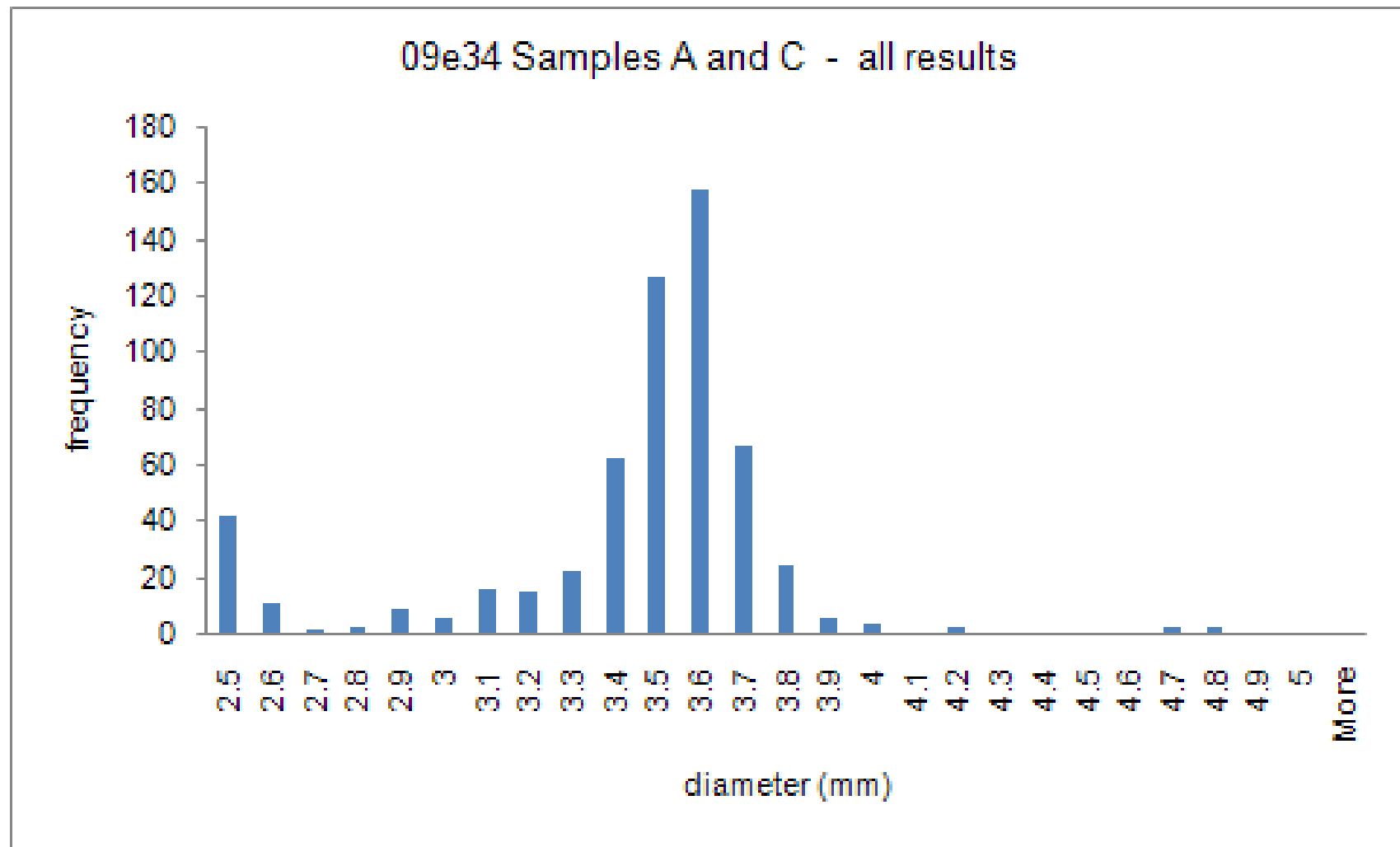
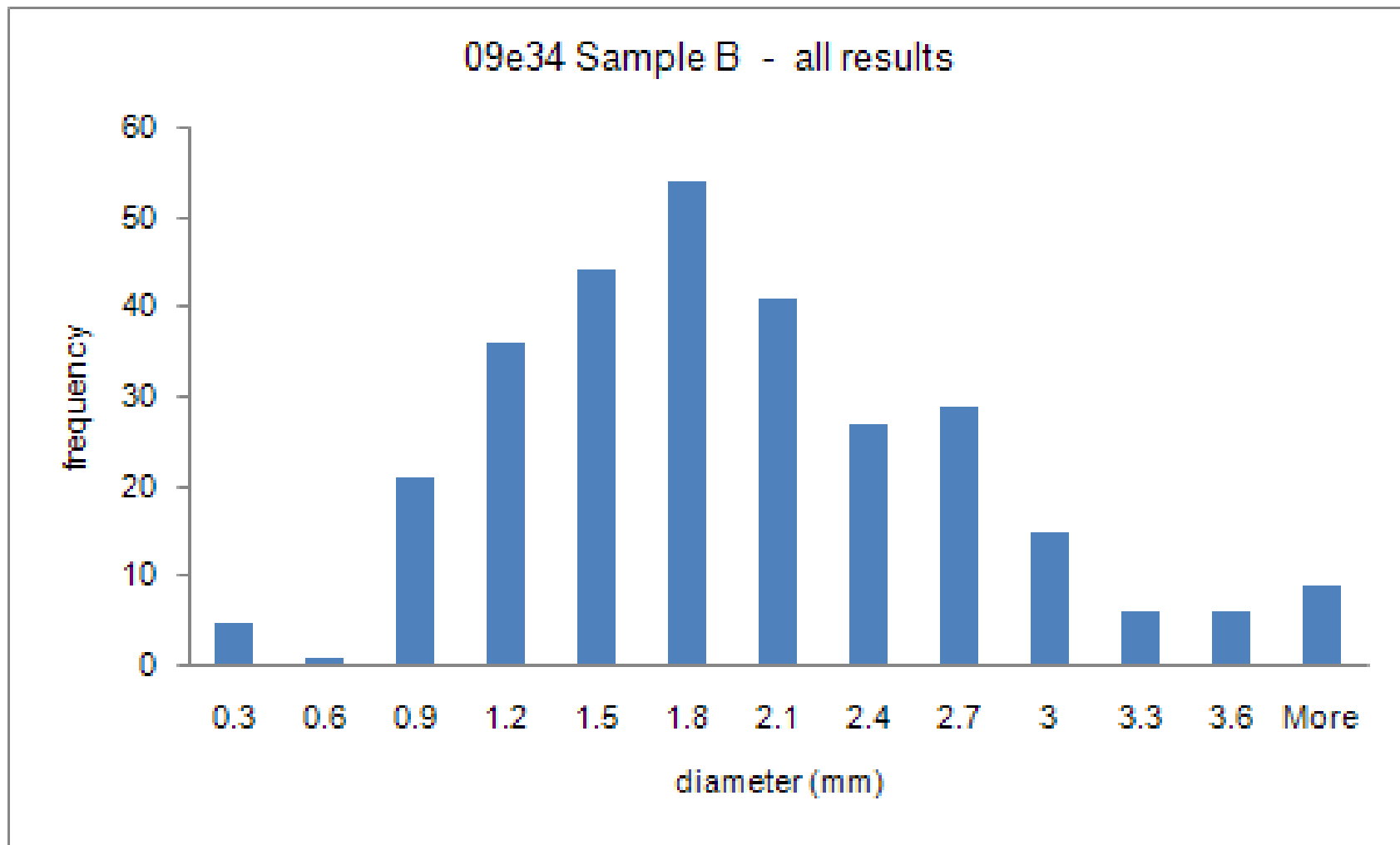


# Ball Pressure Test

# Results Samples A and C



# Results Sample B



# A note about significant figures

- ⓘ This is an excerpt from the results summary

3.68	3.53	1.85	1.82	3.44	3.57
3.55	3.53	2.44	2.46	3.55	3.56
3.1	3.1	1.6	1.5	3.1	3.1
2.758	2.723	1.373	1.34	2.939	2.942
3.5	3.6	2.4	2.7	3.6	3.6
3.53	3.58	3.27	1.1	3.68	3.64
3.68	3.59	1.62	1.61	3.66	3.57
3.5	3.5	2.2	0.9	3.6	3.6
3.7	3.7	0.8	0.8	3.7	3.7
3.514	3.488	0.977	2.679	3.455	3.492
3.7	3.7	2.6	2.7	3.6	3.6
2.5	2.4	1.7	1.7	2.3	2.5
3.6	3.6	2.1	1.9	3.6	3.5

- ❗ Given the measuring methods available, how many significant figures are appropriate?
- ❗ How does the standard indicate the result should be reported?
- ❗ Is there any justification for reporting 3 decimal places?

