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By Gordon Siebring

# AVOID 3 A.M. MAINTENANCE

Attention to heating equipment details makes a big difference in your bottom line.

**A**t 10°F, you have one hour from the time your greenhouse heaters fail until critical damage occurs to your crop. Even if repairs are made, the salvaged plants may not be profitable.

Gas and oil-fired unit heaters are the most common type found in smaller greenhouses. The heaters can be maintained by the owner or a reliable staff person with some basic skill training. Your attention to heating equipment details can make a major difference in your annual bottom line.

## Avoid heating mistakes

Liquid fuels stored outside fail to flow when critical low temperatures are reached. When stored outside, liquid propane will not evaporate adequately to supply undersized fuel lines and oversized heater demands.

Gas unit heaters with low gas pressure “poof” at startup, which can extinguish the pilot light, causing unit heater failure. This is also referred to as flame rollout or backfire from the burner tube. This can snuff out the standing pilot light. This situation is caused by low gas pressure in severely cold weather when all of the heaters are creating a fuel drain. The extinguished pilot light causes unit heater failure on the next call for heat.

An inline vaporizer may be required to alleviate poor planning of tank size, misjudgment on pipe sizing or inadequate sizing of pressure

regulator orifices. A simple rule of thumb is that a 500-gallon tank should be expected to supply no more than 600,000 Btus of demand.

Oil tanks should be sheltered from cold temperatures as No. 2 fuel oil starts to flow sluggishly at 0°F. Oil tanks should be equipped with two pipe supply and return lines. This avoids air in the pipes from causing burner failure by loss of fuel prime to the pump from cold oil. Supply lines should be ½-inch copper tubing for long-distance runs and should not exceed the recommended pump demands for lift and distance from the storage tanks. Always flare the pipe ends rather than using the easy ferules and compression sleeves, which allow air leakage over time.

Most gas unit heaters are not damaged in the greenhouse environment by direct water contact because they are hung from the ceiling. However, continued 95-percent relative humidity will eventually cause heater failures because of rust formation.

In cold weather (below 20°F) for more than a few days, the location of heaters can produce a condition of “warm nose and cold toes.” The floor is cold because warm air is up around the greenhouse ceiling, a situation caused by solar gain and the natural tendency of heat to rise.

The simplest way to move heat from the ceiling to the floor where it's needed in the plant zone, is to install a squirrel cage fan in a corner away from the heaters. Aim the air from

the fan directly toward the ceiling. This moves warm air to the floor.

Horizontal airflow fans even temperatures from one end of the greenhouse to the other. They work for hot-water or steam heating systems or for unit heaters.

## Gas burner preparation

Take precautions to avoid electrical shock. Carry a spare gas valve suitable for your units. Check gas pressure when all of the units are running on a cold day. LP gas should be 10½ to 11 inches of manifold pressure on unit heaters. Natural gas should be about 3½ inches of manifold pressure. You can obtain these measurements using a water column tester.

Clean the unit heater pilot each fall after wasps have finished building their nests in the burners. Check and clean the thermal couple connections at the gas valve. Check the alignment of the thermal couple for the pilot to have full flame contact or expect to experience nuisance outages on older units.

Gas heaters with electronic ignitions require you to carry an extra control board on the shelf. Remember, if the bad control board was placed on the spare parts storage shelf previously, it doesn't get better with age. Throw away defective controls. It eliminates losing your temper and saves your crops.

Check the safety fan and limit switch operation for on and off function. Always check for chimney blockages caused by bird nests, breakage or wind and rust damage.

All heater units should have proper chimney installation and never reduce the chimney size. The chimney should have a down-draft cap and always have 2 feet of vertical pipe for each horizontal foot of travel.

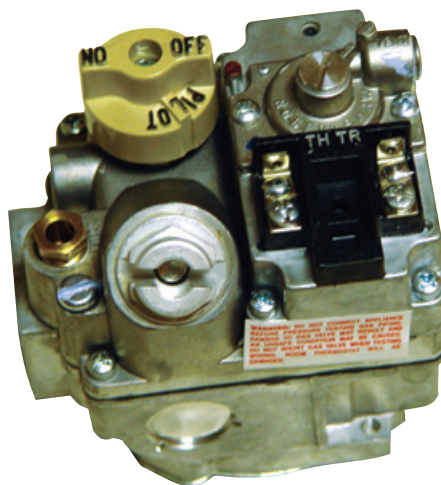
Draft inducers or power venting units should be checked for off-season damage. The safety override prevents heater function and can cause crop damage from heater malfunction.

