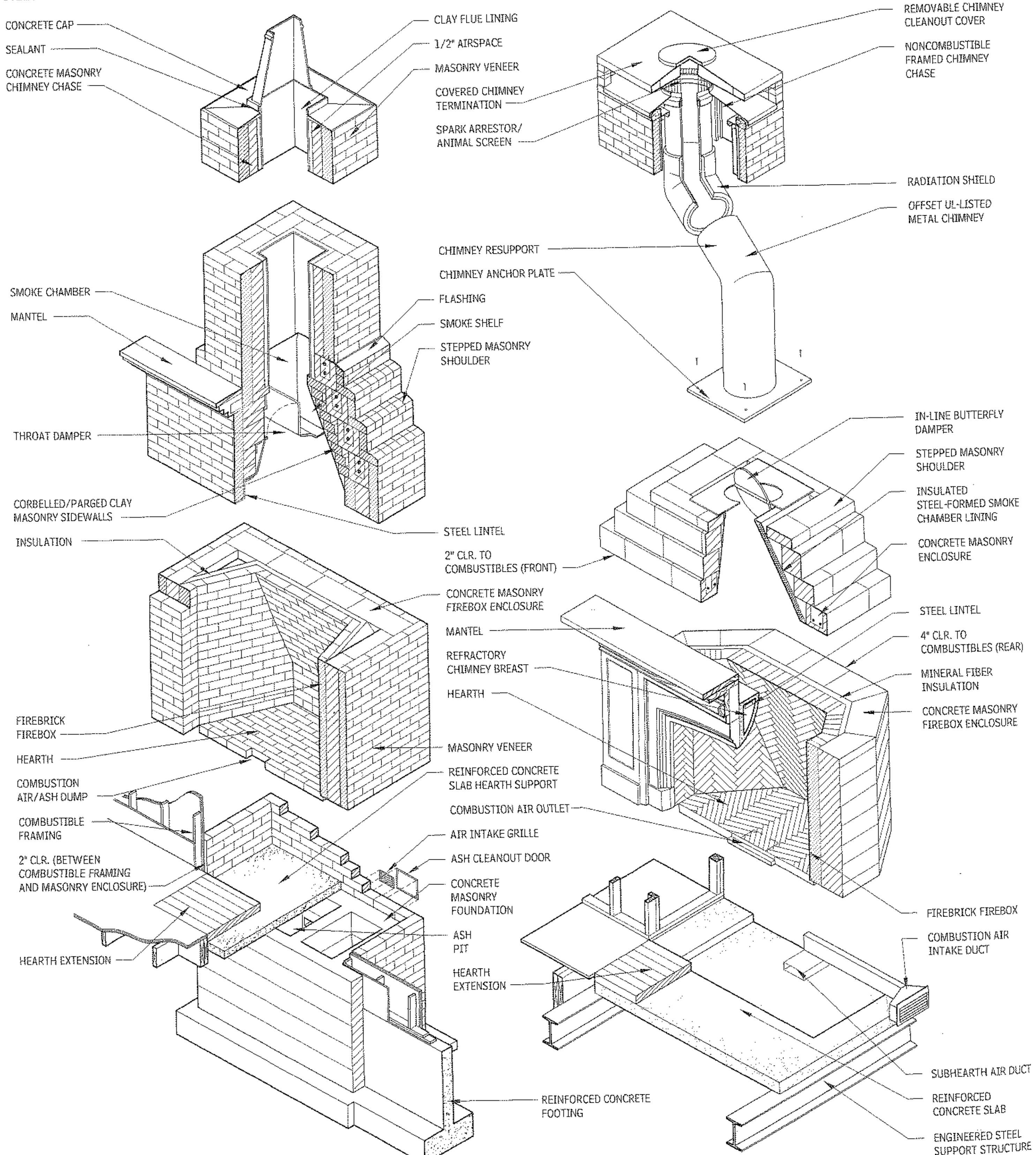
MASONRY FIREPLACE CONSTRUCTION
3.123



Contributor:
Walter Moberg, Moberg Fireplaces, Inc., Portland, Oregon.

PERFORMANCE CRITERIA

Site-built fireplaces are typically designed to operate as open systems, without closed doors but including screens, and be capable of either wood burning or housing certain gas appliances. This is the classical form for the fireplace, used for direct radiant heat and ambience.

In this model, three elements are integral to sustaining an efficient combustion process, one that expels all of the products of combustion from the firebox to the atmosphere:

- *Carefully shaped engine*: An efficient aerodynamic enclosure for the fire
- *Warm exhaust system*: A properly sized chimney of adequate height, capable of sustaining flue temperatures
- *Open carburetor*: Conditioned makeup air from the room and combustion air from the exterior, combined to create a positive flow across the opening of the fireplace and to efficiently feed the (dry) fuel load

With all three elements in balance, a fireplace will perform as intended, not spill smoke into the room and provide supplemental heat during the peak of the fire.

TRADITIONAL AND MODERN DESIGN

Masonry fireplaces must set on footings and foundations built on firm soils. The massive weight of all-masonry assemblies is best supported on terra firma. In contrast to hearth extensions, which are typically cantilevered to minimize the overall footprint, an engineered footing larger than the foundation must be created for permanent stability.

Typically, all-masonry fireplaces are constructed with brick, stone, or block, from footing to termination, lined with firebrick in the firebox and clay tiles in the chimney above the smoke chamber. With more refined internal geometry, modern fireplaces are typically built at various levels of a building and can set on engineered slabs supported by steel frames. Easily navigating structural elements, lightweight insulated UL-listed chimneys can offset without complication and terminate in covered enclosures. In this era of pollution control and energy awareness, the modern fireplace incorporates advanced insulations and stainless steels to house sensitive exhaust, confining fuel loads to smaller hearths that complete combustion.

TYPICAL SINGLE-FACE CONSTRUCTION

The most common format for open masonry fireplaces, at least in the last few thousand years, has been with a firebox that is enclosed in masonry with only one side (face) open to the room. This allows for an excellent combustion environment, increasing combustion temperatures and reflecting a significant amount of heat into the room. However, open single-face fireplaces must also exhaust the fire, smoke, and heat through a throat and smoke chamber into a flue, "powering" the flue, in order to maintain a constant flow to the exterior atmosphere. Following the route of the chimney backward, it geometrically "breaks" into the room at the lintel—hence, called the chimney breast.

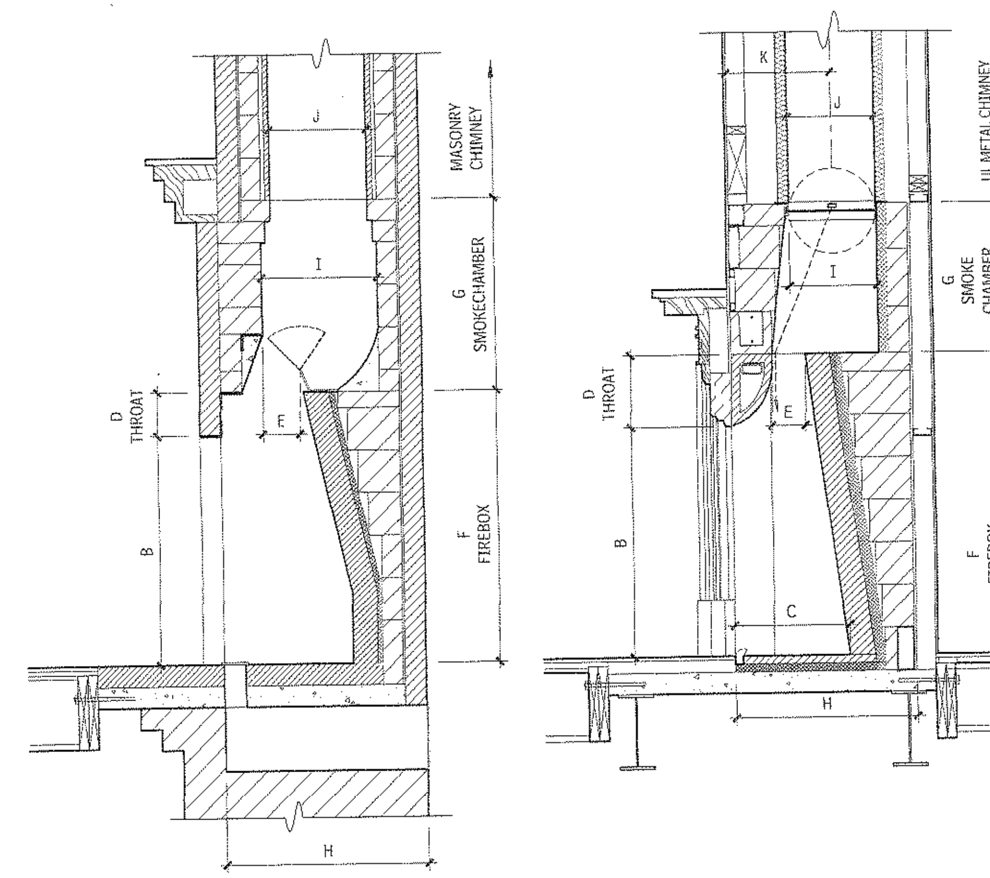
TRADITIONAL CONSTRUCTION

Traditional fireplace construction supports a damper at a narrowing of the firebox throat, at least 8 in. above the opening in the façade. A tapered smoke chamber transforms the rectilinear flow of air and smoke from the fireplace into a square or round flue. Parging of the smoke chamber reduces resistance, and gentle corbeling can support the vertical column of clay flue tiles, which rest on the firebox mass. Ideally, clay masonry is used in the smoke chamber area. Traditionally, masonry façades and dampers are supported at the opening with steel lintels; and at the rear, they rest on the firebrick firebox. However, even hot ASTM-class firebrick will rise and fall with the expansion of heat and must remain independent of the structural casing of the fireplace. Permanent mineral-fiber insulation blankets are useful in building fireboxes to create room for expansion around metal, and to contain heat.

MODERN CONSTRUCTION

Modern fireplace construction is based on the lessons of the ages, but utilizes advanced materials to optimize performance and integrate with building programs. Air ducts and insulation protect steel-reinforced slabs, and continuously sloped rear walls reflect heat both into fuel loads for better combustion and toward the room for greater efficiencies. Heavy permanent mineral-fiber and glass insulation enable fireboxes to heat up quickly, and curved refractory chimney breasts—based on 400-year-old European designs—create smooth airflows from the opening to the throat. Insulated smoke chambers, lined with heavy steel forms, clay tiles, or firebrick, continue the cause of better draft—key to vigorous and clean combustion and *safe* for *stick-frame* construction. Typically, there are CMU casings, isolated from the hot internal chambers, which form permanent structural housings and are also reinforced in seismic areas.

MASONRY FIREPLACE SECTIONS
3.124



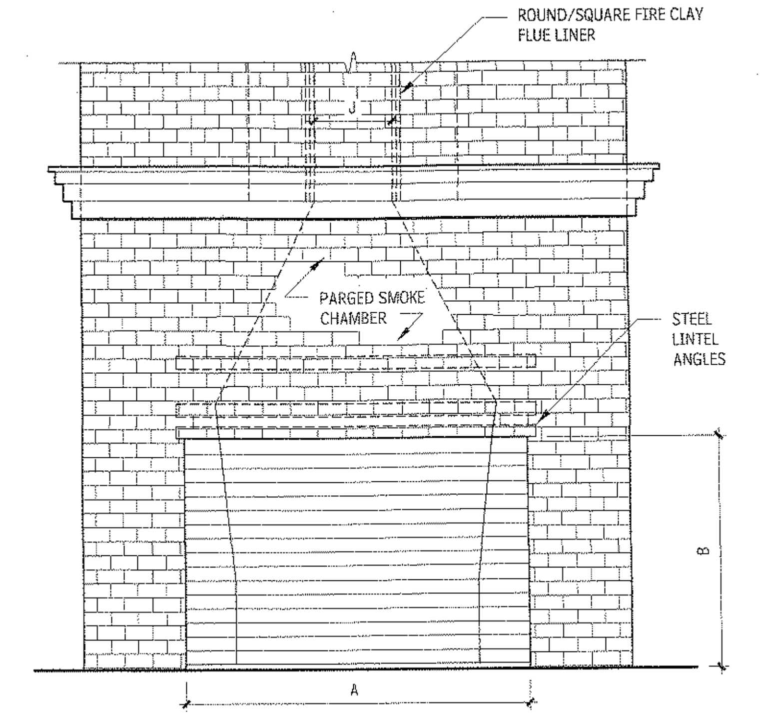
TRADITIONAL MODERN

NOTE

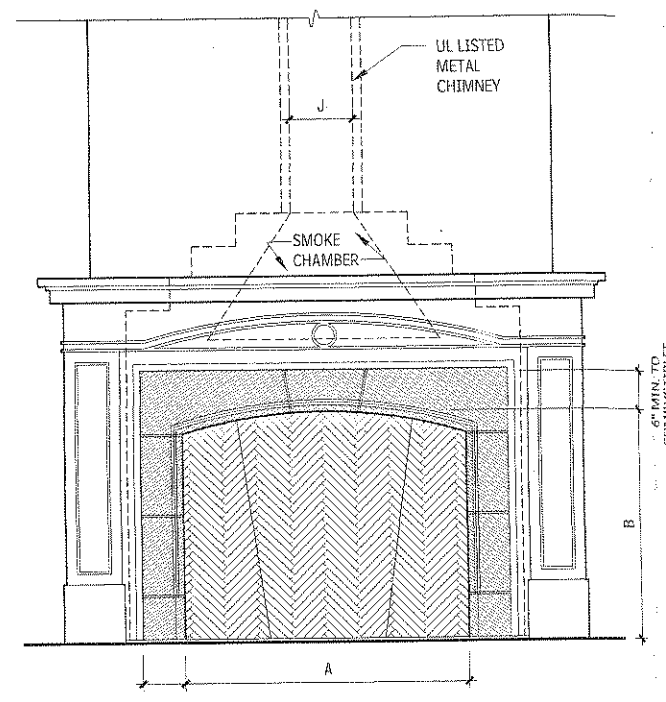
3.124 Refer to Tables 3.127 and 3.128 for standard dimensions.

Contributor:
Walter Moberg, Moberg Fireplaces, Inc., Portland, Oregon.

MASONRY FIREPLACE ELEVATIONS
3.125

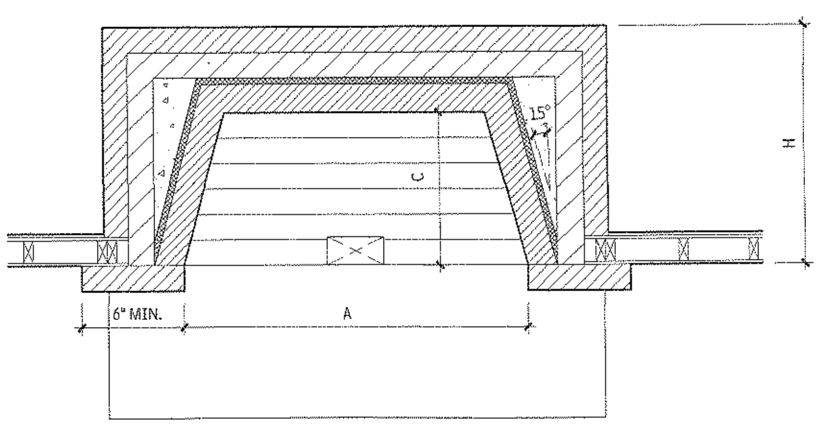


TRADITIONAL

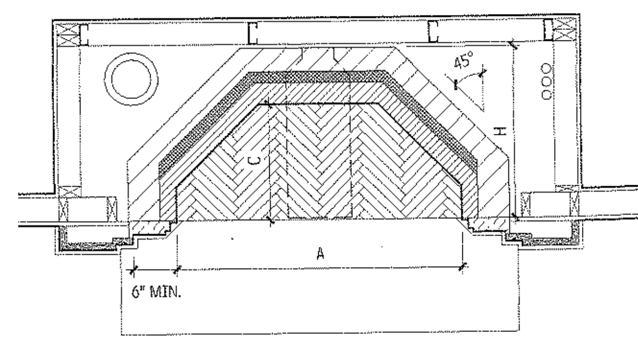


MODERN

MASONRY FIREPLACE HEARTH PLANS
3.126



TRADITIONAL



MODERN

TRADITIONAL FIREPLACE DIMENSIONS (IN.)
3.127

A	B	C[a]	D	E[b]	F	G	H	I	J[c]
24	24	16	8	3.5	32	18	29.5	13.5	10
30	28	16	8	3.5	36	24	29.5	13.5	10
36	30	16	8	4	38	28	29.5	13.5	12
42	32	18	8	4	40	30	31.5	15.5	12
48	36	20	8	4.5	42	36	33.5	17.5	14
54	38	22	8	4.5	46	42	35.5	19.5	16
60	40	24	8	5	48	48	37.5	21.5	18

MODERN FIREPLACE DIMENSIONS (IN.)
3.128

A	B	C	D[a]	E	F	G	H[b]	I	J[c]	K
36	30	20	11.5	5	41.5	20	31	13	12	17
42	33.5	20	11.5	6	45	24	31	13	12	17
48	40	21	13.5	6.5	53.5	24	34	15	14	18
54	43	22	13.5	6.5	56.5	28	36	17	16	19
60	47	24	13.5	7	60.5	32	38	19	18	20
72	58	26	16	7	64	40	41	23	22	21
84	65	29	18.5	8	83.5	48	44	25	24	23
96	72	31	21	9.5	93	60	46	25	24	24

NOTES

3.125 Refer to Tables 3.127 and 3.128 for standard dimensions.
3.126 Refer to Tables 3.127 and 3.128 for standard dimensions.
3.127 a. Assumes minimum masonry façade thickness of 4 in. to achieve minimum 20-in. code-required hearth depth.
b. Recommended minimum net horizontal opening with damper blade fully open, which varies by manufacturer.
c. To determine flue liner outside dimensions (O.D.), dimensions are equal to the inside dimension (I.D.)of the flue liner (J), plus at least 2 in. Consult manufacturers for flue liner sizing that matches or is the next size larger on round and square liners—for example, 15-in. round liner (I.D.) for 14-in. sizing, or 16-in. by 16-in. square liner (O.D.) with 1-in. wall thickness. Minimize use of rectangular liners to optimize fireplace flue performance.
3.128 a. Modern construction utilizes taller than code-minimum throats of 8 in., incorporating firebrick above the chimney breast until the throat is reached.
b. Most codes require minimum firebox and smoke chamber masonry thicknesses of 8 in. when at least 2 in. of ASTM firebrick is used.
c. Metal chimneys must be listed to UL 103HT and be tested for use with masonry fireplaces. Exterior dimensions are typically 2 in. or 4 in. greater than interior dimensions, and typically require 2-in. clearance to combustibles.

