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NEXT MONTH....Repairing Wood Columns

Relining Your Chimney Flue

By John Mark Garrison

Whether you're reactivating a fireplace, buying a wood or coal stove, or adapting your heating system, you'll probably have to reline a flue or two. There are several different chimney-relining methods. Sorting out these options wasn't easy — we had to resolve conflicting information from manufacturers, installers, homeowners, fireplace specialists, and building codes — but now we've finally got it!

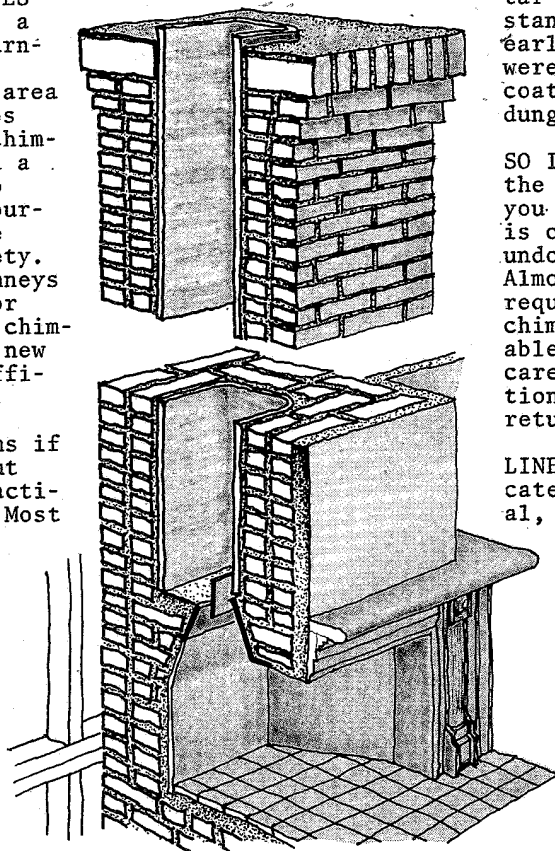
THE DO-IT-YOURSELF SHELVES of most bookstores have a crowd of books about burning wood or coal. But, unfortunately, there's one area that's overlooked, sometimes with tragic results: the chimney. It seems people spend a lot of time learning how to make an intelligent stove purchase, but very little time thinking about chimney safety. This is alarming! Old chimneys have often been neglected or altered. And even a sound chimney may be unsuited to its new fuel or these new, super-efficient wood stoves.

YOU FACE additional problems if you have been thinking about adapting, reopening, or reactivating an unused chimney. Most heating systems in older buildings were converted once or more in the past. A flue pipe may have been cut into an old fireplace flue for a coal-burning stove; vents for basement oil or gas burners may have been run up the existing chimney stack. An entire fireplace could have been sealed up and then hidden behind a new wall.

MOST OFTEN, you'll be required to install a liner in an old masonry chimney. A house built in the 20th century probably had a baked-clay flue liner as part of its original construction. But older chimneys, as they were being built, were parged on the inside with a special refractory mortar that was capable of withstanding high heat. And very early houses had chimneys that were either unlined or else coated with a mixture of cow dung and mortar.

SO IF YOU'RE about to change the fuel you burn or the way you burn it, and your chimney is old and unlined, it will undoubtedly need a new liner. Almost all building codes now require it. And even if your chimney already has an acceptable liner, please note that a careful, professional inspection should be made before you return an inactive flue to use.

LINERS fall into three basic categories: (1) the traditional, baked-clay liner; (2) a variety of metal liners; and (3) a poured-cement "liner" that hardens around a temporary, deflatable form inside the flue. All of these liners are UL approved and can be recommended for use under certain circumstances. This article will clarify precisely what those differing circumstances are.



