Chapter 15

SERVICE PROCEDURES



IN THIS CHAPTER

- A systematic approach to troubleshooting
- Time-saving troubleshooting suggestions


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FAMILY

Chapter 15

Service Procedures

Introduction

The most interesting and challenging part of an Oilheat 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. Your job is like a detective's—you 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 you with an understanding of the operation of the various components of Oilheat systems. This chapter explains how to use that knowledge to repair systems without wasting time or replacing parts that are working properly.

Before you get 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 oil in the tank?
- Is the blower door closed? (There is a switch on many blower doors that prevents the system from operating if it's 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 your expertise, among the most common are:

- No heat
- Insufficient heat
- Too much heat
- No hot water
- Water leak
- Oil leak
- Odors, smoke or soot
- Oil tank and/or piping
- Thermostats, controls or electric supply
- Heat distribution system
- Oilburner components

You need to approach each problem ***carefully*** and ***systematically***.

***Carefully*—never do anything that can put you, other people, or property in danger.**

Wear appropriate Personal Protective Equipment and protect your 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 making sure that there is not a fire or an oil buildup in the combustion chamber.

Wear protective equipment



***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 oil in the tank before you start disassembling the oilburner.

Most importantly, NEVER assume anything. Don't assume that the reset was only pressed once; don't assume that the last service technician installed the correct nozzle; don't assume that your dispatcher told you the correct reason for the call and don't assume that because a customer says they have plenty of oil that their tank isn't empty.

An example of a systematic troubleshooting routine:

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

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

When you arrive at the customer's home, listen to what the customer says and ask questions to clarify the situation. Depending on the type of trouble, you may want 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 sweep has just been performed.

Ask if they have pressed the reset button, how many times and what happened after it was pressed.

Once you think you understand exactly what the problem is, proceed to the appliance area and on your way, check the electrical switch and oil tank gauge. When

Check service card



you get to the burner, read the service card on the unit to see what work previous technicians have performed.

Step 2. The investigation: At this point, you know what the problem is (no heat) and what work has been recently performed. Now is time to narrow down your investigation.

Assume that you find the primary control is off on safety. You know that in an oilheat system, electricity flows from the circuit breaker to a switch to the limit controls to the primary control to the burner components. Since the control is off on safety, you can eliminate everything from the primary control back—the limit controls, switches or circuit breaker cannot have caused the problem.

You have determined that the problem is probably the fuel supply, the primary control or a burner problem. There could also be a low voltage situation. Use your electrical meter to check. If the voltage is correct, move on to the next step.

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.

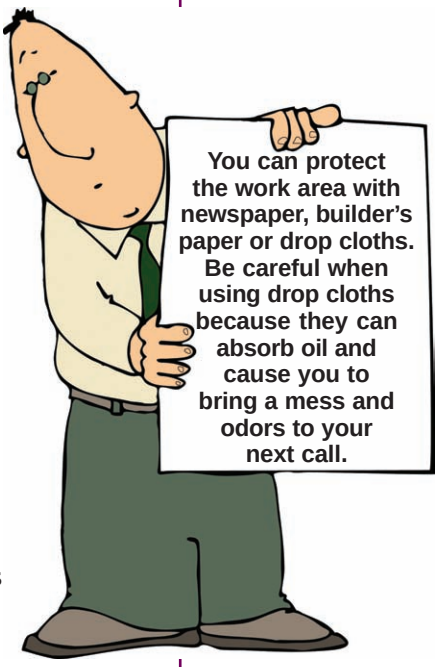
Open the observation door to check for a flame or excess oil in the chamber, if there is no flame or oil, leave the door open to allow any excess pressure to escape in the event of a delayed ignition when the burner starts.

Press the reset button and observe what happens:

- If the burner ignites and runs properly but shuts off on safety, you should visually check the cad-cell eye and leads; and 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're dirty.

- If the eye and head are clean, disconnect the cad cell leads from the control, start the burner and install a 1,000-ohm resistor across the F-F terminals to simulate a fire and connect your ohmmeter to the disconnected leads to check the resistance through the cad cell. If the resistance is high, the cell is either defective or is not sighting the fire correctly. If the resistance is below 1,500 ohms check the leads again, either they're crimped or the control is defective.

