Chapter Six

A DISCUSSION OF KICK POINT/ BEND POINT AND BALANCE POINT

Key words/phrases for understanding the information in Chapter 6:

Bend Point - The point of maximum bending on a shaft as measured by compressing one end of the shaft toward the other.

Cut Shaft - The shaft that has been trimmed according to the manufacturer's directions and is ready for installation into the club.

Cut Shaft Balance Point - The point of equal weight distribution on two sides of a shaft as trimmed for installation into a clubhead.

Completed Club Balance Point - The point of equal weight distribution on two sides of a shaft fully assembled with a clubhead and grip.

Deflection - The deviation of the tip from the butt centerline of a shaft after a known unit of force is applied to the tip.

Frequency - The number of oscillations a shaft makes over a known period of time after the tip is pulled down and released while mounted in a special frequency-measuring device. Measured in cycles per minute (cpm).

Kick Point - The point of maximum bending on a shaft as measured by deflecting the tip end of the shaft with a constant weight or force

Raw Shaft - The shaft as it is manufactured before trimming and installation into a golf club.

Raw Shaft Balance Point - The point of equal weight distribution on two sides of a shaft before trimming.

Torque - The rotational twisting of a shaft during the golf swing. Measured in degrees.

Point of Balance - The spot were a shaft achieves equilibrium. That is, whether in its raw, cut or assembled form, the point at which a shaft has all its weight distributed equally on two sides.

Without a doubt the single most confusing part of the Dynacraft/Apollo shaft-testing project involved trying to explain the various specifications, which describe the position of maximum bending on a shaft. Currently the golf industry uses three separate terms - flex point, bend point and kick point - in an effort to describe to golfers and clubmakers that shafts are designed to bend more in one particular location than another. While it is often thought that these three terms all refer to the same specification, it is important to understand that different definitions exist for at least two of those three descriptions.

While bend point and kick point both refer to the maximum point of bending on a shaft, how they are measured creates the difference in their definitions. Bend point is determined through a mechanical test, which compresses one end of the shaft toward the other to create a curve. Either through a predetermined amount of compressive force or by dictating how much of a curve must be achieved through the application of force, the position on the shaft that deviates the farthest from the shaft's original center line is defined as the bend point. To contrast, securing the butt and applying a predetermined amount of force to the tip, creating a bend in the shaft, measures kick point. Often measured under the same test conditions as deflection, the kick point is said to be the point on the shaft that deviates the farthest from a straight line drawn from the tip to the butt, when the shaft is in the curved state. The third term, flex point, is not commonly used by manufacturers of shafts and is an extraneous reference that has only had the effect of adding more confusion to the matter. As flex point has most often been used in the same context as bend point, for this discussion we will disregard its presence and use only the term bend point or kick point.

Currently the majority of the shaft manufacturers determine the position of maximum bending on a shaft by subjecting their samples to the bend point test described above. While a small number of companies also do perform kick point testing, its application and significance is only now being explored in an attempt to determine the role of a shaft's maximum point of bending in overall shaft performance.

Since the 1970's, when the point of maximum bending of a shaft was first awarded significance as a shaft fitting factor, it has been believed that the specification plays a major role in shot trajectory and contributes to clubhead feel just prior to - and through - impact with the ball. Within the shaft industry, there are three possible location points of maximum bending, which are identified as high, mid and low. Because the industry only uses generic descriptions for locating bend point, golfers have been mistakenly led to believe that high means a point just below the grip, mid refer to the middle of the shaft and low indicate a point just above the hosel. No actual measurements for the specification have ever been offered; rather, the industry has left it up to golfers and clubmakers to speculate on the actual location.

Along with the assumption that high means high, mid means middle and low means low also has come a logical acceptance that no matter the manufacturer, each of the three positions of maximum bending are found in the same location on the shaft. In other words, if True Temper, Royal Precision and Apollo all say high bend point, it is assumed the point of maximum bending would be in the same position somewhere above the middle of the shaft but below the grip. If the manufacturers refer to their shafts as having a mid bend point, the location was felt to be in the center of the shaft. If low was the designation, it was assumed all three companies' shafts would bend more somewhere below the middle but above the clubhead.

Little has ever been written about a shaft's point of maximum bending other than the belief that a high bend point shaft would supposedly create a low shot trajectory, a mid bend point would create a medium trajectory and a low bend point would create a higher trajectory. Principles of clubfitting professed that accomplished players who had little trouble getting the ball airborne should use shafts with a high bend point and beginners or golfers who needed help getting the ball up should use a low bend point shaft. Those players whose ability was somewhere in between were left with the suggestion to use the mid bend point shafts.

As far as the contribution of the point of maximum bending to clubhead feel, the predominant opinion has been that bend point acted somewhat like a "hinge" on the shaft. As the club accelerated into impact (at a decelerating rate, for all you swing theoreticians) a low "hinge" was supposed to make the clubhead feel as if it snapped, or whipped through the ball. At the other end of the spectrum, a high "hinge" shaft was said to deliver more of a sweeping sensation coming into the ball, or a firm tip feel to the golfer just prior to and through the impact position. And finally, the feel associated with mid bend point shafts was described as something in the middle, in a somewhat non-specific term of being in between a "whip" and a "sweep".

An analogy has sometimes been offered which explains the principle as being somewhat like extending one's arm out straight and in one action after another, bending the wrist, the elbow and then the shoulder. Flex the wrist forward with the arm held out and you were said to have created the feel of a low bend point. Bend the elbow forward after straightening the arm to understand the concept of mid bend point; and finally, move the arm forward only from the shoulder and one supposedly had simulated the feel of a high bend point. Of course, such comparisons are oversimplified, but they do hold some support among golfers and clubmakers who have no other way to relate to the contribution of this mysterious shaft specification to clubhead feel.

Unfortunately, such analogies have been offered because few golfers have a refined sense of perception, which enables them to actually feel the movement of the shaft during the swing. Ask virtually any group of players of average ability and it is likely that well over half cannot detect the action of the shaft through impact. The only viable feedback from average-to-less-able golfers has been an occasional comment that a general feeling of more solid contact with the ball could be felt after switching from a high to a low bend point shaft. Thus, from the opinions conceived in the 1970's, the industry seems to have perpetuated a largely unsubstantiated belief that the contributions of bend point were in the areas of shot trajectory and changes of feel at impact.

