



service and maintenance procedures

UPFLOW/HORIZONTAL,
VARIABLE-SPEED, 2-STAGE,
INDUCED-COMBUSTION FURNACES

333BAV 333JAV Series B

Cancels: SP04-43

SP04-50
10-97

NOTE: Read the entire instruction manual before performing any service or maintenance.

This symbol → indicates a change since the last issue.

These procedures are for size 60,000 through 120,000 Btuh units.

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SAFETY CONSIDERATIONS

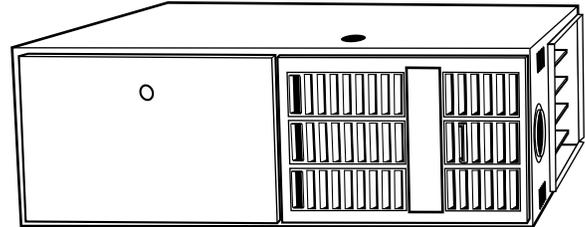
Installing and servicing heating equipment can be hazardous due to gas and electrical components. Only trained and qualified personnel should install, repair, or service heating equipment.

Untrained personnel can perform basic maintenance functions such as cleaning and replacing air filters. All other operations must be performed by trained service personnel. When working on heating equipment, observe precautions in the literature, tags, and labels attached to or shipped with the unit and other safety precautions that may apply.

→ Follow all safety codes. In the United States, follow all safety codes including the National Fuel Gas Code NFPA No. 54-1996/ANSI Z223.1-1996. In Canada, refer to the current edition of the National Standard of Canada CAN/CGA-B149.1- and .2-M95 Natural Gas and Propane Gas Installation Codes. Wear safety glasses and work gloves. Have fire extinguisher available during start-up and adjustment procedures and service calls.

Recognize safety information. This is the safety-alert symbol ⚠. When you see this symbol on the furnace and in instructions or manuals, be alert to the potential for personal injury.

Understand the signal words DANGER, WARNING, and CAUTION. These words are used with the safety-alert symbol. DANGER identifies the most serious hazards which **will** result in severe personal injury or death. WARNING signifies a hazard which **could** result in personal injury or death. CAUTION is used to identify unsafe practices which **would** result in minor personal injury or product and property damage.

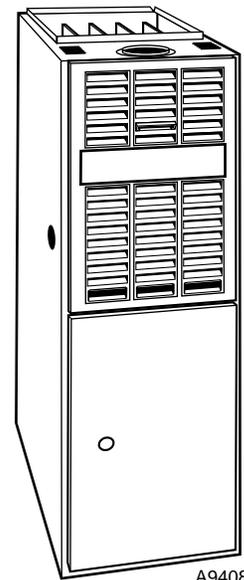


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Fig. 1—Model 333BAV or 333JAV Horizontal



CERTIFICATION OF MANUFACTURING SITE



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Fig. 2—Model 333BAV or 333JAV Upflow

WARNING: The ability to properly perform maintenance on this equipment requires certain expertise, mechanical skills, tools, and equipment. If you do not possess these items, do not attempt to perform any maintenance on this equipment other than those procedures recommended in the User's Manual. A FAILURE TO FOLLOW THIS WARNING COULD RESULT IN POSSIBLE DAMAGE TO THIS EQUIPMENT, SERIOUS PERSONAL INJURY, OR DEATH.

ELECTROSTATIC DISCHARGE (ESD) PRECAUTIONS PROCEDURE

CAUTION: Electrostatic discharge can affect electronic components. Take precautions during furnace installation and servicing to protect the furnace electronic control and motor. Precautions will prevent electrostatic discharges from personnel and hand tools which are held during the procedure. These precautions will help to avoid exposing the control to electrostatic discharge by putting the furnace, the control, the motor, and the person at the same electrostatic potential.

1. Disconnect all power to the furnace. **DO NOT TOUCH THE CONTROLS OR ANY WIRE CONNECTED TO THE CONTROLS PRIOR TO DISCHARGING YOUR BODY'S ELECTROSTATIC CHARGE TO GROUND.**
2. Firmly touch a clean, unpainted, metal surface of the furnace chassis which is close to the controls. Tools held in a person's hand during grounding will be satisfactorily discharged.
3. After touching the chassis you may proceed to service the controls, motor, or connecting wires as long as you do nothing that recharges your body with static electricity (for example; **DO NOT** move or shuffle your feet, **DO NOT** touch ungrounded objects, etc.).
4. If you touch ungrounded objects (recharge your body with static electricity), firmly touch furnace again before touching control or wires.
5. Use this procedure for installed and uninstalled (ungrounded) furnaces.
6. Before removing a new control or motor from its container, discharge your body's electrostatic charge to ground to protect the control or motor from damage. If the control or motor is to be installed in a furnace, follow items 1 through 5 before bringing the control, or motor, or yourself into contact with the furnace. Put all used AND new controls and motors into containers before touching ungrounded objects.
7. An ESD service kit (available from commercial sources) may also be used to prevent ESD damage.

