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# Using a Wood Stove to Heat Greenhouses

Gloria Whitefeather-Spears

**Gloria Whitefeather-Spears** is Greenhouse Manager for the Red Lake Forestry Greenhouse, PO Box 279, Red Lake, MN 56671; Tel: 218.679.3310; E-mail: [gspears@paulbunyon.net](mailto:gspears@paulbunyon.net).

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**Abstract:** The Red Lake Tribal Forestry Greenhouse in Red Lake, MN, utilizes four types of outdoor furnaces for heating through the fall, winter, and spring. The WoodMaster® is a highly efficient, wood-fired furnace that provides forced-air heat to the greenhouse. The Heatmor™ furnace is an economical wood-fired alternative that can provide lower insurance rates due to the large number of safety features. The Charmaster™ is a combination wood and oil furnace that is used as a backup system when ambient temperatures reach  $-34^{\circ}\text{C}$  ( $-30^{\circ}\text{F}$ ). The Lennox™ furnace is an oil-burning furnace that provides a third backup system for the greenhouse.

**Keywords:** alternative heating systems, alternative fuel, outdoor furnace, in-floor heat, forced-air heat

## Why Use an Outdoor Furnace?

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Wood-fired outdoor furnaces are becoming popular alternatives to heating greenhouses throughout the winter. Outdoor furnaces have a number of advantages over other sources of heat for both residential and commercial uses.

### Cheap Heat

Wood is a renewable resource and, depending on the location of the greenhouse operation, can provide a source of low cost heat throughout the season.

### Safety

An outdoor furnace removes the danger of structure fires caused by indoor wood stoves. The usual installation distances for most furnaces range from 15 to 45 m (50 to 150 ft), but this distance can be doubled if desired or necessary. Safer outdoor units may also result in lower insurance rates.

### Convenience

The wood-burning furnace can be situated beside the woodpile, eliminating the need to haul wood from the pile to the furnace. An injection air furnace burns any type and quality of wood, wet or dry, and unsplit in lengths of 90 to 140 cm (36 to 54 in). The large capacity firebox can achieve burn times averaging 23 hours or more per fill.

### Cost Savings

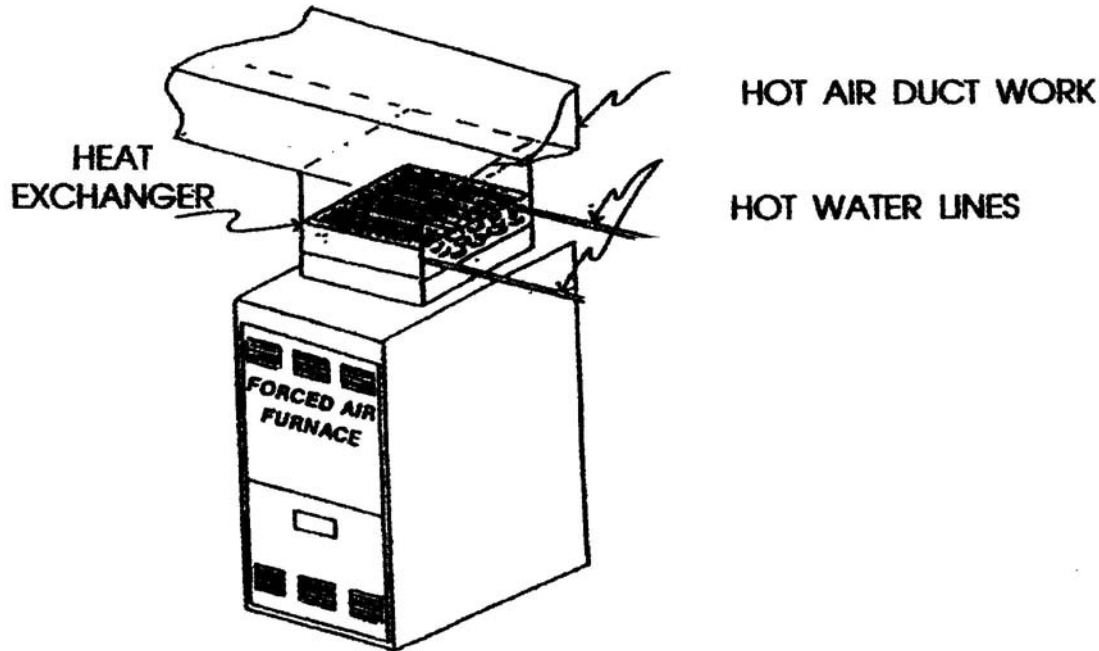
Outdoor furnaces can easily heat most residential and commercial buildings, shops, garages, motels, factories, and restaurants. One furnace can heat multiple buildings.

