

UL Solutions Evaluation Report

ULC ER-R40695-01

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UL Category Code:

ULEX7 Insulation for Canada

CSI MasterFormat®

06 16 36 Wood Panel Product Sheathing

07 21 13.13 Foam Board Insulation

COMPANY:

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1. SUBJECT

ZIP System® R-Sheathing ¹

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2. SCOPE OF EVALUATION

2015 National Building Code of Canada, NBCC (Sept. 28, 2018)
2020 National Building Code of Canada, NBCC (July 15, 2019)

Clause 1.2.1.1.(1)(a) Table 9.23.17.2.-B Article 9.25.2.2	Compliance with this Code (Acceptable Solution from Division B) Rating for Wall Sheathing when Applying CSA O325, Forming Part of Sentence 9.23.17.2.(1) Insulation Materials
Clause 1.2.1.1.(1)(b) Article 4.3.1.1 Article 9.23.3.5 Subsection 9.23.13 Article 9.23.13.6	Compliance with this Code (Alternative Solutions that will achieve at least the minimum performance required by Division B objectives and functional statements) Design Basis for Wood (CSA O86) Fasteners for Sheathing or Subflooring Bracing for Low to Moderate Wind and Seismic Forces Materials in Braced Wall Panels

These products were evaluated for the following properties:

ZIP System® R-Sheathing

- Structural Performance (ASTM E72 / E2126)
- Thermal Resistance (CAN/ULC-S704.1)
- Oriented Strand Board (CSA O325)
- Hygrothermal Assessment (WUFI)
- Water Vapour Permeance (ASTM E96)

3.0 REFERENCED DOCUMENTS

ASTM:

ASTM E72	Standard Test Methods of Conducting Strength test of Panels for Building Construction
ASTM E2126	Standard Test Methods for Cyclic (Reversed) Load Test for Shear Resistance of Vertical Elements of the Lateral Force Resisting Systems for Buildings
ASTM E96	Standard Test Method for Water Vapor Transmission of Materials

CSA:

CSA O86	Engineering Design in Wood
CSA O325	Construction Sheathing

ICC-ES:

ICC-ES AC10	Acceptance Criteria for Quality Documentation
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WUFI: Computer Software Pro 6.2

ULC:

CAN/ULC-S704.1 Standard for Thermal Insulation, Polyurethane and Polyisocyanurate, Boards, Faced

4.0. USES

The installed **ZIP System® R-Sheathing** functions as a structural exterior wall sheathing and provides a continuous insulation layer, when installed per manufacturer's installation instructions. See ULC ER-R40695 for the **ZIP System Wall Sheathing** performance criteria as a secondary plane of protection against water infiltration.

This Report does not address air tightness, exterior wall assembly fire performance, sealing of openings or penetrations, double-sheathed walls, or use in areas of high winds zones. Additional evaluations and testing are required to meet these and other applications.

5.0 PRODUCT DESCRIPTION

ZIP System R-Sheathing is a factory-assembled panel comprised of **ZIP System wall sheathing (OSB)** manufactured in compliance with CSA O325 and **polyisocyanurate rigid foam insulation board** manufactured in compliance with CAN/ULC-S704, bonded with a polyvinyl acetate (PVA) adhesive. The OSB has thickness of 11 mm (7/16 in.) and the rigid foam insulation board has thicknesses range of 12.7, 25, 38 to 50 mm (½, 1, 1½ and 2 in.). On-site installation defines minimum fastener framing penetration.

