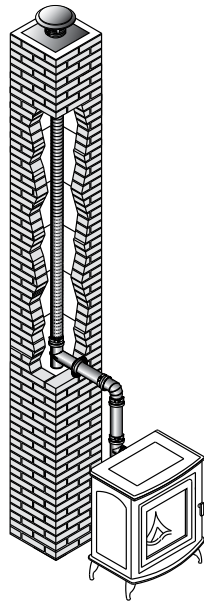


Gas Furnace



Gas Stove

Relining for Gas

Ever since the 1970s energy crisis, manufacturers have greatly improved efficiency ratings of gas & oil furnaces, boilers, stoves, and inserts. Our trade has been fairly successful in educating the public about the benefits – and necessities – of lining chimneys for solid fuel appliances.

Today, gas relining stands poised for a large growth spurt. The reasons are simple: Over the past fifteen years, Natural Gas has experienced terrific growth rates as a primary home heating fuel. Economical, clean, efficient, piped directly into people's homes, it often replaces oil, especially in large population centers.

As with solid fuel heating equipment, much research was done to improve furnace and boiler designs, but not much attention was given to one highly significant part of any heating appliance: its exhaust system. The effects of these well-engineered appliances venting into conventional chimneys became very apparent.

Read on to learn how to identify problem chimneys and what solutions are available today. If you educate yourself in this specialized field, you will encounter a good opportunity for business growth.

DuraVent has thoroughly researched this market, and can help you with solid technical advice. Our VENTINOX[®] product is affordable, and has performed in thousands of homes for over twenty-five years. Information and materials are available through our distributors or directly from us.

We appreciate your feedback and business.

HOME SAFETY - Relining Chimneys For Gas Appliances

GAS RESEARCH INSTITUTE COMMISSIONS BATTELLE LABORATORIES TO CONDUCT STUDY.

In the mid-eighties, gas appliance manufacturers needed help in the selection of corrosion resistant materials for high efficiency, gas fired space-heating equipment. "For maximum efficiency, residential heating equipment must be designed to operate in a condensing mode, in which the latent heat associated with the water vapor in the flue gas is partially recovered. Because the resulting flue-gas condensate is corrosive, materials in the condensing region of the heat exchanger must be corrosion resistant." "The approach of this research was to investigate (1) the corrosivity of the condensate generated in the field using both indoor and outdoor air for combustion and (2) the corrosion resistance of metals in accelerated laboratory corrosion tests." The report does not address chimneys or chimney liners as such. However, field experience and conclusions reached in the report directly relate to the relining trade.

Conclusions of the study which concern us, are:

1. The amount of condensation produced within a furnace or boiler is related to its efficiency rating. Appliances featuring 90% and greater efficiency are referred to as "condensing furnaces." The dew point of the flue gases occurs within the appliance. The dew point is the temperature at which water is released from a gas (approx. 120 to 150° F).
2. Condensate produced by these appliances can be acidic. Acidity levels depend on concentrations of indoor and/or outdoor pollution that is drawn into the heater with the combustion air. Natural gas and "clean" combustion air would not produce significant acidity levels.

Combustion air drawn into the furnace from indoors can be the greater carrier of airborne chlorides than outside air. Chlorides originate from carpeting, leaking refrigerators, paints and thinners, laundry detergents and other household items commonly stored in basements and furnace rooms.
3. Three distinct condensate zones can be identified within a heat exchanger. A "wet" zone, the area that is continually wet with condensate. A "wet/dry" zone, the area that cycles through periods of wetting and drying and a "dry" zone, the area that stays continually free of condensate.
4. The zone that accumulates the most acidic condensate and experiences the greatest corrosion rate is

the 'wet/dry' zone. Here, exhaust vapors condense during the "off" cycle and evaporate again during the "on" cycle of a heater. With each cycle, the acidity level in this zone increases.

