Polyiso Insulation: There’s Always Something

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Polyisocyanurate Insulation: There's Always Something

Joint CRCA/NRCA Research

Speaker:

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Waunakee, WI

Topics

- Polyisocyanurate Facer Adhesion
  - Background
  - ASTM C209
  - Peel
  - Discussion
- Preliminary: Polyisocyanurate Facer Biological Growth
  - Background
  - Sample Results
  - Discussion
- Questions

Polyisocyanurate Facer Adhesion

- Wind failures of low slope roofs is not a new topic
- Field research pointed to edge metal as typical initiation point
  - Ergo…ES-1 and GT-1 standards
- Local forensic investigations point to facer delamination as initiation or contributory to progressive failure
  - Small areas become much larger to huge in size
- Once failure of membrane (single-ply) starts surrounding areas must handle increased load.
- Results seen are a “progressive peel” of the membrane


LACROSSE


AMES


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


20
32
INCH
1
2
50
10
3
64
16
4
STAINLESS


TRAMEX
MOISTURE ENCOUNTER

Polyisocyanurate Facer Adhesion

- Joint NRCA and CRCA Study
- Topic: Facer adhesion to polyisocyanurate insulation for the Chicagoland Area.
- Two parts
  - ASTM C209 Perpendicular Pull
  - Investigative Peel Study
- Peel goals
  - What is the peel strength?
  - Can it be done in the field?

Polyisocyanurate Facer Adhesion

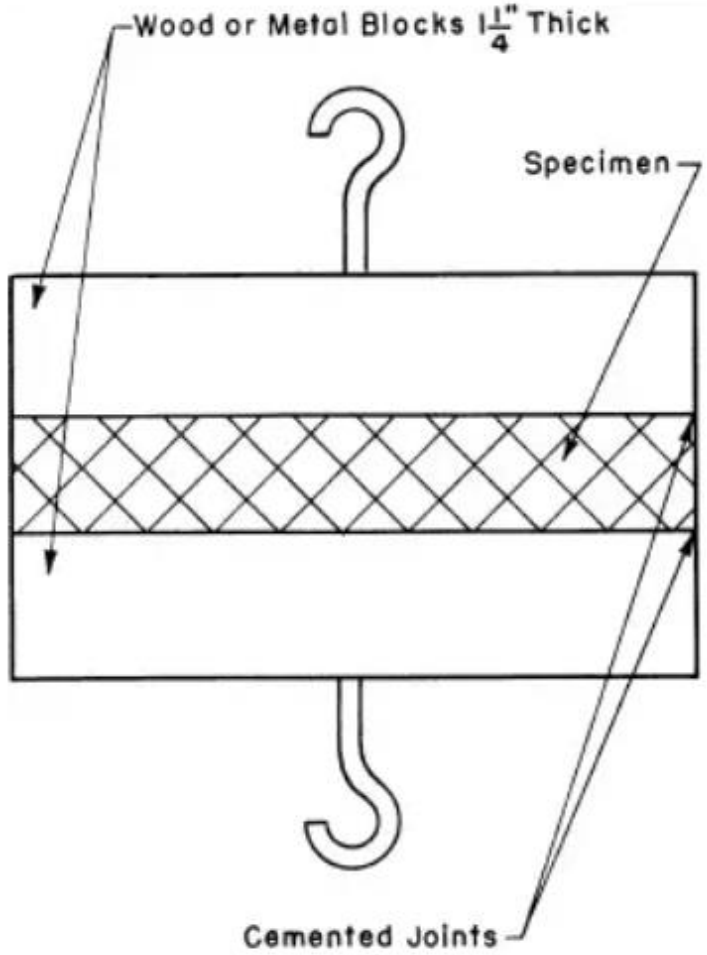
- Currently four manufacturing facilities for polyisocyanurate feed the Greater Chicagoland Area
- Henceforth referred to as Manufacturer A, B, C and D
- Two types of facers used
  - **ASTM C1289 Polyisocyanurate Classification: Type II, Class 1**
    - Commonly called: Paper Facers
    - “cellulosic fibers and glass fibers”
  - **ASTM C1289 Polyisocyanurate Classification: Type II, Class 2**
    - Commonly called: Coated Glass
    - “polymer bonded fibrous glass mats bonded with organic polymer binders and coated with organic polymer, clay, or other inorganic substances”

Polyisocyanurate Facer Adhesion

- 23 - 4x8 ft boards sampled from the Chicagoland Market
- Manufacturer A
  - 4 Coated Glass Facers
  - 4 Paper Facers (Glass Reinforced Felts)
- Manufacturer B
  - 4 Coated Glass Facers
  - 4 Paper Facers (Glass Reinforced Felts)
- Manufacturer C
  - 4 Paper Facers (Glass Reinforced Felts)
- Manufacturer D
  - 3 Paper Facers (Glass Reinforced Felts)

ASTM C209 Perpendicular Pull

ASTM C209 Perpendicular Pull



1¼ in. = 32 mm

FIG. 2 Apparatus for Determination of Tensile Strength Perpendicular to Surface

- 2 inch x 2 inch Sample of polyisocyanurate
- Wood blocks are hot glued to the facers
- Load Frame (MTS / Instron) used to pull apart
- Peak Load (typically fracture) is reported converted to Pounds per Square Foot (PSF)
- No report of which facer (top/bottom)

Results of ASTM C209 Perpendicular Pull

		ASTM C209	
		AVG (PSF)	ST.D (PSF)
Manufacturer A	Coated Glass	1888	556
Manufacturer B	Coated Glass	1874	730
Manufacturer A	Paper	2041	908
Manufacturer B	Paper	1301	409
Manufacturer C	Paper	1029	495
Manufacturer D	Paper	1185	327

