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ENGINEERING JUDEGMENT REPORT

ABOUT

DENSELEMENT & DENSDEFY SYSTEMS

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PREPARED FOR

THE BUILDING AGENCY

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1 SUMMARY

The Building Agency has requested an engineering judgement to evaluate the

- Georgia-Pacific Gypsum DensElement Barrier System, and
- Georgia-Pacific DensDefy Liquid Barrier System

For their suitability of use in relation to the following New Zealand Building Code (NZBC) clauses:

- B1 - Structure
- B2 - Durability
- C3 - Fire
- E2 – Exterior Moisture

This report constitutes the compliance pathway of the proposed barrier systems with the NZBC and must be read in conjunction with the supporting documentation.

Subject to project-specific design and installation per manufacturer recommendations, Oculus Limited is satisfied on reasonable grounds that the DensElement Barrier System and DensDefy Liquid Barrier System will meet the relevant provisions of the New Zealand Building Code.

2 SYSTEMS OVERVIEW

The systems evaluated in this report include the following components and accessories:

DensElement Sheathing
A Type X external sheathing board with a non-combustible gypsum core and glass mat facers. Available in 15.9mm (5/8") thickness, with 1.219m wide panels up to 3.7m in length.

DensDefy™ Liquid Barrier
A fluid-applied, single component, silyl-terminated polymer (STP) air and water-resistive barrier applied by roller or with spray equipment. The elastomeric membrane adheres to common construction surfaces. Available in 5-gallon pails.

DensDefy™ Liquid Flashing
A waterproofing and detailing compound made with STP Technology creating an elastomeric flashing membrane that seals rough openings and penetrations. Available in a 20-oz sausage.

DensDefy™ Transition Membrane
A self-adhered impermeable membrane comprised of 16 mils of butyl adhesive and 9 mils of HDPP facer. It is primarily used as a transitioning accessory between dissimilar materials. 75-feet rolls available in 15 cm, 22 cm, or 30 cm widths.

The DensElement Barrier System consists of sheathing, liquid flashing and transition membrane. This system is to be used as the exterior wall sheathing with integrated air and water resistive barrier.

The DensDefy Liquid Barrier System consists of liquid barrier, liquid flashing and transition membrane. This system is to be used as an air and water resistive barrier over a suitable substrate.

Compliance pathway of these systems is set out in Section 5 of this report.

3 CONDITIONS OF THIS REPORT

The compliance potential set out in this report for the DensElement & DensDefy barrier systems has been evaluated using compliance documentation relevant to the proposed components and accessories. This report and any building consent resulting does not guarantee the building will achieve compliance with the New Zealand Building Code; only that it can achieve compliance as designed. Assumptions and limitations of the compliance potential set out in this report are described in Section 6.

4 PERFORMANCE REQUIREMENTS

The NZBC Clauses and applicable Performance Requirements included within this review's scope are listed in Table 1 below. Demonstration that a product or assembly can meet the Performance Requirements of the clause ensures that the Functional Requirement and the Objective of the clause will be met.

Table 1: NZBC Function Requirements and Applicable Performance Requirements

NZBC	Functional Requirement	Applicable Performance Requirements within the scope of review
B1 Structure	B1.2 *Buildings*, *building elements*, and *site work* shall withstand the combination of loads that they are likely to experience during *construction* or *alteration* and throughout their lives.	B1.3.2 and B 1.3.3 a), f), h), m)
B2 Durability	B2.2 *Building* materials, components, and *construction* methods shall be sufficiently durable to ensure that the *building*, without reconstruction or major renovation, satisfies the other functional requirements of this code throughout the life of the *building*.	B2.3.1 a), b), and B2.3.2 a), b)
C3 Fire	C3.2 *Buildings* with a *building height* greater than 10 m where upper floors contain sleeping uses or *other property* must be designed and constructed so that there is a low probability of external vertical fire spread to upper floors in the *building*.	C3.5 and C3.7
E2 External moisture	E2.2 *Buildings* must be constructed to provide *adequate* resistance to penetration by, and the accumulation of, moisture from the outside.	E2.3.2

5 COMPLIANCE PATHWAY

This section sets out:

- Summary of the DensElement and DensDefy barrier system's compliance with relevant clauses of the New Zealand Building Code, and
- Relevant documentation considered for each system.

Table 2: Method of Compliance with Applicable Performance Requirements

NZBC Clause	Method of Compliance with Applicable Performance Requirements
B1 Structure	Alternative Solution: DENSELEMENT BARRIER SYSTEM ▪ DensElement sheathing board was successfully tested to ASTM C473 Standard for flexural strength, hardness and nail pull resistance, meeting the requirements of ASTM C1177 for glass mat gypsum substrate to be used as exterior sheathing. ▪ Gravity/self-weight o The DensElement sheathing boards are secured via nails, screws or staples into the supporting framing. Attachment for gravity is covered in the technical and installation guides.

Thickness	Framing Spacing	Panel Orientation	Fastener Spacing – Wood Framing[1]	Fastener Spacing – Metal Framing[1]
5/8" (15.9 mm)	24" (610 mm) o.c. max[2]	Parallel[2] or perpendicular	8" (203 mm) o.c. field[3] & perimeter	8" (203 mm) o.c. along framing

[1] Fire-rated assemblies may require additional fasteners; see specific assembly details.
[2] For racking strength resistance, apply panel edges parallel with framing spaced a maximum of 16" (406 mm) on center (o.c.) for 5/8" (15.9 mm) DensElement® Barrier System.
[3] Fastener spacing around the perimeter of the wall and along intermediate vertical framing members.

Fastener*	Type	Length 5/8" (15.9 mm) Thick Sheathing	Description	Application
	Type S-12	1-1/4" (32 mm)	Bugle-head, fine-thread, corrosion-resistant, drill-point drywall screw	DensElement® Sheathing to heavy-gauge metal framing (18 gauge or thicker)
	Type S	1-1/4" (32 mm)	Bugle-head, fine-thread, corrosion-resistant, sharp-point drywall screw	DensElement Sheathing to light-gauge metal framing furring (20-25 gauge)
	Type W	1-5/8" (41 mm)	Bugle-head, rust-resistant, coarse-thread, sharp-point drywall screw	DensElement Sheathing to wood framing
	Type W, S, and S-12	1-1/4" (32 mm) metal 1-5/8" (41 mm) wood	Wafer-head, corrosion-resistant screws, drill or sharp point	DensElement Sheathing to heavy-gauge or light-gauge, metal or wood framing
	ASTM C514 and 12 gauge	1-3/4" (45 mm)	11-gauge, galvanized nail	DensElement Sheathing to wood framing
	16 gauge galvanized staples	1-5/8" (41 mm)	No. 16 gauge, flattened, galvanized, divergent-point wire staples with not less than a 7/16" (11mm) wide crown outside measure.	DensElement Sheathing to wood framing

- Seismic
  - The DensElement Barrier System has an unfactored ultimate racking strength of 9.544 kN/m when installed per fastener specification for racking strength resistance.
  - The sheathing board may also be used as a component of a shear resisting wall when used in accordance with the product literature.

NZBC Clause	Method of Compliance with Applicable Performance Requirements

- Wind
  - The DensElement Barrier System was successfully tested to ASTM E330 Standard for structural performance and can withstand unfactored ultimate wind loads up to 17.9 kPa.

Sheathing Thickness in. (mm)	Framing Spacing in. (mm)	Screw Spacing in. (mm)	Board Orientation	Ultimate Load PSF* (kPa)	Test Report
5/8 (15.9)	16 (406)	8 (203)	Horizontal	131 (6.3)	ITS #F7036.01-550-44
5/8 (15.9)	16 (406)	6 (152)	Horizontal	170 (8.2)	ITS #F7036.01-550-44
5/8 (15.9)	16 (406)	4 (102)	Horizontal	212 (10.1)	ITS #F7036.01-550-44
5/8 (15.9)	12 (305)	8 (203)	Horizontal	158 (7.6)	ITS #F7036.01-550-44
5/8 (15.9)	12 (305)	6 (152)	Horizontal	212 (10.1)	ITS #F7036.01-550-44
5/8 (15.9)	12 (305)	4 (102)	Horizontal	315 (15.1)	ITS #F7036.01-550-44
5/8 (15.9)	8 (203)	8 (203)	Horizontal	193 (9.2)	ITS #F7036.01-550-44
5/8 (15.9)	8 (203)	6 (152)	Horizontal	261 (12.5)	ITS #F7036.01-550-44
5/8 (15.9)	8 (203)	4 (102)	Horizontal	375 (17.9)	ITS #F7036.01-550-44
5/8 (15.9)	24 (610)	8 (203)	Vertical	69 (3.3)	TPI #89-047
5/8 (15.9)	24 (610)	8 (203)	Horizontal	85 (4.1)	TPI #89-047
5/8 (15.9)	16 (406)	8 (203)	Vertical	96 (4.6)	TPI #89-047

**Apply appropriate safety factor from the design method used to calculate design load.*

- Differential movement
  - The system was successfully tested to ASTM E1233 Standard for Structural Performance and showed no panel deflection failure under transverse load.
  - In general, we expect a system like this to be adequate to accommodate l/100 (1%) inter-storey drift without damage.

Limitation of use

- Design of the supporting structure is project specific and remains the responsibility of the structural engineer.
- The ultimate loads indicated in the literature are unfactored and must not be used as designed loads without appropriate factors of safety.
- Board orientation to be dictated by specific fire wall assembly or shear wall requirements when applicable.
- Sheathing boards are not intended to carry imposed loads and must not be used as a based for nailing or other fastening. Mechanical attachment of exterior claddings must be made directly to the framing.

Supporting documentation

- DensElement Barrier System Technical Guide - 2023
- DensElement Barrier System Testing Matrix - 2023
- ICC-ES Evaluation Report ESR-3786 - January 2023
- DensElement Barrier System Installation Guide - Rev. 6/23
- Georgia-Pacific Gypsum Environmental Product Declaration

B2 Durability	Engineering Judgement and Comparison with Verification Method B2/VM1 ▪ Systems were successfully tested to ASTM E331 in a 4-stage assessment for water penetration after testing for loading, racking and environmental conditioning. ▪ Systems were successfully tested for hydrostatic pressure following weathering by UV light exposure and accelerated aging. ▪ Both systems require fasteners to be fully protected or encapsulated to prevent corrosion. ▪ Systems are intended to be overclad to prevent degradation of the materials for the duration of their intended use and should not be subject to periodic maintenance. DENSELEMENT BARRIER SYSTEM ▪ DensElement Sheathing are manufactured to *ASTM C1177 – Standard Specification for Glass Mat Gypsum Substrate* for use as an exterior sheathing. ▪ DensElement Sheathing was successfully tested to ASTM D3273-12 Standard for Resistance to Growth of Mold. ▪ Glass Mat Gypsum Panels are indicated to have a service life of 60 years. ▪ The system is similar other gypsum sheathing solutions that have in-service history in New Zealand and overseas. DensElement and DensDefy systems form water-resistive barriers with fully protected seams, fasteners and penetrations. When installed per manufacturer literature, we are satisfied they will achieve minimum 15 years durability, or 50 years where required. Limitations of use ▪ The systems must not be exposed to the outdoors for longer than permissible and must be overclad in the finished installation. Supporting documentation ▪ DensElement Barrier System Technical Guide - 2023 ▪ DensElement Barrier System Testing Matrix - 2023 ▪ ICC-ES Evaluation Report ESR-3786 - January 2023 ▪ DensElement Barrier System Installation Guide - Rev. 6/23 ▪ DensDefy Liquid Barrier Product Data Sheet - 2023 ▪ DensDefy Liquid Barrier Technical Guide – 07/21 ▪ DensDefy Liquid Barrier Testing Matrix – 07/21 ▪ ICC-ES Evaluation Report ESR-4708 – August 2022

C3 Fire affecting aeras beyond the fire source

Acceptable Solutions C/AS2, Section 5.8

DENSELEMENT BARRIER SYSTEM

- DensElement Sheathing is non-combustible as tested in accordance with ASTM E 136. It is therefore compliant with C3 through the Acceptable Solutions C/AS2 to C/AS7 pathways.
- The system is compliant with *NFPA 285 – Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components*. This Standard is refenced in C/AS2.
- DensElement Sheathing is UL classified as Type X in accordance with ASTM C1177 and may be used in lieu of 5/8" gypsum sheathing Type X in generic fire-rated wall assemblies.

ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials	Provides comparative measurements of surface flame spread and smoke density measurements with that of select fiber-cement board surfaces under specific fire exposure conditions	✓	Best score of 0 - Flame Spread 0 - Smoke Developed
ASTM E136 Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C	Assists in indicating those materials which do not act to aid combustion or add appreciable heat to an ambient fire; materials passing the test are permitted to limited flaming and other indications of combustion	✓	Non-combustible

DENSDEFY LIQUID BARRIER SYSTEM

- The system is NFPA 285 compliant with multiple assemblies that hold an ICC-ES Evaluation Report.
- The system has a Class A/Class 1 fire rating as tested to ASTM E84 Standard for surface burning characteristics.

ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials	Provides comparative measurements of surface flame spread and smoke density measurements with that of select fiber cement board surfaces under specific fire exposure conditions	✓	Class A rating 25 - Flame Spread 10 - Smoke Developed

Limitations of use

- Membranes are commonly classified as a surface finish due to its nominal thickness. The DensDefy Liquid Barrier System must be used with an adequate substrate.
- Penetrations through the DensElement Sheathing boards must be detailed with an appropriately rated fire sealant.
- The use of these systems beyond UL fire-rated assemblies or assemblies with an ICC-ES Evaluation Report is outside the scope of this assessment and requires independent testing or assessment.
- The spread of fire through cavities in an external wall is outside the scope of this assessment and requires project specific design.

Supporting documentation

- DensElement Barrier System Testing Matrix - 2023
- ICC-ES Evaluation Report ESR-3786 – January 2023
- Georgia-Pacific Gypsum Environmental Product Declaration
- DensDefy Liquid Barrier Testing Matrix – 07/21
- ICC-ES Evaluation Report ESR-4708 – August 2022

E2 External Moisture	Alternative Solution – Comparison with Acceptable Solution E2/AS1 ▪ The generic cavity cladding system shown in E2/AS1 is comprised of three main components: a water-shedding surface, a drained cavity, and a weather-resistive barrier. ▪ The proposed systems constitute the weather-resistive barrier component and are intended for use in a rainscreen cladding approach. ▪ The systems were successfully tested for water penetration resistance to ASTM E331 Standard which is referenced in *AS/NZS 4284:2008 – Testing of building facades*. ▪ The systems were successfully tested to ASTM D2247 Standard for water resistance of coatings. ▪ DensDefy Liquid Flashing was successfully tested to AAMA 714 for water penetration around nails and water immersion and is the nominated product for both systems. DENSELEMENT BARRIER SYSTEM ▪ The sheathing boards are glass mat faced and impregnated with AquaKor™ Technology for a monolithic water repelling and vapour open barrier. ▪ The system was further tested to ASTM E331 with 3 different cladding support types. Water penetration resistance was successful under increasing static air pressure differential up to 900 Pa. These systems will meet the functional requirement of building code clause E2 and applicable performance requirement by preventing water reaching the internal framing. Limitations of use ▪ The cladding must not be directly fixed to the systems. This includes adhered veneer applications. ▪ The cavity between the systems and cladding should be no less than 20 mm, as per E2/AS details, to allow for drainage. ▪ Ventilation provisions must be included at the top and bottom of the cladding design to allow airflow and pressure minimisation behind the cladding. Supporting documentation ▪ DensElement Barrier System Testing Matrix - 2023 ▪ ICC-ES Evaluation Report ESR-3786 ▪ DensElement Barrier System Installation Guide - Rev. 6/23 ▪ GP DensElement Evaluation the Effectiveness of the DensElement Barrier Systems as the primary WRB in Rainscreen Assemblies ▪ GP DensElement Permeability and Performance in Water-Resistive Barriers (WRBs) ▪ Georgia-Pacific Gypsum Environmental Product Declaration ▪ DensDefy Liquid Barrier Testing Matrix – 07/21 ▪ ICC-ES Evaluation Report ESR-4708 – August 2022 ▪ DensDefy Liquid Barrier Installation Guide - 2023 ▪ DensDefy Liquid Flashing Product Data Sheet

6 ASSUMPTIONS AND LIMITATIONS

The compliance potential of each system set out in Section 5 of this report takes account of several assumptions regarding construction, quality assurance, and proper implementation of the design that would be expected. The following assumptions inform the compliance potential for this design:

- Products are installed in accordance with the manufacturer's instructions and are subject to limitations outlined therein. These must be read and implemented in conjunction with a project's site-specific design. The manufacturer, or their representative, will periodically review installation and quality assurance procedures by the applicator as required to ensure the product is installed correctly and will be suitable for warranty coverage.
- This assessment is solely based on the information provided in the preceding sections and in the attached supporting appendices. It is important to note this assessment should not be regarded as a comprehensive evaluation of the systems' suitability for a specific project.
- For project-specific applications, a façade engineer or other designated member of the design team should review this report to assess whether additional information is needed to ensure the systems' appropriateness for the specific project.
- Exterior wall design including, but not limited to, cladding attachments, control joints, material transition details, and window and door integration, are project specific and excluded from this evaluation.
- Systems are intended for use on vertical walls, or slanted walls with adequate drainage measures. They are not suitable for applications where water may pool or pond. This includes locations of through wall flashings.
- Refer to the material data sheets and manufacturer's instructions with respect to compatibility between materials. Where data is unavailable, the designer must seek technical advice from the manufacturer, or their representative, and perform compatibility and adhesion testing prior to full application.
- Although internal moisture is outside of the scope of this evaluation, we assume project specific design will include a mechanical strategy to manage internal moisture and heat loads to reduce the risk of condensation inboard of these barrier systems.

8 COMPLIANCE STATEMENT

Subject to project-specific design and installation per manufacturer recommendations, Oculus Limited is satisfied on reasonable grounds that the DensElement Barrier System and DensDefy Liquid Barrier System will meet the relevant provisions of the New Zealand Building Code.

Prepared by:

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Appendix a. ENCLOSURE SUPPORTING DOCUMENTS

DensElement Barrier System

- DensElement Barrier System Submittal Sheet
- DensElement Barrier System Technical Guide - 2023
- DensElement Barrier System Testing Matrix - 2023
- ICC-ES Evaluation Report ESR-3786 – January 2023
- DensElement Barrier System Installation Guide - Rev. 6/23
- GP DensElement Evaluation the Effectiveness of the DensElement Barrier Systems as the primary WRB in Rainscreen Assemblies
- GP DensElement Permeability and Performance in Water-Resistive Barriers (WRBs)
- Georgia-Pacific Gypsum Environmental Product Declaration
- DensElement Sheathing Repair Guide - 2023
- DensElement Barrier System Limited Warranty International

DensDefy Liquid Barrier System

- DensDefy Liquid Barrier Product Data Sheet - 2023
- DensDefy Liquid Barrier Technical Guide – 07/21
- DensDefy Liquid Barrier Testing Matrix – 07/21
- ICC-ES Evaluation Report ESR-4708 – August 2022
- DensDefy Liquid Barrier Installation Guide - 2023
- DensDefy Liquid Barrier Specifications
- DensDefy Liquid Barrier Limited Warranty

DensDefy Liquid Flashing

- DensDefy Liquid Flashing Product Data Sheet - 2023

DensDefy Transition Membrane

- DensDefy Transition Membrane Product Data Sheet - 2023

Georgia-Pacific

DensElement®

Barrier System

Technical Service Hotline 1.800.225.6119 or

www.gpgypsum.com

Manufacturer

Georgia-Pacific Gypsum
133 Peachtree Street
Atlanta, GA 30303

Technical Service Hotline: 1-800-225-6119

Description

DensElement® Barrier System serves as a water resistant barrier and air barrier when the sheathing joints, fasteners, penetrations, openings and transitions are properly sealed with an approved fluid applied flashing. The DensElement Barrier System consists of:

(a) DensElement® Sheathing made with a treated, water-resistant core, surfaced with fiberglass mats and a GOLD colored coating;
(b) DensDefy™ Liquid Flashing to treat fasteners, sheathing joints, penetration openings and transitions;
(c) Optional DensDefy™ Transition Membrane to treat transitions and rough openings.

DensElement Sheathing is mold resistant, and has scored a 10, the highest level of performance for mold resistance under ASTM D3273 test method.

DensElement Sheathing exhibits dimensional stability providing for a flat and rigid substrate that is noncombustible as defined and tested in accordance with ASTM E136 or CAN/ULC S114. DensElement Sheathing is generally the same strength in both directions, and it may be installed either parallel or perpendicular to wall framing members (always follow specific wall assembly installation instructions as described in the DensElement Barrier System Technical Brochure).

Primary Uses

The DensElement Barrier System is specified to be used as the exterior wall sheathing, the water resistive barrier, and the air barrier as required by building code when the panel joints, fasteners, penetrations, openings and transitions are properly sealed by an approved fluid applied flashing per the manufacturer's recommendations. The DensElement Barrier System can be used under a wide range of adhered, attached and rainscreen cladding systems. These include EIFS, cavity brick and claddings such as wood, vinyl, fiber cement, composite sidings and rainscreen claddings such as insulated metal panels.

The DensElement Barrier System eliminates the need for attached flexible membranes, fluid applied membranes or self-adhered membranes over the field of the sheathing that have typically served as the water resistive barrier and air barrier for building code compliance.

The DensElement Barrier System Sheathing is attached directly to wood or steel framing with recommended fasteners.

Limitations

The following recommendations and limitations are important to ensure the proper use and benefits of DensElement Barrier System. Failure to strictly adhere to such recommendations and limitations may void the limited warranty provided by GP Gypsum for such products. For details, please go to www.denselement.com/resources for warranty information.

DensElement Sheathing, fluid-applied flashing materials, and transition membranes are resistant to normal weather conditions. They are not intended for use as a cladding system, long-term outdoor exposure, for immersion in water, and cascading water from an unfinished roof or floor. Water should always be directed away from the DensElement Barrier System.

Avoid conditions that will create moisture in the air and condensation within the exterior walls. This is especially important during periods when the exterior and interior temperature differentials can create a condensation point within the exterior wall.

The use of forced air heaters creates volumes of water which, when not properly vented, can condense on building materials. The use of heaters and any resulting damage is not the responsibility of Georgia-Pacific Gypsum. Consult heater manufacturer for proper use and ventilation.

When DensElement Barrier System is used in slanted wall applications, protect the sheathing, sealed joints, treated fasteners, and openings from water ponding or settling on the assembly prior to cladding. Also, protect exposed wall ends such as those that may be found in parapets and openings to prevent water from entering the cavity.

Georgia-Pacific Gypsum does not warrant and is not responsible or liable for the performance of any cladding, or cladding system that is attached or adhered to the DensElement Barrier System. The compatibility of any cladding system is the responsibility of the cladding manufacturer or design authority.

Brackets to support heavy cladding such as tile, marble or stone, should be installed directly to the framing and not over the DensElement Sheathing.

Do not apply DensElement Sheathing to cementitious or masonry surfaces.

Do not attach cement board panels directly to DensElement Sheathing.

DensElement Barrier System is not intended for interior applications or as a substrate for adhered exterior tile, stone, or brick.

DensElement Barrier System should not be used in lieu of plywood or OSB where the physical properties of an wood structural panel is required.

Do not use DensElement Sheathing as a base for nailing or mechanical fastening. Fasteners shall be driven into framing and shall be flush with the face, not countersunk.

Do not apply DensElement Barrier System below grade.

Exterior wall design details including, but not limited to, cladding attachments, control joints, material transition details, window and door integration, per the project specification must be properly installed.

Joints, openings, transitions, and penetrations must be properly sealed, taped, or flashed. Failure to do so will void the warranty.

Not for use as a structural sealant.

Not for use in place of appropriate through-wall flashing.

Not for use below grade or in locations designed to be continuously immersed in water.

Technical Data

The DensElement Barrier System is a gypsum sheathing, water resistive barrier, and air barrier system when the joints, fasteners, penetrations, openings, and transitions are properly sealed with an approved fluid-applied flashing.

5/8″ (15.9mm) DensElement Sheathing gypsum panel is UL designation **Type DGG**.

DensElement Sheathing is noncombustible as described and tested in accordance with ASTM E136, UL 723, or CAN/ULC S114.

continued→

Submittal Approvals

Job Name _____

Contractor _____

Date _____

Stamps/Signatures

DensElement® Sheathing has a flame spread and smoke develop rating of 0/0 when tested in accordance with ASTM E84 or CAN/ULC S102.

DensElement Sheathing is manufactured to meet ASTM C1177.

DensElement Sheathing exceeds ASTM C1396 sheathing standards for humidified deflection by a factor of 10 in tests over the standard for regular gypsum sheathing.

DensElement Sheathing has a vapor permeance of >30 (wet cup), >20 (dry cup) for 5/8″ (15.9mm) tested in accordance with ASTM E96.

The DensElement® Barrier System was tested in accordance with applicable sections of ICC-ES Acceptance Criteria (AC) 212, Acceptance Criteria for Water-Resistive Coatings used as Water-Resistive Barriers over Exterior Sheathing, and applicable sections of AC 310, Acceptance Criteria For Water Resistive Membranes Factory Bonded To Wood Based Structural Sheathing.

The DensElement Barrier System was tested in accordance with ASTM E2178, Standard Test Method for Air Permeance of Building Materials, and ASTM E2357, Standard Test Method for Determining Air Leakage of Air Barrier Assemblies.

Handling and Use–WARNING

Refer to the SDS for instructions on safe handling and use of the product. The SDS can be found here: www.buildgp.com/denselement/resources/literature/

Product Data

See physical properties chart below. The DensElement Barrier System holds an ICC-ES Evaluation Report for use as both a water resistive barrier and air barrier. For a copy of the Evaluation Report see www.icc-es.org.

The following are approved flashing/transition accessories for the DensElement Barrier System:

DensDefy™ Liquid Flashing

DensDefy™ Transition Membrane

Physical Properties for DensElement® Sheathing

Properties	5/8″ (15.9 mm) DensElement® Sheathing
Width, nominal	4′ (1219 mm) + 0 – 1/8″ (3 mm)
Length, standard	8′ (2438 mm), 9′ (2743 mm), 10′ (3048 mm), ± 1/4″ (6 mm)
Weight, nominal, lbs./sq. ft. (Kg/m^2)	2.5 (12)
Edges	Square
Bending radius[5]	8′ (2438 mm)
Racking strength[6], lbs./ft. (dry) (N/m), Ultimate–not design value	>654 (9544)
Flexural strength[1,4], parallel, lbf. per Method B	≥100 (445)
Compressive strength	min. 500 psi (3445 kPa)
Humidified deflection[1, 4]	<1/8″ (3 mm)
Permeance[2], Perms (ng/Pa•s•m^2)	>30 (1696)
R Value[3], ft^2•°F•hr/BTU (m^2•K/W)	.67 (0.118)
Combustibility[7]	Noncombustible
Linear expansion with moisture change, in/in %RH (mm/mm %RH)[8]	6.25 x 10^{-6}
Surface burning characteristics per ASTM E84 or CAN/ULC S102: flame spread/smoke developed	0/0
Coefficient of thermal expansion, in/in/°F (mm/mm/°C)[9]	8.5 x 10^{-6} (15.3 x 10^{-6})

[1] Tested in accordance with ASTM C473
[2] Tested in accordance with ASTM E96 (wet cup method)
[3] Tested in accordance with ASTM C518 (heat flow meter)
[4] Specified values per ASTM C1177
[5] Double fasteners on ends as needed
[6] Tested in accordance with ASTM E72
[7] As defined and tested in accordance with ASTM E136, UL 723, or CAN/ULC S114
[8] As stated by Gypsum Association GA-235
[9] Tested in accordance with ASTM E228-85

Georgia-Pacific Gypsum

DISTRIBUTORS
U.S.A. GP Gypsum LLC
Canada Georgia-Pacific Canada LP

SALES INFORMATION AND ORDER PLACEMENT

U.S.A.	West:	**1-800-824-7503**
	Midwest:	**1-800-876-4746**
	South Central:	**1-800-231-6060**
	Southeast:	**1-800-327-2344**
	Northeast:	**1-800-947-4497**
CANADA	Canada Toll Free:	**1-800-387-6823**
	Quebec Toll Free:	**1-800-361-0486**

TECHNICAL INFORMATION
U.S.A. and Canada: **1-800-225-6119,** www.gpgypsum.com

WARRANTIES, REMEDIES AND TERMS OF SALE For current warranty information for this product, please go to www.buildgp.com/warranties. All sales of this product by Georgia-Pacific are subject to our Terms of Sale available at www.gpgypsum.com.

UPDATES AND CURRENT INFORMATION The information in this document may change without notice. Visit our website at www.gpgypsum.com for updates and current information.

CAUTION For product fire, safety and use information, go to www.buildgp.com/safetyinfo or call 1-800-225-6119.

FIRE SAFETY CAUTION Passing a fire test in a controlled laboratory setting and/or certifying or labeling a product as having a one-hour, two-hour, or any other fire resistance or protection rating and, therefore, as acceptable for use in certain fire rated assemblies/systems, does not mean that either a particular assembly/system incorporating the product, or any given piece of the product itself, will necessarily provide one-hour fire resistance, two-hour fire resistance, or any other specified fire resistance or protection in an actual fire. In the event of an actual fire, you should immediately take any and all actions necessary for your safety and the safety of others without regard for any fire rating of any product or assembly/system.

Georgia-Pacific
DensElement®
Barrier System

TECHNICAL GUIDE

DENSELEMENT® BARRIER SYSTEM

DensElement.com

Product Overview

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The Next Generation of Dens That Is a Water-Resistive Barrier and Air Barrier When Properly Sealed

The DensElement® Barrier System consists of DensElement® Sheathing and Georgia-Pacific's DensDefy® Liquid Flashing. When properly installed, and when the seams, joints, fasteners, penetrations, rough openings and material transitions are properly sealed with DensDefy Liquid Flashing, the DensElement Barrier System is a vapor-permeable water-resistive barrier and air barrier (WRB-AB). This system eliminates the expense of buying and installing building wrap, liquid or self-adhered membranes onto the surface of standard gypsum sheathing.

The DensElement Barrier System meets the WRB-AB requirements of the International Building Code (IBC), International Residential Code (IRC) and the International Energy Conservation Code (IECC).

It holds an ICC-ES ESR-3786 Evaluation Report as a WRB-AB, and has been evaluated as an air barrier by the Air Barrier Association of America (ABAA).

Advantage of Using DensElement Barrier System

DensElement Barrier System is a WRB-AB for use under a variety of claddings, rigid insulations, and Exterior Insulation and Finish Systems (EIFS) when seams, joints, fasteners, penetrations, rough openings and material transitions are properly sealed with DensDefy Liquid Flashing. DensElement Barrier System should be specified when fire resistance and a WRB-AB are required. By installing DensElement Barrier System, the integrated sheathing helps to reduce the time and expense of installing a traditional WRB-AB.

Product Overview continued

A Combination Sheathing, WRB-AB

DensElement® Sheathing's fiberglass mat facing and AquaKOR™ technology transform the entire gypsum sheathing into a WRB-AB by integrating the fiberglass mat and gypsum core to form a monolithic, hydrophobic surface that blocks bulk water but allows vapor to pass through. This enables water vapor to dissipate through the system rather than trapping it within the assembly. The bases of recognition for the DensElement® Barrier System to be used as a water-resistive barrier are IBC Section 104 and IRC Section R104 Alternative Materials to the water-resistive barrier requirement defined in IBC Section 1404 and IRC Section R703.

The DensElement Barrier System also serves as a continuous air barrier as prescribed in the IECC, Section C 402 air leakage, for both materials and assemblies provided the seams, joints, fasteners, penetrations, rough openings and material transitions are sealed with DensDefy® Liquid Flashing.

Fire Resistance/NFPA 285

5/8" (15.9 mm) DensElement Sheathing is noncombustible as tested in accordance with ASTM E 136 and CAN/ULC S114, is UL classified as Type DGG and is included in many UL and ULC assemblies. The DensElement Barrier System meets criteria set forth in ICC-ES Acceptance Criteria (AC) 212 for water-resistive barriers and is approved as a component in multiple NFPA 285 compliant assemblies. It has been used as a component in multiple NFPA 285 assemblies that hold an ICC-ES Evaluation Report, including brick, stucco, EIFS and other claddings.

Mold Resistance

When properly used with good design, handling and construction practices, Dens® gypsum products provide increased mold resistance compared to standard paper-faced wallboard. The mold resistance of any building product when used in actual jobsite conditions may not produce the same results achieved in the controlled, laboratory setting. No material can be considered mold proof. For additional information, go to BuildGP.com/SafetyInfo.

Standards and Code Compliance

DensElement Sheathing is manufactured to meet ASTM C 1177. Application standards for DensElement Sheathing, where applicable, are in accordance with Gypsum Association publication GA 253 for gypsum sheathing and ASTM C 1280.

DensElement Barrier System is compliant as a sheathing, and WRB-AB with the codes listed below as documented in ICC-ES ESR-3786 by meeting established WRB-AB acceptance criteria.

2009, 2012, 2015, 2018 IBC

2009, 2012, 2015, 2018 IRC

2009, 2012, 2015, 2018 IECC

2012, 2015, 2018 International Green Construction Code (IGCC)

2020 Florida Building Code – Building

2020 Florida Building Code – Residential

2019 California Building Code (CBC)

2019 California Residential Code (CRC)

2020 City of Los Angeles Building Code (LABC)

2020 City of Los Angeles Residential Building Code (LARC)

Architectural Specifications

A rewritable 3-part guide specifies copy for placement of the DensElement Barrier System in Section 061656 - Gypsum Sheathing - Integrated Vapor-permeable Water-resistive Barrier and Air-barrier or Section 072726 Water-resistive Barrier and Air-barrier Vapor-permeable Integrated Gypsum Sheathing, and downloadable copies of the DensElement Barrier System details may be found at BuildGP.com.

Physical Properties

Product Comparison	5/8" (15.9 mm) DensElement® Sheathing
Width, nominal[5]	4' (1219 mm) ± 3/32" (2.4 mm)
Length, standard[5]	8', 9', 10' (2438, 2743, 3048 mm) ± 1/4" (6 mm)
Weight[9] nominal, lbs./sq. ft. (Kg/m^2)	2.5 (12)
Bending radius (lengthwise)	8' (2438 mm)[6]
Racking strength,[7] lbs./ft. (dry) (N/m) (Ultimate – not design value)	>654 (9544)
Flexural strength,[2] parallel, lbf. (N) (4' weak direction)	≥100 (445)
Compressive strength	min. 500 psi (3445 kPa)
Humidified deflection[2,5]	<1/8" (3 mm)
Permeance,[3] US perms (grained/ft^2.hr.inHg)	>20 (dry cup) >30 (wet cup)
R Value[4], ft^2•°F•hr/BTU (m^2•K/W)	0.67 (0.118)
Combustibility[8]	Noncombustible
Linear expansion with moisture change in/in/%RH (mm/mm %RH)[10]	6.25 x 10^{-6}
Surface burning characteristics[1] flame spread/smoke developed	0/0
Coefficient of thermal expansion in/in/°F (mm/mm/°C)[11]	8.5 x 10^{-6} (15.3 x 10^{-6})

[1] Per ASTM E84 or CAN/ULC-S102
[2] Tested in accordance with ASTM C473
[3] Tested in accordance with ASTM E96
[4] Tested in accordance with ASTM C518 (heat flow meter)
[5] Specified values per ASTM C1177
[6] Double fasteners on ends as needed
[7] Tested in accordance with ASTM E72
[8] As defined and tested in accordance with ASTM E136 or CAN/ULC S114
[9] Approximate weight for design and shipping purposes. Actual weight may vary based on manufacturing location and other factors
[10] As stated by Gypsum Association GA-235
[11] Tested in accordance with ASTM E228-85

To meet the racking shear strength listed in the physical properties table, fastener spacing is 4" (102 mm) o.c. around the perimeter of each panel and 8" (203 mm) o.c. along vertical framing members.

Installing Exterior Wall Cladding over DensElement Barrier System

Conventional exterior claddings—including wood, vinyl, metal or cement composition, stone, brick, EIFS and rainscreen claddings—may be installed over the DensElement® Barrier System. For cladding that utilizes lath such as stucco or adhered masonry stone veneer, install a vapor-permeable water-resistive barrier that meets or exceeds the performance of one layer of #15 felt complying with ASTM D226, Type 1, or ASTM E2556, Type I or II. Consult the design professional for placement within the assembly and integration with flashing accessories to facilitate drainage.

Wall Applications

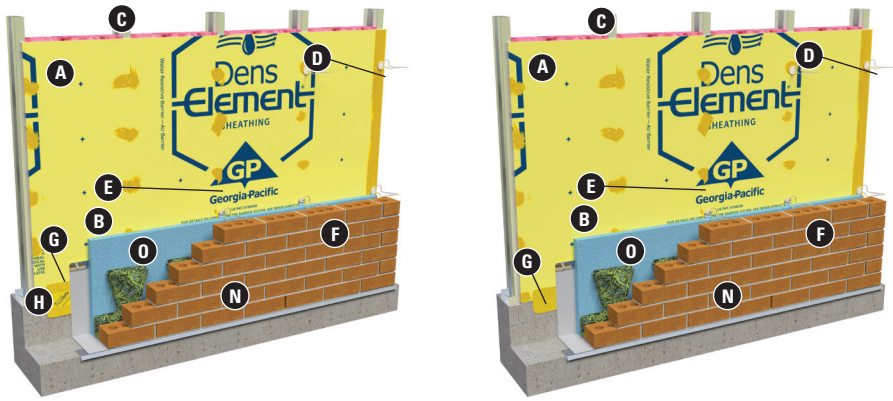
Cladding Installation over DensElement® Barrier System

A. DensElement Barrier System
B. Insulation
C. Framing Member
D. Brick Tie
E. 1" (25 mm) Min. Air space per local code
F. Brick
G. DensDefy® Liquid Flashing
H. DensDefy® Transition Membrane
I. Metal Cladding
J. Through-wall Flashing
K. Fiber Cement Cladding
L. Rainscreen Sub-Framing
M. Z-Furring Channels
N. Stainless Steel Drip Edge
O. Mortar Dropping Collection Device

Important: Illustrations not intended for design or specification purposes.

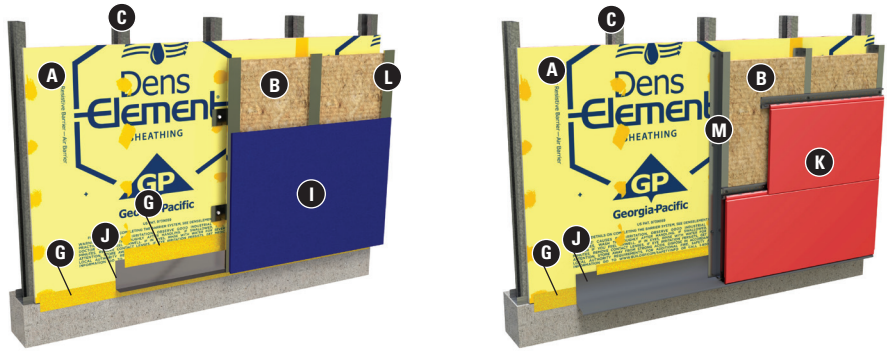
Brick Cavity Wall

Brick can be applied over DensElement® Barrier System just as it would over any other type of sheathing. Attach the masonry ties securely through DensElement Barrier System and into the steel or wood framing members. Space the ties as required by masonry courses. Ensure assembly is properly designed to facilitate drainage.



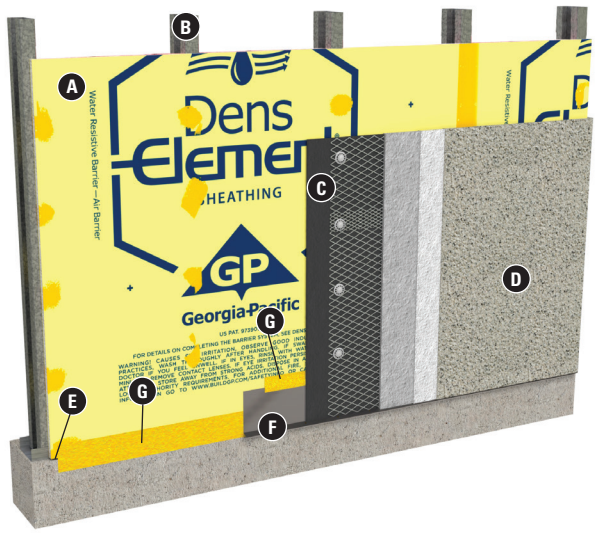
Rainscreen, Fiber Cement and Metal Panel

DensElement® Barrier System can be used in applications behind a variety of rainscreen assemblies. Attach the rainscreen subframing through the DensElement Barrier System and into the framing members. Ensure assembly is properly designed to facilitate drainage.



Wall Applications continued

A. DensElement® Barrier System
B. Framing
C. Min. #15 Felt Complying with ASTM D226, Type I and Lath
D. Conventional Stucco System
E. Minimum 1/4" (6 mm) Gap
F. Flashing and Weeps
G. DensDefy® Liquid Flashing



Conventional Stucco

Stucco systems may be applied over DensElement® Barrier System using one layer of #15 felt complying with ASTM D226 and metal lath. For best practice, system should be properly designed and installed to promote drainage. Lath must be mechanically attached through the DensElement Barrier System into the steel or wood framing. Install stucco system in accordance with the manufacturer's instructions and local building-code requirements. Ensure assembly is properly designed to facilitate drainage.

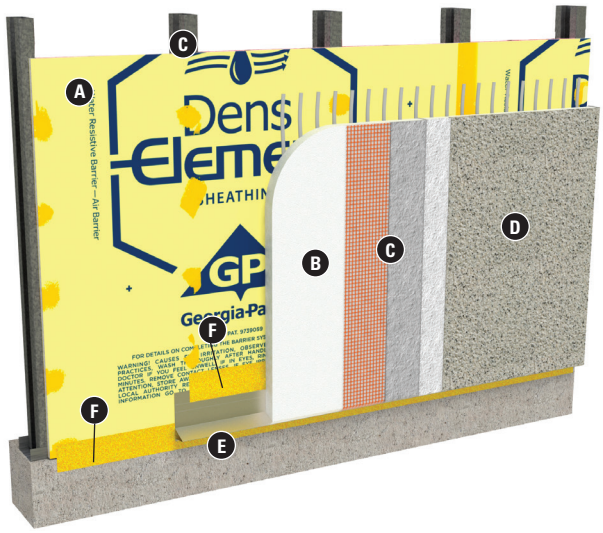
Exterior Insulation and Finish Systems (EIFS)

DensElement® Barrier System is an ideal substrate for EIFS applications.

