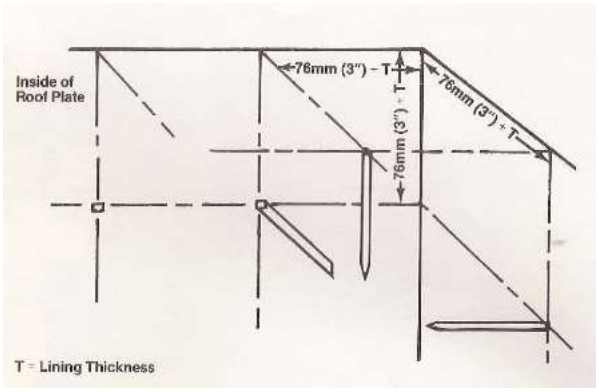
CERAMIC FIBER INSTALLATION PROCEDURES (PART 2)

(Continued from Ceramic Fiber Insulating Linings – Part 1)

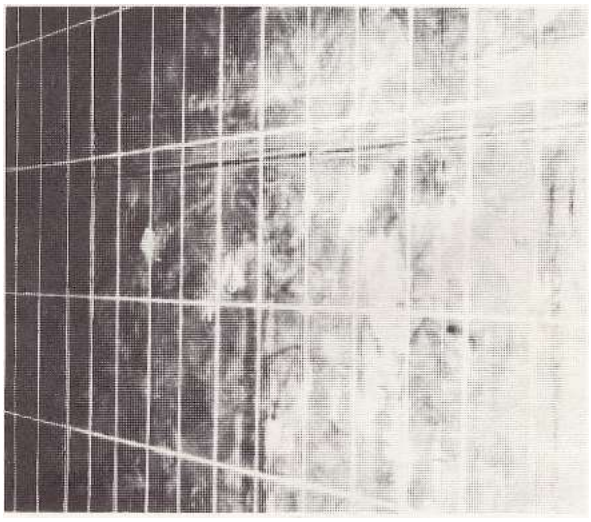
MULTILAYER SYSTEM

Once the lining and the stud layout have been selected, mark their positions on the furnace casing. You may begin at any corner, taking into account the thickness of the lining on the adjacent walls.

From each corner, measure along the two horizontal joints and down the vertical joint a distance equal to 76 mm (3”) plus the thickness of the lining. This ensures that the edge anchors are positioned 76 mm away from the adjacent walls and roof, keeping them accessible and providing sufficient working space between opposing studs. Repeat this process for all corners.



Since bolts are typically arranged in horizontal and vertical rows, mark the perimeter of the area and draw guide lines between opposing marks to form a grid. The intersections indicate the locations for the anchors. Add bolts around burners, flue outlets, and other openings; refer to "Construction Details."



Note: The layout and positioning of the bolts must be precise, as the arrangement is calculated for a specific material width and assembly technique.

- **Stud welding**

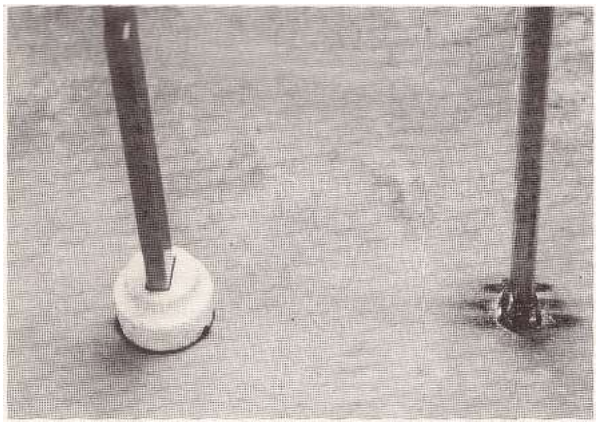
Once marked, weld the studs to the casing using an arc stud welding gun or manual shielded metal arc welding (SMAW). For alloy studs and bases, orient the larger dimension of the cross-section in the vertical plane. Consistent orientation aligns the washers and makes it easier to detect missing or incorrectly

positioned anchors. Manual welding is slower and carries a higher risk of defects; if it is used, refer to Table V to select the appropriate electrodes.

New steel typically does not require cleaning, unless it is contaminated with oil, grease, or mill scale. In the case of rusted or painted steel, the area may need to be ground down. Test the initial welds by bending the stud 45° to either side of its axis; if it holds, the joint is sound. Otherwise, adjust the equipment until consistent results are achieved.

