

**Chapter 7.  
Equipment Calibration for  
Right-of-Way Vegetation Management**

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## **Chapter 7. Equipment Calibration for Right-of-Way Vegetation Management**

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Calibration is the process of measuring and adjusting the amount of chemical your equipment delivers to a target area. Measurement is either collecting or predicting the amount of spray solution your machinery will spray in a period of time. Adjustments in application speed, nozzles, pressure or herbicide concentration are made so the applied amount is the correct amount.

### **MEASUREMENT PHASE**

There are a number of ways to calibrate equipment. One way is by the volume/area method to determine gallons of solution applied per acre. Start with a full tank and travel over some measured distance, a treatment area of known size. After measuring the amount of water needed to refill the tank, the gallons applied per acre can be accurately calculated. The second option is the time/volume method. Hold a container under the nozzle and collect the output for a given amount of time. From this it is possible to determine the gallons applied per minute. Gallons per acre can be estimated by knowing the width of the spray swath and the speed of application. Both of those methods can be used to determine the desired application rate and how to adjust the equipment to achieve the desired rate.

#### **Speed**

Speed and solution output are inversely related. If you increase speed, then output decreases. Conversely, if you slow down, output increases.

#### **Nozzles**

Changing nozzles is a direct relationship for an application rate change. The larger the orifice the more material will be applied. A smaller orifice will apply less material.

#### **Pressure**

Output also depends on pressure. Changing pressure will influence application rate but only by a small margin. It is the least effective way to change application rate. Raise the pressure to apply more material and lower it to spray less. Increasing pressure may also increase drift potential.

### Concentration

Adjustments can also be made in the concentration of the herbicide in the tank. Increasing or decreasing the amount of product in the tank is an effective way of achieving a desired application rate.

### ARITHMETIC PHASE

Measurements and adjustments are critical to proper calibration and application. Adjustments can be made in several ways. Separate from that is the arithmetic supporting calibration. The first one is working with the equipment and the second one is working with the calculator, pencil, and paper. Improper calibration can often occur with arithmetic errors following the measurement phase. The calculations usually involve three findings: 1) how big is the area to be treated, 2) how much a full tank can cover, and 3) how much product to put in the tank. The arithmetic required can be done in a variety of ways. The calculations provided are some simple methods to properly calibrate herbicide applications.

### Area

**Problem 1.** How many acres are there in an area 1,135 ft long by 460 ft wide? (1 acre = 43,560 ft<sup>2</sup>)

Area = length multiplied by the width. Multiplying 1,135 ft by 460 ft, the area covered is 522,100 square feet (ft<sup>2</sup>). This needs to be converted to acres. One acre is equal to 43,560 ft<sup>2</sup>. Dividing 522,100 ft<sup>2</sup> by 43,560 ft<sup>2</sup> per acre, the total area is 11.98 acres.

**Problem 2:** How many acres are treated on a right-of-way 32 miles by long by 16 feet wide? (1 mile = 5,280 feet)

Solution 1: Convert 32 miles to ft (32 x 5,280 = 168,960 ft) and multiply it by 16 ft wide, divide the total (2,703,360 ft<sup>2</sup>) by the acre conversion number (43,560 ft<sup>2</sup>) to get acres (62.1 acres).

Solution 2: As a rule of thumb, an 8-foot swath one mile long equals one acre (16 ft by one mile = 2 acres and so on). So 32 miles times two 8-foot swaths is 2 times 32, which equals 64 acres (approximately).

### Application Rate (Gallons per Acre)

**Problem 3:** If you applied 1,600 gallons of spray to 64 acres, what is the application rate in gallons per acre?

To calculate this, divide 1,600 gallons of spray solution by 64 acres, which equals 25 gallons per acre (gpa).

### Application Rate (Product per Acre)

**Problem 4:** The product label calls for 2 lb of product to be applied per acre. How much product would be required to treat 64 acres?

64 acres (x) 2 lb per acre = 128 pounds

**Problem 5.** If you treat 0.8 acre with 180 pounds of a granular herbicide, how many pounds of product did you apply to one acre?

If 180 pounds of herbicide were applied per 0.8 acre, then 180 pounds divided by 8 will give the amount applied per 1/10 of an acre or 22.5 pounds. Multiply 22.5 pounds by 10 to get the amount for a full acre, 225 pounds of herbicide.

### Product per Tank

**Problem 6.** The sprayer has a tank of 2,400 gallons and it is calibrated to apply 40 gallons of solution per acre. The program calls for Oust at a rate of 3 oz per acre and Roundup at 2 qt per acre.

- A. How many acres can be treated with a full tank?
- B. How much Oust should be added to a full tank of spray solution?
- C. How much Roundup needs to be added to a full tank of spray solution?

Part A. How many acres can you treat with a full tank?

The spray tank holds 2,400 gallons and every acre needs to have 40 gallons of solution applied to it. Every 40 gallons equals an acre. Dividing the tank capacity (2,400 gallons) by the gallons applied per acre (40), you determine that you can apply a full tank to 60 acres.

