Building Papers: Products, Standards and Installation

BETEC
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Arlington, VA
Dave Olson
DOlson@Fortifiber.com
Presentation Summary

- Product Review
- Product Standards
- Building Codes
- Product Installation
  - Exposure
  - Product Compatibility
- Research and Development Projects
Asphalt Saturated Kraft Paper

Timeline

- 1960’s 10 Minute Paper, 30 Minute Paper
- Mid 1960’s Paper integrated onto expanded metal lath/woven wire
- 1979 UBC Requirement for 2 layers Grade D
- 1980’s 60 Minute Paper, 2 Ply Products
- 2000’s Rainscreen combinations
- 2004 IRC/IBC Requirement for 2 layers Grade D
Review of Major Manufacturers

• Fortifiber Building Systems Group
  – Fernley, NV
  – Los Angeles, CA
• Hal Industries
  – Surrey, British Columbia
• Davis Wire
  – Irwindale, CA
Manufacturing Process
Products

- Asphalt-saturated Kraft paper (Grade D) also available in 2-ply rolls
  - 10 minute
  - 30 minute
  - 60 minute
2-Ply Products
## Review of Products

Formulations to Address a Wide Variety of Applications

<table>
<thead>
<tr>
<th>Major Manufacturers</th>
<th>Fortifiber Davis Wire</th>
<th>Fortifiber Hal Davis Wire</th>
<th>Fortifiber Hal Davis Wire</th>
<th>Fortifiber Davis Wire</th>
<th>Fortifiber Hal Davis Wire</th>
<th>Fortifiber Hal Davis Wire</th>
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</thead>
<tbody>
<tr>
<td>Water Holdout</td>
<td>20-Minutes</td>
<td>30-Minutes</td>
<td>60-Minutes</td>
<td>110-Minutes</td>
<td>133-Minutes</td>
<td>150-Minutes</td>
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<tr>
<td>ASTM D-779</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vapor Permeability</td>
<td>200 Grams</td>
<td>170 Grams</td>
<td>75 Grams</td>
<td>95 Grams</td>
<td>103 Grams</td>
<td>67 Grams</td>
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<tr>
<td>ASTM E-96</td>
<td>29 perms</td>
<td>25 perms</td>
<td>11 perms</td>
<td>14 perms</td>
<td>15 perms</td>
<td>10 perms</td>
</tr>
<tr>
<td>Tensile Strength</td>
<td>70 lb. f/inch</td>
<td>68 lb. f/inch</td>
<td>70 lb. f/inch</td>
<td>144 lb. f/inch</td>
<td>144 lb. f/inch</td>
<td>160 lb. f/inch</td>
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<tr>
<td>ASTM D-828</td>
<td>29 lb. f/inch</td>
<td>31 lb. f/inch</td>
<td>60 lb. f/inch</td>
<td>58 lb. f/inch</td>
<td>58 lb. f/inch</td>
<td>110 lb. f/inch</td>
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<tr>
<td>Number of Plies</td>
<td>One</td>
<td>One</td>
<td>One</td>
<td>Two</td>
<td>Two</td>
<td>Two</td>
</tr>
<tr>
<td>(Layers of paper)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Roll Sizes</td>
<td>40”x324 Sq Ft 500</td>
<td>40”x324 Sq Ft 500</td>
<td>40”x240 Sq Ft</td>
<td>40”x162 Sq Ft 250</td>
<td>40”x162 Sq Ft 250</td>
<td>40”x162 Sq Ft</td>
</tr>
</tbody>
</table>
Paperback Woven Wire Rolls
Paperback Expanded Metal Lath Sheets
Innovative Rainscreen
Asphalt Saturated Kraft Paper

A single layer of cellulose fibers. The fiber source is mostly from virgin, unbleached softwood pulp and may have a small percentage of recycled fiber. This results in paper having a:

- More uniform fiber structure
- Small pore size
- Dense fiber matrix.
Asphalt Building Paper
Top View (200X)
Roofing Felt

Felt consists of multiple layers of loosely laid cellulose fibers. The fiber source is unbleached softwood pulp and a high percentage of recycled fibers. This results in felt having a:

- Less uniform fiber structure
- Larger pore size
- Bulky matrix.
No. 15 Roofing Felt
Felt and Kraft Paper to Scale
Federal Specification UU-B-790a

- Federal Specification for Building Paper, Vegetable Fiber:
  - (Kraft, Waterproofed, Water Repellant and Fire Resistant)
  - Classifies paper in terms of:
    - 4 Types
    - 4 Grades
    - 12 Styles
Federal Specification UU-B-790a

Paper Types

- Type I - Barrier Paper
- Type II – Concrete Curing Paper
- Type III – Fire resistant
- Type IV – Insulation tape paper
Federal Specification UU-B-790a

