

Optimizing Sprayer Performance

Calibration & Nozzle Selection

Sprayer Systems Overview

and

Operator Safety

Jim Nedin Consulting Services
Golf Industry Show
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Sprayer Calibration



Repeatable Accuracy

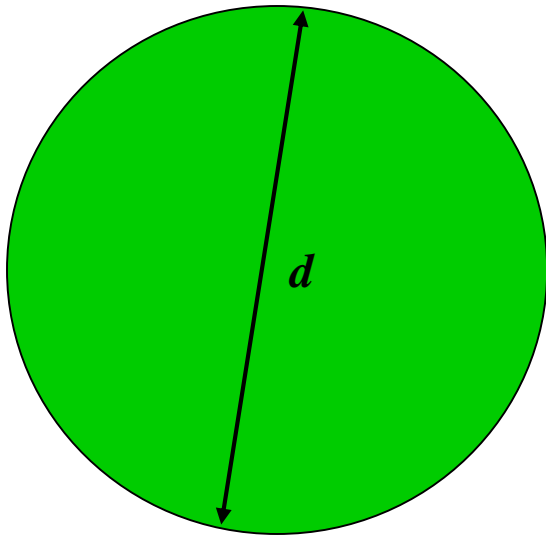




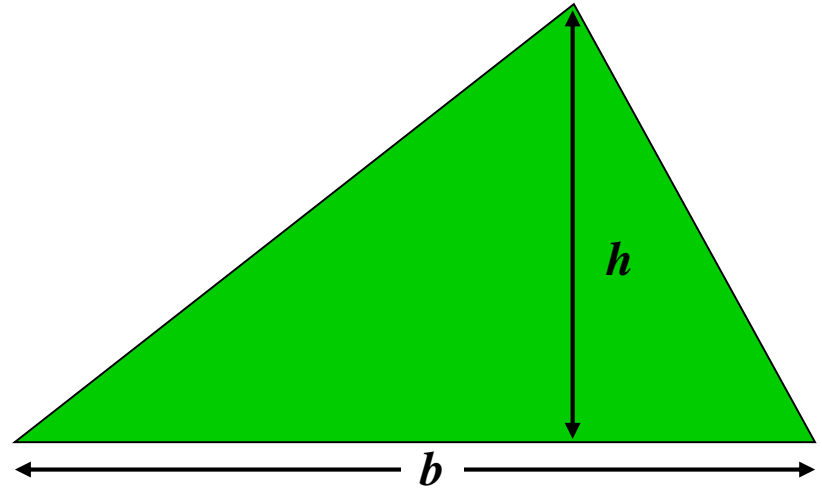


Area Measurement

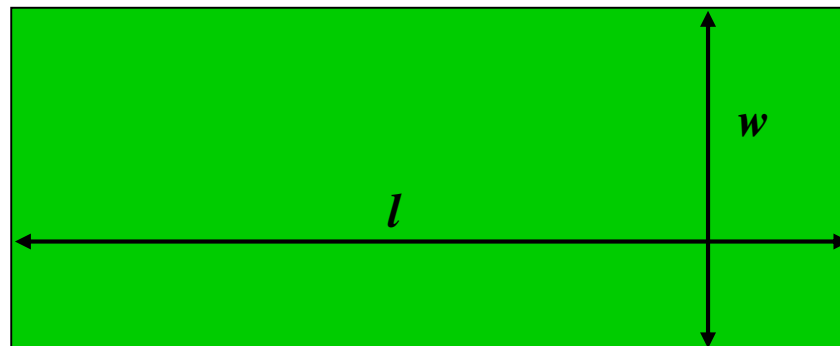
(Acres = Total Area ÷ 43,560)



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



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



$$\text{Area} = \text{Length } x (l) \times \text{Width } (w)$$

Product Applied

≡

Target Area

Sprayer Control and Monitoring Systems



Factors That Control Calibration

- **Flow**
- **Speed**
- **Width**

Flow

Product Label

GPM =

$$\frac{\text{GPK} \times \text{MPH} \times \text{Width (Nozzle Spacing)}}{5940}$$

5940 Constant: Acres

136.36 Constant: Thousand Square Feet

Flow

GPM =

45 gpa x MPH x Width

5940

Speed

MPH =

$$\frac{0.682 \times \text{Length of Run in Feet}}{\text{Time in Seconds}}$$

Speed

$$\text{MPH} = 4$$

$$0.682 \times 200 \text{ feet} = 136.4$$

34.1 seconds

Width

Nozzle Spacing =

Distance Between Nozzles in Inches

Width

Spray Boom Application



Nozzle Spacing

Distance Between Nozzles in Inches

20"

Flow

$$\text{GPM} = 0.606 \text{ (per nozzle)}$$

$$\text{(1.033 gpk)} \quad 45 \text{ gpa} \times 4 \text{ mph} \times 20'' = 3,600 \quad \text{(82.64)}$$

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

$$5940 \quad \text{Constant: Acre}$$

$$(45 \text{ gpa} / 43.56 = 1.033 \text{ gpk})$$

Interpreting Nozzle Charts

Nozzle Tip Number	Pressure (psig)	Capacity 1-Nozzle (GPM)	GALLONS PER ACRE (GPA) - BASED ON WATER														
			20" SPACING					30" SPACING					40" SPACING				
			4 MPH	5 MPH	6 MPH	7.5 MPH	10 MPH	4 MPH	5 MPH	6 MPH	7.5 MPH	10 MPH	4 MPH	5 MPH	6 MPH	7.5 MPH	10 MPH
WRW - 2 RA - 2	20	.14	10.5	8.4	7.0	5.6	4.2	7.0	5.6	4.7	3.7	2.8	5.3	4.2	3.5	2.8	2.1
	30	.17	12.9	10.3	8.6	6.9	5.1	8.6	6.9	5.7	4.6	3.4	6.4	5.1	4.3	3.4	2.6
ISO	40	.20	14.9	11.9	9.9	7.9	5.9	9.9	7.9	6.6	5.3	4.0	7.4	5.9	5.0	4.0	3.0
	50	.22	16.6	13.3	11.1	8.9	6.6	11.1	8.9	7.4	5.9	4.4	8.3	6.6	5.5	4.4	3.3
WRW - 4 RA - 4	20	.28	21	16.8	14.0	11.2	8.4	14.0	11.2	9.3	7.5	5.6	10.5	8.5	7.0	5.6	4.2
	30	.35	26	20	17.1	13.7	10.3	17.1	13.7	11.4	9.2	6.9	12.9	10.3	8.6	6.9	5.1
ISO	40	.40	30	24	19.8	15.8	11.9	19.8	15.8	13.2	10.6	7.9	14.9	11.9	9.9	7.9	5.9
	50	.45	33	27	22	17.7	13.3	22	17.7	14.8	11.8	8.8	16.6	13.3	11.1	8.9	6.6
WRW - 5 RA - 5	20	.36	26	21	17.5	14.0	10.5	17.5	14.0	11.7	9.3	7.0	13.1	10.5	8.8	7.0	5.3
	30	.44	32	26	21	17.1	12.9	21	17.2	14.3	11.4	8.6	16.1	12.9	10.7	8.6	6.4
ISO	40	.50	37	30	25	19.8	14.9	25	19.8	16.5	13.2	9.9	18.6	14.9	12.4	9.9	7.4
	50	.56	42	33	28	22	16.6	28	22	18.4	14.8	11.1	21	16.6	13.8	11.1	8.4
WRW - 6 RA - 6	20	.43	32	25	21	16.8	12.6	21	16.8	14.0	11.2	8.4	15.8	12.6	10.5	8.4	6.3
	30	.52	39	31	26	21	15.4	26	21	17.1	13.7	10.3	19.3	15.4	12.9	10.3	7.7
ISO	40	.60	45	36	30	24	17.8	30	24	19.8	15.8	11.9	22	17.8	14.8	11.9	8.9
	50	.67	50	40	33	27	20	33	27	22	17.7	13.3	25	19.9	16.6	13.3	10.0
RA - 8	20	.57	42	34	28	22	16.8	28	22	18.7	14.9	11.2	21	16.8	14.0	11.2	8.4
	30	.70	51	41	34	27	21	34	27	23	18.3	13.7	26	20	17.1	13.7	10.3
ISO	40	.80	59	48	40	32	24	40	32	26	21	15.8	30	24	19.8	15.8	11.9
	50	.90	66	53	44	35	27	44	35	30	24	17.7	33	27	22	17.7	13.3
WRW - 10 RA - 10	20	.71	53	42	35	28	21	35	28	23	18.7	14.0	26	21	17.5	14.0	10.5
	30	.87	64	51	43	34	26	43	34	29	23	17.2	32	26	21	17.1	12.9
WRW - 15 RA - 15	40	1.0	74	59	50	40	30	50	40	33	26	19.8	37	30	25	19.8	14.9
	50	1.1	83	66	55	44	33	55	44	37	30	22	42	33	28	22	16.6
WRW - 20	20	1.4	105	84	70	56	42	70	56	47	37	28	53	42	35	28	21
	30	1.7	129	103	86	69	51	86	69	57	46	34	64	51	43	34	26
WRW - 20	40	2.0	149	119	99	79	59	99	79	66	53	40	74	59	50	40	30
	50	2.2	166	133	111	89	66	111	89	74	59	44	83	66	55	44	33
WRW - 20	20	2.4	182	145	121	97	73	121	97	81	65	48	91	73	61	48	36
	60	2.4	182	145	121	97	73	121	97	81	65	48	91	73	61	48	36

Gallons Per Acre

$$\text{GPA} = 45$$

$$5940 \times 0.606 \text{ GPM}$$

$$4.0 \text{ MPH} \times 20'' \text{ Nozzle Spacing}$$

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 = $\frac{\text{Ozs.} \times 60}{\text{Sec.} \times 128}$ = _____ = _____ (GPM)

VEHICLE SPEED = $\frac{.682 \times \text{Fl.}}{\text{Seconds}}$ = _____ = _____ (MPH)

NOZZLE SPACING IN INCHES = _____ (W)

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

(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 Today

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

(Volume Conversion) NOZZLE DECIMAL OUTPUT X 128 = 76.8 OUNCES

NOZZLE CATCH TIME IN SECONDS = 30

#1 40

#5 37.5

#9 38

#2 38.5

#6 40

#10 40

#3 38

#7 37

#11 39.5

#4 40

#8 38

#12

Total: 426.5 / 11 = 38.77

AVERAGE OUTPUT 38.77 OUNCES

AV. OP. X 0.95 = 36.83 (-5%)

AV. OP. X 1.05 = 40.71 (+5%)

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

$$\text{GALLONS PER MINUTE} = \frac{38.77 \text{ Ozs.} \times 60}{30 \text{ Sec.} \times 128} = \frac{2,326.2}{3,840} = \underline{0.606} \text{ (GPM)}$$

$$\text{VEHICLE SPEED} = \frac{.682 \times 200 \text{ Ft.}}{34.1 \text{ Seconds}} = \frac{136.4}{34.1} = \underline{4.0} \text{ (MPH)}$$

$$\text{NOZZLE SPACING IN INCHES} = \underline{20} \text{ (W)}$$

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

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

or

$$\text{Multiply GPK} \times 43.56 = \underline{44.99} \text{ (GPA) Gallons per Acre}$$

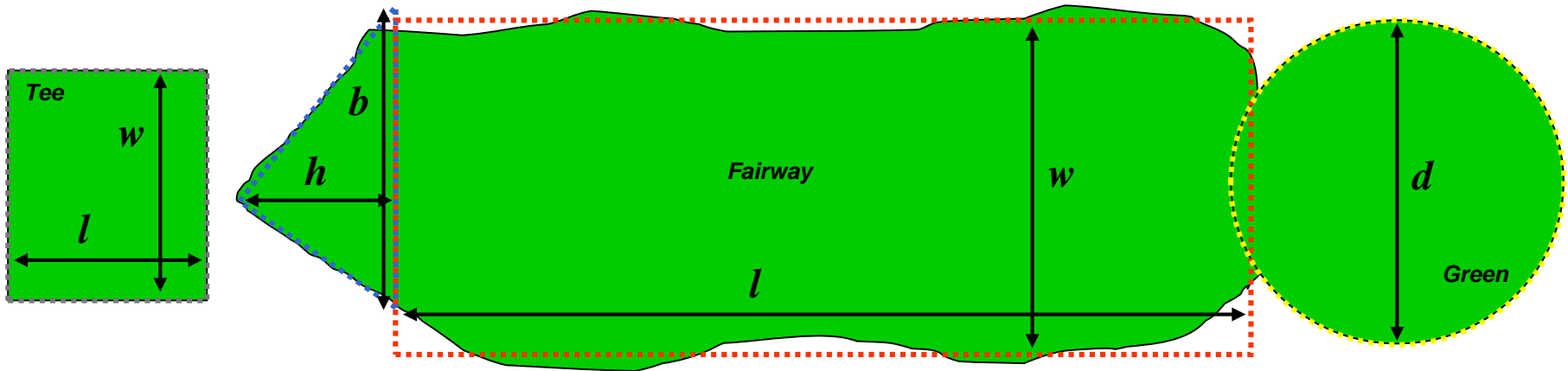
<p>Target GPA = 45 - 5% (45 x 0.95) = 42.75 + 5% (45 x 1.05) = 47.25</p>

