Chapter 15

Service Procedures

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Chapter 15

Service Procedures

Introduction

The most interesting and challenging part of a service technician's job is troubleshooting. Think of all the parts that must work together for a system to function properly; if any one of them becomes defective, the system will malfunction. A technician is like a detective — they must figure out what happened, why it happened, how to fix it and how to keep it from happening again.

Using an electrical meter

The previous chapters have provided an understanding of the operation of the various components of systems. This chapter explains how to use that knowledge to repair systems without wasting time or replacing parts that are working properly.

Before getting involved with in-depth troubleshooting, remember to check the basics:

- Are all the switches on?
- Is the fuse blown or circuit breaker tripped?
- Is the thermostat set above the room temperature?
- Is there fuel in the tank?
- Is the blower door closed? (There is a switch on many blower doors that prevents the system from operating if it is not properly closed.)
- Is there enough water in the steam or hot water system?
- Are the air filters clean?

There are many reasons for a customer to require a technician's expertise, among the most common are:

- No heat
- Insufficient heat
- Too much heat
- No hot water
- Water leak
- Fuel leak
- Odors, smoke or soot

Each problem should be approached ***carefully*** and ***systematically***.

Carefully—never do anything that can put people or property in danger.

Wear protective equipment

Wear appropriate Personal Protective Equipment and protect the work area with drop cloths, newspaper or builder's paper. Use insulated screwdrivers and avoid working on live electrical circuits. Do not press reset buttons without first

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making sure that there is not a fire or a fuel buildup in the combustion chamber.

Systematically—the best service technicians develop standard troubleshooting routines. They go from step to step until they find and correct the cause of the problem.

A systematic approach starts with logic—looking for the obvious solution and then trying to narrow down the problem. Start with the easy—if the heating system is not working, check that all electrical switches are turned on and that there is enough fuel in the tank before starting to disassemble the heating system.

Most importantly, NEVER make assumptions. Do not assume that the reset was only pressed once. Do not assume that the last service technician installed the correct nozzle. Do not assume that the dispatcher gave the correct reason for the call and do not assume that because a customer says they have plenty of fuel that their tank is not empty.

An example of a systematic troubleshooting routine:

Step 1. Information gathering: Effective troubleshooting starts before arriving at the customer's home. When the dispatcher assigns the call, try to get important data such as:

- What problem did the customer report?
- When was the last fuel delivery?
- When was the last tune-up?
- When was the last service call and what was done?

After arriving at the jobsite, listen to what the customer says and ask questions to clarify the situation. Depending on the type of trouble, it may be appropriate to ask if any work has been done recently that might have caused the situation, such as other tradesmen working on the electric or plumbing or if a chimney cleaning has just been performed.

If the customer has no heat, ask if they have pressed the reset button, how many times did they press it and what happened after it was pressed.

After gathering enough information to determine exactly what the problem is, proceed to the appliance area. On the way, check the electrical switch and fuel tank gauge. When arriving at the appliance, read the service card on the unit to see what work previous technicians have performed.

Step 2. The investigation: At this point the problem is clear (no heat) and it is time to narrow down the investigation.

Electricity flows from the circuit breaker to a switch, to the limit controls and then to the primary control, which controls burner

Check service card

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components. If the primary control is found to be in lockout, everything electrically upstream from the primary control, i.e. the limit controls, switches or circuit breaker, cannot have caused the problem. The problem is probably with the fuel supply or with the burner itself.

If the burner is not in lockout, there could be a low voltage situation. Modern electronic primary controls will not operate if incoming voltage is low, but will not go into lockout due to low voltage. Use an electrical meter to check the voltage. If it is correct, move on to the next step. If it is not correct, check voltage at the emergency switch. If it is ok there, the fault is between the switch and the primary control. Continue troubleshooting until the problem is located. If the voltage is not correct, the problem is upstream of the switch and normally requires the services of a licensed electrician.

Step 3. Determine the problem: Next, protect the work area and remove the thermostat wires from the T-T terminals of the primary control (to prevent damage to the thermostat). Install a jumper between the terminals to simulate the thermostat calling for heat throughout the rest of the service call.

