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INDUSTRIAL INSULATORS, INC.

COMMERCIAL AND INDUSTRIAL THERMAL INSULATIONS

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PREFACE

We are pleased to present you with our new insulation catalog which has been designed to assist you in considering the various materials available for each insulation problem. This catalog is arranged so that knowing the operating temperature the various materials which may be used are easily selected with separate sections devoted to cements, finishes, and accessories.

The catalog is divided into seven sections, each separated by an indexed tab. Immediately following each tab is a listing of the available insulations and the temperature range of each material. Detailed information concerning those materials is found on the pages contained in that section.

We will keep you up to date by mailing the latest available data sheets on the materials in this catalog as well as on new materials. By inserting the new data sheets as they are received, this catalog will be your ready reference for up to date information on insulation.

The information furnished herein is based on literature furnished by the manufacturers, and The Industrial Insulators, Inc. accepts no responsibility for use made of such information since materials and methods of application will vary with job conditions.

Upon request, we will furnish detailed specifications for your particular insulation problem as well as additional information on any insulation material, whether or not it is included in this catalog.

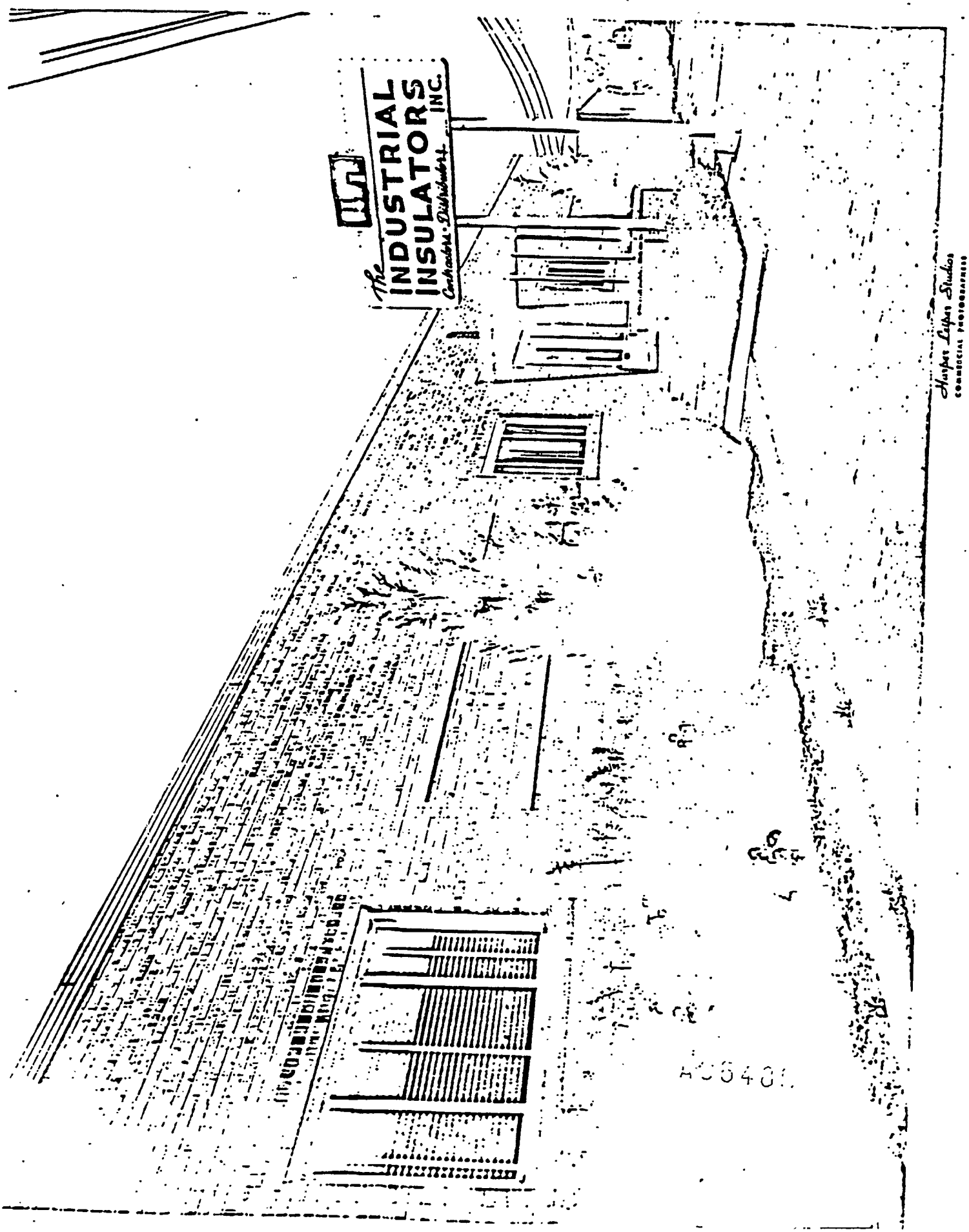
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engineering data

KAYLO & KAYLO 20 THICKNESS STANDARDS, NESTING SIZES

Kaylo & Kaylo 20 Pipe Insulations are precision molded to fit nominal iron pipe sizes from ½" to 39" in diameter, single or double-layer thicknesses. Single layer thicknesses are 1" and 1½", double layer from 1" to 3" in half-sectional or multisegmental form depending on pipe size.

Single layer sectional covering is available for copper tubing sizes from ⅜" to 3" sizes and in thicknesses from 1" to 1½".

Kaylo in single layer, double layer or multiple layer thickne: is designed in accordance with the Simplified Dimensio Standards to allow accurate nesting. Double or multiple la application with staggered joints is recommended to red leakage at the joints where operating temperatures exce 600°F. See Product Data Sheet 5.3 for Economic Thickne recommendations.

SECTIONAL

nom. pipe size	O.D. of pipe	single layer only				single or double layer				
		nom. 1"		nom. 1½"		nom. 2"		nom. 2½"		r
		actual	O.D.	actual	O.D.	actual	O.D.	actual	O.D.	actu
⅜"	.675	1.084	2.88	1.65	4.00	—	—	—	—	—
½"	.84	1.00	2.88	1.56	4.00	2.06	5.00	2.89	6.66	3.3
¾"	1.05	.90	2.88	1.46	4.00	1.96	5.00	2.79	6.66	3.2
1"	1.32	1.08	3.50	1.58	4.50	2.11	5.56	2.66	6.66	3.1
1¼"	1.66	.90	3.50	1.66	5.00	1.94	5.56	2.48	6.66	2.9
1½"	1.90	1.03	4.00	1.53	5.00	2.36	6.66	2.86	7.66	3.3
2"	2.38	1.04	4.50	1.57	5.56	2.12	6.66	2.62	7.66	3.1
2½"	2.88	1.04	5.00	1.87	6.66	2.37	7.66	2.87	8.66	3.37
3"	3.50	1.00	5.56	1.55	6.66	2.05	7.66	2.55	8.66	3.05
3½"	4.00	1.30	6.66	1.80	7.66	2.30	8.66	2.80	9.66	3.36
4"	4.50	1.05	6.66	1.55	7.66	2.05	8.66	2.55	9.66	3.11
4½"	5.00	1.30	7.66	1.80	8.66	2.30	9.66	2.86	10.78	3.36
5"	5.56	1.02	7.66	1.52	8.66	2.02	9.66	2.58	10.78	3.08
6"	6.63	.95	8.66	1.45	9.66	2.02	10.78	2.52	11.78	3.03
7"	7.63			1.52	10.78	2.02	11.78	2.53	12.81	3.16
8"	8.63			1.52	11.78	2.03	12.81	2.66	14.06	3.16
9"	9.63			1.53	12.81	2.16	14.06	2.66	15.06	3.17
10"	10.75			1.59	14.06	2.09	15.06	2.61	16.09	
11"	11.75			1.58	15.06	2.09	16.09			
12"	12.75			1.59	16.09					

AC5437

KEY

IP = Iron Pipe Sizes

CT = Copper Tubing

IL = Inner Layer

OL = Outer Layer

(copper tubing size table)

note:

Insulation for tubing sizes other than standard sizes shown are available only as cut-downs from next larger size tube or pipe and will be slightly elliptical in shape.

INSULATION THICKNESS STANDARDS & TESTING SIZES

nom. tube size	O. D. of tube (nom.)	single layer			
		nom. 1"		nom. 1½"	
		actual	O.D.	actual	O.D.
⅜"	½"	1.18	2.88	1.49	3.50
½"	⅝"	1.11	2.88	1.42	3.50
⅝"	¾"	1.05	2.88	1.61	4.00
¾"	⅞"	.99	2.88	1.55	4.00
1"	1⅛"	1.17	3.50	1.42	4.00
1¼"	1⅜"	1.05	3.50	1.55	4.50
1½"	1⅝"	1.17	4.00	1.42	4.50
2"	2⅛"	.91	4.00	1.41	5.00
2½"	2⅝"	.91	4.50	1.45	5.56
3"	3⅛"	.91	5.00	1.73	6.66

multiple layer—recommended combinations

2"	2½"	3"	3½"	4"	4½"	5"	6"
IL / OL	IL / OL	IL / OL	IL / OL	IL / OL	IL / OL	IL / OL	IL / OL
— / —	— / —	— / —	— / —	— / —	— / —	— / —	— / —
½ x 1 / ½ x 1	½ x 1 / 2½ x 1½	½ x ½ / 3½ x 1½	½ x 1½ / 3½ x 2	½ x 2 / 4½ x 2	½ x 2 / 4½ x 2½	½ x 2½ / 6 x 2½	½ x 3 / 7 x 3
¾ x 1 / 4½ x 1	¾ x 1 / 2½ x 1½	¾ x 1½ / 3½ x 1½	¾ x 1½ / 3½ x 2	¾ x 2 / 4½ x 2	¾ x 2 / 4½ x 2½	¾ x 2½ / 6 x 2½	¾ x 3 / 7 x 3
1 x 1 / 3 x 1	1 x 1 / 3 x 1½	1 x 1½ / 4 x 1½	1 x 1½ / 4 x 2	1 x 2 / 5 x 2	1 x 2 / 5 x 2½	1 x 2½ / 6 x 2½	1 x 3 / 7 x 3
1¼ x 1 / 3 x 1	1¼ x 1 / 3 x 1½	1¼ x 1½ / 4½ x 1½	1¼ x 1½ / 4½ x 2	1¼ x 2 / 5 x 2	1¼ x 2 / 5 x 2½	1¼ x 2½ / 6 x 2½	1¼ x 3 / 7 x 3
1½ x 1 / 3½ x 1	1½ x 1 / 3½ x 1½	1½ x 1½ / 4½ x 1½	1½ x 1½ / 4½ x 2	1½ x 2 / 6 x 2	1½ x 2 / 6 x 2½	1½ x 2½ / 7 x 2½	1½ x 3 / 8 x 3
2 x 1 / 4 x 1	2 x 1 / 4 x 1½	2 x 1½ / 5 x 1½	2 x 1½ / 5 x 2	2 x 2 / 6 x 2	2 x 2 / 6 x 2½	2 x 2½ / 7 x 2½	2 x 3 / 8 x 3
2½ x 1 / 4½ x 1	2½ x 1 / 4½ x 1½	2½ x 1½ / 6 x 1½	2½ x 1½ / 6 x 2	2½ x 2 / 7 x 2	2½ x 2 / 7 x 2½	2½ x 2½ / 8 x 2½	2½ x 3 / 9 x 3
3 x 1 / 5 x 1	3 x 1 / 5 x 1½	3 x 1½ / 6 x 1½	3 x 1½ / 6 x 2	3 x 2 / 7 x 2	3 x 2 / 7 x 2½	3 x 2½ / 8 x 2½	3 x 3 / 9 x 3
3½ x 1 / 6 x 1	3½ x 1 / 6 x 1½	3½ x 1½ / 7 x 1½	3½ x 1½ / 7 x 2	3½ x 2 / 8 x 2	3½ x 2 / 8 x 2½	3½ x 2½ / 9 x 2½	3½ x 3 / 10 x 3
4 x 1 / 6 x 1	4 x 1 / 6 x 1½	4 x 1½ / 7 x 1½	4 x 1½ / 7 x 2	4 x 2 / 8 x 2	4 x 2 / 8 x 2½	4 x 2½ / 9 x 2½	4 x 3 / 10 x 3
	4½ x 1 / 7 x 1½	4½ x 1½ / 8 x 1½	4½ x 1½ / 8 x 2	4½ x 2 / 9 x 2	4½ x 2 / 9 x 2½	4½ x 2½ / 10 x 2½	4½ x 3 / 11 x 3
	5 x 1 / 7 x 1½	5 x 1½ / 8 x 1½	5 x 1½ / 8 x 2	5 x 2 / 9 x 2	5 x 2 / 9 x 2½	5 x 2½ / 10 x 2½	5 x 3 / 11 x 3
	6 x 1 / 8 x 1½	6 x 1½ / 9 x 1½	6 x 1½ / 9 x 2	6 x 2 / 10 x 2	6 x 2 / 10 x 2½	6 x 2½ / 11 x 2½	6 x 3 / 12 x 3
		7 x 1½ / 10 x 1½	7 x 1½ / 10 x 2	7 x 2 / 11 x 2	7 x 2 / 11 x 2½	7 x 2½ / 12 x 2½	7 x 3 / 14 x 3
		8 x 1½ / 11 x 1½	8 x 1½ / 11 x 2	8 x 2 / 12 x 2	8 x 2 / 12 x 2½	8 x 2½ / 14 x 2½	8 x 3 / 15 x 3
		9 x 1½ / 12 x 1½	9 x 1½ / 12 x 2	9 x 2 / 14 x 2	9 x 2 / 14 x 2½	9 x 2½ / 15 x 2½	9 x 3 / 16 x 3

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QUAD. • TRI-SEGMENTAL SEG.

K SEGMENTAL

nom. pipe size	O.D. of pipe	single layer only						single or doubl	
		nom. 1"		nom. 1½"		nom. 2"		nom.. 2½	
		actual	O.D.	actual	O.D.	actual	O.D.	actual	O
								2.55	17.
						2.05	17.00	2.55	18.
14"	14.00			1.42	17.00	1.92	18.00	2.42	19.
15"	15.00			1.42	18.00	1.92	19.00	2.41	20.
16"	16.00			1.41	19.00	1.91	20.00	2.41	21.
17"	17.00			1.41	20.00	1.91	21.00	2.41	22.
18"	18.00			1.41	21.00	1.91	22.00	2.41	23.
19"	19.00			1.41	22.00	1.91	23.00	2.41	24.(
20"	20.00			1.41	23.00	1.91	24.00	2.41	25.(
21"	21.00			1.41	24.00	1.91	25.00	2.41	26.(
22"	22.00			1.41	25.00	1.91	26.00	2.41	27.(
23"	23.00			1.41	26.00	1.91	27.00	2.41	28.(
24"	24.00			1.41	27.00	1.91	28.00	2.41	29.(
25"	25.00			1.46	28.00	1.98	29.00	2.50	30.(
26"	26.00			1.46	29.00	1.98	30.00	2.50	31.(
27"	27.00			1.46	30.00	1.98	31.00	2.50	32.0
28"	28.00			1.46	31.00	1.98	32.00	2.50	33.0
29"	29.00			1.46	32.00	1.98	33.00	2.50	34.0
30"	30.00			1.46	33.00	1.98	34.00	2.50	35.0
31"	31.00			1.46	34.00	1.98	35.00	2.50	36.0
32"	32.00			1.46	35.00	1.98	36.00	2.50	37.0(
33"	33.00			1.46	36.00	1.98	37.00	2.50	38.0(
34"	34.00			1.46	37.00	1.98	38.00	2.50	39.0(
35"	35.00			1.46	38.00	1.98	39.00	2.50	40.0(
36"	36.00			1.46	39.00	1.98	40.00	2.50	41.0(
37"	37.00			1.46	40.00	1.98	41.00	2.50	42.0(
38"	38.00			1.46	41.00	1.98	42.00	2.50	43.00
39"	39.00			1.46	42.00	1.98	43.00	2.50	44.00

Insulation for the nominal pipe sizes range of 25"-39" is furnished in three K-Segmental curvature sizes. Approximately six to eight segments are required to enclose pipes in this size range. The last segment applied must be cut to fit accurately. Letter designates molded K-Segmental size for proper nesting.

* Note: All single layer tri-seg. and quad-seg. sizes shown are also available in sectional form. K-segmental is not available in a fabricated sectional form.

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...ul..i..le layer—recommended combinations

""	2"	2½"	3"	3½"	4"	4½"	5"	6"
	IL	IL	IL	IL	IL	IL	IL	IL
O.D.	OL	OL	OL	OL	OL	OL	OL	OL
17.00			10 x1½ 14 x1½	10 x1½ 14 x2	10 x2 15 x2	10 x2 15 x2½	10 x2½ 16 x2½	10 x3 17 x3
18.00			11 x1½ 15 x1½	11 x1½ 15 x2	11 x2 16 x2	11 x2 16 x2½	11 x2½ 17 x2½	11 x3 18 x3
19.00			12 x1½ 16 x1½	12 x1½ 16 x2	12 x2 17 x2	12 x2 17 x2½	12 x2½ 18 x2½	12 x3 19 x3
20.00			14 x1½ 17 x1½	14 x1½ 17 x2	14 x2 18 x2	14 x2 18 x2½	14 x2½ 19 x2½	14 x3 20 x3
21.00			15 x1½ 18 x1½	15 x1½ 18 x2	15 x2 19 x2	15 x2 19 x2½	15 x2½ 20 x2½	15 x3 21 x3
22.00			16 x1½ 19 x1½	16 x1½ 19 x2	16 x2 20 x2	16 x2 20 x2½	16 x2½ 21 x2½	16 x3 22 x3
23.00			17 x1½ 20 x1½	17 x1½ 20 x2	17 x2 21 x2	17 x2 21 x2½	17 x2½ 22 x2½	17 x3 23 x3
24.00			18 x1½ 21 x1½	18 x1½ 21 x2	18 x2 22 x2	18 x2 22 x2½	18 x2½ 23 x2½	18 x3 24 x3
25.00			19 x1½ 22 x1½	19 x1½ 22 x2	19 x2 23 x2	19 x2 23 x2½	19 x2½ 24 x2½	19 x3 25 x3A
26.00			20 x1½ 23 x1½	20 x1½ 23 x2	20 x2 24 x2	20 x2 24 x2½	20 x2½ 25 x2½A	20 x3 26 x3A
27.00			21 x1½ 24 x1½	21 x1½ 24 x2	21 x2 25 x2A	21 x2 25 x2A	21 x2½ 26 x2½A	21 x3 27 x3A
28.00			22 x1½ 25 x1½A	22 x1½ 25 x2 A	22 x2 26 x2A	22 x2 26 x2½A	22 x2½ 27 x2½A	22 x3 28 x3A
29.00			23 x1½ 26 x1½A	23 x1½ 26 x2 A	23 x2 27 x2A	23 x2 27 x2½A	23 x2½ 28 x2½A	23 x3 29 x3A
30.00			24 x1½ 27 x1½A	24 x1½ 27 x2 A	24 x2 28 x2A	24 x2 28 x2½A	24 x2½ 29 x2½A	24 x3 30 x3A
31.00			25 x1½A 28 x1½B	25 x1½A 28 x2 B	25 x2A 29 x2B	25 x2 A 29 x2½B	25 x2½A 30 x2½B	25 x3A 31 x3B
32.00			26 x1½A 29 x1½B	26 x1½A 29 x2 B	26 x2A 30 x2B	26 x2 A 30 x2½B	26 x2½A 31 x2½B	26 x3A 32 x3B
33.00			27 x1½A 30 x1½B	27 x1½A 30 x2 B	27 x2A 31 x2B	27 x2 A 31 x2½B	27 x2½A 32 x2½B	27 x3A 33 x3B
34.00			28 x1½A 31 x1½B	28 x1½A 31 x2 B	28 x2A 32 x2B	28 x2 A 32 x2½B	28 x2½A 33 x2½B	28 x3A 34 x3B
35.00			29 x1½A 32 x1½B	29 x1½A 32 x2 B	29 x2A 33 x2B	29 x2 A 33 x2½B	29 x2½A 34 x2½B	29 x3A 35 x3B
36.00			30 x1½B 33 x1½C	30 x1½B 33 x2 C	30 x2B 34 x2C	30 x2 B 34 x2½C	30 x2½B 35 x2½C	30 x3B 36 x3C
37.00			31 x1½B 34 x1½C	31 x1½B 34 x2 C	31 x2B 35 x2C	31 x2 B 35 x2½C	31 x2½B 36 x2½C	31 x3B 37 x3C
38.00			32 x1½B 35 x1½C	32 x1½B 35 x2 C	32 x2B 36 x2C	32 x2 B 36 x2½C	32 x2½B 37 x2½C	32 x3B 38 x3C
39.00			33 x1½B 36 x1½C	33 x1½B 36 x2 C	33 x2B 37 x2C	33 x2 B 37 x2½C	33 x2½B 38 x2½C	33 x3B 39 x3C
40.00			34 x1½B 37 x1½C	34 x1½B 37 x2 C	34 x2B 38 x2C	34 x2 B 38 x2½C	34 x2½B 39 x2½C	34 x3B 40 x3C
41.00								
42.00								
43.00								
44.00								
45.00								

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K-Segmental Dimensions:

Letter	In. Dia.	O. Dia.	Approx. Outer Arc
A	26.00"	31.00"	14"
B	31.00"	36.00"	16"
C	36.00"	41.00"	18"

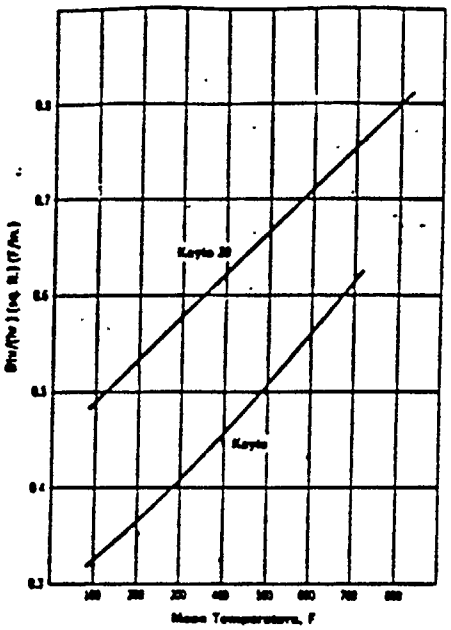
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physical properties

	Kaylo	Kaylo 20
density approximately	11 lb. pcf.	12 lb. pcf.
flexural strength (ASTM C-203)	50 lbs./sq. in.	90 lbs./sq. in.
compressive strength (ASTM C-165) at 5% deformation	120 psi	130 psi
resistance to abrasion (Conventional tumbling test-loss in weight after 10 min.) before heating	——— 9%	3%
after heating for 24 hr. at	750° — 5%	1200F — 5%
at	1000° — 4%	1800F — 20%
at	1200° — 3%	
alkalinity	ph 10	ph 10
corrosion resistance	does not cause or accelerate corrosion of steel, aluminum or stainless steel	
dimensional stability linear shrinkage after heating for 24 hrs. in a muffle at	750° — 0.8%	1200° — 0.7%
at	1000° — 0.9%	1800° — 1.6%
at	1200° — 1.4%	
specific heat	0.22 btu/lb.F	0.22 btu/lb.F
thermal diffusivity sq. ft./hr. at 200F mean Temp.	0.012	0.016

thermal conductivity



sizes

thickness — Kaylo Pipe Insulation is available in single or double layer thicknesses from 1" to 3" depending upon pipe size. Kaylo Tube Insulation is available in single layer thicknesses of 1" and 1½".

pipe sizes — Kaylo Pipe Insulation is available to fit nominal pipe sizes from ½" to 39" in diameter. Kaylo Tube Insulation will fit nominal copper tubing sizes from ⅛" to 3" in diameter.

forms — Kaylo Pipe Insulation is available in sectional or multisegmental form depending upon pipe size. All insulation is furnished in 3 ft. sections.

jackets

canvas — Kaylo Sectional Pipe Insulation includes standard canvas jackets, at no additional charge, on thicknesses up to and including 3", depending on pipe size. Standard canvas is available for segmental forms at a slight additional cost. Bands are available for use with this product at slight additional charge and will be furnished on request.

6 oz. and 8 oz. canvas jackets are available for all types, sizes and thicknesses of Kaylo Pipe and Tube Insulation at an additional charge. These jackets are factory applied on Sectional Pipe and Tube Insulation. On Multisegmental forms, they are furnished but not adhered.

Kaylo Klad — Kaylo is also available with an embossed aluminum jacket .016" thick or .010" thick stainless steel jacket. These jackets provide greater resistance to mechanical damage and present a neat finished appearance to pipe lines. The longitudinal seam has a self-locking joint. Butt sealing strips with integral mastic and protective asbestos cover are furnished for sealing end joints. See data sheet—for complete information on Kaylo Klad.

federal specification compliance

HH-I-00523b — Insulation Block and Pipe Covering, Thermal (Calcium Silicate for Temperatures up to 1200F) Type II (pipe insulation) Class A thru E.

MIL-I-2781D (Int. Amend. 1) — Insulation Pipe Covering, hermal: Grade 1, Class b; Grade II, Class d; Grade III, Class e, .ype I & II.

application recommendations

outdoor lines — Kaylo Pipe Insulations are mechanically fastened by wiring in place using 16 gauge wire on 9" centers and subsequently covered with a weatherproof jacket of metal or 45 lb. roofing felt. See Application Specifications for complete details.

indoor lines — Kaylo for indoor piping work is furnished with a factory-applied canvas jacket and held in place with bands or wire. The jacket has overlapping joint flaps that are smoothly pasted in place. Canvas should be sized to provide a base for painting.

fittings — Fitting are insulated with mitered segments of Kaylo wired in place and finished with a ¼" layer of insulating cement. Flanges and valves are insulated with oversized pipe insulation. They are finished off with canvas pasted in place for indoor lines or reinforced waterproof mastic for outdoor lines.



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Economic thickness

Selection of insulation thicknesses for any specific application should take into consideration the following important criteria. 1. Cost of insulation applied. 2. Cost of heat energy. 3. Cost of capital. 4. Cost of depreciation—plant and insulation. 5. Capital investment in heat production equipment. 6. Temperature differential. 7. Size of the pipe or surface. 8. Conductivity of insulation.

for hot piping, the tabulated thicknesses are optimum thicknesses calculated on an "Economic"* basis for heat conservation under average operating conditions and assures adequate temperature control. Special conditions may warrant the use of other thicknesses.

*From "How to Determine Economic Thickness of Insulation"—National Insulation Manufacturers Association.

economic thickness — kaylo pipe insulation — power & utility piping

(80F ambient air)

PIPE TEMP. / TEMP. DIFF. / IPS	200 / 120			400 / 320			600 / 520			800 / 720			1000 / 920			1200 / 1120		
	ET	HL	ST	ET	HL	ST	ET	HL	ST	ET	HL	ST	ET	HL	ST	ET	HL	ST
½	1	15	94	1	48	118	1½	71	126	1½	105	148	2	132	149	2½	151	139
¾	1	18	97	1	57	132	1½	81	133	2	106	135	2	150	158	2½	170	146
1	1	19	95	1	60	125	1½	88	131	2	116	134	2½	146	137	3	177	139
1¼	1	25	99	1	76	129	1½	98	131	2	136	143	2½	159	137	3	205	142
1½	1	25	97	1	77	129	1½	110	137	2½	123	121	2½	171	138	3	206	142
2	1	30	97	1½	71	113	1½	126	139	2½	144	128	2½	202	148	3	238	152
2½	1	36	98	1½	73	113	2	113	118	2½	153	128	3	197	133	3½	258	136
3	1	42	99	1½	93	117	2	140	123	2½	186	135	3	235	144	3½	278	147
3½	1	42	99	1½	94	117	2	143	124	3	173	121	3½	223	129	4	270	135
4	1	50	100	1½	113	118	2½	145	119	3	197	126	3½	248	135	4	300	141
4½	1	62	101	1½	120	118	2½	160	120	3	220	129	3½	260	137	4	322	143
5	1	70	102	1½	155	122	2½	187	122	3	250	131	3½	310	138	4	360	144
6	1	74	102	2	130	111	2½	194	123	3	260	132	3½	319	139	4½	358	137
7	1½	70	97	2	145	112	2½	214	123	3	268	133	3½	332	140	4½	398	139
8	1½	66	94	2	157	112	2½	228	123	3½	274	124	4	355	134	4½	430	142
9	1½	72	94	2	168	112	2½	242	124	3½	302	126	4	384	135	5	440	137
10	1½	78	94	2	184	112	3	245	118	3½	330	128	4	421	138	5	469	138
11	1½	84	94	2	205	114	3	263	118	3½	354	130	4	440	140	5	499	139
12	1½	90	94	2	229	115	3	282	118	4	333	122	4½	442	132	5	532	140
14	1½	108	96	2½	204	108	3	314	121	4	377	124	4½	485	135	5½	542	136
16	1½	124	96	2½	229	108	3	353	122	4	422	126	4½	541	136	5½	601	137
18	1½	137	96	2½	258	109	3	391	122	4	465	126	4½	594	136	5½	659	139
20	1½	151	96	2½	281	110	3	427	123	4	507	127	4½	648	138	5½	695	140
24	1½	179	96	2½	332	110	3½	442	117	4½	538	122	5	694	133	6	777	136

economic thickness — kaylo pipe insulation — process piping

(80F ambient air)

PIPE TEMP. / TEMP. DIFF. / IPS	200 / 120			400 / 320			600 / 520			800 / 720			1000 / 920			1200 / 1120		
	ET	HL	ST	ET	HL	ST	ET	HL	ST	ET	HL	ST	ET	HL	ST	ET	HL	ST
½	1	15	94	1	48	118	1	84	146	1	125	193	1	174	238	1½	189	203
¾	1	18	97	1	57	132	1	100	170	1	147	214	1	205	265	1½	218	221
1	1	19	95	1	60	125	1	105	158	1	156	196	1½	183	186	1½	237	217
1¼	1	25	99	1	76	129	1	132	178	1	196	224	1½	204	186	1½	263	217
1½	1	25	97	1	77	129	1	135	167	1½	164	165	1½	229	199	1½	295	230
2	1	30	97	1	89	132	1	158	171	1½	188	167	1½	262	202	2	288	182
2½	1	36	98	1	101	133	1½	129	130	1½	192	155	2	237	160	2	307	184
3	1	42	99	1	122	137	1½	165	144	1½	245	176	2	293	179	2½	334	183
3½	1	42	99	1	134	124	1½	166	136	1½	280	180	2	299	170	2½	343	174
4	1	50	100	1	144	136	1½	198	147	2	248	155	2	347	184	2½	393	185
4½	1	62	101	1	149	138	1½	201	154	2	258	158	2	361	188	2½	428	172
5	1	70	102	1	170	140	1½	242	158	2	304	159	2	400	190	2½	490	181
6	1	74	102	1½	160	123	1½	281	156	2	339	161	2	474	193	2½	524	195
7	1½	70	97	1½	176	123	1½	311	154	2	388	161	2½	465	167	2½	624	186
8	1½	66	94	1½	193	123	1½	340	155	2	412	163	2½	476	168	3	548	175
9	1½	72	94	1½	208	123	1½	376	155	2	445	163	2½	540	168	3	640	175
10	1½	78	94	1½	219	123	2	324	136	2½	411	147	2½	576	173	3½	596	166
11	1½	84	94	1½	240	124	2	360	138	2½	450	149	2½	626	175	3½	633	168
12	1½	90	94	1½	261	125	2	404	141	2½	482	150	2½	675	177	3½	679	169
14	1½	108	96	1½	307	127	2	432	142	2½	542	154	2½	757	183	3½	746	172
16	1½	124	96	1½	352	128	2	490	144	2½	610	156	2½	852	185	3½	868	174
18	1½	137	96	1½	392	128	2	543	144	2½	674	156	3	818	168	3½	933	177
20	1½	151	96	1½	431	129	2	598	145	2½	743	157	3	893	169	3½	1020	178
24	1½	179	96	1½	511	129	2	707	146	2½	872	158	3	1048	171	3½	1195	180

table key (ambient still air at 80F) ET — economic thickness; ST — surface temperature; HL — heat loss . . Btu/hr/lineal foot

