BRECKWELL

Hearth Products

Dealer Service Guide for Breckwell Pellet Stoves

Prepared for the exclusive use of authorized dealers
of Breckwell Hearth Products

Manufactured by
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Introduction

Breckwell pellet stoves are designed to be simple and trouble free. Our stoves utilize proven pellet heating technology, and ease of operation and maintenance are high priorities in our designs. We carefully choose component parts which have been shown to be reliable, and we test every part for proper operation before it leaves the factory. We want to make sure that every customer is completely satisfied with their Breckwell stove from the moment they light the first fire.

However, problems do sometimes develop in the field. The performance of Breckwell pellet stoves can be affected by details of the installation configuration, climatic conditions, and the indoor environment. Customer operating habits and choice of fuel can have consequences for both the short and long term performance of the stove. And, like any mechanical product, component parts can become over stressed, worn out, or simply malfunction.

Breckwell's commitment to customer satisfaction doesn't end with the sale, and neither should yours. You will inevitably be called upon to address situations where the customer believes the stove is not operating as it should. Your ability to quickly, accurately and permanently diagnose and solve the problem is critical for customer confidence in both you and the stove.

This Dealer Service Guide is part of Breckwell's effort to provide the resources you need to respond effectively to service problems. This guide will provide you with the information you need on how Breckwell stoves work, and how the component subsystems work together. It will also provide information on installation and maintenance to supplement the instructions in Owner's Manual for each model. This guide also contains a comprehensive troubleshooting guide to help you quickly and surely diagnose mechanical problems.

Use this guide! Every Breckwell dealer should have a copy readily available for reference as soon as a customer contacts you. You will often be able to identify the source of a problem without having to make a service call, and in many cases you can instruct the customer on what to do about it. Every service and installation person should study this guide and be familiar with how to use it. A copy should be on every truck that you send out in the field.

This guide is a living document. It will be updated and expanded as necessary to keep you up to date on new designs and service issue. That also means that we will be listening to your feedback about this guide. Tell us

what you think works or doesn't work about this manual, and tell us what you think would make it better.

How to Use this Guide

This guide is designed both as learning tool and as a reference. It can and should be used as a basis for in-house training for both service personnel and other staff members who come in contact with customers. However, it should not be used solely by itself. All service people need a good basic grounding in the technology of pellets and pellets stoves. Breckwell strongly encourages you to use the *Pellet Appliance Specialist Training Manual* from the HEARTH Education Foundation. Service staff should also be Certified by HEARTH.

Contact HEARTH at (612) 635-9601 or by e-mail at info@hearthed.com.

This guide is also meant to be used in conjunction with the Owner's Manual for each Breckwell pellet stove. Many service problems are actually related to the installation, operation and maintenance of the unit. The Owner's Manual will always contain the information that is appropriate for that model. You can also use it with the customer to identify certain problems without having to make a service call. The Troubleshooting Guide that is included in each manual contains steps that the customer can take to narrow down the problem, and in some cases, solve it on their own.

Section One of this guide contains a detailed description of how Breckwell pellet stoves work, organized by their component systems. You should read and study the material in this section. It will give you a complete grounding in the operation of Breckwell stoves and how their systems work together. You will find that an understanding of these systems will be a big help when you need to diagnose a tricky operational problem. You will also want to use this section for reference when dealing with a problem with a particular component.

Section Two contains information on the steps you should take to inspect and test a stove before delivering it. Checking out the stove according to this guide will reveal any inherent problems or defects, and will allow you to make adjustments in your own facility instead of the customer's living room. This will save you the time, headaches and expense of callbacks, and will reinforce your image as a quality Breckwell dealer. Read this section thoroughly, and make copies as necessary to make sure you and your technicians follow the procedure for every stove.

Section Three contains a comprehensive troubleshooting guide. The charts in this section take you through a logical sequence of observations and tests to home in on the source of the problem as quickly and precisely as possible. This section is meant to be used as an in-field reference when diagnosing tricky operational problems. However, it can also be used over the phone with a customer to narrow down the possibilities before a service call.

It is important for service people to be familiar with how this section works before they need to use it in the field. The most professional dealers will use this troubleshooting section as a tool for in-service training of service personnel. You could, for instance, set up a stove with a "problem", and challenge service staff to find it and fix it. The more practice available, the more diagnosis of complex problems becomes second nature.

Section Four contains technical and reference material as a supplement to the rest of the information in this guide. This will include service bulletins that will be published from time to time to update the guide.

The main text of this guide is written to be directly applicable to the P24 and P2000 series of Breckwell pellet stoves, since their design and operation is most typical of Breckwell stoves. Most of this information will also be directly applicable to other Breckwell pellets stoves, both current and previous models. In some cases a component may be located in a different place than as described in the text, or there may be other minor differences. You should be familiar enough with Breckwell stoves to be able to "translate" this information to the stove you are working on.

In other cases there may be a significant difference between the text description and another stove model. Where this is the case, the text will be marked with a superscript, like this[P23] showing that there is supplemental information related to the indicated model. The information will be found in a sidebar in the margin of the page, in the same vicinity.

P23 and other models:
Information that is different for a particular model or models will be shown in a sidebar box like this one.

Section One

How Breckwell Pellet Stoves Work: Component Parts and Assemblies

Unlike a simple wood stove, a pellet stove relies on a number mechanical and electrical components in order to work properly. These components provide the driving forces to supply the fuel, air, and heat which are necessary for combustion. Other components monitor the status of certain safety conditions and take steps to prevent unsafe conditions from developing. The user controls provided with Breckwell stove allow the choice of heat output and blower speed and provide for automatic ignition. The components are carefully designed to work together to automatically provide optimum performance, safety and user satisfaction. This section reviews the basic operating system of Breckwell pellets stoves, and then looks more closely at the individual components.

It is useful to think of the Breckwell pellet stove component assemblies in terms of their functions:

- **Fuel Supply and Delivery,** which includes the pellet hopper, auger and auger motor, and the electrical components which control them;
- **Combustion,** which includes the combustion air supply, the burnpot and combustion chamber, the firestarter, the internal flue gas passageways, the combustion blower, exhaust system, and electrical components;
- **Heat Exchange and Delivery,** which includes the convection air blower, internal air passageways and heat exchange tubes, and electrical components;
- **Safety Systems,** which includes the air flow switch and the high temp thermodisk, auger thermodisk and blower thermodisk;
- **External Components and Options,** including things like the glass door and accessories such as a thermostat. These components may enhance or modify the basic operation of the stove.

These systems are tied together and monitored by the stove's control panel and electronic circuit board. The proper functioning of each of these systems is critical to the proper performance of the stove, and they must work in harmony to give most satisfactory results for the customer.

1.1 Fuel Supply and Delivery

All Breckwell pellet stoves use an overfeed pellet delivery system. This helps provide good performance with a wide variety of types and grades of pellet fuel, and helps avoid safety problems such as burnback by physically separating the combustion zone from the pellet supply.

1.1.1 Pellet Fuel

Breckwell pellets stoves are reasonably forgiving of marginal-quality fuel. However, for best performance the fuel should be carefully chosen from the best available in a particular area. The fuel should be PFI premium grade fuel, which meets the following requirements:

Heat Content: 8200 Btu/lb. minimum
Bulk Density: 40 lbs. per cubic foot minimum
Moisture Content: 8 percent maximum
Ash Content: 1 percent maximum
Size: 0.23 to 0.35 inches diameter, 1.5 inches long maximum
Fines: 0.5 percent maximum through 1/8 inch. mesh screen

While the standard permits pellets to be up to 1.5 inches long, fuels with many pellets this long should be avoided. Such pellets tend to bridge across the auger flights and do not feed as well, especially at low feed rates. Breckwell recommends fuel with a pellet length of no more than one inch.

A low ash content is important to prevent clinkering. When pellets are burned at high temperatures the noncombustible mineral content of the wood (ash) can melt slightly and fuse together, forming a crusty mass. These clinkers are not easily expelled from the burnpot by air pressure, and can build up and clog the air ports. When present the must be removed by hand.

Most pellet fuels are bagged at a low enough moisture content to avoid any combustion problems. However, care should be taken in the storage and handling of pellets to prevent contamination by moisture. Higher moisture content reduces the heat that can be delivered to the house, can cause ignition problems, and may cause difficulty in holding a low fire.

Fines are the small particles of crushed pellets that can be produced in manufacturing, but which can also be the result of rough shipping and handling. Pellet bags should not be thrown or dropped. Fines can build up in the hopper and clog the auger. Fines can be screened from the pellet fuel before it is added to the hopper. The last few pellets at the bottom of a bag should not be poured into the hopper without screening the fines.

