How do I maintain the combustor's operating condition?

During the start-up of a cold stove, a medium to high firing rate must be maintained for 20 to 30 minutes to insure that the stove, combustor 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 burning 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), it is our recommendation 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 the catalyst operation. When refueling a hot stove that has an internal firebox temperature above 500°F (260°C), no re-firing step is necessary. Just open the bypass damper and load your fuel. The bypass damper can be closed immediately, as long as the fuel is free from any form of moisture.

Combustor temperatures can become extremely hot during operation. Temperatures above 1600°F will damage the catalyst. Temperatures between 1400°F — 1600°F are normal, but temperatures 1200°F — 1400°F are recommended.

How and where should I monitor the combustor's temperature?

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. The upstream temperature gauge will monitor combustor inlet conditions. The second temperature gauge should be mounted on the combustor's exhaust side, about a 1/4" off the surface and centered on the unit. This will monitor the catalytic combustion process. If only one temperature sensor is used, it should be the one that reads the exhaust temperature of the catalytic combustor. Thermocouplings and thermometers of various designs are available for this purpose.

How will I know the combustor is working?

The best way is to have temperature monitors or thermo couplings to monitor the exhaust temperatures of the combustor. When monitors are installed properly and the combustor has had ample time to reach light-off, the exhaust temperatures will rise immediately when the bypass damper is closed. This will indicate the catalyst is operating. Exhaust temperatures are important to monitor. Temperatures above 1800°F (1000°C) will damage the combustor. Temperatures between 1400° and 1600°F (650-760°C) are common, but operating temperatures between 1000° and 1300°F (537-704°C) are recommended. Most of this heat is transmitted to surrounding stove parts via thermal radiation.

Some stoves are equipped with a combustor view port. It should be noted that the combustor glows during the first 20 — 30% of the burn cycle, when the catalyst is receiving the most smoke and burning at a high temperature. The combustor can reach 1000°F and produce a glow. The combustor does not have to glow to be working. As less smoke is present to burn, the combustor temperature drops and the glow will cease. It is suggested that visual checking NOT be a method of determining combustor functionality.

Another method is to visually observe the exhaust coming from the chimney. When the bypass is in the closed position, and the catalytic combustor is in good operating condition, there should be no dark smoke coming from the chimney.

If the catalytic combustor is not working properly, the stove's operator will notice an increase in fuel usage and a build-up of creosote in the system.

Is it all right to 'hot fire' my catalytic stove?

Do not "hot fire" your stove. For many years retailers and installers have advised customers to build an extra hot fire to burn the creosote deposits in the flue system. This advice is harmful to a catalytic stove. Why? Because the catalyst is reducing the particulate, or creosote buildup, therefore the need to hot fire is eliminated.

Does the combustor have to 'glow' before it is working?

This is a misconception. A catalyst can glow during certain stages of combustion. The determination that a catalyst is not working simply because it doesn't glow is inaccurate. During the low burn cycle, when the catalyst is doing the bulk of its work, it usually does not glow. Also, extremely dry wood (oak, ash, etc...) can burn clean enough not to produce a glow in the converter.

Operating a catalytic woodstove

- **DO** burn only dry, well-seasoned wood, not wet or fresh cut wood. Season wood at least twelve months; store outdoors, loosely covered, to allow air to circulate freely through the pile. Wood with snow or rain on it should not be used when refueling. **Why?** Because "green" or wet wood releases less heat because energy from the fire must evaporate the moisture before producing useful heat. **Why?** Because refueling with wet wood will cause moist smoke and cause the combustor to receive a thermal shock which can crack the unit.

- **DO** operate your stove in the bypass mode initially as stated above. Wait until stove temperature is hot enough before engaging the catalyst. **Why?** Because to some extent, the catalyst may reduce the draft. With poor draft, the fire will take longer to develop and the catalyst will take longer to light-off. **Why?** Because by closing the bypass too soon, the catalyst may not have reached it's light-off point and a masking of fly-ash and creosote could blanket the unit or clog the cells. Light off could be sluggish and draft could be restricted.

- **DO** build and maintain hot fires quickly after initial wood loading. **Why?** Because a hot fire will help your catalyst light off faster. However, once lit, the catalyst will stay lit even if the fire burns lower. Catalyst temperatures of 1000°F or more are typical in normal operation. Once the catalyst lights-off, it will stay lit at inlet temperatures around 500°F.

- **DO** operate the stove's internal fans/blowers (if your stove has them) in accordance with the operating instructions. Some manufacturers recommend leaving the fans turned off for 30 minutes after start up and refueling, and setting them on low for small fires. **Why?** Because when the catalyst lights-off, you'll notice a sudden increase in the temperature as the catalyst temperature climes to above 1000°F. Also, the catalyst may glow (though not always) and there will be a sudden decrease in visible pollution from the chimney.

