

IN THE CIRCUIT COURT OF KANAWHA COUNTY, WEST VIRGINIA

IN RE: ASBESTOS CASES

CIVIL DIVISION

PLAINTIFF'S EXHIBIT

NAR-167

BEFORE: HON. A. ANDREW
MacQUEEN

C.A. No. 92-C-8888

NORTH AMERICAN REFRACTORIES
COMPANY'S RESPONSE TO PLAINTIFFS'
JOINT REQUEST FOR ADMISSIONS
DIRECTED TO ALL DEFENDANTS
ON BEHALF OF ALL PLAINTIFFS
PARTICIPATING IN THE KANAWHA
COUNTY MASS TRIAL III

Filed on behalf of:
North American Refractories
Company, One of the Defendants

Counsel of record for this
Party:

JOSEPH S. BEESON, ESQUIRE

ROBINSON & McELWEE
P.O. Box 1791
Charleston, WV 25326
(304) 344-5800

**IN THE CIRCUIT COURT OF KANAWHA
COUNTY, WEST VIRGINIA**

IN RE: ASBESTOS CASES
 CIVIL ACTION NO. 92-C-8888

**NORTH AMERICAN REFRACTORIES COMPANY'S RESPONSE TO PLAINTIFF'S
JOINT REQUEST FOR ADMISSIONS DIRECTED TO ALL DEFENDANTS
ON BEHALF OF ALL PLAINTIFFS PARTICIPATING IN THE KANAWHA
COUNTY MASS TRIAL III**

NORTH AMERICAN REFRACTORIES COMPANY'S GENERAL OBJECTIONS

AND NOW, comes North American Refractories Company, by and through its attorneys, Robinson & McElwee, and files the following Response to Plaintiffs' Joint Request for Admissions for purposes of the consolidated asbestos trial only:

Plaintiffs in the cases in which North American Refractories Company is a defendant have provided no evidence that the Plaintiff workers were ever exposed to any asbestos-containing product manufactured or supplied by North American Refractories Company. Therefore, North American Refractories Company objects to these Requests for Admissions as they are overly broad, unduly burdensome, unreasonably cumulative and duplicative. Moreover, the production of the information sought would cause this Defendant extreme and unreasonable oppression, annoyance, inconvenience and expense. North American Refractories Company further objects to these requests insofar as they seek information constituting trade secrets, confidential financial data or other confidential research, development or commercial information.

North American Refractories Company further objects to these Requests for Admissions insofar as they seek information which is subject to the attorney-client privilege which falls within the realm of the attorney work product doctrine or which is otherwise not

discoverable under the provisions of the West Virginia Rules of Civil Procedure. Without waiving any objections, North American Refractories Company responds as follows.

1. Defendant published and/or distributed product brochures and/or catalogues and/or instructions that dealt in whole or in part with asbestos-containing products manufactured and/or sold and/or used by Defendant.

RESPONSE: It is admitted that in the past North American Refractories Company distributed product catalogues and/or brochures which dealt in part with a small number of products it manufactured and/or sold which contained a small percentage of asbestos; however, Plaintiffs in the cases in which North American Refractories Company is a Defendant have not shown any evidence of exposure to those products. General instructions were available or were provided upon request; however, none dealt specifically with asbestos. North American Refractories Company objects to the remainder of this Request for Admissions as overly broad, irrelevant and unduly vague.

2. The product brochure and/or catalogues and/or instructions referred to in Request for Admission No. 1 above were distributed at some time during the period in which Defendant manufactured and/or sold and/or used asbestos-containing products.

RESPONSE: It is admitted that in the past North American Refractories Company distributed product catalogues and/or brochures which dealt in part with a small number of products it manufactured and/or sold which contained small percentages of asbestos during the period in which those products were manufactured and/or sold; however, Plaintiffs in the cases in which North American Refractories Company is a Defendant have not shown any evidence of exposure to those products. General instructions were also available during that period or were provided upon request; however none dealt specifically

with asbestos. North American Refractories Company objects to the remainder of this Request for Admissions as overly broad, irrelevant and unduly vague.

3. In some of the product brochures and/or catalogues and/or instructions of Defendant concerning asbestos-containing products, pictures of workers handling asbestos containing products appear in the sections devoted to asbestos-containing products.

RESPONSE: North American Refractories Company objects to this request for all reasons stated in its general objections and because it is unduly vague and overly broad in that it fails to specify any time periods to which it refers, thus requesting that this Defendant make an unreasonable search of its records regarding potential products to which Plaintiffs in the cases in which North American Refractories Company is a party have failed to show any evidence of exposure. However, without waiving any objections, North American Refractories Company states that none of its product brochures and/or catalogues and/or instructions had pictures of workers handling asbestos-containing products appearing in sections devoted to asbestos-containing products.

4. In some of the product brochures and/or catalogues and/or instructions of Defendant concerning asbestos-containing products, pictures of workers in the vicinity of asbestos containing products appear in the sections devoted to asbestos-containing products.

RESPONSE: North American Refractories Company objects to this request for all reasons stated in its general objections and because it is unduly vague and overly broad in that it fails to specify any time periods to which it refers, thus requesting that this Defendant make an unreasonable search of its records regarding potential products to which Plaintiffs in the cases in which North American Refractories Company is a party have failed to show any evidence of exposure. However, without waiving any objections, North

American Refractories Company states that none of its product brochures and/or catalogues and/or instructions had pictures of workers in the vicinity of asbestos-containing products appearing in sections devoted to asbestos-containing products.

5. There are no product brochures and/or catalogues and/or instructions of defendant concerning asbestos-containing pipecovering which show a worker wearing a dust mask or respirator while handling asbestos-containing products.

RESPONSE: North American Refractories Company never made or sold asbestos-containing pipecovering.

6. There are no product brochures and/or catalogues and/or instructions of Defendant concerning asbestos-containing products which show a worker wearing a dust mask or respirator while in the vicinity of asbestos-containing products.

RESPONSE: North American Refractories Company objects to this request for all reasons stated in its general objections and because it is overly broad and fails to specify any time period to which it refers, thus requesting that this Defendant make an unreasonable search of its records regarding potential products to which Plaintiffs in the cases in which North American Refractories Company is a party have failed to show any evidence of exposure. However, without waiving any objections, this Defendant's product brochures and/or catalogues and/or instructions do not show a worker wearing a dust mask or respirator while in the vicinity of asbestos-containing products.

7. There are no product brochures and/or catalogues and/or instructions of Defendant concerning asbestos-containing pipecovering which show a worker wearing a dust mask or respirator while handling asbestos-containing products.

RESPONSE: North American Refractories Company never made or sold asbestos-containing pipecovering.

8. There are no product brochures and/or catalogues and/or instructions of Defendant concerning asbestos-containing pipecovering which show a worker wearing a dust mask or respirator while in the vicinity of asbestos-containing products.

RESPONSE: North American Refractories Company never made or sold asbestos-containing pipecovering.

9. There are no product brochures and/or catalogues and/or instructions of Defendant concerning asbestos-containing block which show a worker wearing a dust mask or respirator while handling asbestos-containing block.

RESPONSE: North American Refractories Company never made or sold asbestos-containing block.

10. There are no product brochures and/or catalogues and/or instructions of Defendant concerning asbestos-containing block which show a worker wearing a dust mask or respirator while in the vicinity of asbestos-containing block.

RESPONSE: North American Refractories Company never made or sold asbestos-containing block.

11. There are no product brochures and/or catalogues and/or instructions of Defendant concerning asbestos-containing cement which show a worker wearing a dust mask or respirator while handling asbestos-containing cement.

RESPONSE: North American Refractories Company objects to this request for all reasons stated in its general objections and because it is overly broad and fails to specify any time periods to which it refers, thus, requesting that this Defendant make an

unreasonable search of its records regarding potential products to which Plaintiffs in the cases in which North American Refractories Company is a party have failed to show any evidence of exposure. However, without waiving any objections, this Defendant's product brochures and/or catalogues and/or instructions do not show a worker wearing a dust mask or respirator and handling asbestos-containing cement.

12. There are no product brochures and/or catalogues and/or instructions of Defendant concerning asbestos-containing cement which show a worker wearing a dust mask or respirator while in the vicinity of asbestos-containing cement.

RESPONSE: North American Refractories Company objects to this request for all reasons stated in its general objections and because it is overly broad and fails to specify any time periods to which it refers, thus, requesting that this Defendant make an unreasonable search of its records regarding potential products to which Plaintiffs in the cases in which North American Refractories Company is a party have failed to show any evidence of exposure. However, without waiving any objections, this Defendant's product brochures and/or catalogues and/or instructions do not show a worker wearing a dust mask or respirator while in the vicinity of asbestos-containing cement.

13. Defendant knows of no product brochure and/or catalogue and/or instructions of Defendant that contains a picture of a worker wearing a respirator or dust mask while handling Defendant's asbestos-containing products.

RESPONSE: North American Refractories Company objects to this request for all reasons stated in its general objections and because it is overly broad and fails to specify any time periods to which it refers, thus requesting that this Defendant make an unreasonable search of its records regarding potential products to which Plaintiffs in the cases

in which North American Refractories Company is a party have failed to show any evidence of exposure. However, without waiving any objections, this Defendant knows of no product brochure and/or catalogue and/or instructions which contains a picture of a worker wearing a respirator or dust mask while handling asbestos-containing products.

14. Defendant knows of no product brochure and/or catalogue and/or instructions of Defendant that contains a picture of a worker wearing a respirator or dust mask while in the vicinity of Defendant's asbestos-containing products.

RESPONSE: North American Refractories Company objects to this request for all reasons stated in its general objections and because it is overly broad and fails to specify any time periods to which it refers, thus requesting that this Defendant make an unreasonable search of its records regarding potential products to which Plaintiffs in the cases in which North American Refractories Company is a party have failed to show any evidence of exposure. However, without waiving any objections, this Defendant knows of no product brochure and/or catalogue and/or instructions that contains a picture of a worker wearing a respirator or dust mask while in the vicinity of asbestos-containing products.

15. Defendant knows of no product brochure and/or catalogue and/or instructions of Defendant that contains a picture of a worker wearing a respirator or dust mask while handling Defendant's asbestos-containing pipecovering.

RESPONSE: North American Refractories Company never made or sold asbestos-containing pipecovering.

16. Defendant knows of no product brochure and/or catalogue and/or instructions of Defendant that contains a picture of a worker wearing a respirator or dust mask while in the vicinity of Defendant's asbestos-containing pipecovering.

RESPONSE: North American Refractories Company never made or sold asbestos-containing pipecovering.

17. Defendant knows of no product and/or catalogue and/or instructions of Defendant that contains a picture of a worker wearing a respirator or dust mask while handling Defendant's asbestos-containing block.

RESPONSE: North American Refractories Company never made or sold asbestos-containing block.

18. Defendant knows of no product brochure and/or catalogue and/or instructions of Defendant that contains a picture of a worker wearing a respirator or dust mask while in the vicinity of Defendant's asbestos-containing block.

RESPONSE: North American Refractories Company never made or sold asbestos-containing block.

19. Defendant knows of no product brochure and/or catalogue and/or instructions of Defendant that contains a picture of a worker wearing a respirator or dust mask while handling Defendant's asbestos-containing cement.

RESPONSE: North American Refractories Company objects to this request for all reasons stated in its general objections and because it is overly broad and fails to specify any time periods to which it refers, thus requesting that this defendant make an unreasonable search of its records regarding potential products to which Plaintiffs in the cases in which North American Refractories Company is a party have failed to show any evidence of exposure. However, without waiving any objections, this Defendant knows of no product brochures and/or catalogues and/or instructions which show a worker wearing a dust mask or respirator while handling asbestos-containing cement.

20. Defendant knows of no product brochure and/or catalogue and/or instructions of Defendant that contains a picture of a worker wearing a respirator or dust mask while in the vicinity of Defendant's asbestos-containing cement.

RESPONSE: North American Refractories Company objects to this request for all reasons stated in its general objections and because it is overly broad and fails to specify any time periods to which it refers, thus requesting that this Defendant make an unreasonable search of its records regarding potential products to which Plaintiffs in the cases in which North American Refractories Company is a party have failed to show any evidence of exposure. However, without waiving any objections, this Defendant knows of no product brochures and/or catalogues and/or instructions which show a worker wearing a dust mask or respirator while in the vicinity of asbestos-containing cement.

21. Defendant knows of no product brochure and/or catalogue and/or instructions of defendant that contains a picture of a worker wearing a respirator or dust mask while handling defendant's asbestos-containing products of any kind or nature.

RESPONSE: North American Refractories Company objects to this request for all reasons stated in its general objections and because it is overly broad and fails to specify any time period to which it refers, thus requesting that this Defendant make an unreasonable search of its records regarding potential products to which Plaintiffs in the cases in which North American Refractories Company is a party have failed to show any evidence of exposure, however, without waiving any objections, this Defendant knows of no product brochures and/or catalogues and/or instructions which contains a picture of a worker wearing a respirator or dust mask while handling asbestos-containing products. Nor do such materials show workers handling products designated as asbestos-containing.

22. Defendant knows of no product brochure and/or catalogue and/or instructions of defendant that contains a picture of a worker wearing a respirator or dust mask while in the vicinity of defendant's asbestos-containing products of any kind or nature.

RESPONSE: North American Refractories Company objects to this request for all reasons stated in its general objections and because it is overly broad and fails to specify any time period to which it refers, thus requesting that this Defendant make an unreasonable search of its records regarding potential products to which Plaintiffs in the cases in which North American Refractories Company is a party have failed to show any evidence of exposure. However, without waiving any objections, this Defendant knows of no product brochures and/or catalogues and/or instructions that contain a picture of a worker wearing a respirator or a dust mask while in the vicinity of asbestos-containing products.

23. Defendant did not at any time take any action to inform users and or those exposed to asbestos-containing products of the existence of a Threshold Limit Value (TLV) for asbestos.

RESPONSE: Admitted.

24. Before 1972, Defendant did not at any time take any action to inform users and/or those exposed to its asbestos-containing products of the existence of a Threshold Limit Value (TLV) for asbestos.

RESPONSE: Admitted.

25. Defendant did not at any time take any action to inform users and/or those exposed to asbestos-containing products of the recommendations of the 1946 Fleisher Drinker Study in Conclusion 2 from that study that "the operations of hand saw cutting,

grinding, cement mixing and installation . . . should be equipped with exhaust ventilation to keep the total dust concentration low.

RESPONSE: This Defendant at no time had knowledge of the Fleisher Drinker Study and therefore could not have taken action on any recommendations which may have been set forth in that study. Moreover, that study would appear to pertain to pipecovering and ship building applications which in no way pertain to this Defendant's products or their use.

26. Before 1972, Defendant did not at any time take any action to inform users and/or those exposed to asbestos-containing products of the recommendations of the 1946 Fleisher Drinker Study in Conclusion 2 from that study that "the operations of hand saw cutting, grinding, cement mixing and installation . . . should be equipped with exhaust ventilation to keep the total dust concentration low.

RESPONSE: This Defendant at no time had knowledge of the Fleisher Drinker Study and therefore could not have taken action on any recommendations which may have been set forth in that study. Moreover, that study would appear to pertain to pipecovering and ship building applications which in no way pertain to this Defendant's products or their use.

27. Defendant did not at any time take any action to inform users and/or those exposed to asbestos-containing products of the recommendations of the 1946 Fleisher Drinker Study on Page 15 of that study that "the suggestions made relative to exhaust ventilation and respiratory protection are . . . of value in maintaining . . . low incidence of asbestos".

RESPONSE: This Defendant at no time had knowledge of the Fleisher Drinker Study and therefore could not have taken action on any recommendations which may have been set forth in that study. Moreover, that study would appear to pertain to pipecovering and ship building applications which in no way pertain to this Defendant's products or their use.

28. Before 1972, Defendant did not at any time take any action to inform users and/or those exposed to asbestos-containing products of the recommendations of the 1946 Fleisher Drinker Study on Page 15 of that study that "the suggestions made relative to exhaust ventilation and respiratory protection are . . . of value in maintaining . . . low incidence of asbestos".

RESPONSE: This Defendant at no time had knowledge of the Fleisher Drinker Study and therefore could not have taken action on any recommendations which may have been set forth in that study. Moreover, that study would appear to pertain to pipecovering and ship building applications which in no way pertain to this Defendant's products or their use.

29. Defendant did not take any actions at any time prior to 1972 to inform users and/or those exposed to its asbestos-containing products of either:

- (a) Suggestions regarding exhaust ventilation when using asbestos products and/or;
- (b) Suggestions regarding respiratory protection when using asbestos products.

RESPONSE: Because North American Refractories Company had no reason to believe its small number of products, designed for use in wet or encapsulated forms, which contained small percentages of asbestos that changed into non-asbestos form as a result

of exposure to heat, would in any way require exhaust ventilation and/or respiratory protection, it did not inform anyone of suggestions regarding same. Moreover, this Defendant believed that its large industrial customers were taking whatever respiratory precautions were needed for their workers and workplaces, as was this Defendant.

30. Defendant knows of no test done by it or at its request to determine asbestos dust concentrations resulting from the cutting, handling, application, and use of any asbestos-containing product manufactured or sold by it.

RESPONSE: Because North American Refractories Company had no reason to believe its small number of products, designed for use in wet or encapsulated forms, which contained small percentages of asbestos that changed into non-asbestos form as a result of exposure to heat, could in any way be harmful, it neither performed nor requested tests to determine asbestos dust concentrations.

31. Defendant continued to sell asbestos-containing products after the date on which it claims to have ceased the manufacture of asbestos-containing products.

RESPONSE: To the best of North American Refractories Company's knowledge, information and belief, it ceased its sale of products which contained small percentages of asbestos on or about the same time period in which it ceased the manufacture of such products.

32. Defendant never recalled from dealers, users, or distributors any of its asbestos-containing products that had not been used or sold when Defendant claims to have ceased the sale of asbestos-containing products.

RESPONSE: Because North American Refractories Company had no reason to believe its small number of products, designed for use in wet or encapsulated forms,

which contained small percentages of asbestos that changed into non-asbestos form as a result of exposure to heat could in any way be harmful, it did not recall any products that had not been used or sold. Moreover, this Defendant's products were generally sold to its customers very near in time to their use.

INTERROGATORY DIRECTED TO ALL DEFENDANTS

1. "For each Request for Admission" which you have not admitted, state the following:
 - (a) Who are the witnesses that have knowledge of the facts involving the matter on which the admission is requested;
 - (b) What documents exist which relate the matter on which the admission is requested.

RESPONSE: North American Refractories Company objects to this

Interrogatory as it is overly broad, unreasonably burdensome, and not reasonably calculated to lead to the discovery of admissible evidence. Further, this Defendant objects to this Interrogatory as it seeks information on products to which Plaintiffs in the cases in which North American Refractories Company is a party have failed to present evidence of exposure. Moreover, this Defendant objects to the undue vagueness and confusing nature of this Interrogatory. This Defendant does not know what subpart 1(b) means in its request for documents "which relate the matter on which the admission is requested". Without waiving any objections, this Defendant states that all this information is in the possession of Henderson & Goldberg, P.C.

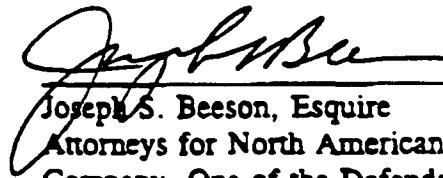
ADDITIONAL REQUEST

1. The Plaintiffs reserve the right to submit additional Requests for Admission as other discovery is answered.

RESPONSE: No response required; however, this Defendant reserves its right to object to all future Requests for Admissions and/or additional discovery.

ROBINSON & McELWEE

BY:



Joseph S. Beeson, Esquire
Attorneys for North American Refractories
Company, One of the Defendants

IN THE CIRCUIT COURT OF KANAWHA COUNTY, WEST VIRGINIA

IN RE: ASBESTOS

CIVIL ACTION NO. 92-C-8888

CERTIFICATE OF SERVICE

I, Joseph S. Beeson, counsel for North American Refractories Company, do hereby certify that service of the attached NORTH AMERICAN REFRACTORIES COMPANY'S RESPONSE TO PLAINTIFFS' JOINT REQUEST FOR ADMISSIONS DIRECTED TO ALL DEFENDANTS ON BEHALF OF ALL PLAINTIFFS PARTICIPATING IN THE KANAWHA MASS TRIAL III has been made upon plaintiffs' counsel by mailing a true and exact copy thereof, as follows:

Scott S. Segal, Esquire
Segal & Davis, L.C.
810 Kanawha Boulevard, East
Charleston, West Virginia 25301

Theodore Goldberg, Esquire
Henderson & Goldberg, P.C.
1030 Fifth Avenue
Pittsburgh, Pennsylvania 15219

James H. Rion, Jr., Esquire
Ness. Motley, Loadholt, Richardson & Poole
151 Meeting Street, Suite 600
P. O. Box 1137
Charleston, South Carolina 29402

David L. Meade, Esquire
Shinaberry, Meade & Venezia
2018 Kanawha Boulevard, East
Charleston, West Virginia 25311

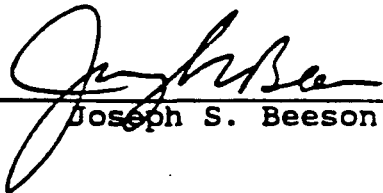
James F. Humphreys, Esquire
Charleston National Plaza
Suite 1113
Charleston, West Virginia 25301

William C. Field, Esquire
2nd Floor
608 Virginia Street, East
Charleston, West Virginia 25301

Thomas H. Sayre, Esquire
Post Office Box 627
Clendenin, West Virginia 25045

John E. Sutter, Esquire
Sutter & Enslein
606 Virginia Street, East
Charleston, West Virginia 25301
Counsel for Plaintiffs

in a properly stamped and addressed envelope this 9th day of August,
1993.



Joseph S. Beeson

IN THE CIRCUIT COURT OF KANAWHA COUNTY, WEST VIRGINIA

IN RE: ASBESTOS CASES

CIVIL DIVISION

BEFORE: HON. A. ANDREW MacQUEEN

C.A. No. 92-C-8888

**DEFENDANT NORTH AMERICAN
REFRACTORIES COMPANY'S
ANSWERS TO PLAINTIFFS' JOINT
INTERROGATORIES AND REQUEST
FOR PRODUCTION OF DOCUMENTS
CONCERNING PRODUCT
IDENTIFICATION TO ALL
DEFENDANTS**

**Filed on behalf of North American
Refractories Company, One of the
Defendants**

Counsel of Record for this Party:

JOSEPH S. BEESON, ESQUIRE

**ROBINSON & McELWEE
P. O. Box 1791
Charleston, WV 25326
(304) 344-5800**

DEFENDANT NORTH AMERICAN REFRACTORIES COMPANY'S
ANSWERS TO PLAINTIFFS' JOINT INTERROGATORIES
AND REQUEST FOR PRODUCTION OF DOCUMENTS
CONCERNING PRODUCT IDENTIFICATION TO ALL DEFENDANTS

AND NOW, comes North American Refractories Company, by and through its attorneys, Robinson & McElwee and files the following Answers to Plaintiffs' Joint Interrogatories and Request for Production of Documents Concerning Product Identification to All Defendants.

1. This defendant has from time to time manufactured, sold and/or distributed refractory products which contained small amounts of asbestos. This defendant never manufactured any refractory product which contained asbestos prior to 1961. This defendant objects to the production of information concerning any facilities or geographic areas where plaintiffs did not work. To do so would require an unreasonable search of this defendant's records, would not lead to relevant information and would cause unreasonable annoyance, oppression, burden and expense to this defendant. This defendant further objects to the production of information concerning any of the facilities involving Shinaberry & Meade or Fields & Maroney plaintiffs inasmuch as this defendant has settled or been dismissed from all of those cases or is not a party. This defendant also objects to providing information concerning facilities which are not identified by specific location.

Without waiving these objections, this defendant is reviewing its records for sales to the numerous sites listed on Exhibit "A". Below are the results of this defendants' investigation to date. Information on additional sites will be provided as it becomes available.

*Has this
been done?*

North American Refractories Company made no sales to the following facilities:

Albright PS
Alcon Rolled Products, Fairmont, WV
Analine Chemical, Charleston
Armory, National Guard
Atomic Energy Plant, Waverly
Bank, Parkersburg National
Beaver Valley #1 PS
Beverly PS - Muskingum River
Borg Warner/Marbon, Parkersburg, WV/Washington, WV
Bruce Mansfield PS
Burger PS
Brilliant PS, Brilliant, OH
Centre Foundry, Wheeling, WV
College, Bethany
College, Concord
Dillies Bottom PS, Dillies Bottom, OH
RE Berger PS, Dillies Bottom, OH
Harglo Glass
Harrison PS, Masontown, PA
Hatfield's Ferry PS
Hospital, Elkins
Hospital, Fairmont General
Hospital, Monongalia General

Hospital, St. Joseph's Parkersburg

Hospital, St. Marys

Hospital, WVU Medical Center

Hospital, Wheeling

Koppers, Follansbee, WV ?

Koppers, Bridgeville, PA

Mall Ohio Valley/St. Clairsville

Master Glass Company

Mine Academy, Beckley

Mobay-Natruim, WV

Muskingum River a/k/a Beverly PS

Plastic Coating, Inc.

Point Marion PS

School Woodrow Wilson High

Solvay Chemical, Moundsville

U. S. Steel, Portsmouth, OH

University of Athens - Ohio U, Athens, OH

Wheeling Downs

Wheeling-Pitt Steel, Beachbottom

Wheeling-Pitt Steel, Martins Ferry

White Sulfur Springs Hotel

Yorkstown PS

North American Refractories Company sold no asbestos-containing products to

the following facilities. North American Refractories Company did sell non-asbestos containing products to these facilities:

*I.D. is for
Steubenville &
Follansbee
Fral Bay & tal
need to clear up
process.*

Amos Power House

Blaw Knox Foundry and Mill, Wheeling, WV

Tidd PS, Brilliant, OH

Appalachian Power Co., Kanawha River Plant, Glasgow, WV

Graham's Station PS

Philip Sporn PS

Mitchell PS

Wheeling-Pitt Steel, East Plant (Follansbee, WV)

Wheeling-Pitt Steel, North Plant (Steubenville)

Wheeling-Pitt Steel, South Plant (Mingo Junction)

Wheeling-Pitt Steel, Wheeling

?
Need the Inc. file
from Bill Smith

2. See answer and objection to Interrogatory Number 1. To the extent this Interrogatory requests information beyond the asbestos-containing products this defendant sold or supplied to the specific facilities at which plaintiffs worked, it is objected to as irrelevant, beyond the scope of relevant discovery and unduly burdensome and oppressive. Investigation is still continuing and this Interrogatory will be supplemented as further information becomes available.

3. See answer and objection to Interrogatory Number 2. Without waiving these objections, this defendant has manufactured numerous refractory products which did not contain asbestos. See product catalog attached as Exhibit "A". Since none of the plaintiffs allege other than asbestos-related disease, to further answer this Interrogatory would require an unreasonable search of this defendant's records, would not lead to relevant information and would cause unreasonable annoyance, oppression, burden and expense to this defendant.

4. North American Refractories Company did distribute two products manufactured by Eagle-Picher. See answer to Interrogatory No. 5.

5. This defendant had a relabeling agreement from 1957 until 1971 with Eagle-Picher to distribute their Super "66" insulating cement as our product under the name Stazon cement and their One-Cote cement as our product under the name Unicote cement. *Insul. Cemen.*

This defendant is unaware of any other relabeling agreement.

6. See answer and objection to Interrogatory No. 1.

7. See answer and objection to Interrogatory No. 1.

8. The only distributor located within the cities or counties listed in Interrogatory Number 8 is the H. R. Curry Company located at 1023 Main Street in Pittsburgh, PA.

Attached are orders evidencing sales of Narco Staz-On Cement to the H. R. Curry Company dated 2/25/71, 3/30/71, 4/16/71, 5/4/71, 7/20/71 and 10/1/71.

Narco Staz-On Cement contained asbestos until some time in 1971. Since this product was manufactured by Eagle-Picher and not by Narco, this defendant is unable to establish exactly when in 1971 asbestos was removed from Staz-On. Therefore, Narco is unable to determine if the Staz-On product sales, all of which took place in 1971, contained asbestos.

9. See Answer to Interrogatory No. 8.

10. This defendant sold no asbestos-containing products to any distributor in the State of West Virginia.

11. N/A. See Answer to Interrogatory No. 10.

12. No.

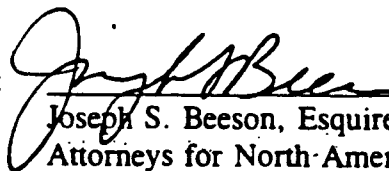
*Stazon
Unicote
1957-1971*

**NORTH AMERICAN REFRACTORIES COMPANY'S ANSWER TO
REQUEST FOR PRODUCTION OF DOCUMENTS**

1. This defendant objects to the production of all records that show sales, receipt, use, re-sold, distribution, inventory, re-order, shipment, bill of lading or orders of asbestos-containing products to any facilities or geographic areas where plaintiffs did not work. To do so would require an unreasonable search of this defendant's records, would not lead to relevant information and would cause unreasonable annoyance, oppression, burden and expense to this defendant. This defendant further objects to the production of records that show sales, etc. of asbestos-containing products to any of the facilities involving Shinaberry & Meade or Fields & Maroney plaintiffs inasmuch as this defendant has settled or been dismissed from all of these cases or is not a party. This defendant also objects to providing records concerning facilities which are not identified by specific location.

Without waiving these objections, this defendant is reviewing its records for sales to the numerous sites listed on Exhibit "A" and the cities and counties listed in Interrogatory Number 8. Attached as Exhibit "B" are the invoices representing sales of products to H. R. Curry Company which may have contained asbestos. Investigation is continuing. Other records will be produced as further information becomes available.

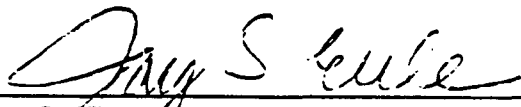
ROBINSON & McELWEE

BY: 

Joseph S. Beeson, Esquire
Attorneys for North American Refractories
Company, One of the Defendants

VERIFICATION

Jay S. Ehle, General Counsel and Secretary of North American Refractories Company, being before me first duly sworn, upon his oath, says that he has read the foregoing Defendant North American Refractories Company's Answers to Plaintiffs' Joint Interrogatories and Request for Production of Documents Concerning Product Identification to All Defendants; that the facts and allegations therein contained are true except insofar as they are therein stated to be upon information, and where stated to be upon information, he believes them to be true.


Jay S. Ehle

Taken, subscribed and sworn to before the
undersigned this 3rd day of

June, 1993.


Notary Public

My Commission Expires: June 11, 1995



REFRACTORIES

- FIRECLAY BRICK
- SUPER DUTY BRICK
- HIGH ALUMINA BRICK
- SILICA BRICK
- INSULATING FIREBRICK
- BASIC REFRACTORIES
- FIRECLAYS
- HI TEMPERATURE MORTARS
- PLASTIC REFRACTORIES
- CASTABLE REFRACTORIES
- RAMMING MIXES
- AIR PLACED REFRACTORIES
- INDUSTRIAL INSULATIONS

NORTH AMERICAN REFRACTORIES CO.
1012 National City — E 6th Bldg • Cleveland, Ohio 44114

an **Eltra** company

New York
Philadelphia
St. Louis

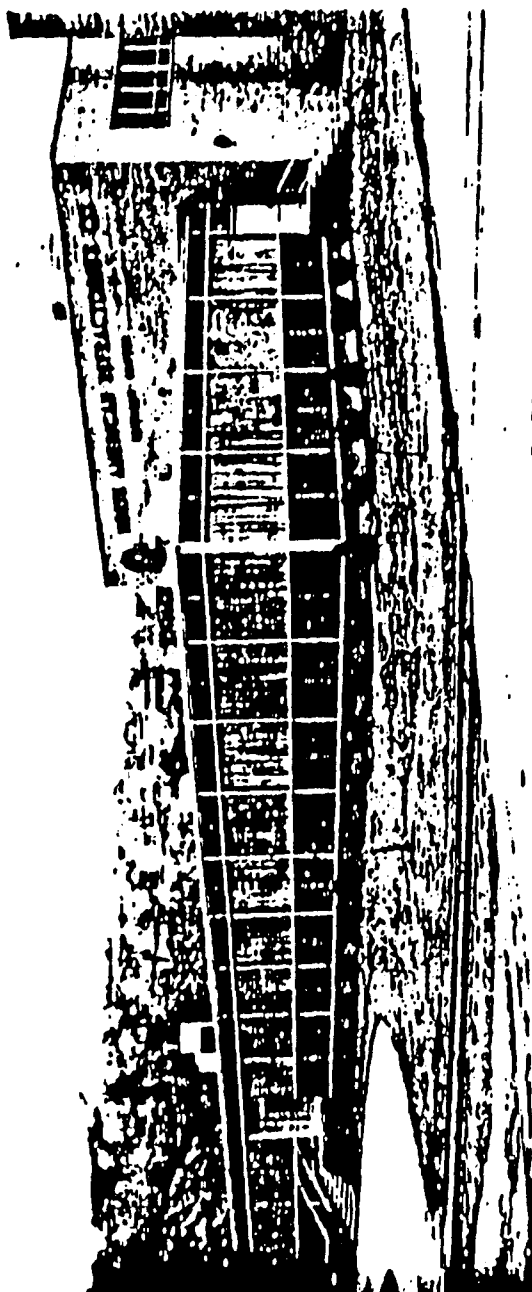
Minneapolis
Boston
Houston

Pittsburgh
Tulsa
Wichita

Chicago
Detroit
Kansas City Mo

NORTH AMERICAN REFRACTORIES, LTD.
Caledonia (Hamilton Area) Ontario, Canada

EXH. 1A



RESEARCH CENTER - CURWENSVILLE, PA.

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 workday booklet outlined for convenient reference in solving everyday problems.

The refractory products covered are highly diversified. They range from high alumina, basic and silica brick 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, castable refractories and ramming mixes 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 firebrick. 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.

*in hot Ash
Safe Use*

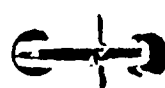


GUARANTEES

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 are 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 manner of installation or 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

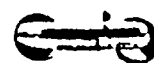
Ninety-five per cent of the tile or shapes shall not show a warpage of greater than one per cent of the diagonal measured when tested in accordance with A.S.T.M. Standard Method C-154.

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.



FIRECLAY BRICK — SUPER DUTY SERVICE

PRODUCT	A. S. T. M. CLASSIFICATION & TYPE	PROCESS	P. C. E.
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MISSOURI QUALITY — FARBER, MISSOURI

NARCO 68	Super Duty Spall Resistant	Dry Press	33 34 (3187° F)
NARCO 68N	Super Duty Spall Resistant	Dry Press	33 34 (3187° F)
NARCO 68 Bung	Super Duty Spall Resistant	Dry Press	33 34 (3187° F)
MOHAWK (High Fired)	Super Duty Slag Resistant	Dry Press	33 34 (3187° F)
MOHAWK BF (High Fired)	Super Duty Spall Resistant	Dry Press	33 34 (3187° F)

PENNSYLVANIA QUALITY — CURWENSVILLE, PA.

NARCO 71	Super Duty Spall Resistant	Dry Press	33 34 (3187° F)
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FIRECLAY BRICK — HIGH DUTY SERVICE

PRODUCT	A. S. T. M. CLASSIFICATION & TYPE	PROCESS	P. C. E.
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MISSOURI QUALITY — FARBER, MISSOURI

FARBER	High Duty Spall Resistant	Dry Press	32 33 (3146° F)
FARBER BF	High Duty Blast Furnace	Dry Press	32 33 (3146° F)

PENNSYLVANIA QUALITY — CURWENSVILLE, PA.

CRESCENT	High Duty Spall Resistant	Dry Press	32 33 (3146° F)
CRESCENT SM	High Duty Slag Resistant	Slit Mud	32 33 (3146° F)

FIRECLAY BRICK—MEDIUM AND LOW DUTY SERVICE

PRODUCT	A. S. T. M. CLASSIFICATION & TYPE	PROCESS	P. C. E.
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OHIO QUALITY — DOVER, OHIO

DOVER	Medium Duty	Dry Press	29 31 1/2 (3054° F)
DOVER SM	Medium Duty	Stiff Mud	29 31 1/2 (3054° F)

FIRECLAY BRICK — LOW DUTY SERVICE

OHIO QUALITY — DOVER, OHIO

BUCKEYE	Low Duty	Dry Press	26 29 (2984° F)
BUCKEYE SM	Low Duty	Stiff Mud	26 29 (2984° F)
KEYSTONE	Low Duty	Dry Press	26 29 (2984° F)
OHIO WIRE CUTS	Low Duty	Stiff Mud — Wire Cut	20 27 (2916° F)

HIGH ALUMINA BRICK

PRODUCT	A. S. T. M. CLASSIFICATION & TYPE	PROCESS	P. C. E.
NARCAI 50	50% Alumina	Dry Press	34 35 (3225° F)
NARCAI 60	60% Alumina	Dry Press	36 37 (3293° F)
NARCAI 60 N	60% Alumina Spall Resistant	Dry Press	36 37 (3293° F)
NARCAI 606	60% Alumina Special	Dry Press	38 (3362° F)
NARCAI 70	70% Alumina	Dry Press	38 (3362° F)
NARCAI 70 D	70% Alumina	Dry Press	38 (3362° F)
SENECA	70% Alumina	Dry Press	38 (3362° F)
NARCAI 75 C	75% Alumina	Dry Press	38 (3362° F)
NARCAI 80	80% Alumina	Dry Press	38 39 (3376° F)
NARCAI 85 B	85% Alumina	Chemically Bonded and Burned	38 39 (3376° F)
NARCAI 85 C	85% Alumina	Chemically Bonded	38 39 (3376° F)
NARCAI 90	90% Alumina	Dry Press	39 40 (3407° F)
NARCAI X	Special High Alumina	Stiff Mud	37-38 (3335° F)

MULLITE BRICK

PRODUCT	A. S. T. M. CLASSIFICATION & TYPE	PROCESS	P. C. E.
NARMULL	Mullite	Dry Press	38 39 (3362° F)

LADLE BRICK

PRODUCT	CLASSIFICATION	PROCESS
LX-50	50% Alumina— Expanding Type	Dry Press
LX-60	60% Alumina— Expanding Type	Dry Press
LX-70	70% Alumina— Expanding Type	Dry Press

SPECIAL PURPOSE REFRACTORY BRICK

PRODUCT	PROCESS
FLINT	Dry Press
FLINT P	Dry Press
NARCAL X	Stiff Mud
NARCAL 85 B	Dry Press

SILICA BRICK

PRODUCT	A. S. T. M. CLASSIFICATION & TYPE	PROCESS	P. C. E.
MtU-R	Type A Roof Quality	Dry Press	3110° F
LO-SP	Type A Roof Quality	Dry Press	3080° F
MtU	Type B Regular Quality	Dry Press	3055° F
NARSIL	Type A Dense Roof Quality	Dry Press	3092° F

BASIC REFRACTORY BRICK

BRAND	NOMINAL MgO CONTENT-%	TYPE OF BOND	TYPE OF PLATING
MAGNESITE			
NARMAG 98	98	Chemical	none
NARMAG 98 C	98	Chemical	metal encased
NARMAG 98 B	98	Fired	none
NARMAG 98 BC	98	Fired	metal encased
SUPER NARMAG B	95	Fired	none
SUPER NARMAG BC	95	Fired	metal encased
NARMAG	95	Chemical	none
NARMAG C	95	Chemical	metal encased
NARMAG B	95	Fired	none
NARMAG BC	95	Fired	metal encased
NARMAG 90	90	Chemical	none
NARMAG 90 C	90	Chemical	metal encased
NARMAG 90 B	90	Fired	none
NARMAG 90 BC	90	Fired	metal encased

MAGNESITE · CHROME

NARMAG 80	80	Chemical	none
NARMAG 80 C	80	Chemical	metal encased
NARMAG 80 B	80	Fired	none
NARMAG 80 BC	80	Fired	metal encased
NARMAG 80 DB	80	Direct Bonded	none
NARMAG 80 DBC	80	Direct Bonded	metal encased
NARMAG 70	70	Chemical	none
NARMAG 70 C	70	Chemical	metal encased
NARMAG 70 B	70	Fired	none
NARMAG 70 BC	70	Fired	metal encased
NARMAG 60	60	Chemical	none
NARMAG 60 C	60	Chemical	metal encased
NARMAG 60 B	60	Fired	none
NARMAG 60 BC	60	Fired	metal encased
NARMAG 60 DB	60	Direct Bonded	none
NARMAG 60 DBC	60	Direct Bonded	metal encased
NARMAG 60 DBR	60	Direct Bonded	none

Chemically bonded brick may be supplied internally plated.

BASIC REFRACTORY BRICK (Cont'd)

BRAND	NOMINAL MgO CONTENT-%	TYPE OF BOND	TYPE OF PLATING
CHROME - MAGNESITE			
NARMAG 60 DBRC	60	Direct Bonded metal encased	
NARMAG 60 DBC	60	Direct Bonded metal encased	
NARMAG 60B	60	Direct Bonded none	
NARMAG 60B C	60	Direct Bonded metal encased	
NARMAG 50 DB	50	Direct Bonded none	
NARMAG 50 DBC	50	Direct Bonded metal encased	
NARMAG 40	40	Chemical none	
NARMAG 40 C	40	Chemical metal encased	
NARMAG 40 B	40	Fired none	
NARMAG 40 BC	40	Fired metal encased	
NARMAG 40 HB	40	High Fired none	
NARMAG 40 HBC	40	High Fired metal encased	
NARMAG 30	30	Chemical none	
NARMAG 30 C	30	Chemical metal encased	
NARMAG 30 B	30	Fired none	
NARMAG 30 BC	30	Fired metal encased	

CHROME

NARCHROME B	Fired	none
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BASIC ROTARY KILN LINERS

MAGNESITE

*SUPER NARMAG K-B	95	Burned
*SUPER NARMAG K-BC	95	Burned

MAGNESITE - CHROME

*NARMAG 80 K-B	80	Burned
*NARMAG 80 K-BC	80	Burned
*ROMAG I	70	Burned
*NARMAG 60 K-DBR	60	Direct Bonded
*NARMAG 60 K-DBRC	60	Direct Bonded
*NARMAG 60B K-DB	60	Direct Bonded
*NARMAG 60B K-DBC	60	Direct Bonded

TYPE OF PLATING

- None (loose plates supplied if desired)
- * Steel plate and cardboard attached

BASIC ROTARY KILN LINERS (Cont'd)

BASIC BRICK FOR BASIC OXYGEN FURNACES

BRAND	MgO CLASS	TYPE
NARTAR PAD	95	Pitch Impregnated
NARTAR 7	95	Pitch Impregnated
SUPER NARTAR AT	95	Pitch Bonded-Tempered
SUPER NARTAR AT-M	95	Pitch Bonded-Tempered
NARTAR BT	90	Pitch Bonded-Tempered
NARTAR BT-M	90	Pitch Bonded-Tempered
SUPER NARTAR A	95	Pitch Bonded
NARTAR B	90	Pitch Bonded

INSULATING FIRE BRICK

PRODUCT	MAX TEMP. OF USE °F	THERMAL CONDUCTIVITY* 800°F	THERMAL CONDUCTIVITY* 1600°F	WT. PER CUBIC FOOT—LBS.
NA-20	2000	1.7	2.2	38.5
NA-23	2300	1.8	2.3	45.2
NA-26	2600	2.0	2.5	47.5
NA-28	2800	2.4	3.0	48.0
NA-30	3000	2.6	3.2	52.0
NA-33	3300	7.1	6.3	84.0
NA-33X	3300	7.1	6.3	83.0

*Btu/Sq. Ft./Hr./°F/in.

► BONDING MORTARS

AIR SETTING

BRAND	CONTAINERS	CONDITION AS SHIPPED
NARCOSET	50, 100 & 200 lb. drums 15 lb. pails	Wet
ALSET (Dry)	100 lb. bags	Dry
ALSET (Wet)	50, 100, 200 lb. drums 5, 15 lb. pails	Wet
NARCO No. 101	100 lb. bags	Dry
SUPERCHIEF (Wet)	100, 200 lb. drums and 100 lb. cartons	Wet
SUPERCHIEF (Dry)	100 lb. bags	Dry
SENECA CHIEF	100 lb. drums	Wet
NARPHOS 85 (Dry)	100 lb. bags	Dry
NARPHOS 85 (Wet)	200 lb. drums	Wet

► ALSO MADE IN CANADA

BONDING MORTARS

RECOMMENDED TEMPERATURE OF USE		USES
MINIMUM	MAXIMUM	
Room	3000° F	Laying all types of fireclay brick, including insulating, where a firm bond is required at all temperatures.
Room	3000° F	A general purpose mortar in dry form for laying all types of fireclay brick. Provides a firm bond at all temperatures.
Room	3000° F	A general purpose mortar supplied in ready to use form for laying all types of fireclay brick. Provides a firm bond at all temperatures.
Room	2900° F	Laying all types of fireclay brick. Formulated so that any unused material may be retempered with water for reuse. Suitable for pumping to job site through hose or pipe, i.e. blast furnace installations.
Room	3100° F	A kyanite base mortar in trowelling consistency for laying all types of fireclay and high alumina brick.
Room	3100° F	A kyanite base mortar supplied in dry form readily mixed with water to any consistency. For laying all types of fireclay and high alumina brick where a firm bond is required at all temperatures.
Room	3200° F	A high alumina mortar for laying all types of fireclay and high alumina brick.
Room	3300° F	Laying all types of high alumina brick, widely used in aluminum melting furnaces to resist penetration and corrosion by aluminum alloys.
Room	3300° F	Similar to NARPHOS 85 (Dry) but in a wet consistency for convenience.

► BONDING MORTARS

HEAT SETTING

BRAND	CONTAINERS	CONDITION AS SHIPPED
NARCO No. 99	100 lb. bags	Dry
NARCOLINE COATING & MORTAR	100 lb. bags	Dry
STEEL-LINE	100 lb. bags	Dry
BERLITE	100 lb. bags	Dry
CHEYENNE	100 lb. bags	Dry

► PLASTIC FIREBRICK

FIRECLAY AND HIGH ALUMINA

BRAND	TYPE OF SET	CONDITION AS SHIPPED	LBS. REQ'D. PER CU. FT. OF CONSTR.	CONTAINERS
NARCO 505	Heat or Air Set	Wet	135	100 lb. cartons
NOJOINT	Heat or Air Set	Wet	140	100 lb. cartons 550 lb. drums

► ALSO MADE IN CANADA

BONDING MORTARS

RECOMMENDED TEMPERATURE OF USE		USES
MINIMUM	MAXIMUM	
2200° F	2900° F	Laying all types of fireclay brick where service conditions call for a heat setting mortar
2000° F	3000° F	Wash coating and mortar for foundry ladles, runners and spouts.
2200° F	3150° F	Extremely fine grained mortar for all types of fireclay and high alumina brick.
2200° F	3150° F	Laying and surface coating brick exposed to molten metal or slag and other applications where graphitic mortars are required at high temperatures.
2200° F	3200° F	Laying and surface coating brick exposed to molten metal or slag at high temperatures. Electric furnace roofs.

