

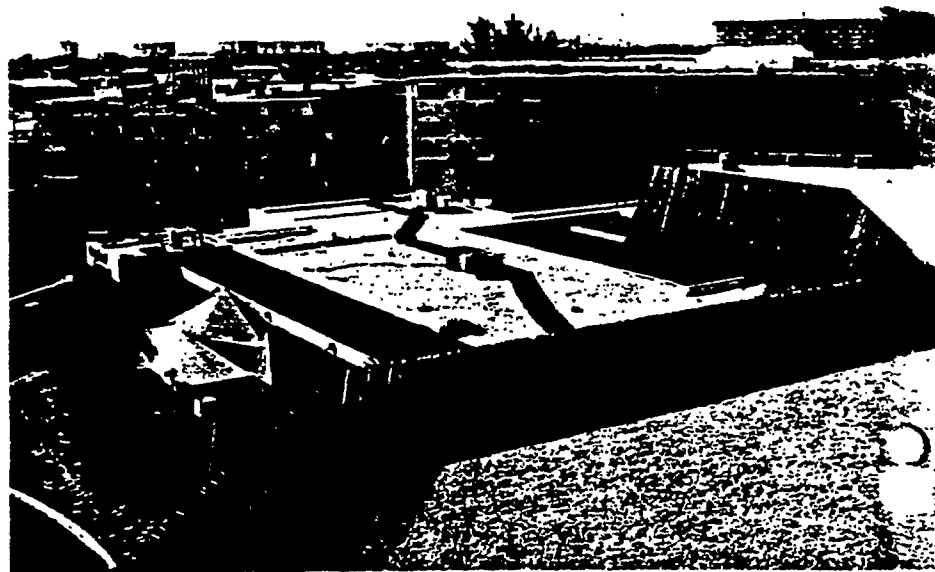
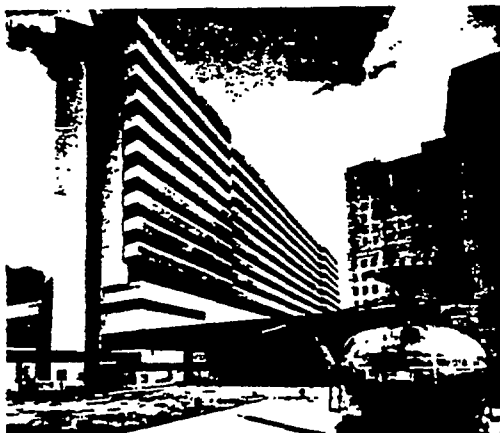
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KOPPERS

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The
Rochester
People



Preface

This manual contains recommended roofing specifications and procedures based on accepted good roofing practices and Koppers years of experience. They are intended to provide the architect, engineer, general contractor, and roofer with the proper information to plan and construct the best roof systems with the most time-proven materials available today.

The availability of a Koppers surety bond or guarantee for roofing and flashing constructed according to the information contained in this manual under Koppers bond and guarantee procedure, and the publishing of these specifications and information shall not be construed as creating any warranty, expressed or implied, with regard to any roofing or flashing for which a bond or guarantee has not been issued.

This roofing manual supersedes all previous roofing manuals published by Koppers in Sweets Catalogs.

The specifications and details contained in this manual have been determined to cover the proper procedure for long lasting roofing systems for most areas of our country.

In certain locations, minor variations in details and specifications may be appropriate due to unusual local conditions, such as wind, temperature, humidity, etc. To assure the best application of the proper specifications and details for your area we recommend you consult your Koppers representative.

Copy in blue, in the text throughout this brochure, indicates where technical changes have been made from the previous catalog.

Notice:

This roofing specification manual contains the latest and best available information as derived from Koppers long experience in the roofing industry. The design criteria and details contained herein have been compiled and are offered

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as a guide for consideration to assist the architect, owner and roofer in an attempt to provide the best roof possible. Responsibility, however, for design of any roofing system, remains with the architect or engineer and building owner.

The contents of this manual are subject to change at the discretion of Koppers Company, Inc. as future developments and experience are achieved.

Product Guide

The products listed below are manufactured to meet the highest quality standards set by Koppers Company, Inc. They are formulated specifically for use in roof and roof maintenance and waterproofing applications

Additional information on these products may be obtained in other sections of this manual or by contacting your Koppers representative.

The products listed below are manufactured to meet applicable Federal and ASTM specifications. If a certification is required on any of these products, it must be requested at the time of order placement.

Products	Description	Federal Spec.	ASTM Spec.	Page No.
Bitumens				
Coal Tar Bitumen	Coal Tar based roofing and waterproofing bitumen	*	D-450-78 Type III	12
Asphalt Type III	Petroleum derived asphalt suitable for roofing applications (Type III—Steep asphalt)	*	D-312-78 Type III	12
Felts				
#15 Tarred Felt	Coal Tar Saturated Organic Fiber Felt	HH-R-595 B Type 15 C Style A	D-227	12
#15 Asphalt Felt	Asphalt saturated organic felt	HH-R-595B	D-226	8
#15 Asphalt Asbestos Felt	Asphalt saturated asbestos felt for flashings	HH-R-590A	D-250	16
Asbestos Base Flashing	Asphalt saturated—Fabric reinforced, base flashing	*	*	16
Vented Base Sheet	Perforated asphalt saturated and surface coated organic fiber felt.	*	D-2626 Except for perforations	11
#43 Coated Base Sheet	Asphalt Saturated and Surface Coated Organic Fiber Felt		D-2626	12
Single-Ply Membrane systems				
KMM® Aluminum Membrane	Aluminum Surface—Single Ply—Five layer laminated roofing membrane	*	*	21
KMM® Standard Membrane	Single Ply—Five layer laminated roofing and waterproofing membrane	*	*	21
Bituminous Aggregate Binder (BAT)	For use with the KMM BAT Topping only	*	*	26
KMM Adhesive	A tenacious asphalt adhesive formulated specifically for adhering KMM membrane	*	*	21
Insulations				
Exeltherm Xtra®	Closed cell phenolic foam with integrally bonded faces	*	*	37
Fabrics				
Tar or Asphalt Saturated Cotton Std. Grade:	A woven cotton fabric saturated with tar or asphalt	*	*	42
Tar or Asphalt Saturated Cotton Spec. Grade:	A woven cotton fabric with higher thread count than above grade	SS-C-450e	D-173	42
Glasfab®	A woven glass membrane available in 20 x 10 or 20 x 20 threads per inch—asphalt or tar coated	HH-C-4666	D-1668	42
Glascoat®	Same as above, except coated with white resin	*	*	42
Jute	Asphalt saturated jute, commonly referred to as treated burlap	HH-B-00800	D-1327	42
U F Mat (White)	A white, lightweight mat comprised of fine glass filaments in a random arrangement reinforced with a swirl pattern	*	*	43
U F Mat (Coated)	Same as above, coated with asphalt	*	*	43
Standard Mesh	Medium weight, white glass strands bound together in a random pattern	*	*	43
Heavy Duty Mesh	Heavy asphalt saturated glass fibers in jackstraw pattern	*	*	43
Patching Glass	Same as heavy duty mesh — cut into convenient size rolls	*	*	43
Stonemat	A polyester underlayment for KMM loose aggregate topping	*	*	21

Products	Description	Federal Spec.	ASTM Spec.	Page No.
Roof cements				
Flash-on #441	Flashing cement formulated for weathering and flow resistance	SS-C-153 Type I	D-2822 Type I	—
Flashing Cement	Not as heavy consistency as Flash-on #441	SS-C-153 Type I	D-2822 Type I	—
Hydroshield	Asphalt cutback. Formulated for application in all weather. Readily bonds to wet surface. Trowel or brush grades.	•	•	36
Tar Roof Cement	Tar based plastic cement	SS-C-153 Type II	•	—
Roof coatings				
Emulsions				
Liquid Asphalt 480	Asphalt emulsion. Will not alligator if properly applied. Heavy bodied, exceptionally high quality, non-fibrated clay emulsion.	•	D-1227 Type III D-1187 Type A	36
Liquid Asphalt 472	Asphalt emulsion. High quality asbestos fibrated, medium body, clay emulsion	SS-R-1781 Type I	D-1227 Type I	—
Liquid Asphalt 484	Fiber glass reinforced, asphalt emulsion	•	•	—
Cutbacks				
Asphalt Roof Coating 454	Medium body, asbestos fibrated cutback coating	SS-A-694D	D-2823 Type I	—
Fiber Coating 415	Tar cutback. Penetrates and resaturates tar and gravel roofs	SS-C-540b	N/A	45
Resaturants				
Roof Resaturant 425	Asphalt Cutback. Combines maximum penetration and coating properties	•	•	45
Roof Resaturant 410	Highest quality tar resaturant available. Excellent penetration and softening qualities.	•	•	45
Primers				
High-Pen Primer 452	Thin asphalt cutback primer with maximum penetrating capabilities	SS-A-701	D-41	16
Coal Tar Concrete Priming Oil	Coal tar based primer for roofing and waterproofing applications	•	D-43	34
Adhesives				
CP Adhesive	Superior asphalt cutback adhesive for asphalt felt applications	•	•	—
Reflective roof coatings				
Alum. Roof Coating 434	Contains 3 lbs. aluminum paste per gallon. Non-fibrated.	TT-C-00493	D-2824 Type I	47
Alum. Roof Coating 435	Reinforced with asbestos fibers. Contains 3 lbs. aluminum paste per gallon.	TT-C-498B	D-2824 Type II	47
Alum. Roof Coating 444	Contains 2 lbs. aluminum paste per gallon. Non-fibrated.	•	•	47
Alum. Roof Coating 445	Contains 2 lbs. aluminum paste per gallon. Reinforced with asbestos fibers.	•	•	47
Colored Roof Coating (White)	White acrylic emulsion decorative coating. To be used over new Liquid Asphalt 480.	•	•	—
Caulkings				
Acrylic #400	One part, gunnable, acrylic caulking.	•	•	—

*Applicable Federal and/or ASTM Guide Specifications are not available for this product.

Koppers Roof Bond/Guarantees Program

Bonds and/or Guarantees are available for listed roofing specifications in this manual. To qualify for a Koppers Roofing Bond or Guarantee, roofing and flashing must be constructed in accordance with Koppers Specifications, with Koppers materials, and by a roofing contractor authorized by Koppers.

Prior to the beginning of any bonded or guaranteed roof application, the contractor must apply for the required document in accordance with Koppers standard procedures.

Roof Bond Program

Koppers bonds are available for 10, 15 or 20 year terms, and only cover coal tar built-up roofing and flashings where approved.

Roof Guarantee Program

Built-Up Roof Guarantees

10-Year Guarantee

A ten-year guarantee with a ten-year renewal option—for 4 and 5 ply Coal Tar Bitumen roofing systems only.

5-Year Guarantee

A five-year guarantee with a five-year renewal option—for 4 and 5 ply Coal Tar Bitumen Built-up Roofing Systems only

Single-Ply KMM Guarantee

A five-year guarantee with a five-year renewal option, KMM membrane applications only

KMM/IRMA Guarantee

A ten-year guarantee covering watertightness and insulation efficiency (80% of the original thermal resistance).

General requirements for bonded or guaranteed roof applications:

1. All roofing to be bonded/guaranteed must be constructed in conformance with Koppers specifications
2. Koppers bonds/guarantees are not available for residential roofing.
3. Koppers bonds/guarantees are transferable upon timely written notice of change of property ownership.
4. Koppers bonds/guarantees are available within the Continental United States in all cases except those areas where Koppers does not presently provide inspection service.
5. Approved flashings may be bonded/guaranteed for terms up to but not exceeding the term for which the roof is bonded.
6. Charges for roofing bonds/guarantees are made on a per square (100 sq. ft.) basis of the roofing membrane.

Coverage:

Koppers roof bonds/guarantees provide for repairs of leaks to the roofing not occasioned by defects in the building, abuse or extreme weather conditions during the term of the bond/guarantee up to the monetary limit specified in the bond

Roof bonds/guarantees DO NOT cover the repair installation or replacement cost of the following

1. Decking materials.
2. Vapor barriers.
3. Insulation products (except KMM/IRMA system)
4. Metal work.
5. Products in the roof assembly furnished by others.
6. Damage to the bonded roofing or flashing caused by the use of the products listed in 1 through 5 above, their installation or attachment
7. Vandalism or owner abuse

Koppers reserves the right to cancel any bond/guarantee if the roof is damaged due to causes not covered by the bond/guarantee if it is determined that the roof's satisfactory performance for the remaining term of the bond/guarantee is impaired. Cancellation due to damage of this type does not provide for any refund of the original cost.

Specification Reference Guide

Type System	Deck	Slope	Spec. No.	Construction	Page
COAL TAR BUILT-UP ROOFING SYSTEMS					
Coal Tar Bitumen	Nailable	1/4" max.	210	4 and 5 ply tarred felt	13
Coal Tar Bitumen	Non-nailable & insulation	1/4" max.	220	4 ply tarred felt	14
KMM ROOFING SYSTEMS					
Loose Laid Membrane Aggregate Topping	Nailable, Non-Nailable and Insulation	1" max.	610	KMM Standard Membrane	27
Loose Laid Membrane Bituminous Aggregate Topping	Nailable, Non-Nailable and Insulation	1 1/4" max.	620	KMM Standard Membrane	27
Adhered Membrane Aluminum Surface	"	1/4" Minimum with Positive Drainage	630	KMM Aluminum Membrane	28
Insulated Roof Membrane Assembly	"	2" Maximum Positive Drainage	690	KMM Standard Membrane	29



BUILT-UP ROOFING SYSTEMS

Coal Tar Bitumen Built-up Roofing Materials and System Discussion

KOPPERSArchitectural and
Construction Materials

7 1/KOP



Description

Koppers Coal Tar Bitumen built-up roofing systems consist of alternate layers of Koppers Coal Tar Bitumen and Koppers tarred felt, surfaced with a heavy top pouring of Koppers Coal Tar Bitumen into which is embedded an aggregate.

Koppers Coal Tar Bitumen built-up roofing systems are used whenever a roof is exposed to water and/or corrosion, and on all level or low sloped roofs where minimum maintenance is required.

Features

Coal Tar Bitumen built-up roofing provides one of the most durable roofing systems known due to its inherent superior water-proofing and weathering characteristics. This is THE time proven roofing system for level and low sloped roofs.

Coal Tar Bitumen provides numerous advantages to an owner. The superior performance of coal tar roofing systems in the areas listed below make coal tar roofing systems unique in the roofing industry.

1. Coal Tar Bitumen has natural resistance to water, air and water vapor penetration.

A tight molecular structure enables Coal Tar Bitumen to resist water penetration and oxidation of the roof surface.

2. Another unique feature of coal tar roofing is its self-healing ability.

Alligatoring and hairline cracks common to most materials, eventually cause damage to the roofing membrane. Coal Tar Bitumen

has a property known as "cold flow" which automatically corrects these conditions before serious damage takes place. This "cold flow" feature heals small mechanical fractures at normal temperatures.

3. Application improvements.

Because Koppers has expertise in the chemistry of aromatic coal tars, Coal Tar Bitumen was developed with the beneficial features of low fume evolution at application temperatures, thus reducing potential irritation during application.

These features represent significant improvements which are in consort with the aims of government, labor, and industry in the areas of reduced air pollution and improved worker conditions.

Uses

1. All "dead" level roofs
2. All water cooled roofs
3. Low sloped roofs with occasional ponding
4. Low sloped roofs with retarded drainage
5. All buildings with level or low sloped roofs that are built for long service life
6. Roofs in most highly corrosive atmospheres

Slopes

Koppers recommends that the maximum roof slope be one-half ($\frac{1}{2}$) inch per foot for all built-up Coal Tar Bitumen roof systems. Koppers does, however, permit slopes up to two (2) inches per foot at flashings that

incorporate tapered cants and for short run crickets or saddles for drainage, provided there are provisions for adequate back nailing, and these crickets or saddles do not cover more than 15% of the roof area.

All felts must be backnailed on slopes one-half ($\frac{1}{2}$) inch per foot or more. For recommendations on roofing procedures for slopes over $\frac{1}{2}$ inch per foot, consult your Koppers representative.

Underwriters Laboratories

Underwriters Laboratories, Inc. Building Materials Directory, TFJR-Built-Up Roof Covering materials lists Koppers Coal Tar Bitumen and tarred felts for use in construction of Class A and B built-up roof coverings.

Additional References: Roof Deck Constructions are listed under U. L. Guide No. (360 RO) TGKX. Roof deck construction materials, such as vapor barriers, insulations, and adhesives are listed under U. L. Guide No. (360 R13) TGYV.

Bonds/Guarantees

Koppers Bonds/Guarantees are available for 5, 10, 15, and 20 year terms. Roof bonds/guarantees cover **ONLY** the built-up roofing and flashing membrane.

For further details, please refer to Page 6 of this manual.

Note: Due to varying architectural designs, Koppers built-up roofing products should not be used on single family residential construction.

General Requirements and Special Conditions

Roof Structure System

In any building the performance of the Built-Up Roofing will be affected to some degree by all of the parts of the roof structure system as well as the inside and outside atmospheric environment. Each component should be investigated for its compatibility with each of the others. The roof structure system may include any or all of the following:

- Outside Atmospheric Conditions
- Roofing System
- Peripheral Details (Flashings)
- Insulation (if present)
- Vapor Barrier (if present)
- Structural Deck including sub purlins (supports)
- Structural Framing
- Air Space (if present)
- Ceiling (if present)
- Interior Air Conditions

You will find information in this manual pertaining to materials and application methods other than for built-up roofing. They are offered to assist the designer in establishing their normal position in the roof structure system. They should not be construed as part of the built-up roofing system, as endorsement, nor as part of the designated specifications other than to establish a suitable roofing base in the roof structure system.

The proper design, specification and positioning of the various components of the roof structure system is the responsibility of the building owner or his designer. Any subsequent failures, due to either the installation or lack of installation will not be Koppers responsibility.

Decks

The deck is the base over which the built-up roofing, or insulation and built-up roofing is applied. Where the term deck is used in this manual without reference to insulation, it shall designate the surface over which roofing is to be applied. All decks shall be clean, smooth, dry, rigid and free of debris. Any deck defect shall be corrected before application of roofing. All decks shall be installed in accordance with the deck manufacturer's specifications and shall be in compliance with Koppers General Requirements.

In approving any deck as satisfactory to receive a Koppers roof, only the deck surface is accepted. It is the responsibility of the building designer and the deck manufacturer to provide for expansion and contraction in a manner that will provide a stable base for the roofing; for support of maximum anticipated loads; secure attachments vertically and laterally, and the selection of the deck material and construction details including their ability to contain bitumens.

(KOPPERS WILL NOT ASSUME RESPONSIBILITY FOR DECK DEFECTS OR BITUMEN SEEPAGE.)

The placing of conduits, bolt heads, etc., above the roof deck and below the roofing membrane is not recommended.

All projections or openings in the deck should be completed prior to the application of the roofing.

Optimum adhesion to the deck is necessary for good roof performance. Where Koppers Bitumen or steep asphalt is used as an adhesive, questionable decks may be tested for dryness and adhesion by pouring one pint of the bitumen, heated to application temperature, over a representative area or areas of the deck. The deck is not satisfactory if the bitumen foams or bubbles, or upon cooling to ambient temperature may be stripped clean of the deck.

When decks can not be sufficiently cleaned to permit adequate adhesion a primer is required.

Metal Decks

Metal Decks: Decks of this type must also be free from loose rust and oily substances.

It is absolutely necessary to install board type insulation on a metal deck before the Koppers roofing is applied.

A metal deck must be clean, smooth, and properly anchored to the steel purlins and all joints correctly lapped and fastened.

Type of metal deck, flute opening and various other factors determine the type and thickness of insulation required. Consult your Koppers representative for recommendations.

Metal roof decks shall be designed so that they will not have a deflection exceeding 1/240 of clear span under all types of loads (live & dead). Designer should take into account roof traffic conditions including mechanical equipment used for roof application.

Note: When applying insulation and roofing over a perforated or acoustical type metal deck, it is recommended that a vapor retarder be installed prior to the application of the insulation or that a base sheet set in steep asphalt be utilized as the first ply of Built-Up Roofing. This is to reduce the possibility of Bitumen dripage.

Application of Vapor Retarder Below Insulation (Felt Type Vapor Retarder)

Coat the ribs of the metal deck with Steep Asphalt and then install two (2) full thicknesses of Koppers No. 15 Asphalt Felt, lapping each sheet nineteen (19) inches over the preceding sheet, mopping with Steep Asphalt the full width of the nineteen (19) inch lap. Extend and adhere all felt up vertical surfaces to a dimension 6" above the plane of the insulation surface.

Attachment of Insulation

Install insulation with approved mechanical fasteners or Steep Asphalt. See "Attachment" Page 10.

a. When attachment is made with steep asphalt it shall be applied to deck at rate of 12 to 15 lbs. per 100 sq. ft., place insulation while steep asphalt is still molten to provide good adhesion.

b. If slope of deck is one-half (1/2) inch per foot or more, insulation must be able to retain nails. In addition to being set in steep asphalt, insulation must be fastened to the metal deck with approved mechanical fasteners in accordance with FM requirements. If two layers of insulation are specified, top layer must be set in steep asphalt, making sure that the joints in the top layer do not coincide with the joints of the bottom layer.

c. If UL and FM requirements are a factor for insurance reasons, the insulation and its method of attachment must be listed and approved in accordance with their current data.

In areas that may exceed the 1/2" per foot maximum slope requirements (short run crickets, saddles or cants), all plies of tarred felt must be back nailed. Wood nailing strips must be provided when the substrate is not considered capable of retaining nails.

Application of Roofing Membrane

For application of roofing materials over the insulation, follow Specification No. 220 Page 14.

Precast Structural Concrete Sections

Precast concrete structural sections demand the same recommendations as poured concrete decks, although the presence of moisture, due to insufficient drying time, is not likely. If the contractor finds one or more slabs resting unevenly, with edges projecting above the surface, this should be corrected by resetting or leveling off. Leveling off should be gradual and smooth to permit insulation full contact with the substrate. All insulation joints must be even and smooth. Open-cell aggregate concrete is not acceptable for filling or leveling low areas. All joints, grouted or not, must be caulked with trowel-grade asphaltic plastic cement. As additional protection from bitumen dripage centered on the joint, an 8 inch wide (min.) felt stripping must be totally embedded in a troweling of plastic cement. Slab sides and ends should be square, rest firmly and evenly on supporting members, and be installed to prevent lateral and vertical movement.

Application of Vapor Retarder Below Insulation
1. On precast concrete decks, solid mop the surface with Coal Tar Bitumen.

2. Lay over the entire surface two (2) full thicknesses of Koppers Tarred Felt, lapping each sheet nineteen (19) inches over the preceding sheet—mopping with Coal Tar Bitumen the full nineteen (19) inches so that in no place shall felt touch felt.

3. Extend and adhere all plies of felt up to vertical surfaces to a dimension 6" above the plane of the insulation surface.

Application of Insulation Over Vapor Retarder

Apply a uniform coating of Coal Tar Bitumen over the entire surface. While hot, embed the insulation. If there are two (2) layers of insulation (e.g. as required for pre-stressed concrete sections) mop the entire surface of the first layer with Coal Tar Bitumen. While hot, embed the second layer of insulation.

Application of Insulation Directly to Deck

Over precast concrete, solid mop with Coal Tar Bitumen. While the bitumen is still hot, embed the insulation. See Insulation section, Page 11. Insulation joints shall not coincide with joints of the precast units.

Application of Roofing Materials to Deck

On precast concrete solid mop with Coal Tar Bitumen.

Complete the system in accordance with Specification No. 220.

In areas that may exceed the $\frac{1}{2}$ " per foot maximum slope requirement (short run crickets, saddles or cants), all plies of tarred felt must be back nailed. Wood nailing strips must be provided when the substrate is not considered capable of retaining nails.

Lightweight Insulating Concrete

Lightweight insulating decks include lightweight aggregate concrete (20 to 40 lbs. per cu. ft. oven dry density); foamed concrete, gypsum and thermosetting asphaltic decks. Except for Dycon® Concrete, lightweight insulating deck systems must be capable of venting excess water vapor to the underside. Koppers will not accept these lightweight insulating decks to be placed over vapor barriers, poured concrete substrates, unvented metals, or any type of base which will not permit these materials to vent from the underside. This is necessary to prevent a water vapor pressure build-up under the built-up roofing. Occasional, or spot vents through the roofing as the only venting method are not satisfactory substitutes for underside.

In addition, lightweight insulating decks shall have sufficient cohesive strength to provide firm attachment of the roofing to the deck and framing to prevent wind uplift damage or blow-offs. Nailable decks must be capable of developing at the very minimum, a 40 pound nail pull-out or withdrawal strength. If the materials do not achieve this value, additional fasteners will be required over and above those quantities described in the ensuing specification (standard is approximately 100 fasteners per square) to achieve a minimum attachment standard of 40 lb. per square foot. Koppers will not be responsible for failure of the insulating deck to remain integral or for disbonding of the roofing from the surface of the deck.

Provisions should be made wherever possible to provide additional venting such as notched wood perimeter nailers, etc., in conjunction with the venting from the underside of the deck. If board type insulation is to be applied over a lightweight insulating deck, provisions must be made between the fill and the board insulation to prevent fill moisture from affecting the insulation and roofing.

Thermosetting Asphaltic Concrete

When applying the roofing membrane directly over a thermosetting Asphaltic Concrete, follow Specification 210 except the first ply of the roofing membrane must be a base sheet set in a solid mopping of steep asphalt.

Application of Membrane Below Board-type Insulation

1. Apply over entire surface one (1) ply of Koppers coated base sheet, lapping each sheet four (4) inches over preceding sheet and nailing at lap no less than nine (9) inches and stagger nailed down center of each sheet on nine (9) inch centers.

2. Extend and adhere all plies to vertical surfaces to a dimension 6" above the plane of the insulation surface.

For vapor barrier provisions contact your Koppers Representative.

Application of Board-type Insulation Over Membrane

Apply a uniform coating of Coal Tar Bitumen over the entire surface and, while hot, embed the insulation. If there are two (2) layers of insulation mop the entire surface of the first layer with Coal Tar Bitumen and, while hot, embed the second layer of insulation.

For application of roofing materials over insulation follow Application Specification No. 220.

Application of Roofing Materials to Deck

1. Apply over entire surface one (1) ply of Koppers coated base sheet, lapping each sheet four (4) inches over preceding sheet and nailing at lap no less than nine (9) inches, and stagger-nailed down the center of each sheet on nine (9) inch centers.

2. Over the base sheet apply three (3) plies of Koppers Tarred Felt, lapping plies twenty-four and two-thirds (24 $\frac{2}{3}$) inches. Where slope of deck is one-half ($\frac{1}{2}$) inch per foot or more, nail each sheet of felt six (6) inches from the back edge on twenty-four (24) inch centers.

All laps shall be mopped with Coal Tar Bitumen the full twenty-four and two-thirds (24 $\frac{2}{3}$) inches, so that in no place shall felt touch felt.

3. Complete the system in accordance with Specification No. 210.

Note: In areas that may exceed the $\frac{1}{2}$ " per foot maximum slope requirement (short run crickets, saddles or cants), all plies of tarred felt must be back nailed. Wood nailing strips must be provided when the substrate is not considered capable of retaining nails.

Poured Gypsum Precast Gypsum

The same recommendations applying to precast concrete slabs apply to precast gypsum slabs and gypsum metal bound planks, except that the first ply of the roofing membrane must be a coated base sheet fastened in accordance with the base sheet alternate. See Page 12. All uneven slabs should be reset or leveled off so that the roof will be laid on a flat and even surface, free from projections and low areas. Because these slabs are precast, the possibility of a high moisture content being present is more remote than in the poured gypsum roof or lightweight insulating concrete roof deck. Poured gypsum decks sometimes cause trouble because the built-up roofing is laid before the deck is thoroughly dry. When this happens the result is a blistered and buckled membrane, or, just as serious, insulation curls and makes an unsatisfactory job. The roofing contractor, backed by the architect, must insist on a thoroughly dry deck before beginning work. He should also see to it that the deck is free of loose sand, frozen scale and other foreign matter. Projections should be removed, low points filled with cement

grout or other suitable material, and all cracks pointed up

Application of Membrane Below Insulation

1. Apply over entire surface one (1) ply of Koppers coated base sheet, lapping each sheet four (4) inches over preceding sheet and nailing at lap no less than nine (9) inches and stagger nailed down center of each sheet on nine (9) inch centers.

2. Extend and adhere all plies to vertical surfaces to a dimension 6" above the plane of the insulation surface.

For vapor retarder provisions contact your Koppers Representative.

Application of Insulation Over Membrane

Apply a uniform coating of coal tar bitumen over the entire surface and, while hot, embed the insulation. If there are two (2) layers of insulation mop the entire surface of the first layer with steep asphalt, and, while hot, embed the second layer of insulation. Insulation joints shall not coincide with joints of precast units.

For application of roofing materials over insulation follow Application Specification No. 220.

Application of Roofing Materials to Deck

1. Apply over entire surface one (1) ply of Koppers coated base sheet, lapping each sheet four (4) inches over preceding sheet and nailing at lap no less than nine (9) inches, and stagger-nailed down the center of each sheet on nine (9) inch centers.

2. Over the base sheet apply three (3) plies of Koppers Tarred Felt, lapping plies twenty-four and two-thirds (24 $\frac{2}{3}$) inches. Where slope of deck is one-half ($\frac{1}{2}$) inch per foot or more, nail each sheet of felt six (6) inches from the back edge on twenty-four (24) inch centers.

3. Complete the system in accordance with Specification No. 210.

Note: In areas that may exceed the $\frac{1}{2}$ " per foot maximum slope requirement (short run crickets, saddles or cants), all plies of tarred felt must be back nailed. Wood nailing strips must be provided when the substrate is not considered capable of retaining nails.



Poured Portland Cement Concrete

The deck surface must be smooth, dry, and free of dirt, dust and debris. Projections should be removed, low points filled with cement grout or other suitable material, and all cracks pointed up. Roof deck shall be properly graded to outlets.

Application of Vapor Retarder Below Insulation
1. Apply a uniform coating of Coal Tar Bitumen to the deck.

2. Lay over the entire surface two (2) full thicknesses of Koppers Tarred Felt, lapping each sheet nineteen (19) inches over the preceding sheet—mopping with Coal Tar Bitumen the full nineteen (19) inches so that in no place shall felt touch felt.

3. Extend and adhere all plies of felt to vertical surfaces to a dimension 6" above the plane of the insulation surface.

Application of Insulation

Apply a uniform coating of Coal Tar Bitumen over the entire surface into which, while hot, embed the insulation. If there are two (2) layers of insulation mop the entire surface of the first layer with Coal Tar Bitumen into which, while hot, embed the second layer of insulation.

Application of Roofing Materials Over Insulation or Deck

Install the roof in accordance with Specification No. 220.

In areas that may exceed the $\frac{1}{2}$ " per foot maximum slope requirement (short run crickets, saddles or cants), all plies of tarred felt must be back nailed. Wood nailing strips must be provided when the substrate is not considered capable of retaining nails.

Wood Plank/Plywood

Wood shall be well seasoned, dry and preferably treated. End joints shall have adequate bearing. Loose or void knot holes, large cracks, etc., shall be covered with sheet metal.

Lumber shall be a minimum of 1" nominal thickness.

Plywood (exterior grade) shall be a minimum of $\frac{3}{4}$ " thickness. Hot Coal Tar Bitumen should never be applied directly to a wood deck. Sandwiched between the heat from above and the heat from below, such material finds its way through the boards into the building. Good practice demands the cushioning and blotting effect of a layer of sheathing paper followed by layers of dry felt. Shiplap and square edge boards should be avoided where possible. If the underside of the roof deck is exposed to air pressure created from open doors or windows, tongue-and-grooved lumber should be used.

Preparation Below Insulation

1. The wood roof deck shall be covered with one (1) layer of approved rosin-sized sheathing paper weighing approximately five (5) pounds per one hundred (100) square feet. The sheathing paper shall be lapped two (2) inches and secured to the deck by occasional nailing.

2. Apply over entire surface one (1) ply of Koppers coated base sheet, lapping each sheet four (4) inches over preceding sheet and nailing
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at lap no less than nine (9) inches and stagger nailed down center of each sheet on nine (9) inch centers.

When the roof insulation is to be nailed and a vapor retarder is not required, the one ply of base sheet may be omitted; however, the sheathing paper is required.

Application of Vapor Retarder Below Insulation
Note: When vapor retarder is required, use these procedures in addition to Preparation Below Insulation noted above.

Lay over the entire surface two (2) full thicknesses of Koppers Tarred Felt, lapping each sheet nineteen (19) inches over the preceding sheet—mopping with Coal Tar Bitumen the full nineteen (19) inches so that in no place shall felt touch felt.

Application of Insulation

1. Mop the entire surface with a uniform coating of Coal Tar Bitumen into which, while hot, firmly embed the insulation.

For application of roofing materials over insulation follow Application Specification No. 220 on Page 14.

Application of Roofing Materials Directly on Wood

For application of roof materials directly on wood decks follow Specification No. 210 on Page 13.

In areas that may exceed the $\frac{1}{2}$ " per foot maximum slope requirement (short run crickets, saddles or cants), all plies of tarred felt must be back nailed. Wood nailing strips must be provided when the substrate is not considered capable of retaining nails.

Structural Wood Fiber

All decking must be installed in strict accordance with the particular deck manufacturer's recommendations for installation. Deck material must be protected during shipment, job site storage and prior to roofing application. No planks which have become structurally weakened due to moisture, fractures or mutilated edges may be used. All joints must be level and preferably grouted full and level with plank surfaces as recommended by the deck manufacturer. All planks must be well anchored to supporting members to resist movement in a fashion recommended by the deck manufacturer. Any planks which bow or deflect or do not seat securely must be replaced. Responsibility for the selection of a particular type of wood fiber deck, its installation, provision for expansion and contraction, its suitability to job requirements, and its ability to support anticipated loads in its environment rests with the designer and deck manufacturer.

