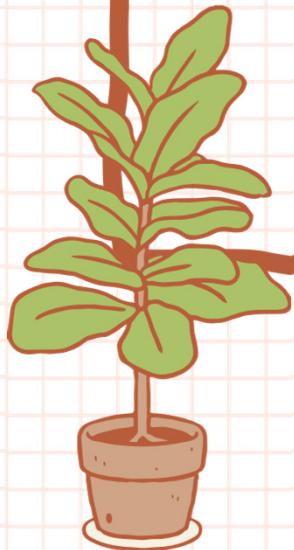


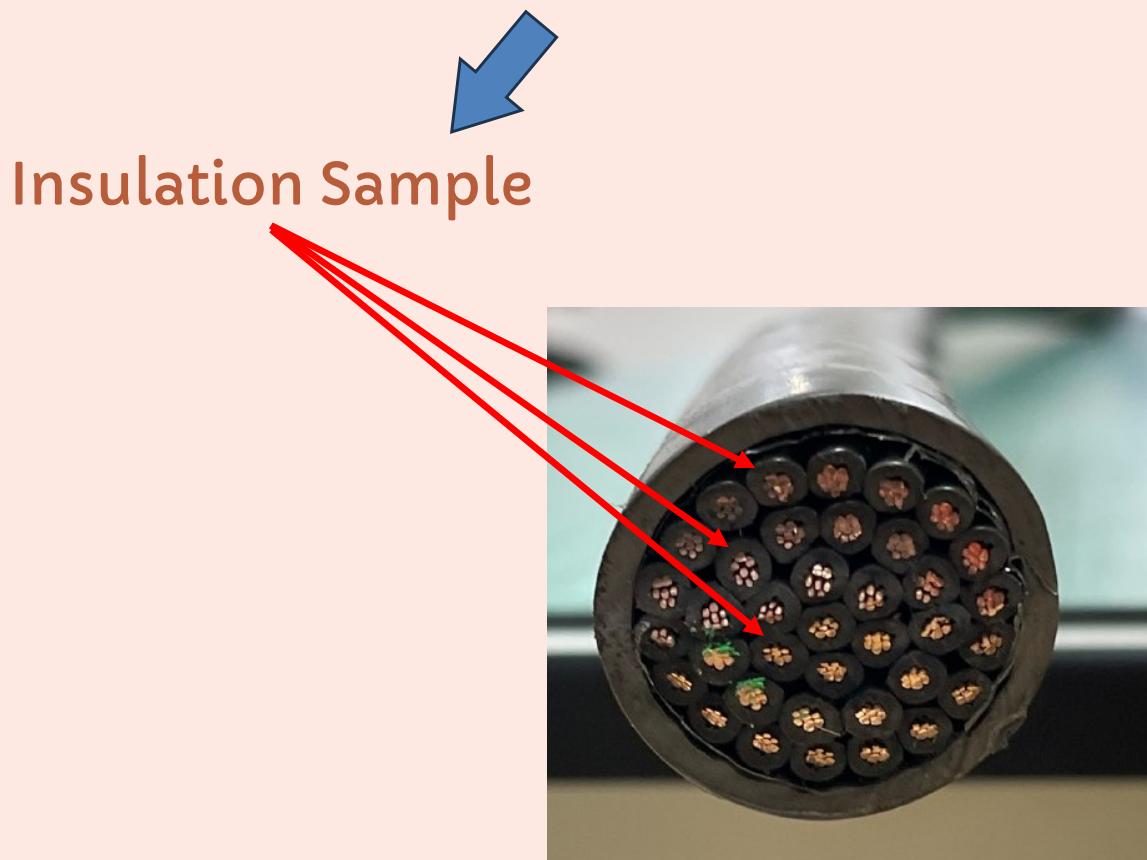


Shrinkage Test

Presented by Keystone-cable



Type of Shrinkage Test



Shrinkage test is a test on insulation

Sampling Criteria

Sampling Length:

- Take 30 cm sample of the cable
- Collect two samples to obtain two values for recording at a later stage

Location for Sampling:

