



ROXUL® COMMERCIAL ROOFING

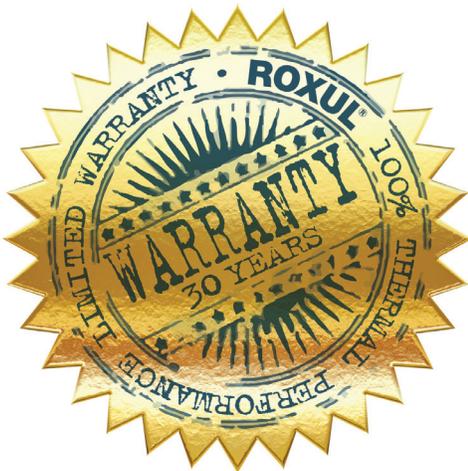
Understanding Climate Requirements
That Drive Performance

ROXUL®
The Better Insulation

High Performance Roofing Insulation Products

ROXUL®/ROCKWOOL® commercial roofing products have been available globally for more than 35 years and have been the insulation of choice for many building owners, architects and roofing consultants who are interested in roofing performance and safety.

In this brochure, we begin to introduce you to our products and explain why you should specify ROXUL stone wool insulation. Our products feature a 30-year limited thermal warranty, and are competitively positioned versus other insulation materials in overall performance.



This brochure highlights our discussion of CLIMATE DRIVEN R-VALUES, based on research initiated by the National Roofing Contractors' Association (NRCA) that looked into the performance of roofing insulation at varying temperatures. The research has been continued by outside firms such as Building Science Corporation, Building Science Consulting Inc., and RDH Building Engineering. This research compares R-value claims for ROXUL stone wool vs. polyiso insulation from four leading North American manufacturers. The study details thermal performance of these types of insulations in the various ASHRAE-defined climate zones. The study clearly points to the advantages that ROXUL stone wool products can provide.

Members of our ROXUL Sales and Specification Team would welcome the opportunity to invite you to "Lunch & Learn" sessions to further the conversation, and to explore why ROXUL stone wool products should be part of your next project.

Learn more about ROXUL products by visiting our website at roxul.com. There you will find additional information such as: technical bulletins, case studies, technical data, additional third-party studies, and more. A special section of our website, called ROXUL RSPEC, has been developed specifically for architects and specifiers. ROXUL RSPEC offers easy-to-navigate tabs with case studies, technical data and design information.

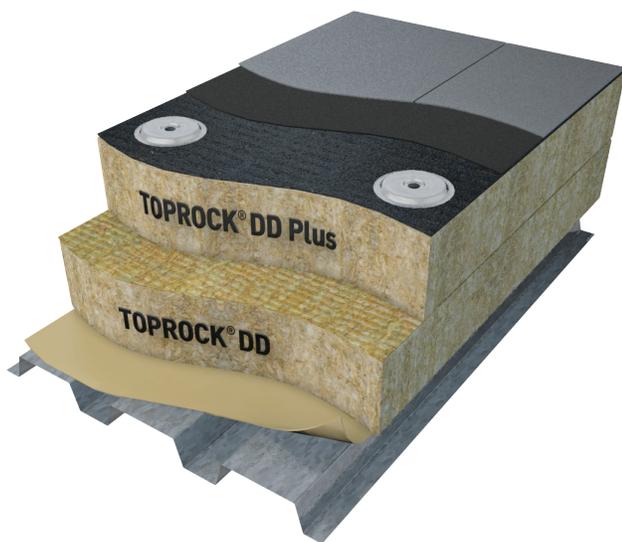
- ✓ No R-value loss over time
- ✓ Non-combustible
- ✓ Impact resistant
- ✓ Water repellent
- ✓ Vapour permeable
- ✓ No off-gassing
- ✓ Resistant to rot, mould, fungi and chemicals
- ✓ Sound absorbent
- ✓ Environmentally sustainable
- ✓ Made from Stone

TOPROCK® DD

Fire Resistant Roofing Insulation

ROXUL® TOPROCK DD has exclusive stone wool dual density properties that feature a higher-density top layer, providing strong point load resistance and effective load distribution to minimize puncture damage to the membrane – particularly during installation.

