



Applied Air®

INSTALLATION, OPERATION AND MAINTENANCE MANUAL FOR THE IFD SERIES DUCT FURNACES

*COPY TO BE MAINTAINED IN A LEGIBLE CONDITION WITH THE DUCT FURNACE.
READ THIS MANUAL CAREFULLY BEFORE INSTALLING AND OPERATING THIS FURNACE
PLEASE GIVE MODEL NO. & SERIAL NO. WHEN CONTACTING THE FACTORY OR
REPRESENTATIVE FOR INFORMATION AND/OR PARTS*

FOR YOUR SAFETY

The use and storage of gasoline or other flammable vapors and liquids in open containers in the vicinity of this appliance is hazardous.

If you smell gas:

1. Open windows.
2. Do not touch electrical switches.
3. Extinguish any open flame.
4. Immediately call you gas supplier.

WARNING

Improper installation, adjustment, alteration, service or maintenance can cause injury or death. Read the installation, operating and maintenance instruction thoroughly before installing or servicing this equipment. This duct furnace must only be serviced by qualified personnel. Do not tamper with the duct furnace or controls.

Certified for installation in the USA and Canada
Duct Furnace: ANSI Z83.8-1996/CGA 2.6-M96

Duct furnace
Model #: _____

Duct furnace
Serial #: _____

Service contractor: _____

Tel #: _____

Date Installed: _____

Applied Air Systems

4830 Transport Drive

Dallas, Texas

75247 USA

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1.0 INTRODUCTION

The following Owner's Manual for the Applied Air equipment outlines installation, operation and service requirements for IFD series of indirect gas fired duct furnace. The IFD series is ETL certified. Certification includes indoor models, high altitude applications, and a wide range of operational conditions. For more information on certification, please contact the Customer Service department at Applied Air Systems. These manuals have been prepared to assist in the installation, operation and maintenance of your duct furnace. It is good practice to know as much as possible about your duct furnace before trying to install or operate it. Read the contents carefully before proceeding. Due to the custom nature of Applied Air equipment, not all possibilities are addressed in this manual. In cases where a special application is not covered, the customer or installer can obtain information from Applied Air's sales representative or the Applied Air factory. Additional component specific manuals may be included with this manual, i.e. burner manuals, to assist in the maintenance or repairs of the furnace.

1.1 Notes

1. Please disregard any information and/or data covering optional components not supplied with the duct furnace.
2. Do not destroy or remove information from this instruction manual. Leave this instruction in the electrical enclosure of the duct furnace.
3. Field installed fuel conversion kits are not available. If your fuel requirements change contact the factory about converting your furnace to/from natural or LP gas.

1.2 Caution

1. Regulations require that service mechanics that work on combustion equipment must be qualified.
2. Contact with moving parts can cause injury or property damage. Automatic control devices may start the duct furnace without warning. To prevent accidental start-up, the maintenance personnel should always lockout all power supplies before working on Applied Air equipment. A duct furnace will often have more than one power connection point; disconnect all sources of power before servicing. Even when locked out electrically, fans located in a parallel or series fan system may be subject to wind milling.
3. Refer to the rating plate for fuel input and supply pressures.
4. **DO NOT attempt to start the burner if the duct furnace is full of vapor or gas, or if the combustion chamber is very hot.**
5. DO NOT use gasoline, crankcase oil or any oil containing gasoline for fuel.
6. DO NOT burn garbage or paper in this heating system. Never leave paper or combustible material near the duct furnace.
7. SHUT OFF the manual fuel supply valve if the burner is shut down for an extended period of time.
8. Ensure all access and clean-out doors are secure before starting the blower and burner.

1.3 Warranty

Applied Air warrants all Applied Air products to be free from defects in material or workmanship, under normal use and service, for a period of twelve (12) months from date of shipment, unless a start-up form is on file and accepted by Applied Air, in which case the warranty is twelve (12) months from date of start-up, or eighteen (18) months from date of shipment, which ever comes first. **Warranty void if any of the following occur:**

1. A qualified heating contractor in accordance with provisions of this service manual and safe practices does not install the duct furnace.
2. The duct furnace was not subject to only normal use in service and was misused, neglected, altered or otherwise damaged.
3. The duct furnace is allowed to operate during building construction period.
4. The duct furnace is installed without proper clearance to combustible materials or located in a confined space without proper ventilation for combustion. (See section 2.0 Installation)
5. The duct furnace is operated in atmospheres containing flammable vapors, chlorinated or halogenated hydrocarbons.
6. The temperature rise across the duct furnace is in excess of that shown on the duct furnace rating plate (see Section 3.0 Operation Instructions).
7. The duct furnace was operated at any time outside its published capacity and/or any other fuel than prescribed.
8. Field wiring is not in accordance with the wiring diagram furnished with the duct furnace.
9. Any automatic controls were inoperative during duct furnace operation.
10. Proper maintenance is not provided on a regular basis as outlined (See Section 4.0 Maintenance).