The PFI standard does not permit the use of binders other than the natural wood lignins that are brought out during the high pressure extrusion process. Pellets or other fuels containing wax or other binders should never be burned in the stove.

Only natural wood pellets should be burned in the Breckwell stoves. Do not burn coal, non-pelletized wood, any petroleum fuel, hogged fuel or any other organic material.

1.1.2 Hopper

The hopper holds a bulk supply of pellets, ready to be fed to the combustion zone. Breckwell stoves can hold up to 70 lbs. of pellets,[P28, P23] which represents a gross heating content of about 570,000 Btus. This supply can last from 12 to 70 hours depending on the heating need and pellet feed rate. Pellets should not be left in the hopper over an extended period, such as over the summer. The can absorb moisture, resulting in feeding and combustion difficulties. Clean out or burn out the remaining pellets at the end of the heating season.

P28, P23:
The hoppers of these models hold about 60 lbs. of fuel.

Bridging of pellets in Breckwell hoppers is not a common problem. However, it is wise to stir the pellets in the hopper from time to time, especially if the fuel contains many long pellets. A maintenance tool is provided to allow the consumer to do this easily and safety. Wax paper can be rubbed on the sides and bottom of the hopper to encourage the smooth flow of pellets.

The auger is exposed in the front inside of the hopper. The auger turns slowly and with very high torque, and can sever a finger. Neither the customer nor a service person should put their hand inside the hopper while the auger is activated (green light on control panel On.) Children should be warned against putting their hands, toys, sticks, or anything else inside the hopper.

1.1.3 Auger

The auger is a helix of hardened steel around a steel shaft. When it turns, pellets are conducted upward to the top end of the feed tube, where they fall by gravity to the burnpot.

P22, P23:
On these models the pitch is 2 inches.

The auger is carefully designed and proportioned for use with each Breckwell stove. The pitch of the helix (distance from the edge of one flight to the edge of the flight immediately above) should be 1 1/8 inches.[P22, P23] A weld attaches the top flight to the auger shaft; this weld should always be on the **top** of the top flight.

The auger turns with a great deal of torque, which allows it to sever long pellets as it feeds. However, excessive fines can become ground into the space between the auger and its housing, creating resistance and possible jamming of the auger. More commonly foreign objects, especially those of metal, can jam the auger. This will not only stop the feeding of pellets, but may bend or dent the auger flights. This will result in erratic feeding and necessitates replacement of the auger.

The auger is held in its tube by a Teflon bushing (also known as a "biscuit") at the bottom of the tube. The auger can be removed (after detachment of the auger motor) by removing the two screws on either side of the auger tube, removing the auger coupling, and sliding the auger carefully

P23:
To remove the auger on this model, remove the two bushing screws, remove the silicone seal, and pry the auger and bushing out of the housing.

P22, P23:
The auger shaft rotates at 1 RPM on these models.

downward.[P23] Care should be taken not to damage the auger while it is out, and to reinstall it fully into the tube in the proper orientation.

1.1.4 Auger Motor

The auger motor is a 0.5 horsepower gear motor which produces very high torque. The motor turns the auger shaft at 4 revolutions per minute.[P22, P23] This rotation rate is designed to coordinate with the feed rate timings built into the circuit board to feed pellets at the proper rate for each setting. A rotation rate significantly different from 4 RPM can cause improper and disappointing stove performance.

When the motor runs it presses against a metal post covered with a rubber "bumper" to the side of the combustion air pipe. This design eliminates vibration and noise when the motor runs. The motor must be properly positioned against the bumper, and the rubber must not be worn.

The auger motor is attached directly to the auger shaft with a coupling. The coupling has set screws on either end. The lower set screw must line up with the flat on the auger motor shaft, and the upper set screw must line up with a depression drilled near the end of the auger shaft. If these screws are not properly aligned, noisy operation and erratic or nonexistent pellet feeding will result.

To remove the auger motor, use an allen wrench to loosen the lower set screw, and pull the motor from the coupling. To remove the auger follow the directions in the auger section above.

Problems with the auger motor itself are rare, and are usually related to a jammed auger. Jamming can cause the gears in the motor to become stripped, which is not repairable in the field. A jammed motor can also overheat. The motor is thermally protected, which means it will turn itself off if it gets too hot. However, overheating can permanently damage the motor, requiring replacement.

1.1.5 Auger Circuit

The auger circuit includes all of the electrical wiring supplying electricity to the motor, the auger thermodisk, and the circuit board. It also includes the high temp thermodisk and air switch, which are primary safety controls.

P23 etc.
There are different combinations of timing cycles for different stove models. See section 1.4.7 for a complete description of cycles for most models.

When the auger button on the control panel is pushed, the circuit board sends electricity directly to the auger motor through the orange wire. Power is actually sent in pulses, the timing of which depends on the feed rate setting. Each pulse will last from 0.7 to 4.5 seconds during a 14 to 15 second cycle.[P23 etc.] This will continue for about 10 minutes, during which the pellets are ignited in the burnpot.

After this period the circuit board stops sending power through the orange wire, but continues to energize the yellow wire. This wire is attached to the

auger thermodisk. In order for power to flow from the yellow wire to the auger motor, the thermodisk must close to complete the circuit.

Heat generated by the fire warms the auger thermodisk, which is attached to the exhaust manifold near the combustion blower. This is a normally open thermodisk; that is, it does not close the circuit until it has warmed up to about 110 °F. After this point the thermodisk will permit power to flow from the yellow wire to the orange wire and on to the auger motor until the stove is turned off.

If the fire in the burnpot does not generate enough heat to warm the auger thermodisk, the electrical connection will not be made. After the 10 minute period, pellets will stop feeding to the burnpot and the fire will die out. This is to prevent pellets from being fed endlessly into a cold stove. It is important that the feed rate control knob be set on the "D" setting during startup, so that sufficient pellets will feed to make a hot, self-sustaining fire. Also if the thermodisk falls below about 90 °F for some reason (such as the fire going out), the thermodisk will again open and interrupt the feeding of pellets.

The high temp thermodisk and the air flow switch are both found on the neutral side of the auger motor circuit. Either of these can interrupt the circuit if they detect improper conditions. The operation of these controls is discussed under Safety Controls, Section 1.4.

The control panel also includes a switch to allow manual feed of pellets. This is intended only for priming the auger on a new stove or after pellets run out, or for delivering a startup supply of pellets to the burnpot on stoves without a firestarter. It should not be used to supply pellets to the burnpot after the fire is ignited. Constant running on manual feed (for more than about one minute) will blow the auger circuit fuse on the back of the circuit board, and could result in an excessive buildup of pellets in the burnpot. While this should not be dangerous, it will cause a smoky and inefficient fire.

1.2 Combustion System

The combustion system is the heart of the stove, and is also the most complex. In order to provide satisfactory performance, the stove must simultaneously provide proper conditions for combustion by managing the flow of combustion air, heat, and exhaust gases, as well as ensure that combustion can be carried on safely.

Although the stove is not a true sealed combustion system, it is still useful to think of the combustion system as a balanced air flow system extending from the air intake to the end of the exhaust vent. Adverse conditions at any point in this system can have adverse effects throughout the stove, and can lead to both safety and performance problems. In order to maintain

favorable conditions for combustion, all of these parts must be installed and maintained to that they can work together.

The combustion system consists of two major sides: the combustion air supply and the exhaust system. The intersection of these sides is at the burnpot. Breckwell stoves utilize a powered negative pressure combustion system. The combustion blower, which is located on the exhaust side, **pulls** the exhaust gases out of the combustion chamber and **pushes** them out through the exhaust vent. As a result, there will always be negative pressure within the combustion chamber, but positive pressure within the vent.

The negative pressure within the combustion chamber pulls fresh combustion air in through the air intake duct, where it is delivered to the burnpot through small holes or ports. The negative pressure in the combustion chamber also ensures that exhaust gases or smoke will not leak out, even if the house is depressurized.

If insufficient air is pulled into the stove the air supply will not match the pellet feed rate, resulting in dirty, incomplete and inefficient combustion. The causes of insufficient air supply can include a leaky or restricted combustion air system or fresh air intake pipe, obstruction of flue gas passageways within the stove, a combustion blower not running at the proper speed, and an obstructed or misinstalled exhaust vent.

On the other hand, excessive air decreases overall stove efficiency and can make pellets burn up faster than they are supplied. This can cause the fire to go out, especially at low burn rates. The supply of combustion air must be properly controlled by the damper in the combustion air intake.

