EQUIPMENT SPECIFICATIONS

Ball Motion Analysis Form

Prologue

In the fall of 2005, the USBC's Equipment Specifications and Certifications team met with the bowling ball manufacturers to form the Ball Task Force. In a joint effort to better understand ball motion and its most influential variables, this task force worked together for two and a half years to complete the USBC Ball Motion Study phases I and II.

The study utilized Harry, USBC's robotic ball thrower, and Super C.A.T.S., the 23-sensor system that measures position, velocity and angles of a bowling ball's path as it travels down the lane. This testing equipment provided the data for multiple regression analysis that lead to a comprehensive understanding of ball motion. Upon completion of the testing several debates within the industry were settled when the results were published in early 2008.

In an effort to bring the USBC Ball Motion Study to bowlers, coaches and pro shops around the world, USBC in conjunction with Mo Pinel, IBPSIA Advanced HOTS instructor and CEO of MoRich, has developed this Ball Motion Analysis Form. Equipment for testing, development and validation of the Ball Motion Analysis form was supplied by Storm Products, Inc. and MoRich Enterprises.

The Ball Motion Analysis Form affords everyone the ability to better understand a ball's dynamic properties based on factors that can be relatively easily measured in a regular bowling center and pro shop environment. The graphical analysis and methods developed in the USBC Ball Motion Study were used to validate this form, so use it with confidence!

Ball Motion Analysis Form Instructions

There should be **ONE** Ball Motion Analysis Form per ball; each ball needs a separate testing form.

Instructional videos are available on the Equipment Specifications page of BOWL.com under Forms, Manuals and Bulletins for reference and instruction on how to obtain certain measurements.

Basic Information

1. Write the Bowler's name and the date of data collection on the top of the form in the blanks provided.
2. Record the bowling center, lane surface type and oil.
3. Record the following information about the bowling ball:
    a. Ball brand
    b. Ball model
    c. Serial number of the ball
    d. Ball Surface – the surface grit or surface preparation the ball has gone through and is at, at the time of data collection.

Drilling Information

1. Record the bowler's PAP (Positive Axis Point) that was used for layout purposes when the ball was drilled.
2. In the Given Layout blank, record the layout used when the ball was drilled.
3. Record the following information about the balance hole if applicable:
    a. Balance Hole Location – can be indicated by a horizontal and vertical measurement from the bowler's center of grip to the center of the balance hole or by the MoRich Gradient Line technique.
    b. Balance Hole Diameter – measure and record on the blank provided
    c. Balance Hole Depth – measure and record on the blank provided
4. Locate the PSA (Preferred Spin Axis) of the ball – reference the "Finding the PSA" video.
5. Locate the X-axis and Z-axis of the ball – also in the "Finding the PSA" video.
6. Use the PSA, X-axis and Z-axis along with the MoRich DeTerminator to measure the 60 Degree Spin Time of the ball. Take this measurement three times and record each on the Spin Time blanks – reference the "60 Degree Spin Time" video.
7. Calculate the average of the three individual Spin Time measurements record the average on the Average blank under Spin Time.
8. Use the found PSA and the Given PAP to determine the Actual Layout of the ball and record on the Actual Layout blank – reference the "Dual Angle Layout" video for an example of determining the Actual Layout using the Dual Angle Layout technique (alternative layout

methods may be used as long as the method chosen is consistent throughout the Ball Motion Analysis Form).

Ball Path Information

1. Have the bowler warm up and find a line to the pocket with the ball to be analyzed.
2. Throw a shot for data collection and watch where the ball is on the lane at the laydown point, the arrows and the breakpoint.
3. Record the location of the ball at the Laydown point – the board at which the ball is at when it first touches the lane
4. Record the location of the ball at the Arrows – the board at which the ball is at when it crosses the arrows
5. Record the location of the ball at the Breakpoint – the board the ball is at when it gets the furthest right point of the ball path for right handed bowlers (the furthest left point of the ball path for left handed bowlers).

Axis Migration Information

1. For the shot that ball path information was recorded, collect the ball from the ball return.
2. Quickly, trace the entire first oil ring of the track flare.
3. Trace the last oil ring of the track flare.
4. Trace the last dry flare ring.
5. Measure the largest arc length from one side of the first oil ring of the track flare to the other. Use the *Track Arc Length to Axis Tilt Conversion Table* to convert the distance measured to Axis Tilt in degrees – reference the "Axis Tilt" video. Record this measurement on the Axis Tilt blank.
6. Align the Armadillo with the first oil ring of the track flare and mark the indicated PAP at Release with a grease pencil. Measure horizontally, then vertically from the center of grip to locate the PAP at Release. Record both the horizontal and vertical measurements on the blank provided for PAP at Release – reference the "Finding PAPs" video.
7. Align the Armadillo with the last oil ring of the track flare and mark the indicated PAP at Breakpoint with a grease pencil. Measure horizontally, then vertically from the center of grip to locate the PAP at Breakpoint. Record both the horizontal and vertical measurements on the blank provided for PAP at Breakpoint.
8. Align the Armadillo with the last dry flare ring and mark the indicated PAP at Pins with a grease pencil. Measure horizontally, then vertically from the center of grip to locate the PAP at Pins. Record both the horizontal and vertical measurements on the blank provided for PAP at Pins.
9. Measure the distance from the PAP at Release to the PAP at Breakpoint and record that as the Axis Migration in Oil.
10. Measure the distance from the PAP at Breakpoint to the PAP at Pins and record that as the Axis Migration in Dry.
11. Sum the Axis Migration in Oil and Axis Migration in Dry and record that as Total Axis Migration.

12. Using the PSA located in the Drilling Information section, find the location of the true pin of the ball by measuring a distance 6 ¾ inches from the PSA through the manufacturer's pin of the ball.
13. Measure the distance from the PAP at Release to the true pin of the ball, found in the previous step, and record as the Distance from PAP at Release to True Pin.
14. Measure the distance from the PAP at Breakpoint to the True Pin of the ball and record as the Distance from PAP at Breakpoint to True Pin.
15. Measure the distance from PAP at Pins to the true pin of the ball and record as the Distance from PAP at Pins to True Pin.
16. Take a digital photo of the axis migration path to complete the documentation. It is helpful to have all the measurements taken written on the ball in grease pencil before taking the photo.

Track Arc Length to Axis Tilt Conversion Table

Maximum arc length across the first track flare ring in oil (inches)	Axis Tilt (degrees)
13.5	0
13	3
12.5	7
12	10
11.5	13
11	17
10.5	20
10	24
9.5	27
9	30
8.5	33
8	37
7.5	40
7	44
6.5	47