

Table 15 . . . Coefficients of Transmission (U) of Pitched Roofs^{a, b}

Coefficients are expressed in Btu per (hour) (square foot) (Fahrenheit degree difference in temperature between the air on the two sides), and are based on an outside wind velocity of 15 mph for heat flow upward and 7.5 mph for heat flow downward

Example—Roof C 4		Example of Substitution	
Resistances used are given below in this table or in Table 5 or 4		Resistances used are given below in this table or in Table 5 or 4	
Construction (Heat flow up)	Resistance (R)	Find U value for same construction with heat flow down (summer conditions)	
1. Outside surface (15 mph wind)	0.17	Total resistance	5.19
2. Slate shingles (1/4 in.)	0.05	Deduct 1. Outside surface (15 mph wind)	0.17
3. Building paper	0.00	5. Air space	0.90
4. Wood sheathing (3/4 in.)	0.88	8. Inside surface (still air)	0.88
5. Air space ^c	0.80		
6. Gypsum lath (3/8 in.)	0.32	Difference	1.60
7. Plaster (sand agg.) (3/4 in.)	0.09	Add 1. Outside surface (7.5 mph wind)	0.25
8. Inside surface (still air)	0.62	5. Air space	0.89
		8. Inside surface (still air)	0.78
Total resistance	5.19	Total resistance	5.40
U = 1/R = 1/5.19	0.31	U = 1/R = 1/5.40	0.29
See value 0.31 in boldface type in table below.			

To Adjust U Values for Construction with Added Insulation between Framing Members, See Table 16

Direction of Heat Flow →		Upward Flow Winter Conditions						Downward Flow Summer Conditions						Number
		Rafter Space						Rafter Space						
		Unventilated, Not to be Further Insulated				Insulated		Unventilated, Not to be Further Insulated				Insulated		
		Asphalt shingles building paper						Asphalt shingles building paper						
Type of Ceiling (Applied Directly to Roof Rafters)		On plywood sheathing (1/2 in.)	On wood shingles (1/2 in.)	Asbestos-cement slate or tile shingles, building paper on wood sheathing (1/2 in.)	Wood shingles on 1 x 4 in. wood strips on 6 in. centers	Roof and sheathing disregarded ^d		On plywood sheathing (1/2 in.)	On wood shingles (1/2 in.)	Asbestos-cement slate or tile shingles, building paper on wood sheathing (1/2 in.)	Wood shingles on 1 x 4 in. wood strips on 6 in. centers	Roof and sheathing disregarded ^d		
Resistance		0.95	1.48	1.09	0.87	—		0.95	1.48	1.09	0.87	—		
Material		R	U	U	U	U	E	F	G	H	I	J		
		A	B	C	D	E		F	G	H	I	J		
None	—	0.57	0.44	0.53	0.60	0.66		0.51	0.40	0.48	0.53	0.56	1	
Gypsum bd. (3/8 in.)	0.32	0.34	0.29	0.32	0.35	0.54		0.30	0.25	0.29	0.31	0.47	2	
Gypsum lath (3/8 in.) & 1/2 in. plas. (lt. wt. agg.)	0.64	0.30	0.26	0.29	0.31	0.46		0.28	0.24	0.27	0.28	0.41	3	
Gypsum lath (3/8 in.) and 1/2 in. plas. (sand agg.)	0.41	0.33	0.28	0.31	0.34	0.52		0.29	0.25	0.28	0.30	0.45	4	
Metal lath and 3/4 in. plas. (lt. wt. agg.)	0.47	0.32	0.27	0.31	0.33	0.50		0.29	0.25	0.28	0.30	0.44	5	
Metal lath and 3/4 in. plas. (sand agg.)	0.15	0.36	0.30	0.34	0.37	0.61		0.32	0.27	0.31	0.33	0.52	6	
Insul. bd. (1/2 in.)	1.19	0.25	0.22	0.24	0.25	0.34		0.23	0.20	0.22	0.23	0.31	7	
Insul. bd. lath and 1/2 in. plas. (sand agg.)	1.68	0.24	0.21	0.23	0.25	0.33		0.22	0.20	0.22	0.23	0.30	8	
Acoustical tile														
(3/4 in.) on gypsum bd. (3/8 in.)	1.51	0.24	0.21	0.23	0.25	0.33		0.22	0.20	0.22	0.23	0.30	9	
(3/4 in.) on furring	1.19	0.26	0.23	0.25	0.27	0.37		0.24	0.21	0.23	0.24	0.34	10	
(3/4 in.) on gypsum bd. (3/8 in.)	1.10	0.21	0.19	0.20	0.21	0.26		0.20	0.18	0.19	0.20	0.26	11	
(3/4 in.) on furring	1.78	0.23	0.20	0.22	0.23	0.30		0.21	0.19	0.20	0.21	0.28	12	
Wood lath and 1/2 in. plas. (sand agg.)	0.40	0.33	0.28	0.31	0.34	0.52		0.29	0.26	0.28	0.30	0.46	13	

