Calibration & Safety of Pesticide Application Equipment Seminar

Calibration Formulas Workbook
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Pesticide Application Technician Seminar
Calibration & Safety of Pesticide Application Equipment

Calibration accuracy and personal safety associated with pesticide application is key to a successful pesticide program.

This seminar will provide participants with a good understanding of sprayer & spreader formulas and application systems used in the turf industry. Topics for discussions will include Importance of Accurate Calibration, Nozzle Types and Sizing, Tank Mixing, Spray System Troubleshooting, Boomless Sprayer Calibration, Spreader Calibration and Personal & Environmental Safety.

**Calibration Formulas and Safety Information**
- Nozzle Uniformity and Boom Sprayer Calibration
- Nozzle Types and Sizing
- Boom Sprayer Calibration: Known Area Method
- Easy Method Sprayer Calibration (128th Acre Test)
- Tank Mixing
- Calibration: Advanced Section Worksheet
- Lawn Guns, Backpacks and Boomless Sprayer Calibration
- Spreader Calibration: Known Area Method
- Personal & Environmental Safety
- Tank Cleaning and Product Dilution Ratio
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NOZZLE UNIFORMITY AND CALIBRATION WORKSHEET

DATE _____________________

NOZZLE CODE = ___________________ PRESSURE = ___________

(Volume Conversion) NOZZLE DECIMAL OUTPUT X 128 = _______ OUNCES

NOZZLE CATCH TIME IN SECONDS = __________

#1 ___________ #5 ___________ #9 ___________
#2 ___________ #6 ___________ #10 __________
#3 ___________ #7 ___________ #11 __________
#4 ___________ #8 ___________ #12 __________

AVERAGE OUTPUT ___________ OUNCES

AV. OP. X 0.95 = ___________ (-5%) AV. OP. X 1.05 = ___________ (+5%)

CLEAN OR REPLACE NOZZLE NOT WITHIN 5% OF AVERAGE, REPLACE ALL IF TWO OR MORE ARE WORN.

GALLONS PER MINUTE = _______ Ozs. X 60 = ___________ = _____ (GPM)
Sec. X 128

VEHICLE SPEED = .682 X _______ Ft. = ___________ = _______ (MPH)
Seconds

NOZZLE SPACING IN INCHES = ___________ (W)

CALIBRATION RATE IN = 136.36 X GPM = ___________ = _______ (GPK)
GALLONS PER 1,000 Sq. Ft. MPH X W

(To Calculate Gallons per Acre: Substitute 136.36 with 5,940)
or

Multiply GPK X 43.56 = ___________ (GPA) Gallons per Acre

ACCEPTABLE ERROR RANGE = GPK (GPA) X 0.95 = ___________ (-5%)
(Target Area vs Sprayed Area)

GPK (GPA) X 1.05 = ___________ (+5%)
Nozzle Uniformity, Speed Calculator and Application Rate

1. Enter date, nozzle code and sprayer operating pressure in appropriate box. Verify that all nozzles are the same type and size along the boom.

2. Catch the flow from each nozzle for exactly the same amount of time. The number of seconds used is usually between 20 and 60, but make sure that at least 20 ounces are collected in each calibration jar (to help reduce error size). It is very important to maintain a constant operating pressure throughout the entire operation. Enter catch times in appropriate boxes.

3. Calculate average nozzle output.

4. Determine if any nozzles are significantly worn or clogged by verifying that all flow rates are within + or - % of the average nozzle output. (Typically between 5% to 10% limit)

5. Clean, replace or recheck nozzles exceeding the predetermined limit.

Speed Calculator

1. Calculate field spraying speed of the machine by laying out a level test course at least 100 feet long (Use a turf area, not a parking lot or cart path). Fill machine ½ full of water to simulate average load and record the exact amount of seconds to travel entire course at operating speed. Use this data in the equation provided.

Application Rate

** GPM and Speed calculations should appear in appropriate boxes (from previous formulas).

1. Measure nozzle spacing in inches. Enter number (in inches) in box.

2. Calculate the calibration rate using the formula provided. Read the product label to determine if this calibration rate falls within guidelines.