CARE AND MAINTENANCE

For continuing high performance and to minimize possible equipment failure, it is essential that periodic maintenance be performed on this equipment. Consult your local dealer as to the proper frequency of maintenance and the availability of a maintenance contract.

WARNING: Never store anything on, near, or in contact with the furnace, such as: 1. Spray or aerosol cans, rags, brooms, dust mops, vacuum cleaners, or other cleaning tools.
2. Soap powders, bleaches, waxes or other cleaning compounds, plastic or plastic containers, gasoline, kerosene, cigarette lighter fluid, dry cleaning fluids, or other volatile fluids.
3. Paint thinners and other painting compounds, paper bags or other paper products.
A failure to follow this warning could result in corrosion of the heat exchanger, fire, personal injury, or death.

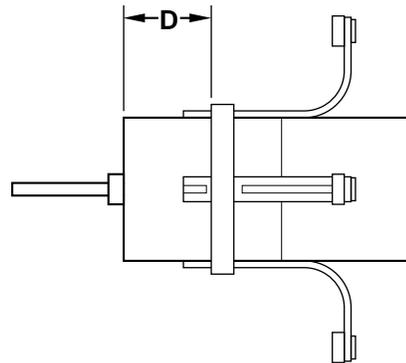
WARNING: Turn off the gas and electrical supplies to the unit before performing any maintenance or service on it. Follow the operating instructions on the label attached to the furnace. A failure to follow this warning could result in personal injury.

CAUTION: As with any mechanical equipment, personal injury can result from sharp metal edges, etc.; therefore, be careful when removing parts.

The minimum maintenance that should be performed on this equipment is as follows:

1. Check and clean air filter each month or more frequently if required. Replace if torn.
2. Check blower motor and wheel for cleanliness each heating and cooling season. Clean as necessary.
3. Check electrical connections for tightness and controls for proper operation each heating season. Service as necessary.

CAUTION: If motor is removed from blower assembly, the motor **MUST** be reinstalled so arrow on end of the motor is pointing in the direction of airflow through the furnace. The belly band **MUST** be the specified distance from the motor end shield surface at the shaft end. (See Fig. 3.)



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DIMENSIONS (IN.)

FURNACE SIZE	D
036060	1
048080	1-1/2
060100	3
060120	3

Fig. 3—Motor Belly Band Location

A. Air Filter Arrangement

The air filter arrangement may vary depending on the application. Refer to Table 1 for filter size information.

WARNING: Never operate unit without a filter or with filter access door removed. A failure to follow this warning could result in fire, personal injury, or death.

1. Upflow and horizontal.
Each furnace requires 1 or 2 filters which are installed in the blower compartment. (See Fig. 4.) To remove filters for cleaning or replacement, proceed as follows:

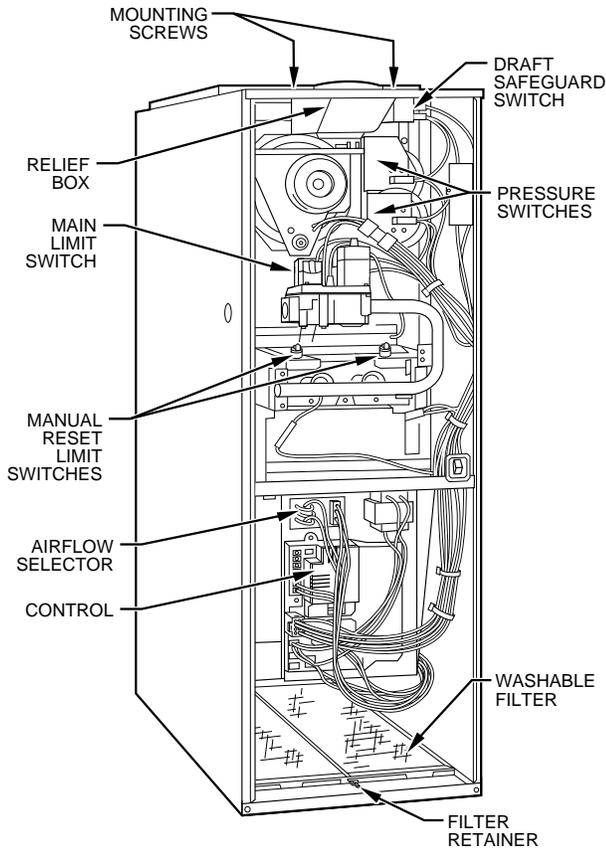
TABLE 1—UPFLOW/HORIZONTAL FILTER SIZE INFORMATION (IN.)

