

# Swingweight

Swingweight can be defined as the weight relationship of a golf club about a fixed fulcrum point. The heavier the head (or tip) end of the club related to the grip (or butt) end of the club, the heavier the swingweight will be. The converse is true as well: a club with a heavier butt related to the tip will have a lower swingweight. Swingweight is measured in letter-number units such as C9, D1, D3, etc., with higher number/letters indicating a heavier swingweight (more weight concentrated in the tip section of the club.) Swingweight plays a role in how a club feels to the golfer. While changes as small as one swingweight (A swingweight point is equal to the approximate weight of a dime placed on the clubhead.) are nearly imperceptible to the golfer, generally an accomplished player can feel changes as little as 2 swingweight points; even most average players start to detect a three swingweight change. In any event, it is important as a clubmaker to keep the swingweights as consistent as possible from club to club in a set to maximize the club's feel to the player.

There are five factors that influence a club's swingweight:

1. The weight of the clubhead
2. The weight of the grip and grip tape
3. The length of the club
4. The weight of the shaft
5. The balance point of the shaft

Swingweight Factors				
Swingweight Change	Increase Factor By	Swingweight Factor	Decrease Factor By	Swingweight Change
+1	2 grams	Headweight	2 grams	- 1
+3	1/2 inch	Length	1/2 inch	- 3
-1	5 grams	Grip Weight	5 grams	+ 1
+1*	9 grams	Shaft Weight	9 grams	- 1*

\* The shaft swingweight equivalent is for illustration purposes only. Unlike the other three factors, as shaft weight changes its effect on swingweight changes at a disproportionate rate. For estimation purposes, however, the above shaft weight-to-swingweight equivalent is acceptable.

## 1. The weight of the head

Component clubheads are cast or forged to certain weight specifications. These weights are designed to suit the modern standards for assembled length. Tolerances in the manufacturing processes generally create a range of +2/-4 gram variations in the weights of the heads. As 2 grams is the approximate equivalent of 1 swingweight, this tolerance in heads may yield the potential of a 3 swingweight range through a set. This is a perfect illustration of the importance of swingweighting sets of clubs. If no swingweighting was done, a given club could be on the low end of tolerance and weigh C8, while another club in the set could be at the high tolerance end and weigh D1; and the other clubs in the set could be anywhere in between. These differences would cause certain clubs to obviously feel different than other clubs which is not a good clubmaking situation. This tolerance is the same when discussing both component and OEM heads.

We mentioned that 2 grams is the equivalent to 1 swingweight point in the head end of the club. This is an accepted norm. In actuality, the 2 gram to 1 swingweight is not exact. Because of the progressive length changes in a set of clubs, the longer the club, the less actual weight that is required to equal 1 swingweight. Shorter clubs require a bit more weight in order to achieve a 1 swingweight change. To be exact, a club that was 38 3/4" long would require 2 grams for a 1 swingweight change. For longer clubs, a lesser amount would be necessary. For clubs shorter than 38 3/4", a bit more weight than 2 grams will be needed for a 1 swingweight increase. But for all practical purposes, we can apply the rule that for every 2 gram increase in the head of the club, the swingweight will increase by 1 point; for every 2 gram decrease in weight in the head of the club, the swingweight will decrease by 1 point.

It should be mentioned that as a good rule of assembly, that all clubs in the set, provided they have the same types of shafts, should have the same swingweight. Thus, if a set of irons is built with steel shafts at a normal length, they all may weigh D2 for example. The pitching wedge may be a swingweight or two heavier as it is designed to potentially play from more difficult lies and

### Examples of Standard Clubhead Weights

Clubhead	Weight
1-wood	198 g
2-wood	203 g
3-wood	208 g
4-wood	213 g
5-wood	218 g
7-wood	228 g
1-iron	229 g
2-iron	236 g
3-iron	243 g
4-iron	250 g
5-iron	257 g
6-iron	264 g
7-iron	271 g
8-iron	278 g
9-iron	285 g
PW	292 g
SW	305 g
UW (60°)	298 g

heavy grass, while the Sand Wedge and/or utility wedge may be several swingweights higher than the rest of the set. This is due to these clubs serving as sand-type clubs; their added weight helps them cut through sand and heavy grass more easily. When assembling woods, very often the driver will have a different shaft than will the rest of a player's woods. It may be a totally different swingweight than the other woods as a result. If the fairway woods all have the same shafts, it would be a normal procedure that they all weigh the same however.

