

Thermal Values

Roof insulations must perform the basic function of helping to control fluctuations in building interior temperature relative to changing exterior temperatures. By reducing interior temperature fluctuations, the comfort of building inhabitants is improved and the air conditioning or heating costs can be controlled. Several factors affect the selection of design thermal values for insulation materials. The performance of roof insulation is also affected by additional factors relative to application of the system.

Roof Insulation Thermal Values

The thermal values of insulation materials are determined by ASTM standard test methods. ASTM standards C 518 and/or C 177 define specific conditions known as steady-state for determination of a material's thermal properties. In summary, these steady-state conditions for determination of K-factors are:

1. The material must be homogeneous through its thickness.
2. The insulation mean temperature must remain constant during the thermal property measuring process (steady-state condition).
3. The insulation must maintain constant mass during the measuring process.

The result of these measurements is the thermal conductivity or K-factor for the material at the specific mean temperature during measurement. The typical mean temperature used by insulation manufacturers is either 40° F or 75° F. Other mean temperatures may be used but may not be representative of roof temperature conditions in the United States. The R-value or thermal resistance value is determined from the above test measurements using the formula:

$$R = \frac{1}{K \text{ factor}}$$

The R-value is expressed as R per inch for design purposes. Table 1 shows R-values for Siplast Lightweight Insulating Concrete materials and other insulation materials.

Roof Insulation Design

Generally, when a designer specifies an insulation, he or she may request that the roof insulation provide a minimum R-value or, when a sloped system is installed that the insulation meet an average R-value. To assist the designer, manufacturers publish tables of insulation values for various thicknesses or combination of materials used in roof insulation.

The following tables list the insulation values for Siplast Lightweight Insulating Concrete Systems. The tables show a U-value, R-value and C-value for several thicknesses of Siplast Lightweight Insulating Concrete Systems.

A U-value incorporates the total system approach to insulation design. The U-value includes the thermal resistance values for roofing and both inside and outside air films in addition to the insulation material.

The C-factor is similar to the K-factor but it applies only to the total thickness of the insulation material. It does not include air films or roofing materials.

R-value is the reciprocal of the C-value and also applies only to the insulation materials.

Roof Insulation Performance

In-place performance of roof insulations can be significantly different than the expected performance based upon design criteria. The reason for this difference may be some or all of the following:

1. The outside temperature changes so that steady-state design conditions are never created.
2. All insulations contain some moisture which can reduce insulation performance.
3. Systems may be installed with gaps and/or fasteners through the insulation and steel deck, which create thermal shorts or localized conditions of high heat flow.
4. Loss of blowing agents in insulations like isocyanurates reduce their thermal design values with time.

Table 1

R-Values of Roof Deck Components	R/Inch	Definitions
ZIC Insulating Concrete 1:6 Mix, 1"	1.49	Thermal Conductivity (k) the thermal transmission, by conductance only, through a one-inch thickness of homogeneous material. Express as BTU-in./hr. sq. ft. °F.
ZIC 1:4 Mix	1.15	
NVS Concrete, 1"	0.90	Thermal Conductance (C) - similar to thermal conductivity but broader. It applies to any thickness of homogeneous and heterogeneous material. Expressed as BTU/hr. sq. ft. °F.
Insulcel Concrete, 1"	1.30	
Zonocel Concrete, 1"	1.10	Thermal Resistance (R) - the reciprocal of thermal conductance (C). Expressed as °F hr. sq. ft./BTU.
Insulperm Insulating Board, 1"	4.00	
Steel Decking	0.00	Thermal Transmittance (U) – also known as overall heat transfer coefficient. The transmission of the heat through a construction air to air. Express as BTU/hr. sq. ft. °F.
Structural Concrete (140 pcf), 1"	0.08	
Medium Weight Concrete (100 pcf), 1"	0.28	
Glass Fiber Board, 1"	3.70	
Expanded Perlite Board, Organic Bonded, 1"	2.78	
DensDeck, ½"	0.56	
Gypsum Foamboard, ½"	0.45	
Outside Air Film (heat flow up-winter) 15 mph	0.17	
Outside Air Film (heat flow down-summer) 7 ½" mph	0.25	
Inside Air Film (heat flow up-winter)	0.61	
Inside Air Film (heat flow down-summer)	0.92	
Built-Up Roofing	0.33	
Polyisocyanurate: Fiberglass Faced, 1"	5.60	
Poured Gypsum (12.5% wood chips), 1"	0.60	
Extruded Polystyrene (1.8 – 3.5 pcf), 1"	5.00	

