2026 Scoring Element Inspection Testing Report

Introduction

The 2026 *FIRST*® Robotics Competition scoring element went through a variety of tests and inspections to ensure a high quality, consistent game piece for the REBUILT™ *presented by Haas* season. Selecting a foam scoring element required high level quality control specifications and inspections based on realistic robot validation testing. *FIRST*® implemented a Request for Proposal (RFP) as a part of this process and ultimately selected AndyMark as our partner. This document was created by AndyMark Engineering in collaboration with *FIRST* to share some of the details of the process with the community.

Round 0: Preliminary Inspection

To begin the process of evaluation, AndyMark received samples in various controllable weights in order to determine which would be preferred. Below is a chart of preliminary inspection data.

Table 1: Preliminary Inspection Data

Expected Weight (g) / Ball #	Actual Weight (g)	Diameter (in)	Deflection Under a Weight (in)	Defects
180a	179.7	5.97	0.875	Pockets at seam
180b	185	5.97	0.75	Good
200a	199.4	5.97	0.625	Good
200b	198.8	6.01	0.625	Good
220a	218.7	6.01	0.33	Good
220b	218	5.97	0.25	Good
230a	223.9	5.93	0.125	Soft spot
230b	224.9	5.97	0.125	Soft spot

We performed initial tests on these samples based on expected usage to verify that they could hold up to *FIRST* Robotics Competition level wear and tear. Based on previous seasons, foam game pieces tend to disintegrate or come apart in large pieces when subjected to *FIRST* Robotics Competition level forces. We tested a few different metrics to determine the weight to recommend.

- **Tackiness**: To avoid scoring elements sticking to each other, we slid game pieces down a ramp at various angles to ensure that they could move.
- **Consistency under compression**: We evaluated the consistency of repetitive, basic launching of the ball through a hooded flywheel system.
- **Destructive testing**: A spinning drivetrain provided a benchmark for time and depth of foam gouging.

The heavier balls performed best during this evaluation but came with a safety risk due to their weight. Based on these tests and their preferences, *FIRST* and AndyMark decided to move forward with the 200g ball.

Round 1: First Off Samples

First off samples arrived in early June 2025. These were the specified weight, diameter, and had the correct logo printing. Two issues were noted upon arrival of this batch:

1. Balls had a noticeable difference in spring rate, ranging from very soft (low spring rate) to hard (high spring rate)
2. Logos peeled off by hand and rubbed off in testing almost immediately.

Initial testing proceeded with these two notes in mind. However, the range and standard deviation on weight and spring rate were higher than we expected our establishing range to be. The charts below show that most of these data points fall into a range, with a number of outliers.

Figure 1: Spring Rate of first batch of samples

Figure 2: Weight of first batch of samples

Upon reviewing the data with the supplier, they indicated that a much tighter weight tolerance would be possible at 215g, due to the way that the ball was formed. This would also decrease the amount of large voids in the foam, leading to consistent experience with this scoring element; the change was approved.

In addition, logos on the scoring elements rubbed off quite easily under force, which was not ideal. We experimented with other options and approved a coating that would protect the ink. Lower spring rate was also indicated to have a positive effect on logo adhesion.

During this timeframe, date code specifications were established for traceability. We opted to use a Julian date code, a three digit "day of the year" number, printed on the ball above the mid seam.

Finally, the supplier found that they could maintain a tighter spring rate range if the ball was squishier. In order to test this, we performed a validation usage test on distance traveled to ensure this course of action would have a positive or neutral impact on usage.

Validation: Endurance and Distance Testing

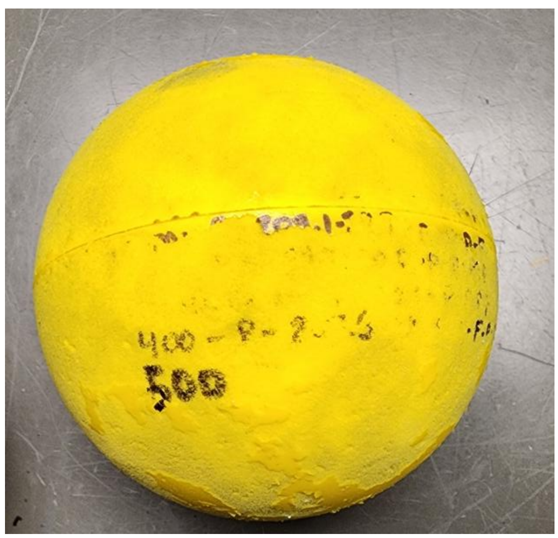
To validate usage of the scoring element, five sample scoring elements were run through 1200 consecutive cycles of intaking, indexing, and launching. These scoring elements varied in spring rate and weight, allowing us to tune our tolerance range of scoring elements to the challenge on the field.

