in pounds of coal per 100 lineal feet of bare pipe is tabulated for temperatures up to 350 deg. fahr. Pounds of coal used are given per 100 lineal feet per month assuming continuous use of the apparatus, 70 per cent boiler efficiency, and 13,000 B.t.u. per lb. The "dollars" column represents the money value of the coal used per 100 lineal feet per month assuming coal at $4.00 per ton and boiler room expense at $1.00 per ton.

The loss of heat per unit area from flat surfaces varies greatly with the size and position of the body. The loss from the surface in a horizontal position is entirely different for the same surface in a vertical position. Also, the loss is different for the same flat surface facing downward than

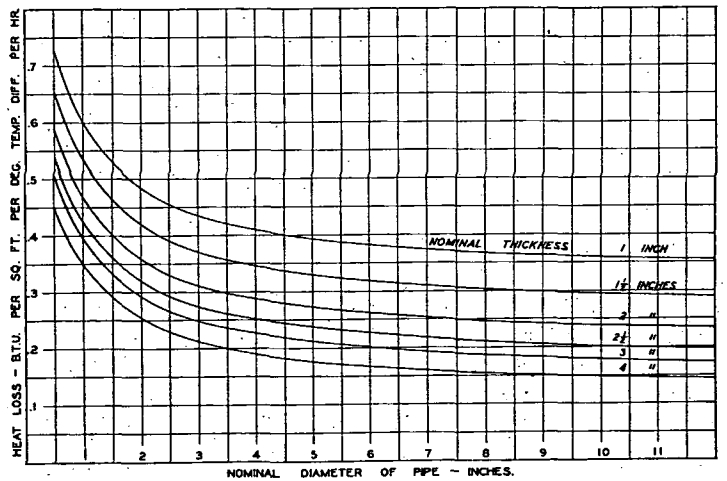


FIG. 3. VARIATION WITH PIPE SIZE OF RATE OF HEAT TRANSMISSION THROUGH A GIVEN THICKNESS OF INSULATION

for it facing upward. For these reasons a single equation or curve has not yet been obtained that will give accurately the heat loss from flat surfaces in various positions. However, until more experimental work has been conducted, it is suggested that the heat loss from flat bare iron surfaces be taken as equal to 95 per cent of the values given for the 18 in. pipe in Fig. 1.

HEAT LOSSES FROM INSULATED SURFACES

Fig. 2 shows the losses from appropriately insulated surfaces compared with losses from bare surfaces. It will be noted that it was necessary to plot the upper part of the bare surface curve to a greatly reduced scale in order to show it on the same sheet with the curves for losses through insulation. Therefore, for a true measure of the relative losses from bare and insulated surfaces, compare the numerical value of the ordinates of the curves rather than the apparent spaces between the curves on the chart.

The chart, Fig. 2, is based on still air conditions, room temperature of 70 deg. fahr., and 5 in. pipe size. The effect of pipe size on losses through insulations of various thicknesses is shown in Fig. 3. (TRANS. A. S. H. & V. E., Vol. 26, p. 375).

For equations by means of which heat losses may be calculated for any thickness of insulation on any pipe size see TRANS. A. S. H. & V. E., Vol. 26, p. 360. Refer also to manufacturers' data for heat losses and efficiencies of different insulations on various sizes of pipes.

CONDUCTIVITIES OF INSULATING MATERIALS

The conductivities in B.t.u. per square foot per hour per inch thick per deg. fahr. temperature difference between inner and outer surfaces of the insulation are given in Table 2 for various types of insulation. In this table the conductivities are shown as functions of the mean temperatures or the mean of the inner and outer surface temperatures of the insulation. This method of expressing conductivities permits their use in the calculation of either single or compound sections. It should be emphasized that in this table all variables due to differences in thickness, different pipe sizes and different air conditions are eliminated.

TABLE 2. CONDUCTIVITIES OF VARIOUS TYPES OF HEAT INSULATING MATERIALS

	Mean Temperature, Deg. Fahr.								
	100	150	200	250	300	350	400	450	500
Laminated Asbestos Type (Approx. 40 laminations per 1 in. thickness)	0.402	0.421	0.442	0.464	0.486	0.510	0.534	0.560	0.586
85 per cent Magnesia Type	0.468	0.480	0.492	0.505	0.518	0.532	0.547	.....	.....
Indented Asbestos Felt Type (Approx. 20 laminations per 1 in. thickness)	0.540	0.570	0.600	0.630	0.660	0.690	0.720	0.750	0.780
Air Cell Type (Four laminations per inch of nominal thickness)	0.529	0.590	0.653	0.712	0.773	.....	.....	.....	.....

RADIATING SURFACE OF PIPES

In order to determine heat losses per linear foot of pipe from known losses per square foot, it is necessary to know the number of square feet area per linear foot of pipe. Table 3 gives these areas for various standard pipe sizes.

TABLE 3. RADIATING SURFACE PER LINEAR FOOT OF PIPE

Pipe Size In.	Surface Sq. Ft.	Pipe Size In.	Surface Sq. Ft.	Pipe Size In.	Surface Sq. Ft.
½	0.22	2	0.622	5	1.456
¾	0.275	2½	0.753	6	1.734
1	0.344	3	0.917	8	2.257
1¼	0.435	3½	1.047	10	2.817
1½	0.498	4	1.178	12	3.338