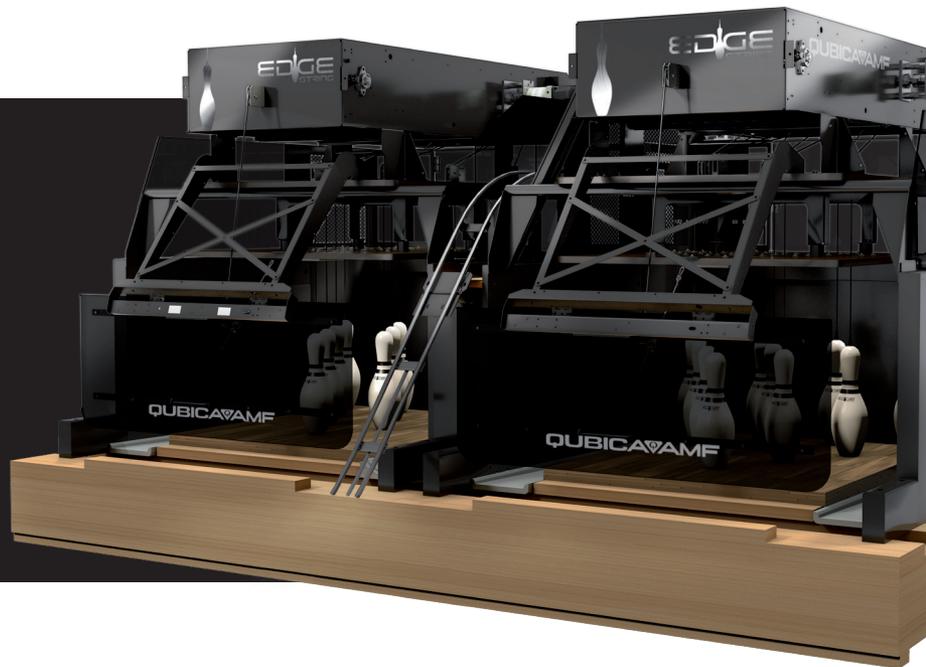


QubicaAMF Research Study: Scoring and Pinfall Behavior of EDGE String Compared to Free-Fall Machines





Scoring and Pinfall Behavior: EDGE String versus Free-Fall

Background

Since the mid-1960's string pinspotting machines have been used for entertainment bowling applications such as five-pin, nine-pin, duckpin and mini-bowling games. More recently string machines are increasingly being used for tenpin bowling — as existing and new bowling investors are drawn to their operational benefits such as reduced maintenance, lower operating costs, decreased energy consumption and less stress for owners and staff.

When we decided to develop the EDGE String pinspotter the product requirements included features to make the play as similar to free-fall machines as possible to deliver the most authentic experience possible for both recreational and competitive sport league bowling. Consequently, EDGE String was designed to meet the relevant dimensions controlled by USBC for certified free-fall machines—these include kickback spacing, ball stop location, pin curtain location and pin deck surface-to-pit floor surface distance. EDGE String was given a unique string handling system to minimize resistance strings can have on pinfall, so pins fall over easily - as close to free-fall as possible.

Lastly, the sport bowling environment is rough on equipment so EDGE String was designed to be uniquely robust — using premium material such as thick hardwood kickbacks, a heavy-duty ball stop, state of the art industrial gearmotors and long-life bearings in the drive train.

EDGE String Designed for the Sport

- Meets relevant dimensions controlled by USBC for free-fall machines
- Unique string management so pins fall over easily — as close to free-fall as possible
- Uniquely robust to perform and last for decades of rigorous sport bowling

In creating EDGE String our hypothesis was the bowling experience, pinfall and overall scoring would be very close to that of free-fall. To test this hypothesis we designed and executed a research study on the scoring and pinfall behavior of EDGE String compared to free-fall machines.

Purpose

Prior to this study no comprehensive side-by-side research between string and free-fall machines had been conducted and little qualitative data existed on how play and scorability compares to free-fall pinspotting machines.

The purpose of this research was to collect real-world quantitative scorability data and qualitative feedback on how EDGE String performs as compared to traditional free-fall machines under sport bowling conditions.

The study was conducted with experienced sport league and elite bowlers—real bowlers under real-world bowling conditions.

Specifically, QubicaAMF collected data to understand the following:

- How the pinfall and pin action on EDGE String compares to free-fall
- How overall scorability on EDGE String compares with free-fall
- How sport league and elite bowlers view the competitive experience on EDGE String versus free-fall

Structure

The study was conducted in a real-world tournament format¹ using a combination of experienced sport league bowlers and elite professional bowlers.