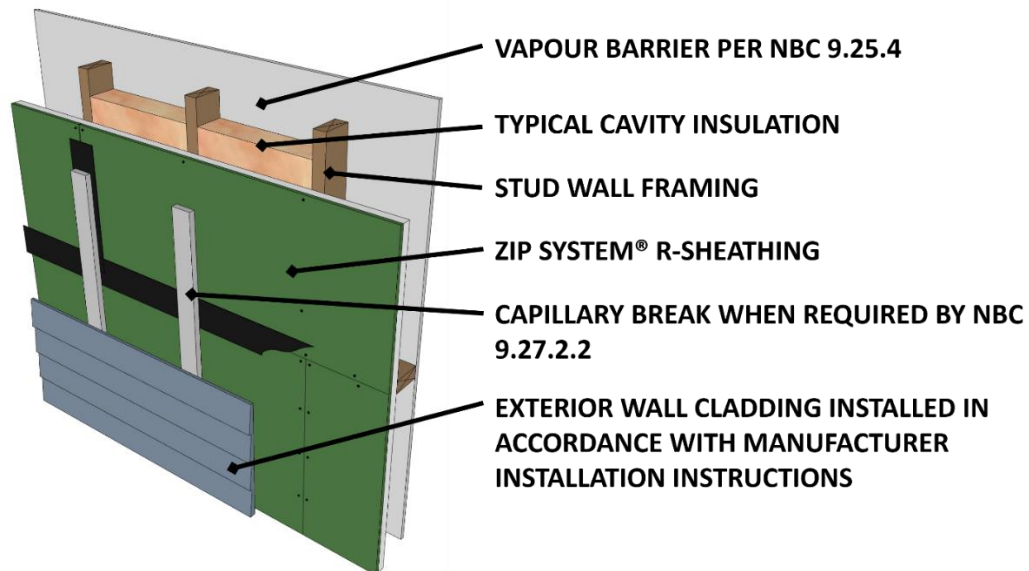


FIGURE 1: TYPICAL ZIP SYSTEM® WALL ASSEMBLY

Table 1 - ZIP System® R-Sheathing Thermal Resistance Properties			
ZIP System R-Sheathing type(Nominal R-value)	Thickness (mm)		RSI (Thermal Resistance Value)
	Rigid Foam Insulation	OSB	m ² ·C·W (R-value)
R-3	12.7	11	0.630 (R3.57)
R-6	25.4	11	1.153 (R6.53)
R-9	38.1	11	1.675 (R9.51)
R-12	50.8	11	2.197 (R12.51)

Note 1: Reported thermal values are for the assembly of rigid foam insulation and 11 mm OSB, the reported values are for design purposes.

6.0 PERFORMANCE CHARACTERISTICS

The **ZIP System R-Sheathing** components include rigid foam plastic insulation which complies with CAN/ULC S704.1 and an Oriented Strand Board (OSB) layer which complies with CSA O325 for Construction Sheathing. ZIP System OSB is adhered to the rigid foam plastic insulation using a water-resistance PVA adhesive.

Table 2: ZIP System® R-Sheathing Performance Characteristics ZIP System® Wall Sheathing Materials and Assembly		
Properties	Requirements	Results
Polyisocyanurate Foam Board	CAN/ULC-S704.1	Type 3 / Class 3
OSB	CSA O325	Compliant

6.2 Engineering Analysis of Nail Joints and Shear Wall with Insulation Performance

Engineering analysis of shear walls was undertaken to evaluate if the same mechanics-based design procedure addressed in CSA O86:14 Engineering Design in Wood applies to shear walls built with an insulated sheathing. Various shear walls were fabricated with insulated sheathing and lumber, and nail joints with different combinations of construction details were tested under both monotonic (ASTM E72) and reversed cyclic loading (ASTM E2126). Variables within the analysis included insulation thickness, nail diameters, nail penetration, nail types and nail spacing patterns (field and edge).

The failure mode of shear walls was mainly due to bending to nails along the perimeter of the sheathing. Fastener type, diameter and penetration had significant impact on the load-deformation performance of the insulated shear walls. The failure modes of insulated shear walls and nail joints were similar to that of standard constructed walls and joints. Based on the engineering analysis, the load-deformation curves of shear walls fabricated with insulation can be reasonable derived using shear wall deflection calculations method in CSA O86.

Table 3 - ZIP System R-Sheathing Fastener Schedule							
Requirements for Part 9 Applications in Low Seismic Zones							
ZIP System R-Sheathing Type	Framing Lumber ¹			Fasteners			
	Stud Materials	Stud Size mm (in.)	Stud Spacing OC mm (in.)	Nail Dimensions mm (in.)		Nail Spacing mm (in.)	
				Diameter	Length	Field	Perimeter
R-3	SPF No. 2	51 x 102 (2 x 4)	610 (24)	3.2 (0.126)	76	305 (12)	152 (6)
R-6					(3.0)		
R-9					102		
R-12					(4.0)		

Table 4 - ZIP System R-Sheathing Fastener Schedule							
Requirements for Part 9 Applications in Higher Seismic Zones and for Part 4							
ZIP System R-Sheathing Type	Framing Lumber ¹			Fasteners			
	Stud Materials	Stud Size mm (in.)	Stud Spacing OC mm (in.)	Nail Dimensions mm (in.)		Nail Spacing mm (in.)	
				Diameter	Length	Field	Perimeter
R-3	SPF No. 2 or DF-L No. 2	51 x 102 (2 x 4)	610 (24)	3.2 (0.126)	76	305 (12)	76 (3)
R-6					(3.0)		
R-9					102		
R-12					(4.0)		

