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 of the adjoining pipe.

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. If aluminum jacketing is used, the aluminum shall have an integral moisture barrier. 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 500°, staples may be used at butt joints of single layer in accordance with the technique showed under "Expansion Control Data," Page 8. Unibestos Catalog (UN-3).

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For complete information on sizes and thicknesses, expansion control data, recommended thicknesses and typical specifications refer to Unibestos Catalog UN-3.

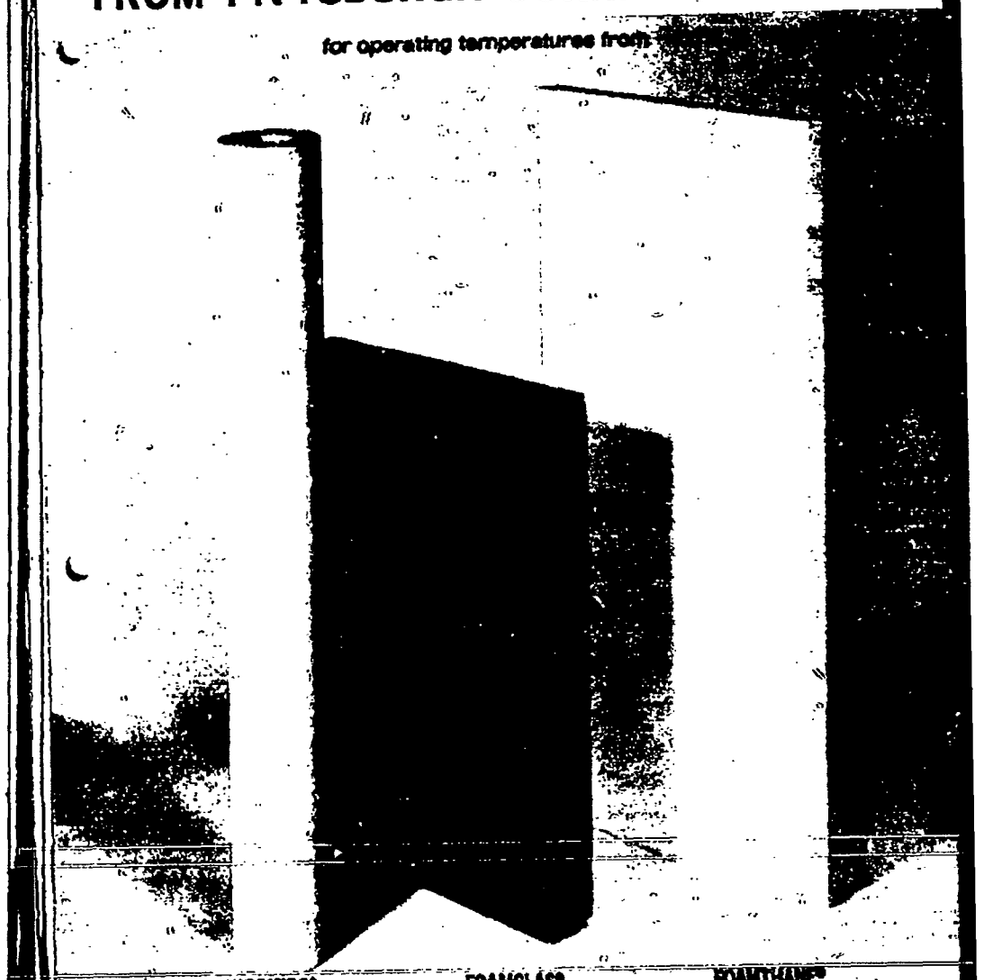
PITTSBURGH CORNING
One Gateway Center Pittsburgh, Pa. 15222

311009

UN-5 Printed in U.S.A. 20M 9/66

INDUSTRIAL INSULATIONS FROM PITTSBURGH CORNING

for operating temperatures from:



UNIBESTOS®
Amosite Asbestos Pipe Insulation
for operating temperatures
from +100°F. to +1200°F.

FOAMGLAS®
Cellular Glass Insulation
for operating temperatures
from −450°F. to +800°F.

FOAMTHANE®
Rigid Polyurethane Foam Insulation
for operating temperatures
from −320°F. to +300°F.

311010

PITTSBURGH CORNING

PLAINTIFF'S EXHIBIT U-694

FOAMGLAS—the only cellular glass insulation—provides long-lasting, maintenance-free insulation service for industrial piping and equipment

FOAMGLAS is a lightweight, rigid insulation composed of millions of completely sealed glass cells . . . each cell an insulating air space. It is a totally inorganic material, having no binders or fillers. It's all glass! Since it is all glass, it's incombustible and greatly reduces fire hazards. It's acid-proof . . . an important factor in the refining and petrochemical plant areas.

The sealed glass cells of FOAMGLAS are impermeable. Water cannot penetrate the material, thus its insulating efficiency remains constant for the life of the job.

Strength and rigidity are other benefits of FOAMGLAS. It will support an average ultimate compressive loading of 7 tons per square foot . . . a significant design consideration. Being rigid, FOAMGLAS will not sag or slump on vertical piping runs and cause possible insulation voids.

FOAMGLAS is available in a wide range of sizes and thicknesses both in the form of flat blocks and as pipe insulation. It is easily fabricated for insulating valves and fittings or any type of industrial application. For more information on available sizes, shapes, and thicknesses, see pages 4 and 5.

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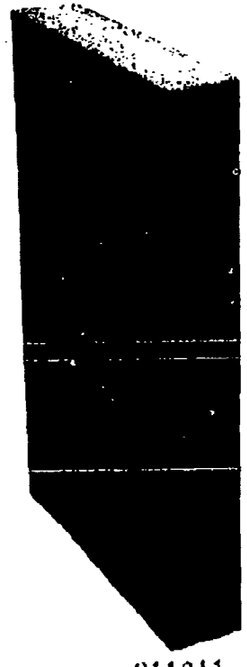


Outstanding Physical Properties of FOAMGLAS

Absorption of Moisture	0.2% by volume when tested according to ASTM Designation C 240-61.
Acid Resistance	Impervious to common acids and acid fumes.
Capillarity	0
Coefficient of Expansion	0.0000046/°F.
Combustibility	Will not burn.
Composition	A true glass—completely inorganic.
Compressive Strength (av., ult.)	100 lbs. per sq. in.
Density	9 lbs. per cu. ft.
Flexural Strength	75 lbs. per sq. in.
Hygroscopicity	No increase in weight in 246 days in air at 90% RH.
Modulus of Elasticity	180,000 lbs. per sq. in.
Permeability	0.00
Shear Strength	40 lbs. per sq. in.
Sound Insulation:	
Sound Absorption	No particular value.
Sound Transmission	Average sound reduction factor 28.3 decibels.
Specific Heat	0.20 btu per lb.
Thermal Conductivity:	
At 50°F	0.38 btu/hr./sq.ft./°F/in.
At 75°F	0.40 btu/hr./sq.ft./°F/in.
Thermal Diffusivity	0.42 sq. ft. per day

FOAMGLAS complies with the requirements of Federal Specification HH-I-551c or revisions thereof.

311011



FOAMGLAS is Waterproof and Vaporproof—This FOAMGLAS feature means constant insulating efficiency for the life of the installation. The sealed glass cells of FOAMGLAS are impermeable, thus are not affected by water. Vapor cannot penetrate the material. As a result, there is no increase in insulation weight . . . an important design consideration.



FOAMGLAS is Acid-Proof—FOAMGLAS is impervious to common acids and acid fumes. In many industrial plants, acid spillage or corrosive atmospheres cause rapid deterioration of ordinary insulations, necessitating costly periodic replacement. The all-glass composition of FOAMGLAS resists common acids and results in a long-lasting, trouble-free installation.



FOAMGLAS is Incombustible—You save money because of this FOAMGLAS feature. No costly fireproofing is necessary with FOAMGLAS. It's completely inorganic and can't burn. This is particularly important in plant areas sensitive to fire hazards such as refining and certain petrochemical operations. FOAMGLAS won't act as a "wick" in the unfortunate event of fire.



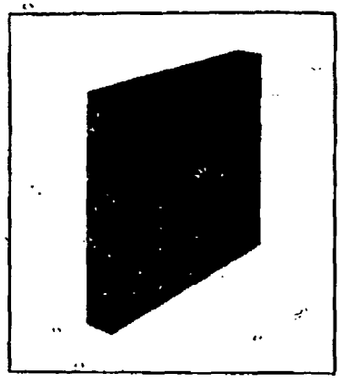
FOAMGLAS is Dimensionally Stable—Temperature differentials often cause other insulations to swell, warp, shrink or otherwise distort. FOAMGLAS, because of its dimensional stability, reduces this problem. This results in a tight-jointed installation and no problems due to insulation gaps.



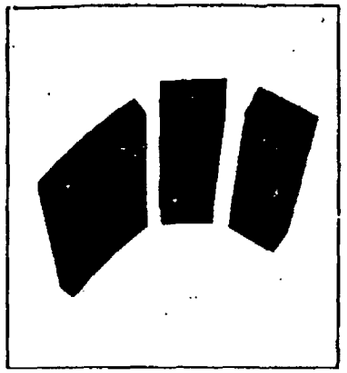
FOAMGLAS is Strong and Rigid—Because of its great strength and rigidity, FOAMGLAS will not slump or compress. This reduces insulation voids and eliminates sagging on vertical piping. Foot traffic over insulated piping, a common industrial plant occurrence, can crush or crumble ordinary insulations. FOAMGLAS supports this foot traffic with no problem.

311012

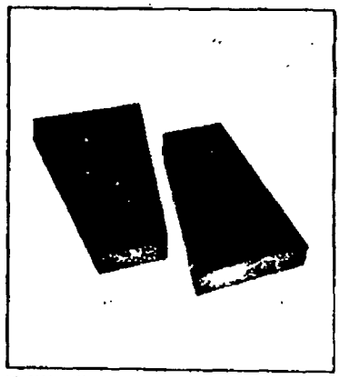
FOAMGLAS is available in a wide range of sizes, shapes and thicknesses to handle any industrial insulation requirement



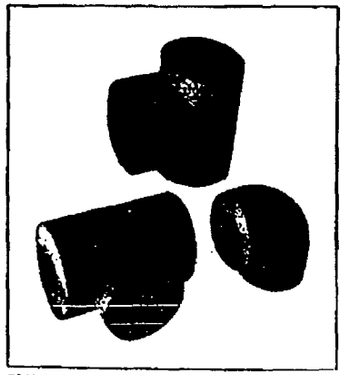
Flat Blocks—For insulation of flat surfaces or large diameter curved surfaces, FOAMGLAS is available in 12" x 18" blocks from 1½" through 4" thickness and in 18" x 24" blocks from 2" through 4" thickness.



FOAMGLAS Curved Segments and Beveled Lags—For accurate, close fitting insulation on curved or shaped surfaces, these factory-made units are available. They are manufactured to fit individual requirements.



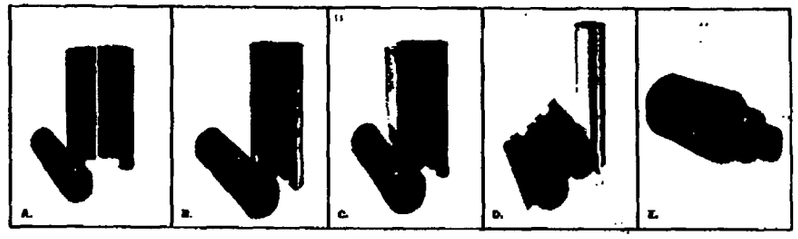
FOAMGLAS Head Segments—Special shaped head segments are furnished for the insulation of tank heads. When installed, these segments form a series of concentric insulation courses. Ellipsoidal, spherical, and cone-shaped heads can be furnished on special order.



FOAMGLAS Valve and Fitting Covers—Another factory-fabricated series of units which can save time and money in the field. Valve and fitting covers are made to customer order in a wide variety of shapes and sizes to fit practically any standard piping components.

311013

Several types of FOAMGLAS pipe insulation are manufactured to handle any piping installation



A. "Regular" Pipe Insulation—FOAMGLAS is available in a complete range of pipe and tubing insulation from ½" copper tubing to 24" I.P.S. in thicknesses from 1" to 4", manufactured to Dimensional Standard thicknesses for proper nesting in multilayer applications.

B. Aluminum Jacketed Pipe Insulation—For those applications where an aluminum jacket is desired, FOAMGLAS is available with a 4 mil thickness, factory-applied jacketing. A handsome, practical finished job results when this is used.