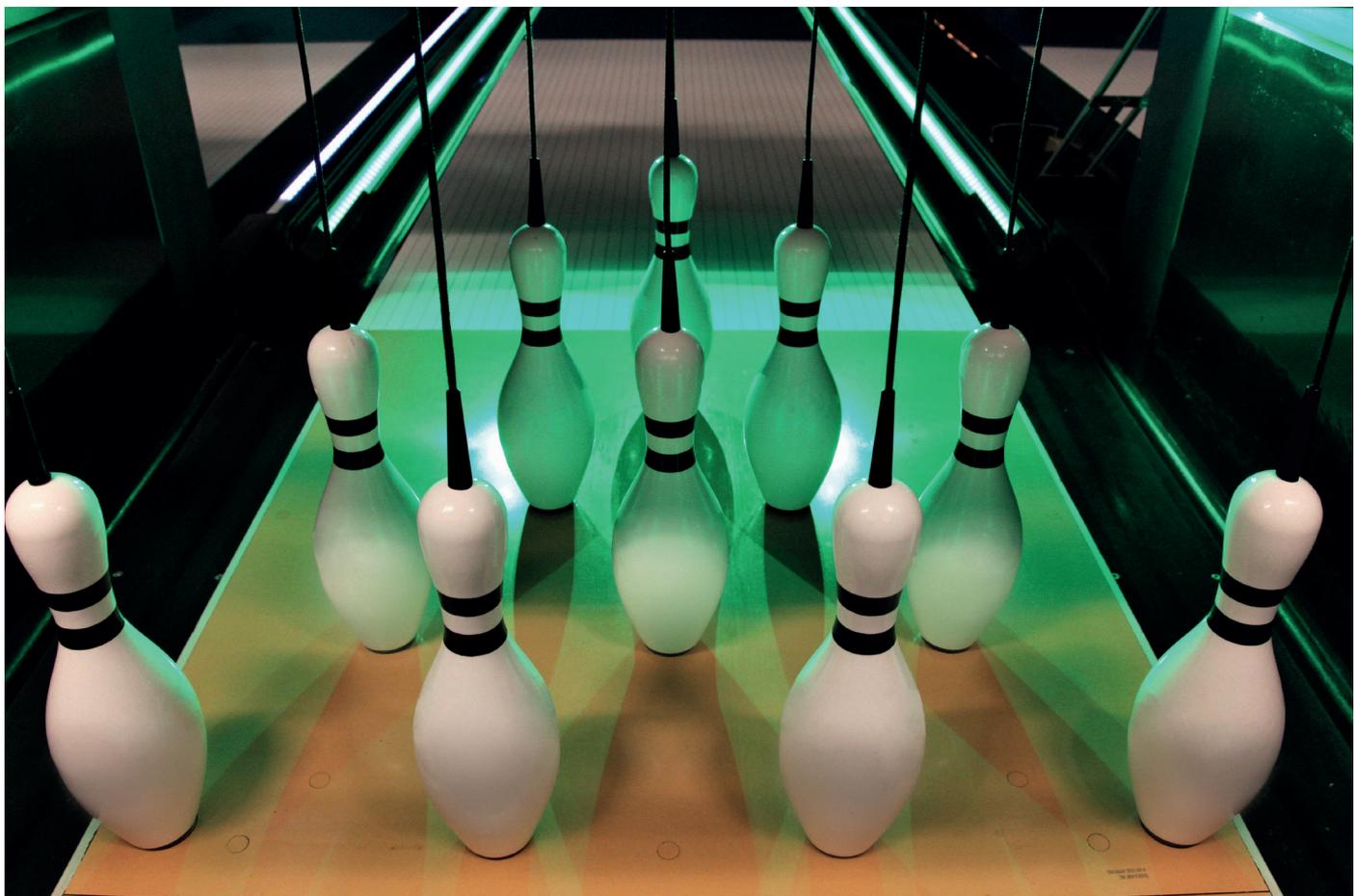
A bowler rotation process ensured each bowler played an equal number of games between QubicaAMF EDGE String machines and free-fall machines. All controllable variables were kept the same, only changing the pinspotting machine between EDGE String and free-fall. Scoring data was collected through the tournament management system within Conqueror X. Additionally, a brief written survey of participants was conducted, along with interviews of a subset of participants.



¹ QubicaAMF "Some Strings Attached" tournament, July 25-26, 2020, HeadPinz Entertainment Center, Naples, FL, USA.

