Product Information Bulletin

BULLETIN NO. 250
ISSUED: March 12, 2018
REPLACES: September 20, 2017

DuroFoam® Insulation Used as Insulating Sheathing - 2012 OBC

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 RSI/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*** continuous insulation as exterior insulating sheathing applied to above grade walls in compliance with the 2012 Ontario Building Code (2012 OBC).

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

2012 OBC, MMA Supplementary Standard SB-12, Chapter 3 provides prescriptive compliance packages which include requirements for the minimum thermal performance and energy efficiency of building envelope and space heating equipment, domestic hot water heating equipment and heat recovery ventilator equipment. Compliance packages are presented in table format in SB-12, Chapter 3 as follows:

a) Zone 1 Building Locations – Tables 3.1.1.2.A (SI), 3.1.1.2.A (IP), 3.1.1.2.B (SI), and 3.1.1.2.B (IP).
b) Zone 2 Building Locations – Tables 3.1.1.3.A (SI), 3.1.1.3.A (IP), 3.1.1.3.B (SI), and 3.1.1.3.B (IP).

The approximate limits of Climate Zones 1 and 2 are illustrated in Figure 1.

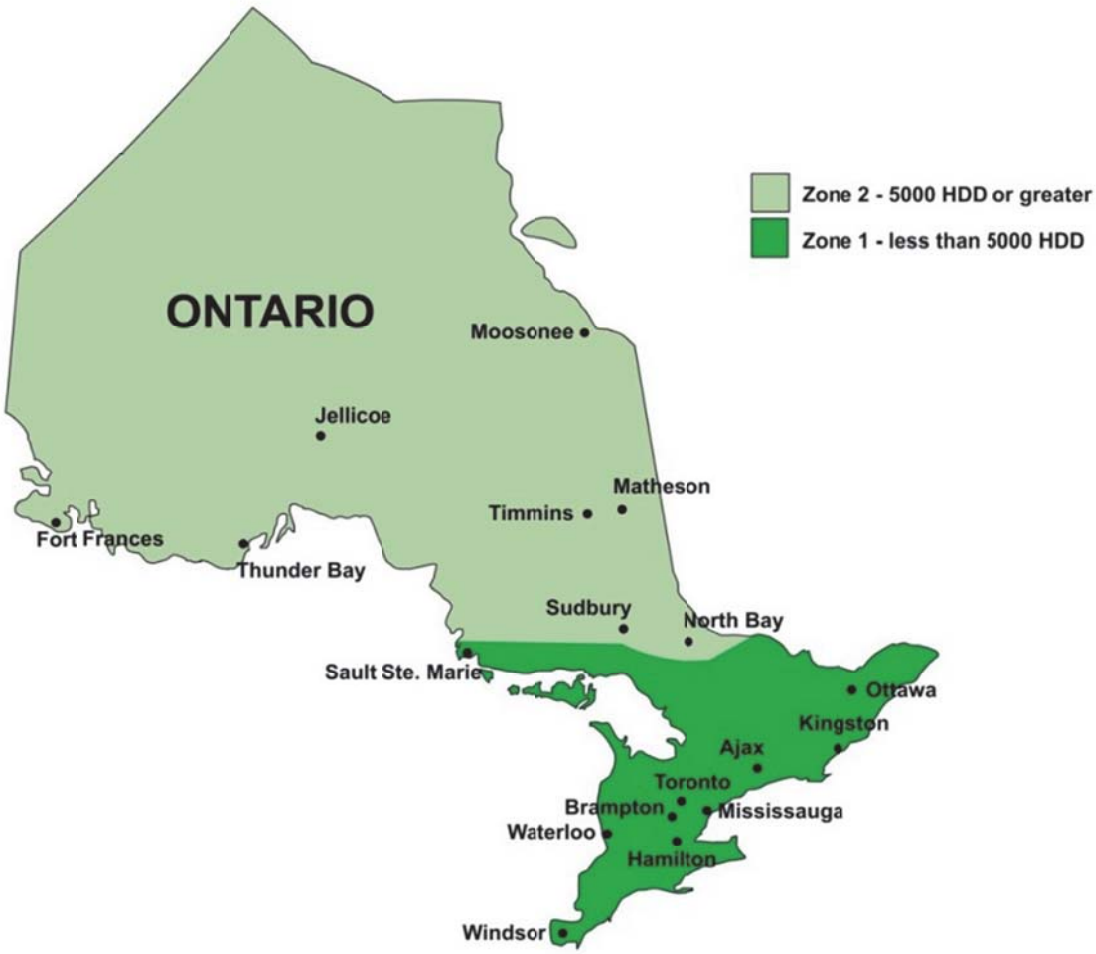

Figure 1 – Ontario Climate Zone Map

Table 2 provides recommended ***DuroFoam*** continuous insulation options to meet MMA SB-12 requirements.

