A-G Appendices

Unit Conversion Table

Appendix A

Length	Approximate Conversion Factor	
centimetre (cm)	x 0.39	inches
metre (m)	x 3.28	feet
kilometre (km)	x 0.62	mile

Area

square metre (m^2)	x 10.76	square feet (ft^2)
hectare (ha)	x 2.5	acres
hectare (ha)	x 10,000	square metres (m^2)
square kilometre	x 0.3861	square mile
acre	x 43,560	square feet (ft^2)

Volume

US gallon	x 0.83	imperial gallon
litre (L)	x 0.035	cubic feet
	x 0.22	imperial gallon
cubic metre (m^3)	x 35.31	cubic feet
	x 1.31	cubic yard
	x 220	imperial gallon
	x 1,000	litres
cubic foot	x 6.24	imperial gallon

Weight

kilogram (kg)	x 2.2	pound
tonne (t)	x 1,000	kilogram
short ton	x 0.9	tonne (t)
short ton	x 2,000	pound

Agricultural

kilograms per hectare (kg/ha)	x 0.89	pounds per acre
kilograms per tonne (kg/t)	x 2	pounds per ton
kilograms per 1,000 litres (kg/1,000 L)	x 10	pounds per 1,000 gallons
tonnes per hectare (t/ha)	x 0.45	tons per acre
litres per hectare (L/ha)	x 0.089	imperial gallons per acre
litres per acre (L/ac)	x 0.22	imperial gallons per acre

Fertilizer

Phosphorous (P)	x 2.3	P_2O_5 (Phosphate)
Potassium (K)	x 1.2	K_2O (Potash)

Quick Look-up Conversion Table

Appendix A

Conversions for Solid Manure Samples

Dry weight to:	Wet weight	dry-weight value x (1 - (% moisture/100))
Percentage to:	kg/tonne	value (%) x 10
Percentage to:	lb/ton	value (%) x 20
kg/tonne to:	lb/ton	value (kg/tonne) x 2
mg/kg to:	kg/tonne	value (mg/kg)/1,000

Conversions for Liquid Manure Samples

Dry weight to:	Wet weight	dry-weight value x (1 - (% moisture/100))
Percentage to:	kg/m^3	value (%) x 10
kg/m^3 to:	kg/1,000 litres	kg/m^3 = kg/1,000 litres
Percentage to:	lb/1,000 gallons	value (%) x 100
kg/1,000 litres to:	lb/1,000 gallons	value (kg/1,000 litres) x 10
mg/L to:	kg/1,000 L	value (mg/kg)/1,000
What is ppm?	ppm = mg/kg = μg/g ppm = mg/L (assuming the density of water)	
L/ha	gal/ac	value (L/ha) / 11.23

Worksheet for Calculating Manure Application Rates: Metric Calculations

Appendix B

- liquid manure application rates are expressed as litres per hectare (L/ha)
- solid and semi-solid manure application rates can be expressed in tonnes per hectare (tonne/ha)

Liquid Manure Application Rate Calculation Worksheet (Metric Units)					
Line #			***Notes in Appendix D**		
1	**Field ID:**		**Crop:**		
2			**Target Yield**		kg/ha
	Step 1 - Soil Test Data: See Laboratory Report				
	Recommended nutrient rate				
3	N	A			kg/ha
4	P_2O_5	B			kg/ha
	Step 2 - Manure Test Data				
5	Total Nitrogen	C			kg/1000L
6	Ammonium Nitrogen	D			kg/1000L
7	Organic Nitrogen (line 5 - line 6)				kg/1000L
8	Phosphorus	E			kg/1000L
9	P_2O_5 (line 8 x 2.3)				kg/1000L
	Step 3 - Amount of manure nutrient available to crop:				
10	Method of application	F			
11	Anticipated weather conditions during spreading	G			
12	Expected volatilization loss (%)	H			
13	Available organic N (line 7 x 25%)				kg/1000L
14	Ammonium nitrogen available (line 6 x [100 - line 12]%				kg/1000L
15	Total available nitrogen (line 13 + line 14)				kg/1000L
16	Total available P_2O_5 (line 9 x 50%)	I			kg/1000L
	Step 4 - Application rate based on N requirements				
17	Nitrogen based application rate (line 3 ÷ line 15 x 1000)	J			litres/ha
18	Amount of available P_2O_5 applied (line 17 ÷ 1000 x line 16)				kg/ha
20	P_2O_5 application check (line 18 ÷ line 4) x 100 (see notes)	K			%
21	Phosphorus based application rate (line 4 ÷ line 16 x 1000)	L			kg/ha
22	Amount of available N applied (line 21 ÷ 1000 x line 15)	M			kg/ha
23	Additional N required (line 3 - line 22)				kg/ha
24	**Step 5 - Select a rate: N or P based** (line 17 or 20)				litres/ha

