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CONVERSION OF THERMAL FOGGERS FOR ULV APPLICATION

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Mount *et al.* (1968) reported on the effectiveness of non-thermal, ultra-low volume (ULV) aerosols applied by ground equipment. Further work by Mount *et al.* (1970) demonstrated that the Leco ULV aerosol nozzle will produce a cold aerosol at least as effective as thermal aerosols at air pressures attainable from a converted Leco 120 fog machine.

This paper deals with practical aspects of converting thermal foggers to operate as ULV aerosol generators. In essence the conversion amounts to removing all parts from a machine except the engine and blower and installing an insecticide system and the Leco nozzle.

The first consideration in converting a machine is whether the engine-blower combination has enough air output to produce sufficiently small droplets with the Leco nozzle. This is important operationally since droplets larger than 25μ will impinge readily on stationary objects reducing the efficiency of the spray and, with insecticides currently in use, possibly damage automobile finishes.

Mount *et al.* (1970) reported on droplet sizes produced by the Leco nozzle at 3.5 psi air pressure. Using the general methods employed by them, further tests were conducted to determine the lowest practical operating pressure for the nozzle. These data are summarized in Table 1. From this table it can be seen that pressures lower than 3.0 psi produce excessively large droplets and operation at lower pressures is not recommended. In practice, the authors operated converted units routinely for one season at 3.0 and 3.5 psi with no reported cases of automobile or vegetation damage and with a higher degree of mosquito control than ever attained with thermal fogging as indicated by daily routine landing rate counts.

Figure 1 shows the air deliveries required to maintain pressures up to 13 psi in the Leco nozzle. These values were determined with a nozzle attached to a Roots-Connersville Model 74 RAI blower

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TABLE 1.—Droplet sizes produced by Leco ULV nozzle at various air pressures using technical malathion. Droplets caught 6 ft. from nozzle.

Pressure (psi)	Flow Rate (Fl. Oz/Min.)	Percent of Total Mass in Indicated Droplet Size Range					Maximum Diameter (μ)	Average Diameter (μ)	Mass Median Diameter (μ)
		<5 μ	5–10 μ	11–15 μ	16–20 μ	>20 μ			
2.5	3.0	<1	5	7	29	59	37	14	27
3.0	3.0	<1	17	35	15	33	23	10	14
3.5[a]	2.85	3	23	34	24	16	27	11	13

[a] From Mount *et al.* (1970). Droplets caught 25 ft. from nozzle.

by noting the blower RPM required to maintain given pressures on a test gauge. All tests were conducted at 68–70° F. and air deliveries were calculated from tables supplied by the manufacturer. A blower capable of delivering at least 160 CFM at 3.0 psi will operate the Leco ULV nozzle effectively.

ENGINE-BLOWER COMBINATION. The Leco 120 and Tifa 100E engine-blower combinations, with certain modifications, are adequate for conversion. Each is discussed below. In general, if the unit is run on propane, more power can be obtained from the engine by converting it to run on gasoline. This will also eliminate the need for a starter-generator which robs power.

LECO 120. This unit is ordinarily furnished with a 7.25 h.p. Wisconsin engine. The blower is a Roots-Connersville model 36 RAI delivering up to 294 CFM at 3.5 psi at 3550 RPM. As furnished, the pulley ratio between the engine and blower is so great that the engine has to run at excessive speed to produce sufficient blower RPM. When the units on hand were changed to a 1:1 pulley ratio the engines (which were propane fueled) would not supply enough power. Since these engines were old anyway, they were replaced with 9.0 h.p. and 10.0 h.p. gasoline engines and the units worked quite well. Even with gasoline conversion, the 7.25 h.p. engines would be working near their maximum to meet the horsepower requirements of the blower at 3.5 psi.

TIFA 100E. This unit is furnished with a 9.0 h.p. Briggs & Stratton engine and a Sutorbilt model 3LVB or 3LVS blower. The blower is rated for a maximum output of 134 CFM at 3.0 psi at 1770 RPM. The blower can be up-rated to 237 CFM at 4.0 psi at 2835 RPM by dynamically balancing the impellers and installing a thrust bearing kit. Five units were oper-

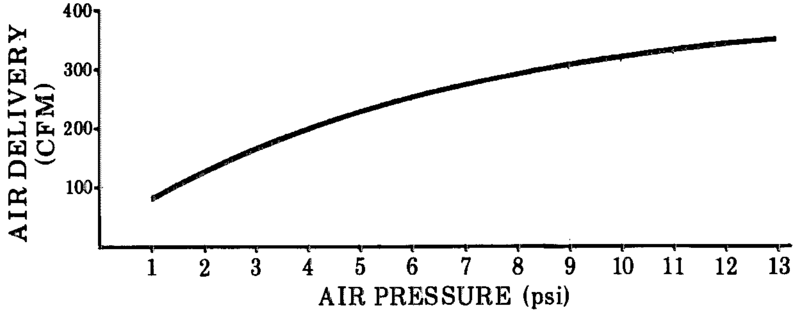

FIG. 1—Air deliveries required to maintain pressures to 13.0 psi in Leco ULV nozzle. Measurements made at 68–70° F. ambient temperature.

ated in this higher range without conversion for one season with no noticeable damage. However, the manufacturer does not recommend this. The engine has sufficient power to operate at the 1:1 pulley ratio standard on the machine.