## Oil burner maintenance, repair

The mystery associated with an oil-burning heater can be solved by some simple component identification and functional explanations. Your 3 a.m. heater failure experience may go like this:

The alarm goes off, you swing out of bed, swear and grumble all the way to the offending unit. Then a kick is in order. If it starts, an elusive poor electrical connection is the culprit. Lots of luck finding it while you are half mad and half asleep.

The burner is actually quite friendly when you understand the function of its components.



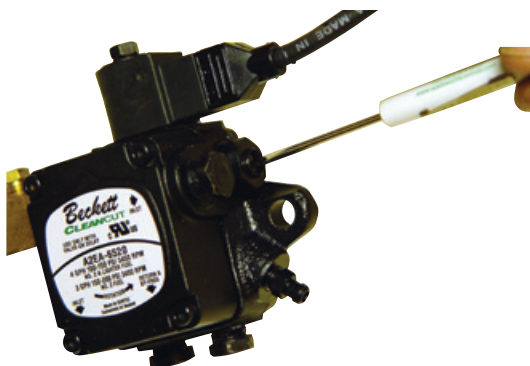
If your greenhouses are equipped with gas unit heaters, you should have a replacement gas valve suitable for the units available.



Electrode adjustment is often the cause of unit heater failure. Inspect electrodes for proper alignment and cleanliness.



Nozzles need not be replaced every year if the fuel supply is kept clean and the oil filters are changed before each heating season.



Older oil burner pumps can lose pressure, which can be adjusted by a simple screw adjustment of usually ½ turn.

## HEAT CONSERVATION CHECKLIST

- Do an annual check for heater efficiency and fuel levels before cold weather.
- Check the central controller for heat and ventilation settings.
- Calibrate not to overheat or overcool.
- Correct inflation fan problems on double poly covered houses.
- Validate the unit heaters actual thermostat settings and function.
- Check fuel tank levels when they can be filled.
- Change fuel filters each year before starting the burner.
- Check greenhouse door latches and cracks around doors.
- Observe shutter repair and function to avoid excessive infiltration of cold air.
- Insulate north walls where applicable.
- Insulate outside walls below the bench-growing zone.
- Lap seal all old glass houses.
- Check operation of all heat curtains.
- Check power supplies for adequate voltage during full load energy demand.
- Start and service emergency generators, be sure to check for fresh fuel and clean filters.
- Change the oil in emergency generators to ensure easy starting.
- Check the condition of emergency generator batteries. Batteries deteriorate with age. Change the batteries if they measure in the caution zone for amps.

The brain is called the primary control or cad cell relay and is usually located on the right side of the burner above the motor. This has the thermostat wire connected to it and the main power source from the unit switch box. It operates the motor, fuel pump and on newer models, the solenoid valve for fuel flow for combustion. It also powers the combustion air blower.

First-time startups in the fall often require resetting the cycle timer by holding the red switch button for 30 to 45 seconds and releasing it. This will recycle the brain function (primary control) and allow for several more tries at burner startup.

Keep an extra primary control on the spare parts shelf. Take time to read the primary control instructions that come with each burner or replacement control. At 3 a.m., you will be

glad you did.

Burner pumps provide oil pressure to atomize fuels for combustion. The operating pressure can be adjusted and should be 100 pounds per square inch. Older units lose pressure, which can be regulated by a simple adjustment screw (see the pump instructions). A half turn is usually adequate if you do not have a pressure gauge.

Nozzles need not be replaced every year if the fuel supply is kept clean and the oil filters are changed before each heating season. Keep an extra nozzle and filter cartridge on the spare parts shelf.

Nozzles are available in gallons per hour (i.e., 1 or 2½ gallons or other size depending on the furnace Btu rating). Do not oversize the nozzles. Undersizing is tolerable by 0.25 gph.

A fan pattern for oil application to the flame is expressed as 60 or 80 degrees. Many angles of oil cloud are available. You should try to match the manufacturer's recommendation as close as possible with replacement nozzles.

