# DUAL ANGLE LAYOUT TECHNIQUE™

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

This technique is comprised of three components:

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

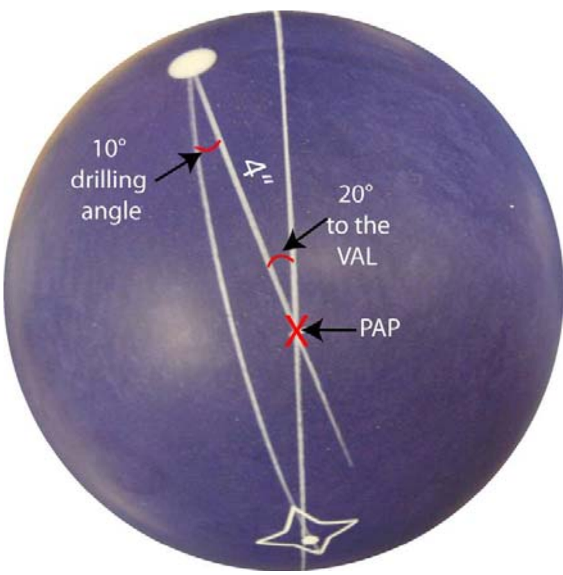
The following statement is rather important so please read it a few times.

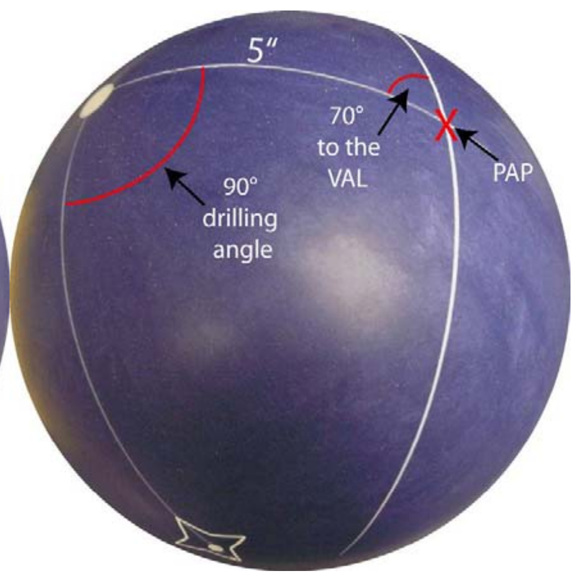
*The DUAL ANGLE LAYOUT TECHNIQUE™ works accurately for ALL bowling balls with the pin out at least 1½". It is also effective for balls with symmetrical or asymmetrical cores.*

Think the following new lingo makes sense? Hopefully it will after we're finished.

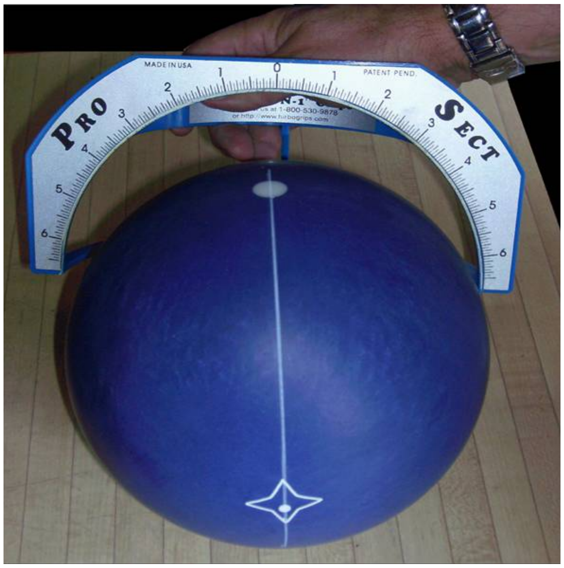
"... a 10°drilling, pin 4" from the PAP, 20° to the VAL"
"... a 90°drilling, pin 5" from the PAP, 70° to the VAL"

Maybe pictures will help.

