January 17-19, 2024
40th CRCA Trade Show & Seminars

Low Rise Adhesive Foam

Current Issues and Joint CRCA/NRCA Research

Speaker:

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Waunakee, WI

Topics

- History of Adhesives in Roofing…Asphalt
- Part A + Part B
- Recent Research
- Field Issues
- Experiment
- Results
  - Loads vs Ratio
  - Micrographs
- Lessons Learned and Recommended Field Procedures
- Questions

History of Adhesives in Roofing…Asphalt

- Since biblical times bitumen had been used for adhesives, roofing and waterproofing.
  - Hanging Gardens of Babylon are believed to be the first mention of natural Pitch / bitumen for waterproofing…Green Roofing!
- 1850’s oil refining of crude oil began making asphalt available around this time.

History of Adhesives in Roofing…Asphalt

- Use of asphalt is the main roofing product for over 100 years to adhere and assemble roofs

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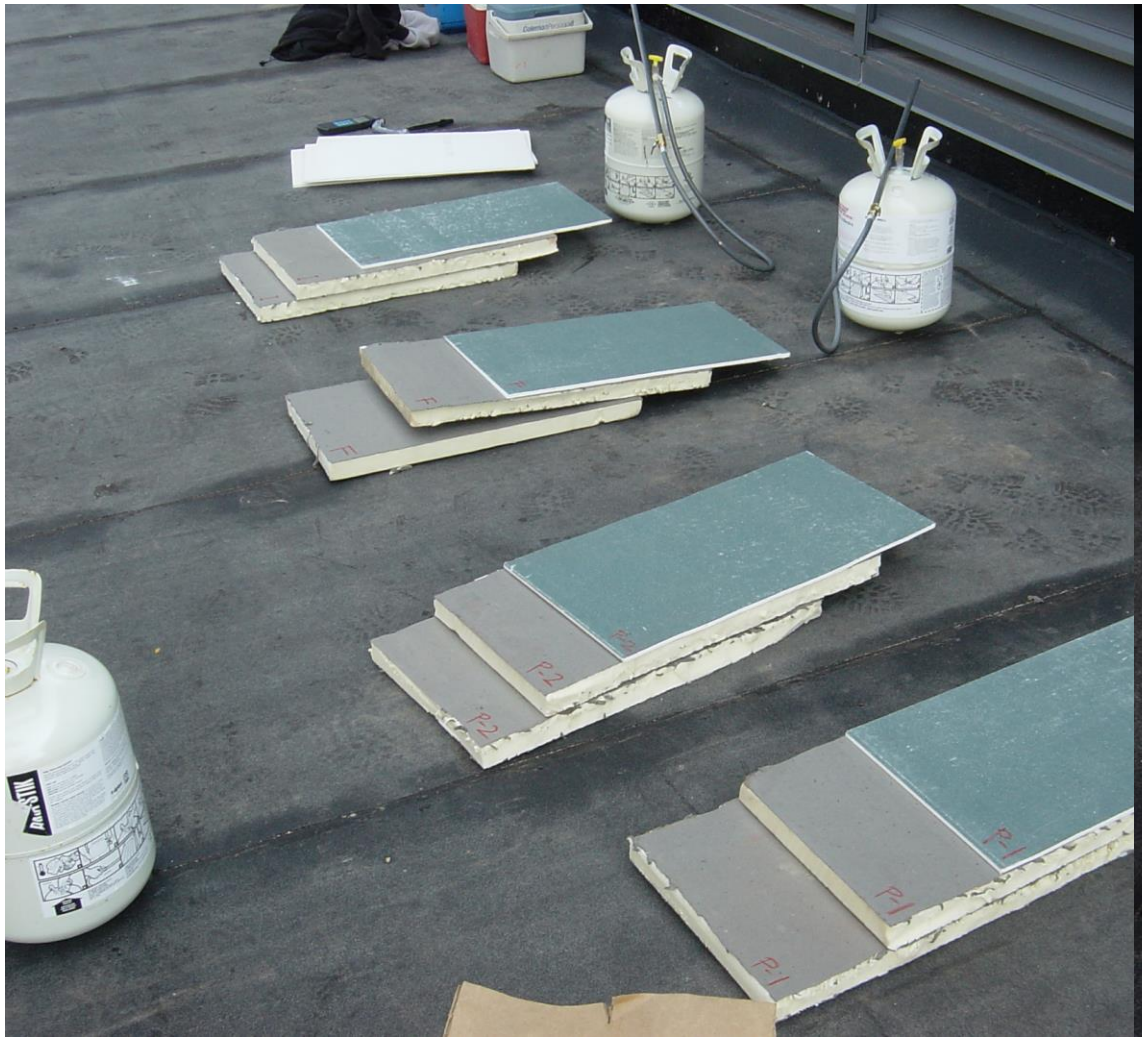
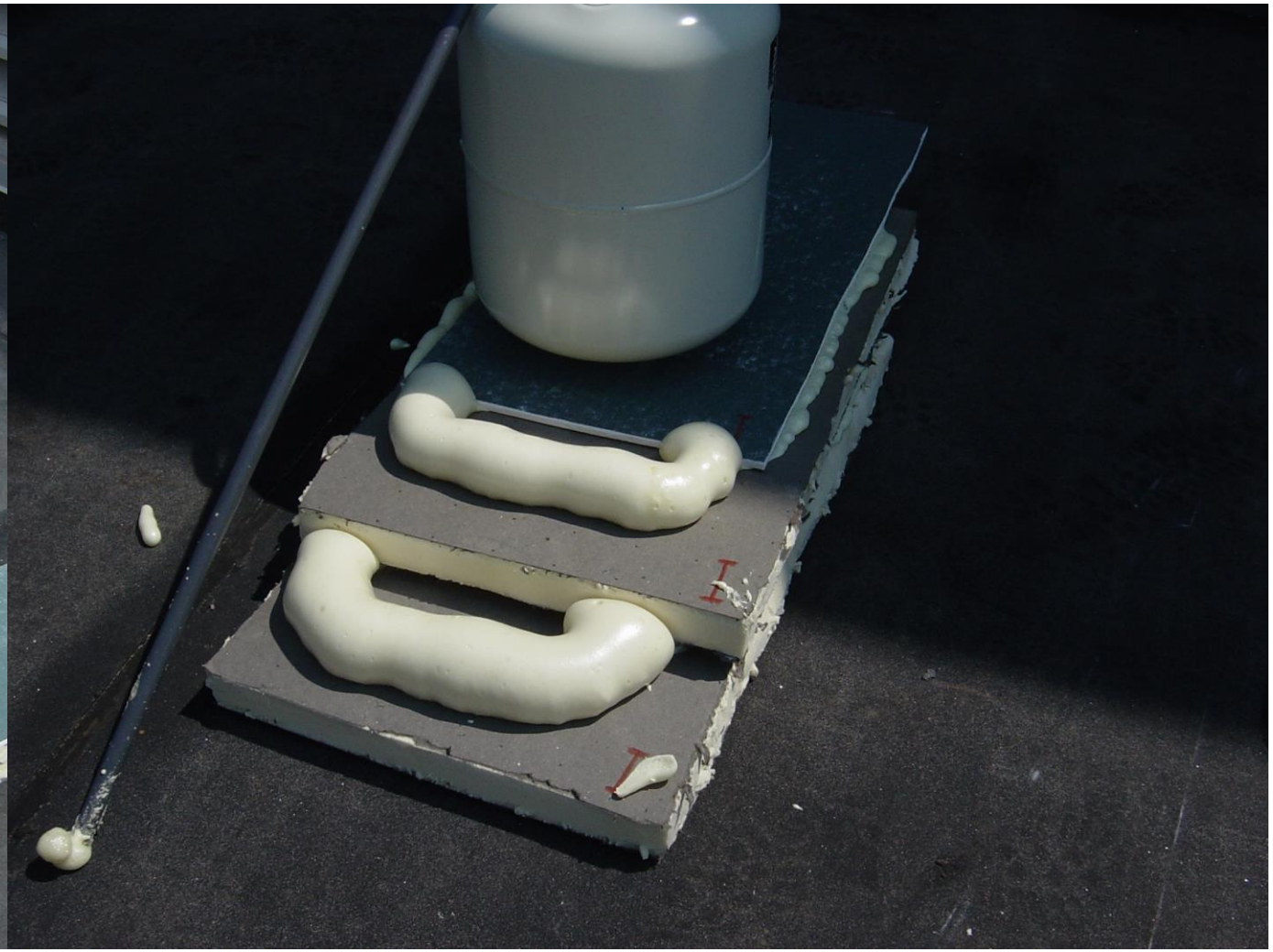
History of Adhesives in Roofing…Asphalt

- Around the turn of the 21st century roofing slowly transitions to low rise polyurethane foam adhesives
  - Asphalt smells (opinions vary)
  - Asphalt is hot
  - Fewer owners and fewer roofers want to work with hot asphalt
- Single component foams come first
  - Dow Insta-Stik

History of Adhesives in Roofing…Asphalt





History of Adhesives in Roofing…Asphalt

- One part foam is satisfactory in uplift performance
- But it is temperamental for optimal performance
  - Rather temperature sensitive
  - Very sensitive to too much or too little free moisture
- Migration to two-part low rise adhesive foam (Part A + Part B)

2006 Installation

2006 Installation

Part A + Part B

- 2 - Part / Dual Component Foam
  - Part A
    - Contains the Isocyanate (Methylene Diphenyl Isocyanate)
  - Part B
    - Contains the polyol (isomer), catalysts, fire retardants, surfactants, water and other magic stuff

- Isocyanate (MDI) and Polyol create urethane bonds (isomer → polymer)
- Isocyanate and water create carbon dioxide (blowing agent)
- When the reactions run as intended good things happen
- When the reactions are off…bad roofs can ensue (off ratio).

