SÜD CHEMIE
PROTOTECH
Air Purification Catalysts

Trouble Shooting Guide for Wood Stoves Equipped with Prototech Catalytic Combustors

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DEFINITIONS

AIRTIGHT STOVE - In an airtight stove, all air enters in through the inlets. Generally, non-airtight stoves are not as efficient and their level of heat output is less controllable than that of an airtight stove.

BAFFLE PLATE - A partition in a stove that controls the direction of the flow of combustion air, flames and flue gases.

BAROMETRIC DAMPER - Damper in a stove pipe that is controlled by changes in air pressure.

BAROMETRIC DRAFT GAUGE - Gauge that measures the amount of draft in a chimney in inches of water.

BURN CYCLE - Time span between refuelings in which the wood is reduced to a bed of hot coals.

BYPASS - Movable door inside a woodstove that is opened when the stove door is opened to give a path of least resistance to smoke to prevent roll-out. It is also open during high-fire modes.

Bypass also refers to the positioning of the combustor in a retrofit which allows smoke to flow around it during high-fire modes or refueling.

CREOSOTE - Condensed wood-gas vapor.

DAMPER - A movable plate or valve in the flue, for controlling the draft.

DOWNSTREAM TEMPERATURE - Outlet temperature of the combustor or temperature of the gas leaving the combustor from the chimney side or face.

DRAFT - Amount of vacuum created by buoyant hot air in the chimney. Draft pulls in oxygen for the combustion process and pulls out exhaust gases.

FIREBRICK - Brick capable of withstanding high temperatures. Used in furnaces, kilns and stoves. Used to mean only "hard" or "dense" firebrick as distinguished from "soft" or "insulating" firebrick.

FIRING RATE - Rate at which fuel is burned in a stove.

FLAME IMPINGEMENT - Flames directly contacting the combustor face.

FLUE COLLAR - The part of a stove to which the chimney connector or chimney attaches.

GASIFIED - Changed to gas.

GLOW-PLUG EFFECT - When a combustor is at temperatures above 1400° F. (760° C.) and periodically causes pockets of wood gas in the firebox to ignite spontaneously.

GREEN WOOD Undried, freshly cut wood from a live tree.

IGNITION TEMPERATURE - The minimum temperature of a flammable mixture of gases at which it can spontaneously ignite.

INSULATING FIREBRICK - Low-density (high porosity), low-thermal-conductivity firebrick intended for use in kilns, furnaces or stoves to reduce heat losses. Has 20-33% more insulation (low conductivity) and heat-storage capacity than that of hard firebrick.

LIGHT-OFF - Activation temperature of the combustor catalyst.

MASKING - Concealing or covering catalyst with a substance which prevents catalytic activity.

NOBLE-METAL CATALYST - A catalyst is a substance that can accelerate a chemical process without being consumed by it. A noble-metal catalyst is one made of a precious metal or metals. (In the combustor, platinum and palladium are used because they are stable under high-heat conditions.)

OXIDATION - Uniting of a substance with oxygen, as in burning.

PITCHY WOOD - Wood that is full of pitch.

PITHY WOOD - Soft, spongy, air-filled wood.

REFRACTORY MATERIALS - Heat-resistant materials used to line stoves and furnaces.

SUBSTRATE - Ceramic base material of the combustor which is coated with washcoat and catalyst.

THERMAL SINK - Large mass or conductive surface that readily removes heat from an appliance or gas stream.

THERMOCOUPLE - Heat-measuring device which operates on thermoelectric current when heated.

UPSTREAM TEMPERATURE - Inlet temperature of the combustor or temperature of the air that is entering the combustor from the stove side or face.

VOLATILES - Substances that vaporize or evaporate quickly.

WASHCOAT - An inert substance, such as alumina, that is deposited on the surface of the substrate to increase the overall surface area and maintain the dispersion of the catalyst evenly across the combustor surface.

II. INTRODUCTION

Heating with wood — it's the self-sufficient answer to continuously rising fuel prices. But it's smoky, smelly and inefficient . . . . . .

That is, until the Süd-Chemie Prototech Catalytic Combustor came along. Now heating with wood is easier and more efficient than ever before, and the smell and smoke are nearly eliminated, too.

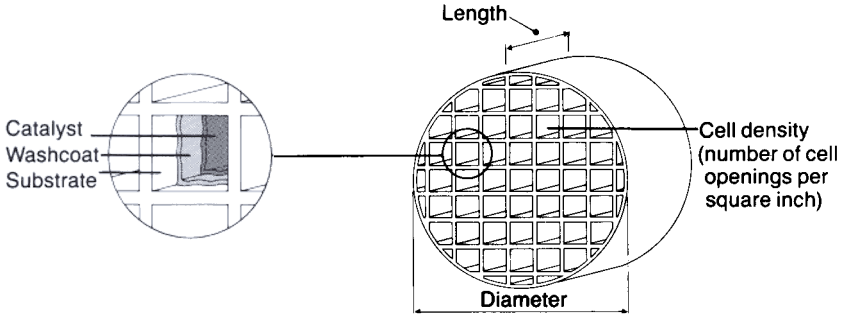
Developed during years of research at Corning incorporated, the Süd-Chemie Prototech Catalytic Combustor is a unique ceramic honeycomb coated with a "noble" metal catalyst, such as platinum or palladium. ***(See Fig. 1)***

Placed between fire and flue, the catalytic combustor literally causes smoke to burn as fuel, creating more heat from less wood. That means a wood stove can be burned slowly, transferring almost all of the energy stored in a log to the room as heat instead of to the outside air as pollution.

And creosote, the smelly, black substance that may clog a chimney, is drastically reduced, thereby substantially lessening the chance of a damaging chimney fire.

Operating a stove equipped with a Süd-Chemie Prototech Catalytic Combustor is not much different than operating a traditional wood stove — in fact, it's even easier in many cases.

