# Experimental Investigation of Surface Film Finish Time of Replicating Materials Microset 101 RT

*Session 3E*
*Surface Engineering I*

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# Objective of Investigation
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Provide time vs temperature guidelines for use of replicate materials utilized to provide three dimensional cylinder bore surface finish characteristics including quantification of torn and folded material

# Process developed to provide improved method of quantifying cylinder bore finish
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Replicate material set and cure times

| Time To Set / Time to insert into Bore | 30 seconds |
|---|---|
| Time to Cure / Time Left in Bore | 5 minutes |

Replicate material is dispensed into replicate bar utilizing a nozzle with an integral scraper to provide a uniform fill

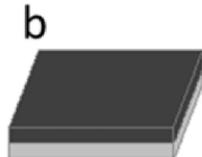Replicator head is inserted into bore and air pressure is applied

Original hone surface

Replicate material cures
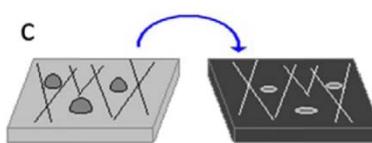
Replicate material is removed producing a negative imprint of the original surface

SEE 3-D replicate is examined with white light interferometer

# Validation of Replicate Developed Surface Finish
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A significant amount of time and effort was expended to develop the 3-D surface replicating material that would:

- Repeatedly provide an accurate replication of the cylinder bore surface
- Have the required rigidity to permit handling between time of application in the replicate bar and initial loading against the cylinder (currently 30 seconds)
- Provide an accurate replicate of the surface to be rapidly developed in an acceptable time interval (currently 5 minutes)
- Avoid adherence to the cylinder bore surface with resultant modification of the replication surface during removal
- Permit use of system over an acceptable operating temperature range (currently 18ºC to 35ºC)

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# Standard Deviation Analysis
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| | Sa | Sci | Spk | Sk | Svk |
|---|---|---|---|---|---|
| | µm | | µm | µm | µm |
| **AVERAGE of Replicate** | 0.241 | 1.335 | 0.531 | 0.643 | 0.609 |
| **Standard Deviation of Replicate** | 0.032 | 0.181 | 0.084 | 0.038 | 0.274 |
| **AVERAGE of Direct** | 0.255 | 1.290 | 0.569 | 0.668 | 0.688 |
| **Standard Deviation of Direct** | 0.035 | 0.141 | 0.310 | 0.060 | 0.217 |
| Minimum of All | 0.185 | 1.094 | 0.375 | 0.543 | 0.293 |
| Maximum of All | 0.295 | 1.586 | 1.131 | 0.715 | 0.979 |
| Average of All | 0.256 | 1.337 | 0.639 | 0.669 | 0.671 |
| Standard Deviation of All | 0.032 | 0.149 | 0.225 | 0.048 | 0.233 |
| Std Dev of Ohlsson, et. all* | 1.02 | 0.901 | 1.185 | 0.844 | 0.658 |
| **6 σ range of Replicate values** | **0.190** | **1.088** | **0.504** | **0.227** | **1.643** |
| **6 σ range of Direct values** | **0.207** | **0.848** | **1.861** | **0.360** | **1.305** |
| **6 σ range of Ohlsson* values** | **6.120** | **5.406** | **7.110** | **5.064** | **3.948** |