- Insulation and coverboard in one
- Suitable for new building, re-roofing, and re-cover applications
- Also used in tapered systems
- Available thicknesses: 2", 2.5", 3", 3.5", 4", 4.5", 5", 5.5", 6"
- R-value of 3.8 per inch as tested at 75°F per ASTM standard



MONOBOARD®

The Ultimate Insulating Coverboard

ROXUL MONOBOARD is a rigid, mono-density roof coverboard with a uniform density that can provide tremendous versatility, and is designed for use as a coverboard and re-coverboard.

- Higher density: now 12.5 lb/ft³ (200 kg/m³)
- Suitable for new building, re-roofing, and re-cover applications
- Also used in tapered systems and fabrications
- Standard thickness: 1.04" / R4 as tested at 75°F per ASTM standard



TOPROCK DD Plus and MONOBOARD Plus are available with an impregnated surface layer of bitumen. This pre-applied coating makes the products compatible with both torch and mop applied membranes, and simplifies the application process, saving time as well as material and labour costs on-site.

Climate Driven R-Value (CDRV)

Declared R-Values – Industry Standard

All insulation manufacturers follow the R-value rule that requires all types of insulation to be tested in accordance with one of the standard industry test methods defined by the American Society of Testing and Materials (ASTM).

The rule requires that R-value tests be conducted at a mean temperature of 23.9°C (75°F) and a temperature differential of 27.8°C (50°F). This means that insulation is usually tested with the cold side at 10°C (50°F) and the warm side at 37.8°C (100°F).

Roofs are subjected to a significant range of temperatures – not only seasonally, but daily as well. Of course, those temperature ranges will vary depending on how and where the roofs are built, as factors such as the climate and the membrane colour affect the heating and cooling of the roof. What does this mean?

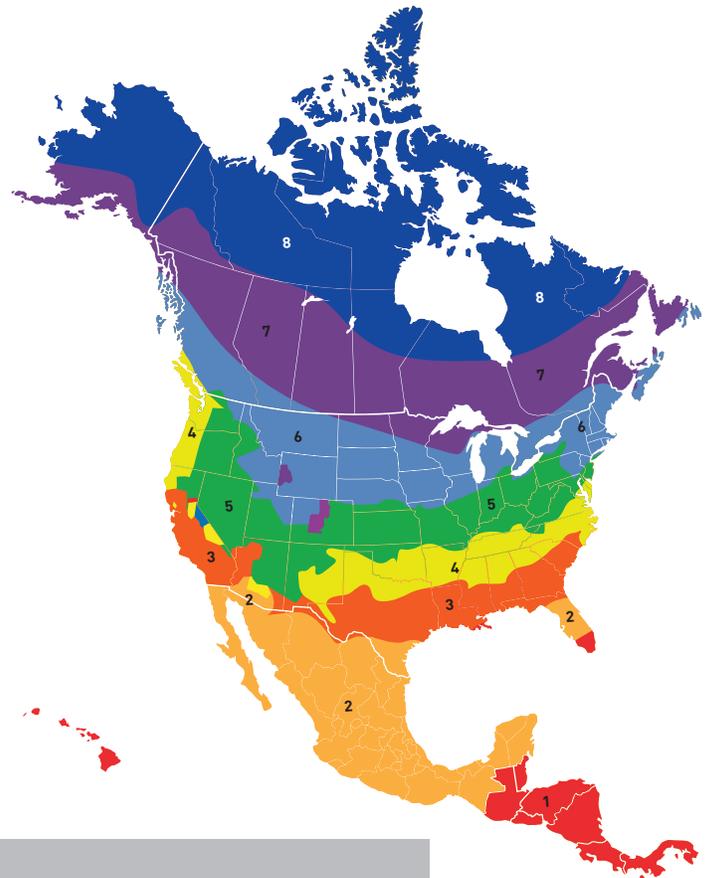
Climate Driven R-Value – In Situ Performance Consideration

Climate driven R-value serves to recognize that some insulation materials exhibit different thermal performance as temperatures change (i.e., the apparent R-value increases as the temperature decreases), and some materials exhibit a loss of thermal performance as temperatures decrease (i.e., the apparent R-value decreases as the temperature decreases).

