



## Q How to prevent fan shutter heat loss

**A**fter a few calculations, I was surprised to find out how much heat loss there is through fan and intake shutters.

Heat loss through a shutter occurs by conduction through the metal or plastic and by air exchange (infiltration) through the cracks between the fan blades. If the shutter closes tightly, then most of the loss is by conduction. If the blades are bent or if the hinges are sticky, then infiltration can cause the greatest loss. I have seen shutters that were open during the winter with gaps as wide as 1 inch.

Calculating shutter heat loss is difficult because there are many variables, such as shutter material, location and temperature difference. External factors include wind direction and speed and adjacent trees, buildings and other obstructions.

And only half of the shutters have to be considered for the air that infiltrates in, as there is an equivalent amount of air that has to be exhausted.

### Infiltration losses

An older American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) method for calculating infiltration losses is based on the linear feet of the crack. For shutters, the conduction loss has to be added.

To determine the heat loss calculation from a 48-inch square shutter, assuming there are 12 blades with an 1/8-inch wide crack and two 1/8-inch cracks along the sides where the hinges are located totaling 56 linear feet. The wind speed is 10 mph and the inside temperature is 65°F with an outside temperature of 20°F.

Infiltration heat loss = 0.18 x air leakage per linear foot x total linear feet x temperature difference

Infiltration heat loss = 0.18 x 200 cubic feet per linear feet - hour x 56 linear feet x (65°F - 20°F) = 9,072 Btu per hour

Conduction heat loss = Surface area x U factor x temperature difference

Conduction heat loss = (4 feet x 4 feet) x 2 Btu per square feet - hour - °F x (65°F - 20°F) = 1,440 Btu per hour

Total heat loss = 9,072 Btu per hour + 1,440 Btu per hour = 10,512 Btu per hour

The heat loss is equal to about 0.10 gallon of fuel oil, 0.13 therm of natural gas or 0.15 gallons of propane per hour. Totaled for 24 hours it amounts to 2.4 gallons of fuel oil, 3.1 therms of natural gas or 3.6 gallons of propane. If the

crack is wider or the wind speed is greater, these values will be larger. Doubling the wind speed about doubles the heat loss. Since aluminum shutters have greater conduction, the heat loss is greater. PVC shutters have slightly less heat loss but are more prone to damage.

### Maintenance measures

Check operation of the fan shutters before the winter heating season. Lubricate bearings, make sure fan blades are straight and close evenly, and caulk around the frame. Make sure the shutter motors are working properly.

Choose a fan with a shutter on the inside wall, which isolates the fan and housing outside the greenhouse. A considerable amount of the sheet metal housing is exposed to the cold when the shutter is located outside the fan.

## SMALL BUDGET SOLUTION

**F**an and shutter systems are usually designed for about 8 cubic feet per minute per square feet of floor area for summer ventilation. During the winter, all fans and shutters are not needed and

at least half of them can be closed off and insulated. Disconnect power to these unused fans and shutters.

A simple method of reducing the heat loss is to cover the shutter or fan with a layer of

plastic film held in place with furring strips attached with deck screws. Double headed nails may also be used for easy removal.

A better method is to use double bubble wrap with

aluminum facing. This material has an R-value of about 3 and will save more heat than just the plain poly film. It is available from most home centers and costs about \$0.40 per square foot.

**?** HAVE A QUESTION? You can write John at [jbartok@rcn.com](mailto:jbartok@rcn.com).



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## LARGE BUDGET SOLUTION

A more permanent solution is to cut a piece of 1-inch thick insulation board and attach it over the shutter. This can be done with tek screws with large heads, sheet metal brackets that allow the insulation to slide over the shutter, magnetic adhesive strips or hook-and-loop closure strips. It is best if the insulation board is faced with aluminum foil to reflect the radiant part of the heat back into the greenhouse.

The insulation board pieces can be stored and reused from year to year. Polyisocyanurate foam board with aluminum foil costs about \$0.70 per square foot. The motor on some shutters may have to be discon-

nected to allow the insulation board to fit.

Commercially available shutter covers are available from sources such as Grainger. These consist of an insulating material with a tough fabric covering. They are flexible and easy to attach with hook and loop or magnetic strips. Cost for a 4- by 4-foot cover is about \$70.

Scott Longfellow, owner of Longfellow's Greenhouses in Manchester, Maine, has built insulated boxes over some of his fans. The cover to the box is split and hinged in the middle so that it can be opened on days when the fan is operated on low speed. The covers are opened in the morning when ventilation may be needed



A more permanent solution to reducing heat loss is to install a piece of 1-inch thick insulation board and attach it over the fan shutter.

and closed before sunset. On cloudy days the cover remains closed all day. Lauray of Salisbury in Salisbury, Conn., has installed sliding covers on its fans.

With increasing heating costs, payback for installing covers over shutters is very short. As winter approaches, check all shutters and cover those that are not needed. GM