Paper Styles

Style 1a, Uncreped, not reinforced
Style 1b, Uncreped, not reinforced, red rosin sized
Style 2, Uncreped, not reinforced, saturated

Style 11 - Reinforced
Federal Specification UU-B-790a

Paper Grades

– Grade A – High water vapor resistance
– Grade B – Moderate water-vapor resistance
– Grade C – Water resistant
– Grade D – Water – vapor permeable
# TABLE 14-1-A GRADE REQUIREMENTS

<table>
<thead>
<tr>
<th>PHYSICAL PROPERTY REQUIREMENT</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Tensile Strength</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Lbs/inch width, both directions</td>
<td></td>
<td></td>
<td></td>
<td>1/6</td>
</tr>
<tr>
<td>Water resistance</td>
<td>24</td>
<td>16</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Permeation of water through papers, hours minimum</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water vapor transmission</td>
<td>4</td>
<td>6</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Maximum</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>35</td>
</tr>
<tr>
<td>Grams per sq. meter per 24 hours</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
1. SCOPE AND CLASSIFICATION

1.1 Scope. This specification covers building papers composed predominantly of sulphate pulp fibers.

1.2 Classification.

1.2.1 Types, grades and styles. The building papers shall be of the following types, grades and styles, as specified (see 6.2):

**Type I – Barrier Paper**
- Grade A – High water-vapor resistance.
- Grade B – Moderate water-vapor resistance.
- Grade C – Water resistant.

**Grade D – Water-vapor permeable.**
- Style 1a – Uncreped, not reinforced.
- Style 1b – Uncreped, not reinforced, red rosin sized.

**Style 2 – Uncreped, not reinforced, saturated.**
- Style 3 – Creped one direction, not reinforced.
- Style 4 – Uncreped, reinforced.
- Style 5 – Creped one direction, reinforced.
- Style 6 – Creped two directions, not reinforced.
- Style 7 – Creped two directions, reinforced.

**Type II – Concrete-curing paper.**
- Grade E – Moisture rentative.
- Style 8 – Regular color, reinforced.
- Style 9 – White, reinforced.

**Type III – Fire-resistant paper.**
- Grade F – Water repellent.
- Style 10 – 56-pound paper.

**Type IV – Insulation tape paper.**
- Grade G – High tensile strength – water resistant.
- Style II – Reinforced.
Building Codes/Product Standards
## Asphalt Saturated Kraft Paper

### Terminology – Code Review

<table>
<thead>
<tr>
<th>Code Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uniform Building Code</td>
<td>Weather-resistive barrier</td>
</tr>
<tr>
<td>International Building Code</td>
<td>Water-resistive barrier</td>
</tr>
<tr>
<td>International Residential Code</td>
<td>Weather-resistant sheathing paper</td>
</tr>
<tr>
<td>National Building Code Of Canada</td>
<td>Wall sheathing membrane</td>
</tr>
</tbody>
</table>
Water Management Assembly

• Drainage Plane
• Drainage Space
• Flashing
• Weep holes

• EEBA Water Management Guide
<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Tensile Strength</td>
<td>Lbs/inch width, both directions</td>
</tr>
<tr>
<td>Water Resistance</td>
<td>Permeation of water through paper, hours minimum</td>
</tr>
<tr>
<td>Water Vapor Transmission</td>
<td>Grams per sq meter per 24 hours</td>
</tr>
</tbody>
</table>
Grade D Requirements

Dry Tensile Strength 20lbs both machine and cross direction

Water Resistance 10 minutes

Water Vapor Transmission
Maximum no limit
Minimum 35 grams
Product Standards

ASTM D-779 Water Resistance of Paper, Paperboard, and other Sheet Materials by the Dry Indicator Method (Boat Test)

ASTM D-828-93 Tensile Properties of Paper, Paperboard using Constant Rate of Elongation Apparatus

ASTM E-96-95 Water Vapor Transmission of Materials
Section 1402.1 Weather resistive barriers. All weather–exposed surfaces shall have a weather resistive barrier to protect interior wall covering. Such barrier shall be equal to that provided for in the U.B.C. Standard 14-1 for kraft waterproof building paper or asphalt saturated rag felt.
2506.4 Weather resistive Barriers. Weather resistive Barriers shall be installed as required in Section 1402.1 and, when applied over wood based sheathing, shall include two layers of Grade D paper.
Such felt or paper shall be applied horizontally, with the upper layer lapped over the lower layer not less than 2 inches. Where vertical joints occur, felt or paper shall be lapped not less than 6 inches.
1404.2 Water –resistive barrier. A minimum of one layer of **No. 15 asphalt felt**, complying with **ASTM D 226 for Type 1 felt** shall be attached to the sheathing, with flashing as described in Section 1405.3 in such a manner as to provide a continuous water resistive barrier behind the exterior wall veneer.
2003 I.B.C. Requirements