Any overlength applications will require considerations so as not to obtain swingweights that are too high, while underlength applications must avoid swingweights that will be unacceptably low. There are options a clubmaker can pursue when building clubs to ensure that the finished clubs will swingweight to his specified weight. The vast majority of heads designed today will swingweight in the C9-D3 range at a standard length (39" #2 iron.) Thus if a clubmaker desires a heavier swing-weighted set of clubs, he can simply add lead tape to the back of the club or lead powder in the hosel. If the club would happen to have a weight port, lead powder can be added there as well. True Temper produces a shaft with a shock-absorbing insert, called the SensiCore that cannot be swingweighted with powder down the shaft. In cases of graphite or SensiCore shafted clubs, weight can be added through lead tape applied to the back of the club or by the installation of lead pins inside of the shaft tips. It is recommended not to add any more than 5 swingweight points (10 grams) in a steel shaft or 6 grams by way of tip pin in a graphite shaft when trying to increase the weight in the head end of a club. More weight than this tends to adversely affect the club's center of gravity and playability. Additionally, the more weight that is added to the shaft, the more likely it is to work loose and cause a rattle in the shaft. The amount of weight that can be added in a weight port is dictated by the size of the port itself. Typically somewhere between 5 and 15 grams of lead powder can be put in the weight port cavity. Any weight in the weight port will not adversely affect playability. In all but very unusual applications the weight port will provide enough room for swingweighting. In such unusual situations, additional weight (up to 10 grams) may be added in the shaft.

The addition of weight is obviously easier than its removal. When building shorter clubs, weight can be added to meet swingweight requirements, either in the shafts of irons or in the weight ports or shafts of woods. One other common method of adding weight should be mentioned. Lead tape can increase swingweight as well. 4" of 1/2" wide lead tape is equal to 1 swingweight point. While many feel the application of lead tape detracts from the cosmetics of the clubhead, it may be the only option in certain unusual applications, and thus deserves noting. The CG of the head is not changed by the addition of lead tape. Often players believe that putting lead tape on a certain position on the club head will influence a draw or fade. It would require nearly 50" of tape to have even a slight effect on ball flight. It is not physically possible to put that much tape on a club head. Look to lead tape to add weight, not to have an effect on ball flight.

In order to remove weight from a head a clubmaker must resort to grinding the head. This is a difficult operation for all but the most highly skilled technicians. Such grinding may have an effect on the playability of the club (i.e., sole angles can be changed, weight distribution altered, head shape changed, etc.) and is not recommended. Additionally, the ground heads will require either plating, in the cases of chromed models, or buffing or tumbling in the cases of stainless heads. A better way to achieve a lower swingweight is to find lighter components in the way of heads and/or shafts.

Any change in the weight of the head end of the golf club, be it in the actual head or in the tip of the shaft, will have noticeable effect on swingweight. An increase in weight will raise the swingweight, a decrease will reduce the swingweight. While small changes in swingweight may not be felt by the golfer, it is the goal of the clubmaker to match the swingweights of a player's clubs in as consistent a manner as possible. Choosing components that match specific weight requirements or making alterations to the actual head weight are the methods a clubmaker can use to reach his goal.

## 2. The weight of the grip and grip tape

Just as any weight change in the head of a club will change swingweight, so will any change in the grip section of the club. The weight of a grip has an influence on swingweight. Given two clubs with the same specifications except for the grip, the club with the heavier grip will swingweight lighter and the one with the lighter grip will swingweight heavier. The amount of weight it takes to change a swingweight in the grip section of a club is approximately 5 grams. Note this approximate 2-1 relationship with swingweight in the head and grip end: It takes just a bit more than twice as much weight to change the swingweight in the grip than in the head. Thus where 2 grams will make a change in the head, it takes 5 grams to make the same change in the grip.

Also note the change occurs in the grip in an opposite manner than in the head. When weight is added in the grip, the swingweight decreases. If weight is removed, the swingweight increases. While actual weight cannot be removed from a grip, we consider removing weight to be the equivalent of using a lighter grip and adding weight to be equal to using a heavier grip or adding buildup tape. Another method to add weight to the grip end of a club is through counterbalancing. This involves epoxying a lead weight in the butt of the club or wrapping lead tape under the grip. This is sometimes done to achieve lighter swingweights, but is not highly recommended as it increases the total weight of the club and changes the balance point of the club; two factors, that when changed, may often prove detrimental to the playability of the club.

