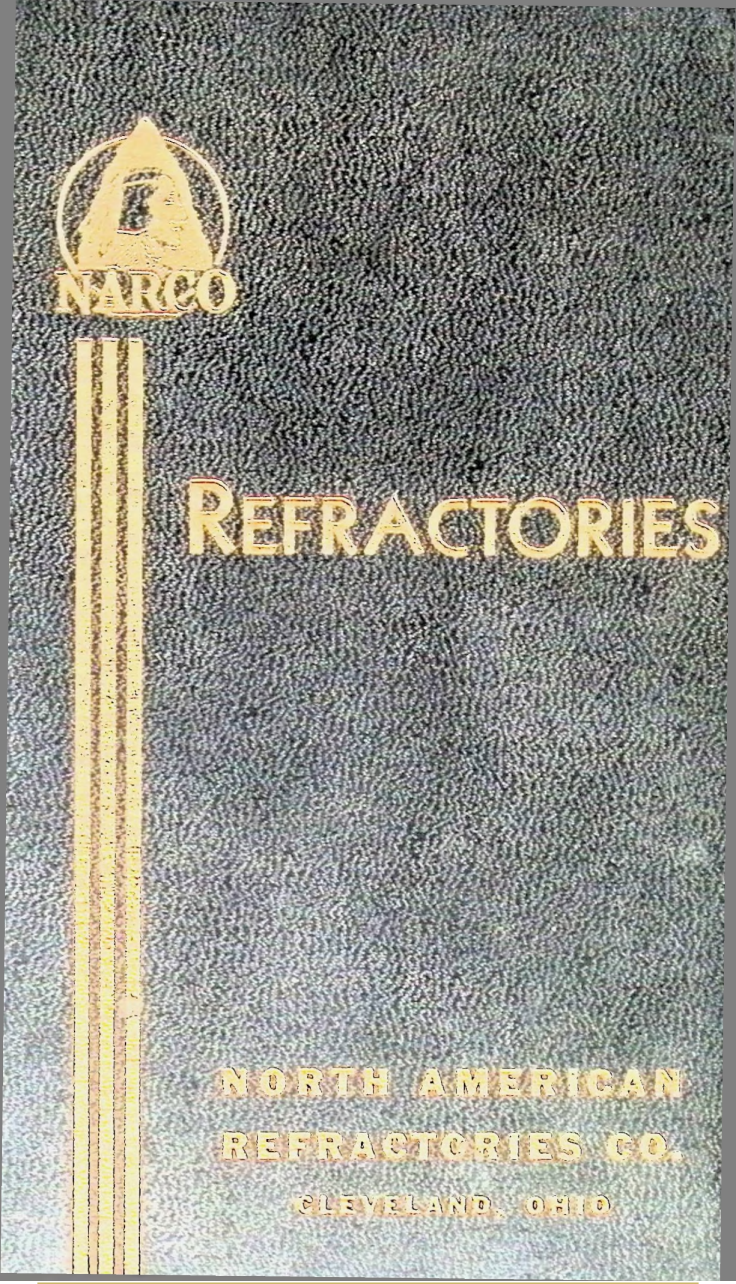

NARCO
REFRACTORIES
NORTH AMERICAN
REFRACTORIES CO.
CLEVELAND, OHIO



REFRACTORIES

- SUPER SILICA BRICK
- SILICA BRICK
- FIRECLAY BRICK
- INSULATING FIREBRICK
- SUPER DUTY BRICK
- HIGH ALUMINA BRICK
- HI TEMPERATURE MORTARS
- PLASTIC REFRACTORIES
- CASTABLE REFRACTORIES
- FIRECLAYS

NORTH AMERICAN REFRACTORIES CO.

1012 National City—E. 6th Bldg. • Cleveland 14, Ohio

New York, Philadelphia — Boston, Buffalo — Pittsburgh, Cincinnati — Chicago, Detroit

NORTH AMERICAN REFRACTORIES, LTD.

191 Victoria Avenue, South • Hamilton, Ontario, Canada



REFRACTORIES

"The Backbone of Industry"

FOREWORD

This pocket-sized booklet is intended to be a handbook for the user of refractories as well as a catalogue. The tables are designed to give complete coverage of all necessary information for the design and application of refractory materials. They have been thoroughly revised to give a maximum of data with emphasis on clearness and easy usage. This is a workaday booklet outlined for convenient reference in solving everyday problems.

The refractory products covered are highly diversified. They range from high alumina and super duty silica to low duty firebrick. For use in conjunction with these various types of brick, there is offered a complete series of high temperature mortars and ground fire clays. The proper one is available for any type of installation. Similarly, a wide variety of plastic refractories and castable refractories are described. The proper selection of these materials is quite important as service life is often determined as much by the mortar used or the refractory specialties employed as it is by the fire brick. The properties of these materials are tabulated for conciseness and clarity.

The products described are backed by ample, proven resources which insure uniformity and availability for years to come. In each major producing district all of the important manufacturing processes are employed to produce refractories that will successfully meet the exacting service conditions of present day furnaces. All mining and manufacturing procedures are under regular laboratory control to insure the consistent, high quality of NARCO products.

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BRANDS OF FIRECLAY BRICK

A.S.T.M. Class	Brand	Process
PENNSYLVANIA BRANDS		
Super Duty	NARCO 71	D.P.
High Duty	CRESCENT	D.P., S.P., H.M.
	–CRESCENT–	D.P.
	CRESCENT Bung	D.P.
	Q.R. GLASS	D.P.
	RELIANCE	D.P.
Intermediate Duty	KING	D.P.
	ELK STEEL	H.M.
Low Duty	KEYSTONE	D.P.
KENTUCKY BRANDS		
High Duty	ASHLAND CROWN	S.P.
	ASHLAND EMPIRE CROWN	H.M.
	ASHLAND HIGRADE	D.P.
Blast Furnace	ASHLAND BF	S.P.
	ASHLAND Bottom Blocks	D.P., S.P.
Intermediate Duty	ASHCO	D.P., S.P.
MISSOURI BRANDS		
Super Duty	NARCO 68	D.P., S.P.
High Duty	FARBER	D.P.
	–FARBER–	S.P.
	FARBER Bung	D.P.
	FARBER C	D.P.
	FARBER F	D.P.
Intermediate Duty	FFB	D.P.
OHIO BRANDS		
Intermediate Duty	DOVER	D.P.
Low Duty	BUCKEYE	D.P., S.P.
	WIRE CUTS	Extruded

D.P. = Dry Press H.M. = Hand Made S.P. = Steam Press

TYPES OF FIRECLAY BRICK

Fireclay brick are the industry's most important product because their wide range of properties fits them for use in a great variety of refractory applications. NARCO fireclay brick plants are located in Pennsylvania, Ohio, Kentucky and Missouri where a wide variety of high-grade flint, semi-flint and plastic bond clays are available in the highest quality. In each district NARCO produces a series of brands with various combinations of properties, so that there is always available a brand to meet successfully any service condition where fireclay brick are applicable.

The properties of fireclay brick are dependent primarily upon the types of clays used, the proportions of the various clays employed and the process of manufacture. The grain structure, moisture content during forming, as well as firing temperatures and procedures also influence the final product.

Brick produced by the dry press method are suitable for a wide variety of service applications. The brick are formed under high pressures by sturdy mechanical presses which gives an excellent balance in the properties of the end product. The brick have good spalling and abrasion resistance and at the same time have reasonable resistance to slag attack. They possess adequate strength and good load-bearing ability at high temperatures.

The steam press method of manufacture gives a strong, dense product with a resulting low porosity. This tight, dense structure is highly resistant to abrasion and to the penetration of slags as well as chemical attack or solution by fluxes.

The hand made process of manufacture has the special characteristic of high versatility. Small quantities can be made most economically by this process and tile of unusual size or complicated shape can be produced.

All products are fired under strict control to give desirable physical and mineral changes thereby producing strong, well-bonded brick. All NARCO brands of fireclay refractories possess uniformity of physical properties, workmanship and size of the finished product.

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SUPER DUTY FIRECLAY BRICK

Increased severity of service conditions in many modern furnaces has made it more economical to use super duty refractories rather than even the best high duty brick. With their greater refractoriness, outstanding spalling resistance, high strength, constancy of volume at high temperatures and ability to withstand many types of corrosive slags, super duty brick offer the furnace builder a material for use under extreme conditions.



Through extensive research, NARCO has developed super duty brands with many desirable properties to resist a combination of destructive forces. In some furnaces super duty brick are used to line only the hot spots while in others the entire hot zone is lined with super duty refractories. The decision is based on, (a) cost per unit of product treated, (b) seriousness of possible failure from use of lower quality brick, (c) cost of interruption in operation, (d) reduction in operating costs because of better process control and (e) insurance against unexpected interruptions.

NARCO 68 and 71 are supplied in standard dry press sizes which method of manufacture insures uniform quality and workmanship. Hand made shapes and tile are available of equally refractory material thus making possible complete super duty installations. NARCO super duty brick are made of a blend of several of the purest and most carefully selected fireclays to insure a super product. In the process of manufacture, the clays are properly proportioned, ground to a definite grain sizing, formed, dried and fired by the most advanced, controlled methods.

NARCO 68 is a Missouri product of medium grain structure. The high spalling resistance and slag resistance, together with high strength, makes NARCO 68 suitable for a wide variety of service conditions.

SUPER DUTY FIRECLAY BRICK

This brand is especially valuable where there is a combination of high temperatures, active slag attack and spalling action. Such conditions occur in oil-fired or coal-fired boilers operating at high ratings, glass tank port necks and uptakes, upper checker chamber walls and upper courses of checker brick, heating furnace roofs, enameling furnaces, and malleable iron air furnace walls and bottoms.

NARCO 68 products are well known wherever super duty brick are used and have established many outstanding service records under extremely severe operating conditions. This wide spread use testifies to the excellent physical and chemical properties of this product which results in increased service life.

NARCO 71 is a Pennsylvania super duty product quite similar to NARCO 68 in grain structure and also in its fields of greater usefulness. The excellent service records for NARCO 71 under adverse conditions were possible because of the high quality of this product. These records were compiled through many years of continued use by satisfied customers.

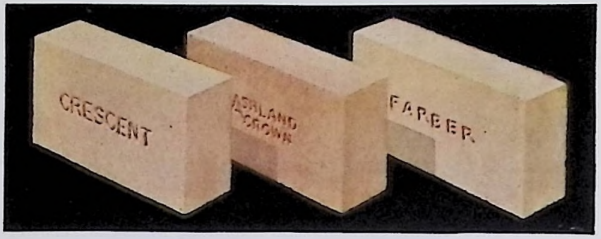
NARCO 71 possesses a remarkable freedom from shrinkage at high operating temperatures which enables tight masonry construction to be maintained throughout the life of the furnace. This brand has found wide application throughout the east since its early development for lining pulverized coal fired boilers, and especially in oil fired furnaces, many of which have been rebuilt from designs intended for coal firing. In this type of service NARCO 71 has not only proved to be decidedly economical, but has also given excellent, uniform operating conditions. Other applications correspond in general to those where the prevailing conditions are too severe for high duty fireclay brick.

In most instances where super duty brick are used, the selection of a proper mortar plays an important part in the construction of the furnace. NARCO has developed several types of mortars as well as super duty fireclay mixtures to meet the demands of the different conditions that may be encountered.



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HIGH DUTY FIRECLAY BRICK



NARCO produces brick of high duty quality in all the major producing districts thus enabling the furnace operator to obtain just the brick for his needs, in a minimum amount of time and at a minimum cost to him. This is possible through the scientific combining of numerous types of clay and variations in the processing methods whereby a series of brands is produced in each district possessing a range of physical properties to combat various combinations of destructive forces present in installations.

Fireclay brick are required to have properties such as high refractoriness, high density, constancy of volume at high temperatures and resistance to thermal shock, slag penetration, erosion, corrosion and abrasion. In one instance the spalling resistance may be of prime importance in one part of a furnace while in another part of the same furnace slag penetration may be dominant. Proper selection of the various types of high duty refractories can materially lengthen the service life of such an installation. It is not unusual to use a high duty brick to withstand certain destructive forces present even when operating temperatures indicate the use of intermediate or low duty brick. Each of our brands possesses to the highest degree the particular properties desired. This high quality was developed by long years of close cooperation with the users of fire brick and the adjusting of the brick properties to suit exactly the service conditions to be encountered.

INTERMEDIATE AND LOW DUTY FIRECLAY BRICK

In general, when refractory structures are subjected to relatively moderate or low temperatures, brick of the intermediate or low duty class give excellent service. They are strong, tough, dense and are especially resistant to abrasion and slag action at moderate temperatures. Thus they find use in cooler sections of boilers, upper parts of cupolas, cooler sections of both vertical and rotary lime kilns and portland cement kilns, heating and annealing furnaces and many similar furnaces or portions of furnaces operated at moderate temperatures.



Of course, both intermediate and low duty brick are used extensively as back-up materials for high and super duty fire brick in a wide variety of furnaces. The toughness and abrasion resistance of these brick enable them to successfully withstand all types of mechanical abuse from causes outside the furnace and thereby protect the weaker but more refractory inner walls.



Low duty and many intermediate duty fire brick are resistant to damage by continued exposure to moisture and freezing conditions. Because of these characteristics they are used widely for underground flues and foundations which are exposed to ground water, and for the outside of furnaces, kilns and chimneys exposed to the weather.

In many industrial furnaces, operating temperatures often call for the use of low or intermediate duty brick but high or even super duty brick must be used to combat the other destructive forces present which shorten the life of the refractories.

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HIGH ALUMINA BRICK

Increased temperatures and other severe operating conditions in many modern furnaces have made it necessary to develop a material of higher refractoriness than super duty brick. Refractories of the high alumina class can meet these more rigid requirements as they are progressively more refractory than fireclay brick in proportion to their alumina content. In addition to temperature resistance, high-alumina refractories have excellent load bearing characteristics and an unusual resistance at alkaline slags. They also retain good spalling resistance at higher temperatures than do high duty or super duty refractories. These outstanding properties enable high alumina brick to withstand the conditions present in the more vulnerable parts of furnaces. NARCO supplies four standard grades of high alumina brick with 50%, 60%, 70% and 80% alumina content. Each one possesses balanced properties which they retain under increasingly severe service conditions.



NARCAL 50, with an alumina content of 50%, has a P.C.E. value of 34-35 which is more refractory than super duty brick. Other important properties are high resistance to spalling and slag attack, high mechanical strength and excellent volume stability at operating temperatures. NARCAL 50 is used extensively in lime kilns of both the vertical and rotary types and in rotary cement kilns. They are also used in boiler furnaces, heating furnaces and forge furnaces where brick are exposed to rapid temperature fluctuations and as top checker brick in glass tank regenerators where alkali attack is severe because of the high temperatures encountered.

NARCAL 60 brick carry these valuable properties to a higher temperature level. They have high volume stability in the presence of lime and alkali fluxes.

These properties dictate use of NARCAL 60 brick in various types of oil-fired furnaces, lime kilns, cement kilns, and at the slag line of metallurgical furnaces, as well as in port walls, uptakes and upper checker courses of glass tanks. Many burner blocks for high temperature furnaces are supplied in NARCAL 60 quality.

NARCAL 70 is furnished with still more refractory qualities to meet extremely severe conditions. Containing 70% alumina, this brick finds its widest application in the hot zones of rotary kilns producing lime, cement and dolomite. The texture is such that there is a relatively low penetration by molten slags and softened clinker, yet it takes on and holds a satisfactory coating in cement kilns.

To complete the line of high-alumina brick, NARCAL 80 is produced to meet the most extreme conditions that can be met by diaspore-base materials. It has extreme refractoriness and resistance to shrinkage and to fluxing action.

NARCAL X brick are manufactured by a special process using a considerable amount of fused alumina as their base material. This combination yields excellent resistance to abrasion with high refractoriness, high strength and excellent volume stability. These brick are well suited for numerous applications such as hearths of various types of heating furnaces, forge furnace hearths, slag lines and areas of mechanical abuse in soaking pits, and the various parts of glass tanks where the attack from volatile alkalies is severe.



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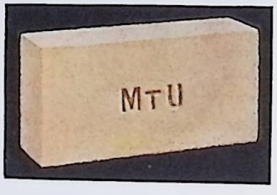
SILICA BRICK

The properties which make silica refractories so desirable are excellent load bearing ability, freedom from shrinkage at high temperatures, high mechanical strength, high refractoriness and rigidity almost up to the melting point.



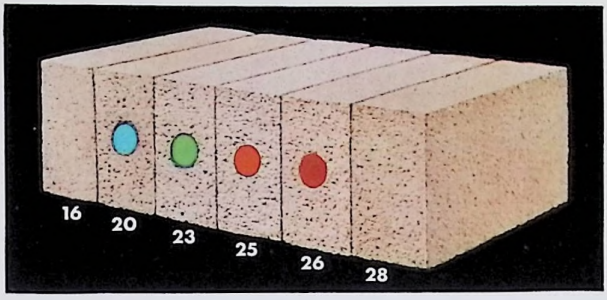
NARSIL is a super duty silica brick developed to meet the demand for a silica refractory that would permit higher furnace temperatures, and longer service life. NARSIL is of maximum purity and runs from 60° to 100° F. higher in refractoriness under load at elevated temperatures than regular silica brick. NARSIL brick are used largely in roofs of open hearth furnaces where there is an overall reduction both in the number of brick per net ton of steel and a reduction in refractories cost.

MT U silica brick are well known wherever silica brick are used due to their excellent service records. They are made from carefully selected raw materials and manufactured under strict control to insure the highest quality silica brick. The firing is carried out at extra high temperatures which are held several days to secure thorough conversion. The extra heat treatment is costly but it insures volume stability under operating conditions.



Some typical applications are open hearth furnace walls and roofs, electric arc steel furnaces and by-product coke ovens. Silica is also used in glass tank superstructure walls and caps, copper reverberatory and refining furnaces, and gas retorts. NARCO's silica Ticknor checkers are giving unusually good service in glass melting furnaces.

INSULATING FIRE BRICK



NARCO, acting as distributors for a leading manufacturer, offers six types of insulating fire brick for furnace construction. This complete line is designed for temperatures from 1600° F. to 2800° F. The selection of any one type depends mainly upon the maximum temperature to be encountered in service.

All types can be used directly exposed in equipment fired with gas, oil, electricity, or powdered fuel. However, insulating fire brick should not be used where they are exposed to molten metal and slags or severe mechanical abrasion. When these conditions prevail, insulating fire brick should be used as back-up insulation.

Insulating fire brick improve furnace operation by:

1. Reducing fuel costs
2. Speeding production
3. Insuring more accurate temperature control
4. Simplifying furnace design
5. Reducing construction costs
6. Quieting furnace noises

The brands A-16, A-20 and A-25 are used where maximum service temperatures reach 1600° F., 2000° F., and 2500° F. respectively. Known as light duty brands, they are most effective where lightness of weight and high insulating value are of prime importance.

The three brands A-23, A-26 and A-28 are used where maximum operating temperatures are 2300° F., 2600° F. and 2800° F. These heavy duty brands are capable of withstanding heavy loads and are particularly suited for any type of exposed face service where slagging and abrasion are not paramount.

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HIGH TEMPERATURE BONDING MORTARS

BRAND	PRINCIPAL USES	General Characteristics		Temperatures of Use		Containers
		Type of Set	Form As Shipped	Minimum	Maximum	
NARCOSET	With all types of clay fire brick (including super duty and insulating) particularly on walls cooled on one side.	Air Set	Wet	Room	3000°F.	50-, 100- and 200-lb. drums
NARCO No. 101	With all types of clay fire brick, particularly on walls cooled on one side.	Air Set	Dry	Room	3000°F.	100-lb. bags
NARCOBOND-S	With high duty and low duty clay fire brick and silica brick, where fast set is desired.	Air Set	Dry	Room	2600°F.	100-lb. bags
NARCO No. 99	With high duty, super duty and high alumina brick, particularly for division walls or in contact with highly alkaline slags.	Heat Set	Dry	2200°F.	3100°F.	100-lb. bags
NARCAL HIGH ALUMINA MORTAR	With 50, 60 and 70 per cent alumina brick.	Heat Set	Dry	2200°F.	3200°F.	100-lb. bags
NARCO-SIL	With all types of silica brick and clay fire brick where acidic slags, molten metals or gases attack the lining.	Heat set	Dry	2200°F.	3100°F.	100-lb. bags
NARCOBOND-L	Flues, foundations of furnaces and chimneys, where water may be encountered.	Hydraulic Set	Dry	Room	2400°F.	100-lb. bags
FIRECLAY MIXTURES AND FIRE CLAYS	With all types of clay fire brick.	Heat set	Dry	1400°F.	3100°F.	Bulk or 100-lb. bags

NARCOSET

NARCO

NARCOSET is an air-setting high temperature bonding mortar which is shipped in wet form. It bonds brickwork securely from normal room temperature to 3000° F. and is recommended for laying fireclay, super-duty fireclay, high alumina and insulating fire brick. NARCOSET is composed of the highest grade clays and calcines which enables it to withstand high temperatures without shrinking, cracking, softening or overfiring. Comparatively thick joints may be used without difficulty because of these properties.

NARCOSET is ready mixed and is supplied in a uniform consistency that is perfect for the average troweled joint. If dipped joints are desired, it may be thinned with water to the proper consistency. Its ability to retain moisture, even in contact with very porous materials such as insulating fire brick, is an invaluable aid to proper bricklaying.

NARCOSET is designed to meet severe service conditions, combat spalling, hold a wall in place under extreme temperature conditions, keep joints tight, hold heat in and cold air out. Every property that has a bearing on furnace life has been developed to an extremely high degree in harmony with all others.

NARCOSET is manufactured under the most modern methods known. All ingredients are proportioned by modern devices and milled in equipment designed especially for this particular manufacturing operation. These procedures coupled with rigid control testing insure that every shipment arrives on the job, in excellent condition and ready for use.

NARCOSET, the finest of air-setting bonding mortars, is shipped in all-metal, air-tight drums in 50-, 100- and 200-pound sizes.

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NARCO NO. 101

NARCO No. 101 is a dry, air-setting high temperature bonding mortar which, when mixed with water, is similar to NARCOSET except for a slightly modified dry strength. It is manufactured from similar high grade materials and, therefore, is similar in refractoriness, workability, freedom from shrinkage and resistance to slagging. It is used widely for laying fire brick wherever a dry mortar is preferred. NARCO No. 101 is shipped dry but comes as close to possessing the desired properties of a wet air-setting mortar as it is possible to secure.



NARCO No. 101 is shipped in 100-lb. burlap bags with waterproof paper linings to insure arrival on the job in excellent condition. To use, it is only necessary to mix the dry mortar thoroughly in a tight mortar box, and add sufficient clean water for the desired consistency.

NARCO No. 101 is easily applied and begins to set very soon after it is applied, forming a strong bond between the brick. This bond is maintained at industrial furnace temperatures.

NARCOBOND S

NARCOBOND S is a dry, air-setting mortar with a silica base, suitable for use with silica or fireclay brick. It possesses air-setting properties similar to NARCO No. 101 except that the air set is secured somewhat faster and the strength developed slightly greater. It has high resistance to abrasion and to some fluxes and so finds exceptional use under certain special conditions.

NARCOBOND S is shipped in 100-lb. burlap bags with waterproof paper linings.

NARCO NO. 99

NARCO No. 99 is a dry, heat-setting mortar of the highest quality with the maximum of refractoriness. A blend of selected raw and calcined clays plus correct grain sizing gives the mortar a desirable balance of properties.



NARCO No. 99 possesses negligible shrinkage, has excellent workability and great resistance to solution and attack by slags. It develops a satisfactory bond above 2200° F. and finds its greatest use between that temperature and 3100° F. which is the practical limit of most fuel-fired industrial furnaces.

It finds special application in piers, division walls of boilers and furnaces, baffles, division arches and target walls where soaking heats are encountered and extreme refractoriness is demanded. It is also used widely in furnaces where alkali attack is severe.

NARCO No. 99 is shipped in 100-pound, waterproof, paper-lined, burlap bags to insure safe arrival on the job. Since it contains no air-setting ingredients, it may be stored indefinitely without change. To use, it is necessary only to mix it with clean water and permit a short time for slaking of the plastic clay.

NARCOBOND L

NARCOBOND L is a hydraulic-setting mortar for use up to 2400° F., and is well suited for use in flues, stacks, foundations and similar parts of furnace structures, especially where water may be present during emergency conditions.

NARCOBOND L is shipped in burlap, paper-lined bags, ready for use after mixing with water. In order to develop the full strength of the mortar joint the brick should be soaked in water for a short time before use.

NARCOBOND L should be stored in a dry location and kept free from moisture and high storage temperatures.

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NARCO-SIL

NARCO-SIL is a super silica mortar used in conjunction with regular MT U silica brick or NARSIL super duty silica brick wherever furnace conditions are very severe. It has unusual balanced properties such as maximum refractoriness, excellent workability, high resistance to slag erosion, negligible shrinkage, good bonding characteristics and high load-bearing ability. It contains no fire clay or siliceous clay whatever, but makes use of other special ingredients to give it outstanding plasticity and bonding power.



NARCO-SIL possesses excellent workability shown by a very satisfactory water retention period and at the same time excellent body and freedom from stickiness. These properties plus good bonding characteristics and resistance to erosion make NARCO-SIL well suited for service in open-hearth furnaces operating at the highest rates. These same properties, plus a chemical composition practically identical to that of the best silica brick, give longer life to caps and upper structure of glass tanks.

NARCO-SIL is shipped in 100-lb. burlap, paper-lined bags. To use, it is only necessary to mix with clean water to the desired consistency.

MT U SILICA CEMENT

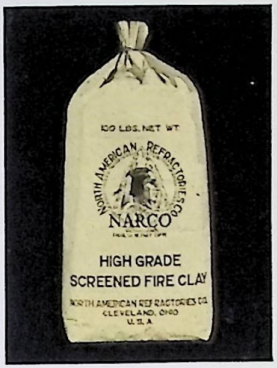
MT U SILICA CEMENT is produced in two grades, coke oven and open hearth, which are standard mortars for laying silica brick. MT U Coke Oven Cement is also used in glass tanks as well as in coke ovens. Both grades possess high refractoriness and good working properties.

These products can be troweled easily, and are also used satisfactorily for dipped joints. They develop a strong ceramic bond when heated to furnace operating temperatures.

They are supplied in bulk or multi-wall paper bags of 100-lb. capacity.

NARCO FIRECLAY MIXTURES
FIRECLAYS AND CALCINES

FIRECLAY MIXTURES: When service conditions in furnaces are not severe, fireclay mixtures offer the most economical mortars with a balance in properties to give good furnace construction. They are highly refractory, reasonably low in shrinkage, possess good bonding characteristics at high temperatures and have good workability.



These mixtures are available in multi-wall paper bags although, if desired, mixtures can be shipped in bulk.

NARCAL HIGH ALUMINA MORTAR MIX is designed for use with 50%, 60%, and 70% alumina-diaspore fireclay brick. It is the lowest priced material recommended for use with high alumina refractories.

NARCO SUPER FIRECLAY MIXTURES are prepared for use with super duty fireclay brick as the most reasonably priced mortar that can be recommended for this type of brick.

There are special PLASTIC CLAY-FLINT CLAY MIXTURES for use with high duty fire brick to avoid the shrinkages encountered with straight plastic fire clay and yet have a mortar of excellent plasticity and body.

RAW FIRE CLAYS: NARCO offers a wide variety of raw, ground fire clays which may be used for mortar. The diversity of clays available permits the selection of those with the desired properties of refractoriness, dry and fired strength, and bonding characteristics.

CALCINED CLAYS: Various calcined fire clays are available for furnace work and for preparing ceramic bodies. These may consist of ground and screened high duty fire brick or of calcined virgin flint clay of high quality. They are shipped in heavy multi-wall paper bags or, if desired, may be shipped in bulk where extreme economy is necessary.

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PLASTIC AND CASTABLE REFRACTORIES

BRAND	PRINCIPAL USES	General Characteristics			Temperature of Use		Containers
		Type	Condition As Shipped	Pounds per cu. ft	Minimum	Maximum	
NARCO SUPER 505 PLASTIC	Patching and new monolithic construction where service is unusually severe.	Plastic	Wet	145	2000°F.	3100°F.	100-lb. water-tight cartons
NARCO 505 PLASTIC	Patching and new monolithic construction heated over 2000°F. on hot face.	Plastic	Wet	135	2000°F.	3000°F.	100-lb. water-tight cartons
NARCOLINE	Patching and new monolithic linings where slag resistance is imperative.	Plastic	Wet	145	2000°F.	3100°F.	100-lb. water-tight cartons
NARCO HEARTH	Patching and new monolithic construction in thick sections heated up to 2700°F. on hot face.	Castable	Dry	120	Room	2700°F.	100-lb. bags
NARCO BAFFLEMIX	Patching and new monolithic construction in thin sections heated up to 2700°F. on hot face.	Castable	Dry	116	Room	2700°F.	100-lb. bags
NARCOCRETE	Patching and new monolithic construction where light weight and insulating value are important.	Castable	Dry	70	Room	2450°F.	50-lb. bags
NARCOLITE	Patching and new monolithic construction where light weight and high insulating values are essential.	Castable	Dry	50	Room	2000°F.	50-lb. bags

NARCO PLASTIC REFRACTORIES

NARCO plastic refractories are available in two grades: NARCO 505 for moderate and high duty service, and NARCO SUPER 505 for more severe operating conditions. Both grades are ready-to-use refractory materials in plastic form suitable for repairing furnace walls and for building monolithic linings in boiler settings, heating and annealing furnaces, forge furnaces, ladles and forming burner blocks or other special shapes. Both NARCO 505 and NARCO SUPER 505 are composed of the best grades of raw and calcined clays obtainable and are compounded to give maximum service and ease of installation.

NARCO 505 is intended for use in those places where high duty fire brick would ordinarily be adequate. The plastic form of this material makes it adaptable for economical patching and lining construction where it is not practical or convenient to use standard fire brick.

NARCO SUPER 505 can be used under the most severe furnace conditions. It has a refractoriness and composition similar to that of super duty fire brick and thus is designed for use in applications beyond the limits of NARCO 505 PLASTIC. It serves the purpose of patching and repairing installations where appreciably higher refractoriness is necessary.

These products are shipped in easy-to-handle, 100-lb. cartons and sealed in newly-developed, moisture-proof plastic envelopes to retain the special workability incorporated at the plant. Before packing, the plastic refractory is cut in convenient slabs two inches thick.

Estimate 135 pounds of NARCO 505 or 145 pounds of NARCO SUPER 505 PLASTIC to form a cubic foot.

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NARCOLINE

Slag resistant plastic refractory

NARCOLINE is a slag-resistant plastic refractory which is at its best when in contact with molten metal or in applications where reducing conditions exist. NARCOLINE has proven exceptional when used in foundry ladles, spouts and blast furnace runners or wherever high resistance to solution from many types of slags is necessary.



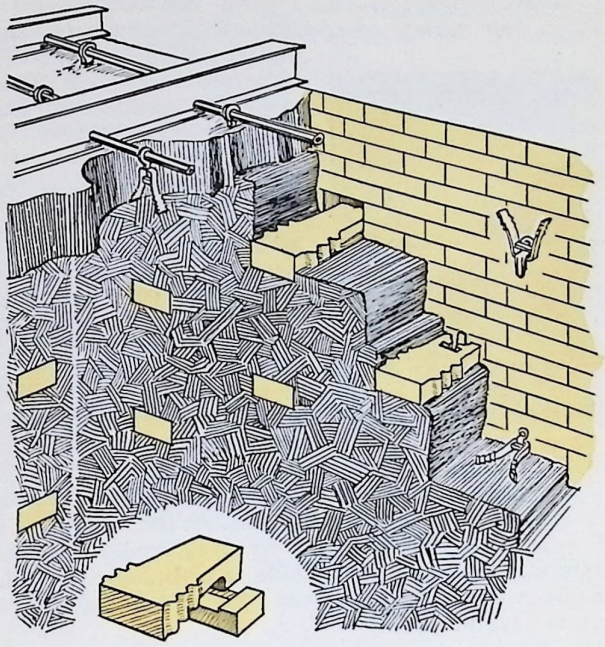
NARCOLINE is composed of super duty materials and possesses balanced properties which insure excellent service life. Only the very best raw materials are selected for this product and are combined in such a manner as to insure ease of installation and close packing to produce maximum density. This product is manufactured under strict plant control and a workability range can be provided from very stiff for air hammer installation to very soft for hand placing.

Although NARCOLINE gives its best results in a reducing atmosphere, when it is exposed to strongly oxidizing conditions the properties of this slag-resistant plastic are those of super duty plastic with all of the high refractoriness and excellent resistance to slag attack and spalling of the best of that class of product.

NARCOLINE is shipped in easy-to-handle 100-lb. cartons. The plastic is cut into 2-inch slices which facilitates installation. NARCOLINE is sealed in newly-developed, moisture-proof plastic envelopes which retain the special workability incorporated at the plant.

For estimating purposes, allow 145 pounds of NARCOLINE for each cubic foot of lining.

ANCHORS FOR INSTALLATION OF PLASTIC AND CASTABLE REFRACTORIES



Shown in the above illustration are various types of anchors and how they are used in a typical wall and flat arch.

The refractory anchors shown are designed for high temperatures and severe service conditions. The anchor tile may be installed using either the refractory box mounted in the wall or metal clips. Both methods allow flexibility of movement in service and also allow the anchor tile to be readily replaced.

The metal anchors shown are flexible in application, easily installed and free to move during expansion and contraction of the walls or arches. Their use in monolithic furnace walls insures safe, strong construction.

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NARCO produces four types of castable refractories for a wide variety of applications. These are mixtures that are shipped dry and are to be mixed with clean water, cast in place and cured for approximately eighteen hours to develop strength. They may then be dried and fired similar to any other refractory.



NARCO HEARTH is a medium-grained product developed for wide use under severe service conditions up to 2700°F. Raw materials for this product are carefully blended to give ample refractoriness, negligible shrinkage in service, good strength and reasonable resistance to spalling and abrasion. It is designed for use in large sections such as floors, sidewalls, arches and doors of large furnaces. At the same time, it is equally suitable for construction of smaller furnaces, ash pits, car slabs for tunnel kilns or heat treating furnaces or for the repair of worn spots in furnaces operated up to 2700°F.

NARCO HEARTH is shipped dry in 100-lb. waterproof bags. Allow 120 pounds of NARCO HEARTH for each cubic foot of construction.

NARCO BAFFLEMIX is a similar product with a top operating temperature of 2700°F. but is furnished in a finer grain size so that thin sections may be cast easily. NARCO BAFFLEMIX is especially suited for casting baffles around boiler tubes, for forming thin door linings, for dental furnaces and other small heating devices. It is also convenient for forming complicated shapes and tile for emergency repairs or special construction.

NARCO BAFFLEMIX is also shipped in 100-pound waterproof bags and requires 116 pounds per cubic foot of construction.

NARCOCRETE is an insulating castable with a hydraulic-setting action which permits rapid utilization after casting in position. Composed of an insulating aggregate, this castable when fired in place has two outstanding advantages in insulating value and light weight. When these considerations are important in service, NARCOCRETE is recommended and may be used up to operating temperatures of 2450°F.



NARCOCRETE is especially valuable for heat-retaining doors and for providing a smooth insulating layer for foundations of furnaces, tunnel kiln cars and annealing furnace cars. In such cases heat losses are reduced and uniform temperature conditions promoted.

NARCOCRETE is shipped in 50-lb. waterproof burlap bags. For estimating purposes, allow 70 pounds of NARCOCRETE as shipped for each cubic foot of furnace wall.

NARCOLITE is a lightweight castable refractory with a density of 50 lbs. per cubic foot. Some typical applications are lining hot air flues, upper walls, arches and doors of annealing and tempering furnaces, glass lehrs, domestic heating furnaces, air preheaters, oil refining units and waste heat boilers. In each of the above installations NARCOLITE is valuable because of (a) its good insulating value, (b) its low density thus requiring only small supporting members, (c) its low heat capacity and quick heat-up to operating temperatures, (d) its volume stability and (e) its excellent workability and ease of placing.

This material is used wherever the top temperature does not exceed 2000°F. and abrasion or serious fluxing action is absent. It is shipped in 50-pound bags and can be installed by molding, casting, troweling or spraying.

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NARCHROME MORTAR (Air-Set)

NARCHROME MORTAR (Air-Set) is an air-setting, high temperature bonding mortar with a chrome ore base. The only preparation necessary is mixing with clean water to the consistency desired, thereby obtaining a mortar excellent for laying or coating all types of basic brick, as well as clay and high alumina, when these are in contact with highly corrosive slags or oxides.



NARCHROME MORTAR (Air-Set) has excellent workability and suspension characteristics along with a high refractoriness and good bonding strength which properties are desirable for numerous applications over a wide temperature range. The air-setting ingredients, after drying, form a strong bond until a ceramic bond is developed at higher temperatures.

NARCHROME MORTAR is supplied in dry form and is shipped in 100-lb. bags.

NARCHROME MORTAR (Heat-Set)

NARCHROME MORTAR (Heat-Set), with chrome ore as its base, is a chemically neutral high temperature mortar of maximum refractoriness. This high refractoriness imparts maximum resistance to basic and ferrous slags. It possesses a small amount of air-set but depends chiefly on high temperatures to obtain its permanent set in service.

NARCHROME MORTAR (Heat-Set) has high water retention and good plasticity which makes it ideal for all types of troweled joints. It is also widely used for patching small holes in furnaces or in NARCHROME PLASTIC. Strong adhesive characteristics make this mortar very suitable for bonding and spray-coating all kinds of refractories.

Furnished dry in 100-lb. bags, it requires only the addition of water before using.

NARCHROME PLASTIC REFRACTORY

NARCHROME PLASTIC REFRACTORY is a neutral chrome product supplied in the plastic condition ready to use. Strength and hardness are developed upon air drying with strength being further increased when the plastic is heated to high temperatures. This plastic possesses good grain sizing for maximum density and the required plasticity to be rammed into place.



The hard, dense, finished surface is highly resistant to a wide variety of slags and mechanical abrasion and thus finds wide usage in installations such as rammed bottoms of soaking pits, heating furnaces, heat-treating and forging furnaces, and walls and bottoms of pulverized coal-fired boilers.

NARCHROME PLASTIC REFRACTORY is furnished in 200-lb. steel drums. Approximately 195 pounds are required to ram a cubic foot.

NARCHROME CASTABLE REFRACTORY

NARCHROME CASTABLE REFRACTORY is a chrome ore base, hydraulic-setting material which is recommended for temperatures up to 2850°F. To use, mix with clean water to the desired consistency and then pour like concrete.

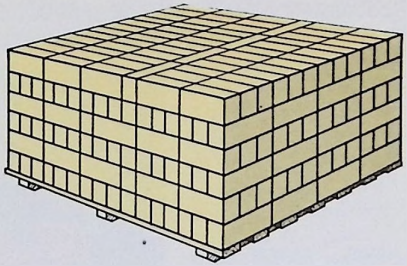
Like NARCHROME PLASTIC REFRACTORY, it has excellent resistance to chemical attack by fluxes, basic slags and molten metals and may be used for patching walls and floors of NARCHROME PLASTIC.

