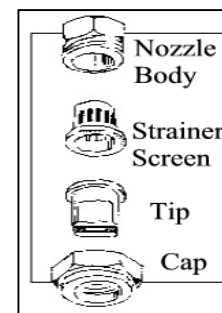


## Selecting Nozzle Tips and Strainers.

The efficiency and success of your spray program hinges on a tiny part that typically costs no more than \$2 to \$3 dollars each. If you don't choose nozzles properly and replace them when they're worn or damaged, the following can result from the misapplication of pesticides:

- Increased risk of environmental damage due to drift or over-application
- Increase risk to the applicator.
- Reduced yields due to crop stress and chemical carryover.
- Re-spraying costs.



Consider this! If a pesticide costs \$15 per acre and due to worn nozzles you are over-applying by 15 percent, you'll spray an additional \$ 2.25 of chemical per acre. If you spray a lot of acres, this can add up!

### Types of Nozzle Patterns

When applying pesticides it is important to select the right nozzles for the right situation. No one nozzle fits all applications. The type of nozzle that will work best depends on:

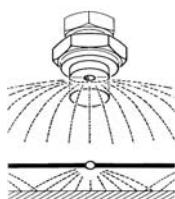
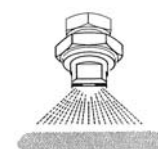
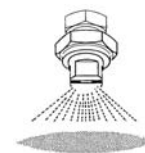
- The type of product you're applying. For example, soil applied pesticides need bigger droplets.
- The droplet size for maximum coverage and drift control. Larger droplets reduce drift but smaller droplets increase plant coverage and reduce droplet "bounce."
- Desired sprayer output (gallons-per-acre or gpa). Read the pesticide label to determine if there is an optimum sprayer output for the product.

Nozzle spray patterns come in three basic angles (65°, 80° and 110°) and are of three basic types: solid stream, fan, and cone. Some special-purpose nozzle tips or devices produce special patterns. These include "raindrops," "flooding," and others that produce wide-angle fan such as broadjets.

**Solid stream nozzles** - These nozzles are used in handgun sprayers to spray a distant or specific target such as livestock or tree pests. They also are used for crack and crevice treatments in and around buildings. Solid stream nozzles may be attached to booms to apply pesticides in a narrow band or inject them into the soil.

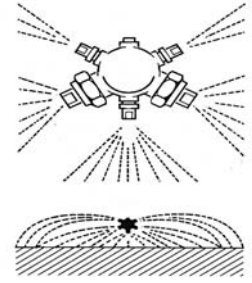
**Fan pattern nozzles** - At least three types of nozzle tips have fan patterns. They are used mostly for uniform spray coverage of surfaces; for example, broadcast soil applications of herbicides or insecticides.

- The tapered flat fan nozzle tip makes a narrow oval pattern with tapered ends and is used for broadcast herbicide and insecticide spraying at 15 to 60 pounds-per-square-inch. The pattern is designed to be used on a boom and to be overlapped 30 to 50 percent for even distribution. Spacing on the boom, spray angle, and boom height determine proper overlap and should be carefully controlled.
- The even flat fan nozzle makes a narrow oval pattern without the tapered ends. Spray delivery is uniform across its width. It is used for band spraying and for treating walls and other surfaces. It is not useful for broadcast applications. Boom height and nozzle spray angle determine the width of the band sprayed.

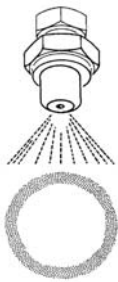


- Flooding (flat fan) nozzles deliver a wide-angle flat spray pattern that produce large spray droplets. If used for broadcast spraying, these nozzles should be overlapped to provide double coverage. They are often used for applying liquid fertilizers or fertilizer-pesticide mixtures or for directing herbicide sprays up under plant canopies.

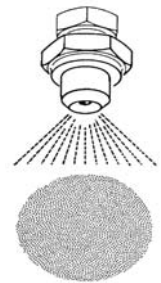
- Cluster nozzles or broadjets are used either without a boom or at the end of booms to extend the effective swath width. One type is simply a large flooding deflector nozzle that will spread spray droplets over a swath up to 70 feet wide from a single nozzle tip. Cluster nozzles are a combination of a center-discharge and two or more off-center-discharge fan nozzles. Coverage may be variable because the spray pattern is not uniform and spray droplets vary in size from very small to very large. Keep in mind that the small droplets may cause a drift. Since no boom is required, these nozzles are particularly well suited for spraying hedgerows, fencerows, and other hard-to-reach locations where uniform coverage is not critical.



**Cone pattern nozzles** - Hollow and solid cone patterns are used where penetration and coverage of plant foliage or other irregular targets are desired. They are most often used to apply fungicides and insecticides to foliage, although some types are used for broadcast soil applications of herbicides or fertilizers or combinations of the two.