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Clay Liners

CLAY (TILE) LINERS have long been the approved method for new construction, so they have a known track record and could therefore be considered the most reliable. They are also readily available from a local building-materials yard or your installer, and come in a variety of round or rectangular sizes. (Round liners create a better draft, as smoke spirals as it travels upward; the corners in the rectangular tiles impede the flow. On the other hand, round tiles may reduce the functional size of the flue. See sidebar on p. 190.) Most contractors prefer to use the rectangular liner because it's easier to store and install. Liners come in thicknesses from 5/8 inch up to 1 1/2 inches; 5/8 inch is sufficient for most residential use.

THE PRIMARY DISADVANTAGE of this method is that, in all cases, it requires partial demolition of the existing chimney. The installation is therefore messy and time consuming. The exact extent of demolition depends on specific conditions: If the chimney is relatively straight, it's possible simply to remove a section of bricks at each floor level and slide the liner up and down inside the flue.

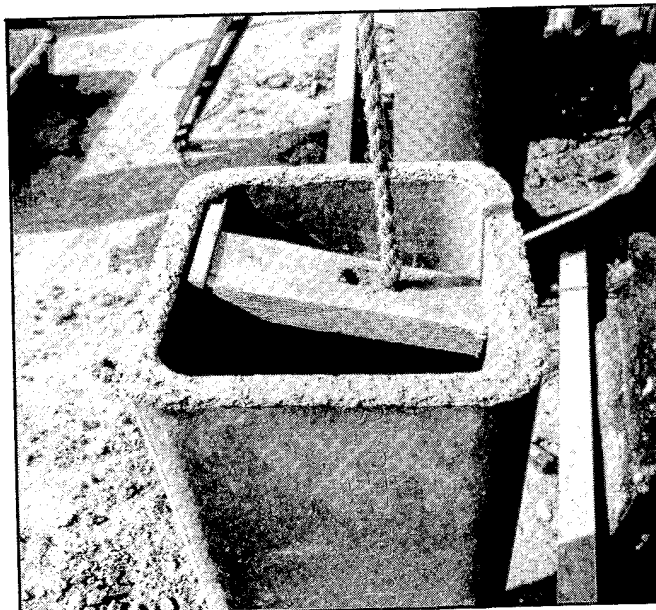
IF THERE ARE BENDS OR OFFSETS in the chimney, these sections will have to be dismantled as well in order to cut and fit the liner. The whole operation requires a knowledgeable and skilled contractor who can make sure that the joints fit tightly and are well mortared, and that the sections of liner align with one another to provide a smooth, unobstructed surface. A botched job, with gaps in the mortar or badly fitting joints, means a chimney that is still dangerous.

IF YOUR EXISTING CHIMNEY needs partial rebuilding anyway, this method won't involve much extra demolition. On the other hand, you'll want to consider adjacent building materials. Installing a clay liner may require breaking through sections of plaster walls or wood panelling.

THE INSULATION FACTOR is not a crucial one with this method. A clay liner increases the insulating capacity of a chimney slightly, by the amount equivalent to the additional thickness of masonry. It does, of course, leave an insulating airspace between liner and existing stack walls.

Metal Liners

INSERTING A METAL LINER is usually simpler and cheaper. If the chimney is a straight run from top to bottom, the installation is easy. If there are bends or offsets, however, these will have to be handled in the same way as with clay liner . . . by removing a section of brick at each bend. Angle sections of pipe are available for this purpose.



Above: This section of clay liner has been buttered with refractory mortar. It will be lowered onto another, similarly coated section, and will have another section lowered onto it. Below: In this photo, you can see that the chimney stack has four flues, only one of which is being lined.



THE MOST COMMON VARIETY of metal pipe is stainless steel sections from 6 to 36 in. in length, and from 5 to 10 in. in diameter. These fit together with small sheet-metal screws. Starting from the top of the chimney, one section is lowered down at a time, the next section is screwed to it, and so on to the bottom of the chimney. Rain caps and other fittings are available to complete the installation.

