Optimizing Sprayer Performance

Calibration & Nozzle Selection

Sprayer Systems Overview and Operator Safety

Jim Nedin Consulting Services
Golf Industry Show
January 27, 2020
Sprayer Calibration
Repeatable Accuracy
Area Measurement

(Acres = Total Area ÷ 43,560)

Area = \( \frac{\pi (3.14) \times \text{Diameter}^2}{4} \) (\( d \))

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

Area = \( \text{Length} \times (l) \times \text{Width}(w) \)
Product Applied = Target Area
Sprayer Control and Monitoring Systems
Factors That Control Calibration

- Flow
- Speed
- Width
Flow

GPM =

GPK x MPH x Width (Nozzle Spacing)

5940 Constant: Acres

136.36 Constant: Thousand Square Feet
Flow

GPM =

\[
\frac{45 \text{ gpa} \times \text{ MPH} \times \text{ Width}}{5940}
\]
Speed

\[
\text{MPH} = \frac{0.682 \times \text{Length of Run in Feet}}{\text{Time in Seconds}}
\]
Speed

MPH = 4

0.682 x 200 feet = 136.4

34.1 seconds
Width

Nozzle Spacing =

Distance Between Nozzles in Inches
Width

Spray Boom Application

Nozzle Spacing

Distance Between Nozzles in Inches

20”
Flow

GPM = 0.606 (per nozzle)

\[
(1.033 \text{ gpk}) \times 45 \text{ gpa} \times 4 \text{ mph} \times 20'' = 3,600
\]

Constant: Thousand Square Feet

\[
136.36 \text{ (Constant: Thousand Square Feet)}
\]

Constant: Acre

\[
5940 \text{ (Constant: Acre)}
\]

\[
(45 \text{ gpa} / 43.56 = 1.033 \text{ gpk})
\]
Interpreting Nozzle Charts
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Gallons Per Acre

GPA = 45

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\frac{5940 \times 0.606 \text{ GPM}}{4.0 \text{ MPH} \times 20" \text{ Nozzle Spacing}}
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**GALLONS PER ACRE (GPA) - BASED ON WATER**

- **20° SPACING**
- **30° SPACING**
- **40° SPACING**
Calibration Formulas
Nozzle Uniformity and Calibration Worksheet
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 = __________ Sec. X 128 = ________ (GPM)

VEHICLE SPEED = .682 X __________ Ft = ________ Seconds = ________ (MPH)

NOZZLE SPACING IN INCHES = __________ (W)

CALIBRATION RATE IN = __________ 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
Nozzle Uniformity Catch Test

To ensure a quantifiable sample size, utilize the “15/15 Rule”
15 ounces per nozzle (minimum sample size) / 15 seconds per nozzle (minimum catch time)
**NOZZLE UNIFORMITY AND CALIBRATION WORKSHEET**

**DATE** ____________

**NOZZLE CODE** = **Turf Jet #6** (0.6 gpm @ 40 psi)  **PRESSURE** = __________

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

**NOZZLE CATCH**  **TIME IN SECONDS** = _______

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Total: 426.5 / 11 = 38.77

**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 = \(\frac{38.77}{30} \text{ Ozs. } \times \frac{60}{\text{Sec. } \times 128} \times \frac{2326.2}{3840} = 0.606 \) (GPM)

VEHICLE SPEED = \(\frac{0.682 \times 200}{34.1 \text{ Seconds}} = \frac{136.4}{34.1} = 4.0 \) (MPH)

NOZZLE SPACING IN INCHES = 20 (W)

CALIBRATION RATE IN IN GALLONS PER 1,000 Sq. Ft. = \(\frac{136.36 \times \text{GPM}}{\text{MPH} \times \text{W}} = \frac{82.63}{80} = 1.033 \) (GPK)

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

or

Multiply GPK \times 43.56 = 44.99 (GPA) Gallons per Acre

Target GPA = 45
- 5\% (45 \times 0.95) = 42.75
+ 5\% (45 \times 1.05) = 47.25
Product Applied = Target Area
Multiple Area Measurement

Tee:
(Rectangle) Length ($l$) 45’ x Width ($w$) 70’
Area = Length ($l$) x Width ($w$)

Fairway:
(Triangle) Base ($b$) 110’ x Height ($h$) 45’
Area = $\frac{Base (b) \times Height (h)}{2}$
(Rectangle) Length ($l$) 900’ x Width ($w$) 150’
Area = Length ($l$) x Width ($w$)

Green: (Circle) Diameter ($d$) 120’
Area = $\frac{\pi (3.14) \times Diameter^2 (d)}{4}$

- **Tee:**
  - 45’ x 70’ = 3,150 sq. ft. ÷ 43,560 = 0.07 Acres

- **Fairway:**
  - 110’ x 45’ ÷ 2 = 2,475 sq. ft. ÷ 43,560 = 0.06 Acres
  - 900’ x 150’ = 135,000 sq. ft. ÷ 43,560 = 3.1 Acres

- **Green:**
  - 3.14 x 120’$^2$ ÷ 4 = 11,304 sq. ft. ÷ 43,560 = 0.26 Acres

**Total Sq. Ft. = 151,929 ÷ 43,560 = 3.5 Acres**
Multiple Area Measurement

Target Area: 3.5 Acres
Application Rate: 45 GPA
Target Volume: 157.5 Gallons
Proper Nozzle Selection Size and Type
4 X Pressure to Double Flow Rate
**4 x Pressure to Double Flow**

Flow Doubled

\[ \text{Flow Doubled} \begin{align*}
256\text{ozs} &= 2.00 \\
128\text{ozs} &= 1.00
\end{align*} \]

Nozzle Chart

\[ \begin{align*}
\text{GPM}_1 &= 12.648 \\
\sqrt{\text{PSI}_1} &= 3.556
\end{align*} \]

\[ \begin{align*}
\text{GPM}_2 &= 12.648 \\
\sqrt{\text{PSI}_2} &= 6.324
\end{align*} \]

Pressure @ nozzle

\[ X = 160\text{psi} \]

