GOLF F·A·C·T·S

FACTS ABOUT CLUB TECHNOLOGY SERIES

A GUIDE FOR:
MEASURING & ADJUSTING GOLF CLUB ANGLES

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MITCHELL GOLF

Introduction

The golf industry has struggled over many years in recognizing the proper measuring methods to determine golf club angles. In the past manufacturers had generally claimed that only they could measure their club's angles because they had their own proprietary method.

The specification gauge disciples in the golf industry have long advocated the only way to measure club angles is by placing the club head on its sole center (defined by the middle of the score lines) on the base of the specification gauge. That method at best is subjective to the eye and practically impossible to repeat. The fact is the golf ball is struck on the club's face, not on its sole.

Therefore, the proper geometric measurement for loft, lie & face angles is to register the club's face attitude in a square and horizontal plane to precisely measure the club's angles in relation to the shaft plane. The ideal method is to register the club's score lines to a known square relationship to the measuring gauge. This allows for accuracy and repeatability. It becomes the benchmark for comparing lie angle marks on irons produced from an impact board. The angles displayed on the bending machine gauge become relative to any adjustment required and are not used to determine if the manufacturers specifications are accurate or not.

After proper registration in the bending machine clubs can then be adjusted to fit the individual needs of golfers allowing for game improvement while creating customer service profits for golf industry professionals.

Terms

As Cast: Metallurgical state of alloy, in casting process as poured into mold.

Bending Bar: Piece of equipment that fits over the hosel of a golf club and used for adjusting angles. Bending bars are available in many sizes and designs to accommodate various hosels.

Blind Bore: A bore configuration of metal woods in which the shaft penetrates the bore to a standard depth of 1/2" from the sole of the club head.

Bore Depth: The depth measurement of the hosel bore or shaft penetration.

Bore Type: The term used to describe how far a shaft penetrates into a club's hosel.

Bulge: The heel to toe radius of a metal wood and hybrid club face.

Center of Gravity (CG): The center of a club head's weight distribution.

Club Head Volume: Head size measured in cubic centimeters (cc's) when measured by liquid displacement. See USGA Appendix II for club size limits.

C. O. R. (Co-efficient of Restitution): Term used to describe the trampoline effect of the golf ball rebounding off a golf club's face.

Dynamic Lie Marks: The imprint marks left on the sole of an iron head from an impact board.

Droop: Term used to describe the bending down of the golf shaft perpendicular to the ground when a club is swung.

Face Attitude: The orientation of the club's face to its forward pointing direction.

Face Angle: Face Angle is the angle formed by the shaft plane to the square face plane with no sole influence. When viewed in a playing position, face angle is the angle formed by the club's face plane (open, square, closed) and the shaft plane when the club head is soled in it's natural lie angle position.

Gear Effect: Term used to describe the effect of face bulge of a metal wood when a ball is hit more on the toe or heel, which causes the ball flight to curve back towards the target.

Geometry: The mathematical study of the properties of, and relations between, points, lines, angles, surfaces and solids in space. NOTE: Angles are constant when measured from parallel planes.

Terms

Heat Treating: Precipitation Hardening process by which stainless steels used in cast golf club heads are hardened for corrosion resistance, yield strength, wear resistance and ductility.
Horizontal Face Plane (Attitude): The horizontal registration of the score lines of a golf club's face.

Hosel: The entry point of the shaft into the head on any golf club.

Leading Edge: The forward most point of the club's face.

Lie Angle: The angle formed between the shaft plane and the horizontal face plane (attitude).

Loft Angle: The angle formed by the shaft plane and the pitch of the face.

M1 Bore: Bore type in a wood in which there is 1.5" from the ground line to the point at which the shaft bottoms out in the hosel.

M2 Bore: Type of wood bore in which the shaft bottoms out in the hosel 1-inch from the ground line.

Metal Wood Bore: The bore configuration of a type of metal wood head in which the distance from the ground line to the bottom of the bore is 1 1/2 inches.

Offset: The distance from the forward edge of the hosel to the leading edge of the club's face, which is trailing the hosel.

On-set: The distance from the forward edge of the hosel to the leading edge of the club's face, which is forward of the hosel.

Progressive Offset: An incrementally progressive amount of offset designed into a set of irons with the longer irons having more and the shorter irons having less.

Rockwell Hardness: An alpha/numeric scale used to grade metal hardness based on the composition of the steel alloy. Forged carbon steel irons are typically B80 while cast stainless steel heads are; 431/C18, 17-4/C35 and maraging steel is C45.

Score Lines: Grooves on a club's face.

Standards: A model to be followed or imitated.

Trailing Edge: The most rearward edge of a club 's sole.

An Industry Guide To Angle Adjustments

Golf instructors and club fitters know that angle bending is among the fastest ways to improve a player's ball flight. Whether changing the lie to improve accuracy or changing loft to make certain that the player's clubs are progressively consistent for distance, angle bending is a major factor in club performance.

When it comes to loft and lie, many players have incorrect ideas about what can be done and what effect changes may have on playability. Being an industry professional, it is important to become knowledgeable to all facets of club bending. When you do so, you become the equipment expert and your golfers will rely on you as their source of equipment alteration.

Here are some facts and fallacies for you to be aware of so you can better serve the needs of your golfers.

Can cast clubs be bent?

Most irons can be bent, but the question of being able to bend cast clubs is still asked. The simple answer to that question is "yes". Cast 17-4 stainless steel irons will be more difficult to bend since they are harder (C34-38 on the Rockwell Scale) than 431 (C18-25) or forged carbon steel (high B's on the scale).

Keep in mind that we are assuming the iron has the proper heat treatment and annealing that will permit bending. Annealing ensures a more consistent grain structure in the metal. Heat treatment makes the head hard enough to withstand constant golf ball impacts.

Also, the club must have a hosel design that will allow bending. Special bars may be required for certain hosel designs such as those with a shorter hosel. With proper equipment nearly all hosel designs can be bent accurately and consistently ensuring properly fitted clubs for your golfers.

There is also a misconception that clubs that have been bent have "memory" that makes them naturally return to the original specification. This is simply not true. Once a club is bent to a given specification it will stay there until changed by an outside force of either bending again or striking a hard object.

Can today's metal woods be bent?