A NEW, FLEXIBLE, stainless steel liner overcomes the difficulties of installing metal pipe in curved or offset chimneys. (Word isn't in yet on how easy it is to clean.) This corrugated metal tube, in diameters from 5 to 8 inches, is sold by the linear foot. (see page 192) A rope is first lowered down the chimney. The liner is fastened to it at

the top using a special bracket. The liner is then fed down the chimney and guided with the rope from below. (For a stove, the pipe itself is simply led through a hole in the side of the chimney, eliminating the need for a thimble to the appliance.) A metal cap is installed, same as for rigid pipe.

SINGLE-WALL STEEL LINERS don't provide any additional insulation for the flue, and in fact probably decrease the insulating capacity of the chimney somewhat, due to the tendency of metal to transmit heat to the outside. This disadvantage may be partially overcome if you fill the space between the liner and the masonry with an insulating material such as mica chips or vermiculite. Do not use fiberglass, as moisture will render it useless. **ABSOLUTELY** avoid the use of any flammable material, such as styrofoam.

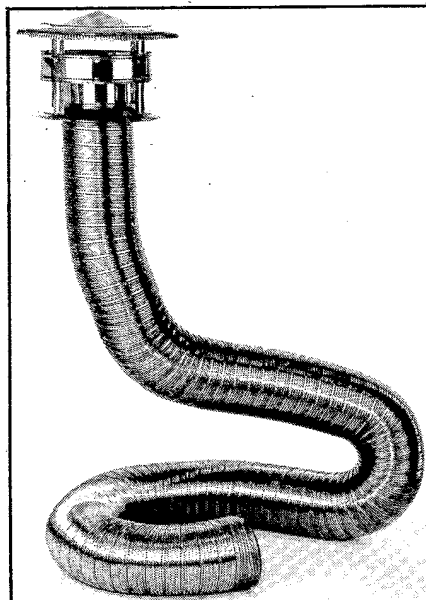
THE DOUBLE- AND TRIPLE-WALL, "self-insulating" steel flue pipes are designed to be used as unenclosed stove pipe. Double-wall pipes have the space between the steel walls filled with asbestos or mineral wool. The triple-wall pipes use air space to insulate and are actually less insulative because the air is allowed to circulate between the inner and outer chamber. These have little application for relining an existing masonry chimney.

ONLY STAINLESS STEEL should be used for flue lining. Simple stove pipe will not stand up to the high temperatures and prolonged exposure to tars and acids. Stainless steel is classed by Underwriter's Laboratories as "Class A, All Fuel" pipe. Nevertheless, because of recent evidence, The OHJ goes on record as recommending that NO metal liner of any sort be used with coal, due to the metal's inability to resist attack by sulfuric and nitric acid. An attempt has been made to overcome this problem by using a different steel alloy in installations for use with coal stoves. Molybdenum steel, resistant to chemical attack, is available--but this is too new and unpredictable, and also too expensive for most residential purposes.

A **MORE TRIED-AND-TRUE ANSWER** to the problem of metal's vulnerability is the enamel-coated steel liner, which is similar to single-wall steel pipe but has a baked-on coating that's resistant to chemical attack. See page 192 for more information on this product.

Poured-Cement Liners

YOUR THIRD CHOICE is new in the States, although it's been used in England since the 1960s. There, extensive use of coal made metal liners impractical, and an alternative to the relatively destructive installation of a clay liner was sought. In outline, the