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Temp. Pipe Size	1300			1400			1500			1600			1700			1800		
	ET	HL	ST	ET	HL	ST	ET	HL	ST	ET	HL	ST	ET	HL	ST	ET	HL	ST
½	2½	221	152	2½	245	160	3	254	150	3	278	157	3	304	164	3½	313	156
¾	2½	243	156	3	252	148	3	278	155	3	305	162	3½	314	154	3½	342	161
1	2½	269	161	3	277	152	3	306	160	3½	316	152	3½	345	159	3½	375	166
1¼	3	279	149	3	310	157	3	342	165	3½	351	157	3½	384	164	3½	417	172
1½	3	284	153	3½	309	146	3½	362	160	3½	368	160	4	397	160	4	434	168
2	3	337	156	3½	347	150	3½	383	158	3½	421	165	4	432	159	4	469	166
2½	3	374	160	3½	385	154	3½	425	162	3½	466	170	4	476	163	4	518	171
3	3½	388	150	4	402	146	4	444	153	4½	458	150	4½	500	156	4½	545	163
3½	4	390	142	4	434	149	4	479	156	4½	494	152	4½	539	159	5	555	155
4	4	419	144	4	465	151	4½	481	148	4½	528	154	5	545	151	5	593	158
4½	4	446	145	4½	464	143	4½	512	150	5	530	147	5	579	153	5½	598	151
5	4½	445	138	4½	495	145	5	515	143	5	565	149	5½	585	147	5½	637	153
6	4½	502	141	5	523	140	5	578	146	5½	560	144	5½	655	150	6	678	149
7	4½	550	143	5	572	142	5	632	148	5½	655	147	6	679	146	6	738	151
8	5	560	137	5	622	143	5½	647	142	5½	710	149	6	735	148	6½	761	147
9	5	603	138	5½	630	138	5½	696	144	6	722	143	6	789	149	6½	817	149
10	5	653	140	5½	681	139	5½	752	146	6	779	145	6½	809	145	6½	880	150
11	5½	652	134	5½	724	140	6	754	140	6	829	146	6½	859	146	7	890	146
12	5½	693	135	5½	770	141	6	801	141	6½	834	141	6½	911	147	7	943	147
14	5½	742	136	6	776	137	6	857	143	6½	891	143	7	926	143	7	1007	148
16	6	772	132	6	858	138	6½	896	139	7	934	139	7	1020	144	7½	1058	145
18	6	844	133	6½	886	134	6½	978	140	7	1018	140	7½	1059	141	7½	1153	146
20	6	917	134	6½	960	135	6½	1060	141	7	1102	142	7½	1146	142	7½	1247	148
24	6	1060	136	6½	1108	137	7	1157	138	7½	1206	139	7½	1318	144	8	1366	145
30	6½	1195	133	7	1253	134	7½	1312	135	7½	1440	141	8	1497	142	8½	1555	143
36	6½	1620	142	7	1690	144	7½	1790	147	7½	1950	153	8	2050	155	8½	2150	158

ET—economic thickness HL—heat loss . . . Btu/hr/lineal foot ST—surface temperature

OWENS-CORNING FIBERGLAS CORPORATION

Industrial and Commercial Construction Materials Division, 717 Fifth Avenue, New York, New York 10022
General Offices, Toledo, Ohio 43601

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HIGH
TEMPERATURE
INSULATION
BY
PITTSBURGH CORNING
FOR SERVICE
UP TO 500°F



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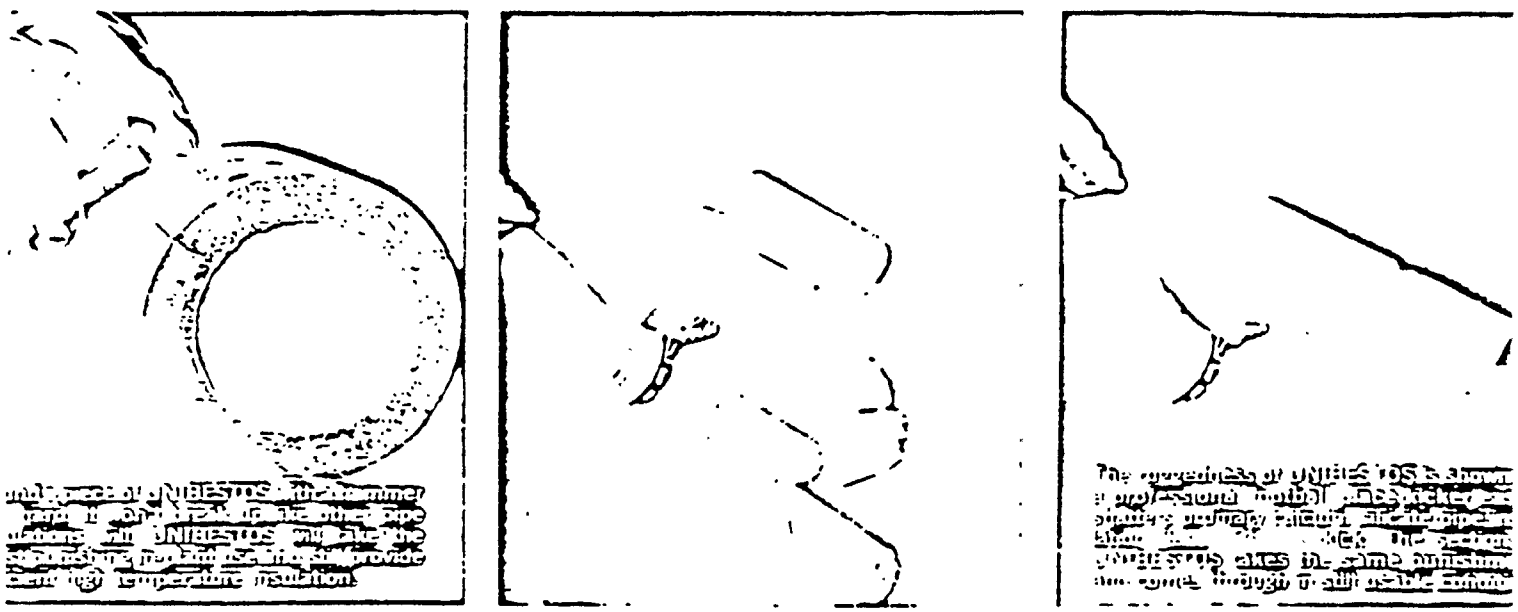
UNIBESTOS Insulation . .

. . . provides superi

Pittsburgh Corning's UNIBESTOS is the best high temperature piping and equipment insulation available to you today. The very nature of its composition: Amosite asbestos which comprises most of UNIBESTOS; sodium silicate which is its binder; and the diatomaceous silica filler, gives UNIBESTOS a combination of thermal, chemical and physical properties unsurpassed in high temperature insulation.

UNIBESTOS is efficient in insulating, and it's rugged, too . . . so rugged it s reusable, long after other types of insulation would have been replaced.

UNIBESTOS has been through extensive, controlled tests . . . comparing it with the other types of high temperature insulations . . . and no matter what the test has been . . . highest temperatures over long periods of time; heat loss



at joints; thermal conductivity . . . UNIBESTOS is excellent. When actual performance of UNIBESTOS both in the laboratory and in actual installations is compared to other types of high temperature insulation, it is easy to see why it will do a better job in refineries, chemical plants, petrochemical plants, utilities plants and marine applications—anywhere the best insulation is needed for piping and equipment.

The outstanding performance of UNIBESTOS . . . both in tests and on-the-job installations results from its special combination of superior materials, advanced engineering and modern, efficient manufacturing methods. The long interlacing fibers between abutting sections of UNIBESTOS form positive heat seals, making single-layer application possible. These long fibers also give UNIBESTOS its ability to resist rough handling in transit and on the job. It won't

405407

RUGGED AND TOUGH

handleability"

break up and dust as other commonly used materials do, even after continued removal and reapplication.

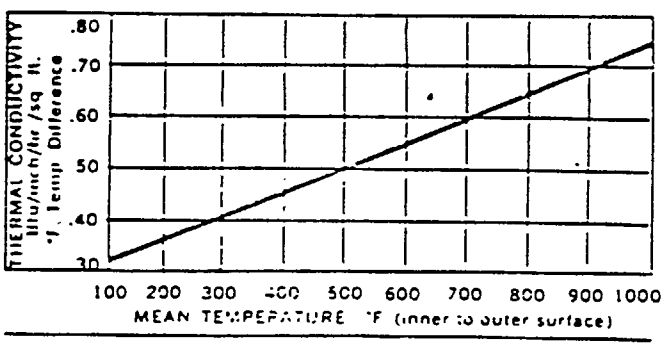
UNIBESTOS withstands moisture, acids, fumes, and corrosive atmospheres. UNIBESTOS, when dried, returns to its original rugged physical characteristics and to the same high insulating efficiency. UNIBESTOS, available in full round sections up to 44" insulation O.D., has gained widespread acceptance as the time-saving way to insulate underground lines. Requiring less handling, no special banding, UNIBESTOS full cylinders are the ideal insulation for tunnel or conduit application. And naturally it won't support combustion . . . it's completely incombustible . . . affording protection for piping in case of fire or sudden and extreme rises in temperature.

UNIBESTOS' inherent strength and resilience make it the most practical high temperature insulation for use in refineries and chemical plants where frequent maintenance and/or changes must be accomplished. Other insulations would crumble, break, fall apart, but UNIBESTOS can be removed and put back on as often as necessary and still provide efficient insulation. UNIBESTOS' ruggedness provides other benefits, too . . . for contractor and user. It has great shock resistance, will take rough handling before, during and after installation thus there is less cleanup after installation, too. UNIBESTOS will also withstand compression without crumbling; heavy tools can be dropped on the line . . . workers can even walk on piping covered with UNIBESTOS without fear of it cracking or crumbling.

PHYSICAL PROPERTIES OF UNIBESTOS

Density	16 lb./ft.³
Compressive Strength	(12.5 lb./in.² | 1800 lb./ft.²) (dry; at 5% deformation)
Lineal Shrinkage	0.0% to 1200°F. (one surface) exposed to operating temperature for 24 hours
Hygroscopicity	3.5% 70°F. @90% R. H. 24 hours
Combustibility	Will not burn
pH	10.5
Thermal Conductivity (K)	at 300°F mean .41 at 500°F mean .50 at 800°F mean .65
Thermal Shock Resistance	Will not thermal shock
Tensile Strength	67 psi
Acid Resistance	Negligible effect on physical characteristics from common industrial acids and caustics
Leachable Chlorides (average)	Less than 125 ppm
Sodium Silicate Content	Over 60,000 ppm
Noncorrosive	Will not contribute to stress corrosion of stainless steel
UNIBESTOS complies with:	ASTM Designation C391-62T Federal Specification HH-I-561 Type III Class B Military Specification MIL-I-2781 Grade II Class c (750°F.) Grade III Class f (1050°F.)

THERMAL CONDUCTIVITY CURVE OF UNIBESTOS



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UNIBESTOS FOR SINGLE LAYER APPLICATION

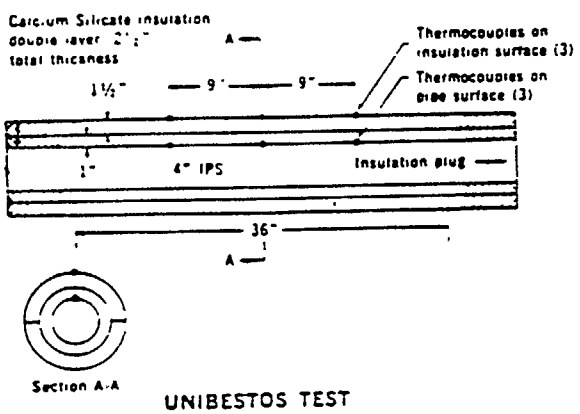
Two inherent advantages found only in UNIBESTOS—the interlocking fibrous joints and negligible shrinkage—make it the most efficient single-layer insulation on the market. In single layer application, the long, interlocking fibers of Amosite in UNIBESTOS form tight heat seals at all butt joints.

Tests witnessed by Pittsburgh Testing Laboratory (see reproduction of test report, right) show performance values measured by actual temperature difference on heated test pipes between UNIBESTOS and a calcium silicate type insulation. These tests illustrate that UNIBESTOS showed less heat loss at joints than the calcium silicate . . . that for equal thicknesses, a single layer of UNIBESTOS loses less heat at the joint than a double layer, staggered joint installation of calcium silicate. This means lower installation costs, faster installation and considerably less material handling on the job.

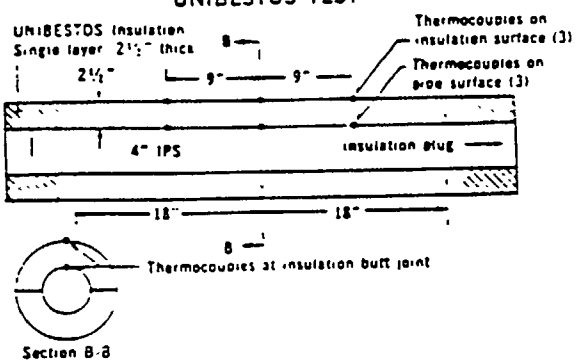
TEST PROCEDURE

Two identical 44" long sections of 4-inch IPS heavy-duty steel pipes were used for the test. Specially wound 38" long Kanthal wires on ceramic cores were centered within the test pipes and provided the electric heat. A Chromel-Alumel thermocouple was peened into the pipe surface at the center of each test pipe, and served as a control for regulating electric heat through Wheelco temperature controllers. These couples were also used to obtain temperature readings when switched to a L & N Indicating Potentiometer. Additional thermocouples were installed on test pipe surfaces 9" on each side of center. Thermocouples were also installed on the outside surface of pipe insulation directly opposite the couples located on test pipe making a total of six thermocouples for each type insulation. Pipe ends were sealed with a calcium silicate based cement. Drawings showing the details of the two test assemblies are shown below.

CALCIUM SILICATE TEST



UNIBESTOS TEST



PITTSBURGH TESTING LABORATORY

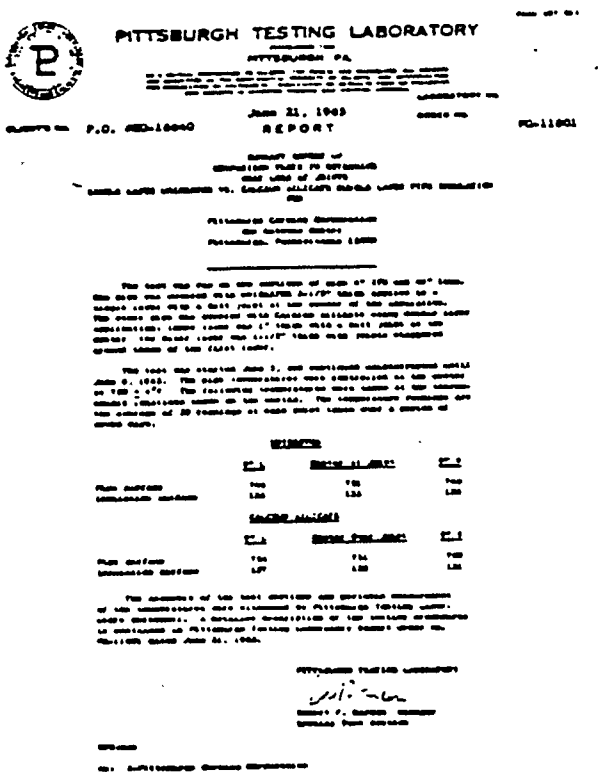


TABLE FROM PTL REPORT (Above)

UNIBESTOS

	9" L	Center at Joint	9" R
Pipe Surface	746	751	746
Insulation Surface	126	133	128
CALCIUM SILICATE			
	9" L	Center over Joint	9" R
Pipe Surface	754	751	760
Insulation Surface	137	139	131

AC5493

Union Carbide trial exhibit UC-4813: The Industrial Insulators, Inc. Catalog of Commercial and Industrial Thermal I...
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ACL Doc 19329 · Page 16 of 64
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CONDUIT TEMPERATURE 7-MONTHS TEST

Four separate sections of 1¼" IPS stainless steel pipe with Chromolux electric heaters were used to test three sections of UNIBESTOS and one section of calcium silicate insulation* (all 4" IPS x 3" thick).

TEST UNIT	AVERAGE PIPE TEMP.	AVERAGE OUTER SURFACE TEMP.	STARTING WATTS	CONCLUDING WATTS
UNIBESTOS	1606°F	155°F	400	370
Calcium Silicate	1585	205	452	461
Calcium Silicate (replacement)	1561	199	458	535
UNIBESTOS	1603	164	410	398
UNIBESTOS	1603	165	344	318

Results—Much more power was required to maintain approximate starting temperatures with the calcium silicate insulation, and the surface temperature was higher. The calcium silicate failed after 3 months' testing because of excessive shrinkage and deep vertical cracks about every two inches. The replacement section of calcium silicate finished the test with the same results as the original piece. The UNIBESTOS had no cracks through the wall thickness. (There was a color change next to the test pipe, characteristic of a chemical change of the iron content in the asbestos which does not affect the insulating efficiency of UNIBESTOS.)

*A calcium silicate type insulation recommended to 1600°F.

JOINT HEAT-LOSS TEST

Test Results of Surface Temperatures and Heat-Loss at Joints	UNIBESTOS Pipe Insulation (Single Layer)	"B" Insulation (Single Layer)	"B" Insulation (Double Layer)
Thickness of covering, inches	2.50	2.48	2.45
Density of covering, lbs./cu. ft.	14.00	12.95	12.24
Energy supplied to heating coil, watts	580	650	610
Energy supplied to heating coils, Btu/hr.	1979	2218	2081
Temperature of pipe, °F	600	600	597
Temperature of test room, °F	75	75	75
Temperature difference (pipe minus room), °F	525	525	522
Average surface temperature (not including joints), °F	114	122	116
Average joint temperature, °F	134	152	143
Average rise in temperature at joint, °F	20	30	27
Heat-loss through end caps, Btu s/hr	246	246	244
Heat-loss through covering, Btu s/hr	1735	1972	1837
Unit heat loss through covering, Btu s/hr per sq. ft. of pipe surface per degree (F) of temperature difference	0.244	0.278	0.260

Results—". . . As a result of this investigation it seems to us it may be fairly concluded that because of its fibrous nature, which permits the extension of fibrous material across the butt joints, UNIBESTOS insulation in single layer construction is equally as efficient as double layer construction in insulating materials of a non-fibrous character where there may be more direct passage of heat through the joint . . ." (Quotation from independent laboratory test)

UNIBESTOS INHIBITS STRESS CORROSION OF STAINLESS STEEL

For many years, industry has been bothered by the problem of stress corrosion of austenitic stainless steel caused by the leaching of chloride from ordinary insulations.

Recent laboratory investigations showed that all of the commonly used high temperature insulating materials contained these leachable chlorides . . . chlorides which caused stress corrosion of austenitic stainless steel under certain conditions. Corrosion-causing chlorides could also enter insulation in industrial or marine atmospheres. Many insulations actually further stress corrosion because (1) they contain none or very little of the necessary inhibitors and (2) they contain high amounts of leachable chlorides.

UNIBESTOS contains, by laboratory analysis, a significantly high amount of sodium silicate (60,730 parts per million), an effective inhibitor of stress corrosion . . . a greater amount than any other high temperature insulation. Corrosion-causing chlorides in UNIBESTOS average less than 125 parts per million.

Dana Test for stress corrosion

In this accelerated corrosion test, a test piece of Type 304 stainless steel heated to 100°C. is placed over a section of thermal insulation which is itself placed in water containing a known amount of chlorides (1500 ppm NaCl solution).

The chlorides in the test solution concentrate on the stainless steel surface as the solution reaching the surface evaporates. Cracking of the stainless steel occurs when the required quantity accumulates.

Criteria for the test is based on the performance of asbestos fiber-sodium silicate type insulation (UNIBESTOS) because it is known to contain large amounts of stress corrosion inhibitor.

Six days without cracking indicates acceptable performance of the insulation being tested.

RESULTS OF ACCELERATED "DANA" TEST PERFORMED ON UNIBESTOS AT LEHIGH TESTING LABORATORY

UNIBESTOS	PARTS PER MILLION
Leachable Chlorides	42.5
Total Silicates (SiO_2)	38 060
Calcium Silicates ($CaSiO_3$)	338
Sodium Silicates (Na_2SiO_3)	60 730

Five samples were subjected to the accelerated Dana Test and were satisfactory after six days exposure. The test was continued and four specimens failed after 18 days. The test was discontinued at this point.

In field installations over a period of years no known failures from cracking have occurred in stainless piping insulated with UNIBESTOS. The asbestos fiber with the highest content sodium silicate binder combine in UNIBESTOS to prevent stress corrosion while providing superior insulating qualities.

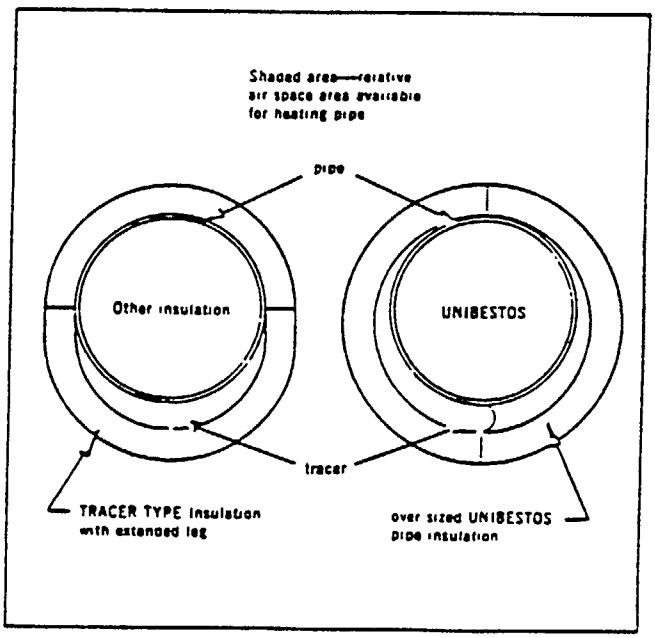
For all stainless steel piping — chemical plants, ships, power plants — wherever it's used, UNIBESTOS gives lasting, trouble free insulation in a wide temperature range — and effectively inhibits stress corrosion at the same time.

For more [illegible] Corning [illegible]

FULL-ROUND AND HALF-ROUND UNIBESTOS SECTIONS REDUCE INSTALLATION COSTS AND PROVIDE MORE EFFICIENT INSULATION

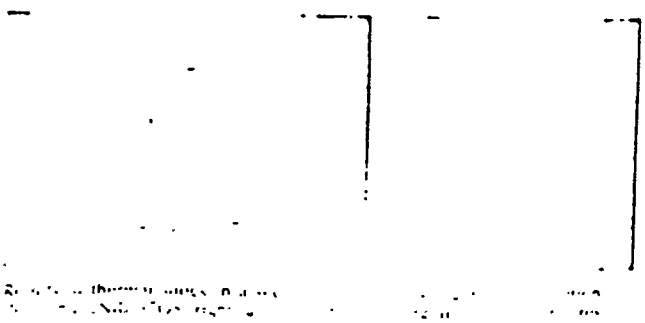
UNIBESTOS is manufactured in full-round and half-round sections in all sizes and thicknesses for insulating lines from ½" to 36" IPS (most insulations stop at or below the 24" pipe size). Full- and half-round sections eliminate lags, small segments which not only take longer to apply, but of necessity contain many more joints in the finished pipe covering. Extended leg sections which other rigid insulations need for traced line application are also eliminated and traced line heat is used more effectively. (See diagram.) In addition, oftentimes the extended leg can be shattered by the weight of piping pulling against it.

Simply place the sections of tough, resilient UNIBESTOS around the pipe (or pipes in case of traced lines) and fasten them in place. The job is done quicker and will last . . . and last.



UNIBESTOS WILL NOT CRACK AT HIGH TEMPERATURE

One reason UNIBESTOS is a "one insulation" material for all applications is that over its entire temperature range (100°F to 1500°F) it will never crack, causing heat loss. High heat shrinkage cracks — common to other insulation — just don't happen with UNIBESTOS.

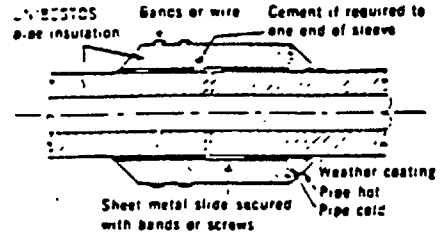


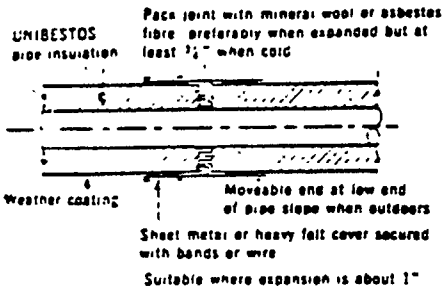
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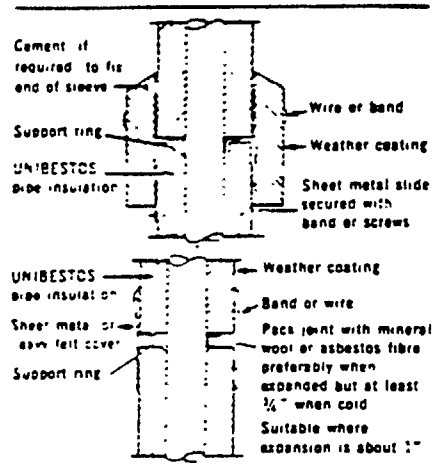
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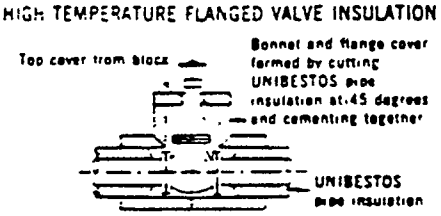
TYPICAL EXPANSION JOINTS AND FITTING COVERINGS



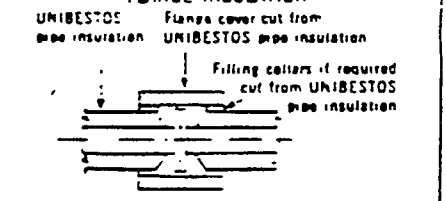




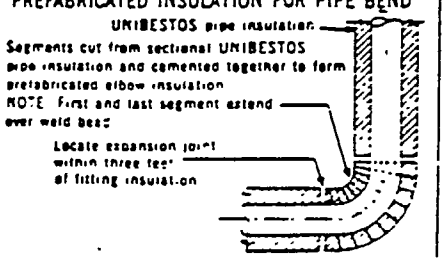
HIGH TEMPERATURE FLANGED VALVE INSULATION



FLANGE INSULATION



PREFABRICATED INSULATION FOR PIPE BEND



Expansion joints and fitting covers are easy to fabricate from UNIBESTOS pipe insulation on the job. Variations can be obtained using different membranes and shield for the expansion gap. All variations should meet with the approval of the design engineer on a specific project.

The number and spacing of expansion joints can be determined from the table below. For example, at 750°F. pipe temperature and 24' spacing, the expansion per joint will be 1.5". Fixed points, bends, etc. should be considered in establishing locations of expansion joints.

EXPANSION CONTROL CHART

(Figures shown below are inches of expansion per joint interval indicated)

Pipe Temperature	Linear Expansion of Pipe* (inches/100 ft.)	INTERVAL OF EXPANSION JOINT SPACING										
		9'	12'	15'	18'	21'	24'	27'	30'	36'	42'	48'
1500°	14.89	1.3	1.8	2.2	2.7	3.1	3.6	4.0	4.5	5.4	6.2	7.1
1450°	14.19	1.3	1.7	2.1	2.6	3.0	3.4	3.8	4.3	5.1	6.0	6.8
1400°	13.59	1.2	1.6	2.0	2.4	2.9	3.3	3.7	4.1	4.9	5.7	6.5
1350°	12.89	1.2	1.6	1.9	2.3	2.7	3.1	3.5	3.9	4.6	5.4	6.2
1300°	12.29	1.1	1.5	1.8	2.2	2.6	3.0	3.3	3.7	4.4	5.2	5.9
1250°	11.69	1.1	1.4	1.8	2.1	2.5	2.8	3.2	3.5	4.2	4.9	5.6
1200°	11.09	1.0	1.3	1.7	2.0	2.3	2.7	3.0	3.3	4.0	4.7	5.3
1150°	10.49	.94	1.3	1.6	1.9	2.2	2.5	2.8	3.1	3.8	4.4	5.0
1100°	9.89	.89	1.2	1.5	1.8	2.1	2.4	2.7	3.0	3.6	4.2	4.7
1050°	9.29	.84	1.1	1.4	1.7	2.0	2.2	2.5	2.8	3.3	3.9	4.5
1000°	8.76	.79	1.0	1.3	1.6	1.8	2.1	2.4	2.6	3.2	3.7	4.2
950°	8.20	.74	.98	1.2	1.5	1.7	2.0	2.2	2.5	3.0	3.4	3.9
900°	7.65	.69	.92	1.1	1.4	1.6	1.8	2.1	2.3	2.8	3.2	3.7
850°	7.11	.64	.85	1.0	1.3	1.5	1.7	1.9	2.1	2.6	3.0	3.4
800°	6.59	.59	.79	.99	1.2	1.4	1.6	1.8	2.0	2.4	2.8	3.2
750°	6.07	.55	.73	.91	1.1	1.3	1.5	1.6	1.8	2.2	2.5	2.9
700°	5.56	.50	.67	.83	1.0	1.2	1.3	1.5	1.7	2.0	2.3	2.7
650°	5.08	.46	.61	.76	.91	1.1	1.2	1.4	1.5	1.8	2.1	2.4
600°	4.58	.41	.55	.69	.82	.96	1.1	1.2	1.4	1.6	1.9	2.2
550°	4.10	.37	.49	.62	.74	.86	.98	1.1	1.2	1.5	1.7	2.0
500°	3.63	.33	.44	.54	.65	.76	.87	.98	1.1	1.3	1.5	1.7
450°	3.16	.28	.38	.47	.57	.66	.76	.85	.95	1.1	1.3	1.5
400°	2.71	.24	.33	.41	.49	.57	.65	.73	.81	.98	1.1	1.3

*Installation temperature assumed at 70°F. Table based on carbon and low-alloy steel pipe

NOTE Use sleeve-type expansion joints only if expansion figure to the right of heavy line in chart is used.