Decks of these types, whether grouted or not, shall be caulked with Koppers Flashing Cement which shall be applied so that the top surface is level and smooth. Felt stripping four (4) to six (6) inches wide set in a troweling of the cement is required to assist in leveling uneven joints and bridge the joint openings thus providing a better surface for the roofing materials.

Caution: care must be taken to avoid bitumen dripage.

Application of Vapor Retarder Below Insulation
Install two (2) plies of No. 15 asphalt felt lapped nineteen (19) inches in Type III steep asphalt. Plies shall be mopped solidly so that in no

place shall felt touch felt. Install insulation in solid mopping of steep asphalt.

Application of Insulation Over Vapor Retarder
Install insulation in a uniform coating of Type III steep asphalt.

Installation of roofing over insulation shall be as per specification outlined below with base sheet mopped solidly to the insulation in steep asphalt as the first ply.

Application of Roofing Materials

Install roofing in accordance with Specification No. 220 except that a base sheet, set in steep asphalt, must be substituted as the first ply. See "Base Sheet Alternate" Page 12.

Complete the system in accordance with Specification No. 220.

In areas that may exceed the $\frac{1}{2}$ " per foot maximum slope requirement (short run crickets, saddles or cants), all plies of tarred felt must be back nailed. Wood nailing strips must be provided when the substrate is not considered capable of retaining nails.

Material Protection

It is the responsibility of the roofing contractor to protect all roll roofing materials and roof insulation from ground or construction moisture and weather before and during construction.

Attachment

Maximum adhesion or secure attachment of all components in the roofing assembly is necessary for satisfactory long term performance of the roofing membrane. Bitumen adhesive and/or fasteners quantities specified by the manufacturer must be capable of passing a minimum uplift resistance of 40 pounds per square foot (psf).

When Building Code requirements dictate a higher uplift resistance than our minimum requirement, additional fasteners or adhesive will be required over and above the quantities described in the ensuing specifications.

Solid moppings of hot applied bitumen have been found to provide an uplift resistance in excess of 120 psf.

When nails or fasteners are used, they must be nailed through disks or have sufficiently large heads to prevent fracture or puncture through the roofing felts.

When possible mechanical fastening of insulation is the preferred means of attachment. However, if properly applied hot applied bitumens are also acceptable.

Contact the insulation manufacturers literature for requirements.

Cold applied adhesives are not acceptable.

Koppers will not be responsible for any damage caused by or the result of unsatisfactory attachment.

For further information contact your Koppers representative.

Expansion Joints (Building)

Since all materials expand and contract due to temperature and/or moisture, the use, location, and design of building expansion joints, especially in the roof structure system, should be taken into consideration at the time of original building design.

Although provisions for adequate expansion joints are the responsibility of the building designer, Koppers offers the following recommendations for the protection of the roofing system against splits caused by expansion and contraction of the building. Building expansion joints should be installed.

1. On roof areas larger than 200 feet in each direction
2. At all places where the structural supports and roof assembly change direction
3. Where type of adjoining deck materials change

Where control or expansion-contraction joints are provided in the structural steel, deck material, or deck system, provisions must be made for continuation of this relief through the built-up roofing system. Koppers realizes that in a climate controlled building there may be little or no expansion AFTER the building is in use, however, building expansion joints are still recommended based upon the following points:

1. During construction the building will not be under a steady state temperature/humidity condition so that thermal and moisture movement can be sufficient to fracture the roofing.
2. If no building expansion joint is provided, the owner must keep the building at the steady state temperature and humidity condition at all times, as holiday shut-downs can fracture the roofing due to the movement of the roof system resulting from temperature/humidity variation.
3. If the occupancy is fairly large, the sudden entrance on a rainy day of many rain-soaked employees may cause moisture movement in the roof structure system which can fracture the roofing.

Water Stops (Temporary Protection)

Water stops consisting of two 12"plies of tarred felt and mopping of Coal Tar Bitumen extending onto the deck and insulation at least 6" and 4", shall be applied at the end of each day's work over exposed edges of insulation. These temporary protective measures must be removed cleanly from the insulation (top surface and vertical joint) and from the deck to ensure tight insulation joints and level insulation surfaces. Improperly corrected water stops have been determined as a cause of roof splits and have prevented moisture vapor movement to vented edge details.

Cut Offs (Permanent Installation)

Venting of roof insulation at walls, curbs, eaves, etc. is recommended for all but a few

special roof structures. Therefore, cut-offs should not be installed at edges of insulation adjoining these areas for venting purposes.

Cut-offs may be installed however, provided they are constructed to run in one direction continuously to vented edges and provided no section of the roofing is isolated or blocked from venting.

Vapor Retarders

Vapor retarders are normally used where the heat flow direction and/or humidity within the building, during any climate or occupancy cycle, might cause the dew point or condensation to occur under the built-up roofing within the insulation chamber. It is important that the vapor retarder, when installed, provide a continuous seal, (including ventilators, skylights, peripheral walls, and other terminations) from the source of the water vapor.

Insulation

Insulations come in varying thicknesses and sizes. Should the manner of attachment as suggested conflict with that specified by the individual insulation manufacturer, the insulation manufacturers specifications shall be followed and in addition, shall be in compliance with Koppers General Requirements.

Good roofing practice dictates that the following points be considered when specifying board type roof insulation.

1. The roofing insulation must be kept dry at all times. It must be of a type approved by Koppers for use with a Koppers built-up roof. It should only be applied over a deck complying with all of Koppers General Requirements.
2. If the roof deck slope is one-half (1/2) inch per foot or more, the insulation must be able to retain nails or wood nailers must be installed perpendicular to the slope at each course of insulation.
- Spacing of nailers must be such that the insulation fits snugly with the nailers but must not be force fitted.
3. No more insulation shall be laid at any one time than can be protected by bitumen and felt in case of sudden weather changes.
4. Edges of insulation shall be brought closely together and shall not be forced into place. Where insulation joins vertical surfaces, the insulation shall be cut in a neat manner allowing approximately one-half (1/2) inch clearance.
5. When more than one (1) layer of insulation is used, joints in each layer shall not coincide. All layers shall be parallel to preceding layers.

Note: When urethane or urethane composite roof insulation is specified, it must be installed in a double layer application. The appropriate urethane product must be installed direct to the roof deck and a second layer of fiberboard, perlite board or glass fiber roof insulation installed over top. The joints of the second layer must not correspond with that of the first. In lieu of the second layer of insulation, a Koppers vented base sheet must be used as the first ply of the membrane. When using other than Koppers Exeltherm Urethane Insulation,

consult the manufacturers' literature for specific information.

Wood Nailing Strips

All non-nailable decks require wood nailing strips at eaves, edges, walls, roof openings, etc. for proper securement of metal flanges. Nailers must be securely and firmly attached to the deck or through to its supporting members. Nailers shall extend not less than 1" beyond the apron or flange.

Roofing felts for all deck areas having a slope of 1/2" per foot or more must be back nailed and therefore non-nailable decks must be furnished with treated wood nailing strips treated with a material compatible with bituminous roofing.

Cold Storage and Freezer Buildings

Koppers will not bond its built-up roofing over these structures if insulation or insulation and vapor barrier is installed over the deck unless there is an adequately ventilated air space between the deck and insulated refrigerated area.

For procedures on non-bonded built-up roofing applications, consult a Koppers representative. When a guaranteed system is required, refer to KMM Specifications, Page 23.

Water Retaining and Retarded Drainage

When the roofing system is subjected to common standing water or retarded drainage refer to the Special Applications Section, Page 15.

Temporary Roofing

Temporary roofing specifications are available for all Koppers Coal Tar Bitumen Built-Up Roofing Systems. Consult your Koppers representative for recommended specifications over various type decks for temporary roof construction.

Reroofing Design Considerations:

During the reroof design and specification phase, and prior to commencement of reroofing work, it is the building owner's responsibility to have his architectural or consulting representative ascertain if the existing roof structure, with the new roof system installed, will meet all local building structural codes.

If additional insulation is to be a part of the new roof system, an evaluation of the dew point and its effect on the roofing system should be determined.

Reroofing application can be complicated since many factors must be considered. For more specific information pertaining to special situations, contact your Koppers representative.

Note: Koppers will not be responsible for any damage caused by excess loads on structural systems or damage due to rate or change in location of new dew point.

BUILT-UP ROOFING SYSTEMS (Cont.)

General Application Procedure

Application of Bitumens
Recommended Weights per 100 sq. ft. (for estimating purposes only)

	Average Interply	Top Coating
Koppers Coal Tar Bitumen	25 lbs.	75 lbs.
Steep Asphalt	23 lbs.	60 lbs.

Average interply weights are based on long years of experience in good roofing practice, and take into account a reasonable variation in the amount of bitumen absorbed in different substrates, and the type of specification. Moppings of bitumen between felts shall be continuous.

Felt Shall Not Touch Felt

It is generally agreed that maximum strength between layers of felt is achieved by the thinnest practical glue line of bitumen. Too thin a layer starves the lap, whereas an excessive layer can permit interply movement on sloped roofs.

Flood Coat

The top pouring is most important, it must be thorough and uniformly covered with specification aggregate embedded into the bitumen while the bitumen is still hot.

Recommended Temperature Limitations:

	Kettle Temp.	Point of Application Temp.
Koppers Coal Tar Bitumen	300-425°F	350-400°F
Steep Asphalt	350-475°F	400-450°F

When roofing bitumens are excessively overheated and/or held for long periods of time, their waterproofing qualities are greatly reduced, and at the same time the volume of fuming is increased. In order to achieve the maximum benefits of low fuming and unequaled waterproofing performance, it is imperative that Koppers Coal Tar Bitumen be heated within the temperature limitations listed above. Close supervision of heating is also good roofing practice for all bitumens.

If heat is desired during a holding period at the jobsite while material is not being drawn off and replenished as under normal usage, kettle temperature should be reduced and not permitted to exceed 350°F for Koppers Coal Tar Bitumen or 425°F for steep asphalt. The kettle should be full lid closed. These temperatures are applicable to job conditions and do not apply to holding or storage in kettles in excess of 4 hours. If bitumen is not to be used for periods over 4 hours, the kettle should be shut off.

Koppers Coal Tar Bitumen may be contained in 1000 gal. or greater capacity heated and automatically controlled closed vessel tankers at 375°F for periods not exceeding 96 hours.

Application of Felt

Piles of felt must be laid shingle fashion.

Where a water flow direction exists, felts should be applied so that the direction of flow is not against the laps. Broom or press all plies of felt into the hot bitumen and lay without wrinkles, buckles or kinks, so that the finished roof is free of pockets or blisters. Each felt ply shall be completely covered with a complete mopping of bitumen.

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The number of plies are controlled by varying widths of the edge laps. Four-ply (4) roofing, for example, is achieved by lapping each ply approximately twenty-seven and one-half (27½) inches.

Koppers felts are marked at the factory with lap lines for this purpose. Except as specifically provided for in Koppers specifications, application of felt lapping methods other than shingle fashion will not be permitted.

When beginning a membrane roofing installation, appropriate width starting strips of felt shall be used at the starting point to achieve the specification ply build-up at that point so that successive felt applications will produce the ply requirements. Overlap ends of all connecting plies of felt (end laps) not less than 10 inches. End stripping or taping of these laps is not permitted.

Application of Koppers Bitumen and Aggregate Surface

The final application of Koppers Roofing is a triple weight application of Koppers Coal Tar Bitumen (approximately 75 lbs./sq.) into which is distributed an approved aggregate while the Bitumen is still hot.

Benefits of aggregate surfacing

1. Protection from foot traffic of other trades during construction and afterwards for routine roof maintenance.
2. Weight as additional protection for wind uplift.
3. Reduced surface temperature.
4. Even flow of water to the drains.
5. Fire protection from burning brands.
6. Protect bitumen from the actinic rays of the sun.

7. Most important—by using an aggregate surface, an additional 75 lb./sq. of Coal Tar Bitumen (the waterproofing agent) is included in the installation.

The application of Koppers Coal Tar Bitumen and aggregate must be done at the time the felts are applied; except in periods of hot, dry weather, when morning dew is not expected, the top surfacing may be delayed overnight.

When the specifier desires glaze coating and/or all work to be completed the same working day, he shall be responsible to so state this requirement in his specifications.

The aggregate surfacing must be applied into the top pouring while the bitumen is still hot so that a uniform layer will be embedded and adhered. The completed roof assembly will have a uniform aggregate surface. Depending on slag weights in certain parts of the country 400 lbs. of slag per square may be required. Occasionally on well applied roofs, small black globes known as "raspberries" or "blackberries" will form in the roof surface. These are not detrimental to the roof.

Aggregate Surfacing

The aggregate to be used should meet the ASTM Specification D1863-64. The basic requirement for this aggregate are as follows:

Sieve Size	Total Passing, Percent
¾"	100
½"	90-100
¾"	40-70
No. 4	0-15
No. 8	0-5
Dust, max. pct.	0.5
Moisture, max. %	
crushed stone and gravel	0.5
Crushed roofing slag	5.0
Unit weight (loose)	
min. lb. per cubic ft	60

Note: In areas where ASTM D-1863-64 quality aggregate is not practically available, ASTM D-448 aggregate gradation sizes #6, #7 or #67 will be acceptable, providing that the aggregate has no more than 3% moisture by weight and meets all other requirements of ASTM D-1863-64.

Cold Weather Application

When roofing is applied at temperatures below 45°F, special precautions must be taken to insure the satisfactory performance of the finished roof. Before applying roofing, moisture, ice, snow, surface water, etc., must be removed from the deck.

Hot applied bitumens tend to congeal rapidly in cold weather. Extra care must be taken to set insulation or roofing as quickly as possible while the bitumen is still hot.

When temperature is below 45°F, felt must be embedded in bitumen while it is still hot and broomed-in immediately with solid pressure to ensure necessary embedment into bitumen.

Do not heat bitumens above the maximum temperature limit listed above to compensate for rapid chilling. Insulated containers along with carefully timed material delivery methods, must be employed.

Note: Bitumen temperatures below those recommended at the "point of application" can result in heavy interply quantities which in turn can potentially contribute to the cause of membrane slippage.

Base Sheet Alternate

When substituted for the first ply in a solid mop application specification, the Base Sheet shall be embedded in a solid mopping of Koppers Steep Asphalt followed by thorough brooming to eliminate air pockets, wrinkles, fish mouths, buckles, etc. The remaining three (3) plies of tarred felt shall be solid mopped with Coal Tar Bitumen in accordance with the specification.

When rosin sized or sheathing paper is a part of the original specification it shall remain and be applied beneath the Base Sheet. Edge laps shall be 4" and end laps shall be 6". The nailing pattern for the Base Sheet shall be 9" on center through the lap and 2" from the edge lap and stagger-nailed down the center of each sheet on 9" centers. (Note: This is approximately 100 nails per square.)

After applying a base sheet as the first ply on the four (4) ply roofing membrane, three (3) additional plies must be installed at once.

When applying the additional three (3) plies of tarred felt, lap each ply shingle fashion 24½ inches. Each ply must be solid mopped with Coal Tar Bitumen.

When specifying the Base Sheet alternate, use the designation BS as a subscript to the specification number, 210 BS (structural wood fiber deck).

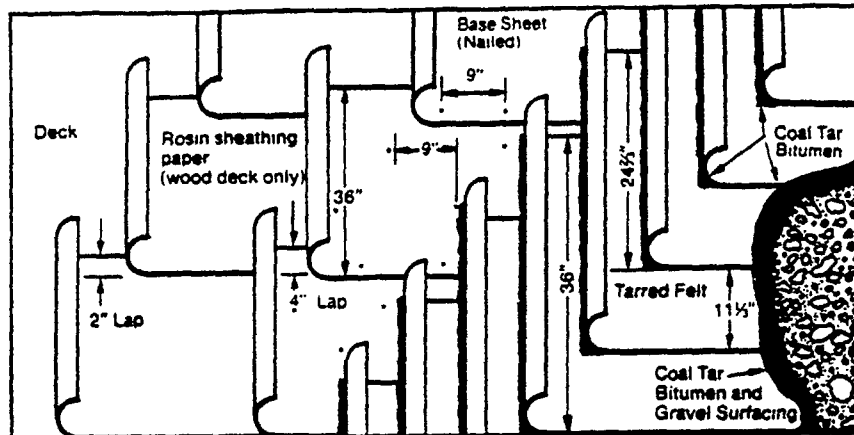
Note: If Koppers Asphalt Coated Base Sheet (ASTM D-2626) is substituted for the first ply of the Coal Tar Bitumen roofing specifications, it must not be left exposed or used as a work surface or temporary roof prior to roof completion. Good roofing practice dictates that the total roofing membrane be complete the same day.

Built-Up Roofing Systems (Cont.)

Koppers Coal Tar Bitumen

KOPPERS | 7 1/KOP
Architectural and
Construction Materials

Specification No. 210 Supersedes Specs. No. 1, No. 12



Available decks without insulation:

Plywood, wood plank, lightweight insulating concrete, poured and precast gypsum.

Slope requirements:

½" per foot maximum.

Materials Required per 100 sq. ft. of roof area (for estimating purposes)

Rosin Sheathing Paper* (1 ply)	5 lbs.	5 lbs.
Coated Base Sheet** (1 ply)	43 lbs.	43 lbs.
Tarred Felt (Mopped in Bitumen) (3 plies)	45 lbs.	45 lbs.
Roofing Bitumen (3 moppings @ 25 lbs. each)	75 lbs.	75 lbs.
Top Pour Coat	75 lbs.	75 lbs.
Surfacing: Slag	300 lbs.	—
Gravel	—	400 lbs.
Approximate Total Weight	543 lbs.	643 lbs.

*Wood Decks only.

**Unless otherwise indicated.

Procedure

1. General Requirements on Pages 8 through 12 and Flashing Detail Specifications on Pages 16 through 20 are a part of this specification and must be adhered to where applicable.

2. When a vapor retarder and/or roof insulation are required, install in accordance with the manufacturer's instructions and comply with Koppers General Requirements and Special Conditions. Follow Specification No. 220 for roofing materials applied to insulation.

Application of roofing direct to roof deck:

1. Over the surface of the roof deck install one layer Rosin Sheathing Paper weighing approximately 5 lbs. per 100 sq. ft. Lap each sheet at least two (2) inches and nail sufficiently to hold in place. (Wood decks only.)

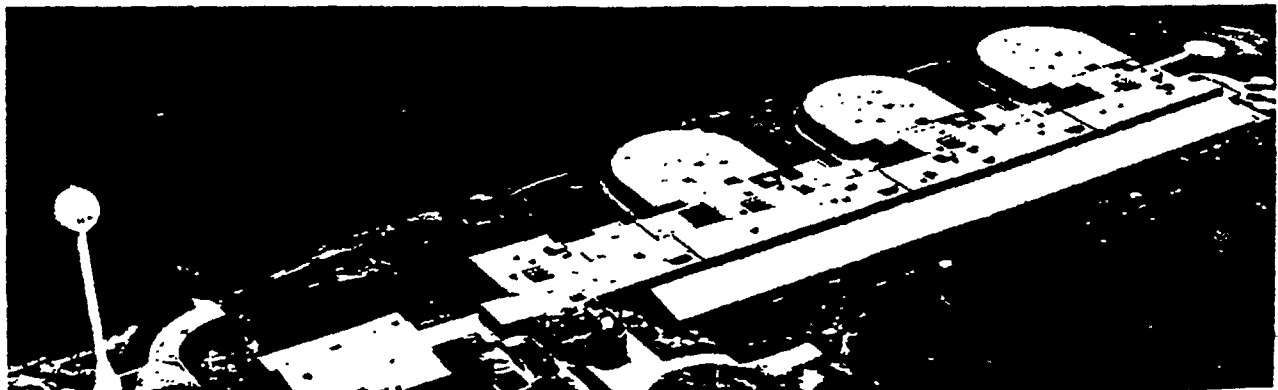
2. Apply over entire surface one (1) ply of Koppers coated base sheet, lapping each sheet four (4) inches over preceding sheet and nailing at lap no less than nine (9) inches and stagger nailed down center of each sheet on nine (9) inch centers.

Note: (This is approximately 100 nails per 100 sq. ft.) Nail shanks are to be of required length for maximum holding power.

3. Over the entire roof area, apply three (3) plies of Koppers Tarred Felt lapping plies twenty-four and two-thirds (24⅔) inches. All laps shall be mopped with Coal Tar Bitumen the full twenty-four and two-thirds (24⅔) inches, so that in no place shall felt touch felt.

4. On short run slopes, such as on crickets and saddles, one-half inch per foot or more, nail each sheet of felt six (6) inches from the back edge on twenty-four (24) inch centers.

5. Pour over the entire surface of the roofing membrane, a uniform coating of Coal Tar Bitumen, and, while hot, embed not less than four hundred (400) pounds of gravel or three hundred (300) pounds of slag for each one hundred (100) square feet.



Specification No. 220 Supersedes Specs. No. 5, No. 10, No. 23, No. 17wi, No. 27

Non-nailable decks

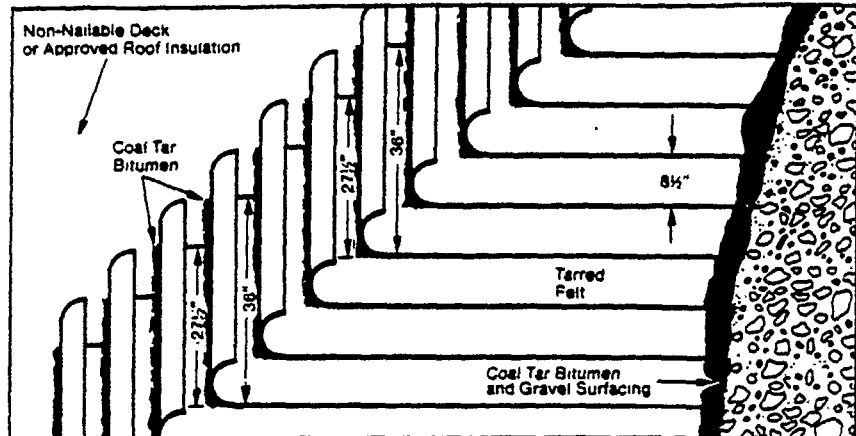
Precast Concrete. Poured Concrete.
Structural Wood Fiber*.

Roof insulations:

Various Decks.

Slope requirements:

$\frac{1}{2}$ " per foot maximum.



Material Required per 100 sq. ft. of roof area (for estimating purposes)

Tarred Felt (Mopped in Bitumen) (4 plies)	60 lbs.	60 lbs.
Roofing Bitumen (4 moppings @ 25 lbs. each)	100 lbs.	100 lbs.
Top Pour Coat	75 lbs.	75 lbs.
Surfacing: Slag	300 lbs.	—
Gravel	—	400 lbs.
Approximate Total Weight	535 lbs.	635 lbs.

Procedure

General Requirements on Pages 8 through 12 and Detail Specifications on Pages 16 through 20 are a part of this specification and must be adhered to where applicable.

When a vapor retarder and/or roof insulation are required, install in accordance with the manufacturer's instructions and comply with Koppers General Requirements and Special Conditions.*

1. Mop deck (or insulation—as applicable) completely with Coal Tar Bitumen.

2. Apply over the entire surface four (4) plies of Koppers Tarred Felt, lapping plies twenty-seven and one-half (27½) inches. Mop solidly between each 27½ inch lap with Coal Tar Bitumen so that in no place shall felt touch felt.

3. On short run slopes of one-half (½) inch per foot or more, such as on crickets and saddles, and when the deck permits nailing, nail along back of upper edge of each sheet on twenty-four (24) inch centers. Where deck does not permit nailing, nailing strips are required and each sheet must be nailed along back or upper edge at spacings to assure penetration of nailers.

4. Pour over the entire surface of the roofing membrane a uniform coating of Coal Tar Bitumen, and, while hot, embed not less than four hundred (400) pounds of gravel or three hundred (300) pounds of slag for each one hundred (100) square feet.

*NOTE: On structural wood fiber decks, the first ply must be a Koppers coated base sheet set in a solid mopping of steep asphalt (see structural wood fiber, page 10).

Water Retaining Roofs



Water Cooled Roofs

- Spray Systems
- Ponded Systems

Water Retaining Roofs

- Process Water

Retarded Drainage Systems

- Controlled Flow

Discussion

Due to Coal Tar Bitumen's natural resistance to water, it may be utilized in the construction of built-up roofing membranes that will be expected to hold water over long periods of time. When applying a membrane that is required to hold water, follow Specification 220 for applications over non-nailable decks (four plies of No. 15 Tarrad Felt set in solid moppings of Coal Tar Bitumen)

Note: The base sheet alternate shall not be used.

When the roof is water cooled or has been designed to be continuously wet the top surfacing of bitumen and gravel must be applied as follows:

1. Pour over the entire surface of the roofing membrane a uniform coating of Coal Tar Bitumen. While hot, embed not less than four hundred (400) pounds of gravel or three

hundred (300) pounds of slag for each one hundred (100) square feet.

2. All loose gravel or slag shall be swept from surface and a second uniform pouring of approximately eighty-five (85) pounds of Coal Tar Bitumen shall be applied over the gravel or slag, into which while hot, shall be applied a second layer of three hundred (300) pounds of gravel or two hundred (200) pounds of slag for each 100 square feet. The entire surface shall then be thoroughly broomed free from all loose gravel or slag. It is advisable to roll the finished surface with a light roller so that aggregate is thoroughly embedded.

3. All flashings will be KMM membrane similar to Specification No. 710 on Page 30 except that a layer of Standard Grade KMM membrane must be installed totally substrate fused prior to the application of the KMM Aluminum membrane top ply.

NOTE: Roofs equipped with controlled flow drainage systems do not require the extra top pour and gravel application.

Design consideration

When designing a water cooled, water retaining or retarded drainage roof assembly, certain design criterion must be considered.

Note:

1. Due to the extremely heavy weight loads normally associated with retained water, pour and precast concrete or other heavy

load bearing decks must be specified. Wood or metal decks should only be considered where ponded or standing water is at a minimum.

Note: Decks requiring a base sheet as the first ply of the roofing system are not permitted for this application.

2. Roof Structure design live loads for this application shall be a minimum of 50 psf and deflection shall not exceed 1/360 of the span, both in addition to the anticipated weight of the water. Insulation joints must be taped in single layer applications. Vapor barriers must be two ply and solid mopped. Use steep asphalt over metal decks. Wood must be treated to prevent warping (see "wood nailing strips").

3. At points where water pressure from a spray system may be excessive, the roof surface should be protected with treated board platforms or other suitable construction to break force of the water. These platforms should be laid on top of the roof surface and not fastened to the deck.

4. Insulation under a Water Cooled Roof should be of a type which is rigid, dimensionally stable with high compressive strength.

5. IT IS MANDATORY THAT THE WATER COOLING SYSTEM BE CLOSED DOWN AND THE ROOF DRAINED PRIOR TO COLD WEATHER. Neither roofing nor the structure will withstand the expansion caused by ice formation.

Built-Up Roofing Systems (Cont.)

Flashing Specifications

General

Flashings are the terminal closures of a roofing system which perform a waterproofing, and in some systems, a decorative function. Flashings must be installed at all intersections formed by vertical surfaces. Their importance cannot be stressed too strongly. Water entering the roofing system through flashings can result in water vapor forces which will destroy the effectiveness of the roofing.

Koppers flashings are an integral part of a Koppers roof. Designed for flexibility so that slight movements do not dislodge them and fastened securely to the wall, they give many years of service.

It is particularly important that the top edge of the flashing be protected by counter flashing, which will insure a diversion of the water away from any opening which might develop between flashing and wall.

NOTE: In any case where the design or anchoring system of metal counter flashing is difficult, the top of the flashing system should be stripped with Koppers KMM

Aluminum Membrane (8" wide min.) centered and totally heat fused over the top edge of the flashing system.

Metal work is only useful for decorative, water shedding, or protection against mechanical damage, and is not a waterproofing part of the flashing system. Because of the high coefficient of expansion of sheet metals and the large temperature changes experienced on a roof, sheet metal or exposed metal components must be isolated from the waterproofing components of the roofing and flashing system as efficiently as possible to prevent the metal from splitting the membrane.

Flashing should be installed as roofing progresses to prevent water damage to insulation or deck under the roofing. If this is not possible water cut-offs must be installed and later removed when flashing is installed. Metal counter flashing or a top seal of KMM Aluminum Membrane must be installed as flashing progresses.

The basic Koppers flashings require a metal cap flashing to be inserted in the

raggle immediately upon completion of base flashing. The cap flashing is to have not less than a four (4) inch exposed apron extending down over the base flashing.

NOTE:

1. If bonded/guaranteed flashing is required, it must be installed in conjunction with a Koppers bonded/guaranteed roof and can be bonded/guaranteed for standard periods up to but not greater than the period for which the roofing is bonded/guaranteed. To be bonded/guaranteed, composition flashings must be set at least 7 1/2" above the roofing base.

2. Metal Cap flashings are not included under any flashing bond/guarantee.

3. Metal work of any description used as flashing or a part of a flashing system is not included under any flashing bond/guarantee.

NOTE: Koppers KMM Flashing Systems are also available for use with Koppers Built-Up Roofing Systems. Specific details and specifications can be found on Pages 30 and 31 of this manual.

Application

Extend plies of roofing felts and bitumen moppings up all walls, parapets and curbs for a distance of two (2) inches above cant strip.

A raggle not less than seven and one-half (7 1/2) inches or more than twelve (12) inches above the roof deck is to be provided.

1. Prime all masonry walls from top to roofing felts to raggle with Koppers Asphalt Primer. Allow to dry thoroughly.

2. In a uniform coating of Koppers Flashing Cement,* install one (1) ply of Koppers No. 15 Asphalt saturated asbestos felt extending from the raggle to not less than four (4) inches from the base of the cant onto the roof.

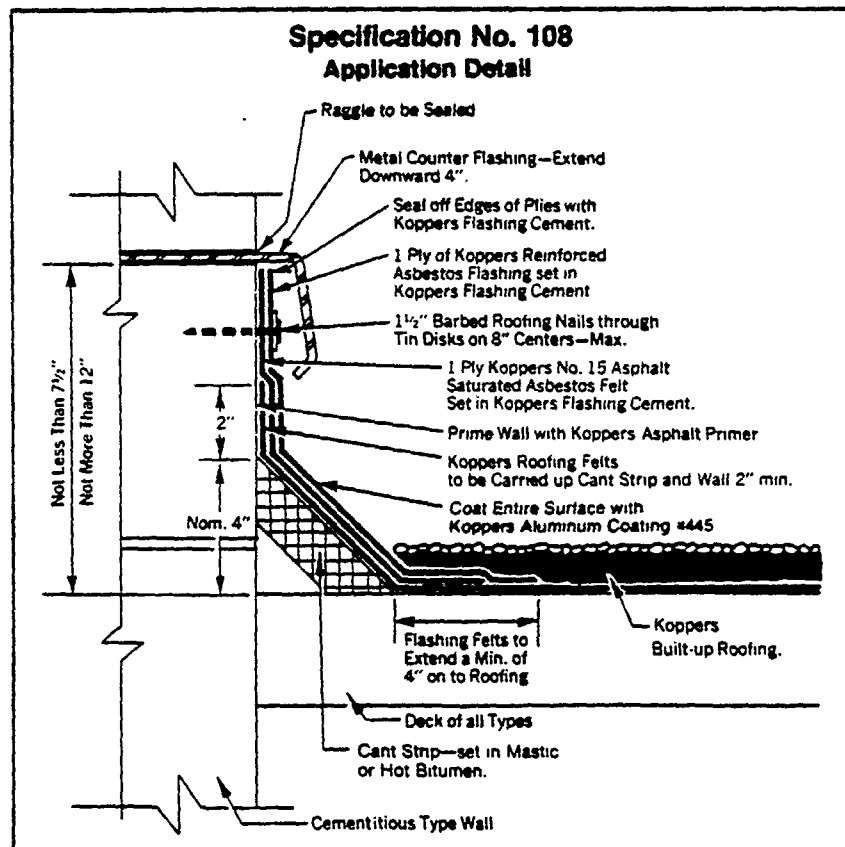
3. On top of this apply a second uniform coat of Koppers Flashing Cement into which embed one (1) ply of Koppers reinforced asbestos base flashing (reinforced fabric side down).

4. Nail with one and one-half (1 1/2) inch masonry roofing nails through flat tin discs along upper edge eight (8) inches o.c. maximum into mortar joints. For concrete construction, nail to treated wood nailing strips set in flush with the surface with appropriate nail through flat tin discs.

End laps for each ply shall be not less than three (3) inches. End laps between plies shall be staggered not less than twenty-four (24) inches.

5. The top edge of the flashing felts are to be sealed with flashing cement. (Stripping of this top edge with Koppers Glasfab Fabric, set in the cement is preferred, but remains optional.)

6. Coat entire surface of flashing with Koppers Aluminum Coating #445 applied at a rate of 2 gal/100 sq. ft. (including nail caps along top edge of flashing as well as top edges of felts)



7. Interply cement shall be troweled uniformly, full height and continuously approximately one-eighth (1/8) inch thick. Plies must be laid in smoothly with no pockets, wrinkles or buckles.

Install metal cap flashing.

***NOTE:** Koppers steep asphalt may be used as an alternate to the two (2) Interply trowelings of asphaltic plastic cement.

All other requirements of this specification must be adhered to.