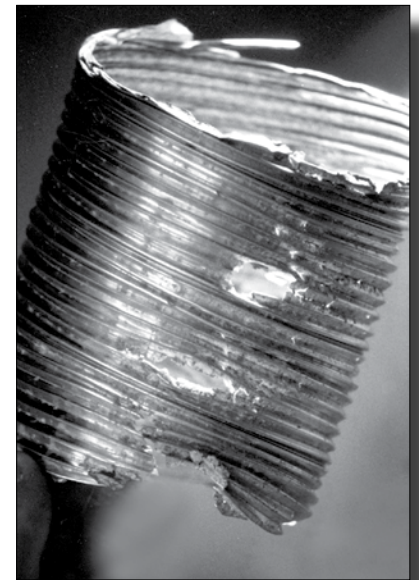
5. Common stainless steels are not immune to the corrosive effects of condensate produced by gas appliances. Most stainless steels tested showed signs of corrosion during testing. However, AL 29-4C, a super-ferritic material, was able to resist corrosion in all zones and was specifically recommended by Battelle Laboratories as an appropriate material for the manufacture of heat exchangers. In contrast, aluminum specimens exhibited corrosion in all zones.

HOW DOES THE BATTELLE LAB STUDY RELATE TO LINERS AND MASONRY CHIMNEYS?

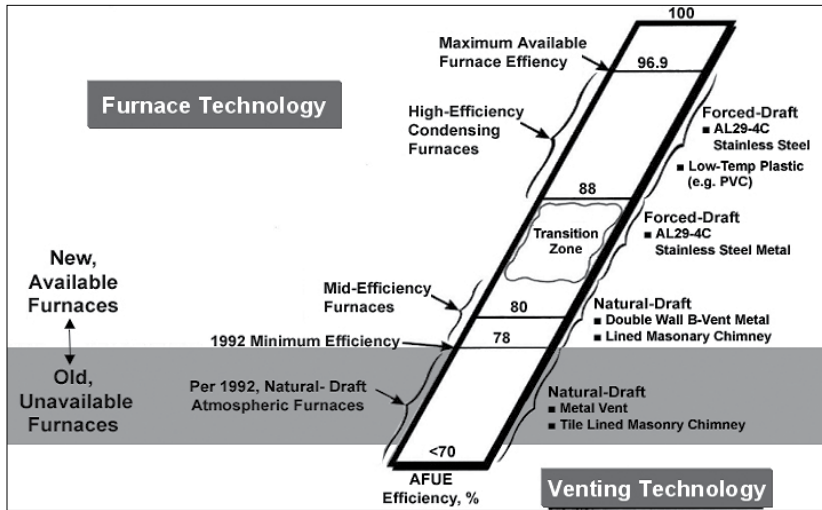
The majority of gas heating appliances in service today are in the 80% efficiency range, not 90% and greater. They are referred to as Mid-Efficiency or "near-condensing" units. Like high efficiency models, they produce significant amounts of water vapor as a natural by-product of combustion. By sacrificing some efficiency, the exit temperatures of exhaust gases are kept just above the dew point, which avoids condensation problems within the heater. The dew point of flue gases now occurs in the vent system. Chimneys, like heat exchangers, develop condensate zones.

Acidity levels in "condensing boilers or furnaces," and in chimneys that vent "near condensing appliances" are similar, since acids are caused by contaminants drawn in with the combustion air, and water. Therefore, condensation zones in the chimney exhibit the same characteristics as those in heat exchangers, they just occur farther up in the heating system. Now that we have established that condensate zones and acidity levels in chimneys can be similar to the ones in the heat exchangers of high efficiency boilers or furnaces, it is logical to conclude that corrosion problems are identical as well.

As the GRI study indicates, "Manufacturers of high efficiency gas appliances need to replace materials



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that were traditionally used in the fabrication of heat exchangers." At the same time, chimney liners made from traditional stainless steels can also no longer meet expected performance criteria.

VENTINOX® ELIMINATES MOISTURE PROBLEMS & PROVIDES SAFE, RELIABLE VENTING FOR GAS APPLIANCES, BOILERS & WATER HEATERS.