Open the observation door to check for a flame or excess fuel in the chamber, if there is no flame or fuel, leave the door open to allow any excess pressure to escape in the event of a delayed ignition when the burner starts.

Press the reset button and observe what happens:

- If the burner ignites and runs properly, but shuts off on safety, visually check the cad-cell eye and leads. Also check the retention head for carbon build up. If the eye and/or retention head is dirty, clean them and continue troubleshooting to determine why they are dirty
- If the eye and head are clean, disconnect the cad cell leads from the control, start the burner and install a jumper across the F-F terminals to simulate a fire and connect an ohmmeter to the disconnected leads to check the resistance through the cad cell. If the resistance is high, there are several possibilities including:
  - the cad cell or leads are defective or the cell is not sighting the fire correctly
  - there could be combustion issues such as too much excess air or air in the fuel supply

If the resistance is below 1,500 ohms, the control is defective.

- If the burner starts, but does not ignite, the problem is related to the combustion process. It could be an ignition problem, a fuel problem or too much excess air
- If nothing happens, the primary control may not be in lockout, but may be sensing flame (safe start). The cad cell leads might be crimped together or the F-F terminals might be shorted
- If the burner hums but does not start, the burner motor might be defective or the fuel unit might be “bound” causing the motor to shut off on overload

Step 4. The 5 Whys: Professional service technicians look beyond the symptoms to find the cause of the problem. For example, if the reset button is pressed and the burner starts, nothing has been fixed. The technician must find out why

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the control went into lockout and take corrective action to keep it from happening again. Modern primary controls have made this job much simpler than it used to be. They save data in their memory allowing the Technician to review what happened during a fault cycle. As with all electronics, updates are frequent, consult the manufacturer's instructions for the primary control being serviced.

When the cause of a problem has been determined, ask "why did this happen?" Continue to ask the same question and eventually the real cause of the problem will be found. For example, suppose a customer has no heat. During the systematic troubleshooting routine, the following may be found:

Why? *The control is in lock-out*

Why? *The motor will not turn*

Why? *The fuel unit has seized*

Why? *The fuel unit is full of rust and water*

Why? *The fuel tank has water in it*

Why? *The vent pipe is rotted and allows rain water to enter the tank*

Sometimes the answer can be found with less than five "Whys", sometimes it might take more than five. The key is to keep asking until the reason for the problem is found and the corrective action necessary is determined.

Step 5. The "Hows": Once the "whys" are known, it's time to correct the immediate problem and keep it from happening again. How is that done? In the situation just reviewed in the "5 Whys" where water was in the tank due to a corroded vent pipe, the following steps are required:

1. Replace the vent pipe.
2. Remove the water from the tank.
3. Clean the fuel lines.
4. Replace the fuel unit.
5. Replace the nozzle.
6. Replace the fuel filter.
7. Reset the primary control (and burner motor if applicable).
8. Fire the unit.
9. Adjust the burner and perform a combustion analysis.

In some situations, a technician might not have the time, equipment or experience necessary to perform all the "Hows". In that case, they should troubleshoot the situation to the best of their ability and contact their supervisor for instructions on how to proceed.

Step 6—Paperwork and exit. Once the "Hows", have been completed, clean up the work area and remove all debris to a receptacle in the service vehicle.

Complete all company paperwork and fill in the service card at the unit. Take a last look around to make sure that the area is clean, that all tools have been returned to their proper place, all jumpers have been removed and all controls and thermostats have been returned to their proper settings.

Give the customer the appropriate copy

Helpful hint:
Try to avoid unplugging any electrical appliances when performing service. If anything must be unplugged, the technician should ask the customer for permission first and leave their truck keys tied to the cord to ensure it will be plugged back in before leaving.

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of the invoice, explain what was done and the efficiency test results and answer any questions. Thank them for their business and move on to the next call.

Troubleshooting suggestions

The following is intended to help technicians troubleshoot typical problems that they are likely to encounter. It is not a list of all possible situations or every step that should be taken to troubleshoot problems.