- Eliminates the need for EIFS manufacturer's WRB-AB coatings.
- Maximum framing spacing 24" (610 mm) o.c. for 5/8" (15.9 mm) DensElement® Sheathing.

Ensure assembly is properly designed to facilitate drainage.

A. DensElement Barrier System
B. Insulation
C. Reinforcing Mesh Embedded in Base Coat
D. Finish Coat
E. Through-wall Flashing
F. DensDefy® Liquid Flashing



Fire-Rated Assemblies

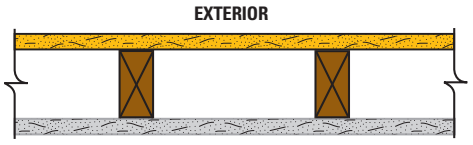
5/8" DensElement® Sheathing is listed in UL fire-rated assemblies under the **Type DGG** designation under Georgia-Pacific Gypsum LLC.

In addition, 5/8" DensElement Sheathing is certified as "Type X" in accordance with ASTM C1177 and may replace 5/8"gypsum sheathing specified as Type X in generic fire-rated wall assemblies. Generic systems in the GA-600 Fire Resistance Design Manual are applicable to the products of any manufacturer, including Georgia-Pacific Gypsum, provided they meet certain standards set forth in such manual, such as Type X gypsum board per applicable ASTM standard with specified thickness and size described in the design. "Type X" as used in this technical guide designates gypsum board manufactured and tested in accordance with specific ASTM standards for increased fire resistance beyond regular gypsum board. Please consult the ASTM standard for the specific product (for example, ASTM C1177 for glass mat gypsum substrate for use as sheathing) for further information and significance of use.

Proprietary GA-600 Designs: Assemblies listed as proprietary in the GA-600 Fire Resistance Design Manual only list one product per manufacturer and may not include all products referenced in the illustrations below. Please consult the specified UL, ULC, cUL or other fire listing or test for a complete list of approved products.

The following designs are for fire rating only. For DensElement® Barrier System WRB-AB performance, the exterior wall joints will need to be flashed as described in this guide. For additional fire safety information concerning DensElement Sheathing, visit BuildGP.com/SafetyInfo.

1-Hour Fire Rating
Design Reference: UL U305, U337, GA WP 8130



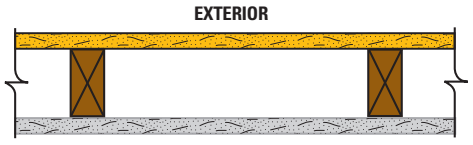
Wall Thickness: 4-3/4" (121 mm)

Weight Per Sq. Ft.: 5.5 psf (27 Kg/m^2)

Exterior: 5/8" (15.9 mm) DensElement Sheathing applied vertically (U337, U305) or horizontally (U305) to 2" (51 mm) x 4" (102 mm) wood studs 16" (406 mm) o.c. with 1-3/4" (45 mm) galvanized roofing nails 7" (178 mm) o.c. for all framing members. Exterior surface covered with weather-exposed cladding or finish system.

Interior: 5/8" (15.9 mm) DensArmor Plus® Fireguard® interior panels or 5/8" (15.9 mm) ToughRock® Fireguard X® gypsum board applied vertically (U337, U305) or horizontally (U305) to studs with 1-7/8" (48 mm) 6d coated nails 7" (178 mm) o.c. Stagger joints on each side.

1-Hour Fire Rating
Design Reference: UL U309, UL U314, GA WP 8105



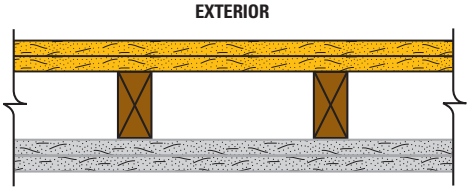
Wall Thickness: 4-3/4" (121 mm)

Weight Per Sq. Ft.: 6.0 psf (29 Kg/m^2)

Exterior: 5/8" (15.9 mm) DensElement Sheathing applied vertically or horizontally to 2" (51 mm) x 4" (102 mm) wood studs spaced 24" (610 mm) o.c. with 1-3/4" (45 mm) galvanized roofing nails 7" (178 mm) o.c.

Interior: 5/8" (15.9 mm) DensArmor Plus Fireguard interior panels or 5/8" (15.9 mm) ToughRock Fireguard X gypsum board applied vertically or horizontally to framing with 1-7/8" (48 mm) 6d coated nails 7" (178 mm) o.c.

2-Hour Fire Rating
Design Reference: UL U301, GA WP 8416



Wall Thickness: 6-1/8" (156 mm)

Weight Per Sq. Ft.: 9.4 psf (46 Kg/m^2)

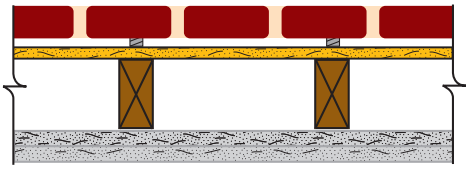
Exterior: Two layers 5/8" (15.9 mm) DensElement Sheathing applied vertically or horizontally to 2" (51 mm) x 4" (102 mm) wood studs 16" (406 mm) o.c. Base layer attached with 1-7/8" (48 mm) galvanized roofing nails 6" (152 mm) o.c. Face layer attached with 2-3/8" (60 mm) galvanized roofing nails 8" (203 mm) o.c. Stagger joints between layers and on base layer of both sides.

Interior: Two layers 5/8" (15.9 mm) DensArmor Plus Fireguard interior panels or 5/8" (15.9 mm) ToughRock Fireguard X gypsum board applied horizontally or vertically to framing. Base layer attached with 1-7/8" (48 mm) 6d cement coated nails 6" (152 mm) o.c. Face layer attached with 2-3/8" (60 mm) 6d cement coated nails 8" (203 mm) o.c. Stagger joints between layers and on base layer of both sides. Sound tested with studs 16" (406 mm) o.c. and nails for base layer spaced 6" (152 mm) o.c.

Fire-Rated Assemblies continued

2-Hour Fire Rating
Design Reference: UL U302, GA WP 8187

EXTERIOR (LOAD-BEARING)



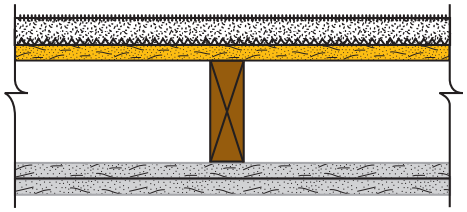
Wall Thickness: 10-1/2" (267 mm)

Exterior: One layer 5/8" (15.9 mm) DensElement® Sheathing applied vertically or horizontally to studs 16" (406 mm) o.c. with 1-3/4" (45 mm) galvanized roofing nails 6" (152 mm) o.c. Face layer is 2" (51 mm) x 4" (102 mm) x 8" (51 mm x 102 mm x 203 mm) clay brick with 1" (25 mm) air space between brick and exterior sheathing. 20-gauge (30 mils) galvanized wire ties attached to each stud with 8d coated nails 2-3/8" (60 mm) as described above, located at every sixth course of bricks.

Interior: Two layers 5/8" (15.9 mm) DensArmor Plus® Fireguard X® interior panels or 5/8" (15.9 mm) ToughRock® Fireguard X® gypsum board applied vertically or horizontally to 2" (51 mm) x 4" (102 mm) wood studs 16" (406 mm) o.c. Base layer attached with 1-7/8" (48 mm) 6d coated nails 8" (203 mm) o.c. Face layer attached with 2-3/8" (60 mm) coated nails 8" (203 mm) o.c.

Generic 2-Hour Fire Rating
Design Reference: GA WP 8192

FIRE SIDE (LOAD-BEARING)



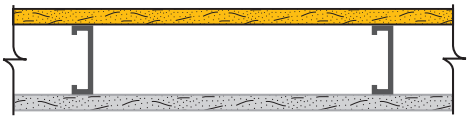
Wall Thickness: 8-5/8" (219 mm)

Exterior: Base layer 5/8" (15.9 mm) DensElement Sheathing retardant treated 2" (51 mm) x 6" (152 mm) wood studs 16" (406 mm) o.c. with 6d coated nails, 1-7/8" (48 mm) long, 0.0915" (2 mm) shank, 1/4" (6 mm) heads, 12" (305 mm) o.c. and covered with a single-layer fire-resistant protective weather retarder paper stapled along each edge at 16" (406 mm) o.c. Galvanized self-furring wire mesh applied over sheathing with 8d galvanized roofing nails, 2-3/8" (60 mm) long, 0.113" (3 mm) shank, 9/32" (7 mm) heads, 6" (152 mm) o.c. Cement stucco applied over wire mesh in two 1/2" (12.7 mm) thick coats with bonding agent applied between coats.

Interior: Base layer 5/8" (15.9 mm) DensArmor Plus Fireguard X® interior panels or 5/8" (15.9 mm) ToughRock Fireguard X gypsum board applied vertically to studs with 6d coated nails, 1-7/8" (48 mm) long, 0.0915" (2 mm) shank, 1/4" (6 mm) heads, 12" (305 mm) o.c. Face layer 5/8" (15.9 mm) DensArmor Plus Fireguard X® interior panels or 5/8" (15.9 mm) ToughRock Fireguard X gypsum board applied horizontally to studs with 8d coated nails, 2-3/8" (60 mm) long, 0.113" (3 mm) shank, 9/32" (7 mm) heads, 8" (203 mm) o.c. at edges and 12" (305 mm) o.c. at intermediate studs.

1-Hour Fire Rating
Design Reference: UL U465, GA WP 8007

EXTERIOR (NON-LOAD-BEARING)



Wall Thickness: 4-7/8" (124 mm)

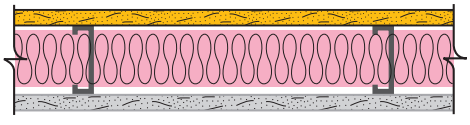
Weight Per Sq. Ft.: 4.6 psf (19 Kg/m^2)

Exterior: 5/8" (15.9 mm) DensElement Sheathing applied vertically or horizontally to min. 3-5/8" (92 mm) corrosion-resistant, 25-gauge (18 mils) steel studs 24" (610 mm) o.c. with 1" Type S Screw corrosion-resistant bugle head screws 8" (203 mm) o.c. at vertical studs and 12" (305 mm) at floor and ceiling runners.

Interior: 5/8" (15.9 mm) DensArmor Plus Fireguard X® interior panels or 5/8" (15.9 mm) ToughRock Fireguard X gypsum board applied vertically to framing with 1" (25 mm) Type S bugle head screws 8" (203 mm) o.c. at board edges and 8" (203 mm) at intermediate studs and 12" (305 mm) at floor and ceiling runners.

1-Hour Fire Rating
Design Reference: UL U425, GA WP 8006

EXTERIOR (LOAD-BEARING)



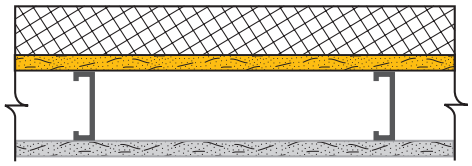
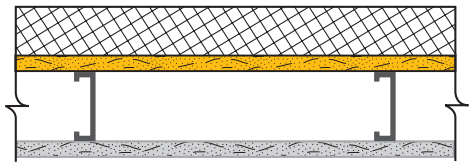
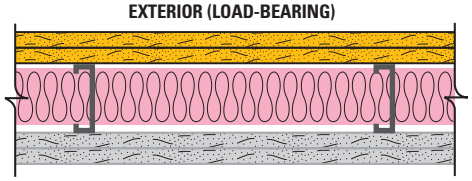
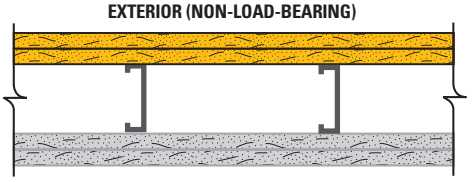
Wall Thickness: 4-3/4" (121 mm)

Weight Per Sq. Ft.: 5 psf (19 Kg/m^2)

Exterior: 5/8" (15.9 mm) DensElement Sheathing applied vertically to min. 3-1/2" (89 mm) corrosion-resistant 25-gauge (33 mils) steel studs 24" (610 mm) o.c. with 1" (25 mm) Type S-12 corrosion-resistant bugle head screws 12" (305 mm) o.c.

Interior: 5/8" (15.9 mm) DensArmor Plus Fireguard X® interior panels or 5/8" (15.9 mm) ToughRock Fireguard X gypsum board applied vertically to framing with 1" (25 mm) Type S-12 bugle head screws 12" (305 mm) o.c. Insulation to completely fill stud cavity.

Fire-Rated Assemblies continued

1-Hour Fire Rating Design Reference: GA WP 8122 **EXTERIOR (NON-LOAD-BEARING)** 	Partition Thickness: 6" – 7" (152 – 178 mm) Varies based on insulation thickness Weight Per Sq. Ft.: 7.0 psf (34 Kg/m^2) Exterior: 5/8" (15.9 mm) DensElement® Sheathing applied vertically to 3-5/8" (92 mm) 18-gauge (43 mils) steel studs 16" (406 mm) o.c. with #6 x 1-1/4" (32 mm) self-drilling, corrosion-resistant, bugle head drywall screws 8" (203 mm) o.c. at edges and ends and 12" (305 mm) o.c. at intermediate studs. Proprietary polymer modified exterior insulation and finish system applied over sheathing. 2" (51 mm) maximum foam-on-plastic thickness. Interior: 5/8" (15.9 mm) ToughRock® Fireguard X® gypsum board or 5/8" (15.9 mm) DensArmor Plus® Fireguard X® interior panels applied vertically to studs with #6 x 1-1/4" (32 mm) self-drilling bugle head drywall screws 8" (203 mm) o.c. at edges and ends and 12" (305 mm) o.c. at intermediate studs.
1-Hour Fire Rating Design Reference: GA WP 8123 **EXTERIOR (NON-LOAD-BEARING)** 	Partition Thickness: 6" – 9" (152 – 229 mm) Varies based on insulation thickness Weight Per Sq. Ft.: 7.0 psf (34 Kg/m^2) Exterior: 5/8" (15.9 mm) DensElement Sheathing applied vertically to 3-5/8" (92 mm) 18-gauge (43 mils) steel studs 24" (610 mm) o.c. with #6 x 1-1/4" (32 mm) self-drilling, corrosion-resistant bugle head drywall screws 8" (203 mm) o.c. at edges and ends and 12" (305 mm) o.c. at intermediate studs. Polymer-based exterior insulation and finish system applied over sheathing. 4" (102 mm) maximum foam-on-plastic thickness. Interior: One layer 5/8" (15.9 mm) ToughRock Fireguard X gypsum board or 5/8" (15.9 mm) DensArmor Plus Fireguard X® interior panels applied vertically to studs with #6 x 1-1/4" (32 mm) self-drilling bugle head drywall screws 8" (203 mm) o.c. at edges and ends and 12" (305 mm) o.c. at intermediate studs.
2-Hour Fire Rating Design Reference: UL U425, GA WP 8203 **EXTERIOR (LOAD-BEARING)** 	Wall Thickness: 6" (152 mm) Weight Per Sq. Ft.: 10 psf (49 Kg/m^2) For two layers of exterior sheathing, the inside layer can be either 5/8" DensGlass® Fireguard® Sheathing or DensElement Sheathing. Exterior: Two layers 5/8" (15.9 mm) DensElement Sheathing applied vertically to min. 3-1/2" (89 mm) corrosion-resistant, 20-gauge (30 mils) steel studs 24" (610 mm) o.c. Base layer attached with 1" (25 mm) Type S-12 corrosion-resistant bugle head screws 12" (305 mm) o.c. Face layer attached with 1-5/8" (41 mm) Type S-12 corrosion-resistant bugle head screws spaced 12" (305 mm) o.c. Joints staggered. Interior: Two layers 5/8" (15.9 mm) DensArmor Plus Fireguard interior panels or 5/8" (15.9 mm) ToughRock Fireguard X gypsum board applied vertically to framing. Base layer attached with 1" (25 mm) Type S-12 bugle head screws 12" (305 mm) o.c. Face layer attached with 1-5/8" (41 mm) Type S-12 bugle head screws spaced 12" (305 mm) o.c. Joints staggered. Insulation to completely fill stud cavity. (Load bearing: 80% of design load.)
2-Hour Fire Rating Design Reference: UL U411, V487 **EXTERIOR (NON-LOAD-BEARING)** 	Wall Thickness: 6 1/8" (156 mm) Weight Per Sq. Ft.: 9 psf (44 Kg/m^2) For two layers of exterior sheathing, the inside layer can be either 5/8" DensGlass Fireguard Sheathing or DensElement Sheathing. Exterior: Two layers 5/8" (15.9 mm) DensElement Sheathing applied vertically to min. 2-1/2" (64 mm) corrosion-resistant, 25-gauge (18 mils) steel studs 24" (610 mm) o.c. Base layer attached with 1" (25 mm) Type S corrosion-resistant bugle head screws 16" (406 mm) o.c. Face layer attached with 1-5/8" (41 mm) Type S corrosion-resistant bugle head screws spaced 8" (203 mm) o.c. Joints staggered. Interior: Two layers 5/8" (15.9 mm) DensArmor Plus Fireguard X® interior panels or 5/8" (15.9 mm) ToughRock Fireguard X gypsum board applied vertically to framing. Base layer attached with 1" (25 mm) Type S bugle head screws 16" (406 mm) o.c. Face layer attached with 1-5/8" (41 mm) Type S bugle head screws spaced 16" (406 mm) o.c. in the field and along vertical edges and 12" (305 mm) o.c. to the floor and ceiling runners. Joints staggered. Batt or blanket insulation optional.

Delivery, Handling and Storage

All DensElement® Barrier System materials shall be delivered in their original bundles or packaging. The plastic packaging used to wrap gypsum sheathing products for rail and/or truck shipment is intended to provide temporary protection from moisture exposure during transit only and is not intended to provide protection during storage after delivery. Such plastic packaging shall be removed immediately upon receipt of the shipment. Failure to remove protective plastic shipping covers can result in condensation, which can lead to damage.

All DensElement Barrier System materials should be kept dry during storage and upon delivery. DensElement® Sheathing shall be neatly stacked flat with care taken to prevent sagging or damage to edges, ends and surfaces. DensElement Sheathing shall be properly supported on risers on a level platform, and fully protected from weather, direct sunlight exposure, dirt and mud, and condensation. DensElement Sheathing shall be stacked flat rather than on edge or end.

Protect the DensDefy® Liquid Flashing and DensDefy® Transition Membrane material from damage, weather, excessive temperatures and construction traffic.

Store the DensDefy Liquid Flashing and DensDefy Transition Membrane material at temperatures of 40 degrees Fahrenheit or above in dry conditions.

Refer to Handling Gypsum Panel Products, GA-801, for proper storage and handling requirements of DensElement Sheathing.

Recommendations and Limitations for Use

The following recommendations and limitations are important to ensure the proper use and benefits of DensElement® Barrier System. Failure to strictly adhere to such recommendations and limitations may void the limited warranty provided by GP Gypsum for such products. For details, please go to BuildGP.com/DensElement/Resources/Literature and click on the warranty tab.

DensElement® Sheathing, DensDefy® Liquid Flashing and DensDefy® Transition Membranes are resistant to normal weather conditions. They are not intended for use as a cladding system, long-term outdoor exposure, for immersion in water, and cascading water from an unfinished roof or floor. Water should always be directed away from the DensElement Barrier System.

DensElement Barrier System is intended for use in vertical wall applications. When used at slanted wall conditions, ensure the wall is adequately sloped to prevent water from pooling or ponding on the system and proper drainage is achieved. DensElement Barrier System should not be used in roof applications. For roof applications, consult our DensDeck® Roof Board literature.

Avoid conditions that will create moisture in the air and condensation within the exterior walls. This is especially important during periods when the exterior and interior temperature differentials can create a condensation point within the exterior wall. The use of forced-air heaters creates volumes of water which, when not properly vented, can condense on building materials. The use of heaters and any resulting damage is not the responsibility of Georgia-Pacific Gypsum. Consult heater manufacturer for proper use and ventilation.

Georgia-Pacific Gypsum does not warrant and is not responsible or liable for the performance of any cladding or cladding system that is attached or adhered to the DensElement Barrier System. The compatibility of any cladding system is the responsibility of the cladding manufacturer or design authority.

Brackets to support heavy cladding such as tile, marble or stone should be installed directly to the framing and not over the DensElement Sheathing.

Do not apply DensElement Sheathing to cementitious or masonry surfaces. Do not attach cement board panels directly to DensElement Sheathing.

DensElement Barrier System is not intended for interior applications or as a substrate for adhered exterior tile, stone or brick.

DensElement Barrier System should not be used in lieu of plywood or OSB where the physical properties of a wood structural panel are required.

Do not use DensElement Sheathing as a base for nailing or mechanical fastening. Fasteners shall be driven into framing and shall be flush with the face, not countersunk.

Application temperature is above 25°F (-4°C) and rising. Do not apply DensElement Barrier System below grade.

Exterior wall design details, including, but not limited to, cladding attachments, control joints, material transition details, and window and door integration, per the project specification, must be properly installed.

Seams, joints, rough openings, transitions and penetrations must be properly sealed, taped or flashed. Failure to do so will void the warranty.

Protect exposed wall ends, such as those that may be found in parapets and rough openings to prevent water from entering the cavity.

Recommendations and Limitations for Use continued

DensDefy® Liquid Flashing is not for use as a structural sealant.

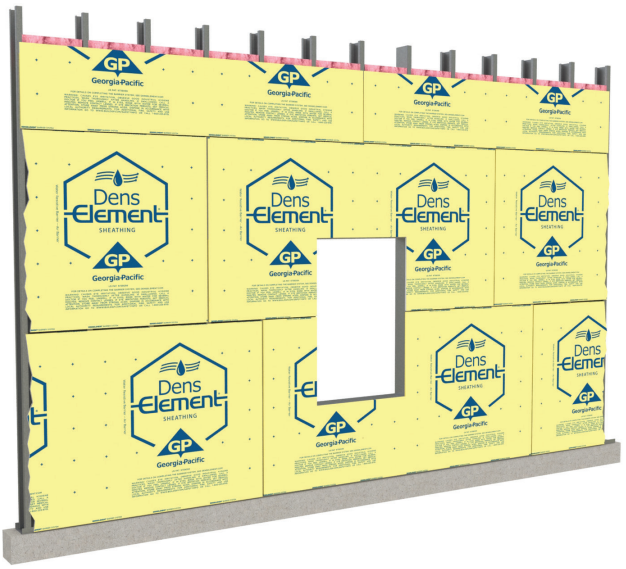
DensDefy Liquid Flashing and DensDefy® Transition Membrane are not for use in place of appropriate through-wall flashing.

NOTE: Joints between DensElement® Panels in fire-rated assemblies must be constructed with the edges and ends in “moderate contact." Small gaps may exist along the joint due to the allowable width tolerance of sheathing stated in ASTM C1177.

Exterior Wall Installation Instructions

DensElement® Sheathing must be installed in accordance with the instructions in this technical guide and Gypsum Association publication GA-253 and ASTM C1280. DensElement Sheathing can be installed parallel or perpendicular to wood or metal framing. Use appropriate board orientations for specific fire assemblies and shear wall applications as defined within this document, other reference documents or as required by the design authority. The framing width shall not be less than 1½” (38 mm) wide for wood framing and 1¼” (32 mm) for steel framing. Framing members shall not vary more than 1/8” (3 mm) from the plane of the faces of adjacent framing. Fasteners shall be driven flush with the panel surface (not countersunk) and into the framing. Locate perimeter fasteners at least 3/8” (9 mm) from the ends and edges of the panel. Nails or screws, as listed in the fastener chart, may be used to attach DensElement Sheathing to framing. DensElement Sheathing is not to be used as a base for nailing or other fastening.

Install DensElement Sheathing with end joints staggered on horizontal applications and vertical applications (when applicable). Ends and edges of the DensElement Sheathing should fit tightly (less than 1/8”). DensElement shall not be less than 8” (178 mm) from the finish grade in weather-protected siding systems, and not less than 12" (305 mm) from the ground for properly drained crawl spaces. Consult with design authority for control joint recommendations.



Fastening and Framing

Thickness	Framing Spacing	Panel Orientation	Fastener Spacing – Wood Framing[1]	Fastener Spacing – Metal Framing[1]
5/8" (15.9 mm)	24" (610 mm) o.c. max[2]	Parallel[2] or perpendicular	8" (203 mm) o.c. field[3] & perimeter	8" (203 mm) o.c. along framing

[1] Fire-rated assemblies may require additional fasteners; see specific assembly details.

[2] For racking strength resistance, apply panel edges parallel with framing spaced a maximum of 16" (406 mm) on center (o.c.) for 5/8" (15.9 mm) DensElement® Barrier System.

[3] Fastener spacing around the perimeter of the wall and along intermediate vertical framing members.

Fastener*	Type	Length 5/8" (15.9 mm) Thick Sheathing	Description	Application
	Type S-12	1-1/4" (32 mm)	Bugle-head, fine-thread, corrosion-resistant, drill-point drywall screw	DensElement® Sheathing to heavy-gauge metal framing (18 gauge or thicker)
	Type S	1-1/4" (32 mm)	Bugle-head, fine-thread, corrosion-resistant, sharp-point drywall screw	DensElement Sheathing to light-gauge metal framing furring (20-25 gauge)
	Type W	1-5/8" (41 mm)	Bugle-head, rust-resistant, coarse-thread, sharp-point drywall screw	DensElement Sheathing to wood framing
	Type W, S, and S-12	1-1/4" (32 mm) metal 1-5/8" (41 mm) wood	Wafer-head, corrosion-resistant screws, drill or sharp point	DensElement Sheathing to heavy-gauge or light-gauge, metal or wood framing
	ASTM C514 and 12 gauge	1-3/4" (45 mm)	11-gauge, galvanized nail	DensElement Sheathing to wood framing
	16 gauge galvanized staples	1-5/8" (41 mm)	No. 16 gauge, flattened, galvanized, divergent-point wire staples with not less than a 7/16" (11mm) wide crown outside measure.	DensElement Sheathing to wood framing

**For screws, meet or exceed ASTM C1002 or C954. Contact fastener manufacturer for correct amount of corrosion resistance.*

Negative Uniform Wind Load

5/8" (15.9 mm) DensElement Sheathing Vertically or Horizontally Applied

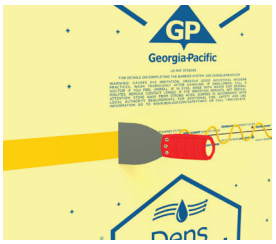
Sheathing Thickness in. (mm)	Framing Spacing in. (mm)	Screw Spacing in. (mm)	Board Orientation	Ultimate Load PSF* (kPa)	Test Report
5/8 (15.9)	16 (406)	8 (203)	Horizontal	131 (6.3)	ITS #F7036.01-550-44
5/8 (15.9)	16 (406)	6 (152)	Horizontal	170 (8.2)	ITS #F7036.01-550-44
5/8 (15.9)	16 (406)	4 (102)	Horizontal	212 (10.1)	ITS #F7036.01-550-44
5/8 (15.9)	12 (305)	8 (203)	Horizontal	158 (7.6)	ITS #F7036.01-550-44
5/8 (15.9)	12 (305)	6 (152)	Horizontal	212 (10.1)	ITS #F7036.01-550-44
5/8 (15.9)	12 (305)	4 (102)	Horizontal	315 (15.1)	ITS #F7036.01-550-44
5/8 (15.9)	8 (203)	8 (203)	Horizontal	193 (9.2)	ITS #F7036.01-550-44
5/8 (15.9)	8 (203)	6 (152)	Horizontal	261 (12.5)	ITS #F7036.01-550-44
5/8 (15.9)	8 (203)	4 (102)	Horizontal	375 (17.9)	ITS #F7036.01-550-44
5/8 (15.9)	24 (610)	8 (203)	Vertical	69 (3.3)	TPI #89-047
5/8 (15.9)	24 (610)	8 (203)	Horizontal	85 (4.1)	TPI #89-047
5/8 (15.9)	16 (406)	8 (203)	Vertical	96 (4.6)	TPI #89-047

**Apply appropriate safety factor from the design method used to calculate design load.*

Components and Installation Instructions

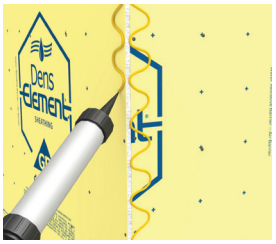
Panel Seams, Vertical Corners, Fasteners and Transitions for WRB-AB Compliance Using DensDefy® Liquid Flashing, Rough Openings and Penetrations.

Panel Seams



1. Apply DensDefy Liquid Flashing over the DensElement® Sheathing joint in a zigzag or ribbon pattern.
2. With a straight-edge tool, spread evenly over the sheathing seam.
3. Apply at a rate to achieve a minimum thickness of 16 wet mils over the entire joint area, leaving no exposed sheathing. Cover a minimum of 1 in. on both sides of the seam.

Vertical Corners

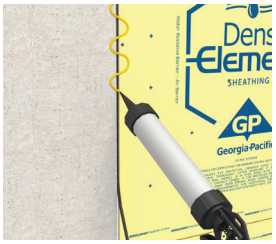


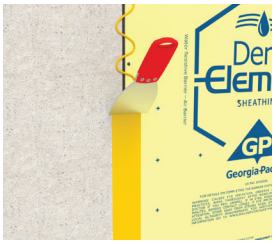
1. Apply DensDefy Liquid Flashing over the inside and/or outside corner in a zigzag or ribbon pattern.
2. With a straight-edge tool, spread evenly over the sheathing corner.
3. Apply at a rate to achieve a minimum thickness of 16 wet mils over the corner area. Cover a minimum of 2 in. on both sides of the corner.

Fasteners

1. The fasteners should be spotted with DensDefy Liquid Flashing and wiped down with a straight-edge tool, leaving a minimum thickness of 16 wet mils over the entire fastener.

Material Transitions With DensDefy Liquid Flashing





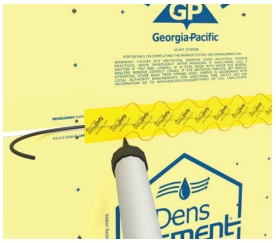
1. If the gap between materials is over 1/4 in., fill the gap between the DensElement Sheathing and adjacent materials with a backer rod.
2. Apply DensDefy Liquid Flashing over the DensElement Sheathing and adjacent material in a zigzag or ribbon pattern.
3. Using a straight-edge tool, spread DensDefy Liquid Flashing over material transition joint.
4. Apply at a rate to achieve a minimum thickness of 16 wet mils. Ensure the flashing is applied a minimum of 2 in. on each substrate material surface.

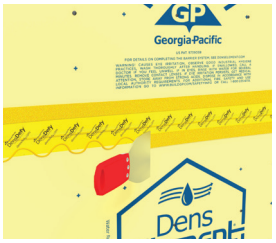
Components and Installation Instructions continued

Material Transitions With DensDefy® Transition Membrane

1. Choose the appropriate DensDefy Transition Membrane width to achieve a minimum 2 in. (50 mm) overlap on both sides of the transition. Pre-cut manageable lengths and place over the center of the transition area. Note: At corners or changes in plane, creasing the membrane prior to placement can help align the membrane.
2. Remove release paper from the DensDefy Transition Membrane and press in place following the contour of the substrate, avoiding wrinkles and fishmouths.
3. Use a J-roller to apply even pressure to fully adhere the membrane and achieve a smooth and wrinkle-free surface.
4. Terminate all DensDefy Transition Membrane edges with a counter flash of DensDefy® Liquid Flashing, ensuring liquid flashing covers membrane and adjacent material, leaving no exposed membrane edges.

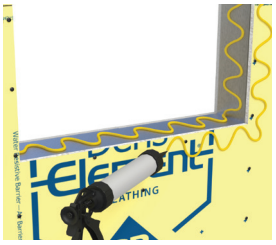
Transitions at Floor Line Conditions or Vertical/Horizontal Expansion Joints

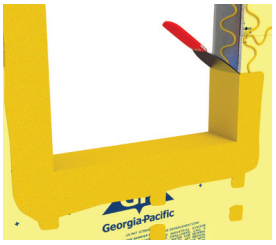




1. For gaps greater than ¼" and less than 1", place pre-cut lengths over the center of the transition area. Loop the membrane in a concave or convex fashion to accommodate potential movement. Use bond-breaker material to ensure membrane does not adhere to surfaces inside the expansion joint. Maintain a minimum 2" (50 mm) overlap on both sides of the joint.
2. Use a J-roller to apply even pressure to fully adhere the membrane and achieve a smooth and wrinkle-free surface.
3. Terminate all DensDefy Transition Membrane edges with a counter flash of DensDefy Liquid Flashing, ensuring liquid flashing covers membrane and adjacent material, leaving no exposed membrane edges.

Rough Openings With DensDefy® Liquid Flashing

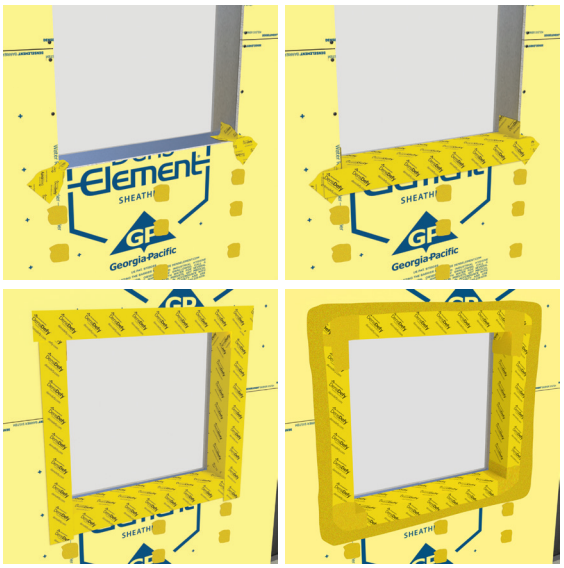




1. Rasp any jagged or uneven DensElement® Sheathing edges and clean framing free of debris and dust or other bond-inhibiting materials. Note: For treated lumber, clean with an isopropyl alcohol wipe and allow to flash off prior to application of DensDefy Liquid Flashing.
2. Apply a bead of DensDefy Liquid Flashing into the entire width of the inside corners of the opening.
3. Apply DensDefy Liquid Flashing over the entire width of the opening sill, jamb and header in a zigzag or ribbon pattern.
4. Apply DensDefy Liquid Flashing over the DensElement Sheathing adjacent to the opening sill, jamb and header in a zigzag or ribbon pattern.
5. With a straight-edge tool, spread DensDefy Liquid Flashing over the entire width of the sill, jamb, header and DensElement Sheathing surface adjacent to the opening.
6. Apply at a rate to achieve a minimum thickness of 16 wet mils over the opening area, leaving no exposed sheathing. Cover a minimum of 2 in. of the sheathing surface adjacent to the opening.

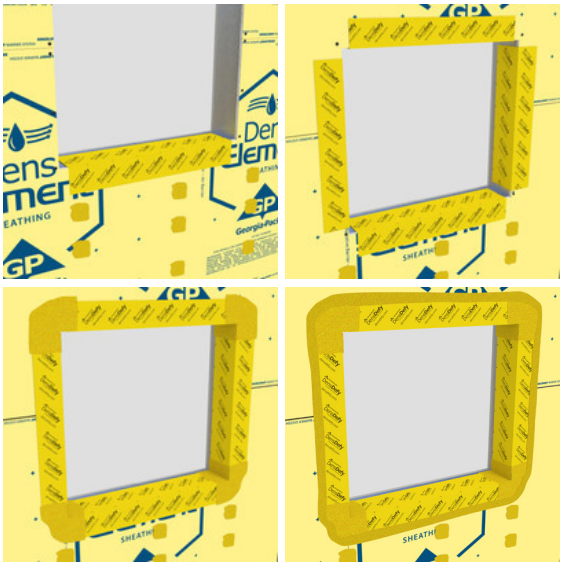
Components and Installation Instructions continue

Rough Openings With DensDefy® Transition Membrane



1. Apply corner reinforcement pieces or "bow ties" at rough opening corners.
2. Choose appropriate DensDefy Transition Membrane widths to achieve a minimum 2 in. (50 mm) overlap on both sides of the transition. Pre-cut manageable lengths. Note: At corners or changes in plane, creasing the membrane prior to placement can help align the membrane.
3. Remove release paper from the DensDefy Transition Membrane and press in place following the contour of the substrate, avoiding wrinkles and fishmouths.
4. Apply pre-cut lengths along rough opening header. Overlap, in a shingle lap fashion, a minimum 2" (50 mm) onto jamb protection.
5. Use a J-roller to apply even pressure to fully adhere the membrane and achieve a smooth and wrinkle-free surface.
6. Terminate all DensDefy Transition Membrane edges with a counter flash of DensDefy® Liquid Flashing, ensuring liquid flashing covers membrane and adjacent material, leaving no exposed membrane edges.

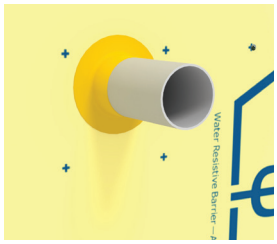
Rough Openings With Combination Method



1. Choose appropriate DensDefy Transition Membrane widths to achieve a minimum 2 in. (50 mm) overlap on both sides of the transition. Pre-cut manageable lengths for handling. Note: At corners or changes in plane, creasing the membrane prior to placement can help align the membrane.
2. Remove release paper from the DensDefy Transition Membrane and press in place following the contour of the substrate, avoiding wrinkles and fishmouths.
3. Apply pre-cut lengths of DensDefy Transition Membrane to sill, jambs and header, keeping membrane 1 - 2 in. from rough opening corners. Cover a minimum of 2 in. of the sheathing adjacent to the opening.
4. Use a J-roller to apply even pressure to fully adhere the membrane and achieve a smooth and wrinkle-free surface.
5. Apply DensDefy Liquid Flashing to all rough opening corners, overlapping the membrane edges by at least 1 in.
6. Terminate all DensDefy Transition Membrane edges with a counter flash of DensDefy Liquid Flashing, ensuring liquid flashing covers membrane and adjacent material, leaving no exposed membrane edges.

Components and Installation Instructions continued

Pipe Penetrations



1. Mechanically secure penetrations. Penetrations should be rigid and secured mechanically.
2. If the gap between materials is over 1/4 in., install backer rod between penetration and DensElement® Sheathing to form a back dam regardless of size of penetration or opening.
3. Apply a thick bead of DensDefy® Liquid Flashing around the penetration.
4. With a straight-edge tool, spread DensDefy Liquid Flashing on the face of the sheathing, over the annulus between the penetration and the sheathing, and onto the penetrating item. Completely seal the joint around the penetration.

High-Performance Gypsum Products from Georgia-Pacific

DensDeck® Roof Board	Fiberglass mat roof board used as the ideal thermal barrier and cover board to improve resistance to wind uplift, hail, foot traffic and fire in a broad range of commercial roofing applications. Look for DensDeck® Prime Roof Board also.
DensGlass® Sheathing	The original and universal standard of exterior gypsum sheathing offers superior weather resistance, with a 12-month limited warranty against delamination or deterioration during exposure to normal weather conditions. Look for the familiar GOLD color. Meets UL 2824 GREENGUARD Certification Program for Microbial Resistance.
DensGlass® Shaftliner	These specially designed panels are perfect for moisture-prone vertical or horizontal shafts, interior stairwells and area separation wall assemblies. Includes a 12-month limited warranty against delamination or deterioration during exposure to normal weather conditions. Meets UL 2824 GREENGUARD Certification Program for Microbial Resistance.
DensArmor Plus® Interior Panel	High-performance interior panel accelerates scheduling because it can be installed before the building is dried-in. Includes a 12-month limited warranty against delamination or deterioration during exposure to normal weather conditions. GREENGUARD and GREENGUARD Gold certified for low VOC emissions. Meets UL 2824 GREENGUARD Certification Program for Microbial Resistance.
DensArmor Plus® Abuse-Resistant Interior Panel	With the same benefits as the DensArmor Plus® Interior Panel, these also offer added resistance to scuffs, abrasions and surface indentations; ideal for healthcare facilities and schools. GREENGUARD and GREENGUARD Gold certified for low VOC emissions. Meets UL 2824 GREENGUARD Certification Program for Microbial Resistance.
DensArmor Plus® Impact-Resistant Interior Panel	With even greater durability than abuse-resistant panels, these have an embedded impact-resistant mesh for the ultimate resistance in high-traffic areas; ideal for healthcare facilities, schools and correctional institutions. GREENGUARD and GREENGUARD Gold certified for low VOC emissions. Meets UL 2824 GREENGUARD Certification Program for Microbial Resistance.
DensShield® Tile Backer	Acrylic-coated tile backer stops moisture at the surface. Lightweight and strong, they are built for speed on the jobsite. Conforms to requirements of 2018 IBC/IRC Code. Meets UL 2824 GREENGUARD Certification Program for Microbial Resistance.
ToughRock® Gypsum Board	Paper-faced line of gypsum panels for a variety of applications including interior wall and ceiling applications, abuse-resistant boards and panels for use in fire-rated assemblies. ToughRock products are GREENGUARD and GREENGUARD Gold certified for low VOC emissions.
ToughRock® Mold-Guard™ Gypsum Board	ToughRock Mold-Guard Gypsum Board products have enhanced mold resistance in comparison to regular ToughRock® Gypsum Boards. They are GREENGUARD and GREENGUARD Gold Certified for low VOC emissions. Meets UL 2824 GREENGUARD Certification Program for Microbial Resistance.
DensElement® Barrier System	DensElement® Barrier System is the result of innovative science called AquaKOR™ Technology that integrates the gypsum core and the fiberglass mat to form a hydrophobic, monolithic surface that blocks bulk water, but allows vapor to pass through. By retaining high permeability, DensElement Barrier System enables moisture vapor to pass through the wall in both directions in any climate. This allows wall assemblies to dry out should they get wet, helping to avoid mildew, mold and deterioration. As DensElement Barrier System is a continuous WRB-AB, no separate WRB-AB is needed. Meets UL 2824 GREENGUARD Certification Program for Microbial Resistance.