C. Fabric Jacketed Pipe Insulation—A labor-saving, factory-applied glass fabric jacketing, applied with a high melting point asphalt, is also available. This jacketing saves time in field applications for both above and below ground piping.

D. FOAMGLAS "Stay-Dry" Pipe Insulation—FOAMGLAS pipe insulation with a special white kraft paper/aluminum laminated jacketing, factory-applied, is also available for the commercial building and industrial markets. Stay-Dry is designed primarily for ice water lines, chilled water lines, low pressure steam lines and dual temperature systems. (For more complete information on Stay-Dry, see page 11.)

E. FOAMGLAS Pipe Insulation is produced in Dimensional Standard thickness to ensure proper nesting in multilayer applications. There are sizes to fit all pipe and copper tubing diameters. In single-layer installation thicknesses from one inch to four inches.

THICKNESS OF FOAMGLAS INSULATION

IRON PIPE SIZES—(INCHES)		NOMINAL 1"		NOMINAL 1½"		NOMINAL 2"		NOMINAL 2½"		NOMINAL 3"		NOMINAL 3½"		NOMINAL 4"	
Nominal	Actual	F.G. Thick.	OD of Covering	F.G. Thick.	OD of Covering	F.G. Thick.	OD of Covering	F.G. Thick.	OD of Covering	F.G. Thick.	OD of Covering	F.G. Thick.	OD of Covering	F.G. Thick.	OD of Covering
														4.11	13.75
														3.89	10.25
												3.61	10.75	4.11	11.75
										3.36	10.75	3.61	11.75	4.36	11.75
										3.11	10.75	3.61	12.75	4.11	12.75
								2.61	10.75	3.24	11.75	3.61	12.75	4.11	14.00
								2.36	10.75	3.05	11.75	3.94	12.75	4.18	14.00
								2.13	11.75	3.03	12.75	3.55	14.00	4.16	15.00
2	2.625			1.53	10.75	2.03	11.75	2.53	12.75	3.16	14.00	3.66	15.00	4.16	16.00
3	3.625			1.63	11.75	2.03	12.75	2.66	14.00	3.16	15.00	3.66	16.00	4.16	17.00
4	4.625			1.53	12.75	2.16	14.00	2.66	15.00	3.05	16.00	3.66	17.00	4.16	18.00
5	5.563			1.53	14.00	2.06	15.00	2.56	16.00	3.06	17.00	3.56	18.00	4.06	19.00
6	6.625			1.53	15.00	2.06	16.00	2.56	17.00	3.06	18.00	3.56	19.00	4.06	20.00
8	8.625			1.53	16.00	2.06	17.00	2.56	18.00	3.06	19.00	3.56	20.00	4.06	21.00
10	10.750			1.53	17.00	2.06	18.00	2.56	19.00	3.06	20.00	3.56	21.00	4.06	22.00
12	12.750			1.53	18.00	2.06	19.00	2.56	20.00	3.06	21.00	3.56	22.00	4.06	23.00
14	14.000			1.50	19.00	2.00	20.00	2.50	21.00	3.00	22.00	3.56	23.00	4.06	24.00
15	15.000			1.50	20.00	2.00	21.00	2.50	22.00	3.00	23.00	3.56	24.00	4.06	25.00
16	16.000			1.50	21.00	2.00	22.00	2.50	23.00	3.00	24.00	3.56	25.00	4.06	26.00
17	17.000			1.50	22.00	2.00	23.00	2.50	24.00	3.00	25.00	3.56	26.00	4.06	27.00
18	18.000			1.50	23.00	2.00	24.00	2.50	25.00	3.00	26.00	3.56	27.00	4.06	28.00
19	19.000			1.50	24.00	2.00	25.00	2.50	26.00	3.00	27.00	3.56	28.00	4.06	29.00
20	20.000			1.50	25.00	2.00	26.00	2.50	27.00	3.00	28.00	3.56	29.00	4.06	30.00
21	21.000			1.50	26.00	2.00	27.00	2.50	28.00	3.00	29.00	3.56	30.00	4.06	31.00
22	22.000			1.50	27.00	2.00	28.00	2.50	29.00	3.00	30.00	3.56	31.00	4.06	32.00
23	23.000			1.50	28.00	2.00	29.00	2.50	30.00	3.00	31.00	3.56	32.00	4.06	33.00
24	24.000			1.50	29.00	2.00	30.00	2.50	31.00	3.00	32.00	3.56	33.00	4.06	34.00
25	25.000														
to	to			1.50	to	2.00	to	2.50	to	3.00	to	3.56	to	4.06	to
36	36.000				39.00		40.00		41.00		42.00		43.00		44.00

1" THICKNESS FURNISHED ONLY WITH FACTORY-APPLIED JACKET AND IN THE SIZES LISTED

Sizes in this area are furnished in sectional form

Sizes 16inch, Aluminum Jacketed, Stay-Dry White Jacket and Stay-Dry Aluminum Jacket pipe insulation is furnished in these thicknesses only.

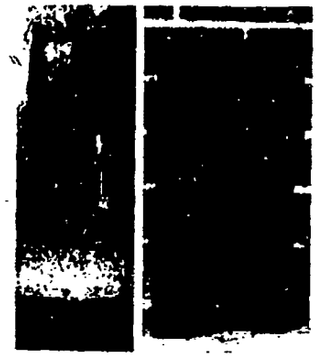
Sizes in this area are furnished in segmental form. (Number of sections vary with size O.D.)

Asterisks mean closed above are not furnished in these sizes.

All pipe sizes and thicknesses in shaded area above are made in 24" lengths. All others in 18" lengths only.
Note: 4" is maximum single-layer thickness supplied. For greater thickness use multi-layer combinations of above thicknesses. Copper tubing insulation also available in Dimensional Standard thicknesses.

311014

These applications are typical of the long-life insulation performance customers receive with a FOAMGLAS installation



Buried 10 Years in Wet Sand—In 1953, FOAMGLAS was installed on underground heating lines in seven Savannah, Georgia schools. One and one-half inches of FOAMGLAS was used to insulate the lines. When unearthed recently, a sample of the FOAMGLAS proved to be in perfect condition after ten years in wet, sandy soil. No costly waterproofing was used. The FOAMGLAS was installed using standard specifications.



12 Years on a Wood Pulp "Cooker"—Even after 12 years in the humid, corrosive atmosphere of Union Bag-Camp Paper Corporation's Savannah, Georgia mill, FOAMGLAS has continued to give constant insulation efficiency. Spillage from caustic cooking liquors hasn't hurt the FOAMGLAS, either. The piece of FOAMGLAS removed from this pulp digester was dry and intact . . . still insulating perfectly.



7-Year-Old Overcoat, Unbuttoned, Checked, Then Buttoned Up! After seven years of hard service for Sinclair Refining Company, Marcus Hook, Pa., a section of 2" FOAMGLAS was removed from this ethylene receiving vessel. The FOAMGLAS was dry. Only an outer paint coating shows any wear. Despite a wide range of outside temperatures and high humidity conditions, FOAMGLAS has provided constant insulation value.

311015

Suggested thicknesses for high temperature piping and equipment

Operating Temperature °F	Insulation Thickness					Optional Thickness for Critical Applications	
	4" to 6" Pipe	8" to 12" Pipe	14" to 24" Pipe	26" to 36" Pipe	38" to 48" Pipe	30" to 48" Pipe	Over 48" Pipe & Flat
Up to 300°	1	1	1	1½	1½	1½	2
301° to 400°	1	1½	1½	2	2	2	2
401° to 500°	1½	1½	2	2½	2½	2½	2½
501° to 600°	2	2	2½	3	3	3	3
601° to 700°	2	2½	3	3	3½	3½	3½
701° to 800°	2½	3	3	3½	4	4	4

Suggested thicknesses for low temperature piping and equipment

MINIMUM SUGGESTED THICKNESSES FOR SPECIFIED TEMPERATURES

Figures in table are degrees Fahrenheit and are minimum temperatures for use with thickness and design conditions stated. When design temperature falls between two thickness columns, use the greater thickness. Table is based on thickness required to prevent condensation on surfaces with .3 emissivity, in 80° F still air at 80% relative humidity. Heat gains average 8-9 Btu/Hr/S.F. insulation surface. Where other design conditions are used, thicknesses should be adapted to meet job requirements.

Iron Pipe Size	Suggested FOAMGLAS Thickness																					
	1"	1½"	2"	2½"	3"	3½"	4"	4½"	5"	5½"	6"	6½"	7"	7½"	8"	8½"	9"	9½"	10"	10½"	11"	11½"	12"
½"	65	60	-25	-45	-65	-140	-275	-350	-395	-200	-420												
¾"	50	25	-10	-25	-70	-125	-225	-295	-320	-340	-415	-450											
1"	50	25	-10	-25	-70	-120	-160	-250	-300	-345	-410	-450											
1½"	50	30	5	-25	-60	-105	-145	-200	-250	-305	-375	-425	-460										
1½"	50	30	15	-15	-45	-110	-120	-183	-230	-250	-345	-330	-400	-420									
2"	50	30	15	-15	-45	-85	-120	-175	-225	-290	-340	-385	-430	-470									
2½"	50	30	15	-10	-35	-65	-105	-153	-175	-225	-295	-330	-395	-435	-450								
3"	50	30	15	-10	-35	-60	-105	-135	-175	-275	-350	-330	-390	-415	-450								
3½"	50	30	15	-10	-25	-45	-105	-135	-175	-215	-295	-330	-355	-415	-450								
4"	50	30	30	0	-20	-45	-85	-135	-150	-205	-255	-300	-340	-375	-420	-450							
4½"	50	30	30	0	-20	-25	-65	-105	-160	-205	-255	-300	-340	-360	-420	-450							
5"	50	25	25	0	-25	-25	-60	-100	-160	-175	-225	-270	-305	-345	-380	-415	-450						
6"	50	25	25	0	-25	-25	-20	-105	-125	-150	-185	-240	-250	-305	-350	-385	-430	-450					
7"		65	25	0	-25	-40	-45	-85	-130	-150	-185	-200	-275	-305	-340	-375	-410	-450					
8"		45	25	0	-25	-25	-60	-45	-110	-145	-175	-215	-255	-325	-325	-350	-385	-425	-450				
9"		45	25	5	-10	-25	-25	-60	-105	-125	-170	-200	-240	-265	-315	-345	-380	-415	-425	-450			
10"		45	30	10	-10	-25	-20	-20	-105	-125	-150	-185	-225	-265	-300	-330	-360	-410	-420	-420	-450		
11"		45	30	15	-5	-25	-25	-20	-105	-125	-145	-175	-200	-255	-290	-320	-335	-385	-425	-450			
12"		45	30	15	-5	-25	-25	-25	-85	-105	-130	-170	-205	-245	-285	-325	-335	-375	-420	-425	-450		
14"		45	30	15	0	-25	-25	-25	-80	-105	-130	-150	-195	-225	-265	-295	-325	-355	-395	-425	-450	-450	
15"		45	30	20	0	-25	-25	-25	-75	-105	-125	-150	-180	-210	-250	-285	-310	-340	-365	-405	-425	-450	
16"		45	30	20	0	-25	-25	-40	-70	-105	-125	-145	-175	-200	-225	-275	-305	-335	-360	-400	-425	-435	-450
18"		50	35	25	0	-25	-25	-25	-65	-105	-120	-145	-170	-200	-225	-250	-280	-310	-335	-375	-395	-425	-450
20"		50	30	20	0	-25	-25	-25	-65	-105	-120	-145	-170	-200	-225	-250	-280	-310	-335	-375	-395	-425	-450
22"		50	30	20	5	-10	-25	-25	-60	-85	-105	-125	-145	-175	-200	-225	-250	-280	-305	-345	-365	-395	-415
27"		50	35	20	5	-10	-25	-25	-60	-75	-105	-120	-140	-170	-195	-220	-250	-280	-305	-335	-360	-385	-405
30"		50	30	20	10	-5	-25	-40	-55	-75	-105	-115	-135	-160	-175	-205	-230	-260	-285	-325	-345	-365	-390
Vessel O.D.																							
42"		50	30	25	10	-5	-20	-35	-35	-70	-95	-110	-130	-155	-175	-195	-220	-250	-270	-310	-330	-355	-375
48"		50	30	25	10	-5	-20	-35	-30	-70	-90	-105	-125	-150	-170	-195	-225	-245	-270	-305	-325	-350	-370
54"		50	35	25	10	-5	-20	-35	-30	-65	-85	-105	-125	-155	-175	-190	-215	-240	-260	-295	-315	-340	-360
60"		50	60	25	10	-5	-20	-30	-30	-65	-85	-100	-125	-140	-165	-185	-210	-230	-260	-290	-310	-330	-350
66"		50	45	25	10	-5	-15	-30	-30	-65	-80	-105	-120	-145	-160	-180	-205	-230	-260	-285	-305	-325	-345
72"		50	40	25	10	0	-15	-30	-30	-60	-80	-105	-115	-135	-155	-180	-200	-230	-255	-285	-305	-360	-380
78"		50	60	25	10	0	-15	-30	-45	-65	-85	-105	-115	-135	-155	-175	-200	-225	-250	-280	-300	-355	-340
84"		55	35	25	10	0	-15	-30	-45	-65	-80	-105	-115	-130	-150	-170	-190	-220	-250	-270	-290	-310	-330
108"		50	60	25	10	0	-15	-30	-45	-60	-75	-105	-110	-130	-150	-170	-190	-210	-240	-265	-290	-305	-325
132"		55	60	25	10	0	-15	-30	-45	-60	-75	-105	-110	-130	-145	-170	-190	-210	-240	-265	-290	-305	-320
156"		50	40	25	10	0	-15	-30	-45	-60	-75	-95	-110	-125	-145	-165	-185	-205	-230	-255	-280	-305	-325
Over 161" to Flat		10	40	25	15	0	-10	-25	-40	-55	-45	-80	-105	-110	-130	-145	-165	-180	-200	-220	-240	-265	-280