1.2.1 Combustion Air Supply

The combustion air supply includes the combustion air pipe built into the stove and any duct used to take air from a remote location. The combustion air damper is built into the pipe.

It is not absolutely necessary that combustion air be taken from outdoors with Breckwell stoves. However, use of outdoor air is recommended, and can minimize pressure related problems in the house. Mobile home installations **must** use an outdoor air supply. Combustion air should never be taken from a garage, attic or crawl space, or any area that may contain flammable vapors or be subject to major pressure deviations. Outside air ducts should, in general, be as short and direct as possible.

A 1 3/4 inch inside diameter flexible or rigid metal pipe or duct can be connected to the end of the combustion air pipe at the back of the stove. Do not use plastic dryer vent or other nonmetallic duct. See the Owner's Manual supplied with each stove for complete information on use of an outside air duct with that stove.

The combustion air pipe extends through the back of the combustion chamber and projects about 3/4 inch into the stove. The burnpot mounts on this projection.

The adjustment of the combustion air damper plays a crucial role in the quality of combustion and user satisfaction. Ideally, the damper would be readjusted to provide the perfect air supply each time the feed rate setting is changed. Since this is not practical, a setting that works for the feed rates most commonly used, and the individual characteristics of the installation and fuel supply, needs to be found.

It is usually best to start with the damper pushed fully in, and then back it out slowly until the best position is found. In general, the damper should be pulled out 1/4 inch plus 1/8 inch for each feed rate setting above "Low". In other words, for a feed rate setting of "D" the damper should be pulled out about 5/8 inch.

At the ideal setting, the flame will be bright and yellow, moving rapidly but not wildly. If the flame is dull, reddish and lazy, the damper is too far in. If the flame flickers wildly like a blowtorch, the damper is too far out. If the fire tends to go out on the Low setting the damper should be pushed in slightly. If soot tends to build up on the glass or in the venting system, the damper should be opened a bit.

It is best to avoid making major adjustments to the damper. This only results in overadjustment as you chase the right setting back and forth. Make adjustments about 1/16 inch at a time, and wait for the new air setting to come into balance with the fuel supply. Then adjust again if necessary.

In some cases it may be difficult to find a setting that works well for all feed rate settings. Instruct the customer on how to carefully adjust the damper to get best results for the feed rate they select. This may only need to be a small adjustment – 1/16 to 1/8 inch between low and moderate burn rates. Make sure the customer understands that overadjustment can cause more problems than underadjustment.

1.2.2 Burnpot

The burnpot is a rectangular container with sloping interior sides and a space between the inner and outer walls. Air from the combustion air pipe is introduced into this space and injected into the pot through a number of small holes, or ports. This provides for good turbulence and mixing of the air with the gases given off by the burning fuel. For proper operation these ports must be keep open and unobstructed. The force of the incoming air will keep the burnpot free of loose ashes. However, high ash fuel can cause formation of clinkers which may not be ejected, and which must be removed by hand.

Pellets fall into the burnpot from the auger feed tube above. In order to "catch" the pellets, the burnpot must be properly positioned. It should be

mounted in the combustion air pipe and firestarter tube and pushed all the way back until it is stopped by the end of the firestarter tube. The burnpot will end up about 1/8 inch in front of the back wall of the firebox..

Pellets should not be allowed to build up to the edges of the burnpot. If this tends to happen at high pellet feed rates, the combustion air supply is probably adjusted too low, or the feed rate timing sequence is incorrect.

Ashes will accumulate on the bottom of the firebox. They should not be allowed to fill the firebox, but should be removed periodically. If the stove is not equipped with an ash pan, they should simply be scraped together and removed with a small shovel or scoop. If the stove has an ash pan, the ashes can be scraped through the hole in the firebox floor to the ash pan in the pedestal. Cleaning should only be done with the stove Off and cool. Avoid the use of standard vacuum cleaners, as the fine ash can get through the filter and damage the motor and blow out into the room. A vacuum intended for this purpose, such as a chimney sweeping vac or Love-Less Ash Vac, can be used.

1.2.3 Firestarter

The optional firestarter permits automatic ignition of the pellets in the burnpot, without the use of matches or gelled alcohol. The firestarter is a metal cylinder about 3 inches long, which is inserted into a tube projecting through the back of the firebox. This tube projects about 1 1/2 into the combustion chamber. The burnpot is mounted on this projecting tube. The end of the tube is cut at an angle to match the slope of the inside wall of the burnpot. The end of the tube should butt up against the inside wall.

The firestarter should be inserted into the tube so that its end is about 1/8 inch from the **top** end of the tube. If the firestarter is not at or near this location, it may not be effective at lighting the pellets. The firestarter is held in position by a set screw near the back end of the tube. Do not overtighten this set screw – it is only necessary that it be snugged to hold the firestarter in position.

Although it glows red hot, the firestarter does not ignite the pellets by contact. Instead, hot air is drawn across the hot surface and into the burnpot through the hole in the side. This hot air ignites the pellets. There is a small hole on the **bottom** of the firestarter tube, just outside the back wall of the firebox. This hole must be open and unobstructed to allow air to flow into the tube to the burnpot. One frequent cause of ignition failure is plugging of this hole with wads of ceramic fiber insulation or other debris.

1.2.4 Internal Flue Gas Passageways

Hot gases given off by the fire rise to the top of the combustion chamber, across the heat exchange tubes. From there they are drawn into the top of vertical flue passageways at the corners of the firebox. At the bottom these flues connect to a horizontal passageway across the bottom rear of the

firebox. This connects to the exhaust manifold at the bottom right of the rear wall. The manifold takes the flue gases to the combustion blower.

It is important that these passageways be kept clear, both for good heat exchange and to prevent obstruction of flue gas flow. Because of the turbulent nature of pellet combustion, flyash will be drawn into the vertical flues and will tend to settle at the bottom of all passageways. At least a light layer of soot will also accumulate on the internal walls. If the stove is not operated or vented properly, this soot can become thick, and may be joined by tarry or crusty creosote.

Access shutters are located at convenient spots to allow access for cleaning all parts of the flue passageways. Use a small wire or bristle brush to reach all surfaces. Scrape the soot and ash out to the firebox and remove. (See ash removal instructions in the Burnpot section.) Cleaning should be done as often as necessary, but at least once a year.

Special care should be taken when cleaning the exhaust manifold. There is a small tap in the wall of the manifold which leads to the air pressure switch. This tube must be kept clear. After you are done cleaning, run a pipe cleaner or small wire through the hole and pull out any debris that might have entered.

1.2.5 Combustion Blower

The combustion blower is what drives the combustion system. It is absolutely necessary that it be kept in good working order, or the system will break down and the stove will not operate.

The combustion blower is exposed to extremely harsh conditions: high temperatures and soot, smoke and other particles in the flue gases. It also must run constantly at maximum speed from the time the stove is turned on to when it is switched off. The blower used on Breckwell stoves is very durable and has proved to be remarkably trouble-free.

Problems with the combustion blower most commonly relate to deposits of combustion products. Poor stove operation with insufficient air or poor quality fuel can lead to build up of creosote on the impeller blades and shaft. This increases resistance to the blower rotation and decreases the negative pressure that can be generated by the blower. It may also cause the blower motor to overheat. If this happens, the motor's thermal protection will shut the blower down, which will immediately stop pellet feeding. After an incident of overheating it may be possible to return the blower to service after it is cleaned, but it may also need to be replaced.

If inspection of the venting system shows deposits of creosote, the blower should also be removed and inspected. Clean the impeller and all internal surfaces of any adhered deposits. Soot does not generally cause a problem, as it can be swept away by the movement of the blower. However, the inside of blower should be cleaned at the same time the manifold is cleaned.

On some stoves it may be most practical to remove the blower rather than clean through the manifold.

It is the combustion blower's job to generate the negative pressure in the firebox. The air switch senses this negative pressure through a tap in the exhaust manifold, and if there is sufficient pressure, allows the auger to run. However, if the blower runs too slow, not enough negative pressure may be generated. In addition to the resistance caused by deposits, insufficient voltage can cause the blower to run slow.

If a foreign object enters the exhaust passageway it can cause a ticking or clanging sound, or may damage the blower impeller. In rare cases the impeller can become loose on the shaft. You can retighten the set screw to remedy this.

The combustion blower does not need to be oiled.

1.2.6 Venting System

Although the venting system is the "tail end" of the system, details of the system can influence the performance of the entire stove, all the way back to the burnpot.

P23:
The P23 does not use the Quick Connect system, and the flue collar is not tapered as described.