- If the burner starts but does not ignite, you know the problem is related to the



Ohmmeter connected to leads



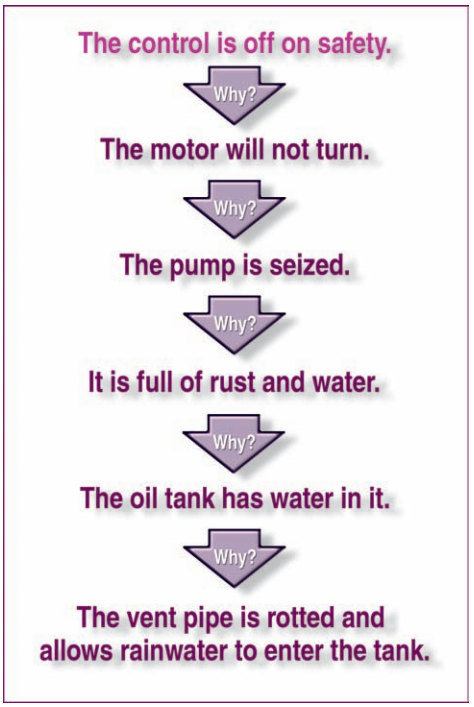
combustion process. It could be an ignition problem, an oil problem or excess air.

• If nothing happens, the control might be sensing flame. 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 pump 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 you press the reset button and the burner starts, you have not fixed anything. You have to find out why the control went off on safety and take corrective action to keep it from happening again.

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



Sometimes you will find the answer with less than five "whys"; sometimes it might take more than five. The key is to keep asking until you are satisfied that you know the reason for the problem and the corrective action to take.

Step 5. The "Hows": Once you know the "whys" you need to correct the immediate problem *and* keep it from happening again. "How" do you do that? In the situation we just reviewed in the "5 Whys" the following steps are required:

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

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

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

Complete your company's paperwork and fill in the service card at the unit. Take

a last look around to make sure that the area is clean, that you have taken all your tools, removed all jumpers and returned all controls and thermostats to their proper settings.

Give the customer the appropriate copy of the invoice, explain what you did and the efficiency test results and answer any questions they have. Thank them for their business and return to your vehicle to move on to your next call.

Helpful hint: try to avoid unplugging any electrical appliances when performing service. If you must unplug anything, ask the customer for permission first and leave your truck keys tied to the cord to ensure you will plug it back in before you leave.

Troubleshooting suggestions

The following is intended to help you troubleshoot typical problems that you are likely to encounter. It is not a list of all possible situations or each and every step you should take to troubleshoot problems.

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

If the primary control has no power:

1. Check the limit controls. If the limit control has power coming through it there is a problem with the wiring between the limit and the primary control. NOTE: Make sure you have checked all of the limit controls; for example—on a system with both a high limit aquastat and a low water cut-off, you must make sure that both are allowing electricity to pass through to the primary control.

2. If the limit control 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 you reset the circuit breaker and the unit runs, do not leave right away because something *caused* the breaker to trip. Use an ammeter to determine if any of the system components are malfunctioning.

If the primary control has the correct input voltage, but no power is going to the burner motor, igniter or oil valve:

1. Check to be sure that there is not a fire in the chamber. (Cad cell primaries will not energize if a fire is sensed.)

2. Make sure that the thermostat is set well above room temperature and the heat anticipator is set to the current draw of the control circuit.

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. Use your ohmmeter to perform the test mentioned earlier.

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

A. Motor runs but no flame

1. Disconnect the nozzle line and check the oil flow. If water is found in the oil, drain it from the tank.

2. If the flow is good and water free, check the nozzle and ignition system (see next section B, on following page.)

3. If there is no flow, check the oil solenoid valve and bleed the pump.

4. If the pump cannot be primed, make sure all valves are open and check for oil (Stick the tank, the gauge may be wrong).

5. If there is sufficient oil, check the oil filter and perform a vacuum test (see Chapter 4), the oil line or tank vent may be clogged.

6. If the vacuum is high, clean the oil 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 pump test (see Chapter 4.)

B. Motor runs with oil flow but no ignition

1. Check the electrodes/porcelains/ ignition cables for defects.

2. Check the electrode setting and nozzle position.

3. Check the transformer connections.

4. Verify that correct primary voltage is supplied to ignition transformer/igniter.

C. Motor runs with oil pressure and ignition but no flame

1. Check the nozzle and replace if plugged.

2. Check the oil pressure, set to manufacturer specs.

3. Check the air settings—adjust as necessary (too much air can “blow out” the flame.)

Nozzle gauge



Checking oil pressure



D. 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:

- If water is found, drain it from the tank and lines

- If air is found, perform pump tests to determine why. (Chapter 3)

4. Check air settings—adjust as necessary.

E. 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 you condemn the motor.

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

If the oilburner 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, verify that heat anticipators are properly set 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 the motor.