2 layers of Grade D weather resistive barrier behind stucco over wood based sheathing
R703.2 Weather resistant sheathing paper. Asphalt saturated felt free from holes and breaks, weighing not less than 14 lbs per 100 square feet (0.683 kg/m²) and complying with ASTM D 226 or other approved weather-resistant material shall be applied over studs or sheathing of all exterior walls as required by table R703.4.
Such felt or material shall be applied horizontally, with the upper layer lapped over the lower layer not less than 2 inches (51 mm). Where joints occur, felt shall be lapped not less than 6 inches (152 mm).
Exception: Such felt or material is permitted to be omitted in the following situations.

- In detached accessory buildings.
- Under panel siding with shiplap joints or battens.
- Under exterior wall finish materials as permitted in Table R703.4
- Under paperbacked stucco lath.
2004 IRC Changes

Exceptions allowing a builder not to use a weather resistive barrier have been eliminated.
2004 IRC Changes

**RB 224 IRC** will require the use of a weather resistive, vapor permeable barrier with performance equivalent to two layers of Grade D paper behind stucco
37.3.1.2 Barriers shall be a minimum of one layer of building paper meeting the Federal Specification UUB-790a, Specification for Building Paper, Vegetable Fiber: Kraft Waterproofed, Water Repellent, and Fiber Resistant for Kraft waterproof building paper with Type 1 felt in accordance with ASTM D-226, Standard Specification for Asphalt Saturated Organic Felt Used in Roofing and Waterproofing.
37.3.1.4 The barrier shall be applied horizontally and lapped upper layer over lower layer in weatherboard fashion for lengths of not less than 3 in. (76 mm) horizontally and 6 in. (152 mm) vertically.
2 layers of Grade D weather resistive barrier behind stucco over wood based sheathing
National Building Code of Canada

Subsection 9.23.17.3 Wall Sheathing membrane

1. Except as provided in Articles 9.23.17.4, 9.23.17.5, 9.23.17.6., at least one layer of sheathing membrane shall be applied beneath siding, stucco or masonry.
National Building Code of Canada Installation Requirements

Shall be applied so that joints are lapped not less than 4”

Applied horizontally, the upper sheets shall overlap the lower sheets.
Width Tolerance: -6 mm

Pliability: Shall not crack when bent 90° around a 15mm mandrel at -10± 2°C

Tensile Strength: 3.5 N/mm

Water Vapour Permeance
Min.: 170 ng/Pa·s·m²
Max.: 1400

Water Vapour Permeance (max) after accelerated aging: 2900
Applications

• Weather barriers must be installed in shingle lap fashion
Design Considerations

• Paper based products allowed for “Walls” within 30° of vertical

• Paper based products are not allowed on “Roofs” with a slope of less than 60° from horizontal
Product Exposure Limits

- Davis Wire  
  Cover product as soon as possible

- Fortifiber  
  Cover product as soon as possible

- Hal  
  Cover product as soon as possible
Product Compatibility

- Compatible with all dissimilar products in contact with WRB

- Use systems of products from manufacturers that have tested for compatibility

- Document compatibility with sealant manufacturer
Applications

- Weather-resistive barriers are used behind:
  - Three-Coat Portland Cement Plaster (Stucco)
  - One Coat
  - EIFS
Applications

- Water-resistive barriers are also used behind:
  - Other claddings such as Stucco Brick, Hardboard Siding, Vinyl, Aluminum, Fiber Cement and Wood Siding
System Requirements

• The success of the system depends on all of the components in the building envelope performing equally well.
Proper Installation
Review of Current Building Science Findings
• Project Objective:
  
  – To determine if a stucco wall assembly would drain water between the basecoat and the WRB
Additional Observations

- Stucco basecoat developed shallow random waves that channel water down the wall

- Natural drainage channels were created on the back of the stucco
• Project Findings:

• Proper installation of WRB and integration with flashing is one of the most important factors in the successful performance of exterior walls.
• Project Findings:

– 2 layers of WRB was shown to provide better drainage control than one layer behind all types of cladding not just stucco.
– Building paper swelled when wet and shrank when dry creating natural drainage channels in stucco

– 2 layers of building paper create an airspace behind stucco providing drainage
References

– American Society Testing Materials
– Building Science Corporation
– Davis Wire
– Fortifiber Building Systems Group
– Hal Industries
– International Code Council
– National Building Code of Canada
– National Fire Protection Association
– Northwest Walls and Ceiling Bureau
– Oakridge National Lab
– United States General Services Administration