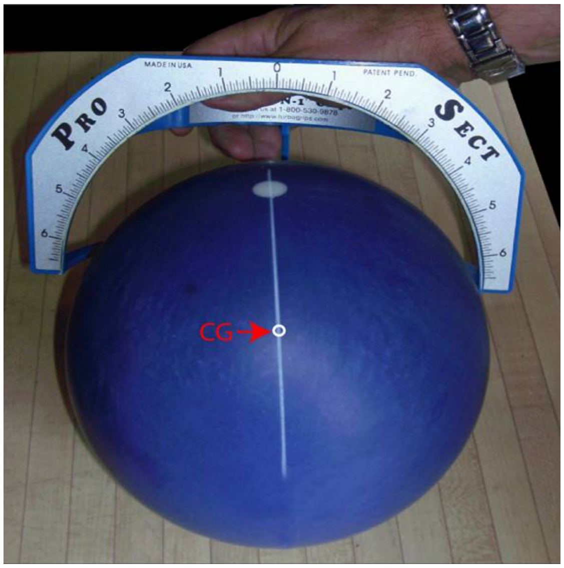



## *** The Drilling Angle




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.

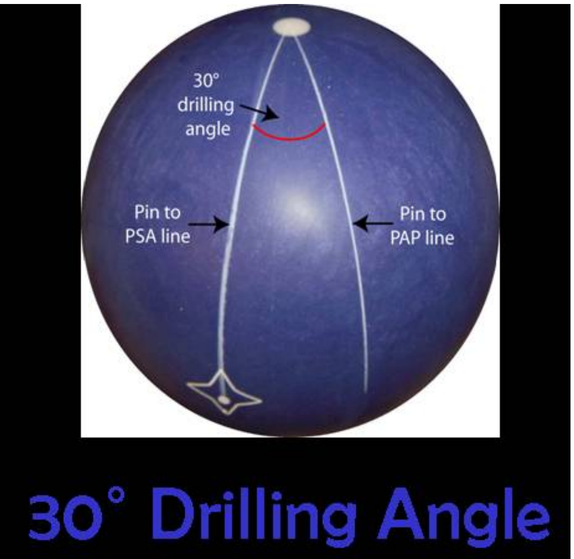


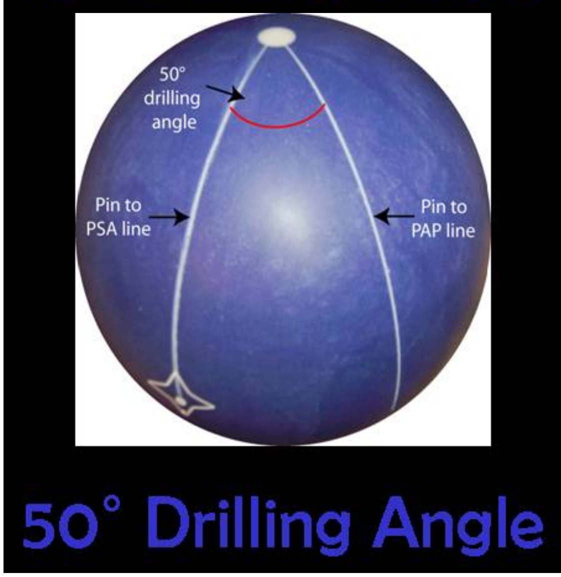

For a ball with a **symmetrical core**, the drilling angle measures the angle between a line drawn from the pin through the center of gravity (cg) and the line drawn from the pin through the PAP.

