KAISER REFRACTORIES



HANDBOOK

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BLAST FURNACE GUN CASTABLE

FOR LINING REPAIRS THAT EXTEND BLAST FURNACE LIFE

Kaiser Refractories unique Blast Furnace Gun Castable was developed to gain "a few months' grace" before shut-down of the blast furnace for complete relining. In practice it has materially extended campaign life and increased daily and monthly tonnages. Many steel producers now repair blast furnace stacks by gunning, to reduce overall operating costs.

RESISTS CO DISINTEGRATION. Blast Furnace Gun Castable is composed of selected fireclay materials with a very pure calcium-aluminate binder, very low in iron to resist CO disintegration. In addition, the tight monolithic structure provides excellent strength and resists abrasion.

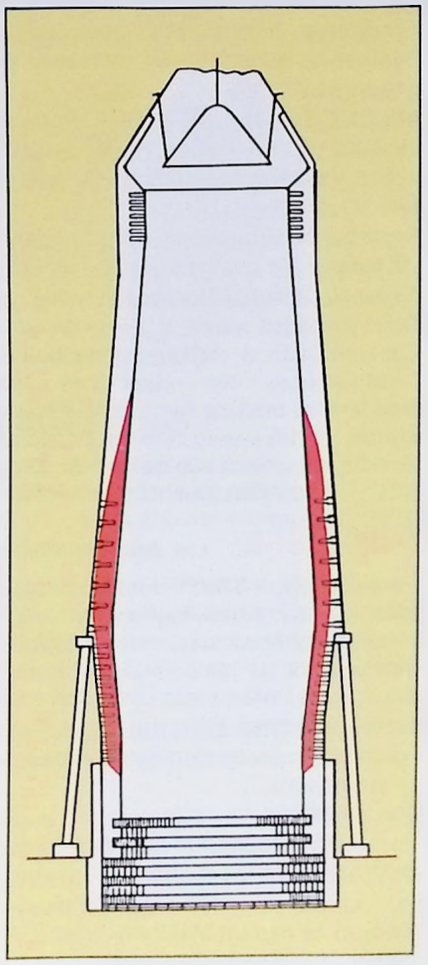
FOR GUN APPLICATION. Blast Furnace Gun Castable is especially suited for rapid gun application with minimum rebound. In addition to blast furnace stacks it is used for gunning repairs on transfer car linings and spouts, open-top iron ladles, hot metal mixer spouts, and many other applications requiring a strong, low-iron castable for service to 2800°F where the gunned placement method is preferred.

AN EXAMPLE OF A TYPICAL BLAST FURNACE LINING REPAIR: Diameter 28 feet; gunned repair from mantle upward 22 feet with thickness ranging from 18 to 24 inches. Also bosh area from top of tuyeres to mantle, tying into previously gunned inwall.

MATERIAL USED: 335 tons Blast Furnace Castable.

REBOUND: Approximately 20%.

PLACEMENT EQUIPMENT: Two dry-type nozzle guns.



FURNACAST

HIGH TEMPERATURE, LOW IRON, HIGH STRENGTH CASTABLE

Furnacast is a 2800°F castable with very good strengths throughout its temperature range. CO disintegration is not a factor with this very low iron material. Due to its grain sizing, this castable forms a very light structure with excellent abrasion and erosion resistance. Furnacast also has good resistance to chemical attack.

TYPICAL APPLICATIONS. Ingot mold hot tops • Soaking pit curbs and covers • Vertical lime kilns • Precast shapes • Grey iron ladles.