ROXUL® stone wool insulation is an example of an insulation that performs better than manufacturer declared R-value in colder temperatures, while polyisocyanurate (polyiso or ISO) insulation R-values have been shown to decrease in colder temperatures. In warm temperatures, all insulations exhibit drops in performance, to varying degrees.

“Some insulation materials exhibit better thermal performance... and some materials exhibit worse thermal performance as temperatures get colder.”

- John Straube, Building Science Consulting:
“Understanding the Temperature Dependence of R-values for Polyisocyanurate Roof Insulation.”



In which climate zone are you designing roof assemblies?

Think about climate driven R-values for improved performance.

ROXUL® Solutions

STONE WOOL ASSEMBLIES FOR ULTIMATE PERFORMANCE

1st Recommended Design Consideration

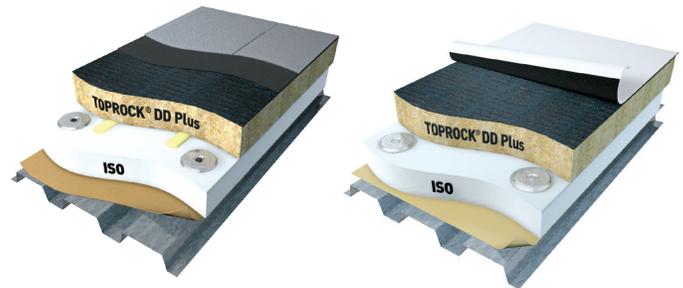
With recent research into roof system performance showing the effects that insulation and the membrane system can have on the performance of the building, designers now have more information to help them make better decisions on building performance. By using different materials, such as membrane, fasteners and insulation, designers are able to create optimal solutions that are economically feasible and will perform as designed over the long term.



DUAL INSULATION ASSEMBLY USING ROXUL

2nd Recommended Design Consideration

A dual insulation assembly is a roof assembly that combines two different types of roofing insulation materials. An example of a dual insulation assembly is a top layer of ROXUL TOPROCK® DD placed upon a base layer of polyiso insulation. This type of roof takes advantage of the distinct properties of both materials to create a high performance roof system.



A dual insulation assembly has been shown to be competitively priced to a two layer polyiso roof with coverboard due to the reduction of layers and labour required.

Individual project pricing will depend on region.

Benefits of a dual insulation assembly

This assembly takes advantage of the properties of two materials. By using TOPROCK DD as the top layer of the roof system, a standard coverboard is not needed, because the higher density top layer of the product acts as an insulating coverboard. In addition, the dimensional stability of the product and its stable R-value help to minimize heat loss, and will keep the second layer at a more constant temperature. With the polyiso layer's temperature kept more constant by the top layer, the R-value performance will be closer to optimal performance, and the system will have the advantage of the higher R-value-per-inch of the product.

Climate Driven R-value

The NRCA conducted a research study after noticing a drop in thermal performance in polyiso roof boards over varying temperatures. Their original results are displayed here for your reference.

In recent years, BSC and RDH have also conducted their own studies into the effects of climate and temperature on R-value performance.

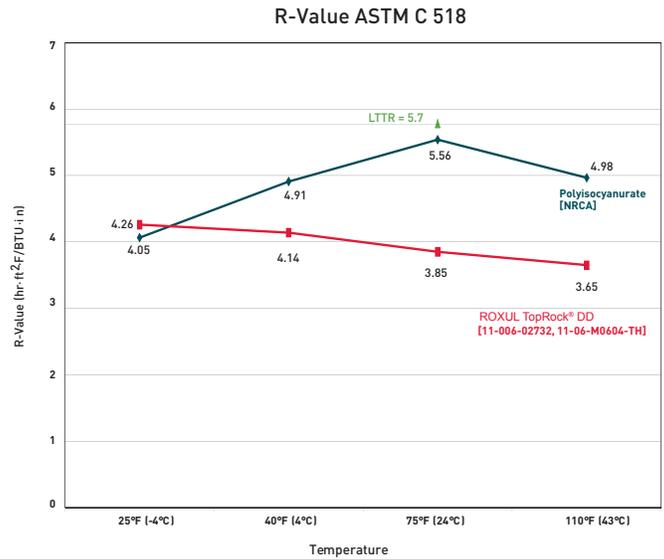
The concept of **climate driven R-value focuses strictly on climate or temperature when predicting R-values in situ**. That is to say other factors such as aging, off-gassing, dimensional stability and thermal bridging can further reduce the expected performance of your design.