Product Applied

≡

Target Area

Multiple Area Measurement



Tee:

(Rectangle) Length (l) 45' x Width (w) 70'

$$\text{Area} = \text{Length } (l) \times \text{Width } (w)$$

$$45' \times 70' = 3,150 \text{ sq. ft. } \div 43,560 = 0.07 \text{ Acres}$$

Fairway:

(Triangle) Base (b) 110' x Height (h) 45'

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

$$110' \times 45' \div 2 = 2,475 \text{ sq. ft. } \div 43,560 = 0.06 \text{ Acres}$$

(Rectangle) Length (l) 900' x Width (w) 150'

$$\text{Area} = \text{Length } (l) \times \text{Width } (w)$$

$$900' \times 150' = 135,000 \text{ sq. ft. } \div 43,560 = 3.1 \text{ Acres}$$

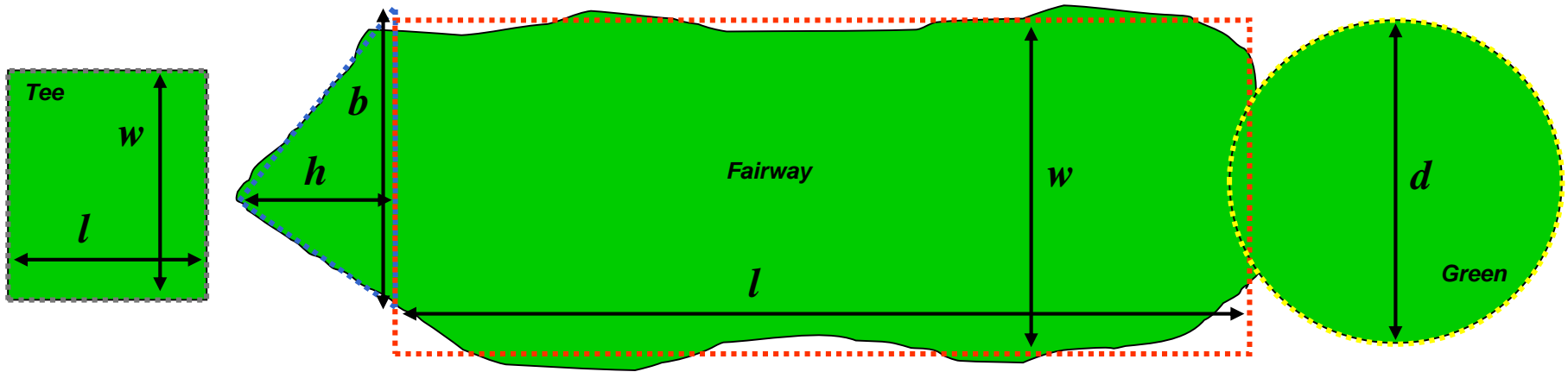
Green: (Circle) Diameter (d) 120'

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

$$3.14 \times 120'^2 \div 4 = 11,304 \text{ sq. ft. } \div 43,560 = 0.26 \text{ Acres}$$

$$\text{Total Sq. Ft.} = 151,929 \div 43,560 = 3.5 \text{ Acres}$$

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
256ozs = 2.00 $\frac{12.648}{GPM_1}$ Pressure @ nozzle

Nozzle Chart
128ozs = 1.00 $\frac{12.648}{GPM_2}$ X = 160psi

$3.556^2 = 12.645^2$

Nozzle Chart
40psi

6.324

Formula represents the relationship between pressure and flow

4 x Pressure to Double Flow (Active Ingredient)

1.000 gal @ 40 psi	= 3.00 oz AI	% increase
1.083 gal @ 50 psi	= 3.25 oz AI	8.3%
1.167 gal @ 60 psi	= 3.50 oz AI	16.7%
1.250 gal @ 70 psi	= 3.75 oz AI	25.0%
1.333 gal @ 80 psi	= 4.00 oz AI	33.3%
1.417 gal @ 90 psi	= 4.25 oz AI	41.7%
1.500 gal @ 100 psi	= 4.50 oz AI	50.0%
1.583 gal @ 110 psi	= 4.75 oz AI	58.3%
1.667 gal @ 120 psi	= 5.00 oz AI	66.7%
1.750 gal @ 130 psi	= 5.25 oz AI	75.0%
1.833 gal @ 140 psi	= 5.50 oz AI	83.3%
1.917 gal @ 150 psi	= 5.75 oz AI	91.7%
2.000 gal @ 160 psi	= 6.00 oz AI	100.0%

4 x Pressure to Double Flow (Active Ingredient)

1.000 gal @ 40 psi = 3.00 oz AI	% increase
1.042 gal @ 45 psi = 3.13 oz AI	4.15%
1.083 gal @ 50 psi = 3.25 oz AI	8.3%
1.167 gal @ 60 psi = 3.50 oz AI	16.7%
1.250 gal @ 70 psi = 3.75 oz AI	25.0%
1.333 gal @ 80 psi = 4.00 oz AI	33.3%
1.417 gal @ 90 psi = 4.25 oz AI	41.7%
1.500 gal @ 100 psi = 4.50 oz AI	50.0%
1.583 gal @ 110 psi = 4.75 oz AI	58.3%
1.667 gal @ 120 psi = 5.00 oz AI	66.7%
1.750 gal @ 130 psi = 5.25 oz AI	75.0%
1.833 gal @ 140 psi = 5.50 oz AI	83.3%
1.917 gal @ 150 psi = 5.75 oz AI	91.7%
2.000 gal @ 160 psi = 6.00 oz AI	100.0%

**1-Gallon
Per/Min Nozzle**

1

2

15psi @ 20" h X 20" w

23psi @ 20" h X 20" w

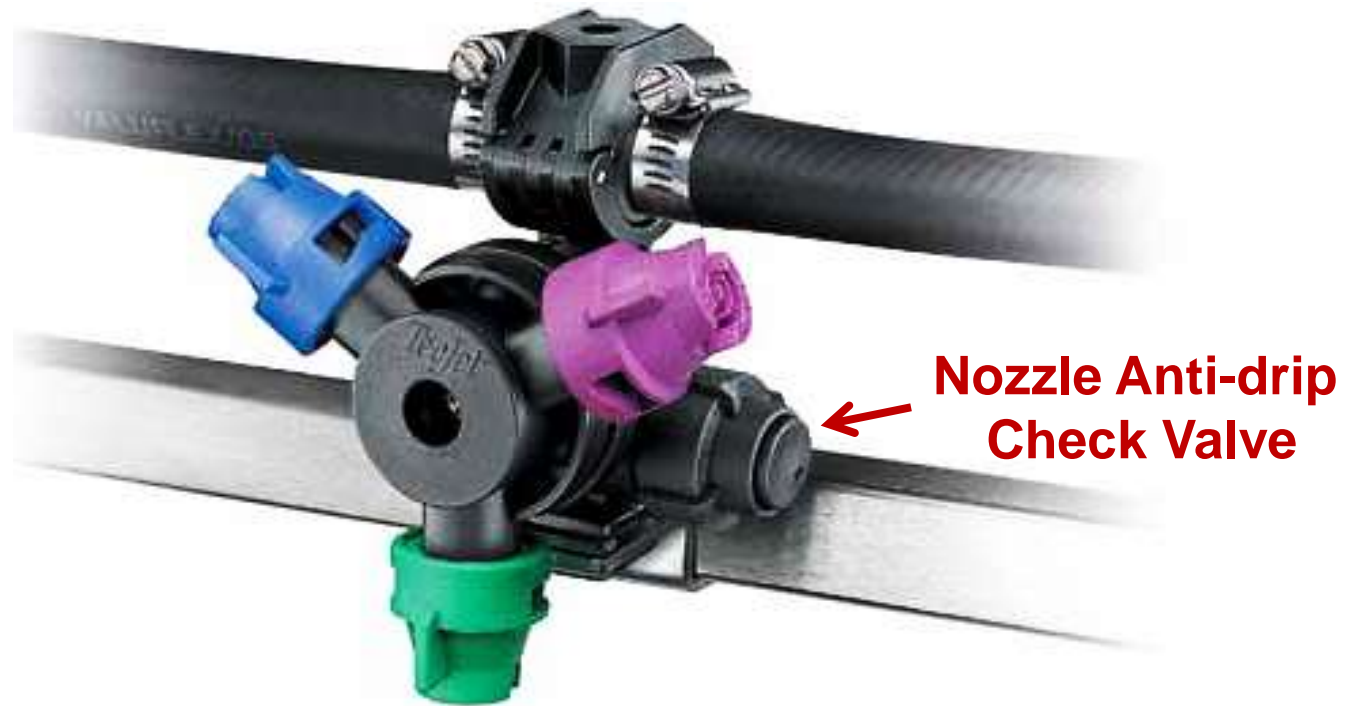
3

4

40psi @ 20" h X 20" w

65psi @ 20" h X 20" w

Triple Turret Assembly



Back end of
Diaphragm Check Valves
(Nylon)



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

PART NUMBER	APPROXIMATE OPENING PRESSURE
21950-2-NY	2 PSI (0.14 bar)
21950-8-NYB	8 PSI (0.6 bar)
21950-10-NYB	10 PSI (0.7 bar)
21950-15-NY	15 PSI (1 bar)
21950-20-NYB	20 PSI (1.4 bar)