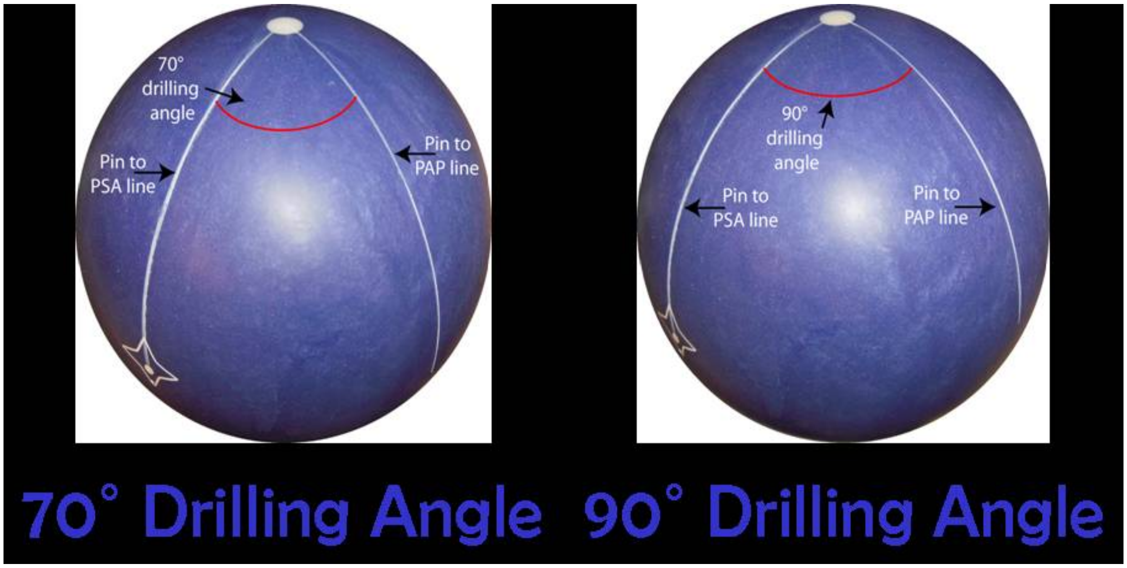
The pin on both types of balls is the **low RG axis** of the ball. The reason the drilling is different for both type of balls is that a ball with **symmetrical core** <u>does not</u> have a PSA before drilling. A ball with an **asymmetrical core** <u>does</u> have a PSA before drilling which allows the driller to draw the line from the pin to the actual PSA of the ball. The drilling angle has been used by some manufacturers to identify drilling techniques for some time now. Lou Marquez of Turbo 2-n-1™ Grips has identified a drilling technique using both the drilling angle and what he calls the "secondary" angle to the VAL.

By choosing the correct ball and then using the DUAL ANGLE LAYOUT TECHNIQUE™, the ball driller can provide the exact ball reaction desired for any bowler. The range of drilling angles to choose from is from **a minimum of 10°** and to **a maximum of 90°.**

- A **10° drilling** technique will roll the **soonest** of all the effective drilling angles.
- A **90° drilling** technique will roll the **latest** of all the effective drilling angles.




Pin and PSA distances to PAP for different Drilling Angles

| Mass Bias Position | Drilling Angle | Pin to Positive Axis Point Distance | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1" | 1½" | 2" | 2½" | 3" | 3½" | 4" | 4½" | 5 | 5½" | |
| 1 | 90° | 6¾" | 6¾" | 6¾" | 6¾" | 6¾" | 6¾" | 6¾" | 6¾" | 6¾" | 6¾" | PSA to PAP Distance |
| 2 | 70° | 6⅜" | 6¼" | 6⅛" | 6" | 5⅞" | 5¾" | 5⅝" | 5½" | 5⅜" | 5¼" | |
| 3 | 50° | 6⅛" | 5¾" | 5½" | 5¼" | 5" | 4¾" | 4½" | 4⅜" | 4¼" | 4" | |
| 4 | 30° | 5⅞" | 5⅜" | 5" | 4⅝" | 4⅛" | 3⅞" | 3½" | 3⅛" | 3" | 2¾" | |
| 5 | 10° | 5¾" | 5¼" | 4¾" | 4¼" | 3¾" | 3⅜" | 2⅞" | 2½" | 2" | 1½" | |

## *** The Pin to PAP Distance

The flare potential of an undrilled ball is dominated by the total differential of the designed ball (see those published numbers are actually used for something). If the core is so dominant, does the coverstock have any impact on the flare potential? Well yes, but only a small effect and it's based upon the friction it encounters as it travels down the lane. Oil and lane types do play a part in how much fiction can be encountered. So beware that one drilling may match well to one house/center and not well in another! This latter is especially important if you're drilling a ball for another facility. Hence, the pin to PAP distance is used to control the amount of flare of the drilled ball and determines what **percentage of the ball's flare potential** the drilled ball will have.

## 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

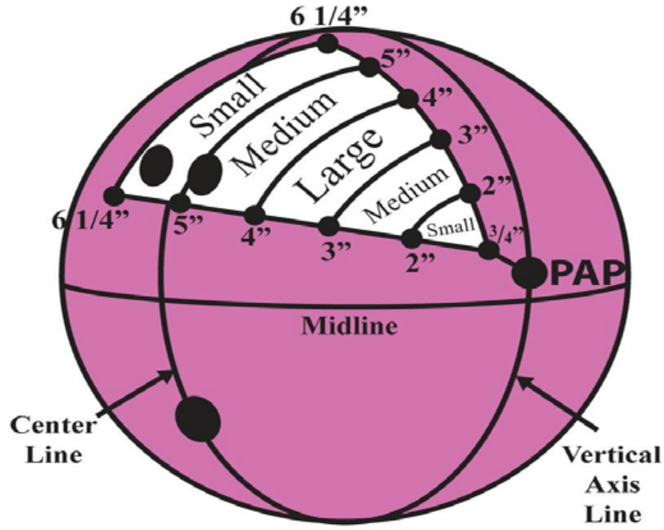
**2"** to **3"** from **PAP**
for earlier breakpoint

**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 cored balls

Track flare is determined by **PIN** to **PAP** distance.