Fig. 1 The Süd-Chemie Prototech Catalytic Combustor



From 5 to 30 percent of the chemical energy contained in every log escapes up the chimney when wood is burned in a conventional airtight stove. The Süd-Chemie Prototech Catalytic Combustor is designed to make use of this energy, converting it into useful heat as it lessens chimney creosote build-up and air pollution.

The catalytic combustor consists of a durable, temperature-resistant ceramic composition which is extruded into a cellular, or honeycomb, configuration. After extrusion, this ceramic monolith is fired and then covered with a noble-metal catalyst.

When wood smoke contacts this catalyst, chemical changes occur that cause the smoke to ignite at temperatures around 500° F. (260° C.) — temperatures easily found in a wood-stove firebox. Normally, smoke will ignite and burn only at temperatures around 1000° F. (540° C).

Properly designed and operated, a wood-burning appliance incorporating a Süd-Chemie Prototech Catalytic Combustor can produce up to:

* **50 percent more heat;**

* **90 percent less creosote;**

* **90 percent less air pollution.**

For these reasons, the Süd-Chemie Prototech Catalytic Combustor is the combustor of choice for manufacturers who wish to offer the most technologically advanced stove models and retrofit devices on the market.

IV. OPERATING A CATALYTIC STOVE OR RETROFIT

On a showroom floor, a combustor-equipped stove may look like any other wood stove. But once a combustor-equipped stove is installed and ready for use, there are certain slight differences an operator must keep in mind. These differences involve obtaining conditions favorable to combustor performance, such as:

reaching proper catalytic operational temperatures, commonly known as **light-off;**

maintaining the conditions that support catalytic burning;

proper bypass positioning

Achieving Catalytic Light-Off — At least once during each burning cycle, the temperature within the stove should be raised high enough to cause the catalyst to become active. The most convenient time to do this is during fuel loading. Gas inlet temperatures to the combustor of between 500 and 700° F. (260-370° C.) will initiate catalytic burning.

NOTE: In units equipped with a viewport, it should be noted that the combustor usually glows during the first 1/4 to 1/3 of the burn cycle. You should be aware, though, that the combustor need not glow to be working. The use of temperature monitors is a more reliable means of determining if the combustor is functioning.

Maintaining Catalytic Burning Conditions — During the start-up of a cold stove, a medium to high firing rate must be maintained for about 20 minutes. This insures that the stove, catalyst and fuel are all stabilized at proper operating temperatures. Even though it's possible to have gas temperatures reach 600° F. (320° C.) within two or three minutes after a fire is started, if the fire is turned down immediately to low-fire conditions, it will result in either the fire or the combustor going out.

At the end of a burn cycle, it's possible that the amount of burning charcoal might not provide sufficient temperatures or fuel for the catalyst. During the refueling of a hot stove that has an internal firebox temperature below 500° F. (260° C.), we recommend that the stove be fired for about 10 minutes to ensure that the catalyst reaches 600° F. (320° C.). Doing this will ensure sufficient temperatures and proper amounts of volatiles for catalyst operation.

When refueling a hot stove that has an internal firebox temperature above 500° F. (260° C.), no refiring step is necessary. Just load the fuel and continue to operate. Temperatures within the firebox will be hot enough to support catalytic burning and wood pyrolysis.

Methods for determining these temperatures are included in the Temperature Monitors section.

Bypass — Whenever the stove is being loaded or when it is being operated in the high-fire mode the bypass should be in the open position. This keeps smoke from entering the room when the door is opened and also prevents overfiring of the combustor during high-fire conditions. Once light-off has been accomplished and the stove has been turned down, the bypass can be closed.

Retrofits — Once in place, a retrofit catalytic combustor unit operates in the same manner as a catalytic stove. Follow above guidelines for efficient operation.

In all cases, retrofit units should be located as close to the flue collar as possible. Avoid elbows and lengths or extensions of stovepipe between the stove and the retrofit unit for the most efficient operation. Retrofit units will vary in design and operation according to the type of stove being retrofitted.

(Caution: Before installing a catalytic appliance on an existing chimney, be sure that the chimney has been cleaned and any creosote build-up removed. Failure to do this could result in a chimney fire.)

RECOMMENDED FUELS

Catalytic stoves and retrofits are designed to burn natural wood only — Burning materials other than natural wood will appreciably shorten the life of the catalyst. Use quality fuel wood that is available in your area. Do not burn trash or garbage, artificial or paper logs, gift wrappings, coal, lighter fluids, chemical starters, treated or painted wood, driftwood or chemical cleaners. These contain chemicals that may cause the catalyst to become deactivated, and may release toxic particles or gases into the air.

DRAFT CONTROLS *(See Fig. 2)*

The proper amount of draft is important in both the catalytic appliance as well as a non-catalytic unit. Without enough draft the burning process cannot take place. Installations with a draft of .02" of water or less are considered marginal and may not burn reliably. In the combustor-equipped appliance it is not recommended that the draft exceed .06" of water or overfiring can occur. The recommended operating range is .03-.06" of water.