Let's look at an example. A grip that weighs approximately 50-55 grams is considered to be a "standard" weight grip. Suppose we have a club that swingweights at D2 and currently has such standard weight grips, an example of them being Golf Pride Tour Velvet (50.8 grams) models. A customer wants the clubs regripped with Jumbo Victory grips which weigh 68 grams. The difference in weight is a bit over 17 grams. Grip weights are listed in most major component company catalogs and on manufacturer's web sites. As 1 swingweight point in the grip approximates 5 grams, we will see a change in swingweight of about 3 1/2 points when making this change. The club will now swingweight a bit more than C8, providing a noticeable change in the feel of the club. Any additional build up tape will have an effect on swingweight as well. Generally, for every 1/64" a grip is built up, the resulting change in swingweight due to the weight of the tape will be 1/2 point (decrease.) Three wraps of masking tape will produce approximate reduction in swingweight of 1 point. Also, be aware that although a heavier grip will decrease the swingweight of the club, it will have the reverse effect on the total weight of the club and will thus cause it to increase. The amount of increase will be dependent upon the actual weight of the grip.

It is evident that any change in weight at the grip end of the club has an effect on the swingweight of the club as well as on the total weight. This is another example of how changing one club specification has a direct effect upon another specification. Grip weight must be considered when assembling any club as it has an immediate bearing on the weight of the club.

### 3. The length of the club

The reason that clubheads are manufactured with different weight specifications has a direct bearing on the intended assembled length of the specific club. Longer length clubs will be fitted with heads of lighter weight. The standard progression from club to club is 1/2", the exception being in the wedges and possibly the #9 iron which may all be the same 35 1/2" length as a standard. The corresponding change in head weights between heads is 7 grams. Again, exceptions will occur in the wedges due to their intended usage requiring the heads to be heavier. By observing the table to the right, the effect of length on weight can be noted.

Club	Head Weight	Shaft Weight	Swingweight At		
			38.5"	38"	37.5"
5-iron	257 g	125 g	D6	D3	D0
5-iron	257 g	105 g	D4	D1	C8
5-iron	257 g	80 g	D0	C7	C4

As a club's length is increased, its corresponding swingweight increases as well. This is easy to understand when looking at a swingweight scale. As a club is made longer, the head of it is farther from the scale's fulcrum point and thus the swingweight will be higher. For every 1/2" of length increase, the swingweight will increase 3 points. As a club is made under standard by 1/2", the swingweight will be decreased 3 points. This is an important consideration for a clubmaker when assembling overlength or underlength clubs. Clubs made overlength will be heavier, both in swingweight and total weight, provided the same components are used to assemble both length of club. As clubs are made extremely overlength, the clubmaker must search for ways to make the club swingweight in the "normal" range. The choices here include using a lighter weight head, a lighter weight shaft (this will potentially reduce the overall weight of the club), or possibly a heavier grip (but keep in mind this heavier grip will increase the overall weight of the club.) If clubs are to be made shorter and swingweight maintained, the clubmaker's choices include adding weight in the shaft or in the weight port, choosing a heavier head, using a heavier shaft, or possibly using a lighter grip.

Clubmakers are often faced with applications of overlength or underlength clubs. In most cases a swingweight in the desired range can be achieved through a variety of methods. As clubs are made longer, a heavier swingweight is expected and is acceptable; conversely as a club is made shorter, its swingweight is expected to be lighter. It is important to realize that club length is yet another specification that has an effect on other club specifications. By becoming familiar with what happens as a club's length is increased or decreased, a clubmaker can assemble clubs to fit his customer's needs.

### 4. The weight of the shaft

Much in the same manner as head weight or grip weight, the weight of a club's shaft has a definite influence on the swingweight of the finished club. As a general statement regarding shaft weight versus swingweight, it can be said that the lighter the shaft, the lighter the final swingweight, provided no change is made to any other specification of the club. This is true as evidenced when considering the lorythmic type swingweight scale. As this scale is based upon a 14" fulcrum point and from slightly more than two thirds (in the case of a driver) to nearly one third (short irons) of a club's shaft lies in front of this fulcrum point, it is easy to

understand how a shaft's weight effects swingweight. Simply put, all of a club's weight in front of the fulcrum point will be considered as head weight, while all behind the 14" mark will act as grip weight.

