

## APPLICATION EQUIPMENT AND CALIBRATION REFERENCES

### NOZZLE NOMENCLATURE

Many types of spray nozzles are available, each providing different flow rates, spray angles, droplet sizes, and spray patterns. Some commonly used nozzle types are shown in Figures 1 and 2. Nozzles that produce flat-fan spray patterns are in Figure 1, and those that produce cone spray patterns are in Figure 2. Table 1 may be used as a guideline for selecting the proper nozzle type for each application. Nozzle manufacturers often code spray nozzles to indicate specific spray characteristics. The tip number may indicate the nozzle type, flow rate, and spray-fan angle. Other characteristics are identified, with letters representing specific operating conditions. Table 2 lists the nomenclature for various types of commercially available nozzles. Many nozzles are now color-coded for ease of identification, and Table 3 gives the color codes used by two nozzle manufacturers.

### SPRAYER CALIBRATION GUIDELINES

#### VARIABLES AFFECTING APPLICATION RATE

Three variables affect the amount of spray mixture applied per acre: the nozzle flow rate, the ground speed of the sprayer, and the effective sprayed width per nozzle.

The gallons of spray applied per acre may be determined from the three variables in the following equation:

$$\text{GPA} = \frac{\text{GPM} \times 5,940}{\text{MPH} \times W}$$

where

GPA = spray applied, in gallons per acre

GPM = output per nozzle, in gallons per minute

MPH = ground speed, in miles per hour

W = effective sprayed width per nozzle, in inches.

For broadcast spraying, W = the nozzle spacing. For band spraying, W = the bandwidth. For row-crop applications (such as spraying from drop pipes or directed spraying), W = row spacing (or bandwidth) divided by the number of nozzles per row (or band).

5,940 = a constant to convert gallons per minute, miles per hour, and inches to gallons per acre

#### SELECTING THE PROPER NOZZLE TIP

The proper nozzle size may be selected by determining the required flow rate from each nozzle at a selected application rate (GPA), ground speed (MPH), and effective sprayed width (W) in inches per nozzle. The required flow rate per nozzle may be determined from the following equation:

$$\text{GPM} = \frac{\text{GPA} \times \text{MPH} \times W}{5,940}$$

Select a nozzle that gives the required flow rate when the nozzle is operated within the recommended pressure range.

*The information in this chapter is provided for educational purposes only. Product trade names have been used for clarity, but reference to trade names does not imply endorsement by the University of Illinois; discrimination is not intended against any product. The reader is urged to exercise caution in making purchases or evaluating product information.*

*Label registrations can change at any time. Thus the recommendations in this chapter may become invalid. The user must read carefully the entire, most recent label and follow all directions and restrictions. Purchase only enough pesticide for the current growing season.*

### CALIBRATING THE SPRAYER

Install the selected nozzle tips in the sprayer. Determine the flow rate for each nozzle in ounces per minute (OPM) from the following equation:

$$\text{OPM} = \text{GPM} \times 128 \text{ (1 gallon = 128 ounces)}$$

Measure the flow rate using a flow meter, or collect the output from a nozzle using a container marked in ounces. Adjust the pressure until the required GPM or OPM is collected. Check the nozzle flow rate frequently. Adjust the pressure to compensate for small changes in output resulting from nozzle wear. Replace the nozzle tips and recalibrate when the output has changed 10 percent or more from that of a new nozzle or when the pattern has become uneven.

### FLOW RATE

Nozzle flow rate varies with spraying pressure. The relationship between GPM and pressure (pounds per square inch, or PSI) is as follows:

$$\frac{\text{GPM}_1}{\text{GPM}_2} = \frac{\sqrt{\text{PSI}_1}}{\sqrt{\text{PSI}_2}}$$

With this relationship, doubling the flow through the nozzle requires increasing the pressure by a factor of four. The equation may be used to determine nozzle flow rates achieved at various pressures.

#### EXAMPLE:

If a certain nozzle has a flow rate of 0.6 GPM at a pressure of 40 PSI, what would the flow rate be if the nozzle were operated at 15 PSI?