Part B. How much Oust needs to be added to mix a full tank of spray solution?

Since you can apply a full tank to 60 acres and you are using 3 oz of herbicide per acre, you will need 3 oz per acre times 60 acres or 180 total oz of Oust. Since Oust is a dry product, to convert ounces to pounds, divide 180 oz by 16 oz per pound. You will have to add 11.25 lb of Oust to the full tank of 2,400 gallons.

Part C. How much Roundup needs to be added to mix a full tank of spray solution?

You are adding 2 qt per acre for 60 acres for a total of 120 qt of Roundup. To convert quarts to gallons divide the 120 qt of Roundup by 4, since there are 4 qt in a gallon, which is 30 gallons of Roundup.

### Percent Solution

**Problem 7.** How many gallons of surfactant would you add to a 1,500-gallon tank at the use rate of  $\frac{1}{4}\%$ ?

Adjuvants are usually mixed or expressed as “percent solution.” One percent is equal to a part per hundred and is usually expressed as a decimal equivalent.

$$50\% = (50 \text{ divided by } 100) = 0.50$$

$$25\% = (25 \text{ divided by } 100) = 0.25$$

$$10\% = (10 \text{ divided by } 100) = 0.10$$

$$5\% = (5 \text{ divided by } 100) = 0.05$$

$$1\% = (1 \text{ divided by } 100) = 0.01$$

$$\frac{1}{2}\% = (\frac{1}{2} \text{ or } 0.5 \text{ divided by } 100) = 0.005$$

$$\frac{1}{4}\% = (\frac{1}{4} \text{ or } 0.25 \text{ divided by } 100) = 0.0025$$

In this problem take the  $\frac{1}{4}\%$  (0.25) and divide it by 100 to get the decimal equivalent (0.0025). Multiply 0.0025 times the gallons in the tank, 1,500 gal, and you will need 3.75 gal of surfactant to add to the tank.

**Problem 8.** You are preparing for a high volume application of a 1% spray solution with a 400-gallon tank. The instructions are to “spray to wet.” How much product should you add to the tank?

One percent of 400 gallons is 4 gallons ( $400 \times 0.01 = 4$ ). Therefore you need to add 4 gallons of product to the tank as it is filling.

**Problem 9.** A low volume application is to be made with a 5-gallon backpack sprayer applying a 12% spray solution. How much product would be added to the tank?

Five gallons multiplied by 12% (0.12) equal 0.6 gallons ( $5 \times 0.12 = 0.6$ ).

### Rate Per 100 Gallons

**Problem 10.** Your label instructs you to use 5 oz of surfactant per 100 gallons of mixed solution. How many quarts of surfactant will be required for a 1,500-gallon tank?

(16 fluid oz = 1 pint; 32 fluid oz = 1 quart; 128 fluid oz = 1 gal)

If you have a 1,500-gallon tank you simply need to divide this number by 100 and then multiply the answer by 5 oz. Thus, 15 multiplied by 5 oz gives 75 oz of surfactant in a 1,500-gallon tank. To convert this into quarts divide 75 oz by 32 oz per quart. The amount of surfactant to add to the 1,500 gallons is 2.3 quarts.

### Altering Speed and Output

**Problem 11.** If a sprayer applies 30 gal per acre (gpa), and is traveling at 10 miles per hour, how many gallons would be applied at 15 miles per hour?

Since speed and output are inversely related, increasing one decreases the other, the formula

$$\text{Old Rate} \times \text{Old Speed} = \text{New Rate} \times \text{New Speed}$$

can be used to calculate the answer. Use the known variables, such as speed and output (rate), and then divide them by the new variables trying to be found. Multiply the original speed (10 mph) and original output (30 gpa) and divide by the new speed (15 mph) to arrive at the new output rate of 20 gallons per acre. The equation would read:

$$(10 \text{ mph}) \times (30 \text{ gpa}) \text{ divided by } (15 \text{ mph}) = (20 \text{ gpa}) \text{ the new rate.}$$

If speed increases the gallons applied per acre must decrease.

**Problem 12.** A sprayer is applying 40 gallons per acre at 12 mph, how many gallons per acre would be applied at a new speed of 10 mph?

When speed is decreased, output must increase. Using the same formula as the previous problem, the original values of 40 gpa at 12mph would be equal to the new values of 10 mph at 48 gpa. The new application rate will increase since the equipment is going slower.

$$(12 \text{ mph}) \times (40 \text{ gpa}) \text{ divided by } (10 \text{ mph}) = (48 \text{ gpa}) \text{ the new rate.}$$

**Problem 13.** A sprayer is applying 20 gallons per acre at 12 mph. How fast would it have to travel to apply 30 gallons per acre?

