Table 3 .... Thermal Conductances and Resistances of a Plane[a] Air Space[a]

Position of Air Space	Direction of Heat Flow	Air Space: Mean Temp,[a] F	Air Space: Temp Diff,[a] F deg	¾ in. Thickness: Thermal Conductance — C: Value of E[c,d] 0.03	0.05	0.2	0.5	0.82	¾ in. Thickness: Thermal Resistance[e] — R: Value of E[d] 0.03	0.05	0.2	0.5	0.82
Horiz.	Up	90	10	0.42	0.44	0.61	0.96	1.32	2.39	2.26	1.63	1.05	0.76
		50	30	0.58	0.60	0.73	1.0	1.24	1.73	1.67	1.37	1.0	0.78
		50	10	0.43	0.45	0.59	0.86	1.15	2.33	2.23	1.71	1.16	0.87
		0	20	0.55	0.56	0.66	0.86	1.07	1.83	1.79	1.53	1.16	0.93
		0	10	0.45	0.46	0.56	0.76	0.98	2.23	2.16	1.78	1.31	1.02
		−50	20	0.58	0.59	0.66	0.80	0.95	1.73	1.71	1.53	1.25	1.05
		−50	10	0.47	0.48	0.55	0.70	0.85	2.11	2.07	1.81	1.44	1.18
45° Slope	Up	90	10	0.33	0.36	0.53	0.87	1.24	3.01	2.81	1.90	1.16	0.81
		50	30	0.50	0.51	0.65	0.92	1.20	2.02	1.95	1.54	1.09	0.83
		50	10	0.34	0.36	0.50	0.77	1.06	2.94	2.78	2.02	1.30	0.94
		0	20	0.46	0.48	0.58	0.78	0.99	2.16	2.07	1.74	1.29	1.01
		0	10	0.36	0.37	0.47	0.67	0.88	2.81	2.71	2.13	1.49	1.13
		−50	20	0.50	0.51	0.58	0.72	0.88	1.99	1.96	1.72	1.38	1.14
		−50	10	0.38	0.39	0.46	0.60	0.75	2.66	2.59	2.19	1.67	1.33
Vertical	Horiz.	90	10	0.28	0.31	0.48	0.82	1.19	3.54	3.23	2.10	1.22	0.84
		50	30	0.34	0.36	0.49	0.76	1.04	2.95	2.80	2.04	1.32	0.96
		50	10	0.27	0.29	0.42	0.70	0.99	3.72	3.48	2.38	1.43	1.01
		0	20	0.31	0.32	0.42	0.62	0.84	3.23	3.10	2.38	1.60	1.19
		0	10	0.25	0.27	0.37	0.57	0.78	3.96	3.76	2.73	1.78	1.28
		−50	20	0.32	0.33	0.40	0.54	0.69	3.15	3.06	2.51	1.85	1.44
		−50	10	0.24	0.25	0.32	0.46	0.61	4.23	4.07	3.16	2.18	1.64
45° Slope	Down	90	10	0.29	0.31	0.48	0.82	1.19	3.51	3.24	2.09	1.21	0.84
		50	30	0.29	0.31	0.44	0.71	0.99	3.47	3.27	2.27	1.41	1.01
		50	10	0.26	0.28	0.42	0.69	0.98	3.82	3.57	2.40	1.45	1.02
		0	20	0.26	0.27	0.37	0.58	0.79	3.83	3.65	2.67	1.74	1.27
		0	10	0.23	0.25	0.35	0.55	0.76	4.28	4.04	2.83	1.88	1.31
		−50	20	0.25	0.26	0.33	0.47	0.62	4.05	3.90	3.06	2.13	1.61
		−50	10	0.21	0.22	0.29	0.43	0.58	4.84	4.63	3.48	2.33	1.72