Worksheet for Calculating Manure Application Rates: Metric Calculations Continued

Appendix B

Solid Manure Application Rate Calculation Worksheet (Metric Units)					
Line #			***Notes in Appendix D**		
1	**Field ID:**		**Crop:**		
2			**Target Yield**		kg/ha
	Step 1 - Soil Test Data: See Laboratory Report				
	Recommended nutrient rate				
3	N	A			kg/ha
4	P_2O_5	B			kg/ha
	Step 2 - Manure Test Data				
5	Total Nitrogen	C			kg/tonne
6	Ammonium Nitrogen	D			kg/tonne
7	Organic Nitrogen (line 5 - line 6)				kg/tonne
8	Phosphorus	E			kg/tonne
9	P_2O_5 (line 8 x 2.3)				kg/tonne
	Step 3 - Amount of manure nutrient available to crop				
10	Method of application	F			
11	Anticipated weather conditions during spreading	G			
12	Expected volatilization loss (%)	H			
13	Available organic N (line 7 x 25%)				kg/tonne
14	Ammonium nitrogen available (line 6 x [100 - line 12]%				kg/tonne
15	Total available nitrogen (line 13 + line 14)				kg/tonne
16	Total available P_2O_5 (line 9 x 50%)	I			kg/tonne
	Step 4 - Application rate based on N requirements				
17	Nitrogen based application rate (line 3 ÷ line 15)	J			tonnes/ha
18	Amount of available P_2O_5 applied (line 17 x line 16)				kg/ha
20	P_2O_5 application check (line 18 ÷ line 4) x 100 (see notes)	K			%
21	Phosphorus based application rate (line 4 ÷ line 16)	L			tonnes/ha
22	Amount of N applied (line 21 x line 15)	M			kg/ha
23	Additional N required (line 3 - line 22)				kg/ha
24	**Step 5 - Select a rate: N or P based** (line 17 or line 21)				tonnes/ha

Worksheet for Calculating Manure Application Rates: Imperial Calculations

Appendix C

- liquid manure application rates are expressed as gallons per acre (gal/ac)
- solid and semi-solid manure application rates can be expressed in ton per acre (ton/ac)

