

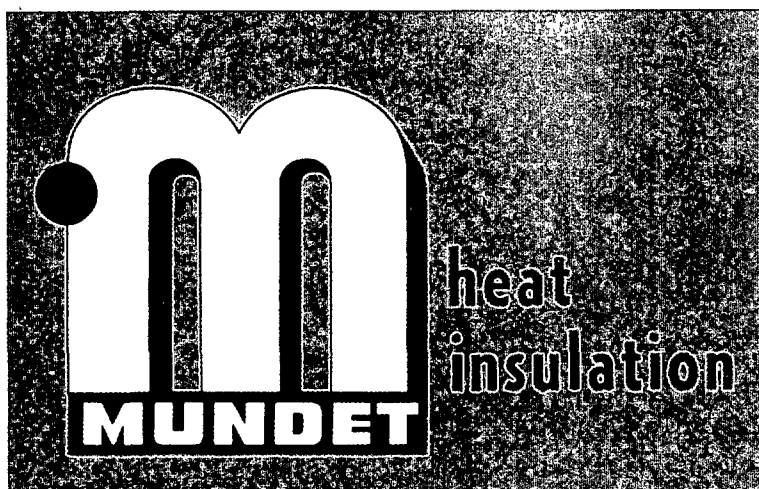


"custom-molded"

**85% MAGNESIA
HEAT insulation**

Engineering
and Specification Data

Mundet Cork Corporation



MUNDET
"custom-molded"
light density type
85% MAGNESIA
pipe and block insulation

► to specifiers, applicators, and users of heat insulation

A new Mundet plant is now in operation for the manufacture of "Custom-Molded" 85% Magnesia pipe covering and block insulation.

Each unit of this plant is part of an integrated plan to produce improved heat insulation of superior efficiency, economy and durability . . . with assurance of longer-lasting service.

With the most modern facilities in the United States heat insulation manufacture, operations are as nearly automatic and precision controlled as experience and technical knowledge can make them. Manufacturing processes, equipment and methods contribute to the production of heat insulation of superior effectiveness and of real money-saving importance to the user.

In addition to the new magnesia plant at North Bergen, N. J., Mundet has a modern cork processing plant at Hillside, N. J. where molded cork pipe covering and corkboard for low temperature insulation are manufactured.

Copyright 1951—Mundet Cork Corporation

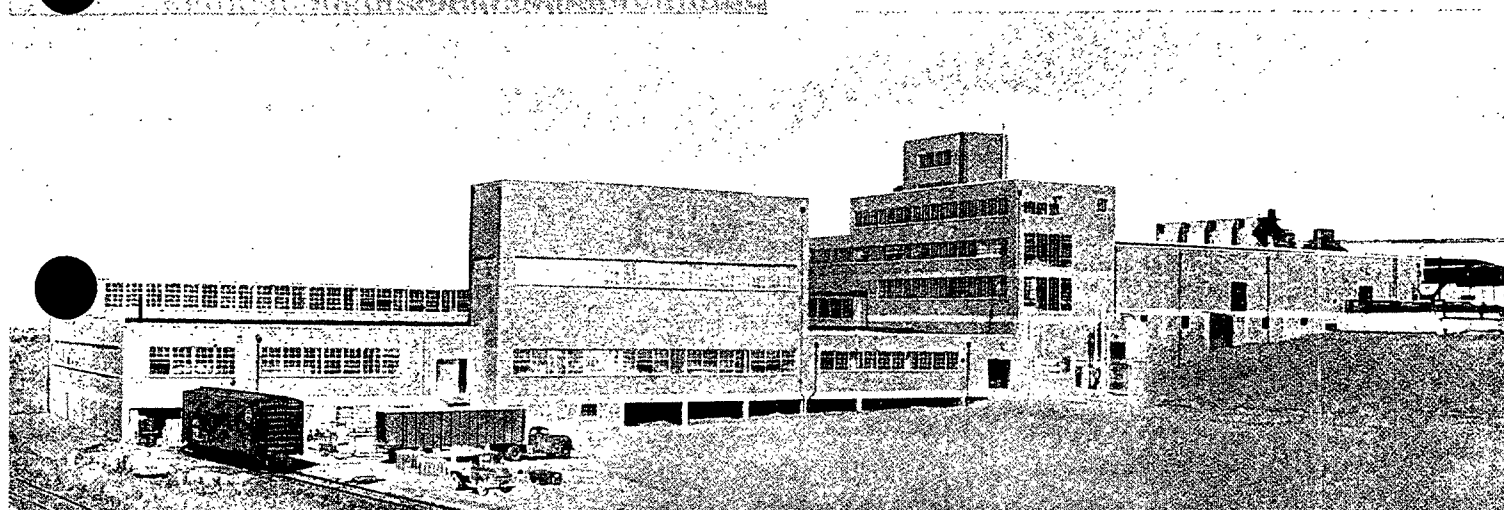
► for heat ranges up to 550°- 600° F.

Practical steam men have long recognized the superiority of 85% magnesia. Its reliable heat harnessing efficiency has made this type of insulation the world's standard for over 60 years. To the known high efficiency of magnesium carbonate, improvements have been added to make Mundet "Custom-Molded" 85% Magnesia the ideal insulation for all heat ranges up to 550°—600° F.

Consider this improved heat insulation on the basis of the only true measurement of value: its capacity to serve at highest insulating efficiency over a long period of years . . . perhaps even for the life of a plant.

high temperature insulation

For temperature ranges above 600°F., Mundet will provide a special high-temperature insulation with improved advantages, similar to Mundet "Custom-Molded" 85% Magnesia. This insulation is designed for use on steam lines, boilers, fittings and other heated surfaces where higher temperatures are met. Full information will be sent on request.



85% magnesia heat insulation



some of the many advantages

controlled uniformity

Precision manufacture on the latest type of automatic equipment insures uniformity of product in all the important qualities affecting insulating performance as well as that of density to within a tolerance of $\pm 1/2$ lb per cubic foot.

thermal conductivity

Following is report of test of Mundet "Custom-Molded" 85% Magnesia pipe covering prepared by United States Testing Company, Inc. Copy of report will be sent on request.

determination of thermal conductivity (k) factor through the mean temperature range 100°F to 500°F

mean temperature °F	thermal conductivity (k) btu./hr./sq ft./°F/in
100	0.338
200	0.363
300	0.408
400	0.454
500	0.500

smooth finish

Mundet "Custom-Molded" 85% Magnesia is molded to exact finished size and thickness; it is not molded oversize and then milled or machined to size. This method produces a smooth finish on the inner and outer surfaces, thus adding to the appearance and effectiveness of the insulation.

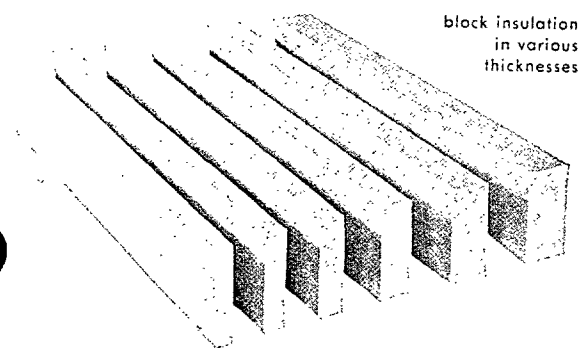
precision pipe fit

Each size and thickness is accurate and identical. No spaces are left for the escape of heat. The whole heated surface is snugly enclosed; longitudinal and end joints butt tightly.

other advantages

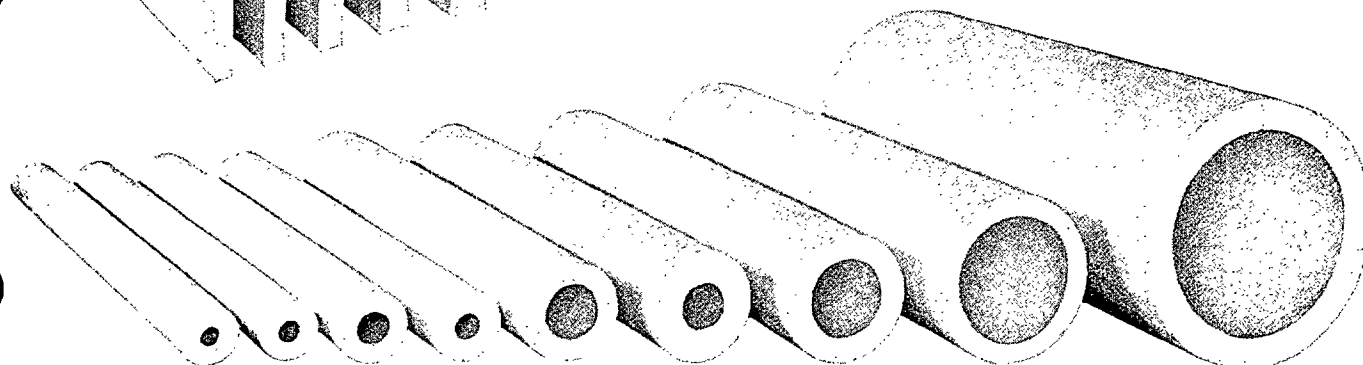
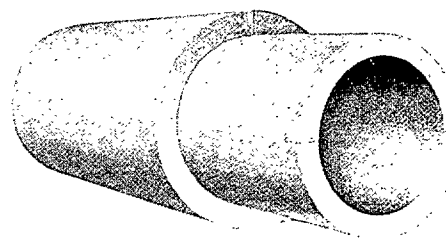
Under "physical characteristics" (page 5) other important advantages of Mundet "Custom-Molded" 85% Magnesia are outlined.

Mundet "Custom-Molded" 85% Magnesia pipe covering and blocks



block insulation
in various
thicknesses

double layer
sectional
pipe covering
up to 18" IPS



single layer pipe covering up to 18" IPS shown unsplit and uncanvassed

Mundet Cork Corporation

process of manufacture

The following descriptions and accompanying illustrations (taken in our plant) cover a few of the more important steps in the manufacture of Munder 85% magnesia pipe covering and blocks.

These manufacturing operations are an integral part of the modern Munder concept of superior quality insulation, efficiently produced.

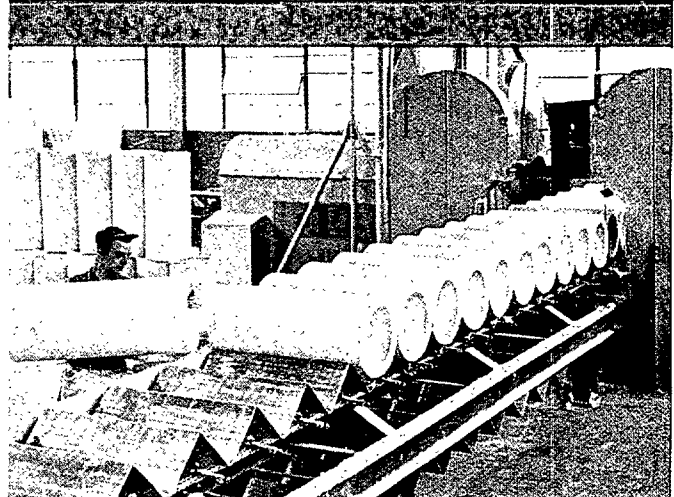
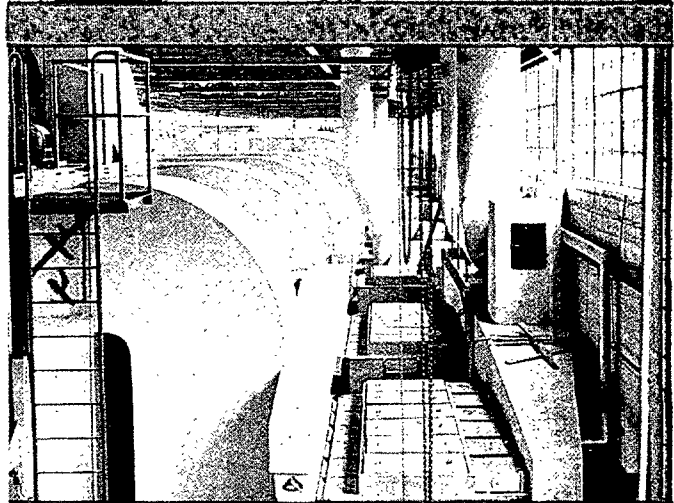
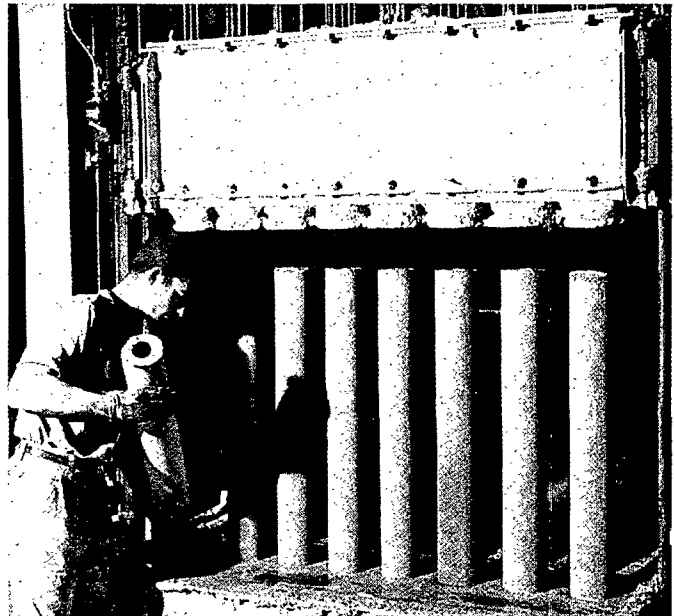
1. Magnesium carbonate (magnesia) and asbestos fibres, from which most of the water has been removed in filtering, moves by a screw conveyor into large revolving mixers (not shown). In the mixers a measured amount of water, which determines the final density of the insulation, is added and the machines rotated to produce a thoroughly homogeneous mixture.

This mixture of magnesia and asbestos fibres is weighed out by an overhead traveling scale into a battery of extruding machines. Reciprocating metal rods, called agitating fingers (shown at top of illustration), vibrate through the mold in order to dislodge any air bubbles and to assure longitudinal alignment of the asbestos fibres. The removal of a section of pipe covering from the mold is shown in top illustration.

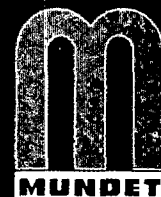
2. After being molded, the insulation, either in the form of pipe covering or solid blocks, is placed on racks and transferred to the drying ovens (shown at right). These ovens, fired by fuel oil, maintain a 400°F temperature.

3. The lower right-hand illustration shows the sections of pipe covering being placed on a moving conveyor after they emerge from the drying ovens. At the end of the conveyor is a machine which trims the ends of the insulation sections so that each piece is of standard length with trued ends which insure that the pieces will fit snugly together.

Before packing, each pipe covering section is slit in half longitudinally by machine. These sections are then wrapped in a standard canvas jacket and packed in cartons.