FURNACE CASING WIDTH	FILTER SIZE†		FILTER TYPE
	Side Return	Bottom Return	
14-3/16	(1) 16 X 25 X 1*	(1) 14 X 25 X 1	Cleanable
21	(1) 16 X 25 X 1	(1) 20 X 25 X 1*	Cleanable
24-1/2	(2) 16 X 25 X 1*	(1) 24 X 25 X 1	Cleanable

* Factory-provided with the furnace.

† Filters may be field modified as required by cutting and folding the frame as indicated on the filter.

- a. Turn off electrical supply before removing blower and control access doors.
- b. Release filter retainer from clip at front of furnace casing. (See Fig. 4.) For side return, clips may be used on either or both sides of the furnace.



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Fig. 4—Upflow/Horizontal Component Identification

- c. Slide filter out.
- d. Clean filters by spraying tap water through filter from opposite direction of airflow.
- e. Rinse and let dry. Oiling or coating of filter is not recommended or required.
- f. Place filter in furnace.
- g. Replace blower and control access doors and turn on electrical supply to furnace.

B. Blower Motor and Wheel

For long life, economy, and high efficiency, clean accumulated dirt and grease from the blower wheel and motor annually.

The following steps should be performed by a qualified service technician:

The motors have prelubricated sealed bearings and require no lubrication.

Remember to disconnect the electrical supply before removing access doors.

Clean as follows:

1. Remove blower access door.
2. Disconnect blower electrical leads from motor. Squeeze latches to remove connectors from motor. Disconnect green ground wire from screw. Note location of wires for reassembly.
3. Remove control.
4. Remove screws holding blower assembly to blower deck and slide blower assembly out of furnace.
5. Mark blower wheel, motor, and motor support in relation to blower housing before disassembly to ensure proper reassembly.
6. Loosen setscrew(s) holding blower wheel on motor shaft.
7. Remove bolts holding motor and motor mount to blower housing and slide motor and mount out of housing. Motor mount belly band need not be removed unless motor is to be replaced.

CAUTION: The blower wheel should not be dropped or bent as balance will be affected.

8. Remove blower wheel from housing.
 - a. Mark cutoff plate location to ensure proper reassembly.
 - b. Remove screws holding cutoff plate and remove cutoff plate from housing.
 - c. Lift blower wheel from housing through opening.
9. Clean blower wheel and motor using a vacuum with soft brush attachment. Do not remove or disturb balance weights (clips) on blower wheel blades.
10. Reinstall blower wheel by reversing items 8 a through c. Be sure wheel is positioned for proper rotation.
11. Reassemble motor and blower by reversing items 4 through 7.

CAUTION: Be sure the motor is properly positioned in the blower housing. The motor arrow must point in the direction of airflow through the furnace after the blower assembly has been reinstalled in the furnace.

12. Reinstall blower assembly in furnace.
13. Reinstall control. If motor has ground wire, be sure it is connected as before.
14. Connect blower electrical leads to motor. Please note that connections are polarized for assembly. **DO NOT FORCE.**
15. If power choke is attached to blower housing, ensure it is connected in series with black power lead to motor.

C. Cleaning Heat Exchanger

The following steps should be performed by a qualified service technician:

NOTE: Deposits of soot and carbon indicate the existence of a problem which needs to be corrected. Take action to correct the problem.

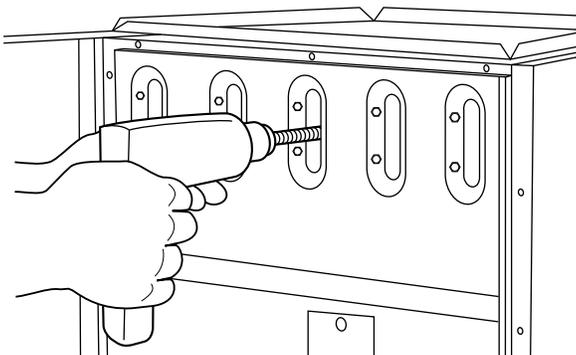
If it becomes necessary to clean the heat exchanger because of carbon deposits, soot, etc., proceed as follows:

1. Turn gas and power to furnace to OFF.
2. Remove control and blower access doors.
3. Disconnect wires to the following components. Mark wires to aid in reconnection of:

- a. Draft safeguard switch.
 - b. Inducer motor.
 - c. Pressure switch(es).
 - d. Limit overtemperature switch(es).
 - e. Gas valve.
 - f. Hot surface ignitor.
 - g. Flame-sensing electrode.
 - h. Wiring connectors leading to control.
4. Remove 2 screws that secure relief box. (See Fig. 4.)
 5. Remove 8 screws that secure flue collector box to center panel. Be careful not to damage sealant.
 6. Remove complete inducer assembly from furnace, exposing flue openings.
 7. Using field-provided small wire brush, steel spring cable, reversible electric drill, and vacuum cleaner, clean cells as follows:
 - a. Assemble wire brush and steel spring cable.
 - (1.) Use 48 in. of 1/4-in. diameter high-grade steel spring cable (commonly known as drain clean-out or Roto-Rooter cable).
 - (2.) Use 1/4-in. diameter wire brush (commonly known as 25-caliber rifle cleaning brush).

NOTE: The materials needed in items (1.) and (2.) can usually be purchased at local hardware stores.

- (3.) Insert twisted wire end of brush into end of spring cable, and crimp tight with crimping tool or strike with ball-peen hammer. **TIGHTNESS IS VERY IMPORTANT.**
 - (4.) Remove metal screw fitting from wire brush to allow insertion into cable.
- b. Clean each heat exchanger cell.
 - (1.) Attach variable-speed, reversible drill to end of spring cable (end opposite brush).
 - (2.) Remove cell outlet plates. **IMPORTANT:** Replace screws in center panel to secure heat exchanger cells before cleaning.
 - (3.) Insert brush end of cable into upper opening of cell and slowly rotate with drill. **DO NOT** force cable. Gradually insert at least 36 in. of cable into 2 upper passes of cell. (See Fig. 5.)



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Fig. 5—Cleaning Heat Exchanger Cell

- (4.) Work cable in and out of cell 3 or 4 times to obtain sufficient cleaning. **DO NOT** pull cable with great force. Reverse drill and gradually work cable out.
- (5.) Remove burner assembly and cell inlet plates.

NOTE: Be very careful when removing the burner assembly to avoid breaking the ignitor. See Fig. 6 for the correct ignitor location.

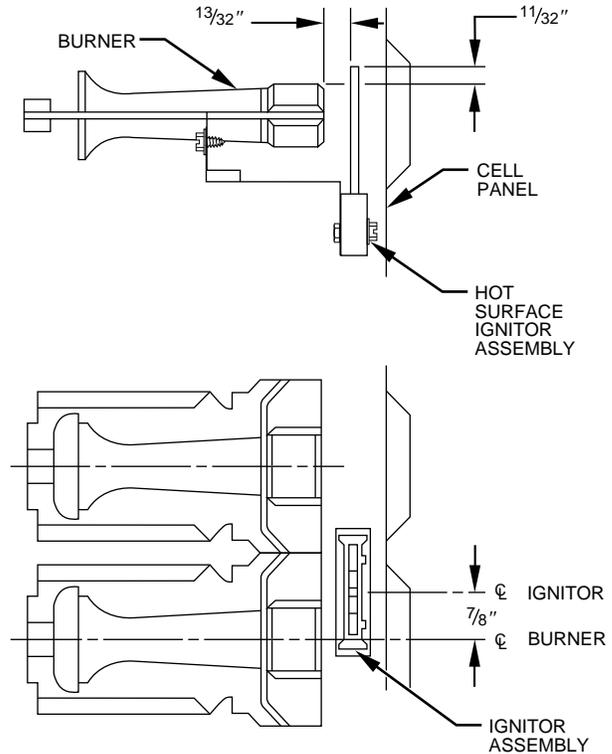


Fig. 6—Position of Ignitor to Burner

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- (6.) **IMPORTANT:** Replace screws in center panel to secure heat exchanger cells before cleaning.
 - (7.) Insert brush end of cable in lower opening of cell, and proceed to clean 2 lower passes of cell in same manner as 2 upper passes.
 - (8.) Repeat foregoing procedures until each cell in furnace has been cleaned.
 - (9.) Using vacuum cleaner, remove residue from each cell.
 - (10.) Using vacuum cleaner with soft brush attachment, clean burner assembly.
 - (11.) Reinstall cell outlet plates and screws **FIRST**; then, reinstall cell inlet plates and burner assembly. Care must be exercised to center the burners in the cell openings.
8. After cleaning flue openings, clean flue collector. Check sealant on flue collector to ensure that it has not been damaged. If new sealant is needed, contact your dealer or distributor.
 9. Replace flue collector assembly, making sure all 8 screws are secure.
 10. Reinstall relief box.
 11. Reconnect wires to the following components:
 - a. Draft safeguard switch.
 - b. Inducer motor.
 - c. Pressure switches.
 - d. Limit overtemperature switch(es).
 - e. Gas valve.
 - f. Hot surface ignitor.