Field Issues

- 2 - Part / Dual Component Foam
  - Just like the single component foam, dual components can have problems
  - Two major categories of problems (forensic) seen
    - Off ratio foam
    - Unreacted foam

Field Issues

- 2 - Part / Dual Component Foam
  - Off Ratio A Bias (too much A)
    - Hard, brittle and glassy foam
    - Can have extremely low strength
  - In the field it will “crunch” under thumb pressure
  - “Crispy”


20
50
10
INCH
1
2
3
4
STAINLESS
5
6
7
8
32
64
16

Field Issues

- 2 - Part / Dual Component Foam
  - Off Ratio B Bias
    - Soft and doughy consistency
    - Tends not to bond at all, it is present but doesn’t adhere.
    - Consistency under pressure from thumb is similar to memory foam or worse, just a souffle like mass that will collapse to nothing under pressure

Field Issues

- 2 - Part / Dual Component Foam
  - Unreacted A and or B components
    - Unmixed or massively off ratio
  - Unmixed, massively off ratio possible bad product
  - Result is zero bond
  - Forensically will have the consistency of maple syrup or honey
    - Tacky
  - Field staff should see this as it doesn’t react…

Field Issues

- 2 - Part / Dual Component Foam
  - Does not stick to asphalt!!!
- FM Roof in Texas
  - Contractor could not pass uplift testing
    - 120PSF target -> 35 PSF failure
- Forensic cuts showed a bond break at old BUR on concrete deck
  - Spudded off (Spud Bar)
- Manufacturer contacted foam manufacturer
  - “Well yes, our foam doesn’t stick to fresh asphalt. Didn’t we tell you?”
- Current foam kits now say
  - “Prime previously unexposed asphalt”

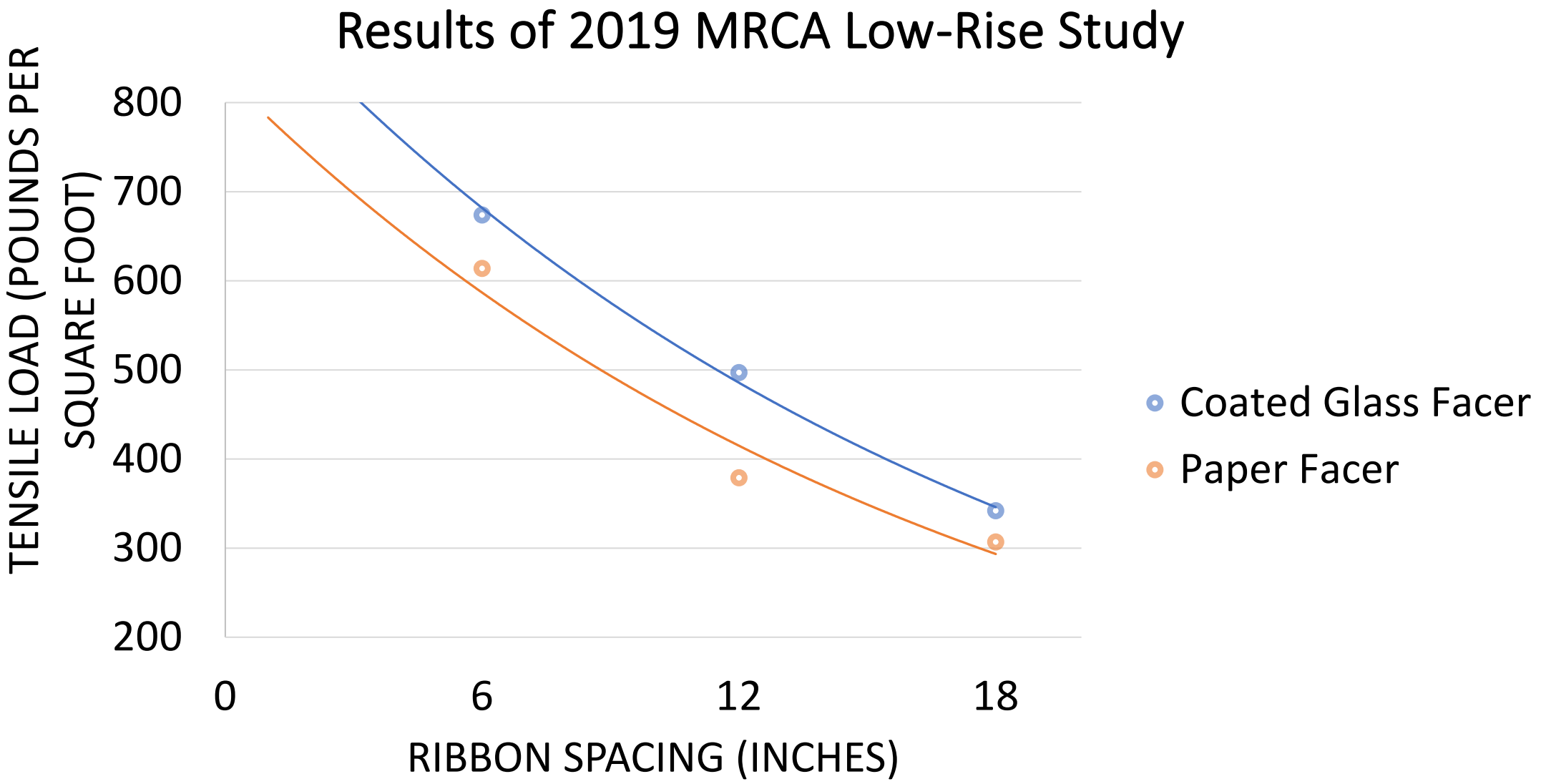

Milwaukee
DEWALT

Recent Research

- The MRCA has conducted research on low rise adhesive foams
- 2019 research has been published as a research booklet by MRCA
- Research conducted by WJE main laboratory in Chicago
- This level of research focused on bulk adhesive strengths and ribbon spacing
  - Very coarse ribbon spacing
- In addition, the research focused on adhesion to paper faced polyisocyanurate versus coated glass faced polyisocyanurate

Recent Research

- A custom metal plate was bonded to polyisocyanurate flat stock and then separated with a load frame in tension.
  - One manufacturer of adhesive
  - Ribbon spacing 6, 12 and 18 inches
  - Paper Facer and Coated Glass Facer


Results of 2019 MRCA Low-Rise Study
TENSILE LOAD (POUNDS PER SQUARE FOOT)
800
700
600
500
400
300
200
0
6
12
18
RIBBON SPACING (INCHES)
Coated Glass Facer
Paper Facer

Recent Research

- Consider maximum uplifts in wind ratings (FM) go to just over 300 PSF
- Failure point was always in the polyisocyanurate core
  - Not cohesive or adhesive for the low-rise foam
- Begs the question of condemnation of a roof system for adhesive ribbons that are slightly out of specification…

Recent Research

- 2021 MRCA Convention was held in Milwaukee, WI
- New testing data was presented by WJE (Phase 2 per se)
- Focused on
  - Expired foam properties
  - Varying application temperature
  - Cure Time

Experiment

- Purpose: To test the strength of low-rise adhesive foam against A/B mixing ratio
  - Manufactured intent is 1:1 or 50/50
- Use a reaction frame for a bonded plate test.
  - CDX Plywood to CDX Plywood
- 6 inch by 6 inch plate
  - Converted and tared for Pounds per Square Foot
- Acquired two different kits from distribution in the Chicago area
  - Blue color (Manufacturer 1)
  - Yellow color (Manufacturer 2)