2.0 INSTALLATION

CAUTION

The equipment installation shall conform with local building codes, or in the absence of local codes in accordance with the Installation Code for Gas Burning Appliances and Equipment, *CAN1-B149 in Canada* or *Z223.1 in USA*, and applicable Provincial/State Regulations; which should be carefully followed in all cases. Authorities having jurisdiction should be consulted before installations are made.

Installation may be in accordance with applicable standards including;

Installation Code for *Natural Gas Burning Appliances and Equipment, CAN1-B149.1*

Installation Code for *Propane Burning Appliances and Equipment, CAN1-B149.2*

Installation Code for *USA National Fuel Gas Code, Z223.1*

Standard on *Aircraft Hangars, ANSI/NFPA 409*

Standard for *Parking Structures, ANSI/NFPA 88A*

Standard for *Repair Garages, ANSI/NFPA88B*

Safety First: Ensure that all practices of the Construction Safety Association and O.S.H.A. as well as practical common sense are continuously in use.

2.1 Receiving and Storing

1. INSPECT the duct furnace carefully upon arrival for any shipping damage. If damaged, sign the carrier's bill of lading with a notation "Damaged During Shipment" or "Received Damaged."
2. Check the packing slip against all items received. If any items are missing, sign the carrier's bill of lading with the notation "Shipment Received Less Item"
3. When unloading the duct furnace follow the 2.2 Handling and Suspension section following.
4. All control components and accessories that are shipped separately for field installation should be stored in a locked storage area.
5. If the duct furnace and/or its accessories cannot be installed immediately, it should be stored in a dry and clean area. If this is not possible and the duct furnace must be stored outside, it should be protected from the weather with tarpaulins or plastic coverings.

2.2 Lifting and Handling

1. Before the duct furnace is placed in its installed location, check that the hoisting equipment and permanent supports are adequate for the weight as indicated on the General Arrangement Drawing plus a weight allowance for servicemen and equipment.

2. NOTE: Hooks, jacks, slings, or chains must not be applied to the duct furnace casing or to any of its components. Every duct furnace is supplied with lifting lugs unless otherwise specified, use ALL lifting lugs on each duct furnace section. The lifting points must be at the center of gravity to assure that the duct furnace is level during hoisting and prior to setting. **Lifting lugs are not to be used for permanently suspending the furnace.**
3. The duct furnace is to be leveled with the hanging load distributed equally to all lugs. DO NOT hang or support the duct furnace from the service platform (if supplied.)
4. When hoisting indoor duct furnace to be suspended, it is recommended that a separate chainfall be used at each lifting point. The chainfalls should only be removed after the duct furnace supports are permanently installed.
5. Use spreader bars to provide vertical lifting force only at the lifting points, and to prevent damage to the duct furnace. Provide additional blocking and coverings as required to prevent damage to the duct furnace finish and/or components. Assure that all crating and packaging used for shipment that may interfere with the placing or assembling of the duct furnace is removed before lifting the duct furnace into place.
6. If a fork lift truck is used, caution must be taken to ensure that the forks do not damage the duct furnace or its components. The forks must extend beyond the opposite side of the duct furnace to prevent damage.
7. Check that there are, or will be, no explosive, flammable or toxic vapors, or abnormally excessive dust in the area where the duct furnace is located.
8. Check that the duct furnace is securely mounted and braced and will not be subject to swaying or movement that would put a stress on fuel or electrical connections.
9. Mount and install all accessory items that may have been shipped separately for field installations; i.e., filter boxes, filter, inlet cowls, louvers, discharge heads, plenums, dampers, etc.

2.3 Installation Clearances

For Safety and Service, the following minimum clearances and guidelines shall be observed:

Model	Location				
	Top	Front	Back	Side	Type of Floor
IFD	10"	10"	10"	20"	Combustible or non-combustible

1. There should be a minimum 36" clearance from the front of the duct furnace flue outlet on outdoor duct furnace.
2. The National Electrical Code (NEC or CEC) requires a minimum of 36" service space between the face of any electrical enclosure and any wall or obstruction.
3. Provide sufficient clearance to open doors, install piping and ducting, flame observation port, high limit switch, control panel, main fan motor, and all access panels.