Liquid Manure Application Rate Calculation Worksheet (Imperial Units)					
Line #			***Notes in Appendix D**		
1	**Field ID:**		**Crop:**		
2			**Target Yield**		bu/ac
	Step 1 - Soil Test Data: See Laboratory Report				
	Recommended nutrient rate				
3	N	A			lb/ac
4	P_2O_5	B			lb/ac
	Step 2 - Manure Test Data				
5	Total Nitrogen	C			lb/1000 gal
6	Ammonium Nitrogen	D			lb/1000 gal
7	Organic Nitrogen (line 5 - line 6)				lb/1000 gal
8	Phosphorus	E			lb/1000 gal
9	P_2O_5 (line 8 x 2.3)				lb/1000 gal
	Step 3 - Amount of manure nutrient available to crop				
10	Method of application	F			
11	Anticipated weather conditions during spreading	G			
12	Expected volatilization loss (%)	H			
13	Available organic N (line 7 x 25%)				lb/1000 gal
14	Ammonium nitrogen available (line 6 x [100 - line 12]%				lb/1000 gal
15	Total available nitrogen (line 13 + line 14)				lb/1000 gal
16	Total available P_2O_5 (line 9 x 50%)	I			lb/1000 gal
	Step 4 - Application rate based on N requirements				
17	Nitrogen based application rate (line 3 ÷ line 15 x 1000)	J			gal/ac
18	Amount of available P_2O_5 applied (line 17 ÷ 1000 x line 16)				lb/ac
20	P_2O_5 application check (line 18 ÷ line 4) x 100 (see notes)	K			
21	Phosphorus based application rate (line 4 ÷ line 16 x 1000)	L			gal/ac
22	Amount of available N applied (line 21 ÷ 1000 x line 15)	M			lb/ac
23	Additional N required (line 3 - line 22)				lb/ac
24	**Step 5 - Select a rate: N or P based** (line 17 or 21)				gal/ac

Worksheet for Calculating Manure Application Rates: Imperial Calculations Continued

Appendix C

Solid Manure Application Rate Calculation Worksheet (Imperial Units)					
Line #			***Notes in Appendix D**		
1	**Field ID:**		**Crop:**		
2			**Target Yield**		bu/ac
	Step 1 - Soil Test Data: See Laboratory Report				
	Recommended nutrient rate				
3	N	A			lb/ac
4	P_2O_5	B			lb/ac
	Step 2 - Manure Test Data				
5	Total Nitrogen	C			lb/ton
6	Ammonium Nitrogen	D			lb/ton
7	Organic Nitrogen (line 5 - line 6)				lb/ton
8	Phosphorus	E			lb/ton
9	P_2O_5 (line 8 x 2.3)				lb/ton
	Step 3 - Amount of manure nutrient available to crop				
10	Method of application	F			
11	Anticipated weather conditions during spreading	G			
12	Expected volatilization loss (%)	H			
13	Available organic N (line 7 x 25%)				lb/ton
14	Ammonium nitrogen available (line 6 x [100 - line 12]%				lb/ton
15	Total available nitrogen (line 13 + line 14)				lb/ton
16	Total available P_2O_5 (line 9 x 50%)	I			lb/ton
	Step 4 - Application rate based on N requirements				
17	Nitrogen based application rate (line 3 ÷ line 15)	J			ton/ac
18	Amount of available P_2O_5 applied (line 17 x line 16)				lb/ac
20	P_2O_5 application check (line 18 ÷ line 4) x 100 (see notes)	K			%
21	Phosphorus based application rate (line 4 ÷ line 16)	L			ton/ac
22	Amount of N applied (line 21 x line 15)	M			lb/ac
23	Additional N required (line 3 - line 22)				lb/ac
24	**Step 5 - Select a rate: N or P based** (line 17 or 21)				ton/ac

Notes for Liquid and Solid Manure Application Rate Calculation Worksheets

Appendix D

These notes are provided to assist in the completion of the Manure Application Rate Calculation Worksheets that appear on the previous pages. For help refer to the line number or letter in the worksheets.

A. [Line 3] Enter the amount of N to be applied as recommended by the soil test

B. [Line 4] Enter the amount of P_2O_5 to be applied as recommended by the soil test

C. [Line 5] Enter the total amount of total N in the manure from the manure analysis. Total nitrogen is often measured as Total Kjeldahl Nitrogen (TKN)
For liquid manure: Example: lab test says total N = 0.30%
wet % x 100 = lbs/1,000 gallons — N = 0.30 x 100 = 30 lb/1,000 gal
wet % x 10 = kg/1,000 liters — N = 0.30 x 10 = 3.0 kg/1,000 L

For solid manure: Example: lab test says total N = 0.4%
wet % x 20 = lb/ton — N = 0.40 x 20 = 8 lb/ton
wet % x 10 = kg/tonne — N = 0.40 x 10 = 4 kg/tonne

D. [Line 6] Enter the amount of ammonium N (NH_4) from the manure analysis (this is the nitrogen that is immediately available).

