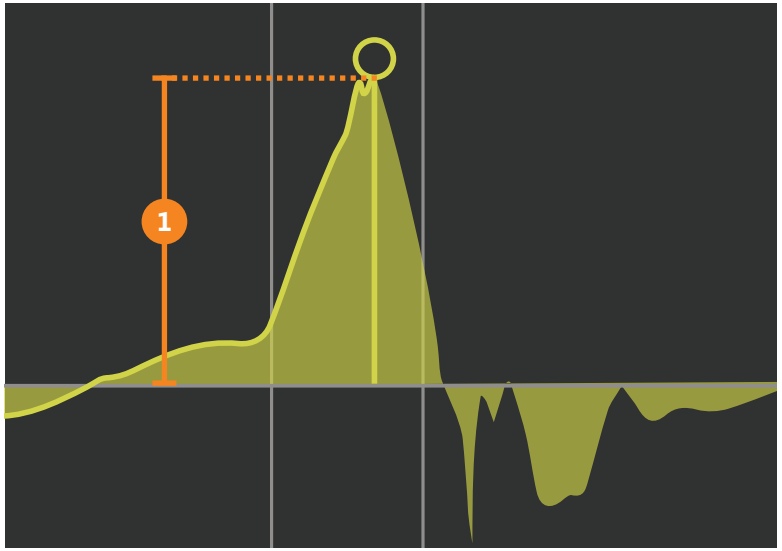
TORQUE GRAPH SHAPE



The shape of the torque graph can reveal several variations of the same basic sequence of direction of rotation. A common factor in successful swings is that the shape is repeatable (for each individual player).

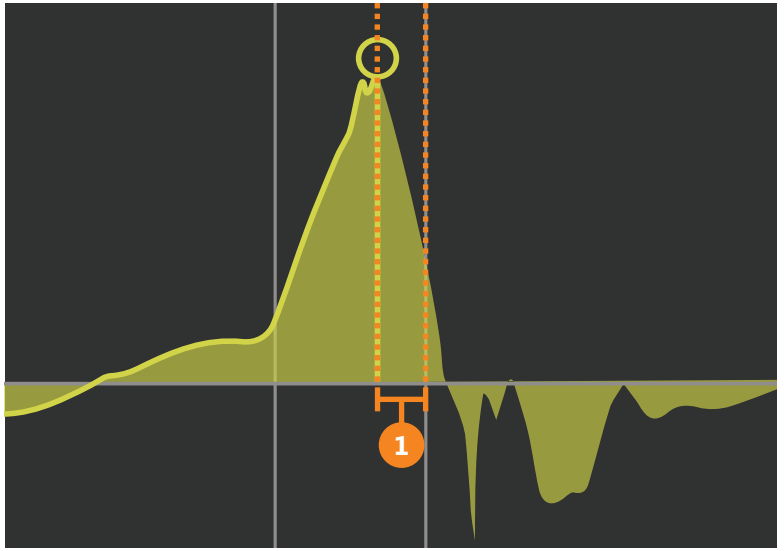
Most PGA Tour players perform controlled and determined rotations throughout the swing, which is seen in the torque graph as smooth transitions in direction changes. The typical direction of rotation is clockwise at the beginning of the downswing, opposite of upper body rotation, before suddenly decreasing around midway through the downswing as it moves toward counter-clockwise rotation approaching impact. Multiple rapid changes of direction can indicate unnecessary or even detrimental movement.

MAGNITUDE OF MAXIMUM TORQUE



1 The magnitude of maximum torque provides the basis of force available for subsequent transfer throughout the upper body, with greater torque generally resulting in greater clubhead speed. The primary means of generating this initial force at the legs is pressing against the ground.