Contributor:
Walter Moberg, Moberg Fireplaces, Inc., Portland, Oregon.

EXTERIOR-INTERIOR SITING

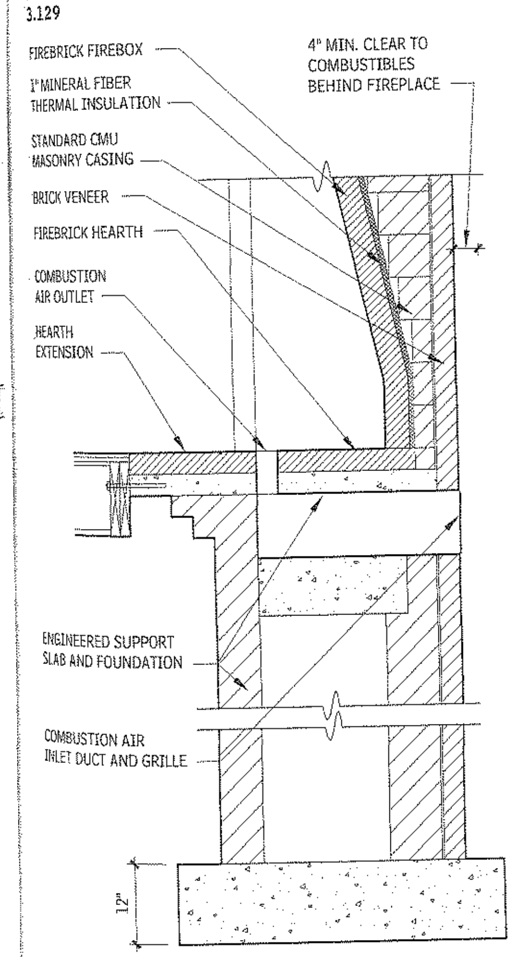
Certainly, the siting of a fireplace is an important consideration in performance (cold exterior versus warm interior, for example), but there are also important architectural programs that mandate location and appearance. In the last century, many sitings for all-masonry fireplaces have occurred on exterior walls, where the decorative masonry cladding of chimneys has increased real estate values.

Ironically, this location for fireplaces creates a chronically cold environment for fireboxes and flues, diminishing combustion and flue temperatures, and impacting performance. Without exception, it is better to place both fireplace and flue within the conditioned interior of a building, where fires and exhausts benefit from warmer conditions and more vigorous flows from taller chimneys. Ideally, this is the modern setting that also incorporates insulated chambers for even better and more efficient conditions. Primed and insulated flues, top dampers, and glass doors can aid in optimizing the performance at exterior locations.

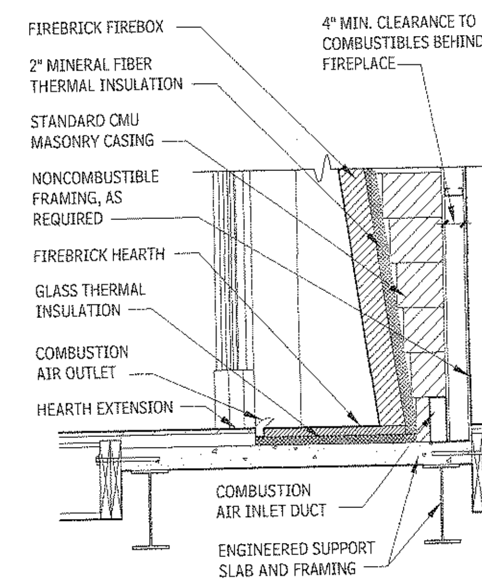
FOUNDATIONS AND HEARTH SUPPORTS

Footings are designed to accommodate the intended load on specific soils. Commonly, 12-in.-thick footings, which extend 6 in. past foundation walls, form an adequate base. Corbelled masonry foundation walls, capped with engineered cantilevered concrete slabs, provide noncombustible support for hearth extensions and may integrate combustion air and ash dump features. In modern buildings, high-temperature and high-psi-rated glass insulations protect steel-reinforced slabs from hot firebrick hearths. These slabs are engineered into the steel frame structures of homes and buildings, and must provide adequate clearances to combustible ceilings below. Typically, a 4- to 6-in. thick slab is large enough for a hearth extension. Lighter-weight façades and metal flues are often used to reduce working loads.

FOUNDATION AND SUPPORT METHODS
3.129

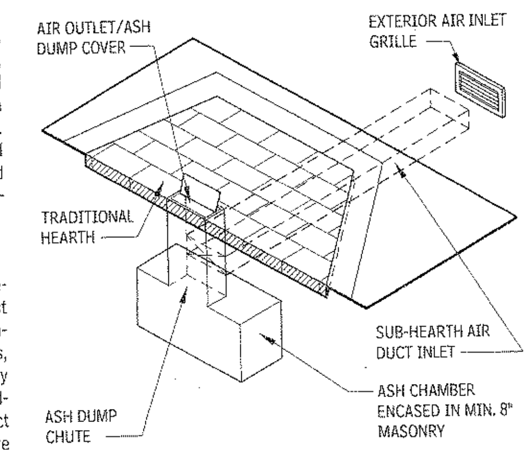


TRADITIONAL FOOTING



MODERN UPPER LEVEL SLAB

COMBINATION ASH DUMP
3.130

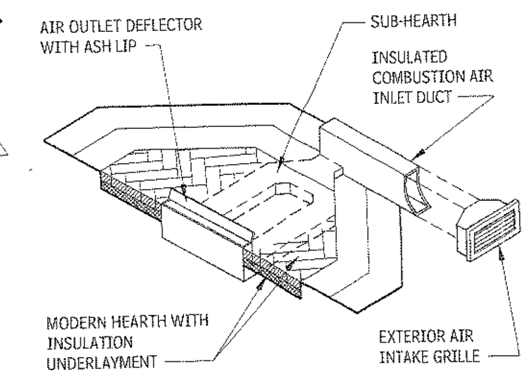


Contributor:
Walter Moberg, Moberg Fireplaces, Inc., Portland, Oregon.

COMBUSTION AIR

Combustion air is typically a code requirement, and must be properly sized, routed, and terminated to assist, rather than detract from, performance. Traditionally, many open fireplaces have air outlets built into firebox sidewalls, creating only "dilution air" that reduces chimney temperatures rather than serving combustion. Air outlets must be placed symmetrically in front of or beneath the fuel load. Typically, 6-in. round or 48-in^2 rectangle ducts with larger exterior grilles will service medium fuel loads, although in-line dampers help in controlling the negative effects of wind loads on exterior walls. Combustion air supplying the firebox is not a substitute for substantial conditioned makeup air, which must be supplied from the room. Although not defined in the code, makeup air is a much larger quantity of air, and vital to spill-free operations.

SUB-HEARTH AIR FRAME
3.131



LINTELS AND THROATS

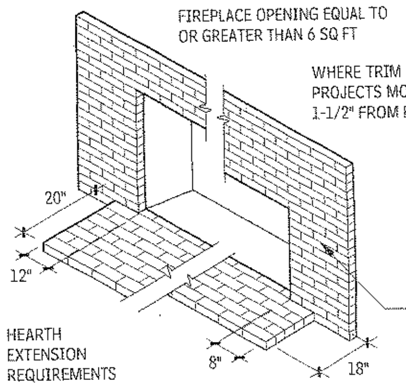
A minimum of 8 in. of vertical masonry is required before the firebox can be brought to its narrowest point—the "throat." Traditionally, steel lintels, surfaced with mineral insulation, have supported metal dampers at the throat.

CHIMNEY BREAST AND SMOKE CHAMBERS

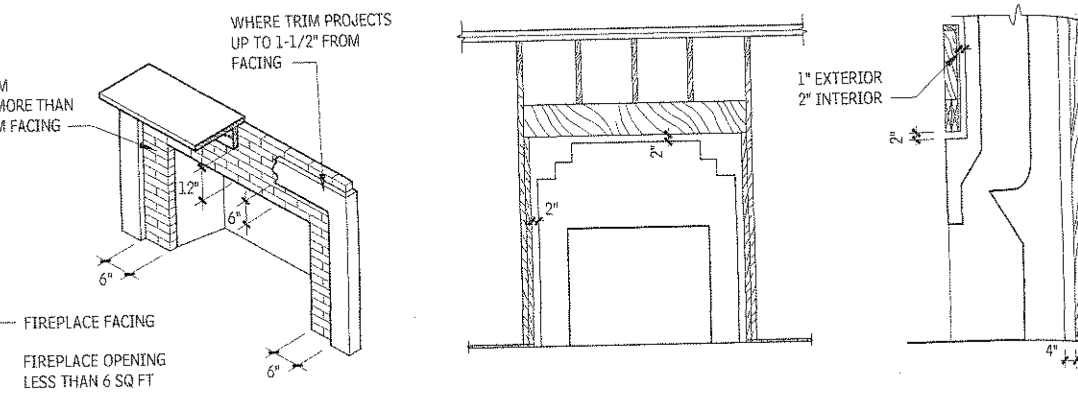
In recent decades, there has been expanded use of refractory or clay *chimney breasts*, which form both the structural lintel across the opening and a carefully curved corbelling to the throat. Individual or precast blocks or tiles, hung on steel tubes or angles create warm air foils, which draw room air into the throat at the point where fireboxes are most vulnerable to spilling smoke. From the throat to the chimney, carefully formed *smoke chambers* transform the flow of gasses out of the firebox and into the flue, with an aerodynamic transition that avoids abrupt changes.

Typically, building codes limit interior wall slopes of smoke chambers to 45°. Traditionally, clay-masonry plenums, parged smooth with high-temperature cement, are handcrafted by skilled masons. Modern fireplaces now incorporate prefabricated linings of heavy steel or fireclay, which assure good geometries. Ideally, the modern fireplace smoke chamber is also lined with permanent mineral or ceramic insulation, to begin the warm and protected path for the products of combustion created in the firebox.

CRITICAL CODE-REQUIRED CLEARANCES
3.132

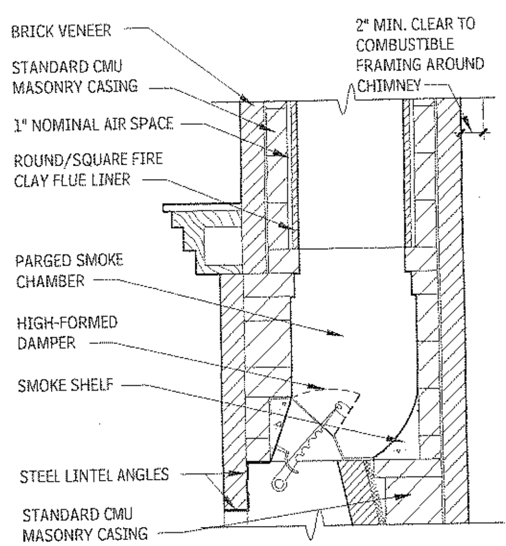


FIREPLACE HEARTH EXTENSION DETAILS

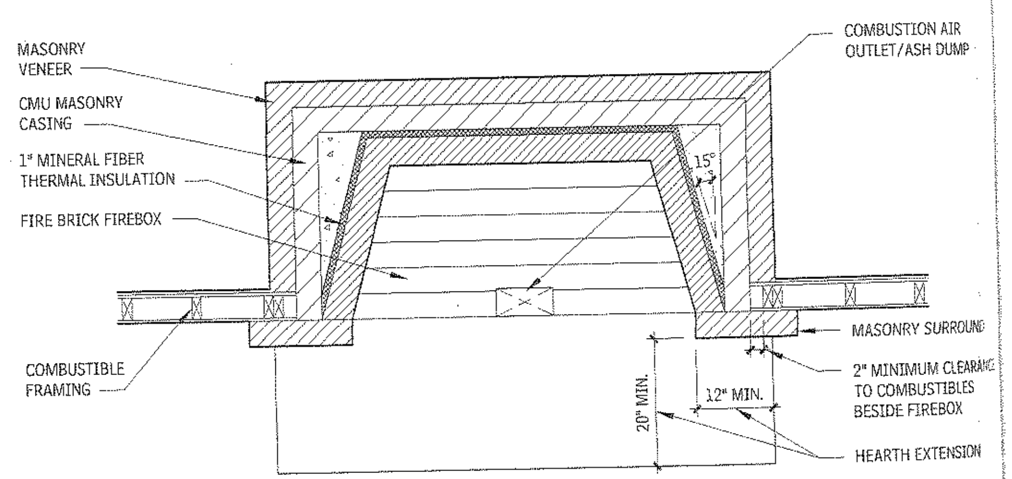


FIREPLACE CLEARANCE TO COMBUSTIBLE MATERIAL

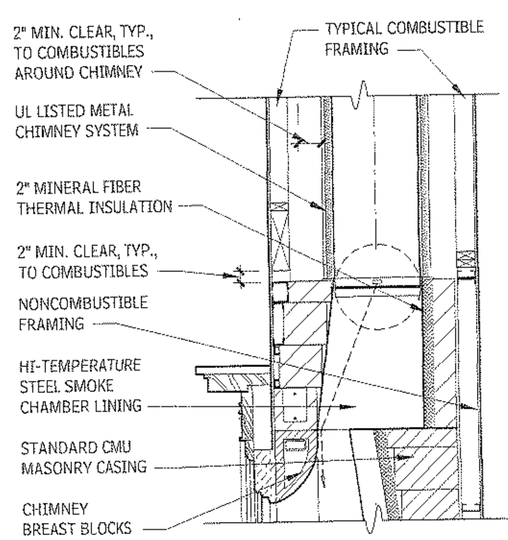
CHIMNEY BREASTS AND SMOKE CHAMBERS/FIREBOXES AND FRAMING
3.133



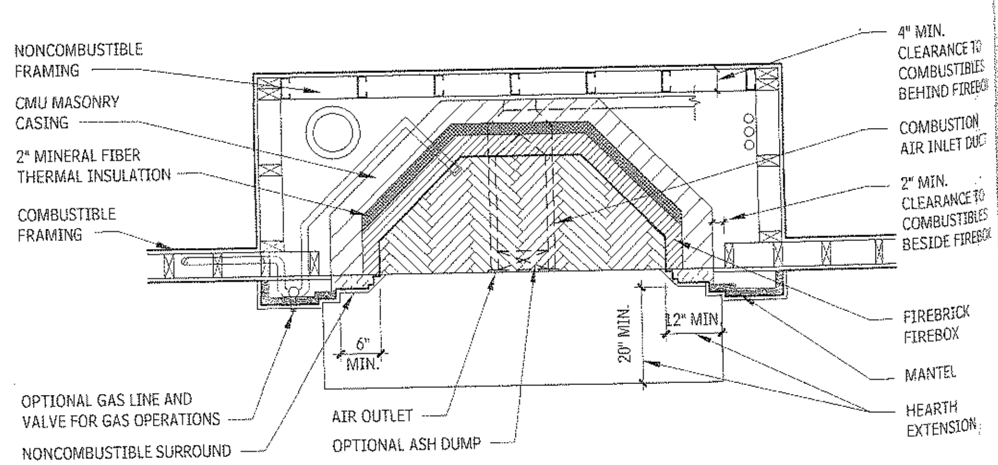
TRADITIONAL PARGED SECTION



TRADITIONAL HEARTH PLAN



MODERN LINING SECTION



MODERN HEARTH PLAN

Contributors:
Walter Moberg, Moberg Fireplaces, Inc., Portland, Oregon; Brian E. Trimble, PE, Brick Institute Association, Reston, Virginia.