Stud Alloy	Welding Rod
304SS	Stainless Electrode Type 304 AC/DC coated
310SS	Stainless Electrode Type 316 AC/DC coated
330SS	330SS-80 Electrode AC/DC titania coated
Inconel 601	Inconel Electrode AC/DC coated or Incolloy 112 Electrode coated
304SS Whistle Base	Stainless Electrode Type 304 AC/DC coated
310SS Whistle Base	Stainless Electrode Type 316 AC/DC coated

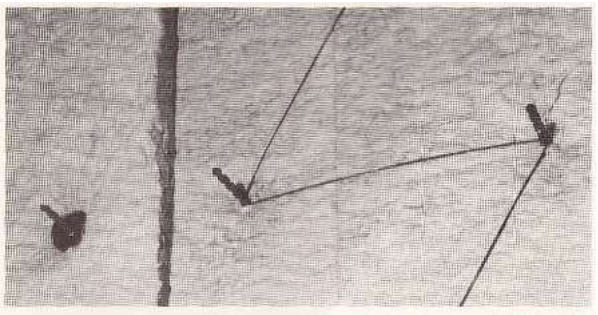
Ceramic ferrules contain the molten pool around the base of the stud. Once the weld has solidified, remove them with a sharp tap from a hammer so that the first layer of insulation sits firmly against the casing. firmemente contra la carcasa.



- **Backing insulation**

Once the studs have been welded, install the backup insulation.

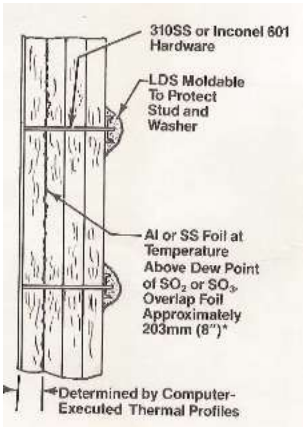
To temporarily hold the insulation in place on the roof, attach "speed clips" to one out of every four studs, or use commercial elastic bands stretched across 3 or 4 studs. You can press these into place using a 19 mm or 25.4 mm (3/4" or 1") I.P.S. pipe, 203–305 mm (8–12 inches) in length. If using "cuplocks," do not place speed clips within 76 mm (3 inches) of the hot face, as they will interfere with the installation; however, elastic bands may be used in that area.



Around burner blocks and other openings, avoid exposing the backup insulation to temperatures exceeding its rated limit. Terminate the lower-temperature layers at these points and replace them with fiber blankets suitable for higher temperatures. Refer to "Construction Details."

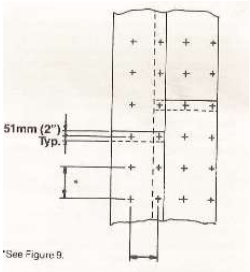
- **Vapor barrier**

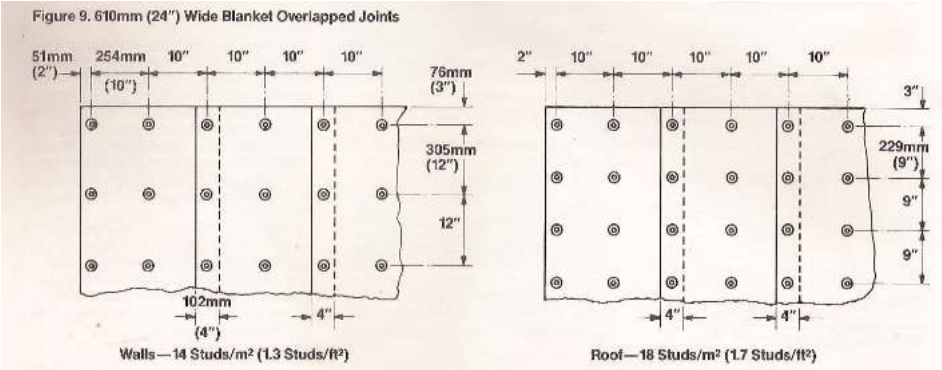
Fuels with a sulfur content exceeding 0.5% generate SO_2 and SO_3—gases that can attack the casing and the welds of the studs. Stagger the joints between layers by at least 76 mm (3”) to prevent these gases from reaching the casing. When the interface temperature exceeds the dew point of the gases (approximately 250 °C), install a stainless steel vapor barrier behind the first 25–51 mm (1–2”) layer of insulation blanket. When combined with a protective coating—such as a bituminous, coal-tar epoxy, or Stalastic-type coating—this helps prevent corrosion.



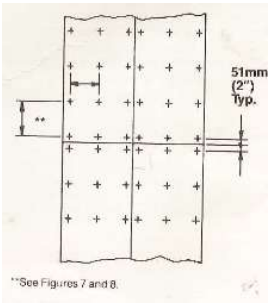
- **Blanket insulation for the hot face**