**Large** Track Flare

**2 ¾"** to **6 ¼"** from **PAP**

Pin distances closer to 6 ¼" produce more FORWARD ROLL (less axis rotation)

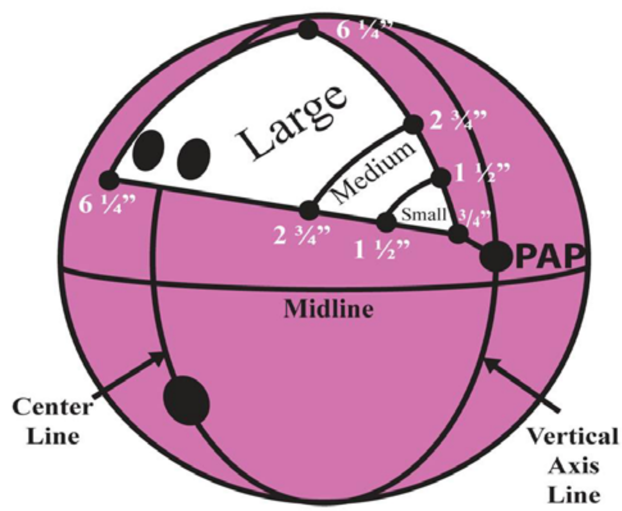
Pin distances closer to 2 ¾" produce more SIDE ROLL (more axis rotation)

**Medium** Track Flare

**1 ½"** to **2 ¾"** from **PAP**

**Small** Track Flare

**¾"** to **1 ½"** from **PAP**



## *** The Angle to the VAL

The angle between the Pin to PAP line and the VAL is referred to as "the angle to the VAL." This angle is as important as either of the first two components of the Dual Angle Layout Technique™. Changing the angle between the Pin to PAP line and the VAL has a very significant effect on how much the **RG** and the **total differential** of the drilled ball changes from the same specifications of the undrilled ball. The angle between the Pin to PAP line and the VAL is effective from **a minimum of 20°** and to **a maximum of approximately 70°.**

- Using the **minimum 20° angle** will result in the drilled ball **revving up the quickest** and **transitioning the fastest** at the breakpoint.
- Using the **maximum 70° angle** will result in the drilled ball **revving up the slowest** and **transitioning the slowest** at the breakpoint.

Using a smaller angle between the Pin to PAP line and the VAL **(minimum of 20°)** will lower the **RG** and increase the **total differential** of the drilled ball. These changes will result in the ball revving up faster and transitioning quicker. Using a larger angle between the Pin to PAP line and the VAL **(maximum of approximately 70°)** will raise the **RG** and lower the **total differential** of the drilled ball. These changes will result in the ball revving up slower and transitioning slower.

Strong Asymmetrical Ball

Drilling: 50°, Pin 5" from PAP, Different Angles to the VAL

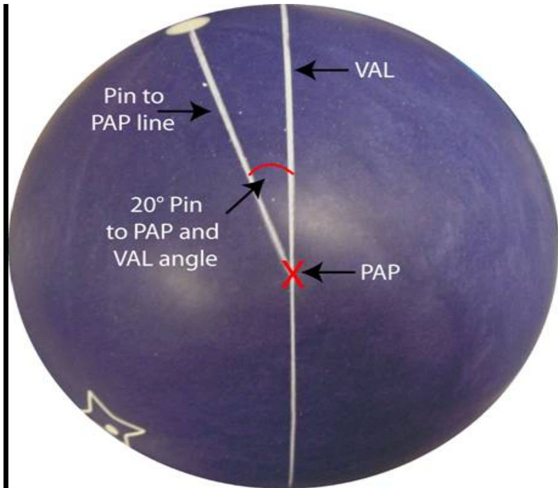
| Angle to VAL | Low RG Axis | Asym Diff | Total Diff |
|---|---|---|---|
| Undrilled | 2.488 | 0.030 | 0.048 |
| 20° | 2.493 | 0.038 | 0.051 |
| 45° | 2.498 | 0.035 | 0.041 |
| 70° | 2.500 | 0.033 | 0.039 |