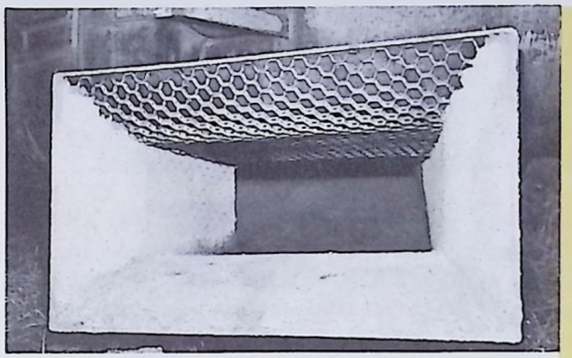
LO-ERODE

EROSION-RESISTANT CASTABLE FOR AREAS OF PUNISHING WEAR

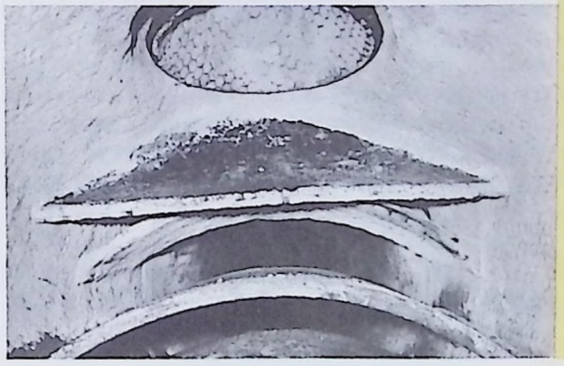
Lo-Erode is an economical, highly effective, abrasion and erosion resistant low-iron castable for service in temperatures up to 2400°F.

RESISTS WEAR. The strong, hard aggregate and special bonding agent of Lo-Erode combine to give a rugged, monolithic texture. In the temperature range for which it is intended it resists punishing wear of particle-laden gases. Lo-Erode has proven to be an exceptional veneer patching material over old linings. It is high in strength and has good volume stability. Lo-Erode is shipped dry in 100-pound moisture-proof bags and needs only to be mixed with water for casting or gunning use.

TYPICAL APPLICATIONS. Catalyst lines • Seal pots • Cyclones • Catalytic cracking units • Regenerator stacks • Refinery reactors • Wear areas of rotary kiln coolers • Dust collector flues • Blast furnace blow pipes • Sintering furnaces • Other ducts, flues and lines where abrasive conditions exist.



Refinery cyclone is lined with Lo-Erode to resist extreme erosive action of high velocity gases and particles. Hex steel supporting refractory material is welded to steel shell.



The outstanding erosion-resistance of Puro-Tab makes it ideal for applications such as a single-layer lining, in hex mesh, in the "sugar scoop" section of a catalytic cracking unit.

HI-STRENGTH L.I.

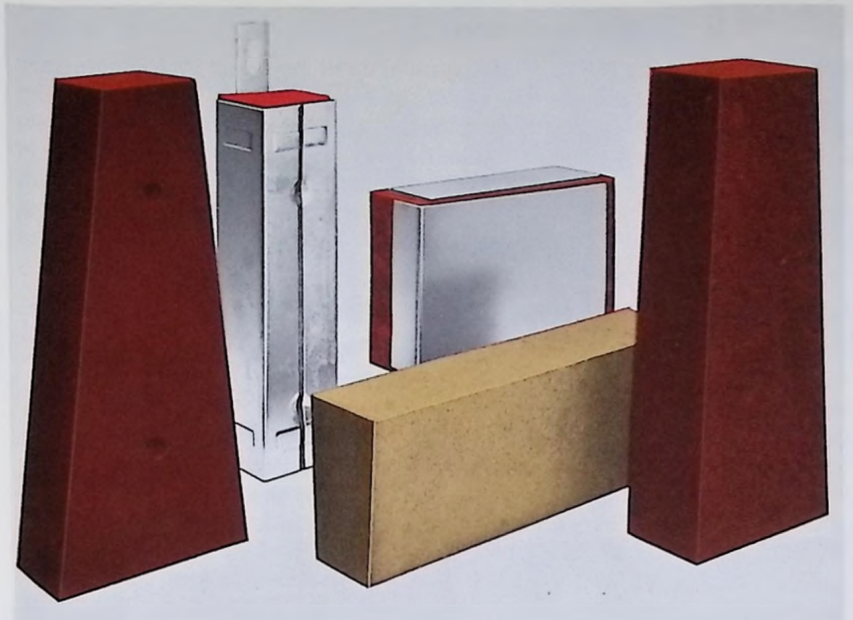
LOW-IRON, HIGH-STRENGTH CASTABLE FOR SERVICE TO 2600°F

Hi-Strength L.I. was developed to meet the demands for a low-iron castable in the 120 Lb./Cu. Ft. range. A low-iron content makes it ideal for reducing atmospheres. It has excellent strength throughout its temperature range and very good abrasion and erosion resistance.

Hi-Strength L.I. can be cast, troweled, extruded, or gunned.

TYPICAL APPLICATIONS. Oil refinery vessel linings — Cyclones, Lines, Reactors, Reformers, etc. • Tunnel kiln cars • Blast furnace patches, inwalls and tops • Petrochemical reactors, stacks, lines.