Authority for Values: ASHRAE Handbook of Fundamentals, Independent Laboratories, Manufacturer's Literature.
 NRCA Roofing and Waterproofing Manual.

Thermal Values for 1:6 ZIC Designs Over Metal Decks

Thermal Values Based on 2 inches of 1:6 ZIC with or without Insulperm over metal decking

Thickness of Insulperm (Inches)	26 Ga. Metal ---- 15/16" Corrugation				24 Ga. Metal ---- 1-5/16" Corrugation				22 Ga. Metal ---- 1-1/2" B-Decking			
	Weight of Metal, Insulperm, & ZIC (PSF)	U-Factor*		R-Factor	Weight of Metal, Insulperm, & ZIC (PSF)	U-Factor*		R-Factor	Weight of Metal, Insulperm, & ZIC (PSF)	U-Factor*		R-Factor
		No Ceiling				No Ceiling				No Ceiling		
		Heat Flow				Heat Flow				Heat Flow		
	UP	Down		UP	Down		UP	Down		UP	Down	
0"	5.7	0.213	0.197	3.6	6.3	0.205	0.189	3.8	6.4	0.208	0.192	3.7
1"	6.1	0.113	0.109	7.7	6.6	0.111	0.106	7.9	6.8	0.111	0.107	7.9
1-1/2"	6.2	0.093	0.090	9.7	6.7	0.091	0.088	9.9	6.8	0.091	0.088	9.8
2"	6.2	0.079	0.076	11.6	6.8	0.077	0.075	11.8	6.9	0.078	0.075	11.8
2-1/2"	6.3	0.068	0.067	13.5	6.8	0.067	0.065	13.8	7.0	0.068	0.066	13.7
3"	6.3	0.060	0.059	15.4	6.9	0.060	0.058	15.7	7.0	0.060	0.058	15.6
3-1/2"	6.4	0.054	0.053	17.4	7.0	0.053	0.052	17.6	7.1	0.054	0.052	17.6
4"	6.5	0.049	0.048	19.3	7.0	0.048	0.048	19.5	7.2	0.049	0.048	19.5
5"	6.6	0.041	0.041	23.1	7.1	0.041	0.040	23.4	7.3	0.041	0.040	23.3
6"	6.7	0.036	0.035	26.9	7.3	0.035	0.035	27.2	7.4	0.035	0.035	27.2
7"	6.9	0.031	0.031	30.8	7.4	0.031	0.031	31.0	7.5	0.031	0.031	31.0
8"	7.0	0.028	0.028	34.6	7.5	0.028	0.027	34.9	7.7	0.028	0.028	34.8
9"	7.1	0.025	0.025	38.4	7.7	0.025	0.025	38.7	7.8	0.025	0.025	38.6
10"	7.3	0.023	0.023	42.2	7.8	0.023	0.023	42.5	7.9	0.023	0.023	42.4
11"	7.4	0.021	0.021	46.0	7.9	0.021	0.021	46.3	8.1	0.021	0.021	46.3
12"	7.5	0.020	0.019	49.9	8.1	0.020	0.019	50.1	8.2	0.020	0.020	50.1

*Includes air films and roofing membrane

Notes:

1. ZIC properties are based on the material at minimum dry density. The thermal conductivity data is derived from independent testing of materials in accordance with ASTM Specification C 177. Thermal conductivity of roof insulation components is based on 40° F mean temperature. U-factors are based on series-parallel heat flow calculations defined in the ASHRAE Handbook of Fundamentals and are shown in constant thickness insulation. All values shown are intended only as guidelines. Insulation performance for all materials and/or systems is affected by building environment, installation and design procedures which may cause variations from calculated values.

