

Building Envelope Design by ROXUL®

COMFORTBOARD™ 80

Exterior Insulated Sheathing for High-Performance
Residential Wall Systems

Welcome to Today's Safe, Quiet, Energy Efficient Home

ROXUL Pushes the Building Envelope Forward

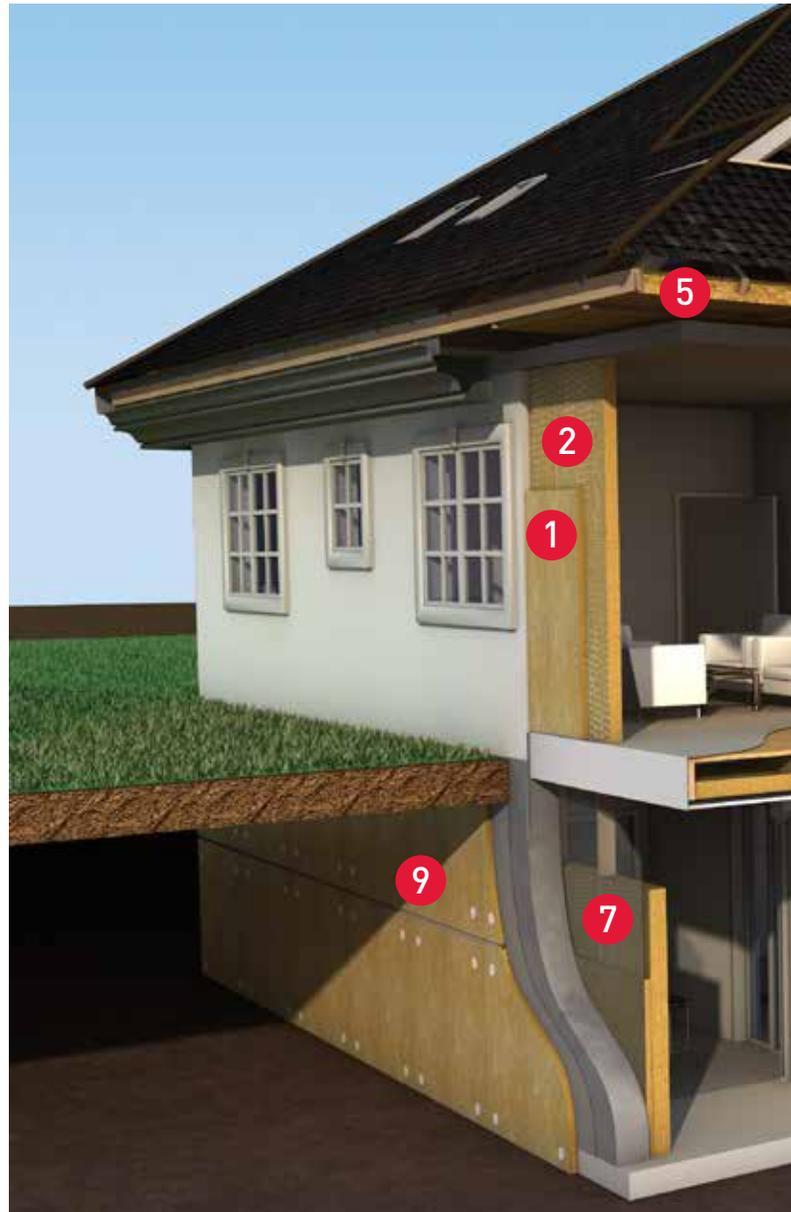
As the building industry seeks new and innovative ways to save energy and create quieter and safer homes, ROXUL leads the way with a multitude of exterior and interior insulation products designed to improve the performance of the building's envelope. The ROXUL line of fire-resistant insulation products include:

ROXUL COMFORTBOARD™ 80: Rigid stone wool insulation board fastened to outside studs to improve thermal performance to the building envelope.

ROXUL COMFORTBATT®: Thermal insulation for use in exterior walls, attics and crawl spaces. It provides indoor comfort and energy savings all year round.

ROXUL SAFE'n'SOUND®: Soundproofing insulation for use in interior walls, ceilings and floors to help create a quieter home.