Nozzle Selection

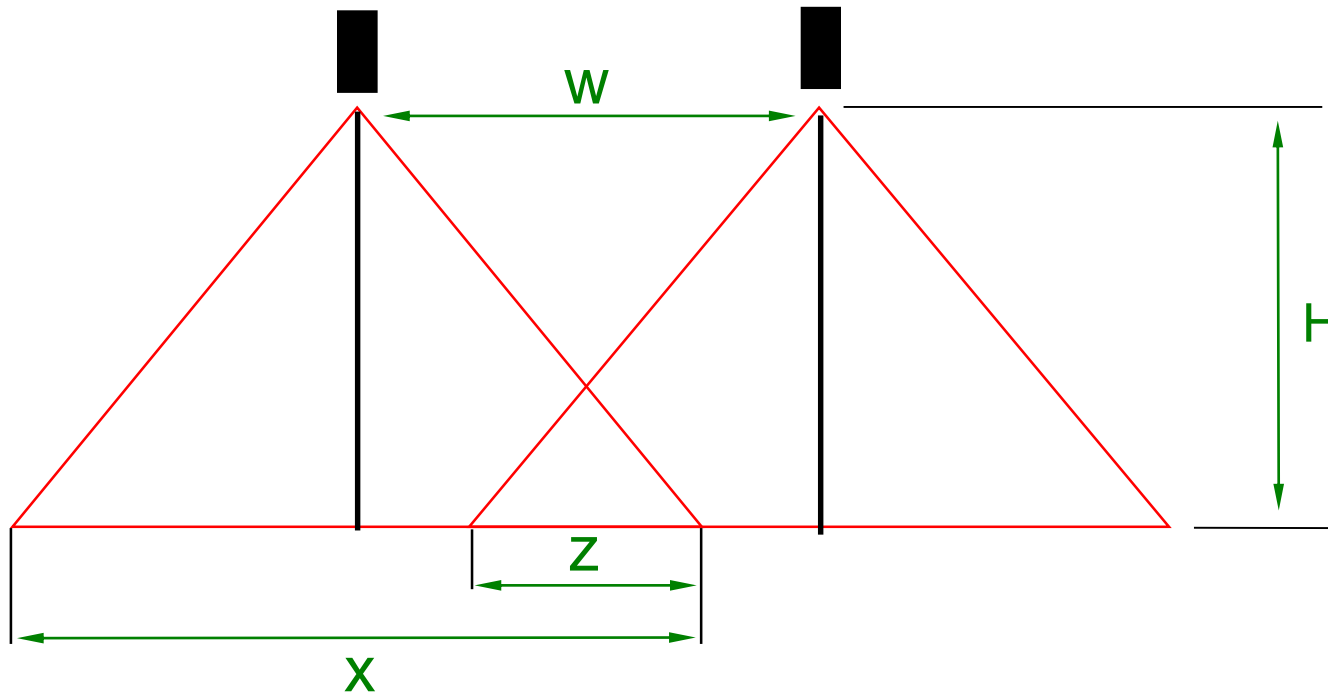


Nozzle Overlap

80° Spray Angle = ? Percentage Overlap

- $X = 28''$
- $W = 20''$
- $Z = (28-20)/20*100$
- $Z = 40\%$

~ Width = ~ Height

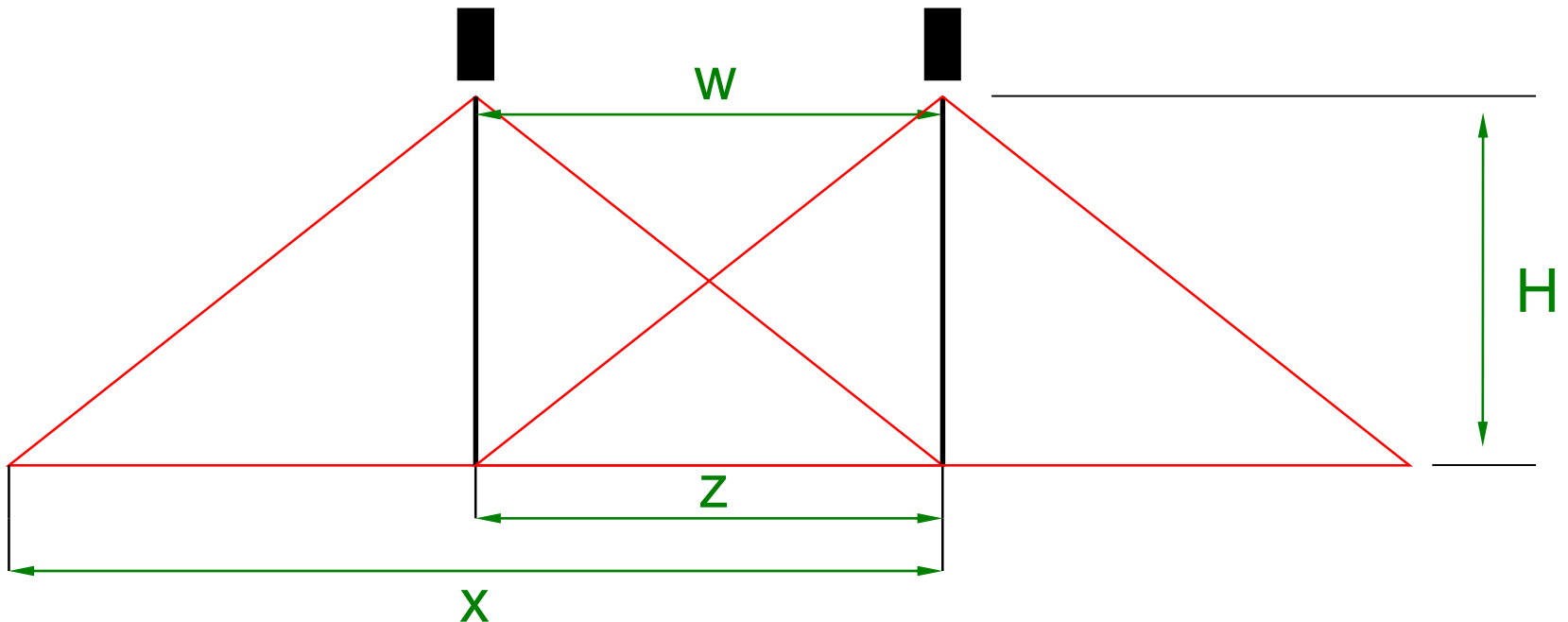


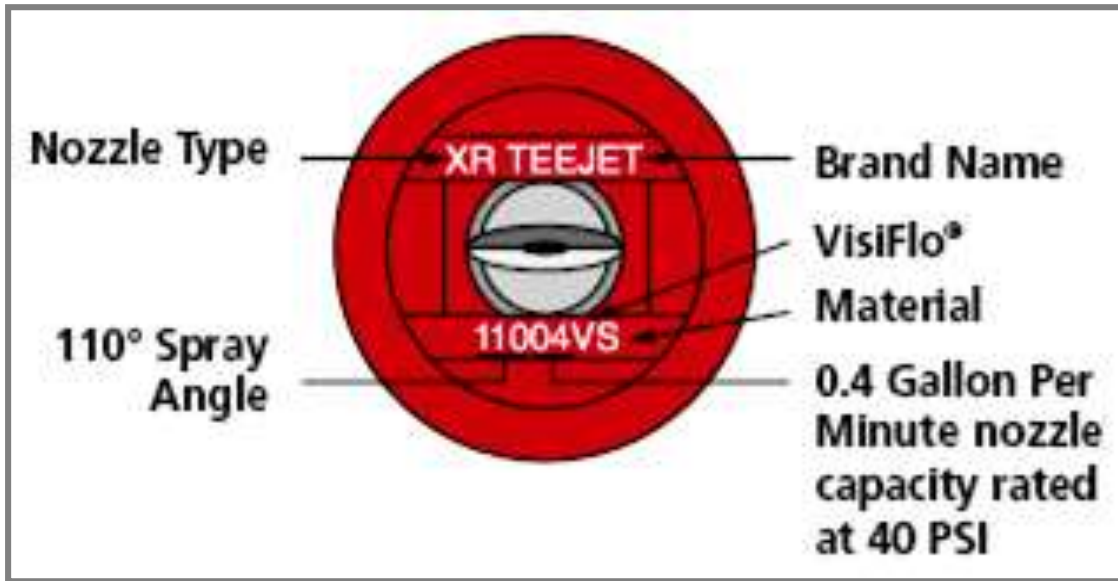
Nozzle Overlap




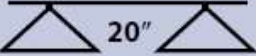
110° Spray Angle = ? Percentage Overlap

- $X = 40''$
- $W = 20''$
- $Z = (40-20)/20*100$
- $Z = 100\%$

~ Width = ~ Height









 	 PSI	DROP SIZE		CAPACITY ONE NOZZLE IN GPM	CAPACITY ONE NOZZLE IN OZ./MIN.	 20"										GALLONS PER 1000 SQ. FT.			
		80°	110°			GPA													
						4 MPH	5 MPH	6 MPH	8 MPH	10 MPH	12 MPH	15 MPH	20 MPH	2 MPH	3 MPH	4 MPH	5 MPH		
XR8001 XR11001 (100)	15	M	F	0.061	7.8	4.5	3.6	3.0	2.3	1.8	1.5	1.2	0.91	0.21	0.14	0.10	0.08		
	20	F	F	0.071	9.1	5.3	4.2	3.5	2.6	2.1	1.8	1.4	1.1	0.24	0.16	0.12	0.10		
	30	F	F	0.087	11	6.5	5.2	4.3	3.2	2.6	2.2	1.7	1.3	0.30	0.20	0.15	0.12		
	40	F	F	0.10	13	7.4	5.9	5.0	3.7	3.0	2.5	2.0	1.5	0.34	0.23	0.17	0.14		
	50	F	VF	0.11	14	8.2	6.5	5.4	4.1	3.3	2.7	2.2	1.6	0.37	0.25	0.19	0.15		
	60	F	VF	0.12	15	8.9	7.1	5.9	4.5	3.6	3.0	2.4	1.8	0.41	0.27	0.20	0.16		
XR80015 XR110015 (100)	15	M	F	0.092	12	6.8	5.5	4.6	3.4	2.7	2.3	1.8	1.4	0.31	0.21	0.16	0.13		
	20	M	F	0.11	14	8.2	6.5	5.4	4.1	3.3	2.7	2.2	1.6	0.37	0.25	0.19	0.15		
	30	F	F	0.13	17	9.7	7.7	6.4	4.8	3.9	3.2	2.6	1.9	0.44	0.29	0.22	0.18		
	40	F	F	0.15	19	11.1	8.9	7.4	5.6	4.5	3.7	3.0	2.2	0.51	0.34	0.26	0.20		
	50	F	F	0.17	22	12.6	10.1	8.4	6.3	5.0	4.2	3.4	2.5	0.58	0.39	0.29	0.23		
	60	F	F	0.18	23	13.4	10.7	8.9	6.7	5.3	4.5	3.6	2.7	0.61	0.41	0.31	0.24		

Air Induction Spray Nozzles



 	 PSI	CAPACITY ONE NOZZLE IN GPM	CAPACITY ONE NOZZLE IN OZ./MIN.	 20°											
				GPA								GALLONS PER 1000 SQ. FT.			
				4 MPH	5 MPH	6 MPH	8 MPH	10 MPH	12 MPH	15 MPH	20 MPH	2 MPH	3 MPH	4 MPH	5 MPH
AI11005 (50)	30	0.43	55	32	26	21	16.0	12.8	10.6	8.5	6.4	1.5	0.97	0.73	0.58
	40	0.50	64	37	30	25	18.6	14.9	12.4	9.9	7.4	1.7	1.1	0.85	0.68
	50	0.56	72	42	33	28	21	16.6	13.9	11.1	8.3	1.9	1.3	0.95	0.76
	60	0.61	78	45	36	30	23	18.1	15.1	12.1	9.1	2.1	1.4	1.0	0.83
	70	0.66	84	49	39	33	25	19.6	16.3	13.1	9.8	2.2	1.5	1.1	0.90
	80	0.71	91	53	42	35	26	21	17.6	14.1	10.5	2.4	1.6	1.2	0.97
	90	0.75	96	56	45	37	28	22	18.6	14.9	11.1	2.6	1.7	1.3	1.0
100	0.79	101	59	47	39	29	23	19.6	15.6	11.7	2.7	1.8	1.3	1.1	
AI11006 (50)	30	0.52	67	39	31	26	19.3	15.4	12.9	10.3	7.7	1.8	1.2	0.88	0.71
	40	0.60	77	45	36	30	22	17.8	14.9	11.9	8.9	2.0	1.4	1.0	0.82
	50	0.67	86	50	40	33	25	19.9	16.6	13.3	9.9	2.3	1.5	1.1	0.91
	60	0.73	93	54	43	36	27	22	18.1	14.5	10.8	2.5	1.7	1.2	0.99
	70	0.79	101	59	47	39	29	23	19.6	15.6	11.7	2.7	1.8	1.3	1.1
	80	0.85	109	63	50	42	32	25	21	16.8	12.6	2.9	1.9	1.4	1.2
	90	0.90	115	67	53	45	33	27	22	17.8	13.4	3.1	2.0	1.5	1.2
100	0.95	122	71	56	47	35	28	24	18.8	14.1	3.2	2.2	1.6	1.3	
AI11008 (50)	30	0.69	88	51	41	34	26	20	17.1	13.7	10.2	2.3	1.6	1.2	0.94
	40	0.80	102	59	48	40	30	24	19.8	15.8	11.9	2.7	1.8	1.4	1.1
	50	0.89	114	66	53	44	33	26	22	17.6	13.2	3.0	2.0	1.5	1.2
	60	0.98	125	73	58	49	36	29	24	19.4	14.6	3.3	2.2	1.7	1.3
	70	1.06	136	79	63	52	39	31	26	21	15.7	3.6	2.4	1.8	1.4
	80	1.13	145	84	67	56	42	34	28	22	16.8	3.8	2.6	1.9	1.5
	90	1.20	154	89	71	59	45	36	30	24	17.8	4.1	2.7	2.0	1.6
100	1.26	161	94	75	62	47	37	31	25	18.7	4.3	2.9	2.1	1.7	