2. A roofing membrane will add the following typical weights to the system weight listed above:

Modified Bitumen	2 pounds per sf
4 ply built-up roof with gravel	6 pounds per sf
Mechanically fastened single ply	0.5 pounds per sf

Thermal Values for 1:4 ZIC Designs Over Metal Decks

Thermal Values Based on 2 inches of 1:4 ZIC with or without Insulperm over metal decking

Thickness of Insulperm (Inches)	26 Ga. Metal ---- 15/16" Corrugation				24 Ga. Metal ---- 1-5/16" Corrugation				22 Ga. Metal ---- 1-1/2" B-Decking			
	Weight of Metal, Insulperm, & ZIC (PSF)	U-Factor*		R- Factor	Weight of Metal, Insulperm, & ZIC (PSF)	U-Factor*		R- Factor	Weight of Metal, Insulperm, & ZIC (PSF)	U-Factor*		R- Factor
		No Ceiling				No Ceiling				No Ceiling		
		Heat Flow				Heat Flow				Heat Flow		
		UP	Down			UP	Down			UP	Down	
0"	7.6	0.258	0.234	2.8	8.3	0.248	0.226	2.9	8.3	0.252	0.229	2.9
1"	8.1	0.126	0.120	6.8	8.7	0.123	0.118	7.0	8.8	0.124	0.118	7.0
1-1/2"	8.1	0.102	0.098	8.7	8.8	0.100	0.096	8.9	8.9	0.100	0.096	8.9
2"	8.2	0.085	0.082	10.7	8.9	0.084	0.081	10.8	9.0	0.084	0.081	10.8
2-1/2"	8.3	0.073	0.071	12.6	9.0	0.072	0.070	12.8	9.0	0.072	0.070	12.7
3"	8.4	0.064	0.063	14.4	9.0	0.064	0.062	14.6	9.1	0.064	0.062	14.6
3-1/2"	8.4	0.057	0.056	16.3	9.1	0.057	0.055	16.5	9.2	0.057	0.056	16.5
4"	8.5	0.052	0.051	18.2	9.2	0.051	0.050	18.4	9.3	0.051	0.050	18.4
5"	8.7	0.043	0.043	22.0	9.3	0.043	0.042	22.2	9.4	0.043	0.042	22.2
6"	8.8	0.037	0.037	25.7	9.5	0.037	0.036	26.0	9.6	0.037	0.036	25.9
7"	9.0	0.033	0.032	29.8	9.7	0.032	0.032	29.7	9.7	0.033	0.032	29.7
8"	9.1	0.029	0.029	33.2	9.8	0.029	0.029	33.5	9.9	0.029	0.029	33.4
9"	9.3	0.026	0.026	37.0	10.0	0.026	0.026	37.2	10.0	0.026	0.026	37.2
10"	9.4	0.024	0.024	40.7	10.1	0.024	0.024	40.9	10.2	0.024	0.024	40.9
11"	9.6	0.022	0.022	44.5	10.3	0.022	0.022	44.7	10.3	0.022	0.022	44.6
12"	9.7	0.020	0.020	48.2	10.4	0.020	0.020	48.4	10.5	0.020	0.020	48.4

*Includes air films and roofing membrane

Notes:

- ZIC properties are based on the material at minimum dry density. The thermal conductivity data is derived from independent testing of materials in accordance with ASTM Specification C 177. Thermal conductivity of roof insulation components is based on 40° F mean temperature. U-factors are based on series-parallel heat flow calculations defined in the ASHRAE [Handbook of Fundamentals](#) and are shown in constant thickness insulation. All values shown are intended only as guidelines. Insulation performance for all materials and/or systems is affected by building environment, installation and design procedures which may cause variations from calculated values.

