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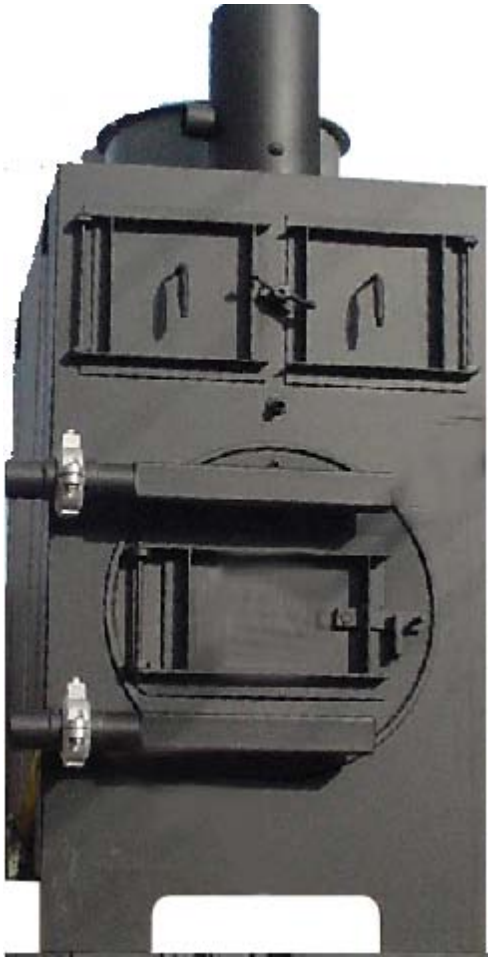
B.C.S. Shop Heaters



OPERATION & MAINTENANCE MANUAL
HAND FIRED SYSTEMS

8-09

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This publication is intended for use by trained personnel to operate and maintain BCS Shopheating Furnaces. Read this manual carefully before beginning.

Installation is to be performed only by a qualified installer.

Save These Instructions.

Refer to markings on shop heater for additional information.

SECTIONS MARKED BY THIS SYMBOL CONTAIN IMPORTANT SAFETY INFORMATION. READ AND FOLLOW COMPLETELY.

WARNING! RISK OF FIRE OR EXPLOSION! DO NOT BURN GARBAGE, GASOLINE, DRAIN OIL OR ANY OTHER FLAMABLE LIQUID.

CAUTION – HOT SURFACES
KEEP CHILDREN AWAY
DO NOT TOUCH DURING OPERATION

DOOR SHOULD ONLY BE OPENED FOR FUEL LOADING AND CLEANING. DOORS SHOULD REMAIN CLOSED AT ANY OTHER TIME.

INSPECT AND CLEAN FLUES AND CHIMNEY REGULARLY

OPERATION

1.1 INTRODUCTION

THIS STOVE WAS DESIGNED TO BURN WOOD ONLY. IT IS NOT DESIGNED TO BURN PAPER, PLASTICS OR WASTE MATERIALS.

Shop Heater furnaces are designed to need minimum attention and maintenance while providing a reliable, efficient source of heat and means of waste wood elimination. These instructions will give you an understanding of the operating principles involved, thus making it easier to adjust the burner to meet your specific needs.

1.2 INITIAL START UP - COLD BURNER

DO NOT USE CHEMICALS OR FLUIDS TO START THE FIRE
DO NOT BURN GARBAGE, GASOLINE, NAPHTHA, ENGINE OIL OR OTHER INAPPROPRIATE MATERIALS

It is necessary to use newspaper and kindling when firing up a cold burner, similar to the way a campfire is started. In normal continuous operation this will not be necessary, as a sufficient bed of coals will remain for 12-18 hours

1. Setting up air valves. The following valve settings are a good starting point but may not be optimum for your situation. Check for negative pressure by turning on the induction fan and placing a piece of paper over the fully open inlets of the intake manifolds. Pressure should be enough to hold the paper to the inlet without sucking it in. After determining that negative pressure exists, remove paper and turn off fan. Turn the over fire (upper) air valve to the full open position, and open the under fire (lower) air valve to the middle position. Further adjustments will depend on the emission and heat output from your burner.