85% magnesia heat insulation



physical characteristics

compressive strength

Compressive strength is psi to produce $\frac{1}{8}$ " compression in $1\frac{1}{2}$ " thick sample 75-85 lbs.

ductile strength

Through the use of long asbestos fibres running longitudinally, greater strength is built into Mundet "Custom-Molded" 85% Magnesia. It exceeds the modulus of rupture requirements of the U.S. Navy Specifications, indicating fully adequate "machine test" strength. It does not "powder," settle or disintegrate even under heavy vibration. It withstands handling and may be removed and reapplied if necessary.

light weight

Mundet 85% Magnesia weighs only 11 lbs per cubic foot $\pm \frac{1}{2}$ lb. Its light weight makes even the larger sizes and thicknesses easy for one man to handle, thus simplifying and speeding up application.

easy to apply

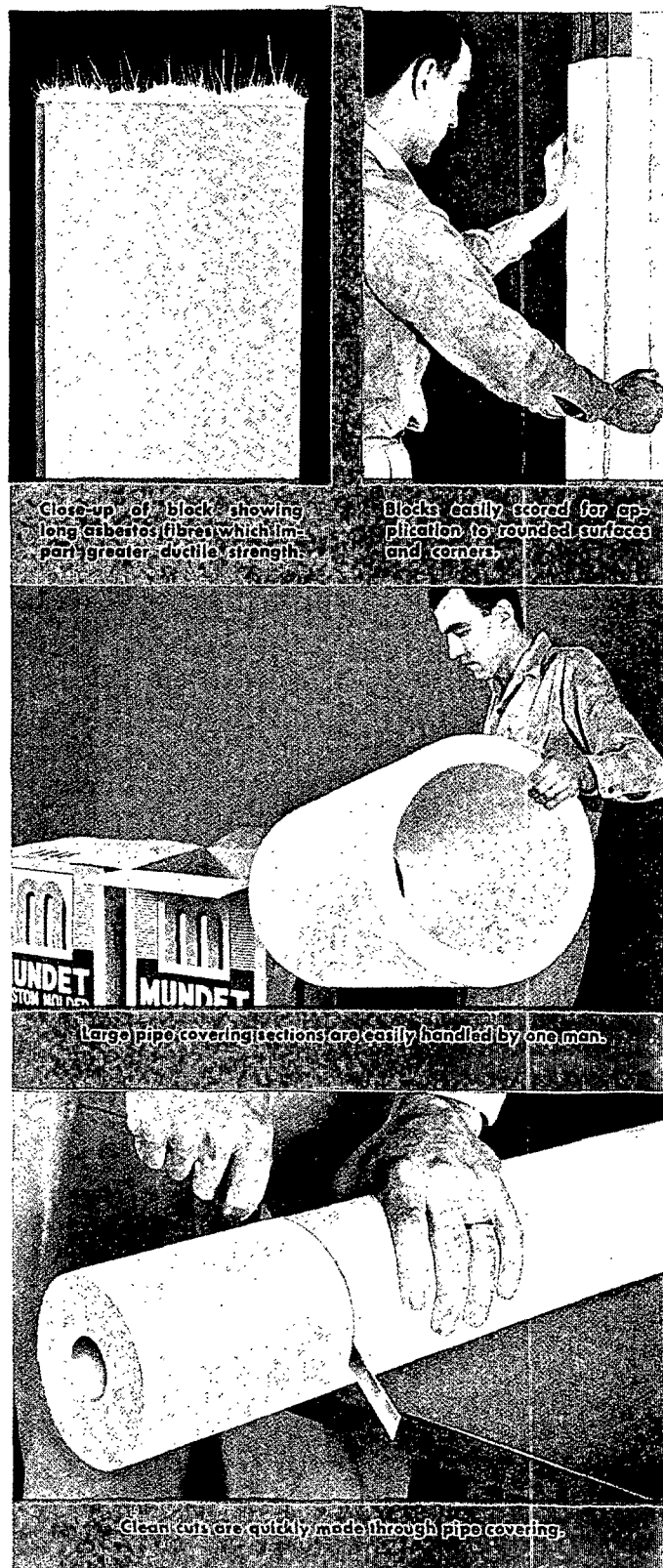
It cuts easily and cleanly, even without canvas support. No chipping or crumbling. Blocks score clean, easily, thus reducing time necessary for application.

minimum shrinkage

Steam or water leakage does not affect the structural characteristics. (Linear shrinkage—24 hr soaking period at maximum useable temperature 1-2%; volume shrinkage—24 hr soaking period at maximum useable temperature 3-6%.)

guarantee

The Company unqualifiedly guarantees that its material and workmanship are of the best and agrees to make good, without cost to the customer, any defect that may be chargeable to inferior material or workmanship as indicated in its contract form.



Mundet "Custom-Molded" 85% Magnesia pipe covering

simplified thickness standards for Mundet 85% magnesia pipe covering

Simplified thickness standards of prime sizes and thicknesses are intended to reduce the number of standard sizes and thicknesses of covering required for individual selection.

By slightly varying the wall thickness, every size and thickness will exactly fit over or into another standard size and thickness. This permits a great many unusual assemblies in addition to those shown on the chart.

Usually the variations in wall thickness are plus, but the minus cases are more than compensated for by the higher insulating value of Mundet *light density type* 85% magnesia.

notes applying to table

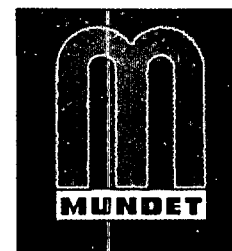
1. Prime sizes and thicknesses: large red figures.
2. Assembled sizes and thicknesses: large black figures.
3. Small red figures in parentheses shown immediately under each assembled thickness, are pipe sizes of layers used to make each assembled thickness. Thickness of such layers are indicated by:

No underline: Nominal 1" thick
 One underline: Nominal 1½" thick
 Two underlines: Nominal 2" thick
 Three underlines: Nominal 2½" thick

4. Sectional covering. All the above sizes and thicknesses are furnished in sectional form except: in the case of 16", 17" and 18" pipe sizes, in nominal 3" and 4" thicknesses, are furnished with sectional inner layer, and segmental outer layer.

nominal pipe sizes inches	copper tubing nominal 1" thick	iron pipe					
		nominal 1" thick	nominal 1½" thick	nominal 2" thick	nominal 2½" thick	nominal 3" thick	nominal 4" thick
¼"		⅞"					
⅜"	⅞"	1 ⅛"			2 ⅝" (⅜"-2 ½")	3 ⅝" (⅜"-2 ½")	
½"	1 ⅛"	1"	1 ⅝"	2 ⅛" (½"-2 ½")	2 ⅝" (½"-2 ½")	2 ⅝" (½"-2 ½")	3 ⅞" (½"-4 ½")
¾"	1"	2 ⅝" (¾"-2 ½")	1 ⅝" (¾"-2 ½")	2 ⅝" (¾"-2 ½")	2 ⅝" (¾"-2 ½")	3 ⅝" (¾"-2 ½")	3 ⅝" (¾"-4 ½")
1"	1 ⅝"	1 ⅝"	1 ⅝"	2 ⅝" (1"-3")	2 ⅝" (1"-3")	3 ⅝" (1"-4")	4 ⅝" (1"-5")
1 ¼"	1 ⅝"	2 ⅝" (1 ¼"-3")	1 ⅝" (1 ¼"-3")	2 ⅝" (1 ¼"-3")	2 ⅝" (1 ¼"-3")	2 ⅝" (1 ¼"-3")	3 ⅝" (1 ¼"-5")
1 ½"	1 ⅝"	1 ⅝"	1 ⅝"	2 ⅝" (1 ½"-3 ½")	2 ⅝" (1 ½"-4 ½")	3 ⅝" (1 ½"-6")	4 ⅝" (1 ½"-6")
2"	1 ⅝"	1 ⅝"	1 ⅝"	2 ⅝" (2"-4")	2 ⅝" (2"-4")	3 ⅝" (2"-5")	4 ⅝" (2"-6")
2 ½"	1 ⅝"	1 ⅝"	1 ⅝"	2 ⅝" (2 ½"-4 ½")	2 ⅝" (2 ½"-5")	2 ⅝" (2 ½"-5")	4 ⅝" (2 ½"-7")
3"	1 ⅝"	1 ⅝"	1 ⅝"	2 ⅝" (3"-5")	2 ⅝" (3"-5")	3 ⅝" (3"-6")	4 ⅝" (3"-7")
3 ½"		1 ⅝"	1 ⅝"	2 ⅝" (3 ½"-6")	2 ⅝" (3 ½"-6")	3 ⅝" (3 ½"-6")	4 ⅝" (3 ½"-8")
4"		1 ⅝"	1 ⅝"	2 ⅝" (4"-6")	2 ⅝" (4"-6")	3 ⅝" (4"-6")	4 ⅝" (4"-8")
4 ½"		1 ⅝"	1 ⅝"	2 ⅝" (4 ½"-7")	2 ⅝" (4 ½"-7")	3 ⅝" (4 ½"-7")	3 ⅝" (4 ½"-8")
5"		1 ⅝"	1 ⅝"	2 ⅝" (5"-7")	2 ⅝" (5"-7")	3 ⅝" (5"-8")	4 ⅝" (5"-9")
6"		1"	1 ½"	2 ⅝" (6"-8")	2 ⅝" (6"-8")	3 ⅝" (6"-9")	4 ⅝" (6"-10")
7"			1 ⅝"	2 ⅝"		3 ⅝" (7"-10")	4 ⅝" (7"-11")
8"			1 ⅝"	2 ⅝"	2 ⅝"	3 ⅝" (8"-11")	4 ⅝" (8"-12")
9"			1 ⅝"	2 ⅝"		3 ⅝" (9"-12")	4 ⅝" (9"-14")
10"			1 ⅝"	2 ⅝"	2 ⅝"	3 ⅝" (10"-14")	4 ⅝" (10"-15")
11"			1 ⅝"	2 ⅝"		3 ⅝" (11"-15")	4 ⅝" (11"-16")
12"			1 ⅝"	2 ⅝"	2 ⅝"	3 ⅝" (12"-16")	4 ⅝" (12"-17")
14"			1 ½"	2"	2 ½"	3" (14"-17")	4" (14"-18")
15"			1 ½"	2"		3" (15"-18")	4" (15"-18")
16"			1 ½"	2"	2 ½"	3" (16"-19")	4" (16"-20")
17"			1 ½"	2"		3" (17"-20")	4" (17"-21")
18"			1 ½"	2"	2 ½"	3" (18"-21")	4" (18"-22")

85% magnesia heat insulation



complementary pipe covering sizes

The table of complementary sizes shown below indicates the sizes and thicknesses of pipe covering which will exactly fit over or into other sizes and thicknesses.

nominal pipe sizes inches	O.D. pipe inches	core diam. pipe covering inches	O.D. covering 1" th.	cover fits into	O.D. covering 1½" th.	cover fits into	O.D. covering 2" th.	cover fits into	O.D. covering 2½" th.	cover fits into
¼"	.540	.622	2.422	2" x1"						
⅜"	.675	.708	2.959	2½" x1"						
½"	.840	.909	2.959	2½" x1"	4.093	3½" x1"				
¾"	1.050	1.120	2.959	2½" x1"	4.093	3½" x1"				
1"	1.315	1.387	3.591	3" x1"	4.598	4" x1"				
1¼"	1.660	1.735	3.591	3" x1"	5.100	4½" x1"				
1½"	1.900	1.977	4.093	3½" x1"	5.100	4½" x1"				
2"	2.375	2.455	4.598	4" x1"	5.667	5" x1"				
2½"	2.875	2.959	5.100	4½" x1"	5.667	5" x1"				
3"	3.500	3.591	5.667	5" x1"	6.737	6" x1"				
3½"	4.000	4.093	6.737	6" x1"	6.737	6" x1"				
4"	4.500	4.598	6.737	6" x1"	7.740	7" x1½"				
4½"	5.000	5.100	7.740	7" x1½"	7.740	7" x1½"	8.750	8" x1½"		
5"	5.563	5.667	7.740	7" x1½"	8.750	8" x1½"	9.760	9" x1½"		
6"	6.625	6.737	8.752	8" x1½"	9.760	9" x1½"	10.860	10" x1½"		
7"	7.625	7.745	.....	.....	10.860	10" x1½"	11.854	11" x1½"		
8"	8.625	8.752	.....	.....	11.854	11" x1½"	12.877	12" x1½"	14.136	14" x1½"
9"	9.625	9.760	.....	.....	12.877	12" x1½"	14.136	14" x1½"		
10"	10.750	10.893	.....	.....	14.136	14" x1½"	15.113	15" x1½"	16.120	16" x1½"
11"	11.750	11.900	.....	.....	15.113	15" x1½"	16.120	16" x1½"		
12"	12.750	12.908	.....	.....	16.120	16" x1½"	17.190	17" x1½"	18.197	18" x1½"
14"	14.000	14.167	.....	.....	17.190	17" x1½"	18.197	18" x1½"		
15"	15.000	15.175	.....	.....	18.197	18" x1½"	19.175	*19" x1½"		
16"	16.000	16.188	.....	.....	19.205	*19" x1½"	20.212	*20" x1½"		
17"	17.000	17.190	.....	.....	20.212	*20" x1½"	21.220	*21" x1½"		
18"	18.000	18.198	.....	.....	21.220	*21" x1½"	22.227	*22" x1½"		

* Segmental

recommended thicknesses of 85% magnesia pipe covering

temp. range (F.)	pipe insulation thickness* (nominal in.)				equipment insulation thickness, in.**
	pipe sizes, in.				
	½ to 3½	4 to 6	7 to 10	11 and over	
100-200	1	1	1 ½	1 ½	1 ½
200-300	1	1 ½	1 ½	2	2
300-400	1 ½	2	2 ½	2 ½	2 ½
400-500	1 ½	2	2 ½	3	3
500-600	2	2 ½	3	3 ½	3 ½

* Thicknesses for average conditions; exceptional conditions may necessitate thicker insulation.

** For outdoor lines and equipment, use ½ in. thicker insulation than listed.

Note: Table prepared from data supplied by MIMA.

heat savings through use of Mundet 85% magnesia blocks—with recommended thicknesses

temp. hot surface up to:	recom- mended block thick- ness, in.	blocks with no finish			with ½" magnesia cement		
		bare loss	savings	eff.%	bare loss	savings	eff.%
150°F.	1½	143.8	127.9	88.9	143.8	130.2	90.6
250°F.	2	412.3	383.7	93.0	412.3	386.9	93.9
350°F.	2½	784.9	746.7	95.2	784.9	750.5	95.6
450°F.	3	1281.6	1235.1	96.4	1281.6	1238.7	96.6
550°F.	3½	1932.6	1878.8	97.1	1932.6	1882.5	97.4

Notes: Efficiencies of hard finish cement is approximately 1% less than values for finish given in table.