- A roofing membrane will add the following typical weights to the system weight listed above:

Modified Bitumen	2 pounds per sf
4 ply built-up roof with gravel	6 pounds per sf
Mechanically fastened single ply	0.5 pounds per sf

Thermal Values for 1:6 ZIC Concrete

Design Over Type N-24 Metal Deck

Thermal Values Based on 2 inches of 1:6 ZIC Concrete with or without Insulperm over metal decking

Thickness of Insulperm (Inches)	22 Ga. Metal Type N 3" Profile				R- Factor
	Weight of Metal, Insulperm, & ZIC (PSF)	U-Factor*		Heat Flow	
		No Ceiling			
		Heat Flow			
		UP	Down		
0"	7.3	0.205	0.188	3.8	
1"	7.7	0.109	0.104	8.1	
1-1/2"	7.8	0.089	0.086	10.1	
2"	7.8	0.076	0.074	12.0	
2-1/2"	7.9	0.066	0.064	14.0	
3"	7.9	0.059	0.057	16.0	
3-1/2"	8.0	0.053	0.052	17.9	
4"	8.1	0.048	0.047	19.8	
5"	8.2	0.040	0.040	23.7	
6"	8.3	0.035	0.034	27.5	
7"	8.5	0.031	0.030	31.4	
8"	8.6	0.028	0.027	35.2	
9"	8.7	0.025	0.025	39.0	
10"	8.9	0.023	0.023	42.9	
11"	9.0	0.021	0.021	46.7	
12"	9.1	0.019	0.019	50.5	

**Includes air films and roofing membrane*

Notes:

1. ZIC properties are based on the material at minimum dry density. The thermal conductivity data is derived from independent testing of materials in accordance with ASTM Specification C 177. Thermal conductivity of roof insulation components is based on 40° F mean temperature. U-factors are based on series-parallel heat flow calculations defined in the ASHRAE Handbook of Fundamentals and are shown in constant thickness insulation. All values shown are intended only as guidelines. Insulation performance for all materials and/or systems is affected by building environment, installation and design procedures which may cause variations from calculated values.
2. A roofing membrane will add the following typical weights to the system weight listed above:

Modified Bitumen	2 pounds per sf
4 ply built-up roof with gravel	6 pounds per sf
Mechanically fastened single ply	0.5 pounds per sf

**Thermal Values for NVS Concrete
Designs Over Concrete and Reroofing Substrates**

Thickness of Insulperm (Inches)	Values Based on 1 Inch of NVS Concrete					Values Based on 1.5 Inches of NVS Concrete				
	Dry Weight of Insulperm & NVS Concrete (PSF)	Wet Weight of Insulperm & NVS Concrete (PSF)	U - Factor		R- Factor	Dry Weight of Insulperm & NVS Concrete (PSF)	Wet Weight of Insulperm & NVS Concrete (PSF)	U - Factor		R- Factor
			No Ceiling					No Ceiling		
			Heat Flow					Heat Flow		
			UP	DOWN				UP	DOWN	
0"	2.9	5.7	0.498	0.417	0.9	4.4	8.5	0.407	0.351	1.4
1"	3.4	6.6	0.168	0.158	4.8	4.9	9.5	0.156	0.147	5.3
1-1/2"	3.5	6.7	0.128	0.122	6.7	5.0	9.6	0.121	0.115	7.2
2"	3.6	6.9	0.103	0.099	8.6	5.1	9.7	0.099	0.095	9.1
2-1/2"	3.7	7.0	0.087	0.084	10.4	5.1	9.8	0.083	0.081	10.9
3"	3.8	7.1	0.075	0.073	12.3	5.2	9.9	0.072	0.070	12.8
3-1/2"	3.9	7.2	0.066	0.064	14.1	5.3	10.1	0.064	0.062	14.6
4"	3.9	7.4	0.059	0.057	16.0	5.4	10.2	0.057	0.056	16.4
5"	4.1	7.6	0.048	0.047	19.6	5.6	10.4	0.047	0.050	20.1
6"	4.3	7.8	0.041	0.040	23.3	5.7	10.7	0.040	0.042	23.8
7"	4.4	8.1	0.036	0.035	26.9	5.9	10.9	0.035	0.036	27.4
8"	4.6	8.3	0.032	0.031	30.6	6.0	11.2	0.031	0.032	31.1
9"	4.7	8.6	0.028	0.028	34.2	6.2	11.4	0.028	0.029	34.7
10"	4.9	8.8	0.026	0.025	37.8	6.4	11.7	0.025	0.026	38.4
11"	5.1	9.1	0.024	0.023	41.5	6.5	11.9	0.023	0.024	42.0
12"	5.2	9.3	0.022	0.021	45.1	6.7	12.1	0.021	0.022	45.6