2.4 General Installation

1. It is the customer and installation personnel responsibility to determine if the duct furnace is equipped with all of the safety devices required for the particular application. Safety considerations include the accessibility of the equipment to non-service personnel, the provision of electrical lockout switches, maintenance procedures, and automatic control sequences.
2. Duct furnaces must be level. Failure to provide a level-mounting surface for the duct furnace will result in a variety of operational problems.
3. Clearly identify all emergency shut off devices.
4. Make duct connections to the casing by applying caulking around the connection and screwing flanged ducts directly to the casing and/or flange with self-tapping sheet metal screws. It is important to seal all duct connections to prevent air leakage and system performance problems. Ducts connected to the furnace shall have removable access panels on both the upstream and downstream sides of the furnace. These openings shall be accessible when the furnace is installed and shall be sized to allow the observation of smoke or reflected light inside the casing to indicate the presence of leaks in the heat exchanger. The covers for the openings shall be attached in such a manner as to prevent leaks.
5. The furnace must not be operated in the presence of chlorinated vapors. When such vapors mix with the products of combustion, highly corrosive compounds result, which will cause the premature failure of the heat exchanger and other components.
6. If installing a duct furnace model, IFD, the furnace is connected to a return air duct or any other inlet air restriction, the duct furnace shall be installed on the positive pressure side of the air-circulating blower.
7. When the duct furnace is installed in an enclosed duct furnace room it is imperative that the duct furnace room itself is not used as an air plenum. Ductwork must be used for all supply and return air to and from the duct furnace, as well as any other fans, which may be installed in the same room.

2.5 Drains and Traps

1. Heat Exchanger Condensate - These duct furnaces are supplied with a condensation removal pipe connection. Condensate from the heat exchanger is acidic and may contain chemical compounds requiring special drainage. The drain must be installed in accordance with all plumbing codes. The condensate is to be drained via 1/2" PVC or steel pipe with an indirect connection to the plumbing wastes. Where a condensate neutralizer is used, an overflow shall be provided such that condensate will be directed to the drain in the event that the neutralizer becomes plugged. Indoor installations typically require a condensate trap to be installed to prevent combustion gases entering the space. Outdoor duct furnaces may require special attention to drains to prevent freezing and clogging of the drain line.
2. Since the condensate is drained by gravity, avoid long runs of drain piping. If a long run of trapping cannot be avoided or the piping has water flow restrictions such as several elbows, add extra height to provide enough hydrostatic head to overcome the frictional losses. Always slope piping down a minimum of 1/8" per foot in the direction of the flow.

2.6 Combustion Air Requirements

1. If the duct furnace is installed in furnace rooms, confined areas or low-leakage construction buildings, provisions must be made for combustion air. The duct furnace shall be located such that a negative pressure will not be created, which will starve the burner of combustion air. The combustion air vent piping should not be less than 24 Ga. galvanized steel, and not more than 50 feet nor less than 10 feet in length.
2. NOTE: Outdoor Combustion Air Kits should be used where there is a possibility of exposure to substances such as:

Chlorinated laundry products	Carbon tetrachloride
Permanent wave solutions	Halogen-type refrigerants
Chlorinated waxes and cleaners	Cleaning solvents (perchloroethylene)
Chlorine based pool chemicals	Printing inks, paint removers, etc.
Water softening chemicals	Cements and glues
De-icing salts or chemicals	Anti-static fabric softeners
Masonry acid washing materials	Hydrochloric acid
3. NOTE: The above also applies to the circulating air intake. Use 100% external air.
4. Combustion air shall be provided at a rate of at least 10 CFM, or 1 square inch of free opening, per hour of rated input. If a separate mechanical means provides this air, an interlock with the combustion blower shall be provided.
5. In some cases, local authorities require that combustion air be ducted directly to the burner. Refer to the relevant standards in the current CAN1-B149.1, CAN1-B149.2, B139 and Z223.1 in USA.

2.7 Exhaust Stack and Venting

1. Installations must be in accordance with the requirements of authorities having jurisdiction. Flue outlet pressure must not exceed rating on the name plate for maximum over fire pressure on positive fired chambers, or maintain the over fire draft pressure for the furnace on negative fired chambers with I.D. fans.
2. A vent connector shall be equivalent to a minimum of 24 Ga. galvanized steel. It shall have a minimum clearance of at least 9" to combustible material. All horizontal runs should have a minimum rise of 1/4" per foot of horizontal run in the direction of discharge.
3. Refer to the rating plate for the category of appliance to select the venting. Consult the authorities having jurisdiction, and use a gastight, watertight venting system constructed of material resistant to corrosion by condensate.
4. The National Fuel Gas Code, ANSI Z223.1, specifies a 4 foot (1.22m) horizontal vent terminal clearance from gas and electric meters, regulators and relief equipment. The Canadian B149.1, Natural Gas Installation Code specifies a 6 foot (1.83m) horizontal vent terminal clearance to gas and electric meters and relief devices.
5. Do not install dampers or other restrictive devices in the flue vent pipe.
6. Stack terminations must be kept to approved distances from fresh air intakes, rooflines, etc. Guy wires may be required to brace the stack above rooflines.