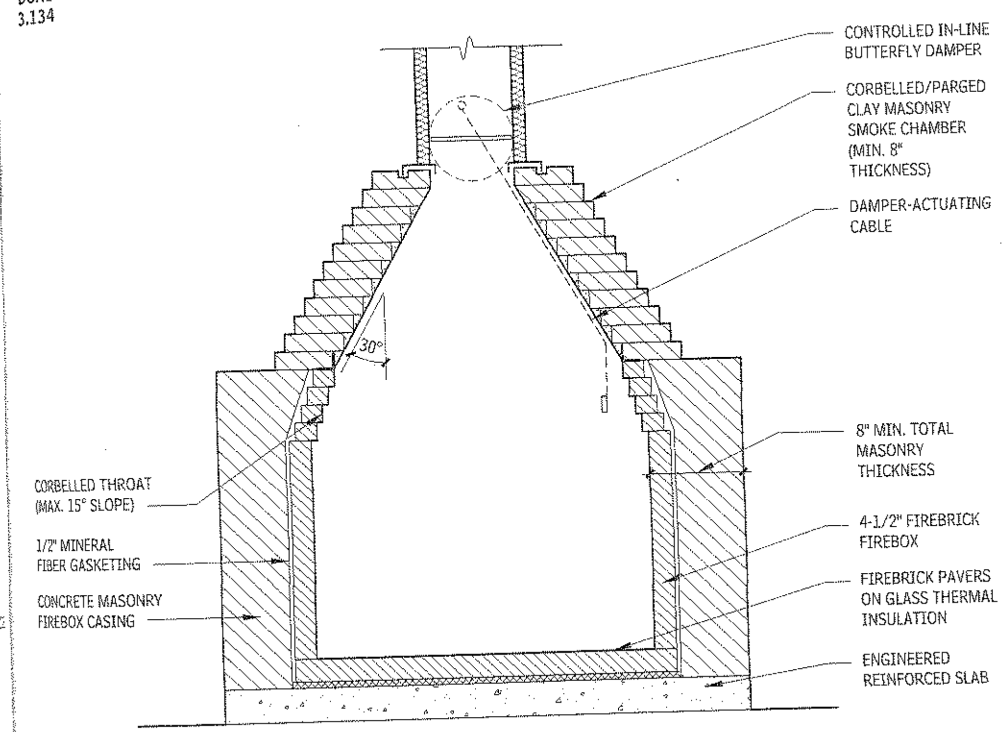
TYPICAL MULTIFACED CONSTRUCTION DETAILS
To create visual options for fire viewing from different rooms or from a range of points in a single room, designers are given wide leeway by current codes. However, more openings and/or open faces create challenges for fireplace operations. Unless fuel loads increase with opening sizes, the same heat is powering flues that must maintain airflows/pressures over larger areas. Dual-face, or "see-through," fireplaces must be carefully constructed and have taller chimneys to create adequate draft for their additional opening conditions.

LARGE FIREBOXES
As fireboxes increase in size, so must the throats and smoke chambers. However, if the fuel-loading areas and chimney height do not increase proportionally as well, then the building blocks for good performance will be absent. Larger fireboxes also require greater care in sizing and design.

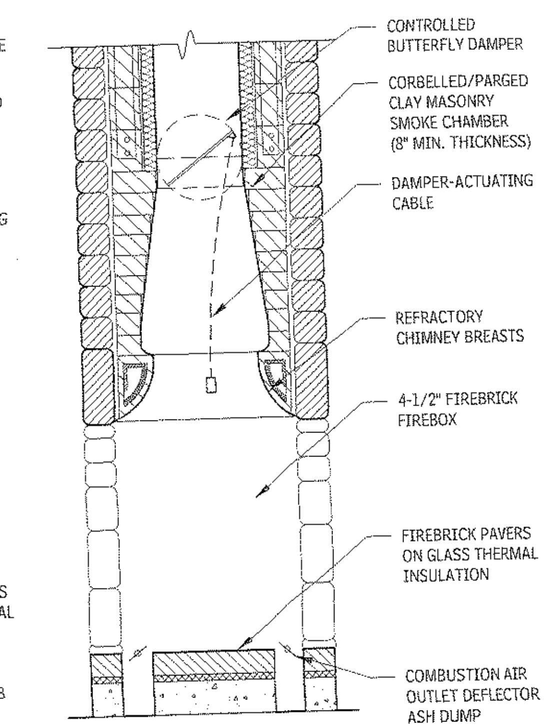
STRUCTURAL OBSTACLES
Firebox flues should prevail in the competition for building space, but sometimes there are significant structural obstacles that require adaptation by the fireplace. That said, smoke chambers must have balanced and symmetrically placed flue connections, and chimneys cannot offset greater than 30 degrees off vertical, and only with a maximum of two offsetting runs.

TWIN-FLUE DESIGNS
Twin flues, aerodynamically connected with split smoke chambers, can share the requirements of exhausting flue gasses, but they must be balanced before they terminate, or one flue will compete with the other. Rejoining flues and draft inducement are two ways to balance their draft.

DUAL-FACED, SINGLE FLUE
3.134



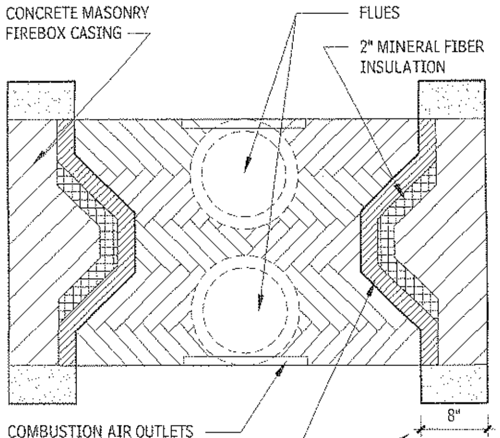
ELEVATION



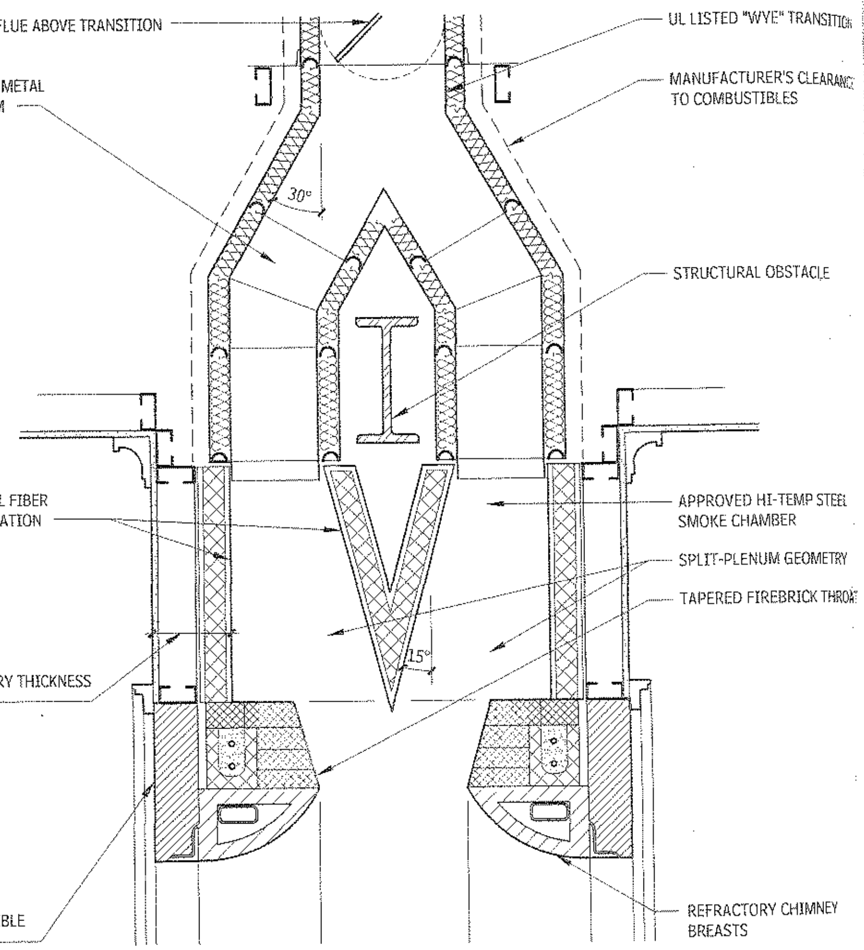
SECTION

Contributor:
Walter Moberg, Moberg Fireplaces, Inc., Portland, Oregon.

DUAL-FACED, TWIN-FLUES
3.135



PLAN

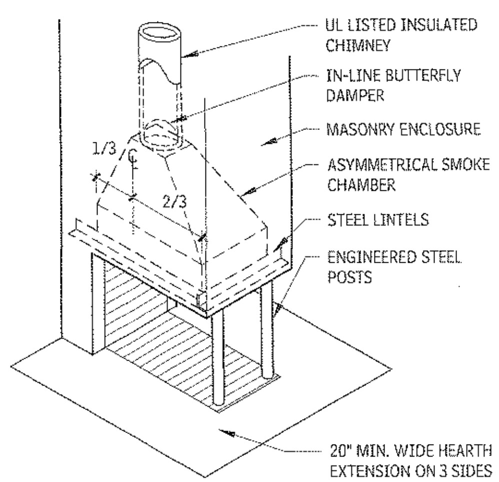


SECTION

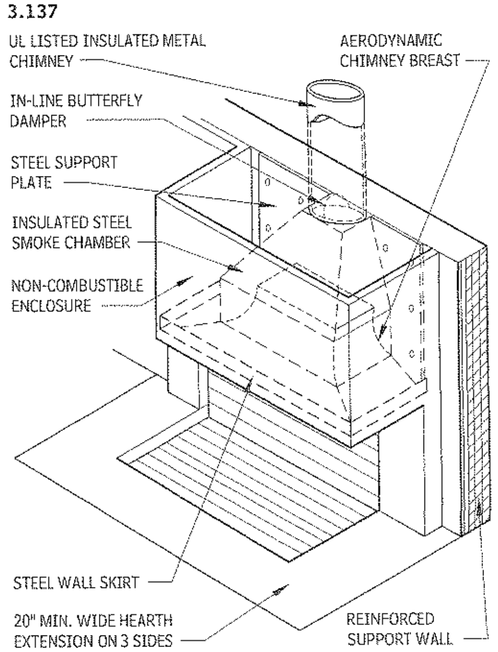
SMOKE CHAMBERS
Traditionally, multifaced masonry fireplaces have depended heavily on steel-form smoke chambers, given the complex shapes required in small volumes—although efficient corbelled designs are possible. Recently, engineered plenums with code-equivalent insulated enclosures have given new potential to old ideas.

PROJECTED FIREPLACES
Some design programs seek even greater fire-viewing potential, with openings on three sides, or faces. Traditionally, peninsula designs with steel columns have provided a variety of multi-sided geometries. Modern adaptations actually hark back to ancient times when bracketed stone lintels projected from structural walls. With steel reinforcing and UL-listed metal chimneys, the modern "projected" fireplace offers a wide variety of architectural forms.

PENINSULA FIREPLACE WITH STEEL COLUMNS
3.136



MODERN FIREPLACE PROJECTED FROM REINFORCED WALL
3.137



Contributors:
Walter Moberg, Moberg Fireplaces, Inc., Portland, Oregon; Richard J. Vitullo, AIA, Oak Leaf Studio, Crownsville, Maryland.

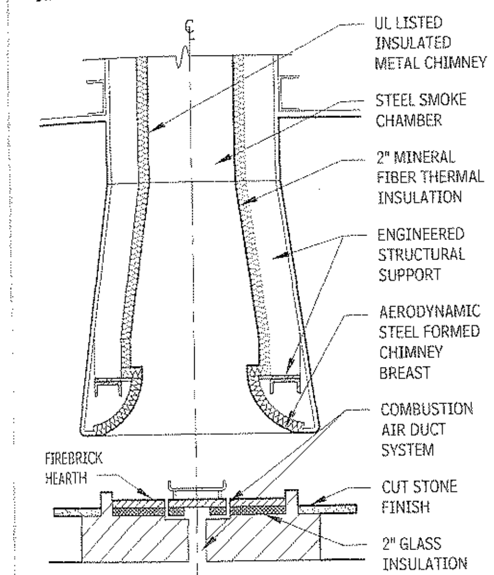
OPEN-SUSPENDED DESIGN
For the ultimate in fire viewing, suspended hoods, traditionally found in restaurants, offer aerodynamic exhausts over custom masonry bases. Typically, these aerodynamic hoods are engineered with exhaust fans (as in kitchens). Alternatively, there are UL-listed fireplaces with fireboxes and hearths that are suspended completely in the air, and some that even rotate for alternate viewing positions.

TYPICAL CHIMNEY AND TERMINATION DESIGNS

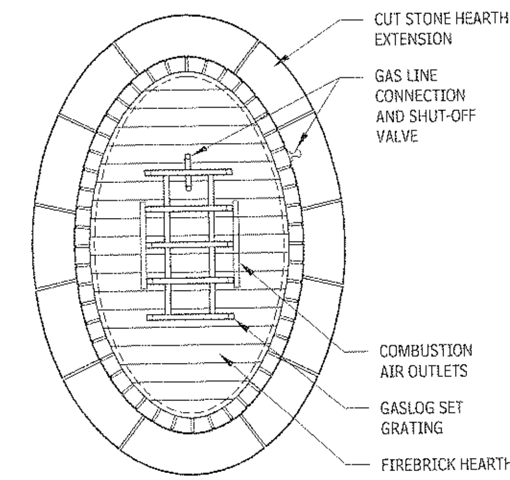
OPEN-TOP FLUES
Traditionally, in North America, clay-tile-lined masonry chimneys have been built "open-top" and exposed to exterior conditions. When operated frequently, these flues dissipate moisture from the internal heat of the fireplace. However, masonry chimneys must be flashed and firestopped to expel moisture and achieve the required 2-in. clearances to combustibles, as shown in Figure 3.139. Alternatively, certain UL-listed chimneys, constructed with in-line drains, can emulate traditional masonry programs, including decorative chimney pots.

COVERED FLUES
Whether masonry or metal flues are used, all chimneys benefit from being covered and protected from the elements, as indicated in Figure 3.140. Minimum areas of free opening must still be designed with four times the cross-sectional area of the flue. When creating custom terminations, follow the minimum guidelines of each flue manufacturer. Custom terminations with circular screens and removable chimney cover plates will allow for long-term maintenance of the flue system.

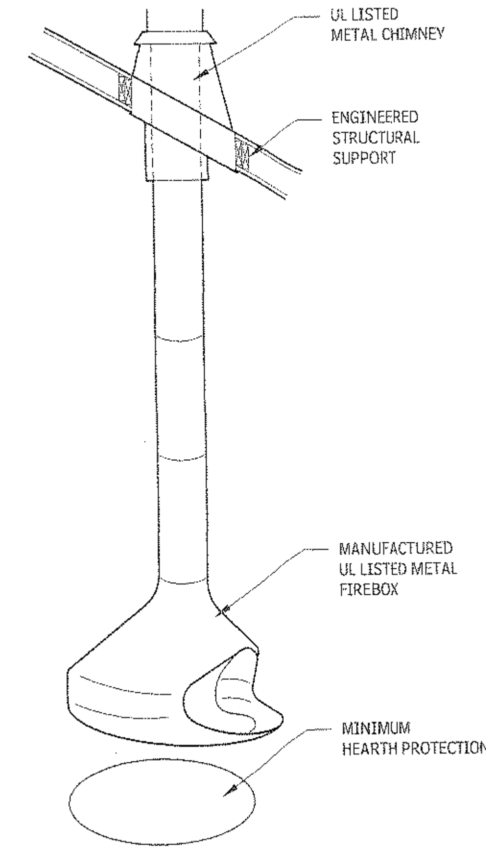
OPEN AND SUSPENDED FIREPLACES
3.138



OPEN SUSPENDED HOOD – SECTION



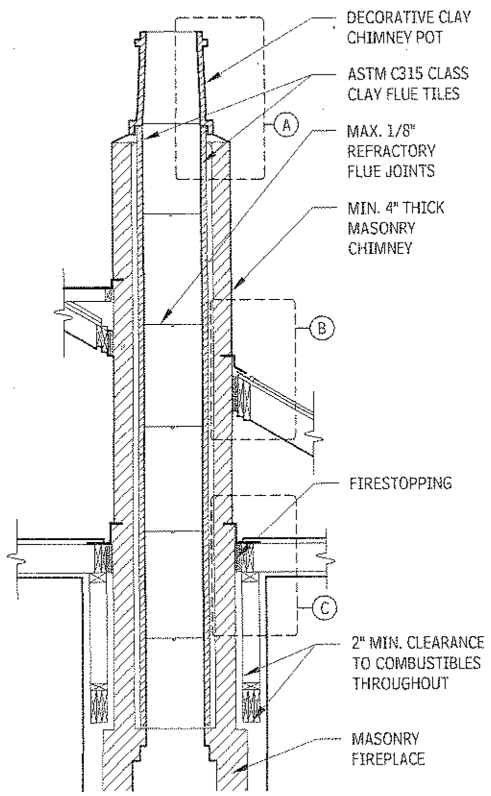
MASONRY BASE FOR OPEN SUSPENDED HOOD – PLAN



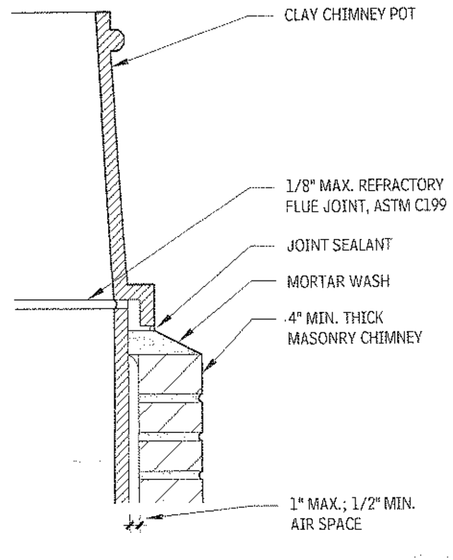
FABRICATED SUSPENDED FIREPLACE

Contributor:
Walter Moberg, Moberg Fireplaces, Inc., Portland, Oregon.