But are they? Is it the shaft's point of maximum bending, whether defined as bend point or as kick point, that affects shot trajectory or alters the feel at impact? In the 1980's, in an effort to probe further into the matter, a number of members of the golf industry began to question the actual location of shaft bend points and wondered just how far apart a high and a low bend point actually were. Understanding that working with steel did limit the ability to intentionally elicit a change in bend point location when compared to graphite. Nonetheless by the middle 1980's some shaft manufacturers began to claim that the maximum distance from the highest high bend point to the lowest low bend point could never be more than 2-3” on steel shafts and 5-6” on graphite shafts. The greater variation in the graphite shafts was attributed to the wide range of strengths in the different composite material types as well as the fiber alignment positions that were utilized in the production of the shafts.

Such news was shocking to a golf equipment industry that had assumed a high-to-low range that was much greater. For the first time, a few clubmakers and members of the equipment industry actually began to question the contribution of bend point to shot trajectory and clubhead feel. How could a difference of just 2-3” (or less) in bend point make the ball fly noticeably lower or higher or create the feel difference between a whip of the clubhead through the ball and a firm sweep of the shaft through impact? Was it bend point/kick point that created the change in trajectory and clubhead feel or was it some other aspect within the design of the shaft?

Because the shaft’s maximum point of bending has been considered a meaningful specification in shaft fitting, it was important for the Dynacraft/Apollo shaft testing project to record its measurement and conduct an analysis of the results. However, with two different ways to express the point of maximum bending on a shaft - bend point and kick point - the question of which bending specification should be included in the test project needed answered.

As described earlier, bend point is the predominant specification that most shaft manufacturers choose to describe the position of maximum bending. However, bend point is a static specification that is measured by compressing one end of the shaft toward the other until a curve is created in the shaft. Such a motion of the shaft is not achieved at any point in the normal golf swing. In fact, the closest a shaft comes to achieving the condition of a bend point test position during the course of play is when a golfer happens to lean on the club while waiting for his or her turn to hit. Therefore, the question of what relevance such a test would have to an overall fitting recommendation became a point of serious discussion among the Dynacraft and Apollo personnel involved in the project.

After considering several points on both sides of the discussion, all parties agreed that the shaft-testing project would first try to use the kick point test as the means to describe a shaft’s maximum point of bending. As described before, in the kick point test, the shaft is secured at the butt end while a force is applied to the tip end to create a bend in the shaft. With the shaft in a curved position, the point on the shaft that deviates the farthest from a line drawn from the tip to the butt is designated as the kick point.

The primary reason the shaft-testing project focused on kick point more than bend point was because, as a static test, kick point more closely simulates the bending action of the shaft during the swing. Just as the golfer holds on to the butt end of the shaft and makes a swing, which creates a bend in the shaft, so too does the kick point test create a similar bend in the shaft. It was agreed by all involved in the test project that kick point is a different test than bend point, and as such, the measurements obtained must be taken purely as the kick point and not confused with bend point. Still, it was also agreed that comparisons of the general location of kick point to bend point could be made to determine, for example, if the kick point on a company’s low bend point shaft was lower than the kick point on a high bend point shaft made by the same company.

Obtaining the Kick Point Data

Apollo’s personnel measured kick point using their computer-driven shaft testing apparatus. Once the machine deflected the tip of the shaft under 6 lbs. of force and recorded the shaft’s deflection measurement, an optical tracking device traced the exact curve of the shaft into the computer’s memory. The computer then “drew” a line from the center of the tip to the center of the butt and recorded the position on the shaft that was the greatest distance from this tip to butt line. Through the use of the optical tracking device, this distance was measured and noted in the computer as the kick point of the shaft. Because deflection was measured in two opposite directions, so too was kick point. The final measurement was then calculated by the computer as an average of the two opposite kick point measurements.

As with most of the individual tests in the project, kick point was measured on both the raw and the cut shafts. Again, for full understanding of this data, clubmakers must remember that the raw shafts represent each of the test shafts in their uncut, unassembled form, while the cut group consisted of each of the shafts after they had been trimmed for installation. In total, more than 800 different shafts for woods and irons were measured. All cut shaft testing was performed on each wood shaft as trimmed for installation into a metal Driver and on each iron shaft after trimming for installation into a #5-iron. Again, as with the other tests, the L-flex shafts were tested at cut shaft lengths which corresponded to ladies standard Driver and #5-iron playing lengths. The A, R, S and X-flex shafts were all tested at cut shaft lengths which corresponded only to men's standard Driver and #5-iron playing lengths.

As with the torque measurements, more emphasis was placed on the analysis of the cut shaft kick points rather than the measurements obtained from each of the shafts in their raw uncut form. All those involved in the testing project agreed that in order to use the data to eventually make fitting recommendations, it was far more important to focus on the cut shaft kick points since golfers play with shafts in their cut, assembled form; not in the raw uncut form.

Still, since the testing project provided the opportunity to do so, all of the raw shafts were measured for kick point so it would be possible to study all aspects of the relationship of the maximum point of bending from one shaft to another. While most of the comparisons to be made in this chapter will deal with cut shaft kick points, the complete list of all raw and cut shaft data is no longer part of the addendum. After the 1993 addendum was printed, kick point measurements were not included as part of the shaft comparison charts, for reasons that will be mentioned later in this chapter. Therefore, some of the shafts listed in this chapter may not be familiar to the reader, but the important message is about kick point in general.

A Preliminary Analysis of Raw Shaft Kick Point

Because nothing in the way of quantitative measurements have ever been published about kick point or bend point, before the testing it was not known whether the manufacturers' high, mid or low descriptions of bend point referred to the shafts in their raw form or in their cut form. Therefore, one of the functions of performing a raw shaft kick point analysis was to determine not only how kick point might relate to the manufacturers' own designations of bend point. Also wanted to see if the shafts performed in the same progression of high to low in kick point location as the manufacturers indicated in their published descriptions for bend point. Chart 6-1 includes a list of the raw shaft kick point locations for a number of the industry's most popular steel and graphite at the time. Listed is each manufacturer's designation for the bend point of the shaft as well as the raw lengths of the shafts as tested. All kick point locations from the Dynacraft/Apollo testing are measured in inches up from the tip end of the shaft.

Chart 6-1 - Raw Shaft Kick Point Measurements

Shaft	Mfrs. Bend Point Description	Raw Shaft Kick Point Wood	Location Iron
Aldila (Woods - 44", Irons - 39")			
HM-55 R	High	20.05"	N/A
HM-40 R	Mid	20.04"	17.30"
Low Torque R	Low	19.83"	17.42"
Apollo (Woods - 47", Irons - 41")			
AP44 R&S	High	21.63"	18.62"
Spectre R&S	Mid	21.59"	18.58"
Shadow R&S	Low	21.74"	18.26"
Royal Precision (Woods - 47", Irons - 41")			
Pro Pel II R&S	High	22.14"	18.64"
Phoenix R&S	Mid	21.53"	19.31"
Microtaper R&S	Low	21.86"	18.66"
True Temper (Woods - 47", Irons - 41")			
Dynamic R&S	High	21.71"	18.64"
TT Lite R&S	Mid	21.59"	18.62"
Jet Step R&S	Low	21.48"	18.63"

After studying the raw shaft kick point measurements in Chart 6-1, it can be seen that very few of the manufacturers' shafts fall in a kick point sequence that matches with each firm's bend point descriptions. For example, the kick point measurements of True Temper's Dynamic, Jet Step and TT Lite R & S combination flex parallel tip wood shafts and Apollo's AP44, Shadow and Spectre combination flex parallel tip iron shafts do coincide with the high, mid, low descriptions for each as offered by the companies.

