Furnace Installation and Owners Manual

A-MAIZE-ING HEAT

LDJ Manufacturing,Inc. • Pella, IA

Model LDJ620-9 Furnace

Model LDJ620-10 Furnace

Model 14 Bin

Made in America to Heat American Homes with American Grown Grain

LDJ620_E01_R03_2006.03

This manual explains the proper installation, operation, and maintenance of your A-MAIZE-ING HEAT® furnace. Study and understand these instructions thoroughly before installing, operating, or maintaining the furnace. Failure to do so could result in serious injury or death and/or equipment damage. Consult your A-MAIZE-ING HEAT® dealer or LDJ Manufacturing, Inc. if you do not understand the instructions in this manual or need additional information.

LDJ Manufacturing, Inc. recommends that you retain this manual for future reference of operation, maintenance, and parts information.

The instructions, illustrations, and specifications in this manual are based on the latest information available at the time of publication. Your furnace may have product improvements and options not yet contained in this manual.

LDJ Manufacturing, Inc. reserves the right to make changes at any time without notice or obligation.

Additional copies of these instructions are available from LDJ Manufacturing, Inc.

A-MAIZE-ING HEAT

LDJ Manufacturing, Inc. • Pella, IA

Furnace tested and certified by
Underwriters Laboratories

LDJ Manufacturing, Inc.
1833 Highway 163
Pella, Iowa 50219, USA

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WARRANTY

LDJ Manufacturing, Inc. warrants the A-MAIZE-ING HEAT® furnace against any defects in workmanship and materials for a period of one (1) year after the date of purchase. LDJ Manufacturing, Inc. will repair or replace as necessary any defective parts within the warranty period.

LDJ Manufacturing, Inc. warrants the heat exchanger and burner only, for a period of five (5) years after the date of purchase. LDJ Manufacturing, Inc. will replace any defective heat exchanger or burner parts free of charge within the five (5) year period. All heat exchanger and burner claims will be limited to parts only, labor is not provided.

This warranty does not take effect until the warranty registration card is sent in. If the card is not filled out and returned to LDJ Manufacturing, Inc. within 30 days of date of purchase, warranty claims on your unit may be denied. All warranty claims must be reported to the nearest A-MAIZE-ING HEAT® dealer.

DISCLAIMER OF LIABILITY

The foregoing warranty constitutes the only warranty made by LDJ Manufacturing, Inc. regarding the A-MAIZE-ING HEAT® furnace. LDJ Manufacturing, Inc. makes no warranty as to the merchantability or as to the fitness of this product for any particular purpose. LDJ Manufacturing, Inc. disclaims any and all liability for damages, consequential or otherwise, cost or expense of any sort or nature arising out of the use of the A-MAIZE-ING HEAT® furnace or any alleged defect in design, manufacture, assembly, instructions, or labeling thereof.

WELCOME TO THE A-MAIZING-HEAT® FURNACE

Congratulations on your purchase of the A-MAIZE-ING HEAT® biomass fueled furnace. We are honored that you selected the A-MAIZE-ING HEAT® furnace. The A-MAIZE-ING HEAT® furnace is the first biomass fired furnace to be listed by Underwriters Laboratories. The UL listing is your assurance of a safe and quality product.

As convenience fuels become more expensive and less abundant, corn and pellets as fuel are becoming very attractive and viable as alternative heat sources. With high energy costs it makes sense to use a heat source that utilizes a resource that is readily available and cost effective.

LDJ Manufacturing, Inc. believes that there is no substitute for safety and quality. You can have confidence that your A-MAIZE-ING HEAT® furnace will serve your heating needs now, and for years to come. We emphasize that you follow our policy of SAFETY FIRST when installing and using your A-MAIZE-ING HEAT® furnace. The installation and owners manual must be read before installing and operating your A-MAIZE-ING HEAT® furnace.

Your A-MAIZE-ING HEAT® furnace is a practical alternative heat source specifically designed for residential use. Proper care of this appliance should result in many years of service and comfort. An annual checkup by a certified HVAC service person is recommended.

If you have any problems, questions, or concerns, please contact your nearest A-MAIZE-ING HEAT® dealer, or contact LDJ Manufacturing, Inc. at 866-535-7667 for information on the dealer nearest you.

SAFETY INSTRUCTIONS

⚠WARNING **Failure to follow these safety instructions may result in serious injury or death and/or property damage.**

- Do not install or use this product unless the instructions within this manual have been carefully read and understood.
- This heating appliance must be installed in accordance with local codes.
- Installation is to be performed by a qualified installer, according to state and local codes.
- Maintain adequate minimum clearances to combustible materials (refer to “Furnace Clearances and Accessibility” on page 5).
- Install in an area with adequate air for combustion and ventilation: **a minimum of 60 cubic feet per minute.**
- Do not connect this heating appliance to a chimney flue serving any other heating device.
- Disconnect all power to the unit before performing routine maintenance or service. Before servicing, allow the unit to cool.
- Establish a regular service and maintenance schedule for efficiency and safe operation (refer to page page 18). Have a qualified service person perform tasks you are not familiar with.

⚠CAUTION **Children and adults should be alerted to potential high service temperatures of the burner door. KEEP CHILDREN AWAY!**

⚠DANGER **Risk of fire or explosion. Do not burn gasoline, oil, garbage or other flammable substances.**

⚠WARNING **Do not burn treated corn. Treatment chemicals can be unknown and their inhalation can result in serious health problems or death.**

- Do not place clothing or other flammable materials on or near this appliance.
- Ashes should be placed in a metal container with a tight fitting lid. The closed container of ashes should be placed on a non-combustible floor or on the ground, well away from all combustible materials pending final disposal. If the ashes are disposed of by burying in soil or otherwise dispensed, they should be retained in the closed container until all clinkers have thoroughly cooled.

CONTACT INFORMATION

If you have any questions about this product or its installation, please contact us:

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Website	www.cornheat.com
Email	info@ldj-products.com

INSTALLATION AND LOCATION CONSIDERATIONS

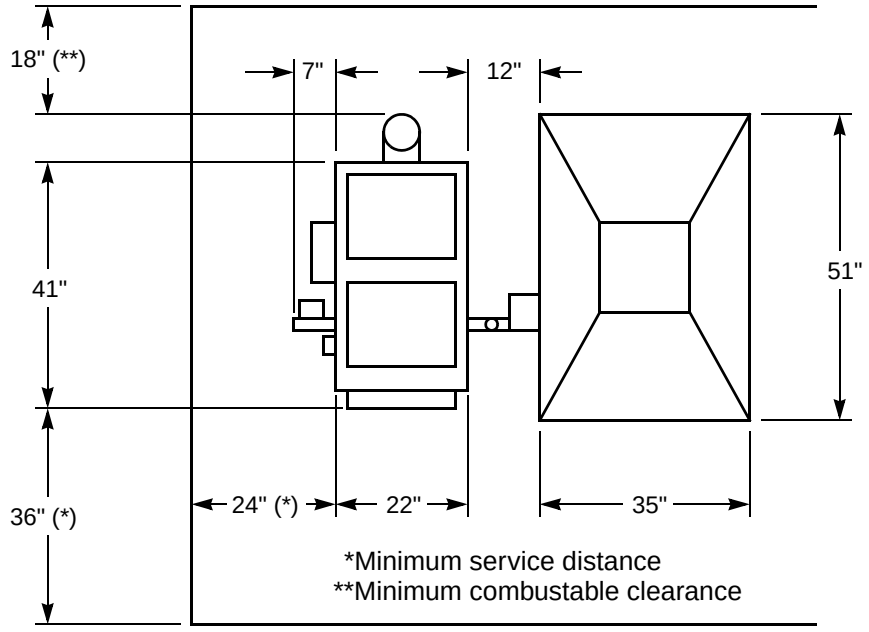
WARNING **Failure to install the A-MAIZE-ING HEAT® furnace according to the guidelines and instructions contained within this manual may result in serious injury or death, property damage, or voiding of the warranty.**

Installation Configurations

IMPORTANT: The A-MAIZE-ING HEAT® furnace is designed for use as a primary heat source furnace. It should be installed with its metal hot air plenum connected to the hot air duct work, and its metal cold air joined to the return air system.

This unit is not intended to be an add-on unit to another furnace. If you intend to use the A-MAIZE-ING HEAT® furnace in conjunction with another furnace, air back-feed prevention measures must be taken to prevent the overheating of either furnace.

Furnace Clearances and Accessibility



The following are the minimum distances the furnace may be to a combustable surface:

top	32"
either side	6"
front	30"
rear-most surface on back (furnace or flue)	18"

For ease of service, the following minimum distances are recommended:

top	32"
side opposite bin	24"
front	36"
rear-most surface on back (furnace or flue)	18"

The overall dimensions of the A-MAIZE-ING HEAT® furnace are as follows:

furnace cabinet width ..... 22"
furnace cabinet depth (with door) ..... 41"
furnace cabinet height..... 51"
widest point of furnace (cabinet + burner fan) ..... 29"
storage bin width..... 35"
storage bin depth ..... 51"
storage bin height ..... 47"
overall width when assembled (as configured above) ..... 76"

Combustion Air Requirements

⚠WARNING **Failure to provide adequate combustion air can lead to increased carbon monoxide production and increased emissions of combustion gases into the building, which may cause death or serious injury.**

The furnace must have a minumum supply of 60 cubic feet of air per minute. Consult a qualified furnace installer to analyze if the air supply is adequate. In newer air-tight homes, the combustion air may need to be brought in from the outside.

Venting

⚠WARNING **Failure to provide correct chimney venting can lead to increased carbon monoxide production and increased emissions of combustion gases into the building, which may cause death or serious injury.**

Do not connect this heating appliance to a chimney flue serving any other heating device.

Venting may be provided using a lined masonry chimney or a listed chimney (class ‘A’). The chimney has two functions:

1. To exhaust smoke and flue gases that are the result of combustion.
2. To provide “draft” to the furnace. This provides a continous supply of fresh air into the appliance so that proper combustion is possible.

Important Installation Points

- The connection from the heating appliance to the chimney must be made using 6" black pipe.
- Avoid using more than two elbows in connecting the furnace to the chimney.
- Any horizontal runs of connector pipe should have a minimum rise of 1/4" per foot of run to allow condensation to flow back to the firebox.
- A minimum distance of 18" must be maintained between the connection pipe and combustible wall surfaces.
- A minimum distance of 32" must be maintained between the connection pipe and combustable ceiling surfaces.

Masonry Chimney

An existing lined masonry chimney must be cleaned and inspected. All connections made to the chimney must comply with NFPA Standard 211 and all applicable building codes. Consult a qualified furnace installer and/or local building inspector to make sure the chimney and connections comply and are safe.

Listed Chimney

A listed chimney must be rated for a solid-fuel burning appliance and must comply with NFPA

Standard 211 and all applicable building codes. Consult a qualified furnace installer and/or local building inspector to make sure the chimney and connections comply.

For more information on venting with listed chimneys, refer to “Venting Information” on page 34.

Barometric Draft Controls

IMPORTANT: In order for the furnace to operate correctly, 0.04" to 0.06" water column of draft during low-fire operation must be established and maintained. Low-fire operation is when the thermostat is satisfied and no fuel is being augered into the burner. If the chimney draft is too high, the fire will go out. If the draft is too low, smoke may back up into the furnace and storage bin, creating a possible hazard.

The procedure for establishing the proper chimney draft will be discussed in the “Installation” section starting on page 7.

For more information on the barometric draft regulator, refer to “Barometric Draft Control Information” on page 36.

INSTALLATION

Required Tools

- Flat bit screwdrivers
- Phillips screwdriver
- 5/16" hex driver
- 3/8" hex driver
- 7/16" wrench
- 7/16" socket
- Drill and 1/4" bit

Unpacking and Setup - Furnace

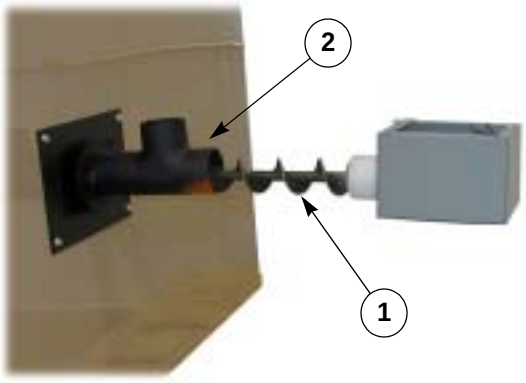
IMPORTANT: Before unpacking and assembling the A-MAIZE-ING HEAT® furnace, review the “Installation and Location Considerations” section starting on page 5 for the proper placement of the furnace and storage bin.

Step 1: Remove all shipping materials.

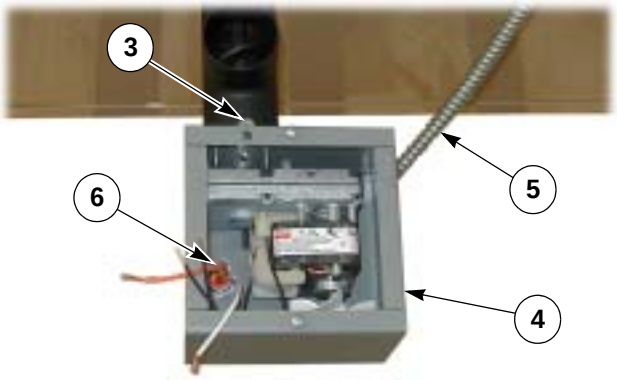
Step 2: Remove three screws holding furnace to pallet and remove furnace from pallet.

- Access one screw by removing filter door.
- Remove the other two screws from beneath the pallet.

Step 3: Remove auger motor assembly and hardware package from ash pan drawer.



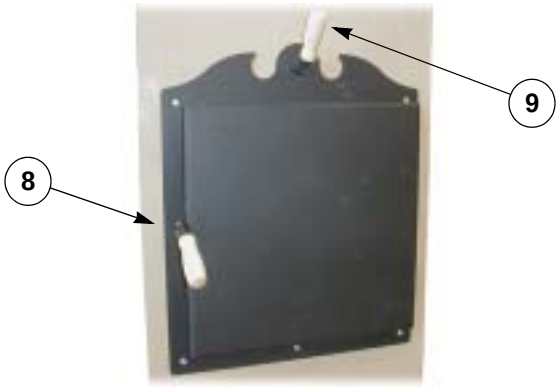
Step 4: Insert burner auger assembly **(1)** into burner auger tube **(2).**



Step 5: Secure auger assembly into position with self-tapping bolt **(3)**.

