CENTER PIVOT CALIBRATIONS FOR APPLYING WASTEWATER

A Quick Field Reference Guide

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This publication contains only a brief overview of the calibration procedure and data sheets used to calculate application uniformity of a center pivot applying wastewater.
For a more detailed discussion and in-depth calibration steps, see UGA Extension Bulletin 1458.

Step-by-Step Calibration Procedure (Equations for calculations are on the following data worksheets)

1. Determine the ***Wetted Diameter*** of your nozzle or sprinkler.
2. Determine the ***Collection Cup Spacing.*** Generally, 25 feet up to max of 50 feet between cups.
3. Determine ***Number of Cups Needed*** to collect wastewater from all sprinklers/nozzles starting after the first tower.
4. Place collection cups in a row, equally spaced in the direction of travel.
5. Mark the starting point. Operate the pivot normally and mark the end point. Measure the ***Time*** taken for the system to pass over all cups. Measure between the start and end points to determine the ***Travel Distance.***
6. Immediately record volumes or depths of water in each collection cup.
7. Calculate ***Average Application Depth*** (inches, centimeters, or millimeters).
8. Determine **"usable" cups** and ***Effective Diameter*** of pivot.
9. Recalculate the ***Average Application Depth*** for the "usable" collection cups (using data from Proc. 7).
10. Calculate the reference ***Travel Speed***.
11. Calculate the ***Deviation Depth*** for each "usable" collection cup.
12. Determine the ***Average Deviation Depth*** (using data from Proc.11).
13. Calculate the ***Application Uniformity (U_C)***.
14. Determine the calibration results (using Table 1).

Table 1. Uniformity Coefficient meaning for wastewater application acceptability.

Uniformity Coefficient (U_C)	Acceptability for Wastewater Application
100	Perfect application across center pivot to acceptable
85 – 99	Great application to acceptable
70 – 85	Good application to acceptable
Below 70	Not acceptable to adjustments required

Reference Hawkins, G.L., W. Porter, S. Hollifield, and B. Shirley. 2016. Calibration of Center Pivot Systems for Wastewater Applications, UGA Extension Bulletin 1458.

Collection Table for Calibrating a Wastewater Center Pivot System

Date: _____ Name of Site/Field of Center Pivot System: _____

Name of Person Collecting Data: _____ Weather Conditions: _____

Type of Application Package (sprinkler, nozzle, on-top of system, on drops): _____

Pressure of System at Pivot Point: _____ Distance Between Collection Cups: _____

Collection Cup Label	Measured Depth of Liquid (in, cm, mm	Deviation Depth (Absolute difference from measured and average depth) (in, cm, mm)	Christiansen Uniformity Coefficient (U_C)	Comments
TOTAL SUM				
AVERAGE				

Calculation Sheet Used for Calibrating a Wastewater Center Pivot System

Date: _____

Name of Site/Field of Center Pivot System:_____

Name of Person Collecting Data: _____

Weather Conditions: _____

Type of Application Package (sprinkler, nozzle, on-top of system, on drops): _____

Pressure of System at Pivot Point: _____

NOTE: The following notation is used below: Step # (Corresponding procedure # from text).

Step 1 (Proc. 1) ***Wetted Diameter*** of sprinkler or nozzle: _____ (feet, meters, inches)

Step 2 (Proc. 2) ***Spacing*** between each collection cup:_____ (feet, meters, inches)

Step 3 (Proc. 6) ***Time*** for center pivot tower to move across all cups: _____ minutes

Step 4 (Proc. 6) ***Travel Distance*** to get complete coverage of cups: _____ feet/meters

Step 5 (Proc. 7) Measure depths in each collection cup. Use data collection table (on page 7).

Step 6 (Proc. 8) ***Calculate Average Application Depth***:

$$\text{Average Application Depth (in, cm, mm)} = \frac{\text{Sum of collected depths (in, cm, mm)}}{\text{Number of collection cups}}$$

$$\underline{\qquad\qquad\qquad} \text{ (in, cm, mm)} = \frac{\text{(in, cm, mm)}}{\text{(\#)}}$$

Step 7 (Proc. 9) Calculate ***Usable Average Application Depth*** from the usable collection cups. These are the cups where the measured depth is greater than half the Average Application Depth.