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

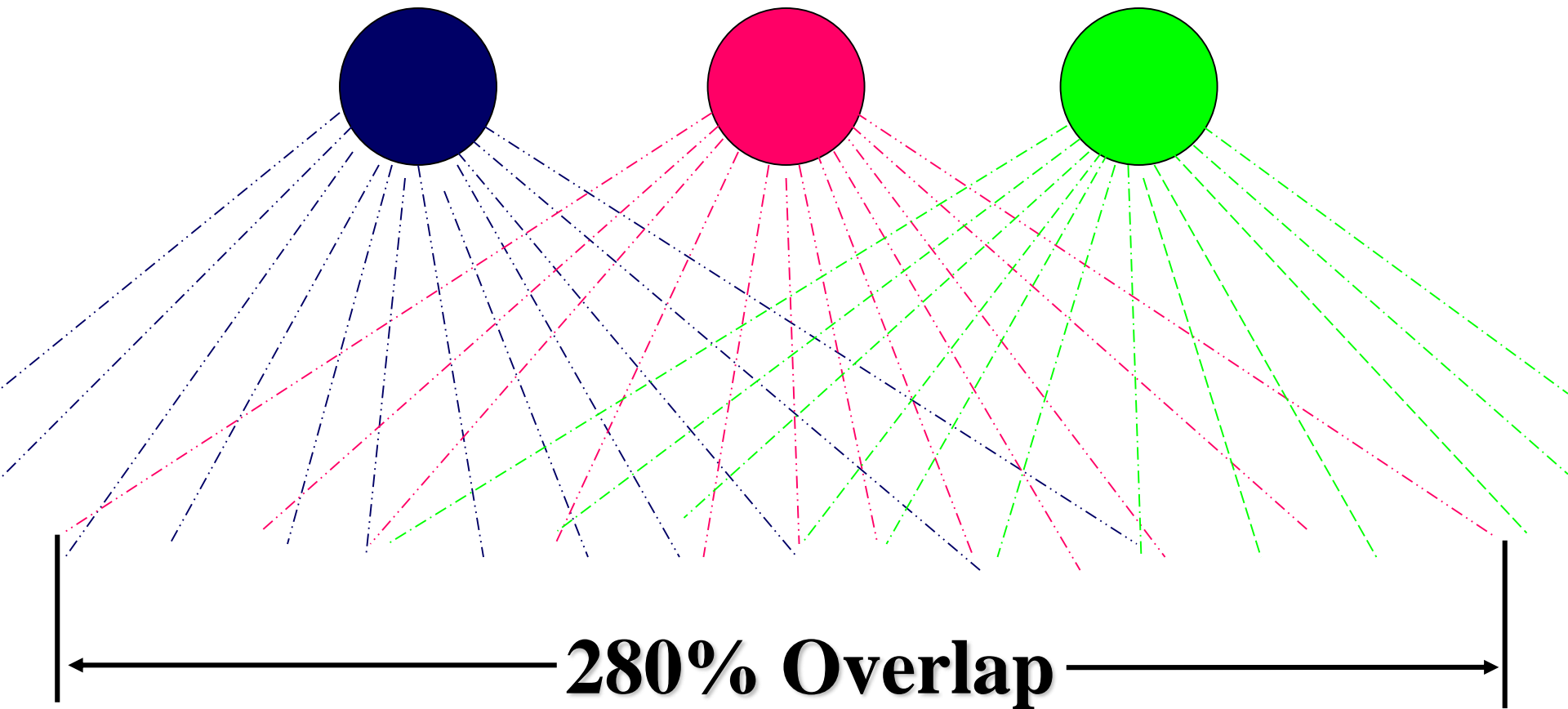
Pressure Range: 25psi - 75psi



Turbo TurfJet Nozzle Pattern

20" Height / 20" Width

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



Mode of Action

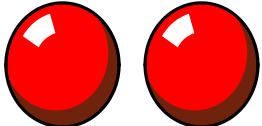
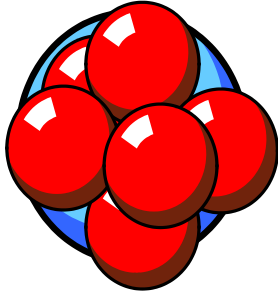
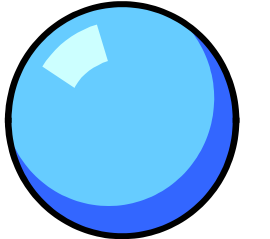
- ***Contact***
- ***Systemic***
- ***Penetrant***

Turf Fungicides
Systemic Mode of Action

Single-site (17)	Multi-site (7)
Heritage	Aliette
Accost	Chipco 26019
Apron	Chipco Signature
Banner Maxx	Curalan
Bayleton	Prodigy
Cavalier	Prostar
Compass	Touche
Eagle	
Engage	
Fungo 50	
Patchwork	
Revere	
Rubigan	
Subdue Maxx	
Terrachlor	
T-Methyl E-Pro	
Turfcide	

Nozzle Orifice Size

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



Fills in the gaps

Driftable Fine

Nozzle Type (0.50 GPM Flow)	Approximate Percent of Spray Volume Less Than 200 Microns	
	15 PSI	40 PSI
XR TeeJet® 110°	14%	22%
XR TeeJet 80°	6%	12%
DG TeeJet 110°	N/A	11%
DG TeeJet 80°	N/A	7%
TT – Turbo TeeJet®	<1%	<6%
TF – Turbo FloodJet®	<1%	<1%
AI TeeJet® 110°	N/A	<1%

Comparison of Droplet Size



XR Flat-fan



Air-induction



TurfJet

	Herbicides				Fungicides		Insecticides	
	Soil Incorporated	Pre-Emergence	Post-Emergence		Contact	Systemic	Contact	Systemic
			Contact	Systemic				
Extended Range Flat Spray			Excellent	Good	Excellent	Good	Excellent	Good
Extended Range Flat Spray <i>at pressures below 30 PSI (2 bar)</i>	Good	Good	Good	Very Good	Good	Very Good	Good	Very Good
Wide Angle Pre-orifice Flat Spray			Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
Wide Angle Pre-orifice Flat Spray <i>at pressures below 30 PSI (2 bar)</i>	Good	Good	Good	Excellent	Good	Excellent	Good	Excellent
Air Induction Flat Spray	Very Good	Very Good	Good	Excellent	Good	Excellent	Good	Excellent
Twin Flat Spray			Excellent		Excellent		Excellent	
Wide Angle Pre-orifice Flood Spray	Excellent	Excellent		Very Good		Very Good		Very Good



Extended Range Flat Spray



Wide Angle Pre-orifice Flat Spray



Air Induction Flat Spray



Twin Flat Spray



Wide Angle Pre-orifice Flood Spray

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

Easy Method Sprayer Calibration

128th Acre Test

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 / Nozzle Spacing in Inches = Test Course in Feet) **e: 4080 / 20 in = 204 ft**
5. Drive the test course at your normal spraying speed and record travel time in seconds. **e: 40 sec... 204 ft = 3.5 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.
(**Example:** 45 ounces collected equals 45 GPA application rate)

Easy Method Sprayer Calibration

Nozzle Spacing - Test Course Chart

Nozzle Spacing (Inches)	Test Course Length (Feet)
20	204
18	227
16	255
14	291
12	340
10	408

**$4080 / \text{Nozzle Spacing in Inches} =$
Test Course Length in Feet**



Toro Sprayer Calibration Tool

<http://www.toro.com/en-us/customer-support/pages/educational-technical-references/sprayer-calibration/spray-calibration.aspx>



Toro Sprayer Calibration.Ink

Education and Technical Reference

[Service Reference CD-ROM](#)
[Operator and Safety Training](#)
[Service Training Guides](#)
[Service Training Center](#)
[Spray Calibration Tool](#)
[Purchase Education Materials](#)
[Service Tips](#)
[Service Manuals](#)

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.).



Toro Sprayer Calibration Tool

**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



Company Information

Company Name - Highland Country Club
 Address 1 - 21348 Highland Road
 City - Bellevue
 State - MN Zip Code - 66234

Phone Number - 555-333-8888
 Date - 9/16/12

Applicator Name: John Smith
 License No: BR-549
 Product to be applied: Daconil

Nozzle Uniformity Screen Results

Variation Percentage - 5 %
 Catch Time - 30 Seconds
 Pressure - 40 P.S.I

Nozzle Catch Test Results

Nozzle 1 - 40 Ozs
 Nozzle 2 - 38 Ozs
 Nozzle 3 - 38 Ozs
 Nozzle 4 - 40 Ozs
 Nozzle 5 - 38 Ozs
 Nozzle 6 - 40 Ozs
 Nozzle 7 - 37 Ozs
 Nozzle 8 - 38 Ozs
 Nozzle 9 - 38 Ozs
 Nozzle 10 - 40 Ozs
 Nozzle 11 - 40 Ozs

Nozzle Output

Average Output - 38.77 Ozs
 Minimin Allowable - 36.83 Ozs
 Maximum Allowable - 40.70 Ozs
 G.P.M per Nozzle - 0.61 G.P.M

Results from Speed Calculator Screen

Distance Traveled in Feet - 200
 Time in Seconds - 34.1
 M.P.H - 4
 G.P.A Output - 45.3 G.P.A
 G.P.K Output - 1.04 G.P.K

Results from Rate Calculator Screen

G.P.M per Nozzle - 0.61 G.P.M
 M.P.H - 4 M.P.H
 Nozzle Spacing - 20 Inches
 G.P.K Output - 1.04 G.P.K
 G.P.A Output - 45.3 G.P.A

Results from Calibration / Tank Mixing Screen

Product Label Rate (Ounces per 1000 Square Feet) - 4 Ozs
 Actual Sprayer Calibration rate (Gallons per 1000 Square feet) - 1.04 Gals
 Area to be Sprayed (in 1000 SqFt) - 80.15
 Area to be Sprayed (in Acres) - 1.84 Acres
 Ounces of Product per gallon of water - 3.846 Ozs
 Total Water Required - 83.356 Gals
 Total Product Required (In Ounces) - 320.6 Ozs
 Total Product Required (In Gallons) - 2.50 Gals

Results from Multiple Tank Mixing Screen

Tank 1 to 1
 Sprayer Tank Capacity - 50 Gals
 Total Water required - 83.356 Gals
 Total Water per Tank - 50Gals
 Ounces per Gallon - 3.846 Ozs
 Ounces of Product per Tank - 192.3 Ozs
 Gallons of Product per Tank - 1.5 Gals

Tank 2
 Total Water per Tank - 33.356Gals
 Ounces per Gallon - 3.846 Ozs
 Ounces of Product per Tank - 128.287176 Ozs
 Gallons of Product per Tank - 1 Gal

Results from Nozzle Selection Screen

Desired Application Rate (Gallons per 1000 Square Feet) - 1.04 G.P.K
 Application Speed - 4 M.P.H
 Nozzle Spacing - 20 Inches
 Gallons per Minute (Per Nozzle) - 0.61 G.P.M
 Maximum Gallons per Minute (Per Nozzle) - 0.64 G.P.M
 Minimum Gallons per Minute (Per Nozzle) - 0.58 G.P.M

Notes from Information Screen

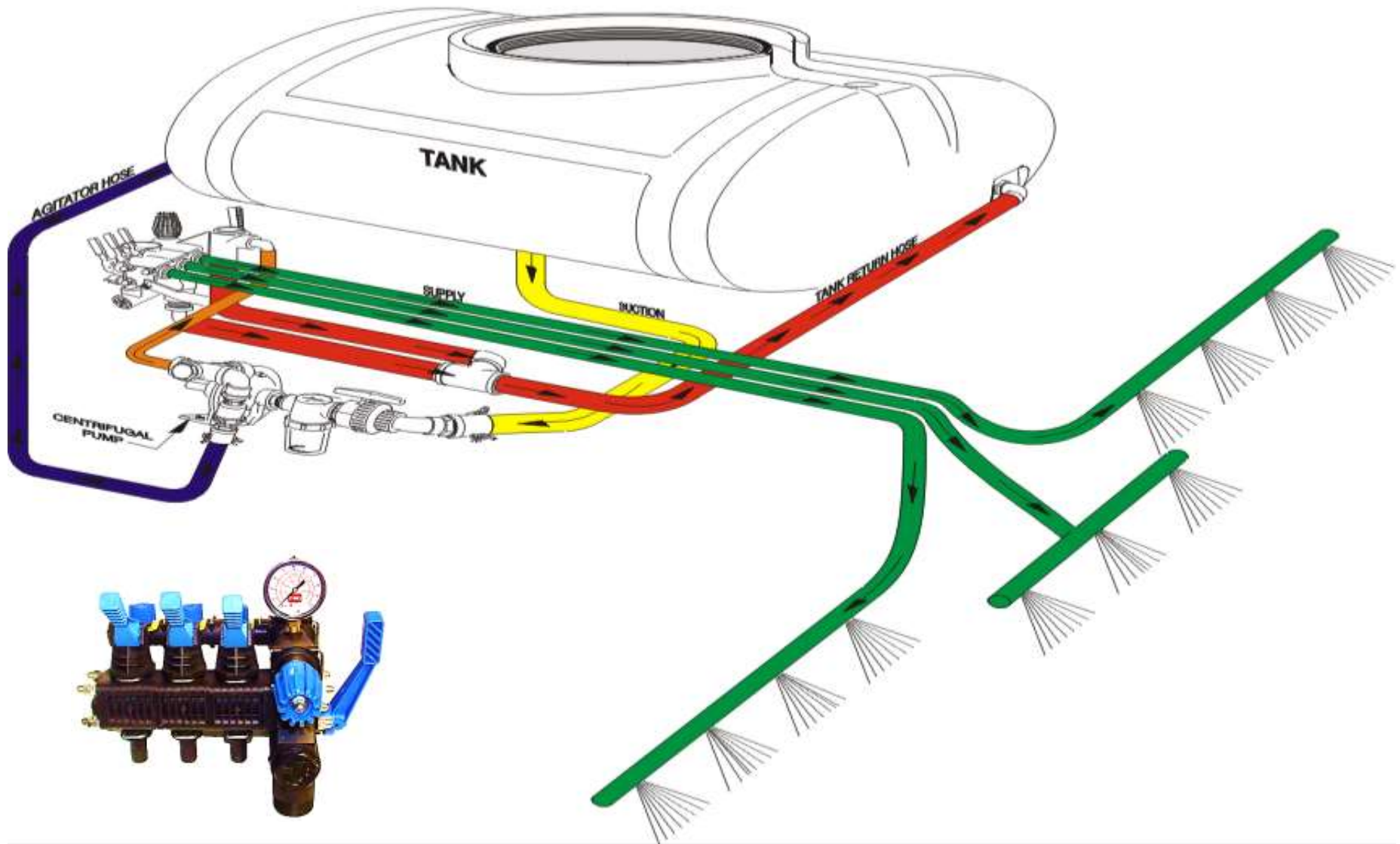
Notes: 70 degrees, Slightly Windy, Applied 4 ozs. per GPK.
 Sprayed Green and Tees. No Disease Present.