SAFE® 45: Lightweight fire separation board used in combination with ROXUL Batt Insulation as a "partition wall system." This "party" wall system improves sound dampening and fire performance, while guaranteeing moisture resistance. It also reduces labor and material costs usually associated with adding a double layer of gypsum over the wall studs.



- ❶ COMFORTBOARD™ 80 on exterior wall (outside)
- ❷ COMFORTBATT® R14/15 on a 2 x 4 wall
- ❸ COMFORTBATT® R22/23 on a 2 x 6 wall
- ❹ COMFORTBATT® R28/R30 in a cathedral ceiling

- ❺ COMFORTBATT® R28/30 + CB R14/R15 parallel on the attic
- ❻ Multi-unit partition wall with 3.5" COMFORTBATT® on both sides and SAFE® 45 as fire separation board



7 Basement Wall – COMFORTBOARD™ 80 (1.5”) against the concrete wall (moisture barrier behind the COMFORTBOARD™ 80) with wood studs in front and COMFORTBATT® R14/15 in the studs (basement system) therefore full height R20/21

8 SAFE'n'SOUND® on interior partition and basement ceiling

9 COMFORTBOARD™ 80 on exterior foundation wall below grade

Superior Building Envelope Performance

As society demands more energy efficient buildings, codes and builders are responding by increasing the R-value of the building enclosure, in particular, the above-grade wall. Given that the cavity of the standard 2 x 6 wood frame wall used in low-rise housing is already filled with insulation, the clear path forward to higher R-values is to add layers of exterior insulation.

ROXUL COMFORTBOARD 80 is a rigid stone wool insulation board fastened to the outside face of the exterior studs used in residential construction and designed to provide increased thermal performance to the building envelope. The stone wool-based insulation is made from natural stone with a minimum of 40% recycled content, which gives it thermal and fire-resistant properties that other insulations can't match.

As building codes adjust to increased effective R-value requirements, the need for insulated sheathing will increase accordingly, and ROXUL COMFORTBOARD 80 leads the way as the exterior insulation of choice for residential applications.

Today, building codes are moving to mandate "effective R-values" vs. nominal – and insulated exterior wall sheathing will play a major role to help builders achieve this requirement. ROXUL COMFORTBOARD 80 is the better sheathing insulation.



As an exterior insulation, ROXUL COMFORTBOARD 80 is fastened to the exterior OSB/plywood sheathing or structural stud wall and is designed to provide increased thermal performance to the building envelope

Canada's Highest Rated LEED® - Platinum Residence Built With ROXUL®



ROXUL Leads The Way

North Vancouver's first LEED® for Homes project and the highest rated LEED-Platinum single family residence in Canada was built using both ROXUL stone wool COMFORTBOARD™ 80 and COMFORTBATT on the building envelope.

Affectionately known as "Shore House", this modern and green architectural home incorporates the latest in sustainable design, construction techniques and eco-friendly quality products. The combination creates a high-performance, energy-efficient home that reduces monthly utility bills, maintenance and energy costs and promises a higher re-sale value for the new owners.

To view this remarkable home, built using ROXUL COMFORTBOARD 80 on the exterior and COMFORTBATT in the interior, visit www.theshorehouse.ca

LEED® for Homes Canada is a Green Building rating system that was established by the Canada Green Building Council. It is a third-party certification that is unbiased and confirms a Homebuilder's best building practices.

What Makes A ROXUL® Building Envelope A Better Wall System

Factors That Contribute to Superior Thermal Performance

With informed consumers and the building industry pushing for innovative solutions that are truly energy efficient, ROXUL raises the bar in developing wall systems with excellent long-term thermal performance. This is the result of two inherent properties in its insulating systems – lack of thermal loss due to dimensional changes, and product that is not produced with blowing agents, which can off-gas and result in lower long-term thermal performance.

As well, the use of ROXUL COMFORTBOARD 80 in conjunction with COMFORTBATT in the wall cavity contributes to a higher effective R-value wall system, increasing the performance of the residential building envelope.

