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Introduction

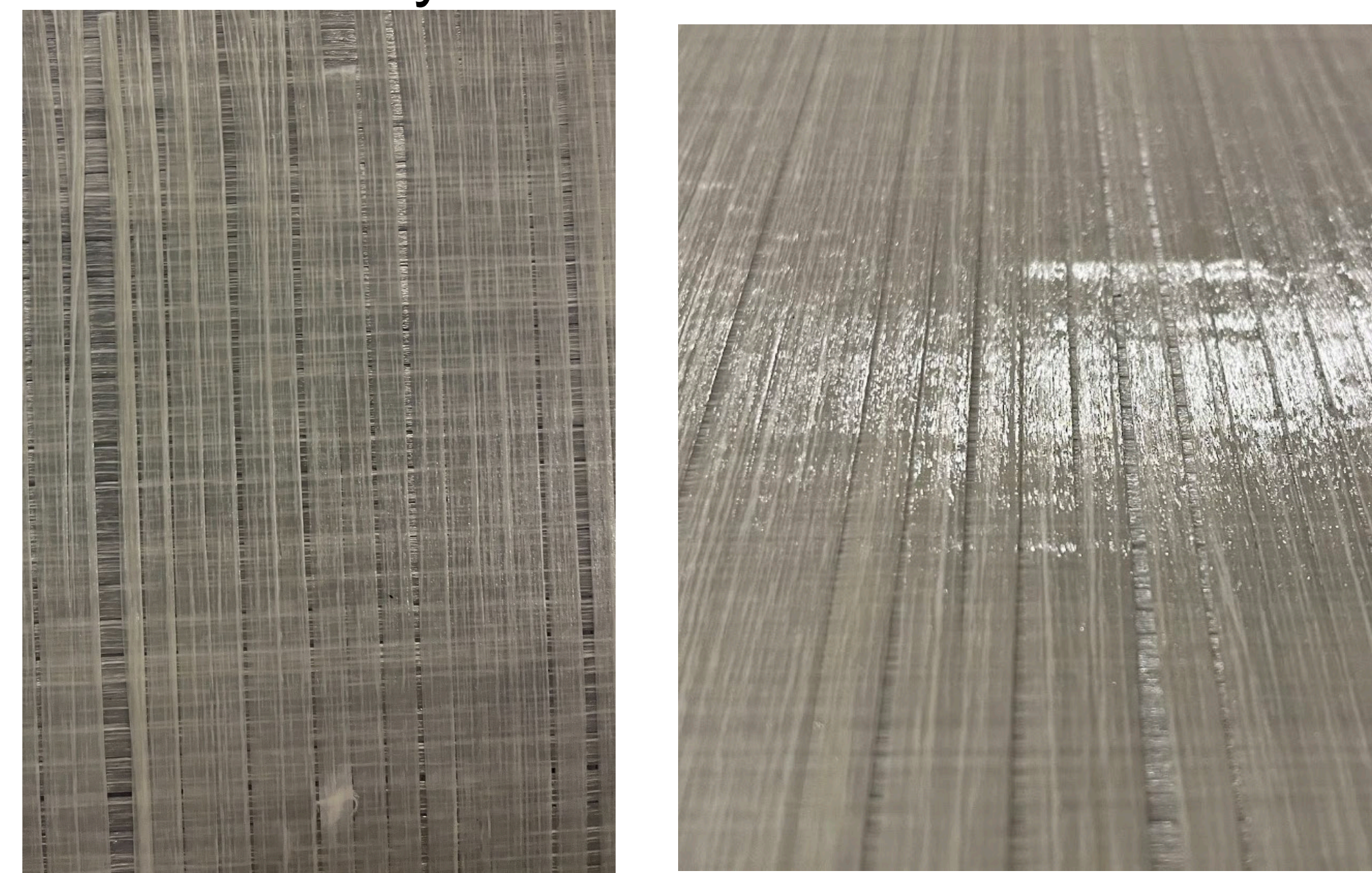
- Automated Fiber placement
 - Fiber-processing head attached to a robotic arm that places fibers along a path
 - Automated processes apply pressure and heat to material
 - Understanding the relationship between AFP process conditions, manufacturers can optimize the AFP process for the best quality and consistency of composite parts
 - Understand how process control of various AFP configurations effects consolidation
 - Flat and round mandrels