Balls were assessed visually and functionally at least every 50 cycles. By cycle 375, it was noted that the higher spring rate balls were beginning to look heavily abraded on the surface compared to lower spring rate balls.

Figure 3: Higher Spring Rate ball at 375 cycles (right)

Lower spring rate balls did not exhibit this behavior until cycle 500.

Figure 4: Lower Spring Rate ball at 500 cycles:



Additionally, distance launching was validated with the same conditions to assess what differences spring rate and weight would have on distance traveled. Five balls were used in this assessment, with spring rates at the highest, lowest and around the average of the first sample batch. Samples were launched using the same validation rig used for cycle endurance testing.

Figure 5: Distance launching test - landing locations

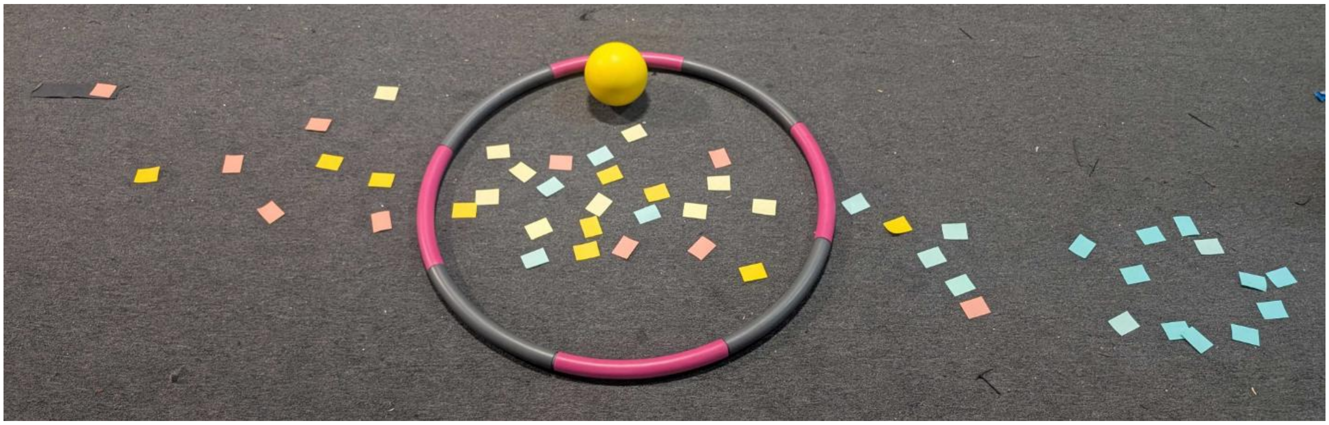
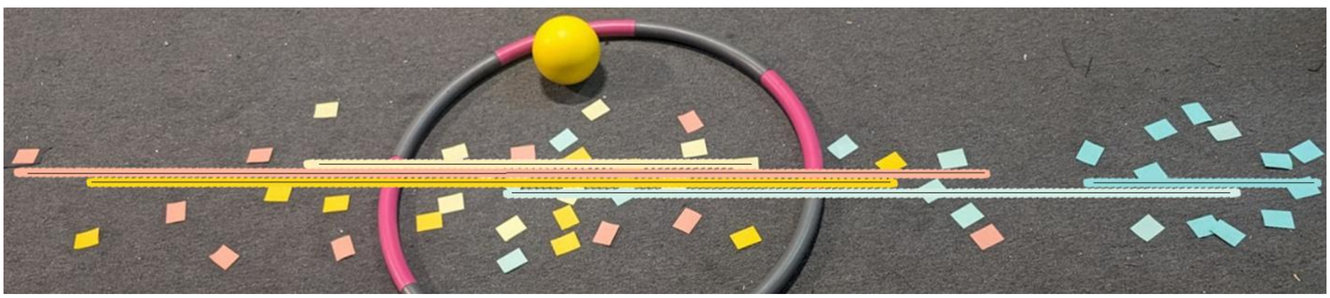


Figure 6: Distance launching test results with range variance measurement shown



For scale, the hoop is 33" ID, smaller than the eventual ID of the HUB (48" ID).

