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Product Information Bulletin

DuroFoam® Plus Insulation for Radiant Floor Heating Systems

DuroFoam® Plus insulation is an expanded polystyrene (EPS) insulation that can be used as the insulation component in radiant floor heating systems. ***DuroFoam Plus*** insulation decreases heat loss to ground, allows uniform heat distribution to the floor area above and ensures the floor area will be warmed faster. Table 1 provides ***DuroFoam Plus*** insulation material properties as per CAN/ULC-S701[1].

Table 1 – *DuroFoam Plus* Insulation Material Properties

Material Property	ASTM Test Method	Units	Values
Thermal Resistance *Minimum RSI per 25 mm (R per inch)*	C518	$m^2 \cdot {}^oC/W$ $(ft^2 \cdot h \cdot {}^oF/BTU)$	0.70 (4.04)
Compressive Resistance *Minimum @ 10% Deformation*	D1621	kPa (psi)	110 (16)
Flexural Strength *Minimum*	C203	kPa (psi)	240 (35)
Water Vapour Permeance[2] *Maximum*	E96	$ng/(Pa \cdot s \cdot m^2)$ (Perms)	30 (0.5)
Water Absorption[3] *Maximum*	D2842	% By volume	4.0
Dimensional Stability *Maximum, 7 Days @ 70 ± 2°C (158 ± 4°F)*	D2126	% Linear Change	1.5
Limiting Oxygen Index *Minimum*	D2863	%	24

1. ***DuroFoam Plus*** insulation properties are third party certified to CAN/ULC-S701, ***Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering***, under a certification program administered by Intertek and listed by the Canadian Construction Materials Centre (CCMC) under evaluation listing number 12425-L (Type 2).
2. WVP values quoted are maximum values for 25-mm thick samples with natural skins intact. Lower values will result for thicker materials.
3. The water absorption laboratory test method involves complete submersion under a head of water for 96 hours. The water absorption value above is applicable to specific end-use design requirements only to the extent that the end-use conditions are similar to test method requirements.

Canadian Codes – Energy Efficiency Requirements

Division B, Part 9, Section 9.36 of the National Building Code of Canada 2010 (NBC 2010), 2012 British Columbia Building Code (2012 BCBC) and 2014 Alberta Building Code (2014 ABC) 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. Table 2 provides minimum ***effective thermal resistance*** (**RSI_{eff}/R_{eff}**) requirements as per NBC 2010, 2012 BCBC, 2014 ABC, Tables 9.36.2.8.A. and 9.36.2.8.B. for heated slabs below grade or in contact with the ground.

Table 2 – Minimum RSI_{eff}/R_{eff} for Below-Grade Heated Floors in Contact with Ground

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 - $m^2 \cdot {}^\circ C/W$	2.32	2.32	2.32	2.84	2.84	2.84
R-value - $ft^2 \cdot hr \cdot {}^\circ F/BTU$	13.2	13.2	13.2	16.1	16.1	16.1

Table 3 provides annual heating degree days and applicable climate zones for a number of building locations In British Columbia, Alberta, Saskatchewan and Manitoba as per NBC 2010, 2012 BCBC and 2014 ABC, Division B, Appendix C.

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

Location	HDD	Zone	Location	HDD	Zone	Location	HDD	Zone
British Columbia			**Alberta**			Saskatoon	5700	7a
Victoria	2650	4	Lethbridge	4500	6	Yorkton	6000	7b
Abbotsford	2860	4	Medicine Hat	4540	6	Prince Albert	6100	7b
Vancouver	2950	4	High River	4900	6	Hudson Bay	6280	7b
Comox	3100	5	Calgary	5000	7a	Nipawin	6300	7b
Kelowna	3400	5	Edmonton	5120	7a	Uranium City	7500	8
Kamloops	3450	5	Grande Prairie	5790	7a	**Manitoba**		
Whistler	4180	6	Athabasca	6000	7b	Morden	5400	7a
Cranbrook	4400	5	Peace River	6050	7b	Winnipeg	5670	7a
Prince George	4720	6	Fort McMurray	6250	7b	Steinbach	5700	7a
Smithers	5040	7a	Fort Chipewayan	7100	8	Swan River	6100	7b
Mackenzie	5550	7a	Rainbow Lake	7200	8	Flin Flon	6440	7b
Fort St. John	5750	7a	**Saskatchewan**			The Pas	6480	7b
Dease Lake	6730	7b	Moose Jaw	5170	7a	Thompson	7600	8
Fort Nelson	6710	7b	Regina	5600	7a	Churchill	8950	8

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.

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

Tables 4 and 5 provides examples of basement slab construction using ***DuroFoam Plus*** insulation installed as a continuous insulation layer beneath the basement slab to meet minimum **RSI_{eff}/R_{eff}** requirements as per Table 2 Because ***DuroFoam Plus*** insulation is installed beneath the heated basement slab, the insulation is installed as a continuous layer. The calculation below does not include the additional RSI/R that would be added for any floor finishes.

Table 4 – RSI_{eff} (R_{eff}) Calculation - Climate Zones 4, 5 and 6

System Description	RSI_{eff}	R_{eff}
Horizontal Air Film (above floor)	0.16	0.9
102 mm (4") Concrete Slab	0.04	0.2
76 mm (3") ***DuroFoam Plus*** Insulation	2.13	12.1
Polyethylene moisture barrier	----	----
Total Effective Thermal Resistance	**RSI-2.33**	**R-13.2**

Table 5 – RSI_{eff} (R_{eff}) Calculation - Climate Zones 7a, 7b and 8

System Description	RSI_{eff}	R_{eff}
Horizontal Air Film (above floor)	0.16	0.9
102 mm (4") Concrete Slab	0.04	0.2
102 mm (4") ***DuroFoam Plus*** Insulation	2.84	16.2
Polyethylene moisture barrier	----	----
Total Effective Thermal Resistance	**RSI-3.04**	**R-17.3**