Valley Linear
Design Guide

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www.valleyirrigation.com

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Introduction

The purpose of this design guide is to acquaint the irrigation designer with some of the unique considerations involved in designing Linear irrigation machine installations. This guide does not attempt to cover the basic irrigation design considerations such as water quality, crop consumptive use requirements, water management, climate, etc; it is assumed the irrigation designer will have already investigated these factors, and is now faced with having to consider how a linear machine might be applied to a specific irrigation situation. There are many variables to be considered, and specific recommendations are sometimes difficult to determine, but the well informed machine designer should be able to combine the information in this design guide with his own knowledge and information from other sources to arrive at a well-designed irrigation tool for the farmer.

Overhang Lengths and Miscellaneous Dimensions

Description of the Valley Linear

The linear cart is used on both Center Feed and End Feed Machines.

Each machine will have a free-standing span located in the approximate center of the machine. If the ditch or pipeline is located at the edge of the field, the 4-wheel cart will be the end tower adjacent to the ditch. If the ditch or pipeline is located at a position other than the edge of the field, the cart will be a part of the freestanding span that is adjacent to the ditch or pipeline.

The placement of tower boxes varies with the type of machine. The two types are:

1. **Center Feed** - This has an end tower box on each of the two end towers. The 4-wheel cart will be part of the free-standing span. Directly over the cart, there is a center feed tower box. At the far end of the free-standing span away from the cart is the central pulse tower box.
2. **End Feed** - The central pulse tower box stays on the far end of the machine. It is located at the third tower from the end. Rainger intermediate tower boxes are installed on both ends of the free-standing span. The significant difference with an end feed machine is that there is no tower box on the span directly over the control panel or cart, and only one end tower box located on the far end of the machine.

Exception: With below ground guidance the central pulse tower box is located at the far end of the freestanding span.

The linear is guided by either an above ground cable or buried wire, GPS Guidance or Furrow Guidance.

1. **Cable Guidance** - The cable guidance machine consists of an above ground cable supported by posts running parallel with the ditch or pipeline. Two guidance support arms are attached at angles to the cart. As the machine travels through the field, two pairs of vertical steering arms, (one on each end), straddle the cable. If no pressure is applied to the leading arms, the machine is on course. If it varies slightly off course, movement of one arm will call for a steer in the appropriate direction. If, for some reason, no corrective steer occurs, the control arm will move far enough to break the safety circuit and shut the entire machine down. The trailing control arms are part of the safety machine in that if the cart wanders or twists to the degree that the rear of the cart moves away from the guidance cable far enough, it will break the safety circuit. Steering is not affected by the trailing set of control arms. In addition, should the cable break, the vertical steering arms will sense this consequently, shutting down the machine.
2. **Below Ground Guidance** - The below ground guidance machine consists of a buried single loop wire running through the center of the field. A slight curve of this wire at each end of the field is necessary to counter the effects of the return wire electrical field.

   Located in the middle of the free-standing span attached to a tube suspended from the truss rods are five antennas. Two safety and one reference antenna are located in the middle of the tube, and on each end there is a steering antenna; one forward, one reverse.

   The reference antenna sits directly above the buried wire monitoring its signal. As the forward or reverse steering antenna moves to the left or right of the buried wire it will become in phase or out of phase with the reference antenna and cause the machine to steer back onto the wire.

   The two safety antennas are located on each side of the buried wire. As long as the wire stays in between these two antennas the machine will continue to run. Should one or the other safety antenna cross over the wire, the safety circuit will be open and the machine will shut down.
3. **Furrow Guidance** - The furrow guidance machine utilizes a "V" shaped furrow, 3 in to 4 in deep, running the length of the field. Resting in and following this furrow are front and rear guide shoes, each attached to the end of a long square tube assembly that mounts to a pivot point on the drive unit leg attachment plate. On the drive unit end of the tube is an actuator arm which is positioned between the vertical control arms extending from beneath the steering box. Should the drive unit wander away from the furrow, the actuator arm would move the vertical control arms which would depress a steer switch bringing the machine back into correct position. If the steer switch should fail, a back-up safety switch would shut the machine down. If the actuator arm breaks or slips from between the vertical control arms, the control arms move to a position that will trip a safety switch and shut down the machine.
4. **GPS Guidance** - The GPS guidance machine consists of GPS antenna and an RTK radio antenna and GPS control panel that are mounted on the linear. Configuration of the linear determines where the antennas are located. The GPS guidance machine utilizes existing GPS satellite positioning and an RTK correction signal from a local reference station to accurately guide the machine along a predetermined path.

   GPS guided machines do not require the central pulse tower box. Minimum length of run must be twice the length of the machine. Total length of the machine must be greater than 150 ft and less than 3200 ft.

   GPS guidance is not allowed with drop spans.

Overhang Lengths and Miscellaneous Dimensions

Linear Design Criteria

The following are excerpts from the linear design guide which you should keep in mind when installing a new linear machine.

1. There should be absolutely no bow in the line of cable that the machine is guiding from. In most cases this will result in the ditch having to be perfectly straight. Abrupt changes in direction should be avoided. The best method we have found to install the cable guidance stakes is by using a transit and flagging in a stake line. Then drive the cable guidance posts on this line and by either using a square or level, ensure that the posts are straight vertically. Crooked posts can cause varying wheel tracks.
2. The Valley Linear was designed to be used on relatively level fields. You should not attempt to install a linear on any severe rolling or sloping terrain. Also, the cart path must be flat and free of any ruts or tracks which would force side loads into the cart frame. Should ruts develop in the cart path, the owner operator should grade down the surface smooth and maintain it in that condition during irrigation season. It is also necessary to ensure that the path does not rise more than six inches above the top of the ditch. This is necessary to provide positive contacts between the guidance arms and the guidance cable.
3. In the event that a machine will be placed in a furrowed field, the machine should be run down the field once to locate the wheel track and these wheel tracks should then be left flat or disk down. It is desirable that the machine operate at 90 degrees to deeply furrowed fields or parallel to the furrows. When operating parallel to the furrows it is recommended to establish the wheel tracks first, and create the furrows using the tracks as a guide.
4. The erection of a linear machine begins with the freestanding span in, or as close as possible, within 5 ft (1.52 m), to its final operational location, with or without a 4-wheel cart. Spend some extra time to recheck the location. The "add spans" can be built in line or grouped and towed into position using tow dollies.
5. A Center Feed Machine will have the 4-wheel cart in position on the freestanding span adjacent to the guidance cable, and, therefore is easier to position. With an End Feed Machine, you may end up with the 4-wheel cart a few feet away from the cable. In this case, it is possible to manually steer the machine over to the cable. Do not attempt to drag it sideways to the cable line.

Irrigation Equipment near Airports and Crop Dusting Aircraft

- If any part of the irrigation machine comes within 3200 ft (975 m) of an airport runway, especially the approach (ends) of the runway, additional warning markers may be required. In the United States, CFR Title 14, Chapter I, Subchapter E, Part 77 – Safe, Efficient Use, and Preservation of the Navigable Airspace describes when marking is needed.

  This document is available at: www.ecfr.gov
- Marking requirements vary depending on the location of the irrigation equipment relative to the runway, the type of airport (Civil, Military, or Heliport) and other factors. Contact the local airport authority for guidance and specific recommendations. In the United States, guidelines for marking structures near airports are published by the Federal Aviation Administration in Advisory Circular AC 70/7460-1L – Obstruction Marking and Lighting.

  Available here: www.faa.gov/regulations_policies/advisory_circulars
- For irrigation machines near private or unregulated airfields, including farm-based airstrips, Valley strongly recommends complying with the same standards and requirements as Civil airports as shown in Part 77.
- Regulations vary by country, contact your local aviation authority for guidance.

  Overhang cables, including overhang back cables are a particular danger. In locations where low-flying aircraft are likely, such as within 1,500 ft (457 m) of an end of an airport runway, or where crop dusting aircraft are common, Valley recommends adding obstruction markers to overhang cables to improve their visibility.

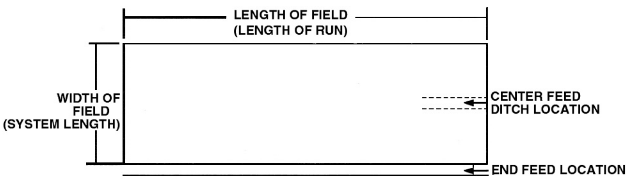
  For large overhangs (36 ft / 10.97 m Heavy Duty and longer), five 12 in (300 mm) or 20 in (500 mm), aviation orange marker balls are sufficient. One near the rabbit ears, two in the middle of the back cables and two in the middle of the highest overhang cables. Refer to Section 3.5 in AC70/7460-1 for additional details. Aviation marker balls are available online and from a variety of aviation and airport safety equipment providers.

Overhang Lengths and Miscellaneous Dimensions

Field Dimensions

The initial field/machine design for the linear machine begins with the determination of field dimensions and the location of a ditch, either at the edge of a field or through the approximate center of the field. This, of course, determines whether we have an end feed or center feed machine. Also, there are two possibilities concerning the ditch – it may be an existing ditch or a new ditch must be located and constructed.

6. Definition of dimensional terms.



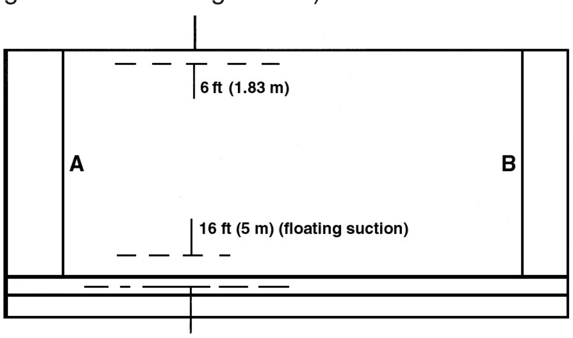
The following mini~matrix will serve as a guide to our starting point.

	New Ditch	Existing Ditch
END FEED	Section Two*	Section Two*
CENTER FEED	Section Four	Section Three

*Refer to the “General Ditch Guidelines” table below.

Section One - End Feed

STEP 1: Measure field at "A" and "B". The shortest dimension, less 16 ft (4.87 m) for the inlet length, for dirt ditch and 10.7 ft (3.26 m) for concrete ditch, less 6 ft (1.82 m) for end tower or overhang clearance Is the longest machine we can install (assuming that span lengths can be arranged to fit).

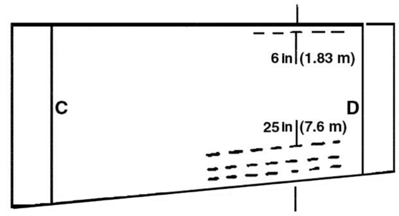


Section Two - End Feed

STEP 1: Measure field at "C" and "D". The longest machine length (considering span lengths) will be the shortest dimension, less 6 ft (1.82 m) clearance, less 10.7 ft (3.26 m) for inlet, and less distance to centerline of ditch type from the General Ditch Guidelines table.

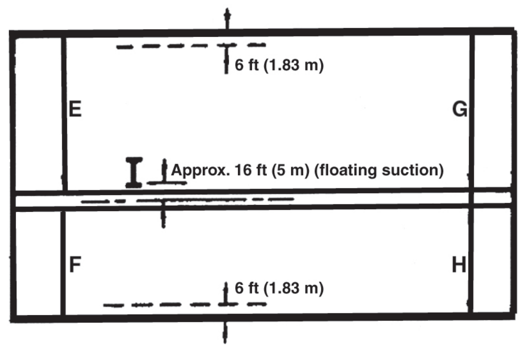
General Ditch Guidelines

Ditch Type	Distance
Dirt 2 to 1 Slope	8 ft (2.43 m)
Dirt 1.5 to 1 Slope	6 ft (1.82 m)
Concrete	4 ft (1.21 m)



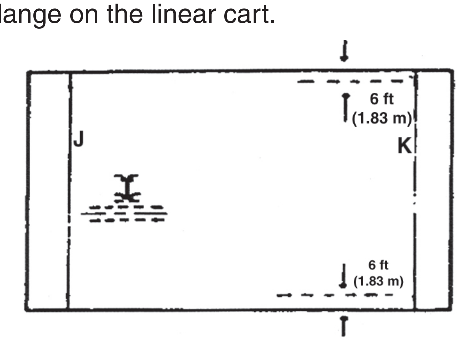
Section Three - Center Feed

STEP 1: Measure field at "E", "F", "G", and "H". The shortest dimension "E" or "G" added to the shortest of "F" or "H" will be used to determine our machine length. Remember to add 1.5 ft (0.45 m) for the transition pipe. Also deduct 6 ft (1.82 m) from each end for clearance. Finally, remember that the free-standing span (with boss unit) in the center of the field must be positioned approximately 12 ft (3.65 m) away from the center line of the ditch, using the span flange as the calculation point.



Section Four - Center Feed

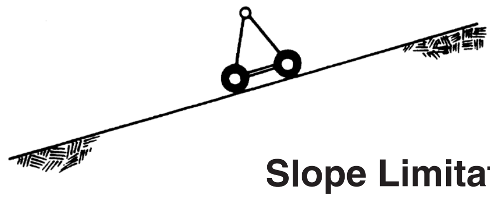
STEP 1: Measure field at "J" and "K". The shortest dimension, if any difference, will be used to determine the maximum machine length, less 6 feet on each side for clearance. At the approximate center of the machine locate the free-standing span, considering GPM requirements, pipe sizing, available span lengths, etc. Remember to add 1.5 ft (0.45 m) or "O" for transition pipe. Once the free-standing span is located, calculate the position of the centerline of the ditch approximately 12 feet (3.65 m) outside of the flange on the linear cart.



STEP 2. End of run adjustments.

(Consider potential for moving machine beyond field boundary for convenience during cultivation and harvest operation.)

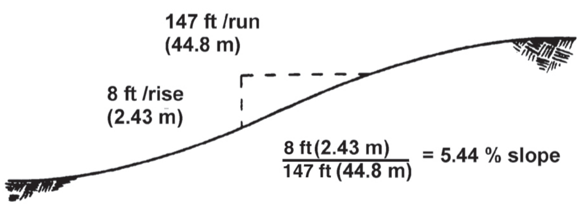
Slopes and Slope Limitations



Slopes

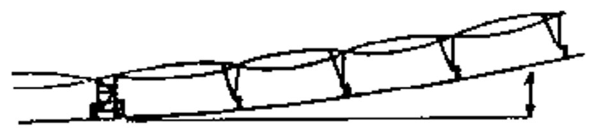
Measure all questionable field slopes to assure irrigation machine compatibility. Slope percentage equals rise divided by run.

$$\% \text{ Slope} = \frac{\text{rise}}{\text{run}} = \frac{8 \text{ ft } (2.43 \text{ m})}{147 \text{ ft } (44.8 \text{ m})} = 5.44\% \text{ slope}$$



Slope Limitations

7. A maximum slope of 5% is recommended for good practice on hose drag linear machines. Hose pulling capability is compromised when climbing up hills.
8. Ditch Feed linears are generally limited to flat fields, due to the presence of a ditch.



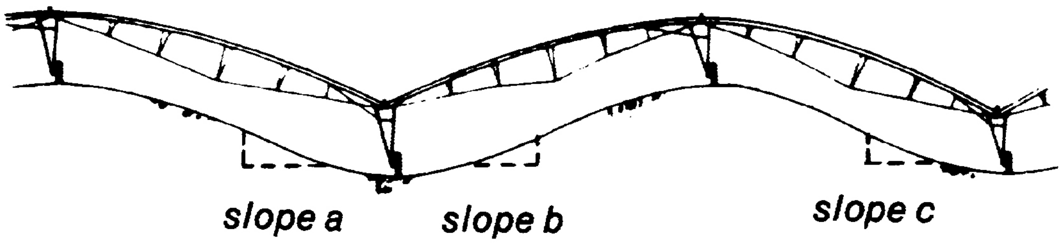
Side Slope

9. Maximum side slope over any point in field is 4% over entire field is 2%.

Slope Limitations

Slope Absorption

Slope absorption at the drive unit must be considered.

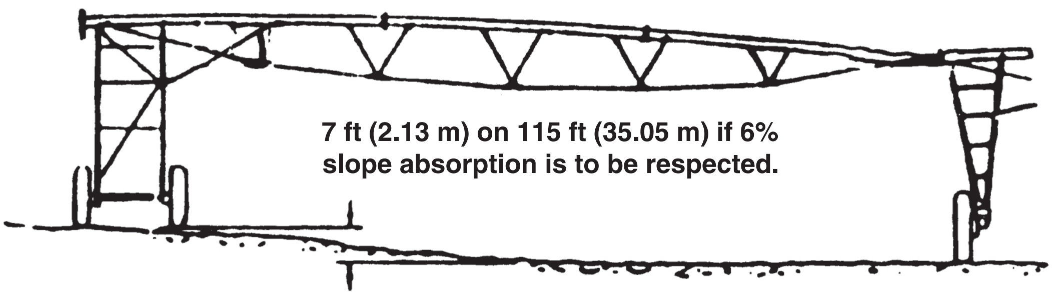


The ball and socket joint on undertruss spans allows a sum of slope (a + b) or (b + c) without significant torsional loading.

Maximum Slope Absorption Permissible on Linear 6%

The 4-wheel cart tower must be operated on a level roadway.

This roadway must be kept free of ruts. The tower adjacent to the cart tower must be less than 8 feet (2.44 M) different in elevation from the cart tower roadway.



Drop Spans

Model 8000, Model 8120 (6 5/8 in (168 mm) only)

Machine Spans and Profiles

10. Available on all span lengths, 6 5/8 in spans only.
11. Available only on standard profile spans.
12. Available with all traction options.

Machine Length

1. Allow an additional three feet of machine length for the drop span hardware.
2. No maximum length restriction other than the standard restrictions.
3. Five (5) spans minimum length is required.

Center Feeds

1. All guidance types are allowed except GPS Guidance. **GPS guidance is not allowed with drop spans.**
2. Below Ground Guidance - The pulse timer box is located on the outer end of the free-standing span. Multiple spans may be dropped as long as one span is left outside of the free-standing span. Spans may be dropped from either end of the machine.
3. Cart Mounted Guidance - The pulse timer box is located on the third tower from the end. The outer one or two spans may be dropped if one span is left outside of the free-standing span.

End Feeds

1. All guidance types are allowed except GPS Guidance. GPS Guidance is not allowed with drop spans.
2. Below Ground Guidance - The pulse timer box is located on the outer end of the free-standing span. Multiple spans may be dropped as long as one span is left outside of the free-standing-span.
3. Cart Mounted Guidance - The pulse timer box is located on the third tower from the end. The outer one or two spans may be dropped if one span is left outside of the free-standing span.

Slope Capability

1. Slopes at the location where the span is dropped should be limited to 5%.
   (a) Dirt work may be required to insure the ball hitches align when picking up the dropped span.
2. No ridge crop limitations.

Machine Alignment

1. Machines longer than six spans are required to have full-floating alignment. Full-floating alignment will be discontinued one drive unit prior to the drop span drive unit, and will be continued one drive unit beyond the drop span drive unit. Drop spans are also allowed on five span machines with modified alignment.
2. If GPS positioning is being used, the antenna can not be located on the dropped spans. Move it to the inner part of the machine.
3. If only one span is being dropped with full-floating alignment, there will be left over alignment components.

Machine Speed

1. With spans dropped, the end drive unit speed will no longer match the cart speed. The machine must not be run faster than 80% to avoid shutdown. The machine will steer more than normal in this configuration.