311016

General application specification for FOAMGLAS insulation on hot and cold piping and equipment

Note: The specification outlined below and on the following page is general in nature. Complete FOAMGLAS Application Specifications are available detailing the insulation of High, Medium, Low, and Dual Temperature piping and equipment and for Spheres and Underground Piping. Contact our Industrial Insulation Sales Department for copies of these specifications.

How to apply FOAMGLAS as pipe insulation (–450°F. to +800°F.)

Cold Piping (below +50°F.)

1. Butter joints with an approved sealer (see accessories listing on page 12). In multilayer applications where temperature of piping is below recommended range of sealer, seal only the outer layer joints.

2. Apply FOAMGLAS to clean surface of pipe with joints tightly butted and secure with bands. Bands shall be on 9" centers with 18" lengths of insulation and on 12" centers for 24" lengths.

3. Apply finish. Regular *unwrapped* pipe insulation installed indoors need not be finished, except to increase abrasion resistance or to improve appearance. Regular insulation installed outdoors shall be protected by painting with asphalt base aluminum paint, a coating of asphalt mastic, or by applying one of the finishes listed below.

Hot Piping

1. Apply FOAMGLAS as for Cold Piping except that no joint sealer is required.

2. Apply finish. Finish on all hot piping shall be of the glass-fabric membrane or jacket type (see finishes).

Finishes

A variety of materials may be used for finishing FOAMGLAS pipe insulation to meet specific design conditions. Typical finishes include:

Indoor or Outdoor

Glass-Fabric and Aluminum-Jacketed (factory applied)

FOAMGLAS pipe insulation may be used without additional finish.

Glass-Fabric Reinforced Mastics (PC Pittcote 300 asphalt cutback or Pittcote 400 Vinyl Emulsion)

Regular *unwrapped* insulation shall first be tack-coated with fibrated asphalt cutback using about two gallons per 100 square feet. Into this a layer of asphalt impregnated glass cloth shall be embedded, overlapping all ends 3" minimum, and then another coating of about four gallons per 100 square feet of cutback applied.

Light Gauge Sheet Metal

Shall be applied over the insulation. Provide a minimum 3" overlap and fasten snugly with corrosion-resistant bands. *Insulation shall first be given a thin coating of cutback.*

Asphalt-Impregnated Felt

Shall be secured over the insulation by bands with ends lapped.

Indoor Only

Canvas and Lagging Cement

One layer of rosin-sized paper may be used if desired. Apply canvas using lagging cement, taking care to remove wrinkles, and cement all edges. Locate seams where least noticeable. Paint as desired.

White kraft-foil laminate jacketing

See "Stay-Dry" information on page 11.

Fitting Insulation

Fitting insulation shall be applied in the same manner as adjacent pipe insulation with sufficient bands to hold securely in place. Where it is impractical to finish fittings the same as adjoining pipe insulation (foil, metal jacket or felt), fittings may be finished with glass-fabric and cutback, and painted to match jacket if desired.

Hangers

Hangers for cold lines shall be on the outside of the insulation with curved sheet metal shields used between the hangers and the bottom of the insulation, bearing stress to be less than 35 psi. On hot lines they may be used either inside or outside of the insulation. If located inside the insulation, the insulation shall be trimmed closely around the hanger.

How to apply FOAMGLAS as equipment insulation (–450°F. to +800°F.)

General

Vessels shall be insulated with FOAMGLAS Curved Segments, Beveled Lags or Flat Blocks depending upon size and shape of equipment.

Sidewalls

On vertical equipment, exceeding 2 feet in diameter and 10 feet in height, angle, plate, or rod supports shall be welded around the shell at top and bottom. The width of the support shall support at least one-half the thickness of the outer layer of insulation. On horizontal equipment, the courses of blocks around the vessel are held in place temporarily by a rope having a coil spring insert or with temporary adhesives until they can be fastened securely with bands and seals.

Heads

Curved Heads—Constant radius heads may be insulated with special factory-shaped head segments.

On ellipsoidal heads, and as an alternate for all other heads, the sidewall insulation may be extended to a point in line with the crown of the head so that a flat circular disk made of standard flat blocks may be installed. When this type of construction is used on large vessels, the extended materials shall be properly supported.

All head insulation, as well as insulation around manholes and other connections, may be fastened in place using a floating-ring steel rod or standard cable. One end of the band is fastened to the floating rings and the other is anchored to an extra band placed around the sidewall insulation.

Flat Heads

Shall be insulated with standard flat blocks trimmed to fit inside the extended sidewall insulation.

Removable Heads and Manholes

Heads and Manholes that must be removed occasionally may be insulated so that insulation can be removed without damage. Covers are assembled and installed as a complete unit, or in sections. On large vessels, additional external support should be provided for the removable heads. These covers should be protected with sheet metal or fabric membranes.

Cold Applications (Below +50°F.)

1. Butter joints with a mastic-type sealer (see accessories listing on page 12). In multilayer applications where temperature of equipment is below recommended range of sealer, only the outer layer joints shall be sealed.

2. Apply FOAMGLAS directly to clean equipment surface with joints staggered. Additional layer or layers of insulation shall be applied in the same manner as first layer, with side and end joints staggered over joints of preceding layer. Insulation is secured with metal bands. Bands shall be on 9" centers with 18" lengths of insulation and on 12" centers for 24" lengths.

3. Apply finish.

Hot Applications

1. Apply FOAMGLAS as for Cold Applications except that no joint sealer is required.

2. Apply finish. On all hot equipment, finish shall be of the glass-fabric membrane or jacket type (see finishes).

Finishes

A variety of materials may be used to finish FOAMGLAS equipment applications to meet specific design conditions. Typical finishes include:

Glass-Fabric Reinforced Mastics (PC Pittcote 300 asphalt cutback or Pittcote 400 Vinyl Emulsion)

Insulation shall first be tack-coated with fibrated asphalt cutback using about two gallons per 100 square feet. Into this, a layer of asphalt impregnated glass cloth shall be embedded, overlapping all ends 3" minimum, and then another coating of about four gallons per 100 square feet of cutback applied. Paint with asphalt base aluminum paint, vinyl paint, etc., if desired.

Aluminum or sheet metal jacket shall be applied over the insulation. *Insulation will first be given a thin coating of cutback.* Provide a minimum 3-inch overlap and fasten snugly with corrosion-resistant bands.

Asphalt Impregnated Felt

An asphalt-impregnated felt shall be secured over the insulation with corrosion-resistant bands. Edges shall be overlapped.

311017

311018

FOAMGLAS is an excellent underground piping insulation which offers a number of time and money-saving benefits

The combination of high compressive strength and impermeability makes FOAMGLAS one of the finest insulations available for underground piping systems. Simply by applying FOAMGLAS to the pipe or tubing section and sealing it according to our standard specifications, a line can be installed via the "direct burial" method. That is, merely by first covering the insulated piping with a sand bed, backfill can be put directly over the line. This eliminates the need for concrete tunnels or other costly protective systems. You can even insulate the pipe section above ground (where it's easy) and lower it into the trench.

Underground, FOAMGLAS will retain its constant efficiency because its all-glass cells are completely closed and thus are impermeable. Moisture problems are eliminated. FOAMGLAS is not affected by soil acids either, because being all glass, it is inorganic. Even when buried in wet, sandy soil for as long as ten years with no maintenance whatsoever, FOAMGLAS continues to perform perfectly [See Page 6]. Because of its high compressive strength, surface traffic over the insulated piping will not crush or compress the FOAMGLAS.

Pittsburgh Corning also handles the necessary materials required for a complete installation. We will be happy to send you a complete, detailed application specification for FOAMGLAS underground systems. Write for a copy of FI-104e.

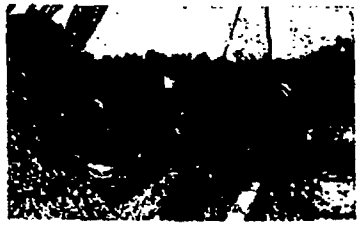


The photo above shows a typical underground distribution system insulated with FOAMGLAS. Note how the insulated pipe is laid on a sand bed, is covered with more sand and then backfilled directly over this with no other protective supports.

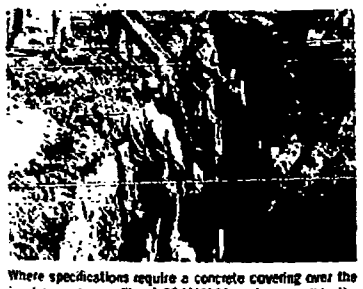
These customers are already benefiting from the advantages of a FOAMGLAS-insulated job.



A water table just below the surface was one deciding factor in the selection of moisture-proof FOAMGLAS pipe insulation on this chilled water system at Tulane University. The FOAMGLAS supported an overburden of up to seven feet and it was unaffected by soil moisture conditions.



Forty foot lengths of pipe were insulated with FOAMGLAS above ground and then lowered onto a sand bed in 6 to 11 feet deep trenches at International Business Machines' San Jose, California, plant. Figures proved this technique to be two or three times less costly than the concrete tunnel method.



Where specifications require a concrete covering over the insulation, the rigidity of FOAMGLAS makes possible the direct pouring of concrete over the insulation. In this Virginia City, Minnesota, job, an entire municipal steam distribution system of 12,235 lineal feet was insulated with FOAMGLAS.

FOAMGLAS Stay-Dry... a completely fire-retardant insulation for commercial buildings



Take a piece of FOAMGLAS Pipe Insulation, wrap it with a fire-retardant, white kraft/foil laminate jacketing, and you have Stay-Dry. Stay-Dry is designed for use in the temperature range from +35°F. to +860°F. It is used extensively for hot water lines, low pressure steam lines, chilled water lines and dual temperature lines in hospitals, offices, banks, hotels, etc.

It is available in 1" Dimensional Standard thickness for iron pipe and copper tubing sizes up to 6" I.P.S. and in 1½" Dimensional Standard thicknesses from ½" through 12" I. P. S. Sizes through 6" I.P.S. are shipped in 24" lengths; 8", 10" and 12" in 18" lengths. Easy-to-apply two-piece FOAMGLAS fitting covers are also available for all standard fittings so that a complete Stay-Dry installation is available for any building.

Suggested FOAMGLAS Stay-Dry Insulation Thicknesses

Operating Temperature	Cold Water 60°F.*	Ice Water 35°F.*	Hot Water, Low Pressure Steam	
			Up to 250°F.	Up to 350°F.
Pipe and Tubing Sizes Up to 6" I.P.S.	1"	1½"	1"	1½"
Pipe Sizes 8", 10" & 12"	1½"	1½"	1½"	1½"

*Thickness will prevent condensation at 90°F. Ambient and 80% Relative Humidity.

Note: Dual Temperature thicknesses should be based on cold cycle requirements.