Symmetrical Ball

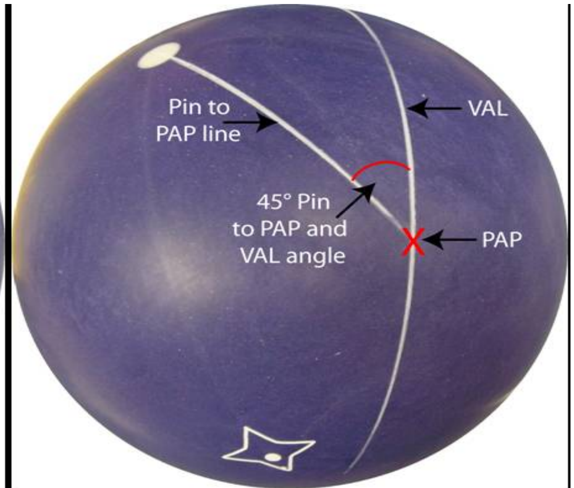
Drilling: 50°, Pin 5" from PAP, Different Angles to the VAL

| Angle to VAL | Low RG Axis | Asym Diff | Total Diff |
|---|---|---|---|
| Undrilled | 2.463 | 0.000 | 0.050 |
| 20° | 2.469 | 0.008 | 0.051 |
| 45° | 2.473 | 0.004 | 0.043 |
| 70° | 2.475 | 0.004 | 0.041 |

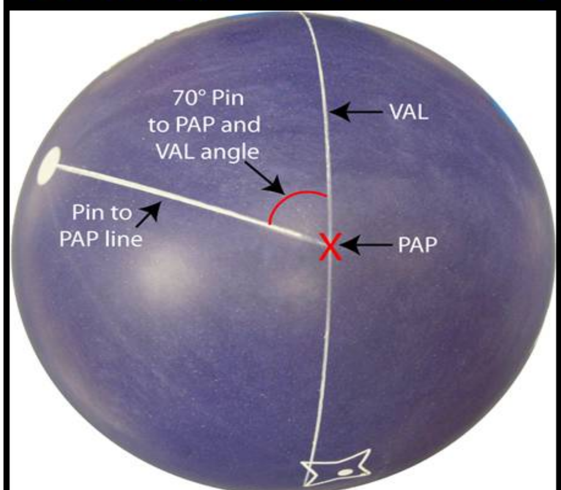
For most bowlers, the largest "safe" angle between the Pin to PAP line and the VAL should result in the pin ending up just below the finger holes. Very high track bowlers are the exception to that rule. For very high track bowlers, the maximum angle between the Pin to PAP line and the VAL should result in the pin ending up just above the fingers.




20°Angle to the VAL



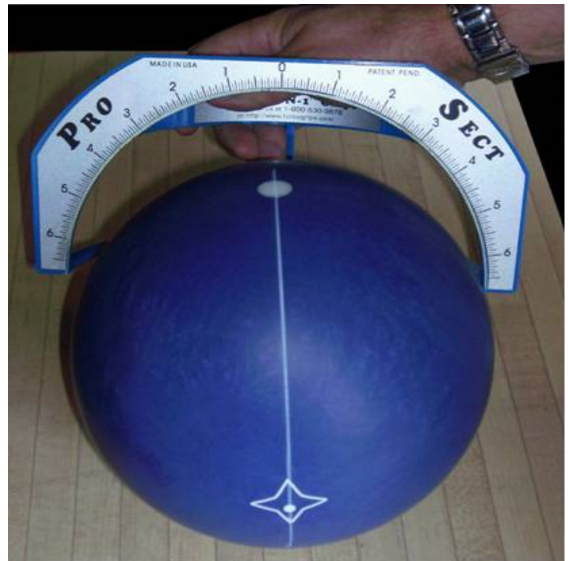

45°Angle to the VAL




70°Angle to the VAL

## ***The Method for a DUAL ANGLE Layout

Making sense yet? Well maybe the upcoming pictures will help. For starters, you will need a Pro Sect® from Turbo 2-n-1™ Grips. 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. Attempting to use this technique without using the proper equipment will result in disastrous results!