E. [Line 8] Enter the total elemental P from the manure analysis
For liquid manure: Example: lab test says total P = 0.09%.
wet % x 100 = lbs/1,000 gallons — N = 0.09 x 100 = 9 lb/1,000 gal
wet % x 10 = kg/1,000 liters — N = 0.09 x 10 = 0.9 kg/1,000 L

For solid manure: Example: lab test says total P = 0.2%
wet % x 20 = lbs/ton — N = 0.20 x 20 = 4 lb/ton
wet % x 10 = kg/tonne — N = 0.20 x 10 = 2 kg/tonne
To convert Total P to P_2O_5 — **Total P x 2.3**

F. [Line 10] Volatilization occurs when ammonium is converted to ammonia gas. Losses vary with different application methods (e.g. injected, surface applied/incorporated, irrigated).

G. [Line 11] Indicate anticipated weather conditions.

H. [Line 12] Enter the estimated volatilization losses (%) based on the weather conditions at application and the time to incorporation.

Volatilization losses (%) associated with different application methods and weather conditions

Application Methods	Cool Wet	Cool Dry	Warm Wet	Warm Dry	Average Losses
Injected	0	0	0	0	0
Incorporated within 1 day	10	15	25	50	25
Incorporated within 2 days	13	19	31	57	30
Incorporated within 3 days	15	22	38	65	35
Incorporated within 4 days	17	26	44	72	40
Incorporated within 5 days	20	30	50	80	45
Not incorporated	40	50	75	90	64
Irrigated	Above factors +10%	Above factors +10%	Above factors +10%	Above factors +10%	
Applied to cover crop	25	25	40	50	35

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Notes for Liquid and Solid Manure Application Rate Calculation Worksheets Continued

Appendix D

I. [Line 16] Phosphorus in manure comes in two forms: organic phosphorus (released after decomposition) and inorganic phosphorus (readily available). Approximately 50% of the equivalent P_2O_5 is considered to be available within a growing season.

J. **Liquid Manure**
[Line 17] The nitrogen-based application rate is calculated by taking the nitrogen requirement as recommended in the soil test (Line 3) and dividing by the total available nitrogen in the manure and multiplying by 1,000. This will give you the application rate in L/ha or imperial gal/acre.

Solid Manure
[Line 17] The nitrogen-based application rate is calculated by taking the nitrogen requirement as recommended in the soil test (Line 3) and dividing by the total available N in the manure (Line 15) will give you an application rate in tonne/ha or ton/ac.

K. [Line 20] Basing your application rate on nitrogen may result in an application of phosphorus that exceeds crop requirements. Phosphorus should be monitored annually.

a) If the application rate of P_2O_5 is less than the recommendation in the soil test, supplement with commercial fertilizer.

b) If the amount of P_2O_5 exceeds the soil test recommendation producers may wish to consider an application rate based on phosphorus instead of nitrogen.

c) An appropriate rate of starter commercial phosphorus placed with the seed is recommended.

L. **Liquid Manure**
[Line 21] The phosphorus-based application rate is calculated by taking the P_2O_5 requirement as recommended in the soil test (Line 4) and dividing by the total available P_2O_5 in the manure (Line 16) and multiplying by 1,000. This will give you an application rate in L/ha or gal/acre. When basing your application rate on phosphorus, you need to next calculate the applied available nitrogen (N) and determine the additional N requirement by subtracting the applied N from the crop requirement (Line 3).

