

Technical Information

Useful Formulas

$$\text{GPM (Per Nozzle)} = \frac{\text{GPA} \times \text{MPH} \times \text{W}}{5,940}$$

$$\text{GPM (Per Nozzle)} = \frac{\text{GAL}/1000\text{FT}^2 \times \text{MPH} \times \text{W}}{136}$$

$$\text{GPA} = \frac{5,940 \times \text{GPM (Per Nozzle)}}{\text{MPH} \times \text{W}}$$

$$\text{GAL}/1000\text{FT}^2 = \frac{136 \times \text{GPM (Per Nozzle)}}{\text{MPH} \times \text{W}}$$

GPM – Gallons Per Minute

GPA – Gallons Per Acre

GAL/1000FT² – Gallons Per 1000 Square Feet

MPH – Miles Per Hour

W – Nozzle spacing (in inches) for broadcast spraying

– Spray width (in inches) for single nozzle, band spraying or boomless spraying

– Row spacing (in inches) divided by the number of nozzles per row for directed spraying

Nozzle Spacing

If the nozzle spacing on your boom is different than those tabulated, multiply the tabulated GPA coverages by one of the following factors.

20'	
OTHER SPACING (INCHES)	CONVERSION FACTOR
8	2.5
10	2
12	1.67
14	1.43
16	1.25
18	1.11
22	.91
24	.83
30	.66

Useful Formulas for Roadway Applications

$$\text{GPLM} = 60 \times \frac{\text{GPM}}{\text{MPH}} \quad \text{GPM} = \frac{\text{GPLM} \times \text{MPH}}{60}$$

GPLM = Gallons Per Lane Mile

Note: GPLM is not a normal volume per unit area measurement. It is a volume per distance measurement. Increases or decreases in lane width (swath width) are not accommodated by these formulas.

Measuring Travel Speed

Measure a test course in the area to be sprayed or in an area with similar surface conditions. Minimum lengths of 100 and 200 feet are recommended for measuring speeds up to 5 and 10 MPH, respectively. Determine the time required to travel the test course. To help ensure accuracy, conduct the speed check with a partially loaded (about half full) sprayer and select the engine throttle setting and gear that will be used when spraying. Repeat the above process and average the times that were measured. Use the following equation or the table at right to determine ground speed.

$$\text{Speed (MPH)} = \frac{\text{Distance (FT)} \times 60}{\text{Time (seconds)} \times 88}$$

Speeds

SPEED IN MPH	TIME REQUIRED IN SECONDS TO TRAVEL A DISTANCE OF:		
	100 Feet	200 Feet	300 Feet
1.0	68	136	205
1.5	45	91	136
2.0	34	68	102
2.5	27	55	82
3.0	23	45	68
3.5	19	39	58
4.0	17	34	51
4.5	15	30	45
5.0	14	27	41
5.5	—	25	37
6.0	—	23	34
6.5	—	21	31
7.0	—	19	29
7.5	—	18	27
8.0	—	17	26
8.5	—	16	24
9.0	—	15	23

30'	
OTHER SPACING (INCHES)	CONVERSION FACTOR
26	1.15
28	1.07
32	.94
34	.88
36	.83
38	.79
40	.75
42	.71
44	.68

40'	
OTHER SPACING (INCHES)	CONVERSION FACTOR
28	1.43
30	1.33
32	1.25
34	1.18
36	1.11
38	1.05
42	.95
44	.91
48	.83

Miscellaneous Conversion Factors

One Acre = 43,560 Square Feet
= 43.56 1000FT² Blocks
= 0.405 Hectare

One Hectare = 2.471 Acres

One Gallon Per Acre

= 2.9 Fluid Ounces per 1000FT²
= 9.35 Liters Per Hectare

One Gallon Per 1000FT² = 43.56 GPA

One Mile = 5,280 Feet
= 1,610 Meters
= 1.61 Kilometers

One Gallon = 128 Fluid Ounces
= 8 Pints
= 4 Quarts
= 3.79 Liters
= 0.83 Imperial Gallon