2. Load the firebox. Begin by loading crumpled newspaper into the front of the firebox. Place a layer of kindling on top of the newspaper 4-6 inches deep, not too tightly packed so as to allow adequate air infiltration. Any small, preferably dry pieces of wood will do. Place progressively larger pieces on top of the pile ending with full size pieces of fuel. Do not fill the firebox more than one third full and never block the under fire air nozzles when loading the burner.

3. Ignite the pile of kindling by lighting the newspaper. Allow it to burn for a minute, making sure that the fire catches, before closing the burner door.

4. Turn on the induced draft fan switch.

NOTE: THE INDUCED FAN ALWAYS REMAINS RUNNING WHENEVER THE BURNER IS IN OPERATION. THE ONLY EXCEPTION TO THIS IS IF THE BURNER OVERHEATS; THE INDUCED DRAFT FAN WILL AUTOMATICALLY TURN OFF TO PREVENT OVERHEATING.

Due to the mass of metal in these systems, it will take from 10 to 30 minutes for the burner to become hot enough to turn on the thermostatically controlled hot air/cooling fan. The very first time the burner is fired there will be a small amount of smoke from the paint. You may also hear an occasional crack because the burner has tack welds in certain areas to aid in fabrication that are designed to break as the burner first heats up.

1.3 REGULAR OPERATON

INSPECT FLUE PIPES, JOINTS AND SEALS REGULARLY TO ENSURE THAT SMOKE AND FLUE GASES ARE NOT DRAWING INTO, AND CIRCULATED BY THE AIR CIRCULATION SYSTEM

DANGER – RISK OF FIRE OR EXPLOSION – BURN WOOD ONLY DO NOT BURN GARBAGE, GASOLINE, DRAIN OIL OR OTHER FLAMMABLE LIQUIDS

The key to clean and efficient burning is multistage combustion. The first stage of combustion, the primary stage, burns the fuel with oxygen from the under fire air supply. This results in heat and smoke, which is unburned gases and particulate. In the secondary stage of combustion, BCS furnaces burn the smoke and much of the particulate with over fire air to make the final exhaust cleaner and to obtain more heat and energy.

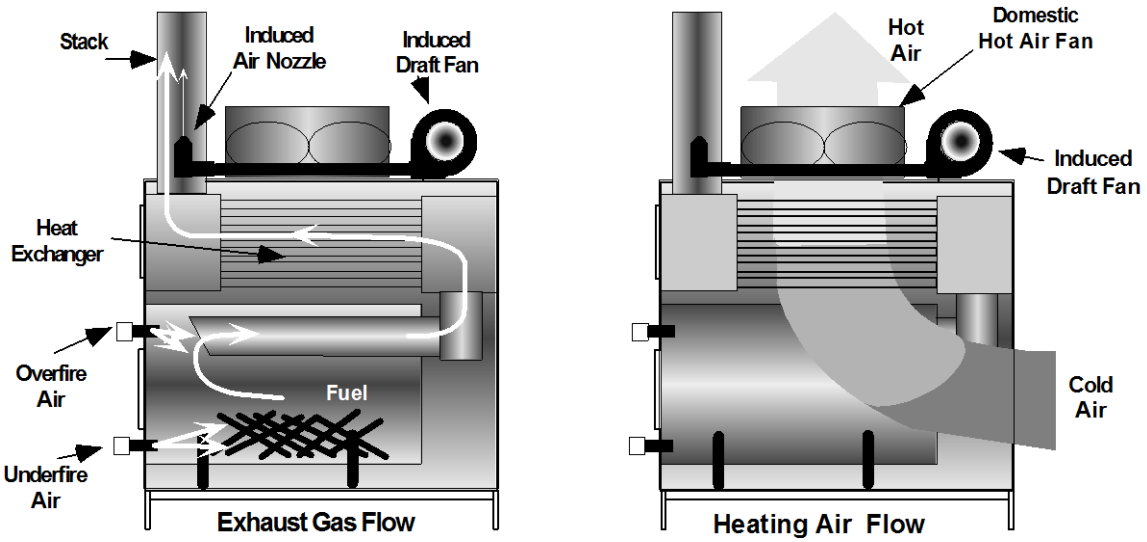
As the operator there are three aspects of the combustion process that you control:

1. The amount of under fire air going into the burner. This is controlled by the lower of the two hand valves at the front of the burner.
2. The amount of over fire air going into the burner. This is controlled by the top hand valve at the front of the burner.
3. The amount of fuel fed to the burner.