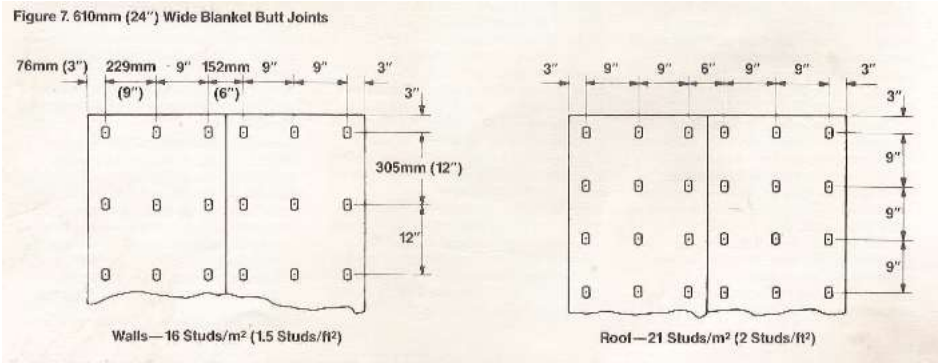
The anchor layout corresponds to the installation of the hot face, using either overlapped or butt joints. Staggering the joints in the backup layers may result in them not aligning with the studs; this is normal and does not affect the system. If operating temperatures exceed 1038 °C for Durablanket S or 1177 °C for Durablanket 2600, install the hot face in sections of 1830–2440 mm (6–8 ft).

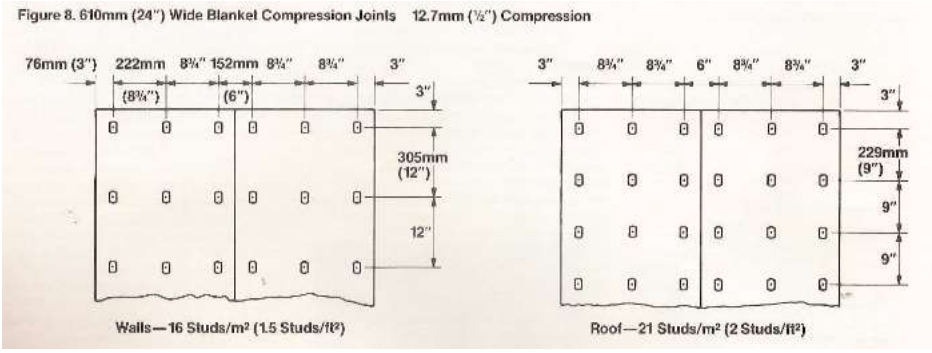




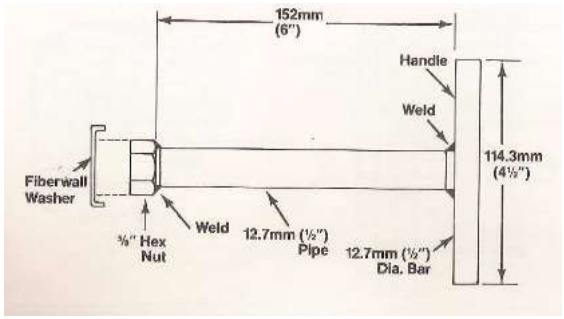
In installations using butt or compression joints, position the studs adjacent to the blanket end joints, 51 mm (2”) on each side of the junction.







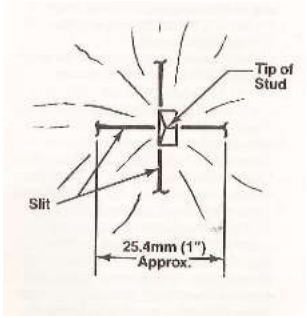
To install a metal washer, press it down until the lining is slightly compressed, then rotate it 90° to secure it. The tool shown makes this operation easier.



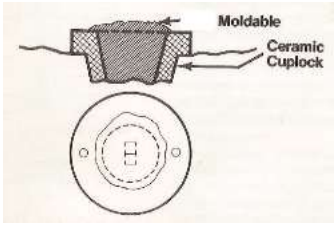
For temperatures between 1093°C and 1150°C, use 51 mm (2”) ceramic *cuplock*-style retainers on the hot face and reduce the length of the alloy studs by 38 mm (1½”). Since the stud will not protrude through the final layer (or the last two layers), these layers cannot be installed directly onto it. For vertical walls, begin at the top: unroll the blanket, align it with the studs, and secure it at 3 or 4 points using *cuplocks*. Unroll the remainder downward and install the remaining retainers. For ceilings, it is recommended to work

with a team of three: two people hold the blanket in place while the third installs the retainers. Install all remaining *cuplocks* as soon as possible.

To accommodate the *cuplock* stem, make a cross-shaped cut approximately 25 mm wide and 51 mm deep around the stud, inserting the knife blade through the blanket and parallel to the stud.



Press the *cuplock* in until its tab slightly compresses the lining, then rotate it 90° to lock it in place. The two points of the tab should be positioned 90° from their original orientation. Completely fill the opening with moldable ceramic fiber putty (approx. 29 cm³ per piece) and cover the top.

