A Future FOR THE Sport

HISTORICAL HARDNESS/ FOOTPRINT RESEARCH REPORT

DECEMBER 2023

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PURPOSE

To investigate the correlation between the manufactured hardness of a bowling ball and its footprint. Conventional wisdom has been that footprint, and therefore performance, changed at a different rate if a bowling ball's hardness was below 72D.

SUMMARY

USBC published a new standard operating procedure (SOP) to repeatably measure the footprint diameter of a bowling ball in fall of 2023. Data from that report showed:

- A bowling ball's production hardness and footprint size are strongly correlated to one another.
- Balls that measure softer through use do not exhibit a strong correlation to change in footprint.

Following publication, USBC was contacted by a ball manufacturer and asked if the linear correlation between hardness and footprint was still true for balls below 72D.

The manufacturer noted there was discussion in the market that it was an "accepted fact" that historical testing commissioned by ABC in the 1970s showed a demarcation at 72D at which point the footprint of a bowling ball grows exponentially. This individual suggested that information might exist in USBC's historical archives on this topic.

After dedicating several staff members to search through paper archives for hours, USBC located the paper file from 1976 on this topic.

The report titled "Surface Hardness of Bowling Balls" was prepared for the American Bowling Congress by Dr. W. Wayne Siesennop. In his report, Dr. Siesennop indeed recommends setting the lower limit for bowling ball hardness between 72-75D.

However, his data does not indicate a demarcation at 72D at which the footprint grows exponentially. Dr. Siesennop's data shows the linear correlation between hardness and footprint continues in the same linear fashion from 72-60D.

In short, the "accepted fact" that 72D should be the lower limit for bowling hardness due to demarcation or exponential footprint change is not supported by the data reviewed by USBC.

HISTORY

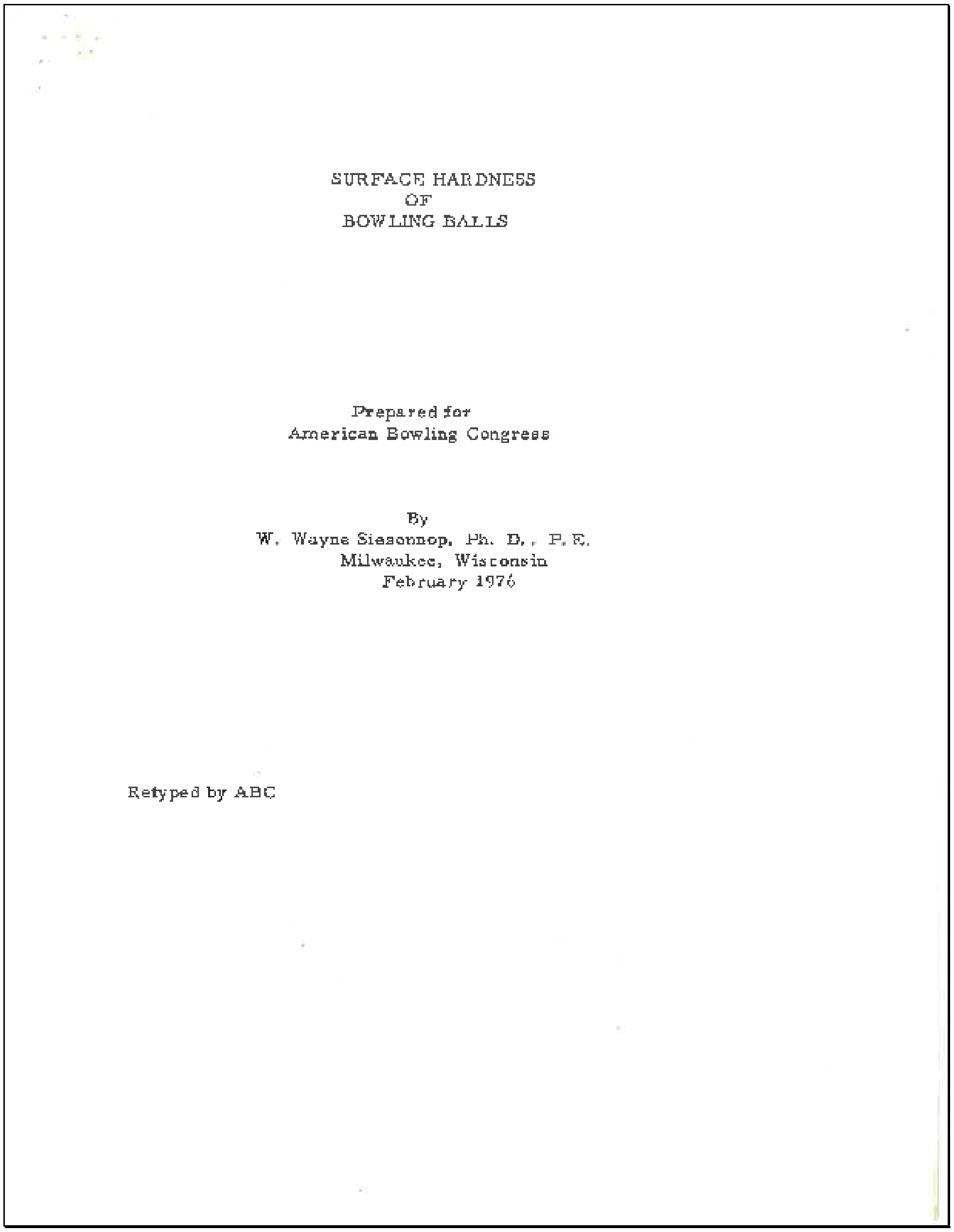
Following an extensive search of physical documents from the 1970s, USBC staff found documentation that was kept in support of a legal case in 1976. ABC had just announced the implementation of its new hardness specification at the 1976 annual convention.