Experiment

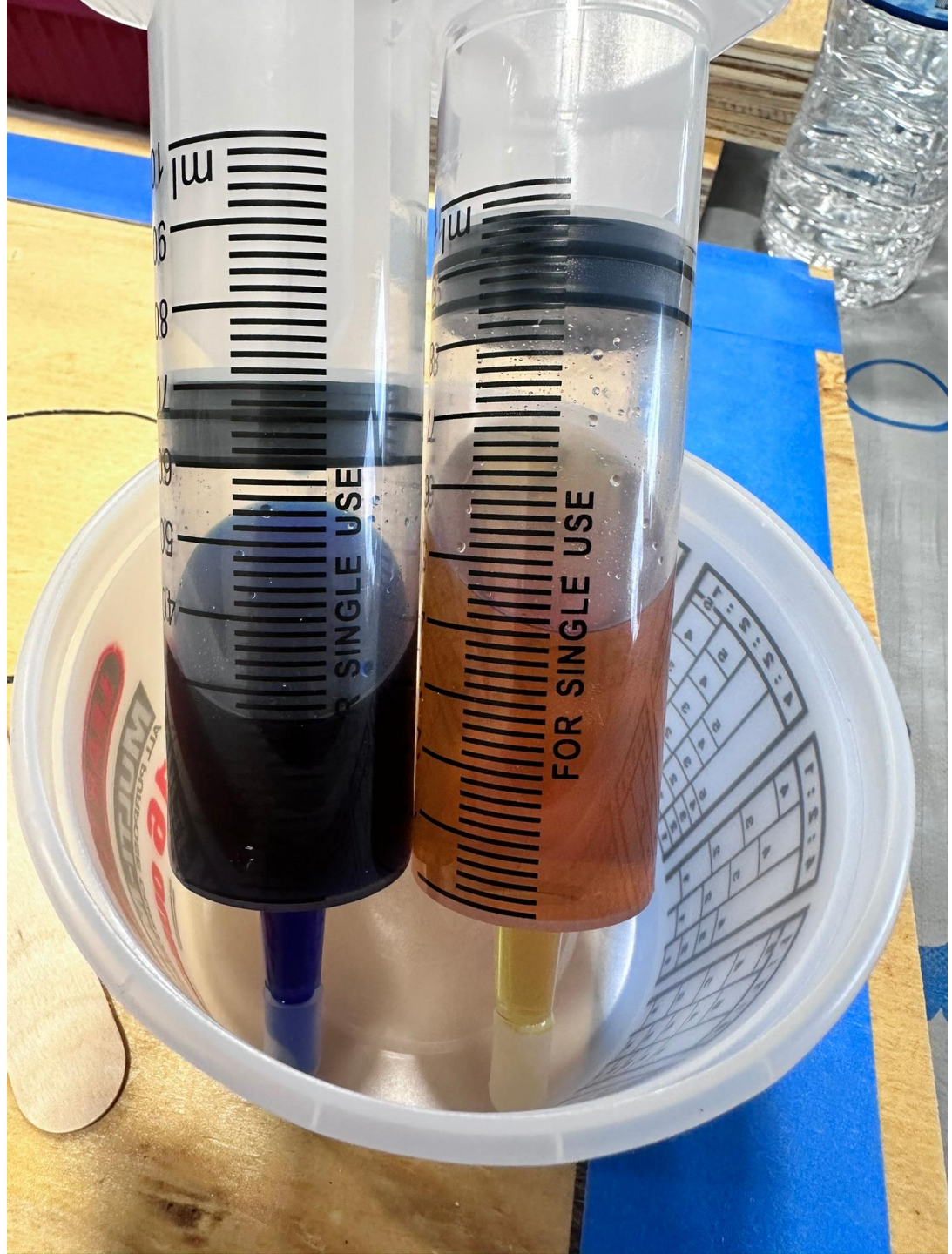
- Ratios tested

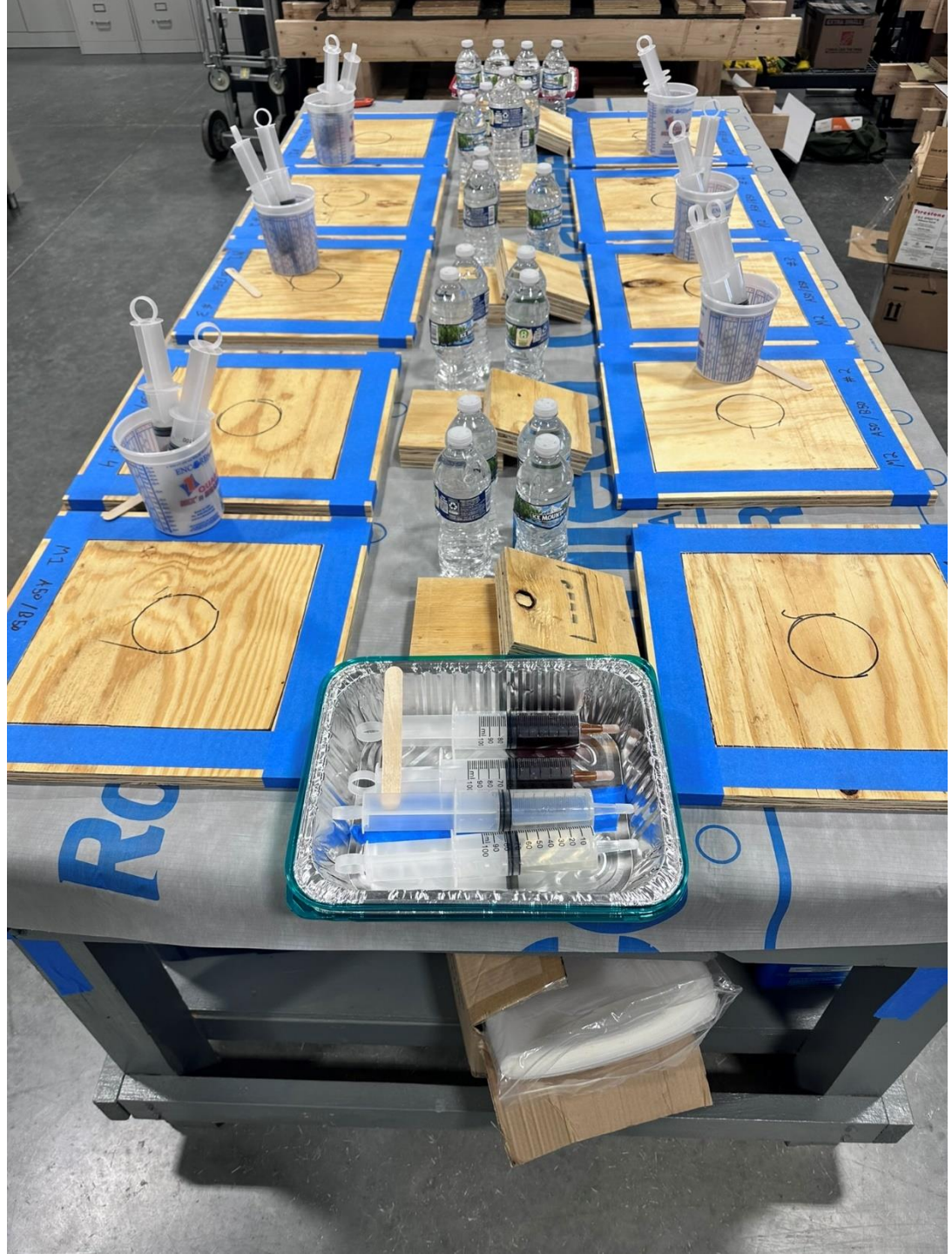
Part A	Part B
50	50
60	40
70	30
80	20
20	80
30	70
40	60