#### SOLUTION:

Rearrange the formula to obtain  $\text{GPM}_2$ :

$$\text{GPM}_2 = \frac{\sqrt{\text{PSI}_2}}{\sqrt{\text{PSI}_1}} \times \text{GPM}_1$$

Solve for the new flow rate:

$$\text{GPM}_2 = \frac{\sqrt{15 \text{ PSI}}}{\sqrt{40 \text{ PSI}}} \times 0.6 \text{ GPM}$$

$$\text{GPM}_2 = \frac{3.873}{6.325} \times 0.6$$

$$\text{GPM}_2 = 0.61 \times 0.6 = 0.4$$

### EFFECT OF SOLUTION DENSITY ON NOZZLE FLOW RATE

Density is the weight of a solution per unit volume (pounds per gallon). Specific gravity (SG) is the weight of a solution relative to water, which weighs 8.34 pounds per gallon. Nozzle flow rate varies inversely with the square root of specific gravity. Conversion factors to compare flow rates of solutions of any known density may be calculated as follows:

$$\text{Conversion factor} = \sqrt{\text{SG}}$$

Table 4 may be used to predict the flow rate from various solutions and to select the proper nozzle size from a nozzle catalog table. Because nozzle tables are based on spraying water, the conversion factors from the table may be multiplied by the desired GPM or GPA to determine the water flow rate for the solution being sprayed. Use the converted GPM or GPA to select the proper nozzle size from the catalog.

#### EXAMPLE:

$$3 \text{ GPM (28\% N)} \times 1.13 = 3.39 \text{ (water)}$$

If the flow rate (GPM) or application rate (GPA) of water is known, the GPM or GPA of a solution may be predicted by dividing the flow or application rate by the conversion factor.

#### EXAMPLE:

$$20 \text{ GPA (water)} \div 1.13 = 17.7 \text{ GPA (28\% N)}$$

### MEASURING GROUND SPEED

To measure ground speed, mark off a distance in the field to be sprayed or in a field with similar surface conditions. Suggested distances are 100 feet for speeds up to 5 miles per hour, 200 feet for speeds from 6 to 10 miles per hour, and at least 300 feet for speeds above 10 miles per hour. At the engine throttle setting and gear used for actual spraying, determine the travel time between the measured stakes. Calculate ground speed using Table 5, or apply the following formula:

$$\text{Travel speed (MPH)} = \frac{\text{distance (feet)} \times 60}{\text{time (seconds)} \times 88}$$

## SPRAY OVERLAP

For uniform application, each nozzle type must be operated at a spacing and height that provide a specific spray overlap. The overlap may vary from 20 percent to more than 100 percent. The percent overlap or spray coverage is illustrated in Figure 3 and Table 6 and may be calculated from the following formulas:

$$\text{Percent overlap} = \frac{\text{spray coverage} - \text{nozzle spacing}}{\text{nozzle spacing}}$$

$$\text{Spray coverage} = (\text{nozzle spacing} \times \text{percent overlap}) + \text{nozzle spacing}$$

## SPRAY-ANGLE COVERAGE AT VARIOUS HEIGHTS

Table 7 lists the theoretical coverage of spray patterns, as calculated from the included angle of the spray and the distance from the nozzle orifice (Figure 4). These values are based on the assumption that the spray angle remains the same throughout the entire spray distance. In practice, the tabulated spray angle does not hold for long spray distances. Adjust the spray height to give proper spray overlap. Table 8 lists suggested minimal spray heights.

## NOZZLE WEAR

Nozzle tips are available in a variety of materials, including hardened stainless steel, stainless steel, thermoplastic, and brass. Ceramic and hardened stainless steel are the most wear-resistant materials but also are the most expensive. Stainless steel tips have excellent wear resistance when used with either corrosive or abrasive products. Nylon and other synthetic plastics (thermoplastics) are resistant to corrosion and abrasion, but they vary considerably in their wear life, depending on the material used to mold the tips. Brass

tips wear rapidly when used to apply abrasive products such as wetttable powders, and they are corroded by some liquid fertilizers.

Figure 5 shows the percent increase in flow rates after a 40-hour wear test for flat-fan nozzles constructed of various materials.

## TECHNIQUES FOR REDUCING SPRAY DRIFT

When pesticides are applied, there is always a chance that some escapes from the target area. Although drift cannot be eliminated completely, the use of proper equipment and spraying techniques maintains drift deposits within acceptable limits. The type of nozzle, pressure, height, and spray volume all affect the off-target movement. The ability to reduce drift is no better than the weakest component in the spraying procedure. A summary of recommended procedures for minimizing spray drift is given in Table 9.

One of the best practices available for minimizing drift damage is the use of drift-control additives to increase the size of spray droplets. Tests indicate that downwind drift deposits are reduced from 50 to 80 percent with the use of drift-control additives. They do not eliminate drift, however, and common sense must remain the primary factor in reducing drift damage. A number of additives are commercially available; they must be mixed and applied according to label directions to be effective.

## PRESSURE DROP THROUGH SPRAYING SYSTEMS

Hoses and fittings must be selected to keep pressure drops within acceptable limits. Tables 10 to 12 give pressure drops through various sizes of hose, pipe, and coupling. The information in Table 13 is provided for reference in making any conversions needed to calibrate spray equipment properly during pesticide application.