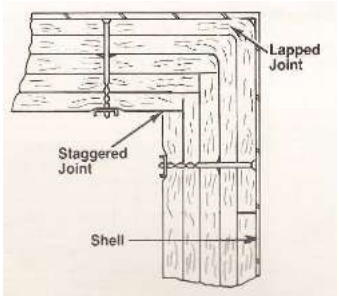


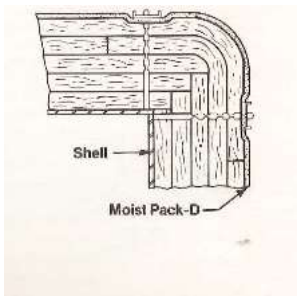
Before commissioning, inspect all anchorages and verify that the retainers are in place, locked, and filled with moldable sealant.

Construction details

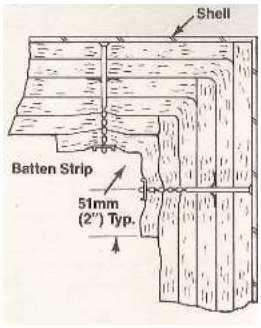
1. Corners

The joints between walls, and between walls and the ceiling, must be constructed with stepped or overlapping seams to prevent hot gases from reaching the casing.

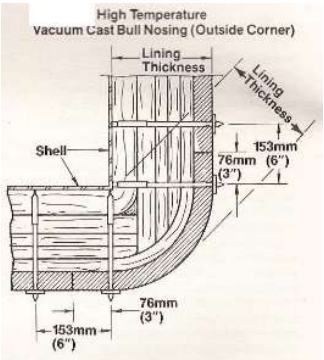


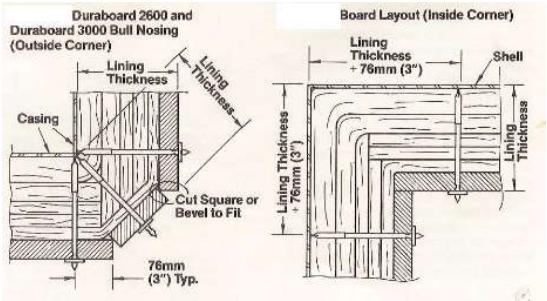


The corner can also be reinforced with an additional strip, in addition to staggering or overlapping the joints.



In high-temperature applications involving panels, the backing layers must extend around both interior and exterior corners to maintain the continuity of the insulation.

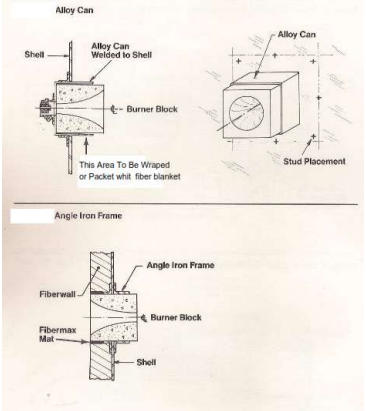




2. Dense refractory blocks for burners

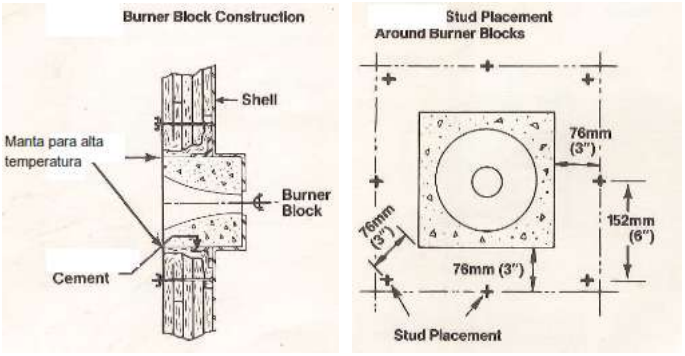
Multilayer linings are compatible with almost all gas or liquid-fuel burners, including those with flat, deflected, or long flames. Unlike conventional linings made of brick or castable material, the multilayer system is typically thinner and does not support the weight of the burner block.

Therefore, the block must be supported by a mount or sleeve attached to the casing, which can be fabricated from stainless steel.



When using a stainless steel casing, place an insulation blanket between the casing and the block to reduce heat transfer to the metal structure. The block should not protrude more than 12.7–25.4 mm (½–1”) from the hot face, in order to prevent thermal spalling.