7. The stack should be installed in such a manner that access to the appliance is not obstructed. Do not support the weight of the stack on the flue connection of the heating section.
8. Approved methods must be followed when putting the stack through walls, floors, roofs, etc.
9. Any exhaust stack shall have a minimum of at least 36" clearance to combustible material.
10. The pressure measured with a manometer at the test port in the burner compartment must not exceed the "Maximum Overfire Positive" pressure on positive fired duct furnaces.
11. Gravity Venting Adjustment: The flue draft should be adjusted at the damper of the burner fan when the duct furnace is operating on high fire.
12. Power Venting Adjustment: The flue draft should be adjusted at the damper of the induced draft (I.D.) fan when the duct furnace is operating on high fire.

2.8 Gas Installation

FOR YOUR SAFETY
Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.

1. Installations must be in accordance with the requirements of authorities having jurisdiction. Emergency manual shut down valve should be provided upstream of piping to duct furnace and labeled for quick identification. Color-coding of pipe may be required and is recommended. Carefully check the duct furnace rating plate for the fuel type, supply pressure and input rating.
2. Gas supply pressure, higher than 14"w.c. (3.5kPa), requires an additional field installed gas regulator. Install the high-pressure gas regulator and relief valve (if supplied), in the gas line to the duct furnace. The high-pressure regulator and relief valve should be, if possible, mounted at least 5 to 10 feet upstream from the appliance regulator on the duct furnace. Run the gas line to the duct furnace and mount these items so as not to interfere with or hinder access to the duct furnace or any of its components.
3. The gas line to the duct furnace should be taken off the top of the main gas line. An approved drip leg with screwed cap should be installed at the bottom of the vertical drop in the gas line to the duct furnace.
4. If not provided with vent limiters, vent the main gas appliance regulator, the pilot regulator, and the gas pressure switches to the outdoors. The high-pressure regulator relief valve and normally open vent valve (if supplied) must be vented to atmosphere separately from all of the components in accordance with applicable codes. Vent lines should terminate outside the building with a turndown elbow and fly screen.

2.9 Electrical Installation

CAUTION

Installations must be in accordance with the requirements of authorities having jurisdiction. Do not cut holes in the floor of outdoor model duct furnaces as the bottom of the duct furnace has been made waterproof. Wiring diagrams are included in the control cabinet of the duct furnace. The power requirements are indicated on the duct furnace rating plate. Authorities having jurisdiction should be consulted before installations are made.

Installation may be in accordance with applicable standards including;

The Canadian Electrical Code Part 1 - CSA Standard C22.1

National Electric Code in USA, (ANSI / NFPA 70)

1. Field wiring is indicated on the wiring diagram, typically dashed lines. Where field wiring of the control circuit is required, take care to size the field wiring for a maximum 10% voltage drop. The VA rating of the transformer can be assumed to be the maximum load.
2. Reconnect all disconnected wiring on the duct furnaces that were split for shipment.
3. When connecting a power supply to a three-phase motor, take care that the three-phase wiring gives you the correct motor and blower rotation on all motors.
4. Should any original wire supplied with the furnace have to be replaced, it must be replaced with wiring material having a temperature rating of at least 105°C. See field-wiring diagram for requirements for shielded or twisted wire.
5. Temperature controllers, limit controllers, remote selector switches, remote panels, door switches, or any other auxiliary electrical item shall be connected to the terminals provided, as shown on the wiring diagram.
6. If a space thermostat is used with the furnace, locate the thermostat so that cold drafts and hot discharge air streams do not affect its performance. Do not mount the thermostat on the casing of the duct furnace, or any other location where it may be affected by radiated and conducted heat. Refer to the instruction furnished with the thermostat for further details.

3.0 OPERATING INSTRUCTIONS

CAUTION

Provincial and State regulations require that service mechanics must be licensed to work on combustion equipment.

The duct furnace should not be started or serviced by unqualified personnel. Although many maintenance items do not require the service of a licensed mechanic, it is recommended that a licensed mechanic supervise any work done on the duct furnace by unlicensed personnel. Unqualified personnel should not be allowed to work unsupervised.

