## Opal Sands Resort
## Clearwater, FL

### Friday, January 10, 2020

| | Opal Sand | Beach Salon | Sand Salon |
|---|---|---|---|
| 7:15 AM | **Breakfast** | | |
| 7:30 AM | Codes & Standards<br>7:30-8:30<br>Ober | | |
| 7:45 AM | | | |
| 8:00 AM | | | |
| 8:15 AM | | | |
| 8:30 AM | Codes Development<br>8:30-9:30<br>Hickman | | D6878 TPO Considerations for Revision<br>8:30-9:30<br>Sanborn |
| 8:45 AM | | | |
| 9:00 AM | | | |
| 9:15 AM | | | |
| 9:30 AM | DORA Listing Service<br>9:30-10:30<br>Malpezzi | Annual Conference Timing<br>9:30-10:15<br>Carpenter / Reel | |
| 9:45 AM | | | |
| 10:00 AM | | | Voc Reg Monitoring<br>10:00-11:00<br>Bates |
| 10:15 AM | | | |
| 10:30 AM | | Code Compliance Interface<br>10:30-11:30<br>Hull / Cadena / Younkin | |
| 10:45 AM | DORA Rule for Adding Fire & Impact<br>10:45-11:30<br>Morrison / Sherwin | | |
| 11:00 AM | | | Very Severe Hail FAQ<br>McQuillen<br>11:00-11:45 |
| 11:15 AM | | | |
| 11:30 AM | Air Intrusion<br>11:30-12:00, Janni | Digital Content & Communications<br>11:30-12:00, Burzynski | |
| 11:45 AM | | | |
| 12:00 PM | **Lunch** | | |
| 12:15 PM | | | |
| 12:30 PM | | | |
| 12:45 PM | Air Barrier Details<br>12:45-1:45<br>Janni | IA-1 Revision<br>12:45-1:45<br>Childs | Fastener Plate Pull-Through<br>12:45-1:45<br>Mader |
| 1:00 PM | | | |
| 1:15 PM | | | |
| 1:30 PM | | | |
| 1:45 PM | | Code Official Training<br>1:45-2:15, Chamberlain | IBHS Training<br>1:45-2:45<br>Darsch |
| 2:00 PM | Wetting Curves<br>2:00-2:30, Hawn | | |
| 2:15 PM | | | |
| 2:30 PM | | | |
| 2:45 PM | **Tech Committee**<br>2:45-3:30<br>Mader | | |
| 3:00 PM | | | |
| 3:15 PM | | | |
| 3:30 PM | | | |
| 3:45 PM | | | |

SPRI
Code and Standards Task Force
Opal Sands Resort
Clearwater, FL
January 10, 2020
7:30 a.m.

AGENDA

I. Call to Order — R. Ober

II. Roll Call & Reading of SPRI Antitrust Statement

III. Review Task Force Objectives

IV. Codes
   a. ICC-ES
   b. California

V. Industry Associations
   a. AAI
   b. ASHRAE
   c. CIB
   d. CRRC
   e. FM
   f. RICOWI
   g. Industry Summit

VI. Standards
   a. ANSI activity
   b. ASTM activity
   c. SPRI Standards

VII. Adjournment

465 Waverley Oaks Road, Suite 421 – Waltham, MA 02452
t. 781.647.7026 f. 781.647-7222 e. info@spri.org

Return to Schedule

SPRI
Code Development Task Force
Opal Sands Resort
Clearwater, FL
January 10, 2020
8:30 a.m.

AGENDA

| | | |
|---|---|---|
| I. | Call to Order | A. Hickman |
| II. | Roll Call & Reading of SPRI Antitrust Statement | |
| III. | Review Task Force Objectives | |
| IV. | Review results for ICC Group B Code change proposals | |
| V. | Review 2020 plans to prepare for next ICC code change cycle | |
| VI. | ASHRAE update | |
| VII. | Florida update | |
| VIII. | Adjournment | |

Return to Schedule

SPRI
DORA Listing Service Task Force
Opal Sands Resort
Clearwater, FL
January 10, 2020
9:30 a.m.

AGENDA

I. Call to Order — J. Malpezzi

II. Roll Call & Reading of the SPRI Antitrust Statement

III. Program Statistics

IV. Request an Assembly Feature
   a. Status Update (for public users to request an assembly from a participating listing owner)

V. Searching Techniques

VI. Future of DORA
   a. Individual company sales efforts
   b. Strategic/Collaborative promotion efforts
   c. Fire & Impact and Edge Meeting/Metal Roofing
      i. Development/forward momentum
      ii. Demo/reminder on some of newer features as applicable

VII. Adjournment

Return to Schedule

SPRI
DORA Rule Fire & Impact Task Force
Opals Sands Resort
Clearwater, FL
January 10, 2020
10:45 a.m.

AGENDA

| | | |
|---|---|---|
| I. | Call to order | S. Morrison/J. Sherwin |
| II. | Roll call & reading of SPRI Antitrust Statement | |
| III. | Update on fire standards | Jenny Sherwin |
| IV. | Update on impact standards | Scott Morrison |
| V. | Adjournment | |

Return to Schedule

SPRI
Air Intrusion Task Force
Opal Sands Resort
Clearwater, FL
January 10, 2020
11:30 a.m.

AGENDA

I. Call to Order — A. Janni

II. Roll Call & Reading of SPRI Antitrust Statement

III. Report on how many RFP's SPRI received

IV. RFP review task group talk about setting up a date, time, and location to interview those that provided RFPs

V. Any new business

VI. Adjournment

Return to Schedule

SPRI
Air Barrier Details Task Force
Opal Sands Resort
Clearwater, FL
January 10, 2020
12:45 p.m.

AGENDA

I. Call to Order — A. Janni

II. Roll Call & Reading of SPRI Antitrust Statement

III. Update from Adam Ugliuzza (Intertek, ABAA)
   a. Review the comments and changes to details from ABAA.
   b. Review details to SPRI's comments given to ABAA from October meeting

IV. Any new business

V. Adjournment

Return to Schedule

SPRI
Roof Substrate Materials - Wetting Curves Task Force
Opal Sands Resort
Clearwater, FL
January 10, 2020
2:00 p.m.

AGENDA

| | | |
|---|---|---|
| I. | Call to order | D. Hawn |
| II. | Roll Call & Reading of SPRI Antitrust Statement | |
| III. | Review document prepared for approval to publish (attached) | |
| IV. | Call for vote to approve to the Technical Committee the effort to publish | |
| V. | Adjournment | |

Confidential – not for distribution outside the SPRI Technical committee until the approved document is published to the SPRI website

12-21-2019 – Wetting Curves Task Force

The following data/reporting is ready for a vote to release for publishing to the SPRI website. Note that there is some limited data we are still waiting on for the final testing of materials at TRR-80 moisture content. Those samples are taking a long time to condition and achieve those moisture content levels. The conditioning is in progress and the TBD data will be inserted into the tables and final NRC reporting.

The SPRI - Roof Substrate Wetting Curves Data v.2020 introduction, statement of intended purpose, and acknowledgements have been reviewed by SPRI counsel. Carl Silverman further reviewed the entire document put before you.

The data tables are reproduced from the NRC reporting that follows as back up to the data tables. The NRC report will be fully complete and bear official signatures once the reporting is fully complete and has gone through their internal review process. The content of that is not to be changed from what is included here. However, some minor editorials as suggested to NRC (copy attached) may be made. If there are any substantive changes this will be recirculated, to discuss them, but none are anticipated. Prior to publish, SPRI counsel will provide a final review to assure there are no substantive changes.

The full reporting is anticipated prior to the Spring SPRI meeting and therefore the approval of this format of reporting is of value to expedite completion of the task as reported to the RCI Foundation that financially supported this endeavor.

Thank you for your review in advance of our task force and technical meeting in January. We will be voting on this output and the approval to move forward with publishing it to the SPRI website as soon as the final data is available.

The PDF document for vote follows as well as an FYI PDF of editorial commentary sent to NRC.

Return to Schedule

## Executive Summary

**Background:** In the 1980's the US Army Corps of Engineers Cold Regions Research and Engineering Laboratory (CRREL) set out to determine the thermal resistance ratio for a number of commonly used materials at that time (Tobiasson et al, 1987) 1 . This set of data determined the amount of moisture a material could absorb before losing 20% of its original thermal resistance (R) value. SPRI Inc. membership approached the National Research Council Canada (NRCC), via a request for proposal ("RFP"), to update the existing properties of the substrate materials that are commonly used in low slope membrane roof assemblies.

**Objective:** To develop a robust experiential dataset showing the effect of moisture content on the thermal and mechanical performance on an up-to-date (2018-2019) list of substrate materials provided by SPRI.

**Measurement Lab:** All experiments were carried out at the NRCC's lab. NRCC is one of the world's leading labs with expertise in characterization of building materials, which develops standard test methods, maintains and enhances a unique hydrothermal material property database, and is published by ASHRAE. It is also a national calibration laboratory. To maintain quality and reproducibility, none of the testings' were outsourced.

**Material Requirement:** Figure 1 lists all the materials to be tested and their respective categoryies. In total, there were 21 substrate materials selected by SPRI that are commonly used in low slope membrane roofing. These materials are grouped in to four categories as follows:

1. Insulation;
2. Gypsum;
3. Wood products; and
4. Concrete.

As per the SPRI-RFPequest For Proposal (RFP - dated: 31st January 31, 2017 and March 5,th 2018), most of the materials required to perform the testing were supplied in sufficient quantity by SPRI Member Companies. Materials purchased by NRCC in consultation with SPRI are also marked in the Figure 1.

**Test Condition:** Materials were exposed (Figure 2) to various simulated temperature and relative humidity conditioning. Requirements for the two project specific conditions marked as "VD- 48hrs" and "TRR 80" are explained in Appendix 7. Five classical properties (moisture content, thermal resistance, compressive strength, flexural strength, and fastener plate pull through) were measured after the conditioning of each of the materials. This approach has been synchronized with the SPRI – RFP.

---

1.Tobiasson, W., Greatorex, A., & Pelt, D. V. (1987). Wetting of Polystyrene and Urethane Roof Insulations in the Laboratory and on a Protected Membrane Roof. *Journal of Thermal Insulation*. 11(2), 108-119. Doi: 10.1177/10907 19638701 100206.

**Sample Preparation:** Figure 3 shows an overview of the present approach~~,~~ including test conditions, number of measurements made for each material property, and standards that were used. Sample dimensions are also listed for each test based on the relevant standard, along with the number of specimens per test. Summations of the number of specimens in each group and total number of measurements demonstrate the robustness of this project.

**Project Updates:** Project progresses were presented at the SPRI quarterly Tech Meetings in 2019 (January 18,~~th 2019~~, April 16,~~th 2019,~~ July 16,~~th 2019~~ and October 22.~~nd 2019~~). SPRI M~~m~~ember Company representatives'~~ship~~ comments and reviews were incorporated into this report.

**Reporting:** This report contains all of the measured data in tabular format. The data for each property is presented as follows:

Appendix 1: Moisture Content;
Appendix 2: Thermal Resistance;
Appendix 3: Compressive Strength;
Appendix 4: Flexural Strength; and
Appendix 5: Fastener Plate Pull through.

Each appendix presents the respective standards used for each material type, sample dimensions, and number of specimens used for testing. Each appendix is also concluded with tabulated measured data and remarks.

NRCC in consultation with SPRI developed an experimental procedure for the determination of the fastener plate pull through the substrate material~~,~~ which was applied consistently for all substrate materials. This test protocol labelled as "NRCC – FPPT" is documented in Appendix 6. As well, there is no consensus-based procedure for adding moisture into materials~~,~~. NRCC in consultation with SPRI developed a procedure (Appendix 7) based on the methodology described in (Tobiasson et al, 1987) [n 1].

[page 7 of 42]

## Measured Data and Remarks

The size and number of specimens tested for the Moisture Content can be seen in Table 1-1, while the moisture conditions, which were reached using a climate chamber, are shown in Table 1-2. Three moisture conditions were outlined in the RFP~~equest For Proposal (RFP)~~. To obtain the dry mass, the specimens were initially dried either at 220° ±4° or 140°F~~,~~ until the change in mass was less than 0.1% of the specimen mass over 24 hours for three successive days. The materials were then left in each condition until the change in mass was less than 0.1% over 24 hours. The results for the insulation materials can be seen in Table 1-3 and Table 1-4 for gypsum, wood and concrete.

[page 13 of 42]

Return to Schedule

## Measured Data and Remarks

After each moisture condition was reached, the specimens were wrapped in a thin plastic film with a negligible thickness to maintain the moisture content. To take into consideration any moisture loss that could have occurred during the test period, weight measurements were taken both before and after testing, and the average value was used when determining the experimental moisture content. The specimens were tested at a mean temperature of 75 ±2°F and a temperature differential of 40 ±2°F. Based on the RFP, the wood thermal transmission was not required, and it has not been included in this report. Due to the non-destructive nature of the test, the same specimens were used for all conditions.

For MC4 and MC5, which corresponds to "VD-48hrs" and "TRR-80", the materials had a very high moisture content, which in early testing proved to be problematic due to moisture migrating to the cold plate during the test. Preliminary tests were conducted, and it was found that reversing the heat flow from the conventional approach (top plate to have the high temperature and the bottom the low temperature) provided more accurate results (Valovirta & Vinha, 2004)2 . Reversing the heat flow direction for MC4 and MC5 avoids cycles of condensation and evaporation on the top plate. This eliminates inconsistent and erroneous data results. For five materials from the insulation group (Polyiso II Class 1, Polyiso II Class 2, Polyiso II Class 4, XPS IV, SPUF II ), MC3 was reached using the vapor drive method described in Appendix 7 for 24 hours.