Sprayer Systems and Components

MANUAL VALVE SPRAY SYSTEM

Fixed Speed w/ Centrifugal Pump

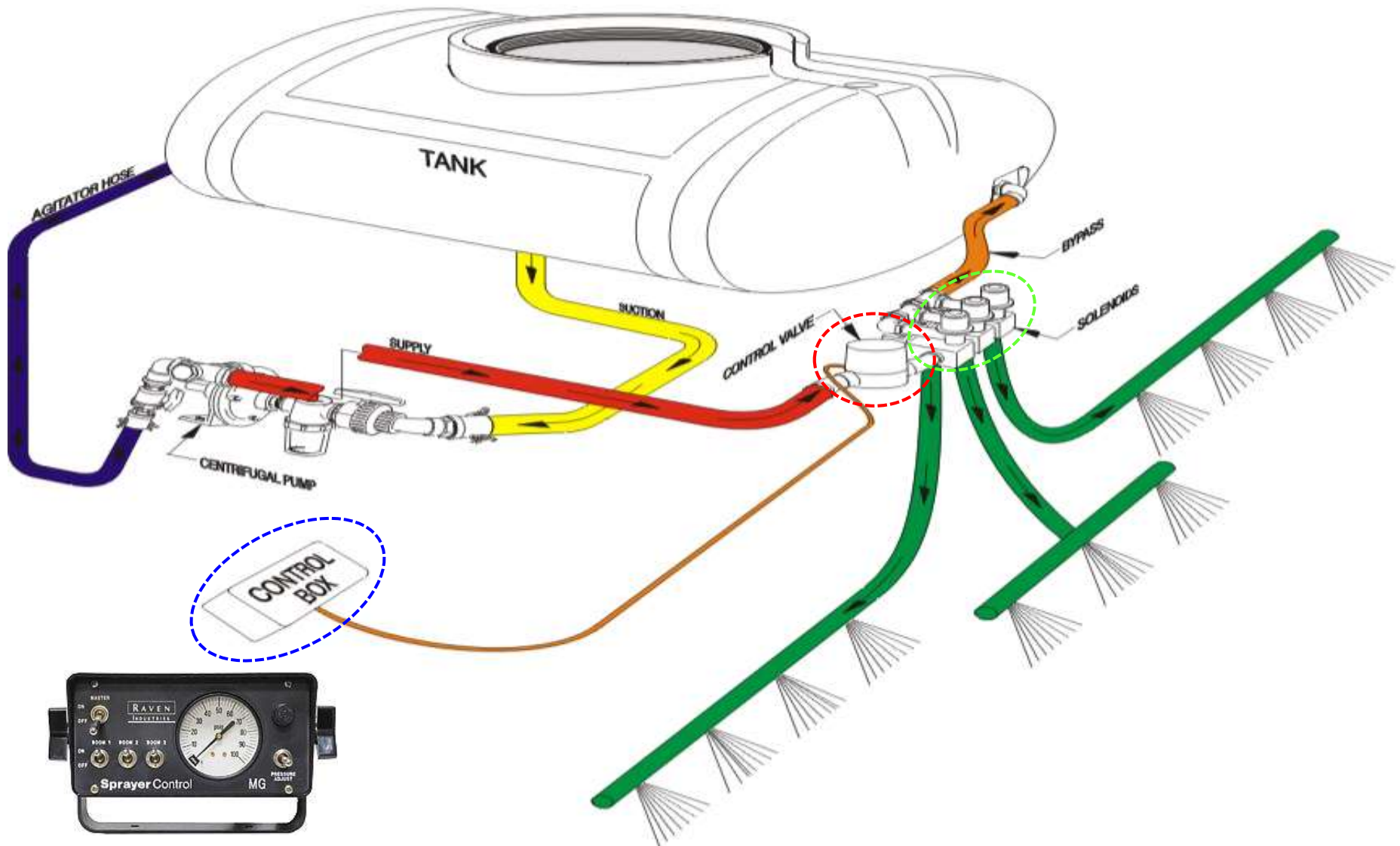
Plumbing Schematic



STANDARD ELECTRIC SPRAY SYSTEM

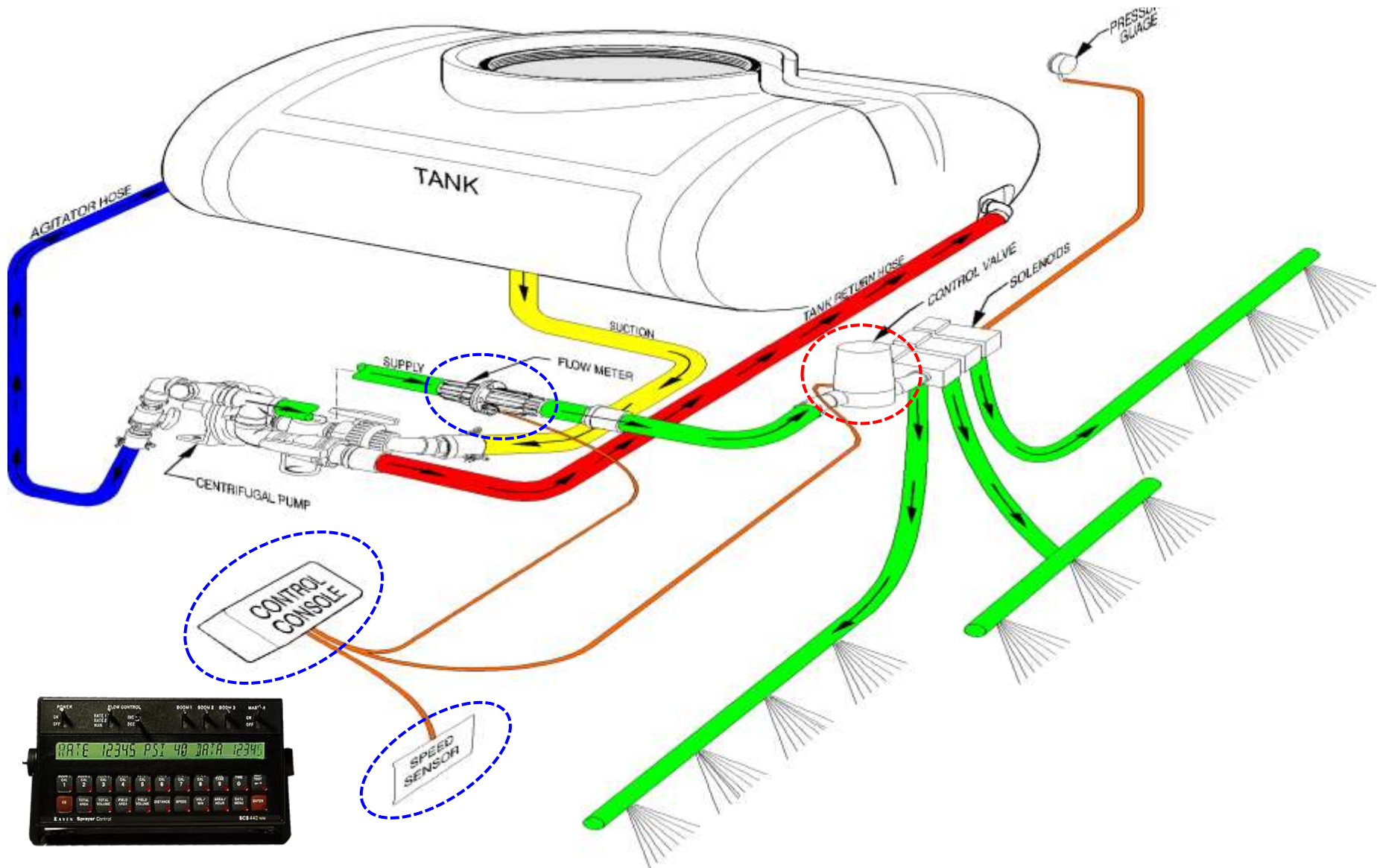
Fixed Speed w/ Centrifugal Pump

Plumbing Schematic



COMPUTER CONTROL SPRAY SYSTEM

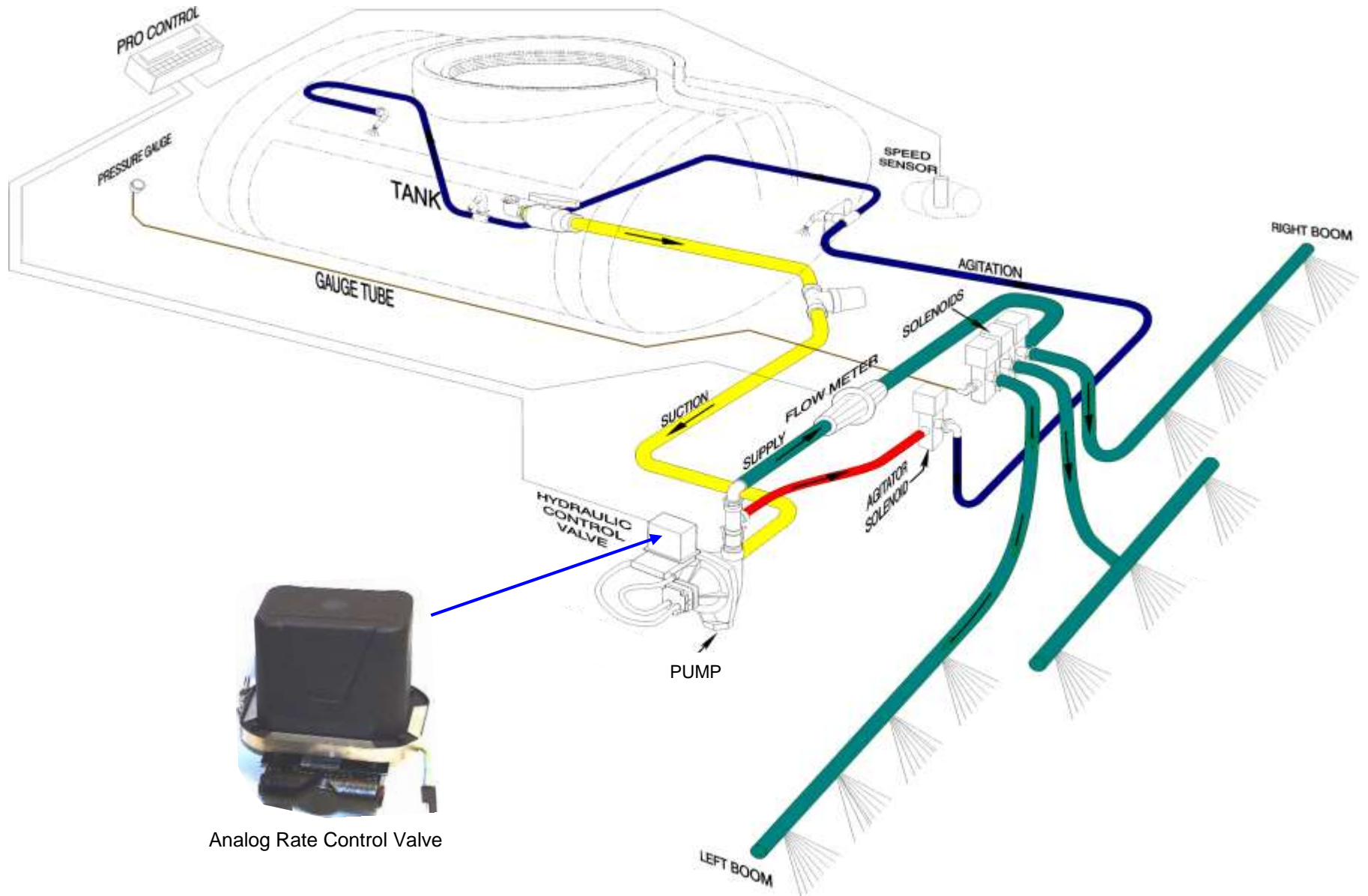
Variable Speed within a Fixed Gear w/ Centrifugal Pump Plumbing Schematic