The venting system starts at the outlet of the combustion blower. Most Breckwell stoves include a "Quick-Connect" detachable exhaust connector which makes attachment of double wall vent pipe or chimney liner easy.[P23] The vent pipe or liner can be attached to the flue collar section while it is off the stove, and the stove manuevered into position. The flue collar is then bolted back onto the flanged Quick Connect fitting. The tapered design allows three inch diameter vent pipe to slip on easily, yet still holds the pipe securely. On most stoves the exhaust adapter can be attached for either vertical or horizontal venting.

Breckwell stoves can use either Type L vent pipe (listed as pellet vent by the manufacturer), or a listed chimney lining system. It is also possible to utilize an existing factory-built chimney through the use of an adapter from 3 inch Type L vent to a 6 inch or 8 inch flue. However, Breckwell strongly recommends that the vent or chimney liner extend fully up through the chimney to provide the best draft during a power failure and to minimize ash fallout.

For full information on the installation the venting system see the Owner's Manual which accompanies each stove. This guide will only discuss installation factors which can cause operational problems with the stove.

For proper venting, the proper size vent pipe must be used. Most installations can use 3 inch pipe. However, longer horizontal vent runs, and systems with extra turns, cause more resistance to flue gas flow. This reduces the amount of exhaust gas that can be moved by the combustion blower, which in turn reduces the amount of negative pressure generated in

the combustion chamber. In some cases, this will cause the air switch to not detect sufficient pressure, which will shut down the stove.

The Equivalent Vent Length (EVL) needs to be calculated for long or complex venting systems. To calculate the EVL, use the following conversions:

90 degree elbow or Tee	= 5 equivalent feet
45 degree elbow	= 3 equivalent feet
Horizontal pipe run	= 1 equivalent foot per actual foot
Vertical pipe run	= 0.5 equivalent feet per actual foot

Simply add up the equivalent feet for the full venting system. If the EVL is greater than 15 feet, the vent should be 4 inches in diameter. At elevations above 3,000 feet 4 inch vent pipe should be used if the EVL is greater than 7 feet.

If the proper size pipe for the EVL is used, the combustion blower will normally be able to generate enough air flow to allow the stove to operate without a problem. there are, however, exceptions. You should always strive to keep the venting system as short and straight as possible to minimize nuisance shutdowns due to excessive resistance.

Obstructions in the venting system are another common cause of shutdowns. Obstructions can include foreign objects or accumulations of creosote. If shutdowns occur which did not occur when the stove was new, you should suspect an obstructed venting system. Shutdowns due to excessive vent resistance or obstruction are usually accompanied by poor flame quality – a lazy, red, dirty flame – and problems with heat output.

Shutdowns can also be caused by pressure differentials between the exhaust outlet and the combustion air inlet. If the exhaust outlet is located against a sidewall on the windward side of the house, the pressure of wind against the house will work against the combustion blower. If the air inlet is on the same wall in the vicinity of the outlet, the wind pressure will be more or less balanced on both ends of the system, and a shutdown is unlikely. But if the combustion air inlet is inside the house or along a different wall, a shutdown can result.

The venting system is under positive pressure. That means that if there are any leaks in the system, flues gases will be forced out of the pipe. The results of this can range from an annoying smoke odor in the house to a buildup of dangerous carbon monoxide. All pipe joints should be sealed. For best results, Breckwell recommends that each joint be sealed with a high temperature silicone such as RTV, and then wrapped with a metallic tape. However, at least one joint near the stove should not be sealed with silicone, so that it can be disconnected for inspection, cleaning or future diagnostic tests.

1.2.7 Combustion System Circuits

The combustion system circuits include both the combustion blower circuit and the firestarter circuit. The combustion blower circuit includes the blower thermodisk and the blower. In addition the combustion system interfaces with the auger system through the air flow switch and the circuit board.

When the On/Off switch on the control panel is switched On, the blue wire from the circuit board to the blower thermodisk is energized and the combustion blower is turned on immediately. As the blower speeds up, it creates negative pressure in the combustion zone. When the negative pressure reaches a certain magnitude, the air flow switch closes, which tells the circuit board that a fire can be started safely.

When the auger button on the control panel is pressed, the circuit board energizes the red wire leading to the firestarter. The firestarter begins to heat up, and after a minute or two will begin to visibly glow. Meanwhile, the auger circuit has been energized, and pellets are fed to the burnpot. Once pellets build up to the level of the firestarter hole, they will be ignited. The circuit board will allow about 10 minutes for this to happen. After that period both the firestarter and the startup auger feed will be turned off. If a fire is not established by that time the stove will not be successfully started.

Once a fire is established it will heat up the blower thermodisk. This is a normally open thermodisk, which means that it does not close the circuit until it warms up. Once the thermodisk reaches about 110 °F the blower thermodisk will close, completing the connection between the purple wire which runs from the terminal strip, and the combustion blower. This has no immediate effect on stove operation. As long as the stove is turned On, the circuit board will supply electricity to the blower through the blue wire. But once the switch is turned Off, the blue wire is deenergized.

However, if the blower thermodisk is closed, the purple wire will continue to supply power to keep the blower running. This ensures that the blower will continue to exhaust the products of combustion until the fire is gone. Once the thermodisk again cools below about 90 °F it will open the circuit and shut the blower off. (The blower will run indefinitely, regardless of temperature, if the On/Off switch is On.)

The air flow switch constantly monitors the pressure in the combustion zone. If for any reason the pressure falls below a certain level, the switch will open and stop the flow of pellets. This will not turn off the combustion blower, which will continue to run even after the fire is out, until the stove is switched Off. The same thing can happen if the high temp thermodisk detects excessive temperatures. The operation of these safety devices is discussed in more detail under Safety Controls, Section 1.4.

1.3 Heat Exchange and Delivery

The ultimate purpose of a pellet stove is to deliver usable heat to warm the house. Even if the combustion system is working well, the stove will not truly be doing its job unless it can efficiently transfer the heat. The heat exchange and delivery system performs this function. This system includes the convection blower, the air plenum and the heat exchange tubes, and the associated electrical circuit.

Heat exchange involves a balance between supply and demand. Heat will always flow from a location of greater concentration (hotter) to an area of lesser concentration (cooler). The flow of heat will be greater the greater the temperature difference. In order to encourage efficient heat exchange, it is desirable to have the heat exchanger as cool as possible. One way to accomplish this is to have a high volume of air flow through the heat exchange tubes. This is the purpose of the convection blower, which will always create more efficient heat exchange than a passive, gravity convection air system.

Another way to promote efficient heat exchange is to supply as much surface area as possible for heat to transfer from the hot flue gases to the circulating air. This is why Breckwell stoves include many individual heat exchange tubes. Hot gases flow around these tubes, while the blower forces air through the inside.

Finally, heat exchange is a function of time. The longer time the hot gases spend in the heat exchanger, the more heat will be transferred. This is why Breckwell stoves have such a long path between the combustion chamber and the exhaust system. During the time the gases are negotiating this path, they are giving off heat. This is also the reason why opening the combustion air damper too much can decrease heating efficiency. The excessive air flow not only cools the hot gases more than necessary, but also simply blows the hot gases through the heat exchange passageways too quickly.

But heat exchange can be too efficient. Complete combustion of the pellets requires that high temperatures be maintained around the combustion zone. If too much heat is taken away by the heat exchanger, combustion can suffer. For this reason, it is best to match the rate of heat exchange to the rate of combustion. That is why the convection blower on Breckwell stoves changes speed as the pellet feed rate setting is changed.

1.3.1 Convection Blower

The convection blower drives the heat exchange system. The blower produces a high airflow (when appropriate) and sufficient pressure to force the air through the plenum and heat exchange tubes.

The convection blower can run at any of four speeds, depending on the setting of the feed control knob. The circuit board changes the blower speed

by limiting the voltage supplied to the blower. The following table shows the approximate voltage at the blower for each feed rate setting.

Convection Fan Voltage (most models)

Low	B	C	D	E	Max	High Fan
60 V	75 V	90 V	115 V	115 V	115 V	115 V

For the P23 and other models with small circuit boards with only four feed rate settings, the following table gives the approximate blower voltages:

Convection Fan Voltage (P23 etc.)

Low	B	C	High	High Fan
65 V	80 V	105 V	115 V	115 V

The High Fan switch on the control panel will override the blower speed selected by the feed rate, and cause the blower to run at maximum speed regardless of the setting. This is useful for delivering a large amount of heat to quickly warm up a cold house. However, the High Fan switch should not be used indefinitely with a low feed rate, as combustion will suffer.