Table 2 – *DuroFoam* Continuous Insulation for Above Grade Walls

MMA SB-12 Reference	Compliance Package	Minimum Effective RSI (R)[1]	*DuroFoam* Continuous Insulation		
			RSI (R)	Thickness	
				mm	in.
Zone 1 – Table 3.1.1.2.A Space Heating Equipment AFUE ≥ 92%	A2, A5	3.58 (20.3)	0.99 (5.6)	38	1 1/2
	A3	3.28 (18.6)	1.32 (7.5)	51	2
	A4, A6	3.77 (21.4)	0.99 (5.6)	38	1 1/2
Zone 1 – Table 3.1.1.2.B Space Heating Equipment 84% ≤ AFUE < 92%	B1, B2	3.77 (21.4)	0.99 (5.6)	38	1 1/2
	B3, B4	4.21 (23.9)	1.32 (7.5)	51	2
	B5, B6	4.46 (25.3)	1.95 (11.2)	76	3
Zone 2 – Table 3.1.1.3.A Space Heating Equipment AFUE ≥ 92%	A1	3.58 (20.3)	0.99 (5.6)	38	1 1/2
	A2, A5	4.46 (25.3)	1.95 (11.2)	70	3
	A3	1.77 (21.4)	0.99 (5.6)	38	1 1/2
	A4, A6	4.21 (23.9)	1.32 (7.5)	51	2
Zone 2 – Table 3.1.1.3.B Space Heating Equipment 84% ≤ AFUE < 92%	B1, B2	4.21 (23.9)	1.32 (7.5)	51	2
	B3, B4, B5, B6	4.65 (26.4)	1.95 (11.2)	76	3

Note 1: The *effective RSI/R values* for MMA SB-12 compliance packages above is calculated as per MMA SB-12, Appendix A, Sentence 1.3.2.1.(2) using the formula below from National Building Code of Canada 2010 which includes all wall assembly components, from interior air film to exterior air film. *Effective RSI/R* for wall assemblies using ***DuroFoam*** continuous insulation options *above* meet or exceed MMA SB-12 minimum requirements for each compliance package.

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

Where: $RSI_F\ (R_F)$ = thermal resistance of wood framing, and
$RSI_C\ (R_C)$ = thermal resistance of cavity insulation

2. 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

3. 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 206 for additional information on installation requirements.

4. Vapour Barrier System Requirements

Article 9.25.4.1. requires all thermally insulated wall, ceiling and floor assemblies to be constructed have a vapour barrier with a vapour permeance less than 60 ng/(Pa•s•m^2) as per Sentence 9.25.4.2.(1) to prevent condensation. ***DuroFoam*** insulating sheathing is not intended to provide the principal protection against vapour diffusion in an above grade wall application.

5. Position and Properties of *DuroFoam* Continuous 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*** continuous 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 2012 OBC, Table 9.25.5.2 (see Table 3 below) 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.

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 - 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		

In this type of wall assembly, it is assumed the vapour barrier function will 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 OBC, Volume 2, Appendix Note A-9.25.5.2.

Table 4 provides minimum ratio of outboard to inboard thermal resistance for various locations in Ontario based upon Climatic Data provided in 2012 OBC, Supplementary Standard SB-1, Table 1.2.