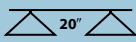
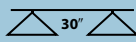
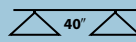
One Pound Per Square Inch

= 0.069 bar
= 6.896 Kilopascals

One Mile Per Hour = 1.609 Kilometers Per Hour

Suggested Minimum Spray Heights

The nozzle height suggestions in the table below are based on the minimum overlap required to obtain uniform distribution. However, in many cases, typical height adjustments are based on a 1 to 1 nozzle spacing to height ratio. For example, 110° flat spray tips spaced 20 inches apart are commonly set 20 inches above the target.

	(Inches)			
				
TP, TJ	65°	22–24"	33–35"	NR*
TP, XR, TX, DG, TJ, AI, XRC	80°	17–19"	26–28"	NR*
TP, XR, DG, TT, TTI, TJ, DGTJ, AI, AIXR, AIC, XRC, TTJ, AITTJ	110°	16–18"	20–22"	NR*
FullJet®	120°	10–18"***	14–18"***	14–18"***
FloodJet® TK, TF, K, QCK, QCTF, 1/4TTJ	120°	14–16"***	15–17"***	18–20"***

* Not recommended.

** Nozzle height based on 30° to 45° angle of orientation (see page 24 of catalog).

*** Wide angle spray tip height is influenced by nozzle orientation. The critical factor is to achieve a double spray pattern overlap.

Technical Information

Spraying Liquids with a Density Other Than Water

Since all the tabulations in this catalog are based on spraying water, which weighs 8.34 lbs. per USA gallon, conversion factors must be used when spraying liquids that are heavier or lighter than water. To determine the proper size nozzle for the liquid to be sprayed, first multiply the desired GPM or GPA of liquid by the water rate conversion factor. Then use the new converted GPM or GPA rate to select the proper size nozzle.

Example:

Desired application rate is 20 GPA of 28%N. Determine the correct nozzle size as follows:

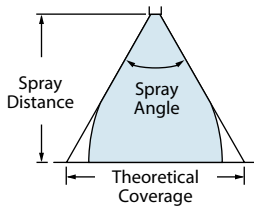
$$\begin{aligned} &\text{GPA (liquid other than water)} \times \\ &\text{Conversion Factor} \\ &= \text{GPA (from table in catalog)} \\ &20 \text{ GPA (28\%)} \times 1.13 \\ &= 22.6 \text{ GPA (water)} \end{aligned}$$

The applicator should choose a nozzle size that will supply 22.6 GPA of water at the desired pressure.

WEIGHT OF SOLUTION	SPECIFIC GRAVITY	CONVERSION FACTOR
7.0 lbs./gal.	.84	.92
8.0 lbs./gal.	.96	.98
8.34 lbs./gal.	1.00 – WATER	1.00
9.0 lbs./gal.	1.08	1.04
10.0 lbs./gal.	1.20	1.10
10.65 lbs./gal.	1.28 – 28% nitrogen	1.13
11.0 lbs./gal.	1.32	1.15
12.0 lbs./gal.	1.44	1.20
14.0 lbs./gal.	1.68	1.30

Spray Coverage Information

This table lists the theoretical coverage of spray patterns as calculated from the included spray angle of the spray and the distance from the nozzle orifice. These values are based on the assumption that the spray angle remains the same throughout the entire spray distance. In actual practice, the tabulated spray angle does not hold for long spray distances.