The structure of the study was as follows:

Location	HeadPinz in Naples, Florida
Dates	July 25 and July 26, 2020
Number of Participants	65 Bowlers
Combined Participant Average Bowling Experience	20 Years
Combined Participant Bowling Average	222
String Machine Used	QubicaAMF EDGE String
Free-Fall Machine Used	Brunswick A2
Number of Lanes	8 Lanes of EDGE String, 8 Lanes of free-fall
Bowling Lane Surface	QubicaAMF SPL Select
Pins Used	QubicaAMF AMFlite Glow Pins
Scoring and Management System Used	QubicaAMF BES X and Conqueror X
Bowling Ball Used	Varied. Participants were allowed to use their own balls





Results

Scoring Comparison

After 65 bowlers, with 20 years competitive experience on average, bowled 671 games between EDGE String and free-fall (half of the games were bowled on EDGE String and half on free-fall machines) the overall average score in free-fall was 203.4 and 204.7 on EDGE String. The table below summarizes the scoring between EDGE String and the A2 free-fall machines.

Overall Average Scoring Results	Free-Fall	EDGE String
Pinfall	68,149	68,799
Games Bowled	335	336
Average Score	203.43	204.76

The overall scoring was just 1.3 pins higher on EDGE String.

Strike, Spare & Split Comparison

In addition to overall scoring, data on the strike, spare and split performance between EDGE String and the A2 free-fall machines was captured. The strike conversion rate on EDGE String was 1.4% lower than free-fall and the spare conversion rate was a 4.6% higher. There were 2.3% fewer split leave situations with EDGE String, however when splits were left the split conversion rate on EDGE String was 8% higher than the A2 free-fall machines. The table below summarizes these results.

Strike, Spare & Split Results	Strikes	Spares	Splits Left	Splits Converted
Free-Fall	1,939	1,139	334	44
EDGE String	1,892	1,311	250	53
Free-Fall Conversion %	52.6 %	30.9%	9.1 %	13.2%
EDGE String Conversion %	51.2 %	35.5 %	6.8 %	21.2%
EDGE String-to-Free Fall Variance	-1.4 %	4.6 %	-2.3 %	8.0 %

Participant Feedback

Qualitative feedback from the bowlers on pinfall and pin action behavior between EDGE String and free-fall was captured.

Feedback across bowlers interviewed was very consistent, with the most common observations as follows:

- Strikes are a little harder to achieve on EDGE String

Solid pocket hits carry well, rewarded with strikes just like on free-fall

Light pocket and half-pocket hits don't carry as well, so fewer of these resulted in strikes

- Spares and splits are in general a little easier to pick up on EDGE String than on free-fall
- The pins are consistently on-spot, with no "bad racks" as sometimes seen with free-fall machines
- There was no deadwood to slow the pace of play as you sometimes get with free-fall

Additionally, the results of a written survey found 97% of participants would bowl on EDGE String pinspotters in a competitive sport tournament.

Analysis of Results

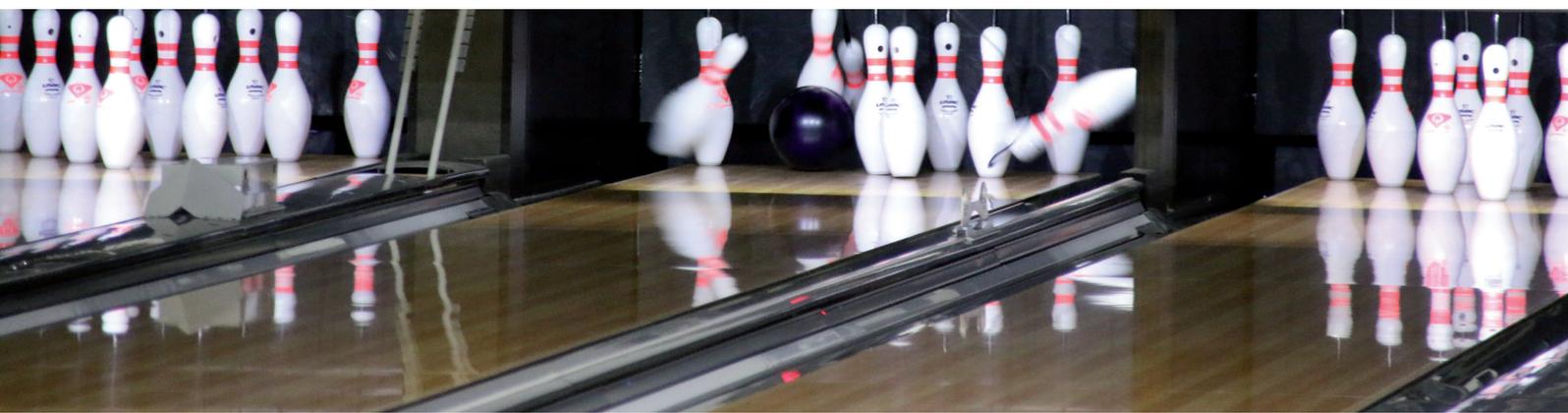
The results show differences in pin action and pinfall behavior exist between EDGE String and free-fall, however overall scoring performance between EDGE String and free-fall is very close. In other words, the end result is about the same but the path travelled to get there differs somewhat.