Fast Outward Drying

Vapor-permeable insulation like ROXUL COMFORTBOARD 80 has the added benefit of allowing fast outward drying during cold weather. This dries the wood-frame cavity very quickly, even if the framing is wet from construction or becomes wet because of incidental water leaks.

Decreased Thermal Bridging

ROXUL COMFORTBOARD 80 insulation helps reduce thermal bridging through wood studs, leading to a better performing thermal wall. In a typical single-family building, wood studs make up 25% of the wall surface, so it's important to ensure the use of exterior insulation to complete the building envelope.

Dimensional Stability

The dimensional stability of an insulation material is necessary for the faultless function of the wall system. Dimensional changes in materials vary according to their physical properties.

Thermal expansion co-efficients express the rate at which materials shrink or expand when cooled or heated. Made from stone wool, ROXUL COMFORTBOARD 80 insulation has a smaller thermal expansion coefficient than insulation materials such as foam plastics. Poor dimensional stability can cause shrinking, expansion, and buckling of a system's insulation. These actions can lead to thermal bridging, waterproofing breaches, and unpredictable insulation performance.

Material Type	Expansion Co-Efficient $10^{-6} \text{m/m}^\circ\text{C}$	Actual Expansion at Temperature Difference 50° on a 10 Meter Board (mm)
Plywod (Dry)	3.5	2
Stone Wool	5.5	3
Concrete	12	6
Steel	12	6
Expanded Polystyrene	70	35
Extruded Polystyrene	80	40
Polyurethane	100	50
Polyisocyanurate	120	60

Some foam products may be considered vapor retarders when in excess of 2 inches. This can substantially affect the drying potential of the wall cavity and restrict the wall system from drying out, increasing the chance of mold and mildew growth. A 2" layer of XPS has an approximate perm rating of 0.55, which is classified as semi-impermeable. In comparison, COMFORTBOARD 80 has a perm rating of 30 and is classified as vapor-permeable.

ROXUL® Stone Wool Outperforms Plastic Foams and Fiberglass

More “Breathability” than Plastic Foams

COMFORTBOARD 80 is moisture resistant, yet vapor- permeable insulation (30 perms) and will allow transient vapors to pass through without restriction. This unique vapor-permeable quality of insulation allows for an increased potential for drying “breathability” without trapping moisture in the wall assembly. The stone wool insulation in a wall assembly does not wick water, which means that any bulk water that contacts the outer surface will drain and not be absorbed into the body of the insulation.

Wall with XPS [Water Content (kg/m³)]

Layer/Material	Start of Calc.	End of Calc.	Min.	Max.
Brick (Old)	3.34	9.34	1.76	51.08
Air Layer 25 mm	1.88	7.72	0.89	10.16
1" Extruded Polystyrene Insulation (XPS)	0.31	0.58	0.23	0.77
Spun Bonded Polyolefine Membrane (SBP)	0.00	0.00	0.00	0.00
Oriented Strand Board	83.25	78.66	71.09	89.53
Fiberglass	1.86	0.88	0.41	1.87
Vapor Retarder (0.1 perm)	0.00	0.00	0.00	0.00
Interior Gypsum Board	8.65	4.43	2.75	8.65

Wall with ROXUL COMFORTBOARD 80 [Water Content (kg/m³)]

Layer/Material	Start of Calc.	End of Calc.	Min.	Max.
Brick (Old)	3.34	9.36	1.94	51.50
Air Layer 25 mm	1.88	8.15	0.97	9.71
1.5" ROXUL COMFORTBOARD 80	0.02	0.04	0.01	0.12
Spun Bonded Polyolefine Membrane (SBP)	0.00	0.00	0.00	0.01
Oriented Strand Board	83.25	90.99	49.79	95.28
ROXUL COMFORTBATT	0.07	0.05	0.01	0.10
Vapor Retarder (0.1 perm)	0.00	0.00	0.00	0.00
Interior Gypsum Board	8.65	4.44	2.75	8.65

Better Acoustics

As building trends move towards higher density communities, it’s time to start thinking about improving acoustics on exterior walls – planes, trains and automobiles all contribute to noisier living space and with a ROXUL stone wool wall system, that noise can be significantly reduced. Compared to other types of insulation, the stone wool content of wall systems provides increased density and effectively reduces airflow and, essentially, sound transmission.