- g. Flame-sensing electrode.
 - h. Wiring connectors leading to control.
12. Reconnect vent pipe to relief box.
 13. Replace blower door only.
 14. Turn power and gas to ON.
 15. Set thermostat and check furnace for proper operation.
 16. Verify blower airflow and that airflow rate changes between heating and cooling.
 17. Check for gas leaks.
 18. Replace control door.

	WARNING: Never use a match or other open flame to check for gas leaks. Use a soap-and-water solution. A failure to follow this warning could result in fire, personal injury, or death.
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D. Electrical Controls and Wiring

NOTE: There may be more than 1 electrical supply to unit.

The electrical ground and polarity for 115-v wiring must be maintained properly. Refer to Fig. 7 and 8 for field wiring information and to Fig. 9 for unit wiring information. If the polarity is NOT correct, the furnace control will display rapid flashing on the status LED and prevent heat operation. The control system also requires an earth ground for proper operation of the microprocessor and variable-speed motor.

NOTE: Be aware that measurement of current (amperes) and power (watts) for the ICM2+ variable-speed motor will be accurate only when the meter provides true root-mean-square (RMS) measurements.

With power disconnected from unit, check all electrical connections for tightness. Tighten all screws on electrical connections. If any smoky or burned connections are noticed, disassemble the connection, clean all parts and stripped wire, and reassemble properly and securely. Electrical controls are difficult to check without proper instrumentation; therefore, reconnect electrical power to unit and observe unit through 1 complete operating cycle.

The 24-v circuit contains an automotive-type, 3-amp fuse located on the main control. Any 24-v electrical shorts during installation, service, or maintenance could cause this fuse to blow. If fuse replacement is required, use ONLY a 3-amp fuse. The control will display code 24 when the fuse needs replacement.

The control in this furnace is equipped with an LED status light to aid in installation, servicing, and troubleshooting. It can be viewed through the sight glass or window on the blower access door. The control indicates status with the LED on continuously, rapid flashing, or a code composed of 2 digits. (The first digit is the number of short flashes, the second is the number of long flashes.) Refer to the service label on the blower compartment door for code explanations and useful troubleshooting suggestions. (See Fig. 10.)

It is important to note that power to the furnace must not be interrupted and the furnace blower door must not be removed until the LED status code(es) is recorded. When power to the control is interrupted, the status memory is erased.

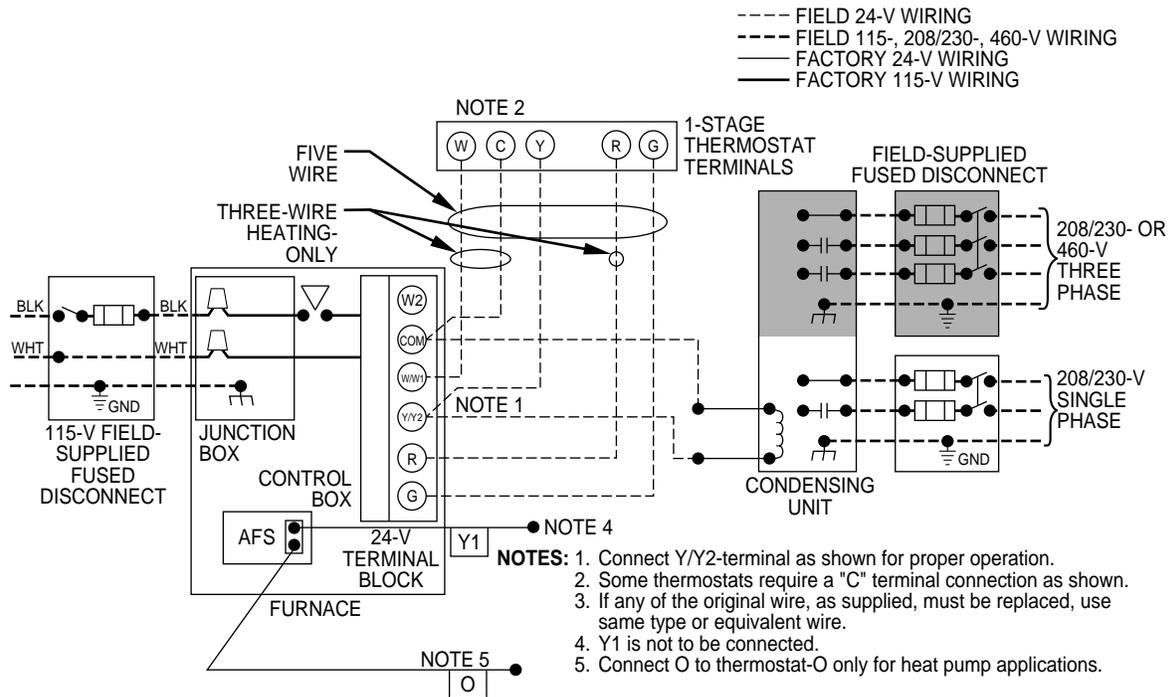
The control will store up to 5 previous codes but will not store non-current codes longer than 48 hr. To retrieve previous codes, if present, no thermostat inputs to the control must be present and all time delays must expire. Remove 1 of the red main limit wires 1 to 4 sec until the LED light goes out, then reconnect it. (See Fig. 4.) (Do not leave red wire disconnected for longer than 4 sec as the control will assume an overtemperature condition exists and will respond with indoor blower operation.) This places the control in the status recall mode and displays the first code stored in memory. Record the code and repeat the disconnect and reconnect of the red wire, recording each code until code 11 is displayed indicating no additional faults. After the last code is displayed or after 2 minutes in the code recall mode, the control will return to normal standby mode.