⚠ WARNING

- **LINEAR MACHINES ARE SUSCEPTIBLE TO VARIATIONS IN LOCATION RELATIVE TO THE WHEEL TRACK. THE OPERATOR SHOULD BE PRESENT WHEN THE MACHINE RETURNS TO THE POINT WHERE SPANS WERE DROPPED, TO MAKE SURE IT STOPS IN THE CORRECT LOCATION AND THAT THERE IS NO CONTACT BETWEEN SPANS.**

Drop Span Considerations

Drop Spans (Continued)

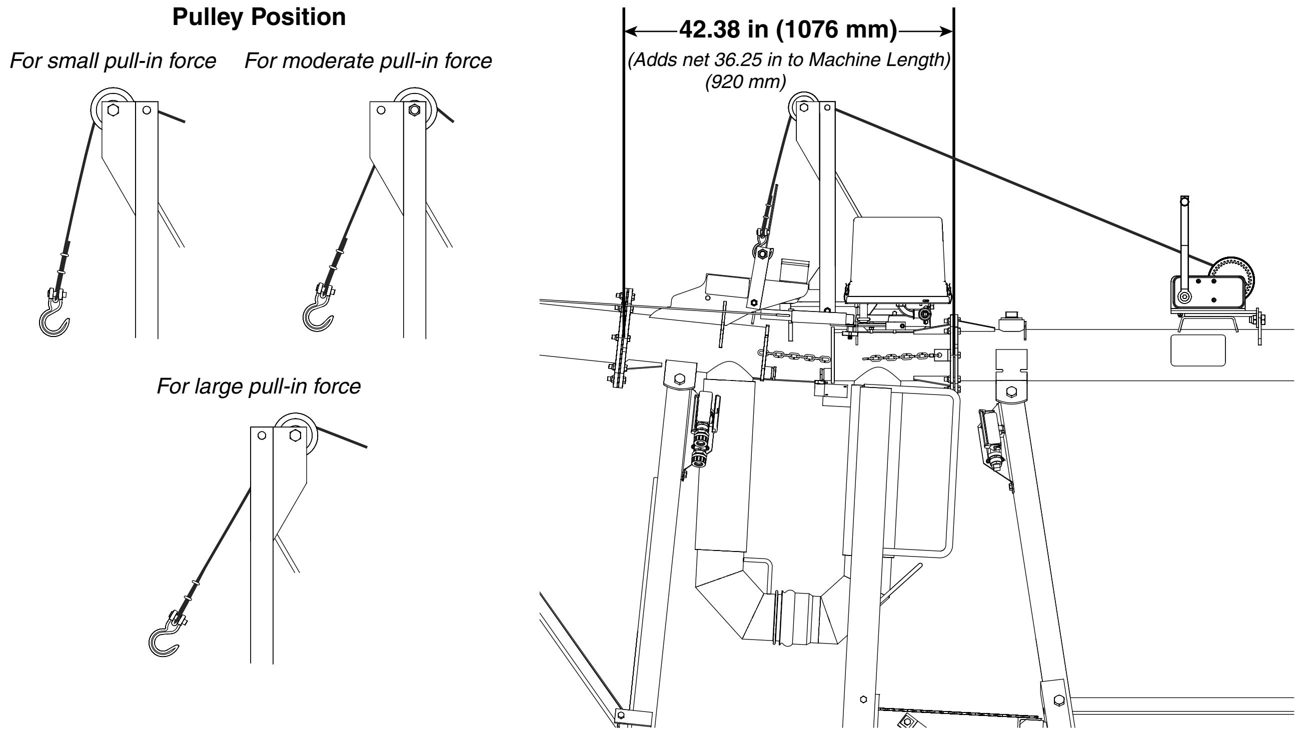


Figure 1-10-1

Drop Span Details

On machines with drop spans there are some special considerations that need to be made for proper operation both during setup by the dealer and operation by the customer.

When operating a machine with a drop span there are several different methods that can be used to reduce the time spent disconnecting/connecting the spans. Following these methods will also assist in proper management of the machine with respect to application of water. Please read and consider this section carefully.

It must also be noted that there is a possibility for an extreme increase in the mainline and cart pressure when the drop span is used on a machine without a properly functioning VFD (Variable Frequency Drive). This is due to restricting the machines flow rate, in some cases quite significantly. Prior to ordering a drop span, it would be best to perform analysis of the effect it may have on a particular machine.

Drop Span Electrical Considerations

At the drop span, the electrical cable is limited to 11 conductors when making connections to the span being dropped.

Procedure to Adjust Percent Timer

The slow down timer will not be used when dropping span(s) on a linear machine. The reduction in machine flow when dropping off span(s) will result in the cart pressure increasing or staying the same if using a VFD. The slow down timer must be set to 80% in the drop span box to allow the new end tower to not run ahead of the next to last tower when running at high percent timer settings.

Drop Spans (Continued)

Sprinkler Package With Pressure Regulators

For sprinklers with pressure regulators, no adjustment to the percent timer setting is needed.

Sprinkler Package Without Pressure Regulators

For sprinklers without pressure regulators a higher percent timer setting must be calculated to apply the same application depth without the drop spans. Use Formula 1.1 to calculate the correct percent timer setting.

> ⚠ **CAUTION**
>
> - **IT IS IMPORTANT TO REMEMBER THAT THE HIGHEST PERCENT TIMER SETTING TO USE WHEN DROPPING SPAN(S) IS 80%. THIS IS DUE TO THE LAST SPAN HAVING A DIFFERENT CENTER DRIVE RPM COMPARED TO THE LAST DROP SPAN.**

Formula 1.1

For **unregulated** machines:

- $\sqrt{P2/P1} \times Pm$ (%) = Adjusted Percent Timer Setting (%)

*See Figure 1 below for a graph to help solve for $\sqrt{(P2/P1)}$

Where:

- P1 = Cart inlet pressure when all spans are present
- P2 = Cart inlet pressure when spans are dropped (should be greater than P1)
- P_m = Percent timer setting that the machine was set at before the spans were dropped

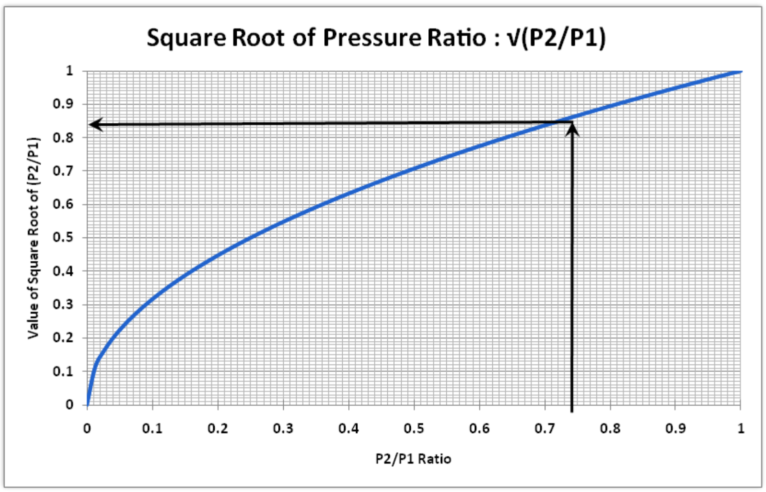


Figure 1

Graph of the square root of P2/P1. This can be used when a calculator with the square root function is not available. Divide P2 by P1, and then find that value on the x-axis. Follow that value up until you hit the curved line, then from that point go horizontally to the y-axis; this is the value of the square root of P2/P1.

Special Considerations

Special considerations are required; if any of the following applies, you may wish contact Valley:

- The drop span tire size doesn't match LRDU tire size.
- You are unsure of how to select the end gun/end gun nozzle to be used on the drop span.
- If you have any other questions or concerns regarding the drop span.

There may be other special considerations that need to be accounted for, and in most cases there will be a solution. Some general solutions to allow the slowdown timer to be used (rather than having to adjust the machines percent timer) include:

- Changing the tire size on drop span or LRDU.
- Adjusting the pump.
- Changing the sprinkler package.
- Changing or adding an end gun and/or end gun nozzle on the drop span.

Conclusion

Using a drop span is an effective way to pick up additional acres in an irregular shaped field; however, special considerations need to be made in its application, operation, and setup. Utilizing the slowdown timer feature can greatly aid in proper operation in combination with one of the operation methods discussed. Care must be taken to ensure maximum mainline and/or pivot pressure doesn't get exceeded when utilizing the drop span.

Overhang Lengths and Miscellaneous Dimensions

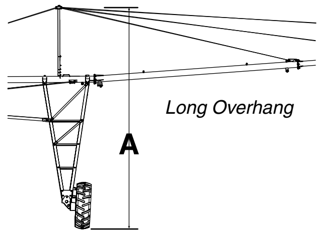
6 5/8 in (168 mm) OVERHANGS* 7000 series / 8000 / 8120	
Length	
(feet)	(meters)
82.0	24.99
73.0	22.25
64.0	19.50
54.0	16.45
45.0	13.71
36.0	10.97
27.0	8.22
18.0	5.48
9.0	2.74
2.5	0.76

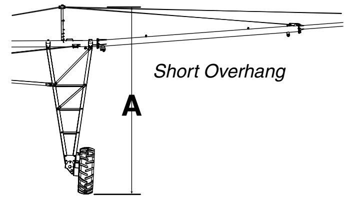
*Poly Available

6 in (152 mm) OVERHANGS 7000 series / 8000 / 8120	
Length	
(feet)	(meters)
100.0	30.48
82.0	24.99
73.0	22.25
64.0	19.50
54.0	16.45
45.0	13.71
36.0	10.97
27.0	8.22
18.0	5.48
9.0	2.74

5 in (127 mm) OVERHANGS 8120	
Length	
(feet)	(meters)
74.0	22.55
55.9	17.03
37.7	11.49
28.5	8.68
19.2	5.85
2.5	0.76

Overhang Length		Poly Required Min Span Length		Galvanized Min. Span Length	
ft	m	ft	m	ft	m
100	30.5	-	-	180	55
83	25.3	180	55	135	41.1
74	22.6	160	49	123	37.5

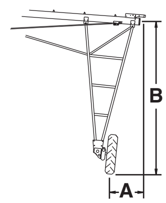




OVERHANG HEIGHT (A)

Tire Size	Long Overhang in (m)			Short Overhang in (m)		
	Low	Standard	High	Low	Standard	High
11.2 x 24	248.0 (6.29)	284.0 (7.21)	323.0 (8.20)	161.5 (4.10)	197.5 (5.01)	236.5 (6.00)
14.9 x 24	250.5 (6.36)	286.5 (7.27)	325.5 (8.26)	164.0 (4.16)	200.0 (5.08)	239.0 (6.07)
16.9 x 24	251.5 (6.38)	287.5 (7.30)	326.5 (8.29)	165.0 (4.19)	201.0 (5.10)	240.0 (6.09)
11.2 x 38	255.0 (6.47)	291.0 (7.39)	330.0 (8.38)	168.5 (4.27)	204.5 (5.19)	243.5 (6.18)
12.4R x 38	255.0 (6.47)	291.0 (7.39)	330.0 (8.38)	168.5 (4.27)	204.5 (5.19)	243.5 (6.18)

Drive Unit Heights 6 5/8 in (168.3 mm).



TOWER-WHEEL CHART

Tires	A
New/Recap	27.9 in (708 mm)
High Float 14.9 x 24	26.2 in (665 mm)
Maxi Float 16.9 x 24	24.8 in (629 mm)
11.2 x 38	28.5 in (723 mm)
12.4R x 38	28.5 in (723 mm)

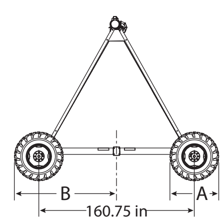
NOTE: The "A" dimension can vary ±3.0 in depending on span length and crown.

DRIVE UNIT HEIGHT (B)

(to center of pipe)

Tire Size	B		
	Low	Standard	High
11.2 x 24	120.0 in (3.04 m)	156.0 in (3.96 m)	195.0 in (4.95 m)
14.9 x 24	122.5 in (3.11 m)	158.5 in (4.02 m)	197.5 in (5.01 m)
16.9 x 24	123.5 in (3.13 m)	159.5 in (4.05 m)	198.5 in (5.04 m)
11.2 x 38	127.0 in (3.22 m)	163.0 in (4.14 m)	202.0 in (5.13 m)
12.4R x 38	127.0 in (3.22 m)	163.0 in (4.14 m)	202.0 in (5.13 m)

Drive Unit Heights 6 5/8 in



TOWER WHEEL DIMENSIONS

(front)

Tires	A		B
	Diameter	*Radius	
11.2 x 24	43.4 in (1.1 m)	20.0 in (0.50 m)	102.08 in (2.59 m)
14.9 x 24	49.8 in (1.2 m)	22.6 in (0.57 m)	105.28 in (2.67 m)
16.9 x 24	52.5 in (1.3 m)	23.5 in (0.58 m)	106.63 in (2.70 m)
11.2 x 38	57.4 in (1.4 m)	27.0 in (0.68 m)	109.08 in (2.77 m)
12.4R x 38	59.7 in (1.5 m)	27.0 in (0.68 m)	100.23 in (2.54 m)

***NOTE:** This is a "Loaded" radius.

Management Methods and Methods of Operation

Management Methods

(a) The two factors that have the greatest effect on management method are depth of water applied per pass, and type of soil.

(b) The depth of water applied per pass is determined by the speed of the machine when irrigating and controlled by a percentage timer just like a center pivot.

(c) The depth of water to be applied will be determined by crop rooting depth, soil type, leaching effects on undesirable salts or desirable nutrients, etc. Runoff should be avoided. Generally we have learned that light soils require frequent shallow depth applications while heavy soils require less frequent deeper depth applications.

(d) The management method selected should take into account the control of the water source. Since each management method contains some time factor when the machine is not pumping water from the ditch (refueling, maintenance, moving dry, at rest, etc.) It is imperative that the water can either be shut off, or some provision made for overflow.

(e) A device which senses the level or flow of water in the ditch can be wired to a pump kill to shut off a well, if a well is used for the water source. A similar device can trigger an electrically operated valve.

(f) In flowing ditches, an overflow will be needed to handle excess water in the case of a unplanned shutdown.

(g) In some cases the availability of water is predetermined, such as an irrigation district, where the user may get water five days out of every six, or a similar arrangement. The machine management method should take these restrictions into account.

Methods of Operation

The key factors to be determined by selecting a method of machine operation are:

Irrigating time	=	Available hours for watering.
Dry run time	=	Time spent moving the machine without water.
Reset time	=	Time spent not being moved or used to irrigate.
Maintenance time	=	Planned maintenance, such as refueling, oil change, etc.
Management contingency time	=	Allowances for management error such as running out of fuel, no attendant when machine needs to be reversed at end of pass, etc.
Down time	=	Allowance for unplanned interruptions.
Hose configuration	=	Time required to change hose after reaching the end of hose stop for a riser times the number of risers in the run.

Machine Capacity

Method I and Method II

Method I

Method I is a good method for many fields and soils. The machine is started at one end of the field and run to a point somewhere in the middle of the field, wet, or irrigating as it moves. At the middle point, the machine is stopped; the speed control is set at 100%, and the machine is moved dry to the other end of the field. At this end, the machine is reversed and speed is reset to desired application depth, and the machine is returned to the middle point. At the middle point, the machine is stopped. By the time the machine reaches this point, the first part of the field that was irrigated has probably dried sufficiently to let the machine speed be reset to 100% and allow the machine to be run dry to the original end of the field without danger of deep rutting caused by running across recently irrigated wet ground.

Note the importance of the machine operator being required to be present at the completion of each step in the process in order to change mode (wet or dry), direction (forward or reverse), and set speed (change percentage timer). If the operator was only 30 minutes late each time the machine reached the end of a step of the cycle (even if it was 3 a.m.), two hours of time would be used with out accomplishing any irrigation. See Figure 1-14-1.

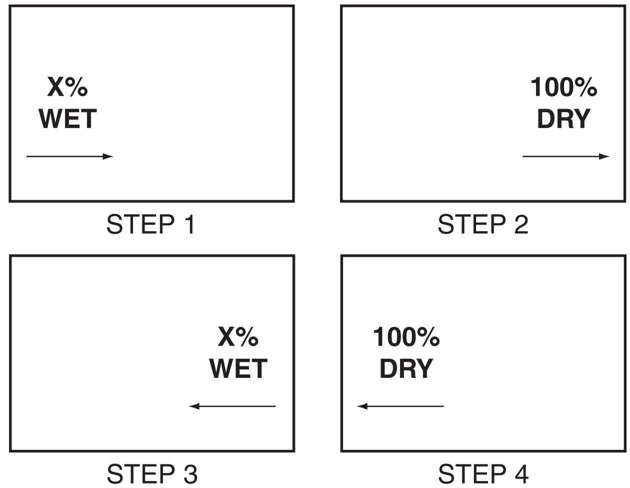


Figure 1-14-1 **Method I**

Method II

Method II Is a good method where minimal operator attention is available and/or irrigation is largely supplemental in nature. The machine is started at one end of the field and run wet to the opposite end. To avoid deep ruts from running the machine back over the newly irrigated field, the machine is allowed to rest for a period of time sufficient to let the field dry out a bit. Because there is no immediate need for machine reversal at the completion of step 1, no critical attendance by the machine operator is required. Also, maintenance can be performed on the machine during the rest period, step 2. At the end of the step 2 period, the machine is returned quickly and dry to the starting point. See Figure 1-14-2.

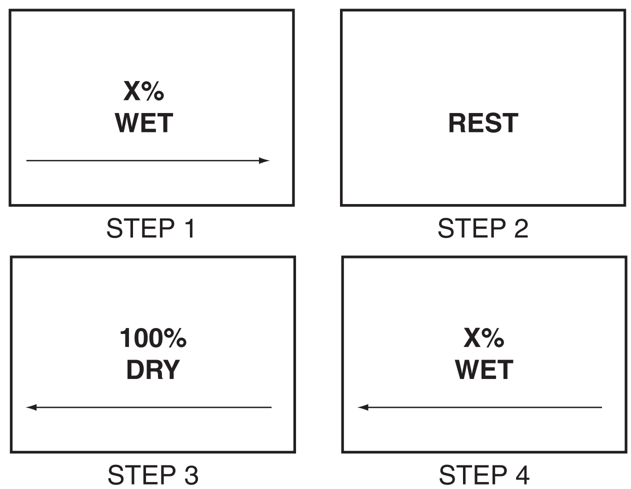


Figure 1-14-2 **Method II**

Step 3 could be replaced with step 4 in some soils.

Method III and Method IV

Method III

Method III is probably limited to frequent shallow applications on relatively sandy soils. The machine is run wet back and forth across the field, and is reversed over freshly irrigated ground - a practice that is probably allowable only where applications have been shallow and where soil type (sandy) does not readily cause ruts when wet. See Figure 1-15-1.

Method IV

Method IV is similar to Method I, except it is probably more suitable in situations where the water source cannot be independently controlled by the machine operator and/or it is not desired or possible to turn the water off while the machine is being operated. The machine is started at one end and run wet with a fairly deep application to a middle point. At the middle point the speed is increased so that a shallower amount is applied to the second part of the field. Upon reaching the end of the field, the machine is reversed and slowed down to apply the deep application. If the previous shallow application and soil type are compatible, wheel track rutting may be minimized even though the machine is crossing freshly irrigated ground. This situation will obviously be worst right at the end of the field; as the machine progresses through step three it will be irrigating progressively dryer soil. When the machine reaches the middle point, the speed is increased to apply the shallow depth while the machine is moving to the original point. See Figure 1-15-2.