Position of Air Space	Direction of Heat Flow	Air Space: Thickness, in.	Air Space: Mean Temp, F	¾ inch Thickness[b]: Thermal Conductance — C: Value of E 0.03	0.05	0.2	0.5	0.82	¾ inch Thickness[b]: Thermal Resistance — R: Value of E 0.03	0.05	0.2	0.5	0.82
Horiz.	Down[f]	¾	90	0.28	0.31	0.48	0.82	1.19	3.56	3.25	2.08	1.21	0.84
			50	0.26	0.28	0.42	0.69	0.98	3.80	3.55	2.39	1.44	1.02
			0	0.23	0.25	0.35	0.55	0.76	4.28	4.04	2.83	1.83	1.31
			−50	0.21	0.22	0.29	0.43	0.58	4.84	4.63	3.48	2.33	1.72
		1½	90	0.17	0.19	0.36	0.71	1.07	5.96	5.24	2.76	1.48	0.95
			50	0.16	0.17	0.31	0.59	0.88	6.41	5.74	3.21	1.71	1.14
			0	0.14	0.15	0.25	0.45	0.67	7.18	6.59	3.97	2.21	1.50
			−50	0.12	0.13	0.20	0.34	0.50	8.23	7.63	4.95	2.90	2.02
		4	90	0.10	0.12	0.30	0.64	1.01	9.98	8.08	3.33	1.56	0.99
			50	0.09	0.11	0.25	0.52	0.81	10.7	8.94	4.08	1.91	1.23
			0	0.08	0.09	0.19	0.39	0.61	12.4	10.9	5.20	2.54	1.65
			−50	0.07	0.08	0.15	0.29	0.45	14.0	12.3	6.67	3.40	2.24

Actual thicknesses of lumber assumed to be as follows:

Nominal	Actual	Nominal	Actual
1 in. (S-2-S)	25/32 in.	3 in. (S-2-S)	2½ in.
1½ in. (S-2-S)	1 5/16 in.	4 in. (S-2-S)	3½ in.
2 in. (S-2-S)	1½ in.	Finish flooring,	
2½ in. (S-2-S)	2½ in.	(maple or oak)	¾ in.

It should be noted that the effects of poor workmanship in construction and installation have an increasingly greater percentage effect on heat transmission as the coefficient becomes numerically smaller. Failure to meet design estimates may be caused by lack of proper attention to exact compliance with specifications. A factor of safety may be employed as a precaution when it is desirable.

Caution

Although the validity of calculating U values for all of the types of constructions in Tables 5 through 17 has not been fully demonstrated, calculated values are given because measured values are not available. It is emphasized that the calculated values in Tables 5 through 17 are given for the convenience of the reader.

In calculating U values, exemplary conditions of components and installations are assumed, i.e., insulating materials are uniformly of the nominal thickness and conductivity, air spaces are of uniform thickness and surface temperatures, that effects due to moisture are not involved, and that installation details are in accordance with design. Some evidence of departures of measured values from calculated values for certain insulated constructions is given in *Building Materials*

(Continued on p. 427)

Table 3 .... Thermal Conductances and Resistances of a Plane[a] Air Space[a] (Concluded)