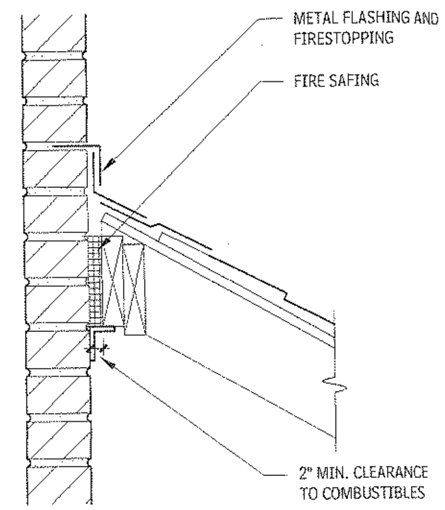
TRADITIONAL CLAY-TILE MASONRY FLUES
3.139



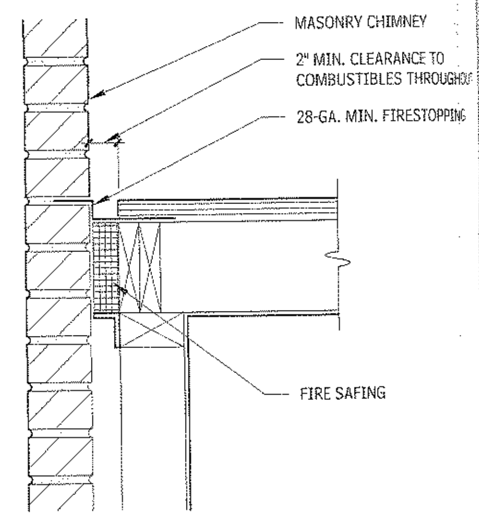
TRADITIONAL CLAY TILE MASONRY FLUES



DETAIL A



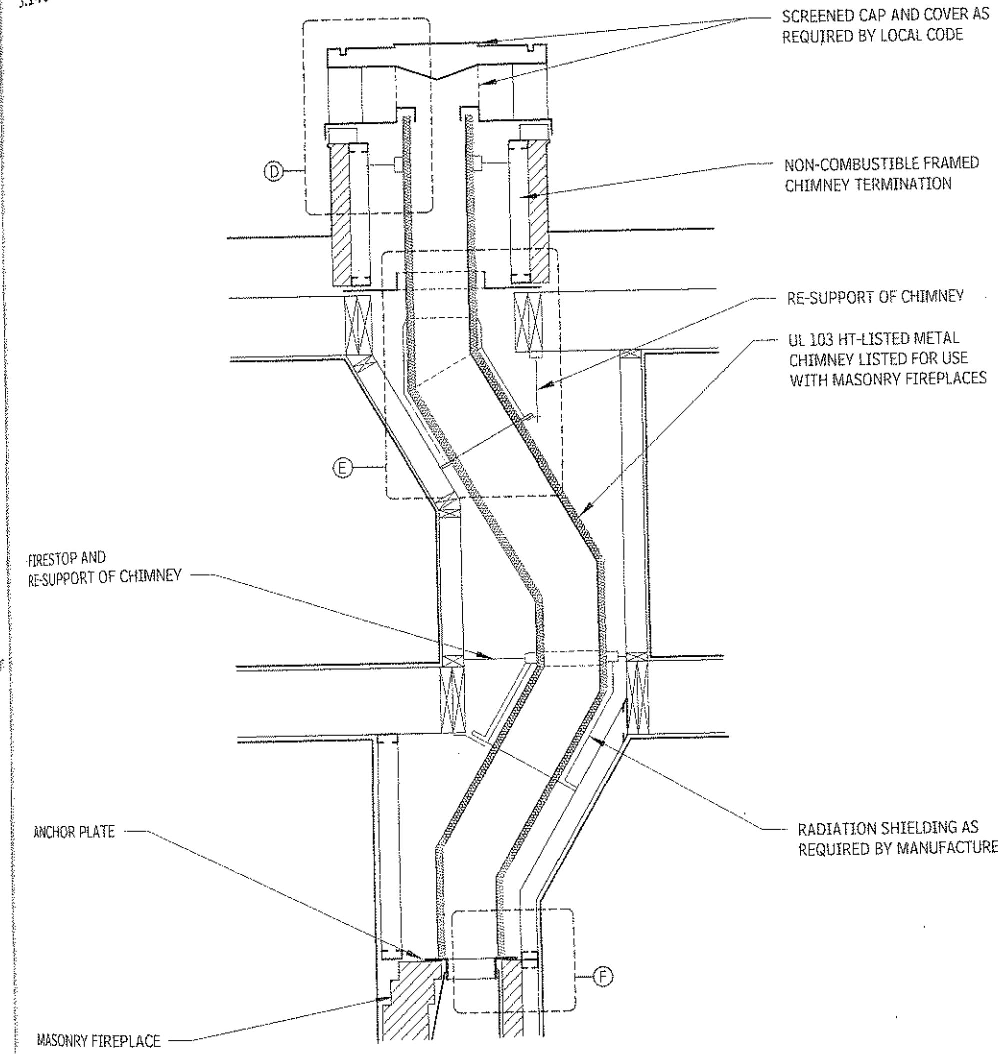
DETAIL B

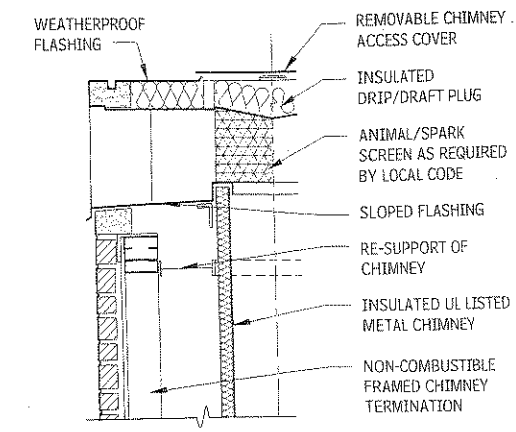


DETAIL C

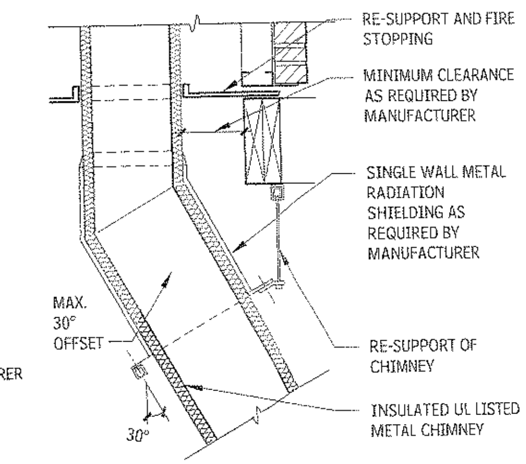
Contributor:
Walter Moberg, Moberg Fireplaces, Inc., Portland, Oregon.

MODERN UL LISTED METAL FLUES
3.140

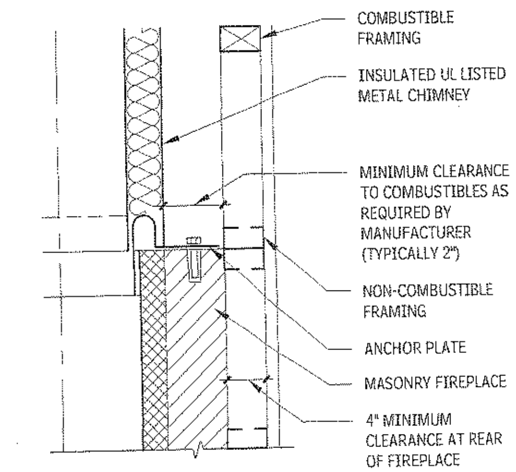




DETAIL D



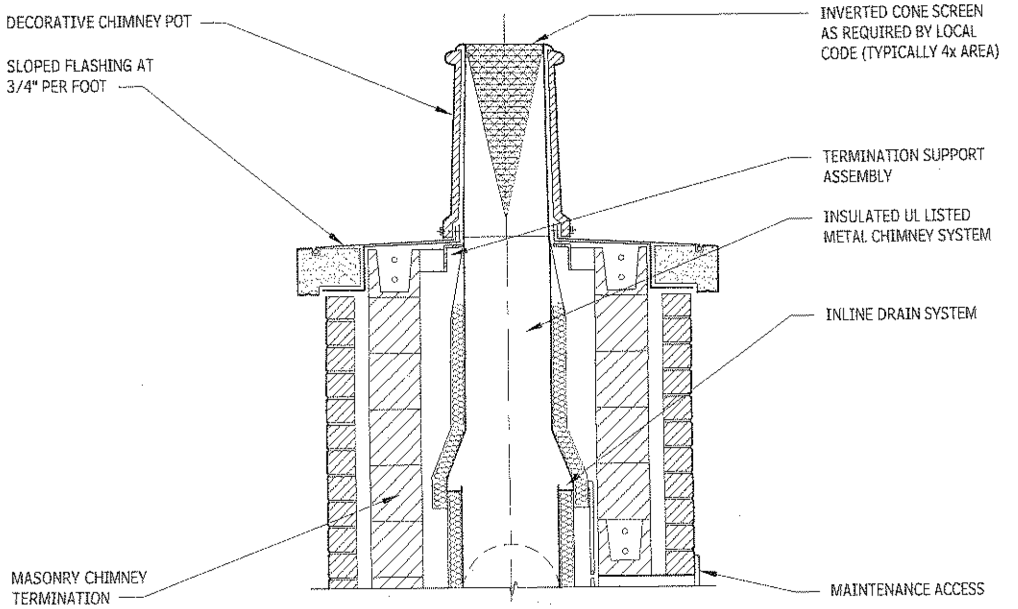
DETAIL E



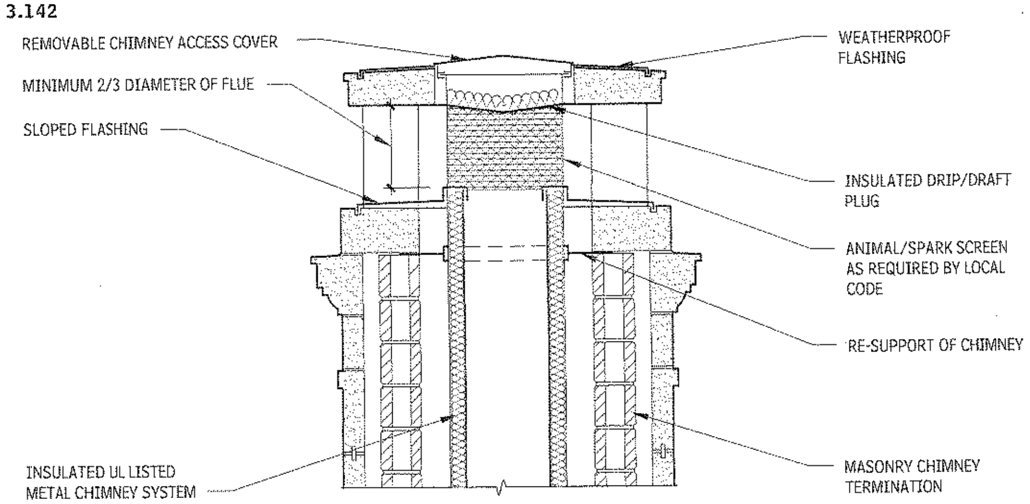
DETAIL F

Contributor:
Walter Moberg, Moberg Fireplaces, Inc., Portland, Oregon.

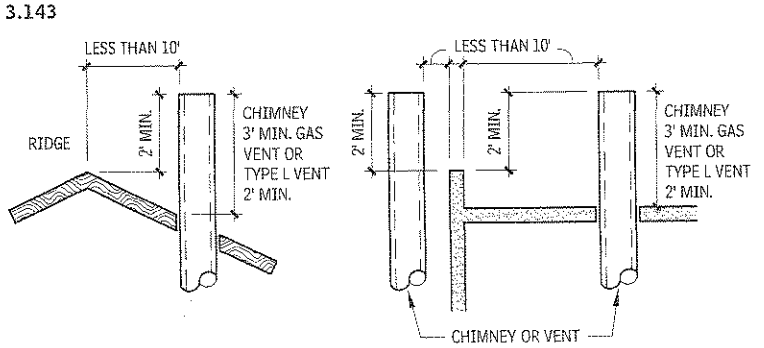
OPEN-TOP METAL FLUE
3.141



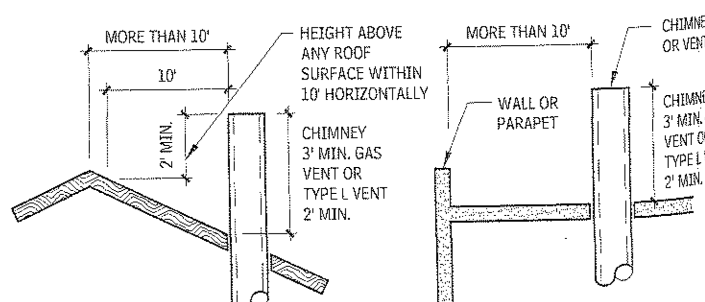
COVERED MASONRY CAP
3.142



CRITICAL CODE-REQUIRED CHIMNEY CLEARANCES
3.143



TERMINATION LESS THAN 10' FROM RIDGE, WALL, OR PARAPET



NOTE:
NO HEIGHT ABOVE PARAPET REQUIRED WHEN DISTANCE FROM WALLS OR PARAPET IS MORE THAN 10 FT.

TERMINATION MORE THAN 10' FROM RIDGE, WALL, OR PARAPET

Contributors:
Grace S. Lee, Rippeteau Architects, PC, Washington, DC; Brian E. Trimble, PE, Brick Institute Association, Reston, Virginia; Walter Moberg, Moberg Fireplaces, Inc., Portland, Oregon.

CHIMNEY SIZING
Overall chimney height, chimney size, and firebox opening area are closely related. See Figure 3.144 for optimizing conditions. Larger openings require taller chimneys to provide equivalent performance—sometimes taller than the minimums required by code.