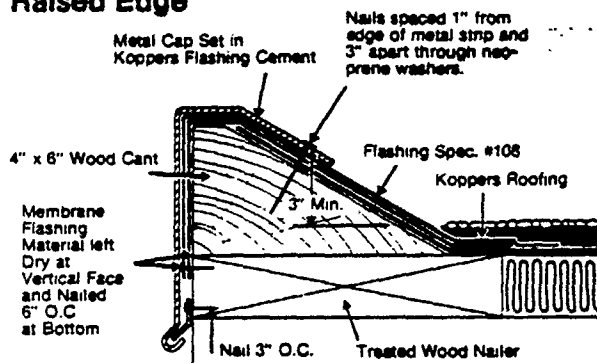
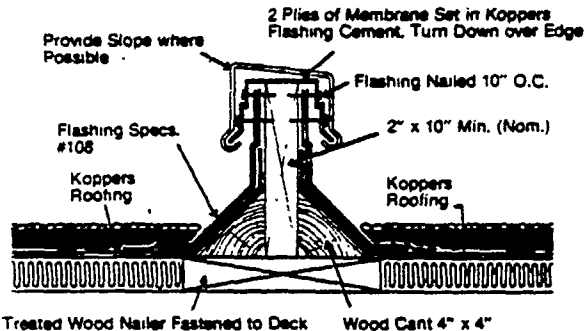
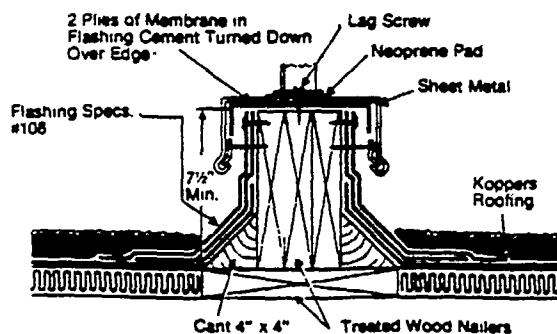
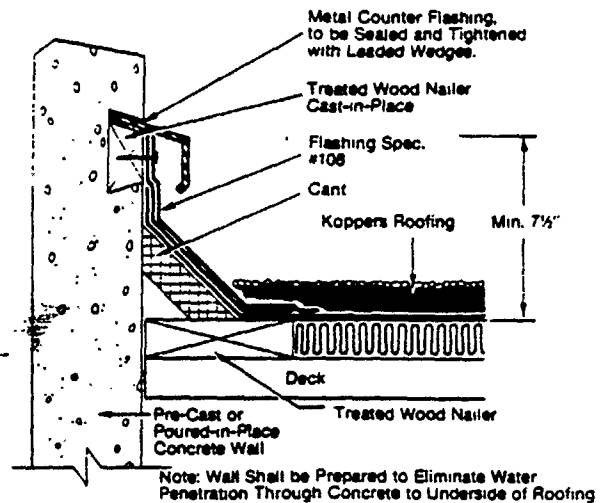
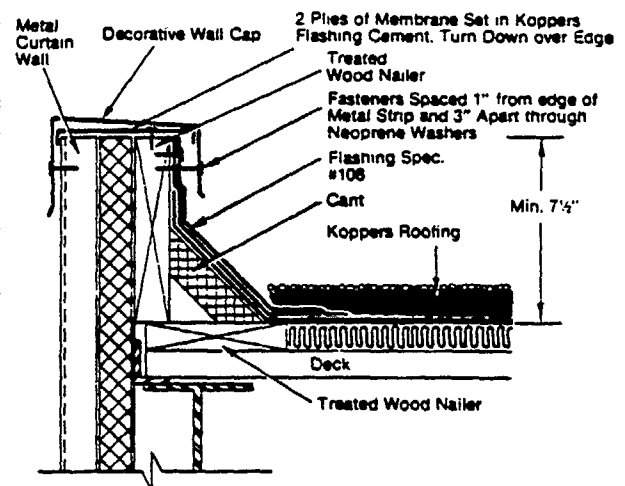
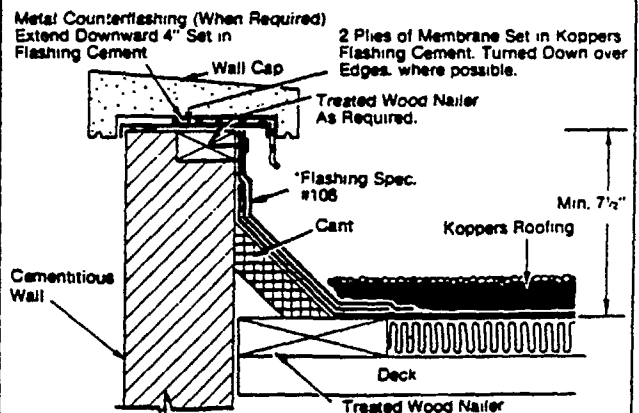
General information

There are numerous flashing details that have been proven by experience over the years. There are normally a number of acceptable construction details for accomplishing one purpose. The architect should select a detail that best serves the purpose under the various and different conditions concerned with the specific job at hand. In certain cases, slight modifications are necessary to adjust a proven detail to job conditions or one method may serve better than another.

The details shown in this manual are some suggestions based on experience. Space limitations prohibit listing many others.

Design or selection is a responsibility of the architect.

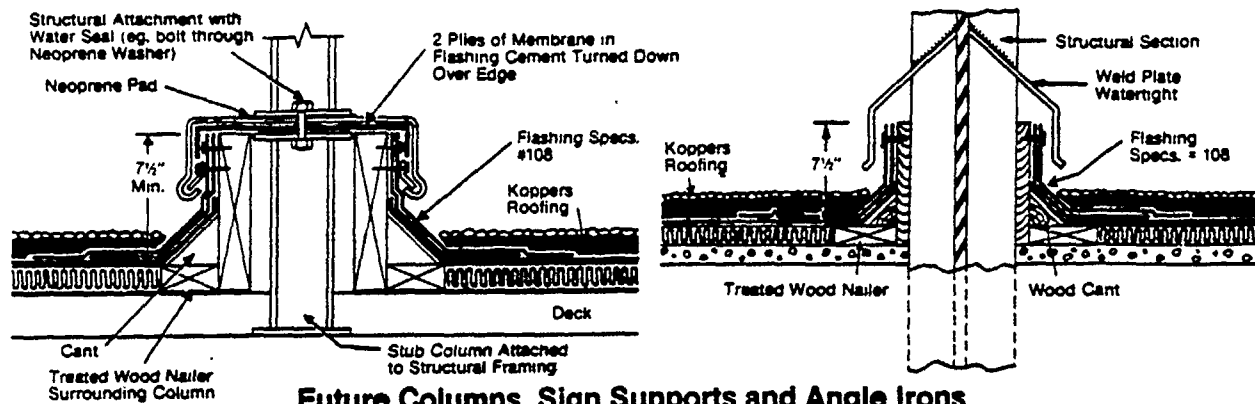
Koppers representatives are available to review flashing details to assist the architect in providing the best details for specific jobs.

Raised Edge**Relief Joint****Equipment Support****Parapet/Precast or Poured Concrete****Parapet/Metal Curtain Wall****Parapet/Wall Cap**

*Note: When composition flashing does not extend up to wall cap or wall cap does not provide water egress protection, a metal counterflashing must be installed according to procedures found in flashing specifications.

Built-Up Roofing Systems (Cont.)

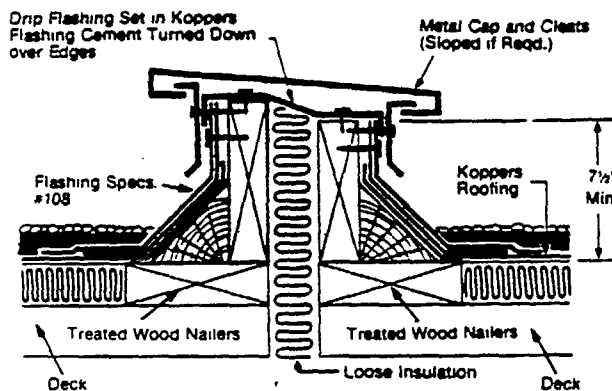
Flashing Details (continued)



Future Columns, Sign Supports and Angle Irons

At all locations where stub or future columns, sign supports and angle irons are to penetrate built-up roofing, Koppers recommends wooden curved base units with cant strips to be installed to accept KMM flashing systems. Where structural steel section

extends beyond "stub" height, metal cap flashing with tight fit to the structural section must be fabricated and continuously welded to the projection to assure a watertight metal cap.



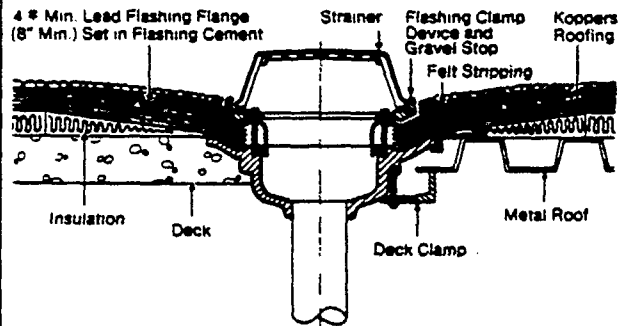
Curbed Expansion Joint

Curb expansion joints are to be flashed in accordance with Koppers specifications for parapet walls. Metal cap must be designed to expand so as not to disturb flashing.

It is the responsibility of the designer of the building to provide for adequate expansion joints.

For the protection of the roofing system against splits caused by expansion and contraction, Koppers recommends that an expansion joint be installed: (1) on roof areas larger than 200 feet in each direction, (2) at all places where the structural supports and roof assembly change direction, (3) where type of adjoining deck materials change.

Where control, expansion, or contraction joints are provided in structural steel, deck material, or deck system, provisions must be made for continuation through the roofing system. See (Expansion Joints) Page 11.



Roof Drain

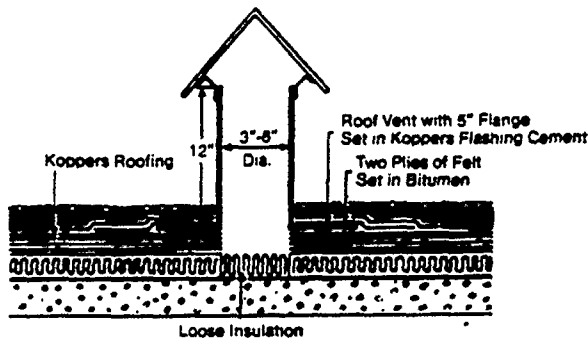
All roof drains shall be provided with metal roof drain flashing flanges which extend at least 12" beyond drain opening and shall be stripped with felt in accordance with drain detail. All drains should be provided with expansion joint sleeves.

The sheet metal flange furnished with the drain must be cemented to the surface of the felt with hot Coal Tar Bitumen or flashing cement. Over the flange apply, with alternate moppings or trowelings, two (2) reinforcing plies of felt so that the first extends not less than three (3) inches beyond the outer edge of the flange, and the second not less than six (6) inches.

Roof drains must be of a type provided with a wide lead or copper flange. Strainer construction should provide adjustment for meeting variations in roof level or slope.

To obtain proper drainage, roof drains should be located at points of lowest expected deflection in roof deck.

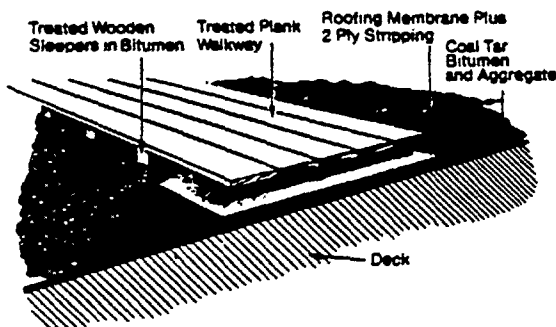
Note: Special care must be taken to prevent bitumen migration into drain openings.



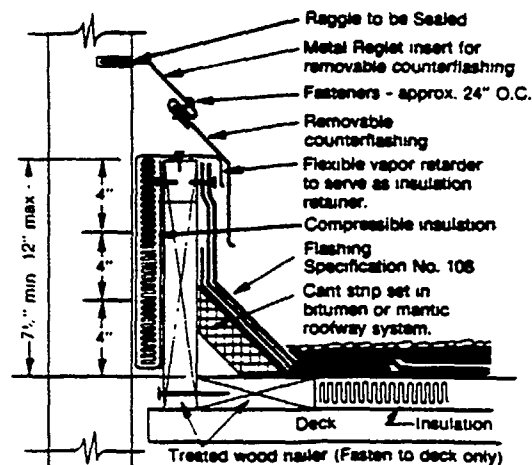
Roof Vent

Koppers does not recommend occasional or spot vents through the roof as the only venting method or a substitute for underside or continuous vented systems. There may be certain instances where spot or mushroom type vents might be deemed advisable by the designer for a new building (eg. at expansion joints for vent relief on long run underside continuous venting systems, etc.)

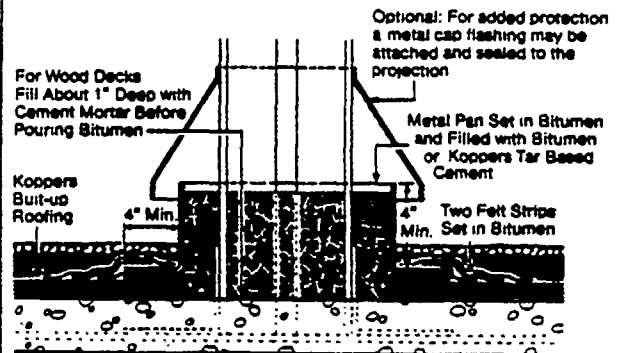
Walkways (Treated Wood Walkway)



Non Wall Support Flashing



Note: Suggested detail where possibility exists that differential movement will occur between deck and vertical surface. This detail is intended as a guide only.



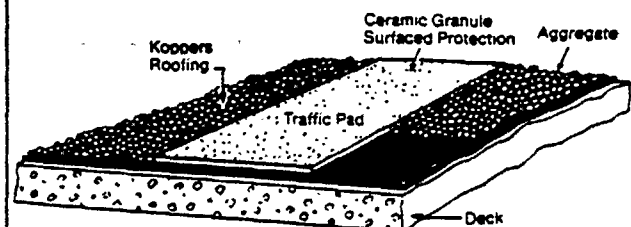
Pitch Pocket

Although controversial, the "Pitch Pocket" is one of the most frequently used design details.

The sheet metal flange must be cemented to the surface of the felt with hot coal-tar-bitumen or flashing cement. Over the flange apply, with alternate moppings, two (2) reinforcing plies of tarred felt so that the first extends not less than three (3) inches beyond the outer edge of the flange and the second no less than six (6) inches.

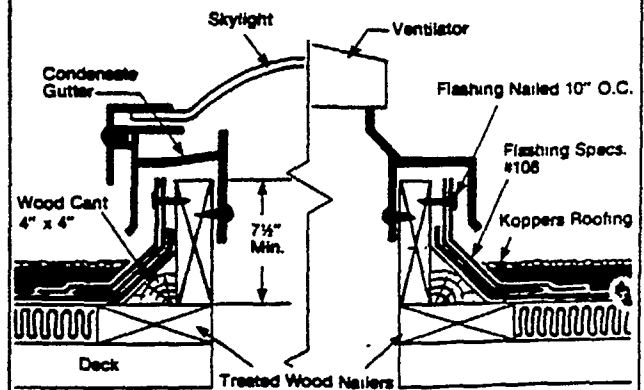
Fill metal pan with hot coal-tar-bitumen or flashing cement. Paint exposed sections of all reinforcing rods with dampproofing paint.

Traffic Pad



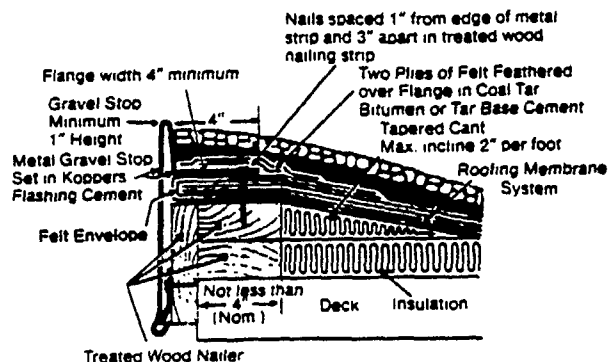
Roof Opening

Curbs extending a nominal 10 inches to 14 inches above roof surface shall be provided at all openings for skylights, ventilators, expansion joints, etc., to provide for installation of KMM flashing.

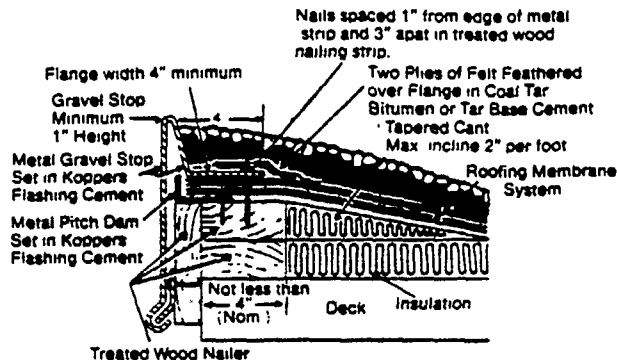


Built-Up Roofing Systems (Cont.)
Flashing Details (continued)

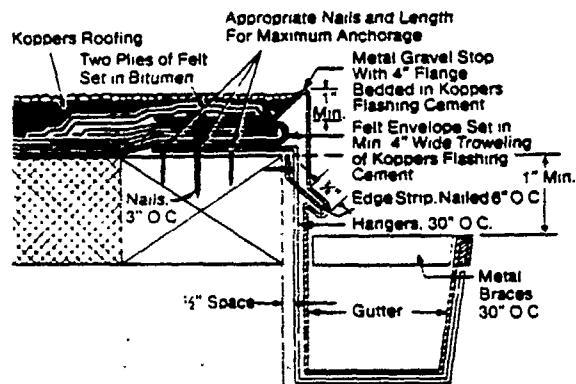
Tapered Cant



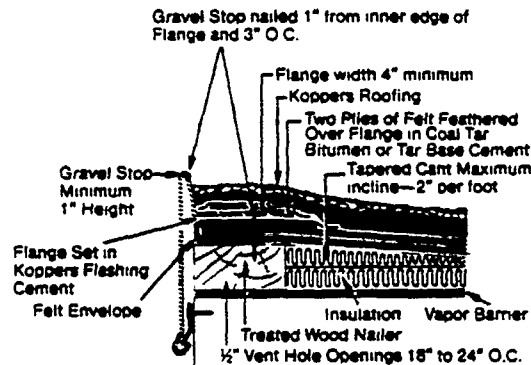
Tapered Cant



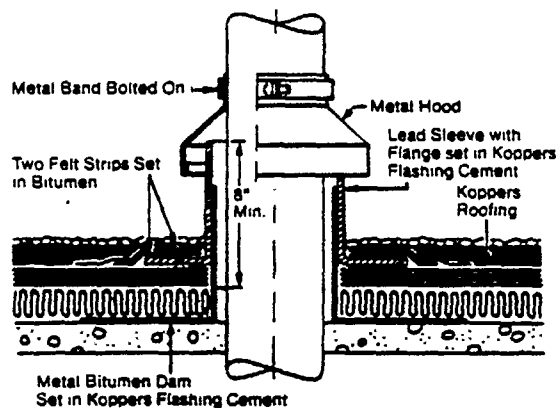
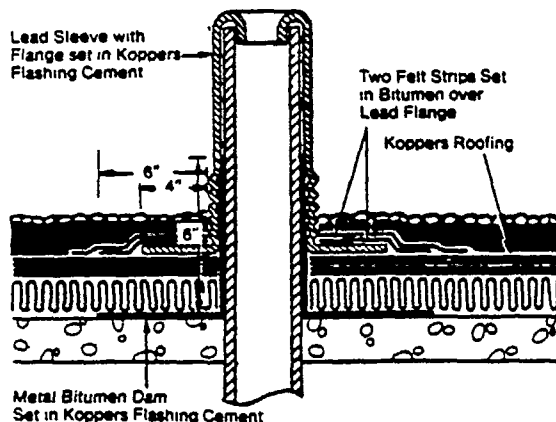
Hanging Gutter



Vented Edge



Vent Pipes, Stacks, Flagpoles, and Other Projections



All vent pipes, stacks, flagpoles, or other projections penetrating the built-up roofing, whether indicated on drawings or not, must have a proper metal sleeve flashing with flange, pan flashing with flange or other flanged flashing installed.

Behind metal sleeves and beneath the roofing membrane next to deck install a metal bitumen dam as shown in detail. The sheet

metal flange must be cemented to the surface of the felt with a mopping of hot Coal Tar Bitumen. Over flange apply, with alternate moppings, two (2) reinforcing plies of felt so that the first extends not less than three (3) inches beyond the outer edge of the flange and the second not less than six (6) inches.

SINGLE-PLY ROOFING SYSTEMS

KMM® Membrane Systems

Materials and System

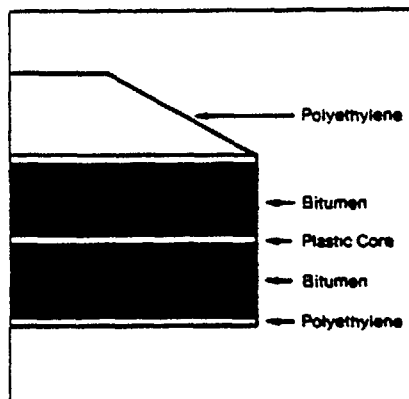
Description

KMM membrane is a versatile, prefabricated sheet of cold-applied roofing and waterproofing material. It is designed for application in roofing, reroofing, maintenance roofing, foundations, plazas and various other areas of construction where effective waterproofing is required.

KMM membrane is supplied in two types.

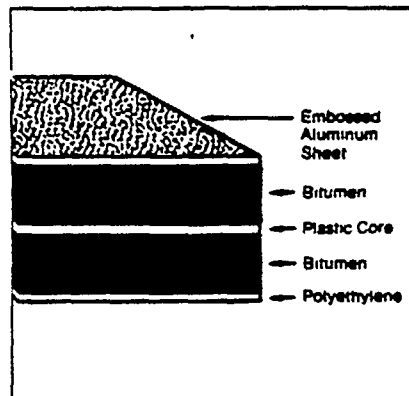
KMM Standard Membrane

KMM Standard membrane is a five-layer laminate composed of a thick, flexible plastic core protected on each surface by a layer of modified bitumen and an outer film of polyethylene.



KMM Aluminum Membrane

KMM Aluminum membrane is a five-layer laminate composed of a thick, flexible plastic core which is protected on each side with a layer of modified bitumen. The top surface is a heavy, embossed aluminum sheet and the bottom surface is a film of polyethylene.



Both versions of KMM membrane are supplied in the form of compact, ready-to-apply rolls.

Both KMM membranes are designed for use in various roofing and waterproofing applications.

KMM Standard membrane, loosely laid, is normally used in roofing systems which incorporate an aggregate surface or where protection from the atmospheric elements



is afforded to the KMM surface by other means. KMM Standard membrane is appropriate for use in vertically as well as horizontally applied waterproofing systems where surface protection is specified.

KMM Aluminum membrane is ideally used in roofing systems in which the roof slope is too steep to permit aggregate surfacing. It is also employed in flashing systems.

KMM membrane has good elongation properties to withstand normal structural movement when recommended architectural practices are followed. It is suitable for application over most decks and commonly used insulating materials which provide continuous support for the KMM membrane.

KMM membrane is simple to install. It results

in a completely waterproof system. It is factory-made and provides a factory-assured quality material of uniform thickness and composition.

The function of the bitumen covering is to serve as a carrier and protector of the central plastic core, to provide the basis for the heat fusion between the sheets and to add to the water resistance of the laminate.

Product Information KMM Membrane

	KMM Standard Membrane	KMM Aluminum Membrane
Roll Size	43" x 33 L.F. 118 sq. ft. 107 sq. ft. coverage	43" x 33 L.F. 118 sq. ft. 107 sq. ft. coverage
Thickness (nominal)	160 mils	120 mils
Weight (nominal)	99 lbs./roll (includes packaging & core)	76 lbs./roll (includes packaging & core)

KMM Adhesive

A rapid setting, asphalt base adhesive that bonds KMM Membrane to most surfaces.

Package Size: 5 and 55 gal. containers.

Weight: Approx. 55 lbs. per 5 gallon container and 600 lbs. per 55 gallon drum.

Stonemat

A polyester mat of high burst strength used under stone topping. Rolls are 8' x 450'.

Color Coatings for KMM Aluminum Membrane

Field applied coatings for KMM Aluminum membrane are available in 14 colors. For color selection consult Koppers Master Color Selection Chart 560-L under Koppers Acrylic Emulsion No s. 600 and 610.

KMM® Roofing Systems

General Requirements

The data contained herein is primarily oriented toward roofing systems. However, much of the information is also applicable for waterproofing systems. Contact your Koppers representative for specific data concerning KMM waterproofing and/or further information pertaining to KMM roofing systems.

KMM Membrane is not intended to offer chemical resistance and must not be used on roofs subjected to corrosive or otherwise damaging solutions, vapors, etc.

Roof Structure System

In any building, the performance of the roofing will be affected to some degree by all of the parts of the roof structure system as well as the inside and outside atmospheric environment. Each component should be investigated for its compatibility with each of the others. The roof structure system may include any or all of the following:

- Outside air conditions
- Roofing system
- Peripheral details (flashings)
- Insulation (if present)
- Vapor retarder (if present)
- Structural deck, including subpurlins (supports)
- Structural framing
- Air space (if present)
- Ceiling (if present)
- Interior air conditions

You will find information in this manual pertaining to materials and application methods other than for KMM roofing. They are offered to assist the designer in establishing their normal position in the roof structure system. They should not be construed as part of the KMM roofing system, as endorsement or as part of the designated specifications, other than to establish a suitable roofing base in the roof structure system.

The proper design, specification and positioning of the various components of the roof structure system are the responsibility of the building owner or his designer. Any subsequent failures due to either the installation or lack of installation will not be Koppers responsibility.

General Deck Requirements

The deck is the base over which the KMM membrane is applied. Where the term deck is used without reference to insulation, it shall designate the surface over which roofing is to be applied. Any deck defect shall be corrected before application of roofing. All decks shall be installed in accordance with the deck manufacturer's specifications, and shall be in compliance with Koppers General Requirements.

In approving any deck as satisfactory to receive a KMM system, only the deck surface is accepted. It is the responsibility of the building designer and the deck manufacturer to provide for expansion and contraction in a manner that will provide a stable base for the KMM membrane, for support of maximum

anticipated loads, for secure attachments vertically and laterally, and for the selection of the deck material and construction details including their ability to contain bitumens or adhesives used for attachments of the KMM membrane or other components of the system. Koppers will not assume responsibility for deck defects, or the effect of deck defects on Koppers roofs.

The placing of conduits, bolt heads, etc., above the roof deck and below the roofing membrane is not recommended.

All projections or openings in the deck should be completed prior to the application of the roofing. Insulate all hot water and steam pipes which project through or are near the surface to be roofed or waterproofed. This is to prevent possible damage to the KMM system.

Condition of Roof Surfaces to Receive KMM Membrane

All surfaces must be dry, frost free, reasonably smooth, clean, rigid and free from debris, loose materials, projections, holes, release agents or other contaminants which might cause rupture of the membrane and/or adversely affect the KMM membrane application and performance. Dust shall be removed from the surface immediately before application of the KMM membrane system, especially from those which incorporate the use of KMM Adhesive to adhere the membrane to its substrate.

METAL DECKS

Decks of this type must also be free from loose rust and oily substances. Deflection should not exceed 1/240 of the span. Decks of this type are not suitable for application of KMM membrane without insulation being placed between the deck and the KMM membrane.

POURED STRUCTURAL CONCRETE

Where insulation is specified on concrete slopes exceeding 2" per foot, insulation stops shall be installed to retain insulation in place. Treated wood insulation stops 2" (nom.) wide, and equal to the thickness of the insulation, shall be installed to the top of the surface of the deck by means of bolts, screws, or other acceptable fastener, countersunk to be flush with surface of insulation stop.

All concrete and masonry surfaces must be cured, dry and free of loose material. All cracks, holes, voids and open areas shall be wetted with water and then carefully filled with Portland Cement Mortar, struck flush, and permitted to dry.

When KMM Adhesive is to be applied directly to the concrete surface, the concrete must be cured, free of moisture, dust and other contaminants including curing agent and form release agents. Over freshly poured concrete or where a curing agent has been used, apply a glass base sheet, strip mopped in steep asphalt (12-15 lbs./sq.) or mechanically fastened with approved fasteners, prior to the application of KMM Adhesive.

Concrete surfaces to which KMM Adhesive is directly applied must be primed with Koppers High-Pen Primer 452 at the rate of 1/2-3/4 gal. per square.

PRECAST CONCRETE DECKS

All joints must be grouted smooth and level with the deck surface. All slab surfaces must be even with the surface of the adjacent slab, or edges must be gradually and smoothly tapered to adjacent slab. When KMM aluminum membrane is to be applied directly to deck surface, prime the surface with Koppers High-Pen Primer 452 at the rate of 1/2-3/4 gal. per square, strip all joints with with 6" wide felt strip set in Koppers Flashing Cement, or 6" wide KMM Standard membrane substrate-fused.

WOOD FIBER DECKS

KMM Aluminum Membrane should not be applied directly over wood fiber decks. A glass base sheet set in steep asphalt must be applied prior to the application of KMM Aluminum Membrane. The base sheet shall be laid unattached prior to KMM Standard application.

WOOD DECKS

Plywood shall be exterior grade. All wood shall be well seasoned, dry, and preferably treated. End joints shall have adequate bearing. Loose or void knot holes, large cracks, etc., shall be covered with appropriate material. All nail heads must be flush with surface of wood decking.

KMM® Aluminum: Not to be applied directly to wood decking. Where specified over wood decks, the wood surface shall be covered as follows:

1. Plywood (1/2" min.), or wood plank, or tongue and groove (1" nominal min.).

- a. Starting at the low edge of the deck, nail an 18" width of No. 15 asphalt felt to the deck. Nail along both lower and upper edges, spacing the nails approximately 18" on centers in staggered fashion.

- b. Coat the top of the starter strip with 2 1/2-3 gals. per 100 sq. ft. of CP Adhesive (steep asphalt is an acceptable substitute). When the adhesive is tacky, place a full 36" width of No. 15 asphalt felt to completely cover the starter strip keeping the lower edge of the 36" width even with the lower edge of the starter strip. Broom the felt thoroughly into the adhesive with a stiff bristle brush. Nail the upper part of the first full ply to the deck at 18" intervals 4" down from the upper edge and 18" intervals 14" down from the upper edge of the felt.

- c. Coat the upper 19" of the first ply of felt with 2 1/2-3 gals. per 100 sq. ft. of CP Adhesive. When the adhesive has become tacky, embed the second ply in the adhesive, lapping it 19" over the first ply. Be sure that the second ply covers all nail heads in the first ply. Broom lower half of felt carefully into adhesive to eliminate wrinkles and fishmouths. Nail the upper portion of the second ply to the deck in the same manner as the first. Proceed up the slope in this manner, lapping each sheet 19" over the preceding sheet. There shall be no exposed nail heads in the finished felt application.

d. The end of the underlying felt shall be nailed to the deck at 9" intervals approximately 2" in from the end. The end of the overlapping felt shall overlap 6" and shall not be nailed to the deck, but shall be carefully cemented to the underlying strip making sure that no nail heads are exposed. End laps of any ply shall be staggered at least 2" from end lap of preceding ply.

ALTERNATE METHOD: Glass base sheet overlapped 4" at side and 6" at ends, fastened with Berryfast Tapefast System with tape strips over side laps and two strips in the field equally spaced, or nailed as per Fastener Chart using 100 nails per square.

2. Wood Planks or tongue and groove (2" nominal min.). A glass base sheet shall be nailed over wood planks with approximately 100 nails per square as per Fastener Chart or fastened with Berryfast Tapefast System using a tape over 4" overlap of base sheet and two tapes in the field equally spaced.

KMM® Standard Membrane: When applied over wood decks, lay a glass base sheet unattached over the deck surface, lapping 4" on side and 6" on end laps.

POURED GYPSUM

Deck must be cleared of dirt and debris and all other foreign matter and all holes, cracks or other voids must be filled flush with the surface.

Poured gypsum decks sometimes cause trouble because the roofing is laid before the deck is thoroughly dry. When this happens the result is a blistered and buckled membrane, or, just as serious, insulation curls and makes an unsatisfactory job. The roofing contractor, backed by the architect, must insist on a thoroughly dry deck before beginning work.

PRECAST GYPSUM DECKS

All joints must be grouted smooth and level with the deck surface. Slab surfaces must be even with the adjacent slab surface or the edges must be gradually and smoothly tapered to the adjacent slab.

KMM Standard may be loose laid directly over the deck surface.

Prior to the application of KMM Aluminum, nail a glass base sheet terminating at the base of the cant or at the perimeter of the deck under metal edges.

Lightweight Insulating Decks

Lightweight Insulating decks include lightweight aggregate concrete (20 to 40 lbs. per cu. ft. over dry density); foamed concrete, gypsum and thermosetting asphaltic decks. Except for Dycon® Concrete, lightweight insulating deck systems must be capable of venting excess water vapor to the underside. Koppers will not accept these lightweight insulating decks to be placed over vapor barriers, poured concrete substrates, unvented metals, or any type of base which will not permit these materials to vent from the underside. This is necessary to prevent a water vapor pressure build-up under the built-up roofing. Occasional, or spot vents through the roofing as the only venting method are not satisfactory substitutes for underside venting.

RECOMMENDED FASTENERS FOR BASE SHEET ATTACHMENT

Unless otherwise specified, when a nailed base sheet is to be used as an underlayment for KMM membrane, the base sheet must be a glass base sheet. Side laps are to be 4" and end laps are to be 6". The base sheet shall be fastened with approved nails and the pattern shall be on 9" centers, 2" from the edge lap and staggered down the center of each sheet. (Note: This is approximately 100 nails per square.)