3.68
3.55
3.1
2.758
3.5
3.53
3.68
3.5
3.7
3.514
3.7
2.5
3.6

# A note about accurately reporting observations

- Each sample A, B and C were tested twice (known duplicates).
- Samples A and C were the same material (blind duplicates)
- The repeatability between known duplicates is very frequently better than between blind duplicates
- ?
- This observation occurs not only for this program.

difference between means for Samples A and C	difference between known duplicate A	difference between known duplicate B
0.3	0.1	0.0
1.8	0.0	0.0
0.3	0.1	0.0
0.3	0.1	0.1
0.3	0.0	0.0
1.0	0.0	0.1

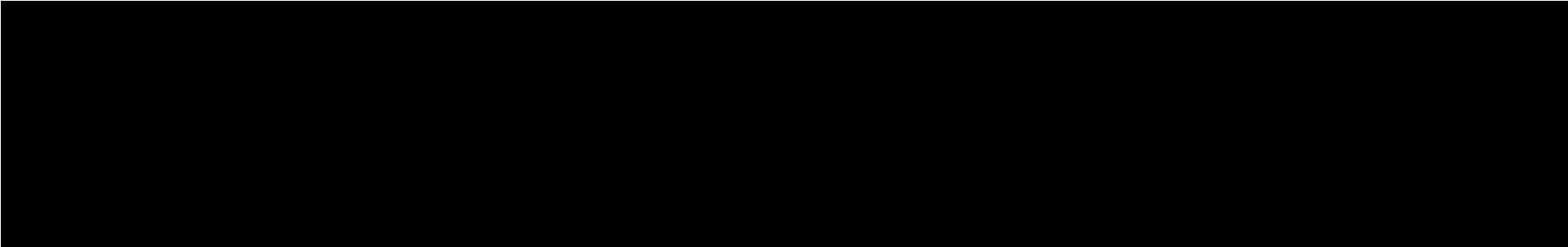
# Sample B was variable in performance

- ⚠ Yet: many, MANY participants reported identical results for the known duplicates.
- ⚠ A total of 3 participants in 09e34 and 4 in 09e34 CSP questioned the samples.  
( $<3\%$ )



# Sample B 09e34

- ⓘ Was included for a different purpose.
- ⓘ Not intended to be a trick
- ⓘ The original purpose was demonstration of the fact that plastics are often inherently variable, and that production often involves substitution of brands of material. Some brands are better than others.
- ⓘ This relays the importance of ongoing monitoring of products and samples even after certification has taken place. (message to NCB's!)

- 
- ! Sources of bias in most tests include having an expectation of the result, particularly when making a measurement that involves human “judgment”

### **3 General description of the test**

With the test specimen at a temperature specified in the relevant specification, a specified downward force is applied through a steel ball and dimension  $d$  of the indentation is measured as described in 7.2.

### **4 Test apparatus**

The test apparatus consists essentially of the elements listed below.

#### **4.1 Loading device**

The loading device shall consist of a 5 mm diameter pressure ball (a finished steel ball for rolling bearings in accordance with ISO 3290) attached to a system of weights designed to apply a downward force equivalent to a  $20\text{ N} \pm 0,2\text{ N}$  load including the mass of the pressure ball.

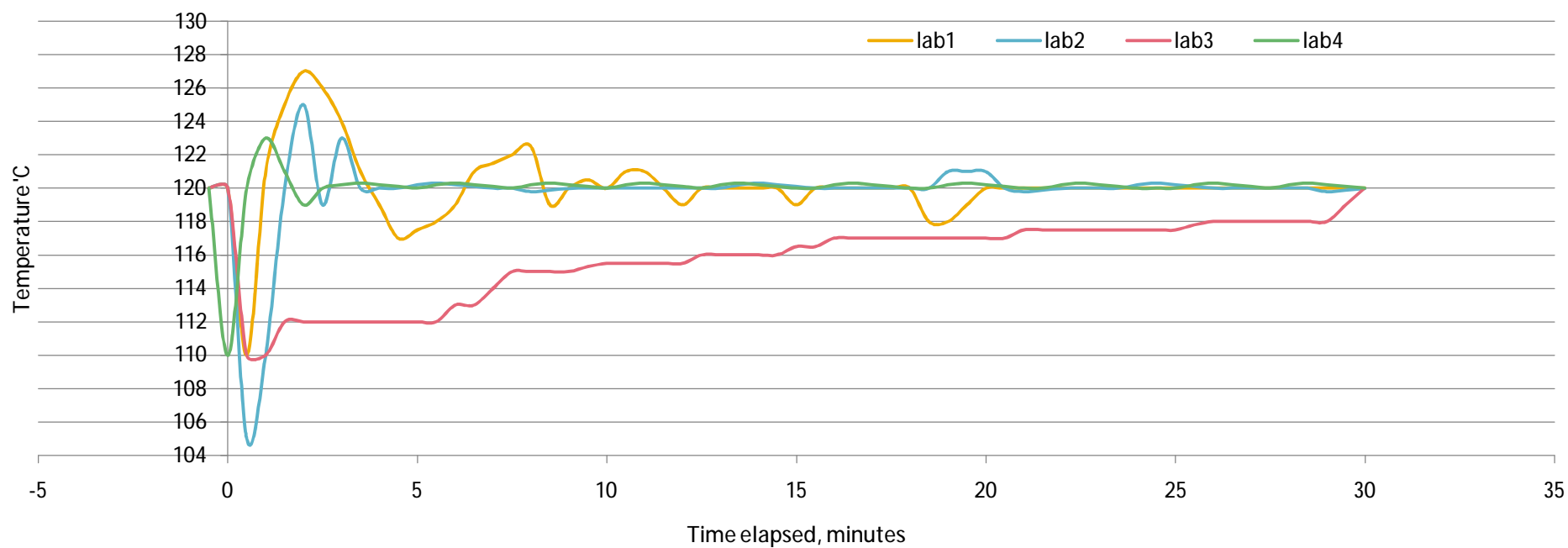
# Equipment

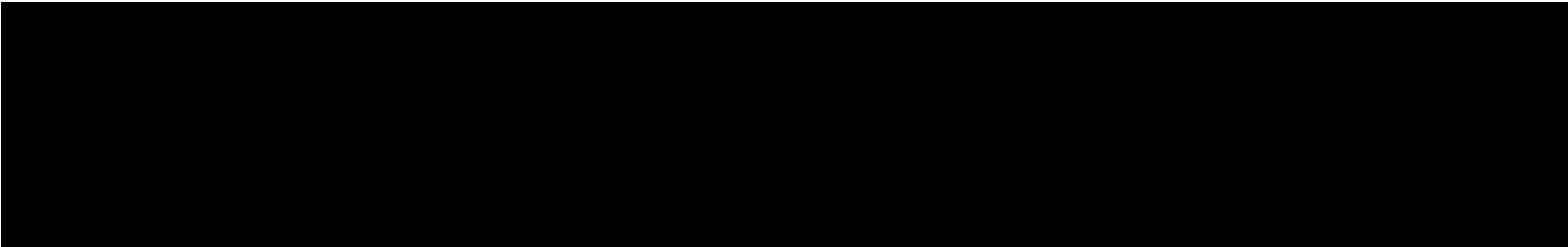
- ⚠ Temperature recovery of ovens....
- ⚠ This is not specified in the standards, but
- ⚠ We know 5 degrees can make a difference to the test result (past PTP data)
- ⚠ The test lasts for 60 minutes, yet some labs report it takes 120-180 minutes for temperature to stabilise after opening the door.
- ⚠ Other labs can obtain full and stabilised temperatures within 5 minutes.

# We ask:

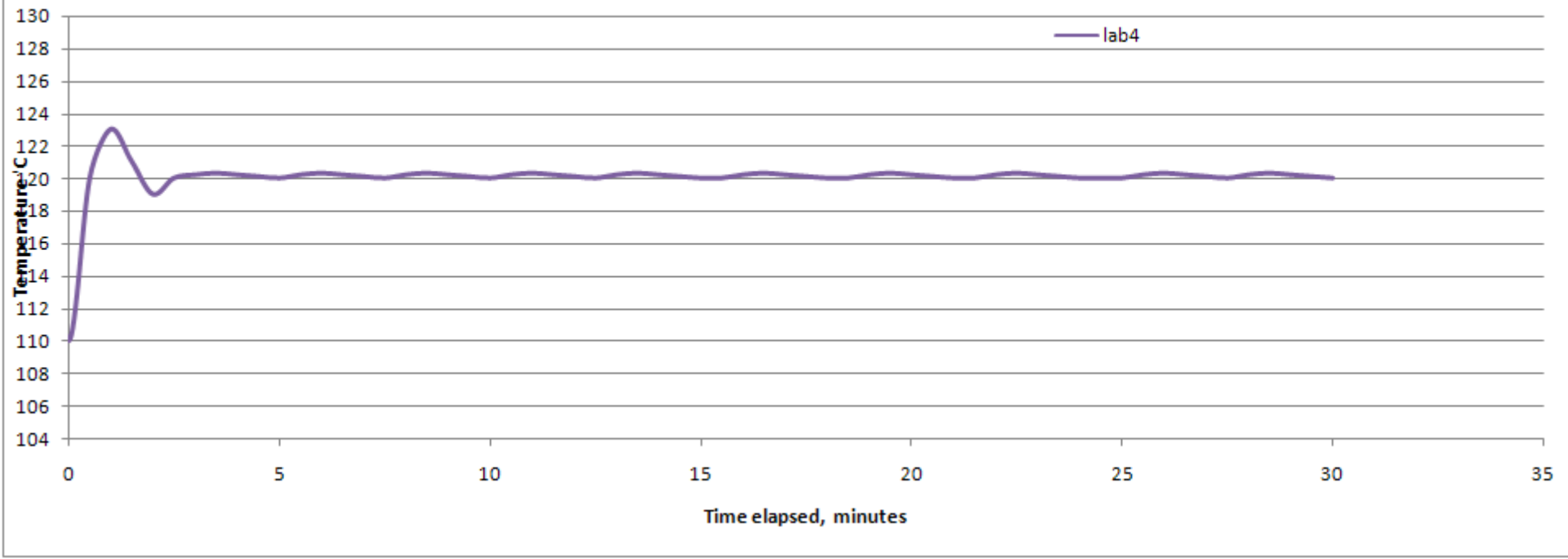
- ⓘ What is the temperature for the bulk of the testing time?
- ⓘ How much time (out of 60 minutes) could the test be more than 2 degrees away from the target?