Table 5 – Shear Strength of Assemblies²				
Based on Reversed Cyclic Loading Test (ASTM E2126) for Part 9 application in Higher Seismic Zones and Part 4 Structural Design				
ZIP System R-Sheathing Type	Part 9 – Housing and Small Buildings ³		Part 4 – Structural Design For Seismic Zone ⁴	
	Maximum Seismic Zone Applicability		Specified Shear Strength (kN/m)	
	Stud material SPF No. 2	Stud material DF-L No. 2	Stud material SPF No. 2	Stud material DF-L No. 2
R-3	$0.5 < S_a(0.2) \leq 1.0$	$0.5 < S_a(0.2) \leq 1.0$	7.73	8.80
R-6 ⁵	$S_a(0.2) \leq 0.5$	$S_a(0.2) \leq 0.5$	6.88	6.83
R-9			5.90	5.02
R-12			5.23	4.87

Footnotes for Tables 3, 4, and 5

¹ SPF = Spruce-Pine-Fir; DF-L = Douglas Fir-Larch

² Reported values based on construction details and fastening schedule outlined in Tables 3 and 4 above

³ Maximum design hourly wind pressure $q_{1/50} \leq 1.2$ kPa

⁴ Based on 3.2 mm diam. nail with a minimum penetration of 12.5 d. at 76 mm spacing along panel edges and field fastening at 305mm spacing.

⁵ Based on physical testing, the ZIP System® R-Sheathing R-6 results were close to the next seismic zone, evaluating engineers may consider the R-6 for use up to $S_a(0.2)=0.61$

6.3 Engineering Analysis of Fastener Nail Lateral Capacity Performance, Wood Species

An engineering analysis of the nail joint lateral capacity was undertaken to evaluate the capacity equivalency of the ZIP System R-Sheathing panels made from southern pine wood species and from aspen wood species. A symmetric double shear test apparatus (aka NordTest) was utilized to evaluate values of insulation thickness (12.7 and 51 mm) with OSB (11 mm thickness) manufactured with southern pine and aspen wood species utilizing framing lumber of southern pine or Douglas fir and common nails (63.5 mm for R-3 and 101mm for R-12).

Analysis on the key parameters of lateral load test results from each combination did not show statistical differences between the wood species groups except the K_e parameter for the R-12 material, concluding that the aspen based panels preformed similar to the pine based panels.

6.4 WUFI Hygrothermal Assessment

WUFI Hygrothermal modelling was undertaken to predict the hygrothermal performance of wood framed wall assemblies constructed with the **ZIP System R-Sheathing panels**. The following parameters were utilized to evaluate the assemblies:

- WUFI Pro 6.2
- Conventional code compliant assembly with R24 fiberglass batt insulation with 12.5mm interior gypsum board and 6mil poly vapour barrier. Vinyl siding with a vented cavity over 50mm ZIP System R-Sheathing (R-12) completed the wall section model.
- Five (5) climate zones including Vancouver (zone 4C), Edmonton (zone 7), Toronto (zone 5A), Quebec City (zone 7), and St. Johns (zone 6A). Climate files were ASHRAE Year 3, the third worst year in terms of moisture.
- Interior climate conditions ranging from 21 to 24°C with relative humidity levels varying from 30% (winter) to 50% (summer).
- Two (2) orientations: direction of prevailing wind-driven rain and minimal solar radiation exposure
- Simulation period of nine (9) years

In all computer models, the **ZIP System Wall Sheathing** OSB remained below a 12% moisture content. This is below the conservative limit of 19% moisture content that is applied to sheathing and other wood-based products to minimize the risk of fungal growth and decay (Canadian Wood Council 2021 and Guide for On-Site Moisture Management of Wood Construction by FPIInnovations).

ZIP System R-Sheathing has a reported water vapour permeance value less than $60 \text{ ng}/(\text{Pa}\cdot\text{s}\cdot\text{m}^2)$ when measured in accordance with ASTM E96 Procedure A. As such, the material is identified as a low air and water vapour permeance material. As the **ZIP System R-Sheathing** material is installed on the cold side of the wall assembly, the exterior wall assembly complies with NBCC Subsection 9.25.5 (“Properties and Position of Materials in the Building Envelope”) with respect to the outboard insulation requirements in NBCC Table 9.25.5.2 (“Ratio of Outboard to Inboard Thermal Resistance”).