Georgia-Pacific Gypsum

U.S.A. GP Gypsum
CANADA Georgia-Pacific Canada LP

SALES INFORMATION AND ORDER PLACEMENT

U.S.A.
Pacific Southwest: **1-800-824-7503**
Midwest: **1-800-876-4746**
Central: **1-800-231-6060 x 7709**
North: **1-800-947-4497**
Pacific Northwest: **1-800-444-0092**
South: **1-800-327-2344**

CANADA Canada Toll Free: **1-800-387-6823**

TECHNICAL HOTLINE
U.S.A. and Canada: **1-800-225-6119**

TRADEMARKS
Unless otherwise noted, all trademarks are owned by or licensed to Georgia-Pacific Gypsum.

WARRANTIES AND TERMS OF SALE
For current warranty information, please go to BuildGP.com/Warranties and select the applicable product. All sales by Georgia-Pacific are subject to our Terms of Sale available at BuildGP.com/TC.

CAUTION
For product fire, safety and use information, go to BuildGP.com/SafetyInfo or call 1-800-225-6119.

HANDLING AND USE
Refer to SDS for Instructions on safe handling and use of the product here:

BuildGP.com/DensElement/Resources/Literature/

FIRE SAFETY CAUTION
Passing a fire test in a controlled laboratory setting and/or certifying or labeling a product as having a one-hour, two-hour, or any other fire resistance or protection rating and, therefore, as acceptable for use in certain fire-rated assemblies/systems, does not mean that either a particular assembly/system incorporating the product, or any given piece of the product itself, will necessarily provide one-hour fire resistance, two-hour fire resistance, or any other specified fire resistance or protection in an actual fire. In the event of an actual fire, you should immediately take any and all actions necessary for your safety and the safety of others without regard for any fire rating of any product or assembly/system.

DensElement.com

Proof positive. The Science Behind the System.

The DensElement® Barrier System
An Integrated WRB-AB Solution

Dens Element™ BARRIER SYSTEM
GP
Georgia-Pacific

Rigorous Testing.
Optimal Performance.

All-in-One Water-Resistive and Air Barrier Solution Met All The Challenges

Understanding design considerations, limitations and realistic performance is critical for any water-resistive and air barrier (WRB-AB) system. The research and development teams at Georgia-Pacific recognizes the requirement scientific proof of success before introducing innovative new systems, like the patented DensElement® Barrier System. Rigorous testing of the various assemblies and the individual components of the system is a crucial step to have confidence in your WRB-AB system.

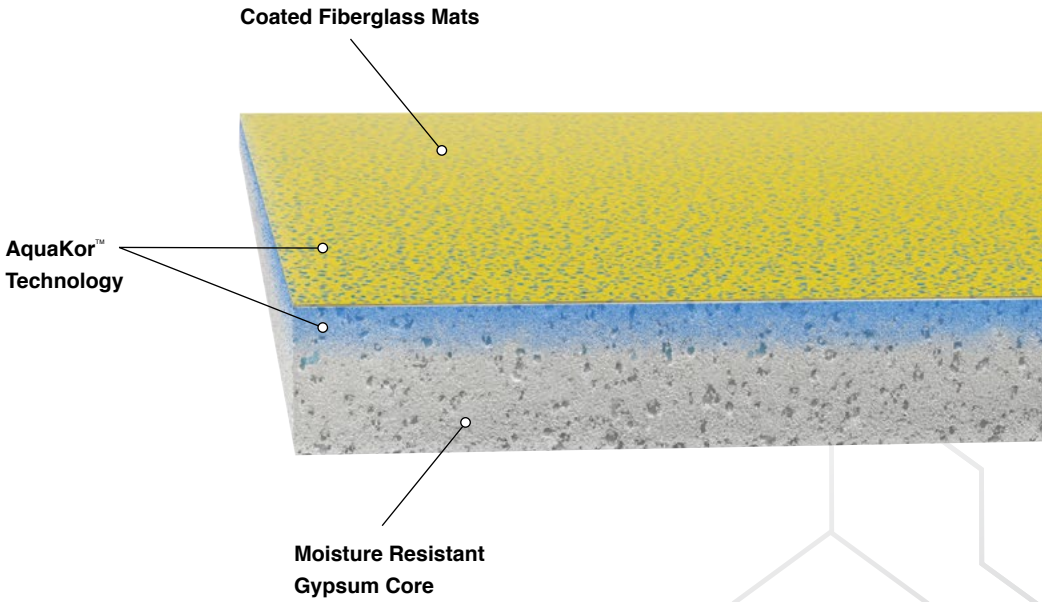
The following tables demonstrate only a sampling of the specific experiments performed on the system to replicate potential real-world exposure. This exhaustive testing resulted in the evidence needed for the International Code Council to confirm the performance of the DensElement® Barrier System as a combination exterior wall sheathing, water-resistive and air barrier (WRB-AB) system as described in ICC-ES Evaluation Report ESR-3786.

A Proven Chemistry

AquaKor™ Technology

Conventional fluid-applied WRB-AB membrane systems can be time and labor intensive; requiring installers to coat the entire sheathing surface with potential coating thickness variations. Instead of simply duplicating this traditional approach, Georgia-Pacific Gypsum engineers and chemists went to the drawing board to develop a more efficient system.

The DensElement® Barrier System with AquaKor™ Technologyis the result. It features a proprietary formulation that integrates the gypsum core and fiberglass mat to form a hydrophobic, monolithic surface that blocks bulk water, but allows vapor to pass through. This eliminates the need for a separate WRB-AB, which reduces the potential for installer error associated with field-applied WRB-AB systems. The end result is a faster, easier installation process that provides the protection of a continuous WRB-AB.



System Assembly

DENSELEMENT® BARRIER SYSTEM ASSEMBLY TESTING			
TEST	**DESCRIPTION**	**MEETS OR EXCEEDS**	**RESULTS**
DensElement® Testing in Accordance with ICC-ES AC212			
ASTM C297 Standard Test Method for Flatwise Tensile Strength of Sandwich Construction	Provides information on the strength and quality of core-to-facings bonds; Pull strength must meet 15 psi	✓	> 19 psi Exceeded requirement by > 25%
ASTM D2247 Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity	Water resistance tested over a treated joint for 24-hours per day for 14 days at 100% relative humidity and 100°F	✓	No signs of panel cracking, crazing, blistering, erosion or other deleterious effects were observed
Freeze-ThawTesting per ICC-ES AC212 Water-Resistive Coatings Used as Water-Resistive Barriers Over Exterior Sheathing	Samples subjected to 10 freeze-thaw cycles with temperatures ranging from -20°F to 120°F; this is a pass/fail test	✓	No cracking or delamination of the WRB surface
ASTM E96 Standard Test Method for Water Vapor Transmission of Materials	Obtain reliable values of water vapor transfer through permeable and semipermeable materials, expressed in suitable units	✓	> 30 perms System has high vapor permeability. Tested using the Wet Cup Method to measure weight loss due to water vapor from the cup transmitting through the material to the test atmosphere and humidity of the test chamber.
ASTM E331 Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference	Water penetration testing of the assembly; test includes windows, brick ties, penetrations; no visible water penetration allowed at sheathing joints or nail penetrations	✓	No leaks! Two separate wall assemblies tested for robustness; windows, transitions, penetrations and brick ties passed all inspections
ASTM E331 (4-Stage)	ASTM E331 is performed twice in ICC-ES AC 212. First as a stand-alone test, second as a part of a 4-part test. In this 4-stage event, water penetration was tested after the DensElement® Barrier System was subjected to three other test methods – loading, racking and environmental conditioning – as described below		
STAGE 1 **ASTM E1233** Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Cyclic Air Pressure Differential	The first stage of conditioning for the ASTM E331 test – transverse load testing (panel deflection test); no failure of WRB allowed; this is a pass/fail test	✓	**No WRB failure!** Per IBC code requirements, DensElement® Barrier System endured 10 specified deflection cycles with no WRB failure (deflection specified per IBC table 1603.4)
STAGE 2 **ASTM E72** Standard Test Methods of Conducting Strength Tests of Panels for Building Construction	The second stage of conditioning for the ASTM E331 test – racking test (panel strength test); no failure of WRB allowed during or after racking; this is a pass/fail test	✓	**No WRB failure!** System was racked at 1/8" net deflection
STAGE 3 **Restrained Environmental Conditioning of Panel with WRB-AB**	The third stage of conditioning for the ASTM E331 test – system subjected to water and heat after being deflected and racked; no failure of WRB allowed; this is a pass/fail test	✓	**No WRB failure!** System subjected to 5 cycles of 24-hour water spray and 24-hour radiant heat on panels that were tested structurally
STAGE 4 **ASTM E331** Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference	The final stage of testing using the components that have already undergone stage 1-3 testing; the system was then tested to determine its resistance to water penetration under uniform static air pressure differences	✓	**No leaks!** Assembly tested in chamber using a 5 gal/hr water spray with 137 Pa (2.84 psf) static air pressure

DENSELEMENT® BARRIER SYSTEM ASSEMBLY TESTING

	TEST	DESCRIPTION	MEETS OR EXCEEDS	RESULTS
	Hydrostatic Pressure Test (3-Stage) per ICC-ES AC212 Water-Resistive Coatings Used as Water-Resistive Barriers Over Exterior Sheathing	In this 3-stage event, hydrostatic pressure was tested after the DensElement® Barrier System was subjected to two other test methods – UV light exposure and accelerated aging – as described below		
STAGE 1	**Ultraviolet (UV) Light Exposure**	The first stage of conditioning for the hydrostatic head test – a sample with a joint was exposed to high heat for an extended period; this is a pass/fail test	✓	**No WRB failure!** System subjected to 21 cycles of UV light at 135°F to 140°F for 10 hours per day, followed by conditioning for 14 hours per day for a total of 210 hours; no delamination
STAGE 2	**Accelerated Aging**	The second stage of conditioning for the hydrostatic head test – the previous sample with a joint was taken from the UV exposure test and subjected to 25 accelerated aging cycles	✓	**No WRB failure!** System subjected to high heat oven drying and soaked in water for 18 hours at room temperature; no delamination
STAGE 3	**Hydrostatic Pressure Test per AATCC Test Method 127-1985** for Water Resistance	The final stage of testing uses the components that have already undergone stages 1-2; the system was then tested for leakage and to verify performance and durability	✓	**No leaks!** Assembly tested under 550 mL of water in a 22-in. column for 5 hours; column had 6-in. diameter and spanned a full joint plus 1-in. of sheathing on either side
	Additional Testing for ABAA Material/System Evaluation			
	ASTM D1970 (modified) Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection	ASTM D1970, is to confirm DensElement® Barrier System meets a waterproofing standard by laying it flat, driving two nails into it, and backing out the nails a quarter of an inch. The bottom is cut out of a one gallon can, and it is sealed with silicone around the two nails. Water is added to the can, and it is left for a period of time.	✓	No leaks allowed where fasteners penetrate through DensElement® Sheathing- Pass
	ASTM D4541-09-e1 Standard test method for pull-off strength of coatings (DensElement® mat surfacing in this case) using portable adhesion testers.	The pull-off strength of the mat on DensElement® Sheathing is a performance property that may be referenced. This test method serves as a means for uniformly preparing and testing the facer surface, and evaluating and reporting the results.	✓	Exceeds minimum 16 psi pull-off requirement by approx 25%
	Additional Testing for EIMA Policy			
	ASTM E2273 Standard Test Method for Determining Air Leakage of Air Barrier Assemblies	Standard Test Method for Determining the Drainage Efficiency of Exterior Insulation and Finish Systems (EIFS) Clad Wall Assemblies	✓	DensElement® Barrier System exceeded 90% drainage on three EIFS assemblies from three EIFS manufacturers
	Additional Testing for Energy Code (IECC) Compliance			
	ASTM E2357 Standard Test Method for Determining Air Leakage of Air Barrier Assemblies	Simulates the performance of various air barrier materials/accessories when combined into an assembly; results will assign an air leakage rating for the assembly	✓	Exceeded IECC requirements by 75% for assembly code requirements of 0.04 cfm/ft2 at 75 Pa with below code air infiltration rates of 0.01 cfm/ft2 at 75 Pa
	Additional Testing for IBC CHAPTER 14 Compliance			
	NFPA 285 Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components	Provides a standardized fire test procedure for evaluating the suitability of exterior, non-load bearing wall assemblies and panels used as components of curtain wall assemblies that are constructed using combustible materials or that incorporate combustible components for installation on buildings where the exterior walls are required to be non-combustible	✓	Wall assembly engineering evaluations completed for the DensElement® Barrier System compliance with NFPA 285
	Additional Testing for ICC-ES ESR 3786: AC310 Section 4.5			
	Water Penetration Testing ASTM E331 test with addition of a roof-wall intersection	Assembly with additional roof-wall intersection must pass ASTM E331 criteria	✓	No leaks

Component Testing

SHEATHING COMPONENT TESTING			
TEST	**DESCRIPTION**	**MEETS OR EXCEEDS**	**RESULTS**
DensElement® Testing Accordance with ICC-ES for ICC ES ESR 3786			
ASTM C473 Standard Test Method for Physical Testing of Gypsum Panel Products	Test methods cover (1) flexural strength; (2) core, end, and edge hardness; (3) nail pull resistance; (4) humidified deflection; (5) end squareness; (6) nominal thickness; (7) recessed- or tapered-edge depth; (8) width; (9) length; (10) water resistance of core-treated water repellant gypsum panel products; and (11) surface water resistance of gypsum panel products with water-repellant surfaces	✓	Gypsum physical properties testing as covered in ASTM C1177
ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials	Provides comparative measurements of surface flame spread and smoke density measurements with that of select fiber-cement board surfaces under specific fire exposure conditions	✓	Best score of 0 - Flame Spread 0 - Smoke Developed
ASTM E136 Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C	Assists in indicating those materials which do not act to aid combustion or add appreciable heat to an ambient fire; materials passing the test are permitted to limited flaming and other indications of combustion	✓	Non-combustible
AAMA 714 Voluntary Specification for Liquid-Applied Flashing Used to Create a Water-Resistive Seal Around Exterior Wall Openings in Buildings	Establishes minimum performance requirements for liquid-applied flashing used to provide a water-resistive seal around exterior wall openings in buildings that includes fenestrations, such as windows and doors, as well as other through-wall penetrations	✓	DensDefy® Liquid Flashing approved for use and listed in ICC-ES ESR-3786
Additional Testing for ABAA Material/System Evaluation			
ASTM E2178 Standard Test Method for Air Permeance of Building Materials	Measurement of the air permeance of flexible sheet or rigid panel-type materials; results may be useful in determining suitability of that material as a component of an air retarder system	✓	Sheathing exceeded IECC requirements by 50% for code requirements of 0.004 cfm/ft² at 75 Pa with below code air infiltration rates of 0.002 cfm/ft² at 75 Pa
Mold Resistance			
ASTM D3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber	Determines the resistance of interior coatings to mold growth; useful in estimating the performance of coatings designed for use in interior environments that promote mold growth	✓	Highest Score of 10

Canada Testing

ADDITIONAL AIR BARRIER SYSTEM AND COMPONENT TESTING FOR CANADIAN CODE COMPLIANCE

TEST	DESCRIPTION	MEETS OR EXCEEDS	RESULTS
ASTM E2178 with additional **CAN/ULC S741** test requirements Specimens installed per ASTM E2178, with incremental negative and positive test pressures followed by decremental pressures. Upon completion, the specimens were tested for Ultra-Violet/Condensation exposure followed by Heat Exposure for 772 hours.	CAN/ULC S741 requirement; Where the air leakage characteristic determined for unconditioned specimens is less than 0.01 (L/s.m2) at 75 Pa pressure difference, the air leakage characteristic of the conditioned specimens shall not increase by more than 0.001 (L/s.m2) at 75 Pa pressure difference	✓	DensElement® Sheathing meets the prior to UV exposure (unconditioned) requirement <.02L/s.m2 @ 75 Pa and the post UV exposure (conditioned) requirements of not increasing by more than 0.001 (L/s.m2)@ 75 Pa
ASTM E2357 with additional **CAN/ULC S742** test requirements ASTM E2357 plus the required Wind Pressure Loading/Deflection Testing/Air Leakage Rate Testing at cold temperature of -20 degree C in the test chamber	Wind pressure loading of 650 Pa for Sustained wind load, 950 Pa for Cyclic wind load, and 1410 Pa for Gust wind load	✓	DensElement® Barrier System is classified as A1 (air leakage not exceeding 0.05 L/(s.m2) @75 Pa) when subjected to sustained hourly wind load of 650 Pa and the cyclic and gust loads that are equivalent to a building height of 12 meters
ASTM D1623 with additional **CAN/ULC 716 .1** Standard Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics	Measures bond strength of the EIFS adhesive to the DensElement® sheathing under three different conditions	✓	The bond strength exceeds the test requirements under all three required test conditions
CAN/ULC 716.1 Annex B/ISO 15148 Water absorption co-efficient as measured by g/m2.s1/2	Measures water absorption under the method defined in this standard. Samples must absorb less than 4 g/m2.s1/2	✓	The water absorbed 0.0021 g/m2.s1/2, far less than the required minimum absorption of 4 g/m2.s1/2.
CAN/ULC 716.1 Annex C Joint durability test as defined in standard	Treated joints were subjected to 15 cycles of 65 degree C for 15 hours and minus 10 degrees C for 5 hours	✓	No apparent deterioration or perforation after the 15 cycles

AAMA – *The American Architectural Manufacturers Association* A material-neutral organization, the AAMA proactively and effectively influences codes, construction and specification issues

EIMA – *EIFS Industry Members Association* A not-for-profit trade organization committed to advancement and growth of demand for EIFS.

ASTM – *ASTM International* A globally recognized leader in the development and delivery of voluntary consensus standards used around the world to improve product quality, enhance health and safety, strengthen market access and trade, and build consumer confidence.

ICC – *International Code Council* An association dedicated to developing model codes and standards used in the design, build and compliance process to construct safe, sustainable, affordable and resilient structures.

NFPA – *National Fire Protection Agency* A global, nonprofit organization, established in 1896, that delivers information and knowledge through more than 300 consensus codes and standards, research, training, education, outreach and advocacy.

IECC – *International Energy Code* The IECC is a model code that regulates minimum energy conservation requirements for new buildings

DensElement.com

GP Technical Hotline: (800) 225-6119

DensElement® Barrier System is backed with a limited warranty.

Visit DensElement.com for more details.

GP Gypsum LLC
133 Peachtree Street, N.E.
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ICC EVALUATION SERVICE®

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ICC-ES Evaluation Report

ESR-3786

Reissued January 2023

This report is subject to renewal November 2024.

DIVISION: 07 00 00—THERMAL AND MOISTURE PROTECTION
Section: 07 25 00—Water-resistive Barriers/Weather Barriers
Section 07 27 00—Air Barriers

DIVISION: 09 00 00—FINISHES
Section: 09 29 00—Gypsum Board

REPORT HOLDER:

GEORGIA-PACIFIC GYPSUM LLC

EVALUATION SUBJECT:

DENSELEMENT™ BARRIER SYSTEM

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2018, 2015, 2012 and 2009 *International Building Code®* (IBC)
- 2018, 2015, 2012 and 2009 *International Residential Code®* (IRC)
- 2018, 2015, 2012 and 2009 *International Energy Conservation Code®* (IECC)
- 2018, 2015 and 2012 *International Green Construction Code™* (IGCC)

For evaluation for compliance with codes adopted by the Los Angeles Department of Building and Safety (LADBS), see ESR-3786 LABC and LARC Supplement.

Properties evaluated:

- Water resistance
- Air leakage
- Structural
- Noncombustibility
- Surface-burning characteristics
- Fire-resistance-rated construction
- Physical properties

2.0 USES

DensElement™ Barrier System is a combination exterior wall sheathing, air barrier and water-resistive barrier system. This report recognizes the use of the DensElement™ Barrier System when installed with the DensElement™ sheathing and liquid-applied flashing as described in this report on walls of all types of construction and dwellings under the IRC. The DensElement™ Barrier System is intended for use as an alternate to the water-resistive barrier prescribed in Chapter 14 of the IBC and Chapter 7 of the IRC, as an air barrier material prescribed in accordance with 2018 and 2015 IECC Sections C402.5 and R402.4; 2012 IECC Sections R402.4 and C402.4; 2009 IECC Sections 402.4 and 502.4; IRC Section N1102.4 and 2018 IgCC Section 701.3 and 2015 IgCC Section 605.1.2, and as a component of an air barrier assembly in accordance with 2018 and 2015 IECC Section C402.5 and 2012 IECC Section C402.4.1.2.2. The sheathing may be used to resist transverse wind loads when installed in accordance with Section 4.2.1, and racking loads due to wind and seismic forces when installed in accordance with Section 4.2.2. The $^{5}/_{8}$-inch (15.9 mm) thick sheathing, Type X, may be used as a component of a fire-resistance-rated wall assembly when installed in accordance with Section 4.3. The system is classified as a noncombustible material in accordance with 2018, 2015 and 2012 IBC Section 703.5 (2009 IBC Section 703.4).

3.0 DESCRIPTION

3.1 DensElement™ Sheathing:

DensElement™ Sheathing complies as a glass mat gypsum substrate in accordance with ASTM C1177 as specified in Table 2506.2 of the IBC and Section R702.3.1 of the IRC. The glass mat facer and core of the sheathing is treated to provide water resistance. The sheathing is classified as a noncombustible building material in accordance with ASTM E136. The sheathing is ½-inch (12.7 mm) or $^{5}/_{8}$-inch (15.9 mm) thick and 48 inches wide (1219 mm), has square edges and is available in lengths up to 12 feet (3.7 m).

When tested in accordance with ASTM E96 (water method), the $^{5}/_{8}$-inch-thick (15.9 mm) sheathing, has a vapor permeance of 24 perms when tested with a sealed joint and 32 perms when tested without a joint.

When tested in accordance with ASTM E96 (water method), the ½-inch-thick (12.7 mm) sheathing has a vapor permeance of 33 perms when tested with a sealed joint.

When tested in accordance with ASTM E2178, the sheathing has an air permeability less than 0.004 cfm/ft^2 (0.02 L/s•m^2) under a pressure differential of 0.3 inches of water gauge (75 Pa).

3.2 Liquid Applied Flashing:

The liquid-applied flashings used to seal the sheathing joints, fastener heads and to flash penetrations must be Georgia-Pacific DensDefy™ Liquid Flashing or Prosoco R-Guard® FastFlash® liquid flashing. The liquid-applied flashings are a polymer based material. The liquid-applied flashings are applied in a minimum 2-inch-wide (51mm) band with a minimum 16 wet mils over joints, interfaces and transitions. Fastener heads must be completely covered with the liquid flashing materials so no portion of the fastener head is exposed. The flashing materials are packaged in tubes and pails of varying quantities. Materials have an approximate shelf life of 12-months from date of manufacture when stored in a cool dry place.

4.0 DESIGN AND INSTALLATION

4.1 Installation: DensElement™ sheathing must be attached to wall framing in accordance with ASTM C1280 (Standard Specification for Application of Gypsum Sheathing) and GA-253 (Application of Gypsum Sheathing) for IBC applications, or IRC Table R602.3 (1) and IRC Section R702.3.5 for IRC applications; the manufacturer's published installation instructions; and this report.

DensElement™ sheathing must be attached with the yellow-colored side facing the exterior. Sheathing fasteners must be flush with the panel surface without countersinking through the glass mat facer. The sheathing must not be used as a nailing base and any attachments of exterior coverings must be made directly to the framing.

Sheathing exposed fastener heads must be sealed with the liquid applied flashing described in Section 3.2 of this report to ensure the fastener heads are not exposed. The sheathing joints, openings, penetrations and transitions must be sealed with the liquid applied flashing described in Section 3.2 and as detailed in Section 4.1.1 of this report. The sheathing surface must be free of ice and frost during application of liquid flashing.

4.1.1 The DensElement™ sheathing surface must be free of contaminants prior to the application of the liquid-applied flashing. Apply liquid flashing over the sheathing joint in a zig-zag or ribbon pattern dispensed from either a tube-type container or pail and then spread evenly with a straight edge knife or trowel. Cover a minimum of 1 inch (25 mm) on both sides of the joints to achieve a 2-inch (51 mm) width of coverage. Apply at a rate to achieve a wet mil thickness of 16 mils over the entire area.

4.1.2 For the perimeter or openings, penetrations, terminations and transitions, a minimum 2-inch-wide (51 mm) liquid-applied flashing must be installed in accordance with Georgia Pacific published installation instructions. See Figure A for a typical joint, fastener, opening, penetration and transition sealing details.

The manufacturer's published installation instructions and this report must be strictly adhered to, and a copy of the instructions must be available at all times on the jobsite during installation.

4.2 Design:

4.2.1 Transverse Wind Resistance: DensElement™ Sheathing may be used to resist transverse wind loads as permitted by the applicable code for gypsum sheathing.

4.2.2 Shear Resistance: DensElement™ Sheathing may be used as components of conventional light framed walls for resisting shear loads when installed as described in this section.

4.2.2.1 Prescriptive Wall Bracing: The DensElement™ sheathing boards are equivalent to gypsum sheathing for use as bracing to resist lateral loads due to wind and seismic forces. When installed as prescribed by code for gypsum sheathing, the DensElement™ sheathing board may be used as wall bracing in accordance with 2018 and 2015 IBC Section 2308.6.3, Method GB; 2012 and 2009 IBC Section 2308.9.3, Method 5; subject to the limitations in IBC Section 2308.2, or in accordance with 2018, 2015 and 2012 IRC Section R602.10.4, Method GB; 2009 IRC Section IRC R602.10.2, Method GB, as applicable.

4.2.2.2 Engineered Shear Walls: The DensElement™ sheathing boards may be used as a component of engineered shear walls when designed in accordance with IBC Section 2305 for wood framed walls or 2018 IBC Sections 2211.1 and 2211.1.1, 2015 and 2012 IBC Section 2211.6; 2009 IBC Section 2210.6 for light steel framed walls. The design wind and seismic loads must not exceed the allowable racking shear capacity for gypsum sheathing shown in the AWC 2015 SDPWS for recognition under the 2018 and 2015 IBC and 2018 and 2015 IBC Table 2306.3(3); AF&PA 2008 SDPWS for recognition under the 2012 IBC and 2012 IBC Table 2306.3(3); and the 2009 IBC Table 2603.7. Design wind loads must be determined in accordance with Section 1609 of the IBC. Design seismic loads must be determined in accordance with Section 1613 of the IBC.

For seismic design, the substrate may be used as a component of wood-framed engineered shear walls for resisting seismic loads in Seismic Design Categories A, B, C, and D. The response modification factor, R, must be equal to 2; the system overstrength factor, Ω_o, must be equal to 2½; and the deflection amplification factor, C_d, must be equal to 2. The maximum building height is 35 feet (10.6 m) for buildings located in Seismic Design Category D areas.

Structural members, systems and components, including boundary studs and plates, must be anchored to resist design forces and to provide continuous load paths for these forces to the foundation.

4.3 Fire-resistance-rated Wall Assemblies:

4.3.1 One-hour Fire-resistance-rated Load-bearing Wall: The 5/8-inch-thick (15.9 mm) DensElement™ Sheathing, Type X, is installed vertically to both faces of a wood stud partition wall with nominal 2-by-4 studs at 16 inches (406 mm) on center. The wall must be bridged every 5 feet (1524 mm), maximum, and the board on one face installed with joints staggered 16 inches (406 mm) from those on the opposite face. The boards are attached using 1¾ inch-long (45 mm) galvanized nails with a 7/16-inch-diameter (11.1 mm) head and 0.128-inch-diameter (3.25 mm) shank, spaced 8 inches (203 mm) on center at edges and intermediate studs. Allowable bearing loads must not exceed 2030 pounds (9030 N) per stud, 78 percent of the allowable F'_c, or 78 percent of the calculated stress with studs having a slenderness ratio, l_e/d, of 33, whichever is less.

4.3.2 One-hour Fire-resistance-rated Non-load-bearing wall: The $^5/_8$-inch-thick (15.9 mm) DensElement™ Sheathing, Type X, is installed horizontally to both faces of a steel stud wall, of minimum No. 25 gage [0.018 inch (0.457 mm) base-metal-thickness steel, minimum $3^5/_8$-inch-deep (92 mm) web, minimum 1.25-inch flanges and minimum $^3/_{16}$-inch returns, spaced 24 inches (609.6 mm) on center. The board on one face is installed with joints staggered 24 inches (609.6 mm) from those on the opposite face. The boards are attached with $1^1/_4$-inch-long (31.7 mm), Type S, screws spaced 8 inches (203 mm) on center on the stud with 1 inch (25.4 mm) spacing from the joints, 12 inches (304.8) on center for end fastening, and 6 inches on center for edge fastening. The joints are taped with $3^1/_4$-inch-wide (82.6 mm) flashing tape and the fastener heads are coated with liquid-applied flashing.

4.3.3 Other Fire-resistance-rated Construction: One layer of $^5/_8$-inch-thick (15.9 mm) DensElement™ Sheathing, Type X, may be substituted for the gypsum sheathing specified for exterior faces of assemblies Nos. 13-1.1, 13-1.3, 14-1.3, 14-1.5, 15-1.1, 15-1.5, 15-1.6 of 2018, 2015 and 2012 IBC Table 721.1(2) (2009 IBC Table 720.1(2)).

4.4 Air Barrier Assembly: DensElement™ Sheathing fastened to 16-inch-center (406 mm), steel-framed wall, using No. 6 self-drilling screws spaced at 8 inches (203 mm) on center in the field and perimeter, forms an air barrier assembly when the joints between the panels and the perimeter of penetrations are sealed with the liquid flashing, as described in Section 4.1. The assembly has demonstrated an air leakage less than 0.04 cfm/ft^2 (0.2 L/s•m^2) under a pressure differential of 0.3 inches of water gauge (75 Pa) when tested in accordance with ASTM E2357.

4.5 Water-resistive Barrier Assembly: The DensElement™ Barrier System when installed in accordance with Section 4.1 of this report may be used as an alternate to the water-resistive barrier prescribed in IBC Chapter 14 or IRC Chapter 7.

5.0 CONDITIONS OF USE

The DensElement™ Barrier System described in this report complies with, or is a suitable alternative to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 The products must be manufactured, identified and installed in accordance with this report, the manufacturer's published installation instructions and the applicable code. If there is a conflict between the manufacturer's published installation instructions and this report, this report governs.

5.2 When the sheathing is not installed as bracing, as described in Section 4.2.2.1, or as an engineered shear wall, as described in Section 4.2.2.2, the stud walls must be braced by other materials in accordance with the applicable code.

5.3 Shear walls using the sheathing must not be used to resist forces imposed by masonry and/or concrete walls.

5.4 The DensElement™ Barrier System must be covered with a code complying exterior wall covering.

6.0 EVIDENCE SUBMITTED

6.1 Reports of physical property testing in accordance with ASTM C473, for compliance with ASTM C1177.

6.2 Reports of surface-burning tests in accordance with ASTM E84 (UL 723).

6.3 Reports of noncombustibility tests in accordance with ASTM E 136

6.4 Reports of tests on a fire-resistance-rated wall assembly in accordance with ASTM E119 (UL 263) and fire analysis.

6.5 Data in accordance with Sections 4.1, 4.2, 4.3, 4.4 4.7 and 4.8 of the ICC-ES Acceptance Criteria for Water-resistive Coatings Used as Water-resistive Barriers Over Exterior Sheathing (AC212), dated February 2015 (Editorially revised April 2018).

6.6 Report of wind-driven rain tests in accordance with ASTM E331.

6.7 Report of flashing tests with applicable AAMA 714 standard for liquid-applied flashings described in Section 3.2 of this report.

6.8 Report of air leakage tests in accordance with ASTM E2178 and ASTM E2357.

6.9 Quality documentation.

7.0 IDENTIFICATION

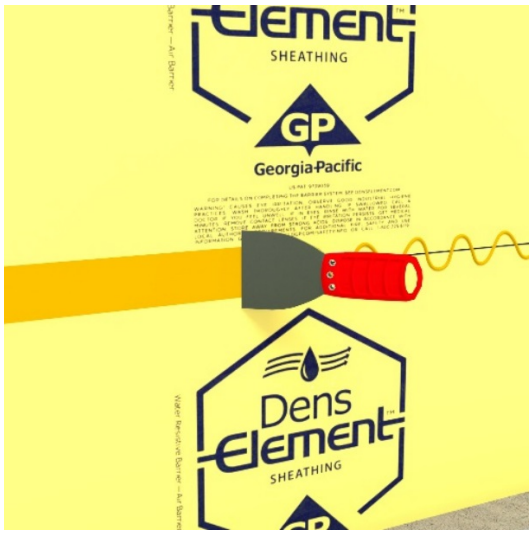
7.1 Each DensElement™ Sheathing board is identified with the manufacturer's name (Georgia-Pacific Gypsum LLC), a plant identifier and date code, the product name, the board thickness, and the evaluation report number (ESR-3786).

The liquid flashings must be identified with the product name and company name described in Section 3.2 of this report.

7.2 The report holder's contact information is the following:

GEORGIA-PACIFIC GYPSUM LLC
2861 MILLER ROAD
DECATUR, GEORGIA 30035
(800) 225-6119
www.buildgp.com

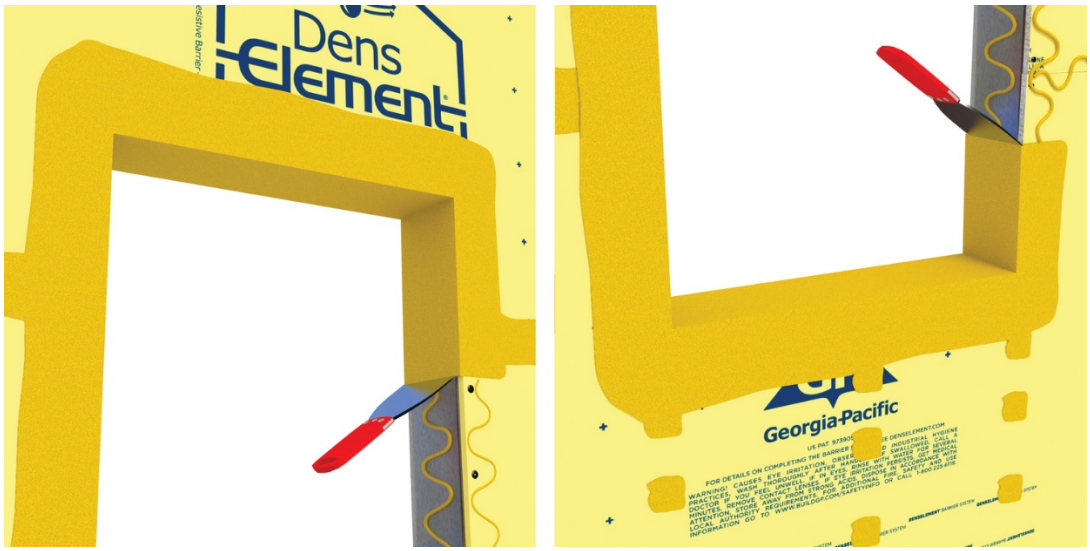
FIGURE 1—DENSELEMENT™ BARRIER SYSTEM



Joint Sealing

Penetration Sealing

Corner Sealing



Opening Sealing

FIGURE 1—DENSELEMENT™ BARRIER SYSTEM (CONTINUED)

DIVISION: 07 00 00—THERMAL AND MOISTURE PROTECTION
Section: 07 25 00—Water-resistive Barriers/Weather Barriers
Section: 07 27 00—Air Barriers

DIVISION: 09 00 00—FINISHES
Section: 09 29 00—Gypsum Board

REPORT HOLDER:

GEORGIA-PACIFIC GYPSUM LLC

EVALUATION SUBJECT:

DENSELEMENT™ BARRIER SYSTEM

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that DensElement™ Barrier System, described in ICC-ES evaluation report ESR-3786, has also been evaluated for compliance with the codes noted below as adopted by the Los Angeles Department of Building and Safety (LADBS).

Applicable code editions:

- 2020 *City of Los Angeles Building Code* (LABC)
- 2020 *City of Los Angeles Residential Code* (LARC)

2.0 CONCLUSIONS

The DensElement™ Barrier System, described in Sections 2.0 through 7.0 of the evaluation report ESR-3786, complies with the LABC Chapters 7, 14, 22, 23 and 25, and the LARC Sections R602.10.4 and R703.2, and is subjected to the conditions of use described in this supplement.

3.0 CONDITIONS OF USE

The DensElement™ Barrier System described in this evaluation report supplement must comply with all of the following conditions:

- All applicable sections in the evaluation report ESR-3786.
- The design, installation, conditions of use and identification of the DensElement™ Barrier System are in accordance with the 2018 *International Building Code®* (IBC) provisions noted in the evaluation report ESR-3786.
- The design, installation and inspection are in accordance with additional requirements of the LABC Chapters 16 and 17, Sections 2211, 2305, 2306, 2308, and 2503, as applicable.
- The DensElement™ Barrier System has not been evaluated under the LABC Chapter 7A or the LARC Section R337 for use in the exterior design and construction of new buildings located in any Fire Hazard Severity Zone within State Responsibility Areas or any Wildland—Urban Interface Area.
- The seismic design provisions for hillside buildings referenced in LABC Section 2301.1 have not been considered and are outside of the scope of this supplement.

This supplement expires concurrently with the evaluation report, reissued January 2023.

DIVISION: 07 00 00—THERMAL AND MOISTURE PROTECTION
Section: 07 25 00—Water-resistive Barriers/Weather Barriers
Section: 07 27 00—Air Barriers

DIVISION: 09 00 00—FINISHES
Section: 09 29 00—Gypsum Board

REPORT HOLDER:

GEORGIA-PACIFIC GYPSUM LLC

EVALUATION SUBJECT:

DENSELEMENT™ BARRIER SYSTEM

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that the DensElement™ Barrier System, described in ICC-ES evaluation report ESR-3786, has also been evaluated for compliance with the codes noted below.

Applicable code editions:

- 2019 *California Building Code* (CBC)

For evaluation of applicable chapters adopted by the California Office of Statewide Health Planning and Development (OSHPD) AKA: California Department of Health Care Access and Information (HCAI) and the Division of State Architect (DSA), see sections 2.1.1 and 2.1.2, below.

- 2019 *California Residential Code* (CRC)

2.0 CONCLUSIONS

2.1 CBC:

The DensElement™ Barrier System, described in Sections 2.0 through 7.0 of the evaluation report ESR-3786, complies with CBC Sections 703.2, 703.5, and 1403.2; and CBC Chapters 22, 23 and 25, provided the design and installation are in accordance with the 2018 *International Building Code*® (IBC) provisions noted in the evaluation report and the additional requirements of CBC Chapters 7, 14, 16, 22, 23 and 25, as applicable.

2.1.1 OSHPD: The applicable OSHPD Sections of the CBC are beyond the scope of this supplement.

2.1.2 DSA: The applicable DSA Sections of the CBC are beyond the scope of this supplement.

2.2 CRC:

The DensElement™ Barrier System, described in Sections 2.0 through 7.0 of the evaluation report ESR-3786, complies with CRC Sections R602.10.4 and R703.2, provided the design and installation are in accordance with the 2018 *International Residential Code*® (IRC) provisions noted in the evaluation report.

This supplement expires concurrently with the evaluation report, reissued January 2023.

Georgia-Pacific

DensElement®

Barrier System

INSTALLATION GUIDE

System Solutions

DensElement® Barrier System unites science with technology. Comprised of only approved components, it has undergone rigorous performance testing for conformance with the current water-resistive barrier and air barrier requirements of the International Building Code (IBC) and the International Energy Conservation Code (IECC). Today, those components include:

- DensElement® Sheathing
- DensDefy® Liquid Flashing
- DensDefy® Transition Membrane

Revolutionizing the Water-Resistive & Air Barrier System

Keep walls dry. It sounds simple, but time and time again water infiltration is the main culprit for failure within a building envelope. History has proven that typical construction will allow some moisture to penetrate either the structural wall or rough openings. It's not a question of if moisture will get into a building; it's a question of when.

So how can you ensure that when moisture gets into your building that it can get out too? The DensElement® Barrier System, with AquaKor™ Technology is the answer. Until now, industry-accepted water-resistive and air barrier (WRB-AB) products have not delivered fully:

- Building wraps may rip and tear even in mild breezes, let alone strong storms. Even where they stay on, staple holes may provide air and water access to the structural walls.
- Conventional fluid-applied WRB-AB membrane systems can be time and labor intensive, requiring installers to coat the entire sheathing surface with potential coating thickness variations.
- DensElement Barrier System eliminates the WRB-AB application step, so the system is faster and easier to install than fluid-applied, self-adhered and building wrap applications.

Scientifically Enhanced

The key to the unique benefits offered by the DensElement® Barrier System can be found in its proprietary advancement, AquaKor™ Technology, which integrates the gypsum core and the fiberglass mat to form a hydrophobic, monolithic surface that blocks bulk water but allows vapor to pass through. This eliminates the need for a separate WRB-AB, which reduces the potential for installer error associated with field-applied WRB-AB systems. The end result is a faster, easier installation process that provides the protection of a continuous WRB-AB.

Every seam or penetration causes potential for moisture intrusion. So, for maximum protection, the system is complete with tested and approved DensDefy® Liquid Flashing, which fills and seals seams, fasteners, openings, penetrations and transitions.

DensElement® Sheathing must be installed in accordance with the instructions in this brochure, Gypsum Association publication GA-253 Application of Gypsum Sheathing and ASTM C1280 Standard Specification for Application of Exterior Gypsum Panel Products for Use as Sheathing.

SHEATHING INSTALLATION INSTRUCTIONS

Framing

DensElement® Sheathing can be installed on wood or metal framing spaced up to a maximum 24 inches on center. Use appropriate framing and spacing specific to fire assemblies, shear wall applications or as required by the design authority. Wood framing width shall be a minimum of 1-½" (38 mm) and steel framing width shall be a minimum of 1-¼" (32 mm). Framing members must be in plane with not more than 1/8" (3 mm) variation from the plane of adjacent framing members. Framing fasteners shall not protrude more than ⅛" (3 mm) to ensure the sheathing will be installed against the framing.

Do not apply DensElement Sheathing directly to cementitious or masonry surfaces. When abutting concrete or masonry, provide a minimum ¼" gap between sheathing and cementitious surface.

Cutting Sheathing

DensElement® Sheathing can be cut from the face side by scoring and snapping or by sawing. To score the panel, use a sharp knife to cut through the gold facer into the gypsum core, then snap the cut panel back away from the cut face and finally cut the back facer along the crease.