**Includes air films and roofing membrane*

Notes:

1. NVS Insulating Concrete properties are based on the material at minimum dry density. The thermal conductivity data is derived from independent testing of materials in accordance with ASTM Specification C 177. Thermal conductivity of roof insulation components is based on 40° F mean temperature and NVS Concrete is based on 75° F mean temperature. U-factors are based on series-parallel heat flow calculations defined in the ASHRAE Handbook of Fundamentals and are shown in constant thickness insulation. All values shown are intended only as guidelines. Insulation performance for all materials and/or systems is affected by building environment, installation and design procedures which may cause variations from calculated values.

2. A roofing membrane will add the following typical weights to the system weight listed above:

Modified Bitumen	2 pounds per sf
4 ply built-up roof with gravel	6 pounds per sf
Mechanically fastened single ply	0.5 pounds per sf

When using NVS in a reproofing or recover application, Siplast strongly recommends that a registered structural engineer evaluate the design and verify that the existing structure is capable of supporting the added weight of the new assembly.

**Thermal Values for Zonocel Concrete
Designs Over Metal Decks**

Thermal Values Bases on 2 inches of Zonocel Concrete with or without Insulperm over metal decking

Thickness of Insulperm (Inches)	26 Ga. Metal ---- 15/16" Corrugation				24 Ga. Metal ---- 1-5/16" Corrugation				22 Ga. Metal ---- 1-1/2" B-Decking			
	Weight of Metal, Insulperm, & Zonocel Concrete (PSF)	U-Factor*		R- Factor	Weight of Metal, Insulperm, & Zonocel Concrete (PSF)	U-Factor*		R- Factor	Weight of Metal, Insulperm, & Zonocel Concrete (PSF)	U-Factor*		R- Factor
		No Ceiling				No Ceiling				No Ceiling		
		Heat Flow				Heat Flow				Heat Flow		
	UP	Down		UP	Down		UP	Down		UP	Down	
0"	7.4	0.266	0.241	2.7	8.0	0.256	0.232	2.8	8.1	0.026	0.026	2.7
1"	7.8	0.128	0.122	6.7	8.5	0.125	0.120	6.9	8.6	0.126	0.120	6.8
1-1/2"	7.9	0.103	0.099	8.6	8.6	0.101	0.097	8.8	8.7	0.102	0.098	8.7
2"	8.0	0.086	0.083	10.5	8.7	0.085	0.082	10.7	8.7	0.085	0.082	10.7
2-1/2"	8.1	0.074	0.072	12.4	8.7	0.073	0.071	12.6	8.8	0.073	0.071	12.6
3"	8.1	0.065	0.063	14.3	8.8	0.064	0.063	14.5	8.9	0.064	0.063	14.4
3-1/2"	8.2	0.058	0.057	16.2	8.9	0.057	0.056	16.4	9.0	0.057	0.056	16.3
4"	8.3	0.052	0.051	18.1	9.0	0.052	0.051	18.3	9.0	0.052	0.051	18.2
5"	8.4	0.044	0.043	21.8	9.1	0.043	0.043	22.0	9.2	0.043	0.043	22.0
6"	8.6	0.038	0.037	25.6	9.3	0.037	0.037	25.8	9.3	0.037	0.037	25.7
7"	8.7	0.033	0.032	29.3	9.4	0.033	0.032	29.5	9.5	0.033	0.032	29.5
8"	8.9	0.029	0.029	33.0	9.6	0.029	0.029	33.2	9.6	0.029	0.029	33.2
9"	9.0	0.026	0.026	36.7	9.7	0.026	0.026	37.0	9.8	0.026	0.026	36.9
10"	9.2	0.024	0.024	40.5	9.9	0.024	0.024	40.7	9.9	0.024	0.024	40.6
11"	9.3	0.022	0.022	44.2	10.0	0.022	0.022	44.4	10.1	0.022	0.022	44.4
12"	9.5	0.020	0.020	47.9	10.2	0.020	0.020	48.1	10.2	0.020	0.020	48.1