Use manufacturer’s catalogue charts to help verify your calculations.
Target Area vs. Sprayed Area

Target Area Rate

Example: \( \text{100 Gallon Sprayer Tank} = 83,000 \text{ sq. ft. coverage} \)
\( 1.2 \text{ Target Area Rate (GPK)} \)

Acceptable Error Range (5%)

\[
1.2 \times 0.95 = 1.14 \text{ (-5%)} \\
1.2 \times 1.05 = 1.26 \text{ (+5%)}
\]

Sprayed Area Rate (-5% Error)

Example: 88,000 sq. ft. of coverage is achieved using 100 gallons of carrier at 1.2 Target Area Rate (GPK).

Actual Rate: \( \frac{100}{88} = 1.136 \text{ (-5%)} \) less product and carrier applied

Sprayed Area Rate (+5% Error)

Example: 79,000 sq. ft. of coverage is achieved using 100 gallons of carrier at 1.2 Target Area Rate (GPK).

Actual Rate: \( \frac{100}{79} = 1.265 \text{ (+5%)} \) more product and carrier applied
## SPEED CHART

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<thead>
<tr>
<th>Seconds per 100'</th>
<th>FPM</th>
<th>MPH</th>
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**SOURCE:** \( \frac{682 \times \text{FEET (DISTANCE)}}{\text{SECONDS (TIME)}} = \text{MPH} \)

\( \frac{\text{MPH} \times 5280}{60} = \text{FPM} \)
**NOZZLE SELECTION AND SIZING WORKSHEET**

*DATE _____________________*

RECOMMENDED CALIBRATION RATE (CR) = ___________ GALLONS Per 1,000 Sq. Ft.  
(Refer To Product Label)

NOZZLE SPACING (W) = ___________ (INCHES BETWEEN NOZZLES)

VEHICLE SPEED (MPH) = ___________ (FIELD SPRAYING SPEED)

NOZZLE CODE = ___________ (FROM CATALOG CHART)

NOZZLE HEIGHT = ___________ (INCHES FROM TURF)

GALLONS PER MINUTE = \( \frac{CR \times MPH \times W}{136.36} \) = ___________ = _______ (GPM)

NOZZLE RANGE ACCEPTABILITY:  
GPM X .95 = -5% ___________

GPM X 1.05 = +5% ___________

**REFER TO NOZZLE CHART FOR SIZING OPTIONS**

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<th>NOZZLE SIZE &amp; CODE</th>
<th>PSI</th>
<th>GPM</th>
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<td>3.</td>
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Nozzle Selection and Sizing

1. Determine the recommended calibration rate. (Refer to product label.)

2. Measure nozzle spacing in inches.

3. Determine the spraying speed you will be using in the field.

4. Determine the appropriate nozzle size from manufacturer's charts.

5. Calculate the nozzle flow rate necessary to achieve the desired calibration rate with the sprayer.

6. Use nozzle manufacturer's catalogue to determine the nozzle identification code that corresponds to the nozzle style and flow rate chosen for the equipment.

6. Follow nozzle manufacture’s recommendation for proper nozzle height.
Typical Nozzle Types

ÅFlat Fan
  ÅStandard / XR / Turbo
  ÅTwin Jet
  ÅAir Induction

ÅCone
  ÅWhirl-Hollow (Wide Angle)
  ÅFull-Solid (Wide Angle - Large Droplets)

ÅFlood
  ÅFlat Fan (Wide Angle - Large Droplets)
### NOZZLE PERFORMANCE DATA CHART

**NOZZLE TYPE:** TORO TURF JET  
**ANTI-DRIFT CHARACTERISTICS**  
**SPACING:** 20 INCHES  
**CALIBRATION RATE:** US GAL / 1,000 SQ FT

<table>
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<th>Orifice Size</th>
<th>Color Code</th>
<th>Operating Pressure</th>
<th>Nozzle Capacity</th>
<th>Calibration Rate at:</th>
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The manufacturer's suggested spray height for this particular nozzle is 20 - 24 inches at 20 inch spacing.  
The spray height and spacing create 280* - 300* percent spray pattern overlap from nozzle to nozzle.  
*Percent of spray pattern overlap is unique to specific nozzle types.

