NELSON

PIVOT POCKET GUIDE

Nelson Irrigation Corporation offers a full range of water application solutions for mechanized irrigation. From control valves to pivot sprinklers, and pressure regulators to end guns — the package is complete.

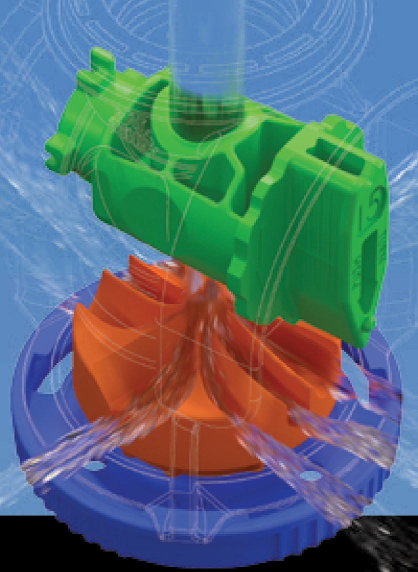
nelsonirrigation.com

INTRODUCING THE NEW 3030 SERIES SPRINKLER

AT THE HEART OF THE 3030 SERIES PIVOT PRODUCTS IS THE NEW 3NV NOZZLE. BUILT WITH THE PRECISION ACCURACY OF THE 3TN, THIS INNOVATIVE DIAL-NOZZLE COMBINES MULTIPLE FUNCTIONS SO YOU CAN EFFECTIVELY MANAGE YOUR SYSTEM.

MANAGE YOUR SYSTEM WITHOUT EVER HAVING TO REMOVE A NOZZLE.

- QUICK-CHANGE — PUSH & TURN, AUDIBLE “CLICK”
- STAINLESS STEEL SPRING FOR ACCURATE AND SECURE POSITIONING
- COVERS COMPLETE NOZZLE RANGE, USING THE SAME NUMBERING AND FLOW RATES AS THE 3TN NOZZLE SYSTEM
- SAME COLOR-CODES AS 3TN BUT ODD-SIZE NOZZLES HAVE WEATHER-ENDURING SCALLOPED EDGE



ARROW INDICATES FLOW DIRECTION AND NOZZLE FUNCTION: IN, ON, OFF, FLUSH OR LINE FLUSH

THE 3NV NOZZLE FITS ALL EXISTING NELSON PIVOT SPRINKLER TYPES: ROTATOR, SPINNER, ACCELERATOR, SPRAYHEAD, ORBITOR, PART CIRCLE. MAXIMIZE EFFICIENCY WITH THE SQUARE THREAD FITTING.

UPGRADE YOUR PIVOT SPRINKLER PACKAGE!

10 REASONS TO RETROFIT / RENOZZLE YOUR PIVOT

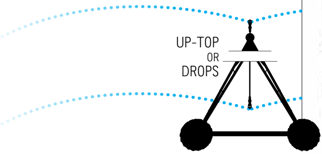
1. To add PRESSURE REGULATORS to compensate for pressure fluctuations and stabilize flowrate.
2. To replace old technology for better IRRIGATION EFFICIENCY.
3. To improve IRRIGATION UNIFORMITY.
4. To operate at lower pressure and SAVE ENERGY.
5. To improve crop yield and get a HIGHER RETURN PER ACRE.
6. To adjust flow rates to MATCH SOIL AND CROP REQUIREMENTS.
7. To REPLACE WORN OUT SPRINKLERS AND NOZZLES.
8. To MINIMIZE OPERATING COSTS.
9. To take advantage of local power utility COST-SHARING PROGRAMS.
10. To REDUCE RUNOFF and solve wheel-tracking problems.

Differences in crops, soils, farming practices and climatic conditions worldwide - coupled with regional differences in the availability of water and energy require a diverse array of center pivot sprinkler options. Choose from the following:

R

ROTATOR®

10-50 psi (0.7-3.4 bar)
50-74’ (15.2-22.6 m)
Low Application Rate



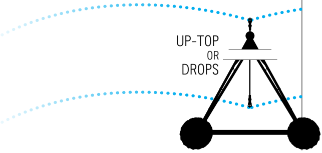
The Rotator® features the greatest throw distance available on drop tubes. The wide water pattern from rotating streams equates to lower average application rates, longer soak time and reduced runoff. More overlap from adjacent sprinklers improves uniformity.

3000 Series (3TN nozzle)
or 3030 Series (3NV nozzle).

A

ACCELERATOR

6-15 psi (0.4-1 bar)
30-55’ (9.1-16.8 m)
Low-Med. Application Rate



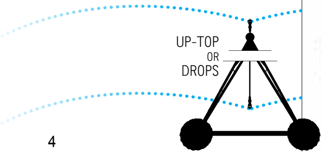
The Accelerator maximizes performance of in-canopy water application. Designed as a hybrid of Rotator® and Spinner technology, the Accelerator increases rotation speed through the nozzle range. Choose from Gold (maximum diameter), Maroon (wind-fighting) and Navy (up-top) plates.