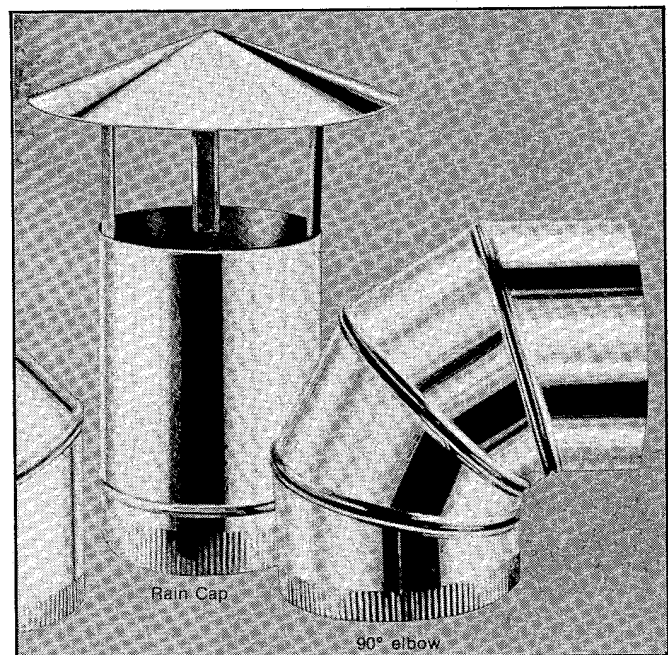
This is the new Z-Flex flexible stainless steel liner for chimneys with offsets.

process is simple: A new cement lining is pumped into the chimney around a flexible, inflatable form, which is removed after the cement has cured. In practice, of course, the procedure is a little more complicated.

IN THIS COUNTRY, the system is marketed by at least four operations. The two with widest distribution are National SUPA-FLU Systems, Inc., and the BPF or British Poured Fluelineer system, available through Chimney Relining, Inc. (see p. 192 for listings). Both of these companies market the system through certified dealers only, so availability is limited in some parts of the country.

AFTER A DETAILED inspection and repairs, a rubber "former" (which before inflation resembles a fire hose) is dropped down the chimney from the top, extending all the way down and out through the fireplace or furnace opening. The installer places a wooden form around the bottom of the hose, bracing it to prevent mortar from escaping at the bottom. Any secondary fireplaces or openings are similarly sealed. The rubber former is inflated to the desired flue size (usually 6 to 8 in. in diameter). Spacers hold the rubber former away from the chimney's walls and center it in the opening.

IN CHIMNEYS WITH OFFSETS, as with the other liner types, it's usually necessary to cut a hole in the side of the chimney in order to position the former properly. A special cement mortar in a slurry consistency is mixed on the



These are some components of stainless steel liner pipe.

ground and pumped by hose to the top of the chimney, then down around the form. This mix, a proprietary formula, is basically a cementitious, refractory mortar with admixtures to decrease its weight and increase its insulating capacity, as well as aid its workability, durability, and fire retardancy. Properly applied, the mixture also seals cracks and increases the stability of the chimney.

AFTER THE MIX HAS CURED (10 to 12 hours), the former is deflated and removed, along with the other formwork. Any finish work is done now. Barring major repair work to the chimney, the whole process can be completed in two days.

THE MORTAR MIXTURE can withstand temperatures in excess of 2000° F., while clay or metal liners both start to melt at about 1700°. Temperatures over 1700° would be encountered only during a chimney fire. Still, it's nice to know that a cement-lined chimney could survive such a fire . . . IF, that is, the installation was done right.