Learn more about the studies conducted on these websites:

NRCA: www.nrca.net "Comparing Polyiso R-values"

Building Science Corporation: www.buildingscience.com "BSC-502"

RDH Building Engineering: www.rdh.com "Conventional Roofing Study"



Polyisocyanurate data taken from "Testing R-values" by Mark S. Graham, NRCA Professional Roofing March 2015 edition. TOPROCK DD data taken from third party test #11-006-02732, 11-06-M0604-TH.

Beyond Climate Driven R-Value Performance

Other factors that negatively impact thermal performance are:

Blowing Agents

Blowing agents may condense (changing from a gas to a liquid) in cold climates, causing the R-value to decrease. Unlike foam plastic insulation materials that use blowing agents, ROXUL® stone wool insulation does not.

Dimensional Stability

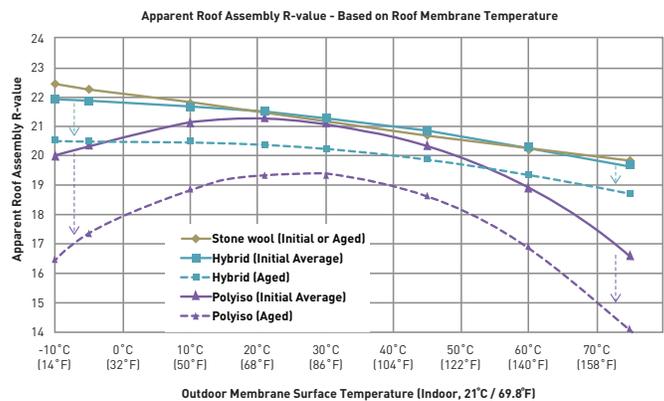
Polyiso roof boards, per ASTM 1289 standard, can lose up to 2% of their size and be within standards, increasing gaps in the insulation layer.

Thermal Bridging

Heat transfer will increase when conducted through attachment systems. The type and quantity of fastener will influence the rate of heat transfer and therefore influence thermal performance of the system.

Aging

The graph below, excerpted from RDH Building Engineering, shows the effects that the aging of the Polyiso roof board has on its thermal performance over varying surface temperatures.¹



¹Source: RDH Building Engineering, "Monitored Field Performance of Conventional Roofing Assemblies - Measuring the Benefits of Insulation Strategy" as presented at the Symposium on Building Envelope Technology, November 2013.

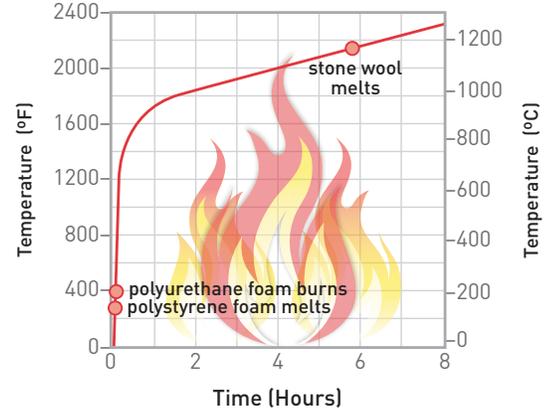


Fire Resistant Insulation To Prevent Flame Spread And Toxic Smoke Development

ROXUL® stone wool insulation has a melting point that exceeds the temperatures of most commercial fires.

ROXUL stone wool roofing insulation is non-combustible and will not develop toxic smoke or promote flame spread, even when directly exposed to fire.

Therefore it will not add fuel to an existing fire, as foam plastics tend to do; making it ideal for use in high occupancy buildings.



Stone wool provides passive fire protection – a strong complement to active systems such as sprinklers. This is important while a building is operational and just as important in the construction and maintenance stages.

TOPROCK® DD and MONOBOARD® products meet the requirements for FM 4470 NCC (Non-Combustible Core) Rated Roof Insulation.