Even though a lot of people will immediately say no, the correct answer is "yes" with certain requirements. While there are limitations, many of today's metal woods are indeed bendable, especially stainless steel heads. Forged titanium models are bendable as well. Their softer titanium structure allows bending. Provided the hosel of the wood is long enough to allow the bending bar to fit over its length, metal woods can be bent to custom fit a player. This applies to both face angle and lie.

What about bending the loft of a metal wood? When you bend the hosel forward or back from the face plane you close or open the club's face angle. This will change the playing loft of the club by changing the trajectory of the ball but it can potentially cause misdirected shots because the golfer may not square the club face in a horizontal attitude.

An Industry Guide To Angle Adjustments

If a metal wood has an adjustable hosel it cannot be bent, but the amount of change between each setting can be measured properly with the proper angle machine.

Unfortunately, the angles of each setting do not repeat from metal woods of the same brand and model. Furthermore, when shafts are interchanged between to metal woods of the same brand and model the lie and face angles do not always repeat. The tolerance between the machined shaft tip and the hosel receptor vary and produce angle variations. This is true with all manufacturers.

Do club companies manufacture progressively consistent clubs?
In short the answer is "no". While they certainly try to make consistent product, they do not necessarily do so. It would be nice to believe that every set comes from the factory with precise specifications, but this is just not the case.

There are often inconsistencies in the lofts and lies of the clubs. Clubs are mass-produced with certain +/- manufacturing tolerances in every factory. However, you can easily bend the lofts and lies to be progressively consistent from one club to the next with zero tolerance. Plus you can bend the angles to a consistent specification precisely fit for any golfer.

Are there standards for loft and lie angles?
One of the most overused words in the golf industry is "Standard." Instead of the word standard, perhaps the word average should be used.

A quick look on the internet at specifications for the best selling #5 irons from four major manufacturers shows lie angles of 61.0, 61.5, 61.5 and 62 degrees. Not surprisingly there is no stated tolerance on any site, making one wonder just how close that 61.75-degree specification is. A look at standard lofts of #5 irons from these same manufacturers shows 21.5, 23, 24 and 25 degrees.

As an industry professional you should use the manufacturer's specifications as a reference only. When adjusting loft ask the player if they have any distance gaps between clubs that a loft change of a degree or two will correct.

The word standard really doesn't come into play with club performance fitting. Each player should be matched to his or her own individual specifications. If you want to call those specifications standard for that player, fine. But make sure you record the details for future reference, thereby setting their "standard" for improved individual performance.

It is vital to know the exact specification of the club's angles when checking for a proper fit using a lie test. The lie test could show the need for the club to be more upright or flatter.

The performance is the key element during the lie test, which determines a specific angle in degrees. The test club must be measured and adjusted to the new angle.

An Industry Guide To Angle Adjustments

Remember the set is not necessarily progressively consistent and therefore each club should be bent to a predetermined angle in relation to the test club. Do not bend every club in the set by the proverbial "2 degrees up or flat" thinking you adjusted the entire set consistently.

How does bending influence bounce?
Any change in a club's loft will correspondingly change the club's bounce. The relationship is one-to-one. As you decrease the loft of a club by one degree, you reduce its bounce a degree at the same time. The bounce angle increases equal to the amount of any loft increase.

A one or two degree change in loft will not cause a bounce or dig sole with today's clubs. But if you are changing lofts on older more flatter-soled irons, bounce should be taken into account.

If you do change the loft more than two degrees on a club, sole grinding may be necessary to restore the sole angle to a more playable position. Changes in lie do not affect the bounce of a club in any manner.

Can you be sure that a club will not break during bending?
Even the most skilled repair professionals can occasionally break a club. Generally breakage is a result of some type of inconsistency in the metallurgy of the club. Cast clubs may have voids in their internal structure. These voids are effectively weak spots that when subjected to pressure from bending will often cause hosel breakage.

In addition the club may not have been heat-treated properly and can be very brittle. The hosel of the iron may have been bored off-center resulting in inconsistent hosel wall thicknesses. Breakage can occur when bending pressure is applied to the thinner hosel area. None of these manufacturing inconsistencies can be identified prior to bending.

A properly manufactured club may be bent many times without breaking. There is no worry about bending a club that was bent last year or last week. It can be re-bent without any negative effect on it.

Are all bending machines accurate in their readings?
No, in fact all machines with fixed measuring gauges will not be accurate when measuring clubs with offset, progressive offset or face progression hosel positions. Machines that adjust for all hosel positions, such as Mitchell® Angle Machines are accurate regardless of the offset or hosel design of the golf club. Mitchell® machines are capable of bending and measuring clubs simultaneously. Spec Gauges are not required when measuring in a Mitchell® Angle Machine.

What is Proper Club Head Registration?
Club head registration is the key element when bending or measuring clubs. Proper registration requires the club to be clamped securely in the bending machine with the face square and horizontal by positioning the club's score lines

An Industry Guide To Angle Adjustments

parallel to a horizontal reference point. Score lines are manufactured into the club's face parallel to the face attitude. The face attitude at impact is what directs the ball's flight.

The club's sole and its imaginary ground line have nothing to do with the attitude of the club's face at impact. Measuring the club's lie off the center of the club's sole in a specification gauge is impossible to do accurately and it is almost impossible to repeat the measurement. Loft and lie angles are accurately measured from the club's face attitude (horizontal score lines) to the shaft plane.

How much can a club be bent?

The common industry answer is "2 degrees." This limit is only recommended when changing the lofts on irons due to the potential effect such bends will have on the sole angle of the club. If the hosel design and manufacturing processes allow, the lie of an iron can be bent 3-4 degrees or more with no compromise to the integrity of the head. This is especially true of clubs made with long hosels.

Practice on a few old irons in order to become comfortable in bending lie more than 2 degrees. It is easy to do in a machine that securely holds the club. Machines without adjustable sole clamps will often allow the iron to slip during bending, making the repair professional think the club bent when it didn't.