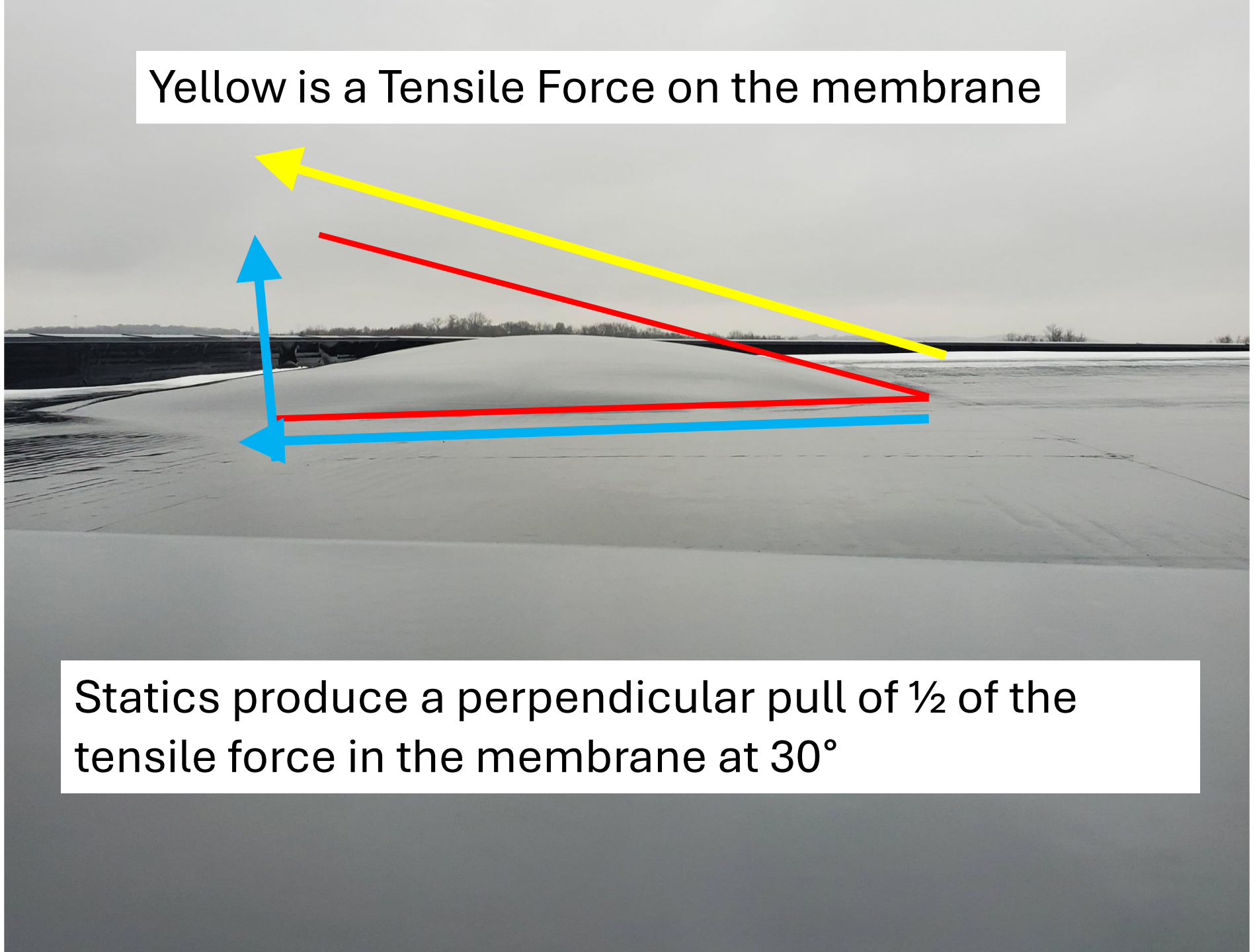
Results of ASTM C209 Perpendicular Pull

- Average for all samples
  - 1,553 PSF
  - 10.8 PSI
- Keep these numbers in mind we will return to these numbers later…

Investigative Peel Study

Investigative Peel Study

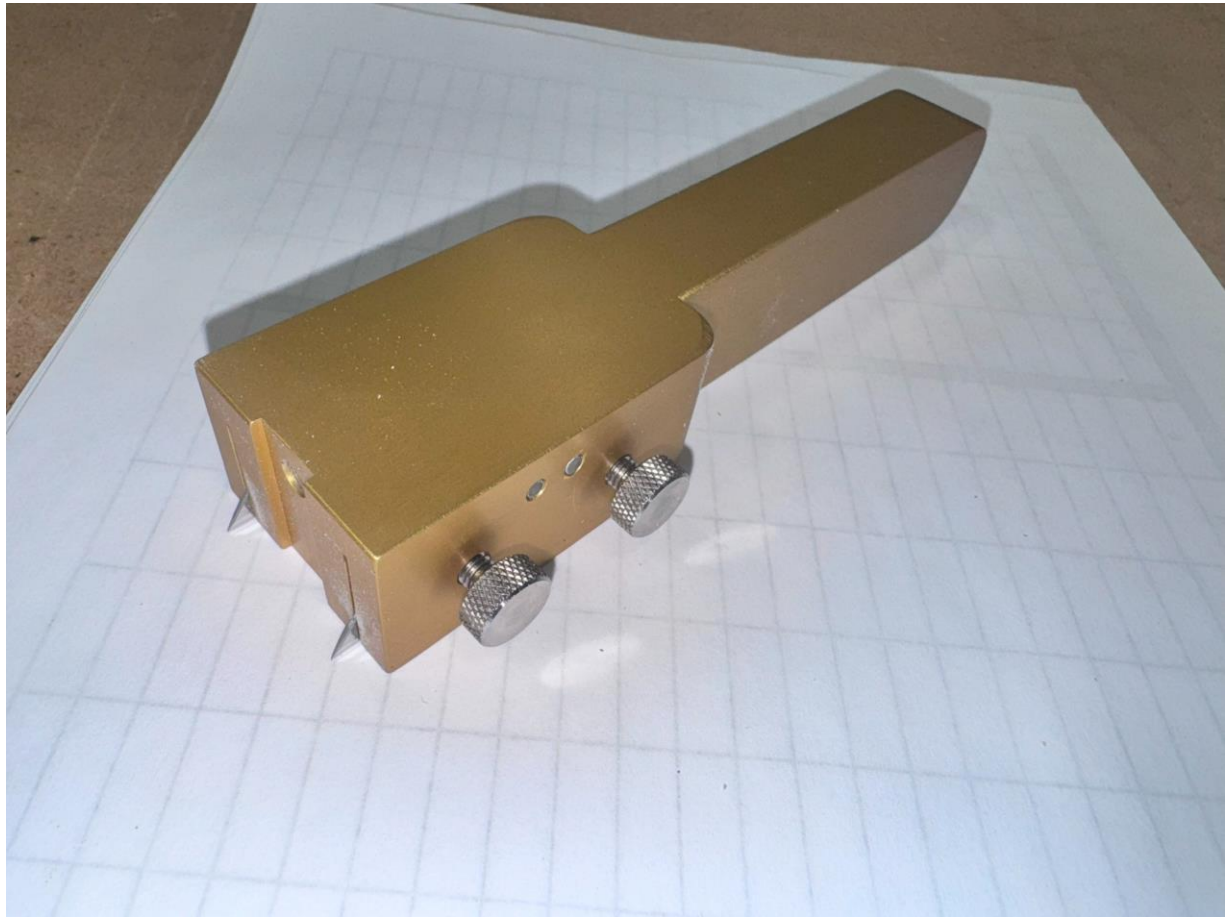
- Interested in the angle at the “peel front”
- Anecdotal evidence suggests 30 degrees is the approximate value of blistering and progressive peels