The blower speed can also be overridden by the action of a safety control. If either the air flow switch or the high temp thermodisk shuts down the auger, the circuit board will also slow the convection blower down to its minimum speed.

On order to move air through the heat exchanger, the blower must have a supply of air. The openings built into the outer walls of freestanding stoves permit sufficient air to be admitted to the blower intake. With fireplace inserts, the air must be taken from the fireplace. It is important that the openings included in the insert cover flanges not be blocked, and that they freely communicate with the fireplace.

There are few problems associated with the convection blower. If a foreign object is drawn or stuck into the impeller, the blades can be bent. This will reduce the amount of air flow and increase noise. The impeller set screw at the attachment to the shaft can also become loose. The impeller may clang or rub against the blower housing.

If the blower becomes jammed by a foreign object, not only will air flow cease, but the blower may become overheated. If this happens the internal thermal protection will shut the blower down. It may be possible to continue using the blower once the problem is cleared. However, the blower could have been damaged and may need to be replaced.

The convection blower motor should be oiled once a year. Use a just one or two drops of SAE 20 motor oil. The stove Owners Manual illustrates the lubrication points.

If the blower needs to be removed from the stove for replacement or service, it should be replaced carefully to prevent vibration, noise or air

leakage. Make sure the rubber gasketing is properly positioned. The mounting screws should be torqued to equal tightness and not overtightened.

1.3.2 Convection Air Plenum

The plenum is the large passageway that conducts all of the air from the convection blower around the back of the firebox, and delivers it to the heat exchange tubes. The plenum picks up heat from the back of the firebox and from the corners next to the vertical flue passageways.

Since the plenum is large, it is unlikely that it would become obstructed, and it should not need cleaning or other service under normal circumstances. The high temperature thermodisk is mounted to the outside of the plenum. If insufficient air flows through the plenum to cool the back of the stove, it could become overheated. The high temp thermodisk would shut down the auger under these circumstances. The function of the thermodisk is discussed in detail in the section on Safety Controls, Section 1.4.

1.3.3 Heat Exchange Tubes

The Breckwell stove includes 16 heat exchange tubes[P23, P28] arrayed across the top of the firebox. The tubes are made of 3/4 inch ID steel. Together these tubes provide more than 375 square inches of heat exchange surface which is one reason that Breckwell stoves are so efficient.

In order to keep them working efficiently, insulating soot and flyash needs to be periodically cleaned from the outer surface of the tubes. Breckwell stoves include a built-in heat exchanger cleaner: a metal plate with holes surrounding each tube. The plate can be pulled the full length of the tubes to scrape off the soot. Breckwell recommends two passes with the cleaning plate, twice a week. If the stove is hot the hole in the handle of the Breckwell maintenance tool can be used to engage the hook at the end of the tube cleaner rod.[P2000] After use the cleaning plate should be left in position toward the back of the stove.

It is unlikely that any tubes would become blocked as a result of stove operation. However, sometimes children will stick objects down through the holes. This would decrease the heat exchange efficiency, and in an extreme case could limit air flow enough to overheat the stove. If there is a problem with the stove shutting down from the high temp thermodisk, use a flashlight to inspect each tube. If an object can't be removed from the front, it may be possible to push it out the back. The convection blower can be removed to gain access to the plenum to fish the object out.

1.3.4 Convection Blower Circuit

The convection blower circuit includes the blower thermodisk, the blower, and the circuit board. Action of the blower circuit can also be affected by the safety controls in the auger circuit.

P23, P28:
The P23 has 12 heat exchange tubes. The P28 has 17 tubes.

P2000:
The P2000 uses a flat angled handle for the heat exchanger cleaner, which does not fit the maintenance tool. A glove must be worn to clean the tubes while the stove is hot.

When the stove is switched On, the circuit board sends power immediately to the convection blower through the pink wire. Initially, the voltage to the blower is low; about 60 volts, so the blower runs at the slowest speed. However, once the air flow switch closes (and assuming the high temp thermodisk is also closed) the circuit board adjusts the voltage based the setting of the feed control knob. Pressing the auger button and starting the ignition sequence does not affect the combustion blower.

Once a fire is established it will heat up the blower thermodisk. This is a normally open thermodisk, which means that it does not close the circuit until it warms up. Once the thermodisk reaches about 110 °F the blower thermodisk will close, completing the connection between the purple wire, which runs from the terminal strip, and the blue wire on the other side of the thermodisk. This has no immediate effect on stove operation. As long as the stove is turned On, the circuit board will supply electricity directly to the convection blower through the pink wire. But once the switch is turned Off, the circuit board stops sending power to the pink wire.

However, if the blower thermodisk is closed, power will conduct from the purple wire, through the thermodisk and the blue wire, to the circuit board. The circuit board will supply this power to the pink wire, reducing the voltage based on the feed rate setting. This ensures that the blower will continue to run, and cool the stove, until the fire is gone. Once the thermodisk again cools below about 90 °F it will open the circuit and shut the blower off. (The blower will run indefinitely, regardless of temperature, if the On/Off switch is left On.)

If either the air flow switch or the high temp thermodisk opens during stove operation, the circuit board will sense the malfunction. The board will reduce the voltage to the convection blower to the minimum, so it runs at the slowest speed. The blower will continue to run until the blower thermodisk cools, and the stove is turned Off.

1.4 Safety Controls

Every Breckwell stove includes several safety controls which monitor the operating condition of the stove and, if necessary, act to shut down combustion to avoid development of a hazard. Because safety is integrated into every aspect of the stove's operation, these controls have also been discussed in other sections. This section will go into more detail about how these controls work, their effects, and how to diagnose a safety-related problem.

The main safety controls are the air flow switch and the high temp thermodisk, with the circuit board serving as the brains of the safety system. (The auger thermodisk and blower thermodisk also serve safety functions, but they are discussed in the context of the other component systems.)

1.4.1 Air Flow Switch

Because the Breckwell stoves utilize a powered negative pressure combustion system, it is important that negative pressure be maintained in the combustion zone. (See the section on the Combustion System, Section 1.2, for a full discussion on how the negative pressure system works.) Without sufficient negative pressure the pellets will not be properly burned. More important from a safety standpoint, a loss of negative pressure could cause the escape of combustion products into the home.

The air flow switch is actually an air *pressure* switch. It uses a flexible diaphragm which responds to the difference between the pressure inside the stove and the surrounding air. If the negative pressure in the stove is strong enough the diaphragm flexes to make an electrical contact which closes a circuit. If the negative pressure falls too low, the diaphragm pulls away, breaking the electrical contact.

The air switch is connected to a tap on the exhaust manifold by a red rubber tube. The tube must be securely attached to both the manifold tap and the barb on the side of the switch, or the pressure in the combustion zone will not be properly monitored. The tube includes two small intentional holes. These can be covered or uncovered to adjust the sensitivity of the air switch to the installation and climatic conditions.

The air switch closes when the negative pressure reaches approximately 0.15 inches of water column (inWC; 37 Pa). It will remain closed until the pressure falls below about 0.1 inWC (25 Pa). It is important to understand that these are the pressures sensed by the switch in the exhaust manifold; pressures at other points in the combustion system will almost certainly be different. In order to use these pressures for diagnosis, you must be prepared to measure the pressure directly at the air switch. This will be discussed in a later section.

The air switch is actually part of a branch of the internal circuitry of the circuit board. It is connected by a white wire to the circuit board. The other terminal of the air switch is connected by a gray wire to the high temp thermodisk on the neutral side of the auger motor circuit.

1.4.2 High Temp Thermodisk

The high temp thermodisk is attached to the outside of the convection air plenum. Its purpose is to monitor the temperature of the stove and shut down combustion if an overheat situation develops. As long as the convection blower is running, and air is moving freely through the plenum, the stove should be kept cool enough that the high temp thermodisk should not be activated.

The thermodisk is actually a part of the auger circuit. The gray wire leading from the neutral side of the auger motor is attached to one side of the disk, while the white wire attached to the other side leads to the neutral side of

the terminal strip. In order for the auger to run, the thermodisk must complete the connection between these two wires.

The high temp thermodisk is normally closed, which means that under normal conditions it makes the connection between the gray and white wires, and the auger can run. The thermodisk opens if it reaches about 300 °F. This breaks the circuit and immediately stops the auger motor. As discussed below, the circuit board also detects the interruption of the circuit and takes additional steps. The thermodisk will not close again until the temperature drops below about 250 °F.

1.4.3 Operation of the Safety Controls

When the stove is first turned On, the internal cicuitry of the cirucit board is energized. The white wire which leads from the circuit board to the air flow switch serves as the neutral leg for this circuit. Since the air flow switch is still open, no electrical connection is made, and the circuit board remains in a "standby" mode.