Core-insert cone nozzles produce either a solid or hollow cone spray pattern. They operate at moderate pressures and give a finely atomized spray. They should not be used for wettable powders because their small passages clog easily and they wear rapidly due to abrasion.



Disk-core nozzles produce a cone-shaped spray pattern, which may be hollow or solid. The spray angle depends on the combination of disk and core used and also on the pressure. Disks made of very hard materials resist abrasion well, so these nozzles are recommended for spraying wettable powders at high pressures.

Adjustable cone nozzles change their spray angle from a wide cone pattern to a solid stream when the nozzle collar is turned. Many manual sprayers are equipped with this type of nozzle. Handguns for power sprayers have adjustable nozzles that usually use an internal core to vary the spray angle.

## Nozzle Material

Just as nozzles come in many different patterns, they are also made of many different materials. Some naturally wear better and last longer than others.

**Brass** nozzles resist corrosion from most pesticides but may be corroded by liquid fertilizers. They also wear quickly from abrasion due to the use of wettable powders and grit in the spray water. Excessively high sprayer pressure will also cause brass nozzles to wear. They are the cheapest nozzle and probably the best material for general use.

**Plastic** nozzle tips will not corrode, resist abrasion better than brass, but may swell when exposed to some solvents. Their useful life is about equal to that of brass nozzles.

**Stainless steel** nozzle tips, while expensive, offer good corrosion resistance, are suited for high pressures, and last longer than brass. Hardened stainless steel nozzles resist abrasion from certain formulations like wettable powders and flowables.

**Aluminum** nozzles resist some corrosive materials but are easily corroded by some fertilizers, and their useful life is much shorter than brass.

Nozzle tips made of **tungsten carbide and ceramic** are highly resistant to abrasion and corrosion and are the best material for high pressures and wettable powders. They last much longer than brass.

Top-quality nozzles are a must if you're going to spray thousands of dollars of pesticides as cost-effectively as you can. It is important to note that the life of a nozzle is affected by factors other than the material from which it is manufactured. For instance, do you use a clean water source to mix your chemicals or do you draw from a farm pond that may have a lot of abrasive materials in the water? What types of product are you spraying? Wettable powders and liquid fertilizers are a couple of the more abrasive products you'll run through your sprayer.

## Nozzle Selection

In general, nozzle selection is based on nozzle output in gallons-per-minute (gpm), desired sprayer output in gallons-per-acre (gpa) and field speed. The following formula will help you determine nozzle output in gallons-per-minute based on sprayer output in gallons-per-acre, field speed in miles-per-hour and nozzle spacing.

$$\text{GPM} = \frac{\text{GPA} \times \text{MPH} \times \text{W}}{5940}$$

GPM = gallons per minute per nozzle  
 GPA = Total sprayer output in gallons per acre  
 MPH = Miles per Hour (your field speed)  
 W = Nozzle spacing in inches for boom sprayers.  
     = Sprayed width in inches for boomless nozzles  
 5940 = A constant.

**Example:** You want your sprayer to apply 32 gallons-per-acre (gpa) for maximum coverage. Nozzle spacing is 20 inches on your boom and you find you can spray your fields effectively at 7 miles-per-hour. How much do you need to collect from under each nozzle on your boom to achieve this sprayer output?

$$\text{GPM} = \frac{\text{GPA} \times \text{MPH} \times \text{W}}{5940} = \frac{32 \text{ gpa} \times 7 \text{ mph} \times 20''}{5940} = \frac{4480}{5940} = 0.754 \text{ or } 0.75 \text{ gpm}$$

You can now go to your dealer and request nozzles that apply 0.75 gallons-per-minute or you can consult a tip chart to find the right nozzle. You can check the nozzles already on your boom by collecting from each of the nozzles to see if they meet your specifications. You may want to convert gallons-per-minute to ounces-per-minute. Since there are 128 ounces in one gallon, simply multiply 128 x gpm. In the above example, 128 multiplied by 0.75 equals 96. You will need to collect 96 ounces-per-minute from each nozzle on your boom to achieve 32 gallons-per-acre. This is provided you keep your field speed at 7 miles-per-hour and your nozzles are spaced at 20-inch intervals.