Condensation causes significant problems in masonry chimneys. Acids break down and erode clay tiles, bricks and mortar, destroying the chimney from the inside. Central heating units in the 80% to 83% efficiency range emit low temperature flue gases into the base of a chimney. Experience shows, that even appliances with lower efficiency ratings (higher flue gas temperatures) can produce condensation, especially during the first few minutes of their "on" cycle. This probability increases when a furnace and water heater are vented into the same flue and the water heater operates during the "off" cycle of the boiler or furnace. **In cold climates, or during cold weather periods in warmer regions, rapid cooling of flue gases often leads to condensation on cold flue surfaces.**

Condensation problems can be identified by spalling bricks, chips of flue tiles and mortar in the cleanout pit, signs of mildew and moss on walls, white efflorescence stain on brickwork, leaks around cleanout doors and water stains on walls around or near the chimney.

ARE ACIDS THE ONLY CAUSE OF CHIMNEY DETERIORATION?

Even without acids, moisture produced by a boiler or furnace can cause significant damage. In colder climates, wet exterior chimneys can experience numerous freeze and thaw cycles each day. This causes the erosion of mortar joints and the cracking and spalling of bricks and

clay tiles.

Deterioration is accelerated in flues previously used to vent oil and coal heaters. Chemical deposits left by these fuels now combine with water to form additional destructive acids that can attack masonry and clay tiles. When aluminum liners are used in such contaminated environments, they can be destroyed in short order from the outside-in.

SOME MULTI-FUEL HEATERS CAN CREATE PROBLEMS.

Venting of multi-fuel appliances like oil and gas, oil and wood or gas and wood can be problematic for chimneys. Outlawed in many communities across the country, these

appliances can cause significant damage in venting systems. If you are called in to clean a chimney servicing a combination appliance, be sure to ask the customer how much one fuel is burned as compared to the other. Such details can tell you what to expect in the chimney.

IS CHIMNEY DETERIORATION THE ONLY REASON TO RELINE?

Poor draft results when an efficient gas furnace is discharged into a relatively large masonry chimney flue. The already low temperature exhaust gases expand and cool further, losing the buoyancy necessary to carry them up and out the chimney. As a result, they remain in the flue longer, increasing the possibility of carbon monoxide leakage into the home. Therefore, a chimney may have to be lined just to size the flue properly and to create sufficient draft.

Overall Efficiency of a heater is negatively impacted by poor draft, as combustion air is delivered into the combustion chamber at the same volume or velocity as flue gases are allowed to exit from the appliance. If insufficient volumes of oxygen are mixed with the fuel, incomplete combustion results. This can significantly and negatively impact the performance of a gas appliance. Efficiency ratings achieved in the test labs and featured as marketing advantages in sales literature can not be duplicated where it counts: in your customer's home.

HOW CAN PROBLEM CHIMNEYS BE IDENTIFIED?

When you are called to a home to perform any of the services your company offers, and the dwelling is heated with a relatively new oil or gas heater, spend the time looking for the following:

A) Structural Symptoms Caused by Condensation

- 1) Check for obvious signs of moisture on chimney walls

HOME SAFETY - Relining Chimneys For Gas Appliances

facing either the exterior or living quarters. Look out for: Wet spots, discoloration of plaster walls, spalling of bricks or masonry, peeling wallpaper, blistering paint, mildew, etc.

- 2) Conduct your quick visual inspection floor by floor. Start from the basement and follow the chimney all the way to the attic. Since flue gases cool with distance from the heat source, condensation may not occur right away, but can be severe higher up.
- 3) Check the base of any flues used to vent gas appliances. Any quantities of sand or small pieces of bricks or masonry at the bottom of the flue can point to condensation problems.

B) Health Symptoms Caused by Carbon Monoxide An improperly operating chimney can recycle by-products of combustion into the furnace intake air. If this oxygen-starving process continues long enough, deadly carbon monoxide can be produced and quickly build up to toxic levels inside a home.

Although carbon monoxide is difficult to detect (a colorless, odorless, tasteless gas) it causes several physical symptoms. If customers or members of their families complain about unexplained sleepiness, nausea, headaches, dizziness or heart fluttering, it could be the result of carbon monoxide poisoning caused by a plugged or faulty flue.

Don't be afraid to ask your customers if members of their family show any of these symptoms. Make it part of your safety check.