Step 6: Remove cover from auger motor housing **(4)**.

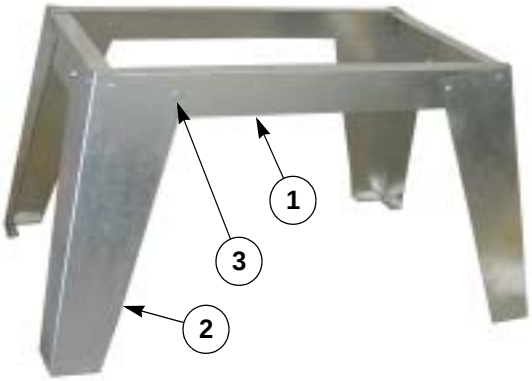
Step 7: Attach flex conduit **(5)** from electrical box on side of furnace to furnace auger motor housing with conduit lock nut **(6)**.



Step 8: Install wooden handles onto door handle **(8)** and heat exchanger cleaner **(9)** by twisting them on. **Do not drive them on**, splitting may result.

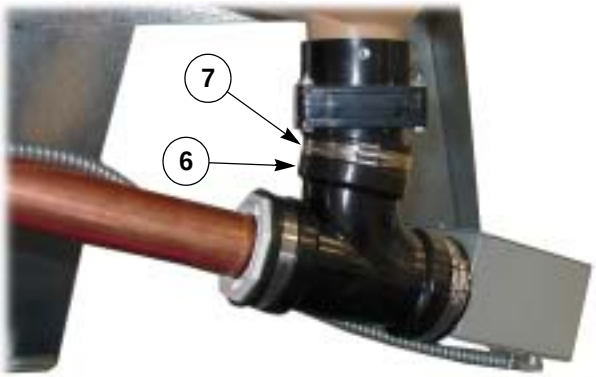
Unpacking and Setup - Storage Bin

Step 1: Remove base parts and storage bin from shipping container.



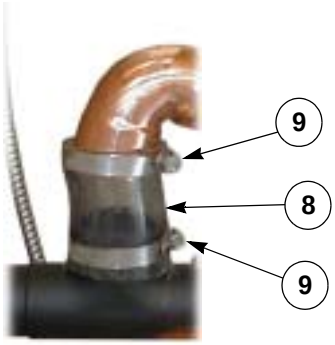
Step 2: Assemble base rails **(1)** and legs **(2)** together with sixteen 1/4"-20 x 1/2" bolts **(3)** and nuts.

Step 3: Position storage bin **(4)** on top of base **(5)**. Make sure it is level and fitted against base at all corners.

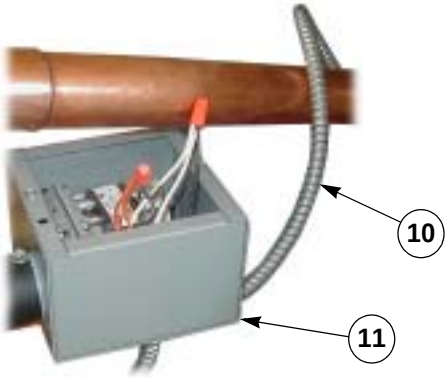


Step 4: Slide auger boot **(6)** with clamp **(7)** over bin outlet. Tighten clamp securely.

Step 5: Install two sheet metals screws through clamp, auger boot, and into the bin outlet for a permanent connection.



Step 6: Install coupler **(8)** between bin auger tube and furnace fuel inlet. Secure with two hose clamps **(9)**.



Step 7: Attach flexible conduit **(10)** from bin auger to furnace auger motor housing **(11)** with a conduit locknut.

Step 8: Connect one black bin auger motor wire to the two orange wires in the auger motor housing with a wire nut connector.

Step 9: Connect the other black bin auger motor wire to the two white wires in the auger motor housing with a wire nut connector.

Step 10: Install cover on auger motor housing.

Ducting

IMPORTANT: The hot and cold air furnace connections to the A-MAIZE-ING HEAT® furnace must not be less than 196 square inches. Any reduction in size of the connections will restrict air movement through the heat exchanger, resulting in overheating and operational problems with the furnace.

NOTE: For more information on ducting guidelines and installation, refer to “Ducting Information” on page 38.

Chimney Vent

WARNING **Failure to provide correct chimney venting can lead to increased carbon monoxide production and increased emissions of combustion gases into the building, which may cause death or serious injury.**

Do not connect this heating appliance to a chimney flue serving any other heating device.

Step 1: Make sure an approved lined masonry or listed chimney is installed for the A-MAIZE-ING HEAT® furnace. All chimneys and connections made to the chimney must comply with NFPA Standard 211 and all applicable building codes. Consult a qualified furnace installer and/or local building inspector to make sure the chimney and connections comply.

Refer to “Venting” on page 6 and “Venting Information” on page 34 for additional information.

Step 2: Make sure the furnace and storage bin are correctly placed. Refer to “Furnace Clearances and Accessibility” on page 5 for proper clearance dimensions.

Step 3: Connect furnace to chimney with 6" metal flue pipe using sheet metal screws to secure (refer to “Venting” on page 6).

Barometric Draft Control

Install the baromatric draft control according to the directions beginning on page 36. It will be adjusted (refer to “Draft Adjustment” on page 15) after the installation of the furnace is complete and a fire has been built

Draft Guage

The draft guage is installed to monitor the chimney draft measured in inches of water column. The A-MAIZE-ING HEAT® furnace requires 0.04 to 0.06 water column inches of draft.

Install the draft guage as follows:

NOTE: There are parts in the kit that will not be used in this installation.

Step 1: Remove gauge and installation accessories from box.

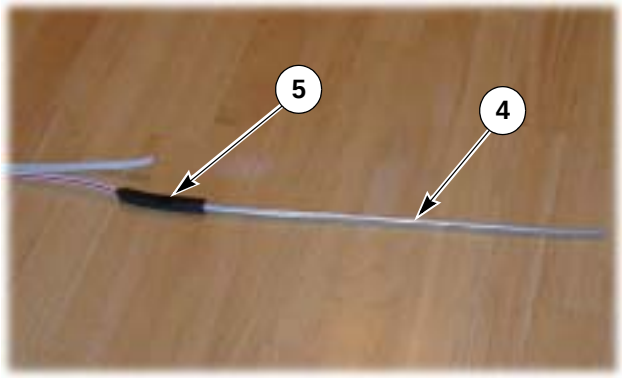
Step 2: Select an installation location close to the flue pipe where the gauge can remain level.

Step 3: Hold gauge in position and install one 1-3/4" screw through top hole **(1)**; do not fully tighten.

Step 4: Level unit with bubble level **(2)** located in face of unit and install a second 1-3/4" screw through bottom hole **(3)**; do not fully tighten.

Step 5: Check level of unit and tighten screws.

Step 6: Drill a 1/4" hole into the flue connection pipe at a location between the furnace flue connection and the barometic draft control.



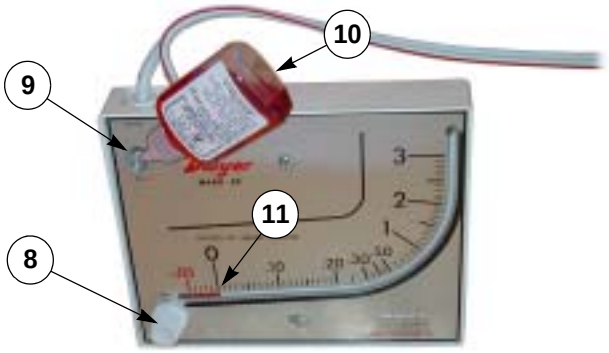
Step 7: Straighten the aluminum tube **(4)** included with the draft gauge kit.

Step 8: Uncoil the white rubber tubing and slip the black rubber connection **(5)** over one end of the aluminum tube. The other tube will just hang and be left unconnected.

Step 9: At the opposite end of the double tubing, split the two individual hoses apart for about 1-1/2".

Step 10: At the top of the unit, connect the hoses to it.

- Connect the all white hose to the port marked HIGH **(6)**.
- Connect the white hose with the red line to the port marked LOW **(7)**.



Step 11: Turn the ZERO SET **(8)** knob counter-clockwise 2 to 3 turns.

Step 12: Loosen and remove the FILL **(9)** plug.

Step 13: Open the bottle of red gage oil **(10)** and install nozzle top.

Step 14: Carefully pour oil into the FILL opening until the red gage oil reaches ZERO **(11)**.

Step 15: Re-install FILL plug.

Step 16: If the red gage oil is not exactly on ZERO, adjust it by turning the ZERO SET knob clockwise or counter-clockwise.

Step 17: Slide the aluminum tube about 2" to 3" into the hole drilled into the flue.

Step 18: The draft gauge is now ready to be used.

Electrical Connections

WARNING **Turn off electric power at the breaker box or service panel before making any electical connections. The ground connection must be completed before making line voltage connections. Failure to do so can result in electrical shock, severe personal injury, or death.**

WARNING **The furnace cabinet must be permanently grounded. A ground screw is provided in the junction box for this purpose. Failure to properly ground the furnace cabinet can result in fire, electrical shock, personal injury, or death.**

Electrical Supply

IMPORTANT: All electrical work must conform to local codes and ordinances or with the National Electrical Code. If unfamiliar with wiring and codes, have a licensed electrician perform the electrical connection.

The electrical supply to the furnace should be from a 120V, 15 amp protected circuit. Make all connections inside box **(1)**:

- Black wire to black wire
- White wire to white wire
- Ground wire (green) to ground terminal.

Thermostat

A thermostat is not included with the A-MAIZE-ING HEAT® furnace. Read and follow all directions included with the thermostat. The location of the thermostat has an important effect on the overall performance of the furnace.

The thermostat relay **(2)** is located above the electrical supply connection box. Connect the thermostat wires to terminals “R” and “W” on the relay.

The relay terminal markings are as follows:

- “**R**” - 24V power supply to thermostat
- “**W**” - Heat signal from thermostat
- “**G**” - Fan full time signal from thermostat
- “**Y**” - A/C signal from thermostat
- “**C**” - 24V common

OPERATION

Burner Lighting

IMPORTANT: Corn or pellets containing stalks, fines, dirt, etc. may cause the augers to plug, resulting in excessive wear and possible auger motor failure. Also, burning treated corn is not recommended because of increased clinker buildup and the extinguishing properties of the treatment used on the corn.

NOTE: If the furnace has ash and clinkers left over from a previous burn in the burner pot, they must be completely removed before lighting a new fire.

NOTE: Use of powdered graphite.

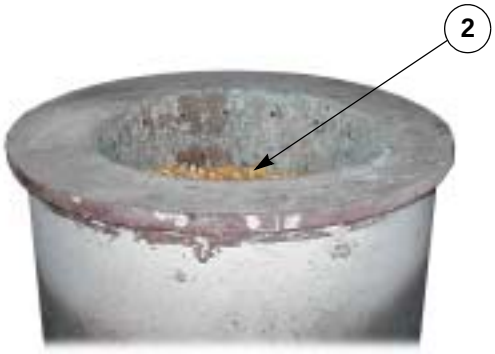
- During the initial lighting of the furnace, skip *step* 1 and only add 2 to 3 cups of corn or pellets to the storage bin.
- Then add 1 tablespoon of powdered graphite.
- Continue with *steps* 2 through 7 below.
- As this mixture feeds into the storage bin auger, repeat this procedure one more time.
- The powdered graphite will lubricate the storage bin auger until it begins to polish from the flow of corn/pellets.
- This operation should be repeated at the beginning of each heating season.
- This operation should also be repeated if the hopper is allowed to run empty and a sticky smoke film coats the storage bin auger tube.
- Powdered graphite may also be added about once a month at a time when the storage bin is low on fuel to help the auger stay lubricated and polished.

NOTE: When lighting the LDJ620-10 furnace (variable BTU output), always light it with the furnace set for 100,000 BTU output. After the furnace has run for thirty minutes, make the desired adjustments to the output. Refer to “Variable BTU Timer (LDJ620-10 only)” on page 17 for more information.

Step 1: Fill the storage bin **(1)** with dry (15% or less moisture) and clean (USDA #2 or better) corn or pellets.

Step 2: Turn on electrical power to the furnace.

Step 3: Turn the thermostat to its highest setting.



Step 4: Fill the burner pot with corn/pellets **(2)** to the lower set of air holes on the inside of the burner.

Step 5: Finish filling the burner pot with kindling wood and paper, or pelletized wood **(3)**. Gelled fire starter may be used as a substitute for the paper.

Step 6: Light fire and move the START/OFF/ON switch **(4)** to START. This will start the burner blower only (the auger motors will not turn until the furnace has reached operating temperature). Keep the switch in the START position for 5 to 10 minutes, or until you see a good even fire.

Step 7: With the fire **(5)** well started, move the START/OFF/ON switch to ON.

Step 8: Set wall thermostat to desired temperature.

Step 9: If the corn/pellets do not completely ignite, it may be necessary to add more kindling a couple of times to get it completely burning.

Draft Adjustment

After the furnace has been lit and has cycled a few times, the chimney draft will need to be adjusted.

The barometric draft control, installed in the metal flue pipe connecting the furnace to the chimney, must be adjusted so the A-MAIZE-ING HEAT® furnace has 0.04 to 0.06 water column inches of draft. Refer to “Barometric Draft Control Information” on page 36 for adjustment instructions.

The draft gauge installed earlier (refer to “Draft Guage” on page 10) will be used to set the barometric draft control.

IMPORTANT: The chimney draft should never exceed 0.06 water column inches. On extremely tall chimneys or chimneys larger than 6" in diameter, it may be necessary to install a secone barometric draft control, or to reduce the outlet opening of the chimney to approximately 28 square inches, or both to maintain the chimney draft at 0.04 to 0.06 water column inches.