TRR-80 is the moisture content required by each material to reduce the thermal resistance by 20%. It is calculated using the following equation, where TRR=80:

$$TRR = 100 \times \frac{\text{Wet R-value}}{\text{Dry R-value}}.$$

The "Dry R-Value" of the materials was known and the "Wet R-Value" was calculated. The amount of moisture required to achieve the calculated "Wet R-value" was estimated. Each of the materials wasere conditioned using the vapor drive method until the estimated moisture content required to reach TRR-80 was achieved. The specimens were tested and it was verified to see if the amount of moisture absorbed was enough to allow the materials to reach their calculated "Wet R-value". This process was repeated continuously until a value very close to TRR-80 was reached. Note that the thermal transmission TRR-

___

[2] Valovirta, 1., & Vinha , J. (2004). Water Vapor Permeability and Thermal Conductivity as a function of Temperature and rfelative Humidity. ASHRAE



80 moisture content was used to condition materials for the determination of the compressive strength, flexural strength and fastener plate pull through at MC4. The measured data for insulation materials can be seen in Table 2-3 and for gypsum and concrete in Table 2-4.

## Measured Data and Remarks

The moisture contents for MC1 and MC2 were achieved using a climate chamber. The vapor drive method, explained in Appendix 7, was used to reach MC3 and MC4. For insulation materials the standard specifies a loading rate ranging from 0.01 inch/min to 0.5 inch/min. B~~, b~~ased on this as well as the individual material standards, the following loading rates were selected to be used: cellular glass (0.01 inch/min)~~,~~; perlite board (0.05 inch/min)~~,~~; fiber board (0.05 inch/min)~~,~~; and all other insulation materials (0.1 inch/min). The loading rate for the concrete was selected in accordance with ASTM C513-11 and ASTMC165-07 to be 0.05 inch/min. The measured results can be seen in Table 3-3 for the insulation materials and Table 3-4 for the gypsum, wood and concrete.

[page 24 of 42]

## Measured Data and Remarks

The moisture contents for MC1 and MC2 were achieved using a climate chamber. The vapor drive method, explained in Appendix 7, was used to reach MC3 and MC4. For insulation materials and the concrete, the standard does not specify a specific loading rate~~,~~. B~~ b~~ased on this as well as individual material standards, the following loading rates were selected to be used: cellular glass (0.17 inch/min)~~,~~; perlite board (2 inch/min);~~ and~~ all other insulation materials (1.67 inch/min); and~~, while~~ for concrete (2 inch/min). For wood materials the standard does not specify a specific loading rate. B~~, b~~ased on this as well as individual material standards, a loading rate of 0.29 inch/min was selected to be used. The measured results can be seen in Table 4-3 for the insulation materials and Table 4-4 for the gypsum, wood and concrete.

[page 29 of 42]

**7. Report**

7.1 Report the following information:

7.1.1 Complete description of the test specimen including the dimensions and weight of the specimen.

7.1.2 Record the peak pull through load.

**8. Precision and Bias**

8.1 The repeatability relative standard deviation has not been determined because it is greatly dependent~~d~~ upon the nature of the material and its variations.

**9. Keywords**

9.1 fastener plate, fastener, pull through.

[page 38 of 42]

Return to Schedule

# SPRI - Roof Substrate Wetting Curves Data v.2020

## Introduction

The Single Ply Roofing Industry (SPRI, Inc. or "SPRI") is comprised of commercial roofing industry experts dedicated to providing an open forum for discussion, education, and innovation. SPRI is the leading authority in single-ply roofing with membership including membrane manufacturers, raw material suppliers, component manufacturers, consultants, sales representatives and testing/research agencies. Since 1982, SPRI has developed industry standards, as well as provided support and leadership in various roofing system research programs.

## Statement of Intended Purpose

SPRI's Wetting Curves Task Force Committee has facilitated the testing of materials to publish the impact of moisture exposure to the physical and thermal property characteristics of most common above-deck materials used in commercial roof construction installations over the past 15 to 20 years, as well as products that are presently available in today's market. The data presented is made available to assist individual(s) with their assessment of the suitability of in-situ roofing system components for continued use or reuse. SPRI's data is not intended to be, nor should it be construed as, a recommendation for component selection for new or re-roofing projects. The determination of continued use or reuse of products in existing construction, and interpretation of data, is the sole responsibility of the design professional and/or other applicable parties involved with the roofing project, inclusive of the roof materials manufacturer/supplier with warranty obligations. Compliance with applicable Building and Energy Code requirements should also be included in one's evaluation.

**When citing this data source, please mention "*SPRI - Roof Substrate Wetting Curves Data v.2020*" to confirm acknowledgement of this important intended purpose.**

## Acknowledgements

SPRI would like to acknowledge the financial support received from the RCI Foundation. Its contribution was both important and appreciated. Further, SPRI acknowledges all manufacturers that provided materials to facilitate testing by NRC that were essential in this endeavor. Finally, the long-standing Wetting Curves SPRI Task Force support was vital to this endeavor.

## Data and Report Follows

**Table 1. Moisture content measured data – Insulation, Gypsum, Wood, and Concrete**

| Material | Applicable Standard | 50% RH 44˚F | 90% RH 79˚F | 60% RH 90˚F |
|---|---|---|---|---|
| | | MC (%) | MC (%) | MC (%) |
| Mineral Fiber | ATSM C 726-05 | 0.2 | 0.2 | 0.2 |
| Cement Board | ASTM C 1325-18 | 2.3 | 5.5 | 4.8 |
| EPS I | ASTM C578-07 (Type I) | 0.9 | 1.1 | 0.8 |
| EPS VIII | ASTM C578-07 (Type VIII) | 0.6 | 0.7 | 0.5 |
| Cellular glass | ASTM C 552-17 | 0 | 0 | 0 |
| Perlite board I | ASTM C 728-05 (Type 1) | 2.1 | 4.3 | 2.3 |
| Perlite board II | ASTM C 728-05 (Type 2) | 2.0 | 4.2 | 2.5 |
| Fiberboard II | ASTM C 2018-95 (Type II Grade 1) | 6.9 | 14.1 | 7.4 |
| Polyiso II Class 1 | ASTM C 1289-07 (Type II class 1) | 3.2 | 6.4 | 3.3 |
| Polyiso II Class 2 | ASTM C 1289-07 (Type II class 2) | 0.8 | 1.6 | 1.0 |
| Polyiso II Class 4 | ASTM C 1289-07 (Type II class 4) | 0.8 | 1.7 | 1.1 |
| XPS IV | ASTM D 578 (Type IV ) | 0.3 | 0.5 | 0.2 |
| SPUF II | ASTM C 1029-05a (Type II) | 1.3 | 3.1 | 2.9 |
| Gypsum - Green | ASTM C 1396-14 | 1.5 | 15.9 | 15.6 |
| Gypsum - White | ASTM C 1396-14 | 0.99 | 0.7 | 0.7 |
| Gypsum Fiber | ASTM C 1278 | 2.0 | 15.7 | 14.7 |
| Glass Mat Gypsum | ASTM C 1177-13 | 1.5 | 16.4 | 16.2 |
| Plywood | PS-1 Plywood | 8.6 | 15.6 | 9.2 |
| OSB | ASTM D 7033 | 7.3 | 14.3 | 8.1 |
| Lightweight cellular concrete | ASTM C869/C869M-11 | 0.2 | 0.5 | 0.4 |
| Vermiculite/perlite concrete | ASTM C 332 | 8.0 | 17.9 | 17.0 |

Return to Schedule

**Table 2. Thermal transmission measured data – Insulation, Gypsum, and Concrete**

| Material | Applicable Standard | 50% RH 75 ˚F | | 90%RH 75˚F | | VD-48 hours | | TRR 80 | |
|---|---|---|---|---|---|---|---|---|---|
| | | R-Value | MC (%) | R-Value | MC (%) | R-Value | MC (%) | R-Value | MC (%) |
| Mineral Fiber | ATSM C 726 | 3.8 | 0.4 | 3.8 | 5 | 1.4 | 23 | 3.1 | 7 |
| Cement Board | ASTM C 1325 | 0.4 | 0.9 | 0.4 | 1 | 0.3 | 9 | 0.3 | 5 |
| EPS I | ASTM C578 (Type I) | 3.8 | 0.9 | 3.7 | 1 | 3.6 | 70 | 3.0 | 630 |
| EPS VIII | ASTM C578 (Type VIII) | 3.7 | 0.5 | 3.7 | 8 | 3.6 | 50 | 3.0 | 386 |
| Cellular glass | ASTM C 552 | 0.5 | 0 | 0.5 | 0 | 0.5 | 0 | TBD | |
| Perlite board I | ASTM C 728 (Type 1) | 2.7 | 1.4 | 2.7 | 3 | 1.7 | 33 | 2.2 | 17 |
| Perlite board II | ASTM C 728 (Type 2) | 2.2 | 1.5 | 2.1 | 4 | 1.4 | 32 | 1.8 | 25 |
| Fiberboard II | ASTM C 2018 (Type II Grade 1) | 1.7 | 5.7 | 1.6 | 10 | 1.5 | 40 | 1.5 | 38 |
| Polyiso II Class 1 | ASTM C 1289 (Type II class 1) | 5.4 | 1.5 | 4.9 | 47 | 4.9 | 51 | 4.4 | 135 |
| Polyiso II Class 2 | ASTM C 1289 (Type II class 2) | 5.4 | 0.6 | 4.9 | 9 | 4.8 | 29 | 4.4 | 81 |
| Polyiso II Class 4 | ASTM C 1289 (Type II class 4) | 1.3 | 0.7 | 1.2 | 22 | 1.2 | 25 | TBD | |
| XPS IV | ASTM D 578 (Type IV ) | 4.7 | 0.4 | 5.2 | 9 | 4.6 | 14 | TBD | |
| SPUF II | ASTM C 1029 (Type II) | 5.2 | 0.5 | 4.7 | 53 | 4.4 | 72 | 4.0 | 147 |
| Gypsum - Green | ASTM C 1396 | 1.1 | 5 | 0.7 | 10 | 0.3 | 42 | 0.9 | 19 |
| Gypsum - White | ASTM C 1396 | 1.1 | 2 | 0.7 | 13 | 0.5 | 40 | 0.9 | 9 |
| Gypsum Fiber | ASTM C 1278 | 0.4 | 0 | 0.4 | 0 | 0.3 | 20 | 0.4 | 15 |
| Glass Mat Gypsum | ASTM C 1177 | 0.4 | 5 | 0.4 | 8 | 0.3 | 27 | 0.4 | 14 |
| Lightweight cellular concrete | ASTM C869/C869M | 0.9 | 10 | 0.8 | 16 | 0.5 | 28 | 0.8 | 15 |
| Vermiculite/perlite concrete | ASTM C 332 | 1.1 | 11 | 0.9 | 18 | 0.4 | 35 | 0.9 | 18 |

*Note: Data measured for MC1 condition is available.

**Table 3. Compressive strength measured data – Insulation, Gypsum, Wood, and Concrete**

| Material | Applicable Standard | 50%RH 75 ˚F | | 90%RH 75 ˚F | | VD-48hours | | TRR 80 | |
|---|---|---|---|---|---|---|---|---|---|
| | | Strength (psi) | MC (%) | Strength (psi) | MC (%) | Strength (psi) | MC (%) | Strength (psi) | MC (%) |
| Mineral Fiber | ATSM C 726 | 28 | 0 | 20 | 0 | 13 | 21 | | |
| Cement Board | ASTM C 1325 | 1265 | 0 | 1148 | 2 | 1260 | 12 | | |
| EPS I | ASTM C578 (Type I) | 15 | 1 | 15 | 1 | 11 | 56 | | |
| EPS VIII | ASTM C578 (Type VIII) | 20 | 0 | 20 | 7 | 14 | 33 | | |
| Cellular glass | ASTM C 552 | 54 | 0 | 54 | 0 | 54 | 0 | | |
| Perlite board I | ASTM C 728 (Type 1) | 55 | 2 | 41 | 4 | 50 | 24 | | |
| Perlite board II | ASTM C 728 (Type 2) | 65 | 1 | 66 | 4 | 26 | 31 | | |
| Fiberboard II | ASTM C 2018 (Type II Grade 1) | 18 | 5 | 11 | 9 | 5 | 75 | | |
| Polyiso II Class 1 | ASTM C 1289 (Type II class 1) | 27 | 1 | 25 | 7 | 22 | 24 | | |
| Polyiso II Class 2 | ASTM C 1289 (Type II class 2) | 31 | 3 | 29 | 6 | 25 | 21 | | |
| Polyiso II Class 4 | ASTM C 1289 (Type II class 4) | 90 | 4 | 84 | 5 | 60 | 9 | TBD | |
| XPS IV | ASTM D 578 (Type IV ) | 33 | 7 | 32 | 1 | 28 | 7 | | |
| SPUF II | ASTM C 1029 (Type II) | 23 | 1 | 20 | 3 | 29 | 28 | | |
| Gypsum - Green | ASTM C 1396 | 748 | 0 | 700 | 0.3 | 600 | 12 | | |
| Gypsum - White | ASTM C 1396 | 500 | 0 | 400 | 2 | 200 | 57 | | |
| Gypsum Fiber | ASTM C 1278 | 780 | 0 | 730 | 0.4 | 685 | 22 | | |
| Glass Mat Gypsum | ASTM C 1177 | 900 | 0 | 850 | 0.7 | 789 | 13 | | |
| Plywood | PS-1 Plywood | 142 | 7 | 98 | 15 | 95 | 31 | | |
| OSB | ASTM D 7033 | 38 | 6 | 26 | 12 | 20 | 25 | | |
| Lightweight cellular concrete | ASTM C869/C869M | 973 | 7 | 875 | 16 | 658 | 29 | | |
| Vermiculite/perlite concrete | ASTM C 332 | 751 | 8 | 652 | 18 | 500 | 38 | | |