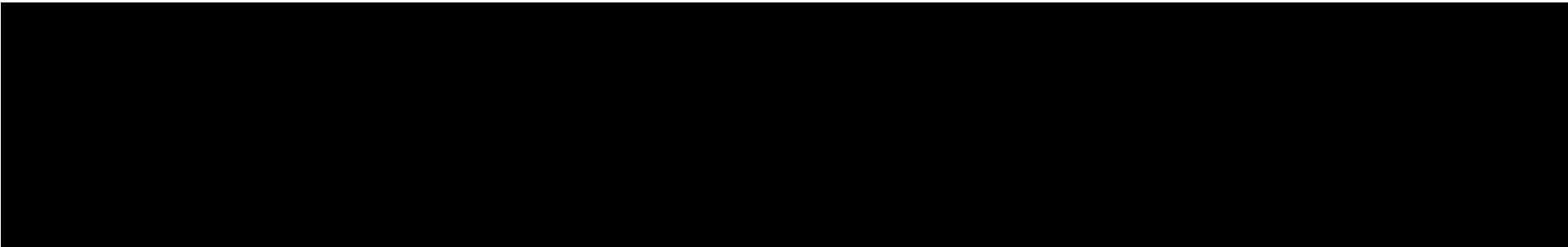
## Temperature Recovery - Ball Pressure Test



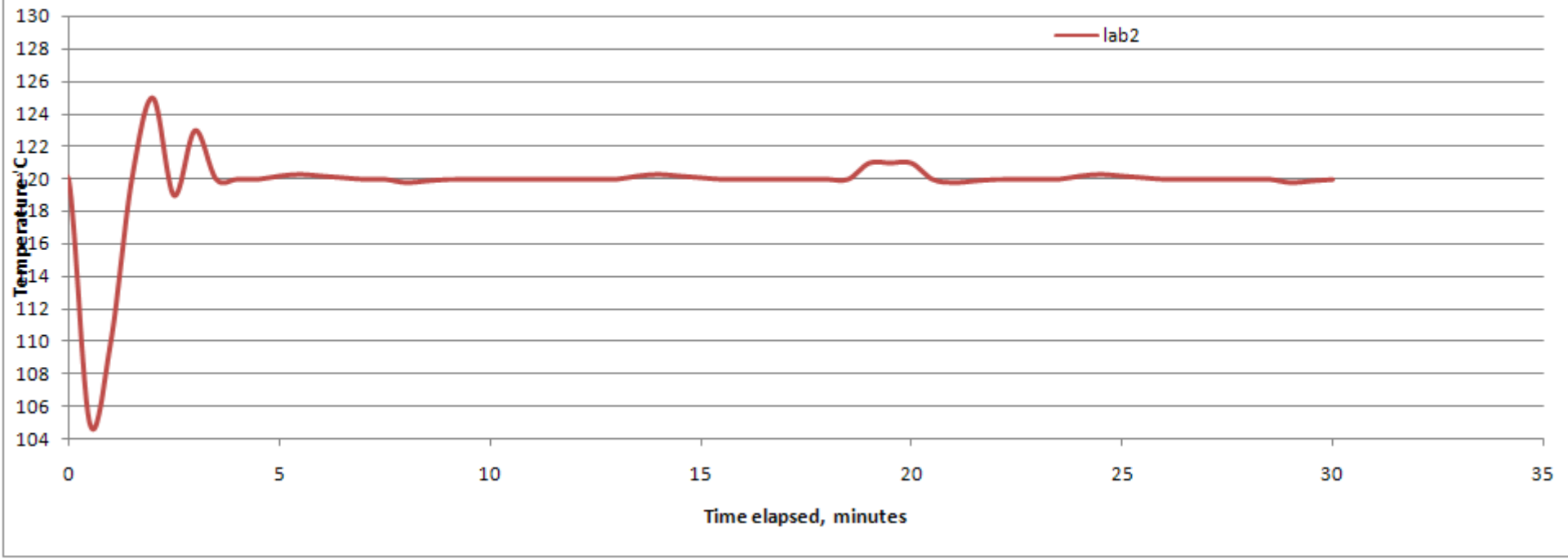


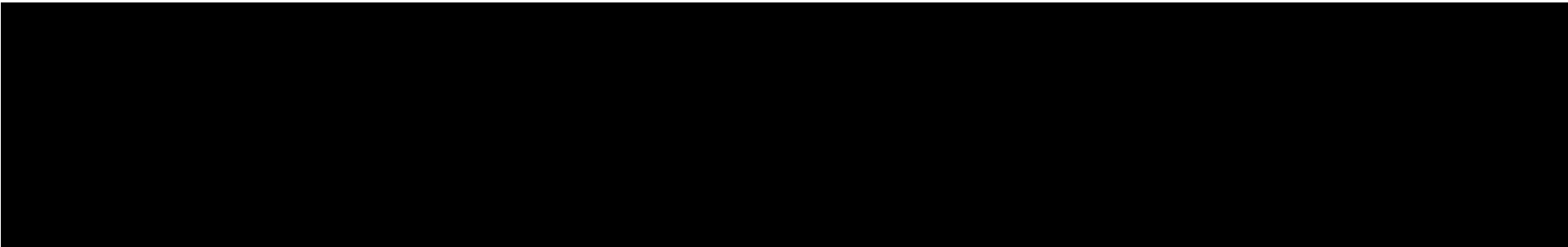
### Temperature Recovery - Ball Pressure Test