Formula represents the relationship between pressure and flow
<table>
<thead>
<tr>
<th>Gallons</th>
<th>PSI</th>
<th>Ounces AI</th>
<th>Percentage Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.000</td>
<td>40</td>
<td>3.00</td>
<td></td>
</tr>
<tr>
<td>1.083</td>
<td>50</td>
<td>3.25</td>
<td><strong>8.3%</strong></td>
</tr>
<tr>
<td>1.167</td>
<td>60</td>
<td>3.50</td>
<td><strong>16.7%</strong></td>
</tr>
<tr>
<td>1.250</td>
<td>70</td>
<td>3.75</td>
<td><strong>25.0%</strong></td>
</tr>
<tr>
<td>1.333</td>
<td>80</td>
<td>4.00</td>
<td><strong>33.3%</strong></td>
</tr>
<tr>
<td>1.417</td>
<td>90</td>
<td>4.25</td>
<td><strong>41.7%</strong></td>
</tr>
<tr>
<td>1.500</td>
<td>100</td>
<td>4.50</td>
<td><strong>50.0%</strong></td>
</tr>
<tr>
<td>1.583</td>
<td>110</td>
<td>4.75</td>
<td><strong>58.3%</strong></td>
</tr>
<tr>
<td>1.667</td>
<td>120</td>
<td>5.00</td>
<td><strong>66.7%</strong></td>
</tr>
<tr>
<td>1.750</td>
<td>130</td>
<td>5.25</td>
<td><strong>75.0%</strong></td>
</tr>
<tr>
<td>1.833</td>
<td>140</td>
<td>5.50</td>
<td><strong>83.3%</strong></td>
</tr>
<tr>
<td>1.917</td>
<td>150</td>
<td>5.75</td>
<td><strong>91.7%</strong></td>
</tr>
<tr>
<td>2.000</td>
<td>160</td>
<td>6.00</td>
<td><strong>100.0%</strong></td>
</tr>
</tbody>
</table>
### 4 x Pressure to Double Flow (Active Ingredient)

<table>
<thead>
<tr>
<th>Gal</th>
<th>Pressure (psi)</th>
<th>Flow (oz AI)</th>
<th>% Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.000 gal</td>
<td>40</td>
<td>3.00</td>
<td></td>
</tr>
<tr>
<td>1.042 gal</td>
<td>45</td>
<td>3.13</td>
<td>4.15%</td>
</tr>
<tr>
<td>1.083 gal</td>
<td>50</td>
<td>3.25</td>
<td>8.3%</td>
</tr>
<tr>
<td>1.167 gal</td>
<td>60</td>
<td>3.50</td>
<td>16.7%</td>
</tr>
<tr>
<td>1.250 gal</td>
<td>70</td>
<td>3.75</td>
<td>25.0%</td>
</tr>
<tr>
<td>1.333 gal</td>
<td>80</td>
<td>4.00</td>
<td>33.3%</td>
</tr>
<tr>
<td>1.417 gal</td>
<td>90</td>
<td>4.25</td>
<td>41.7%</td>
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<tr>
<td>1.500 gal</td>
<td>100</td>
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<td>1.583 gal</td>
<td>110</td>
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<td>58.3%</td>
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<td>120</td>
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<td>66.7%</td>
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<tr>
<td>1.750 gal</td>
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<td>1.833 gal</td>
<td>140</td>
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<tr>
<td>1.917 gal</td>
<td>150</td>
<td>5.75</td>
<td>91.7%</td>
</tr>
<tr>
<td>2.000 gal</td>
<td>160</td>
<td>6.00</td>
<td>100.0%</td>
</tr>
</tbody>
</table>
Triple Turret Assembly

Nozzle Anti-drip Check Valve

<table>
<thead>
<tr>
<th>PART NUMBER</th>
<th>APPROXIMATE OPENING PRESSURE</th>
</tr>
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<tbody>
<tr>
<td>21950-2-NY</td>
<td>2 PSI (0.14 bar)</td>
</tr>
<tr>
<td>21950-8-NYB</td>
<td>8 PSI (0.6 bar)</td>
</tr>
<tr>
<td>21950-10-NYB</td>
<td>10 PSI (0.7 bar)</td>
</tr>
<tr>
<td>21950-15-NY</td>
<td>15 PSI (1 bar)</td>
</tr>
<tr>
<td>21950-20-NYB</td>
<td>20 PSI (1.4 bar)</td>
</tr>
</tbody>
</table>

CP21953-EPR
Diaphragm EPDM or Viton

Note: Nib on diaphragm fits into hole in end cap assembly.

21950-NYB
ChemSaver End Cap Assembly Nylon/polypropylene

Back end of Diaphragm Check Valves (Nylon)
Nozzle Selection
Nozzle Overlap

80° Spray Angle = ? Percentage Overlap

- \( X = 28'' \)
- \( W = 20'' \)
- \( Z = \frac{(28-20)}{20} \times 100 \)
- \( Z = 40\% \)

\[ \sim \text{Width} = \sim \text{Height} \]
Nozzle Overlap

110° Spray Angle = ? Percentage Overlap

- $X = 40''$
- $W = 20''$
- $Z = \frac{(40-20)}{20} \times 100$
- $Z = 100\%$

~ Width = ~ Height
<table>
<thead>
<tr>
<th>Drop Size</th>
<th>Capacity One Nozzle in GPM</th>
<th>Capacity One Nozzle in OZ./MIN.</th>
<th>GPA</th>
<th>Gallons per 1000 sq. ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4 MPH</td>
<td>5 MPH</td>
<td>6 MPH</td>
<td>8 MPH</td>
</tr>
<tr>
<td>XR8001</td>
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<td>15</td>
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<td>0.071</td>
<td>9.1</td>
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<td>4.2</td>
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<td>30</td>
<td>0.087</td>
<td>11.7</td>
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<td>7.4</td>
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<td>7.1</td>
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<td>6.8</td>
<td>5.5</td>
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<td>20</td>
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<td>14</td>
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<td>6.5</td>
</tr>
<tr>
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<td>9.7</td>
<td>7.7</td>
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<tr>
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<td>0.15</td>
<td>19</td>
<td>11.1</td>
<td>8.9</td>
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<td>7.7</td>
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<td>0.15</td>
<td>19</td>
<td>11.1</td>
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</tr>
<tr>
<td>50</td>
<td>0.17</td>
<td>22</td>
<td>12.6</td>
<td>10.1</td>
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<td>0.18</td>
<td>23</td>
<td>13.4</td>
<td>10.7</td>
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</table>
## Air Induction Spray Nozzles