Savings and losses are in btu per sq. ft. per hr. Air temperature is taken as 70°F. Bare losses represent an average for horizontal and vertical surfaces for an average condition of surface (emissivity taken as 0.85).

heat saved with thicknesses recommended

Mundet 85 % magnesia pipe covering expressed in btu's per lineal ft. per hr.

temperature of line—°F.	150°F.		250°F.		350°F.		450°F.		550°F.	
temperature difference	80°F.		180°F.		280°F.		380°F.		480°F.	
pipe size, in.	bare losses	savings	bare losses	savings	bare losses	savings	bare losses	savings	bare losses	savings
½"	38.2	27.8	108.8	85.3	203.9	164.8	327.2	280.0	485.3	426.0
¾"	46.7	34.4	133.2	104.3	250.0	212.3	402.0	347.7	597.2	533.7
1	57.2	42.7	163.2	132.9	306.8	265.8	494.2	435.1	735.7	667.0
1¼	70.8	55.3	202.1	164.3	380.6	335.6	614.4	547.9	916.1	834.4
1½	80.1	63.1	228.6	190.1	431.0	379.0	696.6	621.6	1039.7	956.1
2	98.0	77.1	280.1	235.7	528.9	470.2	856.3	771.7	1280.6	1184.5
2½	116.7	94.4	333.7	280.0	631.0	557.4	1023.1	916.0	1532.3	1430.6
3	139.8	113.7	399.8	340.3	757.2	679.5	1229.7	1117.7	1844.4	1718.9
3½	157.8	132.2	451.7	393.9	856.1	758.3	1391.8	1250.3	2089.6	1960.6
4	175.8	143.8	503.5	446.6	955.1	878.0	1554.1	1443.1	2335.3	2205.2
4½	193.7	162.1	554.9	483.8	1053.3	961.5	1715.3	1583.1	2579.7	2441.5
5	213.6	175.1	612.1	521.9	1162.8	1070.8	1895.2	1762.7	2852.6	2701.9
6	250.9	204.1	719.4	644.2	1368.3	1263.3	2233.2	2083.0	3365.2	3191.9
7	285.7	247.7	819.4	730.9	1560.1	1442.6	2548.9	2379.3	3845.0	3679.0
8	320.0	278.0	918.3	820.2	1749.7	1644.2	2861.3	2709.2	4320.1	4138.4
9	354.4	308.2	1017.2	909.4	1939.7	1804.8	3174.6	2979.7	4796.6	4597.8
10	392.9	343.6	1128.2	1013.3	2152.9	2023.5	3526.5	3340.4	5332.4	5115.1
11	426.3	364.2	1225.3	1080.0	2337.6	2173.4	3831.4	3656.8	5797.1	5563.6
12	459.9	402.6	1321.1	1187.5	2523.8	2376.0	4139.0	3946.1	6265.9	6016.9
14	501.5	436.5	1441.1	1320.8	2754.9	2588.9	4521.0	4313.8	6848.7	6603.6
16	567.8	494.4	1632.4	1496.7	3123.2	2936.5	5130.4	4899.1	7778.7	7504.9
18	633.5	552.1	1821.9	1671.2	3488.4	3282.1	5735.1	5478.9	8702.4	8406.1
20	698.9	608.7	2010.6	1845.1	3852.3	3625.8	6337.8	6057.4	9623.5	9292.5
24	828.5	721.8	2384.5	2189.0	4574.2	4307.3	7539.3	7209.2	11454.5	11065.5
30	1020.6	888.8	2939.5	2698.2	5646.5	5320.5	9315.3	8911.9	14181.1	13707.3

notes:

These computations hold for still air at 70°F. The pipe is taken as black pipe in average condition for bare loss calculations. The emissivity is taken as 0.85. Convection losses are computed from the following formula:

$$Q_c = 1.016A \times \frac{1}{D^{0.2}} \times \frac{1}{T^{0.181}} \times d^{1.266}$$

where A is the area in sq. ft., D is diameter in inches, T is the average temperature of pipe and ambient in de-

grees Rankine (°F + 460), and dt is the temperature difference in °F between the pipe and surrounding air.

Radiation losses are computed from the following:

$$Q_R = 17.4 \times 10^{-10} p (T_1^4 - T_2^4) A$$

where p is the emissivity and T_1 and T_2 are the absolute temperatures of the hotter and cooler surfaces, T_2 is taken as 530°R for the above tables. (R is Rankine temperature).

85% magnesia heat insulation



Mundet "Custom-Molded" 85% Magnesia segmental pipe covering

Mundet segmental pipe covering can be furnished in all conventional sizes, thicknesses or types, including double layer (double standard) and curved radius blocks. The segmental pipe covering is molded in segmental form to a predetermined standard radius. Only the edges are milled so that the segments will conform precisely to the required diameter. The inner and outer surfaces are left with their original smooth molded facing. These are designed for pipe covering applications where sectional (2-piece) pipe covering cannot be used due to size limits.

All pipe sizes larger than 18 inches, and all other pipe sizes not listed on page 6 are furnished in segmental form.

The following table shows the number of segments per section of pipe covering for all thicknesses of segmental pipe covering.

nominal pipe sizes inches	number of segments	nominal pipe sizes inches	number of segments
19	10	24	12
20	10	26	13
21	11	27	14
22	11	28	14
23	12	30	15

Mundet 85% magnesia cement

Mundet 85% magnesia cement is used for filling joints and cracks in 85% magnesia pipe covering and blocks. It is a highly efficient insulating cement, recommended for temperatures up to 600°F. It is not recommended for hard finishes.

This cement is mixed with water to the proper consistency, and usually applied in layers of 1/4 in thickness over 85% magnesia blocks where the insulated areas are to be finished with canvas or mastic.

The conductivity of Mundet 85% magnesia cement averages approximately 10% higher than this material in molded form due to the cement being of higher density upon application.

Furnished in 50 lb, 3 ply paper bags.

Covering capacity: approximately 30 sq ft, 1 inch thick, per bag.



data for heat transfer calculations

flat surfaces (slabs)

The rate of heat flow through a slab of any material may be expressed as:

$$q = \frac{(t - t_c)}{\frac{L}{k} + \frac{1}{h}} \quad (\text{equation 1})$$

where,

q = rate of heat flow from cold surface of material, btu per sq ft per hour

L = thickness of slab, inches

k = thermal conductivity, btu per hour per deg F per sq ft per inch

h = surface coefficient of heat transfer, btu per hour per deg F per sq ft

t = hot ambient temperature, deg F

t_c = cold ambient temperature, deg F

For an insulation composed of several layers, the rate of heat flow becomes:

$$q = \frac{(t - t_c)}{\frac{L_1}{k_1} + \frac{L_2}{k_2} + \frac{L_3}{k_3} + \frac{1}{h}} \quad (\text{equation 2})$$

The meaning of the letters L , k , and h are the same as for equation 1; the subscripts refer to the several layers.

Both k and h vary with the temperature. The values of k should correspond to the mean temperature of the insulating slab; and the values of h should correspond to the difference between outside (cold surface) temperature and cold ambient, or $(t_o - t_c)$. The k values for 85% magnesia insulation are given on p. 3 and may be plotted as a function of temperature. The h values are given on p. 11, Fig. 1. As a close approximation to mean temperature, the average of hot and cold ambients may be taken. The hot surface temperature is assumed in equations 1 and 2 to be the same as that of the hot ambient. The cold surface temperature may be found by trial and error as follows:

Estimate a value of cold surface temperature, t_o , say 30 degrees F above the cold ambient temperature, t_c . Determine $t_o - t_c$, then enter chart on fig. 1, p. 11, and read off corresponding h value. With this value of h substituted in equation 1 or 2, solve for q . A truer value of

$$t_o - t_c = q/h \quad (\text{equation 3})$$

may now be determined. Now use Fig. 1 again to select a new value of h ; introduce into equation 1 or 2 and redetermine q . The process of trial and error may be repeated several times until the value of q , hence also of h and $t_o - t_c$, does not change very much in two successive trials.

cylindrical surfaces (pipe insulation)

The rate of heat flow per lineal pipe foot may be found from equation 4:

$$Q = \frac{\pi (t - t_c)}{\frac{1}{hd_o} + \frac{1}{2k} \ln d_o/d_i} \quad (\text{equation 4})$$

where d_o and d_i are outside and inside diameters of the insulation, t the temperature of the inner surface (which is so close to the temperature of steam or hot water flowing inside the pipe that this value may be used), k the mean conductivity of the insulation, and h the rate of heat transfer at the outside surface. Be sure that consistent units are used and that the natural logarithm of d_o/d_i enters into equation 4.

Assume a value of outside surface temperature, say 30 degrees above that of the cold ambient, t_c , and proceed as with flat surfaces. The first approximation of Q having been obtained, calculate $t_o - t_c$ from equation 5:

$$(t_o - t_c) = Q/\pi hd_o \quad (\text{equation 5})$$

Read h again from Fig. 1 (this curve holds for both flat and cylindrical surfaces), and continue with further trials until a constant or nearly constant value of Q is reached in successive trials. If more accuracy is desired, the value of k should be adjusted to that of the exact mean temperature instead of the approximate average of hot and cold ambient temperatures.

two-layer cylindrical surfaces

In a similar manner to the single layer, rate of heat flow is:

$$Q = \frac{\pi (t - t_c)}{\frac{1}{hd_o} + \frac{1}{2k_1} \ln d_o/d_1 + \frac{1}{2k_2} \ln d_1/d_i} \quad (\text{equation 6})$$

where d_o is the outside diameter of the insulation, d_1 the diameter between the two layers, and d_i the diameter of the inner layer (OD of the pipe); k_1 and k_2 are conductivities for the outer and inner layer respectively; other quantities are as before. (For more layers simply add terms to the denominator like those above involving the conductivity and natural log.)

The calculation is a little more involved than that for the single layer but is basically the same. Both k_1 , k_2 and h are functions of temperature, and more trials may have to be made than with one layer. Assume mean temperatures for each layer of insulation, then from the data available

85% magnesia heat insulation



of k versus temperature select values for k_1 and k_2 . Assume an outside temperature and determine h as for slabs. Then solve for Q in equation 6 and $(t_o - t_c)$ from equation 5. A new value of h may then be determined. In order to determine new values for conductivity, determine the mean temperatures as follows:

Call the terms in the denominator of equation 6 R_i , R_1 , and R_2 respectively, each representing a thermal resistance. The temperature is divided in proportion to these thermal resistances. Hence the temperature at the outside surface is:

$$t_o = t_c + \frac{R_i}{R_i + R_1 + R_2}(t - t_c) \quad (\text{equation 7})$$

and the temperature between the layers is:

$$t_1 = t_c + \frac{R_1 + R_i}{R_i + R_1 + R_2}(t - t_c) \quad (\text{equation 8})$$

Having obtained the outside and inside temperatures for each layer, the mean temperature is easily found.

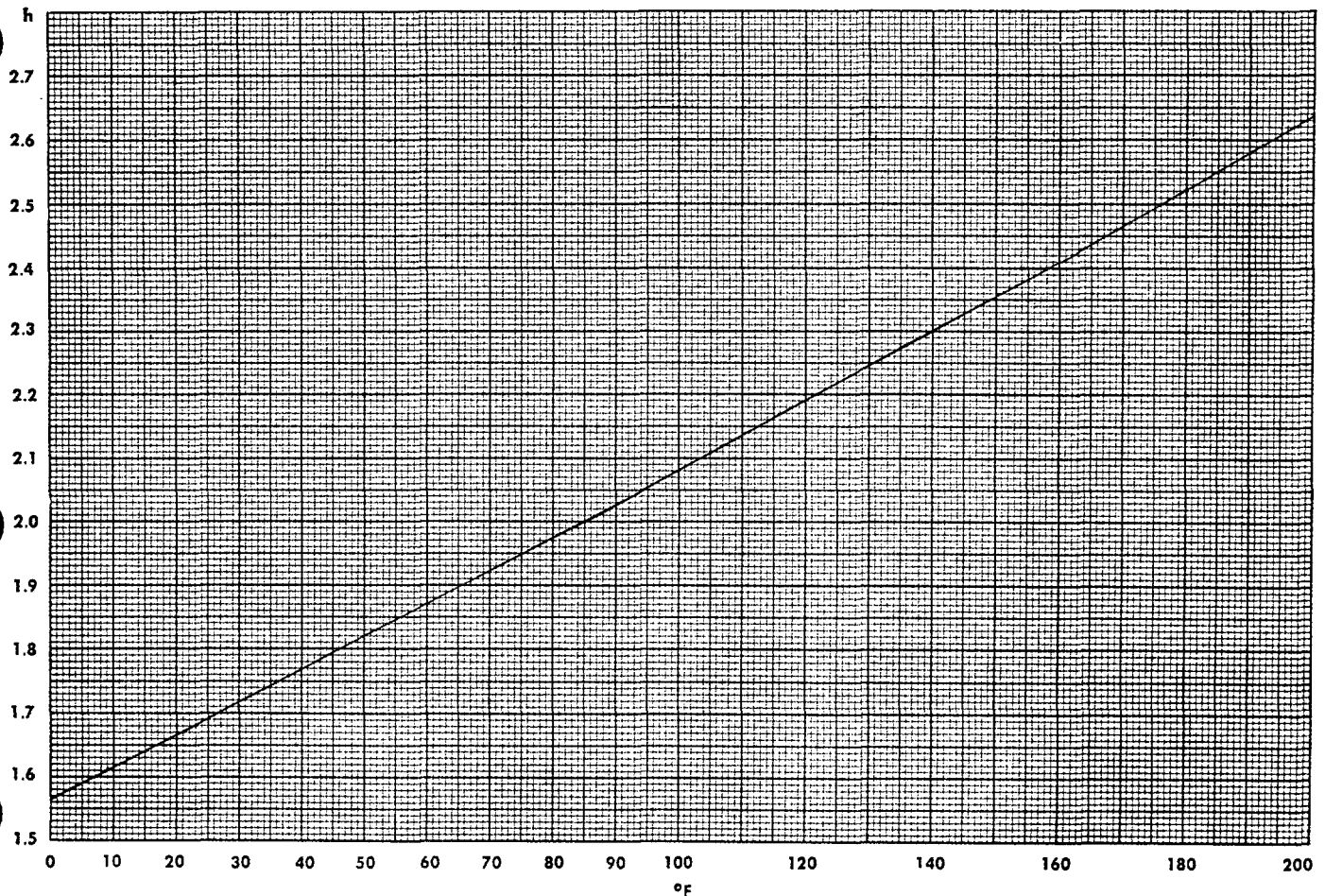
Solve for Q several times until, as with single layers, the value for successive trials does not change appreciably.

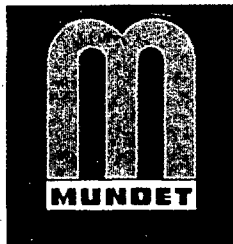
effect of windage

The values of h shown below are for still air only. The radiation component of h will decrease slightly when windage is present due to decreased surface temperature. But the convection component will increase markedly, depending upon wind velocity and direction, pipe diameter, and other factors. Hence no simple table of windage increase factors for heat loss should be made. In general, for moderate winds of up to 25 miles per hour, the heat loss will be between one and four times the loss without windage. The overall influence on efficiency, however, is usually not more than a few percent.

note: The graph below is for an average pipe insulation finish. With different finishes, the radiation component will vary slightly but the convection component remains unaffected.

h versus temperature difference between surface and ambient. h is in btu per sq ft per hr per degree F. (Fig. 1)





85% magnesia heat insulation

contract service

Complete installation services are available by trained, experienced specialists, operating from Mundet district offices in key cities throughout the United States.

Mundet warehouses and inventories of standard insulating materials are maintained at many points, to insure prompt local service.

Recommendations and estimates may be obtained promptly by contacting the Mundet home office in North Bergen or any of our branches. We will be glad to cooperate in every possible way to insure the most effective insulation performance.

MUNDET CORK CORPORATION

Manufacturers of light density type 85% magnesia under one or more of the following United States Letters Patents: 2,131,374; 2,209,753; 2,209,754; 2,209,752; 2,339,041.

Insulation Division—7101 Tonnelle Ave., North Bergen, N. J.

district offices:

ATLANTA: 339-41 Elizabeth Street, N.E.