#1 No heat—the unit is cold and the burner is not operating. Figure 15-1

A. Primary control has no power:

1. Check the limit controls, starting with the one immediately upstream of the primary control. If any component of that string is not allowing current to pass, determine the reason why and correct it. For example, if the low water cut-off has current coming in, but is not allowing it to pass through, make sure the water level is sufficient before condemning the control.
2. If the limit control string has no power coming to it, check the switch. If there is no power to the switch, check the circuit breaker or fuse.
3. If the circuit breaker is reset and the unit runs, the technician must find what caused the breaker to trip. Measure the amperage of system components, such as burner motors, circulator motors and blower motors to determine the cause, otherwise the problem will likely re-occur.

B. Primary has correct input voltage but is not powering burner components:

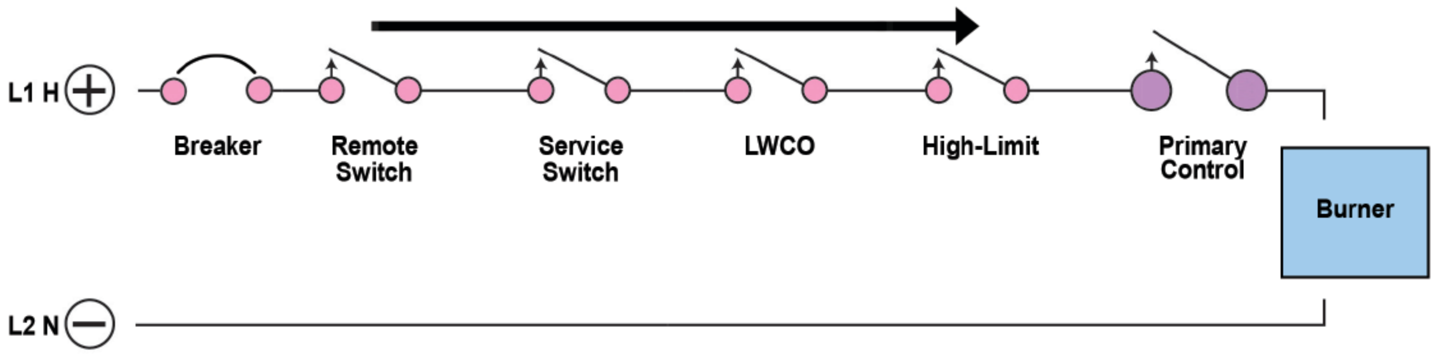
1. Check to be sure that there is not a fire in the chamber.
2. Make sure that the thermostat is set well above room temperature.
3. If the burner still does not start, disconnect the thermostat wires from the T-T terminals of the primary control and install a jumper.

If the burner starts, there is a problem with the thermostat or its wiring.

4. If the burner still does not start, disconnect the cad cell leads from the F-F terminals.

- If the burner starts, there is a problem with the cad cell or its leads
- If the burner does not start, check to be sure that there is not a piece of wire or something else shorting out the F-F terminals
- If there is nothing shorting out the F-F terminals, the control is probably malfunctioning.

Figure 15-1: Basic circuit to burner



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C. If the primary control is passing the correct voltage through to the burner components but:

- **Motor does not start**
  1. The motor might be off on thermal overload. If there is a reset, press it. If there is no reset, check to see if the motor feels hot, if it does, give it a few minutes to cool down.
  2. If the motor still does not start, the trouble is in the motor or motor circuit.
  3. If the motor has a capacitor, check it before condemning the motor.
- **Motor runs but no flame**
  1. Disconnect the nozzle line and check the fuel flow. If water is found in the fuel, drain it from the tank.
  2. If the flow is good and water free, check the nozzle and ignition system.
  3. If there is no flow, check the solenoid valve and prime the fuel unit.
  4. If the fuel unit cannot be primed, make sure all valves are open and check for fuel (Stick the tank, the gauge may be wrong).
  5. If there is sufficient fuel, check the fuel filter and perform a vacuum test (see Chapter 4), the fuel line or tank vent may be clogged.
  6. If the vacuum is high, clean the fuel line with a push-pull pump.
  7. If the vacuum is low, check the coupling.
  8. If the coupling is good, check the pump strainer.
  9. If everything checks OK, perform a complete fuel unit test (see Chapter 4).
- **Motor runs with fuel flow but no ignition**
  1. Check the ignitor/electrodes/porcelains/ignition cables for defects.
  2. Check the electrode setting and nozzle position.
  3. Check the ignitor connections.
  4. Verify that correct primary voltage is supplied to ignition transformer/ignitor.
- **Motor runs with fuel flow and ignition but no flame**
  1. Check the nozzle and replace if defective.
  2. Check the fuel pressure, set to manufacturer specs.
  3. Check the air settings—adjust as necessary (too much air can "blow out" the flame).
- **Burner fires, but shuts off on safety**
  1. If a stack relay is installed:
     - Check the helix, clean and/or reposition as necessary
     - Check that there is sufficient temperature in the flue
  2. If a cad cell control is installed:
     - Check the cell, clean and re-position as necessary
     - Check the air tube and end cone, clean/replace as necessary
  3. Check for water or air in the nozzle line:

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- If water is found, drain it from the tank and lines
- If air is found, perform fuel unit tests to determine why. (Chapter 4)

4. Check air settings, adjust as necessary.

#2 No heat—the unit is warm but no heat is being delivered.

If the burner operates properly but no heat comes from the radiation or ductwork, the problem is with the delivery system. Make sure that all thermostats are set to call for heat and:

Hot water system

1. Check for closed hand or motorized valves.
2. Check that there is sufficient pressure in the system.
3. Check that the circulator is operating properly.
4. Check the flow control valve.
5. Check that the system is not air bound.
6. Check that the high limit is set properly.
7. Check that the reverse aquastat is set properly.

Warm air system

1. Check that the fan-limit control is set properly
2. Check that all dampers are open
3. Check that air filters are clean
4. Check to see if the blower is operating:
    - If it is, check the drive belt
    - If it is not, check for correct voltage from the fan control, if that is acceptable then check motor and capacitor

Steam system

1. Check the water level—too much water in the system will prevent steam from rising.
2. Check for closed hand or motorized valves.
3. Check the main vents.
4. Check the pressuretrol setting.

#3 Insufficient heat—the burner is operating but the house is much cooler than the thermostat setting.

Sometimes this occurs because it is much colder than normal and the house just cannot “keep up” with the outside temperature and/or the system (boiler, furnace, piping, radiation, ductwork) might be undersized.

Other causes for insufficient heat:

A. Burner trouble

1. The burner might be under-fired. Make sure that the burner’s firing rate is properly set for the boiler or furnace.

B. Control circuit

1. Check the heat anticipator settings if applicable
2. Check that the thermostat is properly located. Thermostats are affected by the heat generated by lamps, appliances or fireplaces and should not be located near any heat source.

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3. Check that limit controls and reverse acting aquastats are properly set.

C. Heating systems

1. Check to be sure that the steam vents are operating properly.
2. Check that pipes and/or ductwork are properly insulated.
3. Check that airflow through air filters, radiators, or baseboard is not obstructed by dust, closed air dampers, carpet, furniture or curtains.
4. Check that the water level is adequate in steam systems.
5. Check that hot water systems are not air bound.
6. Check that blowers and their pulleys and belts are functioning properly.

#4 Too much heat

When the customer complains of too much heat, the most likely causes are:

1. Thermostat stuck, set too high, improperly located or defective.
2. Limit control defective or set too high.
3. Flow control valve stuck.
4. Motorized valve stuck.

#5 No hot water

Troubleshooting a "no hot water" call with an oil-fired water heater is basically the same as troubleshooting a no heat call: check the burner and the limit control. When the hot water comes from a domestic hot water coil or storage tank:

1. Check the aquastat settings.
2. Check to be sure the water level in the boiler is above the coil.
3. Check the mixing valve.
4. If there is a storage tank installed:
   - Check the control setting
   - Check the circulator
   - If the tank seems to be full of hot water but the water coming from the hot tapping is cool, check the dip tube on the inlet to the tank

#6 Water leak

Depending on the severity of the leak, this can be a minor inconvenience or a major problem.

Helpful hint—Always treat all electrical circuits as if they were energized.

USE CAUTION! Never work on electrical components while they are wet or when standing on wet floors.