### Specifications

<table>
<thead>
<tr>
<th>PSI</th>
<th>Capacity One Nozzle in GPM</th>
<th>Capacity One Nozzle in OZ./MIN.</th>
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<tr>
<td>30</td>
<td>0.43</td>
<td>55</td>
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<tr>
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<tr>
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### GPA

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<th>6 MPH</th>
<th>8 MPH</th>
<th>10 MPH</th>
<th>12 MPH</th>
<th>15 MPH</th>
<th>20 MPH</th>
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<td>30</td>
<td>32</td>
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<td>6.4</td>
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<td>37</td>
<td>30</td>
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<td>7.4</td>
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<td>42</td>
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<tr>
<td>60</td>
<td>45</td>
<td>36</td>
<td>30</td>
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<td>12.1</td>
<td>9.1</td>
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<tr>
<td>70</td>
<td>49</td>
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<td>33</td>
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<td>80</td>
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<td>11.7</td>
<td>8.3</td>
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</table>

### Gallons Per 1000 Sq. Ft.

<table>
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<tr>
<th>PSI</th>
<th>2 MPH</th>
<th>3 MPH</th>
<th>4 MPH</th>
<th>5 MPH</th>
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<tbody>
<tr>
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<td>0.73</td>
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<tr>
<td>80</td>
<td>2.4</td>
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<td>2.7</td>
<td>1.8</td>
<td>1.3</td>
<td>1.1</td>
</tr>
</tbody>
</table>

### Nozzle Options

- **AI11005 (50)**
- **AI11006 (50)**
- **AI11008 (50)**
TurfJet (TTJ) - Wide Angle Flat Spray Nozzles

- Originally developed for Toro, specifically for turf applications
- Available in stainless steel or in polymer (through Tee Jet)
- Direct replacement for Delavan Raindrop nozzles
- ¼’ NPT threaded inlet for easy and versatile installation
- Can mount at 45 or 90 degree giving greater nozzle body flexibility

Pressure Range: 25psi - 75psi
Turbo TurfJet Nozzle Pattern
20” Height / 20” Width

nozzle spray width: 76”
nozzle-to-nozzle overlap: 38”

280% Overlap
Mode of Action

- Contact
- Systemic
- Penetrant
<table>
<thead>
<tr>
<th>Turf Fungicides</th>
<th>Systemic Mode of Action</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Single-site (17)</strong></td>
<td></td>
</tr>
<tr>
<td>Heritage</td>
<td>Aliette</td>
</tr>
<tr>
<td>Accost</td>
<td>Chipco 26019</td>
</tr>
<tr>
<td>Apron</td>
<td>Chipco Signature</td>
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<td>Banner Maxx</td>
<td>Curalan</td>
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<td>Bayleton</td>
<td>Prodigy</td>
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<td>Prostar</td>
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<td>Compass</td>
<td>Touche</td>
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<td>Eagle</td>
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<td>Engage</td>
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<td>T-Methyl E-Pro</td>
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<tr>
<td>Turfcide</td>
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<tr>
<td><strong>Multi-site (7)</strong></td>
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</tr>
</tbody>
</table>

Nozzle Orifice Size

Cutting Droplet Size in Half
Results in Eight Times the Number of Droplets

500 Microns

250 Microns

250 Microns

Fills in the gaps
# Driftable Fine

<table>
<thead>
<tr>
<th>Nozzle Type (0.50 GPM Flow)</th>
<th>Approximate Percent of Spray Volume Less Than 200 Microns</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>15 PSI</td>
</tr>
<tr>
<td>XR TeeJet® 110°</td>
<td>14%</td>
</tr>
<tr>
<td>XR TeeJet 80°</td>
<td>6%</td>
</tr>
<tr>
<td>DG TeeJet 110°</td>
<td>N/A</td>
</tr>
<tr>
<td>DG TeeJet 80°</td>
<td>N/A</td>
</tr>
<tr>
<td>TT – Turbo TeeJet®</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>TF – Turbo FloodJet®</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>AI TeeJet® 110°</td>
<td>N/A</td>
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</tbody>
</table>
Comparison of Droplet Size

XR Flat-fan  Air-induction  TurfJet
<table>
<thead>
<tr>
<th>Herbicides</th>
<th>Fungicides</th>
<th>Insecticides</th>
</tr>
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<tbody>
<tr>
<td><strong>Soil Incorporated</strong></td>
<td><strong>Post-Emergence</strong></td>
<td><strong>Contact</strong></td>
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<tr>
<td>Extended Range Flat Spray</td>
<td>Excellent</td>
<td>Good</td>
</tr>
<tr>
<td><strong>Pre-Emergence</strong></td>
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<td></td>
</tr>
<tr>
<td>Good</td>
<td>Good</td>
<td>Good</td>
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<tr>
<td>Wide Angle Pre-orifice Flat Spray</td>
<td>Very Good</td>
<td>Very Good</td>
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<tr>
<td>Air Induction Flat Spray</td>
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<td>Very Good</td>
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<tr>
<td>Twin Flat Spray</td>
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</tr>
<tr>
<td>Wide Angle Pre-orifice Flood Spray</td>
<td>Excellent</td>
<td>Excellent</td>
</tr>
</tbody>
</table>
Tank Mixing Safeguards
Tank Mixing
Formulations and Mixing Order

- Emulsifiable Concentrates (EC or E)
- Soluble Powders (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
1. Fill spray tank with clean water.
2. Verify that spacing between nozzles is equal. (Record Inches)
3. Perform nozzle uniformity test.
4. Measure test course. (Use formula to determine course length)
   \(4080 \div \text{Nozzle Spacing in Inches} = \text{Test Course in Feet}\)
   \(\text{Example: } 4080 \div 20 \text{ in} = 204 \text{ ft}\)
5. Drive the test course at your normal spraying speed and record travel time in seconds.
   \(\text{Example: } 40 \text{ sec} \ldots 204 \text{ ft} = 3.5 \text{ mph}\)
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.
   \(\text{Example: } 45 \text{ ounces collected equals } 45 \text{ GPA application rate}\)
Easy Method Sprayer Calibration

Nozzle Spacing - Test Course Chart

<table>
<thead>
<tr>
<th>Nozzle Spacing (Inches)</th>
<th>Test Course Length (Feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>204</td>
</tr>
<tr>
<td>18</td>
<td>227</td>
</tr>
<tr>
<td>16</td>
<td>255</td>
</tr>
<tr>
<td>14</td>
<td>291</td>
</tr>
<tr>
<td>12</td>
<td>340</td>
</tr>
<tr>
<td>10</td>
<td>408</td>
</tr>
</tbody>
</table>

4080 / Nozzle Spacing in Inches = Test Course Length in Feet
Toro Sprayer Calibration Tool

Sprayer Calibration Tool

The Toro Sprayer Calibration Tool contains numerous programs to assist the Spray Technician to efficiently calibrate their sprayers.

