

Standard Operating Procedure: SOP-BALL-29

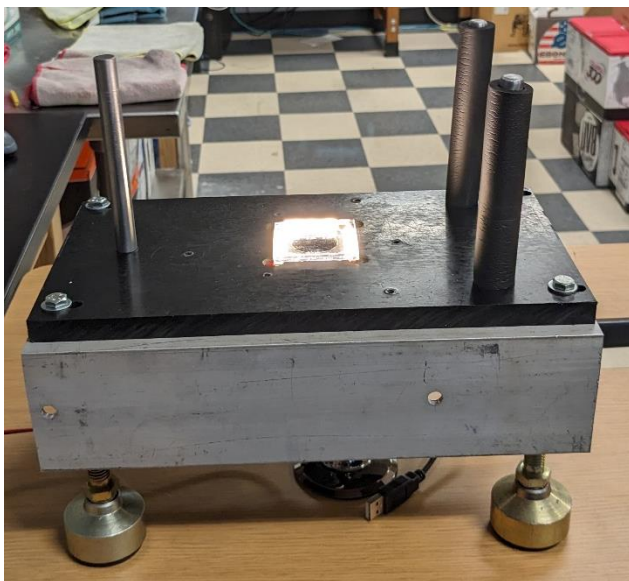
Footprint Measurement

PURPOSE

Measure the contact area between a bowling ball and the ground.

MATERIALS

- USB Microscope.
- Footprint apparatus.
- 2-D bubble level.
- 2" x 2" borosilicate glass with engraved mm scale.
- Image processing software (Keyence VH-X) microscope.



Footprint Apparatus



Contact Glass with LED Lights

SET-UP

- Ensure the glass plate on the footprint apparatus is a level surface.
- Power on LED lighting on the device.
- Connect USB microscope to PC.
- Open Microsoft camera application and select the USB microscope device.

SAMPLE PREPARATION

- Allow the sample to acclimate to the testing environment.
- Clean the sample with Isopropyl Alcohol.

PROCEDURE

1. Place bowling ball onto footprint apparatus such that the contact area is visible in the microscope's field of view.
2. Adjust lighting intensity as needed with the microscope's built-in ring light control.
3. Using the camera app on your PC, take a picture of the contact area within 10 seconds of placing the ball on that location.
4. Name the picture in the following format: "Brand," "Ball Name," "Serial," "Picture number.jpg."
5. Rotate the ball to a new location and repeat steps 2 through 4 until images of the sample are taken in 10 total locations.
6. Resize the images to 1600:1200 resolution for compatibility with the Keyence VH-X microscope.
7. Open an image with the Keyence VH-X microscope and select measure.
8. On the measurements selection pane select a two-point measurement.
9. Click on the outside edge of one of the measurement scale tick marks, then click the edge of a tick mark that is 5 ticks away making sure to click the same relative side as the first edge selected. This measurement has a true distance of 5 mm (0.197").
10. On the measurement's selection pane, select three-point diameter measurement.
11. Click three points around the edge of the observed footprint.
12. Save the data to a .csv file with the same naming scheme from Step 3.
13. Derive a conversion from the measured result to final measurement with the following formula:

$$\text{Footprint Diameter} = \frac{\text{True Distance}}{\text{two - point measurement}} (\text{diameter measurement})$$

Where the true distance is the actual distance of 5 tick marks on the measurement scale, the two-point measurement is the output for that distance from the microscope, and the diameter measurement is the output for the footprint diameter from the microscope.

14. Calculate the footprint for each measured image and report the average of all 10 measurements.

CALIBRATION

1. Ensure that the measurement scale on the glass is accurate (has not been damaged or distorted).
2. All measurements are scaled based on results of measuring the measurement scale on the glass. This ensures that the measurements are accurate.