$$\text{Usable Average Application Depth (in, cm, mm)} = \frac{\text{Sum of collected depths}}{\text{Number of collection cups}}$$

$$\underline{\qquad\qquad\qquad} \text{ (in, cm, mm)} = \frac{\text{(in, cm, mm)}}{\text{(\#)}}$$

Step 8 (Proc. 10) Compute reference ***Travel Speed***:

$$\text{Travel Speed} \left(\frac{\text{ft}}{\text{min}}, \frac{\text{m}}{\text{min}}\right) = \frac{\text{Distance traveled (ft, m)}}{\text{Travel time (min)}}$$

$$\underline{\qquad\qquad\qquad} \left(\frac{\text{ft}}{\text{min}}, \frac{\text{m}}{\text{min}}\right) = \frac{\text{(ft, m)}}{\qquad\qquad\qquad}$$

Calculation Sheet Used for Calibrating a Wastewater Center Pivot System (continued)

Step 9 (Proc. 11-12) ***Calculate Average Deviation Depth:***

$$\text{Average Application Depth (in, cm, mm)} = \frac{\text{Sum of deviation depths from collection table}}{\text{Number of usable cups}}$$

$$\underline{\qquad\qquad\qquad} \text{ (in, cm, mm)} = \frac{\text{(from table)}}{\text{(\#)}}$$

Step 10 (Proc. 13) Calculate ***Christiansen Uniformity Coefficient (U_c):***

$$U_c = \frac{\text{Average depth from Step 7 - Average deviation from Step 9}}{\text{Average depth from Step 7}} \text{ x100}$$

$$\underline{\qquad} = \frac{\text{(Step 7) - (Step 9)}}{\text{(Step 7)}} \text{ x100}$$

Step 11 (Proc. 14) Determine the calibration results using the table below.

Uniformity Coefficient (U_c)	Acceptability for Wastewater Application
100	Perfect application across center pivot to acceptable
85 – 99	Great application to acceptable
70 – 85	Good application to acceptable
Below 70	Not acceptable to adjustments required

Calculation of Application Rates Based on Different Ways of Measuring Volume in Collection Cups

If amount of liquid in collection cups (assuming equal diameter at top and bottom) is measured in inches, then the following **Gallons per Acre** were applied. The numbers are summative, so to calculate 1.5 inches, add the 1.0 and 0.5 numbers.

Inch in Cup	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
Gallons/Acre	2,715	5,431	8,146	10,862	13,577	16,292	19,008	21,723	24,439	27,154

The following table provides information on the **Gallons per Acre** applied if the volume in the collection cups is measured in milliliters (mL). The bolded numbers on the left side are in equal increments of inches.

Cup Measurement		mL in Collection Cups						
cm	inches	1	10	20	30	40	50	60
1	0.39	13,613	136,135	272,270	408,404	544,539	680,674	816,809
1.27	**0.50**	**8,440**	**84,404**	**168,807**	**253,211**	**337,615**	**422,019**	**506,422**
2	0.79	3,403	34,034	68,067	102,101	136,135	170,168	204,202
2.54	**1.00**	**2,110**	**21,101**	**42,202**	**63,303**	**84,404**	**105,505**	**126,606**
3	1.18	1,513	15,126	30,252	45,378	60,504	75,630	90,757
4	1.57	851	8,508	17,017	25,525	34,034	42,542	51,051
5	**1.97**	**545**	**5,445**	**10,891**	**16,336**	**21,782**	**27,227**	**32,672**
6	2.36	378	3,782	7,563	11,345	15,126	18,908	22,689
7	2.76	278	2,778	5,557	8,335	11,113	13,891	16,670
7.62	**3.00**	**234**	**2,345**	**4,689**	**7,034**	**9,378**	**11,723**	**14,067**
8	3.15	213	2,127	4,254	6,381	8,508	10,636	12,763
9	3.54	168	1,681	3,361	5,042	6,723	8,403	10,084
10	3.94	136	1,361	2,723	4,084	5,445	6,807	8,168
10.16	**4.00**	**132**	**1,319**	**2,638**	**3,956**	**5,275**	**6,594**	**7,913**
11	4.33	113	1,125	2,250	3,375	4,500	5,625	6,750
12	4.72	95	945	1,891	2,836	3,782	4,727	5,672
12.7	**5.00**	**84**	**844**	**1,688**	**2,532**	**3,376**	**4,220**	**5,064**
15.24	**6.00**	**59**	**586**	**1,172**	**1,758**	**2,345**	**2,931**	**3,517**

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