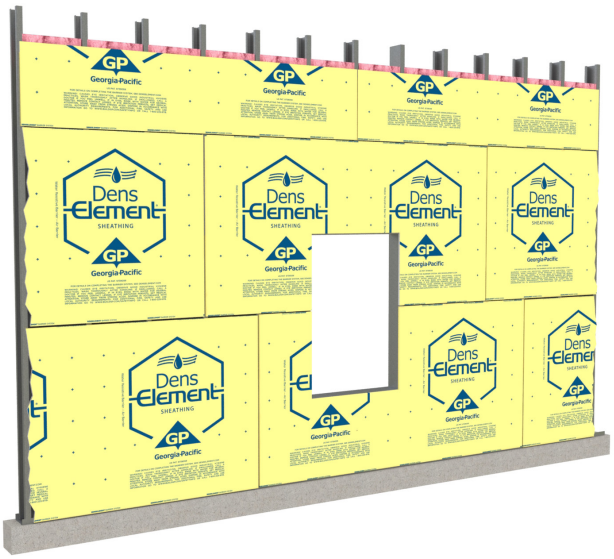
Where gypsum sheathing meets projecting surfaces, the gypsum sheathing shall be neatly scribed and cut. Cutouts for pipes or other small openings can be cut with a saw. All cut edges and ends of gypsum sheathing shall be trimmed to obtain neat-fitting joints when gypsum sheathing is installed.

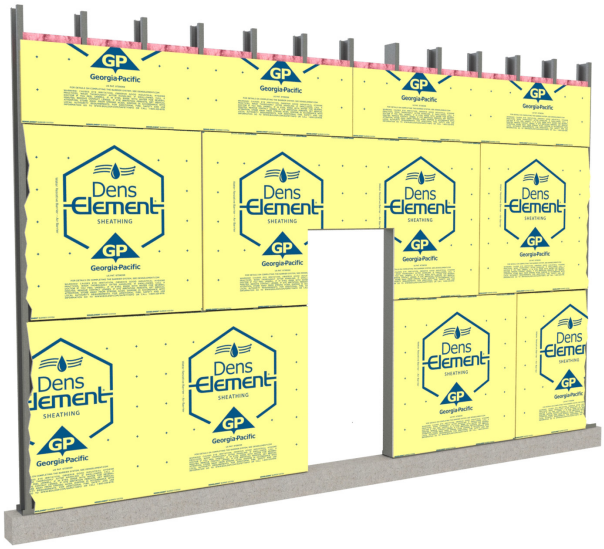
Sheathing Installation

DensElement® Sheathing can be installed parallel or perpendicular to wood or metal framing. Use appropriate board orientations specific to fire assemblies, shear wall applications or as required by the design authority.

Install DensElement Sheathing with end joints staggered on horizontal applications and vertical applications (when applicable). Ends and edges of the DensElement Sheathing should fit tightly and be in moderate contact. DensElement Sheathing shall not be less than 8'' (203 mm) from the finish grade in weather-protected siding systems, and not less than 12" (305 mm) from the ground for properly drained crawl spaces.

Gypsum sheathing shall not be continuous through building construction joints. Consult with design authority for control-joint recommendations.Gypsum sheathing shall be located so that panel seams shall be offset a minimum of 4" (100 mm) from the corner of openings.





SHEATHING INSTALLATION INSTRUCTIONS

Fastening

Fasteners shall be driven flush with the panel surface into the framing and not countersunk. Fasteners should not expose the gypsum core and fastener heads should not break through the fiberglass facer. Locate perimeter fasteners at least ⅜" (9 mm) from the ends and edges of the panel. Fastener spacing should be a maximum of 8" (203 mm) on center along framing, but use appropriate fastener spacing specific to fire assemblies, shear wall applications or as required by the design authority.

Nails or screws, as listed in the Fastener Guide, may be used to attach DensElement® Sheathing to framing. Care should be taken when driving screws to not strip the framing member around the screw shank.

Fastening and Framing

Thickness	Framing Spacing	Panel Orientation	Fastener Spacing – Wood Framing[1]	Fastener Spacing – Metal Framing[1]
⅝" (15.9 mm)	24" (610 mm) o.c. max[2]	Parallel[2] or perpendicular	8" (203 mm) o.c. field[3] & perimeter	8" (203 mm) o.c. along framing

[1] Fire-rated assemblies may require additional fasteners; see specific assembly details.
[2] For racking strength resistance, apply panel edges parallel with framing spaced a maximum of 16" (406 mm) on center (o.c.) for ⅝" (15.9 mm) DensElement® Barrier System.
[3] Fastener spacing around the perimeter of the wall and along intermediate vertical framing members.

Fastener Guide

Fastener*	Type	Length for 5/8-in.-(15.9 -mm-) Thick Sheathing	Description	Application
	Type S-12	1¼" (32 mm)	Bugle head fine thread, corrosion-resistant drill point drywall screw	DensElement® Sheathing to heavy-gauge metal framing (18 gauge or thicker)
	Type S	1¼" (32 mm)	Bugle head fine thread, corrosion-resistant sharp point drywall screw	DensElement Sheathing to light-gauge metal framing furring (20-25 gauge)
	Type W	1⅝" (41 mm)	Bugle head, rust-resistant, coarse thread sharp point screw	DensElement Sheathing to wood framing
	Type W, S and S-12	1¼" (32 mm) metal 1⅝" (41 mm) wood	Wafer head, corrosion-resistant screws, drill or sharp point	DensElement Sheathing to heavy-gauge or light-gauge, metal or wood framing
	ASTM C514 and 12 gauge	1¾" (45 mm)	11-gauge, galvanized nail	DensElement Sheathing to wood framing
	16 gauge galvanized staples	1⅝" (41 mm)	No. 16 gauge, flattened, galvanized, divergent point wire staples with not less than a 7/16 in.- (11 mm-) wide crown outside measure	DensElement Sheathing to wood framing

*For screws, meet or exceed ASTM C1002 or C954. Contact fastener manufacturer for correct amount of corrosion resistance.

DENSDEFY® LIQUID FLASHING AND DENSDEFY® TRANSITION MEMBRANE INSTALLATION INSTRUCTIONS

To receive flashing materials, surfaces must be clean, sound, and free of frost, dust, dirt, debris, contaminants and other bond-inhibiting agents. Treated lumber must be dry and may be solvent wiped with isopropyl alcohol to aid adhesion of DensDefy™ Products. DensDefy® Liquid Flashing can be applied to damp surfaces and tolerates moisture exposure after application. To receive DensDefy® Transition Membrane, surfaces must be completely dry.

Dispense DensDefy Liquid Flashing from a 20-oz. sausage-type caulking gun. At 70°F (21°C) and 50% relative humidity, liquid flashing begins to skin within 30–60 minutes. DensDefy Liquid Flashing is moisture curing. Low temperatures and low relative humidity slow curing time. High temperatures and high relative humidity accelerates curing time. Protect adjacent surfaces. Clean tools and equipment with mineral spirits or similar solvent immediately after use. Cured liquid flashing must be removed mechanically. Follow all safety precautions.

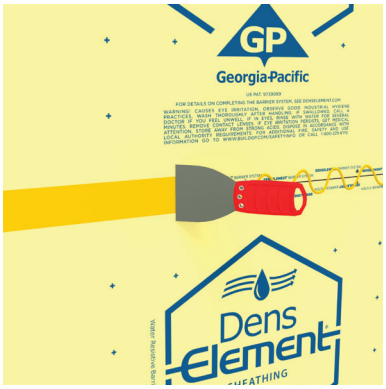
DensDefy Transition Membrane is available in 6-, 9- and 12-in.- (152.4-, 228.6- and 304.8-mm-) wide rolls. When using DensDefy Transition Membrane, determine appropriate widths and lengths prior to cutting. DensDefy Transition Membrane may be cut with scissors or a sharp utility knife. Use of longest lengths possible will minimize overlaps. For longer lengths, additional applicators may help avoid wrinkles or fish mouths. Use a J roller to apply even pressure to fully adhere the membrane and achieve a smooth and wrinkle-free surface. Treat all edges with DensDefy Liquid Flashing

Panel Seams

1. Apply DensDefy® Liquid Flashing over the DensElement® Sheathing seam in a zigzag or ribbon pattern.

2. With a straight-edge tool, spread evenly over the sheathing seam.

3. Apply at a rate to achieve a minimum thickness of 16 wet mils over the entire seam area, leaving no exposed sheathing. Cover a minimum of 1" on both sides of the seam.



Fasteners

1. The fasteners should be spotted with DensDefy Liquid Flashing and wiped down with a straight edge tool, leaving a minimum thickness of 16 wet mils over the entire fastener.

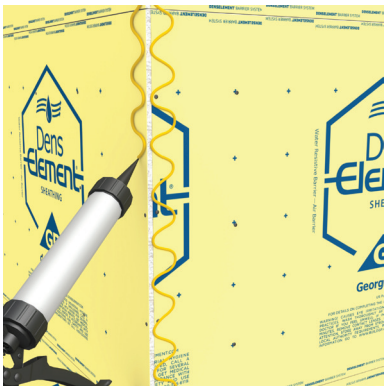
DENSDEFY® LIQUID FLASHING AND DENSDEFY® TRANSITION MEMBRANE INSTALLATION INSTRUCTIONS

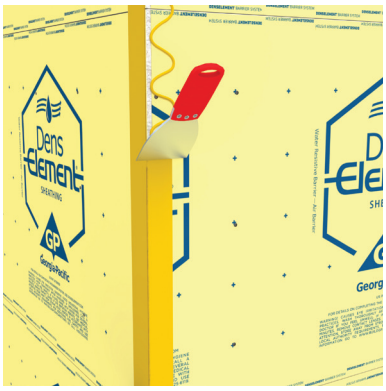
Vertical Corners

1. Apply DensDefy Liquid Flashing over the inside and/or outside corner in a zigzag or ribbon pattern.

2. With a straight edge tool, spread evenly over the sheathing corner.

3. Apply at a rate to achieve a minimum thickness of 16 wet mils over the corner area. Cover a minimum of 2" on both sides of the corner.





Material Transitions With DensDefy® Liquid Flashing

1. If the gap between materials is over ¼", fill the gap between the DensElement® Sheathing and adjacent materials with a backer rod.

2. Apply DensDefy Liquid Flashing over the DensElement Sheathing and adjacent material in a zig-zag or ribbon pattern.

3. Using straight edge tool, spread DensDefy Liquid Flashing over material transition.

4. Apply at a rate to achieve a minimum thickness of 16 wet mils. Ensure the flashing is applied a minimum of 2" on each substrate material surface.

DENSDEFY® LIQUID FLASHING AND DENSDEFY® TRANSITION MEMBRANE INSTALLATION INSTRUCTIONS

Material Transitions With DensDefy® Transition Membrane

1. Choose the appropriate DensDefy Transition Membrane width to achieve a 2" (50 mm) minimum overlap on both sides of the transition. Pre-cut manageable lengths and place over the center of the transition area.

Note: At corners or changes in plane, creasing the membrane prior to placement can help align the membrane.

2. Remove release paper from the DensDefy Transition Membrane and press in place following the contour of the substrate, avoiding wrinkles and fishmouths.

3. Use a J roller to apply even pressure to fully adhere the membrane and achieve a smooth and wrinkle-free surface.

4. Terminate all DensDefy® Transition Membrane edges with a counter flash of DensDefy Liquid Flashing, ensuring liquid flashing covers membrane and adjacent material, leaving no exposed membrane edges.

ROUGH OPENINGS

Rough Openings with DensDefy® Liquid Flashing

1. Rasp any jagged or uneven DensElement® Sheathing edges and clean framing free of debris and dust or other bond-inhibiting materials.
2. Apply a bead of DensDefy Liquid Flashing into the entire width of the inside corners of the opening.
3. Apply DensDefy Liquid Flashing over the entire width of the opening sill, jamb and header in a zig-zag or ribbon pattern.
4. Apply DensDefy Liquid Flashing over the DensElement Sheathing adjacent to the opening sill, jamb and header in a zig-zag or ribbon pattern.
5. With a straight edge tool, spread DensDefy Liquid Flashing over the entire width of the sill, jamb, header and DensElement Sheathing surface adjacent to the opening.
6. Apply at a rate to achieve a minimum thickness of 16 wet mils over the opening area, leaving no exposed sheathing. Cover a minimum of 2" of the sheathing surface adjacent to the opening.

ROUGH OPENINGS

Rough Openings with DensDefy® Transition Membrane

1. Apply corner reinforcement pieces or "bow ties" at rough opening corners.

2. Choose appropriate DensDefy Transition Membrane widths to achieve a 2" (50 mm) minimum overlap on both sides of the change in plane. Refer to project specifications for required treatment dimensions. Pre-cut manageable lengths for handling.

Note: At corners or changes in plane, creasing the membrane prior to placement can help align the membrane.

3. Remove release paper from the DensDefy Transition Membrane and press in place following the contour of the substrate, avoiding wrinkles and fishmouths.

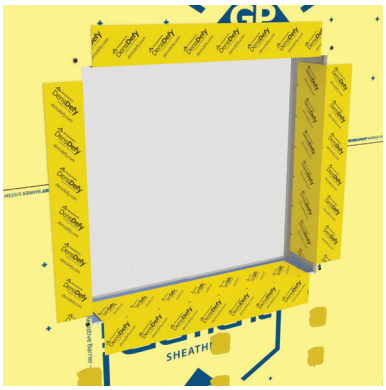
4. Apply pre-cut lengths to sill, covering a minimum of 2" (50 mm) of the sheathing adjacent to the opening and wrap a minimum of 4" (100 mm) up rough opening jambs.

5. Apply pre-cut lengths along rough opening jambs. Overlap, in a shingle-lap fashion, a minimum 2" (50 mm) onto sill protection.

6. Apply pre-cut lengths along rough opening header. Overlap, in a shingle-lap fashion, a minimum 2" (50 mm) onto jamb protection.

7. Use a J roller to apply even pressure to fully adhere the membrane and achieve a smooth and wrinkle-free surface.

8. Terminate all DensDefy Transition Membrane edges with a counter flash of DensDefy® Liquid Flashing, ensuring liquid flashing covers membrane and adjacent material, leaving no exposed membrane edges.



Rough Openings with Combination Method

1. Choose appropriate DensDefy Transition Membrane widths to achieve a 2" (50 mm) minimum overlap on both sides of the change in plane. Refer to project specifications for required treatment dimensions. Pre-cut manageable lengths for handling.

Note: At corners or changes in plane, creasing the membrane prior to placement can help align the membrane.

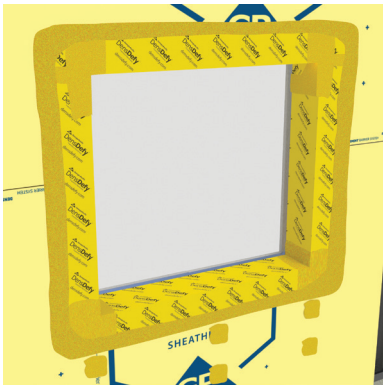
2. Remove release paper from the DensDefy Transition Membrane and press in place following the contour of the substrate, avoiding wrinkles and fishmouths.

3. Apply pre-cut lengths of DensDefy Transition Membrane to sill, jambs and header, keeping membrane 1 - 2" from rough opening corners. Cover a minimum of 2" of the sheathing adjacent to the opening.

4. Use a J roller to apply even pressure to fully adhere the membrane and achieve a smooth and wrinkle-free surface.

5. Apply DensDefy® Liquid Flashing to all rough opening corners, overlapping the membrane edges by at least 1".

6. Terminate all DensDefy Transition Membrane edges with a counter flash of DensDefy Liquid Flashing, ensuring liquid flashing covers membrane and adjacent material, leaving no exposed membrane edges.



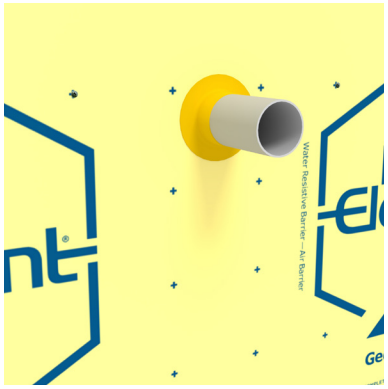
PENETRATIONS

1. Mechanically secure penetrations. Penetrations should be rigid and secured mechanically.

2. If the gap between materials is over ¼", install backer rod between penetration and DensElement® Sheathing to form a back dam regardless of size of penetration or opening.

3. Apply a thick bead of DensDefy® Liquid Flashing around the penetration.

4. With a straight edge tool or curved spatula, spread DensDefy Liquid Flashing on the face of the sheathing, over the annulus between the penetration and the sheathing, and onto the penetrating item. Completely seal the joint around the penetration.



DensElement® Barrier System

DensDefy® Liquid Flashing Application Chart*

Container: 20-oz. Sausage

2-inch wide panel seam coverage	
Wet Mil Thickness	**Coverage (linear feet)**
16 (minimum)	85
24	60
32	42
2x4-inch framed opening coverage	
Wet Mil Thickness	**Coverage (linear feet)**
16 (minimum)	25-30
24	37-45
32	12-15

* Coverage shown is an estimate only. Actual coverage will vary based on experience level of applicator and other factors such as the width of application area. Coverage assumes that joints and corners are butted tightly together and gaps and voids are prefilled with backer rod. Perform a project mock up to determine more accurate coverage estimates.

Georgia-Pacific
Building Products

U.S.A. *GP Gypsum LLC*
CANADA *Georgia-Pacific Canada LP*

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Evaluating the Effectiveness of the DensElement® Barrier System as the Primary WRB in Rainscreen Assemblies

DensElement® Barrier System Passes the Water Penetration Test

In three separate, high-pressure water penetration tests, DensElement® Barrier System proved successful in withstanding bulk water. Read on for more information on successful rainscreen assemblies using DensElement Barrier System with a variety of rainscreen attachment systems.

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Evaluating the Effectiveness of the DensElement® Barrier System as the Primary WRB in Rainscreen Assemblies

DensElement® Barrier System Passes the Water Penetration Test

Abstract

Considering weather events, changes in temperature, and building movement, it is unlikely that any building will remain 100% weatherproof. But with the right materials and assembly, extra steps can be taken to reduce the risk of damage under both normal and severe weather conditions.

Georgia-Pacific Gypsum enlisted Intertek to conduct three water penetration resistance tests in accordance with ASTM E331, *Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.* To simulate severe wind-driven rainy weather conditions, three separate wall assemblies utilizing DensElement® Barrier System as the primary water-resistive barrier (WRB) were subjected to high volumes of water on the surface of the wall while simultaneously applying uniform static pressure to the opposite side of the wall for a specified period of time. The same high-stress water penetration tests were conducted on DensElement Barrier System with Knight Wall's ThermaStop System, ECO Cladding Alpha V and Alpha H aluminum brackets, and fiberglass Cascadia Clips. With all three assemblies passing the tests, the results showed each assembly's ability to prevent water from reaching the interior cavity, which demonstrates their capacity to stand strong against potential weather-related water leaks.

Prior Test Findings

Eco Cladding brackets

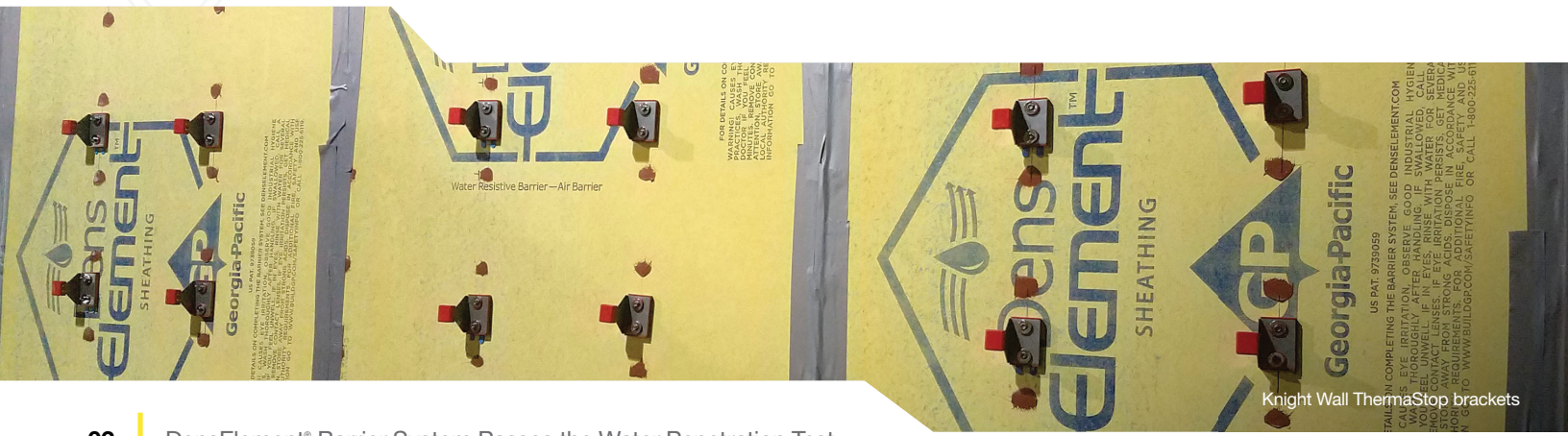
The DensElement® Barrier System is a UL classified Type X gypsum sheathing, water-resistive barrier, and air barrier (WRB-AB) combination all in one—consisting of DensElement® Sheathing and fluid-applied flashing (in this case, PROSOCO R-Guard® FastFlash® liquid flashing). When the sheathing joints, openings, penetrations, fasteners, and material transitions are properly sealed, the system meets uniform code requirements for use as a water-resistive barrier and air barrier.

Previous third-party cladding tests performed by RDH Building Sciences[1] revealed that the way cladding fasteners were attached to the wall surface had the most bearing on how and why the assembly leaked under varying weather conditions. Prior demonstrations of multiple weather-resistive barrier systems including the DensElement Barrier System, a thin-mil fluid-applied WRB, and a thick-mil fluid-applied WRB were tested with various cladding attachment clips and Z Girt arrangements (applied both flange up and flange down).

Five 4x8' test walls were constructed for the test, with a sixth wall panel constructed to demonstrate water penetration on an extruded polystyrene (XPS) insulation installed on the exterior and attached only with long screws. In these prior demonstrations, water was applied at a rate of 7.5 gallons per hour per square foot for 60 minutes at the following pressures: 0 Pa, 300 Pa, 600 Pa, 900 Pa, and 1,250 Pa (equaling 100 mile-per-hour sustained winds). These demonstrations pushed well beyond typical water volumes, pressures, and time durations to purposefully take the various assembles to failure and observe where and why leakage occurred to help determine best practices.

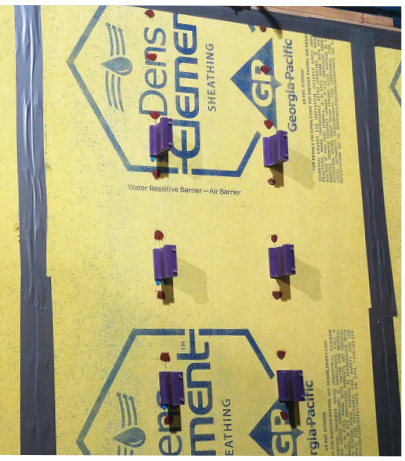
In these demonstrations, leaks occurred at the cladding attachment fasteners on all three WRB systems, as well as where the fasteners for the XPS insulation penetrated the sheathing. Whether the cladding attachment was fastened through the DensElement Barrier System or through the fluid-applied WRB membrane over the glass mat sheathing made little difference. In all instances, the testing demonstrated that, if water found a penetration, it didn't make a measurable difference whether the penetration was through DensElement Sheathing, thin-mil fluid-applied WRB, or thick-mil fluid-applied WRB.

In general, the assemblies did not leak if the cladding fasteners were installed tight to the sheathing or fluid-applied WRB surface—nor did the ones with the cladding fasteners installed with adequate spacing away from the wall surface to allow for water drainage behind the cladding attachment. Rather, most leaks occurred when the space between the WRB surface and cladding attachment was large enough for water to enter behind the attachment but not wide enough for the water to effectively drain in between.



Knight Wall ThermaStop brackets

New Test Developments



Cascadia Clips

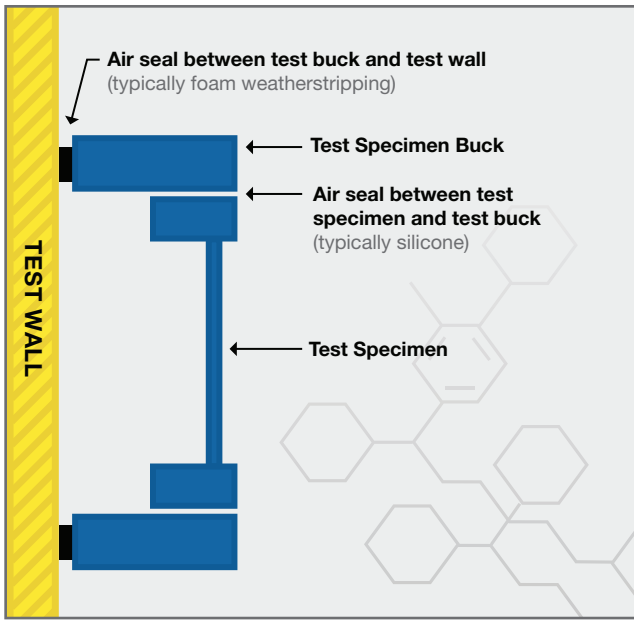
Evaluated in accordance with ASTM E331-00(2016), *Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference*, Intertek's tests yielded positive results across all three separate demonstrations: DensElement Sheathing with Knight Wall's ThermaStop System, ECO Cladding Alpha V and Alpha H aluminum brackets, and fiberglass Cascadia Clips. In all instances, Georgia-Pacific Gypsum provided the initial test specimens, which Intertek will retain post-demonstration for a minimum of four years from completion.

All test walls were constructed using 18ga steel studs spaced 16" on center. A sheet of nominal 5/8"-thick DensElement Sheathing was secured to the studs with #8 x 1-1/4" Philips Bugle-Head fine thread self-drilling drywall screws spaced 8" on the center. The walls utilized two 2'x8' Southern Yellow Pine boards on the jambs to facilitate the testing. All fasteners were spot-treated with PROSOCO R-Guard® FastFlash® Liquid Flashing. Each test used an overall area of 32 square feet, measuring 48" wide by 96" high.

In all instances, the systems were tested positioned flush against the DensElement Barrier System as well as with an intent for drainage. For the Knight Wall ThermaStop System test, the Knight Wall thermal break anchors were attached to the DensElement Sheathing using two #10 x2-1/2" screws. Three Knight Wall ThermaStop brackets were attached flush to the sheathing, and three additional Knight Wall brackets were attached utilizing a 1/16" inverted U-shaped shim installed between the sheathing face and the bracket to allow for drainage.

For the ECO Cladding aluminum bracket test, the ECO Cladding aluminum anchors were attached to the DensElement Sheathing using two #8 x 1-1/2" screws. Three ECO Cladding Alpha V vertical brackets and three Alpha H horizontal brackets were attached flush to the sheathing. ECO Cladding subframe systems are designed to be installed without the need for additional shimming for drainage.

For the fiberglass Cascadia Clips test, the fiberglass Cascadia Clips were attached to the DensElement Sheathing using two #10 x 4-1/2" screws. Three purple 3" fiberglass Cascadia Clips were attached flush to the sheathing, and three additional Cascadia Clips were attached utilizing a 1/16" inverted U-shaped shim installed between the sheathing face and the clip to allow for drainage.



Results

Across all three demonstrations, the DensElement Barrier System resisted water penetration after being subjected to increasing pressures and durations. Under extreme weather condition simulations, including 30 minutes of sustained winds of more than 75 mph, the DensElement Barrier System withstood water penetration into the assembly after Knight Wall's ThermaStop System, ECO Cladding Alpha V and Alpha H aluminum bracket, and fiberglass Cascadia Clip installation.

Under increasing uniform static air pressure differences from 137 to 900 Pa and increasing time durations from 15 to 30 minutes, all assemblies passed the test.

These cumulative results suggest that, when installed under Georgia-Pacific guidelines, DensElement Barrier System provides excellent water penetration resistance with these three commonly used subframe systems.

DensElement Barrier System's scientific innovation helps stop water on the surface of the board. Patented AquaKor Technology™ fills microscopic voids in the glass mat and gypsum core to create a hydrophobic, monolithic surface that blocks bulk water while retaining vapor permeability. This enables water vapor to dissipate through the system rather than trapping it within the assembly.

KNIGHT WALL THERMASTOP BRACKET TEST RESULTS (Test Specimen #4-6)

WATER PENETRATION TEST	RESULTS	ALLOWED
per ASTM E331 at 137 Pa (2.86 psf) for 15 minutes	✓	No leakage
per ASTM E331 at 300 Pa (6.27 psf) for 30 minutes	✓	No leakage
per ASTM E331 at 600 Pa (12.35 psf) for 30 minutes	✓	No leakage
per ASTM E331 at 900 Pa (18.80 psf) for 30 minutes	✓	No leakage

ECO CLADDING ALUMINUM BRACKET TEST RESULTS (Test Specimen #7-9)

WATER PENETRATION TEST	RESULTS (NON-SHIMMED)	ALLOWED
per ASTM E331 at 137 Pa (2.86 psf) for 15 minutes	✓	No leakage
per ASTM E331 at 300 Pa (6.27 psf) for 30 minutes	✓	No leakage
per ASTM E331 at 600 Pa (12.35 psf) for 30 minutes	✓	No leakage
per ASTM E331 at 900 Pa (18.80 psf) for 30 minutes	✓	No leakage

* Per manufacturer's instructions, additional shims are not approved for use with ECO Cladding brackets.

FIBERGLASS CASCADIA CLIP TEST RESULTS (Test Specimen #1-3)

WATER PENETRATION TEST	RESULTS	ALLOWED
per ASTM E331 at 137 Pa (2.86 psf) for 15 minutes	✓	No leakage
per ASTM E331 at 300 Pa (6.27 psf) for 30 minutes	✓	No leakage
per ASTM E331 at 600 Pa (12.35 psf) for 30 minutes	✓	No leakage
per ASTM E331 at 900 Pa (18.80 psf) for 30 minutes	✓	No leakage

GENERAL NOTE: All testing was performed in accordance with the referenced standard(s). All pressures were run consecutively.

In Summation

These findings show that, in conjunction with the tested cladding attachment systems, DensElement Barrier System provides excellent resistance against bulk water from wind-driven rain. When properly installed, DensElement Barrier System is a proven reliable WRB-AB across a variety of wall assembly designs, whereas misapplication and failure to properly install can result in unwanted leaks, water damage, and air flow. For this reason, pay extra close attention to proper detailing and installation, and follow Georgia-Pacific installation guidelines.

Unlike in this test situation, actual building scenarios should also include a cladding installed over the subframe, adding to the building envelope's ability to deflect wind-driven rain. In such rainscreen assemblies, the drainage space that these subframes creates between the sheathing and cladding helps to promote drainage and further mitigate the risks of bulk water entering the interior side of the wall assembly during a storm.

Rainscreen assemblies have grown in popularity for a number of reasons. Providing extra support against potentially damaging weather, rainscreen systems help manage moisture and protect the building's structure from mold and other harmful effects—ultimately reducing maintenance needs.

With these testing results, designers can feel confident selecting DensElement Barrier System as their primary WRB-AB system of choice behind the rainscreen, particularly when using Knight Wall ThermaStop Systems, ECO Cladding Alpha V and Alpha H aluminum brackets, or fiberglass Cascadia Clips for the sub-frame.

Further simplifying the assembly process, compliance with NFPA 285 standard fire safety testing to evaluate the fire propagation characteristics of exterior wall assemblies is easier to achieve by using the DensElement Barrier System.[2] Since DensElement® Sheathing is non-combustible, the requirements in IBC1402.5 for combustible water-resistive barriers, are not applicable and therefore DensElement Sheathing is exempt from NFPA 285 assembly testing. Therefore, this section does not require new testing to replace a current WRB-AB solution with DensElement Sheathing in any wall assembly that is currently NFPA 285 approved.

An effective WRB-AB in rainscreen assemblies, DensElement Barrier System is as versatile as it is reliable. Compatible across current leading cladding choices, the integrated sheathing system easily accommodates a variety of design styles—freeing designers to bridge creativity with constructability.

For both performance and design, DensElement Barrier System provides the versatility necessary to accommodate a variety of cladding options used with rainscreen, such as fiber cement, metal panels, terracotta panels, high-density laminate or composite panels, and more. For architects, combining your rainscreen assembly with DensElement Barrier System's proven WRB-AB effectiveness and cladding versatility means flexibility and freedom of design. For everyone else, it means peace of mind that the assembly can stand strong when needed to perform.

Sources

1 "Cladding Attachments Put to the Test: Testing for Leakage Under Extreme Water and Wind" DensElement® Barrier System White Paper, Georgia-Pacific Gypsum: https://denselement.com/blog/technical-white-paper-cladding-attachments-put-to-the-test/

2 Technical Bulletin: "Changes to the 2018 IBC: NFPA 285 requirement applicability to DensElement™ Barrier System" Georgia-Pacific Gypsum

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Permeability and Performance in Water-Resistive Barriers (WRBs)

Identifying the Proper Choice for Applications

Contrary to popular belief, building codes do allow for use of permeable WRBs in cold climates. In fact, high-perm water-resistive barriers may actually be preferable in many cold-climate applications.

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Permeability and Performance in Water-Resistive Barriers (WRBs)

Identifying the Proper Choice for Applications

Abstract

The topic of *water-resistive barrier* (WRB) *permeability* in a building assembly is wrought with confusion. The design principles make the topic sound simple - prevent moisture issues by ensuring the building envelope manages moisture and the movement of air throughout the building, and allow for moisture in the assembly to drain away or evaporate - but the science behind it can quickly get technical and confusing.

Generalizations and misconceptions about accomplishing these principles are perpetuated based on practices that have lagged behind advancements in understanding the movement of water vapor through a wall assembly, inaccurate application of dew point analysis, and a misunderstanding of the differences in application of *vapor retarders, vapor barriers,* water-resistive barriers and air barriers. The complexity caused by air carrying moisture is a factor in the correct application of envelope components fighting moisture intrusion.

This has led to the common misunderstanding that code* only allows for the use of *impermeable WRBs* in cold climate zones, which is not the case. In this white paper, we'll address why code* allows both high- and low-perm WRBs, with proper selection depending on the other materials used within the wall assembly. We'll present how understanding code* requirements and *vapor drive* dynamics is key to designing an optimal wall assembly.

For the purposes of this white paper, WRBs above 10 perms, when tested per ASTM E96 Procedure B (wet cup), are classified as *high permeability*. WRBs less than 10 perms (wet cup) are classified as *low permeability*.

Water's Three Invasive Forms

Determining the appropriate degree of permeability in the assembly begins with an understanding of the forms of water that the assembly confronts.

Liquid – Gravity and wind can pull rainwater, groundwater, and melting snow into the envelope, but so can surface tension, capillary action and differences in air pressure.

Vapor – Water in a gaseous form that exists in the air both inside the building and outside of the building can diffuse through the building envelope through differential vapor pressure.

Solid – Moisture can condense and freeze within the envelope, compromising its integrity through the contraction and expansion that occurs when ice thaws, returns to liquid water, and refreezes again.

Follow the Three D's: Deflect, Drain, Dry

Good water management can be achieved by following three basic principles: deflect, drain, and dry. No matter how hard you try to avoid water infiltrating your structure, it's just a matter of when it will get in and to what degree. But the rule still stands: Deflect water wherever possible. When water can't be deflected, drain as much of it away from the building envelope assembly as possible. For any water that does get into the building envelope assembly, create as much ability for fast drying as possible.

Strategy One: Deflect

Inevitably, all buildings will eventually leak due to the natural movement and degradation of materials over time. Cladding serves as the first defensive protocol against the most significant cause of building envelope deterioration – driving rain. It acts as the primary plane of deflection. A variety of cladding systems exist.

Sandwich panels are impervious to rain. Through the tongue and groove connecting of the impermeable metal panels, water, vapor and air barriers are achieved.[1]

Curtain Walls are comprised of aluminum frames with infill panels, glazed or opaque, which are fixed to the frames. While aesthetically pleasing, water infiltration, condens-ation and air leakage can occur and in cold climates, condensation can occur and ice can form.[2]

But where primary deflection fails, secondary water-resistive barriers help to manage liquid water concerns by stopping water from moving deeper into the wall assembly. Rainscreens are a component of double-wall construction.[3] While some water will find its way into the cavity, direct rain is deflected and the wall is protected from significant amounts of water. The inner part of the wall assembly provides the airtightness, structural stability and the thermal insulation.[4]

Good design practice further protects buildings when proper flashing and channels for drainage are included and permeability of the WRB is optimized for drying. This is where water-resistive and air-resistive barriers come crucially into play to avoid mold, mildew, corrosion, decay, and other issues that can cause critical damage to building structures and human health. A variety of tools are available to help prevent damage from water that passes the primary weather barrier in its different forms.

Strategy Two: Drain

Liquid water in the assembly needs to be able to drain to the exterior of the building. A number of cladding types, such as stucco, wood, fiber cement, concrete and masonry absorb water and become, as Building Science Corp. refers to them, reservoir claddings. Absorbed water is transported by capillary action. Keeping water from the wall assembly begins with controlling that capillary action in the cladding, which is the

function of a drainage plane, along with ample space between the reservoir cladding and the wall assembly.

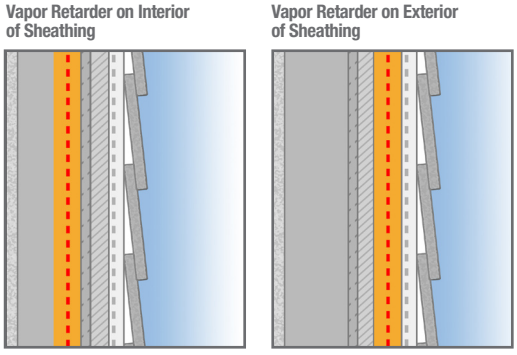
An air barrier inwardly placed from the cladding can function as the drainage plane if it is continuously sealed. When absorbed water is exposed to the sun's heat, the water turns to vapor, and serious inward vapor drive occurs – even in warm climates.[5] Drainage cavities formed by drainage mats and channels can help facilitate this action. Vapor drive occurs in an assembly when pressure differentials between the inside and the outside of the building cause moisture-laden vapor to move from an area of high pressure to an area of low pressure where cooler, drier air is present. Pressure differentials are only a consideration for the assembly if the materials have the permeability to allow for vapor diffusion, where vapor molecules pass through porous materials. The rates of vapor diffusion are dependent upon the degree of permeability. Although it has often been considered a negative occurrence for the envelope, vapor diffusion can actually perform an important drying function and should be considered a necessary component for proper assembly design.

Strategy Three: Dry

As water heats, the vapor particles are able to travel through much smaller openings in the wall assembly. Creating the ability for that vapor to escape the assembly becomes crucial to long-term building endurance, regardless of the locale and climate outside.

Cooling air becomes less able to hold moisture, raising relative humidity as water vapor density falls. At 100% relative humidity, the air is saturated in moisture, condensing into dew droplets that can form on the surface of the assembly. Whether condensation occurs within the wall assembly is a function of the temperature of the wall components. In a cold winter climate, for example, the indoor temperature is likely around 70° F degrees, while the outside temperature may be 10° F degrees. Based on the wall assembly components, the temperature of the sheathing may be at the dew point, where moisture-laden air condenses as water droplets. When components such as continuous insulation are added, outbound of the exterior sheathing, the location within the assembly where dew point temperature is reached may also be moved outbound of the sheathing. In this scenario, a vapor permeable WRB may allow water vapor to be carried beyond the secondary water barrier and, assuming a drainage cavity is in place, allow for liquid water to form where it can be safely drained out of the assembly.

Complexity in building envelope design occurs because the dew point is variable depending on atmospheric pressure and temperature, as well as the variance in the assembly components and their temperature throughout the building. This results in variances in the temperature of the wall assembly components. Condensation can occur on any of the assembly components, driving consideration of material usage with vapor diffusion capabilities as a means of moisture management. Understanding this dew point analysis plays a vital role in successfully designing and constructing new buildings and assessing the state of existing ones.



When water condenses on a building's exposed internal surfaces (like cold windows), this is called surface condensation. When it occurs within the fabric of the building (such as on

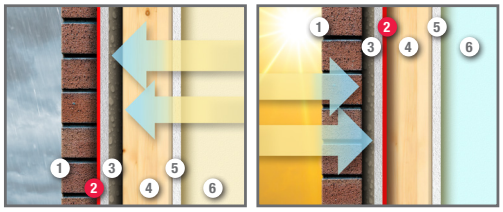
the surfaces of assembly materials), it is called interstitial condensation, which can cause mold and other moisture-related issues. Historically in cold climates, a vapor retarder was installed on top of the sheathing to prevent vapor diffusion from the exterior to the interior. This, however, results in potential condensation from the warm, moist interior air in high pressure toward the cold, dry exterior air in low pressure. The warm, moist air cannot escape, causing condensation to occur on the inward-facing side of the sheathing.

Conversely, when the weather is warm outside, placing a vapor retarder on interior side of the sheathing restricts the movement of warm, moist outside air in high pressure toward the cool, dry low-pressure air inside the building, causing condensation to form on the outwardly facing side of the sheathing.

The natural response to this is to assume placing a vapor retarder on both sides of the sheathing will solve the dilemma; however, this only restricts moisture-laden vapor from escaping the building in both directions. Water vapor needs to escape for the assembly to remain dry. It can move inside or outside to dry, or the location where dew point is reached must be strategically located so when liquid water forms it can drain out and away from the building.

In freezing conditions when ice forms on the wall, the concern is that melting water can leak into the building materials as the water droplets heat up and expand. Warmer temperatures inside create opportunities for condensation to evaporate.

Vapor Retarder Placement for Warm & Cold Weather



1. Cladding
2. Vapor Barrier
3. Exterior Sheathing
4. Wall Studs
5. Interior Drywall
6. Building Interior

Building Code Requirements

Industry nomenclature has contributed to confusion about materials application. The lowest permeability occurs in a vapor retarder that has a permeance rating of 0.1 perm or less referred to as a vapor barrier. Vapor retarder permeance ratings can range from 0.1 perm through up to 10 perms. Such vapor retardant materials come in a range of products, including gypsum mats, asphalt saturated building papers, oil- or latex-based paints, elastometric coating, vinyl wall coverings, or sometimes a combination of these materials. Water-resistive barriers resist liquid water from entering the building envelope, while air barriers prevent the uncontrolled flow of air. Some products may act as both water-resistive barriers and air barriers, and in some cases a single product may act as a water-resistive barrier, air barrier, and vapor retarder. Unfortunately, because multiple functions may be performed by single components, confusion has arisen about how to label these products leading to improper naming and even improper understanding of the functions of these components. As an example, it is not uncommon for an "air and vapor barrier" to be referenced when the design professional is actually describing an "air and water-resistive barrier."