It may be used for walls and floors of water-cooled boiler furnaces and lower walls and hearths of heating furnaces where high iron oxide slags normally cause severe erosion and abrasion.

NARCHROME CASTABLE REFRACTORY is supplied dry in 100-lb. bags and about 185 lbs. of material is required to cast one cubic foot of lining.

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PALLETIZING



NARCO is equipped to furnish refractories on pallets to users who desire such shipments in order to facilitate the unloading and handling of refractories by mechanical means.

The standard pallets are 36″ x 48″ in size and have 2″ x 3″ runners. The capacity of such a pallet ranges from approximately 450 to 500—9″ equivalent in fire clay and silica refractories, depending on the weight factor of the type of refractory involved.

Palletized shipments of refractories can be made by either truck or rail. Various types of pallet protection and methods of loading box cars for rail shipment are illustrated in the Refractories Institute Manual "Recommended Equipment and Procedure for the Palletized Loading and Shipment of Refractory Brick" dated February 1953. References shown in this manual should be given to facilitate expediting orders for palletized shipments.

Charges and refund credit on pallets and other equipment used in such shipments can be obtained through our sales representatives or our general office in Cleveland.

GUARANTEES

NARCO uses extreme care throughout every phase of production and distribution of its refractories in order to furnish only high quality materials which in its judgment is best suited for the purposes for which they are intended.

The consumer will find it advantageous to seek and select the material which will give him the best results and to exercise care and discretion in the use of the material which he receives.

In the sale of refractories, no performance guarantees are made, since the manufacturer has no control over the conditions to which his products are subjected in service.

SIZE DEVIATIONS

When tested in accordance with Standard Method C-134 of the American Society for Testing Materials, nine-inch brick shall not show a size variation of more than plus or minus two per cent. Tile or shapes shall not show a size variation of more than plus or minus two per cent on dimensions of four inches or over, and plus or minus three per cent on dimensions smaller than four inches.

WARPAGE

Ninety-five per cent of the tile or shapes shall not show a warpage of greater than one per cent of the diagonal measured when tested in accordance with A.S.T.M. Standard Method C-154.

OVERSHIPMENTS

The following overages shall be allowable on all shipments of shapes that are not standard:

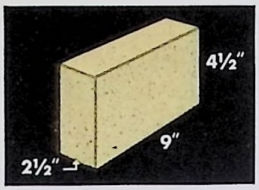
Quantity Specified	Overages
1 to 100	10%*
101-1,000	7%
1,001-5,000	3%
5,001-10,000	2%
Over 10,000	1%

* Not less than one shape. If in sets, 1 complete set.

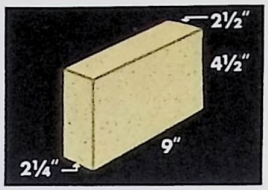
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STANDARD FIRECLAY BRICK SIZES *

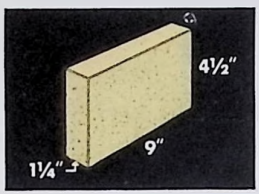
9" x 4½" x 2½" SERIES



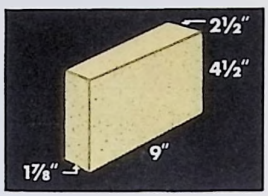
9" STRAIGHT
9"x 4½"x 2½"



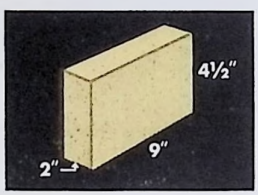
No. 1-X WEDGE
9"x 4½"x (2½"-2¼")
6'-9" Inside Radius



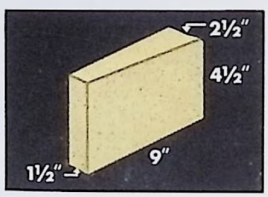
SPLIT BRICK
9"x 4½"x 1¼"



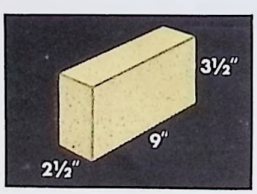
No. 1 WEDGE
9"x 4½"x (2½"-1⅞")
2'-3" Inside Radius



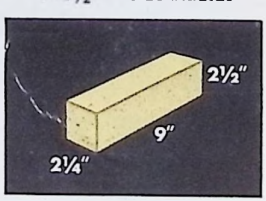
2 INCH BRICK
9"x 4½"x 2"



No. 2 WEDGE
9"x 4½"x (2½"-1½")
1'-1½" Inside Radius



SMALL 9" BRICK
9"x 3½"x 2½"

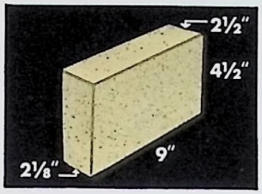


SOAP BRICK
9"x 2½"x 2¼"

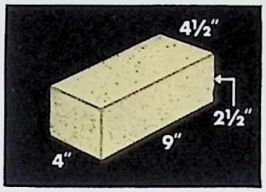
* Also standard in silica brick

STANDARD FIRECLAY BRICK SIZES *

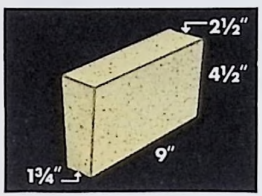
9" x 4½" x 2½" SERIES



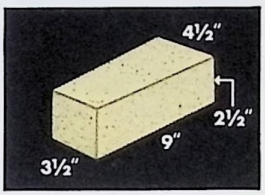
No. 1 ARCH
9"x 4½"x (2½"-2⅛")
2'-1½" Inside Radius



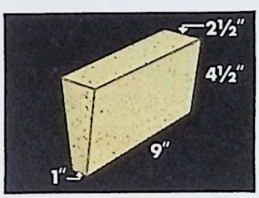
No. 1 KEY
9"x (4½"-4") x 2½"
6'-0" Inside Radius



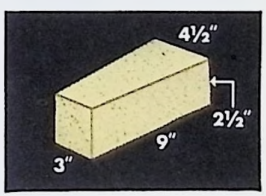
No. 2 ARCH
9"x 4½"x (2½"-1¾")
10½" Inside Radius



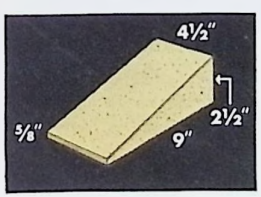
No. 2 KEY
9"x (4½"-3½") x 2½"
2'-7½" Inside Radius



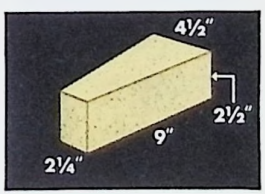
No. 3 ARCH
9"x 4½"x (2½"-1")
3" Inside Radius



No. 3 KEY
9"x (4½"-3") x 2½"
1'-6" Inside Radius



NECK BRICK
9"x 4½"x (2½"-⅝")



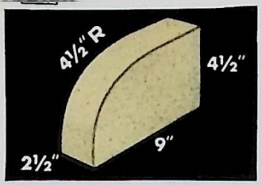
No. 4 KEY
9"x (4½"-2¼") x 2½"
9" Inside Radius

* Also standard in silica brick

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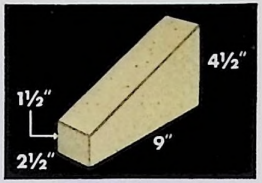
STANDARD FIRECLAY BRICK SIZES

9" x 4½" x 2½" SERIES



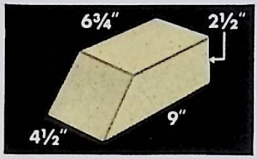
JAMB BRICK*

9"x 4½"x 2½"



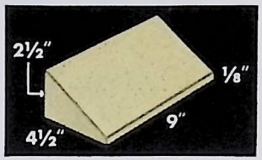
EDGE SKEW*

9"x (4½"-1½") x 2½"



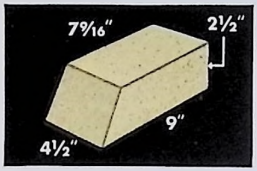
48° END SKEW*

(9"-6¾") x 4½"x 2½"



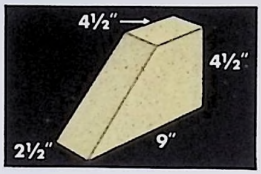
FEATHEREDGE*

9"x 4½"x (2½"-⅛")



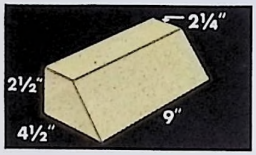
60° END SKEW*

(9"-7 9/16") x 4½"x 2½"



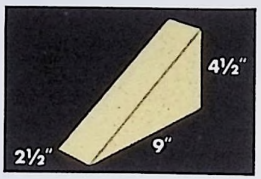
ANGLE "A" SKEW †

(9"-4½") x 4½"x 2½"



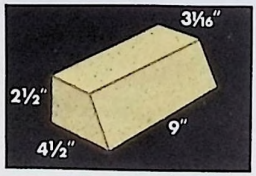
48° SIDE SKEW*

9"x (4½"-2¼") x 2½"



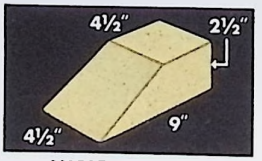
ANGLE "B" SKEW †

(9"-0") x 4½"x 2½"



60° SIDE SKEW*

9"x (4½"-3 3/16") x 2½"



ANGLE "C" SKEW †

(9"-4½") x 4½"x 2½"

* Also standard in silica brick
† Not 9" series but used frequently

STANDARD FIRECLAY BRICK SIZES *

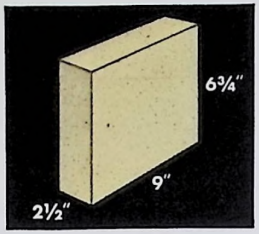
9" x 4½" x 3" SERIES

Name of Brick	Dimensions	Inside Radius
9" Straight—3" Series	9"x4½"x3"	—
Small 9" Brick—3" Series	9"x3½"x3"	—
9" Soap—3" Series	9"x2¼"x3"	—
9" Split Brick—3" Series	9"x4½"x1½"	—
9" No. 1 Arch—3" Series	9"x4½"x(3"-2¾")	4'-1½"
9" No. 2 Arch—3" Series	9"x4½"x(3"-2½")	1"-10½"
9" No. 3 Arch—3" Series	9"x4½"x(3"-2")	9"
9" No. 4 Arch—3" Series	9"x4½"x(3"-1")	2¼"
9" No. 1 Wedge—3" Series	9"x4½"x(3"-2¾")	8'-3"
9" No. 2 Wedge—3" Series	9"x4½"x(3"-2½")	3'-9"
9" No. 3 Wedge—3" Series	9"x4½"x(3"-2")	1'-6"
9" No. 1 Key—3" Series	9"x(4½"-4")x3"	6'-0"
9" No. 2 Key—3" Series	9"x(4½"-3½")x3"	2'-7½"
9" No. 3 Key—3" Series	9"x(4½"-3")x3"	1'-6"
9" No. 4 Key—3" Series	9"x(4½"-2¼")x3"	9"
9" Feather Edge—3" Series	9"x4½"x(3"-⅛")	—
9" Neck Brick—3" Series	9"x4½"x(3"-⅝")	—
9" Edge Skew—3" Series	9"x(4½"-1½")x3"	—
9"—48° End Skew—3" Series	(9"-6 5/16")x4½"x3"	—
9"—48° Side Skew—3" Series	9"x(4½"-1 13/16")x3"	—
9"—60° End Skew—3" Series	(9"-7¼")x4½"x3"	—
9"—60° Side Skew—3" Series	9"x(4½"-2¾")x3"	—
9" Jamb Brick—3" Series	9"x4½"x3"	—

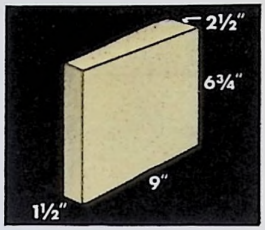
* Also standard in silica brick.

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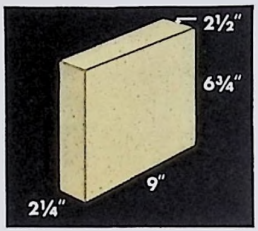
STANDARD FIRECLAY BRICK SIZES



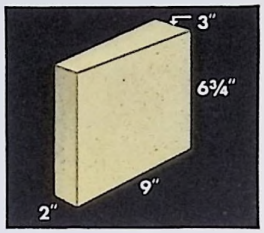
LARGE 9" STRAIGHT*
9"x 6¾"x 2½"
9"x 6¾"x 3"



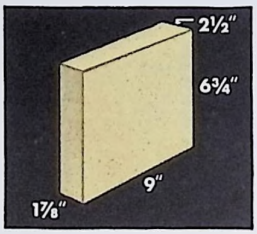
LARGE 9" No. 2 WEDGE*
9"x 6¾"x (2½"-1½")
1'-1½" Inside Radius
9"x 6¾"x (3"-2½")
3'-9" Inside Radius



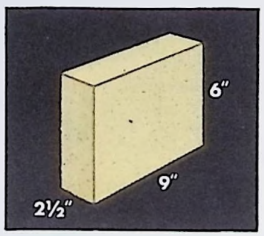
LARGE 9" No. 1-X WEDGE*
9"x 6¾"x (2½"-2¼")
6'-9" Inside Radius



LARGE 9" No. 3 WEDGE*
9"x 6¾"x (3"-2")
1'-6" Inside Radius



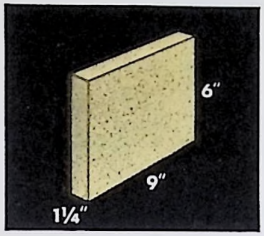
LARGE 9" No. 1 WEDGE*
9"x 6¾"x (2½"-1⅞")
2'-3" Inside Radius
9"x 6¾"x (3"-2¾")
8'-3" Inside Radius



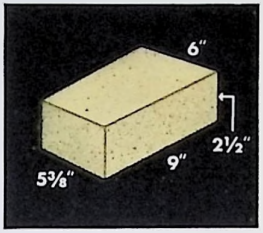
FLAT BACK STRAIGHT
9"x 6"x 2½"

* Also standard in silica brick

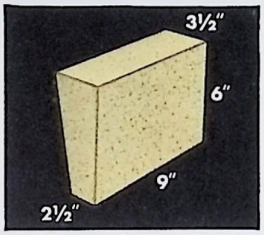
STANDARD FIRECLAY BRICK SIZES



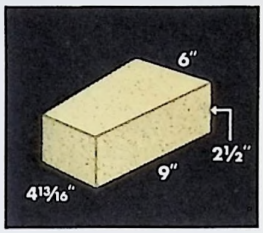
FLAT BACK SPLIT
9"x 6"x 1¼"



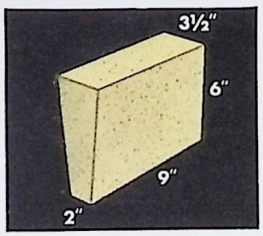
9"x 6" No. 1 KEY
9"x (6"-5⅜") x 2½"
9"x (6"-5⅜") x 3"
6'-6" Inside Radius



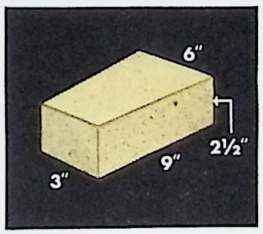
No. 1 FLAT BACK ARCH
9"x 6"x (3½"-2½")
1'-3" Inside Radius



9"x 6" No. 2 KEY
9"x (6"-4 13/16") x 2½"
9"x (6"-4 13/16") x 3"
3'-0" Inside Radius



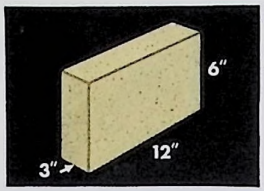
No. 2 FLAT BACK ARCH
9"x 6"x (3½"-2")
8" Inside Radius



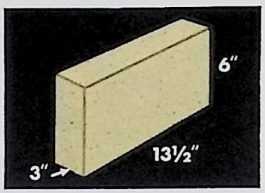
9"x 6" No. 3 KEY
9"x (6"-3") x 2½"
9"x (6"-3") x 3"
9" Inside Radius

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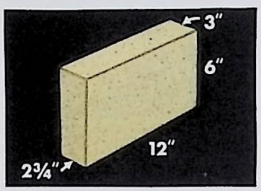
STANDARD FIRECLAY BRICK SIZES



12"x 6" STRAIGHT*
12"x 6"x 3"



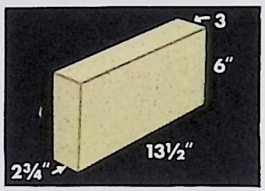
13½"x 6" STRAIGHT*
13½"x 6"x 2½"
13½"x 6"x 3"



12"x 6" No. 1 WEDGE*
12"x 6"x (3"-2¾")
11'-0" Inside Radius

12"x 6" No. 2 WEDGE*
12"x 6"x (3"-2½")
5'-0" Inside Radius

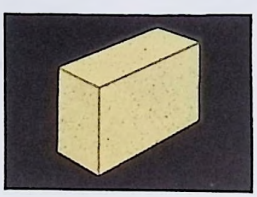
12"x 6" No. 3 WEDGE*
12"x 6"x (3"-2")
2'-0" Inside Radius



13½"x 6" No. 1 WEDGE*
13½"x 6"x (3"-2¾")
12'-4½" Inside Radius

13½"x 6" No. 2 WEDGE*
13½"x 6"x (3"-2½")
5'-7½" Inside Radius

13½"x 6" No. 3 WEDGE*
13½"x 6"x (3"-2")
2'-3" Inside Radius

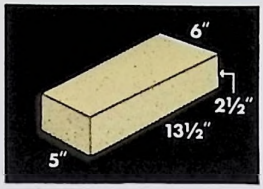


OPEN HEARTH CHECKERS

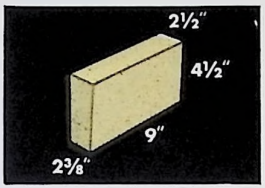
9"x 6"x 3"
10½"x 4½"x 3"
10½"x 4½"x 4½"
13½"x 4½"x 3"
13½"x 6"x 3"
13½"x 4½"x 4½"
13½"x 6"x 2½"

*Also standard in silica brick

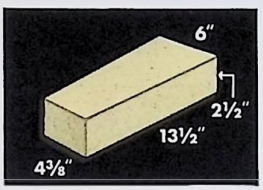
STANDARD FIRECLAY BRICK SIZES



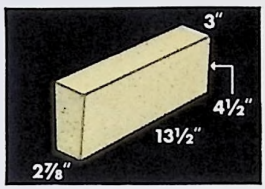
13½"x 6" No. 1 KEY
13½"x (6"-5") x 2½"
13½"x (6"-5") x 3"*
5'-7½" Inside Radius



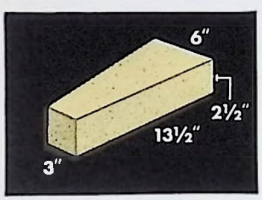
9" BUNG ARCH
9"x 4½"x (2½"-2⅜")
7'-1½" Inside Radius



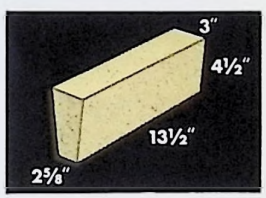
13½"x 6" No. 2 KEY
13½"x (6"-4⅜") x 2½"
13½"x (6"-4⅜") x 3"*
3'-0" Inside Radius



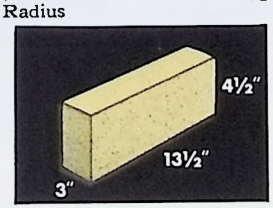
No. 105 BUNG ARCH
13½"x 4½"x (3"-2⅞")
9"x 4½"x (3"-2⅞")
8'-7½" Inside Radius



13½"x 6" No. 3 KEY
13½"x (6"-3") x 2½"
13½"x (6"-3") x 3"*
1'-1½" Inside Radius



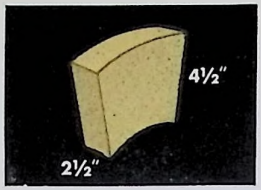
No. 103 BUNG ARCH
13½"x 4½"x (3"-2⅝")
2'-7½" Inside Radius



No. 101 SQUARE BUNG
13½"x 4½"x 3"
9"x 4½"x 3"

*Also standard in silica brick

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STANDARD 9" CIRCLE BRICK

Fireclay

Dimensions of all Circle Brick

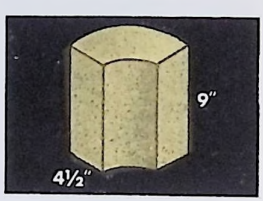
Outside Chord . . approx. 9 inches
Radial Dimension . . . . . 4½ inches
Thickness . . . . . 2½ inches

Name 2½" Series	Inside Chord in Inches	Outside Chord in Inches	Diameter in Inches		Number of Brick Per Ring
			Inside	Outside	
24-33	6 7/32	8 17/32	24	33	12
36-45	7 1/32	8 25/32	36	45	16
48-57	7 1/2	8 29/32	48	57	20
60-69	7 27/32	9	60	69	24
72-81	8 1/16	9 1/16	72	81	28
84-93	8 7/32	9 1/8	84	93	32
96-105	8 5/32	8 29/32	96	105	37
108-117	8 9/32	8 31/32	108	117	41
120-129	8 3/8	9	120	129	45

Circle brick of 3-inch thickness are furnished when desired. They are specified by adding the suffix 3 to the Name, thus, 24-33-3.

STANDARD 9 x 4½ x 9" CUPOLA BLOCKS

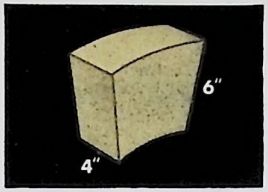
Fireclay



Dimensions of all Blocks

Outside Chord . . . approx. 9 inches
Radial Dimension . . . . . 4½ inches
Height . . . . . 9 inches

Name of Block	Inside Chord in Inches	Outside Chord in Inches	Diameter in Inches		Number of Blocks Per Ring
			Inside	Outside	
A	5 15/32	8 9/16	16	25	9
B	5 29/32	8 7/16	21	30	11
C	6 15/32	8 5/8	27	36	13
D	6 11/16	8 11/16	30	39	14
E	7 11/32	9	40	49	17
F	7 19/32	8 15/16	51	60	21
G	7 27/32	9	60	69	24
H	7 29/32	8 7/8	73	82	29



STANDARD 6" CUPOLA BLOCK and STANDARD 6" ROTARY KILN BLOCKS

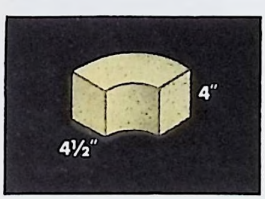
Fireclay

Dimensions of all Blocks

Outside Chord approx. . . . . 9 inches
Radial Dimension . . . . . 6 inches
Thickness . . . . . 4 inches

Name of Block	Inside Chord in Inches	Outside Chord in Inches	Diameter in Inches		Number of Blocks Per Ring
			Inside	Outside	
30-42	6 1/4	8 23/32	30	42	15
36-48	6 5/8	8 13/16	36	48	17
42-54	6 29/32	8 7/8	42	54	19
48-60	7 5/32	8 15/16	48	60	21
54-66	7 11/32	9	54	66	23
60-72	7 17/32	9 1/32	60	72	25
66-78	7 21/32	9 1/16	66	78	27
72-84	7 25/32	9 3/32	72	84	29
78-90	7 29/32	9 3/32	78	90	31
84-96	8	9 1/8	84	96	33
90-102	7 27/32	8 7/8	90	102	36
96-108	7 15/16	8 29/32	96	108	38
102-114	8	8 15/16	102	114	40
108-120	8 1/16	8 31/32	108	120	42
114-126	8 1/8	9	114	126	44
120-132	8 3/16	9	120	132	46
123-135	8 7/32	9 1/32	123	135	47
126-138	8 1/4	9 1/32	126	138	48

NOTE: Although cupola blocks and rotary kiln blocks are manufactured in duplicate sizes they are not interchangeable in most cases. Service conditions dictate variations in physical and chemical properties.



STANDARD 9 x 4½ x 4" CUPOLA BLOCKS

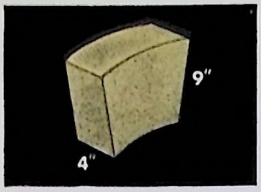
Fireclay

Dimensions of all Blocks

Outside Chord approx . . . . 9 inches
Radial Dimension . . . . . 4½ inches
Height . . . . . 4 inches

Name of Block	Inside Chord in Inches	Outside Chord in Inches	Diameter in Inches		Number of Blocks Per Ring
			Inside	Outside	
27-36	6 15/32	8 5/8	27	36	13
32-41	7 1/8	9 1/8	32	41	14

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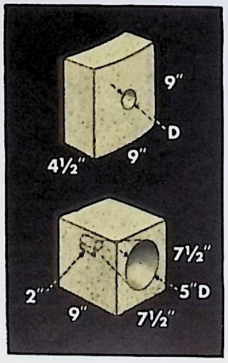
STANDARD 9 x 9 x 4" ROTARY KILN BLOCKS

Fireclay

Dimensions of all Blocks

Outside Chord . . . approx. 9 inches
Radial Dimension . . . . . 9 inches
Thickness. . . . . 4 inches

Name of Block	Inside Chord in Inches	Outside Chord in Inches	Diameter in Inches		Number of Blocks Per Ring
			Inside	Outside	
48-66	6 17/32	9	48	66	23
54-72	6 25/32	9 1/32	54	72	25
60-78	6 31/32	9 1/16	60	78	27
66-84	7 1/8	9 3/32	66	84	29
72-90	7 9/32	9 3/32	72	90	31
78-96	7 13/32	9 1/8	78	96	33
84-102	7 5/16	8 7/8	84	102	36
90-108	7 7/16	8 29/32	90	108	38
96-114	7 17/32	8 15/16	96	114	40
102-120	7 5/8	8 31/32	102	120	42
108-126	7 23/32	9	108	126	44
114-132	7 25/32	9	114	132	46
117-135	7 13/16	9 1/32	117	135	47
120-138	7 27/32	9 1/32	120	138	48
123-141	7 7/8	9 1/32	123	141	49
126-144	7 3/4	8 7/8	126	144	51
132-150	7 13/16	8 7/8	132	150	53
138-156	7 7/8	8 29/32	138	156	55
144-162	7 15/16	8 15/16	144	162	57
150-168	7 31/32	8 15/16	150	168	59



CUPOLA SLAG HOLE BLOCK

Name of Block	D in Inches	Inside Dia. Inches	Outside Dia. Inches
S-1-A	1½	51	60
S-1-B	2	51	60

MALLEABLE FURNACE TAP-OUT BLOCK

9" x 7½" x 7½"

Tap-Out-1 with ¾" Tap Hole for Hand Ladles

Tap-Out-2 with 1" Tap Hole for Bull Ladles



CURVEX CUPOLA BLOCKS 6" LINING

Fireclay

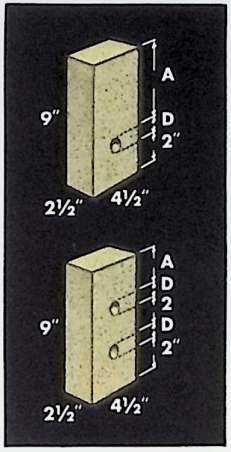
approx. 9" x 6" x 4"

Number of Pieces Required Per Ring

Diameter Inside Brickwork	No. per Ring	Diameter Inside Brickwork	No. per Ring	Diameter Inside Brickwork	No. per Ring
		4'-0"	18	6'-0"	26
		4'-3"	19	6'-3"	27
2'-6"	12	4'-6"	20	6'-6"	28
2'-9"	13	4'-9"	21	6'-9"	29
3'-0"	14	5'-0"	22	7'-0"	30
3'-3"	15	5'-3"	23	7'-3"	31
3'-6"	16	5'-6"	24	7'-6"	32
3'-9"	17	5'-9"	25	8'-0"	34

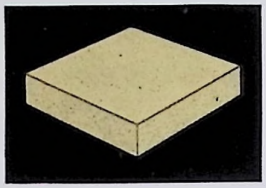
CUPOLA TAP-OUT BLOCKS

(One and Two-Hole Types)



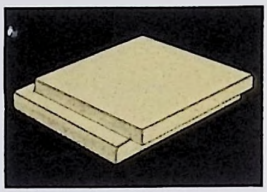
Name of Block	A in Inches	D in Inches
One Hole Type		
T-1-A	6½	½
T-1-B	6¼	¾
T-1-C	6	1
T-1-D	5¾	1¼
T-1-E	5½	1½
T-1-F	5⅞	1⅛
Two Hole Type		
T-2-A	4	½
T-2-B	3½	¾
T-2-C	3	1
T-2-D	2½	1¼
T-2-E	2	1½
T-2-F	3¾	⅝

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SQUARE EDGE TILE

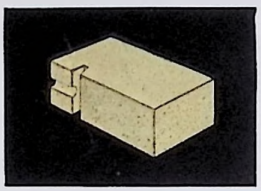
These are made in various lengths, widths and thicknesses.



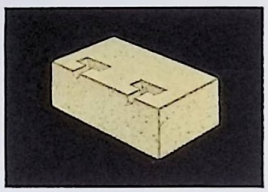
SHIPLAP TILE

Made in various sizes with two sides lapped or as shown four sides lapped.

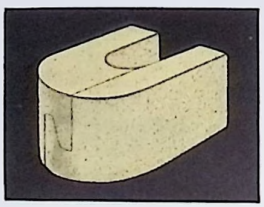
MARINE BOILER TILE



1 BOLT TYPE

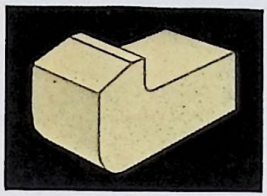


2 BOLT TYPE

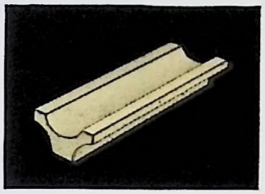


BLOW OFF PROTECTOR TILE

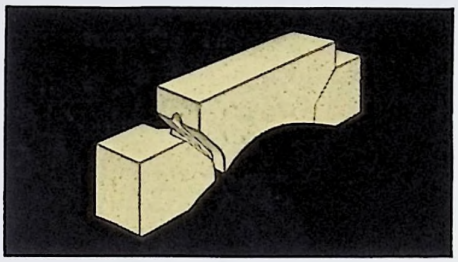
(2 to set)



SOOT BLOWER TILE

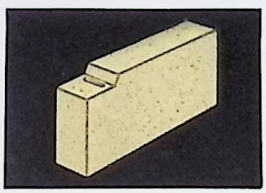


BOILER BAFFLE TILE

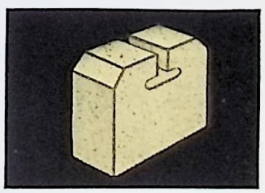


BOILER DOOR ARCH TILE AND SKEWBACKS

(3 pieces to set for 16″, 18″ and 20″ doors)



BOILER ANCHOR TILE OR HOLDING TILE



SUSPENDED REAR ARCH TILE

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STANDARD SILICA BRICK SIZES

Silica brick are produced in 9″x4½″x2½″ series and 9″x4½″x3″ series as shown in detail for fireclay brick on pages 32, 33, 34 and 35 indicated by asterisks (*). They are also standard in 9″x6¾″x2½″ series and 9″x6¾″x3″ series, page 36, and some other sizes as shown on pages 38 and 39 which are marked by asterisks (*) and listed below.

Name	Dimensions	Number Per Ring	Diameter of Ring Inside	Diameter of Ring Outside
STANDARD 12" x 4½" x 3" SIZES				
Straight	12″x4½″x3″	..	..	..
No. 1-X Wedge	12″x4½″x(3″-2⅞″)	604	46′-0″	48′-0″
No. 1 Wedge	12″x4½″x(3″-2¾″)	302	22′-0″	24′-0″
No. 2 Wedge	12″x4½″x(3″-2½″)	151	10′-0″	12′-0″
No. 3 Wedge	12″x4½″x(3″-2″)	76	4′-0″	6′-0″
STANDARD 12" x 6" x 3" SIZES				
Straight	12″x6″x3″	..	..	..
No. 1 Arch	12″x6″x(3″-2¾″)	151	11′-0″	12′-0″
No. 2 Arch	12″x6″x(3″-2½″)	76	5′-0″	6′-0″
No. 3 Arch	12″x6″x(3″-2″)	38	2′-0″	3′-0″
No. 1-X Wedge	12″x6″x(3″-2⅞″)	604	46′-0″	48′-0″
No. 1 Wedge	12″x6″x(3″-2¾″)	302	22′-0″	24′-0″
No. 2 Wedge	12″x6″x(3″-2½″)	151	10′-0″	12′-0″
No. 3 Wedge	12″x6″x(3″-2″)	76	4′-0″	6′-0″
No. 1 Key	12″x(6″-5½″)x3″	151	22′-0″	24′-0″
No. 2 Key	12″x(6″-5″)x3″	76	10′-0″	12′-0″
STANDARD 12" x 9" x 3" SIZES				
Straight	12″x9″x3″	..	..	..
No. 1-X Wedge	12″x9″x(3″-2⅞″)	604	46′-0″	48′-0″
No. 1 Wedge	12″x9″x(3″-2¾″)	302	22′-0″	24′-0″
No. 2 Wedge	12″x9″x(3″-2½″)	151	10′-0″	12′-0″
No. 3 Wedge	12″x9″x(3-2″)	76	4′-0″	6′-0″
STANDARD 13½" x 4½" x 3" SIZES				
Straight	13½″x4½″x3″	..	..	..
No. 1 Arch	13½″x4½″x(3″-2¾″)	113	8′-3″	9′-0″
No. 2 Arch	13½″x4½″x(3″-2½″)	57	3′-9″	4′-6″
No. 3 Arch	13½″x4½″x(3″-2″)	29	1′-6″	2′-3″
No. 4 Arch	13½″x4½″x(3″-1″)	15	0′-4½″	1′-1½″

STANDARD SILICA BRICK SIZES (Continued)

Name	Dimensions	Number Per Ring	Diameter of Ring Inside	Diameter of Ring Outside
STANDARD 13½" x 6" x 3" SIZES				
Straight	13½″x6″x3″	..	..	..
No. 1 Arch	13½″x6″x(3″-2¾″)	151	11′-0″	12′-0″
No. 2 Arch	13½″x6″x(3″-2½″)	76	5′-0″	6′-0″
No. 3 Arch	13½″x6″x(3″-2″)	38	2′-0″	3′-0″
No. 1-X Wedge	13½″x6″x(3″-2⅞″)	679	51′-9″	54′-0″
No. 1 Wedge	13½″x6″x(3″-2¾″)	340	24′-9″	27′-0″
No. 2 Wedge	13½″x6″x(3″-2½″)	170	11′-3″	13′-6″
No. 3 Wedge	13½″x6″x(3″-2″)	85	4′-6″	6′-9″
No. 1 Key	13½″x(6″-5″)x3″	85	11′-3″	13′-6″
No. 2 Key	13½″x(6″-4⅜″)x3″	52	6′-0″	8′-3″
No. 3 Key	13½″x(6″-3″)x3″	29	2′-3″	4′-6″
STANDARD 13½" x 9" x 3" SIZES				
Straight	13½″x9″x3″	..	..	..
No. 1 Arch	13½″x9″x(3″-2¾″)	227	16′-6″	18′-0″
No. 2 Arch	13½″x9″x(3″-2½″)	113	7′-6″	9′-0″
No. 3 Arch	13½″x9″x(3″-2″)	57	3′-0″	4′-6″
No. 1-X Wedge	13½″x9″x(3″-2⅞″)	679	51′-9″	54′-0″
No. 1 Wedge	13½″x9″x(3″-2¾″)	340	24′-9″	27′-0″
No. 2 Wedge	13½″x9″x(3″-2½″)	170	11′-3″	13′-6″
No. 3 Wedge	13½″x9″x(3″-2″)	85	4′-6″	6′-9″
STANDARD 15" x 6" x 3" SIZES				
Straight	15″x6″x3″	..	..	..
No. 1-X Wedge	15″x6″x(3″-2⅞″)	754	57′-6″	60′-0″
No. 1 Wedge	15″x6″x(3″-2¾″)	377	27′-6″	30′-0″
No. 2 Wedge	15″x6″x(3″-2½″)	189	12′-6″	15′-0″
No. 3 Wedge	15″x6″x(3″-2″)	95	5′-0″	7′-6″
STANDARD 15" x 9" x 3" SIZES				
Straight	15″x9″x3″	..	..	..
No. 1-X Wedge	15″x9″x(3″-2⅞″)	754	57′-6″	60′-0″
No. 1 Wedge	15″x9″x(3″-2¾″)	377	27′-6″	30′-0″
No. 2 Wedge	15″x9″x(3″-2½″)	189	12′-6″	15′-0″
No. 3 Wedge	15″x9″x(3″-2″)	95	5′-0″	7′-6″
STANDARD 18" x 6" x 3" SIZES				
Straight	18″x6″x3″	..	..	..
No. 1-X Wedge	18″x6″x(3″-2⅞″)	905	69′-0″	72′-0″
No. 1 Wedge	18″x6″x(3″-2¾″)	453	33′-0″	36′-0″
No. 2 Wedge	18″x6″x(3″-2½″)	227	15′-0″	18′-0″
No. 3 Wedge	18″x6″x(3″-2″)	113	6′-0″	9′-0″
STANDARD 18" x 9" x 3" SIZES				
Straight	18″x9″x3″	..	..	..
No. 1-X Wedge	18″x9″x(3″-2⅞″)	905	69′-0″	72′-0″
No. 1 Wedge	18″x9″x(3″-2¾″)	453	33′-0″	36′-0″
No. 2 Wedge	18″x9″x(3″-2½″)	227	15′-0″	18′-0″
No. 3 Wedge	18″x9″x(3″-2″)	113	6′-0″	9′-0″

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OTHER COMMON SILICA BRICK SIZES

Name	Dimensions	Number Per Ring	Diameter of Ring Outside	Diameter of Ring Inside
9" x 9" x 2½" SIZES				
Straight	9"x9"x2½"	..	..	..
No. 1-X Wedge	9"x9"x(2½"-2¼")	227	13'-6"	15'-0"
No. 1 Wedge	9"x9"x(2½"-1⅞")	91	4'-6"	6'-0"
No. 2 Wedge	9"x9"x(2½"-1½")	57	2'-3"	3'-9"
9" x 9" x 3" SIZES				
Straight	9"x9"x3"	..	..	..
No. 1 Wedge	9"x9"x(3"-2¾")	227	16'-6"	18'-0"
No. 2 Wedge	9"x9"x(3"-2½")	113	7'-6"	9'-0"
No. 3 Wedge	9"x9"x(3"-2")	57	3'-0"	4'-6"
13½" x 4½" x 2½" SIZES				
Straight	13½"x4½"x2½"	..	..	..
No. 1 Arch	13½"x4½"x(2½"-2⅛")	76	4'-3"	5'-0"
No. 2 Arch	13½"x4½"x(2½"-1¾")	38	1'-9"	2'-6"
No. 3 Arch	13½"x4½"x(2½"-1")	19	0'-6"	1'-3"
13½" x 4½" x 3" SIZES				
No. 1-X Wedge	13½"x4½"x(3"-2⅞")	679	51'-9"	54'-0"
No. 1 Wedge	13½"x4½"x(3"-2¾")	340	24'-9"	27'-0"
No. 2 Wedge	13½"x4½"x(3"-2½")	170	11'-3"	13'-6"
No. 3 Wedge	13½"x4½"x(3"-2")	85	4'-6"	6'-9"
21" x 6" x 3" SIZES				
Straight	21"x6"x3"	..	..	..
No. 1-X Wedge	21"x6"x(3"-2⅞")	1056	80'-6"	84'-0"
No. 1 Wedge	21"x6"x(3"-2¾")	528	38'-6"	42'-0"
No. 2 Wedge	21"x6"x(3"-2½")	264	17'-6"	21'-0"
No. 3 Wedge	21"x6"x(3"-2")	132	7'-0"	10'-6"
21" x 9" x 3" SIZES				
Straight	21"x9"x3"	..	..	..
No. 1-X Wedge	21"x9"x(3"-2⅞")	1056	80'-6"	84'-0"
No. 1 Wedge	21"x9"x(3"-2¾")	528	38'-6"	42'-0"
No. 2 Wedge	21"x9"x(3"-2½")	264	17'-6"	21'-0"
No. 3 Wedge	21"x9"x(3"-2")	132	7'-0"	10'-6"

REFRACTORY CONSTRUCTION DATA

ESTIMATING REFRACTORY MATERIALS

In estimating brick quantities for refractory construction using standard brick the following net amounts will be useful. Added allowances should be made for expansion joints, breakage, cutting, and mortar joints.