VENTINOX® OFFERS OPPORTUNITIES IN THE MULTI-MILLION DOLLAR GAS RELINING BUSINESS

Approximately 60% of all homes in the United States are heated by gas. (43% in the Northeast, 73% in the Midwest, 43% in the South and 64% in the West.) A

significant percentage of the estimated 2.5 million gas furnaces and boilers sold each year replace electric and oil heating systems or older gas heaters. How many liners need to be installed in your territory?

VENTINOX®'s super alloys consistently out-perform aluminum and commonly available stainless steel liners in corrosive environments. VENTINOX® liners are made from the right materials and welded, not just interlocked or crimped. Axial and circumferential expansion and contraction during heating cycles are absorbed without creating stresses within the system. VENTINOX® liners do not "grow" out of the top of a chimney. VENTINOX® forms an air and watertight conduit from the appliance to the chimney top. The welded "backbone" renders VENTINOX® lightweight, yet stronger than its competition. VENTINOX® is made in a state of the art manufacturing facility, carries a life-time warranty and serves in thousands of homes since 1979.

Material Choices

Our top of the line **VENTINOX®VG** Gas Liner is constructed from AL 29-4C®, "a specifically designed ferritic stainless steel containing 29% chromium and 4% molybdenum as critical alloy additions. 0.05% titanium is added to combine with carbon and nitrogen to improve weldability, toughness and resistance to intergranular corrosion. This combination represents the best balance of corrosion resistance, ductility and cost." AL29-4C® offers extreme resistance to chloride ion pitting, crevice corrosion and stress corrosion cracking, as well as general corrosion in oxidizing and moderately reducing environments. AL29-4C® experienced no measurable weight loss at chloride levels measured in condensate developed in the Battelle Laboratory tests (see Figure 1).

Our **VENTINOX®VFT** is constructed from 316Ti, an austenitic stainless steel alloy, typically containing 17% Chromium, 12% Nickel, 2.5% Molybdenum and .31%



Wet exterior wall



Spalling bricks



Blistering paint, mildew



Debris at bottom of flue

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Titanium. 316Ti offers excellent corrosion resistance to acidic solutions that contain nitric, nitrous, sulfuric, sulfurous and hydrochloric acids. The addition of titanium provides great physical strength and durability. Typical applications include chemical storage tanks, pressure vessels and use in marine or chemical environments. 316 Ti performs consistently and significantly better than Type 304 stainless steel or aluminum when exposed to corrosive condensates created by fully or partially condensing natural gas or propane fired heating appliances (see Chart).

Construction

Like all of our lining products, VENTINOX®VG and VENTINOX®VFT are continuously welded, seamless and air and watertight. Starting as a flat strip, the liner's open corrugations are formed gently. Spiral winding overlaps one set of corrugations, which are continuously electric resistance welded while being bathed in a stream of cooling water. This produces a lightweight but strong liner, free of any stress that could make other liners susceptible to corrosion. The VENTINOX® weld forms a solid "backbone", spiraling around the liner and over its entire length.

VENTINOX® Components

The components for VENTINOX®VG or VENTINOX®VFT liners are fabricated from 28 gauge AL29-4C® or 316 respectively. All of the components are manufactured to material and tolerance standards exceeding specifications common in the chimney liner industry.

VENTINOX® components feature a unique built-in locking band that fastens any component onto a VENTINOX® liner without the need for pre-drilling holes and the use of pop rivets. This eliminates the probability for using pop rivets made from dissimilar materials and therefore avoids the so often "weakest link" within a system. For more information on our FasClamp™ system, go to our web site www.duravent.com.

Insulation

Gas fired appliances produce a significant volume of moisture during the combustion process. Since modern units deliver most of the heat they generate to living areas, little heat is going into the chimney to keep this moisture in vapor form. When cool flue gases come in contact with cold chimney surfaces, the dew point is reached quickly, water forms and draft becomes sluggish or insufficient altogether.