7.0 INSTALLATION

Installation of the **ZIP System R-Sheathing** must comply with this report and the manufacturer's published installation instructions. The manufacturer's published installation instructions shall be available at the jobsite at all times during installation.

- A. The system must be installed in accordance with the manufacturer's installation instructions, see Huber Engineered Woods document *ZIP System® R-Sheathing Installation Manual – Canada*, revised 2022
- B. **ZIP System R-Sheathing** fastener type and fastener spacing (field and perimeter) shall comply as appropriate with Table 3 or 4 in this Evaluation Report.
- C. Exterior cladding to be attached as per NBCC Article 9.27.5
- D. The use of this product as a sheathing membrane is addressed in ULC ER-R40695 ZIP System® Wall, see UL Product iQ website. All installed panel joints must be sealed with **ZIP System™ Flexible Flashing Tape** in order for the proprietary sheathing to function as the secondary plane of protection.
- E. The OSB panel thickness of the R-Sheathing is to be within the 11 mm to 12.5 mm range.
- F. The maximum rigid foam insulation thickness of the R-Sheathing shall be 51 mm (2 in.).
- G. The nail diameter for sheathing-to framing connection in any wall shall not exceed 3.8mm. The minimum nail penetration into wood framing members shall be 12.5 times the specified nail diameter for insulated sheathing.

8.0 CONDITIONS OF USE

The **ZIP System R-Sheathing** material described in this report has been evaluated in accordance with code sections listed in Section 2.0, subject to the following conditions:

- A. Installed exterior cladding systems to include a capillary break / vented air space meeting NBCC Article 9.27.2.2.
- B. The thickness and thermal resistance of this product shall meet the requirements of NBCC Table 9.25.5.2 for the respective HDD of the building location.
- C. This product must be clad and protected from ultraviolet (UV) within 60 days of installation.
- D. This product is manufactured in six manufacturing locations including: Diboll TX., Northglenn CO., East Moline IL., Camp Hill PA., and Etobicoke ON CA. each under UL's audit of quality elements.
- E. The ZIP System Wall Sheathing material remains in compliance with CSA O325 under continuous surveillance by an accredited ISO/IEC 17065 certification body. The ZIP System R-Sheathing insulation material remains in compliance with CAN/ULS-S704 (Type 3 / Class 3).
- F. ZIP System Wall Sheathing brace walls to comply with NBCC Subsection 9.23.13 Bracing to Resist Lateral Loads Due to Wind and Seismic Forces, except Article 9.23.16.6 Materials in Braced Wall Panels.

9.0 SUPPORTING EVIDENCE

Huber Engineered Woods LLC has submitted technical documentation for ULC's review. The test and evaluation data submitted for this product is summarized below.

- A. Sample Selection of **ZIP System R-Sheathing** product for testing by an ISO/IEC 17025 accredited testing bodies.

- B. Engineering analysis of nail joints and shear wall performance under monotonic loading (ASTM E72), test report submitted by Wood Science and Technology Centre, University of New Brunswick.
- C. Engineering analysis of insulated shear walls under cyclic loading (ASTM E72 and ASTM E2126), test report submitted by Wood Science and Technology Centre, University of New Brunswick.
- D. Sheathing Lateral Capacity Equivalency Verification for southern pine and aspen wood species, conducted by Timber Products Inspections.
- E. Engineering WUFI Hygrothermal Modelling report, conducted by RDH Building Science Laboratories.
- F. Test data in accordance with ASTM E96, Water Vapour Transmission Measurement, test reports from an accredited ISO/IEC 17025 accredited testing laboratory.
- G. Test data in accordance with CAN/ULC-S704.1;2017, test reports from an accredited ISO/IEC 17025 accredited testing laboratory.
- H. Quality Control manual indicating OSB manufacturing compliance with CSA O325 Construction Sheathing.
- I. Zip System® R-Sheathing Installation Manual Canada, 2022.

10.0 IDENTIFICATION

ZIP System® R-Sheathing described in this evaluation report are identified by a marking bearing the report holder's name (**Huber Engineered Woods LLC**) and the evaluation report number **ULC ER-R40695-01**. The validity of the evaluation report is contingent upon this identification appearing on the exposed face of the foam board.

11.0 CLIENT LOCATION / CONTACT

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