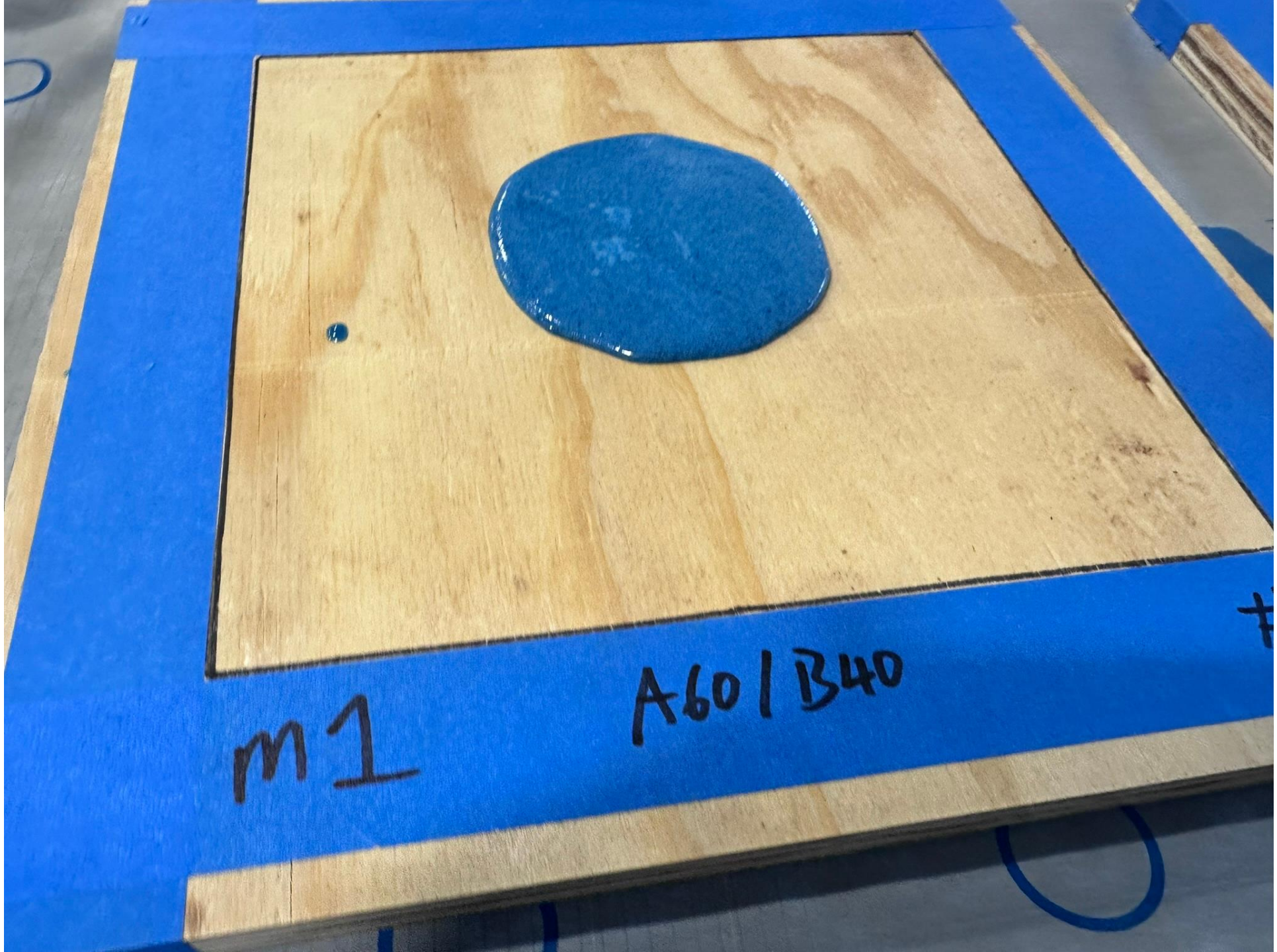
Experiment

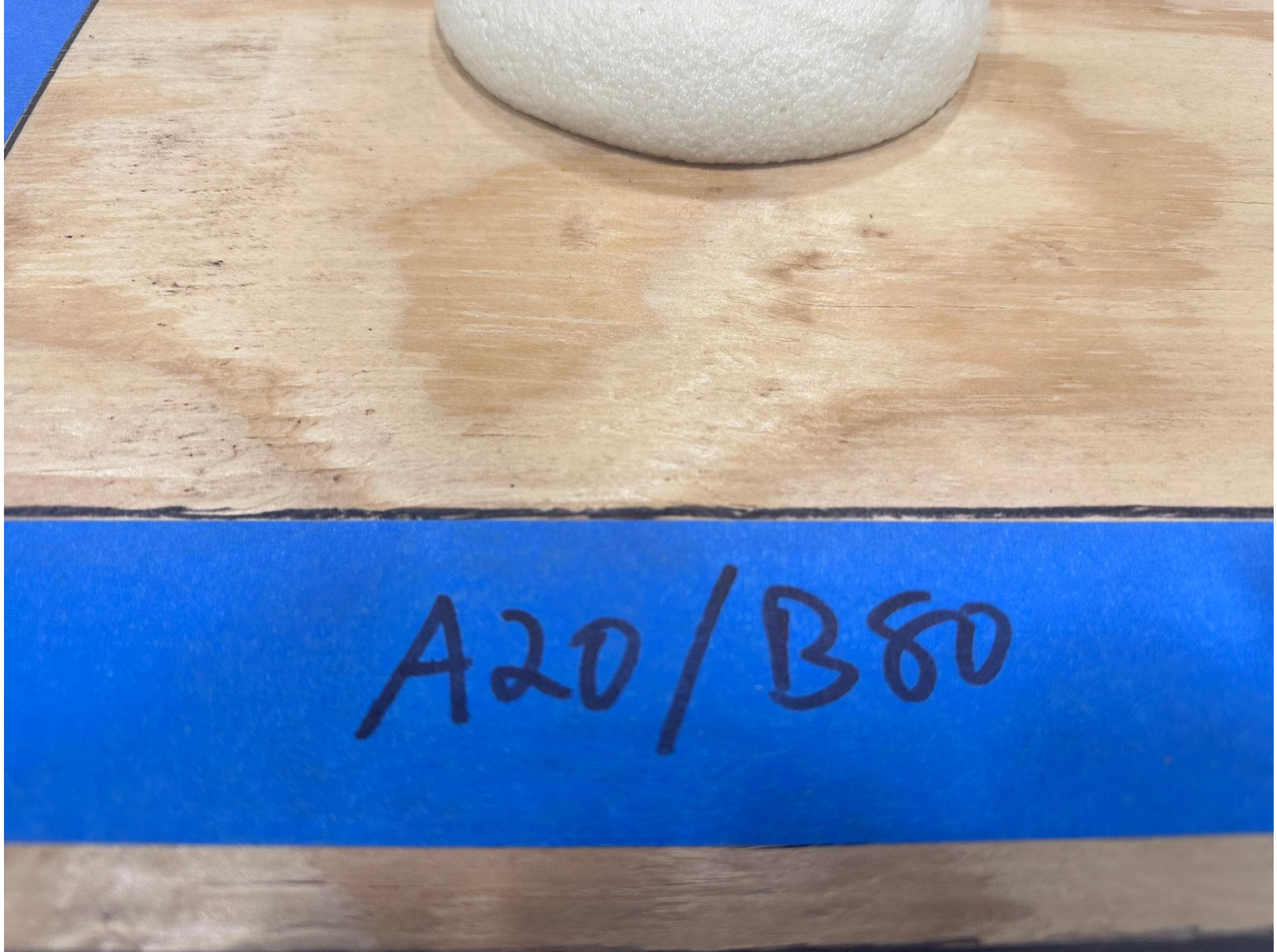
- Capped and graduated syringes were drawn from larger samples of bulk kits
- Five replicates of each ratio + manufacturer
  - 70 total tests
- A+B mixed and stirred vigorously
- Applied mixture allowed to react (“kick”)
- Plate applied with weight for 1 hour
- Allowed to cure a minimum of 24 hours before pulls
- Microscope slides prepared of each mix