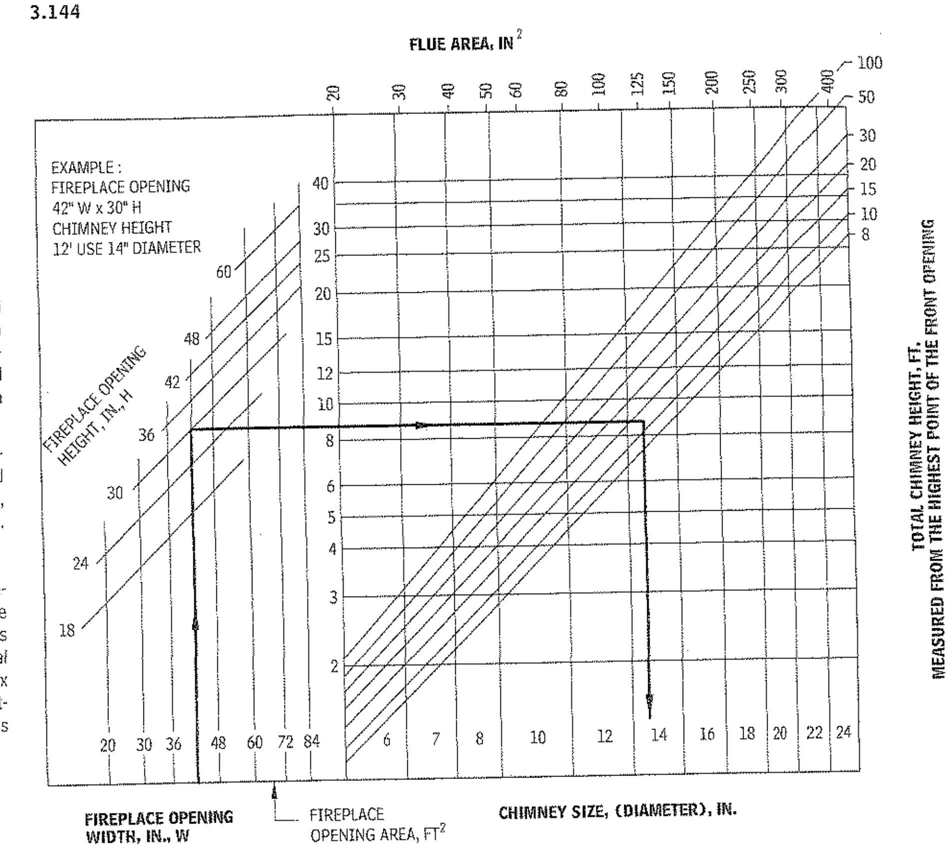
CLEAN-BURNING FIREPLACES
Clean-burning fireplaces include Rumford fireplaces and masonry heaters.

RUMFORD FIREPLACES
There are many emerging designs for so-called clean-burning fireplaces, and some of the most popular build on the popularized concepts of Count Rumford, an eighteenth-century designer/inventor/scientist. Although the concept of particulates (now measured in EPA standards) was not yet understood, this designer built upon European traditions and added his own features. Through experimentation, efficient masonry inserts were created in brick and cast-iron, and filled vacuous fireboxes around London, resulting in an open/radiant heater concept that has lasted for two centuries.

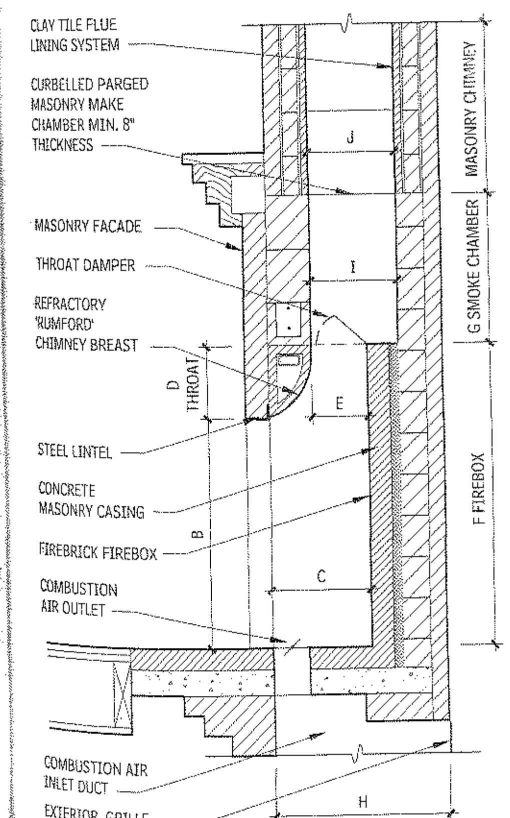
Key features in this design include obliquely splayed firebox sidewalls, which flare at 45° and reflect heat back into the room, and the resurrection of the French/Italian curved chimney breast, which make for good aerodynamic flows and minimized resistance.

TRADITIONAL DESIGNS
One popular version of the Rumford emulates the very shallow fireboxes of earlier designs, and has won an exception for that in the building code. When fired with wood in "tee-pee" style, it has proven both efficient and cleaner-burning than other traditional designs. This design typically incorporates vertical rear firebox walls with narrow throats, and minimizes the overall fireplace footprint in plan. Taller openings allow for larger radiant firebox walls and increased heating efficiencies.

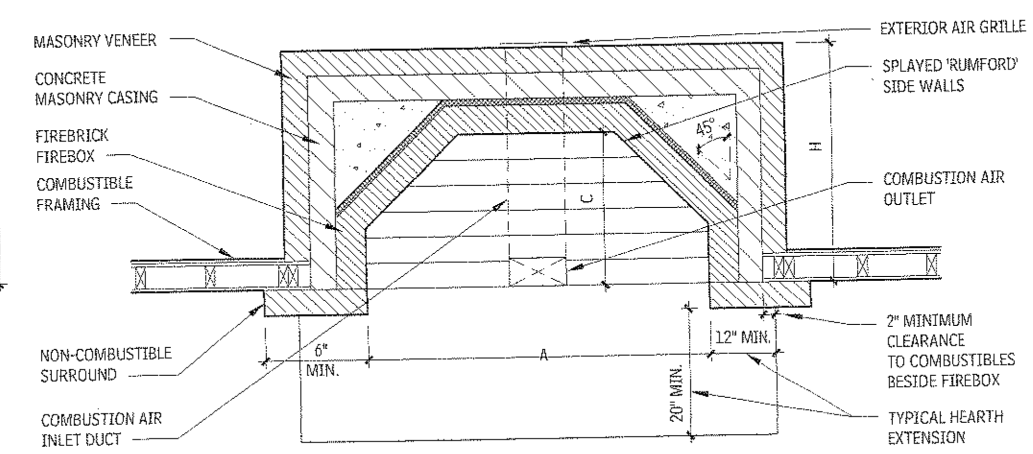
CHIMNEY SIZING CHART FOR FIREPLACES
3.144



RUMFORD—TRADITIONAL CONSTRUCTION
3.145



SECTION



PLAN

TRADITIONAL RUMFORD FIREPLACE CONSTRUCTION DIMENSIONS (IN.)

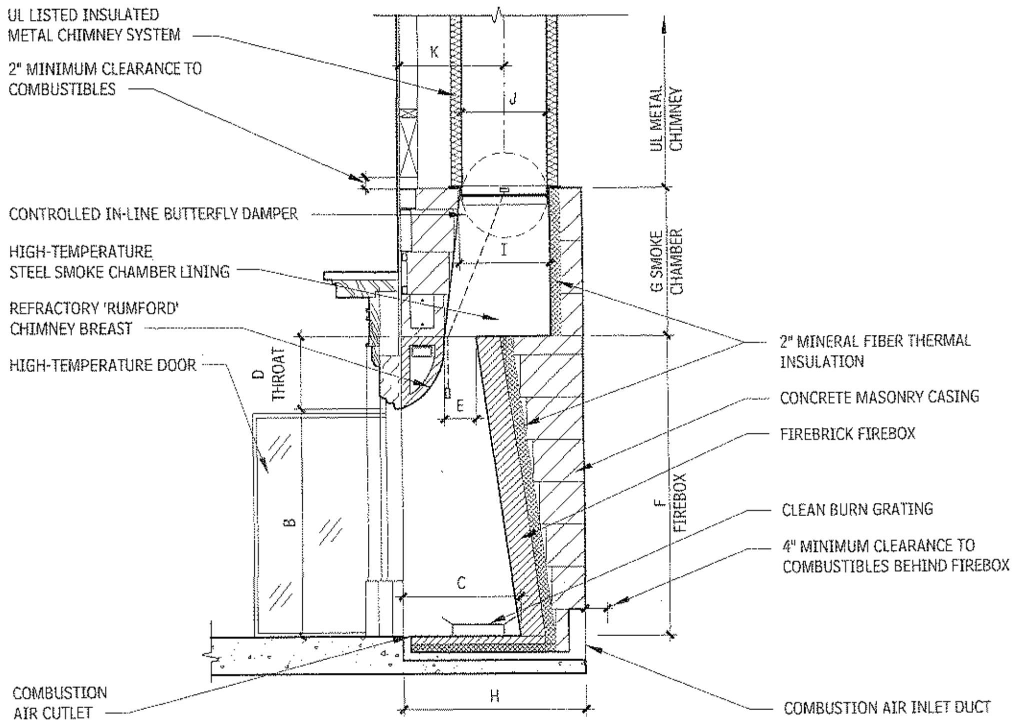
A	B	C[a]	D	E	F	G	H	I	Jw	Jl[b]
24	24	12	12	3.5	36	18	25.5	9.5	8	8
30	30	12	12	3.5	42	24	25.5	9.5	8	10
36	36	14	12	4	48	28	27.5	11.5	10	12
42	40	14	12	4	52	30	27.5	11.5	10	14
48	44	16	12	4.5	66	36	29.5	13.5	12	16
54	48	18	12	4.5	60	42	31.5	15.5	14	18
60	52	20	12	5	64	48	33.5	17.5	16	20

NOTE

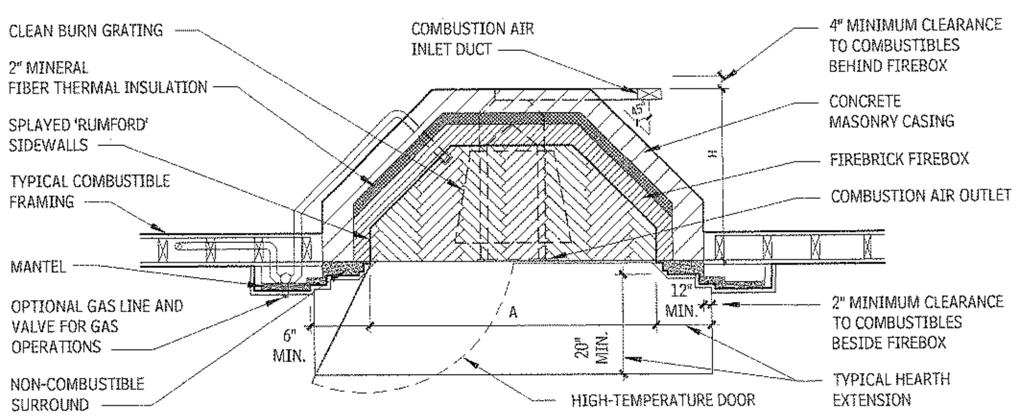
3.145 a. Traditional Rumford designs may be constructed with inner hearths as shallow as 12 in. (compared to standard 20 in. minimum), but must have an adequate additional hearth extension to protect combustible floors during operations.
b. Shallower Rumford designs may not easily employ square or round flues. Shown in Figure 3.144 are typical minimum rectangular dimensions; Jw (width) by Jl (length). Consult manufacturers for matching minimum flue dimensions. Minimize rectangularity of flue to optimize performance.

Contributor:
Walter Moberg, Moberg Fireplaces, Inc., Portland, Oregon.

RUMFORD—MODERN CONSTRUCTION
3.146



SECTION



PLAN

MODERN RUMFORD FIREPLACE CONSTRUCTION DIMENSIONS (IN.)
3.146

A	B	C	D[a]	E	F	G	H	I	J[b]	K
36	30	20	13.5	5	43.5	20	31	13	12	17
42	33.5	20	13.5	6	47	24	31	13	12	17
48	40	21	13.5	6.5	53.5	24	34	15	14	18
54	43	22	13.5	6.5	56.5	28	36	17	16	19
60	47	24	13.5	7	60.5	32	38	19	18	20

MODERN METHODS

Recent developments in clean-burning fireplaces have improved on the 200-year-old phenomenon and been adapted to modern uses. Still built with 45° side walls and curved chimney breasts, this design also has a sloped rear wall for hotter/cleaner firebox temperatures. Designed to accept modern gratings, it can be enhanced with closed-door operations—tripling its efficiency and reducing the emissions of polluting particulates. Manufactured masonry components typically utilize a fully insulated core that protects the masonry casing and have built-in air channels to improve combustion.

MASONRY HEATER CONSTRUCTION

Site-built masonry heaters are a unique class of masonry fireplaces that started in Europe 500 years ago. Masonry heaters make use of two basic principles to obtain high-temperature combustion and heating efficiencies:

- Controlled air intake to the combustion chamber/firebox
- A heat exchange system of baffled chambers through which hot combustion gasses are circulated

Such heaters are intrinsically efficient and clean-burning devices. Many of the site-built masonry heaters (or masonry "stoves") used in North America are adapted from those used in northern and eastern Europe, which were employed for cooking as well as heating.

Modern masonry heaters come in a wide variety of shapes and sizes and materials. The size and layout of the house, the climate, and the needs of the homeowner are all considered in the design of a masonry heater. For optimum performance, it should be located near the center of the house.

Masonry heaters may be custom-built on-site, or assembled from fabricated components. Modern masonry heaters may incorporate fire viewing, bake ovens, stoves, and warming benches. In most masonry heaters, heated exhausts are drawn down from the top of the smoke chamber through baffles on the insides of the heater, while room air rises by convection along the exterior surfaces of the masonry. This construction allows for even heating of the masonry and efficient radiant heating of the room. Baffles converge below the firebox and open out to the flue at the base of the chimney, or rise again for top-venting designs.

CLEARANCES AND REQUIREMENTS

ASTM E 1602, "Standard Guide for Construction of Solid Fuel Burning Masonry Heaters" provides dimensions and clearances. In addition, it's important to be aware of two safety concerns that apply to brick masonry heaters but that are not listed in most building codes:

- Integrity of the enclosing walls of the heater
- Temperature of the exterior surfaces of the walls

To maximize the integrity of brick-built masonry heater walls, they should be designed with two wythes of brick (per ASTM C 216 or C 62 for facing brick) with a nominal 1-in. airspace between them. The airspace is filled with a compressible, noncombustible material such as mineral fiber insulation. To safeguard against the effects of the higher surface temperatures of the heater, a minimum 12-in. clearance should be observed between the heater and combustibles; and there should be a 20-in. extended hearth in front.

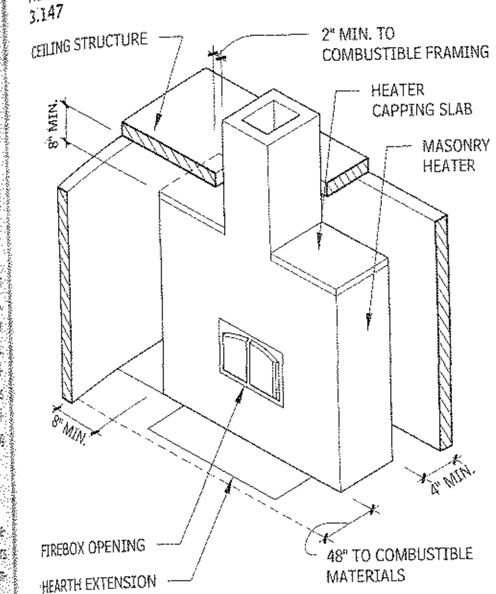
For specific clearances and other requirements, consult ASTM E 1602 and local codes. Many clearances may be reduced if an engineered protection system is provided.

NOTES

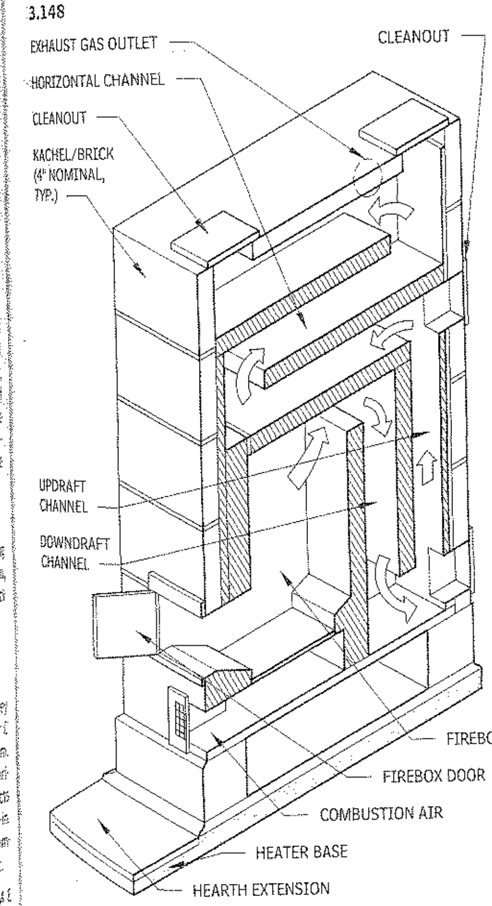
3.146 a. Modern Rumford fireplaces designed for closed-door operations require taller throats, and benefit from more than the minimum 6-in. surround requirement, to dissipate heat from lintel/chimney breast areas.
b. Metal chimneys must be listed to UL 103HT and be tested for use with masonry fireplaces. Exterior dimensions are typically 2 or 4 in. greater than interior dimensions and typically require 2-in. clearances to combustibles.

