The Science Of Golf Clubs And Golf Club Performance

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Game Improvement Golf

ORICL
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My Lifetime Golf Love Affair!

- WPGA Caddy Scholarship to attend Carnegie-Mellon University
- 35 year ORNL career
  - BUT 8 years ago started pursuing a 2nd career as a Professional Club Fitter
- Certified Professional Club Fitter, and Recognized by Golf Digest in 2011, 2013, and 2015
- Wrote a Kindle book on Club Fitting, and eBook on Putting Improvement
- Do a weekly blog and podcast, and monthly newsletter, dedicated to club fitting and golf improvement

Topics for Today

- What Do Golfers Want?
- Some Golf Club Basics
- What Matters In Golf Club Performance
- What Does Modern Technology Do For Us?

The Golfer's "Bag Of Tricks"

- Driver
- Fairway Woods
- Irons and "Hybrids"
- Wedges
- Putter

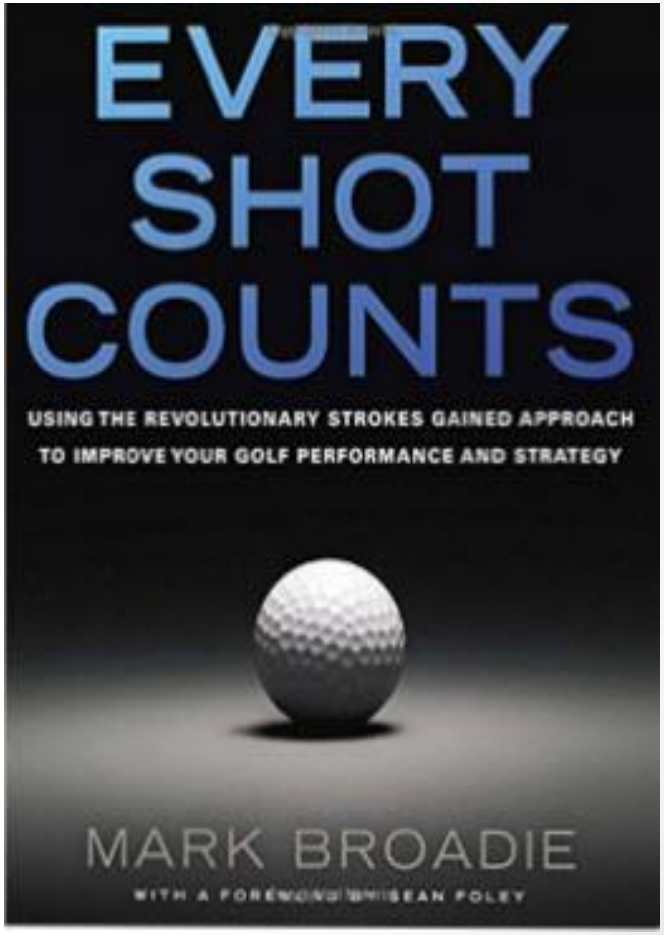
Golfers Want To SHOOT LOWER SCORES!

- Hit golf shots as far as we can
- Hit “consistent” shots
- Be able to control shots when near the green, get “up and down”
- Putt with confidence

"Drive For Show, Putt For Dough?"

Well……NO!!

- Mark Broadie developed the "Strokes Gained" concept
- Defines the quality of different types of shots
- Changes the way we look at the importance of different types of golf shots



From Club Performance Standpoint: BEST WAY TO LOWER SCORES

- In Order Of Importance:
  - Fairway clubs – woods, hybrids, and irons
  - Driver
  - Short game clubs – wedges
  - Putter

- For a 90 shooting golfer, increasing driving distance by 20 yards worth almost 2 strokes a round

Golf Club Performance Largely Depends On These Factors

- Length
- Loft
- Face Angle
- Lie Angle
- Head Design
- Set Makeup
- Grip Size/Style
- Total club weight / shaft weight
- Swingweight / MOI
- Shaft flex and shaft flex profile
- Your Golf Swing!