For example, if the machine has a capacity for applying 0.4 in depth at 100% speed, and it is desired to apply a total of 2 in, the application would be:

Steps 1 and 3 = 1.2 in (25% setting)

<u>Steps 2 and 4 = 0.3 in</u> (100% setting)

Total = 1.5 in

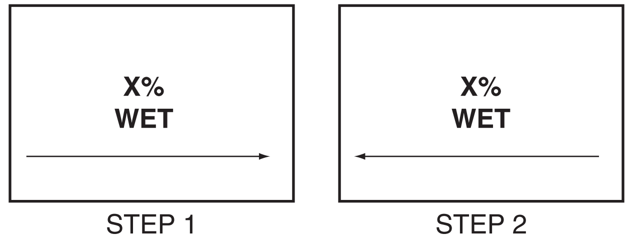


Figure 1-15-1 **Method III**

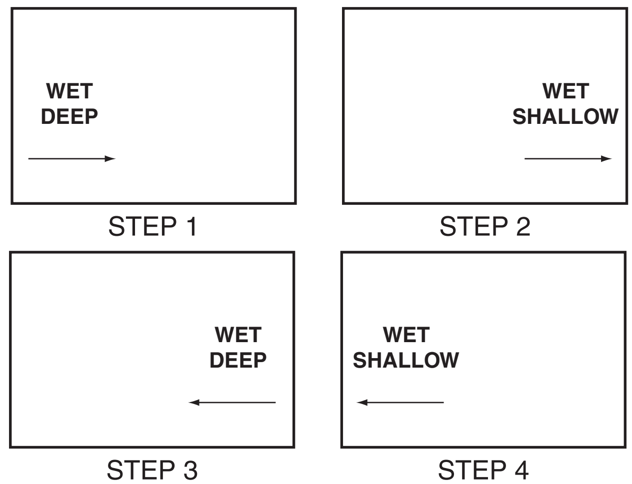


Figure 1-15-2 **Method IV**

Machine Capacity

Capacity Worksheet

Step Determine Application Depth

1. Application depth for 2 passes* Inches __________
2. **Determining Irrigation Time**
   Application depth for 2 passes Inches __________
   Crop consumptive use Inches per day __________
   Required Irrigation Time (in hours) Irrigation time hours _________
3. **Down Time Calculations**
   (a) Dry run time Hours for 2 passes __________
   (b) Rest time Hours for 2 passes __________
   (c) Maintenance time Hours for 2 passes __________
   (d) Management contingency time Hours for 2 passes __________
   (e) Down time Hours for 2 passes __________
   (f) Hose change time Hours for 2 passes __________
   Total Non-Irrigating Time Hours for 2 passes __________
4. **Determine Available Hours for Watering**
   Total irrigation time required (in hours) Hours __________
5. **Multiplier for Water Increase**
   Multiplier used to increase GPM required Multiplier __________
   $$\frac{\text{\_\_\_\_\_\_\_ Hours available for watering (Step 4)}}{\text{\_\_\_\_\_\_\_ Hours irrigating time (Step 2)}} = \text{\_\_\_\_\_\_\_\_\_\_\_}$$ Multiplier
6. **Determine New Inches per Day Capacity**
   New inches per day machine capacity in/day capacity __________
   Multiplier (Step 5) _____ x crop consumptive use _____ in/day = new in/day capacity
7. **Machine GPM**
   Converts calculations into machine GPM requirements GPM/acre _________
   $$\frac{\text{in/day}}{0.053} = \text{\_\_\_\_\_\_\_\_\_\_ GPM/Acre}$$
8. **Calculate Irrigated Acres**
   Using field dimensions calculate acres Field width (feet) __________
   Field length (feet) __________
   (width x length) / 43,560 = Acres Total Acres __________
9. **Determining Total Machine Flow Requirements**
   Establishes the total flow required for the machine US GPM __________
   Total acres X GPM/acre = US GPM

* Two passes - from a starting point at one end of the field to the other end of the field and back again to the starting point. (I.e. one complete cycle.)

Comparisons

Center Feed Versus End Feed

(a) High gallonage/high acreage machines designed with center cart will have less voltage drop and wire size may be reduced accordingly.

(b) End feed designs leave the field free of obstructions (such as the ditch) for ease of field operations.

(c) If there is no overriding concern or desire for one versus the other, both designs should be figured and compared.

(d) With a center feed the pressure loss and pipe size are reduced by the center location of the cart.

Uniform Pipe Diameter Versus Combination Pipe

(a) High gallonage/high acreage machines may require combinations of larger pipe diameters near the pump unit and smaller pipe diameters away from the pump unit to stay within power unit capacity limitations and limitations on total drive units. As a general rule, 2600 ft (792 m) center feeds in excess of 2600 GPM (590 M^3/h) should utilize approximately 30% 8-5/8 in (219 mm) diameter pipe.

(b) Combination pipe sizes require a few extra design steps in figuring pressure loss.

(c) All span lengths and pipe diameters available may be used on the linear.

(d) Maximizing the pipe diameter will normally result in lowering the power requirements and/or allowing greater capacity at the expense of additional drive units.

Determine Machine Length and Span Configuration

(a) Be sure and use exact span dimensions (see Linear Friction Loss - Table 2 on page 1-18).

(b) Remember the 1.5 ft (457 mm) transition pipe when using combination pipe (see Linear Friction Loss - Table 2 on page 1-18).

(c) Remember the vertical relationship between the ditch water level and the cart tower ground level will affect the horizontal relationship of the cart tower and the ditch (see Linear Friction Loss - Table 2 on page 1-18).

(d) The vertical relationship of the cart above the canal can also affect the machine steering/guidance.

(e) Cart path.

(f) Remember to have adequate end of machine clearance.

Pressure Loss

Linear Friction Loss

All 6-5/8 in Diameter Pipe
(PSI)

Table 2

	Basic Machine Length in Feet																										
GPM	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600	2700	2800	2900	3000	3100	3200	3300	3400
500	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3	4	4	4	4	4	4	4	4	5
600	2	2	2	2	2	2	3	3	3	3	3	4	4	4	4	4	5	5	5	5	5	6	6	6	6	6	6
700	2	2	3	3	3	3	4	4	4	4	5	5	5	5	6	6	6	6	7	7	7	7	8	8	8	8	9
800	3	3	3	4	4	4	5	5	5	6	6	6	6	7	7	7	8	8	8	9	9	9	10	10	10	11	11
900	3	4	4	4	5	5	6	6	6	7	7	8	8	8	9	9	10	10	10	11	11	12	12	13	13	13	14
1000	4	4	5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12	13	13	14	14	15	15	16	16	17
1100	5	5	6	6	7	8	8	9	9	10	11	11	12	12	13	13	14	15	15	16	16	17	18	18	19	19	20
1200	5	6	7	8	8	9	10	10	11	12	12	13	14	14	15	16	16	17	18	19	19	20	21	21	22	23	23
1300	6	7	8	9	10	10	11	12	13	14	14	15	16	17	18	18	19	20	21	22	22	23	24	25	26	26	27
1400	7	8	9	10	11	12	13	14	15	16	16	17	18	19	20	21	22	23	24	25	26	27	27	28	29	30	31
1500	8	9	10	11	12	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
1600	9	11	12	13	14	15	16	18	19	20	21	22	23	25	26	27	28	29	30	32	33	34	35	36	37	39	40
1700	10	12	13	14	16	17	18	20	21	22	24	25	26	27	29	30	31	33	34	35	37	38	39	41	42	43	45
1800	12	13	15	16	17	19	20	22	23	25	26	28	29	31	32	33	35	36	38	39	41	42	44	45	47	48	49
1900	13	14	16	18	19	21	23	24	26	27	29	31	32	34	35	37	39	40	42	43	45	47	48	50	51	53	55
2000	14	16	18	19	21	23	25	27	28	30	32	34	35	37	39	41	42	44	46	48	50	51	53	55	57	58	60
2100	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43	45	46	48	50	52	54	56	58	60	62	64	66
2200	17	19	21	23	25	27	30	32	34	36	38	40	42	44	46	49	51	53	55	57	59	61	63	65	67	70	72
2300	18	21	23	25	27	30	32	34	37	39	41	44	46	48	50	53	55	57	60	62	64	66	69	71	73	76	78
2400	20	22	25	27	30	32	35	37	40	42	45	47	50	52	55	57	59	62	64	67	69	72	74	77	79	82	84
2500	21	24	27	29	32	35	37	40	43	45	48	51	53	56	59	61	64	67	69	72	75	77	80	83	86	88	91
2600	23	26	29	32	34	37	40	43	46	49	52	55	57	60	63	66	69	72	75	78	80	83	86	89	92	95	98
2700	25	28	31	34	37	40	43	46	49	52	55	59	62	65	68	71	74	77	80	83	86	89	92	96	99	102	105
2800	26	30	33	36	40	43	46	49	53	56	59	63	66	69	72	76	79	82	86	89	92	96	99	102	105	109	112
2900	28	32	35	39	42	46	49	53	56	60	63	67	70	74	77	81	84	88	91	95	98	102	105	109	113	116	120
3000	30	34	37	41	45	49	52	56	60	64	67	71	75	79	82	86	90	94	97	101	105	109	112	116	120	124	127
3100	32	36	40	44	48	52	56	60	64	68	72	76	80	84	88	91	95	99	103	107	111	115	119	123	127	131	135
3200	34	38	42	46	51	55	59	63	68	72	76	80	84	89	93	97	101	105	110	114	118	122	127	131	135	139	143
3300	36	40	45	49	54	58	63	67	71	76	80	85	89	94	98	103	107	112	116	121	125	130	134	138	143	147	152
3400	38	42	47	52	57	61	66	71	76	80	85	90	94	99	104	109	113	118	123	127	132	137	142	146	151	156	160
3500	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	124	129	134	139	144	149	154	159	164	169
3600	42	47	52	58	63	68	73	79	84	89	94	100	105	110	115	121	126	131	136	142	147	152	157	163	168	173	178
3700	44	50	55	61	66	72	77	83	88	94	99	105	110	116	121	127	132	138	143	149	155	160	166	171	177	182	188
3800	46	52	58	64	70	75	81	87	93	99	104	110	116	122	128	133	139	145	151	157	162	168	174	180	186	191	197
3900	49	55	61	67	73	79	85	91	97	103	109	116	122	128	134	140	146	152	158	164	170	176	182	189	195	201	207
4000	51	57	64	70	76	83	89	96	102	108	115	121	127	134	140	147	153	159	166	172	178	185	191	198	204	210	217

Pressure loss with an al 6-5/8 in diameter pipe machine $= \text{(Machine Length)} \times \left(\frac{GPM}{17710}\right)^{1.85}$

Pressure loss with an all 8 5/8 in diameter pipe machine = .267 x 6 5/8 in pressure loss
Pressure loss with an all 10 in diameter pipe machine = .127 x 6 5/8 in pressure loss

Linear Design - VTools

Refer to the screenshots below. From the V2O Home page, click Resources. Click Software. Finally, click the VTools Linear Design link to open the Linear Design excel spreadsheet. This program supports Linear Design. Click on following link for access to login screen: http://v2o.valmont.com

NOTE

•It is recommended to use the VTools spreadsheet Linear Design for machines with multiple pipe diameters. The spreadsheet can be found on the V2O Home Page, Resources, Software.

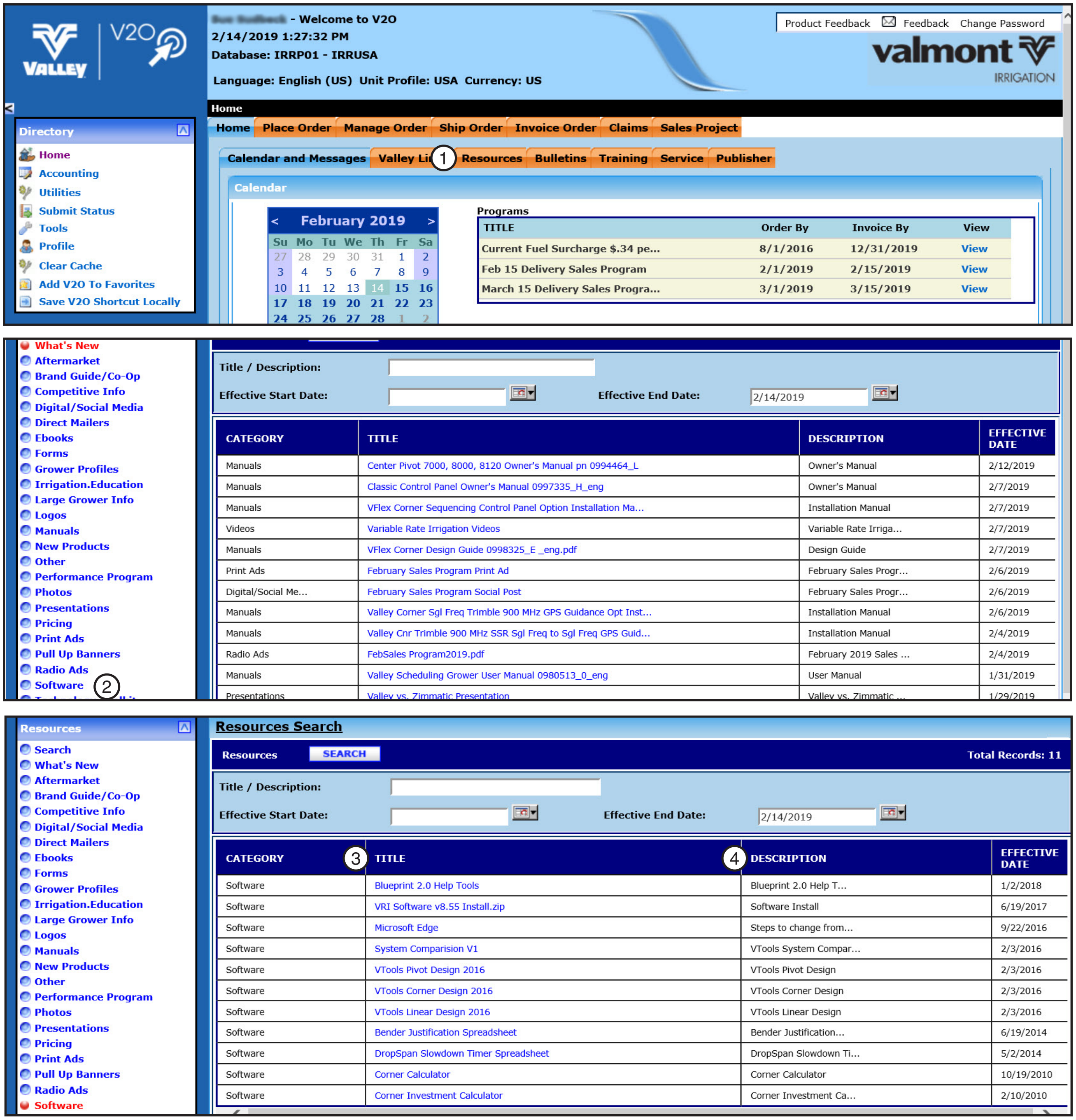


Figure 1-19-1 1. Resources 3. Title
2. Software 4. Description

Electrical Requirements

Electrical Design Guidelines and Limitations

Center Drive Design Parameters

All standard speed linears will be equipped with the helical gear center drive (34 RPM on end drive units and 43 RPM on middle drive units).

All high-speed linears will use 56 RPM worm gear center drives on the end drive units with 68 RPM helical gear center drives on intermediate drive units.

The motor RPM for the cart will depend on whether the machine is end-feed or center-feed.

The number of spans and length of 12 AWG span cable is limited due to motor starting current and voltage drop. The addition of booster pumps to the machine further restricts the length of 12 AWG wire that can be used. The following limitations are the maximum spans and lengths of 12 AWG span wire that can be used on the outer end of a machine. Any machine length beyond or number of spans beyond the limits must be 10 AWG span wire. For example, if the machine in question is high-speed and 10 spans long with a 5 hp booster pump, the limitation is 6 spans of 12 AWG span wire starting on the end of the machine. The remaining 4 spans into the cart must be 10 AWG. 8 AWG span wire is only used if all 10 AWG exceeds allowable voltage drop.

NOTE

- **It is recommended that cord drag linear machines not use 12 AWG span wire. The additional voltage drop exceeds what is allowable due to the power supply cord limits and the allowable machine voltage drop.**

No Booster Pump

Standard Speed: 12 spans -2160 ft (658 m)- 12 AWG

High-Speed: 10 spans -1800 ft (549 m)- 12 AWG

2 hp Booster Pump

Standard Speed: 10 spans -1800 ft (549 m)- 12 AWG

High-Speed: 8 spans -1440 ft (439 m)- 12 AWG

5 hp Booster Pump

Standard Speed: 7 spans -1260 ft (384 m)- 12 AWG

High Speed: 6 spans -1080 ft (329 m)- 12 AWG

7.5 hp Booster Pump

Standard Speed: 6 spans -1080 ft (329 m)- 12 AWG

High-Speed: 5 spans -900 ft (274 m) - 12 AWG

Span Wire Current Limitations

12 AWG span wire is limited to 20 amps.

10 AWG span wire is limited to 30 amps.

8 AWG span wire is limited to 45 amps.

When machine current is over 20 amps, 12 AWG span wire must not be used on spans where span current is over 20 amps. A 12 to 10 AWG fused tower box must be used at the transition point between 12 and 10 AWG span wire.

When machine current is over 30 amps, 10 AWG span wire must not be used on spans where span current or voltage is over 30 amps. A 10 to 8 AWG fused tower box must be used at the transition point between 10 and 8 AWG span wire.

Booster Transformer Limitations

Maximum linear machine voltage cannot exceed 480 volts where the booster transformer is located. Voltage for machine electrical devices cannot exceed 505 volts (380 volts for 50 Hz international machines).

A booster transformer must be placed on the machine where span current drops below 28.5 amps. The maximum current rating for the booster transformer is 30 amps. When a booster transformer is used the amperage requirement at the transformer will increase by 5%. This must be considered when making a selection for panel fuses.

Voltage Limitations

Maximum cart voltage is 505 volts (420 volts for 50 Hz international linears).

Minimum voltage at the end tower is 440 volts (340 volts for 50 Hz international linears).

Additional Power Requirements

All calculations shown include ONLY the requirements for the operation of the linear machine. In the event other equipment such as chemical injector pump is used the power requirements must be added.

Cord Drag Linear: Make sure to allow approximately 15 ft (4.5 m) to 20 ft (6 m) of cable for making connections, i.e. a 450 ft (137.1 m) cable will have 430 ft (131 m) of linear run. Cord Drag cable is 8 AWG copper Type W "Mining Cable".

Linear Machine Amperage

Machine continuous amp draw must be known to determine generator size and supply wire size to the irrigation machine. Amp draw is based on the electrical load to the machine, i.e., number of drive motors, high-speed, booster pump, etc.

The formula for calculating the average amperage draw for various machine configurations is shown below:

Design current = 125% of the full load current of the largest motor, plus 110% of the full load current of the remaining motors multiplied by their duty cycle with the machine running at 100%.

4-wheel Endfeed Standard Speed

Amps = (No. of Spans - 1) (0.89) (1.9) + A*

4-wheel Cart
Worm Drive
"A" - Endfeed Standard Speed

Booster Pump	Booster Pump Side 2			
Side 1	0	2 hp	5 hp	7.5 hp
0	4.47	9.19	13.31	15.81
2 hp (1.5 kW)	9.19	13.59	17.71	20.21
5 hp (3.73 kW)	13.31	17.71	21.34	23.84
7.5 hp (5.6 kW)	15.81	20.21	23.84	28.04

4-wheel Endfeed High Speed

Amps = (No. Of Spans - 1) (0.89) (1.8) + B*

4-wheel Cart
Helical Drive
"B" - Endfeed High-Speed

Booster Pump	Booster Pump Side 2			
Side 1	0	2 hp	5 hp	7.5 hp
0	8.80	13.42	17.54	20.04
2 hp (1.5 kW)	13.42	17.82	21.94	24.44
5 hp (3.73 kW)	17.54	21.94	25.57	28.07
7.5 hp (5.6 kW)	20.04	24.44	28.07	30.27

Rainger Centerfeed Standard Speed

Amps = (No Of Spans (0.89) (1.1) + C*

Rainger Cart
"C" - Centerfeed Standard Speed

Booster Pump	Booster Pump Side 2			
Side 1	0	2 hp	5 hp	7.5 hp
0	2.59	7.42	11.55	14.05
2 hp (1.5 kW)	7.42	11.82	15.95	18.45
5 hp (3.73 kW)	11.56	15.45	19.58	22.08
7.5 hp (5.6 kW)	14.05	17.65	21.78	24.28

Rainger Endfeed Standard Speed

Amps = (No Of Spans -1) (0.89) (1.1) + E*

Rainger Cart
"E" End Feed Standard Speed

Booster Pump	Booster Pump Side 2			
Side 1	0	2 hp	5 hp	7.5 hp
0	3.80	8.63	12.76	15.26
2 hp (1.5 kW)	8.63	13.03	17.16	19.66
5 hp (3.73 kW)	12.76	16.66	20.79	23.29
7.5 hp (5.6 kW)	15.26	18.86	22.99	25.49

Rainger Centerfeed High-Speed

Amps = (No. Of Spans) (0.91) (1.8) + D*

Rainger Cart
"D" - Centerfeed High-Speed

Booster Pump	Booster Pump Side 2			
Side 1	0	2 hp	5 hp	7.5 hp
0	6.00	10.62	14.74	17.25
2 hp (1.5 kW)	10.61	15.02	19.14	21.65
5 hp (3.73 kW)	14.74	18.65	22.77	25.28
7.5 hp (5.6 kW)	17.24	20.85	24.97	27.48

Rainger Endfeed High-Speed

Amps = (No. Of Spans - 1) (0.91) (1.8) + F*

Rainger Cart
"F" End Feed High-Speed

Booster Pump	Booster Pump Side 2			
Side 1	0	2 hp	5 hp	7.5 hp
0	8.80	13.42	17.54	20.04
2 hp (1.5 kW)	13.42	17.82	21.94	24.44
5 hp (3.73 kW)	17.54	21.45	25.57	28.07
7.5 hp (5.6 kW)	20.04	23.65	27.77	30.27

Motor		Std.	Hi Speed	2 hp	5 hp	7.5 hp
Amp Draw	Worm Drive	1.9	2.55			
Amp Draw	Helical Drive	1.1	1.8			
Amp Draw				4.0	7.3	9.3

$$hp = \frac{(\sqrt{3})(V)(A)(PF)}{(746)(EFF)}$$

A = Average amp Draw
PF = Power Factor (.8)
EFF = See Chart Below
V = Volts (480)

Lima Generator Efficiency and Amps

Size	5 kW	7.5 kW	10 kW	12 kW	15 kW	20 kW	25 kW	30 kW
Efficiency	0.809	0.826	0.837	0.847	0.872	0868	0.876	0.884
Max. amps	8A	11A	15A	18A	23A	30A	38A	45A

Amp draw additions for various standard speed options.