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DIRECT-BONDED BASIC BRICK

Direct Bonding, one of the most significant advancements in the production of basic brick in the past decade, was initiated by Kaiser Refractories, and a patent (U.S. Patent No. 2,571,101) was issued in 1951 covering the process of direct-bonding periclase grains.

Simply explained, direct-bonding (as opposed to conventional bonding) is the **coalescence, the growing together into one body,** of periclase-to-periclase and periclase-to-chrome grains within a brick structure. This unification forces a segregation of intermediary silicates and accomplishes a firm coalescence of the two principal constituents. This results, then, in (1) high hot-strength, (2) better load-bearing, (3) high density, (4) low porosity, (5) excellent resistance to spalling (damage by thermal cycling), and (6) improved resistance to chemical alteration.

Kaiser Refractories produces direct-bonded brick (under the trademark COELEX) at plants located at Moss Landing, California and Columbiana, Ohio and offers the widest selection of direct-bonded brick in the industry. Qualities range from 40% to 98% MgO, and are available plain or metal-encased.

COELEX 98 (PLAIN OR METAL-ENCASED)

Coelex 98 offer maximum resistance to chemical attack by basic slags and to metallic penetration. Being direct-bonded they are very low in porosity, which makes them even more volume-stable; they are exceptionally resistant to abrasion and to corrosion by destructive slags. Coelex 98 have excellent resistance to thermal spalling and relatively high resistance to creep; they



have the highest hot-load-bearing ability of any brick in the K/R basic product line. Coelex 98 brick are designed and recommended for specialized application in furnaces operating under extremely high temperatures where chemical compatibility is favorable, or where resistance to metallic oxides is vastly important—such as high wear areas in electric and open-hearth furnaces and various steel processing facilities. They are well adapted for certain vacuum degassing applications, and for use in high temperature alloy furnaces as well as in large induction furnaces.

COELEX 80 (PLAIN OR METAL-ENCASED)

The Coelex 80 brand is the highest periclase-chrome-bearing brick in the K/R Direct-Bonded group. They contain a relatively small amount of chrome ore, just sufficient to provide excellent resistance to thermal shock and good load-bearing ability at high temperatures.

Coelex 80 brick have unusually low porosity, good creep resistance, high hot strength, and possess excellent resistance to basic slags. They are recommended for specialized high temperature applications, calling for a high magnesia-chrome-bearing product.

THE FOLLOWING ARE TYPICAL APPLICATIONS FOR COELEX 80 DIRECT-BONDED BRICK:

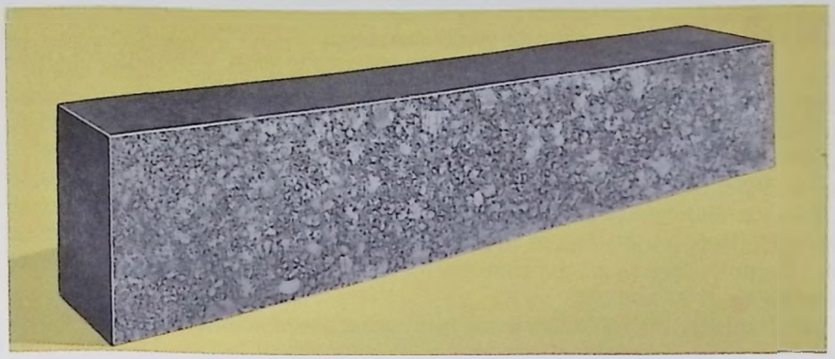
Type of Furnace	Where used
Degassing Units	Snorkels; Bottom; Lower sidewalls
Electric Arc Furnaces	Sidewalls and slagline
Lime Kilns (Vertical)	Linings
Open-hearth Furnaces	Slagline

COELEX 60 (PLAIN OR METAL-ENCASED)

Coelex 60, characterized as direct-bonded 60% MgO brick, are specially formulated from high-purity seawater periclase and chrome. High-firing imparts high hot-strength and improves their resistance to slag attack and thermal shock. Coelex 60 brick have good creep resistance, good resistance to spalling and compatibility with furnace working slags. They are recommended for general steel mill furnace applications that require exceptional resistance to mechanical stress, and where severe temperatures, heavy slag, and exposure to fume and molten metal are encountered. They are highly resistant to chemical attack and are particularly recommended for wear spots subject to erosion and/or corrosion. Coelex 60 are considered one of the leading open-hearth roof brick.

