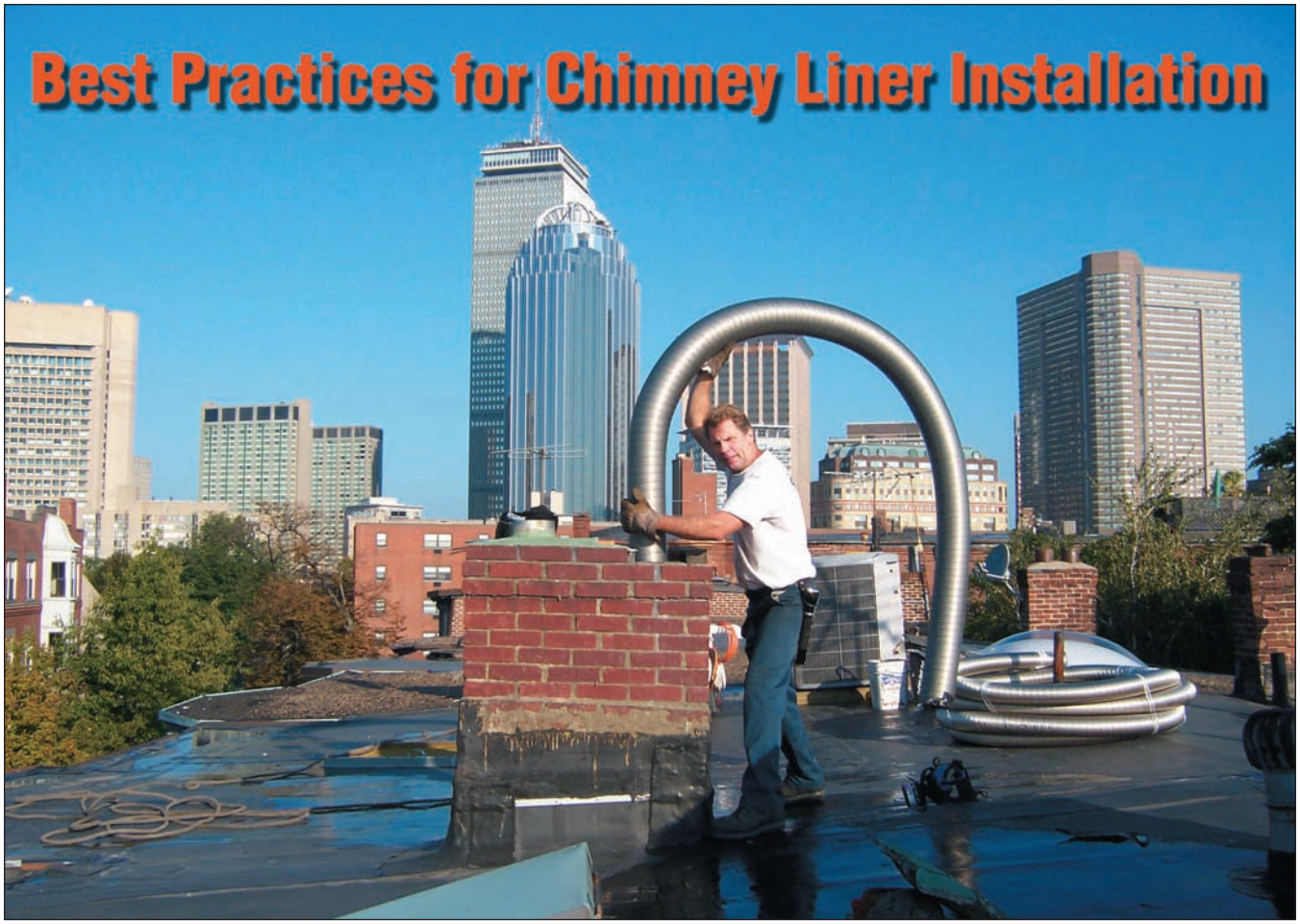
The relining of chimneys is a challenging task. Here are six key steps to help you make those critical decisions necessary to the job.

Best Practices for Chimney Liner Installation



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Installation of flexible liner.

Introduction

The installation of relining systems is challenging because it involves a number of decisions that can make the installer responsible for the later performance and safety of the system. The installer must answer a series of questions:

- Can the existing chimney be relined?
- Will relining resolve the safety and performance problems that prompted action?
- What size and type of lining materials and insulation, among the many options available, should be selected?
- What steps and equipment will be needed for installation.