However, in all other cases of studying a selection of high, mid and low bend point shafts against the kick point measurements for each, the shafts did not follow the progression of kick point location.

Each of the manufacturers produces many more shafts than what were included in this chart. One purpose of these listings is to see if the ranking of kick point measurements in the test were in sequence with the manufacturers' own bend point rankings. Among the three True Temper raw length steel shafts, the test project's kick point data places the wood shafts in the same high-to-mid-to-low ranking as claimed by TT's bend point testing. But among the iron shafts, the kick point measurements showed the Jet Step was in the middle between the Dynamic (with the highest kick point) and the TT Lite (with the lowest kick point). Continuing an inspection of the ranking columns, very few of the other companies' kick points fell in the same category as their stated bend point relationship. Please understand that the purpose of creating a ranking from the kick point data was not to say that the TT Lite is a low kick point shaft, but rather to sequence the shafts in order from highest to lowest, based upon the test information.

Perhaps one of the most interesting points that can be observed from this list of raw shaft measurements is how close together all of the kick point locations were. In this selection of what have to be accepted as some of the industry's most popular shafts, the range from the highest to the lowest raw shaft kick point was little more than 1". And in fact, were it not for the Phoenix R & S iron shaft, the high-to-low range in kick points for the steel shafts would have been less than 1/2". Admittedly, Chart 6-1 includes only a small number of the full complement of shafts that were included in the test. In addition, the chart also deals only with measurements of the raw shaft kick points. As was mentioned in the introductory discussion, it was agreed by all involved in the Dynacraft/Apollo test project that cut shaft kick point was more important as a contribution to fitting information because golfers simply do not use shafts in their raw uncut form.

An Analysis of Cut Shaft Kick Point Measurements

Since the previous comparison was made between an assortment of shafts in their raw, uncut form, the next question that has to be asked is how a study of the kick points of the same shafts in their cut form would compare. Chart 6-2 lists the cut shaft kick point measurements of the same group of shafts included in Chart 6-1. For the raw shafts that were R & S combination flex, the cut shaft data in the chart will be for the R-flex version.

Chart 6-2 - Cut Shaft Kick Point Measurements-

Shaft	Mfrs. Bend Point Description	Raw Shaft Kick Point Location Wood	Iron
Aldila			
HM-55 R	High	18.88"	N/A
HM-40 R	Mid	18.54"	15.94"
Low Torque R	Low	18.30"	15.84"
Apollo			
AP44 R	High	18.56"	16.11"
Spectre R	Mid	18.46"	16.08"
Shadow R	Low	18.57"	16.07"
Royal Precision			
Pro Pel II R	High	18.56"	16.04"
Phoenix R	Mid	18.74"	16.22"
Microtaper R	Low	18.47"	16.03"
True Temper			
Dynamic R	High	18.88"	16.04"
TT Lite R	Mid	18.64"	16.25"
Jet Step R	Low	18.59"	16.07"

Unlike the raw shaft data, in which the shaft lengths did vary slightly, all of the cut shaft lengths for wood shafts were 41.375" and 36" for the iron shafts, representing the shafts as they were set up for installation into men's standard length metal wood Drivers and #5-irons. With this note of uniformity, the cut shaft kick point data can thus be taken to be more comparable from a shaft-to-shaft standpoint.

It is quite obvious from the chart of cut shaft kick points that as a shaft is trimmed, its kick point changes drastically. But not only does the kick point move significantly farther down the shaft after trimming, but the location may change in such a way that the kick point is no longer in the same sequence when compared to other shafts. By comparing Chart 6-1 to Chart 6-2 it can be seen that the kick point relationship between the three shafts from each of the four manufacturers can change as a result of trimming. For example, in Chart 6-1, Royal Precision's Phoenix iron shaft had the highest kick point of the three Royal Precision entries. Microtaper was the mid kick point shaft of the group while Pro Pel II was the lowest. On the cut shafts, Phoenix remained the high kick point entry, but Pro Pel II moved to the mid kick point location and Microtaper tested as the lowest of the group. The change was even more dramatic among the True Temper shafts in this comparison. While the Jet Step R remained in the middle through both tests, Dynamic was the high kick point shaft of the group in raw form but after trimming it became the low kick point entry among the cut shaft measurements! TT Lite was just the opposite - low in the raw shafts and high among the cut versions.

So far, all of the kick point information has centered only on a select group of only 12 different shafts produced by four different manufacturers. While the kick point findings of these 12 shafts represents a significant analysis, by no means can wholesale judgments be made about the correlation of kick point to bend point on such a small number of test subjects.

Following are a series of charts (6-3 through 6-6) which list the kick point locations of parallel tip steel shafts for Drivers and #5-irons and parallel tip graphite shafts for Drivers and #5-irons. Each chart is set up with three headings - High Bend Point, Mid Bend Point and Low Bend Point - with the shafts listed accordingly based on designations from their manufacturers. All of the shafts listed under the Low Bend Point column are considered to be low bend point shafts by their manufacturer. All under the Mid Bend Point column are considered to be mid bend point shafts by their manufacturer and finally, each shaft found under the High Bend Point column is considered by its manufacturer to be a high bend point shaft. The kick point locations for the different flexes of each shaft are listed to enable comparisons to be made to all the other shafts in each chart. From this data it will be possible to see if the industry's high bend point shafts actually do have high kick points, and so on, in relationship to the mid and low bend point shafts. Because the 1" difference in their standard assembly lengths can cause confusion in such a quantitative comparison, L-flex shafts are not included.