Roof Deck	Fastener	Special Instructions
Wood-Planks or Tongue & Groove	11, 13, 14, 16, 17, 18	None
	1, 3, 4, 7, 8	See Note 1
Plywood, 1/2" min.	11, 13, 14, 16, 17, 18	None
	3, 4, 7, 8	See Note 1
Gypsum, Poured (1-7 Days)	6, 9	See Note 1
Poured (Dry)	12	See Note 1
Structural Wood Fiber	2, 5, 6	See Note 1
Concrete, Poured	15, 19	None
Concrete, Precast	15, 19	None
Lt. Wt. Insulating Concrete-Poured	2, 5, 6, 10	See Note 1
Lt. Wt. Insulating Concrete-Precast	2, 5, 6	See Note 1

Note 1 — Heads of nails must be covered by one of the following methods:

- 1) No. 15 asphalt felt or base sheet solid mopped in hot asphalt (20 lbs. sq.).
- 2) 6" squares of base sheet adhered with KMM adhesive, 3) 6" squares of KMM Standard fused in place.

Type of Fastener and Source of Supply

1. Roofing nails, 3/8"-7/16" head, 11 or 12 gauge.
2. Insuldeck hoe-nail-E.G. Bldg. Fasteners.
3. Roofing Nail Annular thread, 3/8" dia. head, 11 gauge.
4. Roofing Nail Spiral thread, 3/8" dia. head, 11 gauge.
5. Capped ES-Nail, 1" cap — ES Products.
6. Tube-Loc Nail, 1" dia. cap — Simplex.
7. Squarehead Cap Nail, annular thread, 1" cap.
8. Squarehead Cap Nail, spiral thread, 1" cap.
9. Nail-Tite Type A, 1 1/4" dia. cap-ES Products.
10. Zono-tite or Nail-Tite MK III, W. R. Grace of ES Products.
11. Roofing Staple, Berryfast Tapefast System, Berryfast.
12. Gypsum Roof Deck Nail (old gypsum decks), Simplex.
13. Dekfast, (steel plate), Construction Fasteners.
14. Dekfast P (plastic plate), Construction Fasteners.
15. Dekfast C, for concrete (steel or plastic plate), Construction Fasteners.
16. Grefco Perma-fastener, Grefco.
17. GAF, Gafite, GAF.
18. Fabco Insulfix Type P, Fabco.
19. Fabco Confix (Type P plate), Fabco.

In addition, lightweight insulating decks shall have sufficient cohesive strength to provide firm attachment of the roofing to the deck and framing to prevent wind uplift damage or blow-offs. Nailable decks must be capable of developing at the very minimum, a 40 pound nail pull-out or withdrawal strength. If the materials do not achieve this value, additional fasteners will be required over and above those quantities described in the ensuing specification (standard is approximately 100 fasteners per square) to achieve a minimum attachment standard of 40 lb. per square foot. Koppers will not be responsible for failure of the insulating deck to remain integral or for disbonding of the roofing from the surface of the deck.

Provisions should be made wherever possible to provide additional venting such as notched wood perimeter nailers, etc. in conjunction with the venting from the underside of the deck. If board type insulation is to be applied

over a lightweight insulating deck, provisions must be made between the fill and the board insulation to prevent fill moisture from affecting the insulation and roofing.

KMM Standard may be loosely laid directly over the deck surface.

When KMM Aluminum is specified, a glass base sheet must be nailed as per the Fastener Chart, terminating the base sheet at the base of the cant or at the perimeter of the deck under metal edges.

Precast Lightweight Insulating Decks

All joints must be grouted smooth and even with the surface of the deck. Slab surfaces must be even with the surface of the adjacent slab or the edges must be gradually and smoothly tapered to the adjacent slab.

Expansion Joints (Building)

KMM roofs, especially those employing the loose laid membrane concept, are able to withstand building movement to a greater degree than conventional materials, but good design practices dictate that expansion joints should be employed for protection of the overall roofing system. The use, location and design of building expansion joints should be taken into consideration at the time of the original building design.

Although provisions for adequate expansion joints are the responsibility of the building designer, Koppers offers the following recommendations for the protection of the roofing system due to stresses caused by expansion and contraction of the building. Building expansion joints should be installed:

1. On large roof areas at least 200 feet in each direction.
2. At all places where the structural supports and roof assembly change direction.
3. Where types of adjoining deck materials changes.

Where control, expansion or contraction joints are provided in structural steel, deck materials or deck system, provisions must be made for their continuation through the roofing system. Koppers realizes that in a climate-controlled building there may be little or no-expansion after the building is in use. However, building expansion joints are still recommended based upon the following points:

1. During construction, the building will not be under a steady-state temperature/humidity condition so that thermal and moisture movement can be sufficient to disturb and possibly injure the roofing system.
2. If no building expansion joint is provided, the owner must keep the building at the steady-state temperature and humidity condition at all times, as holiday shutdowns may injure the roofing system due to the movement of the building system resulting from temperature/humidity variation.
3. If the occupancy is fairly large, the sudden entrance on a rainy day of many rain-soaked employees may cause rapid moisture movement in the roof structure system which may damage the roofing system.

Underwriters Laboratories

Underwriters Laboratories, Inc. Building Materials Directory. Built-up Roofing Covering Materials, lists KMM Membrane for use in construction of class A, B, or C built-up roof coverings. Specifier should consult this directory for complete details.

Guarantee

A guarantee is available on KMM Membrane roofs when applied by a KMM Qualified Applicator. See page 6 for further information.

Wood Nailing Strips

All non-nailable decks require wood nailing strips at eaves, edges, walls, roof openings, etc., for proper securing of metal flanges. Nailers must be securely and firmly attached to the deck or through to its supporting members. Nailers shall extend not less than 1" beyond the apron or flange.

Nailers should be treated to preserve their condition and hence their nail retentive power for the expected life of the roofing. Creosote or oilborn preservatives may affect the roofing they contact and should not be used. Nailers should be pressure-treated with a waterborn preservative such as Wolman® salts or with penta applied in a liquified petroleum gas carrier such as the Cellon® process.

Wolman® and Cellon® are registered trademarks of Koppers Company, Inc.

Traffic Surface

Where heavy traffic is anticipated over KMM Membrane, a suitable traffic surface such as Careytred should be provided.

Inspection and Patching

All KMM membrane must be carefully inspected for construction damage and imperfect heat fusion prior to the installation of the protective topping. It is advisable to inspect lap fusions at the end of each work day. Any holes or tears must be patched with the appropriate KMM membrane. The patch must extend at least 4" in all directions from the edges of the tear or puncture. Seal into position with interply fusion and top sealing for Standard KMM membrane. Seal Aluminum KMM membrane by inter-ply fusion. Streaks or seams of bitumen on Aluminum KMM membrane may be touched up by high quality varnish-base aluminum paint.

Vapor Retarder

Vapor retarders are normally used where the heat flow direction and/or humidity within the building, during any climate or occupancy cycle, might cause moisture to migrate upward into the insulation chamber. It is important that the vapor retarder provide a continuous seal around ventilators, skylights, peripheral walls, and other terminations from the source of the water vapor.

Other Requirements Materials Protection

Although KMM membrane is waterproof in the roll, good practice dictates that it should be protected when stored outside by raised platforms and adequate cover.

Cold Storage and Freezer Buildings

KMM roofing systems may be used in cold storage and freezer building applications; with or without a ventilated air space between the deck and the insulated refrigerated area. For specific recommendations, consult your local Koppers representative.

Waterstops (Temporary Protection)

At the end of each day's work, waterstops must be installed to protect the insulation or substrate against water penetration. Waterstops consist of a single ply of KMM membrane (Standard of Aluminum Grade) extending a minimum of 6" beyond the terminal edge of the insulation. The leading edge of the membrane is then substrate-fused to the deck and top-sealed. Water-stops should be continuous and tight.

These temporary protective measures must be detached cleanly when work is resumed. KMM Membrane must be removed from the deck back to the top of the insulation.

Board Type Insulations

These insulations come in varying thicknesses and sizes. The insulation manufacturer's specifications shall be followed and, in addition, shall be in compliance with Koppers General Requirements.

Roofing equipment must be of a type which will not damage the insulation used. Broken or damaged insulation sheets can only be used when the damaged portion is cut out.

No more insulation shall be laid in a day than can be protected by KMM membrane in case of sudden weather changes. Edges of insulation shall be brought closely together and shall not be forced into place. Where insulation joins vertical surfaces, the insulation shall be cut in a neat manner, allowing at least 1/4" clearance. Insulation joints must be staggered.

When more than one layer of insulation is used, joints in each layer shall not coincide. All layers shall be parallel to preceding layers.

When applying KMM Aluminum over rigid insulation boards on roofs with less than 2" per foot slope, all insulation joints shall be taped with 6" wide (min.) asphalt felt, reinforced kraft paper tape, embedded in KMM Adhesive (1 1/2 gals/square) or steep asphalt.

Glass fiber roofing tape embedded in steep asphalt or 6" wide KMM Standard, fused and featheredged may also be used. When taping is required, insulation joints should be laid continuous to facilitate taping. This procedure also applies to top layer of multi-layers of insulation when taping is required.

Insulation applied over roofs with a barrel configuration shall be covered with a ply of base sheet set in steep asphalt and glaze coated, prior to the application of KMM.

When slope is under 2"/ft. and a ply of base sheet is applied over the insulation, taping may be omitted. However, all insulation and felt must be roofed over with KMM, and not left uncovered overnight.

Single-Ply Roofing Systems (Cont.)

General Terminology and Reroofing Application Information

Fiberglass insulation boards are approved underlayments for KMM Aluminum and Standard.

Perlite insulation may be used under KMM Aluminum only when a No. 15 asphalt felt is firmly attached to the perlite with steep asphalt, prior to the application of KMM Aluminum. KMM Standard may be loose laid directly over the perlite insulation.

Polystyrene is not acceptable under KMM Aluminum. Polystyrene with minimum 1.5 lb. density is acceptable under KMM Standard when polystyrene is covered with a loose laid base sheet. No. 15 asphalt felt may be used instead of the base sheet, over polystyrene with minimum 2 lb. density.

Fiberboard insulation may be used under KMM Standard only when a No. 15 asphalt felt is laid loose over the fiberboard or under KMM Aluminum if the No. 15 asphalt felt is firmly attached with steep asphalt.

Urethane and urethane composite insulation boards over metal decks must be mechanically fastened with 5 approved fasteners per 3' x 4' board. Fasteners must be located at each corner and in the center of the board. For double layer applications, it is acceptable to fasten the first layer and solid mop the second layer in steep asphalt at the rate of 30 lbs. per square. On other decks and over existing smooth surface, urethane and urethane composite boards may be mechanically fastened as stated above, or solid mopped in steep asphalt at the minimum rate of approximately 30 lbs. of asphalt but of sufficient quantity to insure maximum attachment. Over existing gravel surfaces, insulation must be mechanically fastened. Urethane and urethane composite boards must not be applied over existing roofs if the existing insulation is not dry.

Consult your Koppers Representative for use of other types of insulation.

Insulation Attachment

Where attachment of insulation is required in these specifications, adhesive and/or fasteners must possess a minimum uplift resistance of 40 pounds per square foot (PSF).

Suitability of the kind of attachment is dependent upon the type of insulation and its substrate. This should be investigated by the specifier along with the various requirements, including wind uplift resistance, as described in the local building code and/or policies of the insurance agencies involved.

Koppers will accept the use of mechanical fasteners providing insulation manufacturer recommendations are followed, and the fastener is one of the following

Deklast Grelco Perma-fastener GAF Galite or FABCO Insul-Fixx Type P. Other types of FM Approved fasteners may be used providing:

- 1) A No. 15 Asphalt Felt or base sheet is solid mopped in asphalt to cover all insulation, or
- 2) all fastener heads are covered with 6" squares of base sheet adhered with KMM Adhesive, or
- 3) 6" square of KMM are fused over fastener heads.

Under loose laid KMM Standard Membrane, insulation other than urethane, urethane composite, and isocyanurate may be laid loose if the thickness of the board is minimum 3/4". Care must be exercised to insure snug joints.

Terminology

Heat Fusion

Heat fusion is a general term used to describe specific methods of adhesion of one layer of KMM membrane to another surface. In the process of heat fusion, the bitumen of the membrane is heated with a direct flame until it is plastic enough to flow under pressure. When pressure is immediately exerted to this softened bitumen, it fuses to the surface to which it is applied. Specific types of heat fusion are described below. It should be noted that the external plastic film present will break and draw apart with the proper application of the flame.

Substrate fusion is the specific type of heat fusion used to secure the KMM membrane to a substrate. The underside of the KMM membrane is heated until plastic. The heated underside is then quickly pushed or forced against the substrate surface so that a slight "run-out" of bitumen from beneath the edge of the membrane is observed. A 4"-wide fused seal is to be obtained.

Interply fusion is the specific type of heat fusion used to obtain a waterproof seal between two overlapping sections of KMM membrane. In practice, the flame is applied simultaneously to both surfaces of KMM membrane until each becomes plastic. For KMM Aluminum membrane end laps, heat the bottom of the overlapping section until it becomes plastic. The two surfaces are pressed together to form a fused lap or seam of at least 4" in width. A slight "run-out" of bitumen from the lap joint is to be obtained.

Top sealing is the specific type of heat fusion used to make the second seal at substrate-fused and interply-fused joints. It is applicable only to KMM Standard membrane. Top sealing is accomplished by heating a 2" to 3" section at the edge of the top sheet until plastic. To develop a smooth, continuous filled joint, move the softened bitumen from the top sheet over the joint and onto the overlapped membrane with a roundnosed trowel.

Heat fusion equipment: The recommended torch equipment for fusing KMM laps is the KMM Torch Tip attached to the Goss AP-8 or AP-12 handle. A roundnosed KMM Trowel is recommended for substrate fusion, interply fusion and top sealing.

KMM Aluminum Interply Fusion

The watertight lap is obtained on Aluminum KMM membrane by the heat-fusion attachment of the upper sheet to the exposed 4" selvage edge of the lower sheet. Overlapping membrane must extend over the selvage edge and approximately 1/2" onto the aluminum surface. During interply fusion of this lap, a bitumen bead shall be forced from between the mated edges. A slight heating of the edge of the upper aluminum surface while pressing with a trowel will also be beneficial in obtaining a uniform waterproof bond.

Bituminous Aggregate Topping (BAT)

BAT consists of a combination of graded gravel and KMM aggregate binder. See Page 26 for complete description.

Recommended quantity of gravel is 650 to 700 lbs. per square (approximately 1/2" to 1" thickness).

Loose Aggregate Topping

Loose aggregate topping consists of a stone aggregate applied loose over, Koppers Stonemat and the KMM membrane at a minimum rate of 1,000 lbs. per square (approximately 1 1/2" thickness of loose stone).

Note: Slag, soft limestone, and crushed coral are not permissible aggregates.

Reroofing Specifications

Reroofing Design Considerations:

During the reroof design and specification phase, and prior to commencement of roofing work, it is the responsibility of the building owner to have his architectural and/or structural consultant ascertain if the existing roof structure with the new roof installed will meet all local building codes, including structural limitations. If additional insulation is to be part of the reroof, an evaluation of the dew point location and its effect on the roofing system shall be determined by the owner.

Note: Koppers will not be responsible for any damage caused by excess loads on structural systems or damage due to rate or change in location of dew point.

Condition of Surface to Receive KMM Membrane

a. Gravel Surfaced Roofs: Remove loose gravel and repair any existing blisters, buckles, etc. Apply a minimum 1/2" approved insulation, mechanically fastened, prior to application of KMM Membrane.

b. Smooth Surfaced Roofs: Remove or repair, as necessary, any blisters or other abnormality of the existing membrane to give a surface which is free of sharp edges prior to the application of KMM membrane. Repairs must be made with layer of Standard KMM membrane substrate-fused and top sealed at the edges.

Prior to applying KMM Adhesive for KMM Aluminum Membrane application, prime roof surface with Hi-Pen 452 Primer at the rate of approx. 1/2 gallon per 100 ft.²

c. Moisture in the Existing Roof: KMM Aluminum membrane (Specification No. 630) is always adhered to the substrate. It is not recommended for application directly over roofs which contain moisture without taking precautions to allow venting of the entrapped water vapor pressure.

KMM Standard membrane (Specification Nos. 610, 620 and 690) is loosely laid and ballasted by an aggregate topping. This system will tolerate dampness in the substrate and, depending upon the existing situation, extra precautions may be required such as spot or perimeter venting.

Note: For recommendations regarding specific precautions to be taken, see your local Koppers sales representative.

Loose Aggregate Topping and BAT Installation Information

Loose Aggregate Top Surfacing for Specification 610

A. Aggregate:

Washed round river gravel graded to ¾" nominal size (S.P. No. 57 — U.S. Department of Commerce Simplified Practice Recommendation R-163). See "Aggregate Size Table" below.

Where washed round river gravel is not available, aggregate samples must be submitted to Koppers representative for approval.

B. Application

1. Stonemat must be installed prior to aggregate surfacing, overlaying 4" minimum at end and side laps. Stonemat must extend at least 2" beyond edge of aggregate at perimeter of roof but in no case should it extend beyond outside edge of gravel stop. Stonemat must completely cover KMM Standard.

2. Over the Stonemat, apply loose aggregate at the rate of 1000 lbs. min. per sq. (approx. 1½" thickness of loose stone).

3. Aggregate application by gravel buggy is recommended. Slag is not a permissible aggregate.

Koppers Bituminous Aggregate Topping (BAT) — Top Surfacing for Specification 620

BAT topping consists of graded gravel and KMM Aggregate Binder.

The BAT is applied to the roof as topping at the rate of 650 to 700 lbs. per square (approximately ¾" to 1" thickness).

A. Materials

KMM Aggregate Binder was formulated for binding the specified aggregate applied over KMM Standard roof systems to protect the KMM membrane. KMM Aggregate Binder is not intended for use as an adhesive or repair material. Binder should be kept in warm storage during cold weather.

Aggregate: The gravel aggregate is to be clean and size graded to nominal ¾" round gravel. (This is equivalent to S.P. No. 8— U.S. Department of Commerce Simplified Practice Recommendation R-163).

B. General Application Instructions

Preparation:

1. BAT is applied when the KMM roofing and flashing applications are complete.

2. Roof surface must be free of ponded water.

3. Lay No 15 non-perforated asphalt felt loosely over KMM Membrane prior to BAT topping.

Application of BAT Topping:

BAT is applied in three steps resulting in a protective topping weighing 650-700 pounds per square. The steps are as follows:

1. Gravel aggregate is applied at the rate of 450-475 lbs. per 100 sq. ft. on the No. 15 felt. Aggregate application by gravel buggy is recommended.

2. KMM Aggregate Binder should be stirred thoroughly until the material is of uniform consistency. KMM Aggregate Binder is sprayed on the aggregate at the rate of approximately 3 gallons per 100 sq. ft. using suitable

spray equipment. Keep KMM Aggregate Binder at room temperature prior to pumping during cold weather.

3. An additional layer of aggregate is then applied over the binder at the rate of 200-225 lbs. per 100 sq. ft. to achieve a finished surface. Aggregate application by gravel buggy is recommended. Heavy accumulations of aggregate should be evenly distributed. Wooden or steel implements should not be used. Aggregate should be applied immediately after applying KMM Aggregate Binder.

Paver Stones

Paver stones are acceptable ballast as long as minimum weight is 1000 lbs. per square.

A. Application:

1. Pavers must be set on pedestals such as Terring Rings. Pavers must fit snugly against spacers.

2. As an alternative to above-mentioned pedestals, pavers may be set on 6" squares of ¾" thick traffic pad such as Careytred. Corners of pavers must be centered on 6" squares allowing an approximate ¼" gap between pavers.

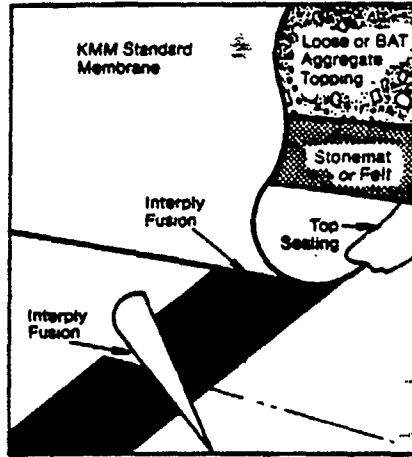
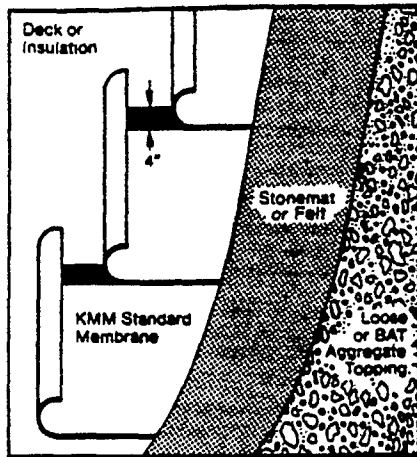
B. Maintenance:

Regular inspections (twice annually) must be made to ascertain that pavers and pedestals remain intact. Deteriorated and broken pavers and pedestals must be replaced to prevent damage to the KMM membrane. If deteriorated or broken pavers and/or pedestals are discovered, inspect KMM for damage.

Aggregate Size Table

Grading Requirements for Coarse Aggregates from ASTM Standard C 33—Standard Specification for Concrete Aggregate Use Size #8 in making Bituminous Aggregate Topping (BAT). Use Size #57 for Loose Aggregate Topping.

Size Number	Nominal Size (Sieves with Square Openings)	Amounts Finer than Each Laboratory Sieve (Square Openings), Weight Percent							
		1½ in. (37.5 mm)	1 in. (25.0 mm)	¾ in. (19.0 mm)	½ in. (12.5 mm)	¾ in. (9.5 mm)	No. 4 (4.75 mm)	No. 8 (2.36 mm)	No. 16 (1.18 mm)
57	1 in. to No. 4 (25.0 to 4.75 mm)	100	95 to 100	—	25 to 60	—	0 to 10	0 to 5	—
8	¾ in. to No. 8 (9.5 to 2.36 mm)	—	—	—	100	85 to 100	10 to 30	0 to 10	0 to 5

KMM® Roofing Systems**Loose Aggregate Topping System Specification No. 610**
Bituminous Aggregate Topping (BAT) System Specification No. 620**General Information**

A. Prior to beginning installation of the KMM roofing system substrates shall be inspected by the roofing contractor for dryness, smoothness, rigidity and freedom from debris. All projections and holes which might cause rupture of the membrane are to be repaired. Review "Conditions of Surface to Receive KMM Membrane", Page 22.

B. End laps of KMM Standard membrane shall be staggered a minimum of 6". Interply fusion of side lap shall be completed before fusing end lap of the same sheet.

C. Any KMM Standard membrane which will not otherwise be covered by a topping shall be protected with a layer of Aluminum KMM membrane extending a minimum of 4" beyond the edges of the unprotected membrane and substrate-fused around its perimeter. Specific details of the installation must be agreed upon between the architect and Koppers prior to installation.

D. Coat face of fiber cant strip with KMM Adhesive (approximately 2 gals/square) and allow to dry before fusing KMM roofing membrane to cant.

E. At the end of each day's work, temporary waterstops must be installed to protect them from water penetration. Waterstops must be completely removed before continuation of application. See Page 23.

F. Prime new and existing metal, porous walls including wood with High Pen Primer 452 at the rate of $\frac{1}{2}$ - $\frac{3}{4}$ gal/square. Allow to dry.

G. For reroofing information, refer to Page 25.

Procedure

General Requirements on Page 21 through 26 and Flashing Detail/Specifications on pages 30 through 32 are a part of this specification and must be adhered to where applicable.

1. Prior to starting the application of the roofing membrane, cushioning or stripping layers of Standard Grade KMM membrane shall be applied in areas of potentially high stress or sharp edges. These areas include interior and exterior corners, major changes in directions of slope, metal flanges, etc. Cushioning layers shall be applied prior to the main KMM membrane system and shall be fused in place, and then top-sealed to form a smooth transition surface.

2. Determine the direction of water drainage and the low point of the deck. The direction of laps shall be such that the water flow is not against the laps. The direction of the overlap shall be changed as the direction of the water flow changes.

3. Beginning at the low point of the roof slope, install one ply of KMM Standard membrane. The membrane shall be laid in a fashion which does not cause water to pass against the lap.

4. Each sheet of KMM membrane shall be set in place for 30 minutes and shall be stretched to remove any wrinkles prior to fusion.

5. All side and end laps shall be 4" and interply-fused and top-sealed. Pressure shall be applied to the top of lap to insure solid fusion.

6. Extend the KMM Standard roofing membrane a minimum of 4" above all cants. Substrate-fuse to face of cant and wall, and top-seal along the upper terminal edge. When fusing KMM to wood or other materials that easily burn, apply torch to KMM only and press KMM into place. Wood surfaces must be primed with High Pen Primer 452 and allowed to dry, prior to fusion of KMM.

7. The contractor shall thoroughly inspect completed KMM membrane at the end of each day's work as well as just before top sealing.

8. Install KMM Aluminum flashings in accordance with flashing specification described on Pages 30 to 32.

9. When the flashings have been completed, lay Stonemat to completely cover KMM that will receive loose aggregate or No. 15 non-perforated asphalt felt when BAT is used. Install a loose aggregate over Stonemat or bituminous aggregate topping over No. 15 non-perforated asphalt felt. Refer to Page 26 for topping information.

Materials

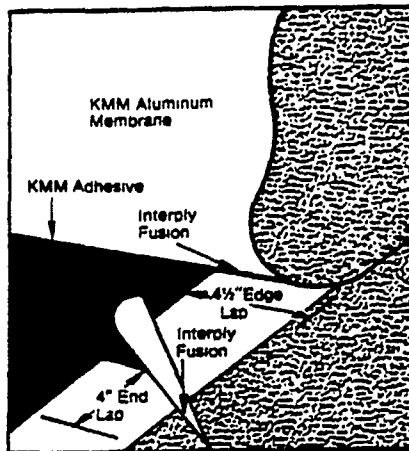
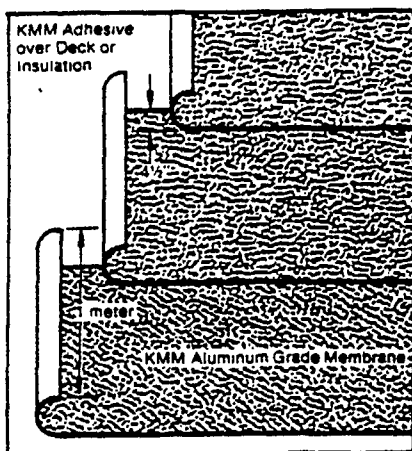
per 100 sq. ft. of roof

KMM Membrane (Standard)	1 ply
Stonemat or No. 15 Non-Perforated Asphalt Felt	1 ply
Surfacings	
Loose Aggregate	1,000 lbs. min
BAT System	650 lbs. min.
Paver Stones	1,000 lbs. min

Slope requirements:

1" per foot maximum with loose aggregate topping, 1½" per foot maximum with BAT topping, 1" per foot maximum with Paver Stones.

Specification No. 630



Procedure

General Requirements of Pages 21 through 26 and Flashing Detail/Specifications on Pages 30 to 32 are a part of this specification and must be adhered to where applicable.

1. Prior to starting the application of the roofing membrane, cushioning or stripping layers of Standard Grade KMM membrane shall be applied in areas of potentially high stress or sharp edges. These areas include interior and exterior corners, major changes in directions of slope, metal flanges, etc. Cushioning layers shall be applied prior to the main KMM membrane system and shall be fused in place and top-sealed to form a smooth transition surface.

2. Determine the direction of water drainage and the low point of the deck. The direction of laps shall be such that the water flow is not against the laps. The direction of the overlap shall be changed as the direction of the water flow changes.

The selvage edge of the Aluminum KMM membrane shall be positioned on the high side so that the direction of the flow of water is not against the laps.

3. Starting at the low point of the deck, set the KMM Aluminum membrane into a full bed of KMM Adhesive (application rate of 1 to 1 1/2 gal. per square)* while the adhesive is still slightly wet. Stiff broom thoroughly moving broom from center to edges of membrane to obtain proper adhesion and to remove all entrapped air from under the membrane. The use of a linoleum roller is also acceptable.

4. Subsequent courses are to be laid with 4\" end and 4 1/2\" side laps, from the first course progressing to the high point. Allow laps to remain open as long as possible before fusing. Side lap shall be interply fused prior to interply fusing of the end lap of the same sheet. Pressure shall be applied on the top of the lap to insure solid contact.

5. Extend the KMM Aluminum roofing membrane a minimum of 4\" above all cants. Substrate fuse to face of cant and wall. When fusing KMM to wood or other materials that burn easily, apply torch to KMM only and press KMM into place. Wood surfaces must be primed with High Pen Primer 452 prior to fusion of KMM.

6. The contractor shall thoroughly inspect the completed KMM membrane at the end of each day's work and when the job is finished.

7. Install KMM Aluminum Flashings in accordance with flashing specifications described on Pages 30 to 32.

8. After completion of the Aluminum KMM roof and flashing system, a high quality "chrome paint" may be applied to any exposed streaks or seams of bitumen.

General Information

A. Prior to beginning installation of the KMM roofing system, substrates shall be inspected by the roofing contractor for dryness, smoothness, rigidity and freedom from debris. All projections and holes which might cause rupture of the membrane are to be repaired. Review "Conditions of Surface to Receive KMM Membrane", Page 22.

B. End laps of KMM Aluminum membrane shall be staggered a minimum of 6\" Interply fusion of side lap shall be completed before fusing end lap of the same sheet.

C. Coat face of fiber cant strips with KMM Adhesive (approximately 2 gals/square) and allow to dry before fusing KMM roofing membrane to cant.

D. Prime new and existing metal, porous walls and decks including wood to which KMM Aluminum or KMM Adhesive will be applied, using High-Pen Primer 452 at the rate of 1/2-3/4 gal/square. Allow to dry.

E. Valleys of roofs sloped 2\" per foot or more shall have a layer of KMM Standard applied prior to application of KMM Aluminum. KMM Standard shall be set in KMM Adhesive (1 1/2-2 gals/square) and top-sealed. KMM Standard shall extend a minimum of 12\" up the roof slope and 6\" up vertical surfaces. Laps shall be 4\" at side and end laps, interply-fused and top-sealed.

F. Leave laps of KMM Aluminum membrane open and delay fusion as long as possible. Be certain that all laps are fused before leaving job for the day.

G. At the end of each day's work, temporary waterstops must be installed to protect from water penetration. Waterstops must be completely removed before continuation of application. See Page 23.

H. KMM Adhesive can be applied by brush, roller, or squeegee. Do not thin adhesive. Mix thoroughly.

I. KMM membrane shall be set into adhesive while adhesive is still slightly wet.

J. Adhesive application to porous insulation boards will require approximately 50% more than specified amount of adhesive.

K. For reroofing information, refer to Page 25

L. Overlap of side laps must extend 12\" onto aluminum surface.

M. Adhesive should be stored at room temperature to facilitate application. Do not apply to frosty or moist surfaces.

Materials

per 100 sq. ft. of roof

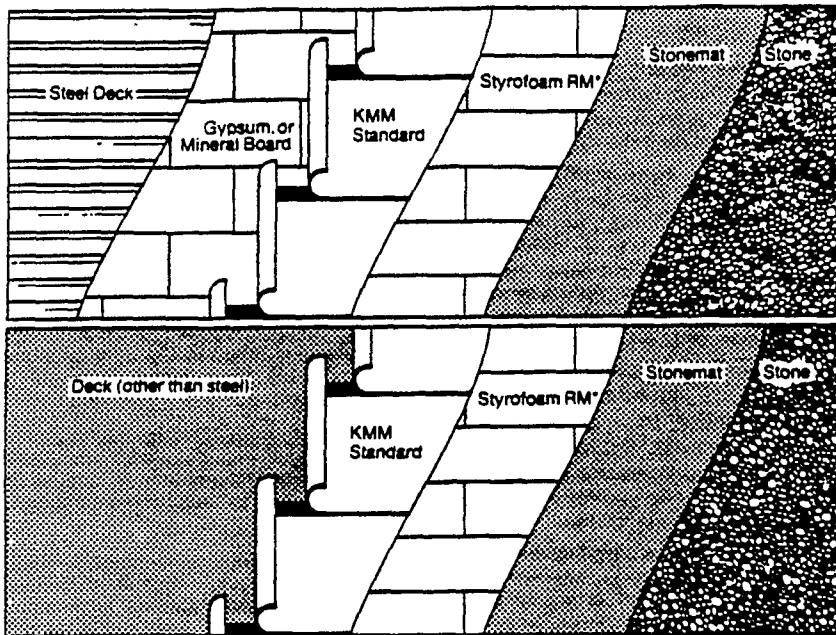
KMM Adhesive 1-1 1/2 gal.*
KMM Membrane (Aluminum) 1 ply

Slope Requirements

1/4\" per foot with positive drainage. Koppers will not be responsible for damage caused by ponding water.

*Depending upon the porosity of the roof deck or insulation, additional KMM Adhesive may be required.

KMM® Insulated Roof Membrane Assembly Specification No. 690



Note: The following general specification is intended only as a guide. For more specific information, consult your Koppers representative.

Procedure

General Requirements on pages 21 to 26 are a part of this specification and must be adhered to where applicable.

1. Decks

A. Poured and precast concrete, gypsum and lightweight concrete decks shall have KMM Standard Membrane laid directly on the deck following guidelines on page 22.

