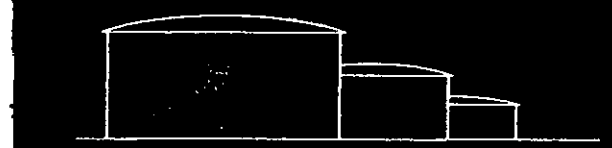
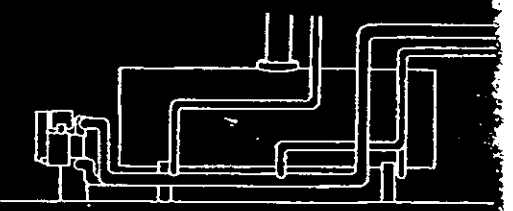
PLAINTIFF'S EXHIBIT
ACS-113

K·M

Industrial Specifications and Data for...





SPRAYED "LIMPET" ASBESTOS



SOLD BY Armstrong CONTRACTING AND SUPPLY CORPORATION LANCASTER, PA.

SPRAYED "LIMPET" ASBESTOS

INDUSTRIAL APPLICATIONS

Introduction:

The spraying of Asbestos Fibers presents many unique problems. In 1932 in England, J. W. Roberts Limited successfully developed a machine which overcame these difficulties and patented several features of it.

Since then SPRAYED "LIMPET" ASBESTOS has gained international acceptance for:

THERMAL INSULATION
FIRE PROTECTION
SOUND CONTROL
CORROSION PREVENTION

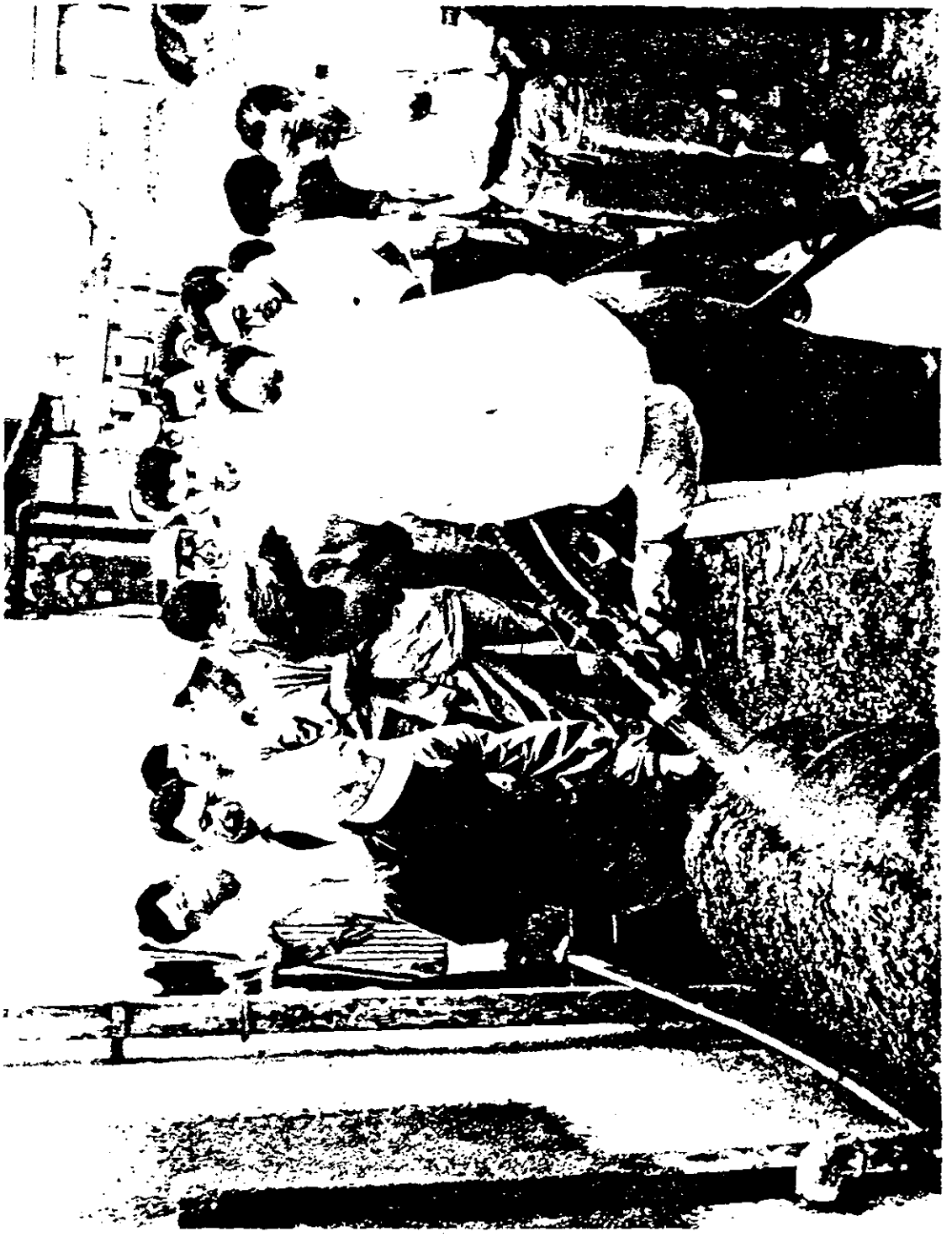
all in one coating — SIMULTANEOUSLY.

Keasbey & Mattison has been licensed as the exclusive U. S. Distributor since 1935 and has conducted a Spray Training School continuously since that time.

SPRAYED "LIMPET" ASBESTOS is sold and applied in the following countries:

Argentine	Germany	Norway
Australia	Greece	Panama
Austria	Holland	Portugal
Belgian Congo	Hungary	Portuguese East Africa
Belgium	India	Portuguese West Africa
Brazil	Israel	Rhodesia, N. and S.
British N. Borneo	Italy	Singapore
Canada	Jamaica	South Africa
Ceylon	Japan	Spain
Chile	Jugoslavia	Sweden
Denmark	Lebanon	Switzerland
Egypt	Luxembourg	Thailand
Fiji	Malaya	Tunisia
Finland	Mexico	U. S. A.
France	New Zealand	

Keasbey & Mattison offers world-wide service through this international organization and guarantees that the quality of materials and standards of workmanship are identical in each country.



SPRAYED "LIMPET" ASBESTOS demonstration at a "LIMPET" school in Japan.

SPRAYED "LIMPET" ASBESTOS has been tested for:

THERMAL INSULATION

SOUND ABSORPTION

FIRE PROTECTION

MOISTURE RE-EVAPORATION

RESISTANCE TO FROST

MECHANICAL DAMAGE: etc.

By:

Department of Scientific & Industrial Research, Elstree, England
National Physical Laboratory, Teddington, England
Corrosion Research Dept. British Iron & Steel Research Association
Underwriters' Laboratories, Inc., Chicago, Ill.
Mellon Institute of Industrial Research, University of Pittsburgh
National Bureau of Standards - U. S. Department of Commerce
R. H. Harry Stanger, A.M.I.C.E., A.M.I. MECH. E., M.I. Struct. E., Elstree, England
Laboratoire National D'Essais, Paris
Centre Scientifique et Technique du Batiment, Paris
Associazione Nazionale Controllo Combustione, Rome
Instituto Elettrotecnico Nazionale Galileo, Ferraris - Turin
For schungsheim fur Warmeschutz E V., Munich
Baustoff-Forschung Buchenhof - Dusseldorf
Bundesanstalt fur Mechanische und Chemische Material Prufung - Hamburg
Prof. Dr. Ing. L. Cremer - Munich
Prof. Dr. Ing. Th. Kristen - Technische Hochschule - Brunswick
Statsproveanstalten, Copenhagen
Magistrat der Stadt Wien, Vienna
Technologisches Gewerbemuseum, Vienna

Thermal Insulation

The physical properties which make Asbestos particularly suited to Thermal Insulation, are so well known, and so universally accepted, that they will not be discussed here.

It should be pointed out, however, that in many cases Asbestos is used merely as a binder or reinforcing agent such as in insulating cements or 85% Magnesia.

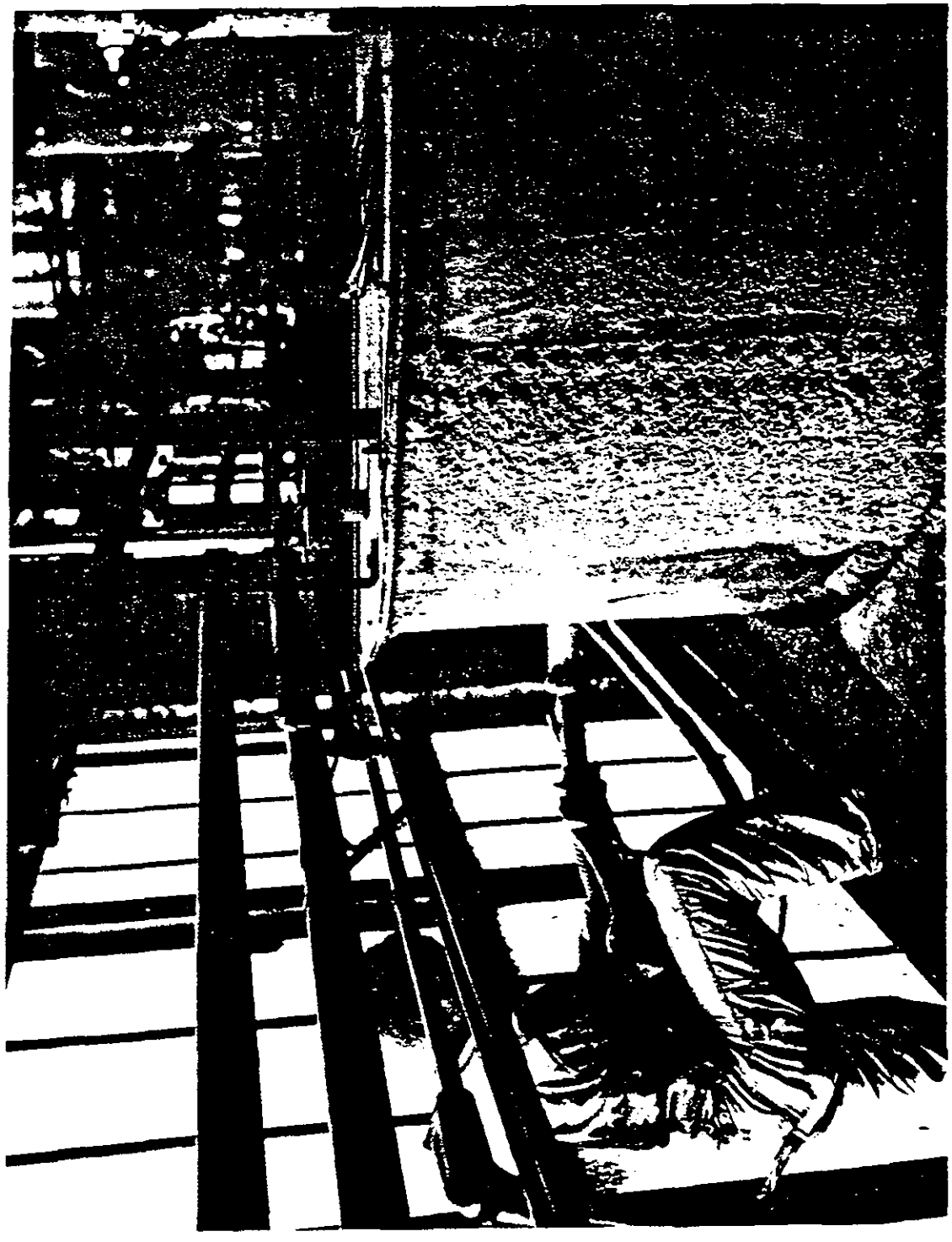
Materials like these would rapidly disintegrate under normal insulation use were it not for the inclusion of Asbestos Fibers. Since SPRAYED "LIMPET" ASBESTOS is composed of 100% Asbestos Fibers and a binding agent, its advantages are obvious. Further, since the material is sprayed additional air is entrapped and so the insulation value of the asbestos is enhanced.