Application Specification for FOAMGLAS Stay-Dry pipe insulation

All piping shall be insulated with FOAMGLAS Stay-Dry Pipe Insulation in accordance with the thickness indicated in Table above.

Stay-Dry Pipe Insulation shall be applied over clean, dry surfaces. Adjoining sections shall be butted firmly together and the longitudinal flap of the vapor barrier jacket shall be sealed with a white vapor barrier lap cement (PC Pittseal 222 or Pittseal 222 F.R.). End joints shall be sealed with factory-furnished 3" wide vapor barrier strips applied with lap cement. Bands shall be applied over edges of joint sealer strips and at center of each section of insulation. On concealed hot piping, the end joint strips may be eliminated. If desired, pipe insulation may be painted with any water-based paint.

All flanges, valves and fittings shall be insulated with fabricated FOAMGLAS fitting covers of a thickness equal to that of the insulation on the adjoining pipe and securely fastened in place. Insulation on flanges, valves and fittings shall be finished with a coating of white vinyl plastic paint (Pittsburgh Corning CS White Insulation Paint), or lagging adhesive followed by an application of canvas or glass cloth and a second coat of paint or lagging adhesive. On cold or dual temperature piping, all fitting joints shall be sealed with a suitable vapor seal (Pittcote 300) prior to the application of a finish.

When in contact with the pipe, clamp hangers shall be insulated separately in the same manner as fittings. The insulation shall be applied upward along the vertical hanger rod to a distance not less than 6" and sealed off (cold piping). On pipe hangers which fit around the insulation, the bearing surface of the hanger sleeve shall be designed to limit the bearing stress on the insulation to 35 psi.

Where vibration of piping is excessive (at compressor juncture, etc.) bore surface of insulation shall be brush coated with Keene's Cement or PC Anti-Abrasive Compound 1A.

This is a general specification and may be altered by the design engineer to include staples, tape instead of bands, or the elimination of bands entirely on a specific job.

(The above specification is for indoor applications only within the specified temperature ranges. For outdoor applications and other temperature ranges see page 7.)

†The white Stay-Dry jacketing is also available in larger sizes and on thicknesses to 4 inches for a broad range of industrial applications. For size and thickness information, refer to chart on Page 5.

FOAMGLAS accessory materials

The materials listed and described below have been thoroughly tested by Pittsburgh Corning technicians, both in the laboratory and in actual field service, for durability and compatibility with FOAMGLAS. Each will provide excellent service in its specific application.

Asphalt-Solvent Primer for Dry Surfaces
PC Primer Sealer 3A—This thin-bodied asphalt-solvent blend is used as a primer coating on porous or poor bonding surfaces, prior to application of mastic-type protective coatings. It is also used as a primer for metal surfaces, cement and masonry walls prior to erecting FOAMGLAS with hot asphalt.

Permanent Mastic Joint Sealer
PC Mastic 100—This is a black permanent non-adhesive mastic containing asphalts and waxes. It is used as a joint sealer where lowest possible vapor permeability is required.

Non-Breathing Insulation Sealer and Coating (Also Corrosion Protection)
PC Pittcote® 300—Pittcote 300 is designed to seal and weatherproof thermal insulations. It is a mastic material for use upon such insulations as mineral wool blanket, calcium and magnesium silicate, vegetable fibre board, etc. Applied to metals it is excellent protection against corrosion.

Vinyl Water Suspension Weathercoating, Resistant to Petroleum Solvents
PC Pittcote® 400—This is a vinyl water suspension for use as a weathercoat over thermal insulations, particularly where resistance to petroleum solvents is important.

Vinyl-Base Material for Bore Coating Insulations
PC Anti-abrasive Compound 1A—A vinyl base material, this compound serves as an excellent bore coating for thermal insulations. It gives the surface a hard, tough coating with strong resistance to abrasion. It remains elastic, however, in extremely low temperatures, and may be used in the sub-zero temperature operating range.

Primer for Damp Surfaces and Component for Asphaltic Cement
PC Asphalt Emulsion—This is a clay-type water emulsion for trowel or brush application to insulation surfaces. Resistant to acids, alkalies, water, and weather, it is used as a primer for concrete, masonry, or wood surfaces; as a spot or gob adhesive to porous surfaces; and as a preferred primer for damp surfaces.

Sealer and Expansion Joint Compound
PC Pittseal® 111—Seals against vapor leaks. Pittseal cushions insulations against abrasion, and seals joints against vapor leaks. It remains soft, tough and non-shrinking under rapid and severe temperature fluctuations. Applicable over the temperature range of 100°F. to 300°F. May be trowelled or applied by a caulking gun.

Sealer for Dual-Temperature Insulation Jackets
PC Pittseal® 222—Pittseal 222 is used for sealing laps of white vapor barrier jackets. It has excellent bonding properties with bonding time from immediate up to one hour. Pittseal may be brush applied. When required, it may be thinned with petroleum naphtha or white (unleaded) gasoline. Surface temperature limits are from −30°F. to 250°F. This material is fire retardant in dry state. PC Pittseal 222 FR—Same as above but is completely fire retardant in both wet and dry state.

White Vinyl Sealing Type Paint
PC CS Paint—This is a white vinyl emulsion sealing type, water-thinned paint recommended for walls and ceilings of cooler and freezer rooms. It can be applied directly over FOAMGLAS as well as over approved FOAMGLAS finishes. CS paint can also be used for adhering canvas and glass fabric over pipe and fitting insulation. Applicable over a temperature range of −25° to 125°F.

Vapor Barrier Compound for Coating Insulation
PC Pittcote® 300C—This compound of asphalt, asbestos and cork produces a tough, flexible film having outstanding insulating, weather resistance, and vapor barrier qualities. It cures to a black, glossy, slightly textured film. The film is fire-resistant and will not burn unless subjected to prolonged intense heat. May be brush or spray-applied. For temperatures from −40° to +275°F.

Aluminum Paint for Insulation Finishes
PC Aluminum Paint—A combination of refined asphalt, aluminum paste and suitable solvents which is used for coating cured asphalt surfaces. Provides an attractive heat-reflecting cover when applied. Should *not* be applied unless insulation coatings have cured for at least 30 days. May be used for temperatures from −40°F. to +180°F.

"Breathing" Type Finish for High Temperature Insulation
PC Pittcote® 300B—This is a weather barrier for piping and vessels operating over 212°F. It cures to a film which has minute pores permitting moisture to escape, but prevents liquid from entering. May be applied by spraying, palming, or troweling. For operating temperatures from −20°F. to +275°F.

Sealer and Finish for Insulation on Underground Piping
PC Pittcote® 65—A fast-drying, self-priming heavy duty coal tar base coating designed for application to insulation prior to underground burial. It dries to a surface film in about 1 hour and dries firm enough to handle in 4-6 hours. It can be buried underground shortly after application. It forms a mastic film which won't sag at recommended coverage rate. May be hand or brush-applied (synthetic bristles should be avoided). For operating temperatures (dry heat) −20° to +140°F.; (wet heat) to 100°F.

For complete data on any of the above listed materials, or on other accessory materials used with industrial insulations, contact our Industrial Insulation Sales Department.

211091

Now manufactured by Pittsburgh Corning

UNIBESTOS—a rugged, heavy duty pipe insulation for practically every high temperature insulation requirement

UNIBESTOS is an excellent high temperature insulating material composed largely of long-fibered Amosite asbestos combined with an inert silicious [illegible] earth. This combi[illegible] tion t[illegible] job a[illegible] the a[illegible] high[illegible] wide[illegible] tions[illegible] indus[illegible] on u[illegible]



STOS

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CORRECTION NOTE ON PAGE 12

On the last three FOAMGLAS Accessory Materials listed on Page 12 of this publication...

PC Aluminum Paint
PC Pittcote 300B
and
PC Pittcote 65

the temperature range indicated in the last line of each descriptive paragraph refers to the surface temperature of the outer face of the insulation and *not* to the operating temperature of the piping and/or equipment to be insulated.

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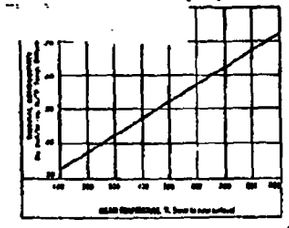
E OF UNIBESTOS



fibers at butt joints, positive heat seals. This means that a single-layer installation is possible with UNIBESTOS without attendant heat loss at the joints. Tests show that for equal thicknesses, a single layer of UNIBESTOS loses considerably less heat at the joint than the outside joint of a double thickness of other kinds of insulation.

UNIBESTOS Comes in Half-Round or Full-Round Sections In All Sizes and Thicknesses—No matter how big a line you wish to insulate (up to 36"

211093

FOAMGLAS accessory materials

The materials listed and described below have been thoroughly tested by Pittsburgh Corning technicians, both in the laboratory and in actual field service, for durability and compatibility with FOAMGLAS. Each will provide excellent service in its specific application.

Asphalt-Solvent Primer for Dry Surfaces
PC Primer Sealer 3A—This thin-bodied asphalt-solvent blend is used as a primer coating on porous or poor bonding surfaces, prior to application of mastic-type protective coatings. It is ...

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ground Piping
t-drying, self-priming
coating designed for
prior to underground

temperature fluctuations. Applicable over the temperature range of −100°F. to 300°F. May be trowelled or applied by a caulking gun.

Sealer for Dual-Temperature Insulation Jackets
PC Pittseal 222—Pittseal 222 is used for sealing laps of white vapor barrier jackets. It has excellent bonding properties with bonding time from immediate up to one hour. Pittseal may be brush applied. When required, it may be thinned with petroleum naphtha or white (unleaded) gasoline. Pittseal 222 FR—Same as above except fire retardant in both wet and dry state.

burial. It dries to a surface film in about 1 hour and dries firm enough to handle in 4-5 hours. It can be buried underground shortly after application. It forms a mastic film which won't ooze at recommended coverage rate. May be hand or brush-applied (synthetic bristles should be avoided). For operating temperatures (dry heat) −20° to +140°F.; (wet heat) to 100°F.

For complete data on any of the above listed materials, or on other accessory materials used with industrial insulations, contact our Industrial Insulation Sales Department.

211093

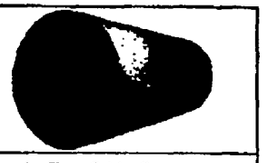
Now manufactured by Pittsburgh Corning

UNIBESTOS—a rugged, heavy duty pipe insulation for practically every high temperature insulation requirement

UNIBESTOS is an excellent high temperature insulating material composed largely of long-fibered Amosite asbestos combined with an inert silicate binder and diatomaceous earth. This combination results in a rugged, durable insulation that withstands even the most severe on-the-job abuse without crumbling, cracking or any of the other problems so often found in ordinary high temperature insulations. It has found very wide acceptance in high temperature applications (up to +1200°F.) in the petrochemical industries, power plants, the marine field and on underground conduit piping.

Amosite Fibers Make the Difference—The extra-long, amosite fibers found chiefly in the Union of South Africa, offer a host of natural insulation advantages. The fibers are tough and resilient. They have a high degree of resistance to moisture and are chemically inert and incombustible. When these fibers are processed by *fiberizing*, they are screened, air blown, and brushed, then "opening up" or fluffing the fibers into an interlaced mass which entraps millions of insulating air spaces.

This base material is then formed into pipe insulation sections of precise thickness and a smooth, inert refractory coating is applied to the outside.



Examine These Outstanding Physical Properties of UNIBESTOS

Density	36 lb./ft.³
Compression Strength	1800 lb./ft.² (dry; at 5% deformation)
Shrinkage	0.10% to (1200°F. (hot surface) exposed to operating temperature for 24 hours
Hygroscopicity	3.5% 75°F. @ 90% R.H. 24 hours
Combustibility	Will not burn
pH	10.5
Thermal Shock Resistance	Will not damage shock
Tensile Strength	67 psi
Acid Resistance	Negligible effect on physical characteristics (concentrated mineral acids at room temperature)
Reinforcing	Will not contribute to stress-corrosion of stainless steel

UNIBESTOS complies with:
ASTM Designation C331-62T
Federal Specification HH-I-541 Type III Class B
Military Specification MIL-I-4781
Grade B Class 6 (750°F.)
Grade C3 Class 4 (1200°F.)