The programs included in the Toro Sprayer Calibration Tool are:

- Nozzle Uniformity Calculator
- Speed Calculator
- Area Calculator
- Application Rate Calculator
- Tank Mixing Calculator
- Multiple Tank Mixing Calculator
- Nozzle Selection Calculator
- Nozzle Pressure Drop Calculator

NOTE: These programs are available in U.S. units of measure (Gallons, Acres, etc.) and Metric (Liters, Hectares, etc.).
A Computer based tool to assist in the proper setting and adjustment of Turf Sprayers.

Select Desired Function

- Enter Information
- Nozzle Uniformity
- Speed Calculator
- Area Calculator
- Application Rate
- Tank Mixing
- Select Correct Nozzle
- Nozzle Pressure Drop
- Print Report
<table>
<thead>
<tr>
<th>Company Information</th>
<th>Results from Nozzle Selection Screen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company Name - Highland Country Club</td>
<td>Desired Application Rate (Gallons per 1000 Square Feet) - 1.04 G.P.K</td>
</tr>
<tr>
<td>Address 1 - 21348 Highland Road</td>
<td>Application Speed - 4 M.P.H</td>
</tr>
<tr>
<td>City - Bellevue</td>
<td>Nozzle Spacing - 20 Inches</td>
</tr>
<tr>
<td>State - MN Zip Code - 66234</td>
<td>Gallons per Minute (Per Nozzle) - 0.61 G.P.M</td>
</tr>
<tr>
<td></td>
<td>Maximum Gallons per Minute (Per Nozzle) - 0.64 G.P.M</td>
</tr>
<tr>
<td></td>
<td>Minimum Gallons per Minute (Per Nozzle) - 0.58 G.P.M</td>
</tr>
<tr>
<td>Phone Number - 555-333-8888</td>
<td>Notes from Information Screen</td>
</tr>
<tr>
<td>Date - 9/16/12</td>
<td>Notes: 70 degrees, Slightly Windy, Applied 4 ozs. per GPK. Sprayed Green</td>
</tr>
<tr>
<td>Applicator Name: John Smith</td>
<td>and Tees. No Disease Present.</td>
</tr>
<tr>
<td>License No: BR-549</td>
<td>Nozzle Uniformity Screen Results</td>
</tr>
<tr>
<td>Product to be applied: Daconil</td>
<td>Variation Percentage - 5 %</td>
</tr>
<tr>
<td>Nozzle Uniformity Screen Results</td>
<td>Catch Time - 30 Seconds</td>
</tr>
<tr>
<td></td>
<td>Pressure - 40 P.S.I</td>
</tr>
<tr>
<td>Nozzle Catch Test Results</td>
<td>Product Label Rate (Ounces per 1000 Square Feet) - 4 Ozs</td>
</tr>
<tr>
<td></td>
<td>Actual Sprayer Calibration rate (Gallons per 1000 square feet) - 1.04 Gals</td>
</tr>
<tr>
<td></td>
<td>Area to be Sprayed (in 1000 SqFt) - 80.15</td>
</tr>
<tr>
<td>Nozzle 1 - 40 Ozs</td>
<td>Area to be Sprayed (in Acres) - 1.84 Acres</td>
</tr>
<tr>
<td>Nozzle 2 - 39 Ozs</td>
<td>Ounces of Product per gallon of water - 3.846 Ozs</td>
</tr>
<tr>
<td>Nozzle 3 - 39 Ozs</td>
<td>Total Water Required - 83.356 Gals</td>
</tr>
<tr>
<td>Nozzle 4 - 40 Ozs</td>
<td>Total Product Required (In Ounces) - 320.6 Ozs</td>
</tr>
<tr>
<td>Nozzle 5 - 38 Ozs</td>
<td>Total Product Required (In Gallons) - 2.50 Gals</td>
</tr>
<tr>
<td>Nozzle 6 - 40 Ozs</td>
<td>Results from Multiple Tank Mixing Screen</td>
</tr>
<tr>
<td>Nozzle 7 - 37 Ozs</td>
<td>Tank 1 to 1</td>
</tr>
<tr>
<td>Nozzle 8 - 38 Ozs</td>
<td>Sprayer Tank Capacity - 50 Gals</td>
</tr>
<tr>
<td>Nozzle 9 - 38 Ozs</td>
<td>Total Water required - 83.356 Gals</td>
</tr>
<tr>
<td>Nozzle 10 - 40 Ozs</td>
<td>Total Water per Tank - 50Gals</td>
</tr>
<tr>
<td>Nozzle 11 - 40 Ozs</td>
<td>Ounces per Gallon - 3.846 Ozs</td>
</tr>
<tr>
<td>Nozzle Output</td>
<td>Ounces of Product per Tank - 192.3 Ozs</td>
</tr>
<tr>
<td>Average Output</td>
<td>Gallons of Product per Tank - 1.5 Gals</td>
</tr>
<tr>
<td>Minimum Allowable - 36.83 Ozs</td>
<td>Results from Speed Calculator Screen</td>
</tr>
<tr>
<td>Maximum Allowable - 40.70 Ozs</td>
<td>Gallons of Product per Tank - 1 Gal</td>
</tr>
<tr>
<td>G.P.M per Nozzle - 0.61 G.P.M</td>
<td></td>
</tr>
</tbody>
</table>