PLASTIC FIREBRICK

RECOMMENDED TEMPERATURE OF USE		USES
MINIMUM	MAXIMUM	
2000° F 300° F	2950° F 2950° F	Lining and patching incinerator, forge furnaces, boilers, driers, and wherever repairs are required in high duty linings. Available with air-setting properties where full deep strength is required
2000° F 300° F	2950° F 2950° F	Lining and patching boiler linings, desulfurizing ladles, foundry ladles and wherever repairs are required in high duty linings. Available with air setting properties where full deep strength is required

► PLASTIC FIREBRICK
FIRECLAY AND HIGH ALUMINA

BRAND	TYPE OF SET	CONDITION AS SHIPPED	LBS. REQ'D. PER CU. FT. OF CONSTR.	CONTAINERS
NOJOINT (Fine)	Heat or Air Set	Dry or Wet	140	100 lb. Bags 100 lb. cartons
NARCO SUPER 505	Heat Set	Wet	145	100 lb. cartons
SHUR-RAM	Heat Set	Wet	152	100 lb. cartons
NARCO-SPAR	Air Set	Wet	150	100 lb. cartons
NARCAL 60 P	Heat Set	Wet	156	100 lb. cartons
NARCAL 70 P	Heat Set	Wet	165	100 lb. cartons
NARCAL 80 P	Heat Set	Wet	175	100 lb. cartons
NARCAL 85 P	Chem. Bond	Wet	181	100 lb. cartons

► ALSO MADE IN CANADA

PLASTIC FIREBRICK

RECOMMENDED TEMPERATURE OF USE		USES
MINIMUM	MAXIMUM	
2000° F 300° F	2950° F 2950° F	Same as NOJOINT except supplied with fine grain size for hand ramming purposes. Also as a packing material between shell and brick of torpedo type transfer ladles.
2000° F	3000° F	Lining and patching heavy duty boilers, slab and billet heating furnaces, soaking pits and similar applications of severe service.
2000° F	3000° F	Lining and patching heavy duty boilers, slab and billet heating furnaces, soaking pits and similar applications of severe service.
300° F	3000° F	Lining and patching sectionally supported furnace walls, piers and arches, soaking pit covers and copings, rotary kiln firing hoods and wherever full deep strength is required throughout the lining.
2000° F	3150° F	Monolithic lining and patching, soaking pits and covers, ladles, spouts, forge furnaces, burner blocks and openings.
2000° F	3200° F	Lining and patching electric furnace roofs and center sections, combustion chambers, crucible furnaces and other applications too severe for super duty plastic fire brick.
2000° F	3250° F	Lining and patching electric furnace roofs and center sections, alloy steel ladles, burner cones, slab heating furnaces and other applications requiring extremely high refractoriness and/or slag resistance.
300° F	3275° F	Lining and patching slab heating furnaces, open hearth charging spouts, combustion chambers, burner blocks and openings, hot metal mixers.

► PLASTIC FIREBRICK
FIRECLAY AND HIGH ALUMINA (Cont'd)

BRAND	TYPE OF SET	CONDITION AS SHIPPED	LBS. REQ'D. PER CU. FT. OF CONSTR.	CONTAINERS
NARCAL 85 TP	Chem. Bond	Wet	180	100 cartons
NARCAL 90 P	Chem. Bond	Wet	190	100 lb. cartons
NARCAL 90 TP	Chem. Bond	Wet	182	100 lb. cartons
SLAG RESISTANT (GRAPHITIC)				
BLACKJACK	Heat Set	Wet	138	100 lb. cartons
NARCOLINE	Heat Set	Wet	135	100 lb. cartons
NARCOLINE D	Heat Set	Dry	135	100 lb. bags
NARCAL 60 PG	Heat Set	Wet	152	100 lb. cartons
NARCAL 70 PS	Heat Set	Wet	162	100 lb. cartons
NARCAL 80 PG	Heat Set	Wet	161	100 lb. cartons
NARCAL 85 PG	Heat Set	Wet	170	100 lb. cartons

► ALSO MADE IN CANADA

PLASTIC FIREBRICK

RECOMMENDED TEMPERATURE OF USE		USES
MINIMUM	MAXIMUM	
300°F	3275°F	Similar to NARCAL 85 P, but finer grain size for patching, troweling and veneering.
300° F	3300° F	Lining and patching soaking pit slag lines and pit bottoms. B. F. troughs and repairs, open hearth steel runners, hot metal mixers, induction furnaces, reheal furnace hearths.
300° F	3300° F	Similar to NARCAL 90 P, but finer grain size for patching, troweling and veneering.
	2700° F	A "glazing" type graphitic plastic for foundry applications in direct contact with metals conveyed at temperatures from 2450° F to 2700° F.
	2800° F	A "glazing" type graphitic plastic similar in application to BLACKJACK but with added stamina for temperatures from 2650° F to 2800° F.
	2800° F	A companion product to NARCOLINE plastic but shipped in dry form. It is only necessary to add water (2 to 3 quarts per 100 lb.) for ramming into place.
2000°F	3150°F	A high alumina graphitic plastic for use where regular graphite plastics fail to give maximum service.
2000°F	3200°F	A high alumina graphitic plastic for more severe temperature conditions.
2000°F	3250°F	A high alumina graphitic plastic for extreme temperature conditions.
2,000°F	3275°F	A high alumina graphite plastic for extreme temperature conditions.

► CASTABLE REFRACTORIES
REGULAR CASTABLES

BRAND	TYPE OF SET	lbs. REQ'D. PER CU. FT. OF CONSTR.	CONTAINERS
NARCON	Hydraulic	127	100 lb. bags
NARCOHEARTH E.S. (Coarse)	Hydraulic	130	100 lb. bags
NARCOHEARTH 23	Hydraulic	128	100 lb. bags
NARCOCAST E.S.	Hydraulic	121	100 lb. bags
NARCOCAST E.S. GUN		*127	
NARCOCAST E.S. (Fine)	Hydraulic	114	100 lb. bags
NARCOCAST E.S. (Coarse)	Hydraulic	127	100 lb. bags
NARCOCAST 25	Hydraulic	125	100 lb. bags
NARCOCAST	Hydraulic	118	100 lb. bags
NARCOCAST GUN		*127	
NARCOCAST E.S. 26		131	
NARCOHEARTH	Hydraulic	120	100 lb. bags

*Gunned Density

► ALSO MADE IN CANADA

CASTABLE REFRACTORIES

	RECOMMENDED TEMPERATURE OF USE		USES
	MINIMUM	MAXIMUM	
Room	2200° F		Paving material around melting pots in the aluminum melting industry. Open hearth charging floors. Exterior floorings around incinerators and similar applications.
Room	2350° F		New monolithic construction and massive installations where strength, mechanical abuse and spalling are factors.
Room	2350° F		An extra coarse castable suitable for massive monolithic installations. Recommended for use in floor paving, car tops, annealing furnace bases, door linings, etc.
Room	2400° F		New monolithic construction and patching where high strength is required. Recommended for use in boilers, ash pits, coke ovens, driers, stacks, flues, ducts, blast furnace piping, car tops and similar applications.
Room	2400° F		New monolithic construction and patching for thin sections and where a dense structure to resist penetration of slags and metal is required.
Room	2400° F		New monolithic construction and patching for service where spalling is a serious condition and strength is also important.
Room	2550° F		An extra coarse castable suitable for massive monolithic installations. Recommended for use in car tops, coke oven doors, door linings, reheat furnaces, annealing furnaces, ash pits and hoppers.
Room	2600° F		New monolithic construction and patching in boilers, coke ovens, furnaces, incinerators, burner blocks and other applications requiring a 2600° F castable.
Room	2600° F		New monolithic construction and patching for applications requiring a 2600° F castable

► CASTABLE REFRACTORIES

REGULAR CASTABLES (Cont'd)

BRAND	TYPE OF SET	LBS. REQ'D. PER CU. FT. OF CONSTR.	CONTAINERS
SUPER NARCOCAST SUPER NARCOCAST GUN	Hydraulic	128 *131	100 lb. bags
NARCOCAST 30	Hydraulic	140	100 lb. bags
GUNCAST	Hydraulic	135	100 lb. bags
NARCOCAST 60	Hydraulic	145	100 lb. bags
NARCOCAST 32 NARCOCAST 32 GUN	Hydraulic	138 *145	100 lb. bags
NARCOTAB	Hydraulic	160	100 lb. bags
ANTI-ERODE	Hydraulic	130	100 lb. bags

*Gunned Density

► ALL MADE IN CANADA

CASTABLE REFRACTORIES

RECOMMENDED TEMPERATURE OF USE		USES
MINIMUM	MAXIMUM	
Room	2800° F	New monolithic construction and patching for furnace linings of all types, soaking pit covers, burner blocks, kilns, combustion chambers, door linings, incinerators.
Room	3000° F	New monolithic construction and patching in large furnaces, billet, and slab heating furnaces, burner blocks, car tops, soaking pit covers, non-ferrous melting furnaces, crucible furnace lining and others.
Room	3100° F	A high alumina castable suitable for gun casting into place. Power house pent-house areas, soaking pit bottoms.
Room	3100° F	New monolithic construction and patching for applications requiring a 3100° F castable and where spalling conditions are encountered.
Room	3200° F	New monolithic construction and patching for applications requiring a 3200° F castable. Roots, walls, burners and blocks, pit covers, forge furnaces, hearths, electric furnace delta sections and others.
Room	3400° F	New monolithic construction and patching for applications where severe temperatures, loads, abrasion and erosion and similar requirements demanding a pure tabular alumina castable.
Room	2500° F	New monolithic construction and patching wherever conditions of extreme erosion and abrasion exceed the ability of standard castables in the intermediate temperature range.

► CASTABLE REFRACTORIES

REGULAR CASTABLES (Cont'd)

BRAND	TYPE OF SET	LBS REQ'D PER CU. FT. OF CONSTR.	CONTAINERS
NARCO BLAST FURNACE CASTABLE	Hydraulic	130	100 lb. bags

INSULATING CASTABLES

AEROCASE L	Hydraulic	46	50 lb. bags
NARCOLITE	Hydraulic	54	50 lb. bags
LOW-K	Hydraulic	63	50 lb. bags
NARCOCRETE	Hydraulic	78	100 lb. bags
NARCOLITE 28	Hydraulic	75	50 lb. bags

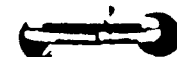
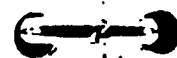
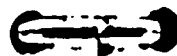
CASTABLE REFRACTORIES

RECOMMENDED TEMPERATURE OF USE		USES
MINIMUM	MAXIMUM	
Room	3000° F	Designed specifically for gunning applications in new monolithic construction and patching wherever conditions call for a product with abrasion and slag resistance and exceptional high strength.
Room	1800° F	Designed for either hot face or back up insulating in new monolithic construction and patching where light weight and insulating values are essential.
Room	2000° F	New monolithic construction and patching in refinery units, industrial ovens, door linings, boiler water-wall backing, back up insulation for heavy refractories and high temperature castables.
Room	2000° F	New monolithic construction and patching where insulating value plus added strength is required. Car tops, annealing furnaces, industrial ovens, boilers and incinerators.
Room	2450° F	New monolithic construction and patching for heat treating furnaces, annealing ovens, refinery vessels, driers, boiler baffles and similar applications where light weight and insulation are essential.
Room	2800° F	New monolithic construction and patching for soaking pit covers, refinery vessels, reheat furnaces, industrial ovens, boilers and incinerators.

► RAMMING MIXES

BRAND	TYPE OF SET	CONDITION AS SHIPPED	lbs. REQ'D. PER CU. FT. OF CONSTR.	CONTAINERS
STEEL-LINE	Heat Set	Dry	137	100 lb. bags 400 lb. drums
CARO-LINE	Heat Set	Dry	132	100 lb. bags
FIRELINE	Heat Set	Dry or Damp	135	100 lb. bags
BERLITE	Heat Set	Dry or Damp	137	100 lb. bags 400 lb. drums
RAMAL 80	Heat Set	Damp	175	100 lb. bags
RAMAL 80 G	Heat Set	Damp	164	100 lb. bags 200 lb. drums
RAMAL 85	Air Set	Damp	190	100 lb. bags
RAMAL 85 G	Heat Set	Damp	174	100 lb. bags

► ALSO MADE IN CANADA



RAMMING MIXES

RECOMMENDED TEMPERATURE OF USE		USES
MINIMUM	MAXIMUM	
2000° F	3150° F	Rammed ladle linings for steel foundries, electric furnace roof delta sections and similar severe service conditions
2000° F	2950° F	New monolithic construction and patching in acid electric furnaces, ladles, side blow converters, wash coatings and similar applications requiring a siliceous fine grained ramming mix at high temperatures.
2000° F	2950° F	New monolithic construction and patching in acid electric furnaces, ladles, side blow converters, and similar applications requiring a siliceous coarse grained ramming mix at high temperatures
2200° F	3150° F	New monolithic construction and patching in ladles, cupolas, tap holes, slag holes and similar applications requiring a graphitic ramming mix for resistance to slag and metal erosion.
2000° F	3250° F	Rammed center sections of electric furnace roofs, malleable furnace bottoms, patching of hot metal transfer cars and hot metal mixers
2000° F	3250° F	Front slagging spouts between cupola tap hole and slag dam. Resists erosion and chemical attack of ferrous metals and slags.
300° F	3250° F	Phosphate bonded. For ramming induction melting furnace linings and other molten metal and slag contact applications.
2000° F	3275° F	For lining and patching blast furnace troughs, cupola spout areas and other applications requiring extremely high refractories and slag resistance.

► RAMMING MIXES

BRAND	TYPE OF SET	CONDITION AS SHIPPED	LBS. REQ'D. PER CU. FT. OF CONSTR.	CONTAINERS
RAMAL 90	Air.Set	Damp	192	200 lb. drums

► GUNNING MIXES

BRAND	TYPE OF SET	CONDITION AS SHIPPED	LBS. REQ'D. PER CU. FT. OF CONSTR.	CONTAINERS
NARCOGUN P-340	Chem. Bond	Dry	150	100 lb. bags
NARCOGUN PD-345	Chem. Bond	Dry	150	100 lb. bags
NARCOGUN FC-325	Chem. Bond	Dry	112	50 and 100 lb. bags
NARCOGUN FCD-342	Chem. Bond	Dry	110	50 and 100 lb. bags
NARCOGUN CO	Heat	Dry	109	80 and 100 lb. bags
NARCOGUN AR	Hydraulic	Dry	114	100 lb. bags

► ALL MIXES MADE IN CANADA

RAMMING MIXES

RECOMMENDED TEMPERATURE OF USE		USES
MINIMUM	MAXIMUM	
300° F	3300° F	High alumina ramming mix for new construction or patching in soaking pits, reheal furnaces, electric furnaces, burner blocks and similar applications where scale, slag, molten metals and high temperature are present.

GUNNING MIXES

RECOMMENDED TEMPERATURE OF USE		USES
MINIMUM	MAXIMUM	
Room	3300° F	Magnesite base gun mix supplied with a liquid phosphate bonding agent for lining power plant boiler bottoms and side walls.
Room	3300° F	Magnesite base gun mix containing a dry phosphate binder for lining power plant boiler cyclones, bottoms and side walls, gun maintenance of BOF back up linings.
Room	2450° F	Fireclay gun mix supplied with a liquid phosphate bonding agent for maintaining coke ovens, soaking pits, zinc reheat furnaces and reheal furnaces.
Room	2450° F	Fireclay gun mix containing a dry phosphate bonding agent for maintaining coke ovens, soaking pits and reheal furnaces.
2000° F	2700° F	Fireclay spray or gun mix for maintenance of coke ovens, soaking pits, blast furnace runners, iron and steel ladles.
Room	1200° F	Abrasion resistant gun mix for low temperature applications such as blast furnace bell area, auxiliary piping, ducts, dust collectors and lime kiln charge zones.

► GUNNING MIXES

BRAND	TYPE OF SET	CONDITION AS SHIPPED	LBS REQ'D PER CU. FT. OF CONSTR.	CONTAINERS
GUNCRETE	Hydraulic	Dry	119	100 lb. bags
NARCOGUN HMC	Hydraulic	Dry	138	100 lb. bags
NARCOGUN 28	Hydraulic	Dry	123	100 lb. bags
NARCO BLAST FURNACE CASTABLE	Hydraulic	Dry	135	100 lb. bags
NARCAL 80 GUN	Air Set	Dry	150	100 lb. bags
NARCAL 85 GUN	Air Set	Dry	165	100 lb. bags

GUNNING MIXES

RECOMMENDED
TEMPERATURE OF USE
MINIMUM MAXIMUM

USES

Room	2400° F	Abrasion resistant gun mix for relinery catalytic cracking units, cyclones, stacks and reactors, dust collector systems and ash hoppers.
Room	2700° F	For lining or maintenance of ladles, soaking pits, soaking pit covers, reheal furnaces, large furnaces, annealing furnaces, etc.
Room	2800° F	A fireclay gun mix for applications requiring a 2800° F refractory material such as soaking pit wall maintenance, Treadwell ladle maintenance, etc.
Room	3000° F	Designed specifically for gunning applications in new monolithic construction and patching wherever conditions call for a product with abrasion and slag resistance and exceptional high strength.
Room	3100° F	High alumina gun mix for hot or cold gun maintenance.
300° F	3300° F	Phosphate bonded gun mix for hot and cold surfaces. As a furnace maintenance material for applications where temperature and slag conditions are too severe for lower alumina materials.

► ALSO MADE IN CANADA

► GUNNING MIXES

BRAND	TYPE OF SET	CONDITION AS SHIPPED	LBS. REQ'D. PER CU. FT. OF CONSTR.	CONTAINERS
AEROGUN	Hydraulic	Dry	35	25 lb bags
NARCOLITE GUNNING MIX	Hydraulic	Dry	65	50 lb. bags
NARCOLINE G	Air Set	Dry	130	100 lb. bags
NARMAG CM-18 GUN	Air Set	Dry	150	100 lb. bags

► BASIC SPECIALTIES

MORTARS

NARCHROME MORTAR (Heat Set)	Heat Set	Dry	100 lb. bags
NARCHROME MORTAR (Air Set)	Air Set	Dry	100 lb. bags
NARMAG MORTAR (Heat Set)	Heat Set	Dry	100 lb. bags
NARMAG MORTAR (Air Set)	Air Set	Dry	100 lb. bags

► ALSO MADE IN CANADA

GUNNING MIXES

RECOMMENDED
TEMPERATURE OF USE
MINIMUM MAXIMUM

USES

Room	1800° F	A lightweight insulating gun mix for back up service in furnace walls, roofs, soot hoppers, top decks, drum coverings, etc.
Room	2000° F	Lightweight insulating gun mix for new monolithic construction, as a back up insulating material in petrochemical applications.
300° F	2950° F	Slag resistant gun mix for new construction or patching in open hearth and blast furnace runners and similar applications requiring a graphitic gunning mix.
Room	3000° F	For lining open hearth doors, open hearth runners, boiler bottom and walls or wherever a chrome material is required. May be gunned or rammed into place.

BASIC SPECIALTIES

2350° F	3100° F	Laying basic, clay or high alumina brick in boilers, heating furnaces and similar installations where slagging is a serious problem.
Room	3000° F	Laying and coating all types of basic brick. Can be used with clay and high alumina brick where resistance to highly basic or high iron content slags is important.
2300° F	3300° F	Laying magnesite and magnesite-chrome brick where a high purity magnesite mortar is required for chemical resistance and refractoriness.
Room	3200° F	Laying magnesite and magnesite chrome brick where a high purity magnesite mortar is required for chemical resistance and refractoriness.

► BASIC SPECIALTIES

CASTABLES

BRAND	TYPE OF SET	CONDITION AS SHIPPED	LBS REQ'D. PER CU. FT. OF CONSTR.	CONTAINERS
NARCHROME CASTABLE	Hydraulic	Dry	165	100 lb. bags

RAMMING MIXES

MAGRAM G.S.	Chemical	Dry	190	100 lb. bags
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GUNNING MIXES

NARCOGUN P-340	Chem. Bond	Dry	150	100 lb. bags
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NARCOGUN PD-345	Chem. Bond	Dry	150	100 lb. bags
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NARMAG CM-18 GUN	Air Set	Dry	150	100 lb. bags
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► SILICA SPECIALTIES

MORTARS

NARCO-SIL	Heat Set	Dry	100 lb. bags
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SILGLAS	Heat Set	Dry	100 lb. bags
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MtU SILICA CEMENT	Heat Set	Dry	100 lb. bags and bulk
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PLASTICS

NARCO SILICA PLASTIC	Heat Set	Wet	100 lb. cartons
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► ALSO MADE IN CANADA

BASIC SPECIALTIES

RECOMMENDED TEMPERATURE OF USE		USES
MINIMUM	MAXIMUM	
Room	3000° F	Walls and hearths of heating and forge furnaces, open hearth doors, boiler furnace walls and floors.
Room	3000° F	For lining delta sections of basic electric furnace roofs and applications where high MgO ramming material is required.
Room	3300° F	Magnesite base gun mix supplied with a liquid phosphate bonding agent for lining power plant boiler bottoms and side walls.
Room	3300° F	Magnesite base gun mix containing a dry phosphate binder for lining power plant boiler cyclones, bottoms and side walls, gun maintenance of BOF back up linings.
Room	3000° F	For lining open hearth doors, open hearth runners, boiler bottom and walls or wherever a chrome material is required. May be gunned or rammed into place.
2200° F	3100° F	Laying silica brick where conditions are especially severe. Glass tank caps, upper structures of glass tanks, open hearth furnace roofs and similar applications.
2200° F	3100° F	Laying silica brick for glass tank caps and open hearth applications where a creamy mortar is preferred.
2000° F	3000° F	Laying and grouting silica brick. Available in two grades for coke oven and open hearth applications.
2200° F	3100° F	For filling small and irregular spaces in silica masonry construction, eliminating cutting of silica brick. For coke oven and glass tank crown maintenance.

INDUSTRIAL INSULATIONS

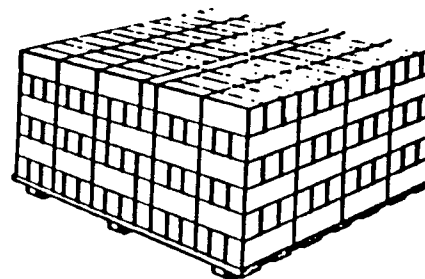
NARCO BLOCK INSULATION

A lightweight mineral wool block insulation for temperatures up to 1900°F. Widely used for back-up purposes in linings for boilers, hot blast stoves, mains and bustle pipes, petroleum cracking furnaces and metallurgical furnaces of all kinds. Packaged in cartons and supplied in the following standard sizes: 18" and 36" lengths, 6" and 12" widths, and thicknesses from 1" to 2½" in ½" increments.

NARCO STAZ-ON

A plastic mineral wool insulation for use up to 1900°F. It has excellent plasticity and adhesive properties and may be applied to any contour. Available in 50 pound multi-wall paper bags.

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 wood pallet is 36" x 48" in size with 2" x 3" high runners. The capacity of such a pallet ranges from approximately 450 to 500 — 9" equivalent in fire clay and silica refractories and 300 to 400 — 9" equivalent in high alumina and basic refractories depending on the weight factor of the type of refractory involved. Pallet loads will approximate 4000 pounds.

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." References shown in this manual should be given to facilitate expediting orders for palletizing shipments.

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 and mines 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.

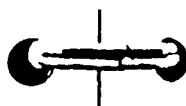
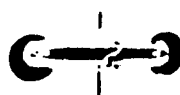
The properties of fireclay brick are dependent primarily upon the types of clays used, the proportions of the various clays employed and the process of manufacture. The grain structure, moisture content during forming, as well as firing temperatures and procedures also influence the final product.

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 stiff mud 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.

Small quantities of special size tile or complicated shapes can be most economically produced by tamping press, air hammer or hand mold process. Utilizing these three processes for small runs has the special characteristic of high versatility and insures careful control of dimensions and detail.

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.



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, volume stability 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 super duty brick are made from 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 to insure uniform quality and workmanship.

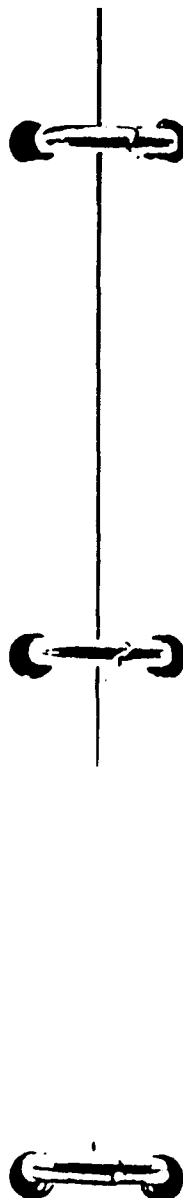
NARCO 68 is a Missouri dry press general purpose super duty brick. Resistance to spalling and vitrification makes NARCO 68 suitable for a wide variety of service applications, including heavy duty boilers, incinerators, heating furnaces, ferrous and non-ferrous furnaces, cement and lime kilns. NARCO 68 brick are well known wherever super duty brick are used and have established many outstanding service records under extremely severe operating conditions. This widespread use testifies to the ex-

SUPER DUTY FIRECLAY BRICK (Cont'd)

cellent physical and chemical properties of this product, which results in increased service life.

NARCO 68 N were especially developed for super duty service where extreme resistance to spalling is required and strength is not as important a factor. In marine boilers, swing type electric furnace roofs and similar applications, NARCO 68 N have provided superior service.

NARCO 71 is the general purpose dry press super duty brick produced in Pennsylvania, similar to NARCO 68 in properties and application. NARCO 71 possesses remarkable freedom from shrinkage at high operating temperatures which enables tight masonry construction to be maintained throughout the life of the furnace. Excellent service records for NARCO 71, under adverse conditions, were possible because of the high quality of this product. These records have been compiled through many years of continued use by satisfied customers.



HIGH FIRED

SUPER DUTY FIRECLAY BRICK

MOHAWK and MOHAWK BF are high fired super duty dry press firebrick compounded from Missouri materials and similar in chemical composition to NARCO 68. Special heat treatment through extremely high temperature firing produces a strong, tough product of low porosity and stability of volume at working temperatures. The desirable properties of hot load bearing strength, resistance to fluid slags and metals, stability under soaking heat and resistance to abrasion and carbon monoxide disintegration assures longer life in furnace structures operated under the most severe conditions.

MOHAWK high fired super duty brick is extremely hard burned brick to provide an extra margin in physical characteristics as low porosity, resistance to slag attack and load bearing ability. Because of these properties MOHAWK is particularly suited for bottom blocks and upper stack areas of blast furnaces which are exposed to severe abrasion by the furnace charge. These characteristics also make MOHAWK ideally suited for many other applications as glass tank checkers and rider tile, torpedo type iron ladles, hot metal mixers, non ferrous furnaces and various vertical and rotary kilns.

MOHAWK BF high fired super duty brick is fired at a temperature slightly less than MOHAWK to provide greater spalling resistance and still maintain a desirable balance of physical properties. MOHAWK BF is particularly suited for the lower stack areas of blast furnaces, large furnaces, billet and slab furnaces, reheat furnaces and other furnace applications where temperature fluctuations are encountered.

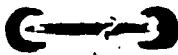
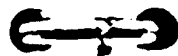
HIGH DUTY FIRECLAY BRICK

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.

MISSOURI — FARBER BRAND

PENNSYLVANIA — CRESCENT BRAND



MEDIUM 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 medium 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 medium 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 medium 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.

**NARCO HIGH ALUMINA
BRICK REFRACTORIES (Cont'd)**

NARCAL 75 C

NARCAL 75 C is a 75% alumina phosphate bonded brick. It has high strength and load bearing ability, and excellent resistance to abrasion, erosion and mechanical abuse. It may be used in air furnace, sidewalls, electric furnace roofs, iron and steel ladles, aluminum melting furnaces, skid rails and furnace hearths.

NARCAL 80

NARCAL 80 is an 80% alumina content brick which combines extreme temperature resistance (P.C.E. 38-39) with high resistance to strong corrosive action of alkalis and other fluxes at high temperatures.

NARCAL 80 brick also possesses excellent thermal spalling resistance, rigidity under load at high temperatures, low porosity, high bulk density and are extremely strong (cold crushing strength 5000-9000 lb. psi.).

NARCAL 80 is used where highly basic slags at high temperatures must be contained, such as malleable furnace bottoms. Also recommended for electric furnace electrode rings, and hot zones of cement kilns.

NARCAL 85B & NARCAL 85C

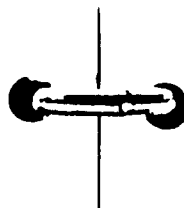
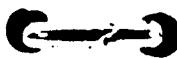
NARCAL 85C is an 85% alumina, chemically bonded refractory brick designed for metal contact in all types of aluminum melting furnaces. It is especially recommended for the critical bottom and sidewalls to a point 12 to 18 inches above sill level. This brick combines high refractoriness (P.C.E. 38-39) with good resistance to penetration and reaction by molten aluminum and its numerous alloys.

NARCAL 85B is a high alumina brick of similar chemical composition. In this case, however, 85B is given a hard burn endowing it with a number of superior properties. Greater strength, volume stability, abrasion-erosion resistance and load bearing properties are gained through the burning process.

NARCAL 90

Highest refractoriness of all NARCO high alumina brick is exhibited by NARCAL 90. With a P.C.E. rating of 40-41, NARCAL 90 is recommended wherever operating conditions are too severe for brick with less than 90% alumina. NARCAL 90's outstanding characteristics include high resistance to thermal spalling, exceptional volume stability at high temperatures, excellent load bearing properties and high resistance to corrosion by slags, volatile alkalis and alkali dusts.

NARCAL 90's exceptional properties are due to its being



**NARCO HIGH ALUMINA
BRICK REFRACTORIES (Cont'd)**

composed primarily of the stable mineral, corundum. NARCAL 90 are recommended for jambs, port floors and arches, and checkers of glass tanks, aluminum melting furnaces, furnace piers and similar applications where heavy loads or severe fluxing are encountered.

NARCAL X

NARCAL X is a specially formulated abrasion and slag resistant brick with remarkable resistance to both at elevated temperatures. NARCAL X contains 64-67% alumina (P.C.E. 37-38).

NARCAL X brick is recommended primarily where service conditions are too severe for standard high alumina brick and where spalling is not a factor. Hearths of all types of heating furnaces, vertical lime kilns, boiler grate lines or severe wear areas of metal mixers and ladles are typical applications.

NARMULL

NARMULL is a special high alumina brick commonly known as mullite, a super refractory brick. Mullite brick depend upon the development and distribution of the mineral mullite throughout its structure for its outstanding properties rather than alumina content. NARMULL is made up of a blend of the best natural sillimanite and synthetic mullite bonded together. NARMULL is outstanding for its load bearing abilities, volume stability, resistance to spalling and slag attack as well as high mechanical strength and resistance to abrasion.

NARMULL has proven itself outstanding in continuous butt-weld furnaces, hot metal cars and rider arches. NARMULL is particularly adapted for blast furnace stove top checkers, sidewalls, and combustion chambers. It is well suited for car top block, kiln furniture, piers, etc.

LADLE BRICK

LX-50, LX-60 and LX-70 ladle brick provide a complete series of high alumina expanding type refractories for lining applications. With alumina contents of 50%, 60% and 70%, much higher temperatures and more active slag conditions can be contained. Each brand provides high density, low porosity and increased refractoriness. Controlled bloating or expanding properties yield tighter joints to prevent metal penetration. Vacuum degassing ladles, tundishes for continuous casting systems, metal mixer ladles and other critically demanding applications can be better served with these products.

SPECIAL PURPOSE REFRACTORY BRICK

FLINT

For installations subject to severe abrasion and/or spalling conditions such as cold zones and chain sections of rotary kilns. Also as pavers for soaking pit areas subject to temperature fluctuations. Acid resistance applications as found in chemical plants, steel mills, cement and lime plants.

FLINT P

For lining blast furnace hot blast mains, uptakes and downcomers to resist dust-laden gases.

NARCAL X

For applications where abrasion resistance is required at high temperature hearths of forge and heating furnaces.

NARCAL 85 B

For applications where abrasion and spalling resistance are required at high temperature hearths of forge and heating furnaces.

TAR IMPREGNATED REFRACTORIES

NARCO Pitch has the production capabilities to provide pitch impregnation for all categories of fireclay, high alumina and basic brick products. Tar impregnated brick can provide enhanced properties for certain types of service environments. More specific information can be provided on these products upon request.

SILICA BRICK

NARCO 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 manufac-

SILICA BRICK

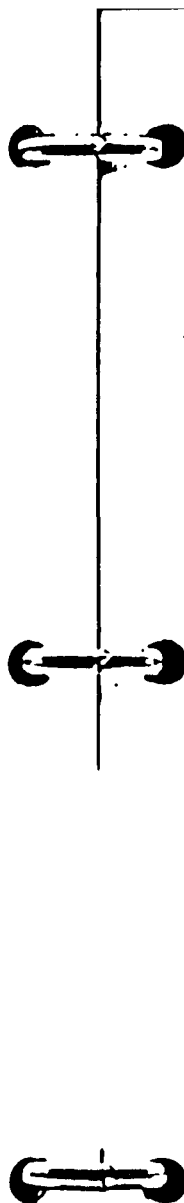
tured under strict control to insure the highest quality silica brick. Firing is carried on carefully controlled schedules to insure mineral conversions to stable crystalline forms. As a result, volume stability is assured under operating conditions.

MrU R is a roof quality pebble base silica brick, developed to meet the demand of industry for a silica refractory that would permit higher furnace temperatures and longer service life. They are of maximum purity and run from 60° to 100°F. higher in refractoriness under load than regular silica brick. MrU R is used largely in roofs of open hearth furnaces, glass tanks, and other applications where refractoriness and load bearing are of prime importance.

LO-SP is a roof quality silica brick developed specifically for the hot patching of open hearth furnace roofs. In LO-SP, through the careful selection, blending and grain sizing of material, improved spalling resistance has been achieved with only a slight decrease in refractoriness.

MrU is a regular quality ganister base silica brick developed for application where greater strength and improved spalling resistance are required. MrU is particularly suited for open hearth applications below the floor level where strength is required and in applications such as swing type electric furnace roofs where spalling resistance is required.

NARSIL is a high density silica brick having the chemical purity of our MrU-R brand. NARSIL has a density of 123 lbs. per cubic foot with an accompanying marked decrease in porosity and permeability that provides superior resistance to penetration in application where vapors, liquids and even fine particulate solids are present. NARSIL is of particular importance in glass tank construction as well as electric furnace roof construction and sidewall construction of acid electric furnace. The higher thermal conductivity of NARSIL is of particular importance in coke oven work. Protected by U.S. Patent No. 3684538.



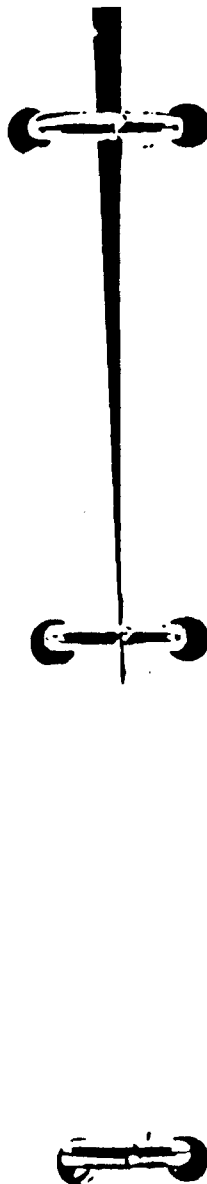
BASIC REFRACTORY BRICK

The term basic refractories is the general classification given refractory materials composed of chrome ore, magnesite, periclase, dolomite and olivine or combinations of these materials. The word "basic" refers to the chemical nature of the materials as opposed to "acid" refractories such as silica materials. Since chrome ore is practically neutral in nature and resists both basic and acid slags equally well, it is arbitrarily classed as a basic material.

Basic brick are used for two main technical reasons: (1) the higher melting point and therefore higher permissible operating temperature and (2) the chemical aspects that improve resistance to basic slags, oxides, dusts, and fumes.

NARMAG Basic Brick have been made possible through the combination of the latest technological developments and the most modern manufacturing equipment applied to basic raw materials of the highest purity. Use of the highest purity seawater Periclase clinker, and high grade Philippine chrome ore as raw materials, bonded with a very high purity chemical binder, give the NARMAG line outstanding chemical properties. These properties in the brick are further enhanced by superior physical features achieved during manufacture through corrected grain sizing, carefully controlled batching and blending of ingredients and improved techniques in forming and metal casing.

NARMAG basic refractories meet the exacting requirements of the metallurgical, glass and cement industries in all basic compositions required (magnesite, magnesite-chrome, chrome-magnesite and chrome). These varied basic compositions are available both burned or chemically bonded, plain, metal encased or internally plated, enabling the selection of a basic brick with the proper chemical and physical properties for the specific requirements of the application.



DIRECT BONDED BASIC REFRACTORIES

Direct bonded basic brick are characterized by the predominance of direct attachment of periclase to periclase or periclase to chrome grains in the brick structure. Such refractories are produced from carefully selected raw material to achieve desired chemistries and incorporate extremely high firing temperatures to develop proper physical properties.

The brands range in qualities from 50 to 96% MgO and display one or more of such benefits as improved slag resistance, lower porosity, greater density and outstanding hot strength properties.

NARMAG 50DB — a direct bonded magnesite-chrome brick of approximately 50% MgO content. For use in copper and copper-nickel service, AOD vessels, and glass furnaces.

NARMAG 60 DB — a direct bonded magnesite chrome brick of approximately 60% MgO content. Displays high hot strength and refractoriness for applications as electric furnace and open hearth walls, mineral processing kilns, glass furnaces as well as non-ferrous furnaces.

NARMAG 60DBR — a direct bonded magnesite-chrome brick of 60% MgO content. It is recommended for open hearth roofs and other applications requiring good resistance to "redox" (reducing-oxidizing) reactions. Such reactions often cause destructive growth or expansion problems with conventional grades of brick.

NARMAG 60B — a direct bonded magnesite-chrome brick of 60% MgO content displaying lowest porosity and highest density for its class. Especially recommended for use under severe slagging conditions as encountered in electric furnaces and AOD vessels. For use in burning zones of cement kilns. Protected by U.S. Patent No. 3,715,223.

NARMAG 80 DB — a direct bonded magnesite-chrome brick in the 80% MgO class. The high refractoriness, greater thermal shock resistance, and excellent resistance to iron bearing slags provides an outstanding product for specific high temperature applications.

SUPER NARMAG B — a direct bonded straight magnesite brick of approximately 96% MgO content. The high hot strength and excellent spalling resistance of this brick makes it particularly suited to glass furnace, rotary lime kiln and other applications requiring a chrome free product.

BASIC REFRACTORIES FOR BASIC OXYGEN FURNACES

The advent of the basic oxygen furnace (BOF) placed new and enormous demands on refractory requirements. This steel making process consumes huge amounts of substantially pure oxygen to convert hot metal and scrap to steel with a high degree of thermal and chemical efficiency. This accomplishment has imposed a number of severe conditions to the refractory lining. High operating temperatures, severe impact and abrasion, wide temperature fluctuations, operating atmospheres of reducing and high iron oxide nature together with active slag conditions have dictated the need for a range of pitch bearing types of basic refractories.

NARCO has played an active role in developing BOF refractories to meet the needs of the basic oxygen process. The NARTAR series includes conventional (unburned) and tempered pitch bonded varieties as well as burned pitch impregnated grades. The combining of these materials in basic oxygen furnace working linings enables balance lining wear which results in lower refractory cost per ton of steel produced.

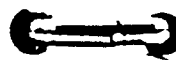
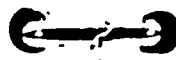
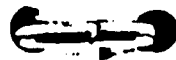
Pitch-Bonded Refractories

SUPER NARTAR A — A pitch-bonded 96% MgO refractory brick produced from high density synthetic periclase. It may be used in any area of the vessel where an un-tempered brick is suitable.

NARTAR B — A pitch-bonded refractory brick made from a blend of synthetic periclase and natural magnesite having an MgO content somewhat lower than SUPER NARTAR A. It is an economical brick for use in areas where an un-tempered brick is suitable and service conditions do not warrant higher MgO grades.

Tempered Pitch-Bonded Refractories

SUPER NARTAR AT — A tempered pitch-bonded 96% MgO refractory brick produced from high density synthetic periclase. This brand is a premium product displaying maximum slag resistance and density. It may be used in all areas of the vessel particularly those where severe slag wear is encountered.



BASIC REFRACTORIES FOR BASIC OXYGEN FURNACES

SUPER NARTAR AT-M — A tempered pitch-bonded 96% MgO refractory brick similar to SUPER NARTAR AT, but modified to provide unusual resistance to slump and spalling during burn in and in the balance of the campaign. It is recommended for vessel areas where spalling may be a problem.

NARTAR BT — A tempered pitch-bonded refractory brick made from a blend of synthetic periclase and natural magnesite having an MgO content somewhat lower than SUPER NARTAR AT. It is an economical brick for use in cones, barrels and bottoms when a higher MgO brick is not required.

NARTAR BT-M — A tempered pitch-bonded refractory brick similar to NARTAR BT, but modified in the same manner as SUPER NARTAR AT-M to provide unusual resistance to slump and spalling during burn in and in the balance of the campaign. It is recommended for vessel areas where spalling may be a problem and where higher MgO is not required.

Burned Pitch-Impregnated Refractories

NARTAR PAD — A burned and pitch-impregnated 96% MgO brick produced from synthetic periclase of high density and low porosity. The outstanding hot strength, spalling resistance and density of NARTAR PAD provide the ultimate refractory for charge pads where resistance to the impact of scrap and hot metal during charging is important. NARTAR PAD provides maximum wear resistance in other areas of the vessel and may be used for the complete lining under the severest operating conditions.

NARTAR 7 — A burned and impregnated 96% MgO brick produced from the same synthetic periclase used in NARTAR PAD. It incorporates proprietary modifications which produce a refractory having the highest density, lowest porosity and highest hot strength available in any product of its class. It is recommended for areas of vessels where hot strength and density are of prime importance. Protected by U.S. Patent No. 3713855.

INSULATING FIRE BRICK

NARCO, acting as distributors for leading manufacturers, offers seven types of insulating fire brick for furnace construction. This complete line is designed for temperatures from 2000°F to 3300°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 operation by:

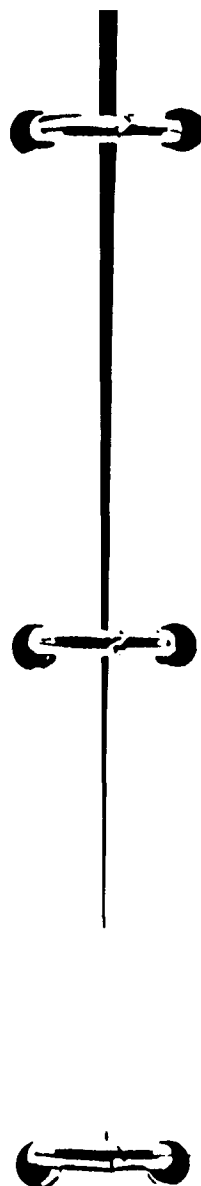
1. Reducing fuel costs
2. Speeding production
3. Insuring more accurate temperature control
4. Simplifying furnace design
5. Reducing construction costs
6. Quieting furnace noises

The brands NA-20, NA-23, NA-26, NA-28, NA-30, NA-33 and NA-33X amply cover temperature applications from 2000°F. to 3300°F. These brands all offer high insulating efficiency, high strength, low content of reducible iron, sulfur-free content, light weight, accurate sizing and spalling resistance.

NARCO INDUSTRIAL INSULATIONS

NARCO BLOCK INSULATION is an all purpose high temperature mineral wool type of block insulation. The low thermal conductivity and lasting high efficiency of NARCO BLOCK INSULATION provides economy in operation and improved temperature control of industrial furnaces and all types of heated equipment. NARCO BLOCK INSULATION is packaged in cartons and supplied in the following standard sizes: 18" and 36" lengths, 6" and 12" widths and thicknesses from 1" to 2½" in ½" increments.

NARCO STAZ-ON Insulating Cement is a highly efficient all purpose rust inhibiting insulating material suitable for all types of heat equipment where temperatures do not exceed 1800° F. It has excellent plasticity and adhesive properties. NARCO STAZ-ON is reclaimable when used at temperatures up to 1200°F. It may be removed from equipment, mixed with water and used again. This is especially important where frequent maintenance work on equipment is necessary. One hundred pounds covers approximately 50 to 55 sq. ft. to a thickness of 1". NARCO STAZ-ON is shipped in 50 pound multi-wall paper bags.



BONDING MORTARS — Air-Setting

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 firebrick. It is composed of the highest grade clays and calcines which enable it to withstand high temperatures without shrinking, cracking, softening or overfiring. Comparatively thick joints may be used without difficulty because of these properties. It 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.



NARCOSET is shipped in all-metal, air tight 15 pound pails and 50, 100, or 200 pound drums.

ALSET (Wet) is an air-setting high temperature bonding mortar which is shipped in wet form. It has been formulated to eliminate all problems arising from shrinkage.



The raw materials used in **ALSET (Wet)** balance each other to yield a product which is stable from the drying-out point to the temperature limit of the brickwork. This gives a solid uniform bond completely across the face of the brick in the wall. There are no cracks to permit any penetration of slag, fly ash, metal or flame . . . because the entire furnace lining is a solid monolithic structure. The possibility of air infiltration, which also lowers the efficiency of a furnace, is eliminated.

ALSET (Wet) has excellent workability. This superior product is easy to mix and will not settle out. No remixing is ever necessary. The fine grain size of **ALSET (Wet)** makes it possible to use thinner dip joints. In a troweling consistency, **ALSET (Wet)** is very smooth and easy to use.

ALSET (Wet) is packed in 50, 100, and 200 pound air tight steel drums and is maintained in stock at all times.

BONDING MORTARS — Air-Setting (Cont'd)

ALSET (Dry) is a dry air setting high temperature mortar which, when mixed with water, has the same excellent properties as **ALSET (Wet)**. It is shipped in 100 pound moisture-resistant bags to insure arrival on the job in excellent condition. To use, it is only necessary to mix the dry mortar thoroughly in a light mortar box and add sufficient clean water for the desired consistency.



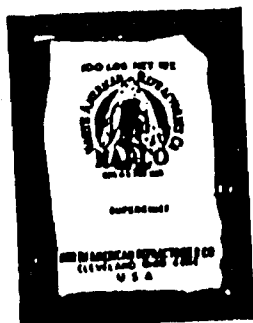
NARCO No. 101 cement is a dry, air-setting high temperature bonding mortar which, when mixed with water, has properties similar to **NARCOSET**. It has special features that enable it to be pumped to the job site through piping or hoses and is so formulated that any unused material may be re-tempered with water for reuse.

NARCO No. 101 cement is shipped in 100 pound moisture-resistant bags to insure arrival on the job site in excellent condition.

SENECA CHIEF is a wet, air setting high alumina mortar. It has excellent strength, exceptionally good in applications where slagging presents a problem. It is recommended for laying fireclay and high alumina brick and may also be used as a slurry or brush coat over new and old brick work. It is furnished in 100 pound drums.

BONDING MORTARS — Air-Setting (Cont'd)

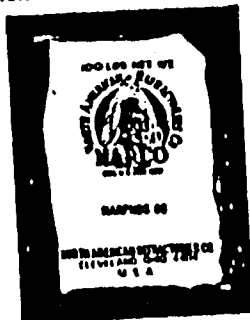
SUPERCHIEF (Wet) is a wet, air setting kyanite base mortar with exceptional volume stability. It has high strength, resists slag attack and abrasion. Superchief is available in mastic, heavy trowel and regular trowel consistency in 100 and 200 pound drums.



SUPERCHIEF (Dry) is a dry kyanite base air setting mortar and when mixed with water has the same properties as SUPERCHIEF (Wet). It is packaged in 100 pound moisture-resistant bags.

NARPHOS 85 (Dry) is a dry phosphate bonded, high alumina mortar for laying up all types of fireclay brick and especially high alumina brick when service conditions require superior refractoriness and resistance to corrosion, erosion and slagging. It is effectively resistant to aluminum dross and metal at critical joint areas. Its non-wetting property prevents joint penetration and corrosion at furnace operating temperatures.

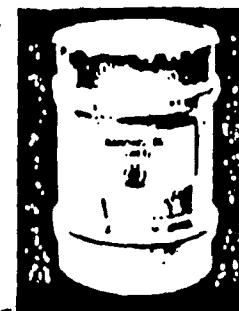
NARPHOS 85 (Dry) is packaged in 100 lb. moisture-resistant bags.