	Thickness of Wall	Required Number of Brick 9"x4½"x2½"	Required Number of Brick 9"x4½"x3"
1 sq. ft. of wall	2½"	3.6	..
1 sq. ft. of wall	3"	..	3.6
1 sq. ft. of wall	4½"	6.4	5.3
1 sq. ft. of wall	9"	12.8	10.7
1 sq. ft. of wall	13½"	19.2	16.0
1 cu. ft. of wall	..	17.1	14.2
Volume of 1000 standard brick		58.6 cu. ft.	70.3 cu. ft.

1 cu. ft. of fireclay brick weighs 120-140 pounds.

1 cu. ft. of silica brick weighs 105-120 pounds.

To allow a sufficient number of extra brick of standard sizes for speedy and sound construction it is suggested that the following quantities be ordered along with the net amount.

FOR BREAKAGE AND CUTTING

Net Amounts	Extra Pieces
Up to 250	10%
251-1,500	5%
1,501-5,000	3%
Over 5,000	2%

WEIGHT OF SPECIALTIES

Name	Type	Condition As Shipped	Pounds per Cu. Ft.
NARCO SUPER 505	Plastic	Wet	145
NARCO 505	Plastic	Wet	135
NARCOLINE	Plastic	Wet	145
NARCHROME PLASTIC REFRACTORY	Plastic	Wet	195
NARCHROME CASTABLE REFRACTORY	Castable	Dry	185
NARCO HEARTH	Castable	Dry	120
NARCO BAFFLEMIX	Castable	Dry	116
NARCOCRETE	Castable	Dry	70
NARCOLITE	Castable	Dry	50

From 300 to 450 pounds of air-set high temperature mortar is sufficient to lay 1000 standard 9-inch brick.

From 250 to 400 pounds of heat-set high temperature mortar is sufficient to lay 1000 standard 9-inch brick.

From 250 to 450 pounds of fire clay is sufficient to lay 1000 standard 9-inch brick.

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BRICKWORK CONSTRUCTION

Furnace structures requiring a refractory lining are designed and constructed for the most efficient service. To utilize good design, careful attention to refractory construction is required. Such construction is a highly specialized and skilled trade and should be entrusted only to experienced FIRE BRICK masons.

To operate efficiently, a furnace wall should be constructed to meet the following somewhat conflicting requirements as far as is practical:

1. The strongest possible bond or tie across joints and through the wall,
2. A construction as airtight as possible,
3. Provision for removing and rebuilding the inside brick courses on the hot face as easily as possible and with the least disturbance to the rest of the wall, and
4. Provision for relieving the fluctuating expansion strains by allowing proper expansion joints.

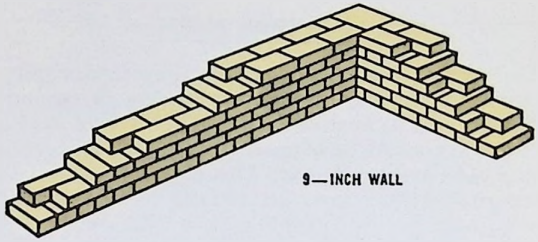
The determining factor in meeting the first three requirements is the type of bond used and the soundness of the brick laying. The type of expansion joint is not dependent on the kind of bond used.

MASONRY BONDS

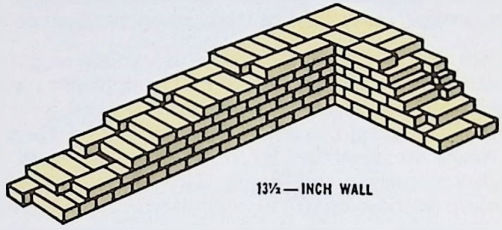
On the opposite page are illustrations of some standard masonry bonds. The wall thickness and type of bond is determined by service conditions present and load due to the height of the wall. To achieve maximum strength plus an airtight or gastight wall, it is important to stagger vertical joints.

The alternate header and stretcher bond is good practice and probably the most common. The only reason for departing from such a bond is to reduce the difficulty of repairing some portions of the furnace walls that require attention previous to the remainder of the furnace. Under such circumstances a compromise is advisable using three, four or five headers to one stretcher course. Once the arrangement of headers to stretchers on the furnace face is established, the same cross bond carries systematically through the wall for walls of any thickness and repeats itself at regular intervals.

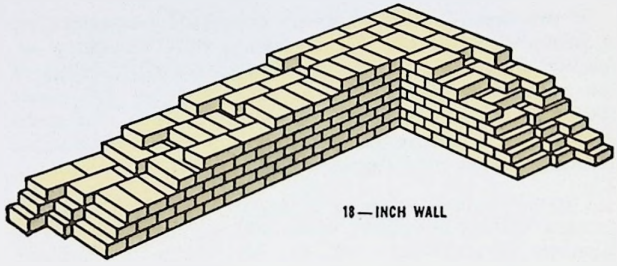
TYPICAL MASONRY BONDS



9—INCH WALL



13½—INCH WALL



18—INCH WALL

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BRICKWORK CONSTRUCTION

(Continued)

EXPANSION JOINTS

One of the important considerations in designing and constructing furnaces is that the brickwork expands and contracts due to heating and cooling. Severe fluctuating stresses are often developed as the temperature inside the furnace rises and falls. This is supplemented by the steep temperature gradient usually present in furnaces whereby the hot face expands more than the cooler parts of the brickwork. It should be noted that this expansion takes place both horizontally and vertically.

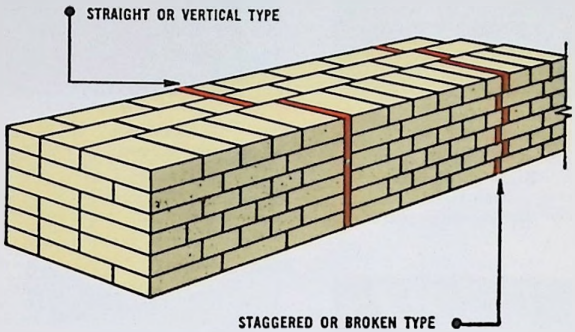
Provision for vertical expansion, except in high walls, is easily made by leaving the wall free to expand upward without encountering boiler drums, piping or other structural members. Vertical contraction during subsequent cooling takes care of itself when the wall settles.

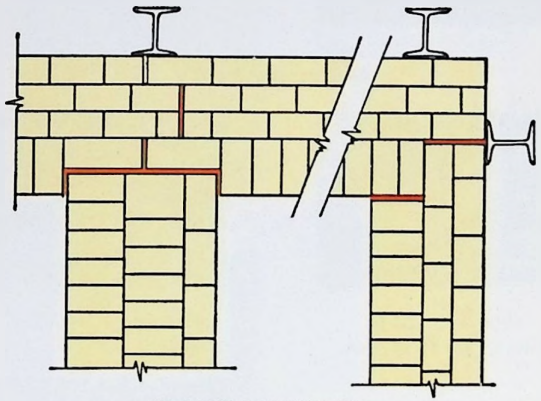
There are two common types of expansion joints for horizontal movement as shown on the opposite page. The "Staggered" or "Broken" type has the open joints staggered at adjoining courses. This type is perhaps simpler and easier to construct as it requires no large 9 inch straights or cutting and fitting. This type also results in a minimum weakening of the wall at the expansion joints. The "Straight" or "Vertical" type with no overlapping headers, allows the wall sections to expand and contract with a greater freedom which results in a minimum of buckling on the inside brick courses. As the ability to open and close easily is the expansion joint's main requisite, the free movement of the "Straight" type probably outweighs any disadvantages.

In practice, expansion joints are usually constructed to provide for double the expansion that will occur on the first heating. This allows for any accidental filling of the expansion joints by mortar, dust, or materials charged into the furnace during operation. To keep joints clean, they are usually packed with a combustible or compressible filler during construction.

There is a large variety of expansion joints used for corners, joining auxiliary walls and separating zones of different temperatures. Shown are examples that are generally considered good practice.

TYPICAL EXPANSION JOINTS



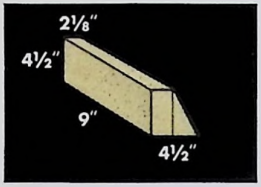


EXAMPLE OF AN AUXILIARY WALL AND CORNER JOINT

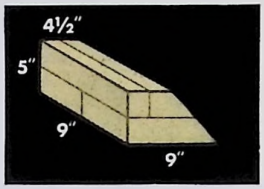
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STANDARD SKEWBACKS

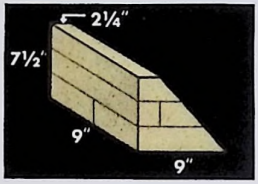
SKEWS BUILT WITH STANDARD BRICK



for ARCH 4½" THICK
Rise 1½" per ft. of span
Skew consists of
1-9" 2-Inch Brick } 2½" Series
1-9" Featheredge }

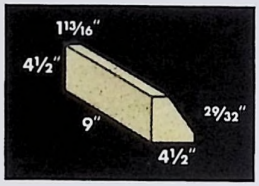


for ARCH 4½" THICK
Rise 2 5/16" per ft. of span
Skew consists of
1-9" 48° Side Skew } 2½" Series
2-9" 48° End Skews }
1-9" Soap Brick }

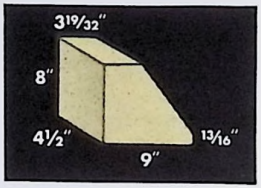


for ARCH 9" THICK
Rise 2 5/16" per ft. of span
Skew consists of
2-9" 48° End Skews } 2½" Series
2-9" 48° Side Skews }
1-9" Soap Brick }

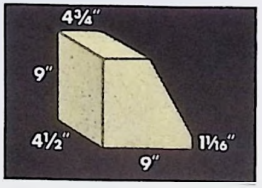
SPECIAL SKEWBACKS



for ARCH 4½" THICK
Rise 2" per ft. of span



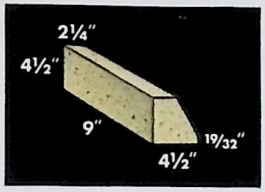
for ARCH 9" THICK
Rise 2" per ft. of span



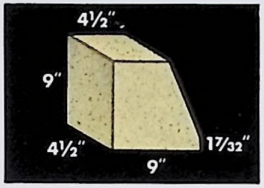
for ARCH 9" THICK
Rise 1½" per ft. of span

SPECIAL SKEWBACKS

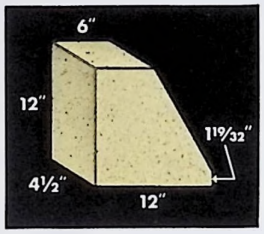
For Arches with Included Angle of 60 Degrees



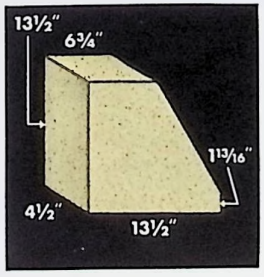
for ARCH 4½" THICK
Rise 1.608" per ft. of span



for ARCH 9" THICK
Rise 1.608" per ft. of span



for ARCH 12" THICK
Rise 1.608" per ft. of span



for ARCH 13½" THICK
Rise 1.608" per ft. of span

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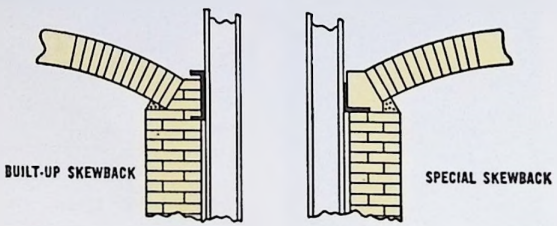
SKEWBACKS IN FURNACES

Skewbacks are masonry units with an inclined face from which an arch is sprung. As illustrated, a single special shape may be used, or a combination of standard brick sizes may be laid up to form the skewback. The one-piece skewbacks are stronger and are generally used for arches of longer spans. The important requirements for skewbacks are high strength and good bearing on the sidewalls.

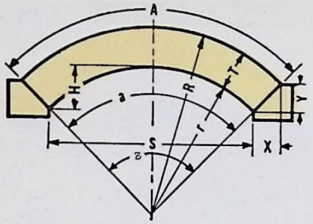
The skewback receives the full thrust of the arch which includes a downward thrust exerted by the weight of the arch as well as an outward thrust on the sidewall. Support of the arch is usually made by steelwork consisting of angles or channels on which the skews rest. These angles and channels are held in place by buckstays generally connected by tie-rods with provisions for adjustment as the furnace temperature rises and falls. If structural steel is not used, the sidewall must be constructed to receive the entire thrust of the arch.

When steelwork is used, the line of thrust should fall within the channel or angle to promote stability of the arch. Skewbacks should be placed so they are protected as much as possible from the destructive forces of the furnace, a precaution which usually lengthens the life of the skewback. To further protect the skewback, a stretcher course should never be used directly below the skewback.

Shown are two commonly used methods which are considered good practice for holding skewbacks.



ELEMENTS OF ARCHES



KEY TO SYMBOLS

S = Span of arch
H = Rise of arch
R = Outside radius of arch
r = Inside radius of arch
T = Thickness of arch
A = Outer arc length
a = Inner arc length
Θ = Central Angle

FORMULAS:

To find the rise when the radius and span are given:

$$H = r - \tfrac{1}{2}\sqrt{4r^2 - S^2}$$

To find the inside radius when the rise and span are given:

$$r = \frac{S^2 + 4H^2}{8H}$$

To find the angle Θ when the radius and span are given:

$$\text{Sine } \tfrac{1}{2}\Theta = \frac{S}{2r}$$

To find the arc lengths when the radius and central angle are given:

Outer arc: $A = \dfrac{2\pi R\Theta}{360}$ Inner arc: $a = \dfrac{2\pi r\Theta}{360}$

VALUES FOR GIVEN RISES PER FOOT OF SPAN

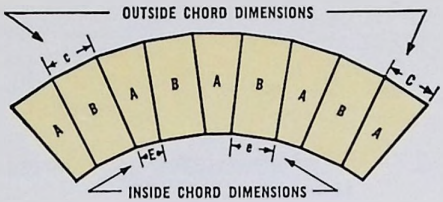
Rise in Inches Per Foot of Span	Inside* Radius is Factor X S	Central Angle Θ Degrees	Central Angle Θ Part of Circle	Inside* Arc is Factor xS	Diff. of* Outer and Inner Arcs Factor xT	Skewback X* is Factor xT	Skewback Y* is Factor xT
1	1.5417	37°50.9′	0.1051	1.0184	0.6606	0.3243	0.9460
1¼	1.2521	47°4.4′	0.1308	1.0287	0.8216	0.3993	0.9168
1½	1.0625	56°8.7′	0.1560	1.0412	0.9799	0.4706	0.8824
1.608	1.0000	60°0.0′	0.1667	1.0472	0.0472	0.5000	0.8660
1¾	0.9301	65°2.5′	0.1807	1.0558	1.1352	0.5376	0.8432
2	0.8333	73°44.4′	0.2048	1.0725	1.2870	0.6000	0.8000
2¼	0.7604	82°13.4′	0.2284	1.0913	1.4351	0.6575	0.7534
2.302	0.7474	83°58.5′	0.2333	1.0954	1.4656	0.6690	0.7433
2½	0.7042	90°28.8′	0.2513	1.1120	1.5792	0.7101	0.7041
2¾	0.6600	98°29.7′	0.2736	1.1346	1.7191	0.7575	0.6528
3	0.6250	106°15.6′	0.2952	1.1591	1.8546	0.8000	0.6000

*Inside radius, inside arc, difference of outer and inner arcs, x and y are obtained by multiplying the factor in each respective column with S or T, whichever applies.

For typical skewbacks refer pages 34, 54, 55 and 56.

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COMBINATIONS TO FORM A RING WITH TWO SIZES OF BRICK



A—A radial brick used with a straight or another radial brick B, which turns a larger circle than A.

B—A straight brick or a radial brick which turns a larger circle than A, both A and B forming the same thickness of arch T.

T—The thickness of the arch formed by A and B.

C—The outside chord of brick A.

c—The outside chord of brick B.

E—The inside chord of brick A.

e—The inside chord of brick B.

D—Given outside diameter of desired ring.

d—Given inside diameter of desired ring.

G—Outside diameter of ring formed by radial brick A alone.

J—Number of brick A to form a ring of outside diameter G.

g—Outside diameter of ring formed by brick B alone if it is radial.

j—Number of brick B to form a ring of outside diameter g.

x—Number of pieces of brick A, used with brick B to form a ring of outside diameter D.

y—Number of pieces of brick B, used with brick A to form a ring of outside diameter D.

S—Total number of pieces of brick A and brick B to form a ring of outside diameter D.

COMBINATIONS TO FORM A RING WITH TWO SIZES OF BRICK

I. When both brick A and B are radial and outside chords are equal (C = c) but inside chords are unequal,

$$(1)\quad S = \frac{\pi D}{C} = \frac{\pi D}{c}$$

$$(2)\quad y = \frac{\pi d - SE}{e - E}$$

II. When brick B is a straight brick and brick A is radial, c=e and

$$(3)\quad x = \frac{2\pi T}{C-E} = \frac{6.2832T}{C-E}$$

$$(4)\quad y = \frac{\pi D - xC}{c}$$

III. When both brick A and B are radial and both chord dimensions of A differ from those of B,

$$(5)\quad Cx+cy = \pi D$$

$$(6)\quad Ex+ey = \pi d$$

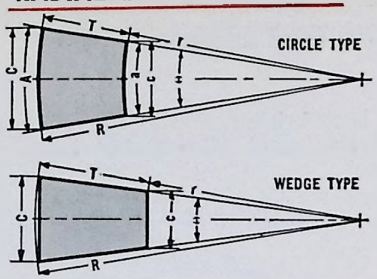
IV. When calculating a series of combinations the following formulas are convenient:

$$(7)\quad x = \frac{J(g-D)}{g-G}$$

$$(8)\quad y = \frac{j(D-G)}{g-G}$$

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RADIAL BRICK FORMULAS



KEY TO SYMBOLS:

a —Inside arc of circle-type brick
A —Outside arc of circle-type brick
c —Inside chord of circle or wedge type brick
C —Outside chord of circle or wedge type brick
r —Inside radius of radial brick
R —Outside radius of radial brick
d —Inside diameter of ring formed by radial brick
T —Radial dimension of brick
Θ —Theta, the included angle of brick
π —Pi—3.1416
S —Total number of a given radial brick required to form a ring

FORMULAS:

$$c = \frac{r\,C}{r+T} = \frac{r\,C}{R} \qquad S = \frac{2\pi T}{C-c} = \frac{\pi D}{C} = \frac{\pi d}{c}$$

$$C = \frac{(r+T)\,c}{r} = \frac{R\,c}{r} = \qquad \text{Sine } \tfrac{1}{2}\,\Theta = \frac{C}{2R} \text{ or } \frac{c}{2r}$$

$$\Theta = \frac{360^\circ}{S}$$

TABLE FOR USE IN DESIGNING RADIAL TYPE BRICK

If the outside chord of a radial brick is desired for a given number of pieces per ring, find the number of pieces in column 1 and multiply the corresponding sine of the half angle in column 2 by the outside diameter of the ring.

If brick with an outside chord of approximately 9″ is desired, find the diameter in column 3 that comes closest to the desired outside diameter. Then multiply the corresponding sine of the half angle in column 2 by the *desired* outside diameter to obtain the actual chord. The number of pieces to form a ring will be found in column 1.

No. of Brick to Circle (1)	Sine of Half Angle (2)	Dia. for 9″ Chord in Inches (3)	No. of Brick to Circle (1)	Sine of Half Angle (2)	Dia. for 9″ Chord Inches (3)
5	.58779	15.312	9	.34202	26.314
6	.50000	18.000	10	.30902	29.124
7	.43388	20.743	11	.28173	31.945
8	.38268	23.518	12	.25882	34.773

Table continued on next page

TABLE FOR USE IN DESIGNING RADIAL TYPE BRICK (Concluded)

NARCO

No. of Brick to Circle (1)	Sine of Half Angle (2)	Dia. for 9″ Chord, in Inches (3)	No. of Brick to Circle (1)	Sine of Half Angle (2)	Dia. for 9″ Chord, in Inches (3)
13	.23932	37.607	57	.05508	163.399
14	.22252	40.446	58	.05414	166.236
15	.20791	43.288	59	.05322	169.109
16	.19509	46.133	60	.05234	171.953
17	.18375	48.980	61	.05147	174.859
18	.17365	51.828	62	.05065	177.690
19	.16459	54.681	63	.04985	180.542
20	.15643	57.534	64	.04907	183.411
21	.14904	60.386	65	.04832	186.258
22	.14231	63.242	66	.04758	189.155
23	.13616	66.099	67	.04687	192.020
24	.13053	68.950	68	.04618	194.890
25	.12533	71.810	69	.04552	197.715
26	.12054	74.664	70	.04486	200.624
27	.11609	77.526	71	.04423	203.482
28	.11197	80.379	72	.04362	206.327
29	.10812	83.241	73	.04302	209.205
30	.10453	86.100	74	.04244	212.064
31	.10117	88.959	75	.04188	214.900
32	.09802	91.818	76	.04132	217.812
33	.09506	94.677	77	.04079	220.642
34	.09227	97.540	78	.04027	223.491
35	.08964	100.402	79	.03975	226.415
36	.08716	103.258	80	.03926	229.241
37	.08481	106.120	81	.03878	232.078
38	.08258	108.985	82	.03830	234.987
39	.08047	111.843	83	.03784	237.844
40	.07846	114.708	84	.03739	240.706
41	.07655	117.570	85	.03695	243.572
42	.07473	120.434	86	.03652	246.440
43	.07299	123.305	87	.03610	249.307
44	.07134	126.156	88	.03569	252.171
45	.06976	129.014	89	.03529	255.030
46	.06825	131.868	90	.03490	257.880
47	.06680	134.731	91	.03452	260.718
48	.06540	137.615	92	.03414	263.620
49	.06407	140.471	93	.03377	266.509
50	.06279	143.335	94	.03341	269.380
51	.06156	146.199	95	.03306	272.232
52	.06038	149.056	96	.03272	275.061
53	.05924	151.924	97	.03238	277.949
54	.05815	154.772	98	.03205	280.811
55	.05709	157.646	99	.03173	283.643
56	.05607	160.514	100	.03141	286.533

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4½" LINING—ARCH BRICK

9" x 4½" x 2½" or 13½" x 4½" x 2½"

Diameter Inside Brickwork	Number Required Per Ring				
	No. 3 Arch	No. 2 Arch	No. 1 Arch	Straight	Total
0'- 6"	19	..	..	..	19
0'- 7"	18	3	..	..	21
0'- 8"	17	5	..	..	22
0'- 9"	15	8	..	..	23
0'-10"	14	10	..	..	24
0'-11"	13	13	..	..	26
1'- 0"	12	15	..	..	27
1'- 1"	10	18	..	..	28
1'- 2"	9	20	..	..	29
1'- 3"	8	23	..	..	31
1'- 4"	7	25	..	..	32
1'- 5"	5	28	..	..	33
1'- 6"	4	30	..	..	34
1'- 7"	3	33	..	..	36
1'- 8"	2	35	..	..	37
1'- 9"	..	38	..	..	38
1'-10"	..	36	3	..	39
1'-11"	..	36	5	..	41
2'- 0"	..	34	8	..	42
2'- 3"	..	31	15	..	46
2'- 6"	..	26	23	..	49
2'- 9"	..	23	30	..	53
3'- 0"	..	19	38	..	57
3'- 3"	..	15	46	..	61
3'- 6"	..	11	53	..	64
3'- 9"	..	8	60	..	68
4'- 0"	..	4	68	..	72
4'- 3"	..	..	76	..	76
4'- 6"	..	..	76	4	80
5'- 0"	..	..	76	11	87
5'- 6"	..	..	76	19	95
6'- 0"	..	..	76	26	102
6'- 6"	..	..	76	34	110
7'- 0"	..	..	76	41	117
7'- 6"	..	..	76	49	125
8'- 0"	..	..	76	56	132
8'- 6"	..	..	76	64	140
9'- 0"	..	..	76	71	147
9'- 6"	..	..	76	79	155
10'- 0"	..	..	76	87	163
10'- 6"	..	..	76	94	170
11'- 0"	..	..	76	102	178
11'- 6"	..	..	76	109	185
12'- 0"	..	..	76	117	193
12'- 6"	..	..	76	124	200
13'- 0"	..	..	76	132	208
13'- 6"	..	..	76	139	215
14'- 0"	..	..	76	147	223



4½" LINING—ARCH BRICK

9" x 4½" x 3" or 13½" x 4½" x 3"

Diameter Inside Brickwork	Number Required Per Ring					
	No 4 Arch	No. 3 Arch	No. 2 Arch	No. 1 Arch	Straight	Total
0'- 4½"	15	..	..	..	..	15
0'- 5"	14	1	..	..	..	15
0'- 6"	13	3	..	..	..	16
0'- 7"	12	5	..	..	..	17
0'- 8"	11	7	..	..	..	18
0'- 9"	10	9	..	..	..	19
0'-10"	8	12	..	..	..	20
0'-11"	7	14	..	..	..	21
1'- 0"	6	16	..	..	..	22
1'- 1"	5	18	..	..	..	23
1'- 2"	4	20	..	..	..	24
1'- 3"	4	22	..	..	..	26
1'- 4"	3	24	..	..	..	27
1'- 5"	1	27	..	..	..	28
1'- 6"	..	29	..	..	..	29
1'- 9"	..	25	7	..	..	32
2'- 0"	..	22	13	..	..	35
2'- 3"	..	19	19	..	..	38
2'- 6"	..	16	25	..	..	41
2'- 9"	..	13	31	..	..	44
3'- 0"	..	10	38	..	..	48
3'- 3"	..	7	44	..	..	51
3'- 6"	..	3	51	..	..	54
3'- 9"	..	..	57	..	..	57
4'- 0"	..	..	54	6	..	60
4'- 3"	..	..	50	13	..	63
4'- 6"	..	..	47	19	..	66
4'- 9"	..	..	44	26	..	70
5'- 0"	..	..	41	32	..	73
5'- 3"	..	..	38	38	..	76
5'- 6"	..	..	35	44	..	79
5'- 9"	..	..	32	50	..	82
6'- 0"	..	..	28	57	..	85
6'- 6"	..	..	22	70	..	92
7'- 0"	..	..	16	82	..	98
7'- 6"	..	..	10	94	..	104
8'- 0"	..	..	3	107	..	110
8'- 3"	..	..	..	113	..	113
8'- 6"	..	..	..	113	4	117
9'- 0"	..	..	..	113	10	123
9'- 6"	..	..	..	113	16	129
10'- 0"	..	..	..	113	22	135
10'- 6"	..	..	..	113	29	142
11'- 0"	..	..	..	113	35	148
11'- 6"	..	..	..	113	41	154
12'- 0"	..	..	..	113	48	161
12'- 6"	..	..	..	113	54	167
13'- 0"	..	..	..	113	60	173
13'- 6"	..	..	..	113	66	179
14'- 0"	..	..	..	113	73	186

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4½" LINING—CIRCLE BRICK

9" x 4½" x 2½" or 9" x 4½" x 3"

Diameter Inside Brickwork	Number Required Per Ring					
	24-33 Circle	36-45 Circle	48-57 Circle	60-69 Circle	72-81 Circle	Total
2'- 0"	12	...	...	...	...	12
2'- 1"	11	2	...	...	...	13
2'- 2"	10	3	...	...	...	13
2'- 3"	9	4	...	...	...	13
2'- 4"	8	6	...	...	...	14
2'- 5"	7	7	...	...	...	14
2'- 6"	6	8	...	...	...	14
2'- 7"	6	9	...	...	...	15
2'- 8"	4	11	...	...	...	15
2'- 9"	3	12	...	...	...	15
2'-10"	3	13	...	...	...	16
2'-11"	1	15	...	...	...	16
3'- 0"	...	16	...	...	...	16
3'- 1"	...	15	2	...	...	17
3'- 2"	...	13	4	...	...	17
3'- 3"	...	12	5	...	...	17
3'- 4"	...	11	7	...	...	18
3'- 5"	...	9	9	...	...	18
3'- 6"	...	8	10	...	...	18
3'- 7"	...	7	12	...	...	19
3'- 8"	...	6	13	...	...	19
3'- 9"	...	4	15	...	...	19
3'-10"	...	4	16	...	...	20
3'-11"	...	2	18	...	...	20
4'- 0"	...	...	20	...	...	20
4'- 1"	...	...	20	1	...	21
4'- 2"	...	...	18	3	...	21
4'- 3"	...	...	16	5	...	21
4'- 4"	...	...	14	8	...	22
4'- 5"	...	...	12	10	...	22
4'- 6"	...	...	10	12	...	22
4'- 7"	...	...	8	15	...	23
4'- 8"	...	...	6	17	...	23
4'- 9"	...	...	4	19	...	23
4'-10"	...	...	3	21	...	24
4'-11"	...	...	1	23	...	24
5'- 0"	...	...	...	24	...	24
5'- 1"	...	...	...	21	4	25
5'- 2"	...	...	...	19	6	25
5'- 3"	...	...	...	17	9	26
5'- 4"	...	...	...	15	11	26
5'- 5"	...	...	...	13	13	26
5'- 6"	...	...	...	12	15	27
5'- 7"	...	...	...	10	17	27
5'- 8"	...	...	...	8	19	27
5'- 9"	...	...	...	6	22	28
5'-10"	...	...	...	4	24	28
5'-11"	...	...	...	2	26	28

Continued on next page

4½" LINING—CIRCLE BRICK

9" x 4½" x 2½" or 9" x 4½" x 3"—Concluded

Diameter Inside Brickwork	Number Required Per Ring					
	72-81 Circle	84-93 Circle	96-105 Circle	108-117 Circle	120-129 Circle	Total
6'- 0"	28	...	...	...	...	28
6'- 1"	26	3	...	...	...	29
6'- 2"	23	6	...	...	...	29
6'- 3"	21	9	...	...	...	30
6'- 4"	19	11	...	...	...	30
6'- 5"	16	14	...	...	...	30
6'- 6"	14	17	...	...	...	31
6'- 7"	11	20	...	...	...	31
6'- 8"	9	22	...	...	...	31
6'- 9"	7	25	...	...	...	32
6'-10"	4	28	...	...	...	32
6'-11"	2	30	...	...	...	32
7'- 0"	...	32	...	...	...	32
7'- 1"	...	28	5	...	...	33
7'- 2"	...	26	7	...	...	33
7'- 3"	...	23	11	...	...	34
7'- 4"	...	20	14	...	...	34
7'- 5"	...	17	18	...	...	35
7'- 6"	...	14	21	...	...	35
7'- 7"	...	11	24	...	...	35
7'- 8"	...	8	28	...	...	36
7'- 9"	...	5	31	...	...	36
7'-10"	...	2	34	...	...	36
7'-11"	...	...	37	...	...	37
8'- 0"	...	...	37	...	...	37
8'- 1"	...	...	30	7	...	37
8'- 2"	...	...	28	10	...	38
8'- 3"	...	...	25	13	...	38
8'- 4"	...	...	24	15	...	39
8'- 5"	...	...	20	19	...	39
8'- 6"	...	...	18	21	...	39
8'- 7"	...	...	16	24	...	40
8'- 8"	...	...	13	27	...	40
8'- 9"	...	...	10	30	...	40
8'-10"	...	...	8	33	...	41
8'-11"	...	...	5	36	...	41
9'- 0"	...	...	...	41	...	41
9'- 1"	...	...	...	41	1	42
9'- 2"	...	...	...	37	5	42
9'- 3"	...	...	...	34	8	42
9'- 4"	...	...	...	30	13	43
9'- 5"	...	...	...	27	16	43
9'- 6"	...	...	...	23	20	43
9'- 7"	...	...	...	20	24	44
9'- 8"	...	...	...	16	28	44
9'- 9"	...	...	...	13	31	44
9'-10"	...	...	...	9	36	45
10'- 0"	...	...	...	...	45	45

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4½" LINING—9-INCH CUPOLA BLOCKS

Diameter Inside Brickwork	Number Required Per Ring								
	A	B	C	D	E	F	G	H	Total
1′-4″	9	..	..	..	..	..	..	..	9
1′-6″	6	4	..	..	..	..	..	..	10
1′-9″	..	11	..	..	..	..	..	..	11
2′-0″	..	6	6	..	..	..	..	..	12
2′-3″	..	..	13	..	..	..	..	..	13
2′-6″	..	..	..	14	..	..	..	..	14
3′-0″	..	..	..	6	10	..	..	..	16
3′-4″	..	..	..	..	17	..	..	..	17
3′-6″	..	..	..	..	14	4	..	..	18
4′-0″	..	..	..	..	5	15	..	..	20
4′-3″	..	..	..	..	..	21	..	..	21
4′-6″	..	..	..	..	..	14	8	..	22
5′-0″	..	..	..	..	..	..	24	..	24
5′-6″	..	..	..	..	..	..	12	15	27
6′-0″	..	..	..	..	..	..	..	29	29
6′-1″	..	..	..	..	..	..	..	29	29

6″ LINING—ARCH BRICK

12″ x 6″ x 3″ or 13½″ x 6″ x 3″

Diameter Inside Brickwork	Number Required Per Ring				
	No. 3 Arch	No. 2 Arch	No. 1 Arch	Straight	Total
2′-0″	38	...	...	...	38
2′-3″	35	6	...	...	41
2′-6″	31	13	...	...	44
2′-9″	29	19	...	...	48
3′-0″	26	25	...	...	51
3′-3″	22	32	...	...	54
3′-6″	19	38	...	...	57
3′-9″	16	44	...	...	60
4′-0″	13	50	...	...	63
4′-3″	9	57	...	...	66
4′-6″	7	63	...	...	70
4′-9″	4	69	...	...	73
5′-0″	...	76	...	...	76
5′-3″	...	72	7	...	79
5′-6″	...	69	13	...	82
5′-9″	...	66	19	...	85
6′-0″	...	63	25	...	88
6′-3″	...	60	32	...	92
6′-6″	...	57	38	...	95
6′-9″	...	54	44	...	98
7′-0″	...	51	50	...	101
7′-3″	...	47	57	...	104
7′-6″	...	44	63	...	107
7′-9″	...	41	69	...	110
8′-0″	...	38	75	...	113
8′-3″	...	35	82	...	117
8′-6″	...	32	88	...	120
8′-9″	...	29	94	...	123
9′-0″	...	25	101	...	126
9′-3″	...	22	107	...	129
9′-6″	...	19	113	...	132
9′-9″	...	16	119	...	135
10′-0″	...	13	126	...	139
10′-3″	...	10	132	...	142
10′-6″	...	7	138	...	145
10′-9″	...	3	145	...	148
11′-0″	...	...	151	...	151
11′-6″	...	...	151	6	157
12′-0″	...	...	151	13	164
12′-6″	...	...	151	19	170

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6" LINING
ROTARY KILN OR CUPOLA BLOCKS
9" x 6" x 4"

Diameter Inside Brickwork	Number Required Per Ring							
	30-42	36-48	42-54	48-60	54-66	60-72	66-78	Total
2'-6"	15	..	..	..	..	..	..	15
2'-9"	8	8	..	..	..	..	..	16
3'-0"	..	17	..	..	..	..	..	17
3'-3"	..	8	10	..	..	..	..	18
3'-6"	..	..	19	..	..	..	..	19
3'-9"	..	..	9	11	..	..	..	20
4'-0"	..	..	..	21	..	..	..	21
4'-3"	..	..	..	10	12	..	..	22
4'-6"	..	..	..	..	23	..	..	23
4'-9"	..	..	..	..	13	11	..	24
5'-0"	..	..	..	..	..	25	..	25
5'-3"	..	..	..	..	..	14	12	26
5'-6"	..	..	..	..	..	..	27	27

Diameter Inside Brickwork	66-78	72-84	78-90	84-96	90-102	96-108	102-114	Total
5'-9"	16	12	..	..	..	..	..	28
6'-0"	..	29	..	..	..	..	..	29
6'-3"	..	18	12	..	..	..	..	30
6'-6"	..	..	31	..	..	..	..	31
6'-9"	..	..	19	13	..	..	..	32
7'-0"	..	..	..	33	..	..	..	33
7'-3"	..	..	..	16	19	..	..	35
7'-6"	..	..	..	..	36	..	..	36
7'-9"	..	..	..	..	17	20	..	37
8'-0"	..	..	..	..	..	38	..	38
8'-3"	..	..	..	..	..	22	17	39
8'-6"	..	..	..	..	..	..	40	40

Diameter Inside Brickwork	102-114	108-120	114-126	120-132	123-135	126-138	Total
8'-9"	22	19	..	..	..	..	41
9'-0"	..	42	..	..	..	..	42
9'-3"	..	24	19	..	..	..	43
9'-6"	..	..	44	..	..	..	44
9'-9"	..	..	36	9	..	..	45
10'-0"	..	..	..	46	..	..	46
10'-3"	..	..	..	..	47	..	47
10'-6"	..	..	..	..	..	48	48

6" LINING—FLAT BACK ARCH BRICK

Diameter Inside Brickwork	Number Required Per Ring			
	No. 2 F.B.A. 9"x6"x(3¼"-2")	No. 1 F.B.A. 9"x6"x(3½"-2½")	F.B. Straight 9"x6"x2½"	Total
1'-4"	26	...	...	26
1'-6"	22	5	...	27
1'-9"	16	14	...	30
2'-0"	11	22	...	33
2'-3"	5	30	...	35
2'-6"	...	38	...	38
3'-0"	...	38	8	46
3'-6"	...	38	15	53
4'-0"	...	38	23	61
4'-6"	...	38	30	68
5'-0"	...	38	38	76
5'-6"	...	38	45	83
6'-0"	...	38	53	91
6'-6"	...	38	60	98
7'-0"	...	38	68	106
7'-6"	...	38	75	113
8'-0"	...	38	83	121
8'-6"	...	38	91	129
9'-0"	...	38	98	136
9'-6"	...	38	106	144
10'-0"	...	38	113	151
10'-6"	...	38	121	159
11'-0"	...	38	128	166
11'-6"	...	38	136	174
12'-0"	...	38	143	181
12'-6"	...	38	151	189
13'-0"	...	38	158	196

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9" LINING—WEDGE BRICK

9" x 4½" x 2½", 9" x 6¾" x 2½" or 9" x 9" x 2½"

Diameter Inside Brickwork	Number Required Per Ring				
	No. 2 Wedge	No. 1 Wedge	No. 1-X Wedge	Straight	Total
2′-3″	57	...	...	...	57
2′-6″	51	10	...	...	61
2′-9″	44	20	...	...	64
3′-0″	38	30	...	...	68
3′-3″	32	40	...	...	72
3′-6″	25	51	...	...	76
3′-9″	19	61	...	...	80
4′-0″	13	70	...	...	83
4′-3″	6	81	...	...	87
4′-6″	...	91	...	...	91
4′-9″	...	88	7	...	95
5′-0″	...	85	13	...	98
5′-3″	...	83	19	...	102
5′-6″	...	81	25	...	106
5′-9″	...	78	32	...	110
6′-0″	...	75	38	...	113
6′-3″	...	73	44	...	117
6′-6″	...	71	50	...	121
6′-9″	...	68	57	...	125
7′-0″	...	66	63	...	129
7′-3″	...	63	69	...	132
7′-6″	...	60	76	...	136
7′-9″	...	58	82	...	140
8′-0″	...	56	88	...	144
8′-3″	...	53	94	...	147
8′-6″	...	50	101	...	151
8′-9″	...	48	107	...	155
9′-0″	...	46	113	...	159
9′-3″	...	43	120	...	163
9′-6″	...	40	126	...	166
9′-9″	...	38	132	...	170
10′-0″	...	35	139	...	174
10′-6″	...	30	151	...	181
11′-0″	...	25	164	...	189
11′-6″	...	20	176	...	196
12′-0″	...	15	189	...	204
12′-6″	...	10	202	...	212
13′-0″	...	5	214	...	219
13′-6″	...	...	227	...	227
14′-0″	...	...	227	7	234
15′-0″	...	...	227	22	249
16′-0″	...	...	227	37	264
17′-0″	...	...	227	52	279
18′-0″	...	...	227	67	294
19′-0″	...	...	227	83	310
20′-0″	...	...	227	98	325
21′-0″	...	...	227	113	340
22′-0″	...	...	227	128	355



9" LINING—WEDGE BRICK

9" x 4½" x 3", 9" x 6¾" x 3" or 9" x 9" x 3"

This table can be used also for 13½" x 9" x 3" arch brick by substituting No. 1, 2, and 3 arch brick for the corresponding wedge brick.