The Bottom Line

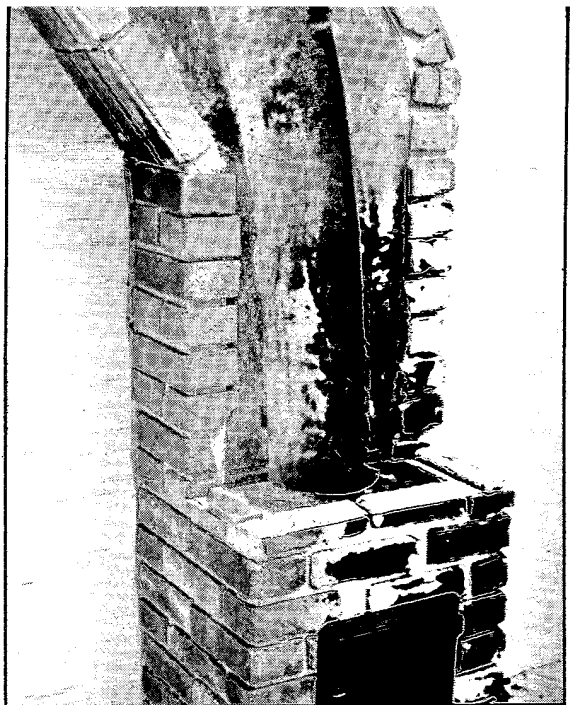
A COMPARISON OF THE COSTS of these different systems is nearly impossible on paper. You can, of course, get estimates locally for each type of lining permitted by code. Cost factors include chimney size and condition, number and acuteness of angles, local regulations, and finish work. Materials vary in cost, too, but that cost is negligible in comparison to labor costs.

CLAY LINERS come in two-foot sections and sell for about \$4 apiece for a per-foot price of \$2. That doesn't include mortar or labor.

A THREE-FOOT LENGTH of standard, stainless steel, single-wall pipe, 6-in. diameter, is about \$23, or about \$7.50 per foot. Shorter sections and angles are higher. Labor costs for this system, however, should be considerably lower. Also, a straight-forward installation isn't beyond the abilities of a handy do-it-yourselfer.

FLEXIBLE STEEL LINER is more expensive, with 6-in. diameter selling for about \$10 per linear foot. Here again, speed and ease of installation probably justify the added material cost.

THE FORM-AND-CEMENT METHOD COSTS vary with the nature of the chimney, but a standard installation in a two-storey house runs between \$700 and \$800. This is comparable to the cost of a clay-tile installation in an internal chimney—where the installer has to break through interior walls.



In this demonstration photo of PermaFlu, supplied by Chimney Relining, Inc., you can see the round flue formed by the cementitious refractory mortar. Supaflu is the trademark name of a similar process.

Basics Of Chimney Construction

Chimney design varies, but basic principles of good construction are the same for all chimneys. The chimney has three functions: (1) to conduct waste gases out of the building; (2) to keep the gases hot while in the flue; and (3) to protect the other building materials from this heat. Good building practice and code regulations reflect these three objectives. If your chimney doesn't stack up to these basics, maybe you should think twice about reactivating unused flues.

- Think of the smoke leaving your stove or fireplace as a stream of water. Any sharp corners or turns, or any projections or roughness on the inside surface, will impede the flow. At no point should the chimney bend more than 30 degrees away from the vertical.

- In buildings where there is more than one flue in a single chimney stack, each flue should be completely separated by at least 4½ inches — the width of one brick. Holes or gaps in the masonry separating one flue from another will interfere with the draft of each. This is especially dangerous when one flue services a fireplace or woodstove and the other vents an oil- or gas-burning furnace. In such a case, the draft from the fireplace could cause back-puffing in the furnace flue, forcing flammable exhaust gases back into the furnace, creating an explosion. (This is also the reason why two heating appliances should not be vented through the same flue; in some areas, building codes specifically forbid it.)

- When a chimney runs along the outside of a building, the wall facing the outside should be 9 inches (the width of two bricks) in thickness, to adequately in-


ulate the flue from the colder outside air during the winter. This, unfortunately, is a rule that's ignored in all but the best construction. In an extremely cold climate, an air space is sometimes built into the chimney on the outside wall to insulate even more.

- There should be no wood touching the chimney in any place. The usual clearances are 2 inches for all framing members and ¾ inch for flooring and sub-floors. A firestop or spacing member in the framing should be installed at every floor level.

- The flue should extend one to two feet above the highest point on the building to prevent eddying air currents from causing back-puffing. On flat roofs, three feet is recommended. If two flues run in the same chimney, the tops should be set at different heights to aid the draft in each. A variety of chimney caps is available to keep rain out of the flue and still provide adequate draft (see p. 192).