**Note:** Refer to the manufacturer's catalog for additional information on proper nozzle use and selection.
BOOM SPRAYER CALIBRATION
WORKSHEET: KNOWN AREA METHOD

DATE ___________

1. MEASURE AREA OF TEST COURSE:

   LENGTH = ________ FEET (USE AT LEAST 100 FEET)

   WIDTH = NOZZLE SPACING = ________ FEET

   LENGTH X WIDTH = ________ SQUARE FEET

2. MEASURE AMOUNT OF MATERIAL APPLIED OVER TEST COURSE:

   a. TIME TO TRAVEL TEST COURSE = ________ SECONDS

   b. NOZZLE CATCH TIME = COURSE TRAVEL TIME

      **AVERAGE NOZZLE OUTPUT = ______ OZS. X NOZZLES = ______ OZS.

      OUNCES = ________ = ________ GALLONS APPLIED
                 128

3. CALCULATE CALIBRATION RATE:

   GALLONS APPLIED = ________ X 1000 = ________ GALLONS PER 1,000
   SQUARE FEET

   GALLONS PER ACRE = GPK X 43.56 = ________ (GPA)

NOZZLE UNIFORMITY

1. ________ 5. ________ 9. ________
2. ________ 6. ________ 10. ________
3. ________ 7. ________ 11. ________
4. ________ 8. ________ 12. ________

   **AVERAGE OUTPUT = ________ OUNCES

      AV.OP. X .95 = ________ (-5%)

      AV.OP. X 1.05 = ________ (+5%)

DATA RECORD

   PSI_____________________
   NOZZLE__________________
   MACHINE_________________
   GEAR____________________
   RPM_____________________
   OTHER__________________

11
Boom Sprayer Calibration: Known Area Method

1. Measure a level test course at least 100 feet long on a turf area (not a parking lot or cart path). The width of this test course will be the spacing between each nozzle in feet.

   \[
   \text{Nozzle Spacing in Inches} = \frac{\text{Test Course Width in Feet}}{12}
   \]

   Total square feet of the area is Length X Width.

2. Fill machine 1/2 full of water to simulate average load and record the exact number of seconds to travel the entire test course at normal operating speed. Use a calibration jar to collect the flow from each nozzle for the same amount of time it took to cover the test course. Calculate the average nozzle output and replace or clean any nozzle with a flow rate not within 5% of the average.

   \[
   \text{Average Nozzle Flow in Ounces} = \frac{\text{Average Gallons Applied}}{128 \text{ Ounces per Gallon}}
   \]

3. Record all data for future use. Calculate your + or - 5% acceptable error range (Target Area vs Sprayed Area). Each time you use your sprayer, the calibration rate must fall within these values. Either repair or replace components causing calibration rate inaccuracy.

   TIPS: Check for wear more frequently when spraying wettable powders.

   Verify the accuracy of your measuring devices.
Easy Method Sprayer Calibration
(128\textsuperscript{th} Acre Test)

1. Fill spray tank with clean water.
2. Verify that spacing between nozzles is equal (record in inches).
3. Perform nozzle uniformity test.
4. Measure test course. (Use chart below or formula to determine course length) 
   \textbf{(Formula:} 4080 / Nozzle Spacing in Inches = Test Course in Feet) 
5. Drive the test course at your normal spraying speed and record travel time in seconds.
6. Park sprayer while maintaining the same engine RPM used to drive the test course.
7. Set pressure to be used while spraying.
8. Collect the output from one nozzle for the same amount of time it took to travel the course.
9. Each ounce collected equals a gallon per application rate.
   \textbf{(Example:} 52 ounces collected equals 52 gallon per acre application rate)

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\textbf{Formula:} 4080 / Nozzle Spacing in Inches = Test Course in Feet
TANK MIXING WORKSHEET

