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FARM Sprayer for Weed Control

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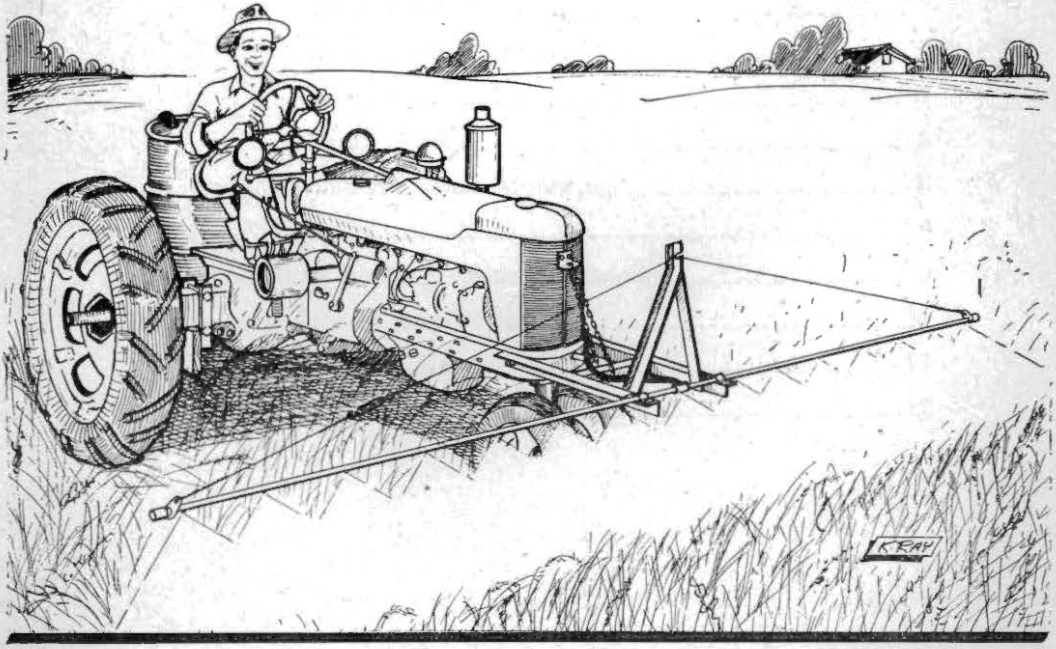

OKLAHOMA AGRICULTURAL EXPERIMENT STATION
OKLAHOMA A. & M. COLLEGE, STILLWATER
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CONTENTS

FARM SPRAYER FOR WEED CONTROL

By W. J. OATES and R. H. WITT*

The rapid development of 2,4-D and other chemicals for killing weeds has brought a demand for plans and specifications of equipment to use in applying these new herbicides. Spraying seems to be the most satisfactory method of application at the present time; and tractor-mounted units are rapidly becoming the most popular type of sprayer for farm use.

A low pressure sprayer that can be used for both weed and insect control can be built easily and inexpensively on the farm. Pressures ranging from 20 to 125 pounds will do both jobs satisfactorily. This bulletin describes the construction of such a unit for tractor mounting. It was designed and tested by the authors as a project of the Agricultural Engineering Department of the Oklahoma Agricultural Experiment Station.

A spray unit of the type described here has many uses on the farm. It can be used to spray dairy barns, poultry houses, livestock or fruit trees; and in emergencies it can be used to fight fires. To convert the unit to these jobs, a garden hose of convenient length is connected to the discharge side of the pump and any type of spray nozzle attached to the hose. (a fan-type spray is preferable.)

Information on spray materials can be obtained from your county agent or by writing: Agricultural Experiment Station, Oklahoma A. & M. College, Stillwater, Oklahoma.

Spray materials for weed killing are discussed in Oklahoma Agricultural Experiment Station publication *Chemical Control of Weeds in Oklahoma.* It can be obtained from county agents or by writing the Experiment Station at Stillwater.

Building The Sprayer

FIXED-BOOM TYPE UNIT

The equipment needed to build a spray unit of the type described here includes:

A pump to provide the pressure.

A mounting to attach pump to the tractor.

A supply tank of convenient size.

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A filter or line strainer to keep the nozzles from becoming clogged.

A device for agitating the spray material in the supply tank.

A pressure gauge.

