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Product Information Bulletin

DuroFoam® Insulation
Insulating Sheathing per BCBC 2018

DuroFoam® insulation board is a moulded expanded polystyrene (EPS) insulation that meets or exceeds CAN/ULC-S701.1, ***Standard for Thermal Insulation, Polystyrene, Boards***. ***DuroFoam*** insulating sheathing applied over the exterior of wood framed walls provide continuous insulation eliminating thermal bridges at wood stud locations.

Table 1 - *DuroFoam* Insulation Material Properties

Material Properties[1]	Units	Values
Thermal Resistance *Minimum per 25 mm (1 inch)* ASTM C518	$m^2 \cdot {}^oC/W$ $(ft^2 \cdot h \cdot {}^oF/BTU)$	0.65 (3.75)
Compressive Resistance *Minimum @ 10% Strain* ASTM D1621	kPa (psi)	70 (10)
Flexural Strength *Minimum* ASTM C203	kPa (psi)	170 (25)
Water Vapour Permeance[2] *Maximum* ASTM E96	$ng/(Pa \cdot s \cdot m^2)$ (Perms)	<30 <(0.5)
Water Absorption[3] *Maximum* ASTM D2842	% By volume	6.0
Dimensional Stability *Maximum* ASTM D2126	% Linear Change	1.5
Limiting Oxygen Index *Minimum* ASTM D2863	%	24
Flame Spread Rating CAN/ULC S102.2	NA	290
Smoke Developed Classification CAN/ULC S102.2	NA	Over 500

The reflective facer on ***DuroFoam*** insulation contains a thin layer of foil embedded within the film. The reflective facer does not increase ***DuroFoam*** insulation thermal resistance (RSI/R-value) – for additional information see Plasti-Fab PIB 253, ***Facts About Thermal Resistance of Reflective Insulation***. The printed green face of ***DuroFoam*** insulation should be left exposed outwards to make use of markings provided for easy cutting of insulation and spacing of fasteners into interior framing as required.

1. ***DuroFoam*** insulation material properties are third party certified to CAN/ULC-S701.1 under an Intertek third party certification program (see Intertek Code Compliance Research Report CCRR-1072 for additional information).
2. WVP values quoted are maximum values for 25-mm (1-inch) thick ***DuroFoam*** insulation with laminated film facers on both sides.
3. The water absorption laboratory test method involves complete submersion under a head of water for 96 hours. The water absorption values above are applicable to specific end-use design requirements only to the extent that the end-use conditions are similar to test method requirements.

This bulletin addresses use of DuroFoam insulation as an exterior insulating sheathing applied to above grade walls in compliance with the British Columbia Building Code 2018 (BCBC 2018).

1. Air Barrier System Requirements

Article 9.25.3.1. requires wall assemblies separating conditioned space from unconditioned space to be constructed so as to include an air barrier system that will provide a continuous barrier to air leakage. ***DuroFoam*** insulation may be used as one component in an air barrier system; however, to meet air barrier system requirements in Articles 9.25.3.2. and 9.25.3.3., requirements for sealing of all air barrier penetrations, such as those created by the installation of doors, windows, electrical wiring, electrical boxes, piping or ductwork, must be addressed.

2. Vapour Barrier System Requirements

Section 9.25.4. requires a vapour barrier to be installed on the warm side of wall assemblies to provide a barrier to diffusion of water vapour from the interior into wall spaces. Although ***DuroFoam*** insulation has a vapour permeance less than 30 ng/(Pa•s•m^2), it is attached to the exterior (cold side) of above grade walls. See requirements below related to **Properties and Position of *DuroFoam* Insulating Sheathing** in the building envelope applicable to low air and vapour permeance thermal insulation.