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# A main hone line is measured and marked showing the instances of Torn and Folded material appearing in each numbered cell
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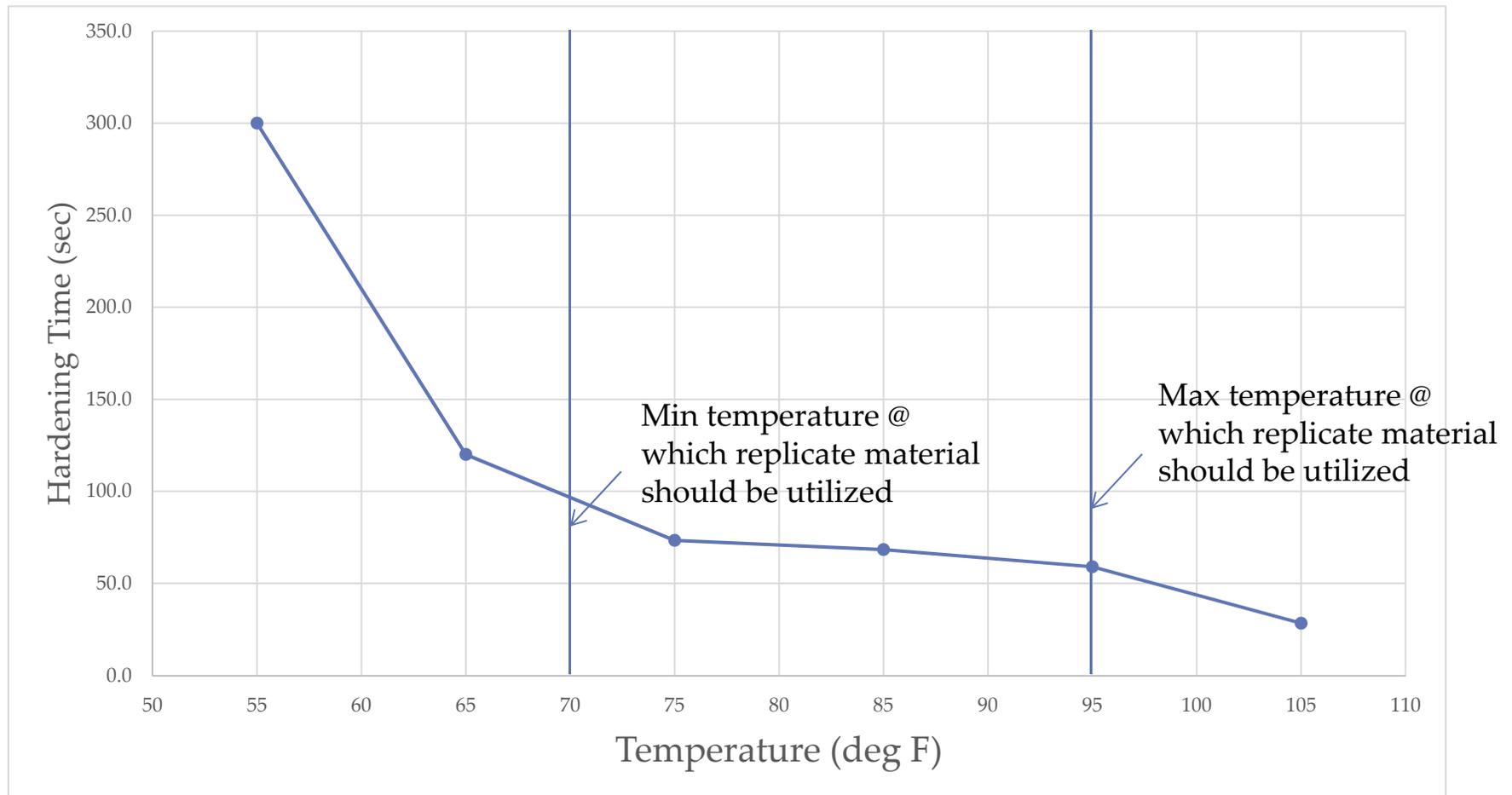SAINT LOUIS UNIVERSITY