**Includes air films and roofing membrane*

Notes:

1. Zonocel Concrete properties are based on the material at minimum dry density. The thermal conductivity data is derived from independent testing of materials in accordance with ASTM Specification C 177. Thermal conductivity of roof insulation components is based on 40° F mean temperature. U-factors are based on series-parallel heat flow calculations defined in the ASHRAE Handbook of Fundamentals and are shown in constant thickness insulation. All values shown are intended only as guidelines. Insulation performance for all materials and/or systems is affected by building environment, installation and design procedures which may cause variations from calculated values.

2. A roofing membrane will add the following typical weights to the system weight listed above:

Modified Bitumen	2 pounds per sf
4 ply built-up roof with gravel	6 pounds per sf
Mechanically fastened single ply	0.5 pounds per sf

**Thermal Values for Insulcel Concrete
Designs Over Concrete and Reroofing Substrates**

Thickness of Insulperm (Inches)	Values Based on 2 Inches of Insulcel Concrete					Values Based on 2.5 Inches of Insulcel Concrete				
	Dry Weight of Insulperm & Insulcel Concrete (PSF)	Wet Weight of Insulperm & Insulcel Concrete (PSF)	U - Factor		R- Factor	Dry Weight of Insulperm & Insulcel Concrete (PSF)	Wet Weight of Insulperm & Insulcel Concrete (PSF)	U - Factor		R- Factor
			No Ceiling					No Ceiling		
			Heat Flow					Heat Flow		
			UP	DOWN				UP	DOWN	
0"	5.0	8.0	0.270	0.244	2.6	6.3	10.0	0.229	0.211	3.3
1"	5.5	8.7	0.129	0.123	6.6	6.7	10.7	0.119	0.114	7.3
1-1/2"	5.5	8.8	0.103	0.099	8.6	6.8	10.8	0.097	0.093	9.2
2"	5.6	8.9	0.086	0.083	10.5	6.9	10.9	0.082	0.079	11.1
2-1/2"	5.7	9.0	0.074	0.072	12.4	6.9	11.0	0.071	0.069	13.1
3"	5.8	9.1	0.065	0.063	14.3	7.0	11.1	0.062	0.061	15.0
3-1/2"	5.8	9.2	0.058	0.057	16.2	7.1	11.2	0.056	0.054	16.9
4"	5.9	9.3	0.052	0.051	18.1	7.2	11.3	0.050	0.049	18.8
5"	6.1	9.5	0.044	0.043	21.9	7.3	11.5	0.042	0.042	22.6
6"	6.2	9.7	0.037	0.037	25.7	7.5	11.7	0.036	0.036	26.3
7"	6.4	9.9	0.033	0.032	29.4	7.6	11.9	0.032	0.032	30.1
8"	6.5	10.1	0.029	0.029	33.2	7.8	12.1	0.029	0.028	33.9
9"	6.7	10.3	0.026	0.026	37.0	7.9	12.3	0.026	0.026	37.7
10"	6.8	10.5	0.024	0.024	40.8	8.1	12.5	0.023	0.023	41.5
11"	7.0	10.6	0.022	0.022	44.6	8.2	12.6	0.022	0.021	45.2
12"	7.1	10.8	0.020	0.020	48.3	8.4	12.8	0.020	0.020	49.0

**Includes air films and roofing membrane*

Notes:

1. Insulcel Insulating Concrete properties are based on the material at minimum dry density. The thermal conductivity data is derived from independent testing of materials in accordance with ASTM Specification C 177. Thermal conductivity of roof insulation components is based on 40° F mean temperature. U-factors are based on series-parallel heat flow calculations defined in the ASHRAE Handbook of Fundamentals and are shown in constant thickness insulation. All values shown are intended only as guidelines. Insulation performance for all materials and/or systems is affected by building environment, installation and design procedures which may cause variations from calculated values.