Return to Schedule

### Table 4. Flexural strength measured data – Insulation, Gypsum, Wood, and Concrete

| Material | Applicable Standard | 50%RH 75 ˚F | | 90%RH 75 ˚F | | VD-48hours | | TRR 80 | |
|---|---|---|---|---|---|---|---|---|---|
| | | Strength (psi) | MC (%) | Strength (psi) | MC (%) | Strength (psi) | MC (%) | Strength (psi) | MC (%) |
| Mineral Fiber | ATSM C 726 | 55 | 0 | 23 | 2 | 17 | 21 | TBD | |
| Cement Board | ASTM C 1325 | 1182 | 1 | 1091 | 6 | 1069 | 12 | | |
| EPS I | ASTM C578 (Type I) | 31 | 1 | 30 | 1 | 32 | 57 | | |
| EPS VIII | ASTM C578 (Type VIII) | 39 | 0 | 37 | 1 | 41 | 33 | | |
| Cellular glass | ASTM C 552 | 89 | 0 | 92 | 0 | 91 | 0 | | |
| Perlite board I | ASTM C 728 (Type 1) | 41 | 2 | 29 | 5 | 14 | 24 | | |
| Perlite board II | ASTM C 728 (Type 2) | 43 | 2 | 42 | 4 | 19 | 31 | | |
| Fiberboard II | ASTM C 2018 (Type II Grade 1) | 248 | 7 | 134 | 9 | 39 | 75 | | |
| Polyiso II Class 1 | ASTM C 1289 (Type II class 1) | 111 | 3 | 85 | 7 | 69 | 24 | | |
| Polyiso II Class 2 | ASTM C 1289 (Type II class 2) | 200 | 1 | 202 | 2 | 106 | 22 | | |
| Polyiso II Class 4 | ASTM C 1289 (Type II class 4) | 445 | 1 | 455 | 2 | 245 | 9 | | |
| XPS IV | ASTM D 578 (Type IV ) | 70 | 0 | 72 | 0 | 76 | 7 | | |
| SPUF II | ASTM C 1029 (Type II) | 41 | 1 | 46 | 2 | 60 | 28 | | |
| Gypsum - Green | ASTM C 1396 | 1539 | 0 | 1471 | 0.7 | 605 | 12 | | |
| Gypsum - White | ASTM C 1396 | 408 | 3 | 274 | 10 | 66 | 57 | | |
| Gypsum Fiber | ASTM C 1278 | 1085 | 0 | 790 | 1.4 | 235 | 22 | | |
| Glass Mat Gypsum | ASTM C 1177 | 669 | 0 | 666 | 1 | 628 | 13 | | |
| Plywood | PS-1 Plywood | 8481 | 7 | 3347 | 15 | 2765 | 31 | | |
| OSB | ASTM D 7033 | 111 | 6 | 76 | 12 | 37 | 25 | | |
| Lightweight cellular concrete | ASTM C869/C869M | 253 | 7 | 141 | 13 | 109 | 29 | | |
| Vermiculite/perlite concrete | ASTM C 332 | 296 | 8 | 161 | 14 | 133 | 38 | | |

**Table 5. Fastener plate pull through measured data – Insulation, and Gypsum**

| Material | Applicable Standard | 50%RH 75 ˚F | | 90%RH 75 ˚F | | VD-48hours | | TRR 80 | |
|---|---|---|---|---|---|---|---|---|---|
| | | Break Load (lbf) | MC (%) | Break Load (lbf) | MC (%) | Break Load (lbf) | MC (%) | Break Load (lbf) | MC (%) |
| Mineral Fiber | ATSM C 726 | 184 | 0 | 175 | 0 | 150 | 20 | TBD | |
| Cement Board | ASTM C 1325 | 370 | 0 | 325 | 12 | 300 | 13 | | |
| EPS I | ASTM C578 (Type I) | 65 | 1 | 72 | 1 | 67 | 58 | | |
| EPS VIII | ASTM C578 (Type VIII) | 87 | 0 | 61 | 1 | 50 | 30 | | |
| Cellular glass | ASTM C 552 | 130 | 0 | 129 | 0 | 131 | 0 | | |
| Perlite board I | ASTM C 728 (Type 1) | 79 | 2 | 50 | 5 | 25 | 26 | | |
| Perlite board II | ASTM C 728 (Type 2) | 215 | 2 | 88 | 5 | 67 | 31 | | |
| Fiberboard II | ASTM C 2018 (Type II Grade 1) | 145 | 7 | 105 | 16 | 55 | 67 | | |
| Polyiso II Class 1 | ASTM C 1289 (Type II class 1) | 156 | 3 | 136 | 7 | 130 | 25 | | |
| Polyiso II Class 2 | ASTM C 1289 (Type II class 2) | 245 | 1 | 244 | 2 | 200 | 22 | | |
| Polyiso II Class 4 | ASTM C 1289 (Type II class 4) | 162 | 1 | 160 | 2 | 136 | 14 | | |
| XPS IV | ASTM D 578 (Type IV ) | 118 | 0.1 | 122 | 0.4 | 125 | 15 | | |
| SPUF II | ASTM C 1029 (Type II) | 111 | 0.5 | 132 | 2 | 121 | 31.4 | | |
| Gypsum - Green | ASTM C 1396 | 300 | 0.1 | 270 | 0.7 | 98 | 13 | | |
| Gypsum - White | ASTM C 1396 | 193 | 3 | 156 | 2.6 | 60 | 52 | | |
| Gypsum Fiber | ASTM C 1278 | 362 | 0.3 | 283 | 1.4 | 180 | 20 | | |
| Glass Mat Gypsum | ASTM C 1177 | 180 | 0.5 | 240 | 1.1 | 178 | 25.8 | | |

Return to Schedule

Choose sensitivity level

NRC·CNRC CONSTRUCTION

# Measured Properties of Substrate Materials Used in Low Slope Membrane Roofs

Author(s):F. Shyti, N. Holcroft and A. Baskaran

Report No.: A1-016072
Report Date: November 22nd 2019
Contract No.: A1-016072
Agreement Date: July 27, 2018

Return to Schedule

# Measured Properties of Substrate Materials Used in Low Slope Membrane Roofs

Author
Flonja Shyti

Approved
Trevor Nightingale
Director General
NRC Construction

Report No: A1-016072
Report Date: 22 November 2019
Contract No: A1-016072
Agreement date: 27 July 2018
Program: Building Regulations for Market Access

xx pages

Copy no. 1 of X

# Table of Contents

# List of Figures





# List of Tables

# Executive Summary

**Background:** In the 1980's the US Army Corps of Engineers Cold Regions Research and Engineering Laboratory (CRREL) set out to determine the thermal resistance ratio for a number of commonly used materials at that time (Tobiasson et al, 1987)[1]. This set of data determined the amount of moisture a material could absorb before losing 20% of its original thermal resistance (R) value. SPRI Inc. membership approached the National Research Council Canada (NRCC), via a RFP, to update the existing properties of the substrate materials that are commonly used in low slope membrane roof assemblies.

**Objective:** To develop a robust experiential dataset showing the effect of moisture content on the thermal and mechanical performance on an up-to-date (2018-2019) list of substrate materials provided by SPRI.

**Measurement Lab**: All experiments were carried out at the NRCC's lab. NRCC is one of the world leading lab with expertise in characterization of building materials, which develops standard test methods, maintains and enhances a unique hydrothermal material property database, published by ASHRAE. It is also a national calibration laboratory. To maintain quality and reproducibility, none of the testings' were outsourced.

**Material Requirement**: Figure 1 lists all the materials to be tested and their category. In total, there were 21 substrate materials selected by SPRI that are commonly used in low slope membrane roofing. These materials are grouped in to four categories as follows:

1. Insulation
2. Gypsum
3. Wood products
4. Concrete

As per the SPRI-Request For Proposal (RFP - dated: 31st January 2017 and March 5th 2018), most of the materials required to perform the testing were supplied in sufficient quantity by SPRI Member Companies. Materials purchased by NRCC in consultation with SPRI are also marked in the Figure 1.

**Test Condition:** Materials were exposed (Figure 2) to various simulated temperature and relative humidity conditioning. Requirements for the two project specific conditions marked as *"VD- 48hrs"* and "TRR 80" are explained in Appendix 7. Five classical properties (moisture content, thermal resistance, compressive strength, flexural strength, and fastener plate pull through) were measured after the conditioning of each of the materials. This approach has been synchronized with the SPRI – RFP.

---

[1] Tobiasson, W., Greatorex, A., & Pelt, D. V. (1987). Wetting of Polystyrene and Urethane Roof Insulations in the Laboratory and on a Protected Membrane Roof. *Journal of Thermal Insulation*, *11*(2), 108–119. doi: 10.1177/109719638701100206

**Sample Preparation**: Figure 3 shows an overview of the present approach, including test conditions, number of measurements made for each material property and standards that were used. Sample dimensions are also listed for each test based on the relevant standard, along with the number of specimens per test. Summations of the number of specimens in each group and total number of measurements demonstrate the robustness of this project.

**Project Updates:** Project progresses were presented at the SPRI quarterly Tech Meetings (January 18th 2019, April 16th 2019, July 16th 2019 and October 22nd 2019). SPRI membership comments and reviews were incorporated into this report.

**Reporting**: This report contains all the measured data in tabular format. The data for each property is presented as follows:

Appendix 1: Moisture Content
Appendix 2: Thermal Resistance
Appendix 3: Compressive Strength
Appendix 4: Flexural Strength
Appendix 5: Fastener Plate Pull through

Each appendix presents the respective standards used for each material type, sample dimensions and number of specimens used for testing. Each appendix is also concluded with tabulated measured data and remarks.

NRCC in consultation with SPRI developed an experimental procedure for the determination of the fastener plate pull through the substrate material, which was applied consistently for all substrate materials. This test protocol labelled as *"NRCC – FPPT"* is documented in Appendix 6. As well, there is no consensus-based procedure for adding moisture into materials, NRCC in consultation with SPRI developed a procedure (Appendix 7) based on the methodology described in (Tobiasson et al, 1987)[1].