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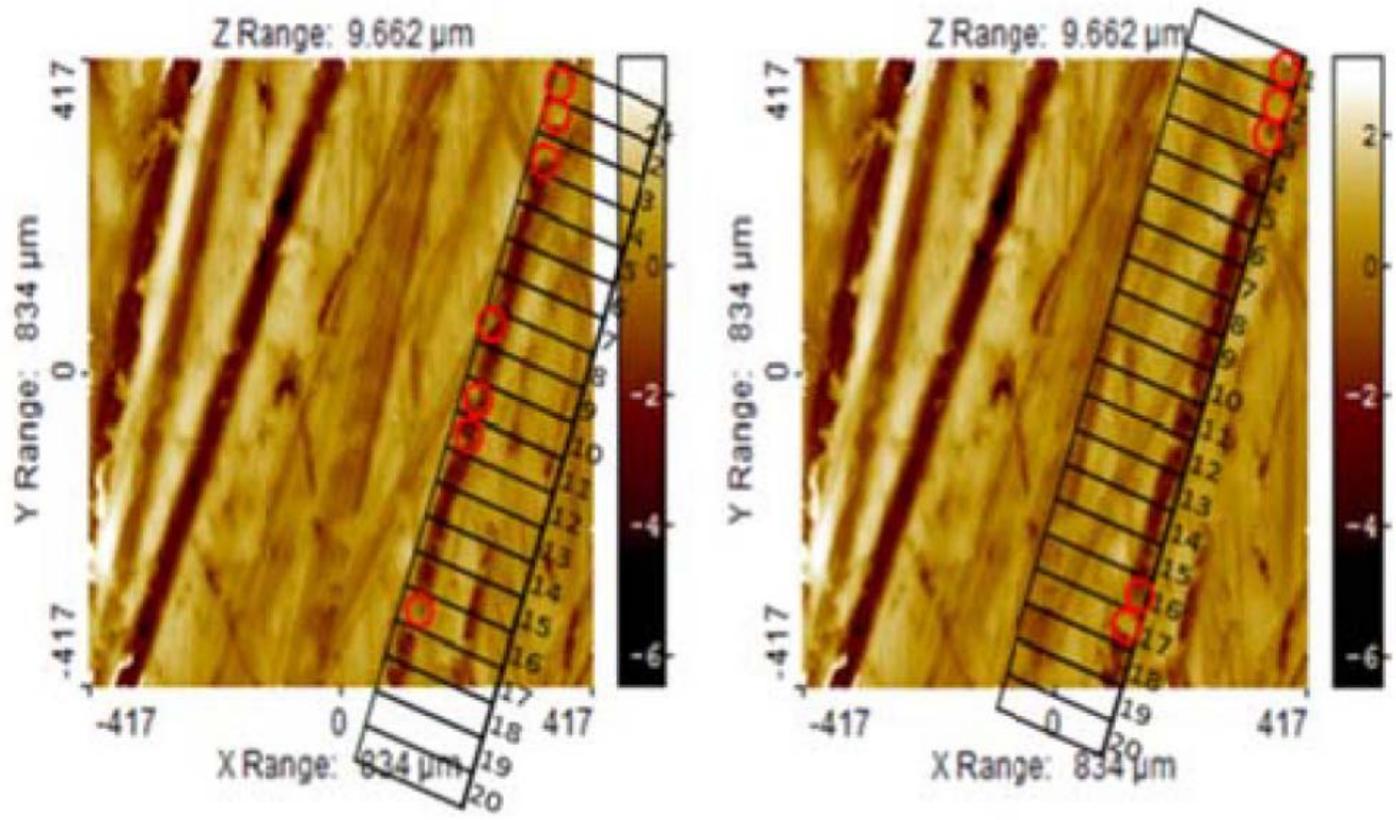
# Correlation between the manual