BONDING MORTARS

Air-Setting

NARPHOS 85 (Wet) is a phosphate bonded high alumina mortar, for laying all types of fireclay and especially high alumina brick, supplied in wet form ready-to-use. NARPHOS 85 (Wet) is furnished in 200 lb. air tight metal drums.



Heat-Setting

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 good 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.

NARCO No. 99 is shipped in 100 pound moisture resistant bags and since it contains no air-setting ingredients, it may be stored indefinitely without change. To use, it is only necessary to mix it with clean water and permit a short time for slaking of the plastic clay.

NARCOLINE COATING & MORTAR is a dry heat-resistant coating and mortar used primarily for wash coating in all types of furnaces and ladles. It is designed to resist the chemical attack of fluid slags and the washing action of molten metal. It may be used as a protective coating over new brickwork or for filling and resurfacing of old refractory walls.

It is shipped dry, in 100 pound moisture resistant bags.



BONDING MORTARS (Cont'd)

Heat-Setting

STEEL-LINE is a high alumina ramming mix, fine grained, with physical and chemical properties that make it suitable for the high temperatures and other service conditions found in most modern metallurgical furnaces. It can be installed quickly and provides a homogeneous, joint-free, monolithic lining.

STEEL-LINE may also be used as a mortar for use in laying all types of fireclay brick where a firm bond is required at low and high temperatures.

STEEL-LINE is shipped moist in 100 pound moisture resistant bags and 400 pound drums when it is to be installed by ramming. For mortar application, it is shipped dry in 100 pound moisture proof bags.

BERLITE is a super-quality, fine grained, graphitic base refractory material, unique in that it may be considered as the "epitome" of specialty refractory materials. It may be applied as a mortar, wash coating, spray coating, rammed or pneumatically gunned lining. It has unusually high refractoriness, no shrinkage or expansion during use, excellent resistance to slag and metal erosion, does not peel or bloat in service, and has numerous applications.

BERLITE is shipped in 100 pound moisture resistant bags. No remixing is necessary and any part or all of a bag can be used with confidence. There are no variations in the individual bags or in an entire shipment. Just add sufficient moisture to provide the desired consistency for each particular job.

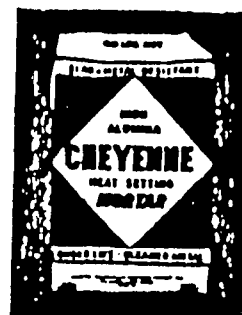
CHEYENNE is a dry, heat-setting kyanite base mortar of exceptionally high refractoriness and negligible shrinkage under extreme service conditions. It is particularly well



BONDING MORTARS — Heat-Setting (Cont'd)

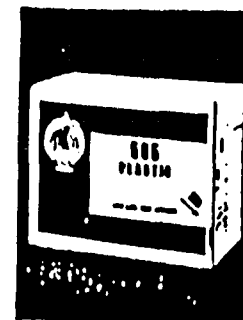
suited for laying up fireclay, or high alumina brick in furnace linings that are subjected to the corrosive action of metals and slags at high temperatures. It is also a superior mortar for torpedo iron ladles. It mixes easily with water to a smooth consistency and has excellent water retention.

CHEYENNE is packaged and shipped in 100 pound bags for convenient use.



PLASTIC FIREBRICK

NARCO 505 is a plastic refractory comparable in quality to high duty fireclay brick and may be used under similar temperature service requirements. This plastic is composed of calcined flint clay, grain sized for maximum density and ramming qualities, properly bonded to produce a workable plastic of desired properties. It is available as a heat setting or air-setting product and is packaged in 100 pound cartons.

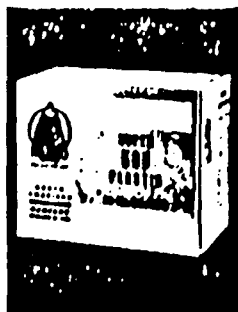


NO-JOINT is identical to **NARCO 505** and available in either air-setting or heat setting quality. It is also available in a fine grain sizing if desired. **NO-JOINT** is packaged in 100 pound cartons and 550 pound drums. It is particularly blended and grain sized for use in foundry ladles, both large and small.

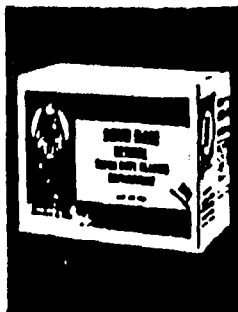


PLASTIC FIREBRICK (Cont'd)

NARCO SUPER 505, as the brand implies, is a plastic refractory of superior properties intended for use where severe operating conditions are prevalent. This super duty plastic is comparable in quality to super duty fireclay brick and finds widespread use where maximum resistance to heat is required. Only the most refractory calcined flint clays are used as the base in this product. It has excellent spalling resistance, good volume stability and low firing shrinkage. Packaged in 100 pound cartons, it is ready for immediate use upon arrival at the job site.



SHUR-RAM represents a considerable improvement over conventional heat-setting super duty plastics in all properties affecting service performance. Its unusual service characteristics make it adaptable to heavy duty furnace requirements found today in the steel, power, chemical and petroleum industries.



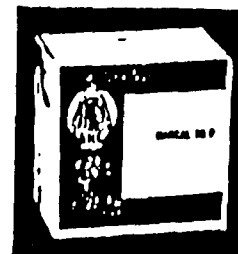
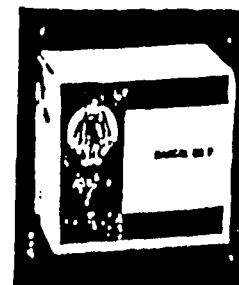
Outstanding features are its high strength at operating temperature, low permeability to resist flux-laden atmospheres, volume stability at operating temperatures, good spalling resistance and low thermal conductivity. It is shipped ready for use in 100 lb. cartons.

NARCO-SPAR is a special super duty air-setting plastic identical in quality to SHUR-RAM, but is so formulated that it has the added advantage of developing exceptional uniform strength at all temperatures ranging from 230°F to 3100°F. It is an excellent general purpose maintenance material possessing good adhesive properties, negligible shrinkage and exceptional strength.



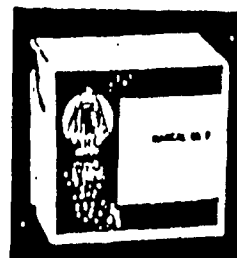
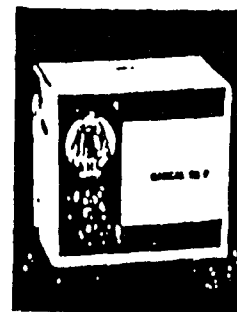
PLASTIC FIREBRICK (Cont'd)

NARCAL 60 P is a heat setting 60% alumina plastic refractory for applications too severe for super duty plastic firebrick. The higher refractoriness of NARCAL 60 P results in less vitrification than lower grade plastics thus providing greater resistance to severe spalling conditions. NARCAL 60 P is pre-sliced and packaged in 100 lb. cartons.



NARCAL 70 P is a 70% alumina heat setting plastic made from selected grogs and bond clays to provide high refractoriness, good strength, and freedom from spalling required for more severe service conditions. NARCAL 70 P is wrapped in polyethylene bags, packed in 100 lb. cartons.

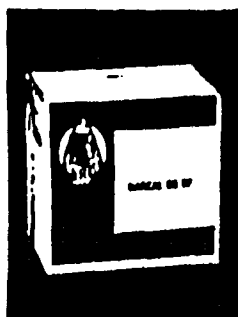
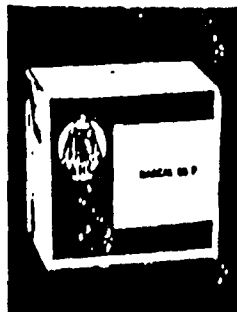
NARCAL 80 P meets requirements of extremely high refractoriness and slag resistance. It is considered one of the finest refractories available in our plastic line, containing the highest alumina and greatest density. It is easily installed by pounding in place without forms as a one-piece lining free of joints, conforming readily to any contour. Packaged in 100 pound cartons, NARCAL 80 P slabs are ready to use at the job site.



NARCAL 85 P is an 85% alumina phosphate bonded air setting plastic refractory. It has excellent resistance to molten metal and slag penetration, has high strength at all temperatures and is resistant to spalling and abrasion. It is shipped in 100 lb. cartons pre-sliced ready-to-use.

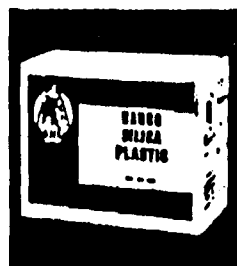
PLASTIC FIREBRICK (Cont'd)

NARCAL 90 P is a 90% alumina phosphate bonded air setting plastic refractory. NARCAL 90 P has a service limit of 3300°F. It has excellent spalling resistance and is not affected by molten metal or slag. It has exceptional resistance to abrasion due to its high strength and grain hardness. NARCAL 90 P is shipped in 100 lb. cartons.

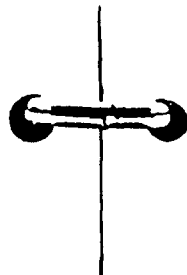


NARCAL 90 TP is 90% alumina fine grained phosphate bonded air setting plastic refractory. This material is supplied in a putty-like consistency which can be trowelled and serves as a companion product to NARCAL 90 P. Principal uses include patching induction furnace linings and ladles as well as veneering furnace walls preventing buildup of metal as well as basic or acid slags. Supplied in 100 lb. cartons.

NARCO SILICA PLASTIC is a silica plastic refractory which was developed for use with silica brick in patching eroded areas, filling cracks, and replacing brick that require considerable cutting. It is as refractory as most silica brick but does not have the expansion characteristics of silica brick. It is shipped in 100 pound cartons.

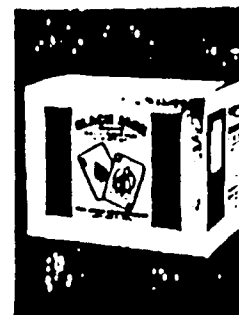


NARCO manufactures a complete series of slag resistant, graphitic type plastic refractories. The graphitic content in refractories minimizes slag and metal penetration, keeps ladles clean, boosts production and cuts maintenance costs. NARCO formulations range from a "glazing" type of black plastic to a high alumina base for super-service in casting steel. These products are as follows.



PLASTIC FIREBRICK (Cont'd)

BLACK JACK is a "glazing" type of plastic. When put in service, the heat vitrifies the surface, sealing the graphite in the plastic so it will not oxidize or burn out. Glazed-in graphite is protected, providing a high refractory body. Glassy surface wears away very slowly. It resists erosion and enlargement of openings and is ideal for cupola tap hole or breast areas. Recommended service temperature is 2450°-2700°F. It is shipped in 100 pound cartons.



NARCOLINE is essentially the same as BLACKJACK. It is installed as a plastic, vitrified on the first heat, and highly resistant to slag and metal penetration. NARCOLINE is justified when operating temperatures are higher, where slag conditions are more severe and where metal is held longer at top temperatures. Recommended service temperature is 2650°-2800°F. NARCOLINE is shipped in 100 pound cartons.

NARCOLINE D is a companion product to NARCOLINE Plastic. It is a dry form of NARCOLINE Plastic and it is only necessary to add water to bring it to the desired ramming consistency. An addition of 2 to 3 quarts of water per 100 lbs. will give the same consistency as NARCOLINE Plastic. Furnished dry in 100 lb. moisture resistant bags.



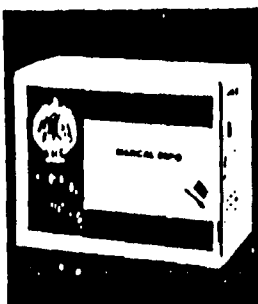
PLASTIC FIREBRICK (Cont'd)

NARCAL 60PG is a high alumina graphite plastic refractory developed for foundry and steel plant applications. It was developed to resist slag build up, higher temperatures and more soaking heat than regular graphite plastics. It is recommended for lining forehearths, ladles, troughs, runners, tap out blocks, slag hole blocks and well areas of cupolas. Recommended service temperature is 2000° - 3150° F. It is shipped in 100 pound cartons.



NARCAL 70PG is a high alumina plastic fortified with graphite. The high alumina grain is not affected by the high temperature or erosion action of hot metals. It is neutral in character and may be used in ladles handling ductile iron, malleable iron, foundry steel etc. Recommended service temperature is 2000° - 3200° F. It is packaged in 100 pound cartons.

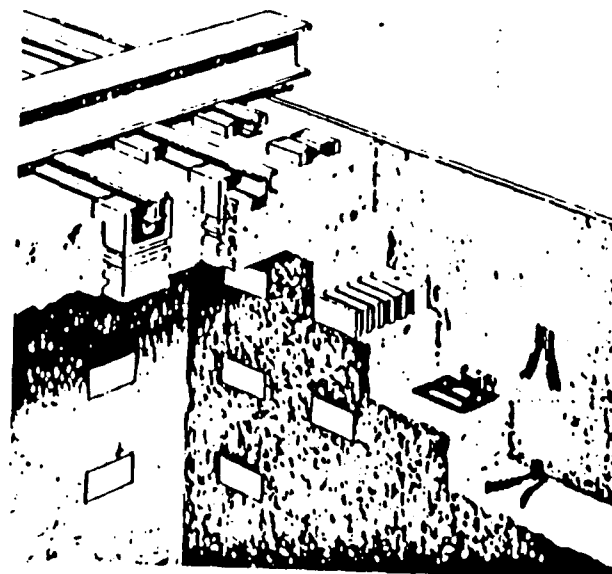
NARCAL 80PG is a high-alumina graphite-bearing plastic refractory. It may be used under the most severe operating conditions and should be considered for areas where longer service is essential. Recommended service temperature is 2000° - 3250° F. It is packaged in 100 pound cartons.



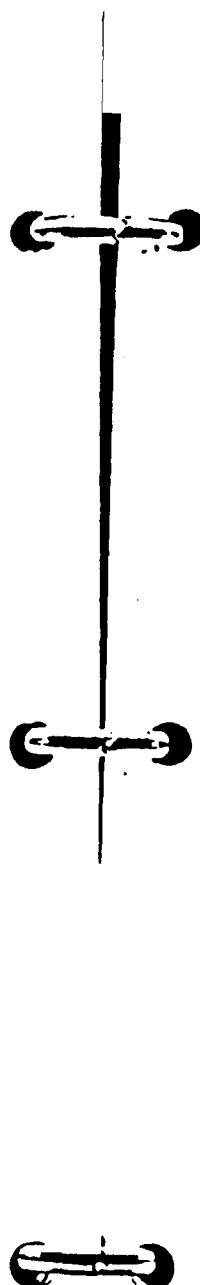
NARCAL 85PG

NARCAL 85PG is a high alumina graphite plastic developed for use in high production blast furnace and foundry cupola applications—specifically for troughs and spouts. This product exhibits superior workability, and strength for installations involving not only complete relining but minor maintenance work as well. The premium product is highly refractory, is non-wetting with respect to molten iron and slag, and is resistant to skull adherence. NARCAL 85PG tear-out is quick and easy when replacement becomes necessary. It is packaged in 100 pound cartons.

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.



ANCHORS FOR INSTALLATION OF PLASTICS AND CASTABLES (Cont)

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.

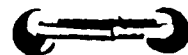
NARCO BLOCK PLASTIC

NARCO BLOCK PLASTIC shapes reduce the cost of installing refractories in furnaces by eliminating labor-intensive placement, ramming, and shaping of conventional plastic refractories. Blocks conform to strict dimensional standards and consistent block density. Dry-out curing and heat-up times are shortened, reducing unproductive furnace time.

Available in SHUR-RAM super-duty refractory plastic and in high-alumina NARCAL 60 and NARCAL 80P.

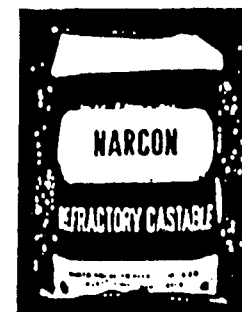
Ideal for soaking pits, slab reheal furnaces, forge furnaces, continuous butt-welding furnaces. Write for descriptive brochure.

NARCO BLOCK PLASTICS can be manufactured to meet any installation requirements. Standard cross sectional dimensions are 9" x 6", 9" x 5", and 9" x 4½". There are no limitations on length, although practical lengths of 9", 12", 13½", or 18" should be specified.



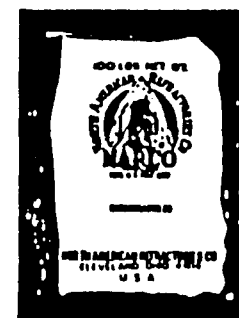
CASTABLE REFRACTORIES Regular Castables

NARCON is an economical, durable castable recommended for poured monolithic structures at all temperatures up to 2200° F. It has good strength and abrasion resistance and is well adapted for use as a paving material around industrial furnaces, aluminum melting pots, boilers and incinerators where the floor must withstand heat and mechanical abuse. It is packaged in 100 pound moisture resistant bags.

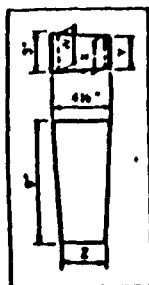


NARCOHEARTH E.S. (COARSE) is an extra coarse castable suitable for massive installations where strength resistance to thermal shock and mechanical abuse are primary factors. It is recommended for use at all temperatures up to 2350° F. It is packaged in 100 pound moisture resistant bags.

NARCOHEARTH 23 is a refractory castable characterized by its extra coarse aggregate and exceptionally high strength. This castable is recommended for use in areas where high compressive strength is essential and in areas subjected to substantial thermal shock. The maximum recommended temperature for Narcohearth 23 is 2350°F. It is shipped in 100 pound moisture resistant bags.



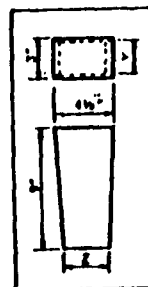
ELECTRIC FURNACE ROOF & DOME SHAPES



9" KEY ARCH

Mark	Dimension in Inches			
	"W"	"X"	"Y"	"Z"
EFR 9 11	3	2 1/2	2 1/2	4
EFR 9 12	2 1/2	2 1/2	2 1/2	4
EFR 9 13	2 1/2	2 1/2	2	4
EFR 9 21	2 1/2	2 1/2	2 1/2	3 1/2
EFR 9 22	2 1/2	2 1/2	2 1/2	3 1/2
EFR 9 23	2 1/2	2 1/2	2	3 1/2
EFR 9 14	2 1/2	1 1/2	1	4
EFR 9 24	2 1/2	1 1/2	1	3 1/2
EFR 9 31	2 1/2	2 1/2	2 1/2	3
EFR 9 32	2 1/2	2 1/2	2 1/2	3
EFR 9 33	2 1/2	2 1/2	2	3

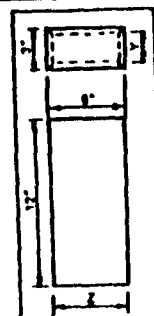
Mark	Dimension in Inches	
	"Y"	"Z"
EFR 9 11	2 1/2	4
EFR 9 12	2 1/2	4
EFR 9 13	2	4
EFR 9 21	2 1/2	3 1/2
EFR 9 22	2 1/2	3 1/2
EFR 9 23	2	3 1/2
EFR 9 31	2 1/2	3
EFR 9 32	2 1/2	3
EFR 9 33	2	3



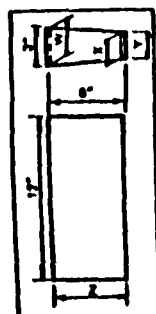
9" KEY WEDGE

Mark	Dimension in Inches			
	"W"	"X"	"Y"	"Z"
EFR 12 11	3	2 1/2	2 1/2	5 1/2
EFR 12 12	2 1/2	2 1/2	2 1/2	5 1/2
EFR 12 13	2 1/2	2 1/2	2	5 1/2
EFR 12 21	2 1/2	2 1/2	2 1/2	5
EFR 12 22	2 1/2	2 1/2	2 1/2	5
EFR 12 23	2 1/2	2 1/2	2	5

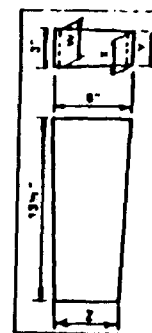
Mark	Dimension in Inches	
	"Y"	"Z"
EFR 12 11	2 1/2	5 1/2
EFR 12 12	2 1/2	5 1/2
EFR 12 13	2	5 1/2
EFR 12 21	2 1/2	5
EFR 12 22	2 1/2	5
EFR 12 23	2	5



12" KEY WEDGE



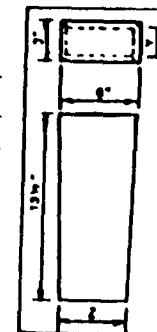
12" KEY ARCH



13" KEY ARCH

Mark	Dimension in Inches			
	"W"	"X"	"Y"	"Z"
EFR 13 11	2 1/2	2 1/2	2 1/2	5
EFR 13 12	2 1/2	2 1/2	2 1/2	5
EFR 13 13	2 1/2	2 1/2	2	5
EFR 13 21	2 1/2	2 1/2	2 1/2	4 1/2
EFR 13 22	2 1/2	2 1/2	2 1/2	4 1/2
EFR 13 23	2 1/2	2 1/2	2	4 1/2
EFR 13 24	2 1/2	1 1/2	1	4 1/2

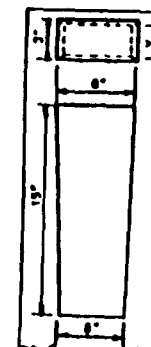
Mark	Dimension in Inches	
	"Y"	"Z"
EFR 13 11	2 1/2	5
EFR 13 12	2 1/2	5
EFR 13 13	2	5
EFR 13 21	2 1/2	4 1/2
EFR 13 22	2 1/2	4 1/2
EFR 13 23	2	4 1/2



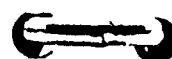
13" KEY WEDGE

Mark	Dimension in Inches			
	"W"	"X"	"Y"	"Z"
EFR 15 11	2 1/2	2 1/2	2 1/2	-
EFR 15 12	2 1/2	2 1/2	2 1/2	-
EFR 15 13	2 1/2	2 1/2	2 1/2	-

Mark	Dimension in Inches	
	"Y"	"Z"
EFR 15 11	2 1/2	-
EFR 15 12	2 1/2	-
EFR 15 13	2	-



15" KEY WEDGE



CASTABLE REFRACTORIES (Cont'd)

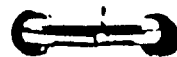
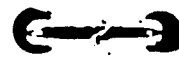
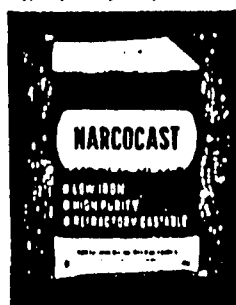
Regular Castables

NARCOCAST EXTRA STRENGTH SERIES castables are specifically designed for applications which require high mechanical strength and abrasion resistance. Maximum recommended temperature is 2400°F. To meet the wide range of conditions encountered in this temperature zone, NARCOCAST EXTRA STRENGTH is available in three grain sizings. Medium grain size NARCOCAST E. S. is designed for most general applications and provides a dense structure to resist slagging and abrasion action. To facilitate casting baffles and thin sections, as well as for trowelling applications, specify NARCOCAST E. S. FINE. For casting thicker and heavier sections, employ NARCOCAST E. S. COARSE to improve spalling resistance and toughness. These three products are shipped in 100 pound moisture resistant bags.



NARCOCAST 25 is another extra-coarse refractory castable fashioned after Narcohearth 23 but with increased refractoriness to withstand higher temperature environments. Narcocast 25 is also recommended where higher compressive strength and thermal shock resistance are major requirements and the temperature does not surpass 2550°F. It is shipped in 100 pound moisture resistant bags.

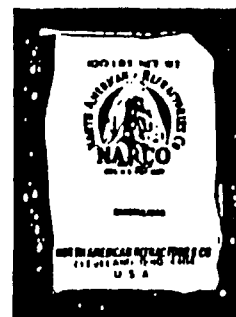
NARCOCAST is an excellent general purpose material for casting new jobs or repair work at operating temperatures up to 2600°F. It is a low iron, high purity, hydraulic setting castable with a fireclay base that permits preparation at needed consistency for pouring or tamping — simply by adding water and mixing. It develops good load bearing strength hydraulically without application of heat. NARCOCAST provides an economical means of forming monolithic and intricate furnace linings, thereby eliminating the necessity of maintaining an inventory of expensive shapes. It is shipped in 100 pound moisture resistant bags.



CASTABLE REFRACTORIES (Cont'd)

Regular Castables

NARCOCAST E. S. 26 is an exceptionally high strength refractory castable developed primarily for coke oven door applications. Narcocast E. S. 26 incorporates high strength and volume stability to form a superior refractory castable for use in many other applications where the temperature does not exceed 2600°F. It is shipped in 100 pound moisture resistant bags.



NARCOHEARTH is a castable similar to NARCOCAST but possessing a slightly higher iron content. It is also suitable for a wide variety of applications where operating temperatures do not exceed 2600°F. It is supplied in 100 lb. moisture resistant bags.

SUPER NARCOCAST is a special super duty castable for use up to 2800°F. where operating conditions are beyond the limits of standard castables. It is composed of a balanced blend of super duty fireclay and is bonded by a high purity calcium aluminate cement. The important characteristics of low iron content, excellent volume stability and high refractoriness commend its use where the requirements are more severe than usual at the additional temperature limit. It is shipped in 100 pound moisture resistant bags.



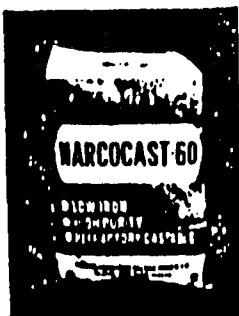
CASTABLE REFRACTORIES (Cont'd)

Regular Castables (Cont'd)

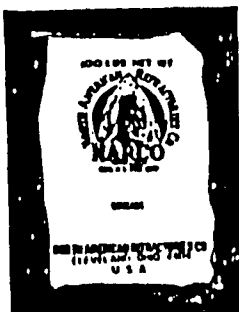
NARCOCAST 30 is a 3000°F high purity, low iron castable consisting of super duty calcined fireclays carefully combined with plasticizers and hydraulic binders. It possesses unusual volume stability and high bulk density. As added outstanding properties, it has high strength through its complete temperature range, with special emphasis on the intermediate temperature zone, and better resistance to spalling. It has also been designed to withstand the effects of high sulphur fuels, reducing and hydrogen atmospheres, fluctuating temperatures, erosion and abrasion. **NARCOCAST 30** is shipped in 100 pound moisture resistant bags.



NARCOCAST 60 is a hydraulic setting, high alumina, low iron 3100°F castable. The important characteristic of this material is its outstanding spalling resistance. The high alumina content of **NARCOCAST 60** assures maximum resistance to vitrification as well as increased density. These properties in addition to compatibility with various furnace atmospheres assures long life under many severe operating conditions. **NARCOCAST 60** is packaged in 100 lb. moisture resistant multiwall bags.



GUNCAST is a high alumina, low iron, 3100°F refractory castable similar to **Narccast 60** but modified in such a way as to make it suitable for guncasting. **Guncast** is typified by its resistance to spalling, vitrification, and shrinkage and its ability to withstand reducing atmospheres, abrasion, and corrosion. It is shipped in 100 pound moisture resistant bags.



CASTABLE REFRACTORIES (Cont'd)

Regular Castables (Cont'd)

NARCOCAST 32 is a high alumina castable suitable for service up to 3200°F. **NARCOCAST 32** possesses good volume stability and resistance to vitrification and spalling. Its composition provides excellent resistance to iron oxide scale attack, furnace fumes and atmospheres. **NARCOCAST 32** is available in 100 lb. moisture resistant bags.



NARCOTAB is a hydraulic setting, high alumina, low iron 3400°F castable composed of a tabular alumina aggregate bonded with a high purity calcium-aluminate binder. The light structure formed upon pouring results in high density, high strength, low permeability, high resistance to abrasion and erosion, resistance to carbon attack, reducing atmospheres and high sulphur oils. It is the answer to furnace problems caused by severe temperatures, spalling conditions and heavy loads. **NARCOTAB** is supplied in moisture resistant multiwall bags of 100 pound capacity.



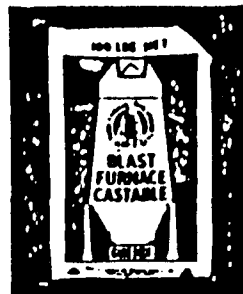
ANTI-ERODE is a hydraulic setting castable developed primarily for resistance to extreme conditions of abrasion and erosion at temperatures up to 2500°F. It has as its base a dense, hard and pure flint clay aggregate with a binding medium of equal strength. Erosion loss tests indicate it to compare favorably with both stiff mud and dry press first quality brick. It is also approximately equivalent in this type service to silicon carbide brick. **ANTI-ERODE** is shipped in 100 lb. moisture resistant bags.



CASTABLE REFRACTORIES (Cont'd)

Regular Castables (Cont'd)

NARCO BLAST FURNACE CASTABLE was developed specifically for pneumatic gun application in new monolithic construction and patching wherever conditions call for a product with high strength resistance to abrasion, slag, carbon attack and reducing atmosphere. It is recommended for application in blast furnaces and may be used from the bottom to the top of the stack, including the bustle pipe, off takes and downcomer pipe areas.



NARCO BLAST FURNACE CASTABLE may also be poured where an installation does not

lend itself to gun application. It is shipped in 100 pound moisture resistant bags.

NARCOLITE is a hydraulic setting light weight insulating castable for use at temperatures to 2000°F in direct contact with flame where abrasion or serious fluxing action are not present. It has good strength and low thermal conductivity for a light weight castable. **NARCOLITE** is shipped in 50 pound moisture resistant bags and requires 54 pounds of material per cubic foot of construction.



LOW-K is a lightweight hydraulic setting castable for use to 2000°F. It was designed to provide an additional margin of strength without impairing its insulating properties. Load conditions, as found in furnace foundations and hearths, are often too great for conventional insulating castables. **LOW-K** provides a structural sound protective heat barrier to meet these conditions and other applications requiring additional strength. **LOW-K** is supplied in 50 lb. bags and requires only 63 pounds of material per cubic foot of construction.



CASTABLE REFRACTORIES (Cont'd)

Insulating Castables (Cont'd)

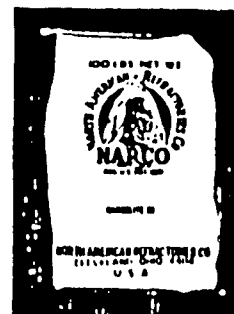
AEROCAST L is hydraulic setting and combines the qualities of refractoriness, strong cold set, good high temperature strength, negligible shrinkage and low thermal conductivity with heat saving insulating values and lightness of weight. **AEROCAST L** may be used for either back up purposes or as a working lining exposed to furnace atmospheres. It is not affected by cycling furnace operations and is free from rehydration. It is suitable for use up to 1800°F, requires 46 pounds per cubic foot installed and is shipped in 50 pound moisture resistant bags.



NARCOCRETE is an insulating, hydraulic setting castable that combines low density and abrasion resistance with refractoriness. It is suitable for use at temperatures up to 2450°F and is shipped in 100 pound moisture resistant bags requiring 85 pounds of material per cubic foot of construction.



NARCOLITE 28 is a 2800° insulating castable used in the construction of joint free monolithics where light weight and high insulating efficiency are performance criteria. Lightweight linings reduce the load on support equipment and high insulating efficiency means sizeable fuel savings resulting from low heat storage and low thermal conductivity. It is shipped in 50 pound moisture resistant bags.



RAMMING MIXES



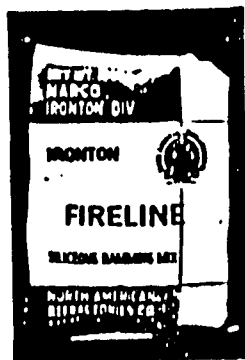
STEEL-LINE is a high alumina, fine grained, heat-set ramming mix, particularly for use in steel foundry ladles and in electric furnace roof delta sections. It can be installed quickly and provides a joint-free monolithic lining.

STEEL-LINE is shipped moist, ready to use, in 100-lb. moisture-resistant bags or 400-lb. drums.

CARO-LINE is a highly siliceous fine grained, heat-setting ramming refractory, blended under close laboratory control. This volume stable product is highly resistant to slag and high temperature metal penetration. **CARO-LINE** was especially developed for lining ladles handling acid electric furnace steel, malleable iron and alloy iron, as well as acid electric furnace bottoms and sidewalls. Mixtures of **CARO-LINE** and coarse silica ganister may be used for ramming the bottoms and sidewalls of acid open hearth or electric furnace installations, reducing the overall refractory cost.

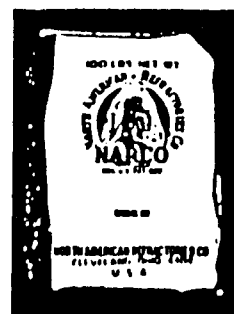
CARO-LINE is shipped in 100-lb. moisture-proof resistant bags and may be stored indefinitely.

FIRELINE is a highly siliceous coarse grained heat setting ramming refractory similar to **CARO-LINE** but is recommended for thicker linings. The coarse grain permits easier and faster drying. This is especially important in the thick linings used in converters and electric furnaces. **FIRELINE** contains a small quantity of boric acid to promote sintering at lower temperatures. **FIRELINE** is shipped dry or damp in 100 lb. moisture resistant bags.



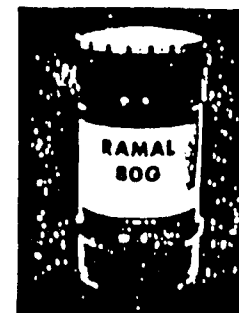
RAMMING MIXES

BERLITE is a super quality, fine grained refractory with graphite added, that provides excellent rammed lining for foundry ladles, cupola spouts and taphole areas. It has high refractoriness, is volume stable, non-wetting and resistant to slag and metal erosion. It is shipped dry in 100-lb. moisture-resistant bags.



RAMAL 80 is a high alumina, heat set, ramming mixture with exceptionally high refractoriness. When rammed into place, it forms a strong, dense homogeneous mass and may be substituted for high alumina brick and shapes in the 80% alumina class. It is shipped damp in 100 pound moisture resistant bags.

RAMAL 80 G is a special 80% alumina ramming mix fortified with graphite especially developed for ramming front slagging spouts of cupolas. The ability to take severe punishment makes **RAMAL 80 G** an economical refractory for tap hole and breast area of the cupola, for ladle and forehearth linings and for runners. **RAMAL 80 G** has high density, volume and contour stability, and high fusion temperature to resist erosion, abrasion and chemical attack even in the 2800°F - 3000°F range. **RAMAL 80 G** is supplied in polyethylene lined 100 lb. bags and 200 lb. metal drums.

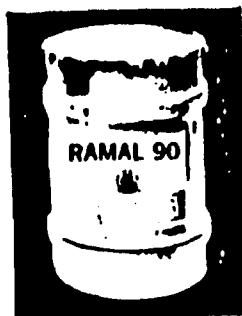
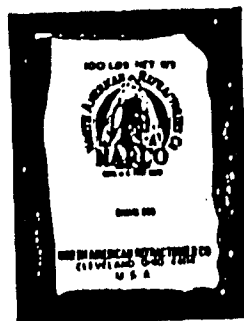


RAMMING MIXES



RAMAL 85 is a high alumina, phosphate bonded air setting ramming mix. It has excellent resistance to molten metal and slag penetration, has high strength at all temperatures and is resistant to spalling and abrasion. It is shipped damp in 100 pound moisture resistant bags.

RAMAL 85G is an extremely high alumina graphite fortified ramming mix specifically developed for high production blast furnace well and spout applications. Outstanding resistance to all types of slag attack and molten iron erosion has resulted in widespread and continued use where dependability, longevity, and overall economy are criteria for refractory selection. It is shipped in 100 pound moisture resistant bags.



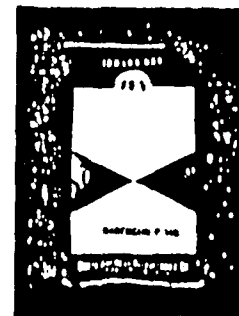
RAMAL 90 is a phosphate bonded alumina ramming mix having good cohesive properties. The high alumina content is responsible for its high bulk density and extreme refractoriness. Scale, slag and molten metals do not readily adhere to it. A veneer of RAMAL 90 laminated to other refractories such as brick, plastic or to itself, will form a structurally sound installation. It is shipped in 100 lb. bags and 200 pound drums.

GUNNING MIXES

Pneumatic emplacement (gunning) provides a practical and efficient method of installing refractory materials. It is a method by which refractory materials are sprayed or shot at high velocity and pressure to form a dense homogeneous lining.

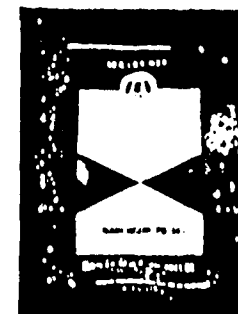
Basically there are two types of air placement guns — dry and wet. With the dry gun the material is charged into the gun in dry form and is tempered with water or a chemical solution while passing through the nozzle. The wet guns are charged with materials in wet form before being fed to the nozzle for application.

Gun mixes are generally supplied in dry form. Some are heat setting, however many contain special binders that develop full strength at all temperatures. Strengths are obtained through the use of air setting or hydraulic setting agents, or chemical binders incorporated in the mix or added in liquid form at time of placement.



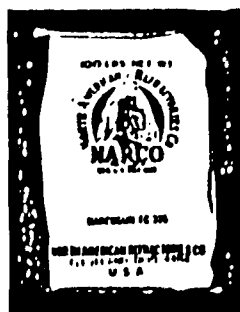
NARCOGUN P-340 is a magnesite gun mix that forms a rigid body in a matter of minutes when nozzle mixed with a 1:1 SPS water ratio. NARCOGUN P-340 is very resistant to slags of high iron contents and is ideally suited for installations such as pulverized coal fired boilers. Shipped dry in 100 lb. multiwall moisture proof bags.

NARCOGUN PD-345 is a magnesite gun mix containing a dry phosphate binder that attains its setting properties when mixed with water at the nozzle. It has high strength at all temperatures and is extremely resistant to basic slags. NARCOGUN P-345 serves as a maintenance material for BOF back up linings as well as pulverized coal fired boilers. Shipped in 100 lb. multiwall moisture resistant bags.

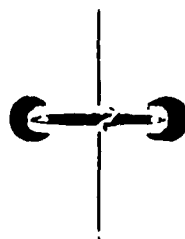


GUNNING MIXES

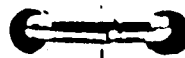
NARCOGUN FC-325 is a fireclay gun mix that develops strength through a chemical bond upon being tempered with a 1:1 SPS water ratio at the nozzle. It can be gunned on hot or cold surfaces to varying thicknesses. Because NARCOGUN FC-325 sets immediately upon contact with hot surfaces, it is well suited for coke oven jamb maintenance. Supplied dry in 50 and 100 lb. multiwall moisture proof bags.



NARCOGUN FCD-342 is dry phosphate bonded fireclay gun mix and is a companion product to NARCOGUN FC-345. Only water added at the nozzle is necessary for application to any installation. It may be applied to either a hot or cold surface and develops strength through the chemical bond. It is ideally suited for coke oven door and wall maintenance. Supplied dry in 80 and 100 pound moisture resistant bags.



NARCOGUN CO is a heat setting, fine grained fireclay spray or gun mix for general coke oven maintenance. It is used for sealing cracks and joints where mortar is missing, leveling bottoms, sealing around charging holes, maintenance of door jambs and ducts work. Supplied dry in 80 and 100 lb. multiwall paper bags.



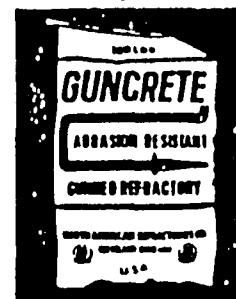
GUNNING MIXES



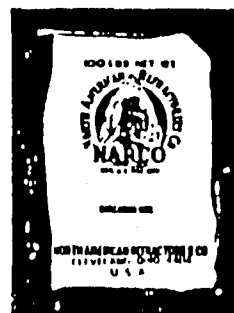
NARCOGUN AR is a high strength, abrasion resistant gunned castable for low temperature application. It is recommended for applications requiring high strength and abrasion resistance at temperatures up to 1200°F; however, it may be used for temperatures up to 2200°F in applications where strength and abrasion resistance are not factors. It is low in iron content and has good resistance to carbon monoxide disintegration.

NARCOGUN AR is supplied in 100 pound moisture resistant bags.

GUNCRETE is an abrasion resistant gun mix for applications up to 2400°F. This material needs only to be tempered with water at the nozzle to develop a high strength hydraulic bond. The bond strength of GUNCRETE together with its tough and dense grain provide an extremely effective abrasion resistant material for dust collector systems, petrochemical and refinery applications, and boiler ash hoppers. GUNCRETE is supplied in 100 lb. multiwall bags.

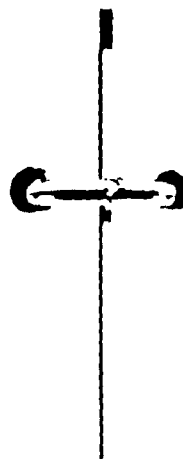


NARCOGUN HMC is a refractory gun mix developed primarily for maintenance of hot metal cars (treadwell ladles or torpedo ladles) but it is also well suited for installations where temperatures do not exceed 2700°F. These installations include soaking pits, soaking pit covers, rehear furnaces, aluminum smelting and holding furnace, arches, sills, jambs and walls above the metal line, large furnaces and annealing furnaces. It is shipped in 100 pound moisture resistant bags.



GUNNING MIXES

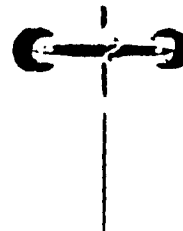
NARCOGUN 28 is a high duty fire clay gun mix for applications up to 2800°F. It is a general purpose type gun mix for all around mill maintenance such as soaking pit, soaking pit covers, open top ladles, hot metal mixers, treadwell ladles, etc. It is shipped in 100 pound moisture resistant bags.



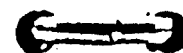
NARCO BLAST FURNACE CASTABLE and GUN MIX is a 3000°F castable developed especially for patching and repairing blast furnace linings. It can be used in all areas from the bottom to the top of the stack.



NARCO BLAST FURNACE CASTABLE and Gun Mix is highly refractory, is exceptionally strong, volume stable, has good abrasion resistance and because of its purity and low iron content will withstand the carbon monoxide atmosphere present in blast furnaces. It is shipped in 100 pound moisture resistant bags.



NARCAL 80 GUN is a high alumina 3100°F gun mix formulated to allow for both hot and cold gunning. This characteristic makes it an ideal choice for the original equipment lining as well as an ideal repair material for high temperature applications in steel holding furnaces, coke oven door jambs, channel type induction furnaces, and the like. It is shipped in 100 pound moisture resistant bags.



GUNNING MIXES

NARCAL 85 GUN is a phosphate bonded high alumina gun mix developed for hot and cold surface application. It is an excellent furnace maintenance material for applications where temperature and slag conditions are too severe for ordinary high duty and super duty refractories. It is packaged and shipped in 100 pound bags.



AEROGUN is an extremely lightweight insulating gun mix developed primarily for back-up service and limited exposed lining applications. In those applications where it is to be used as back-up, Aerogun should not be subjected to temperatures exceeding 1800°. Exposed linings of Aerogun should not be subjected to temperatures above 1600°. Aerogun displays versatility in that it might also be cast or trowelled. It is shipped in 50 pound moisture resistant bags.



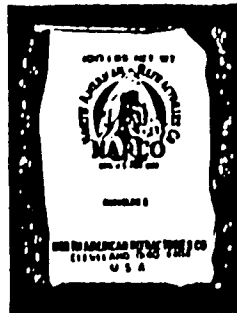
NARCOLITE GUNNING MIX is a hydraulic setting lightweight insulating gun mix developed principally for applications requiring a product with low iron content for use in highly reducing atmospheres. It has a gunned density of only 65 pounds and a service limit of 2000°F. Its high insulating efficiency assures an economical lining. It is shipped in 50 pound multiwall, moisture resistant bags.



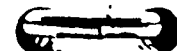
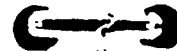
GUNNING MIXES

NARCOLINE G is a dry graphitic type, slag resistant gun mix. Grain size distribution is balanced to give the best gunning properties possible. It has good strength, high density and is resistant to graphite burn out which is essential to maintain maximum slag resistance.

NARCOLINE G is supplied dry in 100 pound multiwall bags.



NARMAG CM-18 is a chrome ore base gun mix with air setting properties. It is applied with a dry type nozzle mix gun where water is added at the nozzle. **NARMAG CM-18** finds wide usage in veneering open walls, uptakes and slag pockets as well as studded tube boiler walls. Supplied in 50 and 100 lb. multiwall paper bags.



SILICA SPECIALTIES

SILGLAS is an especially formulated line grain super silica mortar developed for laying glass tank crowns



SILGLAS has excellent trowelling and suspension characteristics to obtain thin but full joints so necessary for glass tank crown construction. For identification purposes, **SILGLAS** contains a harmless organic dye which turns blue upon mixing the mortar with water. Supplied dry in 100 lb. paper bags.

NARCO-SIL is a super silica mortar used in conjunction with silica brick wherever conditions are severe. It has desirable balanced properties such as maximum refractori-



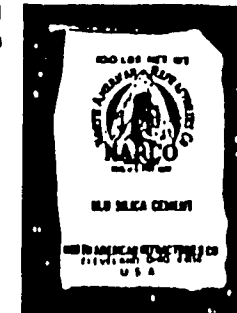
ness, excellent workability, high resistance to slag erosion, negligible shrinkage, good bonding characteristics and high load bearing ability. It contains no fireclay or siliceous clay but makes use of other special ingredients to give it outstanding plasticity and bonding power.

NARCO-SIL is shipped in 100 pound moisture resistant bags. To use, it is only necessary to mix with clean water to desired consistency.

MrU SILICA CEMENT is produced in two grades, coke oven and open hearth, which are standard mortars for laying silica brick. **MrU COKE OVEN CEMENT** is also used in glass tanks as well as 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 pound capacity.



BASIC SPECIALTIES

Mortars

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 pound bags, it requires only the addition of water before using.

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 brick, 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.



BASIC SPECIALTIES (Cont'd)

Mortars

NARMAG MORTAR (Heat Set) is a finely ground, high purity, heat setting magnesite (periclase) bonding mortar, containing in excess of 95% MgO. It is designed for use with our high purity basic brick products such as **NARMAG B**, but may be used with our other basic brick brands as well.

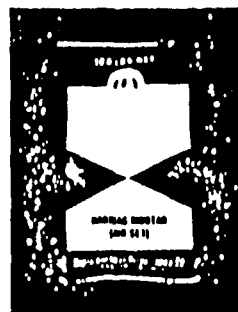


NARMAG MORTAR's particular advantage is the chemical resistance and refractoriness provided by its high magnesia content. In addition, **NARMAG MORTAR** incorporates low shrinkage, excellent troweling characteristics and good water retention properties, even on burned brick. Thus **NARMAG MORTAR** prevents erosion in particularly severe basic applications by (1) securing tight well filled joints upon installation thru its superior handling and physical properties and (2) providing maximum chemical resistance by reason of its high purity.

Supplied in 100 lb. multiwall moisture resistant paper bags.

Supplied in 100 lb. multiwall moisture resistant paper bags.

NARMAG MORTAR (Air Set) is a finely ground high purity air setting magnesite (periclase) bonding mortar for use



with magnesite and magnesite-chrome brick where a strong joint is required regardless of temperature. **NARMAG MORTAR (Air Set)** has the same chemical resistance to basic slag conditions as noted above for the heat setting grade. Supplied in 100 lb. multiwall moisture resistant paper bags.