The specification at that time was the surface hardness of bowling balls shall not be less than 72 durometer D.

The reaction to the specification caused a lawsuit by bowlers and proshop operators that stated that more time should have been allowed for the products that had already been made softer than 72 D purchased by bowlers and proshops to continue their typical life cycle. The plaintiffs asked that the specification be implemented 2 or 3 years down the road.

In the end, the case was dismissed and the court ruled ABC was simply doing its duty to govern the sport of bowling and there was no malintent towards bowlers nor proshops.

Along with the documents supporting the case file, a report titled "Surface Hardness of Bowling Balls" prepared for American Bowling Congress by W. Wayne Siesennop, Ph.D was located.



SURFACE HARDNESS
OF
BOWLING BALLS

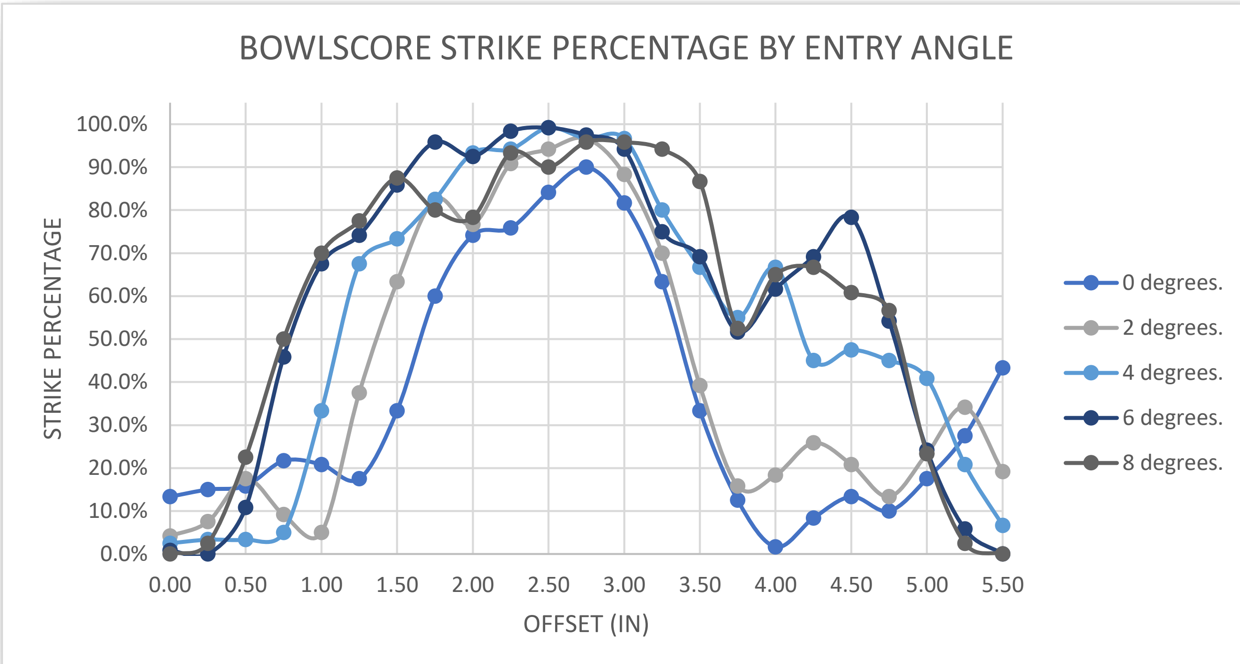
Prepared for
American Bowling Congress

By
W. Wayne Siesennop, Ph. D., P. E.
Milwaukee, Wisconsin
February 1976

Retyped by ABC

DATA ANALYSIS

Dr. Siesennop explains that the investigation of ball hardness was rooted in bowling balls increased ability to strike as they have large hook angles into the pocket. It was theorized that bowling balls entering the pocket at larger "hook angles," or what we now call entry angle, would have wider strike pockets and therefore strike more. Data from our Bowlscore testing clearly shows that this theory was correct. Larger entry angle increases the chance for striking.



This chart comes from our free-fall pin control set in Bowlscore, breaking the data up by the angle that the ramp is delivering the balls into the pocket. Here we can see strike percentages are the lowest with 0 degrees of entry and as the angle increases the odds of striking increase on both the high and light ends of the pocket. This concept was key for their explanation of why a "soaker ball" or a softer ball would score higher because the softer balls would make more contact with the lane, which would increase the frictional force, and ultimately increase the angle into the pins, raising the strike percentage.

The report explains how data was collected on more than 80 balls for durometer hardness by taking a three-measurement average around the surface of the ball. The balls were then also tested for track width (essentially footprint diameter) by rolling the balls across carbon paper supported by glass. The track widths were also measured in three locations under a microscope and the average width was reported. Unfortunately, the data points themselves were not included within the report. However, the author did achieve a relationship between ball hardness and track width that he includes within the report. Figure 4 from the report shows that as hardness decreases, footprint increases. Bowling balls with surface hardness under 78 D show a linear relationship with track width. Once balls have a surface hardness greater than 78 D the trend flattens out and there is little difference in track width. If we apply some measurements to his trendline, we can estimate the slope of the linear trend.