DATE_________________

PRODUCT NAME___________________________

PRODUCT LABEL RATE = ___________ OUNCES PER 1,000 SQUARE FEET

ACTUAL CALIBRATION RATE = _________ GALLONS PER 1,000 SQUARE FEET

PRODUCT PER = PRODUCT LABEL RATE = _________ OUNCES OF PRODUCT
GALLON CALIBRATION RATE _________ PER GALLON OF WATER

AREA TO BE SPRAYED (estimated) = ___________ 1,000 SQUARE FEET

TOTAL WATER REQUIRED = CALIBRATION RATE X AREA TO SPRAY = _________

TOTAL PRODUCT REQUIRED = PRODUCT RATE X AREA TO SPRAY = _________

***********************************************************************

PRODUCT IN TANK #1 = GALLONS OF WATER X PRODUCT PER GALLON

(If Required, Calculate Additional Tank Mixes)

PRODUCT IN TANK #2 = GALLONS OF WATER X PRODUCT PER GALLON
Tank Mixing

1. Determine the recommended application rate from the product label. This value can be in fluid or dry ounces.

2. Enter the calibration rate measured from the sprayer.

3. Calculate the product per gallon ratio according to the worksheet.

4. Calculate the amount of product required for each tank or partial tank. Before adding product, you should fill the tank 1/2 full of water and begin agitation. After product's been added, bring tank up to desired level/volume.

For Planning Purposes,

It May Be Useful To Calculate the Following:

5. Estimate the area to be treated. This value will be slightly larger than actual green or fairway size due to overspray of irregular areas.

6. Estimate the total water requirements. You can use this figure to determine how many spray tanks the application will require.

7. Estimate the product requirements and check if supplies are adequate before mixing.

TIPS: Verify the markings on your spray tank for accuracy and use a dipstick or flow meter to measure partial tanks.

Do not mix more solution than is required for the operation.
Tank Mixing
Formulations and Mixing Order

- Emulsifiable Concentrates (EC or E)
- Soluble Powers (SP)
- Wettable Powders (WP)
- Flowables (F)
- Water Dispersible Granules (WDG or WG)
- Dusts (D), Baits (B), Granules (G), Pellets (P)
- Adjuvants (read pesticide label)

When mixing multiple chemicals together, always…
* Ensure chemicals are compatible (Product Label / Jar Test)
* Add multiple chemicals to tank mix in the specific sequence…

1-Wettable Powders, 2-Flowables, 3-Water Solubles,
4-Adjuvants, 5-Emulsifiable Concentrates
Pesticide Compatibility

• Read Product Label
  – Review formulation compatibility statements

• Jar Test
  – Use a 1-quart clear glass jar and add 1-pint of clear water
    • add 1-1/2 teaspoons for each pound per acre recommended of the wettable powder
    • followed by 1 teaspoon for each quart per acre recommended of the liquid pesticide
    • shake the jar and let it stand for 2-3 minutes
    • if pesticides are non-compatible;
      – products may separate and form layers or a greasy film will form in the mixing container

Note: In some cases a compatibility agent can be added to solve the problem
CALIBRATION:
ADVANCED SECTION WORKSHEET

DATE _____________

1. CALIBRATE THE MPH YOU NEED TO GET EXACTLY 2.0 GALLONS PER 1,000 SQUARE FEET.

2. CALCULATE THE GPM NEEDED FOR 2.0 GALLON PER 1,000 SQUARE FEET. DO YOU NEED TO SELECT A LARGER VOLUME NOZZLE?

3. CALCULATE THE ACTUAL NOZZLE PRESSURE.
(Refer to Nozzle Manufacture’s Flow Chart)

\[
\frac{GPM_1}{GPM_2} = \frac{\sqrt{PSI_1}}{\sqrt{PSI_2}}
\]
Instructions for the Advanced Section

You've measured the actual calibration rate of the sprayer. You want to spray a calibration rate of 2.0 gallons per 1000 square feet. Determine how to make the adjustments in question #1 and #2.