Depending on the various materials used within the wall assembly, code* allows for both high and low-perm WRBs, with proper selection depending on the climate zone, type of building, and other materials used within the wall assembly. Understanding code* and vapor drive dynamics reveals that, often, a vapor-permeable WRB is a preferable choice, provided that the rest of the wall assembly addresses issues of air-tightness and liquid water penetration.

The IBC states:

- *Exterior walls shall provide the building with a water-resistant exterior wall envelope.[6] This envelope shall include flashing.*
- *The exterior wall envelope shall be designed and constructed in such a manner as to prevent the accumulation of water within the wall assembly by providing a water-resistive barrier behind the exterior veneer, and a means of draining water that enters the assembly to the exterior.*
- *Not fewer than 1 layer of No. 15 asphalt felt, complying with ASTM D226 for type 1 felt or other approved materials, shall be attached to the studs or sheathing, in such a manner as to provide a continuous water-resistive barrier behind the exterior veneer.*

It's worth noting that the code* says asphalt felt, or another approved substitute must be used with flashing to keep water outside the sheathing. The International Code Council Evaluation Service (ICC-ES) has evaluated a number of WRB materials for use as a substitute for No. 15 asphalt felt, including but not limited to building wraps, liquid-applied WRBs, Grade D building paper, and certain wall components incorporating rigid foam insulation. Building papers and asphalt felt have a permeability of approximately 30 perms (wet cup). With this level of permeability, the asphalt felt will shed water and allow for drying to the exterior but will not likely be able to serve as the vapor retarder.

The Role of Climate

Climate doesn't entirely dictate WRB choice, but it does play a major role. Analyzing the temperature profile of the varying wall components for specific indoor and outdoor conditions for the building determines the use of specific materials. For example, determining the dew point of a wall configuration informs where you can expect condensation to occur.

The IBC's requirements for exterior walls address different needs for different climate zones, dividing vapor retarders into 3 classes (Section 1404.3 –Vapor Retarders):

Class I:	0.1 perm or less *(e.g. PE film)*
Class II:	0.1 > perm ≤ 1.0 perm *(e.g. oil-based paints)*
Class III:	1.0 > perm ≤10 perm *(e.g. water-based paints, other materials)*

Class I or II vapor retarders (less than 1 perm) are required in cold climates (climate zones 5 through 8 and Marine 4C) and must be installed on the interior side of the framed wall. Class III vapor retarders (1-10 perms) installed on the interior side of the wall assembly are allowed in these climates if certain design conditions are met, such as vented cladding over specified sheathings or continuous insulation used with specified R-values. The exterior portion of the wall assembly must compensate with materials that account for or move the location of the dew point to prevent moisture penetration and trapping.

In cold climates, vapor retarders must always be installed to the inside of the wall to defend against condensation pooling from the warmer temperatures inside the building to the colder outdoors, transforming from vapor to liquid that can accumulate and mold in unconditioned areas like inside batt insulation. Class II vapor retarders should not be used on the interior in climate zones 1 and 2. Class I vapor retarders should not be used in climate zones 1 through 4, other than Marine 4 because of the marine layer's condensation in the air. These climate considerations are where dew point analysis is most important to the hygrothermal modeling of the building fabric to determine the ideal water- and air-restrictive barrier system assembly.

Choosing Climate-Appropriate Permeability

Liquid water isn't the only potential threat that climate can pose. Vapor diffusion is the movement of water vapor molecules through materials when driven by differences in vapor pressure. These differences in vapor pressure are caused by variations in air temperature, among other things. The direction that vapor diffuses through materials is always from high pressure to low pressure, usually this means from the warm side to the colder side. In cold climates, vapor drive typically moves from inside (where it is warm) to outside (where it is cold).

Concerns arise when the higher-density moisture in the warm air becomes trapped inside, pushing in all directions toward the wall, ceiling, and flooring assemblies. High-perm WRBs will allow for drying if there is continuous insulation outbound of the sheathing. This configuration can also shift the location of the dew point outbound of the sheathing. High-perm WRBs aid in vapor diffusion and drying potential moisture intrusion.

In walls with sufficient exterior insulation, the dewpoint temperature of the interior air will be below the temperature of the back of sheathing: therefore condensation due to air leakage cannot occur within the stud space. If an assembly is shown by calculation to be safe against air leakage condensation (using the method described below), then diffusion condensation cannot occur, even if absolutely no vapor resistance is provided inside of the sheathing (i.e., no vapor barrier or other control layer), and even if the sheathing is a vapor barrier (such as foil-faced insulations).[14]

Defining Selection Factors

With climate no longer the primary influence in choice of permeability level, other factors must be considered. The choice may come down to what the WRB's function will be within the wall assembly.

1) Is the WRB meant simply to keep rain water off the sheathing?

2) Is it meant to keep rain water off the sheathing and allow for drying when water intrudes the wall cavity?

3) Is it also intended to serve as a vapor retarder or barrier?

4) Is it also the wall assembly's air barrier?

Comparing Vapor Retardation Performance

Low-Perm WRBs

Building science tells us if a low-perm WRB is used outside the sheathing, it will shed water and retard some level of vapor drive. If properly sealed, some WRBs may also serve as the wall assembly's air barrier. In cold climates, a low-perm WRB will shed water but could also slow the vapor diffusion (or moisture-drying potential), which is driven from the inside to the outside of the building. Without proper diffusion, moisture in the warmer air can settle within the assembly. The impacted components are based on the location of the dew point. This is when mold can develop and degradation can occur.

Primary Concern: Given that a vapor barrier is installed on the outside wall, will water be trapped in the wall assembly?

High-Perm WRBs

High-perm WRBs allow for water shedding, but they do not retard the vapor drive like a low-perm WRB. When properly sealed, they can also serve as the air barrier. In hot or cold climates, a high-perm WRB will shed rainwater; however, it will allow a higher rate of vapor diffusion compared to a low-perm WRB.

Primary Concern: Given that the high-perm WRB has a higher rate of vapor diffusion compared to a low-perm WRB, is moisture being allowed into the wall assembly?

Considering Water Intrusion Via Openings and the Importance of Airtightness vs. Vapor Permeability

Small holes and other openings that exist throughout the structure of exterior walls are perhaps one of the most difficult sources to manage. In fact, testing demonstrates that, when a hole is in extreme water and wind, leaks may occur regardless of the water-resistive barrier used.[7] These leaks allow for a greater volume of water to gain entry.

A common misunderstanding of moisture intrusion is the volume of water attributed to different phenomena such as diffusion through materials or water vapor carried by uncontrolled air movement. Vapor diffusion and vapor drive are often cited as concerns in moisture management. Depending on certain factors – including the climate and location of the building, the wall assembly design, the performance of building control systems and the presence of small air leaks — moisture intrusion via diffusion might only pose a fraction of the risk compared to moisture intrusion via uncontrolled air movement.

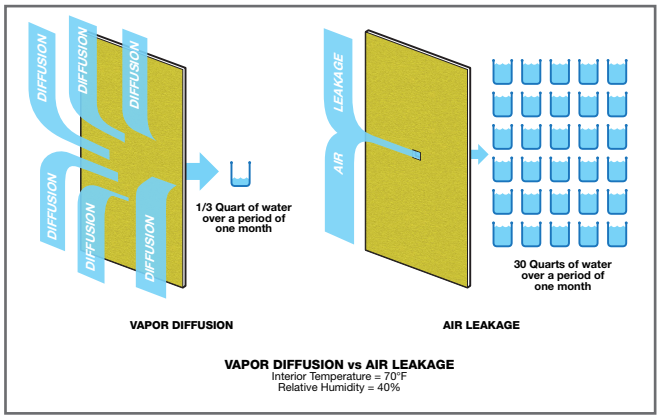


Figure 1: Vapor Diffusion vs. Air Leakage *(Source: Building Science Corporation)*

Vapor retarders slow or stop vapor movement that might occur as a result of diffusion of water vapor through porous materials. Building science research, testing and modeling suggest that the volume and rate at which water diffuses through materials is often minimal. The wall assembly's drying capability is an additional offset to incidental moisture intrusion as a result of vapor diffusion. Good design principles tell us that we should account for the possibility of wetting via diffusion and minor leaks in our assembly and offset that wetting with greater drying capability. However, moisture movement as a result of uncontrolled air leakage can be substantial and more frequently contributes to deleterious effects caused by moisture intrusion. Air leakage normally occurs through holes, cracks, and other openings present in the wall assembly.

This is demonstrated by consultants Building Science Corp. through testing two 4'x8' sheets of drywall, comparing vapor diffusion through one solid piece of gypsum wallboard to the amount of water penetrating the wall cavity when the other piece of gypsum wallboard has a 1" square hole cut in it.[8]

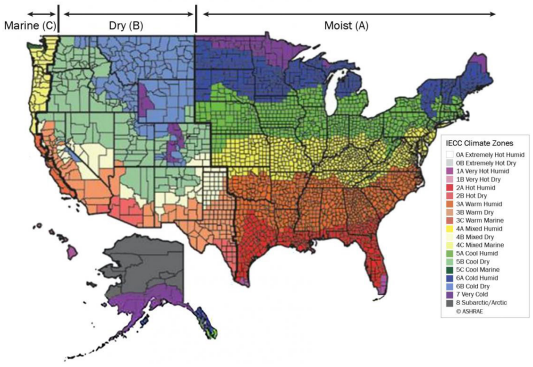
The conditions were:[9]

Position:	**Exterior:**	**Within Cavity:**	**Interior:**
Temp:	80°F	100°F	75°F
Relative Humidity:	75%	100%	60%
Vapor Pressure:	2.49 kPa	6.45 kPa	1.82 kPa

When the two drywall panels were subjected to the same conditions in the experiment, 1 ½ pints of water was collected by diffusion through the painted gypsum wallboard (approximately 5 perms), whereas 14 pints of water was collected through the 1" square hole in the panel. In more simple terms, in the experiment described above, air leakage carried almost 10 times more water vapor through the drywall than vapor diffusion does. This experiment demonstrates why preventing air leakage may be a higher priority in planning for moisture management than vapor diffusion.

It is critical to remember that no matter how masterful the installation, the WRB and sheathing will never be flawlessly sealed. There will always be openings present where water can penetrate over time. Furthermore, each component of the wall assembly, such as insulation, will make its own contribution to the wall assembly's total level of permeability. Use of continuous insulation can provide moisture vapor control and can function as a water-resistive barrier and air barrier.

Climate Zone Map (2021 IECC)[15]



IBC and IRC Building Codes allow for more permeable vapor retarders to be used in climate zones 5, 6, 7 and 8 when the proper amount of plastic foam continuous insulation is used on the outside of the studs.[10] Specific R-values are provided in the codes based on climate zone. The amount of continuous insulation used impacts the heat transfer rate of the assembly.

Since temperature of wall assembly components determines where condensation may occur in the assembly, maintaining an assembly temperature above the dew point temperature can restrict condensation.[11]

Every part of the wall structure must be considered when judging the necessary perm level of the installation's WRB.

Understanding the various factors that affect the transfer of water and air through a building's envelope assembly helps to determine the best low or high-perm vapor retarders to use in your design to best defend against the elements, depending on the conditions that exist.

Modern Innovations in Water-Resistive Barriers

Though it is the only type of WRB called for by the code*, the traditional asphalt felt papers of yesteryear no longer have widespread usage as WRBs. They have since been replaced by mechanically attached sheet products, fluid-applied membranes, self-adhered membranes, and integrated sheathing materials that have gained code* approval through product/system evaluations.

Each of these material types has a wide range of function and permeability. In general, if a WRB material holds a product evaluation report, it has been tested to a specific WRB criteria verifying that the material will keep water outside the sheathing and drain the rain regardless of the permeability and its function as an air barrier or vapor retarder.

Many WRBs also have to meet compliance requirements as air barriers. These solutions have evolved over the past decades in response to demand for greater performance, durability, energy efficiency and ease of installation.[12] Integrated systems have become particularly popular in recent years for their ability to save time, lower costs and produce more reliable results.

Conclusion: Vapor diffusion is far less of a concern than water penetration via air leaks through openings.

DensElement® Barrier System

Georgia-Pacific's DensElement® Barrier System is one of the latest contributions to the industry's collection of integrated products. The gypsum panels integrate the water-resistive barrier and air barrier already within the structure. Specifiers can use the system to address water, and air-resistance needs with a single product.

AquaKor™ Technology transforms the entire gypsum sheathing into a WRB-AB by integrating the fiberglass mat and gypsum core to form a monolithic, hydrophobic surface that blocks bulk water but allows vapor to pass through. This innovative 3-in-1 solution eliminates the need to finish the sheathing with a wrap, peel-and-stick, or fluid-applied barrier. Misapplication risks are thus greatly reduced.

Superior Drying Performance

DensElement Barrier System is vapor-permeable, measuring at greater than 20 perms. Thanks to its high vapor-permeability, the DensElement Barrier System offers excellent drying capability. Using a high-perm, fast-drying WRB may significantly reduce the moisture damage potential in wall assemblies that have taken on moisture.

Code Provisions

ICC-ES Acceptance Criteria AC212 is the basis of recognition for the DensElement Barrier System to be used as a water-resistive barrier. Meeting acceptance criteria AC212 means that the DensElement® Barrier System, without an additional WRB product applied on top of it, performs as well as liquid WRBs applied over sheathing. The DensElement Barrier System also qualifies as a continuous air barrier according to the Air Barrier Association of America and as prescribed in the IECC Section C 402 on building envelope requirements, as related to air leakage, for both materials and assemblies (provided that the joints, fasteners, openings, penetrations, and material transitions are sealed with DensDefy® Liquid Flashing.[13]

In Conclusion

Conventional practices reflect the belief that code* only permits the use of impermeable WRBs in cold climate zones. As has been demonstrated in this white paper, that belief is untrue. Both high- and low-perm WRBs may fulfill code* requirements when considered in the context of other materials within the wall assembly. Understanding code* requirements and the dynamics of vapor drive are essential to designing an optimal wall assembly.

Glossary of Terms

A knowledgeable builder is a successful builder. With such a scientific and technical topic and terms that seem extremely similar, there's bound to be confusion. Know the differences to avoid common misinformation pitfalls.

Dew Point:	the temperature that air must cool to be fully saturated with moisture, condensing to become liquid water "dew drops"
Hygrothermal Modeling:	a computer-based modeling that predicts movement of heat and moisture through buildings
Impermeable WRB:	a liquid water barrier that will not let water vapor pass through
Interstitial Condensation:	the process of water condensing from a vapor to a liquid when moist air permeates hidden spaces inside an enclosed wall, ceiling, or floor structure
Vapor Permeability:	amount of water vapor able to pass through a material
High Vapor Permeability:	water vapor flow is less restricted
Low Vapor Permeability:	water vapor flow is more restricted
Relative Humidity:	the amount of water vapor present in air expressed as a percentage of the amount needed for saturation at the same temperature Surface Condensation: the process of water condensing from a vapor to a liquid on a construction's surface, rather than hidden between its layers
Vapor Barrier:	an impenetrable material that resists water vapor diffusion
Diffusion:	the movement of water gasses through vapor-permeable materials
Drive:	moisture gasses moving from an area of high density to low density (typically moving from warmer temperatures to cooler temperatures)
Retarder:	allows some movement of water vapor between materials
Water-Resistive Barrier:	building materials designed to resist bulk liquid water that has penetrated past the exterior wall cladding
WRB-AB:	water-resistive barrier and air barrier, a membrane that resists liquid water and uncontrolled air flow

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* For purposes of this white paper, code refers to the IBC and IRC uniform code. Please consult local code for deviations. This paper is intended solely for general information and guidance. Ultimately, the design and detailing of any project, assembly or system is the responsibility of a professional, and all projects must comply with applicable building codes and standards. GP Gypsum disclaims any responsibility or liability for the architecture, design, engineering or workmanship of any project, assembly or system.

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Environmental Product Declaration

ACCORDING TO ISO 14025 AND ISO 21930

Type III environmental product declaration (EPD) developed according to ISO 14025 and 21930 for Gypsum 5/8" DensElement® Sheathing Panel

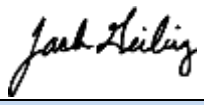
NSF Certified Environmental Product Declaration www.nsf.org

NSF Certified Environmental Product Declaration

This document is a Type III environmental product declaration by Georgia-Pacific LLC that is certified by NSF Certification, LLC as conforming to the requirements of ISO 14025 and ISO 21930. NSF Certification, LLC has assessed that the Life Cycle Assessment (LCA) information fulfills the requirements of ISO 14040 in accordance with the instructions listed in the product category rules cited below. The intent of this document is to further the development of environmentally compatible and sustainable construction methods by providing comprehensive environmental information related to potential impacts in accordance with international standards.

Environmental Product Declaration Summary

GENERAL SUMMARY			
Owner of the EPD	Georgia-Pacific Gypsum LLC 133 Peachtree St NE Atlanta, GA 30303		
Product Group	Glass Mat Gypsum Panels		
Product Name	5/8" DensElement® Sheathing Gypsum Panel		
Product Definition	Gypsum panel is the generic name for a family of sheet products consisting of a non-combustible core primarily of gypsum with a paper or glass mat facing. This EPD is for a gypsum panel with glass mat facing.		
Product Category Rule (PCR)	NSF International, Product Category Rules for North American Gypsum Boards – Gypsum PCR-2019: v1. ISO 21930 Sustainability in building construction – Environmental declaration of building products, Geneva, 2017.		
Declared Unit	1000 square feet, commonly referred to as MSF (92.9 square meters)		
EPD INFORMATION			
Program Operator		NSF Certification, LLC	
Declaration Holder		Georgia-Pacific Gypsum LLC	
Product group Gypsum Panel	**Date of Issue** December 19, 2019 **Updated** August 20, 2020	**Period of Validity** 5 years from the date of issue	**Declaration Number** EPD10308
Declaration Type A “Cradle-to-gate” EPD for 5/8" DensElement® Sheathing Gypsum Panel. Activity stages covered include the product manufacturing (modules A1 to A3). The declaration is intended for use in Business-to-Business (B-to-B) communication.			

Product Applicability and Characteristics 5/8" DensElement® Sheathing gypsum panel is primarily used as an interior surface panel suitable to receive decoration for both residential and commercial building applications. Glass Mat Gypsum Panels are used in single and multiple layer wall systems and has a service life of 60 years. 5/8" DensElement® Sheathing gypsum panel is 5/8 inches thick, or 1.59 cm thick. Glass Mat Gypsum Panels are manufactured to ASTM C1177, Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.	
Content of the Declaration The declaration follows Section 9, Content of the EPD, NSF International, Product Category Rules for North American Gypsum Panel Products – Gypsum PCR-2019: v1.	
LCA Software and Version Number	GaBi 9.5.2.49
LCI Databases and Version Number	GaBi Database, Service Pack 40
This EPD was independently verified by NSF Certification, LLC in accordance with ISO 14025: **Internal** **External** X	Jenny Oorbeck joorbeck@nsf.org 
EPD PROJECT REPORT INFORMATION	
EPD Project Report	Life Cycle Assessment of Georgia-Pacific Gypsum Panel products, Final report 09/2019
Prepared by	Georgia-Pacific LLC 133 Peachtree St NE Atlanta, GA 30303
This EPD project report was independently verified by in accordance with ISO 14025 and the reference PCR:	Jack Geibig – EcoForm jgeibig@ecoform.com 
PCR INFORMATION	
Program Operator	NSF International 789 N. Dixboro Ann Arbor, MI 48105
Reference PCR	NSF International, Product Category Rules for North American Gypsum Panel Products – Gypsum PCR-2019: v1.
Date of Issue	2019
PCR review was conducted by:	Thomas Gloria, Ph.D. Jack Geibig Bill Stough

In order to support comparative assertions, this EPD meets all comparability requirements stated in ISO 14025:2006. However, differences in certain assumptions, data quality, and variability between LCA data sets may still exist. As such, caution should be exercised when evaluating EPDs from different manufacturers, as the EPD results may not be entirely comparable. Any EPD comparison must be carried out at the building level per ISO 21930 guidelines. The results of this EPD reflect an average performance by the product and its actual impacts may vary on a case-to-case basis.

1 PRODUCT IDENTIFICATION

1.1 PRODUCT DEFINITION

Glass Mat Gypsum Panels is Georgia-Pacific Gypsum's name for a family of sheet products consisting of a noncombustible core primarily of gypsum, with glass mat surfacing. Glass Mat Gypsum Panels consists of glass mat surfaces on the face and back. Glass Mat Gypsum Panels have a noncombustible gypsum core. The panel can vary in length and can have specific glass mat facers and additives in the core to enhance physical and performance properties of the board.

Glass Mat Gypsum Panels shall comply with Standard Specification for Gypsum Board ASTM C1177, ASTM C1178, and ASTM C1658.

1.2 PRODUCT STANDARD

Applicable product standards for gypsum wallboard (UNSPSC Code 30161500) include:

- ASTM C473 Standard Test Methods for Physical Testing of Gypsum Panel Products.
- ASTM C1177 Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing
- ASTM D3273-12 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
- ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
- ASTM E119 - 10b- Standard Test Methods for Fire Tests of Building Construction and Materials.

2 PRODUCT APPLICATION

The DensElement® Barrier System is specified to be used as the exterior wall sheathing, the water resistive barrier, and the air barrier as required by building code when the panel joints, fasteners, penetrations, openings and transitions are properly sealed by an approved third party fluid applied flashing per the manufacturer's recommendations.

3 DECLARED UNIT

The declared unit is 1,000 square feet (MSF) of gypsum panel. The conversion factor to kilograms is 0.845 ft^2/kg (=1000 ft^2/1.18E003 kg).

Table 1: Product data summary

PRODUCT	THICKNESS INCHES (CM)	SPECIFIC DENSITY LB/MSF (KG/92.9M^2)	CORE TYPE	ASTM STANDARD
5/8" DensElement® Sheathing Gypsum Panel	5/8" (1.59 cm)	2.61E003 (1.18E003)	Type X	C1177

3.1 TECHNICAL DATA

See Table 2 for a summary of technical data for 5/8" DensElement® Sheathing gypsum panel.

Table 2: Technical Data

TECHNICAL DATA	VALUE AND UNITS/TEST RESULTS/STATEMENT	REFERENCED DOCUMENTS
"R" factor – thermal resistance in US unit [SI unit]	0.67R	ASTM C518
Safety Data Sheet	Yes	Available at gpgypsum.com
Mold resistance (if applicable)	Score 10 out of 10	ASTM D3273
Water Absorption (if applicable)	<5%	ASTM C1177
Surface burning characteristics (if applicable)	See flame and smoke	
Flame Spread	0	ASTM E84
Smoke Developed	0	ASTM E84
Water Vapor transmission Desiccant Method Test	>25 US Perms	ASTM E96
Abuse/Impact resistance test (if applicable)	N/A	
Total Recycled content (%)	Dependent on the facility	As defined in ISO 14021
Pre-consumer (%)	Dependent on the facility	As defined in ISO 14021
Post-consumer (%)	Dependent on the facility	As defined in ISO 14021

4 MATERIAL CONTENT

4.1 DEFINITIONS

Per Glass Mat Gypsum Panels SDS Product List A: calcium sulfated dihydrate (Gypsum), crystalline silica (quartz), and fibrous glass (fiberglass).

The material content for 5/8" DensElement® Sheathing gypsum board is represented by the following quantities*:

Gypsum – 93.7%
Glass mat – 5.12%
Additives (dry and wet) – 1.18%

*Numbers may not add up to exactly 100% due to rounding

Product formulation (wet value at the time of manufacture), on the basis of 1000 square feet (1 MSF or 92.9m^2) of 5/8" DensElement® Sheathing gypsum panel output (dry value) with a finished density of 2.61E003 lb/MSF at 0.5% moisture content at the facility gate.

4.2 PACKAGING

Packaging consists of banding, rail bags and slip sheets; cardboard and metal edge/corner protectors; risers/spacers constructed of gypsum board; and adhesive for risers/spacers.

5 PRODUCT STAGE

The system boundary for the gypsum panel starts with the raw material acquisition and extends through the manufacturing of the panel, cradle-to-shipping gate. All transportation distances for the raw materials, chemicals and the final product were included. Data included from gypsum panel manufacturing, emissions to air, water and soil, and any solid waste or wastewater. The figures below illustrate the system boundary for gypsum facer manufacturing and gypsum wallboard manufacturing.

Table 3: Description of the system boundary

Product Stage			Construction Process Stage		Use Stage							End-of-Life Stage			
Raw Material Supply	Transport	Manufacturing	Transport	Construction-insulation process	Use Stage	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction demolition	Transport	Waste processing	Disposal
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4
X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

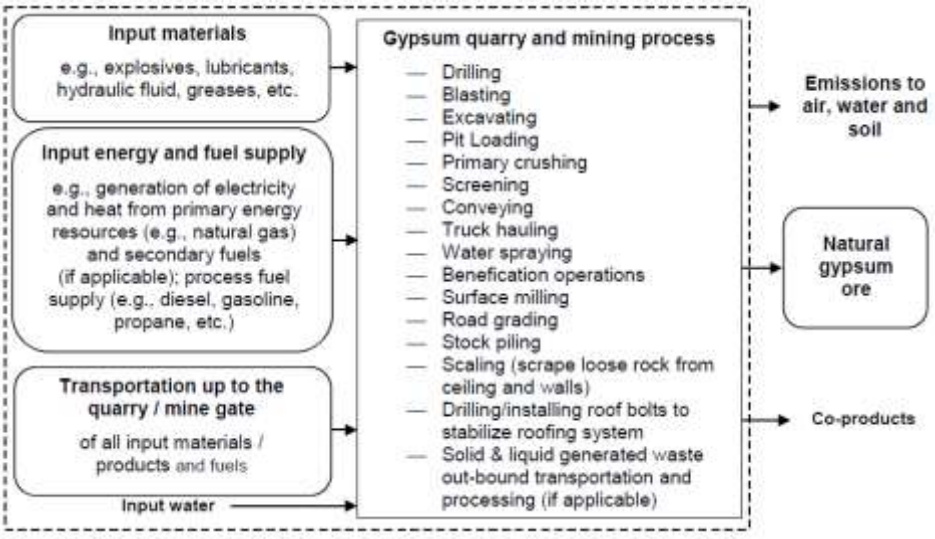


Figure 1: System boundary for gypsum quarry and mining

Gypsum glass mat manufacturing is also included in Module A1.

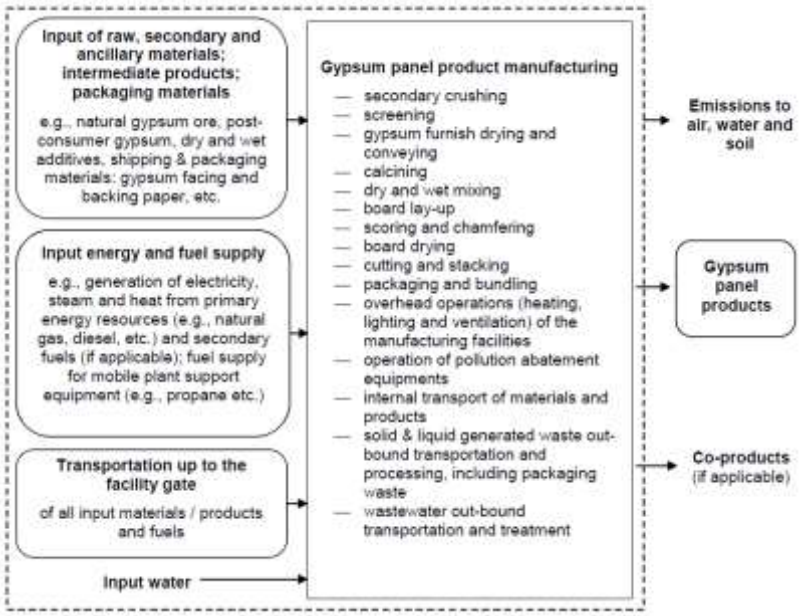


Figure 3: System boundary for gypsum panel product manufacturing

6 LIFE CYCLE INVENTORY

6.1 CUTOFF CRITERIA

The cut-off criteria follows the rules outlined in the Gypsum PCR and did not exceed 3% of the total mass, energy or environmental relevance.

6.2 DATA QUALITY

GP gypsum quarry, gypsum paper, gypsum glass mat, and wallboard facilities estimated, calculated, or measured the collected primary data for the production of natural gypsum, gypsum paper, gypsum glass mat, and gypsum panel product. The data was validated by the plant managers at the facilities and by the internal LCA project team.

All specific processes discussed in the Gypsum Panel Products PCR are considered and modeled to represent gypsum panel products produced at Georgia-Pacific LLC. The background process data were supplied by the USLCI database, GaBi thinkstep LCI database and the US adjusted ecoinvent v 2.2 LCI database and modeled in GaBi 9 with the 2019 database.

6.3 REPRESENTATIVENESS

The 2017 production data from 2 facilities for 5/8" DensElement® Sheathing gypsum panel represents 100% of total GP production in 2017 for that product. Secondary data from appropriate LCI datasets range from 2014-2018.

6.4 ALLOCATION

Allocation is necessary for the gypsum panel and gypsum paper facilities because the mill produces other paper or panel products. The allocation rules for the LCA follow the PCR allocation rules for gypsum panel products.

Mill level data such as air, water and soil emissions, gypsum raw material, paper raw material, water consumption and energy were allocated according to production mass.

FGD gypsum was performed according to the allocation rule outlined in the PCR Section 7. The FGD gypsum is considered burden free as it is not a primary material of the coal-fired power generation and is a waste input.

7 LIFE CYCLE ASSESSMENT

7.1 RESULTS OF THE LIFE CYCLE ASSESSMENT

The LCA results for 5/8" DensElement® Sheathing panel are shown in Table 4. The U.S. Environmental Protection Agency's TRACI (Tool for the Reduction and Assessment of Chemical and other Environmental Impacts) life cycle impact assessment methodology (version 2.1) is applied to calculate environmental performance of gypsum board. Per declared unit, impact indicator results, energy and material resource consumption, and waste are presented in Table 4. Impact indicators used are global warming potential (GWP), acidification potential, eutrophication potential, smog potential, and ozone depletion potential. LCIA results are relative expressions and do not predict impacts on category endpoints, the exceedance of thresholds, safety margins, or risks.

The LCIA results were updated after the initial publication of the EPD due to a service pack update in the LCA software and databases, from service pack 39 to 40. The service pack update included updates to environmental quantities in the secondary data and some conversion factors which may impact some of the LCIA results. There were no changes made to GP primary data in this update.

Table 4: EPD Summary Results - 1 MSF of 5/8" DensElement® Sheathing Gypsum Panel

PARAMETER	UNITS	TOTAL OF PRODUCT STAGE (A1-A3)
ENVIRONMENTAL IMPACTS		
Global warming potential (GWP 100)	kg CO_2-eq	485
Ozone depletion potential (ODP)	kg CFC-11-eq	2.96E-005
Eutrophication potential (EP)	kg N-eq	0.535
Acidification potential (AP)	kg SO_2-eq	2.21
Photochemical ozone creation potential (POCP)	kg O_3-eq	41.7
RESOURCE USE		
RPRE: Renewable Primary energy used as energy carrier (fuel)	MJ	147
RPRM: Renewable primary resources with energy content used as material	MJ	0
NRPRE: Non-renewable primary resources used as an energy carrier (fuel)	MJ	5.59E003
NRPRM: Non-renewable primary resources with energy content used as material	MJ	0
SM: Secondary materials	kg	0
RSF: Renewable secondary fuels	MJ	0
NRSF: Non-renewable secondary fuels	MJ	0
RE: Recovered energy	MJ	0
FW: Use of net fresh water resources	m^3	8.76
Abiotic depletion potential - fossil fuels (ADP_{fossil})	MJ	759
WASTE FLOWS		
HWD: Hazardous waste disposed	kg	3.85E-006
NHWD: Non-hazardous waste disposed	kg	51.8
HLRW: High-level radioactive waste, condition, to final repository	kg	8.68E-005
ILLRW: Intermediate- and low-level radioactive waste, conditioned, to final repository	kg	0.00238
CRU: Components for re-use	kg	0
MR: Materials for recycling	kg	3.05
MER: Materials for energy recovery	kg	0
EE: Exported energy	MJ	0

7.2 INTERPRETATION

The LCA study results found the manufacturing stage has the highest contribution to global warming and smog creation potential. The manufacturing stage includes the gypsum wallboard production and the energy consumption for wallboard manufacturing. The raw materials supply had the highest contribution to acidification potential, eutrophication potential, and ozone depletion potential. This stage includes the extraction and production of all raw materials used in the gypsum panel product.

8 ADDITIONAL ENVIRONMENTAL INFORMATION

8.1 ENVIRONMENT AND HEALTH DURING MANUFACTURING

The following environmental abatement pollution equipment were installed at the surveyed GP facilities to control particulate matter (PM) emissions:

- Fabric Filter – high temperature and low temperature baghouses
- Bin Vents
- Precipitator
- Water Sprinklers for Dust Control

9 DECLARATION TYPE AND PRODUCT AVERAGE DECLARATION

The type of EPD is defined as a “Cradle-to-gate” EPD covering the product stage and is intended for use in Business-to-Business communication. This EPD represents an average performance for the product(s) included in the EPD, manufactured at Georgia-Pacific facilities.

10 DECLARATION COMPARABILITY LIMITATION STATEMENT

Environmental declarations from different programs may not be comparable. The comparison of the environmental performance of gypsum wallboards using the EPD information shall be based on the product's use in and its impact on or within the building and shall consider the complete life cycle (all information modules). EPDs are only comparable if they comply with the NSF PCR for Gypsum Product Panels 2019 v1, include all relevant information modules, and are based on equivalent scenarios with respect to the context of construction works. EPDs prepared from cradle-to-grave life cycle results and based on the same function, RSL, quantified by the same functional unit, and meeting all the conditions for comparability listed in ISO 14025:2006 and ISO 21930:2017 can be used for comparison between products. EPDs without a functional unit may not be compared.

11 EPD EXPLANATORY MATERIAL

For any explanatory material, in regard to this EPD, please contact Georgia-Pacific.

Barry Reid
GP Gypsum
133 Peachtree St. NE
Atlanta, GA 30303
bsreid@gapac.com

For any explanatory material, in regard to the PCR or the verification of this EPD, please contact the program operator.

NSF International
789 N. Dixboro
Ann Arbor, MI 48105
www.nsf.org

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8) TRACI v2.1, http://www.epa.gov/nrmrl/std/sab/traci/

9) Product Category Rules for Gypsum Product Panels. 2019 v1. Program Operator: NSF International

10) Sphera Changelog GaBi Service Pack Update 39 to 40, http://www.gabi-software.com/fileadmin/GaBi_Databases/GaBi_9_2_changelog_SP40_feb2020.pdf

DensElement® Barrier System Repair Guide

In the event that the DensElement Barrier System is damaged during delivery, installation or while in service, the damage should be repaired as soon as possible. Damaged areas should be assessed and repaired to maintain the desired fire-resistance, structural integrity and water-resistive / air barrier (WRB-AB) properties of the system. An appropriate repair method should be chosen according to the type and severity of the damage.[1]

Recommended Tools and Materials

- DensElement® Sheathing
- DensDefy® Transition Membrane
- DensDefy® Liquid Flashing
- Cutting Tool or Knife
- Metal Track
- Standard sheathing fastener
- Soft bristle brush and rags
- Sausage caulking gun
- Straight Edge Tool
- Metal Track
- J-Roller
- Rasp

Misplaced or Stripped Fasteners and Vacated Fastener Holes

If sheathing or cladding fasteners miss the framing, remove the fastener then fill and seal the vacated fastener hole with DensDefy® Liquid Flashing. All effort should be taken to ensure façade fasteners are driven straight and tight to the substrate without being stripped. Façade fasteners not driven properly may need to be evaluated and repaired.

Minor Surface Damage

Minor damage or surface indentations may be sealed with DensDefy® Liquid Flashing. Apply DensDefy® Liquid Flashing, using a straight edge tool to spread the material evenly over the affected area to achieve 16 mils and overlap onto intact sheathing by at least 1 inch.

Deep Indentations or Extensive Surface Damage

Damage to the DensElement® Sheathing that results in the fiberglass mat being torn away, no longer intact with the gypsum core of the sheathing, or leaves the gypsum core exposed must be repaired.

If the fiberglass mat has disengaged from the core of the sheathing in a surface area that is:

- *Greater than 8 inches*, replace that section of sheathing following the steps in the repair section for “Large Size Holes”.
- *Less than 8 inches*, continue steps 1-3 below.

1. Cut away and remove any loose fiberglass mat.
2. Prime any exposed gypsum core with water-based bonding primer or surface conditioner suitable for raw gypsum.
3. Apply DensDefy® Liquid Flashing to the entire primed area, covering a minimum 1" beyond the damaged area on all sides to achieve 16 mils.

[1] For additional guidance for repairing small holes in fire rated assemblies, refer to the Gypsum Association GA-225 Repair of Fire-Rated Gypsum Panel Product Systems.

Small Holes (not Greater than 1 inch)

For WRB-AB repairs in non-fire-rated construction, for holes larger than ¼" and less than 1" install a backer rod or a back dam and cover the entire area with DensDefy® Liquid Flashing.

Small to Medium Sized Holes (1-8 inches)[1]

Small to medium holes may be repaired with infill framing and a panel patch.

1. The patch should be mechanically secured to maintain the integrity of the DensElement® Barrier System:
    - From the back side of the sheathing panel (inside the wall cavity), center a flat metal track on the edge of the cut square opening, leaving half of the metal track exposed to later secure the panel patch.
    - Secure the metal track to the original sheathing using standard sheathing fasteners.
    - Repeat on all four sides of the opening.
    - Fit the panel patch into the hole tightly.
    - Attach the panel patch to the metal track using standard sheathing fasteners.
2. Using a cutting tool or utility knife, square off the hole and surrounding damaged area of the sheathing. It should be cut large enough to secure metal track to all four sides of the hole on the backside of the sheathing.
3. From the backside of the sheathing panel (inside the wall cavity), center a flat metal track on the edge of the square cut opening, leaving half the metal track exposed to later secure the panel patch.
4. Secure the metal track to the original sheathing using standard sheathing fasteners. Repeat on all four sides of the opening.
5. Cut a patch from the same thickness of DensElement sheathing so that it will fit tightly into the patch area.
6. Attach the panel patch to the metal track using standard sheathing fasteners.
7. Treat the seams of the newly patched hole with a minimum of 1 inch of DensDefy® Liquid Flashing on both sides of the seam, at a minimum thickness of 16 wet mils.
8. Treat fastener heads with DensDefy® Liquid Flashing.

[1] For additional reference for repairing small holes, refer to the Gypsum Association GA-225 Repair of Fire-Rated Gypsum Panel Product Systems.

Large Sized Holes (8-inches and greater)

Holes in the DensElement® Sheathing that are larger than 8-inches in diameter should be cut and removed to the closest framing members on both side of the hole. Then:

1. Secure metal track to back of the remaining sheathing (inside the wall cavity) at the top and bottom edges of the opening.
2. Tightly secure the framing to the metal track using standard sheathing fasteners driven through the sheathing and into the metal track.
3. Attach the replacement DensElement® Sheathing to the exposed framing members and the installed metal track with standard sheathing fasteners.
4. Treat the seams of the replacement DensElement® Sheathing with a minimum of 1 inch of DensDefy® Liquid Flashing on both sides of the seam.
5. Seal fasteners heads with DensDefy® Liquid Flashing.

Installed DensDefy Transition Membrane with Bubbles, Fishmouths, or Wrinkles

During the course of installation, if an air bubble, fishmouth or wrinkle form, a J-roller may be used to smooth out the effected area. If after rolling out the area, the bubbles, fishmouths, and or wrinkles are still evident, then the following method can be used to repair the area .

1. Cut the area to release any trapped air and to aid in laying the transition membrane flat to the substrate.
2. Firmly press the DensDefy® Transition Membrane back to the substrate and ensure the desired adhesion is achieved by rolling out the Transition Membrane with a J-roller. The Transition Membrane should be firmly attached around the puncture.
3. Apply DensDefy® Liquid Flashing over the repaired area.
4. With a straight edge tool, spread the DensDefy® Liquid Flashing and apply at a rate to achieve a minimum if 16 wet mils completely covering the affected area.

Damaged DensDefy® Transition Membrane

Damage to DensDefy® Transition Membrane that results in holes or punctures must be repaired. Ensure the area to be repaired is clean, dry, and that all bond-inhibiting agents are removed prior to installing a patch of DensDefy® Transition Membrane to the substrate.

Option 1

1. Cut out the damaged area of the DensDefy® Transition Membrane back to where the transition membrane is completely bonded to the substrate.

2. Cut a patch of the DensDefy® Transition Membrane to fit over the center of the damaged area and a minimum of 2-inch (50mm) overlap on to the non-damaged membrane.
3. Remove release paper from the DensDefy® Transition Membrane and press in place with hands or tool. The Transition Membrane should be firmly attached around the puncture.
4. Apply pressure by rolling with a J-roller to adhere the membrane and achieve a smooth and wrinkle-free surface without voids or fish mouths.
5. Apply DensDefy® Liquid Flashing over all edges of the applied DensDefy® Transition Membrane patch.
6. With a straight edge tool, spread DensDefy® Liquid Flashing evenly over the membrane edge.
7. Apply at a rate to achieve a minimum wet mil thickness of 16 mils over the membrane edge, leaving no exposed membrane edge.

Option 2

1. Apply DensDefy® Liquid Flashing®
2. Using a straight edge tool to spread the material evenly over the effected area to achieve 16 wet mils and 1" passed the damaged area.

These repairs, when done properly, help maintain the water and air resistive properties of the DensElement® Barrier System. For Georgia-Pacific Building Products' limited warranty for the DensElement® Barrier System visit www.DensElement.com for complete warranty details. For additional assistance, contact Georgia-Pacific Building Product's Technical Service at 1-800-225-6119.