Solid Manure
(Line 21) The phosphorus-based application rate is calculated by taking the P_2O_5 requirement as recommended in the soil test (Line 4) and dividing by the total available P_2O_5 in the manure (Line 16). This will give you an application rate in tonne/hectare or ton/acre. When basing your application rate on phosphorus, you need to next calculate the applied avaialble nitrogen (N) and determine the additional N requirement by subtracting the applied N from the crop requirement (Line 3).

M. [Line 22] A check is built into the calculation to determine if the amount of nitrogen applied is meeting crop requirements. If the amount of nitrogen is less than the recommendation in the soil test (Line 3), producers may wish to supplement with commercial fertilizer.

Calibrating Liquid Manure Applicators: Imperial Calculations

Appendix E

Below are Imperial equivalents of the metric calculations presented in Chapter 7.

Liquid Manure Tankers

To determine the volume that will be applied for each load of a liquid tanker, first obtain the manufacturer's rated volume. The actual volume will often be less than the rated volume due to foaming and splashing. Ninety per cent of the rated volume will be a good approximation of the actual volume in each load.

Note: Calculators with only eight digits may be unable to complete the calculations as they are presented. Dividing the top and bottom of the equation by 1,000 prior to doing the calculation will address this problem.

- **Calculate an application rate, using the actual tanker volume, emptying time, ground speed and spread width:**

$$\text{Application Rate (gal/ac)} = \frac{\text{Actual Tanker Volume (gal)} \times 29{,}700}{\text{Emptying Time (s)} \times \text{Ground Speed (mph)} \times \text{Spread Width (ft)}}$$

Example: If the manufacturer's rated volume for a tanker is 4,400 gal, emptying time is 7 minutes (420 s), ground speed is 3.5 mph and the spread width is 23 ft., the application rate is calculated to be:

$$\text{Application Rate} = \frac{(4{,}400 \times 90\%) \times 29.700}{420 \times 3.5 \times 23} = 3{,}480 \text{ gal/ac}$$

- **Adjust the ground speed to achieve a target application rate using the actual tanker volume, emptying time, target application rate and spread width.**

$$\text{Ground Speed (mph)} = \frac{\text{Actual Tanker Volume (gal)} \times 29{,}700}{\text{Emptying Time (s)} \times \text{Application Rate (gal/ac)} \times \text{Spread Width (ft)}}$$

Example: If the manufacturer's rated volume for a tanker is 4,400 gal, emptying time is 7 minutes and the spread width is 23 ft., to achieve a target application rate of 5,300 gal/ac the appropriate ground speed is calculated to be:

$$\text{Ground Speed} = \frac{(4{,}400 \times 90\%) \times 29{,}700}{420 \times 5{,}300 \times 23} = 2.3 \text{ mph}$$

Calibrating Liquid Manure Applicators: Imperial Calculations Continued

Appendix E

- **Calculate an application rate, using the actual tanker volume, spread width and spread length.**

$$\text{Application Rate (gal/ac)} = \frac{\text{Actual Tanker Volume (gal)} \times 43{,}560}{\text{Spread Width (ft)} \times \text{Spread Length (ft)}}$$

Example: If it takes two loads with a 4,400 gal tanker (manufacturer's rating) to cover a 2,600 ft length of field with a 23 ft width of spread, the calculated application rate is:

$$\text{Application Rate} = \frac{(4{,}400 \times 90\%) \times 2 \times 43{,}560}{23 \times 2{,}600} = 5{,}770 \text{ gal/ac}$$

Drag Hose System

- **Calculate an application rate using the flow rate,g round speed and spread width:**

$$\text{Application Rate (gal/ac)} = \frac{\text{Flow Rate (gal/h)} \times 8.25}{\text{Ground Speed (mph)} \times \text{Spread Width (ft)}}$$

Example: If the flow meter indicates a pumping rate of 49,500 gal/h, the ground speed is 3.5 mph and the spread width is 18 ft, the application rate is calculated to be:

$$\text{Application Rate} = \frac{49{,}500 \times 8.25}{3.5 \times 18} = 6{,}480 \text{ gal/ac}$$