The A, B or other nozzle designation indicates what kind of oil cloud is being formed by the nozzle with the oil misted into the flame. B or solid cone nozzles deliver oil all through the spray cloud to produce a mass of flame.

An A nozzle forms a cloud shaped like an empty ice cream cone. When you look inside the cone from the fire view end of the cone, the hollow center allows the flame to burn inside and on the outside of the cone.

Sometimes other combinations and modifications are specified by manufacturers, but A or B nozzles will suffice for spare replacement parts. A nozzle can be disassembled for cleaning if you are caught without a spare.

Know how to remove the oil pipe from the burner to check the nozzle. Do this during the daytime and be sure to turn off the unit heater power supply.

The transformer is held in place by two screws on the front of the burner housing. Flip open the transformer or igniter (the black box in the middle on top of the burner) and the electrodes and oil pipe are exposed. When loosening the copper tubing from the oil pump, be careful not to drop the oil pipe lock nut down into the fan. It makes a terrible noise at start up.

After removing the oil pipe and electrode assembly, feel in the burner air tube to see if the flame retention cone is clear of carbon fouling.

Electrode adjustment is often the cause of heater failure. Inspect the electrodes for proper alignment and cleanliness. Check the condition of the igniter contacts and inspect the spark end for wear damage from high voltage arcing. Keep an extra set of electrodes on the shelf. Read the instruction manual for proper adjustment depending on the burner manufacturer's recommendations.

Check to see that the exhaust fan has not been running when the furnace is hot. The exhaust fan reverses the draft and can cause melting of the burner motor coupling that connects the pump and motor. Keep an extra burner motor coupling on the shelf.

Burner efficiency by proper combustion air, which is induced into the flame by the burner blower, is the single easiest adjustment and produces the biggest waste or savings. A bright yellow flame or a flame jumping out of the combustion chamber no more than 2 to 4 inches with no black tips is what you're looking for. In the absence of a combustion tester, use the above guide for field adjustment. If you operate six or more furnaces you should own a combustion tester and use it. You can realize a 5-8 percent fuel savings if you make sure the heaters are working properly.

The most misunderstood part of the furnace is the fan and limit switch. It has two functions. The three pointers under the cover have recommended settings, which vary by furnace manufacturer. The center pointer tells the blower at what temperature the heat exchanger wishes the blower to start blowing the cool air around it. A setting that is too low causes blowing of cold air. A setting that is too high can damage the heat exchanger. The left pointer indicates when it is cool enough to shut off the blower or fan. The right pointer is the safety burner shut off. In the event that the blower motor fails or a belt breaks, the burner will shut down and not melt the furnace trying to satisfy the thermostat's call for heat.

Never adjust the fan-limit switch without holding the center dial. Failure to do this can ruin the helical spring in the limit control heat probe. Avoid a shock hazard when adjusting the limit switch as there are 120 volts of electricity in the switch.

## Chimney check

Follow the heater manufacturer's suggestions when it comes to sizing and maintenance. Do not downsize the exit chimney. Allow 2 feet of vertical height for each 1 foot of horizontal run. Extend the chimney 2 feet above the peak. Use a down draft cap or a weather cap on top.

The barometric damper in the side of the chimney within 2 feet from the furnace is for saving 15 percent of your fuel when the wind is blowing. It prevents the 0.02 to 0.04 inches of water column vacuum over the flame from being exceeded and vacuuming all the heat up the chimney.

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## SPARE PARTS YOU SHOULD HAVE ON HAND

### Gas furnace parts

- Thermal couple of appropriate length or flame rod
- Pilot assembly (natural or LP gas)
- Gas valve (exact replacement)
- Fan and limit switch
- Unit regulator

### Oil furnace parts

- Electrodes
- Primary control
- Fuel filter
- Igniter or transformer
- Pump-motor coupling
- Fuel pump
- Fan and limit switch
- Cad cell (eye)

## FUEL FOR THOUGHT

Should you change fuels? Consider:

1 gallon of No. 2 heating fuel delivers 140,000 Btus.

1 gallon of propane delivers 91,500 Btus.

1 therm of natural gas (1,000 cubic feet) delivers 100,000 Btus.

A furnace rated at 300,000 Btus per hour consumes approximately 2 gallons of oil, 3 gallons of liquid propane or 3 therms of natural gas. You can do the calculations for the quantity of fuel you purchase annually to heat your greenhouses.

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