- Refer to the notes in section 1.0, at the beginning of this guide before continuing
- Read the below sections before operating this furnace.
- **DO NOT attempt to start the burner if the duct furnace is full of vapor or gas, or if the combustion chamber is very hot.**
- Before starting up the furnace, study and familiarize yourself with the wiring diagram, sequence of operation, flame safeguard, controls, gas train, and burner.

3.1 Start-Up Check List

NOTE: When starting up the duct furnace for the first time or if the duct furnace has been shut down for an extended period of time the same start-up procedures, as outlined in sections 3.2 and 3.3, should be followed.

1. Set all electrical switches and main duct furnace disconnect switch to "OFF" position.
2. Close all duct furnace manual valves and field piping valves.
3. Check the duct furnace supply, discharge, and vent to make sure they are clear and free from any obstructions. Check to make sure all applicable dampers are open or adjusted to their correct settings.
4. Purge all the air from the gas lines per gas codes. Check all connections for leaks and correctness. Ensure that the inlet pressure complies with the rating plate.
5. Inspect all electrical wiring, both field and factory installed, for loose connections. Check all fuse blocks to determine that all fusing is installed.
6. Check all motor thermal overload settings against the rating plate figures.
7. Turn duct furnace disconnect switch "ON" (control switches are still "OFF") and check the supply voltage. Voltage must be within 10% of nameplate rating. If not, consult the electric utility company and have the voltage condition corrected before start-up.
8. Check set points of temperature limiting controls. Refer to the wiring diagram on the duct furnace and set all temperature controls to the temperature settings indicated. The safety operators for the furnace section setpoints are given below for most furnace installations, however refer to the wiring diagram.

High Limit 200°F (93°C) & 210°F(99°C) -- Adjust Burner Air Switch To Field Conditions

Fan Switch 125°F (52°C) ON 90°F (32°C) OFF --Temperature Control Up To Customer

9. Set thermostat in "OFF" position and turn duct furnace control switch "ON" (manual).
10. Check all fan motors for correct rotation. If incorrect, reverse rotation (see motor nameplate wiring diagram).
11. Check the amperage draw of each motor. Refer to rating plate for Full Load Amps (FLA). If actual motor load is significantly different than rated, take corrective action.
12. Re-check voltage at duct furnace disconnect switch with the duct furnace running. If the power is not within 10% of rated, shut duct furnace down and consult electric utility company. Voltage should be within 2% on all phase to phase readings when compared to each other. A 2% voltage difference could cause as much as a 20% current imbalance.
13. Ensure that the flue is in place and as noted in 2.7 line 10 Exhaust Stacks and Venting.
14. Set the operating controls, thermostat, remote panel switches, etc., to allow heating operation of the duct furnace.
15. Initial start up has a tendency to relieve the tightness of nuts, bolts and set screws. Re-check for tightness of hold down bolts, all set screws and keys, and tighten if necessary after approximately eight (8) hours of continuous operation.

3.2 Combustion Operation

CAUTION
DO NOT relight pilot or start burner when the heat exchanger is very hot, full of gas.

NOTE: When starting up the duct furnace for the first time or if the duct furnace has been shut down for an extended period of time the same start-up procedures, as outlined in sections 3.2 and 3.3, should be followed.

1. Refer to burner manufacturer's Installation, Operation, and Maintenance Instructions for proper set-up, operation, and settings. Turn on the main and pilot (if applicable) manual shutoff valves upstream of the firing rate shutoff valve and check for leaks on duct furnace piping, correct leaks.
2. Check the gas supply pressure to the duct furnace, making sure it does not exceed the maximum on the duct furnace rating plate.
3. Connect test instruments, meters, and thermometers on the furnace and controls to measure and record the appropriate data.
4. Close the main manual valve, leaving the pilot open (if applicable).
5. Set the thermostat at highest setting and energize the heating control - burner motor starts, closing the air switch and energizing the ignition control.
6. With power supplied to the ignition controller and all the safety limiting devices are satisfied, a 30 - 90 second pre-purge will start, the pilot valve (if applicable) or main gas valve is energized and a 6-15 second trial to ignite. If the flame sensing probe fails to prove the pilot or main flame, it de-energizes the spark igniter and the controller will lockout on flame failure (10-30 seconds). This safety step is performed to establish the flame sensing, and test any of the safety devices before main burner light off.