A VENTINOX® liner installed into a masonry structure by itself can improve overall systems performance greatly. When testing a gas lining system to UL 1777, no insulation is required to pass the "zero clearance" test. Flue gas temperatures are too low for setting combustible

materials on fire that may surround a masonry chimney. Underwriters Laboratories tests focus mainly on public safety however, and do not necessarily concern themselves with a system's operating performance.

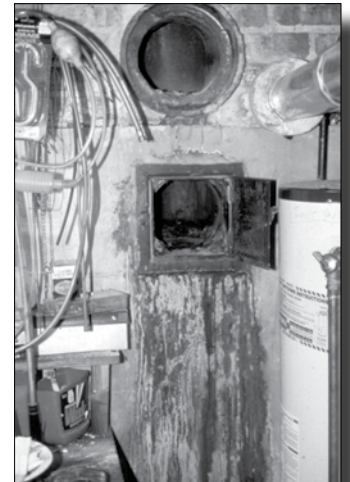
The same low flue gas temperatures that allow us to pass safety tests easily, can be detrimental to the performance of a heater and its vent system. Insulating a liner preserves the available latent heat from the base of the chimney to the top. Draft is established at the beginning of the heater's "on" cycle and the desired efficiency ratings of a boiler or furnace can be achieved.

At the same time, condensation is reduced to a minimum and the "dry" zone is extended as far up into the chimney as possible.

TherMix® Chimney Insulation is the pre-ferred and proven material that is relatively easy to install and delivers the highest heat retention.

For information on TherMix® Chimney Insulation, contact our customer service at **1.800.835.4429** or visit our web site www.duravent.com

Home owners throughout the United States are willing to pay more for high efficiency heating equipment. Without a proper vent system, these units cannot deliver the expected return on investment. **A well-insulated VENTINOX® chimney liner "turns on" as soon as the thermostat calls for heat and provides for an efficient breathing apparatus for any heater.**



Limitations

The flexibility of all VENTINOX® liners depends on the ability of the corrugations to absorb movement. AL29-4C® is less ductile than 316Ti stainless steel and therefore will not tolerate repeated and rapid flexing. Caution should be taken not to abuse the material during installation.

Ovalization?

VENTINOX® liners may be ovalized with the VOV 612, the VENTINOX® Ovalizing Machine. Please refer to technical bulletin #1009 Ovalizing instructions and sizing chart.

HOME SAFETY - Relining Chimneys For Gas Appliances

**Table 10.7: Capacity of Chimney Liner (Common Vent)
with Single-Wall Connectors Serving Two or More Category I Appliances**

Vent Height H (ft)	VENTINOX® Liner Diameter — D																				
	4"			5"			5.5"			6"			7"			8"			9"		
	Combined Appliance Input Rating (Thousands of BTUs per Hour)																				
	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT
67	NA	78	64	NA	113	99	NA	136	122	200	158	144	304	244	196	398	310	257	541	429	332
8	NA	87	71	NA	126	111	NA	150	135	218	173	159	331	269	218	436	342	285	592	473	373
10	NA	94	76	163	137	120	200	163	147	237	189	174	357	292	236	467	369	309	638	512	398
15	121	108	88	189	159	140	232	190	170	275	221	200	416	343	274	544	434	357	738	599	456
20	131	118	98	208	177	156	257	212	190	305	247	223	463	383	302	606	487	395	824	673	512
30	145	132	113	236	202	180	293	244	219	350	286	257	533	446	349	703	570	459	958	790	593
50	159	145	128	268	233	208	337	285	252	406	337	296	622	529	410	833	686	535	1139	954	689
100	166	153	NA	297	263	NA	383	331	NA	469	398	NA	726	633	464	999	846	606	1378	1185	780

Example: Common Venting Two Draft Hood-Equipped Appliances. A 35,000-Btu/hr water heater is to be common venting with a 150,000-Btu/hr furnace, using a VENTINOX® liner (common vent) with a total height of 30 ft. The connector rise is 2 ft for the water heater with a horizontal length of 4 ft. The connector rise for the furnace is 3 ft with a horizontal length of 8 ft. Assume single-wall metal connectors will be used with a VENTINOX® liner. What size VENTINOX® liner (common vent) should be used in this installation?