Notes: 70 degrees, Slightly Windy, Applied 4 ozs. per GPK. Sprayed Green and Tees. No Disease Present.
Sprayer Systems and Components
MANUAL VALVE SPRAY SYSTEM
Fixed Speed w/ Centrifugal Pump
Plumbing Schematic
STANDARD ELECTRIC SPRAY SYSTEM
Fixed Speed w/ Centrifugal Pump
Plumbing Schematic
COMPUTER CONTROL SPRAY SYSTEM
Variable Speed within a Fixed Gear w/ Centrifugal Pump
Plumbing Schematic
COMPUTER CONTROL SPRAY SYSTEM
Hydrostatic Drive w/ Centrifugal Pump
Plumbing Schematic
COMPUTER CONTROL SPRAY SYSTEM
Hydrostatic Drive w/ Diaphragm Pump
Plumbing Schematic
DIAPHRAGM PUMP SPRAY SYSTEM
Plumbing Schematic
High Pressure Relief Valve
(relief valve opens @ 220psi)
Pesticide obstruction located in pressure relief hose
DIAPHRAGM PUMP SPRAY SYSTEM
Plumbing Schematic
High Pressure Relief Valve
(relief valve opens @ 220psi)
Toro MultiPro 5800 Spray System w/ Six Diaphragm Pump

Plumbing Schematic
Toro MultiPro 5800 Spray System
Plumbing Schematic

High Pressure Relief Valve
(relief valve opens @ 220psi)

Pump On – Relief Valve Open
Electronic Control and Electronic Monitor Sprayer System Maintenance

Flowmeter
Mysterious Pressure Increase
Safety
! WARNING!

Chemicals previously used in your sprayer could be debilitating or even fatal.

Don’t take chances! Know what was last used and dress accordingly!
Pesticide Exposure
PERSONAL HEALTH AND SAFETY

ROUTES OF PESTICIDE EXPOSURE

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).

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.

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.

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,
- Coma
- Convulsions
- Headache
- Dizziness
- Pinpoint pupils
- Blurred vision
- Excessive tearing
- Salivation
- Sweating
- Tightness in chest
- Rapid heartbeat
- Elevated blood pressure
- Vomiting
- Cramps
- Diarrhea
- Tremors
- Muscle twitching
- Muscle weakness
- Blisters
- Reddening of skin
- Rash
Symptoms of Pesticide Poisoning

**Acute Toxicity**

- Convulsions
- Headache
- Dizziness
- Sweating
- Rashes
- Blisters

- Pinpoint Pupils
- Blurred Vision
- Salivation
- Rapid Heartbeat
- Vomiting
- Muscle Weakness
Symptoms of Pesticide Poisoning

Chronic Toxicity

• Small doses over a long period of time:
  – Lack of Personal Safety Training
  – Inadequate Personal Protective Equipment (PPE)

• Long-term Effects:
  – Birth Defects
  – Tumors
  – Blood Disorders
  – Nerve Disorders
Specimen Labels
(Pesticide Labels)
TURF & ORNAMENTAL HERBICIDE

ACTIVE INGREDIENTS
Disodium Methanearsonate, Anhydrous* ........................................ 18.90%
Total Arsenic, all in water soluble form, expressed as elemental .......... 7.65%
INERT INGREDIENTS ........................................ 81.10%
TOTAL ........................................ 100%

*Equivalent to 30.0% by weight disodium methanearsonate, hexahydrate.

Keep Out Of Reach Of Children

CAUTION

FIRST AID
- IF SWALLOWED: Drink 1 or 2 glasses of water, induce vomiting by touching the back of the throat, contact a physician or poison control center.
- IF INHALED: Remove to fresh air.
- IF ON SKIN: Wash exposed areas with soap and water, seek medical attention as needed.
- IF IN EYES: Flush eyes with water, contact a physician for irritation as needed.

PRECAUTIONARY STATEMENTS

- HAZARDS TO HUMANS AND DOMESTIC ANIMALS
  CAUTION-Harmful if swallowed or absorbed through the skin. Avoid contact with eyes, skin, or clothing. Avoid breathing vapors or spray mist. If swallowed, induce vomiting immediately by giving two glasses of water and sticking finger down throat. NEVER give anything by mouth to an unconscious person. Seek medical attention. In case of contact with eyes, flush eyes with plenty of water for at least 15 minutes and seek medical attention. Wash exposed skin gently with plenty of soap and water. Keep children and domestic animals away from treated areas until this material has been washed into the soil. Do not feed treated foliage to livestock or allow treated areas to be grazed.

- PERSONAL PROTECTIVE EQUIPMENT (PPE)
  Wear protective clothing when handling or applying this product, including long pants, long-sleeve shirt, and impermeable gloves and boots. Mixer-loaders should include an apron and full-face shield when handling or mixing concentrate. Flagmen should be fully protected during spray operations or mechanical flagmen used. Pilots and ground spray applicators should wear a mask or respirator approved by the Mining Enforcement and Safety Administration and the National Institute for Occupational Safety and Health. Do not apply with hose-end applicators. For exposures in enclosed areas, wear a respirator with either an organic vapor-removing cartridge with a MSHA/NIOSH approved pre-filter or a MSHA/NIOSH-approved canister. Follow manufacturer's instructions for cleaning and maintaining PPE. If no such instructions exist for washables, use detergent and hot water. Keep and wash PPE separate from other laundry.

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- ENVIRONMENTAL HAZARDS
  Do not spray or allow drift onto edible crops, ornamental or other desirable plants. Do not apply when wind, temperature inversions or other weather conditions favor drift away from the target area. Do not apply directly to water, to areas where surface water is present, or to intertidal areas below the mean high water mark. Do not contaminate water by cleaning of equipment or disposal of wastes. Do not apply, allow to drift, or drain or flush equipment onto non-target areas.

