

Insulation Materials Specification Chart from the NIA National Insulation Training Program

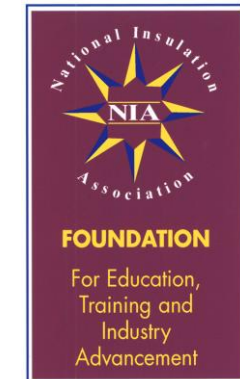
This chart provides the reader with material properties as typically specified in ASTM material specifications and is a guide to performance characteristics but may not be sufficient for writing specifications. This was created by NIA for use by NIA in its training programs and for its members and may not be reproduced by others. Consult the manufacturer for specific properties.

Physical Properties ^{1, 4, 5, 6, 7}	Elastomeric Tube and Sheet	Elastomeric Tube and Sheet – High Temp	Elastomeric Tube and Sheet – Halogen Free	Cellular Glass Block	Cellular Glass Pipe	Polystyrene Board (XPS)	Polystyrene Pipe (XPS)	Polyiso–cyanurate	Phenolic Foam Unfaced	Melamine Foam	Polyolefin Sheet and Tube	Polyimide Foam	Polyimide Foam	Polyimide Rigid Cellular	Physical Properties ^{1, 4, 5, 6, 7}
Type of Material	Cellular	Cellular	Cellular	Cellular	Cellular	Cellular	Cellular	Cellular	Cellular	Cellular	Cellular	Cellular	Cellular	Cellular	Type of Material
ASTM Standard	C534 Grade 1	C534 Grade 2	C534 Grade 3	C552 Grade 6, Type I	C552 Grade 6, Type II	C578 Types VI, V, VI, VII, X, XII, XIII	C578 Type XIII	C591 Grade 2	C1126 Type III	C1410	C1427	C1482 Type I	C1482 Type VI	C1594 Type II, Grade 3, Class I	ASTM Standard
Temp (°F) - Max.	220	350	250	800	800	165	165	300	257	350	200	400	572	600	Temp (°F) - Max.
Temp (°F) - Min.	-297	-297	-297	-450	-450	-65	-320	-297	-290	-40	-150	-328	-328	-423	Temp (°F) - Min.
⁶ Apparent Thermal Conductivity Max. (Btu-in/h ft ² F) at Mean Temperatures of:	(C518 &/or C177)	(C518 &/or C177)	(C518 &/or C177)	(C518 &/or C177)	(C335)	(C518 &/or C177)	(C518 &/or C177)	(C518 &/or C177)	(C518 &/or C177)	(C518)	(C518 & C177)	(C518)	(C518)	(C518 &/or C177)	⁶ Apparent Thermal Conductivity Max. (Btu-in/h ft ² F) at Mean Temperatures of:
-100°F	0.21	0.21	0.21	0.21	0.23	N/A ³	0.181	0.17 – 0.19	0.18 – 0.24	N/A ³	0.29	0.21	0.21	0.066	-100°F
0°F	0.26	0.26	0.26	0.27	0.29	N/A ³	0.221	0.19 – 0.22	0.18 – 0.24	N/A ³	0.33	0.27	0.28	0.138	0°F
75°F	0.28	0.30	0.28	0.31	0.34	0.20 – 0.256	0.256	0.19 – 0.22	0.18 – 0.24	0.27	0.35	0.32	0.34	0.246	75°F
200°F	N/R ³	0.38	N/R ³	0.40	0.43	N/A ³	N/A ³	0.26 – 0.30	0.25 – 0.31	0.41	N/A ³	0.51	0.50	0.396	200°F
400 °F	N/A ³	N/A ³	N/A ³	0.58	0.63	N/A ³	N/A ³	N/A ³	N/A ³	N/A ³	N/A ³	0.82	0.82	0.648	400 °F
600°F	N/A ³	N/A ³	N/A ³	N/A ³	N/A ³	N/A ³	N/A ³	N/A ³	N/A ³	N/A ³	N/A ³	N/A ³	N/A ³	N/A ³	600°F
Compressive Resistance (psi) (C165/C1621) – Min.	N/S ³	N/S ³	N/S ³	60	N/R ³	15 – 100	20	20 – 125	18	N/S ³	N/S ³	0.5 @ 25%	0.5 @ 25%	N/R ³	Compressive Resistance (psi) (C165/C1621) - Min.