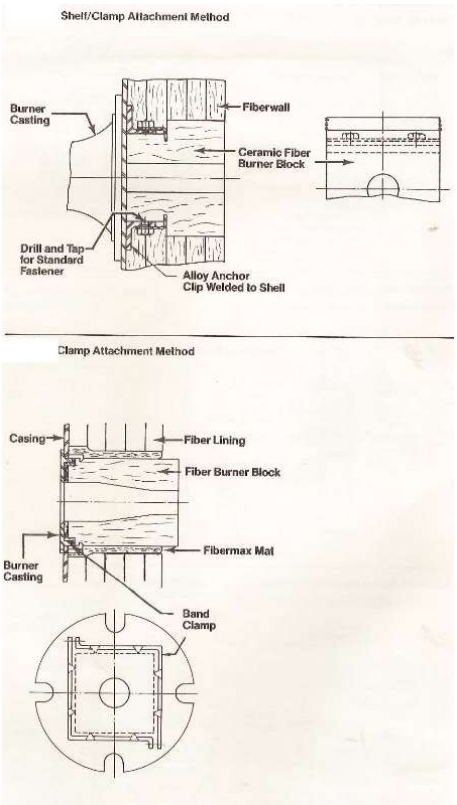
The refractory block conducts heat toward the lining. To avoid excessive shrinkage of the backing material and the formation of paths for hot gases, do not place it directly against the block. Leave a gap of 25–38 mm (1–1½”) and fill it with an insulation blanket suitable for the operating temperature.



3. Ceramic fiber blocks for burners:

Vacuum-formed ceramic fiber blocks are resistant to thermal shock and spalling. They can be attached to the furnace shell using anchors integrated during the manufacturing process, eliminating the need for an expensive stainless steel support structure. They are compatible with both rigid and fiber-based linings. Stepped profiles or a wrap—such as a Fibermax-type blanket—around the block help prevent direct gaps or joints leading to the shell.

To effectively seal the joints, ensure the fiber is maximally compressed at the interfaces between fiber sections, as well as between the fiber and any refractory material.

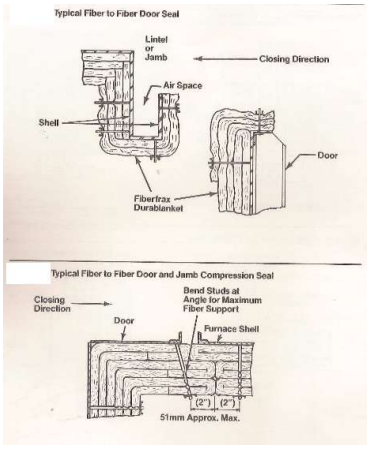


4. Construction and sealing of doors :

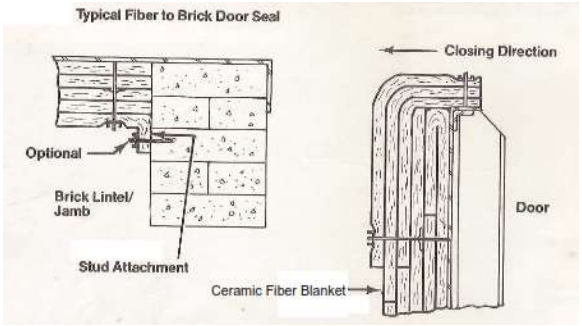
Doors often require frequent maintenance. Multilayer fiber linings and their associated seals help reduce both maintenance needs and costs. Furthermore, they can weigh up to 95% less than doors using conventional refractory materials, which allows for simpler and more economical opening mechanisms.

In general, doors are constructed in the same manner as the rest of the furnace. If they are subject to significant mechanical wear, a modular or "stack-bond" construction is recommended.

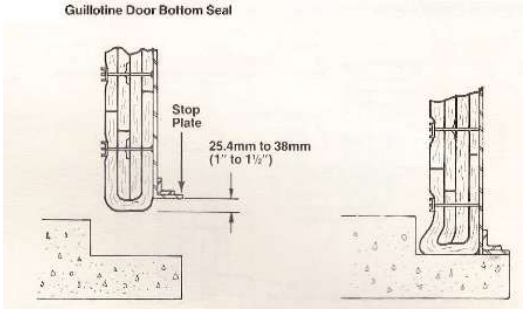
Seals should be designed so that they can be repaired or replaced without affecting adjacent areas of the door or the frame. Their service life depends on the temperature and the frequency of thermal cycles.



The same principles apply to sealing against frames or lintels made of brick or castable refractory. Install adjustable stops to prevent excessive compression.



For guillotine-style doors, the bottom section seals against the hearth or the refractory surface of the car. A fixed stop must limit the compression. The blanket should extend 25–38 mm (1–1½”) below the edge of the door or the stop to ensure a proper seal.

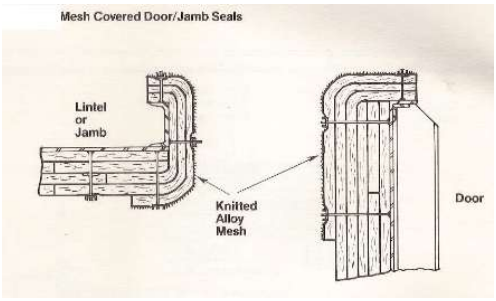


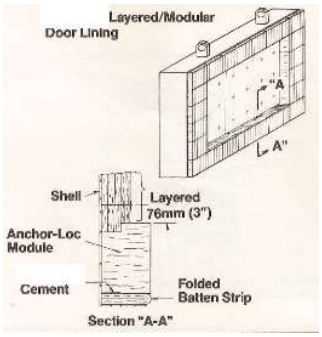
L The vertical seals for guillotine-style doors may require a specific design depending on the closing mechanism.