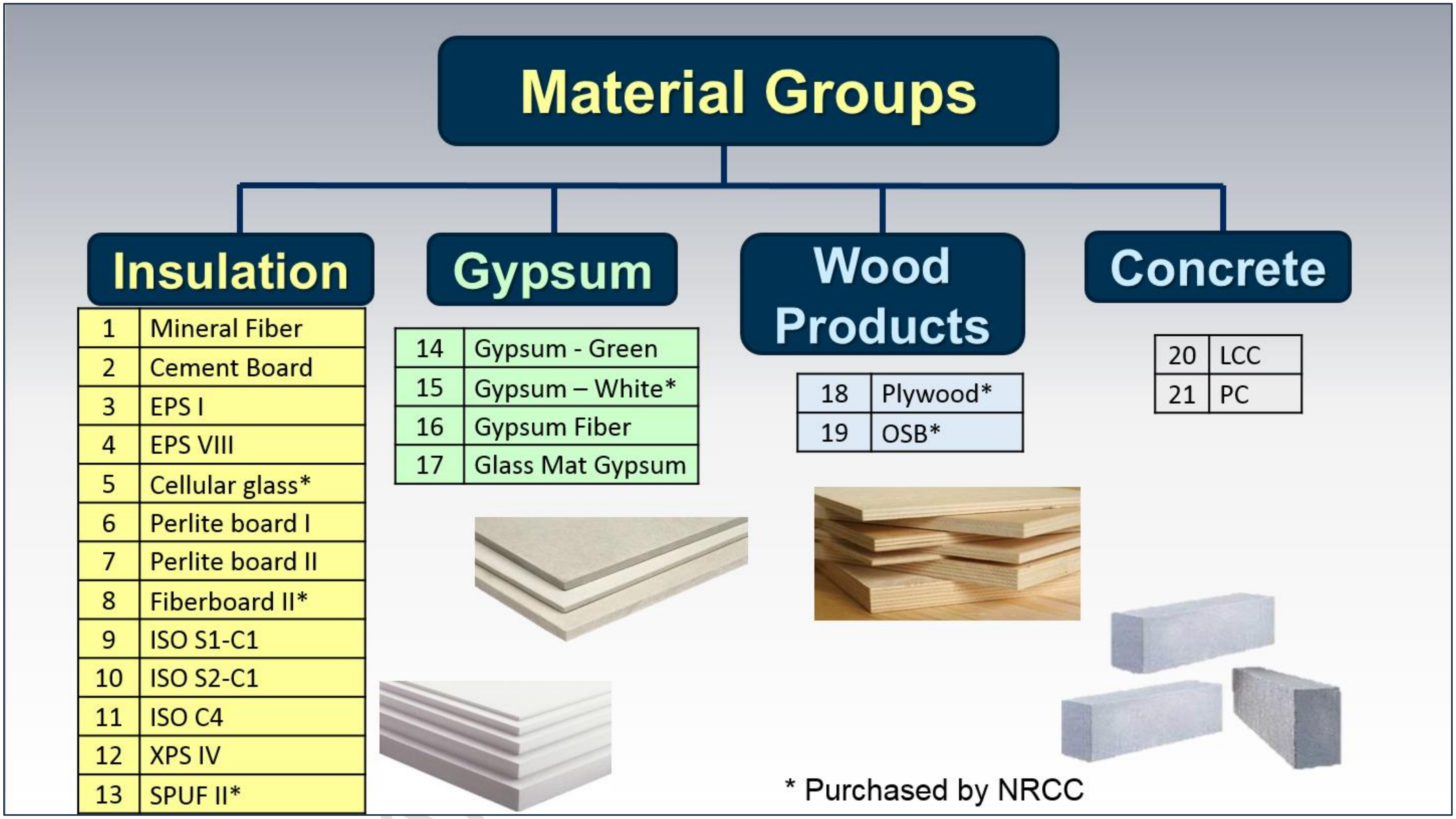


**Figure 1. Common substrate materials used in low slope roofing**

Return to Schedule

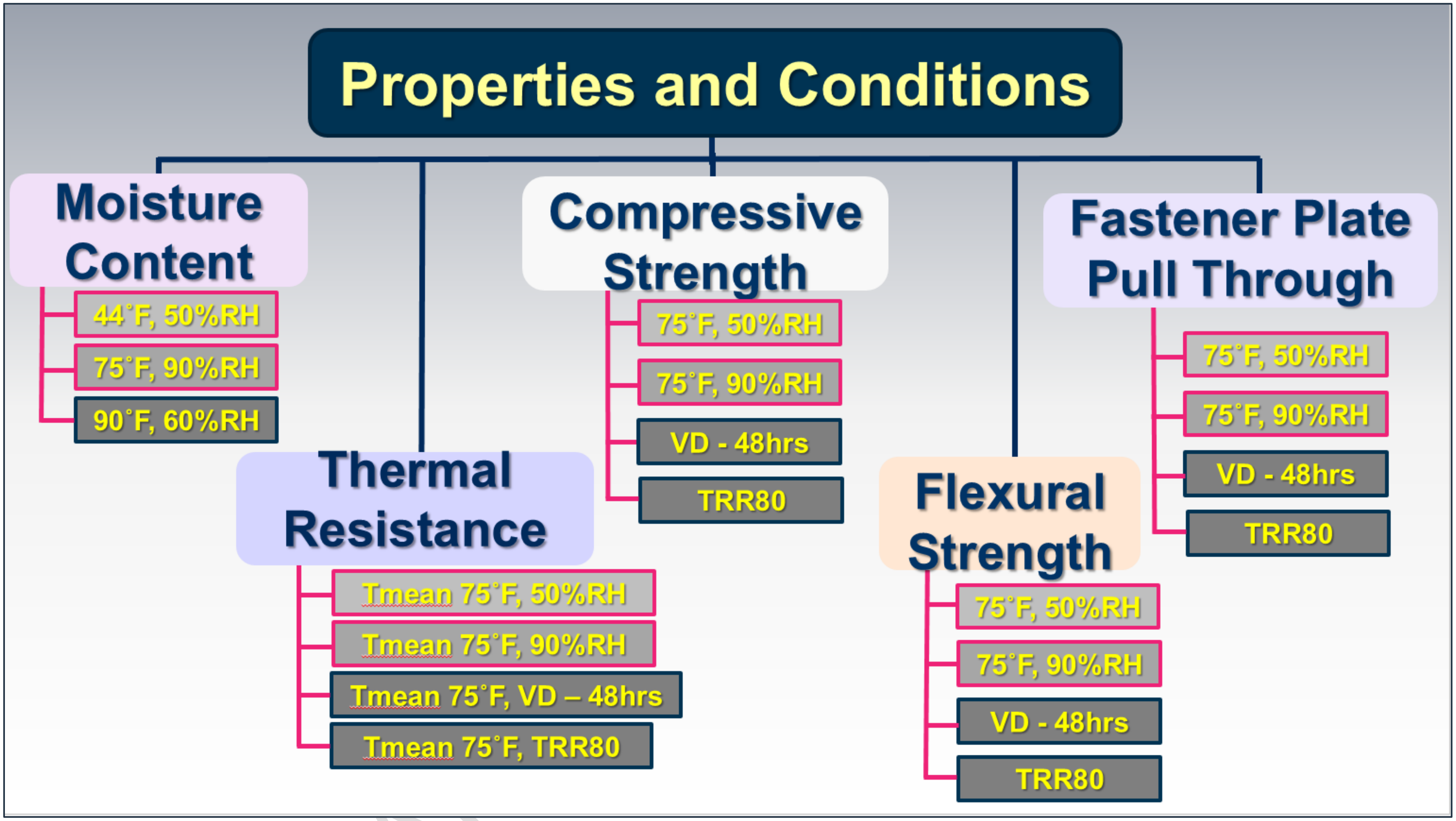


Figure 2. Material propertied and test conditions simulated for each property

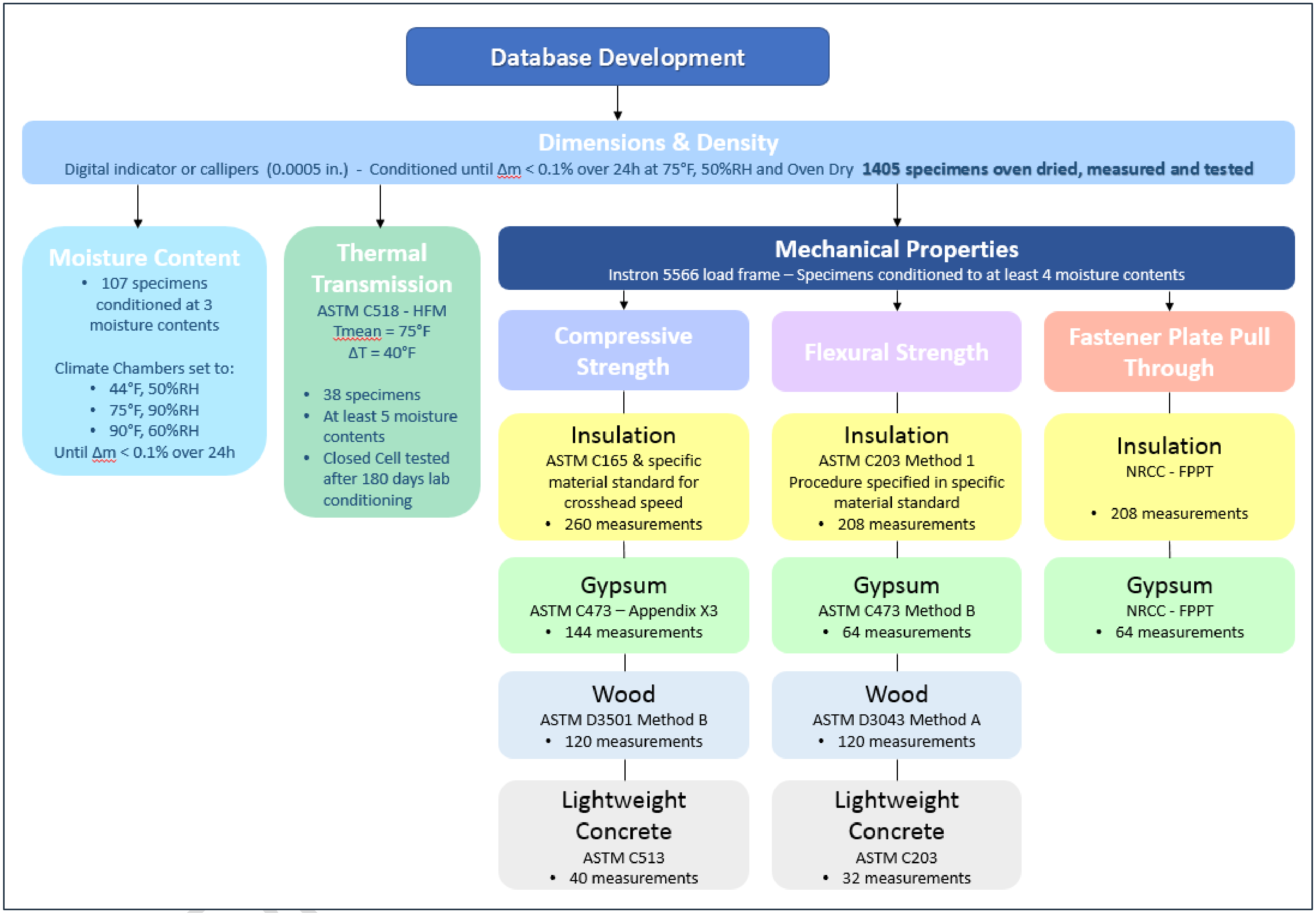


**Figure 3. Flow diagram showing standards referenced, test conditions and number of measurements per test method**

# Appendix 1
# Moisture Content

## Standards Used

**Insulation:**

- ASTM C1616-07 *"Standard Test Method for Determining the Moisture Content of Organic and Inorganic Insulation Materials by Weight"*
- ASTM C303-05a *"Standard Test Method for Dimensions and Density of Preformed Block and Board–Type Thermal Insulation"*

**Gypsum:**

- ASTM D2216-10 *"Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass"*
- ASTM C473-16 *"Standard Test Methods for Physical Testing of Gypsum Panel Products"*

**Wood:**

- ASTM D4442-16 *"Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials"*
- ASTM D2395-14 *"Standard Test Methods for Density and Specific Gravity (Relative Density) of Wood and Wood-Based Materials" (Method A)*

**Concrete:** Same as insulation.



## Samples and Conditioning

**Table 1-1. Moisture content sample size and number of specimens**

| Dimensions | Insulation | Gypsum | Wood | Lightweight Concrete |
|---|---|---|---|---|
| **Thickness (inch)** | 0.5 and 1 | 0.5 | 1/2 and 5/8 | 1 |
| **Width (inch)** | 4 | 12 | 10 grams | 5 |
| **Length (inch)** | 6 | 16 | | 6 |
| **Number of Specimens** | 5 | 4 | 8 | 5 |

**Table 1-2. Moisture content conditions**

| Moisture Condition | Temperature | Relative Humidity |
|---|---|---|
| MC 1 | 44° ±4°F | 50 ±2% |
| MC 2 | 75° ±4°F | 90 ±2% |
| MC 3 | 90° ±4°F | 60 ±2% |

## Measured Data and Remarks

The size and number of specimens tested for the Moisture Content can be seen in Table 1-1, while the moisture conditions, which were reached using a climate chamber are shown in Table 1-2. Three moisture conditions were outlined in the Request For Proposal (RFP). To obtain the dry mass the specimens were initially dried either at 220° ±4° or 140°F, until the change in mass was less than 0.1% of the specimen mass over 24 hours for three successive days. The materials were then left in each condition until the change in mass was less than 0.1% over 24 hours. The results for the insulation materials can be seen in Table 1-3 and Table 1-4 for gypsum, wood and concrete.

**Table 1-3. Moisture content measured data - Insulation**

| Material | Applicable Standard | 50% RH 44˚F | 90% RH 79˚F | 60% RH 90˚F |
|---|---|---|---|---|
| | | MC (%) | MC (%) | MC (%) |
| Mineral Fiber | ATSM C 726-05 | 0.2 | 0.2 | 0.2 |
| Cement Board | ASTM C 1325-18 | 2.3 | 5.5 | 4.8 |
| EPS I | ASTM C578-07 (Type I) | 0.9 | 1.1 | 0.8 |
| EPS VIII | ASTM C578-07 (Type VIII) | 0.6 | 0.7 | 0.5 |
| Cellular glass | ASTM C 552-17 | 0 | 0 | 0 |
| Perlite board I | ASTM C 728-05 (Type 1) | 2.1 | 4.3 | 2.3 |
| Perlite board II | ASTM C 728-05 (Type 2) | 2.0 | 4.2 | 2.5 |
| Fiberboard II | ASTM C 2018-95 (Type II Grade 1) | 6.9 | 14.1 | 7.4 |
| Polyiso II Class 1 | ASTM C 1289-07 (Type II class 1) | 3.2 | 6.4 | 3.3 |
| Polyiso II Class 2 | ASTM C 1289-07 (Type II class 2) | 0.8 | 1.6 | 1.0 |
| Polyiso II Class 4 | ASTM C 1289-07 (Type II class 4) | 0.8 | 1.7 | 1.1 |
| XPS IV | ASTM D 578 (Type IV ) | 0.3 | 0.5 | 0.2 |
| SPUF II | ASTM C 1029-05a (Type II) | 1.3 | 3.1 | 2.9 |

**Table 1-4. Moisture content measured data - Gypsum, Wood, and Concrete**

| Material | Applicable Standard | 50% RH 44˚F | 90% RH 79˚F | 60% RH 90˚F |
|---|---|---|---|---|
| | | MC (%) | MC (%) | MC (%) |
| Gypsum - Green | ASTM C 1396-14 | 1.5 | 15.9 | 15.6 |
| Gypsum - White | ASTM C 1396-14 | 0.99 | 0.7 | 0.7 |
| Gypsum Fiber | ASTM C 1278 | 2.0 | 15.7 | 14.7 |
| Glass Mat Gypsum | ASTM C 1177-13 | 1.5 | 16.4 | 16.2 |
| Plywood | PS-1 Plywood | 8.6 | 15.6 | 9.2 |
| OSB | ASTM D 7033 | 7.3 | 14.3 | 8.1 |
| Lightweight cellular concrete | ASTM C869/C869M-11 | 0.2 | 0.5 | 0.4 |
| Vermiculite/perlite concrete | ASTM C 332 | 8.0 | 17.9 | 17.0 |

# Appendix 2 Thermal Transmission

## Standards Used

**Insulation:**

- ASTM C518-04 *“Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus”*
- **Gypsum:**
- ASTM C518-04 *“Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus"*

**Wood:**

- N/A

**Concrete:**

- Same as insulation.

## Samples and Conditioning

**Table 2 - 1. Thermal transmission sample size and number of specimens**

| Dimensions | Insulation | Gypsum | Wood | Lightweight Concrete |
|---|---|---|---|---|
| **Thickness (inch)** | 0.5 and 1 | 0.5 | N/A | 1 |
| **Width (inch)** | 12 | 12 | | 12 |
| **Length (inch)** | 12 | 12 | | 12 |
| **Number of Specimens** | 2 | 2 | | 2 |

**Table 2 - 2. Thermal transmission moisture content conditions**

| Moisture Condition | Temperature | Humidity |
|---|---|---|
| MC 1(Oven Dry) | 220° ±4°F or 140°F | 0 |
| MC 2 | 75 ±2°F | 50 ±2%%RH |
| MC3 | 75 ±2°F | 90 ±2%% RH |
| MC4 | VD-48hrs | |
| MC5 | TRR-80 | |

## Measured Data and Remarks

After each moisture condition was reached the specimens were wrapped in a thin plastic film with a negligible thickness to maintain the moisture content. To take into consideration any moisture loss that could have occurred during the test period, weight measurements were taken both before and after testing and the average value was used when determining the experimental moisture content. The specimens were tested at a mean temperature of 75 ±2°F and a temperature differential of 40 ±2°F. Based on the RFP the wood thermal transmission was not required and has not been included in this report. Due to the non-destructive nature of the test, the same specimens were used for all conditions.