Castables

NARCHROME CASTABLE REFRACTORY is a chrome ore base, hydraulic setting material which is recommended for temperatures up to 3000°F. To use, mix with clean

BASIC SPECIALTIES (Cont'd)

Castables
water to the desired consistency and then pour like concrete.

Like **NARCHROME PLASTIC REFRACTOR**, 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 REFRACTOR is supplied dry in 100 pound bags and about 165 pounds of material is required to cast one cubic foot of lining.

GUNNING MIXES

**NARMAG
CM-18
GUN**

See Gunning Mixes, Page 82
for detailed information

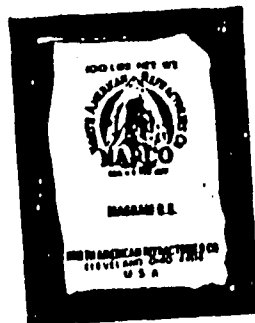
**NARCOGUN
P-340**

See Gunning Mixes, Page 77
for detailed information

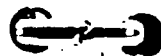
**NARCOGUN
PD-345**

See Gunning Mixes, Page 77
for detailed information

RAMMING MIXES



MAGRAM G.S. is a basic ramming mix developed primarily for ramming the delta sections of basic electric furnace roofs. Unique binders allow Magram G.S. to be either rammed or rammed cast into a refractory material possessing the following attributes: resistance to corrosive furnace fumes, chemical compatibility, adequate strength, high rammed density, ease of placement and short setting time. It is shipped in 100 pound moisture-resistant bags.



ANCHORS and HANGERS FOR MONOLITHIC CONSTRUCTION

The following pages show various types of anchors and accessories offered by NARCO and illustrate a number of practical methods for anchoring and suspending plastic or castable refractories in monolithic furnace linings.

The simplicity of design in NARCO anchors provides various combinations of metal and refractory anchor assemblies adaptable to a wide variety of applications in construction of furnace linings and heat enclosures.

Selection of anchors should be determined by service conditions and temperature gradients encountered through the walls or roof. Components of the anchor assembly must be of correct type to meet these varying conditions.

TEMPERATURE CONSIDERATIONS IN ANCHOR SELECTION

1. Mild steel parts may be used up to 500°F.
2. Cast iron with 1% chrome up to 1000°F.
3. Alloys of 25-12 chrome nickel up to 1550°F.
4. Super duty refractory anchors are recommended at higher temperatures to 3200°F.

The drawings indicate the use of higher temperature resistant parts toward the hot face with adequate lower temperature components in the cooler section of the anchor assemblies.

CONCLUSION

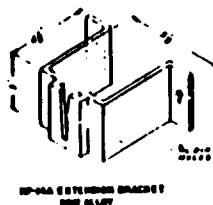
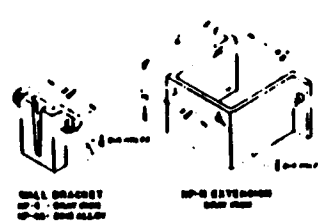
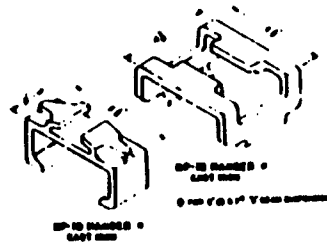
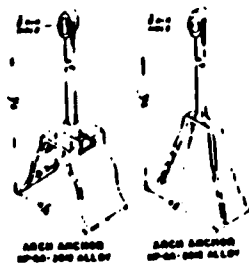
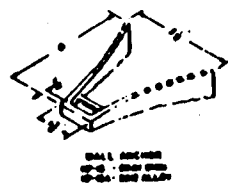
It is extremely important to properly space all NARCO anchor and hanger units to suit design requirements. In general, for wall construction, metal or refractory anchors should be spaced approximately 15 to 18 inch centers. However, under extreme conditions of temperature and excess vibration, 12 inch centers are recommended.

For flat arch or roof construction, NARCO anchors or hangers are usually spaced on 12 inch centers to suit most service conditions.

A supply of the NARCO refractory anchor and hanger assemblies illustrated is maintained with adequate stocks of plastics, castables, and refractory gun mixes for prompt shipment.

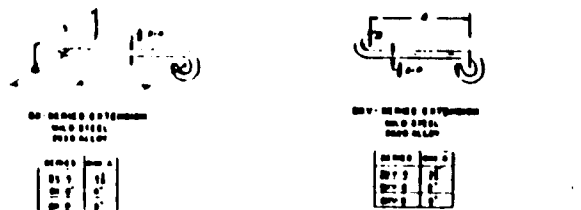
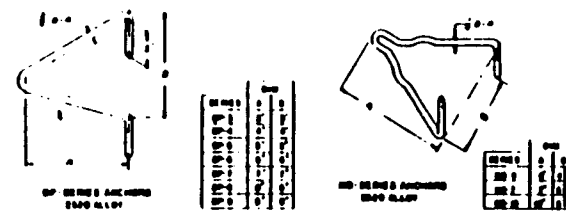
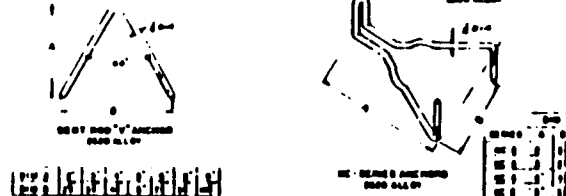
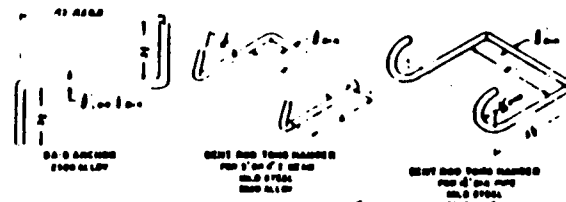
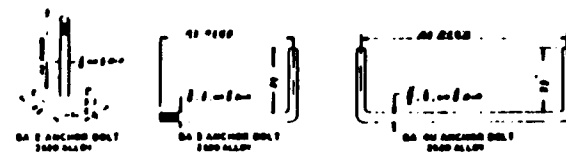
For additional information pertaining to product recommendations and application methods of anchoring systems described herein, consult the Cleveland Office.

METAL ANCHORS AND ACCESSORIES FOR MONOLITHIC CONSTRUCTION

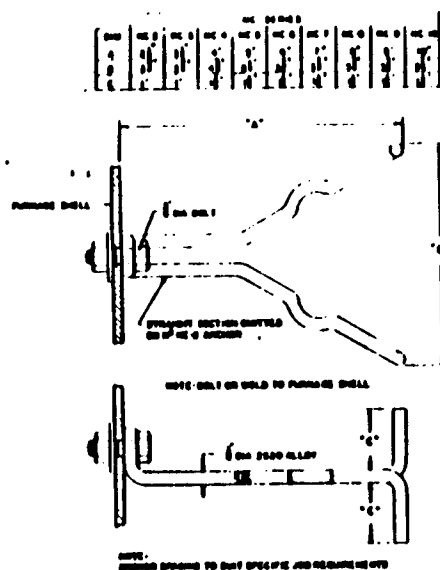


NOTE: ALL ABOVE GRAY IRON ITEMS ARE OF THE BLENDED TYPE

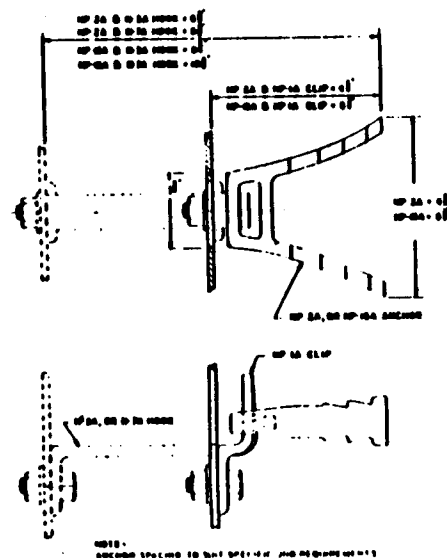
METAL ANCHORS AND ACCESSORIES FOR MONOLITHIC CONSTRUCTION



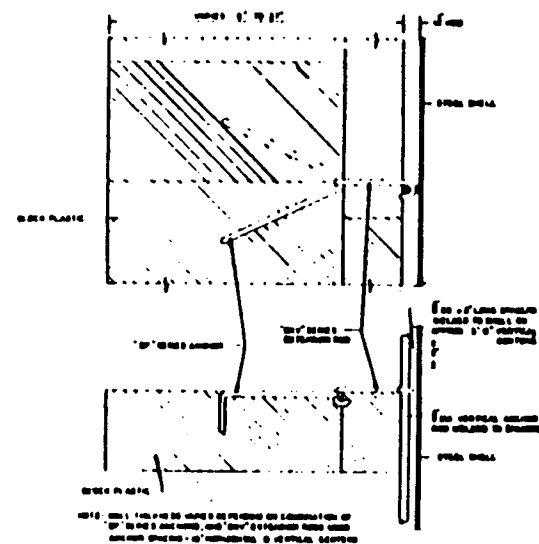
APPLICATION OF "MC" SERIES BENT ROD ANCHORS FOR CASTABLE INSTALLATIONS



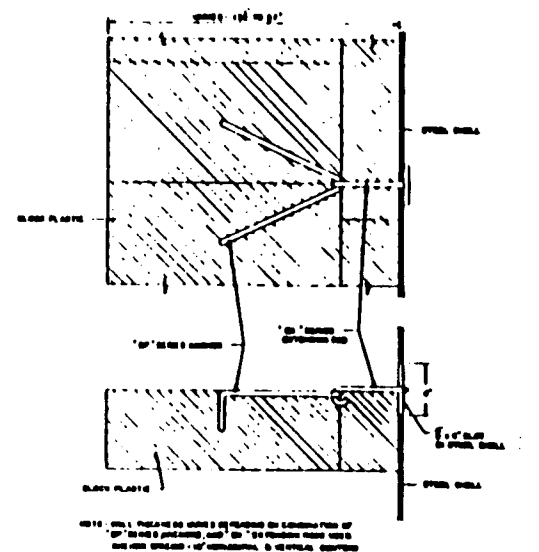
APPLICATION OF NP 2A, OR NP-15A METAL WALL ANCHORS AND FIXTURES



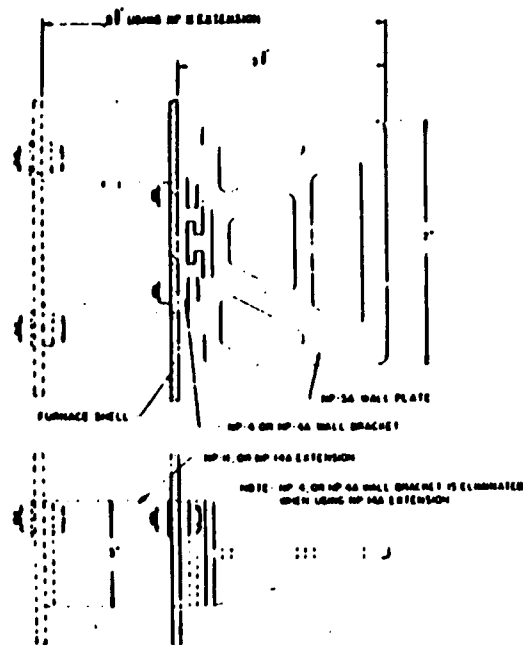
APPLICATION OF "BP" SERIES BENT ROD ANCHORS, & "BX" SERIES EXTENSION RODS FOR BLOCK PLASTIC INSTALLATIONS



APPLICATION OF "BP" SERIES BENT ROD ANCHORS, & "BX" SERIES EXTENSION RODS FOR BLOCK PLASTIC INSTALLATIONS

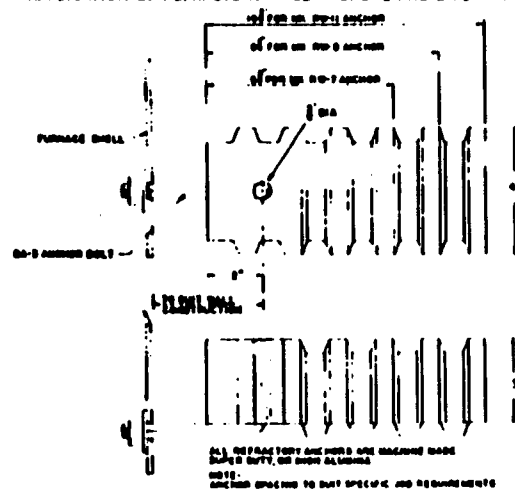


APPLICATION OF NP 5A WALL PLATE AND SUPPORTING FIXTURES

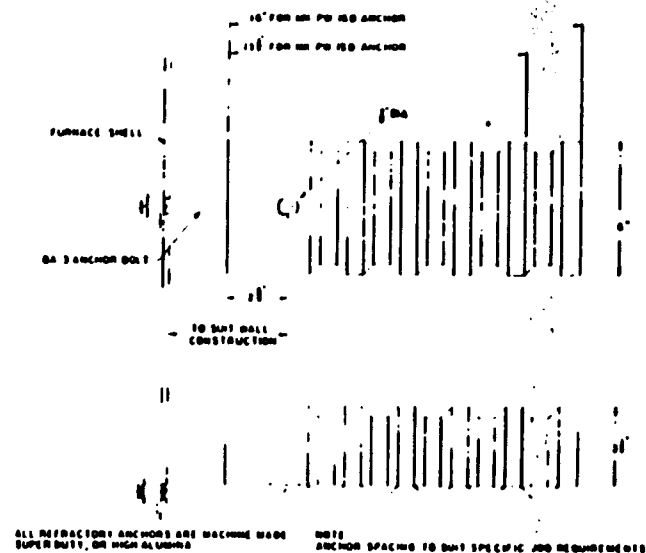


NOTE: WALL PLATE SPACING TO SUIT SPECIFIC JOB REQUIREMENTS

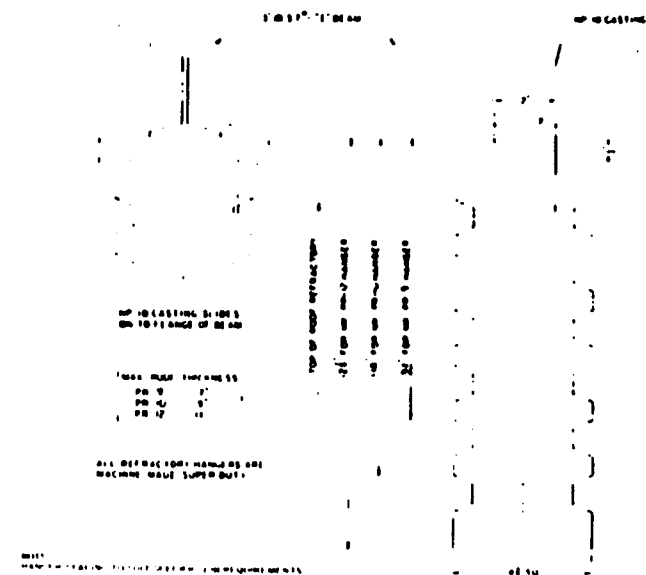
APPLICATION OF REFRACTORY WALL ANCHORS AND BA 3 ANCHOR BOLT



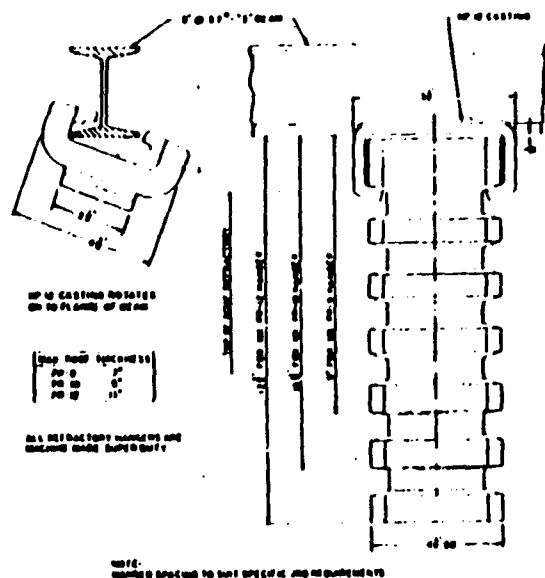
APPLICATION OF REFRACTORY WALL ANCHORS AND BA 3 ANCHOR BOLT



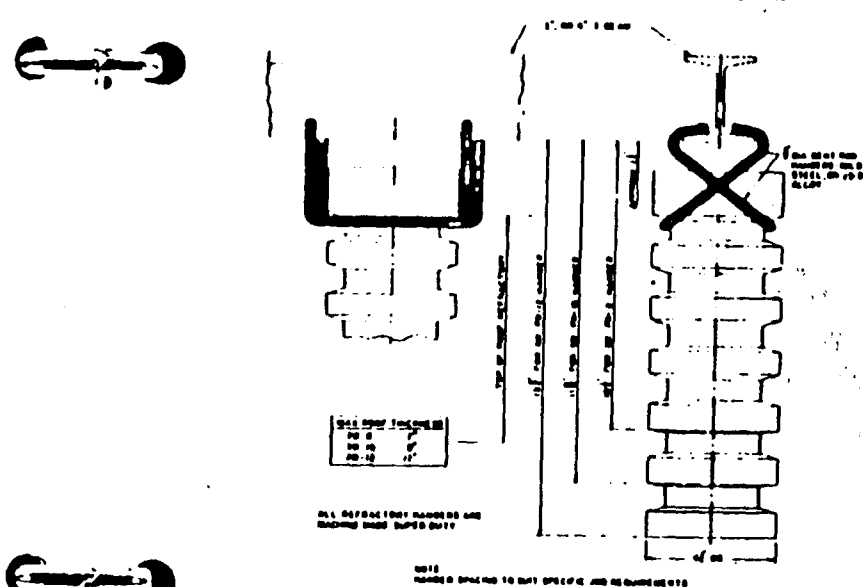
APPLICATION OF REFRACTORY HANGERS AND NP 10 CASTING IN ROOF CONSTRUCTION



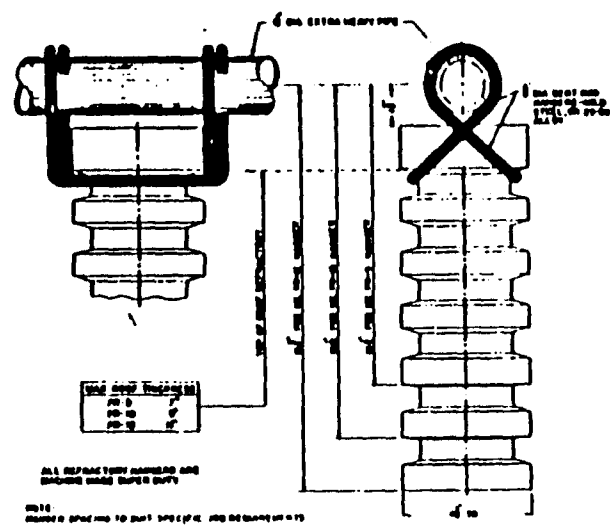
APPLICATION OF REFRACTORY HANGERS AND NP-12 CASTING IN ROOF CONSTRUCTION



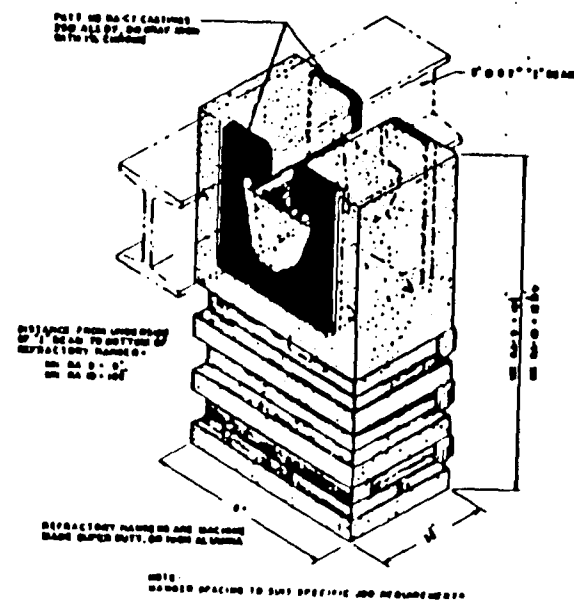
APPLICATION OF REFRACTORY HANGERS AND BENT ROD TONG HANGERS IN ROOF CONSTRUCTION



APPLICATION OF REFRACTORY HANGERS AND BENT ROD TONG HANGERS IN ROOF CONSTRUCTION

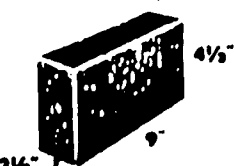
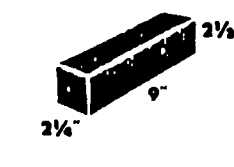


APPLICATION OF REFRACTORY HANGERS IN ROOF CONSTRUCTION



STANDARD FIRECLAY BRICK SIZES*

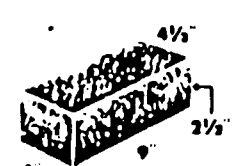
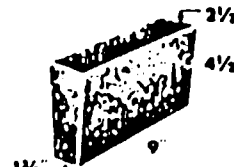
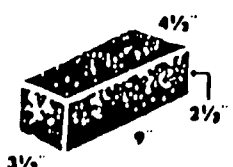
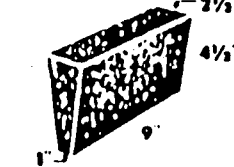
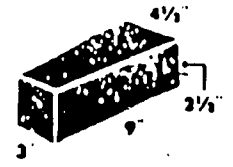
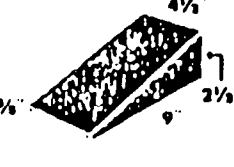
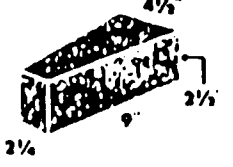
9" x 4 1/2" x 2 1/2" Series

 9" STRAIGHT 9" x 4 1/2" x 2 1/2"	 No. 1-X WEDGE 9" x 4 1/4" x (2 1/2" - 2 1/4") 6" Inside Radius
 SPLIT BRICK 9" x 4 1/2" x 1 1/4"	 No. 1 WEDGE 9" x 4 1/2" x (2 1/2" - 1 1/4") 2' 3/4" Inside Radius
 2 INCH BRICK 9" x 4 1/2" x 2"	 No. 2 WEDGE 9" x 4 1/2" x (2 1/2" - 1 1/2") 1' 1/2" Inside Radius
 SMALL 9" BRICK 9" x 3 1/2" x 2 1/2"	 SOAP BRICK 9" x 2 1/2" x 2 1/2"

* Also standard in silica brick

STANDARD FIRECLAY BRICK SIZES*

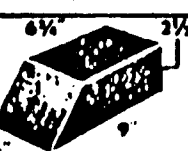
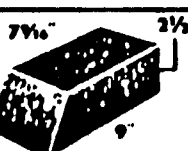
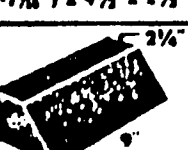
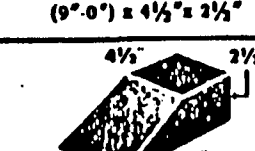
9" x 4 1/2" x 2 1/2" Series

 No. 1 ARCH 9" x 4 1/2" x (2 1/2" - 2 1/2") 2' 1/2" Inside Radius	 No. 1 KEY 9" x (4 1/2" - 4") x 2 1/2" 6' 0" Inside Radius
 No. 2 ARCH 9" x 4 1/2" x (2 1/2" - 1 1/4") 10 1/2" Inside Radius	 No. 3 KEY 9" x (4 1/2" - 3 1/2") x 2 1/2" 2' 7/2" Inside Radius
 No. 3 ARCH 9" x 4 1/2" x (2 1/2" - 1") 3" Inside Radius	 No. 3 KEY 9" x (4 1/2" - 3") x 2 1/2" 1' 6" Inside Radius
 NECK BRICK 9" x 4 1/2" x (2 1/2" - 1/2")	 No. 4 KEY 9" x (4 1/2" - 2 1/4") x 2 1/2" 9" Inside Radius

* Also standard in silica brick

STANDARD FIRECLAY BRICK SIZES

9" x 4 1/2" x 2 1/2" Series

 JAMB BRICK* 9" x 4 1/2" x 2 1/2"	 EDGE SKEW* 9" x (4 1/2" - 1 1/2") x 2 1/2"
 48° END SKEW* (9" - 6 1/2") x 4 1/2" x 2 1/2"	 FEATHER EDGE* 9" x 4 1/2" x (2 1/2" - 1/8")
 60° END SKEW* (9" - 7 1/4") x 4 1/2" x 2 1/2"	 ANGLE "A" SKEW† (9" - 4 1/2") x 4 1/2" x 2 1/2"
 48° SIDE SKEW* 9" x (4 1/2" - 2 1/4") x 2 1/2"	 ANGLE "B" SKEW† (9" - 0") x 4 1/2" x 2 1/2"
 60° SIDE SKEW* 9" x (4 1/2" - 3 1/4") x 2 1/2"	 ANGLE "C" SKEW† (9" - 4 1/2") x 4 1/2" x 2 1/2"

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

STANDARD FIRECLAY BRICK SIZES*

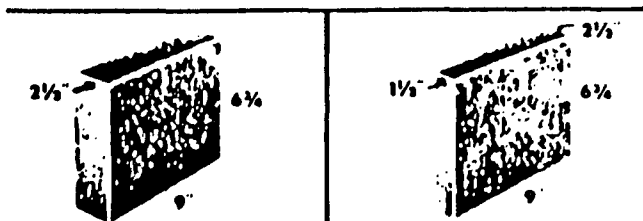
9" x 4 1/2" x 3" Series

Name of Brick	Dimensions	Inside Radius
9" Straight—3" Series	9" x 4 1/2" x 3"	—
Small 9" Brick—3" Series	9" x 3 1/2" x 3"	—
9" Soap—3" Series	9" x 2 1/4" x 3"	—
9" Split Brick—3" Series	9" x 4 1/2" x 1 1/2"	—
9" No. 1 Arch—3" Series	9" x 4 1/2" x (3" - 2 1/4")	4" - 1 1/2"
9" No. 2 Arch—3" Series	9" x 4 1/2" x (3" - 2 1/2")	1" - 10 1/2"
9" No. 3 Arch—3" Series	9" x 4 1/2" x (3" - 2")	9"
9" No. 4 Arch—3" Series	9" x 4 1/2" x (3" - 1")	2 1/4"
9" No. 1 Wedge—3" Series	9" x 4 1/2" x (3" - 2 1/4")	8" - 3"
9" No. 2 Wedge—3" Series	9" x 4 1/2" x (3" - 2 1/2")	3" - 9"
9" No. 3 Wedge—3" Series	9" x 4 1/2" x (3" - 2")	1" - 6"
9" No. 1 Key—3" Series	9" x (4 1/2" - 4") x 3"	6" - 0"
9" No. 2 Key—3" Series	9" x (4 1/2" - 3 1/2") x 3"	2" - 7 1/2"
9" No. 3 Key—3" Series	9" x (4 1/2" - 3") x 3"	1" - 6"
9" No. 4 Key—3" Series	9" x (4 1/2" - 2 1/4") x 3"	9"
9" Feather Edge—3" Series	9" x 4 1/2" x (3" - 1/8")	—
9" Neck Brick—3" Series	9" x 4 1/2" x (3" - 1/8")	—
9" Edge Skew—3" Series	9" x (4 1/2" - 1 1/2") x 3"	—
9"—48° End Skew—3" Series	(9" - 6 1/2") x 4 1/2" x 3"	—
9"—48° Side Skew—3" Series	9" x (4 1/2" - 1 1/4") x 3"	—
9"—60° End Skew—3" Series	(9" - 7 1/4") x 4 1/2" x 3"	—
9"—60° Side Skew—3" Series	9" x (4 1/2" - 2 1/4") x 3"	—
9" Jamb Brick—3" Series	9" x 4 1/2" x 3"	—

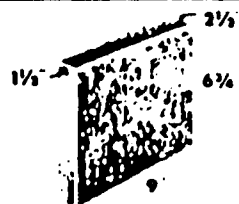
*Also standard in silica brick

STANDARD FIRECLAY BRICK SIZES

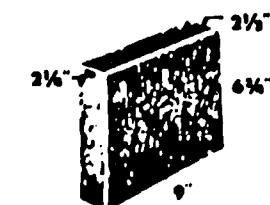
STANDARD FIRECLAY BRICK SIZES



LARGE 9" STRAIGHT*
9" x 6 1/4" x 2 1/2"
9" x 6 1/4" x 3"



LARGE 9" No. 2 WEDGE*
9" x 6 1/4" x (2 1/2" - 1 1/2")
1' - 1 1/2" Inside Radius
9" x 6 1/4" x (3" - 2 1/2")
3' - 9" Inside Radius



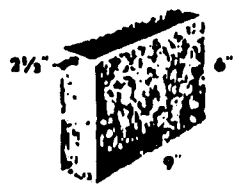
LARGE 9" No. 1-X WEDGE*
9" x 6 1/4" x (2 1/2" - 2 1/4")
6' - 9" Inside Radius



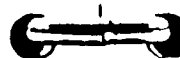
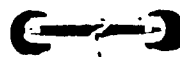
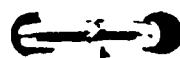
LARGE 9" No. 3 WEDGE*
9" x 6 1/4" x (3" - 2")
1' - 6" Inside Radius



LARGE 9" No. 1 WEDGE*
9" x 6 1/4" x (2 1/2" - 1 1/8")
2' - 3" Inside Radius
9" x 6 1/4" x (3" - 2 1/4")
8' - 3" Inside Radius



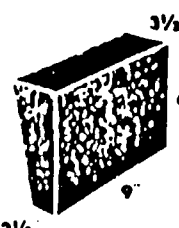
FLAT BACK STRAIGHT
9" x 6" x 2 1/2"



FLAT BACK SPLIT
9" x 6" x 1 1/4"
9" x 6" x 2"



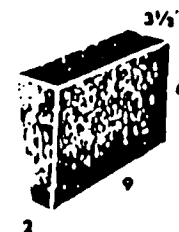
9" x 6" No. 1 KEY
9" x (6" - 5 1/8") x 2 1/2"
9" x (6" - 5 1/8") x 3"
6' - 6" Inside Radius



No. 1 FLAT BACK ARCH
9" x 6" x (3 1/2" - 2 1/2")
1' - 3" Inside Radius



9" x 6" No. 2 KEY
9" x (6" - 4 1/16") x 2 1/2"
9" x (6" - 4 1/16") x 3"
3' - 0" Inside Radius



No. 2 FLAT BACK ARCH
9" x 6" x (3 1/2" - 2")
8" Inside Radius



9" x 6" No. 3 KEY
9" x (6" - 3") x 2 1/2"
9" x (6" - 3") x 3"
9" Inside Radius

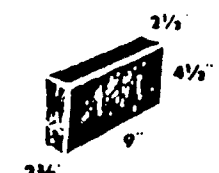
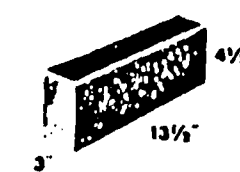
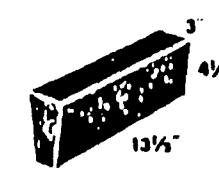
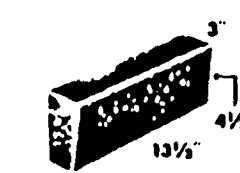
*Also standard in silica brick

STANDARD FIRECLAY BRICK SIZES

Name	Dimensions in inches	Number per Ring	Diameter of Ring	
			Inside	Outside
STANDARD 12" x 6" x 3" SIZES*				
Straight	12x6x3			
No. 1 Arch	12x6x(3-2¼)	151	11'-0"	12'-0"
No. 2 Arch	12x6x(3-2⅝)	76	5'-0"	6'-0"
No. 3 Arch	12x6x(3-2)	38	2'-0"	3'-0"
No. 1-X Wedge	12x6x(3-2⅝)	604	46'-0"	48'-0"
No. 1 Wedge	12x6x(3-2¼)	302	22'-0"	24'-0"
No. 2 Wedge	12x6x(3-2⅝)	151	10'-0"	12'-0"
No. 3 Wedge	12x6x(3-2)	76	4'-0"	6'-0"
STANDARD 13½" x 4½" x 2½" SIZES				
Straight	13½x4½x2½			
No. 1 Arch	13½x4½x(2½-2⅞)	76	4'-3"	5'-0"
No. 2 Arch	13½x4½x(2½-1¾)	38	1'-9"	2'-6"
No. 3 Arch	13½x4½x(2½-1)	19	0'-6"	1'-3"
STANDARD 13½" x 4½" x 3" SIZES*				
Straight	13½x4½x3			
No. 1 Arch	13½x4½x(3-2¾)	113	8'-3"	9'-0"
No. 2 Arch	13½x4½x(3-2½)	57	3'-9"	4'-6"
No. 3 Arch	13½x4½x(3-2)	29	1'-6"	2'-3"
No. 4 Arch	13½x4½x(3-1)	15	0'-4½"	1'-1½"
STANDARD 13½" x 6" x 2½" SIZES				
Straight	13½x6x2½			
No. 1 Key	13½x(6-5)x2½	85	11'-3"	13'-6"
No. 2 Key	13½x(6-4½)x2½	52	6'-0"	8'-3"
No. 3 Key	13½x(6-3)x2½	29	2'-3"	4'-6"
STANDARD 13½" x 6" x 3" SIZES*				
Straight	13½x6x3			
No. 1 Arch	13½x6x(3-2¾)	151	11'-0"	12'-0"
No. 2 Arch	13½x6x(3-2½)	76	5'-0"	6'-0"
No. 3 Arch	13½x6x(3-2)	38	2'-0"	3'-0"
No. 1-X Wedge	13½x6x(3-2⅞)	679	51'-9"	54'-0"
No. 1 Wedge	13½x6x(3-2¾)	340	24'-9"	27'-0"
No. 2 Wedge	13½x6x(3-2⅞)	170	11'-3"	13'-6"
No. 3 Wedge	13½x6x(3-2)	85	4'-6"	6'-9"
No. 1 Key	13½x(6-5)x3	85	11'-3"	13'-6"
No. 2 Key	13½x(6-4½)x3	52	6'-0"	8'-3"
No. 3 Key	13½x(6-3)x3	29	2'-3"	4'-6"

*Also standard in silica brick

STANDARD FIRECLAY BRICK SIZES

 9" BUNG ARCH 9" x 4 1/2" x (2 1/2" - 2 3/8") 7'-1 1/2" Inside Radius	 No. 101 SQUARE BUNG 9" x 4 1/2" x 3" 13 1/2" x 4 1/2" x 3"
 No. 103 BUNG ARCH 13 1/2" x 4 1/2" x (3" - 2 3/4") 2' 7 1/2" Inside Radius	 No. 105 BUNG ARCH 9" x 4 1/2" x (3" - 2 3/4") 13 1/2" x 4 1/2" x (3" - 2 3/4") 8' 7 1/2" Inside Radius

STANDARD MISCELLANEOUS STRAIGHTS

9" x 6" x 2"	10 1/2" x 4 1/2" x 2 1/2"	18" x 6" x 2 1/2"
9" x 7" x 2"	10 1/2" x 4 1/2" x 3"	18" x 6" x 3"
9" x 7 1/2" x 2"	10 1/2" x 4 1/2" x 4 1/2"	18" x 9" x 4 1/2"
	12" x 4 1/2" x 3"	
	13 1/2" x 4 1/2" x 4 1/2"	

*Also standard in silica brick



STANDARD 9" x 4 1/2" x 2 1/2" CIRCLE BRICK

Fireclay

Dimensions of all Circle Brick
Outside Chord approx. 9 inches
Radial Dimension 4 1/2 inches
Thickness 2 1/2 inches

Name of Block 2 1/2" Series	Inside Chord in Inches	Outside Chord in Inches	Diameter in Inches		Number of Brick Per Ring
			Inside	Outside	
24-33	6 1/16	9	24	33	12
36-45	7 3/16	9	36	45	16
48-57	7 13/32	9	48	57	20
60-69	7 1/2	9	60	69	24
72-81	8	9	72	81	29
84-93	8 1/8	9	84	93	33
96-105	8 5/16	9	96	105	37
108-117	8 3/8	9	108	117	41
120-129	8 1/2	9	120	129	45

Also Standard 9" x 4 1/2" x 3" Thick Circle Brick,
Identical to Sizes Listed Above.



9" x 4 1/2" x 9" CUPOLA BLOCKS

Fireclay

Dimensions of all Blocks
Outside Chord approx. 9 inches
Radial Dimension 4 1/2 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 1/16	9	16	25	9
B	6 3/16	9	21	30	11
C	6 1/2	9	27	36	13
D	6 13/16	9	30	39	14
E	7 1/2	9	40	49	18
F	7 13/16	9	51	60	21
G	7 3/4	9	60	69	24
H	8	9	73	82	29



STANDARD 9" x 6" x 4" CUPOLA BLOCKS and 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 1/16	9	30	42	15
36-48	6 3/8	9	36	48	17
42-54	7	9	42	54	19
48-60	7 1/16	9	48	60	21
54-66	7 3/8	9	54	66	23
60-72	7 1/2	9	60	72	26
66-78	7 5/8	9	66	78	28
72-84	7 3/4	9	72	84	30
78-90	7 7/8	9	78	90	32
84-96	7 15/16	9	84	96	34
90-102	8 1/16	9	90	102	36
96-108	8 1/8	9	96	108	38
102-114	8 1/4	9	102	114	40
108-120	8 3/8	9	108	120	42
114-126	8 5/8	9	114	126	44
120-132	8 3/4	9	120	132	46
123-135	8 7/8	9	123	135	48
126-138	8 15/16	9	126	138	49
132-144	8 1/2	9	132	144	51
138-150	8 13/16	9	138	150	53

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.

9" x 4 1/2" x 4" CUPOLA BLOCKS

Fireclay

Dimensions of all Blocks
Outside Chord approx. 9 inches
Radial Dimension 4 1/2 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 1/16	9	27	36	13
32-41	7 1/16	9	32	41	15



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



STANDARD CURVEX CUPOLA BLOCKS 6" LINING

Fireclay

apprdx. 9" x 6" x 4"

Name of Block	Inside Chord in Inches	Outside Chord in Inches	Diameter in Inches		Number of Blocks Per Ring
			Inside	Outside	
48-66	6 1/12	9	48	66	23
54-72	6 3/4	9	54	72	26
60-78	6 5/8	9	60	78	28
66-84	7 1/8	9	66	84	30
72-90	7 3/8	9	72	90	32
78-96	7 5/8	9	78	96	34
84-102	7 7/12	9	84	102	36
90-108	7 1/2	9	90	108	38
96-114	7 11/12	9	96	114	40
102-120	7 21/32	9	102	120	42
108-126	7 23/32	9	108	126	44
114-132	7 25/32	9	114	132	46
117-135	7 5/8	9	117	135	48
120-138	7 5/8	9	120	138	49
123-141	7 7/12	9	123	141	50
126-144	7 7/8	9	126	144	51
132-150	7 29/32	9	132	150	53
138-156	7 11/16	9	138	156	55
144-162	8	9	144	162	57
150-168	8 1/2	9	150	168	59

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)



CUPOLA SLAG HOLE BLOCK

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

MALLEABLE FURNACE TAP-OUT BLOCK

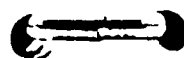
9" x 7 1/2" x 7 1/2"

Tap-Out-1 with 3/4" Tap

Hole for Hand Ladles

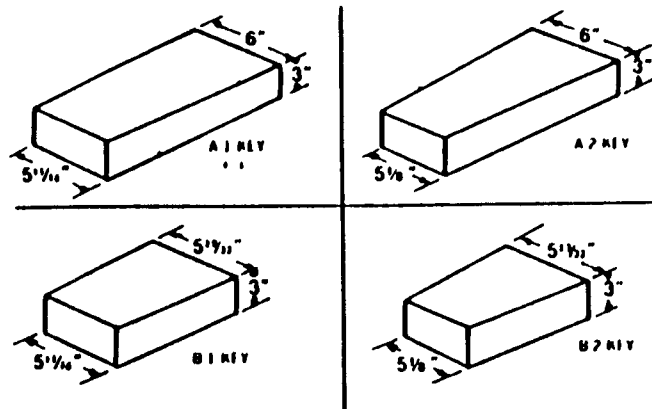
Tap-Out-2 with 1" Tap

Hole for Bull Ladles



Name of Block	A in Inches	D in Inches
One Hole Type		
T-1-A	6 1/2	1 1/2
T-1-B	6 1/4	3/4
T-1-C	6	1
T-1-D	5 1/4	1 1/4
T-1-E	5 1/2	1 1/2
T-1-F	5 3/4	1 3/4
Two Hole Type		
T-2-A	4	1 1/2
T-2-B	3 1/2	3/4
T-2-C	3	1
T-2-D	2 1/2	1 1/4
T-2-E	2	1 1/2
T-2-F	3 1/4	3/8

ALL-KEY BLAST FURNACE LINING BRICK

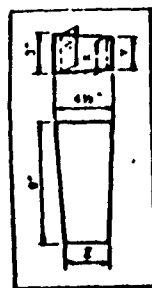


PIECES PER COURSE

ID of Brick Course	Either A-2 or B-2	Either A-1 or B-1	ID of Brick Course	Either A-2 or B-2	Either A-1 or B-1
13' 0"	98	1	18' 0"	81	47
4"	97	2	2"	81	48
6"	97	2	4"	80	50
8"	96	4	6"	79	52
10"	96	6	8"	79	53
			10"	78	55
14' 0"	95	8	19' 0"	77	57
2"	95	9	2"	77	58
4"	94	11	4"	76	60
6"	93	13	6"	76	61
8"	93	14	8"	75	61
10"	92	16	10"	74	65
15' 0"	92	17	20' 0"	74	66
2"	91	19	2"	73	68
4"	90	21	4"	73	69
6"	90	22	6"	72	71
8"	89	24	8"	72	72
10"	89	25	10"	71	74
16' 0"	88	27	21' 0"	70	76
2"	87	29	2"	70	78
4"	87	30	4"	69	80
6"	86	32	6"	69	81
8"	85	34	8"	68	83
10"	85	35	10"	68	84
17' 0"	84	37	22' 0"	67	86
2"	84	38	2"	66	88
4"	84	40	4"	66	89
6"	83	42	6"	65	91
8"	82	44	8"	65	92
10"	82	45	10"	64	94

ID of Brick Course	Either A-2 or B-2	Either A-1 or B-1	ID of Brick Course	Either A-2 or B-2	Either A-1 or B-1
21' 0"	61	96	32' 0"	37	188
2"	61	97	2"	37	186
4"	62	99	4"	37	187
6"	62	100	6"	36	189
8"	61	101	8"	35	190
10"	60	104	10"	29	192
24' 0"	60	105	11' 0"	28	194
2"	59	107	2"	28	195
4"	59	108	4"	27	197
6"	58	111	6"	27	198
8"	58	112	8"	26	200
10"	57	114	10"	25	202
25' 0"	57	115	14' 0"	25	203
2"	56	117	2"	24	205
4"	55	119	4"	23	207
6"	55	120	6"	23	208
8"	54	122	8"	22	210
10"	54	123	10"	22	211
26' 0"	53	125	15' 0"	21	213
2"	52	127	2"	21	215
4"	52	128	4"	20	217
6"	51	130	6"	20	218
8"	50	132	8"	19	220
10"	50	133	10"	18	222
27' 0"	49	135	16' 0"	18	223
2"	49	136	2"	17	225
4"	48	138	4"	17	226
6"	47	140	6"	16	228
8"	47	141	8"	15	230
10"	46	143	10"	15	231
28' 0"	46	145	17' 0"	14	233
2"	45	147	2"	14	234
4"	45	148	4"	13	236
6"	44	150	6"	12	238
8"	44	151	8"	12	239
10"	43	153	10"	11	241
29' 0"	42	155	18' 0"	11	242
2"	42	156	2"	10	244
4"	41	158	4"	9	246
6"	41	159	6"	9	247
8"	40	161	8"	9	249
10"	39	163	10"	8	251
30' 0"	39	163	19' 0"	7	253
2"	38	166	2"	7	254
4"	38	167	4"	6	256
6"	37	169	6"	6	257
8"	36	171	8"	5	259
10"	36	172	10"	4	261
31' 0"	35	174	40' 0"	4	262
2"	35	175	2"	3	264
4"	34	177	4"	3	265
6"	33	179	6"	2	267
8"	33	181	8"	1	269
10"	32	183	10"	1	270
			41' 0"		272

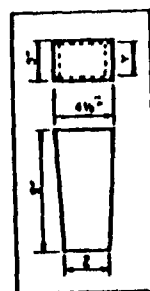
ELECTRIC FURNACE ROOF & DOME SHAPES



9" KEY ARCH

Mark	Dimension in Inches			
	"W"	"X"	"Y"	"Z"
EFR 9 11	3	2 1/4	2 1/4	4
EFR 9 12	2 3/4	2 1/4	2 1/4	4
EFR 9 13	2 1/4	2 1/4	2	4
EFR 9 21	2 3/4	2 1/4	2 1/4	3 1/2
EFR 9 22	2 1/4	2 1/4	2 1/4	3 1/2
EFR 9 23	2 1/4	2 1/4	2	3 1/2
EFR 9 14	2 1/4	1 1/4	1	4
EFR 9 24	2 3/4	1 1/4	1	3 1/2
EFR 9 31	2 3/4	2 1/4	2 1/4	3
EFR 9 32	2 3/4	2 1/4	2 1/4	3
EFR 9 33	2 3/4	2 1/4	2	3

Mark	Dimension in Inches	
	"Y"	"Z"
EFR 9 11	2 1/4	4
EFR 9 12	2 1/4	4
EFR 9 13	2	4
EFR 9 21	2 1/4	3 1/2
EFR 9 22	2 1/4	3 1/2
EFR 9 23	2	3 1/2
EFR 9 31	2 1/4	3
EFR 9 32	2 1/4	3
EFR 9 33	2	3

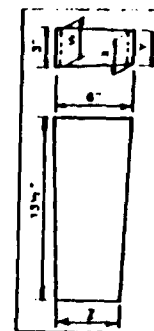
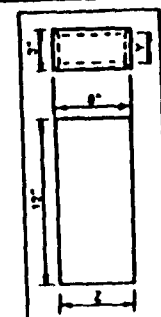


9" KEY WEDGE

Mark	Dimension in Inches			
	"W"	"X"	"Y"	"Z"
EFR 12 11	3	2 1/4	2 1/4	5 1/2
EFR 12 12	2 3/4	2 1/4	2 1/4	5 1/2
EFR 12 13	2 1/4	2 1/4	2	5 1/2
EFR 12 21	2 3/4	2 1/4	2 1/4	5
EFR 12 22	2 1/4	2 1/4	2 1/4	5
EFR 12 23	2 1/4	2 1/4	2	5

Mark	Dimension in Inches	
	"Y"	"Z"
EFR 12 11	2 1/4	5 1/2
EFR 12 12	2 1/4	5 1/2
EFR 12 13	2	5 1/2
EFR 12 21	2 1/4	5
EFR 12 22	2 1/4	5
EFR 12 23	2	5

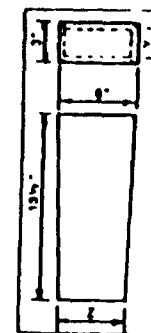
12" KEY WEDGE



12" KEY ARCH

Mark	Dimension in Inches			
	"W"	"X"	"Y"	"Z"
EFR 13 11	2 3/4	2 1/4	2 1/4	5
EFR 13 12	2 3/4	2 1/4	2 1/4	5
EFR 13 13	2 3/4	2 1/4	2	5
EFR 13 21	2 3/4	2 1/4	2 1/4	4 1/2
EFR 13 22	2 1/4	2 1/4	2 1/4	4 1/2
EFR 13 23	2 1/4	2 1/4	2	4 1/2
EFR 13 24	2 1/4	1 1/4	1	4 1/2

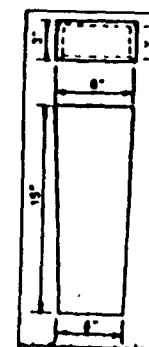
Mark	Dimension in Inches	
	"Y"	"Z"
EFR 13 11	2 1/4	5
EFR 13 12	2 1/4	5
EFR 13 13	2	5
EFR 13 21	2 1/4	4 1/2
EFR 13 22	2 1/4	4 1/2
EFR 13 23	2	4 1/2



13" KEY WEDGE

Mark	Dimension in Inches			
	"W"	"X"	"Y"	"Z"
EFR 15 11	2 3/4	2 1/4	2 1/4	-
EFR 15 12	2 3/4	2 1/4	2 1/4	-
EFR 15 13	2 3/4	2 1/4	2 1/4	-

Mark	Dimension in Inches	
	"Y"	"Z"
EFR 15 11	2 1/4	-
EFR 15 12	2 1/4	-
EFR 15 13	2	-



15" KEY WEDGE

TYPICAL FIRECLAY TILE AND SHAPES



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.
S/L 2 Shiplapped 2 sides
S/L 4 Shiplapped 4 sides



MARINE BOILER TILE



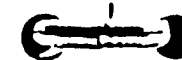
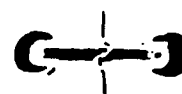
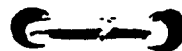
1 BOLT TYPE
9" x 4 1/2" x 2 1/2"



2 BOLT TYPE
9" x 4 1/2" x 2 1/2"



BLOW OFF PIPE
PROTECTOR TILE
4" MAX. PIPE SIZE
(2 to Set)



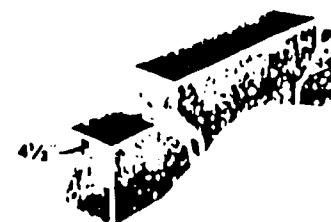
TYPICAL FIRECLAY TILE AND SHAPES



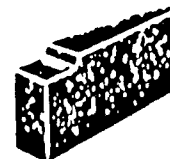
SOOT BLOWER TILE



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

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 91, 92, 93 and 94 indicated by asterisks (*). They are also standard in 9"x6¾"x2½" series and 9"x6¾"x3" series, page 95, and some other sizes as shown on pages 97 and 98 which are marked by asterisks (*) and listed below.