TIMING OF MAXIMUM TORQUE

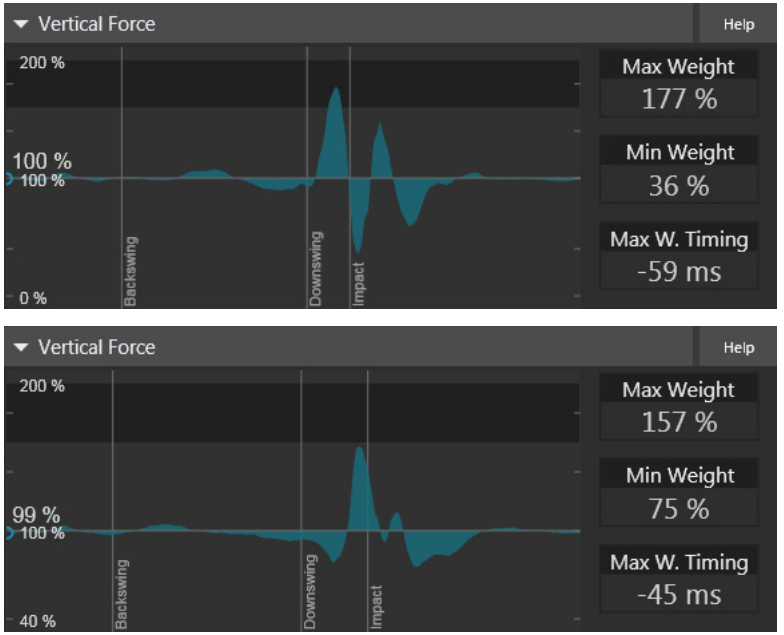


1 To produce clubhead speed, the force the golfer produces must be transferred to the club. Since the maximum torque is measured at the feet, it must occur in sufficient time prior to impact to allow force to transfer to the club for maximum speed. Achieving maximum torque both too close to impact and too early might result in less force available for transfer to the club at the right time. This can prevent the golfer from maximizing clubhead speed at impact.

FORCE FACTOR VALUE

Since the measured torque reflects both vertical and horizontal ground reaction forces, a heavier golfer will tend to produce greater maximum torque. The Force Factor indicates the degree to which the golfer is able to produce torque from the available body mass, or, in other words, how well the golfer utilizes the potential to produce torque. For example, a heavier golfer producing a lower Force Factor than a lighter golfer with the same club might indicate that the heavier golfer is relying more on brute force than technique to achieve the resulting torque compared to the lighter golfer.

VERTICAL FORCE GRAPH SHAPE



The shape of the vertical force graph shows how the golfer's vertical acceleration of body mass (experienced weight) changes throughout the swing. An increase in the graph indicates either upward movement or braking of downward movement, while a decrease in the graph indicates either downward movement or braking of upward movement.

For most PGA Tour players the vertical force is typically slightly less than body weight late in the backswing and early in the downswing, followed by a substantial increase late in the downswing, with vertical force much greater than body weight.

MAGNITUDE OF MAXIMUM AND MINIMUM VERTICAL FORCE

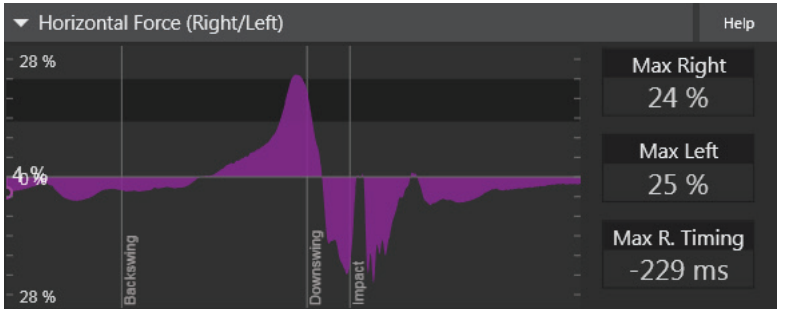
The magnitude of maximum vertical force typically occurs in the downswing, indicating how forcefully the golfer has to resist the downward movement.

The minimum vertical force typically occurs either around the transition from backswing to downswing, around impact, or late in the follow-through, indicating how forcefully the golfer either moves downward or has to resist the preceding upward movement, depending on where in the swing it occurs.

TIMING OF MAXIMUM VERTICAL FORCE

Maximum vertical force typically occurs late in the downswing, after maximum torque. The timing of maximum vertical force is generally related to the pressure shift from trail foot to lead foot, with a pressure shift occurring later relative to the top of the backswing coinciding with a later maximum vertical force.

HORIZONTAL FORCE (RIGHT/LEFT) GRAPH SHAPE



The shape of the horizontal force (right/left) graph shows how the golfer's dominant direction of force changes throughout the swing. An increase in the direction of the right foot indicates either movement to the left or resisting movement to the right, while an increase in the direction of the left foot indicates either movement to the right or resisting movement to the left.