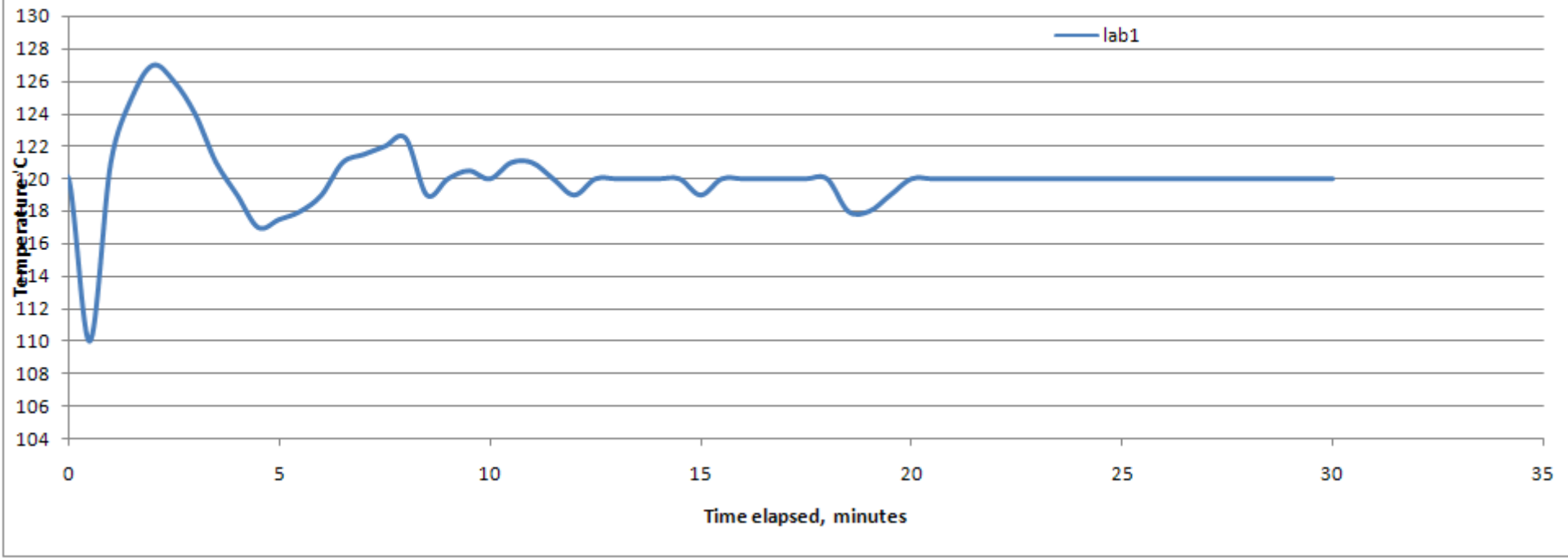


### Temperature Recovery - Ball Pressure Test

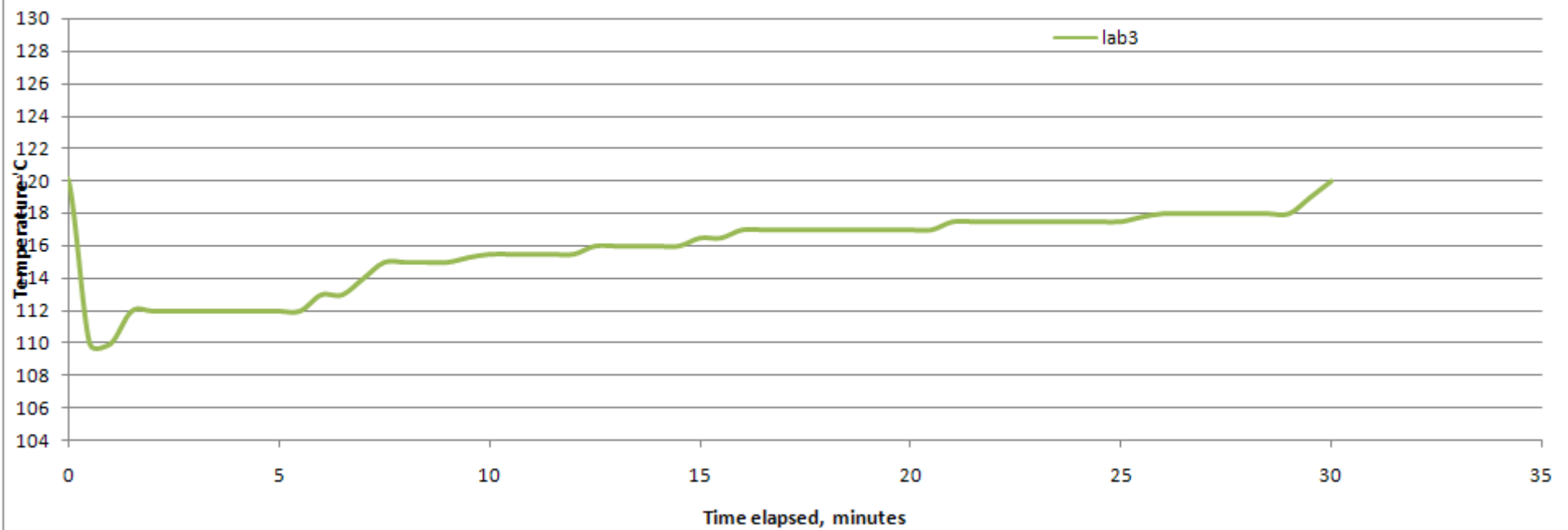




### Temperature Recovery - Ball Pressure Test



## Temperature Recovery - Ball Pressure Test



# Whole Group discussion - Ball Pressure Test

Calibration Data

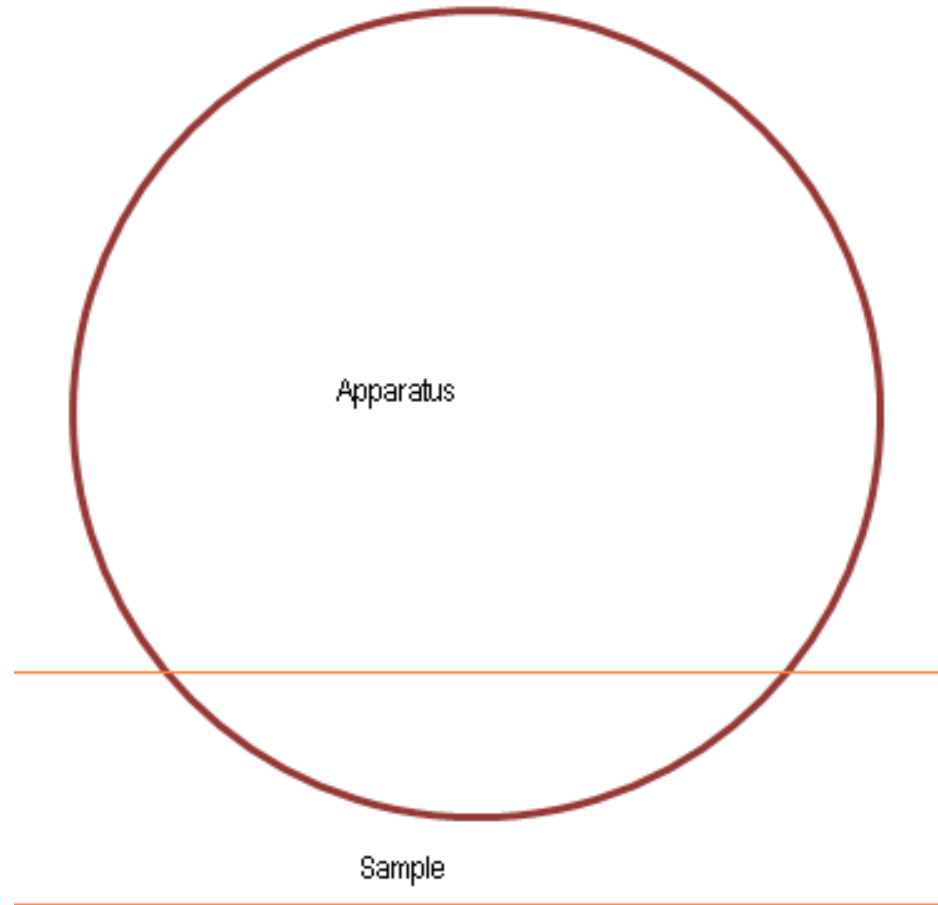
Dimension Nominal Value - mm	Measured Value as Received	Measured Value After	Required Minimum Value	Required Maximum Value	Pass/ Fail
2.5 mm radius	2.539mm	2.539	2.40mm	2.60mm	P
2.039 kg	1.9985 kg	2.0446	2.019kg	2.059kg	P
Balance	OK	OK			P

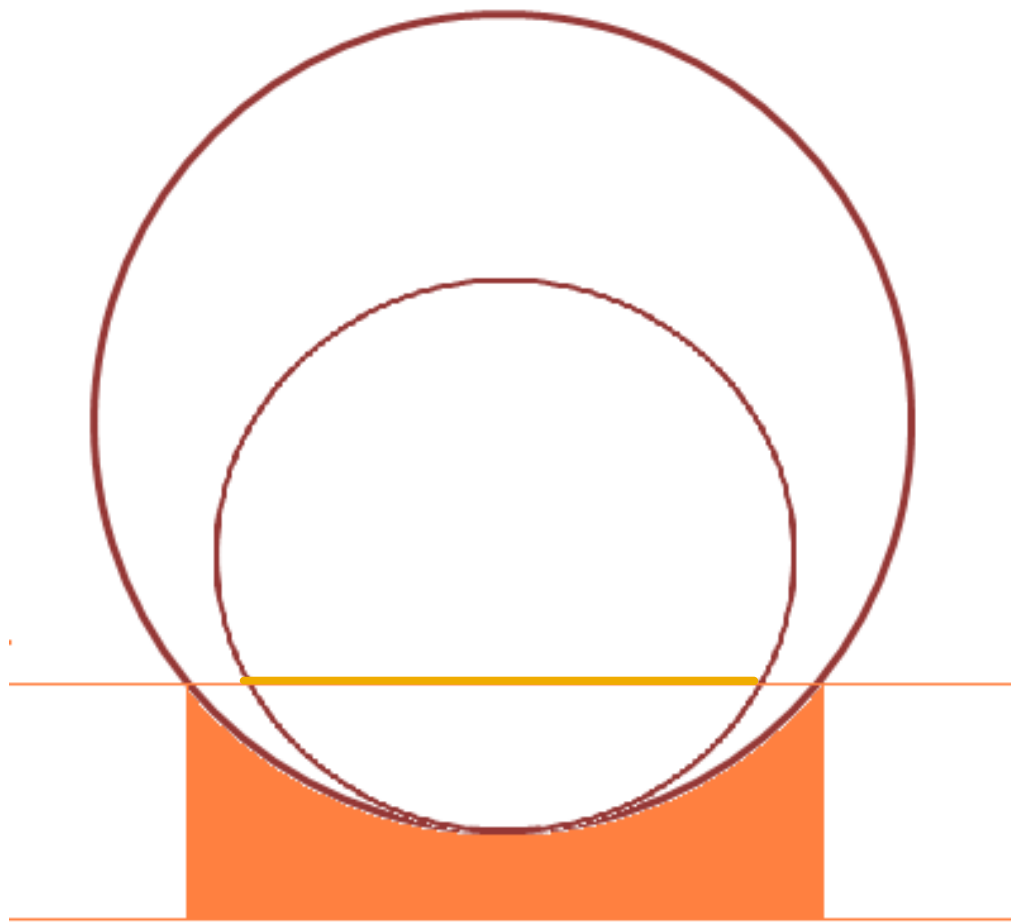
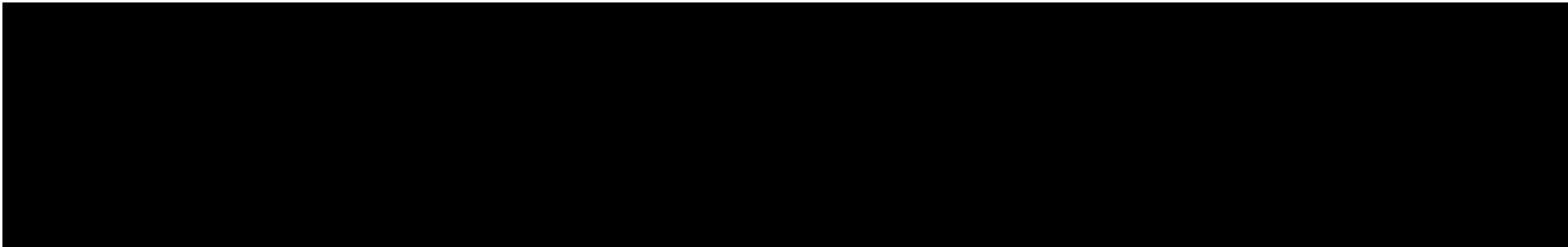
Notes: Shaded area shows out of tolerance condition. Weights were added.