3000 Series (3TN nozzle)
or 3030 Series (3NV nozzle).

S

SPINNER

10-20 psi (0.7-1.4 bar)
42-54’ (12.8-16.5 m)
Low-Med. Application Rate

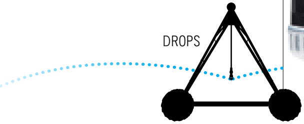


The Spinner utilizes a free-spinning action to produce a gentle, rain-like water pattern. Designed for more sensitive crops and soils, low instantaneous application rates and reduced droplet kinetic energy help maintain proper soil structure.

3000 Series (3TN nozzle)
or 3030 Series (3NV nozzle).

ORBITOR

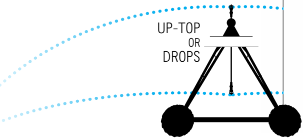
6-20 psi (0.4-1.4 bar)
36-60' (11.0-18.3 m)
Low-Med. Application Rate



The Orbitor features new technology that eliminates the struts of a sprinkler body to provide outstanding uniformity and optimal droplets at low operating pressures. Designed with an innovative, bracketless assembly, debris hang up and water pattern misting common to conventional sprinklers are mitigated. 3000 Series (3TN nozzle) or 3030 Series (3NV nozzle).

SPRAYHEAD

6-40 psi (0.4-2.8 bar)
16-40' (4.9-12.2 m)
High Application Rate



The Sprayhead is a fixed spray designed with future needs in mind. As irrigation requirements change throughout the season, the Sprayhead features a flip-over cap to change spray patterns. It's easily convertible to LEPA or other sprinkler types. 3000 Series (3TN nozzle) or 3030 Series (3NV nozzle).

TRASH-BUSTER

PRESSURE & THROW
DEPENDS ON
SPRINKLER SELECTION
Low-High Application Rate

Developed for the land application of wastewater, the T3000 Trashbuster features an open-architecture body design to pass debris more easily. Available with the 3000 FC, a plug-resistant, flow compensating sprinkler package can simplify maintenance. 3000 Series only (3TN or 3000 FC nozzle).

WATER APPLICATION SOLUTIONS FOR CENTER PIVOTS

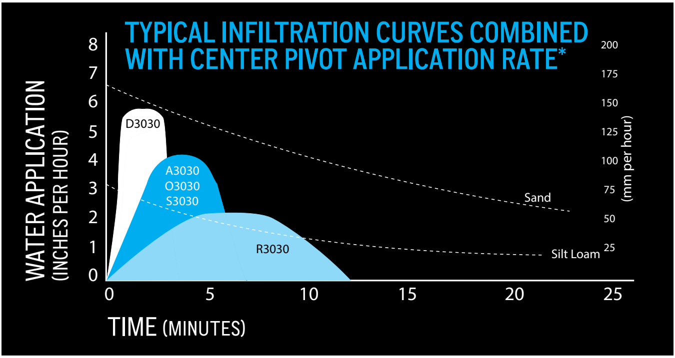
Today, the value of center pivots has increased even further as the tools available in the form of computer controls and sprinkler technology are continually improving. Center pivots no longer apply just water but also nutrients and chemicals to the crop via fertigation and chemigation. Advances in sprinkler technology for mechanized irrigation allow a grower to apply water and chemicals with precision uniformity and high irrigation efficiency. Improvements in irrigation efficiency, uniformity, and the control of runoff are essential to the future of irrigated agriculture.

NELSON STRIVES TO MAXIMIZE IRRIGATION EFFICIENCY

Irrigation efficiency involves the ability to minimize water losses. Such factors as loss of water from wind drift and evaporation from the soil surface and plant affect the level of efficiency. Another factor of irrigation efficiency is simply getting water into the soil and controlling runoff. For mechanized irrigation, the biggest single advancement towards increasing irrigation efficiency has been mounting the sprinkler down out of the wind on drop tubes. Enabling the success of drop tubes are products that spread the water out over a wide area, even when mounted below the truss rods of a center pivot. These rotating and spinning devices operating at low pressure have dual benefits – increased soak time and low application rates. A more complete throw pattern can give twice the soak time of fixed sprayheads.

WHY IS SPRINKLER THROW DISTANCE IMPORTANT? Without sprinkler performance that can apply water at an application rate that more closely matches the infiltration rate of the soil, the efficiency gained with drops and money saved with low pressure is soon lost to runoff. The rate at which a center pivot applies water increases with the higher flow demands required at the outer portion of a center pivot. By increasing the wetted throw distance of the sprinkler, the rate at which water is applied can be reduced to match the soil's infiltration rate.