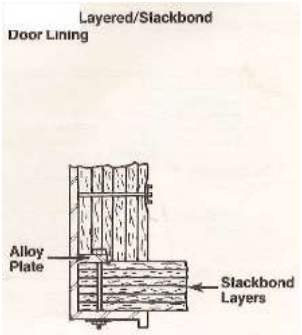
If the door rubs against the frame, modify the design to avoid contact throughout most of the travel, limiting it instead to the final few centimeters of the closing movement.

A woven metal alloy mesh placed over the fiber seal can extend its service life. This approach works well for doors featuring ceramic fiber beams or pillars, as well as for those that combine fiber with refractory brick, lintels, "Fiberstick"-type components, or anchors.

One option is to install modules around the door perimeter, combined with a multilayer lining. Alternatively, the perimeter can be constructed using stacked strips of fiber blanket (*stackbond*), with the core consisting of a multilayer lining (Figure 44).

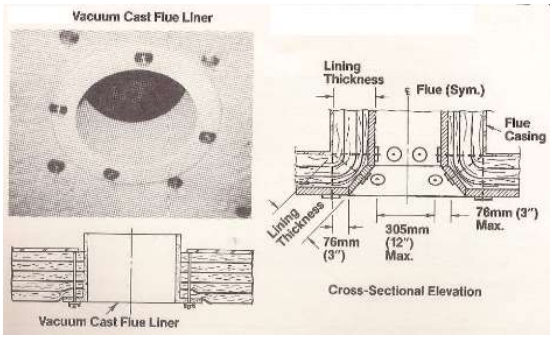






5. Construction of flue ductsonstrucción

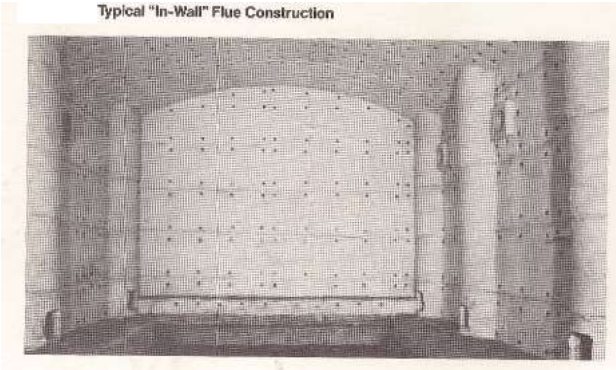
Above 1176 °C (2150 °F), vacuum-formed ceramic fiber boards for high-temperature applications are recommended.



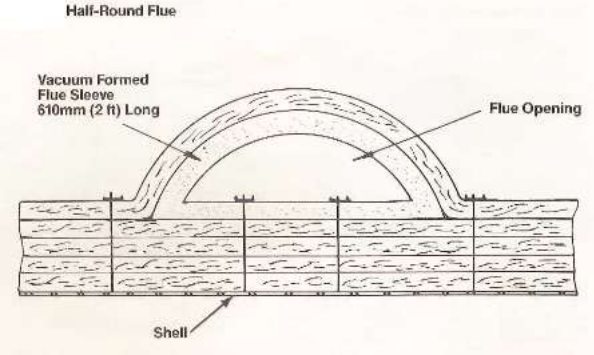
Below 1176 °C (2150 °F), vacuum-formed boards designed for low-temperature applications may be used.

When selecting the internal lining for a duct, also consider the velocity of the hot gases.

In furnaces with in-wall ducts, there are designs that avoid the use of dense refractory components.



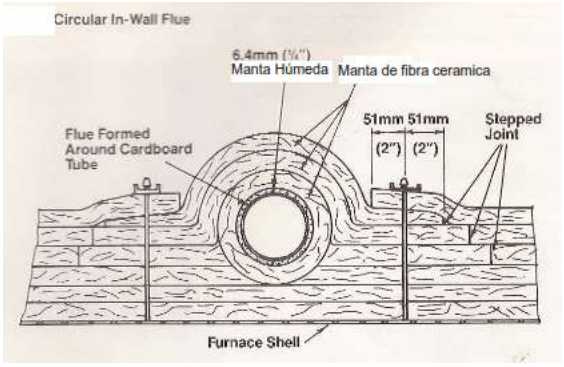
The vacuum-molded, semi-circular pieces—supplied in sections approximately 60 cm long—can be stacked to the required height and secured using notched anchors. Lateral openings are made in the lower sections to connect the furnace to the flue.