**Table 1. Recommended nozzle types for various applications**

Type of application	Extended- range flat-fan	Even flat- fan	Even twin	Regular twin	Flood and turbo- flood	Hollow- cone	Drift- control flat-fan	Rain- drop	Wide- angle full- cone	Turbo flat- fan
<b>Preemergence herbicide</b>										
Broadcast	x	—	—	—	x	—	x	x	x	x
Band	—	x	—	—	—	—	—	—	—	—
<b>Postemergence herbicide</b>										
<i>Contact</i>										
Band	—	x	x	—	—	x	—	—	—	—
Broadcast	x	—	—	x	—	—	x	—	—	x
<i>Systemic</i>										
Band	—	x	—	—	—	—	—	—	—	—
Broadcast	x	—	—	—	x	—	x	x	x	x
<b>Insecticides</b>										
Incorporation	x	—	—	—	x	—	x	x	x	x
Foliar banding	—	x	x	—	—	x	—	—	—	—
Broadcast	x	—	—	x	x	—	x	—	—	x
<b>Soil incorporation</b>										
	x	—	—	—	x	—	x	x	x	x

x denotes recommended use.

— denotes that nozzle is not recommended for this application.

**Table 2. Nomenclature for various types of commercially available nozzles**

Nozzle type	Nozzle nomenclature			
	Chem Farm	Delavan	Lurmark	Spraying Systems
Flat-fan (regular, extended-range, pre-orifice, drift-reduction, turbo)		LF, LFR, R, RF	F	XR, DG, TT
Even-fan		LE	E	E
Low-pressure flat-fan				LP
Twin-orifice and twin-orifice even		2LF		TJ, TJE
Off-center		LX	OC	OC
Flooding		D or F	AN	TK, K, TF
Whirlchamber, Raindrop, wide-angle full-cone	MC	WRW, RA	HW	FL, B, W
Hollow-cone		HB, HC	AF	TX
Hollow-cone (disc and core type)		DC	DC	
Flooding, Raindrop, and whirlchamber (high-capacity)		F, WRW	AN	K, QCK

**Table 3. Color code comparisons for commercially available spray nozzles**

Color	Nozzle number, size, and angle	
	Delavan (ColorJet)	Spraying Systems (VisiFlo)
Orange	80-3, 110-3 RF-3 80-3R, 110-3R F150 80-3E, 40-3E	8001, 11001 XR8001, XR11001 8001E TT11001 TJ60-650134 TX-18 QCK-120, QCTF-120
Dark green	80-6, 110-6 RF-6 80-6R, 110-6R D-3 RA-6 WRW6 F30 RA60 WRW60 80-6E, 40-6E	80015, 110015 XR80015, XR110015 80015E TT110015 QCK-180 TX-4 DG80015, DG110015
Yellow	80-4, 110-4 RF-4 80-4R, 110-4R RA-4 D-2 WRW4 F20 RA-40 80-4E, 40-4E	8002, 11002 XR8002, XR11002 8002E TT11002 TJ60-6502, TJ60-8002 TJ60-4002E, TJ60-8002E QCK-30, QCTF-30 DG8002, DG11002
Dark blue	80-5, 110-5 RF-5 80-5R, 100-5R D2.5 RA-5 WRW5 80-5E, 40-5E	8003, 11003 XR8003, XR11003 8003E TT11003 TJ60-6503, TJ60-8003, TJ60-11003 TJ60-4003E, TJ60-8003E QCK-60, QCTF-60 DG8003, DG11003
Red	80-8, 110-8 RF-8 80-8R, 110-8R D4 RA-8 F-40 RA-80 WRW-80 80-8E, 40-8E	8004, 11004 XR8004, XR11004 8004E TT11004 TJ60-6504, TJ60-8004, TJ60-11004 TJ60-4004E, TJ60-8004E TK-2, TF-2 TX-6 QCK-40, QCTF-40 DG8004, DG11004