- STORAGE AND DISPOSAL: Do not contaminate water, food, or feed by storage or disposal.
  Storage: Store away from other pesticides, fertilizer, seed, food, or feed. Store in original container. Store in a locked storage area not accessible to unauthorized personnel. Absorb leaks or spills onto clay, sand or vermiculite and hold for disposal.
  Pesticide Disposal: Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.
  Container Disposal: Do not reuse empty container. Triple rinse (or equivalent). Then offer for recycling or reconditioning or puncture and dispose of in a sanitary landfill, or incineration, or if allowed by state and local authorities, by burning. If burned stay out of smoke. Dispose of in compliance with all federal, state and local laws.
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Personal Protective Equipment

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)
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)
Properly Filling Spray Tanks

A water supply hose should never be placed directly into the spray tank when mixing and loading chemicals. Water supply contamination may result in the event that back siphoning should occur.
Anti-Siphon Tank Fill
MSDS
(Material Safety Data Sheet)
**PRODUCT IDENTIFICATION**

<table>
<thead>
<tr>
<th>Product Name:</th>
<th>4532 (2 x 2.5 gal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product Code:</td>
<td>4535 (55 gal)</td>
</tr>
<tr>
<td>EPA Registration Number:</td>
<td>1091-14</td>
</tr>
<tr>
<td>Chemical Names:</td>
<td>Disodium methanearsonate, anhydrous</td>
</tr>
<tr>
<td>Synonyms:</td>
<td>DSMA</td>
</tr>
</tbody>
</table>

**INGREDIENT INFORMATION**

<table>
<thead>
<tr>
<th>Active Ingredient (CAS #)</th>
<th>Percent</th>
<th>Inert Ingredients</th>
<th>Exposure Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disodium methanearsonate, anhydrous (2163-80-8)</td>
<td>18.9%</td>
<td></td>
<td>ACGIH/TLV 0.2 mg/m³</td>
</tr>
<tr>
<td></td>
<td>81.1%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**PHYSICAL DATA**

- Boiling Point: 210°C
- Melting Point: N/A
- Freezing Point: about 20°F
- Specific Gravity (20°C): 1.210 at 20°C
- Vapor Pressure (at 20°C mm Hg): N/A
- % Volatile: Approx. 70
- Evaporation Rate: N/A
- Solubility in Water: 100%
- Appearance and Odor: Clear, yellow, nil odor
- pH: 8-9

**FIRE & EXPLOSION DATA**

- Flash Point (Method): Not flammable
- Flammable Limits (vol % in air): LEL N/A,UEL N/A
- Autoignition Temperature: None
- Extinguishing Media: Carbon dioxide, foam, water, dry chemical
- Special Firefighting Procedures: Self-contained air supply
- Unusual Fire and Explosion Hazards: None

**HEALTH HAZARD DATA**

- **Inhalation:** Mildly irritating to respiratory tract. Prolonged exposure may induce mild lung irritation.
- **Eye Contact:** May be slightly irritating to eyes.
- **Skin Contact:** Prolonged contact may cause irritation, not readily absorbed through skin.
- **Chronic Effects of Overexposure:** Irritation of eyes, nose and throat. Dermatitis, headache and nausea.
- **Other Toxic Effects:** N/A

**TOXICITY DATA:**

<table>
<thead>
<tr>
<th>Route</th>
<th>LD₅₀ (rat)</th>
<th>mg/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>ORAL</td>
<td>3.6</td>
<td></td>
</tr>
<tr>
<td>DERMAL</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>INHALATION</td>
<td>&gt;22.1</td>
<td></td>
</tr>
</tbody>
</table>

**EMERGENCY AND FIRST AID PROCEDURES**

- **Ingestion:** Have patient drink several glasses of water. Induce vomiting. Seek medical attention.
- **Skin Contact:** Wash exposed areas of skin with soap and water. Contaminated clothing, including footwear, should be thoroughly cleaned before reuse.
- **Eye Contact:** Flush immediately with plenty of water for at least 15 minutes. If irritation persists, seek medical attention.
- **Inhalation:** Remove to fresh air.

**SPECIAL PROTECTION INFORMATION**

- **Protective Clothing:** Rubber or oil-impermeable gloves.
- **Eye Protection:** Full face shield.
- **Ventilation:** For outdoor use only.
- **Respiratory Protection:** Mask or respirator approved by the Mining Enforcement and Safety Administration and the National Institute for Occupational Safety and Health.
- **Other:** Long pants, long sleeve shirt, boots, apron.

**SPILL OR LEAK PROCEDURES**

- **Steps to be Taken in Case Material is Released or Spilled:** Absorb leaks or spills onto clay, sand or vermiculite and hold for disposal.
- **Waste Disposal Methods:** Do not contaminate water, food, or feed by storage or disposal. Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility. Do not reuse empty container. Triple rinse (or equivalent). Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or incineration, or, if allowed by state and local authorities, by burning. If burned, stay out of smoke. Dispose of in compliance with all Federal, state and local laws.

**SPECIAL PRECAUTIONS**

- **Precautions to be Taken in Handling and Storing:** Store away from other pesticides, fertilizers, seed, food or feed. Store in original container. Store in a locked storage area not accessible to unauthorized personnel.

**ADDITIONAL REGULATORY INFORMATION**

- **DOT Shipping Name:** Compounds, tree or weed killing, N01, liquid.
- **DOT Hazard Classification:** None
- **DOT Label Requirements:** None required
- **UN Identification Number:** None
- **Hazardous Substance:** None
- **Reportable Quantity:** N/A
- **OSHA Hazard Classification:** N/A
- **EPA SARA Title III Data:**
  - **ACUITE:** Moderate
  - **CHRONIC:** Moderate
  - **FIRE:** Low
  - **REACTIVE:** Low
HEALTH HAZARD DATA

Inhalation: Mildly irritating to respiratory tract. Prolonged exposures may induce mild lung irritation.

Eye Contact: May be slightly irritating to eyes.

Skin Contact: Prolonged contact may cause irritation, not readily absorbed through skin.

Chronic Effects of Overexposure: Irritation of eyes, nose and throat. Dermatitis, headache and nausea.

Other Toxic Effects: N/A

TOXICITY DATA:

ORAL (acute): LD₅₀ (rat) 3.6 g/kg

DERMAL (acute): LD₅₀ (rabbit) 10 g/kg

INHALATION (acute): LD₅₀ (rat) >22.1 mg/L

CHRONIC:

SUBCHRONIC:

EMERGENCY AND FIRST AID PROCEDURES

Ingestion: Have patient drink several glasses of water. Induce vomiting. Seek medical attention.