What Matters To Optimize Your Driving Performance

- Center face contact
- Hitting “close to” straight shots
- Optimizing launch conditions to achieve best carry and total distance

LONGER Driver Lengths May NOT Produce Longer Drives

- Tom Wishon (Wishon Golf Technology) summarizes this very well…

“The longer the length beyond what is necessary for golfer comfort and consistent stance/posture position, the more difficult the club will be to swing consistently for EVERY golfer.”

Characteristics Of DRIVER CLUB HEADS

- Loft, face angle, and lie angle
- Head weight and size
- Clubhead material
- Weight distribution in the clubhead

How Large Is The "Sweet Spot" In A Driver?

“Smash Factor” Equation, and Clubhead “COR”

$$SF = \frac{V_{ball}}{V_{clubhead}} = \frac{1 + e}{1 + m/M} \cos(loft) * (1 - 0.14*miss)$$

e = Clubhead “Coefficient of Restitution” (COR)

COR = 0.83 Is The Maximum Any LEGAL Club Face Can Have

- COR = measurement of the energy transfer in a collision between two objects
  - COR = 1 – total energy transfer
  - COR = 0 – no energy transfer
- The USGA measures the clubface COR of clubheads to approve their use
- Driver – 1.50, 6 iron – 1.40 targets

9 Possible Ball Flight Directions

The NEW Ball Flight Laws!

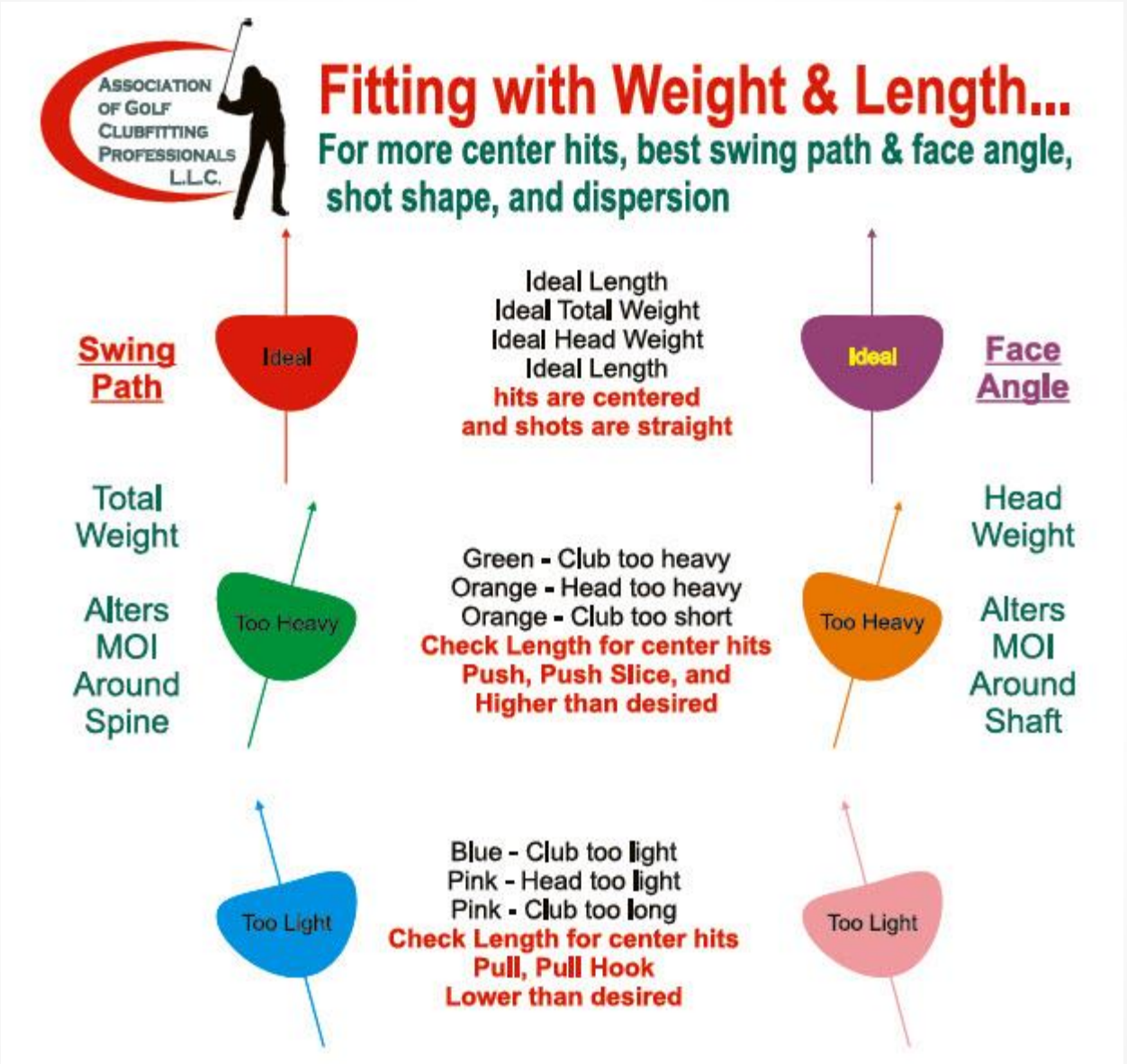
- **OLD** "IDEA" – "To fix a slice, you need to square or close your clubface at impact"