Contributor:
Walter Moberg, Moberg Fireplaces, Inc., Portland, Oregon.

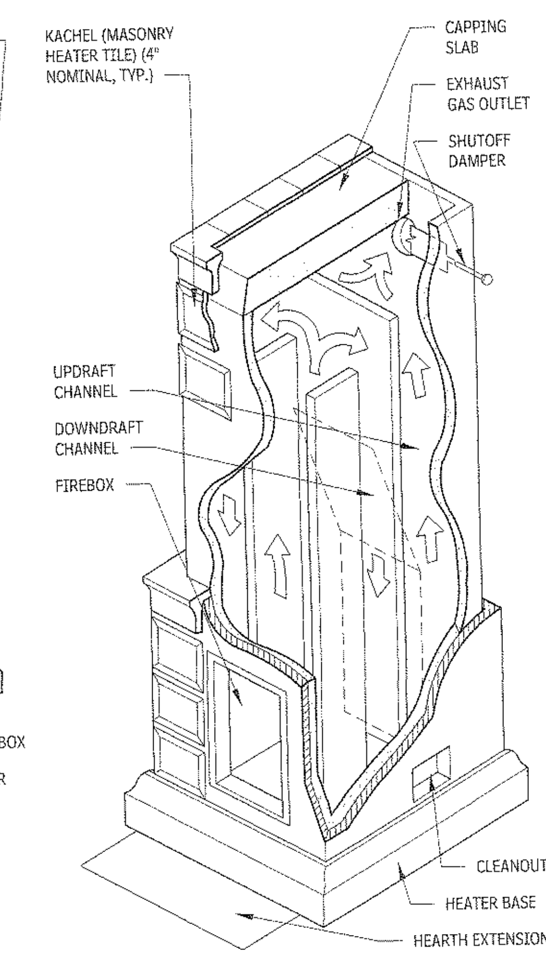
CLEARANCE TO COMBUSTIBLES FOR MASONRY HEATERS
3.147



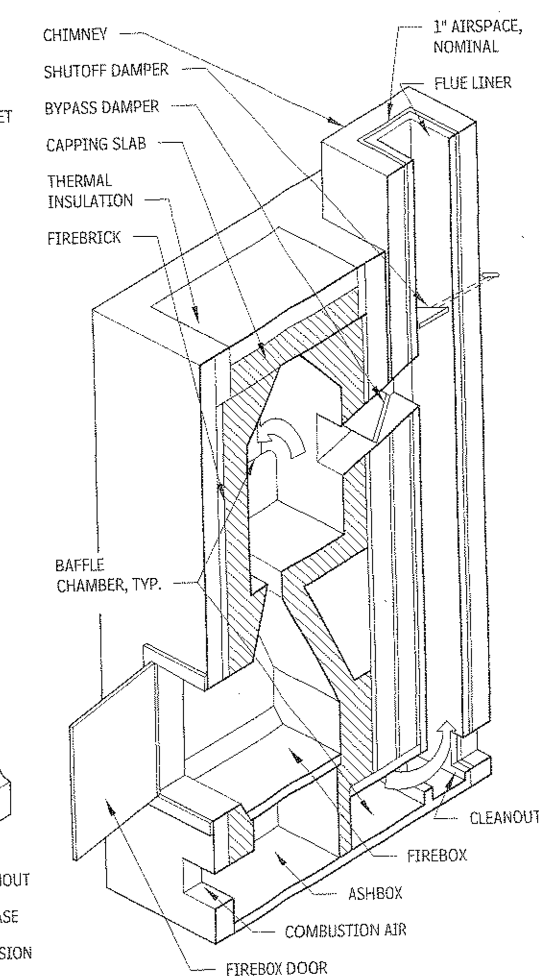
MASONRY HEATER
3.148



GERMAN TILE/BRICK HEATER (GRUNDOFEN)



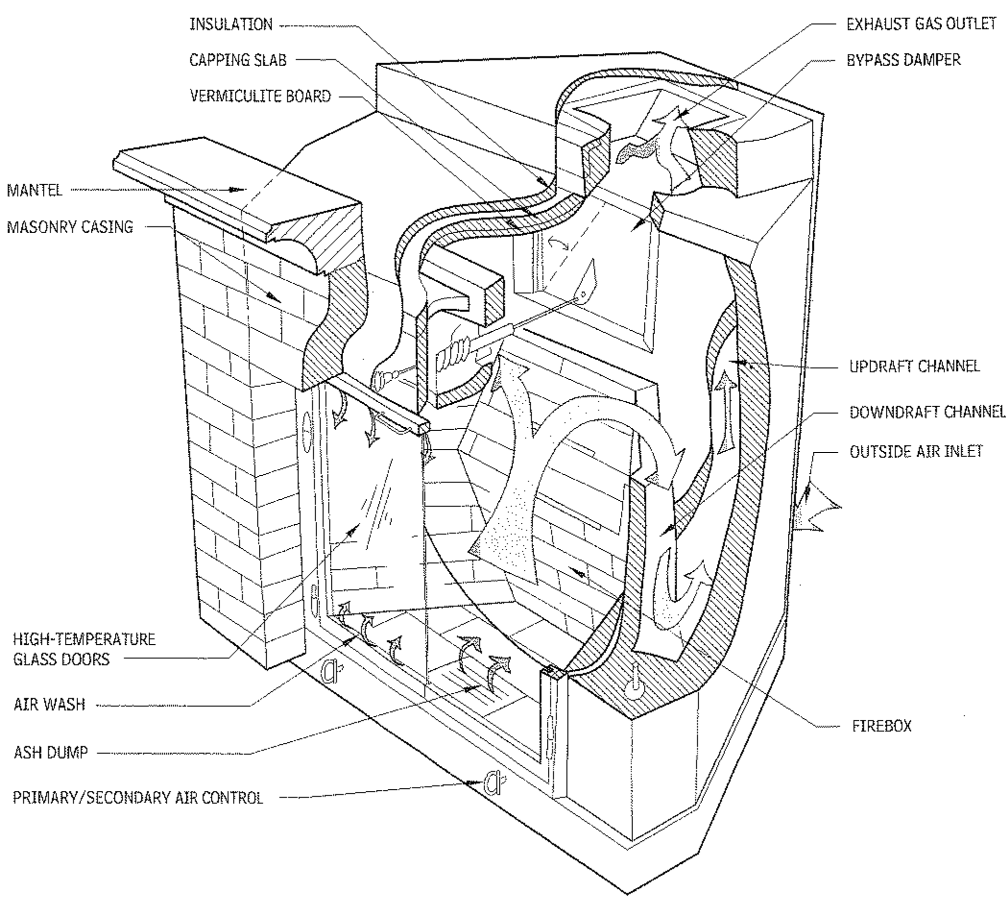
SWEDISH TILE HEATER (KAKELUGEN)



FINNISH (FOUNTAIN-STYLE) HEATER

Contributors:
Heater Association of North America, Randolph, Vermont; Timothy B. McDonald, Washington, DC; Brian E. Trimble, PE, Brick Industry Association, Reston, Virginia; Walter Moberg, Moberg Fireplaces, Inc., Portland, Oregon.

MASONRY HEATER (continued)
3.148



NORTH AMERICAN HEATER

MANUFACTURED FIREPLACES

Wood and gas are the two types of factory-built fireplaces described in this section.

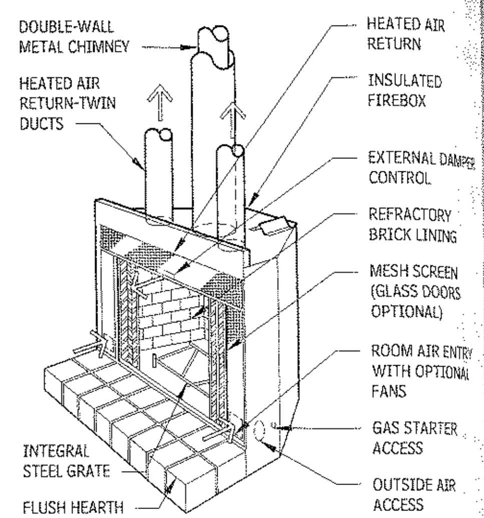
MANUFACTURED WOOD-BURNING FIREPLACES

Underwriters Laboratory Standard UL127 is the national standard for this category of fireplace, recognized by ICC codes for the testing and certification of factory-built fireplaces. In recent years, it has been updated and expanded to include the development of higher-temperature chimneys, closed-door systems, and the addition of decorative gas appliances. Unlike the generalized and prescriptive building codes for masonry/site-built fireplaces, this standard prescribes the methods that determine the specific clearances for each individual product and their "listing."

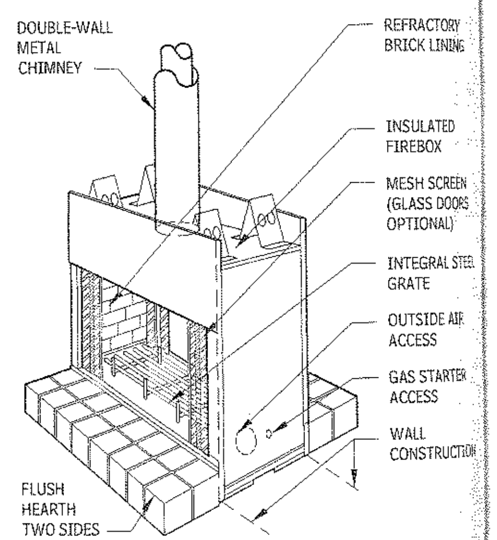
Designers must consult the manufacturer's installation instructions, to verify relevant sizes, clearances, and operating requirements. In general, follow these guidelines:

- Verify codes for maximum and minimum chimney height clearances above roof deck.
- Ensure that chimney pipe has a 2-in. clearance to combustible surfaces. In a multi chase installation, install chimney pipes 20 in. apart, center to center. The chase top must be constructed of noncombustible material.
- See manufacturer's recommendations for chimney joint band and stabilizer locations.
- Use a firestop whenever a ceiling, floor, or sidewall is penetrated.
- Although no special floor support is usually necessary for fabricated fireplaces, check local/state codes to verify exact requirements.
- Verify that facing material does not obstruct louvered or screened area at sides, top, or bottom of fireplace opening. Note, however, that noncombustible finishing material may be used over the black metal on fireplace fronts. See manufacturer's specifications.
- Inadequate ventilation can occur from air conditioning, heating, or other mechanical systems that generate negative air pressures in the fireplace room, so plan for proper ventilation to ensure a smoke-free operation.
- Learn the maximum horizontal distances and offsets for outside air access ducts.
- A noncombustible hearth extension must extend at least 8 in. on either side of firebox openings and 16–20 in. in front of firebox. Refer to manufacturer's instructions.
- Distances from combustible walls perpendicular to the front of the fireplace, including mantels, vary, so consult the manufacturer's specifications.
- Install outlet grilles at least 10 in. below the ceiling for a ducted heat-circulating fireplace.
- Place room furnishings such as drapes, curtains, and chairs at least 4 ft from the firebox opening.

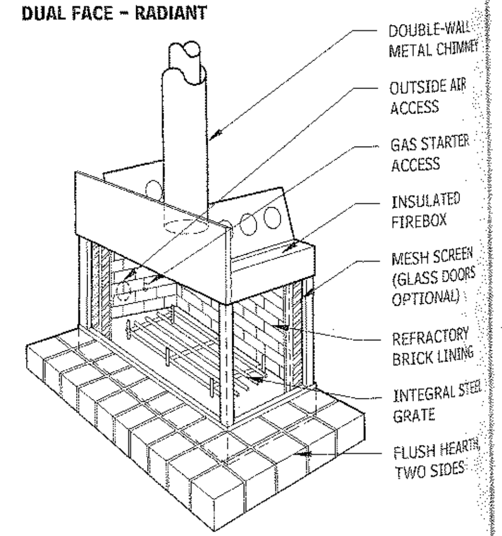
MANUFACTURED FIREPLACE DESIGNS
3.149



SINGLE FACE – HEAT CIRCULATING



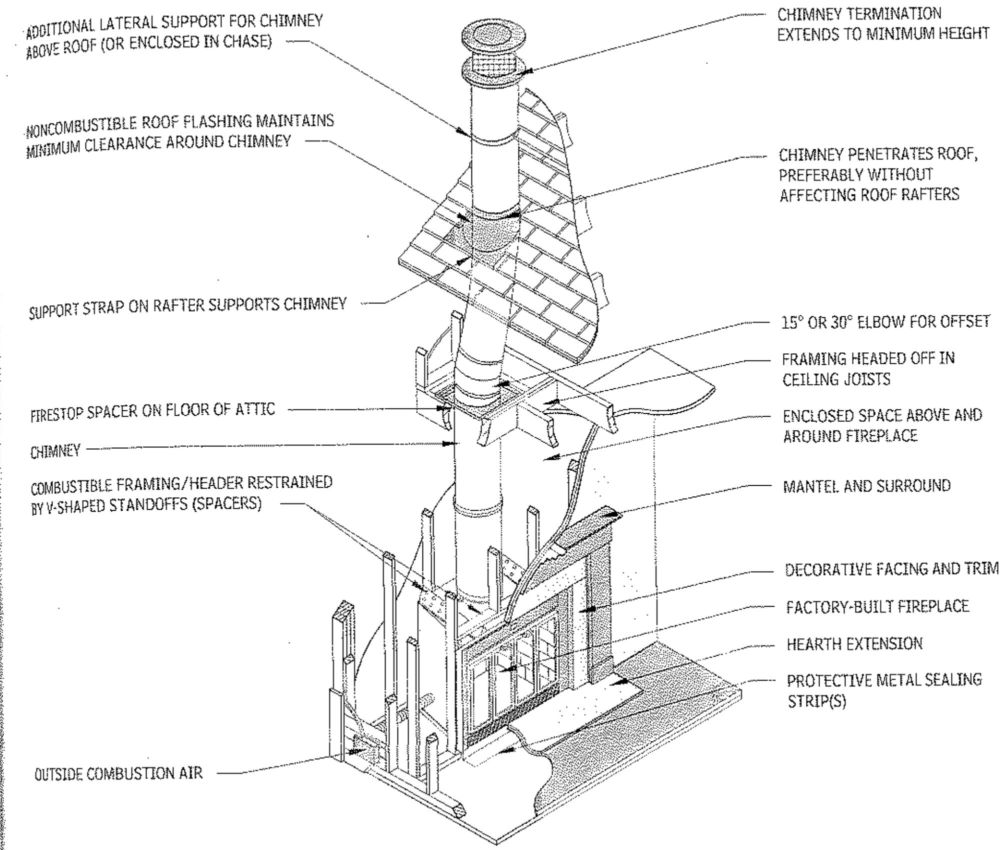
DUAL FACE – RADIANT



CORNER RADIANT

Contributor:
Walter Moberg, Moberg Fireplaces, Inc., Portland, Oregon.

TYPICAL MANUFACTURED (WOOD) FIREPLACE INSTALLATION
3.150



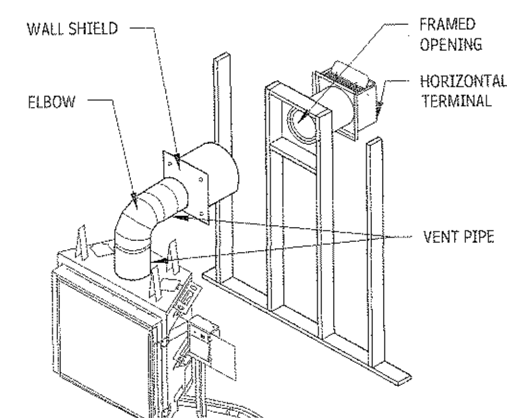
MANUFACTURED GAS BURNING FIREPLACES

Gas-fired, manufactured fireplaces and appliances are now governed by the American National Standards Institute, under a family of specific standards know as ANSI Z21. The proliferation of gas log sets, inserted into existing masonry and factory-built fireplaces, and the diversification of vented and unvented products has led to a confusing array of standards. Generally speaking, so-called yellow flame hearth appliances are classified according to their primary function as a heating device, or their decorative role in simulating wood (i.e., yellow flame) fires.