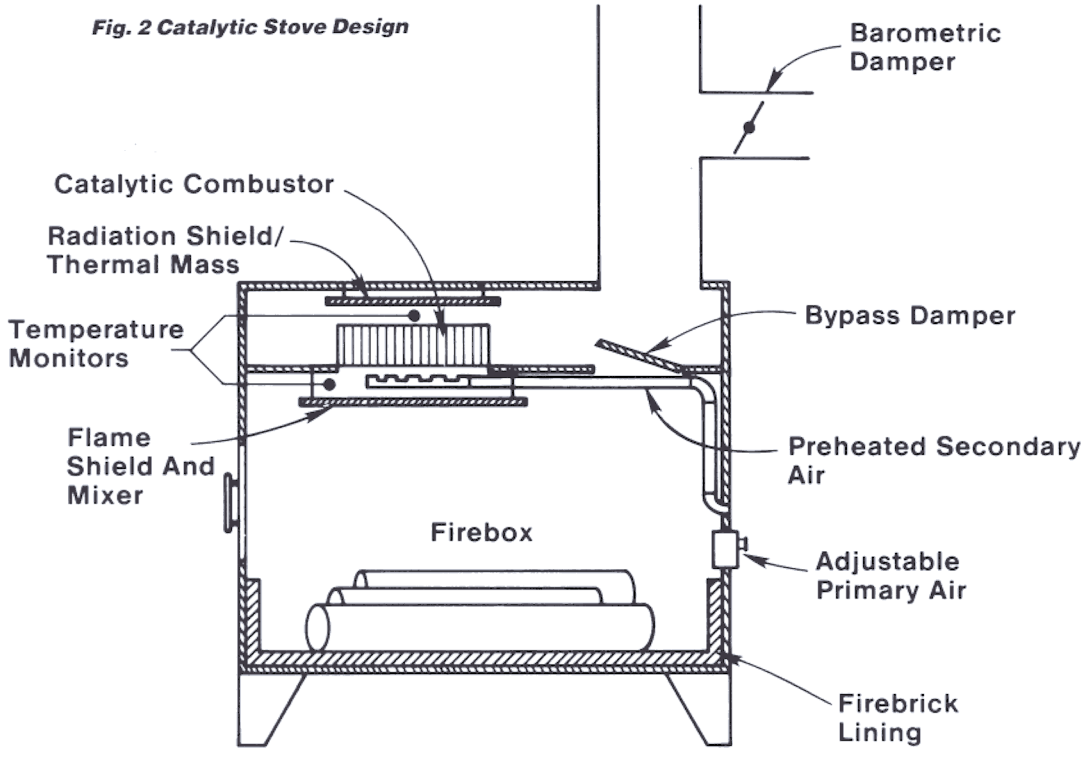
Bypass — The bypass is used in combustor-equipped devices when the stove door is opened for loading or inspection and when the stove is operated in the high-fire mode.

Barometric Damper — A barometric damper can be helpful in stabilizing flow conditions and can minimize the chance of overfiring. It is also advisable to locate a manual damper above a barometric damper for use as a throttling valve in case of a flue fire.

Draft Gauge — Draft conditions vary due to altitude, atmoshperic changes, chimney and wind conditions. Changes in draft can affect the combustor's performance and life. A draft gauge will permit an operator to adjust the stove for more consistent burning. There are a variety of gauges on the market.

Manual Flue Damper — The manual flue damper can be used in conjunction with the draft gauge to regulate draft conditions. It will also serve as a throttling valve should a chimney fire occur.

Fig. 2 Catalytic Stove Design



TEMPERATURE MONITORS

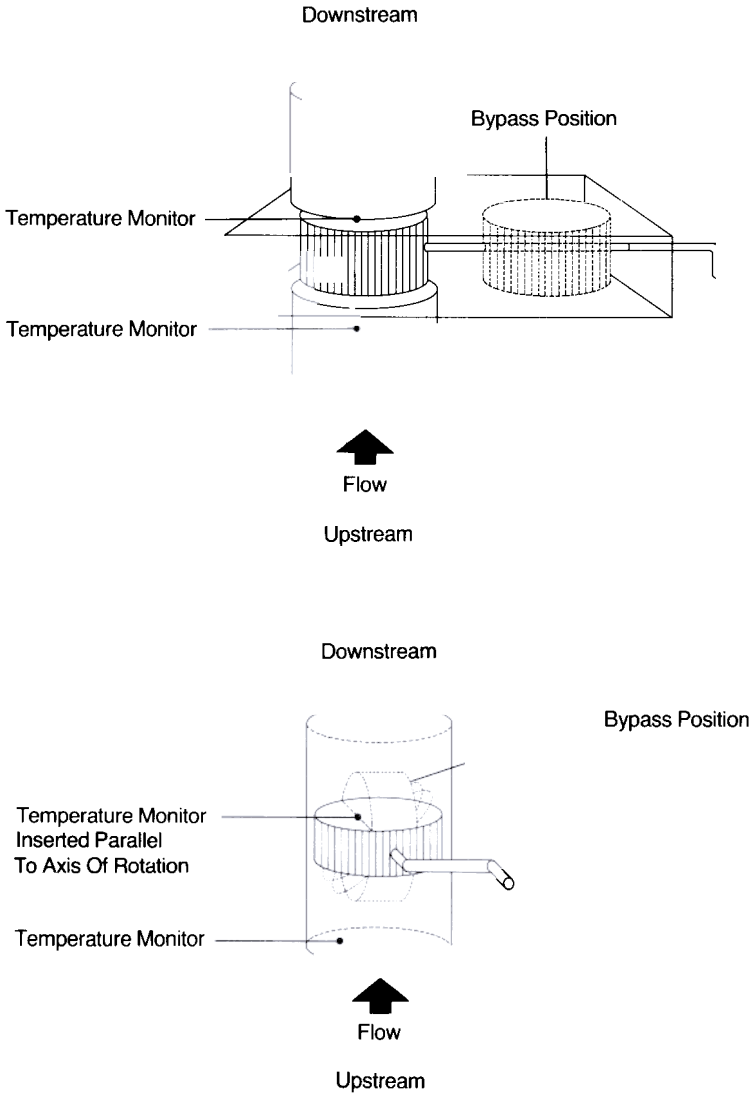
The most effective way of operating a catalytic appliance is by utilizing temperature monitors. Ideally, two sensing positions will give all the information needed to tell when to engage the combustor, how well the combustor is operating, when it's time to refuel and when the combustor is no longer operational. (See Figs. 2 and 3)

The upstream temperature gauge will monitor combustor inlet conditions. The second temperature gauge should contact the ceramic or be within 1/4 of an inch from the outlet face and will monitor the catalytic combustion process. (It may be impractical or impossible to mount a temperature sensor at this location in many stoves.)

If only one temperature sensor is used, it should be the one that contacts the ceramic or is located within 1/4'' of the combustor outlet face.

Thermocouples and thermometers of various designs are available for this purpose.