Diameter Inside Brickwork	Number Required Per Ring				
	No. 3 Wedge	No. 2 Wedge	No. 1 Wedge	Straight	Total
3′-0″	57	...	...	...	57
3′-3″	54	6	...	...	60
3′-6″	50	13	...	...	63
3′-9″	47	19	...	...	66
4′-0″	44	26	...	...	70
4′-3″	41	32	...	...	73
4′-6″	38	38	...	...	76
4′-9″	35	44	...	...	79
5′-0″	32	50	...	...	82
5′-3″	28	57	...	...	85
5′-6″	25	63	...	...	88
5′-9″	22	70	...	...	92
6′-0″	19	76	...	...	95
6′-3″	16	82	...	...	98
6′-6″	13	88	...	...	101
6′-9″	10	94	...	...	104
7′-0″	6	101	...	...	107
7′-3″	3	107	...	...	110
7′-6″	...	113	...	...	113
7′-9″	...	110	7	...	117
8′-0″	...	107	13	...	120
8′-3″	...	104	19	...	123
8′-6″	...	101	25	...	126
8′-9″	...	97	32	...	129
9′-0″	...	94	38	...	132
9′-3″	...	91	44	...	135
9′-6″	...	88	51	...	139
9′-9″	...	85	57	...	142
10′-0″	...	82	63	...	145
10′-6″	...	76	75	...	151
11′-0″	...	69	88	...	157
11′-6″	...	63	101	...	164
12′-0″	...	57	113	...	170
12′-6″	...	50	126	...	176
13′-0″	...	44	139	...	183
13′-6″	...	38	151	...	189
14′-0″	...	32	163	...	195
14′-6″	...	25	176	...	201
15′-0″	...	19	189	...	208
15′-6″	...	13	201	...	214
16′-0″	...	6	214	...	220
16′-6″	...	...	226	...	226
17′-0″	...	...	226	7	233
17′-6″	...	...	226	13	239
18′-0″	...	...	226	19	245

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9" LINING—KEY BRICK

9" x 4½" x 2½" or 9" x 4½" x 3"

Diameter Inside Brickwork	Number Required Per Ring					
	No. 4 Key	No. 3 Key	No. 2 Key	No. 1 Key	Straight	Total
1'-6"	26	...	...	...	...	26
2'-0"	17	13	...	...	...	30
2'-6"	9	25	...	...	...	34
3'-0"	...	38	...	...	...	38
3'-6"	...	29	13	...	...	42
4'-0"	...	21	25	...	...	46
4'-6"	...	13	38	...	...	51
5'-0"	...	4	51	...	...	55
5'-3"	...	...	57	...	...	57
5'-6"	...	...	55	4	...	59
6'-0"	...	...	50	13	...	63
6'-6"	...	...	46	21	...	67
7'-0"	...	...	42	30	...	72
7'-6"	...	...	38	38	...	76
8'-0"	...	...	34	46	...	80
8'-6"	...	...	29	55	...	84
9'-0"	...	...	25	63	...	88
9'-6"	...	...	21	72	...	93
10'-0"	...	...	17	80	...	97
10'-6"	...	...	13	88	...	101
11'-0"	...	...	9	96	...	105
11'-6"	...	...	4	105	...	109
12'-0"	...	...	...	113	...	113
12'-6"	...	...	...	113	5	118
13'-0"	...	...	...	113	9	122
13'-6"	...	...	...	113	13	126
14'-0"	...	...	...	113	17	130
14'-6"	...	...	...	113	21	134
15'-0"	...	...	...	113	26	139
15'-6"	...	...	...	113	30	143
16'-0"	...	...	...	113	34	147
16'-6"	...	...	...	113	38	151
17'-0"	...	...	...	113	42	155
17'-6"	...	...	...	113	47	160
18'-0"	...	...	...	113	51	164
18'-6"	...	...	...	113	55	168
19'-0"	...	...	...	113	59	172
19'-6"	...	...	...	113	63	176
20'-0"	...	...	...	113	68	181
20'-6"	...	...	...	113	72	185
21'-0"	...	...	...	113	76	189
21'-6"	...	...	...	113	80	193
22'-0"	...	...	...	113	84	197
22'-6"	...	...	...	113	88	201
23'-0"	...	...	...	113	93	206
23'-6"	...	...	...	113	97	210
24'-0"	...	...	...	113	101	214
24'-6"	...	...	...	113	105	218
25'-0"	...	...	...	113	109	222

9" LINING—KEY BRICK

9" x 6" x 2½" or 9" x 6" x 3"

Diameter Inside Brickwork	Number Required Per Ring				
	No. 3 Key	No. 2 Key	No. 1 Key	Straight	Total
1'- 6"	19	...	...	...	19
2'- 0"	17	5	...	...	22
2'- 6"	15	11	...	...	26
3'- 0"	13	16	...	...	29
3'- 6"	11	21	...	...	32
4'- 0"	9	26	...	...	35
4'- 6"	7	31	...	...	38
5'- 0"	5	36	...	...	41
5'- 6"	2	42	...	...	44
6'- 0"	...	48	...	...	48
6'- 6"	...	45	6	...	51
7'- 0"	...	41	13	...	54
7'- 6"	...	38	19	...	57
8'- 0"	...	34	26	...	60
8'- 6"	...	31	32	...	63
9'- 0"	...	27	39	...	66
9'- 6"	...	24	46	...	70
10'- 0"	...	21	52	...	73
10'- 6"	...	17	59	...	76
11'- 0"	...	13	66	...	79
11'- 6"	...	10	72	...	82
12'- 0"	...	6	79	...	85
12'- 6"	...	3	85	...	88
12'-10"	...	...	90	...	90
13'- 0"	...	...	91	...	91
13'- 6"	...	...	91	4	95
14'- 0"	...	...	91	7	98
14'- 6"	...	...	91	10	101
15'- 0"	...	...	91	13	104
15'- 6"	...	...	91	16	107
16'- 0"	...	...	91	19	110
16'- 6"	...	...	91	22	113
17'- 0"	...	...	91	26	117
17'- 6"	...	...	91	29	120
18'- 0"	...	...	91	32	123
18'- 6"	...	...	91	35	126
19'- 0"	...	...	91	38	129
19'- 6"	...	...	91	41	132
20'- 0"	...	...	91	44	135
20'- 6"	...	...	91	48	139
21'- 0"	...	...	91	51	142
21'- 6"	...	...	91	54	145
22'- 0"	...	...	91	57	148
22'- 6"	...	...	91	60	151
23'- 0"	...	...	91	63	154
23'- 6"	...	...	91	66	157
24'- 0"	...	...	91	70	161
24'- 6"	...	...	91	73	164
25'- 0"	...	...	91	76	167

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9" LINING

ROTARY KILN BLOCKS 9" x 9" x 4"

Diameter Inside Brickwork	Number Required Per Ring							
	48-66	54-72	60-78	66-84	72-90	78-96	84-102	Total
4'-0"	23	..	..	..	..	..	..	23
4'-3"	11	13	..	..	..	..	..	24
4'-6"	..	25	..	..	..	..	..	25
4'-9"	..	14	12	..	..	..	..	26
5'-0"	..	..	27	..	..	..	..	27
5'-3"	..	..	15	13	..	..	..	28
5'-6"	..	..	..	29	..	..	..	29
5'-9"	..	..	..	12	18	..	..	30
6'-0"	..	..	..	..	31	..	..	31
6'-3"	..	..	..	..	14	18	..	32
6'-6"	..	..	..	..	..	33	..	33
6'-9"	..	..	..	..	..	16	19	35
7'-0"	..	..	..	..	..	..	36	36

Diameter Inside Brickwork	84-102	90-108	96-114	102-120	108-126	114-132	117-135	Total
7'-3"	17	20	..	..	..	..	..	37
7'-6"	..	38	..	..	..	..	..	38
7'-9"	..	22	17	..	..	..	..	39
8'-0"	..	..	40	..	..	..	..	40
8'-3"	..	..	27	14	..	..	..	41
8'-6"	..	..	..	42	..	..	..	42
8'-9"	..	..	..	25	18	..	..	43
9'-0"	..	..	..	..	44	..	..	44
9'-3"	..	..	..	..	27	18	..	45
9'-6"	..	..	..	..	..	46	..	46
9'-9"	..	..	..	..	..	..	47	47

Diameter Inside Brickwork	120-138	123-141	126-144	132-150	138-156	144-162	150-168	Total
10'-0"	48	..	..	..	..	..	..	48
10'-3"	..	49	..	..	..	..	..	49
10'-6"	..	..	51	..	..	..	..	51
10'-9"	..	..	14	38	..	..	..	52
11'-0"	..	..	..	53	..	..	..	53
11'-3"	..	..	..	24	30	..	..	54
11'-6"	..	..	..	..	55	..	..	55
11'-9"	..	..	..	..	34	22	..	56
12'-0"	..	..	..	..	..	57	..	57
12'-3"	..	..	..	..	..	24	34	58
12'-6"	..	..	..	..	..	..	59	59



12" LINING—KEY BRICK

12" x 6" x 2½" or 12" x 6" x 3"

Diameter Inside Brickwork	Number Required Per Ring			
	No. 2 Key	No. 1 Key	Straight	Total
10'-0"	76	...	...	76
10'-6"	72	7	...	79
11'-0"	69	13	...	82
11'-6"	66	19	...	85
12'-0"	63	25	...	88
12'-6"	60	32	...	92
13'-0"	57	38	...	95
13'-6"	54	44	...	98
14'-0"	51	50	...	101
14'-6"	47	57	...	104
15'-0"	44	63	...	107
15'-6"	41	69	...	110
16'-0"	38	75	...	113
16'-6"	35	82	...	117
17'-0"	32	88	...	120
17'-6"	29	94	...	123
18'-0"	25	101	...	126
18'-6"	22	107	...	129
19'-0"	19	113	...	132
19'-6"	16	119	...	135
20'-0"	13	126	...	139
20'-6"	10	132	...	142
21'-0"	7	138	...	145
21'-6"	3	145	...	148
22'-0"	...	151	...	151
22'-6"	...	151	3	154
23'-0"	...	151	6	157
23'-6"	...	151	10	161
24'-0"	...	151	13	164
24'-6"	...	151	16	167
25'-0"	...	151	19	170
25'-6"	...	151	22	173
26'-0"	...	151	25	176
26'-6"	...	151	28	179
27'-0"	...	151	32	183
27'-6"	...	151	35	186
28'-0"	...	151	38	189
28'-6"	...	151	41	192
29'-0"	...	151	44	195
29'-6"	...	151	47	198
30'-0"	...	151	50	201
30'-6"	...	151	54	205
31'-0"	...	151	57	208
31'-6"	...	151	60	211
32'-0"	...	151	63	214
32'-6"	...	151	66	217
33'-0"	...	151	69	220
33'-6"	...	151	72	223

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12" LINING—WEDGE BRICK

12" x 4½" x 3", 12" x 6" x 3" or 12" x 9" x 3"

Diameter Inside Brickwork	Number Required Per Ring					
	No. 3 Wedge	No. 2 Wedge	No. 1 Wedge	No. 1-X* Wedge	Straight	Total
4'- 0"	76	...	...	...	...	76
4'- 6"	69	13	...	...	...	82
5'- 0"	63	25	...	...	...	8[illegible]
5'- 6"	57	38	...	...	...	9
6'- 0"	51	50	...	...	...	1 1
6'- 6"	44	63	...	...	...	07
7'- 0"	38	75	...	...	...	113
7'- 6"	32	88	...	...	...	12
8'- 0"	25	101	...	...	...	1 6
8'- 6"	19	113	...	...	...	132
9'- 0"	13	126	...	...	...	139
9'- 6"	7	138	...	...	...	145
10'- 0"	...	151	...	...	...	151
10'- 6"	...	144	13	...	...	157
11'- 0"	...	139	25	...	...	164
11'- 6"	...	132	38	...	...	170
12'- 0"	...	126	50	...	...	176
12'- 6"	...	120	63	...	...	183
13'- 0"	...	113	76	...	...	189
13'- 6"	...	107	88	...	...	195
14'- 0"	...	101	100	...	...	201
14'- 6"	...	95	113	...	...	208
15'- 0"	...	88	126	...	...	214
15'- 6"	...	82	138	...	...	220
16'- 0"	...	76	151	...	...	227
16'- 6"	...	69	164	...	...	233
17'- 0"	...	63	176	...	...	239
17'- 6"	...	57	188	...	...	245
18'- 0"	...	51	201	...	...	252
18'- 6"	...	44	214	...	...	258
19'- 0"	...	38	226	...	...	264
19'- 6"	...	32	239	...	...	271
20'- 0"	...	25	252	...	...	277
20'- 6"	...	19	264	...	...	283
21'- 0"	...	13	276	...	...	289
21'- 6"	...	7	289	...	...	296
22'- 0"	...	...	302	...	...	302
22'- 6"	...	...	295	13	...	308
23'- 0"	...	...	289	26	...	315
23'- 6"	...	...	283	38	...	321
24'- 0"	...	...	277	50	...	327
24'- 6"	...	...	270	63	...	333
25'- 0"	...	...	264	76	...	340
25'- 6"	...	...	258	88	...	346
26'- 0"	...	...	251	101	...	352
26'- 6"	...	...	245	114	...	359

Continued on next page



12" LINING—WEDGE BRICK

12" x 4½" x 3", 12" x 6" x 3" or 12" x 9" x 3"
—Concluded

Diameter Inside Brickwork	Number Required Per Ring					
	No. 3 Wedge	No. 2 Wedge	No. 1 Wedge	No. 1-X* Wedge	Straight	Total
27'-0"	...	...	239	126	...	365
27'-6"	...	...	233	138	...	371
28'-0"	...	...	226	151	...	377
28'-6"	...	...	220	164	...	384
29'-0"	...	...	214	176	...	390
29'-6"	...	...	207	189	...	396
30'-0"	...	...	202	201	...	403
30'-6"	...	...	195	214	...	409
31'-0"	...	...	189	226	...	415
31'-6"	...	...	182	239	...	421
32'-0"	...	...	176	252	...	428
32'-6"	...	...	170	264	...	434
33'-0"	...	...	163	277	...	440
33'-6"	...	...	158	289	...	447
34'-0"	...	...	151	302	...	453
34'-6"	...	...	145	314	...	459
35'-0"	...	...	138	327	...	465
35'-6"	...	...	132	340	...	472
36'-0"	...	...	126	352	...	478
36'-6"	...	...	119	365	...	484
37'-0"	...	...	113	377	...	490
37'-6"	...	...	107	390	...	497
38'-0"	...	...	101	402	...	503
38'-6"	...	...	94	415	...	509
39'-0"	...	...	88	428	...	516
39'-6"	...	...	82	440	...	522
40'-0"	...	...	76	452	...	528
40'-6"	...	...	69	465	...	534
41'-0"	...	...	63	478	...	541
41'-6"	...	...	57	490	...	547
42'-0"	...	...	50	503	...	553
42'-6"	...	...	44	516	...	560
43'-0"	...	...	38	528	...	566
43'-6"	...	...	32	540	...	572
44'-0"	...	...	25	553	...	578
44'-6"	...	...	19	566	...	585
45'-0"	...	...	13	578	...	591
45'-6"	...	...	6	591	...	597
46'-0"	...	...	...	604	...	604
46'-6"	...	...	...	604	6	610
47'-0"	...	...	...	604	12	616
47'-6"	...	...	...	604	18	622
48'-0"	...	...	...	604	25	629
48'-6"	...	...	...	604	31	635

*NOTE: The No. 1-X Wedge is standard in Silica Materials only. For Fireclay Material, in the case of diameters 22'-0", use combinations of No. 1 Wedge and Straight brick. The quantity of No. 1 Wedge brick remains constant at 302. The quantity of Straight brick is determined by subtracting 302 from the quantity given in the column "Total."

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NARCO

13½" LINING—WEDGE BRICK

13½" x 4½" x 3", 13½" x 6" x 3" or 13½" x 9" x 3"

Diameter Inside Brickwork	Number Required Per Ring					
	No. 3 Wedge	No. 2 Wedge	No. 1 Wedge	No. 1-X* Wedge	Straight	Total
4′-6″	85	...	...	...	...	85
5′-0″	79	13	...	...	...	92
5′-6″	73	25	...	...	...	98
6′-0″	66	38	...	...	...	104
6′-6″	60	50	...	...	...	110
7′-0″	54	63	...	...	...	117
7′-6″	47	76	...	...	...	123
8′-0″	41	88	...	...	...	129
8′-6″	35	100	...	...	...	135
9′-0″	29	113	...	...	...	142
9′-6″	22	126	...	...	...	148
10′-0″	16	138	...	...	...	154
10′-6″	10	151	...	...	...	161
11′-0″	3	164	...	...	...	167
11′-3″	...	170	...	...	...	170
11′-6″	...	167	6	...	...	173
12′-0″	...	160	19	...	...	179
12′-6″	...	154	32	...	...	186
13′-0″	...	148	44	...	...	192
13′-6″	...	141	57	...	...	198
14′-0″	...	135	70	...	...	205
14′-6″	...	129	82	...	...	211
15′-0″	...	123	94	...	...	217
15′-6″	...	116	107	...	...	223
16′-0″	...	110	120	...	...	230
16′-6″	...	104	132	...	...	236
17′-0″	...	97	145	...	...	242
17′-6″	...	92	157	...	...	249
18′-0″	...	85	170	...	...	255
18′-6″	...	79	182	...	...	261
19′-0″	...	72	195	...	...	267
19′-6″	...	66	208	...	...	274
20′-0″	...	60	220	...	...	280
20′-6″	...	53	233	...	...	286
21′-0″	...	48	245	...	...	293
21′-6″	...	41	258	...	...	299
22′-0″	...	35	270	...	...	305
22′-6″	...	28	283	...	...	311
23′-0″	...	22	296	...	...	318
23′-6″	...	16	308	...	...	324
24′-0″	...	9	321	...	...	330
24′-6″	...	4	333	...	...	337
24′-9″	...	...	340	...	...	340
25′-0″	...	...	336	7	...	343
25′-6″	...	...	330	19	...	349
26′-0″	...	...	324	31	...	355
26′-6″	...	...	318	44	...	362
27′-0″	...	...	311	57	...	368
27′-6″	...	...	305	69	...	374

Continued on next page

Diameter Inside Brickwork	Number Required Per Ring					
	No. 3 Wedge	No. 2 Wedge	No. 1 Wedge	No. 1-X* Wedge	Straight	Total
28′-0″	...	...	299	82	...	381
28′-6″	...	...	292	95	...	387
29′-0″	...	...	286	107	...	393
29′-6″	...	...	280	119	...	399
30′-0″	...	...	274	132	...	406
30′-6″	...	...	267	145	...	412
31′-0″	...	...	261	157	...	418
31′-6″	...	...	255	170	...	425
32′-0″	...	...	248	183	...	431
32′-6″	...	...	242	195	...	437
33′-0″	...	...	236	207	...	443
33′-6″	...	...	230	220	...	450
34′-0″	...	...	223	233	...	456
34′-6″	...	...	217	245	...	462
35′-0″	...	...	210	258	...	468
35′-6″	...	...	205	270	...	475
36′-0″	...	...	198	283	...	481
36′-6″	...	...	192	295	...	487
37′-0″	...	...	186	308	...	494
37′-6″	...	...	179	321	...	500
38′-0″	...	...	173	333	...	506
38′-6″	...	...	166	346	...	512
39′-0″	...	...	161	358	...	519
39′-6″	...	...	154	371	...	525
40′-0″	...	...	148	383	...	531
40′-6″	...	...	142	396	...	538
41′-0″	...	...	135	409	...	544
41′-6″	...	...	129	421	...	550
42′-0″	...	...	122	434	...	556
42′-6″	...	...	117	446	...	563
43′-0″	...	...	110	459	...	569
43′-6″	...	...	104	471	...	575
44′-0″	...	...	98	484	...	582
44′-6″	...	...	91	497	...	588
45′-0″	...	...	85	509	...	594
45′-6″	...	...	79	521	...	600
46′-0″	...	...	73	534	...	607
46′-6″	...	...	66	547	...	613
47′-0″	...	...	60	559	...	619
47′-6″	...	...	54	572	...	626
48′-0″	...	...	47	585	...	632
48′-6″	...	...	41	597	...	638
49′-0″	...	...	35	609	...	644
49′-6″	...	...	29	622	...	651
50′-0″	...	...	22	635	...	657
50′-6″	...	...	16	647	...	663
51′-0″	...	...	10	660	...	670
51′-6″	...	...	3	673	...	676
51′-9″	...	...	...	679	...	679
52′-0″	...	...	...	679	3	682
52′-6″	...	...	...	679	9	688

*NOTE: The No. 1-X Wedge is standard in Silica Material only. For Fireclay material, in the case of diameters over 24′-9″, use combinations of No. 1 Wedge and Straight brick. The quantity of No. 1 Wedge brick remains constant at 340. The quantity of Straight brick is determined by substracting 340 from the quantity given in the column "Total".

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13½" LINING—KEY BRICK

13½" x 6" x 2½" or 13½" x 6" x 3"

Diameter Inside Brickwork	Number Required Per Ring				
	No. 3 Key	No. 2 Key	No. 1 Key	Straight	Total
2′-3″	29	...	...	...	29
2′-6″	26	4	...	...	30
2′-9″	25	7	...	...	32
3′-0″	23	10	...	...	33
3′-3″	21	14	...	...	35
3′-6″	19	18	...	...	37
3′-9″	18	21	...	...	39
4′-0″	16	24	...	...	40
4′-3″	14	28	...	...	42
4′-6″	12	31	...	...	43
4′-9″	10	34	...	...	44
5′-0″	8	38	...	...	46
5′-3″	7	41	...	...	48
5′-6″	4	45	...	...	49
5′-9″	3	48	...	...	51
6′-0″	...	52	...	...	52
6′-3″	...	51	3	...	54
6′-6″	...	48	7	...	55
6′-9″	...	46	11	...	57
7′-0″	...	43	16	...	59
7′-3″	...	41	20	...	61
7′-6″	...	38	24	...	62
7′-9″	...	36	28	...	64
8′-0″	...	33	32	...	65
8′-3″	...	31	36	...	67
8′-6″	...	28	40	...	68
8′-9″	...	26	44	...	70
9′-0″	...	23	48	...	71
9′-3″	...	21	52	...	73
9′-6″	...	18	56	...	74
9′-9″	...	16	60	...	76
10′-0″	...	13	64	...	77
10′-3″	...	11	68	...	79
10′-6″	...	8	73	...	81
10′-9″	...	5	77	...	82
11′-0″	...	3	81	...	84
11′-3″	...	...	85	...	85
11′-6″	...	...	85	2	87
11′-9″	...	...	85	3	88
12′-0″	...	...	85	5	90
12′-6″	...	...	85	8	93
13′-0″	...	...	85	11	96
13′-6″	...	...	85	14	99
14′-0″	...	...	85	18	103
14′-6″	...	...	85	21	106
15′-0″	...	...	85	24	109
15′-6″	...	...	85	27	112

Continued on next page



13½" LINING—KEY BRICK

13½" x 6" x 2½" or 13½" x 6" x 3"—Concluded

Diameter Inside Brickwork	Number Required Per Ring				
	No. 3 Key	No. 2 Key	No. 1 Key	Straight	Total
16′-0″	...	...	85	30	115
16′-6″	...	...	85	33	118
17′-0″	...	...	85	36	121
17′-6″	...	...	85	39	124
18′-0″	...	...	85	43	128
18′-6″	...	...	85	46	131
19′-0″	...	...	85	49	134
19′-6″	...	...	85	52	137
20′-0″	...	...	85	55	140
20′-6″	...	...	85	58	143
21′-0″	...	...	85	61	146
21′-6″	...	...	85	65	150
22′-0″	...	...	85	68	153
22′-6″	...	...	85	71	156
23′-0″	...	...	85	74	159
23′-6″	...	...	85	77	162
24′-0″	...	...	85	80	165
24′-6″	...	...	85	83	168
25′-0″	...	...	85	87	172
25′-6″	...	...	85	90	175
26′-0″	...	...	85	93	178
26′-6″	...	...	85	96	181
27′-0″	...	...	85	99	184
27′-6″	...	...	85	102	187
28′-0″	...	...	85	105	190
28′-6″	...	...	85	109	194
29′-0″	...	...	85	112	197
29′-6″	...	...	85	115	200
30′-0″	...	...	85	118	203
30′-6″	...	...	85	121	206
31′-0″	...	...	85	124	209
31′-6″	...	...	85	127	212
32′-0″	...	...	85	131	216
32′-6″	...	...	85	134	219
33′-0″	...	...	85	137	222
33′-6″	...	...	85	140	225
34′-0″	...	...	85	143	228
34′-6″	...	...	85	146	231
35′-0″	...	...	85	149	234
35′-6″	...	...	85	153	238
36′-0″	...	...	85	156	241
36′-6″	...	...	85	159	244
37′-0″	...	...	85	162	247
37′-6″	...	...	85	165	250
38′-0″	...	...	85	168	253
38′-6″	...	...	85	171	256
39′-0″	...	...	85	175	260
39′-6″	...	...	85	178	263
40′-0″	...	...	85	181	266

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4½" ARCH THICKNESS — ARCH BRICK

9" x 4½" x 2½" or 13½" x 4½" x 2½"
1½" Rise Per Foot of Span

Span	Rise	Inside Radius	Number Required Per Course			
			No. 2 Arch	No. 1 Arch	Straight	Total
1'- 0"	1½"	1'- 0 ¾"	5	2	..	7
1'- 1"	1⅝"	1'- 1 13/16"	5	3	..	8
1'- 2"	1¾"	1'- 2 ⅞"	4	4	..	8
1'- 3"	1⅞"	1'- 3 15/16"	4	4	..	8
1'- 4"	2"	1'- 5"	4	5	..	9
1'- 5"	2⅛"	1'- 6 1/16"	3	6	..	9
1'- 6"	2¼"	1'- 7 ⅛"	3	7	..	10
1'- 7"	2⅜"	1'- 8 3/16"	2	8	..	10
1'- 8"	2½"	1'- 9 ¼"	2	8	..	10
1'- 9"	2⅝"	1'-10 5/16"	1	10	..	11
1'-10"	2¾"	1'-11 ⅜"	1	10	..	11
1'-11"	2⅞"	2'- 0 7/16"	1	11	..	12
2'- 0"	3"	2'- 1 ½"	..	12	..	12
2'- 3"	3⅜"	2'- 4 11/16"	..	12	1	13
2'- 6"	3¾"	2'- 7 ⅞"	..	12	3	15
2'- 9"	4⅛"	2'-11 1/16"	..	12	4	16
3'- 0"	4½"	3'- 2 ¼"	..	12	5	17
3'- 3"	4⅞"	3'- 5 7/16"	..	12	6	18
3'- 6"	5¼"	3'- 8 5/8"	..	12	8	20
3'- 9"	5⅝"	3'-11 13/16"	..	12	9	21
4'- 0"	6"	4'- 3"	..	12	10	22
4'- 3"	6⅜"	4'- 6 3/16"	..	12	11	23
4'- 6"	6¾"	4'- 9 ⅜"	..	12	13	25
4'- 9"	7⅛"	5'- 0 9/16"	..	12	14	26
5'- 0"	7½"	5'- 3 ¾"	..	12	15	27
5'- 3"	7⅞"	5'- 6 15/16"	..	12	16	28
5'- 6"	8¼"	5'-10 ⅛"	..	12	18	30
5'- 9"	8⅝"	6'- 1 5/16"	..	12	19	31
6'- 0"	9"	6'- 4 ½"	..	12	20	32
6'- 3"	9⅜"	6'- 7 11/16"	..	12	21	33
6'- 6"	9¾"	6'-10 ⅞"	..	12	23	35

4½" ARCH THICKNESS — ARCH BRICK

9" x 4½" x 3" or 13½" x 4½" x 3"
1½" Rise Per Foot of Span

Span	Rise	Inside Radius	Number Required Per Course				
			No. 3 Arch	No. 2 Arch	No. 1 Arch	Straight	Total
1'- 0"	1½"	1'- 0 ¾"	3	3	..	..	6
1'- 1"	1⅝"	1'- 1 13/16"	3	3	..	..	6
1'- 2"	1¾"	1'- 2 ⅞"	3	4	..	..	7
1'- 3"	1⅞"	1'- 3 15/16"	2	5	..	..	7
1'- 4"	2"	1'- 5"	2	5	..	..	7
1'- 5"	2⅛"	1'- 6 1/16"	2	6	..	..	8
1'- 6"	2¼"	1'- 7 ⅛"	1	7	..	..	8
1'- 7"	2⅜"	1'- 8 3/16"	1	7	..	..	8
1'- 8"	2½"	1'- 9 ¼"	1	8	..	..	9
1'- 9"	2⅝"	1'-10 5/16"	..	9	..	..	9
1'-10"	2¾"	1'-11 ⅜"	..	9	1	..	10
1'-11"	2⅞"	2'- 0 7/16"	..	8	2	..	10
2'- 0"	3"	2'- 1 ½"	..	8	2	..	10
2'- 1"	3⅛"	2'- 2 9/16"	..	8	3	..	11
2'- 2"	3¼"	2'- 3 5/8"	..	7	4	..	11
2'- 3"	3⅜"	2'- 4 11/16"	..	7	4	..	11
2'- 4"	3½"	2'- 5 ¾"	..	7	5	..	12
2'- 5"	3⅝"	2'- 6 13/16"	..	6	6	..	12
2'- 6"	3¾"	2'- 7 ⅞"	..	6	6	..	12
2'- 7"	3⅞"	2'- 8 15/16"	..	6	7	..	13
2'- 8"	4"	2'-10"	..	5	8	..	13
2'- 9"	4⅛"	2'-11 1/16"	..	5	8	..	13
2'-10"	4¼"	3'- 0 ⅛"	..	5	9	..	14
2'-11"	4⅜"	3'- 1 3/16"	..	4	10	..	14
3'- 0"	4½"	3'- 2 ¼"	..	4	10	..	14
3'- 1"	4⅝"	3'- 3 5/16"	..	4	11	..	15
3'- 2"	4¾"	3'- 4 ⅜"	..	3	12	..	15
3'- 3"	4⅞"	3'- 5 7/16"	..	3	12	..	15
3'- 4"	5"	3'- 6 ½"	..	3	13	..	16
3'- 5"	5⅛"	3'- 7 9/16"	..	2	14	..	16
3'- 6"	5¼"	3'- 8 5/8"	..	2	14	..	16
3'- 7"	5⅜"	3'- 9 11/16"	..	2	15	..	17
3'- 8"	5½"	3'-10 ¾"	..	1	16	..	17
3'- 9"	5⅝"	3'-11 13/16"	..	..	17	..	17
3'-10"	5¾"	4'- 0 ⅞"	..	..	18	..	18
3'-11"	5⅞"	4'- 1 15/16"	..	..	18	..	18
4'- 0"	6"	4'- 3"	..	..	18	1	19
4'- 3"	6⅜"	4'- 6 3/16"	..	..	18	2	20
4'- 6"	6¾"	4'- 9 ⅜"	..	..	18	3	21
4'- 9"	7⅛"	5'- 0 9/16"	..	..	18	4	22
5'- 0"	7½"	5'- 3 ¾"	..	..	18	5	23
5'- 3"	7⅞"	5'- 6 15/16"	..	..	18	6	24
5'- 6"	8¼"	5'-10 ⅛"	..	..	18	7	25
5'- 9"	8⅝"	6'- 1 5/16"	..	..	18	8	26
6'- 0"	9"	6'- 4 ½"	..	..	18	9	27

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4½" ARCH THICKNESS — ARCH BRICK

9" x 4½" x 2½" or 13½" x 4½" x 2½"
1.608" Rise Per Foot of Span
(60° Central Angle)

Span	Rise	Inside Radius	Number Required Per Course			
			No. 2 Arch	No. 1 Arch	Straight	Total
1'- 0"	1 19/32"	1'- 0"	6	1	..	7
1'- 1"	1 3/4"	1'- 1"	6	2	..	8
1'- 2"	1 7/8"	1'- 2"	5	3	..	8
1'- 3"	2"	1'- 3"	5	4	..	9
1'- 4"	2 5/32"	1'- 4"	4	5	..	9
1'- 5"	2 9/32"	1'- 5"	4	5	..	9
1'- 6"	2 13/32"	1'- 6"	3	7	..	10
1'- 7"	2 17/32"	1'- 7"	3	7	..	10
1'- 8"	2 11/16"	1'- 8"	3	8	..	11
1'- 9"	2 13/16"	1'- 9"	2	9	..	11
1'-10"	2 15/16"	1'-10"	2	10	..	12
1'-11"	3 3/32"	1'-11"	1	11	..	12
2'- 0"	3 7/32"	2'- 0"	1	11	..	12
2'- 1"	3 11/32"	2'- 1"	1	12	..	13
2'- 2"	3 15/32"	2'- 2"	..	13	..	13
2'- 3"	3 5/8"	2'- 3"	..	13	1	14
2'- 6"	4 1/32"	2'- 6"	..	13	2	15
2'- 9"	4 7/16"	2'- 9"	..	13	3	16
3'- 0"	4 13/16"	3'- 0"	..	13	4	17
3'- 3"	5 7/32"	3'- 3"	..	13	6	19
3'- 6"	5 5/8"	3'- 6"	..	13	7	20
3'- 9"	6 1/32"	3'- 9"	..	13	8	21
4'- 0"	6 7/16"	4'- 0"	..	13	9	22
4'- 3"	6 27/32"	4'- 3"	..	13	11	24
4'- 6"	7 1/4"	4'- 6"	..	13	12	25
4'- 9"	7 5/8"	4'- 9"	..	13	13	26
5'- 0"	8 1/32"	5'- 0"	..	13	14	27
5'- 3"	8 7/16"	5'- 3"	..	13	16	29
5'- 6"	8 27/32"	5'- 6"	..	13	17	30
5'- 9"	9 1/4"	5'- 9"	..	13	18	31
6'- 0"	9 21/32"	6'- 0"	..	13	19	32
6'- 3"	10 1/16"	6'- 3"	..	13	21	34
6'- 6"	10 7/16"	6'- 6"	..	13	22	35

4½" ARCH THICKNESS — ARCH BRICK

9" x 4½" x 3" or 13½" x 4½" x 3"
1.608 Rise Per Foot of Span
(60° Central Angle)