1.4 UNDER FIRE AIR FLOW DETERMINES FUEL CONSUMPTION

The under fire air is the throttle on the burner. The more under fire air coming in the faster the fuel will burn. Wood is both a solid and gaseous fuel. The under fire air consumes the solids and liberates the gases in the fuel during the combustion phase.

Too much under fire air may cause a dark smoke emission that indicates too much gasification producing a fuel rich smoke mixture. Too little under fire air will cause a white smoke that indicates a cold fire - the smoke is not burning. A vigorous fire is necessary for gaseous ignition, and it is vital from an emissions standpoint that the firebox temperatures rise rapidly above 500°F.



1.5 OVER FIRE AIR AFFECTS THE QUALITY OF EMISSIONS

The over fire air controls the emissions and, therefore, the combustion efficiency of the burner. It is this gaseous combustion efficiency that is the most important determinant of high total efficiency and low emission rates. Since more than half of wood's fuel value comes from its gaseous combustion, proper control of this secondary combustion is very important.

Enough over fire air must be provided to allow clean burning, but excessive over fire air will cool the firebox and decrease efficiency.

To optimize:

1. Slowly turn down the over fire air allowing time after each adjustment for the fire to adapt to the new conditions. Continue until the unit starts to emit black smoke.

2. Slowly open the over fire air valve until the smoke disappears. This would be the optimum setting for the current conditions - fuel type, moisture content and size.

See 1.9 TROUBLESHOOTING for more information regarding eliminating smoke.

1.6 STORING WOOD

Wood should be stored out of the weather whenever possible so rain and snow do not reduce the productive BTU content of the fuel. Do not store fuel within the listed "safe clearances" or within the space required for refueling, ash removal or other routine maintenance operations

1.7 LOADING THE FIREBOX

When the burner needs to be loaded, the thermostatically controlled hot air/cooling fan will start to cycle on and off every few minutes and the firebox temperature will have dropped significantly. Leave the induced draft fan on during loading to maintain the draft.

It is recommended that seasoned or dry wood be burned to minimize creosote buildup and maintenance requirements. Greener wood will reduce the output of the furnace.

CAUTION: ALWAYS STAND TO THE SIDE OF, OR BEHIND THE LOADING DOOR WHEN OPENING, AND ALWAYS OPEN SLOWLY. OPENING THE DOOR TOO QUICKLY CAN CAUSE FLAME AND SMOKE TO BE PULLED OUT THE FRONT OF THE BURNER WHICH CAN CAUSE INJURY TO THE OPERATOR.

1. Open loading door. (Close valve first if system is force drafted)

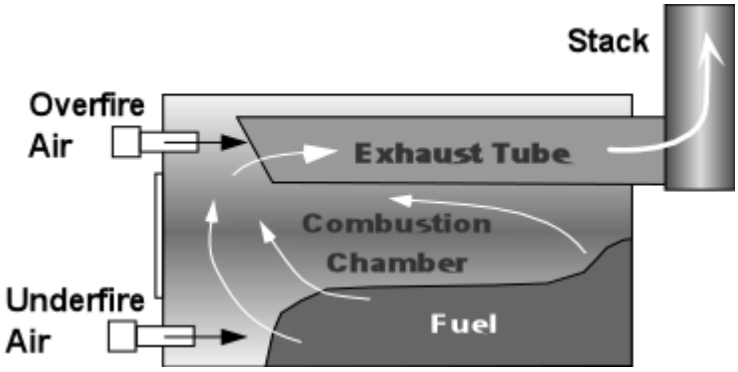
DO NOT OPERATE WITH FUEL OR ASH REMOVAL DOORS OPEN

2. Use the ash hoe supplied with the burner to push the ashes to the rear of the firebox. (If there are too many ashes to accomplish this easily, refer to the section on cleaning the burner.) Then rake the hot coals forward, keeping them well below the lower edge of the loading door and in front of the nozzles. Hot coals are lighter than ashes and will tend to stay on top of the pile as the ashes are pushed back.