Corrosion of Carbon Steel (ASTM C1617)	N/R ³	N/R ³	N/R ³	≤ D.I. Water	≤ D.I. Water	N/S ³	N/S ³	N/S ³	N/R ³	N/R ³	N/S ³	N/R ³	N/R ³	N/R ³	Corrosion of Carbon Steel (ASTM C1617)
Density (lbs/ft ³)	N/R ³	N/R ³	N/R ³	6.12 min	6.12 min	1.2 – 3.0	1.6	1.8 – 6.0	2 – 7.5 min	0.25 – 0.63	2.5 max	0.36 – 0.53	0.35 – 0.55	3.0 max	Density (lbs/ft ³)
Linear Change at Max Temp (C356 / D2126)	7% (C 356)	7% (C 356)	7% (C 356)	N/S ³	N/S ³	2% max (D 2126)	2% max (D 2126)	2% max (D 2126)	2% max (D 2126)	5% max (C 356)	7% max (C 356)	N/S ³	N/S ³	N/S ³	Linear Change at Max Temp (C356 / D2126)
Min. Flexural Strength (psi) Min. (C203)	N/S ³	N/S ³	N/S ³	41	41	40 – 100	45	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	Min. Flexural Strength (psi) Min. (C203)
pH	N/S ³	N/S ³	N/S ³	N/R ³	N/R ³	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	pH
Behavior in a Vertical Tube Furnace (ASTM E136)	N/S ³	N/S ³	N/S ³	Pass	Pass	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	Behavior in a Vertical Tube Furnace (ASTM E136)
Surface Burning Characteristics Max (E84) ⁹ Flame Spread/Smoke Developed	N/R ³	N/R ³	N/R ³	5/0	5/0	N/R ³	N/R ³	N/R ³	25/50 ²	25/50 ²	N/R ³	10/15 ²	10/15 ²	10/15 ²	Surface Burning Characteristics Max (E84) ⁹ Flame Spread/Smoke Developed
Water Vapor Permeability (Perm in) Max (E96) Procedure A or B	0.10 A	0.30 A	0.30 A	0.005 B	0.005 B	1.1 – 2.0 A	2.0 A	2.0 – 4.0 A	5.0 A	N/S ³	0.05 A	N/S ³	N/S ³	8 B	Water Vapor Permeability (Perm in) Max (E96) Procedure A or B
Physical Properties ^{1, 4, 5, 6, 7}	Elastomeric Tube and Sheet	Elastomeric Tube and Sheet – High Temp	Elastomeric Tube and Sheet – Halogen Free	Cellular Glass Block	Cellular Glass Pipe	Polystyrene Board (XPS)	Polystyrene Pipe (XPS)	Polyiso–cyanurate	Phenolic Foam Unfaced	Melamine Foam	Polyolefin Sheet and Tube	Polyimide Foam	Polyimide Foam	Polyimide Rigid Cellular	Physical Properties ^{1, 4, 5, 6, 7}



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Physical Properties ^{1, 4, 5, 6, 7}	Mineral Fiber Pipe	Mineral Fiber Pipe	Mineral Fiber Pipe	Mineral Fiber Blanket	Mineral Fiber Blanket	Mineral Fiber Blanket	Mineral Fiber Blanket	Mineral Fiber Metal Mesh Blanket	Mineral Fiber Board	Mineral Fiber Board	Mineral Fiber Board	Calcium Silicate Pipe and Block	Expanded Perlite Pipe & Block	Micro-porous	Micro-porous	Flexible Aerogel Low Temp	Flexible Aerogel High Temp	Flexible Aerogel Pipe	Flexible Aerogel Dual Temp	Physical Properties ^{1, 4, 5, 6, 7}	
Type of Material	Fibrous	Fibrous	Fibrous	Fibrous	Fibrous	Fibrous	Fibrous	Fibrous	Fibrous	Fibrous	Fibrous	Granular	Granular	Granular	Granular	Granular	Granular	Granular	Granular	Type of Material	
ASTM Standard Specification	C547 Type I	C547 Type II – III & V	C547 Type IV	C553 Type I & II	C553 Type IV	C553 Type V & VI	C553 Type VII	C592 Type I & II	C612 Type 1A – III	C612 Type IV A&B	C612 Type V	C533 Type I	C610	C1676 Type II, Grade 2A Nonhydrophobic	C1676 Type II, Grade 2B Hydrophobic	C1728 Type I, Grade1B	C1728 Type III, Grade1A	C1728 Type III, Grade 2	C1728 Type IV, Grade 1A	ASTM Standard Specification	
Temp (°F) - Max.	850	1200 or 1400(V)	1000	450	850	1000	1200	850 (I) 1200 (II)	450 – 1000	1200	1800	1200	1200	1832	1832	257	1200	1200	482	Temp (°F) - Max.	