Acoustical Performance

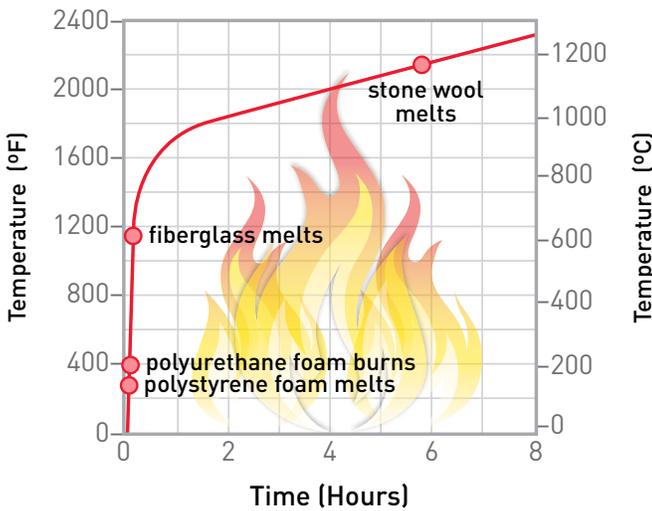
Thickness	ASTM C423						NRC
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	
1.5"	0.21	0.64	0.92	1.00	0.95	1.01	0.90
2.0"	0.43	0.78	0.90	0.97	0.97	1.00	0.90
3.0"	0.75	0.82	0.89	0.94	1.00	1.00	0.90

Results: Stone wool on the outside of the studs will at a maximum increase water content from 0.01 to 0.12 and COMFORTBATT between the studs from 0.01 to 0.10. XPS has an increase from .23 to .77 and fiberglass between the studs from .41 to 1.87. Ten air changes/ hour were included in the calculation.

ROXUL® Stone Wool: Fire-Resistant, Non-Combustible Insulation

A key feature of ROXUL® insulation is fire resistance. COMFORTBOARD 80 is classified as “non-combustible” as determined by ASTM E136 and CAN4-S114. It will not develop toxic smoke or promote flame spread, even when directly exposed to fire, as most other insulation materials do. By comparison, combustible extruded polystyrene (XPS) foam results, when tested to ASTM E84, typically achieve smoke developed up to 175 and can contribute to the spread of fire. The risk of fire spread during construction or after occupancy is considerably reduced when non-combustible ROXUL COMFORTBOARD 80 is used.

Temperature Development in a Standard Fire (ASTM E119)



Fire Safety: Stone Wool Versus Foam

More recently, as a result of the Shanghai fire in 2010, new concerns have been raised about fire safety during construction. In the case of the Shanghai fire, foam insulation was ignited accidentally during construction and quickly spread through the building exterior. Because of these safety concerns, ROXUL firmly believes in the added value that passive fire resistance provides for buildings.



The severity of the Shanghai fire was partially a result of the use of urethane foam insulation, which aided in the spread of flame and smoke.

Fire Performance

Specification	Test	Result
ASTM E 136	Behavior of Materials at 750 °C (1382°F)	Non-Combustible
CAN/ULC S114	Test for Non-Combustibility	Non-Combustible
ASTM E 84(UL 723)	Surface Burning Characteristics	Flame Spread = 5 Smoke Developed = 10
CAN/ULC S102	Surface Burning Characteristics	Flame Spread = 5 Smoke Developed = 10