1. If you only want to change your sprayer speed to achieve the new calibration rate, how fast would you need to go?

\[ MPH = \frac{136.36 \times GPM}{CR \times W} \]

2. Instead of changing your speed to achieve a new calibration rate, you decide to change only nozzle flow. What is the new GPM? Do you need to select a larger nozzle or just change the pressure?

\[ GPM = \frac{CR \times MPH \times W}{136.36} \]

3. This is a useful method to calculate your actual nozzle operating pressure. The formula allows you to compare field measurements to nozzle performance charts. This calculation is used primarily to track the amount of pressure drop in your sprayer.

\[ GPM(1) = \text{Measured nozzle flow from sprayer. (Actual Catch)} \]

\[ GPM(2) = \text{Flow rate from nozzle performance chart.} \]

\[ PSI(1) = \text{Actual nozzle operating pressure. PSI(1) is X, the unknown value. Find X to solve the equation.} \]

\[ PSI(2) = \text{Nozzle pressure from chart that corresponds with GPM(2).} \]
LAWN GUNS, BACKPACKS and BOOMLESS SPRAYERS CALIBRATION WORKSHEET: KNOWN AREA METHOD

DATE _______________

1. MEASURE AREA OF TEST COURSE:

   LENGTH = _________ FEET

   WIDTH = _________ FEET

   LENGTH X WIDTH = _________ SQUARE FEET

2. MEASURE AMOUNT OF MATERIAL APPLIED OVER TEST COURSE:

   a. TIME TO TRAVEL TEST COURSE = _________ SECONDS

   b. NOZZLE OUTPUT (catch time-same as travel test course) = _________ OUNCES

      \[
      \text{OUNCES} = \frac{\text{_________}}{128} = \frac{\text{_________}}{128} \text{ GALLONS APPLIED}
      \]

3. CALCULATE CALIBRATION RATE:

      \[
      \frac{\text{GALLONS APPLIED}}{\text{SQUARE FEET}} = \frac{\text{_________}}{1000} = \frac{\text{_________}}{\text{GALLONS PER 1,000 SQUARE FEET (GPK)}}
      \]

      \[
      \text{GALLONS PER ACRE} = \text{GPK} \times 43.56 = \text{_________} (\text{GPA})
      \]

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<tr>
<th>USEFUL FORMULAS</th>
<th>DATA RECORD</th>
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<td>\text{PSI} ______________</td>
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<td>\text{GALLONS Per 1,000 Sq. Ft.} \times 43.56 = \frac{\text{GALLONS Per ACRE}}{\text{ACRE}}</td>
<td>\text{NOZZLE} ______________</td>
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<td>\text{SPRAYER} ______________</td>
<td>\text{OTHER} ______________</td>
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<td>\text{OTHER} ______________</td>
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Lawn Guns, Backpack and Boomless Sprayer Calibration

1. Pick a level turf area and mark a rectangular test course (length X width - square feet) of approximately:

   500 - 2,000 square feet for backpack sprayers and lawn guns.

   20,000 - 40,000 square feet for boomless sprayers.

2. Measure the exact amount of time to travel the test course under normal spraying conditions. Use a catch can or bag and calibration jar to measure nozzle flow in ounces from the machine for the same exact amount of time it took to cover the test course.

   \[
   \frac{\text{Ounces collected}}{128 \text{ Ounces per gallon}} = \text{Gallons applied over test course}
   \]

3. Calculate the calibration rate according to the worksheet and use it for tank mixing.

4. Record all data for future use.

TIPS:  
Maintain a constant operating speed and pressure throughout entire application.

Verify the accuracy of your measuring devices.