<b>Effect of Shaft Weight on Swingweight</b>			
<b>Club Head</b>	<b>Head Weight</b>	<b>Shaft Weight</b>	<b>Swingweight at 43 1/2"</b>
Driver	198g	125 g	D3
Driver	198g	105 g	D1
Driver	198g	80 g	C7
Driver	198g	60 g	C5

When a change is made in a club's shaft (lighter), a corresponding change in the club's swingweight (as well as total weight) will automatically occur. More weight will be lost toward the tip end of the shaft when compared to the butt end, thus a lower swingweight results. The chart to the left shows a basic relationship between shaft weight and swingweight. This change in swingweight when changing shafts may be nearly as dramatic as when changing the weight of the head of a club. In any event, as shaft weight decreases, swingweight correspondingly decreases as well.

<b>Shaft Weight Classification</b>	
<b>Type</b>	<b>Weight Range</b>
Standard Weight	120 grams +
Light Weight	95 – 119 grams
Very Light Weight	70 – 94 grams
Ultra-Lightweight Weight	50 – 69 grams
Super Light Weight	Below 50 grams

There are five main weight classes of shafts as seen in the table to the left. It is important that, when pre-calculating swingweight, a clubmaker be aware of the weight category of the shaft to be assembled in a given club. As a shaft's weight distribution varies from shaft to shaft, it is nearly impossible to make a blanket statement as to how much influence a certain weight range of shaft will have on swingweight. A shaft that is tip heavy in construction will have a greater effect on a swingweight change than will a more butt heavy shaft. There are certain composite shafts that may actually have a butt heavy as well as a tip heavy section depending upon how the shaft may be trimmed prior to assembly. In general terms, we can make the following conclusion: If we have an example of a standard length, standard head weight, Victory (50 gram) gripped golf club with a parallel steel shaft that weighs D0 as a standard, we can compare what will happen to swingweight if we change the shaft but keep all other specs the same. If we change the shaft to tip heavy graphite,

the swingweight will remain near D0. If we install a butt heavy graphite shaft (as most graphite shafts are butt heavy), the swingweight will be between C4 and C7. A lightweight steel shaft would make the swingweight approximately C7, while titanium or aluminum will produce C8 readings. As a clubmaker, you will have to be acquainted with not only the total weight of the shaft you are using, but its balance point as well when pre-calculating a club's swingweight.

In order to assist in pre-calculating the final swingweight of a club, consider a shaft weight change of approximately 9 grams to change the swingweight by 1 point. A shaft that is 9 grams heavier will increase a club's swingweight by 1 point, one that is 9 grams lighter will decrease it by 1. These two factors are generalities that may be affected by the balance point of the shaft, but they do provide a basis for the clubmaker to use when calculating swingweight.

## 5. The balance point of the shaft

As previously mentioned, the manner in which weight is distributed in a shaft will be reflected in the club's final swingweight. This distribution of a shaft's weight is especially relevant when considering the large number of composite shafts available today. It is important to be aware though, that steel shafts may have different balance points also. Take the example of a True Temper Dynamic iron shaft with a butt-shaft balance point when compared to a Royal Precision Rifle Lite shaft with a mid-shaft balance point. The amount of swingweight change is not nearly as high as expected when installing the Rifle Lite shaft due to the more tip heavy nature of the shaft. When discussing graphite shafts and their balance points, let's look at an Aldila SW with a butt shaft balance point and compare it to a tip heavy shaft such as an Aldila Tgi85 shaft. If using these two shafts in identical clubs, the swingweight of the Tgi85 shafted club would be approximately 4 points heavier due to the nature of the lower balance point of the shaft, even though the shafts are similar in weight.

To summarize the effect of balance point on swingweight, it can be stated that with more weight in the tip end of the shaft than in the butt end, more of the shaft's weight will count as headweight on a swingweight scale. This will have the effect of maintaining a higher swingweight than what might be ordinarily expected for this type of shaft - a factor to consider when pre-calculating swingweight.

## TIPS FOR PRE-CALCULATING SWINGWEIGHT

The process of pre-calculating the swingweight of a finished club is an important consideration of a clubmaker as an initial step in club assembly. With the myriad of shaft weight, grip weight, head weight, club length, etc. combinations possible for a finished club, the pre-calculation step becomes a wise starting point for the clubmaker. The very first step in pre-calculating swingweight is to weigh all of the components prior to doing any assembly work. We can then refer to the two tables below as sample guides for all assembly procedures.