This combination of properties makes UNIBESTOS your best choice for high temperature insulation

UNIBESTOS is Rugged—If one word could be used to describe UNIBESTOS, "rugged" is that word. None of the other commonly used high temperature insulations can withstand the abuse which UNIBESTOS can. It doesn't have to be handled delicately. It won't crumble, crack or thermal shock. It can be re-used time and time again. Walk on it; drop it; bang it around . . . it's still in one piece and giving top performance.

UNIBESTOS Resists Water, Moisture, Fumes, and Acids—You can use UNIBESTOS in high humidities or corrosive atmospheres with no worries of the possibility of failure or loss of efficiency. Even when submerged under water for weeks, UNIBESTOS dries to its original characteristics. Continuous exposure to chemicals and chemical fumes does not change its insulation value or effectiveness.

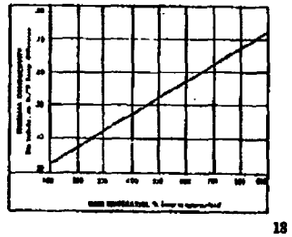
UNIBESTOS Can Be Installed in A Single Layer—Because of the interlocking of Amosite asbestos fibers at butt joints, positive heat seals result. This means that a single-layer installation is possible with UNIBESTOS without attendant heat loss at the joints. Tests show that for equal thicknesses, a single layer of UNIBESTOS loses considerably less heat at the joint than the outside joint of a double thickness of other kinds of insulation.

UNIBESTOS Comes in Half-Round or Full-Round Sections in All Sizes and Thicknesses—No matter how big a line you wish to insulate(up to 36" OD pipe) UNIBESTOS is available in either a half-section or a full round. Instead of time-consuming application of segmental pipe insulation, the UNIBESTOS sections are simply placed around the pipe and fastened.

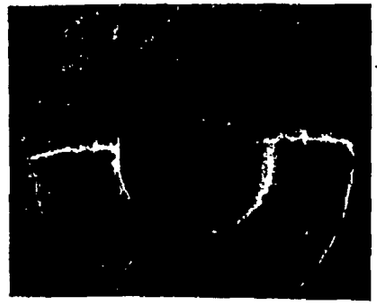
UNIBESTOS is Easy to Work and Handle—UNIBESTOS can be cut, mitered, or grooved with ordinary hand tools and is easily fabricated for elbows, tees, flanges, etc. Fabrication is simple . . . just cut the UNIBESTOS to size and join with sodium silicate adhesive.

UNIBESTOS Won't Shrink — Pipe insulation joints stay tight at elevated temperatures when you specify UNIBESTOS. It is extremely heat stable and it won't react chemically at high temperatures. It doesn't shrink and open up joints . . . thus minimizes heat losses.

THERMAL CONDUCTIVITY CURVE OF UNIBESTOS



Economical, practical *single-layer* application of UNIBESTOS saves time and lowers installation costs

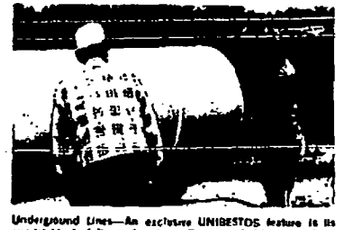


Here is a photo showing the long, fine amosite asbestos fibers which interlock when sections of UNIBESTOS are joined. This interlocking of hundreds of thousands of fibers forms a positive heat seal which eliminates heat losses at joints. Other insulations not having this interlocking action require double layer applications for proper maintenance and control of temperatures. Since only a single layer of UNIBESTOS is necessary to maintain the required temperatures, a significant saving in time and application costs results.

Versatile UNIBESTOS has solved high temperature insulation problems in a wide variety of markets.



Refineries and Petrochemical Plants—Usually, this type of facility is characterized by high humidities and corrosive atmospheres. UNIBESTOS, being inert and unaffected by fumes, moisture and the like, offers superior insulation performance and even provides an additional safety factor in the protection it provides against fire. It is particularly effective on heat traced lines because it will conform to this irregular shaping without cracking or breaking.



Underground Lines—An exclusive UNIBESTOS feature is its availability in full round sections. Because of this, it has been widely used as a time saving insulation for underground distribution piping. The full cylinders provide an ideal way to insulate a line for conduit application. The sections are merely slid onto the pipe. The casing is sealed and a strong, efficient assembly results.



Marine Applications—Aboard ship, UNIBESTOS has few equals. Its fibrous structure withstands the pounding and vibration common to shipboard applications. Again, its incombustibility is an important safety factor. UNIBESTOS has been installed on virtually every atomic powered submarine.



Power Plants—UNIBESTOS is ideal for high temperature steam lines, for commercial steam heat systems, and for exposed critical temperature lines of all types. Tough and resilient, it won't crack or thermal shock, thus maintaining high thermal efficiency and reducing heat losses over longer piping runs.



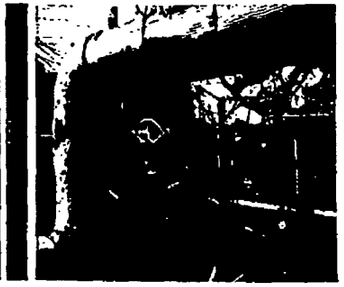
Pulp and Paper Mills—The high humidity, chemical laden fumes common in pulp and paper mills have no effect on the insulation performance of UNIBESTOS. Even after being totally immersed in water for weeks, it dries quickly to its original thermal characteristics.

311004

Typical examples of UNIBESTOS insulation performance



"In a quarter century of experience with UNIBESTOS, it is entirely satisfactory even though it has been drenched, banged, burnt, or otherwise assaulted" says Mr. Julius Schenk, Superintendent of Steam Distribution at



Rochester Gas and Electric, Rochester, New York. UNIBESTOS meets the most rugged of service demands, providing lasting protection and insulation efficiency.



In 1938, UNIBESTOS went to work at a storage, processing and distribution facility of a major New Jersey oil producer. One 100,000 gallon tank, four 20,000 gallon asphalt mixing tanks and 1400 feet of 4-in. and 10-in.



pipe were insulated. Today the UNIBESTOS is as good as the day it went on. This has resulted in substantial savings in both material and maintenance costs.



Savings in initial material costs, installation time and job clean-up are just a few of the advantages which Sun Shipbuilding attributes to UNIBESTOS. Single-layer installations of superheated steam lines is an everyday occurrence. No insulation shrinkage occurs, thus joints stay tight and heat losses are minimized.

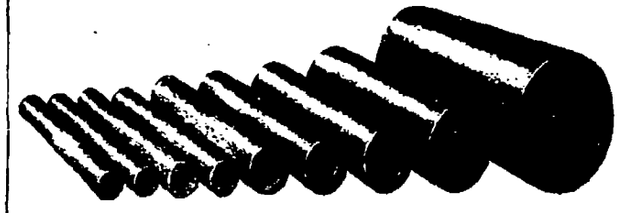


311005

UNIBESTOS is available in the sizes and thicknesses indicated for every high temperature insulation demand

UNIBESTOS is available up to 4" thickness for any size pipe or tubing from ½" tubing through 36" O.D. Pipe. All sections are 36" long. For information on greater thicknesses (up to a maximum insulation O.D. of 44") contact our Industrial Insulation Sales Department or your local UNIBESTOS distributor.

Note: UNIBESTOS is normally furnished in half sections in all sizes and thicknesses. *Full* round sections are also available in every size and thickness on request.



Thickness of UNIBESTOS insulation

IRON PIPE SIZES—(INCHES)		NOMINAL 1"		NOMINAL 1½"		NOMINAL 2"		NOMINAL 2½"		NOMINAL 3"		NOMINAL 3½"		NOMINAL 4"	
NOMINAL	O.D. Actual	UNIBESTOS Thickness	O.D. of Insulation	UNIBESTOS Thickness	O.D. of Insulation	UNIBESTOS Thickness	O.D. of Insulation	UNIBESTOS Thickness	O.D. of Insulation	UNIBESTOS Thickness	O.D. of Insulation	UNIBESTOS Thickness	O.D. of Insulation	UNIBESTOS Thickness	O.D. of Insulation
¼	.54	1 00	2 54	1 00	4 00	2 00	5 00	2 00	6 63	2 00	7 63	2 00	8 63	2 00	9 63
⅜	.67	1 00	2 67	1 00	4 00	2 00	5 00	2 00	6 63	2 00	7 63	2 00	8 63	2 00	9 63
½	.84	1 00	2 84	1 00	4 00	2 00	5 00	2 00	6 63	2 00	7 63	2 00	8 63	2 00	9 63
¾	1.05	1 00	3 05	1 00	4 00	2 00	5 00	2 00	6 63	2 00	7 63	2 00	8 63	2 00	9 63
1	1.32	1 00	3 32	1 00	4 00	2 00	5 00	2 00	6 63	2 00	7 63	2 00	8 63	2 00	9 63
1¼	1.66	1 00	3 66	1 00	4 00	2 00	5 00	2 00	6 63	2 00	7 63	2 00	8 63	2 00	9 63
1½	1.90	1 00	4 00	1 00	4 00	2 00	5 00	2 00	6 63	2 00	7 63	2 00	8 63	2 00	9 63
2	2.38	1 00	4 38	1 00	4 00	2 00	5 00	2 00	6 63	2 00	7 63	2 00	8 63	2 00	9 63
2½	2.88	1 00	4 88	1 00	4 00	2 00	5 00	2 00	6 63	2 00	7 63	2 00	8 63	2 00	9 63
3	3.50	1 00	5 50	1 00	4 00	2 00	5 00	2 00	6 63	2 00	7 63	2 00	8 63	2 00	9 63
3½	4.00	1 00	6 00	1 00	4 00	2 00	5 00	2 00	6 63	2 00	7 63	2 00	8 63	2 00	9 63
4	4.50	1 00	6 50	1 00	4 00	2 00	5 00	2 00	6 63	2 00	7 63	2 00	8 63	2 00	9 63
4½	5.00	1 00	7 00	1 00	4 00	2 00	5 00	2 00	6 63	2 00	7 63	2 00	8 63	2 00	9 63
5	5.56	1 00	7 56	1 00	4 00	2 00	5 00	2 00	6 63	2 00	7 63	2 00	8 63	2 00	9 63
6	6.63	1 00	8 63	1 00	4 00	2 00	5 00	2 00	6 63	2 00	7 63	2 00	8 63	2 00	9 63
7	7.63	1 00	9 63	1 00	4 00	2 00	5 00	2 00	6 63	2 00	7 63	2 00	8 63	2 00	9 63
8	8.63	1 00	10 63	1 00	4 00	2 00	5 00	2 00	6 63	2 00	7 63	2 00	8 63	2 00	9 63
9	9.63	1 00	11 63	1 00	4 00	2 00	5 00	2 00	6 63	2 00	7 63	2 00	8 63	2 00	9 63
10	10.75	.38	11 75	1 00	4 00	2 00	5 00	2 00	6 63	2 00	7 63	2 00	8 63	2 00	9 63
11	11.75	.88	12 75	1 00	4 00	2 00	5 00	2 00	6 63	2 00	7 63	2 00	8 63	2 00	9 63
12	12.75	1.38	13 75	1 00	4 00	2 00	5 00	2 00	6 63	2 00	7 63	2 00	8 63	2 00	9 63
13	14.00			1 00	4 00	2 00	5 00	2 00	6 63	2 00	7 63	2 00	8 63	2 00	9 63
14	15.00			1 00	4 00	2 00	5 00	2 00	6 63	2 00	7 63	2 00	8 63	2 00	9 63
15	16.00			1 00	4 00	2 00	5 00	2 00	6 63	2 00	7 63	2 00	8 63	2 00	9 63
16	17.00			1 00	4 00	2 00	5 00	2 00	6 63	2 00	7 63	2 00	8 63	2 00	9 63
17	18.00			1 00	4 00	2 00	5 00	2 00	6 63	2 00	7 63	2 00	8 63	2 00	9 63
18	19.00			1 00	4 00	2 00	5 00	2 00	6 63	2 00	7 63	2 00	8 63	2 00	9 63
19	20.00			1 00	4 00	2 00	5 00	2 00	6 63	2 00	7 63	2 00	8 63	2 00	9 63
20	21.00			1 00	4 00	2 00	5 00	2 00	6 63	2 00	7 63	2 00	8 63	2 00	9 63
21	22.00			1 00	4 00	2 00	5 00	2 00	6 63	2 00	7 63	2 00	8 63	2 00	9 63
22	23.00			1 00	4 00	2 00	5 00	2 00	6 63	2 00	7 63	2 00	8 63	2 00	9 63
23	24.00			1 00	4 00	2 00	5 00	2 00	6 63	2 00	7 63	2 00	8 63	2 00	9 63
24	25.00			1 00	4 00	2 00	5 00	2 00	6 63	2 00	7 63	2 00	8 63	2 00	9 63
25	26.00			1 00	4 00	2 00	5 00	2 00	6 63	2 00	7 63	2 00	8 63	2 00	9 63
26	27.00			1 00	4 00	2 00	5 00	2 00	6 63	2 00	7 63	2 00	8 63	2 00	9 63
27	28.00			1 00	4 00	2 00	5 00	2 00	6 63	2 00	7 63	2 00	8 63	2 00	9 63
28	29.00			1 00	4 00	2 00	5 00	2 00	6 63	2 00	7 63	2 00	8 63	2 00	9 63
29	30.00			1 00	4 00	2 00	5 00	2 00	6 63	2 00	7 63	2 00	8 63	2 00	9 63
30	31.00			1 00	4 00	2 00	5 00	2 00	6 63	2 00	7 63	2 00	8 63	2 00	9 63
31	32.00			1 00	4 00	2 00	5 00	2 00	6 63	2 00	7 63	2 00	8 63	2 00	9 63
32	33.00			1 00	4 00	2 00	5 00	2 00	6 63	2 00	7 63	2 00	8 63	2 00	9 63
33	34.00			1 00	4 00	2 00	5 00	2 00	6 63	2 00	7 63	2 00	8 63	2 00	9 63
34	35.00			1 00	4 00	2 00	5 00	2 00	6 63	2 00	7 63	2 00	8 63	2 00	9 63
35	36.00			1 00	4 00	2 00	5 00	2 00	6 63	2 00	7 63	2 00	8 63	2 00	9 63
36	37.00			1 00	4 00	2 00	5 00	2 00	6 63	2 00	7 63	2 00	8 63	2 00	9 63

