

# Design Considerations – Roof Insulations

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# Design Considerations

- ✓ Many types of roof insulations available on the market
- ✓ All have different use within a system
- ✓ How do you compare them?

# Design Considerations

- ✓ Every product has a technical data sheet
- ✓ Tech data sheets typically have numbers
  - Are bigger numbers better?
  - Manufacturers that post pass / fail? What does this mean?
- ✓ Essentially to compare you often must understand the test behind the numbers, and realize not all companies reference the same test method.

# Design Considerations

- ✓ Key technical information provided, which we will review
  - Compressive strength
  - Water Absorption
  - Dimensional Stability

# Design Considerations

- ✓ Standards
  - Specification Standard
    - Used to outline minimum performance criteria
    - References testing standards to test materials to meet the criteria within the specification standard
  - Testing standard
    - Outlines testing apparatuses and methodology

- ✓ Materials compared
  - Products that are newer to the market place
  - Often mistakes seen
  - Products with changing standards
- ✓ Rigid Mineral Wool Insulation
- ✓ Polyisocyanurate Insulation – Glass Faced

# Compressive Strength

- ✓ Mineral Fibre Roof Insulation Boards
  - ASTM C 165 – Testing Standard - Standard Test Method for Measuring Compressive Properties of Thermal Insulations
    - Outlines two test methods: A and B
    - Test method A is for Insulations with a straight-line load curve
    - Test Method B is for thermal insulations that become increasingly more stiff as they are compressed
  - Technical data sheet does not outline which method used, However does state that it is for at 10% or 25%, these percentages refer to compression / deformation.
  - Normal Values are 11PSI @10%, 15PSI at 25% for entire board
    - Information for top layer only also provided at 20PSI at 10% or 37PSI at 25%

# Compressive Strength

- ✓ Polyisocyanurate Roof Board Insulation
  - ASTM D 1621 – Testing Standard - Standard Test Method for Compressive Properties of Rigid Cellular Plastics
    - Single test method
    - Complete load – deformation curve used to compute effective modulus of elasticity
  - 2 out of 8 manufacturers refer to their compressive strength as “10% consolidation”
  - Vertical Compressive Strength is typically measured at 10% deformation on roof insulations. Many of the products will creep over the long term, and therefore require adequate safety factors.
  - Normal Minimum values are 20PSI



# Compressive Strength



# Compressive Strength



# Compressive Strength



# Compressive Strength



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# Compressive Strength



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# Compressive Strength



# Water Absorption

- ✓ Mineral Fibre Roof Insulation Boards
  - ASTM C 209 – Testing Standard - Standard Test Methods for Cellulosic Fiber Insulating Board
    - Mineral Fibre Roof Insulation Boards do not contain Cellulosic Fibres, however, the *Specification Standard* for Mineral Fibre Roof Insulation Boards ASTM C 726 references this standard for water absorption.
    - Involves submerging a sample under a 1” head of water for 2 hours.

# Water Absorption

## ✓ Polyisocyanurate Roof Board Insulation

- ASTM C 209 – Testing Standard - Standard Test Methods for Cellulosic Fiber Insulating Board
  - 7 out of 8 Manufacturers Reference this standard
  - Not realistic in terms of terminology of the test standard but this standard is referenced in the ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
  - Normal Result is  $<1\%$
- ASTM D2842 – Testing Standard - Standard Test Method for Water Absorption of Rigid Cellular Plastics
  - 3 out of 8 Manufacturers Reference this standard. All 3 of these have plants in Canada.
  - This test involves submerging the board in a 2" head of water for 96 hours.
  - Normal Result is  $<3.5\%$
  - A note in the standard recognizes that many products will continue to absorb water after the 96 hour time period if left submerged.



# Water Absorption



# Water Absorption



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# Water Absorption



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# Water Absorption



# Dimensional Stability

- ✓ Mineral Fibre Roof Insulation Boards
  - ASTM C 356 – Standard Test Method for Linear Shrinkage of Preformed High-Temperature Thermal Insulation Subjected to Soaking Heat
    - Not included in the specification standard C726.
    - Is for insulations that will see normal hot side temperatures in excess of 93°C.
    - Determines the linear change that occurs after the insulation has been heated for 24 hours
  - Normal results are  $\leq 0.75\%$
  - ASTM D2126 - Standard Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging
    - Included in the specification standard C726
    - The test method outlines the methodology of testing and not the conditions the material is to be subjected to.
      - Results in difficulty in comparing materials if different conditions are chosen by the manufacturer.
  - Normal results are  $\leq 0.1\%$

# Dimensional Stability

- ✓ Polyisocyanurate Roof Board Insulation
  - ASTM D2126 - Standard Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging
    - Included in the specification standard C1289
    - The test method outlines the methodology of testing and not the conditions the material is to be subjected to.
      - Results in difficulty in comparing materials if different conditions are chosen by the manufacturer.
    - Some manufacturers specify the test was over 7 days others do not, the minimum limits are outlined in the specification standard.
    - Standard Limits shown is  $<2\%$

# Dimensional Stability



- ✓ Associated math
  - Mineral Fibre Roof Insulation Boards
    - Typical calculation performed:
      - $0.1\% \times 48 = 0.05''$
  - Polyisocyanurate Roof Board Insulation
    - Typical calculation performed:
      - $2\% \times 96 = 1.92''$
  - Enough? Too much?
    - So if you take and butt 2 - 96" boards together, and expect the board to shrink the maximum to the centre of the board you can expect an almost 2" gap between boards on the long dimension.
    - This is one of the reasons having two layers of insulation with staggered and offset joints is so critical.
    - Experience has shown gaps in the field of up to 1"

# Dimensional Stability





# Dimensional Stability





# Dimensional Stability



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# Thank You

✓ Questions?