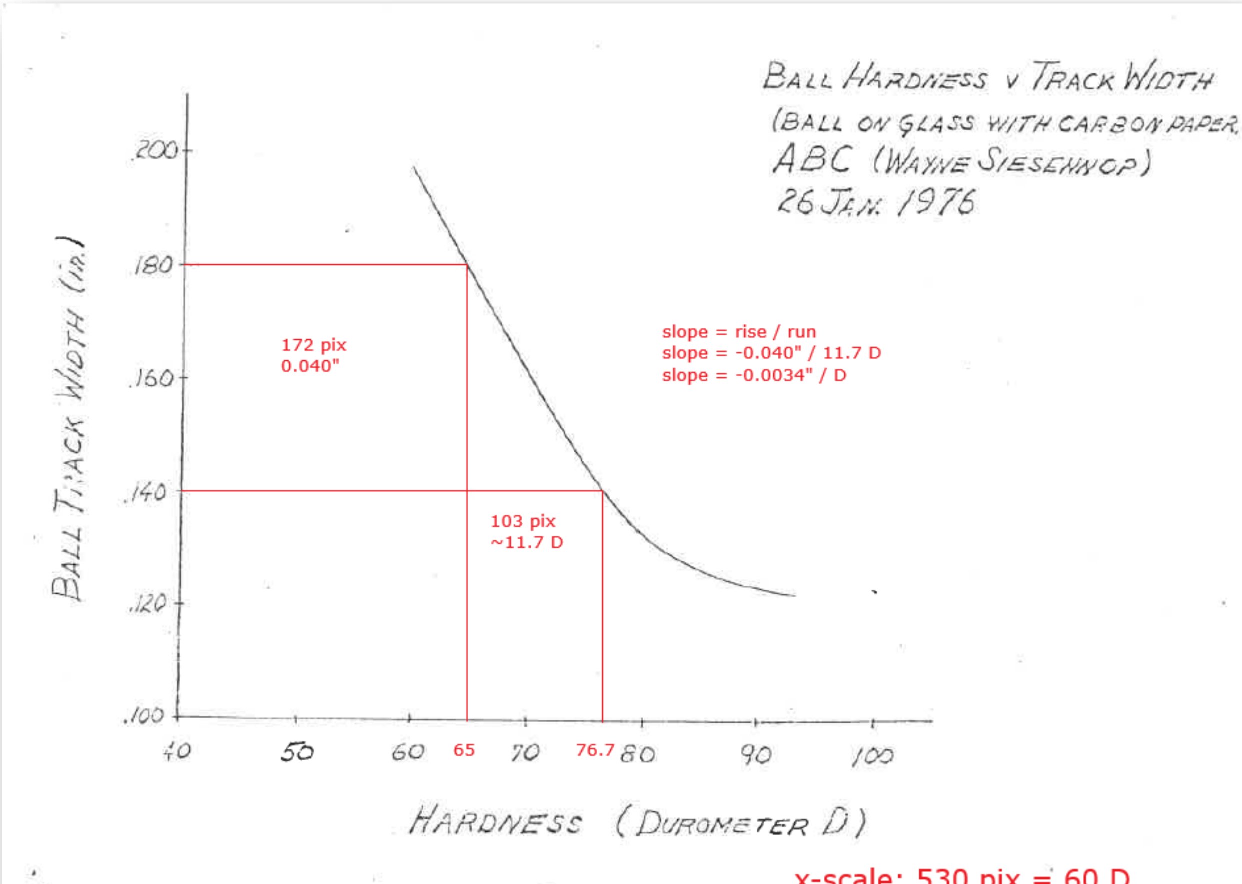