NOTE: DO NOT BLOCK THE UNDERFIRE AIR NOZZLES WITH ASHES OR HOT COALS.

3. After the hot coals have been brought to the front, load the burner and shut the door. It will not take a large amount of hot coals to ignite the new fuel. With some experience you will easily judge when there are not enough hot coals and more kindling is necessary, or when there are too many coals. With small pieces of dry fuel, too many coals may cause dark smoke by igniting an excessive amount of fuel thus creating too large a fire.

The amount of fuel that can be loaded into the burner depends greatly upon the moisture content and the size of the pieces being burned. The reason being that wood, as stated before, is both a solid and gaseous fuel. Small pieces gasify more quickly than larger pieces due to the larger surface area to volume ratio, and dry pieces gasify more quickly than green pieces because the lack of moisture allows them to heat up more quickly. Small dry pieces therefore gasify quickest of all and you must leave room in the burner for the gases to develop and be burned off in the secondary phase of combustion. You will also find that fuels that gasify quickly, deliver their heat more rapidly. Therefore you can give these fuels less under fire air than you would give to green fuel and receive the same amount of heat output.



As a starting point load the firebox 1/3 full of fuel, placing it behind the raked forward pile of coals. As the wood burns and releases its gases the additional 2/3 volume of the firebox area is needed as a combustion space for these gases. Since every customer's wood fuel is different, use this recommendation as a starting point and adjust from there. Wood fuel that is green or that consists of large chunks will gasify more slowly (than small pieces of dry fuel) and customers using this fuel may be able to load their burner as much as 1/2 full, but should never load more than that amount. An overloaded burner will generally produce a dark colored emission even with the over fire valve fully open. It can also create "puffing" (see trouble shooting section below) with small amounts of smoke "puffing" out the door. This occurs because the amount of over fire air is insufficient for the size (rate of gasification) and unburned gases are going up the stack in the form of carbon. In addition, the combustion process may now extend out of the firebox and into the heat exchanger. This can cause damage to stove components not made to withstand the direct flame of combustion.

If a burner is overloaded, do not open the loading door until the pile of fuel has burned down. Turn off the underfire air valve and wait for the charge to burn down.

1.8 OPERATING TEMPERATURES

The recommended operating temperatures will provide for both low emissions and long equipment life. Operating your burner near the low end of the operating range will contribute to a longer life and less maintenance for your burner, while operating near the high end of the range will yield greater fuel consumption and produce more heat output. The importance of operating your equipment within its specified temperature limits cannot be over stressed. 90+% of the damage we have observed with all makes of burners is temperature related.

SHOP HEATER RECOMMENDED OPERATING RANGE
800°-1200° Fahrenheit

The operating range and high temperature limit are dictated by the temperature limits of the steel construction. Generally, the recommended high temperature limit will provide a reasonable operating margin so that the steel will not yield to thermal expansion, a point at which the burner will sustain damage if operated for an extended period of time.

SHOP HEATER HIGH TEMPERATURE LIMIT
1250° Fahrenheit

NOTE: DO NOT EXCEED 1250 DEGREES F. IN FIREBOX; IT WILL CAUSE DAMAGE TO THE EXHAUST TUBE!

1.9 OPERATING FURNACE DURING A PROLONGED POWER OUTAGE

This furnace may be operated during a power outage although without the induced draft fan and warm air distribution fans it will not produce its full rated capacity. If the outage occurs when the furnace is not operational, a small fire should be built initially to develop a natural draft up the stack.

2.0 **TROUBLESHOOTING**

Excessive Coals

Under certain circumstances, a large bed of coals may form in the burner, filling 1/4 of the firebox or more. This has been observed when burning kiln dried Douglas fir and Philippine mahogany scrap such as 6 x 6 cutoffs, etc., or this situation may occur simply by attempting to load the firebox before the previous load has had sufficient time to burn down. When this condition occurs, rake the pile of coals towards the front of the burner, but do not add additional fuel at this time. Raking the coals forward in this manner will achieve a higher burning rate and must be done to reduce the pile of coals before adding more fuel. Adding more fuel on too large a pile of coals may cause an excessively large fire resulting in dark smoke out of the stack.