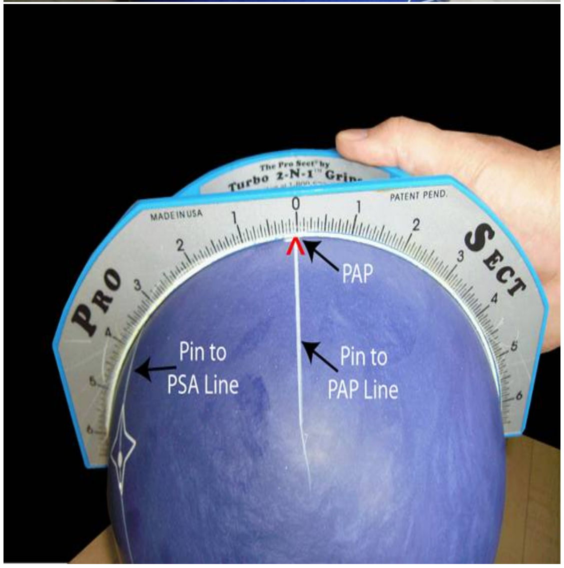
The first step in starting a DUAL ANGLE layout is to draw a line through the pin and the PSA for a ball with an asymmetrical core. For a ball with a symmetrical core, draw a line through the pin and the cg. This line will provide the base line for measuring the drilling angle.

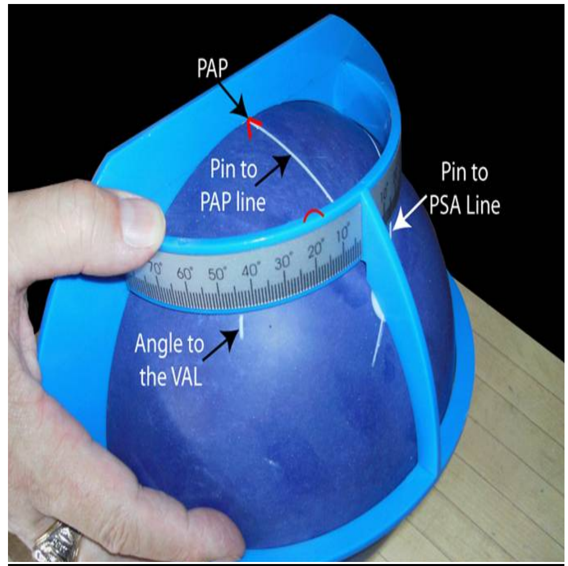

Next, measure and mark the chosen drilling angle by placing the zero point of the Pro Sect® on the pin with the rib on the base line and using the protractor to measure and mark the desired drilling angle.

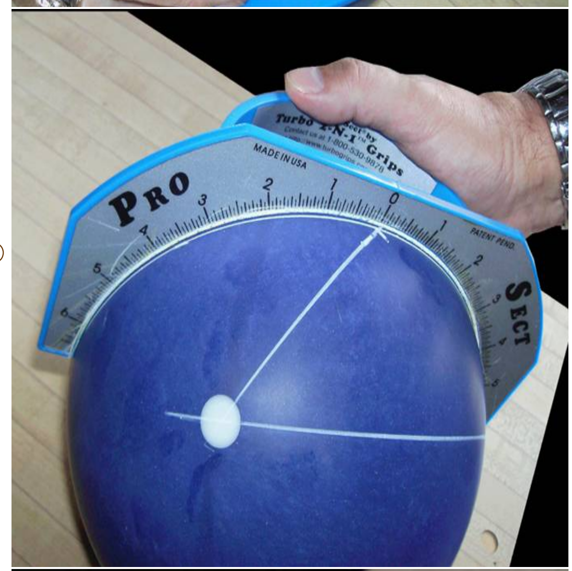
Now draw the Pin to PAP line by using the scale of the Pro Sect® to draw a line from the pin through the marked drilling angle. This completes the marking of the drilling angle on the ball to be drilled.


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®.