Chart 6-3 - Kick Point Location - Steel Driver Shafts

Low Bend Point Shafts	Mid Bend Point Shafts	High Bend Point Shafts
Apollo		
MatchFlex A/R - 18.57"	MatchFlex R - 18.83"	MasterFlex R - 18.63"
Shadow A - 18.66"	MatchFlex R/S - 18.53"	MasterFlex S - 18.70"
Shadow R - 18.57"	Spectre A - 18.64"	MasterFlex X - 18.58"
Shadow S - 18.58"	Spectre R - 18.46"	MatchFlex S - 18.57"
	Spectre S - 18.57"	AP44 R - 18.56"
		AP44 S - 18.51"
Royal Precision		
Microtaper A - 18.75"	Phoenix A - 18.78"	Precision FM 5.5 - 18.57"
Microtaper R - 18.47"	Phoenix R - 18.74"	Precision FM 6.5 - 18.82"
Microtaper S - 18.61"	Phoenix S - 18.68"	Precision FM 7.5 - 18.78"
	UCV-304 R - 18.56"	Pro Pel II A - 18.81"
	UCV-304 S - 18.57"	Pro Pel II R - 18.56"
		Pro Pel II S - 18.57"
True Temper		
Jet Step R - 18.59"	Gold Plus R300 - 18.77"	Dynamic A - 18.80"
Jet Step S - 18.47"	Gold Plus S300 - 18.74"	Dynamic R - 18.88"
	TT Lite A - 18.51"	Dynamic S - 18.70"
	TT Lite R - 18.64"	Dynamic X - 18.54"
	TT Lite S - 18.75"	Dynamic Gold R300 - 18.71"
		Dynamic Gold S300 - 18.52"
		Dynamic Gold X100 - 18.74"

Chart 6-4 - Kick Point Location - Steel #5-iron Shafts

Low Bend Point Shafts	Mid Bend Point Shafts	High Bend Point Shafts
Apollo		
MatchFlex A/R - 16.02”	MatchFlex R - 16.13”	MasterFlex R - 16.11”
Shadow A - 16.03”	MatchFlex R/S - 16.03”	MasterFlex S - 16.08”
Shadow R - 16.07”	Spectre A - 16.39”	MasterFlex X - 16.14”
Shadow S - 16.19”	Spectre R - 16.08”	MatchFlex S - 15.89”
	Spectre S - 16.15”	AP44 R - 16.11”
		AP44 S - 15.97”
Royal Precision		
Microtaper A - 16.03”	Phoenix A - 16.18”	Precision FM 5.5 - 15.70”
Microtaper R - 16.03”	Phoenix R - 16.22”	Precision FM 6.5 - 16.10”
Microtaper S - 16.11”	Phoenix S - 16.22”	Precision FM 7.5 - 16.20”
	UCV-304 R - 16.31”	Pro Pel II A - 16.03”
	UCV-304 S - 16.29”	Pro Pel II R - 16.04”
		Pro Pel II S - 15.83”
True Temper		
Jet Step R - 16.07”	Gold Plus R300 - 16.13”	Dynamic A - 16.08”
Jet Step S - 16.22”	Gold Plus S300 - 16.22”	Dynamic R - 16.04”
	TT Lite A - 16.24”	Dynamic S - 16.06”
	TT Lite R - 16.25”	Dynamic X - 16.20”
	TT Lite S - 15.84”	Dynamic Gold R300 - 16.01”
		Dynamic Gold S300 - 16.06”

Chart 6-5 - Kick Point Location - Graphite/Specialty Driver Shafts

Low Bend Point Shafts	Mid Bend Point Shafts	High Bend Point Shafts
Aldila		
HM-40 Low Flex R - 18.57”	HM-30 R - 18.32”	HM-55 R - 18.88”
HM-40 Low Flex S - 18.48”	HM-30 S - 18.29”	HM-55 S - 18.54”
HM-40 Low Flex X - 18.49”	HM-40 R - 18.54”	Velocitor R - 19.19”
Low Torque R - 18.30”	HM-40 S - 18.68”	Velocitor S - 19.30”
Low Torque S - 18.57”	HM-40 X - 18.31”	Velocitor X - 19.73”
Low Torque X - 18.37”	Questar R - 18.53”	
Receptor A - 18.37”	Questar S - 18.53”	
Vitesse R - 18.18”	Questar X - 18.40”	
Alloy 2000		
Alloy 2000 R - 18.79”		
Alloy 2000 S - 18.71”		
Alloy 2000 X - 18.70”		
Apollo		
G100 R - 18.37”	Boron Tourline R - 18.79”	
G100 S - 18.30”	Boron Tourline S - 18.41”	
	Boron Tourline X - 18.44”	
Grafalloy		
	M29 R - 18.50”	
	M29 S - 18.62”	
Kunnan		
		Comp50 R - 18.77”
		Comp 50 S - 18.56”
Ti Shaft		
Titanium Low Flex A - 18.79”		Ti Standard R - 18.69”
Titanium Low Flex R - 18.74”		Ti Standard S - 18.73”
Titanium Low Flex S - 18.88”		Ti Standard X - 18.69”
Titanium Low Flex X - 18.77”		

Chart 6-6 - Kick Point Location - Graphite #5-iron Shafts

Low Bend Point Shafts	Mid Bend Point Shafts	High Bend Point Shafts
Aldila		
HM-40 Low Flex R - 15.90”	HM-30 R - 16.10”	Velocitor R - 16.35”
HM-40 Low Flex S - 15.88”	HM-30 S - 15.82”	Velocitor S - 16.57”
HM-40 Low Flex X - 16.06”	HM-40 R - 15.94”	Velocitor X - 16.16”
Low Torque R - 15.84”	HM-40 S - 15.90”	
Low Torque S - 15.96”	HM-40 X - 15.79”	
Low Torque X - 15.72”	Questar R - 16.29”	
Vitesse R - 15.94”	Questar S - 15.51”	
	Questar X - 16.01”	
Apollo		
G100 R - 15.94”	Boron Tourline R - 15.96”	
G100 S - 15.95”	Boron Tourline S - 16.58”	
	Boron Tourline X - 15.99	
Grafalloy		
	I29 R - 15.86”	
	I29 S - 16.12”	

Charts 6-3 through 6-6 include kick point locations that are all measured in inches up from the tip. Therefore, for making shaft-to-shaft comparisons, remember that the higher the measurement in the charts, the higher up on the shaft is the kick point. While studying the data in each chart can give clubmakers a good idea of just how kick points of various shafts do compare, perhaps the easiest way to interpret the data is through statistical averages and ranges. Following in Chart 6-7 is a statistical breakdown of all of the kick point measurements that are included in Charts 6-3 through 6-6.