Look at a typical infiltration curve with superimposed application rates for center pivot sprinklers. It is obvious that the Rotator, which provides the widest throw distance on drop tubes, comes the closest to matching infiltration rates of the soil. The best condition for infiltration is to keep the soil surface open and apply water using a wide application width.



*End of 1/4 mile (402 m) system at 8 gpm/acre (4.5 m^3/hr/ha) and travel speed 5 fpm (1.5 m/min)

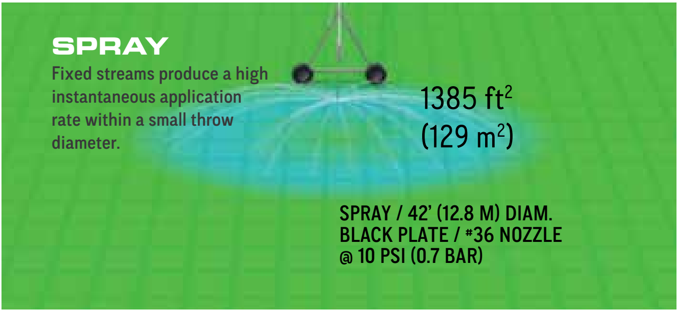
APPLICATION RATE DEFINITIONS.

There are two types of application rates used: Average and Instantaneous. Some understanding of the difference between these two is helpful in nozzle and sprinkler selection.

Average application rate (AAR) is the rate of water application over the wetted area. It is an average value assuming uniformity within the wetted area. Pivot average application rates increase with the higher flow demands required at the outer portion of a center pivot. Consequently, in analyzing different sprinkler options, superior throw distance yields lower average application rates.

Instantaneous application rate (IAR) is also an important element of sprinkler performance especially for bare silt type soils that are prone to compaction. Instantaneous application rate (IAR) is the peak intensity of water application at a point. IAR and droplet kinetic energy (KE) are important variables in maintaining good soil intake rate throughout the season. Pivot sprinklers that produce high instantaneous application rates with high velocity, large droplets are detrimental to some soil types causing damage by sealing off the soil pore space at the surface.

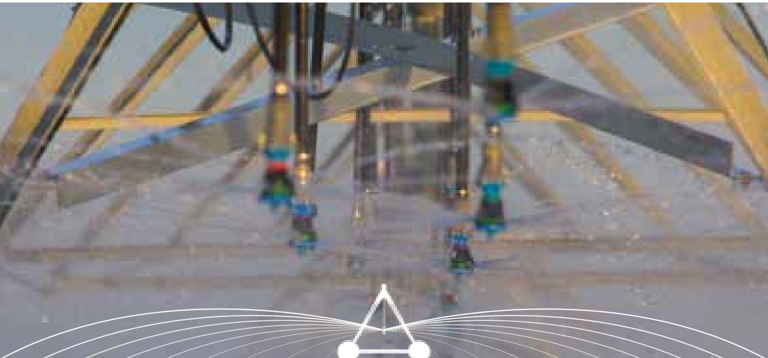
Sprinklers that minimize droplet specific power (KE times application rate) reduce the rates at which KE and water are applied to the soil and will minimize the potential runoff, erosion and non-uniform infiltration. The rate of instantaneous application for a fixed stream type sprinkler can be more than ten times the average if measured at the instant the stream hits the soil. The problem comes when some surface damage occurs, sealing off the soil pore space at the surface. The best condition for infiltration is to keep the soil surface open, and apply water using a wide application width.



CONTROLLING SURFACE SEALING AND RUNOFF

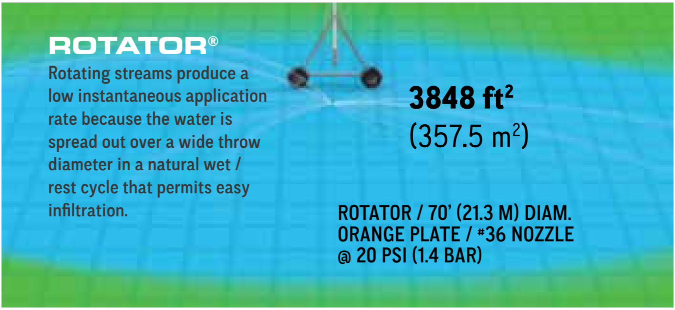
WHY BE CONCERNED WITH RUNOFF?

Runoff is one of the most environmentally sensitive issues involved in irrigation. Runoff can result in unwanted water and fertilizers being carried into streams and rivers. Additionally, soil erosion is not only a pollution issue, but results in lost fertilizer and lower overall crop growth. Increased runoff means lower application efficiency which increases operating costs.



SELECT THE WIDEST WETTED PATTERN.