Yellow is a Tensile Force on the membrane
Statics produce a perpendicular pull of ½ of the tensile force in the membrane at 30°

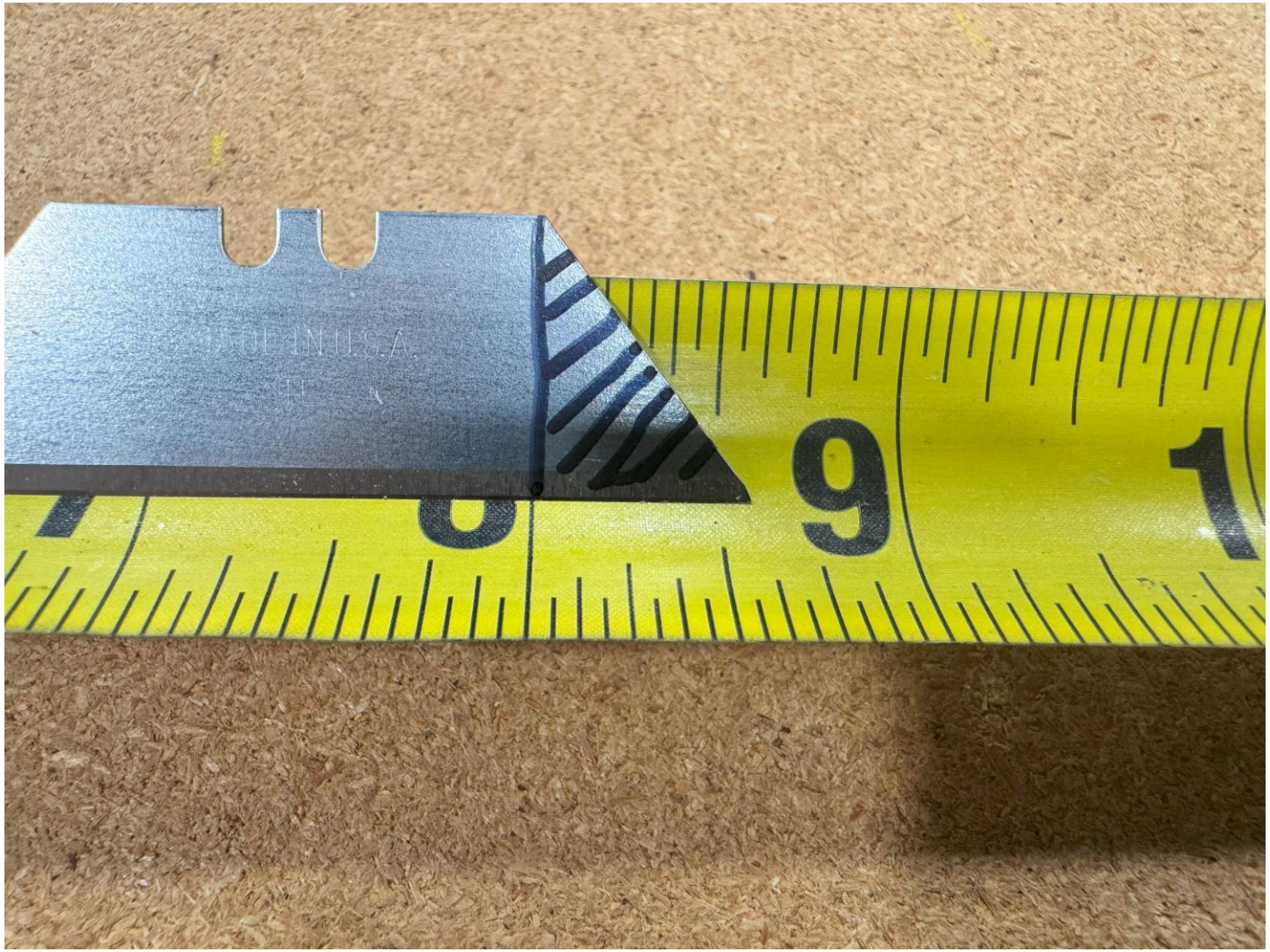
Investigative Peel Study