The fact that "LIMPET" is sprayed also offers the obvious advantage of reduced labor cost. Anyone involved with insulation costs either as a purchaser or as a contractor is aware that labor costs have increased out of all proportion to the price of the insulation. This is particularly true of items of unusual shape where block has to be laboriously cut and fitted by hand.

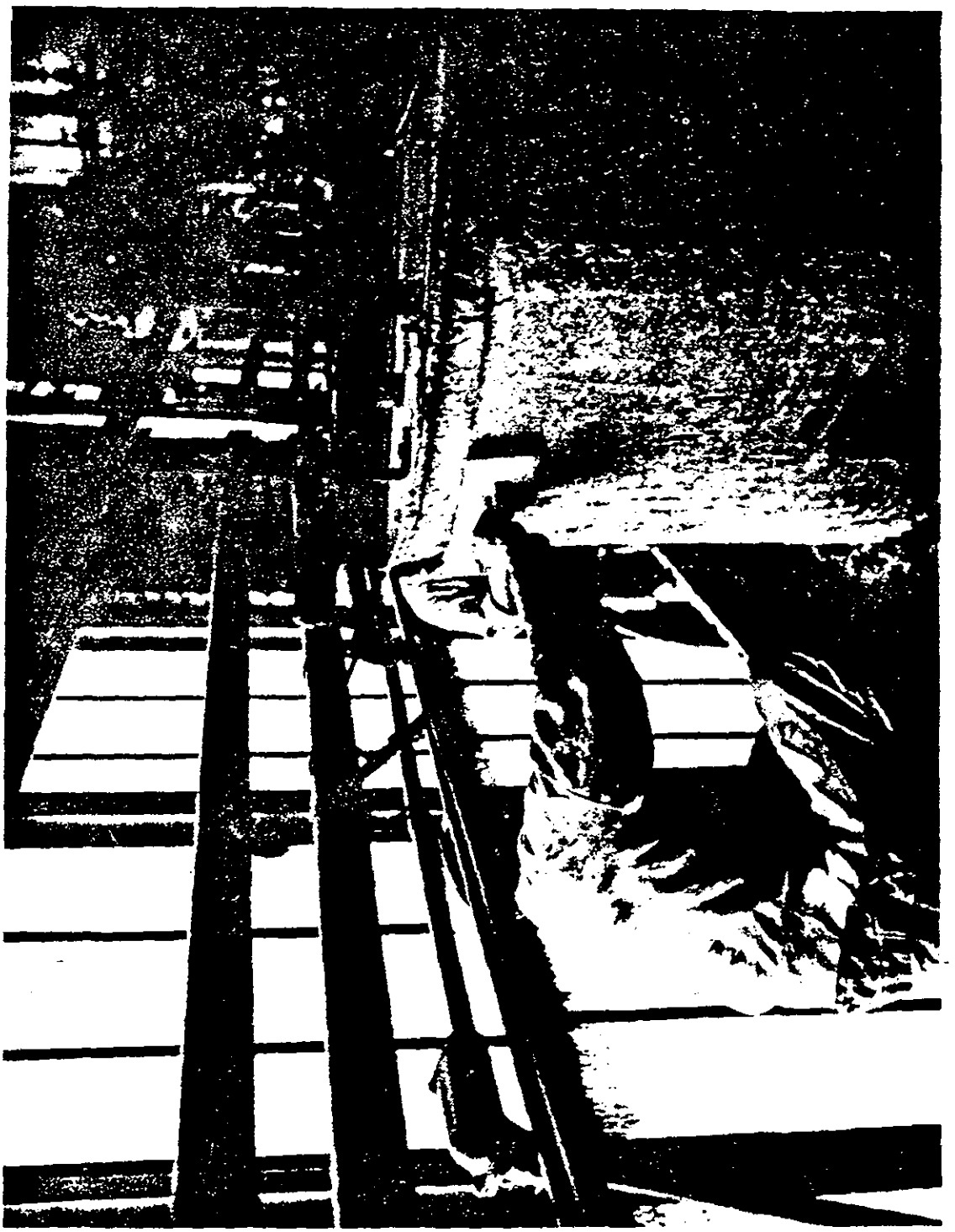
Or in the case of Blanket Type, the fixings required and the difficulty of obtaining the neat appearance so often required is eliminated to some extent by the use of "LIMPET."

Since it can be sprayed in a continuous blanket without seams or joints the "K" Factor is consistent, whereas the "K" Factor of block insulation is normally given for a unit area of the material no provision is made for the joints, which often have to be filled with cement.

The following series of pictures shows the progressive steps in applying "LIMPET" to a storage tank with a cone-shaped bottom half.



First Step — Spraying "LIMPET" to the surface to be insulated. The spray machine is on the floor below, 50 feet away. There is no limit to the distance between machine and work area. Booster units are used for spraying beyond this distance, if machine cannot be brought close enough.



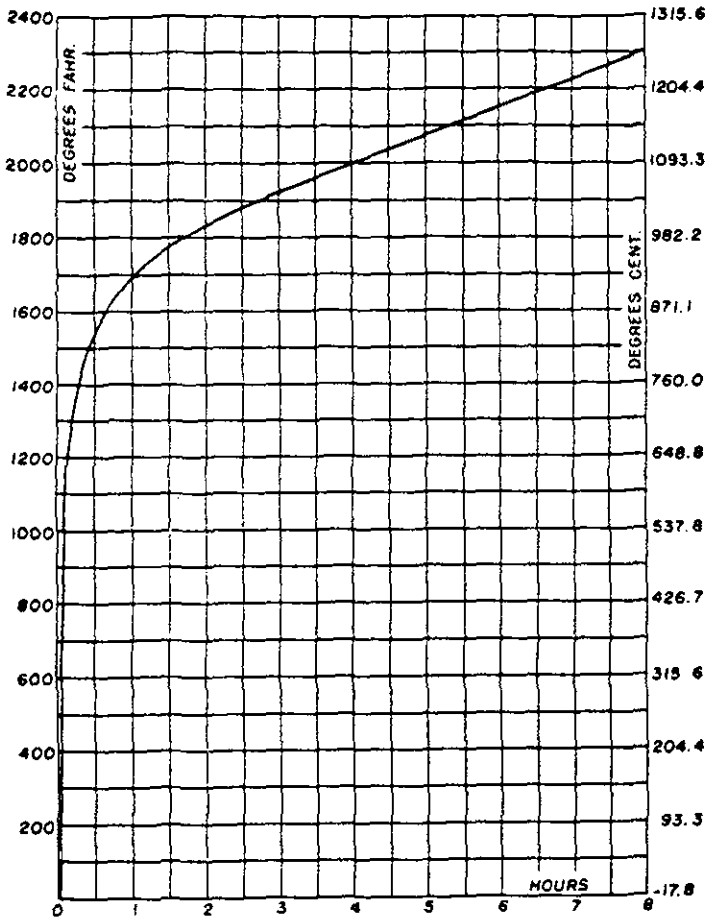
Second Step — After Spraying, the "LIMPET" is pressed to its final thickness with a wooden trowel. This increases the density and strength of the coating. There is no limit to the thickness which may be obtained in one layer.



View of the same vessel on the floor below, after finishing with a troweled coat of BD.2 cement for a hard surface finish. Despite the shape, no pins, clips, or chicken mesh was used. If required, the "LIMPET" may be weatherproofed.

SPRAYED 'LIMPET' ASBESTOS

FIRE PROTECTION



Time-Temperature Curve.

The conduct of fire tests of materials and construction is controlled by the standard time-temperature curve of ASTM E-119. The points on the curve that determine its character are:

1000 F at 5 minutes	1850 F at 2 hours
1300 F at 10 minutes	1925 F at 3 hours
1550 F at 30 minutes	2000 F at 4 hours
1700 F at 1 hour	2300 F at 8 hours or over

The Standard Time-Temperature curve is a composite of many suggested at conferences in 1916-17. Representatives attending were from the National Board of Fire Underwriters, Underwriters' Laboratories, Associated Factory Mutual Fire Insurance Companies, National Bureau of Standards, etc. The Time-Temperature curve of the British Standards Institution is identical in every respect except that the temperature from approximately four hours and up is 50°F higher.

LIST OF APPROVED FIRE-RESISTIVE RATINGS

SYMBOL FOR SPRAYED "LIMPET" ASBESTOS APPLICATION

ASSEMBLY	DESCRIPTION	RATING	"LIMPET" THICKNESS	AUTHORITY
	ROOFING & SIDING ASBESTOS CORRUGATED	1 HR 2 HR	1¼" 2"	FIRE OFFICES COMMITTEE REF. FROSI NO. 528 1955.
	STEEL WALLS (SHIPS BULKHEAD)	1 HR	1¼"	FIRE OFFICES COMMITTEE REF. FROSI NO. 8 1948
	FLOOR 3½" CONCRETE	4 HR.	1"	FIRE OFFICES COMMITTEE ENGLAND REF. FROSI-7 1938

ASSEMBLY	ASS'Y REF.#	DESCRIPTION	RATING (HOURS)	THICKNESS (IN.)	AUTHORITY
	6	BEAM DIRECT TO STEEL	4 3 2	1-3/4 1-5/16 1	U.L.I.R-3705-7 U.L.C. DES. NO.28
	7	BEAM METAL LATH	4	1-1/2 1-1/4*	U.L.I.R-3705-3
	8	COLUMN DIRECT TO STEEL	5 3 3	3-3/8 2-1/4 1-3/4	U.L.I.3705-4-5 F.O.C. 1117
	9	COLUMN DIRECT WITH WEBS FILLED	2	1	F.O.C. 769

LEGEND:

U.L.C. -- UNDERWRITERS' LABORATORIES OF CANADA, TORONTO, ONT.
U.L.I. -- UNDERWRITERS' LABORATORIES INCORPORATED, CHICAGO, ILL.
F.O.C. -- FIRE OFFICES COMMITTEE, GREAT BRITAIN

* -- SPRAYED "LIMPET" ASBESTOS WAS APPLIED OVER METAL LATH 1½" & 1½" THICK TO SIDES AND BOTTOM OF BEAM RESPECTIVELY.