1. Change 4-wheel HOSE DRAG-WORM DRIVE cart motor to 1-1/2 hp, add 1.6 amps.
2. **Add any ancillary equipment amp draw to load requirements shown in tables.**

*Calculations are based off of NEC 675.22 (A) and are approximates. For more accurate calculations on high-speed motors refer to VTools.

Electrical Requirements

Center Feed Standard Speed

30 and 37 RPM Motors

Table 1.1

Centerfeed Standard Speed
No Booster Pump

SPANS	AMPS	GEN	HP	FUSE
2	7.9	7.50	8.5	12.00
3	9.6	7.50	10.3	15.00
4	11.3	7.50	12.2	17.50
5	13.0	10.00	13.8	17.50
6	14.7	10.00	15.6	20.00
7	16.4	12.00	17.2	20.00
8	18.0	12.00	19.0	20.00
9	19.8	15.00	20.2	25.00
10	21.5	15.00	21.9	25.00
11	23.2	20.00	23.7	25.00
12	24.8	20.00	25.5	25.00
13	26.5	20.00	27.2	30.00
14	28.2	20.00	29.0	30.00
15	29.9	20.00	30.7	30.00
16	31.6	25.00	32.2	45.00
17	33.3	25.00	33.9	45.00
18	35.0	25.00	35.6	45.00
19	36.7	25.00	37.3	45.00
20	38.4	30.00	38.7	45.00
21	40.1	30.00	40.4	45.00
22	41.8	30.00	42.1	45.00
23	43.4	30.00	43.8	45.00
24	45.1	30.00	45.5	45.00

Centerfeed Standard Speed
2 hp Booster Pump

+4.4 amps for add. 2 hp BP*

SPANS	AMPS	GEN	HP	FUSE
2	12.6	10	13.4	17.50
3	14.3	10	15.2	20.00
4	16.0	12	16.8	20.00
5	17.7	12	18.6	20.00
6	19.4	15	19.8	25.00
7	21.1	15	21.5	25.00
8	22.8	20	23.4	25.00
9	24.5	20	25.1	25.00
10	26.2	20	26.8	30.00
11	27.8	20	28.6	30.00
12	29.5	20	30.3	30.00
13	31.2	25	31.8	45.00
14	32.9	25	33.5	45.00
15	34.6	25	35.2	45.00
16	36.3	25	36.9	45.00
17	38.0	30	38.3	45.00
18	39.7	30	40.0	45.00
19	41.4	30	41.7	45.00
20	43.1	30	43.5	45.00
21	44.8	30	45.2	45.00

Centerfeed Standard Speed
5 hp Booster Pump

+4.4 Amps For Add. 2 hp BP*
+8.0 Amps For Add. 5 hp BP*

SPANS	AMPS	GEN	HP	FUSE
2	16.7	12	17.6	20.00
3	18.4	15	18.8	25.00
4	20.1	15	20.5	25 00
5	21.8	15	22.3	25.00
6	23.5	20	24.1	25.00
7	25.2	20	25.6	30.00
8	26.9	20	27.6	30.00
9	28.6	20	29.3	30.00
10	30.3	25	30.8	45.00
11	32.0	25	32.5	45.00
12	33.6	25	34.2	45.00
13	35.3	25	36.0	45.00
14	37.0	25	37.7	45 00
15	38.7	30	39.1	45 .00
16	40.4	30	40.8	45.00
17	42.1	30	42.5	45.00
18	43.8	30	44.2	45.00

Centerfeed Standard Speed
7.5 hp Booster Pump

+4.4 Amps For Add. 2 hp BP*
+8.0 Amps For Add. 5 hp BP*
+10.2 Amps For Add. 7.5 hp BP*

SPANS	AMPS	GEN	HP	FUSE
2	19.20	15	19.6	25.00
3	20.90	15	21.4	25.00
4	22.60	20	23.2	25.00
5	24.30	20	24.9	25.00
6	26.00	20	26.7	30.00
7	27.70	20	28.4	30.00
8	29.40	20	30.2	30.00
9	31.10	25	31.6	45.00
10	32.80	25	33.3	45.00
11	34.50	25	35.1	45.00
12	36.10	25	36.8	45.00
13	37.80	30	38.2	45.00
14	39.50	30	39.9	45.00
15	41.20	30	41.6	45.00
16	42.90	30	43.3	45.00
17	44.60	30	45.0	45.00

Standard speed motors are 30 RPM worm drive (1 hp) on end towers and 37 RPM worm drive (1 hp) on all other drive units and cart.

Add 1.6 amps to total amp draw if using 1-1/2 hp motors on cart.

Horsepower is calculated on average running amperage requirements.

Generator size must be adjusted when additional booster pump is added.

Center Feed Standard Speed (Continued)

34 and 43 RPM Motors

Table 1.1 (continued)

Center Feed Standard Speed No Booster Pump

Spans	amps	Rec'd Gen	Min Gen	hp	kW	Fuse
2	4.65	7.5	5	5.19	3.09	12
3	5.69	7.5	5	6.35	3.79	12
4	6.74	7.5	5	7.52	4.48	12
5	7.78	10	7.5	8.45	5.18	12
6	8.82	10	7.5	9.58	5.87	12
7	9.87	12	7.5	10.72	6.56	12
8	10.91	12	7.5	11.85	7.26	12
9	11.96	15	10	12.61	7.95	12
10	13.00	15	10	13.72	8.65	15
11	14.04	20	10	14.82	9.34	15
12	15.09	20	12	15.86	10.03	17.5
13	16.13	20	12	16.96	10.73	17.5
14	17.17	20	12	18.06	11.42	17.5
15	18.22	20	15	18.86	12.12	20
16	19.26	25	15	19.95	12.81	20
17	20.31	25	15	21.03	13.51	25
18	21.35	25	15	22.11	14.2	25
19	22.39	25	15	23.19	14.89	25
20	23.44	30	20	24.16	15.59	25
21	24.48	30	20	25.23	16.28	25
22	25.52	30	20	26.31	16.98	30
23	26.57	30	20	27.38	17.67	30
24	27.61	30	20	28.46	18.36	30

Center Feed Standard Speed 2 hp Booster Pump

+4.4 amps For Additional 2 hp Booster Pump

Spans	amps	Rec'd Gen	Min Gen	hp	kW	Fuse
2	9.51	10	7.5	10.32	6.32	12
3	10.55	10	7.5	11.46	7.02	12
4	11.59	12	10	12.23	7.71	12
5	12.64	12	10	13.34	8.41	15
6	13.68	15	10	14.44	9.10	15
7	14.73	15	10	15.54	9.79	15
8	15.77	20	12	16.58	10.49	17.5
9	16.81	20	12	17.68	11.18	17.5
10	17.86	20	12	18.77	11.88	20
11	18.90	20	15	19.57	12.57	20
12	19.94	20	15	20.65	13.27	20
13	20.99	25	15	21.73	13.96	25
14	22.03	25	15	22.81	14.65	25
15	23.08	25	20	23.78	15.35	25
16	24.12	25	20	24.86	16.04	25
17	25.16	30	20	25.94	16.74	30
18	26.21	30	20	27.01	17.43	30
19	27.25	30	20	28.09	18.12	30
20	28.29	30	20	29.16	18.82	30
21	29.34	30	20	30.24	19.51	30
22	30.38	40	25	30.89	20.21	45
23	31.43	40	25	31.95	20.90	45
24	32.47	40	25	33.01	21.60	45

Center Feed Standard Speed 5 hp Booster Pump

+4.4 amps For Additional 2 hp Booster Pump
+8.0 amps For Additional 5 hp Booster Pump

Spans	amps	Rec'd Gen	Min Gen	hp	kW	Fuse
2	13.63	12	10	14.38	9.07	15
3	14.68	15	10	15.48	9.76	15
4	15.72	15	12	16.53	10.46	17.5
5	16.76	15	12	17.62	11.15	17.5
6	17.81	20	12	18.72	11.84	20
7	18.85	20	15	19.52	12.54	20
8	19.89	20	15	20.60	13.23	20
9	20.94	20	15	21.68	13.93	25
10	21.98	25	15	22.76	14.62	25
11	23.03	25	20	23.73	15.31	25
12	24.07	25	20	24.81	16.01	25
13	25.11	25	20	25.88	16.70	30
14	26.16	25	20	26.96	17.40	30
15	27.20	30	20	28.04	18.09	30
16	28.24	30	20	29.11	18.79	30
17	29.29	30	20	30.19	19.48	30
18	30.33	30	25	30.84	20.17	45
19	31.38	40	25	31.90	20.87	45
20	32.42	40	25	32.96	21.56	45
21	33.46	40	25	34.02	22.26	45
22	34.51	40	25	35.08	22.95	45
23	35.55	40	25	36.14	23.64	45
24	36.59	40	25	37.20	24.34	45

Center Feed Standard Speed 7 1/2 hp Booster Pump

+4.4 amps For Additional 2 hp Booster Pump
+8.0 amps For Additional 5 hp Booster Pump
+10.2 amps For Additional 7.5 hp Booster Pump

Spans	amps	Rec'd Gen	Min Gen	hp	kW	Fuse
2	16.13	15	12	16.96	10.73	17.5
3	17.18	15	12	18.06	11.42	17.5
4	18.22	20	15	18.87	12.12	20
5	19.26	20	15	19.95	12.81	20
6	20.31	20	15	21.03	13.51	25
7	21.35	20	15	22.11	14.20	25
8	22.39	20	15	23.19	14.89	25
9	23.44	25	20	24.16	15.59	25
10	24.48	25	20	25.23	16.28	25
11	25.53	25	20	26.31	16.98	30
12	26.57	25	20	27.39	17.67	30
13	27.61	30	20	28.46	18.37	30
14	28.66	30	20	29.54	19.06	30
15	29.70	30	20	30.61	19.75	30
16	30.74	30	25	31.26	20.45	45
17	31.79	30	25	32.32	21.14	45
18	32.83	40	25	33.38	21.84	45
19	33.88	40	25	34.44	22.53	45
20	34.92	40	25	35.50	23.23	45
21	35.96	40	25	36.56	23.92	45
22	37.01	40	25	37.62	24.61	45
23	38.05	40	30	38.07	25.31	45
24	39.09	40	30	39.12	26.00	45

34 RPM helical drive on end towers and 43 RPM helical drive on Intermediate Drive Units and Cart (except Hose Cart)
Recommended generator size is based on starting motor amperage requirements.
Minimum generator size is based on the average running amperage requirements.
Continuous Horsepower is based on minimum generator size requirements.

Electrical Requirements

Center Feed High-Speed

56 and 68 RPM Motors

Table 1.2

Center Feed High Speed No Booster Pump

SPANS	AMPS	REC'D GEN	MIN GEN	CONT HP for AMPS	CONT KW for AMPS	FUSE
2	9.3	7.5	7.5	10.4	7.7	15
3	10.9	10	7.5	9.9	7.4	17.5
4	12.6	12	10	11.7	8.7	17.5
5	14.2	12	10	13.1	9.8	20
6	15.8	15	12	14.8	11.1	20
7	17.5	15	12	16.5	12.3	20
8	19.1	20	15	18.2	13.6	25
9	20.7	20	15	19.6	14.7	25
10	22.4	20	15	21.3	15.9	25
11	24.0	25	20	23.0	17.2	25
12	25.7	25	20	24.6	18.4	30
13	27.3	25	20	26.3	19.6	30
14	28.9	30	20	28.0	20.9	30
15	30.6	30	25	29.7	22.1	45
16	32.2	30	25	30.9	23.1	45
17	33.8	30	25	32.6	24.3	45
18	35.5	40	25	34.3	25.6	45
19	37.1	40	25	35.9	26.8	45
20	38.8	40	30	37.6	28.1	45
21	40.4	40	30	38.7	28.8	45
22	42.0	40	30	40.3	30.1	45
23	43.7	40	30	41.9	31.3	45
24	45.3					

Center Feed High Speed 2 hp Booster Pump

+4.4 amps For Add. 2 hp BP

SPANS	AMPS	REC'D GEN	MIN GEN	CONT HP for AMPS	CONT KW for AMPS	FUSE
2	13.9	12	10	12.8	14.5	17.5
3	15.5	12	12	14.5	15.8	20
4	17.2	15	12	16.2	17.0	20
5	18.8	15	15	17.9	18.2	25
6	20.4	20	15	19.3	19.5	25
7	22.1	20	15	21.0	20.7	25
8	23.7	20	20	22.7	22.0	25
9	25.4	25	20	24.3	22.9	30
10	27.0	25	20	26.0	24.2	30
11	28.6	25	20	27.7	25.4	30
12	30.3	30	25	29.4	26.6	45
13	31.9	30	25	30.6	27.9	45
14	33.6	30	25	32.3	28.7	45
15	35.2	30	25	34.0	29.9	45
16	36.8	40	25	35.6	31.1	45
17	38.5	40	30	37.3	0.0	45
18	40.1	40	30	38.4	0.0	45
19	41.7	40	30	40.0	0.0	45
20	43.4	40	30	41.6	0.0	45
21	45.0					
22	46.7					
23	48.3					
24	49.9					

Center Feed High Speed 5 hp Booster Pump

+4.4 amps For Add. 2 hp BP

+8.0 amps For Add. 5 hp BP

SPANS	AMPS	REC'D GEN	MIN GEN	CONT HP for AMPS	CONT KW for AMPS	FUSE
2	18.0	15	12	17.0	12.7	20
3	19.7	15	15	18.7	14.0	25
4	21.3	20	15	20.2	15.0	25
5	22.9	20	15	21.8	16.3	25
6	24.6	20	20	23.4	17.5	25
7	26.2	20	20	25.1	18.7	30
8	27.8	25	20	26.8	20.0	30
9	29.5	25	20	28.5	21.3	30
10	31.1	25	25	30.2	22.5	45
11	32.8	25	25	31.4	23.5	45
12	34.4	30	25	33.1	24.7	45
13	36.0	30	25	34.8	25.9	45
14	37.7	30	25	36.4	27.2	45
15	39.3	40	30	38.1	28.4	45
16	40.9	40	30	39.1	29.2	45
17	42.6	40	30	40.8	30.4	45
18	44.2	40	30	42.4	31.6	45
19	45.9					
20	47.5					
21	49.1					
22	50.8					
23	52.4					
24	54.1					

Center Feed High Speed 7.5 hp Booster Pump

+4.4 amps For Add. 2 hp BP

+8.0 amps For Add. 5 hp BP

10.2 amps For Add. 7.5 hp BP

SPANS	AMPS	REC'D GEN	MIN GEN	CONT HP for AMPS	CONT KW for AMPS	FUSE
2	20.5	15	15	19.4	14.5	25
3	22.2	20	15	21.1	15.8	25
4	23.8	20	20	22.8	17.0	25
5	25.4	20	20	24.4	18.2	30
6	27.1	25	20	26.1	19.5	30
7	28.7	25	20	27.8	20.7	30
8	30.3	25	25	29.5	22.0	45
9	32.0	30	25	30.7	22.9	45
10	33.6	30	25	32.4	24.2	45
11	35.3	30	25	34.1	25.4	45
12	36.9	30	25	35.7	26.6	45
13	38.5	40	30	37.4	27.9	45
14	40.2	40	30	38.4	28.7	45
15	41.8	40	30	40.1	29.9	45
16	43.4	40	30	41.7	31.1	45
17	45.1					
18	46.7					
19	48.4					
20	50.0					
21	51.6					
22	53.3					
23	54.9					
24	56.6					

High-speed motors are 56 RPM worm drive (1-1/2 hp) on end towers and 68 RPM helical drive on Intermediate Drive Units and Cart.
Hose Drag will use 68 RPM worm drive (1-1/2 hp) on Cart.
Recommended generator size is based on starting motor amperage requirements.
Minimum generator size is based on the average running amperage requirements. Machines with large booster pumps,
Auto Reverse, 38 in (965.2 mm) tires, and/or faster timer setting may require the recommended generator for optimum operation.
Continuous Horsepower is based on minimum generator size requirements.
[shaded box] Drive for generator is not available in SOC; available for aftermarket.

End Feed Standard Speed

30 and 37 RPM Motors

Table 1.3

Endfeed Standard Speed No Booster Pump

SPANS	AMPS	GEN	HP	FUSE
1	6.6	5	7.2	12.5
2	8.3	7.5	8.9	12.5
3	10.0	7.5	10.7	15
4	11.6	10	12.4	17.5
5	13.3	10	14.2	17.5
6	15.0	10	16.0	20
7	16.7	12	17.6	20
8	18.4	15	18.8	25
9	20.1	15	20.6	25
10	21.8	15	22.3	25
11	23.5	20	24.1	25
12	25.2	20	25.9	30
13	26.9	20	27.6	30
14	28.6	20	29.4	30
15	30.3	25	30.8	45
16	32.0	25	32.5	45
17	33.7	25	34.3	45
18	35.4	25	36.0	45
19	37.1	25	37.7	45
20	38.8	30	39.1	45
21	40.5	30	40.8	45
22	42.2	30	42.5	45
23	43.8	30	44.2	45

Endfeed Standard Speed 2 hp Booster Pump

+ 4.4 amps For Add. 2 hp BP*

SPANS	AMPS	GEN	HP	FUSE
1	11.3	7.5	12.2	17.5
2	13.0	10	13.8	17.5
3	14.7	10	15.6	20
4	16.4	12	17.2	20
5	18.1	15	18.5	25
6	19.8	15	20.2	25
7	21.4	15	21.9	25
8	23.2	20	23.8	25
9	24.8	20	25.5	25
10	26.5	20	27.3	30
11	28.2	20	29.0	30
12	29.9	20	30.7	30
13	31.6	25	32.2	45
14	33.3	25	33.9	45
15	35.0	25	35.6	45
16	36.7	25	37.4	45
17	38.4	30	38.7	45
18	40.1	30	40.4	45
19	41.8	30	42.1	45
20	43.5	30	43.9	45
21	45.2	30	45.6	45

Endfeed Standard Speed 5 hp Booster Pump

+ 4.4 amps For Add. 2 hp BP*
+ 8.0 amps For Add. 5 hp BP*

SPANS	AMPS	GEN	HP	FUSE
1	15.4	12	16.2	20
2	17.1	12	18.0	20
3	18.8	15	19.2	25
4	20.5	15	20.9	25
5	22.2	15	22.7	25
6	23.9	20	24.5	25
7	25.6	20	26.3	30
8	27.3	20	28.0	30
9	29.0	20	29.7	30
10	30.7	25	31.2	45
11	32.3	25	32.9	45
12	34.0	25	34.6	45
13	35.7	25	36.4	45
14	37.4	25	38.1	45
15	39.1	30	39.5	45
16	40.8	30	41.2	45
17	42.5	30	42.9	45
18	44.2	30	44.6	45

Endfeed Standard Speed 7.5 hp Booster Pump

+ 4.4 amps For Add. 2 hp BP*
+ 8.0 amps For Add. 5 hp BP*
+ 10.2 amps For Add. 7.5 hp BP*

SPANS	AMPS	GEN	HP	FUSE
1	17.9	12	18.8	20
2	19.6	15	20.0	25
3	21.3	15	21.8	25
4	23.0	20	23.6	25
5	24.7	20	25.3	25
6	26.4	20	27.1	30
7	28.1	20	28.8	30
8	29.8	20	30.6	30
9	31.5	25	32.0	45
10	33.2	25	33.7	45
11	34.8	25	35.5	45
12	36.5	25	37.2	45
13	38.2	30	38.6	45
14	39.9	30	40.3	45
15	41.6	30	42.0	45
16	43.3	30	44.1	45
17	45.0	30	45.4	45

Standard speed motors are 30 RPM worm drive (1 hp) on end towers and 37 RPM worm drive (1 hp) on all other Drive Units and Cart.