Furnace Operation

Typical Operation Cycle

NOTE: After the furnace has been properly lit and the operating temperature has been reached (refer to “Burner Lighting” on page 13), only the thermostat needs to be set to maintain the desired temperature. The thermostat, furnace temperature sensors, and timers control the augers and blowers.

A typical furnace operation cycle is as follows:

Step 1: Thermostat activates fuel feed system. The combustion fan starts and the augers feed fuel into the burner (HIGH FIRE).

Step 2: Heat builds up in the furnace which activates the blower fan switch. The blower fan starts and warm air is distributed through the ductwork.

NOTE: The furnace blower has three (3) speeds.

- Low (red wire #3)
- Medium (blue wire #2)
- High (black wire #1)

All units are shipped from the factory set to the medium speed. The blower speed can be changed by accessing the 10"x10" control box on the left side of the furnace. Change blower speeds by removing the blue wire from the current speed terminal and reconnect it to the desired speed terminal.

Step 3: When the thermostat setting is satisfied, it will shut off the fuel feed system.

Step 4: To maintain the fire, a furnace timer will activate the fuel feed system for a short period of time followed by a longer period of no fan or auger activity (LOW FIRE).

NOTE: The LOW FIRE timer is factory set to cycle at 2 minutes ON and 6 minutes OFF. This is a suggested setting, but can be adjusted depending upon user experience.

Step 5: The furnace blower will continue to run until the warm air is removed from the furnace.

Clinker Buildup

The A-MAIZE-ING HEAT® furnace feeds the corn/pellets into the bottom of the burner, thereby creating conditions for efficient fuel consumption. The residual ash (clinkers) are then spilled over the top of the burner ring, falling into the ash pan below. This process cleans the burner chamber.

IMPORTANT: If the furnace is installed in an application that causes the furnace to run almost continously, or if incorrect types of corn/pellets are burned, large clinkers can form. These clinkers can stick to burner pot and eventually extinquish the fire. They must be loosened and removed with the clinker tool.

NOTE: If your furnace has been installed in an application where it runs almost continuously, and you are experiencing problems, contact LDJ Manufacturing, Inc. for assistance.

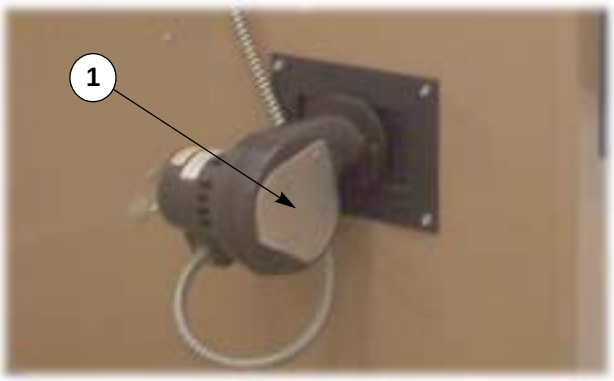
Power Failure Instructions

NOTE: If a power failure does not last longer than 20 to 30 minutes, the furnace will cycle back to operation without starting the fire. If the power failure lasts an extended period of time, the clinkers will have to be cleaned out of the burner pot and the fire restarted.

IMPORTANT: When ashes are removed from the ash pan, they should be placed in a metal container with a tight fitting lid. The closed container of ashes should be placed on a non-combustible floor or on the ground, well away from all combustible materials pending final disposal. If the ashes are disposed of by burying in soil or otherwise dispensed, they should be retained in the closed container until all clinkers have thoroughly cooled.

Summary of Settings and Operation

HIGH FIRE Adjustment

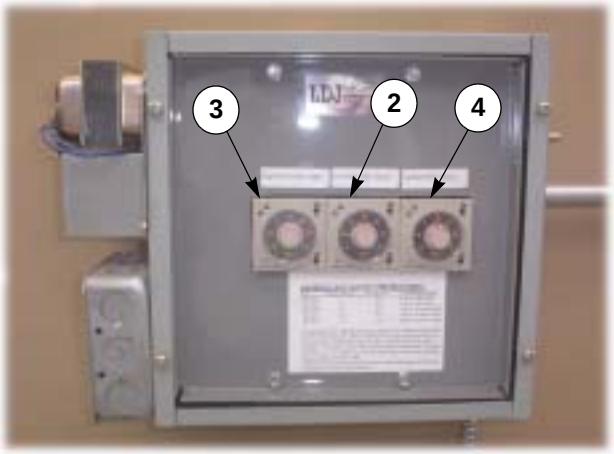


Adjustment of the combustion gate **(1)** on the side of the combustion blower controls fuel air mixture during high fire only. Only adjust this opening when the combustion blower is running. Its adjustment should yield an intense fire that consumes the fuel at the same rate it is augered in.

LOW FIRE Adjustment

The rate of burn during low fire operation is controlled by the amount of chimney draft. Chimney draft must remain below 0.06 water column inches and be consistant (refer to “Draft Adjustment” on page 15).

To maintain the fire, the low fire timer will activate the fuel feed system for a short period of time followed by a longer period of no fan or auger activity (LOW FIRE). Adjusting the on and off cycle time controls the amount of fuel going into the burner pot during low fire operation.



The LOW FIRE timer **(2)** is factory set to cycle at 2 minutes ON and 6 minutes OFF. This is a suggested setting, but can be adjusted depending upon user experience.

After approximately 24 hours of operation, a layer of ash and clinkers forms in the combustion area. After they form, the OFF time can be increased to reduce the amount of fuel consumed during low fire.

NOTE: Timer **(3)** is used for furnaces in special applications. Timer **(4)** is the variable BTU timer and is used on the LDJ620-10 only.

Variable BTU Timer (LDJ620-10 only)

Below are suggested timer settings to obtain various BTU outputs from the LDJ620-10 furnace when burning corn. The actual BTU output may vary depending upon the characteristics of the fuel being burned. Contact LDJ Manufacturing for settings for other fuels (pellets, etc.).

The green arrow indicates the number of seconds the timer is OFF ("1.5" = 15 seconds) and the red arrow indicates the number of seconds the timer is ON.

IMPORTANT: When adjusting the furnace, always start with the settings for 100,000 BTU output and then make further adjustments after the furnace has run for thirty minutes.

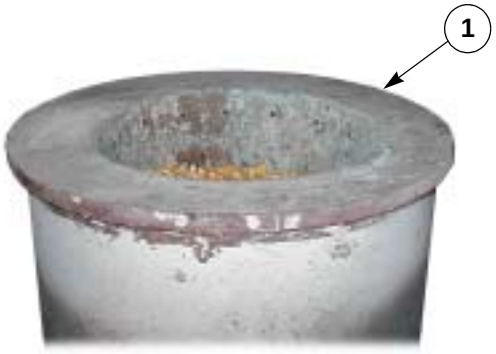
BTU Output	Green Arrow	Red Arrow	Combustion Gate
165,000	0	3.0	full to half open
132,000	1.5	3.0	full to half open
100,000	1.5	2.0	half to one quarter open
90,000	1.5	1.5	half to one quarter open
80,000	1.5	1.0	half to one quarter open

MAINTENANCE

Daily Maintenance

- **Inspect Burner**

  During use, ash and clinkers will be pushed out over the top of the burner pot **(1)** as fuel is augered in at the bottom. Clinkers that appear to be stuck to the side of the burner must be loosened with the included clinker tool.



- **Check Fuel Supply**

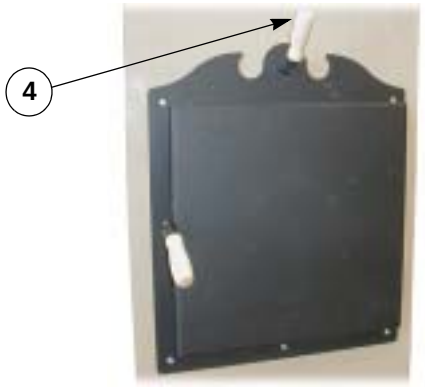
  Check level of corn/pellets in storage bin **(2)**. Refill as necessary to maintain an adequate supply.

Weekly Maintenance

- **Check Ash Drawer**

  Check ash drawer **(3)** and empty as needed. Ashes should be placed in a metal container with a tight fitting lid. The closed container of ashes should be placed on a non-combustible floor or on the ground, well away from all combustible materials pending final disposal. If the ashes are disposed of by burying in soil or otherwise dispensed, they should be retained in the closed container until all clinkers have thoroughly cooled.

- **Clean Heat Exchanger Tubes**
  Pull heat exchanger scraper **(4)** all the way out and push back in. This operation removes ash buildup on the heat exchanger tubes and maintains the efficiency of the furnace.



- **Inspect Air Filter**
  Remove door **(5)** on rear of furnace and inspect air filter. Replace as necessary.

Monthly Maintenance

- **Replace Air Filter**
  Remove door **(5)** on rear of furnace and replace air filter.

Annual Maintenance

- **Inspect Chimney Pipe**
  Remove and inspect all chimney pipe connections. Clean out ash buildup in pipes. Replace any pipe showing any signs of “burning through”.
- **Inspect Motors**
  Clean, oil, and inspect all blower and auger motors. This includes the burner fan **(6)**, main blower fan (accessed through filter door), burner auger **(7)**, and storage bin auger **(8)**.

TROUBLESHOOTING

Tips for Good Combustion

Trouble-free operation of the furnace requires clean and dry corn, correct draft, and sufficient combustion air.

Most burn problems in the furnaces and boilers are because of a few common problems. Before making any repairs, replacing components, etc. check for these common problems:

- wet corn (best moisture is 12-14%)
- dirty corn (lots of ground up corn and fines)
- wrong variety or type of corn, such as high-oil, waxy, or treated (seed corn)
- improper draft (too little or too much)
- insufficient combustion air (not enough fresh air supply, or combustion blower not open far enough).

Take the following steps to ensure best results:

- use 12-14% moisture, standard variety, clean corn from a local farmer
- make sure draft is set correctly
- make sure sufficient combustion air is supplied.

Refer to the tables below for detailed troubleshooting:

Initial Setup Quick Check

Problem	Possible Causes
Fire won't start	Initial startup may require use of kindling wood two or three times before the corn begins to burn completely.
Chimney draft too high	On tall or large chimneys, a second barometric regulator may be required, or it may be necessary to reduce the outlet opening to approximately 28 square inches.
Furnace inefficiency	Incorrect timing during low fire operation. After 24 hours of initial operation, OFF time may be adjusted. Refer to "Operation" on page 13 for timing adjustment information.
Furnace overheating	Furnace installed incorrectly. If furnace is used for add-on service, air backfeeding from the other furnace can cause overheating.
	The hot air output, or the cold air return connections have been reduced to less than 196 square inches.

Operation Quick Check

Problem	Possible Causes
Fire won't start	Leftover ash and clinker buildup from previous use.
Fire goes out	Chimney draft too high; clinkers are building up.
Furnace inefficient and has too much ash	Wet or dirty corn; not enough combustion air; not enough draft; not enough OFF time during low fire operation.

Poor Combustion

Problem	Explanation	What to do
Problems lighting fire	Leftover ash and clinker buildup.	Clean out all ash and clinkers before attempting to relight furnace.
Poor combustion	Dirty corn (especially dense fines), cobs or stalks in corn can restrict air flow preventing combustion.	Avoid dirty corn. If possible purchase corn from local farmer;
	Wet corn burns poorly	Use corn that is 12-14% moisture.
	Wrong variety or treated corn, using specialty corn.	Use of treated corn (seed corn), waxy or high oil varieties is not recommended.
	Insufficient draft can cause the unit to smoke back into the furnace and storage bin. Insufficient draft can also limit the amount of combustion air that the furnace can put back into the chamber.	Furnace requires 0.04 to 0.06 inches water column draft (chimney draft) on low fire.
	Not enough combustion air available to furnace. If the combustion blower is not open far enough, insufficient combustion air will be supplied during high fire operation (i.e. when fuel is being augered in), even if chimney draft is sufficient.	60 cubic feet per minute minimum of fresh air is required.
Clinker build-up	Burning the wrong type or quality of corn or pellets can cause excess clinker buildup due to extra materials and fire extinguishing effect. Improper installation causing the furnace to run on high fire for an extended period can also result in clinker formation	Loosen clinkers manually with a clinker tool.
Corn doesn't feed smoothly into burn chamber	Sliding surfaces can become sticky if furnace is new, has been out of service, or if the hopper has run empty (causing smoke to coat the hopper auger).	When starting the furnace initially, or at the beginning of each season, or whenever the hopper has been run empty, it may be necessary to use powdered graphite to reduce friction and allow corn to flow freely.
Augers are plugged or won't turn or hopper auger is pushing out of position	Buildup of clinkers or foreign material (possible mechanical or motor damage).	Clean out burn chamber and check operation. Use only clean corn. Do not use treated seed corn, hi-oil corn, or waxy corn.
	Corn cob or stalk is stuck in auger; furnace has smoked back through the auger tube causing a build up of sticky residue.	Clean/repair as necessary.
	Burn auger has stopped, forcing hopper auger to bind up.	Clean/repair as necessary.

Problem	Explanation	What to do
Loses fire when weather warms up or won't stay lit in low fire mode	Too much time between idle cycles **(indicated by corn burned down into the pot)**.	Try changing timer — if set at 2 & 10, change to 2 & 8 (experimentation may be necessary).
	Not enough time between idle cycles **(indicated by fire pushing out the top).**	Try changing timer — if set at 2 & 6, change to 2 & 7 (experimentation may be necessary).