- Samples should be taken at least 0.5 m away from the end of the cable length

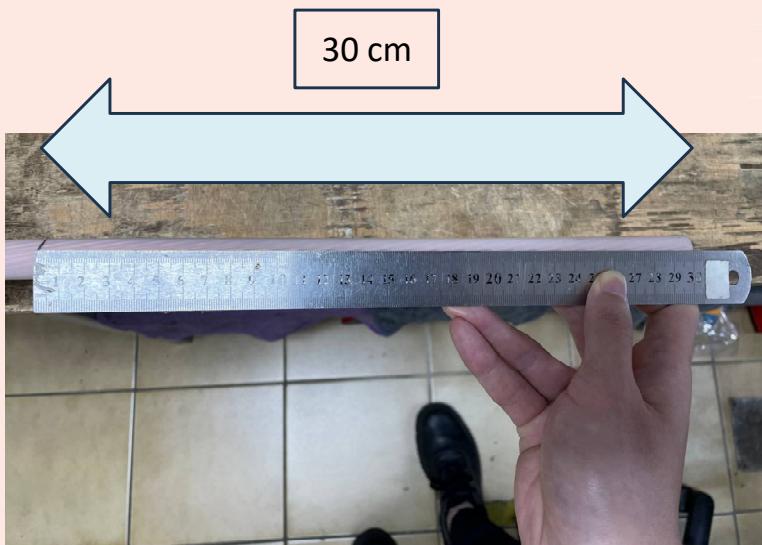
Pre Heating of Oven



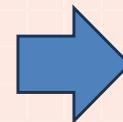
Important information for shrinkage test :

Pre-heat the oven to a temperature of $(130 \pm 3)^\circ\text{C}$, otherwise specified by test requirement (refer to [Appendix 1](#)), as pre-heating takes time!

Preparation of Test Material



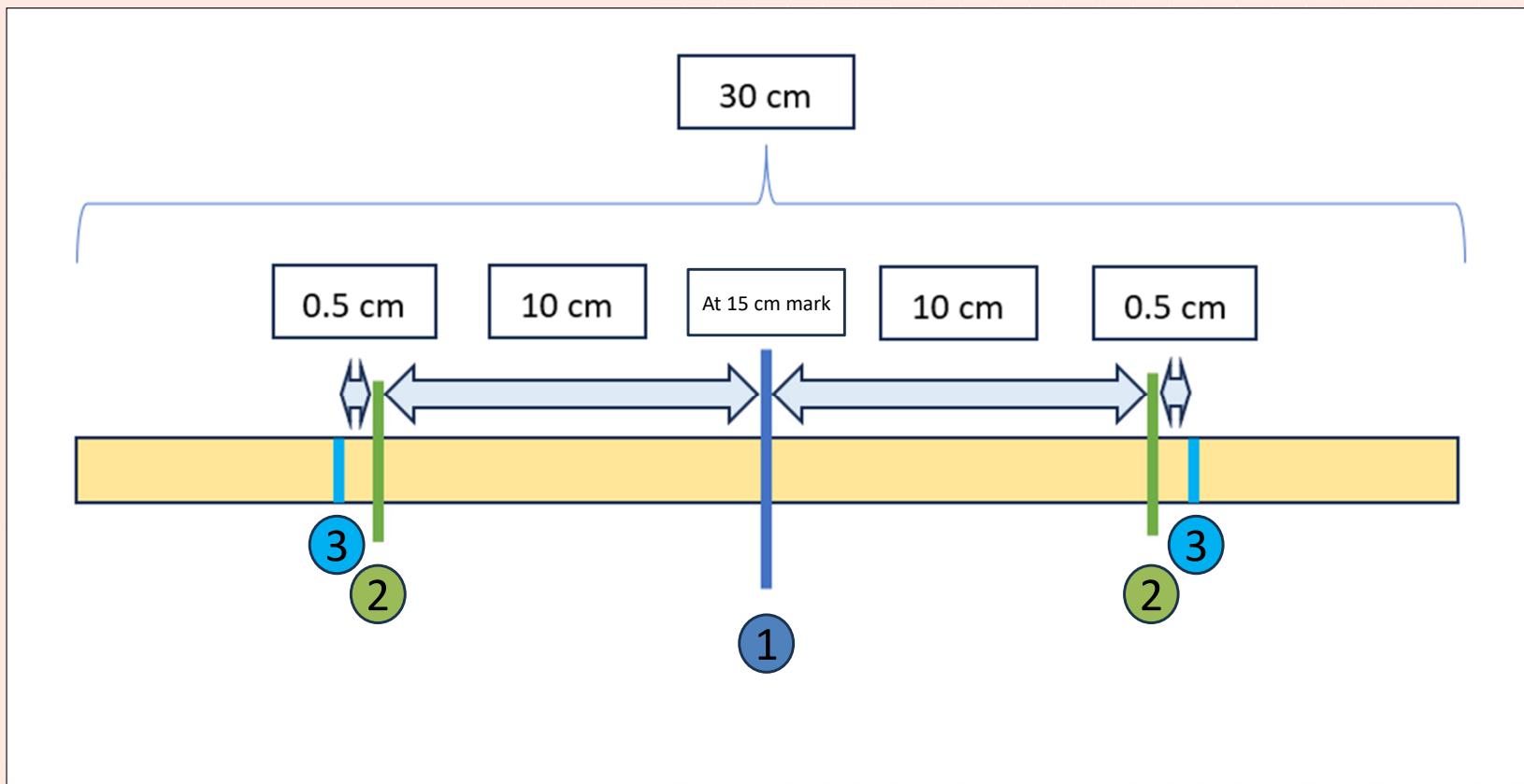
Measure and mark a length of 30 cm on the test material using a ruler