BALTIMORE 30: 612 Battery Avenue

BOSTON: 57 Regent Street, North Cambridge 40

CHARLOTTE 31: 507 S. Cedar Street

CINCINNATI 21: 427 West 4th Street

DALLAS 10: 601 Second Avenue

DETROIT 21: 14401 Prairie Avenue

HOUSTON 11: 2 N. Palmer Street

INDIANAPOLIS 4: 115 E. Washington Street

JACKSONVILLE 6: 800 E. Bay Street

KNOXVILLE: 1221 Grand Ave.

KANSAS CITY 7: 1401 St. Louis Ave.

LOS ANGELES (Maywood): 6116 Walker Ave.

NEW ORLEANS 16: 515-25 N. Front St.

NEW YORK 17: 331 Madison Avenue

PHILADELPHIA 39: 856 N. 48th Street

ST. LOUIS 9: 3176 Brannan Ave.

SAN FRANCISCO 7: 440 Brannan Street

In Canada: Mundet Cork & Insulation, Ltd., 35 Booth Ave., Toronto

Write for the name of our nearest representative if there is no Mundet office in your city.

Printed in U.S.A.

McLEAN - PETERSON CO.,

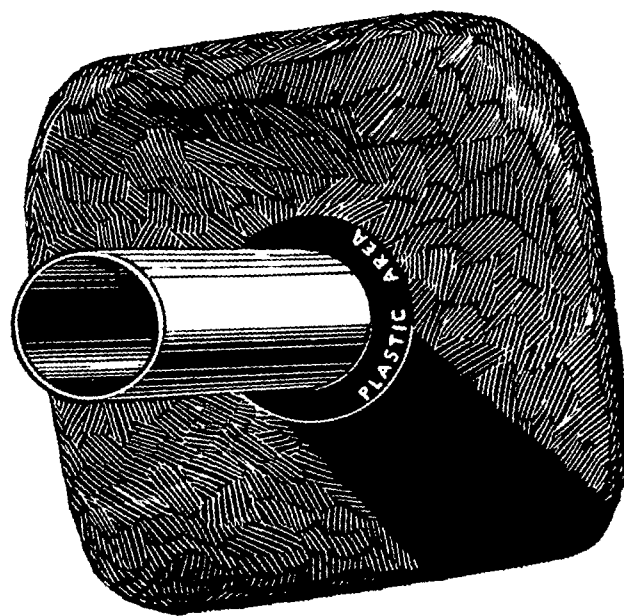
Phone TWood 1-1370

2105 Stewart Road, Cincinnati, 21, Ohio

AIA FILE NO. 37-D-

insul-fil

technical data



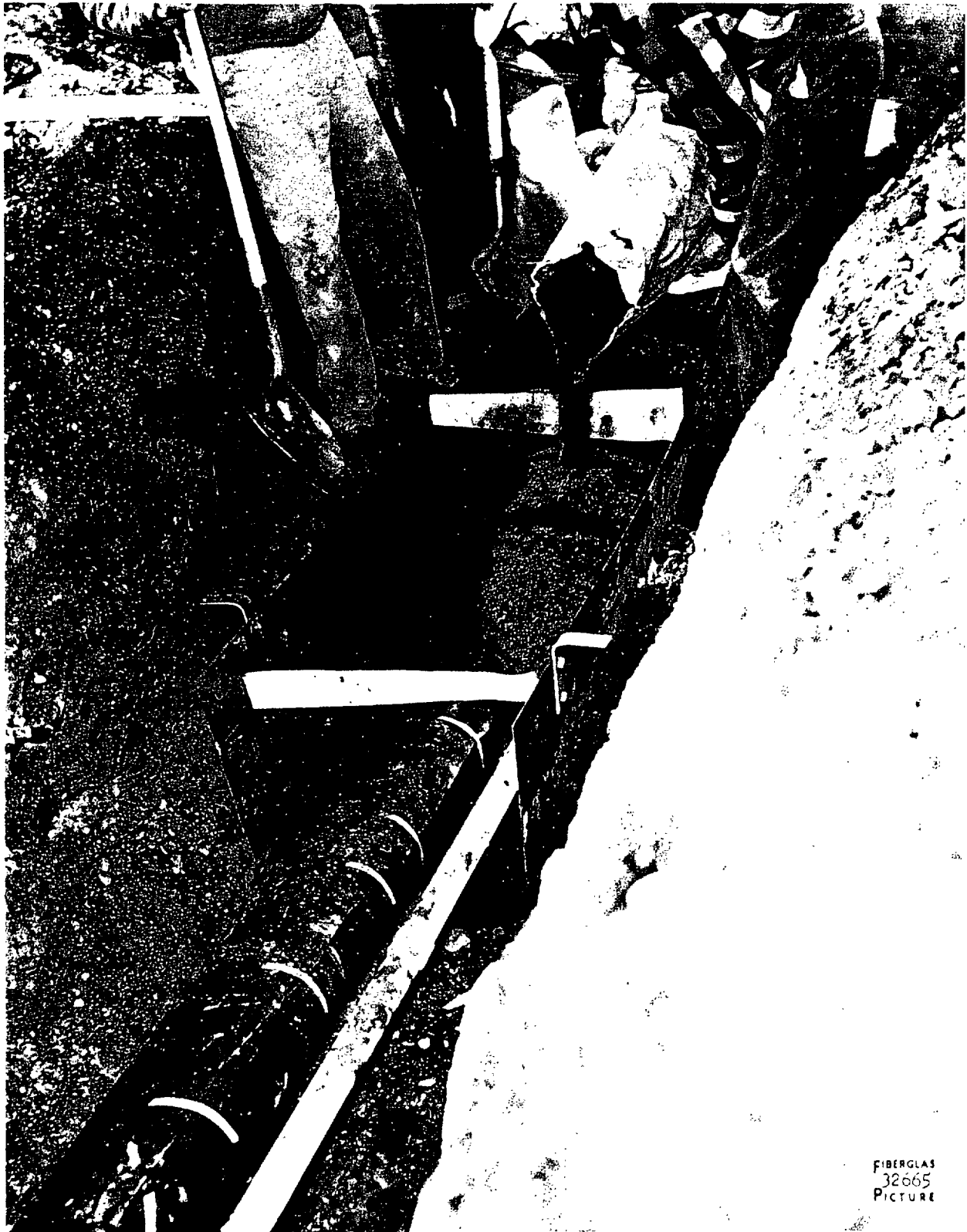
U.S. Patent No. 2,774,383

INSUL-FIL CO., INC. • A Division of MIRACLE ADHESIVES CORP. • 250 PETTIT AVE. • BELLMORE, L. I.



Installing INSUL-FIL at Idlewild International Airport for Port of New York Authority

(Seelye, Stevenson, Value & Knecht — Consulting Engineers)

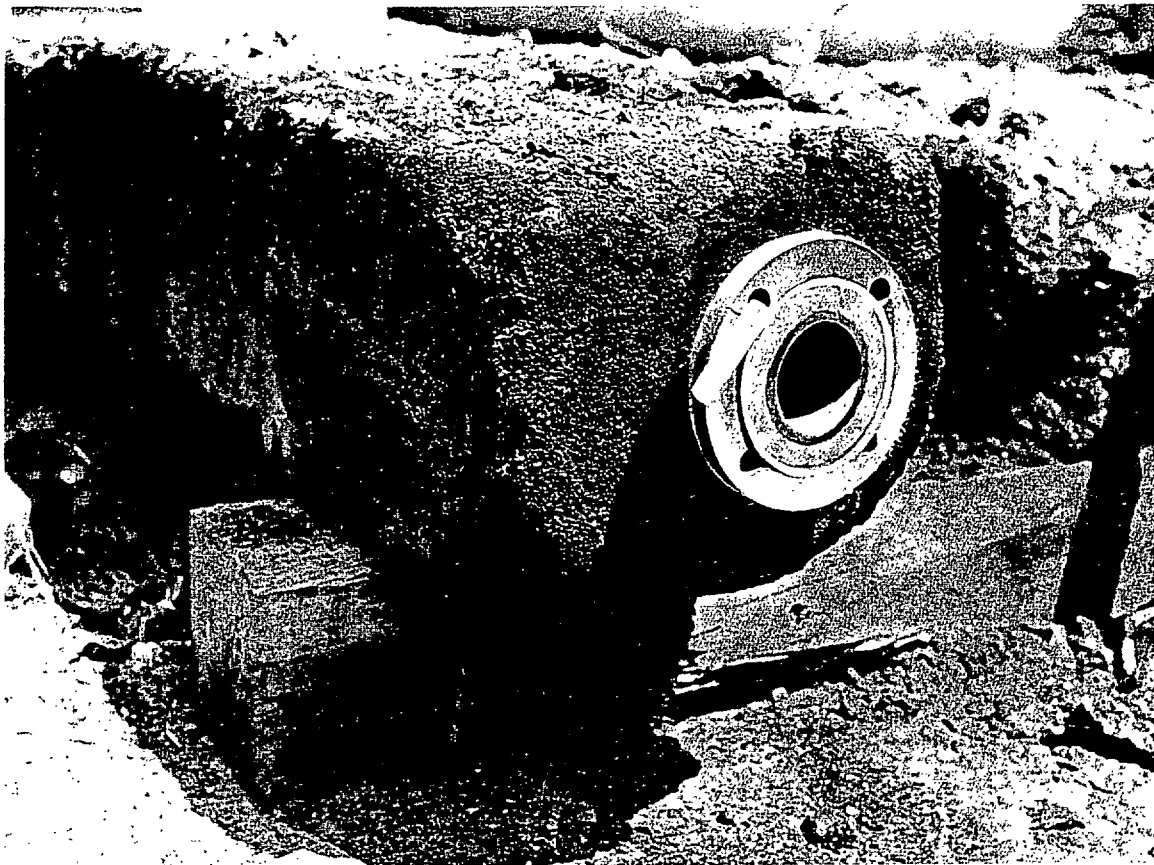


FIBERGLAS
32665
PICTURE

**Installing INSUL-FIL Conduit on 1250' — 6" Fuel Oil line with 3" Steam Tracer plant of
Owens-Corning Fiberglas Corporation, Newark, Ohio**

Roofing jacket prevents INSUL-FIL from filling space between steam and oil lines

(White 2" pipe contains electrical wiring.)



Test section removed from trench for close examination and inspection



Test section of INSUL-FIL Conduit removed from trench for inspection. Careful examination failed to disclose any shrinkage cracks or voids after cooling. This condition remained unchanged after being exposed to the sun and rain for several months. This is proof positive of the structural stability of INSUL-FIL Conduit.

Actual field conditions were simulated in all tests. 150 lbs. steam was used. Lines were subjected to alternate heating and cooling for extended periods of time.

Site was selected to permit flooding for study of effects of moisture on conduit.

Thermo-couples recorded temperatures at pipe and at varying distances from the pipe.

These tests confirm our claims to the structural stability of INSUL-FIL as well as its effectiveness as an insulating material and a protection against pipe corrosion.



Section of INSUL-FIL Conduit removed from pipe after several cycles of heating and cooling gives further evidence of the structural stability of INSUL-FIL Conduit.

TECHNICAL DATA

GENERAL: INSUL-FIL is a composition of a uniform refined heat stable bituminous material and a precoated expanded Perlite aggregate. The INSUL-FIL components and the INSUL-FIL Product are produced by controlled manufacturing procedures. The initial heat from high pressure hot water or steam distribution systems converts the INSUL-FIL to a thermo-plastic, water resistant and highly efficient insulating and corrosion resistant conduit.

BULK DENSITY: Approximately 25 lbs. per cu. ft. (loose volume) or approximately 80 cu. ft. per ton.

PACKAGING: INSUL-FIL is supplied in multi-wall water resistant paper bags containing 2 cu. ft. per bag and weighing approximately 50 lbs. per bag.

OVERALL K FACTOR: K values were determined in the Laboratories of the Research and Development Department of The Atlantic Refining Company. For the purpose of determining relative values, four materials were tested under identical conditions and employing identical procedures in each case. The following results were obtained:

OVERALL K VALUE	
Clay Soil	3.120
100% Bitumen	.74
INSUL-FIL	.451
*Expanded Perlite	.39

*Checks well with K values for this material reported in recent literature.

STRUCTURAL STABILITY: Results of a series of field tests indicated that the structural stability of INSUL-FIL Conduit was superior to a 100% bituminous conduit tested under identical conditions.

TEMPERATURE RANGE: General purpose INSUL-FIL is designed for use with pipe temperatures from 200 deg. F. to 400 deg. F. Inasmuch as refinery facilities are available for producing the bituminous component with controlled softening point, INSUL-FIL can be designed for a wider range of underground steam or high pressure hot water distribution systems to meet special conditions.

DESCRIPTION AND INSTRUCTIONS FOR INSTALLING INSUL-FIL CONDUIT SYSTEMS

1. DESCRIPTION

INSUL-FIL is a composition of a uniform refined heat stable bituminous material and a precoated expanded Perlite aggregate. The INSUL-FIL components and the INSUL-FIL Product are produced by controlled manufacturing procedures. The initial heat from high pressure hot water or steam distribution systems converts the INSUL-FIL to a thermo-plastic, water resistant and highly efficient insulating and corrosion resistant conduit. The process for the manufacture of INSUL-FIL was developed exclusively for INSUL-FIL CO., INC. — a Division of MIRACLE ADHESIVES CORPORATION, in cooperation with the Research and Development Department of THE ATLANTIC REFINING COMPANY. The management of INSUL-FIL CO., INC. has a record of more than twenty-five years experience in the underground insulation field.

2. METHOD OF INSTALLATION

INSUL-FIL shall be installed by pouring the material from the bag directly into the trench. All water shall be removed from the trench before the installation of INSUL-FIL.

INSUL-FIL shall be applied to the clean pipe walls after the pipes have been tested and accepted. Recommended minimum thicknesses are as shown below:

Nominal Pipe Size Inches	Recommended INSUL-FIL Thickness
1" to 6"	4"
8"	5"
10" - 12"	7"
16"	10"

The above table of thicknesses applies to the thickness of the conduit in place. In other words, the thickness of the INSUL-FIL under, above, and on the sides of the pipe.

In the case of multiple pipe installations, the prescribed thicknesses are indicated in "Detail B" which follows.

Prior to installation of INSUL-FIL, all water shall be removed from the trench and the trench shall be kept free from water until the conduit has been formed. Precautions shall be taken to prevent soil being mixed with the INSUL-FIL during installation.

A suitable tool shall be used to pack the INSUL-FIL completely around and against the pipe so as to eliminate any possibility of voids occurring under the pipes.

The top of the pipe or pipes shall be covered with the specified minimum thickness indicated above. The material shall then be thoroughly tamped with tamper constructed of a 8" x 8" x 1/4" steel plate provided with a handle. An approximate 10" stroke shall be used when tamping.

When INSUL-FIL is installed adjacent to manhole or building wall, the installer shall require that the piping contractor provide packing between the piping and sleeves passing thru the wall as shown in Detail "D" of the accompanying detail drawings.

3. FORMING THE INSUL-FIL CONDUIT

The formation of the INSUL-FIL Conduit is accomplished by the introduction of heat in the pipe or pipes. Steam may be available from existing sources or may be made available by the use of Tank Car Type Portable Heaters with sufficient capacity to maintain required temperatures in the pipe during the time required to form the conduit as indicated in Chart No. 1 which follows.