Name	Dimensions	Number Per Ring	Diameter of Ring	
			Inside	Outside
STANDARD 12" x 4½" x 3" SIZES				
Straight	12"x4½"x3"			
No. 1-X Wedge	12"x4½"x(3"-2½")	604	46'-0"	48'-0"
No. 1 Wedge	12"x4½"x(3"-2¼")	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"-2½")	151	11'-0"	12'-0"
No. 2 Arch	12"x6"x(3"-2¼")	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"-2½")	604	46'-0"	48'-0"
No. 1 Wedge	12"x6"x(3"-2¼")	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"-2½")	604	46'-0"	48'-0"
No. 1 Wedge	12"x9"x(3"-2¼")	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"-2½")	113	8'-3"	9'-0"
No. 2 Arch	13½"x4½"x(3"-2¼")	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 (Cont'd)

Name	Dimensions	Number Per Ring	Diameter of Ring	
			Inside	Outside
STANDARD 13½" x 6" x 3" SIZES				
Straight	13½"x6"x3"			
No. 1 Arch	13½"x6"x(3"-2½")	151	11'-0"	12'-0"
No. 2 Arch	13½"x6"x(3"-2¼")	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"-2½")	679	51'-9"	54'-0"
No. 1 Wedge	13½"x6"x(3"-2¼")	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'-4½")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"-2½")	227	16'-6"	18'-0"
No. 2 Arch	13½"x9"x(3"-2¼")	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"-2½")	679	51'-9"	54'-0"
No. 1 Wedge	13½"x9"x(3"-2¼")	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"-2½")	754	57'-6"	60'-0"
No. 1 Wedge	15"x6"x(3"-2¼")	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"-2½")	754	57'-6"	60'-0"
No. 1 Wedge	15"x9"x(3"-2¼")	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"-2½")	905	69'-0"	72'-0"
No. 1 Wedge	18"x6"x(3"-2¼")	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"-2½")	905	69'-0"	72'-0"
No. 1 Wedge	18"x9"x(3"-2¼")	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"

OTHER COMMON SILICA BRICK SIZES

Name	Dimensions	Number Per Ring	Diameter of Ring	
			Inside	Outside
9" x 9" x 2 1/2" SIZES				
Straight	9"x9"x2 1/2"			
No. 1-X Wedge	9"x9"x(2 1/2"-2 1/4")	227	13'-6"	15'-0"
No. 1 Wedge	9"x9"x(2 1/2"-1 1/4")	91	4'-6"	6'-0"
No. 2 Wedge	9"x9"x(2 1/2"-1 1/4")	57	2'-3"	3'-9"
9" x 9" x 3" SIZES				
Straight	9"x9"x3"			
No. 1 Wedge	9"x9"x(3"-2 3/4")	227	16'-6"	18'-0"
No. 2 Wedge	9"x9"x(3"-2 1/2")	113	7'-6"	9'-0"
No. 3 Wedge	9"x9"x(3"-2")	57	3'-0"	4'-6"
13 1/2" x 4 1/2" x 2 1/2" SIZES				
Straight	13 1/2"x4 1/2"x2 1/2"			
No. 1 Arch	13 1/2"x4 1/2"x(2 1/2"-2 1/4")	76	4'-3"	5'-0"
No. 2 Arch	13 1/2"x4 1/2"x(2 1/2"-1 1/4")	38	1'-9"	2'-6"
No. 3 Arch	13 1/2"x4 1/2"x(2 1/2"-1")	19	0'-6"	1'-3"
13 1/2" x 4 1/2" x 3" SIZES				
No. 1-X Wedge	13 1/2"x4 1/2"x(3"-2 1/2")	679	51'-9"	54'-0"
No. 1 Wedge	13 1/2"x4 1/2"x(3"-2 1/4")	340	24'-9"	27'-0"
No. 2 Wedge	13 1/2"x4 1/2"x(3"-2 1/2")	170	11'-3"	13'-6"
No. 3 Wedge	13 1/2"x4 1/2"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"-2 1/2")	1056	80'-6"	84'-0"
No. 1 Wedge	21"x6"x(3"-2 1/4")	528	38'-6"	42'-0"
No. 2 Wedge	21"x6"x(3"-2 1/2")	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"-2 1/2")	1056	80'-6"	84'-0"
No. 1 Wedge	21"x9"x(3"-2 1/4")	528	38'-6"	42'-0"
No. 2 Wedge	21"x9"x(3"-2 1/2")	264	17'-6"	21'-0"
No. 3 Wedge	21"x9"x(3"-2")	132	7'-0"	10'-6"



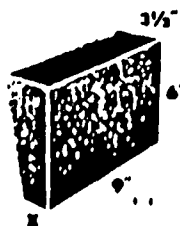
FIRECLAY — HIGH ALUMINA AND BASIC REFRACTORIES

Standard 9" x 6" x 3 1/2"

Wedge-Type Rotary Kiln Blocks

Name or Block No.	Inside Chord "X"	Diameter of Ring		Number per Ring	Number per Foot
		Inside	Outside		
66-W-84	2 1/4	66	84	76	152
72-W-90	2 1/4	72	90	81	162
78-W-96	2 1/2	78	96	86	176
84-W-102	2 1/2	84	102	92	184
90-W-108	2 1/2	90	108	97	194
96-W-114	2 1/2	96	114	103	206
102-W-120	2 3/4	102	120	108	216
108-W-126	3	108	126	113	226
114-W-132	3 1/4	114	132	119	238
117-W-135	3 1/4	117	135	121	242
120-W-138	3 1/2	120	138	124	248
126-W-144	3 1/2	126	144	130	260
132-W-150	3 3/4	132	150	135	270
138-W-156	3 3/4	138	156	140	280
144-W-162	3 1/2	144	162	146	292
150-W-168	3 1/2	150	168	151	302
156-W-174	3 1/2	156	174	156	312
162-W-180	3 1/2	162	180	162	324
168-W-186	3 1/2	168	186	167	334
174-W-192	3 1/2	174	192	173	346
180-W-198	3 3/4	180	198	178	356
186-W-204	3 3/4	186	204	183	366
192-W-210	3 3/4	192	210	189	378
198-W-216	3 3/4	198	216	194	388

NOTE: To facilitate closing the ring and keying of wedge-type rotary kiln blocks, split blocks of both two-third (2/3) and three-quarter (3/4) thickness are available. They are identified by block number followed by the fraction to indicate thickness desired. Two (2) of each of these should be included for each ring and are considered extra pieces since the ring count above is for full size blocks. If the split blocks are included as part of the ring count deduct two (2) full size blocks from the ring count and four (4) from the count per foot.



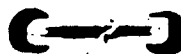
FIRECLAY — HIGH ALUMINA AND BASIC REFRACTORIES

Standard 9" x 6" x 3 1/2"

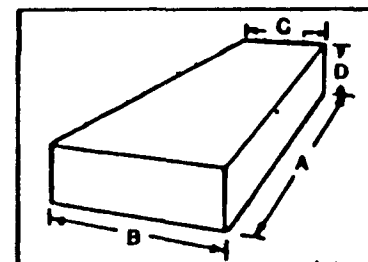
Arch-Type Rotary Kiln Blocks

Name or Block No.	Inside Chord "X"	Diameter of Ring		Number per Ring	Number per Foot
		Inside	Outside		
60-A-72	2 1/12	60	72	64	85 1/3
66-A-78	2 1/6	66	78	70	93 1/3
72-A-84	3	72	84	76	101 1/3
78-A-90	3 1/2	84	90	81	108
84-A-96	3 5/8	84	96	86	114 1/3
90-A-102	3 7/12	90	102	92	122 1/3
96-A-108	3 1/2	96	108	97	129 1/3
102-A-114	3 1/2	102	114	103	137 1/3
108-A-120	3 5/8	108	120	108	144
114-A-126	3 5/8	114	126	113	150 1/3
120-A-132	3 5/8	120	132	119	158 1/3
123-A-135	3 7/16	123	135	121	161 1/3
126-A-138	3 7/16	126	138	124	165 1/3
132-A-144	3 1/2	132	144	130	173 1/3
138-A-150	3 1/2	138	150	135	180
144-A-156	3 1/2	144	156	140	186 1/3
150-A-162	3 1/4	150	162	146	194 1/3
156-A-168	3 1/4	156	168	151	201 1/3
162-A-174	3 1/4	162	174	156	208
168-A-180	3 5/12	168	180	162	216
174-A-186	3 5/12	174	186	167	222 1/3
180-A-192	3 5/12	180	192	173	230 1/3
186-A-198	3 5/12	186	198	178	237 1/3
192-A-204	3 5/16	192	204	183	244

NOTE: To facilitate closing the ring and keying of arch-type rotary kiln blocks, split blocks of both two-third (2/3) and three-quarter (3/4) thickness are available. They are identified by block number followed by the fraction to indicate thickness desired. Two (2) of each of these should be included for each ring and are considered extra pieces since the ring count above is for full size blocks. If the split blocks are included as part of the ring count deduct two (2) full size blocks from the ring count and four (4) from the count per foot.



TYPICAL METAL CASED DOOR JAMB BRICK



Shape Number	Dimensions			
	A	B	C	D
DJ 1 2 1/2	9	4 1/2	1 1/2	2 1/2
DJ 1 3	9	4 1/2	1 1/2	3
DJ 2 2 1/2	9	6 1/2	3 1/2	2 1/2
DJ 2 3	9	6 1/2	3 1/2	3
DJ 3 2 1/2	9	9	6	2 1/2
DJ 3 3	9	9	6	3
BS 115 2 1/2	13 1/2	6 1/2	2 1/2	2 1/2
BS 115 3	13 1/2	6 1/2	2 1/2	3
BS 116 2 1/2	13 1/2	9	5	2 1/2
BS 116 3	13 1/2	9	5	3
DJ 18 1 2 1/2	18	6 1/2	2 1/2	2 1/2
DJ 18 1 3	18	6 1/2	2 1/2	3
DJ 18 2 2 1/2	18	9	5	2 1/2
DJ 18 2 3	18	9	5	3

BOF KEYS—FURNACE LINING BRICK

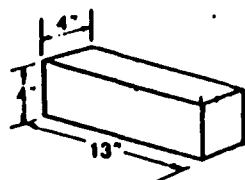
Inside Diameter	18x6x3			18x6x3			21x6x3			24x6x3			27x6x3		
	Key Taper	Key Taper	Key Taper	Key Taper	Key Taper	Key Taper	Key Taper	Key Taper	Key Taper	Key Taper	Key Taper	Key Taper	Key Taper	Key Taper	Key Taper
14'-0"	85	19	6	101	-	22	48	-	38	75	-	54	63	-	-
3'-	84	22	5	104	-	20	92	-	36	79	-	52	66	-	-
6'-	82	25	3	107	-	18	95	-	35	82	-	51	69	-	-
9'-	80	29	2	110	-	17	98	-	33	85	-	49	72	-	-
15'-0"	78	32	-	113	-	16	101	-	32	88	-	47	76	-	-
3'-	76	36	-	111	4	14	104	-	30	91	-	46	78	-	-
6'-	75	38	-	110	7	13	107	-	28	95	-	44	82	-	-
9'-	74	41	-	109	9	11	110	-	27	97	-	43	85	-	-
16'-0"	73	44	-	107	13	10	113	-	25	101	-	41	88	-	-
3'-	71	47	-	105	16	8	116	-	24	104	-	40	91	-	-
6'-	70	50	-	104	19	6	120	-	22	107	-	38	94	-	-
9'-	67	54	-	101	23	5	123	-	21	110	-	36	98	-	-
17'-0"	66	57	-	100	26	3	126	-	19	113	-	35	100	-	-
3'-	64	60	-	99	29	2	132	-	18	116	-	33	104	-	-
6'-	63	63	-	97	32	-	131	-	16	119	-	32	107	-	-
9'-	62	66	-	96	35	-	131	3	14	123	-	30	110	-	-
18'-0"	60	69	-	94	38	-	129	6	13	126	-	29	113	-	-
3'-	58	73	-	93	41	-	128	9	11	129	-	27	116	-	-
6'-	56	76	-	91	44	-	126	13	10	132	-	25	120	-	-
9'-	55	79	-	89	48	-	124	16	8	135	-	23	123	-	-
19'-0"	53	82	-	86	51	-	123	19	7	138	-	22	126	-	-
3'-	52	85	-	87	53	-	121	22	5	141	-	21	129	-	-
6'-	51	88	-	86	56	-	120	25	3	145	-	19	132	-	-
9'-	49	91	-	83	60	-	118	28	2	148	-	18	135	-	-

BOF KEYS—FURNACE LINING BRICK

Inside Diameter	18x6x3			10x6x3			21x6x3			24x6x3			27x6x3		
	Key Taper	Key Taper	Key Taper	Key Taper	Key Taper	Key Taper	Key Taper	Key Taper	Key Taper	Key Taper	Key Taper	Key Taper	Key Taper	Key Taper	
20 0	-	47	95	-	82	63	-	117	31	-	151	-	16	138	-
3	-	45	98	-	79	67	-	115	35	-	150	3	14	142	-
6	-	44	101	-	78	70	-	113	38	-	148	6	12	145	-
9	-	42	102	-	77	73	-	112	41	-	146	10	11	148	-
21 0	-	41	107	-	76	75	-	110	44	-	145	12	10	151	-
3	-	40	109	-	73	80	-	109	47	-	143	16	8	154	-
6	-	38	113	-	72	82	-	107	50	-	142	19	7	157	-
9	-	36	117	-	71	85	-	106	53	-	140	22	5	160	-
22 0	-	35	119	-	68	89	-	104	57	-	139	25	3	164	-
3	-	33	123	-	67	92	-	102	60	-	137	28	2	166	-
6	-	31	126	-	66	95	-	101	63	-	135	32	-	170	-
9	-	30	129	-	65	97	-	99	66	-	133	35	-	168	4
23 0	-	28	132	-	62	102	-	98	69	-	132	38	-	167	6
3	-	27	135	-	61	104	-	96	72	-	131	41	-	165	10
6	-	25	139	-	60	107	-	94	76	-	129	44	-	163	13
9	-	24	141	-	57	111	-	93	79	-	128	47	-	162	16
24 0	-	22	144	-	56	114	-	91	82	-	126	50	-	160	19
3	-	21	147	-	55	117	-	90	85	-	124	54	-	159	22
6	-	19	151	-	54	119	-	88	88	-	122	57	-	157	26
9	-	17	154	-	52	123	-	87	91	-	121	60	-	156	28
25 0	-	16	157	-	50	126	-	85	94	-	120	63	-	154	32
3	-	14	161	-	49	129	-	84	97	-	118	66	-	152	35
6	-	12	164	-	46	133	-	82	101	-	117	69	-	151	38
9	-	11	167	-	45	136	-	80	104	-	115	72	-	149	41
26 0	-	10	169	-	44	139	-	79	107	-	113	76	-	147	45

TYPICAL COPPER INDUSTRY SHAPES

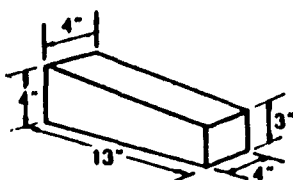
Standard in Basic



Straight

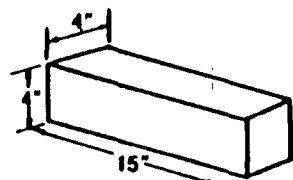
SIZE

13" x 4" x 4" Straight



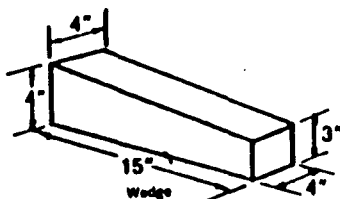
Wedge

13" x 4" x (4" 3") Wedge
13" x 4" x (4" 3 1/2") Wedge
13" x 4" x (4" 3 1/4") Wedge



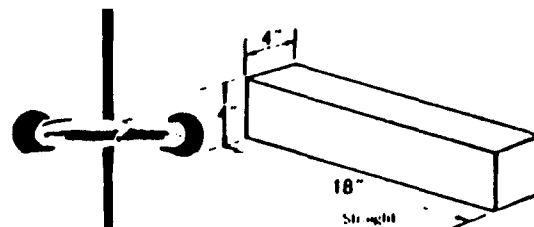
Straight

15" x 4" x 4" Straight



Wedge

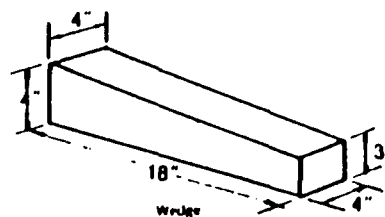
15" x 4" x (4" 3") Wedge
15" x 4" x (4" 3 1/2") Wedge



18"
Straight

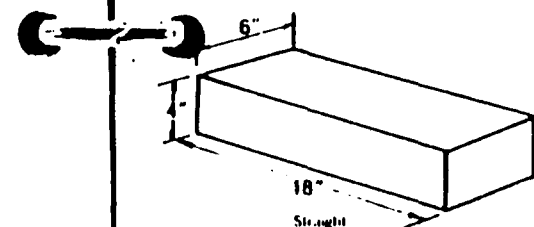
18" x 4" x 4" Straight
and

15" x 4" x 4" Straight
13" x 4" x 4" Straight
12" x 4" x 4" Straight



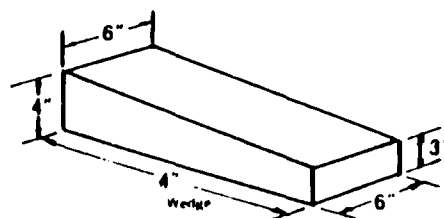
Wedge

18" x 4" x (4" 3 1/4") Wedge
and
18" x 4" x (4" 2 1/4") Wedge
15" x 4" x (4" 3 1/4") Wedge
13" x 4" x (4" 3 1/4") Wedge
13" x 4" x (4" 3 1/2") Wedge
13" x 4" x (4" 3") Wedge



18"
Straight

18" x 6" x 4" Straight
and
15" x 6" x 4" Straight



Wedge

18" x 6" x (4" 3 1/4") Wedge
and
15" x 6" x (4" 3 1/4") Wedge

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" x 4 1/2" x 2 1/2"	9" x 4 1/2" x 3"
1 sq. ft. of wall	2 1/2"	3 6	
1 sq. ft. of wall	3"		3 6
1 sq. ft. of wall	4 1/2"	6 4	5 3
1 sq. ft. of wall	9"	12 8	10 7
1 sq. ft. of wall	13 1/2"	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%

Brand	Condition As Shipped	Pounds of Material per Cubic Foot of Construction
PLASTICS		
BLACK JACK	Wet	138
NARCAL 60 P	Wet	156
NARCAL 60 PG	Wet	152
NARCAL 70 P	Wet	165
NARCAL 70 PG	Wet	162
NARCAL 80 P	Wet	175
NARCAL 80 PG	Wet	161
NARCAL 85 P	Wet	181
NARCAL 85 PG	Wet	170
NARCAL 85 TP	Wet	180
NARCAL 90 P	Wet	190
NARCAL 90 TP	Wet	182
NARCO 505	Wet	135
NARCOLINE	Wet	135
NARCO SILICA PLASTIC	Wet	125
NARCO SUPER 505	Wet	145
NARCO SPAR	Wet	150

WEIGHT OF SPECIALTIES — Concluded

Brand	Condition As Shipped	Pounds of Material per Cubic Foot of Construction
PLASTICS		
NOJOINT	Wet	140
NOJOINT (Fine)	Wet	140
SHUR RAM	Wet	152
CASTABLES		
AEROCASE L	Dry	46
ANTI ERODE	Dry	130
GUNCAST	Dry	135
LOW-K	Dry	63
NARCO B F CASTABLE	Dry	130
NARCOBROME	Dry	165
NARCOCAST	Dry	118
NARCOCAST E.S.	Dry	121
NARCOCAST E.S. (Coarse)	Dry	127
NARCOCAST E.S. (Fine)	Dry	114
NARCOCAST E.S. 26	Dry	131
NARCOCAST 25	Dry	125
NARCOCAST 30	Dry	140
NARCOCAST 32	Dry	138
NARCOCAST 60	Dry	145
NARCOCRETE	Dry	78
NARCOHEARTH	Dry	120
NARCOHEARTH E.S. (Coarse)	Dry	130
NARCOHEARTH 23	Dry	128
NARCOLITE	Dry	54
NARCOLITE 28	Dry	75
NARCON	Dry	127
NARCO TAB	Dry	160
SUPER NARCOCAST	Dry	128
RAMMING MIXES		
BEILITE	Dry	137
CAROLINE	Dry	132
FIRELINE	Dry or Damp	135
HIAL 70	Dry or Damp	155
MAGRAM G.S.	Dry	190
RAMAL 80	Damp	175
RAMAL 80 G	Damp	164
RAMAL 85	Damp	190
RAMAL 85 G	Dry	174
RAMAL 90	Dry	192
STEEL LINE	Dry	137
GUNNING MIXES		
AEROGUN	Dry	35
GUNCRETE	Dry	119

WEIGHT OF SPECIALTIES — Concluded

Brand	Condition As Shipped	Pounds of Material per Cubic Foot of Construction
GUNNING MIXES.		
NARCAL 80 GUN	Dry	154
NARCAL 85 GUN	Dry	165
NARCO W. F. CASTABLE	Dry	135
NARCOCAST GUN	Dry	127
NARCOCAST E.S. GUN	Dry	127
NARCOCAST 32 GUN	Dry	145
NARCOGUN AR	Dry	114
NARCOGUN CO	Dry	109
NARCOGUN FC-325	Dry	112
NARCOGUN FC-342	Dry	110
NARCOGUN HMC	Dry	138
NARCOGUN P-340	Dry	150
NARCOGUN PD-345	Dry	150
NARCOGUN 28	Dry	121
NARCOLINE G	Dry	130
NARCOLITE GUNNING MIX	Dry	65
NARMAG CM-18 GUN	Dry	150

*Gunning mix quantities do not
include rebound losses.*

MORTAR ESTIMATE

From 200 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.

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.

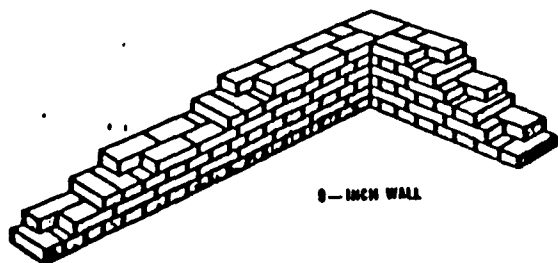
The determining factor in meeting the first three requirements is the type of bond used and the soundness of the brick laying. The type of expansion joint is not dependent on the kind of bond used.

MASONRY BONDS

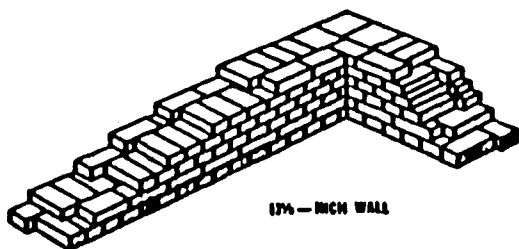
On the opposite page are illustrations of some standard masonry bonds. The wall thickness and type of bond is determined by service conditions present and load due to the height of the wall. To achieve maximum strength plus an airtight or gastight wall, it is important to stagger vertical joints.

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.

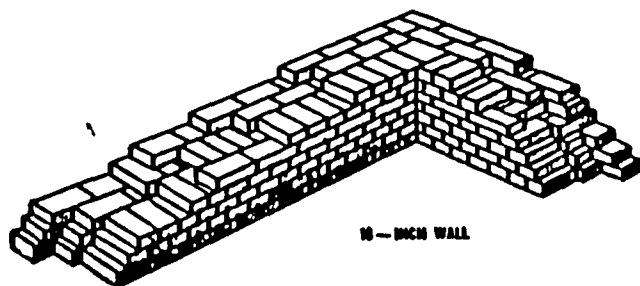
TYPICAL MASONRY BONDS



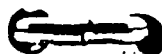
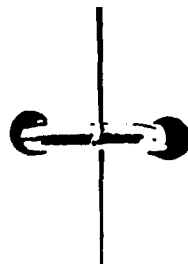
9-INCH WALL



12 1/2-INCH WALL



16-INCH WALL



BRICKWORK CONSTRUCTION (Cont'd)

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.

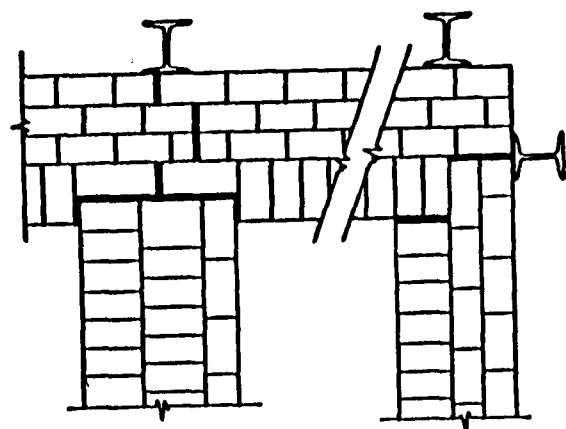
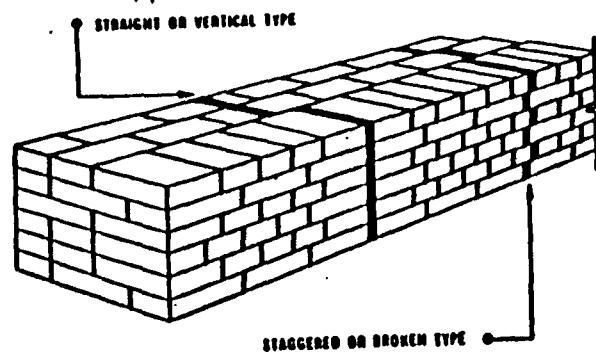
Provision for vertical expansion, except in high walls, is easily made by leaving the wall free to expand upward without encountering boiler drums, piping or other structural members. Vertical contraction during subsequent cooling takes care of itself when the wall settles.

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.

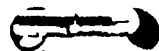
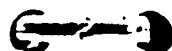
In practice, expansion joints are usually constructed to provide for double the expansion that will occur on the first heating. This allows for any accidental filling of the expansion joints by mortar, dust, or materials charged into the furnace during operation. To keep joints clean, they are usually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

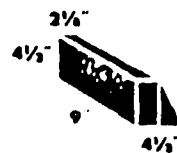


EXAMPLE OF AN AUXILIARY WALL
AND CORNER JOINT



STANDARD SKEWBACKS

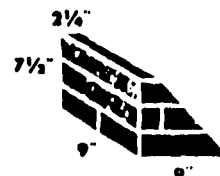
SKEWS BUILT WITH STANDARD BRICK



for
ARCH 4 1/2" THICK
Rise 1 1/2" per ft. of span
Skew consists of
1-9" 2-Inch Brick 2 1/2"
1-9" Featheredge Series



for
ARCH 9" THICK
Rise 2 3/16" per ft. of span
Skew consists of
1-9" 48" Side Skew 2 1/2"
2-9" 48" End Skews Series
1-9" Soap Brick

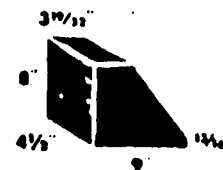


for
ARCH 9" THICK
Rise 2 3/16" per ft. of span
Skew consists of
2-9" 48" End Skews 2 1/2"
1-9" 48" Side Skews Series
1-9" Soap Brick

SPECIAL SKEWBACKS



for
ARCH 4 1/2" THICK
Rise 2" per ft. of span



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



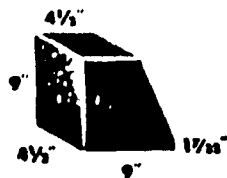
for
ARCH 9" THICK
Rise 1 1/2" per ft. of span

SPECIAL SKEWBACKS

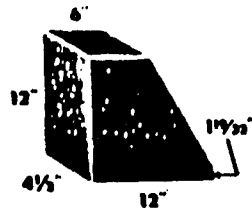
For Arches with Included Angle of 60 Degrees



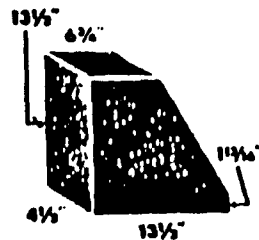
for
ARCH 4 1/2" THICK
Rise 1.608" per ft. of span



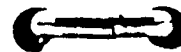
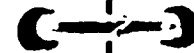
for
ARCH 9" THICK
Rise 1.608" per ft. of span



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



for
ARCH 13 1/2" THICK
Rise 1.608" per ft. of span



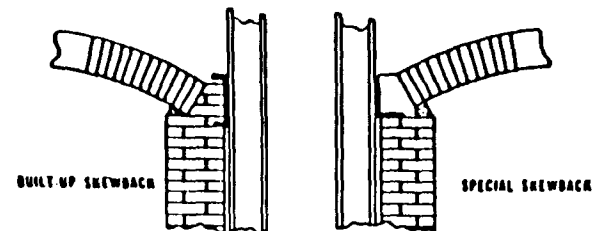
SKEWBACKS IN FURNACES

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.

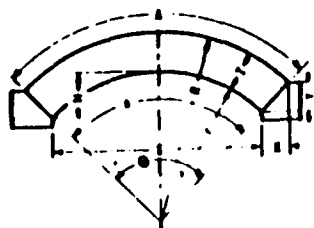
The skewback receives the full thrust of the arch which includes a downward thrust exerted by the weight of the arch as well as an outward thrust on the sidewall. Support of the arch is usually made by steelwork consisting of angles or channels on which the skews rest. These angles and channels are held 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
H = Central Angle

FORMULAS:

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

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

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

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

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

$$\sin \frac{1}{2} H = \frac{S}{2r}$$

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

$$\text{Outer arc: } A = \frac{2\pi R H}{360} \quad \text{Inner arc: } a = \frac{2\pi r H}{360}$$

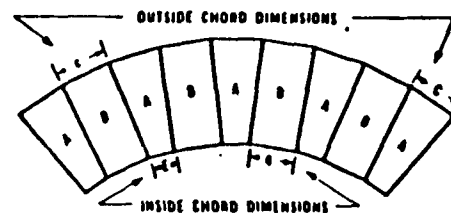
VALUES FOR GIVEN RISES PER FOOT OF SPAN

Rise in Inches Per Foot of Span	Inside * Radius is Factor X S	Central Angle H		Inside * Arc is Factor a S	Diff. of * Outer and Inner Arcs Factor a T	Skewback	
		Degrees	Part of Circle			X* is Factor a T	Y* is Factor a T
1	1.5117	37°50'9"	0.1051	1.0184	0.6606	0.3243	0.9460
1 1/4	1.2521	47°44'	0.1308	1.0287	0.8216	0.3993	0.9168
1 1/2	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	1.0472	0.5000	0.8660
1 3/4	0.9301	65°22'5"	0.1807	1.0558	1.1352	0.5376	0.8432
2	0.8333	73°44'4"	0.2048	1.0725	1.2670	0.6000	0.8000
2 1/4	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
2 1/2	0.7042	90°28'8"	0.2513	1.1120	1.5792	0.7101	0.7041
2 3/4	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 36, 58, 59 and 60.

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, ..

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

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

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

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

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

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

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

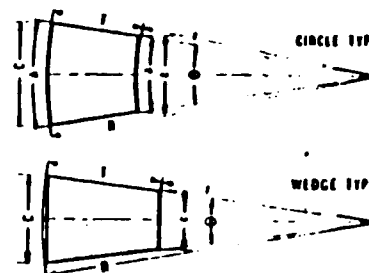
$$(6) Ex + ey = \pi d$$

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

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

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

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
- D - Outside diameter of ring formed by radial brick
- T - Radial thickness of brick
- H - Theta, the included angle of brick
- π - Pi 3.1416
- S - Total number of a given radial brick required to form a ring

FORMULAS:

$$C = \frac{rC}{r + T} = \frac{Rc}{r}$$

$$S = \frac{2\pi T}{C - c} = \frac{\pi D}{C - c} = \frac{\pi d}{C - c}$$

$$C = \frac{(r + T)c}{r} = \frac{Rc}{r} = \frac{C}{\text{Sine } \frac{1}{2} H} = \frac{C}{2R} \text{ or } \frac{c}{2r}$$

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

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)	Des. for 9" Chord in Inches (3)	No. of Brick to Circle (1)	Sine of Half Angle (2)	Des. for 9" Chord in 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

No. of Brick to Circle (1)	Size of Half Angle (2)	Dis. for 9" Chord, in Inches (3)	No. of Brick to Circle (1)	Size of Half Angle (2)	Dis. 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 95.1
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

4½" LINING — ARCH BRICK
9" x 4½" x 2½" or 13½" x 4½" x 2½"

Diameter Inside Backwork	Number Required Per Ring				Total
	No. 1 Arch	No. 2 Arch	No. 3 Arch	Straight	
0' 6"	19				19
0' 7"	18	1			21
0' 8"	17	5			22
0' 9"	15	8			23
0' 10"	11	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	31			36
1' 8"	2	35			37
1' 9"		38			38
1' 10"		36	1		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					Total
	No. 4 Arch	No. 3 Arch	No. 2 Arch	No. 1 Arch	Straight	
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	22				23
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

4½" LINING — CIRCLE BRICK
 9" x 4½" x 2½" or 9" x 4½" x 3"

Diameter Inside Brickwork	Number Required Per Ring					Total
	24 31 Circle	36 45 Circle	48 57 Circle	60 69 Circle	72 81 Circle	
2' 0"	12					12
2' 1"	10	2				12
2' 2"	10	3				13
2' 3"	9	4				13
2' 4"	7	6				13
2' 5"	7	7				14
2' 6"	6	8				14
2' 7"	5	9				14
2' 8"	4	11				15
2' 9"	3	12				15
2' 10"	2	13				15
2' 11"	1	15				16
3' 0"		16				16
3' 1"		14	2			16
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

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

Diameter Inside Brickwork	Number Required Per Ring					Total
	72 81 Circle	84 93 Circle	96 105 Circle	108 117 Circle	120 129 Circle	
6'-0"	29					29
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	31				33
7'-0"		33				33
7'-1"		28	5			33
7'-2"		26	8			34
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"			23	15		38
8'-5"			20	19		39
8'-6"			18	21		39
8'-7"			15	24		39
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

4½" LINING — 9-INCH CUPOLA BLOCKS

[illegible]

6" LINING — ARCH BRICK
 12" x 6" x 3" or 13 1/2" x 6" x 3"

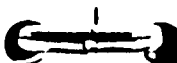
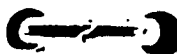
Diameter Inside Brickwork	Number Required Per Ring				Total
	No. J Arch	No. J Arch	No. J Arch	Straight	
2'-0"	38				38
2'-3"	38	6			44
2'-6"	31	13			44
2'-9"	29	19			48
3'-0"	26	25			51
3'-3"	22	32			54
3'-6"	19	38			57
3'-9"	16	44			60
4'-0"	13	50			63
4'-3"	9	57			66
4'-6"	7	63			70
4'-9"	4	69			73
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

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

Diameter Inside Brickwork	Number Required Per Ring								Total
	30-42	36-48	42-54	48-60	54-66	60-72	66-78		
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"						26		26	
5'-3"						14	13	27	
5'-6"							28	28	
66-78 72-84 78-90 84-96 90-102 96-108 102-114									
5'-9"	16	13						29	
6'-0"		30						30	
6'-3"		18	13					31	
6'-6"			32					32	
6'-9"			19	14				33	
7'-0"				34				34	
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	
102-114 114-126 122-135 132-144									
108-120 120-132 126-138									
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"							49	49	
11'-0"							51	51	

**6" LINING
FLAT BACK ARCH BRICK**

Diameter Inside Brickwork	Number Required Per Ring			Total
	No. 2 F.B.A. 9"x6"x(3 1/2"x3")	No. 1 F.B.A. 9"x6"x(3 1/2"x2 1/2")	F.B. Straight 9"x6"x2 1/2"	
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



9" LINING — WEDGE BRICK
9" x 4 1/2" x 2 1/2", 9" x 6 1/4" x 2 1/2" or
9" x 9" x 2 1/2"

Diameter Inside Brickwork	Number Required Per Ring				Total
	No. 2 Wedge	No. 1 Wedge	No. 1 X Wedge	Straight	
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 6¼" x 3" or
9" x 9" x 3"

This table can be used also for 11½" 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

9" LINING — KEY BRICK

9" x 4½" x 2½" or 9" x 4½" x 3"

Diameter Inside Brickwork	Number Required Per Ring					Total
	No. 4 Key	No. 3 Key	No. 2 Key	No. 1 Key	Straight	
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 2 1/2" or 9" x 6" x 3"

Diameter Inside Brickwork	Number Required Per Ring				Total
	No. 3 Key	No. 2 Key	No. 1 Key	Straight	
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	112
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

NOTE: Inside diameters less than 6 feet may require appreciable cutting and a better fit can be obtained using 9 x 4 1/2, a 2 1/2, or 9 x 4 1/2 x 3 keys shown on page 134

9" LINING ROTARY KILN BLOCKS 9" x 9" x 4"

Diameter Inside Brickwork	Number Required Per Ring								Total
	48 56	54 72	60 78	66 84	72 90	78 96	84 102		
4'-0"	23							23	
4'-3"	11	13						24	
4'-6"		26						26	
4'-9"		14	13					27	
5'-0"			28					28	
5'-3"			15	14				29	
5'-6"				30				30	
5'-9"				12	19			31	
6'-0"					32			32	
6'-3"					14	19		33	
6'-6"						34		34	
6'-9"						16	19	35	
7'-0"							36	36	
	84-102		96-114		108-126		117-135		
		90-108		102-120		114-132			
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"							48	48	
	120-138		126-144		138-156		150-168		
		122-141		132-150		144-162			
10'-0"	49							49	
10'-3"		50						50	
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"						26	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

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. 1 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				88
5'-6"	57	38				95
6'-0"	51	50				101
6'-6"	44	63				107
7'-0"	38	75				113
7'-6"	32	88				120
8'-0"	25	101				126
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	75			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 4 1/2" x 3", 12" x 6" x 3" or 12" x 9" x 3"
 — Concluded

Diameter Inside Brickwork	Number Required Per Ring					Total
	No. 3 Wedge	No. 2 Wedge	No. 1 Wedge	No. 1 X Wedge	Straight	
27'-0"			219	176		365
27'-6"			213	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 27'-0", use combinations of No. 1 Wedge and Straight brick. The quantity of No. 1 Wedge brick remains constant at 303. The quantity of Straight brick is determined by subtracting 303 from the quantity given in the column "Total."

13 1/2" LINING — WEDGE BRICK
 13 1/2" x 4 1/2" x 3", 13 1/2" x 6" x 3" or
 13 1/2" x 9" x 3"

Diameter Inside Brickwork	Number Required Per Ring					Total
	No. 3 Wedge	No. 2 Wedge	No. 1 Wedge	No. 1 X Wedge	Straight	
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

Continued Diameter Inside Brickwork	Number Required Per Ring					Total
	No. 3 Wedge	No. 2 Wedge	No. 1 Wedge	No. 1-X* Wedge	Straight	
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 subtracting 340 from the quantity given in the column "Total".

13 1/2" LINING — KEY BRICK 13 1/2" x 6" x 2 1/2" or 13 1/2" x 6" x 3"

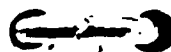
Diameter Inside Brickwork	Number Required Per Ring				Total
	No. 1 Key	No. 2 Key	No. 1 Key	Straight	
2'-3"	29				29
2'-6"	26	4			30
2'-9"	25	7			32
3'-0"	23	10			33
3'-3"	21	14			35
3'-6"	19	18			37
3'-9"	18	21			39
4'-0"	16	24			40
4'-3"	14	28			42
4'-6"	12	31			43
4'-9"	10	34			44
5'-0"	8	38			46
5'-3"	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

NOTE: Inside diameters less than 6 feet may require appreciable cutting to obtain best fit.