Calibrate your equipment at the same speed, pressure and overlap as you will use in the field.
SPREADER CALIBRATION WORKSHEET:
KNOWN AREA METHOD

DATE ________________

1. MEASURE AREA OF TEST COURSE:
   LENGTH = __________ FEET
   WIDTH = __________ FEET
   LENGTH X WIDTH = __________ SQUARE FEET

2. MEASURE AMOUNT OF MATERIAL APPLIED OVER TEST COURSE:
   MATERIAL WEIGHT PRIOR TO APPLICATION = __________ POUNDS
   MATERIAL WEIGHT AFTER APPLICATION = __________ POUNDS
   TOTAL AMOUNT OF MATERIAL APPLIED = __________ POUNDS

3. CALCULATE CALIBRATION RATE:
   POUNDS APPLIED = __________ X 1000 = __________ POUNDS PER 1,000 SQUARE FEET
   POUNDS PER 1,000 SQUARE FEET X 43.56 = __________ POUNDS PER ACRE

USEFUL FORMULAS

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<tr>
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DATA RECORD

SPREADER ________________
SETTING ________________
MATERIAL ________________
PASS WIDTH ________________
MACHINE ________________
GEAR ________________
RPM ________________
OTHER ________________
Spreader Calibration

1. Select a level area preferably covered with turf and mark a rectangular test course of approximately:

   1,000 - 5,000 square feet for small greens spreaders.

   10,000 - 40,000 square feet for larger fairway spreaders.

2. Measure the exact amount of material applied over the area. This can be done by:

   A. Place a (weighed) known amount of material in the spreader. Re-weigh the material left in the spreader after completing the test course.

   B. On larger machines, it may be necessary to place calibration marks on the spreader bin or place a known amount of material in the spreader and measure the total area covered after all material is used.

3. Calculate the calibration rate according to the worksheet.

4. Record all data for future use.

TIPS: Maintain a constant operating speed throughout application.

Flow rate and distance of throw vary according to the size and weight of the material.

Follow manufacturer's recommendations for overlap. If unavailable, determine the amount of overlap required by placing a series of catch cans perpendicular to spreader travel and measuring the application pattern or use between 75-100% overlap of the width of throw.
Spreader Calibration: Known Area Method

Single Pass Calibration

Measure area of test course...
Test Course Length (ft.) x Effective Pattern Width (ft.) = Total sq. ft.

Example: 25 ft. length x 5 ft. effective pattern width = 125 square feet

Note: Rotary / Broadcast spreader effective pattern width is typically between 75% - 100% less than the overall pattern width.
I.e.: overall pattern width = 10 feet; effective pattern width = 5 feet

1. Set the rotary spreader’s rate gate opening to the recommendation published on the fertilizer bag (per spreader brand, model, etc.).

2. Partially fill the spreader with a pre-weighed amount of fertilizer to be used in the application.

3. Walk at your normal application pace. Achieve your application pace several feet before crossing the test course “Starting-line” and maintain your application pace several feet after crossing the test course “Finish-line”.
   * Turn the spreader on when the wheels are directly over the “Starting-line”...
     ... (example: 0 feet).
   * Turn the spreader off when the wheels are directly over the “Finish-line”...
     ... (example: 25 feet).

4. Weigh the amount of fertilizer left in the spreader and subtract that amount from the pre-weighed amount.
   Note: A fraction of an ounce digital or analog scale is required for Single Pass Calibration.

Rotary Spreader Effective Pattern
**Single Pass Spreader Calibration**

*Example:* Test Course - Length: 25 feet X Effective Width: 5 feet = 125 feet

Use an accurate scale to weigh the fertilizer

Use the following method to determine if the spreader needs to be fine turned to accurately apply one pound of nitrogen per thousand square feet, using for example 18-5-9 fertilizer...

\[
\frac{100}{18\%} = 5.6 \text{ lbs. per 1,000 sq. ft.}
\]

\[
\frac{5.6 \text{ pounds of 18-5-9}}{1,000 \text{ square feet}} = \frac{X \text{ pounds of 18-5-9}}{125 \text{ square feet}}
\]

\[
125 \times 5.6 = 700 / 1,000 = 0.7 \text{ pounds of 18-5-9 of fertilizer should have been dispensed during the test}
\]

\[
0.7 \text{ lbs.} \times 16 = 11.2 \text{ ozs. per 125 sq. ft.} \quad \text{Target} = 11.2 \text{ ozs.}
\]
SAFETY WORKSHEET