Note that the direction of force does not necessarily reflect the distribution of pressure within the feet (for example, it is possible to push toward the right using either the inside or the outside of the foot).

For most PGA Tour players the typical direction of total force is toward the right in the late backswing and early downswing before gradually changing toward the left approaching impact. This change of dominant direction will typically coincide with the pressure shift from the trail foot to the lead foot. Note that in the follow-through the golfer has typically turned and is no longer aligned with the original right/left directions.

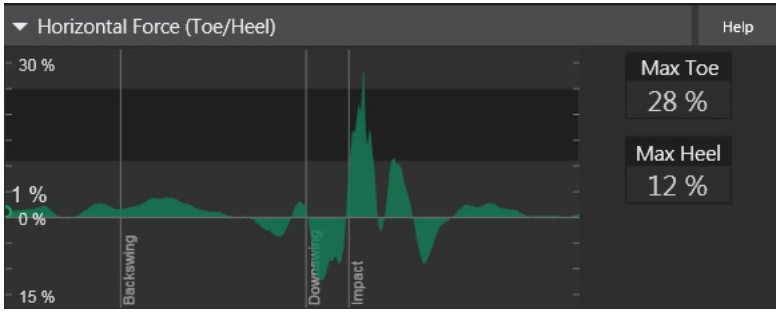
MAGNITUDE OF MAXIMUM HORIZONTAL FORCE TOWARD THE RIGHT AND LEFT

The magnitudes of maximum horizontal force toward the right and left indicate how forcefully the golfer either initiates or resists movement sideways during the swing, typically representing the movement toward the ball early in the downswing and the resistance to this movement late in the downswing.

TIMING OF MAXIMUM HORIZONTAL FORCE TOWARD THE RIGHT

Due to the traction that is present between the golfer and the surface, pushing to the right causes movement to the left. The timing of maximum horizontal force toward the right typically marks the beginning of the pressure shift from trail foot to lead foot.

HORIZONTAL FORCE (TOE/HEEL) GRAPH SHAPE



The shape of the horizontal force (toe/heel) graph shows how the golfer's dominant direction of force changes throughout the swing. An increase in the direction of the toe indicates either backward movement or resisting forward movement, while an increase in the direction of the heel indicates either forward movement or resisting backward movement.

Note that the direction of force does not necessarily reflect the distribution of pressure within the feet (for example, it is possible to push in the toe direction using the heel of the foot).

For most PGA Tour players the typical direction of total force is slightly toward the heels at the beginning of the downswing before gradually changing toward the toes approaching impact, with the maximum value in the toe direction occurring at impact or slightly after. Note that in the follow-through the golfer has typically turned and is no longer aligned with the original toe/heel directions.

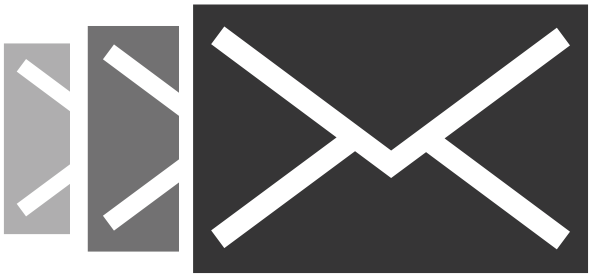
MAGNITUDE OF MAXIMUM HORIZONTAL FORCE TOWARD THE TOES AND HEELS

The magnitudes of maximum horizontal force toward the toes and heels indicate how forcefully the golfer either moves or resists movement forward and backward during the swing. Since force in both directions simultaneously is necessary to create rotation, the resulting differences between the two directions are typically fairly small.

SPECIFICATIONS

PRESSURE PLATE	
Size:	20.5″ x 39.5″
Sensor Size:	0.6″ x 0.6″
Number of Sensors:	2048
Sensing Area:	19″ x 38″
Force Range:	30PSI
Scan Rate:	100Hz
FORCE PLATE	
Channels:	Fx, Fy, Fz, Mx, My, Mz (six degrees of freedom)
Sampling rate:	1000 Hz

SUPPORT



If you have any questions, please contact Swing Catalyst support:
support@swingcatalyst.com

Information can also be found at our Help Center:
www.swingcatalyst.com/help

NOTES

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