Use a cutting tool to cut the test material to the marked 30 cm length

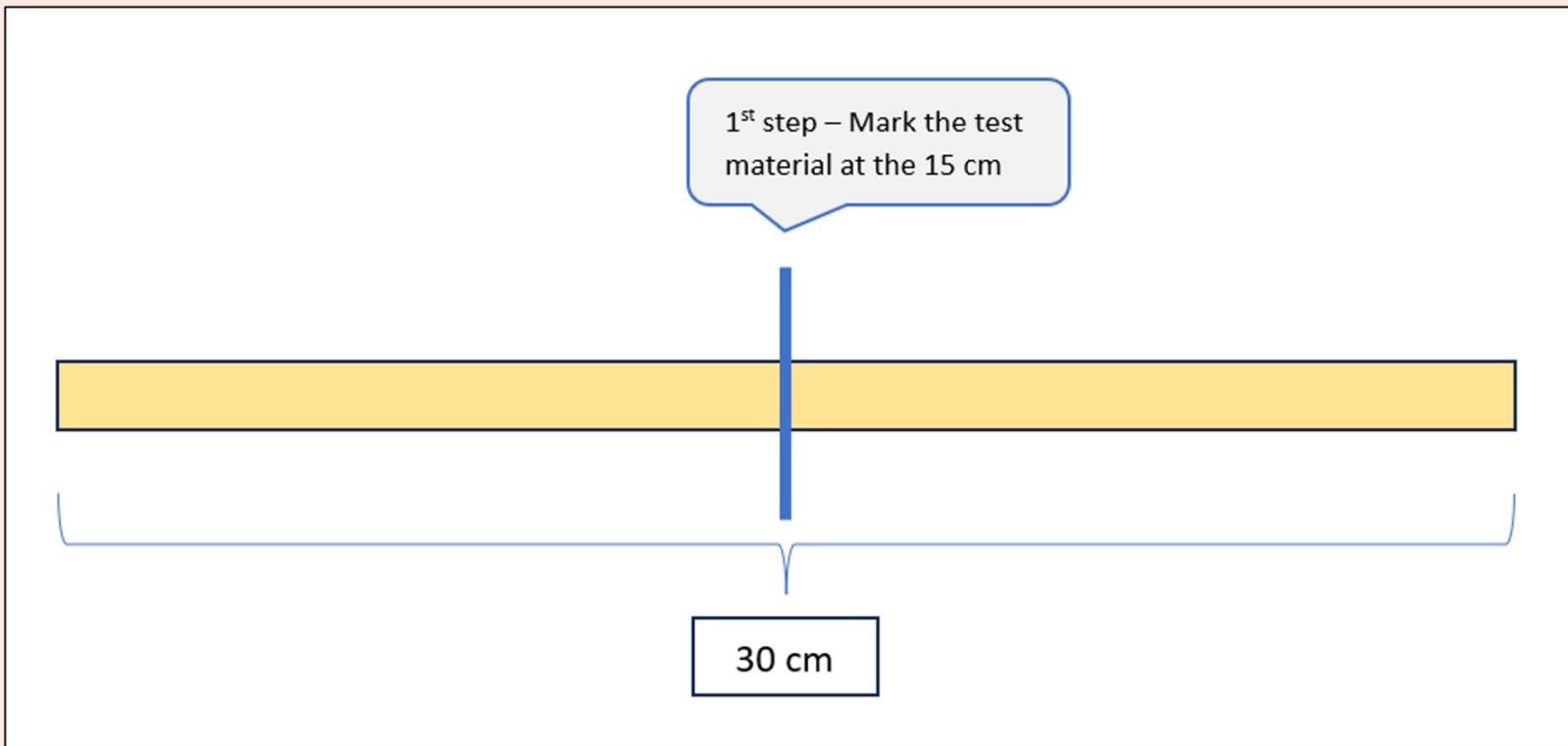
But how to prepare all the markings within the 21 cm section of this 30 cm test material? (next slide)