A wide wetted pattern provides longer soak time for water intake, while providing a lower average application rate. The Pivot Rotator has the furthest throw distance of any of the 3000 or 3030 Series Sprinklers. Advances in the design of Rotator plate technology now provide lower operating pressures and even greater throw distances. Built-in uniformity is made possible by multi-trajectory stream geometry that fills in the water pattern and provides greater overlap.



LOW PRESSURE, HIGH-UNIFORMITY @ 10-15 PSI (0.7 - 1 BAR)

HIGHEST UNIFORMITY @ 15-30 PSI (1-2 BAR)

MAXIMUM THROW @ 15-30 PSI (1-2 BAR)

WIND-FIGHTING @ 20-50 PSI (1.4-3.4 BAR)

UP-TOP @ 15-30 PSI (1-2 BAR)

UP-TOP @ 6-15 PSI (0.4-1 BAR) (ACCELERATOR)

MAXIMUM DIAMETER @ 6-15 PSI (0.4-1 BAR) (ACCELERATOR)

WIND-FIGHTING STREAMS @ 6-15 PSI (0.4-1 BAR) (ACCELERATOR)

USE FINE WATER DROPLETS ON FINE PARTICLE SOIL TYPES.

Droplet kinetic energy is an important part of keeping the soil surface open and maintaining a good soil intake rate throughout the season. Silty clay loam soils benefit from a very fine droplet, maintaining the soil structure integrity. Fine water droplets can be achieved by using a higher pressure and selecting plates with increased diffusion properties. Field reports have shown that gentle, rain-like droplets are good for preventing soil surface sealing problems in certain conditions.

SELECT PROPER SPRINKLER MOUNTING HEIGHTS.

Generally, higher mounting heights benefit uniformity. Higher mounting gives the pattern more distance to maximize the throw of the streams and provide greater sprinkler overlap. However, interference with system structure must be carefully avoided. If sprinklers are placed “in-canopy”, spacings need to be reduced to compensate for smaller wetted diameters.

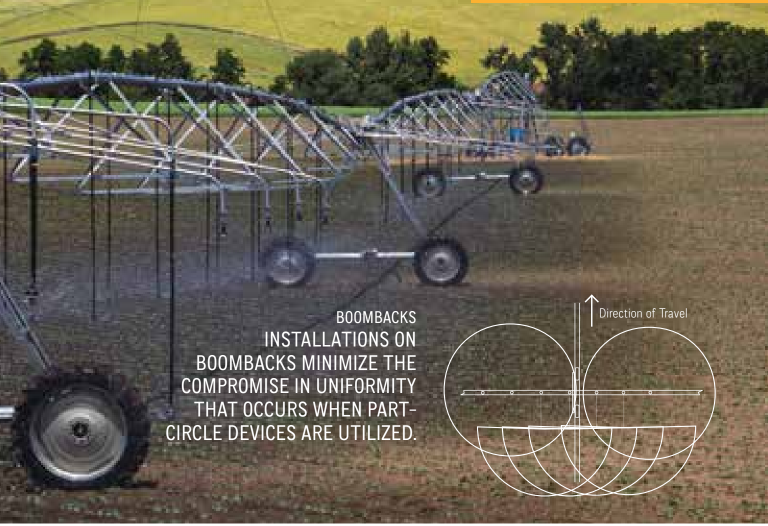
USE RESERVOIR SURFACE BASINS.

Reservoir tillage basins can be used to provide surface storage and minimize runoff. The proper basin and dike shape will have to be determined by experimentation with the soil and slope involved.

DUAL NOZZLE CLIP — REDUCE AVERAGE APPLICATION RATES DURING GERMINATION. Innovations like the 3NV Dual Nozzle Clip allow irrigators to reduce Average Application Rates during germination or the early stages of a crop’s growth curve. A Dual Nozzle Clip holds a secondary nozzle, allowing quick and accurate changes of system flow rate. Lowering average application rates reduces ponding of water and potential erosion, while maintaining the integrity of the soil structure with less intense water droplets. NOTE: Not designed for in-canopy use.

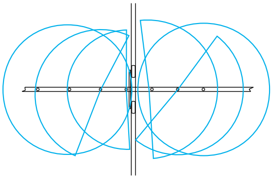
DRY WHEEL TRACK SOLUTIONS - MINIMIZE TRACK RUTTING.

Another variable that affects overall field uniformity is the center pivot’s ability to maintain a uniform travel speed. This can be affected by excessive slippage of the tires due to water in wheel tracks. Wet areas and steep slopes can cause the system to slow down in these areas, thereby increasing the application depth in relation to other parts of the field. Sprinkler technology advances in the form of part circle sprinklers, combined with the use of boombacks can solve this problem and reduce chances of drive units getting stuck by directing the water pattern behind the direction of travel.



BOOMBACKS
INSTALLATIONS ON BOOMBACKS MINIMIZE THE COMPROMISE IN UNIFORMITY THAT OCCURS WHEN PART-CIRCLE DEVICES ARE UTILIZED.

