Ball Motion Analysis Form Instructions
For Use With the Ball Motion Analysis Form and Ball Motion Analysis Video Instructions

Measuring the X, Y, and Z Axes of a Bowling Ball.

1. Place the ball on the deTerminator with the pin aligned with the eyehole of the support arm.

2. Turn the deTerminator on and trace the ball path through the eyehole. The ball will eventually spin about a fixed axis (this axis runs through the bowling ball – from the surface, the ball will spin about a point) – this is known as the Preferred Spin Axis or PSA. This PSA represents the Y or High RG Axis of the bowling ball. Mark the spot through the eye hole (dot) and the top of the arm, creating a small circle about the PSA.

3. Using the pro-sect, draw a line from the PSA towards and through the manufacturer pin of the bowling ball. Mark the point 6 ¾” from the PSA along the line – this will represent your X axis.

4. Now draw a Perpendicular Line from the X axis toward the ‘equator’ of the ball. Mark a spot 6 ¾” down the line from the X axis - this will give you the Z or intermediate RG axis.

5. To ensure the accuracy of this location, take your pro-sect and measure perpendicular from the X axis to Y axis line toward the Z axis. This line should directly intersect where your Z axis is marked and be 6 ¾” in length. If they do intersect and your line is 6 ¾”, you have correctly found all three axes. If not, be sure to check that your lines are 6 ¾” long (this is ¼ of a bowling ball’s circumference) and perpendicularly intersect at the axis locations.
60 Degree Spin Time

The 60 Degree Spin Time measures the strength of the PSA of a bowling balls core. Balls with a High Intermediate Differential will have a strong PSA and a faster 60 Degree Spin Time.

In order to find the 60 Degree Spin Time, the location of the X, Y, and Z axes must be known. In addition to the axis locations, a neutral location equidistant from all three axes must be known.

1. The easiest way to find this point is to take your line between your X and Y axis and mark the midpoint. (The line should be 6 ¾” long, so the mid point will be 3 3/8” from either axis.)

2. Draw a Perpendicular line through the point. For right handed bowler, your mark should be right of the Y to X axis line, and left of the line for lefthanders.

3. Now that your “T” is drawn, mark the distance along that line that is 4 1/8” from both the X axis and Y axis. If you correctly found the midpoint, both of these marks should be at the same point on the line. You have now found the neutral spot!

4a. [Right Handed Bowler] Line up your neutral spot with the eyehole on the right column of the deTerminator.

4b. [Left Handed Bowler] Line up your neutral spot with the eyehole on the left column of the deTerminator.
5. Using a stopwatch or other accurate time telling device (hundredth of a second or greater), power on the deTerminator and start the stopwatch at the same time. Stop the watch when the ball has reached its PSA.
6. For improve accuracy, repeat the spin time calculation 3 times.

THROW THE BALL DOWN THE LANE!

Observing Ball Path/Tracing Rings

1. Throw your ball on a part of the lane where you believe you should be lined up to strike.
2. Determine the ball location at release. This can be done by using someone else to observe, or by determining your lay down point based on where you are sliding. Your lay down point is usually 5-6 boards different from where you slide (may vary depending on bowling styles and body types.)
3. Determine the ball location at the arrows. When the ball crosses over the arrowed region of the lane, determine the board the ball is on at time of crossing.
4. Determine the ball location at the breakpoint. This will be the furthest board right (or left for lefthanders) the ball travels before changing direction.
5. After receiving your ball with these rings, use a grease pencil to trace the first oil ring (the ring closest to your grip line) and last full oil ring (the ring farthest away from your grip line with a full circumference of oil.).
6. Trace the last track flare ring. This will often be different than the last ring with oil as the ball normally migrates past the end of the oil pattern.

Measuring Axis Tilt

The track flares on a bowling ball can tell us many important aspects about a bowler’s release. Finding your axis tilt is one of these important numbers that can be determined from the track rings.

1. Using a pro sect measure the distance from one side of the first oil ring (closest to your grip) to the other. A ball with 0 degrees of axis tilt should have a distance of 13.5”. (Educational Note: This is where the 6 ¾” number comes from – 13.5” is one half the circumference of a bowling ball, and 6 ¾” is ¼ of it – using 1/4 of the circumference allows us to easily and accurately change planes in the ball because of its spherical properties.)

2. Using the “Axis Tilt” table, find the bowler’s Axis Tilt in Degrees.

Finding your Positive Axis Points with an Armadillo.

There are many different methods and techniques for finding your positive axis point, or PAP. The PAP at release is the axis about which your ball initially rotates around when you release the ball onto the lane (being an axis, there is another end of it on the other side of the ball known as the negative axis point, but is less commonly referred to or...
Your bowling ball’s PAP changes as the ball travels down the lane and is known as axis migration.

One of the simplest methods for finding your PAP is using an armadillo device.

1. To find your **Positive Axis Point at release**, use the traced line of your first oil ring and place the armadillo on the bowling ball and find the line on the armadillo that matches the contour of the line most accurately.
2. Mark the location of your axis (the slot at the end of the armadillo.)
3. Mark your grip center line.
4. Find your grip center by finding the equidistant point between the front cut of your finger holes and the front cut of your thumb or thumb slug. (If using an interchangeable thumb slug device, measure from the front edge of your inner slug – do not measure from the outside cut of the hole drilled for the outer sleeve.). For additional clarification, please see page I-5 (page 10 of the .pdf file) of the Equipment Specifications Manual located on Bowl.com.
5. Draw a perpendicular line from your grip center toward the side of the ball with no track rings.
6. Draw a line perpendicular to the line you’ve just drawn (the axis length line) that goes through the marked axis point found from the armadillo. This line will be your vertical axis line or VAL.
7. Measure both the distance from grip center to VAL and the distance from the intersection of those lines to the actual marked PAP at release. For example, if your axis length line is 5” long, and the actual marked PAP is ¾” above the intersection, your PAP is: 5” x ¾” up.
8. To find the **Positive Axis Point at the breakpoint**, use the last oil ring and match a line on the armadillo with that track flare ring.
9. Repeat steps 2-7 to find your PAP at the breakpoint.
10. To find the Positive Axis Point at the pins, use the last dry track ring and match a line on the armadillo with that track flare ring.

Repeat steps 2-7 to find your PAP at the pins.

Measuring Axis Migration

1. Be sure you still have all three of your Positive Axis Points marked (PAP @ Release, Breakpoint, and the Pins.)
2. Using a 6” metal ruler, measure the distance from your PAP at release to the PAP at the breakpoint. This will tell you the axis migration in oil.
3. Measure the distance from your PAP at the breakpoint to your PAP at the pins. This will give you your axis migration in dry.
4. Your total axis migration will be the sum of your axis migration in the oil and your axis migration in the dry.
5. Sketch a picture of the 3 axis points and the corresponding axis migration lines.

NOTE: CLEAN THE BALL EXCEPT THE PSA, PAP at RELEASE and VAL

Post Drilling Dual Angle Layout

In order to measure the strength of the ball layout, the Ball analysis form utilizes the Dual Angle Layout technique. Be sure that your PAP and VAL are both still marked on the bowling ball, as they will be needed to determine the layout.

1. Spin the ball on a deTerminator to find the new PSA (The PSA of a ball changes after drilling.) If you are unsure of how to find the PSA of a bowling ball using a
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deTerminator, see the video on finding the 3 axes of an asymmetrical bowling ball. (Educational Note: All bowling balls (including balls with symmetrical cores) that have been drilled are considered asymmetrical, as you do not remove a symmetrical amount of material from the ball across all planes.

2. Mark the line from the X axis of the ball to the new PSA.

3. Draw a Line from the PAP to the X axis. You should now have all three necessary lines to measure the layout of the ball.

4. The first number in the dual angle layout is the angle between the Pin/X axis to PSA line and the Pin to PAP line. Using your pro-sect, place the 0 of the scale on the pin with the protractor portion facing the opening of the “V” formed by the two lines. Record the angle (0 degrees should be on the Pin-PSA line). This is referred to as the drilling angle.

5. Measure the distance from the PAP to the X axis. This is the second number required.

6. Measure the angle between the Pin-PAP line and the VAL. It may help to turn the ball 180 degrees so you can see the protractor portion of the pro-sect. This is the final number and is referred to as the VAL angle.

7. The Dual angle drilling layout is usually written #x#“x#”. For example, 30x4x50 would be a ball with a 30 degree drilling angle, a 4” pin to PAP @ Release distance, and a 50 degree VAL angle.

8. Determine the size and depth of the weight hole (if applicable). Often it is easiest to ask your pro shop operator for this information.

9. Using a pro-sect, draw a line from the PAP of the ball to the PSA. This is referred to as the gradient line. The closer a weight hole is to the PSA, the more of an effect on core dynamics the hole will have. Rate the strength of the location of the hole, with P4 being strongest and P1 weakest.