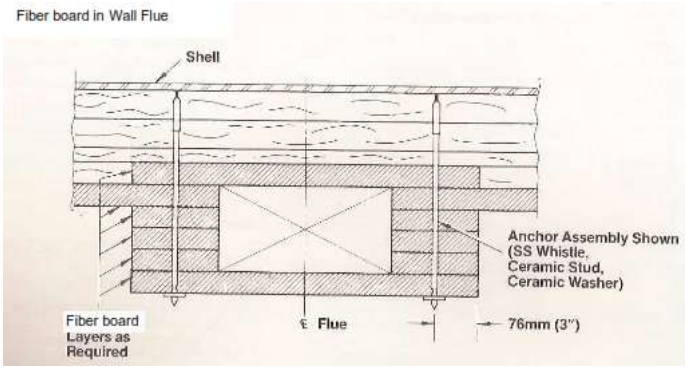
The wet blanket and ceramic fiber boards form the channel and the back wall of the flue. The wet blanket can be prepared by drying pieces—cut to size—over a wooden mold. The boards are cut and stacked to the required height; the opening toward the kiln is created once the installation is complete.

For downdraft flues, cardboard tubes can be used as molds. These can be left in place, as they burn away during the firing process without any detrimental effects, while the wet blanket hardens and retains its shape.

In downdraft flues, cardboard tubes can be used as molds. They can be left in place, as they burn away during firing without any detrimental effects, while the damp blanket hardens and retains its shape.

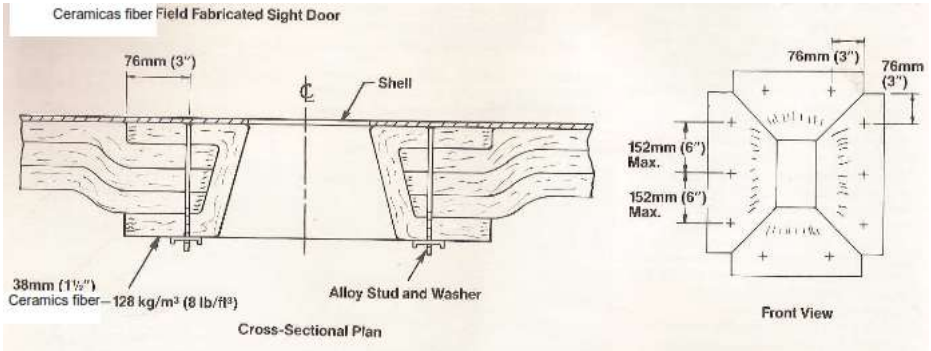


Do not use wet-blanket-type ducts above 1093 °C (2000 °F). For temperatures up to 1482 °C (2700 °F), vacuum-formed ducts made of ceramic fiber boards rated for various temperature ranges are available.

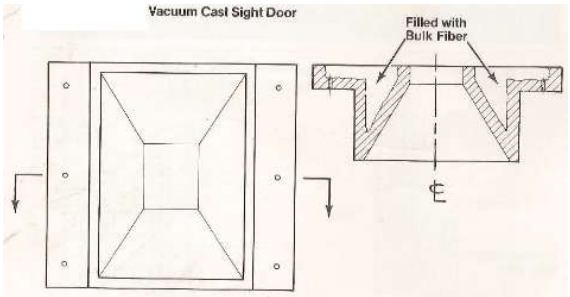


6. Construction of inspection doors

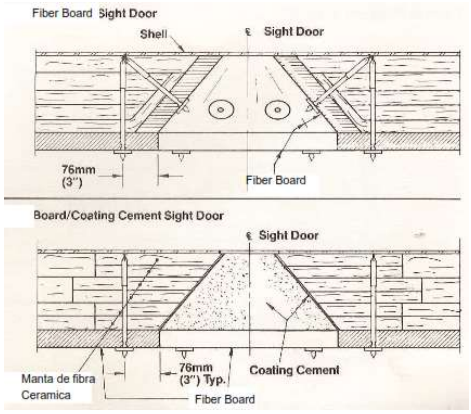
Doors or viewing ports can be integrated into the fiber lining or incorporated via a vacuum-molded monolithic piece. Alternatively, they can be fabricated on-site by cutting the hot-face material to the required geometry.



Another option is a vacuum-molded inspection door, made to the specified dimensions



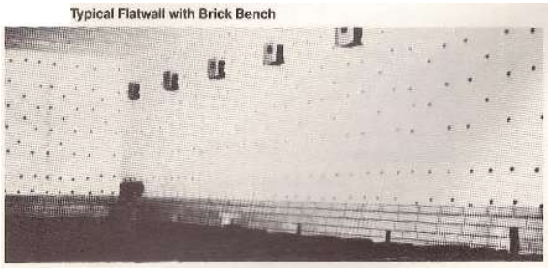
Inspection doors can be fabricated using ceramic fiber boards: one approach employs panels throughout the structure, while another utilizes the cut edges of the backing layers, finished with a coating cement. In both cases, the door backing must have the same thermal rating as the hot face.