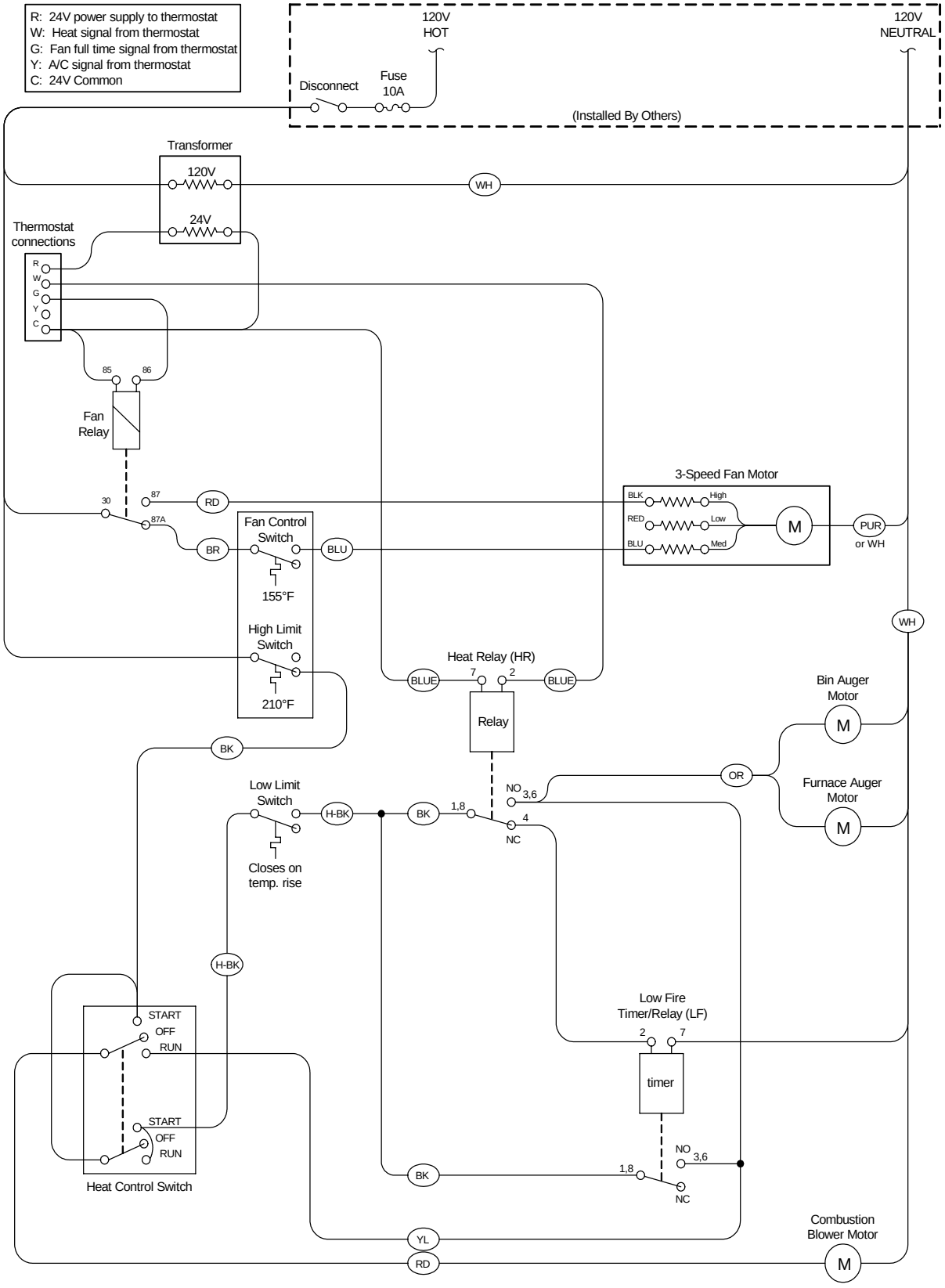
Inefficient Operation and/or Operating Too Hot

Problem	Explanation	What to do
Burns too hot / runs out of corn	Excessive draft will pull too much air through the burn chamber, causing the fire to burn faster than the corn can be supplied.	Chimney draft should never exceed 0.04 inches water column draft. Verify correct installation; install second barometric regulator if necessary (refer to "Barometric Draft Control Information" on page 36).
Furnace keeps opening high limit switch and/or is not blowing much heat through the vents	Filter dirty and restricted.	Replace filter.
	Not enough plenum or ductwork area — the hot air or return air connections have been reduced.	Maintain 196 square inches of connection area for the hot air and return air.
Loses fire when weather warms up or won't stay lit in low fire mode	Too much time between idle cycles **(indicated by corn burned down into the pot)**.	Try changing timer — if set at 2 & 10, change to 2 & 8 (experimentation may be necessary).
	Not enough time between idle cycles **(indicated by fire pushing out the top).**	Try changing timer — if set at 2 & 6, change to 2 & 7 (experimentation may be necessary).

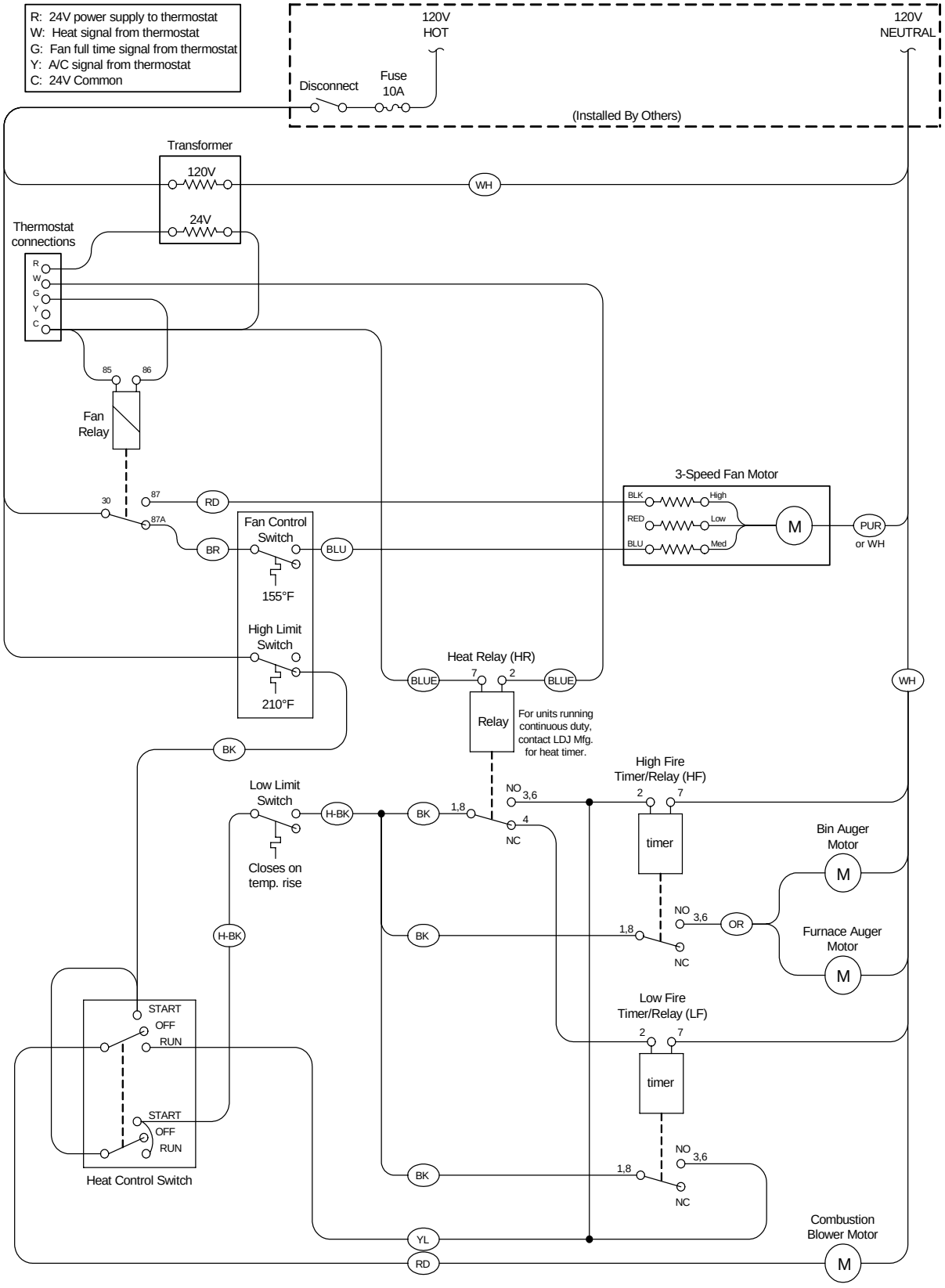
Mechanical / Electrical

Problem	Explanation	What to do
Furnace auger, bin auger, and combustion fan all do not operate	High limit switch defective or disconnected. All power for the furnace auger, bin auger, and combustion fan is supplied through the High Limit Switch.	Verify power to high limit switch. Verify high limit switch is closed when furnace is cool.
Combustion fan will operate but furnace auger and bin auger, do not operate	Variable input timer defective.	Check variable input timer.
	Low limit switch defective.	Check low limit switch.
	Defective heat relay or no HEAT signal from thermostat or defective 24V transformer.	Verify that transformer is okay. Verify HEAT signal from thermostat. Check heat relay.
	The START/OFF/ON switch left in START position after starting fire in burn pot.	Change switch to ON.
Blower fan doesn't operate	Fan control switch defective; no fire in furnace. Blower for furnace operation (usually 'MED' motor speed) won't run until fan control switch senses higher temperature.	Check fan control switch. Restart fire in burn pot.
	Fan relay contacts defective.	Check fan relay.
	Blower motor defective.	Replace blower motor.