3. Position and Properties of *DuroFoam* Insulating Sheathing

DuroFoam insulating sheathing has an air leakage characteristic less than 0.1 L/(s•m^2) at 75 Pa and a water vapour permeance less than 30 ng/(Pa•s•m^2). Article 9.25.5.1. requires that the location of low permeance thermal insulation as per Article 9.25.5.2. must be considered in order to address the possibility of moisture accumulation within the interior wall cavity.

Sentence 9.25.5.2.(1) requires that the ratio between the total thermal resistance of all materials outboard of the interior surface of ***DuroFoam*** insulating sheathing and the total thermal resistance of all materials inboard of that surface must be not less than that required by Table 9.25.5.2., ***Ratio of Outboard to Inboard Thermal Resistance***. Wall assemblies with a ratio of outboard to inboard thermal resistance greater than Table 9.25.5.2 ensure that the inner surface of ***DuroFoam*** insulating sheathing is likely to be warm enough for most of the heating season such that no significant accumulation of moisture will occur when the vapour barrier function is provided by a separate building element installed on the warm side of the assembly. For additional information on assumptions used in developing Table 9.25.5.2., refer to BCBC 2018, Appendix note A-9.25.5.2.

Table 2 - Ratio of Outboard to Inboard Thermal Resistance per BCBC 2018 Table 9.25.5.2.

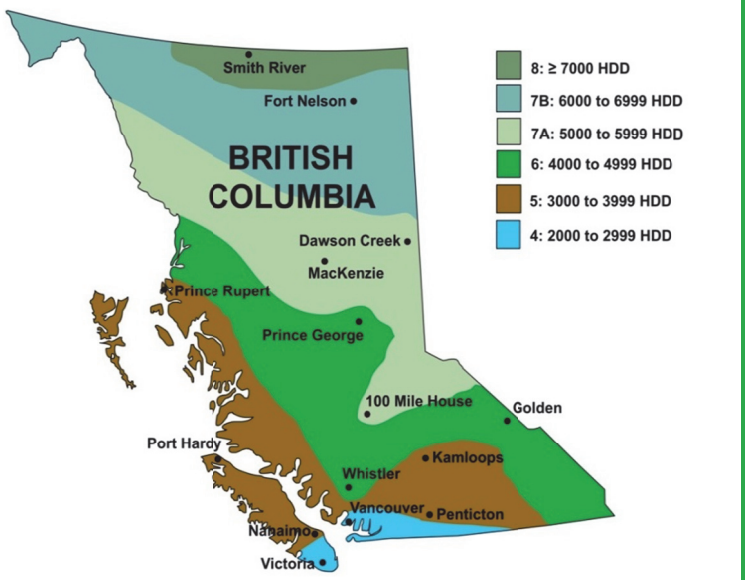
Heating Degree-Days	Ratio	Heating Degree-Days	Ratio
up to 4999	0.20	9000 to 9999	0.55
5000 to 5999	0.30	10000 to 10999	0.60
6000 to 6999	0.35	11000 to 11999	0.65
7000 to 7999	0.40	12000 or higher	0.75
8000 to 8999	0.50		

Energy consumption required to keep the interior of a small building at 21°C when the outside air temperature is below 18°C is roughly proportional to the difference between 18°C and the outside temperature. This relationship holds true for average conditions of wind, radiation, exposure, and internal sources. A heating degree-day (HDD) is defined as the number of degrees the mean temperature (average of high and low temperature) for a given day is below 18°C. The sum of all the daily HDD contributions results in the annual HDD for a location.

Table 3 provides annual heating degree days for some building locations in BC. BCBC 2018, Division B, Appendix C**, *Climatic and Seismic Information for Building Design in Canada*,** provides HDD information for building locations for other locations in BC.