THE FOLLOWING ARE TYPICAL APPLICATIONS FOR COELEX 60 DIRECT-BONDED BRICK:

Type of Furnace	Where used
Electric Furnaces	Sidewalls
Open-hearth Furnaces	Roof; Front and back walls; Up-takes; Bulkheads
Rotary Kilns	Hot zones



PITCH-CONTAINING BASIC BRICK

The basic oxygen steelmaking process (BOSP) demands special qualities of basic brick. At present, nearly all classes of basic brick (dolomite, magnesite, and periclase) used in the working lining of BOSP furnaces are either tar-bonded or burned and tar-impregnated. The functions of the tar (pitch and/or other carbon-yielding materials) are several-fold: (1) to supply a low and high temperature bonding medium; (2) to help protect grains susceptible to hydration from degradation; (3) to inhibit penetration and reaction by slags and metals under operating conditions.

TAR-BONDED BRICK

The series of Kaiser Refractories Tar-Bonded basic brick is composed of T-Bond K, T-Bond M, and T-Bond DP, with the T-Bond K and T-Bond M available both tempered and untempered. The letter "T" following the product name denotes tempering—T-Bond KT and T-Bond MT.

T-BOND KT

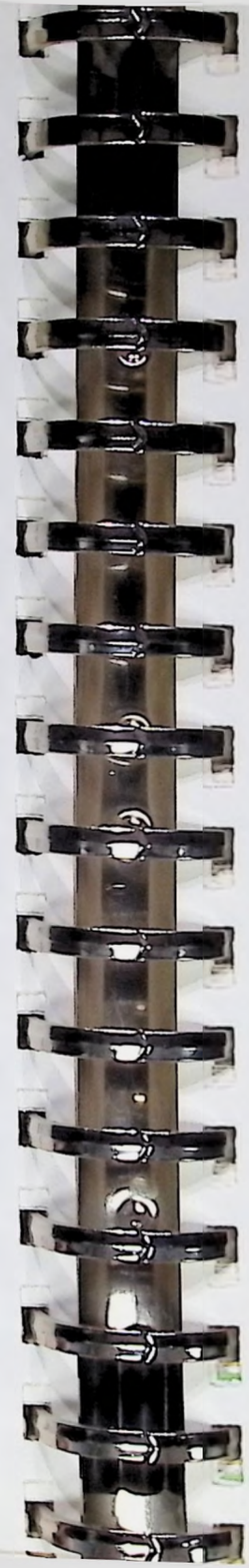
T-Bond KT brick are unique in the industry as a result of their high purity periclase composition. The 98%+ MgO grain, with its special high temperature secondary silicate phase, has the highest resistance to iron oxide attack of any basic refractory grain. They are volume stable, and possess high strength during burn-in. They are recommended for use in the high erosion areas of basic oxygen furnaces.

T-BOND MT

The T-Bond MT brand is a tar-bonded synthetic magnesite brick possessing unusually high strengths from room temperature to operating temperatures. They are volume stable on burn-in. The high-lime magnesite grain, with a minimum of iron oxide, contains controlled additions of certain silicates. T-Bond MT are designed for general usage in basic oxygen furnaces.

T-BOND DP

T-Bond DP brick are manufactured from a mixture of dolomite and periclase, tar-bonded to give outstanding service and shelf-life (resistance to deterioration of the dead-burned dolomite by hydration). Some metallurgical practices in basic oxygen furnace operations are such that the dolomite (CaO • MgO) offers maximum service on a cost-per-ton basis, whereas other practices favor higher MgO products. T-Bond DP brick perform most economically and effectively in basic oxygen steel furnaces where lower FeO slags are encountered, or in conjunction with higher MgO products in sectionalized linings.



TAR-IMPREGNATED (TI) BRICK

COELEX 95-TI (PITCH-IMPREGNATED)

Recent field evaluations have shown that tar-impregnated high-purity periclase refractories give outstanding service in basic oxygen furnaces, as well as in many other metallurgical furnaces.

The Coelex 95-TI brand of tar-impregnated brick is a 95% + MgO brick. After being fired the brick are impregnated with pitch to accomplish complete saturation of the brick pores. In service the pitch is converted to a non-wetting carbon residue. As a high-purity high hot-strength periclase brick it is extremely resistant to mechanical stress and to destruction by penetration of slags and metals. Coelex 95-TI brick are highly recommended for lining the most severe wear and stress areas of basic oxygen steelmaking furnaces.