JOINT STAPLING FOR INSTALLATIONS OPERATING OVER 600°F

Normally, because of the negligible shrinkage inherent in UNIBESTOS, it is not necessary to use staples at butt joints. However, at operating temperatures above 600°F. linear pipe expansion becomes a critical design factor and staples may be desired. It is recommended that 1½" x 1" steel staples be used in accordance with the following procedure*:

1. Determine pipe operating temperature.
2. From Expansion Control Chart above, determine expansion joint spacing.
3. Knowing IPS and recommended thickness, determine the weight of one lineal foot of UNIBESTOS.
4. Multiply weight per lineal foot of UNIBESTOS by one-half the joint spacing.
5. Multiply (4) by 0.6 (coefficient of friction of UNIBESTOS and steel pipe) to find frictional force that staples must resist.
6. Divide (5) by 25 to determine the number of staples required per butt joint.

EXAMPLE: To determine the number of staples required for a 10-inch IPS line operating at 600°F. with a recommended thickness of 2½" UNIBESTOS.

IPS	TEMP	REC. THICK.	WT/FT	JOINT SPACING	½ SPACING x WT/FT	F=	NO. OF STAPLES
10	600	2½	13.77	30	205	123	5

*NOTE This technique is based on expansion of straight horizontal pipe and no allowance is made for elbows, etc.

AC 5502

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UNIBESTOS DOES NOT SHRINK

Chemically inert at high temperatures and extremely heat stable, UNIBESTOS joints stay tight, heat stays in. MORE heat stays in, because UNIBESTOS joints are more efficient in the first place. The long Amosite fibers provide a really tight heat seal.

LESSER THICKNESS IN LARGER PIPE SIZES FOR PERSONNEL PROTECTION

UNIBESTOS is made in 1" thickness up to 12" IPS, and 1½" thickness from 14" to 20" IPS for personnel protection. These thicknesses will maintain a surface temperature of 160°F or lower in use up to 1500°F.

UNIBESTOS IS EASY TO CUT AND WORK

Bends, elbows, tees, expansion joints, fitting covers and other irregular shapes are easily shop or field fabricated with UNIBESTOS. They'll take hard knocks and rough handling without breakage in shipment or installation, and can be removed whenever necessary and reused. The smooth coating on UNIBESTOS makes it easy to handle . . . no sharp splines or other objectionable handling characteristics.

LOW THERMAL CONDUCTIVITY

UNIBESTOS is as efficient an insulation as you can use, over its broad temperature range of 100°F to 1500°F. The low thermal conductivity—"K" Value—of UNIBESTOS will provide maximum thermal efficiency throughout the life of the insulation . . . and UNIBESTOS will outlast other insulations, too. It's stronger, tougher.

SMOOTH REFRACTORY COATING PROVIDES ADVANTAGES

UNIBESTOS is manufactured with a smooth, integral refractory coating which is dust-free and makes UNIBESTOS easy to handle. This smooth, tough coating needs no jacketing indoors, and can be painted, if desired, for color coding.

UNIBESTOS sections can also be provided with canvas and aluminum jacketing at a modest additional charge.

RECOMMENDED UNIBESTOS THICKNESSES FOR PERSONNEL PROTECTION

(Surface Temperature less than 161°F., Ambient Temperature 80°F.)

NOMINAL PIPE SIZE	TEMPERATURE HOT PIPE, °F.													
	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500
	TEMPERATURE DIFFERENCE PIPE TO AIR													
	120	220	320	420	520	620	720	820	920	1020	1120	1220	1320	1420
1" and less	1	1	1	1	1	1	1½	1½	1½	2	2	2½	2½	2½
1½"	1	1	1	1	1	1½	1½	1½	2	2	2	2½	3	3
2"	1	1	1	1	1	1½	1½	1½	2	2	2½	2½	3	3
3"	1	1	1	1	1	1½	1½	2	2	2½	2½	3	3	3½
3½"	1	1	1	1	1	1	1½	1½	2	2	2½	2½	3	3½
4"	1	1	1	1	1	1½	1½	2	2	2½	2½	3	3½	3½
5"	1	1	1	1	1	1½	2	2	2½	2½	3	3	3½	4
6"	1	1	1	1	1½	1½	2	2	2½	3	3	3	3½	4
8"	1	1	1	1	1½	1½	2	2	2½	3	3	3	3½	4
10"	1	1	1	1	1½	1½	2	2½	2½	3	3½	3½	4	4
12"	1	1	1	1	1½	1½	2	2½	2½	3	3½	3½	4	4½
14" to 18"	1	1	1½	1½	1½	1½	2	2½	3	3	3½	3½	4	4½
20"	1	1	1½	1½	1½	2	2	2½	3	3½	3½	4	4	4½

UNIBESTOS pipe insulation is manufactured in thicknesses that conform to accepted industrial and manufacturer's standards known as simplified dimensional standards. In order to conform to these standards the outside diameters of all UNIBESTOS sections closely approximate those of iron pipes.

By conforming to these standards the installation of UNIBESTOS is further simplified and any dimensional confusion or adjustment is eliminated. These uniform manufacturing standards are particularly useful in the fabrication of valve and fitting covers, etc., where nesting layers of UNIBESTOS are required.

RECOMMENDED UNIBESTOS THICKNESSES FOR INDUSTRIAL USE

PIPE TEMP.	200°F			300°F			400°F			500°F			600°F			700°F		
TEMP. DIFF.	120°F			220°F			320°F			420°F			520°F			620°F		
PIPE SIZE	RT	HL	ST	RT	HL	ST	RT	HL	ST	RT	HL	ST	RT	HL	ST	RT	HL	ST
¼	1	16.5	93.5	1	32.8	104	1½	40.2	104	1½	57.3	109	2	67.0	108	2	85.0	114
½	1	19.7	95.8	1	38.1	108	1½	45.8	104	1½	64.4	114	2½	64.4	101	2½	82.2	106
1	1	20.2	93.6	1	39.2	104	1½	50.8	104	1½	71.2	113	2½	73.1	103	2½	92.1	109
1¼	1	25.6	97.3	1	50.8	111	1½	57.5	104	1½	80.1	113	2½	85.8	108	2½	108	113
1½	1	26.3	95.8	1	52.3	108	2	51.4	98.9	2	72.0	104	3	79.5	100	3	99.1	104
2	1	30.7	96.2	1	58.0	109	2	61.5	101	2	86.2	108	3	91.2	103	3	115	108
2½	1	34.8	96.8	1	67.5	110	2	65.1	99.0	2	89.9	106	3	98.2	103	3	122	107
3	1	40.7	97.9	1	80.3	112	2½	70.3	98.7	2½	97.2	105	3½	105	102	3½	131	106
4	1	49.0	98.0	1	95.6	112	2½	82.4	100	2½	115	106	3½	121	103	3½	152	108
5	1	60.0	99.0	1	116	114	2½	95.8	101	2½	132	108	3½	138	105	3½	173	110
6	1½	52.7	93.9	1½	103	105	2½	110	103	2½	152	109	4	145	102	4	182	107
7	1½	57.6	93.9	1½	114	105	2½	123	103	2½	171	110	4	160	103	4	200	108
8	1½	64.4	94.2	1½	127	105	2½	130	102	2½	179	109	4	175	104	4	219	109
9	1½	70.1	94.6	1½	139	106	2½	143	102	2½	197	110	4	185	103	4	231	108
10	1½	74.4	94.1	1½	147	105	3	139	101	3	193	106	4½	193	105	5	259	110
12	1½	86.1	94.3	1½	170	106	3	160	100	3	221	107	5	220	103	5	274	109
14	1½	99.0	95.4	1½	196	107	3	177	101	3	245	108	5	235	104	5	296	109
16	1½	115	95.6	1½	218	108	3	197	101	3	273	109	5	262	104	5	302	105
18	1½	128	95.9	1½	240	108	3	215	102	3	301	109	5	287	104	5	333	107
20	1½	141	96.3	1½	271	109	3½	210	99.0	3½	293	105	5	280	101	5	363	107
24	1½	153	96.6	1½	292	109	3½	246	99.5	3½	343	106	5	328	101	5	425	107

RT = Recommended Thickness HL = Heat Loss (BTU/HR./LF). ST = Surface Temperature (°F.)

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Pipe Temperature	200°F			300°F			400°F			500°F			600°F			700°F			800°F		
Temperature Difference	120°F			220°F			320°F			420°F			520°F			620°F			720°F		
Pipe Size	RT	HL	ST	RT	HL	ST	RT	HL	ST	RT	HL	ST	RT	HL	ST	RT	HL	ST	RT	HL	ST
	1	16 5	93 5	1	32 8	104	1	50 5	116	1	70 8	128	1	93 5	140	1	119	149	1½	116	134
	1	19 7	95 6	1	38 1	108	1	60 9	122	1	85.1	135	1½	84 8	123	1½	107	133.	1½	130	142
1	1	20 2	93 6	1	39 2	104	1	62 4	117	1	87 1	128	1½	94 1	122	1½	118	131	2	126	125
	1	25 6	97 3	1	50 8	111	1	80.5	126	1	112	141	1½	106	123	1½	133	132	2	150	133
1½	1	26.3	95 8	1	52.3	108	1	81.3	122	1	113	135	1½	118	128	1½	150	138	2	146	125
2	1	30 7	96 2	1	58 0	109	1	92 E	123	1	128	136	1½	133	128	1½	169	138	2	174	132
	1	34 8	96 8	1	67 5	110	1	106	124	1	149	138	1½	135	123	1½	172	132	2	182	125
3	1	40 7	97 8	1	80 3	112	1	126	127	1	173	141	1½	175	133	1½	221	144	2	227	139
4	1	49 0	98 0	1	95 6	112	1	149	128	1	209	143	1½	210	136	1½	268	147	2	270	142
5	1	60 0	99 0	1	116	114	1	182	130	1	254	146	1½	251	139	1½	318	150	2½	270	133
6	1	71.1	100	1	139	116	1½	162	117	1½	227	129	2	237	127	2	299	137	2½	313	135
	1½	57 6	93 9	1½	114	105	1½	178	117	1½	250	129	2	264	128	2	333	138	2½	346	136
8	1½	64 4	94.2	1½	127	105	1½	192	118	1½	276	130	2	290	129	2	366	139	2½	365	134
9	1½	70.1	94 6	1½	139	106	1½	219	119	1½	306	131	2	303	127	2	385	137	2½	400	135
10	1½	74 4	94 1	1½	147	105	1½	230	119	1½	323	130	2	343	129	2	435	140	2½	450	138
12	1½	86.1	94 3	1½	170	106	1½	267	118	1½	375	130	2	395	130	2	500	141	2½	520	140
14	1½	89 0	95 4	1½	196	107	1½	307	121	1½	430	134	2	445	133	2	565	144	3	498	133
16	1½	115	95 6	1½	218	108	1½	345	122	1½	480	135	2	500	134	2	635	145	3	556	134
18	1½	128	95 9	1½	240	108	1½	385	122	1½	540	135	2	555	135	2	705	146	3	616	135
20	1½	141	96 3	1½	271	109	1½	406	123	1½	605	136	2½	510	126	2½	649	135	3	678	135
24	1½	153	96 6	1½	302	109	1½	451	124	1½	652	136	2½	600	126	2½	761	136	3	797	136

RECOMMENDED UNIBESTOS THICKNESSES FOR POWER AND UTILITY INDUSTRIES

Pipe Temperature	200°F			300°F			400°F			500°F			600°F			700°F			800°F		
Temperature Difference	120°F			220°F			320°F			420°F			520°F			620°F			720°F		
Pipe Size	RT	HL	ST	RT	HL	ST	RT	HL	ST	RT	HL	ST	RT	HL	ST	RT	HL	ST	RT	HL	ST
	1	16 5	93 5	1	32 8	104	1	50 5	116	1	70 8	128	1½	75.2	111	1½	94 6	125	2	104	119
	1	19 7	95 8	1	38.1	108	1	60.9	122	1	85 1	135	1½	84 8	123	1½	107	133	2	117	126
	1	20 2	93 6	1	39 2	104	1	62 4	117	1	87 1	128	1½	94 1	122	1½	118	131	2	126	125
1¼	1	25 6	97 3	1	50 8	111	1½	57.5	105	1½	80 1	113	1½	106 0	123	2	123	124	2½	132	120
1½	1	26 3	95 8	1	52.3	108	1½	64.3	108	1½	90.1	118	2	94 8	111	2	120	117	2½	132	116
2	1	30 7	96 2	1	58 0	109	1½	72 7	109	1½	101	118	2	113	116	2	142	123	2½	154	121
2½	1	34 8	96 8	1	67 5	110	1½	74 8	104	1½	106	113	2	119	114	2	150	120	2½	164	119
3	1	40 7	97 8	1	80 3	112	1½	95 6	112	1½	134	122	2	147	120	2	186	128	3	178	119
4	1	49 0	98 0	1	95 6	112	1½	115	113	1½	161	124	2	175	123	2	220	132	3	206	120
5	1	60 0	99 0	1	116	114	1½	137	115	1½	192	126	2½	175	116	2½	220	123	3	240	123
6	1	71 1	100	1	139	116	1½	162	117	1½	227	129	2½	203	118	2½	256	126	3½	241	117
	1½	57 6	93 9	1½	114	105	1½	178	117	1½	250	129	2½	226	119	2½	284	127	3½	270	119
8	1½	64 4	94 2	1½	127	105	1½	198	118	1½	276	130	2½	237	117	2½	302	125	3½	295	120
9	1½	70 1	94 6	1½	139	106	1½	219	119	1½	306	131	2½	260	118	2½	329	126	3½	316	120
10	1½	74 4	94 1	1½	147	105	1½	230	119	1½	323	130	2½	290	120	2½	366	128	3½	353	122
12	1½	86 1	94 3	1½	170	106	1½	267	118	1½	375	130	2½	339	122	2½	427	130	4	364	118
14	1½	89 0	95 4	1½	196	107	2	243	112	2	340	122	3	323	116	3	407	123	4	398	120
16	1½	115	95 6	1½	218	108	2	272	112	2	380	122	3	360	117	3	456	125	4	443	121
18	1½	128	95 9	1½	240	108	2	301	113	2	420	123	3	400	118	3	503	126	4	440	121
20	1½	141	96 3	1½	271	109	2	335	113	2	468	124	3	439	118	3	555	126	4	535	122
24	1½	153	96 6	1½	302	109	2	398	114	2	560	125	3	517	119	3	650	127	4½	565	118

TYPICAL SPECIFICATION FOR SINGLE-LAYER APPLICATION

Because of the exceptional heat stability and the negligible shrinkage of UNIBESTOS, practically any installation can be completed using only a single layer of the proper thickness of UNIBESTOS. The specification below details this technique

1. **Temperature Range:** UNIBESTOS shall be used on piping operating from +100°F. to +1500°F.

2. **Thickness Required:** Thickness shall be determined from the table of suggested thicknesses or the most economic thickness may be calculated using the NIMA Guide for determining economic thickness.

3. **Material:** All piping shall be insulated with UNIBESTOS as manufactured by Pittsburgh Corning Corporation.

4. **Application:** UNIBESTOS shall be applied over clean, dry surfaces. Adjoining sections shall be butted firmly together using single-layer applications. Circumferential and longitudinal joints do not require pointing with finishing cement to conserve heat. Insulation under 12" IPS shall be wired in place using 16 gauge soft annealed wire; on pipe sizes over 12", use 14 gauge wire or ½" x .020 Type 302 stainless steel bands. The wiring or bands shall be spaced no greater than 9" on centers. Fittings, flanges, and valves shall be insulated with fabricated mitered segments of UNIBESTOS equal to the thickness of the insulation adjoining pipe.

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900°F			1000°F			1100°F			1200°F			1300°F			1400°F			1500°F		
820°F			920°F			1020°F			1120°F			1220°F			1320°F			1420°F		
RT	HL	ST	RT	HL	ST	RT	HL	ST	RT	HL	ST	RT	HL	ST	RT	HL	ST	RT	HL	ST
1½	140	143	2	146	135	2	171	142	2	196	150	2½	181	132	2½	223	139	3	218	136
1½	159	151	2	165	141	2	193	149	2½	189	134	2½	202	138	2½	228	145	3	242	141
2	149	133	2½	157	127	2½	185	133	2½	212	140	3	218	135	3	242	140	3	272	146
2	181	141	2½	186	134	2½	217	141	3	228	136	3	246	141	3	276	148	3½	291	144
2	176	132	2½	185	128	2½	214	134	3	229	131	3	246	136	3	280	142	3½	295	139
2	210	140	2½	216	135	2½	253	142	3	265	139	3	287	144	3½	302	140	3½	343	147
2	221	136	2½	231	133	2½	269	139	3	282	137	3½	285	134	3½	322	138	4	342	137
2	274	148	2½	279	142	2½	326	150	3	335	146	3½	332	140	3½	377	146	4	397	144
2	325	151	3	291	134	3	338	141	3½	354	139	3½	384	143	4	408	141	4	461	148
2½	322	141	3	338	138	3	394	145	3½	400	141	4	407	138	4	462	143	4½	490	142
2½	376	143	3	389	141	3	453	148	3½	451	142	4	460	139	4	520	144	4½	545	145
2½	419	145	3½	380	132	3½	443	139	3½	508	147	4	503	142	4½	534	140	4½	596	146
2½	438	142	3½	416	134	3½	484	140	4	510	140	4	546	144	4½	580	142	4½	650	148
2½	483	144	3½	446	134	3½	520	141	4	537	139	4½	553	137	4½	621	142	5	650	142
2½	541	147	3½	498	137	3½	579	144	4	601	143	4½	598	139	4½	679	143	5	715	144
2½	629	149	3½	568	138	3½	661	145	4	684	145	4½	680	141	5	722	140	5	814	146
3	600	141	3½	622	141	3½	724	148	4½	685	140	5	697	137	5	790	142	5½	830	143
3	669	142	4	623	134	4	725	141	4½	758	141	5	763	138	5	865	142	5½	916	144
3	742	143	4	690	135	4	803	142	5	771	136	5	806	138	5½	900	140	6	1012	140
3	815	144	4	755	136	4	880	143	5	843	137	5½	865	135	5½	976	140	6	1025	141
3	959	145	4	879	137	4	1024	144	5	980	139	5½	1000	136	6	1060	139	6½	1110	139

900°F			1000°F			1100°F			1200°F			1300°F			1400°F			1500°F		
820°F			920°F			1020°F			1120°F			1220°F			1320°F			1420°F		
RT	HL	ST	RT	HL	ST	RT	HL	ST	RT	HL	ST	RT	HL	ST	RT	HL	ST	RT	HL	ST
2	125	128	2½	137	117	2½	148	123	3	160	121	3	172	126	3	194	131	3½	208	128
2	141	133	2½	142	122	2½	165	127	3	176	125	3½	181	123	3½	203	127	4	219	127
2	151	132	3	147	118	3	172	123	3	197	129	3½	201	127	4	217	126	4	242	130
2½	159	127	3	170	124	3	198	130	3½	211	127	4	192	125	4	242	130	4½	258	128
2½	158	121	3	171	120	3	199	125	3½	213	124	4	219	122	4	247	126	4½	265	127
2½	186	129	3	198	126	3	231	132	4	229	122	4	250	127	4½	271	126	4½	302	131
2½	197	125	3	211	124	3	246	130	4	245	122	4	257	126	4½	287	126	4½	324	131
3	214	125	3½	227	125	3½	265	129	4	282	128	4½	294	127	4½	331	132	5	348	130
3	248	127	3½	263	126	3½	309	132	4½	312	126	4½	316	127	5	358	128	5	401	133
3	289	130	4	276	121	4	320	126	4½	353	129	5	360	126	5	406	131	5½	436	131
3½	288	123	4	316	124	4	368	130	5	372	126	5	400	127	5	459	133	5½	485	133
3½	324	125	4½	328	121	4½	381	126	5	408	127	5	443	128	5½	468	130	5½	527	134
3½	355	126	4½	356	122	4½	415	128	5½	416	124	5½	424	125	5½	511	130	5½	570	135
3½	381	126	4½	386	124	4½	450	129	5½	450	125	5½	480	126	5½	547	131	6	585	132
3½	424	129	4½	420	125	4½	488	130	5½	484	126	5½	528	128	5½	598	133	6	634	134
4	437	124	5	441	122	5	514	127	5½	550	128	5½	595	129	6	638	131	6	724	136
4	478	126	5	473	123	5	551	127	5½	589	129	6	610	127	6	692	132	6½	760	135
4	532	127	5	525	123	5	612	129	5½	650	130	6	678	128	6	768	134	6½	815	135
4	589	127	5½	535	120	5½	624	125	5½	716	131	6	743	129	6½	782	130	6½	880	136
4	643	128	5½	585	122	5½	681	125	5½	781	132	6	806	130	6½	859	131	7	905	132
4½	681	124	5½	678	122	5½	789	127	5½	904	133	6½	875	128	6½	992	132	7	1050	134

RT=Recommended Thickness. HL=Heat Loss (BTU/HR/LF). ST=Surface Temperature (°F.).

5. Finishes:

1. Indoor: On indoor lines, UNIBESTOS does not require a finish. If a finish is desired, it can be painted with any water base paint or a 6 oz. canvas shall be secured with a lagging adhesive. Note: Any standard insulation finish can be used over UNIBESTOS.

2. Outdoor: Outdoor piping shall be finished with a 45 lb. roofing felt lapped not less than 2". Felt jacket shall be secured with 16 gauge copper wire banded on 9" centers. Other finishes such as glass fabric and breathing-type mastic and metal jacketing may be used. Flanges, valves, and fittings may be finished in the same manner as adjacent pipe covering.

On all stainless steel lines, an adhesive compatible with stainless steel should be used for fabrication of fittings, ells, etc.

The above specifications are general in nature and final specifications shall meet with the approval of the design engineer.

*NOTE: UNIBESTOS may also be applied in double layer in accordance with common practice if desired. For piping operating over 600°F, staples may be used at butt joints of single layer in accordance with the technique showed under "Expansion Control Data." Page 8

A35505

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ACL Doc 19329 · Page 22 of 64
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10 IN USA

UN-3 25M 7/65

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THICKNESS OF UNIBESTOS INSULATION

IRON PIPE SIZES—(IN.)		NOMINAL 1"		NOMINAL 1½"		NOMINAL 2"		NOMINAL 2½"		NOMINAL 3"		NOMINAL 3½"		NOMINAL 4"		NOMINAL 4½"		NOMINAL 5"	
NOMINAL	O.D ACTUAL	UNI-BESTOS THICK-NESS	O.D OF INSULA-TION	UNI-BESTOS THICK-NESS	O.D OF INSULA-TION	UNI-BESTOS THICK-NESS	O.D. OF INSULA-TION	UNI-BESTOS THICK-NESS	O.D. OF INSULA-TION	UNI-BESTOS THICK-NESS	O.D. OF INSULA-TION	UNI-BESTOS THICK-NESS	O.D. OF INSULA-TION	UNI-BESTOS THICK-NESS	O.D. OF INSULA-TION	UNI-BESTOS THICK-NESS	O.D. OF INSULA-TION	UNI-BESTOS THICK-NESS	O.D. OF INSULA-TION
½	.84	1.00	2.88	1.56	4.00	2.06	5.00	2.88	6.63	3.38	7.63	3.88	8.63	4.38	9.63				
¾	1.05	.88	2.88	1.44	4.00	1.94	5.00	2.75	6.63	3.25	7.63	3.75	8.63	4.25	9.63				
1	1.32	1.06	3.50	1.56	4.50	2.09	5.56	2.63	6.63	3.13	7.63	3.63	8.63	4.13	9.63				
1¼	1.66	.88	3.50	1.63	5.00	1.91	5.56	2.44	6.63	2.94	7.63	3.44	8.63	3.94	9.63				
1½	1.90	1.00	4.00	1.50	5.00	2.31	6.63	2.81	7.63	3.31	8.63	3.81	9.63	4.38	10.75				
2	2.38	1.03	4.50	1.56	5.56	2.09	6.63	2.59	7.63	3.09	8.63	3.59	9.63	4.16	10.75				
2½	2.88	1.03	5.00	1.84	6.63	2.34	7.63	2.84	8.63	3.34	9.63	3.91	10.75	4.41	11.75				
3	3.50	1.00	5.56	1.53	6.63	2.03	7.63	2.53	8.63	3.03	9.63	3.59	10.75	4.09	11.75				
3½	4.00	1.28	6.63	1.78	7.63	2.28	8.63	2.78	9.63	3.34	10.75	3.84	11.75	4.34	12.75				
4	4.50	1.03	6.63	1.53	7.63	2.03	8.63	2.53	9.63	3.09	10.75	3.59	11.75	4.09	12.75	4.72	14.00	5.22	15.00
4½	5.00	1.28	7.63	1.78	8.63	2.28	9.63	2.84	10.75	3.34	11.75	3.84	12.75	4.47	14.00	4.47	15.00	4.97	16.00
5	5.56	1.00	7.63	1.50	8.63	2.00	9.63	2.56	10.75	3.06	11.75	3.56	12.75	4.19	14.00	4.69	15.00	5.19	16.00
6	6.63	.97	8.63	1.47	9.63	2.03	10.75	2.53	11.75	3.03	12.75	3.66	14.00	4.16	15.00	4.66	16.00	5.22	17.00
7	7.63	1.00	9.63	1.53	10.75	2.03	11.75	2.53	12.75	3.16	14.00	3.66	15.00	4.16	16.00	4.66	17.00	5.16	18.00
8	8.63	1.00	10.75	1.53	11.75	2.03	12.75	2.66	14.00	3.16	15.00	3.66	16.00	4.16	17.00	4.66	18.00	5.16	19.00
9	9.63	1.00	11.75	1.53	12.75	2.16	14.00	2.66	15.00	3.16	16.00	3.66	17.00	4.16	18.00	4.66	19.00	5.16	20.00
10	10.75	.94	12.75	1.59	14.00	2.09	15.00	2.59	16.00	3.09	17.00	3.59	18.00	4.09	19.00	4.59	20.00	5.09	21.00
11	11.75	1.06	14.00	1.59	15.00	2.09	16.00	2.59	17.00	3.09	18.00	3.59	19.00	4.09	20.00	4.59	21.00	5.09	22.00
12	12.75	1.06	15.00	1.56	16.00	2.06	17.00	2.56	18.00	3.06	19.00	3.56	20.00	4.06	21.00	4.59	22.00	5.09	23.00
14	14.00			1.44	17.00	1.93	18.00	2.44	19.00	2.94	20.00	3.44	21.00	3.94	22.00	4.44	23.00	4.94	24.00
15	15.00			1.44	18.00	1.93	19.00	2.44	20.00	2.94	21.00	3.44	22.00	3.94	23.00	4.44	24.00	4.94	25.00
16	16.00			1.44	19.00	1.93	20.00	2.44	21.00	2.94	22.00	3.44	23.00	3.94	24.00	4.44	25.00	4.94	26.00
17	17.00			1.44	20.00	1.93	21.00	2.44	22.00	2.94	23.00	3.44	24.00	3.94	25.00	4.44	26.00	4.94	27.00
18	18.00			1.44	21.00	1.93	22.00	2.44	23.00	2.94	24.00	3.44	25.00	3.94	26.00	4.44	27.00	4.94	28.00
19	19.00			1.44	22.00	1.93	23.00	2.44	24.00	2.94	25.00	3.44	26.00	3.94	27.00	4.44	28.00	4.94	29.00
20	20.00			1.44	23.00	1.93	24.00	2.44	25.00	2.94	26.00	3.44	27.00	3.94	28.00	4.44	29.00	4.94	30.00
21	21.00			1.44	24.00	1.93	25.00	2.44	26.00	2.94	27.00	3.44	28.00	3.94	29.00	4.44	30.00	4.94	31.00
22	22.00			1.44	25.00	1.93	26.00	2.44	27.00	2.94	28.00	3.44	29.00	3.94	30.00	4.44	31.00	4.94	32.00
23	23.00			1.44	26.00	1.93	27.00	2.44	28.00	2.94	29.00	3.44	30.00	3.94	31.00	4.44	32.00	4.94	33.00
24	24.00			1.50	27.00	1.93	28.00	2.44	29.00	2.94	30.00	3.44	31.00	3.94	32.00	4.44	33.00	4.94	34.00
25	25.00					1.93	29.00	2.44	30.00	2.94	31.00	3.44	32.00	3.94	33.00	4.44	34.00	4.94	35.00
26	26.00					1.93	30.00	2.44	31.00	2.94	32.00	3.44	33.00	3.94	34.00	4.44	35.00	4.94	36.00
27	27.00					1.93	31.00	2.44	32.00	2.94	33.00	3.44	34.00	3.94	35.00	4.44	36.00	4.94	37.00
28	28.00					1.93	32.00	2.44	33.00	2.94	34.00	3.44	35.00	3.94	36.00	4.44	37.00	4.94	38.00
29	29.00							2.44	34.00	2.94	35.00	3.44	36.00	3.94	37.00	4.44	38.00	4.94	39.00
30	30.00							2.44	35.00	2.94	36.00	3.44	37.00	3.94	38.00	4.44	39.00	4.94	40.00
31	31.00									2.94	37.00	3.44	38.00	3.94	39.00	4.44	40.00	4.94	41.00
32	32.00									2.94	38.00	3.44	39.00	3.94	40.00	4.44	41.00	4.94	42.00
33	33.00									2.94	39.00	3.44	40.00	3.94	41.00	4.44	42.00	4.94	43.00
34	34.00									2.94	40.00	3.44	41.00	3.94	42.00	4.44	43.00	4.94	44.00
35	35.00									2.94	41.00	3.44	42.00	3.94	43.00				
36	36.00									2.94	42.00	3.44	43.00	3.94	44.00				

All thicknesses are nominal and are subject to standard manufacturing tolerances.

UNIBESTOS is made in three-foot full and half-round sections in a complete range of sizes and thicknesses. It is available for all pipe sizes from ½" to 36" IPS in thickness from 1"-5" (See chart above). It can be used for all applications up to 1500°F and it's easily cut and worked for special shapes. All these add up to the ONE pipe insulation for all your requirements, thereby simplifying ordering, stocking, installation and maintenance.