Compaction and Speed Trial

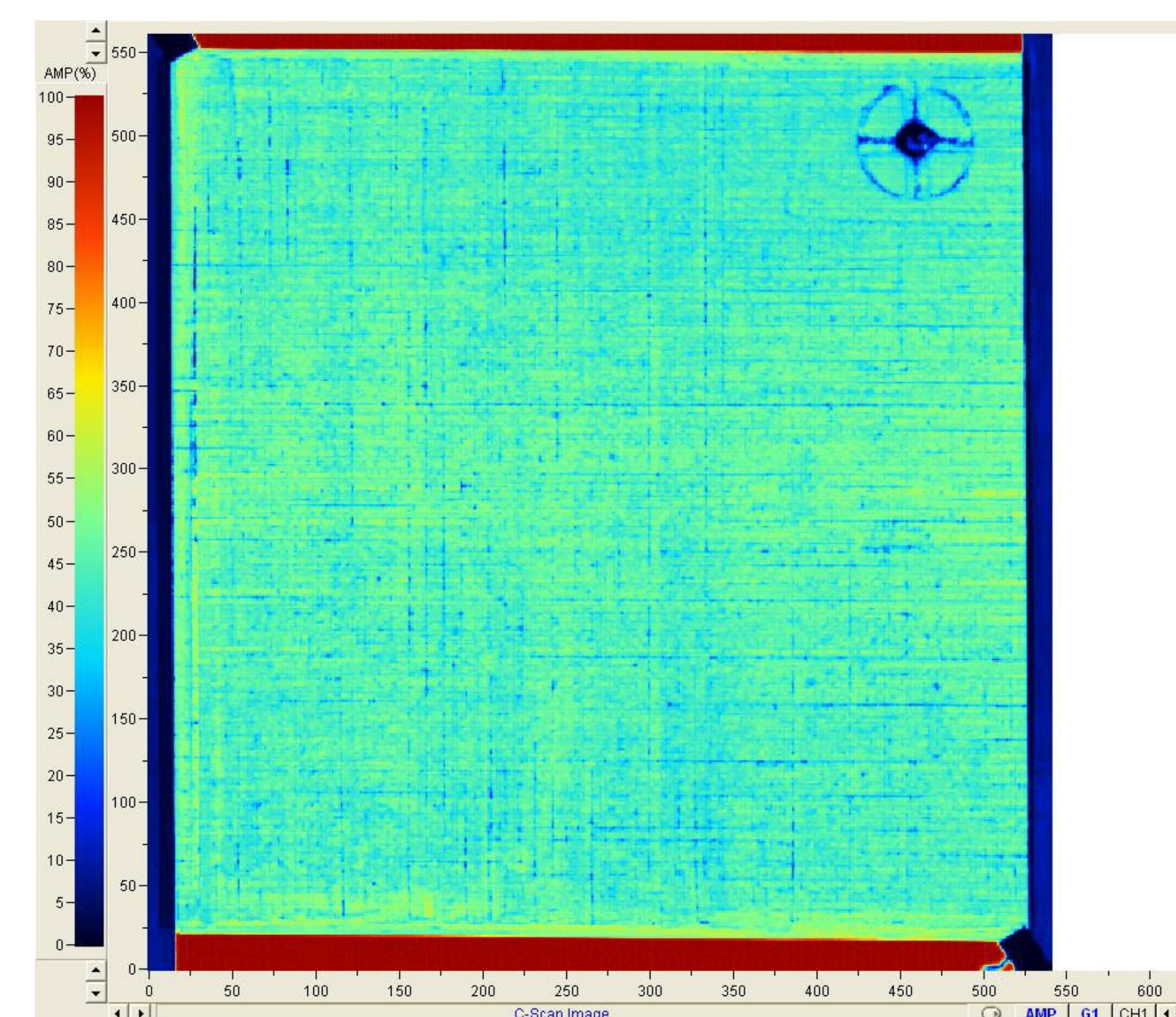
- Compaction Trial
 - Tack was tested by running peel tests with tapes placed on top of one another with release film in between
 - Three levels of compaction
 - 375 N, 600 N, and 900 N**
 - Sufficient tack was found at >400 N compaction
- Speed Trial
 - Four levels of placement speed
 - 1500, 2250, 3500, and 7000 mm/min**
 - Sufficient tack was found at all placement velocities