Designed For Simplified Application And Safer Installation

“The only insulation you can directly torch membranes to.”

The pre-applied bitumen coating on TOPROCK DD Plus and MONOBOARD Plus makes these insulation materials compatible with both torch and mop applied membranes, simplifying the application process and saving time, as well as material and labour costs on-site.



Fire Performance

Specification	Test	Result
FM 4470	NCC	Complies
CAN/ULC S114	Test for Non-combustibility	Non-combustible
CAN/ULC S107	Fire Tests of Roof Coverings	Class A
CAN/ULC S126	Fire Spread Under Roof Deck Assemblies	C7, C18, C28, C38, C48, C52
ASTM E 84 (UL 723) CAN/ULC S102	Surface Burning Characteristics	Flame Spread=0 Smoke Development=0



Moisture Management Properties; Better Than Other Insulations

Repels Water

ROXUL® insulation has superior drying potential, minimizing the risk of condensation buildup – effectively managing stresses on the membrane from changes in temperature. Built-up moisture can cause the formation of blisters and ridging, which can lead to leaks and premature failure of the roofing membrane.

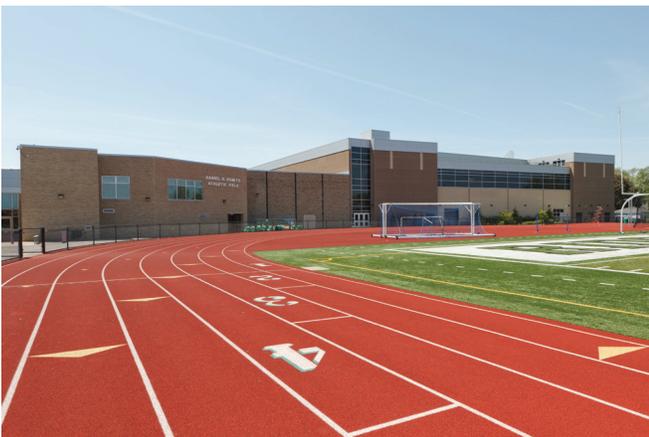


TOPROCK® DD and MONOBOARD® are water repellent yet vapour permeable and will not promote rot, corrosion, mould or bacterial growth.



Minimizing Noise With Superior Sound Absorption

ROXUL stone wool insulation products demonstrate superior sound absorption characteristics. The unique non-directional structure is denser than traditional insulations. This effectively reduces airflow and sound transmissions for excellent noise reduction. These denser structures, coupled with tight, seamless joints, create effective barriers to noise and contribute to a much quieter work environment.



Although Ridgewood High School has served the Chicago suburb of Norridge for over six decades, changing flight plans at O'Hare created a major noise issue. The solution - **ROXUL Tapered System with ROXUL TOPROCK® DD Plus.** ROXUL TOPROCK® DD Plus stone wool insulation demonstrates superior sound reduction characteristics as its non-directional fibre orientation helps to trap and dissipate sound waves.



Dimensionally Stable: ROXUL® Holds Up Year After Year

ROXUL stone wool retains its physical characteristics over time. Unlike foam insulation materials, both TOPROCK® DD and MONOBOARD® have minimal contraction or expansion due to fluctuating temperatures, nor are they adversely affected by the presence of moisture – two critical factors that can compromise a building’s roofing system.

The exceptional stability of ROXUL stone wool eliminates stresses on the roofing membrane, and extends the overall service life of the roof.

Dimensional Stability

Material Type	Co-Efficient of Linear Expansion	Actual Expansion at Temperature Difference of 50°C on a 10 m Section	Actual Expansion at Temperature Difference of 50°F on a 50 ft Section
	10 ⁻⁶ m/m °C	mm	inch
Stone Wool	11	5.5	1/4
Concrete	12	6	1/4
Steel	12	6	1/4
Expanded Polystyrene	63	32	1 1/8
Extruded Polystyrene	63	32	1 1/8
Polyurethane	40-70	20-35	3/4 - 1 1/4
Polyisocyanurate	40-70	20-35	3/4 - 1 1/4