Pipes in the system having low operating temperatures such as hot water circulating lines operating at 180°F. or condensate lines operating at 100°F. shall be subjected to a source of heat, either water or steam, at 220°F. or higher for sufficient time, as indicated on Chart No. 1, to form the Conduit.

Using steam as the medium to form the Conduit, necessitates the use of valves or traps to release the condensate in order to raise the temperature to the required level indicated in Chart No. 1.

In those instances where installations are made in dry soil, trench may be backfilled prior to the application of heat to form the conduit. However, provision should be made for inspection at a convenient point as a check on proper formation of the conduit after heat has been applied for the required time.

Time required to form conduit as indicated in Chart No. 1, shall start from time temperature of the pipe has risen to the point indicated on the Chart, and curing shall be continuous for the time and temperature indicated.

In the event standing water is present in the trench due to a high water table or other reasons, the water shall be pumped from the trench by any approved method and pumping shall continue until conduit is formed and backfilling has been completed.

If heavy snows or rain are encountered during installation of the INSUL-FIL, heat should be applied and the conduit formed prior to backfilling.

4. PROVISIONS FOR EXPANSION LOOPS OR OFFSETS

In addition to the specified thickness, where pipe expansion is provided for by expansion loops or offsets, five inches of INSUL-FIL in addition to the specified thickness shall be installed on the side of each loop or offset in the direction of expansion. Where a loop or offset is subjected to heavy surface or traffic

DESCRIPTION AND INSTRUCTIONS FOR INSTALLING INSUL-FIL CONDUIT SYSTEMS

loads, an extra five inches of INSUL-FIL shall be added to the specified thickness on top of each pipe. Expansion movement on each loop leg or offset shall be limited to a maximum of three inches. Expansion movement of pipes entering bellows or slip-type joints shall be limited to a maximum of four inches.

5. PROVISIONS FOR HEAVY SURFACE OR TRAFFIC LOADS

Where the pipes pass under areas such as streets, roads or railroads supporting heavy loads, an extra three inches of INSUL-FIL shall be added over the top of the specified thickness, except in those instances where other reinforcing means are required to support the loads.

6. BACKFILL — GENERAL

Following the tamping of the INSUL-FIL as per Par. 2 the material shall be covered by the INSUL-FIL bags. A minimum of twelve inches of backfill shall be placed over the bag-covered INSUL-FIL. Manual or machine backfilling methods may be used. Selecting backfill is not necessary. If the backfill is to be consolidated by puddling, the material shall be first conditioned by application of heat as per Par. 3.

7. BACKFILL UNDER PAVED ROADS

Where the INSUL-FIL conduit passes under paved roads the structure may be formed either before or after backfilling. After the structure is formed the well tamped backfill shall be brought to grade before pavement is laid.

8. PIPE CONNECTIONS

Threaded connections on pipe shall not be used in an INSUL-FIL Conduit System without specific approval of the Engineering Department of the INSUL-FIL CO., INC.

All connections on copper piping when used in an INSUL-FIL Conduit System shall be formed by using a high temperature solder or brazing alloy.

9. PIPE SUPPORTS

Pipe supports of the types indicated in Detail "G", shall be provided and spaced not more than 10 feet apart. For spongy or corrosive soil, the type of supports indicated in Detail "H" shall be provided.

Alternate pipe supports for dry, firm, non-corrosive soil such as shown in Detail "I" may be used.

10. PIPE GUIDES

Pipe guides as shown in Detail "E" will permit free movement of the pipe and shall be placed close to the ends of straight runs of pipe, close to the point where pipes enter loops or offsets; guides shall be placed just outside of building or manhole walls where pipes enter an expansion joint. Guides of this type shall also be placed in the center of straight runs, midway between the anchor and expansion facility. Alternate types of guides shall be submitted to the INSUL-FIL CO., INC., for approval.

11. ANCHORS

Details "E" and "F" are the type anchors recommended by the INSUL-FIL CO., INC. The appropriate type shall be spaced so that the expansion on each offset or loop leg shall not exceed three inches. In the case of expansion joints, these anchors shall be so spaced that the maximum movement of each pipe entering the joint shall not exceed four inches.

Alternate types of anchors should be submitted to the INSUL-FIL CO., INC., for approval.

12. USE OF FORMS

Where trenches are wider than is necessary to contain the INSUL-FIL conduit, material can be conserved by the use of forms. These forms may be made of 14 gauge metal approximately 18 inches wide by 96 inches long with a metal handle affixed at each end, for ease of handling. Plywood or other suitable materials may be used in lieu of metal. The forms are placed in position in the trench so as to provide the required thickness of finished conduit. Suitable separators or clumps may be used to hold the forms the proper distance apart. Sufficient backfill may then be placed and lightly tamped behind the forms to furnish support. INSUL-FIL may then be placed inside the forms, properly tamped, as called for in instructions and the backfill firmed by any suitable means outside of the form. The forms may then be easily pulled forward by the handles into the next position and the process repeated.

13. REPAIRS TO PIPING IN INSUL-FIL CONDUIT SYSTEM

Repairs to piping in an INSUL-FIL Conduit System in the event of a leak anywhere in the system are easily and readily effected. In the first place the steam will make its way thru the conduit at the exact point where the leak occurs. The usual expensive cost of excavating to find the location of the leak is eliminated. The conduit is readily removed in the vicinity of the leak. The leaky pipe is cut out — a new section welded in place. INSUL-FIL is dumped in place; the steam turned on and the line is back in service with a minimum of cost and delay.

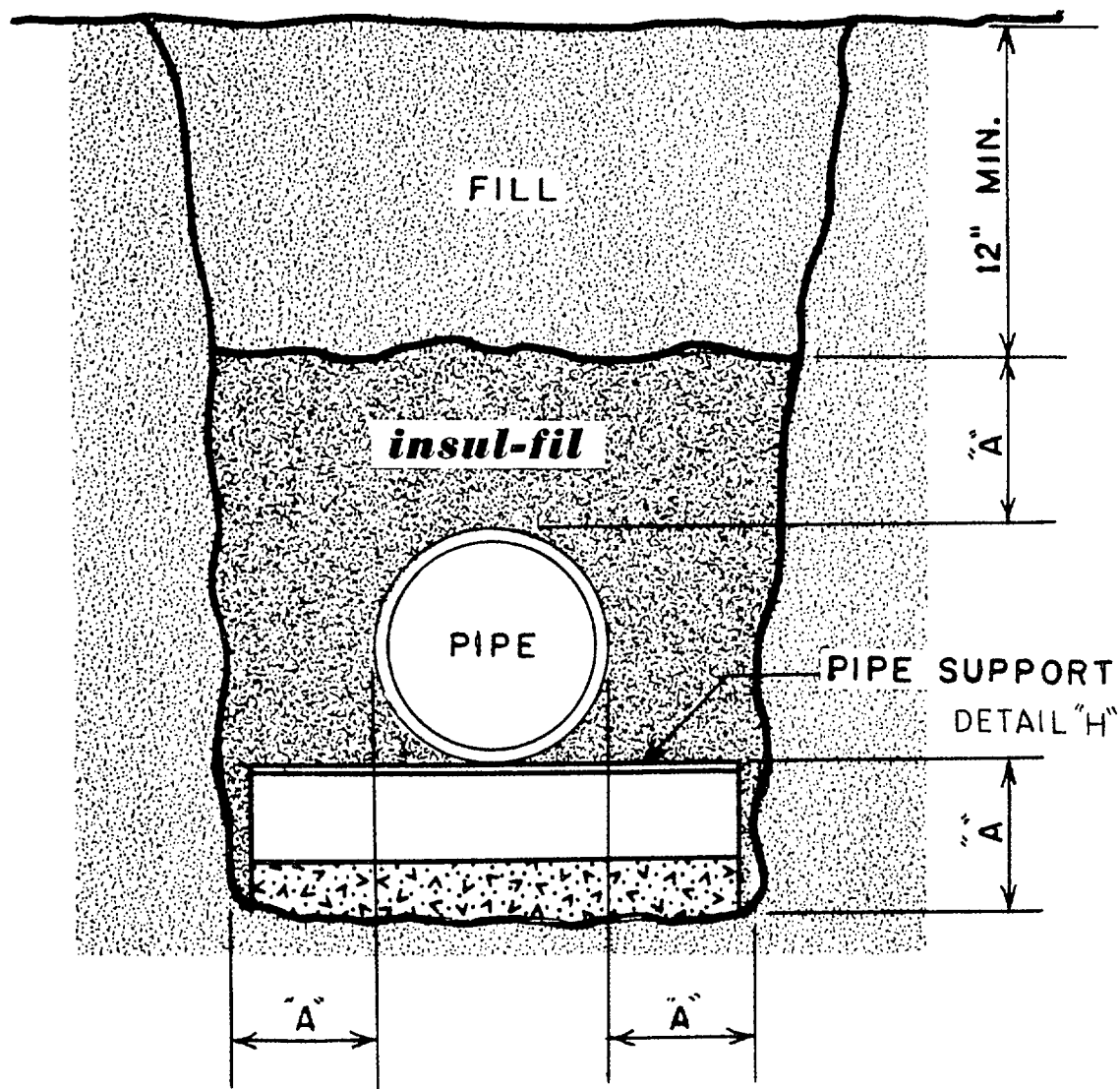
14. ACCOMPANYING DETAIL DRAWINGS

The accompanying drawings are intended solely as an aid and guide in detailing a typical layout for an INSUL-FIL conduit installation.

SHORT FORM SPECIFICATIONS

All underground steam and return piping shown on plans shall be contained in an INSUL-FIL Conduit System installed in accordance with recommendations and instructions of the manufacturer, INSUL-FIL CO., INC., Division of Miracle Adhesives Corporation, 250 Pettit Avenue, Bellmore, L. I., N. Y. Upon completion of the installation, including formation of the conduit, the manufacturer shall certify in writing that the work has been done according to his recommendation and in a satisfactory manner.

All piping shall be tested and approved in accordance with the specification prior to the installation and formation of the INSUL-FIL Conduit System.

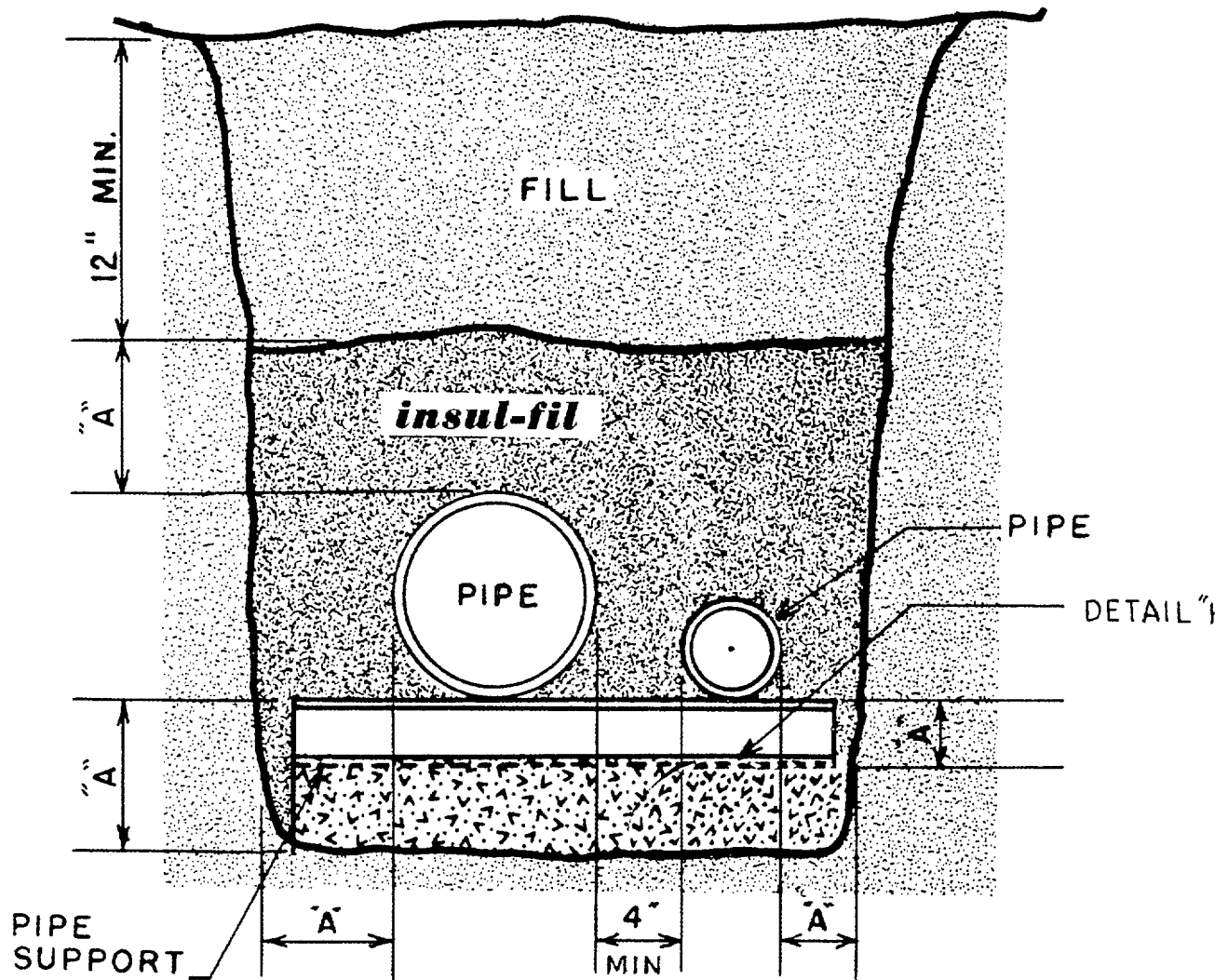


DETAIL "A"

TYPICAL TRENCH SECTION FOR SINGLE PIPE LINE

1. To provide sufficient space for a proper thickness of INSUL-FIL conduit, trenches should be excavated to minimum dimensions shown. Width of trenches may necessarily be increased to provide sufficient working space under various conditions. In such cases, thickness of conduit is maintained by use of metal or plywood forms as set forth in Instructions.
2. Adequate allowance shall be provided for expansion and contraction of all piping. Supports shall be provided as shown in Details "G", "H" or "I". All piping shall be clean, dry and free from scale or any foreign material, prior to installing INSUL-FIL in trench. Minimum trench clearances are indicated.
3. INSUL-FIL shall be poured directly from bags into trench, care being taken that all spaces shall be properly filled; under and at sides of piping. Using suitable tools INSUL-FIL shall be packed carefully around under and against the pipe. Top of pipes shall be covered with INSUL-FIL to a minimum depth as indicated below after being tamped in the manner indicated in Instructions. Pipes placed in areas subjected to heavy loads such as railroads, streets or highways should have an added thickness of INSUL-FIL in the amount of three inches installed on top of the pipe and this shall be in addition to the required thickness indicated below:

PIPE SIZE INCHES	MINIMUM THICKNESS FOR DIMENSION "A"
1-6	4
8	5
10-12	7
16	10

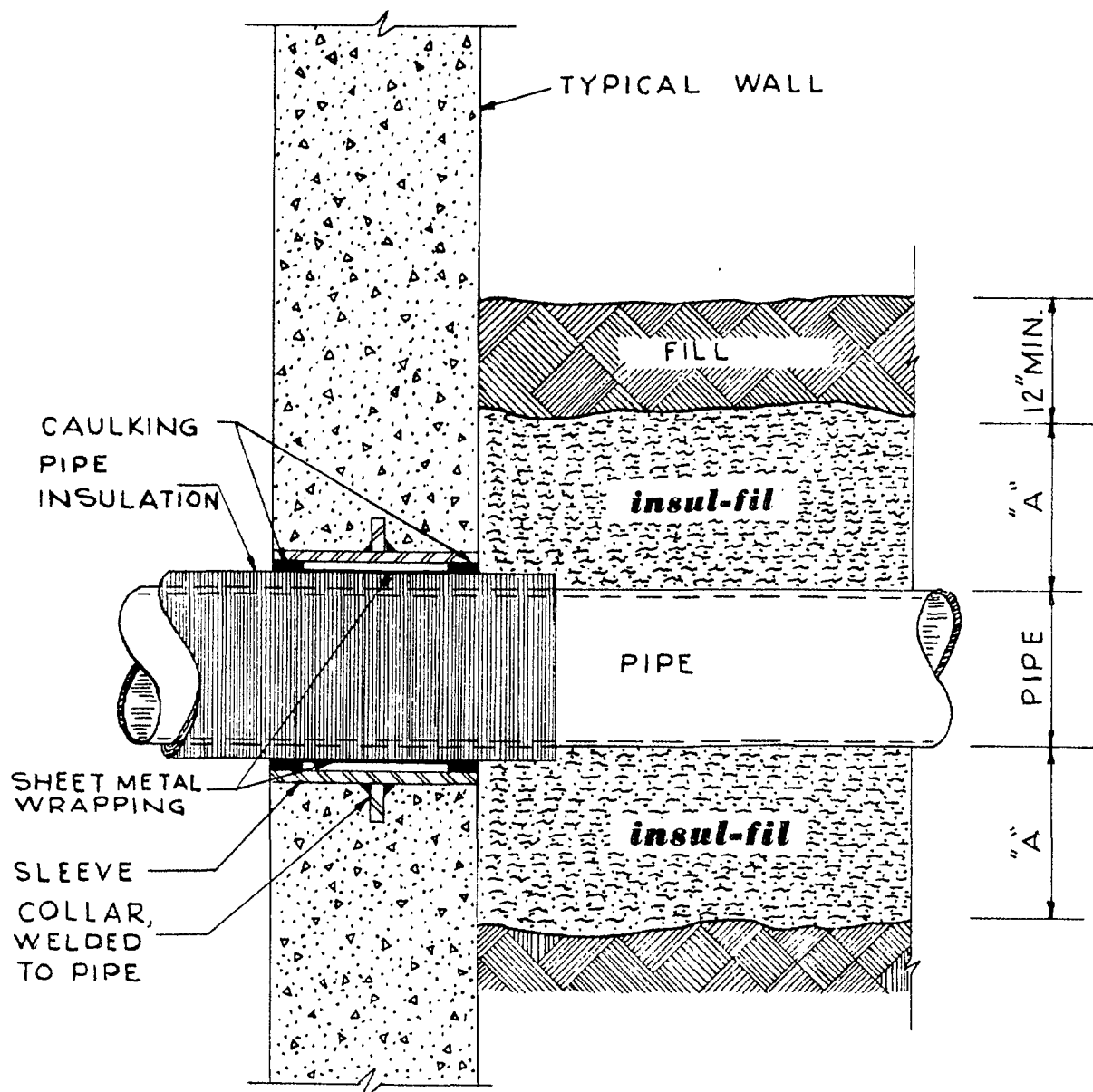


DETAIL "B"

TYPICAL TRENCH SECTION FOR TWO PIPE LINES

1. Trenches containing multiple piping shall be excavated so as to provide minimum dimensions shown. Width of trench may necessarily be increased to provide sufficient working space under various conditions. In such cases, thickness of conduit is maintained by use of forms as set forth in Instructions.
2. Adequate allowance shall be provided for expansion and contraction of all piping. Supports shall be provided as shown in Details "G", "H" or "I". All piping shall be clean, dry and free from scale or any foreign material, prior to installing INSUL-FIL in trench. Minimum trench clearances are indicated.
3. INSUL-FIL shall be poured directly from bags into trench, care being taken that all spaces be properly filled, under and at sides of piping. Using suitable tools INSUL-FIL shall be packed carefully around under and against the pipe. Top of pipes shall be covered with INSUL-FIL to a minimum depth as indicated below after being tamped in the manner indicated in Instructions. Pipes placed in areas subjected to heavy loads such as railroads, streets or highways should have an added thickness of INSUL-FIL in the amount of three inches installed on top of the pipe and this shall be in addition to the required thickness indicated below:

PIPE SIZE INCHES	MINIMUM THICKNESS FOR DIMENSION "A"
1 - 6	4
8	5
10 - 12	7
16	10

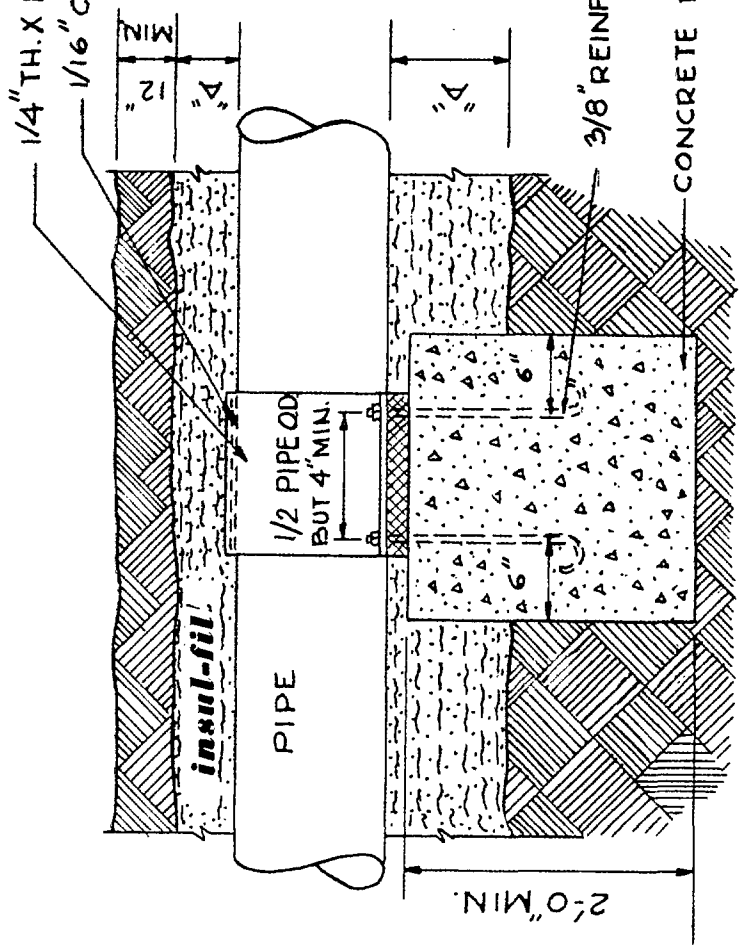
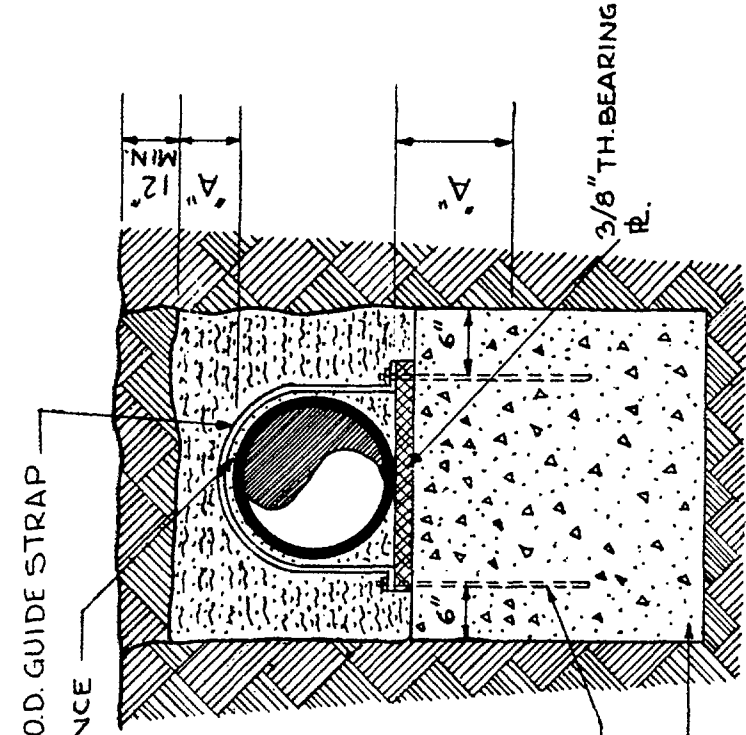
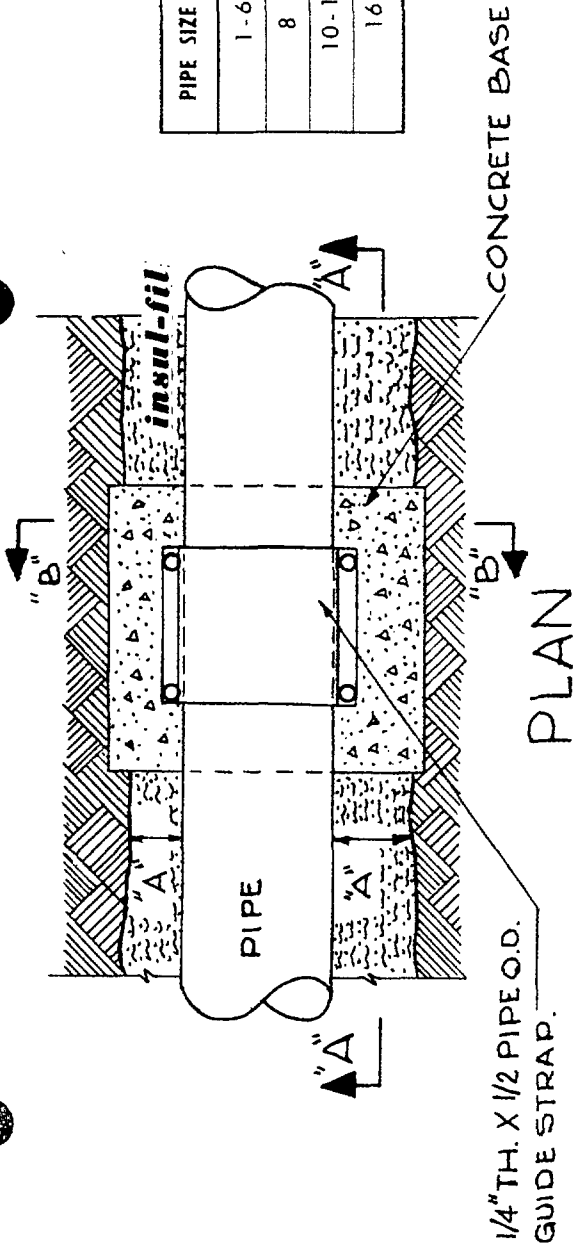


DETAIL "D"
DETAILS FOR WALL ENTRY

Steel pipe shall be used to provide sleeve shown in sketch, size of the sleeve shall be sufficient to provide not less than 1/4 inch annular space between the pipe and the sleeve where the pipe enters the wall. This space shall be caulked as shown prior to the installation of the INSUL-FIL.

DETAIL "E" TYPICAL ANCHOR AND GUIDE

PIPE SIZE INCHES	MINIMUM THICKNESS FOR DIMENSION "A"
1-6	4
8	5
10-12	7
16	10



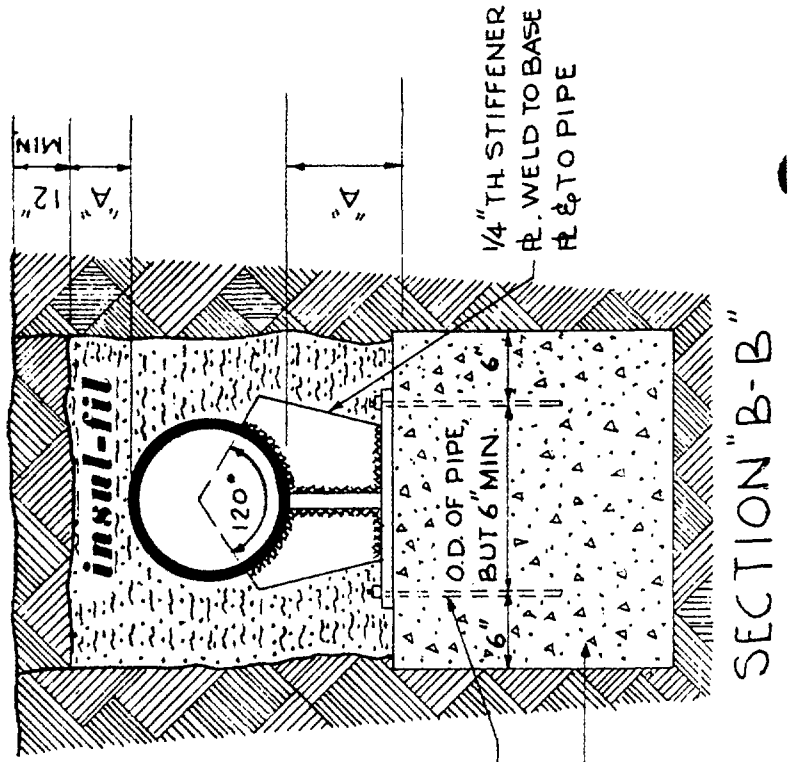
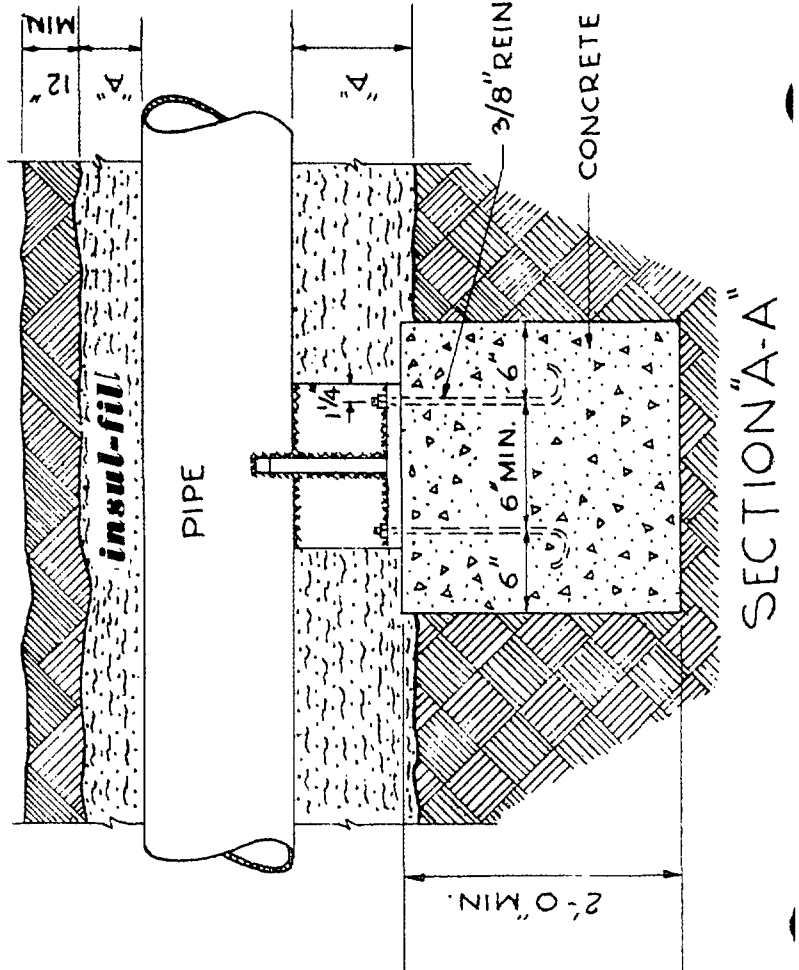
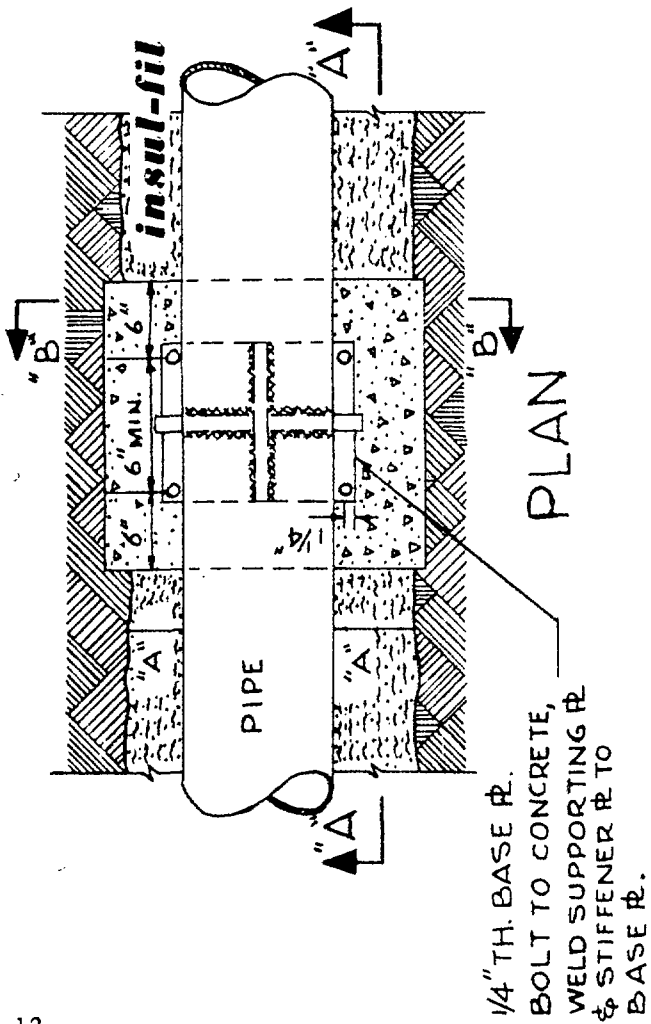
SECTION "A-A"