WIRING DIAGRAM: LDJ620-9 100,000 BTU FURNACE

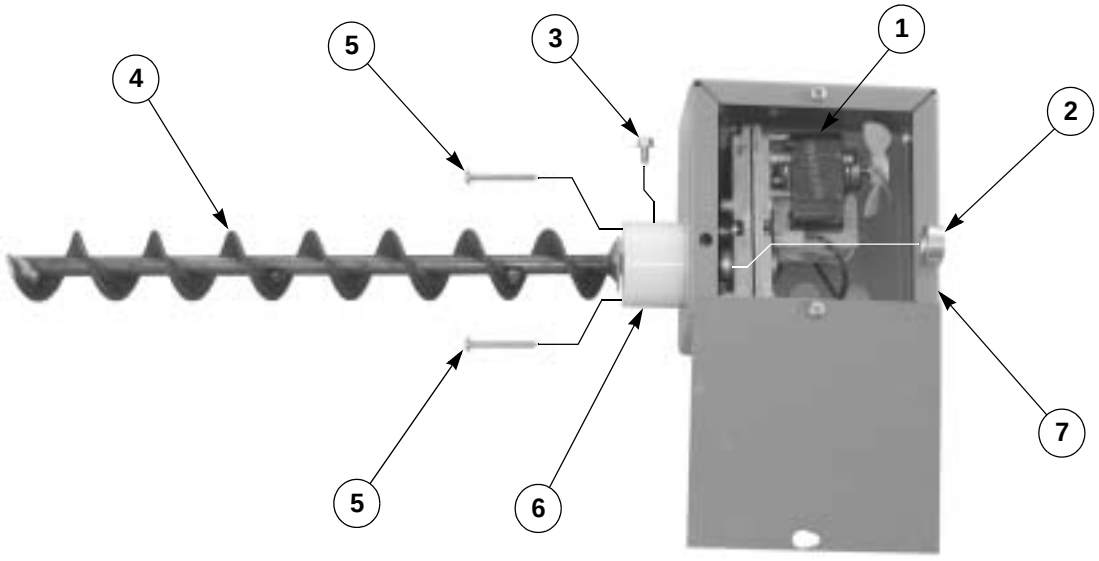


WIRING DIAGRAM: LDJ620-10 165,000 BTU VARIABLE RATE FURNACE



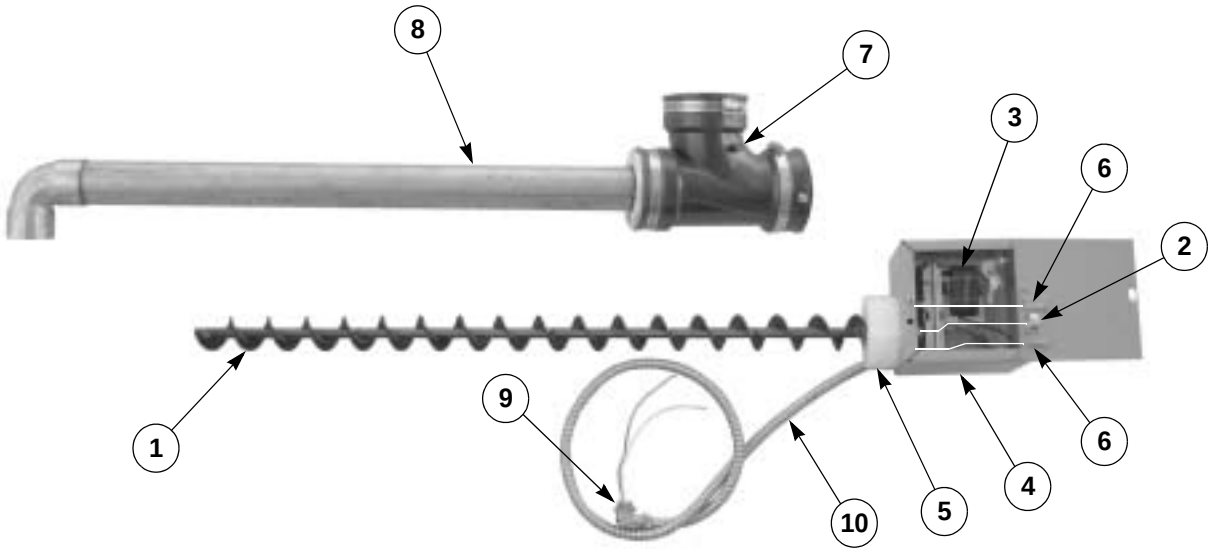
REPAIR PARTS

Burn Pot Auger



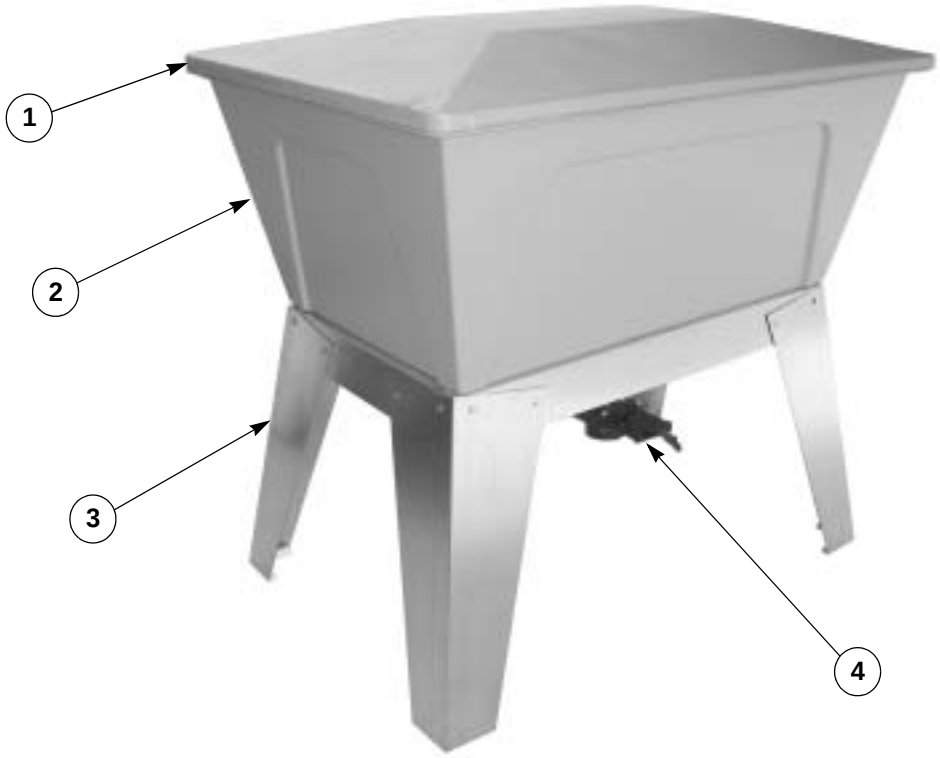
Ref	Part Number	Part Description	Quantity Used	
			LDJ620-9	LDJ620-10
1	1900	Burn Pot Auger Motor - 4 rpm	1	—
1	2000	Burn Pot Auger Motor - 6 rpm	—	1
2	3180	Lock Collar	1	1
3	1980	Bolt, 1/4" x 1/2" Self Tapping	1	1
4	3200	Burn Pot Auger Flighting	1	1
5	2070	Screw - Sheet Metal, #10 x 1-3/4"	2	2
6	3000	Auger Support	1	1
7	1410	6" x 6" Box	1	1

Hopper Bin Auger



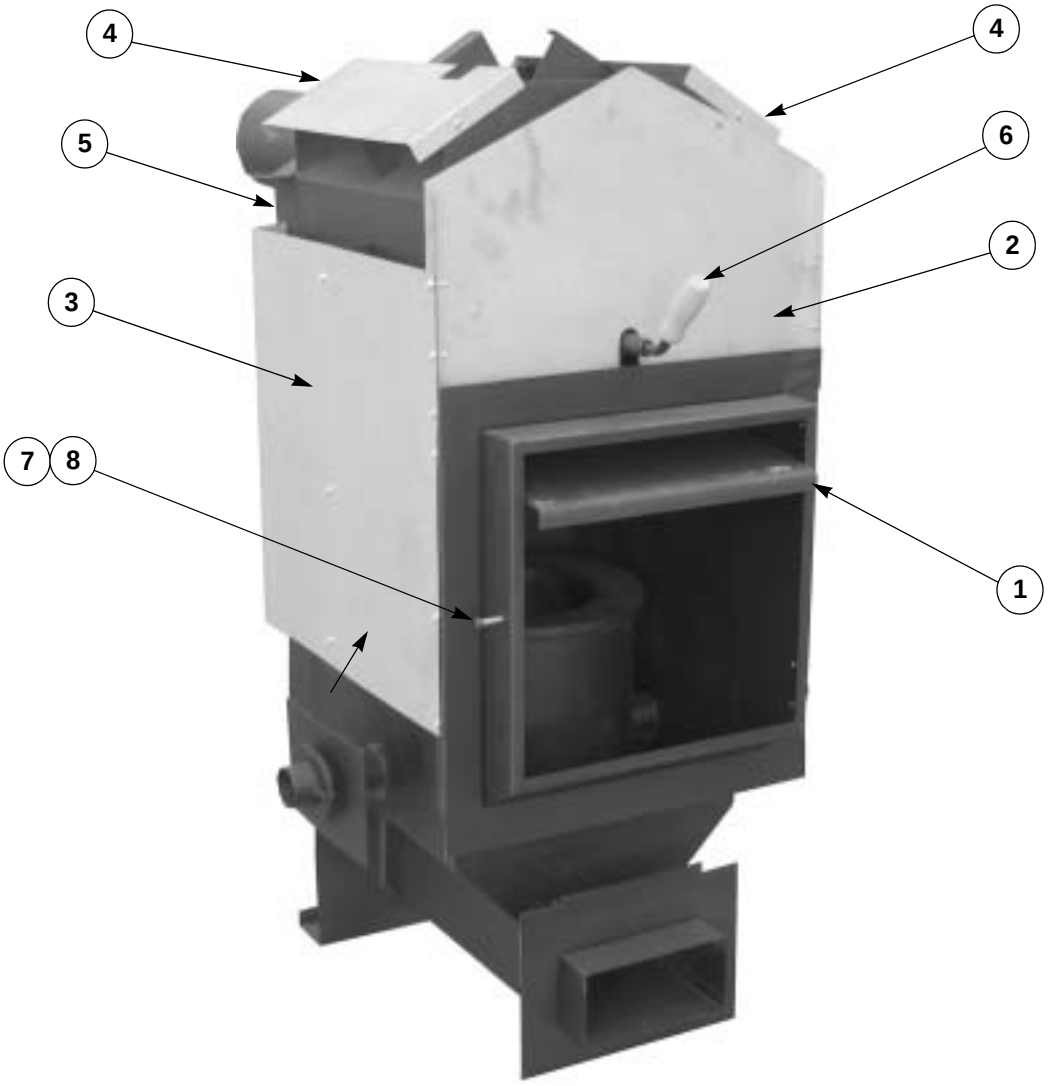
Ref	Part Number	Part Description	Quantity Used	
			LDJ620-9	LDJ620-10
1	A-3220	Bin Auger Flighting	1	1
2	3180	Lock Collar	1	1
3	1880	Bin Auger Motor - 2 rpm	1	—
3	1900	Bin Auger Motor - 4 rpm	—	1
4	1410	6" x 6" Box	1	1
5	A-3070	Auger Support	1	1
6	5000	Lag Bolt - 1/4" x 1"	2	2
7	7530	Rubber Tee	1	1
8	A-7540	Bin Auger Tube	1	1
9	1480	Conduit Fitting	1	1
10	A-1550	Flex Conduit	1	1

Storage Bin - Model 14



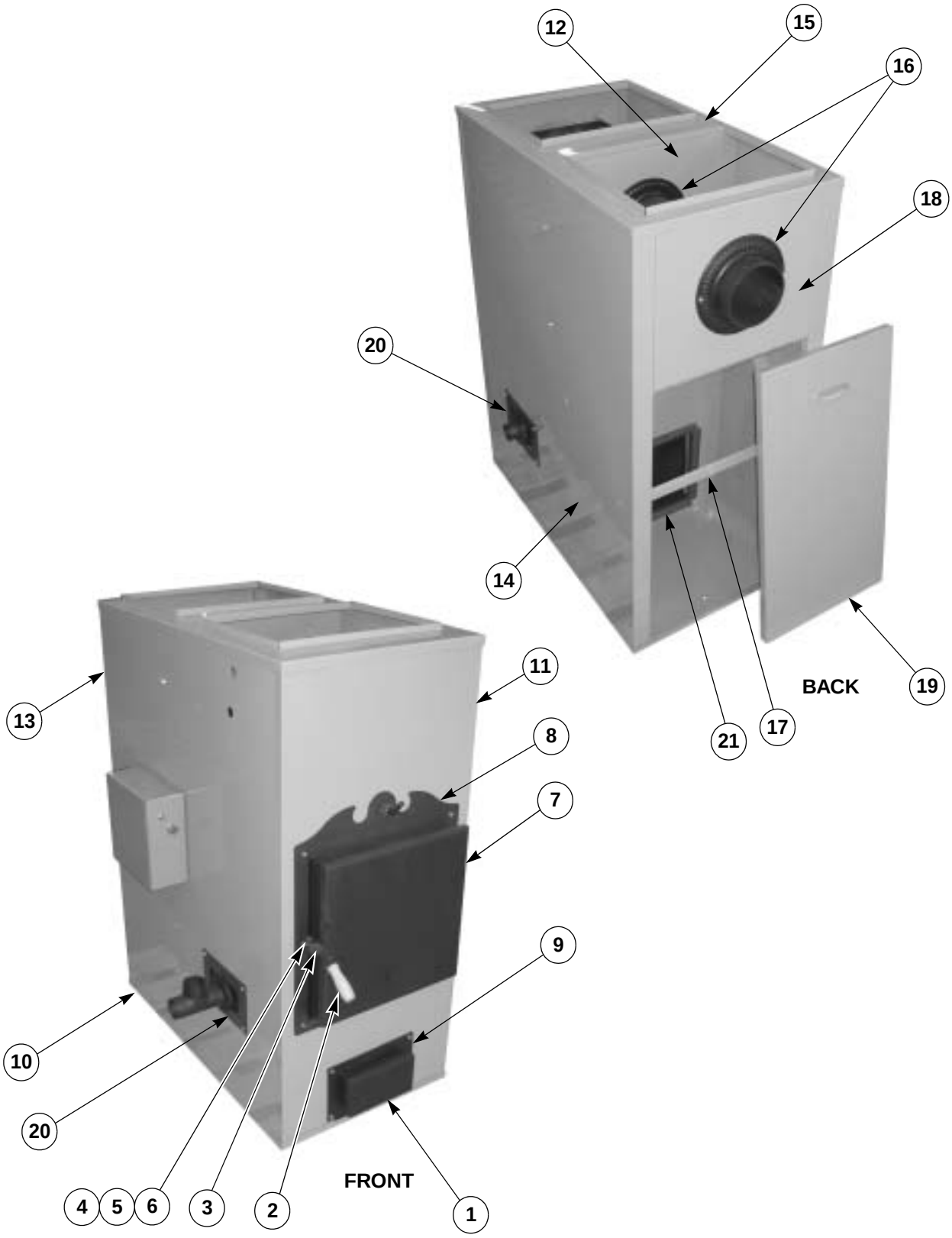
Ref	Part Number	Part Description	Quantity Used	
			LDJ620-9	LDJ620-10
1	7520	Bin Lid	1	1
2	7500	Bin Cavity	1	1
3	7510	Bin Base	1	1
4	7520	Shutoff Valve	1	1

Heat Exchanger



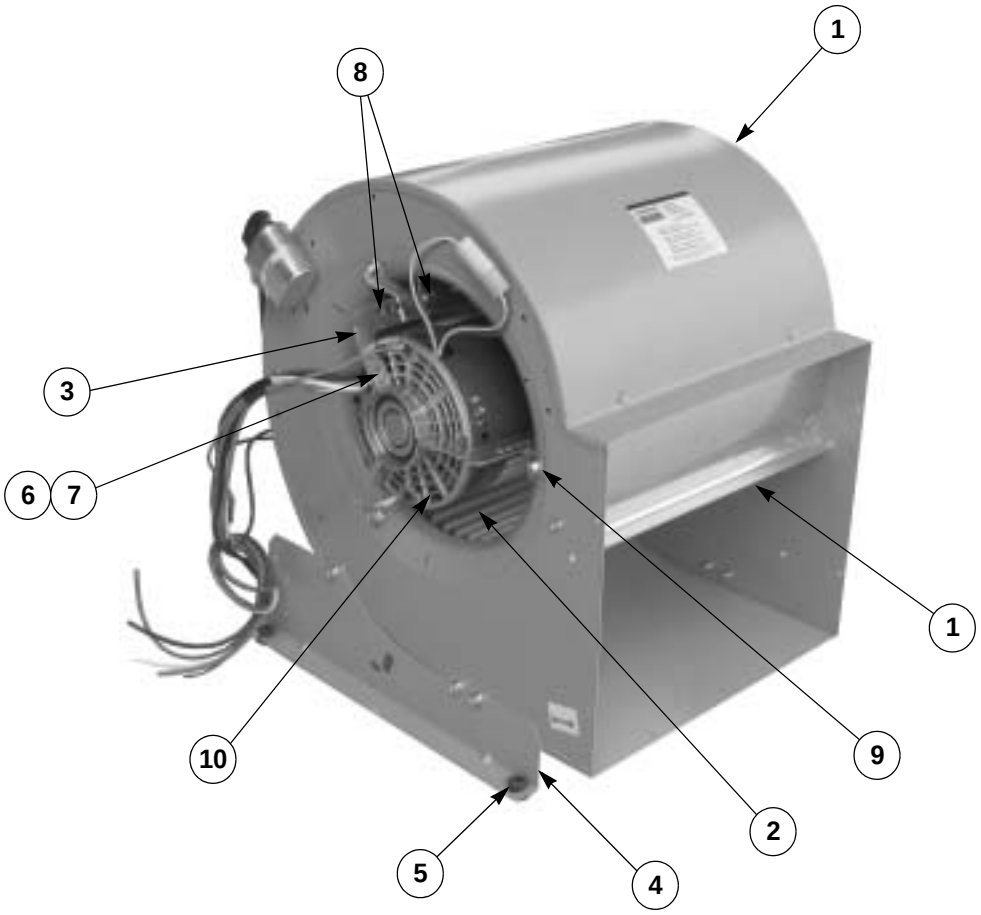
Ref	Part Number	Part Description	Quantity Used	
			LDJ620-9	LDJ620-10
1	5700	Burner Heat Shield	1	1
2	5680	Heat Deflector	1	1
3	5660	Side Heat Shield	2	2
4	5640	Top Heat Shield	2	2
5	A-5720	Heat Exchanger	1	1
6	2200	Wooden Handle	1	1
7	2040	Bolt - Shoulder, 5/16" x 1"	1	1
8	2020	Nut, 1/4"	1	1