ROXUL® Stone Wool : Meeting the Demands for Higher R-Values of Tomorrow

ROXUL Building Envelope - North American Performance Matrix

				COMFORTBATT™		COMFORTBATT™		COMFORTBATT™		COMFORTBATT™		
				16" On Center		24" On Center		16" On Center		24" On Center		
				3.5"		3.5"		5.5"		5.5"		
				CANADA	U.S.	CANADA	U.S.	CANADA	U.S.	CANADA	U.S.	
				R14	R15	R14	R15	R22	R23	R22	R23	
A	COMFORTBOARD™ 80	1.25"	R 5.0	19.00	20.00	19.00	20.00	27.00	28.00	27.00	28.00	NOMINAL R-VALUE
				15.96	16.66	16.36	17.06	21.14	21.84	21.77	22.42	EFFECTIVE R-VALUE
B	COMFORTBOARD™ 80	1.5"	R 6.0	20.00	21.00	20.00	21.00	28.00	29.00	28.00	29.00	NOMINAL R-VALUE
				16.96	17.66	17.36	18.06	22.14	22.84	22.77	23.42	EFFECTIVE R-VALUE
C	COMFORTBOARD™ 80	2.0"	R 8.0	22.00	23.00	22.00	23.00	30.00	31.00	30.00	31.00	NOMINAL R-VALUE
				18.96	19.66	19.36	20.06	24.14	24.84	24.77	25.42	EFFECTIVE R-VALUE
D	COMFORTBOARD™ 80	3.0"	R 12.0	26.00	27.00	26.00	27.00	34.00	35.00	34.00	35.00	NOMINAL R-VALUE
				22.96	23.66	23.36	24.06	28.14	28.84	28.77	29.42	EFFECTIVE R-VALUE
E	NONE			14.00	15.00	14.00	15.00	22.00	23.00	22.00	23.00	NOMINAL R-VALUE
				10.96	11.66	11.36	12.06	16.14	16.84	16.77	17.42	EFFECTIVE R-VALUE

Bridging The Gap Between Stated R-Value Vs Effective R-Value

A material's R-value is the measure of its resistance to heat flow. The higher the R-value, the more the material insulates. Stated R-value tests measure only thermal resistance, not taking into account factors such as:

- Air infiltration due to leakage through gaps
- Permeability of system components
- Convection flows within the wall system
- Thermal mass of components
- Thermal bridging across the building envelope

While the stated or nominal R-value of an insulation product is important, excluding factors such as those listed will alter the effective R-value of the wall system.

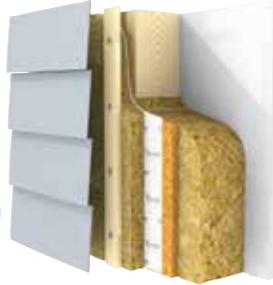
In real-world performance, the installation of ROXUL COMFORTBOARD 80 as the sheathing and ROXUL COMFORTBATT as the wall cavity insulation results in a building envelope that is less susceptible to air infiltration, slumping, and internal convection, especially when compared to fiberglass, plastic foams and other insulation products.

The ROXUL® Wall System: Applications and Installation

Wall Applications (Outside Wall to Interior Wall)

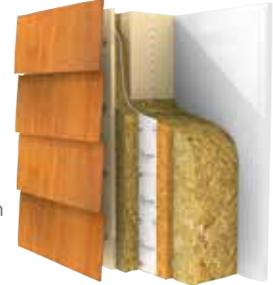
Vinyl Wall Components

- 1 Vinyl Siding
- 2 Fasteners
- 3 1 x 3 Furring Strips
- 4 1.25" (R5) to 3" (R12) of Insulating ROXUL COMFORTBOARD™ 80 Sheathing
- 5 Exterior Air/Moisture Barrier Membrane
- 6 Structural Sheathing
- 7 (2 x 6) Stud Wall @ 24" o.c.
- 8 ROXUL COMFORTBATT® Cavity Insulation
- 9 Vapor Control Layer
- 10 Gypsum Wall Board



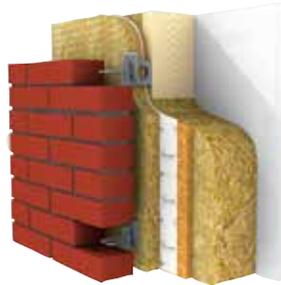
Wood Fiber Wall Components

- 1 Wood Lay Siding
- 2 Fasteners
- 3 1 x 3 Furring Strips,
- 4 1.25" (R5) to 3" (R12) of Insulating ROXUL COMFORTBOARD™ 80 Sheathing
- 5 Exterior Air/Moisture Barrier Membrane
- 6 Structural Sheathing
- 7 (2 x 6) Stud Wall @ 24" o.c.
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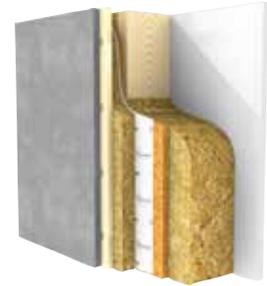
Brick Wall Components