Metallurgy

MATERIAL	HARDNESS	PRIMARY USE
Aluminum	B50-60	Woods, Putter
Carbon Steel	B60-70	Irons, Putters
304 Stainless	B75	Irons Only
Beryllium Copper	B70-80	Irons, Putters
431 Stainless	C18-25	Irons, Putters
100% Titanium	C24-28	Woods
6-4 Titanium	C32-36	Woods, Faces
17-4 Stainless	C34-38	Woods, Irons, Putters
450 Steel (SuperSteel)	C36-40	Woods, Irons
15-5 Stainless	C36-44	Woods
Beta Titanium	C40+	Woods
Maraging Steel	C45-55	Woods, Faces

Subject:

Measuring Lie & Loft Angles - Irons, Metal Woods & Hybrids

- ***Club Head Registration - Irons, Metal Woods, Hybrids***
  - ***Lie Angle***
  - ***Loft Angle***
- ***Playing Loft - Metal Woods & Hybrids***

Subject: Measuring Lie & Loft Angles - Irons, Metal Woods & Hybrids

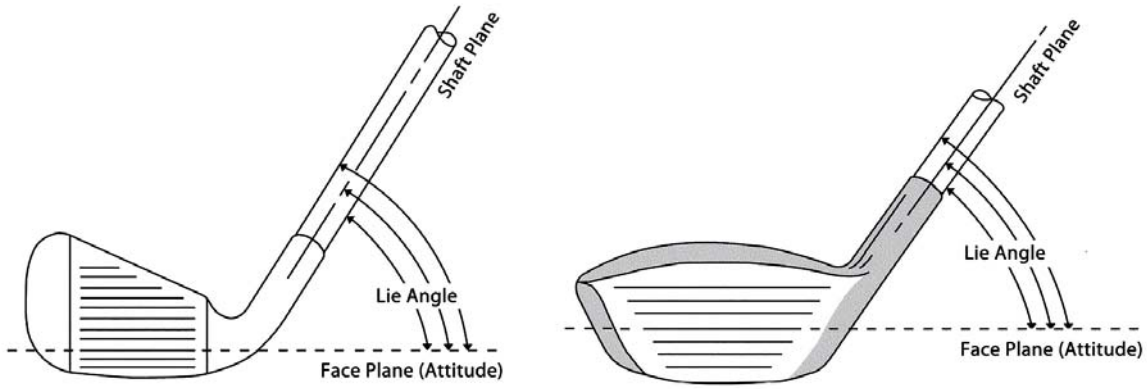
Club Head Registration - Lie & Loft Angles

Geometric Requirements

- » Club Head Must Be In Horizontal Face Plane (Attitude) Regardless Of Sole Radius
- » Club Face Must Be Square
- » Metal Woods And Hybrids - **Club Face Must Be Centered**
- » Lie & Loft Angles Are Constant When Measured From Any Parallel Plane:
  - » Inside Edge Of Shaft
  - » Outside Edge Of Shaft
  - » Center Line Of Shaft
  - » Extension Of Horizontal Face Plane
  - » Extension Of Shaft Plane

Lie Angle

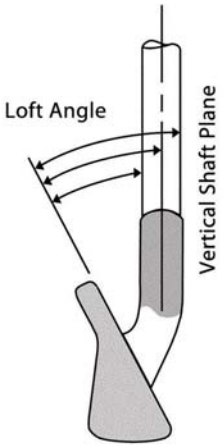
Lie Angle Is The Angle Formed Between The Shaft Plane And The Horizontal Face Plane (Attitude)

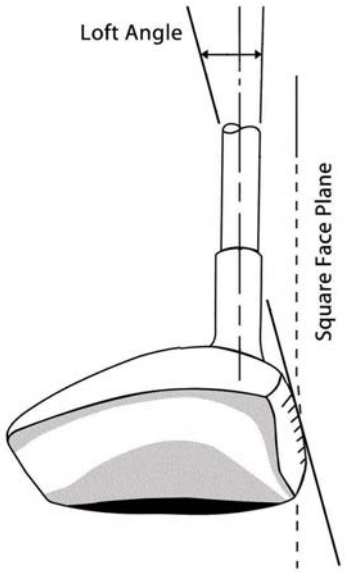


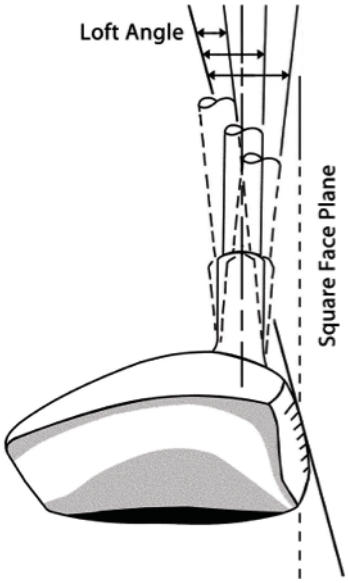
Subject: Measuring Lie & Loft Angles - Irons, Metal Woods & Hybrids

Loft Angle

The Loft Angle Is Formed By The Shaft Plane And The Pitch Of The Face







Playing Loft - Metal Woods & Hybrids

- Metal Woods And Hybrids - Loft Pitch Designed To Sole By Club Designers
- Playing Loft Is The Angle Formed By The Pitch Of The Face To The Open - Square - Closed Shaft Plane When Club Face Is Registered In A Square Position

Subject:

Measuring Face Angles - Metal Woods & Hybrids

- ***Club Head Registration***
- ***Face Angle - Measurement***
- ***Face Angle - Playing Position***

Subject: Measuring Face Angles - Metal Woods & Hybrids

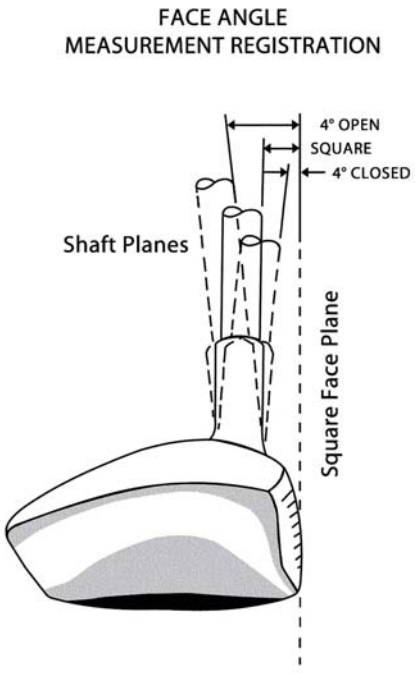
Club Head Registration

Geometric Requirements

- Club Head Must Be In Horizontal Face Plane (Attitude) Regardless Of Sole Radius
- Club Face Must Be Square And **Centered**
- Face Angle Is Measured Off The Shaft Plane To The Horizontal Face Plane (Attitude)
- Face Angles Are Constant When Measured From Any Parallel Plane:
  - Inside Edge Of Shaft
  - Outside Edge Of Shaft
  - Center Line Of Shaft
  - Extension Of Square Face Plane
  - Extension Of Shaft Plane