^a See text section Calculating Overall Coefficients for basis of calculations.

^b Pitch of roof—45 deg.

^c To adjust U values for the effect of added insulation between framing members, see Table 15.

^d When insulation is installed between rafters, the space above should be ventilated and in this case the roof construction is disregarded in calculation of U values.

To adjust U values for pitched roof construction with added insulation between framing members, use the average of values for horizontal and vertical heat flow in Table 16A and either 16C or 16D depending on direction of heat flow.

Table 16 . . . Determination of U Value Resulting from Addition of Insulation or Air Spaces to Uninsulated Building Sections^aPART A. WALLS^a

U Value ^b Without Added Insulation	Fibrous Insulation ^c Thickness—Inches				One Air Space ^d of Effective Emissivity ^d E			Two Air Spaces of Effective Emissivity ^d E			Three Air Spaces of Effective Emissivity ^d E		
	½	1	2	3	0.82 ^e	0.20	0.05	0.82	0.20	0.05	0.82	0.20	0.05
	Col. 1	2	3	4	5	6	7	8	9	10	11	12	13
0.70	0.304	0.194	0.113	0.080	0.752	0.463	0.380	0.437	0.240	0.189	0.298	0.150	0.112
0.60	0.284	0.186	0.110	0.078	0.630	0.412	0.341	0.392	0.225	0.177	0.276	0.144	0.106
0.45	0.246	0.168	0.104	0.075	0.460	0.331	0.280	0.318	0.195	0.158	0.237	0.130	0.098
0.40	0.230	0.161	0.101	0.074	0.409	0.299	0.258	0.291	0.185	0.149	0.222	0.125	0.095
0.35	0.212	0.152	0.097	0.072	0.354	0.267	0.234	0.262	0.172	0.140	0.205	0.119	0.092
0.30	0.192	0.142	0.093	0.069	0.30	0.234	0.207	0.232	0.158	0.130	0.186	0.112	0.087
0.28	0.184	0.138	0.091	0.068	0.28	0.221	0.196	0.220	0.151	0.125	0.178	0.108	0.084
0.26	0.175	0.133	0.089	0.066	0.26	0.208	0.185	0.207	0.144	0.120	0.169	0.104	0.082
0.24	0.166	0.127	0.087	0.065	0.24	0.194	0.173	0.194	0.137	0.115	0.160	0.100	0.079
0.22	0.156	0.121	0.084	0.064	0.22	0.180	0.161	0.180	0.129	0.110	0.150	0.096	0.076
0.20	0.145	0.115	0.081	0.062	0.20	0.165	0.149	0.166	0.120	0.104	0.140	0.091	0.073
0.18	0.134	0.108	0.078	0.060	0.18	0.150	0.137	0.152	0.112	0.098	0.129	0.086	0.069
0.16	0.123	0.100	0.074	0.057	0.16	0.136	0.124	0.137	0.103	0.090	0.118	0.080	0.065
0.14	0.111	0.092	0.069	0.054	0.14	0.120	0.111	0.122	0.094	0.083	0.109	0.075	0.061
0.12	0.098	0.083	0.064	0.051	0.12	0.105	0.098	0.107	0.084	0.075	0.094	0.068	0.056
0.10	0.085	0.073	0.058	0.047	0.10	0.089	0.084	0.091	0.074	0.066	0.082	0.061	0.051
0.08	0.070	0.062	0.050	0.042	0.08	0.073	0.068	0.074	0.062	0.056	0.068	0.053	0.045

^a For constructions with air spaces as insulation, coefficients are based on National Bureau of Standards data in Housing Research Paper No. 37 (U. S. Government Printing Office, Washington, D. C.).