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
16'-0"			85	30
16'-6"			85	33
17'-0"			85	36
17'-6"			85	39
18'-0"			85	43
18'-6"			85	46
19'-0"			85	49
19'-6"			85	52
20'-0"			85	55
20'-6"			85	58
21'-0"			85	61
21'-6"			85	65
22'-0"			85	68
22'-6"			85	71
23'-0"			85	74
23'-6"			85	77
24'-0"			85	80
24'-6"			85	83
25'-0"			85	87
25'-6"			85	90
26'-0"			85	93
26'-6"			85	96
27'-0"			85	99
27'-6"			85	102
28'-0"			85	105
28'-6"			85	109
29'-0"			85	112
29'-6"			85	115
30'-0"			85	118
30'-6"			85	121
31'-0"			85	124
31'-6"			85	127
32'-0"			85	131
32'-6"			85	134
33'-0"			85	137
33'-6"			85	140
34'-0"			85	143
34'-6"			85	146
35'-0"			85	149
35'-6"			85	153
36'-0"			85	156
36'-6"			85	159
37'-0"			85	162
37'-6"			85	165
38'-0"			85	168
38'-6"			85	171
39'-0"			85	175
39'-6"			85	178
40'-0"			85	181
				266



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 ¼"	5	2		7
1'-1"	1½"	1'-1 11/16"	5	3		8
1'-2"	1½"	1'-2 ½"	4	4		8
1'-3"	1½"	1'-3 3/8"	4	4		8
1'-4"	2"	1'-5"	4	5		9
1'-5"	2½"	1'-6 1/16"	3	6		9
1'-6"	2½"	1'-7 1/8"	3	7		10
1'-7"	2½"	1'-8 3/16"	2	8		10
1'-8"	2½"	1'-9 ¼"	2	8		10
1'-9"	2½"	1'-10 3/16"	1	10		11
1'-10"	2½"	1'-11 3/16"	1	10		11
1'-11"	2½"	2'-0 1/16"	1	11		12
2'-0"	3"	2'-1 1/2"		12		12
2'-3"	3½"	2'-4 1/16"		12	1	13
2'-6"	3½"	2'-7 1/8"		12	3	15
2'-9"	4½"	2'-11 1/16"		12	4	16
3'-0"	4½"	3'-2 1/4"		12	5	17
3'-3"	4½"	3'-5 3/16"		12	6	18
3'-6"	5½"	3'-8 3/8"		12	8	20
3'-9"	5½"	3'-11 1/16"		12	9	21
4'-0"	6"	4'-3"		12	10	22
4'-3"	6½"	4'-6 1/16"		12	11	23
4'-6"	6½"	4'-9 3/8"		12	13	25
4'-9"	7½"	5'-0 1/16"		12	14	26
5'-0"	7½"	5'-3 1/4"		12	15	27
5'-3"	7½"	5'-6 1/16"		12	16	28
5'-6"	8½"	5'-10 1/8"		12	18	30
5'-9"	8½"	6'-1 1/16"		12	19	31
6'-0"	9"	6'-4 1/2"		12	20	32
6'-3"	9½"	6'-7 1/16"		12	21	33
6'-6"	9½"	6'-10 3/8"		12	23	35

4 1/2" ARCH THICKNESS — ARCH BRICK

9" x 4 1/2" x 3" or 13 1/2" x 4 1/2" x 3"
1 1/2" Rise Per Foot of Span

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

4 1/2" ARCH THICKNESS — ARCH BRICK

9" x 4 1/2" x 2 1/2" or 13 1/2" x 4 1/2" x 2 1/2"
1 608" Rise Per Foot of Span
(60° Central Angle)

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

4 1/2" ARCH THICKNESS — ARCH BRICK

9" x 4 1/2" x 3" or 13 1/2" x 4 1/2" 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 1/2"	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 1/8"	1'-4"	3	5			8
1'-5"	2 1/4"	1'-5"	2	6			8
1'-6"	2 1/2"	1'-6"	2	6			8
1'-7"	2 3/4"	1'-7"	2	7			9
1'-8"	2 7/8"	1'-8"	1	8			9
1'-9"	2 7/8"	1'-9"	1	8			9
1'-10"	2 7/8"	1'-10"	1	9			10
1'-11"	3 1/8"	1'-11"		9	1		10
2'-0"	3 3/4"	2'-0"		9	1		10
2'-1"	3 11/16"	2'-1"		9	2		11
2'-2"	3 11/16"	2'-2"		8	3		11
2'-3"	3 5/8"	2'-3"		8	3		11
2'-4"	3 5/8"	2'-4"		8	4		12
2'-5"	3 7/8"	2'-5"		7	5		12
2'-6"	4 1/8"	2'-6"		7	5		12
2'-7"	4 1/4"	2'-7"		7	6		13
2'-8"	4 1/4"	2'-8"		6	7		13
2'-9"	4 1/2"	2'-9"		6	7		13
2'-10"	4 1/2"	2'-10"		6	8		14
2'-11"	4 5/8"	2'-11"		5	9		14
3'-0"	4 5/8"	3'-0"		5	10		15
3'-1"	4 5/8"	3'-1"		5	10		15
3'-2"	5 1/8"	3'-2"		4	11		15
3'-3"	5 1/4"	3'-3"		4	12		16
3'-4"	5 1/4"	3'-4"		4	12		16
3'-5"	5 1/2"	3'-5"		3	13		16
3'-6"	5 3/4"	3'-6"		3	14		17
3'-7"	5 3/4"	3'-7"		2	15		17
3'-8"	5 3/4"	3'-8"		2	15		17
3'-9"	6 1/8"	3'-9"		2	16		18
3'-10"	6 1/4"	3'-10"		1	17		18
3'-11"	6 1/4"	3'-11"		1	17		18
4'-0"	6 3/8"	4'-0"		1	18		19
4'-1"	6 3/8"	4'-1"			19		19
4'-2"	6 1/2"	4'-2"			19		19
4'-3"	6 1/2"	4'-3"			19	1	20
4'-6"	7 1/4"	4'-6"			19	2	21
5'-0"	8 1/2"	5'-0"			19	4	23
5'-6"	8 1/2"	5'-6"			19	6	25
6'-0"	9 1/2"	6'-0"			19	8	27
6'-6"	10 1/4"	6'-6"			19	10	29

4 1/2" ARCH THICKNESS — ARCH BRICK

9" x 4 1/2" x 2 1/2" or 13 1/2" x 4 1/2" x 2 1/2"

2" Rise Per Foot of Span

Span	Rise	Inside Radius	Number Required Per Course			
			No. 3 Arch	No. 1 Arch	Straight	Total
1'-0"	2"	10"	8			8
1'-1"	2 1/4"	10 1/4"	8			8
1'-2"	2 1/2"	11 1/4"	7	2		9
1'-3"	2 3/4"	11 3/4"	7	2		9
1'-4"	2 7/8"	11 7/8"	7	3		10
1'-5"	2 7/8"	11 7/8"	6	4		10
1'-6"	3"	12 3/4"	5	5		10
1'-7"	3 1/4"	12 3/4"	5	6		11
1'-8"	3 1/2"	12 7/8"	5	6		11
1'-9"	3 1/2"	12 7/8"	4	8		12
1'-10"	3 3/4"	13 1/4"	4	8		12
1'-11"	3 3/4"	13 1/4"	4	9		13
2'-0"	4"	14 3/4"	3	10		13
2'-1"	4 1/4"	14 3/4"	2	11		13
2'-2"	4 1/2"	15 1/4"	2	12		14
2'-3"	4 1/2"	15 1/4"	2	12		14
2'-4"	4 3/4"	15 3/4"	1	14		15
2'-5"	4 3/4"	15 3/4"	1	14		15
2'-6"	5"	16 1/4"	1	15		16
2'-9"	5 1/2"	17 1/4"		16	1	17
3'-0"	6"	18 3/4"		16	2	18
3'-3"	6 1/2"	19 3/4"		16	3	19
3'-6"	7"	21 1/4"		16	5	21
3'-9"	7 1/2"	22 1/4"		16	6	22
4'-0"	8"	24 3/4"		16	7	23
4'-3"	8 1/2"	26 3/4"		16	9	25
4'-6"	9"	28 3/4"		16	10	26
4'-9"	9 1/2"	30 3/4"		16	11	27
5'-0"	10"	33 1/4"		16	12	28
5'-3"	10 1/2"	35 1/4"		16	14	30
5'-6"	11"	37 1/4"		16	15	31
5'-9"	11 1/2"	39 1/4"		16	16	32
6'-0"	12"	42 3/4"		16	18	34
6'-3"	12 1/2"	45 1/4"		16	19	35
6'-6"	13"	48 3/4"		16	20	36

4 1/2" ARCH THICKNESS — ARCH BRICK
 9" x 4 1/2" x 3" or 13 1/2" x 4 1/2" x 3"
 2" Rise Per Foot of Span

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

4 1/2" ARCH THICKNESS — ARCH BRICK
 9" x 4 1/2" x 2 1/2" or 13 1/2" x 4 1/2" x 2 1/2"
 2 3/4" Rise Per Foot of Span

Span	Rise	Inside Radius	Number Required Per Course				Total
			No. 3 Arch	No. 2 Arch	No. 1 Arch	Straight	
0'-6"	1 1/2"	4 1/2"	4	2			6
0'-7"	1 3/4"	5"	3	3			6
0'-8"	2"	5 1/2"	3	4			7
0'-9"	2 1/4"	6 1/4"	2	5			7
0'-10"	2 1/2"	7"	2	5			7
0'-11"	2 3/4"	8 1/4"	2	6			8
1'-0"	3"	9"	1	7			8
1'-1"	3 1/4"	9 1/4"	1	8			9
1'-2"	3 1/2"	10"		9			9
1'-3"	3 3/4"	11"		9	1		10
1'-4"	4"	12"		8	2		10
1'-5"	4 1/4"	13 1/4"		7	3		10
1'-6"	4 1/2"	14"		7	4		11
1'-7"	4 3/4"	15 1/4"		6	6		12
1'-8"	5"	16 1/2"		6	6		12
1'-9"	5 1/4"	18 1/4"		6	7		13
1'-10"	5 1/2"	19 1/2"		5	8		13
2'-0"	6"	21"		5	9		14
2'-1"	6 1/4"	22 1/4"		4	10		14
2'-2"	6 1/2"	23 1/2"		4	10		14
2'-3"	6 3/4"	25"		3	12		15
2'-4"	7"	26 1/2"		3	12		15
2'-5"	7 1/4"	28 1/4"		3	13		16
2'-6"	7 1/2"	29 1/2"		2	14		16
2'-7"	7 3/4"	31"		2	15		17
2'-8"	8"	32 1/2"		1	16		17
2'-9"	8 1/4"	34 1/4"			17		17
2'-10"	8 1/2"	35 1/2"			18		18
2'-11"	8 3/4"	37 1/4"			18		18
3'-0"	9"	39"			18	1	19
3'-1"	9 1/4"	40 1/4"			18	1	19
3'-2"	9 1/2"	41 1/2"			18	2	20
3'-3"	9 3/4"	43"			18	2	20
3'-4"	10"	44 1/2"			18	3	21
3'-5"	10 1/4"	46 1/4"			18	3	21
3'-6"	10 1/2"	47 1/2"			18	3	21
4'-0"	11"	51"			18	6	24
4'-6"	12"	57"			18	9	27
5'-0"	13"	63"			18	11	29
5'-6"	14"	69"			18	14	32
6'-0"	15"	75"			18	17	35
6'-6"	16"	81"			18	19	37

* More exactly 2 3/4"

4 1/2" ARCH THICKNESS — ARCH BRICK

9" x 4 1/2" x 3" or 13 1/2" x 4 1/2" x 3"

2 1/4" Rise Per Foot of Span

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

* More exactly 2.302"

9" ARCH THICKNESS — WEDGE BRICK

9" x 4 1/2" x 2 1/2", 9" x 6 1/4" x 2 1/2" or 9" x 9" x 2 1/2"

1 1/2" Rise Per Foot of Span

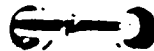
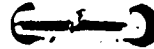
Span	Rise	Inside Radius	Number Required Per Course			
			No. 2 Wedge	No. 1 Wedge	No. 1 X Wedge	Total
1'-6"	2 1/4"	1'-7 1/8"	5	6		11
1'-7"	2 1/4"	1'-8 1/8"	5	7		12
1'-8"	2 1/4"	1'-9 1/8"	4	8		12
1'-9"	2 1/4"	1'-10 1/8"	3	10		13
1'-10"	2 1/4"	1'-11 1/8"	3	10		13
1'-11"	2 1/4"	2'-0 1/8"	2	12		14
2'-0"	3"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

Continued on next page

9" ARCH THICKNESS — WEDGE BRICK

9" x 4 1/2" x 2 1/2", 9" x 6 3/4" x 2 1/2" or
9" x 9" x 2 1/2" — Concluded
1 1/2" Rise Per Foot of Span

Span	Rise	Inside Radius	Numbers Required Per Course				Total
			No. 2 Wedge	No. 1 Wedge	No. 1 X Wedge	Straight	
5'-3"	1'-2 1/8"	5'-6 1/16"		4	26		30
5'-4"	1'-2 1/4"	5'-8"		4	27		31
5'-5"	1'-2 1/8"	5'-9 1/16"		3	28		31
5'-6"	1'-2 1/4"	5'-10 1/16"		3	28		31
5'-7"	1'-2 1/8"	5'-11 1/16"		3	29		32
5'-8"	1'-2 1/4"	6'-0 1/16"		2	30		32
5'-9"	1'-2 1/8"	6'-1 1/16"		2	31		33
5'-10"	1'-2 1/4"	6'-2 1/16"		2	31		33
5'-11"	1'-2 1/8"	6'-3 1/16"		1	32		33
6'-0"	1'-2 1/4"	6'-4 1/16"		1	33		34
6'-1"	1'-2 1/8"	6'-5 1/16"		1	33		34
6'-2"	1'-2 1/4"	6'-6 1/16"		1	34		35
6'-3"	1'-2 1/8"	6'-7 1/16"			35		35
6'-4"	1'-2 1/4"	6'-8 1/16"			36		36
6'-5"	1'-2 1/8"	6'-9 1/16"			36		36
6'-6"	1'-2 1/4"	6'-10 1/16"			36		36
6'-9"	1'-2 1/8"	7'-2 1/16"			36	2	38
7'-0"	1'-2 1/4"	7'-5 1/16"			36	3	39
7'-3"	1'-2 1/8"	7'-8 1/16"			36	4	40
7'-6"	1'-2 1/4"	7'-11 1/16"			36	5	41
7'-9"	1'-2 1/8"	8'-2 1/16"			36	7	43
8'-0"	1'-2 1/4"	8'-6"			36	8	44
8'-3"	1'-2 1/8"	8'-9 1/16"			36	9	45
8'-6"	1'-2 1/4"	9'-0 1/16"			36	10	46
8'-9"	1'-2 1/8"	9'-3 1/16"			36	12	48
9'-0"	1'-2 1/4"	9'-6 1/16"			36	13	49
9'-3"	1'-2 1/8"	9'-9 1/16"			36	14	50
9'-6"	1'-2 1/4"	10'-1 1/16"			36	15	51
9'-9"	1'-2 1/8"	10'-4 1/16"			36	17	53
10'-0"	1'-2 1/4"	10'-7 1/16"			36	18	54
10'-3"	1'-2 1/8"	10'-10 1/16"			36	19	55
10'-6"	1'-2 1/4"	11'-1 1/16"			36	20	56
10'-9"	1'-2 1/8"	11'-5 1/16"			36	22	58
11'-0"	1'-2 1/4"	11'-8 1/16"			36	23	59
11'-3"	1'-2 1/8"	11'-11 1/16"			36	24	60
11'-6"	1'-2 1/4"	12'-2 1/16"			36	25	61
11'-9"	1'-2 1/8"	12'-5 1/16"			36	27	63
12'-0"	1'-2 1/4"	12'-9"			36	28	64
12'-3"	1'-2 1/8"	13'-0 1/16"			36	29	65
12'-6"	1'-2 1/4"	13'-3 1/16"			36	30	66
12'-9"	1'-2 1/8"	13'-6 1/16"			36	32	68
13'-0"	1'-2 1/4"	13'-9 1/16"			36	33	69
13'-3"	1'-2 1/8"	14'-0 1/16"			36	34	70
13'-6"	1'-2 1/4"	14'-4 1/16"			36	35	71
13'-9"	1'-2 1/8"	14'-7 1/16"			36	37	73



9" ARCH THICKNESS — WEDGE BRICK

9" x 4 1/2" x 3", 9" x 6 3/4" x 3" or 9" x 9" x 3"
1 1/2" Rise Per Foot of Span

This table can be used also for 13 1/2" x 9" x 3" arch brick by substituting Nos. 1, 2 and 3 arch brick for the corresponding wedge brick.

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

Continued on next page

9" ARCH THICKNESS — WEDGE BRICK

9" x 4 1/2" x 3", 9" x 6 1/4" x 3" or 9" x 9" x 3"

— Concluded

1 1/4" Rise Per Foot of Span

This table can be used also for 13 1/2" x 9" x 3" arch brick by substituting Nos. 1 and 2 arch brick for the corresponding wedge brick.

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

9" ARCH THICKNESS — WEDGE BRICK

9" x 4 1/2" x 2 1/2", 9" x 6 1/4" x 2 1/2" or

9" x 9" x 2 1/2"

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 11/16"	1'-6"	7	5		12
1'-7"	2 13/16"	1'-7"	6	6		12
1'-8"	2 15/16"	1'-8"	5	8		13
1'-9"	2 17/16"	1'-9"	4	9		13
1'-10"	2 19/16"	1'-10"	3	10		13
1'-11"	3 1/16"	1'-11"	3	11		14
2'-0"	3 13/16"	2'-0"	2	12		14
2'-1"	3 15/16"	2'-1"	2	13		15
2'-2"	3 17/16"	2'-2"	1	14		15
2'-3"	3 19/16"	2'-3"		15		15
2'-4"	3 21/16"	2'-4"		15	1	16
2'-5"	3 23/16"	2'-5"		15	1	16
2'-6"	4 1/16"	2'-6"		15	2	17
2'-7"	4 3/16"	2'-7"		14	3	17
2'-8"	4 5/16"	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 15/16"	3'-1"		13	7	20
3'-2"	5 1/16"	3'-2"		12	8	20
3'-3"	5 3/16"	3'-3"		12	9	21
3'-4"	5 5/16"	3'-4"		12	9	21
3'-5"	5 7/16"	3'-5"		11	10	21
3'-6"	5 9/16"	3'-6"		11	11	22
3'-7"	5 11/16"	3'-7"		11	11	22
3'-8"	5 13/16"	3'-8"		11	12	23
3'-9"	6 1/16"	3'-9"		10	13	23
3'-10"	6 3/16"	3'-10"		10	13	23
3'-11"	6 5/16"	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 13/16"	4'-3"		9	17	26
4'-4"	6 15/16"	4'-4"		8	18	26
4'-5"	7 1/16"	4'-5"		8	18	26
4'-6"	7 3/16"	4'-6"		8	19	27
4'-7"	7 5/16"	4'-7"		7	20	27
4'-8"	7 7/16"	4'-8"		7	21	28
4'-9"	7 9/16"	4'-9"		7	21	28
4'-10"	7 11/16"	4'-10"		6	22	28
4'-11"	7 13/16"	4'-11"		6	23	29
5'-0"	8 1/16"	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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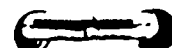
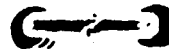
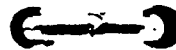
9" ARCH THICKNESS — WEDGE BRICK

9" x 4 1/2" x 2 1/2", 9" x 6 1/4" x 2 1/2" or

9" x 9" x 2 1/2" — 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 1/16"	5'-3"	5	26		31
5'-4"	8 1/8"	5'-4"	5	26		31
5'-5"	8 1/4"	5'-5"	4	27		31
5'-6"	8 1/2"	5'-6"	4	28		32
5'-7"	8 3/4"	5'-7"	4	28		32
5'-8"	9"	5'-8"	4	29		33
5'-9"	9 1/4"	5'-9"	4	29		33
5'-10"	9 1/2"	5'-10"	3	30		33
5'-11"	9 3/4"	5'-11"	3	31		34
6'-0"	9 7/8"	6'-0"	3	31		34
6'-1"	9 15/16"	6'-1"	3	32		35
6'-2"	10 1/16"	6'-2"	2	33		35
6'-3"	10 1/8"	6'-3"	2	34		36
6'-4"	10 1/4"	6'-4"	2	34		36
6'-5"	10 3/8"	6'-5"	1	35		36
6'-6"	10 1/2"	6'-6"	1	36		37
6'-7"	10 5/8"	6'-7"	1	36		37
6'-8"	10 3/4"	6'-8"	1	37		38
6'-9"	10 7/8"	6'-9"		38		38
7'-0"	11 1/16"	7'-0"		38	1	39
7'-3"	11 1/4"	7'-3"		38	3	41
7'-6"	11 1/2"	7'-6"		38	4	42
7'-9"	11 3/4"	7'-9"		38	5	43
8'-0"	11 7/8"	8'-0"		38	6	44
8'-3"	12 1/16"	8'-3"		38	8	46
8'-6"	12 1/4"	8'-6"		38	9	47
8'-9"	12 1/2"	8'-9"		38	10	48
9'-0"	12 3/4"	9'-0"		38	11	49
9'-3"	12 5/8"	9'-3"		38	13	51
9'-6"	12 3/4"	9'-6"		38	14	52
9'-9"	12 7/8"	9'-9"		38	15	53
10'-0"	13 1/16"	10'-0"		38	16	54
10'-3"	13 1/4"	10'-3"		38	18	56
10'-6"	13 1/2"	10'-6"		38	19	57
10'-9"	13 3/4"	10'-9"		38	20	58
11'-0"	13 7/8"	11'-0"		38	21	59
11'-3"	14 1/16"	11'-3"		38	23	61
11'-6"	14 1/4"	11'-6"		38	24	62
11'-9"	14 1/2"	11'-9"		38	25	63
12'-0"	14 3/4"	12'-0"		38	26	64
12'-3"	14 5/8"	12'-3"		38	28	66
12'-6"	14 3/4"	12'-6"		38	29	67
12'-9"	14 7/8"	12'-9"		38	30	68
13'-0"	15 1/16"	13'-0"		38	32	70
13'-3"	15 1/4"	13'-3"		38	33	71



9" ARCH THICKNESS — WEDGE BRICK

9" x 4 1/2" x 3", 9" x 6 1/4" 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 13 1/4" 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. 1 Wedge	No. 2 Wedge	No. 3 Wedge	Total
1'-6"	2 1/16"	1'-6"	10			10
1'-7"	2 1/8"	1'-7"	9	1		10
1'-8"	2 1/4"	1'-8"	9	2		11
1'-9"	2 3/8"	1'-9"	9	2		11
1'-10"	2 1/2"	1'-10"	8	3		11
1'-11"	2 5/8"	1'-11"	8	4		12
2'-0"	3 1/16"	2'-0"	8	4		12
2'-1"	3 1/8"	2'-1"	7	5		12
2'-2"	3 1/4"	2'-2"	7	6		13
2'-3"	3 3/8"	2'-3"	7	6		13
2'-4"	3 1/2"	2'-4"	6	7		13
2'-5"	3 5/8"	2'-5"	6	8		14
2'-6"	4 1/16"	2'-6"	5	9		14
2'-7"	4 1/8"	2'-7"	5	9		14
2'-8"	4 1/4"	2'-8"	5	10		15
2'-9"	4 3/8"	2'-9"	4	11		15
2'-10"	4 1/2"	2'-10"	4	11		15
2'-11"	4 5/8"	2'-11"	4	12		16
3'-0"	4 3/4"	3'-0"	3	13		16
3'-1"	4 7/8"	3'-1"	3	13		16
3'-2"	5 1/16"	3'-2"	3	14		17
3'-3"	5 1/8"	3'-3"	2	15		17
3'-4"	5 1/4"	3'-4"	2	16		18
3'-5"	5 3/8"	3'-5"	2	16		18
3'-6"	5 1/2"	3'-6"	1	17		18
3'-7"	5 5/8"	3'-7"	1	18		19
3'-8"	5 3/4"	3'-8"	1	18		19
3'-9"	5 7/8"	3'-9"		19		19
3'-10"	6 1/16"	3'-10"		19	1	20
3'-11"	6 1/8"	3'-11"		18	2	20
4'-0"	6 1/4"	4'-0"		18	2	20
4'-1"	6 3/8"	4'-1"		18	3	21
4'-2"	6 1/2"	4'-2"		17	4	21
4'-3"	6 5/8"	4'-3"		17	4	21
4'-4"	6 3/4"	4'-4"		17	5	22
4'-5"	7 1/16"	4'-5"		16	6	22
4'-6"	7 1/8"	4'-6"		16	6	22
4'-7"	7 1/4"	4'-7"		16	7	23
4'-8"	7 3/8"	4'-8"		15	8	23
4'-9"	7 1/2"	4'-9"		15	8	23
4'-10"	7 5/8"	4'-10"		15	9	24
4'-11"	7 3/4"	4'-11"		14	10	24

Continued on next page

9" ARCH THICKNESS — WEDGE BRICK

9" x 4 1/2" x 3", 9" x 6 1/4" 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 13 1/2" x 9" x 3" arch brick by substituting Nos. 1 and 2 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 1/2"	5'-0"	14	10		24
5'-1"	8 1/16"	5'-1"	14	11		25
5'-2"	8 1/8"	5'-2"	13	12		25
5'-3"	8 1/4"	5'-3"	13	12		25
5'-4"	8 3/8"	5'-4"	12	14		26
5'-5"	8 1/2"	5'-5"	12	14		26
5'-6"	8 5/8"	5'-6"	12	15		27
5'-7"	8 3/4"	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 5/8"	6'-0"	10	19		29
6'-1"	9 3/4"	6'-1"	9	20		29
6'-2"	9 7/8"	6'-2"	9	20		29
6'-3"	10 1/8"	6'-3"	9	21		30
6'-4"	10 1/4"	6'-4"	8	22		30
6'-5"	10 3/8"	6'-5"	8	22		30
6'-6"	10 5/8"	6'-6"	8	23		31
6'-7"	10 3/4"	6'-7"	7	24		31
6'-8"	10 7/8"	6'-8"	7	24		31
6'-9"	10 1/2"	6'-9"	7	25		32
6'-10"	11 1/8"	6'-10"	6	26		32
6'-11"	11 1/4"	6'-11"	6	27		33
7'-0"	11 3/8"	7'-0"	6	27		33
7'-1"	11 1/2"	7'-1"	5	28		33
7'-2"	11 5/8"	7'-2"	5	29		34
7'-3"	11 3/4"	7'-3"	4	30		34
7'-4"	11 7/8"	7'-4"	4	30		34
7'-5"	12 1/8"	7'-5"	4	31		35
7'-6"	12 1/4"	7'-6"	3	32		35
7'-7"	12 3/8"	7'-7"	2	34		36
8'-0"	12 5/8"	8'-0"	1	36		37
8'-3"	13 1/4"	8'-3"		38		38
8'-6"	13 3/8"	8'-6"		38	1	39
9'-0"	13 5/8"	9'-0"		38	3	41
9'-6"	14 1/4"	9'-6"		38	5	43
10'-0"	14 3/4"	10'-0"		38	7	45
10'-6"	15 1/8"	10'-6"		38	10	48
11'-0"	15 3/4"	11'-0"		38	12	50
11'-6"	16 1/4"	11'-6"		38	14	52
12'-0"	16 3/8"	12'-0"		38	16	54

9" ARCH THICKNESS — WEDGE BRICK

9" x 4 1/2" x 2 1/2", 9" x 6 1/4" x 2 1/2" or 9" x 9" x 2 1/2"

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 1/4"	1'-3 1/4"	10	3		13
1'-8"	3 1/2"	1'-4 1/4"	9	5		14
1'-9"	3 3/4"	1'-5 1/4"	8	6		14
1'-10"	3 1/2"	1'-6 1/4"	7	7		14
1'-11"	3 1/2"	1'-7 1/4"	7	8		15
2'-0"	4"	1'-8"	6	9		15
2'-1"	4 1/4"	1'-8 1/4"	6	10		16
2'-2"	4 1/2"	1'-9 1/4"	5	11		16
2'-3"	4 3/4"	1'-10 1/4"	4	13		17
2'-4"	4 1/2"	1'-11 1/4"	3	14		17
2'-5"	4 1/2"	2'-0 1/4"	2	15		17
2'-6"	5"	2'-1"	2	16		18
2'-7"	5 1/4"	2'-1 1/4"	1	17		18
2'-8"	5 1/2"	2'-2 1/4"	1	18		19
2'-9"	5 1/2"	2'-3 1/4"		18	1	19
2'-10"	5 1/2"	2'-4 1/4"		18	2	20
2'-11"	5 1/2"	2'-5 1/4"		18	2	20
3'-0"	6"	2'-6"		17	3	20
3'-1"	6 1/4"	2'-6 1/4"		17	4	21
3'-2"	6 1/2"	2'-7 1/4"		17	4	21
3'-3"	6 1/2"	2'-8 1/4"		17	5	22
3'-4"	6 1/2"	2'-9 1/4"		16	6	22
3'-5"	6 1/2"	2'-10 1/4"		16	7	23
3'-6"	7"	2'-11"		16	7	23
3'-7"	7 1/4"	2'-11 1/4"		15	8	23
3'-8"	7 1/2"	3'-0 1/4"		15	9	24
3'-9"	7 1/2"	3'-1 1/4"		15	9	24
3'-10"	7 1/2"	3'-2 1/4"		15	10	25
3'-11"	7 1/2"	3'-3 1/4"		14	11	25
4'-0"	8"	3'-4"		14	12	26
4'-1"	8 1/4"	3'-4 1/4"		14	12	26
4'-2"	8 1/2"	3'-5 1/4"		13	13	26
4'-3"	8 1/2"	3'-6 1/4"		13	14	27
4'-4"	8 1/2"	3'-7 1/4"		13	14	27
4'-5"	8 1/2"	3'-8 1/4"		13	15	28
4'-6"	9"	3'-9"		12	16	28
4'-7"	9 1/4"	3'-9 1/4"		12	17	29
4'-8"	9 1/2"	3'-10 1/4"		12	17	29
4'-9"	9 1/2"	3'-11 1/4"		11	18	29
4'-10"	9 1/2"	4'-0 1/4"		11	19	30
4'-11"	9 1/2"	4'-1 1/4"		11	19	30
5'-0"	10"	4'-2"		11	20	31
5'-1"	10 1/4"	4'-2 1/4"		10	21	31
5'-2"	10 1/2"	4'-3 1/4"		10	22	32

9" ARCH THICKNESS — WEDGE BRICK

9" x 4 1/2" x 2 1/2", 9" x 6 3/4" x 2 1/2" or
9" x 9" x 2 1/2" — 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 1/2"	4' 5 1/2"	9	21		32
5' 5"	10 1/2"	4' 6 1/2"	9	21		31
5' 6"	11"	4' 7"	9	24		33
5' 7"	11 1/2"	4' 7 1/2"	9	25		34
5' 8"	11 1/2"	4' 8 1/2"	8	26		34
5' 9"	11 1/2"	4' 9 1/2"	8	27		35
5' 10"	11 1/2"	4' 10 1/2"	8	27		35
5' 11"	11 1/2"	4' 11 1/2"	7	28		35
6' 0"	1' 0"	5' 0"	7	29		36
6' 1"	1' 0 1/2"	5' 0 1/2"	7	29		36
6' 2"	1' 0 1/2"	5' 1 1/2"	7	30		37
6' 3"	1' 0 1/2"	5' 2 1/2"	6	31		37
6' 4"	1' 0 1/2"	5' 3 1/2"	6	32		38
6' 5"	1' 0 1/2"	5' 4 1/2"	6	32		38
6' 6"	1' 1"	5' 5"	5	33		38
6' 7"	1' 1 1/2"	5' 5 1/2"	5	33		39
6' 8"	1' 1 1/2"	5' 6 1/2"	5	33		39
6' 9"	1' 1 1/2"	5' 7 1/2"	5	35		40
6' 10"	1' 1 1/2"	5' 8 1/2"	4	36		40
6' 11"	1' 1 1/2"	5' 9 1/2"	4	37		41
7' 0"	1' 2"	5' 10"	4	37		41
7' 1"	1' 2 1/2"	5' 10 1/2"	4	38		41
7' 2"	1' 2 1/2"	5' 11 1/2"	3	39		42
7' 3"	1' 2 1/2"	6' 0 1/2"	3	39		42
7' 4"	1' 2 1/2"	6' 1 1/2"	3	40		43
7' 5"	1' 2 1/2"	6' 2 1/2"	2	41		43
7' 6"	1' 3"	6' 3 1/2"	2	42		44
7' 9"	1' 3 1/2"	6' 5 1/2"	1	43		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

9" ARCH THICKNESS — WEDGE BRICK

9" x 4 1/2" x 3", 9" x 6 3/4" x 3" or 9" x 9" x 3"
2" Rise Per Foot of Span

This table can be used for 11 1/2" x 9" x 1" 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. 1 Wedge	No. 2 Wedge	No. 3 Wedge	Total
1' 10"	3 1/2"	1' 6 1/2"	12			12
1' 11"	3 1/2"	1' 7 1/2"	11	1		12
2' 0"	4"	1' 8"	11	2		13
2' 1"	4 1/2"	1' 8 1/2"	10	3		13
2' 2"	4 1/2"	1' 9 1/2"	10	4		14
2' 3"	4 1/2"	1' 10 1/2"	10	4		14
2' 4"	4 1/2"	1' 11 1/2"	9	5		14
2' 5"	4 1/2"	2' 0 1/2"	9	6		15
2' 6"	5"	2' 1"	9	6		15
2' 7"	5 1/2"	2' 1 1/2"	8	7		15
2' 8"	5 1/2"	2' 2 1/2"	8	8		16
2' 9"	5 1/2"	2' 3 1/2"	8	8		16
2' 10"	5 1/2"	2' 4 1/2"	7	9		16
2' 11"	5 1/2"	2' 5 1/2"	7	10		17
3' 0"	6"	2' 6"	7	10		17
3' 1"	6 1/2"	2' 6 1/2"	6	11		17
3' 2"	6 1/2"	2' 7 1/2"	6	12		18
3' 3"	6 1/2"	2' 8 1/2"	5	13		18
3' 4"	6 1/2"	2' 9 1/2"	5	14		19
3' 5"	6 1/2"	2' 10 1/2"	5	14		19
3' 6"	7"	2' 11"	4	15		19
3' 7"	7 1/2"	2' 11 1/2"	4	16		20
3' 8"	7 1/2"	3' 0 1/2"	4	16		20
3' 9"	7 1/2"	3' 1 1/2"	3	17		20
3' 10"	7 1/2"	3' 2 1/2"	3	18		21
3' 11"	7 1/2"	3' 3 1/2"	3	18		21
4' 0"	8"	3' 4"	2	19		21
4' 1"	8 1/2"	3' 4 1/2"	2	20		22
4' 2"	8 1/2"	3' 5 1/2"	2	20		22
4' 3"	8 1/2"	3' 6 1/2"	1	21		22
4' 4"	8 1/2"	3' 7 1/2"	1	22		23
4' 5"	8 1/2"	3' 8 1/2"	1	22		23
4' 6"	9"	3' 9"		24		24
4' 7"	9 1/2"	3' 9 1/2"		23	1	24
4' 8"	9 1/2"	3' 10 1/2"		23	1	24
4' 9"	9 1/2"	3' 11 1/2"		22	3	25
4' 10"	9 1/2"	4' 0 1/2"		22	3	25
4' 11"	9 1/2"	4' 1 1/2"		21	4	25
5' 0"	10"	4' 2"		21	5	26
5' 1"	10 1/2"	4' 2 1/2"		21	5	26
5' 2"	10 1/2"	4' 3 1/2"		20	6	26
5' 3"	10 1/2"	4' 4 1/2"		20	7	27

9" ARCH THICKNESS — WEDGE BRICK

9" x 4 1/2" x 3", 9" x 6 1/4" x 3" or 9" x 9" x 3"

— Concluded

2" Rise Per Foot of Span

This table can be used for 11 1/2" x 9" x 3" arch brick, by substituting Nos. 1 and 2 archbrick for the corresponding wedge brick

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

9" ARCH THICKNESS — WEDGE BRICK

9" x 4 1/2" x 2 1/2", 9" x 6 1/4" x 2 1/2" or

9" x 9" x 2 1/2"

2 1/4" Rise Per Foot of Span

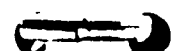
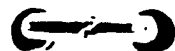
Span	Rise	Inside Radius	Number Required Per Course			
			No. 2 Wedge	No. 1 Wedge	No. 1 X Wedge	Total
1'-6"	3 1/2"	1'-1 1/2"	14			14
1'-7"	3 1/2"	1'-2 1/2"	11	1		14
1'-8"	3 1/2"	1'-2 1/2"	12	2		14
1'-9"	4 1/2"	1'-3 1/2"	11	3		15
1'-10"	4 1/2"	1'-4 1/2"	10	5		15
1'-11"	4 1/2"	1'-5 1/2"	10	6		16
2'-0"	4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

9" ARCH THICKNESS — WEDGE BRICK

9" x 4 1/2" x 2 1/2", 9" x 6 3/4" x 2 1/2" or
9" x 9" x 2 1/2" — Concluded
2 3/4" † Rise Per Foot of Span

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

† More exactly, 2.302".



9" ARCH THICKNESS — WEDGE BRICK

9" x 4 1/2" x 3", 9" x 6 3/4" x 3" or 9" x 9" x 3"
2 3/4" † Rise Per Foot of Span

This table can be used also for 11 1/2" 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. 1 Wedge	No. 2 Wedge	No. 3 Wedge	Total
2'-0"	4 1/2"	1'-5 1/2"	14			14
2'-1"	4 1/2"	1'-6 1/2"	13	1		14
2'-2"	5"	1'-7 1/2"	13	1		14
2'-3"	5 1/2"	1'-8 1/2"	12	3		15
2'-4"	5 1/2"	1'-8 1/2"	12	3		15
2'-5"	5 1/2"	1'-9 1/2"	11	4		15
2'-6"	5 1/4"	1'-10 1/2"	11	5		16
2'-7"	5 1/2"	1'-11 1/2"	11	5		16
2'-8"	6 1/8"	1'-11 1/2"	10	6		16
2'-9"	6 1/2"	2'-0 1/2"	10	7		17
2'-10"	6 1/2"	2'-1 1/2"	10	7		17
2'-11"	6 1/2"	2'-2 1/2"	10	8		18
3'-0"	6 3/4"	2'-2 1/2"	9	9		18
3'-1"	7 1/2"	2'-3 1/2"	9	9		18
3'-2"	7 1/2"	2'-4 1/2"	8	11		19
3'-3"	7 1/2"	2'-5 1/2"	8	11		19
3'-4"	7 1/2"	2'-5 1/2"	7	12		19
3'-5"	7 3/8"	2'-6 1/2"	7	13		20
3'-6"	8 1/8"	2'-7 1/2"	7	13		20
3'-7"	8 1/4"	2'-8 1/2"	6	14		20
3'-8"	8 1/2"	2'-8 1/2"	6	15		21
3'-9"	8 1/2"	2'-9 1/2"	6	15		21
3'-10"	8 1/2"	2'-10 1/2"	6	16		22
3'-11"	9 1/2"	2'-11 1/2"	5	17		22
4'-0"	9 1/2"	2'-11 1/2"	4	18		22
4'-1"	9 1/2"	3'-0 1/2"	4	19		23
4'-2"	9 1/2"	3'-1 1/2"	4	19		23
4'-3"	9 1/2"	3'-2 1/2"	3	20		23
4'-4"	9 1/2"	3'-2 1/2"	3	21		24
4'-5"	10 1/2"	3'-3 1/2"	3	21		24
4'-6"	10 1/2"	3'-4 1/2"	3	22		25
4'-7"	10 1/2"	3'-5 1/2"	2	23		25
4'-8"	10 3/4"	3'-5 1/2"	2	23		25
4'-9"	10 3/4"	3'-6 1/2"	2	24		26
4'-10"	11 1/8"	3'-7 1/2"	1	25		26
4'-11"	11 1/8"	3'-8 1/2"		26		26
5'-0"	11 1/2"	3'-8 1/2"		27		27
5'-1"	11 1/2"	3'-9 1/2"		26	1	27
5'-2"	11 1/2"	3'-10 1/2"		26	1	27
5'-3"	1'-0 3/2"	3'-11 1/2"		26	2	28
5'-4"	1'-0 3/2"	3'-11 1/2"		25	3	28
5'-5"	1'-0 3/2"	4'-0 1/2"		25	4	29

† More exactly, 2.302".

Continued on next page

9" ARCH THICKNESS — WEDGE BRICK

9" x 4 1/2" x 3", 9" x 6 3/4" x 3" or 9" x 9" x 3"

— Concluded

2 1/4" Rise Per Foot of Span

This table can be used also for 13 1/2" x 9" x 3" arch brick by substituting Nos. 1 and 2 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 1/2"	4'-1 1/2"	25	4		29
5'-7"	1'-0 3/4"	4'-2 1/4"	24	5		29
5'-8"	1'-1 1/8"	4'-2 3/8"	24	6		30
5'-9"	1'-1 1/4"	4'-3 1/8"	23	7		30
5'-10"	1'-1 1/2"	4'-4 1/8"	23	7		30
5'-11"	1'-1 5/8"	4'-5 1/8"	23	8		31
6'-0"	1'-1 3/4"	4'-5 3/4"	22	9		31
6'-1"	1'-2"	4'-6 3/4"	22	9		31
6'-2"	1'-2 1/8"	4'-7 1/8"	22	10		32
6'-3"	1'-2 1/4"	4'-8 1/8"	21	11		32
6'-4"	1'-2 1/2"	4'-8 3/8"	21	12		33
6'-5"	1'-2 5/8"	4'-9 3/8"	20	13		33
6'-6"	1'-2 3/4"	4'-10 3/8"	20	13		33
6'-7"	1'-3"	4'-11 3/8"	20	14		34
6'-8"	1'-3 1/8"	4'-11 3/4"	19	15		34
6'-9"	1'-3 1/4"	5'-0 1/4"	19	15		34
6'-10"	1'-3 1/2"	5'-1 1/4"	19	16		35
6'-11"	1'-3 3/4"	5'-2 1/4"	18	17		35
7'-0"	1'-4 1/8"	5'-2 3/4"	18	17		35
7'-1"	1'-4 1/4"	5'-3 1/4"	18	18		36
7'-2"	1'-4 1/2"	5'-4 1/4"	17	19		36
7'-3"	1'-4 3/4"	5'-5 1/4"	17	20		37
7'-4"	1'-4 7/8"	5'-5 3/4"	16	21		37
7'-5"	1'-5 1/8"	5'-6 3/4"	16	21		37
7'-6"	1'-5 1/4"	5'-7 3/4"	16	22		38
7'-7"	1'-5 1/2"	5'-8 3/4"	15	23		38
7'-8"	1'-5 3/4"	5'-8 3/8"	15	23		38
7'-9"	1'-5 7/8"	5'-9 3/8"	15	24		39
7'-10"	1'-6 1/8"	5'-10 3/8"	14	25		39
7'-11"	1'-6 1/4"	5'-11 3/8"	14	25		39
8'-0"	1'-6 1/2"	5'-11 3/4"	14	26		40
8'-3"	1'-7"	6'-2"	12	29		41
8'-6"	1'-7 1/2"	6'-4 1/4"	11	31		42
8'-9"	1'-8 1/8"	6'-6 3/8"	10	33		43
9'-0"	1'-8 1/2"	6'-8 3/8"	9	35		44
9'-6"	1'-9 1/8"	7'-1 1/8"	7	39		46
10'-0"	1'-11 1/8"	7'-5 1/8"	5	44		49
10'-6"	2'-0 1/8"	7'-10 3/8"	3	48		51
11'-0"	2'-1 1/8"	8'-2 1/8"		53		53
11'-6"	2'-2 1/8"	8'-7 3/8"		53	2	55
12'-0"	2'-3 3/8"	8'-11 3/8"		53	4	57
12'-6"	2'-4 3/8"	9'-4 1/8"		53	7	60

1 More exactly, 2.102"

12" ARCH THICKNESS — WEDGE BRICK

12" x 4 1/2" 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 1/2"	6'-0"	21	9		30
6'-3"	10 1/8"	6'-3"	20	11		31
6'-6"	10 1/4"	6'-6"	19	13		32
6'-9"	10 3/8"	6'-9"	18	15		33
7'-0"	11 1/4"	7'-0"	17	17		34
7'-3"	11 3/8"	7'-3"	16	19		35
7'-6"	1'-0 1/8"	7'-6"	15	21		36
7'-9"	1'-0 3/8"	7'-9"	14	23		37
8'-0"	1'-0 1/2"	8'-0"	13	25		38
8'-3"	1'-1 1/8"	8'-3"	12	27		39
8'-6"	1'-1 3/8"	8'-6"	11	29		40
8'-9"	1'-1 5/8"	8'-9"	10	31		41
9'-0"	1'-2 1/8"	9'-0"	8	34		42
9'-3"	1'-2 3/8"	9'-3"	7	36		43
9'-6"	1'-2 5/8"	9'-6"	6	38		44
9'-9"	1'-3 1/8"	9'-9"	5	40		45
10'-0"	1'-4 1/8"	10'-0"	4	42		46
10'-3"	1'-4 3/8"	10'-3"	4	44		48
10'-6"	1'-4 5/8"	10'-6"	3	46		49
10'-9"	1'-5 1/8"	10'-9"	1	49		50
11'-0"	1'-5 3/8"	11'-0"		51		51
11'-3"	1'-6 1/8"	11'-3"		50	2	52
11'-6"	1'-6 3/8"	11'-6"		48	5	53
11'-9"	1'-6 5/8"	11'-9"		47	7	54
12'-0"	1'-7 1/8"	12'-0"		46	9	55
12'-3"	1'-7 3/8"	12'-3"		45	11	56
12'-6"	1'-8 1/8"	12'-6"		44	13	57
12'-9"	1'-8 3/8"	12'-9"		43	15	58
13'-0"	1'-8 5/8"	13'-0"		42	17	59
13'-3"	1'-9 1/8"	13'-3"		41	19	60
13'-6"	1'-9 3/8"	13'-6"		40	21	61
13'-9"	1'-10 1/8"	13'-9"		39	23	62
14'-0"	1'-10 3/8"	14'-0"		38	25	63
14'-3"	1'-10 5/8"	14'-3"		37	27	64
14'-6"	1'-11 1/8"	14'-6"		36	29	65
14'-9"	1'-11 3/8"	14'-9"		35	31	66
15'-0"	2'-0 1/8"	15'-0"		34	33	67
15'-3"	2'-0 3/8"	15'-3"		32	36	68
15'-6"	2'-0 5/8"	15'-6"		32	38	70
15'-9"	2'-1 1/8"	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 4 1/2" 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'-11 1/2"	16'-0"	30	42		72
16'-3"	2'-2 1/2"	16'-3"	29	44		73
16'-6"	2'-2 1/2"	16'-6"	28	46		74
16'-9"	2'-2 1/2"	16'-9"	27	48		75
17'-0"	2'-3 1/2"	17'-0"	25	51		76
17'-3"	2'-3 1/2"	17'-3"	24	53		77
17'-6"	2'-4 1/2"	17'-6"	23	55		78
17'-9"	2'-4 1/2"	17'-9"	22	57		79
18'-0"	2'-4 1/2"	18'-0"	21	59		80
18'-3"	2'-5 1/2"	18'-3"	20	61		81
18'-6"	2'-5 1/2"	18'-6"	19	63		82
18'-9"	2'-6 1/2"	18'-9"	18	65		83
19'-0"	2'-6 1/2"	19'-0"	17	67		84
19'-3"	2'-6 1/2"	19'-3"	16	69		85
19'-6"	2'-7 1/2"	19'-6"	15	71		86
19'-9"	2'-7 1/2"	19'-9"	14	73		87
20'-0"	2'-8 1/2"	20'-0"	13	75		88
20'-3"	2'-8 1/2"	20'-3"	12	77		89
20'-6"	2'-8 1/2"	20'-6"	10	80		90
20'-9"	2'-9 1/2"	20'-9"	10	82		92
21'-0"	2'-9 1/2"	21'-0"	9	84		93
21'-3"	2'-10 1/2"	21'-3"	8	86		94
21'-6"	2'-10 1/2"	21'-6"	7	88		95
21'-9"	2'-10 1/2"	21'-9"	6	90		96
22'-0"	2'-11 1/2"	22'-0"	5	92		97
22'-3"	2'-11 1/2"	22'-3"	3	95		98
22'-6"	3'-0 1/2"	22'-6"	2	97		99
22'-9"	3'-0 1/2"	22'-9"	1	99		100
23'-0"	3'-0 1/2"	23'-0"		101		101
23'-3"	3'-1 1/2"	23'-3"		101	1	102
23'-6"	3'-1 1/2"	23'-6"		101	2	103
23'-9"	3'-2 1/2"	23'-9"		101	3	104
24'-0"	3'-2 1/2"	24'-0"		101	4	105
24'-3"	3'-3 1/2"	24'-3"		101	5	106
24'-6"	3'-3 1/2"	24'-6"		101	6	107
24'-9"	3'-3 1/2"	24'-9"		101	7	108
25'-0"	3'-4 1/2"	25'-0"		101	8	109
25'-3"	3'-4 1/2"	25'-3"		101	9	110
25'-6"	3'-5 1/2"	25'-6"		101	10	111
25'-9"	3'-5 1/2"	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".

13 1/2" ARCH THICKNESS — WEDGE BRICK

13 1/2" x 4 1/2" x 3", 13 1/2" x 6" x 3" or

13 1/2" x 9" x 3"

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

13 1/2" ARCH THICKNESS — WEDGE BRICK

13 1/2" x 4 1/2" x 3", 13 1/2" x 6" x 3" or

13 1/2" x 9" x 3" — Concluded

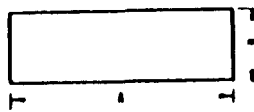
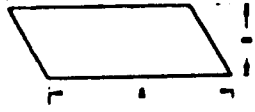
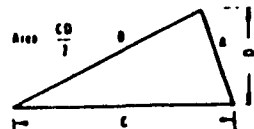
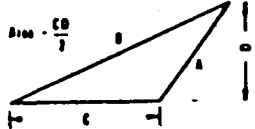
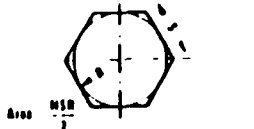
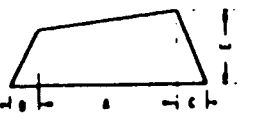
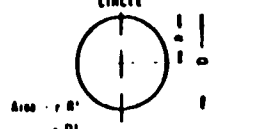
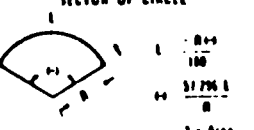
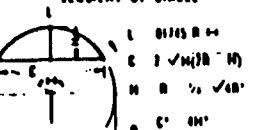
1.608" Rise Per Foot of Span (60° Central Angle)

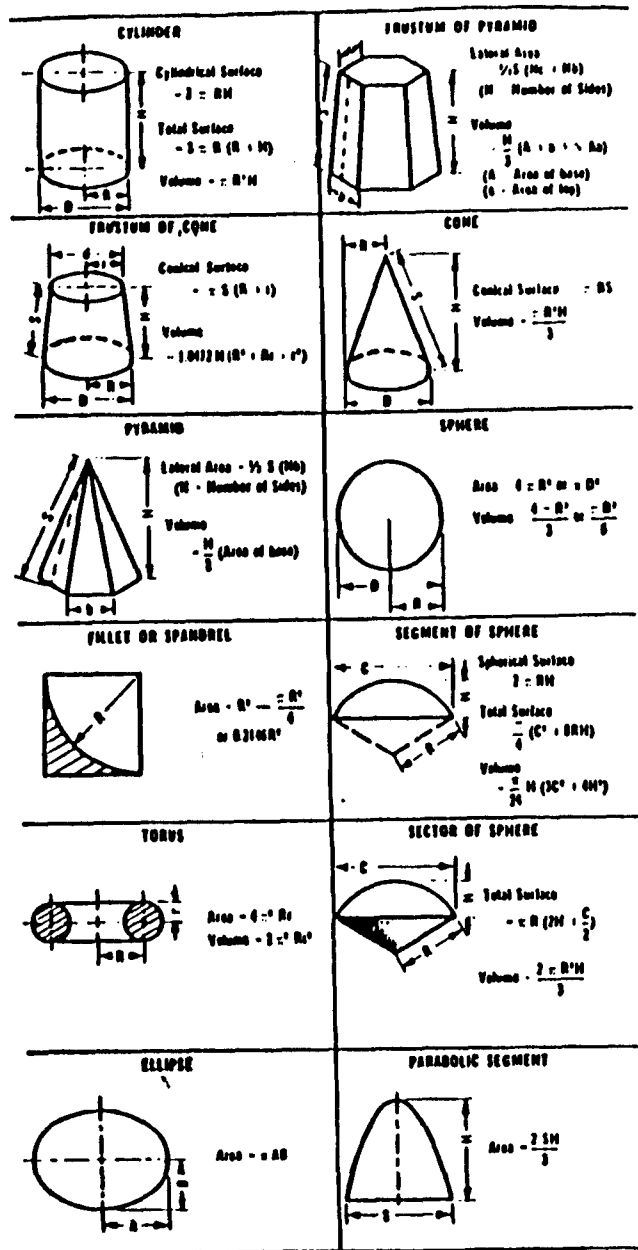
Span	Rise	Inside Radius	Number Required Per Course			
			No. 1 Wedge	No. 1 X Wedge	Straight	Total
15' 9"	2' 1 1/16"	15' 9"	43	28		71
16' 0"	2' 1 1/32"	16' 0"	41	31		72
16' 3"	2' 2 1/32"	16' 3"	40	33		73
16' 6"	2' 2 1/16"	16' 6"	39	35		74
16' 9"	2' 2 1/8"	16' 9"	38	37		75
17' 0"	2' 3 1/16"	17' 0"	37	39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

GEOMETRIC FORMULAS

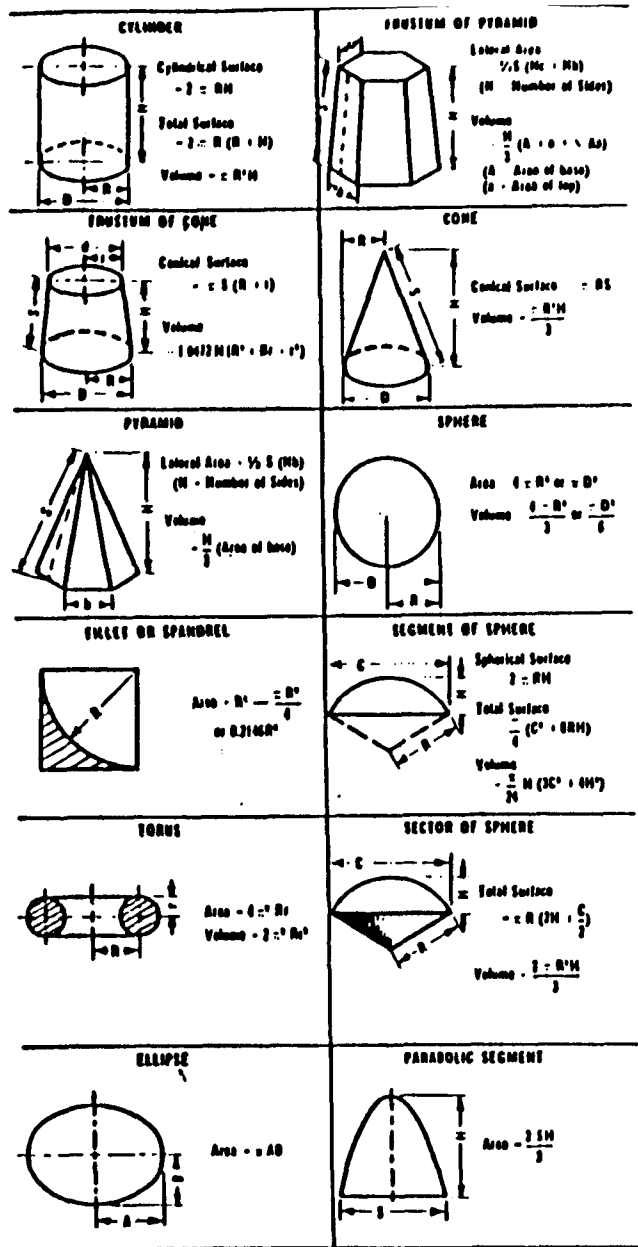
The following formulas for areas and volumes are useful in calculating refractory brickwork.