Face Angle - Measurement

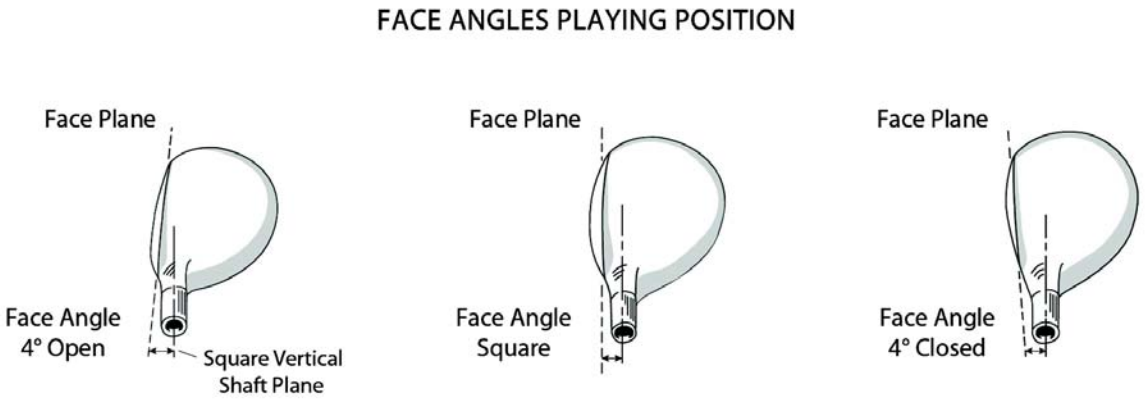
- Angle Formed By The Shaft Plane To The Square Face Plane With No Sole Influence



Subject: Measuring Face Angles - Metal Woods & Hybrids

Face Angle - Playing Position

» Angle Formed By The Club's Face Plane (Open, Square, Closed) To The Shaft Plane When Club Is Soled In Playing Position



Subject:

Bending Lie, Loft & Face Angles

- ***Bending Procedure***
- ***Hosel Designs***
- ***Iron Bending Method***
- ***Metal Wood & Hybrid Bending Method***
- ***Importance Of Hybrid Bending***
- ***Bending Conditions***
- ***Bounce Angle Description & Terms***

Subject: Bending Lie, Loft & Face Angles

Bending Procedure

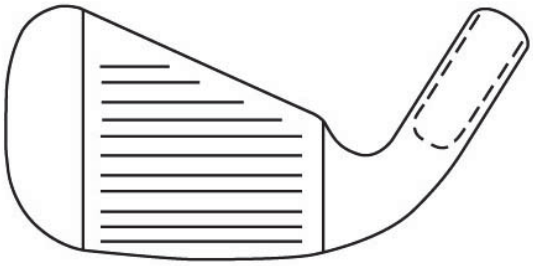
- » Place Bending Bar As Low As Possible On Hosel Of Irons
- » Place Bending Bar As High As Possible On Hosel Of Woods & Hybrids
- » Adjust Bending Bar Knuckle To Snug Fit
- » Exert Pressure In The Direction Of Desired Bend To Take Up Torque
- » Bend Hosel With Short Bumps Of Pressure
- » Bend Hosel In Shaft Plane Parallel With Angle Direction

Bending Iron

Bending Hybrid

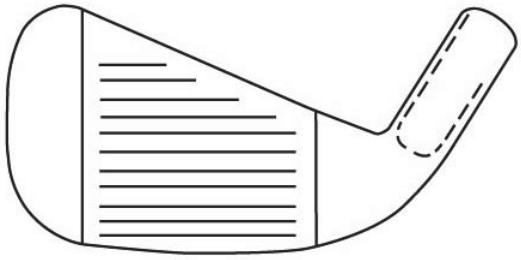
Hosel Designs

- » Length
- » Bore Depth
- » Top Line Separation
- » Outside Diameter
- » Inside Diameter
- » Wall Thickness
- » Off Center Bore

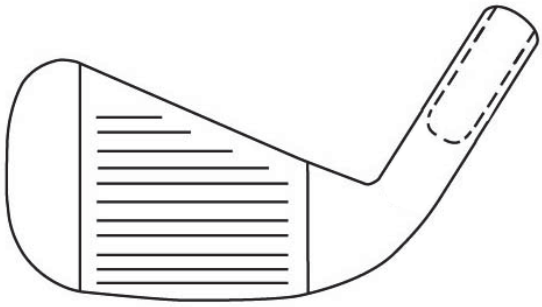


- » Most Friendly Design
- » Bends Up To 4 Or More Degrees Depending On Material & Rockwell Hardness
- » Little Risk Of Cosmetic Damage

Subject: Bending Lie, Loft & Face Angles



» Least Friendly Design
» Bends Up To 2 Degrees Depending On Material & Rockwell Hardness
» Hosel Can Stretch & Form A Flat Spot Or Indentation Blemish



» Friendly Design
» Bends 3-4 Degrees Without Risking Damage For Lie Angle
» Some Models Can Be Bent Up To 6 Degrees, i.e. 2 Degrees Flat to 4 Degrees Up

» Metal Woods & Hybrids Require At Least 1 1/4" Length
» Hosel Must Be Polished To Prevent Damage To Finish
» Club Head Material Must Be Stainless Steel

Subject: Bending Lie, Loft & Face Angles

Iron Bending Method

- » Measure Current Loft And Lie Angles
  - » Record Angles On Mitchell Angle Chart
- » Bend Iron To Desired Loft & Lie Angles
  - » Measure To Confirm Desired Angles
- » Record New Loft & Lie Angles On Mitchell Angle Chart

Metal Wood & Hybrid Bending Method

- » Measure Current Lie And Face Angle
  - » Record Angles On Mitchell Angle Chart
- » Bend To Desired Lie & Face Angles
- » Measure To Confirm Desired Angles
  - » Record New Lie & Face Angles On Mitchell Angle Chart