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PRODUCT INFORMATION

INDUSTRIAL & HIGH TEMPERATURE

PLUMBING HEATING & AIR CONDITIONING

DUCT SYSTEMS

REFRIGERATION

INSULATING FIRE BRICK & REFRACTORIES

FINISHES & WEATHERPROOFING MATERIALS

There's a Johns-Manville insulation for every commercial and industrial purpose— ask for it

JM

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CONTENTS

(FOR IN-714A)

INTRODUCTION

TAB: INDUSTRIAL & HIGH TEMPERATURE

	DATE	REV 1	REV 2	REV 3
IN-169A Thermobestos Brochure	5-67			
IN-529A Thermobestos Scored Block	4-64			
IN-208A Thermobestos Pipe & Block	4-64			
IN-375A Thermobestos Extended Leg	8-61			
IN-293A Metal-On Pipe Insulation	10-61			
IN-525A Metal-On Tank Panels	3-64			
IN-584A Tank Top Insul	5-66			
IN-217A Metal-On Brochure	9-65			
IN-270A Superex Block	7-66			
IN-271A Superex-M Pipe & Block	12-59			
IN-190A Superex Pipe & Block	10-59			
IN-784A 1000°Spin-Glas Blankets	5-68			
IN-785A 1000° Spin-Glas Block	5-68			
IN-348A H. T. Banroc Block	8-62			
IN-512A Turbine Blankets	11-63			
IN-153A Marinite Brochure	3-66			
IN-400A Marinite Molten Metal	3-66			
IN-733A Ht. Treated Molten Metal Marinite	3-67			
IN-273A Marinite Structural	10-66			
IN-695A Marinite Panel	12-65			
IN-579A Refractory-Fiber Products	1-66			
IN-694A Cera Form Ris-A-Sleev	3-66			
IN-283A Cerafelt	11-64			
IN-729A Cera-Kote, Cera-Preg	3-67			
IN-600A Cera Form Board	3-65			
IN-745A Cerapaper	3-67			
IN-693A Fiberchrome	11-65			
IN-777A Fiberchrome Skid & Support	3-68			
IN-762A RF Expansion Joint Board	6-67			
TAB: PLUMBING, HEATING & AIR CONDITIONING				
IN-766A Flame Safe Product Information	12-67			
IN-767A Flame Safe Brochure	12-67			

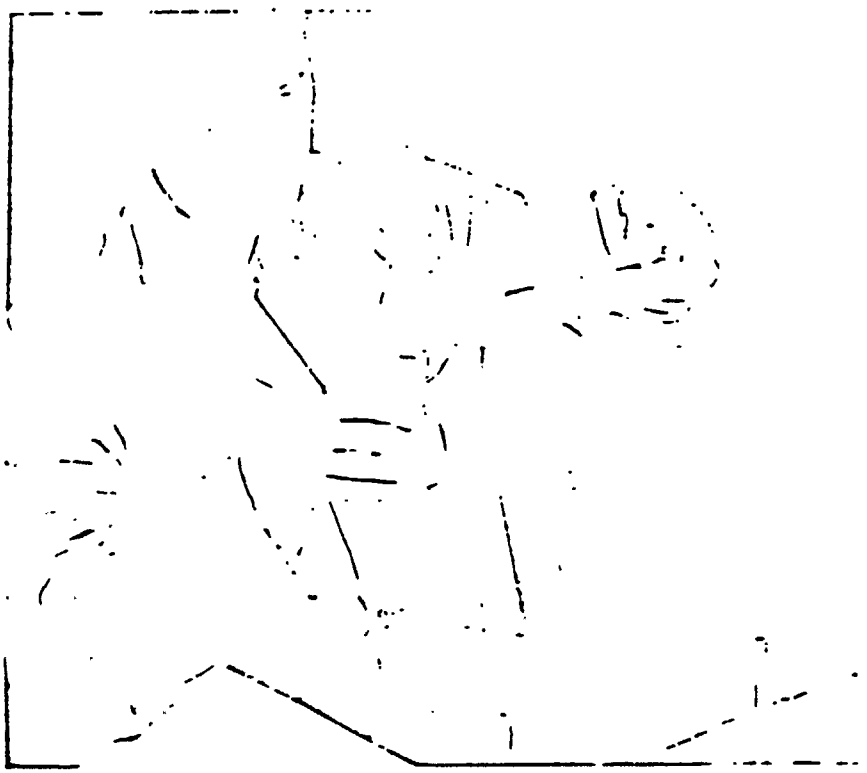
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The secret of J-M insulation leadership ...

Johns-Manville INSULATION RESEARCH



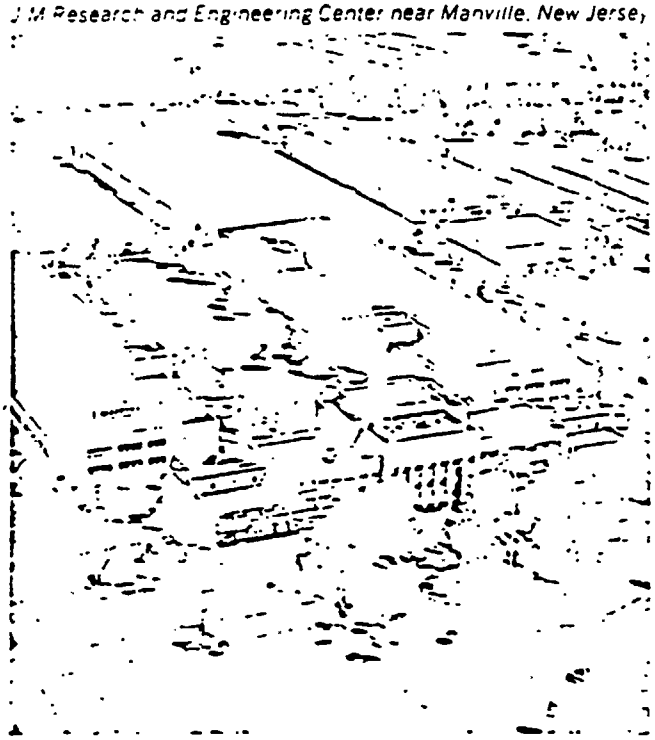
Johns-Manville is continuously conducting an extensive research and development program at its two Research Centers to evaluate materials and methods used in producing quality insulations for industry.

The J-M Research Center near Manville, New Jersey contains the world's largest and most completely equipped laboratories devoted to the study of insulations and allied products for all temperature ranges encountered in modern industry. Fiber glass developments are carried out at the Research and Technical Center at Waterville, Ohio.

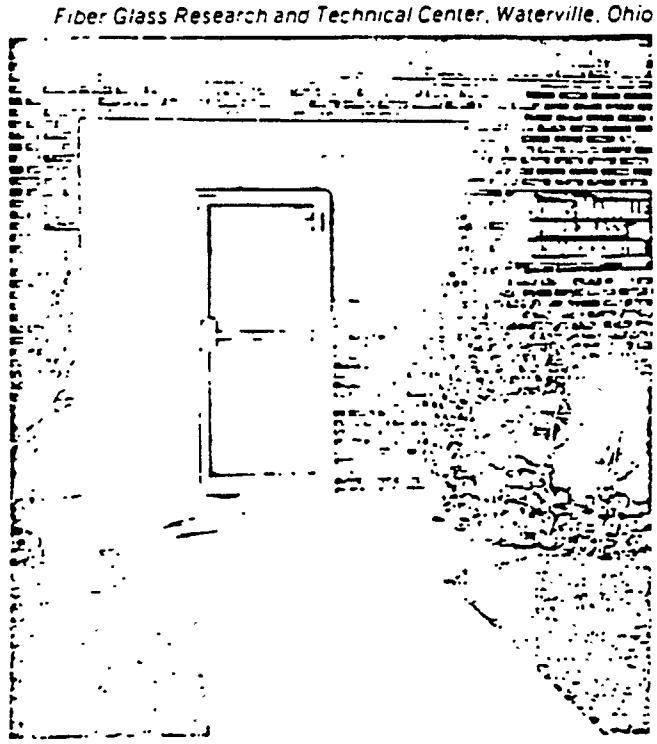
Working with the most advanced laboratory equipment, J-M scientists devote their efforts to the development of new insulating products and further applications for existing ones. In addition, they carry out insulation assignments related to specific customer problems.

This broad research program plays a major part in Johns-Manville's ability to offer exactly the right insulation . . . the most economical and efficient . . . for any equipment or operating temperature.

J-M Research and Engineering Center near Manville, New Jersey



Fiber Glass Research and Technical Center, Waterville, Ohio



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...is brings you the benefit of ...

... A CENTURY'S EXPERIENCE IN THE DEVELOPMENT AND MANUFACTURE OF QUALITY INSULATING MATERIALS...

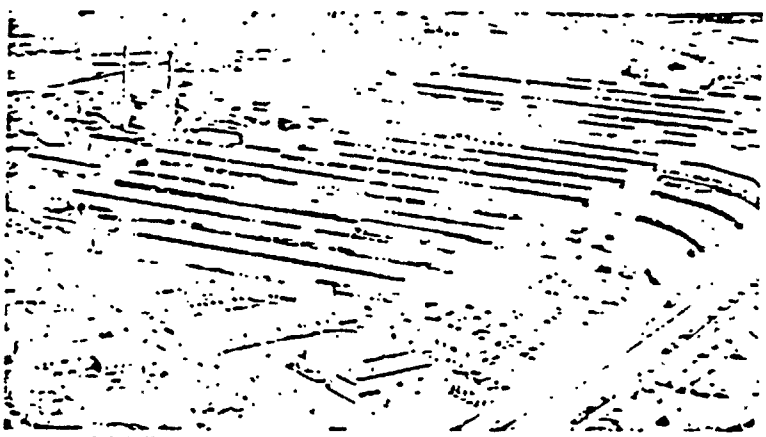
Since 1858, Johns-Manville has developed and improved methods and machines for manufacturing insulations and accessory materials for every industrial and commercial requirement. Today, out of a total of fifty-three manufacturing plants owned and operated by Johns-Manville, fourteen are devoted to the production of industrial insulations and related products.

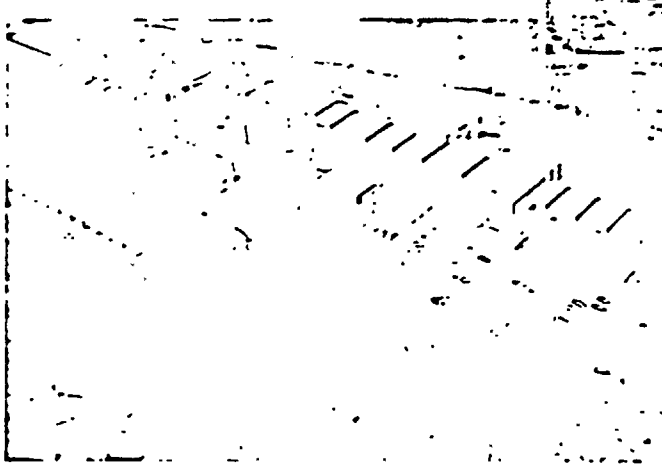
These busy plants are strategically located to provide the best possible service to all sections of the country. From them flow the J-M quality insulating materials that contribute so much to the efficient and economical operation of American industry. At each plant, modern methods of mass production and quality control assure product uniformity and top value for your insulation dollar.

Shown below are several of the J-M plants manufacturing industrial insulations and allied products:

These facilities occupying a 250-acre site, are the largest in the world producing asbestos products. The plant comprises 12 buildings with over 2 million square feet of manufacturing space.

Products produced for the industrial insulations business are high and low temperature insulations, sealing compounds and electrical insulations including asbestos paper, refractory fiber felt insulations for industrial and commercial uses.



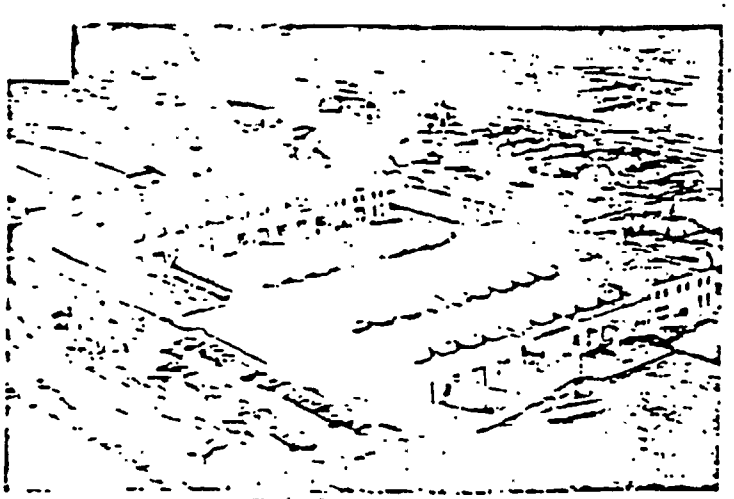


This modern refractories plant is one of the two plants manufacturing J-M insulating firebrick. It is geographically situated to supply industry with the most complete line of insulating firebrick and refractory products to meet the diversified requirements of modern furnace construction.

Products manufactured at Zelienople are: insulating firebrick, refractory castables, gunning or slap-troweling mixes, refractory bonding mortars, and lightweight refractory aggregates and fills. Also special shapes can be manufactured.

Nashua, the largest J-M plant in New England, makes asbestos-cement board materials for a wide range of industrial and commercial applications.

The Billerica plant (right) manufactures marine joiner panels, structural and insulating panels for process equipment and appliances, core panels for use as supplemental veneered faces, flat sheet material for industrial drying trays and pallets, sheathing matrial for refrigerated spaces and food-handling areas, and asbestos-cement sheets for marine uses.



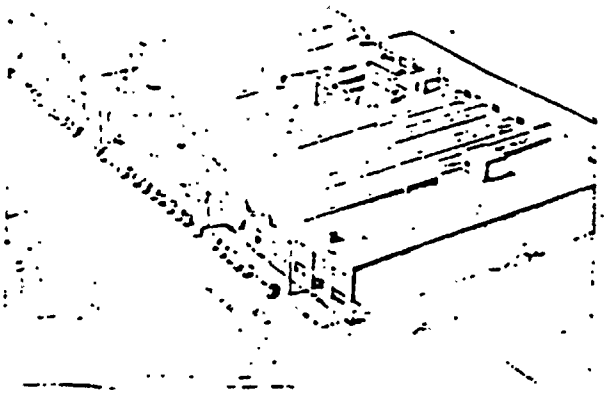
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ACL Doc 19329 · Page 30 of 64 asbestosclaims.law/library/19329/30

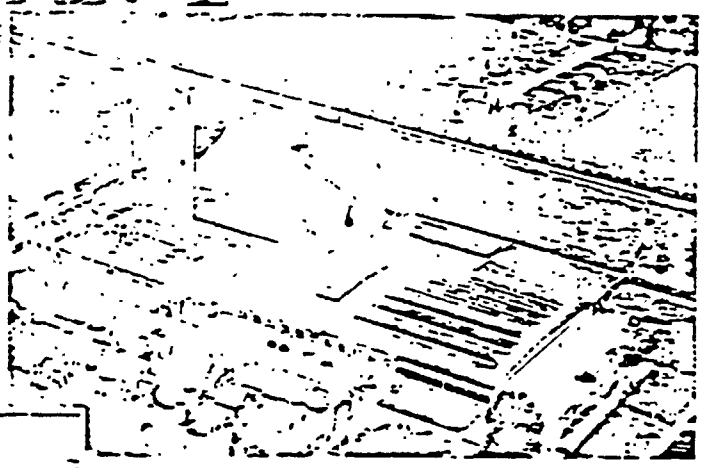
Johns-Manville acquired L O F Glass Fibers Company in 1958 and took over operation of the three Defiance plants. These facilities are among the most highly mechanized plants of their kind in the fiber glass industry. (Perry Street Plant shown at right)

Industrial insulation products made at Defiance are fiber glass insulation for walls and ceilings of commercial buildings, appliance insulations, fiber glass pipe insulation, air duct systems, molded top-liners and headliners for the automotive industry.





Here are manufactured products composed of lime and diatomaceous silica taken from natural deposits nearby. These basic ingredients are bonded with asbestos fibers to form Thermobestos pipe and block insulations. Metal-One prejacketed pipe insulation is also manufactured at Long Beach.



This plant manufactures a variety of fiber glass and mineral fiber products. These include appliance insulations for refrigerators, ranges, freezers and hot water heaters, rigid duct insulation; industrial insulations, and insulations for protecting outdoor tanks and vessels against temperature changes.



One of the largest plants in the world producing asbestos products. These facilities cover 265 acres and consist of 12 buildings with 50 acres of manufacturing space.

Industrial Insulation Division products made at Waukegan are: high and low temperature insulations, insulating cements, asbestos millboard, and refractory fibers.

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ACL Doc 19329 · Page 31 of 64 asbestosclaims.law/library/19329/31

Here's why J-M can give you...

THE BEST SERVICE IN THE WORLD

Complete insulation service is always as near as your local Johns-Manville office or J-M Insulation Contract Unit.

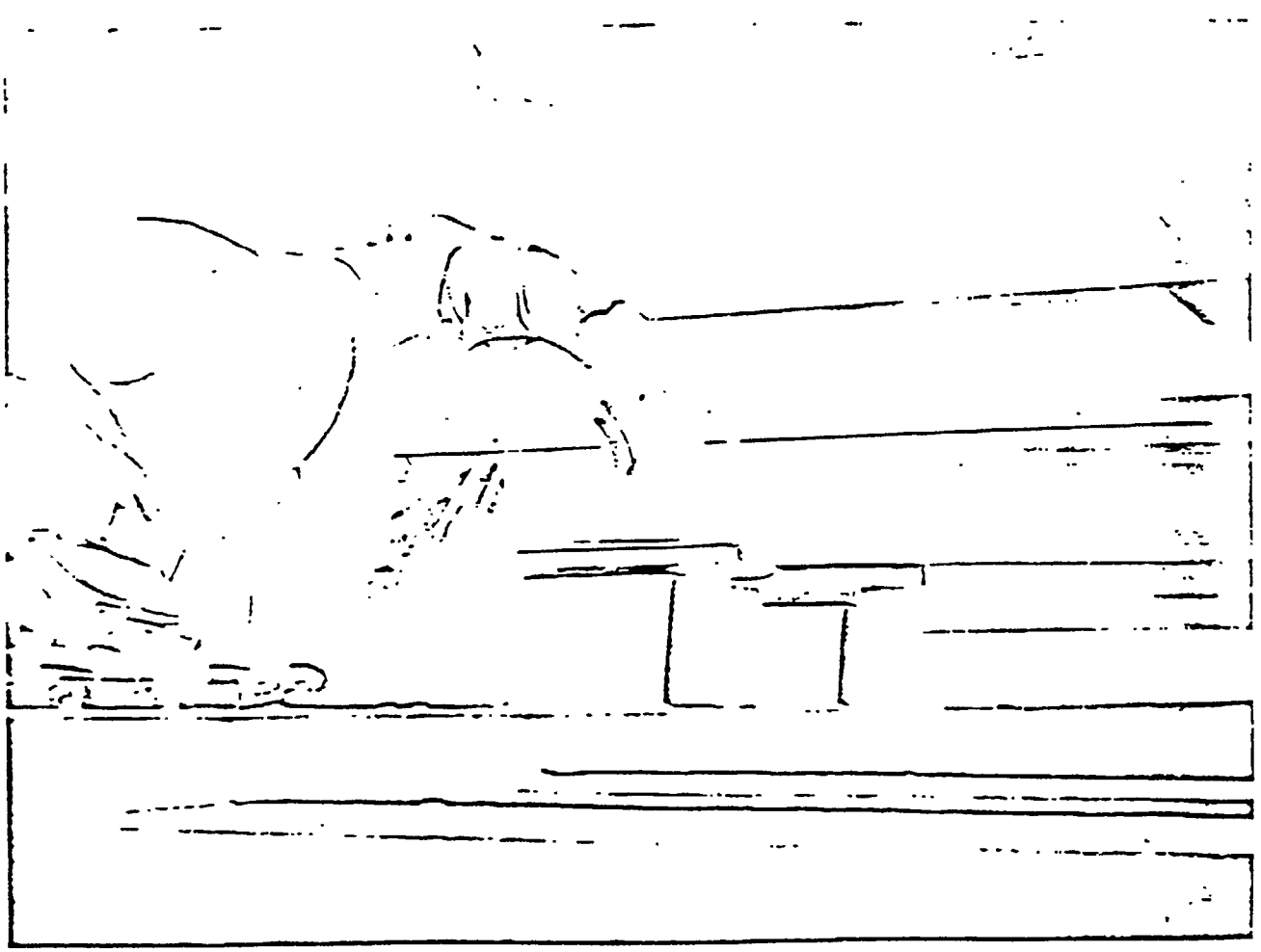
Johns-Manville has established a nation-wide network of Insulation Contract Units to serve you quickly and efficiently. Each unit is staffed with men who combine insulation engineering knowledge with a thorough understanding of modern application techniques. They offer you undivided responsibility for *all* your insulation requirements . . . from minus 300F to plus 3000F.

Among the many services these contractors provide is the ability to give you a quick, accurate bid on the specified J-M insulation, regardless of the size or location of the job.

In many sections of the country, the contractor can offer quick delivery from the J-M Service Center near your job site. Located in Savannah, Ga., Fort Worth, Texas, and Manville, N. J., these centers provide flexibility and speed of shipment to insulation customers. There is also no necessity for you to maintain a large and expensive stock of insulations.

Working with J-M materials and J-M Insulation Engineers, these contractors *know* how to apply Johns-Manville insulations correctly to insure long, trouble-free performance, with maximum return on your insulation investment for years to come.

When your architect or engineer specifies Johns-Manville insulations, remember your local J-M contractor. He's a good man to have around when it comes to solving your insulation problems!



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ACL Doc 19329 · Page 32 of 64 **asbestosclaims.law/library/19329/32**

JOHNS-MANVILLE CONTINUED

ALABAMA
Shook & Fletcher Insulation Co.
Birmingham
Mobile

ALASKA
E. J. Bartells Co.
Anchorage

ARIZONA
Kircher Asbestos & Rubber Co.
Phoenix

ARKANSAS
Arkansas Asbestos & Rubber Co.
Little Rock

CALIFORNIA
Western Asbestos Co.
Fresno
North Sacramento
San Francisco
San Jose
Santa Rosa
Stockton
Industrial Building Materials, Inc.
Los Angeles
Thorpe Insulation Co.
Los Angeles
San Bernardino
Wilmington
Thorpe Insulation Co. of San Diego
San Diego

COLORADO
A. H. Bennett Co.
Denver

CONNECTICUT
Cummings Insulation Co.
Meriden

DISTRICT OF COLUMBIA
J-M Contract Unit
Washington

FLORIDA
J-M Contract Unit
Jacksonville
Miami
Tampa
Shook & Fletcher Insulation Co.
Pensacola

GEORGIA
Shook & Fletcher Insulation Co.
Atlanta

HAWAII
A.I.D. Inc.
Honolulu
Honolulu Iron Works
Honolulu

ILLINOIS
Asbestos & Magnesia Materials Co.
Chicago
A & K Midwest Insulation Co., Inc.
Champaign
Metropolis

INDIANA
Louisville Insulating & Supply Co.
Evansville
J-M Contract Unit
Indianapolis
Valley Insulating Company, Inc.
Mishawaka

IOWA
Iowa Illinois Thermal Insulation Co.
Davenport
Iowa Asbestos Co.
Des Moines

KANSAS
Ludeman Insulations, Inc.
Wichita

KENTUCKY
Louisville Insulating & Supply Co.
Louisville

LOUISIANA
McCarty Corp.
Baton Rouge
New Orleans
Fuller-Austin Insulation Co.
Lake Charles
The J. Graves Insulation Co.
Shreveport

MARYLAND
Reid-Hayden, Inc.
Baltimore

MASSACHUSETTS
P. S. Thorsen Co. of Massachusetts
South Boston
Johnson Asbestos Co.
West Springfield

MICHIGAN
J-M Contract Unit
Detroit
Lansing
Acme Insulations, Inc.
Grand Rapids
Kalamazoo Asbestos Co.
Kalamazoo
J. W. Willman Asbestos Co.
Saginaw

MINNESOTA
Walker Jamar Co.
Duluth
MacArthur Co.
St. Paul

MISSISSIPPI
Homer C. Porter Co.
Jackson
Shook & Fletcher Insulation Co.
Pascagoula

MISSOURI
J-M Contract Unit
North Kansas City
St. Louis
Midwest Material Co.
Joplin

MONTANA
E. J. Bartells Co.
Billings

NEBRASKA
The Eagle Co.
Lincoln
Midwest Asbestos Co.
Omaha

NEVADA
Thorpe Insulation Co.
Las Vegas

NEW JERSEY
John W. Wallace & Co.
Hoboken
H. W. Porter & Co., Inc.
Newark

NEW MEXICO
All Field Insulation Co.
Albuquerque

NEW YORK
J-M Contract Unit
Albany
Mount Vernon
Niagara Asbestos Co.
Buffalo
R. E. Hebert & Co., Inc.
Rochester
G. H. Miner Co., Inc.
Syracuse

NORTH CAROLINA
Reid-Hayden, Inc.
Charlotte

OHIO
J-M Contract Unit
Akron
Cleveland
Columbus
Standard Asbestos Mfg. Co.
Cleveland
L. H. Rogers, Inc.
Dayton
R. E. Kramig & Co., Inc.
Lockland
Sussman Asbestos Co.
Toledo

OKLAHOMA
J-M Contract Unit
Oklahoma City
Tulsa

OREGON
E. J. Bartells Co.
Portland

PENNSYLVANIA
J-M Contract Unit
Harrisburg
Pittsburgh
Wilkes-Barre
Lawton Huffman Co.
Marshalls Creek
Philadelphia Asbestos Co.
Philadelphia
Industrial Furnace Supplies, Inc.
Pittsburgh
Power Engineering Corp.
Wilkes-Barre

RHODE ISLAND
Packings & Insulations Corp.
Providence

TENNESSEE
Brooks-Fisher of Tennessee, Inc.
Knoxville
Young Insulation Co.
Memphis
Nashville

TEXAS
Young Insulation Co.
Amarillo
Cinbar Engineering Co.
Austin
Thorpe Products Co.
Corpus Christi
J-M Contract Unit
Dallas
Houston
San Antonio
Fuller-Austin Insulation Co.
Houston
Aber Co., Inc.
Houston

UTAH
Bullough Asbestos Supply Co.
Salt Lake City

VIRGINIA
Caudle-Hyatt, Inc.
Hopewell
Reid-Hayden, Inc.
Norfolk
Richmond

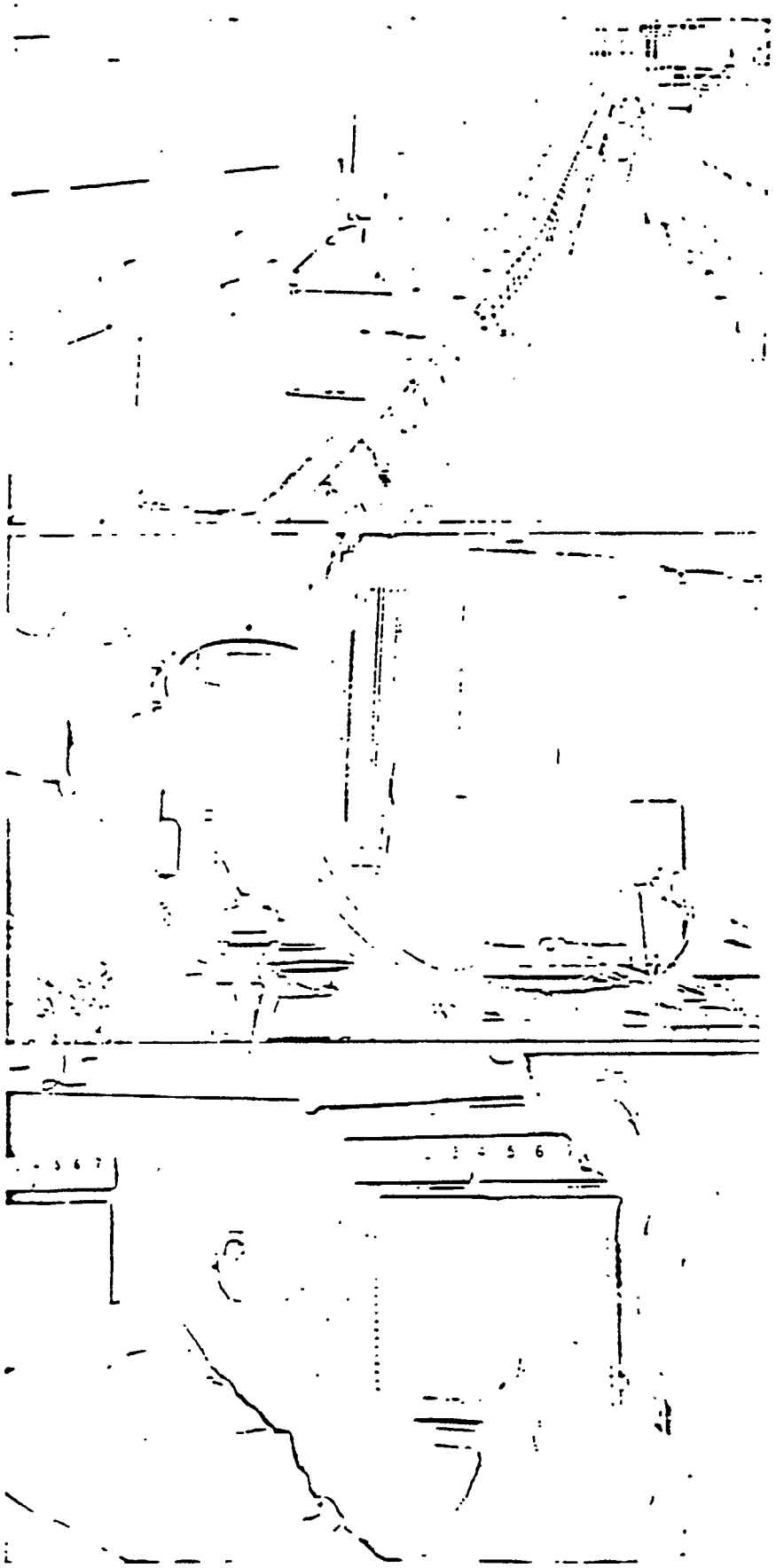
WASHINGTON
E. J. Bartells Co.
Seattle
Spokane
Tacoma

WEST VIRGINIA
J-M Contract Unit
Huntington

WISCONSIN
Industrial Insulation Corp.
Appleton
Bay Insulation Co.
Green Bay
Northwestern Asbestos & Cork Insulation Co.
Green Bay
Manitowoc
Taylor Insulation Co.
Merrill

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ACL Doc 19329 · Page 33 of 64 asbestosclaims.law/library/19329/33



Johns-Manville research, engineering and production specialists combine their knowledge and skills to develop modern, efficient and economical equipment and production methods. A modernization and improvement program assures that J-M products are made under the best possible working conditions on modern machinery utilizing the latest safety features.

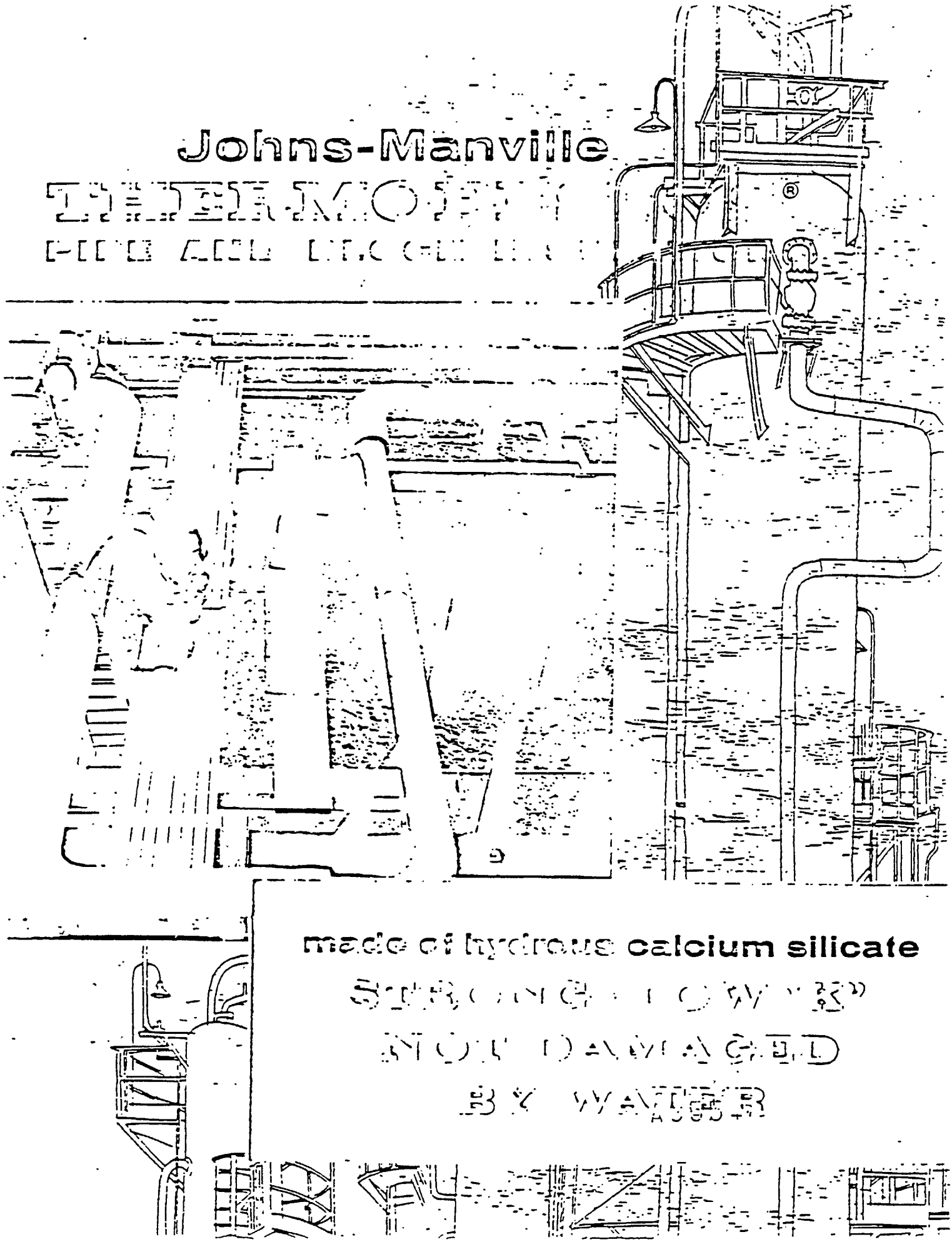
Trained engineers and chemists subject raw materials and finished products to rigid controls. Finished products are inspected to assure their uniformity and adherence to J-M's high standards. Quality control specialists also work with J-M research scientists and production engineers in developing new products and improving existing ones.

