Product Information Bulletin

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DuroFoam® Insulation for Insulating Sheathing - 2012 BCBC

DuroFoam® insulation board is a moulded expanded polystyrene (EPS) insulation that meets or exceeds CAN/ULC-S701, ***Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering***. 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 Property	ASTM Test Method[1]	Units	CAN/ULC-S701[2] Type 1
Thermal Resistance *Minimum per 25 mm (inch)*	C518	$m^2 \cdot {}^oC/W$ ($ft^2 \cdot h \cdot {}^oF/BTU$)	0.65 (3.75)
Compressive Resistance *Minimum @ 10% Deformation*	D1621	kPa (psi)	70 (10)
Flexural Strength *Minimum*	C203	kPa (psi)	170 (25)
Water Vapour Permeance[3] *Maximum*	E96	ng/(Pa·s·m^2) (Perms)	30 (0.5)
Water Absorption[4] *Maximum*	D2842	% By volume	6.0
Dimensional Stability *Maximum, 7 Days @ 70 ± 2°C (158 ± 4°F)*	D2126	% Linear Change	1.5
Limiting Oxygen Index *Minimum*	D2863	%	24

This bulletin addresses use of DuroFoam insulation as an exterior insulating sheathing applied to above grade walls in compliance with the 2012 British Columbia Building Code (2012 BCBC).

1. The test methods used to determine material properties in the above table provide a means of comparing different types of cellular plastic thermal insulation. They are intended for use in specifications, product evaluations and quality control. They do not predict end-use product performance.
2. DuroFoam insulation properties are third party certified under a quality listing program administered by Intertek and are listed by the Canadian Construction Materials Centre (CCMC) under evaluation listing numbers 12424-L (Type 1).
3. WVP values quoted are maximum values for 25-mm thick samples with natural skins intact. Lower values will result for thicker materials.
4. 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.

1. Air Barrier System Requirements

Article 9.25.3.1. requires wall, ceiling and floor assemblies separating conditioned space from unconditioned space or from the ground 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, air barrier system design must consider requirements for sealing of all penetrations of the air barrier system, such as those created by the installation of doors, windows, electrical wiring, electrical boxes, piping or ductwork

2. Vapour Barrier System Requirements

Article 9.25.4.1. requires all thermally insulated wall, ceiling and floor assemblies to be constructed with a vapour barrier sufficient to prevent condensation. Dependent upon thickness, DuroFoam insulation can have a vapour permeance less than 60 ng/(Pa•s•m^2) as per Sentence 9.25.4.2.(1); however, DuroFoam insulating sheathing is not intended to provide the principal protection against vapour diffusion in an above grade wall application. See requirements related to low air- and vapour-permeance materials below.

3. Position and Properties of DuroFoam Insulating Sheathing

Subsection 9.25.5.1. addresses low air- and vapour-permeance materials and implications for moisture accumulation. Because DuroFoam insulating sheathing may have an air leakage characteristic less than 0.1 L/(s•m^2) at 75 Pa and a vapour permeance characteristic less than 60 ng/(Pa•s•m^2), the provisions of Article 9.25.5 should be considered.

Article 9.25.5.2 permits the use of insulating sheathing meeting the above criteria on the exterior of an insulated frame wall based upon the ***ratio of outboard to inboard thermal resistance*** for specific heating degree-day (HDD) ranges. Wall assemblies with ratio of outboard to inboard thermal resistance values greater than those given in Table 9.25.5.2 (see Table 2) ensure that the inner surface of the insulating sheathing is likely to be warm enough for most of the heating season such that no significant accumulation of moisture will occur. As well, the vapour barrier function has to be 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 2012 BCBC Appendix note A-9.25.5.2.

Table 2 - Minimum Ratio of Total Thermal Resistance Outboard to Thermal Resistance Inboard

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		

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 205 for additional information on installation requirements.

5. *Thermal Resistance* of Wall Assemblies with DuroFoam Insulation

2012 British Columbia Building Code (2012 BCBC), Section 9.36 provides 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.

Effective thermal resistance **RSI_{eff} (R_{eff})** of building assemblies is calculated using the following formula which includes the thermal bridging effect due to repetitive structural members such as wood framing members in walls.

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

Table 3 provides ***minimum RSI$_{eff}$/R$_{eff}$*** requirements per 2012 BCBC Tables 9.36.2.6.A. and 9.36.2.6.B. for above grade walls in buildings as noted.