NOTE: 4½" and 5" thicknesses also available from 4" IPS to 36" IPS. Insulation O.D.'s subject to standard tolerances.

311926

Table of suggested thicknesses

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.

You will note that four tables of suggested thicknesses are supplied. These range from the minimum requirements (personnel protection) to the maximum thickness (for commercial work).

Recommended minimum thickness, nominal inches
UNIBESTOS pipe insulation for personnel protection only

(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
	Temperature Difference Pipe to Air										
	120	220	320	420	520	620	720	820	920	1020	1120
1" and Less	1	1	1	1	1	1	1½	1½	1½	2	2
1½"	1	1	1	1	1	1½	1½	1½	2	2	2
2"	1	1	1	1	1	1½	1½	1½	2	2	2½
3"	1	1	1	1	1	1½	1½	2	2	2½	2½
3½"	1	1	1	1	1	1	1½	1½	2	2	2½
4"	1	1	1	1	1	1½	1½	2	2	2½	2½
5"	1	1	1	1	1	1½	2	2	2½	2½	3
6"	1	1	1	1	1½	1½	2	2	2½	3	3
8"	1	1	1	1	1½	1½	2	2	2½	3	3
10"	1	1	1	1	1½	1½	2	2½	2½	3	3½
12"	1	1	1	1	1½	1½	2	2½	2½	3	3½
14" to 18"	1½	1½	1½	1½	1½	1½	2	2½	3	3	3½
20"	1½	1½	1½	1½	1½	2	2	2½	3	3½	3½

Commercial, Industrial Recommended thickness—UNIBESTOS

Pipe Temp.	300°F				400°F				450°F				500°F				600°F				700°F			
Temp. Diff.	120°F				220°F				270°F				320°F				420°F				520°F			
Pipe Size	RT	HL	ST	E	RT	HL	ST	E	RT	HL	ST	E	RT	HL	ST	E	RT	HL	ST	E	RT	HL	ST	E
¼	1	69.7	131.5	70.1	1	92.4	206	78.3	1½	102.5	226	83.2	1½	112.3	239	86.7	2	132.0	268	90.3	2	151.0	294	92.4
½	1	73.7	135.5	70.7	1	97.2	212	79.1	1½	107.5	232	83.8	1½	117.5	245	87.3	2	137.4	274	90.7	2½	157.2	300	92.5
¾	1	79.2	141.0	71.4	1	102.8	219	80.0	1½	113.0	239	84.5	1½	123.0	252	87.9	2	143.4	281	91.1	2½	163.6	307	92.8
1	1	86.3	147.5	72.0	1	109.8	227	80.9	1½	120.0	247	85.3	1½	130.0	260	88.6	2	150.4	289	91.5	2½	170.6	315	93.0
1¼	1	95.6	157.3	72.9	1	119.1	237	82.0	1½	129.3	257	86.4	1½	139.3	270	89.6	2	159.7	299	92.3	2½	179.9	325	93.6
1½	1	104.1	165.8	73.6	1	127.6	246	82.8	1½	137.8	266	87.1	1½	147.8	279	90.2	2	168.2	308	92.9	2½	188.4	334	94.1
2	1	120.7	182.4	74.7	1	144.2	263	83.9	1½	154.4	283	88.2	1½	164.4	296	91.3	2	184.8	325	93.8	2½	205.0	351	94.9
2½	1	137.6	199.3	75.5	1	161.1	280	84.8	1½	171.3	300	89.1	1½	181.3	313	92.1	2	201.7	342	94.5	2½	221.9	368	95.5
3	1	154.0	215.7	76.1	1	177.5	296	85.5	1½	187.7	316	89.8	1½	197.7	329	92.8	2	218.1	358	95.1	2½	238.3	384	96.0
3½	1	170.4	232.1	76.6	1	193.9	313	86.1	1½	204.1	333	90.4	1½	214.1	346	93.3	2	234.5	375	95.6	2½	254.7	401	96.4
4	1	186.8	248.5	77.0	1	210.3	329	86.6	1½	220.5	349	90.9	1½	230.5	362	93.7	2	250.9	391	96.0	2½	271.1	417	96.8
4½	1	203.2	264.9	77.4	1	226.7	345	87.0	1½	236.9	365	91.3	1½	246.9	378	94.1	2	267.3	407	96.3	2½	287.5	433	97.1
5	1	219.6	281.3	77.7	1	243.1	361	87.3	1½	253.3	381	91.6	1½	263.3	394	94.4	2	283.7	423	96.6	2½	303.9	449	97.3
6	1	252.4	314.1	78.1	1	275.9	394	87.8	1½	286.1	414	92.1	1½	296.1	427	94.8	2	316.5	456	96.9	2½	336.7	482	97.5
7	1	285.2	346.9	78.4	1	308.7	426	88.2	1½	318.9	446	92.4	1½	328.9	459	95.1	2	349.3	488	97.1	2½	369.5	514	97.7
8	1	318.0	379.7	78.6	1	341.5	459	88.5	1½	351.7	479	92.7	1½	361.7	492	95.4	2	382.1	521	97.3	2½	402.3	547	97.9
9	1	350.8	412.5	78.8	1	374.3	491	88.8	1½	384.5	511	93.0	1½	394.5	524	95.6	2	414.9	553	97.5	2½	435.1	579	98.1
10	1	383.6	445.3	79.0	1	407.1	524	89.0	1½	417.3	544	93.2	1½	427.3	557	95.8	2	447.7	586	97.6	2½	467.9	612	98.2
11	1	416.4	478.1	79.2	1	439.9	556	89.2	1½	450.1	576	93.4	1½	460.1	589	96.0	2	480.5	618	97.8	2½	500.7	644	98.4
12	1	449.2	510.9	79.3	1	472.7	589	89.4	1½	482.9	609	93.5	1½	492.9	622	96.1	2	513.3	651	97.9	2½	533.5	677	98.5
13	1	482.0	543.7	79.5	1	505.5	621	89.5	1½	515.7	641	93.7	1½	525.7	654	96.3	2	546.1	683	98.0	2½	566.3	709	98.6
14	1	514.8	576.5	79.6	1	538.3	654	89.7	1½	548.5	674	93.8	1½	558.5	687	96.4	2	578.9	716	98.1	2½	599.1	742	98.7
15	1	547.6	609.3	79.7	1	571.1	686	89.8	1½	581.3	706	93.9	1½	591.3	719	96.5	2	611.7	748	98.2	2½	631.9	774	98.8
16	1	580.4	642.1	79.8	1	603.9	718	89.9	1½	614.1	738	94.0	1½	624.1	751	96.6	2	644.5	780	98.3	2½	664.7	806	98.9
17	1	613.2	674.9	79.9	1	636.7	750	90.0	1½	646.9	770	94.1	1½	656.9	783	96.7	2	677.3	812	98.4	2½	697.5	838	98.9
18	1	646.0	707.7	80.0	1	669.5	782	90.1	1½	679.7	802	94.2	1½	689.7	815	96.8	2	710.1	844	98.5	2½	730.3	870	99.0
19	1	678.8	740.5	80.1	1	702.3	814	90.2	1½	712.5	834	94.3	1½	722.5	847	96.9	2	742.9	876	98.6	2½	763.1	902	99.1
20	1	711.6	773.3	80.2	1	735.1	846	90.3	1½	745.3	866	94.4	1½	755.3	879	97.0	2	775.7	908	98.7	2½	795.9	934	99.2
21	1	744.4	806.1	80.3	1	767.9	878	90.4	1½	778.1	898	94.5	1½	788.1	911	97.1	2	808.5	940	98.8	2½	828.7	966	99.3
22	1	777.2	838.9	80.4	1	800.7	910	90.5	1½	810.9	930	94.6	1½	820.9	943	97.2	2	841.3	972	98.9	2½	861.5	998	99.4
23	1	810.0	871.7	80.5	1	833.5	942	90.6	1½	843.7	962	94.7	1½	853.7	975	97.3	2	874.1	1004	98.9	2½	894.3	1030	99.4
24	1	842.8	904.5	80.6	1	866.3	974	90.7	1½	876.5	994	94.8	1½	886.5	1007	97.3	2	906.9	1036	99.0	2½	927.1	1062	99.5
25	1	875.6	937.3	80.7	1	899.1	1006	90.8	1½	909.3	1026	94.9	1½	919.3	1039	97.4	2	939.7	1068	99.0	2½	959.9	1094	99.5
26	1	908.4	970.1	80.8	1	931.9	1038	90.9	1½	942.1	1058	94.9	1½	952.1	1071	97.4	2	972.5	1100	99.1	2½	992.7	1126	99.6
27	1	941.2	1002.9	80.9	1	964.7	1070	91.0	1½	974.9	1090	95.0	1½	984.9	1103	97.5	2	1005.3	1132	99.2	2½	1025.5	1158	99.6
28	1	974.0	1035.7	81.0	1	997.5	1102	91.1	1½	1007.7	1122	95.1	1½	1017.7	1135	97.5	2	1038.1	1164	99.3	2½	1058.3	1190	99.7
29	1	1006.8	1068.5	81.1	1	1030.3	1134	91.2	1½	1040.5	1154	95.2	1½	1050.5	1167	97.6	2	1070.9	1196	99.4	2½	1091.1	1222	99.7
30	1	1039.6	1101.3	81.2	1	1063.1	1166	91.3	1½	1073.3	1186	95.3	1½	1083.3	1199	97.6	2	1103.7	1228	99.4	2½	1123.9	1254	99.7
31	1	1072.4	1134.1	81.3	1	1095.9	1198	91.4	1½	1106.1	1218	95.4	1½	1116.1	1231	97.7	2	1136.5	1260	99.5	2½	1156.7	1286	99.8
32	1	1105.2	1166.9	81.4	1	1128.7	1230	91.5	1½	1138.9	1250	95.5	1½	1148.9	1263	97.8	2	1169.3	1292	99.5	2½	1189.5	1318	99.8
33	1	1138.0	1199.7	81.5	1	1161.5	1262	91.6	1½	1171.7	1282	95.6	1½	1181.7	1295	97.8	2	1202.1	1324	99.6	2½	1222.3	1350	99.8
34	1	1170.8	1232.5	81.6	1	1194.3	1294	91.7	1½	1204.5	1314	95.7	1½	1214.5	1327	97.9	2	1234.9	1356	99.6	2½	1255.1	1382	99.9
35	1	1203.6	1265.3	81.7	1	1227.1	1326	91.8	1½	1237.3	1346	95.8	1½	1247.3	1359	98.0	2	1267.7	1388	99.7	2½	1287.9	1414	99.9
36	1	1236.4	1298.1	81.8	1	1259.9	1358	91.9	1½	1270.1	1378	95.9	1½	1280.1	1391	98.0	2	1300.5	1420	99.7	2½	1320.7	1446	99.9

RT=Recommended Thickness. HL=Heat Loss (BTU/HR/Ft.). ST=Surface Temperature (°F.). E=Efficiency (%).