Experimental Panel Layup

- Conditions
 - Room Temperature – no additional heat
 - Speed – 3500 mm/min
 - Compaction – 600 N
 - Tension – 20 N
 - Cure – 250 F for 2 hours
- 4 ply [0/90]s panels were fabricated
- Tape misalignment when placing with low tension
- Accurate tape placed with higher tape tension
- Cured Ply Thickness: 0.26 ± 0.00765 mm



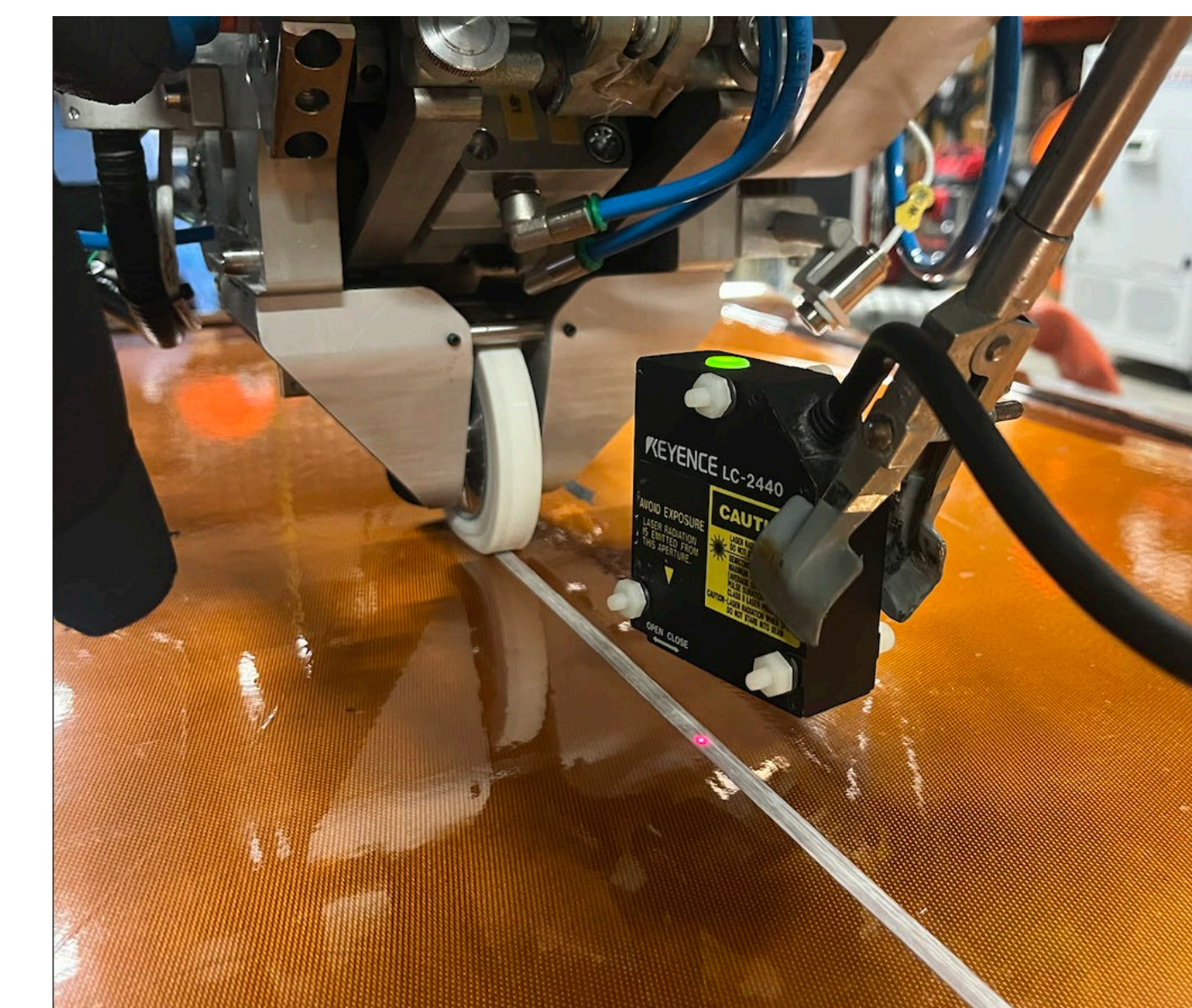
Low Tension (0 N) High Tension (20 N)