B. Wood and wood fiber decks shall have a base sheet laid over deck unattached to the deck.

C. Steel Decks shall be no lighter than 22 gauge. Install a rigid board of 1/2" min. gypsum or 3/4" min. mineral board. Be certain thickness of insulation board is adequate for flute span. 1/2" gypsum board shall be firmly attached to deck with steep asphalt at the rate of 15 lbs. per square, cold adhesive as per manufacturer's instructions, or mechanical fasteners approved by Koppers. Minimum of four fasteners per board is required and shall be located at the corners, 12" from the edges. Rigid board 3/4" or thicker shall be attached with steep asphalt, cold adhesive, or two approved fasteners per board, or may be laid loose.

2. KMM® Standard Membrane Application

KMM® Standard Membrane shall be applied as per KMM Roofing System Specification No. 610. Flashing shall be in accordance with appropriate KMM Flashing Specification.

3. Installation of Styrofoam RM® Brand Plastic Foam

It is recommended that STYROFOAM RM brand plastic foam be placed on the membrane as the membrane is completed.

Install the boards CHanneled side down with closed joints; stagger end joints. The maximum acceptable opening on a random basis is 3/4". Install the foam to within 1/4" to 3/8" of projection and cant strips.

WARNING: STYROFOAM brand insulation is combustible and may constitute a fire hazard if improperly used or installed. It should be adequately protected. Use only as directed by the specific instructions for this product. STYROFOAM brand insulation contains a flame retardant additive to inhibit accidental ignition from small fire sources. During shipping, storage, installation and use, this material should not be exposed to open flames or other ignition sources.

For proper protection of STYROFOAM brand plastic foam in storage, consult the National Fire Protection Association (NFPA) standards or the authority having jurisdiction.

4. Aggregate Surfacing

After placement of STYROFOAM RM, install Stonemat over insulation overlapping 12" and immediately place aggregate over Stonemat. No fabric joints within 6' of perimeter. At roof perimeter, Stonemat shall extend a minimum of 2"-3" beyond edge of foam. An additional 4' piece of fabric is required around projections.

Aggregate shall comply with ASTM C-33 Size Number 57 or 3/4" crushed stone. Apply the aggregate at the rate of 1000 lbs. per square (10 PSF). As a general rule, 3/4" stone at 1000 lbs. per square will be approximately 1 1/2" thick. Place 2000 lbs./square of ballast or 17 lbs./ft² paved around perimeter, drains, and large penetrations.

Concrete pavers may be substituted for the stone to provide added usefulness to the roof area and to provide resistance to extreme winds. Pavers must sit on pedestals. Decorative stone top surfacing of the correct gradation can be used for architectural impact.

General Information

Thermal value of STYROFOAM brand plastic foam insulation. Average values based on five year aging of one inch samples at 75°F when tested by ASTM C177 and/or C518.

Thickness	"R"	"C"
1	5.00	0.20
1 1/4	6.25	0.16
1 1/2	7.50	0.133
1 3/4	8.75	0.114
2	10.00	0.10
2 1/2	12.50	0.08
3	15.00	0.067
3 1/2	17.50	0.057

2. Exposed STYROFOAM RM is subject to yellowing due to direct radiation of sunlight. If STYROFOAM RM is exposed for longer than 3 weeks it is necessary for a Koppers representative to authorize continuing the installation.

3. Roofs must be designed and constructed to drain completely free of water within 48 hours following a rain. Due to the deflection of steel decks, it is almost always necessary to provide slopes to properly placed drains.

The drain must be set directly on the deck so that the clamping ring is not higher than the rigid board. Sumps are recommended.

4. All flashing must be completed in each area prior to installing STYROFOAM RM.

5. Because the stone is not applied in bitumen it need not be dry and installation can occur in any weather.

6. The wood or plywood deck must be properly attached to supporting members and must be of sufficient thickness to prevent excessive deflection between supporting members. Wood roof decks shall consist of well-seasoned lumber, and edges of the board shall be tongued and grooved, ship-lapped or splined to prevent differential flexing of the boards. Any significant voids shall be covered with sheet metal.

*Trademark of the Dow Chemical Company

Materials

per 100 sq. ft. of roof

KMM Standard	1 ply
Styrofoam RM	Desired Thickness
Stonemat	1 ply
Aggregate	1000 lbs. minimum

Slope Requirements

2" Maximum Positive drainage is required.

KMM Flashing Specifications

Description

Flashings are the terminal closures of a roofing system which perform a waterproofing, and in some systems, a decorative function. Flashings must be installed at all intersections formed by vertical surfaces. Their importance cannot be stressed too strongly. Water entering the roofing system through flashings can result in water vapor forces which can destroy the effectiveness of the roofing and insulation.

Koppers flashings are an integral part of a Koppers roof. Designed for flexibility, KMM Aluminum flashings will provide many years of service.

Flashings should be installed as roofing progresses to prevent possible water damage to insulation and/or deck under the roofing.

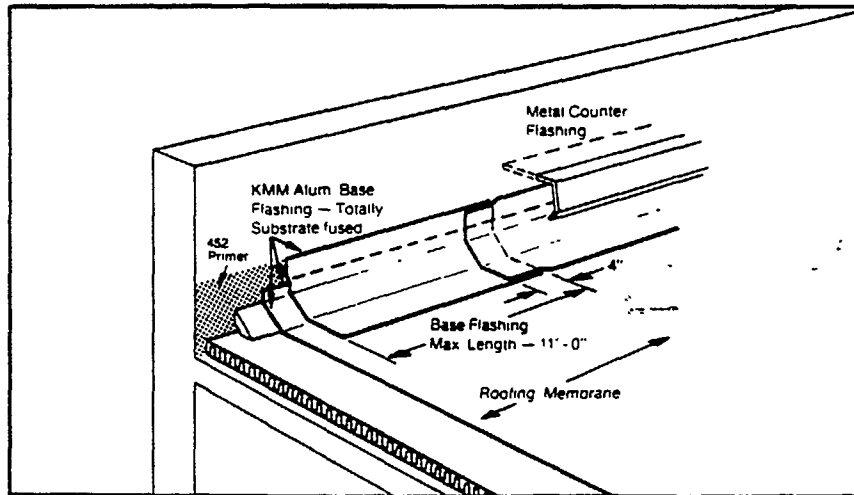
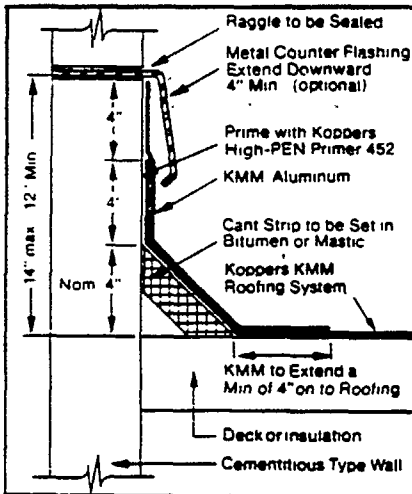
General Requirements

1. All surfaces must be dry, frost free, reasonably smooth, clean, rigid and free from debris, loose materials, projections, holes, release agents or other contaminants which might cause rupture of the membrane and/or adversely affect the KMM membrane application and performance. Dust shall be removed from the surface immediately before application of the KMM Flashing system.
2. If bonded/guaranteed flashing is required, it must be installed in conjunction with a Koppers bonded/guaranteed roof and can be bonded/guaranteed for standard periods up to but not greater than the period for which the roofing is bonded/guaranteed. To be bonded/guaranteed, flashings must be set at least 12" above the roofing surface.
3. Metal Cap flashings are not bondable and are not included under any flashing bond/guarantee.
4. Metal work of any description used as flashing or a part of a flashing system is not bondable and is not included under any flashing bond/guarantee.
5. Vertical flashing that terminates without use of metal counterflashing, must be stripped with 8" wide KMM Aluminum Membrane totally fused 4" onto the wall and 4" onto the KMM Aluminum Membrane.
6. Cant strips shall be set firmly into place with mastic or hot bitumen prior to laying roof membrane.
7. Porous walls including wood must be primed with High Pen Primer 452 at a rate of 1/2 gal/square. Allow primer to dry. (Minimum 4 hours).
8. Corners shall be lapped a minimum of 6" in each direction.
9. All metal and wood to which KMM membrane will be fused shall be coated with High Pen Primer 452 or KMM Adhesive and allowed to dry before fusion of KMM membrane.
10. Where KMM flashing is to be installed on a building with a non-wall-supported deck (tilt slab precast, masonry, curtain wall, etc.) refer to Non-Wall Support flashing detail on page 32.
11. Copper must not come in direct contact with the aluminum surface of KMM. When there is a possibility of such contact, coat the underside of the copper with Koppers Asphalt Roof Coating 454 or KMM Adhesive.

Flashing Specification No. 710 Base Flashing

For flashing with maximum height of 14" from roof surface

Application Detail



1. KMM Aluminum membrane shall be unrolled and cut to desired width and maximum length of 11 feet. **Note:** KMM Aluminum membrane is available in precut rolls 9", 12" and 18" wide by 33' long
2. No 710 Base Flashing shall be fused in place so that it extends a minimum 4" onto surface of roof and a minimum of 4" above termination of roofing membrane on wall.
3. Apply pressure to KMM Aluminum membrane to obtain maximum contact to surface

to which it is applied. There shall be no voids under the Base Flashing membrane. It is imperative that complete attachment be obtained to roof surface, roofing membrane over cant, and the wall. A small bead of bitumen should be squeezed out at edges.

4. Subsequent strips of Base Flashing shall be fused in place in the same fashion overlapping preceding strip 4". Overlap shall be interply fused to preceding strip. Pressure shall be applied to surface of lap to insure adhesion.
5. There shall be no adhesive used in No. 710 Base Flashing application.

6. The flashing must not remain open at the end of the work day.

7. The contractor shall thoroughly inspect the completed flashing system at the end of each day's work.

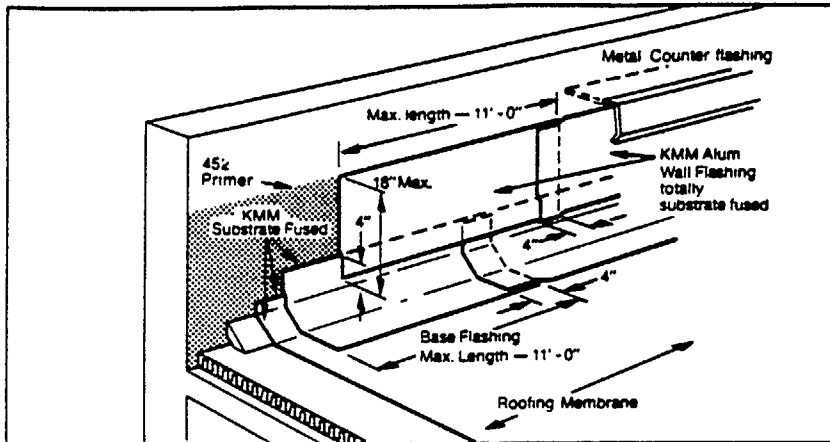
8. A high quality "chrome" paint may be applied to any exposed streaks or seams of bitumen.

9. Install metal counterflashings as required.

10. Complete the top surfacing of the roofing membrane to the base of the cant strip as may be specified.

Flashing Specification No. 720 Wall Flashing

For flashing with maximum height of 28" from surface of roof



Procedure

1. Apply Base Flashing in accordance with Flashing Specification No. 710.
2. KMM Aluminum membrane used in No. 720 Wall Flashing specification shall be unrolled and cut to a maximum length of 11 feet and maximum width of 18 inches. Selvage edge should not be used.

Note: KMM Aluminum membrane is available in precut rolls of 9", 12" and 18" wide by 33" long.

3. KMM Aluminum membrane strips shall be fused into place, overlapping Base Flashing 4". Total substrate fusion to the wall must be achieved.
4. Apply pressure to the fused KMM Alumi-

num membrane to obtain maximum contact to the wall. There shall be no voids under the Wall Flashing membrane. It is imperative that the membrane is completely and tightly fused to the wall. A small bead of bitumen should be squeezed out at edges.

5. 4" overlap shall be interply fused to the Base Flashing, applying pressure to the surface of the lap to insure adhesion.

6. Subsequent strips of KMM Aluminum membrane shall be fused into place overlapping the preceding Wall Flashing 4". Overlap shall be interply fused and pressure applied to the surface of the lap to insure adhesion.

7. The contractor shall thoroughly inspect the complete flashing system at the end of each day's work.

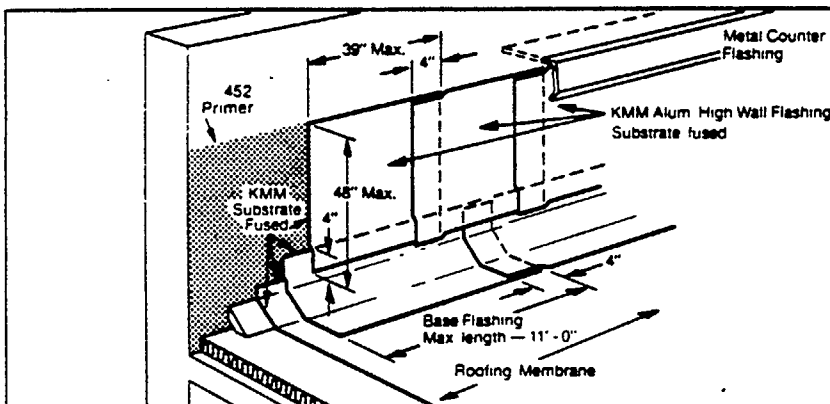
8. A high quality "chrome" paint may be applied to any exposed streaks or seams of bitumen.

9. Install metal counterflashing as required.

10. Complete the top surfacing of the roofing membrane to the base of the cant strip as may be specified.

Flashing Specification No. 730 High Wall Flashing

For flashing with a height in excess of 28" from surface of roof



Procedure

1. Apply Base Flashing in accordance with Flashing Specification No. 710.
2. KMM Aluminum membrane used for High Wall Flashing shall be unrolled and cut into lengths not exceeding 48". Remove the selvage edge, leaving a maximum width of 39".
3. Totally substrate fuse KMM Aluminum Membrane to the wall in pieces not to exceed 39" wide by 48" high with 4" overlaps on base flashing and previously applied pieces.
4. Each piece of KMM Aluminum membrane shall be applied with the 48" maximum length extending vertically up the wall. It shall overlap the previously applied course of Base Flashing

or HighWall Flashing a minimum of 4".

5. Rub, brush or roll thoroughly to obtain proper adhesion and to remove all entrapped air from under the flashing membrane.

6. The contractor shall thoroughly inspect the completed flashing system at the end of each day's work.

7. A high quality "chrome" paint may be applied to any exposed streaks or seams of bitumen.

8. Install metal counterflashing as required.

9. Complete the top surfacing of the roofing membrane to the base of the cant strip as may be specified.

Alternate Method No. 1: Apply flashing using procedure outlined in Flashing Specification No. 720, overlapping 4" onto previously applied lower course, and base flashing.

Alternate Method 2: Apply KMM Adhesive over surface to which the High Wall Flashing is to be applied at a rate of 1 to 1 1/2 gallons per 100 square feet, applying half on primed wall and half on underside of membrane.

Permit volatiles to leave adhesive after application (5 to 20 minutes depending on temperature and atmospheric condition). BEFORE adhesive has filmed over and while slightly wet, set KMM Aluminum membrane into place.

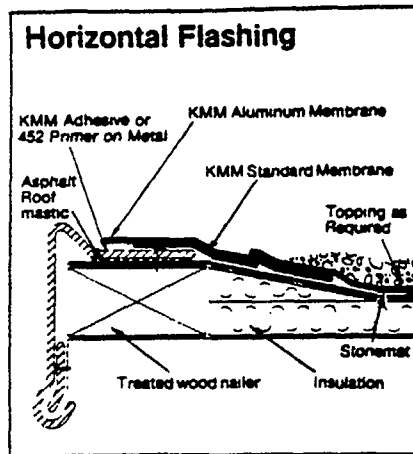
Note: At temperatures below 40°F tack time of adhesive will be extended considerably and special care must be exercised to insure adhesion of membrane.

KMM Aluminum membrane used for High Wall Flashing shall be unrolled and cut into lengths not exceeding 48". Remove the selvage edge, leaving a maximum width of 39".

Each piece of KMM Aluminum membrane shall be applied with the 48" maximum length extending vertically up the wall. It shall overlap the previously applied course of Base Flashing or High Wall Flashing a minimum of 4".

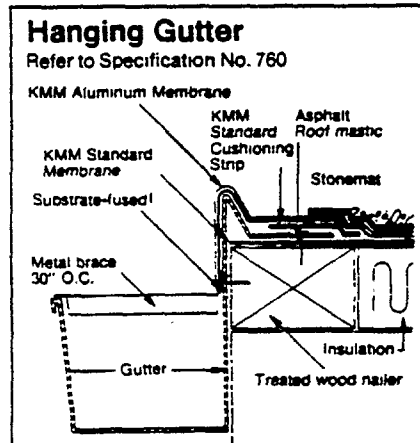
Substrate fuse complete perimeter of each piece of Wall Flashing 4" to wall, and interply fuse to previously applied High Wall and/or Base Flashing.

Flashing Specification No. 760 Horizontal Flashing

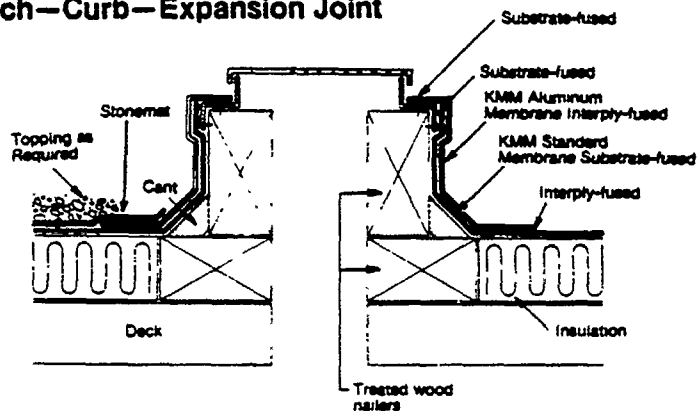


Procedure

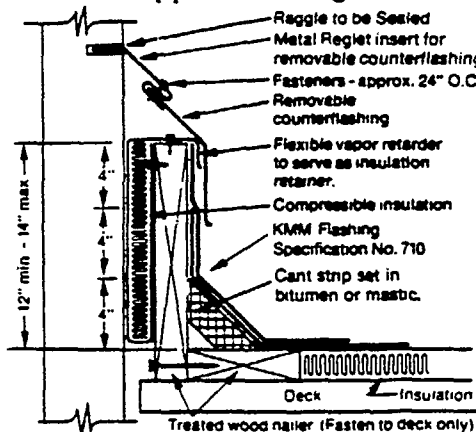
1. All metal to be covered with KMM Membrane shall be coated with High Pen Primer 452 or KMM Adhesive. Allow to dry thoroughly.
2. Strip metal flanges using 4" minimum widths of KMM Standard membrane as a cushioning strip centered along the length of the entire edge of the flange. The cushioning strip must cover the edge of the metal where it meets the roofing membrane a minimum of 2" and must cover all nail heads. The balance of the width of the cushioning strip must extend a minimum of 2" onto the roofing membrane. Cushioning strip shall be fused to the roofing membrane and the metal flange and top sealed at edges.
3. Fuse a strip of KMM Aluminum membrane (approximately 10" wide) to the cushioning strip, roofing membrane, and metal flange so that it extends 4" beyond edge of cushioning strip onto roof membrane and to the outer edge of metal flange.
4. Apply pressure to surface of fused KMM membrane to insure adhesion and solid fusion.
5. Apply surfacing to roof membrane as may be required.



Hatch—Curb—Expansion Joint

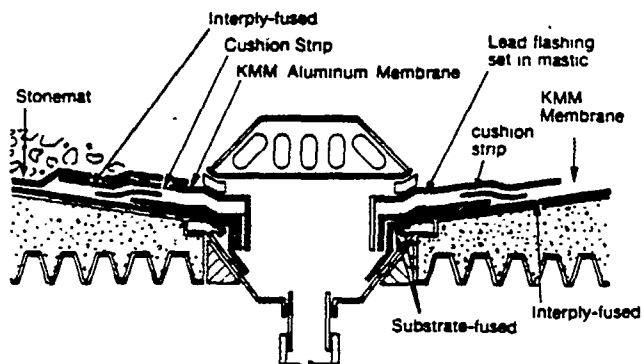


Non-Wall Support Flashing



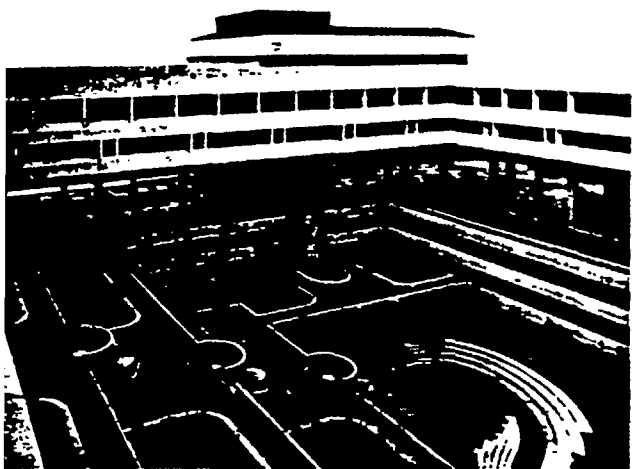
Note: Suggested detail where possibility exists that differential movement will occur between deck and vertical surface. This detail is intended as a guide only.

Roof Drain



Note: Do not apply flame directly to lead flashing

ations and related the waterproofing field and offers the
e possibilities of a specifier engineering assistance in achiev-
plication. ing the best possible waterproofing systems.
years experience in



Coal tar plaza deck and wall waterproofing systems

Membrane Waterproofing Materials

a. Coal Tar Waterproofing Bitumen A.S.T.M. D-450 Type III.

b. Membrane (Select one or combination). GLASFAB—A.S.T.M. D-1668.

Tar Saturated Cotton Fabric—A.S.T.M. D-173
Tarred felt—A.S.T.M. D-227.

c. Concrete Priming Oil—A.S.T.M. D-43-41.

General Requirements

a. Preparation of surfaces: Surfaces to be waterproofed shall be reasonably smooth and free from holes or projections which might cause puncture of the membrane. The surface shall be dry and thoroughly cleaned to remove dust and loose materials immediately before application of the waterproofing. Do not apply waterproofing where effects of freezing or moisture will adversely affect the waterproofing application.

b. Applicator: All membrane waterproofing shall be applied by an experienced roofing and waterproofing contractor.

Application Precautions

a. Waterproofing bitumen shall not be heated above 425°F

b. Roll or press firmly all plies of membrane into the hot bitumen and apply without wrinkles, buckles or kinks.

c. On vertical walls apply hot bitumen with cotton roller mops or by other suitable application techniques.

d. Apply membranes on vertical surfaces in courses not exceeding ten feet in length where immediate and careful backfilling is not possible. After each course of the waterproofing system is completed and before the top mopping is applied; nail each course at the upper edge before the next course is applied. Nail each succeeding course end-lapping not less than 10 inches.

e. Reinforce wall angles, corners or any place the waterproofing membrane course may be subject to unusual stresses with not less than 2 additional plies of fabric or GLASFAB reinforcement and moppings of bitumen.

f. Insulate and protect all hot water and steam pipes which project through or are near the surfaces to be waterproofed. Take the necessary precautions to prevent water from getting between the waterproofing and the waterproofed surface at all points where the membrane is penetrated by drains, pipes, etc. Apply extra plies of reinforcing membrane and bitumen moppings in these areas.

g. Carefully examine laps which have been exposed for any length of time, such as at the junction of a vertical wall and a slab, for defects and insufficient lap areas and repair as necessary before proceeding with further application.

h. Apply all membrane waterproofing systems in a workmanlike manner and use wood nailers treated with a water-borne preservative for all vertical wall waterproofing.

i. Protect the membrane from damage by other trades after installation to maintain the integrity of the waterproofing throughout the structure.

j. Ventilation should be provided in enclosed spaces during application.

Horizontal waterproofing applications:

(1) Beginning at the low point of the slab mop the surface with hot Koppers Waterproofing Bitumen and immediately apply the reinforcing membrane over the entire area. (2) Be sure that each ply is solidly mopped and adhered. (3) For the various waterproofing systems lap the reinforcing plies as follows: (a) Two Ply System—lap 19 inches. (b) Three Ply System—lap 24½ inches. (c) Four Ply System—lap 27½ inches. (d) Five Ply System—lap 29 inches. (4) Mop the entire top surface with Koppers Waterproofing Bitumen. The completed waterproofing forms a firmly bonded system and the reinforcement shall not be exposed at any place. (5) As soon as any portion of the waterproofing has been completed, cover it with the protection course specified, such as brick, tile, concrete, rigid insulation or other specified material.

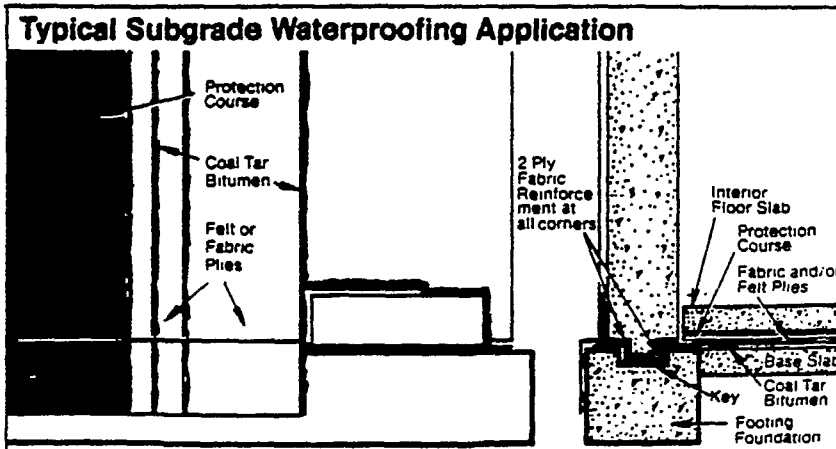
Plaza deck waterproofing applications:

When membrane waterproofing is used in plaza construction with interior drains and the finish slab does not rest immediately on the waterproofing, but on concrete pedestals, in addition to the application pre-

cautions above the following additional precautions shall be taken: (1) If deck is sloped to interior drains, specify Waterproofing Bitumen conforming to ASTM Specification D-450 Type III. (2) Before the pouring or placing of pedestals supporting precast finish slabs, additional reinforcement shall be installed under each pedestal over existing membrane. (3) Extreme care should be taken to protect the finished waterproofing from damage by other trades during construction of towers, etc. Place a protective course over the finished membrane until the wearing surface is placed. (4) On precast concrete systems all joints should be grouted with flashing cement and stripped with a reinforcement fabric.

Below grade wall waterproofing application:

(1) Apply a uniform brush coat of Koppers Concrete Priming Oil over the entire surface to be waterproofed (approximately 1 gallon for each 100 square feet). (2) Mop wall completely with Koppers Waterproofing Bitumen. (3) Starting at the most practical place, install the desired number of plies lapping them as follows: (a) Four Ply—lap 27½ inches. (b) Three Ply—lap 24½ inches. (c) Two Ply—lap 19 inches. (d) When more than 4 plies are used in a membrane, it is recommended that they be installed in at least two operations, i.e., 2 plies over three, 3 plies over three, etc. maintaining the shingle fashion method in each operation. (4) Nail membrane with concrete nails 8 inches on centers through flat tin discs at the end lap horizontally across the membrane. If wood nailers are installed, nail membrane to nailer with 1½ inch roofing nails through flat tin discs 8 inches on centers. (5) Mop the entire surface with Koppers Waterproofing Bitumen. The completed waterproofing forms a firmly bonded system and the reinforcement shall not be exposed at any place. (6) As soon as any portion of the waterproofing has been completed, cover it with a protection course and backfill.



Materials and System Discussion

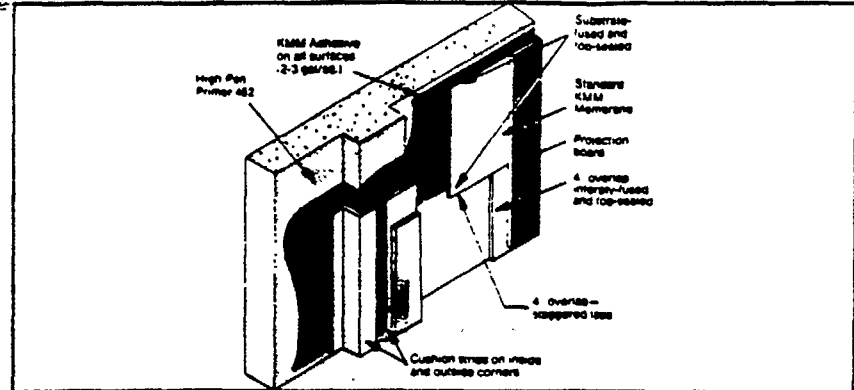
KMM waterproofing specifications are categorized as vertical and horizontal to differentiate between slight differences in application procedures dictated by the orientation of the surface to be waterproofed.

The vertical specification is written for foundation wall waterproofing, but may be modified for other vertical or steep surfaces to be waterproofed. The horizontal specification is written for split-slab or plaza deck applications but can also be modified for other low slope or flat surfaces. Consult your local Koppers sales representative for assistance with these modifications.

General Requirements

1. Surface to which KMM or KMM Adhesive is to be applied must be free of all dirt, debris, release agents, oils, or other contaminants that would impair the proper application and performance of KMM. Cracks or other deficiencies must be corrected before starting application.
2. All surfaces that receive KMM adhesive and/or substrate fusion must be primed with Koppers High-Pen 452 Primer at the rate of $\frac{1}{2}$ - $\frac{3}{4}$ gallon per 100 square feet. Primer must be allowed to dry completely before proceeding.
3. Inside and outside corners must have a double thickness of KMM. This can be accomplished by 1) installing cushion strips of KMM that extend at least 4" in each direction from the corner, or 2) lapping each course of KMM around corner 4" in each direction.
4. Courses may be run horizontally or vertically; however, the top edge of each course must be substrate fused 4" onto the wall.
5. All exposed edges must be top sealed prior to leaving the job overnight.
6. Protection board must be placed as soon as possible to protect KMM membrane.
7. Horizontal waterproofing system must begin at the low point in the deck and layed up the slope.
8. KMM membrane applied vertically in lengths exceeding 11' may be difficult to hold in place. It is for the discretion of the applicator to determine the appropriate length for his particular application.

Vertical KMM Waterproofing System Specification No. 640



Description

Koppers Vertical Waterproofing Specification No. 640 consists of KMM Standard membrane applied to a vertical surface in a full bed of KMM Adhesive. The KMM membrane forms a waterproof system through the use of joint heat fusion, a unique process whereby all contiguous joints are affixed together to develop a monolithic waterproof membrane. In addition, the entire system is completely adhered to the vertical surface to eliminate any voids which might permit collection of water between the surface and membrane.

This system is applicable for use with any vertical structural surface which provides continuous support for the KMM membrane.

The general requirements and application procedures on this page are part of this specification and must be adhered to where applicable.

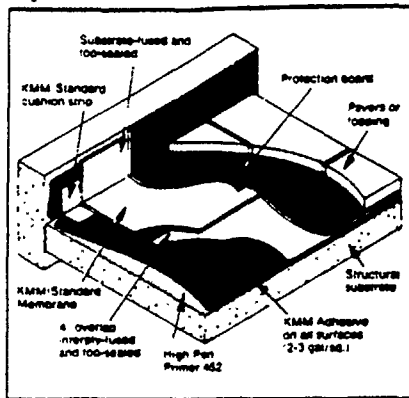
Procedures

1. If cushioning strips are used they must be applied prior to the installation of the KMM waterproofing membrane.
2. Apply adhesive at the rate of 2 to 3 gal. per square after primer has dried.
3. Starting at the low point, set the first course of KMM Standard membrane into a full bed of KMM Adhesive while the adhesive is still slightly wet. Rub and/or brush thoroughly to remove all entrapped air from under the membrane. End and side laps shall be 4". All

end and side laps shall be interply-fused and top-sealed. Bottom of first course shall be substrate fused 4"

4. Substrate-fuse the KMM membrane at all projections.
5. Subsequent sheets shall be set in a full bed of adhesive, from the first course to the high point of the area to be waterproofed. Each course shall end lap the lower course 4" and side laps shall be 4". The top ends of each sheet of KMM membrane shall be substrate-fused and top-sealed.
6. The contractor shall thoroughly inspect the completed KMM membrane at the end of each day's work as well as before the back-filling phase.
7. To eliminate potential abrasions, breaks and punctures, it is strongly recommended that the completed KMM waterproofing system be completely covered immediately, with a $\frac{1}{4}$ " minimum thickness protective board. It should then be permanently back-filled, tamping the backfill as required. Protective board can be installed in KMM Adhesive.
8. Any KMM waterproofing membrane left exposed after backfilling shall be protected with KMM Aluminum membrane or other suitable sunlight-protective materials.
9. When any portion of the membrane is to be permanently exposed, it must be covered with KMM Aluminum Flashing, Specification No. 710 for protection.

Horizontal KMM Waterproofing System Specification No. 650



Description

Koppers Horizontal Waterproofing Specification No. 650 consists of KMM Standard membrane applied to a plaza deck or horizontal surface in a full bed of KMM Adhesive. The KMM membrane forms a waterproof system through the use of joint heat fusion, a unique process whereby all contiguous joints are affixed together to develop a monolithic waterproof membrane.

This system is applicable over any structural deck and/or approved rigid board insulation where the substrate provides continuous support for the KMM membrane. It is ideally suited for application directly to poured structural concrete decks.

Slope

Applicable for deck slopes of 0" to 4" per foot. When slope exceeds 4" per foot see Specification No. 640 on Page 35.

