Product Information Bulletin

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DuroFoam® Insulation for Insulating Sheathing - NBC 2010

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***. The addition of a laminated film to the top and bottom surfaces of ***DuroFoam*** insulation board provides a more durable product that is less susceptible to handling damage.

Table 1 – *DuroFoam* Insulation Material Properties

Material Property[1]	Test Method	Units	Type 1	*DuroFoam* Exterior Insulating Sheathing
Thermal Resistance *Minimum RSI per 25 mm (R per inch)*	ASTM C518	m^2•°C/W (Ft^2•hr•°F/BTU)	0.65 (3.75)	
Compressive Resistance *Minimum @ 10% Deformation*	ASTM D1621	kPa (psi)	70 (10)	
Flexural Strength *Minimum*	ASTM C203	kPa (psi)	170 (25)	
Water Vapour Permeance[2] *Maximum*	ASTM E96	ng/Pa•s•m^2 (perm)	30 (0.5)	
Water Absorption[3] *Maximum*	ASTM D2842	% By volume	6.0	
Dimensional Stability *Maximum, 7 Days @ 70 ± 2°C (158 ± 4°F)*	ASTM D2126	% Linear Change	1.5	
Limiting Oxygen Index *Minimum*	ASTM D2863	%	24	

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

1. ***DuroFoam*** insulation properties are third party certified to CAN/ULC-S701 under a quality listing program administered by Intertek Testing Services. ***DuroFoam*** insulation is listed by the Canadian Construction Materials Centre under CCMC Evaluation Listing 12424-L.
2. ***Maximum*** vapour permeance value for EPS insulation is 300 ng/Pa•s•m^2 for 25-mm (5.2 perms for 1-inch) thickness. The vapour permeance value provided above for ***DuroFoam*** insulation is significantly lower as a result of laminated films. Where water vapour permeance is a design issue, contact Plasti-Fab technical services for additional information.
3. Water absorption % by volume is determined using ASTM D2842 which involves complete submersion under a head of water for 96 hours. The value provided in the table above is the ***maximum*** for CAN/ULC-S701, type 1 EPS insulation without facers.

This bulletin addresses the use of ***DuroFoam*** insulation board as an exterior insulating sheathing board applied to above grade walls in compliance with the National Building Code of Canada 2010 (NBC 2010).

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. ***DuroFoam*** insulation has a vapour permeance less than 60 ng/(Pa•s•m^2) as required by 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 has 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 must be considered.

Article 9.25.5.2 permits the use of ***DuroFoam*** insulating sheathing 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 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 NBC 2010 Appendix note A-9.25.5.2.

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

NBC 2010, 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.

Energy efficiency requirements in NBC 2010, Subsection 9.36.2. are based upon minimum ***effective thermal resistance (RSI_{eff}/R_{eff})*** of building assemblies which includes the effect of thermal bridging due to repetitive structural members such as wood framing members in wall or roof assemblies calculated using the formula below.

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

Table 2 provides ***minimum RSI_{eff}/R_{eff}*** requirements per NBC 2010 Table 9.36.2.6.B. for above grade walls in buildings where a heat recovery ventilator (HRV) is installed and Table 3 provides minimum ratio of outboard to inboard insulation as per NBC 2010 Table 9.25.5.2.

Table 2 - Minimum RSI_{eff}/R_{eff} Where Heat Recovery Ventilator (HRV) Installed

NBC 2010 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
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

Table 3 - 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		

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 4 - NBC 2010, Division B, Appendix C - Annual HDD (Celsius Degree-Days)

Province	Building Location	HDD (Celsius Degree Days)	Province	Building Location	HDD (Celsius Degree Days)
British Columbia	Victoria	2,650	**Quebec**	Montréal	4,200
	Vancouver	2,950		Trois-Rivières	4,900
	Kelowna	3,400		Québec	5,080
	Whistler	4,180		Gaspé	5,500
	Dawson Creek	5,900		Baie-Comeau	6,020
Alberta	Lethbridge	4,650		Schefferville	8,550
	Calgary	5,000	**New Brunswick**	Campbellton	5,500
	Edmonton	5,400		Edmunston	5,400
	Fort McMurray	6,550		Fredericton	4,650
Saskatchewan	Moose Jaw	5,270	**Nova Scotia**	Digby	4,020
	Regina	5,600		Truro	4,650
	Saskatoon	5,700		Halifax	4,200
	Prince Albert	6,100	**PEI**	Charlottetown	4,600
	Uranium City	7,500	**Newfoundland**	St. John's	4,800
Manitoba	Winnipeg	5,670		Labrador City	7,900
	Flin Flon	6,440	**Yukon**	Dawson	8,400
	Thompson	7,600			

DuroFoam continuous insulation increases the ***RSI_{eff}/R_{eff}*** of a wall assembly by eliminating thermal shorts due to wood studs. Table 4 provides ***RSI_{eff}/R_{eff}*** calculations for a wall assemblies using ***DuroFoam*** continuous insulation to meet minimum requirements per NBC 2010, Table 9.36.2.6.B. for buildings where a heat recovery ventilator (HRV) is installed **for** Climate Zones 4 to 7A.

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

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
1-5/8" (41.3 mm) DuroFoam Insulation	**----**	**----**	***1.07***
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**	**1.41**
% Area of Each Component	**23%**	**77%**	**100%**
RSI$_{eff}$ (R$_{eff}$)	**RSI-2.97 (R-16.9)**		

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
1 5/8" (41.3 mm) DuroFoam Insulation	1.07	Inside air film	0.12
Total Outboard RSI	**1.21**	**Total Inboard RSI**	**2.49**
Ratio of Outboard to Inboard RSI		**1.21/2.49**	**0.49**

Table 5 provides ***RSI$_{eff}$/R$_{eff}$*** calculations for a typical wall assemblies using ***DuroFoam*** continuous insulation meeting requirements per NBC 2010, Table 9.36.2.6.B. for buildings in Climate Zones 7B to 8.

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

Wall Construction – Climate Zones 7b and 8 Heating Degree Days 6,000 or Greater	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**