- 1 Brick
- 2 Air Space
- 3 Metal Brick Ties
- 4 1.25" (R5) to 3" (R12) of Insulating ROXUL COMFORTBOARD™ 80 Sheathing
- 5 Exterior Air/Moisture Barrier Membrane
- 6 Structural Sheathing
- 7 (2x6) Stud Wall @ 24" o.c.
- 8 ROXUL COMFORTBATT® Cavity Insulation
- 9 Vapor Control Layer
- 10 Gypsum Wall Board



Cement Board Wall Components

- 1 Cement Board
- 2 Fasteners
- 3 1 x 3 Furring Strips
- 4 1.25" (R5) to 3" (R12) of Insulating ROXUL COMFORTBOARD™ 80 Sheathing
- 5 Exterior Air/Moisture Barrier Membrane
- 6 Structural Sheathing
- 7 (2 x 6) Stud Wall @ 24" o.c.
- 8 ROXUL COMFORTBATT® Cavity Insulation
- 9 Vapor Control Layer
- 10 Gypsum Wall Board



Installation Recommendations

ROXUL COMFORTBOARD 80 high-performance residential wall system boards should be installed on the exterior wood stud frame in combination with COMFORTBATT insulation within the wood stud cavity.

How to Attach the Insulation Boards

COMFORTBOARD 80 should be attached to wood studs using roofing nails (or wood screws) with heads/washers with a minimum diameter of 1" (25 mm) at spacing no more than 12" on center along the perimeter of the board and along the studs. When properly installed, the product's rigid, yet flexible edges allow for a tightly butted edge where boards meet on the wall, further increasing the building's thermal performance.

Vinyl and Wood Siding

- Minimum 1" x 3" furring strip be placed vertically with screw attachment of 16" o.c. for 16" on wood studs and 12" o.c. for 24" on center wood studs.
- #8 or #10 screws recommended.
- Each screw must have a minimum embedment of 1" into the wood stud or substrate.

Brick

- Metal ties or anchors required for nailing into the framing through the insulation boards (to building code requirements).
- 1" (25 mm) space between the masonry and insulation required.

Air/Moisture Barrier

- Air/moisture barrier is required as per building code and necessary for effective air tightness.
- Air/moisture barrier should be applied on the inner side of the insulation board and should be continuous.

Available Sizes

Thickness	1.25"	1.5"	2.0"	3.0"
R-value	R5	R6	R8	R12

Standard board sizes available 2' x 4' and 3' x 4'.
Check with dealer for non-standard board sizes.

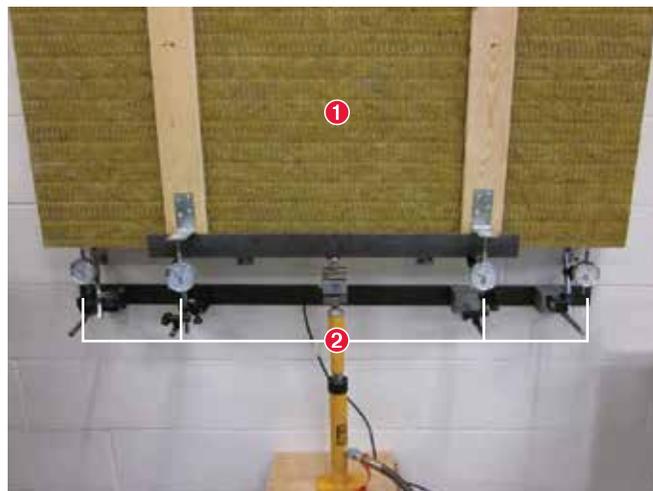
ROXUL COMFORTBOARD™ 80: Superior Cladding Load Performance

Exterior Insulation Deflection Test Results

World-renowned Building Science Corporation (BSC) performed load and deflection testing of COMFORTBOARD 80 under various fastener embedded situations with the results shown below.