General requirements

The general requirements and application procedures on the preceding page are part of this specification and must be adhered to where applicable.

Procedures

1. If cushioning strips are used, they must be applied prior to the installation of the KMM waterproofing membrane.
2. Apply adhesive at the rate of 2 to 3 gal. per square after primer has dried.
3. Starting at the low point of the deck, set the first course of KMM Standard membrane into a full bed of KMM Adhesive while the adhesive is still slightly wet. Rub and/or brush thoroughly to obtain proper adhesion and to remove all entrapped air from under the membrane. End and side laps shall be 4". All end and side laps shall be interply-fused and top-sealed.
4. Substrate-fuse the KMM membrane at all projections.
5. Subsequent sheets shall be set in a full bed of adhesive, from the first course to the high point of the area to be waterproofed. Side laps and end laps shall be 4".

6. Extend the KMM waterproofing membrane, as flashing, up vertical surfaces to a height above the water level expected at the wearing slab. The top of the KMM membrane shall be substrate-fused and top-sealed to the wall. All side laps shall be interply-fused and top-sealed. When vertical waterproofing is required, continue the upturn a minimum of 6" above the height of the wearing surface and substrate-fuse to the wall. Vertical waterproofing membrane shall overlap upturn 4".

7. The contractor shall thoroughly inspect completed KMM membrane at the end of each day's work as well as before application of protective board.

8. Proceed with application of the remaining phase of the horizontal system. Care must be taken to eliminate any puncture or damage of the KMM waterproofing membrane system by other trades.

9. It is required that a suitable protective layer be placed over the entire membrane on both horizontal and vertical surfaces to provide puncture resistance during construction and during placement of the wearing surface as soon as possible.

10. When any portion of the membrane is to be permanently exposed, it must be covered with KMM Aluminum Flashing, Specification #9710 for protection.

Liquid and Mastic Applied Waterproofing and Dampproofing Systems Hydroshield Mastic 451 All-weather cold process mastic membrane system

Hydroshield Mastic 451 is a solvent based asphalt mastic which is unaffected by immersion in water either before or after curing. It will adhere tightly to damp or even wet surfaces. Hydroshield is not damaged by soil alkalinity, acidity or minerals. This unique mastic may be applied under an extreme range of weather and temperature conditions.

Hydroshield Mastic for Dampproofing.

When applied to masonry or concrete construction, Hydroshield Mastic serves as an effective dampproofing barrier to prevent the entrance of moisture by capillarity. Usually only one coat is necessary for dampproofing. Hydroshield Mastic goes on cold and may be applied to a wet or dry surface.

Hydroshield Mastic for Waterproofing.

When a permanent vapor barrier to prevent the entrance of water under a head of pressure is required, Hydroshield Mastic, combined with Koppers Heavy Duty Glass Fiber Mesh, produces a tough, durable waterproofing membrane that cannot rot or deteriorate at sub-grade levels. For details of waterproofing applications, consult your Koppers representative.

Application Guide

	452 Primer Per 100 ft. ² (When Needed)	Hydroshield First Coat Per 100 ft. ²	Koppers Heavy Duty Glass	Hydroshield Top Coat Per 100 ft. ²
Dampproofing	¼ to ½ gal.	2 gal.	None	None
Waterproofing	¼ to ½ gal.	5 gal.	1 or more plies	3 gal.

Liquid Asphalt 480 A cold-applied asphalt emulsion dampproofing.

Liquid Asphalt 480 is a filled, cold-applied, high-quality asphalt emulsion containing Bentonite clay.

When applied to masonry or concrete construction, Liquid Asphalt 480 serves as an effective dampproofing barrier to help prevent the entrance of moisture by capillarity. Usually two coats are necessary for

dampproofing. Liquid Asphalt 480 goes on cold and may be applied to a wet or dry surface. For detailed specifications consult your Koppers representative.

Application Guide

	482 Primer Per 100 ft. ²	Liquid Asphalt 480 Per 100 ft. ² (2 coats)
Dampproofing	¼ to ½ gal.	3 gal.

ROOF INSULATION

EXELTHERM Xtra[®] Insulation

KOPPERS
Architectural and
Construction Materials

The thermally efficient roof insulation with fire resistant properties.



General Description

Exeltherm Xtra roof insulation with fire resistant properties is a rigid, thermoset phenolic foam which will not melt or soften.

Compliance

Exeltherm Xtra roof insulations meet Factory Mutual test requirements as a component for Class I Insulated Steel Deck Roof Construction. When secured to the steel deck with FM approved mechanical fasteners, Exeltherm Xtra roof insulation qualifies for a Class I-90 Windstorm Resistance Classification.

Sizes

Exeltherm Xtra is available in board stock size of 36 inches by 48 inches, in nominal thicknesses of 1.2, 1.4, 1.6, 1.75, 2, 2.5, and 3.0 inches.

Comparative Performance (inches) — FM Class I Type Insulations

"C" value	"R" value	Exeltherm Xtra	Urethane Perlite Composite	Fibrous Glass	Perlite
10	10.00	1.2	1.7	2.44	3.6
.09	11.11	1.4	1.8	2.75	4.0
.08	12.50	1.6	2.0	3.0	4.5
.07	14.30	1.75	2.2	3.56	5.15
.06	16.66	2.0	2.5	4.07	6.0
.05	20.00	2.5	2.9	4.88	7.2
.04	25.00	3.0	—	6.0	9.0

Typical Physical Properties

	Test Method	Exeltherm Xtra	*Urethane	*Isocyanurate
Compressive strength 10% consolidation, psi	ASTM D 1621	25	25	25
Water vapor permeability, perm inches	ASTM C 355	8.19	<1.0	<1.0
Dimensional stability (7 days 158° F, 95% R.H.), %	ASTM D 2126-75	<1.0 (length) <1.0 (width) <1.0 (thickness)	1.5 1.5 <4.0	2.5 1.5 4.0
Water absorption increase by volume (two-hour immersion), %	ASTM C 209	8	<1.0	<1.0
Density lb./ft. (nominal)	ASTM D 1622	3.0	2.0	2.35
Service temperature °F	—	-100 to +300		
Coefficient of linear thermal expansion, per °F	ASTM D 696	13 x 10 ⁻⁵	30 — 80 x 10 ⁻⁵	30 — 80 x 10 ⁻⁵
Fire resistance properties (3" thickness)	ASTM E 84			
Flame spread		20	36-75	20-25
Smoke development		5	450	45-105

*Manufacturers published data

Roof Insulation (Cont.)

Suggested Application Procedures

1. Steel decks — Steel decks suitable for the installation of the Exeitherm Xtra insulation shall be clean, dry and properly graded to all outlets. Apply Exeitherm Xtra insulation with long edges parallel to the flutes and bearing on the surface of the steel deck. Secure the insulation to the steel deck with five Factory Mutual approved mechanical fasteners per 3-foot x 4-foot board or one fastener per every 2.4 square feet. Fastener placement must be in accordance with FM requirements.

Wood nailers shall be treated with a water-based preservative, have a nominal width of six inches and be the same thickness as the insulation. They shall be securely fastened to the deck.

2. Wood Decks — All nailable decks suitable for the installation of Exeitherm Xtra insulation shall be clean, dry, and properly graded to all outlets.

Wood and plywood — Cover the deck with one layer of rosin sheathing paper, lapping each layer not less than 1 inch and nail sufficiently to hold in place. Over the roof area install Exeitherm insulation. Stagger end joints in adjoining courses. Secure each insulation panel with five fasteners per 3-foot x 4-foot board, or one fastener per every 2.4 square feet. Fastener must have sufficient length to penetrate the structural deck at least 1/2 inch but must not protrude through underside of the deck. Set fastener heads flush to the surface of roof insulation.

3. Other type decks — For the application of Exeitherm Xtra insulation to decks other than listed above, consult your Koppers Representative.

Slopes — On decks with slopes greater than two inches per foot, wood insulation stops should be used. They should be treated with a water-based preservative and should be the same thickness as the insulation. They must be securely fastened to the deck perpendicular to the slope line of roof. The maximum spacing of the stops should be 48 inches from face to face.

Bitumen — Exeitherm Xtra roof insulation manufactured with facers integrally bonded is compatible with all types of BUR bitumen and can be laid directly in hot bitumen.

Recommended point-of-application bitumen temperatures are Steep asphalt (Type III) 400° - 450°F Coal Tar Bitumen 350° - 400°F

Vapor Retarder

Vapor retarders are used to control the flow of water vapor from the interior of the building into the roofing assembly. Vapor retarders are located between the deck and the roof insulation in roof assemblies.

The use of a vapor retarder within the roofing assembly usually depends upon the occupancy conditions, whether the outside mean January temperature is below 40° and if the interior winter conditions are expected to be above 45% relative humidity.



Thermal Conductance and Weighting Data

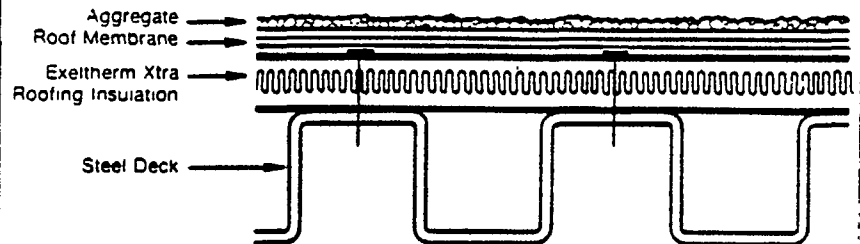
—C— value	—R— value	Nominal thickness (inches)	Pieces per pallet	Sq. ft. per pallet	Weight per pallet (pounds)	Flute spanability (inches)
0.10	10.00	1.2	76	900	417.00	2.5
0.09	11.11	1.4	65	780	404.00	2.5
0.08	12.50	1.6	55	660	379.00	2.5
0.07	14.30	1.75	50	600	369.50	4.25
0.06	16.66	2.0	45	540	369.00	4.25
0.05	20.00	2.5	35	420	345.50	4.25
0.04	25.00	3.0	30	360	345.00	4.25

Note: "R" value means resistance to heat flow. The higher the "R" value, the greater the insulating power. "R" = 1/".C"

The thermal value was determined by ASTM-C 518. All test specimens were prepared in accordance with RIC/TIMA conditioning procedure as outlined in their Bulletin 281-1

Since the architects and building designers are aware of the actual conditions of the specific installation, they have the responsibility for determining if a vapor retarder should be used. The application of the vapor retarder should be in accordance with the recommendations of the manufacturer of the vapor retarder specified and Koppers' general requirements. When FM Class I construction requires a vapor retarder it must be a FM approved vapor retarder system installed in accordance with FM Loss Prevention Data Sheet 1-28. Hot bitumen is the preferred method for attaching Exeltherm Xtra to the vapor retarder system. **Cold Adhesives are not acceptable for the installation of Exeltherm Xtra.**

Typical Steel Roof Deck Application



For approved Class I roof system as illustrated, specify board on the steel deck according to Factory Mutual Approved Guide for Class I, Insulated Steel Deck. See also Bulletins 1-28, 1-29, 1-48, 1-49, 1-52).

Precautions

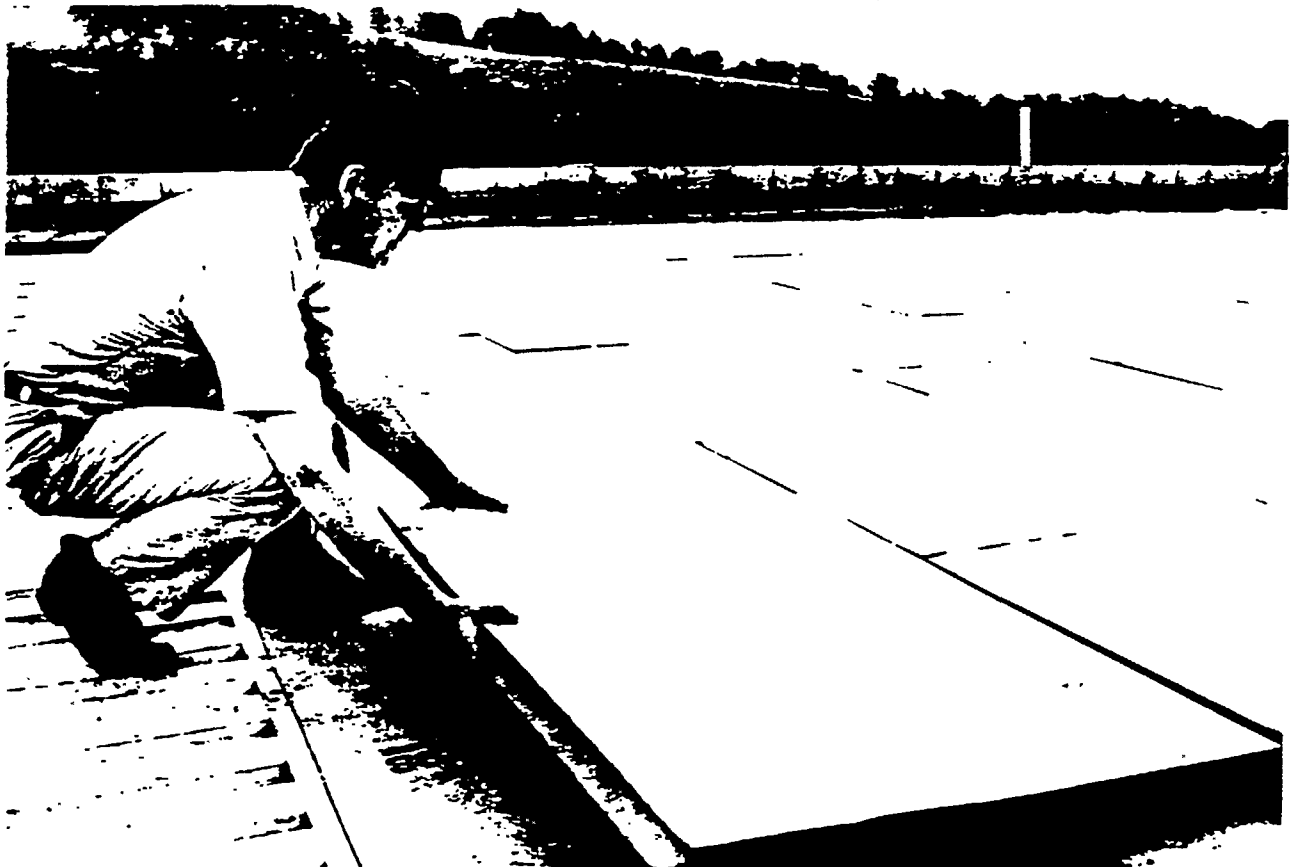
Protection of Material

Exeltherm Xtra roof insulation must be protected from the weather at all times. No more insulation should be laid than can be completely covered with roofing membrane system (which includes aggregate) the same day. At the end of each day's work, or in the event work is stopped abruptly, temporary watertight cut-offs must be installed at all exposed insulation edges. Cut-offs must be removed when work is started again.

Cold Weather Application

Roofing installation at temperatures below 45°F requires special precautions to insure satisfactory performance of the finished roof.

The deck surface must be dry and free from all traces of ice, snow and moisture before applying roof insulation. Any moisture present on the deck at the time the roof insulation is applied may result in poor adhesion of materials to the deck and blistering of the membrane.



Roof Insulation (Cont.)

Important Notes:

Note 1: Koppers acceptance of any deck as satisfactory to receive Exeltherm Xtra roof insulation involves the deck surface only. It is the responsibility of the building designer and the deck manufacturer to establish the requirements for:

a Expansion and contraction in a manner that will create a stable base for the roof insulation

b Support of maximum anticipated loads.

Note 2: Koppers will not assume responsibility for deck defects, bitumen drippage, or the placement of conduits, bolt heads, etc., above the roof deck and below the roofing membrane.

Note 3: All projections or openings in the deck should be completed before the application of the insulation and roofing

Note 4: Optimum adhesion to the deck is necessary for good roof performance. Koppers will not be responsible for any damage caused by, or the result of unsatisfactory attachment.

Note 5: The application technique and specification included in this section apply to conventional built-up roofing. Some specialized 'single-ply' roofing systems may not require attachment of the membrane to the insulation. In this case, the roofing system manufacturer shall be consulted for detailed specifications.

Note 6: Where mechanical fasteners are required, five fasteners must be installed per 3-foot x 4-foot board. One fastener shall be located at each corner and one in the center of the board.

Suggested Short Form Specifications For Standard Built-Up Roofings Systems

Roof insulation shall be Exeltherm Xtra foam panels factory laminated to form an integral bond with the surfacing skins, as supplied by Koppers Company, Inc., Pittsburgh, Pennsylvania. Foam density is to be in excess of two pounds per cubic foot. R" factor shall be _____. Installed thickness(es) shall be as indicated on drawings or specifications. Insulation panels must be laid perpendicular to the direction of the roofing membrane. Insulation shall be laid in parallel courses with cross joints broken. Edges must be butted. Good roofing practices for adhering rigid board insulation to the deck shall be used.

Koppers Company, Inc., supplies rigid phenolic insulation materials. It does not practice architecture or engineering. Roofing that incorporates Koppers insulation products, the company believes, results in a satisfactory installation when properly applied.



Characteristics, properties or performances of materials or application specifications herein described are based on data obtained under controlled test conditions. Koppers makes no warranties, expressed or implied as to the characteristics, properties or performance of its products under any variations from such conditions in actual construction. Koppers assumes no responsibility for the effects of structural movement and makes no implied warranties whatsoever.

No agent, salesman, representative or employee is empowered to change, alter or amend this provision unless it is done in writing by a duly authorized officer or employee of Koppers Company, Inc.

REINFORCEMENT FABRICS

KOPPERS
Architectural and
Construction Materials

The extra strength needed for all roofing and waterproofing systems.

Reinforcement Fabrics are necessary for waterproofing and roofing systems because the waterproofing agents, bitumens, have practically no strength by themselves. Koppers Reinforcement Fabrics provide this extra strength in a manner similar to that of reinforcing rods in concrete. Sometimes called membranes, these fabrics serve as mechanical reinforcement for hot or cold applied bituminous coatings in roofing and waterproofing systems. They also provide the framework to build up coating thicknesses, achieving longer lasting waterproofing systems. Once applied, they form stress-resistant pliable sheets that withstand stresses and strains from wind, vibration, and expansion or contraction due to temperature changes.

Applications Of Koppers Reinforcement Fabrics are many, the largest being with hot or cold applied bituminous coatings in roofing and waterproofing.

Other applications include bridge deck waterproofing and flashings, foundations, slabs, tunnels, subways, pipeline wrapping, pipeline joint wrap, parapet wall treatment, asphalt paving repair and protection, driveways, parking areas and tennis courts.

Many of the reinforcement fabric systems installed over 25 years ago are still in use today. In large construction projects such as highway bridges, their applications have insured complete protection against moisture penetration that ultimately leads to corrosion and the weakening of the structure.

Roof Repairs are long lasting when Koppers Reinforcement Fabric is used. Quick repairs to roofing and flashing membranes are possible if a ply of fabric is embedded in the first application of roof coating. A second application then completely seals the area where blisters and cracks once appeared.

Roof Resurfacing with reinforcement fabric adds strength to existing built-up roofs. Since it is important to select the membrane that performs best with a particular coating, Koppers manufactures fabrics that can be utilized with cold-applied products or hot bitumen. Coated glass fabrics are available as well as glass mats and saturated cotton fabrics. Glass membranes non-rotting feature its ability to conform to irregular surfaces, and its high tensile strength makes it a highly desirable reinforcement. Cotton fabric is often used for stripping-in and covering corrugated metal roofs.

When selecting the proper roof resurfacing reinforcement, it is important to also use the proper amount of coating to assure a long service life.

Other Uses for Koppers Reinforcement Fabrics exist wherever waterproofing systems are required. Tennis courts can better maintain their tight, smooth playing surfaces

with applications of Glasfab® membranes coated with bituminous or synthetic sealers. This waterproofing combination eliminates the recurrence of cracks, thereby preventing water from seeping under the asphalt and gradually breaking up the base.

Tunnels are effectively protected against water seepage into and through the concrete shell with Koppers Reinforcement Fabric embedded in a bituminous compound. A properly installed tunnel waterproofing system prevents rapid deterioration of reinforcing rods, heaving of concrete and the formation of icicles on the underside.

Pipeline protection has been achieved through an application consisting of a bituminous coating (Koppers Tar Enamel) and a reinforcement fabric (Glasfab membranes) to successfully prevent corrosion and soil stress.

Plaza Deck Waterproofing provides subterranean structures with needed protection against moisture. Any subterranean construction, whether used for office space, classrooms, storage or a parking garage, must be watertight, including walls and top surfaces. Landscaped plazas are often constructed on these top surfaces. It is here that Glasfab® is used as the reinforcing membrane in the waterproofing systems placed under the plaza surface.

Glasfab is available with a coating of asphalt or tar, to be compatible with the specified bitumen. Possessing the highest tensile strength of any reinforcing membrane currently in use, Glasfab provides a strong waterproofing system. It strengthens and secures the waterproofing agent between slabs and on walls under the plaza deck.

sealing and protecting them from water and chemical penetration.

When a reinforcing membrane is required that is not coated with asphalt or tar, Koppers fills the need with Glascoat®. Like Glasfab, Glascoat is a woven glass fabric but is coated with white resin. Glass mats and cotton fabrics may be needed in specific cases. Koppers makes these products available as waterproofing membranes, also.

Bridge Deck Waterproofing effectively protects bridge surfaces and substrates from premature deterioration. Koppers Reinforcement Fabric, used in conjunction with coal-tar coatings, repels the adverse effects of weather, salt, gasoline and oil spillage. In addition, the waterproofing prevents spalling of concrete and the corrosion of bridge reinforcing rods caused by penetration of moisture and de-icing chemicals. The woven glass reinforcement fabric serves a function similar to that of steel mesh in concrete. Forming a stress-resistant pliable sheet, the supporting membrane adds strength and serviceability to the inherent water resistance of the coal-tar emulsion.

Foundation Waterproofing And Dampproofing at the time of construction can eliminate the problems of damage-causing leaks. Architects and engineers have long realized the advantages of waterproofing compounds in preventing or retarding the passage of water. The reinforcement fabric enables waterproofing compounds to remain stationary while being built-up to the specific quantities desired, thus allowing the specifier to achieve the build-up necessary to resist existing hydrostatic pressure.



Reinforcement Fabrics (Cont.)

Specifications and Technical Data

Koppers Asphalt Or Coal Tar Saturated Cotton Fabrics are available in both standard and specification grade. The primary difference between the two grades is weight.

Cotton Fabric has the longest successful application record. Specification grade cotton complies with specifications from the federal government, the American Society

for Testing Materials (ASTM), the American Railroad and Engineering Association (AREA) and the American Association of State Highway Officials (AASHTO).

Product	Applicable Specifications	Nominal Sq. Yd. Dry Weight	Sq. Yd. Saturated Wt.	Breaking Strength of Saturated Fabric	Nominal Thread Count	Coating	Color
Specification Cotton Fabric	Fed. Spec. SS-C-450A ASTM D-173-74 AREA and AASHTO for various states.	3.5 oz.	10 oz. minimum	50 Warp 50 Fill Minimum	26 to 32 Warp 24 to 32 Fill	Asphalt or Tar	Black
Standard Cotton Fabric	None	2.0 oz.	8.5 oz. Typical Analysis	40 Warp 20 Fill Typical Analysis	27 Warp 15 Fill Typical Analysis	Asphalt or Tar	Black

Koppers Glasfab® And Glascoat® Woven Glass Fabrics are both well-known and widely accepted in the construction industry. Glasfab, an asphalt or tar coated fabric, and

Glascoat, a white resin-coated fabric are glass fabric is greater than cotton fabric or jute. inorganic woven glass membranes which will not rot, are lightweight and conform to irregular surfaces. The tensile strength of

Product	Applicable Specifications	Nominal Sq. Yd. Dry Weight	Sq. Yd. Saturated Wt.	Breaking Strength of Saturated Fabric	Nominal Thread Count	Coating	Color
Glasfab®	Fed. Spec. HH-C-486b ASTM D-1668-60 Type I & II	1.2 oz. to 2.0 oz. 1.4 oz. min.	1.5 oz. to 2.6 oz. 2 oz. to 3 oz.	75 Warp 75 Fill Minimum	20 X 10 or 20 X 20	Asphalt or Tar	Black
Glascoat®	White	1.2 oz. to 2.0 oz.	1.5 oz. to 2.6 oz.	65 Warp 65 Fill Minimum	20 X 10 or 20 X 20	Resin	White

Koppers Jute (Burlap) Fabric is asphalt saturated. Commonly known as treated burlap, it is a coarse fabric which tends to hold more bituminous roof coating material,

resulting in a heavier build-up of coating in fewer applications. It is quite often specified for roofing and waterproofing. Jute is also used for protection of newly-seeded areas,

embankment erosion control and ditch liners for holding planted materials in place until growth starts.

Product	Applicable Specifications	Nominal Sq. Yd. Dry Weight	Sq. Yd. Saturated Wt.	Breaking Strength of Saturated Fabric	Nominal Thread Count	Coating	Color
Jute	Fed. Spec. HH-B-00800 ASTM D-1327-59	7.5 oz.	9.75 minimum Typical Analysis	50 Warp 50 Fill Typical Analysis	9 Warp 9 Fill Typical Analysis	Asphalt	Black

Koppers Glass Mats are widely used with cold-applied roofing products. They are non-shrinking, possess excellent embedment qualities and conform to irregular surfaces.

The U F Glass Mat is white, lightweight, comprised of fine glass filaments in a random swirl arrangement, reinforced with glass strands at the edges and bonded with

urea formaldehyde. An asphalt coated U F Mat is also available.

Standard Glass Fiber Mesh consists of chopped mono-filaments formed into a random pattern and bonded with a resinous binder.

Heavy Duty Glass Fiber Mesh is constructed of heavy glass yarn, chopped in two inch

lengths and formed into a jackstraw pattern. It is bonded and coated with a pliable asphalt. The open pattern permits excellent bleed-through of the asphalt into which it is embedded.

Product	Binder	Glass Weight 100 sq. ft.	Total Weight 100 sq. ft.	Tensile Strength Width	Tensile Strength Length
U. F. Mat—White	Urea Formaldehyde	9 lbs.	10 lbs.	4 lbs.	13 lbs.
U. F. Mat—Asphalt	Urea Formaldehyde	9 lbs.	35 lbs.	31 lbs.	47 lbs.
Standard Mesh	Resin	1.39 lbs.	1.44 lbs.	10 lbs.	18 lbs.
Heavy Duty Mesh	Asphalt	2.22 lbs.	2.96 lbs.	25 lbs.	34 lbs.

PACKAGING INFORMATION

Fabrics	Roll Width (150' Long) Nominal	Rolls per Carton	Carton Weights
Glasstab	48"	4	48#
	36"	6	52#
	24"	6	40#
	18"	12	52#
	12"	18	52#
	9"	24	52#
	6"	36	52#
	4"	54	52#
3"	72	52#	
Glascoat	36"	6	42#
	24"	6	28#
	18"	12	42#
	12"	18	42#
	9"	24	42#
	6"	36	42#
	4"	54	42#
	3"	72	42#
U. F. Asphalt	36" X 180'	1	21#
Glass Mat	White 36" x 180'	1	7#
Heavy Duty Glass Fiber Mesh	27" X 96'	4	40#
Std. Glass Fiber Mesh	36" X 180'	1	11#

Fabrics	Roll Width (150' Long) Nominal	Rolls per Carton	Carton Weights
Standard Cotton	36"	1	22#
	24"	1	14#
	18"	2	22#
	12"	4	30#
	9"	4	22#
	6"	8	30#
	4"	12	30#
	3"	16	30#
Specification Cotton	36"	1	40#
	24"	1	26#
	18"	2	40#
	12"	3	40#
	9"	4	40#
	6"	6	40#
	4"	9	40#
	3"	12	40#
Jute	36"	1	44#
	24"	1	28#
	18"	2	44#
	12"	3	44#
	9"	4	44#
	6"	6	44#
4"	9	44#	
3"	12	44#	

ANCE PRODUCTS



Roof conditions

Dry Felts & Bare Spots: are caused by the oxidation of surface bitumen on gravel roofs. Roof Felts become exposed to attack by the sun's ultra violet rays, and rapid deterioration follows. Koppers roof restaurants help avoid this situation.

Blisters: usually are formed by the presence of moisture resulting in vapor pressure that has been trapped between plies of felt on either gravel or smooth surface roofs. Koppers roof cements and membranes can solve this problem.

Alligatoring: is a condition almost universal to smooth surface not asphalt roofs. Attack from the sun starts immediately and progresses to the formation of deep roof alligators as time goes by. The appropriate Koppers asphalt emulsions will provide a smooth top surface that will not alligator in the future.

Splits: are the result of excessive movement in the roof system. Freeze-thaw cycles and expansion and contraction may cause roof splits if proper expansion joints have not been provided. Koppers Stripshield and other systems can help control this condition.

Wet Insulation: will greatly effect the performance of any built-up roof. Hydrostatic pressure trapped within the roofing system must be released. Certain types of insulation can be successfully vented. This can help eliminate costly membrane deterioration.

Worn Flashings: can lead to a total roof failure. Koppers cements and membranes offer a system to restore worn flashings to a "like new" condition. If damage is more severe, our KMM aluminum flashing system offers an approach that will provide a completely new flashing with a durable aluminum top surface.

ROOF MAINTENANCE PRODUCTS AND SYSTEMS (Cont.)

Effective Maintenance with Tar and Asphalt Roof Resaturants



Purpose:

Many factors play a part in the service life of a roof. Some factors are uncontrollable. Others can definitely be controlled. There are some aspects of roof degradation that will follow a recognized path and the end result can be predicted.

The normal degradation of a built-up roof begins at the top surface. This is understandable since it is the top surface that is subjected to the deleterious elements of the atmosphere. As soon as a roofing bitumen is exposed to these elements, an age hardening process begins. As the softening point of the bitumen increases, cold flow properties diminish and resistance to moisture penetration decreases. The volatilizing or subliming of a roofing bitumen takes its toll on the performance characteristics of the bitumen.

At some time prior to the roof reaching the point when maintenance is no longer feasible, preventive maintenance should be established, even though the roof may not be leaking excessively. After considering the age, type of bitumen used to construct the roof and general condition, the use of Koppers Roof Resaturants offers an effective means of implementing preventive roof maintenance.

Tar:

Koppers Roof Resaturant 410 has a base of coal tar roofing bitumen, blended with non-volatile oils and graded asbestos fibers. Roof Resaturant 410 provides the maximum softening effect and penetration obtainable from a product of this type. There is no addition of volatiles that would rapidly evaporate.

Koppers Fiber Coating 415 is a tar base product specially formulated to meet Federal Specification SS-C-540. Fiber Coating 415 contains properly graded asbestos fibers plus selected penetrating oils.

Asphalt:

Koppers Roof Resaturant 425 is an asphalt resaturant designed to have the greatest softening effect available in an asphalt base product. Roof Resaturant 425 is a blend of asphalt and oils combined with asbestos fibers to provide a product suitable for flat or sloped gravel roofs.

- Lowers the softening-point of the top pour of bitumen.
- Restores flexibility to dried or otherwise brittle felt.
- Adds additional waterproofing to the surface.
- Provides a means of new gravel embedment.

Procedure:

1. All loose gravel must be removed from roof. If existing gravel is to be reused, it must be washed free of silt.
2. Silt is removed with water pressure, air pressure or vacuuming. If water is used, the roof must be allowed to dry completely before proceeding.
3. Drains are covered with screens to prevent clogging of the drain system.
4. After the roof is properly cleaned, all necessary repairs are made with compatible materials.
5. Koppers Roof Resaturant is applied evenly onto roof at the rate of seven to ten gallons per square. The application rate may vary with the condition of the roof.
6. Gravel or slag is applied to cover the Koppers Roof Resaturant. Gravel shall be in the $\frac{1}{4}$ - $\frac{3}{4}$ " range, and must be washed. Care must be taken to avoid exceeding weight limits of the roof deck. Gravel should be applied immediately after application of resaturant.
7. Precautions must be taken to close off air conditioning air intake ducts during summer heat-load peaks to minimize odor infiltration into occupied buildings during application.

Roof Maintenance Products and Systems (Cont.) Koppers Heavy Duty Roof Shield System...

Description

Koppers Heavy Duty Roof Shield System combines two Koppers roofing materials, Heavy Duty Glass Fiber Mesh and Liquid Asphalt 480.

Liquid Asphalt 480 is a filled, cold applied, high-quality asphalt emulsion containing Bentonite clay. It is the waterproofing component of the Heavy Duty Roof Shield System. The unique gel structure of Liquid Asphalt 480 will not alligator, blister, or flow in hot weather.

Heavy Duty Glass Fiber Mesh is a patented reinforcing mat of a non-woven jackstraw pattern of short cable strands of glass fiber. Each strand is composed of more than 200 glass monofilaments and is completely surrounded with the Liquid Asphalt 480, thereby eliminating water wicking by capillarity into the waterproofed surface.



Application

1. Surface Preparation. If there is a question to the soundness of the existing roof and insulation, a core cut should be made. All minor repairs must be made prior to priming. ANY blister containing moisture must be allowed to DRY before repair is made.

2. Priming. Every effort should be made to remove dust from the surface. If the dust cannot be completely removed, Koppers High Penetration Primer #452 should be applied at the rate of approximately $\frac{1}{2}$ gallon per 100 sq. ft.

If a primer is used, it must be allowed to dry thoroughly before proceeding with Roof Shield application.

3. Flashing. Flashing areas shall be examined, repaired and primed as required. Roof Shield should be applied first to flashing areas.

4. Application. Brush or spray-on an embedding coat of Liquid Asphalt 480 at the rate of

4 gallons per 100 sq. ft. Do not apply if temperatures below 40°F are expected within 8 hours or if rain is expected before the emulsion has time to dry.