Chart 6-7 - Average and Median Cut Shaft Kick Point Measurements

Shafts	Average Kick Point	Median Kick Point	Kick Point Range
Steel Driver Shafts			
High Bend Point	18.66”	18.70”	18.51” - 18.88”
Mid Bend Point	18.65”	18.64”	18.46” - 18.83”
Low Bend Point	18.58”	18.59”	18.47” - 18.75”
Steel #5-iron Shafts			
High Bend Point	16.05”	16.08”	15.70” - 16.20”
Mid Bend Point	16.16”	16.22”	15.84” - 16.31”
Low Bend Point	16.09”	16.07”	16.02” - 16.22”
Graphite/Specialty Driver Shafts			
High Bend Point	18.91”	18.77”	18.54” - 19.73”
Mid Bend Point	18.51”	18.53”	18.29” - 18.79”
Low Bend Point	18.56”	18.57”	18.18” - 18.88”
Graphite #5-iron Shafts			
High Bend Point	16.32”	16.35”	16.16” - 16.44”
Mid Bend Point	16.00”	15.96”	15.51” - 16.58”
Low Bend Point	15.91”	15.94”	15.72” - 16.06”

When all of the data that is included in Charts 6-3 through 6-6 of cut shaft kick points is streamlined into the above information, it becomes much easier to see just how the various shafts rank. Whether looking at the average or the median kick point location for each group of shafts, it appears that there is no sequential correlation between the location of kick point from the testing and the bend point as it is stated by the manufacturers. Simply stated, if each of manufacturers' high bend point shafts do indeed have higher bend points than their mid and low bend point shafts, then the kick point as measured in this test project appears to not correlate to bend point. Again, understand that as of yet we have not studied true bend point readings to see if the manufacturers are correct in their assessment of the point of maximum bending of their shafts. Later in the chapter a number of true bend point measurements will be introduced so it will be possible to see if a relationship truly does exist between kick point and bend point.

The cut shafts that were listed in Charts 6-3 through 6-6 showed no consistent correlation to bend point locations. It is more important to realize that once again the disjointed location of the kick points among the cut shafts was not as important a discovery as how close together all the measurements were. Chart 6-7 also includes a list of the high-to-low range in kick point for all of the types of shafts that were tested. In Chart 6-7, the measurements of the high, mid and low bend point shafts were so close together. Perhaps it is entirely possible that the high to low separations of 2-3" in steel and 5-6" in graphite that have been previously stated by the industry are most likely a myth. The only way that such an increased separation in bend points could be possible would be in a quantitative comparison made between raw shafts. Because the shaft industry's raw shafts vary in length from 43-47" in parallel tip wood form, it is possible that a comparison between a 43" raw shaft and a 47" raw shaft show a greater range in kick point or bend point location than what we have seen. Still, as we do have numerous kick point measurements for raw shafts, it is very doubtful that such a wide range from high to low exist. In the end, such a comparison is meaningless, for the simple reason that the only kick point/bend point data that could possibly be relevant to shot performance would be the cut shaft measurements.

Let's take moment to restate both of the points that have been made in the last several paragraphs. First, it has been recognized that bend point and kick point are shaft specifications that are measured in two different ways which both refer to a shaft's maximum point of bending. Despite the difference in the test procedures, it should stand to reason that kick point can identify the maximum point of bending for a group of shafts in the same location order from high to low as does bend point. In other words, three different shafts have been identified through bend point testing to be ranked in order from high to mid then to low. It is a premise of the Dynacraft/Apollo shaft-testing project that the kick point measurements also should show that the three shafts display the same high-to-mid-to-low progression of location.

Unfortunately, the kick point testing did not support this theory, as the information contained in both Chart 6-1 (raw shaft kick points) and Chart 6-2 (cut shaft kick points) showed no correlation with where the manufacturers said their bend points were located on the shafts. Only later, as true bend point measurements are included in the discussion, will it be possible to know if kick point has any similarity to bend point or if the manufacturers' own listings of bend point locations are accurate or not.

Second, and more importantly, the cut shaft kick point testing of all the steel and graphite shafts showed virtually no significant difference between what are accepted as high, mid and low bend point shafts. Among the cut shafts listed in Charts 6-3 through 6-6 less than 2/3" separated the lowest steel shaft kick point from the highest and less than 2" separated the lowest graphite shaft kick point from the highest! If kick point is related to bend point, at least among a group of very popular steel and graphite shafts that are supposed to vary greatly in bend point. Such a very narrow range of the kick point location would make it very difficult to advance an argument in favor of relating kick point to shot trajectory or clubhead feel.

But as noted, kick point is measured using a slightly different test than is bend point. And as we have recognized, most of the industry's shaft manufacturers do use the bend point test as a way to determine the maximum position of bending of their shafts. Despite the fact those involved with the Dynacraft/Apollo test project believe bend point to be a specification that has very little practical application to the way a shaft is used during the golf swing. For pure comparison and clarification, it is important to give bend point its due respect and offer information from the test project's bend point measurements.

An Analysis of True Bend Point Testing

Because Apollo Shaft Corp. had engineered its testing machinery to perform only kick point testing, another shaft manufacturer was called upon to assist in the recording of true bend point for a number of the test shafts. Advanced Composite Technology (ACT) of Boulder, Colo. entered the shaft industry in the fall of 1989 as one of the few manufacturers of filament-wound graphite shafts. A well-respected producer of composite materials for non-golf applications as well, ACT agreed to perform bend point testing on its traditional compressive-testing device. A number of steel, graphite and specialty metal cut length S-flex wood shafts were tested.

Each cut shaft was positioned between the compression plates of ACT's machine and fixtured with 1/4" of the tip and butt inserted into the compression plates to prevent slipping as the force of bending was applied. Rather than calibrate the uniformity of the bend point testing by a measurement of force, ACT felt to assure consistency in the testing each shaft would be compressed until a single point on the curve of the shaft deviated 2.5" from the original shaft center line. A feeler gauge, which could move horizontally over the shaft, recorded the curve and noted the bend point location as the first position on the shaft to reach the 2.5" deviation from the original straight line. Following in Chart 6-8 is a list of true bend point measurements for a number of the industry's most widely used S-flex steel, graphite and specialty metal shafts. For purposes of comparison, the kick point of each shaft is also included in the chart. In all cases the measurements are indicated in inches up from the tip of the shaft.