- **NOW** WE KNOW….
  - 85% of the starting direction of a shot results from where the CLUB FACE points at impact
  - A slice is created when the CLUB FACE is OPEN to the CLUB PATH at impact
  - The larger the difference between FACE and PATH at impact, the larger the slice

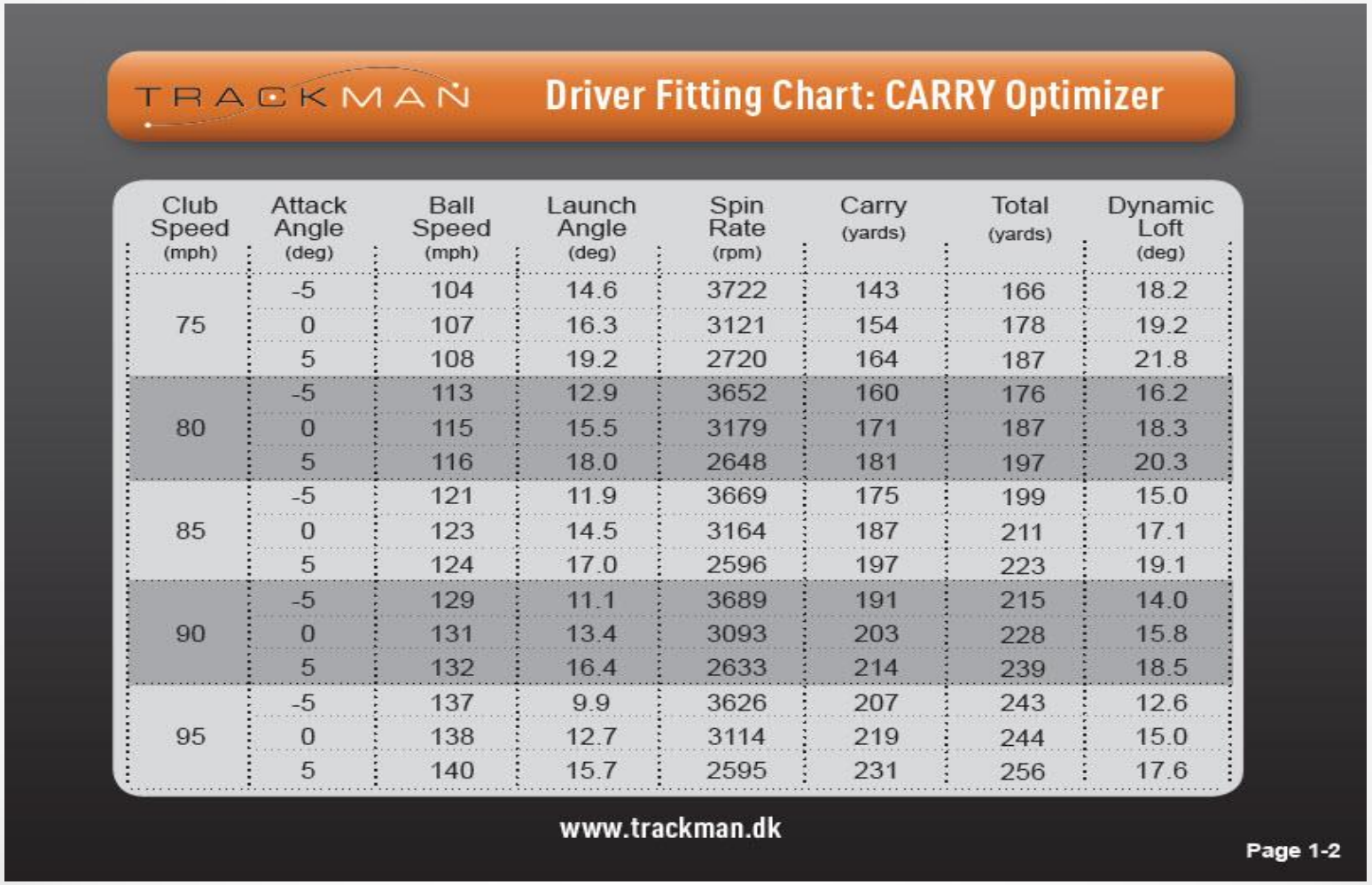
- **How Did Our Knowledge Change?**

What Is A LAUNCH MONITOR?

- An electronic device that measures aspects of what happens during a golf shot.
- Measures things like swing speed and ball speed, launch angle, ball spin, shot carry and total distance, ball flight
- Used in golf instruction and custom club fitting
  - Data lead to knowledge about NEW Ball Flight Laws!


Association of Golf Clubfitting Professionals L.L.C.
Fitting with Weight & Length...
For more center hits, best swing path & face angle, shot shape, and dispersion
Swing Path
Ideal
Ideal Length
Ideal Total Weight
Ideal Head Weight
Ideal Length
hits are centered
and shots are straight
Ideal
Face Angle
Total Weight
Alters MOI Around Spine
Too Heavy
Green - Club too heavy
Orange - Head too heavy
Orange - Club too short
Check Length for center hits