Engineers keep a close watch on equipment and processes as part of the continuing program to improve production. Whenever needed, new machines and equipment are installed to increase production capacity, improve product quality and make work easier. The problems of disposal of industrial wastes are given constant attention in the community interest.

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ACL Doc 19329 · Page 34 of 64 asbestosclaims.law/library/19329/34


Johns-Manville
made of hydrous calcium silicate

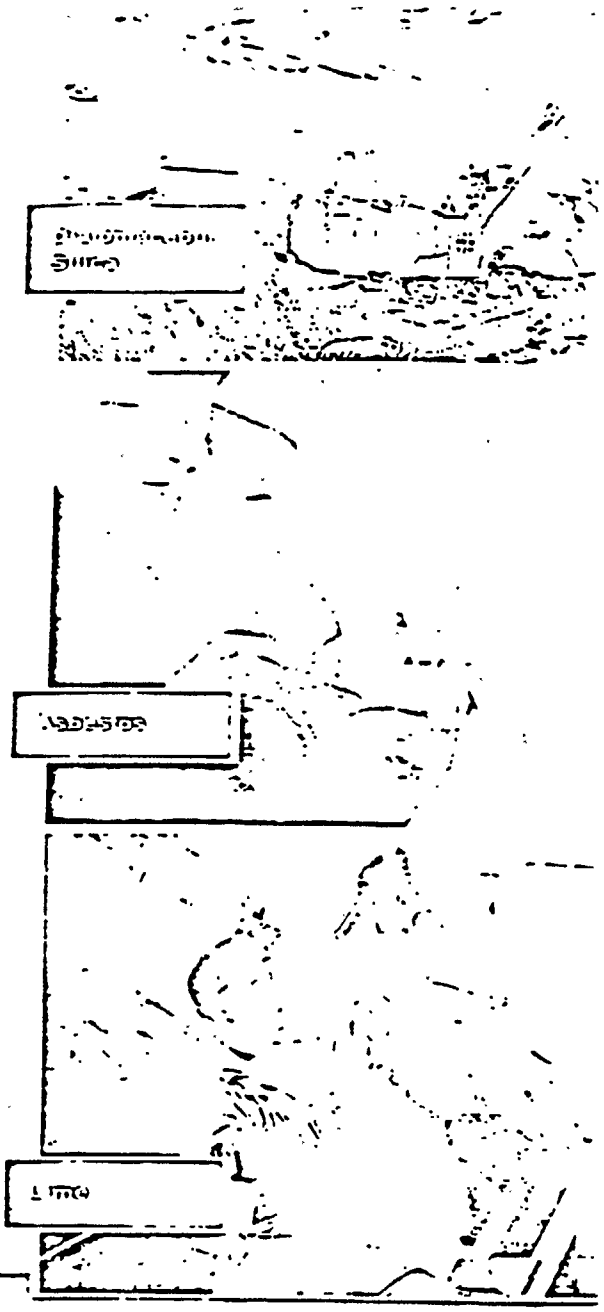
—a completely inorganic insulating material...

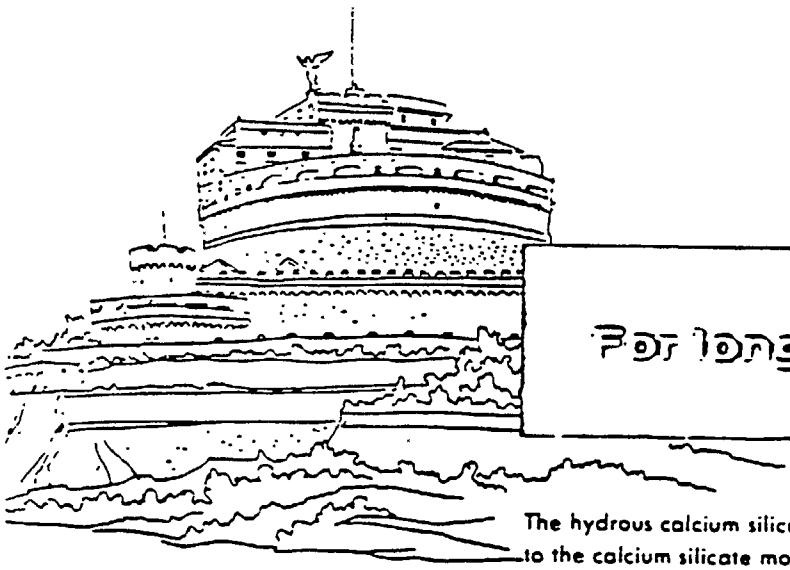
made from asbestos, diatomaceous silica and lime

Johns-Manville Thermobestos is composed of lime and diatomaceous silica taken from natural deposits estimated to be millions of years old. These basic ingredients are bonded with asbestos fibers possessing the tensile strength of piano wire.

An important feature in the manufacture of Thermobestos is the special steam process to which the insulation is subjected after the initial molding. Live steam converts the lime and diatomaceous silica into hydrous calcium silicate, a substance noted for its tough, hard composition as well as its ability to withstand repeated wetting without harm.

The result is a completely inorganic insulating material which, because of its light weight, low thermal conductivity, great structural strength and insolubility in water, is ideal for high temperature process equipment which must withstand the rigors of severe outdoor operating conditions.





For longer lasting installations . . .

Chemically analogous to the early Roman concretes used in such structures as St. Angelo Castle, Thermobestos also withstands time and weather.

The hydrous calcium silicate from which Thermobestos is made is chemically analogous to the calcium silicate mortars and cements produced from lime and pozzolanic aggregates by the builders of antiquity. Like these earlier materials it is strong, hard and virtually ever-lasting. It differs from them principally in its very much lower density which gives it a lightness and low thermal conductivity surprising in so strong a material.

Such structures as St. Angelo Castle in Rome, erected in 138 A.D., the famous Appian Way, started three hundred years before Christ, and the great system of Roman Aqueducts, all built with calcium silicate cements, are still in an excellent state of preservation after a score of centuries. Because of its similar chemical composition, Thermobestos has, to a high degree, the same resistance to time and weather that so strikingly characterizes these ancient constructions.

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ACL Doc 19329 · Page 36 of 64 asbestosclaims.law/library/19329/36

For extra strength . . . for minimum heat loss . . . for maximum moisture resistance



Johns-Manville

THERMOBESTOS

Pipe and Block Insulation

Developed for the most rugged industrial service—Johns-Manville Thermobestos is a superior high temperature pipe and block insulation especially recommended for use in the power generation and process industries on indoor and outdoor piping and equipment operating at temperatures to 1200F. It has the lowest k factor of all insulations in general use in these industries.

Repeated wettings have no permanent effect on Thermobestos. It is light enough for easy handling and fast application, and its unusual structural strength resists breakage and will withstand unusual service abuse. Because it will not burn or carry flame, Thermobestos is ideal for use in the presence of inflammable gases and liquids.

The preferred calcium silicate insulation—Thermobestos has received wide acceptance in the petroleum, chemical, power generation, marine and other industries where its unique combination of properties means excellent temperature control as well as practically unlimited service life. Its consistently outstanding performance has made Thermobestos the *preferred* calcium silicate insulation for rugged service to 1200F.

Comes in a complete range of sizes—Thermobestos is furnished in both sectional pipe insulation and block form. The pipe insulation comes in a complete selection of sizes up to 24" x 4" half sections. 25" through 33" pipe sizes are available in quad segments. Scored blocks 12" x 36" in thicknesses from 1½" to 3½" are available for application on curved surfaces representing a diameter range from 34" through 180". Scored blocks are furnished with three equally spaced scores. Beveled blocks are also available in widths of 6", 12", and 18", by 36" lengths, in a full range of thicknesses.

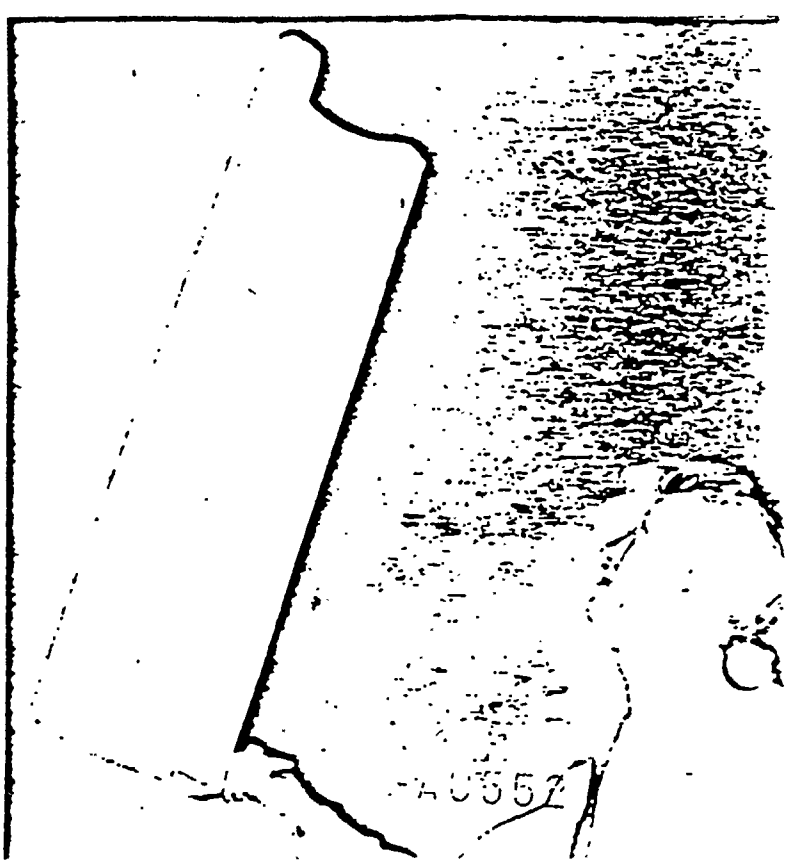
A05520 3

[illegible] why you can have confidence in THERMOBESTOS

[illegible] Strength Johns-Manville Thermobestos is remarkably strong and rigid. Walk on it! Place ladders against it! Use a pipe insulated with it as a scaffold support! Thermobestos can "take it". Similar in chemistry and composition to a very fine concrete, Thermobestos will withstand unusual operating abuse without appreciable damage.

Extreme Lightness "Heft" a piece of Thermobestos. You'll be surprised at its lack of weight. Even the largest section can be easily balanced in one hand — for the outstanding strength and toughness of Thermobestos do not make it heavy. On the contrary, Thermobestos is as light as many insulating materials possessing a fraction of its strength and durability.





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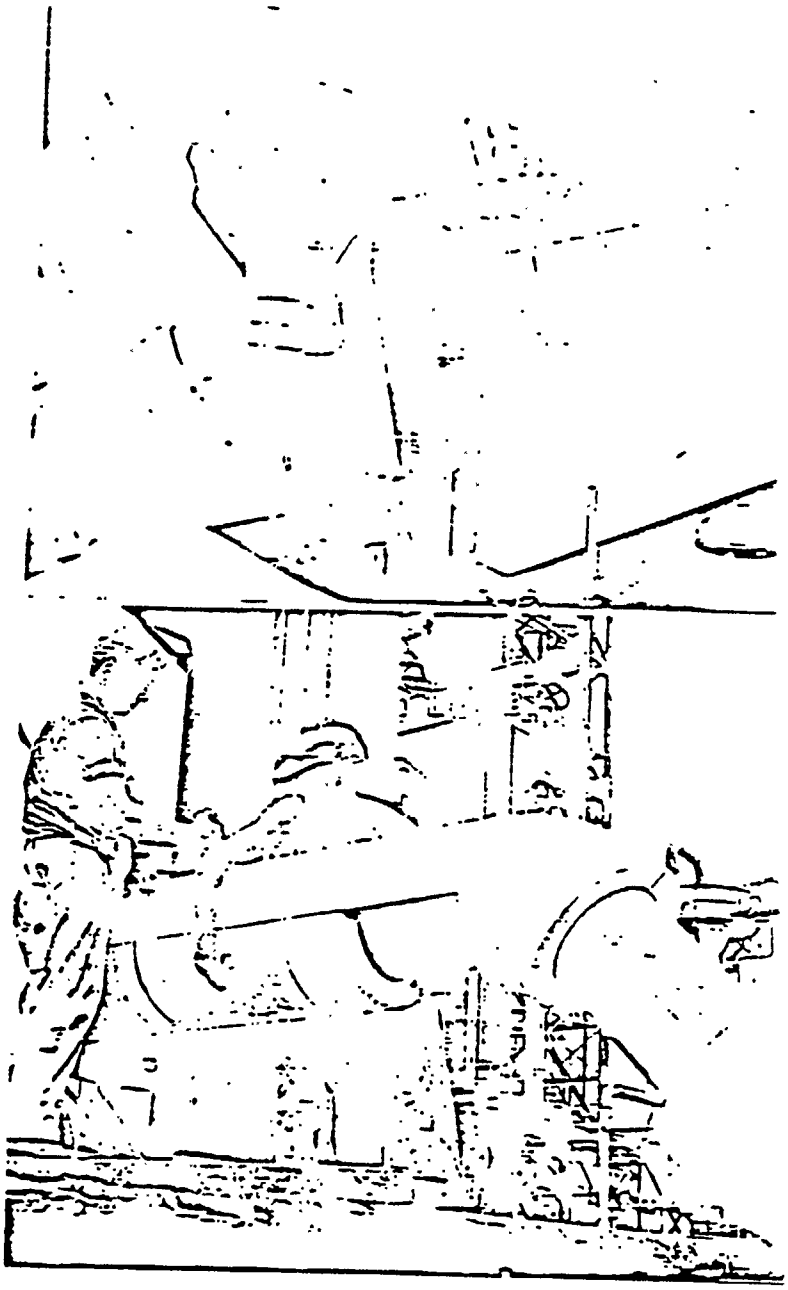
[illegible] Replacement and maintenance costs practically disappear when you specify Thermobestos, for it is so chemically stable that in ordinary circumstances it will last indefinitely. Being 100% inorganic it will neither burn nor rot. Sudden or severe atmospheric changes, condensation, or continuous exposure to high temperatures have no measurable effect on its insulating value.

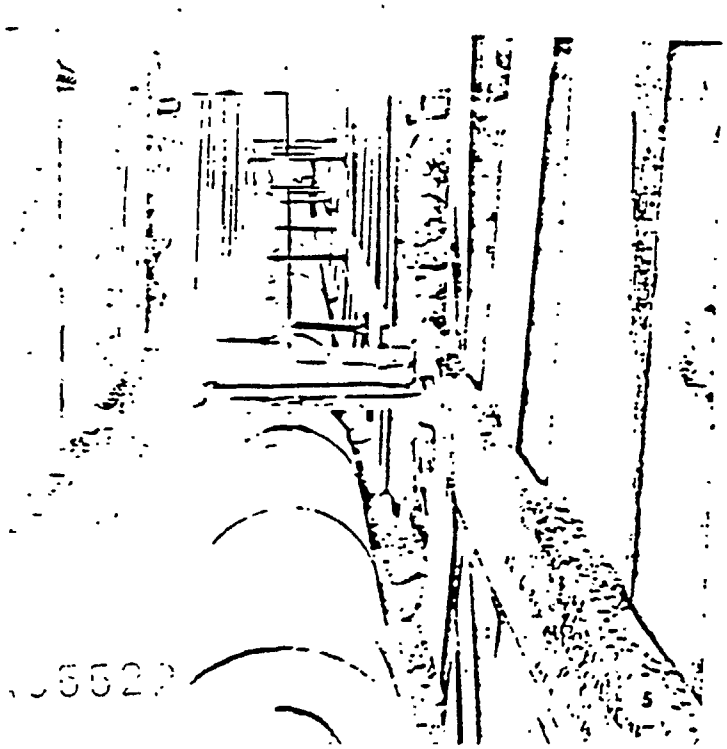
[illegible] Thermobestos is purposely made in large blocks and half-sections to facilitate handling and reduce the number of joints. Its light weight and hard, firm, non-crumbling texture speed application, keep installation costs low and make the material ideal for the shop prefabrication of special shapes.

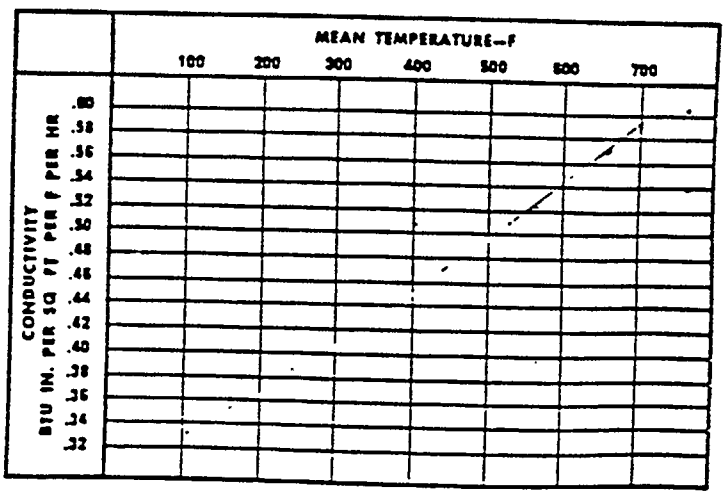
Not Damaged by Water

Thermobestos is ideal for insulating underground steam mains like this one being installed for a large midwestern public utility company. Placed underground and completely covered with a wet concrete "solid pour", it supports the entire weight of the heavy steel pipe, and serves as the sole buffer between it and the concrete. Because it will not crumble or disintegrate with wetting, Thermobestos is unequalled for this rigorous service.

You can soak a piece of Thermobestos in water for a day or a year and still walk on it without damage. Dry it out and its conductivity is as good as new. This excellent resistance to moisture will be appreciated by all operators of outdoor equipment and equipment exposed to excessive dampness or water vapor.

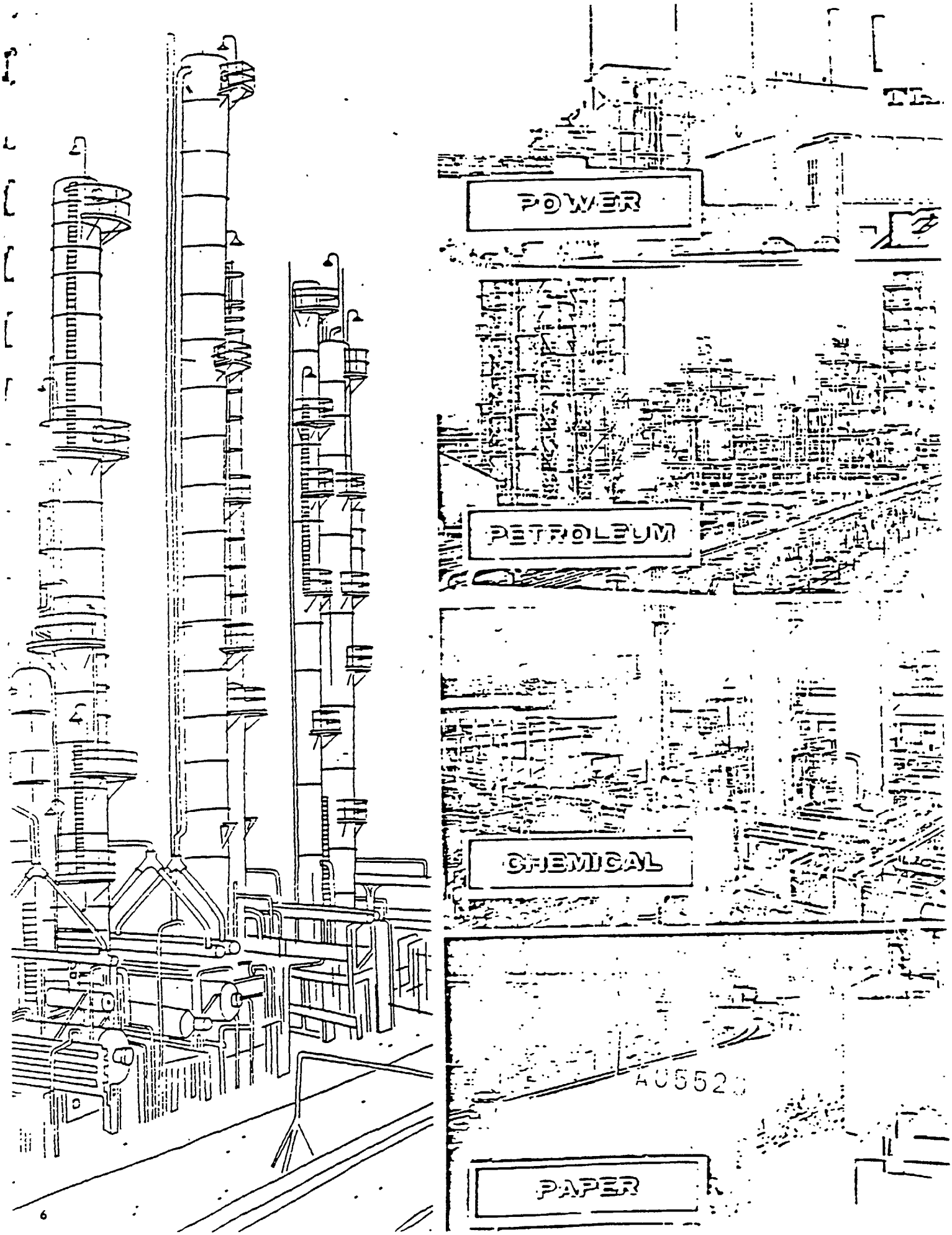






Low Conductivity Thermobestos offers the lowest k factor of all insulations in general use throughout the power generation and process industries. This low conductivity makes possible accurate, uniform temperature control, helps reduce fuel costs and contributes materially to operating efficiency.

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ACL Doc 19329 · Page 39 of 64
asbestosclaims.law/library/19329/39


POWER
PETROLEUM
CHEMICAL
PAPER
A05521

...AND OUT THESE DRY INDUSTRIES...

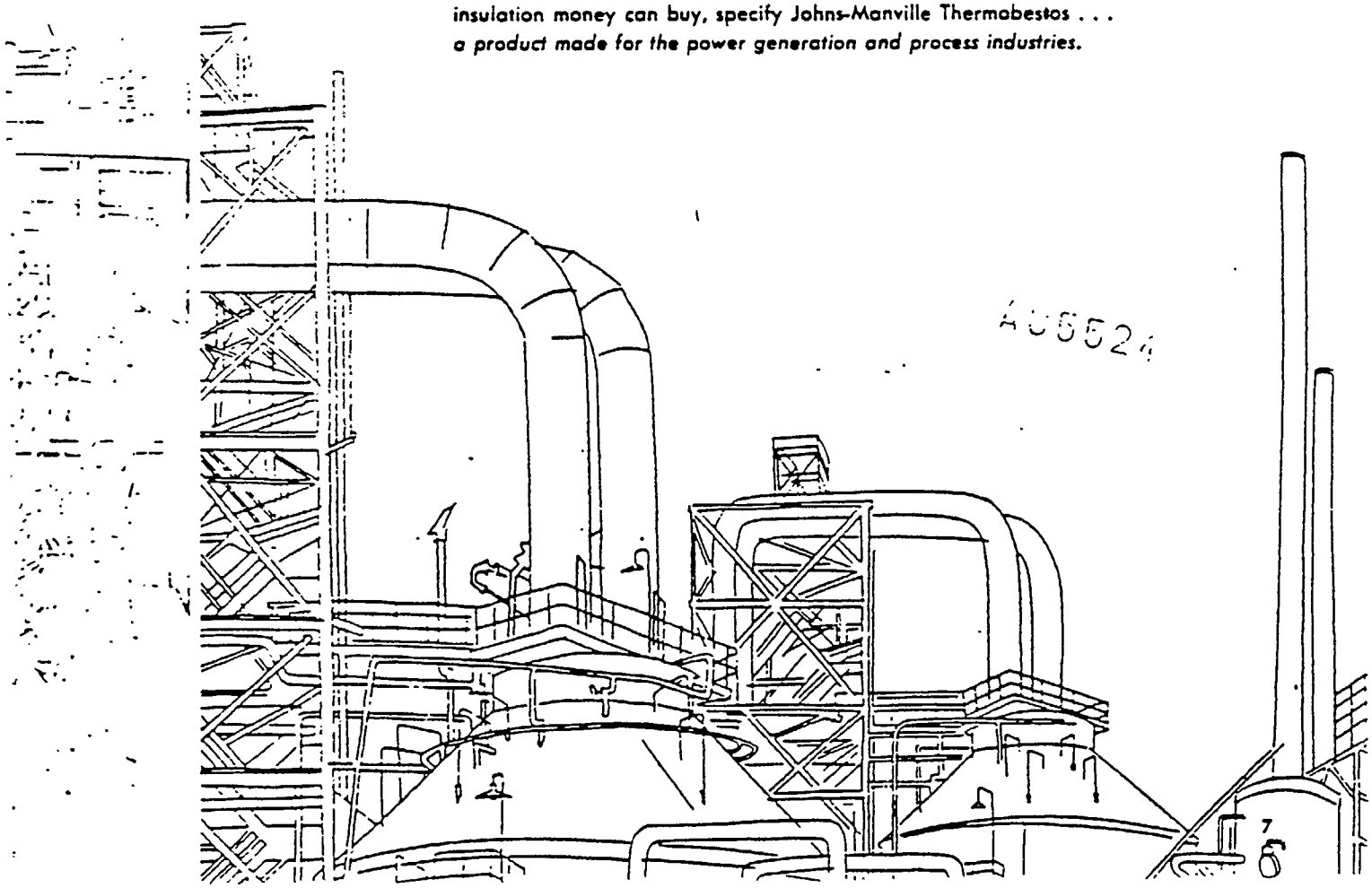
More and more engineers are specifying Thermobestos for rugged service to 1200F, indoors and out

The specifying of insulation is an important function of the modern design engineer in the power generation and process industries. Process control, minimum fuel cost and reduced maintenance expense depend largely on the selection of the right insulating material.

The standards for selecting the right insulation for this service are simple but rigorous: It must keep heat loss to a minimum. It must not deteriorate under constant exposure to temperatures running as high as 1200F. It must be chemically inactive. It must be able to take repeated wetting without damage. And it must be strong and rigid to safely withstand the abuse of everyday operation as well as periodic overhauls.

Because light weight, easy-to-apply Thermobestos is such an insulation, it is being specified by more and more engineers in power plants, in oil refineries, in chemical plants, in paper mills—wherever the highest quality insulating material is indicated.

When *you're* looking for the best high temperature calcium silicate insulation money can buy, specify Johns-Manville Thermobestos . . . *a product made for the power generation and process industries.*



NON-FITTING FIT ON VALVES AND TURNS...

Prefabricated Thermobestos sections assure snug fit, eliminate slipshod "fudging"

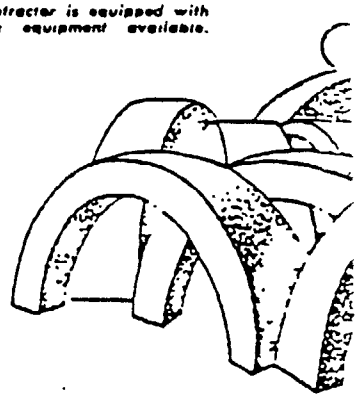
Pipe bends and valves present relatively difficult fitting problems where ordinary insulations are used. And all too often these problems are solved by slipshod workmanship and too great a reliance on fills and cements. When the specified insulation is Thermobestos, however, these fitting problems are greatly simplified. For the strong, hard texture of Thermobestos—which retains its sharp edges without crumbling—makes it possible to prefabricate tube turns, valve covers and other special shapes from standard sections of Thermobestos pipe insulation.

With properly designed and operated power cutting equipment*, Thermobestos segments are easily produced and assembled into the required shape. The segments can be cut with such complete accuracy that tube turns of any radius can be fitted as readily as a straight length of pipe. Because these segments fit together as snugly as the interlocking pieces of a jigsaw puzzle, there are no gaps or hollows to be filled with insulating cement or other filler.

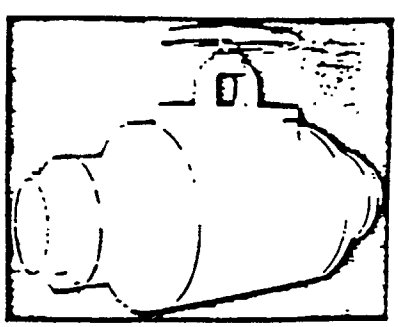
Large valves, normally covered with a number of longitudinal wedges—rough-cut on the job—wired together and "fudged" with plenty of cement, can be neatly and permanently insulated with a few shop prefabricated half sections of Thermobestos.

*Your Johns-Manville Insulation Contractor is equipped with the most modern prefabricating equipment available.