Add 1.6 amps to total amp draw if using 1-1/2 hp motors on cart.

Horsepower is calculated on average running amperage requirements.

Generator size must be adjusted when additional booster pump is added or if auto-reverse option is used.

Electrical Requirements

End Feed Standard Speed (Continued)

34 and 43 RPM Motors

Table 1.3 (Cont.)

End Feed Standard Speed
No Booster Pump

SPANS	AMPS	REC'D GEN	MIN GEN	HP	KW	FUSE
2	4.82	7.5	5	5.37	3.20	12
3	5.86	7.5	5	6.54	3.90	12
4	6.90	10	5	7.70	4.59	12
5	7.95	10	7.5	8.63	5.29	12
6	8.99	10	7.5	9.76	5.98	12
7	10.03	12	7.5	10.90	6.67	12
8	11.08	15	7.5	12.03	7.37	12
9	12.12	15	10	12.79	8.06	15
10	13.17	15	10	13.89	8.76	15
11	14.21	20	10	14.99	9.45	15
12	15.25	20	12	16.04	10.15	17.5
13	16.30	20	12	17.13	10.84	17.5
14	17.34	20	12	18.23	11.53	17.5
15	18.38	25	15	19.04	12.23	20
16	19.43	25	15	20.12	12.92	20
17	20.47	25	15	21.20	13.62	25
18	21.52	25	15	22.28	14.31	25
19	22.56	25	20	23.25	15.00	25
20	23.60	30	20	24.33	15.70	25
21	24.65	30	20	25.40	16.39	25
22	25.69	30	20	26.48	17.09	30
23	26.73	30	20	27.56	17.78	30
24	27.78	40	20	28.63	18.48	30

End Feed Standard Speed
2 hp Booster Pump

+4.4 amps For Additional 2 hp Booster Pump

SPANS	AMPS	REC'D GEN	MIN GEN	HP	KW	FUSE
2	9.67	10	7.5	10.51	6.43	12
3	10.72	10	7.5	11.64	7.13	12
4	11.76	12	10	12.41	7.82	12
5	12.80	15	10	13.51	8.52	15
6	13.85	15	10	14.61	9.21	15
7	14.89	15	10	15.71	9.90	15
8	15.94	20	12	16.75	10.60	17.5
9	16.98	20	12	17.85	11.29	17.5
10	18.02	20	12	18.95	11.99	17.5
11	19.07	20	15	19.74	12.68	20
12	20.11	20	15	20.82	13.38	20
13	21.15	25	15	21.91	14.07	25
14	22.20	25	15	22.99	14.76	25
15	23.24	25	15	23.96	15.46	25
16	24.29	25	20	25.03	16.15	25
17	25.33	30	20	26.11	16.85	25
18	26.37	30	20	27.18	17.54	25
19	27.42	30	20	28.26	18.24	30
20	28.46	30	20	29.33	18.93	30
21	29.50	40	20	30.41	19.62	30
22	30.55	40	20	31.06	20.32	30
23	31.59	40	20	32.12	21.01	30
24	32.64	40	25	33.18	21.71	45

End Feed Standard Speed
5 hp Booster Pump

+4.4 amps For Additional 2 hp Booster Pump
+8.0 amps For Additional 5 hp Booster Pump

SPANS	AMPS	REC'D GEN	MIN GEN	HP	KW	FUSE
2	13.80	12	10	14.56	9.18	15
3	14.84	15	10	15.66	9.87	15
4	15.89	15	12	16.70	10.57	17.5
5	16.93	15	12	17.80	11.26	17.5
6	17.97	20	12	18.90	11.95	20
7	19.02	20	15	19.69	12.65	20
8	20.06	20	15	20.77	13.34	25
9	21.10	20	15	21.85	14.04	25
10	22.15	25	15	22.93	14.73	25
11	23.19	25	20	23.90	15.43	25
12	24.24	25	20	24.98	16.12	25
13	25.28	25	20	26.06	16.81	30
14	26.32	25	20	27.31	17.51	30
15	27.37	30	20	28.21	18.20	30
16	28.41	30	20	29.28	18.90	30
17	29.45	30	20	30.36	19.59	30
18	30.50	30	25	31.00	20.28	45
19	31.54	40	25	32.07	20.98	45
20	32.59	40	25	33.13	21.67	45
21	33.63	40	25	34.19	22.37	45
22	34.67	40	25	35.25	23.06	45
23	35.72	40	25	36.31	23.76	45
24	36.76	40	25	37.37	24.45	45

End Feed Standard Speed
7 1/2 hp Booster Pump

+4.4 amps For Additional 2 hp Booster Pump
+8.0 amps For Additional 5 hp Booster Pump
+10.2 amps For Additional 7.5 hp Booster Pump

SPANS	AMPS	REC'D GEN	MIN GEN	HP	KW	FUSE
2	16.30	15	12	17.14	10.84	17.5
3	17.34	15	12	18.23	11.53	17.5
4	18.39	20	15	19.04	12.23	20
5	19.43	20	15	20.12	12.92	20
6	20.47	20	15	21.20	13.62	25
7	21.52	20	15	22.28	14.31	25
8	22.56	20	20	23.25	15.01	25
9	23.60	25	20	24.33	15.70	25
10	24.65	25	20	25.41	16.39	25
11	25.69	25	20	26.48	17.09	30
12	26.74	25	20	27.56	17.79	30
13	27.78	30	20	28.63	18.48	30
14	28.82	30	20	29.71	19.17	30
15	29.87	30	20	30.78	19.86	30
16	30.91	30	25	31.42	20.56	45
17	31.95	30	25	32.49	21.25	45
18	33.00	40	25	33.55	21.95	45
19	34.04	40	25	34.61	22.64	45
20	35.09	40	25	35.67	23.34	45
21	36.13	40	25	36.73	24.03	45
22	37.17	40	25	37.79	24.72	45
23	38.22	40	30	38.24	25.42	45
24	39.26	40	30	39.29	26.11	45

34 RPM helical drive on cart and end tower and 43 RPM helical drive on Intermediate Drive Units and Cart (except Hose Cart).
Recommended generator size is based on starting motor amperage requirements.
Minimum generator size is based on the average running amperage requirements.
Continuous Horsepower is based on minimum generator size requirements.

End Feed High Speed

56 and 68 RPM Motor

Table 1.3 (Cont.)

End Feed High Speed No Booster Pump

SPANS	AMPS	REC'D GEN	MIN GEN	CONT HP For AMPS	CONT KW For AMPS	FUSE
2	10.4	10	7.5	11.3	8.5	15
3	12.1	10	10	12.7	9.5	17.5
4	13.7	12	10	14.5	10.8	17.5
5	15.4	15	12	16.1	12.0	20
6	17.0	15	12	17.9	13.3	20
7	18.6	15	15	19.3	14.4	25
8	20.3	20	15	21.0	15.7	25
9	21.9	20	15	22.7	16.9	25
10	23.5	20	20	24.3	18.1	25
11	25.2	25	20	26.0	19.4	30
12	26.8	25	20	27.6	20.6	30
13	28.5	25	20	29.3	21.9	30
14	30.1	30	25	30.6	22.8	45
15	31.7	30	25	32.3	24.1	45
16	33.4	30	25	33.9	25.3	45
17	35.0	30	25	35.6	26.5	45
18	36.6	30	25	37.3	27.8	45
19	38.3	40	30	38.3	28.6	45
20	39.9	40	30	39.9	29.8	45
21	41.6	40	30	41.6	31.0	45
22	43.2	40	30	43.2	32.2	45
23	44.8					
24	46.5					

End Feed High Speed 2 hp Booster Pump

+4.4 amps For Add. 2 hp BP

SPANS	AMPS	REC'D GEN	MIN GEN	CONT HP For AMPS	CONT KW For AMPS	FUSE
2	15.1	12	12	15.8	11.8	20
3	16.7	15	12	17.6	13.1	20
4	18.3	15	15	19.0	14.2	25
5	20.0	15	15	20.7	15.4	25
6	21.6	20	15	22.4	16.7	25
7	23.2	20	20	24.0	17.9	25
8	24.9	20	20	25.7	19.1	25
9	26.5	25	20	27.3	20.4	30
10	28.2	25	20	29.0	21.7	30
11	29.8	25	20	30.7	22.9	30
12	31.4	30	25	32.0	23.8	45
13	33.1	30	25	33.6	25.1	45
14	34.7	30	25	35.3	26.3	45
15	36.4	30	25	37.0	27.6	45
16	38.0	30	25	38.0	28.4	45
17	39.6	40	30	39.7	29.6	45
18	41.3	40	30	41.3	30.8	45
19	42.9	40	30	42.9	32.0	45
20	44.5	40	30	44.6	33.2	45
21	46.2					
22	47.8					
23	49.5					
24	51.1					

End Feed High Speed 5 hp Booster Pump

+4.4 amps For Add. 2 hp BP

+8.0 amps For Add. 5 hp BP

SPANS	AMPS	REC'D GEN	MIN GEN	CONT HP For AMPS	CONT KW For AMPS	FUSE
2	19.2	15	15	12.8	9.5	25
3	20.8	15	15	13.8	10.3	25
4	22.5	20	15	14.9	11.1	25
5	24.1	20	20	16.0	12.0	25
6	25.7	20	20	17.1	12.8	30
7	27.4	25	20	18.2	13.6	30
8	29.0	25	20	19.3	14.4	30
9	30.6	25	25	20.4	15.2	45
10	32.3	30	25	21.5	16.0	45
11	33.9	30	25	22.6	16.8	45
12	35.6	30	25	23.6	17.6	45
13	37.2	30	25	24.7	18.5	45
14	38.8	40	30	25.8	19.3	45
15	40.5	40	30	26.9	20.1	45
16	42.1	40	30	28.0	20.9	45
17	43.7	40	30	29.1	21.7	45
18	45.4					
19	47.0					
20	48.7					
21	50.3					
22	51.9					
23	53.6					
24	55.2					

End Feed High Speed 7.5 hp Booster Pump

+4.4 amps For Add. 2 hp BP

+8.0 amps For Add. 5 hp BP

+10.2 amps For Add. 7.5 hp BP

SPANS	AMPS	REC'D GEN	MIN GEN	CONT HP For AMPS	CONT KW For AMPS	FUSE
2	21.7	15	15	22.4	16.7	25
3	23.3	20	20	24.0	17.9	25
4	25.0	20	20	25.7	19.2	25
5	26.6	20	20	27.4	20.4	30
6	28.2	25	20	29.1	21.7	30
7	29.9	25	20	30.8	23.0	30
8	31.5	25	25	32.0	23.9	45
9	33.1	30	25	33.7	25.1	45
10	34.8	30	25	35.4	26.4	45
11	36.4	30	25	37.0	27.6	45
12	38.1	40	30	38.1	28.4	45
13	39.7	40	30	39.7	29.6	45
14	41.3	40	30	41.4	30.9	45
15	43.0	40	30	43.0	32.1	45
16	44.6	40	30	44.6	33.3	45
17	46.2					
18	47.9					
19	49.5					
20	51.2					
21	52.8					
22	54.4					
23	56.1					
24	57.7					

High-speed motors are 56 RPM worm drive (1-1/2 hp) on end towers and 68 RPM helical drive on Intermediate Drive Units and Cart.
Hose Drag will use 68 RPM worm drive (1-1/2 hp) on Cart.
Recommended generator size is based on starting motor amperage requirements.
Minimum generator size is based on the average running amperage requirements. Machines with large booster pumps, Auto Reverse, 38 in (965.2 mm) tires, and/or faster timer setting may require the recommended generator for optimum operation.
Continuous Horsepower is based on minimum generator size requirements.
(shaded) Drive for generator is not available in SOC; available for aftermarket.

Linear Speed Application

Instantaneous Application Rate

The application rate comparisons on this page compare sprinkler package instantaneous application rates (IAR) between linears and center pivots. One advantage linears has compared to center pivots is a lower IAR. This means less chance of water runoff and ponding with linear machines.

Application Rate Comparison

Typical Center Pivot

Inches/Hour at Outer End

GPM	Machine Length in Feet							
	700 ft		1,300 ft		1,900 ft		2,500 ft	
	R[1]	S[2]	R[1]	S[2]	R[1]	S[2]	R[1]	S[2]
500	1.7	3.4	1.1	2.2				
1,000	3.5	7.0	2.1	4.2	1.5	3.0		
1,500			3.2	6.4	2.3	4.6	1.8	3.6
2,000					3.0	6.0	2.4	4.8

Typical Linear Machine

Inches/Hour

GPM	Machine Length in Feet							
	700 ft		1.300 ft		1,900 ft		2,500 ft	
	R[1]	S[2]	R[1]	S[2]	R[1]	S[2]	R[1]	S[2]
500	1.2	2.4	0.6	1.2				
1,000	2.3	4.6	1.2	2.4	0.8	1.6		
1,500			1.9	3.8	1.3	2.6	1.0	2.0
2,000					1.7	3.4	1.3	2.6

R[1] Rotating Spray 60 ft diameter

S[2] Fixed Spray - 30 ft diameter

Formula for determining approximate application rate for linear:

GPM x 96.25 = Application rate

Machine Length X SPDIA + (Inches/hour)

SPDIA = wetted diameter of sprinkler

Formulas

Hours Per Pass at 100% $= \frac{\text{Length of Run (Ft)}}{\text{(60) x Speed}}$

Hours Per Pass at X% $= \frac{\text{Hours Per Pass @ 100\%}}{\text{Timer Setting}}$
(written as a decimal)

GPM/Acre $= \frac{\text{(Crop Requirement in In/Day)}}{\text{Water Increase Multiplier x (0.053)}}$

Machine Gallonage = (GPM/Acre) x (Irrigated Acres)

GPM/Ft $= \frac{\text{Machine GPM}}{\text{SL + EGR}}$

Sprinkler GPM $= \frac{\text{Machine GPM}}{\text{SL + EGR}}$ x Sprinkler Spacing

End Gun GPM = (End Gun Range) x (GPM/Ft)

Application Rate In/Day $= \frac{\text{GPM x 2310}}{\text{Machine Length x Length of Run}}$

Instant. Appl. Rate In/Hr. $= \frac{\text{GPM x 96.25}}{\text{Machine Length x (SPDIA)}}$

In Per Pass @ 100% $= \frac{\text{(Hrs./Pass @ 100\%) x (Appl. Rate In/Day)}}{24}$

In/Pass @ 100% $= \frac{\text{(GPM) (1.6)}}{\text{(Speed) (Machine Length)}}$

In/Pass @ X% $= \frac{\text{In/Pass @ 100\%}}{\text{Timer Setting}}$
(Written as a decimal)

GPM = Machine Gallons Per Hour
SL = Machine Length
EGR = End Gun Radius
SPDIA = Wetted Diameter of Sprinkler

Drive Unit Travel Speed* (Feet/Minute)

	Tire Size						
	11.2-24	14.9-24 Non-Directional	14.9-24	16.9-24	11.2-38	11R 22.5 Recap	12.4R38
	Rolling Circumference						
	127.00	144.60	151.40	161.00	173.43	131.76	173.43
Motor Speed							
30	6.11	6.95	7.28	7.74	8.34	6.33	8.46
34	6.92	7.88	8.25	8.77	9.45	7.18	9.59
56	11.40	12.98	13.59	14.44	15.56	11.82	12.13
68	13.84	15.76	16.50	17.54	18.90	14.36	15.79
86	17.50	19.93	20.87	22.18	23.90	18.16	19.18
100	20.35	23.17	24.26	25.79	27.79	21.12	24.26

Drive Unit Speed(ft/min) $= \frac{\text{(Tire Rolling Circumference x Motor Speed(RPM))}}{\text{(Gearbox Reduction(52) x 12)}}$

*These speeds are estimates only. Actual speeds will vary according to inflation pressure and field conditions. Machine speed should be measured after installation to determine the actual performance.

***RPM and speed for 480 VAC, 60 Hz Service For 50 Hz service reduce travel by factor of 0.833.

% Timer Setting

100	=	________	Hrs/Pass			
90	=	________	÷	(0.9)	= ________	Hrs/Pass
80	=	________	÷	(0.8)	= ________	Hrs/Pass
70	=	________	÷	(0.7)	= ________	Hrs/Pass
60	=	________	÷	(0.6)	= ________	Hrs/Pass
50	=	________	÷	(0.5)	= ________	Hrs/Pass
40	=	________	÷	(0.4)	= ________	Hrs/Pass
30	=	________	÷	(0.3)	= ________	Hrs/Pass
25	=	________	÷	(0.25)	= ________	Hrs/Pass
20	=	________	÷	(0.2)	= ________	Hrs/Pass
15	=	________	÷	(0.15)	= ________	Hrs/Pass
10	=	________	÷	(0.1)	= ________	Hrs/Pass
5	=	________	÷	(0.05)	= ________	Hrs/Pass

% Timer Setting

100	=	________	In/Pass			
90	=	________	÷	(0.9)	= ________	In/Pass
80	=	________	÷	(0.8)	= ________	In/Pass
70	=	________	÷	(0.7)	= ________	In/Pass
60	=	________	÷	(0.6)	= ________	In/Pass
50	=	________	÷	(0.5)	= ________	In/Pass
40	=	________	÷	(0.4)	= ________	In/Pass
30	=	________	÷	(0.3)	= ________	In/Pass
25	=	________	÷	(0.25)	= ________	In/Pass
20	=	________	÷	(0.2)	= ________	In/Pass
15	=	________	÷	(0.15)	= ________	In/Pass
10	=	________	÷	(0.1)	= ________	In/Pass
5	=	________	÷	(0.05)	= ________	In/Pass

Guidance Selection

Above Ground Cable Installation and Adjustment

3. The Linear Guidance machine consists of an above ground cable that is supported by a line of 3/4 in (19.05 mm) pipe posts. During the installation phase, there are two critical points to be observed:
   (a) The posts must be located in a perfectly straight line.
   (b) The cable must be properly tensioned.
4. Posts: It is recommended that the posts be aligned with a transit to assure a straight line installation. They should be located every eighty feet and exactly parallel to the ditch (Ditch Feed) or line of travel (Hose Feed). The two end posts, which are heavy duty welded assemblies, must be solidly embedded in concrete, and should be backsloped to withstand the cable tension. All posts should extend 28 in (711.2 mm) above ground level. See Figure 1-30-1.