- **MTT Strip Cutter**

Thwing-Albert Instrument Company



Investigative Peel Study



Investigative Peel Study

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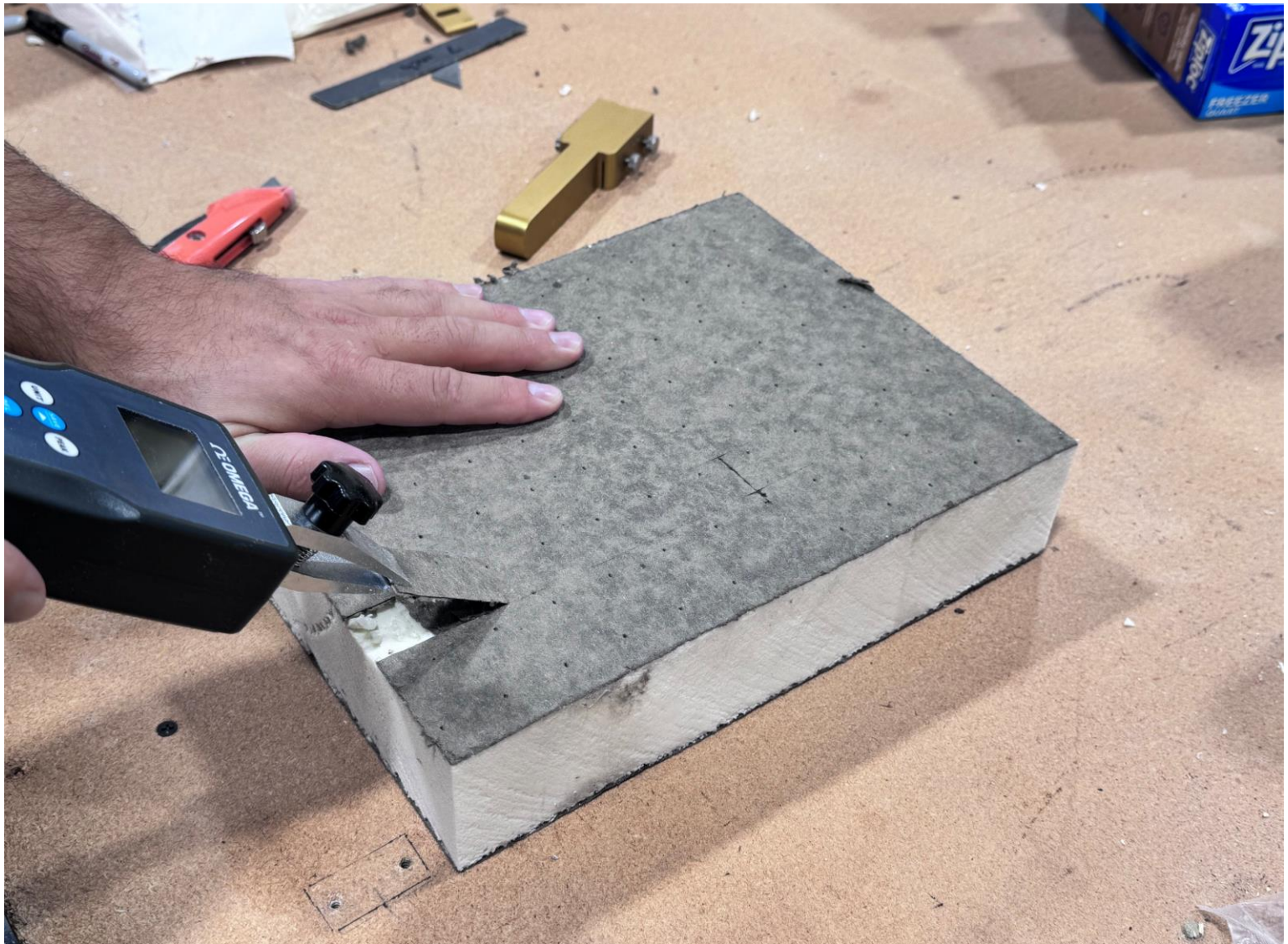