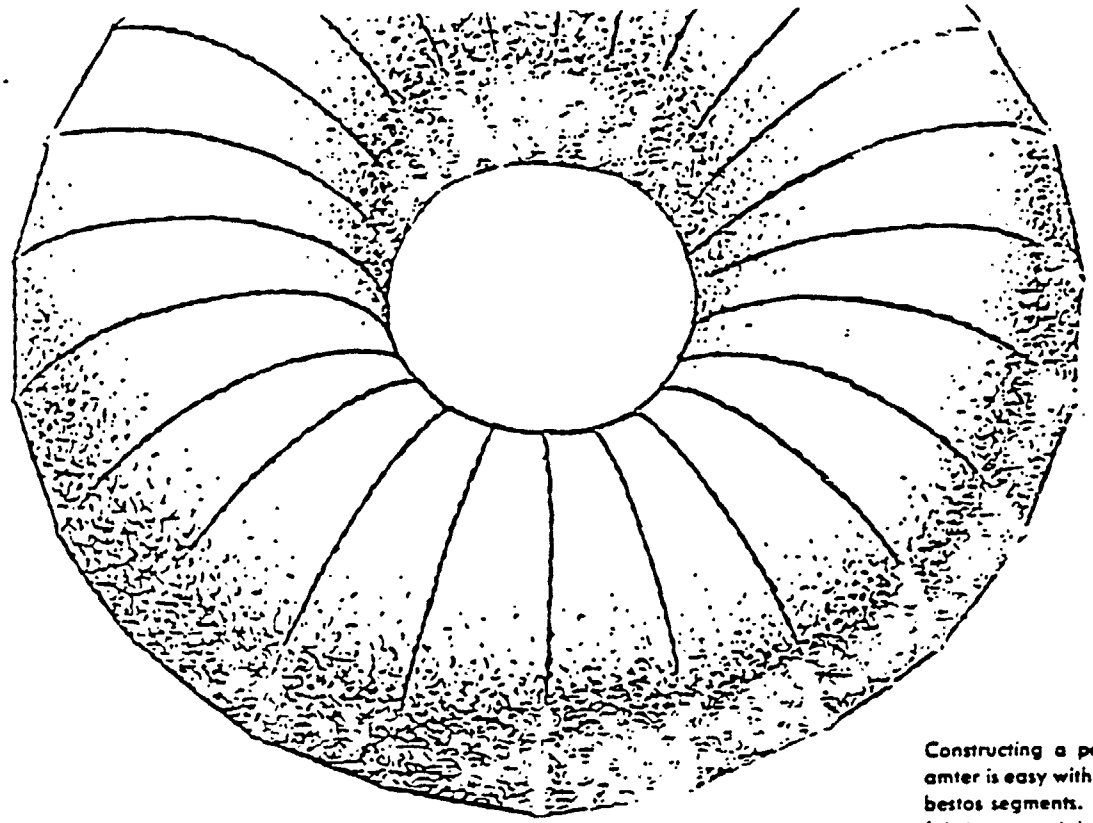
The hard, non-crumbling texture of Thermobestos permits the material to be readily cut into segments which retain sharp edges. (Accuracy in prefabrication is obtained by the use of power cutting equipment and proper templets.)



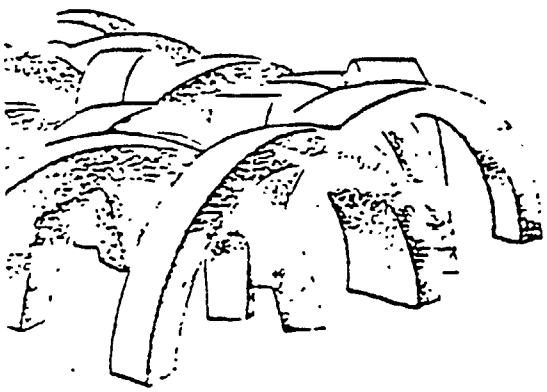
A few large sections of Thermobestos, prefabricated the "J-M" way before application and secured in place with neat metal bands, fit the valve in this illustration like a glove.

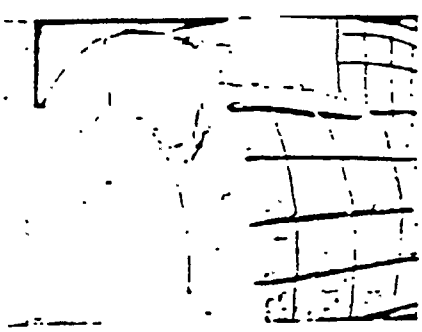
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ACL Doc 19329 · Page 42 of 64
asbestosclaims.law/library/19329/42



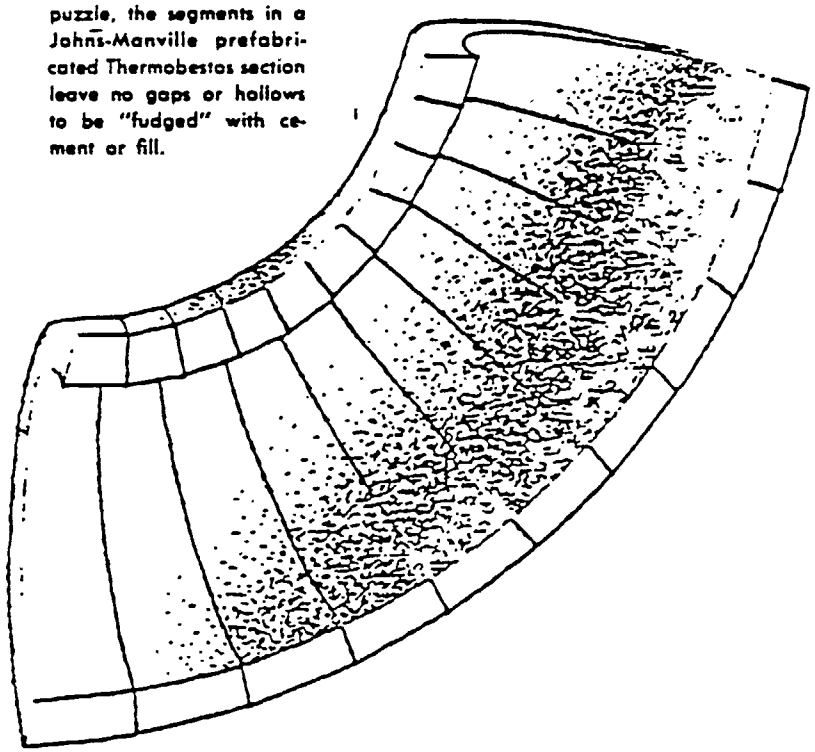
Constructing a perfect circle of any diamter is easy with accurately cut Thermobestos segments. It's just as easy to prefabricate special sections to fit tube turns of any radius.





Usual "on-the-job" valve cover combines ny pieces of ordinary insulation with ity of wire, block scraps and cement. Compare this with the "J-M" way (left).

Fitting together as snugly as the pieces in a jigsaw puzzle, the segments in a Johns-Manville prefabricated Thermobestos section leave no gaps or hollows to be "fudged" with cement or fill.



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ACL Doc 19329 · Page 43 of 64
asbestosclaims.law/library/19329/43

J-M Thermobestos

PIPE INSULATION DATA

PHYSICAL AND THERMAL PROPERTIES*

Property	Value
Density (dry	11 lb per cu. ft.
Transverse Strength (modulus of rupture*	95 psi
Compressive Strength (based on 2" thickness of blocks)	165 psi to produce 5% compression
Linear Shrinkage	1.5% after 24-hr. soaking period at 1200F
Maximum Service Temperature	1200 F

Conductivity at Mean Temperature	100F	200F	300F	400F	500F	600F	700F
(Btu in per sq ft per F per hr.)	.33	.37	.41	46	50	.55	.60

*The figures given in this table are average values obtained in accordance with accepted test methods

COMPLIANCE WITH GOVERNMENT SPECIFICATIONS

Pipe Insulation:

MIL-I-2781:
- Grade I, class b, to 500F
- Grade II, class d, to 750F
- Grade III, class e, type I, to 1050F

FEDERAL HH-I-523 Class 2, to 1200F

Block Insulation:

MIL-I-2819
- Class a to 500F
- Class b, to 1000F

FEDERAL HH-I-523 Class I, to 1200F

COMPLIANCE WITH ASTM STANDARDS

Pipe Insulation: C345-54T, to 1200F

Block Insulation: C344-54T, to 1200F

APPROXIMATE WEIGHT OF THERMOBESTOS PIPE INSULATION PER STANDARD 3-FT. SECTION, POUNDS

Insulation Thickness, Inches	Nominal Pipe Size, Inches											
	½	¾	1	1¼	1½	2	2½	3	3½	4	4½	5
1	1.34	1.27	1.87	1.67	2.18	2.58	2.99	3.35	5.02	4.24	6.14	5.06
1½	2.75	2.66	3.30	4.02	3.85	4.56	6.43	5.70	7.85	7.08	8.91	7.83
2	4.42	4.33	5.28	5.11	4.93	6.91	9.26	8.53	10.6	9.90	12.3	11.2
2½	7.83	7.76	7.64	7.46	10.1	9.71	12.1	11.2	13.8	13.2	16.3	15.4
3	10.5	10.4	10.3	10.1	13.0	12.6	15.4	14.5	18.1	17.4	20.4	19.3

Insulation Thickness, Inches	6	7	8	9	10	11	12	14	15	16	17	18
1	5.48	—	—	—	—	—	—	—	—	—	—	—
1½	8.78	10.3	11.5	12.3	14.3	15.4	16.3	17.0	18.0	18.9	19.7	21.1
2	13.0	14.3	15.6	18.5	19.6	21.1	22.9	23.3	24.7	25.9	27.7	28.1
2½	17.0	18.7	21.8	23.7	25.1	27.5	29.2	29.9	31.7	34.2	35.4	37.2
3	21.4	24.8	27.1	29.2	31.5	33.7	35.9	36.9	39.6	41.8	43.5	45.8

Length, inches	Simplified thicknesses, inches	For copper tubing
36	Nominal 1 (up to and including 6" pipe size only), 1½, 2, 2½, 3 and 3½	To fit straight runs of copper tubing with nominal diameter from ¾ to 6 inch

RECOMMENDED THICKNESSES†

Nominal Pipe Size, Inches	Temperature of Pipe, F: 100 to 199	200 to 299	300 to 399	400 to 499	500 to 599	600 to 699*	700 to 799*	800 to 899*	900 to 999*	1000 to 1099*	1100 to 1200*
	Nominal Thickness, Inches										
Utility—Steam Generation											
1½ & less	1	1	1	1½	1½	1½	2	2½	2½	2½	3
2	1	1	1	1½	1½	1½	2	2½	2½	2½	3
2½	1	1	1½	1½	2**	2	2½	2½	3	3	3½
3	1	1	1½	1½	2**	2	2½	2½	3	3	3½
3½	1	1½	1½	2**	2**	2½	3	3	3	3½	4
4	1	1½	1½	2**	2**	2½	3	3	3½	3½	4
4½	1	1½	1½	2	2**	2½	3	3	3½	3½	4
5	1	1½	1½	2	2½	2½	3	3½	3½	4	4
6	1	1½	2	2	2½	2½	3	3½	3½	3½	4
7	1½	1½	2	2	2½	2½	3	3½	3½	4	4
8	1½	1½	2	2	2½	2½	3½	3½	4	4	4½
9	1½	1½	2	2½	2½	3	3½	3½	4	4	5
10	1½	1½	2	2½	3**	3	3½	4	4	4	5
11	1½	1½	2	2½	3**	3	3½	4	4	4½	5
12	1½	1½	2	2½	3**	3	3½	4	4	4½	5
14 & up	1½	1½	2	2½	3**	3	4	4	4½	4½	5
Process											
1½ & less	1	1	1	1	1	1	1	1½	1½	1½	1½
2	1	1	1	1	1	1	1½	1½	1½	1½	2
2½	1	1	1	1	1	1	1½	1½	1½	2	2
3	1	1	1	1	1	1½	1½	1½	1½	2	2
3½	1	1	1	1	1½	1½	1½	2	2	2	2½
4	1	1	1	1	1½	1½	1½	2	2	2	2½
4½	1	1	1	1	1½	1½	1½	2	2	2	2½
5	1	1	1	1	1½	1½	1½	2	2	2½	2½
6	1	1	1	1½	1½	1½	2	2	2½	2½	2½
7	1½	1½	1½	1½	1½	1½	2	2	2½	2½	2½
8	1½	1½	1½	1½	1½	2	2	2½	2½	2½	3
9	1½	1½	1½	1½	1½	2	2	2½	2½	2½	3
10	1½	1½	1½	1½	2	2	2	2½	2½	3	3½
11	1½	1½	1½	1½	2	2	2½	2½	2½	3	3½
12	1½	1½	1½	1½	2	2	2½	2½	2½	3	3½
14 & up	1½	1½	1½	1½	2	2	2½	2½	3	3	3½
Commercial—Full Year Operation											
1½ & less	1	1½	2	2½**	2½**	—	—	—	—	—	—
2	1	1½	2	2½**	3**	—	—	—	—	—	—
2½	1	2	2½	3**	3**	—	—	—	—	—	—
3	1½	2	2½	3**	3½**	—	—	—	—	—	—
3½	1½	2	2½	3**	3½**	—	—	—	—	—	—
4	1½	2	2½	3**	3½**						
4½	1½	2	2½	3**	3½**						
5	1½	2	2½	3**	3½**						
6	1½	2	3	3½**	4**						
7	1½	2	3	3½**	4**						
8	1½	2	3	3½**	4**						
9	1½	2½	3	3½**	4**						
10	1½	2½	3	3½**	4**						
11	1½	2½	3	3½**	4**						
12	1½	2½	3½	4**	4½**						
14 & up	2	2½	3½	4**	4½**						
Commercial—Seasonal Operation											
1½ & less	1	1	1½	1½	2						
2	1	1	1½	2	2						
2½	1	1½	1½	2	2½**						
3	1	1½	2	2	2½**						
3½	1	1½	2	2	2½**						
4	1	1½	2	2	2½**						
4½	1	1½	2	2	2½**						
5	1	1½	2	2	2½**						
6	1	1½	2	2½	3						
7	1½	1½	2	2½	3						
8	1½	1½	2	2½	3	—	—	—	—	—	—
9	1½	1½	2	2½	3	—	—	—	—	—	—
10	1½	2	2½	3	3½	—	—	—	—	—	—
11	1½	2	2½	3	3½	—	—	—	—	—	—
12	1½	2	2½	3	3½	—	—	—	—	—	—
14 & up	1½	2	2½	3	3½	—	—	—	—	—	—

*At temperatures above 600 F, pipe expansion is a significant factor. For best results pipe insulation should be applied in double-layer construction with staggered joints for all temperatures above 600 F. This construction prevents excessive heat losses and surface temperatures at the joints, caused by pipe expansion, thus eliminating scorched or burned jackets. The construction also eliminates the potential fire hazard of exposing jackets to higher temperatures at the joints. Double-layer, staggered joint construction also minimizes thermal stresses in the insulation by reducing the temperature differential across each layer.

**Available in single or double-layer.

A05527

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J-M Thermobestos

SPECIFICATION DATA

RECOMMENDED THICKNESSES

	Temperature at Surface, F									
	150 to 199	200 to 299	300 to 399	400 to 499	500 to 599	600 to 699	700 to 799	800 to 899	900 to 999	1000 to 1099	1100 to 1200
	Nominal Thickness, Inches										
Utility—Steam Generation	1½	1½	2	2½	3	3	3½	4	4	4½	4½
Process	1½	1½	1½	1½	1½	2	2	2	2½	2½	3
Commercial—Full Year Operation	1½	2½	3½	4	4½	–	–	–	–	–	–
Commercial—Seasonal Operation	1	1	1½	2	2½	–	–	–	–	–	–

*Tabulated thicknesses are optimum thicknesses calculated on an economic (From *How to Determine Economic Thickness of Insulation*—National Insulation Manufacturers Association) basis for heat conservation under average operating conditions and assure adequate temperature control. Other conditions may warrant the use of other thicknesses.

BLOCK INSULATION

STANDARD SIZES		
Length, inches	Thickness, inches	Width, inches
36	1, 1½, 2, 2½, 3, 3½ and 4	6 and 12

Note: For special sizes and curved blocks consult your nearest J-M office

Thermobestos Pipe Insulation

HEAT TRANSMISSION

Values expressed in Btu per linear foot per hour

Nom. Pipe Size, Inches	Pipe Temp., F	Nom. Thickness, Inches	Outside Surf. Temp., F	Btu
1	100	1	83	2.46
	"	1½	82	2.05
	"	2	81	1.84
	200	1	97	15.7
	"	1½	90	13.0
	"	2	87	11.7
	"	2½	85	10.3
	300	1	111	30.5
	"	1½	99	25.3
	"	2	94	22.6
	"	2½	89	19.9
	"	3	88	18.8
	400	1	126	47.0
	"	1½	109	38.9
	"	2	101	34.7
	"	2½	94	30.5
	"	3	92	28.8
	500	1	141	65.3
	"	1½	119	53.8
	"	2	108	48.0
	"	2½	99	42.2
	"	3	96	39.9
	"	3½	93	37.8
	600	1	155	85.6
	"	1½	129	70.2
	"	2	116	62.6
	"	2½	105	55.0
	"	3	101	51.9
	"	3½	97	48.2
	700	1	169	108
	"	1½	139	88.2
	"	2	124	78.5
	"	2½	110	68.9
	"	3	106	65.1
	"	3½	101	61.7
	800	1½	149	108
	"	2	132	95.9
	"	2½	116	84.0
	"	3	111	79.4
	"	3½	106	75.2
	900	1½	160	129
	"	2	141	115
	"	2½	123	100
	"	3	116	94.8
	"	3½	110	89.9
	1000	2	149	135
	"	2½	129	118
	"	3	122	112
	"	3½	115	106
	1100	2	158	157
	"	2½	136	137
	"	3	127	130
	"	3½	120	123
	1200	2½	143	158
	"	3	133	149
	"	3½	126	141
1¼	100	1	83	2.91
	"	1½	82	2.36
	"	2	81	2.08
1¼	200	1	100	18.6
	"	1½	92	15.0
	"	2	88	13.2
	"	2½	85	11.5
	300	1	116	36.2
	"	1½	102	29.1
	"	2	96	25.6
	"	2½	90	22.3
	"	3	89	20.8
	400	1	133	55.8
	"	1½	112	44.7
	"	2	103	39.3
	"	2½	96	34.2
	"	3	93	32.0
	500	1	149	77.8
	"	1½	123	62.0
	"	2	112	54.4
	"	2½	102	47.3
	"	3	98	44.2
	"	3½	95	41.8
	600	1	165	102
	"	1½	135	80.9
	"	2	120	70.9
	"	2½	108	61.6
	"	3	103	57.6
	"	3½	99	54.4
	700	1	180	129
	"	1½	146	102
	"	2	129	89.0
	"	2½	114	77.2
	"	3	108	72.1
	"	3½	104	68.2

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ACL Doc 19329 · Page 45 of 64 asbestosclaims.law/library/19329/45

Nom. Pipe Size	Pipe Temp., F	Nom. Thickness	Outside Surf. Te	Btu
¾	800	1½	157	124
¾	"	2	138	109
¾	"	2½	121	94.2
¾	"	3	114	88.0
¾	"	3½	109	83.2
¾	900	1½	168	149
¾	"	2	147	130
¾	"	2½	127	113
¾	"	3	119	105
¾	"	3½	114	99.4
¾	1000	2	156	153
¾	"	2½	134	133
¾	"	3	125	124
¾	"	3½	119	117
¾	1100	2	165	178
¾	"	2½	142	154
¾	"	3	132	144
¾	"	3½	124	136
¾	1200	2½	149	177
¾	"	3	138	165
¾	"	3½	130	156
1	100	1	83	3.06
1	"	1½	82	2.56
1	"	2	81	2.25
1	200	1	97	19.5
1	"	1½	91	16.3
1	"	2	88	14.3
1	"	2½	86	13.0
1	300	1	111	37.9
1	"	1½	101	31.6
1	"	2	95	27.7
1	"	2½	92	25.1
1	"	3	89	23.3
1	400	1	126	58 4
1	"	1½	111	48.6
1	"	2	103	42.5
1	"	2½	98	38.5
1	"	3	94	35.7
1	500	1	141	81.2
1	"	1½	122	67 4
1	"	2	111	58.8
1	"	2½	104	53.2
1	"	3	99	49.4
1	"	3½	96	46.5
1	600	1	155	106
1	"	1½	133	88.0
1	"	2	119	76.7
1	"	2½	110	69 4
1	"	3	105	64 4
1	"	3½	101	60 5
1	700	1	169	134
1	"	1½	144	111
1	"	2	128	96.3
1	"	2½	117	87.0
1	"	3	111	80 7
1	"	3½	106	75.8
1	800	1½	155	135
1	"	2	136	118
1	"	2½	125	106
1	"	3	117	98.4
1	"	3½	111	92.5
1	900	1½	166	162
1	"	2	145	141
1	"	2½	132	127
	"	3	123	118
	"	3½	117	111

Nom. Pipe Size,	Pipe Temp., F	Nom. Thickness,	Outside Surf. Ter	Btu
1	1000	2	154	166
1	"	2½	140	149
1	"	3	130	138
1	"	3½	122	130
1	1100	2	163	193
1	"	2½	147	174
1	"	3	136	161
1	"	3½	128	151
1	1200	2½	155	200
1	"	3	143	185
1	"	3½	134	174
1¼	100	1	84	3.88
1¼	"	1½	82	2.87
1¼	"	2	82	2.66
1¼	200	1	101	24.8
1¼	"	1½	91	18.3
1¼	"	2	89	17.0
1¼	"	2½	87	15.1
1¼	300	1	119	48.3
1¼	"	1½	101	35.4
1¼	"	2	98	32.8
1¼	"	2½	94	29.2
1¼	"	3	91	26.8
1¼	400	1	137	74.8
1¼	"	1½	112	54.5
1¼	"	2	107	50.4
1¼	"	2½	100	44.8
1¼	"	3	96	41.1
1¼	500	1	155	104
1¼	"	1½	123	75.5
1¼	"	2	116	69.7
1¼	"	2½	108	61.9
1¼	"	3	102	56.8
1¼	"	3½	99	52.9
1¼	600	1	171	137
1¼	"	1½	134	98.6
1¼	"	2	126	91.0
1¼	"	2½	119	80.7
1¼	"	3	109	74.0
1¼	"	3½	104	68 9
1¼	700	1	187	174
1¼	"	1½	145	124
1¼	"	2	135	114
1¼	"	2½	123	101
1¼	"	3	115	92.8
1¼	"	3½	109	86 4
1¼	800	1½	156	152
1¼	"	2	145	140
1¼	"	2½	131	124
1¼	"	3	122	113
1¼	"	3½	115	105
1¼	900	1½	167	182
1¼	"	2	155	167
1¼	"	2½	139	148
1¼	"	3	129	135
1¼	"	3½	121	126
1¼	1000	2	165	197
1¼	"	2½	148	174
1¼	"	3	136	159
1¼	"	3½	128	148
1¼	1100	2	175	229
1¼	"	2½	156	203
1¼	"	3	143	185
1¼	"	3½	134	172
1¼	1200	2½	164	233
1¼	"	3	151	213
1¼	"	3½	141	198

Nom. Pipe Size, I	Pipe Temp., F	Nom. Thickness, I	Outside Surf. Temp	Btu
1½	100	1	83	3.98
1½	"	1½	82	3.24
1½	"	2	81	2.63
1½	200	1	99	25.4
1½	"	1½	93	20.6
1½	"	2	88	16.7
1½	"	2½	86	15.1
1½	300	1	116	49.4
1½	"	1½	104	40.0
1½	"	2	95	32.4
1½	"	2½	92	29.3
1½	"	3	90	27.1
1½	400	1	132	76.3
1½	"	1½	116	61.6
1½	"	2	103	49.7
1½	"	2½	98	44.9
1½	"	3	95	41.6
1½	500	1	149	106
1½	"	1½	127	85.3
1½	"	2	111	68.8
1½	"	2½	104	62.1
1½	"	3	100	57.5
1½	"	3½	97	53.9
1½	600	1	164	140
1½	"	1½	139	112
1½	"	2	119	89.7
1½	"	2½	111	81.0
1½	"	3	106	74.9
1½	"	3½	102	70.2
1½	700	1	179	176
1½	"	1½	151	140
1½	"	2	128	113
1½	"	2½	118	102
1½	"	3	112	93.9
1½	"	3½	107	88 0
1½	800	1½	163	172
1½	"	2	136	138
1½	"	2½	125	124
1½	"	3	118	115
1½	"	3½	112	107
1½	900	1	207	261
1½	"	1½	175	206
1½	"	2	145	165
1½	"	2½	133	148
1½	"	3	124	137
1½	"	3½	118	128
1½	1000	2	154	194
1½	"	2½	141	174
1½	"	3	131	161
1½	"	3½	124	151
1½	1100	2	163	226
1½	"	2½	148	203
1½	"	3	138	187
1½	"	3½	130	175
1½	1200	2	172	260
1½	"	2½	156	233
1½	"	3	145	215
1½	"	3½	136	202
2	100	1	83	4.56
2	"	1½	82	3.65
2	"	2	81	3.13
2	"	2½	81	2.80
2	200	1	99	29.1
2	"	1½	93	23.2
2	"	2	89	19.9
2	"	2½	87	17 8
2	"	3	86	16.3

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Published by AsbestosClaims.Law
ACL Doc 19329 · Page 46 of 64
asbestosclaims.law/library/19329/46

Nom. Pipe Size, Inches	Pipe Temp., F	Nom. Thickness, Inches	Outside Surf. Temp., F	Btu
2	300	1	116	56.8
2	"	1½	104	45.1
2	"	2	98	38.5
2	"	2½	94	34.5
2	"	3	91	31.5
2	"	3½	89	29.3
2	400	1	133	87.6
2	"	1½	116	69.4
2	"	2	106	59.2
2	"	2½	101	52.9
2	"	3	97	48.4
2	"	3½	94	44.9
2	500	1	149	122
2	"	1½	128	96.2
2	"	2	115	81.9
2	"	2½	108	73.2
2	"	3	103	66.9
2	"	3½	99	62.1
2	"	4	97	58.1
2	600	1	165	160
2	"	1½	140	126
2	"	2	125	107
2	"	2½	116	95.4
2	"	3	110	87.1
2	"	3½	105	80.9
2	"	4	101	75.7
2	700	1	180	203
2	"	1½	152	158
2	"	2	135	134
2	"	2½	124	120
2	"	3	116	109
2	"	3½	111	101
2	"	4	106	94.8
2	800	1½	164	194
2	"	2	144	164
2	"	2½	132	146
2	"	3	123	133
2	"	3½	117	124
2	"	4	111	116
2	900	1½	175	232
2	"	2	154	196
2	"	2½	140	175
2	"	3	130	159
2	"	3½	123	148
2	"	4	117	138
2	1000	2	164	232
2	"	2½	149	206
2	"	3	138	188
2	"	3½	129	174
2	"	4	123	163
2	1100	2	173	270
2	"	2½	157	239
2	"	3	145	218
2	"	3½	136	202
2	"	4	129	189
2	1200	2½	166	276
2	"	3	153	251
2	"	3½	143	233
2	"	4	135	217
2½	100	1	83	5.24
2½	"	1½	82	3.78
2½	"	2	81	3.34
2½	"	2½	81	2.98
2½	200	1	100	33.4
2½	"	1½	91	24.0
2½	"	2	89	21.2
2½	"	2½	87	18.9
2½	"	3	86	17.4
2½	300	1	117	65.2
2½	"	1½	101	46.6
2½	"	2	96	41.1
2½	"	2½	93	36.7
2½	"	3	91	33.7
2½	"	3½	89	31.2
2½	400	1	134	101
2½	"	1½	111	71.7
2½	"	2	105	63.1
2½	"	2½	100	56.3
2½	"	3	96	51.7
2½	"	3½	94	47.9
2½	500	1	151	140
2½	"	1½	122	99.3
2½	"	2	113	87.3
2½	"	2½	107	77.9
2½	"	3	102	71.5
2½	"	3½	99	66.3
2½	"	4	96	62.3
2½	600	1	167	184
2½	"	1½	133	130
2½	"	2	122	114
2½	"	2½	114	102
2½	"	3	108	93.2
2½	"	3½	104	86.3
2½	"	4	101	81.2
2½	700	1	182	233
2½	"	1½	144	163
2½	"	2	131	143
2½	"	2½	122	127
2½	"	3	115	117
2½	"	3½	110	108
2½	"	4	106	102
2½	800	1½	155	199
2½	"	2	141	175
2½	"	2½	129	156
2½	"	3	122	143
2½	"	3½	115	132
2½	"	4	111	124
2½	900	1½	166	239
2½	"	2	150	209
2½	"	2½	137	186
2½	"	3	129	170
2½	"	3½	122	158
2½	"	4	116	148
2½	1000	2	160	246
2½	"	2½	146	219
2½	"	3	136	201
2½	"	3½	128	186
2½	"	4	122	174
2½	1100	2	169	287
2½	"	2½	154	255
2½	"	3	143	233
2½	"	3½	134	216
2½	"	4	128	203
2½	1200	2½	162	293
2½	"	3	151	268
2½	"	3½	141	248
2½	"	4	134	233
3	100	1	83	6.18
3	"	1½	82	4.81
3	"	2	82	4.08
3	"	2½	81	3.59
3	200	1	101	39.5
3	"	1½	94	30.6
3	"	2	90	25.9
3	"	2½	88	22.8
3	"	3	87	20.6
3	300	1	119	77.1
3	"	1½	106	59.5
3	"	2	100	50.3
3	"	2½	96	44.2
3	"	3	93	39.9
3	"	3½	91	36.5
3	400	1	137	119
3	"	1½	119	91.6
3	"	2	110	77.3
3	"	2½	103	67.9
3	"	3	99	61.3
3	"	3½	96	56.0
3	500	1	155	166
3	"	1½	132	127
3	"	2	120	107
3	"	2½	112	94.0
3	"	3	106	84.8
3	"	3½	102	77.5
3	"	4	99	72.2
3	600	1	171	219
3	"	1½	145	166
3	"	2	130	140
3	"	2½	120	123
3	"	3	113	110
3	"	3½	108	101
3	"	4	104	94.0
3	700	1	187	277
3	"	1½	158	209
3	"	2	141	175
3	"	2½	129	154
3	"	3	121	139
3	"	3½	114	127
3	"	4	109	118
3	800	1½	170	256
3	"	2	151	214
3	"	2½	138	188
3	"	3	128	169
3	"	3½	121	154
3	"	4	115	144
3	900	1½	182	308
3	"	2	162	257
3	"	2½	147	225
3	"	3	136	202
3	"	3½	128	185
3	"	4	121	172
3	1000	2	172	303
3	"	2½	156	265
3	"	3	144	238
3	"	3½	135	217
3	"	4	128	202
3	1100	2	182	353
3	"	2½	165	308
3	"	3	152	277
3	"	3½	142	252
3	"	4	134	235
3	1200	2	192	407
3	"	2½	174	355
3	"	3	161	319
3	"	3½	149	290
3	"	4	141	270
3½	100	1	83	6.00
3½	"	1½	82	4.84
3½	"	2	82	4.20
3½	"	2½	81	3.73
3½	200	1	98	38.3
3½	"	1½	92	30.8
3½	"	2	90	26.7
3½	"	2½	88	23.7
3½	"	3	86	21.3

A05530

Union Carbide trial exhibit UC-4813: The Industrial Insulators, Inc. Catalog of Commercial and Industrial Thermal I...
Published by AsbestosClaims.Law
ACL Doc 19329 · Page 47 of 64
asbestosclaims.law/library/19329/47