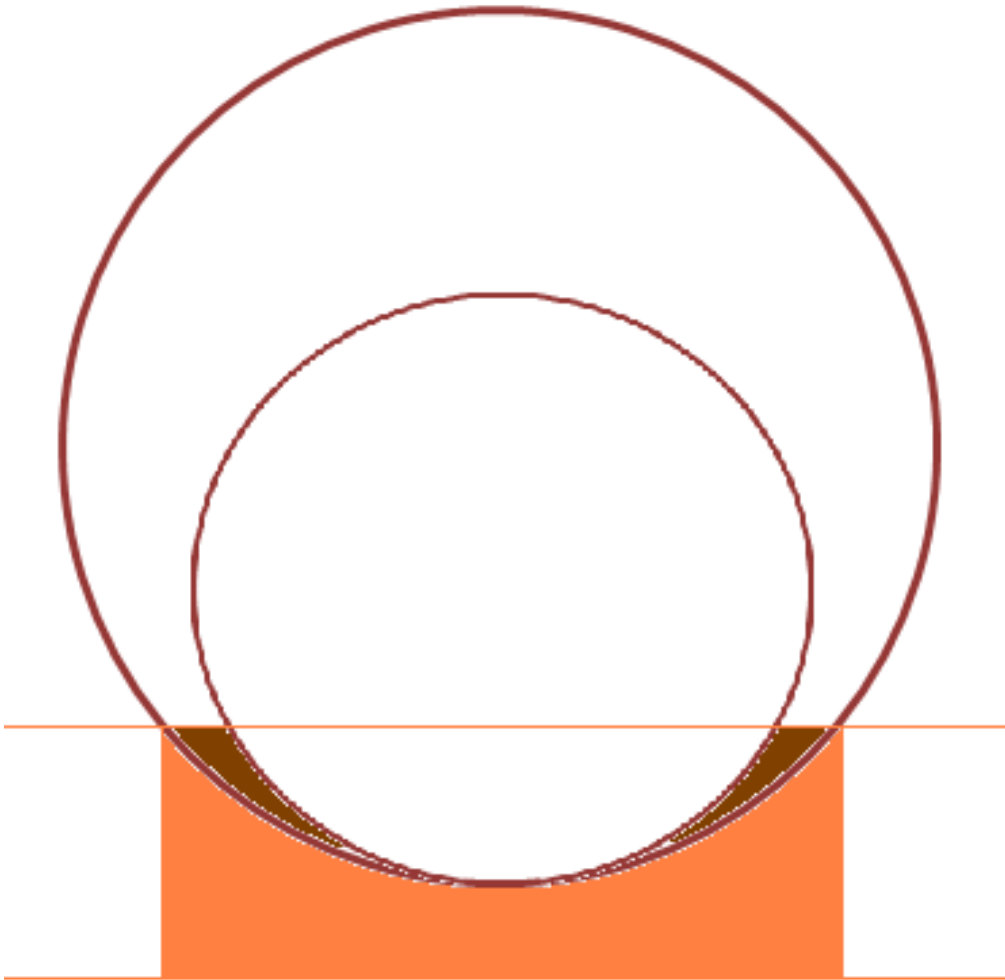
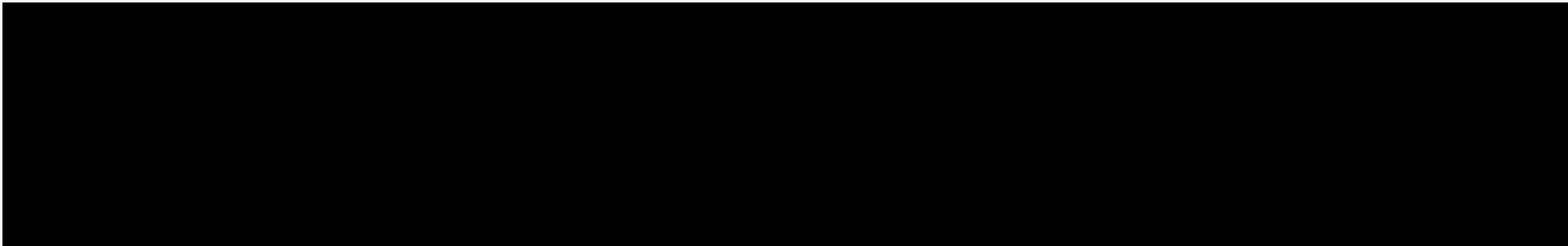
11/11/2014 10:11:11 AM

- ⓘ Above is an excerpt from a calibration certificate.
- ⓘ The requirement in the standard is for the diameter of the ball to be 5.0mm. (In another part of the standard, the radius is mentioned as 2.5mm)
- ⓘ What so you think about the specified limits for required maximum and minimum values?
- ⓘ What do you think about the acceptability of the ball?

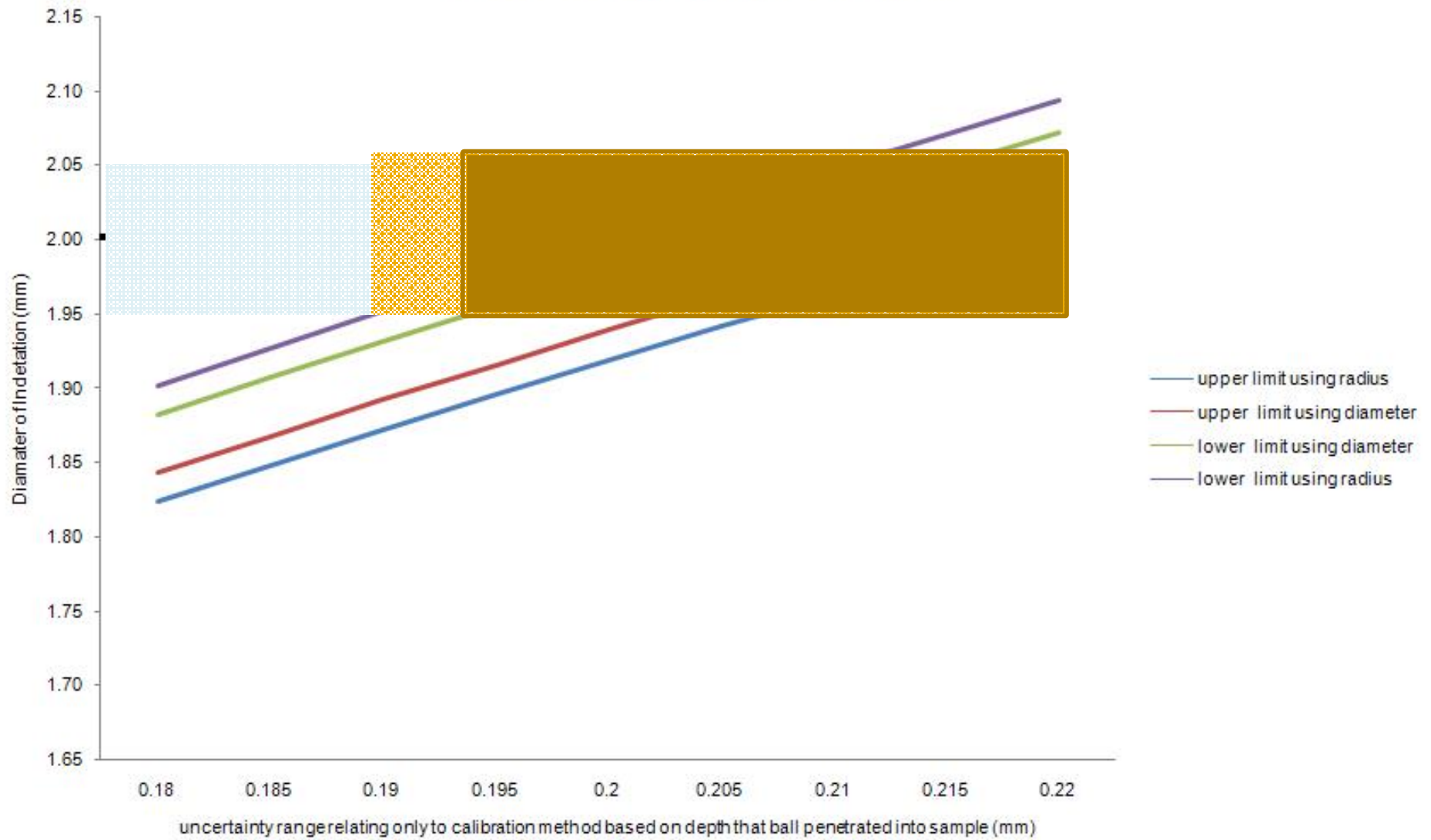
# Does Size Matter?