DATE________________

PESTICIDE NAME___________________________________

1. SPECIAL ENVIRONMENTAL HAZARDS

2. SPECIAL HUMAN HAZARDS

3. LD<sub>50</sub> AND CLASSIFICATION
   ORAL
   DERMAL
   INHALATION

4. EFFECTS OF EXPOSURE

5. FIRST AID
   SKIN
   EYES
   INHALATION
   INGESTION

6. PROTECTIVE GEAR
   EYES
   SKIN
   RESPIRATORY

7. DISPOSAL, CLEANUP OR STORAGE CONSIDERATIONS

Always read entire product label and material safety data sheet (MSDS) before handling any product.
The "Three C's" Program

CONTROL THE SPILL

Immediate steps must be taken to control the spill. Make sure you are properly protected, isolate the area, avoid contact with the material, drift, or fumes, and evacuate any nonessential people from the area. Do not leave the spill unless someone can relieve you, preferably someone who has "Three C's" training. Once the spill is under control, get help immediately and notify your supervisor. Depending on the size of the spill, you may need to contact "HAZ-MAT", police, fire and rescue units, and the Dept. of Natural Resources.

CONTAIN THE SPILL

Contain the spill in as small an area as possible. Use a rake or a shovel to make a dam or dike around the spill to keep it from spreading. Block off any ditches or depressions in the area of the spill to insure the spill's containment. Do not allow the flow of material to reach any bodies of water.

Liquid pesticide spills can be further contained by the use of absorbent materials such as sand, sawdust, kitty litter or absorbent pads. Before using absorbent material, make sure the chemical is compatible with the absorbent material used. A reaction may occur between the spill and the material used to clean up the spill. Pesticides with strong oxidizers may create a fire when mixed with sawdust, thereby compounding an existing problem. (Chlorites in some herbicides and ammonium nitrate in some fertilizers are two examples of oxidizers.)

Dry pesticide spills can be contained by lightly misting the material with water, or by covering the spill with plastic.

CLEAN UP THE SPILL

Liquid: Spread absorbent material over the contaminated area, sweep it up and place it in a heavy-duty plastic bag. Repeat this procedure until the spill is cleaned up.

Dry: Material must be swept up and reused if possible. If material gets wet, becomes contaminated with soil or other debris, it must be swept up and placed in a heavy-duty plastic bag.

To decontaminate or neutralize the area, mix full strength, ordinary household bleach and hydrated lime. Wear protective clothing and work the preparation into the spill area with a course broom. Place the contaminated preparation in a heavy-duty plastic bag. Repeat this procedure several times to insure neutralization of the pesticide. Never hose down the contaminated area to dilute the pesticide. Activated charcoal can be used to minimize significant plant injury in smaller spills. Charcoal can tie up or absorb enough chemical to reduce long-term contamination.

Soil Contamination: Remove the top two or three inches of soil, cover with at least two inches of lime and cover the lime with fresh top soil. Dispose of the contaminated soil. Clean or dispose of all equipment and materials used in the clean up in a manner consistent with label requirements and any EPA, local or state regulations.

All materials used to control, contain, and clean up a pesticide spill must be handled as hazardous waste and must be disposed of in a manner consistent with the label requirements and any EPA, local or state regulations.
Personal Protective Equipment

You need to decide! Read the label. The formulation, signal word, precautionary statements, personal protective equipment statements, the application method, and the projected length of exposure indicate the personal protective equipment you need.

Minimum Exposure
(Such as granular applications and many other routine pesticide activities)

- Protective suit (such as fabric coveralls) worn over normal work clothes
- Chemical-resistant gloves such as rubber, vinyl, or plastic
  (Never use fabric, leather, or paper gloves)
- Socks and shoes or boots

Maximum Exposure
(Such as direct contact with drenching spray, mist blower or knapsack applications, or handling very highly toxic pesticides)

- Chemical-resistant hood or hat
- Goggles or face shield
- Respirator (If the label requires it or if dusts, mists, fogs, or vapors will be generated)
- Chemical-resistant protective suit worn over normal work clothes
  (A chemical-resistant protective suit may cause heat stress under some conditions)
- Chemical-resistant gloves such as rubber, vinyl, or plastic
  (Never use fabric, leather, or paper gloves)
- Chemical-resistant boots or footwear
  (Never wear leather or canvas footwear)
Handling Concentrates

This is the minimum protective clothing and equipment you should wear while mixing and loading pesticides which are moderately to highly toxic.

