

Applying Dual Angle System / Sweet Spot

Angle Sum Variance: +/- 30° for elite bowlers +/- 20° for good bowlers +/- 10° for average bowlers

1) Determine the Sum of angles by analyzing bowler's ball speed & rev rate.

Revs Dominant use higher angle sums – up to 130°

Speed Dominant use smaller angle sums – down to 60°

Speed = Revs use medium angle sums – around 100°

2) Drilling Angle / Sum Adjustments

Lower drilling **angle** for higher Axis Rotation on normal oil conditions

Raise drilling **angle** for lower Axis Rotation on normal oil conditions

Lower drilling **sum** slightly for higher Axis Tilt

Raise drilling **sum** slightly for higher Axis Rotation

3) Determine the angle ratio by analyzing the bowler's axis rotation and tilt.

Axis tilt over 17° use lower ratios (1:2 - 1:3) & longer Pin to PAP (over 4")

Axis rotation over 75° use lower ratios (1:2 - 1:3) & larger angle sums

Axis tilt under 16° use larger ratios (2:1 - 3:1) & shorter Pin to PAP (under 4")

Axis rotation under 45° use higher ratios (2:1 - 3:1) & smaller angle sums

4) Adjust the angles for the pattern the bowler wants to use the ball on.

Dry or short patterns use higher ratio

Wet or long patterns use lower ratio

The **more aggressive** the cover the **larger the sum** of the angles

The **less aggressive** the cover the **smaller the sum** of the angles

To increase skid / reduce flare: Use shorter Pin to PAP on asymmetrical balls

Use longer Pin to PAP on symmetrical balls

These choices help retain axis rotation and tilt longer

Symmetrical balls lose tilt faster than asymmetrical balls

If the ball design creates a later, sharp break point, **use lower ratio** (lower drilling angle to VAL).

If the ball design creates a sooner, forward rolling ball, **use more ratio** (higher drilling angle to VAL)

High tilt players use Pin to PAP distances of 4 1/2" to 5 3/4" (with Asymmetrical balls)

4 1/2" Pin to PAP distance will make the ball come off the spot hard (more angular)

5 3/4" Pin to PAP distance will make the ball roll forward sooner

ASYMMETRICAL Balls exhibit most flare at Pin to PAP distances of 2 3/4" to 6 1/4"

SYMMETRICAL Balls exhibit most flare with Pin to PAP distances of 3 to 4"

Retaining Axis Rotation & Axis Tilt

To retain Axis Rotation and Axis Tilt in SYMMETRICAL equipment, we would tend towards longer pin-pap (> 4") distances, while ASYMMETRICAL equipment we use shorter pin-pap distances (< 3"). We would also chose higher angle ratios (2:1 - 3:1) to promote a longer first transition to make the most of what Axis Rotation and Axis Tilt is available at release.

To burn off Axis Rotation and Axis Tilt quicker in SYMMETRICAL equipment, we would tend toward Max flare pin positions (3" - 4"), while longer pin distances (4"+) in ASYMMETRICAL equipment. We would also chose lower angle rations (1:1 - 1:2) to get the ball to reach the first transition sooner, while trying to eliminate jumpy back end reaction that tends to accompany high Axis Rotation and Axis Tilt.

Drilling Angle

Smaller drilling angles are used to shorten the length of the 1st transition (skid to hook) because the PAP is closer to the Pin to Spin Line.

Larger drilling angles increase the length of the 1st transition because the PAP is farther away from the Pin to Spin Line.

Angle Sum:

Angle sum is the sum of the drilling and VAL angles. The main components that will affect this are ball speed and rev rate. An example of a well matched bowler would be 18mph speed and 300rpm (off the hand). For each 1mph increase or decrease in speed, a corresponding increase or decrease of about 50rpm would stay matched. Bowlers whose ball speed and rev rate are well matched will match up best with angle sums of $100^{\circ} \pm 30^{\circ}$. In general, the $\pm 30^{\circ}$ will stay the same, and the 100° will shift. For bowlers that are speed dominant, you would want to lower the center of the range, to a minimum of $60^{\circ} \pm 30^{\circ}$. For bowlers who are rev dominant, you would want to raise the center of the range, up to a maximum of $130^{\circ} \pm 30^{\circ}$. High axis tilt would lower the center of the range, while high axis rotation would raise the center of the range.