Span	Rise	Inside Radius	Number Required Per Course				
			No. 3 Arch	No. 2 Arch	No. 1 Arch	Straight	Total
1'- 0"	1 19/32"	1'- 0"	4	2	..	..	6
1'- 1"	1 3/4"	1'- 1"	4	3	..	..	7
1'- 2"	1 7/8"	1'- 2"	3	4	..	..	7
1'- 3"	2"	1'- 3"	3	4	..	..	7
1'- 4"	2 5/32"	1'- 4"	3	5	..	..	8
1'- 5"	2 9/32"	1'- 5"	2	6	..	..	8
1'- 6"	2 13/32"	1'- 6"	2	6	..	..	8
1'- 7"	2 17/32"	1'- 7"	2	7	..	..	9
1'- 8"	2 11/16"	1'- 8"	1	8	..	..	9
1'- 9"	2 13/16"	1'- 9"	1	8	..	..	9
1'-10"	2 15/16"	1'-10"	1	9	..	..	10
1'-11"	3 3/32"	1'-11"	..	9	1	..	10
2'- 0"	3 7/32"	2'- 0"	..	9	1	..	10
2'- 1"	3 11/32"	2'- 1"	..	9	2	..	11
2'- 2"	3 15/32"	2'- 2"	..	8	3	..	11
2'- 3"	3 5/8"	2'- 3"	..	8	3	..	11
2'- 4"	3 3/4"	2'- 4"	..	8	4	..	12
2'- 5"	3 7/8"	2'- 5"	..	7	5	..	12
2'- 6"	4 1/32"	2'- 6"	..	7	5	..	12
2'- 7"	4 5/32"	2'- 7"	..	7	6	..	13
2'- 8"	4 9/32"	2'- 8"	..	6	7	..	13
2'- 9"	4 7/16"	2'- 9"	..	6	7	..	13
2'-10"	4 9/16"	2'-10"	..	6	8	..	14
2'-11"	4 11/16"	2'-11"	..	5	9	..	14
3'- 0"	4 13/16"	3'- 0"	..	5	10	..	15
3'- 1"	4 31/32"	3'- 1"	..	5	10	..	15
3'- 2"	5 3/32"	3'- 2"	..	4	11	..	15
3'- 3"	5 7/32"	3'- 3"	..	4	12	..	16
3'- 4"	5 11/32"	3'- 4"	..	4	12	..	16
3'- 5"	5 1/2"	3'- 5"	..	3	13	..	16
3'- 6"	5 5/8"	3'- 6"	..	3	14	..	17
3'- 7"	5 3/4"	3'- 7"	..	2	15	..	17
3'- 8"	5 29/32"	3'- 8"	..	2	15	..	17
3'- 9"	6 1/32"	3'- 9"	..	2	16	..	18
3'-10"	6 5/32"	3'-10"	..	1	17	..	18
3'-11"	6 9/32"	3'-11"	..	1	17	..	18
4'- 0"	6 7/16"	4'- 0"	..	1	18	..	19
4'- 1"	6 9/16"	4'- 1"	..	..	19	..	19
4'- 2"	6 11/16"	4'- 2"	..	..	19	..	19
4'- 3"	6 27/32"	4'- 3"	..	..	19	1	20
4'- 6"	7 1/4"	4'- 6"	..	..	19	2	21
5'- 0"	8 1/32"	5'- 0"	..	..	19	4	23
5'- 6"	8 27/32"	5'- 6"	..	..	19	6	25
6'- 0"	9 21/32"	6'- 0"	..	..	19	8	27
6'- 6"	10 7/16"	6'- 6"	..	..	19	10	29

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4½" ARCH THICKNESS — ARCH BRICK

9" x 4½" x 2½" or 13½" x 4½" x 2½"
2" Rise Per Foot of Span

Span	Rise	Inside Radius	Number Required Per Course			
			No. 2 Arch	No. 1 Arch	Straight	Total
1'- 0"	2"	10"	8	..	..	8
1'- 1"	2 5/32"	10 27/32"	8	..	..	8
1'- 2"	2 11/32"	11 21/32"	7	2	..	9
1'- 3"	2 ½"	1'- 0 ½"	7	2	..	9
1'- 4"	2 21/32"	1'- 1 11/32"	7	3	..	10
1'- 5"	2 27/32"	1'- 2 5/32"	6	4	..	10
1'- 6"	3"	1'- 3"	5	5	..	10
1'- 7"	3 5/32"	1'- 3 27/32"	5	6	..	11
1'- 8"	3 11/32"	1'- 4 21/32"	5	6	..	11
1'- 9"	3 ½"	1'- 5 ½"	4	8	..	12
1'-10"	3 21/32"	1'- 6 11/32"	4	8	..	12
1'-11"	3 27/32"	1'- 7 5/32"	4	9	..	13
2'- 0"	4"	1'- 8"	3	10	..	13
2'- 1"	4 5/32"	1'- 8 27/32"	2	11	..	13
2'- 2"	4 11/32"	1'- 9 21/32"	2	12	..	14
2'- 3"	4 ½"	1'-10 ½"	2	12	..	14
2'- 4"	4 21/32"	1'-11 11/32"	1	14	..	15
2'- 5"	4 27/32"	2'- 0 5/32"	1	14	..	15
2'- 6"	5"	2'- 1"	1	15	..	16
2'- 9"	5 ½"	2'- 3 ½"	..	16	1	17
3'- 0"	6"	2'- 6"	..	16	2	18
3'- 3"	6 ½"	2'- 8 ½"	..	16	3	19
3'- 6"	7"	2'-11"	..	16	5	21
3'- 9"	7 ½"	3'- 1 ½"	..	16	6	22
4'- 0"	8"	3'- 4"	..	16	7	23
4'- 3"	8 ½"	3'- 6 ½"	..	16	9	25
4'- 6"	9"	3'- 9"	..	16	10	26
4'- 9"	9 ½"	3'-11 ½"	..	16	11	27
5'- 0"	10"	4'- 2"	..	16	12	28
5'- 3"	10 ½"	4'- 4 ½"	..	16	14	30
5'- 6"	11"	4'- 7"	..	16	15	31
5'- 9"	11 ½"	4'- 9 ½"	..	16	16	32
6'- 0"	1'-0"	5'- 0"	..	16	18	34
6'- 3"	1'-0½"	5'- 2 ½"	..	16	19	35
6'- 6"	1'-1"	5'- 5"	..	16	20	36



4½" ARCH THICKNESS — ARCH BRICK

9" x 4½" x 3" or 13½" x 4½" x 3"
2" Rise Per Foot of Span

Span	Rise	Inside Radius	Number Required Per Course				
			No. 3 Arch	No. 2 Arch	No. 1 Arch	Straight	Total
1'- 0"	2"	10"	6	1	..	..	7
1'- 1"	2 5/32"	10 27/32"	5	2	..	..	7
1'- 2"	2 11/32"	11 21/32"	5	2	..	..	7
1'- 3"	2 ½"	1'- 0 ½"	5	3	..	..	8
1'- 4"	2 21/32"	1'- 1 11/32"	4	4	..	..	8
1'- 5"	2 27/32"	1'- 2 5/32"	4	4	..	..	8
1'- 6"	3"	1'- 3"	4	5	..	..	9
1'- 7"	3 5/32"	1'- 3 27/32"	3	6	..	..	9
1'- 8"	3 11/32"	1'- 4 21/32"	2	7	..	..	9
1'- 9"	3 ½"	1'- 5 ½"	2	8	..	..	10
1'-10"	3 21/32"	1'- 6 11/32"	2	8	..	..	10
1'-11"	3 27/32"	1'- 7 5/32"	2	9	..	..	11
2'- 0"	4"	1'- 8"	1	10	..	..	11
2'- 1"	4 5/32"	1'- 8 27/32"	1	10	..	..	11
2'- 2"	4 11/32"	1'- 9 21/32"	1	11	..	..	12
2'- 3"	4 ½"	1'-10 ½"	..	12	..	..	12
2'- 4"	4 21/32"	1'-11 11/32"	..	11	1	..	12
2'- 5"	4 27/32"	2'- 0 5/32"	..	11	2	..	13
2'- 6"	5"	2'- 1"	..	11	2	..	13
2'- 7"	5 5/32"	2'- 1 27/32"	..	10	3	..	13
2'- 8"	5 11/32"	2'- 2 21/32"	..	10	4	..	14
2'- 9"	5 ½"	2'- 3 ½"	..	10	4	..	14
2'-10"	5 21/32"	2'- 4 11/32"	..	9	5	..	14
2'-11"	5 27/32"	2'- 5 5/32"	..	9	6	..	15
3'- 0"	6"	2'- 6"	..	8	7	..	15
3'- 2"	6 11/32"	2'- 7 21/32"	..	8	8	..	16
3'- 4"	6 21/32"	2'- 9 11/32"	..	7	10	..	17
3'- 6"	7"	2'-11"	..	6	11	..	17
3'- 8"	7 11/32"	3'- 0 21/32"	..	6	12	..	18
3'-10"	7 21/32"	3'- 2 11/32"	..	5	14	..	19
4'- 0"	8"	3'- 4"	..	4	15	..	19
4'- 2"	8 11/32"	3'- 5 21/32"	..	3	17	..	20
4'- 4"	8 21/32"	3'- 7 11/32"	..	3	18	..	21
4'- 6"	9"	3'- 9"	..	2	20	..	22
4'- 8"	8 11/32"	3'-10 21/32"	..	1	21	..	22
4'-10"	9 21/32"	4'- 0 11/32"	..	1	22	..	23
4'-11"	9 27/32"	4'- 1 5/32"	..	..	23	..	23
5'- 0"	10"	4'- 2"	..	..	23	1	24
5'- 6"	11"	4'- 7"	..	..	23	3	26
6'- 0"	1'- 0"	5'- 0"	..	..	23	5	28
6'- 6"	1'- 1"	5'- 5"	..	..	23	7	30

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4½" ARCH THICKNESS — ARCH BRICK

9" x 4½" x 2½" or 13½" x 4½" x 2½"

2 5/16"* Rise Per Foot of Span

Span	Rise	Inside Radius	Number Required Per Course				
			No. 3 Arch	No. 2 Arch	No. 1 Arch	Straight	Total
0'- 6"	1 5/32"	4 1/2"	4	2	..	..	6
0'- 7"	1 11/32"	5 7/32"	3	3	..	..	6
0'- 8"	1 17/32"	5 31/32"	3	4	..	..	7
0'- 9"	1 23/32"	6 23/32"	2	5	..	..	7
0'-10"	1 29/32"	7 15/32"	2	5	..	..	7
0'-11"	2 1/8"	8 7/32"	2	6	..	..	8
1'- 0"	2 5/16"	8 31/32"	1	7	..	..	8
1'- 1"	2 1/2"	9 23/32"	1	8	..	..	9
1'- 2"	2 11/16"	10 15/32"	..	9	..	..	9
1'- 3"	2 7/8"	11 7/32"	..	9	1	..	10
1'- 4"	3 1/16"	11 31/32"	..	8	2	..	10
1'- 5"	3 1/4"	1'- 0 23/32"	..	7	3	..	10
1'- 6"	3 15/32"	1'- 1 15/32"	..	7	4	..	11
1'- 7"	3 21/32"	1'- 2 3/16"	..	7	4	..	11
1'- 8"	3 27/32"	1'- 2 15/16"	..	6	6	..	12
1'- 9"	4 1/32"	1'- 3 11/16"	..	6	6	..	12
1'-10"	4 7/32"	1'- 4 7/16"	..	6	7	..	13
1'-11"	4 13/32"	1'- 5 3/16"	..	5	8	..	13
2'- 0"	4 19/32"	1'- 5 15/16"	..	5	9	..	14
2'- 1"	4 25/32"	1'- 6 11/16"	..	4	10	..	14
2'- 2"	5"	1'- 7 7/16"	..	4	10	..	14
2'- 3"	5 3/16"	1'- 8 3/16"	..	3	12	..	15
2'- 4"	5 3/8"	1'- 8 15/16"	..	3	12	..	15
2'- 5"	5 9/16"	1'- 9 11/16"	..	3	13	..	16
2'- 6"	5 3/4"	1'-10 7/16"	..	2	14	..	16
2'- 7"	5 15/16"	1'-11 5/32"	..	2	15	..	17
2'- 8"	6 1/8"	1'-11 29/32"	..	1	16	..	17
2'- 9"	6 11/32"	2'- 0 21/32"	..	..	17	..	17
2'-10"	6 17/32"	2'- 1 13/32"	..	..	18	..	18
2'-11"	6 23/32"	2'- 2 5/32"	..	..	18	..	18
3'- 0"	6 29/32"	2'- 2 29/32"	..	..	18	1	19
3'- 1"	7 3/32"	2'- 3 21/32"	..	..	18	1	19
3'- 2"	7 9/32"	2'- 4 13/32"	..	..	18	2	20
3'- 3"	7 15/32"	2'- 5 5/32"	..	..	18	2	20
3'- 4"	7 11/16"	2'- 5 29/32"	..	..	18	3	21
3'- 5"	7 7/8"	2'- 6 21/32"	..	..	18	3	21
3'- 6"	8 1/16"	2'- 7 13/32"	..	..	18	3	21
4'- 0"	9 7/32"	2'-11 7/8"	..	..	18	6	24
4'- 6"	10 3/8"	3'- 4 3/8"	..	..	18	9	27
5'- 0"	11 1/2"	3'- 8 27/32"	..	..	18	11	29
5'- 6"	1'-0 21/32"	4'- 1 11/32"	..	..	18	14	32
6'- 0"	1'-1 13/16"	4'- 5 13/16"	..	..	18	17	35
6'- 6"	1'-2 31/32"	4'-10 5/16"	..	..	18	19	37

* More exactly 2.302".

4½" ARCH THICKNESS — ARCH BRICK

9" x 4½" x 3" or 13½" x 4½" x 3"

2 5/16"* Rise Per Foot of Span

Span	Rise	Inside Radius	Number Required Per Course				
			No. 3 Arch	No. 2 Arch	No. 1 Arch	Straight	Total
1'- 0"	2 5/16"	8 31/32"	7	..	..	..	7
1'- 1"	2 1/2"	9 23/32"	6	1	..	..	7
1'- 2"	2 11/16"	10 15/32"	6	2	..	..	8
1'- 3"	2 7/8"	11 7/32"	6	2	..	..	8
1'- 4"	3 1/16"	11 31/32"	5	3	..	..	8
1'- 5"	3 1/4"	1'- 0 29/32"	5	4	..	..	9
1'- 6"	3 15/32"	1'- 1 15/32"	5	4	..	..	9
1'- 7"	3 21/32"	1'- 2 3/16"	4	6	..	..	10
1'- 8"	3 27/32"	1'- 2 15/16"	4	6	..	..	10
1'- 9"	4 1/32"	1'- 3 11/16"	3	7	..	..	10
1'-10"	4 7/32"	1'- 4 7/16"	3	8	..	..	11
1'-11"	4 13/32"	1'- 5 3/16"	3	8	..	..	11
2'- 0"	4 19/32"	1'- 5 15/16"	2	9	..	..	11
2'- 1"	4 25/32"	1'- 6 11/16"	2	10	..	..	12
2'- 2"	5"	1'- 7 7/16"	2	10	..	..	12
2'- 3"	5 3/16"	1'- 8 3/16"	1	11	..	..	12
2'- 4"	5 3/8"	1'- 8 15/16"	1	12	..	..	13
2'- 5"	5 9/16"	1'- 9 11/16"	1	12	..	..	13
2'- 6"	5 3/4"	1'-10 7/16"	..	14	..	..	14
2'- 7"	5 15/16"	1'-11 5/32"	..	13	1	..	14
2'- 8"	6 1/8"	1'-11 29/32"	..	13	1	..	14
2'-10"	6 17/32"	2'- 1 13/32"	..	12	3	..	15
3'- 0"	6 29/32"	2'- 2 29/32"	..	11	5	..	16
3'- 2"	7 9/32"	2'- 4 13/32"	..	10	6	..	16
3'- 4"	7 11/16"	2'- 5 29/32"	..	10	7	..	17
3'- 6"	8 1/16"	2'- 7 13/32"	..	9	9	..	18
3'- 8"	8 7/16"	2'- 8 7/8"	..	8	11	..	19
3'-10"	8 13/16"	2'-10 3/8"	..	7	12	..	19
4'- 0"	9 7/32"	2'-11 7/8"	..	7	13	..	20
4'- 2"	9 19/32"	3'- 1 3/8"	..	6	15	..	21
4'- 4"	9 31/32"	3'- 2 7/8"	..	6	16	..	22
4'- 6"	10 3/8"	3'- 4 3/8"	..	5	17	..	22
4'- 8"	10 3/4"	3'- 5 27/32"	..	4	19	..	23
4'-10"	11 1/8"	3'- 7 11/32"	..	3	21	..	24
5'- 0"	11 1/2"	3'- 8 27/32"	..	3	22	..	25
5'- 2"	11 29/32"	3'-10 11/32"	..	2	23	..	25
5'- 4"	1'-0 9/32"	3'-11 27/32"	..	1	25	..	26
5'- 6"	1'-0 21/32"	4'- 1 11/32"	..	..	27	..	27
5'- 8"	1'-1 1/16"	4'- 2 13/16"	..	..	27	..	27
5'-10"	1'-1 7/16"	4'- 4 5/16"	..	..	27	1	28
6'- 0"	1'-1 13/16"	4'- 5 13/16"	..	..	27	2	29
6'- 6"	1'-2 31/32"	4'-10 5/16"	..	..	27	4	31

* More exactly 2.302".

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9" ARCH THICKNESS — WEDGE BRICK

9" x 4½" x 2½", 9" x 6¾" x 2½" or 9" x 9" x 2½"

1½" Rise Per Foot of Span

Span	Rise	Inside Radius	Number Required Per Course: No. 2 Wedge	No. 1 Wedge	No. 1-X Wedge	Straight	Total
1'- 6"	2¼"	1'- 7 1/8"	5	6	..	..	11
1'- 7"	2⅜"	1'- 8 3/16"	5	7	..	..	12
1'- 8"	2½"	1'- 9 ¼"	4	8	..	..	12
1'- 9"	2⅝"	1'-10 5/16"	3	10	..	..	13
1'-10"	2¾"	1'-11 ⅜"	3	10	..	..	13
1'-11"	2⅞"	2'- 0 7/16"	2	12	..	..	14
2'- 0"	3"	2'- 1 ½"	1	13	..	..	14
2'- 1"	3⅛"	2'- 2 9/16"	..	14	..	..	14
2'- 2"	3¼"	2'- 3 ⅝"	..	14	1	..	15
2'- 3"	3⅜"	2'- 4 11/16"	..	14	1	..	15
2'- 4"	3½"	2'- 5 ¾"	..	14	2	..	16
2'- 5"	3⅝"	2'- 6 13/16"	..	13	3	..	16
2'- 6"	3¾"	2'- 7 ⅞"	..	13	3	..	16
2'- 7"	3⅞"	2'- 8 15/16"	..	13	4	..	17
2'- 8"	4"	2'-10"	..	12	5	..	17
2'- 9"	4⅛"	2'-11 1/16"	..	12	6	..	18
2'-10"	4¼"	3'- 0 1/8"	..	12	6	..	18
2'-11"	4⅜"	3'- 1 3/16"	..	12	7	..	19
3'- 0"	4½"	3'- 2 ¼"	..	11	8	..	19
3'- 1"	4⅝"	3'- 3 5/16"	..	11	8	..	19
3'- 2"	4¾"	3'- 4 ⅜"	..	11	9	..	20
3'- 3"	4⅞"	3'- 5 7/16"	..	10	10	..	20
3'- 4"	5"	3'- 6 ½"	..	10	11	..	21
3'- 5"	5⅛"	3'- 7 9/16"	..	10	11	..	21
3'- 6"	5¼"	3'- 8 ⅝"	..	10	11	..	21
3'- 7"	5⅜"	3'- 9 11/16"	..	10	12	..	22
3'- 8"	5½"	3'-10 ¾"	..	9	13	..	22
3'- 9"	5⅝"	3'-11 13/16"	..	9	14	..	23
3'-10"	5¾"	4'- 0 ⅞"	..	9	14	..	23
3'-11"	5⅞"	4'- 1 15/16"	..	9	15	..	24
4'- 0"	6"	4'- 3"	..	8	16	..	24
4'- 1"	6⅛"	4'- 4 1/16"	..	8	16	..	24
4'- 2"	6¼"	4'- 5 1/8"	..	8	17	..	25
4'- 3"	6⅜"	4'- 6 3/16"	..	7	18	..	25
4'- 4"	6½"	4'- 7 ¼"	..	7	19	..	26
4'- 5"	6⅝"	4'- 8 5/16"	..	7	19	..	26
4'- 6"	6¾"	4'- 9 ⅜"	..	6	20	..	26
4'- 7"	6⅞"	4'-10 7/16"	..	6	21	..	27
4'- 8"	7"	4'-11 ½"	..	6	21	..	27
4'- 9"	7⅛"	5'- 0 9/16"	..	6	22	..	28
4'-10"	7¼"	5'- 1 ⅝"	..	5	23	..	28
4'-11"	7⅜"	5'- 2 11/16"	..	5	23	..	28
5'- 0"	7½"	5'- 3 ¾"	..	5	24	..	29
5'- 1"	7⅝"	5'- 4 13/16"	..	4	25	..	29
5'- 2"	7¾"	5'- 5 ⅞"	..	4	26	..	30

Continued on next page



9" ARCH THICKNESS — WEDGE BRICK

9" x 4½" x 2½", 9" x 6¾" x 2½" or 9" x 9" x 2½"—Concluded

1½" Rise Per Foot of Span

Span	Rise	Inside Radius	Number Required Per Course: No. 2 Wedge	No. 1 Wedge	No. 1-X Wedge	Straight	Total
5'- 3"	7⅞"	5'- 6 15/16"	..	4	26	..	30
5'- 4"	8"	5'- 8"	..	4	27	..	31
5'- 5"	8⅛"	5'- 9 1/16"	..	3	28	..	31
5'- 6"	8¼"	5'-10 ⅛"	..	3	28	..	31
5'- 7"	8⅜"	5'-11 3/16"	..	3	29	..	32
5'- 8"	8½"	6'- 0 ¼"	..	2	30	..	32
5'- 9"	8⅝"	6'- 1 5/16"	..	2	31	..	33
5'-10"	8¾"	6'- 2 ⅜"	..	2	31	..	33
5'-11"	8⅞"	6'- 3 7/16"	..	1	32	..	33
6'- 0"	9"	6'- 4 ½"	..	1	33	..	34
6'- 1"	9⅛"	6'- 5 9/16"	..	1	33	..	34
6'- 2"	9¼"	6'- 6 ⅝"	..	1	34	..	35
6'- 3"	9⅜"	6'- 7 11/16"	..	..	35	..	35
6'- 4"	9½"	6'- 8 ¾"	..	..	36	..	36
6'- 5"	9⅝"	6'- 9 13/16"	..	..	36	..	36
6'- 6"	9¾"	6'-10 ⅞"	..	..	36	..	36
6'- 9"	10⅛"	7'- 2 1/16"	..	..	36	2	38
7'- 0"	10½"	7'- 5 ¼"	..	..	36	3	39
7'- 3"	10⅞"	7'- 8 7/16"	..	..	36	4	40
7'- 6"	11¼"	7'-11 ⅝"	..	..	36	5	41
7'- 9"	11⅝"	8'- 2 13/16"	..	..	36	7	43
8'- 0"	1'-0"	8'- 6"	..	..	36	8	44
8'- 3"	1'-0⅜"	8'- 9 3/16"	..	..	36	9	45
8'- 6"	1'-0¾"	9'- 0 ⅜"	..	..	36	10	46
8'- 9"	1'-1⅛"	9'- 3 9/16"	..	..	36	12	48
9'- 0"	1'-1½"	9'- 6 ¾"	..	..	36	13	49
9'- 3"	1'-1⅞"	9'- 9 15/16"	..	..	36	14	50
9'- 6"	1'-2¼"	10'- 1 ⅛"	..	..	36	15	51
9'- 9"	1'-2⅝"	10'- 4 5/16"	..	..	36	17	53
10'- 0"	1'-3"	10'- 7 ½"	..	..	36	18	54
10'- 3"	1'-3⅜"	10'-10 11/16"	..	..	36	19	55
10'- 6"	1'-3¾"	11'- 1 ⅞"	..	..	36	20	56
10'- 9"	1'-4⅛"	11'- 5 1/16"	..	..	36	22	58
11'- 0"	1'-4½"	11'- 8 ¼"	..	..	36	23	59
11'- 3"	1'-4⅞"	11'-11 7/16"	..	..	36	24	60
11'- 6"	1'-5¼"	12'- 2 ⅝"	..	..	36	25	61
11'- 9"	1'-5⅝"	12'- 5 13/16"	..	..	36	27	63
12'- 0"	1'-6"	12'- 9"	..	..	36	28	64
12'- 3"	1'-6⅜"	13'- 0 3/16"	..	..	36	29	65
12'- 6"	1'-6¾"	13'- 3 ⅜"	..	..	36	30	66
12'- 9"	1'-7⅛"	13'- 6 9/16"	..	..	36	32	68
13'- 0"	1'-7½"	13'- 9 ¾"	..	..	36	33	69
13'- 3"	1'-7⅞"	14'- 0 15/16"	..	..	36	34	70
13'- 6"	1'-8¼"	14'- 4 ⅛"	..	..	36	35	71
13'- 9"	1'-8⅝"	14'- 7 5/16"	..	..	36	37	73

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9" ARCH THICKNESS — WEDGE BRICK

9" x 4½" x 3", 9" x 6¾" x 3" or 9" x 9" x 3"

1½" Rise Per Foot of Span

This table can be used also for 13½" x 9" x 3" arch brick by substituting Nos. 1, 2 and 3 arch brick for the corresponding wedge brick.

Span	Rise	Inside Radius	Number Required Per Course			
			No. 3 Wedge	No. 2 Wedge	No. 1 Wedge	Total
1'- 6"	2¼"	1'- 7 ⅛"	9	1	..	10
1'- 7"	2⅜"	1'- 8 3/16"	8	2	..	10
1'- 8"	2½"	1'- 9 ¼"	8	2	..	10
1'- 9"	2⅝"	1'-10 5/16"	8	3	..	11
1'-10"	2¾"	1'-11 ⅜"	7	4	..	11
1'-11"	2⅞"	2'- 0 7/16"	7	4	..	11
2'- 0"	3"	2'- 1 ½"	7	5	..	12
2'- 1"	3⅛"	2'- 2 9/16"	6	6	..	12
2'- 2"	3¼"	2'- 3 ⅝"	6	6	..	12
2'- 3"	3⅜"	2'- 4 11/16"	6	7	..	13
2'- 4"	3½"	2'- 5 ¾"	5	8	..	13
2'- 5"	3⅝"	2'- 6 13/16"	5	8	..	13
2'- 6"	3¾"	2'- 7 ⅞"	5	9	..	14
2'- 7"	3⅞"	2'- 8 15/16"	4	10	..	14
2'- 8"	4"	2'-10"	4	10	..	14
2'- 9"	4⅛"	2'-11 1/16"	4	11	..	15
2'-10"	4¼"	3'- 0 ⅛"	3	12	..	15
2'-11"	4⅜"	3'- 1 3/16"	3	12	..	15
3'- 0"	4½"	3'- 2 ¼"	3	13	..	16
3'- 1"	4⅝"	3'- 3 5/16"	2	14	..	16
3'- 2"	4¾"	3'- 4 ⅜"	2	15	..	17
3'- 3"	4⅞"	3'- 5 7/16"	1	16	..	17
3'- 4"	5"	3'- 6 ½"	1	16	..	17
3'- 5"	5⅛"	3'- 7 9/16"	1	17	..	18
3'- 6"	5¼"	3'- 8 ⅝"	..	18	..	18
3'- 7"	5⅜"	3'- 9 11/16"	..	18	..	18
3'- 8"	5½"	3'-10 ¾"	..	17	2	19
3'- 9"	5⅝"	3'-11 13/16"	..	17	2	19
3'-10"	5¾"	4'- 0 7/8"	..	16	3	19
3'-11"	5⅞"	4'- 1 15/16"	..	16	4	20
4'- 0"	6"	4'- 3"	..	16	4	20
4'- 1"	6⅛"	4'- 4 1/16"	..	15	5	20
4'- 2"	6¼"	4'- 5 ⅛"	..	15	6	21
4'- 3"	6⅜"	4'- 6 3/16"	..	15	6	21
4'- 4"	6½"	4'- 7 ¼"	..	14	7	21
4'- 5"	6⅝"	4'- 8 5/16"	..	14	8	22
4'- 6"	6¾"	4'- 9 ⅜"	..	14	8	22
4'- 7"	6⅞"	4'-10 7/16"	..	13	9	22
4'- 8"	7"	4'-11 ½"	..	13	10	23
4'- 9"	7⅛"	5'- 0 9/16"	..	13	10	23
4'-10"	7¼"	5'- 1 ⅝"	..	12	11	23
4'-11"	7⅜"	5'- 2 11/16"	..	12	12	24

Continued on next page



9" ARCH THICKNESS — WEDGE BRICK

9" x 4½" x 3", 9" x 6¾" x 3" or 9" x 9" x 3"

—Concluded

1½" Rise Per Foot of Span

This table can be used also for 13½" x 9" x 3" arch brick by substituting Nos. 1, 2 and 3 arch brick for the corresponding wedge brick.

Span	Rise	Inside Radius	Number Required Per Course			
			No. 2 Wedge	No. 1 Wedge	Straight	Total
5'- 0"	7½"	5'- 3 ¾"	12	12	..	24
5'- 1"	7⅝"	5'- 4 13/16"	12	13	..	25
5'- 2"	7¾"	5'- 5 ⅞"	11	14	..	25
5'- 3"	7⅞"	5'- 6 15/16"	11	14	..	25
5'- 4"	8"	5'- 8"	11	15	..	26
5'- 5"	8⅛"	5'- 9 1/16"	10	16	..	26
5'- 6"	8¼"	5'-10 ⅛"	10	16	..	26
5'- 7"	8⅜"	5'-11 3/16"	9	18	..	27
5'- 8"	8½"	6'- 0 ¼"	9	18	..	27
5'- 9"	8⅝"	6'- 1 5/16"	8	19	..	27
5'-10"	8¾"	6'- 2 ⅜"	8	20	..	28
5'-11"	8⅞"	6'- 3 7/16"	8	20	..	28
6'- 0"	9"	6'- 4 ½"	7	21	..	28
6'- 1"	9⅛"	6'- 5 9/16"	7	22	..	29
6'- 2"	9¼"	6'- 6 ⅝"	7	22	..	29
6'- 3"	9⅜"	6'- 7 11/16"	6	23	..	29
6'- 4"	9½"	6'- 8 ¾"	6	24	..	30
6'- 5"	9⅝"	6'- 9 13/16"	6	24	..	30
6'- 6"	9¾"	6'-10 ⅞"	5	25	..	30
6'- 7"	9⅞"	6'-11 15/16"	5	26	..	31
6'- 8"	10"	7'- 1"	5	26	..	31
6'- 9"	10⅛"	7'- 2 1/16"	4	27	..	31
6'-10"	10¼"	7'- 3 ⅛"	4	28	..	32
6'-11"	10⅜"	7'- 4 3/16"	4	28	..	32
7'- 0"	10½"	7'- 5 ¼"	3	29	..	32
7'- 1"	10⅝"	7'- 6 5/16"	3	30	..	33
7'- 2"	10¾"	7'- 7 ⅜"	3	30	..	33
7'- 3"	10⅞"	7'- 8 7/16"	3	31	..	34
7'- 4"	11"	7'- 9 ½"	2	32	..	34
7'- 5"	11⅛"	7'-10 9/16"	2	32	..	34
7'- 6"	11¼"	7'-11 ⅝"	2	33	..	35
7'- 7"	11⅜"	8'- 0 11/16"	1	34	..	35
7'- 8"	11½"	8'- 1 ¾"	1	34	..	35
7'- 9"	11⅝"	8'- 2 13/16"	..	36	..	36
7'-10"	11¾"	8'- 3 ⅞"	..	36	..	36
7'-11"	11⅞"	8'- 4 15/16"	..	36	..	36
8'- 0"	1'-0"	8'- 6"	..	36	1	37
8'- 6"	1'-0¾"	9'- 0 ⅜"	..	36	3	39
9'- 0"	1'-1½"	9'- 6 ¾"	..	36	5	41
9'- 6"	1'-2¼"	10'- 1 ⅛"	..	36	7	43
10'- 0"	1'-3"	10'- 7 ½"	..	36	9	45
10'- 6"	1'-3¾"	11'- 1 ⅞"	..	36	11	47

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9" ARCH THICKNESS — WEDGE BRICK

9" x 4½" x 2½", 9" x 6¾" x 2½" or
9" x 9" x 2½"
1.608" Rise Per Foot of Span (60° Central Angle)

Span	Rise	Inside Radius	Number Required Per Course			
			No. 2 Wedge	No. 1 Wedge	No. 1-X Wedge	Total
1'- 6"	2 13/32"	1'- 6"	7	5	..	12
1'- 7"	2 17/32"	1'- 7"	6	6	..	12
1'- 8"	2 11/16"	1'- 8"	5	8	..	13
1'- 9"	2 13/16"	1'- 9"	4	9	..	13
1'-10"	2 15/16"	1'-10"	3	10	..	13
1'-11"	3 3/32"	1'-11"	3	11	..	14
2'- 0"	3 7/32"	2'- 0"	2	12	..	14
2'- 1"	3 11/32"	2'- 1"	2	13	..	15
2'- 2"	3 15/32"	2'- 2"	1	14	..	15
2'- 3"	3 5/8"	2'- 3"	..	15	..	15
2'- 4"	3 3/4"	2'- 4"	..	15	1	16
2'- 5"	3 7/8"	2'- 5"	..	15	1	16
2'- 6"	4 1/32"	2'- 6"	..	15	2	17
2'- 7"	4 5/32"	2'- 7"	..	14	3	17
2'- 8"	4 9/32"	2'- 8"	..	14	4	18
2'- 9"	4 7/16"	2'- 9"	..	14	4	18
2'-10"	4 9/16"	2'-10"	..	13	5	18
2'-11"	4 11/16"	2'-11"	..	13	6	19
3'- 0"	4 13/16"	3'- 0"	..	13	6	19
3'- 1"	4 31/32"	3'- 1"	..	13	7	20
3'- 2"	5 3/32"	3'- 2"	..	12	8	20
3'- 3"	5 7/32"	3'- 3"	..	12	9	21
3'- 4"	5 11/32"	3'- 4"	..	12	9	21
3'- 5"	5 1/2"	3'- 5"	..	11	10	21
3'- 6"	5 5/8"	3'- 6"	..	11	11	22
3'- 7"	5 3/4"	3'- 7"	..	11	11	22
3'- 8"	5 29/32"	3'- 8"	..	11	12	23
3'- 9"	6 1/32"	3'- 9"	..	10	13	23
3'-10"	6 5/32"	3'-10"	..	10	13	23
3'-11"	6 9/32"	3'-11"	..	10	14	24
4'- 0"	6 7/16"	4'- 0"	..	9	15	24
4'- 1"	6 9/16"	4'- 1"	..	9	16	25
4'- 2"	6 11/16"	4'- 2"	..	9	16	25
4'- 3"	6 27/32"	4'- 3"	..	9	17	26
4'- 4"	6 31/32"	4'- 4"	..	8	18	26
4'- 5"	7 3/32"	4'- 5"	..	8	18	26
4'- 6"	7 1/4"	4'- 6"	..	8	19	27
4'- 7"	7 3/8"	4'- 7"	..	7	20	27
4'- 8"	7 1/2"	4'- 8"	..	7	21	28
4'- 9"	7 5/8"	4'- 9"	..	7	21	28
4'-10"	7 25/32"	4'-10"	..	6	22	28
4'-11"	7 29/32"	4'-11"	..	6	23	29
5'- 0"	8 1/32"	5'- 0"	..	6	23	29
5'- 1"	8 3/16"	5'- 1"	..	6	24	30
5'- 2"	8 5/16"	5'- 2"	..	5	25	30

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9" ARCH THICKNESS — WEDGE BRICK

9" x 4½" x 2½", 9" x 6¾" x 2½" or
9" x 9" x 2½"—Concluded
1.608" Rise Per Foot of Span (60° Central Angle)

Span	Rise	Inside Radius	Number Required Per Course			
			No. 1 Wedge	No. 1-X Wedge	Straight	Total
5'- 3"	8 7/16"	5'- 3"	5	26	..	31
5'- 4"	8 9/16"	5'- 4"	5	26	..	31
5'- 5"	8 23/32"	5'- 5"	4	27	..	31
5'- 6"	8 27/32"	5'- 6"	4	28	..	32
5'- 7"	8 31/32"	5'- 7"	4	28	..	32
5'- 8"	9 1/8"	5'- 8"	4	29	..	33
5'- 9"	9 1/4"	5'- 9"	4	29	..	33
5'-10"	9 3/8"	5'-10"	3	30	..	33
5'-11"	9 1/2"	5'-11"	3	31	..	34
6'- 0"	9 21/32"	6'- 0"	3	31	..	34
6'- 1"	9 25/32"	6'- 1"	3	32	..	35
6'- 2"	9 29/32"	6'- 2"	2	33	..	35
6'- 3"	10 1/16"	6'- 3"	2	34	..	36
6'- 4"	10 3/16"	6'- 4"	2	34	..	36
6'- 5"	10 5/16"	6'- 5"	1	35	..	36
6'- 6"	10 7/16"	6'- 6"	1	36	..	37
6'- 7"	10 19/32"	6'- 7"	1	36	..	37
6'- 8"	10 23/32"	6'- 8"	1	37	..	38
6'- 9"	10 27/32"	6'- 9"	..	38	..	38
7'- 0"	11 1/4"	7'- 0"	..	38	1	39
7'- 3"	11 21/32"	7'- 3"	..	38	3	41
7'- 6"	1'-0 1/16"	7'- 6"	..	38	4	42
7'- 9"	1'-0 15/32"	7'- 9"	..	38	5	43
8'- 0"	1'-0 7/8"	8'- 0"	..	38	6	44
8'- 3"	1'-1 1/4"	8'- 3"	..	38	8	46
8'- 6"	1'-1 21/32"	8'- 6"	..	38	9	47
8'- 9"	1'-2 1/16"	8'- 9"	..	38	10	48
9'- 0"	1'-2 15/32"	9'- 0"	..	38	11	49
9'- 3"	1'-2 7/8"	9'- 3"	..	38	13	51
9'- 6"	1'-3 9/32"	9'- 6"	..	38	14	52
9'- 9"	1'-3 11/16"	9'- 9"	..	38	15	53
10'- 0"	1'-4 1/16"	10'- 0"	..	38	16	54
10'- 3"	1'-4 15/32"	10'- 3"	..	38	18	56
10'- 6"	1'-4 7/8"	10'- 6"	..	38	19	57
10'- 9"	1'-5 9/32"	10'- 9"	..	38	20	58
11'- 0"	1'-5 11/16"	11'- 0"	..	38	21	59
11'- 3"	1'-6 3/32"	11'- 3"	..	38	23	61
11'- 6"	1'-6 1/2"	11'- 6"	..	38	24	62
11'- 9"	1'-6 7/8"	11'- 9"	..	38	25	63
12'- 0"	1'-7 9/32"	12'- 0"	..	38	26	64
12'- 3"	1'-7 11/16"	12'- 3"	..	38	28	66
12'- 6"	1'-8 3/32"	12'- 6"	..	38	29	67
12'- 9"	1'-8 1/2"	12'- 9"	..	38	30	68
13'- 0"	1'-8 29/32"	13'- 0"	..	38	32	70
13'- 3"	1'-9 5/16"	13'- 3"	..	38	33	71

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9" ARCH THICKNESS — WEDGE BRICK

9" x 4½" x 3", 9" x 6¾" x 3" or 9" x 9" x 3"
1.608" Rise Per Foot of Span
(60° Central Angle)

This table can be used also for 13½" x 9" x 3" arch brick by substituting Nos. 1, 2 and 3 arch brick for the corresponding wedge brick.