**Table 3. Color code comparisons for commercially available spray nozzles (cont.)**

Color	Nozzle number, size, and angle	
	Delavan (ColorJet)	Spraying Systems (VisiFlo)
Brown	80-1.5, 110-1.5 RF-1.5 80-1.5R, 110-1.5R 80-1.5E, 40-1.5E	8005, 11005 XR8005, XR11005 8005E TT11005 FL-5 TK-2.5, TF-2.5 TX-12 QCK-150 DG8005, DG11005
Gray	80-2, 100-2, 110-2 RF-2 80-2R, 110-2R RA-2 WRW2 80-2E, 40-2E	8006, 11006 XR8006, XR11006 8006E TJ60-6506, TJ60-8006, TJ60-11006 FL-6.5 TK-3, TF-3 TX-8 TJ60-8006E QCK-50, QCTF-50
White		8008, 11008 XR8008, XR11008 8008E TJ60-6508, TJ60-8008, TJ60-11008 FL-8 TK-4, TF-4 QCK-20, QCTF-20
Light blue	80-15, 110-15 D7.5 WRW15 80-15E RA 15	TJ60-8010, TJ60-11010 FL-10 TK-5, TF-5 QCK-100, QCTF-100
Light green	80-20 D-10 RA15 WRW20 F100 RA200 WRW200	FL-15 TK-7.5, TF-7.5
Black	RF-1 WRW1.5	TK-10, TF-10 TX-10 QCK-80, QCTF-80

**Table 3. Color code comparisons for commercially available spray nozzles (cont.)**

Color	Nozzle number, size, and angle	
	Delavan (ColorJet)	Spraying Systems (VisiFlo)
Tan, beige	80-10, 110-10 D-5 RA-10 WRW-10 F50 RA-100 WRW-100 80-10E	QCTF-15
Purple	D-6 F-60 RA-120 WRW120	QCK-210
Medium blue	F-80 RA-160 WRW160	
Gold	F-120 RA240 WRW240	