Importance Of Hybrid Bending

- » Lie Angle vs. Face Angle
  - » Have Similar Effect On Ball Flight
- » Playing Loft vs. Loft Number Of Hybrid
  - » Hybrid Lofts Usually In 2 Degree Increments
- » Lie vs. Length
  - » Steel Shafted Usually Shorter Then Graphite Shafted

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Angle Chart
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WOODS	FACE ANGLE		LIE	
	Previous	New	Previous	New
1				
3				
5				
HYBRIDS				
2				
3				
4				
IRONS	**LOFT**		**LIE**	
	Previous	New	Previous	New
3				
4				
5				
6				
7				
8				
9				
PW				

CLUB BRAND

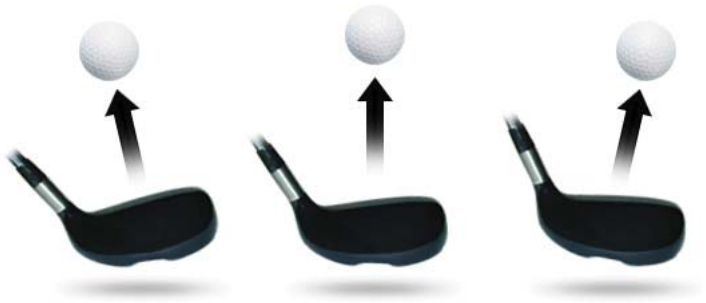
Woods _____ Hybrids _____ Irons _____

Name _____ Date _____

Address _____

Phone _____ Price $ _____

Mitchell Angle Chart

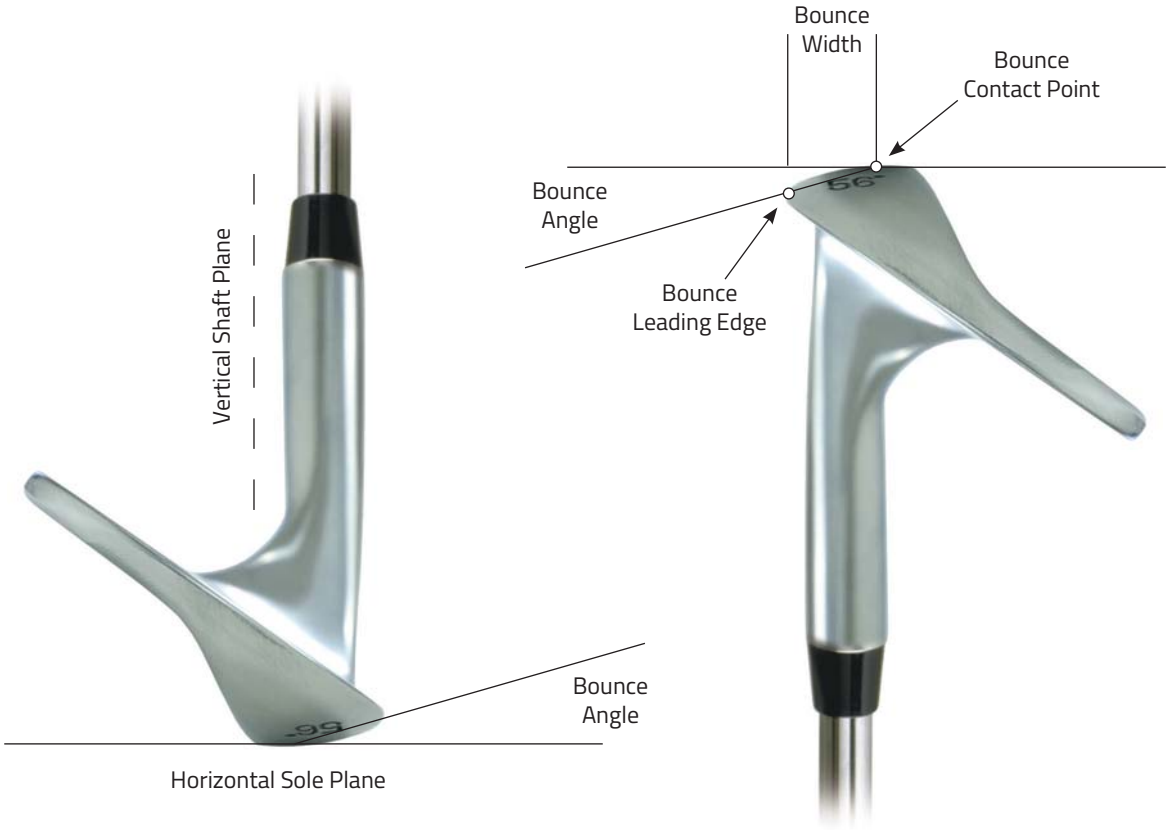


Subject: Bending Lie, Loft & Face Angles

Bending Conditions

- » Each Loft Change Will Equally Change Bounce Angle
  - » 1 Degree More Loft = 1 Degree More Bounce
- » 3-Degree Flatter Lie Angle Change Will Change Swing Weight 1 Point
  - » Not Same Ratio For Upright Lie Angle
- » Loft Changes Have Minimal Effect On Offset
  - » If Bend Is Made As Low As Possible On Hosel

Bounce Angle Description & Terms



Subject:

Interpreting Dynamic Lie Marks

- ***Leading Edge Mark***
- ***Centered Mark***
- ***Trailing Edge Mark***
- ***Quick Reference Chart***

Subject: Interpreting Dynamic Lie Marks

When interpreting lie mark imprints, the range of imprints moves from the leading edge (indicating a closed club face) to the trailing edge (indicating an open club face) as well from toe (indicating lie angle is too flat) to the heel (indicating lie angle is too upright).