2. A roofing membrane will add the following typical weights to the system weight listed above:

Modified Bitumen	2 pounds per sf
4 ply built-up roof with gravel	6 pounds per sf
Mechanically fastened single ply	0.5 pounds per sf

**Thermal Values for Insulcel Concrete
Designs Over Metal Decks**

Thermal Values Based on 2 inches of Insulcel Concrete with or without Insulperm over metal decking

Thickness of Insulperm (Inches)	26 Ga. Metal ---- 15/16" Corrugation				24 Ga. Metal ---- 1-5/16" Corrugation				22 Ga. Metal ---- 1-1/2" B-Decking			
	Weight of Metal, Insulperm, & Insulcel Concrete (PSF)	U-Factor*		R- Factor	Weight of Metal, Insulperm, & Insulcel Concrete (PSF)	U-Factor*		R- Factor	Weight of Metal, Insulperm, & Insulcel Concrete (PSF)	U-Factor*		R- Factor
		No Ceiling				No Ceiling				No Ceiling		
		UP	Down			UP	Down			UP	Down	
0"	7.4	0.236	0.216	3.1	8.0	0.227	0.208	3.3	8.1	0.231	0.211	3.2
1"	7.8	0.120	0.115	7.2	8.5	0.117	0.112	7.4	8.6	0.118	0.113	7.4
1-1/2"	7.9	0.098	0.094	9.1	8.6	0.096	0.092	9.4	8.7	0.096	0.093	9.3
2"	8.0	0.082	0.080	11.1	8.7	0.081	0.078	11.3	8.7	0.081	0.079	11.2
2-1/2"	8.1	0.071	0.069	13.0	8.7	0.070	0.068	13.2	8.8	0.070	0.068	13.2
3"	8.1	0.063	0.061	14.9	8.8	0.062	0.060	15.1	8.9	0.062	0.060	15.1
3-1/2"	8.2	0.056	0.055	16.8	8.9	0.055	0.054	17.0	9.0	0.055	0.054	17.0
4"	8.3	0.051	0.050	18.7	9.0	0.050	0.049	18.9	9.0	0.050	0.049	18.9
5"	8.4	0.042	0.042	22.5	9.1	0.042	0.041	22.7	9.2	0.042	0.041	22.7
6"	8.6	0.037	0.036	26.3	9.3	0.036	0.036	26.5	9.3	0.036	0.036	26.5
7"	8.7	0.032	0.032	30.1	9.4	0.032	0.031	30.3	9.5	0.032	0.031	30.3
8"	8.9	0.029	0.028	33.9	9.6	0.028	0.028	34.1	9.6	0.028	0.028	34.1
9"	9.0	0.026	0.026	37.6	9.7	0.026	0.025	37.9	9.8	0.026	0.025	37.8
10"	9.2	0.024	0.023	41.4	9.9	0.023	0.023	41.7	9.9	0.023	0.023	41.6
11"	9.3	0.022	0.021	45.2	10.0	0.021	0.021	45.4	10.1	0.022	0.021	45.4
12"	9.5	0.020	0.020	49.0	10.2	0.020	0.020	49.2	10.2	0.020	0.020	49.2

*Includes air films and roofing membrane

Notes:

1. Insulcel Insulating Concrete properties are based on the material at minimum dry density. The thermal conductivity data is derived from independent testing of materials in accordance with ASTM Specification C 177. Thermal conductivity of roof insulation components is based on 40° F mean temperature. U-factors are based on series-parallel heat flow calculations defined in the ASHRAE Handbook of Fundamentals and are shown in constant thickness insulation. All values shown are intended only as guidelines. Insulation performance for all materials and/or systems is affected by building environment, installation and design procedures which may cause variations from calculated values.

2. A roofing membrane will add the following typical weights to the system weight listed above:

Modified Bitumen	2 pounds per sf
4 ply built-up roof with gravel	6 pounds per sf
Mechanically fastened single ply	0.5 pounds per sf