Use any recorded status codes, the service label, and the troubleshooting diagram on the following pages to diagnose and correct any problem condition.

E. Troubleshooting

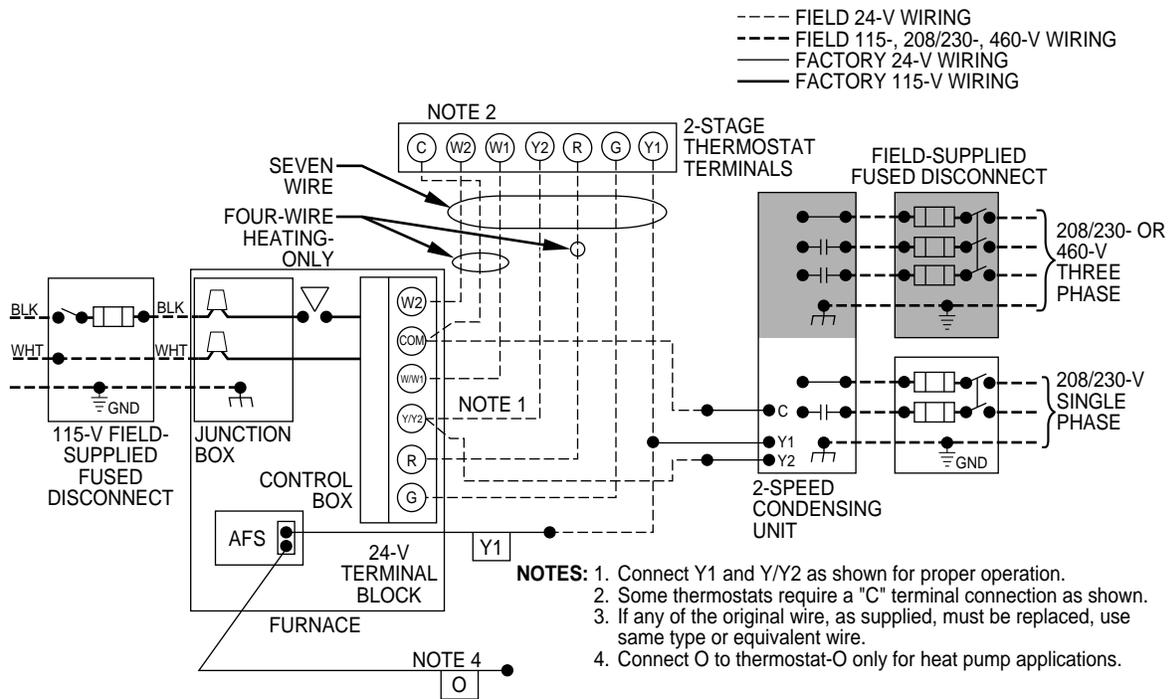
Refer to the service label. (See Fig. 10.) Page 9 contains a troubleshooting guide. This guide can be a useful tool in isolating furnace operation problems. Beginning with the word "Start," answer each question and follow the appropriate arrow to the next item.

The guide will help to identify the problem or failed component. After replacing any component, verify correct operation sequence. More information is available in a separate Troubleshooting Guide for 2-stage gas-fired induced-combustion furnaces.