COMPUTER CONTROL SPRAY SYSTEM

Hydrostatic Drive w/ Centrifugal Pump

Plumbing Schematic

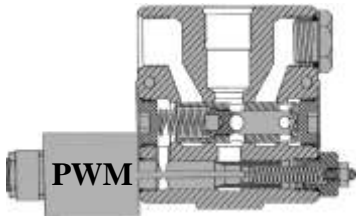
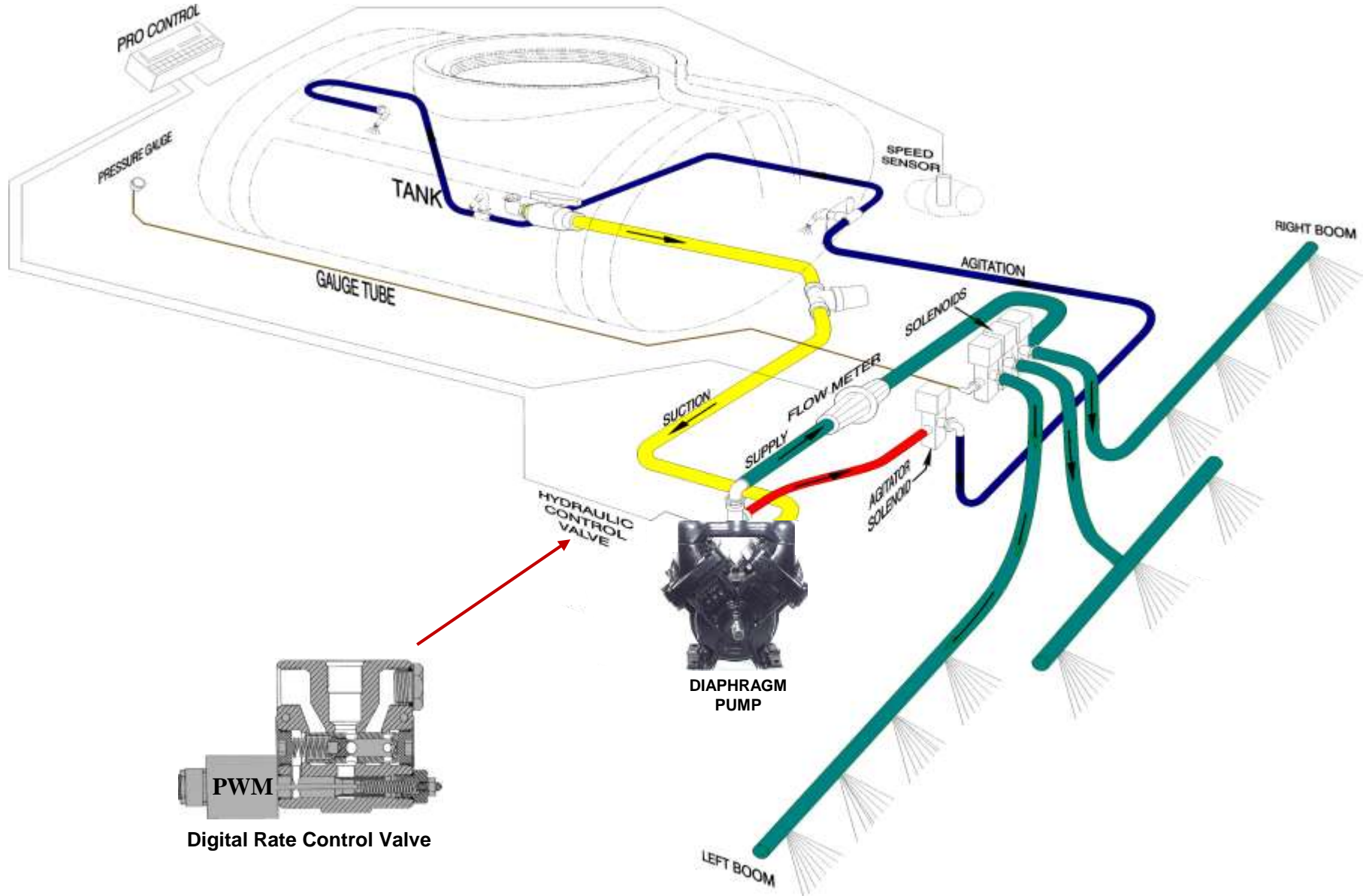


Analog Rate Control Valve

COMPUTER CONTROL SPRAY SYSTEM

Hydrostatic Drive w/ Diaphragm Pump

Plumbing Schematic



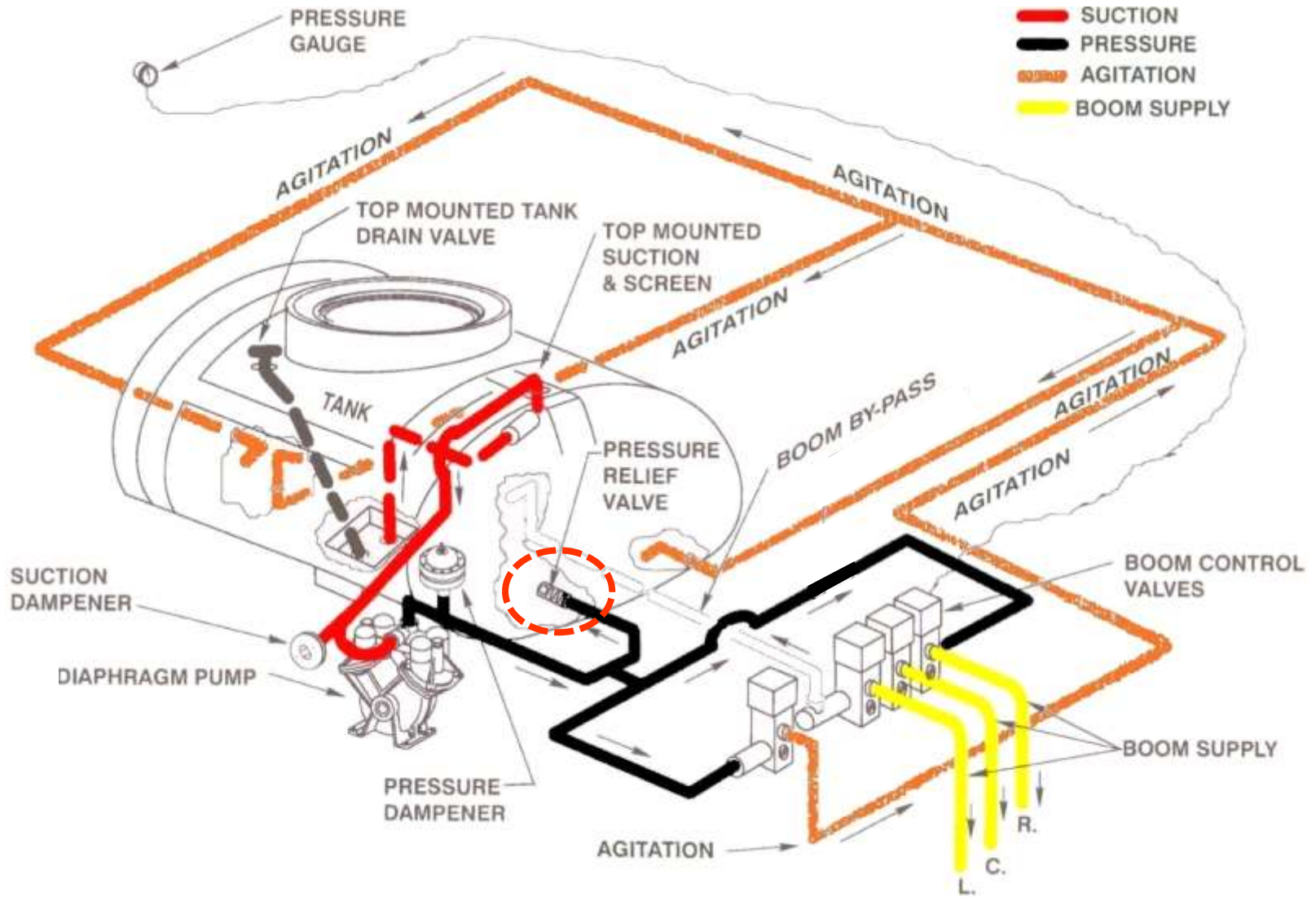
Digital Rate Control Valve

DIAPHRAGM PUMP SPRAY SYSTEM

Plumbing Schematic

High Pressure Relief Valve

(relief valve opens @ 220psi)





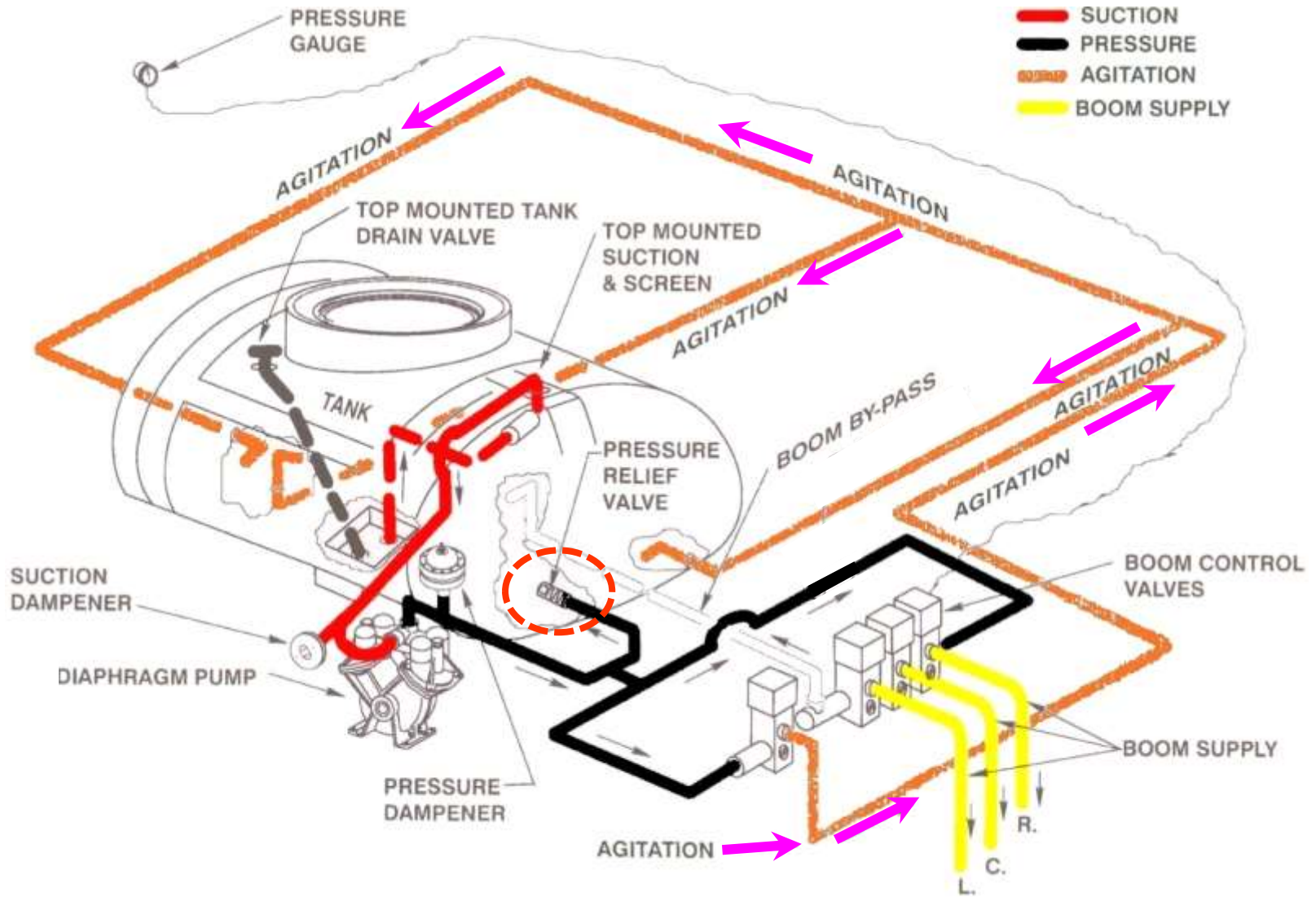
Pesticide obstruction located in pressure relief hose