Span	Rise	Inside Radius	Number Required Per Course			
			No. 3 Wedge	No. 2 Wedge	No. 1 Wedge	Total
1'- 6"	2 13/32"	1'- 6"	10	..	..	10
1'- 7"	2 17/32"	1'- 7"	9	1	..	10
1'- 8"	2 21/32"	1'- 8"	9	2	..	11
1'- 9"	2 13/16"	1'- 9"	9	2	..	11
1'-10"	2 15/16"	1'-10"	8	3	..	11
1'-11"	3 3/32"	1'-11"	8	4	..	12
2'- 0"	3 7/32"	2'- 0"	8	4	..	12
2'- 1"	3 11/32"	2'- 1"	7	5	..	12
2'- 2"	3 15/32"	2'- 2"	7	6	..	13
2'- 3"	3 5/8"	2'- 3"	7	6	..	13
2'- 4"	3 3/4"	2'- 4"	6	7	..	13
2'- 5"	3 7/8"	2'- 5"	6	8	..	14
2'- 6"	4 1/32"	2'- 6"	5	9	..	14
2'- 7"	4 5/32"	2'- 7"	5	9	..	14
2'- 8"	4 9/32"	2'- 8"	5	10	..	15
2'- 9"	4 7/16"	2'- 9"	4	11	..	15
2'-10"	4 9/16"	2'-10"	4	11	..	15
2'-11"	4 11/16"	2'-11"	4	12	..	16
3'- 0"	4 13/16"	3'- 0"	3	13	..	16
3'- 1"	4 31/32"	3'- 1"	3	13	..	16
3'- 2"	5 3/32"	3'- 2"	3	14	..	17
3'- 3"	5 7/32"	3'- 3"	2	15	..	17
3'- 4"	5 11/32"	3'- 4"	2	16	..	18
3'- 5"	5 1/2"	3'- 5"	2	16	..	18
3'- 6"	5 5/8"	3'- 6"	1	17	..	18
3'- 7"	5 3/4"	3'- 7"	1	18	..	19
3'- 8"	5 29/32"	3'- 8"	1	18	..	19
3'- 9"	6 1/32"	3'- 9"	..	19	..	19
3'-10"	6 5/32"	3'-10"	..	19	1	20
3'-11"	6 9/32"	3'-11"	..	18	2	20
4'- 0"	6 7/16"	4'- 0"	..	18	2	20
4'- 1"	6 9/16"	4'- 1"	..	18	3	21
4'- 2"	6 11/16"	4'- 2"	..	17	4	21
4'- 3"	6 27/32"	4'- 3"	..	17	4	21
4'- 4"	6 31/32"	4'- 4"	..	17	5	22
4'- 5"	7 3/32"	4'- 5"	..	16	6	22
4'- 6"	7 1/4"	4'- 6"	..	16	6	22
4'- 7"	7 3/8"	4'- 7"	..	16	7	23
4'- 8"	7 1/2"	4'- 8"	..	15	8	23
4'- 9"	7 5/8"	4'- 9"	..	15	8	23
4'-10"	7 25/32"	4'-10"	..	15	9	24
4'-11"	7 29/32"	4'-11"	..	14	10	24

Continued on next page



9" ARCH THICKNESS — WEDGE BRICK

9" x 4½" x 3", 9" x 6¾" x 3" or 9" x 9" x 3"
—Concluded
1.608" Rise Per Foot of Span (60° Central Angle)

This table can be used also for 13½" x 9" x 3" arch brick by substituting Nos. 1, 2 and 3 arch brick for the corresponding wedge brick.

Span	Rise	Inside Radius	Number Required Per Course			
			No. 2 Wedge	No. 1 Wedge	Straight	Total
5'- 0"	8 1/32"	5'- 0"	14	10	..	24
5'- 1"	8 3/16"	5'- 1"	14	11	..	25
5'- 2"	8 5/16"	5'- 2"	13	12	..	25
5'- 3"	8 7/16"	5'- 3"	13	12	..	25
5'- 4"	8 9/16"	5'- 4"	12	14	..	26
5'- 5"	8 23/32"	5'- 5"	12	14	..	26
5'- 6"	8 27/32"	5'- 6"	12	15	..	27
5'- 7"	8 31/32"	5'- 7"	11	16	..	27
5'- 8"	9 1/8"	5'- 8"	11	16	..	27
5'- 9"	9 1/4"	5'- 9"	11	17	..	28
5'-10"	9 3/8"	5'-10"	10	18	..	28
5'-11"	9 1/2"	5'-11"	10	18	..	28
6'- 0"	9 21/32"	6'- 0"	10	19	..	29
6'- 1"	9 25/32"	6'- 1"	9	20	..	29
6'- 2"	9 29/32"	6'- 2"	9	20	..	29
6'- 3"	10 1/16"	6'- 3"	9	21	..	30
6'- 4"	10 3/16"	6'- 4"	8	22	..	30
6'- 5"	10 5/16"	6'- 5"	8	22	..	30
6'- 6"	10 7/16"	6'- 6"	8	23	..	31
6'- 7"	10 19/32"	6'- 7"	7	24	..	31
6'- 8"	10 23/32"	6'- 8"	7	24	..	31
6'- 9"	10 27/32"	6'- 9"	7	25	..	32
6'-10"	11"	6'-10"	6	26	..	32
6'-11"	11 1/8"	6'-11"	6	27	..	33
7'- 0"	11 1/4"	7'- 0"	6	27	..	33
7'- 1"	11 3/8"	7'- 1"	5	28	..	33
7'- 2"	11 17/32"	7'- 2"	5	29	..	34
7'- 3"	11 21/32"	7'- 3"	4	30	..	34
7'- 4"	11 25/32"	7'- 4"	4	30	..	34
7'- 5"	11 15/16"	7'- 5"	4	31	..	35
7'- 6"	1'- 0 1/16"	7'- 6"	3	32	..	35
7'- 9"	1'- 0 15/32"	7'- 9"	2	34	..	36
8'- 0"	1'- 0 7/8"	8'- 0"	1	36	..	37
8'- 3"	1'- 1 1/4"	8'- 3"	..	38	..	38
8'- 6"	1'- 1 21/32"	8'- 6"	..	38	1	39
9'- 0"	1'- 2 15/32"	9'- 0"	..	38	3	41
9'- 6"	1'- 3 9/32"	9'- 6"	..	38	5	43
10'- 0"	1'- 4 1/16"	10'- 0"	..	38	7	45
10'- 6"	1'- 4 7/8"	10'- 6"	..	38	10	48
11'- 0"	1'- 5 11/16"	11'- 0"	..	38	12	50
11'- 6"	1'- 6 1/2"	11'- 6"	..	38	14	52
12'- 0"	1'- 7 9/32"	12'- 0"	..	38	16	54

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9" ARCH THICKNESS — WEDGE BRICK

9" x 4½" x 2½", 9" x 6¾" x 2½" or 9" x 9" x 2½"
2" Rise Per Foot of Span

Span	Rise	Inside Radius	Number Required Per Course			
			No. 2 Wedge	No. 1 Wedge	No. 1-X Wedge	Total
1'- 6"	3"	1'- 3"	11	2	..	13
1'- 7"	3 5/32"	1'- 3 27/32"	10	3	..	13
1'- 8"	3 11/32"	1'- 4 21/32"	9	5	..	14
1'- 9"	3 1/2"	1'- 5 1/2"	8	6	..	14
1'-10"	3 21/32"	1'- 6 11/32"	7	7	..	14
1'-11"	3 27/32"	1'- 7 5/32"	7	8	..	15
2'- 0"	4"	1'- 8"	6	9	..	15
2'- 1"	4 5/32"	1'- 8 27/32"	6	10	..	16
2'- 2"	4 11/32"	1'- 9 21/32"	5	11	..	16
2'- 3"	4 1/2"	1'-10 1/2"	4	13	..	17
2'- 4"	4 21/32"	1'-11 11/32"	3	14	..	17
2'- 5"	4 27/32"	2'- 0 5/32"	2	15	..	17
2'- 6"	5"	2'- 1"	2	16	..	18
2'- 7"	5 5/32"	2'- 1 27/32"	1	17	..	18
2'- 8"	5 11/32"	2'- 2 21/32"	1	18	..	19
2'- 9"	5 1/2"	2'- 3 1/2"	..	18	1	19
2'-10"	5 21/32"	2'- 4 11/32"	..	18	2	20
2'-11"	5 27/32"	2'- 5 5/32"	..	18	2	20
3'- 0"	6"	2'- 6"	..	17	3	20
3'- 1"	6 5/32"	2'- 6 27/32"	..	17	4	21
3'- 2"	6 11/32"	2'- 7 21/32"	..	17	4	21
3'- 3"	6 1/2"	2'- 8 1/2"	..	17	5	22
3'- 4"	6 21/32"	2'- 9 11/32"	..	16	6	22
3'- 5"	6 27/32"	2'-10 5/32"	..	16	7	23
3'- 6"	7"	2'-11"	..	16	7	23
3'- 7"	7 5/32"	2'-11 27/32"	..	15	8	23
3'- 8"	7 11/32"	3'- 0 21/32"	..	15	9	24
3'- 9"	7 1/2"	3'- 1 1/2"	..	15	9	24
3'-10"	7 21/32"	3'- 2 11/32"	..	15	10	25
3'-11"	7 27/32"	3'- 3 5/32"	..	14	11	25
4'- 0"	8"	3'- 4"	..	14	12	26
4'- 1"	8 5/32"	3'- 4 27/32"	..	14	12	26
4'- 2"	8 11/32"	3'- 5 21/32"	..	13	13	26
4'- 3"	8 1/2"	3'- 6 1/2"	..	13	14	27
4'- 4"	8 21/32"	3'- 7 11/32"	..	13	14	27
4'- 5"	8 27/32"	3'- 8 5/32"	..	13	15	28
4'- 6"	9"	3'- 9"	..	12	16	28
4'- 7"	9 5/32"	3'- 9 27/32"	..	12	17	29
4'- 8"	9 11/32"	3'-10 21/32"	..	12	17	29
4'- 9"	9 1/2"	3'-11 1/2"	..	11	18	29
4'-10"	9 21/32"	4'- 0 11/32"	..	11	19	30
4'-11"	9 27/32"	4'- 1 5/32"	..	11	19	30
5'- 0"	10"	4'- 2"	..	11	20	31
5'- 1"	10 5/32"	4'- 2 27/32"	..	10	21	31
5'- 2"	10 11/32"	4'- 3 21/32"	..	10	22	32

Continued on next page

9" ARCH THICKNESS — WEDGE BRICK

9" x 4½" x 2½", 9" x 6¾" x 2½" or 9" x 9" x 2½"—Concluded
2" Rise Per Foot of Span

Span	Rise	Inside Radius	Number Required Per Course			
			No. 1 Wedge	No. 1-X Wedge	Straight	Total
5'- 3"	10 1/2"	4'- 4 1/2"	10	22	..	32
5'- 4"	10 21/32"	4'- 5 11/32"	9	23	..	32
5'- 5"	10 27/32"	4'- 6 5/32"	9	24	..	33
5'- 6"	11"	4'- 7"	9	24	..	33
5'- 7"	11 5/32"	4'- 7 27/32"	9	25	..	34
5'- 8"	11 11/32"	4'- 8 21/32"	8	26	..	34
5'- 9"	11 1/2"	4'- 9 1/2"	8	27	..	35
5'-10"	11 21/32"	4'-10 11/32"	8	27	..	35
5'-11"	11 27/32"	4'-11 5/32"	7	28	..	35
6'- 0"	1'- 0"	5'- 0"	7	29	..	36
6'- 1"	1'- 0 5/32"	5'- 0 27/32"	7	29	..	36
6'- 2"	1'- 0 11/32"	5'- 1 21/32"	7	30	..	37
6'- 3"	1'- 0 1/2"	5'- 2 1/2"	6	31	..	37
6'- 4"	1'- 0 21/32"	5'- 3 11/32"	6	32	..	38
6'- 5"	1'- 0 27/32"	5'- 4 5/32"	6	32	..	38
6'- 6"	1'- 1"	5'- 5"	5	33	..	38
6'- 7"	1'- 1 5/32"	5'- 5 27/32"	5	34	..	39
6'- 8"	1'- 1 11/32"	5'- 6 21/32"	5	34	..	39
6'- 9"	1'- 1 1/2"	5'- 7 1/2"	5	35	..	40
6'-10"	1'- 1 21/32"	5'- 8 11/32"	4	36	..	40
6'-11"	1'- 1 27/32"	5'- 9 5/32"	4	37	..	41
7'- 0"	1'- 2"	5'-10"	4	37	..	41
7'- 1"	1'- 2 5/32"	5'-10 27/32"	3	38	..	41
7'- 2"	1'- 2 11/32"	5'-11 21/32"	3	39	..	42
7'- 3"	1'- 2 1/2"	6'- 0 1/2"	3	39	..	42
7'- 4"	1'- 2 21/32"	6'- 1 11/32"	3	40	..	43
7'- 5"	1'- 2 27/32"	6'- 2 5/32"	2	41	..	43
7'- 6"	1'- 3"	6'- 3"	2	42	..	44
7'- 9"	1'- 3 1/2"	6'- 5 1/2"	1	44	..	45
8'- 0"	1'- 4"	6'- 8"	..	46	..	46
8'- 3"	1'- 4 1/2"	6'-10 1/2"	..	47	1	48
8'- 6"	1'- 5"	7'- 1"	..	47	2	49
9'- 0"	1'- 6"	7'- 6"	..	47	4	51
9'- 6"	1'- 7"	7'-11"	..	47	7	54
10'- 0"	1'- 8"	8'- 4"	..	47	10	57
10'- 6"	1'- 9"	8'- 9"	..	47	12	59
11'- 0"	1'-10"	9'- 2"	..	47	15	62
11'- 6"	1'-11"	9'- 7"	..	47	17	64
12'- 0"	2'- 0"	10'- 0"	..	47	20	67
12'- 6"	2'- 1"	10'- 5"	..	47	22	69
13'- 0"	2'- 2"	10'-10"	..	47	25	72
13'- 6"	2'- 3"	11'- 3"	..	47	28	75
14'- 0"	2'- 4"	11'- 8"	..	47	30	77
14'- 6"	2'- 5"	12'- 1"	..	47	33	80
15'- 0"	2'- 6"	12'- 6"	..	47	35	82

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9" ARCH THICKNESS — WEDGE BRICK

9" x 4½" x 3", 9" x 6¾" x 3" or 9" x 9" x 3"

2" Rise Per Foot of Span

This table can be used for 13½" x 9" x 3" arch brick, by substituting Nos. 1, 2 and 3 arch brick for the corresponding wedge brick.

Span	Rise	Inside Radius	Number Required Per Course			
			No. 3 Wedge	No. 2 Wedge	No. 1 Wedge	Total
1'-10"	3 21/32"	1'- 6 11/32"	12	..	..	12
1'-11"	3 27/32"	1'- 7 5/32"	11	1	..	12
2'- 0"	4"	1'- 8"	11	2	..	13
2'- 1"	4 5/32"	1'- 8 27/32"	10	3	..	13
2'- 2"	4 11/32"	1'- 9 21/32"	10	4	..	14
2'- 3"	4 1/2"	1'-10 1/2"	10	4	..	14
2'- 4"	4 21/32"	1'-11 11/32"	9	5	..	14
2'- 5"	4 27/32"	2'- 0 5/32"	9	6	..	15
2'- 6"	5"	2'- 1"	9	6	..	15
2'- 7"	5 5/32"	2'- 1 27/32"	8	7	..	15
2'- 8"	5 11/32"	2'- 2 21/32"	8	8	..	16
2'- 9"	5 1/2"	2'- 3 1/2"	8	8	..	16
2'-10"	5 21/32"	2'- 4 11/32"	7	9	..	16
2'-11"	5 27/32"	2'- 5 5/32"	7	10	..	17
3'- 0"	6"	2'- 6"	7	10	..	17
3'- 1"	6 5/32"	2'- 6 27/32"	6	11	..	17
3'- 2"	6 11/32"	2'- 7 21/32"	6	12	..	18
3'- 3"	6 1/2"	2'- 8 1/2"	5	13	..	18
3'- 4"	6 21/32"	2'- 9 11/32"	5	14	..	19
3'- 5"	6 27/32"	2'-10 5/32"	5	14	..	19
3'- 6"	7"	2'-11"	4	15	..	19
3'- 7"	7 5/32"	2'-11 27/32"	4	16	..	20
3'- 8"	7 11/32"	3'- 0 21/32"	4	16	..	20
3'- 9"	7 1/2"	3'- 1 1/2"	3	17	..	20
3'-10"	7 21/32"	3'- 2 11/32"	3	18	..	21
3'-11"	7 27/32"	3'- 3 5/32"	3	18	..	21
4'- 0"	8"	3'- 4"	2	19	..	21
4'- 1"	8 5/32"	3'- 4 27/32"	2	20	..	22
4'- 2"	8 11/32"	3'- 5 21/32"	2	20	..	22
4'- 3"	8 1/2"	3'- 6 1/2"	1	21	..	22
4'- 4"	8 21/32"	3'- 7 11/32"	1	22	..	23
4'- 5"	8 27/32"	3'- 8 5/32"	1	22	..	23
4'- 6"	9"	3'- 9"	..	24	..	24
4'- 7"	9 5/32"	3'- 9 27/32"	..	23	1	24
4'- 8"	9 11/32"	3'-10 21/32"	..	23	1	24
4'- 9"	9 1/2"	3'-11 1/2"	..	22	3	25
4'-10"	9 21/32"	4'- 0 11/32"	..	22	3	25
4'-11"	9 27/32"	4'- 1 5/32"	..	21	4	25
5'- 0"	10"	4'- 2"	..	21	5	26
5'- 1"	10 5/32"	4'- 2 27/32"	..	21	5	26
5'- 2"	10 11/32"	4'- 3 21/32"	..	20	6	26
5'- 3"	10 1/2"	4'- 4 1/2"	..	20	7	27

Continued on next page



9" ARCH THICKNESS — WEDGE BRICK

9" x 4½" x 3", 9" x 6¾" x 3" or 9" x 9" x 3" —Concluded

2" Rise Per Foot of Span

This table can be used for 13½" x 9" x 3" arch brick, by substituting Nos. 1, 2 and 3 arch brick for the corresponding wedge brick.

Span	Rise	Inside Radius	Number Required Per Course			
			No. 2 Wedge	No. 1 Wedge	Straight	Total
5'- 4"	10 21/32"	4'- 5 11/32"	20	7	..	27
5'- 5"	10 27/32"	4'- 6 5/32"	19	8	..	27
5'- 6"	11"	4'- 7"	19	9	..	28
5'- 7"	11 5/32"	4'- 7 27/32"	19	9	..	28
5'- 8"	11 11/32"	4'- 8 21/32"	19	10	..	29
5'- 9"	11 1/2"	4'- 9 1/2"	18	11	..	29
5'-10"	11 21/32"	4'-10 11/32"	18	11	..	29
5'-11"	11 27/32"	4'-11 5/32"	17	13	..	30
6'- 0"	1'- 0"	5'- 0"	17	13	..	30
6'- 1"	1'- 0 5/32"	5'- 0 27/32"	16	14	..	30
6'- 2"	1'- 0 11/32"	5'- 1 21/32"	16	15	..	31
6'- 3"	1'- 0 1/2"	5'- 2 1/2"	16	15	..	31
6'- 4"	1'- 0 21/32"	5'- 3 11/32"	15	16	..	31
6'- 5"	1'- 0 27/32"	5'- 4 5/32"	15	17	..	32
6'- 6"	1'- 1"	5'- 5"	15	17	..	32
6'- 7"	1'- 1 5/32"	5'- 5 27/32"	15	18	..	33
6'- 8"	1'- 1 11/32"	5'- 6 21/32"	14	19	..	33
6'- 9"	1'- 1 1/2"	5'- 7 1/2"	14	19	..	33
6'-10"	1'- 1 21/32"	5'- 8 11/32"	14	20	..	34
6'-11"	1'- 1 27/32"	5'- 9 5/32"	13	21	..	34
7'- 0"	1'- 2"	5'-10"	13	21	..	34
7'- 1"	1'- 2 5/32"	5'-10 27/32"	12	23	..	35
7'- 2"	1'- 2 11/32"	5'-11 21/32"	12	23	..	35
7'- 3"	1'- 2 1/2"	6'- 0 1/2"	11	24	..	35
7'- 4"	1'- 2 21/32"	6'- 1 11/32"	11	25	..	36
7'- 5"	1'- 2 27/32"	6'- 2 5/32"	11	25	..	36
7'- 6"	1'- 3"	6'- 3"	10	26	..	36
7'- 7"	1'- 3 5/32"	6'- 3 27/32"	10	27	..	37
7'- 8"	1'- 3 11/32"	6'- 4 21/32"	10	27	..	37
7'- 9"	1'- 3 1/2"	6'- 5 1/2"	10	28	..	38
7'-10"	1'- 3 21/32"	6'- 6 11/32"	9	29	..	38
7'-11"	1'- 3 27/32"	6'- 7 5/32"	9	29	..	38
8'- 0"	1'- 4"	6'- 8"	9	30	..	39
8'- 1"	1'- 4 5/32"	6'- 8 27/32"	8	31	..	39
8'- 2"	1'- 4 11/32"	6'- 9 21/32"	8	31	..	39
8'- 3"	1'- 4 1/2"	6'-10 1/2"	7	33	..	40
8'- 6"	1'- 5"	7'- 1"	6	35	..	41
9'- 0"	1'- 6"	7'- 6"	4	39	..	43
9'- 6"	1'- 7"	7'-11"	2	43	..	45
10'- 0"	1'- 8"	8'- 4"	..	47	..	47
10'- 6"	1'- 9"	8'- 9"	..	47	2	49
11'- 0"	1'-10"	9'- 2"	..	47	4	51

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9" ARCH THICKNESS — WEDGE BRICK

9" x 4½" x 2½", 9" x 6¾" x 2½" or 9" x 9" x 2½"

2 5/16"† Rise Per Foot of Span

Span	Rise	Inside Radius	Number Required Per Course			
			No. 2 Wedge	No. 1 Wedge	No. 1-X Wedge	Total
1'- 6"	3 15/32"	1'- 1 15/32"	14	..	..	14
1'- 7"	3 21/32"	1'- 2 3/16"	13	1	..	14
1'- 8"	3 27/32"	1'- 2 15/16"	12	2	..	14
1'- 9"	4 1/32"	1'- 3 11/16"	11	4	..	15
1'-10"	4 7/32"	1'- 4 7/16"	10	5	..	15
1'-11"	4 13/32"	1'- 5 3/16"	10	6	..	16
2'- 0"	4 19/32"	1'- 5 15/16"	9	7	..	16
2'- 1"	4 25/32"	1'- 6 11/16"	9	8	..	17
2'- 2"	5"	1'- 7 7/16"	8	9	..	17
2'- 3"	5 3/16"	1'- 8 3/16"	7	11	..	18
2'- 4"	5 3/8"	1'- 8 15/16"	6	12	..	18
2'- 5"	5 9/16"	1'- 9 11/16"	5	13	..	18
2'- 6"	5 3/4"	1'-10 7/16"	5	14	..	19
2'- 7"	5 15/16"	1'-11 5/32"	4	15	..	19
2'- 8"	6 1/8"	1'-11 29/32"	3	17	..	20
2'- 9"	6 11/32"	2'- 0 21/32"	2	18	..	20
2'-10"	6 17/32"	2'- 1 13/32"	2	19	..	21
2'-11"	6 23/32"	2'- 2 5/32"	1	20	..	21
3'- 0"	6 29/32"	2'- 2 29/32"	..	21	..	21
3'- 1"	7 3/32"	2'- 3 21/32"	..	21	1	22
3'- 2"	7 9/32"	2'- 4 13/32"	..	21	1	22
3'- 3"	7 15/32"	2'- 5 5/32"	..	21	2	23
3'- 4"	7 11/16"	2'- 5 29/32"	..	20	3	23
3'- 5"	7 7/8"	2'- 6 21/32"	..	20	4	24
3'- 6"	8 1/16"	2'- 7 13/32"	..	20	4	24
3'- 7"	8 1/4"	2'- 8 1/8"	..	20	5	25
3'- 8"	8 7/16"	2'- 8 7/8"	..	19	6	25
3'- 9"	8 5/8"	2'- 9 5/8"	..	19	6	25
3'-10"	8 13/16"	2'-10 3/8"	..	18	8	26
3'-11"	9 1/32"	2'-11 1/8"	..	18	8	26
4'- 0"	9 7/32"	2'-11 7/8"	..	18	9	27
4'- 1"	9 13/32"	3'- 0 5/8"	..	17	10	27
4'- 2"	9 19/32"	3'- 1 3/8"	..	17	11	28
4'- 3"	9 25/32"	3'- 2 1/8"	..	17	11	28
4'- 4"	9 31/32"	3'- 2 7/8"	..	16	12	28
4'- 5"	10 5/32"	3'- 3 5/8"	..	16	13	29
4'- 6"	10 3/8"	3'- 4 3/8"	..	16	13	29
4'- 7"	10 9/16"	3'- 5 3/32"	..	16	14	30
4'- 8"	10 3/4"	3'- 5 27/32"	..	15	15	30
4'- 9"	10 15/16"	3'- 6 19/32"	..	15	16	31
4'-10"	11 1/8"	3'- 7 11/32"	..	15	16	31
4'-11"	11 5/16"	3'- 8 3/32"	..	15	17	32

† More exactly, 2.302".

Continued on next page

9" ARCH THICKNESS — WEDGE BRICK

9" x 4½" x 2½", 9" x 6¾" x 2½" or 9" x 9" x 2½"—Concluded

2 5/16"† Rise Per Foot of Span

Span	Rise	Inside Radius	Number Required Per Course			
			No. 1 Wedge	No. 1-X Wedge	Straight	Total
5'- 0"	11 1/2"	3'- 8 27/32"	14	18	..	32
5'- 1"	11 23/32"	3'- 9 19/32"	14	18	..	32
5'- 2"	11 29/32"	3'-10 11/32"	14	19	..	33
5'- 3"	1'- 0 5/32"	3'-11 3/32"	13	20	..	33
5'- 4"	1'- 0 9/32"	3'-11 27/32"	13	21	..	34
5'- 5"	1'- 0 15/32"	4'- 0 15/32"	13	21	..	34
5'- 6"	1'- 0 21/32"	4'- 1 11/32"	13	22	..	35
5'- 7"	1'- 0 27/32"	4'- 2 1/16"	12	23	..	35
5'- 8"	1'- 1 1/16"	4'- 2 13/16"	12	23	..	35
5'- 9"	1'- 1 1/4"	4'- 3 9/16"	12	24	..	36
5'-10"	1'- 1 7/16"	4'- 4 5/16"	11	25	..	36
5'-11"	1'- 1 5/8"	4'- 5 1/16"	11	26	..	37
6'- 0"	1'- 1 13/16"	4'- 5 13/16"	11	26	..	37
6'- 1"	1'- 2"	4'- 6 9/16"	11	27	..	38
6'- 2"	1'- 2 3/16"	4'- 7 5/16"	10	28	..	38
6'- 3"	1'- 2 3/8"	4'- 8 1/16"	10	29	..	39
6'- 4"	1'- 2 19/32"	4'- 8 13/16"	10	29	..	39
6'- 5"	1'- 2 25/32"	4'- 9 9/16"	9	30	..	39
6'- 6"	1'- 2 31/32"	4'-10 5/16"	9	31	..	40
6'- 7"	1'- 3 5/32"	4'-11 1/32"	9	31	..	40
6'- 8"	1'- 3 11/32"	4'-11 25/32"	9	32	..	41
6'- 9"	1'- 3 17/32"	5'- 0 17/32"	8	33	..	41
6'-10"	1'- 3 23/32"	5'- 1 9/32"	8	34	..	42
6'-11"	1'- 3 15/16"	5'- 2 1/32"	8	34	..	42
7'- 0"	1'- 4 1/8"	5'- 2 25/32"	7	35	..	42
7'- 1"	1'- 4 5/16"	5'- 3 17/32"	7	36	..	43
7'- 2"	1'- 4 1/2"	5'- 4 9/32"	7	36	..	43
7'- 3"	1'- 4 11/16"	5'- 5 1/32"	7	37	..	44
7'- 4"	1'- 4 7/8"	5'- 5 25/32"	6	38	..	44
7'- 5"	1'- 5 1/16"	5'- 6 17/32"	6	39	..	45
7'- 6"	1'- 5 9/32"	5'- 7 9/32"	6	39	..	45
7'- 7"	1'- 5 15/32"	5'- 8 1/32"	5	41	..	46
7'- 8"	1'- 5 21/32"	5'- 8 3/4"	5	41	..	46
7'- 9"	1'- 5 27/32"	5'- 9 1/2"	4	42	..	46
7'-10"	1'- 6 1/32"	5'-10 1/4"	4	43	..	47
7'-11"	1'- 6 7/32"	5'-11"	4	43	..	47
8'- 0"	1'- 6 13/32"	5'-11 3/4"	4	44	..	48
8'- 6"	1'- 7 9/16"	6'- 4 1/4"	2	48	..	50
9'- 0"	1'- 8 23/32"	6'- 8 23/32"	..	53	..	53
9'- 6"	1'- 9 7/8"	7'- 1 7/32"	..	53	3	56
10'- 0"	1'-11 1/32"	7'- 5 11/16"	..	53	5	58
10'- 6"	2'- 0 7/16"	7'-10 3/16"	..	53	8	61

† More exactly, 2.302".

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9" ARCH THICKNESS — WEDGE BRICK

9" x 4½" x 3", 9" x 6¾" x 3" or 9" x 9" x 3"

2 5/16"† Rise Per Foot of Span

This table can be used also for 13½" x 9" x 3" arch brick by substituting Nos. 1, 2 and 3 arch brick for the corresponding wedge brick.

Span	Rise	Inside Radius	Number Required Per Course			
			No. 3 Wedge	No. 2 Wedge	No. 1 Wedge	Total
2'- 0"	4 19/32"	1'- 5 15/16"	14	..	..	14
2'- 1"	4 25/32"	1'- 6 11/16"	13	1	..	14
2'- 2"	5"	1'- 7 7/16"	13	1	..	14
2'- 3"	5 3/16"	1'- 8 3/16"	12	3	..	15
2'- 4"	5 3/8"	1'- 8 15/16"	12	3	..	15
2'- 5"	5 9/16"	1'- 9 11/16"	11	4	..	15
2'- 6"	5 3/4"	1'-10 7/16"	11	5	..	16
2'- 7"	5 15/16"	1'-11 5/32"	11	5	..	16
2'- 8"	6 1/8"	1'-11 29/32"	10	6	..	16
2'- 9"	6 11/32"	2'- 0 21/32"	10	7	..	17
2'-10"	6 27/32"	2'- 1 13/32"	10	7	..	17
2'-11"	6 23/32"	2'- 2 5/32"	10	8	..	18
3'- 0"	6 29/32"	2'- 2 29/32"	9	9	..	18
3'- 1"	7 3/32"	2'- 3 21/32"	9	9	..	18
3'- 2"	7 9/32"	2'- 4 13/32"	8	11	..	19
3'- 3"	7 15/32"	2'- 5 5/32"	8	11	..	19
3'- 4"	7 11/16"	2'- 5 29/32"	7	12	..	19
3'- 5"	7 7/8"	2'- 6 21/32"	7	13	..	20
3'- 6"	8 1/16"	2'- 7 13/32"	7	13	..	20
3'- 7"	8 1/4"	2'- 8 1/8"	6	14	..	20
3'- 8"	8 7/16"	2'- 8 7/8"	6	15	..	21
3'- 9"	8 5/8"	2'- 9 5/8"	6	15	..	21
3'-10"	8 13/16"	2'-10 3/8"	6	16	..	22
3'-11"	9 1/32"	2'-11 1/8"	5	17	..	22
4'- 0"	9 7/32"	2'-11 7/8"	4	18	..	22
4'- 1"	9 13/32"	3'- 0 5/8"	4	19	..	23
4'- 2"	9 19/32"	3'- 1 3/8"	4	19	..	23
4'- 3"	9 25/32"	3'- 2 1/8"	3	20	..	23
4'- 4"	9 31/32"	3'- 2 7/8"	3	21	..	24
4'- 5"	10 5/32"	3'- 3 5/8"	3	21	..	24
4'- 6"	10 3/8"	3'- 4 3/8"	3	22	..	25
4'- 7"	10 9/16"	3'- 5 3/32"	2	23	..	25
4'- 8"	10 3/4"	3'- 5 27/32"	2	23	..	25
4'- 9"	10 15/16"	3'- 6 19/32"	2	24	..	26
4'-10"	11 1/8"	3'- 7 11/32"	1	25	..	26
4'-11"	11 5/16"	3'- 8 3/32"	..	26	..	26
5'- 0"	11 1/2"	3'- 8 27/32"	..	27	..	27
5'- 1"	11 23/32"	3'- 9 19/32"	..	26	1	27
5'- 2"	11 29/32"	3'-10 11/32"	..	26	1	27
5'- 3"	1'- 0 3/32"	3'-11 3/32"	..	26	2	28
5'- 4"	1'- 0 9/32"	3'-11 27/32"	..	25	3	28
5'- 5"	1'- 0 15/32"	4'- 0 19/32"	..	25	4	29

† More exactly, 2.302".

Continued on next page

9" ARCH THICKNESS — WEDGE BRICK

9" x 4½" x 3", 9" x 6¾" x 3" or 9" x 9" x 3"—Concluded

2 5/16"† Rise Per Foot of Span

This table can be used also for 13½" x 9" x 3" arch brick by substituting Nos. 1, 2 and 3 arch brick for the corresponding wedge brick.

Span	Rise	Inside Radius	Number Required Per Course			
			No. 2 Wedge	No. 1 Wedge	Straight	Total
5'- 6"	1'- 0 21/32"	4'- 1 11/32"	25	4	..	29
5'- 7"	1'- 0 27/32"	4'- 2 1/16"	24	5	..	29
5'- 8"	1'- 1 1/16"	4'- 2 13/16"	24	6	..	30
5'- 9"	1'- 1 1/4"	4'- 3 9/16"	23	7	..	30
5'-10"	1'- 1 7/16"	4'- 4 5/16"	23	7	..	30
5'-11"	1'- 1 5/8"	4'- 5 1/16"	23	8	..	31
6'- 0"	1'- 1 13/16"	4'- 5 13/16"	22	9	..	31
6'- 1"	1'- 2"	4'- 6 9/16"	22	9	..	31
6'- 2"	1'- 2 3/16"	4'- 7 5/16"	22	10	..	32
6'- 3"	1'- 2 3/8"	4'- 8 1/16"	21	11	..	32
6'- 4"	1'- 2 19/32"	4'- 8 13/16"	21	12	..	33
6'- 5"	1'- 2 25/32"	4'- 9 9/16"	20	13	..	33
6'- 6"	1'- 2 31/32"	4'-10 5/16"	20	13	..	33
6'- 7"	1'- 3 5/32"	4'-11 1/32"	20	14	..	34
6'- 8"	1'- 3 11/32"	4'-11 25/32"	19	15	..	34
6'- 9"	1'- 3 17/32"	5'- 0 17/32"	19	15	..	34
6'-10"	1'- 3 23/32"	5'- 1 9/32"	19	16	..	35
6'-11"	1'- 3 15/16"	5'- 2 1/32"	18	17	..	35
7'- 0"	1'- 4 1/8"	5'- 2 25/32"	18	17	..	35
7'- 1"	1'- 4 5/16"	5'- 3 17/32"	18	18	..	36
7'- 2"	1'- 4 1/2"	5'- 4 9/32"	17	19	..	36
7'- 3"	1'- 4 11/16"	5'- 5 1/32"	17	20	..	37
7'- 4"	1'- 4 7/8"	5'- 5 25/32"	16	21	..	37
7'- 5"	1'- 5 1/16"	5'- 6 17/32"	16	21	..	37
7'- 6"	1'- 5 9/32"	5'- 7 9/32"	16	22	..	38
7'- 7"	1'- 5 15/32"	5'- 8 1/32"	15	23	..	38
7'- 8"	1'- 5 21/32"	5'- 8 3/4"	15	23	..	38
7'- 9"	1'- 5 27/32"	5'- 9 1/2"	15	24	..	39
7'-10"	1'- 6 1/32"	5'-10 1/4"	14	25	..	39
7'-11"	1'- 6 7/32"	5'-11"	14	25	..	39
8'- 0"	1'- 6 13/32"	5'-11 3/4"	14	26	..	40
8'- 3"	1'- 7"	6'- 2"	12	29	..	41
8'- 6"	1'- 7 9/16"	6'- 4 1/4"	11	31	..	42
8'- 9"	1'- 8 5/32"	6'- 6 15/32"	10	33	..	43
9'- 0"	1'- 8 23/32"	6'- 8 23/32"	9	35	..	44
9'- 6"	1'- 9 7/8"	7'- 1 7/32"	7	39	..	46
10'- 0"	1'-11 1/32"	7'- 5 11/16"	5	44	..	49
10'- 6"	2'- 0 3/16"	7'-10 3/16"	3	48	..	51
11'- 0"	2'- 1 5/16"	8'- 2 21/32"	..	53	..	53
11'- 6"	2'- 2 15/32"	8'- 7 5/32"	..	53	2	55
12'- 0"	2'- 3 5/8"	8'-11 5/8"	..	53	4	57
12'- 6"	2'- 4 25/32"	9'- 4 1/8"	..	53	7	60

† More exactly, 2.302".