Table 3 - Annual HDD (Celsius Degree Days) for Building Locations

Climate Zone	Location	HDD
4	Victoria	2650
	Chilliwack	2780
	Abbotsford	2860
	Vancouver	2950
5	Nanaimo	3000
	Penticton	3350
	Kamloops	3450
	Prince Rupert	3900
6	Whistler	4180
	Cranbrook	4400
	Prince George	4720
	Golden	4750
7A	Smithers	5040
	Mackenzie	5550
	Fort St. John	5750
	Glacier	5800
7B	Beaton River	6300
	Dease Lake	6730
	Fort Nelson	6710



4. Insulating Sheathing in lieu of Sheathing Membrane

Subclause 9.27.3.4.(2)(b)(i) states that a separate sheathing membrane is not required over insulating sheathing where the joints between boards are sealed. Therefore, when the joints between ***DuroFoam*** insulation boards are sealed, a separate sheathing membrane is not required. Refer to PIB 232 for additional information on installation requirements.

5. *Effective Thermal Resistance (RSI$_{eff}$/R$_{eff}$)* of Wall Assemblies with *DuroFoam* Insulation

BCBC 2018, Section 9.36 provides minimum energy efficiency requirements for buildings 3 storeys or less in building height, having a building area not exceeding 600 m^2 and used for major occupancies classified as residential occupancies.

Table 3 provides ***minimum RSI$_{eff}$/R$_{eff}$*** requirements per BCBC 2018, Tables 9.36.2.6.-A and 9.36.2.6-B for above grade walls in buildings as noted.

Table 4 - Minimum RSI$_{eff}$/R$_{eff}$ of Wall Opaque Assemblies

BCBC 2018 Climate Zones	Zone 4	Zone 5	Zone 6	Zone 7A	Zone 7B	Zone 8
Heating Degree-Days (HDD) Celsius Degree-Days	< 3,000	3,000 to 3,999	4,000 to 4,999	5,000 to 5,999	6,000 to 6,999	≥ 7,000
Table 9.36.2.6.-A - Buildings Where a Heat Recovery Ventilator (HRV) is not Installed						
RSI$_{eff}$ – m^2•°C/W	2.78	3.08	3.08	3.08	3.85	3.85
R$_{eff}$ – ft^2•hr•°F/BTU	15.8	17.5	17.5	17.5	21.9	21.9
Table 9.36.2.6.-B - Buildings Where a Heat Recovery Ventilator (HRV) is Installed						
RSI$_{eff}$ – m^2•°C/W	2.78	2.97	2.97	2.97	3.08	3.08
R$_{eff}$ – ft^2•hr•°F/BTU	15.8	16.9	16.9	16.9	17.5	17.5

RSI$_{eff}$/R$_{eff}$ requirements in Tables 9.36.2.6.-A and 9.36.2.6.-B are based upon calculations for building assemblies which include the effect of thermal bridging due to repetitive structural members such as wood framing members in wall assemblies calculated using the formula below.

$$\mathbf{RSI_{eff}\,(R_{eff})} = \frac{100\%}{\dfrac{\%\text{ with Framing}}{RSI_F\ (R_F)} + \dfrac{\%\text{ Area Cavity}}{RSI_C\ (R_C)}} + \text{RSI(R) Continuous Material Layers}$$

Table 5 provides an example of ***RSI$_{eff}$/R$_{eff}$*** calculations for a 2 x 4 wood stud wall assembly to meet requirements per Table 4 for a building located in Climate Zones 4 to 7A using ***DuroFoam*** continuous insulation. Table 6 provides the ratio of outboard to inboard thermal resistance for this wall assembly demonstrating compliance with minimum requirements in Table 2.