RECTANGLE  Area = AB	PARALLELOGRAM  Area = AB
ACUTE ANGLED TRIANGLE  Area = $\frac{CB}{2}$ Area = $\frac{1}{2} (S - A) (S - B) (S - C)$ where $S = \frac{1}{2} (A + B + C)$	OBTUSE ANGLED TRIANGLE  Area = $\frac{CB}{2}$ Area = $\frac{1}{2} (S - A) (S - B) (S - C)$ where $S = \frac{1}{2} (A + B + C)$
REGULAR POLYGON  Area = $\frac{MAB}{2}$ (where M = Number of Sides)	TRAPEZIUM  Area = $\frac{1}{2} A(B + C)$
CIRCLE  Area = πR^2 or $\frac{\pi D^2}{4}$ Circumference πD or $2\pi R$	ANNULAR RING  Area = $\pi (R^2 - r^2)$ or $\frac{\pi (D^2 - d^2)}{4}$
SECTOR OF CIRCLE  Area = $\frac{AL}{2}$ or $\frac{\pi R^2 A}{360}$	SEGMENT OF CIRCLE  Area = $\frac{R^2 A}{2} - \frac{R^2 \sin A}{2}$ or $\frac{R^2}{2} (A - \sin A)$



CIRCUMFERENCES AND AREAS OF CIRCLES FROM $\frac{1}{16}$ TO 100

Diameter	Circumference	Area	Diameter	Circumference	Area
$\frac{1}{16}$	0.1963	0.0019	5	15.708	14.615
$\frac{1}{12}$	0.2618	0.0027	$5\frac{1}{8}$	16.101	20.629
$\frac{1}{10}$	0.3142	0.0031	$5\frac{1}{4}$	16.493	21.648
$\frac{1}{8}$	0.3927	0.0047	$5\frac{1}{2}$	16.886	22.691
$\frac{3}{16}$	0.5890	0.0076	$5\frac{3}{4}$	17.279	23.758
$\frac{1}{4}$	0.7854	0.0098	$5\frac{7}{8}$	17.672	24.850
$\frac{5}{16}$	0.9817	0.0127	$5\frac{1}{2}$	18.064	25.967
$\frac{3}{8}$	1.1781	0.0145	$5\frac{1}{4}$	18.457	27.109
$\frac{7}{16}$	1.3745	0.0163	6	18.850	28.274
$\frac{1}{2}$	1.5708	0.0177	$6\frac{1}{8}$	19.242	29.465
$\frac{9}{16}$	1.7672	0.0190	$6\frac{1}{4}$	19.635	30.680
$\frac{5}{8}$	1.9635	0.0200	$6\frac{1}{2}$	20.028	31.919
$\frac{11}{16}$	2.1598	0.0212	$6\frac{3}{4}$	20.420	33.183
$\frac{3}{4}$	2.3562	0.0222	$6\frac{7}{8}$	20.813	34.472
$\frac{13}{16}$	2.5525	0.0230	$6\frac{1}{2}$	21.206	35.785
$\frac{7}{8}$	2.7489	0.0237	$6\frac{3}{4}$	21.598	37.122
$\frac{15}{16}$	2.9452	0.0243	7	21.991	38.485
1	3.1416	0.0247	$7\frac{1}{8}$	22.384	39.871
$1\frac{1}{16}$	3.3380	0.0250	$7\frac{1}{4}$	22.777	41.282
$1\frac{1}{8}$	3.5343	0.0252	$7\frac{1}{2}$	23.169	42.718
$1\frac{1}{4}$	3.7307	0.0254	$7\frac{3}{4}$	23.562	44.179
$1\frac{3}{8}$	3.9270	0.0255	$7\frac{1}{2}$	23.955	45.664
$1\frac{1}{2}$	4.1234	0.0256	$7\frac{5}{8}$	24.347	47.173
$1\frac{5}{8}$	4.3197	0.0257	$7\frac{3}{4}$	24.740	48.707
$1\frac{3}{4}$	4.5161	0.0258	8	25.133	50.265
$1\frac{7}{8}$	4.7124	0.0259	$8\frac{1}{8}$	25.525	51.849
2	5.0265	0.0260	$8\frac{1}{4}$	25.918	53.456
$2\frac{1}{16}$	5.2228	0.0261	$8\frac{1}{2}$	26.311	55.088
$2\frac{1}{8}$	5.4191	0.0262	$8\frac{3}{4}$	26.704	56.745
$2\frac{1}{4}$	5.6154	0.0263	$8\frac{7}{8}$	27.096	58.426
$2\frac{3}{8}$	5.8117	0.0264	$8\frac{1}{2}$	27.489	60.132
$2\frac{1}{2}$	6.0080	0.0265	$8\frac{3}{4}$	27.882	61.862
$2\frac{5}{8}$	6.2043	0.0266	9	28.274	63.617
$2\frac{3}{4}$	6.4006	0.0267	$9\frac{1}{8}$	28.667	65.397
$2\frac{7}{8}$	6.5969	0.0268	$9\frac{1}{4}$	29.060	67.201
3	6.7932	0.0269	$9\frac{1}{2}$	29.452	69.029
$3\frac{1}{16}$	6.9895	0.0270	$9\frac{3}{4}$	29.845	70.882
$3\frac{1}{8}$	7.1858	0.0271	$9\frac{1}{2}$	30.238	72.760
$3\frac{1}{4}$	7.3821	0.0272	$9\frac{5}{8}$	30.631	74.662
$3\frac{3}{8}$	7.5784	0.0273	$9\frac{1}{2}$	31.023	76.589
$3\frac{1}{2}$	7.7747	0.0274	10	31.416	78.540
$3\frac{5}{8}$	7.9710	0.0275	$10\frac{1}{8}$	31.809	80.516
$3\frac{3}{4}$	8.1673	0.0276	$10\frac{1}{4}$	32.201	82.516
$3\frac{7}{8}$	8.3636	0.0277	$10\frac{1}{2}$	32.594	84.541
4	8.5599	0.0278	$10\frac{3}{4}$	32.987	86.590
$4\frac{1}{16}$	8.7562	0.0279	$10\frac{1}{2}$	33.379	88.664
$4\frac{1}{8}$	8.9525	0.0280	$10\frac{5}{8}$	33.772	90.763
$4\frac{1}{4}$	9.1488	0.0281	$10\frac{3}{4}$	34.165	92.886
$4\frac{3}{8}$	9.3451	0.0282			



CIRCUMFERENCES AND AREAS OF CIRCLES FROM 1/8 TO 100

Diameter	Circumference	Area	Diameter	Circumference	Area
1/8	0.1963	0.0019	5	15.708	19.635
1/4	0.3927	0.0077	5 1/8	16.101	20.629
3/8	0.5891	0.0157	5 1/4	16.493	21.648
1/2	0.7854	0.0227	5 1/2	16.886	22.691
5/8	0.9817	0.0297	5 3/4	17.279	23.758
3/4	1.1781	0.0368	5 7/8	17.672	24.850
7/8	1.3745	0.0438	6	18.064	25.967
1	1.5708	0.0509	6 1/8	18.457	27.109
1 1/8	1.7672	0.0579	6 1/4	18.850	28.274
1 1/4	1.9636	0.0649	6 1/2	19.242	29.465
1 3/8	2.1599	0.0719	6 3/4	19.635	30.680
1 1/2	2.3562	0.0789	6 7/8	20.028	31.919
1 5/8	2.5525	0.0859	7	20.420	33.183
1 3/4	2.7489	0.0929	7 1/8	20.813	34.472
1 7/8	2.9452	0.1000	7 1/4	21.206	35.785
2	3.1416	0.1071	7 1/2	21.598	37.122
2 1/8	3.3379	0.1141	7 3/4	21.991	38.485
2 1/4	3.5343	0.1212	7 1/2	22.384	39.871
2 3/8	3.7307	0.1282	7 5/8	22.777	41.282
2 1/2	3.9270	0.1353	7 3/4	23.169	42.718
2 5/8	4.1234	0.1423	7 7/8	23.562	44.179
2 3/4	4.3197	0.1494	8	23.955	45.664
2 7/8	4.5161	0.1564	7 1/4	24.347	47.173
3	4.7124	0.1635	7 1/2	24.740	48.707
3 1/8	4.9088	0.1705	8 1/8	25.133	50.265
3 1/4	5.1052	0.1776	8 1/4	25.525	51.849
3 3/8	5.3016	0.1846	8 1/2	25.918	53.456
3 1/2	5.4979	0.1917	8 3/4	26.311	55.088
3 5/8	5.6943	0.1987	8 1/2	26.704	56.745
3 3/4	5.8907	0.2058	8 5/8	27.096	58.426
3 7/8	6.0871	0.2128	8 3/4	27.489	60.132
4	6.2832	0.2199	8 7/8	27.882	61.862
4 1/8	6.4796	0.2269	9	28.274	63.617
4 1/4	6.6760	0.2339	9 1/8	28.667	65.397
4 3/8	6.8724	0.2409	9 1/4	29.060	67.201
4 1/2	7.0688	0.2479	9 1/2	29.452	69.029
4 5/8	7.2652	0.2549	9 3/4	29.845	70.882
4 3/4	7.4616	0.2619	9 7/8	30.238	72.760
4 7/8	7.6580	0.2689	10	30.631	74.662
5	7.8540	0.2759	10 1/8	31.023	76.589
5 1/8	8.0504	0.2829	10 1/4	31.416	78.540
5 1/4	8.2468	0.2899	10 1/2	31.809	80.516
5 3/8	8.4432	0.2969	10 3/4	32.201	82.516
5 1/2	8.6396	0.3039	10 5/8	32.594	84.541
5 5/8	8.8360	0.3109	10 3/4	32.987	86.590
5 3/4	9.0324	0.3179	10 7/8	33.379	88.664
5 7/8	9.2288	0.3249	11	33.772	90.763
6	9.4248	0.3319	11 1/8	34.165	92.886

**CIRCUMFERENCES
AND AREAS OF CIRCLES**
— Continued

Diameter	Circumference	Area	Diameter	Circumference	Area
11	34 558	95 033	17	53 407	226 98
11 ¹ / ₈	34 950	97 205	17 ¹ / ₈	53 800	230 33
11 ¹ / ₄	35 343	99 402	17 ¹ / ₄	54 193	233 71
11 ¹ / ₂	35 736	101 62	17 ¹ / ₂	54 585	237 10
11 ³ / ₄	36 128	103 87	17 ³ / ₄	54 978	240 53
11 ⁷ / ₈	36 521	106 14	17 ⁷ / ₈	55 371	243 98
11 ¹ / ₂	36 914	108 43	17 ¹ / ₂	55 763	247 45
11 ³ / ₄	37 306	110 75	17 ³ / ₄	56 156	250 95
12	37 699	113 10	18	56 549	254 47
12 ¹ / ₈	38 092	115 47	18 ¹ / ₈	56 941	258 02
12 ¹ / ₄	38 485	117 86	18 ¹ / ₄	57 334	261 59
12 ¹ / ₂	38 877	120 28	18 ¹ / ₂	57 727	265 18
12 ³ / ₄	39 270	122 72	18 ³ / ₄	58 120	268 80
12 ⁷ / ₈	39 663	125 19	18 ⁷ / ₈	58 512	272 45
12 ¹ / ₂	40 055	127 68	18 ¹ / ₂	58 905	276 12
12 ³ / ₄	40 448	130 19	18 ³ / ₄	59 298	279 81
13	40 841	132 73	19	59 690	283 53
13 ¹ / ₈	41 233	135 30	19 ¹ / ₈	60 083	287 27
13 ¹ / ₄	41 626	137 89	19 ¹ / ₄	60 476	291 04
13 ¹ / ₂	42 019	140 50	19 ¹ / ₂	60 868	294 83
13 ³ / ₄	42 412	143 14	19 ³ / ₄	61 261	298 65
13 ⁷ / ₈	42 804	145 80	19 ⁷ / ₈	61 654	302 49
13 ¹ / ₂	43 197	148 49	19 ¹ / ₂	62 047	306 35
13 ³ / ₄	43 590	151 20	19 ³ / ₄	62 439	310 24
14	43 982	153 94	20	62 832	314 16
14 ¹ / ₈	44 375	156 70	20 ¹ / ₈	63 225	318 10
14 ¹ / ₄	44 768	159 48	20 ¹ / ₄	63 617	322 06
14 ¹ / ₂	45 160	162 30	20 ¹ / ₂	64 010	326 05
14 ³ / ₄	45 553	165 13	20 ³ / ₄	64 403	330 06
14 ⁷ / ₈	45 946	167 99	20 ⁷ / ₈	64 795	334 10
14 ¹ / ₂	46 339	170 87	20 ¹ / ₂	65 188	338 16
14 ³ / ₄	46 731	173 78	20 ³ / ₄	65 581	342 25
15	47 124	176 71	21	65 973	346 36
15 ¹ / ₈	47 517	179 67	21 ¹ / ₈	66 366	350 50
15 ¹ / ₄	47 909	182 65	21 ¹ / ₄	66 759	354 66
15 ¹ / ₂	48 302	185 66	21 ¹ / ₂	67 152	358 84
15 ³ / ₄	48 695	188 69	21 ³ / ₄	67 544	363 05
15 ⁷ / ₈	49 087	191 75	21 ⁷ / ₈	67 937	367 28
15 ¹ / ₂	49 480	194 83	21 ¹ / ₂	68 330	371 54
15 ³ / ₄	49 873	197 93	21 ³ / ₄	68 722	375 83
16	50 266	201 06	22	69 115	380 13
16 ¹ / ₈	50 658	204 22	22 ¹ / ₈	69 508	384 46
16 ¹ / ₄	51 051	207 39	22 ¹ / ₄	69 900	388 82
16 ¹ / ₂	51 444	210 60	22 ¹ / ₂	70 293	393 20
16 ³ / ₄	51 836	213 82	22 ³ / ₄	70 686	397 61
16 ⁷ / ₈	52 229	217 08	22 ⁷ / ₈	71 079	402 04
16 ¹ / ₂	52 622	220 35	22 ¹ / ₂	71 471	406 49
16 ³ / ₄	53 014	223 65	22 ³ / ₄	71 864	410 97

**CIRCUMFERENCES
AND AREAS OF CIRCLES**
— Continued

Diameter	Circumference	Area	Diameter	Circumference	Area
23	72 257	415 48	29	91 106	660 52
23 ¹ / ₈	72 649	420 00	29 ¹ / ₈	91 499	666 23
23 ¹ / ₄	73 042	424 56	29 ¹ / ₄	91 892	671 96
23 ¹ / ₂	73 435	429 13	29 ¹ / ₂	92 284	677 71
23 ³ / ₄	73 827	433 74	29 ³ / ₄	92 677	683 49
23 ⁷ / ₈	74 220	438 36	29 ⁷ / ₈	93 070	689 30
23 ¹ / ₂	74 613	443 01	29 ¹ / ₂	93 462	695 13
23 ³ / ₄	75 006	447 69	29 ³ / ₄	93 855	700 98
24	75 398	452 39	30	94 248	706 86
24 ¹ / ₈	75 791	457 11	30 ¹ / ₈	94 641	712 76
24 ¹ / ₄	76 184	461 86	30 ¹ / ₄	95 033	718 69
24 ¹ / ₂	76 578	466 64	30 ¹ / ₂	95 426	724 64
24 ³ / ₄	76 969	471 44	30 ³ / ₄	95 819	730 62
24 ⁷ / ₈	77 362	476 26	30 ⁷ / ₈	96 211	736 62
24 ¹ / ₂	77 754	481 11	30 ¹ / ₂	96 604	742 64
24 ³ / ₄	78 147	485 98	30 ³ / ₄	96 997	748 69
25	78 540	490 87	31	97 389	754 77
25 ¹ / ₈	78 933	495 79	31 ¹ / ₈	97 782	760 87
25 ¹ / ₄	79 325	500 74	31 ¹ / ₄	98 175	766 99
25 ¹ / ₂	79 718	505 71	31 ¹ / ₂	98 568	773 14
25 ³ / ₄	80 111	510 71	31 ³ / ₄	98 960	779 31
25 ⁷ / ₈	80 503	515 72	31 ⁷ / ₈	99 353	785 51
25 ¹ / ₂	80 896	520 77	31 ¹ / ₂	99 746	791 73
25 ³ / ₄	81 289	525 84	31 ³ / ₄	100 14	797 98
26	81 681	530 93	32	100 53	804 25
26 ¹ / ₈	82 074	536 05	32 ¹ / ₈	100 92	810 54
26 ¹ / ₄	82 467	541 19	32 ¹ / ₄	101 32	816 86
26 ¹ / ₂	82 860	546 35	32 ¹ / ₂	101 71	823 21
26 ³ / ₄	83 252	551 55	32 ³ / ₄	102 10	829 58
26 ⁷ / ₈	83 645	556 76	32 ⁷ / ₈	102 49	835 97
26 ¹ / ₂	84 038	562 00	32 ¹ / ₂	102 89	842 39
26 ³ / ₄	84 430	567 27	32 ³ / ₄	103 28	848 83
27	84 823	572 56	33	103 67	855 30
27 ¹ / ₈	85 216	577 87	33 ¹ / ₈	104 07	861 79
27 ¹ / ₄	85 608	583 21	33 ¹ / ₄	104 46	868 31
27 ¹ / ₂	86 001	588 57	33 ¹ / ₂	104 85	874 85
27 ³ / ₄	86 394	593 96	33 ³ / ₄	105 24	881 41
27 ⁷ / ₈	86 787	599 37	33 ⁷ / ₈	105 64	888 00
27 ¹ / ₂	87 179	604 81	33 ¹ / ₂	106 03	894 62
27 ³ / ₄	87 572	610 27	33 ³ / ₄	106 42	901 26
28	87 965	615 75	34	106 81	907 92
28 ¹ / ₈	88 357	621 26	34 ¹ / ₈	107 21	914 61
28 ¹ / ₄	88 750	626 80	34 ¹ / ₄	107 60	921 32
28 ¹ / ₂	89 143	632 36	34 ¹ / ₂	107 99	928 06
28 ³ / ₄	89 535	637 94	34 ³ / ₄	108 39	934 82
28 ⁷ / ₈	89 928	643 55	34 ⁷ / ₈	108 78	941 61
28 ¹ / ₂	90 321	649 18	34 ¹ / ₂	109 17	948 42
28 ³ / ₄	90 714	654 84	34 ³ / ₄	109 56	955 25

CIRCUMFERENCES AND AREAS OF CIRCLES — Continued

Diameter	Circumference	Area	Diameter	Circumference	Area
35	109 96	962 11	41	128 81	1320 3
35 1/8	110 35	969 00	41 1/8	129 20	1328 3
35 1/4	110 74	975 91	41 1/4	129 59	1336 4
35 3/8	111 13	982 84	41 3/8	129 98	1344 5
35 1/2	111 53	989 80	41 1/2	130 38	1352 7
35 5/8	111 92	996 78	41 5/8	130 77	1360 8
35 3/4	112 31	1003 8	41 3/4	131 16	1369 0
35 7/8	112 71	1010 8	41 7/8	131 55	1377 2
36	113 10	1017 9	42	131 95	1385 4
36 1/8	113 49	1025 0	42 1/8	132 34	1393 7
36 1/4	113 88	1032 1	42 1/4	132 73	1402 0
36 3/8	114 28	1039 2	42 3/8	133 13	1410 3
36 1/2	114 67	1046 3	42 1/2	133 52	1418 6
36 5/8	115 06	1053 5	42 5/8	133 91	1427 0
36 3/4	115 45	1060 7	42 3/4	134 30	1435 4
36 7/8	115 85	1068 0	42 7/8	134 70	1443 8
37	116 24	1075 2	43	135 09	1452 2
37 1/8	116 63	1082 5	43 1/8	135 48	1460 7
37 1/4	117 02	1089 8	43 1/4	135 87	1469 1
37 3/8	117 42	1097 1	43 3/8	136 27	1477 6
37 1/2	117 81	1104 5	43 1/2	136 66	1486 2
37 5/8	118 20	1111 8	43 5/8	137 05	1494 7
37 3/4	118 60	1119 2	43 3/4	137 45	1503 3
37 7/8	118 99	1126 7	43 7/8	137 84	1511 9
38	119 38	1134 1	44	138 23	1520 5
38 1/8	119 77	1141 6	44 1/8	138 62	1529 2
38 1/4	120 17	1149 1	44 1/4	139 02	1537 9
38 3/8	120 56	1156 6	44 3/8	139 41	1546 6
38 1/2	120 95	1164 2	44 1/2	139 80	1555 3
38 5/8	121 34	1171 7	44 5/8	140 19	1564 0
38 3/4	121 74	1179 3	44 3/4	140 59	1572 8
38 7/8	122 13	1186 9	44 7/8	140 98	1581 6
39	122 52	1194 6	45	141 37	1590 4
39 1/8	122 92	1202 3	45 1/8	141 76	1599 3
39 1/4	123 31	1210 0	45 1/4	142 16	1608 2
39 3/8	123 70	1217 7	45 3/8	142 55	1617 0
39 1/2	124 09	1225 4	45 1/2	142 94	1626 0
39 5/8	124 49	1233 2	45 5/8	143 34	1634 9
39 3/4	124 88	1241 0	45 3/4	143 73	1643 9
39 7/8	125 27	1248 8	45 7/8	144 12	1652 9
40	125 66	1256 6	46	144 51	1661 9
40 1/8	126 06	1264 5	46 1/8	144 91	1670 9
40 1/4	126 45	1272 4	46 1/4	145 30	1680 0
40 3/8	126 84	1280 3	46 3/8	145 69	1689 1
40 1/2	127 24	1288 2	46 1/2	146 08	1698 2
40 5/8	127 63	1296 2	46 5/8	146 48	1707 4
40 3/4	128 02	1304 2	46 3/4	146 87	1716 5
40 7/8	128 41	1312 2	46 7/8	147 26	1725 7

CIRCUMFERENCES AND AREAS OF CIRCLES — Concluded

Diameter	Circumference	Area	Diameter	Circumference	Area
47	147 66	1714 9	61	191 61	2922 5
47 1/8	148 05	1722 2	62	193 78	3019 1
47 1/4	148 44	1731 5	63	197 92	3117 2
47 3/8	148 83	1740 7	64	201 06	3217 0
47 1/2	149 21	1750 1	65	203 20	3318 3
47 5/8	149 62	1759 4	66	207 35	3421 2
47 3/4	150 01	1769 8	67	210 49	3525 7
47 7/8	150 40	1780 1	68	213 63	3631 7
48	150 80	1809 6	69	216 77	3739 3
48 1/8	151 19	1819 0	70	219 91	3848 5
48 1/4	151 58	1828 5	71	223 05	3959 2
48 3/8	151 98	1837 9	72	226 20	4071 5
48 1/2	152 37	1847 5	73	229 34	4185 4
48 5/8	152 76	1857 0	74	232 48	4300 8
48 3/4	153 15	1866 5	75	235 62	4417 9
48 7/8	153 55	1876 1	76	238 76	4536 5
49	154 94	1885 7	77	241 90	4656 6
49 1/8	155 33	1895 4	78	245 04	4778 4
49 1/4	155 72	1905 0	79	248 19	4901 7
49 3/8	156 12	1914 7	80	251 33	5026 5
49 1/2	156 51	1924 4	81	254 47	5153 0
49 5/8	156 90	1934 2	82	257 61	5281 0
49 3/4	157 29	1943 9	83	260 75	5410 6
49 7/8	157 69	1953 7	84	263 89	5541 8
50	158 08	1963 5	85	267 03	5674 5
51	160 22	2042 8	86	270 18	5808 8
52	163 36	2123 7	87	273 32	5944 7
53	166 50	2206 2	88	276 46	6082 1
54	169 65	2290 2	89	279 60	6221 1
55	172 79	2375 8	90	282 74	6361 7
56	175 93	2463 0	91	285 89	6503 9
57	179 07	2551 8	92	289 03	6647 6
58	182 21	2642 1	93	292 17	6792 9
59	185 35	2734 0	94	295 31	6939 8
60	188 50	2827 4	95	298 45	7088 2
			96	301 59	7238 2
			97	304 73	7389 8
			98	307 88	7543 0
			99	311 02	7697 7
			100	314 16	7854 0

CONVERSION TABLES OR EQUIVALENTS

DENSITY EQUIVALENTS									
Grams per CC.	Kg. per Cu. Meter	Lb. Per Cu. In.	Lb. Per Cu. Yd.	U. S. Gal.	Per Cu. Yard	Time (2000 Lb.) Per Cu. Yd.	Time (2000 Lb.) Per Cu. Yd.	Time (2000 Lb.) Per Cu. Yd.	Time (2000 Lb.) Per Cu. Yd.
1.000	1.000	0.03613	1.353	0.0003613	1.353	0.0003613	0.0003613	0.0003613	0.0003613
0.001	0.001	0.000003613	0.001353	0.000003613	0.001353	0.000003613	0.000003613	0.000003613	0.000003613
27.68	27.68	0.0003787	1.046	0.0003787	1.046	0.0003787	0.0003787	0.0003787	0.0003787
0.01602	0.01602	0.00003787	0.01130	0.00003787	0.01130	0.00003787	0.00003787	0.00003787	0.00003787
0.005333	0.005333	0.00005333	0.0005333	0.00005333	0.0005333	0.00005333	0.00005333	0.00005333	0.00005333
0.1198	0.1198	0.004287	1.329	0.004287	1.329	0.004287	0.004287	0.004287	0.004287
1.187	1.187	0.04287	13.29	0.04287	13.29	0.04287	0.04287	0.04287	0.04287
1.329	1.329	0.04801	14.60	0.04801	14.60	0.04801	0.04801	0.04801	0.04801

POWER EQUIVALENTS									
Hp. 1350 Standard	Watts	Cal. per sec.	Watts	Cal. per sec.	Watts	Cal. per sec.	Watts	Cal. per sec.	Watts
1.000	1.000	0.0003613	1.353	0.0003613	1.353	0.0003613	1.353	0.0003613	1.353
0.001	0.001	0.000003613	0.001353	0.000003613	0.001353	0.000003613	0.001353	0.000003613	0.001353
27.68	27.68	0.0003787	1.046	0.0003787	1.046	0.0003787	1.046	0.0003787	1.046
0.01602	0.01602	0.00003787	0.01130	0.00003787	0.01130	0.00003787	0.01130	0.00003787	0.01130
0.005333	0.005333	0.00005333	0.0005333	0.00005333	0.0005333	0.00005333	0.0005333	0.00005333	0.0005333
0.1198	0.1198	0.004287	1.329	0.004287	1.329	0.004287	1.329	0.004287	1.329
1.187	1.187	0.04287	13.29	0.04287	13.29	0.04287	13.29	0.04287	13.29
1.329	1.329	0.04801	14.60	0.04801	14.60	0.04801	14.60	0.04801	14.60

VELOCITY EQUIVALENTS									
Cent. per Sec.	M. per Min.	Km. per Hour	Ft. per Hour	Ft. per Min.	Ft. per Sec.	M. per Min.	Km. per Hour	Ft. per Hour	Ft. per Min.
1.000	1.000	1.609	5.280	1.609	1.609	1.609	5.280	5.280	1.609
0.001	0.001	0.001609	0.005280	0.001609	0.001609	0.001609	0.005280	0.005280	0.001609
100	100	160.9	528.0	160.9	160.9	160.9	528.0	528.0	160.9
37.78	37.78	60.56	193.3	60.56	60.56	60.56	193.3	193.3	60.56
30.48	30.48	48.84	158.7	48.84	48.84	48.84	158.7	158.7	48.84
44.70	44.70	71.88	234.4	71.88	71.88	71.88	234.4	234.4	71.88

THERMAL CONDUCTIVITY EQUIVALENTS									
Cal. per sq. cm. per sec. per °C.	Cal. per sq. cm. per sec. per °F.	Watts per sq. cm. per °C.	Watts per sq. cm. per °F.	Cal. per sq. cm. per sec. per °C.	Cal. per sq. cm. per sec. per °F.	Watts per sq. cm. per °C.	Watts per sq. cm. per °F.	Cal. per sq. cm. per sec. per °C.	Cal. per sq. cm. per sec. per °F.
1.000	1.000	0.0003613	0.0003613	1.353	1.353	0.0003613	0.0003613	1.353	1.353
0.001	0.001	0.000003613	0.000003613	0.001353	0.001353	0.000003613	0.000003613	0.001353	0.001353
27.68	27.68	0.0003787	0.0003787	1.046	1.046	0.0003787	0.0003787	1.046	1.046
0.01602	0.01602	0.00003787	0.00003787	0.01130	0.01130	0.00003787	0.00003787	0.01130	0.01130
0.005333	0.005333	0.00005333	0.00005333	0.0005333	0.0005333	0.00005333	0.00005333	0.0005333	0.0005333
0.1198	0.1198	0.004287	0.004287	1.329	1.329	0.004287	0.004287	1.329	1.329
1.187	1.187	0.04287	0.04287	13.29	13.29	0.04287	0.04287	13.29	13.29
1.329	1.329	0.04801	0.04801	14.60	14.60	0.04801	0.04801	14.60	14.60

HEAT FLOW EQUIVALENTS									
Cal. per sq. cm. per sec. per °C.	Cal. per sq. cm. per sec. per °F.	Watts per sq. cm. per °C.	Watts per sq. cm. per °F.	Cal. per sq. cm. per sec. per °C.	Cal. per sq. cm. per sec. per °F.	Watts per sq. cm. per °C.	Watts per sq. cm. per °F.	Cal. per sq. cm. per sec. per °C.	Cal. per sq. cm. per sec. per °F.
1.000	1.000	0.0003613	0.0003613	1.353	1.353	0.0003613	0.0003613	1.353	1.353
0.001	0.001	0.000003613	0.000003613	0.001353	0.001353	0.000003613	0.000003613	0.001353	0.001353
27.68	27.68	0.0003787	0.0003787	1.046	1.046	0.0003787	0.0003787	1.046	1.046
0.01602	0.01602	0.00003787	0.00003787	0.01130	0.01130	0.00003787	0.00003787	0.01130	0.01130
0.005333	0.005333	0.00005333	0.00005333	0.0005333	0.0005333	0.00005333	0.00005333	0.0005333	0.0005333
0.1198	0.1198	0.004287	0.004287	1.329	1.329	0.004287	0.004287	1.329	1.329
1.187	1.187	0.04287	0.04287	13.29	13.29	0.04287	0.04287	13.29	13.29
1.329	1.329	0.04801	0.04801	14.60	14.60	0.04801	0.04801	14.60	14.60

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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.

C to F				F to C			
C.	F.	C.	F.	C.	F.	C.	F.
17 H	0	10 G	51	10 G	51	10 G	51
17 2	1	11 1	52	11 1	52	11 1	52
16 7	2	11 7	53	11 7	53	11 7	53
16 1	3	12 2	54	12 2	54	12 2	54
15 6	4	12 8	55	12 8	55	12 8	55
15 0	5	13 3	56	13 3	56	13 3	56
14 4	6	13 9	57	13 9	57	13 9	57
13 9	7	14 4	58	14 4	58	14 4	58
13 3	8	15 0	59	15 0	59	15 0	59
12 8	9	15 6	60	15 6	60	15 6	60
12 2	10	16 1	61	16 1	61	16 1	61
11 7	11	16 7	62	16 7	62	16 7	62
11 1	12	17 2	63	17 2	63	17 2	63
10 6	13	17 8	64	17 8	64	17 8	64
10 0	14	18 3	65	18 3	65	18 3	65
9 44	15	18 9	66	18 9	66	18 9	66
8 89	16	19 4	67	19 4	67	19 4	67
8 33	17	20 0	68	20 0	68	20 0	68
7 78	18	20 6	69	20 6	69	20 6	69
7 22	19	21 1	70	21 1	70	21 1	70
6 67	20	21 7	71	21 7	71	21 7	71
6 11	21	22 2	72	22 2	72	22 2	72
5 56	22	22 8	73	22 8	73	22 8	73
5 00	23	23 3	74	23 3	74	23 3	74
4 44	24	23 9	75	23 9	75	23 9	75
3 89	25	24 4	76	24 4	76	24 4	76
3 33	26	25 0	77	25 0	77	25 0	77
2 78	27	25 6	78	25 6	78	25 6	78
2 22	28	26 1	79	26 1	79	26 1	79
1 67	29	26 7	80	26 7	80	26 7	80
1 11	30	27 2	81	27 2	81	27 2	81
0 56	31	27 8	82	27 8	82	27 8	82
0	32	28 3	83	28 3	83	28 3	83
0 56	33	28 9	84	28 9	84	28 9	84
1 11	34	29 4	85	29 4	85	29 4	85
1 67	35	30 0	86	30 0	86	30 0	86
2 22	36	30 6	87	30 6	87	30 6	87
2 78	37	31 1	88	31 1	88	31 1	88
3 33	38	31 7	89	31 7	89	31 7	89
3 89	39	32 2	90	32 2	90	32 2	90
4 44	40	32 8	91	32 8	91	32 8	91
5 00	41	33 3	92	33 3	92	33 3	92
5 56	42	33 9	93	33 9	93	33 9	93
6 11	43	34 4	94	34 4	94	34 4	94
6 67	44	35 0	95	35 0	95	35 0	95
7 22	45	35 6	96	35 6	96	35 6	96
7 78	46	36 1	97	36 1	97	36 1	97
8 33	47	36 7	98	36 7	98	36 7	98
8 89	48	37 2	99	37 2	99	37 2	99
9 44	49	37 8	100	37 8	100	37 8	100
10 0	50						

TEMPERATURE CONVERSION TABLES (Cont'd)
By Albert Sauveur

1000 to 10000			
C	F	C	F
38	100	212	248
43	110	230	254
49	120	248	266
54	130	266	274
60	140	284	286
66	150	302	294
71	160	320	302
77	170	338	314
82	180	356	322
88	190	374	330
93	200	392	342
99	210	410	354
100	212	413	357
104	220	428	362
110	230	446	374
116	240	464	386
121	250	482	398
127	260	500	410
132	270	518	422
138	280	536	434
143	290	554	446
149	300	572	458
154	310	590	470
160	320	608	482
166	330	626	494
171	340	644	506
177	350	662	518
182	360	680	530
188	370	698	542
193	380	716	554
199	390	734	566
204	400	752	578
210	410	770	590
216	420	788	602
221	430	806	614
227	440	824	626
232	450	842	638
238	460	860	650
243	470	878	662
249	480	896	674
254	490	914	686
260	500	932	698
266	510	950	710
271	520	968	722
277	530	986	734
282	540	1004	746

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

TEMPERATURE CONVERSION TABLES (Cont'd)
By Albert Sauveur

1000 to 2000					
C	F	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 — Concluded**
By Albert Sauveur

2000 to 3000					
C	F	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

**TEMPERATURE END POINTS
OF PYROMETRIC CONES**

DEFINITION: Pyrometric Cone Equivalent (P. C. E.) is the case of refractories, the number of that standard cone whose tip would touch the surface of the material being investigated when tested in accordance with the Standard Method of Test for P. C. E. of Fireclay Bricks (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."

LARGE CONES			P.C.E. CONES		
Cone	°C	°F	Cone	°C	°F
022	585	1085	11	1294	2361
021	602	1116	12	1306	2383
020	625	1157	13	1349	2460
019	668	1234	14	1398	2548
018	696	1285	15	1430	2606
017	727	1341	16	1491	2716
016	767	1407	17	1512	2754
015	790	1454	18	1522	2772
014	834	1533	19	1541	2806
013	869	1596	20	1564	2847
012	866	1591	23	1605	2921
011	886	1627	26	1621	2950
010	887	1629	27	1640	2984
09	915	1679	29	1659	3018
08	945	1733	31	1683	3061
07	973	1783	31½	1699	3090
06	991	1816	32	1717	3123
05	1031	1888	32½	1724	3135
04	1050	1922	33	1743	3169
03	1086	1987	34	1763	3205
02	1101	2014	35	1785	3245
01	1117	2043	36	1804	3279
1	1136	2077	37	1820	3308
2	1142	2088	38*	1850	3362
3	1152	2106	39*	1865	3389
4	1168	2134	40*	1885	3425
5	1177	2151	41*	1970	3578
6	1201	2194	42*	2015	3659
7	1215	2219	†Heated at rate of 80°C/hr. ‡Heated at rate of 150°C/hr. *Heated at rate of 600°C/hr.		
8	1236	2257			
9	1260	2300			
10	1285	2345			

*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 had been approved by the A. S. T. M. based on the work of Fairchild and Peters. J. Amer. Cer. Soc. 9, 201 (1926). Revisions in the A. S. T. M. for cones 12 to 37 inclusive were adopted in June, 1955. A. S. T. M. Standards 1955, 711-715. Heating rate 100° Cent per hour (180° F per hour) 150° Cent per hour (270° F per hour). Cone 38, slower rate of heating common in the commercial firing and to use of refractory materials.

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	1 1/2	76.2	0.207	3 in.
2	1	50.8	0.192	2 in.
1 1/2	3/4	38.1	0.148	1 1/2 in.
1	0.50	26.67	0.148	1 0/16 in.
0.883	0.22	4.3	0.115	3/8 in.
	742	18.85	0.135	1/4 in.
	624	15.85	0.120	5/16 in.
	525	13.3	0.105	0.530 in.
	441	11.20	0.105	7/16 in.
	371	9.423	0.092	3/8 in.
2 1/2	312	7.925	0.088	5/16 in.
3	263	6.680	0.070	0.265 in.
3 1/2	221	5.613	0.065	No. 3 1/2
4	185	4.699	0.065	No. 4
5	156	3.962	0.044	No. 5
6	131	3.327	0.036	No. 6
7	110	2.794	0.028	No. 7
8	93	2.362	0.032	No. 8
9	078	1.981	0.033	No. 10
10	065	1.651	0.035	No. 12
12	055	1.397	0.028	No. 14
14	046	1.168	0.025	No. 16
16	0390	0.991	0.0235	No. 18
20	0328	0.833	0.0172	No. 20
24	0276	0.701	0.0141	No. 25
28	0232	0.589	0.0125	No. 30
32	0195	0.495	0.0118	No. 35
35	0164	0.417	0.0122	No. 40
42	0138	0.351	0.0100	No. 45
48	0116	0.295	0.0092	No. 50
60	0097	0.246	0.0070	No. 60
65	0082	0.208	0.0072	No. 70
80	0069	0.175	0.0056	No. 80
100	0058	0.147	0.0042	No. 100
115	0049	0.124	0.0038	No. 120
150	0041	0.104	0.0026	No. 140
170	0035	0.089	0.0024	No. 170
200	0029	0.074	0.0021	No. 200
250	0024	0.061	0.0016	No. 230
270	0021	0.053	0.0016	No. 270
325	0017	0.043	0.0014	No. 325
400	0015	0.038	0.0010	No. 400

* Standard in Refractories Industry.

WEIGHTS OF VARIOUS MATERIALS

Material	Pounds Per Cu Ft (Avg.)	Material	Pounds Per Cu Ft (Avg.)
BRICK		METALS	
Building	87 137	Aluminum	166 168
Fireclay	118 152	Brass, cast	523 534
Silica	102 115	Bronze, 14% Sn	555
Chrome	175 180	Copper, cast, rolled	552 556
Magnesia as brick or fused in furnace	162 170	Copper, rolled or wire	555
CEMENT		Iron, gray cast	438 445
Portland, loose	80 90	Iron, white cast	473 482
Aluminous, loose	90 100	Iron, wrought	486 493
FINE GROUND CLAYS, SILICA CEMENT ETC		Lead, cast	708
Fire Clay	50 110	Lead, rolled	711
Calcined Fire Clay	70 95	Nickel	536 555
Silica Cement	75 83	Steel, cast or rolled	474 490
Magnesia Cement	127	Tin cast	455 459
Chrome Cement	135	Zinc cast	439 447
Grain Magnesite (as shipped)	112	OILS	
COAL AND COKE		Crude	48 62
Anthracite	87 112	Fuel Oil	
Bituminous	75 94	No. 1	51 52
Charcoal	10 35	No. 2	52 53
Coke	23 32	No. 3	54 55
CONCRETE		Bunker C.	60 63
Cement, stone, sand	120 155	Gasoline	44 47
Cement, slag, etc	110 130	Kerosene	48 51
EARTH		Lubricating Oil	55 59
Loam, dry loose	63 76	ROCKS IN SOLID	
Loam, packed	85 95	Chalk	118 125
Loam, soft, loose mud	90 108	Dolomite	175 178
Loam, dense mud	110 125	Granite	165 175
GLASS		Gypsum	143 146
Common window	156 160	Limestone and marble	165 172
Plate	157 161	Magnesite	187 190
Container	152 159	Pumice	40 50
Laboratory	136 140	Quartz	162 165
Optical	133 507	Sandstone	134 162
LIME		Shale	162 172
Mortar	100	Slate, American	175
Quick, loose lumps	53	Soapstone, talc	162 175
Quick, line	75	SAND	
Slaked	81 87	Dry, loose	100
Stone, solid	165 172	Dry, packed	110
Stone, crushed	85 100	Wet, packed	120
MASONRY		Gravel, packed	118
Granite or limestone	165 172	WATER	
Mortar rubble	150 155	As ice	57 2
Sandstone	110 147	At 32°F	62 4
		At 212°F	59 8

GLOSSARY (Cont'd)

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.

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

CORROSION OF REFRACTORIES Destruction of refractory surfaces by the chemical action of external agencies.

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.

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.

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.

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.

FLUX BLOCKS—Refractory shapes which are used in contact with molten glass in furnaces.

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.

GLOSSARY (Cont'd)

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.

GROG Burned refractory material, usually calcined clay or crushed fire brick.

HAUNCH That portion of an arch which is midway between the skewback and the crown.

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

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

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.

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.

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

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

LEAN MORTAR Mortar having poor troweling properties.

NEUTRAL REFRACTORIES A term applied to refractories which are neither strongly basic nor strongly acid, such as chromite, mullite, or carbon.

NINE INCH EQUIVALENT The volume of a 9"x4 1/2"x2 1/2" 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.

GLOSSARY (Cont'd)

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.

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.

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.

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.

RED HEART A harmless reddish core, sometimes found in fire clay refractories.

RING - The sound produced when two brick are struck together or when one brick is tapped with a hard object.

RISE--The vertical distance between a plane connecting the spring lines and the highest point of the under side of an arch.

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.

SCUTCH--A hand tool resembling a small pick with flat cutting edges for trimming brick to the desired size or shape.

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

GLOSSARY — Concluded

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.

SINGLE SCREENED GROUND REFRACTORARY 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.

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

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

SPRING LINE The line of contact between the inside surface of an arch and the skewback.

SPRUNG ARCH An arch which is supported by abutments at the sides or ends only.

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.

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

SUSPENDED ARCH An arch in which the brick shapes are suspended from overhead supporting members.

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.

TOP BRICK Fireclay brick for use in lining the top section of a blast furnace.

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

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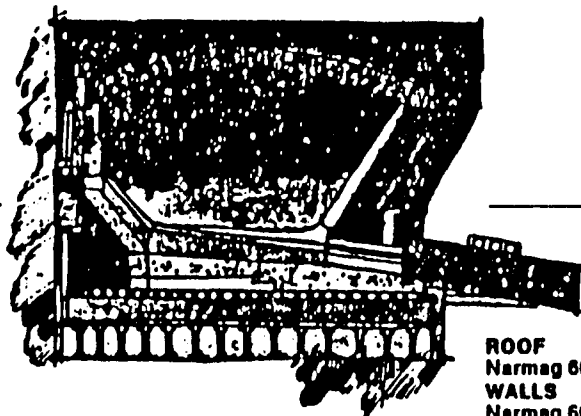
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open hearth and Narco Refractories

Stepped-up demand for steel has also stepped up the service requirements for refractories in existing open hearths. And has placed a large premium on longer life between open hearth relining.

NARCO Refractories for open hearths can be supplied in a number of chemistries to give extended life in the bottom, along the slag line and in the roof where gases and high-impingement flames corrode and erode the lining.

There are NARCO brick and shapes to expedite relining any type, size, and shape of open hearth. Close control of dimensions assures that NARCO refractories can be laid up at top economic speed. And that the refractories will stay firmly in place for many more heats between shut-downs.



ROOF
Narmag 60DBRC
WALLS
Narmag 608C
Narmag 60DBC
Narmag 60DBRC
SUBHEARTH
Narmag 90B
Narmag B



NORTH AMERICAN REFRACTORIES CO.

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Cleveland, Ohio 44114
Phone: 216/621-5200

an **Eltra** company



NARCO REFRACTORIES for Steel Making

- Maximum life between relines
- Low refractory cost per ton of steel
- Products tailored to every service need
- Superior wear resistance



higher-cost
refractories
can cost less...in the long run

More expensive energy sources ... ever-rising hourly rates for masons ... skyrocketing steel-making equipment costs ... the need to increase productivity ...

These factors combine to greatly increase your per-ton cost of making and processing steel. Suddenly, refractories that promise greater life expectancy are economically more attractive ... even when they cost slightly more.