A weed boom with nozzles, and attachments for mounting it on the tractor.

Enough hose to connect the supply tank to the pump and the pump to the weed boom.

Pumps

Any type of pump that will develop and maintain the desired pressure can be used. However, a pump with a built-in pressure regulator or by-pass will usually be more convenient. The rotary, centrifugal and rubber impeller types usually weigh less, have fewer working parts and cost less than a piston type of similar capacity, and for that reason are best for a homemade unit.

Pump capacity will depend upon three things: (1) rate of application (2) width of boom, and (3) rate of travel. It is usually a good idea to choose a pump one-fourth larger than needed. A pump with a one-inch discharge will be large enough for a farm-type unit. The price difference between this and the next smaller size is so slight that the few extra dollars are worthwhile to insure ample capacity for any job.

Rotary Type

These are positive action, gear displacement pumps. The rate of discharge depends upon the speed. These pumps may be secured with a built-in regulator and by-pass valve and can be adjusted for pressures ranging from 0 to 150 pounds per square inch. The by-pass valve is necessary on any positive action pump to prevent damage when the discharge opening is closed while the pump is operating.

Centrifugal Type

These have a rotating impeller and do not require a by-pass or relief valve. The discharge opening can be closed without damaging the pump. Centrifugal pumps must operate

at very high speeds (1200 to 4000 r.p.m.). This type of pump will deliver high volumes but will not build up high pressures.

Rubber Impeller Type

These have a rubber impeller that runs in a special housing designed to flatten the vanes as they pass the discharge opening. The average maximum pressure developed is about 30 pounds. This type of pump does not require a by-pass or relief valve, *but the impeller will wear out in about one to two minutes if allowed to run dry.*

Piston Type

These pumps are built with one or more pistons connected to a crankshaft. The pistons work in smooth-lined cylinders with the necessary valves to keep the liquid flowing in the proper direction. They are positive action pumps designed for high pressures and require a pressure regulator and by-pass valve. As a general rule they have more working parts and are more expensive.

Pump Mountings

When the sprayer is mounted on the tractor instead of in a trailer, the pump may be driven from either the power take-off or the belt pulley. The best method will depend on the type of tractor available. There are three possibilities:

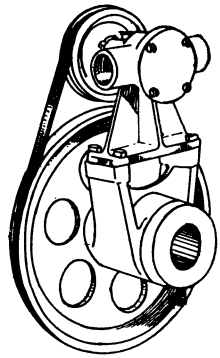
(1) Many manufacturers supply a special mounting with their pumps so that they can be connected directly to the power take-off spline. Figure 1 shows a mounting of this type. This is a very convenient arrangement, but the tractor must be operated at full throttle or the working pressure will be low.

(2) The pump may be mounted on the tractor drawbar as shown in Figure 2. Any reasonable speed desired may be obtained by varying the size of the pulleys used.

(3) On some tractors it may be more desirable to drive the pump from the belt pulley. This may be done by mounting the pump on a bracket as shown in Figure 3. The pulley on the pump must be in line with the belt pulley to get good performance.

Supply Tank

Any type of metal tank or barrel will be satisfactory for holding the spray material. It should be mounted so that the bottom of the tank is as high as the pump, if possible. The pumps mentioned above are self priming and will lift water about fifteen feet when new, but more uniform pressure is ob-



DIRECT TAKE-OFF WITH PUMP
FIG. 1

tained when the tank is mounted in a position that will allow full gravity feed. As the pump becomes worn, priming becomes more difficult. One method of mounting the tank is illustrated in Figure 4.

Filter or Line Strainer

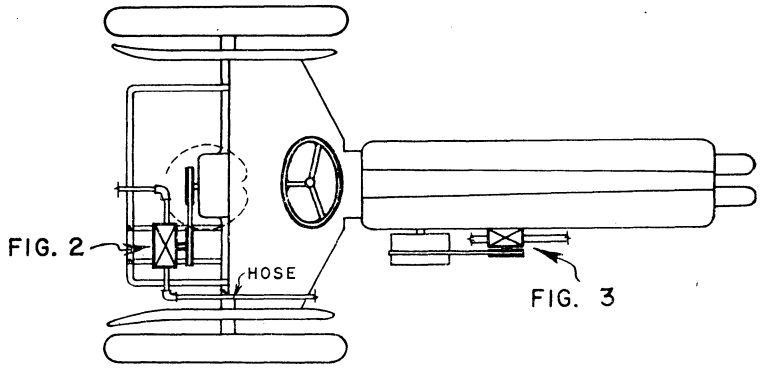
A filter or line strainer should be used between the tank and the pump to prevent rust scales or foreign bodies from damaging the pump and clogging the nozzles. The strainer should be about 200 mesh. Figure 5 shows a simple method of attaching the strainer.

