

Standard Operating Procedure: SOP-BALL-5

Hardness of a Bowling Ball

<u>Rev</u>	<u>Date</u>	<u>Staff Member</u>	<u>Purpose</u>
7	03/21/2023	A. Stanton	Use of feeler gauges instead of sticky notes for durometer set up
6	11/01/2022	D. Speranza	Added: Aligning durometer in stand Clarified temperature target Testing multicolor balls Re-test with second operator Calibrate using multiple ball samples Build-up of polish on durometer indenter Multiple Approval Durometers
5	1/14/2022	A. Stanton	Durometer verification procedure clarification
4	6/17/2020	A. Stanton	Added bowling ball temp to procedure
3	11/20/2019	A. Stanton	Add calibration procedure
2	9/10/2019	J. Milligan	Add stand information, temp range to match ASTM spec requirement, and re-test requirements
1	02/12/09	N. Mours	number of samples and clarification
Origination date: 10/29/07		Originator: T. Robben	

Purpose: To determine the average hardness of a bowling ball

Materials:

- Bowling Ball to be tested
- REX Model DD-3 Digital Durometer or newer version
- REX Model OS-1 Operating Stand (With bowling ball cup base and two weights totaling 4.5 -5 kilograms)
- REX TBK-D Type D Test Block Kit
- ETEKCITY Lasergrip 800 Infrared Thermometer
- Rex Gauge Company Calibration Block – TB-1 Type D (≈ 80 D)
- Feeler gauges





Set Up Procedure:

1. Using the allen wrench, loosen the two screws on the gauge clamp, and carefully place the Rex durometer in the clamp. It is recommended that the clamp be secured on the large diameter section of your Rex durometer called the connector. To prevent damage to the gauge, take care not to over-tighten the screws- only use enough force to secure the gauge.
2. To set the durometer height, first loosen the column lock knob and raise the arm assembly high enough so that a ball can be placed under the indenter of the gauge, onto the ball cup. Place a ball in ball cup on stand. Then lower the arm assembly until the foot of the gauge is approximately 3/8" above the ball. At this point, re-tighten the column lock knob. (NOTE: Durometer should be high enough for the ball to easily clear without touching it when placing the ball in or taking the ball out of the ball cup, but it needs to be low enough that you can depress the durometer to the breakaway when taking your sample).
3. To ensure the durometer is aligned with the center of the top of the ball, pull the handle down to depress the indenter into the bowling ball. Then use a feeler gauge to slide between the ball and the foot of the indenter. Do this on the left and right side of the durometer along with the front and back. If properly aligned, the feeler gauge should slide between the ball and durometer foot the same amount for all four locations. If they are not the same, then the durometer location needs to be adjusted using the column lock knob on the back of the stand that holds the durometer frame in place.
4. To perform a test, fully depress the lever. The foot of the gauge should be in full contact with the ball and the weight shaft assembly should have moved upward in the arm assembly. If the durometer has been properly set, it will not be possible to obtain different readings by pressing harder on the lever once the foot of the gauge contacts the ball.

Test Procedure:

1. Per ASTM specs, balls must be tested when they are within the temperature range of 70-77 deg F. The room thermostat should be set so the ball surface temperature is between 70-74 degrees. The balls should be removed from their box and plastic bag to allow the air to circulate and acclimate the ball to the environment. The balls should acclimate for at least 24 hours.
2. Push the "ON/CLR" button on the durometer.
3. Push the "HOLD" button on the durometer once so the displayed reading will be the maximum value. (NOTE: Readout should now indicate "MAX".)



4. Place the bowling ball to be measured in the ball cup under the durometer.
 - a. Measure the temperature of the ball's surface in 4 different locations around the ball and record on the test form.
 - b. If the average of the 4 temperatures is not within the 70-77 °F range, set ball aside to acclimate to temperature before trying again. If the ball is within the temperature range, proceed.
5. Press "ON/CLR" key to zero the durometer.
6. Using even pressure and a slow pace, pull down the handle on the right side of the durometer stand until the durometer hits the bowling ball and you cannot push the handle down anymore. Then allow the handle to return to the starting position. Be sure that any logos, serial numbers, or other identification markings are avoided when taking a hardness reading.
7. Record the hardness reading from the digital display.
8. Rotate the bowling ball in the ball cup under the durometer, so the next reading can be taken on another random location on the bowling ball. Again, be sure to avoid any logos, serial numbers, or other identification markings on the bowling ball.
9. Repeat Test Procedure steps 5-8 until 10 different locations on the bowling ball have been tested. A good sample of the bowling ball should include a wide range of locations around the bowling ball that includes all the colors on the bowling ball. For multi-color balls, multiple measurements should be taken in each designed color.
10. The overall hardness of the bowling ball will be displayed as an average of the 10 readings taken on the ball.