→ Fig. 7—Heating and Cooling Application Wiring Diagram for Single-Stage Thermostats and/or Single-Speed Condensing Units

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→ Fig. 8—Heating and Cooling Application Wiring Diagram for 2-Stage Thermostats and/or 2-Speed Condensing Units

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⚠ WARNING

Service should be performed only by qualified persons.

SERVICE

If status code recall is needed, do not remove power or blower door.

LED CODE	STATUS
CONTINUOUS OFF	Check for 115V at L1 and L2, and 24V at SEC1 and SEC2.
CONTINUOUS ON	Control has 24V power.
RAPID FLASHING	Line voltage polarity reversed. If twinned, 24V power to one furnace may be out of phase with power to other furnace.

EACH OF THE FOLLOWING STATUS CODES IS A TWO-DIGIT NUMBER WITH THE FIRST DIGIT DETERMINED BY THE NUMBER OF SHORT FLASHES AND THE SECOND DIGIT BY THE NUMBER OF LONG FLASHES.

- 11 NO PREVIOUS CODE** - Stored status codes are erased when power (115V or 24V) to control is interrupted or 48 hours after each fault is cleared.
- 12 BLOWER ON AFTER POWER UP** - Blower runs for 90 seconds, if unit is powered up during a call for heat (R-W/W1 closed). Note: 2-sec. ON-delay.
- 13 LIMIT OR FLAME ROLL-OUT (FRS) SWITCH LOCKOUT** - Auto-reset after three hours. FRS switch requires manual-reset.
Check for: - Refer to #33
- 14 IGNITION LOCKOUT** - Control will auto-reset after three hours. Refer to #34.
- 21 GAS HEATING LOCKOUT** - Control will NOT auto-reset.
Check for: - Mis-wired gas valve - Defective control (valve relay)
- 22 ABNORMAL FLAME-PROVING SIGNAL** - Flame is proved while gas valve is de-energized. Inducer will run until fault is cleared.
Check for: - Leaky gas valve - Stuck-open gas valve
- 23 LOW- OR HIGH-HEAT PRESSURE SWITCH DID NOT OPEN**
Check for: - Obstructed pressure tubing
- Defective pressure switch (stuck closed)
- 24 SECONDARY VOLTAGE FUSE IS OPEN**
Check for: - Short-circuit in secondary voltage (24V) wiring
- 31 HIGH-HEAT PRESSURE SWITCH OR RELAY DID NOT CLOSE OR REOPENED**
Check for: -Control relay may be defective - Refer to #32
- 32 LOW-HEAT PRESSURE, DRAFT SAFEGUARD , OR AUX-LIMIT (DOWNFLOW ONLY*) SWITCH DID NOT CLOSE OR REOPENED**
Check for: - Proper vent sizing (and condensate pitch with side-wall vent)
- Low inducer voltage (115v) * Blower motor and capacitor
- Defective inducer motor - Defective pressure switch
- Excessive wind - Restricted vent
- Inadequate combustion air supply
- Disconnected or obstructed pressure tubing
- 33 LIMIT OR FLAME ROLL-OUT (FRS) SWITCH IS OPEN** - FRS switch requires manual-reset.
Check for: - Inadequate combustion air supply (FRS switch only)
- Dirty filter or restricted duct system - Loose blower wheel
- Defective switch or connections
- Blower motor or capacitor failure
- 34 IGNITION-PROVING FAULT** - Control will retry three times before lockout #14.
Check for: - Oxide buildup on flame-proving sensor (clean with fine sandpaper).
- Proper flame-proving microamps (0.5 minimum)
- Proper control ground continuity
- Flame-proving sensor must be ungrounded
- Smooth flame carryover and ignition - Manual valve(s) OFF
- 43 LOW-HEAT PRESSURE, DRAFT SAFEGUARD, OR AUXILIARY LIMIT SWITCH OPEN WHILE HIGH-HEAT PRESSURE SWITCH IS CLOSED**
Check for: - Disconnected or obstructed pressure tubing
- Defective pressure switch (stuck open)
- Refer to #32 and #33
- 45 REPLACE CONTROL**

320893-101 REV. A

Fig. 10—Service Label

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NOTES:

1. Refer to information label on blower compartment door for procedure for use of LED status codes and problem solving suggestions.
2. LED indicator is viewed through window in blower compartment door.
3. If 115-vac power is de-energized or interrupted during a call for heat, the indoor blower will run for 90 sec before a gas heating cycle begins – **Code 12**.
4. After replacing any component, verify correct operating sequence.