Preparation of Test Material



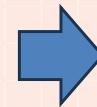
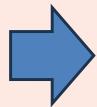
Next slide features a short and interesting video on the steps to prepare this test material!

Preparation of Test Material



Short Video

Cutting Procedures



A real example of markings for
 $20 \text{ cm} \pm 0.5 \text{ cm}$

Use a pen knife and carefully cut
the insulation along both sides of
the outermost markings

Remove the insulation from both ends
of the sample to expose the conductor

You can ensure the test material is
straight by taping down both ends

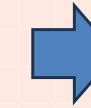
Oven Procedures - Safety



During the experiment:

1. Safety first - Wear gloves before touching any part of the oven
2. Ensure that the temperature of the oven is stable at approximately 130°C before you open the oven door to put in your test material

Oven Procedures



Open the oven door and place your test sample horizontally. The conductor will be supported on the metal plates to prevent the insulation from coming into contact with any metal part of the oven

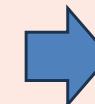
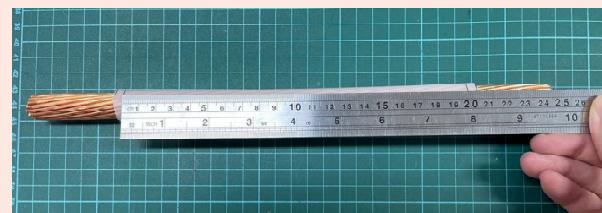
Close the oven door and wait until the temperature reaches the required test temperature before starting the timer

After 1 hour testing duration is complete, place the hot test sample on the designated steel area and close the oven door

Housekeeping – To turn off the oven, press and hold onto the “start/stop” button, eventually after the temperature has cooled down, you can switch oven off. Additionally, do turn off all the lights and fans before leaving the test location

Testing Procedure

Allow the test sample to cool to room temperature



Once the test piece has cooled, measure the distance between the two markings again



Now, we can perform calculation to determine whether your test sample meets the test criteria

Percentage Shrinkage Example

Before heating treatment which is 20 cm

After heating and cooling

$$\text{Percentage Shrinkage} = \frac{\text{distance measured before test} - \text{distance measured after test}}{\text{distance measured before test}} \times 100\%$$

Percentage Shrinkage Practice

After finishing your test sample in the oven and allowing it to cool down, you need to calculate the percentage shrinkage.

Given that the initial marked length before the shrinkage test was 20 cm, and after the test, the length has changed as shown below, calculate the percentage shrinkage.



Try this question now!