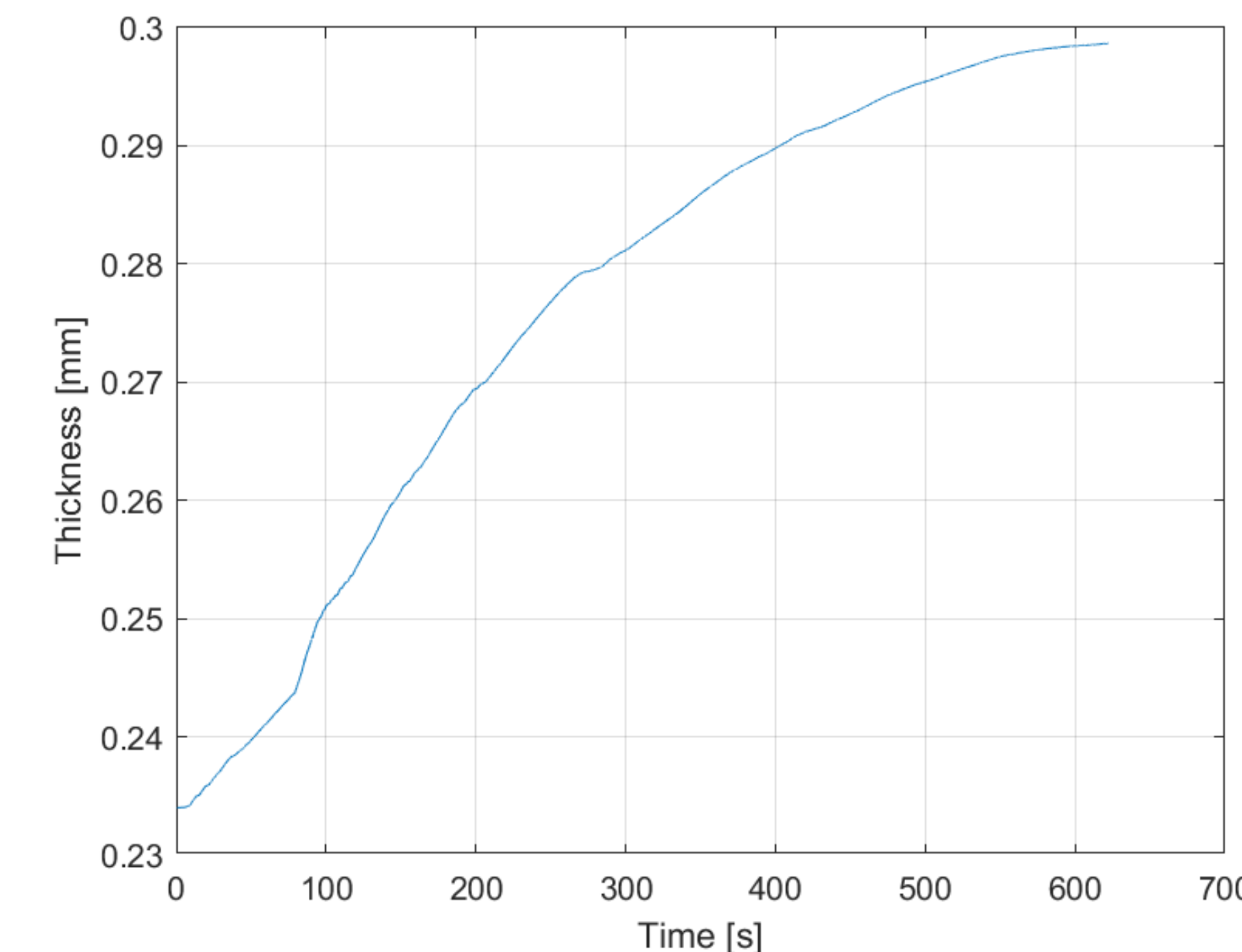
C-scan shows evidence of gaps after cure

Consolidation Evaluation

- Keyence laser was used to measure tape thickness as a function of time after consolidation
- Course was stopped after for ~10 minutes during measurement