Dens Element® BARRIER SYSTEM
GP Georgia-Pacific

DensElement.com

Limited Warranty

INTERNATIONAL

GP Gypsum LLC ("GP") provides the following limited warranty with respect to both (a) DensElement® Sheathing and (b) DensElement Sheathing installed with DensDefy™ Accessories and/or GP approved tape or liquid flashing for the treatment of the joints, fasteners, openings, transitions and penetrations as part of the original building envelope of a commercial or residential property, all as specifically identified and described in GP's current published literature at www.buildgp.com (collectively, the "DensElement® Barrier System"). The limited warranty set forth herein applies to any DensElement Sheathing or any DensElement Barrier System sold by GP and purchased on or after January 1, 2021 (the "Effective Date") for installation in a country other than the United States of America, its territories and Canada. **PLEASE READ THIS DOCUMENT CAREFULLY, AS THIS WARRANTY AND YOUR PURCHASE OF DENSELEMENT SHEATHING AND THE DENSELEMENT BARRIER SYSTEM IS SUBJECT TO ALL OF THE TERMS AND CONDITIONS BELOW.**

LIMITED WARRANTY. GP warrants to each Qualified Purchaser (as defined below) that:

1. Defects: the DensElement Sheathing or DensElement Barrier System installed or to be installed in such structure was, at the time of shipment from the manufacturer, free from manufacturing defects that make it unsuitable for use as a sheathing or water-resistive and air-barrier (WRB-AB) system, respectively (as described at www.buildgp.com), which limited warranty shall have a duration of five (5) years from the date of purchase of the product or, when the DensElement Sheathing is used as a substrate in architecturally specified EIFS, twelve (12) years from the date of purchase of the product for installation; and
2. Exposure: the DensElement Sheathing or the DensElement Barrier System, when properly installed in a structure, will not deteriorate or de-laminate as a result of normal use conditions or as a result of exposure to normal weather conditions for a period of twelve (12) months com-mencing on the date of installation of the DensElement Barrier System in such structure.

A "Qualified Purchaser" is: (i) any purchaser of DensElement Sheathing or GP approved tape or liquid flashing for any DensElement Barrier System for installation in a country other than the United States of America, its territories and Canada; (ii) any person who installs DensElement Sheathing or the DensElement Barrier System in a structure in a country other than the United States of America, its territories and Canada; or (iii) any person who owns a structure in a country other than the United States of America, its territories or Canada that includes DensElement Sheathing or the DensElement Barrier System.

THE FOREGOING IS THE SOLE WARRANTY GIVEN BY GP WITH RESPECT TO DENSELEMENT SHEATHING AND THE DENSELEMENT BARRIER SYSTEM FOR INSTALLATION IN THE COUNTRIES INDICATED AND IS IN LIEU OF, AND GP EXPRESSLY DISCLAIMS, ALL OTHER REPRESENTATIONS, WARRANTIES, GUARANTEES AND CONDITIONS, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. WHERE APPLICABLE LAW DOES NOT PERMIT THE DISCLAIMER OF ANY IMPLIED REPRESENTATION, WARRANTY, GUARANTEE OR CONDITION, THE DURATION OF SUCH IMPLIED REPRESENTATION, WARRANTY, GUARANTEE OR CONDITION SHALL BE LIMITED TO THE GREATER OF NINETY (90) DAYS FROM THE DATE OF PURCHASE OR THE MINIMUM LEGAL DURATION UNDER APPLICABLE LAW.

Terms and Conditions Applicable to Warranties. The foregoing warranties are conditioned on and subject to the additional terms and conditions set forth below.

1. **Exclusions.** The foregoing warranties apply only when DensElement Sheathing and the DensElement Barrier System have been subjected to normal weather and use conditions and have been accorded treatment which is considered good practice in the building industry regarding storage, handling, joint and opening treatment, and maintenance of such products. In addition to this limitation, any damage to DensElement Sheathing or the DensElement Barrier System resulting in whole or in part from the following conditions is NOT GP's responsibility and is NOT covered by the foregoing warranties:
   (a) Failure to store, handle or install DensElement Sheathing or the DensElement Barrier System in accordance with GP's storage, handling and installation instructions (available at www.buildgp.com), applicable building practices and all applicable building codes;
   (b) Improper design or installation of any portion or component of the supportive structure, or failure or distortion of the walls, foundation or any other portion or component of the structure, including settling of the building or movement of framing members;
   (c) Suitability or performance, including failure to establish adequate drainage, of any cladding, coating, finishes, coverings or materials (other than the GP approved tape or liquid flashing for the treatment of the joints, fasteners, openings, transitions and penetrations of the DensElement Barrier System) applied or attached to DensElement Sheathing or the DensElement Barrier System;
   (d) Causes other than normal weather and use conditions, such as: impact with objects; high force winds, earthquake, flood, fire or other acts of God or nature; sustained cascading or pooling of water, or immersion in water; or any other cause beyond GP's control;
   (e) Mold, mildew, fungi, bacteria or other similar conditions;
   (f) Failure to purchase and install DensElement Sheathing or any other components of the DensElement Barrier System within twelve (12) months from its date of manufacture;
   (g) Use of DensElement Sheathing or the DensElement Barrier System other than for its intended use as described at www.buildgp.com; or
   (h) A third-party's actions, omissions or negligence.

DensElement Sheathing and the DensElement Barrier System have natural characteristics that are not to be considered defects or evidence of a breach of warranty.

2. **Remedies.** Before GP will honor any claim, you must give GP written notice of the claim no later than ten (10) days after discovery of any alleged problem with the affected product. Written notice shall be directed to GP Gypsum LLC, 133 Peachtree Street N.E., Atlanta, GA 30303, USA, Attn: Quality Manager. All claims must be accompanied by sales receipts and other supporting documents to evaluate such claim. If GP confirms that the product does not conform with this limited warranty, then GP will, at its sole option, either (i) replace the non-conforming DensElement

(continued on reverse)

Limited Warranty
INTERNATIONAL

Sheathing or DensElement Barrier System, as applicable, (ii) refund the original uninstalled purchase price for the non-conforming DensElement Sheathing or DensElement Barrier System, as applicable, or (iii) where the product has already been installed, reimburse the Qualified Purchaser for the reasonable cost of repair, replacement or disposal of the non-conforming DensElement Sheathing or DensElement Barrier System, as applicable, up to a maximum amount equal to two (2) times the original uninstalled purchase price of the non-conforming DensElement Sheathing or DensElement Barrier System. In no event shall title to any affected product revert to or be transferred to GP, and the Qualified Purchaser shall have the complete control and responsibility for disposal of any non-conforming product, including after disposition of any claim. These remedies are GP's sole and exclusive obligation and liability for any breach of warranty relating to the DensElement Sheathing or DensElement Barrier System and are also the Qualified Purchaser's sole and exclusive remedies for any such breach.

3. **Limitation of Liability. UNDER NO CIRCUMSTANCES WILL GP BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL, CONSEQUENTIAL OR PUNITIVE DAMAGES, INCLUDING, BUT NOT LIMITED TO, LOSS OF PROFITS, LOSS OF USE OF THE PRODUCT OR SYSTEM, COST OF SUBSTITUTE PRODUCTS OR DAMAGE TO PROPERTY, ARISING OUT OF THE PURCHASE OR USE OF THE DENSELEMENT SHEATHING OR DENSELEMENT BARRIER SYSTEM. THIS LIMITATION OF LIABILITY APPLIES TO ANY CLAIM ASSERTED BY THE QUALIFIED PURCHASER, WHETHER ASSERTED AS BREACH OF WARRANTY, BREACH OF CONTRACT, NEGLIGENCE, PRODUCT LIABILITY, STRICT LIABILITY, OR UNDER ANY OTHER LEGAL OR EQUITABLE THEORY. IF AN APPLICABLE COUNTRY DOES NOT ALLOW EXCLUSIONS OR LIMITATIONS OF SPECIAL, INDIRECT, INCIDENTAL, CONSEQUENTIAL OR PUNITIVE DAMAGES, THE ABOVE LIMITATIONS MAY NOT APPLY TO YOU. HOWEVER, IN NO EVENT SHALL GP'S TOTAL LIABILITY ARISING OUT OF OR RELATED TO THE PRODUCTS OR SYSTEMS COVERED UNDER THIS WARRANTY EXCEED THE ORIGINAL PURCHASE PRICE OF THE DENSELEMENT SHEATHING OR DENSELEMENT BARRIER SYSTEM AND THE LABOR COSTS RELATING TO THE ORIGINAL INSTALLATION OF SUCH PRODUCTS**.

4. **Mandatory Arbitration of Claims. ANY DISPUTE OR CLAIM ARISING OUT OF OR RELATING TO THIS LIMITED WARRANTY OR THE PRODUCTS OR SYSTEMS COVERED BY THIS LIMITED WARRANTY (WHETHER BASED IN CONTRACT, INDEMNITY, STATUTE, REGULATION, TORT OR OTHER LEGAL OR EQUITABLE THEORY) (A "DISPUTE") SHALL BE FINALLY RESOLVED BY ARBITRATION IN ACCORDANCE WITH THE INTERNATIONAL INSTITUTE FOR CONFLICT PREVENTION AND RESOLUTION ("CPR") RULES FOR NON-ADMINISTERED ARBITRATION OF INTERNATIONAL DISPUTES ("CPR RULES") BY A SOLE ARBITRATOR. THAT MEANS A NEUTRAL ARBITRATOR, NOT A JUDGE OR JURY, WILL DECIDE ANY DISPUTE**.

   (a) Arbitration Rules. The CPR Rules are available at www.cpradr.org, and CPR shall serve as the Neutral Organization under the CPR Rules. Notices to initiate arbitration should be sent to CPR in accordance with the CPR Rules with a copy addressed to: GP Gypsum LLC, Law Department, 133 Peachtree Street N.E., Atlanta, GA 30303, USA, Attn: Gypsum Division Counsel. Alternatively, you may request that GP initiate the arbitration of a Dispute with CPR by providing written notice of such request to GP at the address above. Any such notice shall describe the nature and basis of the Dispute and the specific relief sought. The seat of the arbitration shall be Atlanta, Georgia; provided, if the relief sought is less than $10,000 (US), you may elect that the arbitration be conducted in person, by phone or on written submissions. The arbitrator shall be a resident of the United States, and the arbitration shall be conducted in the English language. The arbitrator shall apply the law of the State of Georgia without reference to choice of law rules. The arbitrator shall have the authority to decide issues concerning the scope and enforceability of this arbitration provision, including the arbitrability of any dispute or claim, and may award such relief as a court of competent jurisdiction could award. The arbitration shall be governed by the Federal Arbitration Act (9 U.S.C. § 1 et seq.), and judgment upon the award rendered by the arbitrator may be entered in any court having jurisdiction.

   (b) Additional Terms for Consumers. The following additional terms apply solely to any individual consumer who is not a builder, contractor, distributor or other person engaged in the commercial installation or resale of the covered product (a "Consumer"). GP will pay all arbitration filing fees and arbitrator costs for arbitration with a Consumer, and the Consumer shall not be required to reimburse GP for such fees and costs unless the arbitrator determines that the Dispute was frivolous. The Consumer will be responsible for all additional costs that he or she incurs in the arbitration, including, but not limited to, attorneys' fees (if represented by an attorney) and expert witness fees; provided, GP will pay all fees and costs that it is required by applicable law to pay, including payment of attorney's fees and costs required by applicable law. If the arbitration award for a Consumer is greater than GP's last settlement offer, GP will pay the award amount plus a reasonable attorney's fee up to the lesser of three times the award or $5,000 (US).

   (c) Class Action Waiver. **ALL PARTIES TO THE ARBITRATION MUST BE INDIVIDUALLY NAMED, AND THERE WILL BE NO RIGHT OR AUTHORITY FOR ANY DISPUTES TO BE ARBITRATED ON A CLASS, REPRESENTATIVE OR CONSOLIDATED BASIS. YOU MAY NOT PARTICIPATE IN A CLASS OR REPRESENTATIVE ACTION AGAINST GP AS A CLASS MEMBER IF THE CLASS ACTION ASSERTS CLAIMS THAT WOULD FALL WITHIN THE SCOPE OF THIS PARAGRAPH 4.** If this class action waiver is found to be unenforceable by any court or arbitrator, then the arbitration agreement set forth in this Paragraph 4 will not apply to any Dispute between you and GP.

   (d) Jury Trial Waiver. If for any reason the arbitration agreement in this Paragraph 8 is found to be unenforceable, you and GP each expressly and knowingly **WAIVE THE RIGHT TO TRIAL BY JURY OF ANY CLAIM.**

   (e) Opt-Out Rights. **Notwithstanding any contrary provision of this Limited Warranty, GP reserves the right to opt out of mandatory arbitration if named in a lawsuit by a third party that is a defendant brought by a Qualified Purchaser and to require that all related disputes governed by this Limited Warranty be resolved in such lawsuit.**

5. **Non-Transferable.** The foregoing warranties are non-transferable and do not apply to any subsequent purchaser of the covered products or any subsequent owner of a structure. These warranties are not for the benefit of any third parties.

6. **Governing Law.** This limited warranty, its validity and interpretation and any Dispute arising from or relating to this limited warranty shall be governed by the laws of the State of Georgia without regard to conflict of law principles. The United Nations Convention on Contracts for the International Sale of Goods is excluded in its entirety from application to this limited warranty.

7. **Miscellaneous.** This Limited Warranty supersedes all prior and contemporaneous agreements, representations, warranties or understandings, whether oral or written, relating to DensElement Sheathing or the DensElement Barrier System sold for installation the countries indicated. If any provision of the Limited Warranty is determined to be unenforceable for any reason, then the unenforceable provision shall be struck, and the other provisions shall remain in full force and effect. GP reserves the right to discontinue and/or modify this Limited Warranty at any time without notice, provided, any modifications shall not apply to any covered products for which this Limited Warranty is already in effect.

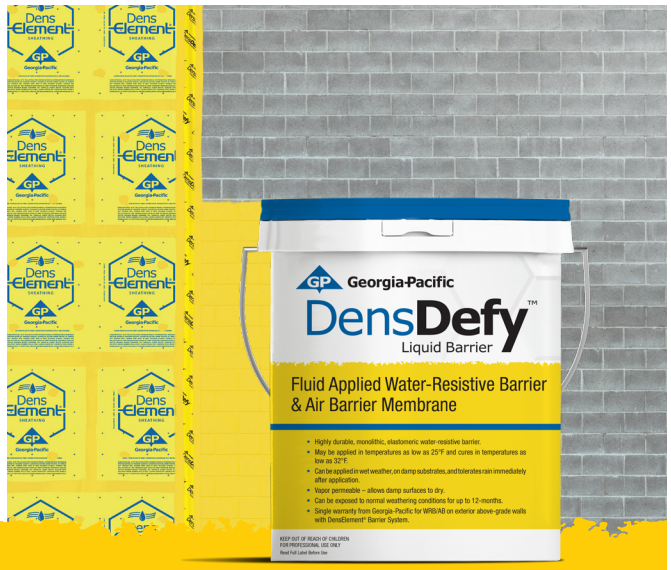
12/20 GP-TM Lit. Item #622936.

Georgia-Pacific Gypsum

Georgia-Pacific
Building Products

Product Data Sheet

DensDefy™
Liquid Barrier



DensDefy™ Liquid Barrier is a fluid-applied Silyl Terminated Polymer (STP) water-resistive and air barrier applied by roller or with spray equipment, and when installed with DensDefy® accessory materials, can offer a complete water-resistive and air barrier system.

The robust, elastomeric membrane formed by DensDefy™ Liquid Barrier adheres to most common construction surfaces such as CMU, concrete, glass mat gypsum sheathing, OSB and plywood and is compatible with a wide range of commonly used construction sealants, coatings, membranes and flashings.

Advantages

- Highly durable, monolithic, elastomeric water-resistive barrier.
- May be applied in temperatures as low as 25°F and cures in temperatures as low as 32°F.
- Can be applied in wet weather, on damp substrates, and tolerates rain immediately after application.
- Vapor permeable – allows damp surfaces to dry.
- Can be exposed to normal weathering conditions for up to 12 months.
- When combined with the DensElement Barrier System, a single-source limited warranty is available.

Preparation

- Protect people, vehicles, property, plants and all other surfaces not intended to receive DensDefy™ Liquid Barrier. To ensure best results, apply to clean surfaces free of frost and contaminants. Chemical residues, surface coatings or films may adversely affect adhesion.

  Note: Treated lumber must be dry and may be solvent wiped with isopropyl alcohol to aid adhesion of DensDefy® products.
- Poured in place concrete must be allowed to cure a minimum of 7 days and be free of any curing compounds or form release agents before application.
- Mortar joints in CMU construction should be struck flush and allowed to cure a minimum of 3 days.
- Fill voids and holes in concrete or CMU with suitable non-shrink grout or mortar.
- Ensure substrate is sound and is undamaged.
- Repair any gouges, punctures or minor damage with DensDefy® Liquid Flashing.
- When applying over exterior sheathing, treat seams and joints with DensDefy® Liquid Flashing prior to application of DensDefy™ Liquid Barrier.

General Technical Data

Physical Properties

FORM	Viscous liquid, yellow color, mild odor
SPECIFIC GRAVITY	1.26–1.33
WT/GAL	10.5–11.5 lbs.
TOTAL SOLIDS	Approx. 99%
VOC CONTENT	<30 g/L
SHELF LIFE	1 year in properly stored, unopened original packaging
SURFACE SKIN / NON-WET TRANSFER TIME (HRS)	2–4
HARDNESS, SHORE A	19–23
TENSILE STRENGTH	>90 psi
ELONGATION AT BREAK	>400% (ASTM D 412)
TRANSFER FREE TIME	< 1 hour (at room temperature and 50% relative humidity)
WATER VAPOR TRANSMISSION	10 Perms (ASTM E96 Method A) 14 Perms (ASTM E96 Method B)
SURFACE BURNING CHARACTERISTICS	Class A (ASTM E84) Flame Spread = 25 Smoke Developed = 10
AIR PERMENANCE	>400% (ASTM D 412)
AIR PERMEANCE	Pass (ASTM 2178) ≤ .02 L/(s.m2) ≤ .0004 cfm/ft2>
AIR LEAKAGE OF AIR BARRIER ASSEMBLIES	Pass (ASTM E2357)
WATER PENETRATION	Pass (ASTM E331)
AIR AND WATER RESISTIVE BARRIER	Pass (AC212)

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Safety Information

Refer to SDS for instructions on safe handling and use of the product which can be found at msds.gp.com.

Surface & Air Temperatures

Note: Temperatures between 32°F (0°C) and 110°F (43°C) are required for proper curing and drying of DensDefy™ Liquid Barrier.

Cold-Weather Conditions/Precautions

- Product may be applied to frost-free substrates at temperatures as low as 25°F (-4°C). Product will not begin to cure until temperatures reach 32°F (0°C) and remain above freezing. Storing product in a heated environment prior to use may help workability and curing in these conditions.

Hot-Weather Conditions/Precautions

- When air or surface temperatures exceed 95°F (35°C), apply product to the shady side of structure before daytime air/surface temperatures reach their peak. Keep containers closed and out of direct sunlight when not in use. Do not apply when substrate temperature exceeds 110°F (43°C).

Low Humidity Conditions/Precautions

- The process of curing may take longer when lower humidity levels occur.

Application

Before use, read Preparation, Hazard Statements and Precautionary Statements which can be found at msds.gp.com.

DILUTION: Do not dilute, alter, or use for applications other than specified.

MIXING: Using a low-speed drill and paddle, mix well from top to bottom and side-to-side for a minimum of 3 minutes before use. Avoid mixing air into the product.

TYPICAL COVERAGE RATES: Coverage rates will vary depending on surface porosity, moisture uptake, installer skill level and other factors. Actual rates must be determined through mock-up applications. Some gypsum sheathing products, OSB and CMU may require additional material and multiple passes to achieve the desired mil thickness and a pinhole void free application.

- Exterior Gypsum Panel: 450–550 sq.ft. per 5 gallon pail when applied at 14-18 wet mils
- OSB/Plywood: 250-350 sq.ft. per 5 gallon pail when applied at 18 wet mils
- CMU: 300–400 sq.ft. per 5 gallon pail when applied 14-18 wet mils total in multiple passes

Application Instructions

1. Using a 1/4" or 3/8" nap lint free roller, apply the DensDefy™ Liquid Barrier to the exterior wall assembly using vertical strokes with a slight diagonal slant. Apply material so that a minimum 14 wet mils are achieved with no pinholes or voids. Porous substrates such as OSB and CMU may require additional material and multiple coats to achieve a pinhole/void-free application. Inspect surface after initial application and touch up as needed. Pinholes may not appear immediately.
2. Seal masonry ties and penetrations as work progresses.
3. Allow product to cure and dry. Wind, high temperatures and high humidity will accelerate drying. Low temperatures and low relative humidity will extend cure time. A light misting of fresh water over the treated surfaces may accelerate curing.
4. Inspect membrane for damage, voids or pinholes prior to covering. Repair any deep gouges, punctures or damaged areas with DensDefy® Liquid Flashing. Overlap repairs, penetration treatments, transitions, rigid flashing and other air barrier components to ensure positive drainage and continuity of the air- and water-resistive barrier.

Limitations

- DensDefy™ Liquid Barrier is not for use as a liquid flashing membrane. Use DensDefy® Liquid Flashing instead.
- Not for use in place of through-wall flashing material.
- Do not install DensDefy™ Liquid Barrier System below grade or in locations that may be continuously immersed in water.
- DensDefy™ Liquid Barrier System is not intended for permanent exposure. It must be covered within 12 months.
- DensDefy™ Liquid Barrier System is not for use with insulated concrete forms (ICFs)
- Treated lumber must be dry and may be solvent wiped with isopropyl alcohol to aid adhesion of DensDefy® products.
- Avoid conditions that will create moisture in the air and condensation within the exterior walls. This is especially important during periods when the exterior and interior temperature differentials can create a condensation point within the exterior wall. The use of forced air heaters creates volumes of water which, when not properly vented, can condense on building materials. The use of heaters and any resulting damage is not the responsibility of Georgia-Pacific Building Products. Consult heater manufacturer for proper use and ventilation.

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- For cladding systems that require multiple layers of water-resistive barriers, the DensDefy™ Liquid Barrier System is intended to replace only the first layer over the wall substrate.
- Avoid the use of solvent-based cleaners, primers, adhesives or accessory products when using the DensDefy™ Liquid Barrier System.
- Exterior wall design details including, but not limited to, cladding attachments, control joints, material transition details, drainage mechanisms, flashing, sealants, and window and door integration must be properly installed per the project specifications and all applicable building code requirements.
- Roofing systems must be capped and sealed and top of walls protected from water intrusion both before and after DensDefy™ Liquid Barrier installation. Water intrusion may interfere with adhesion and/or detrimentally impact the performance of such materials.
- Georgia-Pacific Building Products does not warrant and is not responsible or liable for the performance of any cladding or cladding system that is attached or adhered to the DensDefy™ Liquid Barrier System. The compatibility of any cladding system is the responsibility of the cladding manufacturer or design authority.

Cleanup

Clean tools and equipment with mineral spirits or similar solvent immediately after use and prior to material curing. Follow all safety precautions. Cured material must be removed mechanically.

Curing & Drying

At 70°F (21°C) and 50% relative humidity, product skins in approximately 2 hours and cures in approximately 12 hours when applied at 14 mil thickness. DensDefy™ Liquid Barrier is moisture curing. Low temperatures and low relative humidity slow cure time. Wind, high temperatures and high humidity accelerate drying.

Storage & Handling:

Store in cool, dry place. Do not open until prep work is completed. Keep tightly closed when not dispensing. When stored at or below 80°F (27°C), product has shelf life of 12 months after manufacture date, assuming upright storage of factory-sealed container. Do not double stack pallets. Dispose of in accordance with applicable laws and regulations.

Limited Warranty

For complete warranty details, visit buildgp.com/warranties.

Customer Care

For technical assistance, call 800-225-6119.

Georgia-Pacific

DensDefy™

Liquid Barrier

TECHNICAL GUIDE

DENSDEFY™ LIQUID BARRIER

Product Overview

DensDefy™ Liquid Barrier is a fluid-applied, single-component silyl-terminated polymer (STP) air- and water-resistive barrier applied by roller or with spray equipment over many common substrates.

The robust, elastomeric membrane formed by DensDefy Liquid Barrier adheres to most common construction surfaces such as CMU, concrete, glass mat gypsum sheathing, OSB and plywood, galvanized steel and wood framing, and is compatible with a wide range of sealants and waterproofing or air barrier components.

Summary of Benefits

DensDefy Liquid Barrier creates a robust barrier that helps keep bulk water out, but remains permeable, which allows water vapor to escape and promote drying. DensDefy Liquid Barrier helps prevent air infiltration for a more energy-efficient structure, and can be applied to dry or damp substrates to help eliminate weather delays and accelerate "dry-in" of new buildings. It also may be exposed to UV and normal weather conditions for up to 12 months after installation.

Code Compliance

DensDefy™ Liquid Barrier System conforms to the requirements as a water-resistive barrier and air-barrier with the codes listed below as documented in ICC-ES ESR-4708 by meeting established water-resistive barrier and air-barrier acceptance criteria.

- 2021, 2018, 2015 and 2009 International Building Code® (IBC)
- 2021, 2018, 2015, 2012 and 2009 International Residential Code® (IRC)
- 2021, 2018, 2015 and 2009 International Energy Conservation Code® (IECC)
- 2019 California Green Building Standards Code (CALGreen), Title 24, Part 11
- 2018, 2015 and 2012 International Green Construction Code® (IgCC)
- 2017, 2014 and 2011 ANSI/ASHRAE/USGBC/IES Standard 189.1 - Standard for the Design of High-Performance Green Buildings, Except Low-Rise Residential Buildings
- 2020, 2015, 2012 and 2008 ICC 700 National Green Building Standard™ (ICC 700-2020, ICC 700-2015, ICC 700-2012 and ICC 700-2008)
- 2021 City of Los Angeles Building Code (LABC) and 2021 City of Los Angeles Residential Building Code (LARC)
- DensDefy Liquid Barrier System installed as a water-resistive barrier and an air barrier material, is recognized for use on Types I, II, III, IV and V construction. When used on exterior walls of buildings greater than 40 feet above grade in Types I, II, III or IV construction under the 2021, 2018 and 2015 IBC, installation must comply with Exception 1 of 2021 and 2018 IBC Section 1402.5 (2015 IBC Section 1403.5).

DensDefy Liquid Barrier System has been evaluated as an air barrier by the Air Barrier Association of America (ABAA)

Fire Resistance/NFPA 285

DensDefy Liquid Barrier System is NFPA 285 compliant with multiple assemblies that hold an ICC-ES Evaluation Report, including Brick, Stucco, Metal Panel, and other claddings.

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DensDefy™ Liquid Barrier System Components

DensDefy Liquid Barrier

DensDefy Liquid Barrier is a fluid-applied air- and water-resistive barrier made with STP Technology. This single-component barrier is roller- or spray-applied to produce a seamless, durable membrane on exterior gypsum sheathing, wood sheathing, CMU and concrete walls. DensDefy Liquid Barrier can be applied to dry or damp substrates to help eliminate weather delays and accelerate dry-in of new buildings.

Packaging: Available in 5-gallon pails for roller or spray application.

Typical Coverage Rates: Coverage rates will vary depending on surface porosity, moisture uptake and other factors. Actual rates must be determined through mock-up applications. Some gypsum sheathing products, OSB and CMU may require additional material and multiple passes to achieve the desired mil thickness and a pinhole-void-free application.

- Exterior Gypsum Panel: 450–550 sq. ft. per 5-gallon pail when applied at 14–18 wet mils
- OSB/Plywood: 250–350 sq. ft. per 5-gallon pail when applied at 14–18 wet mils
- CMU: 300–400 sq. ft. per 5-gallon pail when applied at 14–18 wet mils total in multiple passes

DensDefy® Liquid Flashing and Transition Membrane

DensDefy Liquid Flashing is a waterproofing and detailing compound made with STP Technology that seals rough openings and penetrations in new or existing wall assemblies. DensDefy Liquid Flashing creates an elastomeric flashing membrane that is highly durable.

Packaging: Available in a 20-oz. sausage for professional gun application

DensDefy Transition Membrane is a 25-mil composite impermeable membrane that is comprised of 16 mils of butyl adhesive and 9 mils of HDPP facer. It is primarily used as a transitioning accessory between dissimilar materials.

Packaging: 75′ rolls available in 3 widths

Length: 75′ (22 m)

Width: 6″ (15 cm) 8 rolls/box
9″ (22 cm) 4 rolls/box
12″ (30 cm) 4 rolls/box

Georgia-Pacific Building Products Sustainability

Georgia-Pacific Building Products' definition of sustainability is meeting the needs of society today without jeopardizing our ability to do so in the future. We are committed to using resources efficiently to provide innovative products and solutions that meet the needs of customers and society while operating in a manner that is environmentally and socially responsible, as well as economically sound.

Physical Properties: DensDefy™ Liquid Barrier

Physical Properties	
Form	Viscous liquid, yellow color, mild odor
Specific Gravity	1.26–1.33
Weight	10.5–11.5 (lbs/gallon)
Total Solids	Approx. 99%
VOC Content	<30 (g/L)
Shelf Life	1 year in properly stored, unopened original packaging
Surface Skin/Non-Wet Transfer Time	2–4 (hrs)

Cured Properties	
Hardness, Shore A	19–23
Tensile Strength	>90 (psi)
Elongation at Break	>400% (ASTM D 412)
Transfer Free Time	< 1 hour (at room temperature and 50% relative humidity)
Water Vapor Transmission	10 Perms (ASTM E96 Method A) 14 Perms (ASTM E96 Method B)
Surface Burning Characteristics	Class A (ASTM E84) Flame Spread = 25 Smoke Developed = 10

Installation Instructions

For full installation instructions and details, refer to the DensDefy™ Liquid Barrier System Installation Guide.

Dilution and mixing:
Mix well before use. Do not dilute, alter or use for applications other than specified.

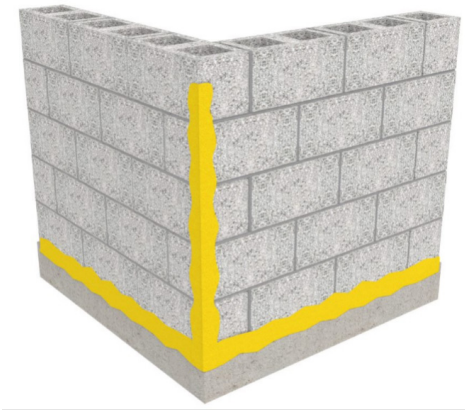
Preparation:
Protect people, vehicles, property, plants and all other surfaces not intended to receive DensDefy Liquid Barrier. Apply to frost-free surfaces free of contaminants, such as chemical residues, surface coatings or other bond-inhibiting materials that may adversely affect adhesion.

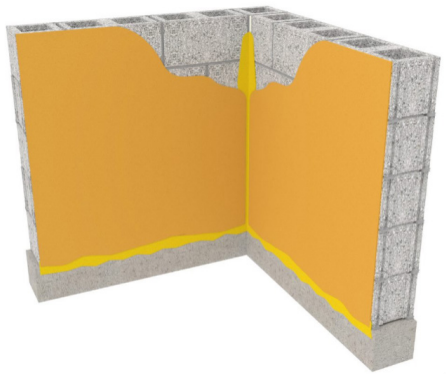
Note: Clean pressure-treated wood with an isopropyl alcohol wipe and allow to flash off before application.

Concrete must be in place 7 days and free of any curing compounds or form release agents before application. Mortar joints in CMU construction must be filled and struck flush, and should have a minimum 3-day cure. Scrape or grind mortar or concrete drippings flush and remove efflorescence or laitance. Fill voids and holes with suitable non-shrink grout or mortar.

Install exterior gypsum sheathing in accordance with GA-253 and the manufacturer's installation instructions. Remove and replace damaged sheathing.

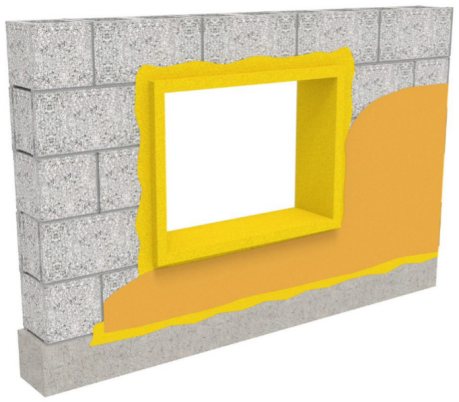
Wall Treatment:
- For exterior gypsum or wood sheathing, treat in-plane sheathing seams, penetrations, corners and changes in plane with DensDefy® Liquid Flashing.
- For CMU or concrete walls, pretreat inside and outside corners with DensDefy Liquid Flashing.





Rough Openings and Material Transitions:
Rough openings and material transitions can be treated with DensDefy® Liquid Flashing or DensDefy® Transition Membrane.

When using DensDefy Transition Membrane, counter flash membrane seams and perimeter with DensDefy Liquid Flashing prior to the application of DensDefy™ Liquid Barrier.



Note: DensDefy Liquid Flashing may be applied over or under DensDefy Liquid Barrier. Overlap DensDefy materials approximately 1" to maintain air- and water-resistive barrier continuity.

If DensDefy Transition Membrane is used, install it first, then counter flash the edges with DensDefy Liquid Flashing, and finally apply DensDefy Liquid Barrier approximately 1" over DensDefy Liquid Flashing.

Allow DensDefy Liquid Flashing to skin over before applying DensDefy Liquid Barrier. Roller or spray apply DensDefy Liquid Barrier to exterior wall, covering with a minimum 14 wet mils without pinholes or voids. Porous substrates such as OSB and CMU may require additional material or multiple coats. Inspect surface after initial application and touch up as needed; pinholes may not appear immediately.

Curing

- **Cold Weather Conditions/Precautions:** Only apply at temperatures above 25°F (-4°C) and rising. Colder temperatures may adversely affect coverage and curing times. Substrate and temperature conditions between 32°F (0°C) and 110°F (43°C) are required for proper curing and drying of material to take place. Keeping material stored in a heated environment prior to use and misting applied material with warm, fresh water will help in these conditions.
- **Hot Weather Conditions/Precautions:** When air or surface temperatures exceed 95°F (35°C), apply product to the shady side of structure before daytime air and surface temperatures reach their peak. Hot surfaces may be cooled with a mist of fresh water. Keep containers closed and out of direct sunlight when not in use. Do not apply when substrate temperature exceeds 110°F (43°C).
- **Low Humidity Conditions/Precautions:** The process of curing may take longer when lower humidity levels occur. A light misting of fresh water over the treated surface will accelerate curing if necessary.

Wall Applications

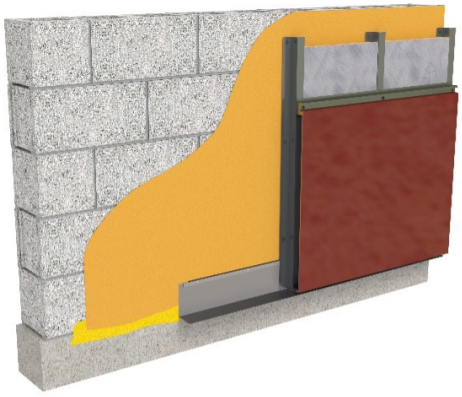
DensDefy™ Liquid Barrier with Brick

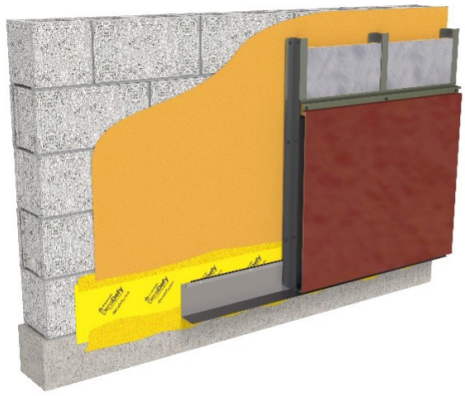
Masonry can be applied over DensDefy Liquid Barrier just as it would over any other type of water-resistive barrier. Brick ties should be installed in accordance with the manufacturer's written installation instructions and local building code requirements. Apply continuous insulation as required by building code or design authority. Brick veneer should be installed with at least a 2" air gap between the brick veneer and substrate.

Important: Applications are presented for illustration only and may not be appropriate for all projects, conditions or components. Please consult an appropriate professional for design and detailing of the project. Georgia-Pacific Building Products does not provide design services.

DensDefy Liquid Barrier with Rainscreen Panels

DensDefy Liquid Barrier can be used in applications behind a variety of rainscreen assemblies. Rainscreen subframes should be installed in accordance with the manufacturer's installation recommendations and code requirements.





Storage and Handling

Store in a cool, dry place. Keep container tightly closed when not dispensing. Do not open container until preparation work has been completed. Do not alter or mix with other chemicals. When stored at or below 80°F (27°C) out of direct sunlight, DensDefy™ Liquid Barrier, DensDefy® Liquid Flashing and DensDefy® Transition Membrane have a shelf life of 12 months from the manufacture date. This shelf life assumes upright storage of factory-sealed containers. Do not double stack pallets. Dispose of unused product and container in accordance with local, state and federal regulations.

Recommendations and Limitations for Use

The following recommendations and limitations are important to ensure the proper use and benefits of DensDefy Liquid Barrier. Failure to strictly adhere to such recommendations and limitations may void the limited warranty provided by Georgia-Pacific Building Products for such products. For details, please go to buildgp.com/warranties.

- DensDefy Liquid Barrier is not for use as a liquid flashing membrane. Use DensDefy Liquid Flashing.
- Not for use in place of appropriate through-wall flashing material.
- Do not use DensDefy™ Liquid Barrier System below grade or in locations that may be continuously immersed in water.
- DensDefy Liquid Barrier System is not intended for permanent exposure. Cover within 12 months after installation.
- DensDefy Liquid Barrier System is resistant to normal weather conditions. It is not intended for use as a cladding system, long-term outdoor exposure, immersion in water or with cascading water from an unfinished roof or floor. Water should always be directed away from DensDefy Liquid Barrier System.
- Do not apply to contaminated or frost-covered surfaces. Treated lumber must be dry and solvent wiped with isopropyl alcohol prior to application of DensDefy Products.
- Avoid conditions that will create moisture in the air and condensation within the exterior walls. This is especially important during periods when the exterior and interior temperature differentials can create a condensation point within the exterior wall. The use of forced-air heaters creates volumes of water which, when not properly vented, can condense on building materials. The use of heaters and any resulting damage is not the responsibility of Georgia-Pacific Building Products. Consult heater manufacturer for proper use and ventilation.
- For cladding systems that require multiple layers of water-resistive barriers, DensDefy Liquid Barrier System is intended to replace only the first layer over the wall substrate.
- Avoid the use of solvent-based primers, adhesives or accessory products with DensDefy Liquid Barrier System.
- Exterior wall design details including, but not limited to, cladding attachments, control joints, material transition details, drainage mechanisms, flashing, sealants, and window and door integration, per the project specification, must be properly installed.
- Roofing systems must be capped and sealed, and top of walls protected from water intrusion both before and after DensDefy Liquid Barrier installation. Water intrusion may interfere with adhesion and/or detrimentally impact the performance of such materials.
- Georgia-Pacific Building Products does not warrant and is not responsible or liable for the performance of any cladding or cladding system that is attached or adhered to DensDefy Liquid Barrier System. The compatibility of any cladding system is the responsibility of the cladding manufacturer or design authority.
- DensDefy Liquid Barrier System is not for use with insulated concrete forms.

Limited Warranty

Georgia-Pacific Building Products provides a limited warranty for DensDefy Liquid Barrier System as part of the original building envelope of a residential or commercial property. For a full copy of the DensDefy Liquid Barrier Limited Warranty, go to buildgp.com/warranties. Georgia-Pacific makes no other warranties, express or implied, and specifically disclaims any warranties of merchantability or fitness for a particular purpose.

Georgia-Pacific
Building Products

U.S.A. GP Gypsum LLC
CANADA Georgia-Pacific Canada LP

SALES INFORMATION AND ORDER PLACEMENT

U.S.A.	Pacific Southwest:	**1-800-824-7503**
	Midwest:	**1-800-876-4746**
	Central:	**1-800-231-6060 x7709**
	North:	**1-800-947-4497**
	Pacific Northwest	**1-800-444-0092**
	South	**1-800-327-2344**
Canada	Canada Toll Free:	**1-800-387-6823**

TECHNICAL HOTLINE

U.S.A. and Canada: **800-225-6119**

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PRECAUTIONS – For product fire, safety and use information, go to buildgp.com/safetyinfo or call 1-800-225-6119.

HANDLING AND USE – Refer to SDS for instructions on safe handling and use of the product here: msds.gp.com.

07/21 Lit #:623072

Georgia-Pacific

DensDefy™

Liquid Barrier

RIGOROUS TESTING. OPTIMAL PERFORMANCE.

ALL-IN-ONE WATER-RESISTIVE AND AIR BARRIER SOLUTION MET ALL OF THE CHALLENGES.

Understanding design considerations, limitations and realistic performance is critical for the successful deployment of any new product. The research and development teams at Georgia-Pacific recognize this as a risk potential and require scientific proof of success before introducing innovative new systems like DensDefy™ Liquid Barrier System. Rigorous testing of the various assemblies and the individual components of the system is a crucial step prior to a real-world launch. The following tables demonstrate only a sampling of the specific experiments performed on the system to replicate potential real-world exposure. This exhaustive testing resulted in the evidence needed for the International Code Council to identify and present the DensDefy Liquid Barrier System as a combination water-resistive and air barrier (WRB/AB) system.