Push, Push Slice, and
Higher than desired
Too Heavy
Head Weight
Alters MOI Around Shaft
Too Light
Blue - Club too light
Pink - Head too light
Pink - Club too long
Check Length for center hits
Pull, Pull Hook
Lower than desired
Too Light

Optimizing Your Driving Distance



TRACKMAN

Driver Fitting Chart: CARRY Optimizer

Club Speed (mph)	Attack Angle (deg)	Ball Speed (mph)	Launch Angle (deg)	Spin Rate (rpm)	Carry (yards)	Total (yards)	Dynamic Loft (deg)
75	-5	104	14.6	3722	143	166	18.2
	0	107	16.3	3121	154	178	19.2
	5	108	19.2	2720	164	187	21.8
80	-5	113	12.9	3652	160	176	16.2
	0	115	15.5	3179	171	187	18.3
	5	116	18.0	2648	181	197	20.3
85	-5	121	11.9	3669	175	199	15.0
	0	123	14.5	3164	187	211	17.1
	5	124	17.0	2596	197	223	19.1
90	-5	129	11.1	3689	191	215	14.0
	0	131	13.4	3093	203	228	15.8
	5	132	16.4	2633	214	239	18.5
95	-5	137	9.9	3626	207	243	12.6
	0	138	12.7	3114	219	244	15.0
	5	140	15.7	2595	231	256	17.6

www.trackman.dk

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What Characteristics Do DRIVER GOLF SHAFTS Have?

- Type – graphite or steel
- Weight
- Flex and flex profile
- Torque

What Are Shaft Flex and Shaft Flex Profile?