- Steady state tape thickness ~0.3mm was reached after 10 minutes



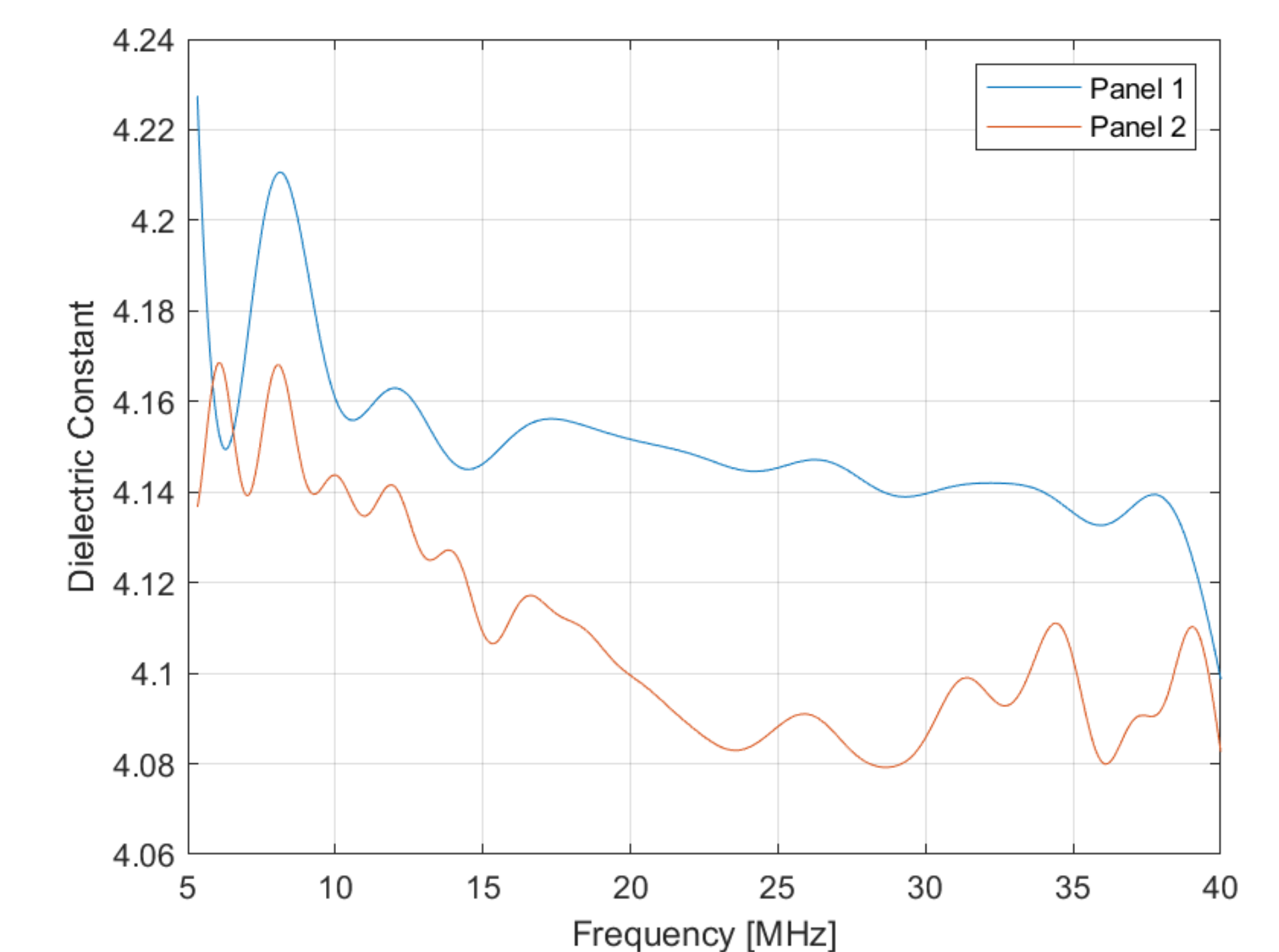
Tape thickness versus time



- Microscopy shows no major defects
- Slightly higher porosity in lead out section of course
- Lead in section is more representative of center sections of the panel

Electromagnetic Evaluation

- Dielectric constant was evaluated through a range of frequencies (5-40 MHz)
- Both panels matched the baseline dielectric constant of 4.2
- Panel 2 had better dielectric properties with higher quality tape alignment



Future Steps

- Mechanical property testing
 - Tension and Compression
- Cylindrical AFP wrapping
 - ~1" thick sections
- Optimize debulk cycle to match thickness versus time relationship and cured ply thickness measurement

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