Furnace Cabinet



Ref	Part Number	Part Description	Quantity Used	
			LDJ620-9	LDJ620-10
1	A-4040	Ash Pan	1	1
2	2200	Wooden Handle	1	1
3	2220	Door Handle	1	1
4	1960	Bolt - Shoulder, 5/16" x 3/8"	1	1
5	2000	Washer - Lock, 5/16"	1	1
6	2020	Nut, 1/4"	1	1
7	A-4180	Burner Door	1	1
8	6460	Door Trim	1	1
9	6440	Ash Drawer Trim	1	1
10	A-6040	Furnace Floor	1	1
11	6220	Front Panel	1	1
12	6200	Cold Air Wall	1	1
13	6280	Bank Side Panel	1	1
14	6240	Right Side Panel	1	1
	6260	Left Side Panel	1	1
15	A-6180	Furnace Top	1	1
16	6400	Trim Ring	2	2
17	A-4260	Filter Rack	1	1
18	6300	Top Rear Panel	1	1
19	A-6340	Filter Access Door	1	1
20	6420	Auger Hole Trim	2	2
21	2180	Fan Sealant, 1/2" thick	1	1

Furnace Blower



Ref	Part Number	Part Description	Quantity Used	
			LDJ620-9	LDJ620-10
1	7F731	Blower - Complete	1	1
2	4C710	Blower Wheel	1	1
3	A40152	Motor Mounting Brackets - Complete	1	1
4	2C355	Housing Supports - Both Sides	1	1
5	8122420	Vibration Pads	4	4
6	—	Screw - Hex Head, #10-24 x 7/8"	6	6
7	—	Nut, #10-24	6	6
8	—	Screw - Hex Head, #10-24 x 3/4"	6	6
9	—	Screw - Hex Head, 1/4-20" x 1/2"	3	3
10	4M098	Motor	1	1

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ADDENDUM

Venting Information

Metalbestos Chimney Systems (USA Only - See separate instructions for Canada)

SHEET S-7

Installation Instructions

Covering - Firestop/ Joist Shield, Trim Plate, Pitched Ceiling Plate and Wall Thimble

Read Sheets GS and MCS for important clearance and safety precautions before installing any of the parts described by these Sheets. Sheets GS and MCS are packaged with Supports. These include the Ceiling Support, Wall Support, Insulated Tee and Anchor Plate. Sheet MCS is also packaged with Model UT, GT and ST insulated pipe and tee sections.

⚠ WARNING

Failure to follow the installation instructions could cause FIRE, CARBON MONOXIDE POISONING, OR DEATH. If you are unsure of installation requirements, call the Phone Number listed on the instructions, 1-800-992-8368 or visit www.selkirkinc.com.

Metalbestos Chimney System (MCS) Model UT, GT and ST require shielded firestops when passing through ceiling joist areas and wall thimbles when passing through walls.

FIRESTOP/JOIST SHIELD (PART NO. JS)

For all MCS Model UT, GT and ST ceiling joist penetrations below the roof (other than that in which a ceiling support is installed), the Firestop / Joist Shield (JS) must be installed. (Ceiling supports incorporate their own firestops so no supplemental firestopping is required.) The firestop performs the following essential functions for both the dwelling and the chimney.

1. Together with a fully framed opening (all four sides) it acts as a fire stop to control vertical and horizontal spread of any fire external to the chimney. (See additional comments on firestopping.)

2. It stabilizes the chimney in the framed opening and defines and maintains the required two inch AIR SPACE clearance to combustibles.

3. It provides supplemental shielding for joist areas.

INSTALLATION REQUIREMENTS

The Firestop/Joist Shield (JS) can be installed on the top or bottom of a joist area but is most effective as a firestop if installed from beneath. As such, unless otherwise directed to do so, install Firestop /Joist Shield (JS) in the orientation shown in Fig. 1A with the plate to the bottom side and the shield extending up through opening (See Fig. 2).

To Install:

1. Frame a level square opening for 2 inches clearance from the outside of the chimney to the framing.

NOTE: If the ceiling is pitched, the JS needs to be installed on the top side and a level frame will need to be built to ensure the JS can be installed level and in a vertical orientation. (See Fig. 3A)

2. Place the Firestop/Joist Shield over the chimney and attach to the framed opening as shown in (See Fig. 2).
3. Nail side flanges into the framing.
4. If installed on top and the Firestop/Joist Shield is to be installed over the flooring, cut a square opening, then place it on top of the flooring, and nail for security.
5. Sub-flooring or finish floor can be placed over the Firestop/Joist Shield edges, provided that 2 inches clearance is maintained from the chimney pipe to the flooring.
6. If the framed opening is larger than necessary, the Firestop/Joist Shield outer edges must be extended by appropriate means (attaching metal plates, 26 gauge galvanized steel or heavier) to completely block the framed opening from any vertical air flow around the chimney.
7. Install the lengths of chimney as necessary to extend through the firestop, securing the joints with locking bands (provided) or three stainless steel sheet metal screws per joint. (See Sheet GS for screw option.)
8. Continue with installation in accordance with the instructions for the other components, as applicable.
9. Enclose the chimney below the Firestop/Joist Shield to prevent any accidental contact with the chimney. Exception - Exposed portions of the chimney which extend into the room in which a freestanding appliance is installed should not be enclosed. In an attic, to prevent blown-in attic insulation from falling against the chimney, either use an Attic Insulation Shield (AIS) or a full enclosure.

THE FUNCTION OF FIRESTOPPING

The purpose of firestopping in a chimney system is to prevent or delay the rapid spread of fire (regardless of the cause) in a home or building. Properly installed, the sheetmetal firestop prevents the chimney passageway from becoming an easy pathway for fire to spread from one floor to another.

IMPORTANT - Chimney Sizes 5", 6", 7", and 8" are Type HT.

FIG. 1A **FIG. 1B**

Firestop/ Joist Shield (JS) Used With MCS Chimney

Opening framed on all four sides at 2" to outside of pipe.

FIG. 2 FIRESTOP/ JOIST SHIELD (JS) INSTALLED

TRIM PLATE (PART NO. TPS)
PITCHED CEILING PLATE (PART NO. PCP)
(Used at ceiling of equipment room only)

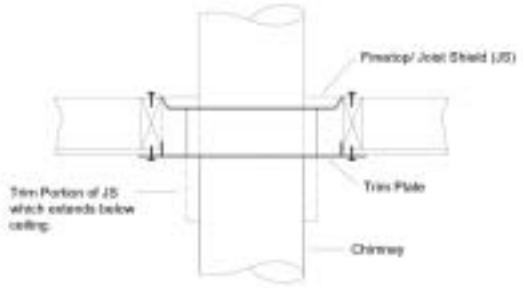
These parts provide for firestopping and a finished appearance for the ceiling opening when the chimney is extended down into the equipment room to a freestanding appliance. (See Figs. 3 and 3A) Use part TPS for flat ceiling installations and part PCP for pitched ceilings. A Firestop/Joist Shield (JS) is used on the top side of the opening in either case.

TPS/PCP installation with JS - The Firestop/Joist Shield (installed on the top side of the framed opening) requires trimming of the portion of the shield which extends beneath the ceiling before installing the TPS or PCP. (See Fig. 3 and Fig. 3A)

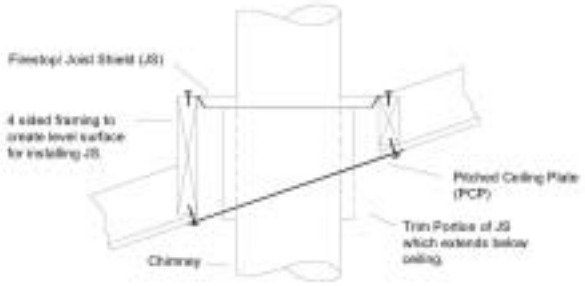
Note: If the ceiling is pitched, a level frame will need to be built to ensure the JS can be installed level and in a vertical orientation. (See Fig 3A)

To trim JS - after setting the JS in position on top of the opening (with open end down), mark a line around the perimeter of the shield at the elevation of the plane of the ceiling (flat or pitched). Use sheetmetal shears to trim the portion of the shield beneath the marked line. The shield should now extend down through the framed opening in the ceiling and end flush with the ceiling surface as shown in Figs. 3 and 3A.

After extending the pipe down through the JS, install the TPS (or PCP if pitched ceiling) by sliding it up around the pipe until it is in contact with the ceiling. Secure the TPS/PCP with screws.



CROSS SECTION - JS IN FLAT CEILING
FIG. 3



CROSS SECTION - JS IN PITCHED CEILING
FIG. 3A

Wall Thimble

(Part No. WT)

A Wall Thimble (WT) must be installed in combustible Through the Wall installations of the Metalbestos Chimney Systems (except Model SSII where its use is optional). Framing Dimensions are as follows:

11" x 11" for 5" diameter
12" x 12" for 6" diameter
13" x 13" for 7" diameter
14" x 14" for 8" diameter

Installation Requirements

1. Verify Thimble opening is appropriate for diameter of pipe being used.

2. Frame a level, square opening to the appropriate size as noted above.

3. Insert the two halves from opposite sides of the wall. (See Figure 4). The half which incorporates the black painted face plate, is for the interior side of the wall.

4. Engage the shields together until a snug fit is achieved. Level the face plates of the thimble with respect to the opening.

5. Attach the face plates to the wall using screws through the predrilled holes found at each corner.

6. Seal around the perimeter of the Wall Thimble's face plate (on exterior side) with an RTV Silicone Sealant to prevent any rain infiltration. (See Fig. 5)

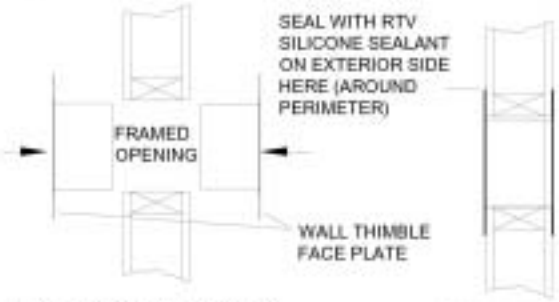
7. Proceed with installation of Wall Support and chimney as described in Sheet S5.

NOTE:

(1) The Wall Thimble accommodates wall thickness of 4 1/2" to 7 1/2". If a larger range is needed due to a thicker wall, it is permissible to field fabricate a metal sleeve extension and rivet or screw it to the shields.

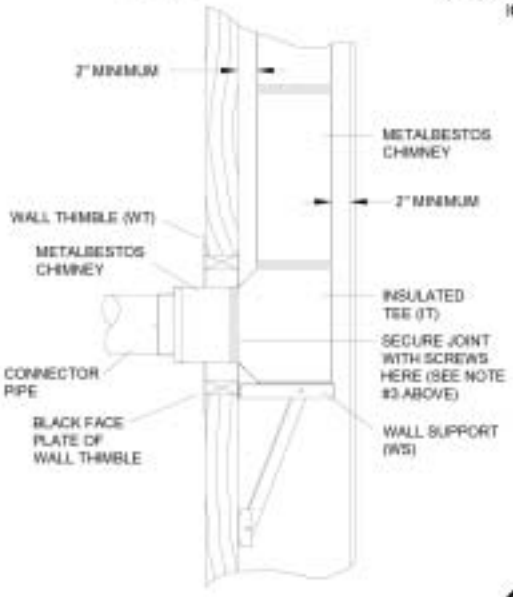
(2) Install Thimble before installing Wall Support Kit and Chimney.

(3) **IMPORTANT:** Due to limited space, Locking Band cannot be used to join the horizontal section passing through Wall Thimble (WT) to snout of Tee. Three #8 x 1/2" Stainless Steel screws should be used. (See Fig. 6 below and Fig. 8 of Sheet GS.)



WALL THIMBLE (WT) HALVES
FIG. 4

WALL THIMBLE (WT) INSTALLED
IG. 5



WALL THIMBLE/ CHIMNEY COMPLETED ASSEMBLY

FIG. 6

SELKIRK®

14801 Quorum Drive Dallas, Texas 75240 1-800-992 VENT (8368)

SELKIRK, LLC
0015141-1203

Barometric Draft Control Information

BAROMETRIC DRAFT CONTROLS

***Model:* 4"-7" RC**

WARNING: *Read the installation instructions carefully and completely before proceeding with the installation.*

ITEMS INCLUDED:

Barometric Draft Control

WHEN SHIPPED WITH A COLLAR ADDITIONAL ITEMS:

Mounting straps, Collar, Mounting Hardware

GENERAL INFORMATION

BAROMETRIC DRAFT CONTROLS WITH OR WITHOUT COLLAR

The Field RC is furnished as standard equipment on many leading brands of oil fired heating equipment. It is calibrated to allow for easy adjustment to the furnace or boiler manufactures specifications. Designed for draft settings from .02" to .08" inches of W.C.