PART-CIRCLE SPRINKLERS CAN BE INSTALLED IN A VARIETY OF CONFIGURATIONS

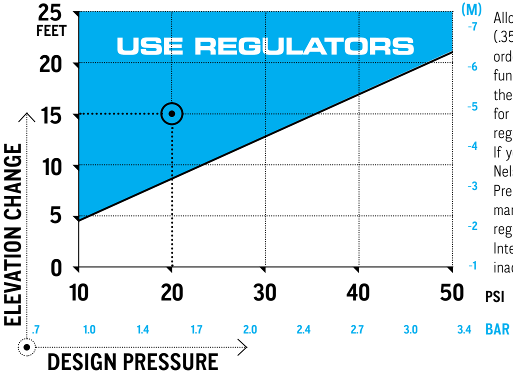


STRAIGHT DROPS
INSTALLATIONS ON STRAIGHT DROPS REQUIRE CAREFUL ADJUSTMENT OF THE ORIENTATION. PART-CIRCLE SPRINKLERS REQUIRE RIGID METAL DROPS.

WHY ARE PRESSURE REGULATORS IMPORTANT?

The function of a pressure regulator in center pivot sprinkler design is to fix a varying inlet pressure to a set outlet pressure regardless of changes in the system pressure due to hydraulic conditions, elevation changes, pumping scenario, etc. The benefits are numerous:

1. Uniform depth of water application.
2. Controlled sprinkler performance (droplet size and throw distance).
3. Flexibility in system operation.



Allow approximately 5 PSI (.35 BAR) extra pressure in order for the regulator to function properly. For example, the minimum design pressure for a 20 PSI (1.4 BAR) pressure regulator is 25 PSI (1.7 BAR). If your system is designed with Nelson sprinklers, use Nelson Pressure Regulators. Individual manufacturers' pressure regulator performance varies. Interchanging could result in inaccurate nozzle selection.

HOW MUCH ELEVATION CHANGE IS ACCEPTABLE? LESS THAN 10% FLOW VARIATION IS A GOOD RULE OF THUMB.

This graph is based on the elevation limit which will cause a flow variation of ten percent or more. If the elevation change from the lowest point is above the line then a flow variation of more than 10 percent will occur. Notice the lower design pressure allows less elevation change before pressure regulators are recommended.

NOTE: Even if elevation changes do not require pressure regulators, you should consider them for their other advantages.

PATENTED PLUG RESISTANT DESIGN
Superior plug-resistance with a single-strut seat design in both the Hi-Flo and Universal Flo models.

CHEMICALLY RESISTANT MATERIALS

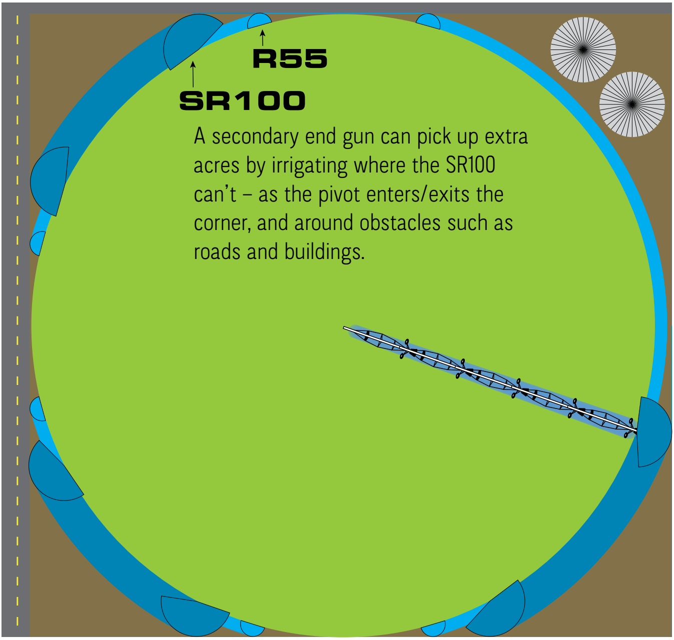
WIDE FLOW RANGE
The Nelson Universal Pressure Regulator has a flow up to 12 GPM (2.7 M^3/H) at 15 PSI (1.0 BAR) and above.

EXTENDED PERFORMANCE & PRECISION ACCURACY
Precision components coupled with an internally lubricated o-ring minimize frictional drag and hysteresis.