^b Based on an indoor-outdoor temperature difference of 70 F deg, and a mean temperature of 50 F. Values are applicable conservatively to winter and summer conditions.

^c U values taken from Tables 5 to 15, based on one nonreflective 2 1/2-in. air space between framing members.

^d Thermal conductivity of fibrous or bulk insulation taken as 0.27 Btu per (hr) (sq ft) (F deg per in.).

^e For values of effective emittance E of air space, see Table 1, Section B.

^f Certain U values in Column 6 differ from Column 1 because they are adjusted to the specific temperature drop across the air space in question as affected by the U value of the construction.

PART B. FLOORS¹—HEAT FLOW DOWN

U Value ^a Without Added Insulation	Fibrous Insulation ^b Thickness—Inches				One Air Space of Effective Emittance ^d E			Two Air Spaces of Effective Emittance ^d E			Three Air Spaces of Effective Emittance ^d E		
	½	1	2	3	0.82	0.20	0.05	0.82	0.20	0.05	0.82	0.20	0.05
	Col. 1	2	3	4	5	6	7	8	9	10	11	12	13
0.70	0.305	0.195	0.113	0.080	0.70	0.240	0.114	0.377	0.122	0.057	0.262	0.086	0.045
0.60	0.284	0.186	0.110	0.078	0.60	0.235	0.111	0.346	0.118	0.056	0.246	0.084	0.044
0.50	0.260	0.175	0.106	0.076	0.50	0.210	0.106	0.310	0.114	0.055	0.228	0.082	0.043
0.45	0.246	0.168	0.104	0.075	0.45	0.200	0.103	0.290	0.111	0.055	0.217	0.081	0.040
0.40	0.230	0.161	0.101	0.074	0.40	0.189	0.100	0.268	0.107	0.054	0.205	0.079	0.040
0.35	0.212	0.152	0.097	0.072	0.35	0.176	0.096	0.244	0.103	0.052	0.192	0.077	0.040
0.30	0.192	0.142	0.093	0.069	0.30	0.162	0.091	0.219	0.098	0.051	0.175	0.074	0.039
0.28	0.184	0.138	0.091	0.068	0.28	0.156	0.089	0.208	0.096	0.050	0.168	0.073	0.039
0.26	0.175	0.133	0.089	0.066	0.26	0.150	0.087	0.197	0.094	0.049	0.161	0.072	0.038
0.24	0.166	0.127	0.087	0.065	0.24	0.143	0.084	0.185	0.091	0.048	0.153	0.070	0.038
0.22	0.156	0.121	0.084	0.064	0.22	0.136	0.081	0.173	0.088	0.047	0.145	0.068	0.037
0.20	0.145	0.115	0.081	0.062	0.20	0.128	0.078	0.160	0.084	0.046	0.136	0.066	0.036
0.18	0.134	0.108	0.078	0.060	0.18	0.119	0.074	0.148	0.080	0.045	0.126	0.064	0.036
0.16	0.123	0.100	0.074	0.057	0.16	0.109	0.070	0.133	0.076	0.044	0.116	0.061	0.035
0.14	0.111	0.092	0.069	0.054	0.14	0.099	0.065	0.118	0.071	0.042	0.105	0.058	0.034
0.12	0.098	0.083	0.064	0.051	0.12	0.088	0.060	0.103	0.066	0.040	0.094	0.054	0.033
0.10	0.085	0.073	0.058	0.047	0.10	0.076	0.054	0.089	0.058	0.037	0.081	0.049	0.031
0.08	0.070	0.062	0.050	0.042	0.08	0.063	0.047	0.072	0.050	0.033	0.068	0.044	0.028

^a For construction with air spaces as insulation, coefficients are based on National Bureau of Standards data in Housing Research Paper No. 37 (U. S. Government Printing Office, Washington, D. C.).

^b Based on a temperature difference of 50 F deg from air to air, and a mean temperature of 50 F.

^c U value taken from Tables 11 and 12, in which it is assumed that the air space between joists or above the suspended ceiling is nonreflective (E = 0.82), and is in thick.

^d Thermal conductivity of fibrous or bulk insulation taken as 0.27 Btu per (hr) (sq ft) (F deg per in.).

^e For values of effective emittance E of air space, see Table 1, Section B.