CONTROL LOCATIONS

The control should be located as close as possible to a furnace or boiler and positioned as shown in Figure 1. It should be 18" from a stack switch and at least 18" from a combustible ceiling or wall. Do not locate in a room separated from the appliance. **NOTE:** *When a sheet metal tee is used instead of the collar, the "B" dimension must not be less than indicated for proper operation. (See Figure 2 and Table 1)*

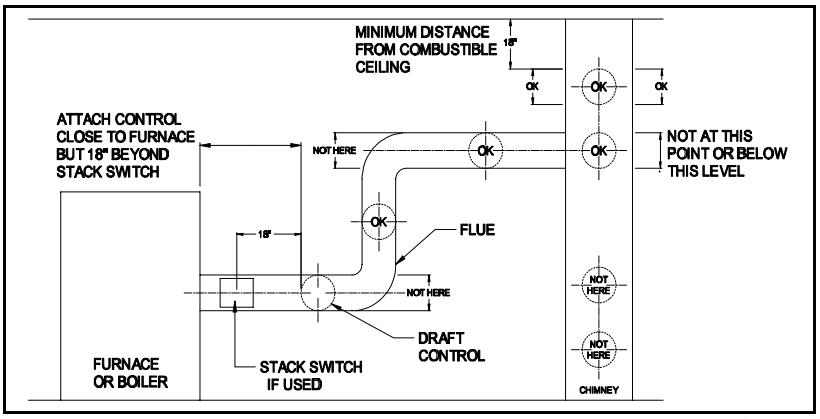


Figure 1

COLLAR INSTALLATION

WHEN SHIPPED WITH A COLLAR

To attach the collar to the flue, see Figure 2 and follow the instructions as follows:

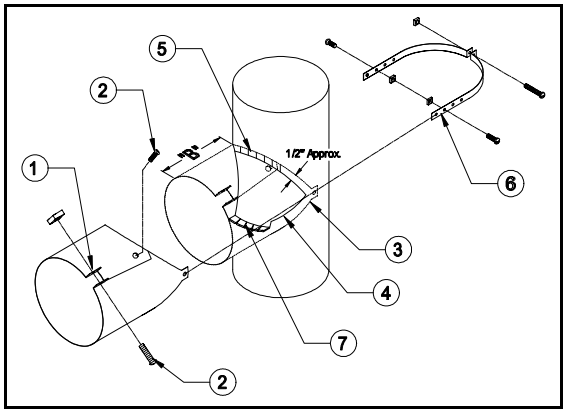


Figure 2

1. Bend the two ears at the front corners of the collar outward. Bend 90°, ¼" behind the single hole on the straps.
2. Insert clamping screw in ears on collar and bolt the remainder of the collar together.
3. Hold the collar against the side of the flue in the exact position it is to be installed (shown by dotted lines) and mark the outline of the collar on the flue.
4. Cut a hole in the flue about ½" inside of the outline.
5. Make a series of cuts about ½" apart from the edge of this hole to the outline marks.
6. Strap the collar to the flue pipe.
7. Bend the tabs formed by the series of cuts outward against the inside of the collar to make a tight joint.
8. Insert the draft control. (See Installation & Adjustment)

If flue pipe is made of material too heavy to bend out into collar, make the diameter of the opening within ½" of the inside diameter of the collar. Seal with high temperature RTV silicone or high temperature foil tape UL listed for the temperature of the application.

For proper settings and operation of the burner and the draft combustion testing instrumentation and draft gauges must be used.

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THE VENTING SOLUTIONS COMPANY
2630 Airport Road • Kinston, NC 28504
Phone: 252-522-3031 • FAX: 252-522-0214
www.fieldcontrols.com

INSTALLATION AND ADJUSTMENT

NOTE: *See sections on control locations and collar installation.*

Insert the draft control into the collar. The front face of the control must be plumb. The pivot points must be level whether the control is on a horizontal, vertical, or sloping flue pipe. Use a spirit level, plumb and level accurately. Secure the control in the collar by tightening the clamping screws. If the collar is not supplied by Field, the control may be held in place by small bolts or sheet metal screws so located as not to interfere with the movement of the gate. When a sheet metal TEE is used instead of the collar, the B dimension must not be less than indicated for proper operation. The "B" dimension prevents the damper gate from obstructing the flue passage way. See Figure 2 and Table 1.

Table 1

RC SIZE	*B-DIMENSION*
4	2 1/2 in.
5	2 1/2 in.
6	1 7/8 in.
7	2 5/8 in.

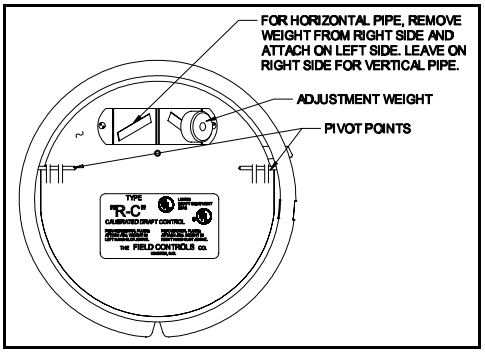

Figure 3

VERTICAL FLUES

The control is shipped for installation in a vertical flue. The adjustment weight should be in the right hand slot when you face the control. (See Figure 3)

HORIZONTAL FLUES

For horizontal flues, remove the weight from the right hand slot and attach it to the left hand slot as shown in Figure 3.

ADJUSTING THE CONTROL

The burner must be running when the adjustment of the control is made. The use of a draft gauge is required to accurately set the over fire draft. Set the over fire draft according to the appliance manufactures installation instructions.

Set the control to maintain as low a draft as will give good combustion and meet the requirements for heat. Turn the adjustment weight counter-clockwise to loosen, then slide in slot to the proper position and tighten. The bracket is marked 2,4,6 and 8, which indicates draft settings of .02",.04", etc. (These are drafts in flue adjacent to control, NOT over-fire drafts)

OIL BURNER COMBUSTION AIR AND OVERFIRE DRAFT SETTING (INCHES OF W.C.)

After the burner has operated for at least 5 to 10 minutes, take draft readings over the fire. For a domestic oil burner, the over-fire draft should be approximately .02" to .03", although there are some makes of burners which require higher drafts. Follow the burner manufacturer installation instructions for proper settings. There must always be enough draft so that the burner does not puff back into the room at the moment it starts, and there should be no objectionable smoke. CO_2 and smoke readings must be taken to determine the proper adjustments.

ADDITIONAL APPLICATIONS (FOR RC SERIES DRAFT CONTROLS)

STOKERS

Adjustments must be made while the stoker is running, with a normal fuel bed depth and its fan adjusted to approximately the correct setting.

A draft gauge must be used to accurately set the overfire draft. Follow the manufacture installation instructions for proper settings. If no instructions are available.

For a domestic stoker, the draft should be set at -.04" OVER THE FIRE, with the STOKER ON. Have just enough draft so that at the moment the stoker starts, it does not gas or puff back into the room through cracks around the fire door (with the fire door closed). If there is objectionable smoke, increase draft slightly.

HAND FIRED PLANTS

Adjust the draft control when a good fire is burning. Close any check damper and open wide any internal damper.

Usually a draft of -.06" will be sufficient for cold weather, with reasonably quick pickup after a banked period. But if plant overheats, change to a lower draft setting. Raise the setting if there is not enough heat.

In mild weather when less heat is needed, or the fire is to be banked, close ash pit draft door partly or entirely. If desired, a check damper also can be used when banking the fire.

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PN 02702600 Rev A 10/00

Ducting Information

Buildings for the 21st Century

Buildings that are more energy efficient, comfortable, and affordable... that's the goal of DOE's Building Technologies Program. To accelerate the development and wide application of energy efficiency measures, the Building Technologies Program:

- Conducts R&D on technologies and concepts for energy efficiency, working closely with the building industry and with manufacturers of materials, equipment, and appliances
- Promotes energy/money saving opportunities to both builders and buyers of homes and commercial buildings
- Works with state and local regulatory groups to improve building codes, appliance standards, and guidelines for efficient energy use

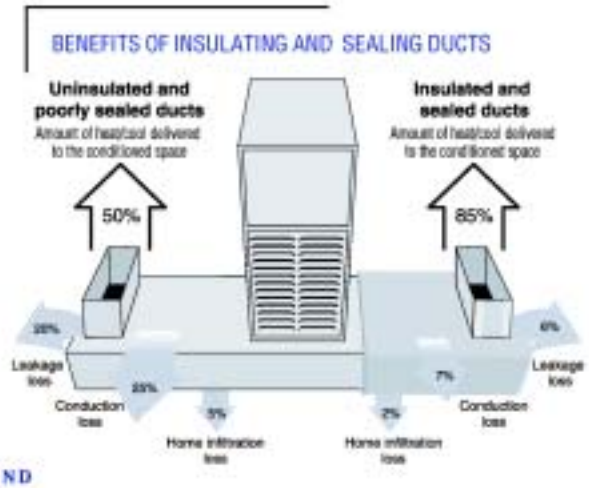
Technology Fact Sheet

AIR DISTRIBUTION SYSTEM INSTALLATION AND SEALING

Proper Duct Installation Increases Efficiency

INTRODUCTION

Central heating and cooling systems use an air distribution or duct system to circulate heated and/or cooled air to all the conditioned rooms in a house. Even when properly designed, duct systems must be installed correctly to be efficient, maintain uniform temperatures throughout the house, operate quietly, and not adversely impact comfort or indoor air quality.



WHY DUCT INSTALLATION AND SEALING ARE IMPORTANT

The efficiency of air distribution systems has been found to be 60-75% or less in many houses because of insufficient and/or poorly installed duct insulation and leaks in duct systems. Properly designed and installed duct systems can have efficiencies of 80% or more for little or no additional cost, potentially saving a homeowner $50-200 or more per year in heating and cooling costs. Moreover, efficient duct system installations can reduce equipment size, further saving money for new or replacement equipment.

Duct systems that leak and/or do not distribute air properly throughout the house may make some rooms too hot and others too cold. Leaky and unbalanced duct systems force conditioned air outside and unconditioned air into the house. This increases heating and cooling costs and may also draw humidity, dust, mold spores, and other contaminants into a home from the attic, crawlspace, or garage and radon gas from the soil. In extreme cases, poorly installed duct systems can induce backdrafting–spillage of flue gases from combustion appliances (e.g., furnace, water heater, fireplace) into the living space–primarily when atmospheric or natural-draft flues are used rather than powered combustion systems.

Duct systems that are undersized for the heating and cooling equipment, have been pinched to fit around structural framing during installation, or have been installed with numerous bends and turns may lead to low air flow rates and high air velocities. Low air flow rates cause the heating and cooling equipment to operate inefficiently. High air velocities increase noise.

Unfortunately, researchers have found these types of duct problems repeatedly in new and existing homes because care was not taken initially in installing the air distribution system.

BUILDING TECHNOLOGIES PROGRAM
OFFICE OF ENERGY EFFICIENCY AND RENEWABLE ENERGY • U.S. DEPARTMENT OF ENERGY

DUCT INSTALLATION PRINCIPLES

The objectives of a properly designed and installed duct system are occupant comfort, proper air distribution, economical heating and cooling system operation, and economical duct installation. Such a duct system is one that

- Provides conditioned air to meet all room heating and cooling loads.
- Ensures that the pressure drop across the air handler is within manufacturer and design specifications.
- Provides proper air flow.
- Prevents air from entering the house or duct system from polluted zones.
- Maintains a neutral pressure in the house by having balanced air flows between the supply and return systems.
- Minimizes duct air temperature gains or losses between the air handler and supply outlets, and between the return register and air handler.

During the design of the duct system, the layout and locations of the ducts are identified, duct materials are chosen, the sizes of the ducts are calculated, insulation levels are identified, and registers are selected. Duct installation ensures that the duct design is achieved in practice by addressing three critical elements:

- **Mechanical integrity**—the system will remain as built for the life of the house, without developing leaks, obstructions, or insulation failure.
- **Freedom from leaks**—all the air moved by the air handler will be drawn from and delivered to the intended conditioned spaces.
- **Proper insulation**—conditioned air does not exchange heat with unconditioned spaces.

DUCT INSTALLATION STANDARDS

The installation guidance presented in this fact sheet should be followed insofar as it does not conflict with applicable building codes and the following standards:

Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA) *Residential Comfort System Installation Standards Manual* (1998, seventh edition) and *Fibrous Glass Duct Construction Standards* (1992, sixth edition). SMACNA's *HVAC Duct Construction Standards—Metal and Flexible* (1995, second edition), although primarily for commercial and industrial projects, details good construction and installation practices that could improve residential applications.

Air Diffusion Council (ADC) *Flexible Duct Performance & Installation Standards* (1996, third edition).

North American Insulation Manufacturers Association (NAIMA) *Residential Fibrous Glass Duct Construction Standards* and *A Guide to Insulated Air Duct Systems*.

Underwriters Laboratory (UL) Standard for Factory-Made Air Ducts and Air Connectors (1996, ninth edition).

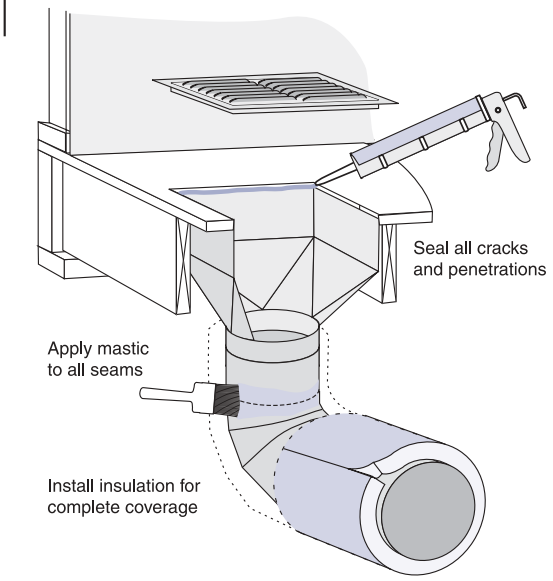
GENERAL DUCT INSTALLATION GUIDELINES

Air distribution ducts are commonly constructed from sheet metal, rigid fiberglass duct board, or flexible duct. General duct installation recommendations specific to these different materials are outlined below. In addition, the air handler, plenums, and duct boots form parts of the air distribution system. General installation guidelines for these components are also provided.

Duct systems should be installed inside the conditioned (living) and semi-conditioned spaces of the house to the greatest extent possible (but not in exterior wall cavities). Any air leakage in ducts located inside the house will not significantly affect the energy efficiency of the heating and cooling system because the conditioned air will remain inside the house. Also, ducts located inside the house need minimal insulation (in hot and humid climates), if any at all.