Torn and Folded material analysis method and the automated Torn and Folded material analysis method for 20 reference images
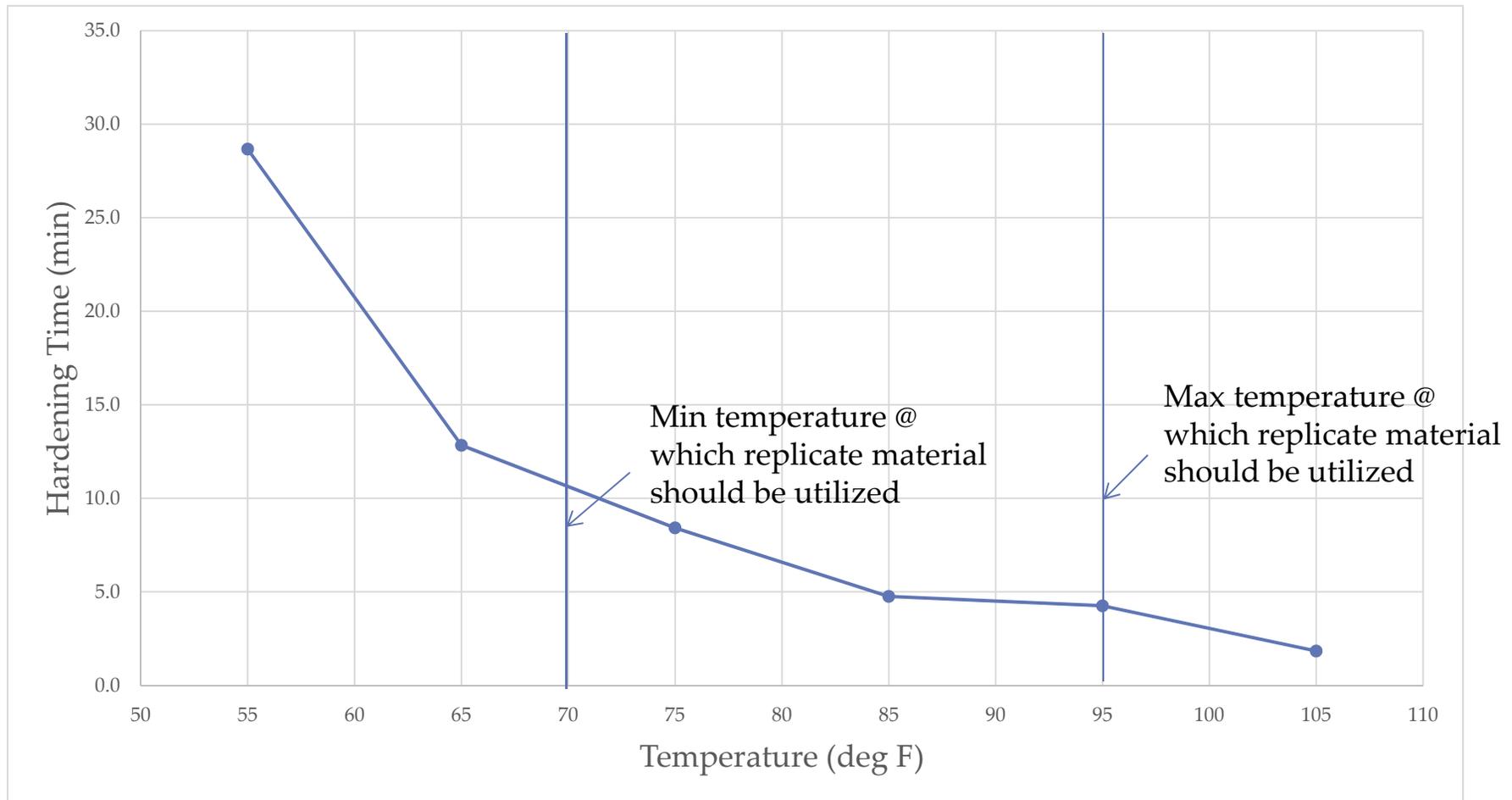## *Session 3E Surface Engineering I*
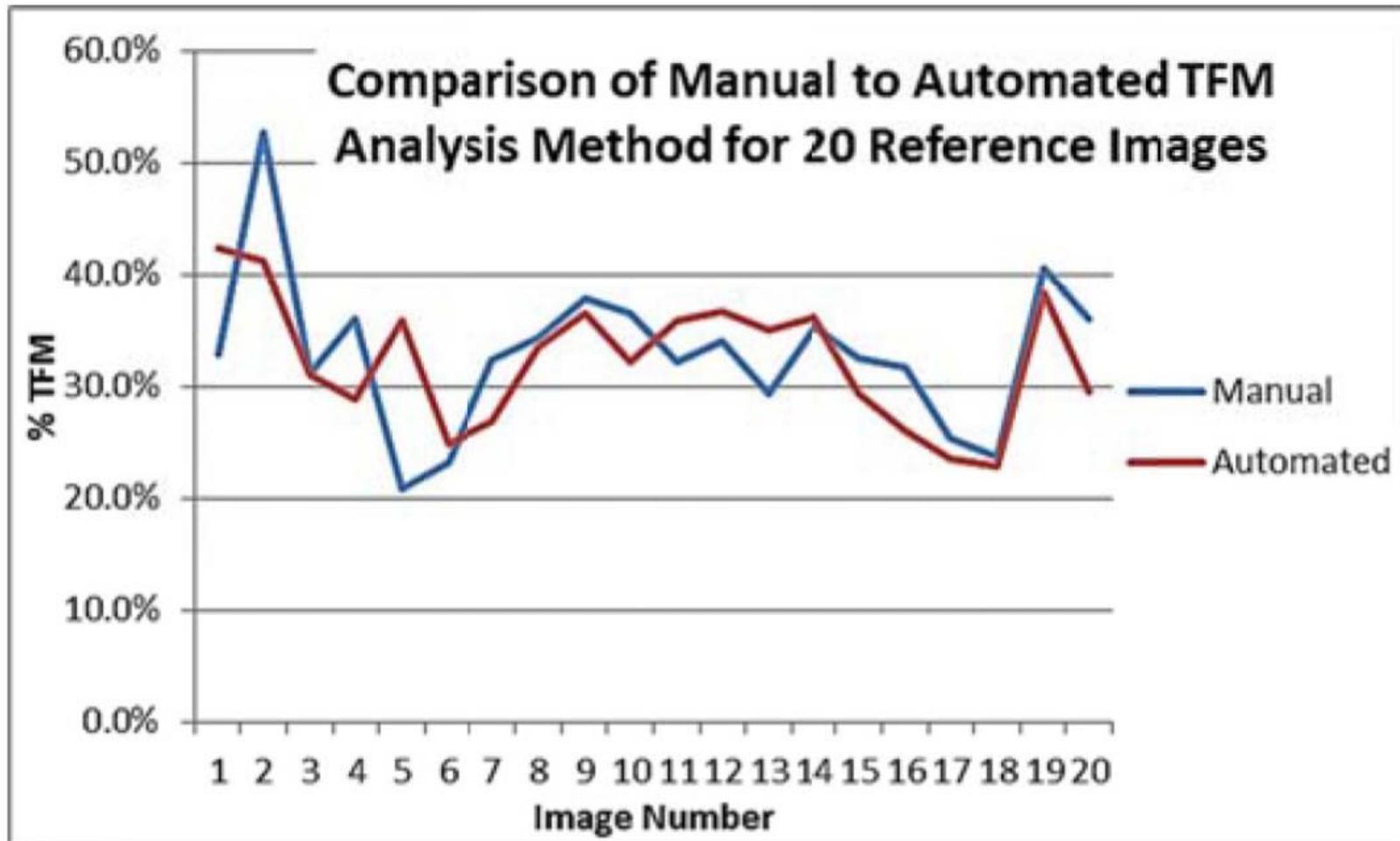