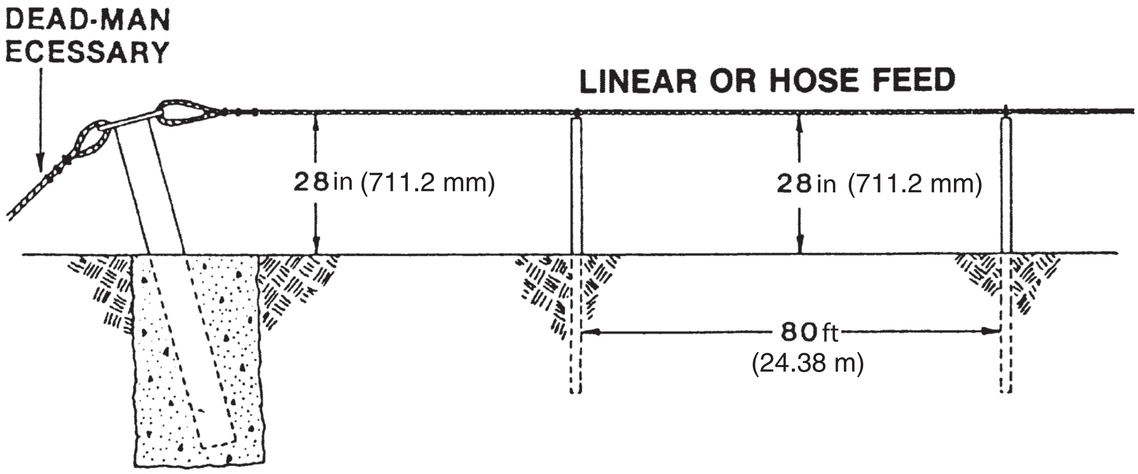


Figure 1-30-1

5. Cable: The cable is attached to the intermediate posts with two small interlocking clips that are inserted into the top of the pipe and then bolted in place. At one end of the cable, permanently attach the cable to the dead-man or end post using a cable eyelet and at least three cable clamps. See Figure 1-30-2.

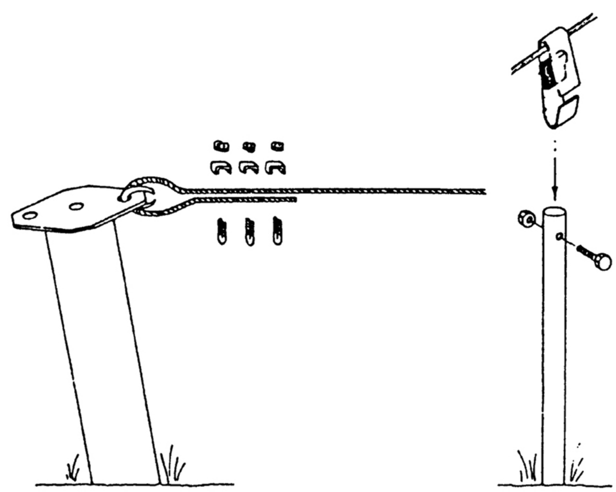


Figure 1-30-2

Above Ground Cable Installation and Adjustment (Continued)

At the end of the cable, pull as much of the slack out of the cable as possible. Then attach a 40-50 ft (12.19 - 15.24 m) pigtail loop to the main cable and hook a 2-ton come-a-long to the pig-tail loop and the end post. See Figure 1-31-1.

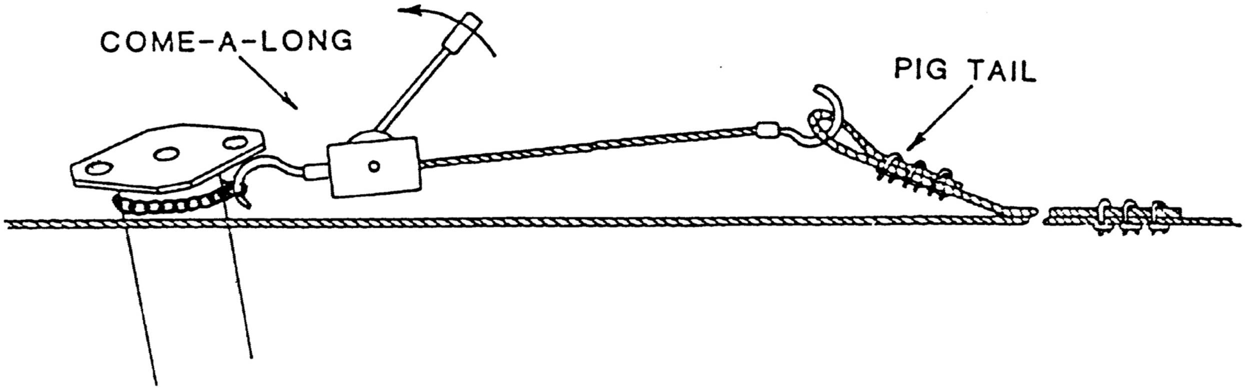


Figure 1-31-1

The final tension of the cable needs to be approximately 2000 lbs. This 2000 lbs can be determined by attaching a fish scale to the main cable halfway between two intermediate posts.

A 33 lb pull on the scale should yield a 4 in (101 mm) deflection in the cable for a Universal or Hose Feed Rainger. See Figure 1-31-2.

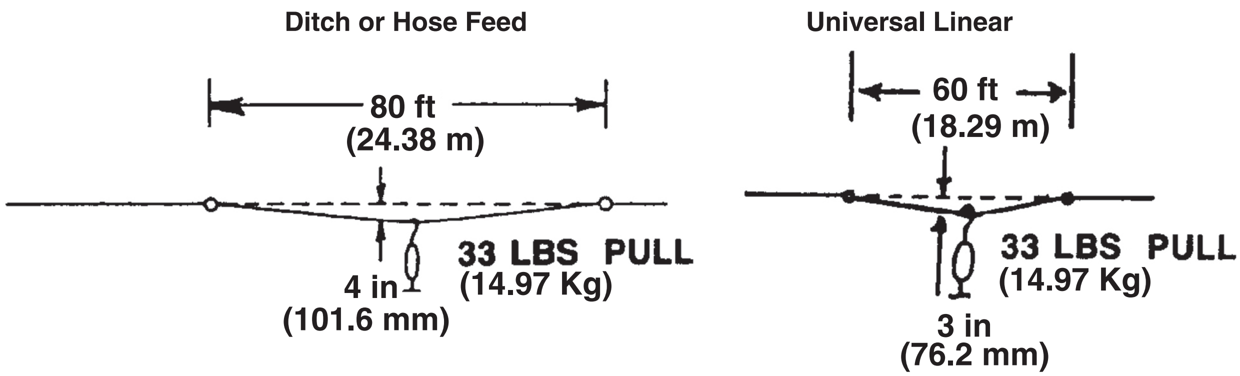


Figure 1-31-2

If the tension is correct, permanently fasten the main cable to the end post as at the first end post and remove both the come-a-long and the pig-tail.

Guidance Cable Splicing Procedure

Cut replacement cable to proper length. Using six splicing sleeves as shown, splice cables together. See Figure 1-31-3.

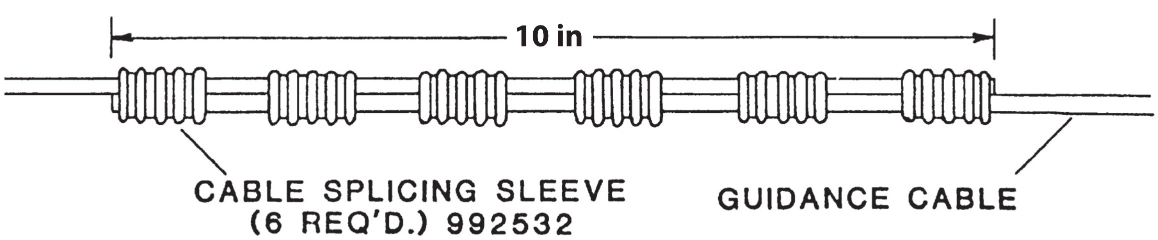


Figure 1-31-3

IMPORTANT: Each sleeve is to be crimped in four places using cable swaging tool (PN 0992531). Start crimping sleeves from one end of the splice and work to the other end, leaving no gaps between the cables. Pull spliced cable tight and reattach to guidance stakes.

Guidance Selection

Cable Guidance Post and Cart Position

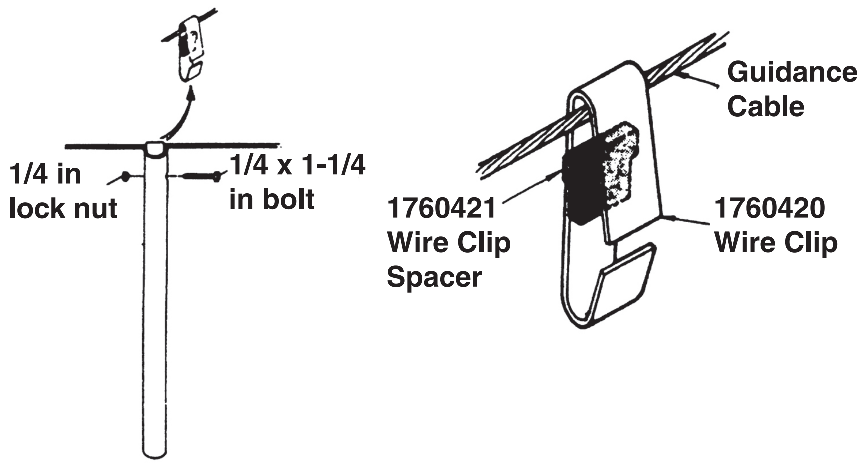


Figure 1-32-1

1760420 Clip and Spacer must be used with the steering arm extensions, 1731047. See Figure 1-32-1.

The cable should be parallel with the edge of the cart frame, both steering boxes the same height above the cable, the cart should be level, and the sensing arms centered over the cable and vertically oriented. See Figure 1-32-2.

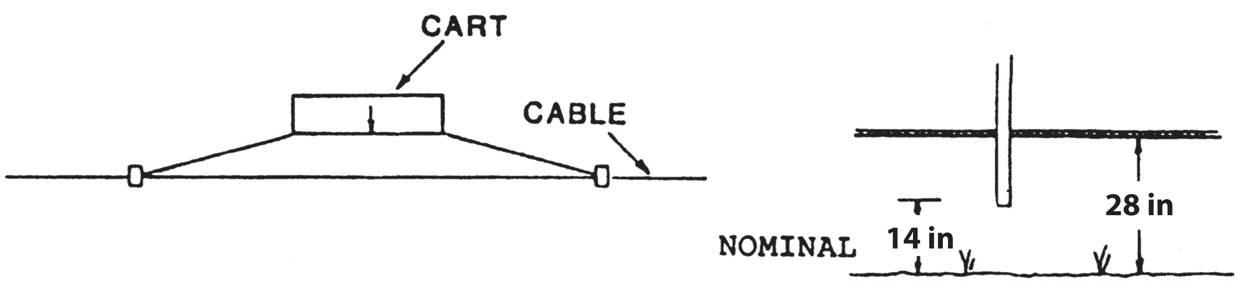


Figure 1-32-2

Ditch Feed or Hose Drag Furrow Guidance

The furrow has a "V" shaped bottom 3 in to 4 in (76.2 - 101.6 mm) deep with a maximum width at the top of 4 in (101 mm). The guide shoe should slide in the furrow at a minimum depth of 3 in (76 mm) and a maximum of 6 in (152 mm). See Figure 1-33-1.

A three foot (0.91 m) wide path on each side of the furrow should be kept clear of any obstructions that could prevent the machine guidance hardware from functioning properly. This path should not have any parallel or perpendicular ridges or furrows through it.

End of Field Shutdown

In addition to standard end-of-field stops, end-of-field shutdown may be accomplished by placing an angle in the furrow where you want the machine to stop. The furrow should be angled away from the drive unit so that when the leading guide shoe has traveled forward 10 ft (3.048 m), it has angled over 2 ft (609.6 mm). This sudden angle change in the guidance arm will stop the machine.

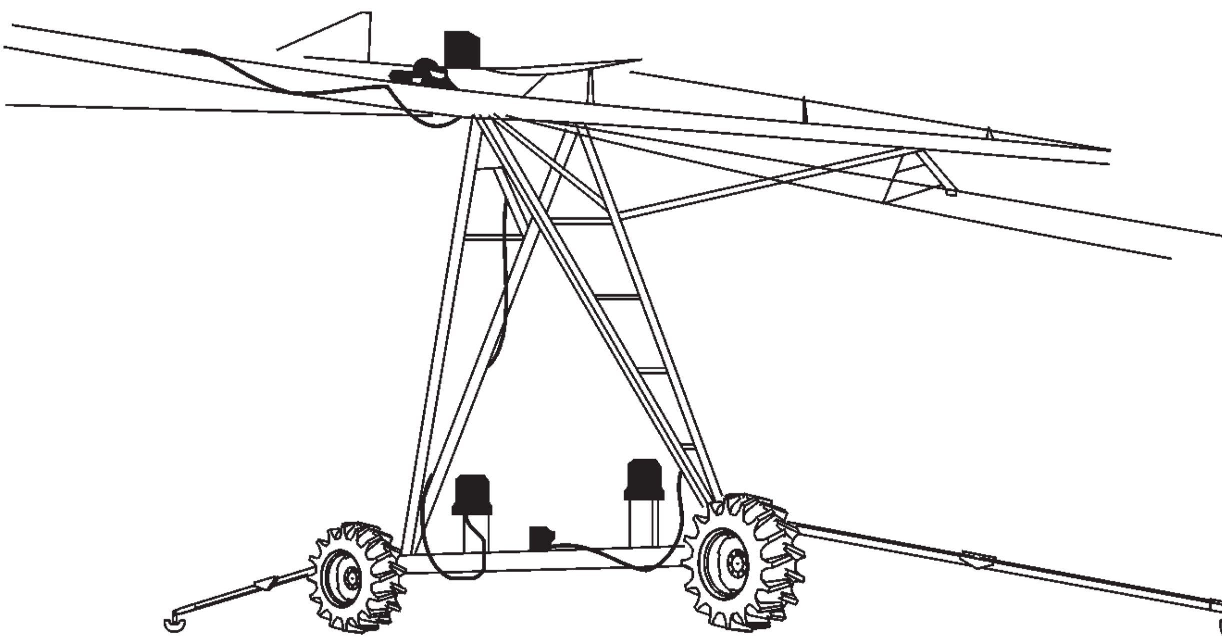


Figure 1-33-1

Ditch Feed or Hose Drag Furrow Guidance (Continued)

Adjustment Procedure

1. Set the steering switches by moving the guide shoe 1-1/4 in (31.8 mm) to the right of neutral. At this location adjust the corresponding steering switch so it is just depressed. Repeat the procedure by moving the guide shoe 1-1/4 in (31.8 mm) to the left of neutral and adjust that steering switch accordingly. After both steering switches have been set, return the guide shoe to the neutral position. See Figure 1-34-1.
2. Set the safety switches by moving the guide skid 16 in (0.40 m) to 20 in (0.50 m) to the right of neutral. At this location adjust the set screw on the safety switch so it is just depressed. Repeat the procedure by moving the guide skid 16 in (0.40 m) to 20 in (0.50 m) to the left of neutral and adjust the screw on the safety switch so it is just depressed. After both safety switches have been set, return the guide skit to the neutral position.
3. Repeat procedure for the other side.

NEVER try to reposition the machine when there are established wheel tracks. This could cause severe structural damage to the machine.

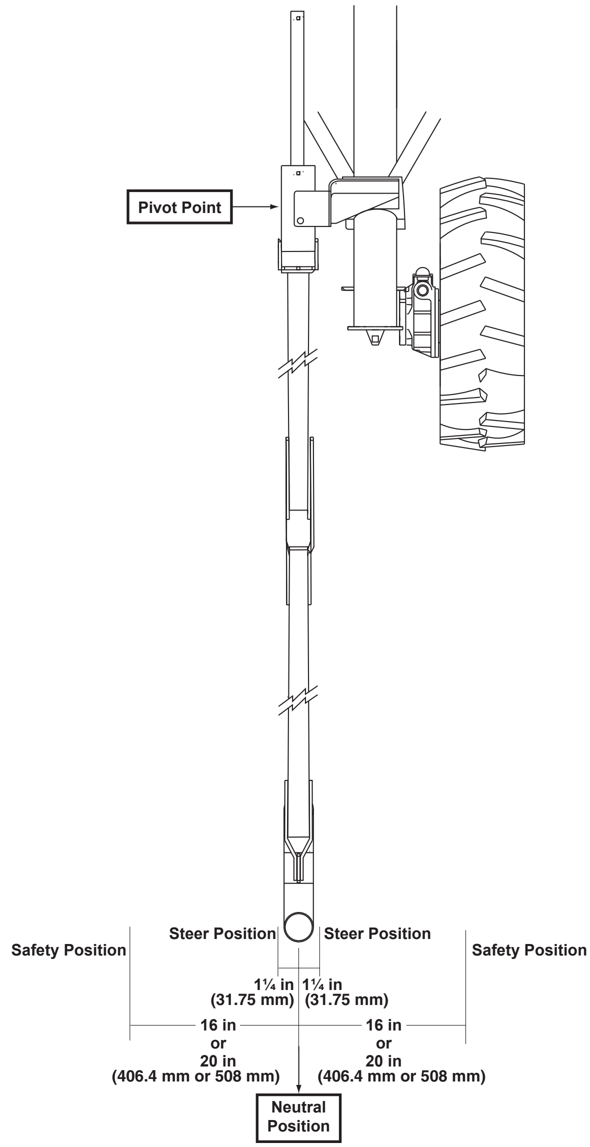


Figure 1-34-1

Furrow can be established with a typical shovel or chisel.

Furrow must be straight within 2 in (50.8 mm) in either direction.

Furrow Guidance shoe will assist in the maintenance of the furrow as shown, but if the furrow is damaged it must be repaired.

Below Ground Guidance - Special Considerations

The following chart will aid in determining which of the previous Wire Burial Charts to use. Once it is determined how deep you want to bury your wire, refer to this chart for your particular free-standing span length. Add together the two measurements. This will provide you with the total distance from the center of the antenna to the buried wire. Locate the Wire Burial Chart that comes the closest to your total. Adjust the figures as necessary if the total distance falls between two of the charts. See Figure 1-35-1.

Span Length	*Center of Antenna to Ground Level
180 ft, 184.8 ft, or 187.5 ft (54.9, 56.3, or 57.2 m)	65 in (1.65 m)
160 ft or 161.2 ft (48.8 or 49.1 m)	67 in (1.7 m)
115 ft,135.2 ft, 140 ft, or 142.3 ft (35.1, 41.2, 42.7, or 43.4 m)	78 in (1.98 m)

* This measurement is an average of wet and dry crowns. It is recommended that the actual height to the antenna be measured for an accurate dimension.

NOTE

•The free-standing span must be on level ground with the antennas leveled and squared.

NOTE

•Oscillator may be placed anywhere on loop. Oscillator is powered with 120 VAC. If 120 VAC is not available, a solar powered option may be purchased.

NOTE

•Special considerations are required when high and ultra high spans are used, signal strength is reduced due to the antenna height above the buried wire.

Single Loop Buried Wire

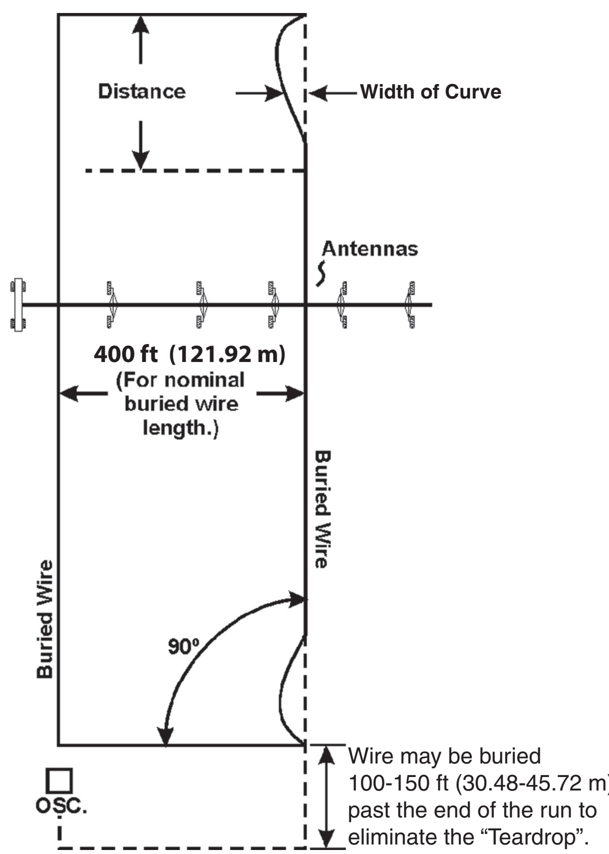


Figure 1-35-1

Below Ground Guidance - Special Considerations (Continued)

IMPORTANT

Below ground guidance – special consideration.