DENSDEFY™ LIQUID BARRIER SYSTEM TESTING

TEST	DESCRIPTION	MEETS OR EXCEEDS	RESULTS
DensDefy™ Liquid Barrier Testing in Accordance with ICC-ES AC212			
ASTM C297 Standard Test Method for Flatwise Tensile Strength of Sandwich Construction	Provides information on the strength and quality of core-to-facings bonds; Pull strength must meet 15 psi	✓	Exceeds 15 psi on: OSB, Plywood, DensGlass and concrete substrates
ASTM D2247 Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity	Water resistance tested over a treated joint for 24 hours per day for 14 days at 100% relative humidity and 100^{0}F	✓	No signs of cracking, crazing, blistering, erosion or other deleterious effects were observed
Freeze – Thaw Testing per ICC-ES AC212 Water-Resistive Coatings Used as Water-Resistive Barriers Over Exterior Sheathing	Samples subjected to 10 freeze-thaw cycles with temperatures ranging from -20^{0}F to 120^{0}F; this is a pass/fail test	✓	No cracking, checking, crazing, erosion, delamination or other deleterious effects were observed
ASTM E96 Standard Test Method for Water Vapor Transmission of Materials	Obtain reliable values of water vapor transfer through permeable and semipermeable materials, expressed in suitable units	✓	**14 Perms** System has high vapor permeability. Tested using the Wet Cup Method to measure weight loss due to water vapor from the cup transmitting through the material to the test atmosphere and humidity of the test chamber.
ASTM E331 Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors and Curtain Walls by Uniform Static Air Pressure Difference	Water penetration testing of the assembly	✓	**No leaks!**
ASTM E331	ASTM E331 is performed twice in ICC-ES AC 212. First as a stand-alone test, and then ASTM E331 is the final stage of a 4-stage event performed on the same assembly. In this 4-stage event, water penetration was tested after the DensDefy™ Liquid Barrier System was subjected to three other test methods—loading, racking and environmental conditioning—as described below.		
STAGE 1 **ASTM E1233** Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Cyclic Air Pressure Differential	The first stage of conditioning for the ASTM E331 test – transverse load testing (panel deflection test); no failure of WRB allowed; this is a pass/fail test	✓	**No WRB failure!** Per IBC code requirements, DensDefy Liquid Barrier System endured 10 specified deflection cycles with no WRB failure. (Procedure A was utilized as modified by Section 4.7.1 of ICC-ES AC212.)
STAGE 2 **ASTM E72** Standard Test Methods of Conducting Strength Tests of Panels for Building Construction	The second stage of conditioning for the ASTM E331 test – racking test (panel strength test); no failure of WRB allowed during or after racking; this is a pass/fail test	✓	**No WRB failure!** System was racked at 1/8" net deflection
STAGE 3 **Restrained Environmental Conditioning of Panel with WRB/AB**	The third stage of conditioning for the ASTM E331 test – system subjected to water and heat after being deflected and racked; no failure of WRB allowed; this is a pass/fail test	✓	**No WRB failure!** System subjected to 5 cycles of 24-hour water spray and 24-hour radiant heat on panels that were tested structurally
STAGE 4 **ASTM E331** Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors and Curtain Walls by Uniform Static Air Pressure Difference	The final stage of testing using the assembly that has already undergone stages 1-3 testing; the system was then tested to determine its resistance to water penetration under uniform static air pressure differences	✓	**No leaks!** Water penetration was conducted on the specimen in accordance with ASTM E 331-00 as modified by Section 4.7.4 of ICC-ES AC212
Hydrostatic Pressure Test (3-Stage) per ICC-ES AC212	In this 3-stage event, hydrostatic pressure was tested after the DensDefy™ Liquid Barrier System was subjected to two other test methods—UV light exposure and accelerated aging—as described below.		
STAGE 1 **Ultraviolet (UV) Light Exposure**	The first stage of conditioning for the hydrostatic head test – a sample with a joint was exposed to high heat for an extended period; this is a pass/fail test	✓	**No WRB failure!** Specimens were exposed to UV lamps for 10 hours per day for 21 days at a specimen temperature of 135-140°F using GE Type H272 RUV (275 W) bulbs with 5.0 W/m2-nm at a wavelength of 315-400 nm at 1 m
STAGE 2 **Accelerated Aging**	The second stage of conditioning for the hydrostatic head test – the previous sample with a joint was taken from the UV exposure test and subjected to 25 accelerated aging cycles	✓	**No WRB failure!** Specimens were exposed to 25 cycles as follows: 1. 120°F for three (3) hours 2. Immersion of coating surface for three (3) hours 3. And then air-dried for 18 hours at ambient lab conditions
STAGE 3 **Hydrostatic Pressure Test per AATCC Test Method 127-98** for Water Resistance	The final stage of testing uses the samples that have already undergone stages 1-2; the system was then tested for leakage and to verify performance and durability	✓	**No leaks!** Specimens were tested in accordance with AATCC-127-98 for hydrostatic resistance using a 55 cm head of water for a minimum period of five (5) hours

DENSDEFY™ LIQUID BARRIER SYSTEM TESTING			
TEST	**DESCRIPTION**	**MEETS OR EXCEEDS**	**RESULTS**
Additional Testing for ABAA Material/System Evaluation			
ASTM E2178 Standard Test Method for Air Permeance of Building Materials	Measurement of the air permeance of flexible sheet or rigid panel-type materials; results may be useful in determining suitability of that material as a component of an air retarder system	✓	Exceeded IECC requirements for material air permeance
Hydrostatic Pressure Test per AATCC Test Method 127 for Water Resistance	System was then tested for water resistance	✓	**No leaks!**
ASTM D1970 Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection	Provides information on the strength and quality of core-to-facings bonds; Pull strength must meet 15 psi	✓	No leaks allowed where fasteners penetrate through specimen. Pass.
ASTM D4541 Standard test method for pull-off strength of coatings	This test method is used to evaluate the pull-off strength of air barrier membranes.	✓	Exceeds minimum 16 psi pull-off requirement
ASTM C1305 Low Temperature Crack Bridging	Test indicates a WRB's ability to bridge preexisting substrate cracks at low temperatures.	✓	No cracking, splitting, pinholes or other conditions at the joints in the substrate
ASTM E2357 Standard Test Method for Determining Air Leakage of Air Barrier Assemblies	Simulates the performance of various air barrier materials/accessories when combined into an assembly; results will assign an air leakage rating for the assembly	✓	Exceeded IECC requirements for assembly
DensDefy™ Liquid Barrier Additional Testing			
ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials	Provides comparative measurements of surface flame spread and smoke density measurements with that of select fiber cement board surfaces under specific fire exposure conditions	✓	Class A rating 25 - Flame Spread 10 - Smoke Developed

CODE COMPLIANCE

DensDefy™ Liquid Barrier System conforms to the requirements as a water-resistive barrier and air barrier with the codes listed below as documented in ICC-ES ESR-4708 by meeting established water-resistive barrier and air-barrier acceptance criteria.

- 2021, 2018, 2015 and 2009 International Building Code® (IBC)
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- 2021 City of Los Angeles Building Code (LABC) 2021 City of Los Angeles Residential Building Code (LARC)
- DensDefy Liquid Barrier System installed as a water-resistive barrier and an air barrier material, is recognized for use on Types I, II, III, IV and Type V construction. When used on exterior walls of buildings greater than 40 feet above grade in Types I, II, III or IV construction under the 2021, 2018 and 2015 IBC, installation must comply with Exception 1 of 2021 and 2018 IBC Section 1402.5 (2015 IBC Section 1403.5).

DensDefy Liquid Barrier System has been evaluated as an air barrier by the Air Barrier Association of America (ABAA).

Fire Resistance/NFPA 285

DensDefy Liquid Barrier System is NFPA 285 compliant with multiple assemblies that hold an ICC-ES Evaluation Report including Brick, Stucco, Metal Panel, and other claddings.

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HANDLING AND USE – Refer to SDS for Instructions on safe handling and use of the product here: msds.gp.com.

07/21. Lit num#: 623070

ICC EVALUATION SERVICE®

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ICC-ES Evaluation Report
ESR-4708

Reissued August 2022
This report is subject to renewal August 2024.

DIVISION: 07 00 00—THERMAL AND MOISTURE PROTECTION
Section: 07 25 00—Water-Resistive Barriers/Weather Barriers
Section: 07 27 00—Air Barriers
Section: 07 65 00—Flexible Flashing

REPORT HOLDER:

GEORGIA-PACIFIC GYPSUM LLC

EVALUATION SUBJECT:

DENSDEFY™ LIQUID BARRIER SYSTEM

1.0 EVALUATION SCOPE

1.1 Compliance with the following codes:

- 2021, 2018, 2015 and 2009 *International Building Code®* (IBC)
- 2021, 2018, 2015, 2012 and 2009 *International Residential Code®* (IRC)
- 2021, 2018, 2015 and 2009 *International Energy Conservation Code®* (IECC)

For evaluation for compliance with codes adopted by Los Angeles Department of Building and Safety (LADBS), see ESR-4708 LABC and LARC Supplement.

Properties evaluated:

- Water-resistive barrier
- Air barrier material
- Surface-burning characteristics

1.2 Evaluation to the following green code(s) and/or standards:

- 2019 California Green Building Standards Code (CALGreen), Title 24, Part 11
- 2018, 2015 and 2012 *International Green Construction Code®* (IgCC)
- 2017, 2014 and 2011 ANSI/ASHRAE/USGBC/IES Standard 189.1–Standard for the Design of High-Performance Green Buildings, Except Low-Rise Residential Buildings
- 2020, 2015, 2012 and 2008 ICC 700 *National Green Building Standard™* (ICC 700-2020, ICC 700-2015, ICC 700-2012 and ICC 700-2008)

Attributes verified:

See Section 3.1.

2.0 USES

The DensDefy™ Liquid Barrier System is used as an alternative to the water-resistive barrier specified in 2021 and 2018 IBC Section 1403.2 (2015 and 2009 IBC Section 1404.2) and IRC Section R703.2 when installed over substrates as described in this report in exterior walls of any construction type. The system also may be used as an air barrier material in accordance with IRC Section N1102.4 and 2021, 2018 and 2015 IECC Sections C402.5 and R402.4 (2009 IECC Sections 402.4 and 502.4). The DensDefy™ Liquid Flashing component of the DensDefy™ Liquid Barrier System may be used as a flashing in accordance with 2021, 2018 and 2015 IRC Section 703.4, when installed in accordance with Section 4.4 of this report.

DensDefy™ Liquid Barrier System complying with ASTM E2570 is used over sheathing where EIFS cladding is to be used in accordance with 2021 and 2018 IBC Section 1407.4.1 (2015 and 2009 IBC Section 1408.4.1) and IRC Section R703.9.2.

The DensDefy™ Liquid Barrier System installed as a water-resistive barrier and an air barrier material, is recognized for use on Types I, II III, IV and Type V construction. When used on exterior walls of buildings greater than 40 feet above grade in Types I, II, III or IV construction under the 2021, 2018 and 2015 IBC, installation must comply with Exception 1 of 2021 and 2018 IBC Section 1402.5 (2015 IBC Section 1403.5).

3.0 DESCRIPTION

3.1 General:

The DensDefy™ Liquid Barrier System consists of: DensDefy™ Liquid Barrier and DensDefy™ Liquid Flashing.

The attributes of the DensDefy™ Liquid Barrier System have been verified as conforming to the requirements of (i) CALGreen Section 5.407.1 for water-resistive barriers and Section A4.407.5 for air barriers; (ii) 2018 IgCC Section 701.3.1.1. and 2015 and 2012 IgCC Section 605.1.2.1 for air barriers; (iii) 2017 and 2014 ASHRAE 189.1 Section 7.3.1.1 and 2011 ASHRAE 189.1 Section 7.4.2.9 for air barriers; (iv) ICC 700-2020 Sections 602.1.8, 11.602.18, 1202.6 and 13.104.1.4; (v) ICC 700-2015 Section 602.1.8, 11.602.1.8 and 12.6.602.1.8; and (vi) ICC 700-2012 Section 602.1.8, 11.602.1.8 and 12.5.602.1.8; and (vii) ICC 700-2008 Section 602.9 for water-resistive barriers. Note that

decisions on compliance for those areas rest with the user of this report. The user is advised of the project-specific provisions that may be contingent upon meeting specific conditions, and the verification of those conditions is outside the scope of this report. These codes or standards often provide supplemental information as guidance.

3.1.1 DensDefy™ Liquid Barrier: DensDefy™ Liquid Barrier is a ready-mixed, flexible, polymer-based, roller or spray-applied liquid coating material. It is packaged in 5-gallon (19 L) buckets weighing 54 pounds (24.5 kg) and has a one-year shelf life after the date of manufacture when stored in its original unopened container at temperatures between 40°F (4.4°C) and 80°F (27°C). The coating is gold color. The DensDefy™ Liquid Barrier coating has a flame-spread index of 25 or less and a smoke-developed index of 450 or less when tested in accordance with ASTM E84.

3.1.2 DensDefy™ Liquid Flashing: DensDefy™ Liquid Flashing is a single-component, ready-mixed, flexible, polymer-based, gun-grade material. DensDefy™ Liquid Flashing is packaged in 20-ounce (591 mL) sausages. It has a one-year shelf life after the date of manufacture when stored in its original unopened container at temperatures between 40°F (4.4°C) and 80°F (27°C). The DensDefy™ Liquid Flashing complies with AAMA 714-19, AAMA 714-15 and AAMA 714-12 in accordance with 2021 and 2018 IBC Section 1404.4 and 2021, 2018 and 2015 IRC Section R703.4, as applicable.

3.2 Water Vapor Transmission:

The water vapor transmission value of DensDefy™ Liquid Barrier, as determined in accordance with ASTM E96, Method A (Dessicant Method) or Method B (Water Method), is as follows:

- ASTM E96 Method A
    - DensDefy™ Liquid Barrier at 15 mil [0.015 inch (0.38 mm)] : 9.6 perms
    - DensDefy™ Liquid Barrier at 15 mil [0.015 inch (0.38 mm)] thickness over DensDefy™ Liquid Flashing at 12 mil [0.012 inch (0.30 mm)] thickness: 3.6 perms
- ASTM E96 Method B:
    - DensDefy™ Liquid Barrier at 15 mil [0.015 inch (0.38 mm)] : 13.9 perms
    - DensDefy™ Liquid Barrier at 15 mil [0.015 inch (0.38 mm)] thickness over DensDefy™ Liquid Flashing at 12 mil [0.012 inch (0.30 mm)] thickness: 5.8 perms

3.3 Substrates:

The use of the DensDefy™ Liquid Barrier System is limited to applications over the following substate materials:

- Oriented strand board, Exposure 1, complying with U.S. DOC PS-2
- Plywood, Exposure 1 exterior grade, complying with U.S. DOC PS-1.
- Glass-mat faced gypsum recognized in a current evaluation report as complying with ASTM C1177.
- Concrete and concrete masonry complying with the applicable code.

4.0 INSTALLATION

4.1 General:

The installation of the DensDefy™ Liquid Barrier System must comply with this report and the manufacturer's published installation instructions. The manufacturer's published installation instructions must be available at the jobsite at all times during installation.

4.2 Substrate Preparation:

The DensDefy™ Liquid Barrier System must be installed on the exterior side of vertical exterior walls, over the substate. The substate type must be one of those listed in Section 3.3 of this report. Substrate must be installed as required by the applicable code. The substrate surfaces must be free of all bond-inhibiting materials, including dirt, oil and other foreign matter. The DensDefy™ Liquid Barrier System must not be installed on below-grade surfaces or on surfaces subject to water immersion. Damaged substrate must be removed and replaced.

4.3 DensDefy™ Liquid Flashing Application:

DensDefy™ Liquid Flashing may be applied in the rough openings, extending onto the sheathing surface 2 inches (50.8 mm) on substrate joints and seams, fastener heads and penetrations. Flashing complying with the applicable code or recognized in an ICC-ES evaluation report, must be installed at transitions to beams, columns, window and door openings, etc., in a manner as to prevent moisture from entering the wall or to redirect the moisture to the surface of the exterior wall finish or to the DensDefy™ Liquid Barrier system that is part of the means of drainage.

4.4 DensDefy™ Liquid Barrier Application:

The DensDefy™ Liquid Barrier must be roller or spray-applied over the substate after the DensDefy™ Liquid Flashing has developed a skin on the surfaces. DensDefy™ Liquid Barrier must be applied to a nominal wet film thickness of 15 mils [0.015 inch (0.38 mm)]. The coating, rough opening treatment and joint sealant should be applied when air and surface temperatures are between 25°F (-4°C) and 110°F (43°C). DensDefy™ Liquid Barrier and DensDefy™ Liquid Flashing must be dry to the touch before covering. At 70°F (21°C) and 50 percent relative humidity, DensDefy™ Liquid Barrier and DensDefy™ Liquid Flashing are typically dry to the touch within two hours. Curing time varies depending on temperature/humidity and surface conditions; cool and/or dry conditions may slow curing, while hot and/or damp conditions may accelerate curing.

5.0 CONDITIONS OF USE

The DensDefy™ Liquid Barrier System described in this report complies with, or is a suitable alternative to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 Installation must comply with this report, the manufacturer's published installation instructions, and the applicable code. In the event of a conflict between this report and the manufacturer's published installation instructions, this report governs.

5.2 For EIFS application, special inspections are required at the jobsite in accordance with 2021 and 2018 IBC Section 1705.17.1(2015 Section 1705.16.1 and 2009 IBC Section 1704.14.1). For other applications, special inspections are not required at the jobsite if installation is done by an installer or contractor trained by the manufacturer, and a certificate of installation is presented to the code official at the completion of each project; otherwise, special inspections are required at the jobsite in accordance with 2021, 2018, and 2015 IBC Section 1705.1.1 (2009 IBC Section 1704.15). Duties of the inspector include verifying field preparation of materials, expiration dates, installation components, curing of components, installation of joints and sealants, applied dry-film thickness and

interface of coating material with flashings. Special inspections are not required under the IRC.

5.3 For EIFS application, EIFS systems must be mechnically fastened to the substate when installing over the DensDefy™ Liquid Barrier System.

5.4 Use of the DensDefy™ Liquid Flashing as a flashing material, integrated with the DensDefy™ Liquid Barrier coating, around windows, doors and other openings on exterior walls, is recognized for use under the 2021 and 2018 IBC and 2021, 2018 and 2015 IRC.

5.5 The DensDefy™ Liquid Barrier System is limited to installations on vertical walls.

5.6 The DensDefy™ Liquid Barrier System must be covered with an exterior wall covering complying with the applicable code or recognized in a current ICC-ES evaluation report.

5.7 Repairing of joints and cracks greater than $^1/_8$ inch (3.2 mm) using DensDefy™ Liquid Barrier System is outside the scope of this report.

6.0 EVIDENCE SUBMITTED

6.1 Data in accordance with the ICC-ES Acceptance Criteria for Water-resistive Coatings Used as Weather-resistive Barriers over Exterior Sheathing (AC212), dated February 2015 (editorially revised July 2020).

6.2 Data in accordance with AAMA 714 per Section 3.4 of ICC-ES Acceptance Criteria for Flexible Flashing Materials (AC148), dated July 2017(editorially March 2021).

6.3 Data in accordance with ASTM E84 (UL 723)

7.0 IDENTIFICATION

7.1 Packages of the DensDefy™ Liquid Barrier described in this report must be identified by a label bearing the report holder's name (Georgia-Pacific Gypsum LLC) and address, product name (DensDefy™ Liquid Barrier) and product number, identification of components, lot or batch number, quantity of material in packaged mix, storage instructions, date of manufacture, shelf life, and the ICC-ES evaluation report number (ESR-4708).

Packages of the DensDefy™ Liquid Flashing described in this report must be identified by a label bearing the report holder's name (Georgia-Pacific Gypsum LLC) and address, product name (DensDefy™ Liquid Flashing) and product number, identification of components, lot or batch.

7.2 The report holder's contact information is the following:

GEOGIA-PACIFIC GYPSUM LLC
2861 MILLER ROAD
DECATUR, GEORGIA 30035
(800) 225-6119
www.buildgp.com

DIVISION: 07 00 00—THERMAL AND MOISTURE PROTECTION
Section: 07 25 00—Water-Resistive Barriers/ Weather Barriers
Section: 07 27 00—Air Barriers
Section: 07 65 00—Flexible Flashing

REPORT HOLDER:

GEORGIA-PACIFIC GYPSUM LLC

EVALUATION SUBJECT:

DENSDEFY™ LIQUID BARRIER SYSTEM

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that the DensDefy™ Liquid Barrier System, described in ICC-ES evaluation report ESR-4708, has also been evaluated for compliance with the codes noted below as adopted by the Los Angeles Department of Building and Safety (LADBS).

Applicable code editions:

- 2020 *City of Los Angeles Building Code* (LABC)
- 2020 *City of Los Angeles Residential Code* (LARC)

2.0 CONCLUSIONS

The DensDefy™ Liquid Barrier System, described in Sections 2.0 through 7.0 of the evaluation report ESR-4708, complies with the LABC Chapter 14, and the LARC Section R703, and is subject to the conditions of use described in this supplement.

3.0 CONDITIONS OF USE

The DensDefy™ Liquid Barrier System described in this evaluation report supplement must comply with all of the following conditions:

- All applicable sections in the evaluation report ESR-4708.
- The design, installation, conditions of use and identification of the DensDefy™ Liquid Barrier System are in accordance with the 2018 *International Building Code®* (IBC) provisions noted in the evaluation report ESR-4708.
- The design, installation and inspection are in accordance with additional requirements of LABC Chapters 14 and 17, as applicable.

This supplement expires concurrently with the evaluation report reissued August 2022.

DIVISION: 07 00 00—THERMAL AND MOISTURE PROTECTION
Section: 07 25 00—Water-Resistive Barriers/Weather Barriers
Section: 07 27 00—Air Barriers
Section: 07 65 00—Flexible Flashing

REPORT HOLDER:

GEORGIA-PACIFIC GYPSUM LLC

EVALUATION SUBJECT:

DENSDEFY™ LIQUID BARRIER SYSTEM

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that the DensDefy™ Liquid Barrier System, described in ICC-ES evaluation report ESR-4708, has also been evaluated for compliance with the codes noted below.

Applicable code editions:

- 2019 *California Buildingl Code*® (CBC)

For evaluation of applicable chapters adopted by the California Office of Statewide Health Planning and Development (OSHPD) aka: California Department of Health Care Access and Information (HCAI) and the Division of the State Architect (DSA), see Sections 2.1.1 and 2.1.2 below.

- 2019 *California Residential Code*® (CRC)
- 2019 *California Energy Code*® (CEC)

2.0 CONCLUSIONS

2.1 CBC:

The DensDefy™ Liquid Barrier System, described in Sections 2.0 through 7.0 of the evaluation report ESR-4708, comply with CBC Chapter 14, provided the design and installation are in accordance with the 2018 *International Building Code*® (IBC) provisions noted in the evaluation report and the additional requirements of CBC Chapters 14 and 17 as applicable. Use as an air barrier must be in accordance with the CEC.

2.1.1 OSHPD: The applicable OSHPD Sections and Chapters of the CBC are beyond the scope of this supplement.

2.1.2 DSA: The applicable DSA Sections and Chapters of the CBC are beyond the scope of this supplement.

2.2 CRC:

The DensDefy™ Liquid Barrier System, described in Sections 2.0 through 7.0 of the evaluation report ESR-4708, complies with CRC Chapter 7, provided the design and installation are in accordance with the 2018 *International Residential Code*® provisions noted in the evaluation report and the applicable provisions of the CRC. Use as an air barrier must be in accordance with the CEC.

This supplement expires concurrently with the evaluation report reissued August 2022.

ICC-ES Evaluation Report

ESR-4708 FBC Supplement

Reissued August 2022

This report is subject to renewal August 2024.

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DIVISION: 07 00 00—THERMAL AND MOISTURE PROTECTION
Section: 07 25 00—Water-Resistive Barriers/Weather Barriers
Section: 07 27 00—Air Barriers
Section: 07 65 00—Flexible Flashing

REPORT HOLDER:

GEORGIA-PACIFIC GYPSUM LLC

EVALUATION SUBJECT:

DENSDEFY™ LIQUID BARRIER SYSTEM

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that the DensDefy™ Liquid Barrier System, described in ICC-ES evaluation report ESR-4708, has also been evaluated for compliance with the codes noted below.

Applicable code editions:

- 2020 *Florida Building Code—Building*
- 2020 *Florida Building Code—Residential*

2.0 CONCLUSIONS

The DensDefy™ Liquid Barrier System, as described in Sections 2.0 through 8.0 of the evaluation report ESR-4708, complies with the *Florida Building Code—Building and Florida Building Code—Residential*, provided the design requirements are determined in accordance with the the *Florida Building Code—Building or the Florida Building Code—Residential,* as applicable. The installation requirements noted in the evaluation report ESR-4708 for the 2018 *International Building Code®* meet the requirements of the *Florida Building Code—Building or the Florida Building Code—Residential*, as applicable, with the following condition:

Installation must meet the requirements of Section 1403.8 of the *Florida Building Code—Building* or Section R318.7 of the *and Florida Building Code—Residential*, as applicable.

Use of the DensDefy™ Liquid Barrier System for compliance with the High-Velocity Hurricane Zone provisions of the *Florida Building Code—Building and Florida Building Code—Residential* has not been evaluated, and is outside the scope of this evaluation report.

For products falling under Florida Rule 61G20-3, verification that the report holder's quality assurance program is audited by a quality assurance entity approved by the Florida Building Commission for the type of inspections being conducted is the responsibility of an approved validation entity (or the code official when the report holder does not possess an approval by the Commission).

This supplement expires concurrently with the evaluation report reissued August 2022.

Georgia-Pacific

DensDefy™ Liquid Barrier

INSTALLATION GUIDE

Introduction

New DensDefy™ Liquid Barrier from Georgia-Pacific works across multiple substrates, helping to protect against water intrusion and mitigating the risk of unwanted air movement.

This highly durable, fluid-applied, water-resistive barrier and air barrier can be applied to damp surfaces, cures quickly and is vapor permeable. DensDefy Liquid Barrier may be applied in temperatures as low as 25°F and cures in temperatures as low as 32°F.

The newly expanded family of DensDefy™ Products is compatible with DensElement® Barrier System, available with product support and backed by a single warranty from Georgia-Pacific.

Preparation

- Before applying DensDefy Liquid Barrier System, ensure the surface is clean and free of frost, dirt, debris, contaminants and other bond-inhibiting materials.
- Protect people, vehicles, property, plants and all other surfaces not intended to receive DensDefy Liquid Barrier.
- Ensure substrates are installed per project specifications and local building code requirements.
- Clean pressure-treated wood with an isopropyl alcohol wipe and allow to flash-off before applying DensDefy Products.
- Concrete must be cured for a minimum of 7 days and masonry mortar joints must be cured for a minimum of 3 days. Masonry joints should be filled and struck flush.
- Damaged sheathing should be removed and replaced.
- All surfaces should have a positive pitch to prevent ponding or pooling of water.
- Cap and seal roofing systems or protect top of walls from water intrusion before and after the air barrier system is installed. Water intrusion may interfere with bonding of air barrier waterproofing materials and/or detrimentally impact the performance of such materials.

Equipment

- DensDefy Liquid Barrier: paint roller frame, pole, 1/4" or 3/8" nap lint-free roller cover, paint screen, low-speed drill and mixing paddle
- DensDefy® Liquid Flashing: professional caulking gun and spreading tool, knife
- DensDefy® Transition Membrane: tape measure, knife, and J-roller

Safety

Wear appropriate PPE for application. Refer to SDS for more information: msds.gp.com.

Storage & Handling

Store in a cool, dry place. Keep container tightly closed when not dispensing. Do not open container until preparation work has been completed. Do not alter or mix with other chemicals. When stored at or below 80°F (27°C) out of direct sunlight, DensDefy Liquid Barrier has a shelf life of 12 months from the date of manufacture. This shelf life assumes upright storage of factory-sealed containers. Do not double stack pallets. Dispose of unused product and container in accordance with local, state and federal regulations.

Product and spray equipment should be stored at 70-75°F (21-24°C) prior to use to ensure proper spraying. Cooler product will be more difficult to spray.

Code Compliance

DensDefy Liquid Barrier System conforms to the requirements as a water-resistive barrier and air-barrier with the codes listed below as documented in ICC-ES ESR-4708 by meeting established water-resistive barrier and air-barrier acceptance criteria.

- 2021, 2018, 2015 and 2009 International Building Code® (IBC)
- 2021, 2018, 2015, 2012 and 2009 International Residential Code® (IRC)
- 2021, 2018, 2015 and 2009 International Energy Conservation Code® (IECC)
- 2019 California Green Building Standards Code (CALGreen), Title 24, Part 11
- 2018, 2015 and 2012 International Green Construction Code® (IgCC)
- 2017, 2014 and 2011 ANSI/ASHRAE/USGBC/IES Standard 189.1-Standard for the Design of High-Performance Green Buildings, Except Low-Rise Residential Buildings
- 2020, 2015, 2012 and 2008 ICC 700 National Green Building Standard™ (ICC 700-2020, ICC 700-2015, ICC 700-2012 and ICC 700-2008)
- 2021 City of Los Angeles Building Code (LABC) and 2021 City of Los Angeles Residential Building Code (LARC)
- DensDefy Liquid Barrier System installed as a water-resistive barrier and an air barrier material, is recognized for use on Types I, II, III, IV and V construction. When used on exterior walls of buildings greater than 40 feet above grade in Types I, II, III or IV construction under the 2021, 2018 and 2015 IBC, installation must comply with Exception 1 of 2021 and 2018 IBC Section 1402.5 (2015 IBC Section 1403.5).

DensDefy Liquid Barrier System has been evaluated as an air barrier by the Air Barrier Association of America (ABAA)

Fire Resistance/NFPA 285

DensDefy Liquid Barrier System is NFPA 285 compliant with multiple assemblies that hold an ICC-ES Evaluation Report, including Brick, Stucco, Metal Panel and other claddings.

Application of DensDefy® Liquid Flashing

Read "Preparation" section of this document and the SDS located at msds.gp.com before use.

Dilution & Mixing

Apply as packaged. Do not dilute, alter or use for applications other than specified. No mixing is required.

Typical Coverage Rates

DensDefy Liquid Flashing is sold in 20-oz. sausages. Coverage varies based on surface texture, irregularities, application width and thickness. A 2-inch-wide, 28-mil-thick application will cover 48 linear feet.

Application of DensDefy™ Liquid Barrier

Before use, read Preparation, Hazard Statements and Precautionary Statements. Refer to msds.gp.com.

Typical Coverage Rates

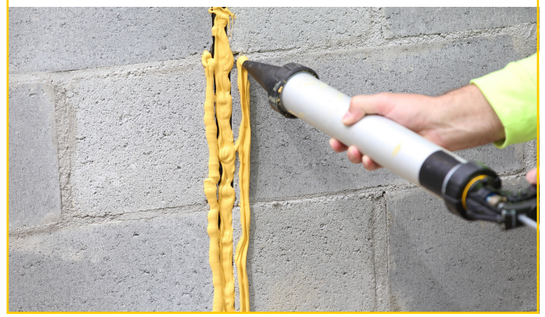
Coverage rates will vary depending on surface porosity, moisture uptake and other factors. Actual rates must be determined through mock-up applications. Some gypsum sheathing products, OSB and CMU may require additional material and multiple passes to achieve the desired mil thickness and an application free of pinholes and voids.

- Exterior Gypsum Panel: 450–550 sq. ft. per 5-gallon pail when applied at 14–18 wet mils
- OSB/Plywood: 250–350 sq. ft. per 5-gallon pail when applied at 14–18 wet mils
- CMU: 300–400 sq. ft. per 5-gallon pail when applied at 14–18 wet mils total in multiple passes

INSTALLATION INSTRUCTIONS

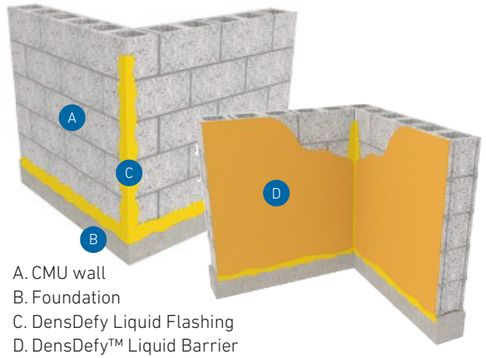
Complete Detail Work With DensDefy™ Products Over All Substrates

Seal vertical corners, openings, penetrations and material transitions on walls with DensDefy® Liquid Flashing as shown in the DensDefy Liquid Flashing installation guide.



Vertical Corners

1. Apply DensDefy Liquid Flashing over the inside/outside corners in a zig-zag or ribbon pattern.
2. With a straight-edge tool, spread evenly over the wall corner.
3. Apply at a rate to achieve a minimum thickness of 16 wet mils over the corner area. Cover a minimum of 2-in. on both sides of the corner.



A. CMU wall
B. Foundation
C. DensDefy Liquid Flashing
D. DensDefy™ Liquid Barrier

Note: For framed wall construction, apply DensDefy Liquid Flashing to sheathing panel seams.

Mix DensDefy™ Liquid Barrier

Mix using a low-speed drill and mixing paddle from top to bottom and side to side for a minimum of 3 minutes before use. Avoid mixing air into the product. Do not dilute or thin.

When remixing previously opened pails, remove any cured material from the pail prior to mixing.

Coat the Field of the Wall with DensDefy Liquid Barrier

Note: DensDefy® Liquid Flashing may be applied over or under the DensDefy Liquid Barrier. Overlap DensDefy materials approximately 1" to maintain air- and water-resistive barrier continuity.

If DensDefy® Transition Membrane is used, install it first, then treat the edges with DensDefy Liquid Flashing, and finally apply the DensDefy Liquid Barrier approximately 1" over the DensDefy Liquid Flashing.

Let DensDefy Liquid Flashing skin over before applying DensDefy Liquid Barrier.

Roller Application

Using a lint-free 1/4" or 3/8" nap roller, apply DensDefy Liquid Barrier in vertical strokes with a slight diagonal slant. Roll back over any edge lines or built up areas to prevent sag. Additional material and passes may be needed over porous substrates to achieve a pinhole-void-free application.

Spray Application

Recommended Spray Equipment	Graco	Titan
Sprayer (>4000 psi, >3 gpm)	833 Direct Immersion or equivalent	PowerTwin 12000di Direct Immersion
Hose (up to 200 ft)	1/2" ID 4000 psi	1/2" ID 4000 psi
Whip (6 to 10 ft)	3/8" whip and gun swivel	3/8" whip and gun swivel
Gun (listed or equivalent)	HD Blue 241706	RX-Apex
Tip	523 reversible tip	HD reversible tip

Recommended Accessories
- Spray tip extension – improves delivery and extends reach
- Spray tip swivel for extension

Note: Other combinations of sprayers, guns and tip sizes can be qualified by the contractor to achieve the desired application properties.

When selecting airless spray equipment, it is important to ensure the sprayer is direct immersion and can maintain at least 3500–4000 psi at the spray tip. Remove all filters prior to spraying.

Proper Power Sprayer Equipment Maintenance

Review the recommended daily maintenance instructions provided by the pump manufacturer.

Before Use: Ensure the sprayer has been flushed with an approved solvent such as mineral spirits. Do not rinse with water.

During Use: Precautions should be taken to prevent open pail of material from skinning during application. Plastic sheeting may be placed on the material to prevent air exposure.

After Use: Ensure all tips, hoses and the sprayer have been completely flushed with mineral spirits or other approved solvent immediately after use. Never run water through the pump when using DensDefy™ Liquid Barrier, as this is a moisture-cure product and will react with any water in the pump and lines. Do not allow DensDefy Liquid Barrier to sit idle in the sprayer for more than 15 minutes. Thoroughly flush equipment with approved solvent after each use.

Product and sprayer should be stored at 70-75°F (21-24°C) prior to use to ensure proper spraying. Cooler product will be more difficult to spray.

General Application Notes

- Apply material so that a minimum 14 wet mils are achieved with no pinholes or voids. Inspect surface after initial application and touch up as needed; pinholes may not appear immediately.

  Note: When spraying over porous substrates such as CMU, spraying in multiple light coats may help minimize pinholes. Alternatively, spraying and then back rolling may also help minimize pinholes and voids.

- Seal masonry ties and penetrations as work progresses.

- Cover pail immediately after use and during any work stoppages to prevent product curing in the container.

Repair

- Inspect membrane for damage, voids or pinholes prior to covering. Repair any deep gouges, punctures or damaged areas with DensDefy® Liquid Flashing. Overlap repairs, penetration treatments, transitions, rigid flashing and other air barrier components to ensure positive drainage and continuity of the air- and water-resistive barrier.

Cleanup

Clean tools and equipment with mineral spirits or similar solvent immediately after use.

Surface and Ambient Air Temps

Between 32°F (0°C) and 110°F (43°C) are required for proper curing and drying of material.

Hot Weather Conditions: When air or surface temps exceed 95°F (35°C), apply product to the shady side of structure before daytime air/surface temps reach their peak. Hot surfaces may be cooled with a mist of fresh water. Keep containers closed and out of direct sunlight when not in use. Do not apply when substrate temp exceeds 110°F (43°C).

Cold Weather Conditions: Product may be applied to frost-free substrates at temperatures as low as 25F° (-3.9°C). Product will not begin to cure until temps reach 32°F (0°C) and remain above freezing. Storing product in a heated environment prior to use and misting applied material with warm, fresh water helps in these conditions.

Low Humidity Conditions: The process of curing may take longer when lower humidity levels occur. A light misting of fresh water over the treated surface will accelerate curing if necessary.

Note: DensDefy Liquid Barrier and DensDefy Liquid Flashing may be applied to damp surfaces and tolerate rain immediately after application. Do NOT apply to surfaces with standing water or frost.

Recommendations and Limitations for Use

The following recommendations and limitations are important to ensure the proper use and benefits of DensDefy™ Liquid Barrier System. Failure to strictly adhere to such recommendations and limitations may void the limited warranty provided by Georgia-Pacific Building Products for such products. For details, please go to buildgp.com/warranties.

- DensDefy Liquid Barrier is not for use as a liquid flashing membrane. Use DensDefy® Liquid Flashing.
- Not for use in place of appropriate through-wall flashing material.
- Do not use DensDefy Liquid Barrier System below grade or in locations that may be continuously immersed in water.
- DensDefy Liquid Barrier System is not intended for permanent exposure. Cover within 12 months after installation.
- DensDefy Liquid Barrier System is resistant to normal weather conditions. It is not intended for use as a cladding system, long-term outdoor exposure, immersion in water or use with cascading water from an unfinished roof or floor. Water should always be directed away from DensDefy Liquid Barrier System.
- Do not apply to contaminated or frost-covered surfaces. Treated lumber must be dry and solvent wiped with isopropyl alcohol prior to application of DensDefy Liquid Barrier System.
- Avoid conditions that will create moisture in the air and condensation within the exterior walls. This is especially important during periods when the exterior and interior temperature differentials can create a condensation point within the exterior wall. The use of forced air heaters creates volumes of water which, when not properly vented, can condense on building materials. The use of heaters and any resulting damage is not the responsibility of Georgia-Pacific Building Products. Consult heater manufacturer for proper use and ventilation.
- For cladding systems that require multiple layers of water-resistive barriers, DensDefy Liquid Barrier System is intended to replace only the first layer over the wall substrate.
- Avoid the use of solvent-based primers, adhesives or accessory products with DensDefy Liquid Barrier System.
- Exterior wall design details including, but not limited to, cladding attachments, control joints, material transition details, drainage mechanisms, flashing, sealants, and window and door integration must be properly installed per the project specifications.
- Roofing systems must be capped and sealed, and top of walls protected from water intrusion both before and after DensDefy Liquid Barrier installation. Water intrusion may interfere with adhesion and/or detrimentally impact the performance of such materials.
- Georgia-Pacific Building Products does not warrant and is not responsible or liable for the performance of any cladding or cladding system that is attached or adhered to DensDefy Liquid Barrier System. The compatibility of any cladding system is the responsibility of the cladding manufacturer or design authority.
- DensDefy Liquid Barrier System is not for use with insulated concrete forms.

Limited Warranty

Georgia-Pacific Building Products provides a limited warranty for DensDefy Liquid Barrier System as part of the original building envelope of a residential or commercial property. For a full copy of the DensDefy Liquid Barrier Limited Warranty, go to buildgp.com/warranties. GP makes no other warranties, express or implied, and specifically disclaims any warranties of merchantability or fitness for a particular purpose.

03/23. Lit #: 623073

Georgia-Pacific
Building Products

U.S.A. GP Gypsum LLC
CANADA Georgia-Pacific Canada LP

SALES INFORMATION AND ORDER PLACEMENT

U.S.A.	Pacific Southwest:	**1-800-824-7503**
	Midwest:	**1-800-876-4746**
	Central:	**1-800-231-6060 x7709**
	North:	**1-800-947-4497**
	Pacific Northwest	**1-800-444-0092**
	South	**1-800-327-2344**
Canada	Canada Toll Free:	**1-800-387-6823**

TECHNICAL HOTLINE

U.S.A. and Canada: **800-225-6119**

WARRANTIES AND TERMS OF SALE – For current warranty information, please go to buildgp.com/warranties and select the applicable product. All sales by Georgia-Pacific are subject to our Terms of Sale available at buildgp.com/tc.

CAUTION – For product fire, safety and use information, go to buildgp.com/safetyinfo or call 1-800-225-6119.

HANDLING AND USE – Refer to SDS for instructions on safe handling and use of the product here: msds.gp.com.

GEORGIA-PACIFIC GYPSUM
SECTION 07 27 26 FLUID-APPLIED MEMBRANE AIR BARRIERS, VAPOR PERMEABLE

SPECIFIER NOTE: This specification section is designed to provide guidance when specifying **DensDefy™ Liquid Barrier**

DensDefy™ Liquid Barrier is a fluid-applied single component Silyl-Terminated Polymer (STP) air and water-resistive barrier applied by roller or with spray equipment over many common substrates.

BASIC USE: DensDefy™ Liquid Barrier can be applied to produce a seamless, durable membrane on exterior gypsum sheathing, wood sheathing, CMU, and concrete walls. The robust, elastomeric membrane formed by DensDefy™ Liquid Barrier adheres to most common construction surfaces such as CMU, concrete, glass mat gypsum sheathing, Exposure 1 OSB and plywood, galvanized steel and wood framing and is compatible with a wide range of sealants and waterproofing or air barrier components.

SUMMERY OF BENEFITS: DensDefy™ Liquid Barrier creates a robust barrier that helps keep bulk water out, but remains permeable, which allows water vapor to escape and promote drying. The DensDefy™ Liquid Barrier helps prevent air infiltration for a more energy efficient structure. DensDefy™ Liquid Barrier can be applied to dry or damp substrates to help eliminate weather delays and accelerate “dry-in” of new buildings. The DensDefy™ Liquid Barrier may be fully exposed to UV and normal weather conditions for up to 12 months after installation.

IMPORTANT: This specification is for general information and guidance and intended solely for use by architects, engineers and other professionals for planning purposes. This specification may not be appropriate for all projects, assemblies, systems or conditions. Ultimately, the design and detailing of the project, assembly or system is the responsibility of a professional, and all projects must comply with applicable building codes and standards. GP Gypsum makes no representation or warranty, express or implied, concerning this specification and disclaims any responsibility or liability for the use of this specification and for the architecture, design, engineering or workmanship of any project, assembly or system.