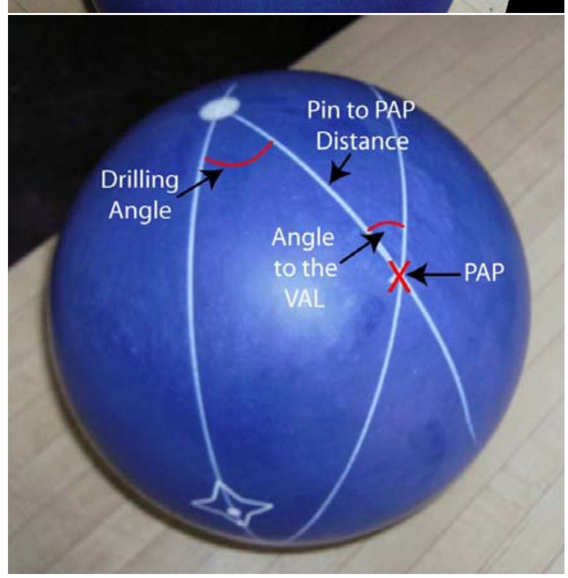

Next, measure and mark the angle between the Pin to PAP line and the VAL by placing the zero point on the scale of the Pro Sect® on the PAP and the rib on the Pin to PAP line. Now measure and mark the angle to the VAL using the protractor.





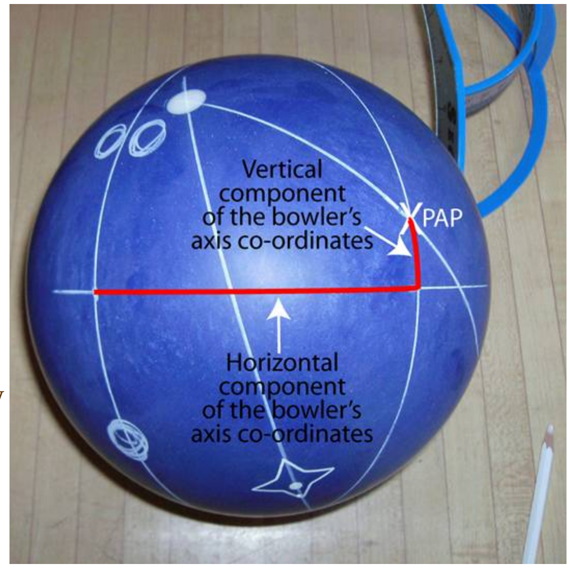




Now draw the VAL using the scale of the Pro Sect® to complete the third and final component of the DUAL ANGLE LAYOUT TECHNIQUE™.




All three components of the DUAL ANGLE LAYOUT TECHNIQUE™ have been marked.

As with all accurate drilling techniques, measure back to the center of the grip using the vertical and horizontal components of the bowler's axis coordinates 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.




Wow, don't pictures help? In summary, the DUAL ANGLE LAYOUT TECHNIQUE™ is composed of three parts: the drilling angle, the Pin to PAP distance *and* the angle to the VAL. Ultimately, the success of this system depends on the ability of the ball driller to make accurate choices for all three!

## ***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. 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 angle to the VAL. Adding the drilling angle and the angle to the VAL together will allow the ball driller to choose how quickly the ball will transition from skid to hook to roll.

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. 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. Yet the drilling angle must still be kept between **10°**and **90°** and the angle to the VAL between **20°** and approximately **70°** (depending on the bowler's track).

Smaller angle sums should always be used for:

- Speed dominant players
- Higher axis tilt players
- Longer oil patterns
- Higher volumes of oil on the lane

Larger angle sums should always be used for:

- Rev dominant players
- Lower axis tilt players
- Shorter oil patterns
- Lower volumes of oil on the lane

Medium angle sums should always be used for players whose ball speed and rev rate match.

*Keep this in mind -- the sum of the drilling angle and the angle to the VAL 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. And the shape of the breakpoint can be controlled by changing the relationship between the drilling angle and the angle to the VAL.*

- Larger drilling angles in relation to the angle to the VAL will create later, sharper breakpoints (more backend).
- Smaller drilling angles in relation to the angle to the VAL will create a sooner, heavier roll (more midlane).

## ***Conclusion

Using the DUAL ANGLE LAYOUT TECHNIQUE™ developed by MoRich, allows the ball driller to design precise ball reactions by choosing the drilling angle, the pin to PAP distance *and* the angle between the Pin to PAP line and the VAL. By knowing the dynamic potential of the undrilled ball and the ball reaction desired for the bowler, the ball driller can create the exact ball motion for every bowler by using the DUAL ANGLE LAYOUT TECHNIQUE™. Once the ball is drilled, it is easy to make surface adjustments to adjust the ball reaction for different lane conditions, oil patterns, and lane surfaces.

**Bear in mind, the degree to which DUAL ANGLE layouts will be successful depends on the ability of the ball driller to make good decisions for *all* three components of the system.**