This paper proposes a series of practical best practices to assist liner installers in making good decisions and to support their efforts to inform customers on why specific recommendations are made. The other goals are to raise the quality and consistency of chimney lining services offered by trained technicians and to promote the correct use of products offered by chimney liner manufacturers. The relining of chimneys serving wood-burning appliances is the main focus, although these best practices also apply generally to chimney relining for oil-, gas- and coal-burning equipment.

1. Reline for valid technical reasons.

There are several good reasons to reline an existing masonry chimney.

Relining may be needed when there is a **change of use** of the chimney, such as the installation of a smaller, more efficient appliance, or an insert into an

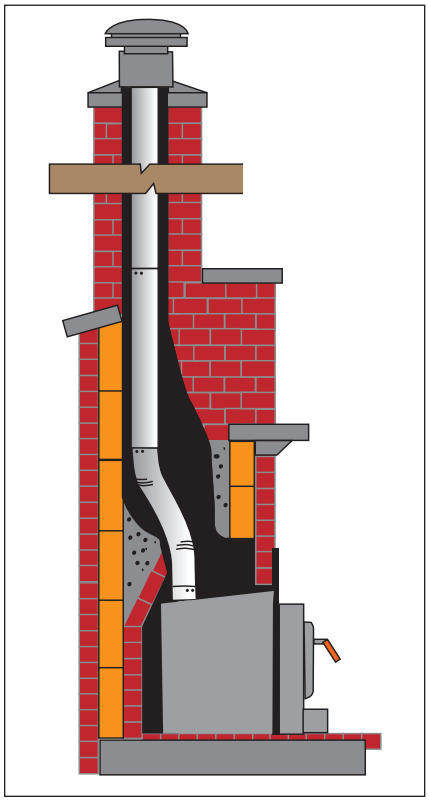
Six best practices are proposed:

1. Reline for valid technical reasons.
2. Provide accurate, credible information to the homeowner.
3. Inspect the chimney carefully and prepare it for relining.
4. Select the appropriate liner for the task.
5. Insulate the liner except in special circumstances.
6. Follow the liner manufacturer's installation instructions and use components correctly.

existing fireplace. Ideally, the flue area should match that of the connected appliance. The nominal 8-by-12-inch clay liner, the most common size in most regions, has more than twice the cross sectional area of a 6-inch diameter flue, which is the most common size for modern wood stoves. Resizing the chimney flue with a new liner that matches the size of the appliance flue collar is a good reason for relining.

Clay liners can fail because of thermal shock caused by a chimney fire, from attack by acids in flue gases, from freeze-thaw cycles in cold climates, or from general deterioration with aging. The most common signs of failure are cracks in clay liners and displacement of broken pieces. There are regional variations in the quality of clay used in the manufacture of clay liners. As a result, some last decades and others deteriorate in a few years, so it is not possible to give an average life expectancy for clay tiles. Whatever the reason for failure, relining is an appropriate solution for a chimney in which the brick or stone shell is still in good condition but the liner has failed.

Signs of flue gas cooling, such as water condensation, visible staining or



Relining is common when there is a change of use of the chimney, such as the installation of an insert into an existing fireplace.

Stains like these are caused by condensation of moisture and creosote from cool flue gases.

rapid creosote formation are problems that can be addressed by the installation of an insulated liner. These symptoms are often accompanied by weak draft, which tends to show up as slow burning, fussy fires and smoke roll-out when the door is opened for loading. While an insulated liner can be an important aspect of the solution, it may not be the total answer because these symptoms can also result from poor fuel and operating practices. Ideally, when solving the problem of excessive flue gas cooling, relining is combined with good advice on fuel preparation and appliance operation.

Where inspection reveals **evidence of combustibility hazards** such as inadequate clearance or the presence of embedded combustibles such as "nailers" or beams supported in the masonry structure, relining with a liner certified for zero clearance from the masonry shell to adjacent combustibles is a good solution. Such liners are always required to be insulated. Note that, even when using a zero external clearance lining system, there must be at least the equivalent of 3.5 inches of solid masonry between the liner and combustible material.

2. Provide accurate, credible information to the homeowner.

Liner installers often find themselves in an apparent conflict of interest, in that they have inspected the chimney during cleaning or after a chimney fire and have determined that relining is needed. They then offer to sell and install the liner, raising at least the possibility that the inspection findings were made in order to sell the liner and not because of a potential hazard or to improve performance. The installer cannot entirely avoid the appearance of conflict, but can manage the situation effectively to minimize it.