1. If a relief valve is leaking:

Steam system—check the steam gauge and the pressuretrol. Remember that residential steam systems should operate at a maximum of 2 PSI and steam relief valves open at 15 PSI. If the relief valve opens, it is likely either the valve or the pressuretrol is malfunctioning.

Hot water system—several things can cause the relief valve to open on a hot water system:

- A full expansion tank

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- A bad diaphragm on a pressurized expansion tank
- A malfunctioning or improperly set aquastat
- A misadjusted or malfunctioning pressure-reducing valve
- A leaking domestic hot water coil
- A leaking indirect water heater coil
- A malfunctioning relief valve

Water heater—check the aquastat and the domestic hot water pressure.

2. **If circulator flange is leaking:** Tightening the flange may stop the leak but it is usually better to replace the gaskets once they start leaking.
3. **If bearing assembly is leaking:** Three-piece circulators have a separate bearing assembly that leaks water from a weep hole when they become defective. With this type of leak, either change the bearing assembly or replace the entire circulator with a one-piece model.
4. **If the boiler is leaking**: It is usually beyond repair. Turn off the electric power and the water supply to the unit, drain the remaining water from the system and contact the service manager for instructions.

Helpful hints:

Many municipalities require the installation of backflow prevention devices that can cause domestic hot water relief valves to open. Often the only way to stop the valve from opening is to install a domestic water expansion tank.

Figure 15-2: Evidence of water coming down chimney

Helpful hints:

Customers often complain of water leaks during rainstorms. These "water leaks" are sometimes caused by rainwater coming down the chimney and leaking onto the floor.

Sometimes low stack temperatures cause flue gases to condense in the chimney and leak onto the floor. Figure 15-2, above

#7 Fuel leaks

Fuel leaks are a serious concern because they can lead to significant damage. The approach to these calls will depend on the severity of the leak.

Minor leaks typically occur at:

1. **Brass fittings**: If the system has

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compression fittings, they should be replaced with flare fittings. If a flare fitting is leaking, turn off the fuel supply then disassemble and inspect the flare. If the flare looks to be in good condition reconnect it, tighten it, clean it with an absorbent rag and run the burner. After several minutes inspect the fitting closely, if there is any evidence of a leak cut out the flare, re-flare the copper, reconnect it and keep checking until the leak has been stopped.

2. **Malleable fittings:** If there is a leak at a malleable fitting, inspect it closely before taking it apart. If the leak appears to be coming from the area where the fitting is threaded, disassemble it, clean it, apply pipe joint compound and reconnect it. If the leak appears to be coming from a crack or sand hole, replace the fitting.

3. **Fuel unit:** If a leak appears to be coming from a fuel unit, check that all the fittings, plugs and bolts that hold the cover are tight. If the leak continues, check the gasket, if it is leaking, replace it. If the fuel unit is still leaking, replace it.

4. **Burner:** Most burners have a "weep hole" in the bottom that allows fuel to drain from the housing. If such a leak is found, check:
   - The fuel unit seal
   - The nozzle adaptor.
   - For an after-drip from the nozzle.

5. **Tanks:** Leaks at tanks often appear as drips or wet spots. If the tank has a leak, check with the service manager for instructions. Some companies use magnet patches for temporary containment of minor leaks until a new tank can be installed.

6. **Fuel lines:** Fuel lines, especially those in contact with concrete or dirt, can develop holes and leak. Do NOT cut out the leaking section and replace it with a new piece of copper. When a leak develops, replace the line from the tank to the burner. If the line is buried in or contacts concrete or earth, install coated copper tubing or install the line in secondary containment.

If a more serious leak is encountered, try to stop the flow of fuel, shut off any sump pumps in the area and close off floor drains and any access to groundwater. Contact the office immediately and spread absorbent materials while waiting for help to arrive.

#8 Odors, smoke, or soot

Several different problems can cause these troubles, among them are:

1. Delayed ignition.
2. Combustion problems.
3. Dirty or defective chimney or flue.
4. Insufficient air in boiler room.
5. Air leaks in the boiler.
6. Defective heat exchanger.
7. House fan sucking air down the chimney.