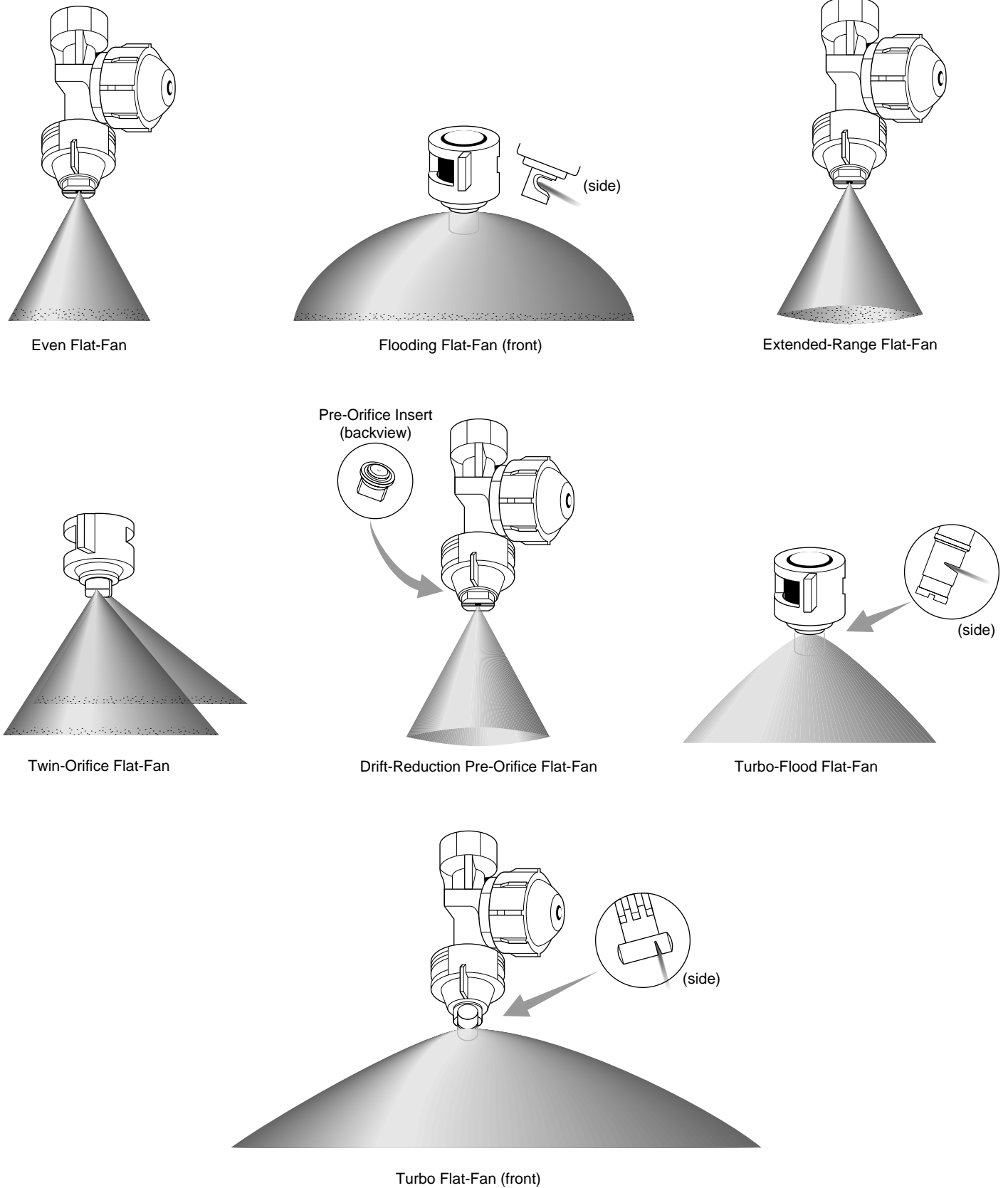
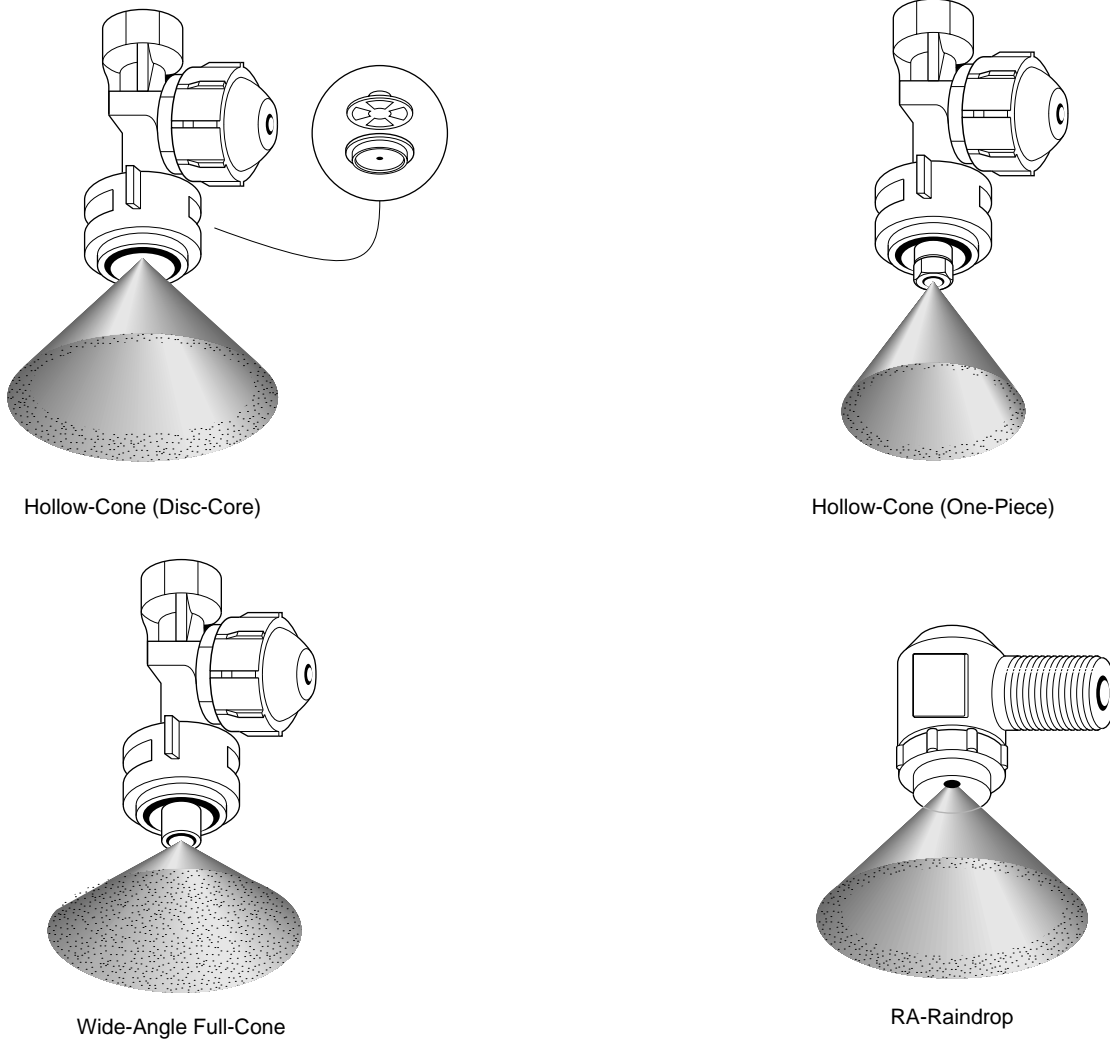


Figure 1. Spray nozzles that produce flat-fan spray patterns.



Hollow-Cone (Disc-Core)

Hollow-Cone (One-Piece)

Wide-Angle Full-Cone

RA-Raindrop

Figure 2. Spray nozzles that produce cone spray patterns.