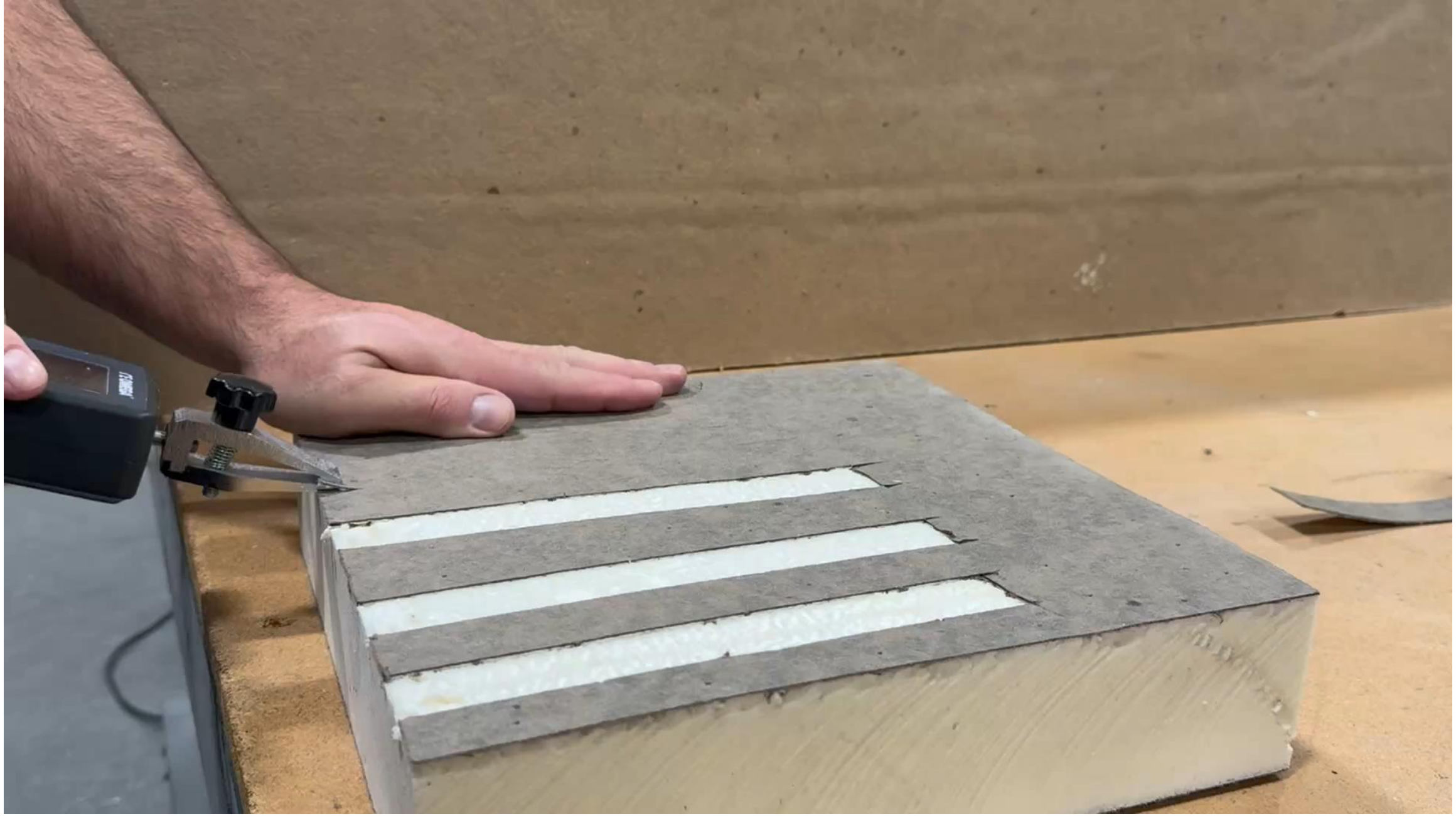

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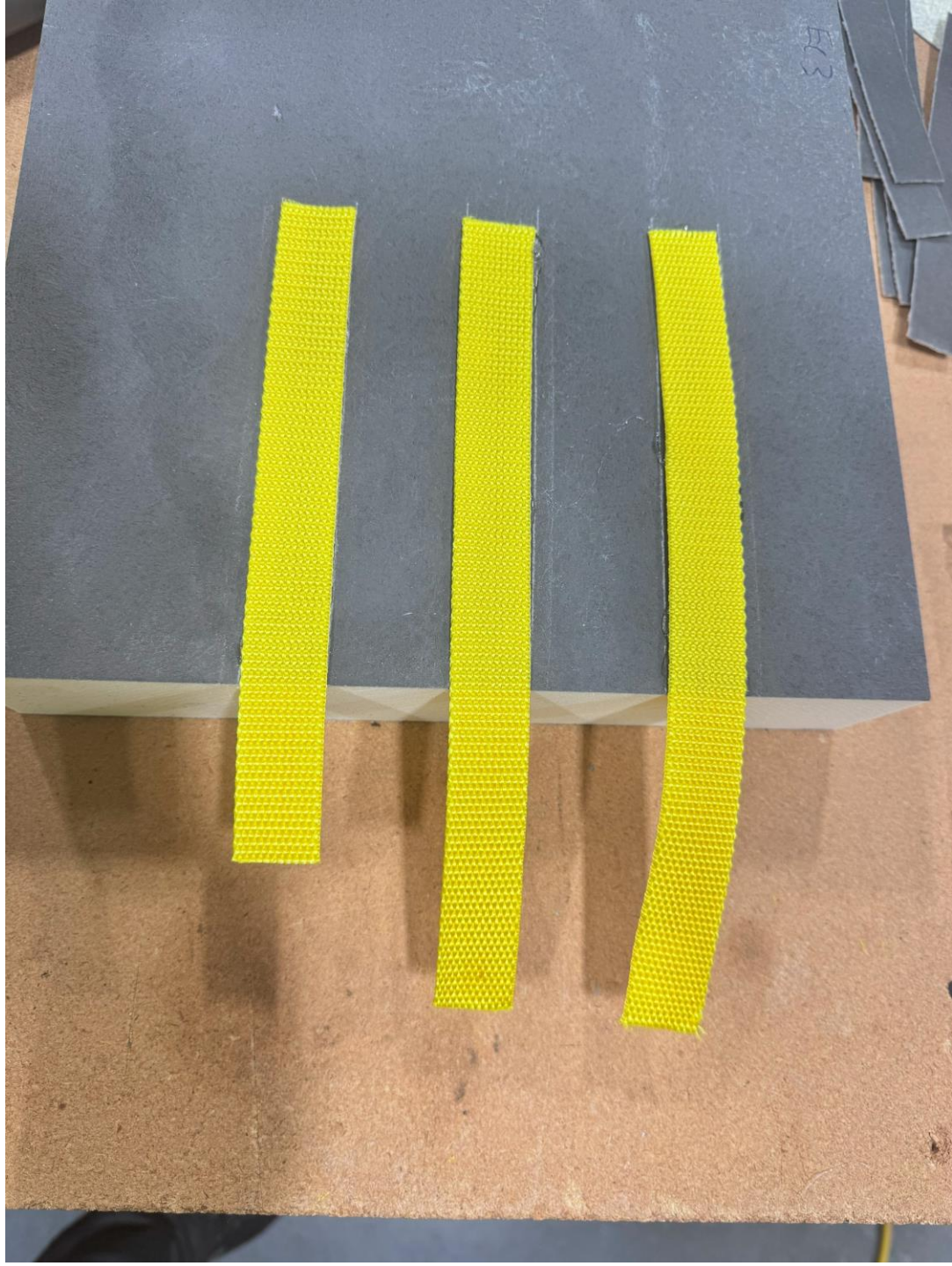