Under common cladding loads, all the insulations tested showed very little deflection (<0.01" [0.25 mm]) up to 12 pounds per square foot (psf) at the loads imposed by lap siding (of wood, vinyl, or fiber cement).

The testing also showed no significant difference at various fastener embedment (in framing, in OSB or combination) at loads less than 20 psf. The tests assumed studs at 24" o.c. and fasteners at a maximum of 16" vertical spacing through 1 x 3 furring strips to simulate worst-case scenario.



- 1 ROXUL COMFORTBOARD 80 attached to wall frame.
- 2 Hydraulic ram with load cell and deflection gauges measuring strapping movement.

The purpose of the study was to quantify the relationship between cladding gravity loads and deflection under cladding weights up to 30 pounds PSF. Results: All insulations showed minimal load deflection.

Exterior Insulation Load and Deflection Performance

Summary of Deflection Results at 1000 lbs					Est Deflection (inches) in Service for Typical Cladding Loads	
Test Series	Test Description	1 st Loading [inches]	2 nd Loading [inches]	3 rd Loading [inches]	Vinyl Siding [1 PSF]	Fiber Cement Siding [4 PSF]
1	1 ¼" COMFORTBOARD™ 80, #8 3" screws, all embedded in framing	.034	.018	0.19	<0.01	<0.01
2	1 ¼" COMFORTBOARD™ 80, #8 3" screws, none embedded in framing	.050	.026	.026	<0.01	<0.01
3	1 ¼" COMFORTBOARD™ 80, #8 3" screws, embedded in top & bottom plate	0.90	0.36	.032	<0.01	<0.01
4	1 ¼" COMFORTBOARD™ 80, #10 3" screws, all embedded in framing	.030	.016	.016	<0.01	<0.01
5	1 ¼" COMFORTBOARD™ 80, 16d 3.5" nails, all embedded in framing	.043	.026	.027	<0.01	<0.01
6	3" COMFORTBOARD™ 80, #10 5" screws, all embedded in framing	.047	.023	.023	<0.01	<0.01



A Global Leader

ROXUL Inc. is part of Rockwool International, the largest producer of stone wool insulation, which is made from natural basalt rock and recycled material.

Rockwool International was founded in 1909 and today operates worldwide with more than 8,500 employees, with 27 factories across three continents.

Rockwool has more than 40 years experience in developing and manufacturing advanced wall system products. For 25 years, ROXUL has been serving the North American market.

In addition to exterior board insulation for residential construction, ROXUL also manufactures a range of other premium insulation products for multiple applications.

ROXUL is the Better Insulation

ROXUL COMFORTBATT® and COMFORTBOARD™ 80 are innovative insulation products offering a world of green features. When ROXUL is the specified insulation, green building developers can earn a variety of LEED® (Leadership in Energy and Environmental Design) points across four key construction categories toward sustainable development.



Environmentally Sustainable

Our stone wool production process utilizes some of the most advanced technology available. The ROXUL facility is designed to capture and recycle rainwater, reduce energy consumption, and create zero waste to landfill by recycling raw materials back into the production process.

ROXUL insulations are created using naturally occurring, inorganic raw materials and materials with a high-recycled content. Stone wool insulation is non-combustible and achieves its thermal performance without the use of blowing agents. The products do not off-gas and are fully recyclable, therefore contributing to a sustainable environment.

ROXUL is pleased to have third-party certification of our products' recycled content for our Milton facility completed by **ICC-ES SAVE™**. All ROXUL products produced in the Milton facility contain a minimum of 40% recycled content. ROXUL products produced in our Grand Forks facility are currently awaiting ICC-ES Save™ certification.

ROXUL demonstrates its commitment to the environment through eco-friendly insulation products and green manufacturing processes.

For further details contact your ROXUL sales representative. Please visit www.roxul.com for the latest information.

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