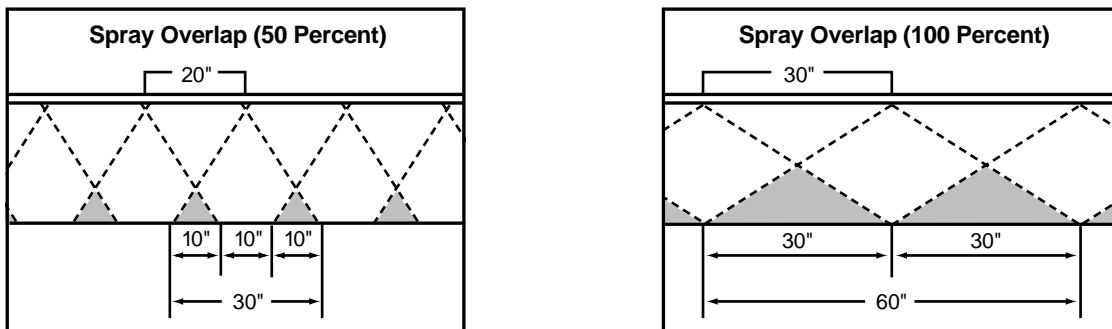


Figure 3. Examples of 50 percent and 100 percent spray overlap.

**Table 4. Specific gravities and conversion factors for selected solution weights**

Solution weight, lb/gal	Specific gravity	Conversion factor
7.0	0.84	0.92
8.0	0.96	0.98
8.34 <sup>a</sup>	1.00	1.00
9.0	1.08	1.04
10.0	1.20	1.10
10.65 <sup>b</sup>	1.28	1.13
11.0	1.32	1.15
12.0	1.44	1.20
14.0	1.68	1.30

NOTE: This table is based on theoretical solution densities only and may vary in actual practice because of differing solution characteristics. Figures apply to flood but not Raindrop nozzles.

<sup>a</sup>Water.

<sup>b</sup>28% nitrogen.

**Table 5. Time required to obtain various travel speeds**

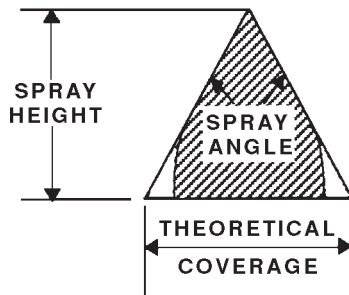
Speed, mph	Travel time, seconds		
	100 ft	200 ft	300 ft
3.0	23	45	68
3.5	20	39	58
4.0	17	34	51
4.5	15	30	45
5.0	14	27	41
6.0		23	34
7.0		19	29
8.0		17	26
9.0		15	23
10.0		14	20
11.0			19
12.0			17
13.0			16
14.0			15
15.0			14

**Table 6. Spray coverage required to obtain proper overlap of spray patterns**

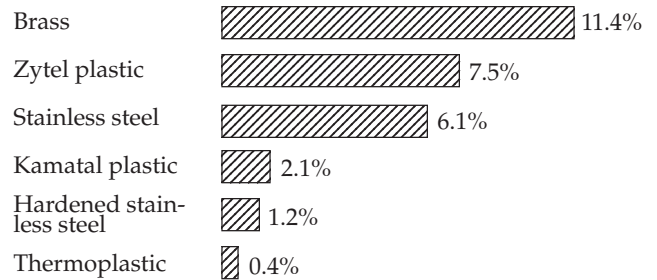
Overlap (%)	Spray coverage at various nozzle spacings						
	20"	25"	30"	35"	40"	50"	60"
20	24	30	36	42	48	60	72
30	26	33	39	46	52	65	78
40	28	35	42	49	56	70	84
50	30	38	45	53	60	75	90
60	32	40	48	56	64	80	96
70	34	43	51	60	68	85	102
80	36	45	54	63	72	90	108
90	38	48	57	67	76	95	114
100	40	50	60	70	80	100	120
110	42	53	63	74	84	105	126
150	50	63	75	88	100	125	150