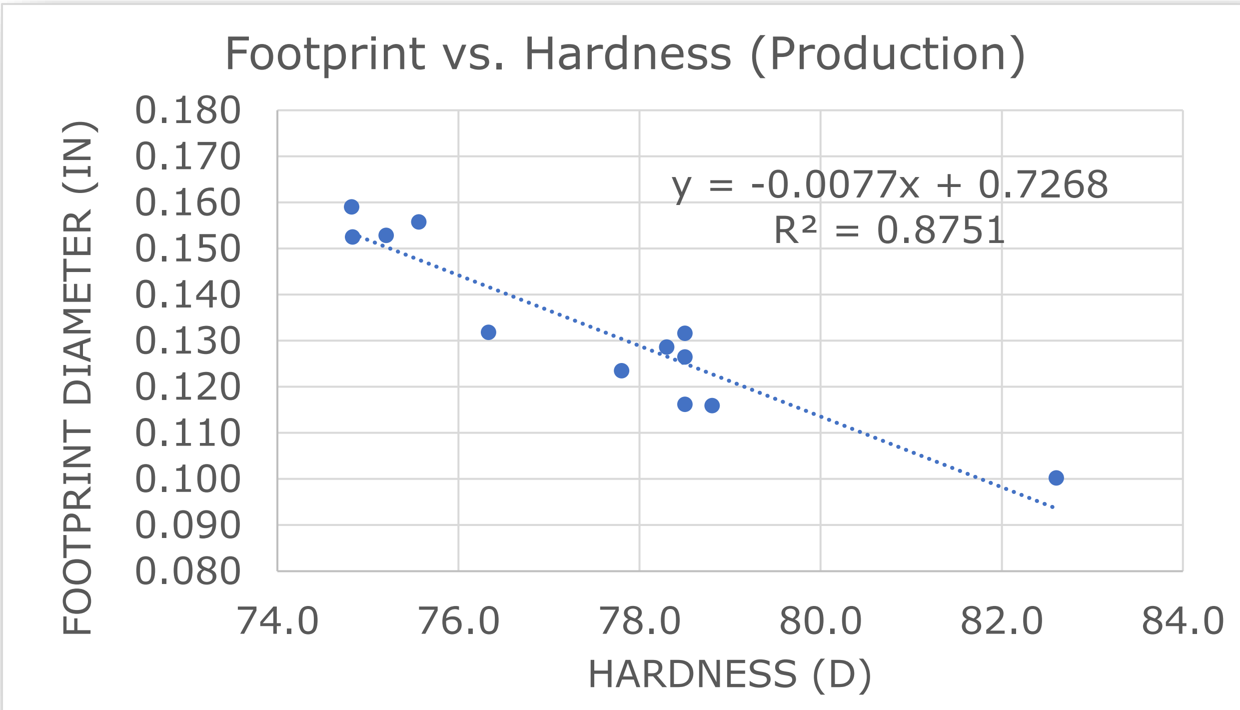