Nom. Pipe Size, Inches	Pipe Temp., F	Nom. Thickness, Inches	Outside Surf. Temp., F	Btu
3½	300	1	113	74.4
3½	"	1½	103	59.7
3½	"	2	98	51.8
3½	"	2½	95	46.0
3½	"	3	92	41.2
3½	"	3½	90	38.1
3½	400	1	128	115
3½	"	1½	115	91.9
3½	"	2	107	79.6
3½	"	2½	102	70.5
3½	"	3	98	63.3
3½	"	3½	95	58.4
3½	500	1	143	160
3½	"	1½	126	127
3½	"	2	117	110
3½	"	2½	110	97.6
3½	"	3	104	87.5
3½	"	3½	101	80.8
3½	"	4	98	75.8
3½	600	1	158	209
3½	"	1½	138	166
3½	"	2	126	144
3½	"	2½	118	127
3½	"	3	111	114
3½	"	3½	107	105
3½	"	4	103	98.7
3½	700	1	173	264
3½	"	1½	150	209
3½	"	2	136	180
3½	"	2½	126	160
3½	"	3	118	143
3½	"	3½	113	132
3½	"	4	109	124
3½	800	1½	161	256
3½	"	2	146	221
3½	"	2½	135	195
3½	"	3	125	175
3½	"	3½	119	161
3½	"	4	114	151
3½	900	1½	173	307
3½	"	2	156	264
3½	"	2½	144	233
3½	"	3	133	209
3½	"	3½	126	192
3½	"	4	120	180
3½	1000	2	166	311
3½	"	2½	152	275
3½	"	3	141	246
3½	"	3½	133	226
3½	"	4	127	212
3½	1100	2½	161	320
3½	"	3	148	286
3½	"	3½	140	263
3½	"	4	133	247
3½	1200	2½	170	368
3½	"	3	156	329
3½	"	3½	147	303
3½	"	4	139	284
4	100	1	84	7.40
4	"	1½	82	5.79
4	"	2	82	4.86
4	"	2½	81	4.24
4	200	1	101	47.3
4	"	1½	95	36.9
4	"	2	91	30.9
4	"	2½	89	27.0
4	"	3	87	24.0
4	300	1	119	92.2
4	"	1½	108	71.6
4	"	2	101	59.9
4	"	2½	96	52.3
4	"	3	93	46.6
4	"	3½	91	42.6
4	400	1	137	143
4	"	1½	121	110
4	"	2	111	92.1
4	"	2½	105	80.2
4	"	3	100	71.5
4	"	3½	97	65.3
4	"	4	95	60.6
4	500	1	155	199
4	"	1½	134	153
4	"	2	122	128
4	"	2½	113	111
4	"	3	107	98.9
4	"	3½	103	90.4
4	"	4	100	83.7
4	"	4½	97	77.0
4	600	1	171	262
4	"	1½	147	200
4	"	2	132	167
4	"	2½	122	145
4	"	3	115	129
4	"	3½	109	118
4	"	4	105	109
4	"	4½	101	100
4	700	1	187	331
4	"	1½	160	252
4	"	2	143	209
4	"	2½	131	182
4	"	3	122	162
4	"	3½	116	148
4	"	4	111	137
4	"	4½	106	126
4	800	1½	173	309
4	"	2	154	256
4	"	2½	141	222
4	"	3	130	197
4	"	3½	123	180
4	"	4	117	167
4	"	4½	112	153
4	900	1½	185	371
4	"	2	165	307
4	"	2½	150	266
4	"	3	139	236
4	"	3½	130	215
4	"	4	124	199
4	"	4½	117	183
4	1000	2	175	362
4	"	2½	160	313
4	"	3	147	278
4	"	3½	138	254
4	"	4	130	235
4	"	4½	123	215
4	1100	2½	169	365
4	"	3	155	323
4	"	3½	145	295
4	"	4	137	273
4	"	4½	129	250
4	1200	2½	178	420
4	"	3	164	372
4	"	3½	153	339
4	"	4	144	314
4	"	4½	135	288
4½	100	1	83	7.14
4½	"	1½	82	5.70
4½	"	2	82	4.87
4½	"	2½	81	4.31
4½	200	1	98	45.5
4½	"	1½	93	36.3
4½	"	2	90	31.0
4½	"	2½	88	27.3
4½	"	3	87	24.6
4½	300	1	114	88.6
4½	"	1½	104	70.4
4½	"	2	99	60.0
4½	"	2½	95	53.0
4½	"	3	93	47.6
4½	"	3½	91	43.8
4½	400	1	130	137
4½	"	1½	116	108
4½	"	2	108	92.2
4½	"	2½	103	81.4
4½	"	3	99	73.1
4½	"	3½	96	67.1
4½	"	4	95	64.7
4½	500	1	145	190
4½	"	1½	128	150
4½	"	2	118	128
4½	"	2½	111	113
4½	"	3	106	101
4½	"	3½	102	92.8
4½	"	4	100	89.4
4½	"	4½	98	84.6
4½	600	1	160	250
4½	"	1½	140	196
4½	"	2	128	167
4½	"	2½	119	147
4½	"	3	113	132
4½	"	3½	108	121
4½	"	4	106	116
4½	"	4½	103	110
4½	700	1	175	315
4½	"	1½	152	247
4½	"	2	138	209
4½	"	2½	128	184
4½	"	3	120	165
4½	"	3½	114	152
4½	"	4	112	146
4½	"	4½	109	138
4½	800	1½	164	302
4½	"	2	148	256
4½	"	2½	137	225
4½	"	3	128	202
4½	"	3½	121	185
4½	"	4	118	178
4½	"	4½	115	168
4½	900	1½	175	362
4½	"	2	158	306
4½	"	2½	145	269
4½	"	3	135	241
4½	"	3½	128	221
4½	"	4	125	213
4½	"	4½	121	201
4½	1000	2	168	361
4½	"	2½	154	317
4½	"	3	143	284
4½	"	3½	135	260
4½	"	4	132	251
4½	"	4½	127	237
4½	1100	2½	163	369
4½	"	3	151	330
4½	"	3½	142	303
4½	"	4	139	291
4½	"	4½	133	275
4½	1200	2½	172	425
4½	"	3	159	380
4½	"	3½	150	348
4½	"	4	146	335
4½	"	4½	140	316

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Union Carbide trial exhibit UC-4813: The Industrial Insulators, Inc. Catalog of Commercial and Industrial Thermal I...
Published by AsbestosClaims.Law
ACL Doc 19329 · Page 48 of 64
asbestosclaims.law/library/19329/48

Nom. Pipe Size, Inches	Pipe Temp., F	Nom. Thickness, Inches	Outside Surf. Temp., F	Btu
5	100	1	84	8.97
5	"	1½	83	6.91
5	"	2	82	5.73
5	"	2½	81	4.92
5	200	1	102	57.4
5	"	1½	96	44.0
5	"	2	92	36.4
5	"	2½	89	31.3
5	"	3	87	27.9
5	300	1	121	112
5	"	1½	109	85.6
5	"	2	102	70.7
5	"	2½	97	60.7
5	"	3	94	54.1
5	"	3½	92	49.1
5	400	1	140	173
5	"	1½	123	132
5	"	2	113	109
5	"	2½	106	93.2
5	"	3	101	83.0
5	"	3½	98	75.4
5	"	4	75	68.0
5	500	1	158	242
5	"	1½	137	183
5	"	2	124	151
5	"	2½	115	129
5	"	3	109	115
5	"	3½	104	104
5	"	4	100	94.0
5	"	4½	98	88.6
5	600	1	175	319
5	"	1½	150	240
5	"	2	135	197
5	"	2½	124	168
5	"	3	117	150
5	"	3½	111	136
5	"	4	106	122
5	"	4½	103	115
5	"	5	101	109
5	700	1½	164	302
5	"	2	146	247
5	"	2½	133	211
5	"	3	125	188
5	"	3½	118	170
5	"	4	112	153
5	"	4½	108	145
5	"	5	105	136
5	800	1½	177	370
5	"	2	157	302
5	"	2½	143	258
5	"	3	133	229
5	"	3½	126	208
5	"	4	118	187
5	"	4½	114	176
5	"	5	110	166
5	900	2	168	363
5	"	2½	153	309
5	"	3	142	274
5	"	3½	133	249
5	"	4	125	224
5	"	4½	120	211
5	"	5	116	198
5	1000	2½	162	364
5	"	3	150	323
5	"	3½	141	293
5	"	4	131	263
5	"	4½	126	248
5	"	5	121	233
5	1100	2½	172	424
5	"	3	159	376
5	"	3½	149	340
5	"	4	138	306
5	"	4½	133	288
5	"	5	127	271
5	1200	2½	181	489
5	"	3	167	433
5	"	3½	156	392
5	"	4	145	352
5	"	4½	139	331
5	"	5	133	312
6	100	1	84	10.6
6	"	1½	83	8.06
6	"	2	82	6.55
6	"	2½	82	5.64
6	200	1	103	67.9
6	"	1½	96	51.4
6	"	2	92	41.7
6	"	2½	89	35.9
6	"	3	88	31.8
6	300	1	123	133
6	"	1½	110	99.9
6	"	2	103	80.8
6	"	2½	98	69.5
6	"	3	95	61.6
6	"	3½	92	54.2
6	400	1	142	206
6	"	1½	125	154
6	"	2	114	124
6	"	2½	107	107
6	"	3	102	94.6
6	"	3½	98	83.1
6	"	4	96	77.3
6	500	1	161	287
6	"	1½	139	214
6	"	2	125	172
6	"	2½	116	148
6	"	3	110	131
6	"	3½	104	115
6	"	4	102	107
6	"	4½	99	99.5
6	600	1	178	379
6	"	1½	153	280
6	"	2	136	225
6	"	2½	126	193
6	"	3	118	171
6	"	3½	111	150
6	"	4	108	139
6	"	4½	104	130
6	"	5	101	121
6	700	1	195	480
6	"	1½	167	353
6	"	2	148	283
6	"	2½	136	242
6	"	3	127	214
6	"	3½	118	188
6	"	4	114	175
6	"	4½	110	162
6	"	5	106	151
6	800	2	159	346
6	"	2½	145	296
6	"	3	135	261
6	"	3½	125	229
6	"	4	120	213
6	"	4½	116	198
6	"	5	112	185
6	900	2	170	415
6	"	2½	155	354
6	"	3	144	313
6	900	3½	133	274
6	"	4	127	255
6	"	4½	122	237
6	"	5	117	221
6	1000	2½	165	418
6	"	3	153	368
6	"	3½	141	323
6	"	4	134	300
6	"	4½	128	279
6	"	5	123	259
6	1100	2½	175	487
6	"	3	162	429
6	"	3½	148	375
6	"	4	141	349
6	"	4½	135	324
6	"	5	129	301
6	1200	2½	184	561
6	"	3	171	494
6	"	3½	156	432
6	"	4	149	401
6	"	4½	142	373
6	"	5	135	347
7	100	1½	83	8.92
7	"	2	82	7.32
7	"	2½	82	6.28
7	"	3	81	5.43
7	200	1½	96	56.9
7	"	2	92	46.6
7	"	2½	90	39.9
7	"	3	88	34.5
7	"	3½	87	31.2
7	300	1½	110	111
7	"	2	103	90.3
7	"	2½	96	77.4
7	"	3	95	66.9
7	"	3½	92	60.5
7	"	4	91	55.5
7	400	1½	124	170
7	"	2	114	139
7	"	2½	108	119
7	"	3	102	103
7	"	3½	99	92.8
7	"	4	96	85.2
7	"	4½	94	79.1
7	500	1½	139	237
7	"	2	126	193
7	"	2½	117	165
7	"	3	110	142
7	"	3½	106	128
7	"	4	102	118
7	"	4½	100	109
7	"	5	97	102
7	600	1½	153	310
7	"	2	137	252
7	"	2½	127	215
7	"	3	118	185
7	"	3½	113	167
7	"	4	108	154
7	"	4½	105	142
7	"	5	102	133
7	"	5½	100	126
7	700	1½	167	391
7	"	2	149	316
7	"	2½	137	270
7	"	3	126	232
7	"	3½	120	210
7	"	4	115	192
7	"	4½	111	179
7	"	5	107	167
7	"	5½	105	158

Union Carbide trial exhibit UC-4813: The Industrial Insulators, Inc. Catalog of Commercial and Industrial Thermal I...
Published by AsbestosClaims.Law
ACL Doc 19329 · Page 49 of 64
asbestosclaims.law/library/19329/49

Nom. Pipe Size, Inche	Pipe Temp., F	Nom. Thickness, Inch	Outside Surf. Temp.,	Btu
7	800	2	161	387
7	"	2½	147	329
7	"	3	135	284
7	"	3½	127	256
7	"	4	122	235
7	"	4½	117	218
7	"	5	113	204
7	"	5½	110	192
7	900	2	172	464
7	"	2½	157	395
7	"	3	144	339
7	"	3½	135	306
7	"	4	129	281
7	"	4½	123	260
7	"	5	119	244
7	"	5½	115	230
7	1000	2½	167	465
7	"	3	152	400
7	"	3½	143	361
7	"	4	136	330
7	"	4½	130	306
7	"	5	125	287
7	"	5½	120	270
7	1100	2½	177	542
7	"	3	161	465
7	"	3½	151	419
7	"	4	143	384
7	"	4½	136	356
7	"	5	131	333
7	"	5½	126	314
7	1200	2½	186	625
7	"	3	170	536
7	"	3½	159	483
7	"	4	151	442
7	"	4½	143	409
7	"	5	137	383
7	"	5½	132	361
8	100	1½	83	9.90
8	"	2	82	8.08
8	"	2½	81	6.62
8	"	3	81	5.96
8	200	1½	96	63.1
8	"	2	92	51.4
8	"	2½	89	42.1
8	"	3	88	37.9
8	"	3½	87	34.2
8	300	1½	111	123
8	"	2	103	99.8
8	"	2½	98	81.6
8	"	3	95	73.4
8	"	3½	93	66.2
8	"	4	91	60.0
8	400	1½	125	189
8	"	2	115	153
8	"	2½	106	125
8	"	3	103	113
8	"	3½	99	102
8	"	4	96	92.0
8	"	4½	94	85.4
8	500	1½	139	263
8	"	2	126	213
8	"	2½	116	174
8	"	3	111	156
8	"	3½	106	140
8	"	4	102	127
8	"	4½	100	118
8	"	5	98	110
8	600	1½	154	344
8	"	2	138	278
8	"	2½	125	226
8	"	3	119	203
8	"	3½	113	183
8	"	4	109	166
8	"	4½	105	154
8	"	5	103	144
8	"	5½	101	136
8	700	1½	167	433
8	"	2	150	350
8	"	2½	135	284
8	"	3	127	255
8	"	3½	121	230
8	"	4	115	208
8	"	4½	111	193
8	"	5	108	180
8	"	5½	105	171
8	800	2	162	428
8	"	2½	144	347
8	"	3	136	311
8	"	3½	129	280
8	"	4	122	254
8	"	4½	117	235
8	"	5	113	220
8	"	5½	111	209
8	900	2	173	513
8	"	2½	154	416
8	"	3	145	373
8	"	3½	136	335
8	"	4	129	303
8	"	4½	124	281
8	"	5	119	263
8	"	5½	116	249
8	1000	2½	164	490
8	"	3	154	439
8	"	3½	145	395
8	"	4	136	357
8	"	4½	130	331
8	"	5	125	309
8	"	5½	122	293
8	1100	2½	174	571
8	"	3	163	511
8	"	3½	153	459
8	"	4	144	415
8	"	4½	137	384
8	"	5	131	359
8	"	5½	127	341
8	1200	2½	183	658
8	"	3	172	588
8	"	3½	161	528
8	"	4	151	477
8	"	4½	144	442
8	"	5	138	413
8	"	5½	133	392
9	100	1½	87	10.9
9	"	2	82	8.47
9	"	2½	82	7.28
9	"	3	81	6.48
9	200	1½	97	69.2
9	"	2	92	53.9
9	"	2½	90	46.3
9	"	3	88	41.2
9	"	3½	87	36.8
9	300	1½	111	135
9	"	2	102	105
9	"	2½	98	89.7
9	"	3	95	79.8
9	"	3½	93	71.4
9	"	4	91	65.3
9	400	1½	125	208
9	"	2	113	161
9	"	2½	107	138
9	"	3	103	123
9	"	3½	99	110
9	"	4	97	100
9	"	4½	95	92.7
9	500	1½	140	288
9	"	2	125	223
9	"	2½	117	191
9	"	3	111	170
9	"	3½	106	152
9	"	4	103	139
9	"	4½	100	128
9	"	5	98	120
9	600	1½	154	378
9	"	2	136	291
9	"	2½	126	249
9	"	3	119	221
9	"	3½	114	198
9	"	4	109	181
9	"	4½	106	167
9	"	5	103	156
9	"	5½	101	147
9	700	1½	168	476
9	"	2	147	366
9	"	2½	136	313
9	"	3	128	277
9	"	3½	121	248
9	"	4	116	226
9	"	4½	112	209
9	"	5	109	195
9	"	5½	106	184
9	800	2	159	447
9	"	2½	146	382
9	"	3	137	339
9	"	3½	129	302
9	"	4	123	276
9	"	4½	118	255
9	"	5	114	238
9	"	5½	111	224
9	900	2	170	536
9	"	2½	156	457
9	"	3	146	405
9	"	3½	137	362
9	"	4	130	330
9	"	4½	125	305
9	"	5	120	285
9	"	5½	117	268
9	1000	2½	166	539
9	"	3	155	478
9	"	3½	145	426
9	"	4	138	389
9	"	4½	132	359
9	"	5	126	335
9	"	5½	122	315
9	1100	2½	176	628
9	"	3	164	556
9	"	3½	153	495
9	"	4	145	452
9	"	4½	138	417
9	"	5	133	389
9	"	5½	128	366
9	1200	2½	185	724
9	"	3	173	640
9	"	3½	162	570
9	"	4	153	520
9	"	4½	146	480
9	"	5	139	448
9	"	5½	134	420

A05530

Union Carbide trial exhibit UC-4813: The Industrial Insulators, Inc. Catalog of Commercial and Industrial Thermal I...
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ACL Doc 19329 · Page 50 of 64
asbestosclaims.law/library/19329/50

Nom. Pipe Size, Inche	Pipe Temp., F	Nom. Thickness, Inch	Outside Surf. Temp.,	Btu
10	100	1½	83	11.6
10	"	2	82	9.49
10	"	2½	82	8.10
10	"	3	81	7.12
10	"	3½	81	6.39
10	200	1½	96	74.0
10	"	2	92	60.3
10	"	2½	90	51.5
10	"	3	88	45.2
10	"	3½	87	40.6
10	"	4	86	37.0
10	300	1½	110	144
10	"	2	103	117
10	"	2½	99	99.8
10	"	3	96	87.7
10	"	3½	93	78.6
10	"	4	92	71.6
10	"	4½	90	66.1
10	400	1½	124	222
10	"	2	115	180
10	"	2½	108	153
10	"	3	104	135
10	"	3½	100	121
10	"	4	98	110
10	"	4½	95	101
10	"	5	94	94.4
10	500	1½	139	308
10	"	2	126	250
10	"	2½	118	212
10	"	3	112	186
10	"	3½	107	167
10	"	4	104	152
10	"	4½	101	140
10	"	5	99	130
10	"	5½	97	122
10	600	1½	153	403
10	"	2	138	326
10	"	2½	128	277
10	"	3	120	243
10	"	3½	115	218
10	"	4	110	198
10	"	4½	107	183
10	"	5	104	170
10	"	5½	102	159
10	700	1½	166	508
10	"	2	150	410
10	"	2½	138	348
10	"	3	129	305
10	"	3½	123	273
10	"	4	117	248
10	"	4½	113	229
10	"	5	110	213
10	"	5½	107	200
10	800	2	161	502
10	"	2½	148	425
10	"	3	138	372
10	"	3½	131	333
10	"	4	125	303
10	"	4½	120	279
10	"	5	116	260
10	"	5½	112	244
10	900	2	173	602
10	"	2½	158	510
10	"	3	147	446
10	"	3½	139	399
10	"	4	132	363
10	"	4½	126	334
10	"	5	122	311
10	"	5½	118	291

Nom. Pipe Size, Inche	Pipe Temp., F	Nom. Thickness, Inche	Outside Surf. Temp., F	Btu
10	1000	2½	169	601
10	"	3	157	525
10	"	3½	147	469
10	"	4	140	427
10	"	4½	133	393
10	"	5	128	365
10	"	5½	124	343
10	1100	2½	178	700
10	"	3	166	611
10	"	3½	156	546
10	"	4	147	496
10	"	4½	140	457
10	"	5	135	425
10	"	5½	130	398
10	1200	3	175	704
10	"	3½	164	629
10	"	4	155	571
10	"	4½	148	525
10	"	5	141	488
10	"	5½	136	458
12	100	1½	83	13.5
12	"	2	82	11.0
12	"	2½	82	9.24
12	"	3	81	8.17
12	"	3½	81	7.31
12	200	1½	96	85.9
12	"	2	93	69.8
12	"	2½	90	58.7
12	"	3	89	51.9
12	"	3½	87	46.4
12	"	4	86	41.9
12	300	1½	111	167
12	"	2	104	135
12	"	2½	99	114
12	"	3	96	101
12	"	3½	94	89.9
12	"	4	92	81.2
12	"	4½	90	74.7
12	400	1½	125	257
12	"	2	115	208
12	"	2½	108	175
12	"	3	104	154
12	"	3½	101	138
12	"	4	98	125
12	"	4½	96	115
12	"	5	94	107
12	500	1½	139	358
12	"	2	127	289
12	"	2½	118	242
12	"	3	113	214
12	"	3½	108	191
12	"	4	104	172
12	"	4½	102	159
12	"	5	99	147
12	"	5½	98	138
12	600	1½	154	468
12	"	2	139	377
12	"	2½	128	316
12	"	3	121	279
12	"	3½	116	249
12	"	4	111	225
12	"	4½	108	207
12	"	5	105	192
12	"	5½	102	180
12	"	6	100	170

Nom. Pipe Size, Inches	Pipe Temp., F	Nom. Thickness, Inche	Outside Surf. Temp., F	Btu
12	700	1½	167	590
12	"	2	151	474
12	"	2½	139	397
12	"	3	130	350
12	"	3½	124	312
12	"	4	118	282
12	"	4½	114	259
12	"	5	110	241
12	"	5½	108	226
12	"	6	105	213
12	800	2	163	581
12	"	2½	149	485
12	"	3	140	427
12	"	3½	132	381
12	"	4	125	344
12	"	4½	121	316
12	"	5	116	293
12	"	5½	113	276
12	"	6	110	260
12	900	2	174	697
12	"	2½	159	582
12	"	3	149	511
12	"	3½	140	456
12	"	4	133	411
12	"	4½	127	378
12	"	5	123	351
12	"	5½	119	329
12	"	6	116	310
12	1000	2½	169	686
12	"	3	158	603
12	"	3½	149	537
12	"	4	141	484
12	"	4½	134	445
12	"	5	129	413
12	"	5½	125	388
12	"	6	121	365
12	1100	2½	179	799
12	"	3	167	701
12	"	3½	157	625
12	"	4	148	563
12	"	4½	142	517
12	"	5	136	479
12	"	5½	131	450
12	"	6	127	424
12	1200	3	177	808
12	"	3½	166	719
12	"	4	156	648
12	"	4½	149	595
12	"	5	143	552
12	"	5½	138	518
12	"	6	133	487
14	100	1½	83	15.3
14	"	2	82	12.3
14	"	2½	82	10.4
14	"	3	81	9.03
14	"	3½	81	8.03
14	200	1½	97	97.8
14	"	2	93	78.4
14	"	2½	91	66.0
14	"	3	89	57.4
14	"	3½	88	51.0
14	"	4	87	46.2
14	300	1½	112	190
14	"	2	105	152
14	"	2½	100	128
14	"	3	97	111
14	"	3½	94	98.9
14	"	4	92	89.4
14	"	4½	91	82.0

A05534

Union Carbide trial exhibit UC-4813: The Industrial Insulators, Inc. Catalog of Commercial and Industrial Thermal I...
Published by AsbestosClaims.Law
ACL Doc 19329 · Page 51 of 64
asbestosclaims.law/library/19329/51

Nom. Pipe Size, Inc	Pipe Temp., F	Nom. Thickness, Inc	Outside Surf. Temp.	Btu
14	400	1½	128	293
14	"	2	117	234
14	"	2½	110	197
14	"	3	105	171
14	"	3½	102	152
14	"	4	99	137
14	"	4½	97	126
14	"	5	95	116
14	500	1½	143	408
14	"	2	129	325
14	"	2½	120	272
14	"	3	114	236
14	"	3½	109	210
14	"	4	106	190
14	"	4½	103	174
14	"	5	100	161
14	"	5½	98	150
14	600	1½	157	535
14	"	2	142	424
14	"	2½	131	356
14	"	3	123	308
14	"	3½	117	274
14	"	4	113	247
14	"	4½	109	227
14	"	5	106	210
14	"	5½	103	196
14	"	6	101	184
14	700	1½	172	674
14	"	2	154	534
14	"	2½	142	447
14	"	3	132	387
14	"	3½	125	344
14	"	4	120	310
14	"	4½	115	284
14	"	5	112	263
14	"	5½	109	245
14	"	6	106	230
14	800	2	166	654
14	"	2½	152	546
14	"	3	142	473
14	"	3½	134	419
14	"	4	127	379
14	"	4½	122	347
14	"	5	118	321
14	"	5½	114	299
14	"	6	111	281
14	900	2½	163	654
14	"	3	151	566
14	"	3½	142	502
14	"	4	135	453
14	"	4½	129	414
14	"	5	124	383
14	"	5½	120	357
14	"	6	117	336
14	1000	2½	173	772
14	"	3	161	667
14	"	3½	151	591
14	"	4	143	533
14	"	4½	137	488
14	"	5	131	451
14	"	5½	127	421
14	"	6	123	395
14	1100	2½	183	900
14	"	3	170	777
14	"	3½	160	688
14	"	4	151	620
14	"	4½	144	567
14	"	5	138	524
14	"	5½	133	489
14	"	6	129	459
14	1200	3	180	895
14	"	3½	169	792
14	"	4	159	714
14	"	4½	152	652
14	"	5	145	603
14	"	5½	139	562
14	"	6	135	528
16	100	1½	83	17.3
16	"	2	82	13.8
16	"	2½	82	11.6
16	"	3	81	10.1
16	"	3½	81	9.0
16	200	1½	98	110
16	"	2	93	88.1
16	"	2½	91	74.0
16	"	3	89	64.1
16	"	3½	88	56.9
16	"	4	87	51.4
16	300	1½	113	215
16	"	2	105	171
16	"	2½	101	144
16	"	3	97	124
16	"	3½	95	110
16	"	4	93	99.6
16	"	4½	91	91.1
16	400	1½	128	331
16	"	2	118	263
16	"	2½	111	221
16	"	3	106	191
16	"	3½	102	169
16	"	4	99	153
16	"	4½	97	140
16	"	5	95	129
16	500	1½	143	460
16	"	2	130	365
16	"	2½	121	306
16	"	3	115	264
16	"	3½	110	234
16	"	4	106	211
16	"	4½	103	193
16	"	5	101	179
16	"	5½	99	166
16	600	1½	158	603
16	"	2	142	477
16	"	2½	132	399
16	"	3	124	345
16	"	3½	118	306
16	"	4	113	276
16	"	4½	109	252
16	"	5	106	233
16	"	5½	104	217
16	"	6	102	203
16	700	1½	172	761
16	"	2	155	601
16	"	2½	142	501
16	"	3	133	433
16	"	3½	126	383
16	"	4	121	346
16	"	4½	116	316
16	"	5	112	292
16	"	5½	109	272
16	"	6	107	255
16	800	2	167	736
16	"	2½	153	613
16	"	3	143	529
16	"	3½	135	468
16	"	4	128	422
16	"	4½	123	385
16	"	5	119	356
16	"	5½	115	331
16	"	6	112	311
16	900	2½	164	734
16	"	3	152	633
16	"	3½	143	560
16	"	4	136	504
16	"	4½	130	461
16	"	5	125	425
16	"	5½	121	396
16	"	6	118	371
16	1000	2½	174	866
16	"	3	162	747
16	"	3½	152	660
16	"	4	144	594
16	"	4½	138	542
16	"	5	132	500
16	"	5½	128	466
16	"	6	124	437
16	1100	2½	185	1010
16	"	3	172	869
16	"	3½	161	768
16	"	4	152	691
16	"	4½	145	630
16	"	5	139	581
16	"	5½	134	541
16	"	6	130	507
16	1200	3	181	1002
16	"	3½	170	884
16	"	4	161	795
16	"	4½	153	725
16	"	5	146	669
16	"	5½	141	622
16	"	6	136	583
18	100	1½	83	18.3
18	"	2	82	15.4
18	"	2½	82	12.9
18	"	3	81	11.2
18	"	3½	81	9.89
18	200	1½	98	123
18	"	2	94	97.9
18	"	2½	91	82.0
18	"	3	89	71.0
18	"	3½	88	62.9
18	"	4	87	56.6
18	300	1½	113	239
18	"	2	106	190
18	"	2½	101	159
18	"	3	97	138
18	"	3½	95	122
18	"	4	93	110
18	"	4½	91	100
18	400	1½	128	369
18	"	2	118	292
18	"	2½	111	244
18	"	3	106	211
18	"	3½	102	187
18	"	4	99	168
18	"	4½	97	154
18	"	5	95	142
18	500	1½	144	513
18	"	2	130	406
18	"	2½	121	339
18	"	3	115	293
18	"	3½	110	259
18	"	4	106	233
18	"	4½	103	213
18	"	5	101	196
18	"	5½	99	182

A05534

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Published by AsbestosClaims.Law
ACL Doc 19329 · Page 52 of 64
asbestosclaims.law/library/19329/52

Nom. Pipe Size, In	Pipe Temp., F	Nom. Thickness, I	Outside Surf. Tem	Btu
18	600	1½	158	672
18	"	2	143	530
18	"	2½	132	442
18	"	3	124	382
18	"	3½	118	337
18	"	4	114	304
18	"	4½	110	277
18	"	5	107	255
18	"	5½	104	238
18	"	6	102	223
18	700	1½	173	848
18	"	2	155	667
18	"	2½	143	555
18	"	3	134	479
18	"	3½	127	423
18	"	4	121	381
18	"	4½	117	347
18	"	5	113	320
18	"	5½	110	298
18	"	6	107	279

Nom. Pipe Size, In	Pipe Temp., F	Nom. Thickness, In	Outside Surf. Temp	Btu
18	800	2	168	817
18	"	2½	154	679
18	"	3	144	585
18	"	3½	135	517
18	"	4	129	465
18	"	4½	124	424
18	"	5	120	391
18	"	5½	116	363
18	"	6	113	340
18	900	2½	165	814
18	"	3	153	701
18	"	3½	144	618
18	"	4	137	556
18	"	4½	131	507
18	"	5	126	467
18	"	5½	122	434
18	"	6	118	406
18	1000	2½	175	961
18	"	3	163	826
18	"	3½	153	728

Nom. Pipe Size, In	Pipe Temp., F	Nom. Thickness, In	Outside Surf. Temp	Btu
18	1000	4	145	655
18	"	4½	139	596
18	"	5	133	549
18	"	5½	128	511
18	"	6	124	478
18	1100	2½	185	1120
18	"	3	172	962
18	"	3½	162	848
18	"	4	153	761
18	"	4½	146	693
18	"	5	140	639
18	"	5½	135	593
18	"	6	131	555
18	1200	3	182	1108
18	"	3½	171	976
18	"	4	162	876
18	"	4½	154	798
18	"	5	147	735
18	"	5½	142	683
18	"	6	137	639

J-M Thermobestos Block Insulation

HEAT TRANSMISSION

Expressed in Btu per square foot per hour

(Based on 80F ambient air temperature)

Temperature, F	Thickness, Inches	Outside Surf. Temp., F	Btu
100	1	83	5.60
"	1½	82	3.94
"	2	82	3.03
"	2½	81	2.47
200	1	99	35.7
"	1½	94	25.0
"	2	91	19.3
"	2½	89	15.7
"	3	87	13.2
300	1	116	69.2
"	1½	106	48.5
"	2	100	37.3
"	2½	96	30.4
"	3	94	25.6
"	3½	92	22.1
400	1	134	106
"	1½	119	74.5
"	2	110	57.3
"	2½	105	46.6
"	3	101	39.2
"	3½	98	33.9
"		96	29.8

Temperature, F	Thickness, Inches	Outside Surf. Temp., F	Btu
500	1½	133	103
"	2	121	79.3
"	2½	114	64 4
"	3	109	54.3
"	3½	105	46.9
"	4	102	41.3
"		100	36.8
600	1½	147	135
"	2	133	103
"	2½	124	84.0
"	3	117	70.7
"	3½	112	61.1
"	4	109	53 7
"	4½	106	48 0
700	2	145	130
"	2½	134	105
"	3	126	88.6
"	3½	120	76.5
"	4	115	67.3
"	4½	112	60.1
"		109	54.3
800	2½	144	129
"	3	135	108
"	3½	128	93 4
"	4	123	82.1
"	4½	118	73.3
"	5	115	66.2
"	5½	112	60.4

Temperature, F	Thickness, Inches	Outside Surf. Temp., F	Btu
900	3	145	129
"	3½	137	112
"	4	130	98.2
"	4½	125	87.6
"	5	121	79.1
"	5½	118	72.1
1000	3½	146	131
"	4	138	115
"	4½	133	103
"	5	128	93.1
"	5½	124	84.8
"	6	121	78 0
1100	4	147	134
"	4½	140	120
"	5	135	108
"	5½	131	98.5
"	6	127	90.5
"	6½	123	83.7
1200	4	156	154
"	4½	149	138
"	5	143	124
"	5½	137	113
"	6	133	104
"	6½	129	96.2

Union Carbide trial exhibit UC-4813: The Industrial Insulators, Inc. Catalog of Commercial and Industrial Thermal I...
Published by AsbestosClaims.Law
ACL Doc 19329 · Page 53 of 64
asbestosclaims.law/library/19329/53

...ing materials



J-M No. 302 Insulating Cement—A very high quality asbestos cement for insulating fittings and sealing joints or for use as a finish over other insulation. May be troweled to a smooth, hard surface. Furnished in 100 lb bags. Covering capacity 25 bd ft per 100 lbs.