Simultaneously, the circuit board turns on the combustion blower, and the convection blower is turned on at low speed. As the combustion blower speeds up, it creates negative pressure in the manifold. When the pressure is sufficient, the air switch closes, completing the connection from the circuit board, through the air flow switch to the high temp thermodisk. If the thermodisk is closed (which it should be, if the stove is not overheated) the connection is complete through the thermodisk to the white wire which joins the other side of thermodisk and the neutral side of the terminal strip.

The completion of this circuit signals the circuit board that the stove is ready to operate. The speed of the convection blower is increased, depending on the current setting of the feed rate knob. If the auger button is pressed, the green light on the control panel will come on, and power will be sent to the auger circuit and the firestarter circuit.

However, if either the air flow switch or the high temp thermodisk opens, the circuit board's circuit will be interrupted. The circuit board will respond to this by shutting down the auger circuit and firestarter circuit. The circuit board will also reduce the voltage to the convection blower to make it run at slow speed. Operation of the combustion blower is not affected.

If the problem that caused the interruption is corrected (that is, pressure is restored, or the thermodisk cools), the circuit board will restore the convection blower to its normal speed. However the auger circuit is not automatically reenergized. The auger button must be pressed again, which initiates a full ignition cycle.

1.4.4 Recognizing Air Switch and Thermodisk Problems

An unexpected shutdown of the fuel feed system can be an annoying problem, and it can be difficult to diagnose the reason. However, some simple observations can point you in the right direction.

When the auger circuit is active the large green light on the control panel will be glowing. The light comes on as soon as the auger button is pressed, and will remain on until the circuit is interrupted or the stove is shut off. If pellets stop feeding, but the green light is still on, the circuit board is still sending power to the auger circuit.

In rare cases the auger thermodisk can cool to the point that it interrupts the circuit. For practical purposes this can only happen if the fire goes out due to insufficient pellet delivery or excessive combustion air. If this happens the green light will still be on.

If the auger stops feeding and the green light goes off, this almost certainly means that the air switch or high temp thermodisk has interrupted the circuit. This indicates the occurrence of a potential safety problem which, if not corrected, could lead to a hazard. The reason for the shutdown should be investigated before putting the stove back in service.

There is a simple way to tell if the air switch or thermodisk is responsible for the interruption. Press the manual feed switch on the control panel. If the auger motor runs and feeds pellets, the air switch is the culprit. If the auger does not run, the high temp thermodisk is open.

1.4.5 Causes of Air Switch Problems

The Troubleshooting and Diagnosis section of this guide contains orderly, step-by-step procedures for tracking down air switch problems. What follows is a more general discussion of the reasons the air switch may be indicating a problem.

True cases of inadequate negative pressure usually boil down one of four causes:

- **Leaks** on the negative pressure side of the combustion blower;
- **Obstruction** of the venting system;
- The combustion blower running **too slow**;
- **Altitude** or other environmental conditions.

Leaks on the negative pressure side of the blower usually involve the stove door or gasketing around the glass. Sometimes the gasketing where the combustion blower joins the exhaust manifold can deteriorate and allow leakage. Inspect the fit of the door and check all gaskets. You can often use a butane lighter to detect locations where air is being drawn into the stove.

Less commonly, an improperly mounted burnpot or cleanout shutters left open can reduce the negative pressure detected by the air switch.

Obstructions of the venting system can include an overly long or complex pipe configuration or the presence of combustion deposits or foreign objects. Wind pressure against the side of the house with the vent termination can also have this effect. A quick way to tell if the venting system is the source of the problem is to detach the vent pipe from the stove's flue collar (don't ignite the pellets!). If the green light will now come on, or the convection blower will run at full speed, the vent system is probably the source of the problem.

The combustion blower can run too slow if it is not supplied with full voltage, or combustion deposits have fouled the impeller or are causing friction. The Troubleshooting and Diagnosis section includes procedures for checking the blower voltage and inspecting for deposits.

At higher elevations there will be less difference between the negative pressure inside the manifold, and the ambient air. Also, the magnitude of the negative pressure detected in the manifold will decrease significantly as the fire is established and the stove warms up, due to the expansion of hot gases. Either cause can create marginal conditions where even a small leak or vent obstruction can result in inadequate pressure. It is still best to try to fix the leaks first. However, if you are satisfied that the stove is reasonably tight and the vent is proper, you may be able to adjust the pressure that the air switch actually sees.

You should first make sure that the air switch itself has not gone bad. The best way to do this is to measure the pressure at the end of the red pressure tube. Use a manometer capable of reading in the range of zero to 1 inWC (248 Pa), preferably with a resolution of 0.05 inWC or less. Detach the red tube from the air switch, and insert a 1/4 inch metal tube connected to your manometer hose into the end of the red tube. Make sure that the metal tube is tight inside the red tube, but do not insert it past the holes in the side of the tube. Turn on the stove and read the manometer. If it indicates at least 0.3 inWC (75 Pa) with the stove cold, the pressure is probably OK, and you should suspect a problem with the switch.

If the pressure is below this value, the switch is probably doing its job, and you may need to boost the pressure that it sees. You can cover one of the holes in the red tube with tape to increase the negative pressure. If one hole is already taped, you can tape the second one, but don't tape both unnecessarily.

See the Troubleshooting and Diagnosis section for more details on this procedure.

1.4.6 Causes of High Temp Thermodisk Problems

Unless the thermodisk itself has gone bad, the cause of a thermodisk shutdown is simple and straightforward: the stove is too hot. This is almost always due to the convection blower not running or not running fast enough

for the combustion rate. Less frequently, blocked air passageways or heat exchange tubes can reduce the air flow to the point that the stove gets too hot.

If the blower is not running you need to inspect the wiring of the blower circuit and check to see if the blower's thermal protection has shut it off. Also check to see that some foreign object has not jammed the blower. If the blower will not run at full speed even after the stove has cooled there may be a problem with the circuit board.

In rare instances the high temp thermodisk can get stuck in the open position, which will render the stove inoperable. See the Troubleshooting and Diagnosis section for procedures and tests to track down thermodisk and convection blower problems.

1.4.7 The Circuit Board

The circuit board is the brains of the stove. Its job is to control the various operations and cycle sequences, and to respond to feedback from the various stove components. All systems comes together at the circuit board; if something goes wrong with the board, the stove will not operate or will not operate correctly.

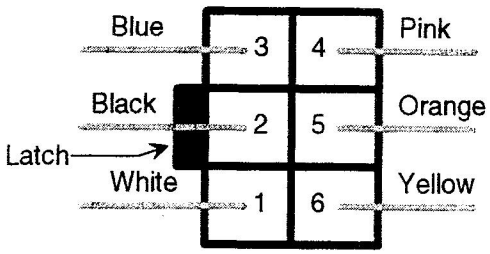
The circuit board is mounted to the control panel, and under normal circumstances is not visible. However, the switches and knobs on the front of the control panel connect directly to the circuit board. These switches should not be abused, or damage to the circuit board is possible. As with all electronic devices, the circuit board is vulnerable to power surges, and it can be permanently damaged by lightning and short circuits.

With the exception of the auger circuit fuse mounted on it, the circuit board is not designed to be field-serviceable. If something goes wrong with the board itself, you can't fix it, and the only fix is to replace the board. However, replacing the board without being sure that the board is really the problem leads to unnecessary consumer expense, callbacks, and unhappy customers. You should not replace the board unless you have eliminated all other explanations for a problem. The Troubleshooting and Diagnosis section contains procedures for determining if a bad board is the cause of the stove operating problem.

The circuit board has two points of electrical connection: the Molex connector and the firestarter wire. The female end of the Molex connector is permanently attached to the bottom of the board. The male end of the Molex connector is attached to the end of the wiring harness, which distributes power to the various component circuits. For proper operation, the male connector must be fully inserted into the female. To disconnect the connector, press down on the levered latch on the side of the male, and gently wiggle the connector free.

The wiring pattern of the connector must be correct in order for the stove to work properly. There are six "cells" in the connector, which can be numbered 1 through 6 (the numbers are not printed on the connector itself.) The wires enter the back of the connector as shown in the diagram. When examining the connector, make sure you are looking at the connector with the latch to the left, as shown in the diagram.

Wiring Pattern of Molex Connector
(Viewed from back)



While it doesn't happen often, it is possible for the wires to come loose where they enter and attach to the male Molex connector. While this can be repaired in the field, a special tool is required. If you find such a problem, contact the factory for advice on whether repair or replacement of the wiring harness is the best course.