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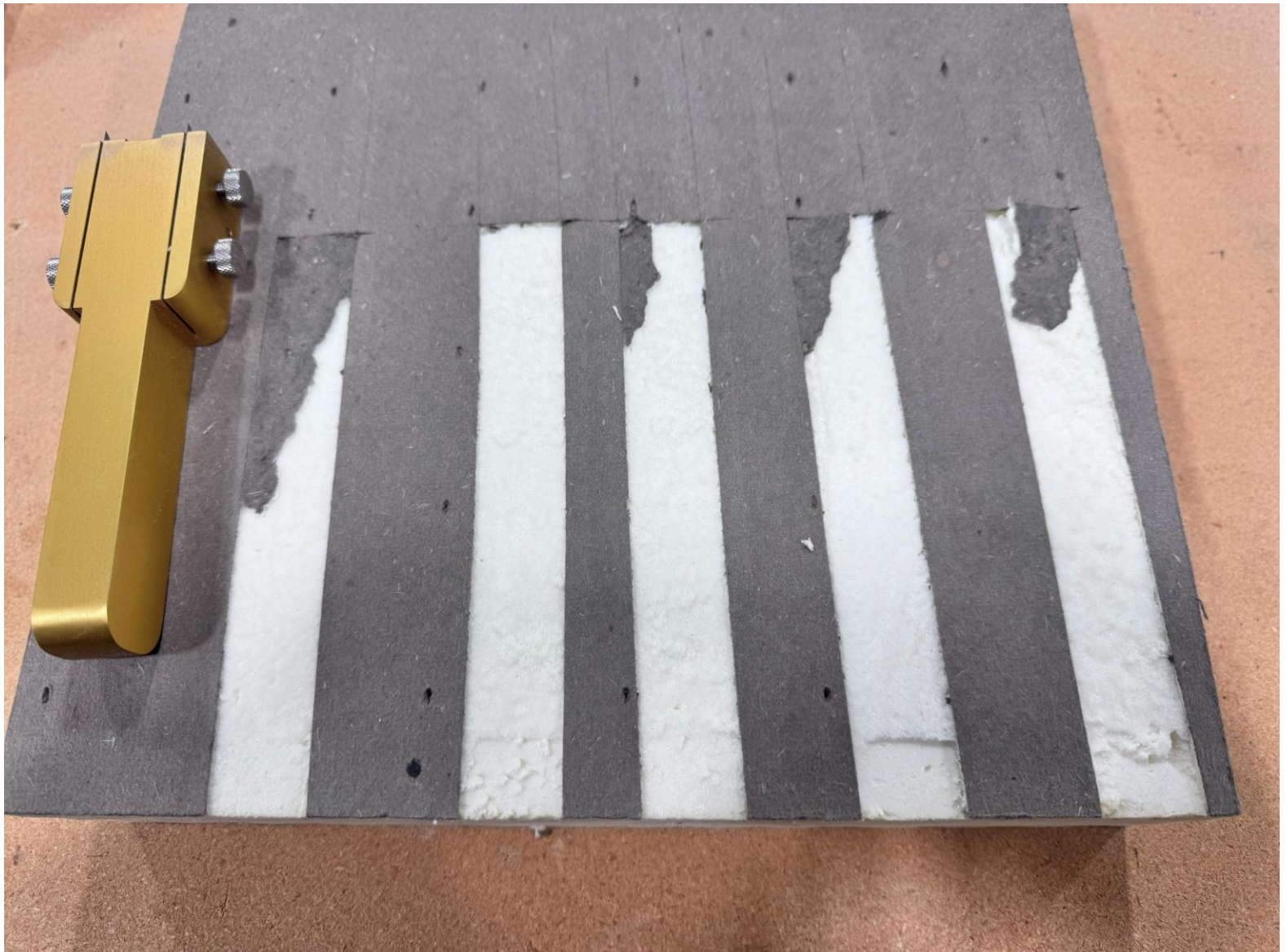

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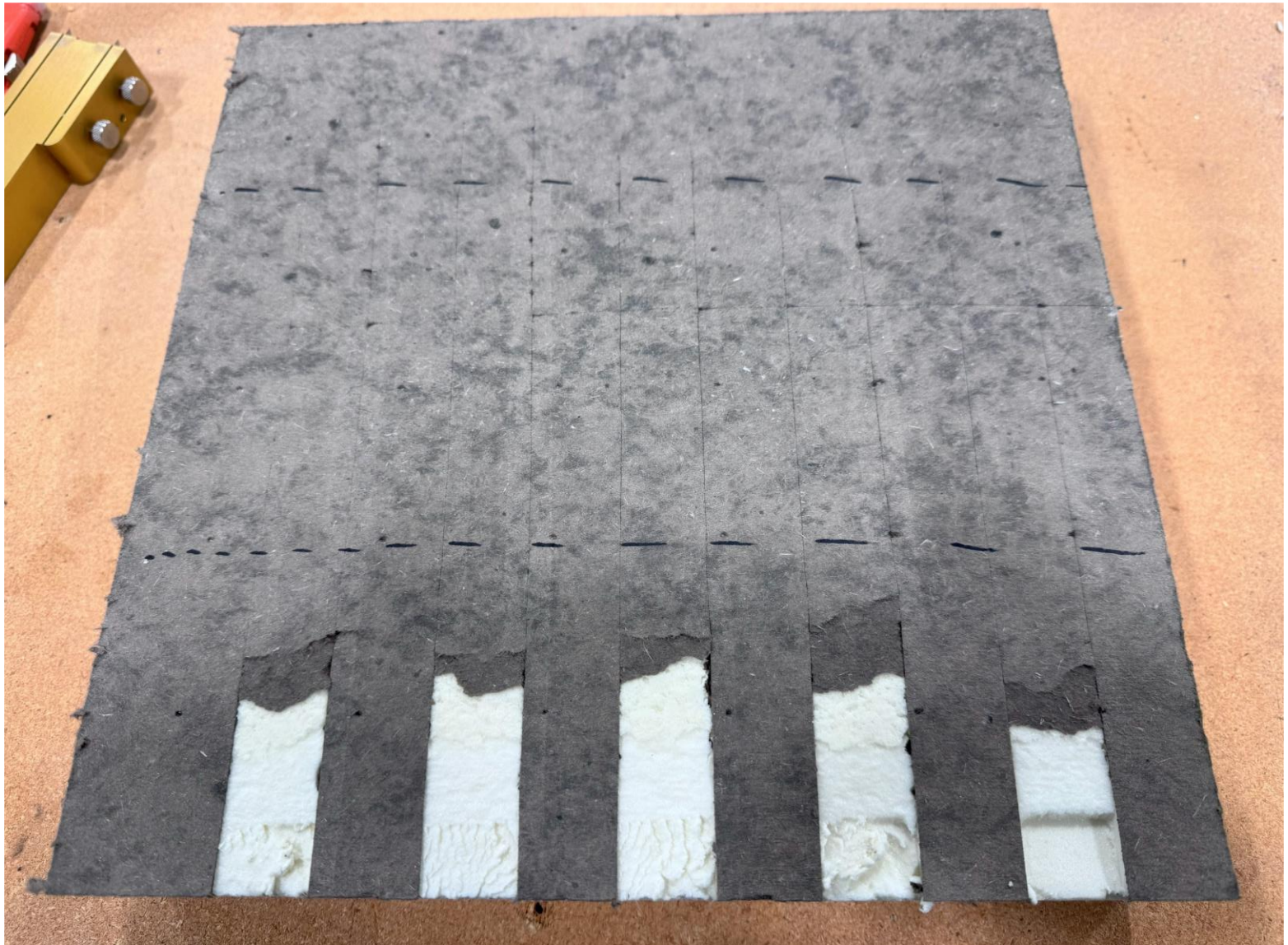