FIGURE 4

Taking an image of this figure allows us to measure the trend in terms of pixels. By measuring the x-axis we found the distance between the 40 D and 100 D tick marks was approximately 530 pixels. Likewise, the distance between the 0.100″ and 0.200″ tick marks on the y-axis was 430 pixels. We can then draw horizontal lines from the y-axis at 0.140″ and 0.180″ until they reach the trendline. Dropping vertical lines from those intersection points to the x-axis allows us to estimate the ball hardness at each point. The results show that a drop of 0.040″ in track width size occurs with a 11.7 D hardness change. Or for every point of hardness increased, there is a corresponding loss of 0.0034″ from the track width.

In our recent footprint research regarding urethane balls, we observed a 0.0077″ decrease in the footprint diameter for each point of hardness increased. In 1976 the research was on rubber and polyester equipment which appears to relate footprint size and surface hardness differently than urethane equipment.



Whatever the case may be, the trend in track width versus surface hardness was presented as a linear trend on the domain of 78 D and less. There is no evidence that anything special happens at a threshold of 72 D.

CONCLUSION

The findings of this research help bring clarity to what happened in the past. The idea that the contact area begins increasing at a larger rate at a hardness of 72 D is not true. Based on the figure provided, the true point where the trend changes shape is in the upper 70s or lower 80s on the D scale.

When setting specifications for bowling balls many factors are inevitably weighed including not only the data and understanding of what the specifications mean, but also impact to all the relevant stakeholders: bowlers, proshops and manufacturers. In choosing a hardness specification of 72 D, ABC was choosing to limit the maximum track width from the trend at approximately 0.157”. They set a specification that would control track widths on the equipment of their time to a range of 0.037” – from the minimum in Figure 4 of approximately 0.120” up to 0.157”. They could have chosen any number. Larger numbers would have taken a stronger stance on regulating the performance of equipment at the expense of harsher impact on the industry. Lower numbers would have impacted the industry less at the expense of less control on the equipment. They chose 72 D potentially to balance these concerns at the time, not because it is a magic number.