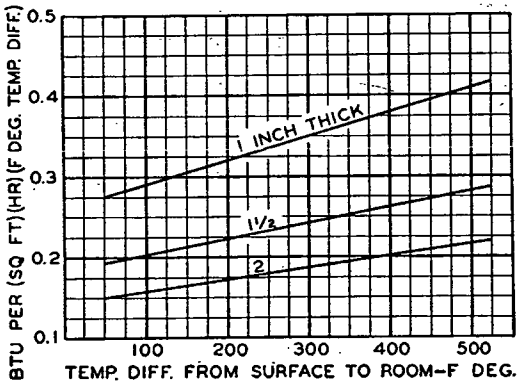

FIG. 4. HEAT LOSS THROUGH INSULATION ON FLAT VERTICAL SURFACE
(Use with Table 6 for Various Insulations)

TABLE 6. HEAT INSULATION FACTORS FOR VARIOUS INSULATIONS

(To be Applied to Figs. 1, 2, 3 and 4)

FORM	TYPE OF PIPE INSULATION	TEMPERATURE DIFFERENCE, PIPE TO AIR, F DEG							
		40	70	100	200	300	500	700	900
PIPE INSULATION	ASBESTOS								
	Molded Amosite and Binder			0.978	0.966	0.955	0.931		
	Laminated Asbestos Paper (35-40/in.)			1.152	1.131	1.110	1.067		
	Corrugated and Laminated (4 ply/in.)		1.595	1.599	1.614	1.628			
	Asbestos Paper (6 ply/in.)		1.442	1.442	1.443	1.444			
	(8 ply/in.)		1.394	1.387	1.375	1.363			
	CALCIUM SILICATE			1.041	1.018	0.996	0.950		
	CELLULAR GLASS			1.195	1.190	1.185	1.175		
	Cork (No added binder)	0.879	0.869	0.859					
	Diatomaceous Silica 22 lb						1.136	1.052	0.968
	Diatomaceous Silica 25 lb						1.296	1.206	1.115
	85% MAGNESIA	1.131	1.119	1.107	1.068	1.027	0.946		
	MINERAL WOOL (Rock Slag or Glass)								
	Low Temp. (Asphalt or Resin Bonded)	0.960	0.961	0.963					
	Low Temp. (Find Fiber Res. Bond)	0.740	0.733	0.727					
	High Temp. (Metal Reinforced)			0.879	0.893	0.907	0.935		
	PLASTICS (Foamed)	0.909	0.914	0.918					
	RUBBER (Foamed)	0.765	0.762	0.759					
	Wool Felt	0.994	0.997	1.000					
	Hair Felt or Hair Felt plus Jute	0.877	0.864	0.851					
BLOCKS AND BOARDS	Asbestos Molded Amosite			1.088	1.067	1.025	1.004	0.962	0.920
	Calcium Silicate			0.988	0.974	0.960	0.932	0.904	0.876
	Corkboard (Natural Binder)	0.861	0.854	0.847					
	Mineral Wool (Low Temp.)	0.917	0.907	0.896					
	Mineral Wool (High Temp.)			0.880	0.901	0.923			
	Mineral Wool (Inorganic Binder)			1.003	0.990	0.978	0.953	0.928	
BLANKETS	Mineral Wool (Felt Flexible Type)	0.815	0.827	0.841	0.896	0.951			
	Mineral Wool (Felt Semi-Rigid Type)	0.830	0.840	0.851	0.895	0.938			
INSULATING CEMENT	85% Magnesia			1.275	1.224	1.173	1.070		
	Mineral Wool			1.370	1.344	1.317	1.264	1.317	

loss by means of surface loss curves such as given in Fig. 5. The curves were plotted from tests conducted at the *Mellon Institute*.

After the true heat loss is obtained, the loss per square foot of pipe surface can be calculated from the relationship:

$$q_i = q_o(r_2/r_1)$$

where

q_i = Btu per (hour) (square foot outer surface of pipe).

The heat loss through two or more thicknesses of insulation applied to a pipe can be calculated by means of the equation:

$$q_o = \frac{t_1 - t_2}{\dfrac{r_2 \log_e \dfrac{r_2}{r_1}}{k_1} + \dfrac{r_3 \log_e \dfrac{r_3}{r_2}}{k_2} + \cdots} \qquad (2)$$

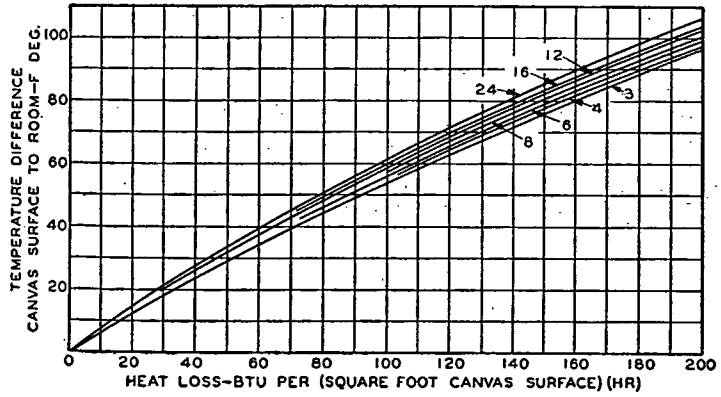

FIG. 5. HEAT LOSS FROM CANVAS-COVERED CYLINDRICAL SURFACES OF VARIOUS DIAMETERS
(Canvas, Roofing and Various Colored Painted Surfaces)

where

r_2 = outer radius of second layer of insulation, inches.

r_n = outer radius of last layer of insulation, inches.

The method of solving Equation 2, which is the most difficult of the two, is given in *Example 3*.

Example 3: Compute the heat loss per linear foot of pipe surface per hour from a 6-in. pipe, insulated with a 3-in. thickness of 1500 F diatomaceous earth, and a nominal 2-in. thickness of 85 percent magnesia. The pipe is operating at a temperature of 1200 F and is exposed to a room temperature of 80 F.

Solution: In figuring the heat loss from Equation 2, it is necessary to first make an assumption for the outer surface temperature t_2 and the temperature between the diatomaceous earth and 85 percent magnesia insulation, so that the mean temperature of each material can be obtained and the thermal conductivity corresponding to the mean temperature of each material substituted in the equation. First assume an outer surface temperature of 135 F and a temperature of 570 F between the two materials corresponding to a mean temperature of (1200 + 570) ÷ 2 or 885 F for the diatomaceous earth and (570 + 135) ÷ 2 or 352.5 F for the 85 percent magnesia insulation.