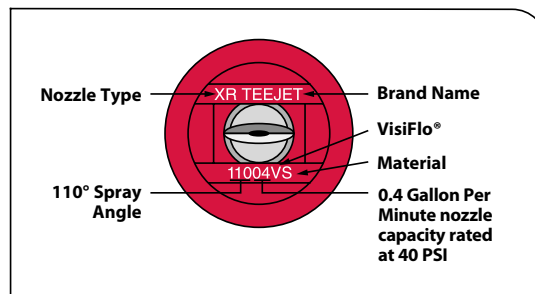


INCLUDED SPRAY ANGLE	THEORETICAL COVERAGE AT VARIOUS SPRAY HEIGHTS (IN INCHES)							
	8"	10"	12"	15"	18"	24"	30"	36"
15°	2.1	2.6	3.2	3.9	4.7	6.3	7.9	9.5
20°	2.8	3.5	4.2	5.3	6.4	8.5	10.6	12.7
25°	3.5	4.4	5.3	6.6	8.0	10.6	13.3	15.9
30°	4.3	5.4	6.4	8.1	9.7	12.8	16.1	19.3
35°	5.0	6.3	7.6	9.5	11.3	15.5	18.9	22.7
40°	5.8	7.3	8.7	10.9	13.1	17.5	21.8	26.2
45°	6.6	8.3	9.9	12.4	14.9	19.9	24.8	29.8
50°	7.5	9.3	11.2	14.0	16.8	22.4	28.0	33.6
55°	8.3	10.3	12.5	15.6	18.7	25.0	31.2	37.5
60°	9.2	11.5	13.8	17.3	20.6	27.7	34.6	41.6
65°	10.2	12.7	15.3	19.2	22.9	30.5	38.2	45.8
73°	11.8	14.8	17.8	22.0	27.0	36.0	44.0	53.0
80°	13.4	16.8	20.2	25.2	30.3	40.3	50.4	60.4
85°	14.7	18.3	22.0	27.5	33.0	44.0	55.4	66.4
90°	16.0	20.0	24.0	30.0	36.0	48.0	60.0	72.0
95°	17.5	21.8	26.2	32.8	40.3	52.4	65.5	78.6
100°	19.1	23.8	28.6	35.8	43.0	57.2	71.6	85.9
110°	22.8	28.5	34.3	42.8	51.4	68.5	85.6	103
120°	27.7	34.6	41.6	52.0	62.4	83.2	104	
130°	34.3	42.9	51.5	64.4	77.3	103		
140°	43.8	54.8	65.7	82.2	98.6			
150°	59.6	74.5	89.5					

Nozzle Nomenclature

There are many types of nozzles available, with each providing different flow rates, spray angles, droplet sizes and patterns. Some of these spray tip characteristics are indicated by the tip number.

Remember, when replacing tips, be sure to purchase the same tip number, thereby ensuring your sprayer remains properly calibrated.



Information About Spray Pressure

Flow Rate

Nozzle flow rate varies with spraying pressure. In general, the relationship between GPM and pressure is as follows:

$$\frac{GPM_1}{GPM_2} = \frac{\sqrt{PSI_1}}{\sqrt{PSI_2}}$$

This equation is explained by the illustration to the right. Simply stated, in order to double the flow through a nozzle, the pressure must be increased four times.

Higher pressure not only increases the flow rate through a nozzle, but it also influences the droplet size and the rate of orifice wear. As pressure is increased, the droplet size decreases and the rate of orifice wear increases.

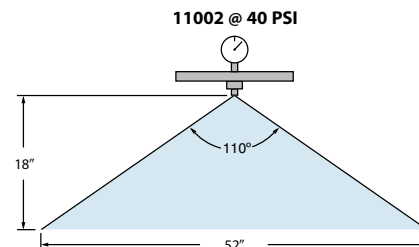
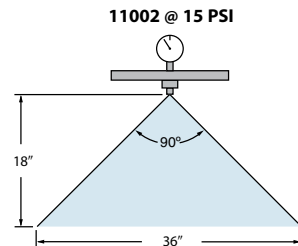
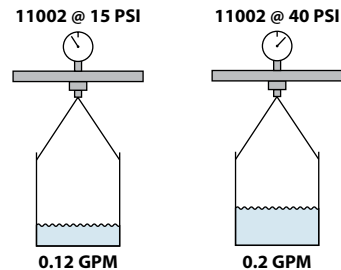
The values given in the tabulation sections of this catalog indicate the most commonly used pressure ranges for the associated spray tips. When information on the performance of spray tips outside of the pressure range given in this catalog is required, contact TeeJet Technologies or your local rep.

