TABLE 10. COEFFICIENTS OF TRANSMISSION (*U*) FOR PIPES INSULATED WITH ROCK WOOL TYPE INSULATION

These coefficients are expressed in Btu per hour per square foot of pipe surface per degree Fahrenheit difference in temperature between pipe and surrounding still air at 70 F

Thickness of Insulation (Inches)	Nominal Pipe Size (Inches)	Hot Water				Steam		
		120 F	150 F	180 F	210 F	227.2 F (5 Lb)	298.7 F (10 Lb)	337.9 F (100 Lb)
		Temperature Difference						
		50 F	80 F	110 F	140 F	157.2 F	228.7 F	267.9 F
1	½	0.631	0.644	0.658	0.672	0.680	0.712	0.730
	¾	0.569	0.581	0.593	0.606	0.613	0.642	0.659
	1	0.518	0.529	0.541	0.552	0.559	0.585	0.600
	1¼	0.476	0.486	0.497	0.507	0.513	0.537	0.551
	1½	0.450	0.460	0.470	0.480	0.485	0.508	0.522
	2	0.422	0.431	0.441	0.450	0.456	0.478	0.490
	2½	0.402	0.411	0.420	0.428	0.434	0.455	0.466
	3	0.385	0.394	0.402	0.411	0.415	0.435	0.446
	3½	0.373	0.381	0.389	0.398	0.402	0.421	0.432
	4	0.363	0.371	0.379	0.387	0.392	0.411	0.422
	4½	0.355	0.363	0.371	0.379	0.383	0.402	0.413
	5	0.348	0.356	0.364	0.371	0.376	0.394	0.404
	6	0.341	0.348	0.356	0.363	0.368	0.386	0.396
	8	0.327	0.335	0.342	0.349	0.353	0.372	0.381
	9	0.321	0.328	0.335	0.342	0.347	0.365	0.374
	12	0.313	0.320	0.327	0.334	0.338	0.355	0.364
1½	½	0.523	0.534	0.545	0.556	0.563	0.590	0.606
	¾	0.468	0.477	0.487	0.497	0.503	0.528	0.542
	1	0.421	0.430	0.440	0.449	0.455	0.477	0.490
	1¼	0.383	0.391	0.399	0.407	0.412	0.433	0.444
	1½	0.359	0.366	0.375	0.383	0.387	0.407	0.419
	2	0.333	0.340	0.348	0.356	0.360	0.378	0.389
	2½	0.314	0.320	0.327	0.335	0.339	0.355	0.365
	3	0.296	0.302	0.310	0.317	0.321	0.337	0.347
	3½	0.286	0.291	0.298	0.304	0.307	0.323	0.332
	4	0.278	0.284	0.290	0.296	0.300	0.315	0.323
	4½	0.270	0.276	0.282	0.287	0.291	0.305	0.313
	5	0.263	0.269	0.275	0.280	0.284	0.298	0.305
	6	0.257	0.262	0.267	0.273	0.277	0.290	0.297
	8	0.244	0.249	0.254	0.260	0.263	0.276	0.283
	9	0.238	0.243	0.248	0.254	0.257	0.270	0.277
	12	0.230	0.234	0.239	0.245	0.247	0.260	0.267
2	½	0.461	0.471	0.481	0.491	0.496	0.520	0.534
	¾	0.409	0.418	0.427	0.436	0.441	0.463	0.475
	1	0.366	0.374	0.382	0.390	0.395	0.415	0.427
	1¼	0.333	0.340	0.347	0.355	0.359	0.377	0.387
	1½	0.310	0.316	0.323	0.330	0.334	0.351	0.360
	2	0.286	0.292	0.298	0.304	0.308	0.323	0.331
	2½	0.268	0.274	0.279	0.285	0.289	0.302	0.310
	3	0.252	0.257	0.262	0.268	0.272	0.284	0.292
	3½	0.241	0.246	0.251	0.257	0.260	0.272	0.280
	4	0.232	0.237	0.242	0.247	0.250	0.262	0.269
	4½	0.225	0.230	0.235	0.240	0.243	0.255	0.262
	5	0.218	0.223	0.228	0.233	0.236	0.247	0.253
	6	0.213	0.217	0.221	0.226	0.228	0.239	0.245
	8	0.200	0.204	0.208	0.213	0.215	0.225	0.231
	9	0.193	0.197	0.201	0.205	0.207	0.218	0.224
	12	0.185	0.190	0.194	0.198	0.200	0.210	0.216

Example 2. Determine the total heat loss for a period of 30 days through a 1-in. (4 ply) thickness of corrugated asbestos insulation on 100 ft of 3-in. pipe carrying steam at 5 lb pressure, and with surrounding air at 60 F. Also determine percentage of heat saving over bare pipe loss.

Solution. Difference in temperature between pipe and surrounding air = 227.2 − 60 or 167.2 deg. From Table 6 the coefficients of transmission for 1-in. corrugated asbestos (4 ply) are 0.608 and 0.652 Btu per hour per square foot per degree temperature difference at temperature differences of 157.2 deg and 228.7 deg, respectively. The difference is 0.044 Btu per hour per square foot per degree temperature difference for a temperature difference of 71.5 deg. For a temperature difference of 167.2 deg (10 deg higher than 157.2 deg) the coefficient of transmission is then $0.608 + \left(\frac{10}{71.5} \times 0.044\right)$, or 0.614 Btu per hour per square foot per degree temperature difference. From Table 2 the area per linear foot of 3-in. pipe is 0.917 sq ft. The total heat loss is therefore 0.917 × 0.614 × 167.2 × 100 (linear feet) × 720 (hours) = 6,779,700 Btu.

From Table 1, and in the same manner it is determined that the loss through an uninsulated 3-in. pipe for the same conditions will be 28,266,100 Btu. The saving due to insulation is 21,486,300 Btu or 76 per cent of the bare pipe loss.

INSULATION FOR COLD SURFACES

Surfaces maintained at low temperatures should be insulated so as to retard the flow of heat from the outside into the low temperature area and to prevent the formation of condensation and of frost if the temperatures are low enough, as well as to prevent corrosion, induced by the presence of condensed moisture on metal surfaces. Materials commonly used for insulating pipes and surfaces at low temperatures are cork, rock cork, hair felt and other felted or fibrous non-absorbent materials. Thermal conductivities of low temperature insulating materials are given in Chapter 3.

Insulating materials are available commercially to meet varying temperature gradients. For example, the thickness of insulation for ice water is approximately 1½-in. if the temperature in the line is not lower than 25 F; the thickness of insulation for brine is approximately 2½ in. where the temperature ranges from 0 deg to 25 F; and the thickness of insulation where the brine temperature ranges from −30 F to zero degrees is approximately 4 in.

Prevention of Condensation on Cold Pipes

In some cases the prevention of condensation rather than the conservation of heat is the governing factor in determining the thickness of insulation required. Fig. 2 may be used for determining the thickness of any material of known conductivity which should be used to prevent condensation on pipes and flat metallic surfaces. The surface resistances used for calculating the family of curves in Fig. 2 are based on the results of tests made on canvas-covered pipe insulation surfaces at Mellon Institute. However, it has been found that the resistance for asphaltic and roofing surfaces is practically the same as for canvas surfaces so that the curves given may be followed with no alteration on account of the surfaces commonly used. (See discussion of surface transfer of heat in Chapter 3).

Moisture will be deposited on a surface whenever its temperature falls to that of the dew-point. The maximum permissible temperature drop is indicated on Fig. 2 at the point where the guide line passes through the horizontal scale at the left center of the chart. This temperature drop