For MC4 and MC5, which corresponds to "VD-48hrs" and "TRR-80" the materials had a very high moisture content, which in early testing proved to be problematic due to moisture migrating to the cold plate during the test. Preliminary tests were conducted and it was found that reversing the heat flow from the conventional approach (top plate to have the high temperature and the bottom the low temperature) provided more accurate results (Valovirta & Vinha, 2004)[2]. Reversing the heat flow direction for MC4 and MC5 avoids cycles of condensation and evaporation on the top plate. This eliminates inconsistent and erroneous data results. For five materials from the insulation group (Polyiso II Class 1, Polyiso II Class 2, Polyiso II Class 4, XPS IV, SPUF II), MC3 was reached using the vapor drive method described in Appendix 7 for 24 hours.

TRR-80 is the moisture content required by each material to reduce the thermal resistance by 20%. It is calculated using the following equation, where TRR=80:

$$TRR = 100 \times \frac{\text{Wet R-value}}{\text{Dry R-value}}$$

The "Dry R-Value" of the materials was known and the "Wet R-Value" was calculated. The amount of moisture required to achieve the calculated "Wet R-value" was estimated. Each of the materials were conditioned using the vapor drive method until the estimated moisture content required to reach TRR-80 was achieved. The specimens were tested and it was verified to see if the amount of moisture absorbed was enough to allow the materials to reach their calculated "Wet R-value". This process was repeated continuously until a value very close to TRR-80 was reached. Note that the thermal transmission TRR-

[2] Valovirta, I., & Vinha , J. (2004). Water Vapor Permeability and Thermal Conductivity as a function of Temperature and Relative Humidity. *ASHRAE*.

80 moisture content was used to condition materials for the determination of the compressive strength, flexural strength and fastener plate pull through at MC4. The measured data for insulation materials can be seen in Table 2-3 and for gypsum and concrete in Table 2-4

**Table 2 - 3. Thermal transmission measured data - Insulation**

| Material | Applicable Standard | 50% RH 75 ˚F | | 90%RH 75˚F | | VD-48 hours | | TRR 80 | |
|---|---|---|---|---|---|---|---|---|---|
| | | R-Value | MC (%) | R-Value | MC (%) | R-Value | MC (%) | R-Value | MC (%) |
| Mineral Fiber | ATSM C 726 | 3.8 | 0.4 | 3.8 | 5 | 1.4 | 23 | 3.1 | 7 |
| Cement Board | ASTM C 1325 | 0.4 | 0.9 | 0.4 | 1 | 0.3 | 9 | 0.3 | 5 |
| EPS I | ASTM C578 (Type I) | 3.8 | 0.9 | 3.7 | 1 | 3.6 | 70 | 3.0 | 630 |
| EPS VIII | ASTM C578 (Type VIII) | 3.7 | 0.5 | 3.7 | 8 | 3.6 | 50 | 3.0 | 386 |
| Cellular glass | ASTM C 552 | 0.5 | 0 | 0.5 | 0 | 0.5 | 0 | TBD | |
| Perlite board I | ASTM C 728 (Type 1) | 2.7 | 1.4 | 2.7 | 3 | 1.7 | 33 | 2.2 | 17 |
| Perlite board II | ASTM C 728 (Type 2) | 2.2 | 1.5 | 2.1 | 4 | 1.4 | 32 | 1.8 | 25 |
| Fiberboard II | ASTM C 2018 (Type II Grade 1) | 1.7 | 5.7 | 1.6 | 10 | 1.5 | 40 | 1.5 | 38 |
| Polyiso II Class 1 | ASTM C 1289 (Type II class 1) | 5.4 | 1.5 | 4.9 | 47 | 4.9 | 51 | 4.4 | 135 |
| Polyiso II Class 2 | ASTM C 1289 (Type II class 2) | 5.4 | 0.6 | 4.9 | 9 | 4.8 | 29 | 4.4 | 81 |
| Polyiso II Class 4 | ASTM C 1289 (Type II class 4) | 1.3 | 0.7 | 1.2 | 22 | 1.2 | 25 | TBD | |
| XPS IV | ASTM D 578 (Type IV ) | 4.7 | 0.4 | 5.2 | 9 | 4.6 | 14 | TBD | |
| SPUF II | ASTM C 1029 (Type II) | 5.2 | 0.5 | 4.7 | 53 | 4.4 | 72 | 4.0 | 147 |

*Note: Data measured for MC1 condition is available.

### Table 2 - 4. Thermal transmission measured data - Gypsum, Concrete

| Material | Applicable Standard | 50% RH 75 ˚F | | 90%RH 75˚F | | VD-48 hours | | TRR 80 | |
|---|---|---|---|---|---|---|---|---|---|
| | | R-Value | MC (%) | R-Value | MC (%) | R-Value | MC (%) | R-Value | MC (%) |
| Gypsum - Green | ASTM C 1396 | 1.1 | 5 | 0.7 | 10 | 0.3 | 42 | 0.9 | 19 |
| Gypsum - White | ASTM C 1396 | 1.1 | 2 | 0.7 | 13 | 0.5 | 40 | 0.9 | 9 |
| Gypsum Fiber | ASTM C 1278 | 0.4 | 0 | 0.4 | 0 | 0.3 | 20 | 0.4 | 15 |
| Glass Mat Gypsum | ASTM C 1177 | 0.4 | 5 | 0.4 | 8 | 0.3 | 27 | 0.4 | 14 |
| Lightweight cellular concrete | ASTM C869/C869M | 0.9 | 10 | 0.8 | 16 | 0.5 | 28 | 0.8 | 15 |
| Vermiculite/perlite concrete | ASTM C 332 | 1.1 | 11 | 0.9 | 18 | 0.4 | 35 | 0.9 | 18 |

*Note: Data measured for MC1 condition is available.

# Appendix 3 Compressive Strength

## Standards Used

**Insulation:**

- ASTM C165-07 *"Standard Test Method for Measuring Compressive Properties of Thermal Insulation"*

**Gypsum:**

- ASTM C473-16 *"Standard Test Methods for Physical Testing of Gypsum Panel Products"*

**Wood:**

- ASTM D3501-05a *"Standard Test Methods for Wood-Based Structural Panels in Compression" (Method B)*

**Concrete:**

- ASTM C513-11 *"Standard Test Method for Obtaining and Testing Specimens of Hardened Lightweight Insulating Concrete for Compressive Strength"*
- ASTM C165-07 *"Standard Test Method for Measuring Compressive Properties of Thermal Insulation"*

## Samples and Conditioning

**Table 3 - 1. Compressive strength sample size and number of specimens**

<table>
<tr><th>Dimensions</th><th>Insulation</th><th>Gypsum</th><th>Wood</th><th>Lightweight Concrete</th></tr>
<tr><td>Thickness (inch)</td><td>0.5 and 1</td><td>0.5</td><td>1/2 and 5/8</td><td>2</td></tr>
<tr><td>Width (inch)</td><td>6</td><td rowspan="2">2.4 Ø*</td><td>7.5</td><td>2</td></tr>
<tr><td>Length (inch)</td><td>6</td><td>15</td><td>2</td></tr>
<tr><td>Number of Specimens</td><td>5</td><td>9</td><td>15</td><td>5</td></tr>
</table>

**Note: Circular specimens with specified diameter*

**Table 3 - 2. Compressive strength moisture content conditions**

<table>
<tr><th>Moisture Condition</th><th>Temperature</th><th>Humidity</th></tr>
<tr><td>MC 1</td><td>75 ±2°F</td><td>50 ±2%%RH</td></tr>
<tr><td>MC 2</td><td>75 ±2°F</td><td>90 ±2%% RH</td></tr>
<tr><td>MC 3</td><td colspan="2">VD-48hrs</td></tr>
<tr><td>MC 4</td><td colspan="2">TRR-80</td></tr>
</table>

## Measured Data and Remarks

The moisture contents for MC1 and MC2 were achieved using a climate chamber. The vapor drive method, explained in Appendix 7 was used to reach MC3 and MC4. For insulation materials the standard specifies a loading rate ranging from 0.01 inch/min to 0.5 inch/min, based on this as well as the individual material standards the following loading rates were selected to be used: cellular glass (0.01 inch/min), perlite board (0.05 inch/min), fiber board (0.05 inch/min), and all other insulation materials (0.1 inch/min). The loading rate for the concrete was selected in accordance with ASTM C513-11 and ASTMC165-07 to be 0.05 inch/min. The measured results can be seen in Table 3-3 for the insulation materials and Table 3-4 for the gypsum, wood and concrete.

NRC.CANADA.CA

**Table 3 - 3. Compressive strength measured data - Insulation**

| Material | Applicable Standard | 50%RH 75 ˚F | | 90%RH 75 ˚F | | VD-48hours | | TRR 80 | |
|---|---|---|---|---|---|---|---|---|---|
| | | Strength (psi) | MC (%) | Strength (psi) | MC (%) | Strength (psi) | MC (%) | Strength (psi) | MC (%) |
| Mineral Fiber | ATSM C 726 | 28 | 0 | 20 | 0 | 13 | 21 | TBD | |
| Cement Board | ASTM C 1325 | 1265 | 0 | 1148 | 2 | 1260 | 12 | | |
| EPS I | ASTM C578 (Type I) | 15 | 1 | 15 | 1 | 11 | 56 | | |
| EPS VIII | ASTM C578 (Type VIII) | 20 | 0 | 20 | 7 | 14 | 33 | | |
| Cellular glass | ASTM C 552 | 54 | 0 | 54 | 0 | 54 | 0 | | |
| Perlite board I | ASTM C 728 (Type 1) | 55 | 2 | 41 | 4 | 50 | 24 | | |
| Perlite board II | ASTM C 728 (Type 2) | 65 | 1 | 66 | 4 | 26 | 31 | | |
| Fiberboard II | ASTM C 2018 (Type II Grade 1) | 18 | 5 | 11 | 9 | 5 | 75 | | |
| Polyiso II Class 1 | ASTM C 1289 (Type II class 1) | 27 | 1 | 25 | 7 | 22 | 24 | | |
| Polyiso II Class 2 | ASTM C 1289 (Type II class 2) | 31 | 3 | 29 | 6 | 25 | 21 | | |
| Polyiso II Class 4 | ASTM C 1289 (Type II class 4) | 90 | 4 | 84 | 5 | 60 | 9 | | |
| XPS IV | ASTM D 578 (Type IV ) | 33 | 7 | 32 | 1 | 28 | 7 | | |
| SPUF II | ASTM C 1029 (Type II) | 23 | 1 | 20 | 3 | 29 | 28 | | |

**Table 3 - 4. Compressive strength measured data - Gypsum, Wood, and Concrete**

| Material | Applicable Standard | 50%RH 75 ˚F | | 90%RH 75 ˚F | | VD-48hours | | TRR 80 | |
|---|---|---|---|---|---|---|---|---|---|
| | | Strength (psi) | MC (%) | Strength (psi) | MC (%) | Strength (psi) | MC (%) | Strength (psi) | MC (%) |
| Gypsum - Green | ASTM C 1396 | 748 | 0 | 700 | 0.3 | 600 | 12 | TBD | |
| Gypsum - White | ASTM C 1396 | 500 | 0 | 400 | 2 | 200 | 57 | | |
| Gypsum Fiber | ASTM C 1278 | 780 | 0 | 730 | 0.4 | 685 | 22 | | |
| Glass Mat Gypsum | ASTM C 1177 | 900 | 0 | 850 | 0.7 | 789 | 13 | | |
| Plywood | PS-1 Plywood | 142 | 7 | 98 | 15 | 95 | 31 | | |
| OSB | ASTM D 7033 | 38 | 6 | 26 | 12 | 20 | 25 | | |
| Lightweight cellular concrete | ASTM C869/C869M | 973 | 7 | 875 | 16 | 658 | 29 | | |
| Vermiculite/perlite concrete | ASTM C 332 | 751 | 8 | 652 | 18 | 500 | 38 | | |

# Appendix 4
# Flexural Strength

## Standards Used

**Insulation:**

- ASTM C203-05 *"Standard Test Methods for Breaking Load and Flexural Properties of Block-Type Thermal Insulation"*

**Gypsum:**

- ASTM C473-16 *"Standard Test Methods for Physical Testing of Gypsum Panel Products" (Method B)*

**Wood:**

- ASTM D3043-00 *"Standard Test Methods for Structural Panels in Flexure"*

**Concrete:** Same as insulation.

## Samples and Conditioning

**Table 4 - 1. Flexural strength sample size and number of specimens**

| Dimensions | Insulation | Gypsum | Wood | Lightweight Concrete |
|---|---|---|---|---|
| **Thickness (inch)** | 0.5 and 1 | 0.5 | 1/2 and 5/8 | 1 |
| **Width (inch)** | 4 | 12 | 2 | 4 |
| **Length (inch)** | 12 | 16 | 26 | 12 |
| **Number of Specimens** | 4 | 4 | 15 | 4 |

**Table 4 - 2. Flexural strength moisture content conditions**

| Moisture Condition | Temperature | Humidity |
|---|---|---|
| MC 1 | 75 ±2°F | 50 ±2%%RH |
| MC 2 | 75 ±2°F | 90 ±2%% RH |
| MC 3 | VD-48hrs | |
| MC 4 | TRR-80 | |

## Measured Data and Remarks

The moisture contents for MC1 and MC2 were achieved using a climate chamber. The vapor drive method, explained in Appendix 7 was used to reach MC3 and MC4. For insulation materials and the concrete the standard does not specify a specific loading rate, based on this as well as individual material standards the following loading rates were selected to be used: cellular glass (0.17 inch/min), perlite board (2 inch/min) and all other insulation materials (1.67 inch/min), while for concrete (2 inch/min). For wood materials the standard does not specify a specific loading rate, based on this as well as individual material standards a loading rate of 0.29 inch/min was selected to be used. The measured results can be seen in Table 4-3 for the insulation materials and Table 4-4 for the gypsum, wood and concrete.