On 1997 and later versions of the circuit board, the firestarter attaches directly to a blade terminal at the bottom of the board. There are two blades at the bottom of the board, on the left and right side.[P23] For stoves with a remote firestarter circuit board, the firestarter wire attaches to the blade on the *left* (viewed facing the back of the board, with the blades at the bottom.) For stoves without the remote firestarter board, the wire from the firestarter element attaches to the blade on the *right* side.

P23:
Since the P23 can use *only* the remote firestarter board, there is only one blade on its main circuit board. Also, there are no jumper pins and a shunt does not need to be used.

There is a set of three jumper pins on the back of the circuit board, near the right edge in the lower half of the board.[P23] A small black jumper (or "shunt") needs to be placed over one pair of these pins, depending on the status of the firestarter. When there is no firestarter attached, or if the remote firestarter board is used, the jumper needs to be placed over the *lower pair* of pins. If no firestarter is present, this will prevent the auger from feeding pellets until a fire has been manually established and the auger thermodisk closed. If the remote firestarter board is used, it will coordinate the auger feed and energize the firestarter during the startup procedure.

For stoves with the firestarter directly attached to the main circuit board (no remote board), the jumper needs to be placed over the *upper two* pins. with the jumper in this position, the main board will coordinate the startup sequence. This will permit the auger to feed pellets to the burnpot, where they can be automatically ignited by the firestarter, as soon as the auger button is pressed.

P23:
The P23 circuit board does not have an auger circuit fuse.

The circuit board includes a fuse to protect the auger circuit.[P23] This fuse will blow if a short circuit occurs in the auger circuit. The fuse will also blow if something causes the auger to run constantly. This could be a malfunction of the control circuit, but it could also result from operating the auger off the manual feed switch for too long (more than about one minute). If this fuse is blown, replace it with a Bussman .75 or 1 AMP, slow blow, 250V, MDL 3/4 fuse (or equivalent).

There are two green lights on the control panel which indicate the status of the systems, and which can be very useful in diagnosing operating problems. The larger green light indicates whether or not the auger circuit has been activated. This light should come on as soon as the auger button is pushed, and remain on until the stove is turned Off. If the green light is off, or does not come on when the auger button is pushed, the possible causes of operating troubles can be narrowed down considerably. The Trouble-shooting and Diagnosis section uses the status of the green light extensively to help track down problems.

The smaller green light[P23] is on only when power is actually being sent to the auger motor. You can use this light to examine the timing of the auger feed cycles. If the auger timing is working correctly, the light should blink on once every approximately 15 seconds. The length of time that the light is actually shining indicates the time that the auger is actually turning. This timing depends on the setting of the feed control knob, and ranges from about 0.7 to 4.5 seconds. The following table shows the range of acceptable auger on time during each 15 second cycle, for each feed control setting, for the P24, P2000, and similar stoves.

P23:
On the P23, the auger timing light is the same size as the other green light, and is visible at the upper left corner of the control panel.

Auger On Time During Each Cycle (Most stoves)					
Low	**B**	**C**	**D**	**E**	**Max**
0.7 - 1.3 sec.	1.1 - 1.7 sec.	1.8 - 2.4 sec.	2.6 - 3.2 sec.	3.8 - 4.4 sec.	4.2 - 4.8 sec.

Other stoves and circuit boards have different total cycle times and auger on times for each setting. Timing charts for each of these stoves is included in Section Four.

The timings for settings B and above are not adjustable in the field. If the actual timing differs significantly from the above chart, and the customer is having difficulties achieving an acceptable burn rate, the circuit board will have to be replaced. However, the timing of the Low setting can be adjusted, if the customer is having trouble holding a fire on the Low setting, or if the burn rate is too high at the Low setting. On the back of the circuit board, near the top right corner,[P23 etc.] there is a potentiometer for setting the Low timing. To decrease the auger on time, turn the pot 1/4 turn counter-clockwise. To increase the auger on time, turn the pot 1/4 turn clockwise.

P23 etc.:
On the P23 and other stoves with the small circuit board, the potentiometer is located near the middle left of the board.

The circuit board includes a provision for connecting an optional millivolt remote thermostat. A pair of terminals for connecting the thermostat wires is located along the left edge of the board, in the upper quarter of the board. Connection of a thermostat is discussed in detail in the section on Accessories and Optional Equipment.

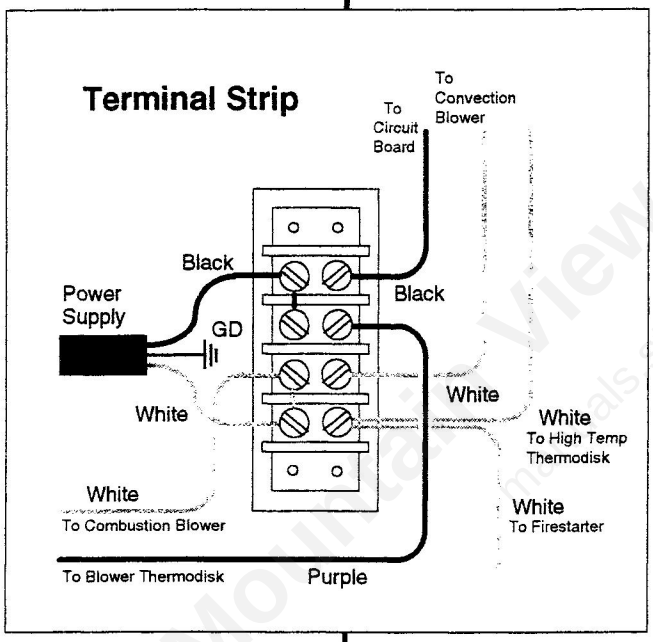
1.4.8 Electrical Power Supply

The electrical power supply must be proper in order for the stove to work properly, and in some cases in order for it to work at all. The vast majority

of homes provide power which is fine for use with a pellet stove, but sometimes the power supply needs to be examined as a possible cause of a stove malfunction. The power supply system for a Breckwell stove starts at the end of the power cord that plugs into an electrical outlet, and includes the power cord, the terminal strip inside the stove, and the wires that connect to the strip.

Breckwell stoves are designed to use a standard household power supply. With all blowers and motors operating, the stove will pull approximately 4 amps at 120 volts, and can be plugged in to a standard 15 amp lighting outlet. With the firestarter also operating, the stove pulls about 5 amps.

The outlet *must* be grounded. Never remove the ground prong from the stove power cord, and never use an ungrounded "cheater" adapter. If the household outlet does not have three prongs, a separate wire can run from a three-prong adapter to a *proven* ground, such as a screw on the outlet box. Grounding of the stove is very important, since an electrical fault within the stove could lead to the entire metal stove body becoming energized.



The voltage of the household power supply is also important. Breckwell stoves are designed to run off of 120 volts AC, with no more than 5 percent variation. Inadequate voltage can lead to circuit board problems and to improper operating speeds for blowers and the auger motor.

The household outlet must be properly polarized; that is, the "hot" and neutral wires must be in the proper position. On a properly polarized outlet, the smaller blade hole should be "hot". You can check this with an inexpensive outlet tester, or with a multimeter. Place one multimeter probe into the smaller outlet hole, and place the other in the ground hole. If this does not result in a reading at or near 120 volts, there is either a problem with the polarity or the ground; this outlet should not be used until repaired.

The power cord, and internal stove wiring, must be properly connected to the stove's terminal strip. The terminal strip is divided into two sides: a "hot" side and a neutral side. The black wire from the power cord, and the black and purple wires that supply power to the stove, should be connected to the "hot" side. The white wire from the power cord, and the while wires to the neutral sides of stove components, should be connected to the other side. The green ground wire from the power cord should be securely connected to a screw on the side of the terminal strip mounting flange. The wiring of the strip should be the same or similar to that shown in the diagram.[P28]

P28:
The P28 uses capacitors to start the blowers, and so has blue wires from each blower connected to the neutral side of the terminal strip. See the wiring diagram in the stove manual for details.

All wires connected to the terminal strip should be held firmly in place and screws should not be loose. All wires throughout the stove should similarly be securely fastened to their point of attachment. Wire-to-wire connections are made with insulated spade connectors, which normally make a very good connection. However, while diagnosing an electrical problem it is wise to make sure that the wire is held by the crimped side of the connector.

Wires are also attached to thermodisks and other components with spade connectors. While checking wiring, make sure that the connector is firmly seated all the way onto the terminal. Where two wires attach to one side of a thermodisk, a chair connector is used. These function the same as the standard spade terminals. However, the chair terminals sometimes have a residual glaze-type finish which can insulate the connector from the terminal. If you find that an electrical connection at a chair terminal is not reliable, or changes if the connector is wiggled, remove the wires and use a fine sandpaper to burnish off the finish.