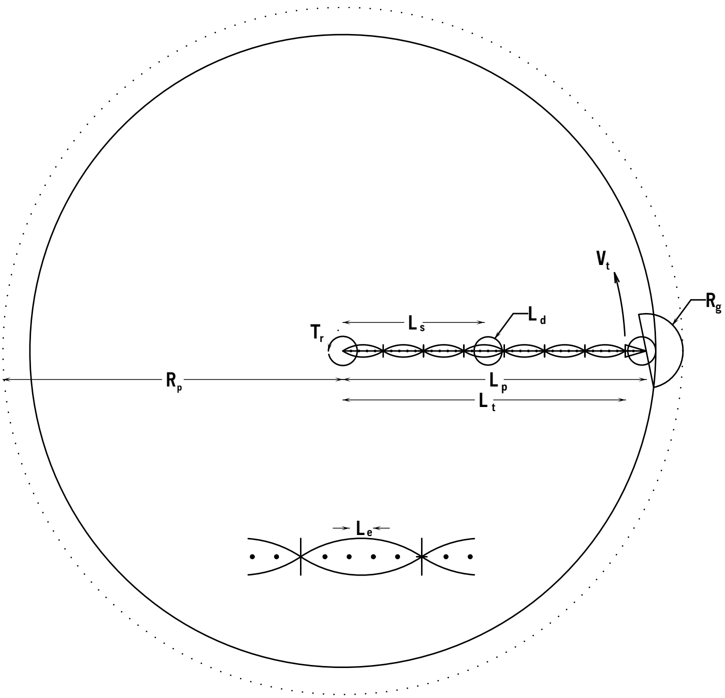
			
R55 = 40-55'	**R75 = 50-70'**	**SR75 = 70-90'**	**SR100 = 90-120'**
(12-17 m) @ 15-40 PSI (1.0-2.8 bar)	(15-21 m) @ 25-60 PSI (1.7-4.2 bar)	(21-28 m) @ 25-80 PSI (1.7-5.5 bar)	(28-37 m) @ 40-80 PSI (2.8-5.5 bar)
18 GPM-84 GPM	**24 gpm-70 gpm**	**30 GPM-160 GPM**	**50 GPM-300 GPM**
(4.1 m^3/h-19.1 m^3/h)	(5.4 m^3/h-15.4 m^3/h)	(6.8 m^3/h-36.3 m^3/h)	(11.4 m^3/h-68.2 m^3/h)

TYPICAL ADDED ACREAGE ON A 1/4 MILE PIVOT

< 10 ADDED ACRES (4.0 ha) full circle	**< 13 ADDED ACRES** (5.3 ha) full circle	**< 17 ADDED ACRES** (6.9 ha) full circle	**< 23 ADDED ACRES** (9.3 ha) full circle
< 6 acres (2.4 ha) corners only	< 7 acres (2.8 ha) corners only	< 9 acres (3.6 ha) corners only	< 11 acres (4.5 ha) corners only



PIVOT DIAGRAM FOR CALCULATIONS
(PAGES 16–19)



LEGEND	U.S. UNITS	METRIC UNITS
A = area	acres	hectares (ha)
Q_p = pivot flow	gpm	m^3/hr
Q_e = sprinkler flow	gpm	liters/min (lpm)
Q_s = required system flow	gpm/acre	m^3/hr/ha
D = applied depth of water	inches	mm
L_p = length of pivot	feet	meters (m)
L_t = distance to last tower	feet	meters (m)
L_e = sprinkler spacing	feet	meters (m)
L_s = distance to sprinkler "x"	feet	meters (m)
L_d = sprinkler diameter	feet	meters (m)
R_p = effective pivot radius	feet	meters (m)
R_g = end gun radius	feet	meters (m)
T_r = time for one revolution	hours	hours
V_t = last tower speed	feet/minute	meters / minute
E_a = irrigation application efficiency	decimal	decimal
E_p = pump efficiency	decimal	decimal
H = pump head	feet	meters (m)
P = power	hp	kw