311927

Process industries

Recommended thicknesses– UNIBESTOS

Process industries

Pipe Temperature	300°F				350°F				400°F				450°F				500°F			
Temperature Difference	120°F				220°F				270°F				320°F				370°F			
Pipe Size	RT	HL	ST	E	RT	HL	ST	E	RT	HL	ST	E	RT	HL	ST	E	RT	HL	ST	E
¼	1	86.5	93.5	76.8	1	92.8	159	79.3	1	99.5	185	81.6	1	70.8	179	83.4	1	93.5	140	85.3
½	1	89.7	95.8	78.7	1	93.1	161	81.3	1	60.8	129	82.1	1	85.1	135	84.0	1	94.8	173	86.2
1	1	90.2	93.6	80.6	1	93.7	163	83.2	1	62.4	117	85.1	1	87.3	139	85.7	1	96.3	172	90.3
1½	1	25.6	97.3	79.9	1	56.8	171	82.5	1	60.5	126	84.6	1	112	161	86.2	1	105	123	91.2
1½	1	26.3	95.8	82.0	1	52.3	163	84.4	1	61.2	122	85.2	1	113	175	87.7	1	109	129	91.1
2	1	30.7	96.3	83.3	1	56.0	170	85.6	1	52.6	129	87.3	1	128	195	88.7	1	110	128	92.1
2½	1	34.0	96.8	83.8	1	67.5	180	86.1	1	106	134	87.7	1	149	158	89.1	1	135	123	93.3
3	1	40.1	97.8	84.3	1	80.5	192	86.4	1	126	147	88.0	1	173	161	89.4	1	135	133	92.1
4	1	45.0	98.0	85.2	1	86.6	212	87.2	1	148	128	88.7	1	209	183	90.0	1	238	135	93.2
5	1	49.0	99.0	85.3	1	106	184	87.7	1	182	130	88.8	1	254	196	90.0	1	251	139	93.4
6	1	74.1	100	86.9	1	139	196	87.1	1½	182	117	90.5	1½	227	179	92.5	2	237	127	94.7
7	1½	57.6	99.9	89.0	1½	116	185	90.7	1½	178	117	90.9	1½	250	179	92.8	2	268	128	94.4
8	1½	64.4	94.2	89.2	1½	127	165	90.8	1½	155	118	92.0	1½	276	180	92.9	2	230	129	95.0
9	1½	70.1	94.6	89.2	1½	139	166	90.8	1½	219	119	94.9	1½	306	181	92.9	2	270	127	95.1
10	1½	72.4	94.8	89.7	1½	117	165	91.2	1½	230	119	97.3	1½	323	180	93.7	4	280	129	95.2
12	1½	84.1	94.3	89.9	1½	170	165	93.4	1½	267	118	92.5	1½	325	180	93.6	2	255	130	95.3
14	1½	83.0	95.4	89.3	1½	196	167	90.9	1½	307	123	92.0	1½	430	181	93.0	2	415	133	95.1
15	1½	175	95.6	89.4	1½	218	168	91.0	1½	345	127	92.1	1½	453	185	93.1	2	520	134	94.5
16	1½	228	96.8	89.5	1½	240	169	90.0	1½	385	132	92.2	1½	525	191	93.2	2	595	135	95.1
20	1½	143	96.3	83.6	1½	218	169	90.1	1½	426	123	92.3	1½	605	135	93.2	2½	530	129	96.1
24	1½	150	96.4	83.7	1½	332	169	90.1	1½	454	138	92.4	1½	659	136	93.2	2½	603	126	95.1

Pipe Temperature	550°F				600°F				700°F				800°F				900°F				1000°F				1100°F			
Temperature Difference	420°F				470°F				570°F				670°F				770°F				870°F				970°F			
Pipe Size	RT	HL	ST	E	RT	HL	ST	E	RT	HL	ST	E	RT	HL	ST	E	RT	HL	ST	E	RT	HL	ST	E	RT	HL	ST	E
¼	1	70.8	179	83.4	1	93.5	140	85.3	1	118	143	88.1	2	145	125	92.6	2	178	102	93.5	2	196	135	94.0
½	1	85.1	135	84.0	1	94.8	173	86.2	1	118	151	83.9	2	165	143	93.5	2	193	159	94.1	2	213	152	95.6
1	1	87.3	139	85.7	1	96.3	172	90.3	1	126	157	83.2	2	149	157	93.2	2	169	132	93.8	2½	197	157	95.3
1½	1	112	161	86.2	1	105	123	91.2	2	155	161	84.1	2	158	161	94.1	2½	186	134	95.3	2½	217	163	95.7
1½	1	113	175	87.7	1	109	129	91.1	2	156	152	84.9	2	156	152	94.9	2½	185	152	95.9	3	252	154	96.9
2	1	128	195	88.7	1	110	128	92.1	2	210	145	85.1	2	210	145	95.1	2½	216	155	96.1	3	265	158	97.1
2½	1	149	158	89.1	1½	135	123	93.3	2	221	156	85.7	2	221	156	95.7	2½	256	155	96.6	3	292	157	97.4
3	1	173	161	89.4	1½	135	133	92.1	2	227	159	85.1	2	274	163	95.6	2½	279	162	95.6	3	335	165	97.5
4	1	209	183	90.0	1½	238	135	93.2	2	290	162	86.5	2	325	153	95.9	3	291	134	97.2	3	358	163	97.5
5	1	254	196	90.0	1½	251	139	93.4	2½	322	161	86.7	3	353	158	97.4	3	384	165	97.6	3½	433	153	98.1
6	2	227	179	92.5	2	237	127	94.7	2½	376	162	86.8	3	389	161	97.4	3	453	163	97.7	3½	431	162	98.2
7	2	250	179	92.8	2	268	128	94.4	2½	419	165	86.9	3	390	162	97.8	3½	463	159	98.0	3½	508	157	98.2
8	2	306	180	93.0	2	270	129	95.0	2½	436	162	87.1	3	406	161	98.0	3½	525	161	98.2	4	557	158	98.5
9	2	355	181	93.2	2	356	129	95.2	2½	501	167	87.1	3	496	162	97.9	3½	579	164	98.2	4	651	163	98.5
10	2	420	181	93.4	2	415	133	95.1	3	559	169	87.2	3	559	163	97.9	3½	683	165	98.2	4	654	165	98.5
12	2	463	181	93.7	2	495	134	95.3	3	620	169	87.5	3	622	161	98.0	3½	721	165	98.2	4½	835	160	98.7
14	2	535	183	93.9	2	558	134	95.3	3	659	162	87.5	4	629	156	98.0	4	723	161	98.4	4½	758	161	98.7
15	2	565	185	94.0	3	594	135	97.3	3	702	161	87.6	4	692	155	98.0	4	853	162	98.0	5	871	156	98.8
16	2	595	186	94.1	3	626	135	97.3	3	745	161	87.6	4	753	156	98.0	4	887	163	98.5	5	923	157	98.8
20	2½	530	189	96.1	3	787	136	97.4	3	859	165	87.6	4	879	157	98.0	4	1024	166	98.5	5	980	159	98.9
24	2½	603	196	95.1	3	787	136	97.4	3	859	165	87.6	4	879	157	98.0	4	1024	166	98.5	5	980	159	98.9

Power, utility

Recommended thicknesses– UNIBESTOS

Power, utility

Pipe Temperature	200°F				250°F				400°F				500°F				600°F			
Temperature Difference	130°F				270°F				320°F				420°F				520°F			
Pipe Size	RT	HL	ST	E	RT	HL	ST	E	RT	HL	ST	E	RT	HL	ST	E	RT	HL	ST	E
¼	1	86.5	93.5	76.8	1	92.8	159	79.3	1	99.5	185	81.6	1	70.8	179	83.4	1½	79.2	111	83.9
½	1	89.7	95.8	78.7	1	93.1	161	81.3	1	60.8	122	82.1	1	85.1	135	84.0	1½	84.8	123	89.2
1	1	90.2	93.6	80.6	1	93.7	163	83.2	1	62.4	117	85.1	1	87.3	139	85.7	1½	93.6	122	90.3
1½	1	25.6	97.3	79.9	1	56.8	171	82.5	1½	59.5	165	83.0	1½	85.8	198	90.2	1½	106.8	128	91.2
1½	1	26.3	95.8	82.0	1	52.3	163	84.4	1½	64.3	168	83.1	1½	90.1	183	90.3	2	94.8	111	93.8
2	1	30.7	96.2	83.3	1	56.0	169	85.6	1½	72.1	169	83.0	1½	104	185	91.1	2	113	115	93.3
2½	1	34.0	96.8	83.8	1	67.5	180	86.1	1½	74.3	164	83.5	1½	105	183	92.4	2	119	134	98.2
3	1	40.1	97.8	84.3	1	80.5	192	86.4	1½	95.6	112	90.9	1½	138	177	91.9	2	140	120	94.0
4	1	45.0	98.0	85.2	1	86.6	212	87.2	1½	115	113	91.3	1½	168	124	92.3	2	175	123	98.6
5	1	49.0	99.0	85.3	1	106	184	87.7	1½	132	115	91.6	1½	192	125	92.5	2½	115	116	95.6
6	1	74.1	100	86.9	1	139	196	87.1	1½	152	117	91.5	1½	227	128	92.5	2½	203	118	95.5
7	1½	57.6	99.9	89.0	1½	116	185	90.7	1½	178	117	91.9	1½	250	129	92.8	2½	226	119	95.6
8	1½	64.4	94.2	89.2	1½	127	165	90.8	1½	155	118	92.0	1½	276	130	92.9	2½	252	117	95.9
9	1½	70.1	94.6	89.2	1½	139	166	90.8	1½	219	119	94.9	1½	305	131	92.9	2½	285	118	96.9
10	1½	72.4	94.8	89.7	1½	117	165	91.2	1½	230	119	97.3	1½	323	130	93.2	2½	290	120	95.9
12	1½	84.1	94.3	89.9	1½	170	165	93.4	1½	267	118	92.5	1½	345	130	93.4	2½	322	122	95.8
14	1½	83.0	95.4	89.3	1½	196	167	90.9	2	293	117	91.2	2	280	122	94.9	3	329	119	96.5
15	1½	175	95.6	89.4	1½	218	168	91.0	2	292	117	93.1	2	300	122	94.9	3	350	117	96.8
16	1½	228	96.8	89.5	1½	240	169	90.0	2	305	112	92.2	2	420	123	94.6	3	420	118	96.6
20	1½	143	96.3	83.6	1½	218	169	90.1	2	426	123	92.3	2	459	126	94.6	3	439	118	95.6
24	1½	150	96.4	83.7	1½	332	169	90.1	2	454	138	92.4	2	540	126	94.6	3	547	119	95.7