To use these tables to assist in pre-calculation steps, refer to the “Standard Swingweight Calculation Through A Set” Table

<b>Swingweight Factors</b>				
<b>Swingweight Change</b>	<b>Increase Factor By</b>	<b>Swingweight Factor</b>	<b>Decrease Factor By</b>	<b>Swingweight Change</b>
+1	2 grams	Headweight	2 grams	- 1
+3	1/2 inch	Length	1/2 inch	- 3
-1	5 grams	Grip Weight	5 grams	+ 1
+1*	9 grams	Shaft Weight	9 grams	- 1*

\* The shaft swingweight equivalent is for illustration purposes only. Unlike the other three factors, as shaft weight changes its effect on swingweight changes at a disproportionate rate. For estimation purposes, however, the above shaft weight-to-swingweight equivalent is acceptable.

<b>Standard Swingweight Calculation Through A Set</b>					
<b>Club</b>	<b>Head Weight</b>	<b>Raw Shaft Weight</b>	<b>Grip Weight</b>	<b>Club Length</b>	<b>Swingweight</b>
1-wood	198 g	125 g <sup>1</sup>	50 g <sup>2</sup>	43”	D0
3-wood	208 g	125 g <sup>1</sup>	50 g <sup>2</sup>	42”	D0
4-wood	213 g	125 g <sup>1</sup>	50 g <sup>2</sup>	41.5”	D0
5-wood	218 g	125 g <sup>1</sup>	50 g <sup>2</sup>	41”	D0
7-wood	228 g	125 g <sup>1</sup>	50 g <sup>2</sup>	40”	D0
1-iron	230 g	127 g <sup>1</sup>	50 g <sup>2</sup>	39.5”	D0
2-iron	237 g	127 g <sup>1</sup>	50 g <sup>2</sup>	39”	D0
3-iron	244 g	127 g <sup>1</sup>	50 g <sup>2</sup>	38.5”	D0
4-iron	251 g	127 g <sup>1</sup>	50 g <sup>2</sup>	38”	D0
5-iron	258 g	127 g <sup>1</sup>	50 g <sup>2</sup>	37.5”	D0
6-iron	265 g	127 g <sup>1</sup>	50 g <sup>2</sup>	37”	D0
7-iron	272 g	127 g <sup>1</sup>	50 g <sup>2</sup>	36.5”	D0
8-iron	279 g	127 g <sup>1</sup>	50 g <sup>2</sup>	36”	D0
9-iron	286 g	127 g <sup>1</sup>	50 g <sup>2</sup>	35.5”	D0
PW	293 g	127 g <sup>1</sup>	50 g <sup>2</sup>	35.5”	D3
SW	300 g	127 g <sup>1</sup>	50 g <sup>2</sup>	35.5”	D6

<sup>1</sup> Raw shaft weight is based on a 46” True Temper Dynamic Gold R300 for woods and a 41” True Temper Dynamic Gold R300 for irons (parallel tip version for each). With proper tip trimming and installation, each shaft’s weight will be reduced slightly throughout the set.

<sup>2</sup> Grip weight is based on the average weight of a M60 Golf Pride Perforated Tour Wrap grip. Traditionally the sand wedge and pitching wedge are designed to play at higher swingweights than the #1-9 irons.

NOTE: Shaft balance point is a parameter that is dependent upon specific shaft trimming. This shaft characteristic may have an impact on swingweight as well, particularly with a tip heavy or butt heavy shaft.

which contains standards for shaft, head, and grip weight as a basis for a typical assembly situation.) and then use the Swingweight Factors Table when determining any assembly changes. The usage of these tables may best be illustrated through a few example assembly procedures. If a clubmaker was assembling a #9 iron to a length of 35 1/2" using a 285 gram head, a Dynamic Gold R300 shaft trimmed according to manufacturer's recommendations, and a 50 gram grip, the final swingweight of the club would be D0. If changes were made to any of these components, then a swingweight change would occur. If instead of a 50 gram grip, the clubmaker used a heavier 55 gram grip, the resulting swingweight change would be to reduce the swingweight by nearly 1 point, making the finished club close to C9. Refer to the Swingweight Factors table to determine the amount of swingweight change caused by the changing of certain specifications. Looking at another situation if the clubmaker uses a sand wedge head that is 304 grams with the same shaft, length and grip and the swingweight parameters, it will yield a D8 finished swingweight due to the heavier head.