Agitators

Some sprays must be mixed continuously while putting them on. This may be done by placing a T fitting on the discharge side of the pump and running a hose back into the tank (Figure 5). A garden hose fitted with a nozzle works well. Good agitation is secured by allowing a portion of the discharge to return to the tank through this hose.

Pressure Gauge

A pressure gauge is needed to help determine an accurate rate of application. It is best to have a gauge reading up to 200 pounds. A low-pressure gauge is likely to be damaged if a pressure beyond its capacity is accidentally applied. Location of the gauge is shown in Figure 5.



TWO TYPES OF BELT DRIVE
FIG. 2 POWER TAKE-OFF
FIG. 3 BELT PULLEY

Boom And Boom Mounting

Weed booms vary a great deal in length, depending upon the acreage to be sprayed. A 20-foot boom will usually be large enough to handle from twenty to one hundred acres. Booms of greater length are more costly since they require more bracing.

For a 20-foot boom, ¾ inch galvanized water pipe, steel or aluminum tubing will serve quite well. Figures 5 and 6 show a suggested method of mounting the boom. This of course will vary with different makes of tractors.

Nozzle fittings may be tapped or welded to the tubing. Nozzles should be spaced according to the manufacturers' specifications but should be between 14 and 20 inches. If the machine is to be used for row crops, the spacing should be one half the row width and should be arranged so that alternate nozzles are over the row.

Nozzles

The best coverage of weeds is obtained with a nozzle that delivers a flat, fan-shaped pattern. These nozzles may be secured with holes of various sizes, to give almost any desired rate of application. The fan-shaped pattern will vary from

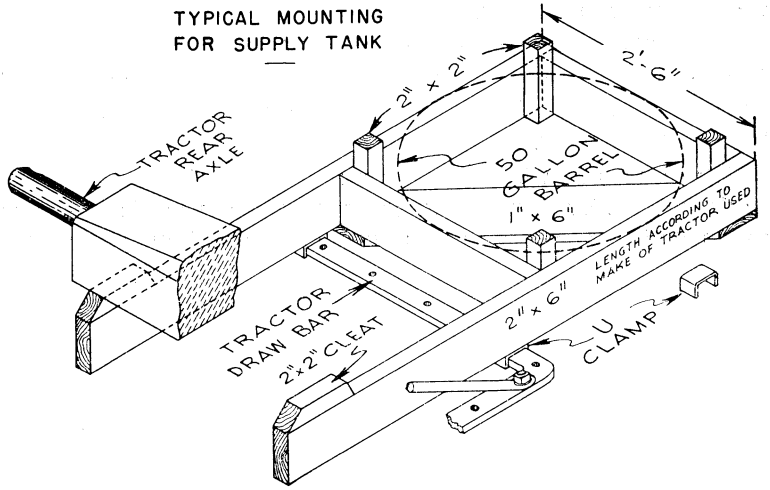


FIG. 4

25 to 80 degrees, so that complete coverage may be obtained with almost any arrangement of the nozzles. The method of determining the size of nozzle to be used is described on page 11.

UNIT WITH FOLDING, ADJUSTABLE BOOM

The sprayer described on the preceding pages has the advantage of being simple and easy to build. However, it is necessary for the operator to get off the tractor seat to change the boom position when going through gates or moving along the highway. This is also necessary when crop growth requires a different boom height.