Skin Contact: Wash exposed areas of skin with soap and water. Contaminated clothing, including footwear, should be thoroughly cleaned before reuse.

Eye Contact: Flush immediately with plenty of water for at least 15 minutes. If irritation persists, seek medical attention.

Inhalation: Remove to fresh air.

SPECIAL PROTECTION INFORMATION

Protective Clothing: Rubber or oil-impermeable gloves.

Eye Protection: Full face shield.

Ventilation: For outdoor use only.

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SPECIAL PRECAUTIONS

Precautions to be Taken in Handling and Storing: Store away from other pesticides, fertilizers, seed, food or feed. Store in original container. Store in a locked storage area not accessible to unauthorized personnel.

ADDITIONAL REGULATORY INFORMATION

DOT Shipping Name: Compounds, tree or weed killing, N.O.I, liquid.

DOT Hazard Classification: None

DOT Label Requirements: None required

UN Identification Number: None

Hazardous Substance: None

Reportable Quantity: N/A

OSHA Hazard Classification: N/A

EPA SARA Title III Data:

ACUTE: Moderate

CHRONIC: Moderate

FIRE: Low

REACTIVE: Low
**HEALTH HAZARD DATA**

**Inhalation:** Mildly irritating to respiratory tract. Prolonged exposures may induce mild lung irritation.

**Eye Contact:** May be slightly irritating to eyes.

**Skin Contact:** Prolonged contact may cause irritation, not readily absorbed through skin.

**Chronic Effects of Overexposure:** Irritation of eyes, nose and throat. Dermatitis, headache and nausea.

**Other Toxic Effects:** N/A

**TOXICITY DATA:**

<table>
<thead>
<tr>
<th>Mode</th>
<th>Endpoint</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ORAL (acute)</td>
<td>LD$_{50}$ (rat)</td>
<td>3.6 g/kg</td>
</tr>
<tr>
<td>DERMAL (acute)</td>
<td>LD$_{50}$ (rabbit)</td>
<td>10 g/kg</td>
</tr>
<tr>
<td>INHALATION (acute)</td>
<td>LD$_{50}$ (rat)</td>
<td>$&gt;22.1$ mg/L</td>
</tr>
</tbody>
</table>

**CHRONIC:**

**SUBCHRONIC:**
# Relative Toxicity Categories of Pesticides

**Important Note:** This safety worksheet is not a substitute for reading the product label and material safety data sheet (MSDS). Always read the entire product label and material safety data sheet prior to each handling of any product or potentially hazardous material. If you don’t understand any part of the product safety information, ask your supervisor for an explanation before you use the product.

<table>
<thead>
<tr>
<th>Toxicity Category</th>
<th>Signal Word on Label.</th>
<th>Oral LD50 (1) (mg/kg) and probable lethal dose (2)</th>
<th>Dermal LD50 (mg/kg) and skin effects.</th>
<th>Eye effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>I Highly Poisonous (3)</td>
<td>DANGER</td>
<td>Up to 50 A few drops To a teaspoon</td>
<td>0-200 Corrosive</td>
<td>Corneal opacity not reversible within 7 days.</td>
</tr>
<tr>
<td>II Moderately Poisonous</td>
<td>WARNING</td>
<td>50-500 A teaspoon to an ounce</td>
<td>200-2,000 Severe irritation at 72 hours</td>
<td>Corneal opacity reversible within 7 days. Irritation persists for 7 days.</td>
</tr>
<tr>
<td>III Slightly Poisonous</td>
<td>CAUTION</td>
<td>500-5,000 An ounce to one pint or pound</td>
<td>2,000-20,000 Moderate irritation at 72 hours</td>
<td>No corneal opacity. Irritation reversible within 7 days.</td>
</tr>
<tr>
<td>IV Relatively non-toxic</td>
<td>CAUTION</td>
<td>Over 5,000 Over one pint or one pound</td>
<td>Over 20,000 Slight irritation at 72 hours</td>
<td>No irritation.</td>
</tr>
</tbody>
</table>

1. Toxicity of product is generally expressed as a LD50 or LC50 value. This is the lethal dose or lethal concentration to 50% of an animal test population in milligrams of material per kilogram of body weight. The lower the LD number, the more toxic the material.

2. Probable oral lethal dose for 150 pound person.

3. If signal word is DANGER by itself, it means that toxicity rating is based on eye and skin irritation.
**MATERIAL SAFETY DATA SHEET**

**PRODUCT IDENTIFICATION**
- Product Name: 4532 (2 x 2.5 gal) 4535 (55 gal)
- EPA Registration Number: 1001-14
- Chemical Names: Disodium methanesulfonate, anhydrous
- Synonyms: DMMA

**INGREDIENT INFORMATION**
- Active Ingredient (CAS #) Percent: Disodium methanesulfonate, anhydrous (2163-80-6) 18.9%
- Inert Ingredients: 81.1%
- Exposure Limits: ACGIH/TLV 0.2 mg/m³

**PHYSICAL DATA**
- Boiling Point: 210°C
- Melting Point: N/A
- Freezing Point: About 20 F
- Specific Gravity: 1.210 @ 20 C
- Vapor Pressure: N/A
- % Volatile: Approx. 70
- Evaporation Rate: N/A
- Solubility in Water: 100%
- Appearance and Odor: Clear, yellow, nil odor
- pH: 5-9

**FIRE & EXPLOSION DATA**
- Flash Point (Method): Not flammable
- Flammable Limits (vol % in air): LEL N/A, UEL N/A
- Autoignition Temperature: None
- Extinguishing Media: Carbon dioxide, foam, water, dry chemical
- Special Firefighting Procedures: Self-contained air supply
- Unusual Fire and Explosion Hazards: None

**REACTIVITY HAZARD DATA**
- Stability: Stable at normal conditions
- Conditions to Avoid: N/A
- Incompatibility: Oxidizing agents; inorganic acids
- Hazardous Polymerization: Will not occur
- Hazardous Decomposition Products: Oxides of carbon and arsenic

**HEALTH HAZARD DATA**
- Inhalation: Mildly irritating to respiratory tract. Prolonged exposures may induce mild lung irritation.
- Eye Contact: May be slightly irritating to eyes.
- Skin Contact: Prolonged contact may cause irritation, not readily absorbed through skin.
- Other Toxic Effects: N/A

**TOXICITY DATA:**
- ORAL (acute): LD₅₀ (rat) 3.6 kg/kg
- DERMAL (acute): LD₅₀ (rabbit) 10 kg/kg
- INHALATION (acute): LD₅₀ (rat) >22.1 mg/L

**EMERGENCY AND FIRST AID PROCEDURES**
- Ingestion: Have patient drink several glasses of water. Induce vomiting. Seek medical attention.
- Skin Contact: Wash exposed areas of skin with soap and water. Contaminated clothing, including footwear, should be thoroughly cleaned before reuse.
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- Inhalation: Remove to fresh air.