## COMPONENT TOLERANCES

With the great variety of component suppliers - not only head manufacturers, but shaft and grip suppliers as well, there will be wide variations in specifications from these suppliers. It therefore becomes a necessity in most cases that a clubmaker pre-calculate the swingweight based upon the raw weights of the component parts that he is using. Also considering manufacturing tolerances of a few grams (+2/-4 grams on heads alone), it is easy to see why all assembled clubs might not swingweight the same after assembly. This +2/-4 variation could possibly yield a 3 swingweight difference between one club and the next. A few grams difference in a grip or shaft could also yield a difference in swingweights of a point or two. Typical grip weight tolerances are +/- 3 1/2 grams, enough to effect swingweight nearly 1 point. Shaft manufacturing tolerances are generally +/- 4 to 5 grams which can produce a 1 swingweight variations among clubs. Balance point tolerances of +/-1/8" can yield 1/2 swingweight differences from one shaft to another. If all of these differences were on the lower side or higher side of tolerances, the swingweight of the finished clubs could be several points too light or too heavy. This situation, while unusual, illustrates the need to pre-calculate swingweight.

To further assist in pre-calculating swingweight, below find some more examples that a clubmaker might encounter when assembling a variety of clubs from different components. By familiarizing yourself with the logic of pre-calculating swingweight, much time will be saved in later assembly procedures-and the finished products will be more accurate examples of your work.

**Example #1**

Calculate a #7-iron with a True Temper Dynamic Gold Lite S300 shaft (109 g) and a Golf Pride M60 Tour Velevet Lite grip (39 g) to a length of 37".

Clubhead	Shaft	Grip	Length
269 g	109 g	39 g	37"

**STEP 1:** Compare each component to the "Swingweighting Factors" table to determine any deviation from standard.

Clubhead	Shaft	Grip	Length
-3 g	-18 g	-11 g	+ 1/2"

**STEP 2:** Determine each component's deviation in swingweight points based on the "Swingweighting Factors" table.

**STEP 3:** Tally the swingweight equivalent changes and compare the results with the D0 swingweight standard.

Clubhead	- 1.5
Shaft	- 2.0
Grip	+2.0
Length	<u>+3.0</u>
Net change =	+1.5 sw over D0. Swingweight = D1.5

**Example #2**

Calculate a #1-wood with a UST ProForce 55 R-flex shaft (63 g) and a Lamkin Crossline Mid-Size grip (67 g) to a length of 46".

Clubhead	Shaft	Grip	Length
195 g	63 g	67 g	45"

**STEP 1:** Compare each component to the "Swingweighting Factors" table to determine any deviation from standard.

Clubhead	Shaft	Grip	Length
-3 g	-62 g	+17 g	+2"

**STEP 2:** Determine each component's deviation in swingweight points based on the "Swingweighting Factors" table.

**STEP 3:** Tally the swingweight equivalent changes and compare the results with the D0 swingweight standard.

Clubhead	- 1.5
Shaft	- 7.0
Grip	- 3.0
Length	<u>+12.0</u>
Net change =	+0.5 sw over D0. Swingweight = D0.5

These examples using swingweighting factor tables are for pre-calculating swingweight prior to assembly. Any changes in the shaft balance point dependent upon specific shaft design or trimming may have an effect on swingweight as well.

While swingweight is by far the most common method of establishing a form of club matching, what is actually being expressed is somewhat confusing to certain clubmakers. Clubmakers for decades have known that club to club matching is necessary for good feel from one club to another in a set of clubs. The development of the swingweight scale helps to express a weight (as well as feel) relationship between clubs. The weight it describes is the weight relationship about a fixed point. This fixed point is a fulcrum based on a 14" fulcrum arm length and has become a standard for club measurement for years.

It has been noted that a golf club also has a balance point. This balance point can be described as the position when a club has an equal amount of weight toward the head end of the club as it does toward the grip end. A simple method of finding a shaft's balance point is to lay a club across your fingers until it rests parallel to the floor. The balance point will change from club to club. Thus there needs to be an industry reference for this balance point. It is the 14" fulcrum point on the swingweight scale.

If you try to balance a golf club 14" from the butt end, you cannot do it. If it were to balance, more weight would have to be added to the butt end of the club. As more weight is added the club once again can balance on your fingers. The mass that is shifted away from the fulcrum point is termed the moment. The distance from the center of gravity of the sliding weight to the fulcrum of the scale multiplied by the mass of the slide weight will yield a measurement that can be expressed in inch/ounces. Such a relationship can be computed on a swingweight scale shows that 1 swingweight point is equal to 1.75 inch/ounces. The effect that weight in one part of a club has on the swingweight of the club is noted that when 1 ounce of weight that is 1.75" from the fulcrum point would have the same effect on the scale as 1 gram of weight being 49.61" from the fulcrum point.