Fireproofing

In many modern plants such as oil refineries, extremely volatile liquids are processed and the fire regulations are severe. SPRAYED "LIMPET" ASBESTOS has a full line of recognized fire tests by such authorities as Underwriters Laboratories, Inc. of Chicago and Canada, and the fire offices Committee of Great Britain.

Acoustics & Noise Control

It is now recognized that excessive noise may actually affect the efficiency and productivity of workers. In addition some processes essential to our way of life are located in built-up areas where the nuisance (Gas Compressor Stations for example) is cause for concern by plant owners.

For the comfort of people in a noisy area "Limpet" may be applied for a noise reduction coefficient (N.R.C.) as high as 90%.

Items of equipment which are noise producers can often be treated or localized, but since the conditions vary so much no standard specification (other than for large flat areas) will cover all of the cases. Keasbey & Mattison will engineer a system for any condition on request.

SPRAYED "LIMPET" ASBESTOS' reverberation-dampening qualities make it a great asset in the treatment of ducting, fan and blower chambers, and similar plants. The objectionable drumming and reverberation inseparable from such installations is consequently eliminated or greatly reduced.

The Sound Absorption Qualities of "LIMPET"

The remarkable acoustical properties of "LIMPET" are shown in the following tables. All the tests shown are with self-bonding fiber.

Tests on Solid Backing

For this group of tests the "LIMPET" was sprayed on a solid backing, with panels laid face up on the floor of the reverberation chamber. This is equivalent to application on a solid surface such as plaster or masonry.

Thickness	Painting	Sound Absorption Coefficient Frequency—cycles per second						Noise Coeff.
		128	256	512	1024	2048	4096	
½"	2 coats	.08	.27	.53	.65	.71	.59	.55
¾"	Unpainted	.08	.19	.70	.89	.95	.85	.70
¾"	2 coats	.09	.23	.67	.90	.93	.87	.70
1"	Unpainted	.30	.42	.74	.96	.95	.96	.75
1½"	Unpainted	.16	.59	.98	.98	.97	.90	.90
1½"	2 coats	.16	.62	.94	.98	.94	.91	.85

Note—Painting was with Oil Emulsion Paint, sprayed on.

Tests on Metal Lath

This group of tests was made on "LIMPET" sprayed directly on metal lath with an air space behind the lath. The thickness of "LIMPET" shown is measured in each case from the back of the lath. Notice particularly the high sound absorption at all frequencies when so applied.

Thickness	Painting	Sound Absorption Coefficient Frequency—cycles per second						Noise Coeff.
		128	256	512	1024	2048	4096	
½"	Unpainted	.25	.78	.97	.81	.82	.85	.85
½"	2 coats	.27	.75	.90	.75	.80	.88	.80
¾"	Unpainted	.41	.88	.90	.88	.91	.81	.90
¾"	2 coats	.49	.90	.93	.86	.81	.82	.90
¾"	10 coats	.48	.91	.91	.86	.87	.87	.90

Note—Painting was with Oil Emulsion Paint, sprayed on.

"Sound Absorption" has been defined and explained by the National Bureau of Standards: "The Sound Absorption Coefficient is defined as the absorbed fraction of the sound energy incident on a material."

The absorption varies at different sound frequencies, which are expressed in cycles (vibrations) per second and indicate the pitch of the sound. No known material has a "flat" curve. Neither do all materials attain maximum absorption at the same frequency.

Corrosion Prevention (Structural Steel)

Owing to the exceptionally strong capillary or wick action, which is a feature of SPRAYED "LIMPET" ASBESTOS, and which arises from the perfect face to face contact and the physical structure of the material (being composed of bundles of extremely fine Fibers*). Any moisture vapor entering the "LIMPET" at times of peak humidity is condensed within the coating and rapidly drawn to the outside face where it is re-evaporated into the atmosphere.

Simplified this means that "LIMPET" 'breathes in' water vapor which would otherwise condense and fall in drops, and when atmospheric conditions return to normal (by the lowering of the humidity) - it 'breathes out' this water again.

COMPARISON OF DIAMETERS OF VARIOUS FIBERS WITH ASBESTOS*

Type of Fiber	Fiber Diameter (Inches)	Fibrils in one Linear Inch
Human Hair	.00158	630
Ramie	.000985	1,015
Wool	.0008 to .0011	910 to 1,250
Cotton	.0004	2,500
Rayon	.0003	3,300
Nylon	.0003	3,300
Glass	.00026	3,840
Rockwool	.000142 to .000284	3,520 to 7,040
Asbestos (Chrysotile)	.000000706 to .0000018	850,000 to 1,400,000

*Canadian Mining and Metullurgical Bulletin, April, 1951

This property by preventing the oxidation of metal surfaces, enables "LIMPET" to function as an effective anti-corrosion treatment, provided that the metal surfaces have been painted to resist attack before the "LIMPET" has been applied. It should be noted that "LIMPET" contains nothing which can at any temperature or under any circumstance attack metals except aluminum which requires special treatment.

The foregoing deals only with the problems of rusting. However, some plants emit fumes with a high sulphur content consequently there can be a build up of moisture vapor which under certain conditions will mean deposition of mild sulphuric acids on unprotected steel which can lead to prohibitive maintenance costs.



An uninsulated toe board painted at intervals during 15-25 years service. Corrosion is very heavy.

Recently several steel columns to which "LIMPET" had been applied in 1934 (26 years) were partially stripped for examination. This was at a dye producing facility of Imperial Chemical Industries in England. The steel was found to be in its original mill condition while unprotected steel (other than bi-yearly painting) was pitted and corroded to an astonishing degree. (A case history of this is being prepared which can be supplied with photographs on request.)



A riveted beam insulated with SPRAYED "LIMPET" ASBESTOS and hard surfacing composition 26 years ago. This beam is in excellent condition. The steelwork was insulated over shop primer in 1934 when the plant was originally built.



A main beam insulated with S. L. A. and hard surfacing composition 26 years ago. The beam is still in excellent condition apart from some slight surface scaling. The steelwork was insulated over shop primer only in 1934 when the plant was originally built.

Corrosion Prevention (Equipment)

This section deals with corrosion with respect to items which have heat within, i.e. Stacks, Ducts, etc. This problem must be approached with caution and is entirely different from steel at ambient temperature.

Because of the ease of application of "LIMPET" (piped through a 2" hose) there is a tendency for users to suggest its application to the inside of large Ducts. In theory clips, mesh and finish are eliminated.

"LIMPET" Should Always Be Applied on the Exterior, Never Inside!

If the "LIMPET" were applied inside, the metal casing of the duct is insulated. It rapidly would reach ambient temperature which would be much lower than that of the hot gases.

Because the temperature gradient is from the inside toward the metal the hot gases will reach dew point and condense within the insulation causing an acidic poultice to build up and cause corrosion.

The following extract will help explain the situation fully.

EXTRACT FROM THE 1955 GUIDE PUBLISHED BY THE AMERICAN SOCIETY OF HEATING AND AIR-CONDITIONING ENGINEERS

CHIMNEYS AND FLUE DUCTS

CONDENSATION AND CORROSION

Sulfur dioxide or sulfur trioxide, formed by the combustion of sulfur in fuels, are the principal corroding substances is flue gases. They become active whenever sufficient moisture is present for the formation of sulfurous or sulfuric acid, and they lower the dew points of flue gases appreciably. Therefore, unless heating equipment is designed for operation at flue gas temperatures below the dew point, which is seldom the case, it is always advisable to maintain temperatures above this value in all parts of the appliance. Excessive spot temperatures in the combustion chamber or elsewhere, on the other hand, are also destructive in that they may result in rapid oxidation of ordinary heating surfaces. American standard requirements for gas furnaces, floor furnaces, and recessed heaters, for example, specify that minimum spot heating surface temperatures during normal operation must neither fall below 178 F (50 F above average dew point) nor exceed 875 F on any portion of the heating surface. In any event it is usually desirable to maintain flue temperatures within the limits indicated not only throughout the appliance, but in its

connecting vent, flue, or chimney as well. Otherwise, excessive condensation and corrosion problems, with resultant customer dissatisfaction, will in all probability be the result. Average dewpoint temperatures of flue gases resulting from the combustion of various fuels, when burned with the amount of excess air normally supplied to insure complete combustion, are shown in the Table.

AVERAGE FLUE GAS DEW-POINT FOR VARIOUS FUELS

Type of Fuel	Average Dew-Point Temperature, F
Anthracite	68
Semi-Bituminous Coal	84
Bituminous Coal	93
Oil	111
Natural Gas	127
Manufactured Gas	137
Propane Gas (2500 B.T.U/cu.ft.)	119
Butane Gas (3200 B.T.U/cu.ft.)	124
Butane-Air Gas Mixture (535 B.T.U/cu.ft.)	121

SPRAYED "LIMPET" ASBESTOS is the ideal material for insulating chimneys, gas flues, etc. By keeping the gases above dew point they leave the ducts in gaseous and relatively inactive form. Proof of this is the tests conducted in 1952 for four steel stacks at the Klip River Power Station in South Africa.

SPRAYED "LIMPET" ASBESTOS - TYPICAL APPLICATION

PROJECT: Thermal Insulation of steel stacks at Klip River Power Station, Johannesburg, South Africa.

Purpose: To maintain flue gases above dewpoint and thereby reduce corrosion of inner surfaces of steel stacks.

DATA:

Diameter of stacks	8 ft. 6 in.
Height of stacks above point of entry of gases	190 ft.
Inlet temperature of gases	275°F
Weight of gases passed up stack	100 lbs./sec.

SPECIFICATION: A SPRAYED "LIMPET" ASBESTOS coating to be applied - of sufficient thickness to maintain the flue gases above 250°F - to the outer surfaces of the stacks. The insulation coating to receive a hard surface coat to withstand rain and hail.

APPLICATION: Steel pins welded - at staggered centers - to the outer surfaces of the stacks to provide support for the insulation and weatherproof coating. SPRAYED "LIMPET" ASBESTOS applied to form a continuous uniform coating of 1" thickness. The surface of the insulation wrapped with chicken wire to form a key for the hard surfacing composition - applied in a thickness of 1/4". Expansion joints provided in the hard surface coating at 6 ft. 0 in. centers.

TEST: Tests were carried out by the Customer - after completion of the first stack - to determine the efficiency of the "LIMPET" coating.

