9.2.3 Orchard Heaters

9.2.3.1 General[1-6]

Orchard heaters are commonly used in various areas of the United States to prevent frost damage to fruit and fruit trees. The 5 common types of orchard heaters—pipeline, lazy flame, return stack, cone, and solid fuel—are shown in Figure 9.2.3-1. The pipeline heater system is operated from a central control and fuel is distributed by a piping system from a centrally located tank. Lazy flame, return stack, and cone heaters contain integral fuel reservoirs, but can be converted to a pipeline system. Solid fuel heaters usually consist only of solid briquettes, which are placed on the ground and ignited.

The ambient temperature at which orchard heaters are required is determined primarily by the type of fruit and stage of maturity, by the daytime temperatures, and by the moisture content of the soil and air.

During a heavy thermal inversion, both convective and radiant heating methods are useful in preventing frost damage; there is little difference in the effectiveness of the various heaters. The temperature response for a given fuel rate is about the same for each type of heater as long as the heater is clean and does not leak. When there is little or no thermal inversion, radiant heat provided by pipeline, return stack, or cone heaters is the most effective method for preventing damage.

Proper location of the heaters is essential to the uniformity of the radiant heat distributed among the trees. Heaters are usually located in the center space between 4 trees and are staggered from 1 row to the next. Extra heaters are used on the borders of the orchard.

9.2.3.2 Emissions[1,6]

Emissions from orchard heaters are dependent on the fuel usage rate and the type of heater. Pipeline heaters have the lowest particulate emission rates of all orchard heaters. Hydrocarbon emissions are negligible in the pipeline heaters and in lazy flame, return stack, and cone heaters that have been converted to a pipeline system. Nearly all of the hydrocarbon losses are evaporative losses from fuel contained in the heater reservoir. Because of the low burning temperatures used, nitrogen oxide emissions are negligible.

Emission factors for the different types of orchard heaters are presented in Table 9.2.3-1 and Figure 9.2.3-2. Factors are expressed in units of kilograms per heater-hour (kg/htr-hr) and pounds per heater-hour (lb/htr-hr).