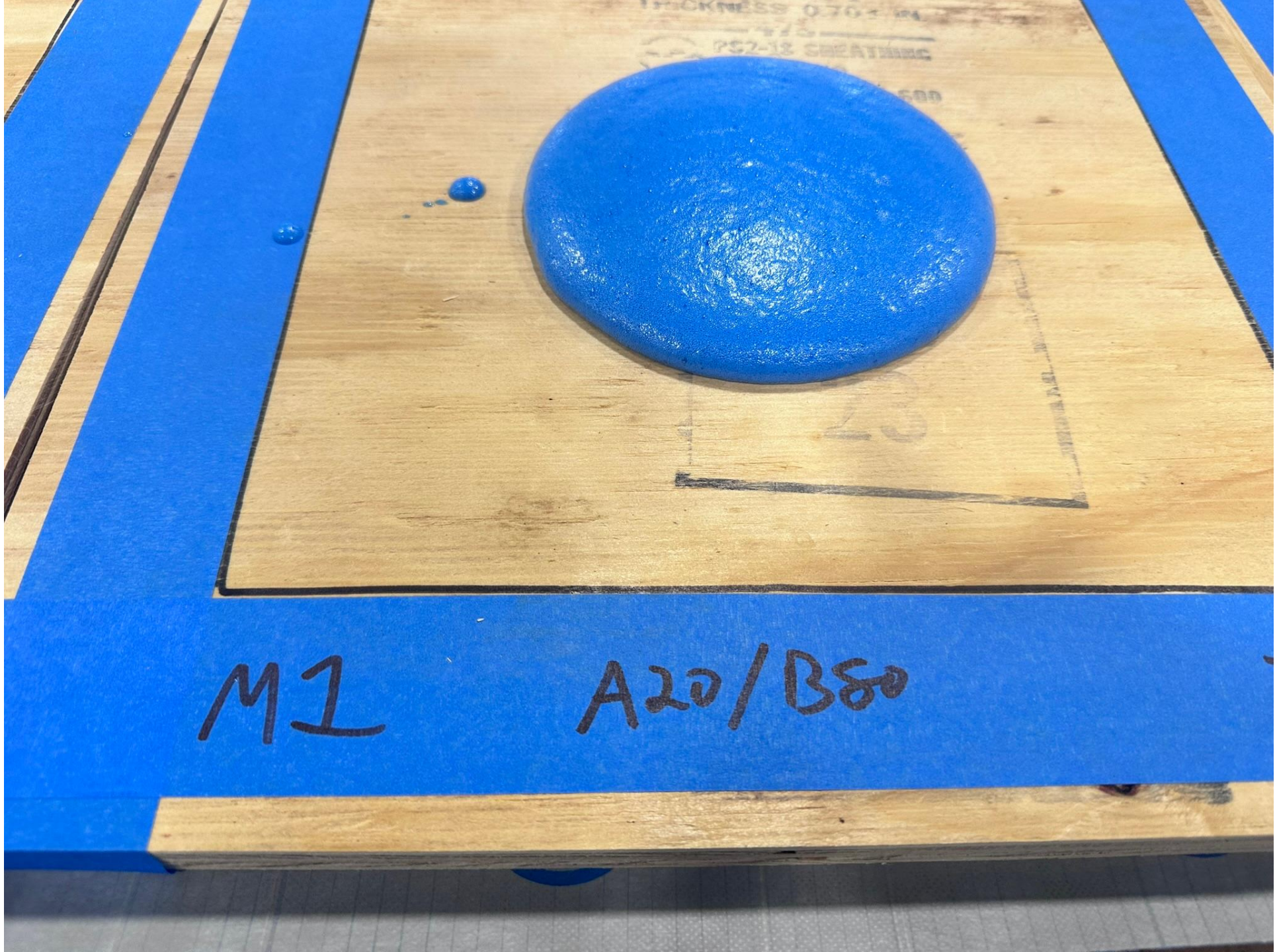

FOR SINGLE USE
FOR SINGLE USE
10
20
30
40
50
60
70
80
90
ml
100

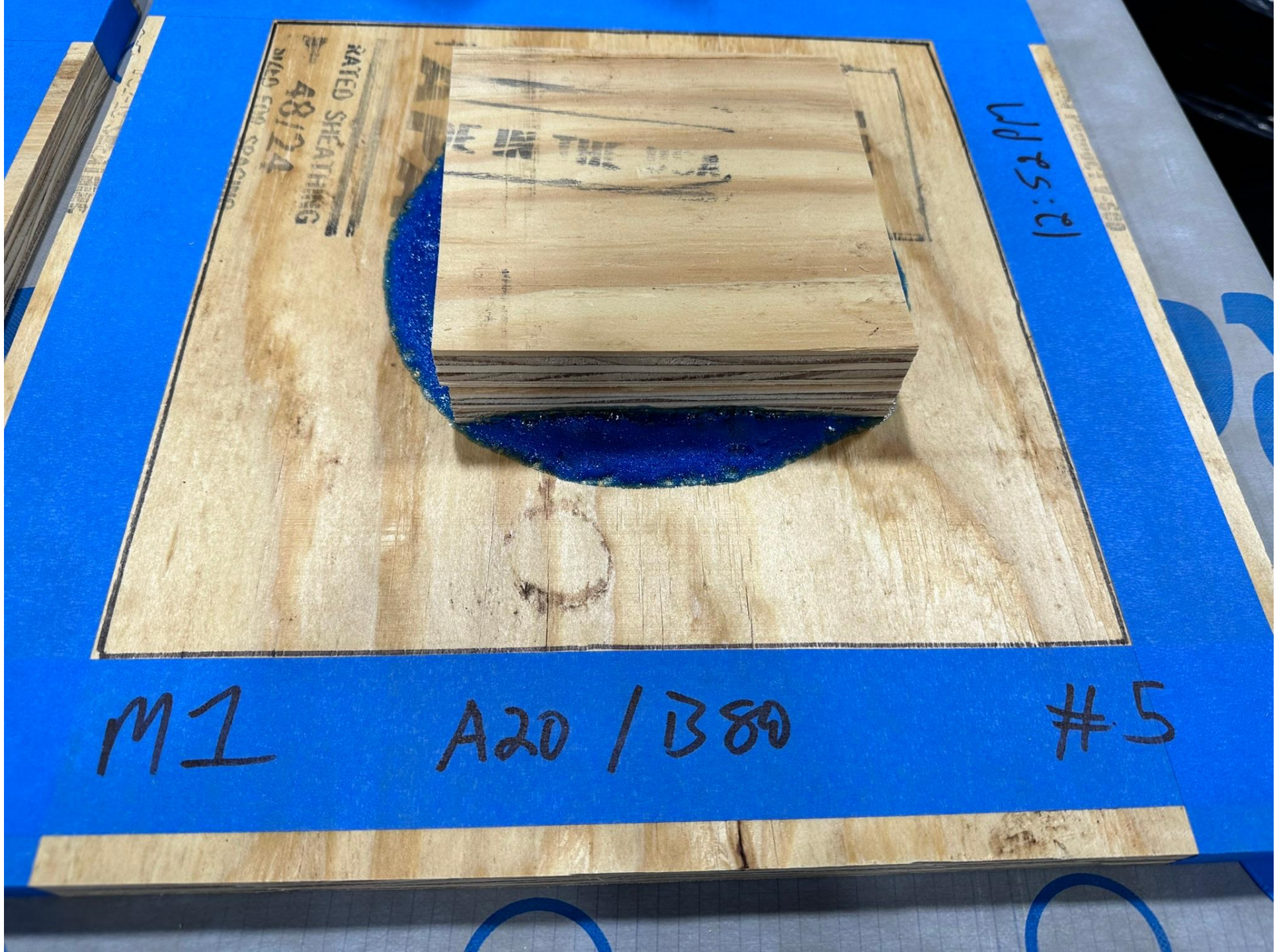

FOR SINGLE USE
FOR SINGLE USE

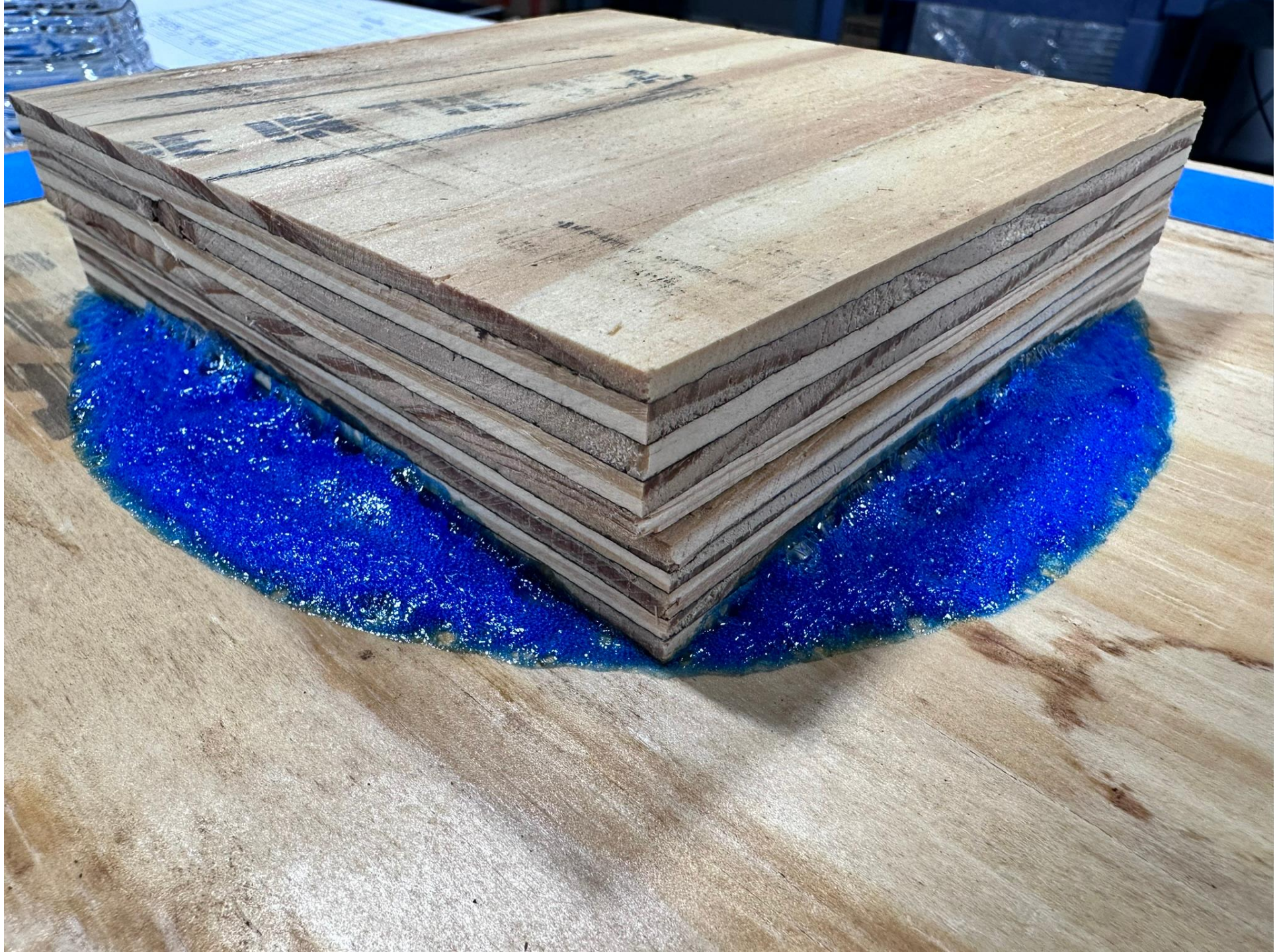


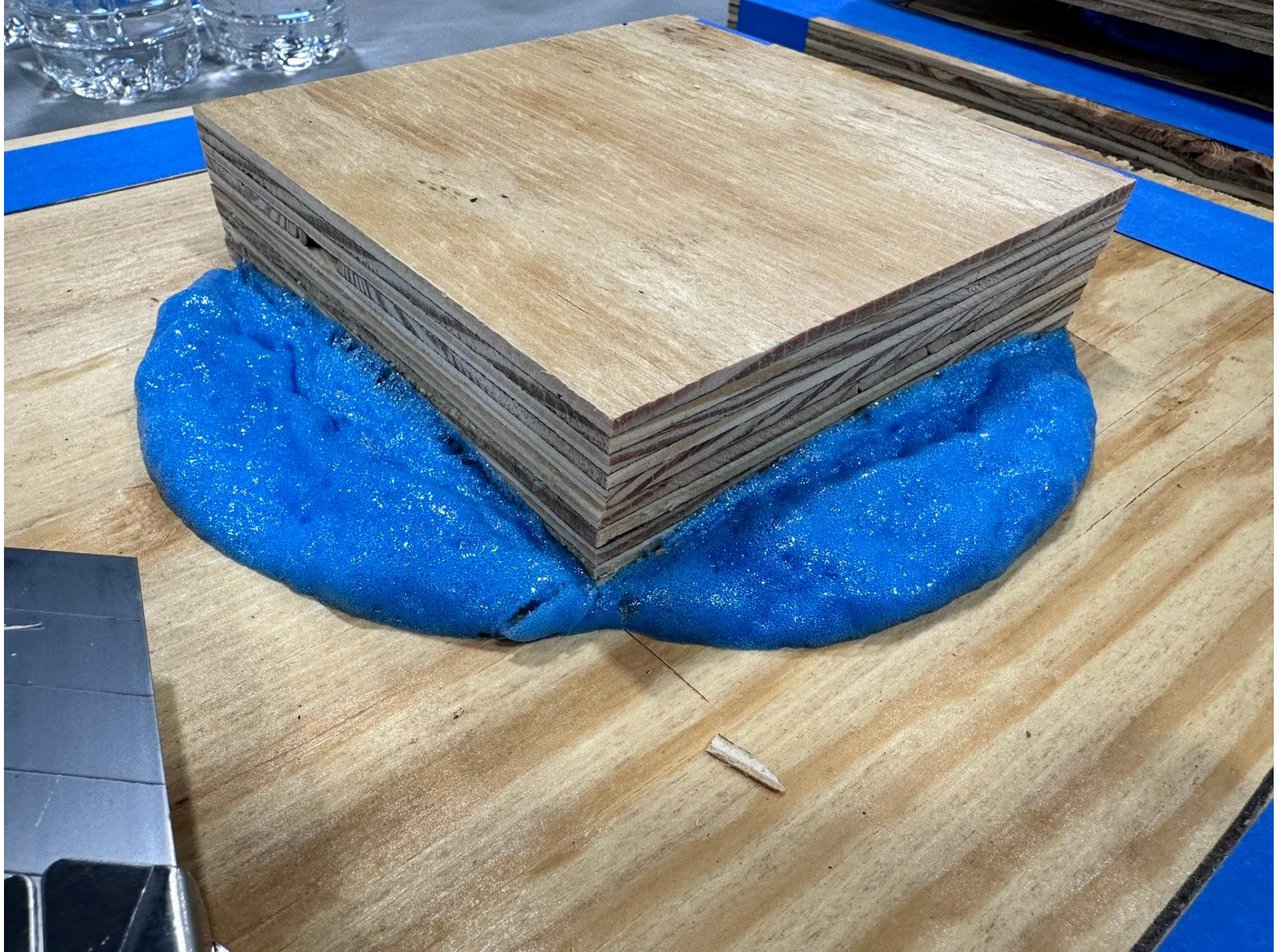

M1
A60 / B40

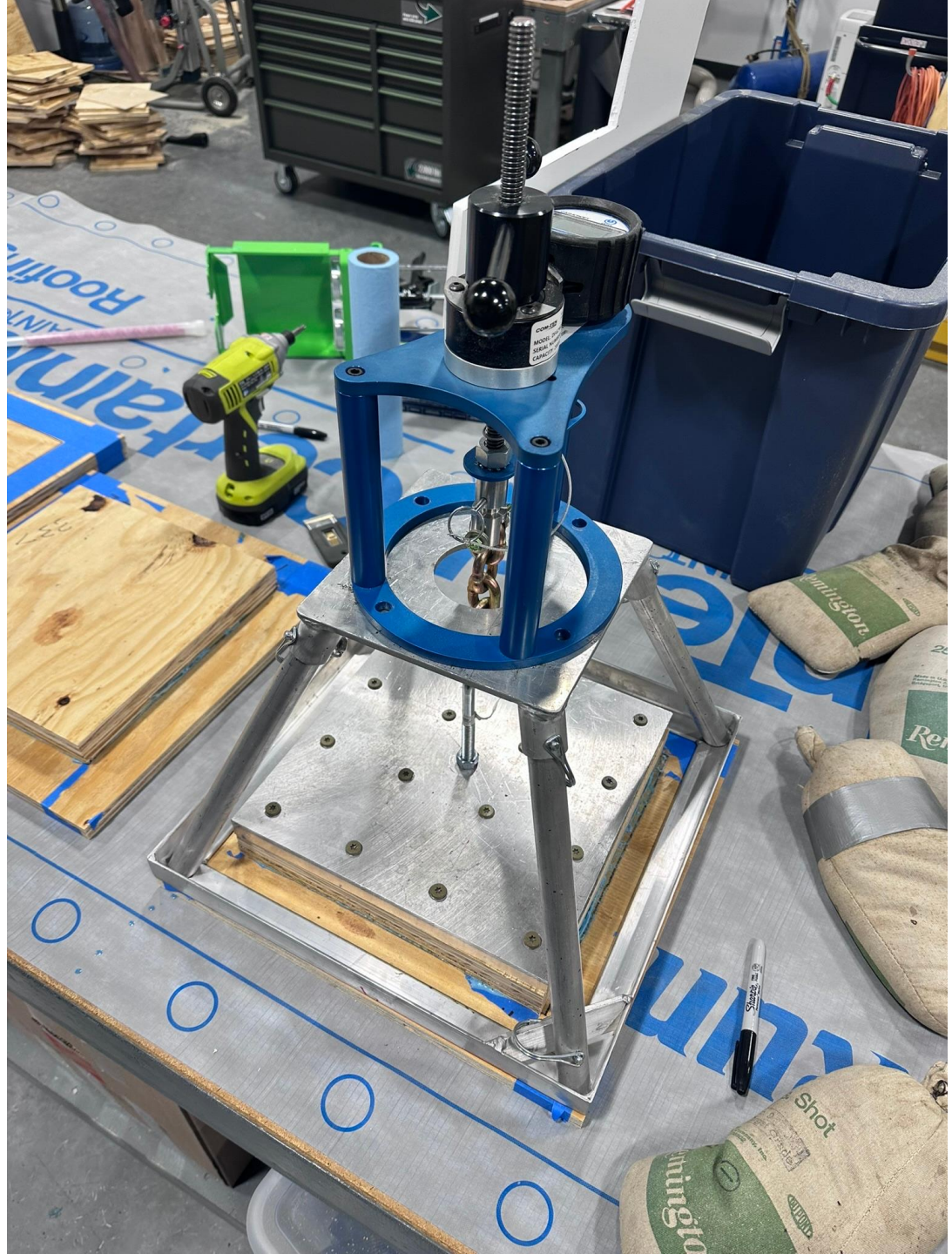

A20/B80


M1
A20/B80


RATED SHEATHING
48/24
M1
A20 / B80
#5








A40/B60
#2
M2
A40/B60

Results

Manufacturer 1 - Blue (Pounds per Square Foot)

Ratios		Replicates					
A	**B**	1	2	3	4	5	Average