7. Frequently the cause for safety lockouts relates to gas pressures that are too high, and or combustion air dampers not set correctly. Cycle pilot several times to make sure that the combustion air and pilot gas pressure is sufficient to provide instant ignition, and a stable flame. Check to make sure the pilot flame signal is steady. Pilot regulator adjustment may be necessary if the adjustment of the needle valve does yield the required flame signal (if applicable).
8. Install a manometer at the test port to check burner manifold pressure.
9. Once pilot has been established (if applicable), the main manual valve is turned on. Reset the controller and the ignition sequence will recycle. Once the main automatic gas valve is energized the burner will light, and the control valve will modulate to thermostat setpoint. Check to make sure the main flame signal is steady.
10. If the burner does not light within a few seconds after pre-purge shut the burner off and repeat the previous steps.
11. Check the combustion air setting. The duct furnace has been test fired in the factory for firing rate and combustion. Field conditions may require adjustments to be made. These checks should be done by a qualified service man.
 - a) When the main flame is established, check the gas manifold pressure at the test points nearest the burner, downstream of the gas control valve. Check the nameplate for the correct pressure and adjust the appliance regulator if necessary.
 - b) Check the CO and O₂ reading at maximum and minimum inputs shown on the rating label. O₂ readings typically range from 4-10%. CO readings should not exceed 400 PPM at any time. Adjust the air/gas ratios with the control linkages making fine adjustments before measuring again.
 - c) Ensure proper overfire draft at test port in burner section is set per nameplate.
 - d) Visually observe the flame and insure that the flame does not impinge on the heat exchanger surface and that there are no hot spots on the combustion chamber.
 - e) Check all gas piping again for leaks using a soap bubble solution.
 - f) When the duct furnace installation is complete, recheck the amperage draw of each motor.
 - g) Insure all safety controls are operative, i.e., flame relay, high limit, air proving switches, etc.
 - h) Reset all operating controls back to proper set-points for normal running conditions.

3.3 High Altitude Operation

The rated output of gas-burning appliances decreases with higher altitudes. For IFD series duct furnace installations at altitudes above 2,000 feet (610 m), the furnace shall be derated 4 percent for each 1,000 feet (305 m) of altitude above sea level. Factory testing and rating plate information is recorded on sea level conditions. High altitude ratings may be obtained by a change in manifold pressure when the appliance is equipped with a gas pressure regulator. Appliances must be suitably marked to indicate their altitude adjusted input rating.

3.4 Shut-down Instructions

EMERGENCY SHUT-DOWN

- Set the disconnect switch to the "OFF" position
 - Close the main manual firing valve in the manifold on gas fired duct furnaces
- NOTE: The installer must clearly identify all emergency shut-off devices

1. De-energize the heating control, turning the burner off.
2. Close the Manual Firing Valve in the manifold on gas fired duct furnaces.
3. If the duct furnace was firing at the time of shut down allow the main blower to run for a sufficient period to cool off the heat exchanger. The duct furnace may have an automatic blower override that will perform this function automatically, running the blower until the air reaches a cool enough temperature.
4. Turn the duct furnace control to the "OFF" position.
5. Set the main power disconnect to the duct furnace to the "OFF" position.
6. Close the Main Manual Shut-Off Valve if the burner is shut down for an extended period of time to prevent gas leaking into the combustion chamber.
7. If the duct furnace is to remain idle for an extended period, it is important that the fan and motor shafts be rotated by hand so that the grease can be spread on the bearing parts to avoid corrosion by moisture condensation and accumulation.

3.5 Suggested Tools And Instruments

1. Volt/Ohm Meter
2. D.C./Microammeter
3. Stack & Temperature Thermometer
4. Gas Pressure Gauge
5. Ammeter
6. U-Tube Manometer (0-10" W.C.)
7. Flue Gas Test Equipment
8. Standard Hand Tools

3.6 Troubleshooting

Refer to burner manufacturer's IOM for additional troubleshooting information.

Symptom	Cause	Remedy
A. Burner motor does not operate.	<ol style="list-style-type: none"> 1. Low or no voltage. 2. Fuse(s) blown. 3. Customer's interlock not closed or connected. 4. Burner "Manual / Auto" switch in "Off" position. 5. Safety and limit circuits open. 6. Ignition control not closed. 7. Overload protection on motor or starter tripped. 8. Motor may be defective or incorrectly wired. 9. Burner relay not closed. 10. Pre-purge timer not closed. 	<ol style="list-style-type: none"> 1. Check power source. 2. Replace fuse(s). 3. Close or connect customer interlock. 4. Place switch in "Manual / Auto" position. 5. Close safety and limit circuits. 6. Check for power or replace. 7. Reset the motor or starter and check amps. 8. Turn power off and check power and wiring. 9. Check for power or replace. 10. Check for power or replace.