**Table 4 - 3. Flexural strength measured data - Insulation**

| Material | Applicable Standard | 50%RH 75 ˚F | | 90%RH 75 ˚F | | VD-48hours | | TRR 80 | |
|---|---|---|---|---|---|---|---|---|---|
| | | Strength (psi) | MC (%) | Strength (psi) | MC (%) | Strength (psi) | MC (%) | Strength (psi) | MC (%) |
| Mineral Fiber | ATSM C 726 | 55 | 0 | 23 | 2 | 17 | 21 | TBD | |
| Cement Board | ASTM C 1325 | 1182 | 1 | 1091 | 6 | 1069 | 12 | | |
| EPS I | ASTM C578 (Type I) | 31 | 1 | 30 | 1 | 32 | 57 | | |
| EPS VIII | ASTM C578 (Type VIII) | 39 | 0 | 37 | 1 | 41 | 33 | | |
| Cellular glass | ASTM C 552 | 89 | 0 | 92 | 0 | 91 | 0 | | |
| Perlite board I | ASTM C 728 (Type 1) | 41 | 2 | 29 | 5 | 14 | 24 | | |
| Perlite board II | ASTM C 728 (Type 2) | 43 | 1.7 | 42 | 4 | 19 | 31 | | |
| Fiberboard II | ASTM C 2018 (Type II Grade 1) | 248 | 7 | 134 | 9 | 39 | 75 | | |
| Polyiso II Class 1 | ASTM C 1289 (Type II class 1) | 111 | 3 | 85 | 7 | 69 | 24 | | |
| Polyiso II Class 2 | ASTM C 1289 (Type II class 2) | 200 | 1 | 202 | 2 | 106 | 22 | | |
| Polyiso II Class 4 | ASTM C 1289 (Type II class 4) | 445 | 1 | 455 | 2 | 245 | 9 | | |
| XPS IV | ASTM D 578 (Type IV ) | 70 | 0 | 72 | 0 | 76 | 7 | | |
| SPUF II | ASTM C 1029 (Type II) | 41 | 1 | 46 | 2 | 60 | 28 | | |

### Table 4 - 4.Flexural strength measured data - Gypsum, Wood, and Concrete

| Material | Applicable Standard | 50%RH 75 ˚F | | 90%RH 75 ˚F | | VD-48hours | | TRR 80 | |
|---|---|---|---|---|---|---|---|---|---|
| | | Strength (psi) | MC (%) | Strength (psi) | MC (%) | Strength (psi) | MC (%) | Strength (psi) | MC (%) |
| Gypsum - Green | ASTM C 1396 | 1539 | 0 | 1471 | 0.7 | 605 | 12 | TBD | |
| Gypsum - White | ASTM C 1396 | 408 | 3 | 274 | 10 | 66 | 57 | | |
| Gypsum Fiber | ASTM C 1278 | 1085 | 0 | 790 | 1.4 | 235 | 22 | | |
| Glass Mat Gypsum | ASTM C 1177 | 669 | 0 | 666 | 1 | 628 | 13 | | |
| Plywood | PS-1 Plywood | 8481 | 7 | 3347 | 15 | 2765 | 31 | | |
| OSB | ASTM D 7033 | 111 | 6 | 76 | 12 | 37 | 25 | | |
| Lightweight cellular concrete | ASTM C869/C869M | 253 | 7 | 141 | 13 | 109 | 29 | | |
| Vermiculite/perlite concrete | ASTM C 332 | 296 | 8 | 161 | 14 | 133 | 38 | | |

# Appendix 5 Fastener Plate Pull Through

## Standards Used

- NRCC – FPPT: Standard Test Method for Fastener Plate Pull Through

## Samples and Conditioning

**Table 5 - 1. Fastener plate pull through sample size and number of specimens**

| Dimensions | Insulation | Gypsum |
|---|---|---|
| **Thickness (inch)** | 0.5 to 1 | 0.5 |
| **Width (inch)** | 14 | 14 |
| **Length (inch)** | 14 | 14 |
| **Number of Specimens** | 5* | 5* |

**Note: For MC 3 and MC 4 moisture conditions only three specimens were tested due to difficulty conditioning multiple specimens and the extremely long time required for the conditioning of the specimens.*

**Table 5 - 2. Fastener plate pull through moisture content conditions**

| Moisture Condition | Temperature | Humidity |
|---|---|---|
| MC 1 | 75 ±2°F | 50 ±2%%RH |
| MC 2 | 75 ±2°F | 90 ±2%% RH |
| MC 3 | VD-48hrs | |
| MC 4 | TRR-80 | |

## Measured Data and Remarks

The test protocol followed for the insulation and gypsum materials can be found in Appendix 6. For MC1 and MC2 the moisture contents were reached using a climate chamber, while for MC3 and MC4 the method described in Appendix 7 was followed. The measured results can be seen in Table 5-3 for the insulation materials and Table 5-4 for the gypsum. Note that materials under the wood and concrete groups were excluded from this property evaluation.

**Table 5 - 3. Fastener plate pull through measured data - Insulation**

| Material | Applicable Standard | 50%RH 75 ˚F | | 90%RH 75 ˚F | | VD-48hours | | TRR 80 | |
|---|---|---|---|---|---|---|---|---|---|
| | | Break Load (lbf) | MC (%) | Break Load (lbf) | MC (%) | Break Load (lbf) | MC (%) | Break Load (lbf) | MC (%) |
| Mineral Fiber | ATSM C 726 | 184 | 0 | 175 | 0 | 150 | 20 | TBD | |
| Cement Board | ASTM C 1325 | 370 | 0 | 325 | 12 | 300 | 13 | | |
| EPS I | ASTM C578 (Type I) | 65 | 1 | 72 | 1 | 67 | 58 | | |
| EPS VIII | ASTM C578 (Type VIII) | 87 | 0 | 61 | 1 | 50 | 30 | | |
| Cellular glass | ASTM C 552 | 130 | 0 | 129 | 0 | 131 | 0 | | |
| Perlite board I | ASTM C 728 (Type 1) | 79 | 2 | 50 | 5 | 25 | 26 | | |
| Perlite board II | ASTM C 728 (Type 2) | 215 | 2 | 88 | 5 | 67 | 31 | | |
| Fiberboard II | ASTM C 2018 (Type II Grade 1) | 145 | 7 | 105 | 16 | 55 | 67 | | |
| Polyiso II Class 1 | ASTM C 1289 (Type II class 1) | 156 | 3 | 136 | 7 | 130 | 25 | | |
| Polyiso II Class 2 | ASTM C 1289 (Type II class 2) | 245 | 1 | 244 | 2 | 200 | 22 | | |
| Polyiso II Class 4 | ASTM C 1289 (Type II class 4) | 162 | 1 | 160 | 2 | 136 | 14 | | |
| XPS IV | ASTM D 578 (Type IV ) | 118 | 0.1 | 122 | 0.4 | 125 | 15 | | |
| SPUF II | ASTM C 1029 (Type II) | 111 | 0.5 | 132 | 2 | 121 | 31.4 | | |

**Table 5 - 4. Fastener plate pull through measured data – Gypsum**

| Material | Applicable Standard | 50%RH 75 ˚F | | 90%RH 75 ˚F | | VD-48hours | | TRR 80 | |
|---|---|---|---|---|---|---|---|---|---|
| | | Break Load (lbf) | MC (%) | Break Load (lbf) | MC (%) | Break Load (lbf) | MC (%) | Break Load (lbf) | MC (%) |
| Gypsum - Green | ASTM C 1396 | 300 | 0.1 | 270 | 0.7 | 98 | 13 | TBD | |
| Gypsum - White | ASTM C 1396 | 193 | 3 | 156 | 2.6 | 60 | 52 | | |
| Gypsum Fiber | ASTM C 1278 | 362 | 0.3 | 283 | 1.4 | 180 | 20 | | |
| Glass Mat Gypsum | ASTM C 1177 | 180 | 0.5 | 240 | 1.1 | 178 | 25.8 | | |

# Appendix 6 Fastener Plate Pull Through – “NRCC – FPPT”

# NRCC-FPPT: Standard Test Method for Fastener Plate Pull Through

## 1. Scope

1.1 This test method provides a laboratory procedure for determining the load required to perform a fastener plate pull through on substrate materials.

1.2 This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

## 2. Summary of Test Method

2.1 The test consists of installing a fastener plate and fastener in the middle of the specimen. The specimen is clamped on a movable holder and once the fastener is fixed the specimen is pulled upwards uniformly by applying a tensile loading.

## 3. Significance and Use

3.1 This method can be useful in determining the fastener plate pull through load. This pull through data can be used to determine component swapping influence on a system for wind uplift testing.

## 4. Test Apparatus

4.1 The test apparatus consists of a movable metal frame which holds the specimen. The metal frame has 4 clamps that clamp the edges of the specimen. The frame is pulled upwards uniformly by applying a tensile loading.

4.2 The fastener is fixed by a clamp that is located at the bottom of the apparatus.

4.3 The setup can be seen in Figure 6-1.

## 5. Test Specimens

5.1 The test specimens' dimensions were set to be 14" x 14".

## 6. Test Procedure

6.1 Place fastener plate in the center of the specimen and install the fastener.

6.2 Place specimen in the movable frame and clamp it at four edge locations.

6.3 Fix the fastener in place using a rigid clamp.

6.4 The frame is pulled upwards uniformly by applying a tensile loading at a rate of 2 inch/min.

## 7. Report

7.1 Report the following information:

7.1.1 Complete description of the test specimen including the dimensions and weight of the specimen.

7.1.2 Record the peak pull through load.

## 8. Precision and Bias

8.1 The repeatability relative standard deviation has not been determined because it is greatly depended on the nature of the material and its variations.

## 9. Keywords

9.1 fastener plate, fastener, pull through

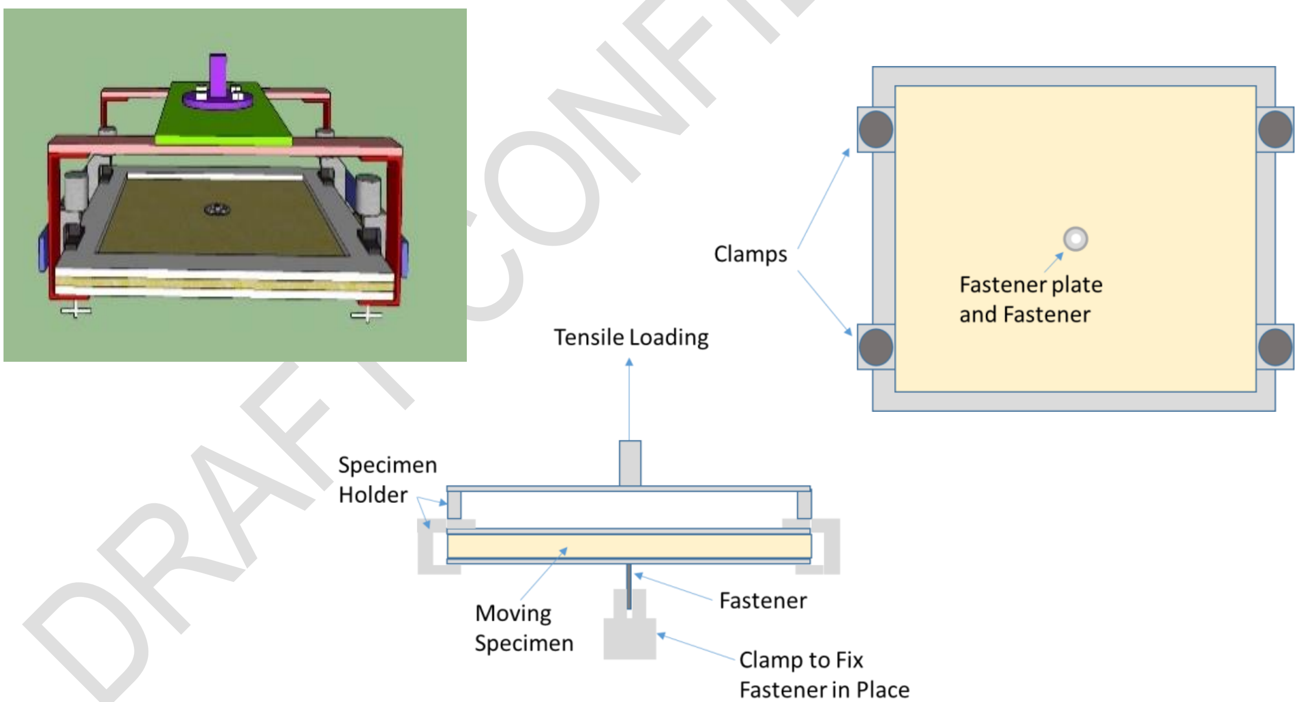


**Figure 6 - 1. Fastener plate pull through apparatus**

Return to Schedule

# Appendix 7 Vapor Drive Methodology – “NRCC – VD”

**NRCC – VD: Standard Test Method for Adding Moisture to Materials using the Vapor Drive Method**

## 1. Scope

1.1 This test method provides a laboratory procedure for adding moisture to materials using the vapor drive apparatus.

1.2 This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

## 2. Reference Document

2.1 Tobiasson, W., Greatorex, A., & Pelt, D. V. (1987). Wetting of Polystyrene and Urethane Roof Insulations in the Laboratory and on a Protected Membrane Roof. *Journal of Thermal Insulation*, *11*(2), 108–119. doi: 10.1177/109719638701100206

## 3. Summary of Test Method

3.1 The test consists of placing a specimen on top of a copper bottom container, which is filled with distilled water and located in a heat flow meter. The top and bottom plate of the heat flow meter are set at different temperatures and the temperature gradient will cause the vapor to be driven into the material.

## 4. Significance and Use

4.1 This method can be useful in determining the effect of moisture in materials. The temperature gradient allows moisture to be added even in those materials that do not absorb moisture through the process of conditioning using a climate chamber or submersion into water.

## 5. Test Apparatus

5.1 The test apparatus consists of a heat flow meter and a copper bottom container. The top plate of the heat flow meter is set at a low temperature while the bottom plate is set at a high temperature. Inside the heat flow meter, a copper-based container is placed. The setup can be seen in Figure A7-1.