- Face shield or goggles
- Respirator (If the label requires it)

- Protective suit (such as fabric coveralls) worn over normal work clothes

- Chemical-resistant apron

- Chemical-resistant gloves such as rubber, vinyl, or plastic (Never use fabric, leather or paper gloves)

- Chemical-resistant boots or footwear (Never wear leather or canvas footwear)
PERSONAL HEALTH AND SAFETY

To effectively guard against pesticide exposure, we must first realize the risk involved when handling pesticides and how they enter our body.

1. Pesticides can enter the body through at least (4) four routes;
   
   A. DERMAL (or through the skin)
   
   Studies show that about 97% of all pesticide exposures occur, through contact with the skin. This absorption is accomplished, by careless handling, while mixing or loading, applying or disposing of pesticides and their containers. The most common of these would be splashes, spills, or drift, while mixing or loading (handling the pesticide in it's most concentrated form). Procedures to guard against such exposure will be covered later in this program.

   B. INHALATION (or breathed into the lungs)
   
   We all know that the lungs oxygenate our blood. So if we inhale a sufficient amount of a pesticide into our lungs, complete and rapid pesticide poisoning will occur when the blood passes through our lungs then out, to travel in the blood stream throughout our entire body. Poisoning by inhalation is not limited by any means. Damage to tissue in the nose, throat, and lungs can also produce long term health problems and illnesses. Procedures to guard against such exposure will be covered later in this program.

   C. ORAL (or through the mouth)
   
   More often than not, children are the victims of this type of exposure, greatly due to a careless applicator or even a parent, who has removed a pesticide from it's original container and put it into an unmarked bottle or a food-type storage container. However, for our purpose here, one must realize that oral exposure can occur with a simple lick of the lips, smoking, chewing (tobacco or gum), eating, or drinking, while handling pesticides. Procedures to guard against such exposure will be covered later in this program.

   D. EYES
   
   The eye, although very small, can absorb enough pesticide to be significantly hazardous. Poisoning here is most generally accomplished through the rubbing of ones eyes, with contaminated hands. Spills, splashes, and drift are also methods of entry to guard against, and procedures to do so will be covered later in this program.

2. Toxicity (LD50 LC50)

   What do we need to know about these two numbers? Simply put, the higher the LD50 or LC50 number is, the lower the incidence of poisoning has occurred in laboratory testing of that pesticide. On the other hand, the lower the LD50 or LC50 number is, the greater the incidence of poisoning has occurred in laboratory testing of that pesticide, and this pesticide will generally carry a signal word of "DANGER". Signal words are derived from LD (lethal dose) or LC (lethal concentrate) numbers, so if you can't find one of these numbers on the label, or MSDS, follow the signal word precautions. Signal words will be covered in the "label" section of this program.

RULE OF THUMB: For personal safety, always wear protective gear and always wash up immediately following contact with any pesticide.
Respirator Standards

NIOSH
(National Institute for Occupational Safety & Health)

1998 Standards: NIOSH 42 CFR Part 84

Three New Classifications for Respirators
(Resistant to Oil Aerosols)

"N" - Not Resistant to Oil
"R" - Resistant to Oil
"P" - Oil Proof

Each classification has three filtering efficiency levels: 95% - 99% - 99.97%

Example: P95 - For most golf course maintenance application: Offers protection against common particulates (dust, mists) whether oil is present or not.

Manufacturers can meet certification criteria to increase efficiency in two ways:
- Increase layers of filtering material
- Use an advanced electret media (AEM) (Permanently Imbedded Electrostatic Charge)
Triple Rinse

Dilution Ratio

*First Rinse = 1:50
*Second Rinse = 1:250
*Third Rinse = 1:125,000

Always fill container or spray tank to one third capacity per rinse.
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Seminar Notes:

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