Table 5 - *RSI$_{eff}$/R$_{eff}$* Calculation for a Building Located in Climate Zone 4 to 7A

Wall Assembly Construction (Building with or without HRV)	Framed Portion		Continuous Layers
	RSI$_F$	RSI$_C$	
Outside Air Film	----	----	0.03
Vinyl Cladding	----	----	0.11
2" (50.8 mm) DuroFoam Continuous Insulation	**----**	**----**	***1.32***
Stud Cavity Insulation	----	2.29	----
2 x 4 Wood Stud @ 16" (406 mm) o/c	0.76	----	----
6 mil polyethylene vapour barrier	----	----	----
1/2" (12.7 mm) Gypsum Wall Board	----	----	0.08
Inside Air Film	----	----	0.12
RSI Sub-Totals	**0.76**	**2.29**	**1.66**
% Area of Each Component	**23%**	**77%**	**100%**
RSI$_{eff}$ (R$_{eff}$)	**RSI-3.22 (R-18.3)**		

Table 6 - Ratio of Outboard to Inboard Thermal Resistance Calculation

Outboard Components	RSI	Inboard Components	RSI
Outside air film	0.03	Stud cavity insulation	2.29
Vinyl cladding	0.11	Gypsum board	0.08
2" (50.8 mm) DuroFoam Insulation	1.32	Inside air film	0.12
Total Outboard RSI	**1.46**	**Total Inboard RSI**	**2.49**
Ratio of Outboard to Inboard Thermal Resistance		**1.46/2.49**	**0.59**

Note: The same wall assembly in Table 5 using 1 ½" (38.1 mm) of ***DuroFoam*** continuous insulation would provide an ***RSI$_{eff}$*** (***R$_{eff}$***) of 2.89 (16.4) which would meet minimum requirements for a building located in Zone 4. Table 7 provides the ratio of outboard to inboard thermal resistance for this alternative Zone 4 wall assembly demonstrating compliance with Table 2 requirements.

Table 7 - Ratio of Outboard to Inboard Thermal Resistance Calculation

Outboard Components	RSI	Inboard Components	RSI
Outside air film	0.03	Stud cavity insulation	2.29
Vinyl cladding	0.11	Gypsum board	0.08
1 1/2" (38.1 mm) DuroFoam Insulation	0.99	Inside air film	0.12
Total Outboard RSI	**1.13**	**Total Inboard RSI**	**2.49**
Ratio of Outboard to Inboard Thermal Resistance		**1.13/2.49**	**0.45**

Table 8 provides an example of RSI_{eff}/R_{eff} calculations for a 2 x 6 wood stud wall assembly using ***DuroFoam*** continuous insulation to meet requirements per Table 4 for a building location in Climate Zones 4 to 8 with HDD less than 8,000 (with or without HRV). Table 9 provides the ratio of outboard to inboard thermal resistance for this wall assembly demonstrating compliance with requirements in Table 2.

Table 8 - RSI_{eff}/R_{eff} Calculation for Building in Climate Zones 4 to 8

Wall Assembly Construction (Building with or without HRV)	Framed Portion		Continuous Layers
	RSI_F	RSI_C	
Outside Air Film	----	----	0.03
Vinyl Cladding	----	----	0.11
2" (50.8 mm) DuroFoam Insulation	----	----	1.32
Stud Cavity Insulation	----	3.34	----
2 x 6 Wood Stud @ 16" (406 mm) o.c.	1.17	----	----
6 mil polyethylene vapour barrier	----	----	----
1/2" (12.7 mm) Gypsum Wall Board	----	----	0.08
Inside Air Film	----	----	0.12
RSI Sub-Totals	**1.17**	**3.34**	**1.66**
% Area of Each Component	**23%**	**77%**	**100%**
RSI_{eff} (R_{eff})	**RSI-4.00 (R-22.7)**		

Table 9 - Ratio of Outboard to Inboard Thermal Resistance Calculation

Ratio of Outboard to Inboard Thermal Resistance Calculation			
Inboard Components	**RSI**	**Outboard Components**	**RSI**
Outside air film	0.03	Stud cavity insulation	3.34
Vinyl cladding	0.11	Gypsum board	0.08
2" (50.8 mm) DuroFoam Insulation	1.32	Inside air film	0.12
Total Outboard RSI	**1.46**	**Total Inboard RSI**	**3.54**
Ratio of Outboard to Inboard RSI		**1.46/3.54**	**0.41**