Table 2: Variance in range for various Spring Rates

Color	**Spring rate**	**Range (in)**
Salmon	30% Higher	77.5
Dark Yellow	10% Higher	64.5
Light Yellow	Average	35
Dark Blue	10% Lower	18
Light Blue	20% Lower	58

In summary, a softer ball with a lower spring rate was optimal for manufacturing, stamping, wear, and launch range. The Dark Blue data set became our nominal specification for spring rate.

Round 2: Production Approved Samples & Start of Production

We received the second round of samples soon after confirming specifications for weight and spring rate.

Figure 7: Spring Rate of second batch of samples

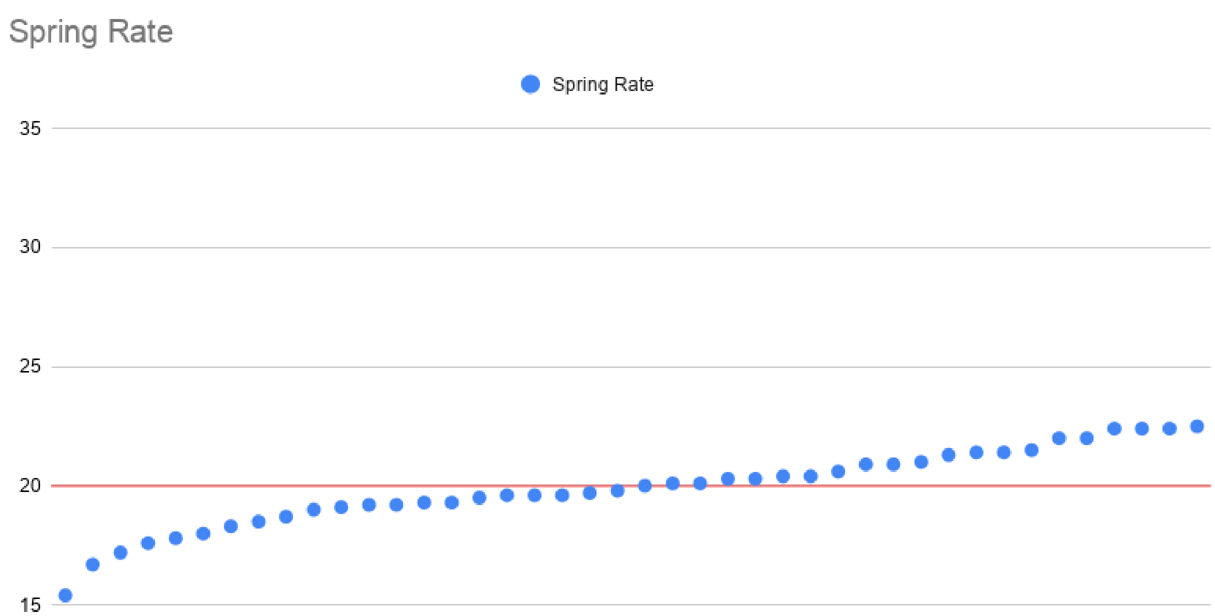


Figure 8: Weight of second batch of samples

Results of testing demonstrated a much tighter range of tolerance, and the start of mass production was approved.

During the initial round of production inspection, a non-conformant number of voids (surface defects) were identified. With the inspector's recommendation, a void size was specified that would not impact use. As production progressed and the process was optimized, void presence decreased.

Quality Control: Day 240

During the course of inspection, it was identified that batch day 240 was above the tolerance for weight. We performed a 100% inspection on this day to identify any outliers.

3318 balls were inspected in Manchester, New Hampshire, 277 of which failed AndyMark's specification for weight. Of those, 246 were pulled for being *under* our spec. This was not initially anticipated with this batch, since it failed in-line inspection due to weight being too high. Further data from day 240 and resultant testing can be found below.