Table 4 – Minimum Ratio Outboard to Inboard Thermal Resistance for Locations

OBC Zone 1 (< 5000 Celsius Degree-Days)			OBC Zone 2 (≥5000 Celsius Degree-Days)		
Building Location	HDD	Min. Ratio of Outboard to Inboard R-value	Building Location	HDD	Min. Ratio of Outboard to Inboard R-value
Barrie	4,380	0.20	Big Trout Lake	7,450	0.40
Belleville	3,910	0.20	Cochrane	6,200	0.35
Brampton	4,100	0.20	Dryden	5,150	0.30
Burlington	3,740	0.20	North Bay	5,300	0.30
Kitchener	4,200	0.20	Moosonee	6,800	0.35
Niagara Falls	3,600	0.20	Sault Ste. Marie	4,960	0.30
Ottawa	4,400	0.20	Sudbury	5,180	0.30
Peterborough	4,400	0.20	Timmins	6,000	0.35
Toronto	3,800	0.20	White River	6,150	0.35

Tables 5 and 6 provide ratio of outboard to inboard thermal resistance calculations for above-grade wall assemblies using ***DuroFoam*** continuous insulating sheathing in combination with cavity insulation to meet 2012 OBC, SB-12.

Table 5 – Zone 1 Above-Grade Wall Ratio of Outboard to Inboard RSI Calculations

			Zone 1 - HDD < 5,000				
SB-12 Compliance Packages			**A2, A5**	**A3**	**A4, A6 B1, B2**	**B3, B4**	**B5, B6**
Outboard Components	**Continuous Materials**		**RSI**	**RSI**	**RSI**	**RSI**	**RSI**
Outside Air Film	0.03		0.03	0.03	0.03	0.03	0.03
Cladding	0.14		0.14	0.14	0.14	0.14	0.14
DuroFoam Continuous Insulation			***0.99***	***1.32***	***0.99***	***1.32***	***1.95***
Total Outboard RSI			**1.13**	**1.46**	**1.13**	**1.46**	**2.09**
Inboard Components	**Continuous Materials**						
Stud cavity insulation			3.34	2.46	3.87	3.87	3.34
Gypsum board		0.08	0.08	0.08	0.08	0.08	0.08
Inside air film		0.12	0.12	0.12	0.12	0.12	0.12
Total Inboard RSI			**3.54**	**2.66**	**4.07**	**4.07**	**3.54**
Ratio of Outboard RSI to Inboard RSI			**0.32**	**0.55**	**0.28**	**0.36**	**0.59**

The calculations in Table 5 confirm that the use of ***DuroFoam*** insulation would meet minimum ratio requirements when used as a component in Zone 1 compliance packages provided in 2012 OBC, SB-12, Chapter 3, Tables 3.1.1.2.A (SI), 3.1.1.2.A (IP), 3.1.1.2.B (SI), and 3.1.1.2.B (IP).

Table 6 — Zone 2 Above-Grade Wall Ratio of Outboard to Inboard RSI Calculations

			Zone 2 - HDD ≥ 5,000					
SB-12 Compliance Packages			**A1**	**A2, A5**	**A3**	**A4, A6 B1, B2**	**B3, B4**	**B5, B6**
Outboard Components	**Continuous Materials**		**RSI**	**RSI**	**RSI**	**RSI**	**RSI**	**RSI**
Outside Air Film	0.03		0.03	0.03	0.03	0.03	0.03	0.03
Cladding	0.14		0.14	0.14	0.14	0.14	0.14	0.14
DuroFoam Continuous Insulation			***0.99***	***1.95***	***1.32***	***1.32***	***1.95***	***1.95***
Total Outboard RSI			**1.13**	**2.09**	**1.46**	**1.46**	**2.09**	**2.09**
Inboard Components	**Continuous Materials**							
Stud cavity insulation			3.34	3.34	3.87	3.87	3.87	3.87
Gypsum board		0.08	0.08	0.08	0.08	0.08	0.08	0.08
Inside air film		0.12	0.12	0.12	0.12	0.12	0.12	0.12
Total Inboard RSI			**3.54**	**3.54**	**4.07**	**4.07**	**4.07**	**4.07**
Ratio of Outboard RSI to Inboard RSI			**0.32**	**0.59**	**0.36**	**0.36**	**0.51**	**0.51**

The calculations in Table 6 indicate that the use of ***DuroFoam*** continuous insulation should be reviewed to ensure that the minimum ratio is met for specific locations in Zone 2 (see Table 4) when used as a component in 2012 OBC compliance packages provided in SB-12, Chapter 3, Tables 3.1.1.3.A (SI), 3.1.1.3.A (IP), 3.1.1.3.B (SI), and 3.1.1.3.B (IP).