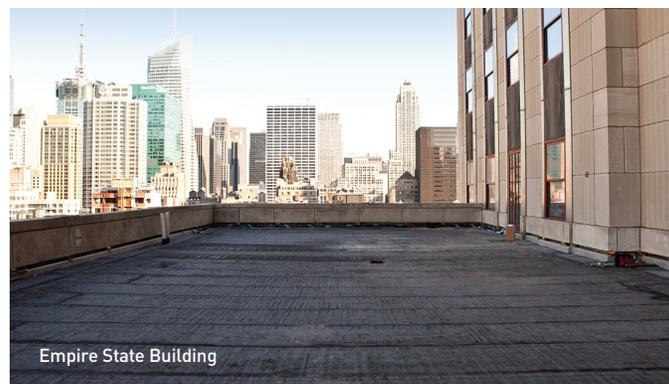
- Stone wool is thermally stable and maintains its R-value over time
- Low thermal expansion/contraction due to temperature variance
- No shrinkage due to off-gassing
- No warping or curling over time
- Life-cycle costing becomes more definitive



Constructability: Easy To Handle, Cut And Install

Comments about stone wool insulation

- Stone wool insulation is easy to install
- No coverboard required
- Easy to cut / fit around edges and openings
- Insulation lies flat and takes up uneven surfaces
- Tight board installation limits gaps
- Tapered solutions to match design requirements available (density of stone wool allows for tapering down to zero)
- Weight not an issue: light enough to handle yet heavy enough to avoid being blown away



Tapered Down to Zero

Experience will vary and proficiency increases as contractors take on more projects using ROXUL stone wool roofing products.

A Global Leader

ROXUL Inc. is a subsidiary of ROCKWOOL International A/S, the world's leading supplier of innovative products and systems based on stone wool. ROCKWOOL International A/S is a publicly held company, which trades on the NASDAQ OMX Nordic Exchange Copenhagen. Operating 28 factories in 18 countries, the ROCKWOOL Group employs more than 10,000 people and features a global network of sales companies, trade offices and dedicated commercial partners. ROXUL® products provide superior thermal and acoustical value and are fire resistant, water repellent, non-corrosive, and resistant to mould.

For more, visit roxul.com

ROXUL is the Better Insulation Choice

ROXUL insulation is innovative, offering a world of green features. Sustainability is a fundamental pillar of our philosophy at ROXUL. We are proud to have our products used in projects targeting LEED® certification, as they can contribute both to energy efficiency and materials credits. For more information, we recommend reading the applicable LEED Reference Guide for detailed descriptions of all credits.

Find out more about how we can assist with your roofing design projects

A ROXUL representative will be pleased to provide you with further details on the products described in this brochure, and can also update you with comprehensive information on the entire line of ROXUL products.

Visit our website at roxul.com, or contact us directly at **1-800-265-6878**.



Environmentally Sustainable

Our stone wool production process uses some of the most advanced technology available. The last decade has seen a new generation of ROXUL manufacturing advancements designed to lower our environmental footprint. These endeavours have included:

- the capture and recycling of rainwater;
- reduction in energy consumption;
- recycling of raw materials back into the production process;
- the use of natural lighting in our facilities; and
- repurposing water used during the manufacturing process.

We are proud that these steps have minimized our impact on the environment and surrounding community resources. But our green programs don't stop there.

ROXUL insulation is created using naturally occurring inorganic raw materials, and reuses waste from other manufacturers as well as from our own plants. Stone wool insulation is non-combustible and achieves its thermal performance without the use of blowing agents. Therefore, our products do not off-gas over time. This feature alone makes a substantial contribution to a cleaner environment.

To remain efficient and environmentally friendly, each ROXUL plant uses a varying combination of new and recycled content. For example, as a direct result of producing less manufacturing waste during the production process, we are able to use up to 40 per cent recycled content. Our continuing effort to improve our overall efficiencies further solidifies our commitment to environmental stewardship within our organization.



Fire
Resistant



Water
Repellent



Saves
Energy



Sound
Absorbent



Easy
Fit



Made
from Stone

TOPROCK® DD is a registered trademark of ROXUL Inc. MONOBOARD® is a registered trademark of ROXUL Inc. LEED® is a registered trademark of United States Green Building Council.

ROXUL[®]
The Better Insulation[™]