**SPECIAL PROTECTION INFORMATION**
- Protective Clothing: Rubber or oil-impermeable gloves.
- Eye Protection: Full face shield.
- Ventilation: For outdoor use only.
- Respiratory Protection: Mask or respirator approved by the Mining Enforcement and Safety Administration and the National Institute for Occupational Safety and Health.
- Other: Long pants, long sleeve shirt, boots, apron.

**SPILL OR LEAK PROCEDURES**
- Steps to be Taken in Case Material is Released or Spilled: Absorb leaks or spills onto clay, sand or vermiculite and hold for disposal.
- Waste Disposal Methods: Do not contaminate water, food, or feed by storage or disposal. Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility. Do not reuse empty container. Triple rinse (or equivalent). Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or incineration, or, if allowed by state and local authorities, by burning. If burned, stay out of smoke. Dispose of in compliance with all Federal, state and local laws.

**SPECIAL PRECAUTIONS**
- Precautions to be Taken in Handling and Storing: Store away from other pesticides, fertilizers, seed, food or feed. Store in original container. Store in a locked storage area not accessible to unauthorized personnel.

**ADDITIONAL REGULATORY INFORMATION**
- DOT Shipping Name: Compounds, tree or weed killing, N01, liquid.
- DOT Hazard Classification: None
- DOT Label Requirements: None required
- UN Identification Number: None
- Hazardous Substance: None
- Reportable Quantity: N/A
- OSHA Hazard Classification: N/A
- EPA SARA Title III Data:
  - ACUTE: Moderate
  - CHRONIC: Moderate
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The Three “C’s”

- Control The Spill
- Contain The Spill
- Cleanup The Spill
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.
SAFETY WORKSHEET

DATE______Today______

PESTICIDE NAME________Insecticide (EC)________

1. **SPECIAL ENVIRONMENTAL HAZARDS** Toxics to fish & wildlife. Apply ½” of water when application is complete. Do NOT allow puddling or runoff. Do Not store near heat or open flame.

2. **SPECIAL HUMAN HAZARDS** May be fatal if swallowed, inhaled or absorbed through skin. Do NOT breath vapors and avoid contact with eyes. If swallowed do NOT induce vomiting. If inhaled, get fresh air. Flush eyes with water. Wash skin with soap & water.

3. **LD50 AND CLASSIFICATION**
   - **ORAL** 50 - 500
   - **DERMAL** 200 - 2,000
   - **INHALATION** Moderately Toxic (Rat = 0.8875 mg/l air - 4 hour)

4. **EFFECTS OF EXPOSURE** May be fatal if swallowed, inhaled or absorbed through skin.

5. **FIRST AID**
   - **SKIN** Wash with plenty of soap and water. Get medical attention.
   - **EYES** Flush immediately with plenty of water. Get medical attention if irritation persists.
   - **INHALATION** Remove victim to fresh air. If not breathing, give artificial respiration. Get medical attention.
   - **INGESTION** Call physician or Poison Control Center immediately. Do NOT induce vomiting unless instructed.

6. **PROTECTIVE GEAR**
   - **EYES** Approved goggles or face shield for cleaning, mixing and loading.
   - **SKIN** Long sleeved shirt and long pants. Shoes, plus socks. Gloves and apron when cleaning, mixing and loading.
   - **RESPIRATORY** Dust / mist filtering respirator (MSHA/NIOSH approval # prefix TC-21C)

7. **DISPOSAL, CLEANUP OR STORAGE CONSIDERATIONS** Triple rinse container, puncture and dispose of in a sanitary land fill, incinerate or burn. If a spill occurs, use absorbent material and properly discard. Do NOT store in or around the home. Do NOT store below 0°F. Follow PPE manufacturer’s washing instructions. Keep and wash PPE separately from other laundry.
Cleanup
Triple Rinse

- Containers
- Spray Tanks
Why 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.
TRIPLE-RINSE ✔
NEUTRALIZED ✔

According to the recommendations of the chemical manufacturer(s) and…

Clean the OUTSIDE of the Sprayer to prevent erosion caused by chemical residue!
Sprayer Winterization

Triple rinse tank and entire spray system.
- Use recommended cleaner (detergent, ammonia or commercial tank cleaner) and recirculate for 15 minutes.
- Operate spray booms long enough to ensure all nozzles and boom hoses are filled with cleaning solution. Let solution stand in system for several hours.
- Drain tank and refill with clean water. Recirculate and spray out through nozzles until empty and repeat.

Service pump and other components requiring maintenance and repair.
- Remove filters, screens and nozzles. Clean and reinstall.

Winterize. Use 5 gallons of automotive antifreeze (50% water solution = 10 gallons), or 10 gallons straight RV antifreeze (follow sprayer manufacturer’s recommendation).
- Note: Automotive antifreeze (ethylene glycol) must be captured from tank and spray nozzles, and properly disposed of. RV antifreeze (propylene glycol) is environmentally safe and can be sprayed directly onto the ground.
- Operate spray system; recirculate antifreeze within, and spray out nozzles.
- Check nozzle output with antifreeze hydrometer/refractometer to ensure antifreeze protection is throughout the entire spray system.
- Disconnect pressure gauge hose (supply and gauge ends). Clean hose out, using compressed air. Leave disconnected while in winter storage. Reconnect prior to use.
- Clean sprayers exterior with mild detergent solution. Repaint all chipped, cracked, and worn painted surfaces.
Thank You!

Jim Nedin Consulting Services
952-221-9177
jimwex2@gmail.com