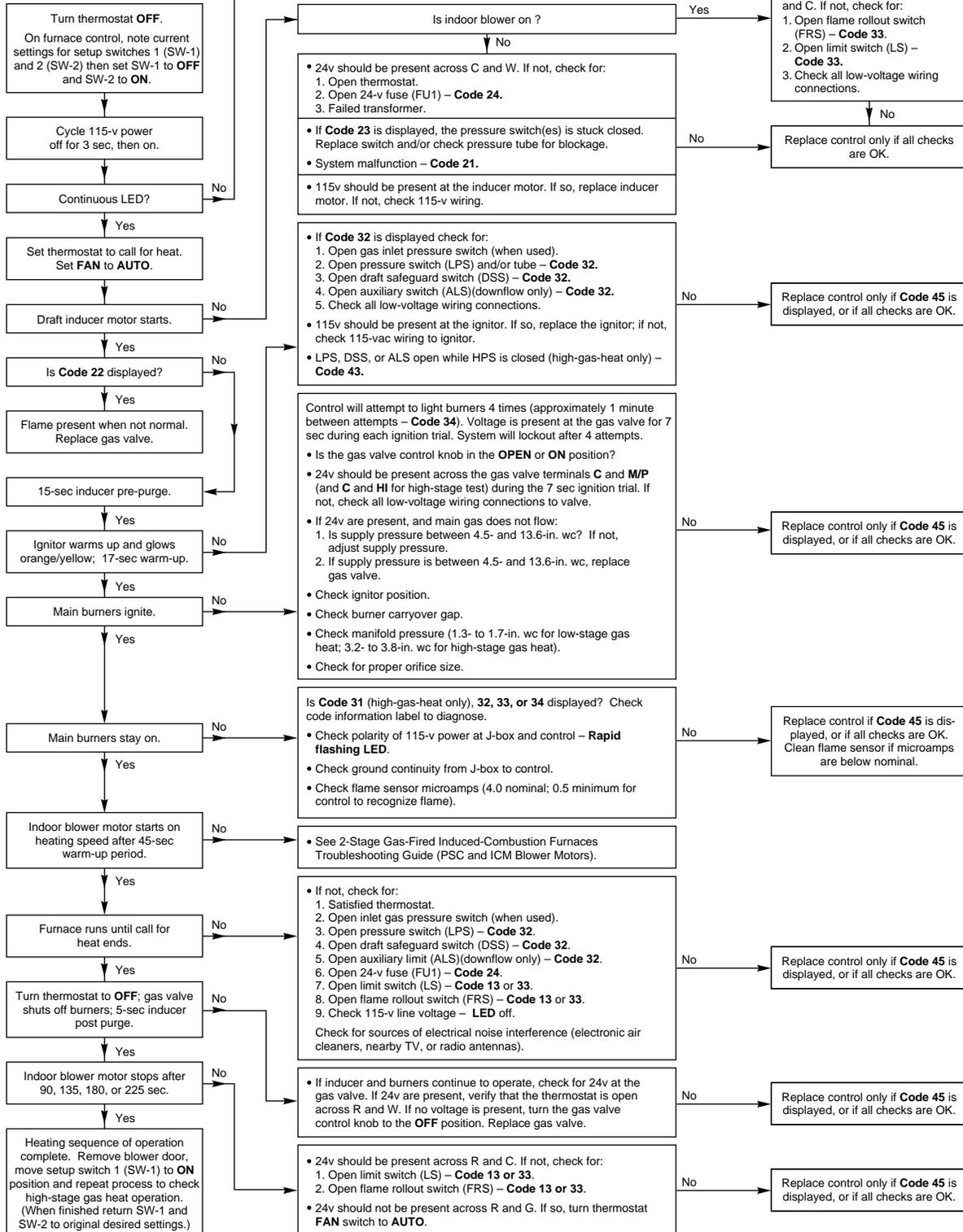
TROUBLESHOOTING GUIDE



ELECTRICAL SHOCK HAZARD

ONLY QUALIFIED AND TRAINED
SERVICE PERSONNEL SHOULD
PERFORM THIS PROCEDURE

START



SERVICE TRAINING

Packaged Service Training programs are an excellent way to increase your knowledge of the equipment discussed in this manual, including:

- Unit Familiarization
- Maintenance
- Installation Overview
- Operating Sequence

A large selection of product, theory, and skills programs is available, using popular video-based formats and materials. All include video and/or slides, plus companion book.

Classroom Service Training plus "hands-on" the products in our labs can mean increased confidence that really pays dividends in faster troubleshooting, fewer callbacks. Course descriptions and schedules are in our catalog.

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