Fig. 3 Catalytic Retrofit Designs



V. POSSIBLE PROBLEMS

Problems encountered with the operation of catalytic-combustor equipped wood stoves are usually the same as those experienced in the operation of traditional wood stoves.

Süd-Chemie Prototech's experience has shown that adoption of good operating practices will eliminate most of these problems.

In addition, it should be noted that problems with catalytic combustors are rare — fewer than 1 percent of combustors are returned for any reason.

Nonetheless, manufacturers and retailers should make themselves aware of the nature, cause and solution to possible problems so as to serve their customers better.

Plugging — Plugging can occur if the combustor is positioned or operated improperly. It may occur when a combustor is located in an area where gas temperatures needed to keep the combustor active are not maintained, or the wrong materials are burned. Evidence of these types of plugging is a coating of black soot, creosote or fly ash on the combustor. Burning materials that produce large flakes or char, such as Christmas wrapping paper or cardboard, can plug enough cells to cause smoke spillage.

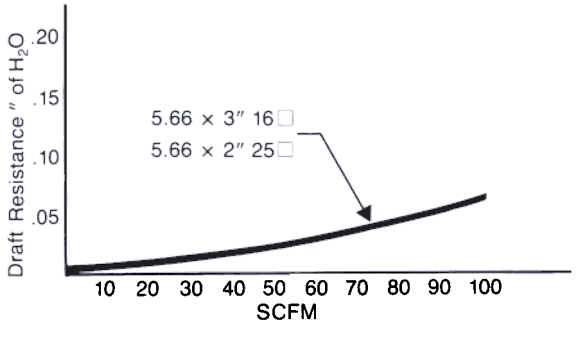
Extreme Temperatures — A combustor becomes extremely hot during operation. Temperatures above 1800° F. (1000° C.) will damage the combustor. Temperatures between 1400 and 1600° F. (760-870° C.) are common, but operating temperatures between 1200 and 1400° F. (650-760° C.) are recommended. Most of this heat is transmitted to surrounding stove parts via thermal radiation.

Flow Restrictions — Because the combustor is mounted in the gas flow stream, it does offer resistance to draft. This restriction or resistance presents two problems:

If the bypass is not open when the fuel-loading door is opened, smoke rollout will occur.

Chimneys that produce marginal draft may prevent operation of a combustor-equipped device. A chimney that provides, on average, .02" of water draft in low-fire operation would probably not operate with a catalytic-combustor appliance in the low-fire mode. In such a case, the combustor resistance would offset the remaining draft, resulting in a system that will not draft.

Fig. 4 Draft Resistance vs. Combustor Configuration



Creosote Build-up — Even though reduction of creosote is one of the primary advantages of a combustor-equipped device, some creosote-forming gases will escape unburned during normal operation. In the event the combustor ceases to function, creosote can be expected to accumulate. Consequently, flues and chimneys should be inspected regularly (every 2-3 months of operation) and any creosote build-up removed. Failure to do this could result in a chimney fire.

Chemical Deactivation — Deactivation can occur when the catalyst is attacked by materials such as compounds of sulphur, phosphorus, or lead and other heavy metals. Burning large quantities of trash, pressure-treated lumber or painted wood can deactivate the catalyst. The operator takes a chance when burning anything other than natural wood. The catalysts are durable and are not likely to be greatly affected by an occasional mistake, but burning large quantities of chemical-laden materials will appreciably shorten the life of the combustor. The catalyst can also be deactivated when it is coated with excessive creosote, carbon or fly ash. This build-up greatly reduces the amount of catalyst available to react with the smoke.

Flame Impingement — Leaving the combustor in the operating position during high-fire modes can result in flames directly contacting the combustor, (i.e., flame impingement). Over a long period of time this will result in cracks on the upstream face of the combustor causing facial crumbling. Most stoves are equipped with a flame guard to reduce this condition.

Excessive Handling — An older combustor, especially one that is uncanned, is susceptible to handling damage. Stress-relief cracks may develop in service but will not affect the performance of the combustor if it is not moved or handled. Handling a unit with these cracks, however, could result in it breaking apart. Excessive handling could also potentially remove some of the catalyst coating. Devices which move the combustor as part of the bypass must be handled with care.

Condensation in Chimney — The burning that takes place in a combustor converts harmful hydrocarbons and carbon monoxide to heat, carbon dioxide and water. The additional water produced by this complete burning can lead to associated problems in the chimney.

Backpuffing — A hot combustor (above 1400° F.) can sometimes act like a glow plug (spontaneous combustion ignitor). Usually the wood gas-to-air mixture is either too lean or too rich to form a highly flammable mixture. There are times when this mixture is just right within the firebox during the normal burning process. If the combustor is running at or above the ignition temperature of the mixture, spontaneous combustion will result, causing the stove to vent puffs of smoke.

Non-uniform Flow — Non-uniform flow causes the combustor to heat and cool unevenly and is a result of stove design and fuel-loading configuration. This occurs when the flow pattern of the stove is concentrated on one side of the combustor. This condition causes thermal stress within the ceramic, resulting in cracking.

VI. TROUBLESHOOTING

Operation of any wood stove can create problems. While the use of a catalytic-combustor equipped stove will substantially lessen some of these problems — such as creosote formation — other traditional wood-stove problems may remain.

These problems are invariably related to such conditions as draft, aging or failure of stove components, flue installation, wood supply, and others.

The following guidelines apply to operation of all wood stoves, with problems related to catalytic stoves addressed where appropriate.