#9 Noise

These calls are often frustrating because the noise can be intermittent. When the technician arrives, the noise may have stopped and they may have to run the burner through several cycles and raise

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all the thermostats to get it to start. Some heating system noises originate in the area near the heating system, but can only be heard in the living area.

Noises can come from:

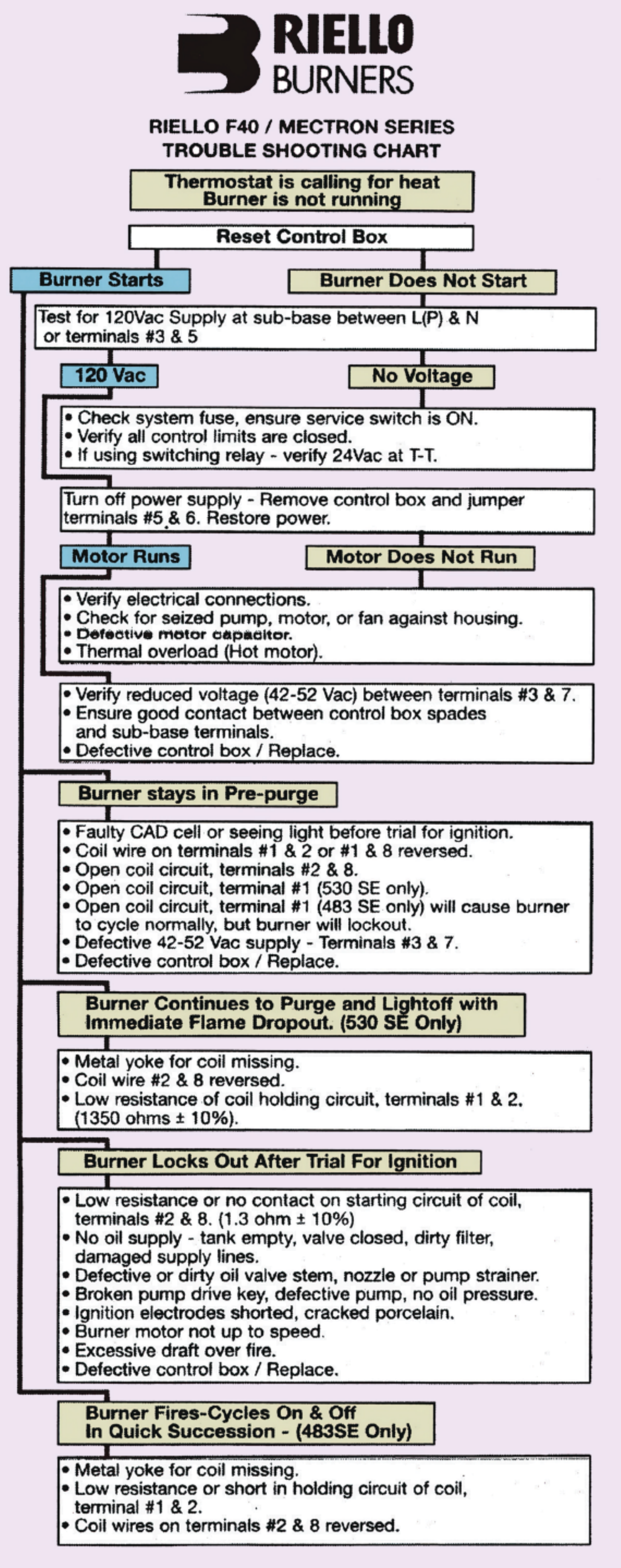
- Worn fuel unit gears
- High vacuum
- Air in fuel line
- Fuel lines in contact with each other, boiler/furnace jacket, beams, or other items
- Air in a hot water heating system
- Electrical circuit—hum from relays, transformers, motors, etc
- Improper control settings (too much pressure or temperature)
- Circulators
- Blowers
- Zone valves
- Loose covers on controls
- Water pipes
- Heating pipes and baseboard
- Chimneys

Conclusion

Much of what a technician learns about troubleshooting will be due to their on-the-job experiences. Remember the "5 Whys" and always look beyond the symptoms for the cause.