Percentage Shrinkage Practice Answer

we can sub all required values into the percentage shrinkage formula:

$$\begin{aligned}\text{Percentage Shrinkage} &= \frac{\text{distance measured before test} - \text{distance measured after test}}{\text{distance measured before test}} \times 100\% \\ &= \frac{20 \text{ cm} - 19.9 \text{ cm}}{20 \text{ cm}} \times 100\% \\ &= 0.5\%\end{aligned}$$



THANK YOU

Appendix 1 - Test Requirement for Shrinkage Test

- 40 -

IEC 60502-1:2021 © IEC 2021

Table 17 – Test requirements for particular characteristics of various cross-linked insulating compounds

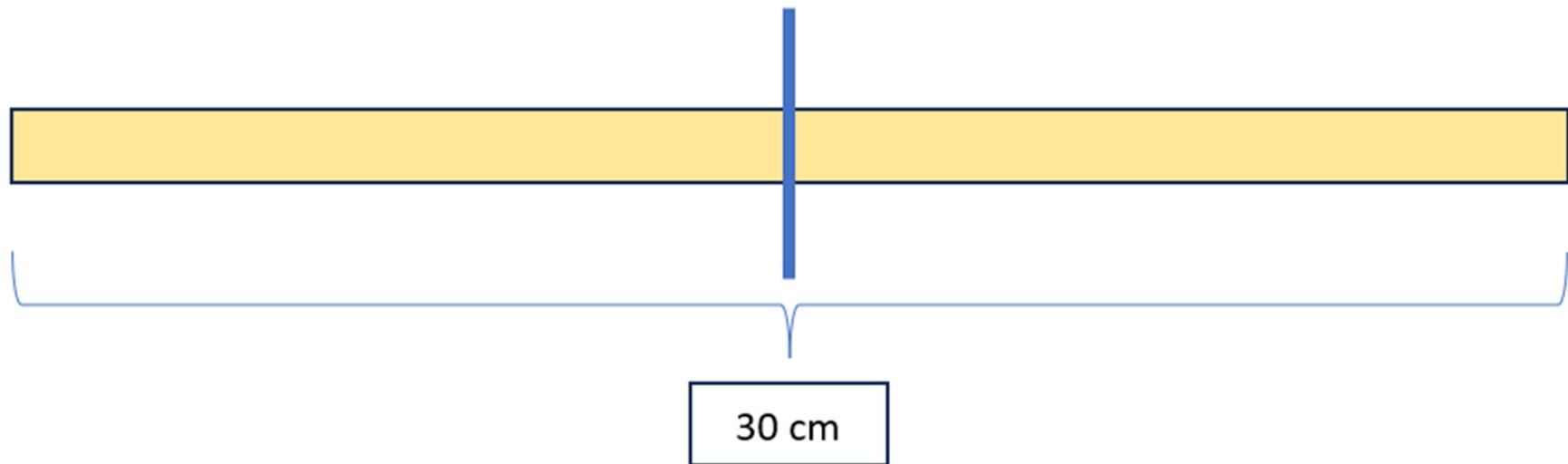
Designation of compound (see 4.2)	Unit	EPR	HEPR	XLPE
Ozone resistance (IEC 60811-403)				
Ozone concentration (by volume)	%	0,025 to 0,030	0,025 to 0,030	–
Test duration without cracks	h	24	24	–
<i>Hot set test</i> (IEC 60811-507)				
Treatment:				
– air temperature (tolerance ± 3 K)	$^{\circ}\text{C}$	250	250	200
– mechanical stress	N/cm^2	20	20	20
Maximum elongation under load	%	175	175	175
Maximum permanent elongation after cooling	%	15	15	15
<i>Water absorption</i> (IEC 60811-402)				
Gravimetric method:				
Treatment:				
– temperature (tolerance ± 2 K)	$^{\circ}\text{C}$	85	85	85
– duration	h	336	336	336
Maximum increase of mass	mg/cm^2	5	5	1 *
<i>Shrinkage test</i> (IEC 60811-502)				
Distance L between marks	mm	–	–	<u>200</u>
Treatment:				
– temperature (tolerance ± 3 K)	$^{\circ}\text{C}$	–	–	130
– duration	h	–	–	1
Maximum shrinkage	%	–	–	4