Pipe Temperature	700°F				800°F				900°F				1000°F				1100°F				1200°F			
Temperature Difference	620°F				720°F				820°F				920°F				1020°F				1120°F			
Pipe Size	RT	HL	ST	E	RT	HL	ST	E	RT	HL	ST	E	RT	HL	ST	E	RT	HL	ST	E	RT	HL	ST	E
¼	1½	94.6	135	84.2	2	104	119	92.8	2	121	128	92.1	2½	123	119	93.2	2½	143	125	94.3	3	160	121	95.1
½	1½	107	133	90.1	2	117	124	92.8	2	141	133	92.8	2½	142	122	94.4	2½	165	137	94.9	3	175	125	95.7
1	1½	115	131	91.2	2	126	125	93.1	2	151	132	93.8	3	147	111	95.3	3	172	129	95.7	3	197	129	96.1
1½	2	127	126	92.8	2½	132	120	93.2	2½	155	127	94.0	3	130	125	95.7	3	155	135	96.1	3½	211	127	96.7
2	2	139	117	93.7	2½	132	115	95.0	2½	158	121	95.4	3	131	132	98.2	3	157	125	96.6	3½	213	124	97.1
2	2	142	123	94.0	2½	134	121	95.2	2½	166	123	95.7	3	160	125	96.4	3	221	132	96.8	4	229	122	97.5
2½	2	150	120	93.7	2½	161	119	95.8	2½	192	125	96.2	3	211	128	96.9	3	248	130	97.1	4	245	122	97.7
2	2	165	121	93.6	3	172	120	96.2	3	214	125	96.6	3½	227	125	97.2	3½	263	129	97.5	4	282	123	97.9
2	2	120	132	96.0	3	205	120	96.6	3	248	127	96.9	3½	263	128	97.4	3½	300	132	97.7	4½	312	126	98.2
2½	2½	123	96.0	3	240	123	96.7	3	289	130	97.0	4	276	131	97.0	4	339	135	98.0	4½	353	129	98.3
2½	2½	136	96.0	3½	231	119	97.2	3½	288	125	97.5	4	316	129	97.9	4	363	133	98.1	5	372	126	98.5
2½	2½	127	96.1	3½	230	119	97.3	3½	324	125	97.6	4½	321	133	98.1	4½	341	138	98.3	5	408	129	98.6
2½	2½	126	96.4	3½	255	120	97.4	3½	356	125	97.6	4½	356	132	98.2	4½	435	139	98.4	5½	416	121	98.7
2½	2½	128	96.4	3½	315	120	97.5	3½	381	125	97.7	4½	325	134	98.2	4½	459	139	98.4	5½	459	125	98.7
2½	2½	128	96.4	3½	253	122	97.5	3½	424	129	97.7	4½	429	135	98.3	4½	483	139	98.4	5½	484	125	98.8
2½	3	130	96.4	4	358	118	97.8	4	437	126	98.0	5	441	132	98.5	5	511	137	98.6	6½	550	130	98.9
3	3	123	96.8	4	356	120	97.8	4	478	126	98.0	5	473	133	98.5	5	558	137	98.6	6½	550	130	98.9
3	3	125	96.9	4	445	121	97.8	4	532	127	98.1	5	525	133	98.5	5	532	139	98.7	6½	550	130	98.9
3	3	126	97.0	4	488	121	97.9	4	583	127	98.1	5½	535	130	98.7	6	536	134	98.8	7	715	133	98.9
3	3	126	97.0	4	535	122	97.9	4	643	128	98.1	5½	585	132	98.7	6	583	135	98.8	7	803	132	98.9
3	3	127	97.0	4½	595	118	98.1	4½	681	124	98.3	5½	670	132	98.7	6	679	137	98.8	7	809	131	98.9

RT–Recommended Thickness. HL–Heat Loss (BTU/HR/FT). ST–Surface Temperature (°F). E–Efficiency (%).

UNIBESTOS expansion control data

Expansion joints and fitting covers are easy to fabricate from UNIBESTOS pipe insulation on the job. Some typical vertical and horizontal expansion joints and fitting coverings are shown on the opposite page. Variations can be adapted 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 1.6". 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 at the joint interval indicated)

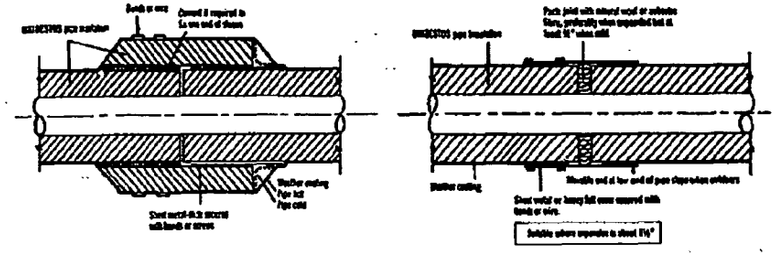
		9'	12'	15'	18'	21'	24'	27'	30'	36'	42'	48'
1200°	11.09	1.0	1.3	1.7	2.0	2.3	2.7	3.0	3.3	4.0	4.7	5.3
1150°	10.49	.94	1.3	1.6	1.9	2.2	2.5	2.8	3.1	3.8	4.4	5.0
1100°	9.89	.89	1.2	1.5	1.8	2.1	2.4	2.7	3.0	3.6	4.2	4.7
1050°	9.29	.84	1.1	1.4	1.7	2.0	2.2	2.5	2.8	3.3	3.9	4.5
1000°	8.76	.79	1.0	1.3	1.6	1.8	2.1	2.4	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	.56	.73	.91	1.1	1.3	1.5	1.6	1.8	2.2	2.6	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°	5.05	.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.

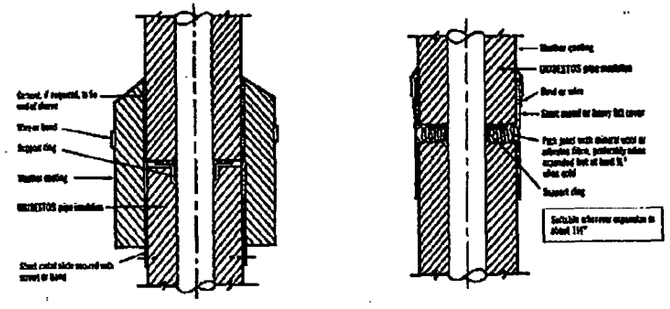
NOTE: Use sleeve-type expansion joints only if expansion figure to the right of heavy line on chart is used.

311930

HORIZONTAL EXPANSION JOINTS

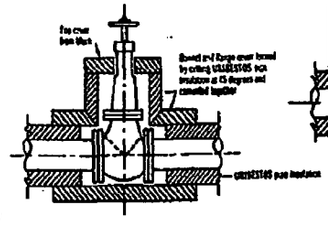


VERTICAL EXPANSION JOINTS

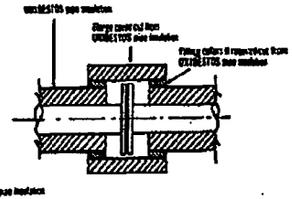


TYPICAL FITTING INSULATION

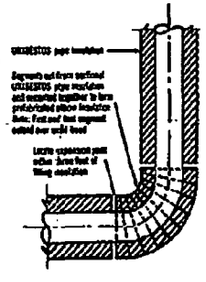
HIGH TEMPERATURE FLANGED VALVE INSULATION



FLANGE INSULATION



PREFABRICATED INSULATION FOR PIPE BEND



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Typical specification for UNIBESTOS

1. Temperature Range. UNIBESTOS shall be used on piping operating from +100°F. to +1200°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" I.P.S. shall be wired in place using 16 gauge soft annealed wire; on pipe sizes over 12" use 14 gauge wire. The wiring 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.

5. Finishes. Indoor: On indoor lines, UNIBESTOS does not require a finish. If a finish is desired, a 6 oz. canvas shall be secured to the insulation with a lagging adhesive.

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 the adjacent pipe covering.

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

UNIBESTOS is available nationally

Pittsburgh Corning provides national distribution for UNIBESTOS. More than 100 distributors stand ready to serve your insulation requirements. The PC authorized UNIBESTOS distributor is highly trained and he is well equipped to survey your job, make recommendations and estimates, and to install UNIBESTOS to meet your requirements. For your next high temperature job: select the insulation most suited to single-layer applications; select the distributor most experienced with high temperature installations.

Call or write your nearest Pittsburgh Corning District office listed on the back cover for the name of your local authorized distributor.



UNIBESTOS insulates the towers and piping at this major oil company refinery in Texas. It is unaffected by the corrosive atmospheres common to this service.



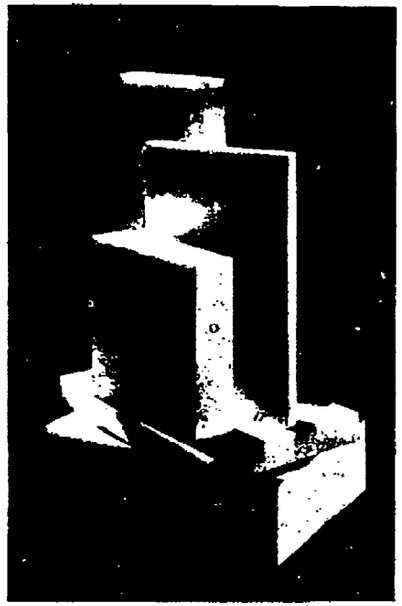
Practically all of the piping is protected with UNIBESTOS on this Jal, New Mexico field processing plant of El Paso Natural Gas Company. UNIBESTOS is available in a wide range of pipe and tubing sizes.



The piping at this large Illinois refinery is protected by UNIBESTOS. Note the ease with which the fabricated sections of UNIBESTOS accommodate the sharp bends of the piping.

FOAMTHANE

a rigid polyurethane foam insulation for operating temperatures from –330°F. to +200°F.



For those applications requiring a foamed plastic insulation, Pittsburgh Corning manufactures FOAMTHANE, a rigid polyurethane foam insulation with an extremely low "K" factor of 0.15 (+40° to +70°F. Mean). This excellent insulation value means that less insulation thickness is required for a given thermal requirement.

Its closed cellular structure assures good moisture resistance. Production under rigid, controlled conditions guarantees uniformity in thermal and physical characteristics which are impossible to attain from foamed-in-place materials.

Pittsburgh Corning supplies FOAMTHANE in board form *only* as standard material, however other units are available at special rates to meet individual customer requirements. Standard boards are supplied in widths to 48"; lengths to 100"; thicknesses from 3/8" to 15" in 1/16" increments. FOAMTHANE is also available in a self-extinguishing type for those requiring this feature in their application.



FOAMTHANE is easily fabricated in special shapes for insulating spheres, tanks and odd-shaped equipment, as well as for piping and all shapes and sizes of ducts.

Look over this physical property listing. See how FOAMTHANE can fit into your insulation requirements.

Composition	A superior rigid polyurethane foam with an extremely low "K" value. The polyether resins have been foamed under laboratory conditions using a halogenated hydrocarbon blowing agent.
Density	1.6 to 2.0 lbs./cu. ft.
Closed Cell Content	90 to 95%
Thermal Conductivity (Average)	0.15 at +40°F. to +70°F. Mean (ASTM C-177)
Compressive Strength (Average)	20-30 psi @ yield point (parallel to foam rise) (ASTM D-1621)
Flexural Strength	30 to 60 psi
Temperature Limits	–330°F. to +200°F.
Capillarity	None
Alkalinity (pH)	Neutral
Chemical Resistance	Unaffected by most petroleum solvents
Coefficient of Expansion	.000075/°F. –50° to +75°F.
Thermal Shock Resistance	Excellent
Vapor Resistance	Less than two perm inches
Noncorrosive	Will not contribute to corrosion of stainless steel or other metals.
Other	Will not rot or contaminate. Will not sustain fungus or vermin. Odor free and non-toxic.

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 of the adjoining pipe.

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. If aluminum jacketing is used, the aluminum shall have an integral moisture barrier. 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°, staples may be used at butt joints of single layer in accordance with the technique showed under "Expansion Control Data," Page 8, Unibestos Catalog (UN-3).

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For complete information on sizes and thicknesses, expansion control data, recommended thickness and typical specifications, refer to Unibestos Catalog UN-3.

PITTSBURGH pc CORNING
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UN-5 Printed in U.S.A.

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product data sheet

UNI-CLAD®

UNIBESTOS® with a Factory Applied .016 Aluminum Jacket



UNIBESTOS, the best high temperature insulation now available with a factory applied .016 inch aluminum jacket with an integral, polyethylene coated, kraft moisture barrier.

The jacketing employs a "Pittsburgh Lap" along the longitudinal joint to insure a good weatherproof seal. Each section is furnished with one butt joint sealer strap which contains a sealing mastic 1" wide x ¼" thick. The sealer strap, once applied, is held firmly in place by a standard locking aluminum band .020 inch thick.

USES:

UNI-CLAD is recommended for applications up to 1500°F. for power plants, refineries, chemical and petrochemical plants as well as other industries where weatherability, ruggedness, durability, and appearance are important factors.

UNI-CLAD offers savings on initial installation costs along with the ability to be removed and reused over and over again which minimizes future operation costs.

AVAILABILITY:

UNI-CLAD is available in sizes from ½" to 24" IPS and up to 5" insulation thickness in 36" lengths.

OPTIONAL JACKETING:

Stainless Steel
Type 304, .010 gauge with polyethylene coated kraft moisture barrier—application and availability same as UNI-CLAD.

Galvanized
Vinyl coated electro galvanized steel, .010 gauge with polyethylene vapor barrier—specifications and availability same as UNI-CLAD.

Felt
Standard felt in 45 pound or 55 pound in either rag or asbestos—availability same as UNI-CLAD.

Canvas
Standard canvas jacketing in 4, 6, and 8 ounce weights—availability same as UNI-CLAD.

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