50	**50**	2195.2	1857.2	1772.4	1753.2	1901.6	1895.9
60	**40**	3768.4	3408.4	3197.2	4383.2	3556.4	3662.7
70	**30**	4337.6	5204.4	4030.0	5252.0	2588.4	4282.5
80	**20**	5092.8	5515.6	4747.2	5630.4	4783.6	5153.9
40	**60**	1079.6	793.2	990.8	959.2	946.0	953.8
30	**70**	844.0	837.2	1028.0	588.0	692.8	798.0
20	**80**	577.2	900.0	643.2	752.4	527.2	680.0

Means a Failure in the plywood plys, not the foam

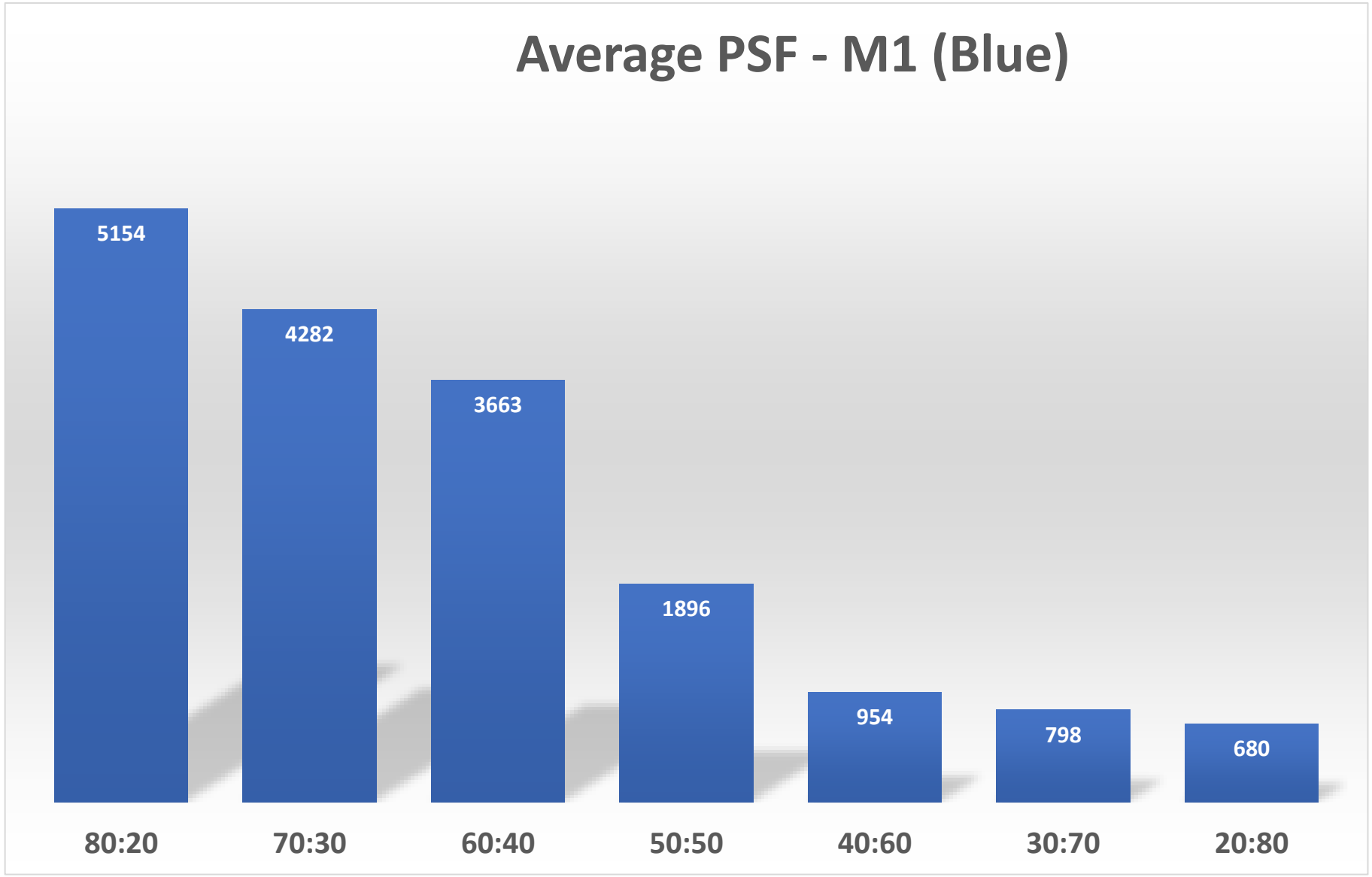
Results

Manufacturer 2 - Yellow (Pounds per Square Foot)