## Uses and Installation of Outdoor Furnaces

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Outdoor furnaces can provide a source of heat for a multiplicity of items and structures, including water heaters, clothes dryers, pools and hot tubs, sidewalks, and driveways. They can be installed as forced air heating, in-floor heating, as a unit heater, to supplement existing boiler heating, or to provide heat for hot water baseboards. This discussion will predominantly focus on forced air and in-floor heating.

## WATER TO AIR HEAT EXCHANGER APPLICATION



**Figure 1.** The heat exchanger works on the same principle as a car heater. Air is blown across the heat exchanger, taking the heat from the water and blowing it through the existing duct work.

### Forced Air Heating

A water-to-air heat exchanger (fig. 1) can be installed in the ductwork directly above an existing furnace (referred to as the plenum). Hot water constantly circulates through the exchanger. The hot water line coming from the hot water tube enters the bottom fitting of the heat exchanger and exits the top fitting, and then returns to the furnace. If the plenum is too large or too small, it must be altered to fit the heat exchanger properly.

The blower, controlled by a thermostat, blows air across the heat exchanger coil and transfers the heat through the house. A more even heat is provided with this system. Any existing furnace can stay in place as a back up. In most cases, the heat exchanger is placed in a horizontal position, keeping all four sides level. The air must be forced through the heat exchanger evenly.

### In-Floor Heating

An in-floor heating system (fig. 2) can be installed by placing hot water pipes in the floor at the time the slab is poured. Water circulates through the tubing and heats the concrete, which radiates and heats the building. Valves control the water flow in each loop. Manual control valves are used between manifolds for temperature control, and electric zone valves are used for more even heat. Thermostats are used to individually control the heat in any part of the building.

### Types of Outdoor Furnaces \_\_\_\_\_

The Red Lake Tribal Nursery currently uses four different types of outdoor furnaces for heating greenhouses through the fall, winter, and spring.

#### WoodMaster®

WoodMaster® (Red Lake Falls, MN) produces four types of furnaces varying in size and type of steel used. The main features of the furnace used at Red Lake Tribal Nursery are reviewed below.

**Forced Air**—The furnace warms water to its optimal heating temperature, which is constantly maintained by automatic controls.

**High Efficiency**—A circulation pump continuously circulates the heated water to provide proper heat distribution and ensure that the desired temperature is maintained.

**Adaptability**—The versatile design of the WoodMaster® makes it compatible with most existing heating systems. The installation is easy and allows the furnace to be used as a primary heat source or in conjunction with an existing heating system.

**Durability**—The welds on every stove are air tested for safety and performance. Total in-house manufacturing guarantees that each unit leaves the factory in showroom condition backed by a 10-year limited warranty.

## IN-FLOOR HEAT APPLICATION

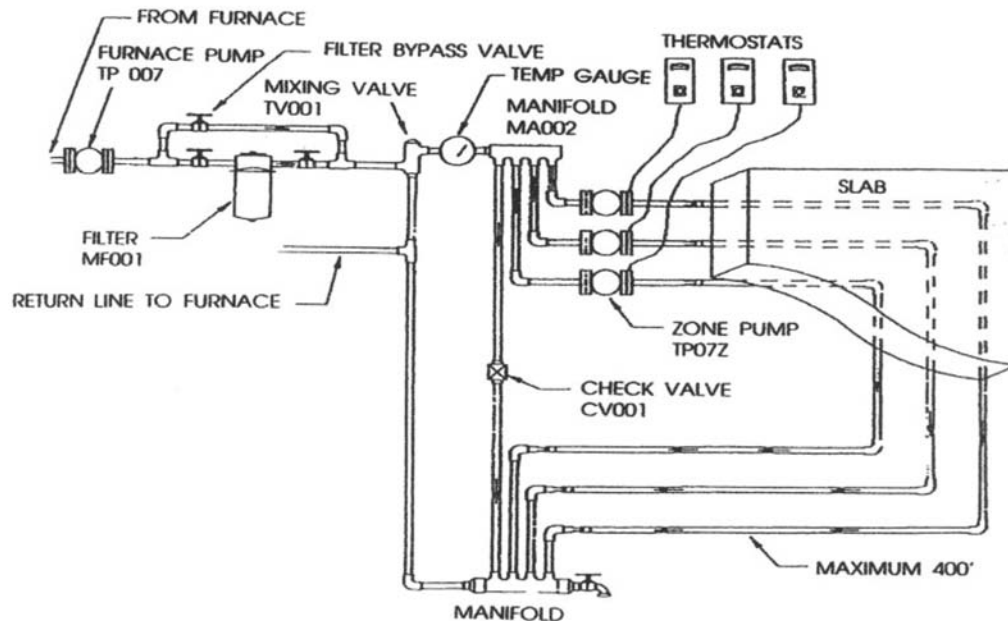


Figure 2. Water flow diagram for in-floor heat.