Do refer to IEC 60502-1,
table 17 for test
requirement and criteria

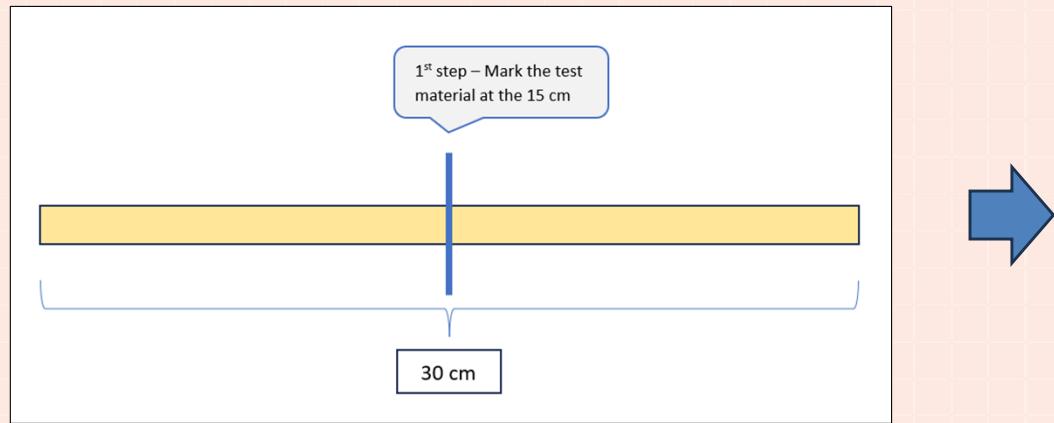


Preparation of Test Material

1st step – Mark the test material at the 15 cm

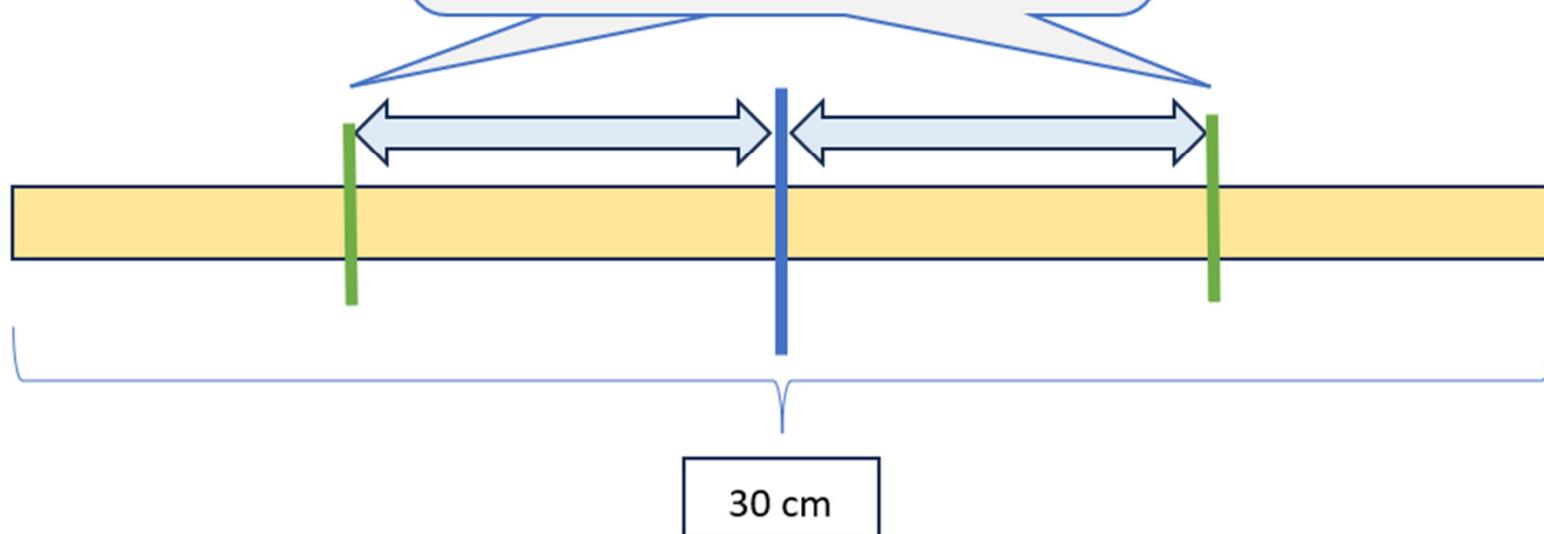


Preparation of Test Material

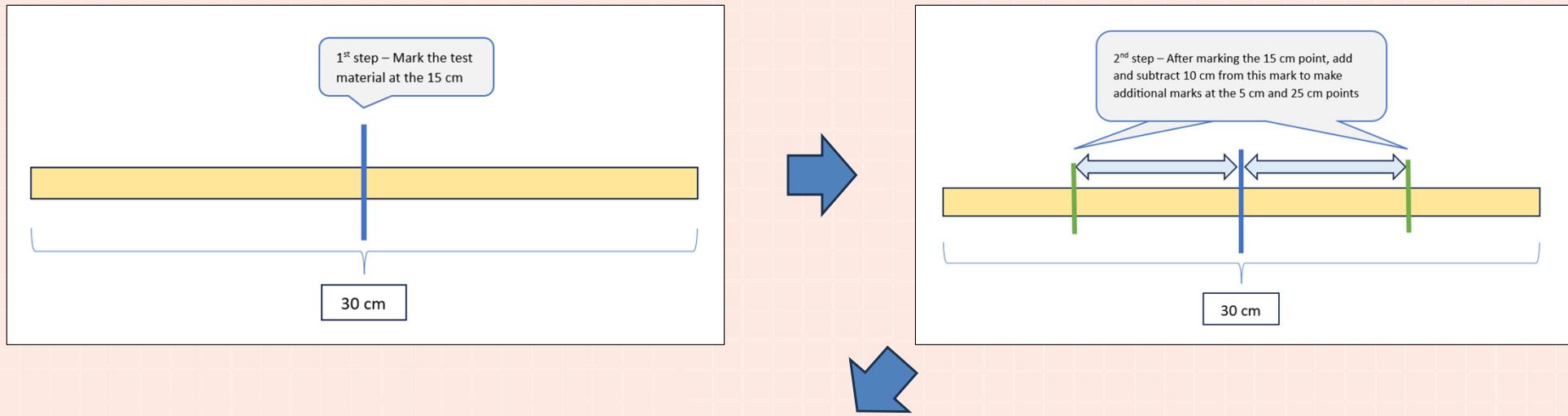


Preparation of Test Material

2nd step – After marking the 15 cm point, add and subtract 10 