Ratios		Replicates					
A	**B**	1	2	3	4	5	Average
50	**50**	3448.0	3577.6	2582.8	3315.2	3950.0	3374.7
60	**40**	1209.6	1578.4	2865.6	2391.2	3738.0	2356.6
70	**30**	12.4	14.8	10.0	10.4	18.4	13.2
80	**20**	0.0	0.0	0.0	0.0	10.0	2.0
40	**60**	5097.2	5303.2	4266.0	5088.0	4547.2	4860.3
30	**70**	427.2	338.8	436.8	398.0	988.8	517.9
20	**80**	56.0	10.8	29.2	3.6	55.6	31.0

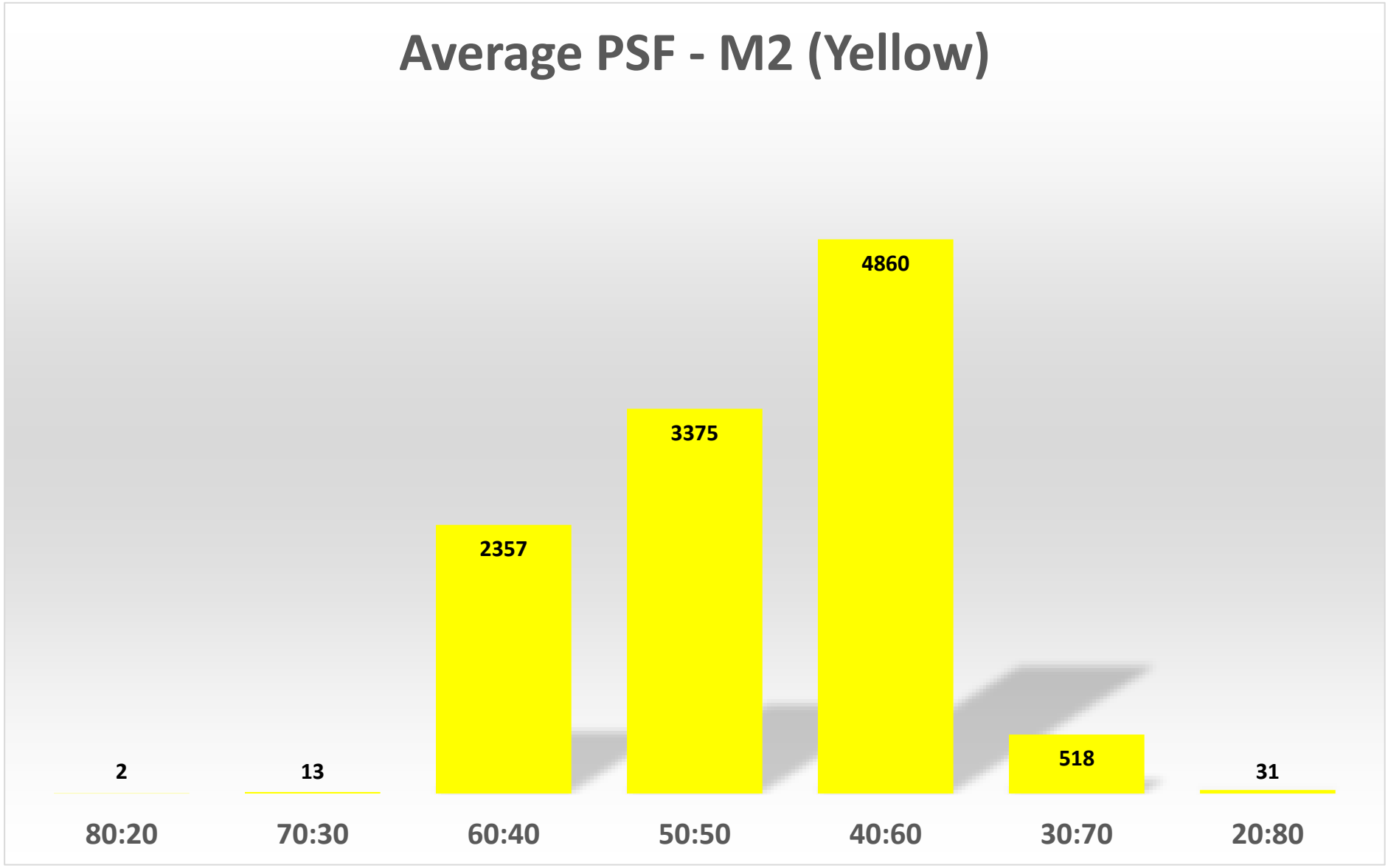
Means a Failure in the plywood plys, not the foam

Results



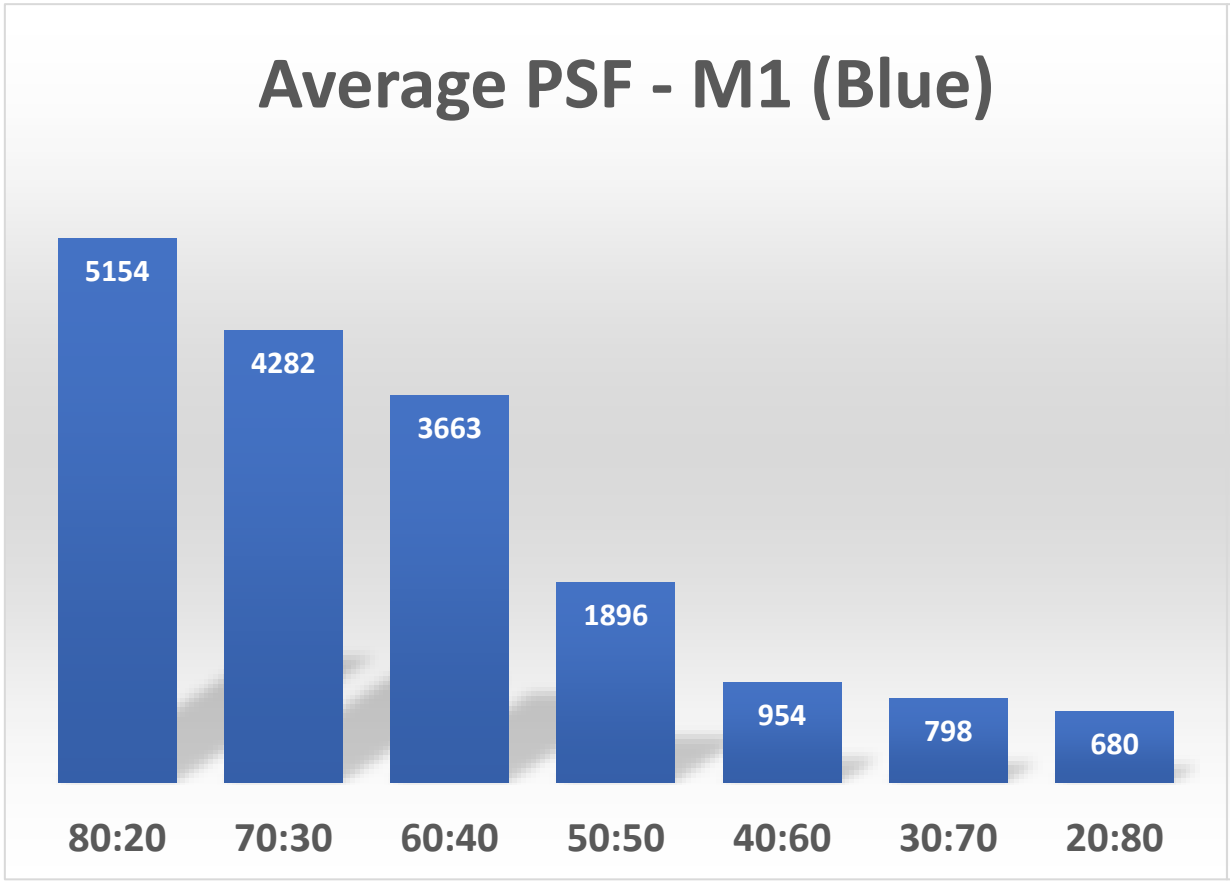
Part A Rich <----> On Ratio <---> Part B Rich