- **Adjust the ground speed to achieve a target application rate using the flow rate, target application rate and spread width.**

$$\text{Ground Speed (mph)} = \frac{\text{Flow Rate (gal/h)} \times 8.25}{\text{Application Rate (gal/ac)} \times \text{Spread Width (ft)}}$$

Example: If the flow meter indicates a pumping rate of 49,500 gal/h and the spread width is 18 ft, a target application rate of 9,100 gal/ac is achieved with a ground speed calculated to be:

$$\text{Ground Speed} = \frac{49{,}500 \times 8.25}{9{,}100 \times 18} = 2.5 \text{ mph}$$

Calibrating Liquid Manure Applicators: Imperial Calculations Continued

Appendix E

- **Calculate your application rate with a drag hose system**

$$\text{Application Rate (gal/acre)} = \frac{\text{Flow rate (gal/h)} \times 8.25}{\text{Ground Speed (mph)} \times \text{Spread Width (ft)}}$$

Example: If your flow meter said you were pumping 60,000 gallons per hour, you have a ground speed of 3.5 mph and a 12 ft spread width, your application width would be:

$$\text{Application Rate} = \frac{60{,}000 \times 8.25}{3.5 \times 12} = 11{,}790 \text{ gal/ac}$$

- **Calculate your ground speed for a drag hose system**

$$\text{Ground Speed (mph)} = \frac{\text{Flow rate (gal/h)} \times 8.25}{\text{Application Rate (gal/acre)} \times \text{Spread Width (ft)}}$$

Example: If your flow meter said you were pumping 60,000 gallons per hour, you had a 12 ft spread width, and you wanted an application rate of 7,000 gallons per acre, your desired ground speed would be:

$$\text{Ground Speed} = \frac{60{,}000 \times 8.25}{7{,}000 \times 12} = 5.9 \text{ mph}$$

Calibrating Solid Manure Spreaders: Imperial Calculations

Appendix F

Solid manure spreaders are usually rated in cubic feet or bushels, and there can be struck load and heaped load capacities. A struck load is a load that is level with the top of the box, and a heaped load is heaped as much as the box will hold. Since the box will probably be heaped as much as possible when hauling manure, the heaped capacity is the most useful value.

Although the spreader boxes have a volume rating, application rates are usually expressed as weight (i.e. in tons) per unit area (i.e. acre). If truck scales are available, determine the weight of manure in a full load by finding the weight of the manure spreader empty and then full. The weight of the manure is the difference between the two.

- **Calculate an application rate using the net weight per load, the spread width and the spread length for a given load.**

$$\text{Application Rate (tons/ac)} = \frac{\text{Net Weight per Load (tons)} \times 43{,}560}{\text{Spread Width (ft)} \times \text{Spread Length (ft)}}$$

Example: If the net weight per load is 4 tons, the spread width is 10 ft and the spread length is 1,000 ft, the application rate is calculated to be:

$$\text{Application Rate} = \frac{4 \times 43{,}560}{10 \times 1{,}000} = 17.4 \text{ tons/ac}$$

If truck scales are not available, the weight of the manure in a full load must be calculated from the known volume and an estimated density because:

Density = Weight/Volume
and therefore
Weight = Density x Volume

To determine the density of the manure:

1. Get a pail of known volume in feet (cu.ft). If the volume of the pail is in gallons, use the conversion table in **Appendix A** to convert to cubic feet.
2. Fill the pail with a typical sample of manure, and pack it in the pail to a density similar to that in the spreader box.
3. Weigh the pail full and then empty the manure and weigh the pail empty.
4. For the weight of the manure, take the difference between the full pail weight and the empty pail weight. [Manure Weight = Full Pail Weight – Empty Pail Weight]
5. Repeat steps 2 to 4 three times to obtain three manure weights.
6. Take the average of the three manure weights.
7. Take the average manure weight (in lb) and divide by the pail volume (in cu.ft) to get the density of the manure. [Density = Weight/Volume]