Spray Angle and Coverage

Depending on the nozzle type and size, the operating pressure can have a significant effect on spray angle and quality of spray distribution. As shown here for an 11002 flat spray tip, lowering the pressure results in a smaller spray angle and a significant reduction in spray coverage.

Tabulations for spray tips in this catalog are based on spraying water. Generally, liquids more viscous than water produce relatively smaller spray angles, while liquids with surface tensions lower than water will produce wider spray angles. In situations where the uniformity of spray distribution is important, be careful to operate your spray tips within the proper pressure range.

Note: Suggested minimum spray heights for broadcast spraying are based upon nozzles spraying water at the rated spray angle.



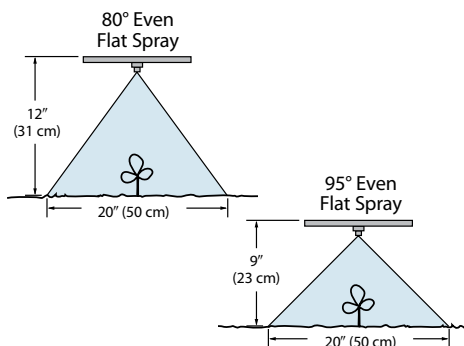
Pressure Drop Through Various Hose Sizes

FLOW IN GPM	PRESSURE DROP IN PSI (10' [3 m] LENGTH WITHOUT COUPLINGS)				
	¼" I.D.	⅜" I.D.	½" I.D.	¾" I.D.	1" I.D.
0.5	1.4	.2			
1.0		.7			
1.5		1.4	.4		
2.0		2.4	.6		
2.5		3.4	.9		
3.0			1.2		
4.0			2.0		
5.0			2.9	.4	
6.0			4.0	.6	
8.0				.9	.3
10.0				1.4	.4

Helpful Reminders for Band Spraying

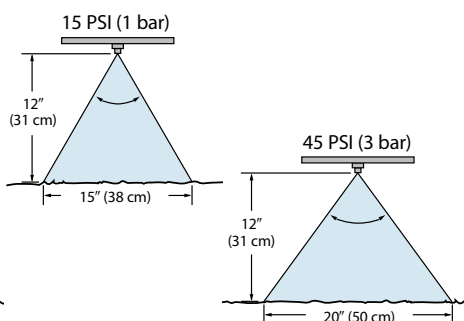
Wider angle spray tips allow the spray height to be lowered to minimize drift.

Example:



The spray angle of the nozzle and the resulting band width are directly influenced by the spraying pressure.

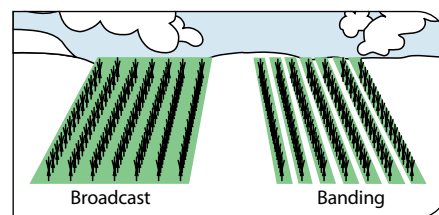
Example: 8002E Even Flat Spray



Use care when calculating:
Field Acres/Hectares vs. Treated Acres/Hectares

Field Acres/Hectares = Total Acres/Hectares of Planted Cropland

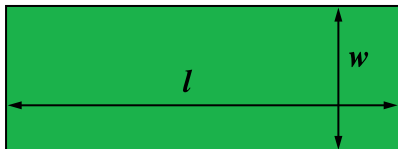
Treated Acres/Hectares =
Field Acres/Hectares X Band Width
Row Spacing



Area Measurement

It is essential to know the amount of area that you intend to cover when applying a pesticide or fertilizer. Turf areas such as home lawns and golf course greens, tees and fairways should be measured in square feet or acres, depending upon the units needed.