U.S. UNITS CALCULATION	U.S. UNITS EQUATION	EXAMPLE
AREA IRRIGATED BY A CENTER PIVOT (Assumes end gun on all the time.)	$A = \frac{3.14 \times (L_p + R_g)^2}{43{,}560}$ A = area (acres) L_p = pivot length (ft.) R_g = end gun radius (ft.)	Find the acreage irrigated by a 1000 ft. pivot with an end gun radius of 130 ft. $A = \frac{3.14 \times (1000 + 130)^2}{43{,}560}$ **A = 92 acres**
HOURS PER PIVOT REVOLUTION @ 100% TIMER	$T_r = \frac{0.105 \times L_t}{V_t}$ T_r = hours per revolution (hr.) L_t = distance to last tower (ft.) V_t = last tower speed (ft./min.)	Find the amount of time needed for the pivot above to complete a revolution at the maximum tower speed of 10 ft./min (100% timer). The machine includes a 40 feet overhang. $L_t = 1000 - 40 = 960$ ft. $T_r = \frac{0.105 \times 960}{10}$ **T_r = 10.08 hrs per revolution**
DEPTH OF WATER APPLIED BY A CENTER PIVOT	$D = \frac{30.64 \times Q_p \times T_r}{(L_p + R_g)^2}$ D = depth of water applied (in.) Q_p = pivot flowrate (gpm) T_r = hours per revolution (hrs.) L_p = pivot length (ft.) R_g = end gun radius (ft.)	Determine the depth of water applied by the above pivot. Flowrate is 700 gpm. Last tower speed is 2.5 ft./min (25% timer). $T_r = \frac{0.105 \times 960}{2.5}$ = 40.32 hrs/rev. $D = \frac{30.64 \times 700 \times 40.32}{(1000 + 130)^2}$ **D = 0.68 inches**
REQUIRED FLOW FOR A GIVEN PIVOT SPRINKLER	$Q_e = \frac{2 \times L_s \times Q_p \times L_e}{(L_p + R_g)^2}$ Q_e = sprinkler flowrate (gpm) L_s = distance to sprinkler (ft.) Q_p = pivot flowrate (gpm) L_e = sprinkler spacing (ft.) L_p = length of pivot (ft.) R_g = end gun radius (ft.)	Determine the flowrate required by a sprinkler located 750 ft. from the pivot, if the sprinkler spacing is 17 ft. Pivot flowrate is 700 gpm. $Q_e = \frac{2 \times 750 \times 700 \times 17}{(1{,}000 + 130)^2}$ $Q_e = \frac{17{,}850{,}000}{1{,}276{,}900}$ **Q_e = 14.0 gpm**

U.S. UNITS CALCULATION	U.S. UNITS EQUATION	EXAMPLE
AVERAGE APPLICATION RATE	$I_a = \frac{2 \times 96.3 \times L_s \times Q_p}{(L_p + R_g)^2 \times L_d}$ I_a = average application rate (in./hr.) L_s = distance to sprinkler (ft.) Q_p = pivot flowrate (gpm) L_p = pivot length (ft.) R_g = end gun radius (ft.) L_d = sprinkler throw diameter (ft.)	Compute the average application rate at the location of 750 ft. from the pivot point. System flow is 700 gpm on 92 acres. Sprinkler coverage is 60 ft. diameter. $I_a = \frac{2 \times 96.3 \times 750 \times 700}{(1000 + 130)^2 \times 60}$ **I_a = 1.3 inches per hour**
REQUIRED SYSTEM FLOW	$Q_s = \frac{ET_p \times 453}{T_p \times E_a}$ Q_s = system flowrate (gpm/acre) ET_p = peak evapotranspiration (in./day) T_p = hours pumping per day E_a = water application efficiency (decimal)	Determine the required system flow if the peak crop water requirement is .30 in/day, water application efficiency is 90% and the system can be operated 18 hours per day. $Q_s = \frac{.30 \times 453}{18 \times .90}$ **Q_s = 8.4 gpm/acre**
POWER REQUIRED	$P = \frac{Q_p \times H}{3960 \times E_p}$ P = power (hp) Q_p = pivot flowrate (gpm) H = head the pump must produce (ft.) E_p = pump efficiency (decimal)	Determine the power required to pump 700 gpm against a head of 200 ft. if pump efficiency is 75% $P = \frac{700 \times 200}{3960 \times .75}$ **P = 47.1 hp**
NOZZLE OR NON-REGULATED SYSTEM FLOWRATE WITH CHANGING PRESSURE.	$Q_1 / Q_2 = \sqrt{P_1} / \sqrt{P_2}$ $Q_1 = Q_2 \times \sqrt{P_1} / \sqrt{P_2}$ Q_1 = flow to determine (gpm) Q_2 = known flow (gpm) P_1 = pressure (psi) for Q_1 P_2 = pressure (psi) for Q_2	Determine the flowrate of a #30 3TN nozzle at 15 psi, knowing the flow at 10 psi is 4.94 gpm. $Q_1 = 4.94 \times \sqrt{15} / \sqrt{10}$ **Q_1 = 6.05 gpm**

CONVERSIONS:

1 horsepower = .746 kilowatts
1 acre = 43,560 ft.^{2}
1 acre-inch = 27,154 gallons (U.S.)
1 ft. of head (water) = .433 PSI

inches/day = gpm/acre x .053
1 U.S. gallon (water) = 8.336 pounds
1 mile = 5,280 feet