On the single loop buried wire, the ends of the guidance wire next to the field boundaries are buried with a slight curve. The purpose of this curve is to maintain proper machine guidance as it approaches the end of the run. Without these curves, the machine would begin to sense the return loop wire and begin a false steer due to the guidance return wire. The curves at the end of the wire run compensate the return wire field, and the machine will operate straight into the end of the run without veering off course as it approaches the return loop. The dimensions for the width of the curves are given in lengths of an inch. The dimensions correspond with the distance from the end of the run, which are shown in feet. They are very critical, and the curves must be precise to the distance chart as possible.

NOTE

- **The curve dimension are not only critical in being measured out in tenths of an inch, but also the curve dimensions are based on antenna height from the buried wire. Curve layout charts have been supplied which will correspond with different antenna heights from the buried wire. If the antenna height is between two of the chart heights, interpolate for the correct layout. These critical height dimensions to the antenna assemblies only affect the end of run at each end of the field. This is why it is so critical to maintain a level field at each end of run area at the ends of the run, otherwise the machine may not react as well to the curve in the buried wire, and my not end up square at the end of the field.**
- **The portion of the below ground guidance wire that the machine follows MUST BE TRENCHED IN rather than ripped in, to insure the best possible straightness.**
- **The wire should be put in the trench straight by using a transit. It should be secured in place, then covered by hand before backfilling. A crooked guidance wire may result in excessive steering/guidance corrections. This combined with wheel ruts in excess 6 in (152 mm) could result in structural damage (see Guidelines). Some dealers have found it advantageous to not backfill the trench at the end of the field until they run the machine to the end of the field. This allows them to adjust the wire slightly if need.**

Below Ground Guidance - Special Considerations (Continued)

Distance Chart - Standard

Distance from End of Run (ft)	Height of Antenna Above Wire - Feet: 4	5	6	7	8	9	10	11	12	13	14	15	16
	Curve Distance (in)												
1	9.0	9.5	9.9	10.1	10.3	10.5	10.6	10.7	10.8	10.9	11.0	11.1	11.1
2	13.6	15.2	16.4	17.3	18.0	18.5	19.0	19.4	19.7	20.0	20.2	20.5	20.7
3	15.3	18.2	20.4	22.1	23.4	24.6	25.5	26.3	26.9	27.5	28.0	28.5	28.9
4	15.3	19.3	22.5	25.1	27.2	28.9	30.4	31.7	32.7	33.7	34.5	35.2	35.9
5	14.5	19.1	23.2	26.6	29.5	31.9	34.0	35.7	37.3	38.7	39.9	40.9	41.9
6	13.3	18.3	22.9	27.0	30.6	33.7	36.4	38.7	40.8	42.6	44.2	45.6	46.9
7	12.2	17.3	22.9	26.8	30.9	34.6	37.8	40.7	43.3	45.5	47.6	49.4	51.0
8	11.1	16.1	21.2	26.0	30.6	34.8	38.5	40.9	44.9	47.7	50.1	52.3	54.3
9	10.2	15.0	20.0	25.0	29.9	34.4	38.6	42.4	45.9	49.1	51.9	54.6	57.0
10	9.3	13.9	18.9	23.9	28.9	33.7	38.2	42.4	46.3	19.9	53.2	56.2	58.9
15	6.5	10.0	14.0	18.5	23.3	28.3	33.4	38.4	46.4	48.2	52.9	57.4	61.6
20	4.9	7.6	10.9	14.6	18.7	23.1	27.8	32.7	37.7	42.8	47.8	52.9	57.8
25	3.9	6.1	8.8	11.9	15.4	19.2	23.4	27.8	32.4	37.2	42.1	47.1	52.2
30	3.3	5.1	7.4	10.0	13.0	16.3	19.9	23.9	28.0	32.4	37.0	41.7	46.6
40	2.5	3.8	5.5	7.5	9.8	12.4	15.3	18.4	21.7	25.3	29.2	33.2	37.4
50	2.0	3.1	4.4	6.0	7.9	10.0	12.3	14.8	17.6	20.6	23.8	27.2	30.8
60	1.6	2.5	3.7	5.0	6.6	8.3	10.3	12.4	14.7	17.3	20.0	22.9	26.0
70	1.4	2.2	3.1	4.3	5.6	7.1	8.8	10.6	12.7	14.8	17.2	19.7	22.4
80	1.2	1.9	2.7	3.7	4.9	6.2	7.7	9.3	11.1	13.0	15.1	17.3	19.7
90	1.0	1.5	2.2	3.0	3.9	5.0	6.1	7.4	8.8	10.4	12.1	13.8	15.8
100		1.0	1.5	2.0	2.6	3.3	4.1	4.9	5.9	6.9	8.0	9.2	10.5
150			1.1	1.5	1.9	2.5	3.0	3.7	4.4	5.2	6.0	6.9	7.8
200				1.2	1.5	2.0	2.4	2.9	3.5	4.1	4.8	5.5	6.2
300				1.0	1.3	1.6	2.0	2.4	2.9	3.4	4.0	4.6	5.2
400						1.2	1.5	1.8	2.2	2.6	3.0	3.4	3.9
500						1.0	1.2	1.5	1.7	2.0	2.4	2.7	3.1
600							1.0	1.2	1.4	1.7	2.0	2.3	2.6
700								1.0	1.2	1.5	1.7	1.9	2.2
800								0.9	1.1	1.3	1.5	1.7	1.9
900									1.0	1.1	1.3	1.5	1.7
1000										1.0	1.2	1.4	1.5
1250											0.9	1.1	1.2
1500												0.9	1.0

Table values are for the distance of guidance wire from centerline of survey points curves are shown in INCHES

Distance Chart - Metric

Distance From End of Run (m)	Height of Antenna Above Wire - Meters: 1.22	1.52	1.83	2.13	2.44	2.74	3.05	3.35	3.66	3.96	4.27	4.57	4.88
	Curve Distance (m)												
0.30	229	241	251	257	262	267	269	272	274	277	279	282	282
0.61	345	386	417	439	457	470	483	493	500	508	513	521	526
0.91	389	462	518	561	594	625	648	668	683	699	711	724	734
1.22	389	490	572	638	691	734	772	805	831	856	876	894	912
1.52	368	485	589	676	749	810	864	907	947	983	1013	1039	1064
1.83	338	465	582	686	777	856	925	983	1036	1082	1123	1158	1191
2.13	310	439	582	681	785	879	960	1034	1100	1156	1209	1255	1295
2.44	282	409	538	660	777	884	978	1039	1140	1212	1273	1328	1379
2.74	259	381	508	635	759	874	980	1077	1166	1247	1318	1387	1448
3.05	236	353	480	607	734	856	970	1077	1176	505	1351	1427	1496
4.57	165	254	356	470	592	719	848	975	1179	1224	1344	1458	1565
6.10	124	193	277	371	475	587	706	831	958	1087	1214	1344	1468
7.62	99	155	224	302	391	488	594	706	823	945	1069	1196	1326
9.14	84	130	188	254	330	414	505	607	711	823	940	1059	1184
12.19	64	97	140	191	249	315	389	467	551	643	742	843	950
15.24	51	79	112	152	201	254	312	376	447	523	605	691	782
18.29	41	64	94	127	168	211	262	315	373	439	508	582	660
21.33	36	56	79	109	142	180	224	269	323	376	437	500	569
24.38	30	48	69	94	124	157	196	236	282	330	384	439	500
27.43	25	38	56	76	99	127	155	188	224	264	307	351	401
30.48		25	38	51	66	84	104	124	150	175	203	234	267
45.72			28	38	48	64	76	94	112	132	152	175	198
60.96				30	38	51	61	74	89	104	122	140	157
91.44				25	33	41	51	61	74	86	102	117	132
121.91						30	38	46	56	66	76	86	99
152.39						25	30	38	43	51	61	69	79
182.87							25	30	36	43	51	58	66
213.35								25	30	38	43	48	56
243.83								23	28	33	38	43	48
274.31									25	29	33	38	43
304.79										25	30	36	38
380.98											23	28	30
457.18												23	25

Table values are for the distance of guidance wire from centerline of survey points shown in MILLIMETERS

Guidance Selection

Below Ground Guidance Linear Oscillator Box Mounting

The following drawings and descriptions will show the operator and installer the function and operation of the linear oscillator panel. We suggest you mount this box on a post mid-way between the machine guidance wires. Be sure to drive a ground rod by the box and ground it to the rod with #6 bare copper wire.

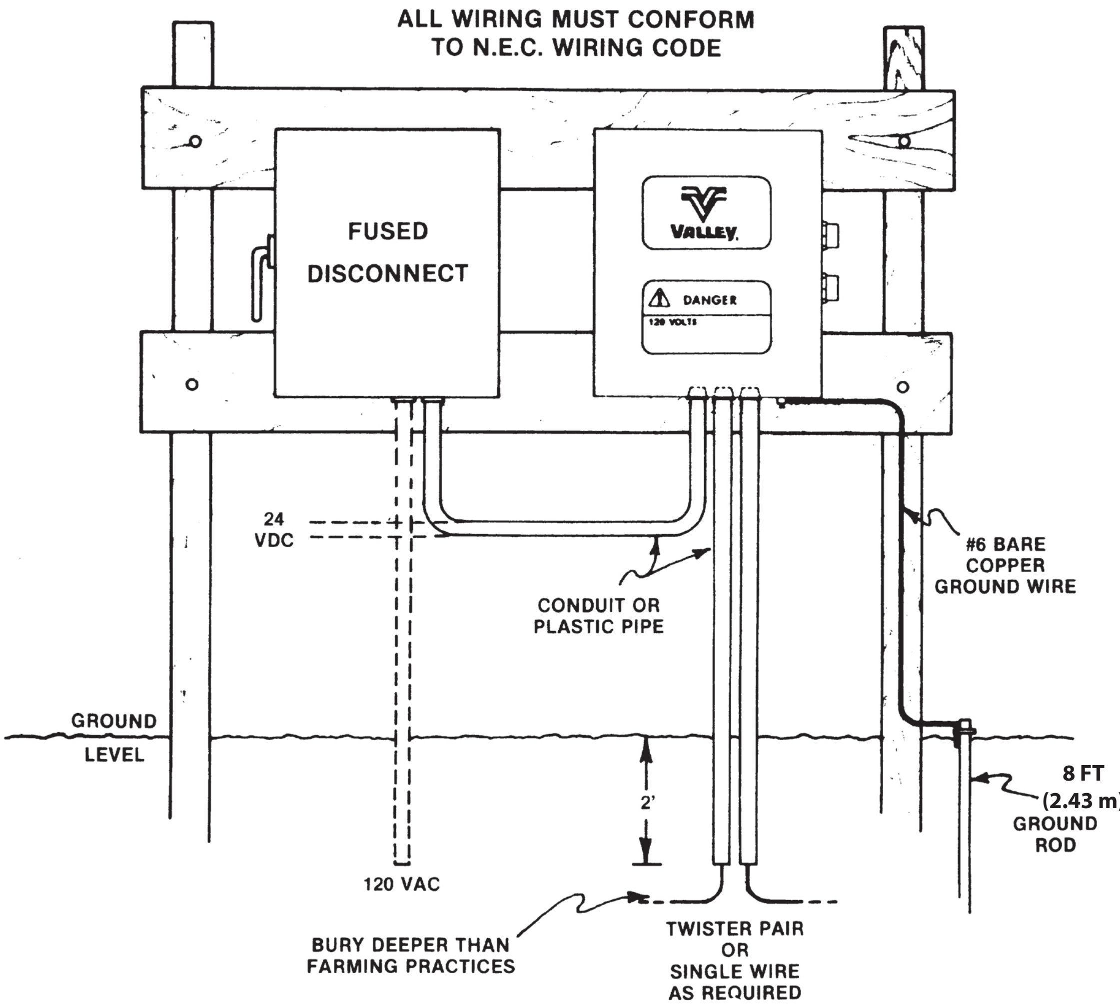


Figure 1-38-1

Adjustment and Squaring of Antennas Below Ground Guidance

Pre-adjust by measuring from the truss rods to the ends of the 6 in (152 mm) antenna tube. Slide the antenna tube either direction until you achieve an equal distance from the truss rod to the end of the tube on both sides. Now adjust antenna support brackets so that they are parallel and generally perpendicular to ground level. Tighten half clamps to prevent any further movement. See Figure 1-39-1, Ill. B.

Next, the antennas must be level with the ground plane. To determine how level the antennas are with the ground, measurements should be taken from the ground level to each antenna. Adjust antennas up or down to attain this levelness. This is done by removing the two bolts and positioning the mounting bracket along the adjusting holes until equal heights are achieved. See Figure 1-39-1, Ill. A.

Finally, with the 3/8 in (9.5 mm) U-bolts loosened, take measurements from center of antenna to hole on top of the ball hitch. Adjust 6 in (152 mm) antenna tube and hardware horizontally until you get an equal measurement at both location. Tighten the 3/8 in (9.5 mm) U-bolts to prevent any further movement. See Figure 1-39-1, Ill. B.

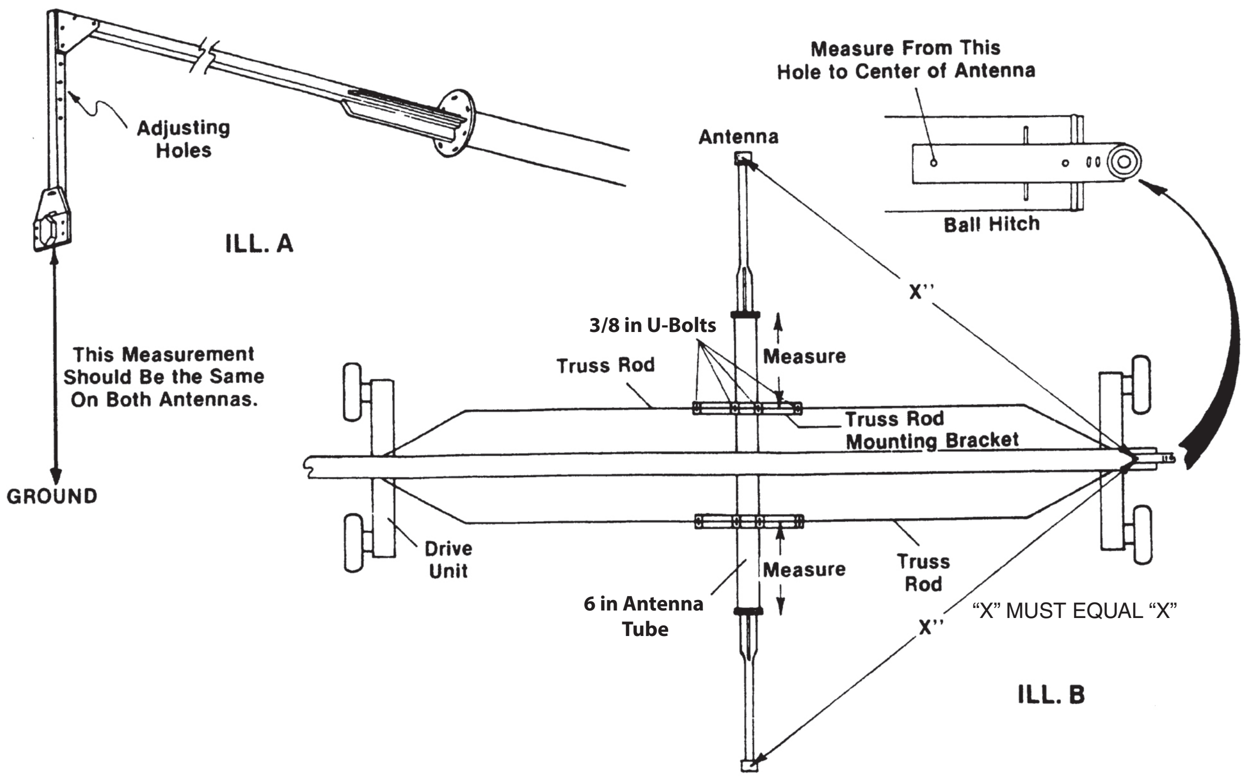


Figure 1-39-1

Guidance Selection

GPS Guidance Limitations

1. Machine Limitations

(a) GPS Guidance is designed to properly operate on machine lengths between 150 ft to 3200 ft (45 m to 975 m).

(b) GPS Guidance is **not** suitable for installation on a linear that is fed with a concrete ditch and rolling suction.

(c) GPS Guidance is **not** suitable for installation on a linear that uses drop spans.

2. Application Limitations

(a) Maximum distance from rover to reference is based on the type of receiver and reference used. This is the distance from the farthest point the rover (receiver on the machine) is to the reference station (receiver that is broadcasting the correction) not the distance to a repeater. Exceeding the maximum distance can increase the chance of losing RTK coverage, which may result in structural damage:

(1) Multi-Frequency 6 Miles or less

(2) Single Frequency 3 Miles

(b) There must be line of site clearance from the reference station to all points in the field.

(c) Requires 100% RTK correction data link in all parts of the field. RTK extend in any of the field is not acceptable.

(d) Repeaters can be used with Valmont approval.

(e) Reference station RTK receiver needs to be permanently mounted with a continuous power source.

(f) Reference station needs to be configured as an absolute base with a 24 hour survey. The reference station location latitude and longitude needs to be recorded in the event the reference station is ever replaced. If it is not all machines that use the reference may run off the original path due to a shift in the reference station's absolute location. A single frequency rover will need a single frequency reference station to connect to. An existing multi-frequency Trimble reference station is not supported and won't communicate.

(g) Acceptable correction communication radios:

(1) 900 MHz, unlicensed, Domestic/Canada.

(2) 916-982 MHz, unlicensed, International only.

(3) 2.4 GHz, unlicensed, International only.

(h) Machine performance is designed to be plus or minus 6 inches (8 inches for single frequency) for the wheel tracks of the tower that the receiver is mounted on over the course of a season.

(i) Machine guidance is limited to straight line path (point-to-point).

(j) Must have a minimum 160 degree view of the sky at any point in the path (see Figure 1-40-1).

(k) The minimum run must be two (2) times the length of the machine. Example: If the machine is 1000 ft (305 m) long the run must be at least 2000 ft (610 m) long. A linear with GGS is designed to run the full length of the run. (No plots.)

(l) GPS guided machines do not require the central pulse tower box.

(m) The field must be relatively flat and the cart path must be level with the first tower.

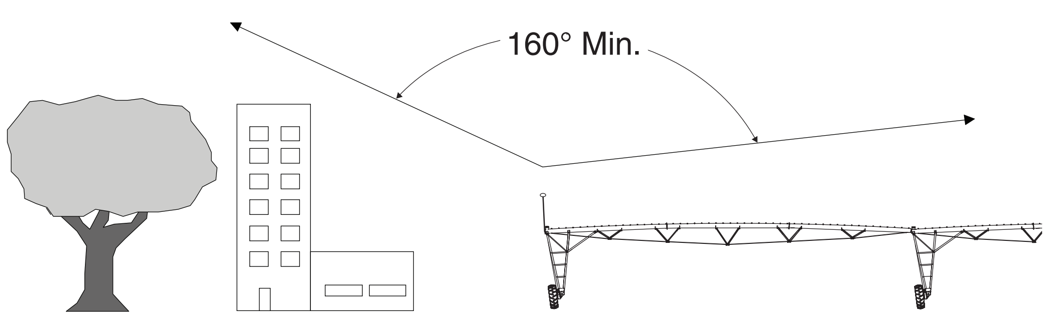


Figure 1-40-1

GGS Design Requirements and Recommendations

Distance to Reference Station

Multi-Frequency 6 Miles or less (Trimble)

This is the distance from the farthest point the rover (receiver on the machine) is to the reference station (receiver that is broadcasting the correction). Not distance to a repeater.