**Table 7. Computed spray coverage at different spray heights for various spray angles**

Spray angle, degrees	Width of spray pattern at various distances from nozzle orifice										
	6"	8"	12"	15"	18"	24"	30"	36"	42"	48"	60"
15	1.6	2.1	3.2	3.9	4.7	6.3	7.9	9.5	11.1	12.6	15.8
25	2.7	3.5	5.3	6.6	8.0	10.6	13.3	15.9	18.6	21.2	26.6
30	3.2	4.3	6.4	8.0	9.7	12.8	16.0	19.3	22.4	25.9	32.0
40	4.3	5.8	8.7	10.9	13.0	17.4	21.6	26.2	30.6	34.9	42.8
45	4.9	6.6	9.9	12.4	14.9	19.8	24.8	29.8	34.8	39.7	49.6
50	5.6	7.4	11.2	14.0	16.8	22.4	28.0	33.6	39.1	44.8	56.0
60	6.9	9.2	13.9	17.3	20.8	27.6	34.6	41.6	48.4	55.4	69.2
65	7.6	10.2	15.2	19.1	22.9	30.5	38.1	45.8	53.2	61.0	76.4
70	8.2	11.2	16.8	21.0	25.2	33.6	42.0	50.4	59.8	67.2	84.0
73	8.8	11.8	17.8	22.2	26.6	36.4	44.4	53.2	62.0	71.0	88.5
75	9.2	12.3	18.4	23.0	27.6	36.8	46.0	55.2	64.2	73.5	92.0
80	10.1	13.4	20.1	25.2	30.2	40.2	50.2	60.4	72.5	80.8	100.0
90	12.0	16.0	24.0	30.0	36.0	48.0	60.0	72.0	84.0	96.0	120.0
100	14.3	19.1	28.6	35.8	42.4	57.2	71.4	86.0	100.0	114.6	143.0
120	20.8	27.8	41.6	52.0	62.4	83.0	104.0	125.0	145.8	166.2	208.0
140	33.0	44.0	65.9	82.4	98.9	131.9	164.8	197.8	230.8	263.8	329.7



**Figure 4. Theoretical coverage of spray pattern.**



**Figure 5. Percent increase in flow rate of flat-fan spray nozzles (after 40-hour wear test).**

**Table 8. Suggested minimal spray heights for given angles**

Spray angle	20-inch spacing	30-inch spacing
65°	22" to 24"	33" to 36"
73°	20" to 22"	29" to 36"
80°	17" to 19"	26" to 28"
110°	10" to 12"	14" to 18"

**Table 9. Summary of recommended procedures for reducing drift damage**

Recommended procedure	Example	Explanation
Select a nozzle type that produces coarse droplets.	Raindrop, wide-angle full-cone, flooding.	Use droplets as large as practical to provide necessary coverage.
Use the lower end of the pressure range.	Use 20 to 40 psi for Raindrop; less than 25 psi for other types.	Higher pressures generate many more small droplets (less than 100 microns).
Lower the boom height.	Use as low a boom height as possible to maintain uniform distribution. Use drops for systemic herbicides in corn.	Wind speed increases with height. Boom height a few inches lower can reduce off-target drift.
Increase the nozzle size.	If normal gallonage is 15 to 20 GPA, increase to 25 to 30 GPA.	Larger-capacity nozzles reduce spray depositing off target.
Spray when wind speeds are less than 10 mph and moving away from sensitive plants.	Leave a buffer zone if sensitive plants are downwind. Spray buffer zone when wind changes.	More of the spray volume moves off target as wind increases.
Do not spray when the air is completely calm.	Absolutely calm air generally occurs in early morning or late afternoon.	Absolutely calm air reduces air mixing, and spray can move slowly downwind.
Use a drift-control additive when needed.	Several long-chain polymers are available.	Drift-control additives increase the average droplet size produced by the nozzles.

**Table 10. Pressure drop for water flow through various hose sizes (in good, smooth condition)**

Flow, GPM	Pressure drop in pounds per square inch (10-foot lengths—without couplings)								
	¼" ID	⅜" ID	⅞" ID	½" ID	⅝" ID	¾" ID	1" ID	1¼" ID	1½" ID
0.2	0.3								
0.3	0.6								
0.4	1.0								
0.5	1.4	0.2							
0.6	2.0	0.3							
0.8	3.3	0.5							
1.0		0.7	0.3						
1.5		1.4	0.6	0.4					
2.0		2.4	1.1	0.6					
2.5		3.4	1.7	0.9					
3.0			2.4	1.2	0.4				
4.0				2.0	0.7				
5.0				2.9	1.0	0.4			
6.0				4.0	1.4	0.6			
8.0					2.6	0.9	0.3		
10					3.6	1.4	0.4		
15						3.0	0.8	0.3	
20							1.4	0.5	0.2
25							2.0	0.7	0.3
30							2.8	0.9	0.4
40								1.6	0.5
50								2.5	0.8
60								3.4	1.2
70									1.6
80									2.0
90									2.6
100									3.0

ID = inside diameter.