Comparison of Manual to Automated TFM Analysis Method for 20 Reference Images

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# Surface Film Finish Time vs Temperature

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Min temperature @ which replicate material should be utilized

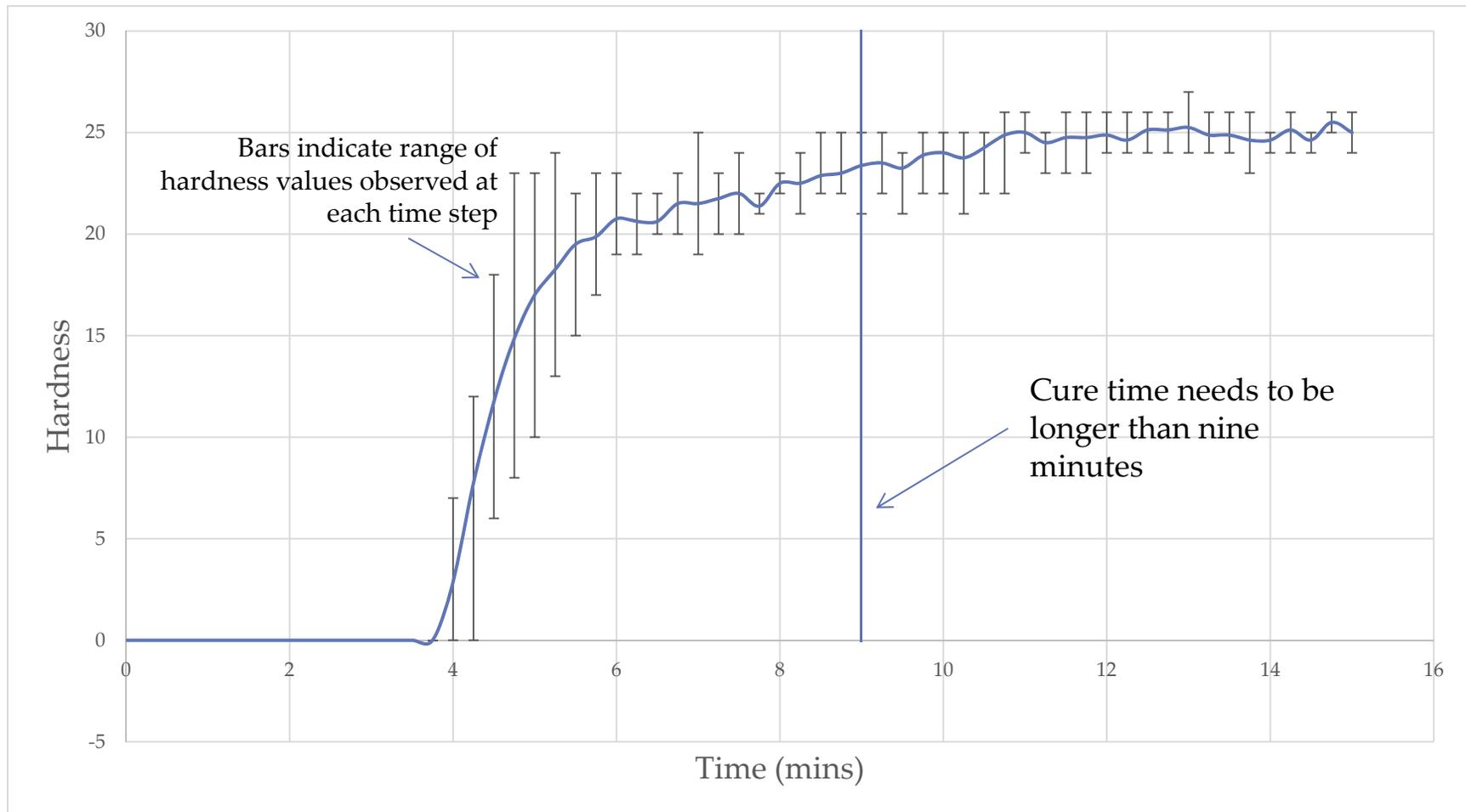Max temperature @ which replicate material should be utilized

# Curing Finish Time vs Temperature
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# Mean Hardness and Variation vs Time at 65 deg F
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Bars indicate range of hardness values observed at each time step