A machine designed to be entirely operated from the tractor seat therefore was designed by Station agricultural engineers. The boom, made in three sections, can be raised and lowered hydraulically. It can also be folded for transporting

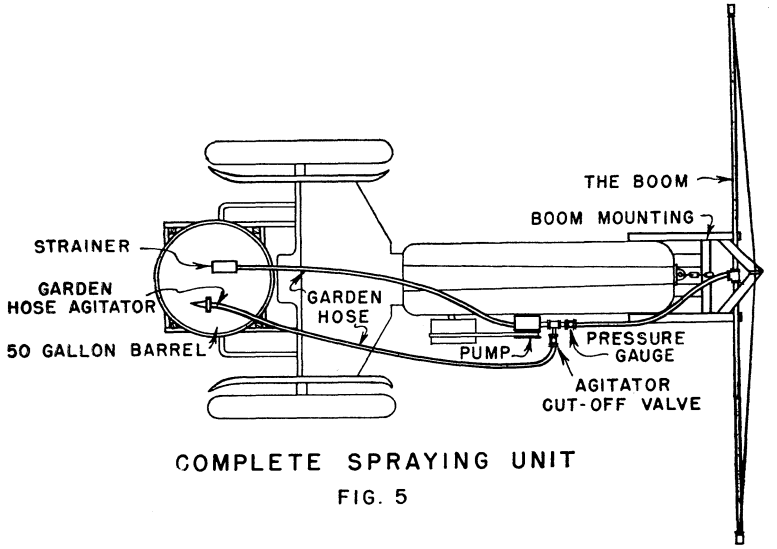
without leaving the tractor seat. Figures 7 and 8 show in detail the plans for constructing this unit.

The sprayer was made to fit a Farmall "Super A" equipped with touch control, but it could be adapted to other types of tractors by making some alterations in the plans.

The boom on this unit is mounted in the rear for convenience. With minor changes, it can be mounted on the front of any row-crop tractor.

The off-set motor on the "Super A" tractor makes it possible to mount the tank as shown in Figure 7. The available space is large enough to accommodate a tank with a capacity of about 75 gallons.

The pump is a bronze gear pump with a built-in pressure regulator and by-pass. Any spray material that is by-passed is returned to the tank and serves as an excellent agitator.



COMPLETE SPRAYING UNIT

FIG. 5

Determining Rate of Application

Finding Size of Nozzle Needed

Tables I and II will be helpful in selecting the proper nozzle size. The following example shows how the tables are used.

EXAMPLE

Suppose you want to apply spray at the rate of 15 gallons per acre ,and your tractor will be driven at 4 miles per hour. Suppose further that your pump pressure is 30 pounds.

In Table I, find the required gallons per acre (in this case, 15) in the left hand column. Then go across to the 4 m. p. h. column and you will find .18. This means that you must have a nozzle that will deliver .18 gallons per minute to put on 15 gallons per acre with the tractor traveling 4 miles per hour.

Now turn to Table II. Find the pressure column headed "30" and go down that column until you find .18 or the nearest thing to it. You find .17. Now go across to the nozzle size in the right hand column and you find .031 or one thirty-second of an inch. That is the nozzle size you will need.