**Table 11. Flow of water through schedule 40 steel pipe of various sizes (seamless or welded construction in good, clean condition)**

Flow, GPM	Pressure drop in pounds per square inch (10-foot lengths)								
	½" ID	¼" ID	⅜" ID	½" ID	¾" ID	1" ID	1¼" ID	1½" ID	2" ID
0.3	0.42								
0.4	0.70	0.16							
0.5	1.1	0.24							
0.6	1.5	0.33							
0.8	2.5	0.54	0.13						
1.0	3.7	0.83	0.19	0.06					
1.5	8.0	1.8	0.40	0.12					
2.0	13.4	3.0	0.66	0.21	0.05				
2.5		4.5	1.0	0.32	0.08				
3.0		6.4	1.4	0.43	0.11				
4.0		11.1	2.4	0.74	0.18	0.06			
5.0			3.7	1.1	0.28	0.08			
6.0			5.2	1.6	0.38	0.12			
8.0			9.1	2.8	0.66	0.20	0.05		
10				4.2	1.0	0.30	0.08		
15					2.2	0.64	0.16	0.08	
20					3.8	1.1	0.28	0.13	
25						1.7	0.42	0.19	0.06
30						2.4	0.59	0.27	0.08
35								0.36	0.11
40								0.47	0.14
45									0.17
50									0.20
60									0.29
70									0.38
80									0.50
90									0.62
100									0.76

ID = inside diameter.

**Table 12. Approximate friction loss in pipe fittings in terms of equivalent feet of straight pipe**

Pipe size, standard weight	Actual inside diameter, inches	Gate value FULL OPEN	Globe value FULL OPEN	45° elbow	Run or standard tee	Standard elbow or run of tee reduced ½	Standard tee through side outlet
⅛	0.269	0.1	8	0.3	0.4	0.7	1.4
¼	0.364	0.2	11	0.5	0.6	1.1	2.2
½	0.622	0.3	18	0.7	1.1	1.7	3.3
¾	0.824	0.4	23	0.9	1.4	2.1	4.2
1	1.049	0.5	29	1.2	1.8	2.6	5.3
1¼	1.380	0.7	38	1.6	2.3	3.5	7.0
1½	1.610	0.8	45	1.9	2.7	4.1	8.1
2	2.067	1.1	58	2.4	3.5	5.2	10.4
2½	2.469	1.3	69	2.9	4.2	6.2	12.4
3	3.068	1.6	86	3.6	5.2	7.7	15.5
4	4.026	2.1	113	4.7	6.8	10.2	20.3
5	5.047	2.7	142	5.9	8.5	12.7	25.4
6	6.065	3.2	170		10.2	15.3	31.0

**Table 13. Reference information for making calibration conversions**

<b>STANDARD ABBREVIATIONS</b>		<b>MISCELLANEOUS EQUIVALENTS</b>	
GPA	= gallons per acre	1 acre	= 43,560 square feet = 0.405 hectares
GPM	= gallons per minute	1 hectare	= 2.471 acres
GPH	= gallons per hour	1 gallon per acre	= 9.35 liters per hectare
MPH	= miles per hour	1 mile	= 5,280 feet = 1,610 meters = 1.61 kilometers
OPM	= ounces per minute	1 pound per square inch =	
PSI	= pounds per square inch	0.070 kilogram/centimeter <sup>2</sup>	= 6.895 kilopascals
<b>VOLUME AND LIQUID MEASURES</b>		1 pound	= 0.454 kilogram
8 fluid ounces	= 1 cup = 236.6 ml	1 inch	= 2.54 centimeters
2 cups	= 32 tablespoons = 1 pint = 473.1 ml		
2 pints	= 64 tablespoons = 1 quart = 946.2 ml		
8 pints	= 4 quarts = 1 gallon =		
128 fluid ounces	= 3,785 ml		
<b>METRIC CONVERSION FACTORS</b>			
During the next few years, a gradual transition to metric (SI) units is expected in the agricultural industry. To facilitate use of these units, selected metric terms and conversion factors are given here.			
To measure	Multiply	By	To obtain
Length	inches	25.40	millimeters (mm)
	inches	2.540	centimeters (cm)
	feet	0.3048	meters (m)
	miles	1.609	kilometers (km)
Area	acres	46.7	square meters (m <sup>2</sup> )
	acres	0.4047	hectares (ha)
Volume	gallons	3.785	cubic decimeters (dm <sup>3</sup> )
	gallons	3.785	liters (L)
	imperial gallons	4.546	liters (L)
Flow rate	gallons/hour (GPH)	3.785	liters/hour (L/h)
	gallons/minute (GPM)	3.785	liters/minute (L/min)
Application rate	gallons/acre (GPA)	9.353	liters/hectare (L/ha)
Pressure	pounds/inch <sup>2</sup> (PSI)	6.895	kilopascals (kPa)
Speed	miles/hour (MPH)	1.609	kilometers/hour (km/h)

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