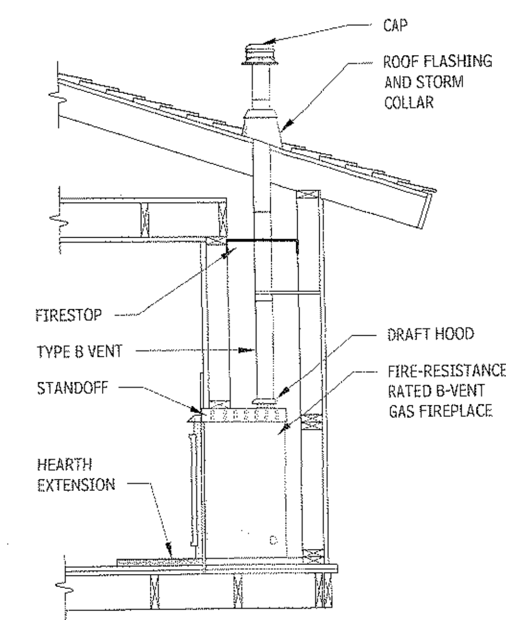
As with UL-listed wood-burning appliances, these devices must be installed according to the specific requirements of their listing and approved manufacturer's instructions. In general, the following apply:

- Vented gas fireplaces utilize either B-vent or direct-vent flues, but the flues are not interchangeable between appliances.
- Vented gas fireplaces and listed gas log sets require automatic ignition cutoff devices for safety.
- B-vent flues include both totally vertical and combined vertical and horizontal configurations, but they must terminate vertically. See the manufacturer's specifications for flue route/height/termination requirements.
- Direct-vent flues include both totally horizontal and combined horizontal and vertical configurations, but they must terminate according to their listing. See the manufacturer's specifications for flue route/height/termination requirements and minimum distances to features on outside walls.
- Listed vented gas log sets require working fireplaces with permanently opened dampers and fireplace screens.
- Unvented gas log sets are not permitted in all jurisdictions and may not be used as the sole source of heating in a dwelling. Consult local code requirements and the manufacturer's specifications for minimum requirements for fireboxes/fireplaces containing these devices.
- Most gas fireplaces and appliances are designed for use with either natural gas or propane fuel, but not both. Ensure that the product is specified for the correct fuel source and that the installation and gas line construction conform to the National Fuel Gas Codes (ANSI Z23.1, NFPA54)

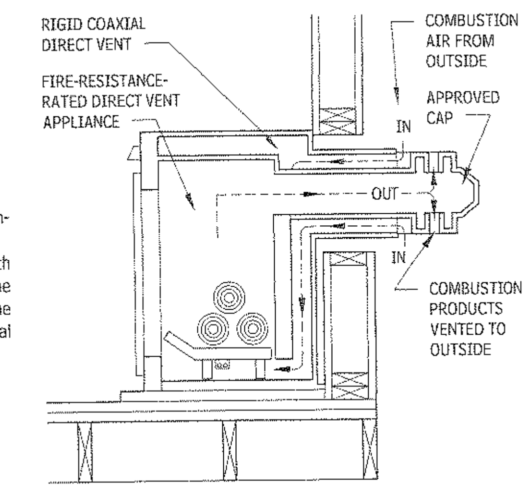
TYPICAL DIRECT-VENT (GAS) FIREPLACE INSTALLATION
3.151



B-VENT (GAS) VERTICAL
3.152



DIRECT VENT (GAS) HORIZONTAL
3.153



Contributors:
Walter Moberg, Moberg Fireplaces, Inc., Portland, Oregon; Hearth, Patio, and Barbecue Education Foundation, Arlington, Virginia.

MANUFACTURED STOVES

This section covers two categories of manufactured stoves:

- Solid-fuel heaters
- Decorative gas appliances

SOLID-FUEL HEATERS

Metal solid-fuel heaters efficiently heat areas ranging in size from a single room to an entire house. They are classified according to the fuel that powers them, either woodstoves (cordwood) or pellet stoves (densified biomass)

Woodstoves manufactured today burn both softwood and hardwood species of cordwood, which have variable moisture and Btu content, but are readily accessible and manually prepared for use. Pellet stoves resemble standard woodstoves, but that is where the similarity ends. Pellet stoves burn pellets that are manufactured from waste materials, such as sawdust, nut hulls, and occasionally unprocessed shelled corn or fruit pits.

BURNING TECHNOLOGIES

Current EPA regulations for solid-fuel appliances have resulted in woodstoves significantly more efficient than those produced previously. The key to efficiency is igniting and burning the smoke and gasses released during combustion, particularly during extended and reduced-heat burns. Burning smoke and gasses reduces fuel consumption, polluting emissions, and the frequency of chimney maintenance. Woodstoves must meet EPA standards for efficiency and cleanliness of burning. These standards differ for catalytic and noncatalytic technology, and within the latter category, for wood-burning and pellet-burning stoves.

APPLIANCE CONFIGURATIONS:

Both woodstoves and pellet stoves can be configured as free-standing, a fireplace insert, or built in.

- *Freestanding* appliances are often chosen in new construction or for renovation when no chimney exists.
- *Fireplace inserts* are often used to retrofit an open fireplace to increase efficiency and heat output.
- *Built-in* heaters are chosen to achieve the look and performance of the fireplace insert without the expense of building a masonry fireplace and chimney. Instead, the built-in uses a high-temperature metal chimney, usually concealed in a chase. Noncombustible materials such as brick, stone, or ceramic tile are applied around the appliance face to give the look of a traditional fireplace.

HEAT DISTRIBUTION, APPLIANCE PLACEMENT, AND SIZING

The design of an appliance determines how it distributes heat. If the outside walls of the firebox are directly exposed to living space, the appliance is primarily a radiant heater. The heat created when waves of infrared energy from a stove strike solid objects is very comfortable in large open areas, but may not be able to reach remote areas of a house.

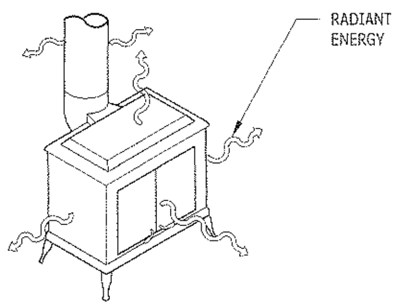
Convection heaters feature double-wall construction. Radiant energy is converted to currents of warm air in the space between the firebox and the surrounding metal cabinet. Natural convection currents of warm air moving through the house, cooling, and returning to the heater, distribute heat gradually or with the assistance of an electric blower.

With the advent of clean glass technology, purely convection heaters completely surrounded by cabinets became rare. Much more common is a third type of heater, which combines the heat distribution qualities of the first two. A combination *radiant/convection heater* employs a cabinet around part of the heater for convection, but radiant energy is emitted from exposed parts of the firebox wall and the ceramic glass of the loading door. The combination offers even distribution of heat, delivering the radiant energy that heats immediate rooms comfortably, and the convection currents that gradually deliver heat to more distant areas. Glass-cleaning air-wash technology and high-efficiency burning give the user a clear view of the fire and make the stove easier to operate.

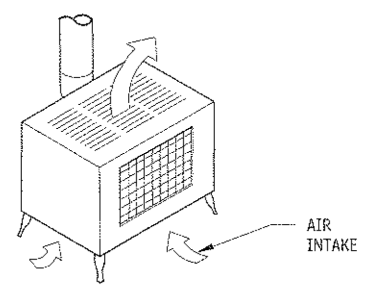
Although a central location and open spaces provide optimum heat distribution, both radiant and combination stoves distribute heat satisfactorily if they are placed in a room of adequate size. Placement is often determined by how the living space is used and the location of the chimney.

The performance of EPA-certified appliances on low burns allows some tolerance for oversizing an appliance for a heating area. However, appliances much too large for the area to be heated make operation in mild weather difficult. Also important are heating expectations: a stove intended for occasional, recreational, or emergency use can be sized differently from one intended as a primary heat source. Manufacturers' recommendations for heating area capacity may not take into account local climate or the specifics of heat loss, so consult a certified dealer.

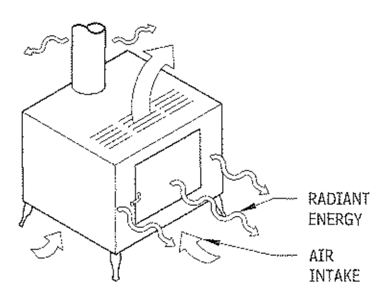
HEAT DELIVERY SYSTEMS
3.154



RADIANT



CONVECTION



COMBINATION RADIANT/CONVECTION

AESTHETICS

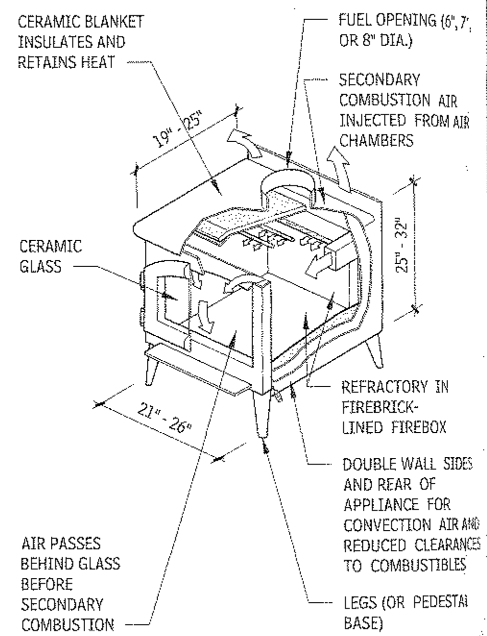
The material used to construct a stove has little effect on heating performance. Cast iron offers decorative features such as arches, curves, and relief work unattainable with steel. Steel stoves may come in styles varied through a choice of legs or pedestals, arched door frames, and brass or gold-plated accents. Stoves with soapstone panels are another option. Air-wash technology, which keeps the glass clean, is perhaps the most popular design feature in all stoves.

NONCATALYTIC APPLIANCES

Noncatalytic systems create the conditions necessary to burn combustible gasses without the use of catalysts. The technology has a number of characteristics:

- Firebox insulation keeps temperatures high.
- Devices that reflect heat back into the firebox create the gas turbulence needed for complete combustion and give the gasses a long route hot enough for them to burn before being cooled.
- Heated secondary air supplies ensure that enough oxygen is present. This secondary air is usually fed to the fire above the fuel bed through ducts with small holes.

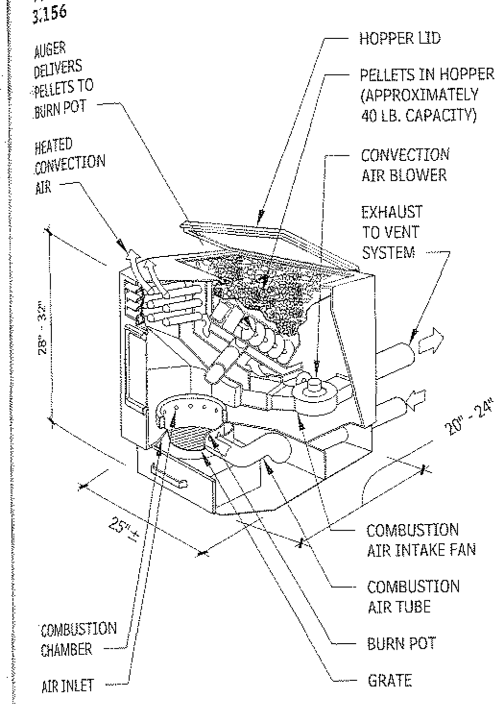
NONCATALYTIC STOVE SYSTEM
3.155



PELLET APPLIANCES

Pellets are a consistently low-moisture fuel made from dried, ground wood waste or other biomass waste compressed into small cylinders about 1/4 in. in diameter and 1 in. long. The pressure and heat used for their production binds the pellets together without the need for additives. Pellets usually burn cleanly because they are fed to the combustion chamber at a controlled rate and are matched with the right amount of combustion air. Pellet-burning stoves generally can operate at lower emission levels than natural firewood appliances. Some pellet stoves also burn corn.

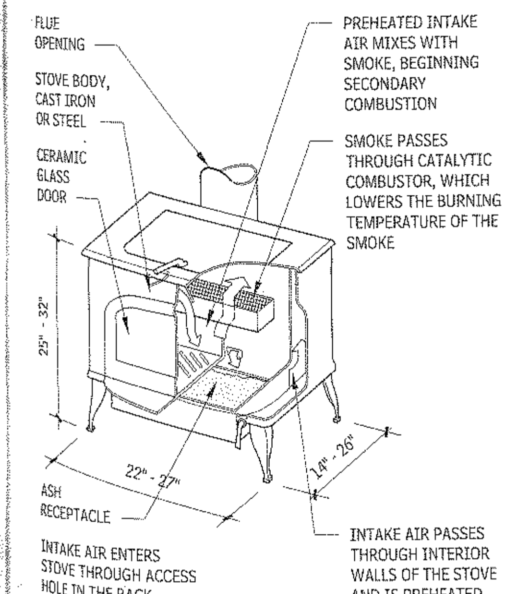
TYPICAL DENSIFIED PELLET APPLIANCE
3.156



CATALYTIC APPLIANCES

A catalyst is a substance that effects a reaction without being consumed in the process. The catalyst in a catalytic combustion appliance is a coated ceramic honeycomb through which exhaust gas is routed. The catalytic coating, usually palladium and/or platinum, lowers the ignition temperature of the gasses from 1000°F to 500°F as they pass through, causing them to ignite. This arrangement allows catalytic appliances to operate at low firing rates and still burn cleanly. Because the catalyst restricts gas flow through the appliance, these units always include a bypass damper into the flue. The damper is opened when the appliance is loaded; when a hot fire has been established, it is closed, forcing the gasses through the combustor for an extended clean burn.

CATALYTIC SOLID-FUEL APPLIANCE
3.157



NOTES

3.161 a. For stoves with legs 2 to 6 in., hearth pad should be 4-in. hollow masonry with 24-gauge (minimum) sheet metal cover.
b. With legs taller than 6 in., hearth pad should be 2-in. solid masonry with 24-gauge (minimum) sheet metal cover.
c. Stoves with legs shorter than 2 in. must be installed on a noncombustible floor, even if there is a hearth pad.

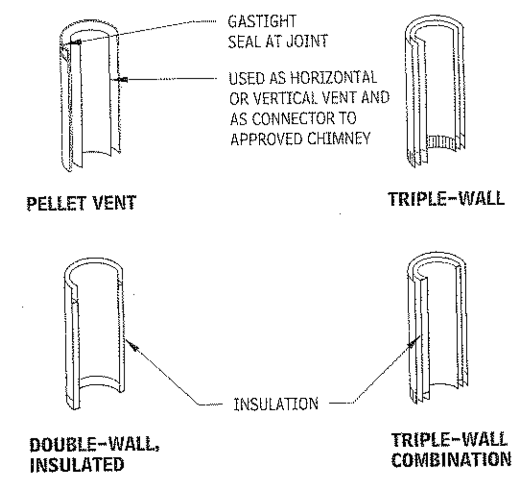
CHIMNEYS AND DRAFT

The woodstove chimney and pellet stove vent are essential components of the solid-fuel heating system. For woodstoves, factory-built metal chimneys offer precise sizing (optimum draft is obtained by matching the cross-sectional area of the flue outlet), safety (heat-tested to 2100°F, according to UL 103 HT), and low maintenance (insulation reduces condensation). Masonry chimneys often need to be downsized with a UL 1777 listed stainless steel, poured or factory-built liner that extends from the appliance to the top of the chimney. Liners improve startup and draft, improve safety, and reduce and simplify maintenance.

Follow code or manufacturers' requirements for chimney clearance and height. For safety, follow the "2 ft/10 ft/3 ft" rule, that is: the chimney must terminate at least 2 ft higher than anything within 10 ft and extend at least 3 ft above the roof penetration. High-efficiency stoves may need added height to ensure adequate draft; a minimum height of 14 ft from appliance to chimney top is generally recommended.

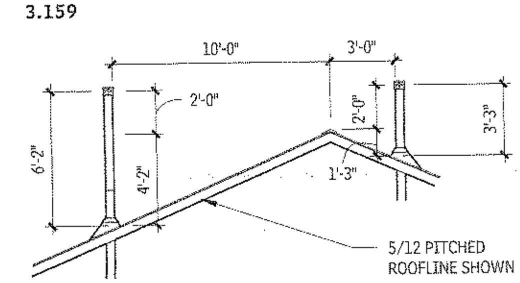
Pellet appliances often use lower-temperature, double-wall pellet venting. Mechanical venting for some appliances may be totally horizontal if clearances to adjacent structures and openings are met, but additional vertical venting is recommended in case of unexpected shutdown. Mechanical draft pellet venting that penetrates the roof can terminate as little as 1 ft above the penetration; natural draft venting must be at least 2 ft higher than anything within 10 ft.

CHIMNEY TYPES FOR WOODSTOVES AND PELLET STOVES
3.158



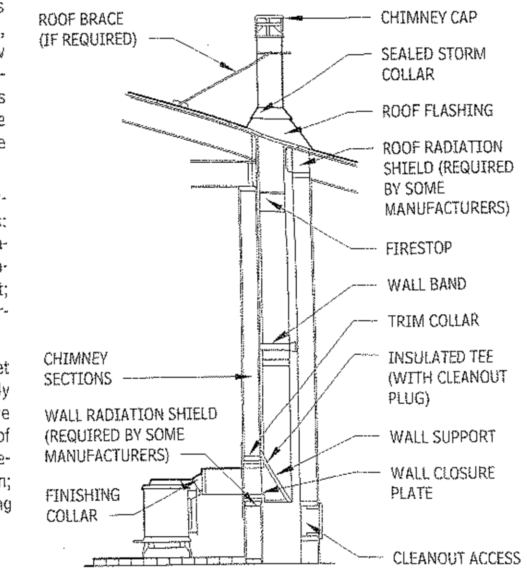
Chimneys keep flue gasses as warm as possible, maintain nearby combustibles at safe temperatures, and exhaust harmful smoke and gasses to the outdoors.