B. No voltage at flame safeguard relay input terminals.	<ol style="list-style-type: none"> 1. See burner motor does not operate Cause 1,2,3,4,5, & 10. 2. Burner motor air proving switch open. 	<ol style="list-style-type: none"> 1. See burner motor does not operate Remedy 1,2,3,4,5, & 10. 2. Check for correct rotation and or adjustment of switch.
C. Flame safeguard relay goes into safety shutdown (Lockout).	<ol style="list-style-type: none"> 1. See technical data sheets on flame safeguard relay. 	<ol style="list-style-type: none"> 1. Determine the cause of lockout. Reset the flame safeguard relay.
D. Pilot does not light after pre-purge has timed out and voltage is present on flame safeguard output terminals.	<ol style="list-style-type: none"> 1. Manual pilot shut-off valve closed (if applicable). 2. Inlet gas pressure lower than minimum gas pressure required. 3. No gas through pilot regulator with sufficient inlet gas pressure (if applicable). 4. No gas flow through pilot solenoid valve (if applicable). 5. Type of gas supplied (natural gas or propane) different than shown on unit rating plate. 6. Flame detection system not sensing pilot flame. (See section for servicing burner). 7. No voltage on secondary side of ignition transformer. 	<ol style="list-style-type: none"> 1. Slowly open valve. 2. Increase gas pressure. 3. Clear obstruction in vent orifice or line, replace if defective. 4. Check for proper installation, and voltage. Correct or replace if defective. 5. Connect to proper fuel supply of contact factory for field conversion parts. 6a. U.V. Sensor – Clean lens, check wiring and spark rod. 6b. Flame Rod - Assure rod is in pilot flame, check wiring, and flame rod. 7. Check wiring. Replace transformer if defective.

E. If pilot does not light after pre-purge has timed out and there is no voltage at flame safeguard relay output terminals.	1. See technical data sheets on flame safeguard relay.	1. Check wiring and replace if defective.
F. If there is no heat with pilot OK (if applicable) and voltage is present at flame safeguard relay output terminals.	<ol style="list-style-type: none"> 1. Manual gas shut-off valve closed. 2. No gas on outlet side of regulator with proper inlet pressure. 3. No gas on outlet side of butterfly valve or actuator with proper inlet pressure. 4. Burner does modulate. 	<ol style="list-style-type: none"> 1. Turn heat off-on switch to the off position. Slowly open all manual gas shut-off valves. 2. Clear obstruction in vent orifice or line. Check for correct size spring. Replace if defective. 3. Check wiring, voltage, and adjustment. Correct wiring or replace if defective. 4. Check wiring and replace if defective.
G. If there is no heat with pilot OK and no voltage is present at flame safeguard relay output terminals.	1. See technical data sheets on flame safeguard relay.	1. Check wiring and replace if defective.

3.7 Final Checks and Adjustments

With the gas input pressure established, the flue gas analysis can now be performed. This is done at the stack.

The following readings should be taken but not limited to:

CO₂% Net Stack Temperature
O₂% Combustion Efficiency
CO %

If necessary, make adjustments on burner air shutter. **DO NOT** change the fuel input rate.

The following list covers general combustion problems and some of the possible cures. Conditions may vary in the field. Refer to combustion chart for efficiency.

CAUTION: Check local codes for maximum allowable percentages and amounts of emissions.

Low Carbon Dioxide (CO₂)

- Fuel input too low
- Excess burner air
- Wrong draft setting

Detectable Carbon Monoxide (CO)

- Fuel input too high
- Not enough burner air
- Restricted draft
- Flame impingement

Excessive Stack Temperature

- Draft setting too high
- Excess burner air
- Fuel input too high

Low Oxygen (O₂)

- Oxygen reading must always be a positive percentage

Cycle burner several times to ensure smooth light off and proper operation. Visually observe the flame pattern. There must be no flame impingement or hot spots on the combustion chamber that could cause scaling.

Check voltage and amperage on all motors.

Check all dampers, linkages, and locking quadrants to make sure they are secure and operating correctly.

Safety and Controls Checkout

Flame Safeguard – Close the last manual gas valve before burner. Operate unit in heat mode. After pilot flame has been established, close manual pilot gas valve (if applicable). The flame safeguard must trip out within 15 seconds.

Gas Pressure Switches – The low gas pressure switch will trip out and must be reset before resuming operation when the inlet gas shut off valve is turned off, or inlet gas pressure is lower than the trip point. The high gas pressure switch can be checked by reducing the setting of its trip point lower than the burner operating pressure. The switch should trip out and shut off the burner. Return the adjustment to its original setting and reset to resume operation.

Temperature Controls - The temperature controls are checked by adjusting control to a higher temperature to allow burner to cycle on. Adjust control to a lower temperature to allow

burner to cycle off. Return the adjustment to its original setting.