Table 3: Inspection data from Day 240 batch

Pallet Number	Pallet 1	Pallet 2	Pallet 3	Pallet 4	Pallet 5	Overall	
Quantity	630	672	672	672	672	3318	**Percent Rejected**
# Fail	37	87	62	63	28	277	8.35%
# Pass	593	585	610	609	644	3041	**Rejected High**
# Heavy	8	6	2	8	6	30	0.90%
Avg Heavy	226.5	226.9	230.7	226.2	226.4	227.3	**Rejected Low**
# Light	28	81	60	55	22	246	7.41%
Avg Light	199.5	200.9	199.1	200.1	200.6	200.0	

Our hypotheses were that these discrepancies were based on humidity/conditions, natural settling (off gassing), and/or that day 240 was just an outlier.

To test settling, we pulled 5 boxes from the AndyMark warehouse to see how they corresponded with our inspection data. If they settled at a lower weight like day 240 had, then we could reduce the low-end specification in the game manual. Through 210 inspected balls, we saw 0 failures, high or low, with an average weight of 216g and similar numbers to our in-line production inspection. This data is below.

Table 4: Inspection data for AndyMark sample boxes

Batch Number	234	254	280	281	282	Overall
Quantity	42	42	42	42	42	210
Avg Weight	216.8	216.2	215.7	218.0	215.1	216.4
3rd Party Avg	216.9	218.2	215.6	210.4	220.6	216.3
# Fail	0	0	0	0	0	0
# Pass	42	42	42	42	42	210
# Heavy	0	0	0	0	0	0
# Light	0	0	0	0	0	0

Next, we ran humidity testing on a group of 12 balls varying the humidity from 30-90%. In very humid conditions, the balls gain about 1g per hour. After 7 hours above control humidity and 3 hours in 90% humidity, most topped out around 5g gained overall.

While it is possible that the balls on day 240 were saturated when inspected, this condition is very obvious - water tends to bead on the surface when pressed, and this would have been very noticeable. This supports our hypothesis that day 240 was an outlier.

Quality Control: Spring Rate Over Time

After the scoring element was revealed on January 10th, 2026, teams began comparing their Kit of Parts (KOP) balls - now named FUEL - to their pre-orders from AndyMark. Teams immediately noted that KOP fuel had a higher spring rate than AndyMark fuel.

To test this more in depth, we pulled 20 of the fuel previously tested in July. Each was noticeably firmer. Not all the fuel we tested changed equally, but all had shifted at least 10% higher than their initial spring rate. These same balls had an average weight loss of 2.7g over the same time period, mirroring what we saw with day 240. These seem to be affected equally. Graphs of this data are below.