With refractories that stretch out the time between major rebuilds, you increase productive on-stream time. With refractories that stand up against the physical and metallurgical punishment of new steel-making processes, you greatly reduce the costly non-productive periods required for patching.

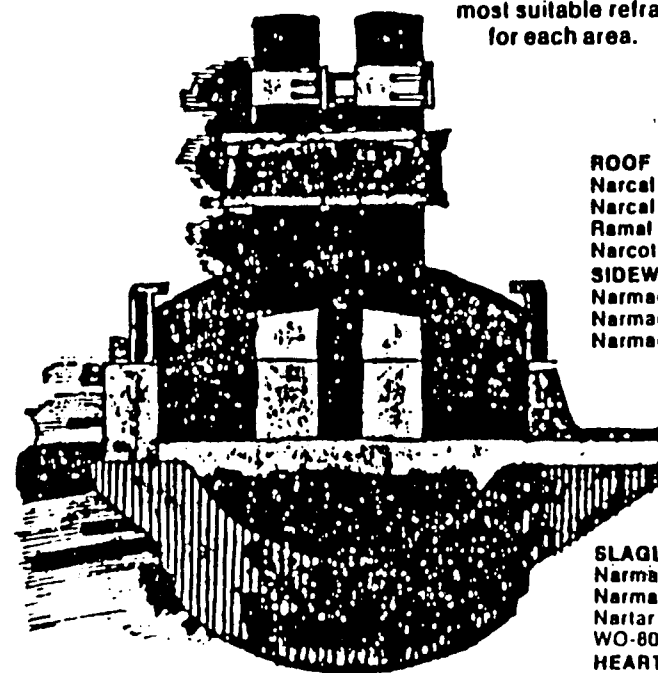
NARCO Refractories can be supplied promptly to handle any process in your steel plant. Basic or acid. Blast furnace to continuous caster. Electric furnace to AOD vessel.

refractories for electric furnaces

In the NARCO line, there are refractories for basic and acid practices in electric furnaces used for making steel.

We have developed refractories that have higher resistance to the destructive effects of basic practice. And we have developed refractories to give longer life in today's ultra-high powered electric furnaces. Properties include better strength at higher temperatures, superior resistance to impact and abrasion, thermal-shock endurance, and low porosity and permeability. Together these properties can keep your electric on-stream longer between repairs and relining, increase your yearly tonnage ... improve your operating ratios, and profitability.

Differences in zone-by-zone refractory service requirements call for a variety of refractories to work together in meeting all the conditions. We can supply the most suitable refractory for each area.



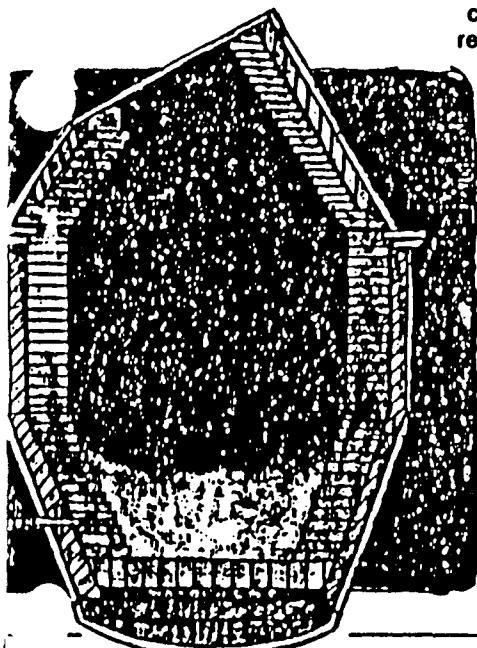
ROOF
Narcal 70D
Narcal 85B
Ramal 85
Narcotab
SIDEWALLS
Narmag 608C
Narmag 60DBC
Narmag 60DBRC

SLAGLINE
Narmag B
Narmag 608
Nartar Pad
WO-808
HEARTH
ALL-BRICK
Nartar Pad
SUBHEARTH
Narmag 90B
Narmag B

Refractories for A.O.D. Lining

In argon-oxygen-decarburization reactors, unique factors cause unusual refractory wear problems. These factors are: thermal shock from temperature variations, oxidation reduction reactions caused by partial oxygen pressures during argon blowing, slag contamination at the hot face, high turbulence during gas injection, low-basicity slags. Plus some unique operating variables inherent in the A.O.D. process.

Obviously, the special conditions in the A.O.D. vessel call for special refractories to meet these conditions. A number of NARCO Refractories have been created to deliver maximum refractory life in A.O.D.'s and keep your refractory cost per ton of steel low.



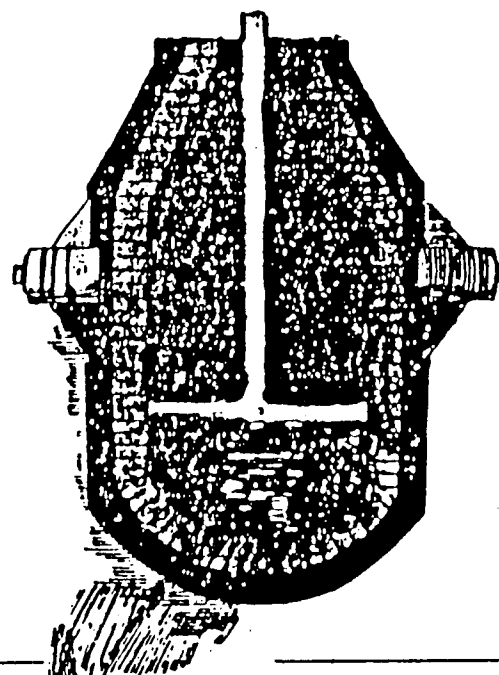
CONE
Narmag 600B
WORKING LINING
Narmag 608
TUYERE ZONE
Narmag 608
Rebonded Fused Grain
BOTTOM
Narmag 608
SAFETY LINING
Narmag 30B
Narmag 608
SEALS
Narcal 90P (plastic)

NARCO low-porosity 60% MgO direct bonded brick (NARMAG 608) with an accessory phase of dicalcium silicate has proved highly satisfactory for use in most areas of A.O.D.'s operating in this country. Rebonded fused-grain brick may be required above the tuyeres to balance wear. NARMAG 608 has shown excellent performance in withstanding the stirring action during gas injection, gas-bubble cavitation, variations in chemistry caused by oxygen pressure variations, temperature fluctuations, and slag/metal chemistry reactions.

There are ideal NARCO refractories for each zone . . . vessel liners, hoods, tuyere area, and safety linings. Ask us for recommendations that have been proved in service in nearly all the A.O.D. shops around the country.

Refractories for BOP's

NARCO has developed a complete family of refractories to meet the special needs and tougher environment of the BOF. We have also accelerated our production and delivery of these special refractories to make the most of the shorter downtime periods required for relining a BOF. Our production schedules and local warehousing for all NARCO refractories for BOF's can provide all your needs promptly.

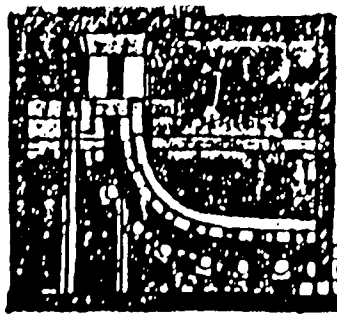


CONE
Nartar BT
Super Nartar AT
Super Nartar AT-M
BARREL
Super Nartar AT
Super Nartar AT-M
Nartar Pad
Nartar 7
CHARGE PAD
Nartar Pad
Nartar 7
BOTTOM
Nartar BT
Super Nartar AT
Super Nartar AT-M
SAFETY LINING
Narmag 90B
Narmag 8
Nartar Pad

Brick dimensional uniformity is quite critical in the life expectancy and endurance of a BOF lining. NARCO shapes are true to size and free from warped surfaces to simplify lay-up and deliver maximum service on extended BOF schedules.

For the newer Q-BOP furnaces, we have adapted certain NARCO refractories originally compounded for BOF's. Presently NARCO refractory materials are used in all Q-BOP's in North America.

The performance and cost of refractory/ton of steel of NARCO materials for the BOF's and Q-BOP's are highly satisfactory both technically and costwise to steel makers throughout the Western hemisphere.

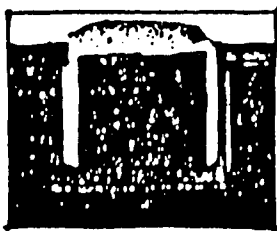
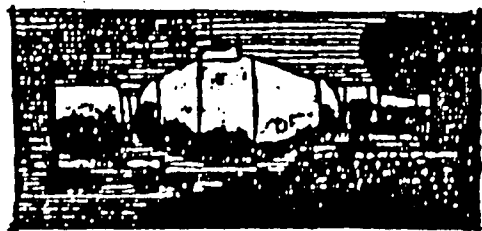


continuous casters

Two major applications for NARCO refractories in continuous casters are the ladle and the tundish.

NARCO refractories with special characteristics have been developed for the tundish applications. These refractories are compounded to have high resistance to: impact wear from the ladle outflow, slagging, gassing, and the chemical/metallurgical effects of special continuous-caster-grade alloys.

Ladle linings used with continuous casters are laid up with NARCO high-alumina, expanding-type ladle brick. These bricks have greater resistance to higher tapping temperatures and extended holding times common in this type of service. Their expansion characteristics provide tighter joints and greater freedom from rat-holing.



other applications in steel making

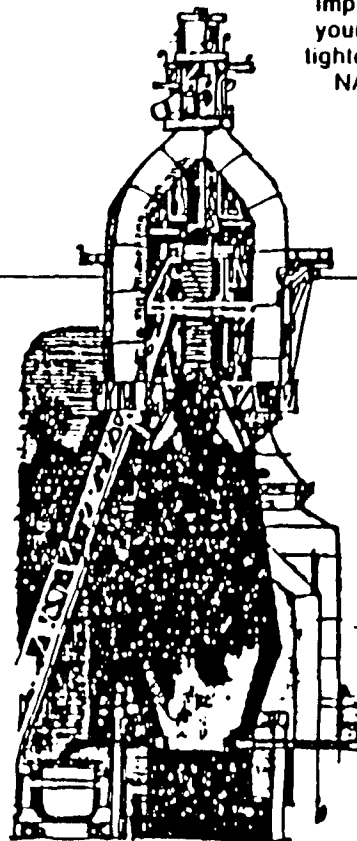
There are job-proved NARCO Refractories for every spot in the steel plant. In addition to the ones already discussed, NARCO Refractories are used in hot-metal cars, and other places where minimum downtime, maximum time between scheduled repairs, and low refractory cost to steel tonnage are important.

Ladle slide gates and nozzles in chemistries to withstand any combination of chemical attack, erosion, and physical opening and shutting of the gates are supplied by NARCO. We can provide shapes and sizes to work perfectly with any ladle gating system.

Call your NARCO man, or write us for technical advice, specification help, and refractory data.

refractories for blast furnaces

Demands for greater blast furnace availability and a decision by many steel makers to eliminate stand-by furnace capacity have greatly increased the importance of top-quality refractories that will stay on the job longer. NARCO researchers have developed improved grades of refractories to meet your demands. To help your masons lay tighter bottoms and walls, we can supply NARCO brick of all grades true to size and free from warpage.



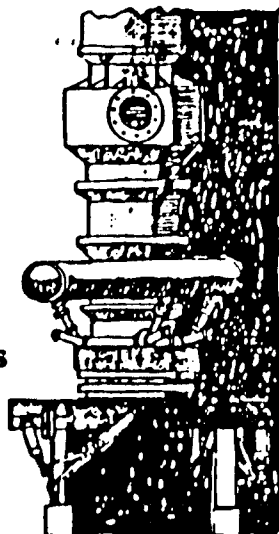
STOCKLINE
Mohawk BF
Farber BF
Narcal 606
UPPER INWALL
Farber BF
Mohawk BF
LOWER INWALL
Farber BF
Mohawk BF
Narcal 606
Narcal 606i

BOSH
Mohawk BF
Narcal 606
Narcal 606i
BOTTOM
Mohawk
Farber BF
GUN REPAIRS
Narco Blast Furnace
Castable

Our NARCO line contains a full range of refractories to operate longer, minimize wear in all blast furnace zones under greatly extended operation periods, and reduce your refractory cost per ton of steel. These refractories have higher resistance to CO disintegration, thermal shock, alkali attack, impact and abrasion, and slag attack.

The NARCO line includes brick shapes, castables, gun mixes, and a variety of mortars. Stoves are also an application where NARCO refractories have an enviable record of life, low cost, and maximum operating service time, top temperatures approaching 2800°F. We also supply special silica brick for the new European-type stoves.

Refractories for Cupolas



Cupolas impose some of the most severe conditions on refractories of any equipment in the foundry. The refractory has to withstand a combination of abrasion, heat, thermal shock, acid or basic slag chemistries and mechanical stress. Added to these are high velocity air blast, spotty air impingement caused by channeling because of non uniform density of the charge, and variations in tuyere design. No one refractory can be the answer to all these punishing variables in day-to-day foundry operations and materials.

MARCO can provide a complete range of refractories developed and proved to work best at each trouble spot.

Taphole	Trough Area	Well & Bottom	Charge Area
RAMAK	RAMAK	RAMAK P	GUNCRETE
RAMAK P	RAMAL 80G	NARCAL 60PG	
RAMAL 85G	RAMAL 85G	NARCOLINE	

Refractories

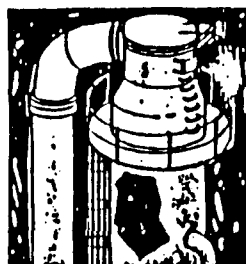


...for Ladles and Forehearth

Transfer and inoculating ladles are readily lined with MARCO Refractories brick ramming mixes, plastics and castables. These have been developed to give maximum resistance to fluid erosion, chemical attack and thermal shock. Users report longer in service life and less repair downtime.

Brick	Plastic	Ramming Mix	Castable
NARCAL 60G	NARCOLINE	BLITZ	NARCOLAS 30
NARCAL 70D	SHUR RAM	CARLINE	NARCOLAS 60
NARTAR PAD	NARCAL 60PG	FIRELINE	
	NARCAL 70P		
	NARPHOS 70P		

...for Anti-Pollution Systems



High temperature entry areas on dust collectors and fume removal systems are protected from heat, corrosives and high velocity dust laden air impingement by MARCO refractory linings. The wide variety of available forms of refractories that can be brick lined, cast or gunned permits their use in all types of hot spot anti-pollution systems and equipment. Call on MARCO for refractory recommendations, as well as for solutions to unusual refractory problems, equipment operations, and slag chemistries. Ask your regional MARCO sales technician. Or write or phone us.



NORTH AMERICAN REFRACTORIES CO.

Hanna Building
Cleveland, Ohio 44115
Phone 216/621-5200

an Eltra Company

NARCO REFRACTORIES for Foundries



A Narco Refractory for every place in the foundry

As the operating objectives of modern foundries continue to focus on profitability and quality assurance, NARCO continues to develop new refractories and improve time-tested ones to help meet those requirements.

Close contact with foundry men from super-visit lets NARCO sales and technical people keep abreast of foundry progress in two areas: the industry state-of-the-art and upgraded equipment and techniques in individual foundries.

This close contact with the user plus the intensive research and development programs at the NARCO Research Center, gives us a lead position in all types, chemistries and forms of foundry refractories.



Refractories for Electric Furnaces

Induction and direct arc electric furnace linings must resist the mechanical impact of scrap charging, stresses set up in tilting, arcing, as well as chemical attack by metal and slag constituents.

Melting temperatures can be especially high and spotty. These hot spots increase localized wear and need for repair.

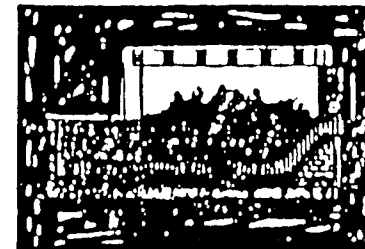
For all types and capacities of electric furnaces, there is a family of NARCO Refractories that will improve productivity, reduce downtime and cut annual refractory costs.

Direct Arc Furnaces

Roofs	Sidewalls
NARCAL 606	MT (I R) (Silica)
NARCAL 700	NARCAL 606 (High Alumina)
	NARCAL 700 (High Alumina)
	Base: NARMAG 600 (Direct Bounded)
	NARMAG 600IR (Direct Bounded)
	NARMAG 600P (Flux Bounded)
	CARMAG (Carbon Magnesite)

Induction Furnaces

Working Linings	Back up Linings	Spouts & Patching
NARCAL 85B	NARCAL 85B	NARCAL 90P
RAMAL 85	NARCAL 700	NARCAL 90P
RAMAL 90	NARCAL 606	NARCAL 85P
		NARCAL 85P



Refractories for Aluminum Furnaces

NARCO brick, castable and plastic refractories have excellent service and performance records in the melting furnaces of many aluminum foundries, both jobbing and captive.

NARCO bricks are especially recommended for their outstanding life under these conditions: Mechanical abuse (shoving, charging and skimming), Aggressive fluxes, Reactive alloys and additives, Intermittent furnace operation.

They especially show excellent life and economy in the sidewalls and hearths exposed to molten aluminum.

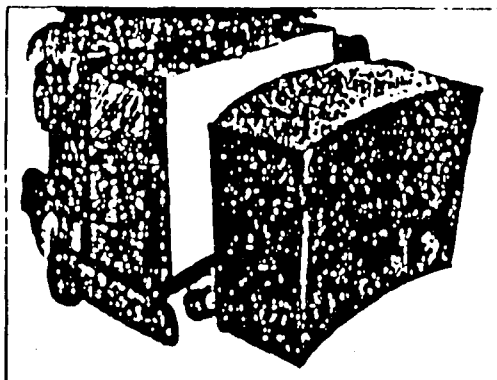
NARCO plastic and castable materials have the rugged properties needed for upper walls and roofs. Their service life, of course, is based on the care used in installation so that a tight and leak-proof lining is obtained. Positive anchorage is also a must.

Combinations of NARCO brick, castable and plastic refractories are operating with high success in many types of aluminum melting furnaces under varying operating conditions.

Recommended NARCO Refractories

Lower Sidewalls & Hearth	Upper Walls	Roofs
NARCAL 85B and 85C brick for metal contact areas	NARCO 68 Super Duty Fuelbrick	NARCO 68 brick and suspended tile
NARCAL 85P Plastic and RAMAL 85 Ramming Mix in metal contact areas under certain specific conditions	SHIR RAM Plastic Fuelbrick	NARCOCAST 30 or NARCOCAST 60 Castable

Customized recommendations and drawings will be supplied on request.



NEW REFRACTORY FROM NARCO...

NARMAQ 608K-C delivers longer life in the burning zone.

This patented refractory was developed by NARCO research to meet the requirements of Portland cement producers for a basic liner that will provide substantially longer burning zone life.

NARMAQ 608K-C refractory is 20% less porous than most direct-bond brick. Its unique combination of properties includes chemical compatibility with the kiln feed, produces faster clinker coating formation, improves fuel utilization. This makes the clinker coating more stable. Combined with the fact that in most cases, the clinker coating can be removed from the liner with minimum damage to the surface of NARMAQ 608K-C refractory.

NARMAQ 608K-C's 20% lower porosity reduces penetration of the refractory pores by alkalies and sulfides. It also holds thermal dimensional changes to a minimum, resulting in less change in refractory microstructure at elevated process temperatures. (The tendency of this product to spall during outages is also less than with other basic brick.)

Chemical compatibility of NARMAQ 608K-C with the feed in the burning zone is excellent. This prevents the development of an overly dense structure in the refractory hot face that can cause undesirable spalling during outages.

Higher strengths at refractory operating temperatures greatly improve the structural stability of the refractory at maximum kiln zone temperatures. It also improves the resistance of the refractory to mechanical torsional stresses set up in kiln and liner during rotation.

For complete information, analysis, and lining recommendations on our newest NARMAQ 608K-C refractory in all standard shapes, call your NARCO sales/service representative.



OUR SERVICE EQUALS OUR LINE... IT'S COMPLETE!

Technical Services: When you need recommendations or answers, the NARCO Technical Services staff will provide them promptly, using the latest developments in refractory technology and the newest improvements in the state of the art as their bases. If yours is an unique problem, NARCO refractories research will provide unique answers... or even develop a special refractory to meet your need.

Quality Control Lab: Uniform adherence to chemical and physical specifications is carefully maintained by regular, statistically-determined production line tests of all NARCO refractory materials in our own Quality Control Laboratories. NARCO also runs tests under conditions that parallel your own operating environments.

Field Service Staff: In the actual installation of refractory materials in commercial kilns, the NARCO Field Installation staff can install NARCO monolithic specialty refractories to

supplement your own lay-up crews or masonry contractors in getting the job done quickly and properly. Our staff can also provide supervisory assistance for your crews when unusual lay-up is required or new materials are being installed.

Engineering: Engineering assistance and lay-up drawings for all parts of your kiln and its auxiliaries are available when you require them.

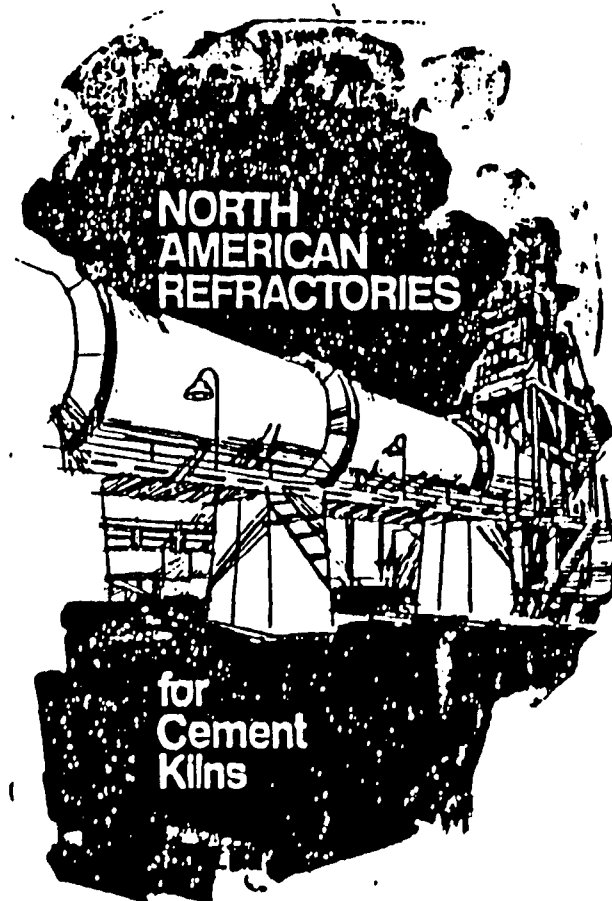
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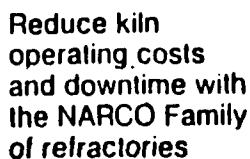


NORTH AMERICAN REFRACTORIES CO.

National City/East Sixth Bldg
Cleveland, Ohio 44114
Phone 216/621-5200

an Eltra Company





Higher rates for skilled masons make rebarbing even more costly. The rate between refractory cost and labor rates now makes it wise to buy better refractories with longer life expectancy, thus reducing labor costs by reducing the number of lin outages.

You are struggling with an unusual combination of operating circum-

stances . . . keep production up . . .
hold maintenance costs down . . . use
energy more efficiently . . . reduce un-
productive downtime . . . make a profit
maintain cement quality and
uniformity

A refractory for every need

The NARCO line of cement kiln refractories was designed to meet the specific thermal, chemical, and mechanical requirements for prolonged service life in each zone of your kiln. We offer one of the most complete lines of refractories available to the Portland cement industry.

NARCO refractory researchers are not resting on their achievements. New combinations of refractory materials are being developed in a continuing program to keep NARCO number one in quality.

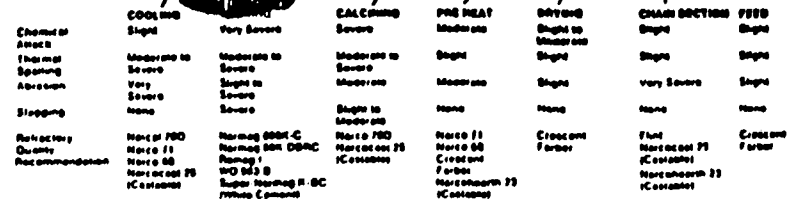
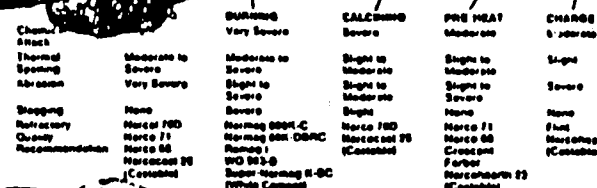
Let our kdn refractory engineers help you select the most suitable NARCO products for your particular kdn, fuel, operating procedures, raw materials, and end products. We can help you keep your kdn running longer between refractory-related outages.

NARCO REFRACTORY SELECTOR CHART FOR ROTARY CEMENT KILNS

From feed end to nose ring, any kiln can be lined with the right NARCO refractory shapes or castables to fully protect the structure, produce more cement with less downtime for refractory repairs and use precious fuel at maximum BTU efficiency.

The complete line of NARCO materials for cement kilns is described in various sections of this catalog. Index tabs will help you turn quickly to the selections that are recommended zone-by-zone on these kiln diagrams.

For specific recommendations and answers to special questions, please call us or your NARCO sales/service engineer.



NORTH AMERICAN REFRACTORIES CO. CLEVELAND, OH 44114
DIVISION OF ELTRA CORPORATION

PLANT NUMBER 50

MANIFEST NUMBER

No. HRC-2-71

D/C 19

PALLETS TYPE	NO.	TERR. CREDIT	INVOICES PRICED	BILL OF LADING	NOTICE SHIPMENT
		G-39	2-S	1-S	1-S
C/A					

SHIP TO

NAME

ADDRESS

CODE

ROUTE VIA

SOLD TO

CUST. NO.

NAME

ADDRESS

H. R. Curry Co., Inc.
1023 Main Street
Sharpsburg
Pittsburgh, Pa. 15215

YEAGER/BREMANS

H. R. Curry Co., Inc.
1023 Main Street
Pittsburgh, Pa. 15215

cc: Sales (2)
Curwensville (2)
H. R. Curry
B. McLean
Pgh.

REMARKS:

Delivery hours 8:00 A.M. to 4:00 P.M.

REQUESTED Hold for Release by Pittsburgh Office

TERMS	DATE ENTERED	CUST. ORDER NO.	CUST. REQ. NO.	CUST. ORDER DATED
NET 30 DAYS	2/25/71	HRC-2-71		
PRICES ARE F.O.B.	SHIPPED FROM	NET WEIGHT	FREIGHT RATE	DATE OF SHIPMENT
CURWENSVILLE PA.				
MINIMUM WEIGHT	PRICES INCLUDE FREIGHT ☐	PPD ☐ COL ☐	TOTAL SHIPPED	9" EQUIV. TONS DATE/RELEASE NO.
	REQUESTED ROUTING		CAR NO. OR B/L NO.	

QUANTITY		BRAND		DESCRIPTION	OUR DWO. NO.	WEIGHT PER PIECE	TOTAL WEIGHT	EQUIV. PER PIECE	TOTAL 9" EQUIV.	BASE	% EXTRA	PRICE	UNIT	AMOUNT
ORDERED	SHIPPED	NO.	NAME											
1 9,000#				ALSET (Wet) in 200# Drums <i>66 drums per pallet (3 Pallets)</i>					9,000#	165.		165.00	NT	
2 12,000#				NARCOSPAR in 100# Boxes					12,000#	110.		110.00	NT	
1 000#				SHUR-RAM in 100# Boxes					12,000#	100.		100.00	NT	
4 1,000#				AEROCASL in 50# Bags					8,000#	122.		122.00	NT	
5 750#				AEROGUN in 25# Bags (1 Pallet)					750#	195.		195.00	NT	
6 3,150#				NARCO STAZ-ON in 50# Bags (3 Pallets)					3,150#	192.		192.00	NT	
7 12,000#				NARCOCAST #32 in 100# Bags					12,000#	203.		203.00	NT	
8								EQUIV.	15,594					
9														
10														
11														
										CB	JJR			

EXHIBIT B

NORTH AMERICAN REFRACTORIES CO. CLEVELAND, OHIO 44114
DIVISION OF ELTRA CORPORATION

PLANT
NUMBER 50

MANIFEST
NUMBER

No. HRC10-71

B/C 73

PALLETS TYPE	NO.	TERR. CREDIT	INVOICES PRICES	BILL OF LADING	NOTICE OF SHIPMENT
		G-39	3-S	1-S	1-S
C/A					

SHIP TO

NAME H. R. Curry Company, Inc.
ADDRESS 1023 Main Street - Sharpsburg
CODE Pittsburgh, Pa. 15215

ROUTE VIA

YEAGER

✓ col Sales (2)
Curwensville (2)
Pgh.
Curry
FJL.

SOLD TO

CUST. NO. 237
NAME H. R. Curry Company, Inc.
ADDRESS 1023 Main Street - Sharpsburg
Pittsburgh, Pa. 15215

REMARKS:

Delivery Hours - 8:30 A.M. to 4:00 P.M.

BILLING DEPARTMENT:

ALLOW THE FOLLOWING DISCOUNT:

17% ON SPECIALTIES

15% ON CRESCENT.

DISTRIBUTED BY

H. R. CURRY CO., INC.

1023 MAIN ST.

SHARPSBURG, PENN. PA. 15215

Phone 721-1100

D. REQUESTED AS Soon As Possible

TERMS	DATE ENTERED	CUST. ORDER NO.	CUST. REQ. NO.	CUST. ORDER DATED
LESS REGULAR 4/1/71	3/30/71	HRC10-71	CONSIGMENT ACCOUNT	
PRICES ARE F.O.B.	SHIPPED FROM	NET WEIGHT	FREIGHT RATE	DATE OF SHIPMENT
CURWENSVILLE, PA.				
MINIMUM WEIGHT	PRICES INCLUDE FREIGHT	PPD COL	TOTAL SHIPPED	9" EQUIV. TONS DATE/RELEASE NO.
26M 7.2ONT	☐			
35M 6.3ONT	REQUESTED ROUTING			CAR NO. OR B/L NO.

QUANTITY		BRAND		DESCRIPTION		OUR DWG. NO.	WEIGHT PER PIECE	TOTAL WEIGHT	EQUIV. PER PIECE	TOTAL 9" EQUIV.	BASE	%EXTRA	PRICE	UNIT	AMOUNT
ORDERED	SHIPPED	NO.	NAME	SIZE											
3,000#			Narcocast	- 100# bags - on 1 pallet						3,000#	130.		130.00	ONT	
3,000#			Narcocast ES Coarse	- 100# bags - 1 pallet						3,000#	130.		130.00	ONT	
100#			Narcocrete	- 100# bags - on 1 pallet						2,000#	190.		190.00	ONT	
1,600#			Alset (wet)	- 200# drums - on 1 pallet						1,600#	165.		165.00	ONT	
60#			Alset (wet)	- 15# cans - in 1 carton						60#	250.		250.00	ONT	
3,000#			Narcocast 60	- 100# bags - on 1 pallet						3,000#	173.		173.00	ONT	
2,400#			Alset (wet)	- 100# drums - on 1 pallet						2,400#	170.		170.00	ONT	
1,050#			Staz-on	- 50# bags - on 1 pallet						1,050#	192.		192.00	ONT	
456			Crescent SM 9" Strt.	2 1/2" series - 1 pallet					1.00	456	205.		205.00	M	
2,280			Crescent DP 9" Strt.	2 1/2" series - 5 pallets					1.00	2,280	00		205.00	M	
1.5360	FT.		Block Insulation	- 2x6x36" - on 1 pallet									.29	BD, F	
			Crescent DP Sq. Edge Tiles	- 4x12x24"					11.38	23	192.	115	4.70	FA	

MANIFEST NO. 8601 NO. 111C17-71

ADDRESS

YEAGER TRUCKING

cc: Sales (2)
Curwensville (2)
Pgh.
Curry
FJL.

B/C 73

[illegible]

TERM. CREDIT

INVOICES	PRICES
----------	--------

BILL OF
LADING

NOTICE OF
SHIPMENTS

G-39

2-S

1-S

1-S

REMARKS:
CONF. TO VONDA MORGAN DO NOT DUP.
DELY HRS. 8:30AM TO 4:00PM.
TAKE EXTRA PRECAUTIONS SO THAT BAGGED
MATERIAL IS NOT DAMAGED IN SHIPMENT.

REQUESTED ASAP

DATE ENTERED	CUST. ORDER NO.	CUST. REQ. NO.	CUST. ORDER DATED
4/16/71	HRC17-71	CONSIGNMENT ACCOUNT	

PRICES ARE F.O.B.	SHIPPED FROM		NET WEIGHT		FREIGHT RATE		DATE OF SHIPMENT	
WURWENSVILLE, PA.							4/19/77	
MINIMUM WEIGHT	PRICES INCLUDE FREIGHT	☐	PPD	COL	TOTAL SHIPPED	9" EQUIV.	TONS	DATE/RELEASE NO.
REQUESTED ROUTING						CAR NO. OR B/L NO.		

BILLING: *Comm.*
ALLOW THE FOLLOWING DISCOUNTS.

SPECIALTIES	17%	STAZ-ON	10%
CRESCENT	15%		
NARCO 71	10%		

QUANTITY		BRAND		DESCRIPTION	OUR DWG. NO.	WEIGHT PER PIECE	TOTAL WEIGHT	EQUIV. PER PIECE	TOTAL 9" EQUIV.	BASE	EXTRA	PRICE	UNIT	AMOUNT
ORDERED	SHIPPED	NO.	NAME											
114				Crescont Sq. Edge Tilo - 2½x9x18" - 1 pallet				1.00	456	192.	75	1.34	EA	
90				Crescont DP Spec. Skew T-7478 - 1 pallet				2.82	254	00	90	1.03	EA	
51				Crescont DP #1 Wedge, 2½" series - 1 pallet				1.00	516	205.		205.00	CM	
60 pcs.				Narco 71 Strt. 9x9x2½" } - on 1 pallet				2.00	100	275.	55	.853	EA	
60 pcs.				Narco 71 #1 Wedge 9x9x2½" }				2.00	120	00	55	.853	EA	
304				Crescont DP 13½x4½x2½ Strt - 1 pallet				1.50	456	192.	40	.403	EA	
3200#				Alset (wet) 200# - on 2 pallets					3200#	165.		165.00	NT	
3000#				Shur-Ram 100# - on 1 pallet					3000#	100.		100.00	NT	
1050#				Staz-on 50# - on 1 pallet					1050#	192.		192.00	NT	
2280 pcs.				Crescont DP 9" Strt, 2½" series - 5 pallets				1.00	2280	205.		205.00	CM	
								EQUIV.	4182					
										CB	JR			



NORTH AMERICAN REFRACTORIES CO.

DIVISION OF ELTRA CORPORATION
CLEVELAND, OHIO 44114

SALES ORDER

PLANT **CURWENSVILLE**

CUSTOMER NO.	ROUTE VIA	BILL OF LADING	NOTICE OF SHIPMENT	CODE	B/C	TERRITORY CREDIT	INVOICES PRICED	SALES ORDER NO.
237	YEAGER	15	15		73	G-39		HRC19-71

BILL TO:

SHIP TO:

R.B. CURRY CO., INC.
1023 MAIN STREET
PITTSBURGH, PA.

SAME

SHIPPING DATES: **SHIPPED APRIL 26, 1971**

DATE ENTERED	CUSTOMER ORDER NO.	CUSTOMER REQ. NO.	CUSTOMER ORDER DATE	REQUESTED ROUTING	RELEASE DATE					
5/4/71	HRC19-71	SEE BELOW								
RELEASE NO.	TERMS	PRICES ARE	PRICES		MINIMUM WEIGHT					
			INCLUDES FREIGHT	PPD	COL					
LESS REG. DISC. CURWENSVILLE										
QUANTITY ORDERED	NAME	DESCRIPTION	SIZE	OUR DWG NO.	EQUIV. PER PIECE	TOTAL EQUIV.	BASE	% EXTRA	PRICE	UNIT
CUST. REQUISITION / CONSIGNMENT ACCOUNT										
3000	NARCOCAST	CASTABLE IN 100# BAGS				3000	173.		173.00	EA
3000	DO	DO DO DO				3000	130.		130.00	EA
3000	NARCO #101	IN 100# BAGS				3000	165.		165.00	EA
1050	NARCO STAZ ON	IN 50# BAGS				1050	192.		192.00	EA
912	CRESCENT DP LG.	9X6-3/4X2-1/2 ST.				912	205.			EA
360	DO	18X9X4-1/2 SQ. EDGE			1.50	1368	192.	20	36.00	EA
		TILE			7.20	648	192.	55	2.14	EA

SPECIAL INSTRUCTIONS

SHIPPED ON MANIFEST # 50-8653 APRIL 26, 1971.
DELIVERY HOURS 8:30AM TO 4:00PM.

BILLING: ALLOW THE FOLLOWING DISCOUNT:
STAZ ON 10% SPECIALTIES 17% CRESCENT 15%

DATE

SALES DEPT.



NORTH AMERICAN REFRACTORIES CO.

DIVISION OF ELTRA CORPORATION
CLEVELAND, OHIO 44114

SALES ORDER

PLANT CURWENSVILLE

CUSTOMER NO.	ROUTE VIA	BILL OF LADING	NOTICE OF SHIPMENT	CODE	B/C	TERRITORY CREDIT	INVOICES PREPARED	SALES ORDER NO.
237	DEBOLT	15	15		73	6-39	35	HRC47

BILL TO:

SHIP TO:

H.R. CURRY COMPANY, INC.
1023 MAIN STREET
PITTSBURGH, PA. 15215

SAME

SHARPSBURG, PA.

SHIPPING DATES: AS SOON AS POSSIBLE

DATE ENTERED	CUSTOMER ORDER NO.	CUSTOMER REG. NO.	CUSTOMER ORDER DATED	REQUESTED ROUTING	RELEASE DATE					
7/20/71	HRC47-71	CONSIGNMENT INVENTORY			7/13/71					
RELEASE NO.	TERMS	PRICES ARE F.O.B.	PRICES		MINIMUM WEIGHT					
	NET 30	CURWENSVILLE, PA	INCLUDES FREIGHT	PPD COL	40M 6.00NT					
QUANTITY ORDERED	NAME	DESCRIPTION	SIZE	OUR DWG NO.	EQUIV. PER PIECE	TOTAL EQUIV.	BASE	EXTRA	PRICE	UNIT
		PALLETS								
456	NARCO 71	9X4-1/2X2-1/2 ST.(1)			1.00	456	275.		275.00	M
150	DO	9X9X2-1/2 ST.C			2.00	300	DO	55	853.	EA
100	DO	DO #1 WEDGE			2.00	200	DO	55	853.	EA
					1.75	175				
304	CRESCENT DP	LARGE ST.								
		9X4-1/2X2-1/2 (1)			1.00	304	205.		205.00	M
552	DO	DO #25PLIT(1)			1.00	552	DO		205.00	M
888	DP	DO #1SPLIT(1)			1.00	888	DO		205.00	M
200	DO	DO FEATHEREDGE (1)			1.00	200	DO		205.00	M
250	DO	DO #2 WEDGE (			1.00	250	DO		205.00	M
516	DO	DO #1 WEDGE (1)			1.00	516	DO		205.00	M
25	CRESCENT 3X12X24	SQ.EDGE-TILE(			8.53	213	192.	115	3.52	EA
482	CRESCENT DP	9X4-1/2X2-1/2 #1 ARCH								
		(1)			1.00	482	205.		205.00	M
912	DO	DO ST. (2)			1.00	912	DO		205.00	M
4800#	ALSET (WET) IN	100#DMRS. (2)				4800#	180.		180.00	NT
3000#	NARCOCAST IN	100# BAGS (1)				3000#	130.		130.00	NT
1050#	STAZ-ON IN	50# BAGS * (1)				1050#	192.		192.00	NT
		TOTAL				5273				
*THIS ITEM WILL NOT BE HANDLED ON CONSIGNMENT FRT. IS INCLUDED IN										

SPECIAL INSTRUCTIONS

THE PRICES.

CONF. ORDER DO NOT DUP. TAKE EXTRA PRECAUTIONS SO THAT BAGGED MATERIALS IS NOT DAMAGED IN SHIPMENT. DELY HOURS 8:30AM TO 4:00PM.

BILLING: SPECIALTIES 17% COMM. NARCO 71 10% COMM. CRESCENT DP 15% COM

JJR

DATE

SALES DEPT.



NORTH AMERICAN REFRACTORIES CO.

DIVISION OF ELTRA CORPORATION
CLEVELAND, OHIO 44114

SALES ORDER

PLANT CURVENSVILLE

BY T.W.X.

BY MAIL MAIL

CUSTOMER NO.	ROUTE VIA	BILL OF LADING	NOTICE OF SHIPMENT	CODE	B/C	TERRITORY CREDIT	INVOICES PRICED	SALES ORDER NO.
237	DEBOLT	S	S		73	6 39	3S HRC74	

SOLD TO

CONSIGNEE TO

SAME AS SOLD TO UNLESS OTHERWISE SPECIFIED

H. R. CURRY CO., INC.
1023 MAIN ST.
PITTSBURGH, PA. 15215

H. R. CURRY CO., INC.
1023 MAIN ST.
SHAMPSBURG, PA.

SHIPPING DATES: SHIPPED 9/24/71

DATE ENTERED	CUSTOMER ORDER NO.	CUST. REQ. NO.	CUSTOMER ORDER DATED	REQUESTED ROUTING	RELEASE DATE					
10/1/71	HRC74-71	CONSIGNMENT ORDER								
RELEASE NO.	TERMS	PRICES ARE F.O.B.	PRICES			MINIMUM WEIGHT				
	NET 30 DAYS	CURVENSVILLE, PA.	INCLUDES FREIGHT	PPD	COL					
			*		XX	40M 6.00NT				
QUANTITY ORDERED	NAME	DESCRIPTION	SIZE	OUR DWG. NO.	EQUIV. PER PIECE	TOTAL 9" EQUIV.	BASE	% EXTRA	PRICE	UNIT
6,000#	NARCOCAST E.S.	FINE, 100# BAGS				6000#	130.		130.00	NT
200#	LOW K.	IN 50# BAGS				200#	145.		145.00	NT
18,000#	SHUR RAM	PLASTIC, 100# CARTONS				18000#	105.		105.00	NT
1,050#	NARCO STAZ-ON	IN 50# BAGS				1050#	192.00		192.00	NT
912	CRESCENT	9X4-1/2X2-1/2 STS			1.00	912	205.		205.00	M
2,100	NA-26 IFB	9X4-1/2X2-1/2 STS			1.00	2100	378.		378.00	M
					T/EQ	3012				

SPECIAL INSTRUCTIONS

SHIPPED ON MANIFEST 50-9906. DO NOT DUP.
TAKE EXTRAP PRECAUTION SO THAT BAGGED MATL IS NOT DAMAGED IN SHIPT.
RECVD HRS 8:30 AM TO 4:00 PM.

BILLING: 17% COMM. ON SPECS; 15% COMM. ON CRESCENT; 10% COMM. ON STAZ-ON NOT CONSIGNMENT; 10% DISC IFB NOT CONSIGNMENT

S.C. JJR

DATE 10/1

TIME

SALES DEPARTMENT

IN THE CIRCUIT COURT OF KANAWHA COUNTY, WEST VIRGINIA

IN RE: ASBESTOS III

CIVIL ACTION NO. 92-C-8888

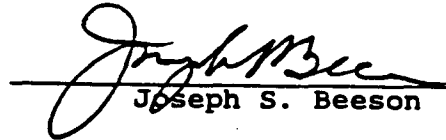
CERTIFICATE OF SERVICE

I, Joseph S. Beeson, counsel for North American Refractories Company, do hereby certify that service of the attached DEFENDANT NORTH AMERICAN REFRACTORIES COMPANY'S ANSWERS TO PLAINTIFFS' JOINT INTERROGATORIES AND REQUEST FOR PRODUCTION OF DOCUMENTS CONCERNING PRODUCT IDENTIFICATION TO ALL DEFENDANTS has been made upon plaintiffs' counsel by mailing a true and exact copy thereof, as follows:

Scott S. Segal, Esquire
Segal & Davis, L.C.
810 Kanawha Boulevard, East
Charleston, West Virginia 25301
and
Theodore Goldberg, Esquire
Henderson & Goldberg, P.C.
1030 Fifth Avenue
Pittsburgh, Pennsylvania 15219
and
James H. Rion, Jr., Esquire
Ness. Motley, Loadholt, Richardson & Poole
151 Meeting Street, Suite 600
P. O. Box 1137
Charleston, South Carolina 29402
and
David L. Meade, Esquire
Shinaberry, Meade & Venezia
2018 Kanawha Boulevard, East
Charleston, West Virginia 25311
and
James F. Humphreys, Esquire
Charleston National Plaza
Suite 1113
Charleston, West Virginia 25301
and

William C. Field, Esquire
2nd Floor
608 Virginia Street, East
Charleston, West Virginia 25301
and
Thomas H. Sayre, Esquire
Post Office Box 627
Clendenin, West Virginia 25045
and
John E. Sutter, Esquire
Sutter & Enslein
606 Virginia Street, East
Charleston, West Virginia 25301
Counsel for Plaintiffs

in a properly stamped and addressed envelope this 17th day of June,
1993.



Joseph S. Beeson

TYPICAL PROPERTIES OF VARIOUS REFRACTORIES

Brick Type	Typical Constituents	P.C.E.	Spalling Resistance (Relative)	Abrasion Resistance (Relative)	Load Bearing Ability (Relative)	Pounds per Sq. Foot	% Porosity	Mean Coefficient of Expansion per 100°F. Between 32°F and 2000°F Temp.	Thermal Conductivity BTU sq. ft. in 1" thickness at 2000°F
Silica	96% SiO ₂	31-32	Poor	Good	Very Good	6-6.5	22-30	6.2x10 ⁻⁷ (1)	12
High Duty Fireclay	40% Al ₂ O ₃ 55% SiO ₂	31-33	Good	Good	Good	7.5-8.5	10-24	3.1x10 ⁻⁷	10
Super Duty Fireclay	42% Al ₂ O ₃ 52% SiO ₂	33-34	Excellent	Good	Good	8.5	12-15	3.0x10 ⁻⁷	10
High Alumina	50-80% Al ₂ O ₃	34-39	Good	Good	Good	8-9	20-35	3.2-4.0x10 ⁻⁷	11
Mullite	62% Al ₂ O ₃ 35% SiO ₂	37-39	Excellent	Good	Excellent	8.5	15-22	3.2x10 ⁻⁷	13
Silicon Carbide	85-90% SiC	37-40(1)	Excellent	Very Good	Excellent	8.7-10	13-28	2.6x10 ⁻⁷	10A
Fused Alumina	85-90% Al ₂ O ₃	37-40	Good	Very Good	Excellent	9-11	20-24	4.3x10 ⁻⁷	17
Chrome	30-45% Cr ₂ O ₃ 15-33% Al ₂ O ₃	38-41	Poor	Fair	Fair	10.5-11	20-28	4.1x10 ⁻⁷	11
Magnesite	83-93% MgO 2-7% Fe ₂ O ₃	38-41	Poor	Fair	Good	9.5-10	20-28	6.8x10 ⁻⁷	14

(1) Densities at 600°F.

(2) Coeff. 64° to 600°F = 1.6x10⁻⁷; 600° to 2000°F = 3.6x10⁻⁷.

GLOSSARY OF TERMS RELATING TO REFRACTORIES

ABRASION OF REFRACTORIES Wearing away of refractory surfaces by the scouring action of moving solids.

ABUTMENT The structural portion of a furnace which withstands the thrust of an arch.

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

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.)

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

AUGER MACHINE A machine for extruding moist clay through a die by means of a revolving screw or auger.

BACK As applied to an arch, the outer or upper surface.

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.

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.

BATTER To reduce the width of brickwork with succeeding courses.

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.)

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.