STOVE - OR RETROFIT-RELATED PROBLEMS

PROBLEM	POSSIBLE CAUSE	SOLUTION
1. SLUGGISH STOVE PERFORMANCE	1. Obstruction in chimney	1. Check for and remove obstruction
	2. Manual damper in chimney is closed	2. Open manual damper
	3. Closing bypass or exhaust damper too soon	3. Follow manufacturer's instructions for proper firing procedures
	4. Wet or unseasoned wood being burned	4. Burn dry, seasoned wood
	5. Too much wood added to too few coals	5. Add small amounts of wood to small coal beds. Once a good bed of coals has been established more wood can be added
	6. Dislodged stove parts	6. Check all movable stove parts. Replace if necessary
	7. Poor chimney draft	7. See section in "Chimney-Related Problems", Pgs. 12-13
	8. Combustor is plugged	8. See section in "Combustor-Related Problems", Pgs. 14-17
2. DROP IN OVERALL EFFICIENCY	1. Cold, windy weather	Weather stripping, calking, insulation, storm windows
	2. Burning wet, pithy, or spongy wood	2. Burn quality wood available in your area
	3. Combustor not in operating mode	3. Close bypass or engage combustor when temperatures are high enough and stabilized
	4. Combustor has fallen out of holder or can	4. Replace combustor
	5. Combustor not functioning	5. See "Combustor-Related Problems", Pgs. 14-17
3. HIGH FUEL CONSUMPTION	. Inexperience in catalytic operation	1. Operate stove with desired heat output in mind. Do not be overly concerned with maintaining light-off temperatures

PROBLEM	POSSIBLE CAUSE	SOLUTION
3. Continued	2. Improper regulation of draft or inlet air	2a. After light-off, close draft in chimney as much as possible. (less than .06 inches of water)
		2b. Install barometric damper—set to .06 inches of water
		2c. Close inlet air control as much as possible
		2d. In non-airtight stoves, fiberglass gasketing can be installed around vents and windows
	3. Burning wet, unseasoned wood or pithy, spongy wood	3. Burn seasoned wood that is dry and of good quality
	4. Cold, windy weather	4. Weather stripping, calking, insulation, storm windows
	5. Smoke bypassing combustor	5. Replace warped stove parts
	6. Bypass stuck open	6. If warped or broken, replace
	7. Combustor not engaged	7. Put combustor in operating position in retrofit or close bypass in stove
	8. Combustor not functioning	8. See "Combustor-Related Problems", Pgs. 14-17
4. BACKPUFFING	1. Gusts of wind	1. Install chimney cap
	2. Hot combustor. (Above 1400° F)	2. Avoid burning soft, pitchy woods, or large amounts of small-diameter wood
	3. Opening doors in a tightly constructed house	3. Slowly open and close outside doors
5. SMOKE ROLLOUT WHEN STOVE DOOR IS OPENED	1. Bypass is closed, or combustor is in operating position	Open bypass. In retrofit, place combustor in bypass position before opening stove door
	2. Manual flue damper is closed	2. Open damper before opening stove door
	3. Wind gusts blowing down chimney	3. Install wind-resistant chimney cap
	4. Smoke flap stuck in "up" position	4. Free smoke flap so it swings down If warped or broken, replace

PROBLEM	POSSIBLE CAUSE	SOLUTION
5. Continued	5. Position of an internal retrofit	5a. Only install an internal retrofit in a stove for which it is designed
		5b. Install a smoke flap
	6. Opening stove door too fast	6a. Wait a few seconds after opening bypass before opening stove door to give smoke a chance to exit stove
		6b. In stoves with the bypass interlocked to the door, open door 1/2 inch, then slowly open all the way
6. OUTLET TEMPERATURE LOWER THAN INLET TEMPERATURE	1. Bypass is open	Once light-off temperatures have been reached and unit is stabilized, close bypass
	2. Light-off not obtained	2. Follow manufacturer's operating instructions
	3. Fuel charge is spent	3. Refuel as necessary for combustor operation. Temperature monitors help in determining when refueling is necessary
	4. Gases bypassing combustor	4. Check parts, particularly bypass. Replace if warped
	5. Combustor coated with fly ash or soot	5. See section on "Combustor-Related Problems-Catalyst Masking", Pg. 14
	6. Combustor has fallen out of can or holder	6. Replace combustor
	7. Combustor not functioning	7. See section on "Combustor-Related Problems", Pgs. 14-17
7. GLOWING STOVE PARTS	Running stove too hot	1 Follow manufacturer's operating instructions
	2. High draft	2. Reduce draft once operating temperatures are reached
	3. Combustor too close to thin-walled parts	3a. Avoid elbows directly after the combustor
		3b. If elbows must be placed directly after the combustor, use ones construced of stainless steel or heavy-gauge steel
	4. Combustor is glowing-Normal during first 1/3 of burn cycle	4. Be familiar with the appearance of the combustor under normal operating conditions

PROBLEM	POSSIBLE CAUSE	SOLUTION
7. Continued	5. Chimney fire. Flue parts glowing beyond combustor	5. Close inlet air and outlet dampers completely. If this doesn't help, vacate home and call fire depart-- ment
8. COMBUSTOR NEVER GLOWS (See note on pg. 4, "Achieving Catalytic Light-Off"	1. Bypass is open or combustor is in bypass position	Close bypass or place combustor in operating position
	2. Unlit combustor	2. Follow manufacturer's operating in- structions
	3. Retrofit added to non-airtight stove	3a. Only add retrofit to an airtight stove
		3b. Fiberglass gasketing can be placed around windows and vents to help stop leakage
	4. Stove dampered down too much	4 Ensure that proper air mixture and draft are available for wood pyrolysis to continue. Follow manufacturer's instructions
	5. Combustor has fallen out of can or holder	5. Replace combustor
	6. Combustor not functioning	6. See section on "Combustor- Related Problems", Pgs. 14-17
9. CREOSOTE RUNNING FROM DRAFT INLET OPENINGS	1. Burning wet, pitchy woods	Burn dry, seasoned wood
	2. Burning too much wood in one load	2. Burn reasonably sized loads so the combustor has a chance to burn the wood gases that are produced
	3. Cool stove walls	3a. If stove is designed for it, a layer of insulating firebrick can be added
		3b. Keep a good bed of coals in the stove