Air Pressure Switches – The air pressure switches can be checked by turning the adjusting screw to call for a higher pressure than is normally used on the system. Recycle is automatic when the switch returned to its original setting. If the burner or draft proving switches open, this could cause the flame safeguard to go into lockout mode.

Limit Controls - The limit controls are checked by adjusting control to a lower temperature setting while the unit is operating on high fire and observe cut-off. Return the adjustment to its original setting. Manual reset may be required on some controls.

Make sure all the safety and controls are working properly.

4.0 MAINTENANCE

If the duct furnace requires stopping to service, follow the section 3.0 on shutting the duct furnace down and starting up.

4.1 Recommended Maintenance

NOTE: The following recommended maintenance schedule should be followed every 6 months unless otherwise specified below. It is highly recommended to schedule the maintenance of the equipment in the spring and fall as equipment demands are commonly most critical after these periods and serve as good prevention practice.

1. Electrical - Check all wiring for loose connections. Check voltage at the duct furnace (while in operation). Check amperage draw against nameplate rating. All contactors should be inspected to ensure that contacts are clean and are making good contact. If contacts are pitted or burned badly, replace contactor points. Single phasing and motor burnouts may result from bad contacts. Check all fuses and replace blown fuses with equivalent size and type.
2. Gas Combustion - Check all fittings, valves and lines for leaks. Check the burner; clean and adjust if necessary. Check the flame sensor; clean if necessary. Check the fuel supply pressure to the duct furnace and the manifold pressure. Check and clean the vent screen if necessary. Refer to burner manufacturer's IOM for servicing the burner.
3. Controls - Clean and recalibrate all controls and check for proper operation. Repair or replace any controls found faulty. Check all damper controls and balancing points for fresh air requirements, tighten any linkages.
4. Motor Lubrication - Refer to motor manufacturer for lubrication recommendations. On motors having grease drain plugs, remove the plugs and operate the motor for 15 minutes before replacing plugs. Do NOT over grease.

Hours of Service (Hours / Day)	Re-Grease Interval		
	Up to 7.5 HP	10 to 40 HP	Over 40 HP
Less than 12	5 Years	3 Years	1.5 Years
More than 12	2 Years	1 Year	9 Months

Motors that run in hot or severe dirt or wet conditions, should be greased at least every six months.

5. Furnace - Furnaces should be inspected at the beginning of heating season, and every 4 months of usage under normal circumstances. If the furnace is exposed to severe conditions where exposure to dust, soot, or other impurities contained in the air, a more frequent inspection is recommended.
 - Clean the burner wheel and rotate the wheel to ensure free movement and tightness
 - Check ignition spark and adjust if necessary
 - Inspect and clean ignition electrodes
 - Check flame supervisor relay flame signal
 - Inspect all safety controls and replace if necessary

- Inspect the flue for blockages. If excessive contamination is present, flush out the flue by removing the exhaust vent pipe and use a water hose to rinse out the contamination. Water and contaminants will wash out of the condensate drain. It may be advisable to temporarily disconnect the normal drain line to prevent a buildup of residue in the drain system when performing a flush out.
 - Clean the burner.
 - Do a flue gas analysis.
 - Inspect area to make sure that no combustible or hazardous material has been stored within clearances as shown on the rating plate.
 - Check for operation of the automatic gas shut off valves, and check them for leakage at the pressure test ports.
 - Inspect all regulators, relief valves, motorized valves, solenoid valves, vent valves, and safety shut off valves. Check their operation and clean as necessary.
 - Inspect and clean all drip legs in fuel lines and in the flue.
 - Inspect the combustion chamber for carbon deposits, soot, scale or rust. Clean if necessary. If there is evidence of flame impingement, a complete burner adjustment must be made.
 - Follow section 3.0 for all details referring to burner operation and start-up.
6. General - Check for any vibration or unusual noise. If any are observed, locate the cause and correct. Check the condensation lines for any blockages or leaks. Check all piping and fittings for any fluid/gas leaks. Refer to manufacturer literature provided for maintenance requirements of optional equipment.

4.2 Recommended Spare Parts

It is recommended that any spare parts required should be ordered at the time the installation is accepted by the Owner. Spare parts allow the duct furnace to be put back into service with minimum disruption in the event of failure. The list of spare parts outlined herein is considered minimum. Installations in remote locations might require more spare parts than listed. Please contact our Parts and Service Department for recommendations.

Spare Parts

Quantity	Part
2 Sets	Fuses
1 pcs.	Flame sensor
1 pcs.	Spark Rod
1 set	Motor Thermal O/L
1 pcs.	Flame Supervisor

5.0 SPECIFICATIONS

The attached literature pertains to the specific duct furnace details