J-M No. 352 Insulating Cement—An asbestos cement for insulating pipe fittings or for use as a finish over other insulation. May be troweled to a smooth hard surface. Furnished in 50 and 100 lb bags. Covering capacity 19 bd ft per 100 lbs.

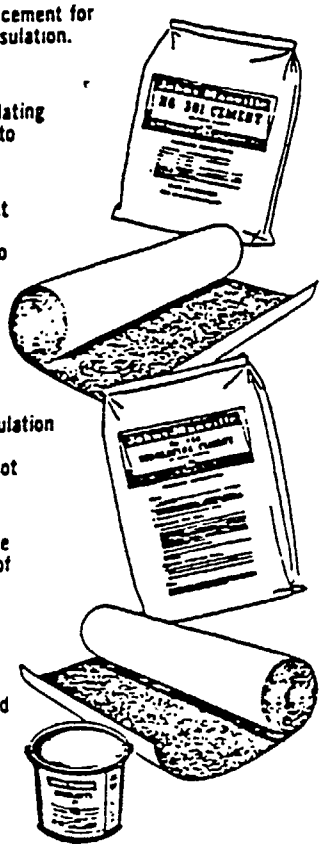
J-M No. 301 Insulating Cement—An hydraulic setting, one coat application cement for insulating pipe fittings and as a finish over other insulation. Negligible drying shrinkage permits application in one layer to desired thickness. Hardens within a few hours. Furnished in 50 lb bags. Covering capacity 36 bd ft per 100 lbs.

J-M No. 450 Insulating Cement—A mineral wool cement for insulating flanges and other irregular surfaces. Furnished in 50 lb bags. ...ing capacity 50 bd ft per 100 lbs.

J-M Double Coated Flexstone®—A rugged, heavy duty, weatherproofing jacket especially recommended for the protection of insulation on outdoor pipes and small diameter cylindrical vessels. Composed of ...-saturated asbestos felt coated with a mineral-filled asphalt. Will not ...ite under prolonged exposure to sunlight. Supplied in rolls 36 in. wide each roll containing 108 sq ft and weighing 50 lbs.

J-M Asbestos Firetard®—A weatherproof jacket designed for use where resistance to the spread of fire is of primary importance. Consists of laminations of heavy asphalt-saturated asbestos felt and plain asbestos felt. Affords excellent insulation protection. Recommended for weatherproofing outdoor pipes and small diameter vessels wherever fire hazards are present. Supplied in rolls 32 in. wide, each roll containing 108 sq ft and weighing 55 lbs.

Insulkote®—A weatherproof coating for use on outdoor insulated ...and vessels. Compounded of selected and processed bitumens, asbestos fiber and mineral fillers. Furnished ready-mixed in two consistencies to facilitate trowel or spray application. Available in water-vapor barrier, non water vapor-barrier and combination purpose types. Furnished in 1, 5, 30 and 55 gal containers. 1 gal covers approximately 6 sq ft to a thickness of ¼ in.





Johns-Manville

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Sales Offices in Principal Cities

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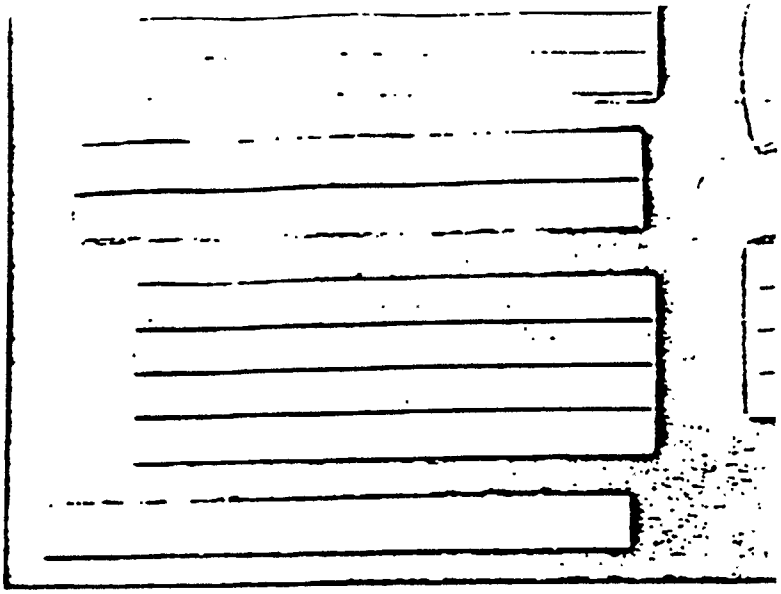
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PRODUCT INFORMATION

type: Scored Block
temp. limit: 1200F



J-M THERMOBESTOS®

DESCRIPTION: A molded, high temperature block insulation, J-M Thermobestos is composed of hydrous calcium silicate bonded with asbestos fibers. It is a completely inorganic insulating material which, because of its light weight, low thermal conductivity, great structural strength and insolubility in water, is ideal for use on large high temperature piping and equipment.

AVAILABLE FORMS: Scored Thermobestos blocks are furnished flat with three V-shaped score marks molded longitudinally on 3-inch centers on one side. This permits cracking along bottom of score marks so that blocks will fit diameters ranging from 34 to 180 inches.

All scored blocks are 12"x36" overall, in the following thicknesses: 1½", 2", 2½", 3", and 3½".

USES: Scored Thermobestos blocks are recommended for application on large-diameter piping and equipment. Vees are approximately 3/8" in width at the open end, and taper to 0" at the bottom, i.e., about 3/8" from the unscored side. By placing scored side against pipe or equipment (so that score marks are parallel to axis) and pressing outer edges toward pipe surface, the bottoms of the Vees are cracked thus permitting block to conform to cylindrical contour. Width of top of Vee makes block adaptable for diameters ranging from 34 to 180 inches. The net effect is the same as applying four 3-inch blocks simultaneously.

ADVANTAGES:

Adaptable

May be used on flat or cylindrical surfaces full width, or in multiples (from one to four) of 3-inch blocks.

Smooth Finish

Requires minimum finishing cement. (However, end joints should be filled with J-M 450 or 301 cement.)

Easy Application

12" wide blocks speed work, reduce number of joints.

Exceptional Strength

When properly applied Thermobestos is only cracked (not broken) along score marks and does not separate into individual 3-inch blocks.

Low Conductivity

Thermobestos has a k factor of only .50 at 500F mean temperature.

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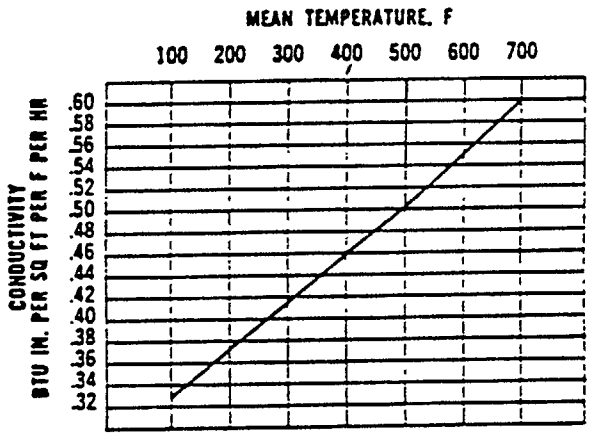
THERMOBESTOS

PHYSICAL PROPERTIES*

Density (dry)	11 lbs per cu ft
Transverse Strength (modulus of rupture)	85 psi
Compressive Strength (based on 2" thickness of block)	165 psi to produce 5% compression
Linear Shrinkage	1.5% after 24-hr soaking period at 1200F
Maximum Service Temperature	1200F

*The figures given in this table are average values obtained in accordance with accepted test methods.

THERMAL CONDUCTIVITY



COMPLIANCE WITH GOVERNMENT SPECS

Block Insulation:

MIL-I-002819D
Class 1, to 500F
Class 2, to 1000F
FEDERAL HH-I-523 A Class 1, to 1200F

COMPLIANCE WITH ASTM STANDARDS

Block Insulation:

C344-54T, to 1200F

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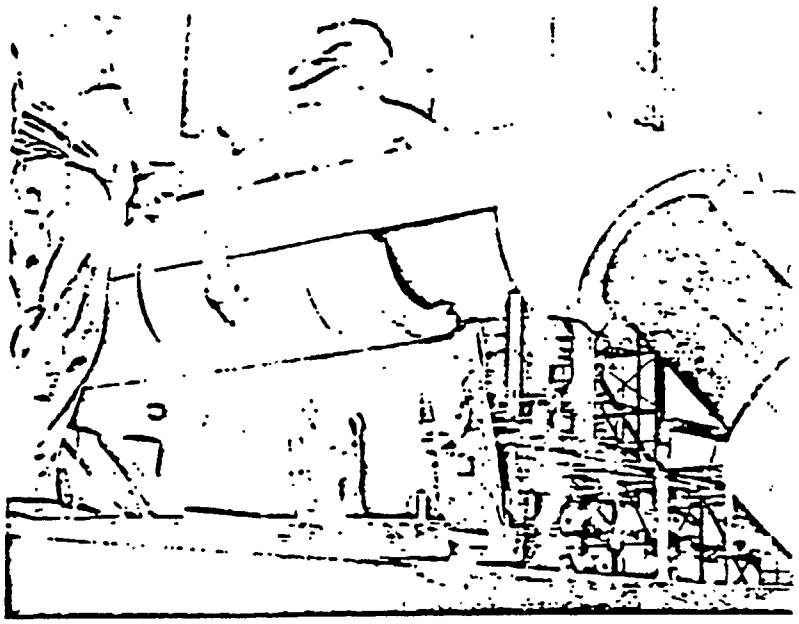
Union Carbide trial exhibit UC-4813: The Industrial Insulators, Inc. Catalog of Commercial and Industrial Thermal I... Published by AsbestosClaims.Law
ACL Doc 19329 · Page 57 of 64 asbestosclaims.law/library/19329/57

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PRODUCT INFORMATION

type: Pipe & Block
temp limit: 1200F



J-M THERMOBESTOS®

DESCRIPTION: A molded, high temperature pipe and block insulation, J-M Thermobestos is composed of hydrous calcium silicate bonded with asbestos fibers. It is a completely inorganic insulating material which, because of its light weight, low thermal conductivity, great structural strength and insolubility in water, is ideal for high temperature piping and equipment.

AVAILABLE FORMS: Thermobestos is furnished in both sectional pipe insulation and block form. The pipe insulation comes in a complete selection of sizes up to 24" x 4" half sections. 25" through 33" pipe sizes are available in quad segments. Scored blocks 12" x 36" in thicknesses from 1½" to 3½" are available for application on curved surfaces representing a diameter range from 34" through 180". Scored blocks are furnished with three equally spaced scores. Beveled blocks are also available in widths of 6", 12", and 18", by 36" lengths, in a full range of thicknesses.

USES: Especially recommended for use in the power generation and process industries on indoor and outdoor piping and equipment operating at temperatures to 1200F. Thermobestos is light enough for easy handling and fast application. Repeated wettings have no permanent effect on it which makes it ideal for installations subjected to weather, or for insulating underground steam lines. Because it will not burn or carry flame, it may also be advantageously specified for use in the presence of inflammable gases and liquids.

ADVANTAGES

Exceptional Strength

Similar in chemistry and composition to a very fine concrete, Thermobestos will withstand unusual operating abuse without appreciable damage.

Extreme Lightness

Thermobestos is as light as many insulating materials possessing a fraction of its strength and durability.

Chemically Stable

100% inorganic, will neither burn nor rot.

Not Damaged by Water

Can be soaked in water without damage. After drying, conductivity will be as good as new.

Easy Application

Thermobestos is purposely made in large blocks and half-sections to facilitate handling and reduce number of joints.

Low Conductivity

Thermobestos offers the lowest *k* factor of all insulations in general use throughout the power generation and process industries.

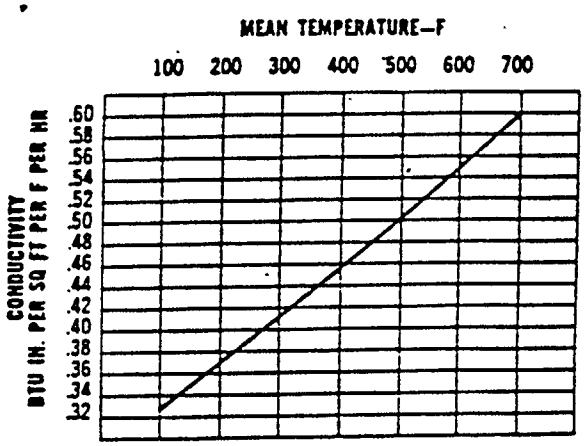
THERMOBESTOS

PHYSICAL PROPERTIES*

Density (dry)	11 lbs per cu ft
Transverse Strength (modulus of rupture)	95 psi
Compressive Strength (based on 2" thickness of block)	165 psi to produce 5% compression
Linear Shrinkage	1.5% after 24-hr soaking period at 1200F
Maximum Service Temperature	1200F

*The figures given in this table are average values obtained in accordance with accepted test methods.

THERMAL CONDUCTIVITY



Pipe Insulation

STANDARD SIZES

Length, inches	Simplified thicknesses, inches	For copper tubing
36	Nominal 1 (from ½" up to & including 6" pipe size only), 1½, 2, 2½, 3, 3½ & 4	To fit straight runs of copper tubing with nom. diameter ⅜ to 3"

COMPLIANCE WITH GOVERNMENT SPECS

Pipe Insulation:

MIL-I-2781 D
- Grade I, class b, to 500F
- Grade II, class d, to 750F
- Grade III, class e, type I and II to 1050F

FEDERAL HH-I-523 A Class 2, to 1200F

Block Insulation:

MIL-I-002819 D
- Class a, to 500F
- Class b, to 1000F

FEDERAL HH-I-523 A Class
- Class I, to 1200F

Block Insulation

STANDARD SIZES

Length, inches	Width, inches	Thickness, inches
36	6 and 12	1, 1½, 2, 2½, 3, 3½ and 4

RECOMMENDED THICKNESSES

Complete pipe and block thickness recommendations are available for steam generation, process industry, commercial full year and commercial seasonal operation applications. See Thermobestos brochure IN-169A, or J-M Insulation Product Information catalog IN-244A.

COMPLIANCE WITH ASTM STANDARDS

Pipe Insulation:

C345-54T, to 1200F

Block Insulation:

C344-54T, to 1200F

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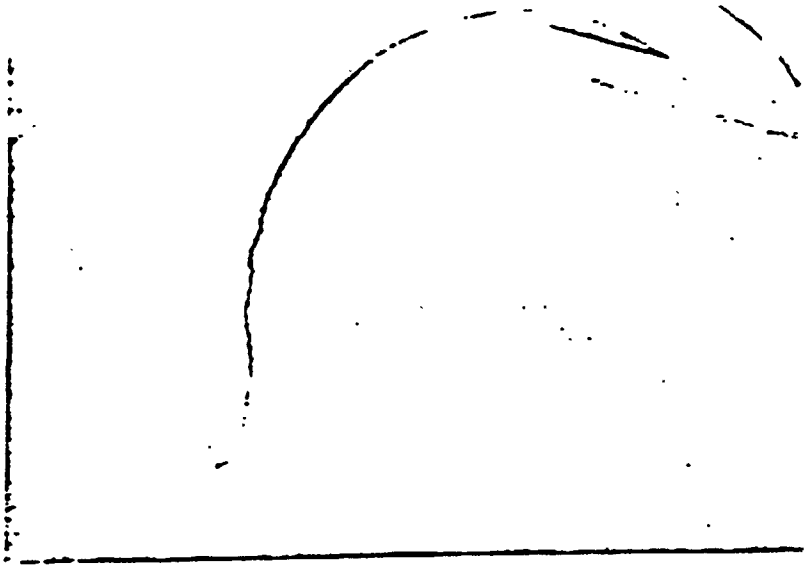
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PRODUCT INFORMATION

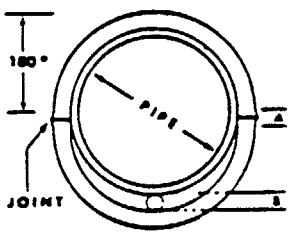
type: Extended Legs for Traced Pipe Lines

temp limit: 1200F



J-M THERMOBESTOS®

DESCRIPTION: Composed of hydrous calcium silicate bonded with asbestos fibers, J-M Thermobestos with extended legs is a high-temperature pipe insulation molded with ⅜" legs on each end of the half circles—or ⅜" straight beyond 180° (½ dimension "A" on adjacent sketch). Extended legs provide allowance for the traced line and the dimension of "B", as shown on the sketch, will be ¾". For special size extended legs, consult J-M sales representative.



AVAILABLE FORMS: Thermobestos is furnished in a complete selection of sectional pipe sizes up to 24" x 3" thick half-sections. Larger sizes are available in quad segments from 25" to 33" P/S in 1½, 2, 2½ and 3" thicknesses. For special applications, Thermobestos with extended legs can be furnished as Metal-On®—a factory-applied aluminum or stainless steel jacket.

USES: For indoor and outdoor piping and equipment, operating at temperatures to 1200F, that have either steam or electrical traced pipe lines. Especially recommended for use in the power generation and chemical and process industries.

ADVANTAGES: Traced lines present a shape problem for insulations which are furnished in half circles; to fit both the main line and the traced line would require an oval insulation a size larger than normal. An oversize insulation does not provide a snug fit and, consequently, lacks physical strength. Extended legs provide an elliptical shape that fits both the main pipe and the traced line properly. In addition, the smaller size insulation made possible by extended legs permits substantial savings in material costs.

Thermobestos with extended legs also offers these advantages:

Exceptional Strength

Similar in chemistry and composition to a very fine concrete, Thermobestos will withstand unusual operating abuse without appreciable damage.

Extreme Lightness

Thermobestos is as light as many insulating materials possessing a fraction of its strength and availability.

Chemically Stable

100% inorganic, will neither burn nor rot.

Not Damaged by Water

Can be soaked in water without damage. After drying, conductivity will be as good as new.

Easy Application

Thermobestos is purposely made in large blocks and half-secuons to facilitate handling and reduce number of joints.

Low Conductivity

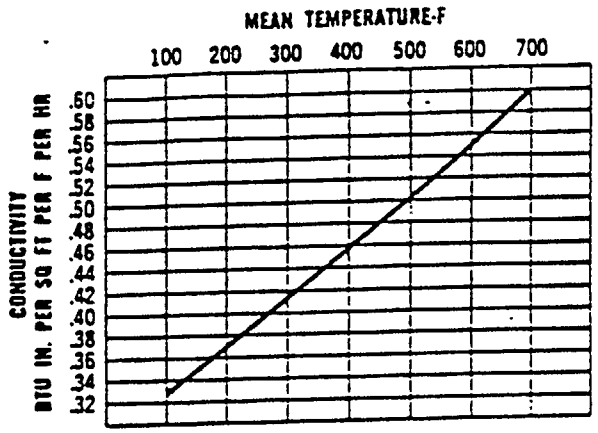
Thermobestos offers the lowest-*k* factor of all insulations in general use throughout the power generation and process industries.

GENERAL PROPERTIES*

Density (dry)	11 lbs per cu ft
Transverse Strength (modulus of rupture)	85 psi
Compressive Strength (based on 2" thickness of block)	165 psi to produce 5% compression
Linear Shrinkage	1.5% after 24-hr soaking period at 1200F
Maximum Service Temperature	1200F

*The figures given in this table are average values obtained in accordance with accepted test methods.

THERMAL CONDUCTIVITY



Pipe Insulation

STANDARD SIZES

Length, inches: 36

Simplified thicknesses, inches: Nominal 1 (from ½" up to & including 6" pipe size only), 1½, 2, 2½, 3, 3½ & 4

For copper tubing: To fit straight runs of copper tubing with nom. diameter ⅜ to 3"

RECOMMENDED THICKNESSES

Complete pipe thickness recommendations are available for steam generation, process industry, commercial full year and commercial seasonal operation applications. See Thermobestos brochure IN-169A.

COMPLIANCE WITH GOVERNMENT SPECS

Pipe Insulation:

MIL-I-2781
- Grade I, class b, to 500F
- Grade II, class d, to 750F
- Grade III, class e
  - type I and II to 1050F

FEDERAL HH-I-523 Class 2, to 1200F

COMPLIANCE WITH ASTM STANDARDS

Pipe Insulation:

C345-54T, to 1200F

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Sales offices in principal cities

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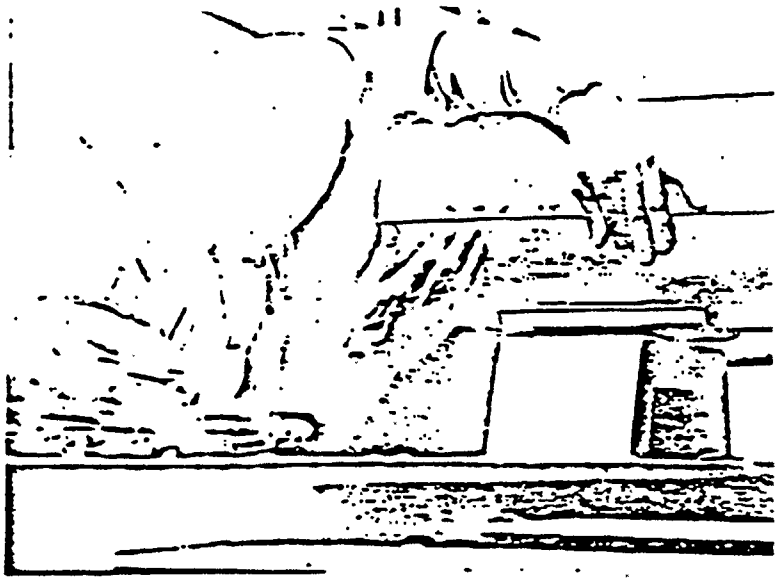
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PRODUCT INFORMATION

type: Pipe
temp limit: 1200F



J-M METAL-ON®

DESCRIPTION: J-M Metal-On pipe insulation consists of high temperature Thermobestos pipe insulation pre-jacketed at the factory with top-quality aluminum. Furnished as an integral package (including a built-in isolation felt), a section of Metal-On snaps on the pipe and locks tightly in place to seal out weather and protect insulation indefinitely. Joints are sealed with either "Regular" or "One Piece" aluminum "snap straps." No sheet metal screws are used. The aluminum alloy jacket is especially selected to give superior corrosion resistance and strength.

AVAILABLE FORMS: Furnished in pipe insulation form only. Available in 36" sections in a complete range of sizes up to 24" pipe size by 3" thickness.

USES: Particularly recommended for use in the power generation, petroleum, chemical and allied industries, especially on outdoor installations, at operating temperatures to 1200F.

ADVANTAGES

Installation Savings

Both insulation and jacket are furnished in a single package, installed in a single operation.

Excellent Weather Protection

Keeps insulation dry during installation, thus avoiding electrolytic corrosion of aluminum through direct contact with wet insulation common where jacket is installed as a separate operation.

Proper Jacket Thickness

Jacket thickness designed to provide, at lowest cost, outstanding appearance, stiffness, workability, and resistance to abuse.

Integral Isolation Felt

A built-in, properly designed barrier between jacketing and insulation.

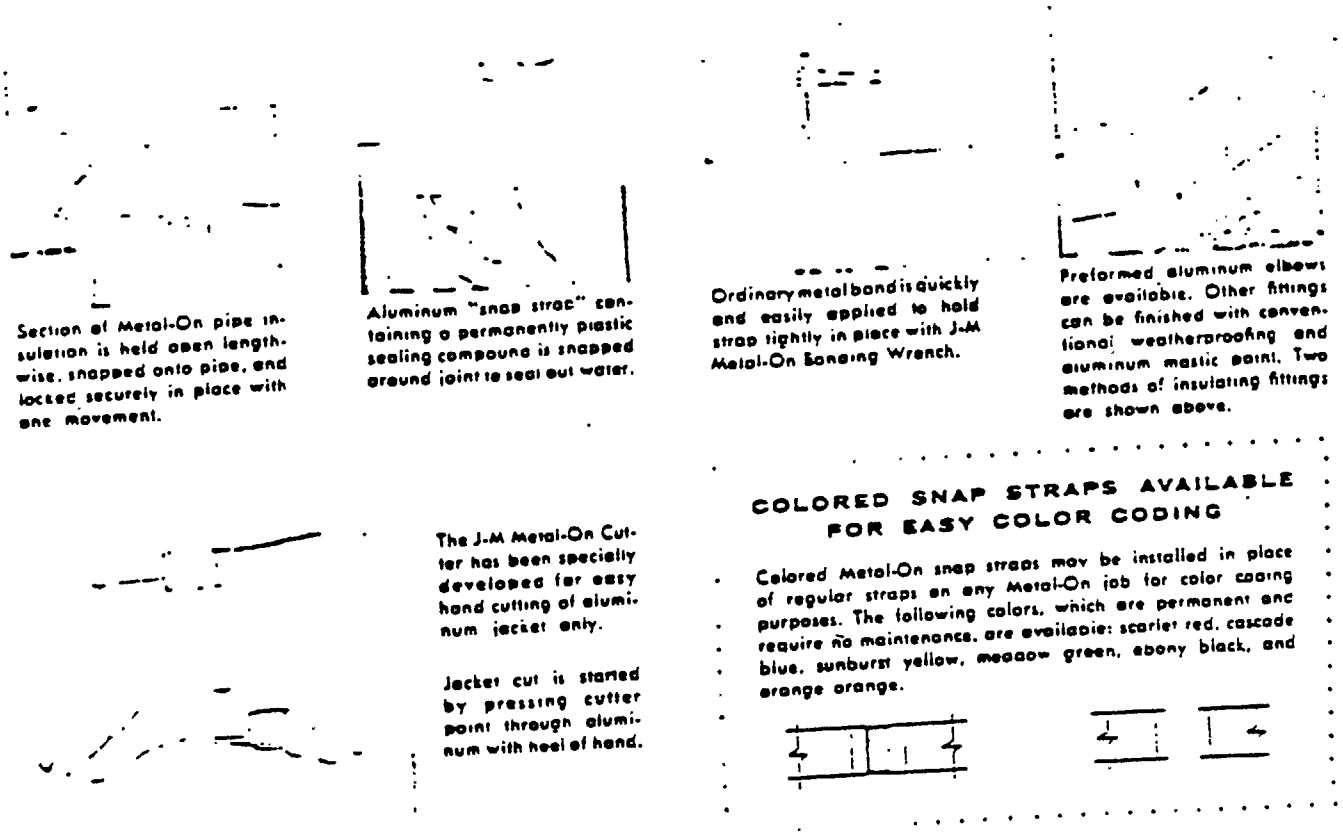
Easy to Remove

Rapid, easy removability for repairs and maintenance.

For Specification Data, including physical and thermal properties, recommended thicknesses, compliance with specifications, etc., see Thermobestos pipe insulation brochure IN-169A.

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Section of Metal-On pipe insulation is held open lengthwise, snapped onto pipe, and locked securely in place with one movement.

Aluminum "snap strap" containing a permanently plastic sealing compound is snapped around joint to seal out water.

Ordinary metal band is quickly and easily applied to hold strap tightly in place with J-M Metal-On Banding Wrench.

Preformed aluminum elbows are available. Other fittings can be finished with conventional weatherproofing and aluminum mastic paint. Two methods of insulating fittings are shown above.

The J-M Metal-On Cutter has been specially developed for easy hand cutting of aluminum jacket only.

Jacket cut is started by pressing cutter point through aluminum with heel of hand.

COLORED SNAP STRAPS AVAILABLE FOR EASY COLOR CODING

Colored Metal-On snap straps may be installed in place of regular straps on any Metal-On job for color coding purposes. The following colors, which are permanent and require no maintenance, are available: scarlet red, cascade blue, sunburst yellow, meadow green, ebony black, and orange orange.

GUIDE SPECIFICATIONS

STRAIGHT PIPING

All piping shall be insulated with Johns-Manville Thermobestos according to recommended thicknesses. (See Thermobestos specification data in brochure IN-169A).

The insulation shall be applied over clean dry pipe with all joints butted firmly together. Double layer insulation, when required, shall be applied with joints staggered, the inner layer secured with wire loops on 12-inch (maximum) centers, and outer layer applied in the same manner as single layer construction. The Thermobestos shall be jacketed with a minimum thickness of .016-inch aluminum, of alloy No. 5005 or No. 3003. A moisture barrier shall be provided between the Thermobestos and the aluminum. The insulation and aluminum shall be secured in place by a continuous friction type point to provide a positive weatherproof seal along the entire length of the aluminum jacket. Also, a .016-inch aluminum preformed strap of minimum width of 1¾ inch and containing a permanently plastic weatherproof sealant shall be centered over each circumferential joint. The strap shall be secured in place with ½-inch (minimum) aluminum banding (.020-inch minimum thickness), or ½-inch stainless steel banding (.015-inch minimum thickness).

FITTINGS

Fittings shall be insulated with prefabricated Thermobestos sections. In addition to the standard specification which applies as to finish (aluminum covers, painted asbestos cloth, Insulkote, etc.), the following shall apply:

A .016-inch aluminum preformed strap, of the same size as used on the straight piping, and containing a permanently plastic weatherproof sealant, shall be centered over the circumferential joint made where the fitting butts against the straight section of pipe. The straps shall be secured in place with ½-inch (minimum) aluminum (.020-inch) or stainless steel (.015-inch) bands.

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