SECTION "B-B"

NOTE: FOR ANCHOR WELD STRAP

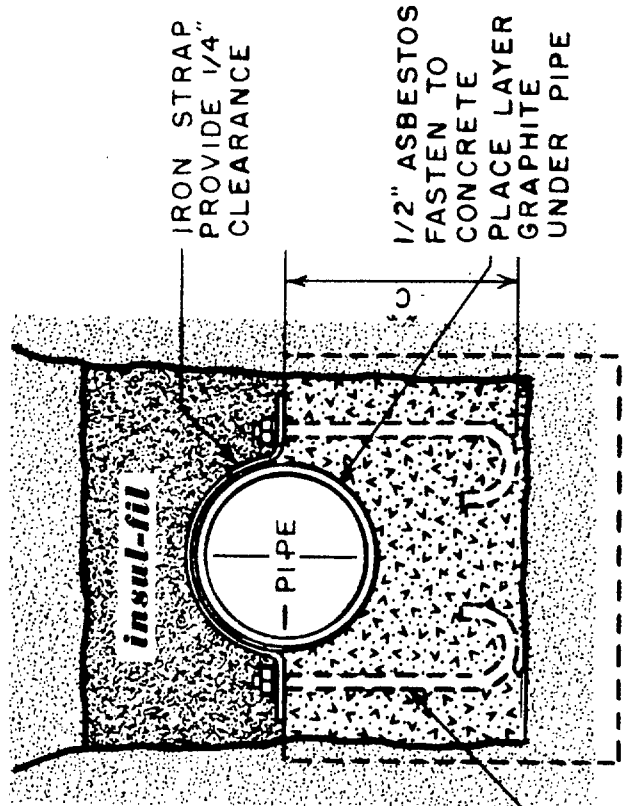
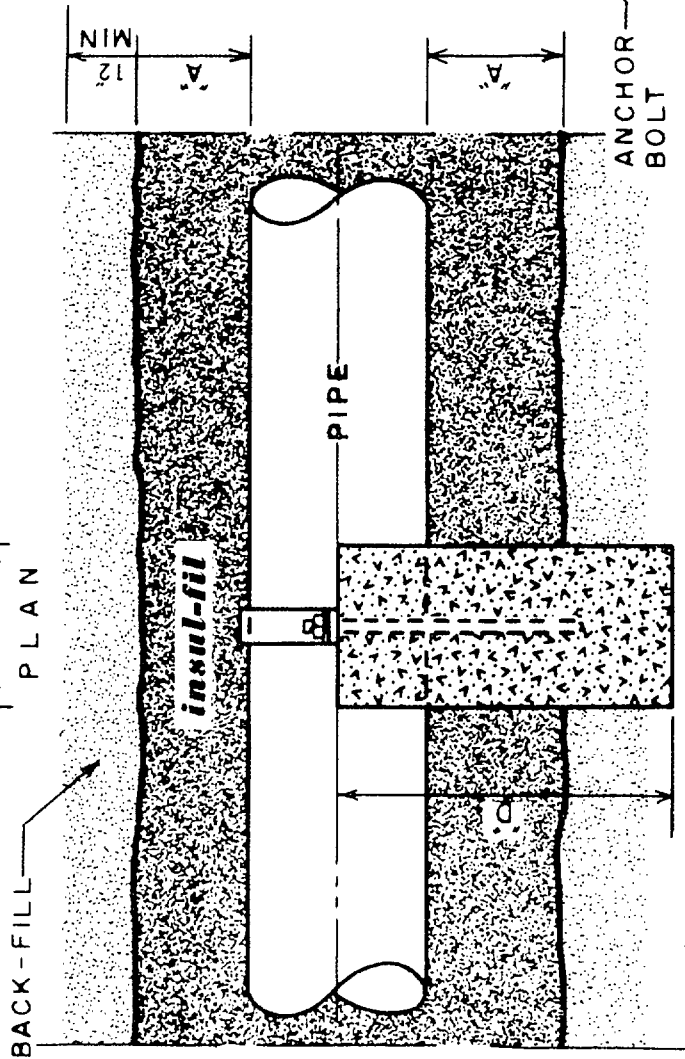
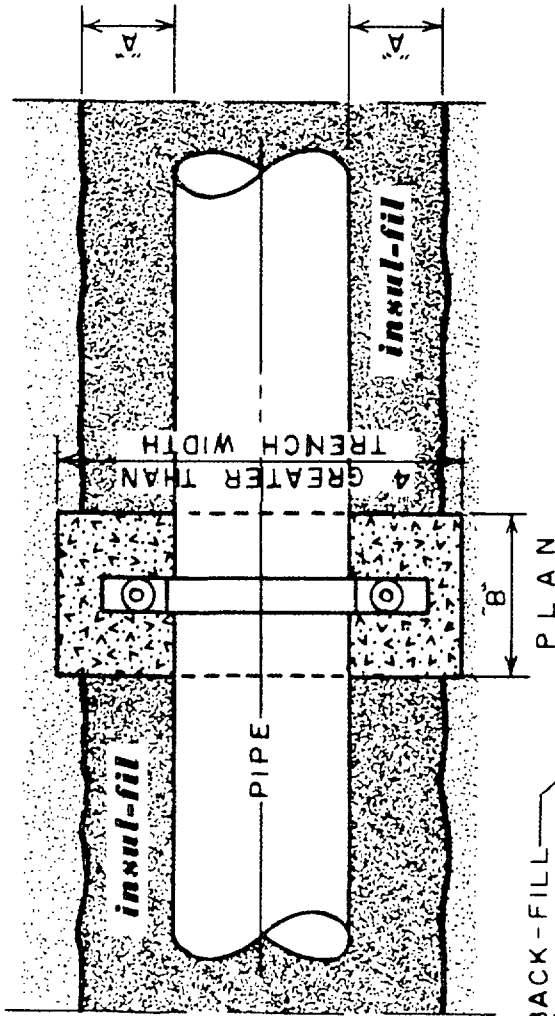
DETAIL "F"
TYPICAL ANCHOR DETAIL

PIPE SIZE INCHES	MINIMUM THICKNESS FOR DIMENSION "A"
1-6	4
8	5
10-12	7
16	10



DETAIL "G" TYPICAL PIPE SUPPORTS AND GUIDES DIMENSIONS ON ANCHORS

	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.
Nominal Pipe Size	1	2	3	4	5	6	8	10	12	14	16	20	22	28
"A"	4	4	4	4	5	5	5	8	10	12	14	16	20	28
"B"	6	6	8	8	10	12	12	12	12	12	14	14	16	20
"C"	6	6	8	10	10	12	12	12	12	12	14	14	16	20
"D"	10	10	10	12	14	14	14	16	16	20	22	22	28	28
Iron Strap Size	1/8" x 2"				1/4" x 2"				1/2" x 2"				1/2" x 2"	



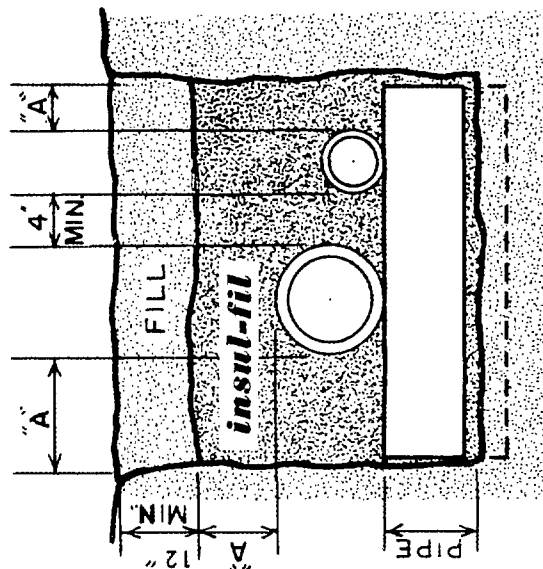
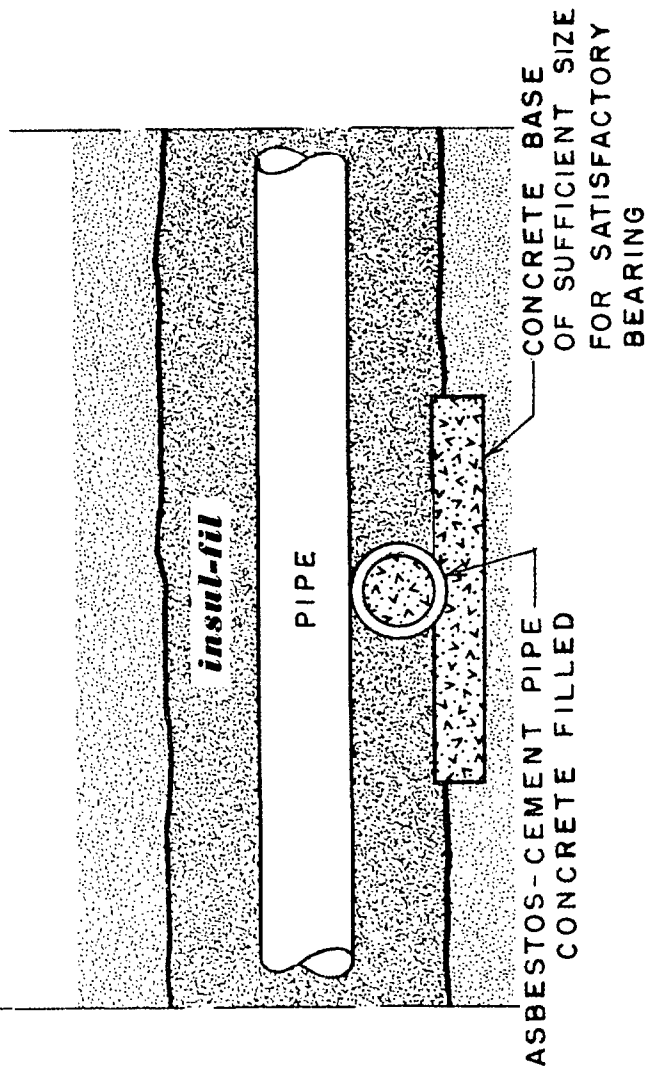
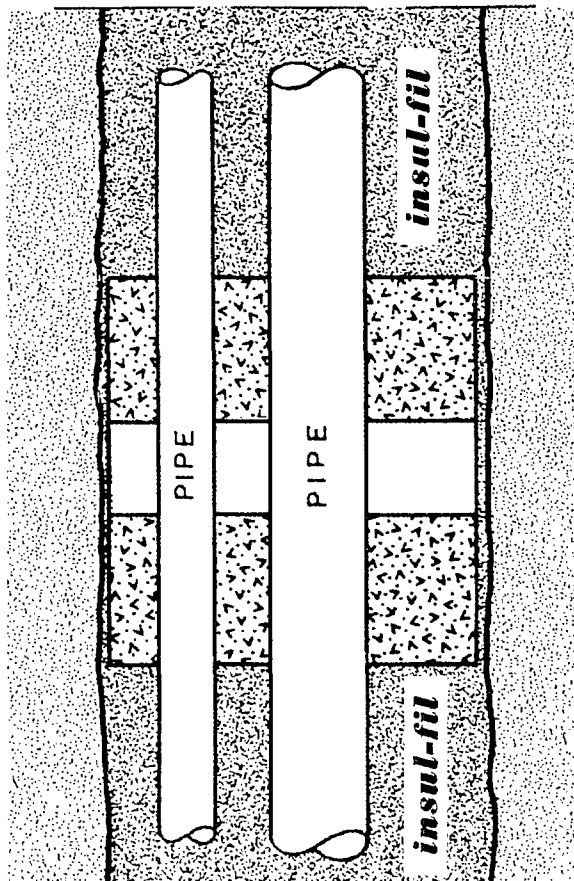
IRON STRAP
PROVIDE 1/4"
CLEARANCE

1/2" ASBESTOS
FASTEN TO
CONCRETE
PLACE LAYER
GRAPHITE
UNDER PIPE

DETAIL "H" SPONGY SOIL PIPE SUPPORTS

Note — Under solid soil conditions, the concrete base under the pipe supports may in some instances be omitted.