CHIMNEY-RELATED PROBLEMS

PROBLEM	POSSIBLE CAUSE	SOLUTION
1. CREOSOTE ACCUMULATION	1. Leaking bypass baffle plate	1a. Replace any damaged parts
		1b. Some leaks can be filled with fiberglass gasketing material
	2. Types and amounts of wood burned	2a. Try not to burn pitchy woods
		2b. Don't overstuff the firebox
		2c. Burn pieces of wood with an approximate diameter of 6 inches or larger
	3. Poorly insulated chimney	3a. Replace single-walled metal chimneys with double-walled insulated chimney sections. (Meet local codes)
		3b. Install a chimney liner in a masonry chimney. (Meet local codes)
		3c. In new installations, utilize an interior chimney rather than an exterior one
		3d. Install a barometric damper and set to .06"
	4. Combustor not functioning	4. See section on "Combustor-Related Problems", Pgs. 14-17
2. TAR AND LIQUID CREOSOTE LEAKING FROM METAL FLUE JOINTS	1. No chimney cap on chimney	1 Install chimney cap
	2. Metal flue assembled improperly	2. Top flue sections should be inserted into lower flue sections
	3. Normal increase in moisture due to higher efficiency of catalytic burning. (Condenses on cool chimney walls)	3a. Replace single-walled chimneys with double-walled insulated sections (Meet local codes)
		3b. Install chimney liner in masonry chimney. (Meet local codes)
		3c. In new installations, try to utilize an interior chimney rather than an exterior one
		3d. Install a barometric damper and set to .06"

PROBLEM	POSSIBLE CAUSE	SOLUTION
3. HEAVY CONCENTRATION OF SMOKE LEAVING CHIMNEY	1. Water vapor. (On cold, still days water vapor may be mistaken for smoke. The difference is that water vapor appears white and will tend to rise vertically and dissipate rapidly while smoke is usually dark or bluish brown and will drift down and settle in low areas near the ground before slowly dissipating)	1 Water vapor is normal and should be of little concern
	2. Wet, pitchy woods being burned	2. Burn dry, seasoned wood
	3. Combustor not functioning	3. See section on "Combustor-Related Problems" Pgs. 14-17
	4. Bypass warped or in open position	4a. Replace warped bypass
		4b. Close bypass
4. RUSTED OR CORRODED FLUE PARTS	1. Added moisture from efficient burning.	Replace wornout parts with corrosion-resistant parts or materials
	2. Overheated flue parts due to a chimney fire.	2a. Same as #1 above
		2b. Have chimney inspected every 2-3 months of operation for creosote buildup
	3. Age. Failure due to normal use	3. Replace worn-out parts with corrosion-resistant replacements
5. ODOR - BOTH INSIDE AND OUTSIDE THE HOME	1. Bypass is open	Close bypass
	2. Smoke is leaking around combustor	2. Check for warped or damaged parts. Replace if necessary
	3. Backpuffs due to wind or hot combustor.	3. See "Stove-or Retrofit-Related Problems-Backpuffing" Pg. 9
	4. Combustor not functioning	4. See "Combustor-Related Problems" Pgs. 14-17
6. POOR-DRAFTING CHIMNEY.	Improper chimney height	1 Extend height of chimney (Meet codes)
	2. Wrong flue size being used. (Ex.- using a 6" flue on an 8" flue collar	2. Use properly sized flue
	3. Cooler temperatures caused by external chimney	3. Insulate chimney or build chimney taller. In new installations, try to utilize internal chimney
	4. Massive stone or masonry chimney	4a. Install chimney liner (Meet codes)
		4b. Extend height

COMBUSTOR-RELATED PROBLEMS

[Photo 1 shows a healthy combustor]

PROBLEM	POSSIBLE CAUSE	SOLUTION
1. PLUGGING *[Photos 2 & 3]*	Burning materials that produce a lot of char and fly ash ***[Photo 2]***	1 Do not burn materials such as garbage, gift wrap or cardboard
	2. Burning wet, pitchy woods or burning large loads of small-diameter wood with the combustor in the operating position without light-off taking place. ***[Photo 3]***	2a. Burn dry, seasoned wood 2b. Don't place the combustor in the operating position until temperatures are high enough to initiate light-off 2c. It may be possible to burn the accumulated soot or creosote off by putting the combustor in a partially open-partially closed position after a "hot" fire has been started
	3. Combustor not functioning. If proper burning procedures have been followed to no avail, the combustor is not functioning	3. Replace combustor
2. CATALYST PEELING	1. Extreme temperatures (above 1800° F. or 1000° C.) at combustor surface can cause the catalyst to peel. Overfiring and flame impingement are primary causes. [***Photo 4*** shows minor peeling that is normal and does not affect function.] [***Photo 5*** shows severe peeling that would close cell openings and cause a plugging problem]	1a. If peeling is severe, remove and replace combustor 1b. Avoid extreme temperatures and flame impingement
3. CATALYST DEACTIVATION	1. Burning large quantities of trash, pressure-treated lumber or painted woods	1a. Burn quality woods available in your area 1b. If you decide the catalyst has been deactivated, replace combustor
4. CATALYST MASKING *[Photos 6, 7 & 8]* The catalyst is coated with a layer of fly ash or soot which prevents catalytic activity	1. Location of combustor. This is especially true in retrofits where the combustor is located too far from the firebox to maintain light-off temperatures. ***[Photo 6]***	Place combustor in a partially open-partially closed position after a "hot" fire has been started to burn soot off
	2. Burning coal causes a sulfur-based compound to coat the catalyst	2. Revert to burning wood and fire the combustor at elevated temperatures for a period of 1 hour. (Five-20 minute high-fire start-ups would do it)