White Smoke

The fire is burning too cold to ignite the gaseous fuel in the secondary phase of combustion and this is going up the stack as white smoke. Heat up the firebox by adding additional under fire air, reducing over fire air, or, if the fire is very small, by adding fuel. Do not mistake steam for white smoke. Steam forms just above a hot stack leaving a short distance of clear exhaust between the stack and the steam plume and steam dissipates quickly. White smoke on the other hand comes out of the stack and does not dissipate but drifts off.

Black Smoke

More gas is being generated by the fuel than can be burned in the secondary combustion phase. The result of this incomplete combustion is a fuel rich mixture going up the stack as black smoke. Cut back on the amount of under fire air or add more over fire air if that valve is not already full open.

Puffing

The gaseous flame goes out from a lack of over fire oxygen, then fresh oxygen comes in, is consumed in a puff as the fire reignites, and the cycle repeats itself. The burner has been overloaded. The fire is too large for the burner and is not getting sufficient over fire air. Close the under fire air valve and open the over fire air valve in an attempt to reduce the size of the fire. In the event of puffing, do not open the loading door as it will extend this cycle. This rhythmic puffing or fluttering is due to the excessive production of combustible gases from an overabundance of small pieces of dry wood or dry wood with glues. Load small dry pieces in small quantities only.

NOTE: IN THE EVENT OF PUFFING, DO NOT OPEN THE FIREBOX LOADING DOOR!

Negative Pressure

If your building has a total loss saw dust collection system or spray paint booth, then your building probably has negative pressure within it (if your outside doors blow open or slam shut due to suction in your building, then you have this problem) and your burner will also have this problem. Since your chimney is connected to the outdoors and the burner sits inside your shop, a severe down draft backwards through the chimney can occur.

Because the proper flow of flue gases can be reduced or reversed by the negative pressure, your burner room must be operated at a neutral or positive pressure. This can be accomplished by ducting air from the area to be heated to the rear air inlet on the burner, using the hot air/cooling fan to pressurize the burner room, thus using the burner room as a positive pressure plenum, and having ductwork or vents to direct the heated air to its destination.

Weak Induced Draft

Check for blockage of the fan inlet, hose or nozzle. Check for a breach in the connection between the induced draft fan and the induced draft nozzle. Check for a blocked stack by opening the upper cleanout doors and looking up the stack with a mirror. Also check for proper rotation of the induced draft fan (towards outlet). An induced draft fan rotating in the wrong direction will produce only about 1/3 the draft of a fan with the correct rotation

MAINTENANCE

2.1 REGULAR CLEANING

1. Establish a routine for the storage of fuel, care of the appliance, and firing techniques.

2. Check daily for creosote buildup until experience shows how often cleaning is necessary.

3. Be aware that the hotter the fire is, the less creosote is deposited, and that weekly cleaning may be necessary in mild weather, even though monthly cleaning may be enough in colder months. A small intense fire is preferable to a large smoldering fire to reduce the amount of creosote deposition.

4. Have a clearly understood plan to handle a chimney fire.

Ash Removal

Ashes should be removed from the firebox when they start to have an adverse effect on primary air flow. Ash is also a great insulator and can slow the transfer of heat out of the firebox.

The optimum time for ash removal is when the burner is relatively cool, typically first thing in the morning after it has cooled down overnight. Use the ash hoe to bring the ashes to the front of the burner, and then push the hot coals to the rear of the burner to separate them from the ashes. Remove ashes with a short handled shovel, a scoop, or a similar tool, and then rake the hot coals to the front of the burner in preparation for loading fuel. Add kindling if necessary. Observe proper precautions when storing ashes for later disposal.

Disposal of ashes;
Ashes should be placed in a metal container with a tight fitting lid. The closed container of ashes should be placed on a noncombustible floor or on the ground well away from all combustible materials, pending final disposal. If the ashes are disposed of by burial in soil or otherwise locally dispersed, they should be retained in the closed container until all cinders have thoroughly cooled.