PIPE SIZE INCHES	MINIMUM THICKNESS FOR DIMENSION "A"
1 - 6	4
8	5
10 - 12	7
16	10



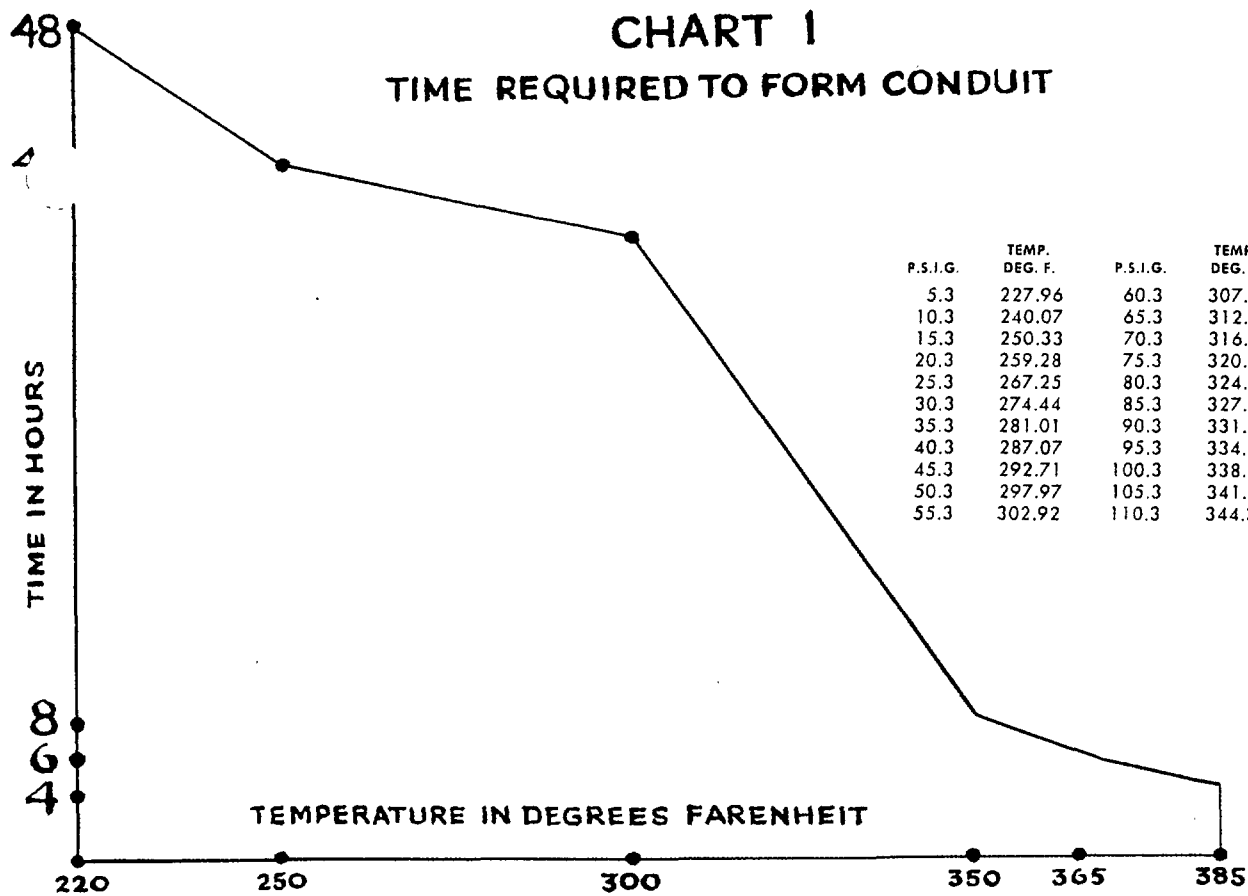
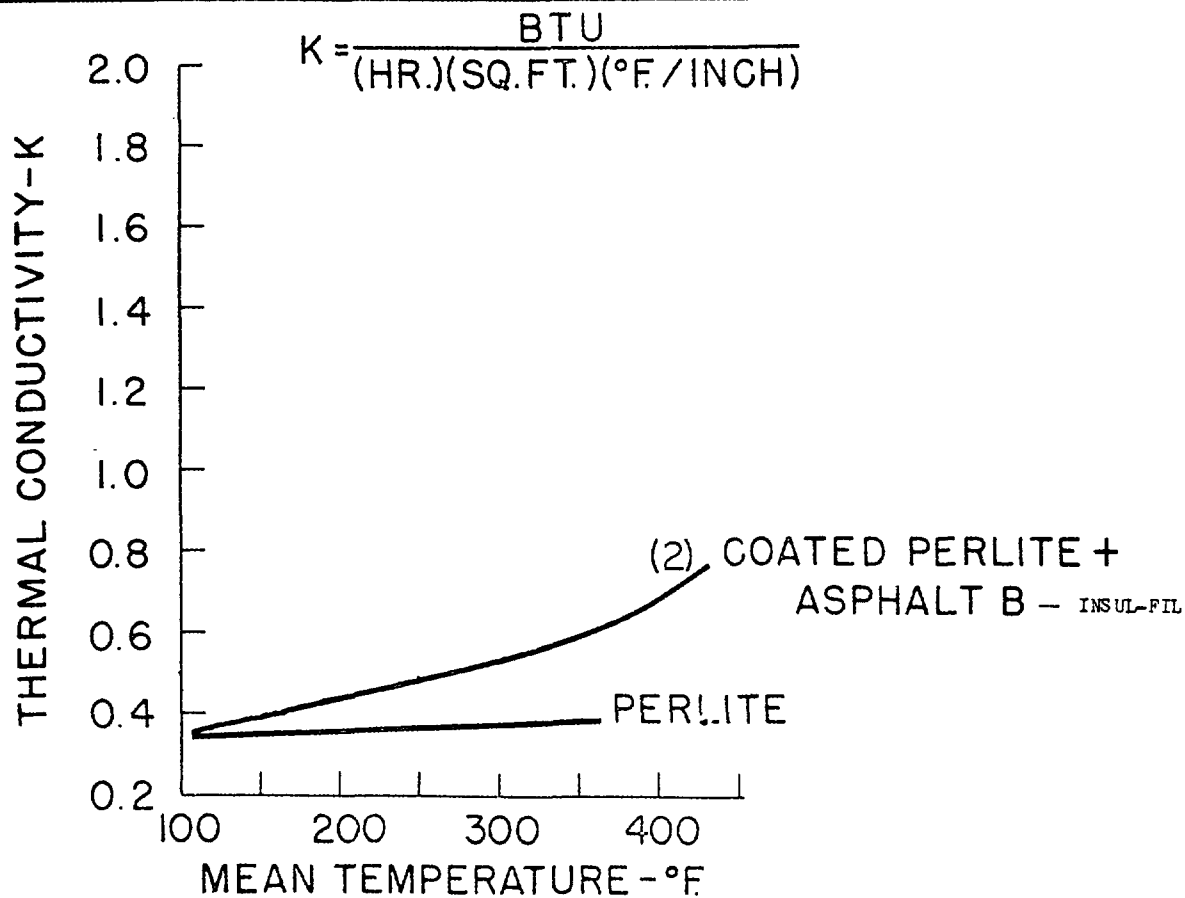
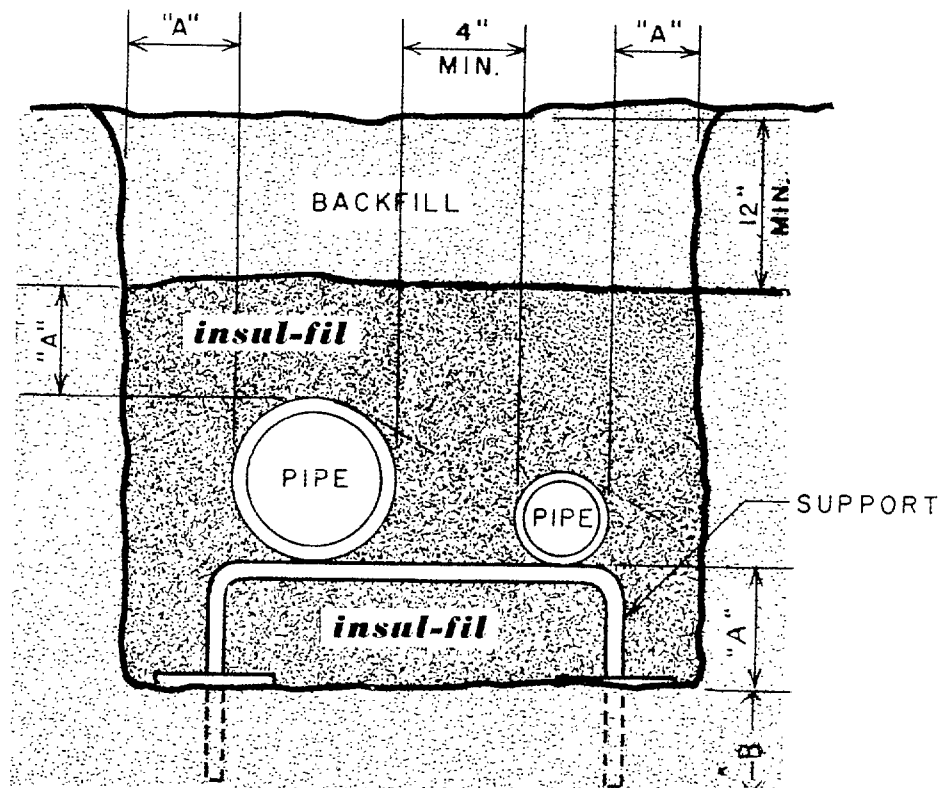
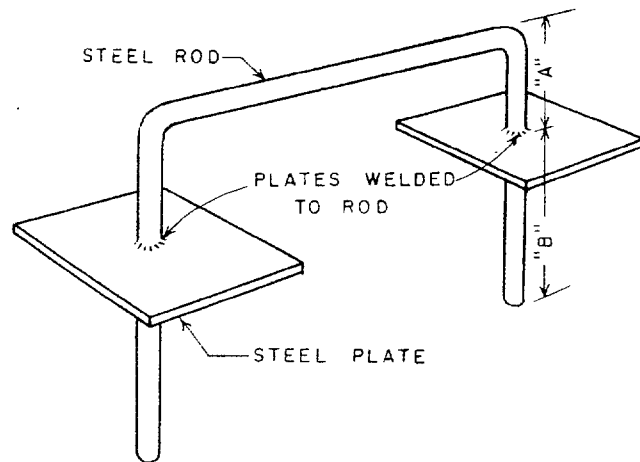


CHART 2

THERMAL CONDUCTIVITY OF INSUL-FIL AT VARIOUS MEAN TEMPERATURES





DETAIL "I"

ALTERNATE PIPE SUPPORTS FOR DRY, FIRM, NON-CORROSIVE SOIL DIMENSIONS

	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.
Nominal Pipe Size	1	2	3	4	5	6	8	10	12	16
"A"*	4	4	4	4	4	4	5	7	7	10
"B"*	6	6	6	8	8	8	8	12	12	12
Steel Rod Dia.*	3/8	3/8	1/2	1/2	1/2	3/4	3/4	3/4	7/8	1
Base Plate	1/8 x 3 x 3	1/8 x 3 x 3	1/8 x 3 x 3	3/16 x 5 x 5	3/16 x 5 x 5	3/16 x 5 x 5	1/4 x 8 x 3	1/4 x 8 x 3	1/4 x 8 x 8	1/4 x 8 x 8

*When more than one pipe are placed in the same trench, use dimensions or sizes for largest size pipe.

The type of pipe support shown should be used only under ideal soil conditions where the soil is dry, firm and non-corrosive.

PACKING DATA

NUMBER SECTIONS PER CARTON PIPE COVERING

Pipe Size	Magnesia	3 Ply Aircell	3/4" Thk. Woolfelt	1/2" Thk. Fiberglas	3/4" Thk. Fiberglas	1" Thk. Fiberglas	Hi-Temp
1/4"	56						
3/8"	56		45	81	56	39	40
1/2"	40	40	40	64	42	39	40
3/4"	40	35	35	56	39	25	27
1"	27	28	28	42	30	25	27
1-1/4"	27	24	24	36	25	42	20
1-1/2"	20	20	20	56	42	30	17
2"	17	15	15	42	30	25	20
2-1/2"	20	12	12	30	25	20	16
3"	16	16	8	25	20	16	8
3-1/2"	8	14	8	20	18		
4"	8	12	8	16			
4-1/2"	8	9	10				
5"	8	6					
6"	6						
7"	4						
8"	2						
10"	1						
12"	1						
14"	1						
5/8" C.T.							
2-1/8" C.T.			15	100		25	
2-5/8" C.T.			12	68		30	
3-1/8" C.T.			12	52		20	
4-1/8" C.T.			12	39		16	

INSUL-FIL APPROVED CONTRACTORS & DISTRIBUTORS

ACME INSULATION CO., INC.
329 Summer Avenue, N.W.
Grand Rapids, Michigan

ACHENBACH & BUTLER, INC.
413 Stokes Avenue
Trenton, N. J.

ASBESTOS PRODUCTS, INC.
710 Raymond Ave.
St. Paul 14, Minn.

ASBESTOS & MAGNESIA MATERIALS CO.
2614 N. Clybourn Ave.
Chicago, Ill.

GUY M. BEATY & CO.
520 South Elliott Street
Charlotte, N. C.

1106 Carter St.
Chattanooga, Tenn.

CARL F. BECKWITH & SON
8385 Lyndon Ave.
Detroit, Michigan

BUEHLER BROTHERS CO.
304 North Wooster Ave.
Dover, Ohio

CARLOW COMPANY
221 City Center Building
Lake Worth, Florida

CLARK ASBESTOS CO.
1893 East 55th Street
Cleveland, Ohio

HAROLD N. DAVIS CO.
401 North Broad St.
Philadelphia, Pa.

DUWE COMPANY
521 N. Washington Ave.
Lansing 33, Michigan

DETROIT FIBERGLAS INS. DIV.
14360 Livernois
Detroit, Michigan

E. J. EDDY, INC.
155 Erie Street
Buffalo 2, N. Y.

HOBART BROS.
200 Davis Street
San Francisco, California

INSUL-COUSTIC CORP.
54-04 43rd St.
Maspeth, L. I., N. Y.

INMAN INDUSTRIES
1516 West 51st St.
Seattle 7, Washington

JOHNSON ASBESTOS CO.
Western Ave.
West Springfield, Mass.

JOHNS-MANVILLE INT'L.
22 East 40th St.
New York, N. Y.
(Export Only)

LITTRELL HARDWARE LINES, INC.
3121 East 12th St.
Los Angeles, California

MUNDET CORK CORP.
427 West Fourth St.
Cincinnati 2, Ohio

Route 1, Box 67-A
Hot Springs, Arkansas

6601 Supply Row
P.O. Box 9301
Houston, Texas

130 Lombrano Street
San Antonio, Texas

315-325 N. Front St.
New Orleans, La.

PROTEXAL MFG. CO., LTD.
510 Canal Bank
Villa St. Pierre
Montreal, Canada

R. I. COVERING CO.
347-351 South Main St.
Providence 3, R. I.

P. S. THORSEN CO. OF MASS.
43½ L. Street
South Boston, Mass.

C. E. THURSTON & SONS
P. O. Box 3387
Norfolk, Va.

8-10 S. Linden St.
P. O. Box 968
Richmond, Va.

P. O. Box 1481
Roanoke, Va.

*State of New York }
Department of State } ss:*

I hereby certify that the annexed copy has been compared with the original document in the custody of the Secretary of State and that the same is a true copy of said original.

Witness my hand and seal of the Department of State on

AUG 12 1998



Special Deputy Secretary of State