While the emulsion is wet, embed Heavy Duty Glass Fiber Mesh into it with firm brush pressure forcing the emulsion through and around the glass strands. Each succeeding glass strip should overlap the preceding one by 2 inches. Roll ends of Heavy Duty Glass Fiber Mesh should overlap 6 inches. Do not allow dry or starved laps. Permit Liquid Asphalt 480 and Heavy Duty Glass Fiber Mesh to dry sufficiently to permit foot traffic.

After the embedding coat is dry, a top coat of Liquid Asphalt 480 is sprayed or brushed on at the rate of 3 gallons per 100 sq. ft.

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Koppers Aluminum Roof Coatings

KOPPERS 71/KOP
Architectural and
Construction Materials

Asphalt base reflective coatings

Koppers asphalt base aluminum coatings contain pure aluminum paste consisting of millions of tiny pigment flakes. When the coating is applied, these flakes rise to the surface and arrange themselves into many shingle-like layers of aluminum. The result is a reflective metal surface that protects the substrate from the elements. With Koppers aluminum coatings, there is no peeling or separating because the asphalt base securely bonds the aluminum to the protected surface.

There is an aluminum coating to suit your needs:

Aluminum Coating 434 contains three pounds of extra quality aluminum paste per gallon of high grade, non-fibrated asphalt base.

Aluminum Coating 435 contains three pounds of extra quality aluminum paste per gallon. This coating is reinforced with asbestos fibers for a thicker, tougher coating and extra life.

Aluminum Coating 444 contains two pounds of extra quality aluminum paste per gallon of

high grade non-fibrated asphalt base.

Aluminum Coating 445 is the same as 435 but contains two pounds of paste per gallon.

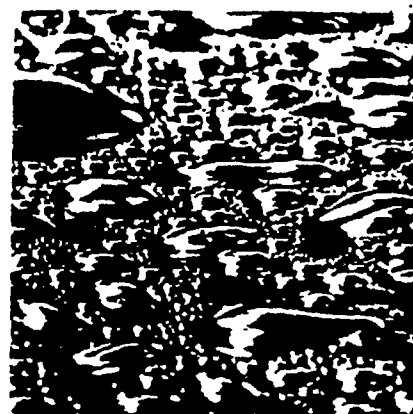
Application:

1. **Preparation**—The surface to be coated should be cleaned of all loose material such as gravel, dirt, dust, rust or scale. All breaks, cracks, holes and other structural deficiencies should be repaired prior to applying the Aluminum Coating.

2. **Priming**—Before applying Aluminum Coatings to roofs, dry or dusty felts should be primed with Koppers High-Penetration Primer 452 at the rate of approximately ½ gallon per 100 square feet. This preliminary step insures proper adhesion of the Aluminum Coating.

3. **Coating**—Stir thoroughly before and occasionally during application. Apply with spray or brush.

4. **Curing**—Allow one month curing time before application over new asphalt emulsion coated roofs. Allow three months curing time before application over new asphalt or solvent type asphalt coated roofs. Do not apply over "dead level" surfaces subject to standing water.



Guards against moisture penetration

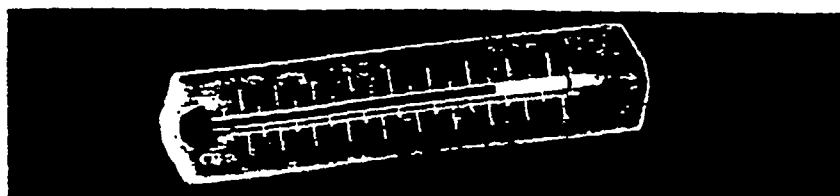
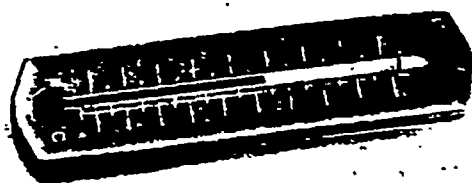
Koppers asphalt aluminum roof coatings contain millions of tiny pigment flakes in an aluminum paste. Upon application, these flakes rise to the surface and arrange themselves into a shingle-like layer of aluminum. The asphalt base in Koppers aluminum roof coatings provides excellent adhesion to the existing surface. The result is a reflective surface that guards the substrate against moisture penetration.

COVERING CAPACITY	Type of Surface	Non-Fibrated Aluminum	Fibrated Aluminum
Per 100 sq. ft.)	Metal	¾ to 1½ gallon	1 to 1½ gallons
	Composition	½ to 1 gallon	2 to 3 gallons



Protection against sunlight

Koppers aluminum roof coatings create a metallic surface that reflects sunlight. The reflective surface shields the substrate from ultraviolet damage while providing additional defenses against cracking or drying.



Cooling energy savings

Koppers aluminum coatings also help building interiors to stay cooler in the summer. Aluminum roof coating reflects eight times more than the BTU per hour, per square foot reflected by a black roof coating. This translates into less demand being placed on the air conditioning system. In such instances, Koppers aluminum roof coatings represent an economic and efficient means of conserving energy.

*Study results available upon request.

Harmon Company, Inc.
Engineering Division
New York, N.Y.

KOPPERS

and
KOPPER-ROD

KOPPERS

KOPPERS COMPANY, INC.
Pittsburgh, Pa. 15219

82% of Koppers Manufacturing Sales Going to Growing Markets

Distribution of 1969 Manufacturing Sales to Consuming Industries	SALES (\$ Million)	% OF TOTAL	MAJOR KOPPERS PRODUCTS USED
NON-BUILDING CONSTRUCTION (Roads, sewers, etc.)	\$ 74.8	17%	CRESOTED PILING • PROTECTIVE COATINGS • ROAD PAVING MATERIALS • WATERPROOFING MATERIALS • TREATED LUMBER • REINFORCED PLASTIC STRUCTURAL SHAPES • SWIMMING POOL PLUMBS • PAVEMENT SEALER • AGGREGATES • LAMINATED LIGHTING STANDARDS & STRUCTURAL PRODUCTS • DIMENSIONAL WHITE SPRUCE LUMBER • CRESOTED POSTS •
CHEMICAL & RUBBER	\$ 54.6	12%	ANTIOXIDANTS • ELECTROSTATIC PRECIPITATORS • MALEIC ANHYDRIDE • COATING RESINS • NAPHTHALENE • PHTHALIC ANHYDRIDE • RESORCINOL • ADHESIVE RESINS • STYRENE • TAR ACIDS • ALKYL RESINS • REINFORCED PLASTIC STRUCTURAL SHAPES • TAR BASES • INDUSTRIAL FANS • PISTON & SEALING RINGS •
PLASTICS	\$ 49.1	11%	POLYESTER & AMINO RESINS • POLYETHYLENE FILM • CONVENTIONAL POLYSTYRENE • EXPANDABLE POLYSTYRENE • POLYETHYLENE (HIGH & LOW DENSITY) • RESORCINOL • CONTAINER CLOSURES • ABS RESINS • ETHYLENE • STYRENE •
ARCHITECTURAL CONSTRUCTION (Structures, houses, plants, etc.)	\$ 39.4	9%	POLYETHYLENE FILM • LAMINATED WOOD STRUCTURAL PRODUCTS • RESORCINOL RESINS & ADHESIVES • TREATED LUMBER & POLES • ROOFING & WATERPROOFING MATERIALS • SOUND CONTROL EQUIPMENT • CRESOTE • CRESOTED FOUNDATION & MARINE PILING • FIRE-RETARDANT LUMBER & SHAKES AND SHINGLES • PROTECTIVE COATINGS •
TRANSPORTATION	\$ 38.6	9%	CRESOTE • CRESOTED CROSSTIES & PILING • CAR DECKING • SOUND CONTROL EQUIPMENT • OTHER TREATED & UNTREATED WOOD PRODUCTS • REINFORCED PLASTIC REFRIGERATOR CAR LINER PANELS • FANS • PISTON RINGS • COUPLINGS • POLYESTER RESINS •
UTILITIES: ELECTRIC & TELEPHONE	\$ 38.6	9%	CRESOTED UTILITY POLES & CROSSARMS • REINFORCED PLASTIC STRUCTURAL SHAPES & POLE LINE HARDWARE • ELECTROSTATIC PRECIPITATORS • TREATED & COLOR-COATED UTILITY POLES & CROSSARMS • TREATED & COLOR-COATED LAMINATED LIGHTING STANDARDS • SOUND CONTROL EQUIPMENT • INDUSTRIAL FANS • LAMINATED POWER TRANSMISSION STRUCTURES • PISTON RINGS • PROTECTIVE COATINGS •
PAPER	\$ 35.6	8%	CONTAINER MACHINERY • COUPLINGS • EXPANDABLE POLYSTYRENE SHEET • POLYETHYLENE • ELECTROSTATIC PRECIPITATORS • LATEX • PROTECTIVE COATINGS • RESORCINOL • REINFORCED PLASTIC STRUCTURAL SHAPES • TREATED LUMBER & ROOF DECKING • LAMINATED STRUCTURAL PRODUCTS • SODIUM SULFITE & SULFATE •
IRON & STEEL	\$ 24.3	6%	COKE PLANT EQUIPMENT • CONTRACT FABRICATION • COUPLINGS • ELECTROSTATIC PRECIPITATORS • FOUNDRY COKE • MINERAL PROCESSING EQUIPMENT • PITCH • PISTON RINGS •
MACHINERY	\$ 18.3	4%	COUPLINGS • PISTON & SEALING RINGS • SOUND CONTROL EQUIPMENT • INDUSTRIAL FANS • PROTECTIVE COATINGS • ELECTRONIC CONTROLS •
GOVERNMENT	\$ 12.2	3%	PISTON & SEALING RINGS • SOUND CONTROL EQUIPMENT • TREATED LUMBER • LAMINATED STRUCTURAL PRODUCTS • COUPLINGS • ROAD MATERIALS & AGGREGATES • REINFORCED PLASTIC PRODUCTS • WATER & SEWAGE TREATMENT EQUIPMENT • SEALS •
LUMBER	\$ 10.2	2%	CRESOTE • OTHER WOOD PRESERVATIVES • DIMENSIONAL WHITE SPRUCE LUMBER • COMMERCIAL TREATING SERVICE • LAMINATED BEAMS • RESORCINOL RESINS & ADHESIVES • TREATED LUMBER •
NON-METALLIC MINERALS (Mining)	\$ 10.1	2%	COUPLINGS • ELECTROSTATIC PRECIPITATORS • TREATED LUMBER • MINERAL PROCESSING EQUIPMENT •
NON-FERROUS METALS	\$ 9.5	2%	ELECTRODE BINDER PITCH FOR ALUMINUM PRODUCTION • INDUSTRIAL COKE • PISTON RINGS • MINERAL PROCESSING EQUIPMENT • COUPLINGS • PROTECTIVE COATINGS •
TEXTILES	\$ 6.8	2%	LATEX • POLYESTER BUTTON BLANKS & BUTTONS • RESORCINOL •
UTILITIES: GAS	\$ 5.5	1%	GAS APPARATUS • INDUSTRIAL FANS • ELECTRONIC CONTROLS • PROTECTIVE COATINGS • TREATED LUMBER • INTERIOR & EXTERIOR PROTECTIVE PIPELINE COATINGS & PRIMERS •
AGRICULTURE	\$ 4.8	1%	PISTON RINGS • POLYETHYLENE FILM • TREATED BUILDING POLES, POSTS & LUMBER •
MISCELLANEOUS	\$ 9.3	2%	

TOTAL MANUFACTURING SALES \$441.7 100%

LEGEND

↑ Markets growing at a rate faster than average growth expected for national economy over next ten years (↑ 5% annually)
 ↓ Markets growing at a rate slower than average expected for national economy over next ten years.

<u>1967</u>	<u>1966</u>	<u>1965</u>	<u>1964</u>	<u>1963</u>	<u>1962</u>	<u>1961</u>	<u>1960</u>
\$450,495	\$445,779	\$386,436	\$346,025	\$302,500	\$312,718	\$280,989	\$310,815
\$24,044	\$22,264	\$22,200	\$21,573	\$16,164	\$15,450	\$14,644	\$16,352
\$4,600	\$3,347	\$1,123	\$1,356	\$1,241	\$1,252	\$1,301	\$959
\$4,836	\$6,300	\$7,851	\$8,856	\$7,098	\$6,116	\$6,346	\$7,529
\$14,508	\$12,617	\$13,226	\$11,361	\$7,825	\$8,082	\$6,997	\$7,864
\$2.83	\$2.46	\$2.63	\$2.28	\$1.53	\$1.55	\$1.32	\$1.50
\$1.40	\$1.40	\$1.20	\$1.20	\$1.00	\$1.00	\$1.00	\$0.95
\$12,698	\$14,381	\$15,004	\$15,287	\$13,193	\$11,918	\$11,997	\$13,316
\$2.56	\$2.94	\$3.13	\$3.24	\$2.79	\$2.48	\$2.48	\$2.75
4,957	4,891	4,795	4,715	4,733	4,812	4,846	4,839
16,959	16,890	15,646	16,183	15,818	16,307	16,434	16,983
\$7,243	\$5,342	\$7,036	\$5,216	\$2,566	\$2,742	\$1,605	\$127
\$30,118	\$48,742	\$29,808	\$15,720	\$18,334	\$13,744	\$22,625	\$20,118
\$131,054	\$121,837	\$89,373	\$92,565	\$91,317	\$92,097	\$96,558	\$97,598
\$72,485	\$67,966	\$34,298	\$28,062	\$22,738	\$29,711	\$31,077	\$23,497
\$117,100	\$118,990	\$106,603	\$92,098	\$85,853	\$85,207	\$85,778	\$88,389
\$294,058	\$282,036	\$239,023	\$213,271	\$180,891	\$193,261	\$161,817	\$187,317
\$115,620	\$111,064	\$95,908	\$84,136	\$74,138	\$80,157	\$75,378	\$75,048
\$35.65	\$34.32	\$34.25	\$33.42	\$32.32	\$31.63	\$30.84	\$30.75

KOPPERS

1969 Annual Report

◀ FOLD OUT FOR FINANCIAL STATEMENTS

Koppers Company, Inc. and Consolidated Subsidiaries

Ten-Year Financial Highlights

(All figures in thousands, except per share information and number of stockholders)

	<u>1969</u>	<u>1968</u>
Revenue from sales and other income	\$536,369	\$451,739
Income before income taxes and interest charges and after minority interest ..	\$41,301	\$29,472
Interest charges	\$6,690	\$4,552
Income taxes	\$16,254	\$9,037
Net income	\$18,357	\$15,383
*Earnings per share of common stock	\$3.70	\$3.18
Dividends declared and paid, per share of common stock	\$1.60	\$1.50
Total of all taxes	\$25,841	\$17,139
*Taxes per share of common stock	\$5.38	\$3.56
*Number of shares of common stock outstanding	4,802	4,811
Number of stockholders at year-end	16,437	16,831
*Earnings retained in the business	\$9,963	\$8,098
Gross additions to fixed assets and investments	\$39,913	\$31,662
Net book value of land, buildings, equipment and depletable properties	\$165,766	\$144,354
Term debt due after one year	\$92,889	\$76,396
Wages, salaries and pension expense	\$138,920	\$121,720
Materials, supplies and services	\$329,398	\$275,469
Working capital at year-end	\$119,915	\$109,265
Book value per share of common stock outstanding at year-end	\$39.16	\$37.19

*Based on average number of shares of common stock outstanding during year.

Notes to Financial Statements December 31, 1969

1. Principles of consolidation and change in accounting

The consolidated statements include the accounts of the Company, all of its subsidiaries (except one foreign company owned 52%) and the Company's 50% share of the assets and liabilities and income and expenses of Sinclair-Koppers Company, a partnership owned by the Company and Atlantic Richfield Company.

The foreign non-consolidated subsidiary and 50% owned companies are carried at cost. One domestic company, approximately 50% owned, is carried at equity in underlying net assets. In prior years the Company carried its investment in this company at cost and reflected dividends in consolidated income as they were received. In 1969 the Company retroactively adopted the equity method of accounting for this investment, under which the Company's share in its earnings is reflected in current income. The effect of this change was to increase net income for the years 1969 and 1968 by \$747,000 and \$658,000, respectively, and to increase earnings retained in the business at January 1, 1968 by \$2,432,399.

The Company's equity in the net assets of the foreign non-consolidated subsidiary and 50% owned companies at December 31, 1969 exceeds the carrying value (cost) of the Company's investment therein by \$3,900,000. The Company's equity in the net income of these companies in 1969 amounted to \$1,560,000 and dividends of \$206,000 were received and taken into consolidated income.

During 1969 one company was acquired in exchange for Company common shares held in treasury and was accounted for as a pooling of interests. As a result, earnings retained in the business at January 1, 1969 were decreased \$106,974 and capital in excess of par value was increased \$21,163. The financial statements for 1968 were not restated because of the immaterial amounts involved. One other business was purchased in early 1969 and its operations, from date of acquisition, are included in the consolidated financial statements.

Capital in excess of par value was reduced by \$99,770 in 1969 representing the cost of treasury shares issued as additional consideration for a company acquired in 1965 and accounted for as a pooling of interests.

2. Pension plans

The Company and its consolidated subsidiaries have several trustee pension plans covering substantially all their employees. The total pension expense for 1969 was \$3,302,000, which includes \$613,000 for interest on and amortization of prior service cost over periods ranging to 40 years. All pension provisions are paid into trust funds. The unfunded prior service cost under all plans at December 31, 1969 approximated \$11,030,000 which includes \$1,000,000 resulting from increased benefits under certain plans for hourly employees granted in 1969.

3. Income taxes

The provisions for income taxes have been reduced by \$1,240,000 and \$1,317,000 in 1969 and 1968, respectively, for the investment credit.

The Company provides deferred income taxes for income and expense items which are reflected in the financial statements in years different from those in which they are reflected in the Company's income tax returns. The principal items of difference are the excess of guideline depreciation under an accelerated method claimed for tax purposes over book depreciation under the straight line method, earnings of consolidated foreign subsidiaries and deferred compensation.

4. Intangible assets

Intangible assets consist of \$1,196,006 unamortized cost of patents and \$3,205,945 excess of purchase price over net assets of a business acquired in December 1968. The excess of cost over net assets is not being amortized since there has been no decline in value.

5. Term debt due after one year

The note agreements contain various restrictions as to dividend payments and incurrence of additional term debt. Under the most restrictive provisions at December 31, 1969, \$36,319,000 of consolidated earnings retained in the business was available for cash dividends and the Company could incur additional term debt of \$25,930,000.

The notes payable to banks bear interest at the prime rate in effect on the date of the notes and are represented by 90-day notes which are renewable until April 30, 1971, at which time they can be converted into term notes, which will be payable in ten equal semiannual installments commencing October 31, 1971 and bear interest at the prime rate plus $\frac{1}{4}\%$. The prime rate at December 31, 1969 was $8\frac{1}{2}\%$ per annum.

6. Stock option plan

During 1969, under the Company's stock option plan for officers and key employees, options on 18,640 shares were granted, and 23,500 shares were issued on exercise of options at prices ranging from \$19.25 to \$30.50 per share. At December 31, 1969, options covering 68,365 shares were outstanding and no shares were available for future grants.

Options granted prior to January 1, 1964 were at 95% of market value at date of grants and are exercisable over a seven year period. Options granted after January 1, 1964 were at 100% of market value at date of grant and are exercisable over a five year period. The \$358,348 excess of cost of treasury shares over the proceeds resulting from exercise of options during the year was charged to capital in excess of par value.

7. Commitments and contingencies

The 1970 rentals on properties operated by the companies under long-term leases will amount to \$2,190,000. In addition, the companies are required to pay taxes, insurance, repairs and maintenance and alterations under certain of the leases.

The unexpended balance of open fixed asset expenditure authorizations at December 31, 1969 amounted to \$39,513,000.

The Company has guaranteed \$9,560,000 indebtedness of 50% owned companies and other corporations.

Consolidated Balance Sheet December 31, 1969 and 1968 (See accompanying notes)

LIABILITIES

	1969	1968*
Current liabilities:		
Federal income tax	\$ 6,672,544	\$ 925,802
Other taxes	5,304,468	3,710,533
Accounts payable and accruals other than taxes	49,589,167	41,059,550
Advance payments received on contracts	7,454,731	14,724,402
Term debt due within one year	2,430,268	2,617,955
Notes payable to banks	1,463,998	—
Total current liabilities	72,915,176	63,039,247
Term debt due after one year (Note 5):		
6% notes due \$3,000,000 annually commencing August 1, 1977	50,000,000	50,000,000
Notes payable to banks	22,000,000	8,000,000
5.8% promissory notes due \$670,000 annually commencing August 15, 1972..	10,000,000	10,000,000
Other, including Euro-currency loans, average interest rate of 8% at December 31, 1969	10,888,658	8,395,672
	92,888,658	75,395,672
Deferred compensation	3,446,345	3,068,413
Deferred income taxes (Note 3)	11,191,851	9,223,562
Minority shareholders' interest in subsidiaries	960,527	98,800
Total liabilities	181,402,557	151,825,694

STOCKHOLDERS' EQUITY

Cumulative preferred stock, \$100 par value:		
Authorized 300,000 shares, issued 150,000 shares, 4% series	15,000,000	15,000,000
Preference stock, no par value:		
Authorized 1,000,000 shares in 1969, issued—none	—	—
Common stock, \$5 par value, authorized 8,000,000 shares in 1969 and 6,000,000 in 1968, issued 4,973,528 shares (Note 6)	24,867,640	24,867,640
Capital in excess of par value (Notes 1 and 6)	48,064,420	48,501,375
Earnings retained in the business (Notes 1 and 5)	121,615,813	111,653,045
	194,547,873	185,022,060
Less 160,620 shares of common stock in treasury at cost at December 31, 1969....	6,049,977	7,648,540
Common stockholders' equity	188,497,896	177,373,520
Total preferred and common stockholders' equity	203,497,896	192,373,520
	<u>\$384,900,453</u>	<u>\$344,199,214</u>

STATEMENTS—Koppers Company, Inc. and Consolidated Subsidiaries

Consolidated Balance Sheet December 31, 1969 and 1968 (See accompanying notes)

ASSETS

	<u>1969</u>	<u>1968*</u>
Current assets:		
Cash	\$ 12,051,214	\$ 14,268,977
Accounts receivable less allowance of \$649,894 for doubtful accounts in 1969 ..	100,130,475	88,443,591
Inventories, at lower of cost (first-in, first-out) or market:		
Product inventories including work in process	59,759,652	53,266,957
Raw materials and supplies	15,665,143	14,442,697
Prepaid expenses	5,223,149	1,881,563
Total current assets	<u>192,829,633</u>	<u>172,303,785</u>
Investments:		
Non-consolidated subsidiary and 50% owned companies (Note 1)	14,481,721	14,584,411
Other investments, at cost	4,219,909	5,757,533
Notes and accounts receivable due after one year	<u>2,341,170</u>	<u>1,369,191</u>
	21,042,800	21,711,135
Fixed assets, at cost:		
Buildings	45,788,175	40,155,873
Machinery and equipment	<u>306,065,526</u>	<u>275,325,231</u>
	351,853,701	315,481,104
Less accumulated depreciation	<u>200,310,377</u>	<u>182,708,694</u>
	151,543,324	132,772,410
Depletable properties, less accumulated depletion	4,428,208	1,986,773
Land	<u>9,794,647</u>	<u>9,594,394</u>
	165,766,179	144,353,577
Intangible assets (Note 4)	4,401,951	4,793,139
Deferred charges	<u>859,890</u>	<u>1,037,578</u>
	<u><u>\$384,900,453</u></u>	<u><u>\$344,199,214</u></u>

* Restated to conform to classifications and accounting change adopted in 1969.

KOPPERS

1969 Annual Report

FINANCIAL

Consolidated Statement of Income and Earnings Retained in the Business

Years ended December 31, 1969 and 1968 (See accompanying notes)

	1969	1968*
Net sales	\$533,312,104	\$448,695,339
Operating expenses (Note 2):		
Cost of sales	411,193,610	348,979,137
Depreciation and depletion	17,163,628	14,628,119
Taxes, other than income taxes	9,586,385	8,101,406
Selling, research, general and administrative expenses	57,124,008	48,210,191
	<u>495,067,631</u>	<u>419,918,903</u>
Operating profit	<u>38,244,473</u>	<u>28,776,936</u>
Other income (Note 1):		
Dividends, interest, etc.	1,089,431	1,070,275
Profit on sale of capital assets	1,090,802	1,198,663
Equity in earnings of company approximately 50% owned, dividends received 1969—\$66,240, 1968—\$109,440	877,049	824,084
	<u>3,057,282</u>	<u>3,093,022</u>
	<u>41,301,755</u>	<u>31,869,958</u>
Interest expense	<u>6,690,358</u>	<u>4,552,361</u>
	<u>34,611,397</u>	<u>27,317,597</u>
Provision for income taxes:		
Federal (Note 3):		
Currently payable	11,118,681	5,485,727
Deferred	1,839,000	4,034,370
State and foreign	3,296,742	848,077
	<u>16,254,423</u>	<u>10,368,174</u>
Income before extraordinary item	<u>18,356,974</u>	<u>16,948,923</u>
Extraordinary item, net of applicable income taxes	<u>—</u>	<u>(1,066,000)</u>
Net income for the year	<u>18,356,974</u>	<u>15,882,923</u>
Earnings retained in the business at beginning of period	<u>111,653,045</u>	<u>101,122,334</u>
Increase resulting from accounting change (Note 1)	<u>—</u>	<u>2,432,899</u>
Increase (decrease) resulting from pooling of interests (Note 1)	<u>(106,974)</u>	<u>30,683</u>
	<u>129,903,045</u>	<u>119,468,839</u>
Cash dividends paid:		
On preferred stock, \$4.00 per share	600,000	600,000
On common stock, \$1.60 per share in 1969 and \$1.50 per share in 1968	7,687,232	7,215,794
	<u>8,287,232</u>	<u>7,815,794</u>
Earnings retained in the business at end of period	<u>\$121,615,813</u>	<u>\$111,653,045</u>
 Average number of shares of common stock outstanding during year	 4,801,959	 4,811,494
Per share of common stock:		
Earnings before extraordinary item	\$3.70	\$3.40
Extraordinary item	—	(.22)
Net earnings	<u>\$3.70</u>	<u>\$3.18</u>

* Restated to conform to classifications and accounting change adopted in 1969

Source and Disposition of Funds
(In thousands of dollars)

SOURCE	1969	1968
Net income	\$18,357	\$15,883
Depreciation and depletion	17,164	14,623
Increase in long-term debt	16,493	3,911
Decrease in other assets	6,836	(474)
	<u>\$58,850</u>	<u>\$33,948</u>
DISPOSITION		
Dividends paid	\$ 8,287	\$ 7,816
Capital expenditures and investments	39,913	31,662
Increase in working capital	10,650	(5,530)
	<u>\$58,850</u>	<u>\$33,948</u>

Report of Certified Public Accountants

ARTHUR YOUNG & COMPANY
CERTIFIED PUBLIC ACCOUNTANTS

2500 Koppers Building
Pittsburgh, Pa. 15219

The Board of Directors and Stockholders
Koppers Company, Inc.

We have examined the accompanying consolidated balance sheet of Koppers Company, Inc. and consolidated subsidiaries at December 31, 1969 and the related consolidated statement of income and earnings retained in the business for the year then ended. Our examination was made in accordance with generally accepted auditing standards, and accordingly included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances.

In our opinion, the statements mentioned above present fairly the consolidated financial position of Koppers Company, Inc. and consolidated subsidiaries at December 31, 1969 and the consolidated results of their operations for the year then ended, in conformity with generally accepted accounting principles applied on a basis consistent with that of the preceding year after giving retroactive effect to the equity method of accounting for a company approximately 50% owned as described in Note 1.

Pittsburgh, Pennsylvania
January 19, 1970

Arthur Young & Company

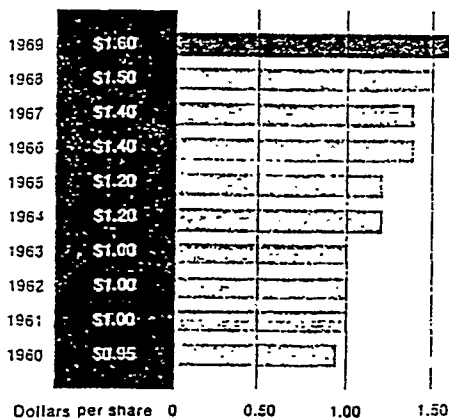
Other Financial Matters

In summarizing the Company's past performance and its present financial position and outlook, the growth in earnings appears to management to be of special significance. On a per-share basis, earnings in the 1960's have moved from \$1.20 in 1959, to \$3.70 in 1969. This represents a compound growth rate of 12 per cent per year over the ten-year period.

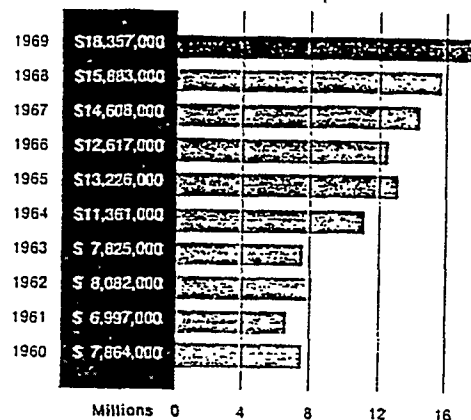
Cash flow from Koppers operations—consisting of earnings applicable to common shareholders plus provisions for depreciation, depletion and deferred taxes—totalled \$36.8 million in 1969, equal to \$7.66 per common share. This compares with cash flow in 1968 of \$33.5 million or \$6.96 per common share.

Taxes had a significant impact on the Company's earnings. The total of all taxes for the year 1969 was \$25.8 million, up from \$17.1 million in 1968. These amounts represented \$5.38 per common share in 1969, as against \$3.56 the year before.

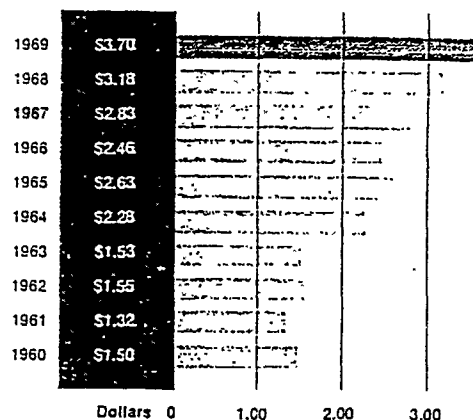
Dividends Paid to Common Stockholders



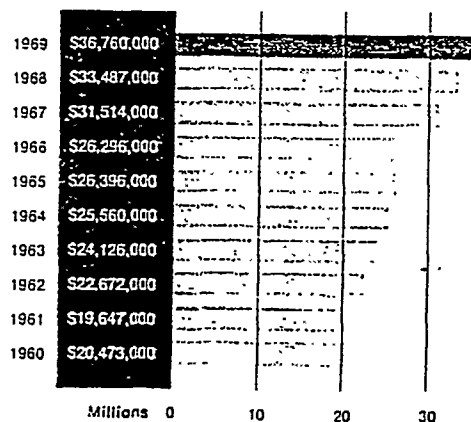
Net Income



Earnings Per Share



Cash Flow



occurred early in the year with the acquisition of Swanson Lumber Co., Ltd., of Edmonton, Alberta, Canada, and TPL Industries, Ltd., of Vancouver, B.C. Swanson is one of the largest North American producers of dimensional white spruce lumber, which is marketed primarily in the U. S. for use in framing in residential and mobile housing.

TPL Industries is the largest Canadian producer of glue-laminated structural products and a leading manufacturer of chemically impregnated wood products such as utility poles, piling, and fire retardant lumber, as well as corrugated steel culverts.

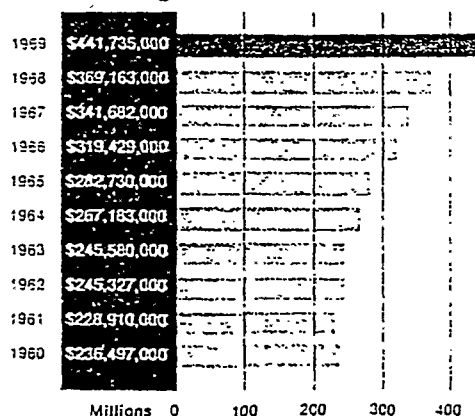
Expansion and modernization of our chemical facilities continued during 1969. Construction was started on a new 130 million pound per year phthalic anhydride plant near Chicago. On completion of this new facility in mid-1970, Koppers will be the largest producer of this chemical

in the U. S. Demand for phthalic anhydride continues to be strong for use in the manufacture of paints, polyester resins, and plasticizers.

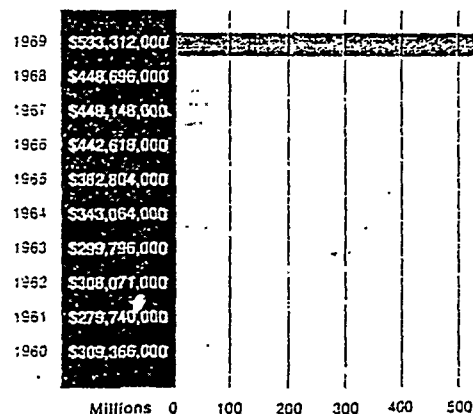
For the third consecutive year, work proceeded on our program to expand capacity to produce container machinery. With the completion of this latest expansion in 1970, Koppers capacity will be triple the 1966 level. This equipment is used by the packaging industry to convert kraft paper into corrugated board and subsequently into corrugated containers.

Koppers capital expenditures in 1970 are expected to continue at approximately the 1969 level. A substantial portion will be for the new phthalic anhydride plant and other chemical facilities, for road materials operations, for wood treating capacities and facilities to process railroad crossties, for piston and sealing rings, and for Sinclair-Koppers polyethylene and polystyrene facilities.