Temp (°F) - Min.	0	0	0	0	0	0	0	0	0	0	80	80	80	176	176	-321	75	75	-321	Temp (°F) - Min.	
Apparent Thermal Conductivity Test Method in the Stated Standard Specification	(C335)	(C335)	(C335)	(C518 &/or C177)	(C518 &/or C177)	(C518 &/or C177)	(C518 &/or C177)	(C518 &/or C177)	(C518 &/or C177)	(C518 &/or C177)	(C518 &/or C177)	(C335)	(C518 &/or C177)	(C518, C177 &/or C201)	(C518, C177 &/or C201)	C177	C177	C335	C177	Apparent Thermal Conductivity Test Method in the Stated Standard Specification	
⁶ Apparent Thermal Conductivity Max. (Btu-in/h ft ² F) at Mean Temperatures of:																				⁶ Apparent Thermal Conductivity Max. (Btu-in/h ft ² F) at Mean Temperatures of:	
	⁶ Apparent Thermal Conductivity Max. (Btu-in/h ft ² F) at Mean Temperatures of:																				
-100°F	N/A ³	N/A ³	N/A ³	N/A ³	N/A ³	N/A ³	N/A ³	N/A ³	N/A ³	N/A ³	N/A ³	N/A ³	N/A ³	N/S ³	N/S ³	0.10	N/A ³	N/A ³	0.12	-100°F	
0°F	N/A ³	N/A ³	N/A ³	N/A ³	N/A ³	N/A ³	N/A ³	N/A ³	N/A ³	N/A ³	N/A ³	N/A ³	N/A ³	N/S ³	N/S ³	0.11	N/A ³	N/A ³	0.14	0°F	
75°F	0.24	0.24	0.24	0.36 (I) 0.31 (II)	0.25	0.31 (V) 0.26(VI)	0.25	0.25	0.25 – 0.26	0.24 – 0.25	0.45	N/A ³	N/A ³	N/S ³	N/S ³	0.12	0.14	0.16	0.15	75°F	
200°F	0.31	0.31	0.31	0.55 (I) 0.44 (II)	0.34	0.44 (V) 0.36(VI)	0.34	0.34	0.34 – 0.36	0.30 – 0.34	0.47	0.45	0.53	0.211	0.211	0.13	0.16	0.18	0.16	200°F	
400 °F	0.51	0.45	0.45	N/R ³	N/R ³	0.89 (V) 0.60(VI)	0.55	0.55 (I) 0.53 (II)	0.55	0.42 – 0.55	0.52	0.55	0.64	0.242	0.242	N/A ³	0.20	0.24	0.20	400 °F	
600°F	N/R ³	0.65	0.65	N/A ³	N/R ³	1.50 (V) 1.05(VI)	0.89	N/R (I) 0.75 (II)	0.90	0.63 – 0.85	0.59	0.66	0.75	0.272	N/A ³	N/A ³	0.25	0.33	N/S	600°F	
Compressive Resistance (psi) (C165/C1621) - Min.	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	0.083 – 0.174 @10%	0.347 @ 10%	6.94 @ 10%	100 @ 5%	70 @ 5%	7.3 @ 10%	3.6 @ 10%	5 @ 10%	3 @ 10%	3 @ 10%	5 @ 10%	Compressive Resistance (psi) (C165/C1621) - Min.	