The test results were as follows:

		Insulated Stack	Uninsulated Stack
12'0' above Gas Inlet	Ambient temperature °F	73.4	73.4
	Gas temperature °F	269.6	267.8
	Plate temperature °F	228.2	179.6
5' 0" from top of stack	Ambient temperature °F	66.2	65.3
	Gas temperature °F	267.8	233.4
	Plate temperature °F	222.8	107.6
Temp. Drop	Gas °F	1.8	34.4
	Plate °F	5.4	72.0

Fiber Blends

Since the development of SPRAYED "LIMPET" ASBESTOS in the early thirties there have been many blends of 100% Asbestos Fibers for specialized uses. Examples are - Railway passenger coaches, for anti-drumming and thermal insulation for both tropical and cold climates. Ship's hull insulation, Industrial High Temperature Insulation, Steel Building Insulation, Fireproofing, lighter color blends for exposed acoustical treatment and so on.

In the United States Keasbey & Mattison has now standardized on two fiber blends which cover all industrial applications. They are LW.25 and LB.8. The former stands for "LIMPET" White, blend No. 25 and the latter for "LIMPET" Blue blend No. 8. They are recognizable immediately on sight by their distinctive colors.

LW.25

This is a blend of Amosite Fibers (Calcium- Magnesium- Silicate) consisting of long fine but non-flexible fibers used for this reason for insulation compositions. A dry inorganic binder is incorporated with the Asbestos Fibers. This blend is the standard used to obtain all U. L. I. Fire Retardant Ratings and is commonly used for acoustical use and condensation control. Its recommended temperature limit is 700°F. (Hot face).

The following table has been established from weights obtained by skilled spray operators. For estimating purposes allowance should be made for variation in take-off, skill of operators and overall material requirements.

APPROXIMATE COVERAGE OF LW.25 AT DIFFERENT THICKNESSES ON LARGE FLAT AREAS

Thickness Finished	Ounces per sq. ft.	Lbs. per 100 sq. ft.	Sq. ft. per 84 lb. bag
1/2"	9.8	61	137
1"	14.6	91	92
1-1/2"	19.4	121	69
2"	24.2	151	56
3"	33.8	211	40

NOTE: For first applications a safe estimate is 1 lb. per sq. ft. 1" thick.

LB.8

This blend is of Crocidolite Asbestos (Soda-Iron-Magnesium Silicate) specially developed for high temperature insulation. Formerly its recommended temperature limit was 1200°F. Approximately 100° above that needed for the insulation of steam turbines. With the insulation trend in modern processing toward higher and higher temperatures LB.8 has been applied successfully to a hot face temperature of 1380°F and its temperature limit has not yet been determined. See steam turbine section for the initial 1-1/4" heavy density method for the higher temperature range.

APPROXIMATE COVERAGE OF LB. 8 AT DIFFERENT THICKNESSES ON FLAT AREAS

Thickness Finished	Ounces per sq. ft.	Lbs. per 100 sq. ft.	Sq. ft. per 100 lb. bag
1/2"	11.5	71	97
1"	17.6	110	64
1-1/2"	23.4	146	48
2"	24.2	182	38
3"	33.8	255	27

NOTE: LB. 8 is less compressible than LW. 25 and the coverage in the above table is obtainable on first applications.

BD. 2 - Bull Dog Finish No. 2

This product is made by K&M. It is an Asbestos and Portland Cement mixture which is troweled on where a hard surface finish is required on "LIMPET." It may be used on cold items (Fireproofed Columns, vessel skirts, etc.) or heated equipment (Ducts, Boilers, Turbines, etc.).

Since "LIMPET" has a high wicking action it should be lightly oversprayed with water before BD. 2 is applied. The mixture should be 1 pound of BD. 2 to 3 pounds of water, only sufficient being mixed to use within 1 hour.

On hot equipment or in a warm area slightly more water may be used and the BD. 2 must be damped every hour for eight hours to prevent cracking.

Additionally where expansion and contraction of metal can be expected the BD. 2 must be scored with a cement finisher's tool through to the "LIMPET" to control cracking. Panels should be no more than 20 square feet.

Where condensation is likely BD. 2 should only be painted with water paint. Where it is not expected oil-base paint may be used, provided it is alkali resistant.

BD. 2 should never be used outdoors on equipment which cycles from hot to cold over any period of time. In such cases weatherproofing of the breathing type reinforced with chicken mesh should be applied.

Other Finishes

Any insulation cement with a Portland Cement content is liable to crack when used on high temperature equipment, even if reinforced with chicken mesh. If

the precautions above are observed any cracking of BD. 2 will be slight or generally controlled if scored.

In areas where appearance is important a canvas finish over the BD. 2 may be necessary.

In the event of customer preference for a certain type of finish it should be kept in mind that any finish which performs well on other types of insulation will work over "LIMPET."

If it is plastic slightly more water than normal should be used and the "LIMPET" damped slightly.

COVERAGE OF BD. 2 AT DIFFERENT
THICKNESSES ON LARGE FLAT AREAS

Thickness	Ozs. sq. ft.	Lbs. 100 sq. ft.	Sq. ft. 50 lb. bags
1/8"	9.5	59.4	84
1/4"	19.0	118.8	42
3/8"	28.5	178.2	28

BD. 2 is mixed in the proportion of 19 gallons of water to 50 lbs. of BD. 2

Introduction to Specifications

To anyone who has never seen "LIMPET" sprayed, the automatic reaction is to compare it mentally with paint spraying or cement slurry. They cannot be compared. Both of the previous items are mixed with liquids and then ejected from a nozzle under hydraulic pressure. Consequently, these operations are difficult to control for either accurate placement or thickness.

SPRAYED "LIMPET" ASBESTOS is unique in that during the major part of the spray process, the fiber is DRY.

Description of Process

Dry fiber is fed to the machine hopper, where it is opened and fluffed. It is then conveyed up an inclined creeper sheet. Two circular wire brushes meter and drop the fiber into a fan unit, which by air pressure drives the fiber through a two-inch rubber hose. (Standard length 50 feet.)

The asbestos leaves the gun still dry. A series of apertures at the gun also sprays a fine water mist, which is focused to wet the fiber nine inches from the gun end.

The surface being sprayed is 18 inches from the gun. Very little water is used. For example, a handful of "LIMPET" just sprayed, when squeezed will only show a few drops of water between the fingers.

"LIMPET" Comparison to Conventional Materials

The most common insulation materials are insulating cements, blocks, and blankets. Each of these materials has certain characteristics which dictate the best use of the material.

Conversely these characteristics dictate when the material should not be used.

SPRAYED "LIMPET" ASBESTOS is truly unique because it has the best feature of the conventional materials. Additionally, "LIMPET" offers unusual advantages because the process is largely mechanized.

The following check list details:

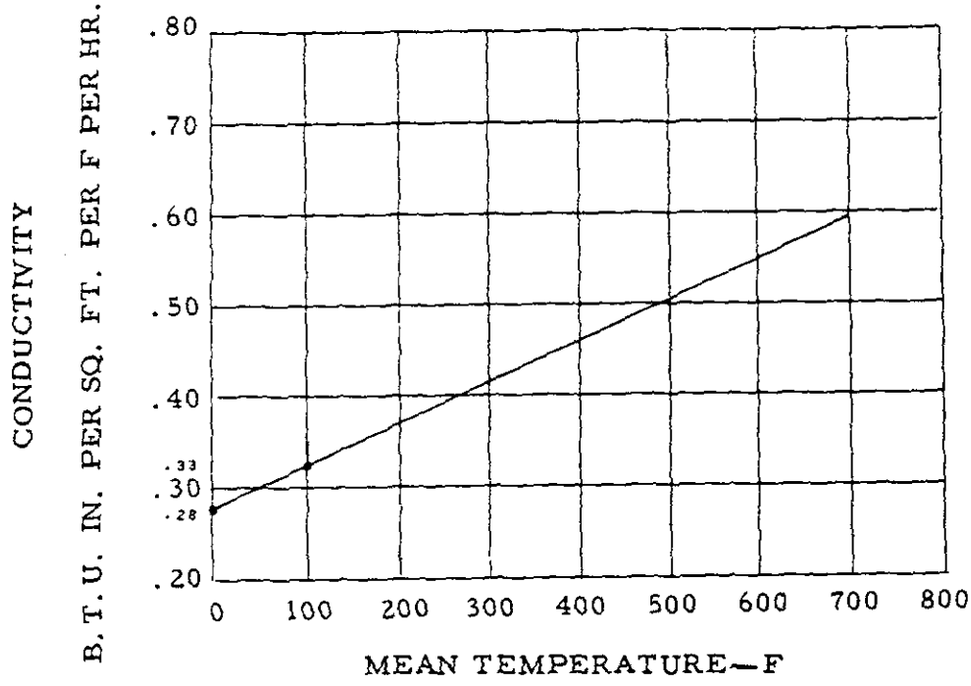
THE ADVANTAGES OF SPRAYED "LIMPET" ASBESTOS

FEATURES	"LIMPET"	Blocks	Blankets	Cement
1. Good "K" Factor	X	X	X	X
2. Fast Application for large areas	X		X	
3. No cutting or fitting.	X			X
4. Any thickness in one layer.	X			
5. Fast drying.	X	X	X	
6. Clean.	X		X	
7. Perfect face contact on all shapes.	X			X
8. Minimum reinforcement.	X			
9. Easily patched.	X			X
10. Resistance to vibration.	X	X		
11. No joints.	X			X
12. Machine applied.	X			

THERMAL CONDUCTIVITY OF

SPRAYED "LIMPET" ASBESTOS

FOR HIGH TEMPERATURES



Economical Thickness

The recommended economical thicknesses are underlined in the Heat Transmission Table. They are the optimum thickness based on heat conservation under most operating conditions and assure adequate temperature control. Other conditions may warrant the use of other thicknesses.

Surface temperatures are given only to indicate an approximate value for personnel protection and safety. They are theoretical values, usually based on one set of conditions such as indicated in the Heat Transmission Table. Actual surface temperatures vary widely depending on surface finishes, velocity of air, radiation from nearby objects, etc. The major reason for heat insulation is to save valuable heat, therefore the proper thickness should be based on Economics.

Our applicators can help you determine the economical thickness to suit your conditions. Also check with them for the use of SPRAYED "LIMPET" ASBESTOS at higher temperatures than those shown.