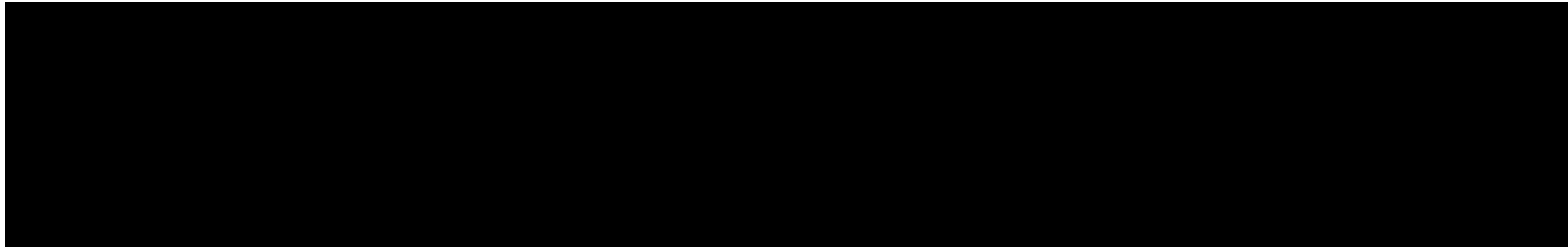






Effect of Calibration Method: Ball Pressure Apparatus





calibration method/depth  
of indentation (theoretical)

0.185

upper limit using radius

1.8

upper limit using diameter

1.9

lower limit using diameter

1.9

lower limit using radius

1.9

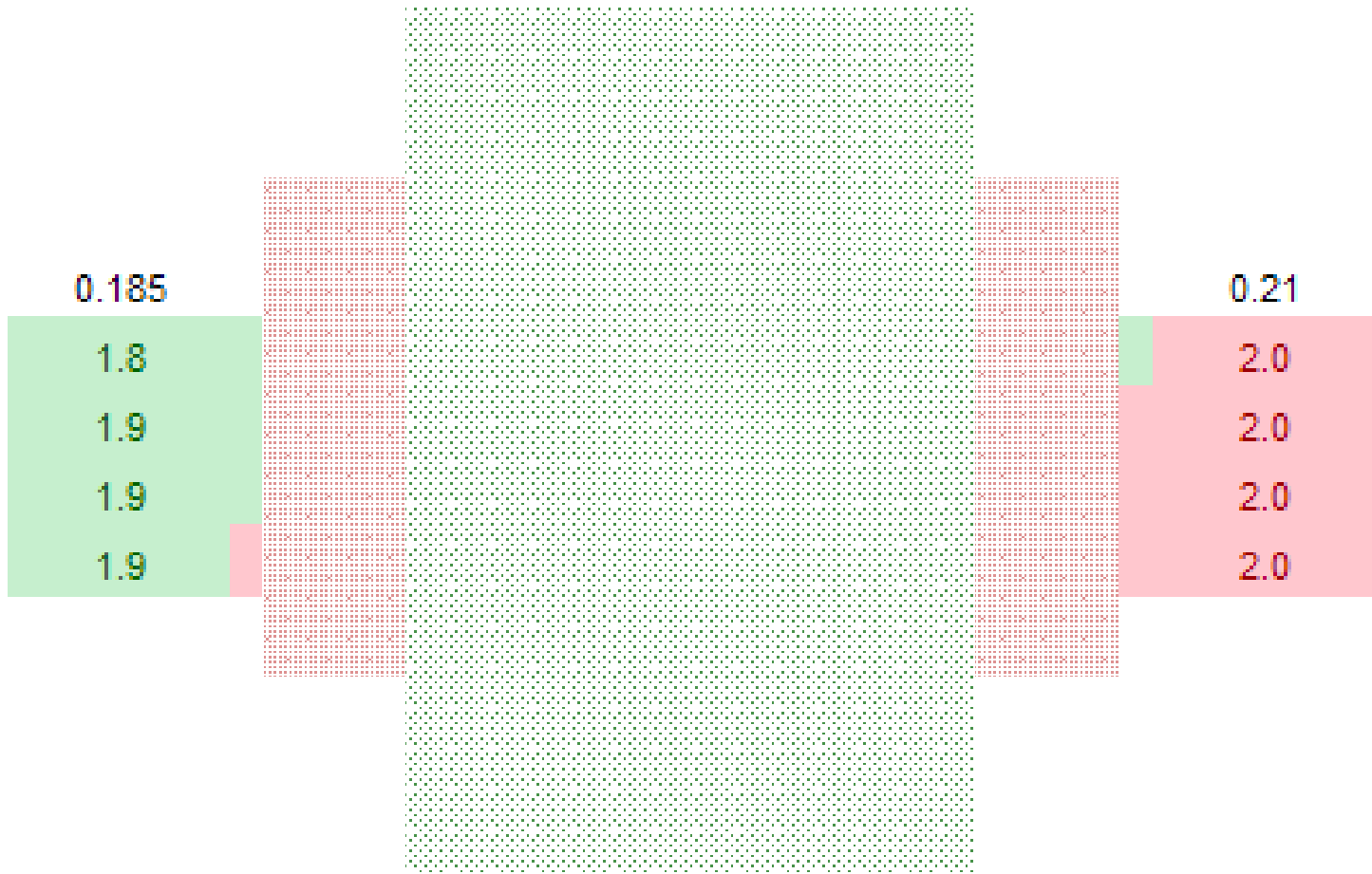
0.21

2.0

2.0

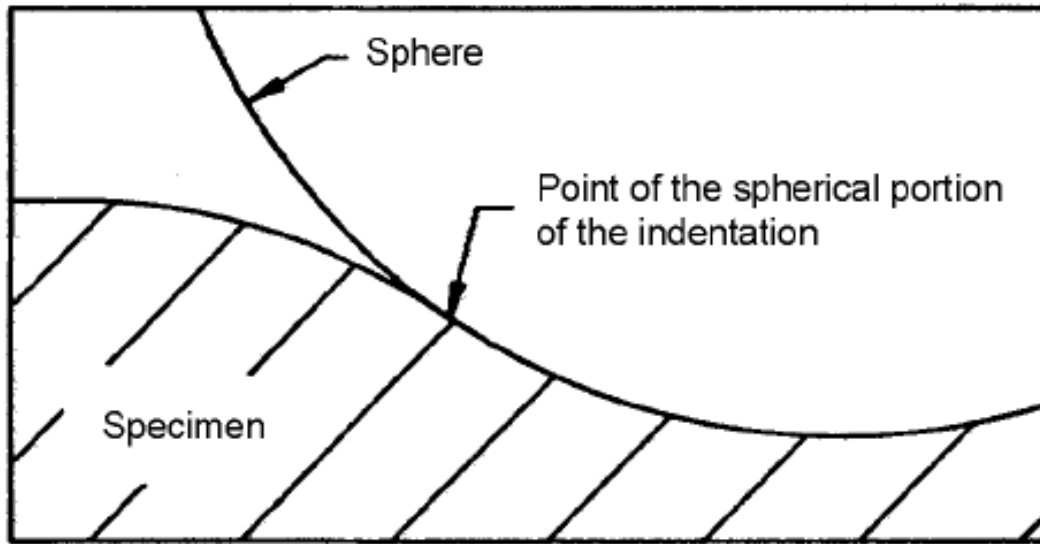
2.0

2.0



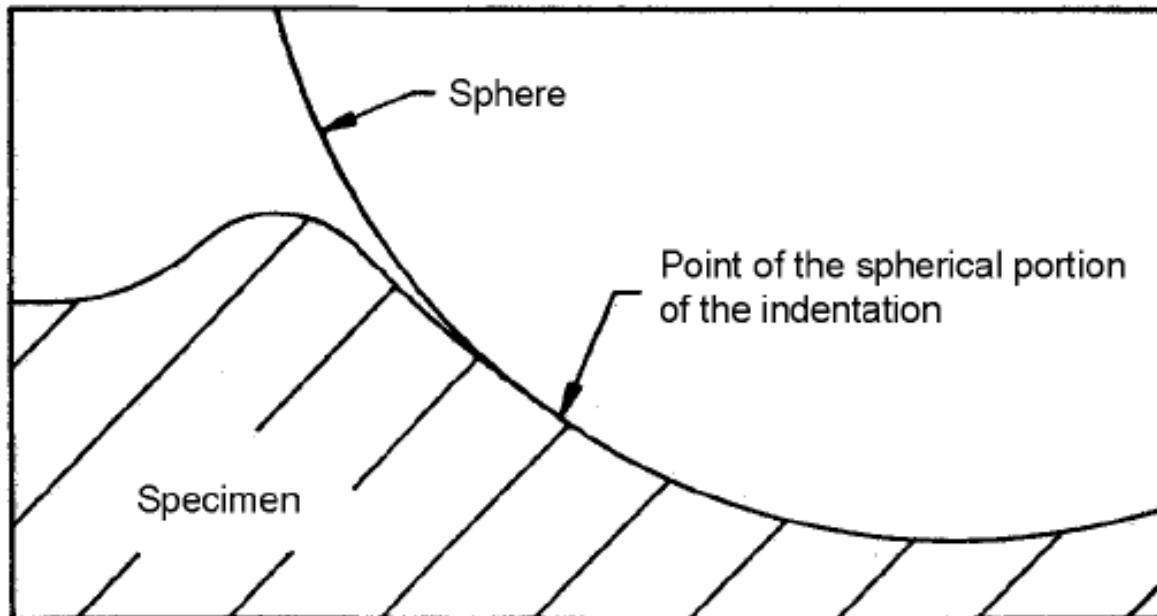
# So? Does (Ball) Size Matter?