## 6. Test Specimens

6.1 Prepare test specimens in accordance with the standard that applies to the material that will be tested after the vapor drive is complete.

## 7. Test Procedure

7.1 Place the test specimen onto the copper bottom container which contains distilled water.

7.2 Place the copper bottom container along with the specimen in the heat flow meter such that the copper bottom container is on top of the hot plate and the top of the specimen is in contact with the cold plate of the heat flow meter.

7.3 Set the top plate of the heat flow meter at a low temperature (39˚F) and the bottom plate at a high temperature (104˚F).

7.2 Remove test specimen from apparatus periodically, remove excess moisture from the surface using a paper towel.

7.3 Weigh the test specimen and continue the process until the desired moisture content is achieved.

## 8. Report

8.1 Report the following information:

8.1.1 Complete description of the test specimen including the dimensions, weight of the specimen before and after the vapor drive, and time required to achieve the required amount of moisture content.

8.1.2 Report the moisture content at VD-48hrs, representing the amount of moisture the material gained after being in the vapor drive apparatus for 48 hours.

8.1.3 Report the moisture content at TRR-80, representing the amount of moisture the material gained after being in the vapor drive apparatus until the moisture content caused a 20% drop in R-value.

## 9. Precision and Bias

9.1 The repeatability relative standard deviation has not been determined because it is greatly depended on the nature of the material and its variations.

## 10. Keywords

10.1 vapor drive, moisture content

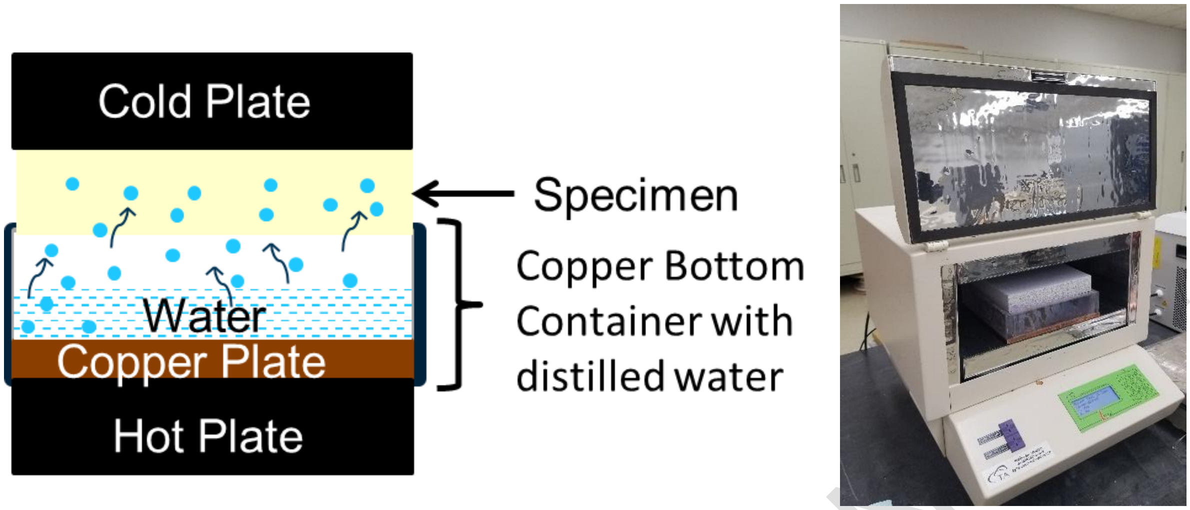


**Figure 7 - 1. Vapor drive apparatus**

Return to Schedule

SPRI
Technical Committee
Opal Sands Resort
Clearwater Beach, Florida
January 10, 2020
2:45 p.m.

AGENDA

| | | |
|---|---|---|
| I. | Call to Order | C. Mader |
| II. | Roll Call & Reading of SPRI Antitrust Statement | |
| III. | Minutes<br>Vote on approval of the minutes of the October 2019 meeting (attached) | |
| IV. | Review of Completed Objectives | C. Mader |
| V. | Task Force Reports | |
| | A. Air Barrier Details | A. Janni |
| | B. Air Intrusion | A. Janni |
| | C. Codes Development | A. Hickman |
| | D. Codes & Standards | M. Ennis |
| | E. Code Compliance Interface | E. Younkin/L. Hull |
| | F. Code Official Training | B. Chamberlain |
| | G. D6878 TPO Considerations for Revision | W. Sanborn |
| | H. DORA® Listing Service<br>Marketing<br>Database/Oversight | <br>J. Greko<br>J. Malpezzi |
| | I. DORA Rule for Adding Fire & Impact | S. Morrison/J. Sherwin |
| | J. Fastener Plate Pull-Through | C. Mader |
| | K. IA-1 Revision | S. Childs |
| | L. IBHS Training | M. Darsch |
| | M. Very Severe Hail FAQ | J. Schwetz |
| | N. VOC Regulatory Monitoring | J. Bates |
| | O. Wetting Curves<br>Vote on the publication of the testing results (see Wetting Curves TF Agenda) | D. Hawn |
| V. | Annual Conference Timing | Carpenter/Reel |
| VI. | Website/Digital Content & Communication | B. LeClare |
| VII | New Business | |
| VIII. | Adjournment | |

Return to Schedule

SPRI
Technical Committee Task Force
Hilton Denver City Center
Denver, CO
October 22, 2019

**MINUTES**

**Call to Order**
The Technical Committee meeting was called to order at 3:30 p.m. MDT by Technical Committee Chair Chris Mader. The SPRI Antitrust Statement was read. *

**Roll Call**
*Those present were:*
Chris Mader, OMG Roofing Products
Adam Aharonian, SFS Group USA
Brian Alexander, TruFast
Maury Alpert, Polyglass USA, Inc.
Warren Barber, National Gypsum
Bas Baskaran, NRCC
Justin Bates, H.B. Fuller Construction Products
Adam Bembenek, Mule-Hide Products Co., Inc.
Adam Burzynski, Carlisle Construction Materials
Scott Carpenter, SFS Group USA, Division Construction
Brian Chamberlain, Carlisle Construction Materials
Stephen Childs, OMG Roofing Products
Stan Choiniere, StanCConsulting
Gareth Christopher, IKO Industries Ltd
Todd Corley, Siplast
Mike Darsch, Sika Sarnafil
Phillip David, IB Roof Systems
Brian Davis, GAF
Carl Flieler, Canadian General Tower Limited
Mike Giangiacomo, Flex Membrane Int'l Corp.
Kirk Goodrum, Siplast
Keith Grzybowski, Firestone Building Products
Jason Hackman, Benchmark Inc.
David Hawn, Dedicated Roof & Hydro-Solutions
George Howell, Martin Marietta Magnesia Specialties
Lynsey Hull, NEMO | etc.
Al Janni, Duro-Last Roofing, Inc.
Joseph Kalwara, Firestone Building Products
Shaun Kerschen, Atlas Roofing Corporation
Stephanie Kiriazes, Firestone Building Products
Brendan Knapman, ROCKWOOL
Sara Krompholz, Intertek
Edward Krusec, Hunter Panels
Mikael Kuronen, Georgia-Pacific Gypsum LLC
Bob LeClare, ATAS International, Inc.
Colin Litow, Continuus Materials, LLC
Joe Malpezzi, Carlisle Construction Materials
Rick Martelon, Johns Manville Corporation
Saverio Marzella, ROCKWOOL
Tim McFarland, Mule-Hide Products Co., Inc.
Tim McQuillen, Johns Manville Corporation
Scott Morrison, J.S. Held LLC
Steve Moskowitz, Atlas Roofing Corporation
Jim Pieczynski, Blue Ridge Fiberboard, Inc.
Brian Randall, National Gypsum
Ron Reed, Intertek
Bob Reel, H.B. Fuller Construction Products
Andrew Reynolds, Benchmark, Inc.
Jim Rubenacker, Sika Sarnafil
William Sanborn, Johns Manville Corporation
Michael Schwent, GAF
Joe Schwetz, Sika Sarnafil
CJ Sharp, ICP Building Solutions Group
Flonja Shyti, NRCC
Kurt Sosinski, Tremco, Inc.
Myles Sosnoff, Metal-Era, Inc.

*SPRI Antitrust Statement: SPRI complies with antitrust laws and requires participants in its programs to comply with antitrust laws. Discussions which could affect competitive pricing decisions or other competitive factors are forbidden. There may be no discussions of pricing policies or future prices, production capacity, profit margins or other factors that may tend to influence prices. In discussing technical issues, care should be taken to avoid discussing potential or planned competitive activities. Members and participants should be familiar with the SPRI Antitrust Policy and act in conformity with it.

Return to Schedule

Emily Standard, PRI
Zeb Sukle, Johns Manville Corporation
Todd Taykowski, Firestone Building Products
Mike Taylor, Blue Ridge Fiberboard, Inc.
Sid Teachey, USG Corporation
Nathan Vail, Intertek
Ryan VanWert, Duro-Last Roofing, Inc.
Diana Vitiritti, SITURA Inc.
Steve Wadding, Polyglass USA, Inc.
Martin Ward, GAF
Riku Ylipelkonen, ICP Building Solutions Group

*Staff present were:*
Mike Ennis, SPRI
Randy Ober, SPRI
Carl Silverman, Esq., SPRI

**Discussion**

<u>On motion duly made, the minutes of the July 2019 Technical Committee meeting were approved as distributed.</u>

<u>On motion duly made, the Technical Strategic Plan was approved for submission to the SPRI Board.</u>

**Task Force Reports**

1. Air barrier details - Task Force Chair Al Janni reported the following items:
   a. Responses were received from AABA & GAF & Fibertite; and
   b. There were good comments that will be forwarded to AABA.
2. Air Intrusion - Task Force Chair Al Janni reported the following items:
   a. Two responses have been received on the request for proposal (RFP), with one more expected;
   b. The responses will be reviewed by the Task Force, which may elect to have an in-person meeting with the respondents.
3. Code Development – Mike Ennis reported the following items for Task Force Chair Amanda Hickman:
   a. Reviewed plans for the upcoming Public Comment hearings in Vegas;
   b. The Code Development Strategic plan was approved; and
   c. SPRI's increased participation in the National Building Code of Canada (NBCC) was discussed.
   d. <u>On motion duly made, it was approved, with one abstention, to request that the SPRI Board allocate an amount not to exceed $5000 to have Tony Crimi provide a summary of the NBCC process and key contacts at the next available meeting.</u>
4. Codes & Standards - Task Force Chair Mike Ennis reported the following items:
   a. International Code Council Evaluation Service (ICC ES) and Innovation Research Lab have signed a cooperating agreement to offer testing services;
   b. The National Research Council Canada, (NRCC) is developing a resiliency standard that will cover membrane roof systems and will be included in the NBCC;
   c. Oak Ridge National Laboratory (ORNL) is offering a nonexclusive, royalty free license for use of the roof savings calculator.
5. Code Compliance and Product Approval – Task Force Chair Lyndsay Hull reported the following items:
   a. Miami Dade (MD) recently decided to no longer allow Private Labeled Products (PLA) for membranes; and
   b. Phil Smith, FM Approvals, called Jorge Acebo at MD and is working with them to allow PLAs.
6. Code Official Training – Task Force Chair Mike Ennis reported the following items:
   a. Polyisocyanurate Insulation Manufacturers Association (PIMA) would like to participate in these Code Official training programs with SPRI. The Task Force agreed to have PIMA help at EduCode and SPRI would work with them at a program scheduled in Denver, CO.

7. Annual Conference – Task Force Chair Bob Reel reported the following items:
    a. The Task Force is evaluating the potential for moving the Conference to a different time of the year; and
    b. In 2020, the Conference will be held at the Opal Sands in Clearwater.
8. D6878 TPO Considerations for Revision – Task Force Chair Will Sanborn reported the following items:
    a. Including new type for FleeceBACK Thermoplastic Polyolefin (TPO) in ASTM D6878;
    b. 4 out of 5 manufacturers have submitted samples to SRI;
    c. Made several modifications to original test procedures; and
    d. Impact testing was discussed and will be refined before the next meeting.
9. DORA Listing Service: Task Force Chair Joe Malpezzi reported the following items:
    a. The program overview includes:
        i. 52 participating companies;
        ii. 1647 products listed; and
        iii. 3312 listed assemblies.
    b. Revising search function for modified bitumen assemblies;
    c. Google Analytics will determine who & how people are using DORA;
    d. DORA was presented at several trade association shows; and
    e. <u>On motion duly made, the Technical Committee approved the recommendation that the SPRI Board fund $1,000 to trademark the full name for DORA.</u>
10. DORA Rules for adding fire and impact – Task force Co-Chair Scott Morrison reported the following items:
    a. Seven members are investigating rules for fire, Jenny Sherwin is leading this effort; and
    b. Rules for impact will be completed by the end of the first quarter.
11. Fastener Plate Pull-Through – Task Force Chair Chris Mader reported the following items:
    a. The Task Force reviewed the minutes from the meeting held with FM and discussed how the proposed standard will be used; and
    b. The Task Force will create an ANSI Standard based on the FM standard, an ANSI Project Initiation Notification Form (PIN) has been issued.
12. IA-1 Revision – Task Force Chair Stephen Childs reported the following items:
    a. This was the first meeting of this Task Force; and
    b. The canvass list was reviewed, and potential revisions were discussed.
13. IBHS training – Task Force Chair Mike Darsch reported the following items:
    a. This was the first meeting of this Task Force;
    b. The proposed training will mimic the Fortified program and will train the contractor;
    c. DORA will identify which assemblies are Fortified; and
    d. A meeting with IBHS will be conducted.
14. RP-4 Revision – Task Force Chair Todd Taykowski reported the following items:
    a. 11 out of 15 members of the canvass group voted affirmative regarding the actions taken to address the Tom Smith negative, two abstained and two did not vote. The revision is now complete; and
    b. Bas Baskaran suggested that a new task force be created to study roofs with parapets.
15. Very Severe Hail FAQ – Task Force Chair Tim McQuillen reported the following items:
    a. This was the first meeting of this Task Force; and
    b. Possible action items identified were:
        i. Development of an FAQ white paper document to be presented at IIBEC;
        ii. Possibly develop a SPRI Hail Resistance Standard; and
        iii. Have a meeting with FM.
16. VOC Regulatory Monitoring – Task Force Chair Justin Bates reported the following items:

a. Parachlorobenzotrifluoride (PCBTF) has been added to Prop 65. Roof Coatings Manufacturers Association (RCMA) has concerns that as a result, the exemption currently in place at South Coast Air Quality Management District (SCAQMD) will be lost.
b. On motion duly made, the Technical Committee approved submission of the recommendation to the SPRI Board, to hire Association Research Inc. (ARI), at an expense not to exceed $3,500, to prepare, facilitate and compile the results of a survey of the SPRI Members on the usage data of PCBTFs.