Corrosion of Carbon Steel (ASTM C1617)	≤5 ppm Cl ⁻	≤5 ppm Cl ⁻	≤5 ppm Cl ⁻	≤5 ppm Cl ⁻	≤5 ppm Cl ⁻	≤5 ppm Cl ⁻	≤5 ppm Cl ⁻	≤5 ppm Cl ⁻	≤5 ppm Cl ⁻	≤5 ppm Cl ⁻	≤5 ppm Cl ⁻	< DI	< DI	N/R ³	N/R ³	< 5ppm CL	< 5ppm CL	< 5ppm CL	< 5ppm CL	Corrosion of Carbon Steel (ASTM C1617)	
Density (lbs/ft ³)	N/R ³	N/R ³	N/R ³	6 (max) ¹¹	8 (max) ¹¹	10 (max) ¹¹	12 (max) ¹¹	10 (Type I) 12 (Type II) max	8-10 (max) ¹¹	12	20	15 (max)	15 (max)	11.9 – 18.7	11.9 – 18.7	5 – 11.2	10 – 15	10 – 15	10 – 15	Density (lbs/ft ³)	
Linear Change at Max Temp (C356 / D2126)	2% max (C 356)	2% max (C 356)	2% max (C 356)	N/S ³	N/S ³	N/S ³	N/S ³	4% max (C 356)	2% max (C 356)	2% max (C 356)	4% max (C 356)	2% (C 356)	2 – 8% max (C 356)	2 – 10% max	2 – 10% max	<2%	< 2%	< 2%	< 2%	Linear Change at Max Temp (C356 / D2126)	
Min. Flexural Strength (psi) Min. (C203)	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	50	45	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	Min. Flexural Strength (psi) Min. (C203)	
pH	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	pH	
Behavior in a Vertical Tube Furnace (ASTM E136)	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	Pass	N/S ³	N/S ³	N/S ³	Pass	Pass	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	Behavior in a Vertical Tube Furnace (ASTM E136)	
Surface Burning Characteristics Max (E84) ⁹ Flame Spread/Smoke Developed	25/50	25/50	25/50	25/50	25/50	25/50	25/50	25/50	25/50	25/50	25/50	25/50	0/0	0/5	0/10	0/10	25/50	5/10	5/10	25/50	Surface Burning Characteristics Max (E84) ⁹ Flame Spread/Smoke Developed
Water Vapor Permeability (Perm in) Max (E96) Procedure A or B	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	N/S ³	Water Vapor Permeability (Perm in) Max (E96) Procedure A or B	
Physical Properties ^{1, 4, 5, 6, 7}	Mineral Fiber Pipe	Mineral Fiber Pipe	Mineral Fiber Pipe	Mineral Fiber Blanket	Mineral Fiber Blanket	Mineral Fiber Blanket	Mineral Fiber Blanket	Mineral Fiber Metal Mesh Blanket	Mineral Fiber Board	Mineral Fiber Board	Mineral Fiber Board	Calcium Silicate Pipe and Block	Expanded Perlite Pipe & Block	Micro-porous	Micro-porous	Flexible Aerogel Low Temp	Flexible Aerogel High Temp	Flexible Aerogel Pipe	Flexible Aerogel Dual Temp	Physical Properties ^{1, 4, 5, 6, 7}	

Notes:

- All properties are for the generic material type and will vary by grade and by manufacturer. All properties should be verified with individual manufacturers. Properties that are not stated may or may not be an indication that a material is not appropriate for applications depending on that property. This should be verified with the specific manufacturer.
- Surface burning characteristics may vary with thickness and/or formulation. See the manufacturer's data sheets.
- The following are the definitions used in this chart for special situations:
N/A = Not applicable—The mean temperature for thermal conductivity is outside the scope of the ASTM standard for this material classification.
N/S = Not stated—The ASTM standard makes no mention of this property.
N/R = Not required—The ASTM Standard for this material classification does NOT have a required performance for this property but the ASTM standard does discuss this property or another material classification within the standard has a requirement for this property.
- All properties listed above are for the core insulation material only and may not be indicative of the performance of an insulation system including vapor retarders, adhesives and sealants.
- Many materials can be used for applications outside of the ranges listed above but additional precautions must be followed. The specific manufacturer should be consulted for detailed recommendations.
- Some values such as specific thermal conductivities at various mean temperatures may be interpolated or extrapolated by a small amount.
- This chart has been established for products with current ASTM standards.
- Data found in this chart is generally derived from ASTM Standards. Some exceptions were made to provide more complete information on materials for better comparison purposes. In those cases, the information was derived by consensus of manufacturers and the NIA TIC Committee approval. This table does not contain all ASTM data points.
- For guidance on Surface Burning Characteristics testing of products used in Canada, refer to the appropriate ASTM product specification for requirements or use CAN/ULC-S102, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- In ASTM E96, Procedure A is the dry cup method and Procedure B is the wet cup method.
- These values are for design purposes only.