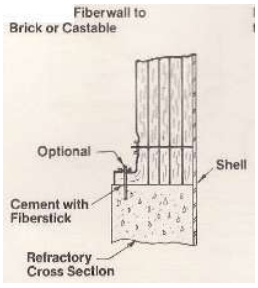
Select the anchors for sight glasses and inspection windows based on the operating temperature.

7. Joints between multilayer systems and brick or refractory material:

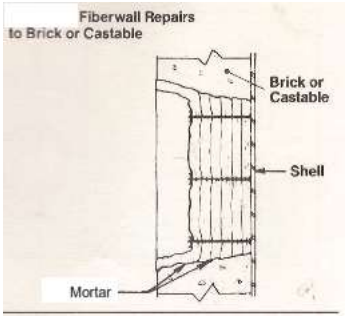
In some furnaces, the refractory material at the base of the side walls provides protection against mechanical damage



The transition between the refractory and the multilayer system must not create a direct path to the casing. Cut the backing material 25–38 mm (1–1½") away from the refractory and fill the gap with a blanket of the same type as that used for the hot face. Overlap this blanket onto the refractory and secure it using refractory cement or appropriate anchors.

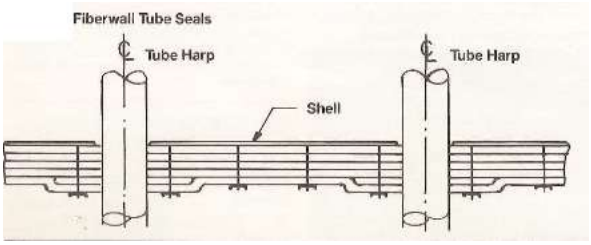


To repair a refractory lining, remove the damaged material down to the shell, weld on serrated anchors, and install a multi-layer patch. Fill any gaps between the rigid refractory and the layers using bulk fiber or strips of blanket insulation; seal cracks with moldable refractory putty.

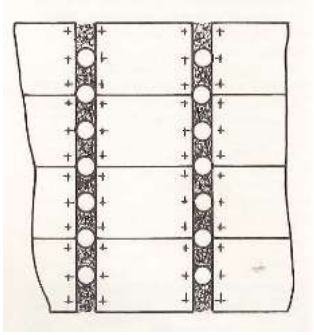


8. Sealing of tube row

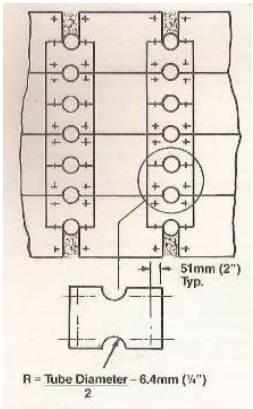
To seal rows of pipes, first extend the backing insulation layers up to the pipes.



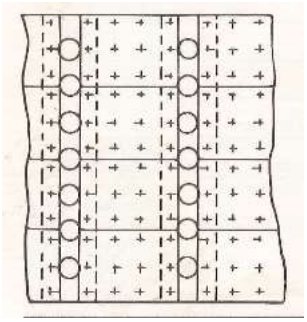
Fill the spaces between the tubes with bulk fiber or scraps of blanket material.



Place pre-cut pieces over the studs to keep the insulation in place.



Finally, install the hot-face layer between the rows of tubes.



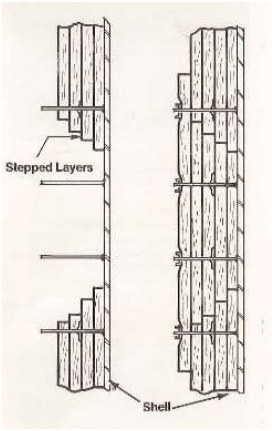
9. Repairs to damaged multi-layer coatings :

Although the multilayer system resists thermal shock and typically does not crack or detach as a result, it can be damaged by impacts, falling loads, or pipe ruptures. Repairing it is simpler than repairing a conventional refractory lining.

The furnace can be cooled down quickly, and since no drying or curing is required, it can be returned to service in less time.

To perform a repair, remove at least four washers or retainers and cut out the damaged area using a sharp knife. If the damage does not reach the furnace shell and the anchors remain intact, remove only the affected layers. If only the hot face is damaged, applying a patch over the area may be sufficient.

If anchors need to be replaced, remove the entire thickness down to the shell. Stagger the joints between layers and replace any broken or severely damaged studs. Reinstall the insulation according to the original procedure. In systems with overlapping joints, the hot-face patch must overlap on all four sides.



Conclusion

Proper layout execution, the welding of anchors, and careful detailing around burners, ducts, and doors result in an efficient, lightweight, multi-layer lining that is resistant to thermal shock. This also enhances thermal performance and simplifies maintenance and repairs.

The next technical bulletin will cover ceramic fiber module systems, their properties, operational advantages, and installation methods.