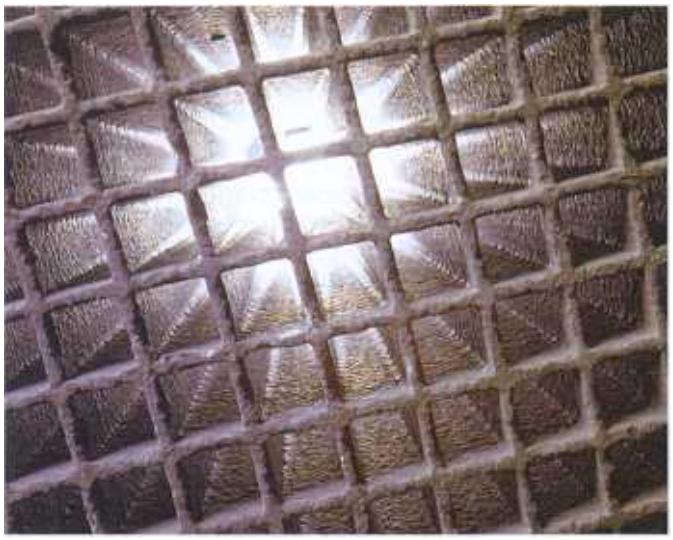


Photo #1 Healthy Combustor

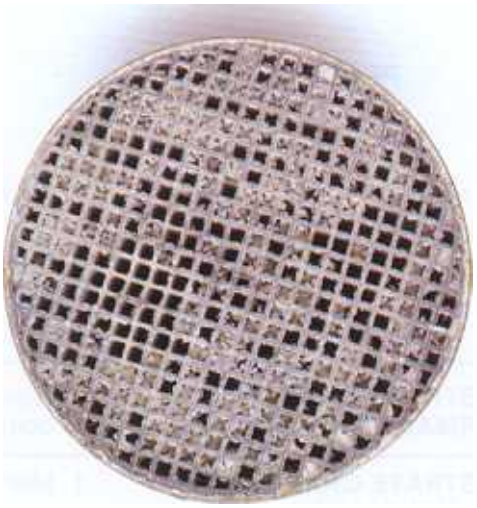


Photo #2 Fly-Ash Plugging

Photo #3 Creosote Plugging

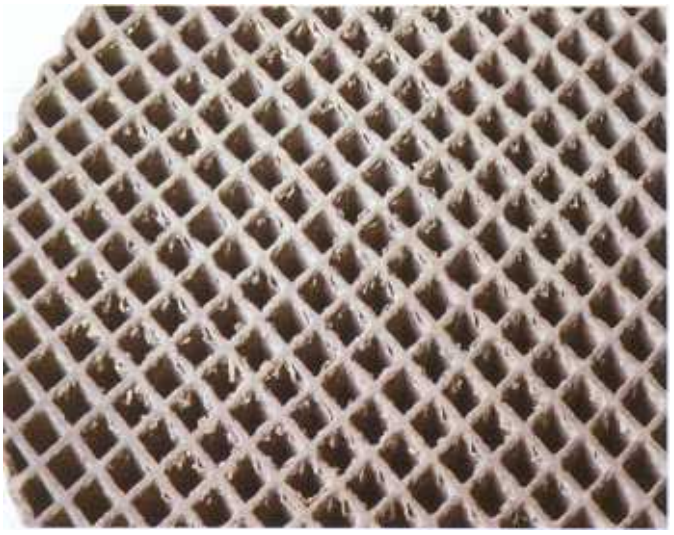


Photo #4 Minor Peeling

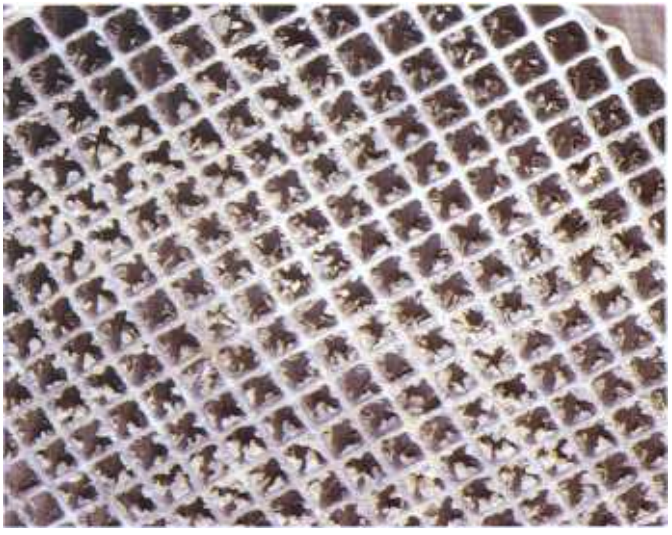


Photo #5 Severe Peeling

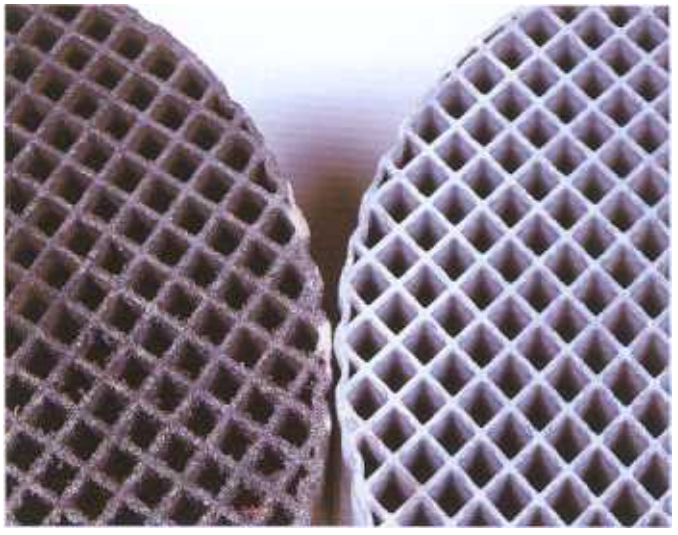


Photo #6 Masking with soot (on left)