Pin-PAP Distance

Note that the following ranges refer to asymmetrical cores, which have different properties at longer pin-PAP distances than do symmetrical cores. Bowlers with medium tilt will match up best with pin-PAP distances in the 4-5" range. Bowlers with higher tilt would want to use slightly longer distances, while bowlers with lower tilt would want to use shorter pin-PAP distances.

Angle Ratio

Angle ratio is the ratio of drilling angle to VAL angle. Acceptable ratios range from 1:3 to 3:1. The range used by a bowler is dependent on axis tilt and axis rotation. The more axis tilt and/or axis rotation a bowler has, the lower the angle ratios the bowler should use. A bowler with 30° degrees of axis rotation and 15° of axis tilt would do best between 1:1 and 2:1. A bowler with 75° axis rotation and $< 10^{\circ}$ axis tilt, would do best between 1:3 and 1:1.

AFTER DRILLING – With a symmetrical ball use Pin to center of thumbhole for measuring layout! The Mass Bias is near the thumbhole when no balance hole is present and moves towards balance hole when present.

Bowler Example 1 – Speed Equals Revs, Average Tilt & Rotation

Speed: 17-18

Rev Rate: ~350

Axis Tilt: ~15°

Axis Rotation: 50° - 70°

Sweet Spot Estimate: 100°

Range Of Angles: 80° to 120°

Ratios: 1:1 – 3:1

For Asymmetrical balls

Long and strong: 90° x 3" x 30° with a P3 hole

Completely strong: "Double Thumb"

Strong midlane: 45° x 4" x 25° with a P4 hole

Control: 70° x 4 1/2" x 50° with a P1 or P2 hole, if necessary

Mania for Nationals: 55° x 3 1/4" x 35° with a P3 hole

Bowler Example 2 – Rev Dominant, Low Speed

Right Handed

Speed - 15-16 MPH (at release)

Revs - 325 (290 min and 355 max)

Axis Tilt - 13° (can vary from 7° to 15°)

Axis Rotation - 45° (approx)

Sweet Spot Estimate: 130°

Range Of Angles: 100° to 150°

Ratios: 1:1 – 2:1

For Asymmetrical balls:

Long and Strong - 90° x 3" x 25°

Heavy Oil - 50° x 3 1/4" x 45°

Very Dry - 90° x 1 3/4" x 55° with a P1 hole

Control - 90° x 2 1/4" x 65°

For Symmetrical balls:

Long and Strong - 90° x 3 1/4" x 25°

Heavy Oil - 50° x 3 1/4" x 45°

Very Dry - 90° x 5 1/2" x 55° with a P1 hole

Control - 90° x 5" x 65°

Bowler Example 3 – Speed Dominant, Higher Axis Tilt

Speed: ~18.3 to 18.8 mph off hand
Rev Rate: 285 to 300 rpm
Axis Rotation: ~60°
Axis Tilt: 20°

Sweet Spot Estimate: 80°
Range Of Angles: 60° to 100°
Ratios: 1:1 – 1:2

For Asymmetrical balls:

FRENZY: 45° x 4 1/2" x 50° with a P2 hole
Craze: 40° x 4 1/4" x 40° with a P3 hole
Mania: 25° x 4" x 25° with a P3.5 hole

The key number is 20° of axis tilt. If there's oil at the back of the pattern, or carry down, the ball has a tendency to "skip out" on him, plus with the speed domination to go with the tilt, we have to guard against a "wet/dry" reaction. Basically, the combination of speed dominant and excess tilt needs the ball to start transitioning earlier and smoother.

Bowler Example 4 – Speed Dominant, Low Revs, High Axis Tilt

Speed: 17 (off hand)
Rev Rate: 220
Axis Tilt: 30°
Axis Rotation: 45°
Speed Dominant

Sweet Spot: 60°
Range of Angles 50° - 80°
Ratio: 1:2 – 1:3

Symmetrical: 10° x 3" x 35° with a P4 hole. Use a low top ball with the pin out 4+".
Asymmetrical: 20° x 5" x 40° with a P4 hole. Use a low top ball with the pin out 4++"

Bowler Example 5: Low Axis Rotation, Low Axis Tilt, Low Revs

Speed: 15 mph off hand
Rev Rate: 200
Initial Axis Rotation: 7°
Initial Axis Tilt: 10°
Synthetic Lanes on THS
Speed = Revs but with low revs

Sweet Spot: 110°
Range of Angles: 90° - 130°
Ratio: 2:1 - 3:1

Benchmark: 85° x 3¼" x 25° (symmetrical & asymmetrical)

This layout is for a low Axis Rotation, low Axis Tilt, low Speed, low Rev bowler and will get max flare with the 3¼" Pin and a chance to preserve the Axis Rotation / Axis Tilt with the dual angle layout.