SPRAYED "LIMPET" ASBESTOS INSULATION
HEAT TRANSMISSION

Expressed in B. T. U. per square foot per hour (based on 80° F ambient still air temperature)

FOR FLAT AND LARGE DIAMETER SURFACES

THICKNESS	100		200		300		400		500		600		700		800		900		1000		1100		1200		1350	
	S.T.	H.L.	S.T.	H.L.	S.T.	H.L.	S.T.	H.L.	S.T.	H.L.	S.T.	H.L.	S.T.	H.L.	S.T.	H.L.	S.T.	H.L.	S.T.	H.L.	S.T.	H.L.	S.T.	H.L.	S.T.	H.L.
1"	89	5.6	99	35.6	116	69.2	134	106																		
1-1/2"	82	3.9	94	25.0	106	48.5	119	74.8	133	103	147	135														
2"	82	3.0	91	19.3	100	37.3	110	57.3	121	79.3	133	103	145	130												
2-1/2"	81	2.5	89	15.7	96	30.4	105	46.6	114	64.4	124	84.0	134	105	144	129										
3"			87	13.2	94	25.6	101	39.2	109	54.3	117	70.7	126	88.6	135	108	145	129								
3-1/2"					92	22.1	98	33.9	105	46.9	112	61.1	120	76.5	128	93.4	137	112	146	131						
4"							96	29.8	102	41.3	109	53.7	115	67.3	123	82.1	130	98.2	138	115	147	134	156	154		
4-1/2"									100	36.8	106	48.0	112	60.1	118	73.3	125	87.6	133	103	140	120	149	138	160	165
5"											104	44.7	109	54.3	115	66.2	121	79.1	128	93.1	135	108	143	124	153	146
5-1/2"													107	50.6	112	60.4	118	72.1	124	84.8	131	98.5	137	113	142	101
6"															110	56.3	114	66.7	121	78.0	127	90.5	133	104	141	123
6-1/2"																			117	73.2	123	83.7	129	96.2	138	118
7"																					121	78.3	126	89.2	135	107

S.T. - Surface Temperature

H.L. - Heat Loss

Keasbey & Mattison Co., Ambler, Pa.

SPRAYED "LIMPET" ASBESTOS

THERMAL INSULATION FOR HIGH TEMPERATURES

APPLICATION SPECIFICATIONS

1. Scope of Work

This specification covers the furnishing, delivery, unloading, hauling, storing, protecting and application of SPRAYED "LIMPET" ASBESTOS Thermal Insulation on equipment, tanks, vessels, ducts, fans, etc.

2. Work by Contractor

The contractor shall furnish all supervision, labor, materials, tools and equipment to perform the work specified herein.

3. By Owner

Owner shall furnish 200 to 220 volt, 60 cycle, single or three phase, A.C. electric power, air at 8 cubic feet per minute minimum and water at no less than 35 p.s.i., 4 gallons per minute (contractor can furnish air if necessary).

4. Application and Workmanship

The application of SPRAYED "LIMPET" ASBESTOS shall be carried out solely by applicators approved and appointed by Keasbey & Mattison Company and shall be:

a. By skilled tradesmen, fully conversant with the methods of application as taught by the manufacturer and as laid down in the specifications.

b. By the use of equipment supplied by Keasbey & Mattison Company

c. The completed application shall be even in texture and applied to the required thickness or thicknesses as defined on the drawings and listed in the instructions issued against the specific contract.

5. General

This specification is designed to insure the thermal insulation by SPRAYED

"LIMPET" ASBESTOS shall be in accordance with the standard laid down by Keasbey & Mattison Company. Adherence to the following specifications will insure that maximum advantage is derived from the low thermal conductivity and diffusivity value of the material.

6. Material - "LIMPET" ASBESTOS Fiber

Material of the appropriate grade supplied by Keasbey & Mattison Company will be used, and shall comprise selected asbestos fiber only, with an inorganic binder. It must be free from adulterants in the form of rock, mineral, slag, wool, glass.

7. Temperature Range

On surface temperatures up to 700°F Keasbey & Mattison Company SPRAYED "LIMPET" ASBESTOS Grade LW. 25 shall be used. Surface temperatures from 701°F to 1350°F use only Grade LB. 8.

8. Insulation Thickness

Thickness is to be determined by the permissible heat loss allowed for the surrounding conditions.

9. Surface Preparation

All surfaces to be treated should be clean, firm, and free from dust, dirt, grease, flaking paint or any other foreign matter likely to create a false bond. Concrete surfaces shall be free from loose particles; metal lath surfaces free from rust.

10. Spraying Equipment

Only machines supplied by Keasbey & Mattison Company and designed for spraying LW. 25 and LB. 8 are to be used.

11. Density

LW. 25 after pressing with hand trowel shall have a density of 14 to 15 oz. per sq. ft. 1" thick.

LW. 8 after pressing with hand trowel shall have a density of 17 to 18 oz. per sq. ft. 1" thick.

The following are suggested specifications for the use of SPRAYED "LIMPET" ASBESTOS and are for guidance only and specific questions with regard to other applications can be answered by contacting Keasbey & Mattison Company's Industrial Applicators.

PART ONE (1)

SPECIFICATION FOR OUTSIDE STORAGE TANKS, VESSELS, HEAT EXCHANGERS, ETC. VERTICAL STORAGE TANKS & VESSEL FLASHING AT EAVE (TOP NOT INSULATED)

A steel angle shall be furnished and continuously welded at the eave of the tank of vessel by others. It shall extend 1/2" beyond the thickness of the insulation. See Dwg. No. SLA-1.

Flashing at bottom - See Dwg. No. SLA-1

Flashing at Manholes, support angles, etc. - See Dwg. No. SLA-1.

Finish

After SPRAYED "LIMPET" has been applied and pressed to proper thickness and density, regular 1" hexagonal 20 gauge wire mesh (galvanized or monel wire at customer's choice) shall be wrapped around and laced as per standard practice.

Over this surface two coats of Foster's H.I. Mastic 90-07 or approved equal shall be applied. The first coat is to be troweled into and flush with wire mesh. The second coat shall be applied immediately following the initial set and while still damp. The second coat shall be applied to yield a minimum dry thickness of 1/8" on top of the wire mesh, (8 gallons per 100 square feet). The minimum dry thickness of complete application shall be no less than 1/4" (16 gallons per 100 square feet).

Note:

Foster's Safetee Mastic 60-80 carrying Underwriter's label is recommended when insulation is to be protected and part of a unit or plant operating in a possible fire hazard area.

Alternate: Finish #1

If a hard surface finish is desired K&M's BD.2 finishing cement shall be troweled to 1/4" thickness over 1" hexagonal 20 gauge wire mesh which is

applied over the "LIMPET" as mentioned above. Over this apply 1" hexagonal 20 gauge wire mesh as mentioned and apply two coats of Foster's H.I. Mastic 90-07 as mentioned in finish specification above.

Alternate: Finish #2

Weatherproofing of large diameter vertical tanks or vessels using corrugated aluminum jacket should have factory applied moisture barrier.

(The following is based on .024" thick aluminum x 1-1/4" or 2-1/2" corrugations. Other thicknesses and corrugations may be used at customer's choice.)

Before spraying "LIMPET" ASBESTOS Insulation, determine the length of the .024" thick x 1-1/4" or 2-1/2" corrugated aluminum sheets with factory attached moisture barrier that will work most economically in the height of a tank or vessel. Also determine the circumferential lap desired (minimum 3") and at the proper location of the lap, at the top of the second course place a row of aluminum composite weldable studs of the proper length as manufactured by K.S.M. (or approved equal) at every third valley of the corrugations of the 2-1/2" corrugated aluminum sheets or every sixth valley of the 1-1/4" corrugated aluminum sheet. See Dwg. No. SLA-1A.

At the top of every other course place a row of studs as outlined above until the top of vessel is reached. A row of studs should also be placed at the eave of tank or vessel; about 4" below the flashing angle. See Dwg. SLA-1A.

After the studs are placed and K&M Co. SPRAYED "LIMPET" ASBESTOS Insulation is applied, start the first course of corrugated aluminum sheets. Lap the vertical joint two (2) corrugations, if 1-1/4" corrugated sheets are used and one (1) corrugation if 2-1/2" corrugated sheets are used. See Dwg. SLA-1A.

About 6" from the base of the first course place a 3/4" wide x .020" thick stainless steel strap with breather spring as manufactured by the-Techalloy Company, Inc. Other bands and breather spring should be spaced on centers not to exceed 4'-0". See Dwg. No. SLA-1A.

At the top of the first course place "S" clips at every third valley or every sixth valley depending on size of corrugations. This supports the second course (the "S" clips are made by bending the 3/4" wide x .020" stainless steel strap. The clips should be large enough to allow a circumferential lap of at least 3"). See Drawing No. SLA-1A.

Place the second course of corrugated sheets in the "S" clips, lapping the vertical joint the same as first course. A band, as mentioned above, is to

be placed 4" to 6" above the bottom of the lap (if so desired the band may be placed in "S" clip. See Drawing No. SLA-1A), the top of the second course to be impaled over the welded studs. The bottom of the third course is impaled over the studs at the top of the second course (Minimum lap 3"), place aluminum burr over aluminum head. Upset aluminum head of stud with rivet set or steel hammer. Intermediate bands and breather springs are applied as mentioned above between laps, on not more than 4'-0" centers.

The above procedure is followed until top of tank is reached. See Drawing No. SLA-1A.

To seal around protruding angles etc. use Foster's foamseal 30-45.

PART TWO

2:1 THE FOLLOWING SPECIFICATION IS FOR INDOOR VESSELS, BREACHINGS, DUCTS, FANS, BOILER, FLASH TANKS, HEAT EXCHANGER, DEAERATOR, FEED WATER HEATER, STAGE HEATERS, STEAM DRUM HEAD, ETC.

2:1-A Supports

Supports in the form of cables, rods and studs must be applied before the application of SPRAYED "LIMPET" Insulation. These supports are also used for fastening of 1" hexagonal wire mesh. See Drawing SLA-2.

2:1-B Finish

After SPRAYED "LIMPET" Insulation is applied and pressed to the proper thickness and density 1" hexagonal 20 gauge wire mesh (galvanized or monel wire at customer's choice) is to be stretched and laced tightly to the support studs, cables, rods, etc. See Dwg.

Over the hexagonal wire mesh trowel to a smooth finish a 3/8" coat of Keasbey & Mattison Company's BD. 2 finishing cement. If on large areas where it can be assumed that expansion and contraction are to be allowed for, the BD. 2 cement before it becomes dry must be scored with a cement finisher's tool through to the "LIMPET" to control cracking. The scoring should be in the form of panels about 4'-0" by 4'-0" square.

2:1-C Optional Finish

Where excellent appearance is desired, 6 oz. or 8 oz. canvas should be adhered securely over the BD. 2 finishing cement lapping all fabric seams a minimum of 2" and sized using Foster's Lagfas 81-42W or approved equal. The sizing coat shall be by brush application at the rate of 100 square feet

per gallon. To provide a more durable finish and/or decorative finish, one brush coat of Lagtone (color as selected) may be applied at the rate of 80 to 90 square feet per gallon in lieu of the sizing coat of Lagfas 81-42W. If this optional finish is used, the scoring mentioned above can be omitted.

2:1-D Removable Heads

See Drawing SLA-3 (indoor or outdoor).