It has been previously noted that 2 grams of weight in the head was approximately 1 swingweight. Remember though, that this is only true with a 38.75" club. Due to the effect of weight relationship to the fulcrum point of the scale, less than 2 grams is needed to make up 1 swingweight point when clubs are longer than 38.75". Conversely, less than 2 grams is needed for 1 swingweight point as clubs are shorter than 38.75". It is important to realize that head mass is only one consideration when assembling a club and calculating swingweight. The weights of the grip, shaft, backscrew, whipping, ferrule, grip tape, and epoxy all combine in influencing swingweight. While obviously the head, shaft, and grip are the major influence on a club's swingweight, the other factors have a cumulative effect on swingweight that cannot be ignored.

<b>Average Weight of Minor Clubmaking Components</b>	
2" Grip Tape (10" strip)	= 2.8 g
2" Build-up Tape (10")	= 1.4 g
Epoxy	= 1 - 3 g <sup>1</sup>
Ferrule	= 1 - 3 g
Backscrew	= 1.5 g
Whipping	= 1.5 g

<sup>1</sup> Epoxy weight is approximately the minimum required to adequately bond the shaft to the head. Overuse of epoxy (a frequent habit of less experienced clubmakers) can significantly affect weight.

Using balance point to determine swingweight leads to the following formula:

$$\text{Swingweight} = (\text{static weight in ounces}) \times (\text{balance point of the club down from the butt} - 14") = (\text{inch/ounces})$$

The swingweight formulation is derived from the summation of all the distances from the balance point of each component to the scale fulcrum point, multiplied by the mass of each component. By understanding balance point relationships, swingweight can be estimated prior to club assembly. To make as accurate calculations as possible, the 1/8" thickness of the grip cap must be considered in determining the shaft's balance point.

Determining the balance point of components is relatively easy. Set up a piece of angle iron on a flat surface. Place each component on the angle iron until it balances and mark this balance position with a felt pen. Use a ruler to measure the balance point dimension for each club and record this measurement. The distance of each component's balance point to the 14" fulcrum point of the scale must then be determined. Let's assume a grip has a balance point 5 1/2" from the butt end. The balance point is therefore 8 1/2". This comes from subtracting 5 1/2" from the fulcrum point length of 14" (14" - 5 1/2" = 8 1/2"). The balance point of each component must be determined in the same manner. The swingweight can now be determined.

The following example will detail how to use this procedure:

A 200g metal wood Driver requiring a ferrule and a M1 bore (1.5" BBGM) will be assembled with an Aldila HM-40 Tour Gold shaft and a Golf Pride M60 Tour Wrap grip. The Driver will be built to a 44" playing length and the grip will be installed to a +1/64" oversized (requiring two strips of build up tape and one strip of 2-way grip tape).

The balance point of the components are measured as follows:

<b>Component</b>	<b>Weight</b>	<b>Balance Point From 14" Fulcrum Point</b>
Clubhead	200 g / 7.05 oz.	30"
Shaft (cut)	88.1 g / 3.11 oz. (balance point is 18.88" from butt)	42.5" <sup>1</sup>
Grip	50.8 g / 1.79 oz. (balance point is 3.5" from butt)	10.5"
2" Grip Tape	2.8 g / 0.10 oz. (balance point is 5" from butt)	9"
2" Masking Tape	2.8 g / 0.10 oz. (balance point is 5" from butt)	9"
Ferrule	2.0 g / 0.07 oz.	26.75"
Epoxy	2.0 g / 0.07 oz.	28"
<sup>1</sup> -1/8" is added to the cut shaft balance point to allow for thickness of grip cap.		