cm from this mark to make additional marks at the 5 cm and 25 cm points

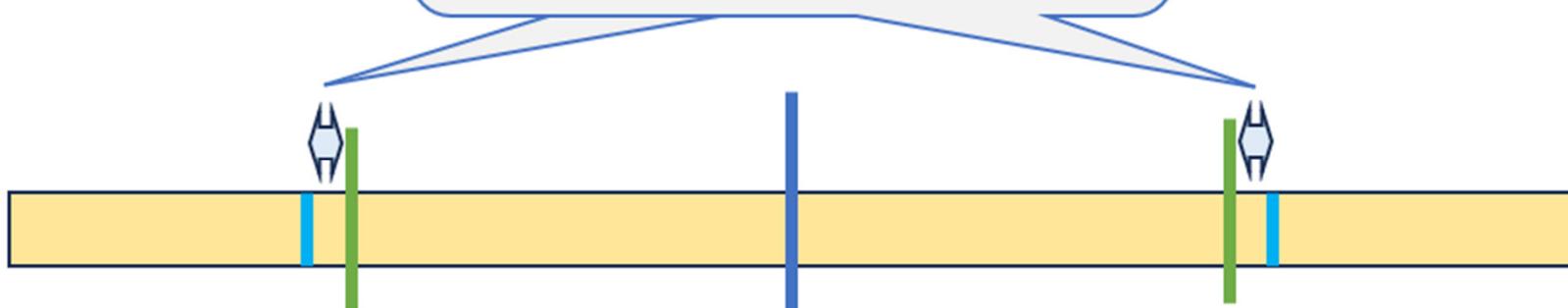


Preparation of Test Material



Preparation of Test Material

3rd step – After marking the 5 cm and 25 cm points, subtract 0.5 cm to the 5 cm mark **and** add 0.5 cm from the 25 cm mark to make additional marks at 4.5 cm and 25.5 cm points



30 cm

Preparation of Test Material