Solution:
In the common vent capacity portion of Table 10.7, find the row associated with a 30 ft vent height and read over to the NAT + NAT portion of the 6-in diameter columns to find a maximum combined capacity of 257,000 Btu/hr. Now reduce by 20% ($257,000 \times 0.8 = 205,600$). Since the two appliances total only 185,000 Btu/hr, a 6 in. VENTINOX® liner (common vent) can be used.

Example: Single Draft Hood-Equipped Appliance (from page 6)

Solution: Table 10.2 should be used to solve this problem, because single-wall vent connectors are being used with a VENTINOX® liner.

Read down the first column in Table 10.2 until the row associated with a 10-ft. height and 5-ft. lateral is found. Read across this row until a vent capacity greater than 120,000 Btu/hr is located, realizing that you must multiply the NAT Max value in the shaded columns by 0.8 ($186,000 \times 0.8 = 148,800$). In this case, a 6-in diameter vent has the capacity of 148,800 Btu/hr and can be used for this application.

NOTE:

These examples are only used to familiarize yourself with reading and using the tables. For complete tables, refer to NFPA 54 National Fuel Gas Code or call us at 1.800.835/4429 for help.

HOME SAFETY - Relining Chimneys For Gas Appliances

INSTALLATION SUGGESTIONS FOR GAS LINERS

I. Installation Procedures

The VENTINOX® Installation Manual (download from our website www.duravent.com for your copy) and the following information should be used as a guide.

- 1) The masonry chimney must be thoroughly cleaned and inspected before relining. Caution: debris found in gas flues can be acidic. Follow proper safety procedures during cleaning operations. Always rinse and lubricate tools to avoid corrosion and empty acidic debris from your vacuum.
- 2) Any loose mortar or broken clay tiles should be removed and all structural cracks repaired.
- 3) Proper sizing of the liner is extremely important. Use the tables on page 6 and 7 or NFPA 54 to calculate specific size requirements. A good hint: determine if the customer plans to add other gas appliances in the future. Example: a chimney for the existing gas furnace needs relining. An electric water heater might be replaced with a gas unit when necessary. If you size the liner to match the needs of the furnace alone, it may not be large enough to service additional appliances later.
- 4) Good liner insulation is crucial to reducing condensation in the chimney. Any Underwriters Laboratories approved insulation method for stainless steel liners is acceptable. Remember that our primary concern here is to keep the liner warm to reduce condensation, not the danger resulting from high temperatures. The type and minimum thickness of insulation materials recommended for solid fuel liners should be used as a guideline. The amount of insulation may vary according to the location and operating conditions of a chimney. Example: exterior chimneys facing north tend to run much colder than interior chimneys, and would benefit from more insulation. If you face a situation requiring a judgment call, please feel free to contact our technical staff.

WHAT'S THE BOTTOM LINE?

Experience gained in the solid fuel industry demonstrates, that a heating system is not complete unless a proper vent system is provided for a boiler or furnace. To maximize efficiency ratings of the appliance alone is a shortsighted approach for serving the energy conscious public. It is necessary to optimize the functioning of each systems component and so maximizes the overall performance, efficiency and safety of a heating system.

With VENTINOX®, you can offer your customers the optimal vent system for their gas heating appliances:

- it is welded, not interlocked or crimped
- it is reasonably priced
- is available in 3" through 12" diameters
- can be ordered in job specific lengths
- is made from the right metals for the job
- is water and vapor tight
- exhibits little or no expansion/contraction during operating cycles
- features ideal installation weight
- offers a complete assortment of parts and components
- makes pop rivets unnecessary
- is supported by a knowledgeable technical staff
- is made by solid manufacturers right here in the USA

The information presented in this Newsletter has been carefully collected and researched. Resources and references include: National Fire Protection Assoc., National Fuel Gas Code, Underwriters Laboratories Inc., Allegheny Ludlum, Battelle Laboratories, & others. We continue our research into gas venting and will issue updates periodically. If you wish to be included in our mailings, give us a call or contact us via our website. We'd like to hear from you.

DuraVent

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