1.5 Stove Exterior

1.5.1 Glass Door

Unlike a wood stove, the door on a pellet stove does not need to be opened frequently -- normally just for removing ashes. Therefore, most of the time the door is really functioning as part of the firebox wall, and needs to perform as part of the combustion system. The essential parts of the door include the hinges and latch, metal frame, the glass, the air wash system, and various gaskets.

The door is mounted with simple hinge pins and can be removed by unlatching it and lifting upward. The latch mechanism uses a cam to pull the door tight up against the stove body, and is spring-loaded to provide proper tension. To increase or decrease the spring tension, the two jam nuts at the end of the handle rod can be loosened and repositioned as necessary.

The door frame is made of cast iron and plated with 24 carat gold. Unless it is subjected to extreme abuse, the door frame should not warp or break, and field service is unlikely. The gold plating must be cared for properly. It should be cleaned only with a soft cloth and water or a nonabrasive metal polish; abrasive cleaners of any sort should never be used.

The glass is a high temperature ceramic which will withstand both extreme temperature gradients and impact. The glass is held against the door frame with several retaining brackets and by the air wash plate on the bottom. A continuous woven fiberglass gasket is sandwiched between the glass and the frame on the top and sides. If the glass needs to be replaced, use a Torx screwdriver to remove the retaining brackets and air wash, and carefully remove any broken glass and small shards. Mount the new glass carefully, making sure that the gasket is in place and continuous around the top and

sides, and that there is a slight gap between the glass and door frame on the bottom.

The exterior of the glass can be cleaned with any standard nonabrasive glass cleaner. The interior of the glass may accumulate some dusty soot during normal operation, and should be wiped clean once a week. If more resistant deposits, such as creosote, adhere to the glass, a commercial wood stove glass cleaner can be used.

The air wash plate is carefully designed to admit the right volume and velocity of air to keep most combustion products away from the glass. In order to work it must be correctly mounted and undamaged. If you find significant deposits on the glass of a properly operating stove, or uneven patterns of deposits, the air wash may need attention. Make sure that it is properly mounted and not bent or distorted. Make sure that nothing is obstructing the space between the plate and the glass or between the bottom of the glass and the door frame. with the combustion blower operating and the door closed, the flame of a butane lighter should be drawn into the space between the glass and the frame across the entire bottom of the glass.

Because the air flow in a pellet stove must be so carefully controlled, the gaskets on the door are important. They must be continuous and in good condition. There are two gaskets on the door: between the glass and the door frame, and between the door and stove body. Replacement gasket is usually locally available. The door gasket is 5/8 inch firm, round woven fiber, and is simply pushed into the channel around the perimeter of the door. The glass gasket is 1/8 by 3/8 inch woven fiber tape with adhesive backing. This gasket should be carefully applied around the top and sides of the opening in the door frame, and should not cover the bottom air wash.

With good gasketing in place and the door properly adjusted, very little air should leak in around the door frame and glass. If the gasketing is worn or has gaps, or the door is misadjusted, the air leakage could reduce the negative pressure in the firebox to the point where the air flow switch shuts the stove down. To test for a proper seal around the door, insert a dollar bill between the door and frame at all points around the frame. You should not be able to pull it out without difficulty.

1.6 Accessories and Optional Equipment

A number of accessories and options are available for Breckwell pellet stoves. Those which could need service, or which could play a part in an operational problem, are discussed here.

1.6.1 Wall Thermostat

P23 etc.:
The P23 and some older models do not contain a provision for attaching a thermostat.

Breckwell itself does not provide a thermostat as either standard equipment or as an option. However, the circuit board includes a provision for connecting a thermostat obtained locally.[P23] This must be a millivolt type thermostat.

Instructions for installing and connecting the thermostat are included in Section 3.6.1. From a service and troubleshooting standpoint, incorrect placement of the thermostat jumper (or "shunt") can cause improper or erratic operation. There is a set of four pins near the thermostat wire terminals at the upper left of the circuit board. When no thermostat is present, the jumper should be placed over the *top two* pins. If a thermostat has been installed, the jumper should be moved to the *lower two* pins. If this jumper is not set correctly the thermostat will not work. If the jumper is set incorrectly with no thermostat present, the following behavior will result:

- If the jumper is on the lower two pins, the convection blower will only run at low speed, and the auger will feed only at the lowest rate, regardless of the setting of the feed rate knob.
- If the jumper is on the middle two pins, the feed rate will be normal, but the convection blower will run only on low.
- If the jumper is not present or connected to only one pin, the stove will not work or will operate unpredictably.

With a thermostat installed and the jumper properly set, there are some intentional differences in the way the stove will operate:

- The thermostat will *not* start the fire! It will control the heat output of the stove once a fire is started, but the fire must still be started in the conventional manner. The thermostat should be turned to a high setting, to make sure its contacts are closed, while starting the stove. Once a fire is established (abut 10 minutes), the thermostat can be adjusted to maintain the desired temperature.
- When the thermostat is not calling for heat, the pellet feed rate will be automatically adjusted to the low setting, regardless of the setting of the feed rate control knob. The convection blower speed will be reduced to the minimum.
- When the thermostat calls for heat, the pellet feed rate (and convection blower speed) will be increased to the rate set by the feed control knob.
- When the stove is controlled by the thermostat, feed rate settings of E and Max will feed pellets at the same rate as setting D. This change will be reflected in the auger timing cycles (see the description of auger timings in the Circuit Board section.)
- The feed rate for the Low setting, or settings B through D, will not be changed.

If you are investigating a problem related to the stove not operating predictably or at the expected heat output, always check the circuit board to make sure that the jumper settings are correct and that the thermostat wires are securely connected to the terminals. Also, make sure that the customer understands how the stove is *supposed* to operate under thermostat control, so that they don't mistake intended operation for a malfunction.

1.6.2 Retrofit Firestarter

Since mid-1997, all Breckwell pellet stoves except the P23 series have included the Hot Rod firestarter as standard equipment. The firestarter can be added to the P23, or previous versions of other models, without a great deal of trouble. Detailed instructions for retrofitting a firestarter are included in Section 3.6.2. Once installed, it will function just as if it had been installed as original equipment, and the diagnostic and trouble shooting procedures are the same as explained in other sections of this guide. The discussion below give background information and highlights some service issues which might arise from incomplete or improper installation of the firestarter.

Breckwell provides two types of firestarter: one which connects directly to the main circuit board and is controlled by it, and one which uses a remote circuit board. Both systems use the same Hot Rod firestarter element. The P23 series stoves can *only* use the system with the remote firestarter board. Other stove models may be able to use either type, depending on the type of main circuit board in the stove and when the stove was produced. All stoves produced prior to 1996 use the remote circuit board; most stoves produced since 1996 (except the P23) have connections for either system.

On main circuit boards that can accept either type of firestarter, proper connection of the firestarter wire, and placement of the jumper (shunt) is important. Some boards will have two blade-type terminals for connection of the wire. Other boards will have a red-striped white wire coming off the board, as well as a blade terminal. Both boards will have a set of three pins near the right hand edge (looking at the back of the board). A jumper needs to be placed over either the upper two, or lower two of these pins. The following table shows how these connections are made, depending on the type of main circuit board and firestarter.

Connection of Firestarter to Main Circuit Board

Circuit Board Type	Remote Firestarter	Direct Firestarter
1996: With red-striped wire and one blade terminal	Connect to red-striped wire. Jumper on lower two pins.	Connect to blade terminal on right side of board. Jumper on upper two pins.
1997: With two blade terminals	Connect to blade terminal on left side of board. Jumper on lower two pins.	Connect to blade terminal on right side of board. Jumper on upper two pins.

These connections affect how the stove operates and can lead to unsatisfactory results if not done properly. If you are investigating a complaint where the firestarter does not heat up, or the auger does not feed pellets during startup, check to see that the connections have been made as shown in the table.

1.6.3 Ceramic Log Set

The P28 series stoves have a ceramic log set as standard equipment. The log set is available as an option on other models. Installation of the logs is simple and straightforward, but they must be properly positioned to avoid combustion problems.

The logs must be centered in the stove and pushed *all the way to the back* to make sure that the hole in the logs is over the burnpot. If the logs are out of position, they can prevent pellets from falling into the burnpot. Also impingement of the flames against the logs will contribute to a dirty, inefficient burn, and can cause deposits on the glass and in the venting system.