Leading Edge Mark
Closed Face

Centered Mark
Square Horizontal Face

Trailing Edge Mark
Open Face

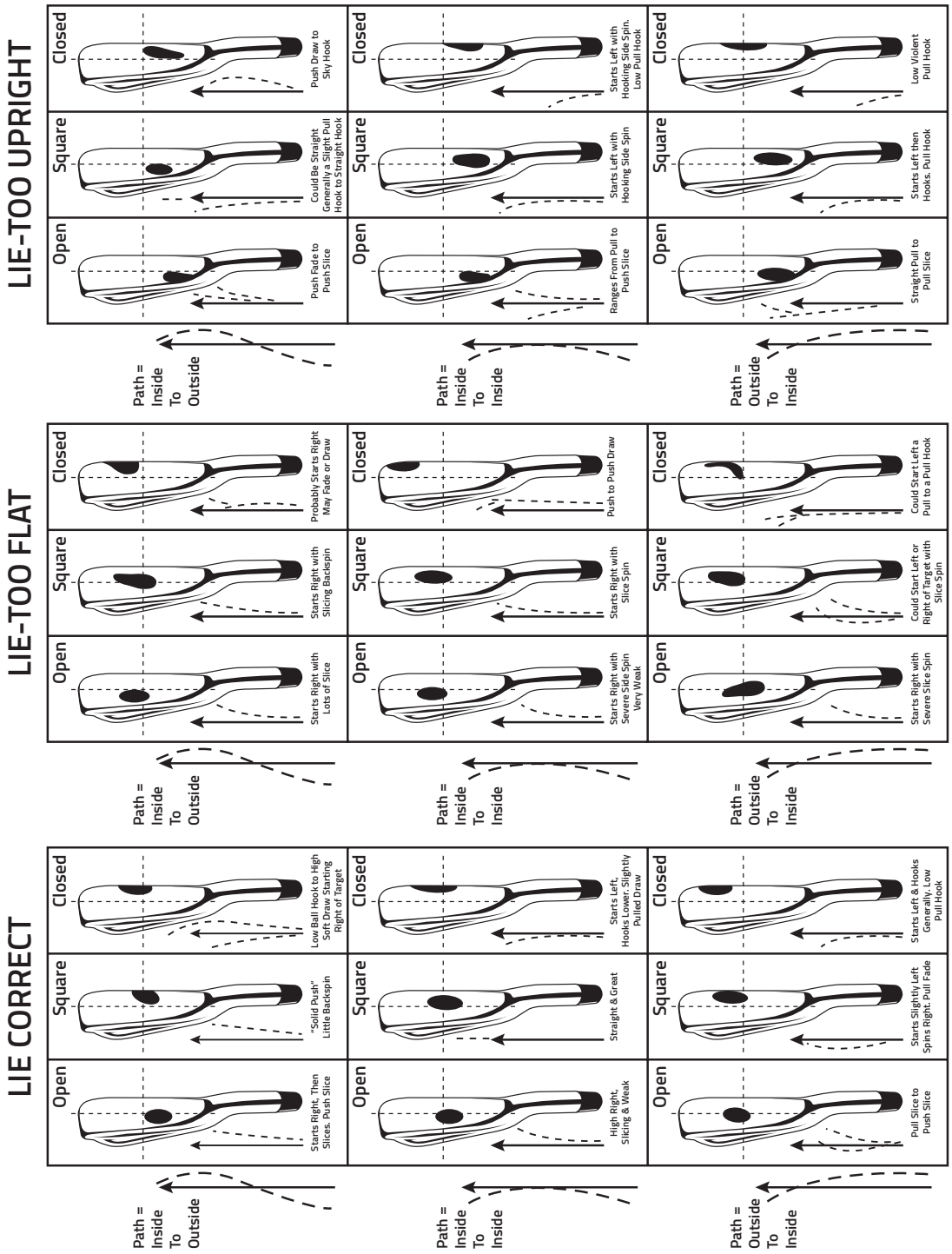
Do not confuse upright or flat lies with upright or flat swings. They are not the same and one does not necessarily produce the other.

Keep in mind that a leading edge, toe-down imprint mark may be the result of a closed clubface at impact and a correct club head path. The opposite is true with a trailing edge heel-down imprint mark may be caused by an open clubface with a correct path. These imprint marks may not be an incorrect lie angle. Even more confusing is a center leading edge imprint mark that may be caused by to upright of a lie angle, a closed clubface and an out-to-in club path.

Club length, shaft-flex and the golfer's swing characteristics all contribute to fitting lie angle correctly. Let ball flight results be the guide in interpreting lie imprint marks. The best way to check lie angles is to use only those imprint marks that resulted in shots with decent directional control, ideal trajectory and tilt axis curvature.

Subject: Interpreting Dynamic Lie Marks

LIE ANGLE CHART - QUICK REFERENCE



Produced by Henry-Griffitts. Artwork re-created with permission by Mitchell Golf Equipment Company. | 2015

Subject:

Subject: Ball Flight

- ***What The Golf Ball Needs To Know***
- ***5-Ball Flight Laws***
- ***Tilt Axis***
- ***9-Ball Flight Patterns***
- ***Angle Adjustment Effects***

Subject: Ball Flight

What The Golf Ball Needs To Know

You may be aware that the collision of the club head with a stationary golf ball happens in approximately a millisecond. The implied laws of physics from this collision are either achieved or overcome with the result determining the flight of the golf ball.

We must remember that as the golfer swings the club head, the club tries to square and sole itself that would result in a perfect impact position to launch the golf ball. But of course, this does not generally happen 100% of the time. As a matter of fact it seldom happens perfectly. That is why golf is a game of a degree of misses and not of perfect shots.

So what does a golf ball asks from a golf club head at impact?

- How Fast Is The Club Head Moving (Speed)
- Where Is The Impact Point (Centeredness)
- What Direction Is The Club Head Moving (Path)
- What Direction Is The Face Pointing (Face)
- Descending Or Ascending Arc Of Club Head (Angle Of Approach)

These five questions are answered through physics. They determine the Ball Flight Laws, which were identified in the PGA Teaching Manual as a result of the study from the book *In Search Of The Perfect Swing*.