DIAPHRAGM PUMP SPRAY SYSTEM

Plumbing Schematic

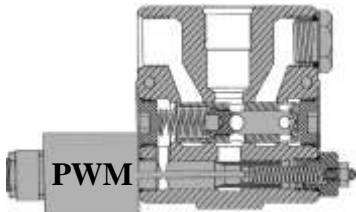
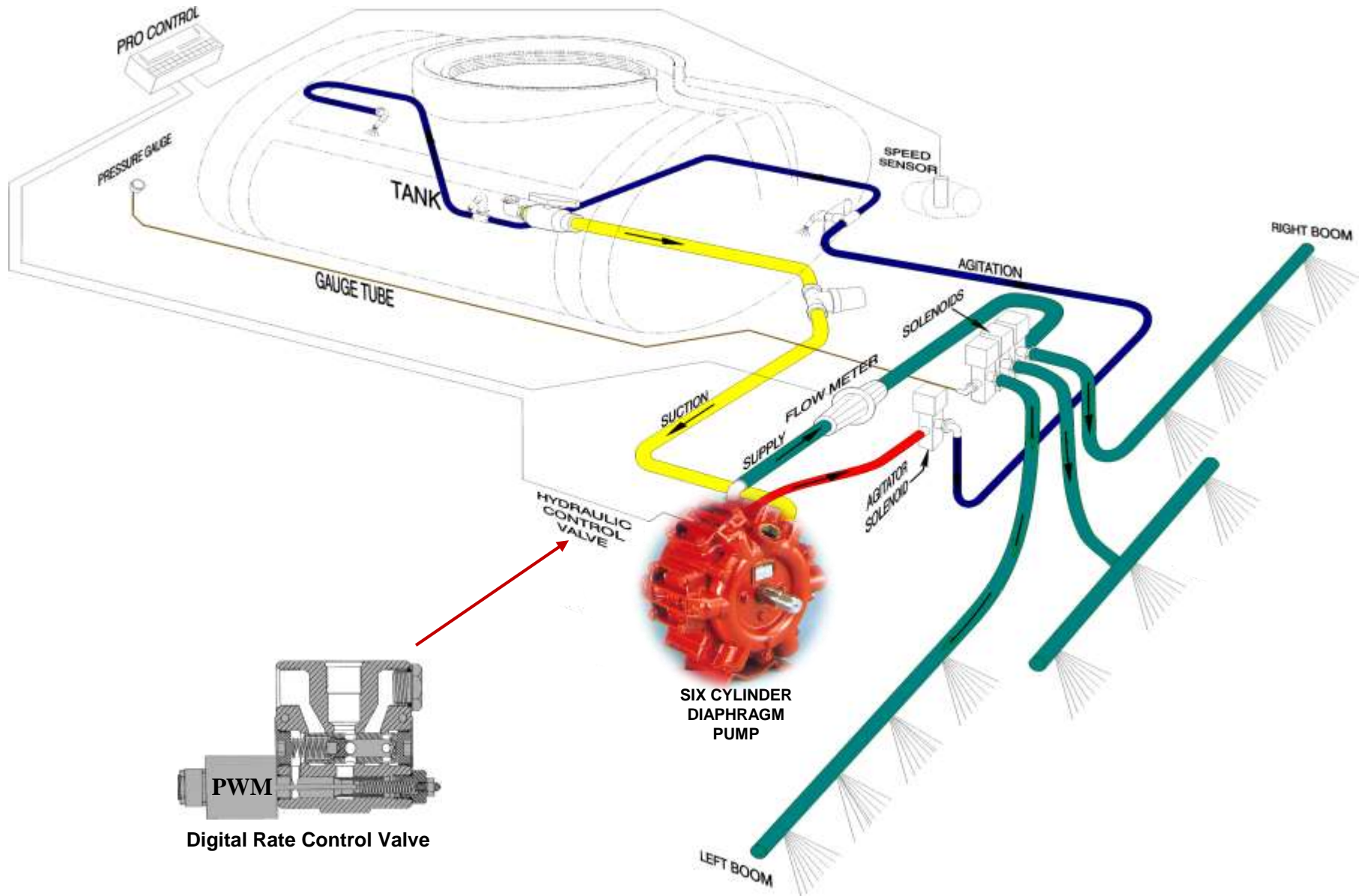
High Pressure Relief Valve

(relief valve opens @ 220psi)



Toro MultiPro 5800 Spray System w/ Six Diaphragm Pump

Plumbing Schematic



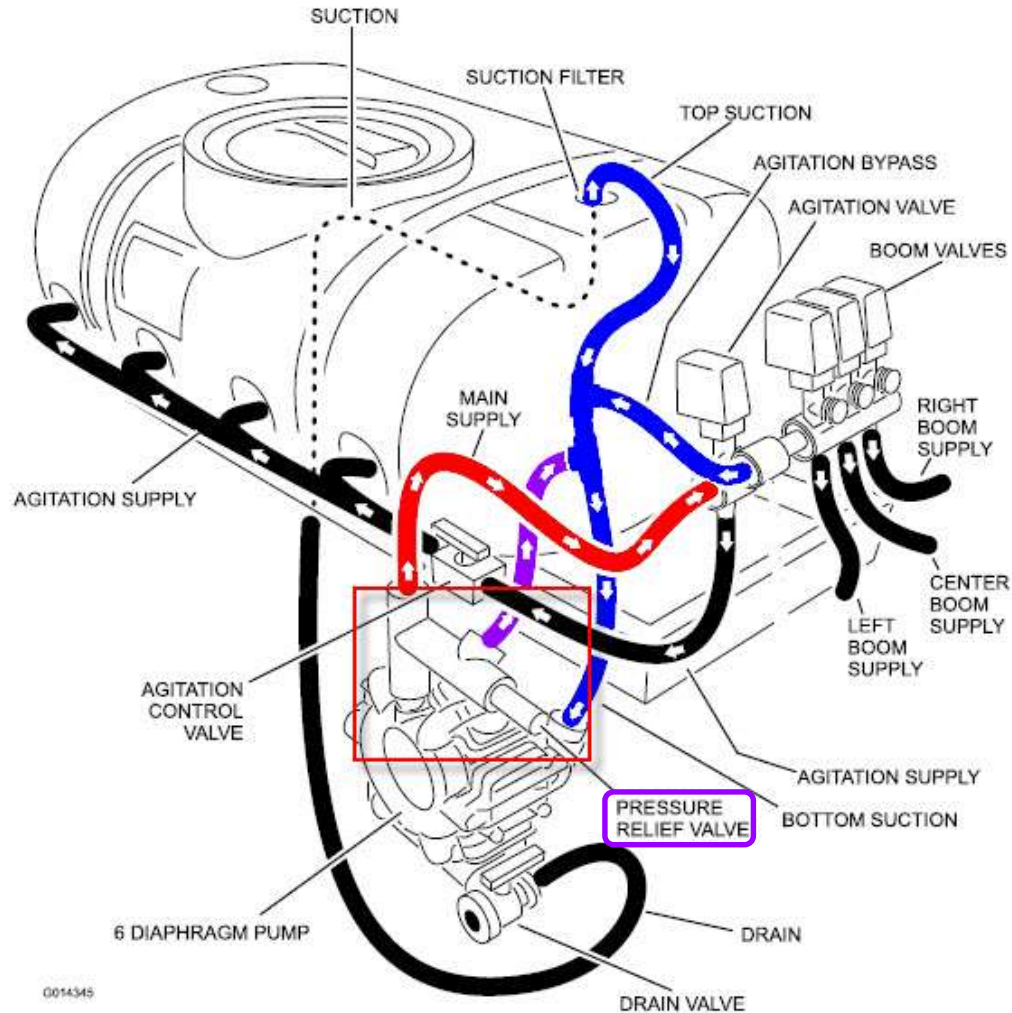
Digital Rate Control Valve

Toro MultiPro 5800 Spray System

Plumbing Schematic

High Pressure Relief Valve

(relief valve opens @ 220psi)



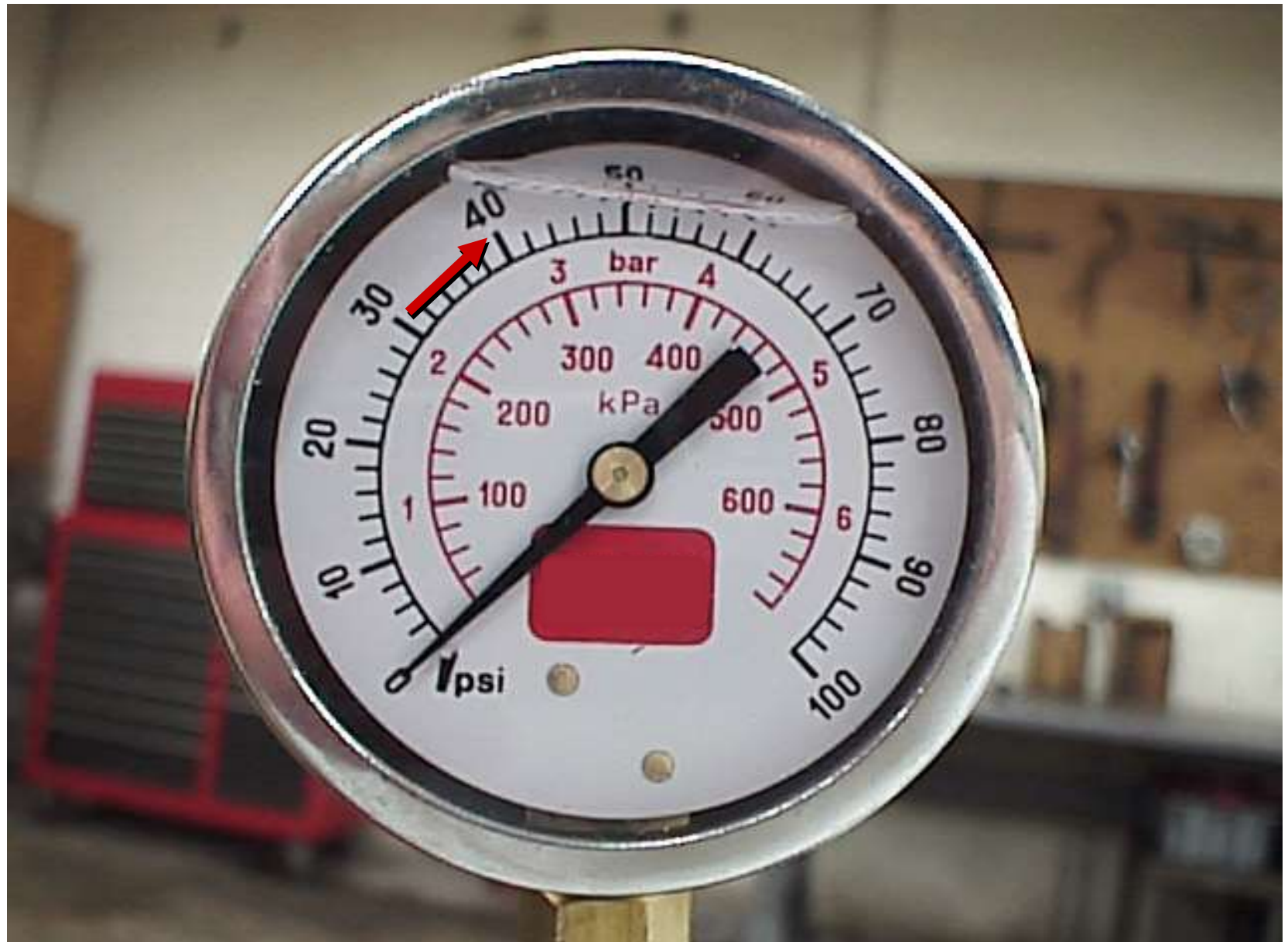
Pump On – Relief Valve Open

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!*



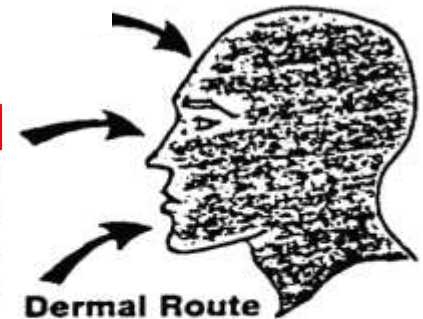
Pesticide Exposure

PERSONAL HEALTH AND SAFETY

ROUTES OF PESTICIDE EXPOSURE

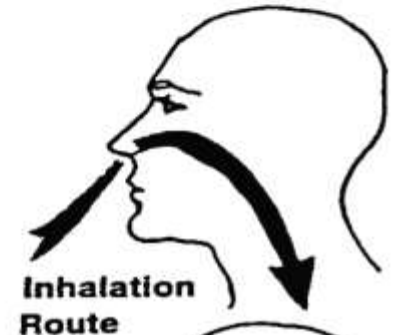
A. DERMAL (or through the skin)

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).