One way to eliminate skepticism is to provide photographic or video evidence of the liner failure. Another is to be careful and deliberate in the description of all conditions that justify the recommendation for relining. Providing the reasons in writing or in a hand-out sheet on relining are good strategies for increasing confidence in the legitimacy of the recommendation. Suggesting to the customer that they might wish to get a second opinion and cost estimate demonstrates good faith and may boost the customer's confidence to the extent that they don't bother to act on the suggestion.

On the other hand, the surest way to increase skepticism is by attempting to use the fear of fire to frighten the customer into purchasing the liner. The use of fear tactics is a common cause of complaints about companies promoting liner installations.

3. Inspect the chimney and prepare it for relining.

New liners should only be installed in chimneys that are structurally sound and fully cleaned of deposits. It is important to **clean the chimney thoroughly,** including the removal of hard, baked-on creosote. If left in place when the new liner is installed these deposits could outgas into the living space when subsequently heated because there would no longer be a flow path to outdoors. In a severe case of heating, if the new liner were not insulated, the deposits could ignite, creating a potential hazard.

Any **deterioration of the masonry should be repaired** before relining. Typical deterioration includes a loose crown or weak and eroded mortar joints.

Remove the original clay liner if necessary. If the clay liner is damaged or if the space it occupies is needed to accommodate the new liner and its insu-

Damaged crown and eroded mortar joints should be repaired before relining.

lation, it should be removed. Clay tile removal is a difficult and potentially dangerous job requiring the right tools and good planning.

During the inspection and preparation for relining, the flaws in the chimney should be revealed. **Unused breeches and hidden combustibles** are examples of problems that can be discovered and corrected at this stage. Such problems should be corrected before proceeding with the reline.

4. Select the appropriate liner for the task.

A number of optional liner types are available, each having special features that can make it suitable in particular situations. The basic requirement for any liner is that it meet the requirements of

The chimney should be cleaned thoroughly before relining.

UL Standard 1777, Chimney Liners, and is suitably listed and labeled. The label or stamp will specify whether the liner is suitable for Category 1 gas- or propane-fired appliances, for oil-fired appliances, or for solid fuel-fired appliances. Provided they do not conflict with the listing label, the liner manufacturer may make other recommendations regarding the suitability of particular liner models for special purposes, such as the venting of coal-fired appliances.

Stainless steel liners, of the kind suitable for chimneys serving solid fuel-fired appliances, are available in either **rigid or flexible** forms. In general, flex liners are made of thinner stainless steel of a higher grade than rigid liners. While a dealer or installer may prefer one or the other, there is no evidence to suggest that either rigid or flex liners perform better or are more durable than the other. The important point is that, in

Flex liners are the most common type, and must be used for relining chimneys with offsets.

achieving a listing under UL 1777, both types of liner are subjected to the same temperature and corrosion tests and are therefore considered to be equivalent.

Flex liner is the best choice if the chimney has an offset, since it is difficult and expensive to install an offset using rigid liner within a masonry structure. In straight chimneys, either flex or rigid are acceptable.

Rigid and flex liners can be **insulated with either a fiber blanket or a mixed insulation** based on vermiculite, depending on the terms of the product listing. The insulation used must be clearly referenced in the liner installation instructions and must be installed exactly as described in the instructions. The form of insulation and the way it is installed is critical because this affects the permitted clearances, both internal and external, as determined during safety

A rigid liner being assembled.

testing to UL 1777.

Another form of certified liner is referred to as **poured-in-place, solid set.** This cementatious liner material is pumped into place around an inflated rubber bladder or a vibrating former. Once the forming device is removed, a smooth flue passage remains. The liner material itself insulates because it has a vermiculite base. Poured in place liners require the use of expensive specialized equipment and experienced operators, and as a result their cost is generally higher than stainless steel liners. Poured-in-place liners are sometimes favored for installations in heritage buildings because they can permit any form of top termination, or cap, to be used, and because poured-in-place liners are also claimed to provide some structural strength to the chimney from the inside.

Theoretically, **clay liners** can be retrofitted into existing masonry shells using specialized equipment, but this is rarely done.

Specialized components and liner assemblies have been listed for **installation in existing factory-built metal chimneys.** These installations should only be undertaken if the exact procedure and component use is set out in the liner manufacturer's instructions. Currently, relining of metal chimneys is rarely done.

5. Insulate liners except in special circumstances.

The one key principle that applies to the question of insulating stainless steel liners is this: The only circumstance in which insulation is not required by the terms of the product listing is if the clearances of the existing chimney comply in all respects to the requirements of the NFPA 211 solid fuel installation code, or the building code enforced locally. Ideally, all masonry chimneys would comply with the simple clearance rules in the code, but most experts agree that the majority of masonry chimneys do not have sufficient clearance to combustible materials.