CONNECTION OF HEAD TO BLOWER. The Leco 120 and Tifa 100E blowers have threaded outlets of 4″ and 2½″ respectively. The Leco ULV head attaches by means of a non-standard flange. Connection of the head to the blower can be made with a fabricated flange welded to standard pipe fittings.

In actual operation it was found desirable to have the head aimed upward, either 45° or vertical, rather than horizontal. This precludes the possibility of blasting the concentrated insecticide onto automobiles or passersby. Also, by propelling the aerosol cloud to a higher level, drift and swath width are increased.

The simplest connection would be a street ell screwed into the blower with flange welded to the terminal end. A hole of appropriate size is drilled and tapped in this ell for connection of a line to an air-pressure gauge and for a port to supply air pressure to the insecticide tank (see below).

Because of the larger quantity of air handled and because air volume is critical to efficient operation, it is advisable to replace the flat screen over the inlet port of the blower with one less prone to clogging. A cylindrical screen offers more surface area and minimizes the clogging problem.

INSECTICIDE SYSTEM. Utilizing the air pressure from the blower, or an external pressure source, the insecticide system can be made pumpless. The former is the simplest and has the advantage of making it impossible to flood the machine with insecticide when the blower is not running.

The system consists of a tank, lines, flow meter and control valve. Figure 2 shows arrangement of these and other components of the conversion.

A Firestone 10-gallon stainless beverage tank makes a good insecticide tank. It is supplied with fittings and relief valve and is ready to use without modification. For insecticide lines, Imperial NSR tubing and Hi-Seal brass fittings are easy to work and chemical-resistant. A small flow meter such as Fisher Porter Model 313701L should be used to accurately monitor insecticide flow. This meter also has a built-in needle valve for flow regulation. To avoid bubbling in the meter, the tube should be inverted and the meter body mounted with the needle valve on top. A solenoid valve mounted as close as possible to the head allows remote control and quick cutoff. The propane solenoid on the standard Leco 120 or Tifa 100E works well without modification.

GENERAL OPERATION. Operation of the ULV conversion is quite simple. The operator needs to monitor only the flow rate and air pressure. The only controls are a needle valve for flow rate and an off-on switch for the solenoid valve. Maintenance is minimal and mixing is eliminated since insecticide concentrate is used.

Insecticide cost using 95 percent malathion at 3 fluid ounces per minute at 10 m.p.h. vehicle speed for one season was $8.55 per hour with a malathion price of $6.08 per gallon. On the other hand, thermal fogging at 80 gallons per hour with 6 ounces of malathion per gallon in diesel would have cost $28.52 per hour (based on diesel @ 11¢ per gallon) not including the labor for mixing. Fuel consumption was greatly reduced because of the absence of the burner.

Operational safety is increased since the aerosol is not produced as a dense cloud which can obstruct visibility. Also, the truck carries only a small amount of concentrate rather than hundreds of gallons of diesel.

Mount *et al.* (1970) reported good kills in cage tests at a vehicle speed of 20 m.p.h. This presents the possibility of increasing the area covered by present equipment 2–3 times at a cost of less than ⅓ that of thermal fogging.

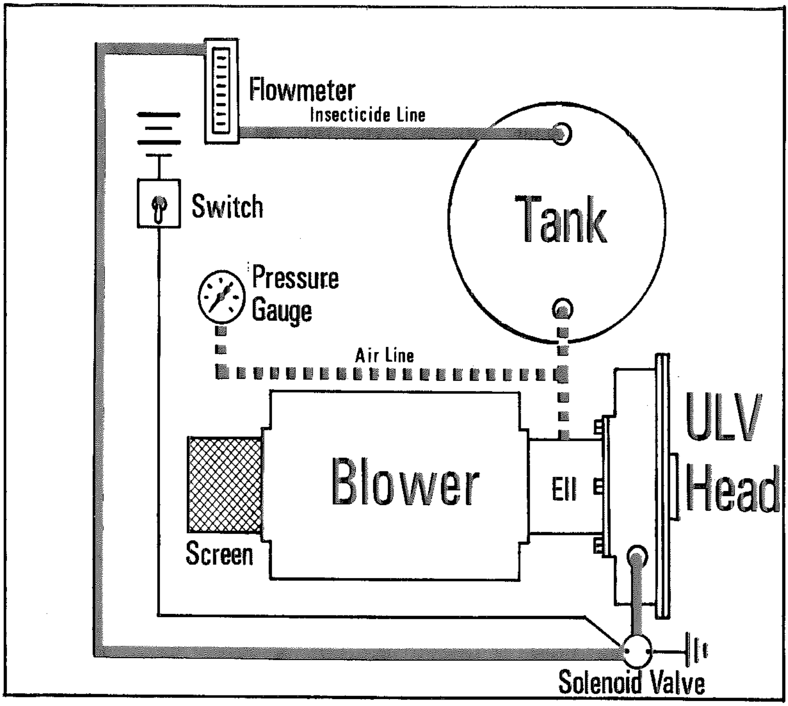

FIG. 2.—Schematic Diagram of ULV Conversion.

SUMMARY. The Leco 120 and Tifa 100E foggers, with certain modifications, are suitable for conversion to ULV. Air requirements of the Leco ULV nozzle at various pressures were determined to establish criteria for conversion of other machines. In actual operation, ULV was found more effective than thermal fogging and offers the advantage of simplicity, low maintenance, much lower insecticide cost, greater safety, and the possibility of increased coverage per unit.

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