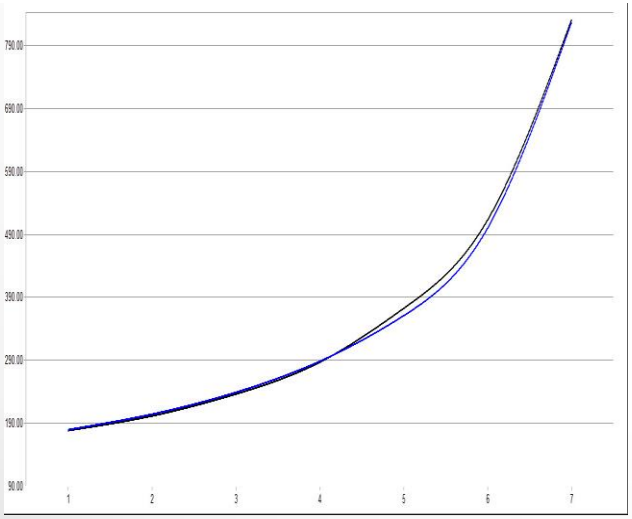
- **Shaft Flex** is a measure of how much a golf shaft can bend when a golfer applies a force to it (swings the golf club)

- **Shaft Flex Profile** is a measure of how the shaft flex varies along the length of the golf club.

- There are **NO STANDARDS** for what the flex of a golf shaft is.

Shaft Flex Profile Measurements

FREQUENCY



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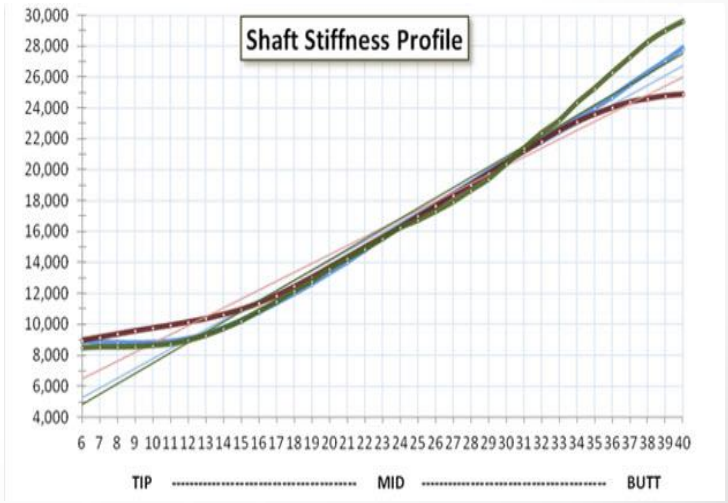


Why Golf Shaft Flex Profile Matters

- Golfers swing at different
  - Swing Speeds
  - Downswing Tempos
  - Club “Release
- Matching the golf shaft profile to these swing characteristics matters

Two Different Club "Release" Patterns

EARLY

LATE

Why Driver FACE ANGLE Matters

- Driver FACE ANGLE – where the face of the driver points, relative to your target line, when you address the golf ball
- Playing with the correct face angle for you can help improve your shot dispersion
- Golfers OFTEN do not realize the face angle that their drivers have
  - MANY drivers with OPEN face angles – this promotes Slices and Pushed Shots

What Matters To Optimize Your Iron/Hybrid Performance

- Center face contact
- Hitting “close to” straight shots
- Club performance consistency throughout the set of irons and hybrids

What Matters for Irons And Hybrid Clubs

- Clubhead Design and Performance
- Club Lofts, Lie Angles, Loft Gaps
- Shaft flex, flex profile, weight, type of shaft
- Club Length
- Club “Swingweight” or “MOI”
- Iron club set makeup

"Vanishing Loft Disease" Continues

- Iron lofts have increased since 1960…
  - 1960 6 iron – 36 degrees
  - 2006 6 iron – 30 degrees
  - Some iron sets now have 6 irons 27 degrees of loft
- Yes lower loft creates more "6 iron" distance, but…
- Stronger club lofts is why "hybrid clubs" and "gap wedges" are now being played