Rectangular Areas



Area = Length (l) x Width (w)

Example:

What is the area of a lawn that is 300 feet long and 150 feet wide?

$$\begin{aligned} \text{Area} &= 300 \text{ feet} \times 150 \text{ feet} \\ &= 45,000 \text{ square feet} \end{aligned}$$

By using the following equation, it is possible to determine the area in acres.

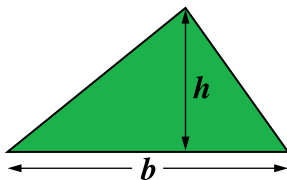
$$\text{Area in acres} = \frac{\text{Area in square feet}}{43,560 \text{ sq. ft. per acre}}$$

(There are 43,560 square feet in an acre.)

Example:

$$\begin{aligned} \text{Area in acres} &= \frac{45,000 \text{ sq. ft.}}{43,560 \text{ sq. ft. per acre}} \\ &= 1.03 \text{ acres} \end{aligned}$$

Triangular Areas



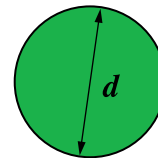
$$\text{Area} = \frac{\text{Base } (b) \times \text{Height } (h)}{2}$$

Example:

The base of a corner lot is 250 feet while the height is 50 feet. What is the area of the lot?

$$\begin{aligned} \text{Area} &= \frac{250 \text{ feet} \times 50 \text{ feet}}{2} \\ &= 6,250 \text{ square feet} \\ \text{Area in acres} &= \frac{6,250 \text{ square feet}}{43,560 \text{ sq. ft. per acre}} \\ &= 0.14 \text{ acre} \end{aligned}$$

Circular Areas



$$\text{Area} = \frac{\pi \times \text{Diameter}^2 (d)}{4}$$

$$\pi = 3.14159$$

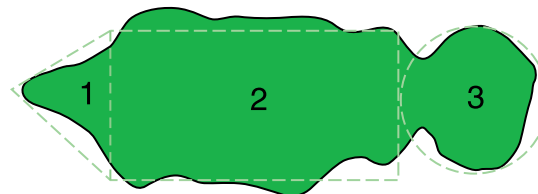
Example:

What is the area of a green that has a diameter of 45 feet?

$$\begin{aligned} \text{Area} &= \frac{\pi \times (45 \text{ feet})^2}{4} = \frac{3.14 \times 225}{4} \\ &= 1,590 \text{ square feet} \end{aligned}$$

$$\begin{aligned} \text{Area in acres} &= \frac{1,590 \text{ square feet}}{43,560 \text{ sq. ft. per acre}} \\ &= 0.04 \text{ acre} \end{aligned}$$

Irregular Areas



Any irregularly shaped turf area can usually be reduced to one or more geometric figures. The area of each figure is calculated and the areas are then added together to obtain the total area.

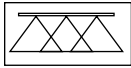
Example:

What is the total area of the Par-3 hole illustrated above?

The area can be broken into a triangle (area 1), a rectangle (area 2) and a circle (area 3). Then use the previously mentioned equations for determining areas to find the total area.

$$\begin{aligned} \text{Area 1} &= \frac{25 \text{ feet} \times 30 \text{ feet}}{2} = 375 \text{ square feet} \\ \text{Area 2} &= 25 \text{ feet} \times 475 \text{ feet} = 11,875 \text{ square feet} \\ \text{Area 3} &= \frac{3.14 \times (45 \text{ feet})^2}{4} = 1,590 \text{ square feet} \\ \text{Total Area} &= 375 + 11,875 + 1,590 = 13,840 \text{ square feet} \\ &= \frac{13,840 \text{ square feet}}{43,560 \text{ sq. ft. per acre}} = 0.32 \text{ acre} \end{aligned}$$

Sprayer Calibration



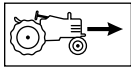
Broadcast Application

Sprayer calibration (1) **readies your sprayer for operation** and (2) **diagnoses tip wear**. This will give you optimum performance of your TeeJet® tips.