**Insulation**—High efficiency, noncombustible insulation prevents any chance of fire. A red warning light located to the front of the furnace warns when water is needed. The large water capacity at the top of the fire drum reduces water evaporation. Even under heavy burning conditions only 8 to 19 L (2 to 5 gal) are needed per year.

The WoodMaster® furnace used at Red Lake as a water capacity of 1,900 L (500 gal), and is rated at 140,000 BTUs.

### Heatmor™

A Heatmor™ furnace (Warroad, MN) is manufactured from stainless steel with a low chrome/nickel content and high corrosion resistance. The outer insulated door eliminates heat loss to the environment, and the firebrick-lined firebox allows a hotter, more complete burn. Due to an injection air system, the burn cycle in this furnace is very hot and brief. Less wood is consumed, less creosote is formed in the chimney, and even the wettest wood burns easily.

**Safety**—The Heatmor™ furnace is safe, with little to no fire danger from the furnace. The outside door lock prevents access from small children, and lessens the chance of tampering. An automatic high-limit switch shuts off the forced draft. Additional safety features include a low water indicator, safety pressure relief system, adjustable water temperature, pressure release overflow, and an anti-flashback door safety latch.

**Economical**—The Heatmor™ furnace provides the ability to heat outbuildings, multi-dwellings, and any other domestic heating needs.

**Convenient**—Chimney flues provide easy access for general maintenance. The burn cycle can last up to 12 to 24 hours, and the ash auger provides an easy ash removal system. In addition, the furnace comes completely wired.

**Lower Insurance Rates**—Several other safety features are provided by the Heatmor™ furnace, including the insulated door handle, inner door safety latch, and an atmospheric pressure system. In addition, the system has been lab tested by both PFS Corporation (Cottage Grove, WI) and CSA International (Chicago, IL) and approved to UL standards. The outer insulated door will not expose a hot door to personnel working around the furnace. These safety features may result in lower insurance premiums.

The Heatmor™ furnace system in use at Red Lake has a water capacity of 570 L (150 gal), and is rated at 100,000 BTUs.

### Charmaster™

The Charmaster™ furnace is a forced air and water-to-air heat exchanger, and is a combination wood and oil furnace. Wood is the primary fuel source at Red Lake, with oil as the backup system. Either #1 or #2 fuel oil can be used in this system. The Charmaster™ stove is much smaller than the other systems used at Red Lake.

**Plenum**—The super large heat exchanger cuts chimney heat loss. This feature can cut wood consumption up to 50% or more.

**Zone Pumps and Blowers**—Zone pumps circulate water from the pipes to the heat exchanger when thermostats

call for heat in various areas. The furnace blowers distribute the hot air throughout the greenhouses. Honeywell thermostats activate the zone pumps and furnace blowers simultaneously.

The Charmaster™ furnace is used when outside temperatures drop to  $-34\text{ }^{\circ}\text{C}$  ( $-30\text{ }^{\circ}\text{F}$ ). There is no water storage system, as the water is fed through circulating pipes. The furnace is rated at 140,000 BTUs.

## Lennox™

The Lennox™ furnace (Richardson, TX) is an oil-burning furnace that provides a third backup system for the greenhouse. This system burns #1 or #2 heating oil. Like the Heatmor™, the Lennox™ furnace is constructed of stainless steel, and resembles most home furnaces.

## Annual Maintenance \_\_\_\_\_

At the Red Lakes Tribal Forestry Greenhouses, annual maintenance on all wood- and oil-burning furnaces is important prior to seasonal use.

## Off-Season

Fireboxes in wood-burning furnaces are protected during the summer by placing chimney caps over the chimney when not in use.

## Pre-Season Inspection/Care

All furnace pumps are inspected prior to use to determine if they are working properly. Boilers are tested periodically by local dealers, and fuel filters are changed. As cooler weather approaches, the systems are fired-up and allowed to burn for 7 days. At this time, prescribed, annual boiler treatments are added to the boilers.

## Seasonal Use

Ash augers are used often during the heating season (as required). Ash is removed and made available to local people for processing hominy corn. Water levels are maintained at proper levels and furnaces are checked daily or during every shift. When furnaces are not in use, water is left in the stoves to protect boilers from rusting and corrosion. Any required service work is done by a qualified service technician.