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12" ARCH THICKNESS — WEDGE BRICK

12" x 4½" x 3", 12" x 6" x 3" or 12" x 9" x 3"
1.608" Rise Per Foot of Span
(60° Central Angle)

Span	Rise	Inside Radius	Number Required Per Course			
			No. 2 Wedge	No. 1 Wedge	No. 1-X* Wedge	Total
6'- 0"	$9\frac{21}{32}$"	6'- 0"	21	9	..	30
6'- 3"	$10\frac{1}{16}$"	6'- 3"	20	11	..	31
6'- 6"	$10\frac{7}{16}$"	6'- 6"	19	13	..	32
6'- 9"	$10\frac{27}{32}$"	6'- 9"	18	15	..	33
7'- 0"	11 ¼"	7'- 0"	17	17	..	34
7'- 3"	$11\frac{21}{32}$"	7'- 3"	16	19	..	35
7'- 6"	1'- 0 $\frac{1}{16}$"	7'- 6"	15	21	..	36
7'- 9"	1'- 0 $\frac{15}{32}$"	7'- 9"	14	23	..	37
8'- 0"	1'- 0 $\frac{7}{8}$"	8'- 0"	13	25	..	38
8'- 3"	1'- 1 ¼"	8'- 3"	12	27	..	39
8'- 6"	1'- 1 $\frac{21}{32}$"	8'- 6"	11	29	..	40
8'- 9"	1'- 2 $\frac{1}{16}$"	8'- 9"	10	31	..	41
9'- 0"	1'- 2 $\frac{15}{32}$"	9'- 0"	8	34	..	42
9'- 3"	1'- 2 $\frac{7}{8}$"	9'- 3"	7	36	..	43
9'- 6"	1'- 3 $\frac{9}{32}$"	9'- 6"	6	38	..	44
9'- 9"	1'- 3 $\frac{11}{16}$"	9'- 9"	5	40	..	45
10'- 0"	1'- 4 $\frac{1}{16}$"	10'- 0"	4	42	..	46
10'- 3"	1'- 4 $\frac{15}{32}$"	10'- 3"	4	44	..	48
10'- 6"	1'- 4 $\frac{7}{8}$"	10'- 6"	3	46	..	49
10'- 9"	1'- 5 $\frac{9}{32}$"	10'- 9"	1	49	..	50
11'- 0"	1'- 5 $\frac{11}{16}$"	11'- 0"	..	51	..	51
11'- 3"	1'- 6 $\frac{3}{32}$"	11'- 3"	..	50	2	52
11'- 6"	1'- 6 ½"	11'- 6"	..	48	5	53
11'- 9"	1'- 6 $\frac{7}{8}$"	11'- 9"	..	47	7	54
12'- 0"	1'- 7 $\frac{9}{32}$"	12'- 0"	..	46	9	55
12'- 3"	1'- 7 $\frac{11}{16}$"	12'- 3"	..	45	11	56
12'- 6"	1'- 8 $\frac{3}{32}$"	12'- 6"	..	44	13	57
12'- 9"	1'- 8 ½"	12'- 9"	..	43	15	58
13'- 0"	1'- 8 $\frac{29}{32}$"	13'- 0"	..	42	17	59
13'- 3"	1'- 9 $\frac{5}{16}$"	13'- 3"	..	41	19	60
13'- 6"	1'- 9 $\frac{11}{16}$"	13'- 6"	..	40	21	61
13'- 9"	1'-10 $\frac{3}{32}$"	13'- 9"	..	39	23	62
14'- 0"	1'-10 ½"	14'- 0"	..	38	25	63
14'- 3"	1'-10 $\frac{29}{32}$"	14'- 3"	..	37	27	64
14'- 6"	1'-11 $\frac{5}{16}$"	14'- 6"	..	36	29	65
14'- 9"	1'-11 $\frac{23}{32}$"	14'- 9"	..	35	31	66
15'- 0"	2'- 0 $\frac{1}{8}$"	15'- 0"	..	34	33	67
15'- 3"	2'- 0 $\frac{17}{32}$"	15'- 3"	..	32	36	68
15'- 6"	2'- 0 $\frac{29}{32}$"	15'- 6"	..	32	38	70
15'- 9"	2'- 1 $\frac{5}{16}$"	15'- 9"	..	31	40	71

Continued on next page

*NOTE: The No. 1-X Wedge is standard in Silica Material only. For Fireclay Material in the case of Arches with Spans over 11'-0", use combinations of No. 1 Wedge and Straight brick. The quantity of No. 1 Wedge brick remains constant at 51. The quantity of Straight brick is determined by subtracting 51 from the quantity given in the column "Total".

12" ARCH THICKNESS — WEDGE BRICK

12" x 4½" x 3", 12" x 6" x 3" or
12" x 9" x 3"—Concluded
1.608" Rise Per Foot of Span (60° Central Angle)

Span	Rise	Inside Radius	Number Required Per Course			
			No. 1 Wedge	No. 1-X* Wedge	Straight	Total
16'- 0"	2'- $1\frac{23}{32}$"	16'- 0"	30	42	..	72
16'- 3"	2'- 2 $\frac{1}{8}$"	16'- 3"	29	44	..	73
16'- 6"	2'- $2\frac{17}{32}$"	16'- 6"	28	46	..	74
16'- 9"	2'- $2\frac{15}{16}$"	16'- 9"	27	48	..	75
17'- 0"	2'- $3\frac{11}{32}$"	17'- 0"	25	51	..	76
17'- 3"	2'- $3\frac{23}{32}$"	17'- 3"	24	53	..	77
17'- 6"	2'- 4 $\frac{1}{8}$"	17'- 6"	23	55	..	78
17'- 9"	2'- $4\frac{17}{32}$"	17'- 9"	22	57	..	79
18'- 0"	2'- $4\frac{15}{16}$"	18'- 0"	21	59	..	80
18'- 3"	2'- $5\frac{11}{32}$"	18'- 3"	20	61	..	81
18'- 6"	2'- 5 ¾"	18'- 6"	19	63	..	82
18'- 9"	2'- 6 $\frac{5}{32}$"	18'- 9"	18	65	..	83
19'- 0"	2'- $6\frac{17}{32}$"	19'- 0"	17	67	..	84
19'- 3"	2'- $6\frac{15}{16}$"	19'- 3"	16	69	..	85
19'- 6"	2'- $7\frac{11}{32}$"	19'- 6"	15	71	..	86
19'- 9"	2'- 7 ¾"	19'- 9"	14	73	..	87
20'- 0"	2'- 8 $\frac{5}{32}$"	20'- 0"	13	75	..	88
20'- 3"	2'- 8 $\frac{9}{16}$"	20'- 3"	12	77	..	89
20'- 6"	2'- $8\frac{31}{32}$"	20'- 6"	10	80	..	90
20'- 9"	2'- $9\frac{11}{32}$"	20'- 9"	10	82	..	92
21'- 0"	2'- 9 ¾"	21'- 0"	9	84	..	93
21'- 3"	2'-10 $\frac{5}{32}$"	21'- 3"	8	86	..	94
21'- 6"	2'-10 $\frac{9}{16}$"	21'- 6"	7	88	..	95
21'- 9"	2'-10 $\frac{31}{32}$"	21'- 9"	6	90	..	96
22'- 0"	2'-11 $\frac{3}{8}$"	22'- 0"	5	92	..	97
22'- 3"	2'-11 $\frac{25}{32}$"	22'- 3"	3	95	..	98
22'- 6"	3'- 0 $\frac{3}{16}$"	22'- 6"	2	97	..	99
22'- 9"	3'- 0 $\frac{9}{16}$"	22'- 9"	1	99	..	100
23'- 0"	3'- $0\frac{31}{32}$"	23'- 0"	..	101	..	101
23'- 3"	3'- 1 $\frac{3}{8}$"	23'- 3"	..	101	1	102
23'- 6"	3'- $1\frac{25}{32}$"	23'- 6"	..	101	2	103
23'- 9"	3'- 2 $\frac{3}{16}$"	23'- 9"	..	101	3	104
24'- 0"	3'- $2\frac{19}{32}$"	24'- 0"	..	101	4	105
24'- 3"	3'- 3"	24'- 3"	..	101	5	106
24'- 6"	3'- 3 $\frac{3}{8}$"	24'- 6"	..	101	6	107
24'- 9"	3'- $3\frac{25}{32}$"	24'- 9"	..	101	7	108
25'- 0"	3'- 4 $\frac{3}{16}$"	25'- 0"	..	101	8	109
25'- 3"	3'- $4\frac{19}{32}$"	25'- 3"	..	101	9	110
25'- 6"	3'- 5"	25'- 6"	..	101	10	111
25'- 9"	3'- $5\frac{13}{32}$"	25'- 9"	..	101	11	112

*NOTE: The No. 1-X Wedge is standard in Silica Material only. For Fireclay Material in the case of Arches with Spans over 11'-0", use combinations of No. 1 Wedge and Straight brick. The quantity of No. 1 Wedge brick remains constant at 51. The quantity of Straight brick is determined by subtracting 51 from the quantity given in the column "Total".

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13½" ARCH THICKNESS—WEDGE BRICK

13½" x 4½" x 3", 13½" x 6" x 3" or 13½" x 9" x 3"

1.608" Rise Per Foot of Span (60° Central Angle)

Span	Rise	Inside Radius	Number Required Per Course			
			No. 2 Wedge	No. 1 Wedge	No. 1-X* Wedge	Total
6'- 0"	9 21/32"	6'- 0"	27	3	..	30
6'- 3"	10 1/16"	6'- 3"	26	5	..	31
6'- 6"	10 7/16"	6'- 6"	25	7	..	32
6'- 9"	10 29/32"	6'- 9"	24	9	..	33
7'- 0"	11 1/4"	7'- 0"	22	12	..	34
7'- 3"	11 21/32"	7'- 3"	21	14	..	35
7'- 6"	1'- 0 1/16"	7'- 6"	21	16	..	37
7'- 9"	1'- 0 15/32"	7'- 9"	20	18	..	38
8'- 0"	1'- 0 7/8"	8'- 0"	19	20	..	39
8'- 3"	1'- 1 1/4"	8'- 3"	18	22	..	40
8'- 6"	1'- 1 21/32"	8'- 6"	17	24	..	41
8'- 9"	1'- 2 1/16"	8'- 9"	16	26	..	42
9'- 0"	1'- 2 15/32"	9'- 0"	14	29	..	43
9'- 3"	1'- 2 7/8"	9'- 3"	13	31	..	44
9'- 6"	1'- 3 9/32"	9'- 6"	12	33	..	45
9'- 9"	1'- 3 11/16"	9'- 9"	11	35	..	46
10'- 0"	1'- 4 1/16"	10'- 0"	10	37	..	47
10'- 3"	1'- 4 15/32"	10'- 3"	9	39	..	48
10'- 6"	1'- 4 7/8"	10'- 6"	8	41	..	49
10'- 9"	1'- 5 9/32"	10'- 9"	7	43	..	50
11'- 0"	1'- 5 11/16"	11'- 0"	6	45	..	51
11'- 3"	1'- 6 3/32"	11'- 3"	5	47	..	52
11'- 6"	1'- 6 1/2"	11'- 6"	4	49	..	53
11'- 9"	1'- 6 7/8"	11'- 9"	3	51	..	54
12'- 0"	1'- 7 9/32"	12'- 0"	2	53	..	55
12'- 3"	1'- 7 11/16"	12'- 3"	1	55	..	56
12'-4½"	1'- 7 29/32"	12'- 4½"	..	57	..	57
12'- 6"	1'- 8 3/32"	12'- 6"	..	56	1	57
12'- 9"	1'- 8 1/2"	12'- 9"	..	55	4	59
13'- 0"	1'- 8 29/32"	13'- 0"	..	54	6	60
13'- 3"	1'- 9 5/16"	13'- 3"	..	53	8	61
13'- 6"	1'- 9 11/16"	13'- 6"	..	52	10	62
13'- 9"	1'-10 3/32"	13'- 9"	..	51	12	63
14'- 0"	1'-10 1/2"	14'- 0"	..	50	14	64
14'- 3"	1'-10 29/32"	14'- 3"	..	49	16	65
14'- 6"	1'-11 5/16"	14'- 6"	..	48	18	66
14'- 9"	1'-11 23/32"	14'- 9"	..	47	20	67
15'- 0"	2'- 0 1/8"	15'- 0"	..	46	22	68
15'- 3"	2'- 0 17/32"	15'- 3"	..	45	24	69
15'- 6"	2'- 0 29/32"	15'- 6"	..	44	26	70

Continued on next page

*NOTE: The No. 1-X Wedge is standard in Silica Material only. For Fireclay Material in the case of Arches with Spans over 12'-4½", use combinations of No. 1 Wedge and Straight brick. The quantity of No. 1 Wedge brick remains constant at 57. The quantity of Straight brick is determined by subtracting 57 from the quantity given in the column "Total".



13½" ARCH THICKNESS—WEDGE BRICK

13½" x 4½" x 3", 13½" x 6" x 3" or 13½" x 9" x 3"—Concluded

1.608" Rise Per Foot of Span (60° Central Angle)

Span	Rise	Inside Radius	Number Required Per Course			
			No. 1 Wedge	No. 1-X* Wedge	Straight	Total
15'- 9"	2'- 1 5/16"	15'- 9"	43	28	..	71
16'- 0"	2'- 1 23/32"	16'- 0"	41	31	..	72
16'- 3"	2'- 2 1/8"	16'- 3"	40	33	..	73
16'- 6"	2'- 2 17/32"	16'- 6"	39	35	..	74
16'- 9"	2'- 2 15/16"	16'- 9"	38	37	..	75
17'- 0"	2'- 3 11/32"	17'- 0"	37	39	..	76
17'- 3"	2'- 3 23/32"	17'- 3"	36	41	..	77
17'- 6"	2'- 4 1/8"	17'- 6"	35	43	..	78
17'- 9"	2'- 4 17/32"	17'- 9"	34	45	..	79
18'- 0"	2'- 4 15/16"	18'- 0"	33	48	..	81
18'- 3"	2'- 5 11/32"	18'- 3"	32	50	..	82
18'- 6"	2'- 5 3/4"	18'- 6"	31	52	..	83
18'- 9"	2'- 6 5/32"	18'- 9"	30	54	..	84
19'- 0"	2'- 6 17/32"	19'- 0"	29	56	..	85
19'- 3"	2'- 6 15/16"	19'- 3"	28	58	..	86
19'- 6"	2'- 7 11/32"	19'- 6"	27	60	..	87
19'- 9"	2'- 7 3/4"	19'- 9"	26	62	..	88
20'- 0"	2'- 8 5/32"	20'- 0"	25	64	..	89
20'- 3"	2'- 8 9/16"	20'- 3"	24	66	..	90
20'- 6"	2'- 8 31/32"	20'- 6"	23	68	..	91
20'- 9"	2'- 9 11/32"	20'- 9"	22	70	..	92
21'- 0"	2'- 9 3/4"	21'- 0"	21	72	..	93
21'- 3"	2'-10 5/32"	21'- 3"	19	75	..	94
21'- 6"	2'-10 9/16"	21'- 6"	18	77	..	95
21'- 9"	2'-10 31/32"	21'- 9"	17	79	..	96
22'- 0"	2'-11 3/8"	22'- 0"	16	81	..	97
22'- 3"	2'-11 25/32"	22'- 3"	15	83	..	98
22'- 6"	3'- 0 3/16"	22'- 6"	14	85	..	99
22'- 9"	3'- 0 9/16"	22'- 9"	13	87	..	100
23'- 0"	3'- 0 31/32"	23'- 0"	12	89	..	101
23'- 6"	3'- 1 25/32"	23'- 6"	10	94	..	104
24'- 0"	3'- 2 19/32"	24'- 0"	8	98	..	106
24'- 6"	3'- 3 3/8"	24'- 6"	6	102	..	108
25'- 0"	3'- 4 3/16"	25'- 0"	4	106	..	110
25'- 6"	3'- 5"	25'- 6"	2	110	..	112
26'- 0"	3'- 5 13/16"	26'- 0"	..	113	1	114
26'- 6"	3'- 6 19/32"	26'- 6"	..	113	3	116
27'- 0"	3'- 7 13/32"	27'- 0"	..	113	5	118
27'- 6"	3'- 8 7/32"	27'- 6"	..	113	7	120
28'- 0"	3'- 9"	28'- 0"	..	113	9	122

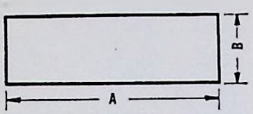
*NOTE: The No. 1-X Wedge is standard in Silica Material only. For Fireclay Material in the case of Arches with Spans over 12'-4½", use combinations of No. 1 Wedge and Straight brick. The quantity of No. 1 Wedge brick remains constant at 57. The quantity of Straight brick is determined by subtracting 57 from the quantity given in the column "Total".

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GEOMETRIC FORMULAS

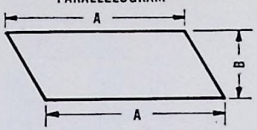
The following formulas for areas and volumes are useful in calculating refractory brickwork.

RECTANGLE



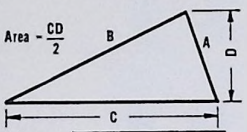
Area = AB

PARALLELOGRAM



Area = AB

ACUTE-ANGLED TRIANGLE

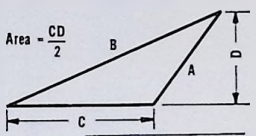


Area = $\frac{CD}{2}$

Area = $\sqrt{S(S-A)(S-B)(S-C)}$

where S = ½ (A + B + C)

OBTUSE-ANGLED TRIANGLE

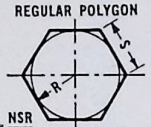


Area = $\frac{CD}{2}$

Area = $\sqrt{S(S-A)(S-B)(S-C)}$

where S = ½ (A + B - C)

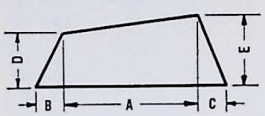
REGULAR POLYGON



Area = $\frac{NSR}{2}$

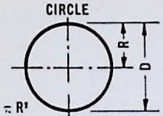
(where N = Number of Sides)

TRAPEZIUM



Area = ½ |A(D - E) - BD - CE|

CIRCLE



Area = πR^2

or $\frac{\pi D^2}{4}$ Circumference = $2\pi R$ or πD

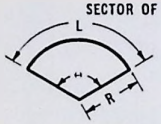
ANNULAR RING



Area = $\frac{1}{4}\pi (D-d)(D-d)$

or .7854 $(D^2 - d^2)$

SECTOR OF CIRCLE



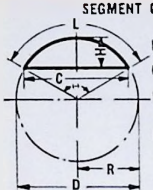
$L = \frac{\pi R \circ}{180}$

$\circ = \frac{57.296\ L}{R}$

$R = \frac{2 \times \text{Area}}{L}$

Area = $\frac{RL}{2}$ or $\pi R^2 \times \frac{\circ}{360}$

SEGMENT OF CIRCLE



L = .01745 R ∘

$C = 2\sqrt{H(2R-H)}$

$H = R - \frac{1}{2}\sqrt{4R^2 - C^2}$

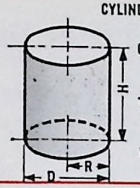
$R = \frac{C^2 + 4H^2}{8H}$

$\circ = \frac{57.296L}{R}$

Area = ½ |RL − C (R − H)|

or $\pi R^2 \times \frac{\circ}{360} - \frac{C(R-H)}{2}$

CYLINDER

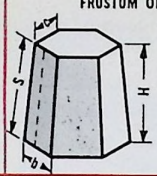


Cylindrical Surface = $2\pi RH$

Total Surface = $2\pi R(R + H)$

Volume = $\pi R^2 H$

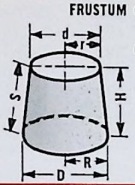
FRUSTUM OF PYRAMID



Lateral Area = ½S (Nc + Nb)
(N = Number of Sides)

Volume = $\frac{H}{3}(A + a + \sqrt{Aa})$
(A = Area of base)
(a = Area of top)

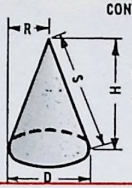
FRUSTUM OF CONE



Conical Surface = $\pi S(R + r)$

Volume = $1.0472\,H(R^2 + Rr + r^2)$

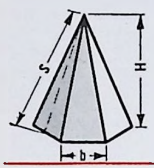
CONE



Conical Surface = πRS

Volume = $\frac{\pi R^2 H}{3}$

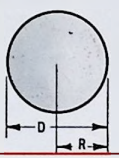
PYRAMID



Lateral Area = ½ S (Nb)
(N = Number of Sides)

Volume = $\frac{H}{3}$ (Area of base)

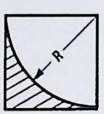
SPHERE



Area = $4\pi R^2$ or πD^2

Volume = $\frac{4\pi R^3}{3}$ or $\frac{\pi D^3}{6}$

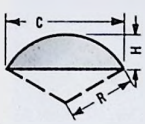
FILLET OR SPANDREL



Area = $R^2 - \frac{\pi R^2}{4}$

or $0.2146R^2$

SEGMENT OF SPHERE

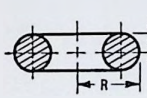


Spherical Surface = $2\pi RH$

Total Surface = $\frac{\pi}{4}(C^2 + 8RH)$

Volume = $\frac{\pi}{24}H(3C^2 + 4H^2)$

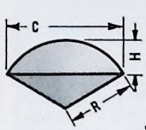
TORUS



Area = $4\pi^2 Rr$

Volume = $2\pi^2 Rr^2$

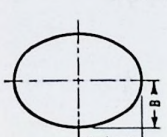
SECTOR OF SPHERE



Total Surface = $\pi R\left(2H + \frac{C}{2}\right)$

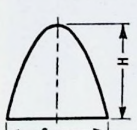
Volume = $\frac{2\pi R^2 H}{3}$

ELLIPSE



Area = πAB

PARABOLIC SEGMENT



Area = $\frac{2\ SH}{3}$

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CIRCUMFERENCES AND AREAS OF CIRCLES FROM 1/64 to 100

Diameter	Circumference	Area
1/64	.04909	.00019
1/32	.09818	.00077
1/16	.19635	.00307
1/8	.39270	.01227
3/16	.58905	.02761
1/4	.78540	.04909
5/16	.98175	.07670
3/8	1.1781	.11045
7/16	1.3745	.15033
1/2	1.5708	.19635
9/16	1.7672	.24850
5/8	1.9635	.30680
11/16	2.1598	.37122
3/4	2.3562	.44179
13/16	2.5525	.51849
7/8	2.7489	.60132
15/16	2.9452	.69029
1	3.1416	.78540
1 1/8	3.5343	.99402
1 1/4	3.9270	1.2272
1 3/8	4.3197	1.4849
1 1/2	4.7124	1.7671
1 5/8	5.1051	2.0739
1 3/4	5.4978	2.4053
1 7/8	5.8905	2.7612
2	6.2832	3.1416
2 1/8	6.6759	3.5466
2 1/4	7.0686	3.9761
2 3/8	7.4613	4.4301
2 1/2	7.8540	4.9087
2 5/8	8.2467	5.4119
2 3/4	8.6394	5.9396
2 7/8	9.0321	6.4918
3	9.4248	7.0686
3 1/8	9.8175	7.6699
3 1/4	10.210	8.2958
3 3/8	10.603	8.9462
3 1/2	10.996	9.6211
3 5/8	11.388	10.321
3 3/4	11.781	11.045
3 7/8	12.174	11.793
4	12.566	12.566
4 1/8	12.959	13.364
4 1/4	13.352	14.186
4 3/8	13.745	15.033
4 1/2	14.137	15.904
4 5/8	14.530	16.800
4 3/4	14.923	17.721
4 7/8	15.315	18.665
5	15.708	19.635
5 1/8	16.101	20.629
5 1/4	16.493	21.648
5 3/8	16.886	22.691
5 1/2	17.279	23.758
5 5/8	17.672	24.850
5 3/4	18.064	25.967
5 7/8	18.457	27.109
6	18.850	28.274
6 1/8	19.242	29.465
6 1/4	19.635	30.680
6 3/8	20.028	31.919
6 1/2	20.420	33.183
6 5/8	20.813	34.472
6 3/4	21.206	35.785
6 7/8	21.598	37.122
7	21.991	38.485
7 1/8	22.384	39.871
7 1/4	22.777	41.282
7 3/8	23.169	42.718
7 1/2	23.562	44.179
7 5/8	23.955	45.664
7 3/4	24.347	47.173
7 7/8	24.740	48.707
8	25.133	50.265
8 1/8	25.525	51.849
8 1/4	25.918	53.456
8 3/8	26.311	55.088
8 1/2	26.704	56.745
8 5/8	27.096	58.426
8 3/4	27.489	60.132
8 7/8	27.882	61.862
9	28.274	63.617
9 1/8	28.667	65.397
9 1/4	29.060	67.201
9 3/8	29.452	69.029
9 1/2	29.845	70.882
9 5/8	30.238	72.760
9 3/4	30.631	74.662
9 7/8	31.023	76.589
10	31.416	78.540
10 1/8	31.809	80.516
10 1/4	32.201	82.516
10 3/8	32.594	84.541
10 1/2	32.987	86.590
10 5/8	33.379	88.664
10 3/4	33.772	90.763
10 7/8	34.165	92.886

CIRCUMFERENCES AND AREAS OF CIRCLES —Continued

Diameter	Circumference	Area
11	34.558	95.033
11 1/8	34.950	97.205
11 1/4	35.343	99.402
11 3/8	35.736	101.62
11 1/2	36.128	103.87
11 5/8	36.521	106.14
11 3/4	36.914	108.43
11 7/8	37.306	110.75
12	37.699	113.10
12 1/8	38.092	115.47
12 1/4	38.485	117.86
12 3/8	38.877	120.28
12 1/2	39.270	122.72
12 5/8	39.663	125.19
12 3/4	40.055	127.68
12 7/8	40.448	130.19
13	40.841	132.73
13 1/8	41.233	135.30
13 1/4	41.626	137.89
13 3/8	42.019	140.50
13 1/2	42.412	143.14
13 5/8	42.804	145.80
13 3/4	43.197	148.49
13 7/8	43.590	151.20
14	43.982	153.94
14 1/8	44.375	156.70
14 1/4	44.768	159.48
14 3/8	45.160	162.30
14 1/2	45.553	165.13
14 5/8	45.946	167.99
14 3/4	46.339	170.87
14 7/8	46.731	173.78
15	47.124	176.71
15 1/8	47.517	179.67
15 1/4	47.909	182.65
15 3/8	48.302	185.66
15 1/2	48.695	188.69
15 5/8	49.087	191.75
15 3/4	49.480	194.83
15 7/8	49.873	197.93
16	50.266	201.06
16 1/8	50.658	204.22
16 1/4	51.051	207.39
16 3/8	51.444	210.60
16 1/2	51.836	213.82
16 5/8	52.229	217.08
16 3/4	52.622	220.35
16 7/8	53.014	223.65
17	53.407	226.98
17 1/8	53.800	230.33
17 1/4	54.193	233.71
17 3/8	54.585	237.10
17 1/2	54.978	240.53
17 5/8	55.371	243.98
17 3/4	55.763	247.45
17 7/8	56.156	250.95
18	56.549	254.47
18 1/8	56.941	258.02
18 1/4	57.334	261.59
18 3/8	57.727	265.18
18 1/2	58.120	268.80
18 5/8	58.512	272.45
18 3/4	58.905	276.12
18 7/8	59.298	279.81
19	59.690	283.53
19 1/8	60.083	287.27
19 1/4	60.476	291.04
19 3/8	60.868	294.83
19 1/2	61.261	298.65
19 5/8	61.654	302.49
19 3/4	62.047	306.35
19 7/8	62.439	310.24
20	62.832	314.16
20 1/8	63.225	318.10
20 1/4	63.617	322.06
20 3/8	64.010	326.05
20 1/2	64.403	330.06
20 5/8	64.795	334.10
20 3/4	65.188	338.16
20 7/8	65.581	342.25
21	65.973	346.36
21 1/8	66.366	350.50
21 1/4	66.759	354.66
21 3/8	67.152	358.84
21 1/2	67.544	363.05
21 5/8	67.937	367.28
21 3/4	68.330	371.54
21 7/8	68.722	375.83
22	69.115	380.13
22 1/8	69.508	384.46
22 1/4	69.900	388.82
22 3/8	70.293	393.20
22 1/2	70.686	397.61
22 5/8	71.079	402.04
22 3/4	71.471	406.49
22 7/8	71.864	410.97

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CIRCUMFERENCES AND AREAS OF CIRCLES
—Continued

Diameter	Circumference	Area
23	72.257	415.48
23 1/8	72.649	420.00
23 1/4	73.042	424.56
23 3/8	73.435	429.13
23 1/2	73.827	433.74
23 5/8	74.220	438.36
23 3/4	74.613	443.01
23 7/8	75.006	447.69
24	75.398	452.39
24 1/8	75.791	457.11
24 1/4	76.184	461.86
24 3/8	76.578	466.64
24 1/2	76.969	471.44
24 5/8	77.362	476.26
24 3/4	77.754	481.11
24 7/8	78.147	485.98
25	78.540	490.87
25 1/8	78.933	495.79
25 1/4	79.325	500.74
25 3/8	79.718	505.71
25 1/2	80.111	510.71
25 5/8	80.503	515.72
25 3/4	80.896	520.77
25 7/8	81.289	525.84
26	81.681	530.93
26 1/8	82.074	536.05
26 1/4	82.467	541.19
26 3/8	82.860	546.35
26 1/2	83.252	551.55
26 5/8	83.645	556.76
26 3/4	84.038	562.00
26 7/8	84.430	567.27
27	84.823	572.56
27 1/8	85.216	577.87
27 1/4	85.608	583.21
27 3/8	86.001	588.57
27 1/2	86.394	593.96
27 5/8	86.787	599.37
27 3/4	87.179	604.81
27 7/8	87.572	610.27
28	87.965	615.75
28 1/8	88.357	621.26
28 1/4	88.750	626.80
28 3/8	89.143	632.36
28 1/2	89.535	637.94
28 5/8	89.928	643.55
28 3/4	90.321	649.18
28 7/8	90.714	654.84
29	91.106	660.52
29 1/8	91.499	666.23
29 1/4	91.892	671.96
29 3/8	92.284	677.71
29 1/2	92.677	683.49
29 5/8	93.070	689.30
29 3/4	93.462	695.13
29 7/8	93.855	700.98
30	94.248	706.86
30 1/8	94.641	712.76
30 1/4	95.033	718.69
30 3/8	95.426	724.64
30 1/2	95.819	730.62
30 5/8	96.211	736.62
30 3/4	96.604	742.64
30 7/8	96.997	748.69
31	97.389	754.77
31 1/8	97.782	760.87
31 1/4	98.175	766.99
31 3/8	98.568	773.14
31 1/2	98.960	779.31
31 5/8	99.353	785.51
31 3/4	99.746	791.73
31 7/8	100.14	797.98
32	100.53	804.25
32 1/8	100.92	810.54
32 1/4	101.32	816.86
32 3/8	101.71	823.21
32 1/2	102.10	829.58
32 5/8	102.49	835.97
32 3/4	102.89	842.39
32 7/8	103.28	848.83
33	103.67	855.30
33 1/8	104.07	861.79
33 1/4	104.46	868.31
33 3/8	104.85	874.85
33 1/2	105.24	881.41
33 5/8	105.64	888.00
33 3/4	106.03	894.62
33 7/8	106.42	901.26
34	106.81	907.92
34 1/8	107.21	914.61
34 1/4	107.60	921.32
34 3/8	107.99	928.06
34 1/2	108.39	934.82
34 5/8	108.78	941.61
34 3/4	109.17	948.42
34 7/8	109.56	955.25

CIRCUMFERENCES AND AREAS OF CIRCLES
—Continued

Diameter	Circumference	Area
35	109.96	962.11
35 1/8	110.35	969.00
35 1/4	110.74	975.91
35 3/8	111.13	982.84
35 1/2	111.53	989.80
35 5/8	111.92	996.78
35 3/4	112.31	1003.8
35 7/8	112.71	1010.8
36	113.10	1017.9
36 1/8	113.49	1025.0
36 1/4	113.88	1032.1
36 3/8	114.28	1039.2
36 1/2	114.67	1046.3
36 5/8	115.06	1053.5
36 3/4	115.45	1060.7
36 7/8	115.85	1068.0
37	116.24	1075.2
37 1/8	116.63	1082.5
37 1/4	117.02	1089.8
37 3/8	117.42	1097.1
37 1/2	117.81	1104.5
37 5/8	118.20	1111.8
37 3/4	118.60	1119.2
37 7/8	118.99	1126.7
38	119.38	1134.1
38 1/8	119.77	1141.6
38 1/4	120.17	1149.1
38 3/8	120.56	1156.6
38 1/2	120.95	1164.2
38 5/8	121.34	1171.7
38 3/4	121.74	1179.3
38 7/8	122.13	1186.9
39	122.52	1194.6
39 1/8	122.92	1202.3
39 1/4	123.31	1210.0
39 3/8	123.70	1217.7
39 1/2	124.09	1225.4
39 5/8	124.49	1233.2
39 3/4	124.88	1241.0
39 7/8	125.27	1248.8
40	125.66	1256.6
40 1/8	126.06	1264.5
40 1/4	126.45	1272.4
40 3/8	126.84	1280.3
40 1/2	127.24	1288.2
40 5/8	127.63	1296.2
40 3/4	128.02	1304.2
40 7/8	128.41	1312.2
41	128.81	1320.3
41 1/8	129.20	1328.3
41 1/4	129.59	1336.4
41 3/8	129.98	1344.5
41 1/2	130.38	1352.7
41 5/8	130.77	1360.8
41 3/4	131.16	1369.0
41 7/8	131.55	1377.2
42	131.95	1385.4
42 1/8	132.34	1393.7
42 1/4	132.73	1402.0
42 3/8	133.13	1410.3
42 1/2	133.52	1418.6
42 5/8	133.91	1427.0
42 3/4	134.30	1435.4
42 7/8	134.70	1443.8
43	135.09	1452.2
43 1/8	135.48	1460.7
43 1/4	135.87	1469.1
43 3/8	136.27	1477.6
43 1/2	136.66	1486.2
43 5/8	137.05	1494.7
43 3/4	137.45	1503.3
43 7/8	137.84	1511.9
44	138.23	1520.5
44 1/8	138.62	1529.2
44 1/4	139.02	1537.9
44 3/8	139.41	1546.6
44 1/2	139.80	1555.3
44 5/8	140.19	1564.0
44 3/4	140.59	1572.8
44 7/8	140.98	1581.6
45	141.37	1590.4
45 1/8	141.76	1599.3
45 1/4	142.16	1608.2
45 3/8	142.55	1617.0
45 1/2	142.94	1626.0
45 5/8	143.34	1634.9
45 3/4	143.73	1643.9
45 7/8	144.12	1652.9
46	144.51	1661.9
46 1/8	144.91	1670.9
46 1/4	145.30	1680.0
46 3/8	145.69	1689.1
46 1/2	146.08	1698.2
46 5/8	146.48	1707.4
46 3/4	146.87	1716.5
46 7/8	147.26	1725.7

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CIRCUMFERENCES AND AREAS OF CIRCLES
—Concluded

Diameter	Circumference	Area	Diameter	Circumference	Area
47	147.66	1734.9	61	191.64	2922.5
47 1/8	148.05	1744.2	62	194.78	3019.1
47 1/4	148.44	1753.5	63	197.92	3117.2
47 3/8	148.83	1762.7	64	201.06	3217.0
47 1/2	149.23	1772.1	65	204.20	3318.3
47 5/8	149.62	1781.4	66	207.35	3421.2
47 3/4	150.01	1790.8	67	210.49	3525.7
47 7/8	150.40	1800.1	68	213.63	3631.7
			69	216.77	3739.3
48	150.80	1809.6	70	219.91	3848.5
48 1/8	151.19	1819.0	71	223.05	3959.2
48 1/4	151.58	1828.5	72	226.20	4071.5
48 3/8	151.98	1837.9	73	229.34	4185.4
48 1/2	152.37	1847.5	74	232.48	4300.8
48 5/8	152.76	1857.0	75	235.62	4417.9
48 3/4	153.15	1866.5	76	238.76	4536.5
48 7/8	153.55	1876.1	77	241.90	4656.6
			78	245.04	4778.4
			79	248.19	4901.7
49	153.94	1885.7	80	251.33	5026.5
49 1/8	154.33	1895.4			
49 1/4	154.72	1905.0	81	254.47	5153.0
49 3/8	155.12	1914.7	82	257.61	5281.0
49 1/2	155.51	1924.4	83	260.75	5410.6
49 5/8	155.90	1934.2	84	263.89	5541.8
49 3/4	156.29	1943.9	85	267.04	5674.5
49 7/8	156.69	1953.7	86	270.18	5808.8
			87	273.32	5944.7
			88	276.46	6082.1
50	157.08	1963.5	89	279.60	6221.1
			90	282.74	6361.7
51	160.22	2042.8	91	285.89	6503.9
52	163.36	2123.7	92	289.03	6647.6
53	166.50	2206.2	93	292.17	6792.9
54	169.65	2290.2	94	295.31	6939.8
55	172.79	2375.8	95	298.45	7088.2
56	175.93	2463.0	96	301.59	7238.2
57	179.07	2551.8	97	304.73	7389.8
58	182.21	2642.1	98	307.88	7543.0
59	185.35	2734.0	99	311.02	7697.7
60	188.50	2827.4	100	314.16	7854.0

DECIMALS OF AN INCH FOR EACH 1/64

Common Fraction	Decimal	Common Fraction	Decimal
1/64	.015625	33/64	.515625
1/32	.03125	17/32	.53125
3/64	.046875	35/64	.546875
1/16	.0625	9/16	.5625
5/64	.078125	37/64	.578125
3/32	.09375	19/32	.59375
7/64	.109375	39/64	.609375
1/8	**.125**	**5/8**	**.625**
9/64	.140625	41/64	.640625
5/32	.15625	21/32	.65625
11/64	.171875	43/64	.671875
3/16	.1875	11/16	.6875
13/64	.203125	45/64	.703125
7/32	.21875	23/32	.71875
15/64	.234375	47/64	.734375
1/4	**.25**	**3/4**	**.75**
17/64	.265625	49/64	.765625
9/32	.28125	25/32	.78125
19/64	.296875	51/64	.796875
5/16	.3125	13/16	.8125
21/64	.328125	53/64	.828125
11/32	.34375	27/32	.84375
23/64	.359375	55/64	.859375
3/8	**.375**	**7/8**	**.875**
25/64	.390625	57/64	.890625
13/32	.40625	29/32	.90625
27/64	.421875	59/64	.921875
7/16	.4375	15/16	.9375
29/64	.453125	61/64	.953125
15/32	.46875	31/32	.96875
31/64	.484375	63/64	.984375
1/2	**.5**	**1**	**1.**

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CONVERSION TABLES OR EQUIVALENTS

LENGTH EQUIVALENTS

Kilometer	Meter	Centimeter	Millimeter	Inch	Foot	Yard	Miles
1	1,000	10^5	10^6	39,370	3,280.83	1,093.61	0.62137
0.001	1	100	1,000	39.37	3.28083	1.09361	0.0006214
10^{-5}	0.01	1	10	0.3937	0.032808	0.010936	0.0000062
10^{-6}	0.001	0.1	1	0.03937	0.0032808	0.0010936	0.00000062
2.54×10^{-5}	0.0254	2.540	25.40005	1	0.083333	0.02778	0.0000158
3.048×10^{-4}	0.30480	30.480	304.801	12	1	0.33333	0.00018939
9.144×10^{-4}	0.914402	91.440	914.4	36	3	1	0.0005682