A final piece of troubleshooting advice: "Listen, look and think before starting to rip, tear and destroy."

The following Troubleshooting charts were provided by Beckett Corp. and Riello. We thank them for allowing us to share them with you.



Basic Troubleshooting provided by Beckett

Recommended Equipment

1. Electrical test meter (VOLTS, OHMS, AMPS).
2. Ignition transformer tester.
3. Combustion analyzer kit (oxygen or carbon dioxide, smoke, stack temperature, draft, system efficiency).
4. Pressure/vacuum gauge (0-200 psig and 0-30: Hg).
5. Full assortment of standard hand tools.

Preliminary Steps

1. Check oil level in supply tank.
2. Make sure all oil line valves are open.
3. Examine combustion chamber for excessive unburned oil. Clean if necessary.
4. Measure line voltage at primary control input connections. It should be 120 volts. Lower than 105 volts AC may cause operating problems. If there is no reading, check for open switches or circuit breakers.
5. Make sure thermostat or other controlling device is calling for burner operation.
6. Check primary control to see if safety reset switch is "locked out."

Determining Malfunction Causes

1. Disconnect nozzle line connector tube and reposition it so that it will deliver oil into a container. Tighten flare nut at pump discharge fitting.
2. Reset primary control safety switch if it is locked out. Turn power ON. Observe the following:
   - **Contact action of primary relay control.** Does it pull in promptly, without arcing erratically or chattering?
   - **Oil delivery.** You should have an immediate, clear, steady stream. White frothy oil means air in the supply system, which must be corrected. No delivery means severe restriction somewhere.
   - **Ignition arc.** You should hear ignition arc buzzing. If not, test output voltage of transformer. If below 9,000 volts, replace.
   - **Motor.** Does it pull up quickly and smoothly? Listen for RPM change and audible "click" as the centrifugal switch disconnects start (auxiliary) winding.
3. If cause of failure has not been identified:
   - Reconnect nozzle line fittings for burner fire test.
   - Reset primary control if necessary. Run several cycles. Observe flame quality. Use a flame mirror, if possible, to see if flame base is stable and close to combustion head. Is flame centered, uniform in shape, and relatively quiet? Are head and chamber free of carbon formations or impingement? Sometimes a defective or partially plugged nozzle can cause trouble.

Additional Procedures:

If the problem still has not been identified, a more thorough evaluation of the basic system must be made. The following procedures may be helpful:

Primary Control System (Cad Cell Type) starts burner, supervises operating cycles, shuts burner off at end of heat call, and locks out ON SAFETY if there is a flame failure.

1. Measure electrical voltage at primary input (usually black) and neutral lead (usually white) connections. It should be 120 volts.
2. Jumper thermostat (TT terminals) or otherwise energize primary control.
3. Control relay should pull in. If not, make sure wiring connections are secure and cad cell is not "seeing" stray light (chamber glow).
4. If relay pulls in, but motor fails to start, measure voltage between neutral lead (usually white) and primary control lead for motor (usually orange). Relay switch contacts may be defective, causing a severe voltage drop.
5. If relay fails to pull in, or is erratic and chatters, even when wiring connections are secure, replace control.
6. Check safety lockout timing by removing one F (cad cell) lead from control. Start burner and count seconds until control locks out. Time should be reasonably close to rating plate specifications on control body.
7. To check cad cell, start burner and unhook both cad cell leads from control FF terminals. Jumper FF screw terminals to keep burner operating. Measure OHMS resistance across cad cell leads **as it views the flame.** It should be 1600 OHMS or less. Preferred reading is 300-1000 OHMS. Next, with meter connected to cad cell leads, turn burner OFF. DARK conditions should give a reading of 100,000 OHMS or infinity. If reading is lower, let refractory cool down, and check for stray light entering burner through air inlet, or around transformer base-plate. If cad cell is not performing within these guidelines, replace it.
8. The control may be governed by a room thermostat. Be sure heat anticipator setting or rating of the thermostat matches the 24 volt current draw.

This information is usually printed on the control body. Erratic operation may be caused by improper anticipator settings. Settings are typically .2 or .4 amps. This value can usually be measured by connecting a multitester in SERIES with one of the TT leads, and reading the value on the appropriate milliampere scale.