Chart 6-8 - Cut Shaft Bend Point Measurements for S-flex Shafts

Shaft	Mfrs. Bend Point Designation	Actual Bend Point	Actual Kick Point
Steel Shafts for Woods			
Apollo			
AP44	High	16.7"	18.51"
Spectre	Mid	16.5"	18.57"
Shadow	Low	16.0"	18.58"
Royal Precision			
Pro Pel II	High	16.5"	18.57"
Phoenix	Mid	16.6"	18.68"
Microtaper	Low	15.8"	18.61"
True Temper			
Dynamic	High	17.5"	18.70"
TT Lite	Mid	17.1"	18.75"
Jet Step	Low	16.7"	18.47"
Steel Shaft Range		1.7"	0.28"
Graphite/Specialty Metal Shafts for Woods			
Aldila			
HM-55	High	17.6"	18.54"
Velocitor	High	17.5"	19.30"
HM-40	Mid	16.7"	18.68"
Low Torque	Low	16.8"	18.57"
HM-40 Low Flex	Low	16.5"	18.48"
Kunnan			
K2	High	16.8"	18.60"
K3	Mid	17.2"	18.72"
K4	Low	16.8"	18.50"
Apollo			
Boron Tourline	Mid	16.3"	18.41"
G100	Low	16.0"	18.30"
Specialty Metal			
Alloy 2000	Low	16.5"	18.71"
Ti Standard	High	17.5"	18.73"
Titanium Low Flex	Low	16.3"	18.88"
Graphite/Specialty Metal Range		1.6"	1.00"

In almost all of the shafts as listed in groups by manufacturer, the ACT bend point tests showed that the shafts did actually rank in the same order of bend point location as indicated by each manufacturer. Only the Kunnan and the Royal Precision shafts showed a deviation in relative bend point location from what each manufacturer indicated for the shafts. Therefore, among the True Temper steel shafts, for example, the Dynamic displayed the highest bend point, the TT Lite was next highest and the Jet Step had the lowest bend point, just as the manufacturer stated for each of the three patterns. What this initial test observation indicates is simply that the ACT bend point test seemed to show that most of the manufacturers of shafts do. In fact, use a bend point test that is similar to ACT's instead of a kick point test to define their shafts' maximum point of bending.

While this is no great revelation, it is still interesting that given the fact most of the test shafts did rank in the same order of bend point location offered by their respective manufacturers. However, there were still groups that did not. The Kunnan K2, despite the fact it is listed as having a high bend point, had the same bend point (16.8") as the K4, which is listed as a low bend point.

From the testing, is it possible to determine a standard for low, mid or high bend point location? In other words, in the study of pure bend point testing (not kick point), so far we have only discussed the relative location of the bend point of a certain group of shafts by their manufacturer. For example, of the three Apollo steel shafts tested, the AP44, which is said to have a high kick point, did have the highest bend point of the three. Following in order was the Spectre and the Shadow, which are listed as mid and low respectively, just as Apollo product information indicates.

But how do all shafts of the same ordained bend point compare to actual bend point location? Is the bend point of all the different high bend point shafts in the same place on the shaft? Or is the location of a high bend point from one manufacturer equivalent to a mid bend point location on another shaft? Taking the same data that was included in Chart 6-8 and repositioning it by bend point classification will allow such an observation to be made. Following in Chart 6-9 is a list of the true bend point locations for the S-flex steel; graphite and specialty metal shafts and their manufacturers' stated bend point location.

Chart 6-9 - Actual Bend Point Locations by Manufacturer's Bend Point DesignationChart 6-7 - Average and Median Cut Shaft Kick Point Measurements

Low Bend Point		Mid Bend Point		High Bend Point	
Aldila HM-40 Low Flex	16.5"	Aldila HM-40	16.7"	Aldila HM-55	17.6"
Aldila Low Torque	16.8"	Apollo Boron Tourline	16.3"	Aldila Velocitor	17.5"
Alloy 2000	16.5"	Apollo Spectre	16.5"	Apollo AP44	16.7"
Apollo G100	16.0"	Royal Precision Phoenix	16.6"	Royal Precision Pro Pel II	16.5"
Apollo Shadow	16.0"	Kunnan K3	17.2"	Kunnan K2	16.8"
Royal Precision Microtaper	15.8"	True Temper TT Lite	17.1"	Ti Shaft Standard	17.5"
Ti Shaft Low Flex	16.3"				
True Temper Dynamic	17.5"				
True Temper Jet Step	16.7"				
Average	16.4"		16.7"		17.2"
Range	15.8" - 16.7"		16.3" - 17.2"		16.5" - 17.6"

The average bend point calculation did indicate that the actual bend point locates listed above fell into the predicted low-to-mid-to-high sequence to each other. The data also showed that there was some crossover among bend point locations. Among those shafts listed as "low bend point", the bend point measurement varied from 15.8" for the Microtaper all the way up to 16.7" for the Jet Step. Among those listed, as "mid bend point", the HM-40, Boron Tourline, Spectre and Phoenix all were lower or equal to the Jet Step. Even among "high bend point" shafts, the Pro Pel II had a lower bend point than the Jet Step. Therefore, it is not possible to establish a consistent industry location for any three generic descriptions of bend point.

Of course the bend point testing was limited to only 22 S-flex wood shafts. The shafts that were selected were chosen not just to provide a representation of different manufacturers' bend point designations, but also for the supposed extreme of bend point locations as well. For example, when the Aldila Velocitor was designed in the early 1980's, it was said in the promotional literature to have the highest bend point of any shaft yet produced. Because of this statement by the manufacturer, the Velocitor was included in the testing. If the industry's estimated high-to-low bend point separation of 5-6" was true, the high-to-low range in this testing should have shown up reasonably close in comparison that included the ultra-high bend point shaft such as the Velocitor. As can be seen from Charts 6-8 and 6-9, the bend point range among the graphite shafts (including the Velocitor) did not vary the supposed 5-6" amount, but only some 1.6".

Still, after studying all the bend point data, eventually the matter comes down to the question of just how much difference in bend point is significant, or rather can a difference of less than 2" in bend point significantly affect the trajectory and the clubhead feel of any shaft? During the bend point testing that was performed by ACT, the Ti Shaft Standard has a bend point 1.2" higher than the Titanium Low Flex. Curious about the difference, Sandvik, maker of the Ti line of shafts, subjected both shafts to mechanical testing in an effort to determine the trajectory difference between the two shafts. Using high-speed cameras to capture the ball as it left the clubface after impact, the company determined that between two identical Drivers, the Titanium Low Flex propelled the ball 1º higher. Other than the 1.2" difference in bend point, the only other differences were the Low Flex version had a 5 5/8" longer parallel tip section and the torque was nominally higher by 0.3º.

A Final Word about Bend Point and Kick Point

As stated earlier in this chapter, bend point is a compressive test, which does not occur in the golf swing, but is a method the shaft industry using to measure the point of maximum bending or the stiffness distribution of the shaft. However, kick point is more analogous to the swing because the butt end is securely clamped, then a load or a force is applied to the tip of the shaft. In the swing, the golfer holds the butt end of the shaft securely by the hands. The shaft is then bowed due to the forces supplied by the golfer.

Refer back to Chart 6-8. Even though the bend point difference was 1.2", the actual kick point location of the Titanium Standard was within 1/8" of the Titanium Low Flex. The Dynamic shaft has a 1.7" higher bend point than the Microtaper, yet the kick point difference is only 0.09" higher. If the 1º change in trajectory is considered negligible, then is the primary benefit of bend point or kick point classification for feel?