NOTE: ASH CAN RETAIN ENOUGH HEAT TO BE A FIRE DANGER FOR MANY DAYS AFTER REMOVAL FROM THE BURNER, STORE IN A SAFE METAL CONTAINER FOR AT LEAST 2 WEEKS BEFORE DISPOSAL.

Frequency of ash removal depends to a large extent on the type of fuel burned. Experience has shown that the burning of bark results in the greatest ash build-up due to dirt and mineral content. Burning clean lumber results in the lowest ash build-up.

Heat Exchanger Tube Cleanout

Over a period of time, soot gradually builds up in the heat exchanger tubes and causes poor heat transfer and a restriction of exhaust gas flow. The net result is a considerable increase in the amount of heat energy wasted up the stack. In some cases restrictions in the heat exchanger may cause smoking out the loading door.

Tube cleanout is needed when the stack temperature remains consistently high (100-200 degrees above the stack temperature of clean burner), typically at least every 8 weeks. Frequent cleaning will result in more efficient furnace operation.

Tube cleanout:

1. Open the access door to the heat exchanger tubes.

2. Attach the fine wire brush to the clean out rod and mount this assembly on an electric drill.

3. Run this tool, in forward rotation, down the length of each tube 2 or 3 times to loosen the soot. Deposits of soot will collect at the front and back ends of the heat exchanger as you clean the tubes.

4. After cleaning all the tubes, clean the collected soot at the front and rear of the heat exchanger. If the furnace had been shut down and is cold, a vacuum cleaner can be used to clean the soot out of each tube after the tool has been run through it.

The use of the fine wire, followed by a thorough vacuuming of the heat exchanger tubes on a cold heat exchanger will yield the best possible results when the tubes are cleaned regularly. The coarse wire brush should be used only when necessary to remove the few heavy deposits that may be left by the fine brush. Use the coarse brush only after the fine brush has been used or it may grab in the tubes.

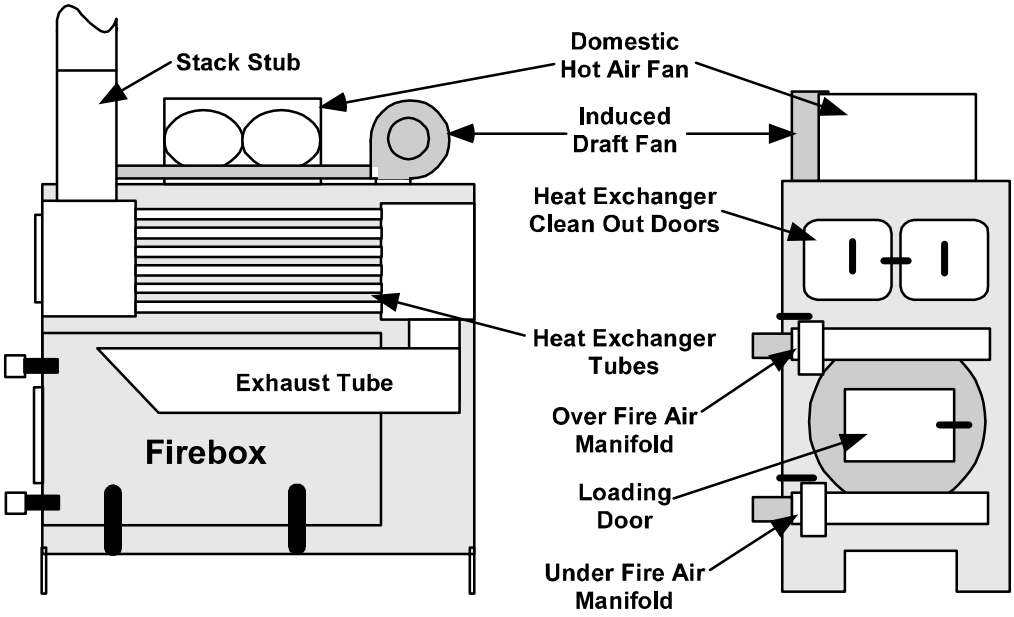
Creosote – Formation and Need for Removal. When wood is burned slowly, it produces tar and other organic vapors, which combine with expelled moisture to form creosote. The creosote vapors condense in the relatively cool chimney flue of a slow-burning fire. As a result, creosote residue accumulates on the flue lining. When ignited, this creosote makes an extremely hot fire. The chimney connector and chimney should be inspected at least twice monthly during the heating season to determine if a creosote buildup has occurred. If creosote has accumulated, it should be removed to reduce the risk of a chimney fire.