Figure 9: Change in Weight for 20 previously tested samples

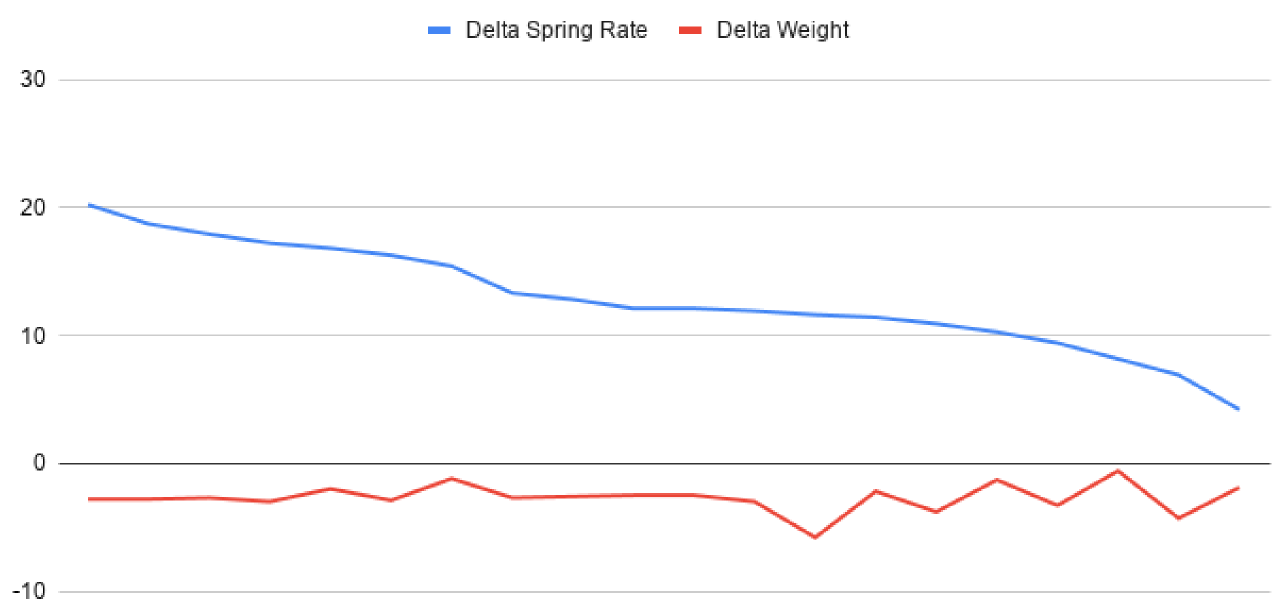
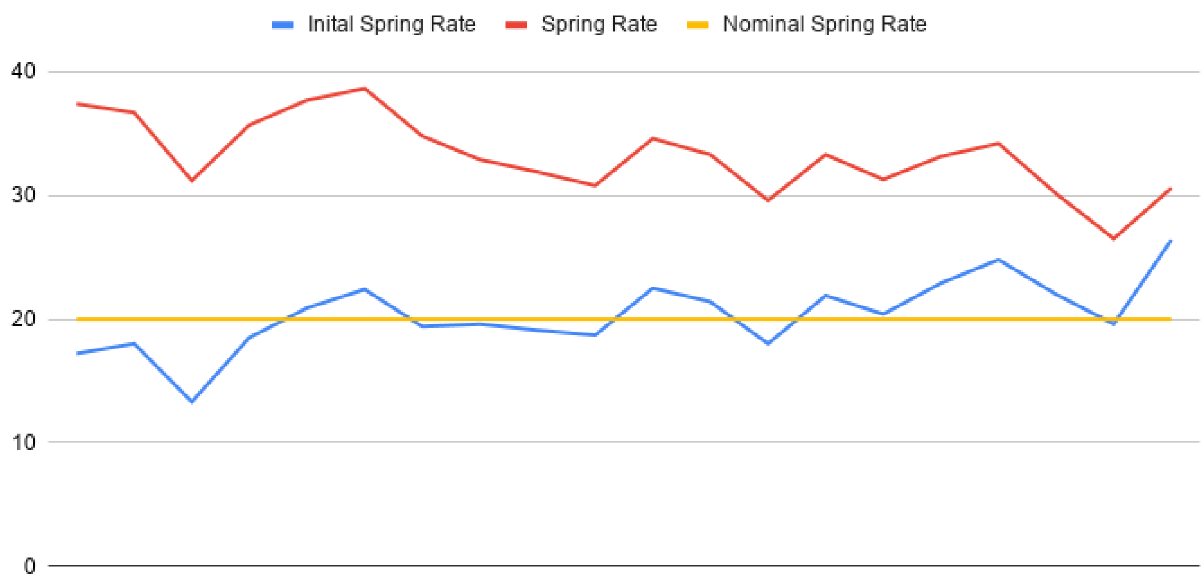


Figure 10: Change in Spring Rate for 20 previously tested samples



Time seemed to be the best indicator for fuel compression - more time, higher force to compress. In a shortened manufacturing timeline, the life of how inspection points behave on a lengthened time scale is difficult to predict. All fuel tested from the KOP was within specifications during the post manufacturing inspection and all the fuel used on official fields would be similarly aged, providing a consistent experience.

Conclusions

The effort that goes into developing something as simple as “a foam ball” may come as a surprise to many, but this project is an excellent showcase of the quality standards *FIRST* challenges all their suppliers to achieve. There are times where adapting to scoring element variation is an intentional “part of the challenge” for teams, but for REBUILT a higher level of rigor and consistency was important. AndyMark appreciates the opportunity to work with *FIRST* and leverage our supplier network to create a sturdier, more consistent scoring element and better team experience.