To calculate swingweight from the above information, multiple each component's weight in ounces by its distance from the fulcrum point of the swingweight scale. Then follow this formula:

**Swingweight =**

<b>(Clubhead weight) x (Balance point from fulcrum point)</b>	<b>(7.05) X (30)</b>	<b>=</b>	<b>211.50</b>
<b>(Shaft weight) x (Balance point from fulcrum point)</b>	<b>(3.11) X (5)</b>	<b>=</b>	<b>15.55</b>
<b>(Ferrule weight) x (Balance point from fulcrum point)</b>	<b>(0.07) X (26.75)</b>	<b>=</b>	<b>1.87</b>
<b>(Epoxy weight) x (Balance point from fulcrum point)</b>	<b>(0.07) X (28)</b>	<b>=</b>	<b><u>1.96</u></b>
			<b>230.88</b>

<b>(Grip weight) x (Balance point from fulcrum point)</b>	<b>(1.79) X (10.5)</b>	<b>=</b>	<b>18.80</b>
<b>(Grip Tape weight) x (Balance point from fulcrum point)</b>	<b>(0.10) X (9)</b>	<b>=</b>	<b>0.90</b>
<b>(Build-up Tape weight) x (Balance point from fulcrum point)</b>	<b>(0.10) X (9)</b>	<b>=</b>	<b><u>0.90</u></b>
			<b>20.60</b>

$$230.88 - 20.60 = 210.28 \text{ inch/ounces}$$

From previous inch/ounce balance point research done in clubmaking, it has been determined that D0 is equivalent to 213.25 inch/ounces. By comparing the calculations used in this example to swingweight equivalent, the following conclusions can be made:

$$213.25 \text{ inch/ounces (D0)} - 210.28 \text{ inch/ounces} = 2.97 \text{ inch/ounces}$$

$$1.75 \text{ inch/ounces} = 1 \text{ swingweight point}$$

$$2.97 \text{ inch/ounces} / 1.75 \text{ inch/ounces} = 1.7 \text{ swingweights}$$

Thus, for the this example, the deviation from D0 swingweight is 1.7, yielding a swingweight of C8.3. This allows us to precisely determine how much weight must be added to the clubhead end of this driver to achieve a desired swingweight of D0. However, making this determination requires a final calculation.

Because we are working within the scope of all golf club component balance points, the weight to be added will be put on the clubhead via either a lead tip pin (graphite shaft) or lead tape. Therefore the distance of the clubhead's balance point to the swing-weight scale's fulcrum point (30") must be divided by the inch/ounces required to achieve D0 (2.97 inch/ounces). This will reveal precisely how much weight should be added to the clubhead.

$$2.97 \text{ inch/ounces} / 30'' \text{ (balance point of clubhead)} = 0.01 \text{ ounce or } 2.8 \text{ grams}$$

Regardless of which method used to determine a club's weight parameters, it is vital that the weight of clubs be matched from one to another as much as possible. This allows the feel of all of a player's clubs to be generally the same, promoting consistency and accuracy. As a clubmaker, it is up to you to decide which system of swingweighting and its calculation is the best for you. Again, the main objective is that swingweighting be done on all clubs in as a precise and consistent manner as possible.

### SWINGWEIGHTING TIPS

<p>2 grams is approximately 1 swingweight point in the head end of the club.</p> <p>5 grams is approximately 1 swingweight point in the grip end of the club.</p> <p>The weight of one dime on the head of a club increases the swingweight by approximately 1 point, a quarter increases it by @ 3 points, a dollar bill by 1/2 point.</p> <p>1 ounce equals 28.35 grams.</p> <p>To convert from grams to ounces, divide by 28.35.</p> <p>To convert from ounces to grams, multiple by 28.35.</p> <p>Adding 1/2" in length adds 3 swingweight points.</p> <p>Subtracting 1/2" in length decreases 3 swingweight points.</p> <p>Making a club's lie 3 degrees flatter will increase the swingweight by 1 point.</p> <p>Making a club's lie 3 degrees more upright decrease the swingweight by 1 point.</p>	<p>Changing shafts from steel to graphite without making any adjustments to length will decrease the swingweight 5-6 points. Exceptions would be tip heavy and heavier weight graphite shafts.</p> <p>Three layers of masking tape under the grip will decrease the swingweight by 1 point.</p> <p>One 4 1/2" long piece of lead tape 1/2" wide (standard golf industry size lead tape) will increase the swingweight by 1 point.</p> <p>Applying finish to a wooden club will add approximately 1 swingweight point.</p> <p>Installing whipping to a wood will increase swingweight between 1/2 and 3/4 of a swingweight point.</p> <p>A wooden wood backscrew will increase the swingweight by approximately 1/2 point.</p> <p>If weight is added, regardless of where it is placed, the overall weight of the club will increase, however the swingweight will not necessarily change.</p> <p>When weight is removed from anywhere on the club, the total weight of the club will decrease, however the swingweight will not necessarily change.</p>
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