C

K-98-TI

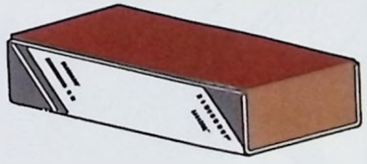
K-98-TI brick are produced from high-purity K-grain periclase. After being formed and fired they are scientifically tar-impregnated. The resulting product is highly resistant to basic slags, under reducing conditions. K-98-TI brick have proven performance advantages in the lower sidewalls and slag lines of electric furnaces.

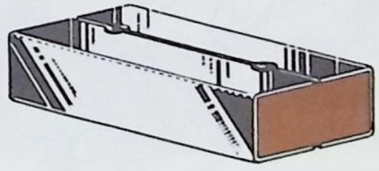
METAL-ENCASED BASIC BRICK

The metal encasement principle, as applied to basic brick, is not new; in fact, steel plating is so widely accepted that a large proportion of chemically-bonded, burned, and direct-bonded basic brick installed today are metal encased. It is commonly known that the service life of chemically-bonded basic brick is materially improved by external plating; during the furnace campaign the steel plate oxidizes and is partially absorbed, forming a firm bond between the brick and providing thermal expansion allowance at the hot face. Resistance to thermal spalling is greatly increased.

Metal encased brick give excellent service in many applications, such as open hearth roofs and walls, electric arc furnace sidewalls and copper reverberatory furnace roofs. The gauge of steel utilized and the method by which it is affixed to the brick will vary depending upon the brick composition and its application. Following are typical views of common shapes with standard 3-side and 4-side encasement:

STRAIGHTS





continued on page C • 14

Exterior plating under
Reissue Patent No. 25,615.

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M-BLOCK INSULATION

FOR TEMPERATURES UP TO 1900°F

M-Block, mineral wool block insulation, is made from chemically stable mineral fiber and other selected high temperature insulators. It combines physical stability and mechanical strength with high thermal efficiency. It is furnished in a wide range of convenient sizes to provide the industrial user with a single, easily worked insulation for every application from room temperatures to 1900°F.

EASY TO INSTALL

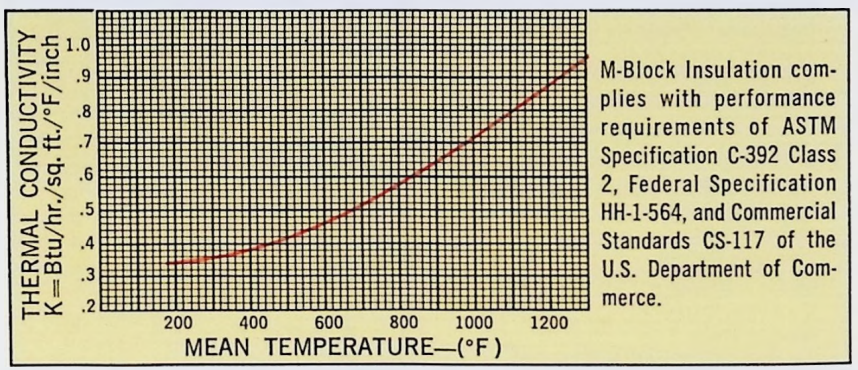
Light-weight, low-density M-Block is available in thicknesses up to 4 inches. Most installations will require only one layer, providing reduced installation cost and increased efficiency. Due to its high mechanical strength, M-Block requires a minimum of reinforcement. It is easily cut with knife or saw to form any shape, and it can be pressed over projections without cutting. The embossed surface of M-Block provides a strong grip for insulating cement finishes.

RESISTANT TO MOISTURE

In refractory back-up insulation M-Block is often used in conjunction with castables. The water repellent surface reduces excessive absorption of water needed for proper hydration of cements and castable refractories.

THERMAL CONDUCTIVITY

Pure mineral fibers combined with binder and other materials produce a product of low thermal conductivity and high refractoriness. M-Block Insulation possesses the necessary dead-air space, light weight and durability that make a truly good insulating material. Its density is 21 to 22 pounds per cubic foot. M-Block Insulation is an outstanding insulating material for heated equipment, as indicated by the conductivity chart below.