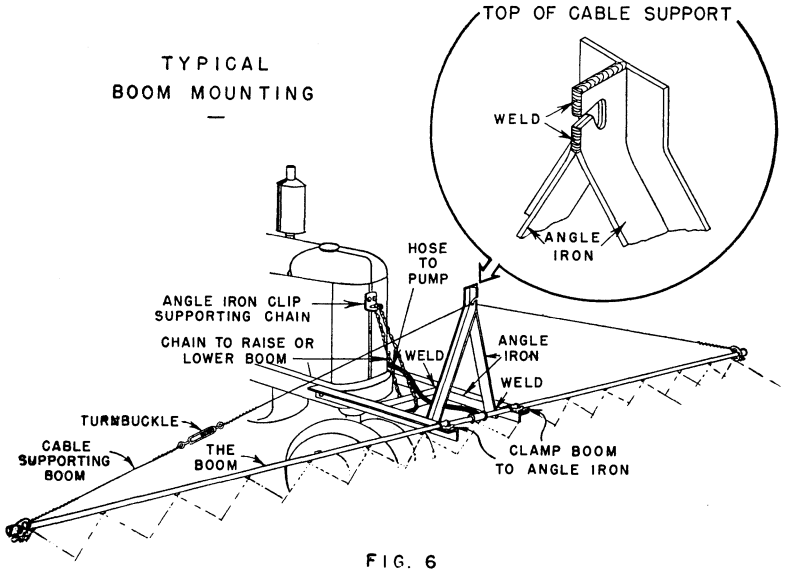
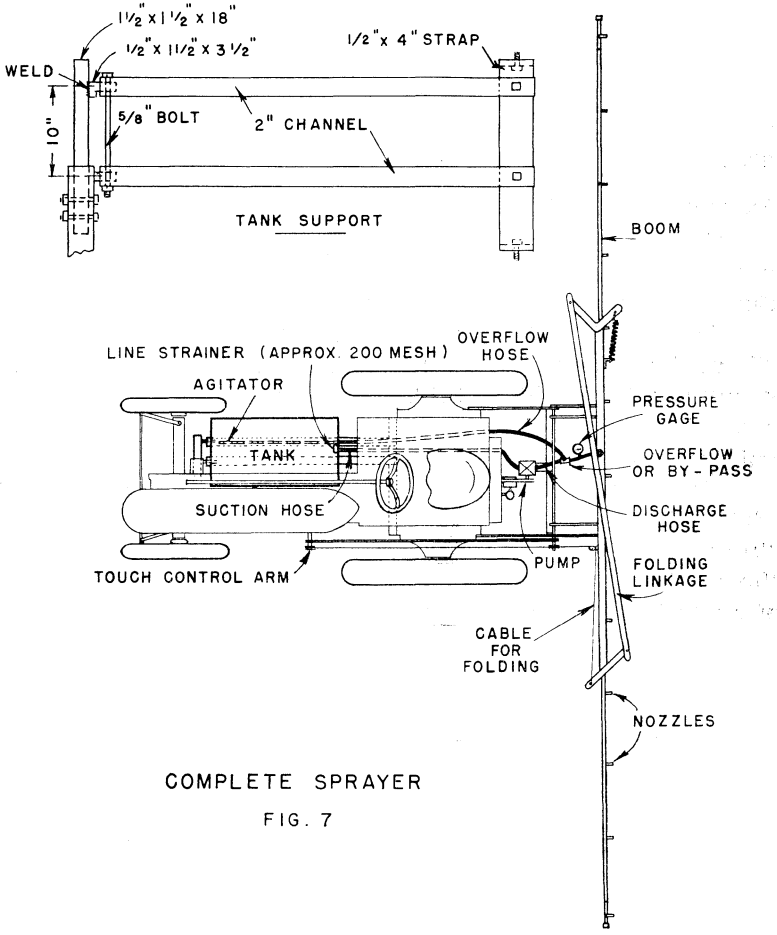


FIG. 6



COMPLETE SPRAYER

FIG. 7

Checking Rate of Application

After building the sprayer unit it will be necessary to check the exact rate of application. It may be done as follows:

Start the sprayer, hold a container under a nozzle, and catch the discharge for one minute. Measure the amount discharged, and multiply this by the number of nozzles. Then multiply that quantity by 60 to get the discharge per hour of the nozzles.

