

(dollars) $\div 13,000$ (Btu) $\times 2000$ (lb) $\times 0.55$ (efficiency) = \$0.804. The total cost of heat lost per year = 0.804×181.6 (thousand Btu) = \$146.00. (A closely approximate solution of such a problem may be made quickly by the use of the estimating chart given in Fig. 1.)

TABLE 3. HEAT LOSS FROM BRIGHT COPPER PIPE GIVEN ONE THIN COAT OF CLEAR LACQUER

*Expressed in Btu per hour per linear foot per degree Fahrenheit
between the pipe and surrounding still air at 70 F*

NOMINAL PIPE SIZE (INCHES)	Hot WATER (Type K Copper Tube)				STEAM (Standard Pipe Size Pipe)		
	120 F	150 F	180 F	210 F	227.1 F (5 Lb)	297.7 F (50 Lb)	337.9 F (100 Lb)
	TEMPERATURE DIFFERENCE						
	50 F	80 F	110 F	140 F	157.1 F	227.7 F	267.9 F
1/2	0.240	0.265	0.282	0.307	0.401	0.461	0.478
3/4	0.320	0.356	0.373	0.414	0.477	0.571	0.578
1	0.390	0.437	0.463	0.507	0.598	0.681	0.710
1 1/4	0.470	0.537	0.554	0.614	0.700	0.812	0.840
1 1/2	0.540	0.612	0.645	0.714	0.830	0.966	0.990
2	0.690	0.762	0.818	0.892	1.005	1.164	1.201
2 1/2	0.840	0.937	0.991	1.085	1.178	1.361	1.420
3	0.960	1.025	1.135	1.270	1.400	1.625	1.700
3 1/2	1.100	1.250	1.318	1.442	1.580	1.845	1.905
4	1.241	1.400	1.480	1.556	1.750	2.040	2.130
4 1/2	.....	.....	.....	.....	1.910	2.240	2.350
5	1.480	1.685	1.790	1.965	2.130	2.415	2.610
6	1.700	1.936	2.052	2.272	2.450	2.810	2.990
8	2.200	2.500	2.630	2.854	3.120	3.425	3.730

TABLE 4. HEAT LOSS FROM HORIZONTAL TARNISHED COPPER PIPE

*Expressed in Btu per hour per linear foot per degree Fahrenheit
between the pipe and surrounding still air at 70 F*

NOMINAL PIPE SIZE (INCHES)	HOT WATER (Type K Copper Tube)				STEAM (Standard Pipe Size Pipe)		
	120 F	150 F	180 F	210 F	227.1 F (5 Lb)	297.7 F (50 Lb)	337.9 F (100 Lb)
	TEMPERATURE DIFFERENCE						
	50 F	80 F	110 F	140 F	157.1 F	227.7 F	267.9 F
1/8	0.250	0.287	0.300	0.321	0.433	0.500	0.530
3/16	0.340	0.381	0.409	0.429	0.533	0.543	0.654
1/4	0.440	0.475	0.509	0.536	0.636	0.746	0.803
5/16	0.500	0.559	0.618	0.622	0.764	0.878	0.934
3/8	0.580	0.656	0.710	0.750	0.904	1.053	1.120
1/2	0.730	0.825	0.890	0.957	1.101	1.273	1.364
5/8	0.880	1.000	1.091	1.143	1.305	1.490	1.605
3/4	1.040	1.175	1.272	1.343	1.560	1.800	1.940
7/8	1.180	1.350	1.454	1.535	1.750	2.020	2.170
1	1.460	1.500	1.635	1.715	1.941	2.240	2.430
1 1/8	.....	.....	.....	.....	2.131	2.465	2.650
1 1/4	1.600	1.812	1.980	2.071	2.387	2.770	2.990
1 1/2	1.840	2.125	2.270	2.430	2.740	3.210	3.440
1 3/4	2.400	2.685	2.910	3.110	3.310	4.050	4.370

HEAT LOSSES FROM INSULATED PIPES

The conductivities of various materials used for insulating steam and hot water systems are given in Table 8. They are given as functions of the mean temperatures or the mean of the inner and outer surface tem-

TABLE 5. RADIATING SURFACE PER LINEAR FOOT OF PIPE

NOMINAL PIPE SIZE (INCHES)	SURFACE AREA (Sq Ft)	NOMINAL PIPE SIZE (INCHES)	SURFACE AREA (Sq Ft)	NOMINAL PIPE SIZE (INCHES)	SURFACE AREA (Sq Ft)
1/2	0.22	2	0.622	5	1.456
3/4	0.275	2 1/2	0.753	6	1.734
1	0.344	3	0.917	8	2.257
1 1/4	0.435	3 1/2	1.047	10	2.817
1 1/2	0.498	4	1.178	12	3.338

TABLE 6. RADIATING SURFACE PER LINEAR FOOT OF COPPER TUBING

Outside diameter $\frac{1}{8}$ in. greater than nominal size

TUBE SIZE (INCHES)	SURFACE AREA (Sq Ft)	TUBE SIZE (INCHES)	SURFACE AREA (Sq Ft)	TUBE SIZE (INCHES)	SURFACE AREA (Sq Ft)
1½	0.164	2	0.556	5	1.342
¾	0.229	2½	0.687	6	1.604
1	0.295	3	0.818	8	2.128
1¼	0.360	3½	0.949	..	....
1½	0.426	4	1.080	..	....

TABLE 7. AREAS OF FLANGED FITTINGS, SQUARE FEET^a

NOMINAL PIPE SIZE (INCHES)	FLANGED COUPLING		90 DEG. ELB.		LONG RADIUS ELB.		TEE		CROSS	
	Standard	Extra Heavy	Standard	Extra Heavy	Standard	Extra Heavy	Standard	Extra Heavy	Standard	Extra Heavy
1	0.320	0.438	0.795	1.015	0.892	1.083	1.235	1.575	1.622	2.07
1½	0.383	0.510	0.957	1.098	1.084	1.340	1.481	1.925	1.943	2.53
1½	0.477	0.727	1.174	1.332	1.337	1.874	1.815	2.68	2.38	3.54
2	0.672	0.848	1.65	2.01	1.84	2.16	2.54	3.09	3.32	4.06
2½	0.841	1.107	2.09	2.57	2.32	2.76	3.21	4.05	4.19	5.17
3	0.945	1.484	2.38	3.49	2.68	3.74	3.66	5.33	4.77	6.95
3½	1.122	1.644	2.98	3.96	3.28	4.28	4.48	6.04	5.83	7.89
4	1.344	1.914	3.53	4.64	3.96	4.99	5.41	7.07	7.03	9.24
4½	1.474	2.04	3.95	5.02	4.43	5.46	6.07	7.72	7.87	10.07
5	1.622	2.18	4.44	5.47	5.00	6.02	6.81	8.52	8.82	10.97
6	1.82	2.78	5.13	6.99	5.99	7.76	7.84	10.64	10.08	13.75
8	2.41	3.77	6.98	9.76	8.56	11.09	10.55	14.74	13.44	18.97
10	3.43	5.20	10.18	13.58	12.35	15.60	15.41	20.41	19.58	24.87
12	4.41	6.71	13.08	17.73	16.35	18.76	19.67	26.65	24.87	

*Including areas of accompanying flanges bolted to the fitting.

peratures of the insulations. It should be emphasized that the case of average values obtained from a number of tests made at different temperatures are very material, also that all variables due to differences in thickness of the fact and air conditions are eliminated. Individual manufacturers increase only the will, of course, vary in conductivity to some extent change the internal