- ⓘ In cases where the measured result is closer to the pass/fail limit
- ⓘ Confidence is improved when ball is calibrated using the diameter



IEC 1542/01

Figure 2c

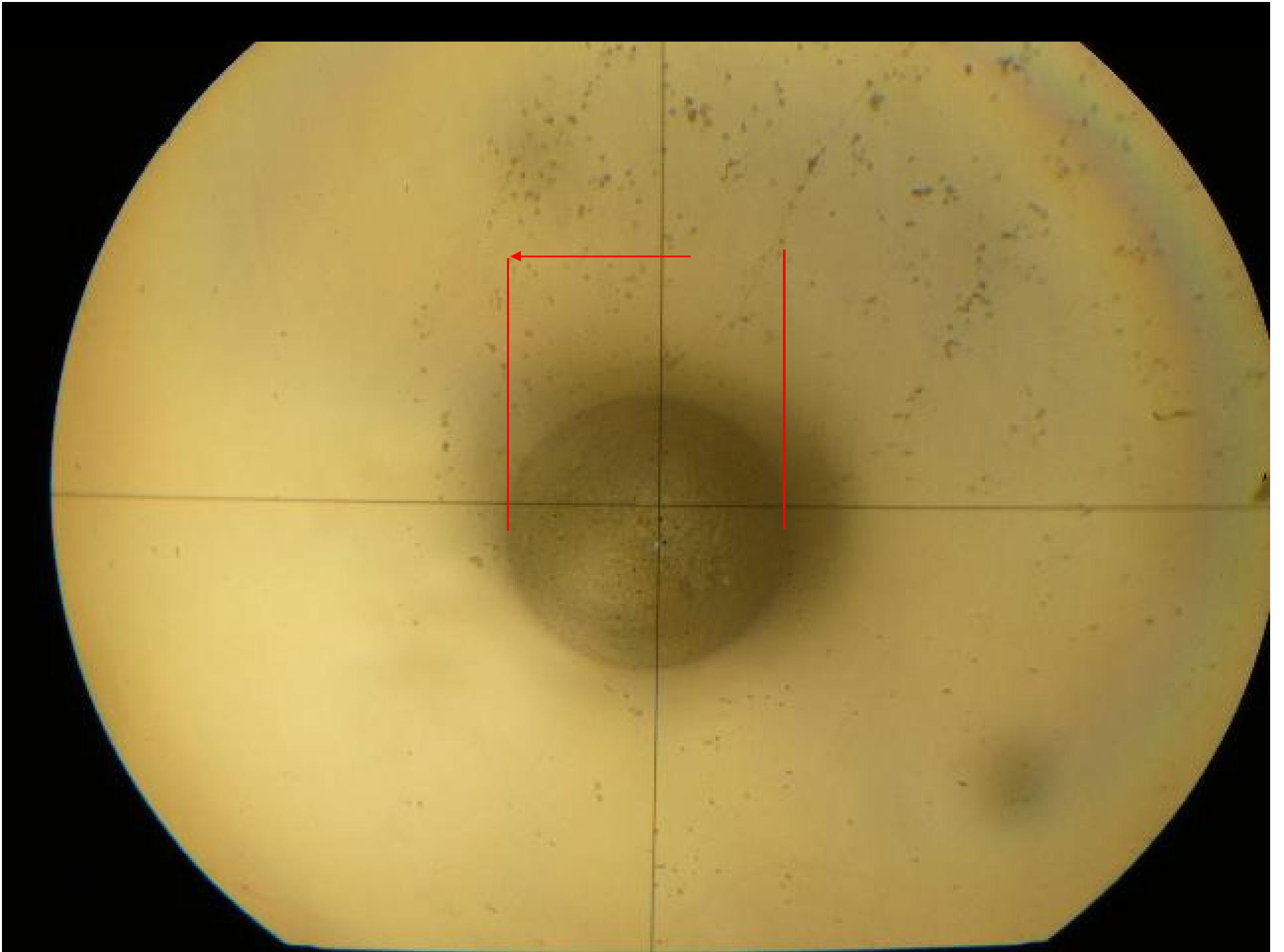


Q4 12  
(19)

3.7-3.8.

1,4








A #1

2.17



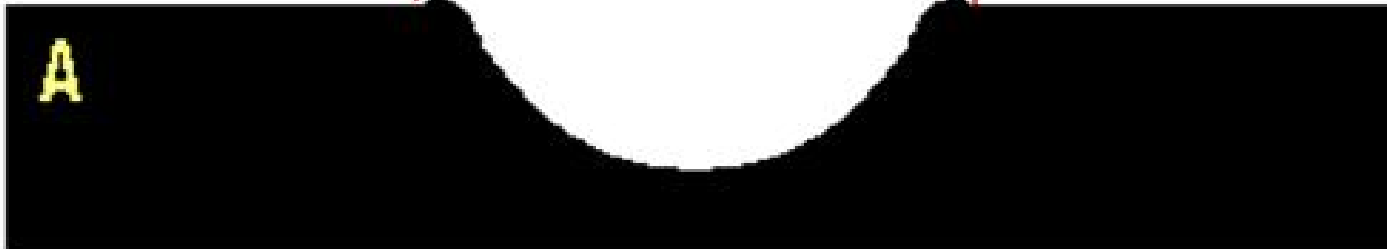
3.31mm

??

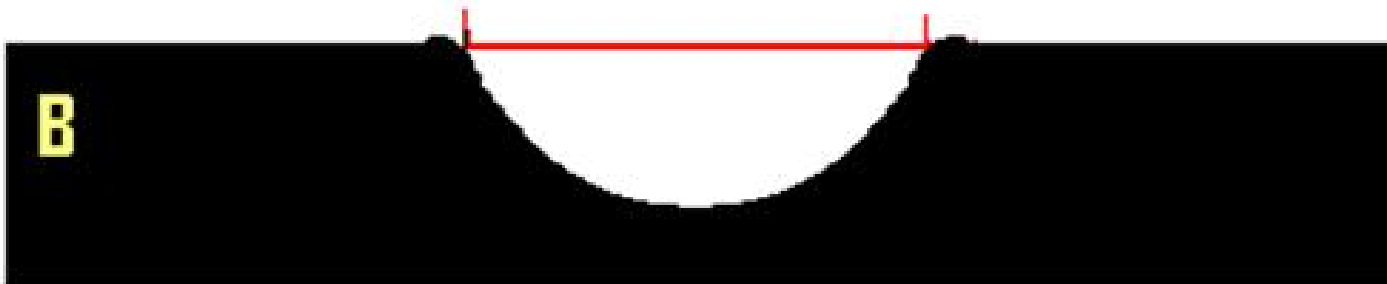
- ⓘ Although none of the photographs accurately show 3 dimensional image the way the eye sees it, all pictures look like the measurement is taken at the “solid” edge.
- ⓘ Point of inflexion?

# What is the effect of choice of measuring points?

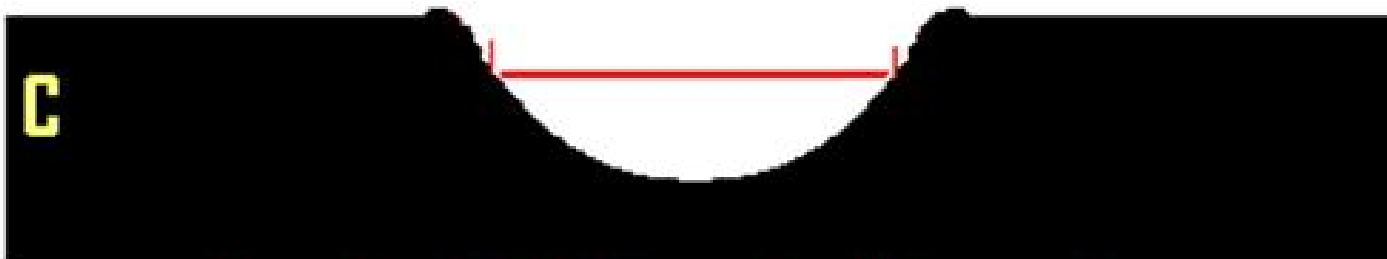
- ⓘ This may depend on the characteristics of the sample.
- ⓘ In 09e34, all the samples had clear, clean indentations. Samples A/C (duplicates) had very reproducible results. Sample B had inherent variations within the sample (wide results)
- ⓘ The question about measuring points was asked:



between the outer extremities, including any distorted material around the indentation