If I have a low Axis Rotation, low Axis Tilt, High Speed, High Rev bowler I could use a similar Drill Angle & Vertical Angle, but adjust the PIN towards 1 3/4 for Asymmetrical balls and towards 5 for Symmetrical balls to actually control/reduce the flare, but still help preserve the Axis Rotation and Axis Tilt.

Bowler Example 6: Slightly Rev Dominant

Speed: 16mph off hand
Rev rate: 250 - 300 rpm (best guess by comparison)
Rotation: 40° - 50° (best guess)
Tilt: 17°
Surface: deteriorating Guardian for 1st 30 feet, pine in rear 30 feet.
Oil: Medium-heavy oil (my best guess) to begin, transitioning to medium-light rapidly
Slightly Rev Dominant

Sweet Spot is 105°
Range of Angles: 85° - 125°
Ratio: 2:1 - 1:1

Benchmark: 60° x 4" x 45° (symmetrical & asymmetrical)

For Bad Guardian: 90° x 5" x 35° (symmetrical)
90° x 2½" x 35° (asymmetrical)
Use the balance hole and the surface to tweak the reaction

Bowler Example 7: Speed Equals Revs, Very Low Axis Tilt

Ball Speed: 18.5 mph (in the heads)

Rev Rate: 450 rpm

PAP: 4 7/8 over 1/2 up

Axis Rotation: 45 deg

Axis Tilt: 3 deg

Sweet Spot: 110°

Range of Angles: 90° - 130°

Ratio: 1:1 – 3:1

Asymmetrical: 75° x 3" x 40° with a P2 hole (on medium ball for medium oil)

60° x 3¼" x 30° with a P3 hole (on strong ball for heavy oil)

Bowler Example 8: Low Speed, High Revs, High Axis Rotation

Speed: 12 – 13 (max) at end of lane

Rev Rate: 300 - 350

Initial Axis Rotation: 70° - 90°

Initial Axis Tilt: 13°

Bowl mostly on drier THS, and Kegel # 6, synthetic lanes

Totally rev dominant

Sweet Spot: 130°

Range of Angles: 100° - 160°

Ratio: 2:1 – 1:2

Asymmetrical 80° x 5" x 60°

Symmetrical 90° x 2 ¼" x 50°

Slightly different angles are used because symmetrical cored balls lose axis tilt faster than asymmetrical cored balls. The bowlers' axis tilt is medium but ball speed is very low, so we need to retain axis tilt for as long as possible.

Bowler Example 9: Rev Dominant

Speed: 17.5 off hand
Rev Rate 500
Initial Axis Rotation: 55°
Initial Axis Tilt: 15°
Synthetic HPL Heads, Murray last 40
Dry THS and Dry versions of PBA patterns
Rev Dominate

Sweet Spot: 120°
Range of Angles: 90° - 150°
Ratio: 1.5:1 – 2:1

Benchmark Layout

Symmetrical: 80° x 4.5" x 45°
Asymmetrical: 75° x 2.5" x 45°

Bowler Example 10: Slightly Rev Dominant, Lower Axis Tilt

Ball Speed: 17mph (off my hand)
Rev Rate: 360
Initial Axis Rotation: 45° - 60°
Initial Axis Tilt: 10°

Sweet Spot: 110°
Range of Angles: 90° - 120°
Ratio: 1:1 – 3:1

Asymmetrical: 75° x 3½" x 25° with a P3 hole (strong ball on heavy oil)
Symmetrical: 80° x 4½" x 25° with a P3 hole

Benchmark Layouts for walled-up THS

Bowler A: Tons of hand, not enough lane
Bowler B: Normal revs, balanced with speed, likes playing 2 arrow
Bowler C: Weak wrist, rev challenged, break point at 7-8 board

Bowler A: Angle Sum - 145° to 160°
Bowler B: Angle Sum - 115° to 130°
Bowler C: Angle Sum - 85° to 100°

Bowler A: Pin to PAP - Asymmetrical = 1½" Symmetrical = 5¼"
Bowler B: Pin to PAP - Asymmetrical = 2" Symmetrical = 4¾"
Bowler C: Pin to PAP - Asymmetrical = 2½" Symmetrical = 4¼"