If ball results indicate the hardness is below the minimum:

1. Take out the Rex calibration block and measure the temperature of the surface in 2 different locations with the infrared thermometer.
(NOTE: Testing is to be conducted when calibration block is within the ambient temperature window of 70-77 °F and the surface has had time to acclimate to that temperature, same as we test bowling balls.)
2. If the average of the 2 temperatures is not within the 70-77 °F range, set calibration block aside to acclimate to temperature before trying again. If the calibration block is within the temperature range, proceed to step 3.
3. Place calibration block beneath the durometer needle and push the "ON/CLR" and "HOLD" buttons.



(NOTE: Calibration block may need to be placed on a platform or block to reach the durometer height set for the bowling ball.)

4. Verify that the durometer is operating correctly by taking 3 readings from different locations on the calibration block surface. The results should fall within the range specified with the test block (normally ± 2 of the listed value for the test block).
5. If durometer passes the test block requirements, re-do Test Procedure steps **1-10** with a different operator.
6. If the second operator's results confirm the results from the first operator, the ball fails the test. If the second operator gets results that pass specification when the first operator's results failed the spec, then the manufacturer is given the benefit of the doubt and the ball passes.
7. If durometer does not pass the test block test, send durometer out to be repaired by REX.

Calibration and Monitoring:

Sample Selection

- Each year a set of 8 approval balls [the monitoring set] will be selected from the Ball Inventory based on the following criteria
 - At least 5 months old from the serial number date
 - Hardness standard deviation < 0.3
- The previous monitoring set will be measured on the same day a new monitoring set is first tested so that the difference between the groups is documented and a new target for the durometer's appraisal of the new group is set.
- A two-sample-t test can be used to evaluate the mean difference between the groups as well as the confidence interval of the difference.

Monitoring

- The monitoring set will be measured at the start of each month to determine the accuracy of the durometer
- Each sample will be tested utilizing the standard operating procedure for measuring bowling ball hardness.
- If a variance greater than $0.4 D$ from the target for the monitoring set is observed, the test will be repeated by another operator. If the difference still remains greater than $0.4 D$ off of target, the durometer will be sent in for calibration/adjustment. Staff will utilize a paired-t comparison to determine if the durometer is off target.

Standard Calibrations

- Despite the results of the durometer monitoring, the durometer will be sent in for calibration after every 6 months of use.



Indenter Changes

- If the indenter is found outside of ASTM requirements for conical angle or radius of the tip and needs to be replaced, it is imperative that the durometer be adjusted to maintain accurate results on the monitoring set.
- The monitoring set will be tested prior to shipment for calibration, and upon return.
- If an indenter change causes a significant change in the durometer's readings, it may be immediately returned for adjustment to maintain accuracy on the monitoring set. If standard adjustments cannot meet our target for the monitoring set within ASTM specifications an additional indenter change may be requested to better match the original indenter.

Notify manufacturers whenever durometer is calibrated and ask if they want to send balls to evaluate their durometer results to the official USBC durometer.

Buildup of polishes on durometer indenter:

After testing a polished ball model, the durometer indenter should be cleaned to ensure polish build-up is not affecting the next model. A sanded ball will be measured 10 times to clean the needle.

Multiple Approval Durometers

To ensure continuous hardness testing is available and to develop a back-up procedure in case the approval durometer fails, USBC will have one or more back-up durometers. These will be calibrated with the durometer manufacturer to get results to average similar hardness as the approval durometer. A back-up durometer can only be utilized if it passes a paired-t analysis with the approval durometer on the test ball monitoring group. In this way, the USBC is prepared if a problem develops with the approval durometer. The back-up durometer will be used when the normal approval durometer is unavailable.