Product Information Bulletin

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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 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 2012 Ontario Building Code (2012 OBC).

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 in next section related to low air- and vapour permeance materials.

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 as per Table 2 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. 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 OBC, Volume 2, 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 206 for additional information on installation requirements.

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

DuroFoam insulation applied as continuous insulation over the exterior of above-grade wood stud frame wall systems increases the energy efficiency of this portion of the building envelope. Table 3 below provides minimum thermal resistance for the insulation component for above-grade walls per 2012 OBC, Supplementary Standard SB-12, Tables 2.1.1.2.A and 2.1.1.3.A.

Table 3 – Minimum RSI/R-value for Insulation Component in Above-Grade Walls

Zone 1 (< 5,000 heating degree-days)			Zone 2 (≥ 5,000 heating degree-days)		
Compliance Packages			Compliance Packages		
I & J	A, D-H & L-M	B-C	H-J & M	D-G	A-C
3.87 (R22)	4.23 (R24)	4.75 (R27)	4.23 (R24)	4.75 (R27)	5.11 (R29)

When DuroFoam insulation is installed over wood framed walls with cavity insulation, the ***effective thermal resistance*** (***RSI_{eff}/R_{eff}***) calculated as per the ***National Code of Canada 2010*** is increased because thermal shorts due to wood studs (which leave a large portion of the wall area un-insulated) are eliminated as illustrated in Table 4 below. ***RSI_{eff}/R_{eff}*** of building assemblies calculated using the formula below includes the effect of the thermal bridging effect due to repetitive structural members such as wood framing members in walls.

$$RSI_{eff}/R_{eff} = \frac{100\%}{\frac{\%\text{ Area with Framing}}{RSI_F\ (R_F)} + \frac{\%\text{ Area without Framing}}{RSI_C\ (R_C)}}$$

Table 4 — Above-Grade Wall Effective R-value Calculations

Zone 1 Wall Construction		
Compliance Package A, D-H & L-M	**R_F Through Studs**	**R_C Through Cavity**
Outside Air Film	0.17	0.17
Vinyl Cladding	0.62	0.62
DuroFoam Insulation, 1.5" (38 mm) thick	***5.62***	***5.62***
Stud Cavity Insulation	***----***	***19.00***
2 x 6 Wood Stud @ 24" (610 mm)	6.82	----
6 mil polyethylene vapour barrier	----	----
Gypsum Wall Board, 1/2" (12.7 mm) thick	0.45	0.45
Inside Air Film	0.68	0.68
R-value Sub-Totals	**14.37**	**26.55**
% Area of Each Component	**19%**	**81%**
R_{eff} (RSI_{eff})	**R-22.9 (RSI-4.03)**	

Zone 2 Wall Construction		
Compliance Package A, D-H & L-M	**R_F Through Stud**	**R_C Through Cavity**
Outside Air Film	0.17	0.17
Vinyl Cladding	0.62	0.62
DuroFoam Insulation, 2.5" (64 mm) thick	***9.37***	***9.37***
Stud Cavity Insulation	----	***19.00***
2 x 6 Wood Stud @ 24" (610 mm)	6.92	----
6 mil polyethylene vapour barrier	----	----
Gypsum Wall Board, 1/2" (12.7 mm) thick	0.45	0.45
Inside Air Film	0.68	0.68
R-value Sub-Totals	**18.22**	**30.30**
% Area of Each Component	**20%**	**80%**
R_{eff} (RSI_{eff})	**R-26.8 (RSI-4.71)**	

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 5 – Minimum Ratio Outboard to Inboard R-value Based Upon Climatic Data from 2012 OBC, Supplementary Standard SB-1, Table 1.2

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

Calculate the ***ratio of outboard to inboard thermal resistance*** by dividing the total R-value of all components outboard of the inner face of the DuroFoam insulation by the total thermal resistance of all components inboard of the DuroFoam insulation. A sample calculation is provided in Table 6 below using the wall construction as per Table 4.

Table 6 - Ratio of Outboard to Inboard Insulation

OBC Zone 1 DuroFoam Insulation System (Less than 5000 Celsius Degree-Days)			
Outboard Insulation Components	R-value	Inboard Insulation Components	R-value
Outside Air Film	0.17	Stud cavity insulation	19.00
Vinyl Cladding	0.62	Gypsum Wall Board, 1/2" (12.7 mm)	0.45
DuroFoam Insulation, 1 ½" (38 mm) thick	5.63	Inside Air Film	0.68
Total Outboard R-value	**6.42**	**Total Inboard R-value**	**20.13**
Ratio of Outboard to Inboard R-value		**R-6.42/R-20.13**	**0.32**

OBC Zone 2 DuroFoam Insulation System (5000 or more Celsius Degree-Days)			
Outboard Insulation Components	R-value	Inboard Insulation Components	R-value
Outside air film	0.17	Stud cavity insulation	19.00
Vinyl cladding	0.62	Gypsum Wall Board, 1/2" (12.7 mm)	0.45
DuroFoam Insulation, 2 ½" (64 mm) thick	9.37	Inside Air Film	0.68
Total Outboard R-value	**10.17**	**Total Inboard R-value**	**20.13**
Ratio of Outboard to Inboard R-value		**R-10.17/R-20.13**	**0.51**

Based upon the calculations above, the addition of DuroFoam insulation to a wall assembly with cavity insulation per construction provided in Table 4 of this bulletin would be acceptable for use in Zone 1 and 2 building locations.