- **DO** burn moderately sized loads of wood that will provide several hours of uninterrupted burning and minimize door openings. **Why?** Because minimizing door openings keeps the temperature high, which reduces pollution. Frequent door openings increases pollution.

- **DO NOT** burn trash, treated wood, particle board, plywood, plastic, petroleum products or any other foreign matter. Seasoned dried wood only. **Why?** Trash produces fly-ash. Treated wood, particle board, and plywood contain chemicals that, when burned and inhaled, are hazardous. Other fuels may overheat and damage your stove. Cardboard, foil and plastic may block exhaust flow through the catalyst, causing smoke to spill into your room. Burning foreign matter can also poison the catalyst and cut back on it's efficiency.

- **DO NOT** operate your stove in the catalyst bypass mode after the catalyst has reached the recommended temperature (500°F focused on the combustor for 20-30 minutes). **Why?** Because at this point, your catalyst should be working for you (to produce more heat using less firewood) and for the environment (destroying smoke and the cancer-causing pollution in the smoke).

- **DO NOT** over fire your stove, especially when the catalyst is in place. Avoid catalyst temperatures near or above 1800°F. This is another reason to use a catalytic temperature monitor. **Why?** Because catalytic combustors can be damaged or destroyed by prolonged high heat. If temperatures are above 1800°F, switch to the bypass mode and allow the catalyst to cool down to about 1000°F before resuming normal catalytic operation.

Why Combustors Need To Be Replaced

- **Thermal Shock**
    - Occurs when refueling with wood containing moisture. Moist smoke is sent to the combustor when the by-pass is closed and the results are thermal shock and cracking of the substrate. Continual practice of this will cause the combustor to deteriorate.
- **Fatigue**
    - The catalytic combustor has a six year life expectancy when used according to recommend manufacturer's guidelines. Although some combustors have operated with efficiency for as long as ten years, the combustor's life is based on the stove operator, maintenance, fuels used, and the stove manufacturer's design.
- **Mishandling**
    - Dropping the combustor.
    - Using abrasive tools while cleaning it.
    - Using high pressure air to blow the cell free of debris.
    - Using cleaning solvents to clean the combustor.
    - Beating the combustor to remove it from its holding device.
- **Direct Flame Impingement**
    - Flames burning for long periods of time directly into the combustor with the by-pass, or damper, closed will damage the combustor. Allowing this to happen will change the makeup of the catalyst and reduce efficiency. Flame impingement will cause the substrate to break down.
- **Poisoning**
    - This happens by burning materials other than seasoned, dried wood. Foreign matter such as garbage, painted wood, large amounts of colored paper, cardboard, rubber, plastic, paneling, oily products and so on, will eventually reduce the efficiency of the catalyst.

Why is 'flame impingement' bad for the catalyst?

Direct flame contact is death to the catalyst. A catalyst burns the byproducts in the smoke. The gases such as CO, HC, and O2 ignite with each other in a chemical reaction in the presence of the catalyst (while passing through the honeycomb configuration). Direct flame inhibits this reaction by changing the chemical make-up of the catalyst breaking down the substrate or ceramic. Today's modern wood burning stoves are designed so that flame impingement is unlikely. However, it is not impossible. A strong fast draft can pull the flames into the catalyst. A hot fire with all the primary air controls wide open or perhaps the firebox door or ash pan door ajar are other ways the catalyst might receive flame impingement. Stacking too many logs in the firebox can elevate flames too close to the combustor.

What causes thermal shock to the combustor?

A sudden temperature change or uneven temperatures to the combustor's substrate can cause cracking. In other words, two different substances are passing through the combustor at the same time. One of the main reasons for this happening is refueling with wood containing some form of moisture. This can be wood that has been exposed to snow or rain, or perhaps green wood that

has not been stacked and seasoned for at least one year. The thermal shock comes when the moist smoke comes in contact with the combustor running at temperatures in excess of 1000°F (540 C). The cell walls will develop hairline cracks and eventually pieces will start to fall off the combustor. This loss of surface area means there will be less catalytic surface space and less efficiency of the combustor.

What causes my stove to back puff?

When the combustor has an exhaust temperature over 1400° F. (760° C.) it can act like a glow plug (spontaneous combustion ignitor). Usually the wood gas-to air mixture is either too lean or 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.

What causes the combustor to become plugged?

Plugging can occur if the stove is operated improperly. Not allowing the combustor to achieve light-off (closing the bypass to soon). Burning materials that produce large flakes or char, such as wrapping paper or cardboard, can plug enough cells to cause smoke spillage. Burning wet wood can also cause plugging.

What are other reasons the catalyst might lose efficiency over a period of time?

The catalyst was designed to burn seasoned dried wood only. Burning garbage, painted wood, product with glue, plastic, rubber, large amounts of colored paper, petroleum products and other foreign materials will poison your unit if done on a regular basis. Eliminate all doubt on this subject, **BY BURNING ONLY SEASONED DRIED WOOD.**