Examining all the steel and specialty metal shafts, the largest difference in kick point was merely 0.64" for both cut Driver and #5-iron shafts. This should not be surprising if we look at a simplified approach. If a shaft made from a homogenous material was manufactured with a constant diameter from the tip to the butt end, then the point of maximum bending should occur in the center of the shaft. However, all the wood shafts tested possessed a .335" tip diameter, while the butt end of the shafts ranged from .560" to .620". In a golf shaft, the tip end is smaller and weaker than the larger butt end. Therefore, the point of maximum bending must be located somewhere on the tip side of the center of the shaft. Because there are only limited number of ways the manufacturer can taper the shaft from .335" to somewhere between .560" and .620", then the point of maximum bending can only change a small amount as well.

The Rocket shaft, by True Temper, was made many years later than we had last sent shafts to Apollo to be tested. Due to the very large bubble formation located just below the grip, plus the long parallel tip section, it should measure the lowest bend point of any steel shaft made at the present time. Geometry plays an important role in the placement of the point of maximum bending. Steel shafts that have relatively high bend point/kick point reading usually have very short parallel tip sections. On the other hand, most shafts that are described as low bend point/low kick point, and measured as such, possessed long parallel tip sections.

The geometry of graphite and composite shafts can been manufactured with a wider assortment of tip and butt diameters and still not cause the shafts to become overly stiff as would be the case with steel, if made oversized. In recent years, there have been graphite shafts made with big tip diameters, larger butt diameters, enhanced bubbles and even combinations of the three. Unfortunately, these geometric shafts have not been tested on Apollo's testing apparatus to see how much, if any, change to the kick point location can occur.

Graphite and composite shafts, on the other hand, are made of multi-layers positioned with both longitudinal and radial plies to independently alter the flex, torque and bend point of the shaft. From the kick point data, graphite shafts did exhibit a wider range than did steel, but still the difference was a little over 2" with Driver shafts and a little more than 1" with #5-iron shafts. While there was overlap in the actual kick point measurements verses what the manufacturers stated as the bend point of their shaft, maybe the manufacturers are not stating an actual position. Maybe what the manufacturers are referring to is the relative ball flight of their own shafts against other shafts in their line using either robot or human testing?

A Question of Shaft Weight and Balance Point

Two parameters that have not been discussed in detail are shaft weight and balance point. Three balance point tests were conducted as part of the Dynacraft/Apollo shaft-testing project. Balance Point #1 (BP1) was the point of equal weight distribution on the raw, uncut shaft. Balance Point #2 (BP2) was the point of equal weight distribution on the cut shaft. Lastly, Balance Point #3 (BP3) was point of equal weight distribution on the completed club. In each case, the balance point was measured either from the tip of the shaft, or in the case of BP3, was from the groundline.

While it was interesting to record the balance point of each raw shaft, as with so many other shaft parameters, the raw shaft data had very little bearing on the true performance of the shaft. For obvious reasons the information obtained from recording the balance point of the cut shaft (BP2) and especially the assembled club (BP3) would be more important from the standpoint of searching for a possible shaft performance contribution.

From studying how close together all the shaft kick point and bend point measurements were, it became difficult to see how the shafts' maximum point of bending could possibly have any significant effect on shot trajectory and clubhead feel. One question that surfaced was whether shaft balance point could be a major factor that influences shot trajectory and clubhead feel the same that it does with clubhead design.

Shaft weight, shaft balance point, length and headweight are all factors that influence the final swingweight of the club. Because the shaft study tried to maintain uniformity, the length and swingweight in the testing was standardized. For instance, all men's flex #5-shafts were tested at 37.5" and a D-1 swingweight. Due to the weight of the shaft and the shaft's balance point, the headweights ranged from approximately 257 to 273 grams. A byproduct of the heavier head on a lighter shaft is the balance points shifts closer to the head. Charts 6-10 though 6-12 illustrate the difference in completed club balance point at identical lengths and swingweights of over 2000 shafts that we have tested so far.

Chart 6-10 - Deviation in Complete Club Balance Point for Steel Shafts

	DRIVER			#5 IRON		
Flex	**Low**	**High**	**Deviation**	**Low**	**High**	**Deviation**
L	10.85"	11.96"	1.11"	7.56"	8.59"	1.03"
A	11.39"	12.68"	1.29"	8.06"	9.17"	1.11"
R	11.39"	12.68"	1.29"	8.09"	9.49"	1.40"
S	11.43"	12.85"	1.42"	8.05"	9.26"	1.21"
X	12.10"	12.80"	0.70"	8.33"	9.35"	1.02"

L flex measured at standard ladies length (42" Driver, 36.5" #5-iron, C-6 swingweight)
Men's flex shafts measured at standard men's length (43" Driver, 37.5" #5-iron, D-1 swingweight)

Chart 6-11 - Deviation in Complete Club Balance Point for Graphite Shafts

	DRIVER			#5 IRON		
Flex	Low	High	Deviation	Low	High	Deviation
L	9.68”	10.54”	0.86”	5.12”	7.56”	2.44”
A	10.22”	11.58”	1.36”	5.55”	8.18”	2.63”
R	9.85”	12.33”	2.48”	5.59”	8.84”	3.25”
S	10.68”	12.14”	1.46”	5.83”	8.91”	3.08”
X	11.02”	11.98”	0.96”	5.77”	8.94”	3.17”

L flex measured at standard ladies length (42” Driver, 36.5” #5-iron, C-6 swingweight)
Men’s flex shafts measured at standard men’s length (43” Driver, 37.5” #5-iron, D-1 swingweight)

Chart 6-12 - Deviation in Complete Club Balance Point for All Shafts

	DRIVER			#5 IRON		
Flex	Low	High	Deviation	Low	High	Deviation
L	9.68”	11.96”	2.28”	5.12”	8.59”	3.47”
A	10.22”	12.68”	2.46”	5.59”	9.17”	3.62”
R	9.85”	12.68”	2.83”	5.59”	9.49”	3.90”
S	10.68”	12.85”	2.17”	5.83”	9.26”	3.43”
X	11.02”	12.80”	1.78”	5.77”	9.35”	3.58”

L flex measured at standard ladies length (42” Driver, 36.5” #5-iron, C-6 swingweight)
Men’s flex shafts measured at standard men’s length (43” Driver, 37.5” #5-iron, D-1 swingweight)

Examining the steel shafts first, there is greater than 1” separation in the completed club balance point between of the same flex clubs built to the identical length and swingweight. To put that amount in perspective, you would need to place more than one ounce of weight on the head in an existing club to change the balance point 1” closer to the tip. The additional weight would make the club feel definitely more “head heavy” than before the weight was added.