Points where the indentation commences relative to the plane of the sample face

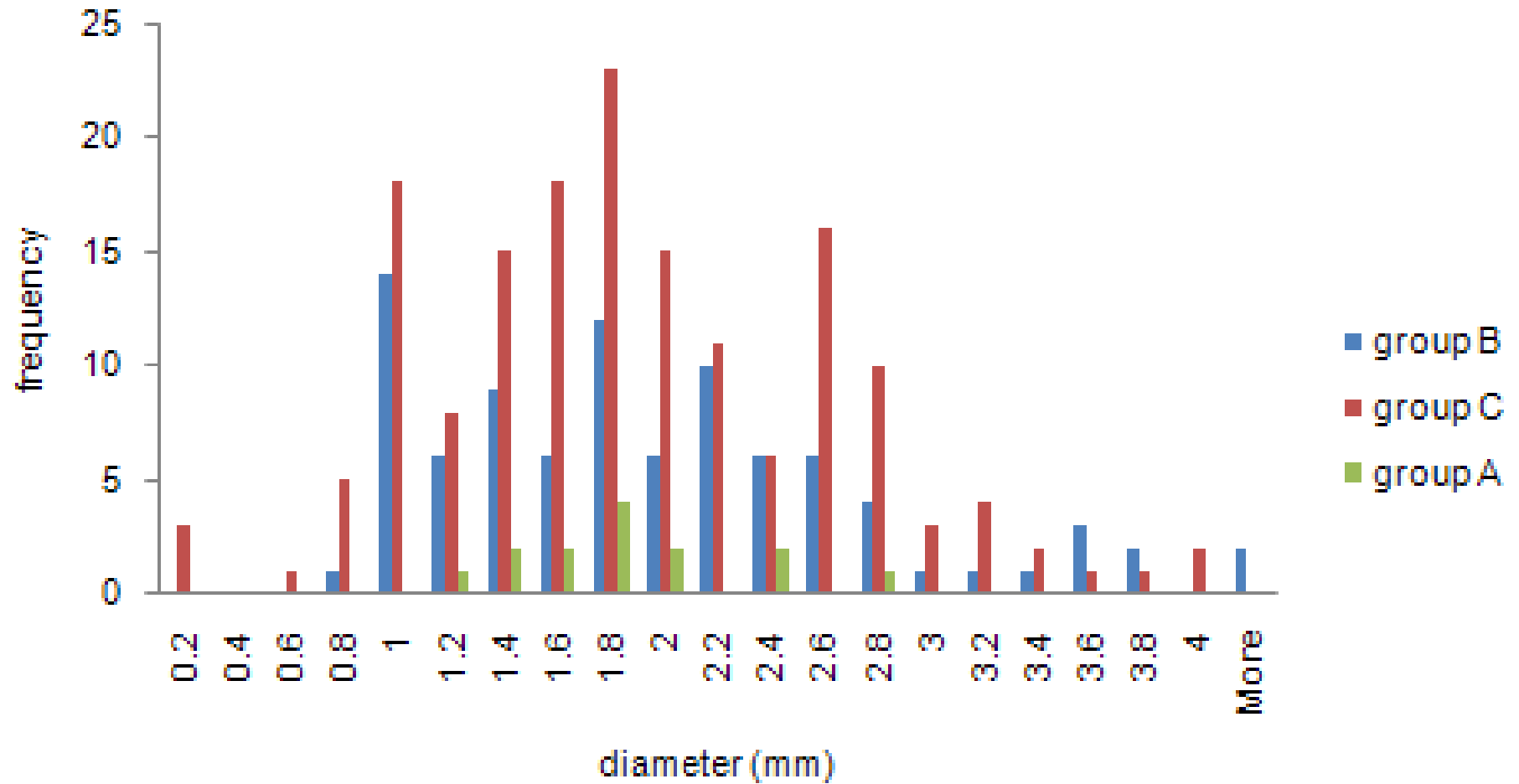


between the points of inflexion produced by the apparatus

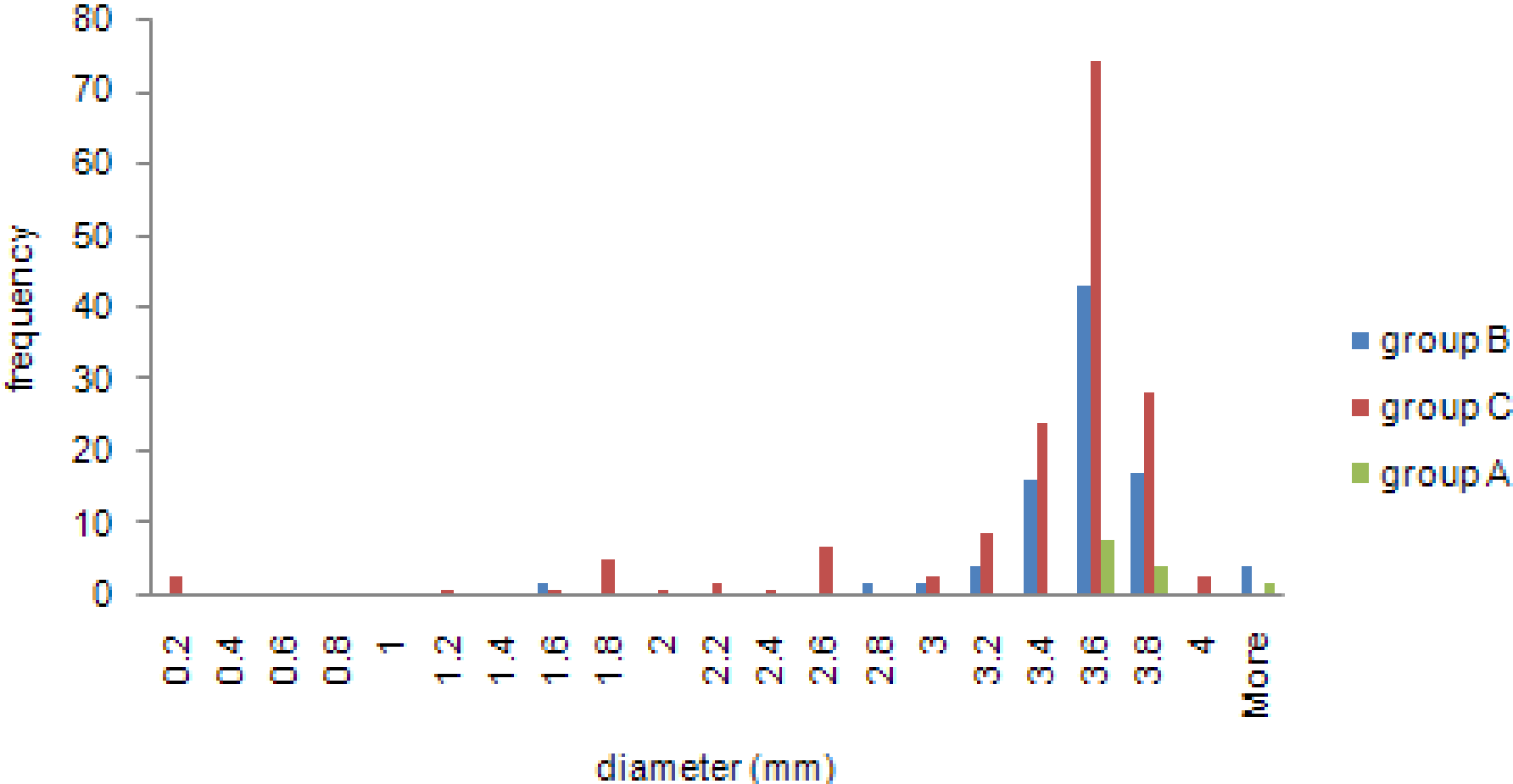
- ⓘ Group A: took the widest area of deformation
  - ⓘ Group B: took the points of indentation relative to the surface of the sample
  - ⓘ Group C: took the point of inflexion
- 
- ⓘ Results?

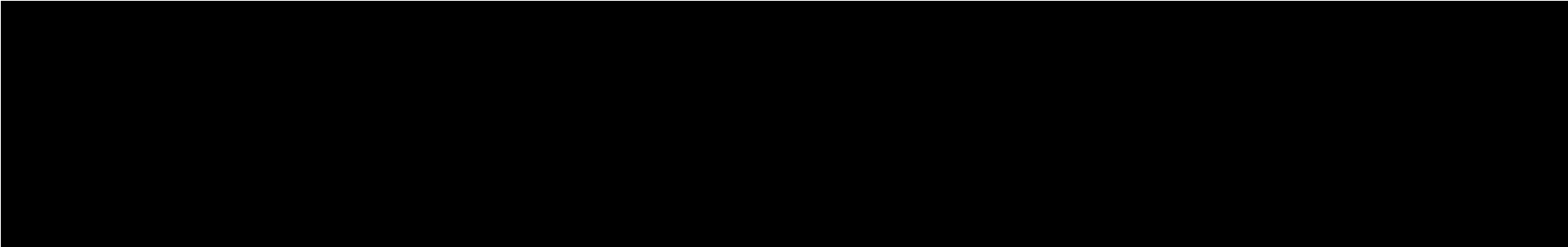
- ❗ 15% of the comments received regarding the choice of measuring points used the words “difficult” or “impossible” when referring to determining the point of inflexion

Sample B



# Sample A



- 
- Complete the handout for ball pressure test
  - Identify all the steps in the testing process
  - Highlight the possible risks of obtaining inaccurate test results
  - Prioritise them
  - Suggest some mitigating activities that could be implemented as preventive actions

### **3 General description of the test**

With the test specimen at a temperature specified in the relevant specification, a specified downward force is applied through a steel ball and dimension  $d$  of the indentation is measured as described in 7.2.

### **4 Test apparatus**

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# Sum up - Ball Pressure Test

# Sum up – preventive actions