## Preventing Drift

When applying pesticides, small droplets can be formed and easily moved off the target area by wind. The causes of drift are predominately due to the spray equipment setup and climatic conditions:

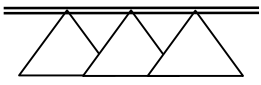
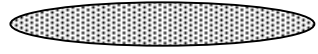
- **Droplet size** – The smaller the nozzle size coupled with greater the spray pressures equals smaller droplets and the greater the proportion of driftable droplets. Select a nozzle that reduces the number of fine droplets produced.
- **Spray Tip Height** – As the distance between the spray tip and target area increases, the greater the impact wind speed will have on drift.
- **Operating Speed** – Increased operating speeds can cause the spray to be diverted back into upward wind currents created behind the sprayer that trap small droplets.
- **Wind Velocity** – Wind has the greatest impact on drift. It is important for spraying to take place during the relatively calm hours of the day. Refer to pesticide labels for velocity recommendations.
- **Air Temperature and Humidity** – In temperatures over 77° F with low relative humidity, small droplets are especially prone to drift due to the effects of evaporation.
- **Pesticide Properties and Spray Output Volumes** – Before applying pesticides, always read the label for certain restrictions and recommended volumes. Always use high output volumes when practical.

## Using Tip Charts For Nozzle Selection

Nozzle manufacturers provide detailed charts of tip performance. You can match your spraying needs to chart specifications to decide what tips and strainers to use. It is important to remember that the best way to make major changes in sprayer output (GPA) is to either change field speed or to change nozzle tips. Changing sprayer pressure should be used to make only minor changes in sprayer output. Increased pressure can result in spray drift and equipment wear.

The charts include the factors you must consider in order to choose the right nozzles: (1) field speed, (2) spray volume for both nozzles and total sprayer output, and (3) pressure.

Here is what a portion of a manufacturer's tip chart might look like:

Tapered Flat Fan Nozzle Tips																					
		Adjust spray height to overlap 30% of each edge of pattern		<table border="1"> <tr> <th colspan="3">Suggested Minimum Spray Height</th> </tr> <tr> <td>65° spray angle</td> <td colspan="2">– 22-24" height</td> </tr> <tr> <td>80° spray angle</td> <td colspan="2">– 17-19" height</td> </tr> <tr> <td>110° spray angle</td> <td colspan="2">– 15-18" height</td> </tr> </table>						Suggested Minimum Spray Height			65° spray angle	– 22-24" height		80° spray angle	– 17-19" height		110° spray angle	– 15-18" height	
Suggested Minimum Spray Height																					
65° spray angle	– 22-24" height																				
80° spray angle	– 17-19" height																				
110° spray angle	– 15-18" height																				
Spray Tip No.* and Strainer Screen Size**	PSI	Capacity 1 nozzle in GPM	Capacity 1 Nozzle oz./min.	GPA (gallons-per-acre) (20" nozzle spacings)																	
				5 mph	6 mph	7 mph	8 mph	9 mph	10 mph												
TP6506	30	0.52	67	31	26	22	19.3	17.2	15.4												
TP8006	35	0.56	72	33	28	24	21	18.5	16.6												
TP11006	40	0.60	77	36	30	25	22	19.8	17.8												
(50)	50	0.67	86	40	33	28	25	22	19.9												
	60	0.73	93	43	36	31	27	24	22												
TP6508	30	0.69	88	41	34	29	26	23	20												
TP8008	35	0.75	96	45	37	32	28	25	22												
TP11008	40	0.80	102	48	40	34	30	26	24												
(50)	50	0.89	114	53	44	38	33	29	26												
	60	0.89	125	58	49	42	36	32	29												
TP6510	30	0.87	111	52	43	37	32	29	26												
TP8010	35	0.94	120	56	47	40	35	31	28												
TP11010	40	1.00	128	59	50	42	37	33	30												
(24)	50	1.12	143	67	55	48	42	37	33												
	60	1.22	156	72	60	52	45	40	36												

\* **Nozzle tip numbers** – A method of coding nozzle tips is to print identification numbers on the face of the nozzle. For the above TP8008 nozzle, TP means “tapered flat fan”, the next two digits indicates a 80° spray fan. The last two digits indicates the nozzle output is 0.80 gallons-per-minute at a pressure of 40 psi.

\*\***Filter Screens/strainers** – range in size from 10 – 200 mesh. A 50 mesh denotes 50 openings per inch; the larger the number the finer the screen.

**Example:** A pesticide labels call for a minimum sprayer output of 30 gallons of water per acre. Boom nozzle spacing is 20-inches. To keep drift to a minimum so you want to use the lowest spray pressure as possible. You want a field speed of 5 to 7 miles-per-hour.

Look under the “GPA” column until you find a GPA greater than 30 fitting your specifications and spraying situation. The most practical entry appears under the 7 mph column and indicates 32 GPA. Now follow the column to the left and you will find that you can choose between three different nozzles: TP6508, TP8008 or the TP11008 with a 50-mesh screen. You choose the TP 8008 with spray height of 17 to 19 inches. In order to achieve the desired GPA of 32, your sprayer pressure needs to be at 35 psi and you need to drive at a field speed of 7 mph. You can also double-check your nozzles by collecting 0.75 gallons-per-minute or 96 ounces-per-minute of water from each nozzle.