Position of Air Space	Direction of Heat Flow	Air Space: Mean Temp,[a] F	Air Space: Temp Diff,[a] F deg	4 in. Thickness[b]: Thermal Conductance — C: Value of E[c,d] 0.03	0.05	0.2	0.5	0.82	4 in. Thickness[b]: Thermal Resistance[e] — R: Value of E[d] 0.03	0.05	0.2	0.5	0.82
Horiz.	Up	90	10	0.34	0.36	0.53	0.88	1.24	2.94	2.75	1.87	1.14	0.80
		50	30	0.47	0.48	0.62	0.89	1.17	2.14	2.06	1.62	1.13	0.85
		50	10	0.35	0.37	0.50	0.78	1.07	2.88	2.75	1.99	1.29	0.94
		0	20	0.44	0.45	0.55	0.75	0.98	2.25	2.22	1.81	1.33	1.03
		0	10	0.36	0.37	0.47	0.67	0.89	2.77	2.67	2.11	1.48	1.12
		−50	20	0.46	0.47	0.54	0.68	0.84	2.17	2.12	1.84	1.46	1.20
		−50	10	0.38	0.39	0.46	0.60	0.75	2.64	2.57	2.18	1.66	1.33
45° Slope	Up	90	10	0.31	0.33	0.51	0.85	1.21	3.22	3.00	1.93	1.18	0.82
		50	30	0.43	0.45	0.58	0.85	1.14	2.32	2.22	1.71	1.17	0.88
		50	10	0.31	0.33	0.47	0.74	1.04	3.18	3.00	2.13	1.34	0.96
		0	20	0.40	0.41	0.51	0.71	0.93	2.50	2.42	1.95	1.40	1.08
		0	10	0.32	0.34	0.44	0.64	0.85	3.09	2.97	2.29	1.57	1.17
		−50	20	0.42	0.43	0.50	0.64	0.79	2.39	2.33	2.00	1.56	1.26
		−50	10	0.34	0.35	0.42	0.56	0.71	2.97	2.89	2.40	1.79	1.41
Vertical	Horiz.	90	10	0.27	0.29	0.46	0.81	1.17	3.73	3.44	2.16	1.24	0.91
		50	30	0.36	0.38	0.52	0.78	1.07	2.74	2.62	1.94	1.23	0.94
		50	10	0.27	0.29	0.43	0.70	0.99	3.69	3.45	2.34	1.43	1.01
		0	20	0.34	0.35	0.45	0.65	0.87	2.93	2.86	2.22	1.53	1.16
		0	10	0.28	0.29	0.39	0.59	0.81	3.69	3.48	2.56	1.69	1.24
		−50	20	0.35	0.36	0.43	0.57	0.72	2.82	2.78	2.33	1.76	1.39
		−50	10	0.29	0.30	0.37	0.51	0.67	3.45	3.34	2.70	1.95	1.50
45° Slope	Down	90	10	0.21	0.23	0.40	0.74	1.11	4.84	4.36	2.50	1.34	0.90
		50	30	0.28	0.29	0.43	0.70	0.98	3.61	3.39	2.33	1.44	1.02
		50	10	0.21	0.23	0.36	0.64	0.93	4.79	4.41	2.75	1.57	1.08
		0	20	0.26	0.27	0.37	0.57	0.78	3.92	3.73	2.71	1.76	1.27
		0	10	0.21	0.23	0.33	0.53	0.74	4.67	4.39	3.05	1.89	1.35
		−50	20	0.26	0.27	0.34	0.48	0.64	3.82	3.68	2.92	2.06	1.67
		−50	10	0.22	0.23	0.30	0.45	0.60	4.47	4.29	3.29	2.24	1.67

[a] Spaces of uniform thickness bounded by moderately smooth surfaces.
[b] Interpolation between ¾ and 4-inch thick air spaces gives values of conductance that are within ±5.0 percent of the data, except for those values as indicated by the following table of maximum departures. For more precise values, the reference should be consulted.

Maximum Departures from Data (percent) of Interpolated Conductance Values Between ¾ and 4-inch Thick Air Spaces

Direction of Heat Flow	Mean Temp., F	Temp. Diff., deg F	Value of E: 0.03	0.05	0.2	0.5	0.82
45° Up	0	20	+ 5.7	—	—	—	—
	−50	20	+10.0	+10.0	+ 8.6	+ 6.3	+5.4
Horiz.	90	10	+12.5	+11.5	+ 6.4	—	—
	50	30	−10.4	− 8.3	− 6.4	—	—
	0	20	−12.7	−11.3	− 9.4	− 6.8	−5.2
	0	10	− 8.0	− 8.1	− 6.4	—	—
	−50	20	−18.0	−17.9	−15.0	−11.3	−9.2
	−50	10	−20.3	−19.3	−16.6	−12.2	−9.5
45° Down	90	10	+35.5	+32.5	+18.0	+ 9.3	+6.4
	50	10	+27.0	+24.5	+14.1	+ 8.4	+5.7
	0	10	+15.8	+13.8	+ 8.8	+ 5.2	—
	−50	20	−10.0	−11.0	− 8.4	− 5.9	—
	−50	10	− 8.9	− 7.9	—	− 5.9	—

[c] Interpolation, and moderate extrapolation, of conductance values are permissible for other values of mean temperature, temperature difference, and effective emissivity E. Conductance values for 0 and −50 F mean temperatures were extrapolated from the experimental data, using a dimensionless correlation.
[d] Effective emissivity of space, E, is given by $1/E = 1/\epsilon + 1/\epsilon - 1$, where ϵ and ϵ are the emissivities of the surfaces of the air space. (See Section B of Table 2.)
[e] The resistance values were determined from the relationship $R = 1/C$ prior to rounding off the conductance value to two decimal places for tabulation.
[f] The conductances of horizontal spaces with heat flow downward are substantially independent of temperature difference.
[g] Based on National Bureau of Standards data presented in Housing Research Paper No. 32, Housing and Home Finance Agency, 1954 (Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.).