PROBLEM	POSSIBLE CAUSE	SOLUTION
4. Continued	3. Accumulation of fly ash. ***[Photos 7 & 8]*** Photo 8 shows combustor with fly-ash buildup on the left half and the results of brushing with a soft bristled brush on the right half	3. Brush cooled combustor with a soft-bristled brush or vacuum lightly At least once per burning season, carefully remove combustor and brush off trailing or downstream face, also
5. SUBSTRATE CRACKING-THERMAL *[Photo 9]*	Normal operation, as long as combustor remains intact	1 If cracking causes large pieces to fall out, replace combustor
6. SUBSTRATE CRACKING-MECHANICAL *[Photo 10]*	1. Mishandling or abuse	1 Handle with care
	2. Distortion of holding collar	2. Combustor should be held firmly in its can. It should slide easily into and out of the holding collar of the stove. If severe cracking has resulted in loss of large chunks of combustor, replace combustor. Also replace any warped stove parts
7. SUBSTRATE CRUMBLING *[Photo 11]*	1. Extreme thermal shock. (Combustor being worked too hard)	Bypass combustor when stove is run in high-fire mode
SEE NOTE BELOW	2. High draft	2 Do not exceed .06" of water draft Install a manual damper and draft gauge, or a barometric damper
8. COLOR VARIATIONS *[Photo 12]*	1. Variation in color from combustor to combustor or within a combustor can occur. (New combustors)	1 These color variations are normal and do not affect combustor performance
9. CATALYST ABRASION	1. High draft can cause fly ash to grit-blast the surface of the combustor. This is especially true in internal retrofits or stove designs that place the combustor in close proximity to the ash bed	1a. If more than 1/2" of catalyst (as measured along length of cell) is abraded, replace combustor 1b. Measure chimney draft and control to .06" of water or less

NOTE Substrate crumbling in Model 6000 combustors is accelerated by overfiring, particularly if direct flame impingement occurs, or if underfire air* is present during high burn conditions either by stove design or by opening of ash pan to increase firing rate.

Model 12000 or Model LONG-LIFE® combustors (produced in 1985 and later) are not likely to show this condition.

* Underfire air is air entering the firebox through the ash bed, either by a low position of the primary air inlet or by air entering around poorly sealed ash pan or through an open ash pan.

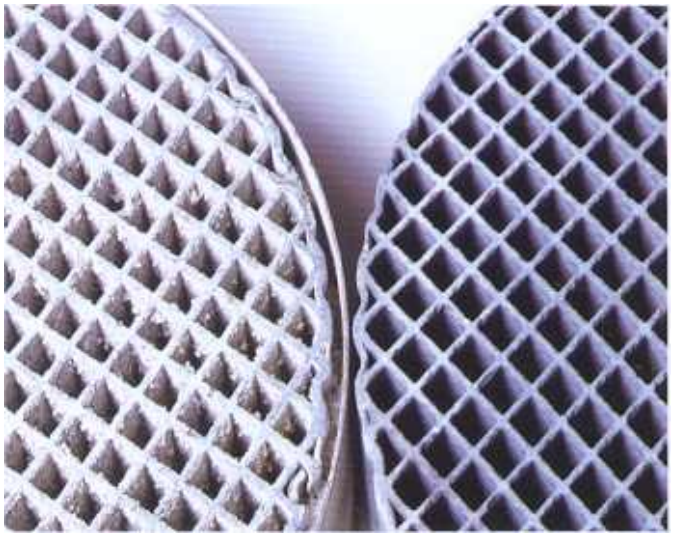


Photo #7 Masking with Fly-Ash (on left)

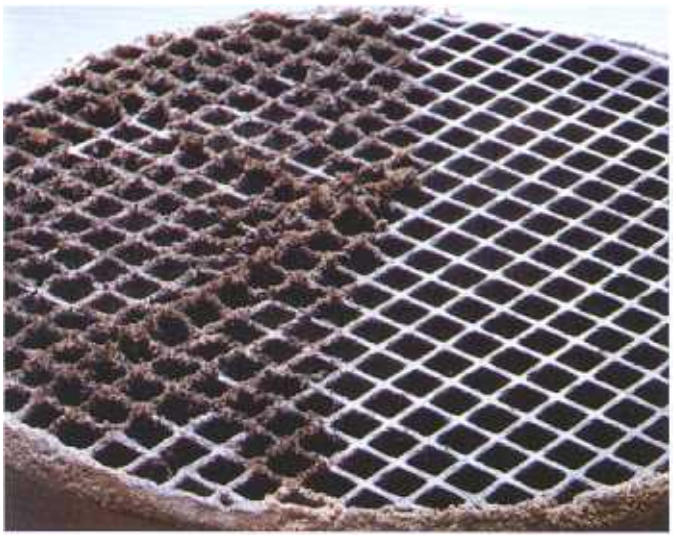


Photo #8 Fly-Ash Buildup (left) - Brushed off (right)

Photo #9 Thermal Cracking

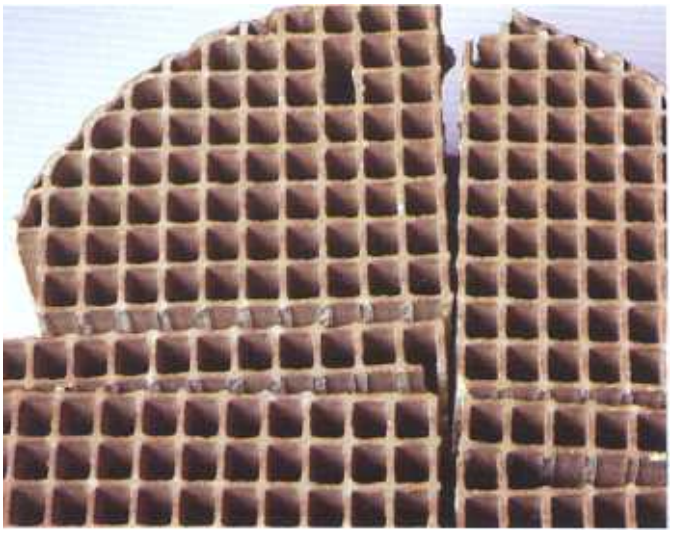


Photo #10 Mechanical Cracking

Photo #11 Substrate Crumbling (Model 6000)

Photo #12 Color Variations (New Combustors)

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