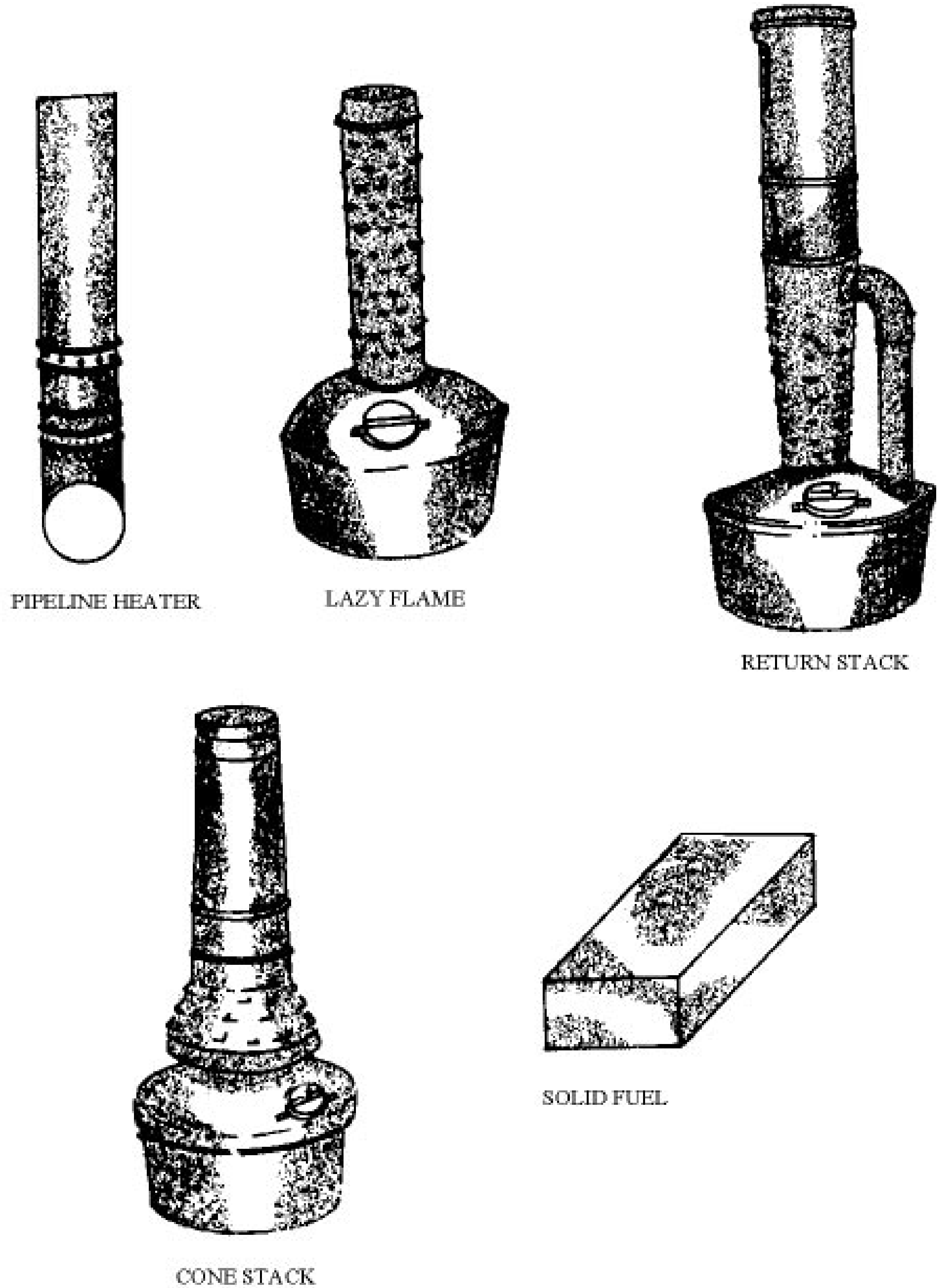

Figure 9.2.3-1. Types of orchard heaters.[6]