Duct systems should be hard-ducted as much as possible. Duct system installations that use the house structure or building framing (e.g., building cavities, closets, raised-floor air handler plenums, platform returns, wall stud spaces, panned floor joists) as supply or return ducts can be relatively

BOOT AND DUCT CONNECTION HIGHLIGHTS

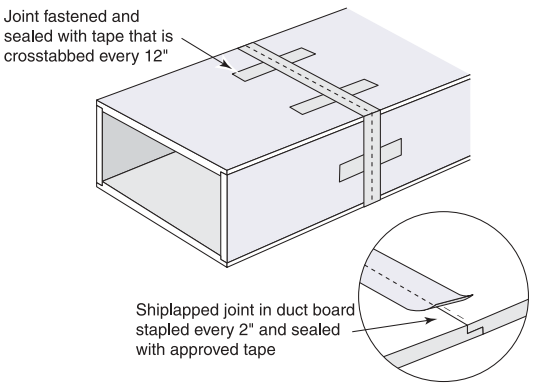


inexpensive to install. However, they should be avoided because they are difficult to seal and cannot always be insulated. In addition, because they tend to be rough and have many twists and turns, it is difficult to build them so as to ensure good air distribution. Even return plenums built under a stairway or in a closet, for example, should be avoided if a completely ducted system is possible.

Sheet Metal Ducts

Sheet metal is the most common duct material and can be used on most all supply and return duct applications (for plenums, trunks, branches, and runouts). Sheet metal ducts have a smooth interior surface that offers the least resistance to air flow. They must be carefully and completely sealed during construction/installation, using approved tapes or preferably mastic, because each connection, joint, and seam has potential leakage. Screws should be used to mechanically fasten all joints. When located in an unconditioned space, sheet metal ducts must be insulated with either an interior duct liner or exterior insulation.

DUCT BOARD



Fiberglass Duct Board Ducts

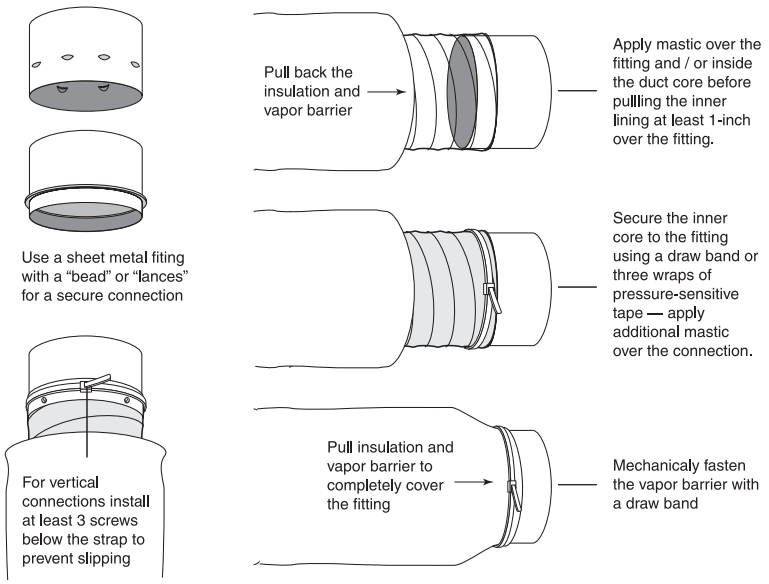
Fiberglass duct board is insulated and sealed as part of its construction. It is usually used to form rectangular supply and return trunks, branches, and plenums, although it can be used for runouts as well. Fiberglass duct board provides excellent sound attenuation, but its longevity is highly dependent on its closure and fastening systems. Connections should be mechanically fastened using shiplap or V-groove joints and stapling and sealed with approved pressure-sensitive tapes and mastic.

Flexible Nonmetallic Ducts

Flexible nonmetallic duct (or flex duct) consists of a duct inner liner supported on the inside by a helix wire coil and covered by blanket insulation with a flexible vapor-barrier jacket on the outside. Flexible duct is often used for runouts, with metal collars used to connect the flexible duct to supply plenums, trunks, and branches constructed from sheet metal or duct board. Flexible duct is also commonly used as a return duct. Flexible duct is factory-insulated and has fewer duct connections and joints. However, flexible duct is easily torn, crushed, pinched, or damaged during installation. It has the highest resistance to air flow. Consequently, if used, it must be properly installed.

AIR DISTRIBUTION SYSTEM INSTALLATION AND SEALING

FLEX DUCT SEALING TIPS



Flexible nonmetallic ducts should not have an air-permeable core. Flexible ducts must be stretched to their full length and cut to fit (not compressed) using the minimum length required to make the connection. Flexible duct that is not fully stretched has high air-flow resistance and tends to sag between supports. Connections and joints must be mechanically fastened using drawstraps and sealed using mastic. Bends in flexible ducts should not exceed 90 degrees and should have a radius greater than one duct diameter.

✓ Air Handler

Because system pressures are highest at the air handler, holes, cracks, and other openings at the air handler will cause more air leakage than elsewhere in the system. Air handlers located in the attic, garage, or crawlspace, or outside in single-packaged heat pumps or gas-packs, warrant special attention. Use mastic, cork rope or tape, or caulk to permanently seal unused holes, seams, wire penetrations, and refrigerant and condensate line penetrations in the air handler cabinet. Use approved pressure-sensitive tapes to seal access panels.

Connections between the air handler cabinet and the main supply and return plenums or ducts should be sealed with mastic or approved pressure-sensitive tapes. It is sometimes easier to remove service panels and seal these areas from the inside using mastic.

✓ Plenums

Fiberglass duct board is often used to build supply and return plenums. Mastics or approved tapes may be used to assemble butt joints on fiberglass duct board components such as plenum boxes. Although it is not recommended, closets, spaces under stairs, and other such areas of the house are often used as return plenums. Because these plenums are located inside the house, the need to seal them is often overlooked. Unless they are well sealed, these plenums will frequently allow unconditioned air to be drawn into the system from the attic, crawl space, or outside. Be sure to seal all such plenums completely—all seams, gaps, and penetrations through the ceiling, floor, and walls. Seal the air handler unit to the shelf of a closet return system.

✓ Duct Boots and Elbows

Seal all joints between ducts, duct boots, and/or elbows with mastic or approved tapes. Seal any leaks in the boots or elbows with mastic, approved tape, or elastomeric caulk. Extend duct boots at the supply and return registers through the wall, ceiling, or floor material and make sure duct boots are sealed to the ceilings, walls, or floors. Sometimes boots may be most easily sealed from the inside, after installation; however, the sealing material must be installed so that it does not interfere with installation or removal of the register.

AIR DISTRIBUTION SYSTEM INSTALLATION AND SEALING

INSTALLATION MATERIALS

✓ Fasteners

Mechanical fasteners—screws, staples, and draw bands—should be used to secure all joints between sections of duct. Materials intended to seal against air leaks—such as tapes, mastics, and other sealants—should not be used to hold sections of duct together except where mechanical fasteners are not feasible. Ducts should also be well supported so that joints are not pulled apart or the duct distorted (pinched) so that its air flow is reduced.

- **Screws**—On transverse joints in round sheet metal ducts that use sleeves or swedge or crimped fittings, use at least three metal screws equally spaced around the joint to ensure that the joint cannot become separated. For vertical connections made on flexible duct, install at least three screws below the drawband used to secure the inner lining to prevent slippage. Duct boots must be mechanically secured to the building using screws so that the boots do not rely on the ducts for support.
- **Staples and Tape**—Ducts constructed from fiberglass duct board should be fastened together using clinching staples on approximately 2-inch centers and approved pressure-sensitive tape. Where staples cannot be used, joints should be held together using approved pressure-sensitive tapes. The tape should be placed over the seam and 8-inch-long (minimum) crosstabs taped on each side of the duct with a distance of 12 inches or less between crosstabs.
- **Drawbands**—When joining flexible ducts to each other or to other types of duct, the flexible duct must be fitted over a beaded sleeve or collar and attached with drawbands (UV-resistant nylon duct ties or preferably metal worm-drive hose clamps, both with a temperature rating of 165°F)—one drawband to secure the inner lining and a second drawband to attach the outer insulation jacket.
- **Support Straps**—Round sheet metal ducts suspended in the air should be supported by hangers at least every 10 feet. Flexible ducts suspended in the air should be supported at least every 4 feet by straps that are at least 1½ to 1¾ inches wide, and they should not sag more than ½ inch for each foot of distance between the supports. Straps used on flexible ducts should not constrict the inner diameter of the duct or cut the outer jacket.

✓ Sealing Materials

The two primary materials used to seal ducts during installation are mastic and tapes, although other sealants may also be used in special applications. Use all mastics, tapes, and other sealants according to manufacturer instructions. Clean and dry joints, seams, and openings of oil, grease, and dirt before applying sealants, especially when using tapes and non-mastic sealants. Duct insulation does *NOT* stop leakage and is *NOT* a sealing material; in fact, dirty insulation is a telltale sign of air leakage.

- **Mastics**—Mastics that meet UL Standards 181A or 181B may be used to seal duct joints. Use mastics labeled UL 181A-M for fiberglass ducts, UL 181B-M mastics for flexible ducts, and either for rigid metal ducts and components. Water-based mastics are preferable to petroleum-based mastics because they have shorter curing times, easier cleanup, and more "forgiving" application characteristics. Mastic must not be diluted. Mastic should be applied liberally over the entire joint between and over mated surfaces. When using over holes or gaps that are larger than 1/8 to 1/4 inch, apply a thick layer of mastic followed by at least one layer of fiberglass mesh tape, topped by a layer of mastic that fills the scrim pattern completely and covers the mesh.
- **Tapes**—Heat-activated and pressure-sensitive tapes that meet UL Standards 181A or 181B and are marked for use in the intended application can be used to construct ducts and, in some cases, seal ducts and other distribution system components. Heat-activated tape should be labeled UL 181A-H and used only on rigid fiberglass ducts. Use pressure-sensitive tapes labeled UL 181A-P for rigid fiberglass ducts, 181B-FX for flexible ducts, and either for rigid metal ducts and components. Pressure-sensitive tape used on rigid fiberglass ducts should be rubbed firmly until the pattern of the facing reinforcement shows through the surface of the tape. When taping traverse joints, wrap the tape three times.

  Pressure-sensitive metallic tape with non-butyl adhesive is useful to temporarily seal air handler access panels that may need to be opened in the future. When sealing access panels, a card should be taped to the access panel that says "Please Replace Any Tape That is Removed" as a reminder to future repair personnel.

  Cloth-backed rubber-adhesive (duct) tapes should not be used because they deteriorate with time and exposure to heat. Pressure-sensitive metallic tape with butyl adhesive (not meeting UL Standard 181) can be used to seal metal-to-metal connections. Cork tape can be used to seal gaps where refrigerant lines penetrate the air handler unit cabinet.

AIR DISTRIBUTION SYSTEM INSTALLATION AND SEALING

For more information, contact:

Energy Efficiency and Renewable Energy Clearinghouse (EREC)
1-800-DOE-3732
www.eere.energy.gov

Or visit the Building Technologies Program Web site at www.buildings.gov

Or refer to the Duct Installation and Sealing Standards, Specification of Energy-Efficient Installation
Consortium for Energy Efficiency
617-589-3949
www.cee1.org/resid/rsac/hvac.php3

Written and prepared for the U.S. Department of Energy by:

Southface Energy Institute
404-872-3549
www.southface.org

U.S. Department of Energy's Oak Ridge National Laboratory
Buildings Technology Center
865-574-5206
www.ornl.gov/btc

SMACNA's manuals may be obtained from 4201 Lafayette Center Drive, Chantilly, Virginia 20151-1209 703-803-2980, www.smacna.org

ADC's standards can be obtained from 1000 East Woodfield Rd, Ste. 102, Schaumburg, Illinois 60173 847-706-6750, www.flexibleduct.org

NAIMA standards and guidelines can be obtained from Canal Center Plaza, Ste. 310, Alexandria, Virginia 22314 703-684-0084, www.naima.org

UL's standards may be obtained from www.ul.com

The International Energy Conservation Code can be obtained from the International Code Council 703-931-4533, www.intlcode.org

DUCT LEAKAGE TESTING

Once ducts have been installed and sealed, the only way to really know how leaky they are is to conduct a duct airtightness test. Such tests can be performed using a special fan called a blower door or, better, with a special duct blower. Often, energy efficiency incentive programs, such as the DOE/EPA Energy Star® Program, require duct leakage testing (usually performed in less than an hour) to confirm the airtightness of the ducts. A typical requirement is that duct leakage measured when the ducts are pressurized to 25 Pascals should not exceed 5% of the system air flow rate.

DUCT INSULATION

Insulate all portions of duct systems located outside of the conditioned space (including boots and plenums), typically using flexible or rigid fiberglass insulation. Metal ducts located in the conditioned space may be insulated to prevent condensation. Adhere to the following guidelines when selecting and installing the insulation.

Select the insulation levels for the duct system in accordance with the 2000 International Energy Conservation Code. Use higher duct insulation levels in ducts located outside the conditioned space than those specified by this Code, especially when variable-speed air handling equipment is being used. Lower air flows provided by variable-speed heating and cooling systems to improve operating efficiency increase the resident time of air within the air distribution system, which in turn increases thermal losses in the winter and thermal gains in the summer. Attic insulation placed over ducts helps where it is possible.

Insulation must be continuous, especially at plenums, boots, elbows, and connections (i.e., no gaps or voids in the insulation).

Wraps of spirally-wrapped unfaced insulation should overlap at least 2 inches.

Permanently secure insulation to the duct with draw bands, non-corrosive wire, rust-resistant staples or nails, or pressure-sensitive tape wrapped at least three times around the circumference. Parallel-wrapped faced insulation is usually secured with pressure-sensitive tape. Secure unfaced parallel-wrapped insulation at least every 18 inches along its length using non-taping methods. Attachments should not compress the insulation more than 20% along straight duct lengths and no more than 50% in bends.

When flexible ducts are joined, the insulation jackets must overlap at least 2 inches. The overlap must be secured and sealed with a draw band or with three staggered wraps of pressure-sensitive tape.

Install a continuous vapor barrier outside the insulation (e.g., foil-faced fiberglass insulation sealed with pressure-sensitive metallic tape) on metal ducts that are used for space cooling, except in dry climates where condensation on the duct surface will not occur. Tears in the insulation facing (especially the outer lining of flexible duct) must be avoided to prevent moisture accumulation in the insulation, which significantly reduces its effectiveness.

At duct terminations (e.g., boots, collars), the insulation jackets of flexible ducts should be pulled over the insulation and secured and sealed to the fitting with a draw band, mastic and fiberglass mesh tape, or three wraps of pressure-sensitive tape.

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