The Ignition System is generally comprised of an ignition transformer and two electrodes that deliver a concentrated spark across a fixed gap to ignite oil droplets in the nozzle spray. Delays in establishing spark at the beginning of the burner cycle can result in "puff backs," which can fill the room with fumes. If spark is inadequate, burner may lock out on safety. If transformer is suspect, make the following checks:

1. Measure voltage between transformer/primary lead and neutral connection. It should be 120 volts on the primary input side.
2. Secondary terminals of a good transformer deliver 5000 volts each to ground, for a total of 10,000 volts between the terminals. Measure this with a transformer tester or use a well-insulated screwdriver to draw an arc across the two springs. This should be at least 3/4" in length. Check **each** secondary output terminal by drawing a strong arc between the spring and base. If arc is erratic, weak, or unbalanced between the two terminals, replace transformer.
3. Transformer failures and ignition problems can be caused by the following:
   - An excessive gap setting on ignition electrodes will cause higher than normal stress on the internal insulation system. This can lead to premature failure. Set electrode gap according to manufacturer's instructions (typically 5/32").
   - High ambient temperatures can lower effectiveness of internal insulation system.
   - High humidity conditions can cause over-the-surface arc tracking, both internally and externally, on ceramic bushings.
   - Carbon residue and other foreign materials adhering to porcelain bushings can contribute to arc tracking and subsequent failure.
   - Low input line voltage can cause reduced transformer life. It should be at least 105 volts AC.
   - Ignition electrodes must have good contact with transformer springs. Any arcing here must be eliminated. The only arcing should be at the electrode tips.
   - Electrode insulating porcelains must be clean and free of carbon residue, moisture, crazing, or pin hole leaks. Leakage paths can contribute to faulty ignition.
   - Electrode settings must conform to specifications for gap width, distance in front of nozzle face, and distance above the nozzle center line. Improper positioning can produce delayed ignition, spray impingement on electrodes, carbon bridging, and loss of ignition, which can lead to safety lockouts.
   - Replace electrodes if tips are worn or eroded. Replace questionable porcelain insulators.

The Burner Motor drives the blower wheel and fuel pump by means of a shaft coupling. To diagnose motor problems, follow these guidelines:

1. Motor fails to start.
   - Check for adequate voltage between motor/primary lead and neutral connection with the motor energized. Line voltage must be within 10% of motor rating plate specified voltage.
   - If motor hums when energized, but shaft does not rotate, the start switch may be defective. With the power turned OFF, rotate blower wheel by hand. If it turns freely, replace motor.
   - If blower does not turn freely, check for a bound fuel unit, jammed blower, dry bearings, or a grossly misaligned shaft coupling. Oil bearings with SAE 20W oil. Or, if permanently lubricated, does not need to be oiled.
2. Other motor-related problems.
   - If overload protection has tripped, start motor and measure current draw. It should not exceed rating plate specifications under load conditions by more than 10%. Excessive amp draw usually indicates an overload condition, defective start switch, or shorted windings.
   - If motor is noisy, check alignment of shaft with coupling. Tighten or slightly loosen motor-to-burner-housing bolts in an alternate sequence. Check for loose blower wheel, excessive radial shaft play or loose start switch parts.
   - It is difficult, and usually not cost effective, to rebuild motors in the field. Replace them, instead.
   - If motor operates normally, but does not drive pump shaft, check coupling for slippage due to stripped end caps.

The Fuel Pump transfers oil from the supply tank, cleans it with a strainer or similar mechanism, pressurizes the oil for good atomization at the nozzle, and provides a good shutoff at the end of the run cycle. Manufacturers provide excellent installation and service information. Please read and follow it carefully. Many burner problems can be traced to incorrect installation of oil piping and fittings.

Chapter 15: Additional Resources

NORA has compiled a library of additional technical resources for your continued education. Scan the QR code or go to the web address. Check back often, as NORA will continually add content as it becomes available.

You will find:

- Videos
- Technical Bulletins
- Instructions
- and More

https://Learning.NORAweb.org/service_procedures