CALCULATING CHIMNEY HEIGHTS WITH PITCHED ROOFS
3.159



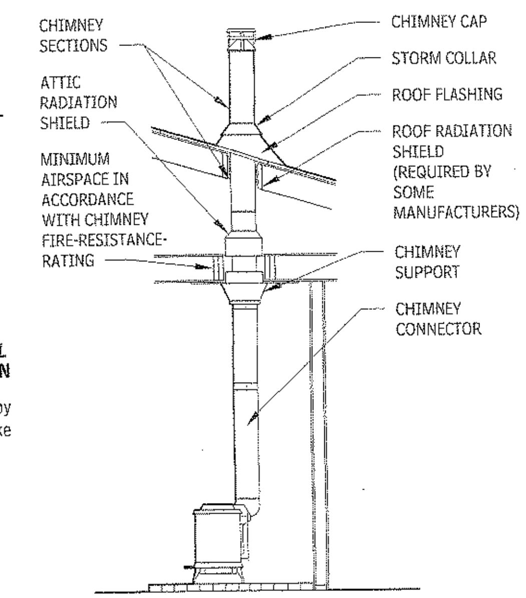
Chimney height must meet minimum draft requirements, generally 14 ft from stove to the chimney cap.

THROUGH-THE-WALL INSTALLATION—FACTORY-BUILT CHIMNEY
3.160



Chimney must meet manufacturers' recommendations for minimum height.

STANDARD CEILING INSTALLATION—FACTORY-BUILT CHIMNEY
3.161



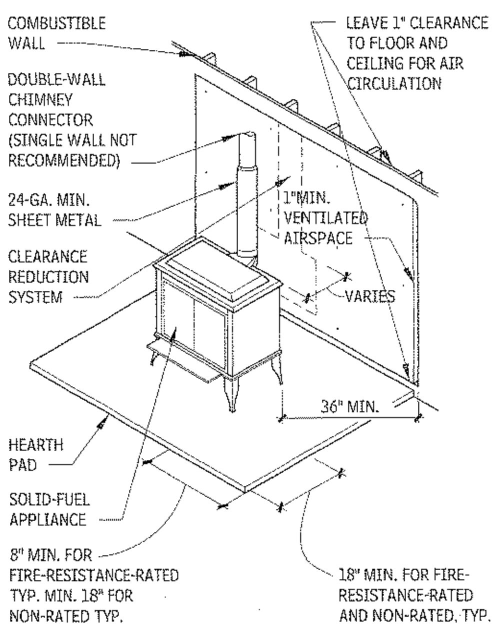
INSTALLATION

Underwriters Laboratories (UL) tests and lists most woodstoves tested for close clearances to unprotected combustibles. Brick or sheet-metal protectors are not usually necessary, and their use in any case cannot reduce required clearance to less than 12 in. Use of double-wall connector pipe from the appliance to the chimney may be recommended to reduce clearances for woodstoves, but such pipe must be listed for use with both the appliance and the chimney to which it will be connected.

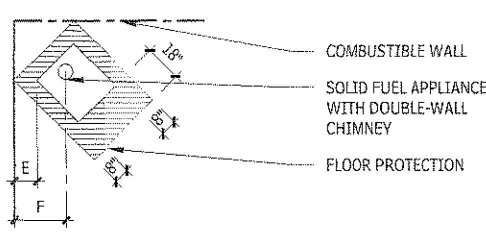
Pellet appliances are listed by the UL (but to a different standard) for very close clearances. They are usually vented with listed pellet venting from the appliance to the outside.

Unlisted appliances should be installed according to the provisions of NFPA 211. Acceptable floor protection materials and minimum size for these stoves are generally specified by the manufacturers; if they are not, follow NFPA 211 or local code requirements.

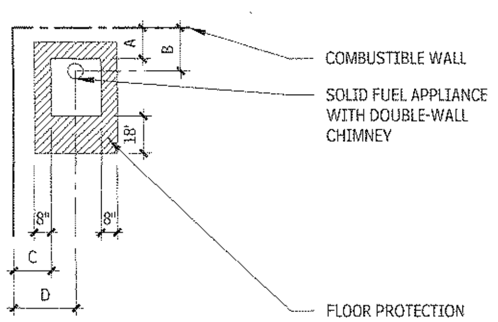
SOLID-FUEL APPLIANCE WALL CLEARANCE REDUCTION SYSTEM
3.162



MINIMUM CLEARANCES TO COMBUSTIBLES (IN.)
3.163



CORNER INSTALLATION



PARALLEL INSTALLATION

SINGLE-WALL CONNECTOR (RESIDENTIAL)					
A	B	C	D	E	F
15	21	18	30	11	25
DOUBLE-WALL CONNECTOR (LISTED MOBILE HOME OR RESIDENCE, CLOSE CLEARANCE)					
A	B	C	D	E	F
8	14	16	28	7	21

NOTES

3.163 a. Floor protection is required as follows: minimum extension beyond loading door, 18 in.; beyond other sides, 8 in.
b. All clearances shown are subject to change based on manufacturers' specifications, local codes, and any clearance reduction systems used.

Contributors:
Walter Moberg, Moberg Fireplaces, Inc., Portland, Oregon; Hearth, Patio, and Barbecue Education Foundation, Arlington, Virginia.

DECORATIVE GAS APPLIANCES
The three typical types of decorative gas appliances described here are conventional venting, direct venting, and unvented.

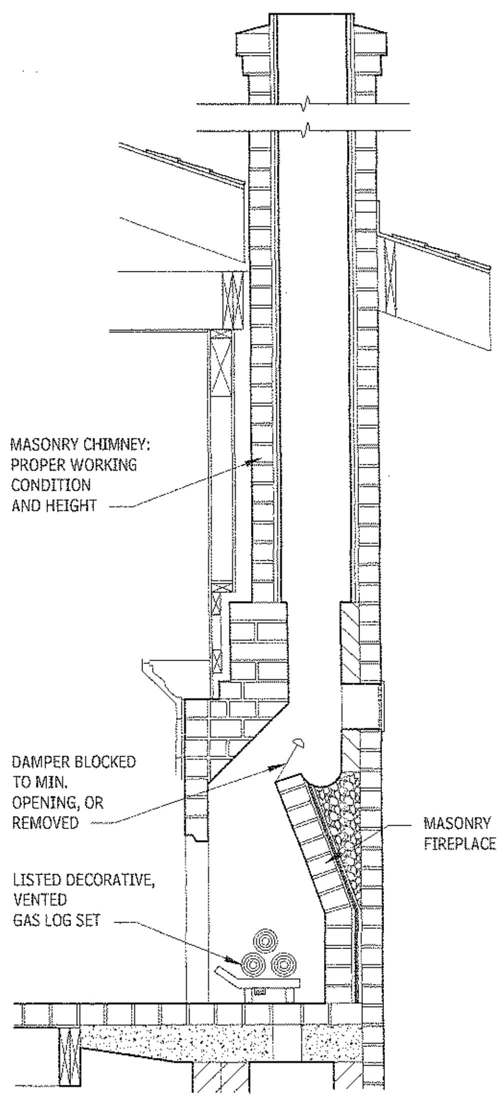
CONVENTIONAL VENTING
Conventional venting systems interact with the interior of the house for combustion, dilution, and excess air intake. By-products of combustion are exhausted to the outdoors. Conventional venting includes the Type B vent, chimneys, and chimney liners.

Both masonry and factory-built chimneys draw combustion air and excess air from within the house, and discharge combustion by-products outside. They are both designed to prevent dilution air from entering the system downstream of the appliance (as in Type B vent draft hoods).

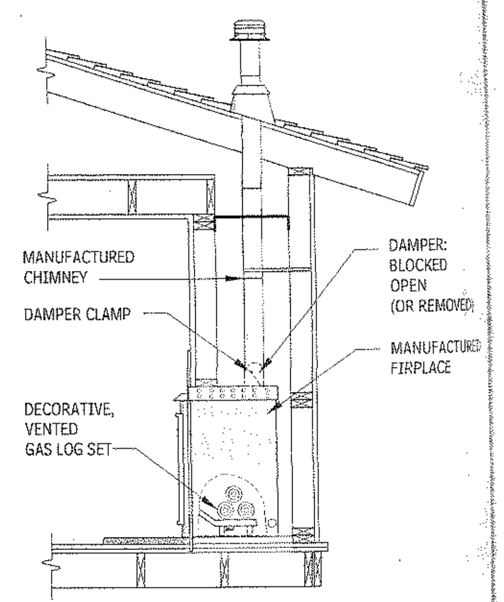
Gas appliances must not be connected to a chimney flue serving a separate appliance (fireplace, woodstove, or fireplace insert) designed to burn solid fuel.

Vented gas log sets almost always use the existing chimney flue, whereas vented fireplace inserts and freestanding stoves are connected to a chimney and use a listed liner system to the top of the chimney.

VENTED GAS LOG SETS
3.164



MASONRY FIREPLACE

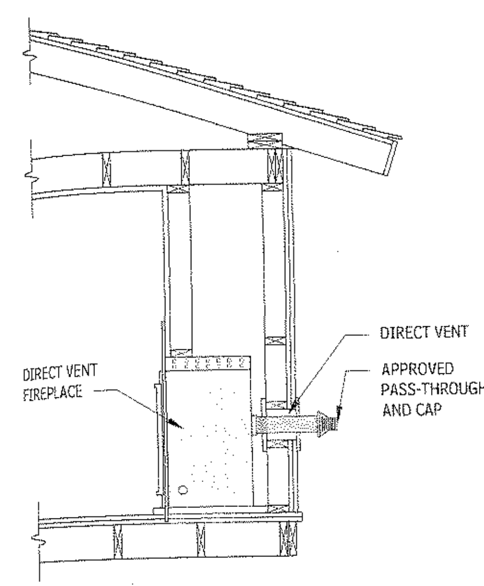


MANUFACTURED FIREPLACE

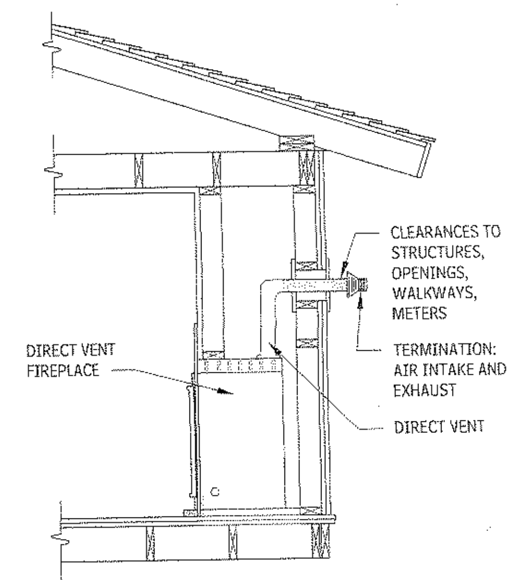
DIRECT VENTING
Direct vent is a sealed system that brings in all of the appliance's combustion air from the outdoors and exhausts combustion by-products to the outside. No other source of combustion air is necessary. The direct-vent built-in fireplace and its venting system are tested and listed as a system. The two design types of direct vents are *coaxial* (a smaller pipe inside a larger pipe) and *colinear* (two separate pipes).

Only the direct-vent products specified may be used with the appliance, and only in the configurations indicated in the appliance manufacturer's installation instructions may be implemented. (For guidelines on interpreting both manufacturers' instructions and regulations, see the Hearth, Patio, and Barbecue Education Foundation's *Gas Hearth Systems Manual*, Appendix A.)

DIRECT-VENTING SOLUTIONS
3.165



DIRECT VENTING – HORIZONTAL



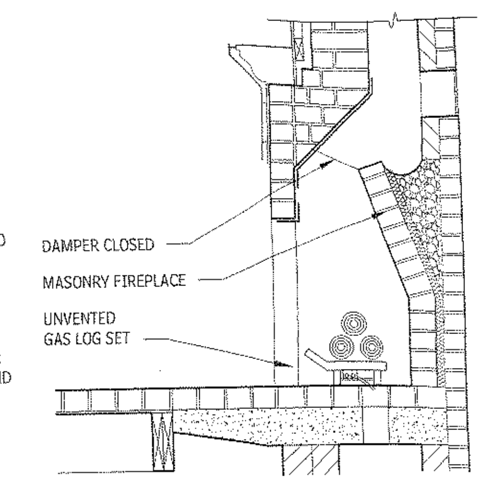
DIRECT VENTING – VERTICAL

UNVENTED
For jurisdictions that allow unvented gas appliance installation, there are a number of code requirements regarding combustion air calculation and sources, as well as use of room restrictions for bathrooms and bedrooms. Manufacturers' instructions for unvented gas hearth appliances typically include details of calculating and providing combustion air needs. Additional requirements in the IFGC include:

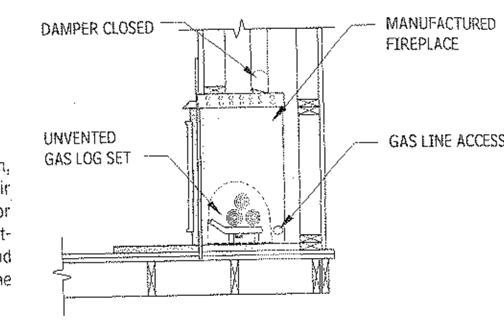
- The maximum input rating must be 40,000 Btu/hr.
- One or more unvented appliances may not be used as the sole source of comfort heating in a dwelling unit.

For guidelines on interpreting manufacturers' instructions and regulations, see the Hearth, Patio, and Barbecue Education Foundation's *Gas Hearth Systems Manual*, Appendix A.

UNVENTED GAS LOG SET
3.166



MASONRY FIREPLACE



MANUFACTURED FIREPLACE

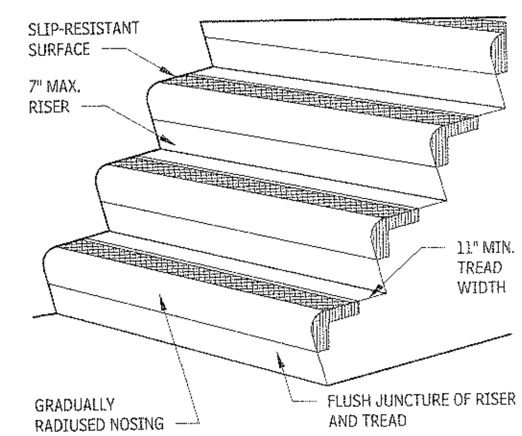
STAIRS

DESIGN CONSIDERATIONS

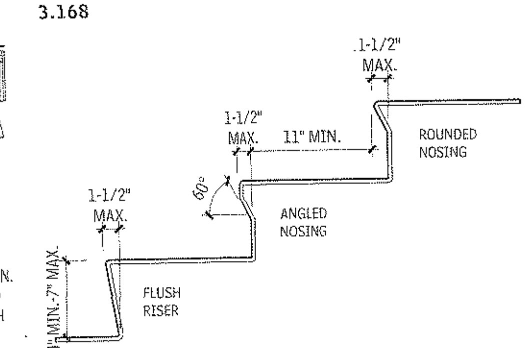
TREADS, RISERS, AND NOSINGS
Riser and tread dimensions must be uniform for the entire length of the stair. Americans with Disabilities Act (ADA)—Architectural Barriers Act (ABA) Guidelines for Buildings and Facilities; the Americans with Disabilities Act Accessibility Guidelines (ADAAG); and the International Building Code (IBC), which references the ICC/ANSI A117.1 Accessible and Usable Buildings and Facilities all indicate a minimum tread dimension of 11 in., nosing to nosing; a maximum riser height of 7 in.; and a maximum overhang dimension of 1-1/2 in. Open risers are not permitted on stairs accessible to persons with disabilities.

OSHA standards require tread finishes to be "reasonably slip resistant" by using nosing material with a slip-resistant finish. Treads without nosings are acceptable, provided that the tread is serrated or other slip-resistant design. Uniform color and texture are recommended for clear delineation of edges.

STAIR ELEMENTS
3.167



RISER DESIGN
3.168



Nosings without abrupt edges that project no more than 1-1/2 in. beyond the edge of the riser are recommended. A safe stair uses a 1/2-in.-radius abrasive nosing that is firmly anchored to the tread, with no overhangs and a clearly visible edge.

Contributors:
Hearth, Patio, and Barbecue Education Foundation, Arlington, Virginia; Walter Moberg, Moberg Fireplaces, Inc., Portland, Oregon; Eric K. Beach and Annica S. Emilsson, Rippeteau Architects, PC, Washington, DC.