Manufacturing Sales



Total Sales



tions. A large contract received in late December, however, significantly increased the construction backlog at year-end. Total Company backlog on December 31, 1969 was \$228 million, about equal to the \$229 million on hand at the end of 1968.

Record Manufacturing Performance

The largest manufacturing sales increase was recorded by Forest Products and was accounted for in part by the division's Canadian expansion discussed on the following page. Strong gains in sales of chemically

impregnated wood products to commercial markets, along with increases in sales of laminated wood structurals and railroad crossties, also contributed to the division's 35 per cent sales improvement.

Metal Products recorded a 23 per cent gain in sales on the strength of the division's expanded container machinery line and increases in piston rings and seals, power transmission couplings, and sound control equipment.

Chemical sales continued on a good upward trend in 1969, particu-

larly for phthalic anhydride and polyester resins. Both are important products in the fast-growing reinforced plastics industry. Foundry coke and construction materials also contributed to Organic Materials' \$14 million increase.

Sinclair-Koppers continued to grow at a strong rate in 1969. A smooth start-up and sustained high level of operation of the 200 million-pound per year styrene monomer plant at Kobuta, Pa., had a significant effect on the year's results. Good sales increases were achieved in other product lines including expandable polystyrene, high and low density polyethylene and polyethylene film.

Strong Construction Operations

The strong performance of the Engineering and Construction Division in 1969 was highlighted by the completion of several large steel installations.

One of the world's most advanced steelmaking facilities, designed and engineered by Koppers, was completed and successfully started up in Spain.

The facility includes a basic oxygen furnace shop and an 18-strand continuous casting plant. This is the first large integrated steelmaking complex designed for the entire output to be continuously cast. Koppers also designed and helped build the blast furnaces which supply iron to the new one-million-metric ton-per-year steel facility.

Capital Investment Remains High

Capital investment continued at a high level in 1969 as Koppers invested \$40 million in new plant construction and expansion and modernization.

A major diversification and expansion of our forest products operations

1966	1965	1964	1963	1962	1961	1960
\$129,960	\$117,390	\$ 96,124	\$ 95,537	\$103,844	\$100,863	\$105,587
36,363	75,390	68,511	57,920	51,907	42,082	47,166
59,450	51,973	40,754	37,194	37,153	34,348	31,092
44,656	36,977*	61,794	54,929	52,423	51,617	52,652
\$319,429	\$292,730	\$267,183	\$245,580	\$245,327	\$228,910	\$236,497
121,325	98,233	74,308	52,352	61,680	49,865	72,105
1,361	1,841	1,573	1,864	1,064	965	764
\$442,618	\$382,604	\$343,064	\$299,796	\$308,071	\$279,740	\$309,366

Operating and Financial Review

Koppers manufacturing sales increased in 1969 for the eighth straight year, to a record \$442 million, up from \$369 million the previous year. Construction sales increased to \$31 million, from \$78 million in 1968. Koppers total sales reached an all-time high of \$533 million, compared with \$449 million in 1968.

Income before Federal income taxes in 1969 was \$34.6 million, up from \$27.3 million the year before. Net in-

come totaled \$18.4 million, a substantial increase from \$15.9 million in 1968. After provision for payment of preferred stock dividends, this was equal to earnings of \$3.70 per share of common stock outstanding, as against \$3.18 per share in 1968. Net income in 1968 was reduced by a non-recurring write-off of assets of \$1.1 million on an after-tax basis, equal to 22 cents per common share.

Koppers income for 1968 has been restated to reflect the Company's adoption of the equity method of accounting for its investment in Ameri-

can Aniline Products, Inc., as reported at the end of the first half of 1969. This accounting change affects earnings for both years by about the same amount.

New orders for Koppers products were strong throughout 1969; the year-end manufacturing backlog was 23 per cent above 1968 and established a record. Order bookings in our construction business were low during the year because of curtailment of capital expenditures in the steel industry in the face of uncertain economic outlook and monetary condi-

Every Division
Contributed
to Koppers
19% Sales Gain
in 1969

Net Sales by Division (Sales in thousands of dollars)	1969			1968	1967
	Sales	% of Total	% Increase 1968-1969		
Organic Materials	\$157,313	29%	49%	\$143,630	\$133,259
Forest Products	127,128	24%	170%	94,518	93,793
Metal Products	93,405	18%	200%	75,999	68,490
Plastics Operations*	63,889	12%	21%	55,016	45,110
Total Manufacturing	\$441,735	83%	87%	\$369,163	\$341,682
Engineering and Construction	90,741	17%	25%	73,348	105,427
Other Sales	836	—	—	1,185	1,039
TOTAL	\$533,312	100%	72%	\$448,696	\$448,148

*In 1965, the operations of Koppers Plastics Division were transferred to the Sinclair-Koppers Company, a partnership with Atlantic Richfield Company. Since then the Company's Plastics Operations include Koppers' half share of Sinclair-Koppers sales.

Executive Changes

Several major executive appointments were made during 1969.

Thomas C. Keeling, Jr.
Director
International Operations

Donald E. Lemmon
Industrial Relations Department

Edward D. Losch
Corporate Development

Donald MacArthur
Washington Office

Dr. William N. MacIay
Director of Research

Paul C. McConnaughey
Organic Materials Division

Jack D. Rice
Engineering and Construction Division

Donald C. Smith
Forest Products Division

Richard E. Spatz
Organic Materials Division

Paul Wayman
Organic Materials Division

B. Otto Wheeley
Marketing Department

Robert G. Wilson
General Manager
Engineering and Construction Division

Other Officers

Thomas M. St. Clair
Comptroller



Nicholas Kay, 57, was elected vice president and general manager of the Metal Products Division. He succeeded Harry B. Cummings who retired during the year. Mr. Kay has been assistant general manager of the division since 1959. He has held various operating and management responsibilities since joining Metal Products in 1940.



Donald E. Lemmon, 46, was named vice president and manager of industrial relations. He has been with the Company for 14 years and was assistant manager of industrial relations with responsibility for all plant labor negotiations prior to his present assignment.



Thomas M. St. Clair, 34, was appointed comptroller of the Company. In addition to internal control functions, his responsibilities include direction of other financial and accounting activities. Mr. St. Clair joined Koppers in 1958; since 1966 he has served as assistant to the general manager of the Engineering and Construction Division.

*Board of Directors

Vance Brand
President
International Investment Co.

Stanley N. Brown
Former Vice President
Koppers Company, Inc.

Fletcher L. Byrom
President
Koppers Company, Inc.

Fred C. Foy
Chairman of the Board
Koppers Company, Inc.

Douglas Grymes
Executive Vice President
Koppers Company, Inc.

Curtis E. Jones
Vice President
Mellon National Bank and Trust Company

Thomas C. Keeling, Jr.
Chairman and President
Koppers International, C.A.

Andrew W. Mathieson
Vice President and Governor
T. Mellon and Sons

Robert H. McClintic
Chairman of the Board
Gordon Terminal Service Company

Robert S. Oelman
Chairman of the Board
National Cash Register Company

Nathan W. Pearson
Vice President and Governor
T. Mellon and Sons

Dr. H. Guyford Stever
President
Carnegie-Mellon University

O. P. Thomas
Chairman, Executive Committee
Atlantic Richfield Company

*Officers

Fred C. Foy
Chairman of the Board

Fletcher L. Byrom
President

Douglas Grymes
Executive Vice President

Vice Presidents

William M. Barnes
Forest Products Division

Burnett G. Bartley, Jr.
General Manager
Forest Products Division

A. William Capone
Treasurer

Thomas C. Cochran, Jr.
General Counsel and Secretary

Arthur W. Cowles
Executive Department

Donald L. DeVries
Metal Products Division

David L. Eynon, Jr.
Corporate Growth Planning

John A. Hagan
Engineering and Construction Division

James F. Haley
Transportation and Traffic Services

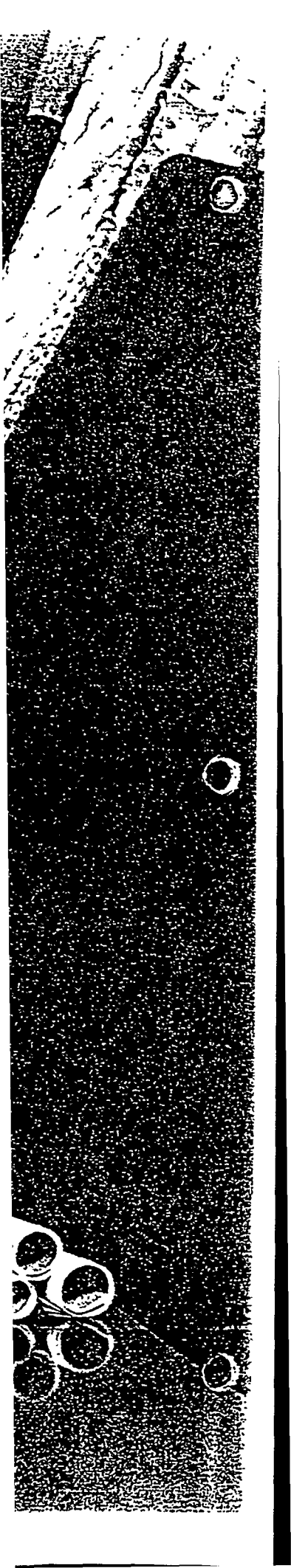
Max C. Hanisch
Forest Products Division

William B. Jackson
General Manager
Organic Materials Division

Alfred E. Jones
Purchasing and Traffic Department

Nicholas Kay
General Manager
Metal Products Division

*See changes on pages 2 and 3.





"Koppers can silence the noise of a gas turbine engine so that its operation in the middle of a town is not disturbing. Our capability in this area is outstanding and our growth shows it. We are now applying this proprietary technology to the development of solutions to the problems of sound pollution in industry and other areas of our environment."

Nicholas Kay

Vice President and General Manager

Metal Products Division

Many experts warn that noise levels in cities are increasing and could some day become lethal. Electric utilities, for example, have found that one way to meet the increased demand for power in cities is to add gas turbines to their generating facilities. It's a potentially noisy solution.

Koppers is solving the problem with highly engineered sound control systems that reduce a turbine's noise to a whisper. Koppers sales of this type of equipment have doubled in the past two years.

Koppers also silences the noise of jet aircraft engines being ground tested. Our latest design is being used

in test cells to quiet the giant engines built for new jumbo jet aircraft.

This same technology is a basis for economical solutions to many environmental sound problems faced by U. S. industries. Environmental legislation and public demand will expand the market potential in this area.

Koppers is also involved in another important area of environmental control—air pollution abatement. The Company is a leading supplier of electrostatic precipitators to the four major markets for this equipment: electric utilities, the steel industry, producers of rock products, and pulp and paper manufacturers.

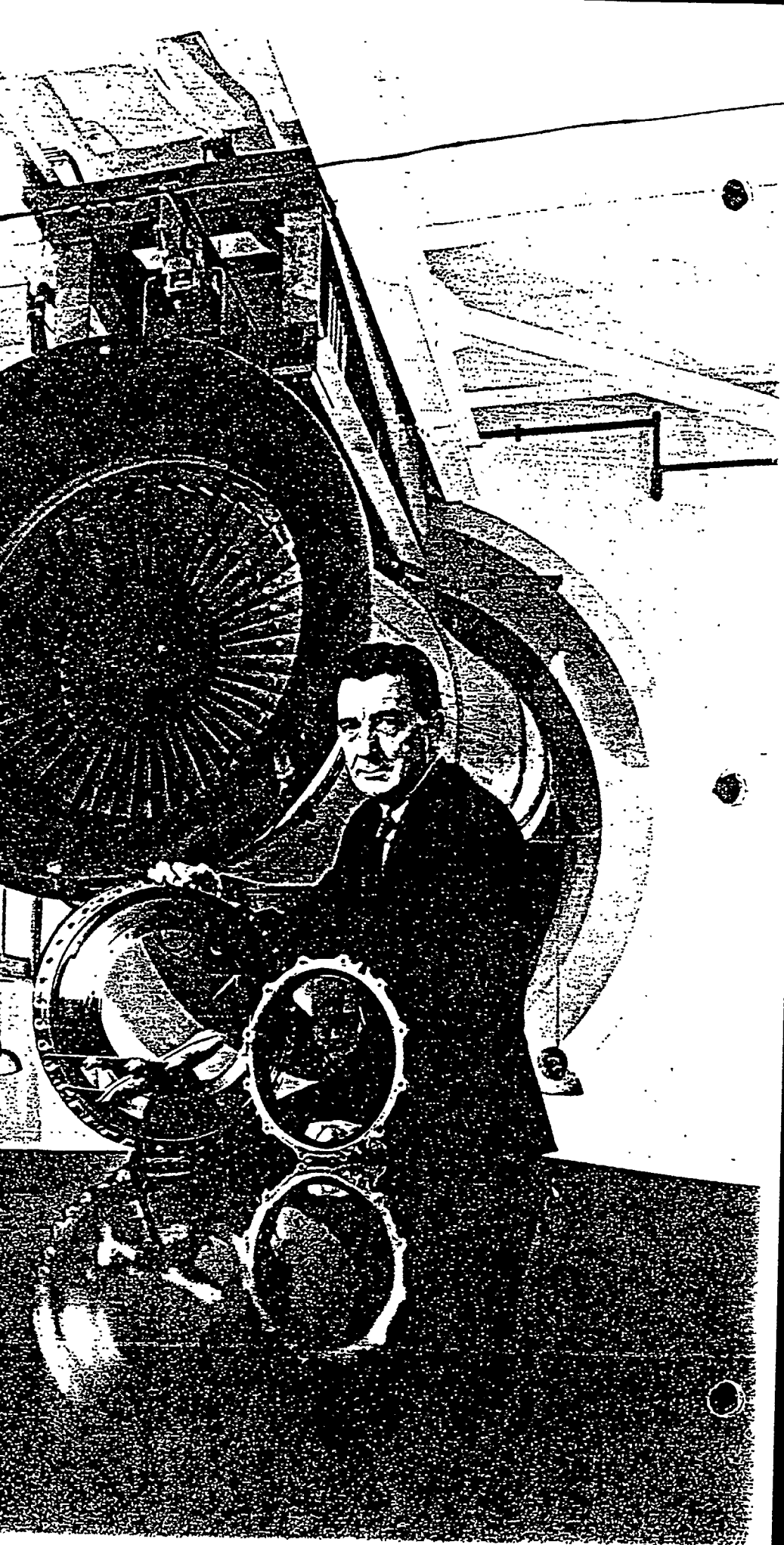
Koppers has greatly expanded its line of machinery used by the packaging industry to convert kraft paper into corrugated board and then into containers. Manufacture of this equipment also has been established within the European Common Market.

Demand for such equipment is growing at a rate of about nine per cent annually. Koppers, however, has

nearly doubled its sales of container machinery during the past three years and expects to continue to grow at a rate above the industry average. As industrialization progresses in other countries, worldwide demand for corrugated containers will increase substantially.

Koppers sales of industrial piston rings have increased by 50 per cent over the past four years. We have concentrated our capabilities in recent years in the high-performance segment of this industry—in truck and off-highway high-speed diesel engine applications. Sales to this market are expected to double by the mid-1970's. In addition, a trend in farm machinery to higher powered engines will require use of the type of high-performance rings produced by Koppers.

This test cell, which contains one of the engines used on the new jumbo jet aircraft, is equipped with Koppers sound control equipment. Koppers precision-made shaft seals are used inside the huge jet engines.



"Koppers has become the major U. S. designer and supplier of all-wood electric power transmission structural systems. Growth in this area will be substantial as the demand for electric energy doubles in the next decade and triples by 1985. In addition, the basic capability to make wood a permanent and more versatile material of construction for which new architectural uses can be developed will provide dramatic growth for the Company."

Burnett G. Bartley, Jr.

Vice President and General Manager

Forest Products Division

Construction of high voltage transmission structures represents a potential annual market in the U. S. of \$2.5 billion. Wood structures have outstanding potential in this market because wood is economical and provides excellent insulation capabilities.

As the major U. S. wood laminating and chemical wood treating company, Koppers has a basic position in the electric power transmission structure field. For many years, we have been the largest supplier of electric power poles to the utility field.

Since entering the high voltage transmission market two years ago, Koppers has also become the leading supplier of wood structures for such lines. In late 1969, the Company received the largest contract ever placed by a utility for all-wood structures—a contract to supply more than 2,600 wood structural towers for a

368-mile long power line in Utah.

Koppers sales to the architectural and construction market have grown rapidly during the past five years through the addition of new products. Sales to this market now represent more than half the division's volume. The strong upward trend is expected to continue.

Sales of fire retardant shakes and shingles, introduced to the market late in 1968, doubled in 1969. Hundreds of local building codes have been amended to permit use of these attractive roofing materials on commercial structures in densely populated urban areas where there is a desire to improve appearance.

In 1969 we introduced a new fire retardant chemical process of impregnating wood exposed to weather which opens markets where wood could not previously be used. This process makes wood permanently fire retardant for use in virtually any type of exposed exterior application.

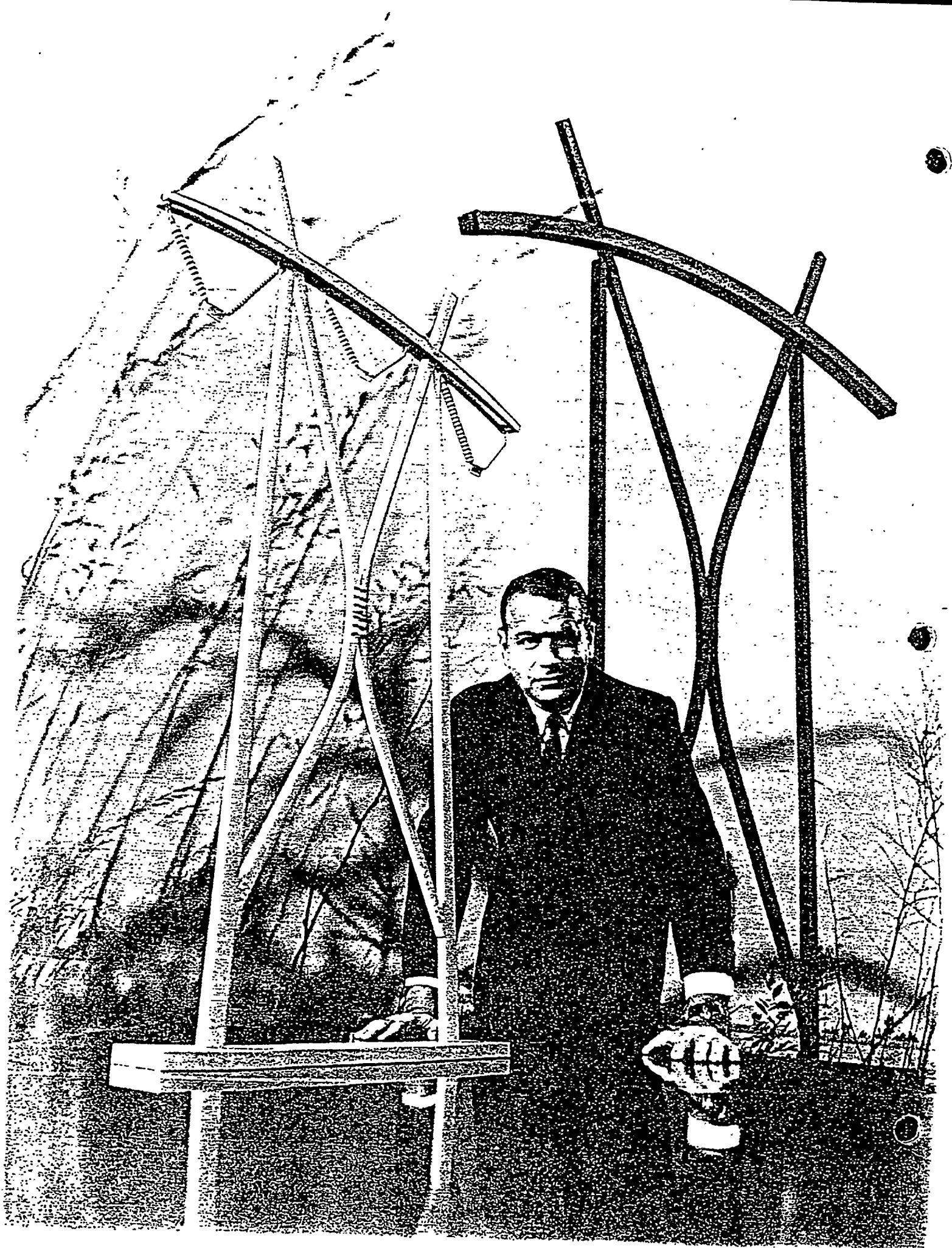
Koppers has the annual capacity to produce more than 200 million board feet of dimensional western white spruce lumber. White spruce is used predominantly in the U. S. in the construction of residential and mobile homes. Demand for this lumber is

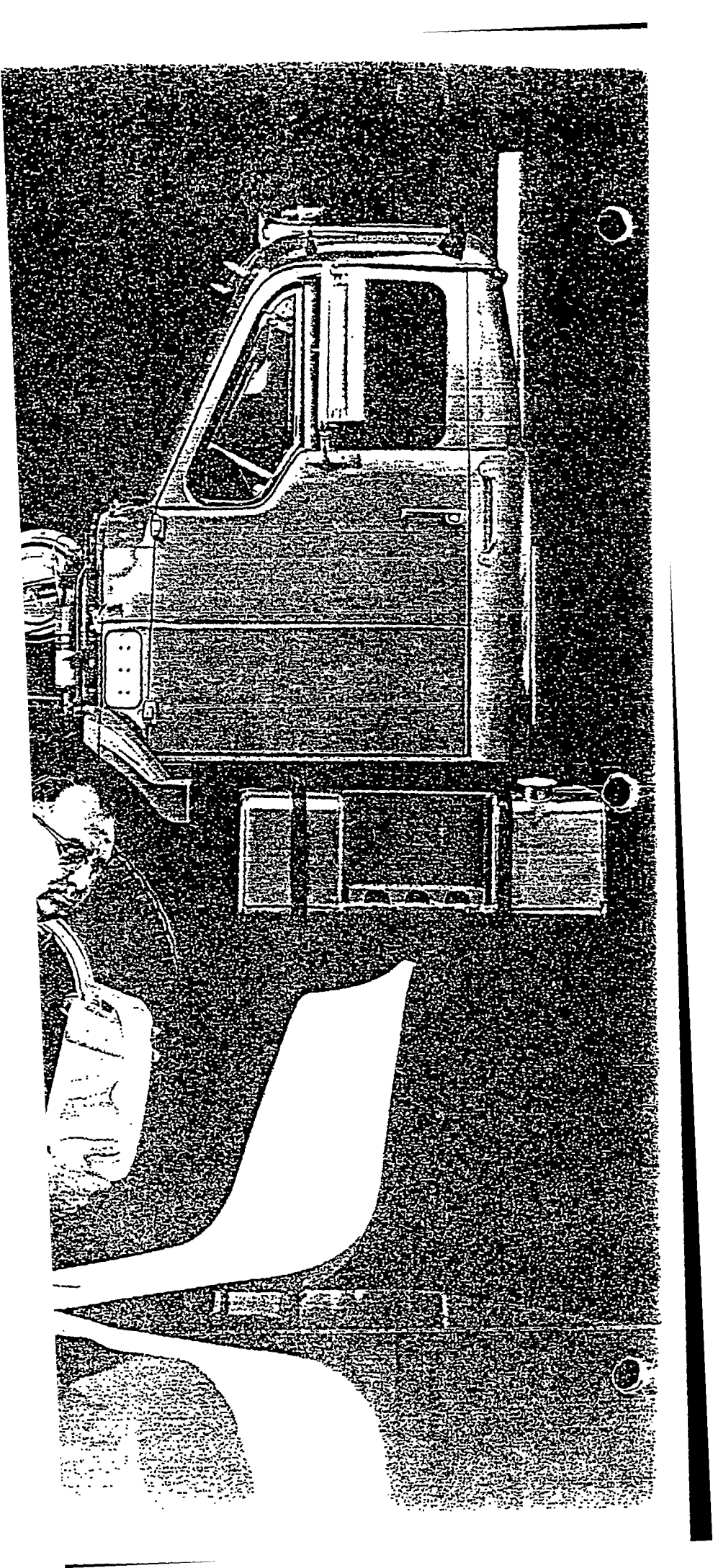
expected to be strong during the 1970's to fill requirements for mobile homes and private residential and multiple family dwellings.

Participation in the growing recreation field has been increased with the commercial introduction of Koppers modular floating dock system. This proprietary design combines CELLON treated decking and a flotation system of Sinclair-Koppers plastics to form a high-quality dock system for the commercial marina market. The engineered modular dock system provides permanence, versatility, attractive appearance, and low installation and maintenance costs.

Substantially increased demand for railroad crossties is expected during the 1970's. Since about 40 per cent of all crossties in the U. S. were installed 40 to 50 years ago, a large segment will have to be replaced over the next ten years. Programs to improve rights of way so as to permit carriers to increase their carloadings and their volume of traffic will also be an important factor.

During 1969, Koppers successfully built and tested the first Dreyfus design 345 kv transmission tower, created for high-voltage electric lines where pleasing appearance is a prime consideration.





about \$150 million, or one-third of our total manufacturing sales, came from products we did not produce ten years ago.

Management Strength

Koppers management team has expanded as the Company has grown. Koppers today is in the hands of young, knowledgeable and enthusiastic managers.

Each division manager heads a group of experienced personnel. Many of these men helped to plan and to carry out the capital expansion programs that have produced Koppers growth during the past five years.

Because of the opportunities created by growth, the Company is in a position to attract the capable personnel needed to contribute to its continuing progress.

In this Annual Report, you will find statements by the general manager of each of Koppers divisions describing the progress that has been achieved by his division in specific operations. These statements precede reports on product lines that will significantly contribute to the Company's continued growth.

Growth for the 1970's

As Koppers enters the 1970's, continuation of the Company's growth trend is expected for three main reasons:

- As our penetration increases in recently entered markets, Koppers sales will grow at a substantially higher rate than the markets generally.
- We will realize further benefits from new and expanded facilities completed early in our investment program as plant operations approach optimum levels. Since annual levels of capital investment have remained high, more recent expansions will begin to benefit earnings over the next several years.
- Annual levels of new capital investment are expected to increase in the 1970's as projects now in the planning stage are carried out.

Board of Directors

Two recent developments have reduced the membership of Koppers board of directors.

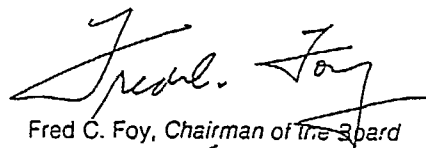
It is with deep regret that we report the death on January 25, 1970, of Robert H. McClintic, who had served as a director of the Company for over 30 years. Mr. McClintic was chairman of the board of Gordon Terminal Service Company of Pittsburgh and had been associated with Koppers since 1931. He held the positions of assistant to the president and member of the executive committee

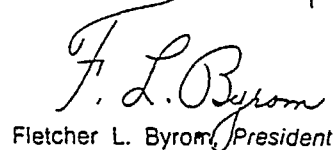
while with the Company and was named to the board in 1938. Mr. McClintic later resigned his responsibilities as a Koppers employee to devote more time to other business interests.

O. P. Thomas, chairman of the executive committee of Atlantic Richfield Company, has resigned from the board because of the increasing demands of other business responsibilities. Mr. Thomas served as a director since 1965.

Outlook for 1970

Koppers sales and earnings are expected again to show improvement. Koppers total backlog of unfilled orders at the end of 1969 was essentially the same as at the end of 1968. The manufacturing portion was at a record level and substantial improvement occurred in the construction backlog late in 1969.


Fred C. Foy, Chairman of the Board


Fletcher L. Byron, President

Frederic L. Byrom, left, has been elected chairman of the board of Koppers effective February 1, 1970. He has been president of the Company since 1960 and chief executive officer for the past two years.

Douglas Brymes, right, has been elected president and will continue to serve as Koppers' chief administrative officer, a position he has held since 1968. Mr. Brymes, 55, has been executive vice president for three years.

Mr. Byrom, 51, succeeds Fred C. Foy (seated) who is retiring after serving as chairman for the past 12 years. Mr. Foy, who reached Koppers' mandatory retirement age of 65 in January, 1970, will continue to serve as a director.



KOPPERS

1969 Annual Report

January 26, 1970

To Our Shareholders:

Koppers continued its growth in 1969.

Income before income taxes rose 27 per cent from 1968; earnings per share increased over 16 per cent to \$3.70. Total sales increased 19 per cent to \$533 million.

Growth was evident throughout the Company. Every division achieved increased earnings and sales. Results for 1969 are presented more fully in the operating and financial review on page 16.

Improved earnings and sales in recent years are the result of programs (outlined in previous annual reports) that were generated to strengthen, modernize and expand the Company.

In the 1966 report to shareholders we stated that new-facilities under construction as part of Koppers intensified capital investment program would have an increasing impact on performance and predicted that by 1969 Koppers would realize significant improvements in earnings.

We point this out now to emphasize how the basic character of the Company has changed during the past decade. Koppers has worked to achieve a leadership position in each of its major areas of operation. This has been accomplished in terms of cost . . . quality . . . market position . . . and technical services.

As the result of the increased operating strength achieved in the decade of the 1960's, Koppers earnings have more than tripled since 1959, going

from \$1.20 per share to \$3.70 per share in 1969. Sales over the same period have more than doubled, from \$250 million in 1959 to \$533 million.

This increased profitability has resulted in a significant improvement in the return on the total common equity and total capital invested in Koppers.

A Decade of Progress

To help shareholders understand the nature of our strength, it may be helpful to summarize the Company's progress over the past decade to set the tone for Koppers entrance into the 1970's.

At the start of the 1960's, the Company's manufacturing operations varied in size and in potential for profit and growth. A few product lines had good growth potential. Many, however, were commodities similar to products of competitors. Others were directed to relatively static markets. At that time, Koppers depended heavily on its engineering and construction business for a major portion of total annual earnings. A program was launched to strengthen and expand the Company's manufacturing businesses.

Our objectives were:

- to concentrate only in those lines of business where Koppers had or could achieve a leadership position;
- to direct a high percentage of our products into markets that offered potential for significant growth.

By 1965, all major product lines were on a sound and competitive basis. Each was believed to have good growth potential. Cyclical effects of the construction business on Koppers overall performance were substantially reduced.

At that point, Koppers intensified its capital investment activities. Substantial manufacturing capacity was added to permit the Company to take advantage of its leadership positions in rapidly growing markets. We invested more than \$180 million in the years 1965 through 1969. This average of \$36 million per year was twice the average annual rate in the first five years of the decade. In 1969, we invested \$40 million for new plant facilities and for expansion and modernization. Capital investment in 1970 is expected to continue at about the same level.

The ability of our operating units to adapt and innovate products to meet market growth opportunities was important to Koppers growth in the 1960's. In 1969, 82 per cent of Koppers manufacturing sales were in markets growing at a faster rate than the average growth expected for the national economy. In addition, in 1969

KOPPERS COMPANY, INC.

Pittsburgh, Pa. 15219 Area code 412 391-3300

Common Stock

Symbol: KOP

Exchange Listings: New York Stock Exchange

Midwest Stock Exchange Pacific Coast Stock Exchange

Transfer Agents

Mellon National Bank and Trust Company, Mellon Square,
Pittsburgh, Pa. 15230

Bankers Trust Company, 16 Wall Street, New York, N. Y. 10015

Harris Trust and Savings Bank, 111 W. Monroe Street,
Chicago, Ill. 60690

Bank of America National Trust and Savings Association,
One South Van Ness Avenue, San Francisco, California 94120

Stock Registrars

Pittsburgh National Bank, P. O. Box 746, Pittsburgh, Pa. 15230

Morgan Guaranty Trust Company, 23 Wall Street, New York, N. Y. 10015

Continental Illinois National Bank and Trust Company of Chicago,
231 South LaSalle Street, Chicago, Ill. 60690

Wells Fargo Bank, 464 California Street,
San Francisco, California 94120

Dividend Disbursing Agent

Mellon National Bank and Trust Company, Mellon Square,
Pittsburgh, Pa. 15230

1969 at a Glance

	<u>1969</u>	<u>1968*</u>
Income before extraordinary items	\$ 18,357,000	\$ 16,949,000
Extraordinary items	—	(1,066,000)
Net income	\$ 18,357,000	\$ 15,883,000
Per share of common stock:		
Earnings before extraordinary items....	\$3.70	\$3.40
Extraordinary items	—	(.22)
Net earnings	\$3.70	\$3.18
Dividends per share of common stock	\$1.60	\$1.50
Manufacturing sales	\$441,735,000	\$369,163,000
Total sales	\$533,312,000	\$448,696,000
Cash flow per share of common stock	\$7.66	\$6.96
Total taxes	\$ 25,841,000	\$ 17,139,000
Capital expenditures	\$ 39,913,000	\$ 31,662,000
Backlog at year-end	\$227,706,000	\$229,024,000
Number of employees	15,361	13,655

*Restated to conform to classifications and accounting changes adopted in 1969.

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	Manufacturing Sales to Consuming Industries
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Location for Annual Meeting:

The annual meeting of the shareholders of the Company will be held at 11 a.m. on Monday, March 30, 1970, in the Chatham Ballroom, on the second floor of the Chatham Center office building, Pittsburgh, Pennsylvania.

Our determination to direct Koppers products and services to growing end markets has led to some interesting and exciting areas of business—where you might not expect to find Koppers—as in the recreation field, education, and environmental control. The Company's involvement in these and other growth markets is described in *One-Eighth of Koppers*, a brochure recently sent to shareholders and available upon request.