METRIC CALCULATION	METRIC EQUATION	EXAMPLE
AREA IRRIGATED BY A CENTER PIVOT (Assumes end gun on all the time.)	$A = \frac{3.14 \times (L_p + R_g)^2}{10{,}000}$ A = area (ha) L_p = pivot length (m) R_g = end gun radius (m)	Find the area irrigated by a 400m pivot with an end gun radius of 40m. $A = \frac{3.14 \times (400 + 40)^2}{10{,}000}$ **A = 60.8 ha**
HOURS PER PIVOT REVOLUTION @ 100% TIMER	$T_r = \frac{0.105 \times L_t}{V_t}$ T_r = hours per revolution (hr.) L_t = distance to last tower (m) V_t = last tower speed (m/min.)	Find the amount of time need-ed for the pivot above to complete a revolution at the maximum tower speed of 3m/min. (100% timer). The machine includes a 15m overhang. L_t = 400–15 = 385m $T_r = \frac{0.105 \times 385}{3}$ **T_r = 13.5 hours per revolution**
DEPTH OF WATER APPLIED BY A CENTER PIVOT	$D = \frac{Q_p \times T_r \times 318.3}{(L_p + R_g)^2}$ D = depth of water applied (mm) Q_p = pivot flowrate (m^3/hr) T_r = hours per revolution (hrs.) L_p = pivot length (m) R_g = end gun radius (m)	Determine the depth of water applied by the above pivot. Flowrate is 240 m^3/hr. Last tower speed is 0.75 m/min (25% timer). T_r = 0.105 x 385 = 53.9 hrs/rev 0.75 $D = \frac{240 \times 53.9 \times 318.3}{(400 + 40)^2}$ **D = 21.3 mm**
REQUIRED FLOW FOR A GIVEN PIVOT SPRINKLER	$Q_e = \frac{2 \times L_s \times Q_p \times L_e}{(L_p + R_g)^2}$ Q_e = sprinkler flowrate (lpm) L_s = distance to sprinkler (m) Q_p = pivot flowrate (m^3/hr) L_e = sprinkler spacing (m) L_p = length of pivot (ft.) R_g = end gun radius (ft.)	Determine the flowrate required by a sprinkler located 250m from the pivot, if the sprinkler spacing is 5m. Pivot flowrate is 240 m^3/h. $Q_e = \frac{2 \times 16.7 \times 250 \times 240 \times 5}{(400 + 40)^2}$ $Q_e = \frac{10{,}020{,}000}{193{,}600}$ **Q_e = 51.8 lpm**

METRIC CALCULATION	METRIC EQUATION	EXAMPLE
AVERAGE APPLICATION RATE	$I_a = \frac{2 \times 1000 \times L_s \times Q_p}{(L_p + R_g)^2 \times L_d}$ I_a = average application rate (mm/hr.) L_s = distance to sprinkler (m) Q_p = pivot flowrate (m^3/hr) L_p = length of pivot (m) R_g = end gun radius (m) L_d = sprinkler throw diameter (m)	Compute the average application rate at the location of 250m from the pivot point. System flow is 240 m^3/hr and sprinkler coverage is 18m diameter. $I_a = \frac{2 \times 1000 \times 250 \times 240}{(400 + 40)^2 \times 18}$ **I_a = 34.4 mm per hour**
REQUIRED SYSTEM FLOW	$Q_s = \frac{ET_p \times 10}{T_p \times E_a}$ Q_s = system flowrate (m^3/hr/ha) ET_p = peak evapotranspiration (mm/day) T_p = hours pumping per day E_a = water application efficiency (decimal)	Determine required system flow if the peak crop water requirement is 8mm/day, water application efficiency is 90% and the system can be operated 18 hours per day. $Q_s = \frac{8 \times 10}{18 \times .90}$ **Q_s = 4.9 m^3/hr/ha**
POWER REQUIRED	$P = \frac{Q_p \times H \times 9.81}{3600 \times E_p}$ P = power (kW) Q_p = pivot flowrate (m^3/hr) H = head the pump must produce (m) E_p = pump efficiency (decimal)	Determine the power required to pump 240 m^3/hr against a head of 60 m. Pump efficiency is 75% $P = \frac{240 \times 60 \times 9.81}{3600 \times .75}$ **P = 52.3 kW**
NOZZLE OR NON-REGULATED SYSTEM FLOWRATE WITH CHANGING PRESSURE.	$Q_1 / Q_2 = \sqrt{P_1} / \sqrt{P_2}$ $Q_1 = Q_2 \times \sqrt{P_1} / \sqrt{P_2}$ Q_1 = flow to determine (lpm) Q_2 = known flow (lpm) P_1 = pressure (bar) for Q_1 P_2 = pressure (bar) for Q_2	Determine the flowrate of a #30 3TN nozzle at 1 bar, knowing the flow at 0.7 bar is 18.7 lpm. $Q_1 = 18.7 \times \sqrt{1} / \sqrt{0.7}$ **Q_1 = 22.35 lpm**

CONVERSIONS:

1 litre/sec = 3.6 m3/hr
1 mm/hr = 10m3/hr/ha
1 mm/day = 0.417 m3/hr/ha (24 hr operation)
1 m3/hr = 4.403 U.S. gpm

1 m = 1.42 psi
1 bar = 14.5 psi
1 bar = 10.2 m
1 bar = 100 kPa

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