Cure time needs to be longer than nine minutes

*(chart axes: Hardness vs Time (mins))*

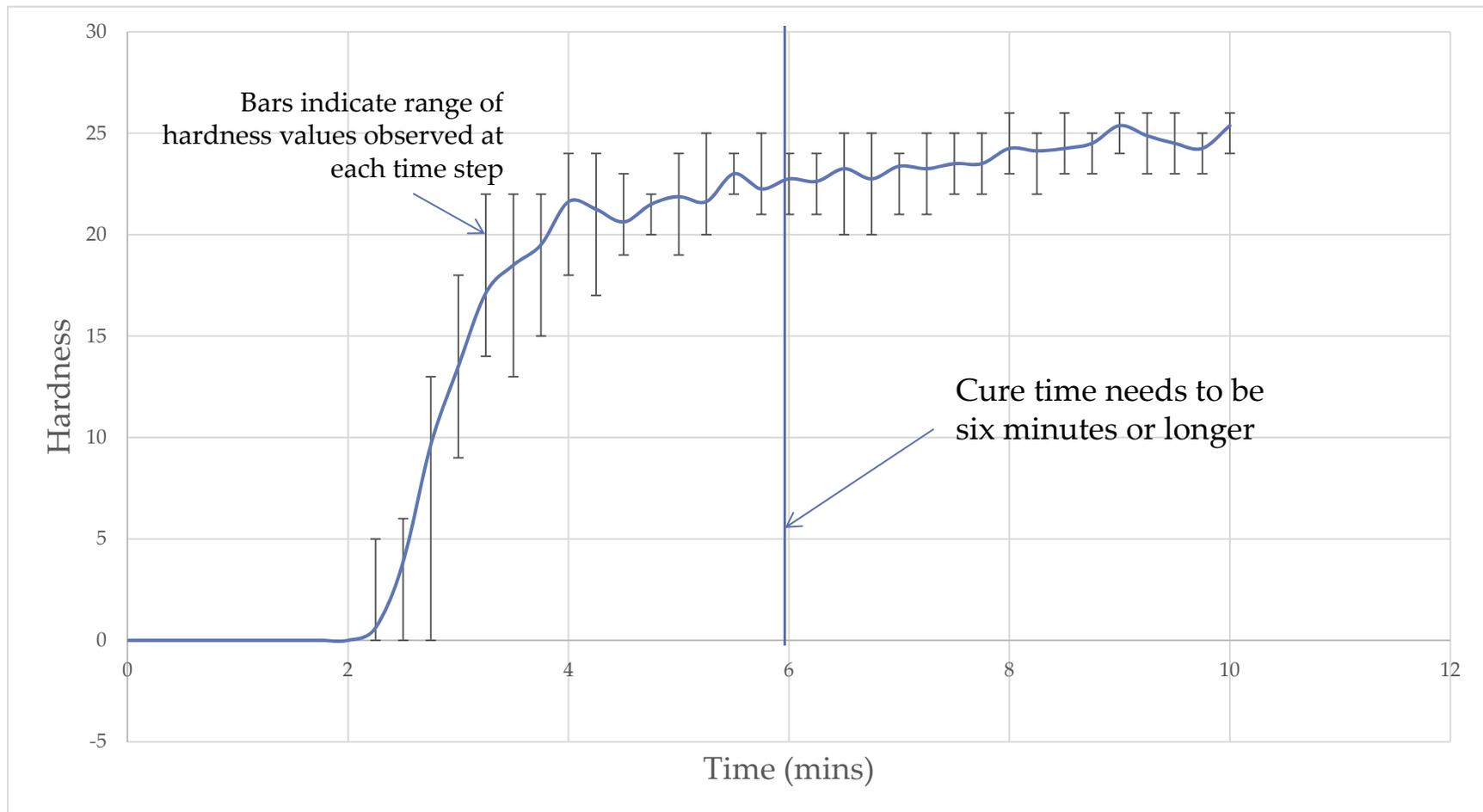SAINT LOUIS UNIVERSITY
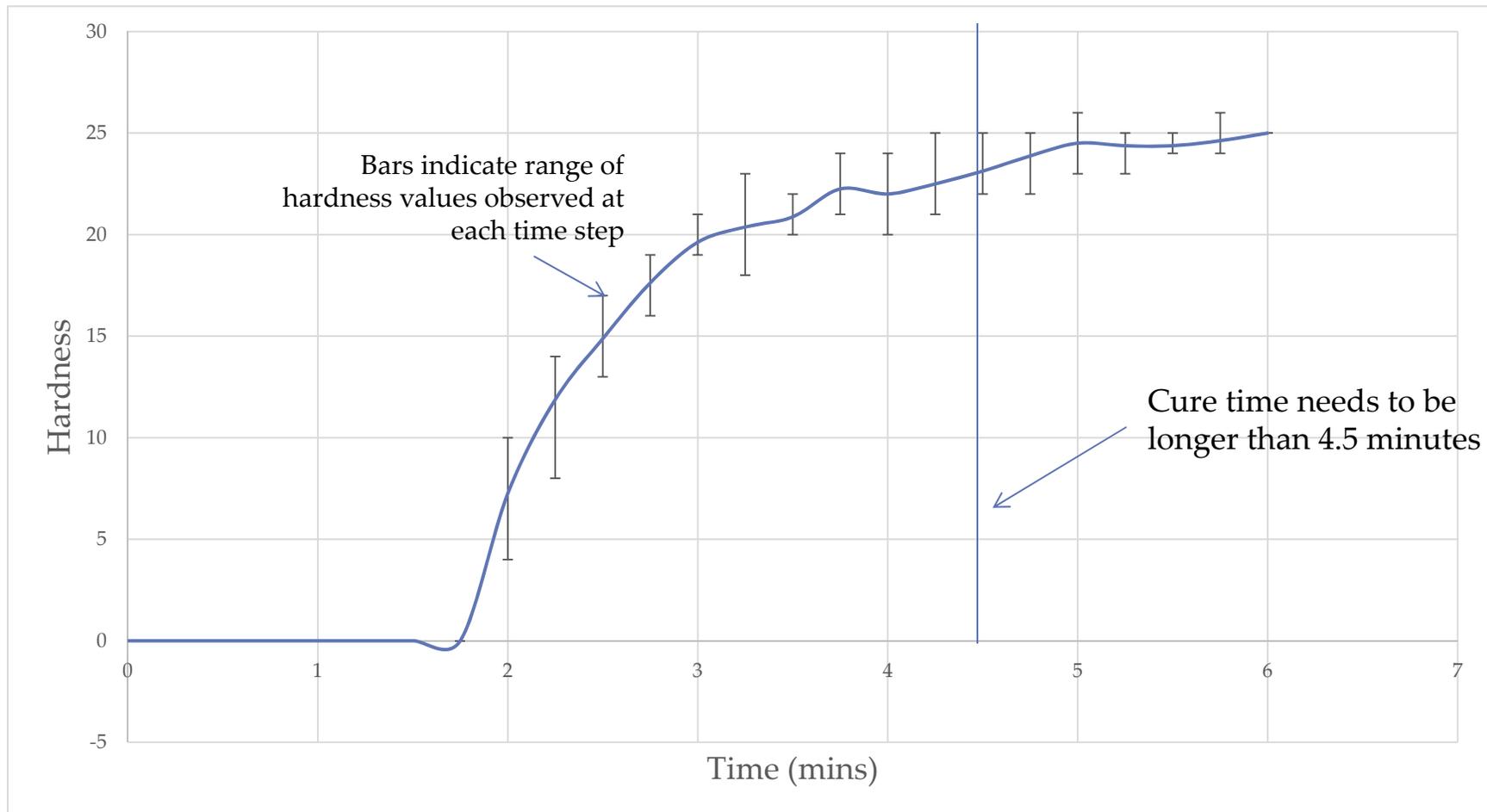
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# Mean Hardness and Variation vs Time at 75 deg F
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# Mean Hardness and Variation vs Time at 85 deg F
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# Curing Finish Time
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