17. WD-1 update – Task Force Chair Joe Malpezzi reported the following items:
    a. There is one remaining negative. The Task Force revised the document to address this negative; and
    b. The revised copy will be sent to the National Roofing Contractors Association (NRCA) for review with a request to withdraw its negative.
18. Wetting Curves - Task Force Chair Dave Hawn reported the following items:
    a. A limited number of tests remain. NRCC hopes to have all testing completed by the end of December;
    b. Notification and an opportunity to review the data will be provided on the SPRI website; and
    c. The Task Force plans to vote on the approval of the NRC report at the January Conference.
19. Website/Digital Content & Communication – Chair Adam Burzynski reported the following items:
    a. Several links to SPRI Member Resources are non-functional, they will be repaired;
    b. Google Analytics shows where people are mostly landing on the SPRI website (Standards);
    c. The Task Force will attempt to improve users experience;
    d. SPRI is changing the Members Only section password to “SPRImember20”;
    e. Blog content continues to be developed and posted; and
    f. Use of social media to promote SPRI will be increased to include such items as SPRI events attended and new blogs.

**New Business**
Mr. Janni asked for submission of names of people to be recognized for their contribution to SPRI during the past year. Submissions should be sent to info@spri.org.

**Adjournment**
There being no further business, the meeting was adjourned at 4:05 p.m. MDT.

Submitted by: Mike Ennis, SPRI Technical Director

These minutes were reviewed by SPRI Legal Counsel.

SPRI
Conference Committee Task Force
Opal Sands Resort
Clearwater Beach, FL
January 10, 2020
9:30 a.m.

AGENDA

| | | |
|---|---|---|
| I. | Call to Order | Reel/Carpenter |
| II. | Roll Call & Reading of SPRI Antitrust Statement | |
| III. | Identify Preferred Conference Time of Year. | |
| IV. | Action Items | |
| V. | Adjournment | |

465 Waverley Oaks Road, Suite 421 – Waltham, MA 02452
t. 781.647.7026 f. 781.647-7222 e. info@spri.org

Bylaws – related to conference timing

**Section 2. Annual Meeting**. The organization shall hold an Annual Meeting at such time and place as determined by the Board.

**Section 3. Special Meetings**. Special Meetings are defined as single (or otherwise expressly designated) topic meetings that are time or subject critical in nature. Special Meetings of the organization may be called by the Board at the request of the President. Notice of such Special Meetings shall be given at least three (3) days prior thereto.

**Section 4. Notice of Meetings.** Written notice of the Annual Meeting of the organization shall be communicated to the last known physical or email address of each Member not less than ten (10) days nor more than thirty (30) days before the date of the meeting. Notice of any other meeting shall be given not less than three (3) days nor more than thirty (30) days before the date of the meeting.

**Section 3 Manner of Election and Term of Office.** Each Regular Member shall appoint a person to serve as its Director on the Board for a minimum of one (1) year or until such time as a different representative is appointed by that Regular Member. In addition, eight (8) Associate Directors shall be elected by the voting Members at the organization's Annual Meeting after consideration of the recommendation of the Nominating Committee. Associate Directors shall serve staggered two (2) year terms. Officers shall be elected by the voting Members from among the Directors following recommendations by the Nominating Committee, and each Officer is elected then to serve a two (2) year term.

Return to Schedule

SPRI
Code Compliance Interface Task Force
Opal Sands Resort
Clearwater, FL
January 10, 2020
10:30 a.m.

SPRI
SINGLE PLY ROOFING INDUSTRY

AGENDA

I. Call to Order — L. Cadena/L. Hull/E. Younkin

II. Roll Call & Reading of SPRI Antitrust Statement

III. Review October meeting notes/minutes

IV. Summarize January 9th meeting with Miami-Dade

V. Open discussion for new items

VI. Adjournment

SPRI
Digital Content & Communications
Opal Sands Resort
Clearwater, FL
January 10, 2020
11:30 a.m.

AGENDA

I. Call to Order — A. Burzynski

II. Roll Call & Reading of SPRI Antitrust Statement

III. Website
  a. Update on standards webpage
  b. Education page review – ensure all links are active/working

IV. Blogs – Review Schedule and Topics
  Define topics and schedule for 2020

V. Social Media
  Schedule & strategy for LinkedIn Content

VI. Adjournment

Return to Schedule

SPRI
IA-1 Task Force
Opal Sands Resort
Clearwater, FL
January 10, 2020
12:45 p.m.

AGENDA

I. Call to Order — S. Childs

II. Roll Call & Reading of the SPRI Antitrust Statement

III. Review of revised standard (to be distributed on site)

IV. Canvass list

V. Action Items and Assignments

VI. Adjournment

465 Waverley Oaks Road, Suite 421 – Waltham, MA 02452
t. 781.647.7026 f. 781.647-7222 e. info@spri.org

| Participant | Company | Interest Category |
| --- | --- | --- |
| Alexander, Brian | Trufast | Producer |
| Cadena, Luis | NEMO | General Interest |
| Canon, Richard | Canon Fabrications, LLC | User |
| Choiniere, Stan | StanCConsulting | User |
| Garrigus, Peter | Choice Adhesives | Producer |
| Hawn, David | Dedicated Roof & Hydro-Solutions, LLC | User |
| Janni, Al | Duro-Last, Inc. | User |
| Lash, Norbert | H. B. Fuller | Producer |
| Mader, Christopher | OMG Roofing Products | Producer |
| Malpezzi, Joseph | Carlisle Construction Materials Incorporated | Producer |
| Marston, Caroll | Marston Consulting | General Interest |
| McQuillen, Tim | Johns Manville | Other Producer |
| Reynolds, Andrew | Benchmark, Inc. | General Interest |
| Roodvoets, Dave | DLR Consultant | General Interest |
| Savoy, Tom | Insulfoam LLC | Other Producer |
| Shyti, Flonja | National Research Council of Canada | General Interest |
| Smith, Phil | FM Approvals / FM Global | User |

Return to Schedule

SPRI
Code Official Training Task Force
Opals Sands Resort
Clearwater, FL
January 10, 2020
1:45 p.m.

AGENDA

| | | |
|---|---|---|
| I. | Call to Order | B. Chamberlain |
| II. | Roll Call & Reading of SPRI Antitrust Statement | |
| III. | Update on PIMA/SPRI communication | |
| IV. | Discuss updates for EduCode 2021 | |
| V. | Adjournment | |

Return to Schedule

SPRI
D6878 TPO Consideration for Revision
Opal Sands Resort
Clearwater, FL
January 10, 2020
8:30 a.m.

AGENDA

W. Sanborn

I. Call to Order

II. Roll Call & Reading of SPRI Antitrust Statement

III. Update on the ASTM ILS testing program

IV. Discussion of the fleece back hail resistance testing

V. Adjournment

Return to Schedule

SPRI
VOC Regulation Monitoring
Opal Sands Resort
Clearwater, FL
January 10, 2020
10:00 a.m.

AGENDA

| | | |
|---|---|---|
| I. | Call to Order | J. Bates |
| II. | Roll Call & Reading of SPRI Antitrust Statement | |
| III. | Review PCBTF Survey results from ARI | |
| IV. | Summary of OEHHA PCBTF workshops | |
| V. | SCAQMD Rule 102 proposed changes | |
| VI. | Rule 1168 Technology Assessment | |
| VII. | Adjournment | |

465 Waverley Oaks Road, Suite 421 – Waltham, MA 02452
t. 781.647.7026 f. 781.647-7222 e. info@spri.org

Return to Schedule

SPRI
Very Severe Hail FAQ Task Force
Opal Sands Resort
Clearwater, FL
January 10, 2020
11:00 a.m.

AGENDA

I. Call to Order — T. McQuillen

II. Roll Call & Reading of SPRI Antitrust Statement

III. Recap of FM Coalition meeting

IV. Establish objective of the Task Force group

V. Adjournment

Return to Schedule

SPRI
Fastener & Board Pull-Through Task Force
Hilton Denver City Center
Clearwater, FL
January 10, 2020
12:45 p.m.

AGENDA

I. Call to Order — C. Mader

II. Roll Call & Reading of SPRI Antitrust Statement

III. Discuss Task Force name change

IV. Review BPT-1 draft

V. Propose changes within 30 days

VI. Provide a clean-up draft to Factory Mutual by March 2020
Should SPRI invite FM to April 2019 meeting?

VII. Adjournment

465 Waverley Oaks Road, Suite421, Waltham, MA 02452
t. 781.647.7026 f. 781.647-7222 info@spri.org

ANSI/SPRI/FM BPT-1 20XX

# Test Standard for Comparative Pull-Through Strengths of Stress Plates and Substrate Board Materials Used with Low Slope Roofing Systems

Table Of Contents



## 1.0 Introduction

### 1.1 Scope

This Standard provides ~~the~~ basic requirements and procedures for testing ~~different~~ substrate board materials, ~~different~~ *stress plates*, ~~different~~ *fasteners*, or various combinations of these components, on a comparative basis.

### 1.2 Definitions

All words defined within this section are italicized throughout the standard

ANSI
American National Standards Institute

Board Stock
Insulation materials commonly used in commercial flat roofing that are manufactured into square or rectangular sheets. (e.g. polyisocyanurate, expanded polystyrene, mineral wool, etc.)

Cover Board
A sheet product commonly used as the top layer in insulation systems to protect the underlying materials from potential rooftop hazards.

Fastener
A mechanical component used to secure various roofing materials to the roof deck.

Roof Assembly
A system of interacting roofing components designed to resist various forces or threats. (e.g. wind uplift, hail, foot traffic, water, fire, etc.)

Stress Plate
A specially designed washer that is when used in conjunction with a fastener to secure board stock, cover board, or thermal barrier materials does what?.

Return to Schedule

Substrate
The surface upon which a component is applied. (e.g. *board stock* may be the substrate for a *stress plate*)

Thermal Barrier
A sheet product commonly used as the base layer in insulation systems to protect the above components from internal fire.

## 2.0 General Information

*Roof assemblies* are tested for wind uplift resistance in accordance with various Standards~~, such as ANSI/FM 4474~~. (include list of potential tests in commentary?) Each assembly is made up of various components. The test procedure in this Standard is useful in qualifying new components for tested roofing assemblies, determining criticality of components for new roof assembly testing, or other such applications.

## 3.0 BPT-1 Procedure

### 3.1 Sample Setup

3.1.1 The ~~appropriate~~ *substrate* board shall be cut to a size that ~~is~~ allows ~~appropriate~~ for a *substrate* securement fixture with a free area (what is free area?) of 14” x 14” square.

3.1.2 The stress plate and/or fastener shall be installed through the middle of the substrate board

### 3.2 Test Setup

3.2.1 Install t~~T~~he test sample ~~is installed~~ and secure~~d~~ in a tensile test machine~~,~~ in preparation for a load to be applied perpendicular to the substrate board.

3.2.1.1 It is acceptable to statically secure the substrate securement fixture and move the fastener, or to statically secure the fastener and move the substrate securement fixture.

3.2.1.2 The tensile test machine shall be calibrated within 12 months of the date of testing, in accordance with a standard that is traceable to a nationally recognized source.

### 3.3 Test Method

3.3.1 ~~The sample is tested to failure, so e~~Ensure adequate personal protective equipment is available and in use, such as eye protection.

3.3.2 Force is exerted perpendicular to the plane of the substrate board at a speed of 2 in./min (51 mm/min).

3.3.3 The sample shall be tested to failure.

~~3.3.3~~3.3.4 The ultimate failure load observed for each test sample is recorded.

**Formatted:** Indent: Left: 0.5"

Appendix A – Commentary

This Commentary consists of explanatory and supplementary material with the intent of helping test labs, system designers, and other interested parties in applying the preceding Standard.

This Standard does not provide requirements for sample sizing. Factory Mutual requires a sample size of three (n=3) for their purposes, but other jurisdictions may require larger sample sizes. It is the responsibility of the interested parties to determine their needs as it pertains to sample sizes.

This Standard is intended to be a basis of practical comparative testing for roof system components that are within the scope of this Standard. Acceptable applications include, but aren't limited to :

1) Determination of most critical component combinations
   a. Prior to full scale roof assembly testing, it's reasonable to perform small scale testing in accordance with this standard to determine the most critical component combinations. Using the most critical component combinations in full scale roof assembly testing would allow all comparatively tested components to be included in the tested assembly.

2) Inclusion of new or revised components into existing roof assemblies
   a. Should a manufacturer need to change a particular product, or release a new product, it's reasonable to perform comparative small-scale testing in accordance with this standard to determine if the new components perform as well or better than the existing components.

SPRI
IBHS Training Task Force
Opal Sands Resort
Clearwater, FL
January 10, 2020
1:45 p.m.

AGENDA

I. Call to order — M. Darsch

II. Roll call & reading of SPRI Antitrust Statement

III. Discuss with IBHS what objectives and tasks they would like to see included in the program

IV. Review Steep Slope Training Guide

V. Any action items left uncovered

VI. Discuss next steps

VII. Adjournment

465 Waverley Oaks Road, Suite 421 – Waltham, MA 02452
t. 781.647.7026 f. 781.647-7222 e. info@spri.org