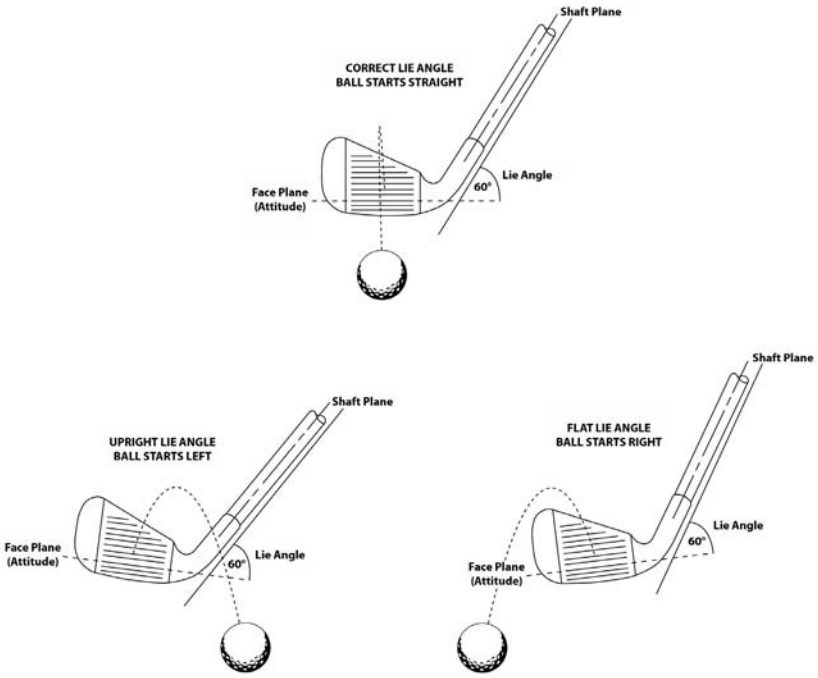
The 5-Ball Flight Laws

1. **Speed** - The velocity with which the club head is traveling, Speed influences the distance the ball will be propelled, as well as the trajectory and shape of the resulting shot.
2. **Centeredness** - The exactness with which the ball makes contact on the face of the club relative to the percussion point or "sweet spot". Contact could be either on the center, fore (toe), aft (heel), above or below that "sweet spot".
3. **Path** - The direction of the arc described by the club head in its travel away from and then back toward the target. Its line of travel at impact is one of the primary factors influencing direction for a full shot.
4. **Face Angle** - The degree at which the leading edge of the club's face is at right angles to the swing path. It will determine the accuracy of the ball's flight along that line, or produce a left or right curve away from that line. However, Ball Flight Law #4, Face Angle should have a second part - **Face Attitude** - The direction the face plane is pointing at impact relative to lie angle. The ball rebounds 90 degrees off the face plane producing the tilt axis of the ball, thus its starting direction and eventual curvature.
5. **Angle of Approach** - The angle formed by the descending or ascending arc of the club head on the forward swing in relation to the slope of the ground. Due to its influence on the ball's spin rate, the trajectory and the distance the ball travels will be affected.

Subject: Ball Flight

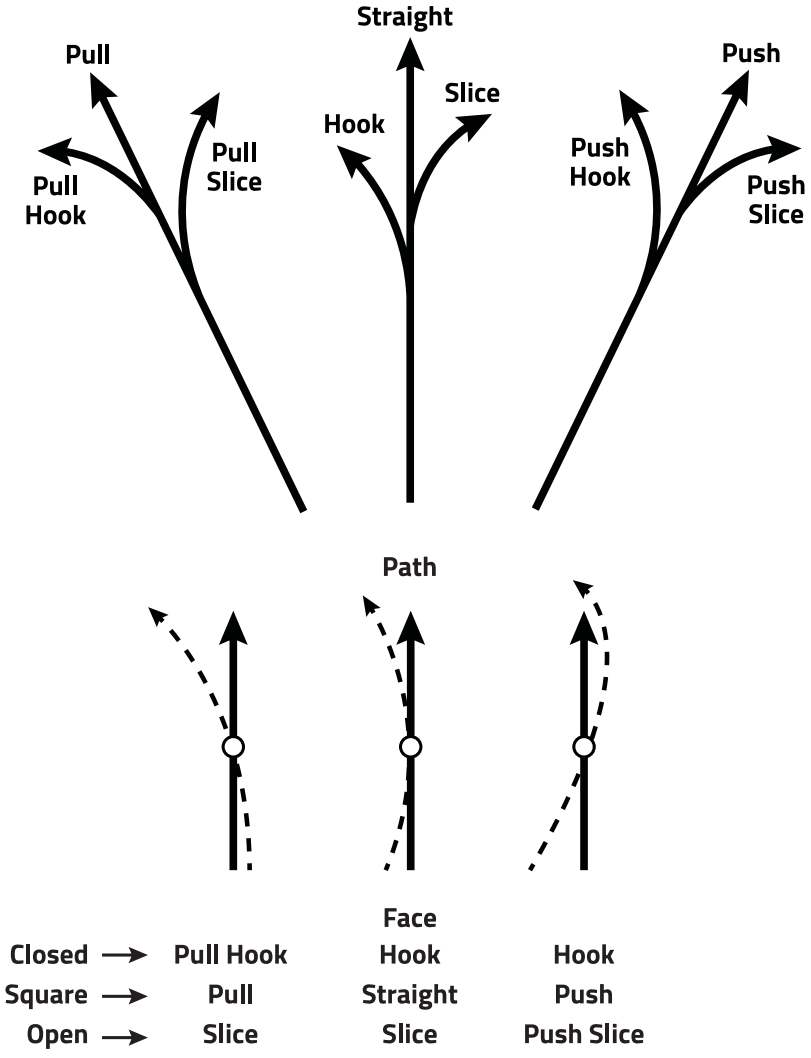
Since the publishing of the PGA Teaching Manual in 1990, technology has given golf industry professionals more insight into these laws of physics. What has been learned is Law #4 Face has a third dimension at play, that being "face attitude". This is commonly referred to as lie angle, but the effect it has on ball flight is important in determining the initial direction the ball starts, more so than face angle and club head path.

Therefore the term "Face Attitude" should be added to the Ball Flight Laws' description. This addition to Ball Flight Law #4 is the principle - "Impact." Impact determines the "Tilt Axis Spin" of the golf ball, which is largely due to "Face Attitude". Tilt axis spin is the initial axis the ball rotates on, which determines the curvature of the ball flight.



9-Ball Flight Patterns

The golf ball rebounds perpendicular to the club's face attitude. When the leading edge of a club's face angle is pointing to the right of the target line (open for a right-handed golfer) with a horizontal face attitude (horizontal lie angle) and the club path is parallel to the direction the leading edge is pointing, a push ball flight with a horizontal spin axis (no tilt) will result as illustrated in the 9-Ball Flight Patterns.