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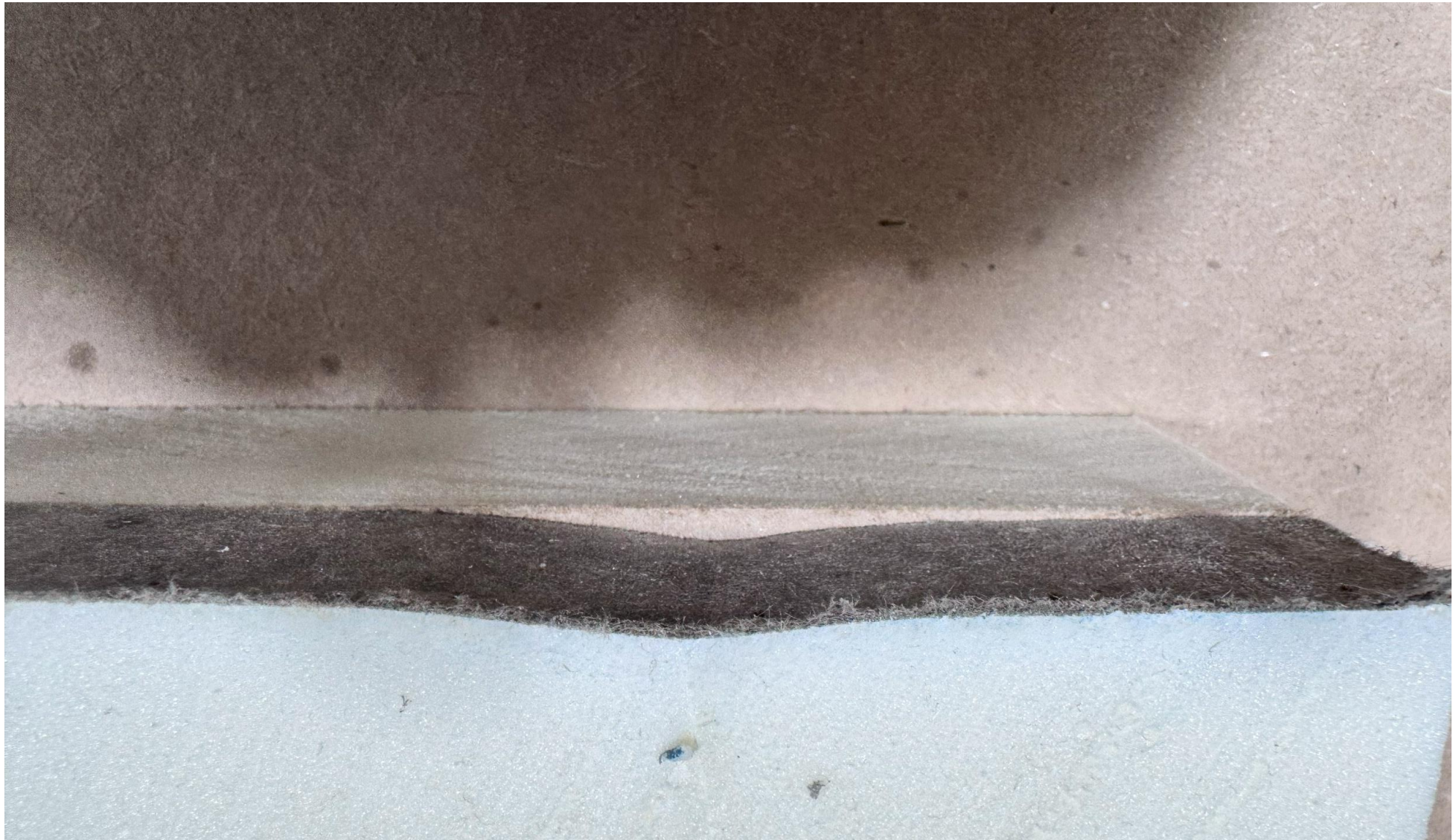

Investigative Peel Study

Investigative Peel Study

Results of 30° Peel

			LBS. Per Inch			
			AVG	STD	MAX	MIN
Manufacturer A	Coated Glass	MD	2.78	0.62	3.53	1.85
		XMD	3.03	0.44	3.53	2.51
Manufacturer B	Coated Glass	MD	2.30	0.31	2.80	1.98
		XMD	2.30	0.28	2.66	2.05
Manufacturer A	Paper	MD	2.52	0.78	4.03	1.01
		XMD	2.89	0.94	4.80	1.02
Manufacturer B	Paper	MD	2.52	0.61	3.71	1.25
		XMD	2.36	0.53	3.60	1.27
Manufacturer C	Paper	MD	2.83	0.59	3.98	1.72
		XMD	2.97	0.57	4.19	1.76
Manufacturer D	Paper	MD	2.61	0.56	3.87	1.68
		XMD	2.19	0.76	3.92	0.64

Combined	MD	2.59
	XMD	2.62

Investigative Peel Study

- Discussion
  - Very uniform average results with some variation within manufacturer
    - No clear “winners or losers” in results
  - Anecdotal observation of differing sides of the board (UP/DOWN) and peel results
  - Knit lines and dimensional instability plays a role
  - **Peel strength is 10% or less of perpendicular pull results for D209**
  - Peel is clearly an actor in wind loss
  - More investigation needed

Preliminary: Polyiso Facer Biological Growth

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- More prevalently observed in recent years is biological growth
  - Commonly called mold…
- Typically found in large moisture intrusion issues. But also, simple leaks
- Original question posed was what mold is growing on our polyisocyanurate facers, and can we identify it?

Preliminary: Polyiso Facer Biological Growth

- Talked with scientists at Wisconsin State Occupational Health Laboratory in Madison, WI.
  - Mold spores are everywhere in our environment
  - Spores generally don’t care what food they eat…if conditions a right they will grow
  - So, no spore should be unique to polyisocyanurate facers
- Question was reformed
  - Where do the mold spores come from?