Furthermore, a thorough inspection of a masonry chimney to confirm beyond doubt that it has adequate clearances can be a difficult and time-consuming job, depending on whether access to inspect clearances is straightforward or requires the removal of enclosures. Considering the challenges inherent in determining code compliance of an existing masonry chimney, the installer should

Blanket insulation must be carefully installed.

assume that insulation is required around the liner if adequate clearances cannot be determined anywhere along the chimney's length.

Even if clearances comply with the code there are other good reasons to insulate. Insulation around the liner **reduces heat loss** from the flue gases to the surrounding masonry. Natural draft is produced by the temperature difference between the flue gases and the outdoor air – the greater the temperature difference, the stronger the draft. Stainless steel liners have little mass and when they are backed up by insulation they **heat up quickly** and absorb a relatively small amount of heat from the flue gases. Therefore, the average flue gas temperature in an insulated stainless steel flue rises fast when a fire is started, meaning that **fires kindle rapidly and smolder less.** Strong natural draft also r**educes smoke rollout** when the stove, furnace or fireplace door is opened for reloading.

Installing mixed insulation around the liner.

Since both wood smoke and water vapor condense on cool surfaces, keeping the flue liner hot is a good way to **reduce both creosote deposits and water damage** in the form of staining and freeze-thaw deterioration. The use of insulation around chimney liners is an effective strategy for reducing maintenance costs and extending the life of the masonry chimney.

For safety and performance reasons, chimney experts recommend that all liner installations include the insulation specified by the liner manufacturer.

6. Follow the liner manufacturer's instructions and use components correctly.

The manufacturer's installation instructions are the primary document the installer must refer to. Because UL 1777 is a performance standard and so does not specify a particular approach, manufacturers are free to use virtually any design, provided the product can pass the various tests in the standard. As a result, it is not possible to generalize about most installation issues. However, it is possible to highlight some of the critical features the installer must be aware of and seek guidance for in the installation instructions.

Liner support components differ in design and function for rigid and flex liners. Rigid liners must be securely supported from the bottom and must be free to slide at the top to accommodate thermal expansion. At the same time, the top termination assembly must shed water, snow and ice. The primary support for flex liners is at the top, but the bottom termination must also be securely mounted for stability. Every liner manufacturer has a specific set of support components, each of which must be used exactly as specified in the instructions.

The use of **internal spacers** is required for some liners in some circumstances. Spacers are required if certification testing demonstrated that to successfully pass the performance tests the liner must be supported inside the masonry structure so that a minimum clearance between the liner and the masonry is maintained. This clearance is usually one inch. The usual circumstances in which internal spacers are required is where an uninsulated liner passes through an offset, which, if spacers were not used, would cause the liner to rest against the masonry. In straight systems, these spacers are not usually required because it is assumed that the liner will hang (or be supported from the bottom) straight within the masonry. Internal spacers are not required where liners are surrounded by the insulation material specified by the manufacturer.

The instructions will specify the **correct fasteners** to be used. The two main options are rivets and screws. Whatever fastener is used, it should be stainless steel to resist corrosion. Some concern has been expressed about the possibility of screws working themselves loose as the liner expands and contracts with hundreds of heating and cooling cycles. As a result, rivets tend to be the preferred fastener. On the other hand, stainless steel screws are the preferred fastener for components that must be removed periodically, such as chimney caps and clean out covers. Again, the manufacturer's instructions should specify the appropriate fastener and how it is to be installed.

The **top and bottom terminations** of the liner are critically important to its safety, function and durability and are normally specified in detail in the manufacturer's instructions. The bottom termination design deals with how the liner is to be supported and how it is to mate with flue pipes in a secure way. The instructions may also deal with the problem of connecting to a masonry chimney through a combustible wall, an area that has significant risk of overheating if the correct components are not installed or if they are installed incorrectly.

Summary

The relining of existing chimneys is an important part of the hearth industry and is one of the more challenging tasks for any hearth technician. Not only is the work physically demanding, but it also requires a number of critical decisions to be made. As a result, chimney liner installers need good product knowledge, awareness of building code requirements and good judgment. A good way to prepare yourself technically and to present yourself professionally is to earn certification from one of the following national organizations.

National Fireplace Institute
http://nficertified.org
(703) 524-8030

Chimney Safety Institute of America
http://www.csia.org
(317) 837-5362

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