SURFACE AND AREA EQUIVALENTS

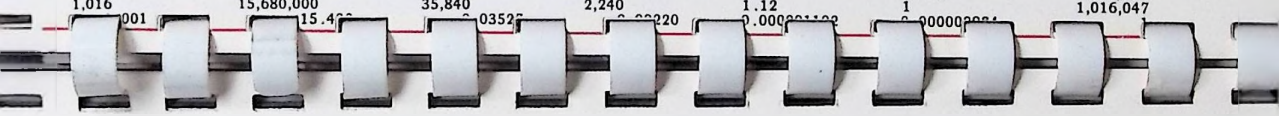
Sq. Meters	Sq. Inches	Sq. Feet	Sq. Yard	Acres	Sq. Miles	Sq. Centimeter	Sq. Millimeter
1	1,550	10.76	1.196	0.0002471	0.0000003861	10,000	10^6
0.0006452	1	0.006944	0.0007716	0.0000001594	0.0000000002491	6.452	645.2
0.09290	144	1	0.1111	0.00002296	0.00000003587	929.0	92,903
0.8361	1,296	9	1	0.0002066	0.0000003288	8,361	836,131
4,047	6,272,640	43,560	4,840	1	0.001562	40,468,726	$4,047 \times 10^6$
2,589,998	—	27,878,400	3,097,600	640	1	25.9×10^9	25.9×10^{11}

VOLUME AND CAPACITY EQUIVALENTS

Cu. Inch	Cu. Foot	Cu. Yard	U. S. Fluid Oz.	U. S. Quart		U. S. Gallon	Liters	Cu. Centimeter
				Liquid	Dry			
1	0.0005787	0.00002143	0.5541	0.01732	0.01488	0.004329	0.01639	16.39
1,728	1	0.03704	957.5	29.92	25.71	7.481	28.32	28,320
46,656	27	1	25,853	807.9	694.3	202.0	764.6	764,559
1.805	0.001044	0.00003868	1	0.03125	0.02686	0.007812	0.02957	29.57
57.75	0.03342	0.001238	32	1	0.8594	0.25	0.9463	946.3
67.20	0.03889	0.00144	37.24	1.164	1	0.2909	1.101	1,101
231	0.1337	0.004951	128	4	3.437	1	3.785	3,785
61.03	0.03531	0.001308	33.81	1.057	0.9081	0.2642	1	1,000

WEIGHT EQUIVALENTS

Kilograms	Grains	Ounces	Pounds	Tons		Grams
				Short	Long	
1	15,432	35.27	2.205	0.001102	0.0009842	1,000.0
0.00006480	1	0.002286	0.0001429	0.00000007143	0.00000006378	0.0648
0.02835	437.5	1	0.0625	0.00003125	0.00002790	28.35
0.4536	7000	16	1	0.0005	0.0004464	453.59
907.2	14,000,000	32,000	2,000	1	0.8929	907,184
1,016	15,680,000	35,840	2,240	1.12	1	1,016,047
.001	15.4	.03525	.00220	0.000001102	0.00000[illegible]	



DENSITY EQUIVALENTS

Gram Per CC.	Kg. Per Cu. Meter	Lb. Per Cu. In.	Lb. Per Cu. Ft.	Lb. Per Cu. Yd.	Lb. Per U. S. Gal.	Tons (2000 Lb.) Per Cu. Yard	Tons (2240 Lb.) Per Cu. Yard
1	1,000	0.03613	62.43	1,686	8.345	0.8428	0.7525
0.001	1	0.00003613	0.06243	1.686	0.008345	0.8428×10^{-3}	0.7525×10^{-3}
27.68	27,680	1	1,728	46,656	231	23.33	20.83
0.01602	16.02	0.0005787	1	27	0.1337	0.01350	0.012054
0.005933	0.59327	0.00002143	0.03704	1	0.004951	0.0005	0.0004464
0.1198	119.8	0.004329	7.481	202.0	1	0.1010	0.09017
1.187	1,187	0.04287	74.07	2,000	9.902	1	0.8929
1.329	1,329	0.0401	82.96	2,240	11.09	1.12	1

POWER EQUIVALENTS

Hp. (550 Standard Ft.-lb. per sec.)	Metric Hp.	Kw. (1000 joules per sec.)	M. Kg. per sec.	Ft. lb. per sec.	K. Cal. per sec.	Btu per sec.	Cal. per sec.
1	1.0138	0.7457	76.04	550	0.1782	0.7068	178.23
0.9863	1	0.7355	75	542.5	0.1758	0.6971	175.79
1.341	1.3596	1	101.97	737.56	0.2390	0.9478	239.01
0.01315	0.01333	0.009807	1	7.233	0.00234	0.009295	2.3438
0.001818	0.001843	0.001356	0.1383	1	0.000324	0.001285	0.3240
5.611	5.689	4.1840	426.7	3,086	1	3.966	1,000
1.415	1.434	1.055	107.8	778.16	0.2522	1	252.16
0.005611	0.005689	0.004184	0.4267	3.086	0.001	0.00397	1

VELOCITY EQUIVALENTS

Cm. per Sec.	M. per Sec.	M. per Min.	Km. per Hour	Ft. per Sec.	Ft. per Min.	Miles per hr.
1	0.01	0.6	0.036	0.03281	1.9685	0.02237
100	1	60	3.6	3.281	196.85	2.237
1.667	0.01667	1	0.06	0.0547	3.281	0.03728
27.78	0.2778	16.67	1	0.9113	54.68	0.6214
30.48	0.3048	18.29	1.097	1	60	0.6818
0.5080	0.005080	0.3048	0.01829	0.01667	1	0.01136
44.70	0.4470	26.82	1.609	1.467	88	1

ANGULAR MEASURE EQUIVALENTS

Circle	Degrees	Minutes	Seconds	Radians
1	360	21,600	1,296,000	6.283185
0.00278	1	60	3,600	0.017453
0.0000463	0.01667	1	60	0.0002909
7.7×10^{-7}	0.00028	0.01667	1	0.0000048481
0.159155	57.2958	3,437.75	206,265	1

THERMAL CONDUCTIVITY EQUIVALENTS

Cal. per sec. per sq. cm. per cm. per °C	International watts per sq. cm. per cm. per °C	Cal. per hr. per sq. cm. per cm. per °C	B.t.u. per hr. per sq. ft. per in. per °F	B.t.u. per day per sq. ft. per in. per °F
1	4.1833	3,600	2,901.0	69,624
0.2390	1	860.6	693.5	16,643
0.000278	0.001162	1	0.8058	19.34
0.0003447	0.001441	1.241	1	24.0
0.0000144	0.0000601	0.05171	0.04167	1

HEAT FLOW EQUIVALENTS

Cal. per sec. per sq. cm.	Cal. per hr. per sq. cm.	B.t.u. per hr. per sq. ft.	B.t.u. per day per sq. ft.	Watts per sq. cm.
1	3,600	13,263	318,322	4.183
0.0002778	1	3.684	88.42	0.001162
0.0000754	0.2714	1	24	0.0003154
0.00000314	0.01131	0.04167	1	0.00001314
0.2390	860.6	3,171	76,094	1

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TEMPERATURE CONVERSION TABLES
By Albert Sauveur

Note: The numbers in bold face type refer to the temperature either in degrees Centigrade or Fahrenheit which it is desired to convert into the other scale.

0 to 100

C.		F.	C.		F.
—17.8	0	32	10.6	51	123.8
—17.2	1	33.8	11.1	52	125.6
—16.7	2	35.6	11.7	53	127.4
—16.1	3	37.4	12.2	54	129.2
—15.6	4	39.2	12.8	55	131.0
—15.0	5	41.0	13.3	56	132.8
—14.4	6	42.8	13.9	57	134.6
—13.9	7	44.6	14.4	58	136.4
—13.3	8	46.4	15.0	59	138.2
—12.8	9	48.2	15.6	60	140.0
—12.2	10	50.0	16.1	61	141.8
—11.7	11	51.8	16.7	62	143.6
—11.1	12	53.6	17.2	63	145.4
—10.6	13	55.4	17.8	64	147.2
—10.0	14	57.2	18.3	65	149.0
— 9.44	15	59.0	18.9	66	150.8
— 8.89	16	60.8	19.4	67	152.6
— 8.33	17	62.6	20.0	68	154.4
— 7.78	18	64.4	20.6	69	156.2
— 7.22	19	66.2	21.1	70	158.0
— 6.67	20	68.0	21.7	71	159.8
— 6.11	21	69.8	22.2	72	161.6
— 5.56	22	71.6	22.8	73	163.4
— 5.00	23	73.4	23.3	74	165.2
— 4.44	24	75.2	23.9	75	167.0
— 3.89	25	77.0	24.4	76	168.8
— 3.33	26	78.8	25.0	77	170.6
— 2.78	27	80.6	25.6	78	172.4
— 2.22	28	82.4	26.1	79	174.2
— 1.67	29	84.2	26.7	80	176.0
— 1.11	30	86.0	27.2	81	177.8
— 0.56	31	87.8	27.8	82	179.6
0	32	89.6	28.3	83	181.4
0.56	33	91.4	28.9	84	183.2
1.11	34	93.2	29.4	85	185.0
1.67	35	95.0	30.0	86	186.8
2.22	36	96.8	30.6	87	188.6
2.78	37	98.6	31.1	88	190.4
3.33	38	100.4	31.7	89	192.2
3.89	39	102.2	32.2	90	194.0
4.44	40	104.0	32.8	91	195.8
5.00	41	105.8	33.3	92	197.6
5.56	42	107.6	33.9	93	199.4
6.11	43	109.4	34.4	94	201.2
6.67	44	111.2	35.0	95	203.0
7.22	45	113.0	35.6	96	204.8
7.78	46	114.8	36.1	97	206.6
8.33	47	116.6	36.7	98	208.4
8.89	48	118.4	37.2	99	210.2
9.44	49	120.2	37.8	100	212.0
10.0	50	122.0			



TEMPERATURE CONVERSION TABLES
—Continued
By Albert Sauveur

100 to 1000

C.		F.	C.		F.
38	100	212	288	550	1022
43	110	230	293	560	1040
49	120	248	299	570	1058
54	130	266	304	580	1076
60	140	284	310	590	1094
66	150	302	316	600	1112
71	160	320	321	610	1130
77	170	338	327	620	1148
82	180	356	332	630	1166
88	190	374	338	640	1184
93	200	392	343	650	1202
99	210	410	349	660	1220
100	212	413	354	670	1238
104	220	428	360	680	1256
110	230	446	366	690	1274
116	240	464	371	700	1292
121	250	482	377	710	1310
127	260	500	382	720	1328
132	270	518	388	730	1346
138	280	536	393	740	1364
143	290	554	399	750	1382
149	300	572	404	760	1400
154	310	590	410	770	1418
160	320	608	416	780	1436
166	330	626	421	790	1454
171	340	644	427	800	1472
177	350	662	432	810	1490
182	360	680	438	820	1508
188	370	698	443	830	1526
193	380	716	449	840	1544
199	390	734	454	850	1562
204	400	752	460	860	1580
210	410	770	466	870	1598
216	420	788	471	880	1616
221	430	806	477	890	1634
227	440	824	482	900	1652
232	450	842	488	910	1670
238	460	860	493	920	1688
243	470	878	499	930	1706
249	480	896	504	940	1724
254	490	914	510	950	1742
260	500	932	516	960	1760
266	510	950	521	970	1778
271	520	968	527	980	1796
277	530	986	532	990	1814
282	540	1004	538	1000	1832

INTERPOLATION FACTORS

0.56	1	1.8	3.33	6	10.8
1.11	2	3.6	3.89	7	12.6
1.67	3	5.4	4.44	8	14.4
2.22	4	7.2	5.00	9	16.2
2.78	5	9.0	5.56	10	18.0

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1000 to 2000

C.		F.	C.		F.
543	**1010**	1850	821	**1510**	2750
549	**1020**	1868	827	**1520**	2768
554	**1030**	1886	832	**1530**	2786
560	**1040**	1904	838	**1540**	2804
566	**1050**	1922	843	**1550**	2822
571	**1060**	1940	849	**1560**	2840
577	**1070**	1958	854	**1570**	2858
582	**1080**	1976	860	**1580**	2876
588	**1090**	1994	866	**1590**	2894
593	**1100**	2012	871	**1600**	2912
599	**1110**	2030	877	**1610**	2930
604	**1120**	2048	882	**1620**	2948
610	**1130**	2066	888	**1630**	2966
616	**1140**	2084	893	**1640**	2984
621	**1150**	2102	899	**1650**	3002
627	**1160**	2120	904	**1660**	3020
632	**1170**	2138	910	**1670**	3038
638	**1180**	2156	916	**1680**	3056
643	**1190**	2174	921	**1690**	3074
649	**1200**	2192	927	**1700**	3092
654	**1210**	2210	932	**1710**	3110
660	**1220**	2228	938	**1720**	3128
666	**1230**	2246	943	**1730**	3146
671	**1240**	2264	949	**1740**	3164
677	**1250**	2282	954	**1750**	3182
682	**1260**	2300	960	**1760**	3200
688	**1270**	2318	966	**1770**	3218
693	**1280**	2336	971	**1780**	3236
699	**1290**	2354	977	**1790**	3254
704	**1300**	2372	982	**1800**	3272
710	**1310**	2390	988	**1810**	3290
716	**1320**	2408	993	**1820**	3308
721	**1330**	2426	999	**1830**	3326
727	**1340**	2444	1004	**1840**	3344
732	**1350**	2462	1010	**1850**	3362
738	**1360**	2480	1016	**1860**	3380
743	**1370**	2498	1021	**1870**	3398
749	**1380**	2516	1027	**1880**	3416
754	**1390**	2534	1032	**1890**	3434
760	**1400**	2552	1038	**1900**	3452
766	**1410**	2570	1043	**1910**	3470
771	**1420**	2588	1049	**1920**	3488
777	**1430**	2606	1054	**1930**	3506
782	**1440**	2624	1060	**1940**	3524
788	**1450**	2642	1066	**1950**	3542
793	**1460**	2660	1071	**1960**	3560
799	**1470**	2678	1077	**1970**	3578
804	**1480**	2696	1082	**1980**	3596
810	**1490**	2714	1088	**1990**	3614
816	**1500**	2732	1093	**2000**	3632

TEMPERATURE CONVERSION TABLES
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2000 to 3000

C.		F.	C.		F.
1099	**2010**	3650	1377	**2510**	4550
1104	**2020**	3668	1382	**2520**	4568
1110	**2030**	3686	1388	**2530**	4586
1116	**2040**	3704	1393	**2540**	4604
1121	**2050**	3722	1399	**2550**	4622
1127	**2060**	3740	1404	**2560**	4640
1132	**2070**	3758	1410	**2570**	4658
1138	**2080**	3776	1416	**2580**	4676
1143	**2090**	3794	1421	**2590**	4694
1149	**2100**	3812	1427	**2600**	4712
1154	**2110**	3830	1432	**2610**	4730
1160	**2120**	3848	1438	**2620**	4748
1166	**2130**	3866	1443	**2630**	4766
1171	**2140**	3884	1449	**2640**	4784
1177	**2150**	3902	1454	**2650**	4802
1182	**2160**	3920	1460	**2660**	4820
1188	**2170**	3938	1466	**2670**	4838
1193	**2180**	3956	1471	**2680**	4856
1199	**2190**	3974	1477	**2690**	4874
1204	**2200**	3992	1482	**2700**	4892
1210	**2210**	4010	1488	**2710**	4910
1216	**2220**	4028	1493	**2720**	4928
1221	**2230**	4046	1499	**2730**	4946
1227	**2240**	4064	1504	**2740**	4964
1232	**2250**	4082	1510	**2750**	4982
1238	**2260**	4100	1516	**2760**	5000
1243	**2270**	4118	1521	**2770**	5018
1249	**2280**	4136	1527	**2780**	5036
1254	**2290**	4154	1532	**2790**	5054
1260	**2300**	4172	1538	**2800**	5072
1266	**2310**	4190	1543	**2810**	5090
1271	**2320**	4208	1549	**2820**	5108
1277	**2330**	4226	1554	**2830**	5126
1282	**2340**	4244	1560	**2840**	5144
1288	**2350**	4262	1566	**2850**	5162
1293	**2360**	4280	1571	**2860**	5180
1299	**2370**	4298	1577	**2870**	5198
1304	**2380**	4316	1582	**2880**	5216
1310	**2390**	4334	1588	**2890**	5234
1316	**2400**	4352	1593	**2900**	5252
1321	**2410**	4370	1599	**2910**	5270
1327	**2420**	4388	1604	**2920**	5288
1332	**2430**	4406	1610	**2930**	5306
1338	**2440**	4424	1616	**2940**	5324
1343	**2450**	4442	1621	**2950**	5342
1349	**2460**	4460	1627	**2960**	5360
1354	**2470**	4478	1632	**2970**	5378
1360	**2480**	4496	1638	**2980**	5396
1366	**2490**	4514	1643	**2990**	5414
1371	**2500**	4532	1649	**3000**	5432

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TEMPERATURE END POINTS OF PYROMETRIC CONES

DEFINITION: Pyrometric Cone Equivalent (P. C. E.)—In the case of refractories, the number of that standard cone whose tip would touch the supporting plaque simultaneously with a cone of the material being investigated when tested in accordance with the Standard Method of Test for P. C. E. of Fireclay Brick (A. S. T. M. Designation C-24) of the American Society for Testing Materials.

NOTE: The terms "fusion point," "softening point," "deformation point," and "melting point" have heretofore been loosely used for "pyrometric cone equivalent."

No. of Cone	End point* Degrees Cent.	Degrees Fahr.	No. of Cone	End point* Degrees Cent.	Degrees Fahr.
022	605	1121	7	1250	2282
021	615	1139	8	1260	2300
020	650	1202	9	1285	2345
019	660	1220	10	1305	2381
018	720	1328	11	1325	2417
017	770	1418	12	1335	2435
016	795	1463	13	1350	2462
015	805	1481	14	1400	2552
014	830	1526	15	1435	2615
013	860	1580	16	1465	2669
012	875	1607	17	1475	2687
011	905	1661	18	1490	2714
010	895	1643	19	1520	2768
09	930	1706	20	1530	2786
08	950	1742	23	1580	2876
07	990	1814	26	1595	2903
06	1015	1859	27	1605	2921
05	1040	1904	28	1615	2939
04	1060	1940	29	1640	2984
03	1115	2039	30	1650	3002
02	1125	2057	31	1680	3056
01	1145	2093	32	1700	3092
1	1160	2120	†32½	1722	3131
2	1165	2129	33	1745	3173
3	1170	2138	34	1760	3200
			35	1785	3245
4	1190	2174	36	1810	3290
5	1205	2201	37	1820	3308
6	1230	2246	38	1835	3335

*NOTE: Pyrometric cones do not give an accurate measurement of temperature. Where it is desired to interpret P. C. E. values approximately in terms of temperature, the table above may be used. This table has been approved by the A. S. T. M. It is based on the work of Fairchild and Peters, J. Amer. Cer. Soc. 9, 701-43, 1926. Heating rate 150° Cent. per hour for cones .022 to 20, inclusive, and 100° Cent. per hour for cones 23 to 38, inclusive. The temperatures do not apply to the slower rates of heating common in the commercial firing and the use of refractory materials.

†Not included in the tests of Fairchild and Peters. The temperatures given are approximate.

FURNACE TEMPERATURES

Kind of Furnace	Degrees C	Degrees F
Boilers	1000 to 1600	1800 to 2900
By-Product Coke Ovens	1000 to 1500	1830 to 2730
Cement Kilns, hot zone	1300 to 1600	2400 to 2900
Copper Converters	1200 to 1300	2200 to 2400
Copper Refining Furnaces	1250 to 1550	2300 to 2800
Copper Reverberatories	1300 to 1570	2400 to 2850
Copper Roasters	700 to 810	1300 to 1500
Gas Producer	1260 to 1370	2300 to 2500
Glass Annealing Furnaces	430 to 540	800 to 1000
Glass Tanks, bottle	1370 to 1600	2500 to 2900
Glass Tanks, plate	1370 to 1650	2500 to 3000
Iron and Steel Furnaces		
Annealing Oven	760 to 980	1400 to 1800
Blast Furnace, tapping	1370 to 1540	2500 to 2800
Bessemer Converter	1540 to 1650	2800 to 3000
Electric Furnaces	1450 to 1700	2650 to 3100
Heating Furnaces	980 to 1310	1800 to 2400
Malleable Furnaces	1300 to 1650	2400 to 3000
Open Hearths		
Melting Chamber	650 to 1680	1200 to 3050
Checkers	200 to 1430	400 to 2600
Soaking Pits	1150 to 1370	2100 to 2500

COLOR SCALE FOR TEMPERATURES

Lowest visible red	475	885
Lowest visible red to dark red	475 to 650	885 to 1200
Dark red to cherry red	650 to 750	1200 to 1380
Cherry red to bright cherry red	750 to 815	1380 to 1500
Bright cherry red to orange	815 to 900	1500 to 1650
Orange to yellow	900 to 1090	1650 to 2000
Yellow to light yellow	1090 to 1315	2000 to 2400
Light yellow to white	1315 to 1540	2400 to 2800
White to dazzling white	1540 and over	2800 and over

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MELTING POINTS OF METALS AND ALLOYS*

	Degrees Fahrenheit		Degrees Centigrade	
Aluminum	1220.2±0.2	b	660.1±0.1	
Antimony	1166.9±0.2	b	630.5±0.1	
Bronze	1920	approx.	1050	approx.
Brass	1725	approx.	940	approx.
Cadmium	609.6±0.2	b	320.9±0.1	
Calcium	1562	±35	850	±20
Copper	1981.4±0.2	b	1083	±0.1
Gold	1945.4±0.0	a	1063	±0.0
Iridium	4429	±5	b 2443	±3
Iron, pure	2802	±5	1539	±3
Cast iron, white	2100	approx.	1150	approx.
Cast iron, gray	2245	approx.	1230	approx.
Steel, plain carbon (1% carbon and less)	2680	approx.	1470	approx.
Wrought iron	2750	approx.	1510	approx.
Lead	621.1±0.2	b	327.3±0.1	
Magnesium	1202	±4	650	±2
Nickel	2647	±2	b 1453	±1
Palladium	2826	±2	b 1552	±1
Platinum	3216	±1.8	b 1769	±1
Rhodium	3560	±5	b 1960	±3
Silicon	2602	±35	1428	±20
Silver	1761.4±0.0	a	960.8±0.0	
Tin	449.4±0.2	b	231.9±0.1	
Titanium	3300	±180	1815	±100
Tungsten	6116	±35	b 3380	±20
Vanadium	3145	±90	1730	±50
Zinc	787.1±0.2	b	419.5±0.1	

NOTE: a. Primary fixed points, International Temperature Scale of 1948.
b. Secondary fixed points, International Temperature Scale of 1948.

MELTING POINTS OF MINERALS AND OXIDES*

		°F	°C
Alumina (Corundum)	Al_2O_3	3700	2038
Beryllia	BeO	4660	2570
Carbon (Sublimes)	C	6600	3650
Chromium Oxide	Cr_2O_3	4110	2265
Forsterite	$2MgO{\cdot}SiO_2$	3492	1922
Lime	CaO	4658	2570
Magnesia	MgO	5072	2800
Silica (Cristobalite)	SiO_2	3133	1723
Silicon Carbide (decomposes)	SiC	4082	2250
Spinel	$MgO{\cdot}Al_2O_3$	3875	2135
Zirconia	ZrO_2	4890	2700
Zircon	$ZrO_2{\cdot}SiO_2$	3227†	1775†

* Adjusted to the International Temperature Scale of 1948.
† Dissociation Temperature.

COMPARISON OF TYLER AND U. S. SIEVE SERIES

TYLER STANDARD SIEVE SERIES*				U.S. Series approx. equivalent
Tyler mesh	Opening, in.	Opening, mm.	Dia. of wire, in.	
—	3	76.2	0.207	3 in.
—	2	50.8	.192	2 in.
—	1½	38.1	.148	1½ in.
—	1.050	26.67	.148	1.06 in.
—	0.883	22.43	.135	⅞ in.
—	.742	18.85	.135	¾ in.
—	.624	15.85	.120	⅝ in.
—	.525	13.33	.105	0.530 in.
—	.441	11.20	.105	7/16 in.
—	.371	9.423	.092	⅜ in.
2½	.312	7.925	.088	5/16 in.
3	.263	6.680	.070	0.265 in.
3½	.221	5.613	.065	No. 3½
4	.185	4.699	.065	No. 4
5	.156	3.962	.044	No. 5
6	.131	3.327	.036	No. 6
7	.110	2.794	.0328	No. 7
8	.093	2.362	.032	No. 8
9	.078	1.981	.033	No. 10
10	.065	1.651	.035	No. 12
12	.055	1.397	.028	No. 14
14	.046	1.168	.025	No. 16
16	.0390	0.991	.0235	No. 18
20	.0328	.833	.0172	No. 20
24	.0276	.701	.0141	No. 25
28	.0232	.589	.0125	No. 30
32	.0195	.495	.0118	No. 35
35	.0164	.417	.0122	No. 40
42	.0138	.351	.0100	No. 45
48	.0116	.295	.0092	No. 50
60	.0097	.246	.0070	No. 60
65	.0082	.208	.0072	No. 70
80	.0069	.175	.0056	No. 80
100	.0058	.147	.0042	No. 100
115	.0049	.124	.0038	No. 120
150	.0041	.104	.0026	No. 140
170	.0035	.089	.0024	No. 170
200	.0029	.074	.0021	No. 200
250	.0024	.061	.0016	No. 230
270	.0021	.053	.0016	No. 270
325	.0017	.043	.0014	No. 325
400	.0015	.038	.0010	No. 400

* Standard in Refractories Industry.

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WEIGHTS OF VARIOUS MATERIALS

Material	Pounds Per Cu.Ft. (Avg.)
BRICK	
Building	87–137
Fireclay	118–152
Silica	102–115
Chrome	175–180
Magnesia as brick or fused in furnace	162–170
CEMENT	
Portland, loose	80–90
Aluminous, loose	90–100
FINE GROUND CLAYS, SILICA CEMENT ETC.	
Fire Clay	50–110
Calcined Fire Clay	70–95
Silica Cement	75–83
Magnesia Cement	127
Chrome Cement	135
Grain Magnesite (as shipped)	112
COAL AND COKE	
Anthracite	87–112
Bituminous	75–94
Charcoal	10–35
Coke	23–32
CONCRETE	
Cement, stone, sand	120–155
Cement, slag, etc.	110–130
EARTH	
Loam, dry loose	63–76
Loam, packed	85–95
Loam, soft, loose mud	90–108
Loam, dense mud	110–125
GLASS	
Common window	156–160
Plate	157–161
Container	152–159
Laboratory	136–140
Optical	133–507
LIME	
Mortar	100
Quick, loose lumps	53
Quick, fine	75
Slaked	81–87
Stone, solid	165–172
Stone, crushed	85–100
MASONRY	
Granite or limestone	165–172
Mortar rubble	150–155
Sandstone	110–147

Material	Pounds Per Cu.Ft. (Avg.)
METALS	
Aluminum	166–168
Brass, cast	523–534
Bronze, 14% Sn	555
Copper, cast, rolled	552–556
Copper, rolled or wire	555
Iron, gray cast	438–445
Iron, white cast	473–482
Iron, wrought	486–493
Lead, cast	708
Lead, rolled	711
Nickel	536–555
Steel, cast or rolled	474–490
Tin cast	455–459
Zinc cast	439–447
OILS	
Crude	48–62
Fuel Oil	
No. 1	51–52
No. 2	52–53
No. 3	54–55
Bunker C-	60–63
Gasoline	44–47
Kerosene	48–51
Lubricating Oil	55–59
ROCKS IN SOLID	
Chalk	118–175
Dolomite	175–178
Granite	165–175
Gypsum	143–146
Limestone and marble	165–172
Magnesite	187–190
Pumice	40–50
Quartz	162–165
Sandstone	134–162
Shale	162–172
Slate, American	175
Soapstone, talc	162–175
SAND	
Dry, loose	100
Dry, packed	110
Wet, packed	120
Gravel, packed	118
WATER	
As ice	57.2
At 32°F	62.4
At 212°F	59.8



TYPICAL PROPERTIES OF VARIOUS REFRACTORIES

Brick Type	Typical Constituents	P.C.E.	Spalling Resistance (Relative)	Abrasion Resistance (Relative)	Load Bearing Ability (Relative)	Pounds per 9" Equiv.	% Porosity	Mean Coefficient of Expansion per °F (Between 32°F and 2000°F Temp.)	Thermal Conductivity BTU/sq. ft./in. /1°F./hr. at 2000°F.
Silica	96% SiO_2	31–32	Poor	Good	Very Good	6-6.5	22–30	$62x10^{-7}$ (2)	12
High Duty Fireclay	40% Al_2O_3 55% SiO_2	31–33	Good 3–20%	Good	Good	7.5-8.5	10–24	$31x10^{-7}$	10
Super Duty Fireclay	42% Al_2O_3 52% SiO_2	33–34	Excellent 0-4%	Good	Good	8.5	12–15	$30x10^{-7}$	10
High Alumina	50-80% Al_2O_3	34–39	Excellent	Good	Good	8-9	20–35	$32\text{-}40x10^{-7}$	11
Mullite	62% Al_2O_3 35% SiO_2	37–39	Excellent	Good	Excellent	8.5	15–22	$32x10^{-7}$	13
Silicon Carbide	85-90% SiC	37–40(1)	Excellent	Very Good	Excellent	8.7-10	13–28	$26x10^{-7}$	108
Fused Alumina	85-90% Al_2O_3	37–40	Good	Very Good	Excellent	9-11	20–24	$43x10^{-7}$	17
Chrome	30-45% Cr_2O_3 15-33% Al_2O_3	38–41	Poor	Fair	Fair	10.5-11	20–28	$41x10^{-7}$	11
Magnesite	83-93% MgO 2-7% Fe_2O_3	38–41	Poor	Fair	Good	9.5-10	20–28	$68x10^{-7}$	14

(1) Dissociates at 4082°F. (2) Coeff. 68° to 600°F.—$163x10^{-7}$, 600° to 2000°F.—$24x10^{-7}$.

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GLOSSARY OF TERMS RELATING TO REFRACTORIES

ABRASION OF REFRACTORIES—Wearing away of refractory surfaces by the scouring action of moving solids. (*A*)

ABUTMENT—The structural portion of a furnace which withstands the thrust of an arch. (*R*)

ACID REFRACTORIES—Refractories containing a substantial amount of uncombined silica which, when heated, may react chemically with basic refractories, slags or fluxes. (*R*)

AIR SET—The property of a material to develop high strength when dried, an example being air-setting mortars. (Not to be confused with hydraulic set.) (*R*)

AMERICAN BOND—Brickwork in which stretcher courses are the principal portion, with headers laid every 5th, 6th, or 7th course. (*R*)

AUGER MACHINE—A machine for extruding moist clay through a die by means of a revolving screw or auger. (*R*)

BACK—As applied to an arch, the outer or upper surface. (*R*)

BAG WALL—A refractory baffle wall between the combustion chamber and the charge in a kiln or furnace.

BASIC REFRACTORIES—Refractories whose major constituent is either lime or magnesia and which, when heated, may react chemically with acid refractories, slags or fluxes. (*R*)

BASKETWEAVE CHECKERWORK—An arrangement of checker brick with continuous vertical flues in which the plan view suggests the weave of a basket.

BAT—A broken burned brick or shape. (*R*)

BATTER—To reduce the width of brickwork with succeeding courses. (*R*)

BLOATING—Swelling of a refractory when in the thermo-plastic state, caused by temperatures in excess of that for which the material is intended, an exception being the use of this property in one type of ladle brick. (See also Secondary Expansion.) (*R*)

BULLNOSE BRICK—See Jamb Brick.

BURN—The degree to which the bond and other necessary physical and chemical properties of a refractory have been developed during manufacture by heat treatment in a kiln. (*R*)

GLOSSARY—Continued

BUTTERED JOINT—Mortar joint made by trowelling mortar along the edges of the face of a brick, tile or shape and laying it without a complete mortar bed.

CLAY-GROG MORTAR—A refractory mortar made of ground clay and grog for use in laying fireclay brick. (*R*)

CORBEL—One or more courses of brick, each projecting beyond the one below it to form a support. (*R*)

CORROSION OF REFRACTORIES—Destruction of refractory surfaces by the chemical action of external agencies. (*A*)

DE-AIRED BRICK—Brick molded or formed from a mix which has been subjected to a partial vacuum during the forming process.

DIE—A mold used for shaping brick in a machine or a form for shaping an extruded column. (*R*)

DIVISION WALL—Wall dividing any two major sections of a furnace.

DOUBLE-SCREENED GROUND REFRACTORY MATERIAL—A refractory material that contains a natural gradation of particle sizes resulting from grinding or crushing and from which particles coarser and finer than two specified sizes have been removed by screening. (*A*)

DROP MACHINE SILICA BRICK—Silica brick formed by dropping a quantity of a prepared mix from a considerable vertical distance into a mold followed by slicking to size.

DRY PRESS BRICK—Brick formed under high pressure from moistened, but dry-appearing, ground ceramic materials.

EROSION OF REFRACTORIES—Wearing away of refractory surfaces by the washing action of moving liquids. (*A*)

FIRST QUALITY FIRECLAY BRICK—A trade term usually indicating high duty fireclay brick as classified by A.S.T.M.

FLASH MARKS—Discoloration on the surface of a brick resulting from the adherence of fly ash or the impingement of a reducing flame during burning. (*R*)

FLUX BLOCKS—Refractory shapes which are used in contact with molten glass in furnaces. (*R*)

FUSION-CAST REFRACTORY—Refractory material made by fusing refractory compositions in an electric furnace and pouring the molten material into molds to solidify and form finished shapes.

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GANISTER—A dense, high-silica rock (quartzite), suitable for use in the manufacture of silica refractories. Note—Confusion sometimes results from the use of this term because in some parts of the United States it is applied to crushed fire brick or mixtures of either crushed fire brick or silica rock with clay. (*R*)

GROG—Burned refractory material, usually calcined clay or crushed fire brick. (*R*)

HAUNCH—That portion of an arch which is midway between the skewback and the crown. (*R*)

HEADER—A brick laid in a wall on its largest face with its longest dimension at right angles to the face of the wall. (*R*)

HEARTH AND BOSH BRICK—Fireclay brick for use in lining the hearth walls and bosh sections of a blast furnace. (*R*)

HERRINGBONE BOND—Brick laid in an angular or zigzag fashion, forming a herringbone pattern in the plan view.

HOT TOP—A special refractory shape or construction which is placed on top of an ingot or casting mold to hold a quantity of molten iron which will later flow downward to compensate for the shrinkage as the ingot solidifies.

INWALL BRICK—Fireclay brick for use in lining the inwall section of a blast furnace. (*R*)

JACK ARCH—A sprung arch with plane, horizontal, outer and inner surfaces.

JAMB BRICK—A brick modified so that the corner of one end and side is rounded with a radius approximately equal to the width of the brick. (*R*)

KILN MARKS—Irregularities on the surface of a refractory caused by deformation under load during burning. (*R*)

LAMINATIONS—Planes or contours of weakness in a molded refractory, which may develop during the forming process. (*R*)

LEAN MORTAR—Mortar having poor troweling properties. (*R*)

NEUTRAL REFRACTORIES—A term applied to refractories which are neither strongly basic nor strongly acid, such as chrome, mullite, or carbon. (*R*)

NINE-INCH EQUIVALENT—The volume of a 9″x4½″x2½″ brick (101.25 cubic inches) which unit is used to express the amount of material in a single shape, shipment, or period of production of refractory materials.

NOZZLE BRICK—A tubular refractory shape used in a ladle with a hole through which steel is teemed at the bottom of a ladle, the upper end of the shape serving as a seat for the stopper. (*R*)

OVERFIRING—Heating to a temperature sufficient to cause either pronounced deformation or bloating.

PERMEABILITY—The property of allowing liquids or gases to flow into or through a material. (*R*)

PIGEONHOLE CHECKER—An arrangement of checker brick in continuous parallel horizontal rows, so that alternate courses of bricks are parallel and intervening courses are laid at 90 degrees to adjacent courses.

POURING PIT REFRACTORIES—Refractories used for the transfer and control of flow of molten steel in ingot molds. Note.—The materials include ladle brick, sleeves, nozzles, stoppers, hot tops, runner brick, etc. (*R*)

RAMMING MIX—A refractory material which, when tempered with water, will have suitable properties to allow it to be rammed into place to form a monolithic furnace lining and which develops structural strength when subsequently heated in the furnace. Note.—Usually of a less plastic nature than plastic refractories. (*R*)

RED HEART—A harmless reddish core, sometimes found in fireclay refractories.

RING—The sound produced when two brick are struck together or when one brick is tapped with a hard object. (*R*)

RISE—The vertical distance between a plane connecting the spring lines and the highest point of the under side of an arch. (*R*)

ROWLOCK—Brick laid on edge with their longest dimension at right angles to the furnace wall.

RUNNER BRICK—A refractory shape having a hole or holes through which molten steel is conveyed during the teeming of bottom-poured ingots. (*R*)

SCUTCH—A hand tool resembling a small pick with flat cutting edges for trimming brick to the desired size or shape. (*R*)

SECOND QUALITY FIRECLAY BRICK—A trade term usually indicating intermediate duty fireclay brick as classified by A.S.T.M.

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SECONDARY EXPANSION—A characteristic of some fireclay refractories to develop permanent expansion at temperatures within their useful range in service. Note—A behavior not to be confused with the bloating caused by excessive temperatures which impair the useful properties of a refractory. (*R*)

SINGLE-SCREENED GROUND REFRACTORY MATERIAL—A refractory material that contains a natural gradation of particle sizes resulting from grinding or crushing and from which particles coarser than a specified size have been removed by screening. (*A*)

SLEEVES—Tubular refractory shapes used to protect the metal rod which holds the stopper head in the valve assembly of a bottom-pouring ladle. (*R*)

SOLDIER COURSE—A course of brick laid in a wall on end with their narrower side parallel to the furnace wall. (*R*)

SPRING LINE—The line of contact between the inside surface of an arch and the skewback. (*R*)

SPRUNG ARCH—An arch which is supported by abutments at the sides or ends only. (*R*)

STEAM PRESSED BRICK—Brick made by repressing blanks cut from a column of clay from an auger machine.

STIFF MUD REPRESSED BRICK—See steam pressed brick.

STOPPER HEAD—A refractory shape, usually made of clay and graphite, which is a movable valve head seating on the nozzle brick, the assembly forming a valve for the metal in bottom-pouring ladles. (*R*)

STRETCHER—A brick laid in a wall with its largest face horizontal and its longest dimension parallel to the face of the wall. (*R*)

SUSPENDED ARCH—An arch in which the brick shapes are suspended from overhead supporting members. (*R*)

THIRD QUALITY FIRECLAY BRICK—A trade term usually indicating low duty fireclay brick, as classified by A.S.T.M.

TILE—Rectangular refractory shapes in sizes larger than standard brick and usually typified by thinness with respect to length and width. (*R*)

TOP BRICK—Fireclay brick for use in lining the top section of a blast furnace. (*R*)

TUYERE BRICK—A refractory shape containing one or more holes through which air and other gases are introduced into a furnace. (*R*)

NOTE:
(*A*) Definition from A.S.T.M. Definitions of Terms Relating to Refractories C 71.
(*R*) Definitions of the American Refractories Institute. Bulletin No. 87.

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