Many Different Iron Head Designs

A "Typical Iron Set Makeup

Specifications

	3	4	5	6	7	8	9	P	W
LOFT	21°	24°	27°	30°	34°	38°	42°	46°	50°
LIE	60°	61°	62°	62.5°	63°	63.5°	64°	64°	64°
OFFSET	.161"	.150"	.137"	.122"	.110"	.098"	.087"	.075"	.063"
LENGTH	39.00"	38.50"	38.00"	37.50"	37.00"	36.50"	36.00"	35.75"	35.50"
SWINGWEIGHT	D2	D2	D2	D2	D2	D2	D2	D2	D2

Why Do Iron **LIE ANGLES** Matter?

- Correct iron lie angles promote straight shots and center face contact
  - Too upright – possible face at impact to left of target
  - Too flat – possible face at impact to right of target
- DYNAMIC lie angle testing is necessary

How HEAD HEAVY Is A Golf Club?

Swingweight and MOI

- **SWINGWEIGHT** – a measure of a golf club's weight around a 14 inch fulcrum from the grip end of the golf club.
  - A **static** measurement

- **MOI** (moment of inertia) - a measure of a golf club's resistance to motion about an axis
  - A **physical property** of a golf club

What Characteristics Do IRON GOLF SHAFTS Have?

- Type – graphite or steel
- Type – “parallel tip” or “taper tip”
- Flex and flex profile
- Torque

IRON SET FREQUENCY MATCHING

Can Improve Shot Consistency, Feel

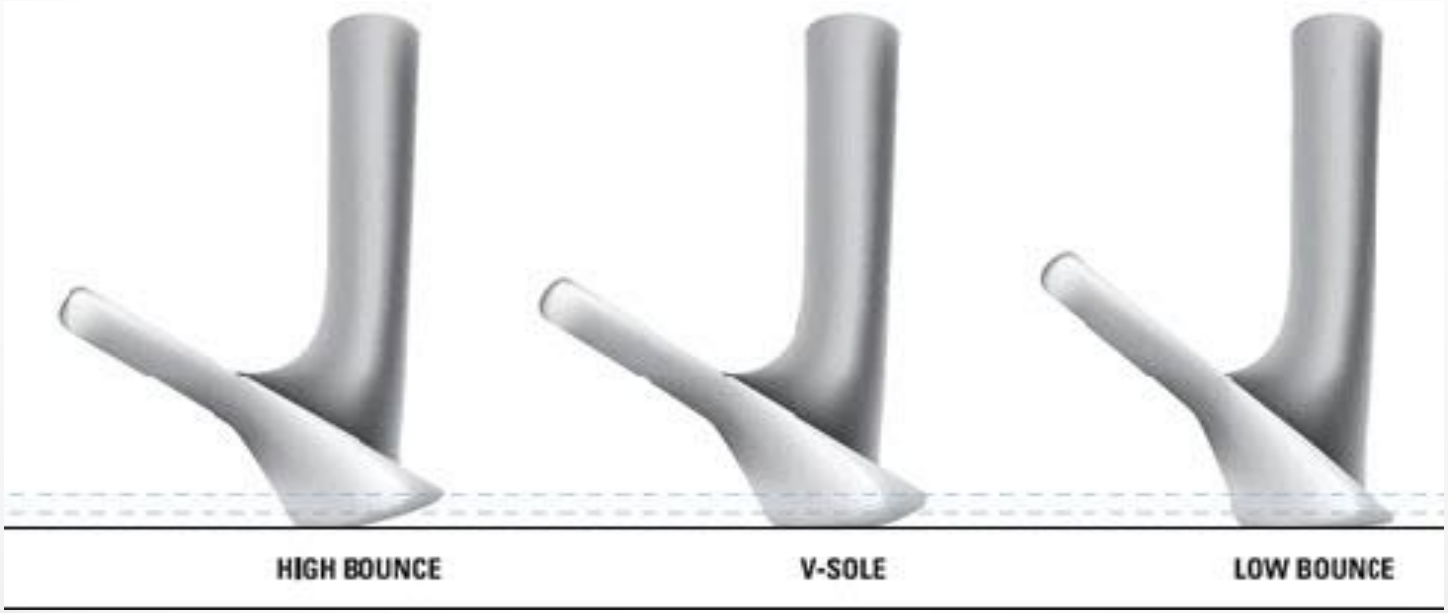
- Create same club flex for all irons in a set
- Often 4 cpm frequency difference between clubs is used
  - But sometimes softer “frequency slopes” can be better
- Can “tip” parallel tip iron shafts to create difference club flexes