2:2 THE FOLLOWING COVERS ECONOMIZER, AIR HEATER, FURNACE HOUSING, ROOF HOUSING, INDUCED DRAFT DUCTS AND FANS, HOT AIR DUCTS, GAS DUCTS, RECIRCULATING DUCTS, PRECIPITATORS, ETC.

2:2-A Supports

Weld #10 gauge KSM studs or approved equal to top, sides and bottom. Studs should be 24" o.c. on the top, 18" o.c. on the sides and sloping portions. On the bottom the studs should be 12" o.c. See Drawing SLA-4.

The length of the stud to be determined by the thickness of the insulation.

2:2-B Finishes

After K&M SPRAYED "LIMPET" ASBESTOS has been applied and before pressing, apply 1" hexagonal 20 gauge wire mesh (galvanized or monel wire at customer's choice). Then press, forcing hex mesh into "LIMPET" fastening same to the #10 gauge pins with 1-1/2" x 1-1/2" square speed washers. Corner beads to be applied to all corners. See Drawing No. SLA-4.

Then apply 3/8" thick coat of K & M Co. BD. 2 finishing cement troweled smooth and scored in 4'-0" square panels before drying using cement finisher's tool through to the "LIMPET" to control cracking. See Drawing SLA-4.

2:2-C Alternate Finish

Plasterer's Screed 4'-0" o.c. may be used for expansion in lieu of the above mentioned scoring.

2:2-D Optional Finish

See optional finish paragraph 2:1-C above.

PART THREE

3:1 THE FOLLOWING SPECIFICATION IS FOR STEAM TURBINES.

3:1-A Supports

If welding is permissible owner, manufacturer, or contractor shall weld KSM rectangular welding pins 1/8" x 3/8" split X the proper length, or approved equal, spaced approx. 18" o.c. on the lower half of casing only. See Drawing SLA-5.

3:1-B Alternate #1

If welding is not permissible, the casing may be drilled and tapped for 1/4" studs approx. 18" o.c. on the lower half of casing only by the owner or manufacturer. The studs are to be proper length with speed washers. See Drawing SLA-5 and SLA-5A.

3:1-C Brackets for Straps

The brackets are to be similar to those on Drawing SLA-5. They may be fastened by welding if this is permissible, or they can be fastened by drilling and tapping the flange. See Drawing SLA-5. These brackets are to be located at the four (4) quarter points of the circumference.

3:1-D Finish

If the turbine insulation is to be covered with a steel or aluminum casing or cladding, the "LIMPET" shall be left in its natural pressed finish. Several parts of this casing should be left off during startup period to allow the moisture to be driven off.

3:1-D-1 Alternate #1

In lieu of metal cladding, the "LIMPET" shall be finished with a 1/4" coat of BD. 2, reinforced with 1" hexagonal 20 ga. wire mesh (made from Monel or S.S. wire). This mesh is to be stretched tight over the KSM studs and secured with speed clips. See Drawing SLA-5 or 5A. After the BD. 2 is applied, it should be scored in 4-foot square panels through to the "LIMPET" using a cement finisher's tool.

3:2-A Application Procedures

The SPRAYED "LIMPET" ASBESTOS shall be built up to the required thick-

ness in two layers. Where adjacent surfaces have different thicknesses, a third layer is permissible. No more than half-an-hour (1/2) shall elapse between layers.

3:2-B The sequence of operation shall be as follows:

1. A suitable area on the underside shall be picked for a guide.

2. With water pressure at 15 p.s.i., an initial layer is sprayed to approx. 2-1/4".

3. This layer is not pressed, but consolidated to approx. 1-1/4" with a steel trowel edge, forming a criss-cross pattern.

4. The KSM rectangular welding pins mentioned in Paragraph 3:1-A are bent over into the coating as shown on Drawing SLA-5.

4a. If #10 Ga. KSM welding pins mentioned in alternate Paragraph 3:1-D-1 place a 1-1/2" x 1-1/2" speed washer over the coating as shown on Drawing SLA-5A.

5. With water pressure reduced to 12 p.s.i. spray second layer to 1/2" greater than required finished thickness, then press to final thickness.
   Note: Water pressures given are for when the water source is level with the spray area. Allow 1 p.s.i. more or less for every 2 ft. below or above water source, respectively.

6. After the guide layer is complete, repeat the procedure on adjacent areas until bottom half of turbine is covered.
   Note: Above procedure is for a one machine operation. If two or more machines are used, one crew may spray and compact initial layer continuously while second crew follows and completes spraying.

7. If the customer wishes an easy break-open point at flanges for repair work, the "LIMPET" should be tapered into casing. Asbestos paper three-quarters the length of the taper may be adhered to same with sodium silicate or staples. Then the "LIMPET" can be sprayed to the flange and asbestos paper. This procedure allows for easy removal of the "LIMPET" for repair work.

8. Place the 3/4" x .020 stainless steel straps through the brackets mentioned in Paragraph 3:1-C and tighten under final coat-

ings on lower casing and fasten using wing type stainless steel seals as manufactured by Acme or approved equal.

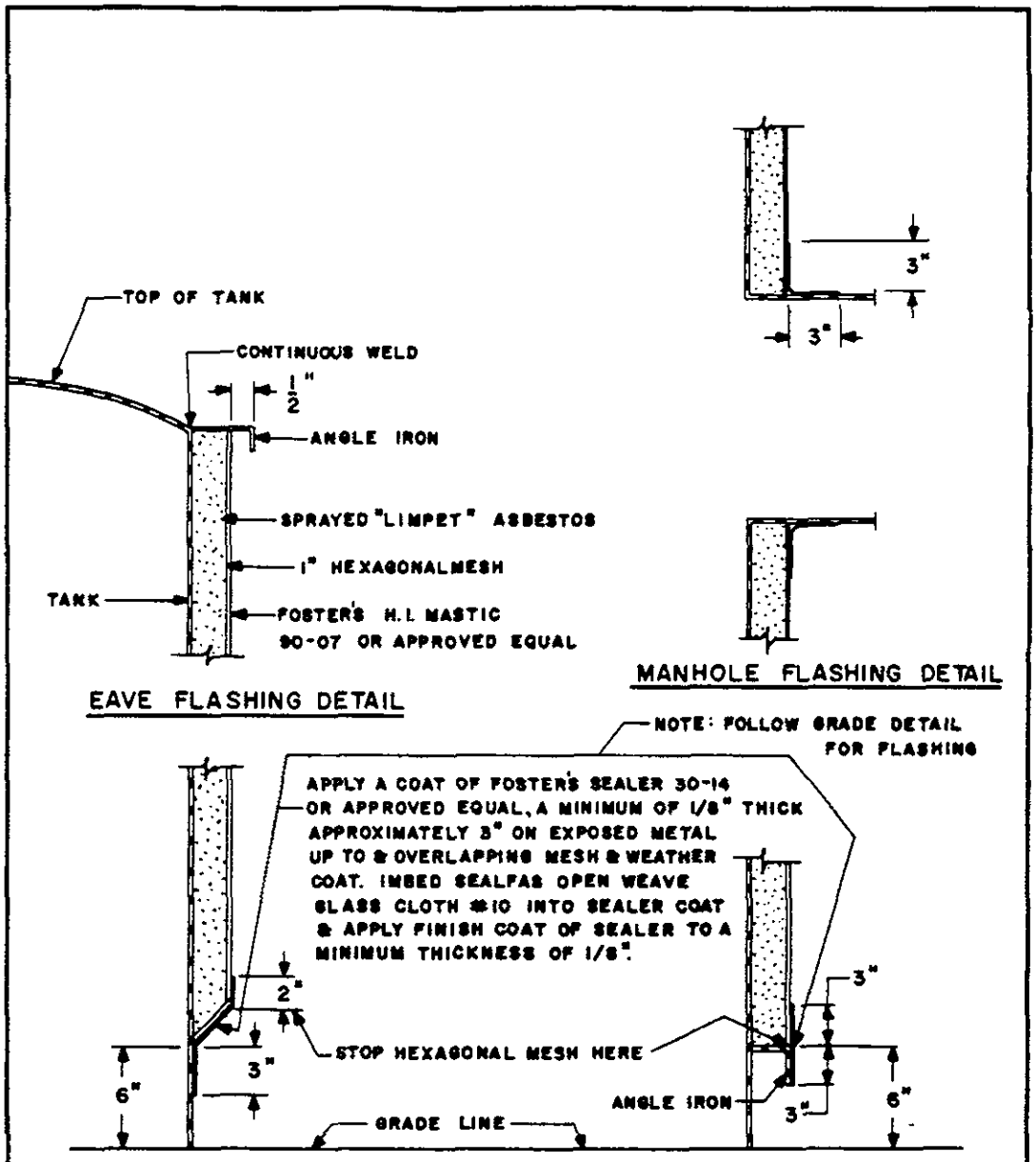
8a. If BD. 2 finish is used, 1" hexagonal mesh as specified in Paragraph 3:1-D-1 is to be used in lieu of bands.

3:2-C Flange Bolts

If so desired, Asbestos Paper or Cloth may be wrapped around bolts above the flange and secured with wire. Space between bolts and casing shall be hand-packed with dry LB. 8 "LIMPET." This will facilitate removal for repair work.

3:3-A Spraying Sequence:

1. Underside of turbine casing.
2. Steam transfer lines above the casing.
3. Top half of turbine casing.
4. Horizontal flange.
5. Steam main to casing.
6. Valve chests and auxiliaries.