Equipment Needed:

- TeeJet Calibration Container
- Calculator
- TeeJet Cleaning Brush
- One new TeeJet Spray Tip matched to the nozzles on your sprayer
- Stopwatch or wristwatch with second hand

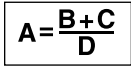
STEP NUMBER 1



Check Your Tractor/Sprayer Speed!

Knowing your real sprayer speed is an essential part of accurate spraying. Speedometer readings and some electronic measurement devices can be inaccurate because of wheel slippage. Check the time required to move over a 100- or 200-foot strip on your field. Fence posts can serve as permanent markers. The starting post should be far enough away to permit your tractor/sprayer to reach desired spraying speed. Hold that speed as you travel between the “start” and “end” markers. Most accurate measurement will be obtained with the spray tank half full. Refer to the table on page 124 to calculate your real speed. When the correct throttle and gear settings are identified, mark your tachometer or speedometer to help you control this **vital** part of accurate chemical application.

STEP NUMBER 2



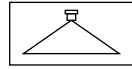
The Inputs

Before spraying, record the following:

	EXAMPLE
Nozzle type on your sprayer.	TT11004 Flat
(All nozzles must be identical)	Spray Tip
Recommended application volume20 GPA
(From manufacturer’s label)	
Measured sprayer speed6 MPH
Nozzle spacing.20 Inches



STEP NUMBER 3



Calculating Required Nozzle Output

Determine GPM nozzle output from formula.

$$\text{FORMULA: GPM} = \frac{\text{GPA} \times \text{MPH} \times \text{W}}{5,940 \text{ (constant)}}$$

$$\text{EXAMPLE: GPM} = \frac{20 \times 6 \times 20}{5,940} = \frac{2,400}{5,940}$$

ANSWER: 0.404 GPM

STEP NUMBER 4



Setting the Correct Pressure

Turn on your sprayer and check for leaks or blockage. Inspect and clean, if necessary, all tips and strainers with TeeJet brush. Replace one tip and strainer **with an identical new tip and strainer** on sprayer boom.

Check appropriate tip selection table and determine the pressure required to deliver the nozzle output calculated from the formula in Step 3 for your new tip. Since all of the tabulations are based on spraying water, conversion factors must be used when spraying solutions that are heavier or lighter than water (see page 125).

Example: (Using above inputs) refer to TeeJet table on page 5 for TT11004 flat spray tip. The table shows that this nozzle delivers 0.40 GPM at 40 PSI.

Turn on your sprayer and adjust pressure. **Collect and measure the volume of the spray from the new tip for one minute in the collection jar.** Fine tune the pressure until you collect .40 GPM.

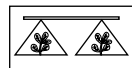
You have now adjusted your sprayer to the proper pressure. It will properly deliver the application rate specified by the chemical manufacturer at your measured sprayer speed.

STEP NUMBER 5



Checking Your System

Problem Diagnosis: Now, check the flow rate of a few tips on each boom section. If the flow rate of any tip is 10 percent greater or less than that of the newly installed spray tip, recheck the output of that tip. If only one tip is faulty, replace with new tip and strainer and your system is ready for spraying. However, if a second tip is defective, **replace all tips on the entire boom**. This may sound unrealistic, but two worn tips on a boom are ample indication of tip wear problems. Replacing only a couple of worn tips invites potentially serious application problems.



Banding and Directed Applications

The only difference between the above procedure and calibrating for banding or directed applications is the input value used for “W” in the formula in Step 3.

For single nozzle banding or boomless applications:

$$W = \text{Sprayed band width or swath width (in inches).}$$

For multiple nozzle directed applications:

$$W = \text{Row spacing (in inches) divided by the number of nozzles per row.}$$