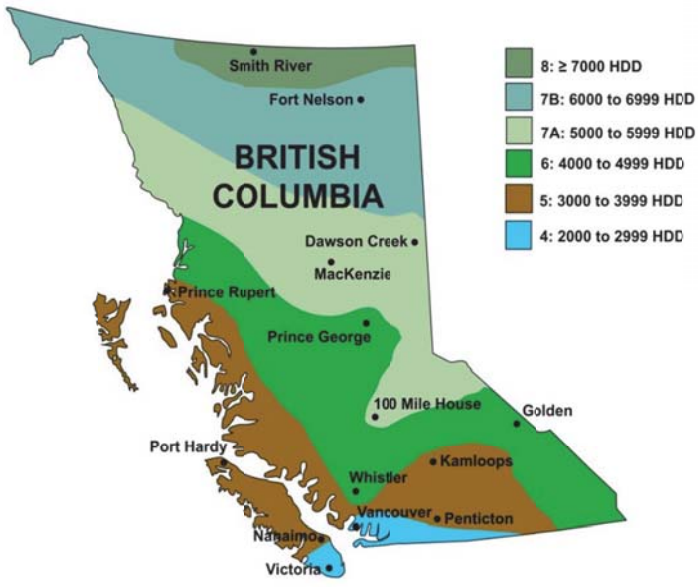
Table 3 - Minimum RSI$_{eff}$/R$_{eff}$ of Wall Opaque Assemblies

2012 BCBC 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•^{o}C/W	2.78	3.08	3.08	3.08	3.85	3.85
R$_{eff}$ – ft^2•hr•^{o}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•^{o}C/W	2.78	2.97	2.97	2.97	3.08	3.08
R$_{eff}$ – ft^2•hr•^{o}F/BTU	15.8	16.9	16.9	16.9	17.5	17.5

Table 4 provides annual heating degree days for some building locations in Climate Zones 4 to 7b as per 2012 BCBC, Division B, Appendix C.

Table 4 - Annual HDD (Celsius Degree Days) for Building Locations

Climate Zone	Locations	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



Tables 5 provides ***RSI$_{eff}$/R$_{eff}$*** calculations for a wall assembly using ***DuroFoam*** insulating sheathing to meet requirements per Table 3 for buildings in Climate Zones 7b to 8 with 2 x 4 construction.

Table 5 - *RSI$_{eff}$/R$_{eff}$* of Typical Wall Assembly with DuroFoam Continuous Insulating Sheathing

Wall Construction – Climate Zones 4 to 7a Heating Degree Days Less Than 6,000	RSI$_{eff}$ Calculation		
	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	----	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)**		

Ratio of Outboard to Inboard Insulation Calculation			
Outboard Insulation Components	**RSI**	**Inboard Insulation 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 RSI		**1.46/2.49**	**0.59**

Tables 6 provides RSI$_{eff}$/R$_{eff}$ calculations for a wall assembly using ***DuroFoam*** insulating sheathing to meet requirements per Table 3 for buildings in Climate Zones 4 to 7a with 2 x 6 construction.

Table 6 - *RSI$_{eff}$/R$_{eff}$* of Typical Wall Assembly with DuroFoam Continuous Insulating Sheathing

Wall Construction – Climate Zones 4 to 7a Heating Degree Days Less Than 6,000	RSI$_{eff}$ Calculation		
	Framed Portion		Continuous Layers
	RSI$_F$	RSI$_C$	
Outside Air Film	----	----	0.03
Vinyl Cladding	----	----	0.11
1-1/2" (38.1 mm) DuroFoam Insulation	----	----	***0.99***
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**	**1.33**
% Area of Each Component	**23%**	**77%**	**100%**
RSI$_{eff}$ (R$_{eff}$)	**RSI-3.67 (R-20.9)**		

Ratio of Outboard to Inboard Insulation Calculation			
Outboard Insulation Components	**RSI**	**Inboard Insulation Components**	**RSI**
Outside air film	0.03	Stud cavity insulation	3.34
Vinyl cladding	0.11	Gypsum board	0.08
1.5" (38.1 mm) DuroFoam Insulation	0.99	Inside air film	0.12
Total Outboard RSI	**1.13**	**Total Inboard RSI**	**3.54**
Ratio of Outboard to Inboard RSI		**1.13/3.54**	**0.32**