FOR TECHNICAL OR SALES SUPPORT CONTACT:
Georgia-Pacific Gypsum
133 Peachtree Street, NE
9th floor
Atlanta, GA 30303
770-688-3888
1-800-225-6119
www.buildgp.com

TECHNICAL HOTLINE
U.S.A. and Canada: **1-800-225-6119**
techservices@gapac.com

SECTION 07 27 26 FLUID-APPLIED MEMBRANE AIR BARRIERS, VAPOR-PERMEABLE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fluid-applied. vapor-permeable, membrane air barrier

1.2 RELATED SECTIONS

Specifier Note: If including this optional RELATED SECTIONS, please only include the sections included in the project manual.

A. Division 01 Section "Sustainable Design Requirements" for additional requirements, including [LEED] documentation requirements.
B. [Section 014000 Quality Requirements;] [Section 014529 Testing Laboratory Services;] [Section 014533 Code-Required Special Inspections and Procedures;] coordination with owners' independent testing and inspection agency
C. Section 014339 Mock-Ups; exterior wall mock-ups
D. Section 015000 Temporary Facilities and Controls; Work Schedule requirements to prevent weather or sunlight exposure beyond the manufacturer limits; project requirements to protect installed material prior to and during the enclosure work is completed.
E. Section 03300 Cast-In-Place Concrete; requirements for smooth and protrusion free surface
F. Section 042000 Unit Masonry; Requirements for masonry joints are flush and filled with mortar, removal of excess mortar on brick ties.
G. Section 061600 Sheathing for air barrier substrates and joint treatment
H. Section 075000 Roofing Membrane; roof assembly and air barriers interface coordination and sequencing
I. Section 092900 Gypsum Board
J. Exterior wall claddings

1.3 REFERENCE STANDARDS

A. AAMA- American Architectural Manufactures Association
   1. AAMA 711 Voluntary Specification for Self-Adhering Flashing Products Used for the Installation of Exterior Wall Fenestration Products.
   2. AAMA 714 Voluntary Specification for Liquid Applied Flashing Used to Create a Water Resistive Seal Around Exterior Wall Openings in Buildings
B. ASTM- American Society for testing and Material Standards www.astm.org
   1. ASTM C1177 Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing
   2. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials
   3. ASTM E96 Standard Test Methods for Water Vapor Transmission of Materials

4. ASTM E2178 Standard Test Method for Air Permeance of Building Material
5. ASTM E2357 Standard Test Method for Determining Air Leakage of Air Barrier Assemblies
6. ASTM D412 Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension

C. Building Codes and Standards
1. 2015 ICC-ES AC 212 CIC ES Water-resistive Coatings Used as Water-resistive Barriers over Exterior Sheathing
2. 2021, 2018, 2015, and 2009 IBC International Building Code
3. 2021, 2018, 2015, 2012, and 2009 IRC International Residential Code
4. 2021, 2018, 2015, and 2009 IECC International Energy Conservation Code
5. US Environmental Protection Agency's AIM VOC regulations

D. GA - Gypsum Association
1. GA-253 Application of Gypsum Sheathing

E. NFPA - National Fire Protection Association
1. NFPA 285 Standard Fire Test Method for Evaluating of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components

F. US Department of Commerce (DOC)
1. DOC PS 1 - Structural Plywood
2. DOC PS 2 - Performance Standard for Wood-Based Structural Panels

1.4 SUBMITTALS

A. Submittals: Submit in accordance with Division 1 requirements.

B. Product Data: Submit manufacturer’s product data including accessory material types, composition, descriptions, and properties.

C. Installation instructions and substrate preparation recommendations.

D. Shop Drawings of Mock-Up; Shop drawings of proposed mock-up(s) including plans, elevations, details, and air barrier transitions.

E. Shop Drawings: Submit shop drawings indicating locations and extent of fluid-applied air barrier membrane system, including details of typical conditions, special joint conditions, intersections with other building envelope systems and materials; counter flashings and details showing bridging of envelope at substrate changes, details of sealing penetrations, and detailed flashing around windows and doors

F. Sample warranty: Submit a sample warranty identifying the terms and conditions of the warranty as herein specified.

G. VOC Regulations: Provide products that meet volatile organic emission standards.

H. Evaluation reports: Accredited laboratory testing for materials

1.5 WARRANTY

A. Provide manufacturer's standard warranty for the fluid-applied air barrier membrane to be free of manufacturing defects that make it unsuitable for its intended use. Warranty period shall be Ten (10) years from the date of installation of the product.

B. Provide manufacturer's standard warranty for use as a drainage plane when the cladding systems are properly designed and installed, with a warranty period of 10 years from the date of installation of the product or.

1.6 QUALITY ASSURANCE- PRECONSTRUCTION CONFERENCE

A. Conduct preconstruction conference onsite at project
B. Review air barrier products and installation requirements
C. Mock-up construction and expectations
D. Testing and inspection requirements
E. Sequencing and coordination of air barrier work with other materials and sections
F. Compatibility of materials that will interface with the primary fluid-applied membrane material and accessories.

1.6 QUALITY ASSURANCE- MATERIAL

A. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. (0.2 L/s x sq. m of surface area at 75 Pa), when tested according to ASTM E 2357.

1.7 QUALITY ASSURANCE - MOCK UP

A. Provide air barrier for mock-up for each backup wall construction as specified in [Section 014339 Mock-Ups.] [Section _____].
B. Include examples of surface preparation, detailing of penetration, crack and joint treatment, air barrier application, termination conditions, flashing, transitions to roof and foundation materials, and adjacent materials.

1.8 QUALITY ASSURANCE – REGULATORY COMPLIANCE

A. Comply with US Environmental Protection Agency's AIM VOC regulations
B. Comply with 2015 ICC-ES AC 212 CIC ES Water-resistive Coatings Used as Water-resistive Barriers over Exterior Sheathing
C. Comply with 2018 and 2021 IRC requirements for continuous air barrier
D. Comply with 2018 and 2021 air barrier requirements of the IBC and IECC

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver and accept materials to the Project site in original packaging with seals unbroken and label with Manufacturer's name.
B. Protect materials from damage, excessive temperatures, and construction traffic.
C. Store materials in a cool and dry area.
D. Handle materials in accordance with the manufacturer's recommendation,

1.10 FIELD CONDITIONS

A. Temperature: Install the air barrier materials within the range of ambient and substrate temperature recommended by the material manufacturer.

B. Field Conditions: Do not install the air barrier when the temperature of the substrate surface or air temperature are below or above the manufacturer's recommendations.
C. Sequencing: Coordinate installation of the roof assembly to ensure the roof assembly is sufficiently installed to prevent accumulation of water in the interior of the building. Schedule other work requiring interface with the air barrier to ensure proper sequencing.
D. Compatibility. Do not allow air barrier materials to come in contact with chemically incompatible materials.
E. Ultra-violet exposure. Do not expose air barrier materials to sunlight longer than as recommended by the material manufacturer.

PART 2 PRODUCTS

2.1 MANUFACTURERS
A. Basis-of-Designs: Provide air barrier products manufactured by Georgia-Pacific Gypsum LLC 1-800-225-6119; email: techservices@gapac.com www.buildgp.com or comparable products approved by the Architect in agreement with Division 1 General Requirements.
B. Source Limitations: Obtain the primary air-barrier materials from a single source manufacturer.

2.2 MATERIALS
A. Primary Air Barrier Material: DensDefy™ Liquid Barrier - single component Silyl-Terminated Polymer (STP) air and water-resistive barrier applied by roller or with spray equipment applied at a minimum of 14 wet mils
B. Air Barrier Accessory Materials
1. Fluid applied flashing for joints, inside and outside corners, material transitions, board to board seams, wall to slab, and penetrations
a. DensDefy™ Liquid Flashing - a waterproofing and detailing compound made with STP Technology
2. Self-Adhering transition membrane for flashing of rough openings, material transitions, and wall to slab
a. DensDefy™ Transition Membrane - 25-mil composite impermeable membrane that is comprised of 16 mils of butyl adhesive and 9 mils of HDPP facer.

2.3 PERFORMANCE
A.Fluid-Applied Membrane Air Barrier Performance
1.Air Performance ASTM E2178; Air Permeance ASTM E2178: ≤0.004 cfm/sg ft of surface area at 1.57-lbf/sq. ft (≤0.02 L/s x sq. m of surface area at 75-Pa)
2. Vapor Performance ASTM E96; Minimum of 14 Perms

3. Tensile Strength of Sandwich Construction ASTM C297: pull strength meeting or exceeding 15 psi.
4. Elongation: ASTM D412 >400% at break
5. Surface Burning Characteristics: ASTM E84; Class A; a flame spread of no greater than 25; smoke development of 10
6. VOC content <30 g/L.
7. Pass Hydrostatic Pressure Test (3-stage) per ICCES AC212
8. Exposed to normal weathering conditions for up to 12 months

B. Fluid Applied Flashing Performance
1. Comply with AAMA 714-19: Voluntary Specification for Liquid-Applied Flashing Used to Create a Water-Resistive Seal Around Exterior Walls in Openings in Buildings

C. Self-Adhering Transition Membrane Performance
1. Comply with AAMA 711: Voluntary Specifications for Self-Adhering Flashing Used for Installation of Exterior Wall Fenestration Products.

PART 3 EXECUTION

3.1 EXAMINATION

A. Before applying the air barrier material ensure the following conditions are met.
1. Verify that the surfaces conditions are suitable prior to commencing installation
2. Concrete: Provide concrete in conformance with applicable building codes
3. Concrete Masonry Units (CMU) are in conformance with the applicable building code and masonry joints are flush and filled.
4. Masonry surfaces have cured for the recommended time period by the membrane manufacturer and are free from release and curing agents, excess mortar, or other contaminates.
5. Gypsum Sheathing is installed in accordance with GA-253 and compliance with ASTM C1177
6. Substrates are smooth without large voids or sharp protrusions.
7. Structural Plywood meets the established requirements of DOC PS 1 Structural Plywood
8. Oriented Strand Board (OSB) meets the establishes requirements of DOC PS 2 Performance Standard for Wood-Based Structural Panels

B. Test for capillary moisture by plastic sheet method according to ASTM D4263
C. Verify sealants are compatible with air barrier membrane used.
D. Ensure field conditions are met as outlined in Part 1 – General Requirements.
E. Proceed with air barrier installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

A. Clean, prepare, and treat substrate in accordance with the air barrier manufacturers written instructions

B. Apply treatment to board-to-board seams in sheathing and surface cracks in masonry substrates per the air barrier manufacturers written instructions.
C. Remove all bond inhibiting agents, such as dust, mud, oils, curing compounds or any other substances that might prevent placement and bonding of membrane
D. Fill voids with a substrate patching material
E. Mask or cover adjacent areas to protect from over-spray

3.3 GENERAL INSTALLATION AIR BARRIER MEMBRANE

A. Install fluid-applied air barrier membrane and system accessories to achieve a monolithic, void-free, continuous building envelope.
B. Install fluid-applied air barrier and system accessories in accordance with manufacturer's written instructions.
C. Install fluid-applied membrane using equipment and methods in the air barrier written instructions to achieve required free-film thickness by the manufacturer.

3.4 GENERAL INSTALLATION OF ACCESORY MATERIALS

A. Install accessory materials according to the Air Barrier written instruction to seal and connect air barrier material to adjacent material
B. Transitions: Seal, flash, and connect air barrier material continuously to below-grade structures, roofing membrane, floor-to floor conditions, window and glazing systems including curtain wall and storefront assemblies, door system, and other exterior wall openings.
    1. Self-adhered transition membrane at transitions and rough openings: By the end of each workday, flash all edges of the applied self-adhered membrane with a manufacturer approved liquid flashing. Overlap self-adhere transitional membrane using a shingle lap method and roll-out installed membrane to ensure a secure adhesion to the substrate
C. Penetrations: Seal around all exterior wall penetrations with liquid flashing or manufacture approved sealant to prevent air and water infiltration. For round or square pipe/duct penetrations use specified fluid applied flashing, refer to the air barrier written instructions for proper sealing.

3.5 FIELD QUALITY CONTROL

A. Do not cover installed fluid-applied air barrier membrane assembly until required inspections have been completed and installation has been accepted.
B. Where applicable, allow for owner's inspection and air barrier testing and reporting.
C. If the inspections or testing reveal any deficient application, remediate deficient work promptly

3.6 PROTECTION

A. Protect air barrier membrane assembly from damage during installation and during the construction period.

B. Coordinate to protect air barrier membrane from UV light exposure for a period greater than the acceptable by the air barrier membrane manufacture.
C. Use cleaning agents and procedures recommended by the manufacturer of affected construction to remove spills, stains, and overspray prior to curing.

END OF SECTION

Georgia-Pacific

DensDefy™ Liquid Barrier

Limited Warranty

GP Gypsum LLC ("GP") provides the following limited warranty with respect to DensDefy™ Liquid Barrier together with approved DensDefy™ accessories for the treatment of any joints, fasteners, openings, transitions and penetrations as part of the original building envelope of a commercial or residential property, all as identified and described in GP's current published literature at www.buildgp.com (collectively, the "DensDefy Liquid Barrier System"). The limited warranty set forth herein applies to any DensDefy Liquid Barrier System installed in the United States or its territories on or after July 1, 2021.

PLEASE READ THIS DOCUMENT CAREFULLY, AS THIS WARRANTY AND YOUR PURCHASE OF THE DENSDEFY LIQUID BARRIER SYSTEM IS SUBJECT TO ALL OF THE TERMS AND CONDITIONS BELOW.

Limited Warranty. GP warrants to each Qualified Purchaser of the DensDefy Liquid Barrier System for installation as part of the original building envelope of a commercial or residential structure that:

(1) Defects: the DensDefy Liquid Barrier System installed or to be installed in the structure was, at the time of shipment from the manufacturer, free from manufacturing defects that make it unsuitable for use as a water-resistive and air-barrier (WRB-AB) (as described at www.buildgp.com); and

(2) Drainage Plane: the DensDefy Liquid Barrier System, when properly installed in the structure and when cladding systems are properly designed and installed to promote drainage, is suitable for use as a drainage plane.

Each of the limited warranties above shall have a duration of ten (10) years from the date of installation of the DensDefy Liquid Barrier System.

A "Qualified Purchaser" is: (i) any purchaser of the DensDefy Liquid Barrier System; (ii) any person who installs the DensDefy Liquid Barrier System in a structure; or (iii) any person who owns a structure that includes the DensDefy Liquid Barrier System.

EXCEPT AS SPECIFICALLY AGREED OR PUBLISHED BY GP IN WRITING, THE FOREGOING WARRANTY IS THE SOLE WARRANTY GIVEN BY GP WITH RESPECT TO DENSDEFY™ LIQUID BARRIER OR THE DENSDEFY LIQUID BARRIER SYSTEM. GP DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. WHERE APPLICABLE LAW DOES NOT PERMIT THE DISCLAIMER OF ANY IMPLIED WARRANY, THE DURATION OF SUCH IMPLIED WARRANTY SHALL BE LIMITED TO THE GREATER OF NINETY (90) DAYS FROM THE DATE OF SALE OR THE MINIMUM LEGAL DURATION FOR SUCH IMPLIED WARRANTY UNDER APPLICABLE LAW. Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you.

Terms and Conditions Applicable to Warranties. The foregoing warranties are conditioned on and subject to the additional terms and conditions set forth below.

1. The foregoing warranties apply only when the DensDefy Liquid Barrier System and its components have been subjected to normal weather and use conditions and have been accorded treatment which is considered good practice in the building industry regarding storage, handling, joint and opening treatment, installation, and maintenance. In addition to this limitation, any damage to the DensDefy Liquid Barrier System resulting in whole or in part from the following conditions is NOT GP's responsibility and is NOT covered by the foregoing warranties:

(a) Failure to store, handle or install the DensDefy Liquid Barrier System or its components in accordance with GP's storage, handling and installation instructions (available at www.buildgp.com), applicable building practices and all applicable building codes;

(b) Improper design or installation of the system, assembly or any portion or component of the structure, or failure or distortion of the walls, foundation or any other portion or component of the structure, including settling of the building or movement of framing members, or failure to establish adequate drainage;

(c) Suitability or performance of any cladding, coating, finishes, coverings or materials (other than DensDefy accessories for the treatment of any joints, fasteners, openings, transitions and penetrations) applied or attached to the DensDefy Liquid Barrier System;

(d) Causes other than normal weather and use conditions, such as: impact with objects; high force winds, earthquake, flood, fire or other acts of God or nature; sustained cascading or pooling of water, or immersion in water; or any other cause beyond GP's control;

(e) Application in temperatures less than 25°F (-4°C), to frost-covered or contaminated surfaces or to onto insulated concrete forms;

(f) Exposure without cladding or other adequate covering for more than twelve (12) months from the date of installation;

(g) Mold, mildew, fungi, bacteria or other similar conditions;

(h) Failure to install within twelve (12) months from the date of manufacture;

(i) Use of the DensDefy Liquid Barrier System other than for its intended use as described at www.buildgp.com; or

(j) A third-party's actions, omissions or negligence.

The DensDefy Liquid Barrier System has natural characteristics that are not to be considered defects or evidence of a breach of warranty.

2. Before GP will honor any claim under this Limited Warranty, a Qualified Purchaser must give GP written notice of the claim no later than ten (10) days after discovery of any alleged problem. Written notice shall be directed to GP Gypsum LLC, 133 Peachtree Street N.E., 8th Floor, Atlanta, GA 30303, Attn: Quality Manager. All claims must be accompanied by sales receipts and other supporting documents. GP shall have twenty (20) days thereafter to inspect the DensDefy Liquid Barrier System. The Qualified Purchaser must grant reasonable access for inspection and shall not make any alteration or repair to the DensDefy Liquid Barrier System before GP's inspection. If GP's inspection confirms that the DensDefy Liquid Barrier System does not conform with this Limited Warranty, then GP will, at its sole option,

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DensDefy™
Liquid Barrier

Limited Warranty

(continued)

either (i) replace the non-conforming DensDefy Liquid Barrier System, (ii) refund the original uninstalled purchase price for the non-conforming DensDefy Liquid Barrier System, or (ii) where the DensDefy Liquid Barrier System has already been installed, reimburse the Qualified Purchaser for the reasonable cost of repair or replacement of the non-conforming DensDefy Liquid Barrier System, up to a maximum amount equal to two (2) times the original uninstalled purchase price of the non-conforming DensDefy Liquid Barrier System. These remedies are GP's sole and exclusive obligation and liability for any breach of warranty relating to the DensDefy Liquid Barrier System and are also the Qualified Purchaser's sole and exclusive remedies for any such breach.

3. **UNDER NO CIRCUMSTANCES WILL GP BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL, CONSEQUENTIAL OR PUNITIVE DAMAGES, INCLUDING, BUT NOT LIMITED TO, LOSS OF PROFITS, LOSS OF USE OF ANY PRODUCT OR SYSTEM, COST OF SUBSTITUTE PRODUCTS OR DAMAGE TO PROPERTY, ARISING OUT OF THE PURCHASE OR USE OF THE DENSDEFY LIQUID BARRIER SYSTEM. THIS LIMITATION OF LIABILITY APPLIES TO ANY CLAIM, WHETHER ASSERTED AS BREACH OF WARRANTY, BREACH OF CONTRACT, NEGLIGENCE, PRODUCT LIABILITY, STRICT LIABILITY, OR UNDER ANY OTHER LEGAL OR EQUITABLE THEORY.** Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

4. The foregoing warranties are non-transferable and are not for the benefit of any third parties.

5. This is the entire warranty between GP and the Qualified Purchaser with respect to the subject matter hereof and supersedes all prior and contemporaneous agreements, representations, warranties or understandings, whether oral or written, relating thereto. GP reserves the right to discontinue and/or modify this Limited Warranty at any time without notice; provided, any discontinuation or modification shall not apply to any DensDefy Liquid Barrier System purchased prior to such time.

6. The provisions of this Limited Warranty are severable. If any provision of the Limited Warranty is determined to be unenforceable for any reason, then the unenforceable provision shall be struck, and the other provisions of this Limited Warranty shall remain in full force and effect.

7. This Limited Warranty gives you specific legal rights, and you may also have other rights, which vary from state to state.

8. **ARBITRATION AGREEMENT. PLEASE READ THIS DOCUMENT CAREFULLY. IT AFFECTS LEGAL RIGHTS BY REQUIRING BINDING ARBITRATION, WAIVING CLASS ACTION CLAIMS, AND WAIVING THE RIGHT TO TRIAL BY JURY.**

(a) Mandatory Arbitration of Claims. **EXCEPT FOR DISPUTES OF $10,000 OR LESS, WHICH MAY BE FILED IN SMALL CLAIMS COURT OR ITS EQUIVALENT, ANY DISPUTE OR CLAIM ARISING OUT OF OR RELATING TO THIS LIMITED WARRANTY OR THE PRODUCTS COVERED BY THIS LIMITED WARRANTY (WHETHER BASED IN CONTRACT, INDEMNITY, STATUTE, REGULATION, TORT OR OTHER LEGAL OR EQUITABLE THEORY) (A "DISPUTE") SHALL BE FINALLY RESOLVED BY ARBITRATION IN ACCORDANCE WITH THE INTERNATIONAL INSTITUTE FOR CONFLICT PREVENTION AND RESOLUTION ("CPR") RULES FOR NON-ADMINISTERED ARBITRATION CURRENTLY IN EFFECT ("CPR RULES"). THAT MEANS A NEUTRAL ARBITRATOR, NOT A JUDGE OR JURY, WILL DECIDE ANY DISPUTE.**

(b) Arbitration Rules. The CPR Rules are available at www.cpradr.org. Notices to initiate arbitration should be sent to CPR in accordance with the CPR Rules with a copy addressed to: GP Gypsum LLC, 133 Peachtree Street N.E., 24th Floor, Atlanta, GA 30303, Attn: Gypsum Division Counsel. Alternatively, you may request that GP initiate the arbitration of a Dispute with CPR by providing written notice of such request to GP at the address above. Any such notice shall describe the nature and basis of the Dispute and the specific relief sought. Except as otherwise noted below for Consumers, the seat of the arbitration shall be Atlanta, Georgia; provided, if the relief sought is less than $10,000, you may elect that the arbitration be conducted by phone or on written submissions. The arbitrator shall apply the law of the State of Georgia without reference to choice-of-law rules, which shall also govern the interpretation and enforcement of this Limited Warranty. The arbitrator shall have the authority to decide issues concerning the scope and enforceability of this arbitration provision, including the arbitrability of any Dispute, and may only award such relief as a court of competent jurisdiction could award. The arbitration shall be governed by the Federal Arbitration Act (9 U.S.C. § 1 et seq.), and judgment upon the award rendered by the arbitrator may be entered in any court having jurisdiction.

(c) Additional Terms for Consumers. Additional Terms for Consumers. The following additional terms apply solely to any individual consumer who is not a builder, contractor, distributor or other person engaged in the commercial installation or resale of the covered product (a "Consumer"). The arbitration will be conducted by a sole arbitrator and will take place in the county where the Consumer resides. GP will pay all arbitration filing fees and arbitrator costs for arbitration with a Consumer, and the Consumer shall not be required to reimburse GP for such fees and costs unless the arbitrator determines that the Dispute was frivolous. The Consumer will be responsible for all additional costs that he or she incurs in the arbitration, including, but not limited to, attorneys' fees (if represented by an attorney) and expert fees; provided, GP will pay all fees and costs that it is required by applicable law to pay, including payment of attorney's fees and costs required by applicable law. If the arbitration award for a Consumer is greater than GP's last settlement offer, GP will pay the award amount plus a reasonable attorney's fee up to the lesser of three times the award or $7,500 (US).

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(continued)

(d) Class Action Waiver. **ALL PARTIES TO THE ARBITRATION MUST BE INDIVIDUALLY NAMED, AND THERE WILL BE NO RIGHT OR AUTHORITY FOR ANY DISPUTES TO BE ARBITRATED ON A CLASS, REPRESENTATIVE OR CONSOLIDATED BASIS. YOU MAY NOT PARTICIPATE IN A CLASS OR REPRESENTATIVE ACTION AGAINST GP AS A CLASS MEMBER IF THE CLASS ACTION ASSERTS CLAIMS THAT WOULD FALL WITHIN THE SCOPE OF THIS PARAGRAPH 8.** If this class action waiver is found to be unenforceable by any court or arbitrator, then the entire arbitration agreement set forth in this Paragraph 8 will not apply to any Dispute between you and GP.

(e) Jury Trial Waiver. If for any reason the arbitration agreement in this Paragraph 8 is found to be unenforceable, you and GP each expressly and knowingly **WAIVE THE RIGHT TO TRIAL BY JURY OF ANY CLAIM.**

(f) Opt-Out Rights. **Notwithstanding any contrary provision of this Limited Warranty, GP reserves the right to opt out of mandatory arbitration if named in a lawsuit by a third party that is a defendant brought by a Qualified Purchaser and to require that all related disputes governed by this Limited Warranty be resolved in such lawsuit.**

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Effective Date 7/1/2021

Georgia-Pacific
Gypsum

Georgia-Pacific Building Products

Product Data Sheet

DensDefy®
Liquid Flashing

DensDefy® Liquid Flashing is a waterproofing, and detailing compound made with STP Technology which seals rough openings, penetrations, joints, sheathing fasteners and seams in new or existing wall assemblies.

DensDefy® Liquid Flashing creates an elastomeric flashing membrane which is highly durable. It eliminates the need for joint reinforcing tape reducing installation time.

Advantages

The inclusion of DensDefy® Liquid Flashing with the DensElement® Barrier System and DensDefy™ Liquid Barrier System delivers a complete, tested solution providing water-resistive and air barrier continuity.

Ease of Use
- No priming is required, bonds to most building materials.

Versatility
- Easy to apply to complex geometries.
- Compatible with many sealants and waterproofing or air barrier components.

Weather Resistant
- Provides a durable, weather-tight seal.
- Bonds and cures in adverse weather conditions, on damp substrates, and tolerates rain immediately after application.
- Will not tear or lose effectiveness when exposed to normal weather conditions during construction.
- May be fully exposed to UV and normal weather conditions for up to 12 months.
- Application temperature can be above 25°F and rising. Product is able to cure at 32°F.

Limitations
- Not for use as a structural sealant.
- Not for use as a through-wall flashing.
- Not for use below grade or in locations designed to be continuously immersed in water.
- Spans 1" maximum gap over backer rod.
- May not be used for service temperatures above 180°F.
- Cap and seal roofing systems or protect top of walls from water intrusion before and after the air barrier system is installed. Water intrusion may interfere with bonding of air barrier waterproofing materials and/or detrimentally impact the performance of such materials.

Avoid conditions that will create moisture in the air and condensation within the exterior walls. This is especially important during periods when the exterior and interior temperature differentials can create a point within the exterior wall. The use of forced air heaters creates volumes of water which, when not properly vented, can condense on building materials. The use of heaters and any resulting damage is not the responsibility of Georgia-Pacific Building Products.

Consult heater manufacturer for proper use and ventilation.

Regulatory Compliance

VOC Compliance
Complies with California SCAQMD Rule 1168 (VOC limits for sealants and adhesives).

Safety Information
Always read full label and SDS for precautionary instructions before use. Use appropriate safety equipment and job-site controls during application and handling.

For additional product fire, safety and use information go to buildgp.com or call 1-800-225-6119.

Preparation
- Before applying the DensDefy® Liquid Flashing, ensure the surface is clean, and free of dirt, debris, contaminants, and other bond inhibiting materials.
- Protect people, vehicles, property, plants and all other surfaces not intended to receive DensDefy® Liquid Flashing.
- Treated lumber must be dry and may be solvent wiped with isopropyl alcohol to aid adhesion of DensDefy® products.
- Poured in place concrete must be allowed to cure a minimum of 7 days and be free of any curing compounds or form release agents before application.
- Mortar joints in CMU construction must be allowed to cure a minimum of 3 days.
- If adhering to Insulated Concrete Forms (ICFs), gently clean the surface with water and let dry.
- Ensure substrate is sound and is undamaged.
- All surfaces should have a positive pitch to prevent ponding or pooling water

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General Technical Data

Physical Properties

FORM	viscous paste, mild odor, gold color
SPECIFIC GRAVITY	1.39 - 1.48
pH	not applicable
WT/GAL	11.60 – 12.35 lbs
TOTAL SOLIDS	99%
VOC CONTENT	30 g/L maximum
FREEZE POINT	not applicable
SHELF LIFE	1 year in tightly sealed, unopened container
HARDNESS, SHORE A	40-50
TENSILE STRENGTH	>150 psi
ELONGATION AT BREAK	>350% ASTM D412*
WATER VAPOR TRANSMISSION	12 perms (ASTM E96)
CORROSIVE PROPERTIES	Non-corrosive
AAMA 714	PASS

Surface & Air Temperatures

Surface and Ambient Temperatures

- Application temperature above 25°F (-3.8°C) and rising. Ensure the substrate is free of frost or ice prior to application.

Hot Weather Conditions/Precautions

- When air/surface temps exceed 95°F (35°C), apply product to the shady side of structure before daytime air and surface temps reach their peak. Keep containers closed and out of direct sunlight when not in use. Do not apply when temp exceeds 110°F (43°C).

Cold Weather Conditions/Precautions

- May be applied to frost-free substrates at temps above 25°F (-3.8°C). Ensure the substrate is free of frost or ice prior to application. Product will not begin to cure until temps reach 32°F (0°C) and remain above freezing. Keeping sausages warm prior to application may make product easier to apply and spread.

Low Humidity Conditions/Precautions

- Curing may take longer when lower humidity levels occur.

Surfaces with Standing Water or Frost

- While DensDefy® Liquid Flashing may be applied to dampsurfaces and tolerates rain immediately after application, do not apply to surfaces with standing water or frost.

Equipment

Reference DensElement® Barrier System Installation Guidelines for specific recommendations of appropriate equipment.

- Dispense DensDefy® Liquid Flashing with a sausage type caulking gun and spread with a spreading tool.
- Do not use soapy water or solvent to help with the tooling process or to slick the surface profile..

Personal Protective Equipment

- **Eye/Face Protection:** Wear safety glasses with side shields (or goggles) and a face shield.
- **Skin Protection:** Hand protection – Wear appropriate chemical resistant gloves.
- **Other:** Wear appropriate chemical resistant clothing. Refer to SDS for more information: https:// buildgp.com/resources. Once on the website click SDS.

Storage & Handling

Store in a cool, dry place. Keep container tightly closed when not dispensing. Do not open container until preparation work has been completed. Do not alter or mix with other chemicals. When stored at or below 80°F (27°C) DensDefy® Liquid Flashing has a shelf life of 12 months after the date of manufacture. This shelf life assumes upright storage of factory-sealed containers. Do not double stack pallets. Dispose of unused product and container in accordance with local, state and federal regulations.

Application of DensDefy® Liquid Flashing

Read “Preparation” section of this document and the SDS located at https://buildgp.com/resources before use.

Dilution & Mixing

Apply as packaged. Do not dilute or alter, or use for applications other than specified. No mixing required.

Typical Coverage Rates

CCoverage rates will vary depending on surface texture, substrate porosity, installer skill level and other factors. Actual rates should be determined through mock-up applications. DensDefy® Liquid Flashing is sold in 20 oz sausages.

DensElement® Barrier System DensDefy® Liquid Flashing Application Chart*

Container: 20 oz. “Sausage”

2 inch joint width coverage	
Minimum Mil Thickness	**Coverage (linear feet)**
16 (minimum)	85
24	60
32	42
2x4 framed opening coverage	
Minimum Mil Thickness	**Coverage (linear feet)**
16 (minimum)	25-30
24	37-45
32	12-15

* Coverage shown is an estimate only. Actual coverage will vary based on experience level of applicator and other factors

* Coverage assumes that joints and corners are butted tightly together and gaps and voids are prefilled with backer-rod

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Installation Instructions

Sealing Panel Seams, Corners, Fasteners, Transitions, Rough Openings and Penetrations for WRB-AB Compliance Using DensDefy® Liquid Flashing

Dispense DensDefy® Liquid Flashing from a 20-oz. sausage-type caulking gun. For best results, spread/tool DensDefy® Liquid Flashing while still wet, within 2–3 minutes of gun application.

Note: DensDefy® Liquid Flashing shall be installed at a minimum of 16 wet mils.

Refer to DensElement® Barrier System Installation Guide for more detailed instructions.

Panel Seams

1. Apply DensDefy® Liquid Flashing over the DensElement® Sheathing joint seam.
2. With a straight-edged tool, spread evenly over both sides of the seams.

Corners

1. Apply DensDefy® Liquid Flashing over the inside and/or outside corner.
2. With a straight edge tool, spread evenly over the sheathing corner, extending over both sides of the corner.

Fasteners

1. The fasteners should be spotted with DensDefy® Liquid Flashing and wiped down with a straight edge tool leaving a minimum thickness of 16 wet mils over the entire fastener.

Rough Openings

1. Rasp jagged or uneven DensElement® Sheathing edges and clean framing free of debris and dust or other bond-inhibiting materials.
2. Apply a bead of DensDefy® Liquid Flashing into the entire width of the inside corners of the opening return.
3. Apply DensDefy® Liquid Flashing over the opening sill, jamb and header as well as the DensElement Sheathing adjacent to the opening.
4. With a straight edge tool, spread DensDefy® Liquid Flashing over the entire width of the sill, jambs, header and DensElement® Sheathing surface adjacent to the opening.

Pipe Penetrations

1. Penetrations should be rigid and mechanically secured.
2. If the gap between materials is over 1/4", install backer rod between penetration and DensElement® Sheathing to form a back dam regardless of size of penetration or opening.*
   *Only acceptable for non fire rated assemblies.
3. Apply a thick bead of DensDefy® Liquid Flashing around the penetration.
4. Use a straight edge tool to feather and completely seal the joint around the penetration.

Material Transistions

1. If the gap between materials is over 1/4" fill the gap with a backer rod fill the gap with a backer rod.
2. Apply DensDefy® Liquid Flashing over the DensElement® Sheathing and adjacent material.
3. Using straight edge tool, spread DensDefy® Liquid Flashing over material surface.
4. Using straight edge tool, spread DensDefy® Liquid Flashing over material transition joint.
5. Apply at a rate to achieve a minimum thickness of 16 wet mils. Ensure the flashing is applied a minimum of 2". on each substrate material surface.

Repair

After curing, voids or pinholes can be filled with an additional application of DensDefy® Liquid Flashing. For additional repair instructions, refer to the DensElement® Barrier System Repair Guide.

Curing

At 70°F (21°C) and 50% relative humidity, product skins within 30–60 minutes and dries in 4–6 hours. DensDefy® Liquid Flashing is moisture curing. Low temperatures and low relative humidity slow dry time. High temperatures and high relative humidity accelerates cure time.

Clean-up

Clean tools and equipment with mineral spirits or similar solvent immediately after use and prior to material curing. Follow all safety precautions. Cured material must be removed mechanically.

Warranty

Visit buildgp.com/warranties for limited warranty details.

Customer Care

Our sales and technical experts are available to assist.
Call our GP Technical Hotline at 800-225-6119, or visit our website at denselement.com. Georgia-Pacific is not responsible for providing quality control. Proper application is the responsibility of the applicator.

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DensDefy® Liquid Flashing Product Test Results

AAMA 714-19: Voluntary Specification for Liquid-Applied Flashing Used to Create a Water-Resistive Seal Around Exterior Walls in Openings in Buildings

Test	Method	Requirement	Result
Adhesive Strength to Substrate (lbf)	ASTM C794	≥ 5	Pass
Water penetration around Nails	ASTM D1970 Section 7.9	Shall Pass 31 mm (1.2 in) of Water	Pass
Accelerated Aging (lbf/in)	ASTM G154, UVA cycle 1 ASTM C794, Visual	≥ 5	Pass
Elevated Temperature (lbf/in) Level 3 = 176º F for 7 days	AAMA 711 ASTM C794 Level 3	≥ 5	Pass
Thermal Cycling (10 cycles)	AAMA 711 ASTM C794	≥ 5	Pass
Crack Bridging Ability Category II 10 Cycles	ASTM C1305/ AAMA 714 Section 5.6	Water holdout of 550 ml for 24 hrs.	Pass
Water Immersion (lbf)	AAMA 714, Section 5.7 ASTM C794	≥ 5	Pass
Damp Surfaces	ASTM C794	≥ 5	Pass
Moisture Vapor Permeance	ASTM E96 Procedure B	≥ 10	Pass
Additional Testing For Energy Code (IECC) Compliance[1]			
*Air Leakage of Air Barrier Assemblies	ASTM E2357	0.04 cfm/ft² at 75 Pa	Exceeded IECC requirements with below code air infiltration rates of 0.01 cfm/ft² at 75 Pa
Fire Testing			
Surface Burning Characteristics	ASTM E84	Criteria for ICC and NFPA Class A Building Material: Flame Spread ≤ 25 Smoke Developed ≤ 450	Meets Class A Building Material Flame Spread: 15 Smoke Developed: 10
Surface Burning Characteristics of Building Materials and Assemblies (Canada)	CAN/ULC S102-10	N/A	Flame Spread Rating: 5 Smoke Developed Classification: 25

Testing was completed as required in AAMA 714-19:
Voluntary Specification for Liquid Applied Flashing used to Create a Water-Resistive Seal around Exterior Wall Openings in Buildings.
*ABAA: Air Barrier Association of America Acceptance Criteria for Liquid Applied Membranes
1. Meets ICC-ESR 3786

DensDefy® Transition Membrane

DensDefy® Transition Membrane is a 25-mil composite impermeable membrane that is comprised of 16 mils of butyl adhesive and 9 mils of HDPP facer. It is primarily used as a transitioning accessory in the DensElement® Barrier System.

Basic Uses

DensDefy® Transition Membrane is an impermeable self-adhered sheet designed for use as a rough opening flashing and transition membrane for connecting dissimilar materials to maintain air and moisture barrier continuity. DensDefy® Transition Membrane bonds to most surfaces such as glass mat gypsum sheathing, poured concrete, masonry, steel, and wood based substrates.

Features and Benefits

- The high-performance butyl has been tested and is compatible with the DensElement® Barrier System.
- Primerless application allows for faster installation time.
- Manufactured to a preset, uniform thickness that will not create excessive build up in rough openings while still providing exceptional strength/durability.
- Rugged HDPP film protects high-performance butyl membrane against incidental damage during the construction process.
- Variety of widths available for project specific needs.
- Ability to be installed in a wide range of temperatures.

Packaging

Length	75' (22 m)
Width	6" (15 cm) 8 rolls/box
	9" (22 cm) 4 rolls/box
	12" (30 cm) 4 rolls/box

Colors

Gold HDPP facer with Black DensDefy® logo.

Storage

Store DensDefy® Transition Membrane in the original, unopened packaging in a clean, dry, and protected location where temperatures do not exceed 100°F (37°C).

Product has a shelf life of 12 months.

DensDefy® Transition Membrane General Technical Data

TEST	RESULT	METHOD
TENSILE STRENGTH (AAMA 711 Section 5.1) **MD** **CMD**	 1350 psi 1138 psi	ASTM D1970 Section 7.3
Nail Sealability (AAMA 771 Section 5.2)	PASS	ASTM D1970
ELONGATION	442%	ASTM D412
WATER ABSORPTION	0	ASTM D570
AAMA 711	PASS	ASTMC765 ASTM D903 ASTM D3330 Method F
WATER VAPOR PERMEABILITY	0.05 perms	ASTM E96 Method A
WATER VAPOR PERMEABILITY	0.07 perms	ASTM E96 Method B

Installation Instructions

Surfaces to receive membrane must be dry, clean, firm, free of bond-inhibiting agents, such as dust, mud, oils, curing compounds or any other substances that might prevent placement and bonding of membrane.

Determine appropriate widths and lengths of DensDefy® Transition Membrane prior to cutting. DensDefy® Transition Membrane may be cut with scissors or a sharp utility knife. Use of longest lengths possible will minimize overlaps. For longer lengths, two applicators may reduce risk of wrinkles or fishmouths. DensDefy® Transition Membrane must be applied a minimum of 2" (50 mm) onto each substrate or change of plane.

Transitions at Dissimilar Materials

1. Choose the appropriate DensDefy® Transition Membrane width to achieve a 2" (50 mm) minimum overlap on both sides of the transition. Place over the center of the transition area.
2. Press in place, avoiding wrinkles and fishmouths. Use a J roller to apply even pressure to fully adhere the membrane and achieve a smooth and wrinkle-free surface.
3. Terminate all DensDefy® Transition Membrane edges with a counter flash of DensDefy® Liquid Flashing.

Protection at Rough Opening

1. Apply corner reinforcement pieces at rough opening corners.
2. Choose appropriate DensDefy® Transition Membrane widths for treatment area. Press in place starting at the sill, covering the sheathing adjacent to the opening, the sill, and wrapping up jambs.
3. Place membrane on rough opening jambs, then header, overlapping each piece onto the previous layer.
4. Use a J roller to apply even pressure to fully adhere the membrane.
5. Terminate all DensDefy® Transition Membrane edges with a counter flash of DensDefy® Liquid Flashing.

Limitations

- Not intended for permanent exposure,cover within 12 months.
- Application temperature is above 25°F (-4°C) and rising.
- Not intended for dynamic joints.
- May not be used for service temperatures above 180°F.
- Do not apply to damp, contaminated or frost covered surfaces.
- Treated lumber must be dry and may be solvent wiped with isopropyl alcohol to aid adhesion of DensDefy® products.
- If wood is installed in the returns of rough openings, temporary protection may be needed to keep surfaces dry. DensDefy® Transition Membrane cannot be applied to damp substrates.
- Cap and seal roofing systems or protect top of walls from water intrusion before and after the air barrier system is installed. Water intrusion may interfere with bonding of air barrier waterproofing materials and/or detrimentally impact the performance of such materials.
- Avoid conditions that will create moisture in the air and condensation within the exterior walls. This is especially important during periods when the exterior and interior temperature differentials can create a condensation point within the exterior wall. The use of forced air heaters creates volumes of water which, when not properly vented, can condense on building materials. The use of heaters and any resulting damage is not the responsibility of Georgia-Pacific Building Products. Consult heater manufacturer for proper use and ventilation.

Warranty

GP's limited warranties for the DensDefy® Transition Membrane and the DensElement® Barrier System are available at buildgp.com/warranties.

GP MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED, AND SPECIFICALLY DISCLAIMERS ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

Applicable Standards

DensDefy® Transition Membrane is in compliance with AAMA 711 and has been tested to industry standards for self-adhering flashing used for installation of exterior wall fenestration products: