DUAL ANGLE LAYOUT TECHNIQUE™ provides the ball driller with an easy, effective and accurate method of choosing the best layout to match every bowler to every lane condition.
Three components of the DUAL ANGLE LAYOUT TECHNIQUE™

1. The Drilling Angle
2. The pin to Positive Axis Point (PAP) distance
3. The Angle between the pin to PAP line and the VAL (the VAL angle)

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Terminology for the DUAL ANGLE LAYOUT TECHNIQUE™

Examples:

“...a 10° drilling angle, pin 4" from the PAP,
20° VAL angle”

“...a 90° drilling angle, pin 5" from the PAP,
70° VAL angle”
The **DUAL ANGLE LAYOUT TECHNIQUE™** works accurately for balls with **symmetrical** cores with the pin out at least 1 ½” and all balls with **asymmetrical** cores.
Examples of **DUAL ANGLE** Layouts

- 10° drilling angle
- 20° to the VAL
- PAP

- 90° drilling angle
- 70° to the VAL
- PAP

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For a ball with an **asymmetrical core**, the drilling angle measures the angle between the line drawn from the pin to the preferred spin axis (**PSA**) of the ball and the line drawn from the pin through the **PAP**. This line is referred to as the **base line**.
The Drilling Angle

For a ball with a **symmetrical core**, the drilling angle measures the angle between a line drawn from the pin through the center of gravity (\(cg\)) and the line drawn from the pin through the **PAP**. Again, this line will be the **base line** for the layout.
The pin on both types of balls is the low RG axis of the ball.

The reason the drilling angle is different for both types of balls is that a ball with a symmetrical core does not have a PSA before drilling.

A ball with an asymmetrical core does have a PSA before drilling which allows the driller to draw the line from the pin to the actual PSA of the ball.
The recommended range of drilling angles to choose from is from a minimum of 10° and to a maximum of 90°.

A 10° drilling angle will roll the start up the soonest of all the effective drilling angles.

A 90° drilling angle will start up the latest of all the effective drilling angles.
Common Drilling Angles

10° Drilling Angle

30° Drilling Angle

50° Drilling Angle

70° Drilling Angle

90° Drilling Angle

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### Pin and PSA distances to PAP for different Drilling Angles

<table>
<thead>
<tr>
<th>Mass Bias Position</th>
<th>Drilling Angle</th>
<th>Pin to Positive Axis Point distance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1&quot;</td>
</tr>
<tr>
<td>2</td>
<td>70°</td>
<td>6 3/8&quot;</td>
</tr>
<tr>
<td>3</td>
<td>50°</td>
<td>6 1/8&quot;</td>
</tr>
<tr>
<td>4</td>
<td>30°</td>
<td>5 7/8&quot;</td>
</tr>
<tr>
<td>5</td>
<td>10°</td>
<td>5 3/4&quot;</td>
</tr>
</tbody>
</table>
Track Flare for Symmetrical Balls

Track Flare for symmetrical cored balls
Track flare is determined by PIN to PAP distance.

**Large** Track Flare
3” to 4” from PAP

**Medium** Track Flare
2” to 3” from PAP for earlier breakpoint
4” to 5” from PAP for later breakpoint

**Small** Track Flare
¾” to 2” from PAP for earlier breakpoint
5” to 6¼” from PAP for later breakpoint
Track Flare for Asymmetrical Balls

Track Flare for asymmetrical cored balls
Track flare is determined by PIN to PAP distance.

**Large Track Flare**
2 3/4” to 6 1/4” from PAP

Pin distances closer to 6 1/4” produce more FORWARDED ROLL
(less axis rotation)

Pin distances closer to 2 3/4” produce more SIDE ROLL
(more axis rotation)

**Medium Track Flare**
1 1/2” to 2 3/4” from PAP

**Small Track Flare**
3/4” to 1 1/2” from PAP
The VAL angle

The angle between the pin to PAP line and the VAL is referred to as “the VAL angle.”

This angle is as important, if not more important than either of the first two components of the DUAL ANGLE LAYOUT TECHNIQUE™.
The Angle to the VAL

For most bowlers, the largest “safe” angle between the pin to PAP line and the VAL (the VAL angle) should result in the pin ending up just below the finger holes.

Very high track bowlers are the exception to that rule. For very high track bowlers, the maximum angle between the pin to PAP line and the VAL (the VAL angle) should result in the pin ending up just above the fingers.

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Common VAL Angles

20° VAL Angle

45° VAL Angle

70° VAL Angle

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The Method for a DUAL ANGLE Layout

To do a DUAL ANGLE layout, a ball driller will need a Pro Sect®. The Pro Sect® has a protractor to accurately measure the angles used in the DUAL ANGLE layout and a scale to measure the pin to PAP distance and to measure back to the center of the grip from the bowler’s PAP.
The Method for a DUAL ANGLE Layout

The first step in starting a DUAL ANGLE layout is to draw a line through the pin and the PSA for a ball with an asymmetrical core.

For a ball with a symmetrical core, draw a line through the pin and the cg. This line will provide the base line for measuring the drilling angle.
The Method for a **DUAL ANGLE** Layout

The ball driller should measure and mark the chosen drilling angle by placing the zero point of the scale of the **Pro Sect®** on the pin with the rib on the base line and using the protractor to measure and mark the desired drilling angle.

Marking the Drilling Angle

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The ball driller should now draw the pin to **PAP** line by using the scale of the **Pro Sect®** to draw a line from the pin through the marked drilling angle.

**Drawing the pin to PAP Line**

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The Method for a DUAL ANGLE Layout

The ball driller has now completed marking the drilling angle on the ball to be drilled. The next step in completing a DUAL ANGLE layout is to measure and mark the distance from the pin to the PAP on the pin to PAP line by using the scale of the Pro Sect®.
The Method for a DUAL ANGLE Layout

Next, the ball driller has to measure and mark the angle between the pin to PAP line and the VAL (the VAL angle) by placing the zero point on the scale of the Pro Sect® on the PAP and the rib on the pin to PAP line. The ball driller can now measure and mark the VAL angle using the protractor.

Marking the angle between the pin to PAP line and the VAL

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The Method for a DUAL ANGLE Layout

The ball driller now draws the VAL using the scale of the Pro Sect® to complete the third and final component of the DUAL ANGLE LAYOUT TECHNIQUE™.
The Method for a DUAL ANGLE Layout

The ball driller has, now, finished all three components of the DUAL ANGLE LAYOUT TECHNIQUE™.
The Method for a DUAL ANGLE Layout

As with all accurate drilling techniques, the ball driller measures back to the center of the grip using the vertical and horizontal components of the bowler’s axis co-ordinates to find the center of the bowler’s grip. After drawing the centerline of the grip, perpendicular to the midline, the ball driller can now drill the ball.
The effective use of **DUAL ANGLE Layouts**

In summary, the **DUAL ANGLE LAYOUT TECHNIQUE™** is composed of three parts: the drilling angle, the pin to **PAP** distance and the **VAL** angle.

 Ultimately, the success of this system depends on the ability of the ball driller to make accurate choices when choosing the drilling angle, the pin to **PAP** distance and the **VAL** angle.

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The effective use of **DUAL ANGLE** Layouts

The beauty of the **DUAL ANGLE LAYOUT TECHNIQUE™** is that it allows the ball driller to keep the desired ball reaction in perspective when matching the bowler to the lane condition.
The effective use of *DUAL ANGLE* Layouts

By making a good decision in choosing the pin to *PAP* distance, the ball driller can determine the amount of friction between the ball and the lane by controlling the track flare of the drilled ball.
Once the amount of friction is determined, the ball driller can shape the breakpoint by choosing the drilling angle and the VAL angle.

Adding the drilling angle and the VAL angle together will allow the ball driller to choose how quickly the ball will transition from skid to hook to roll.
The effective use of **DUAL ANGLE** Layouts

If the two angles add up to **30°**, the ball will transition as quickly as possible.  

If the two angles add up to **160°**, the ball will transition as slow as possible.

The ball driller should keep the sum of the two angles between **30° and 160°** to create effective ball reactions while still allowing the ball to maintain hitting power.
The ball driller must still keep the drilling angle between 10° and 90° and the VAL angle between 20° and approximately 70° (depending on the bowler’s track).
The effective use of **DUAL ANGLE** Layouts

- The ball driller should use smaller angle sums for speed dominant players and larger angle sums for rev dominant players. The ball driller should use medium angle sums for players whose ball speed and rev rate match.

- The ball driller should use smaller angle sums for higher axis tilt players and larger angle sums for lower tilt players.
The effective use of DUAL ANGLE Layouts

- The ball driller should use smaller angle sums for longer oil patterns and larger angle sums for shorter patterns.

- The ball driller should use smaller angle sums for higher volumes of oil on the lane and larger angle sums for lower volumes of oil.
The effective use of **DUAL ANGLE** Layouts

In conclusion, the sum of the drilling angle and the **VAL** angle determines how quickly the ball transitions from skid to hook to roll.

Using a smaller sum of the two angles will turn **translational energy** into **rotational energy** faster, which results in the ball revving up sooner.
Decisions in creating Ball Reactions for the Bowler with Dual Angle Layouts

- Choose the pin to PAP distance.

- Choose the sum of the drilling angle and the VAL angle.

- Choose the ratio of the drilling angle to the VAL angle.
The effective use of **DUAL ANGLE** Layouts

Even though the sum of the drilling angle and the **VAL** angle controls the rate that the ball transitions from skid to hook to roll, the ball driller can control the shape of the breakpoint by changing the relationship between the drilling angle and the **VAL** angle.
The effective use of DUAL ANGLE Layouts

Larger drilling angles in relation to the VAL angle will create later, sharper breakpoints (more backend).

Smaller drilling angles in relation to the VAL angle will create a sooner, heavier roll (more midlane).
Thanks for your interest in DUAL ANGLE LAYOUTS as a tool to provide better ball reactions for bowlers.

RADICAL Bowling Technologies