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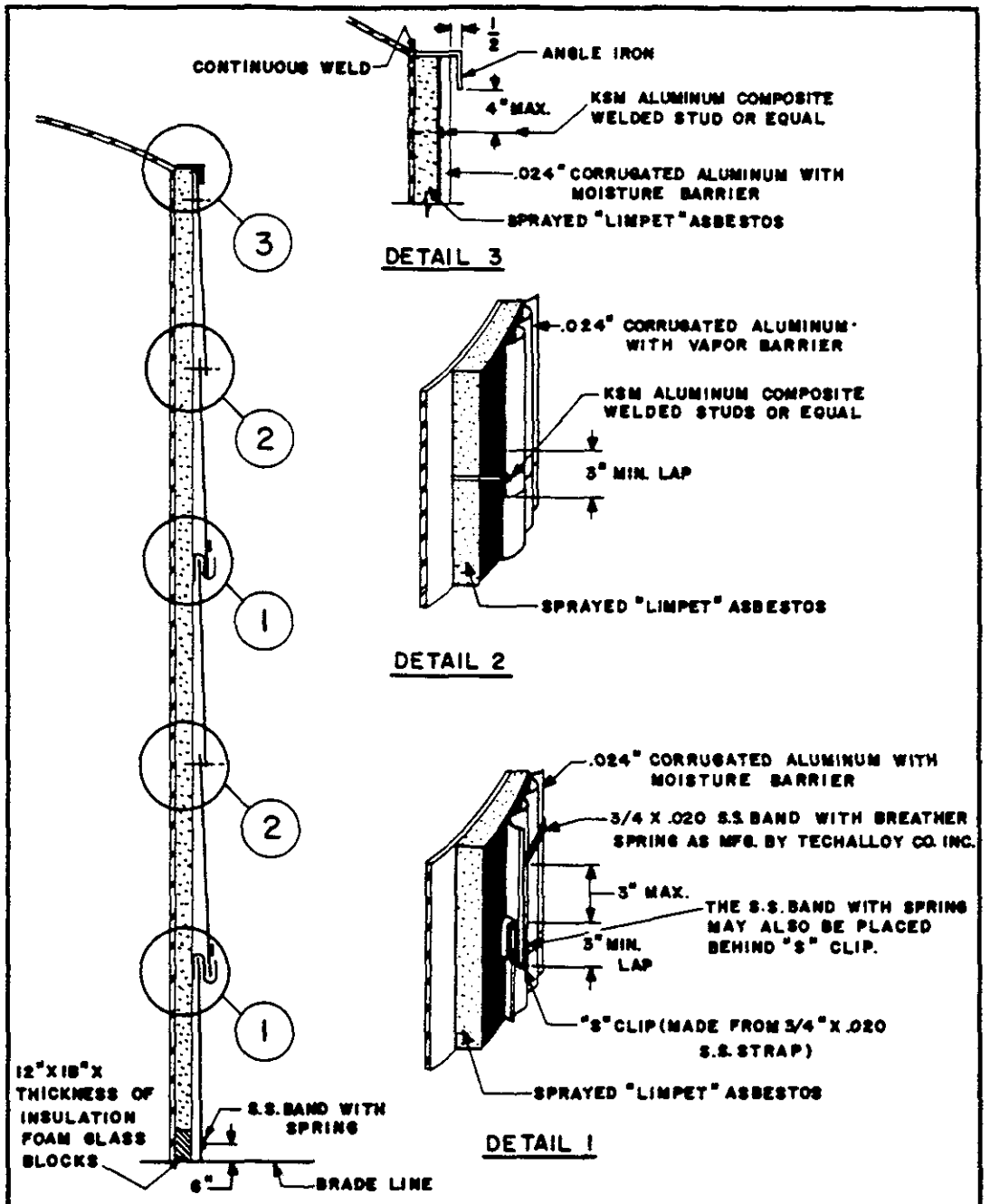
SPRAYED "LIMPET" ASBESTOS THERMAL INSULATION FOR OUTSIDE STORAGE TANKS & VESSELS			DRAWING NO. S.L.A. – 1
DRAWN BY E.F.Ott Jr.	APPROVED	KEASBEY & MATTISON COMPANY AMBLER, PENNA.	DATE 1-5-61



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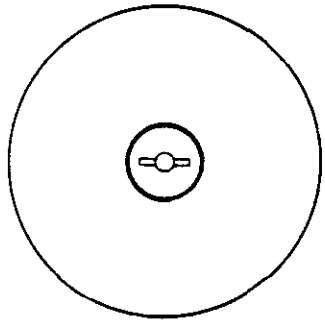
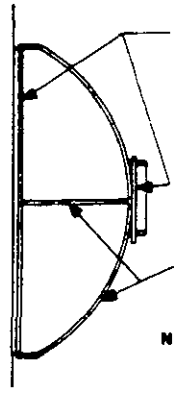


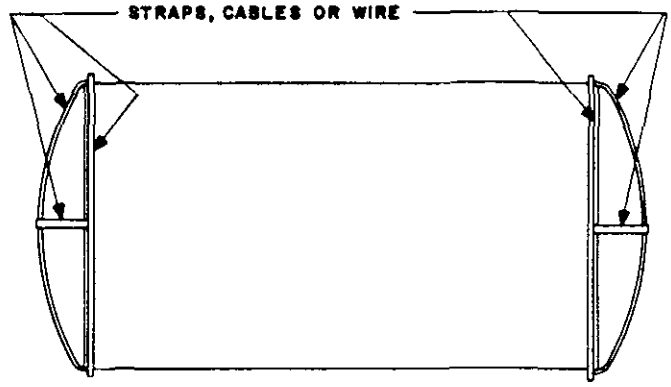


NOTE: FASTEN LACING WIRE TO STRAPS, CABLES, ETC. TO FASTEN 1" HEXAGONAL MESH AFTER SPRAYED LIMPET ASBESTOS IS APPLIED.

FRONT SIDE

STEAM DRUM HEAD

NO SCALE

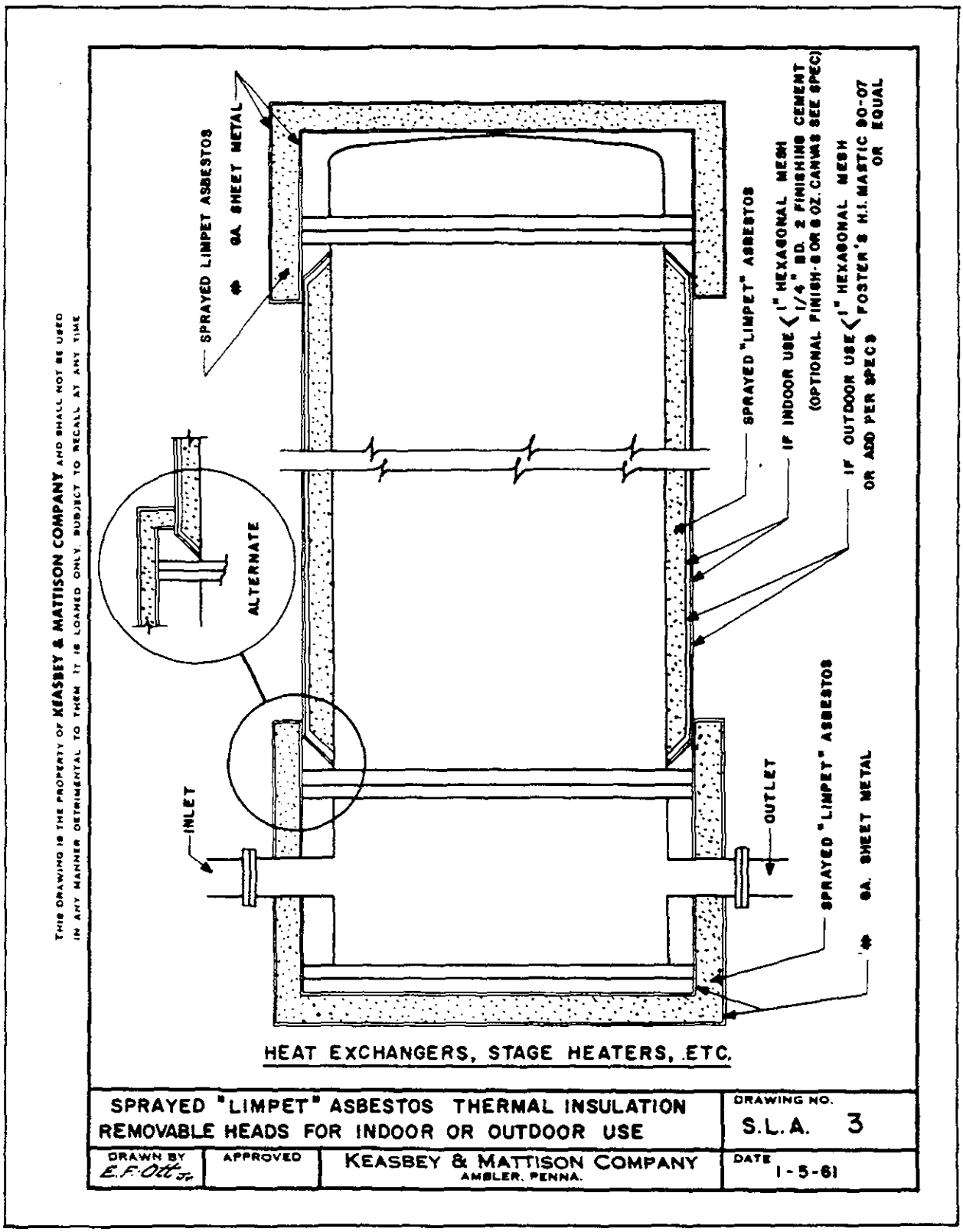


STORAGE TANKS ETC.

NO SCALE

NOTE: FASTEN LACING WIRE TO STRAPS, CABLES, ETC. TO SECURE 1" HEXAGONAL WIRE MESH AFTER SPRAYED "LIMPET" ASBESTOS IS APPLIED. KSM OR EQUAL WELDED STUDS MAY BE USED IN LIEU OF STRAPS, CABLES, ETC.

SPRAYED "LIMPET" ASBESTOS THERMAL INSULATION FOR INSIDE STEAM DRUM HEADS - STORAGE TANKS, ETC.			DRAWING NO. S.L.A. 2
DRAWN BY E. F. Ottz	APPROVED	KEASBEY & MATTISON COMPANY AMBLER, PENNA.	DATE 1-5-61