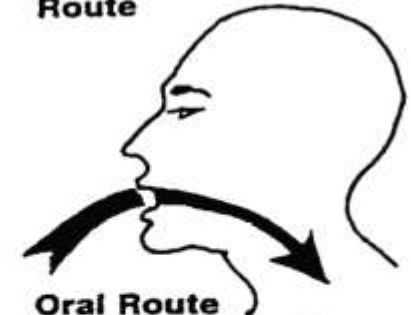
B. INHALATION (or breathed into the lungs)

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.



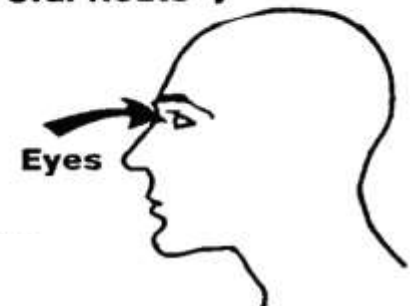
C. ORAL (or through the mouth)

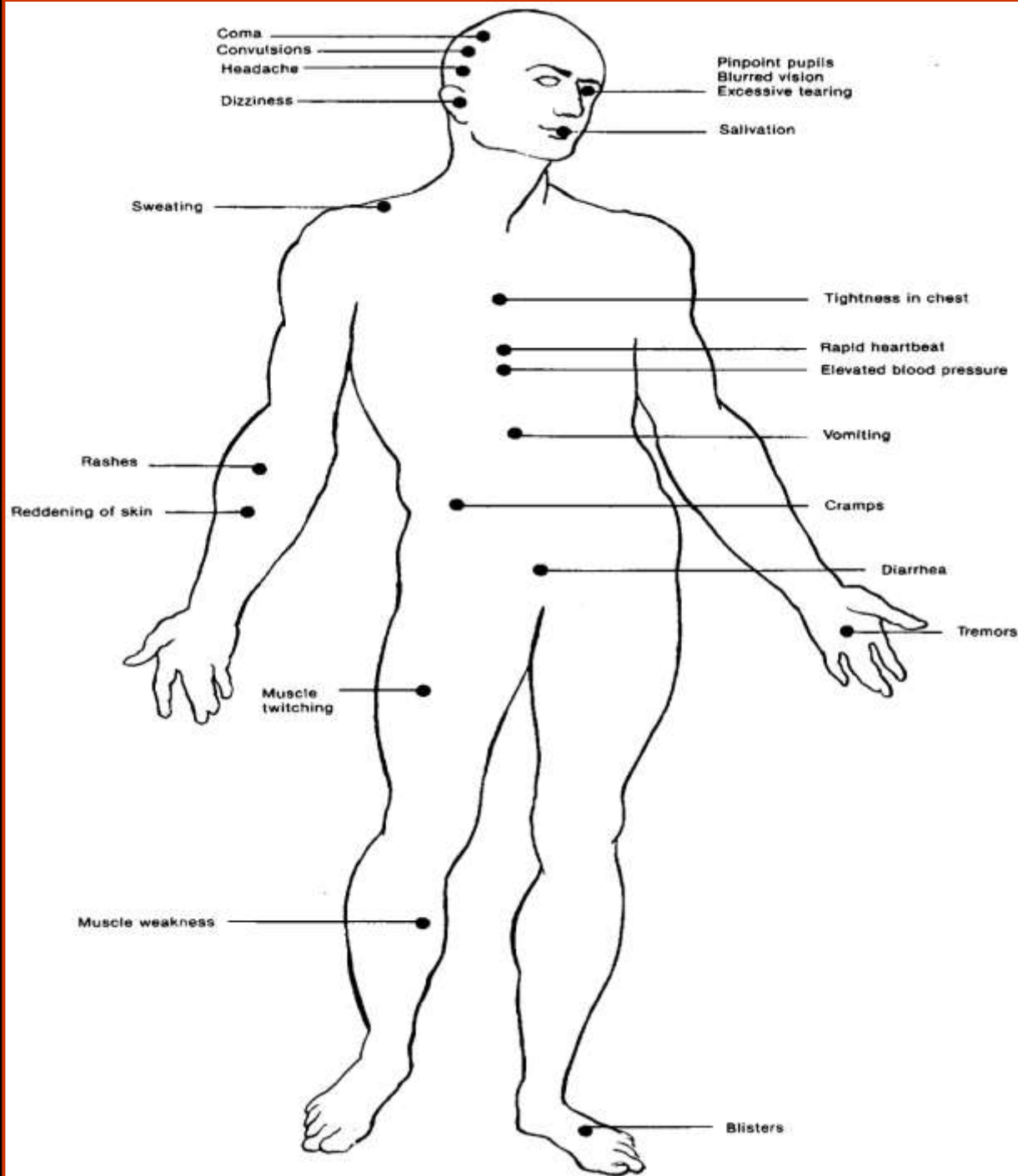
More often than not, children are the victims of this type of exposure, greatly due to a careless applicator or even a parent, who has removed a pesticide from it's original container and put it into an unmarked bottle or a food-type storage container. However, for our purpose here, one must realize 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,





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.

USER SAFETY RECOMMENDATIONS: Users should: wash hands before eating, drinking, chewing gum, using tobacco, or using the toilet; remove clothing immediately if pesticide gets inside, wash thoroughly, and put on clean clothing; remove PPE immediately after handling this product. Wash the outside of gloves before removing. As soon as possible, wash thoroughly and change into clean clothing.

• 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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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.

• 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.

USER SAFETY RECOMMENDATIONS: Users should: wash hands before eating, drinking, chewing gum, using tobacco, or using the toilet; remove clothing immediately if pesticide gets inside, wash thoroughly, and put on clean clothing; remove PPE immediately after handling this product. Wash the outside of gloves before removing. As soon as possible, wash thoroughly and change into clean clothing.

Personal Protective Equipment

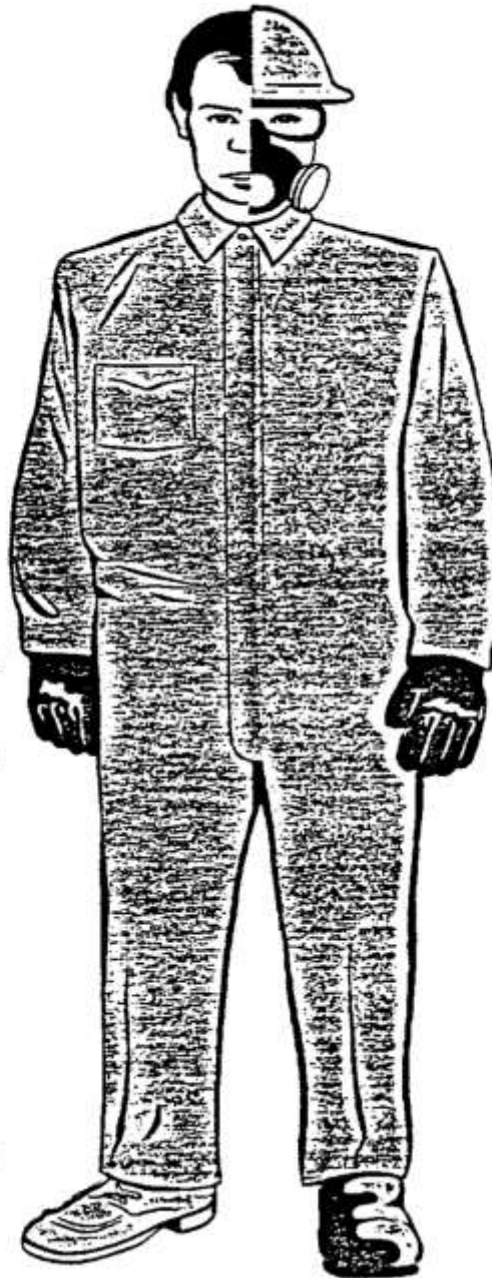
Minimum Exposure

(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

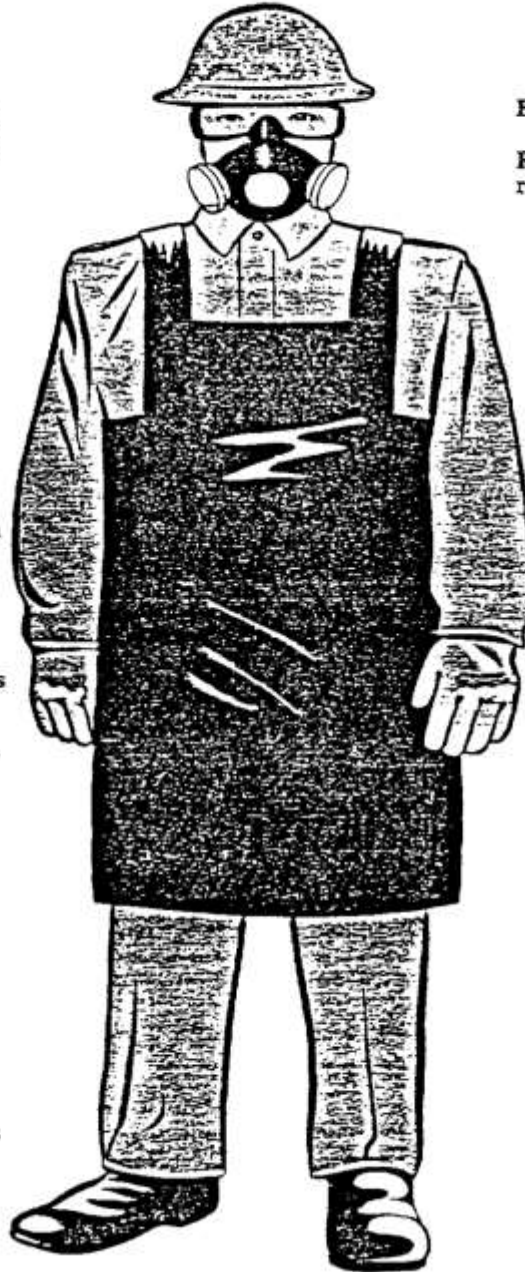
This is the *minimum* protective clothing and equipment you should wear while mixing and loading pesticides which are moderately to highly toxic.

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)



Face shield or goggles

Respirator (If the label requires it)

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



Anti-Siphon Tank Fill

Club Car

1000 Cultivation



MSDS

(Material Safety Data Sheet)

MATERIAL SAFETY DATA SHEET

PRODUCT IDENTIFICATION

Product Name:

Product Code: 4532 (2 x 2.5 gal)
4535 (55 gal)

EPA Registration Number: 1001-14

Chemical Names: Disodium methanearsonate, anhydrous

Synonyms: DSMA

INGREDIENT INFORMATION

Active Ingredient (CAS #)	Percent
Disodium methanearsonate, 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 (20 C): 1.210 @ 20 C

Vapor Pressure (@ 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

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.

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

Other Toxic Effects: N/A

TOXICITY DATA:

ORAL (acute):	LD ₅₀ (rat) 3.6 g/kg
DERMAL (acute):	LD ₅₀ (rabbit) 10 g/kg
INHALATION (acute):	LD ₅₀ (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-impervious gloves.

Eye Protection: Full face shield.

Ventilation: For outdoor use only.

Respiratory Protection: Mask or respirate 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, NOI, 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

MATERIAL SAFETY DATA SHEET

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pH: 8-9

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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

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INHALATION (acute):	LD ₅₀ (rat) >22.1 mg/L

CHRONIC:

SUBCHRONIC:

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ACUTE: Moderate

CHRONIC: Moderate

FIRE: Low

REACTIVE: Low

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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:

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.

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

- (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

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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 (20 C): 1.210 @ 20 C

Vapor Pressure (@ 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

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.

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Other Toxic Effects: N/A

TOXICITY DATA:

ORAL (acute): LD₅₀ (rat) 3.6 g/kg

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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-impervious gloves.

Eye Protection: Full face shield.

Ventilation: For outdoor use only.

Respiratory Protection: Mask or respirate 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, NOI, 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

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.

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 ENVIROMENTAL HAZARDS** Toxic 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** **“WARNING”** Statement
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.
RESPIRTORY 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!**

Always!!!



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. Re-circulate 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.

Questions

Questions

Questions

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Questions

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Thank You!

Jim Nedin Consulting Services

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