- As to the size of the flue: For a fireplace, the flue area should be 1/10 the size of the area of the fireplace opening for a chimney over 15 feet tall. For a shorter chimney, this should be increased slightly.

- There are standard practices for safe and efficient stovepipe installation and stove hookup. You should, of course, become absolutely familiar with these before burning solid fuel.

If Your Chimney Is . . .		And Your Heating System Is . . .			
		Coal-Burning	Woodstove/Insert	Wood Fireplace	Gas/Oil Furnace
		Single-Flue	Straight Slightly Offset Moderately Offset	cement; clay cement; clay cement	cement; clay cement; clay clay; cement
Multi-Flue	Straight Slightly Offset Moderately Offset	clay; enam. clay clay	stainless clay clay	stainless; clay flexible flexible	stainless flexible flexible
A Do-It-Yourself Job (straight flues only)		<i>don't</i>	<i>don't</i>	stainless; flexible	stainless; flexible

cement = poured cementitious refractory mortar; clay = clay tiles; enam. = enamelled steel; stainless = stainless steel liner pipe; flexible = flexible stainless steel. *We've based these guidelines for choosing a liner on conservative safety standards first, then economy. It should not override the recommendations of a competent installer or building codes.*

Some Conclusions

WE CAN'T DISMISS any of the three basic relining systems, nor can we pick out one as "best." We've never before seen a clear discussion of these options, never found a logical list of dos and don'ts. So the OHJ editors and I have come up with a set of conservative guidelines to help you make a choice. We welcome any further experience or expert commentary from any of our readers.

- The single, most important factor is that you trust your installer. If one mason or fireplace specialist comes highly recommended, buy that person's time AND expertise. If she or he has been installing clay tile for 30 years with the approval of the building inspector, for heaven's sake don't insist on an explanation of how many pennies you'd save by using metal.

- Don't trust someone who's never done it before to install clay tile in a chimney with offset angles. It takes special skill to mitre the clay tiles and mortar them in the bends. (Be sure refractory cement is used.)

- Unless your circumstances are unusual, metal isn't cost-effective for wood-burning stoves. It lasts from 4 to 10 years. Clay tile lasts upwards of 50 years, as does a poured liner.

- You can get away with a metal liner for exhausting a little-used fireplace. Just be sure to have it cleaned every year or so.

- We have doubts about the flexible steel liner for use with wood, because of the difficulty of cleaning creosote from the corrugations. In a few years, sweeps will know more about it. But it sounds like a great answer for any masonry chimney, straight or not, that is just used to

vent exhaust from a gas or oil furnace.

- DO NOT use metal liner if you're burning coal. Enamelled metal may be okay, but won't last as long as clay or poured lining. It makes sense only if you'd save a lot on labor costs for a straight chimney. (Installing enamelled metal in an offset chimney costs as much as clay.)

- The ONLY method we consider do-it-yourself is steel liner--and then only if the chimney is straight and sound, you're not burning coal, and the job is inspected by a fire marshal, qualified chimney sweep, professional installer, or code officer before its first use.

- Poured linings have the advantage of no seams--important for chimneys with offsets, because there's no seam or shelf for creosote to collect on. But it will cost as much or more than clay liner, because the installer will have to break the masonry, just as with clay.

- Dealers of the poured linings themselves expressed doubts about its use in multi-flue chimney stacks. It's virtually impossible to be sure of the condition of the brick partition between the flues. If there were any structural weakness in that partition, the added weight of Supaflu or Permaflu might cause it to give way. Also, any cracks would allow the slurrylike cement mixture to flow through into the other flue.

- Now for the requisite mention of reversibility: A clay liner or a metal liner can be removed--not easily, but it's possible. A poured lining, bonded to the original masonry chimney, cannot. This isn't a serious consideration for most old houses, with one exception: If the installation job is botched, you've got a real mess. We're back to the importance of finding a competent installer. 