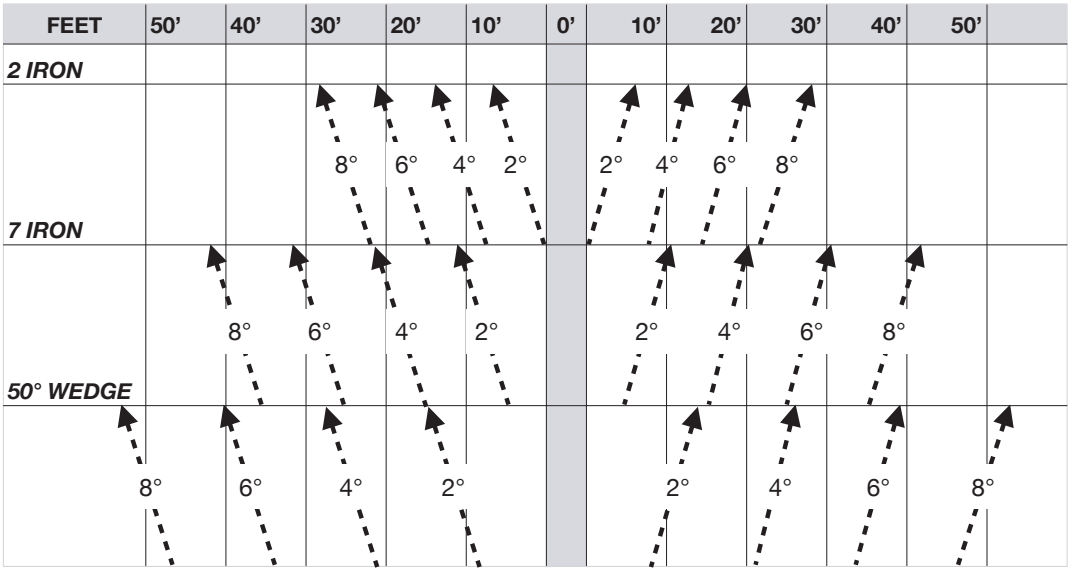

FlightScope
Main Menu
D 12.4°
Club Analysis
Name My Name
Driver 1
GO
Face Angle
3.2 R°
Ball Angle (H)
3.4 R°
4.7 R°
Club Strike (H)
Swing Plane | Horizontal
4.4 R°
Ball Speed
157.6 mph
1.41
Smash
Club Head Speed
112.0 mph
Dynamic Loft
9.2°
Ball Angle (V)
8.1°
-0.6°
Club Attack (V)
Swing Plane | Vertical
58.2°
Total Spin
3001 rpm
Ball Spin Axis
-4.5°
Graphs
Table
Angles
Master your passion
Next Club


FlightScope
Main Menu
Next Club
D 12.4°
Shot Plot
Name My Name
Driver 1
GO
100
200
300
Shot
Carry Dst.
Total Dst.
Smash
Strike Dir.
Launch Angles
Speed
Spin
1
279 yds
288 yds
1.39
3.2° L
Vertical 12.6°
Horizontal 0.6° L
Ball 165.8 mph
Clubhead 119.3 mph
Axis 5.3°
Back 2955 rpm
Side 273 rpm

Angle Adjustment Effects On Ball Flight

DISPERSION - LEFT/RIGHT

Club #	Deviation From Straight Ahead					Directional Displacement				
	2°	4°	6°	8°	10°	2°	4°	6°	8°	10°
2 - 17° 200 yds	.61°	1.22°	1.83°	2.44°	3.04°	6.4°	12.8°	19.2°	25.5°	31.9°
3 - 20° 190 yds	.73°	1.45°	2.18°	2.90°	3.62°	7.2°	14.5°	21.7°	28.9°	36.0°
4 - 23° 180 yds	.85°	1.70°	2.54°	3.38°	4.22°	8.0°	16.0°	24.0°	31.9°	39.8°
5 - 26° 170 yds	.98°	1.95°	2.92°	3.88°	4.82°	8.7°	17.4°	26.0°	34.6°	43.2°
6 - 30° 160 yds	1.15°	2.31°	3.45°	4.59°	5.73°	9.7°	19.3°	29.0°	38.6°	48.1°
7 - 34° 150 yds	1.35°	2.69°	4.03°	5.36°	6.68°	10.6°	21.2°	31.7°	42.2°	52.7°
8 - 38° 140 yds	1.56°	3.12°	4.67°	6.21°	7.73°	11.5°	22.9°	34.3°	45.7°	57.0°
9 - 42° 130 yds	1.80°	3.59°	5.38°	7.14°	8.89°	12.3°	24.5°	36.7°	48.9°	61.0°
PW - 46° 120 yds	2.07°	4.13°	6.18°	8.20°	10.19°	13.0°	26.0°	39.0°	51.9°	64.7°
SW STG - 50° 110 yds	2.38°	4.75°	7.10°	9.42°	11.69°	13.7°	27.4°	41.1°	54.7°	68.3°
SW MID - 55° 100 yds	2.85°	5.69°	8.49°	11.24°	13.93°	15.0°	29.9°	44.8°	59.6°	74.4°



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Conclusion

Golf club manufacturers do not have to make precise nor consistent sets of club. They do, however, need to manufacture clubs with designs capable of being adjusted at the point of sale. The most important design requirements are satisfactory hosel length and shape and metal hardness in cast clubs. It is important to point out that due to the investment cast process, cast club heads do not have precise and consistent angles as previously claimed. The fact is, cast clubs need angle adjustments in order to make a set progressively consistent.

The golf industry needs to embrace a different marketing tactic in reference to "standard" angles. Manufacturers have varying "standards." Therefore, when a golfer is recommended a 2° upright lie; the 2-degrees is upright from what? One manufacturer's 2° upright is not the same as another's. If the set is not checked to compare the progression of angles, how would the golfer know his set is progressively consistent at 2° upright.

Herein lies a serious flaw in club fitting. With the proper equipment, dynamic club fitting eliminates this flaw and allows the club fitter to adjust the lie angles to actual whole numbers, i.e., 62°, rather than just 2° upright. This should be done at the point of purchase by the club fitter so the golfer knows exactly what his club's angle performance numbers are. Club fitters can even be creative by adjusting the club's angles to enhance the golfer's shot making by adjusting for inconsistent performance of individual clubs in the set.

Golf club angles make a difference in club performance and influence how golfers swing the club.

"Ball flight is directly influenced by golf club specifications. Measuring, altering and retrofitting golf clubs is the best method of improving performance. I have never played with a stock or custom fit club that I did not alter in some form."

- **Ed Mitchell, PGA**
Founder / Mitchell Golf

MitchellGolf.com / 800-437-1314