What Matters For Great Wedge Performance?

- Control distances for shots of around 100 yards
- Easily control and create shorter shots near the green – chips and pitches – to get the ball near to the hole
- Create good shots out of sand traps

Two Definitions Of **WEDGE BOUNCE**

- "The resistance to the club digging into the turf"
- "The angle between the club leading edge and the lowest point on the sole"



What Is The Best **WEDGE BOUNCE?**

The Bounce That Allows Your Wedge With The Swing That You Use To Interact With The Ground In A Way That Lets You Create The Best Feel And Control For Your Shots

Great Putters…

- Aim their putter well at address
- Hit their putts on their intended lines
- Know how to “read greens” well
- Have great putting speed control
- Are supremely confident in their putting skills

What Matters for Putters

- Putter loft, lie, length
- Putter head design, lines on face, putter offset
- Putter “face balancing”
- Putter weight and weight distribution

Average "First Putt" Distance, PGA Tour

35 Feet!

Reference – "There Is More To Putting Than Meets The Eye"

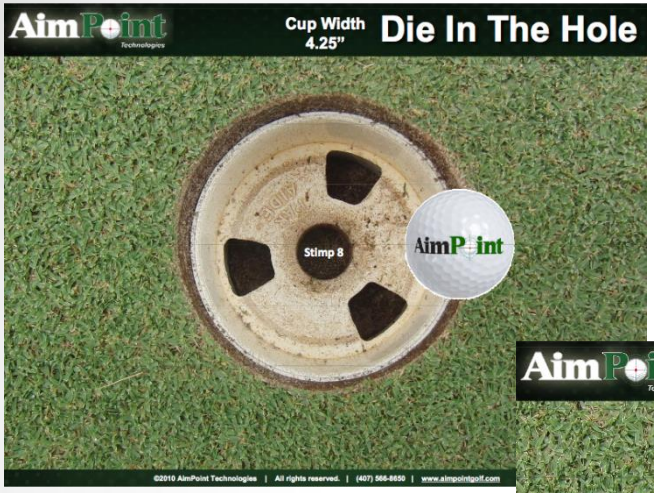
Aim – How Good Is GOOD?

- **From 6 feet away:**
  - 1 degree off – miss center 1.3 inches
  - 2 degrees off – miss center 2.5 inches
    - You miss the hole!
  - 3 degrees off – miss center 3.8 inches
  - 6 degrees off – miss center 7.6 inches
  - 10 degrees off – miss center 12.7 inches

Key Variables That Influence Putter Aim

- Geometric Head Design
- Hosel Design
- Offset
- Lie and Length
- Line Configurations
- Loft

Speed Control Is A HUGE Factor In Great Putting!



Correct Putter Weighting Helps Golfers To NATURALLY Control Speed

- Putter Head Weight
- Putter “Counter Weighting”

Putter Face Balance Can Influence Stroke Performance

ACKNOWLEDGEMENTS…

- Dave Tutleman web site materials
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- Edel Golf Putter and Wedge Fitting Training
- Mark Sweeney “capture speed” slides
- Slides from John Schiavone “Every Shot Counts” presentation

Thank You!


GAME
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GOLF
TAKING YOUR GAME TO NEW HEIGHTS!
GOLF DIGEST RECOGNIZED
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