Calibrating Solid Manure Spreaders: Imperial Calculations Continued

- **Calculate the manure density:**

Density = Weight/Volume

Example: If a 0.67 cu.ft pail weighed 2 lb empty and 18 lb (on average) full, the density would be:

$$\text{Density} = \text{Weight/Volume} = \frac{(18\text{-}2)\ \text{lb}}{0.67\ \text{cu. ft.}} = 24\ \text{lb/cu. ft}$$

- **Calculate an application rate using the spreader box volume, manure density, spread width and spread length.**

$$\text{Application Rate (tons/ac)} = \frac{\text{Box Volume (cu.ft)} \times \text{Manure Density (lb/cu.ft)} \times 21.78}{\text{Spread Width (ft)} \times \text{Spread Length (ft)}}$$

Example: If the box volume of a spreader is 280 cu.ft, the manure density is 24 lb/cu.ft, the spread width is 10 ft and the spread length is 575 ft, the application rate is calculated to be:

$$\text{Application Rate} = \frac{280 \times 24 \times 21.78}{10 \times 575} = 25.5\ \text{tons/ac}$$

- **Calculate an application rate using the spreader box volume, manure density, emptying time, ground speed and spread width.**

$$\text{Application Rate (tons/ac)} = \frac{\text{Box Volume (cu.ft)} \times \text{Manure Density (lb/cu.ft)} \times 14.85}{\text{Emptying Time (s)} \times \text{Ground Speed (mph)} \times \text{Spread Width (ft)}}$$

Example: If the box volume of a spreader is 280 cu.ft, the manure density is 24 lb/cu.ft, the emptying time is 70 s, the ground speed is 5 mph and the spread width is 10 ft, the aplication rate is calculated to be:

$$\text{Application Rate} = \frac{280 \times 24 \times 14.85}{70 \times 5 \times 10} = 28.5\ \text{tons/ac}$$

Calibrating Solid Manure Spreaders: Imperial Calculations Continued

Appendix F

- **Adjust the ground speed to achieve a target application rate using the spreader box volume, manure density, emptying time, target application rate and spread width.**

$$\text{Ground Speed (mph)} = \frac{\text{Box Volume (cu.ft)} \times \text{Manure Density (lb/cu.ft)} \times 14.85}{\text{Emptying Time (s)} \times \text{Application Rate (tons/ac)} \times \text{Spread Width (ft)}}$$

Example: If the box volume of a spreader is 280 cu.ft, the manure density is 24 lb/cu.ft, the emptying time is 70 s and the spread width is 10 ft, to achieve a target application rate of 24 tons/ac the required ground speed is calculated to be:

$$\text{Ground Speed} = \frac{280 \times 24 \times 14.85}{70 \times 24 \times 10} = 6 \text{ mph}$$

Alternatively, an application rate can be calculated without knowing the manure density. Instead, the rate is estimated based on the measured weight of manure spread over a small, known area. In the field, the manure spreader passes over a sheet of plastic cut to specific dimensions (eg. 3 ft x 3 ft). The manure on the plastic sheet is picked up with the sheet and its weight determined using a scale. These steps are repeated several times so that an average application rate can be determined.

- **Calculate an application rate using the weight of manure and sheet area.**

$$\text{Application Rate (tons/ac)} = \frac{\text{Net Weight of Manure (lb)} \times 21.78}{\text{Sheet Area (ft}^2\text{)}}$$

Example: If the net weight of manure on a 3 ft x 3 ft plastic sheet is 15 lb, the application rate is calculated to be:

$$\text{Application Rate} = \frac{15 \times 21.78}{9} = 36.3 \text{ tons/ac}$$

Annual Manure Management Summary

Annual Manure Management Summary					
Crop Year	Total volume or weight of manure on farm				
Field (legal description)	Hectares/Acres	Crop	Manure Rate	Volume or Weight Required	Volume or Weight of Manure Remaining