2.2 LONG-TERM MAINTENANCE

CLEANING OF THE HEAT EXCHANGER, FLUE PIPE, CHIMNEY AND DRAFT INDUCER IF USED, IS ESPECIALLY IMPORTANT AT THE END OF THE HEATING SEASON TO MINIMIZE CORROSION DURING THE SUMMER MONTHS BY ACCUMULATED ASH

Stack Cleanout

Over a period of time, soot and scale may gradually build up in the stack or may fall to the bottom of the stack. Inspect your stack for buildup once or twice a year. If necessary use a flue brush to clean the inside of the stack. Soot and debris can be removed through the Heat Exchanger Clean out Doors at the front of the burner.



Specifications subject to change without notice

Exhaust Tube

The exhaust tube or “afterburn chamber” which runs down the top of the inside of the firebox, reburns the flue gasses as they leave the firebox. This heavy wall pipe is the only component in the furnace which has heat on both sides of it so it wears faster then the other cooled components. Under normal operating conditions this tube could need to be replaced every four to six years. Operating the furnace at temperatures higher then 1200 degrees, or burning particleboard, will shorten the life expectancy of this exhaust tube. The furnace is designed to make exhaust tube replacement relatively simple and inexpensive.

NOTE: It is important to maintain the exhaust tube in good condition. If heat causes the exhaust tube to close up over time the air flow through the furnace will be reduced as will the output of the furnace. If heat causes the exhaust tube to shorten, the rear of the heat exchanger will be exposed to excessive heat.

NEVER-SEEZ

Burner doors that become difficult to swing open and shut over time can be freed up by applying a small amount of NEVER-SEEZ to the hinges.

The stainless nozzles in your burner have been installed with NEVER-SEEZ on the threads. If they are removed for any reason, apply a generous amount of NEVER-SEEZ or a similar anti-seize compound to the threads before reinstalling.

The two 6” threaded clean out plugs at the rear of the furnace have NEVER-SEEZ applied and have been screwed in tight for shipping. After removing them to clean ash from the furnace, re-apply NEVER-SEEZ and install them snug but not tight.

Ductwork

The inside and the top of the ductwork attached to your BCS burner system may collect a significant layer of dust over time which should be considered a fire hazard. Check your ductwork periodically and clean out accumulations of material.

Nozzles

Just inside the firebox door are three under fire and three over fire nozzles. They are 2-3/8 inches wide by 6 inches long, made of stainless steel, and screwed into the front of the stove. These nozzles are expendable extensions of the under fire and over fire air manifolds.

Check the condition of the nozzles at least twice a year; if the nozzles have become thin and/or have shortened due to deterioration replace them. Replacement nozzles are available from BCS. Use a pipe wrench or strap wrench to remove the old nozzles. Coat the threads of the new nozzles generously with NEVER-SEEZ or a similar lubricant and install.

SAFETY

3.1 TRAINED PERSONNEL

You should restrict the operation of the burner to authorized and trained personnel. A properly trained employee will save money while an untrained one can inadvertently cause costly damages to your wood burning system or your shop. Be sure to obtain operating instructions for your equipment and familiarize employees with these.

3.2 OPERATOR SAFETY

Your operator should use care when opening the door of a hot furnace, for example to load more fuel or to check on its location. We recommend that the operator wear a face shield, gloves, and non-flammable clothing before opening the door.

3.3 SAFETY LABELS

Make sure that all applicable safety labels are posted in clearly noticeable locations. Safety labels to be posted by each burner are provided at no charge to our customers. Please contact BCS if you need additional labels.

Place this caution notice on wall near firebox door, in view of operator.