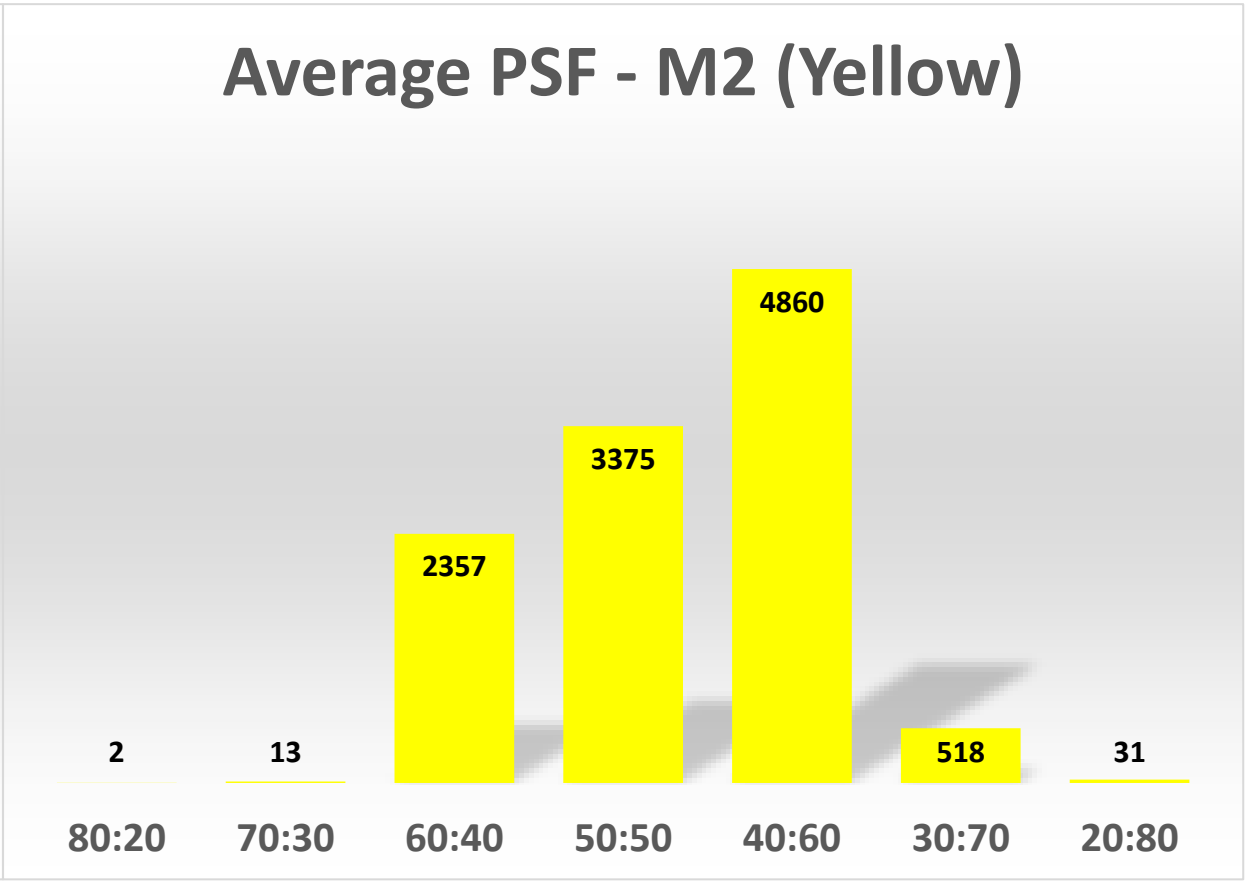
Results



Part A Rich <----> On Ratio <---> Part B Rich

Results


Average PSF - M1 (Blue)
5154
4282
3663
1896
954
798
680
80:20
70:30
60:40
50:50
40:60
30:70
20:80

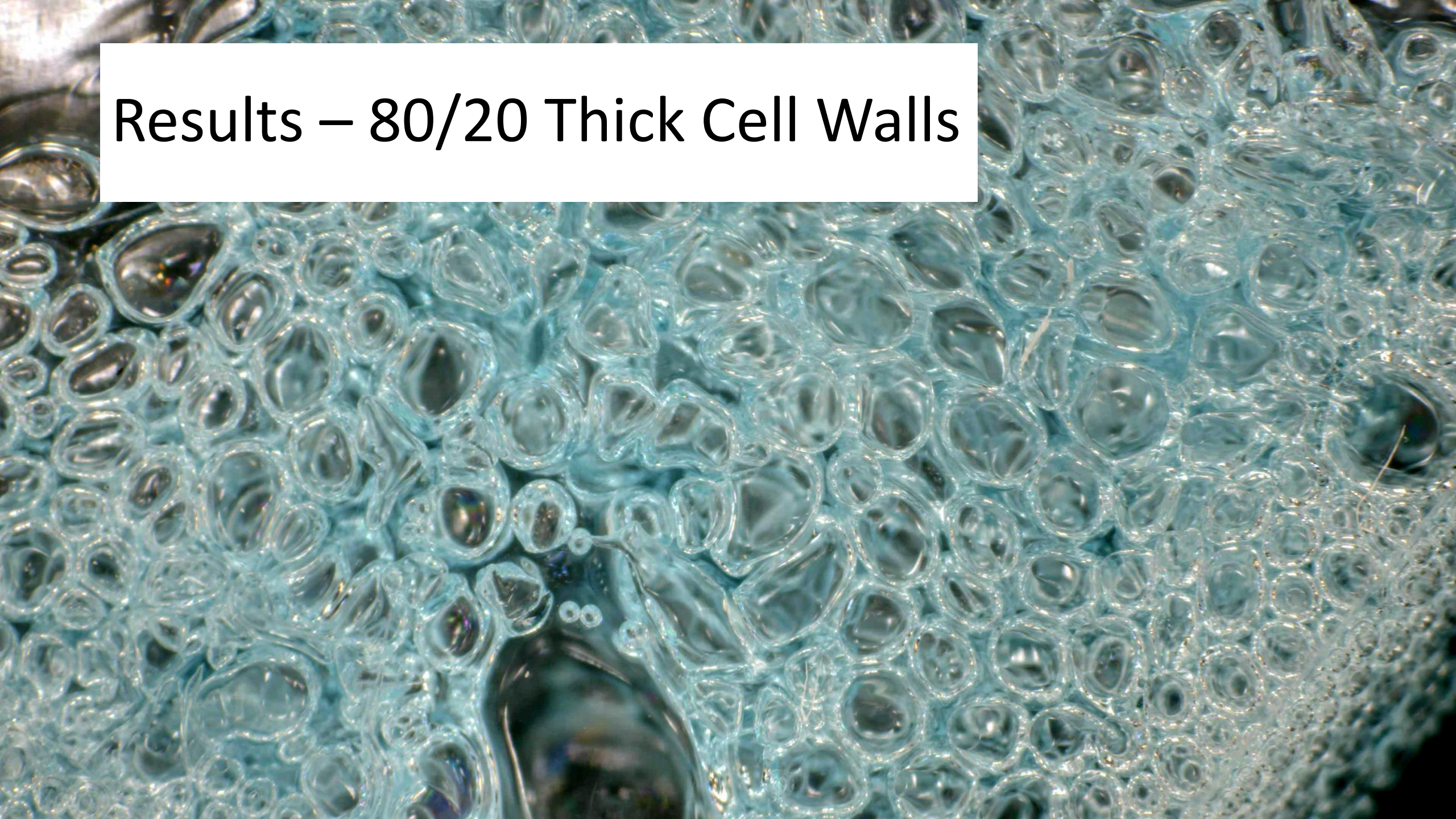

Average PSF - M2 (Yellow)
2
13
2357
3375
4860
518
31
80:20
70:30
60:40
50:50
40:60
30:70
20:80

Results – 50/50 M1

Results 50/50 M1 Plywood After Testing

Results – 20/80 M1 Abnormal Cell Formation

Results – 80/20 Thick Cell Walls



Results

Lessons Learned and Recommended Field Procedures

- Not all low-rise foams behave the same when off ratio happens
  - Reasons for off ratio can be varied
- Office and jobsite staff need to watch consumption of Part A versus Part B
  - Field brings back more Part A than Part B???
  - Field asks for more of one rather than both???
- Inspect and Maintain carts daily
- Recommend one worker be responsible for the foam
- Check kits upon reception for expiration dates!

Lessons Learned and Recommended Field Procedures

- Have spare nozzles (Static Mixing Nozzle)
  - Follow instructions –
    - M1“Remove static mixing nozzle when stopping for more than one minute.”
  - Mix will react in the nozzle and influence ratio
- The “drizzle” approach has been used too
  - Slowly allow small amount of foam to drizzle out into trash bag between applications.
  - Nozzle vs drizzle vs $
- Look for the “kick”
  - Time to kick is temperature and ratio dependent
  - No kick? STOP…there is a problem.

Lessons Learned and Recommended Field Procedures

- Cartridges are to a magic bullet either!!!
  - Inspect for expiration date
  - Check cartridge
- Do not let up on cartridge (plungers) and let the nozzle be turned upright
  - Runs back into Part A and Part B cartridges
  - “Backwash” like a beer


PART 35 A
POM-0722-0156
11-25

Questions?

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