M-Block Insulation complies with performance requirements of ASTM Specification C-392 Class 2, Federal Specification HH-1-564, and Commercial Standards CS-117 of the U.S. Department of Commerce.

ECONOMICAL

K/R M-Block Insulation costs less per board foot than many insulators of inferior thermal value and temperature range. Material, construction and maintenance costs are less, as are fuel costs. In fact, K/R M-Block Insulation will pay for itself in a short period of time in fuel savings alone. M-Block's durability and high efficiency insure sustained savings throughout the long life of the material.



RECOMMENDED THICKNESSES

Operating temperatures, cost of fuel, operating time, ambient temperature and other factors determine the most economical thickness for block insulation. The following table, taken from U.S. Department of Commerce Commercial Standards CS-117, offers a practical guide for typical applications—and maximum efficiency.

OPERATING TEMPERATURES °F	THICKNESS OF M-BLOCK	OPERATING TEMPERATURES °F	THICKNESS OF M-BLOCK
Up to 200°F	1"	700 to 900	3½"
200 to 400	1½"	900 to 1100	4"
400 to 500	2"	1100 to 1300	4½"
500 to 600	2½"	1300 to 1500	5"
600 to 700	3"	1500 to 1600	5½"

PHYSICAL PROPERTIES

Temperature Range	Up to 1900°F
Thermal Conductivity	See Graph
Compressive Strength	18 psi
Breaking Strength (10" span)	30 lb. per bd. ft.
Shrinkage at 1900°F (lineal)	1.9%
Density	1.8 lb. per bd. ft.
Stability	Inert, durable
Resistance to Moisture	Water repellent
Resistance to Corrosion	Noncorrosive
Handling Characteristics	Cleaner, less dusting

TYPICAL APPLICATIONS

Blast Furnace Stoves
Refractory Back-up
Ceramic Kilns
Tanks
Towers
Ovens
Fan Housings
Boiler Walls
Melting Tanks
Annealing Pits
Hot Air Ducts
Heat Treating Furnaces
Chilling Pits
Turbines
Pit Covers
Breechings



Start tab, pull tape completely around carton, leaving base as holding tray.



Note ease with which M-Block can be removed from base for ready use.

Kaiser Refractories (excerpt) (1960s)
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VEE-BLOCK INSULATION VERMICULITE BLOCK INSULATION

Vee-Block is a vermiculite block insulation designed for applications up to 1800°F. It is lightweight, retains its strength at high temperatures, and shrinkage is negligible. Vee-Block can be easily sawed to fit odd shapes, areas and contours; it has an extremely low coefficient of heat transfer. It is furnished in 1" to 6" thicknesses, any size up to 12" x 36". Shipped in cartons.

VEE-BLOCK MIX VERMICULITE-BASE CASTABLE

Vee-Block Mix is an extremely lightweight, vermiculite-base castable insulation material with an installed weight of only 24 pounds per cubic foot. It provides approximately the same thermal conductivity as block insulation. Vee-Block Mix provides a highly efficient insulation up to 1600°F. It is ideal for single coat applications in such furnace locations as walls, roofs, soot hoppers, arches, and other similar areas. It is shipped in 50-pound bags, ready for mixing with water.

HARD-TOP FINISHING CEMENT

Hard-Top is a hydraulic-setting insulating and finishing cement designed for use on heated equipment of all types, including valves, fittings and pipes. It is commonly used as a one-coat finish over block and blanket insulation where temperatures do not exceed 1200°F. Sets up hard, without heat.

PLASTIC INSULATION APPLY TO HOT SURFACES—SAVES HEAT

Plastic Insulation is made with a base of specially prepared mineral fiber combined with other ingredients to provide a material of great adhesiveness, exceptional workability, resistance to severe usage and vibration, practically no shrinkage, and high insulating value in service to 1800°F. Applied by hand or troweled, it adheres readily to any clean, unpainted surface—without reinforcement—in thicknesses up to two inches. One 50-pound bag economically covers approximately 25 square feet of surface one-inch thick.

Plastic Insulation is recommended for insulating valves, large piping, flanges, steam gates, flues, ducts, boiler settings, tanks, heaters, furnaces—any hot surface where saving heat is worthwhile.



Plastic Insulation is excellent for patching or for new installations, over block or alone.



APPLICATION INFORMATION

APPLICATION OF REFRACTORIES

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