As with the previous problem, the gallons per acre are increasing, consequently the mph must decrease. The product of the original speed and output (20 gpa X 12 mph = 240) divided by the new output (30 gpa) will give the new speed, which is 8 mph.

$$(12 \text{ mph}) \times (20 \text{ gpa}) = (8 \text{ mph}) \times (30 \text{ gpa})$$

### Partial Tank

**Problem 14.** The sprayer is applying 40 gallons of spray solution per acre and the tank size is 2,200 gal. The mix is Karmex at 6 lb per acre. To refill the sprayer when there is 300 gal of solution left in the tank, how much Karmex do you have to add to refill?

A full tank is 2,200 gallons but there are 300 gallons left. As a result, you only need to add 1,900 gallons to fill the tank (2,200 – 300 = 1,900). The 1,900 gallons of fresh water divided by 40 gal per acre solution rate = 47.5, which is the amount of acres that will each need to have 6 lb of Karmex. 47.5 acres times 6 lb of Karmex for each acre equals 285 lb of Karmex that needs to be added before the tank is completely filled with the 1,900 gal of fresh water.

### Pump Capacity

**Problem 15.** How many gallons per minute must a pump supply to apply 30 gallons per acre when treating a 16 ft swath at 12 miles per hour?

To calculate gallons per minute first determine how many minutes it takes, traveling at 12 miles per hour, to go one mile. This can be determined by dividing 60 minutes per hour by 12 miles per hour, which is equal to 5 minutes per mile. Next, determine how many acres were covered in one mile of right-of-way treating a 16 ft swath. One mile of right-of-way with an 8-foot swath is equal to one acre. Consequently, one mile with a 16-foot swath is 2 acres. The only other

calculation required is to determine how many gallons to apply over the two acres. Since you already know that 30 gallons will be applied on one acre, then 60 gallons will be applied to 2 acres. Because 2 acres are covered per mile and one mile takes 5 minutes to cover, then 60 gallons will be applied every 5 minutes. By dividing 60 gallons by 5 minutes the gallons applied per minute will be 12, the minimum pump capacity that must be used to make a proper application.

### **SUMMARY**

To properly calibrate the amount of material to apply to a given area, it is important to know a couple of formulas. For example, a one-mile strip of an 8-foot swath is equal to one acre. In another example, the original output times the speed is equal to the new output times the new speed. With some simple basics on how to properly calibrate equipment and calculate the proper amount of herbicide to add to a tank, potential over- or under-applications can be avoided and effective weed control can be achieved. Knowing how your equipment is calibrated, how to make adjustments to it for accurate calibration, and how to figure the amounts of acres and chemical requirements are the most important concepts to learn. Minor amounts of application error may seem unimportant when looking at a single nozzle output, but when multiplied by numerous nozzles on a boom and by numerous miles of treatment, the error can be tremendous at the end of a day, week, or job, if not corrected.

**Chapter 7 Example Test Questions**

1. How many acres are in an area 24 ft wide and 12 miles long?
  - A. 12
  - B. 24
  - C. 36
  - D. 48
  
2. If you applied 1,200 gallons of spray solution to 50 acres, what was the application rate in gallons per acre?
  - A. 12
  - B. 24
  - C. 36
  - D. 48
  
3. If the product is to be applied at 3 ounces per acre and you are to treat 75 acres, how many pounds of herbicide will you apply?
  - A. 8
  - B. 10
  - C. 12
  - D. 14
  
4. The sprayer has a tank of 1,200 gallons and is calibrated to apply 30 gallons per acre. How many acres will a full tank treat?
  - A. 40
  - B. 60
  - C. 80
  - D. 100
  
5. How many gallons of surfactant would you add to an 800-gallon tank at the use rate of  $\frac{1}{4}\%$ ?
  - A. 0.25
  - B. 1.67
  - C. 2.00
  - D. 3.25
  
6. How much product would be added to a 3.4-gallon tank to have a 15% spray solution?
  - A. 0.1
  - B. 0.5
  - C. 1.1
  - D. 2.0
  
7. If a sprayer applies 40 gpa while traveling 8 mph, how many gpa would be applied at 12 mph?
  - A. 12.8
  - B. 16.4
  - C. 22.3
  - D. 26.7

8. A sprayer is applying 12 gallons per acre at 15 miles per hour. At what speed would it apply 30 gallons per acre?
  - A. 2
  - B. 4
  - C. 6
  - D. 8
  
9. How many gallons per minute must a pump supply to apply 24 gallons per acre when treating an 8 ft swath at 10 miles per hour?
  - A. 4
  - B. 6
  - C. 8
  - D. 12
  
10. You are applying 30 gallons of spray solution per acre from a 2700 gallon spray tank using Herbicide A at a rate of 5 pounds per acre. When you stop for water you still have 300 gallons of spray solution left in the tank. How much more Herbicide A has to be added to refill the tank?
  - A. 120
  - B. 160
  - C. 200
  - D. 400

Answers:

- |      |      |      |      |       |
|------|------|------|------|-------|
| 1. C | 3. D | 5. C | 7. D | 9. A  |
| 2. B | 4. A | 6. B | 8. C | 10. D |