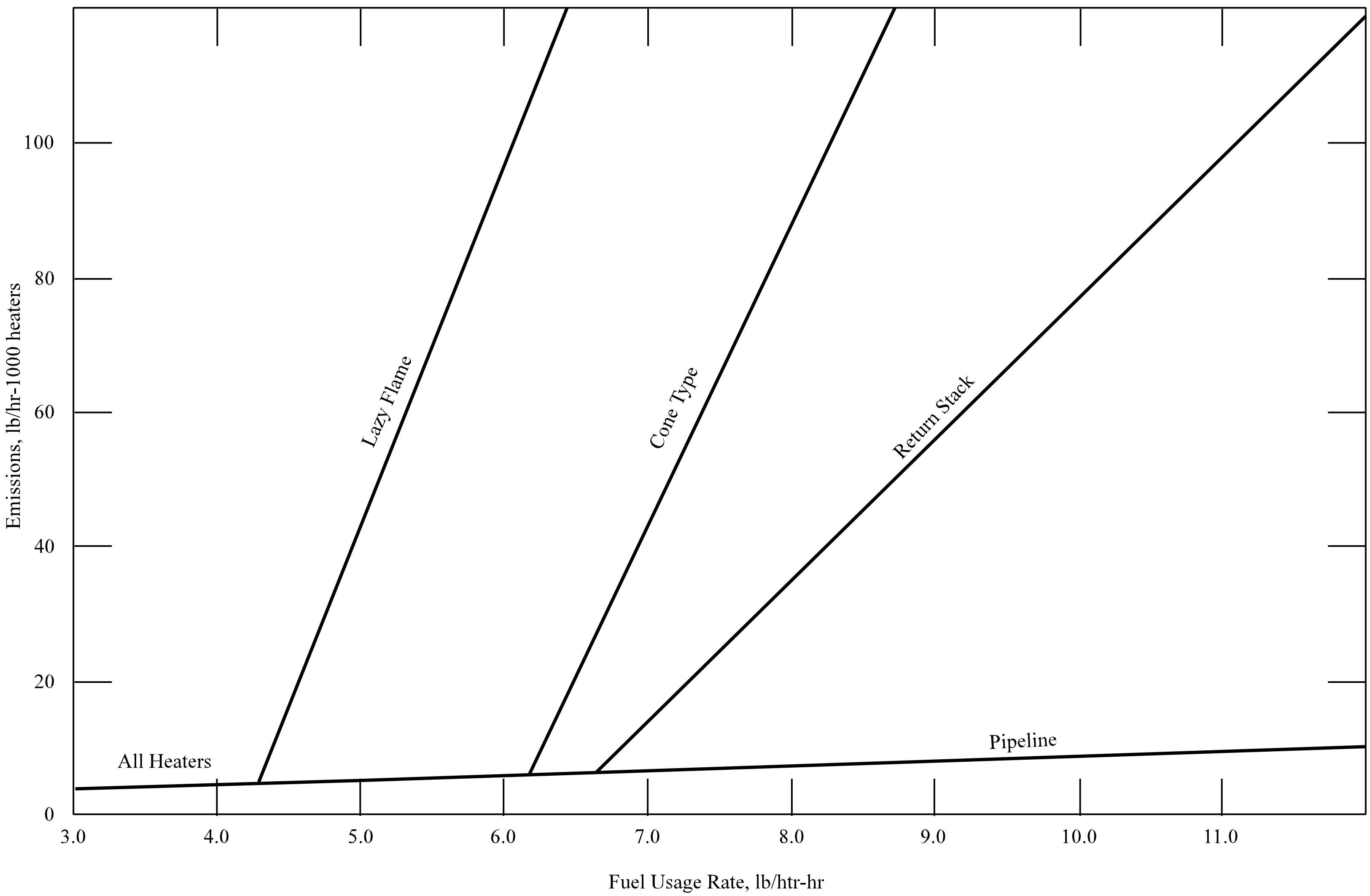

Figure 9.2.3-2. Particulate emissions from orchard heaters.[3,6]

Table 9.2.3-1 (Metric And English Units). EMISSION FACTORS FOR ORCHARD HEATERS[a]

EMISSION FACTOR RATING: C

Pollutant	Type Of Heater				
	Pipeline	Lazy Flame	Return Stack	Cone	Solid Fuel
Particulate					
kg/htr-hr	__[b]	__[b]	__[b]	__[b]	0.023
lb/htr-hr	__[b]	__[b]	__[b]	__[b]	0.05
Sulfur oxides[c]					
kg/htr-hr	0.06S[d]	0.05S	0.06S	0.06S	ND
lb/htr-hr	0.13S	0.11S	0.14S	0.14S	ND
Carbon monoxide					
kg/htr-hr	2.8	ND	ND	ND	ND
lb/htr-hr	6.2	ND	ND	ND	ND
VOCs[e]					
kg/htr-hr	Neg	7.3	7.3	7.3	Neg
lb/htr-hr	Neg	16.0	16.0	16.0	Neg
Nitrogen oxides[f]					
kg/htr-hr	Neg	Neg	Neg	Neg	Neg
lb/htr-hr	Neg	Neg	Neg	Neg	Neg

[a] References 1,3-4, and 6. ND = no data. Neg = negligible.
[b] Particulate emissions for pipeline, lazy flame, return stack, and cone heaters are shown in Figure 9.2.3-2.
[c] Based on emission factors for fuel oil combustion in Section 1.3.
[d] S = sulfur content.
[e] Reference 1. Evaporative losses only. Hydrocarbon emissions from combustion are considered negligible. Evaporative hydrocarbon losses for units that are part of a pipeline system are negligible.
[f] Little nitrogen oxides are formed because of the relatively low combustion temperatures.

References For Section 9.2.3

1. Air Pollution In Ventura County, County Of Ventura Health Department, Santa Paula, CA, June 1966.

2. Frost Protection In Citrus, Agricultural Extension Service, University Of California, Ventura, CA, November 1967.

3. Personal communication with Mr. Wesley Snowden, Valentine, Fisher, And Tomlinson, Consulting Engineers, Seattle, WA, May 1971.

4. Communication with the Smith Energy Company, Los Angeles, CA, January 1968.

5. Communication with Agricultural Extension Service, University Of California, Ventura, CA, October 1969.

6. Personal communication with Mr. Ted Wakai, Air Pollution Control District, County Of Ventura, Ojai, CA, May 1972.