Preliminary: Polyiso Facer Biological Growth

- Question was reformed
  - Where do the mold spores come from?
    - On the facer already at manufacture?
    - Transport to job site?
    - Construction process?
    - In service?
      - Leaks
      - Air flow


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COMPARATIVE


TC-1 1/2/20

Preliminary: Polyiso Facer Biological Growth

- Study sampling
  - As received polyisocyanurate (in “wrapper”)
  - Right after construction
  - Roof at end of life
- Time between initiation of work and testing deadlines limited sampling to
  - As received polyisocyanurate (in “wrapper”)
  - Lab samples (handled and transported out of bundle / “wrapper”

Preliminary: Polyiso Facer Biological Growth

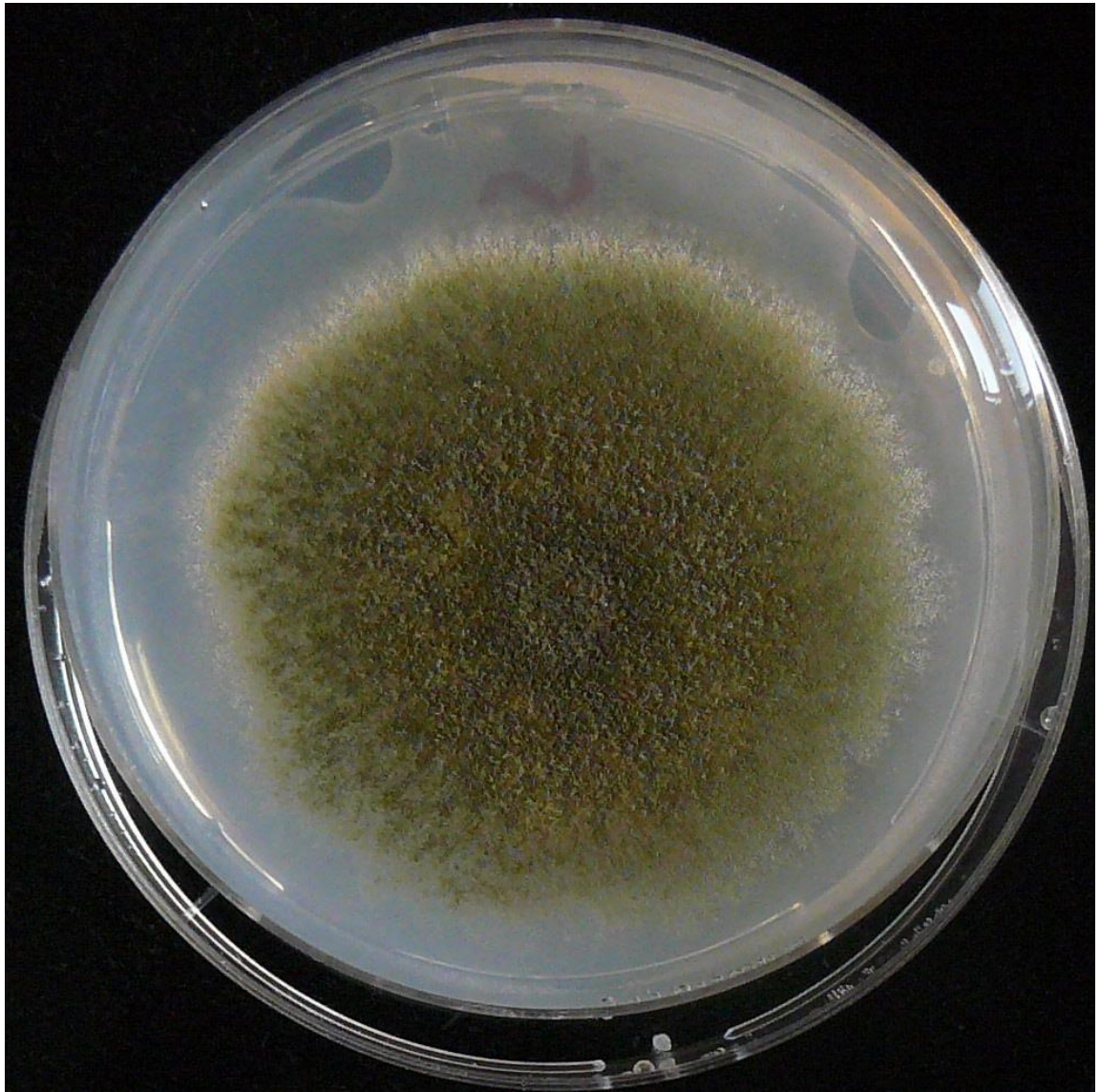
- Testing for mold…
  - Sealed samples 4 inch x 4 inch of facer with some attached foam
  - Subsampled by lab to 1 inch x 1 inch
  - Water Vortex Separation
  - Cultured on media for 6-10 days
  - Results and identification reported

Preliminary: Polyiso Facer Biological Growth

Laboratory Samples		
Manufacturer A	Coated Glass	No Fungi Detected
Manufacturer B	Coated Glass	Aspergillus Species
Manufacturer A	Paper	No Fungi Detected
Manufacturer C	Paper	No Fungi Detected
Manufacturer B	Paper	Non-Sporilating Fungi
Manufacturer D	Paper	No Fungi Detected

New Samples		
Manufacturer D	Paper	Miscellaneous Unidentified
Manufacturer E	Paper	No Fungi Detected

Preliminary: Polyiso Facer Biological Growth



Preliminary: Polyiso Facer Biological Growth

- **Moisture is crucial:** Mold thrives in humid environments and needs water to grow and spread, making leaks, condensation, and high humidity major concerns.
- **Food source:** Mold can digest a wide range of organic materials, meaning many common household items can serve as potential food sources.
- **Oxygen requirement:** Mold needs oxygen to survive, although it can grow even at low oxygen concentrations.
- **Temperature range:** Most molds grow best between 60°F and 80°F, with many not growing below 40°F.
- **Most mold species cannot grow at temperatures significantly above 140°F (60°C) or are even destroyed after three hours above this temperature**

Preliminary: Polyiso Facer Biological Growth

- Discussion
  - Preliminary results. More sampling at cultures needed to better understand source
    - To be completed in 2025 as materials and roofs are available
  - Current limited results suggest spores are everywhere and are a fact of life, with some randomness
  - Hot roofs (black) may provide a hidden benefit of killing spores
  - Cool roofs (white) may have a susceptibility of not killing spores
  - Mold needs correct food, moisture, oxygen and temperature to grow

Questions?

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