As in the case of the simple wall, f_i and f_o are always the inside and outside surface coefficients for the two materials in contact with air. If the air is still (no wind), then for the same material f_i and f_o are the same, and $f_i = f_o$; but, if the outside air is in motion, then f_o is always greater than f_i and will increase as the wind velocity increases. Values for f_i in still and moving air have been determined for various building materials at the University of Minnesota under a coöperative research agreement with the Society[1]. The range of values for ordinary building materials is comparatively small and for practical purposes may be assumed constant for either still air or any given wind velocity, particularly in view of the fact that the surface resistances usually comprise only a small part of the total resistance of the construction, except in the case of thin, highly conductive walls.

TABLE 1. CONDUCTANCES OF AIR SPACES[a] AT VARIOUS MEAN TEMPERATURES

MEAN TEMP DEG FAHR	CONDUCTANCES OF AIR SPACES FOR VARIOUS WIDTHS IN INCHES						
	0.128	0.250	0.364	0.493	0.713	1.00	1.500
20	2.300	1.370	1.180	1.100	1.040	1.030	1.022
30	2.385	1.425	1.234	1.148	1.080	1.070	1.065
40	2.470	1.480	1.288	1.193	1.125	1.112	1.105
50	2.560	1.535	1.340	1.242	1.168	1.152	1.149
60	2.650	1.590	1.390	1.295	1.210	1.195	1.188
70	2.730	1.648	1.440	1.340	1.250	1.240	1.228
80	2.819	1.702	1.492	1.390	1.295	1.280	1.270
90	2.908	1.757	1.547	1.433	1.340	1.320	1.310
100	2.990	1.813	1.600	1.486	1.380	1.362	1.350
110	3.078	1.870	1.650	1.534	1.425	1.402	1.392
120	3.167	1.928	1.700	1.580	1.467	1.445	1.435
130	3.250	1.980	1.750	1.630	1.510	1.485	1.475
140	3.340	2.035	1.800	1.680	1.550	1.530	1.519
150	3.425	2.090	1.852	1.728	1.592	1.569	1.559

[a]Thermal Resistance of Air Spaces, by F. B. Rowley and A. B. Algren (A.S.H.V.E. TRANSACTIONS, Vol. 35, 1929).

The conductances of air spaces at various mean temperatures and widths, for ordinary building materials, are given in Table 1. These results were likewise obtained at the University of Minnesota under a coöperative research agreement with the Society.

Values for k and C, the conductivity and conductance of building materials and insulations, are given in Tables 2, 3, 4, 5 and 6, and are taken from the published values of various investigators. It should be noted that values of k and C as well as U are dependent on the temperature range, and it is therefore desirable that the investigator determine heat-transmission values under conditions approximating those existing under actual conditions. Recommended values for calculating the coefficients of transmission of various types of construction are given in Table 7.

[1]Surface Conductances as Affected by Air Velocity, Temperature and Character of Surface, by F. B. Rowley, A. B. Algren and J. L. Blackshaw (A.S.H.V.E. TRANSACTIONS, Vol. 36, 1930). See also references at end of chapter.

While most building materials have surfaces which show similar characteristics as far as the transmission of heat is concerned, it is a well-known fact that certain surfaces such as aluminum bronze, gold bronze, aluminum foil, or in fact any metallic, highly polished surface presents a greater resistance to heat transmission than the surface of the average building material.

The greater heat resistance of such metallic surfaces is due primarily to their higher reflectivity and consequent lower emissivity of radiant heat. The use of multiple layers of metallic surfaces, combined with air spaces of low resistance, provides a definite insulating effect. Factors for single air spaces of various thicknesses bounded by aluminum foil are given in the accompanying tabulation:

CONDUCTANCES OF AIR SPACES BOUNDED BY ALUMINUM FOIL UNDER VARIOUS CONDITIONS AND FOR VARIOUS WIDTHS

CHARACTER OF SURFACES	WIDTH OF AIR SPACE—INCHES														AUTHORITY
	0.25	0.28	0.33	0.35	0.375	0.4	0.5	0.62	0.675	0.7	0.75	1.00	1.50	3⅝	
Plain Foil To Plain Foil			0.69[b] 0.64[c] 0.65[d] 0.59[e]				0.62[a] 0.57[b] 0.54[c] 0.54[d] 0.43[e]	0.55[b]			0.53[a] 0.55[b] 0.46[c] 0.46[d]	0.48[a] 0.56[b] 0.41[c] 0.42[d]	0.42[e]		E. R. Queer,* Pennsylvania State College
	0.82[v] 0.88[w] 0.94[x]	0.74[s] 0.81[t] 0.83[u]		0.61[p] 0.65[q] 0.70[r]		0.55[l] 0.60[m] 0.63[n]	0.45[i] 0.47[j] 0.52[k]			0.37[f] 0.44[g] 0.47[h]					Ralph B. Mason†
	0.88[z] 1.00[ee]		0.75[ff]		0.61[z]		0.50[y] 0.48[aa] 0.52[gg] 0.52[hh]		0.47[bb] 0.49[gg]		0.48[cc] 0.49[ff]	0.48[dd] 0.46[ff]			J. L. Gregg**
					0.64[ii] 0.72[ii]										Prof. G. B. Wilkes, Mass. Inst. of Tech.
Crumbled Foil Surfaces	1.40		1.11				0.74					0.41			J. L. Gregg**
					0.80 0.88										Prof. G. B. Wilkes, Mass. Inst. of Tech.

NOTES

a—Mean Temp. 95 F; 9 in. horizontal air space.
b— " " 95 F; 9 in. vertical air space.
c— " " 65 F; " " " "
d— " " 65 F; 9 in. horizontal air space.
e— " " 65 F; 11⅝ in. vertical air space.
f— " " 97.2 F; high side, 123.5 F; low side, 70.9 F.
g— " " 129.7 F; " ", 174.2 F; " ", 70.7 F.
h— " " 152 F; " ", 232.1 F; " ", 72.0 F.
i— " " 94.7 F; " ", 122.3 F; " ", 67.1 F.
j— " " 129.7 F; " ", 191.8 F; " ", 67.6 F.
k— " " 190.4 F; " ", 258.8 F; " ", 68.4 F.
l— " " 92.5 F; " ", 121.7 F; " ", 63.3 F.
m— " " 127.1 F; " ", 190.8 F; " ", 63.5 F.
n— " " 162.9 F; " ", 262.3 F; " ", 63.6 F.
p— " " 106.0 F; " ", 136.4 F; " ", 75.5 F.
q— " " 145.0 F; " ", 214.2 F; " ", 75.7 F.
r— " " 182.6 F; " ", 290.0 F; " ", 75.3 F.
s— " " 105.6 F; " ", 135.4 F; " ", 75.8 F.
t— " " 141.5 F; " ", 207.0 F; " ", 76.0 F.
u— " " 177.0 F; " ", 278.3 F; " ", 75.8 F.
v— " " 99.0 F; " ", 129.7 F; " ", 68.2 F.
w— " " 137.6 F; " ", 205.8 F; " ", 69.4 F.
x— " " 174.7 F; " ", 279.6 F; " ", 69.8 F.
y— " " 105 F; wooden separators occupying 6% of space
z— " " 107 F; " " " " " "
aa— " " 106 F; " " " " " "
bb— " " 100 F; " " " " " "
cc— " " 99 F; " " " " " "
dd— " " 92 F; " " " " " "
ee— " " 93 F; " " " 8% " "
ff— " " 92 F; " " " " " "
gg— " " 98 F; " " " " " "
hh— " " 97 F; fiber insulation separators occupiyng 8% of space.
ii— " " 115 F;

*From data in paper entitled, Importance of Radiation in Heat Transfer Through Air Spaces (*Heating, Piping and Air Conditioning*, November, 1931).
†Computed from data in article entitled, Thermal Insulation with Aluminum Foil (*Industrial and Engineering Chemistry*, March, 1933).
**Computed from data in paper entitled, Properties of Metal Foil as an Insulation (*Refrigerating Engineering*, May, 1932).

Coefficients of transmission of various types of wall, ceiling, floor and roof construction with aluminum insulation can be readily calculated. The present installation practice indicates that air spaces of ½ in. to 1½ in. are preferred but manufacturers' recommendations should be closely followed in the application of aluminum foil insulation.