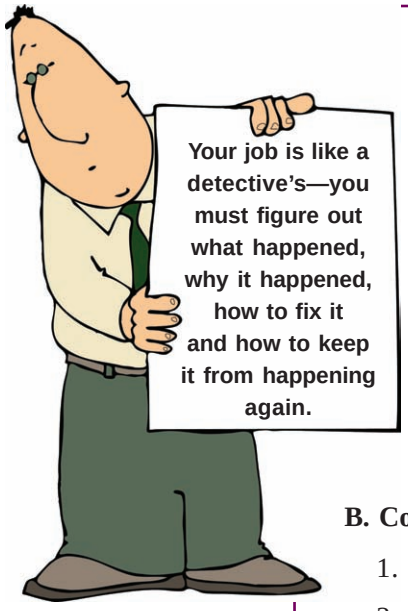
Steam system

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 electrical circuits for motorized valves.
4. Check the main vents.
5. 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.

The best Service Technicians develop standard troubleshooting routines. They go from step to step until they find and correct the cause of the problem.



Other causes for insufficient heat:
A. Burner trouble

1. The burner might be underfired. 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.

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.

3. Check that the 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.

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#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; you check the burner and the limit control. When the hot water comes from a domestic hot water coil or storage tank, you should:

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's 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.

1. **USE CAUTION!** Never work on electrical components while they are wet or when you're standing on wet floors.

Helpful hint—Treat all electrical circuits as if they were energized even when you're sure they aren't.

2. 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—a number of things can cause the relief valve to open on a hot water system:

- A full expansion tank.
- 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 malfunctioning relief valve.

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

Helpful hint—many municipalities require the installation of backflow prevention devices that can cause heating system relief valves to open. Often the only way to stop the valve from opening is to install a domestic water expansion tank.

Remember that each gallon of oil burned creates a gallon of water in the combustion gases. If the boiler water temperature drops below 130 degrees, the water in the combustion gases will condense in the heat exchanger, mimicking a water leak.

3. Circulator flange gaskets can leak. Tightening the flange may stop the leak but it is usually better to replace the gaskets once they start leaking.

4. Older style circulators often had a separate bearing assembly that would leak water from a weep hole when they became defective. With this type of leak, you can either change the bearing assembly or replace the entire circulator with a modern water lubricated model.

5. If the boiler itself 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 your supervisor for instructions.

Helpful hint—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.

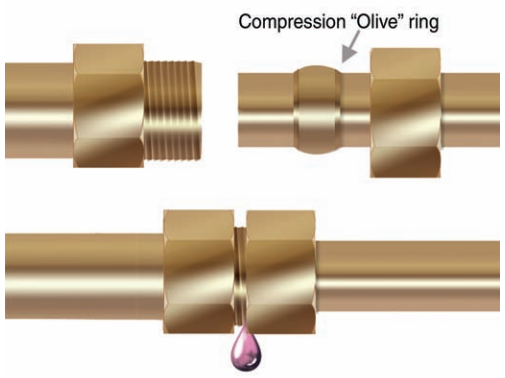
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#7 Oil leaks

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

Minor leaks typically occur at:

1. **Brass fittings:** If the system has compression fittings, they should be replaced with flare fittings. If a flare fitting is leaking, turn off the oil supply then



Compression fitting

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's any evidence of a leak cut out the flare, re-



flare the copper, reconnect it and keep checking until you're sure the leak has been stopped.

2. **Malleable fittings:** If you find 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 of 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 pump is still leaking, replace it.

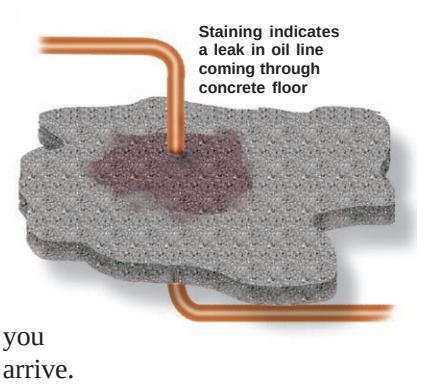
4. **Oilburner:** Most burners have a "weep hole" in the bottom that allows oil to drain from the housing. If you find such a leak check:

- The pump seal.
- The nozzle adaptor.
- For an after-drip from the nozzle.