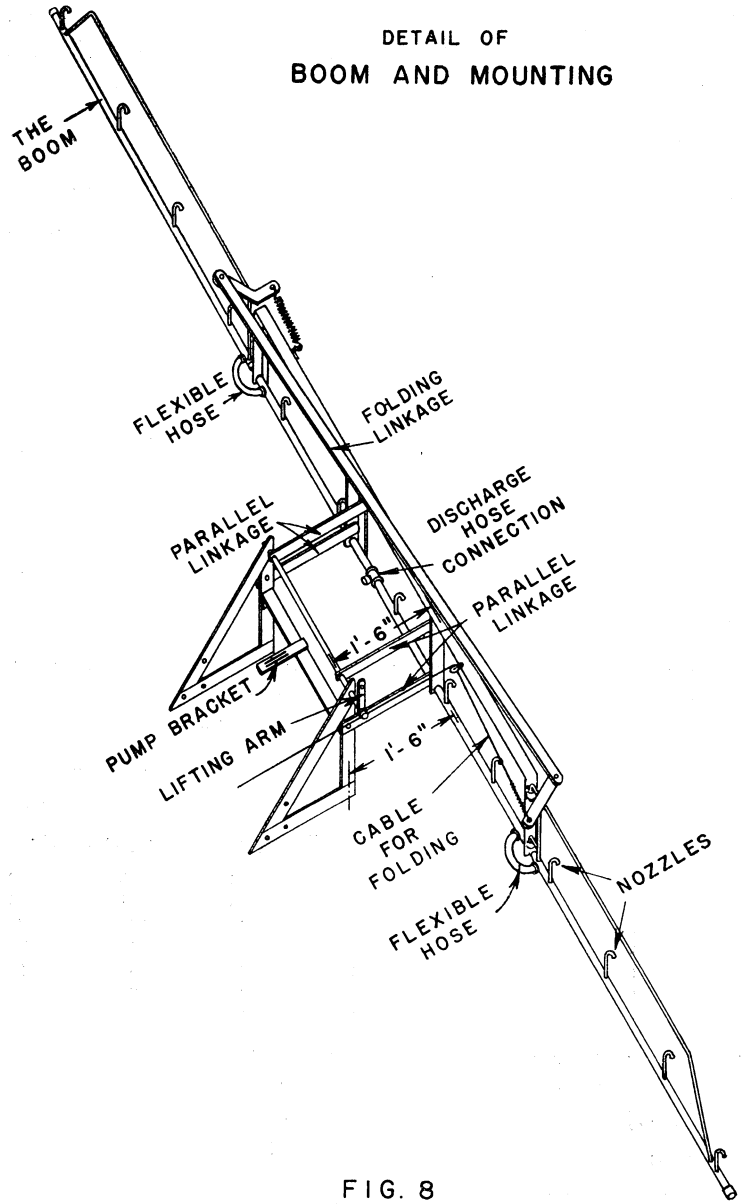

DETAIL OF
BOOM AND MOUNTING
THE BOOM
FLEXIBLE HOSE
FOLDING LINKAGE
PARALLEL LINKAGE
DISCHARGE HOSE CONNECTION
PARALLEL LINKAGE
1'-6"
PUMP BRACKET
LIFTING ARM
1'-6"
CABLE FOR FOLDING
FLEXIBLE HOSE
NOZZLES

FIG. 8

Divide the boom width by 8.25 and multiply by the speed of the tractor in miles per hour. This gives the number of acres covered per hour. The discharge per hour divided by the acres per hour will give the rate of application per acre.

EXAMPLE

You have a 20-foot boom with 15 nozzles. Tractor speed is 4 m.p.h. One nozzle discharges 1.3 pints per minute. Multiply 1.3 pints x 15 nozzles x 60 minutes and you get 1163 pints or 145.4 gallons per hour.

Now: $\frac{\text{20-foot boom x 4}}{8.25} = 9.69$ acres.

$\frac{145.4}{9.69} = 15$ gallons per acre.

Many times you may find the particular size of nozzle being used will not give exactly the desired rate at a certain tractor speed. If you are getting less material than you want, decrease your tractor speed a little. If you are getting too much material, increase your speed so that you will move over the ground a little faster.

*TABLE I.—Discharge per Nozzle in Gallons per Minute Needed to Get Required Rate per Acre at Different Rates of Travel. Nozzle Spacing 18 Inches.**

Rate of Application (Gallons per Acre)	Rate of Travel (Miles per Hour)			
	2.5	3.5	4.0	4.5
	Gallons per Minute per Nozzle			
5	.038	.053	.060	.068
10	.076	.106	.121	.136
15	.11	.16	.18	.20
20	.15	.21	.24	.27
30	.23	.32	.36	.41
40	.30	.42	.49	.55
60	.46	.64	.73	.87

* For other nozzle spacings, multiply the above figures as follows:

For nozzle spacing of—	Multiply by—
12 inches	.67
14 inches	.78
16 inches	.89
20 inches	1.11

This section, particularly Tables I and II, is adapted from "Build Your Own Sprayer," A. E. Circular 23, Agricultural Extension Service, North Dakota Agricultural College, Fargo, N. Dak. (October, 1947).

TABLE II.—Nozzle Size Needed to Get Desired Rate of Discharge. (Capacities in this table are approximate. For exact discharge capacity of type of nozzle actually used, see the manufacturer's chart.)

Capacity of Nozzle (Gallons per Minute) at Pressure* of—						Size of Nozzle Hole (Inches)
15	20	30	40	50	60	
	.07	.09	.10	.11	.12	.020 or 1/50
.12	.14	.17	.20	.22	.24	.031 or 1/32
..25	.28	.35	.40	.44	.48	.046 or 3/64
.37	.42	.52	.60	.66	.72	.063 or 1/16
.61	.70	.86	1.0	1.1	1.21	.078 or 5/64

* Pressure in pounds per square inch.