To begin with, the data shows the strike conversion rate on EDGE String is only 1.4% lower than on free-fall. This very small difference is a consequence of the string imparting some resistance on the pin's ability to fall. On EDGE String this gap is so small because, unlike the alternative string machine products on the market, EDGE String's handling system was designed to minimize string resistance to pinfall. Participant observations add more color, indicating it is the "light"

or "weak" pocket hits which drive the strike conversion difference. Lighter hits did not result in strikes as easily on EDGE String as they did on free-fall.

Our research found the spare conversion rate on EDGE String to be 4.6% higher than free-fall. This is a direct result of the pins being attached to strings and those strings sometimes knocking over pins that otherwise may not fall on a free-fall machine. This is also why split conversions on EDGE String were 8% higher than on free-fall.

The results of the study point to the slightly lower strike conversion rate on EDGE String being offset by higher spare and split conversion rates – resulting in overall scorability on EDGE String very close to free-fall.



Conclusions

This research study on scoring and pinfall behavior of EDGE String compared to free-fall machines provides practical insight into real-world performance on EDGE String as compared to free-fall machines.

This study's findings support our hypothesis that the bowling experience, pinfall, and overall scoring on EDGE String is very close to that of free-fall.

The performance and play on EDGE String compared to free-fall, as found by this study, is why Andrew Oram, CEO, IBF, referred to EDGE String as "the leading string technology available for sport bowling".

- At just 1.3 pins higher, the overall scorability on EDGE String is very close to free-fall

- With a strike conversion rate just 1.4% lower than free-fall, the strike performance on EDGE String is very close to free-fall
- Pinfall and pin action on EDGE String is different than free-fall, but it does not appear to be enough that gameplay integrity is compromised – the game remains one of skill and challenge
- Bowlers may need to adjust their approach when playing on EDGE String versus free-fall in certain situations - not unlike what they must do for differing lane conditions, balls, pins, etc.
- The performance and bowling experience on EDGE String under sport applications is likely acceptable for sport league bowlers, given 97% of participants in the study indicated they would bowl on EDGE String in a competitive sport tournament



Participant Feedback



"What I noticed most was the off hits—like the half pocket hits, the light mixers and like spare shooting — were the biggest differences between the EDGE String and the free-fall. But, the flush hits seemed almost exact. I didn't see a huge difference in that."

- Kenny Ryan, Some Strings Attached Invitational, Champion



"As a competitive bowler you want to make sure that they score true to the way you throw the ball and I felt like the string machines did today...I definitely think that these machines should be USBC approved. I think they're a step in the right direction for bowling."

- Jason Couch, Some Strings Attached Open Champion



"One thing that surprised me is that on the string side, you get a perfect rack every single time. I shot 300 on EDGE String and I can't wait to bowl on it again."

- Carlos Eduardo Granados, Some Strings Attached Invitational, 300 Game



"I think it's eye opening to see how the pins react in a different way, but in the end it's bowling. It's the spares that you make that maybe you wouldn't ordinarily make. I think that's the biggest surprise".

- Verity Crawley



"Before I came out here I was already thinking, 'Oh, carry percentage is going to be so much higher on EDGE String versus the free-fall machines.' And it really wasn't. What surprised me the most about the EDGE String is that there was still really good pin action. It almost didn't even seem that different from traditional bowling."

- Ashly Galante



"I feel like this is one of the better string pin machines out there. I've seen a couple of videos online and the balls quite not going through the pins the right way, and I was really impressed with how my ball was going through the pins."

- Nate Garcia



"Initially I thought you'd be able to get a lot more off-hits on the string. And it was just the opposite. You had to hit them really well, you had to make good shots, but when you did hit them well, you got the strikes. The expectation was that there would be some sort of noticeable difference. When you went from one end of the house to the other you kind of forgot for a moment, until you saw the pins reset. For me, I actually didn't notice at times that I was bowling on a string machine."

- Chris Keane



"I expected it to be a little bit more of a difference between the free-fall and the string machines. I think that the machines have come a long way, so I am actually positively surprised."

- Carlos Tobon



"They're definitely more realistic than the string machines I've bowled on in the past. Bowling on the EDGE String, the carry was a lot more realistic. And I actually really liked it...I would forget I was bowling on the string pins."

- Elise Bolton



"What surprised me most about bowling on the EDGE String was actually how realistic it is. When I heard stories about what it was, I kind of thought 'oh, it's not going to be good,' but it's so close to free-fall pins that it was good."

- Ron Martin III