5. **Tanks:** Minor leaks at tanks often appear as drips or wet spots. If the tank has a minor leak, put a magnet patch on it and call you supervisor for instructions.

6. **Oil lines:** oil lines, especially those in contact with concrete, 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, install coated copper tubing or install the line in secondary containment.

If you encounter a more serious leak, try to stop the flow of oil, shut off any sump pumps in the area and close off floor drains and any access to groundwater. Contact your office immediately and spread absorbent while you wait 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 you arrive, the noise may have stopped and you will have to run the burner through several

cycles and raise 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:

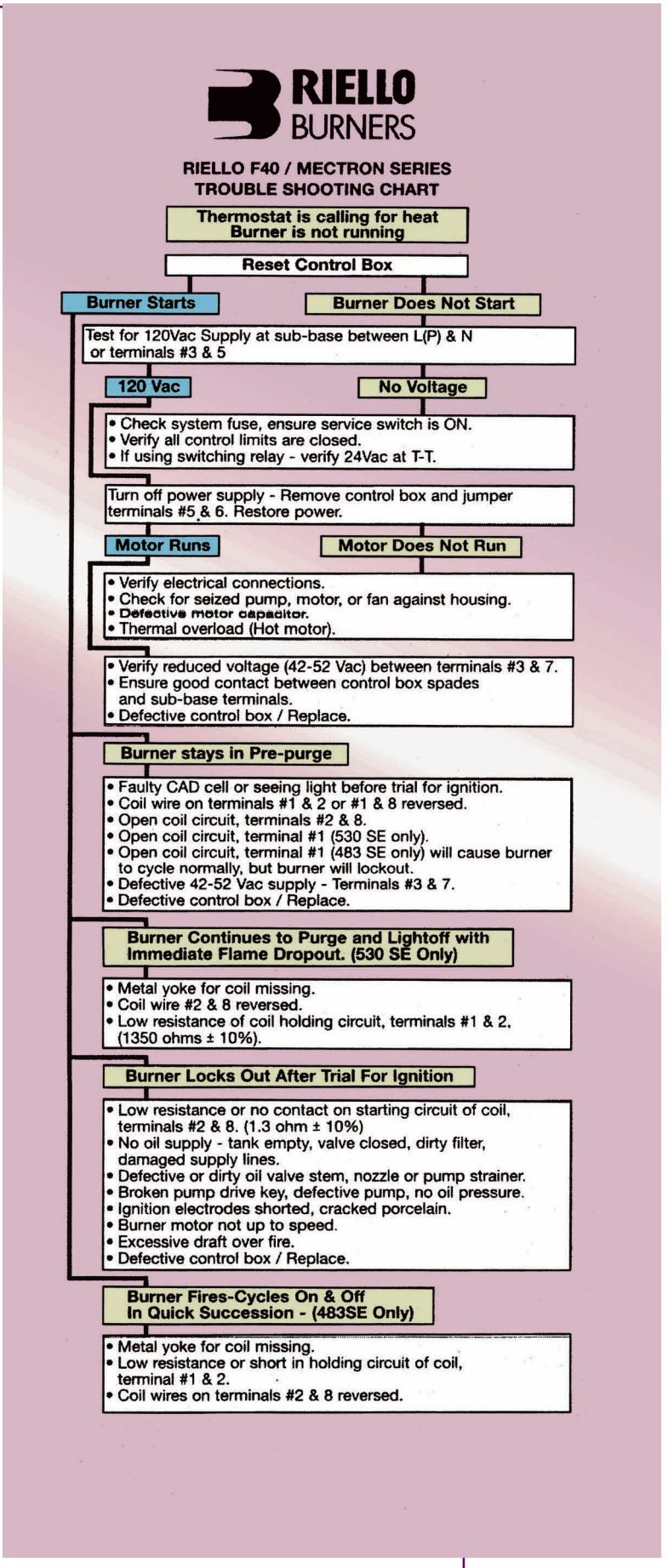
- Worn pump gears
- High vacuum
- Air in oil line
- Oil lines in contact with each other, boiler/furnace jacket, beams, or other items
- Air in a hot water heating system
- Electrical circuit—hum from relays, transformers, motors, etc
- Improper control settings (too much pressure or temperature)
- Circulators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

Conclusion

Much of what you learn about troubleshooting will be due to your on-the-job experiences. We hope that you will remember the "5 Whys" and always look beyond the symptoms for the cause.

A final piece of troubleshooting advice: "Listen, look and think before you 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.