SPRAYED LIMPET ASBESTOS
8A. SHEET METAL
SPRAYED "LIMPET" ASBESTOS
IF INDOOR USE 1" HEXAGONAL MESH 1/4" SD. 2 FINISHING CEMENT (OPTIONAL FINISH-8 OR 6 OZ. CANVAS SEE SPEC)
IF OUTDOOR USE 1" HEXAGONAL MESH OR ADD PER SPECS FOSTER'S H.I. MASTIC 30-07 OR EQUAL
ALTERNATE
INLET
OUTLET
SPRAYED "LIMPET" ASBESTOS
8A. SHEET METAL
HEAT EXCHANGERS, STAGE HEATERS, ETC.
SPRAYED "LIMPET" ASBESTOS THERMAL INSULATION
REMOVABLE HEADS FOR INDOOR OR OUTDOOR USE
DRAWING NO. S.L.A. 3
DRAWN BY E.F.Otto
APPROVED
KEASBEY & MATTISON COMPANY AMBLER, PENNA.
DATE 1-5-61
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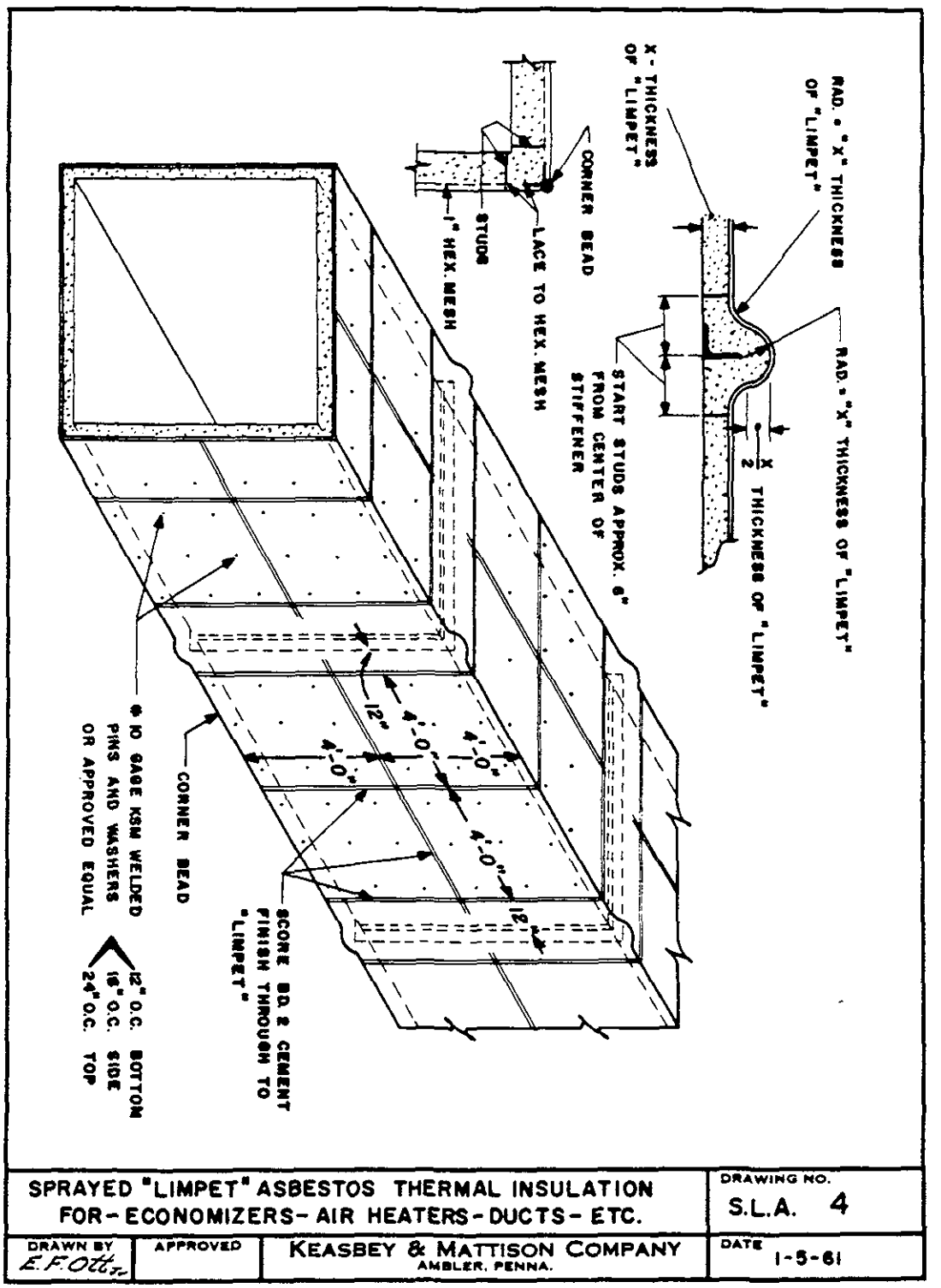

SPRAYED "LIMPET" ASBESTOS THERMAL INSULATION FOR - ECONOMIZERS - AIR HEATERS - DUCTS - ETC.			DRAWING NO. S.L.A. 4
DRAWN BY E.F.Otts	APPROVED	KEASBEY & MATTISON COMPANY AMBLER, PENNA.	DATE 1-5-61

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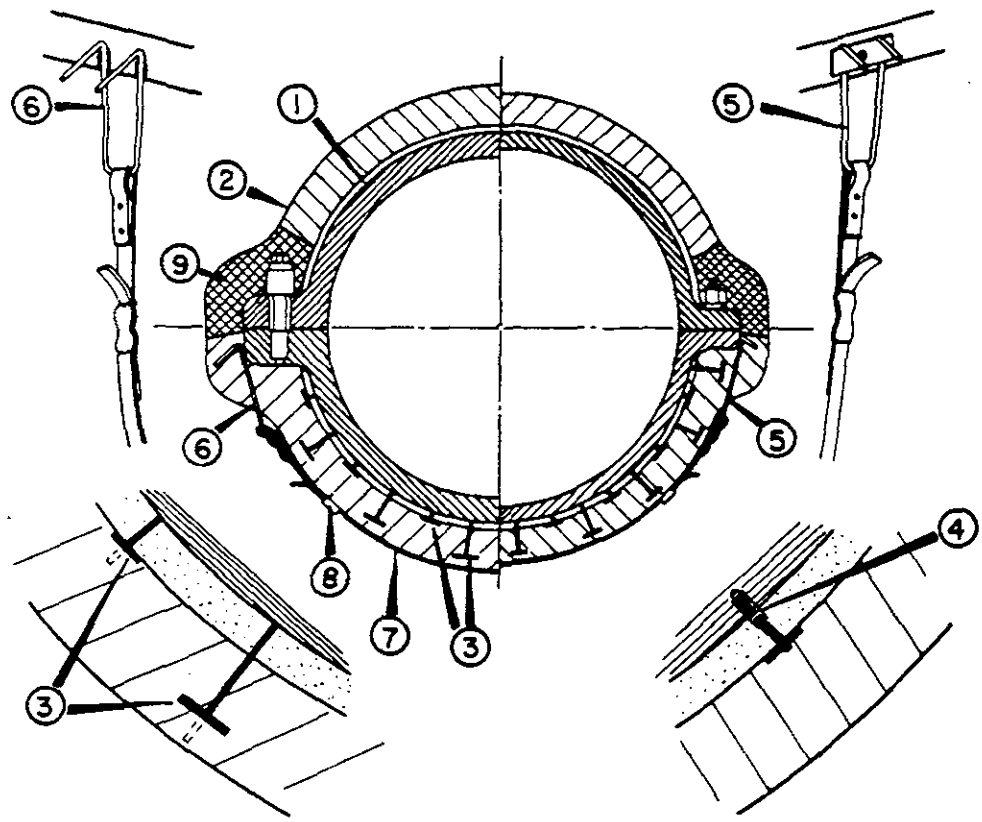

NOTES –

1 HIGH DENSITY LAYER.

2 NORMAL DENSITY.

3 KSM RECTANGULAR WELDING PINS 1/8" X 3/8" SPLIT BY THE PROPER LENGTH.

4 ALTERNATE: IF WELDING IS NOT PERMISSABLE, CASING TO BE DRILLED AND TAPPED FOR STUDS AND SPEED WASHERS.

5 STRAP BRACKET SCREWED ON.

6 STRAP BRACKET WELDED ON.

7 S.S. STRAP 3/4" X .020" THICK.

8 SEAL.

9 SEPERATE FLANGE JOINT ISOLATION.

SPRAYED "LIMPET" ASBESTOS THERMAL INSULATION FOR STEAM TURBINES			DRAWING NO. S.L.A. 5
DRAWN BY E.F. Otte	APPROVED	KEASBEY & MATTISON COMPANY AMBLER. PENNA.	DATE 2-5-61

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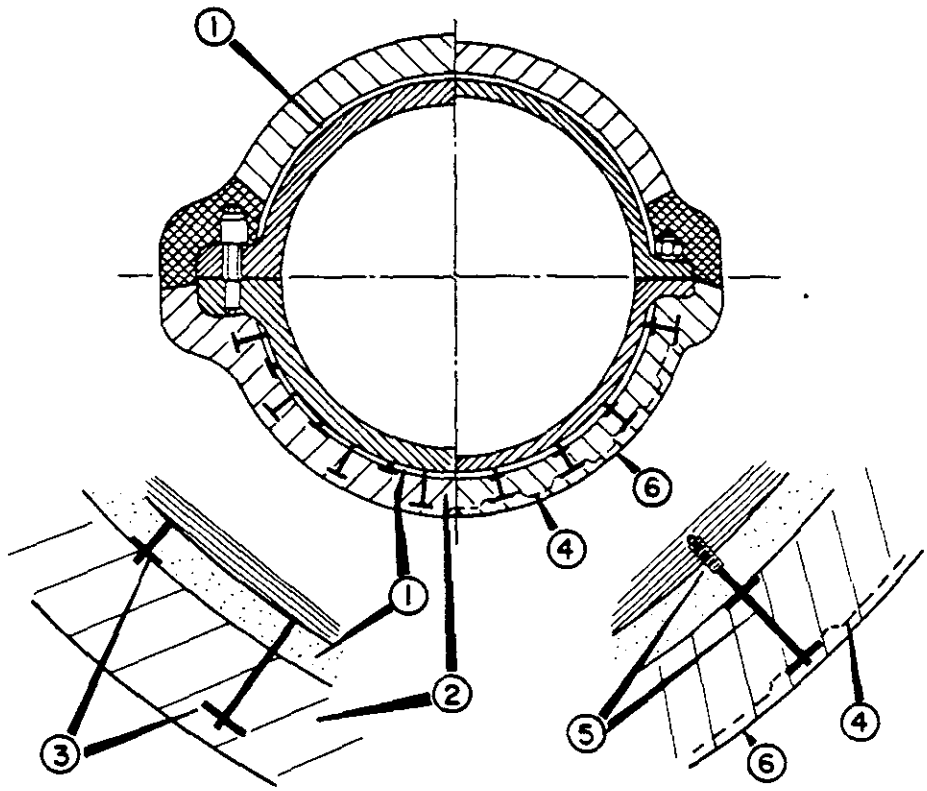


NOTES —

1 HIGH DENSITY

2 NORMAL DENSITY

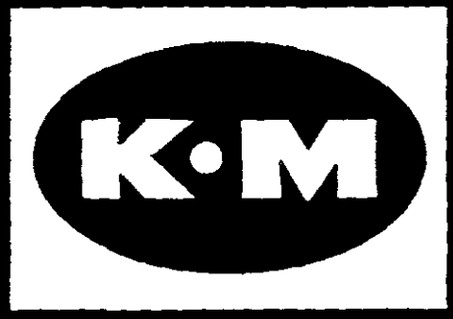
3 KSM NO. 10 GA. PIN AND 1 1/2" X 1 1/2" SPEED WASHERS OR EQUAL.

4 1" HEXAGONAL 20 GA. WIRE MESH.

5 ALTERNATE: IF WELDING IS NOT PERMISSABLE, CASING TO BE DRILLED AND TAPPED FOR STUDS AND SPEED WASHERS.

6 80-2-FINISHING CEMENT.

SPRAYED "LIMPET" ASBESTOS THERMAL INSULATION FOR STEAM TURBINES			DRAWING NO. S.L.A. 5A
DRAWN BY E.F.Otis	APPROVED	KEASBEY & MATTISON COMPANY AMBLER, PENNA.	DATE 2-5-61



Exclusive applicator of SPRAYED "LIMPET" ASBESTOS as High-Temperature Thermal Insulation

ARMSTRONG CONTRACTING & SUPPLY COMPANY

120 NORTH LIME STREET • LANCASTER, PENNSYLVANIA

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