There are two interesting observations made from looking deeper into the balance point location of the completed clubs. The first, shafts that were listed under the low end of the range were shafts that were also the lightest in their respective flex designation. The shafts on the high end of the range were all the heaviest shafts in their flex designation. This should come of no surprise, because the lighter the shaft, usually the greater the headweight is necessary to achieve a specific swingweight.

Secondly, and maybe more importantly, shafts that fell on the high side of the range were all labeled high bend point by the manufacturer. The shafts that are on the low side of the range were either low or mid bend point, with the majority labeled as low bend point. This is not to say that balance point is completely the answer to why some steel shafts hit the ball higher than others using the same head did. Rather it is a possible explanation, but it nevertheless does pose an interesting debate. The shafts that were on the lower end of the balance point range were not only the lightest shafts, but also the most flexible and highest torque steel shafts made, which could be a viable reason why the ball flight may be higher.

Chart 6-11 showed that graphite shafts exhibit an even wider range of balance points. Graphite shafts have been produced the same weight as standard weight steel shafts all the way as shafts half the weight or lower. Weight distribution has even been further expanded by the geometric design of certain shaft. Looking at the graphite #5-iron deviation in Chart 6-11, the range is greater than 3” in some cases. The low end of the spectrum for each flex consists of a special design - the large butt shafts. These large butt shafts (as large as 0.865”) require lighter weight grips, thus the balance point of the club is shifted closer to the head. Large butt wood shafts were tested, but not at the 43” length. Therefore the range for graphite wood shafts would have been much larger had they been included.

It is interesting to note that the manufacturer labeled all the graphite shafts that fell on the high side of the balance point range as high bend point. However, the opposite statement cannot be said of the low range of the completed club balance points. This is partially due to the fact that the torque rating influences the bend point classification of shafts. Shafts that are lightweight and possess a low BP3, but have very low torque rating, are considered a high bend point. As the torque rating increases, the bend point classification is then labeled mid or low. Keep in mind that this is the manufacturer’s designation, and not the actual measured bend point or kick point of the shaft.

Chart 6-12 shows the deviation possible will all shafts. Again, the range for the Driver shafts would have paralleled the #5-iron results if the large butt shaft were included. The large range in balance point (nearly 4”) is considerable knowing that the length and swingweight were identical.

Here is one final note on balance point. A shaft that is lighter in weight than another does not necessarily mean that it will require more head weight to achieve a specific swingweight or cause a lower balance point. In fact weight, weight is only one part of the equation. Where the weight is located is also a determinate of how much head weight is needed and where the completed balance point of the club will be located.

Chart 6-13 - Shaft Weight and Balance Point

Model	Shaft	BP2	BP3	Head Weight	Swingweight Length
Aldila Tgi 85 S-flex	81.9 g	17.06”	7.95”	260.2 g	D-1 / 37.5”
Rocket w/ SensiCore S-flex	110.8 g	19.44”	9.14”	264.3 g	D-1 / 37.5”

There are certain graphite shafts that have been manufactured with more material in the tip in order to produce normal swingweights without the use of heavier heads. One such shaft is the Aldila Tgi85. As you can see from Chart 6-13, the Tgi85 only required a 260.2 g head to achieve a D-1 swingweight at 37.5”. In comparison, the Rocket with SensiCore weighed 28.9 g more than the Tgi85, but required more head weight to achieve the same swingweight. Although the Rocket shaft is heavier, more weight is concentrated closer to the butt end. The cut shaft balance point (BP2) is nearly 1.6” closer to the tip on the Tgi85 than it is on the Rocket. Although the BP3 is still higher than the Tgi85, there would have been much higher separation if the Tgi85 had not been designed tip heavy.

A Final Word on Kick Point, Bend Point and Balance Point

While the entire study on kick point, bend point and balance point did not reveal any definitive conclusions; feedback from golfers says certain shafts play and feel different. Both feel and performance are the two key issues that cannot be ignored when fitting a golfer for the proper shaft. However, there were some unmistakable facts that did surface from the testing.

Whether expressed as kick point or bend point, a shaft maximum point of bending, did not vary from high to low by nearly as much as previously thought. While the high-to-low range in bend point had been stated to be 2-3” in steel and 5-6” in graphite, Dynacraft/Apollo kick point tests showed the maximum range to be 0.64” in steel and 2.34” in graphite. The bend point testes revealed a 1.7” range in steel and 1.6” in graphite within a limited number of specially selected shafts.

There appears to be no common relationship between kick point and bend point. The terms kick point and bend point have been used interchangeably in the golf industry to describe a shaft’s maximum point of bending, although different testing methods are used. Bend point is a compression test, which does not occur in the golf swing. Kick point is more analogous to the actual swing, where the butt end is securely clamped, and then a force is applied to the tip of the shaft by the golfer to cause the shaft to bend. Whether kick point or bend point is discussed, the order of high, mid or low should follow in sequence. Using both tests on the same shafts, the order did follow in the sequence the manufacturers listed, while in other cases the order changed.

There appears to be no standard location on a shaft for the various high, mid and low bend point or kick point designations.

Although the testing revealed kick point locations occurred approximately 45% from the tip regardless if the shaft was cut or uncut, Driver or #5-iron, or steel, graphite or any other material. The bend point location was approximately 40% up from the tip of the shaft. The testing showed that some low bend point shafts had the same bending position as supposed high bend point shafts. Part of the answer may be the limited geometric configurations to which shafts are designed.

While shafts do exhibit some difference in their maximum point of bending, it is not possible to say with any conviction that this specification has a definitive effect on shaft performance. Until definitive proof can be established to confirm how it could be possible for so little separation in kick point to create distinct feel and performance differences between two shafts, it is hard to say for sure if kick point or bend point is the real explanation for the difference in shot trajectory. Without a doubt, studying the point of maximum bending was the most frustrating and most confusing aspect of this testing project.

We cannot rule out the possibility that balance point, or the weight distribution of the golf club, may have a pronounced effect on trajectory. On more occasions that not, the higher completed club balance point was almost always listed as a high bend point. The range of balance points within clubs of identical length and swingweight was much greater than the small range in bend point or kick point.

Kick point and bend point may not be the answer at all as why there are different shot trajectories among different shafts. The kick point and bend point tests were conducted on raw shafts. Again, golfers never play clubs without heads and grips. The influence of the weight of the club being swung head and swung between 40 and more than 100 mph, might cause the shaft to react differently than in static testing. Maybe we shouldn’t be concerned with the maximum point of bending at all, but more on how much the shaft tip bends forward just prior to impact. As we continue to keep testing shafts, someday we may be able to explain how, if any of the factors in this chapter, affect trajectory and by how much.