Exceeding this distance will void warranty, increase +/- 8 in (0.2 m) tolerance, will cause structural damage, and increase the chance of losing RTK coverage.

Single Frequency 3 Miles or less

Exceeding this distance will void warranty, increase +/- 10 in (0.3 m) tolerance, will cause structural damage, and increase the chance of losing RTK coverage. Exceeding three miles distance to the reference station will cause machine to be inoperative due to the hard three mile limit with single frequency.

Length of machine:

Linear: 46 m (150 ft) to 975 m (3200 ft)

Linear:

- Minimum run is based upon length of machine.
- Length of machine x 2 = min run (2000 ft machine x 2 = min 4000 ft run).
- Ditch Feed Linear with a concrete ditch or rolling suction are not supported.
- Machines with dropspans are not supported.
- All general linear installation rules apply.

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Table of Contents (Continued)

Table of Contents (Continued)

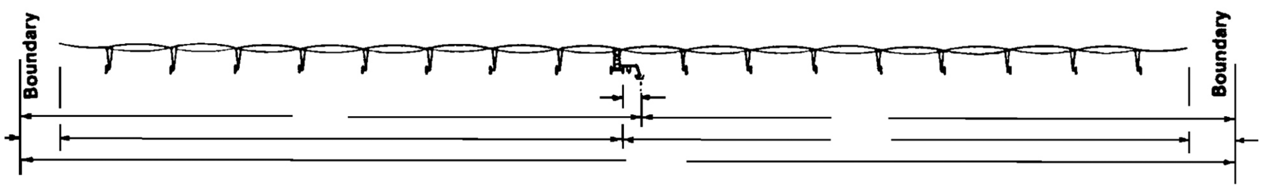
Rainger Linear Ditch Feed

Ditch Feed - Rainger Linear Design Worksheet

CUSTOMER ________________________________ DEALER ____________________________________

DATE ______________________________________ SALESMAN _________________________________

1. Acres Irrigated - ____________________ Acres
2. System Discharge - _______________ GPM (Refer to Capacity Worksheet on page 1-15)
3. Desired End Pressure - _______________ PSI
4. Pressure Regulators Included - ____ Yes ____ No
5. Total System Length - _________________ ft
6. __________ End Feed __________ Center Feed
7. Altitude Above Sea Level - ________________ ft
8. Maximum Operating Temperature - _________ °F
9. Field Suction Lift _______ ft (Distance from water level in ditch to ground level cart tires roll on)
10. Field Elevation Change ___________________ ft



11. **Total System Pressure Requirement**

> **NOTE**
>
> • **Each side of a center feed system must be handled separately. Design pressure requirements are based upon the side with the largest PSI loss.**

Determine Percentage of Total Length of Each Pipe Diameter and Their Multipliers

Pipe Size	Length	Percent Length
6-5/8 in	ft	
8-5/8 in	ft _____	_____

Total Pressure Loss for Pipe Combinations 100%

6-5/8 in = Total 6-5/8 in inch loss
OR
Use VTools spreadsheet linear design on V2O

Pressure Loss, PSI	=	_______________		_________________
Desired End Pressure PSI (Required for Sprinklers)	+	_______________	+	_________________
Pressure Regulators, Add 5 PSI (except on 6 PSI pkg)	+	_______________	+	_________________
Field Elevation Change __________ ft ÷ 2.31	±	_______________	±	_________________
Field Suction Lift ____________ ft ÷ 2.31	+	_______________	+	_________________
TOTAL SYSTEM PRESSURE REQUIREMENTS*		_______________		_________________
(Use this value in Pump Performance Charts) page 2-34		_______________		_________________

* Designers may want to add extra (10%) PSI to allow for nozzle and pump wear.

Ditch Feed - Rainger Linear Design Worksheet (Continued)

12. **Suction Lift Requirement****
    Field Suction Lift (Water Surface to Chart Wheel Path) ...... ________________ ft
    Altitude Correction Factor.. + ________________
    Total Field Suction Lift .... ________________ ft

13. **Use the total system and suction lift pressure requirement value in Pump Charts A - D and select pump.**

> **NOTE**
>
> **•An increase in pump pressure and RPM will often give a smaller pump lift.**

Pump Chart	GPM	RPM	PSI	hp	Lift**
________	________	________	________	________	________

14. **Generator Size and Horsepower Requirement**
    Number of Spans ________
    Machine Speed ______ Regular ______ High
    Booster Pumps ______ None ______ 1 _____ 2
    Generator Size ______ kW (see page 1-18)
    Horsepower Required ______ hp (see tables on page 1-22 to page 1-26)

15. **Engine Selection For** **RPM**
    Pump Horsepower (Step 13) _______hp
    Generator Horsepower (Step 14) + _______hp
    Total Horsepower = _______hp
    Derating Factors x _______hp
    (See page 2-83)
    Adjusted Horsepower Requirement hp***
    Brand/Model
    (See page 2-83) for
    Available Engine Horsepower _______hp

16. **Generator Sheave Size** (see page 2-84) ____________ inches

** Designers must verify actual field suction lift with pump capabilities.
*** Designers may want to add extra hp to allow for engine wear.

Rainger Linear Ditch Feed

Checklist

Critical Items

1. **Span Layout** ________________________

   Free-standing span-location and length ________
   Cart Location ________________________
   Machine span locations-diameter and length _________
   Transition Locations ___________________
   Tire sizes and locations ________________
   Gear motor RPM locations ______________

2. **Farming Practices**

   Row height and direction _______________
   Planter and row width _________________

3. **Field Layout**

   Obstructions _________________________
   Clearances __________________________
   Ditch to cart distance (No. of extensions) ___
   Canal dimensions _____________________
   Dirt or Concrete ditch _________________
   Bottom width ________________________
   Side slope __________________________
   Operating water depth _________________
   Water control in ditch-overflow? __________
   Control of dirt, trash, weeds in ditch _______
   Suction orientation relating to spans Suction winch
   Ditch Inboard ______ Ditch Outboard ______

4. **Chemigation**

   Pump size ___________________________
   Tank size ____________________________
   Check valves _________________________
   Controls _____________________________

5. **End Flush Capabilities/Needs** __________

6. **Sprinkler Package**

   Adjustable nozzle height _______________
   Special Drive Unit drains _______________
   Special Drive Unit boombacks ___________

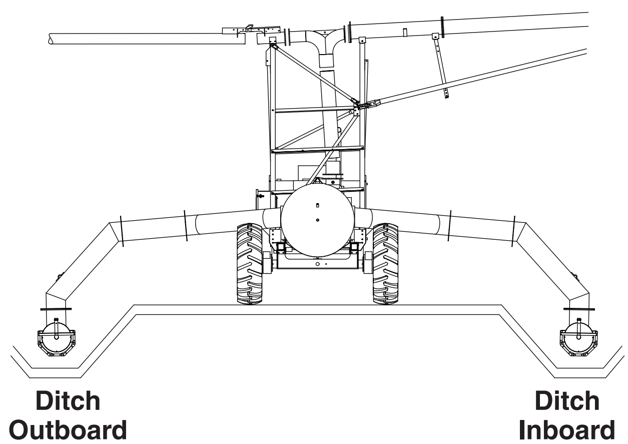


Figure 2-6-1

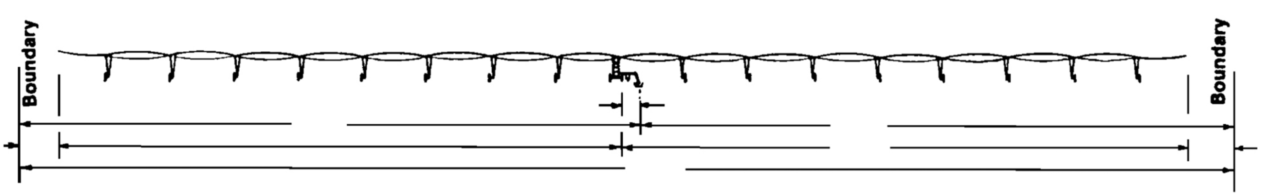


Figure 2-6-2

Guidelines

System Spans And Profiles

Linear cart available as standard profile only, 6-5/8 in (168 mm), 8-5/8 in (219 mm), or 10 in (254 mm) diameters.

Swing Around cart available as standard profile only, 6-5/8 in (168 mm) or 8-5/8 in (219 mm) diameters.

> **NOTE**
> - **Deep Trussing is required on all cart spans.**

Low Profile

(a) Available with all spans.

(b) No Carts available as low profile.

(c) For Swing Around, first span and first drive unit must be standard profile.

High Profile

(a) Available on all 6-5/8 in (168 mm), 8-5/8 in (219 mm), and 10 in (254 mm) spans.

(b) No Carts available in high profile.

(c) For Swing Around, first span and first drive unit must be standard profile.

Ultra High Profile

(a) Available on all 6 5/8 in (168 mm) and 8-5/8 in (254 mm) linear spans.

(b) Cart in standard profile only, first drive unit from the cart can be high profile.

(c) Not available on swing around.

Tire Requirements

1. 14.9 x 24 or 16.9 x 24 tires **MUST** be used on the cart.

   Location of free-standing span should be noted on order.

System Length

1. End Feed with cable guidance or furrow guidance at cart 1300 ft (396 m) maximum length.

   Center Feed or End Feed with furrow guidance located in the center of the machine 2600 ft (792 m) maximum length.

   End Feed or Center Feed with below ground located in the center of the machine - 3200 ft (975 m) maximum length.

   Center Feed with cable guidance located in the center of the machine - 3200 ft (975 m) maximum length.

   GPS Guidance is designed to properly operate on machine lengths between 150 ft to 3200 ft (45 m to 975 m).

> **NOTE**
> - **Maximum length from guidance hardware to furthest end of machine - 1600 ft (487).**

Maximum Length Swing Around Linear – 1300 ft (396 m) with cart mounted cable guidance or furrow guidance; with below ground guidance or furrow guidance located at the center of the machine. Cart anchors must be used for Swing Arounds longer than 1000 ft (304 m) or 6 spans.

Base Beams

1. 4-Wheel Cart linears (except Universal Linear) are only available with non-tow base beams.
2. 4-Wheel Linear cart available as ditchfeed or hose drag swing around.

Electrical

1. Maximum control panel voltage 505 volts, 60 Hz (400 volts, 50 Hz).
2. Minimum voltage at the last drive unit 440 volts, 60 Hz (350 volts, 50 Hz).
3. Maximum machine current 30 amps unless the 45 amp package is used.
   (a) 45 amp package includes a control panel, which has a larger capacity disconnect and contactors. This package must be used on all machines with amp draw exceeding 30.0 amps.
   (b) Drive unit fuse package includes fuse block and (3) fuses for fusing the drive unit motors. Must be used in the following instances:
      (i) Whenever the 45 amp package is used on an end feed machine.
      (ii) Whenever a 5 hp (3.7 Kw) or 7.5 hp (5.6 Kw) booster pump is used.
      (iii) On a center feed machine if the current draw on one side of the cart exceeds 30.0 amps.
4. One second time delay is used on any span that shows the tendency to rapidly start and stop due to the floating alignment. This delay is an option which may be ordered as necessary, for high-speed motors. Typically one half of the spans are ordered with time delays.
5. Induced voltage package consists of a relay and resistance heater to bleed off induced voltage. This is used whenever rapid cycling of the contactor occurs which is also when you use the one second time delay. One second time delay units are used in order to insure there is no induced voltage on the opposite run wire.

Guidelines (Continued)

Guidance

(See system length for limitations.)

1. Cable (located at cart only) - The cable is supported 28 in (711 mm) above the ground by a support post located every 80 feet (24 m).
2. Below ground guidance - Available on all ditch feed and hose drag linears. **The below ground guidance wire must be trenched in rather than ripped in.** Straightness of the wire is of the utmost importance for proper machine operation. Refer to the hose drag design section for special consideration concerning wire burial. End field wire burial needs curved section. See Service Manual for details.
3. Furrow guidance can be located on Linear 4 Wheel Ditch Feed and Hose Drag, Universal Cart or Free-Standing span drive unit.

   Furrow must not vary more than two (2) inches (50 mm) from straight.
4. GPS must have a minimum length of run of 2 times longer than the machine length (i.e. 1000 ft of machine length will be 2000 ft of run).
5. GPS guidance on dirt ditches with floating inlets.

> **NOTE**
>
> - **GPS guidance not allowed on ditch feed machines with concrete ditches and rolling suctions.**
> - **GPS guidance is not allowed with drop spans.**

Alignment

1. Full floating alignment – May be used on all linears.
   (a) Required for all linears of six spans or more. Optional on five spans or less.
   (b) It is recommended that the sprinklers adjacent to the drive units be lowered below the pipeline to avoid spraying on the alignment system.
2. Modified Alignment
   (a) Available for all linears with five spans or less.
   (b) It is recommended that the sprinkler adjacent to the drive units be lowered below the pipeline to avoid spraying on the alignment system.
   (c) When using with a drop span review specification in the drop span section.

Wheel Tracks

1. Depth - Maximum allowable depth 4 in (101 mm).
2. Please inform the customer that they are responsible for maintaining wheel track depth to a maximum of 4 in (101 mm). Track fillers, tillers, small discs, drive unit booms or floatation tires can be used to control the depth of wheel tracks. Special caution should be taken with the swing around linear when in pivot operation in controlling wheel track depth to a maximum of 4 in (101 mm).
3. Wheel track establishment - On a new machine, the first pass should be made with the machine running dry at 100% timer setting. The return pass should be made while applying water at 100%. On a machine operating in existing tracks which have become too deep, perform the following:
   (a) Disc the tracks down.
   (b) Run the machine dry over the soil at 100% timer setting. Make the return pass applying water at 100%.
   (c) If any portion of the previous track remains, disc the track again and re-establish the track. Repeat this procedure until the machine is operating on a flat level track.
   (d) Typically linear machines need larger tires on heavy soils to minimize wheel track depth.
   (e) If berms are built, a wide-flat area of 3 ft (1 m) is recommended and compacted to prevent wheel tracks.
   (f) Boom-backs to divert the water spray away from the wheel-tracks.

Motor/Tire Combination

1. The motor-tire combination must maintain a minimum 25% increased differential ground speed on intermediate drive units compared to end drive units (or cart on end feed).

Tire Loading

1. Side walls of some tires will deteriorate more rapidly when loaded excessively, especially in hot climates.
2. Reduce tire pressure to increase tire flotation/surface area.

Ditch Specifications

Ditches - General

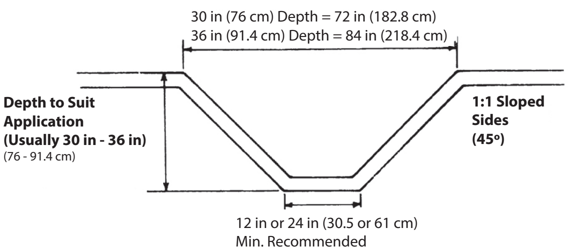
Minimum Dimensions

- Recommended minimum water depth at pump suction = 26 in (66 cm).
- Recommended minimum bottom width for lined ditch = 12 in (30.5 cm) for single suction.
- Recommended minimum bottom width for un-lined ditch + 36 in (91.4 cm) for single suction.
- For bypassing suctions out of a common ditch, allow 2x suction width + desired clearance, floats, extended or shortened suction, etc.

Typical Ditch Construction

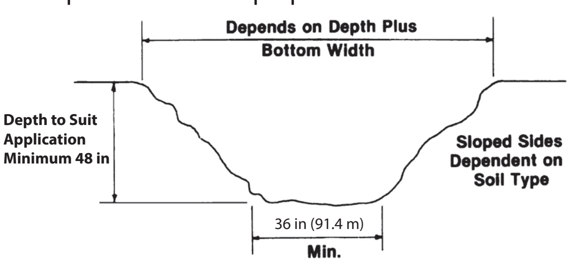
(a) Concrete lined ditch.

(b) The maximum slope of a ditch with a movable dam is 1%.



For complete design and construction parameters see ASAE 289.1 or your area NRCS office.

- Dirt/earth unlined ditch. Width depends on depth and side slope plus bottom width.



Soil Type		Depth of Ditch
	Up to 4 in (1.2 m)	Over 4 in (1.2 m)
Heavy (Clay)	1/2 : 1	1 : 1
Medium (silt loam)	1 : 1	1-1/2 : 1
Medium Light (sandy loam)	1-1/2 : 1	2 : 1
Light (sand)	2 : 1	3 : 1

- Many local considerations determine ditch construction. Linear systems are being operated from large drainage ditches, diverted natural waterways, deep narrow trenches, etc. In many cases the local dealer and/or farmer have constructed special devices to accommodate a particular situation - such as dams, floats, extended or shortened suctions, etc.

Typical Allowable Side Slopes

Soil Conservation Service Area Engineers, local irrigation district engineers, extension technical service personnel, and local contractors can often furnish assistance and advice in ditch construction.

Level Ditches

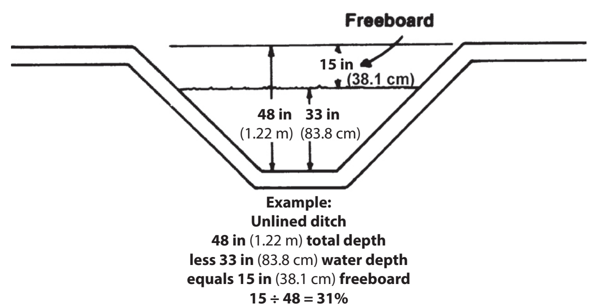
If a level ditch can be installed with an acceptable amount of dirt work, this is probably the preferred system. In this case, the ditch serves as a long narrow reservoir. Float controls can be used to control the water level in the ditch, and problems of potential overflow are greatly reduced.

Size Of Ditch

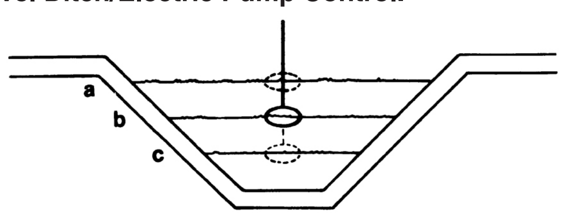
Compliance with minimum dimensions given will easily accommodate the gallonage required for the largest linear system.

References on ditch design recommend a freeboard* allowance of 30-35% of the total depth for unlined ditches, and 20% of the total depth on lined ditches.

***Freeboard is the safety factor for overflow.**



Level Ditch/Electric Pump Control.



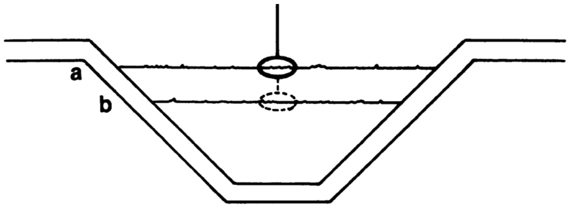
(a) Overflow level - float shuts pump off.

(b) Minimum level - float turns pump on.

(c) Allowance for silt buildup.

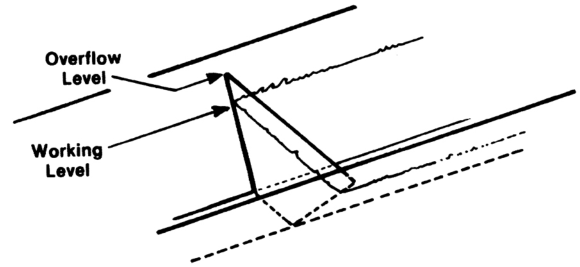
Ditch Specifications (Continued)

Level Ditch/Internal Combustion Pump Control



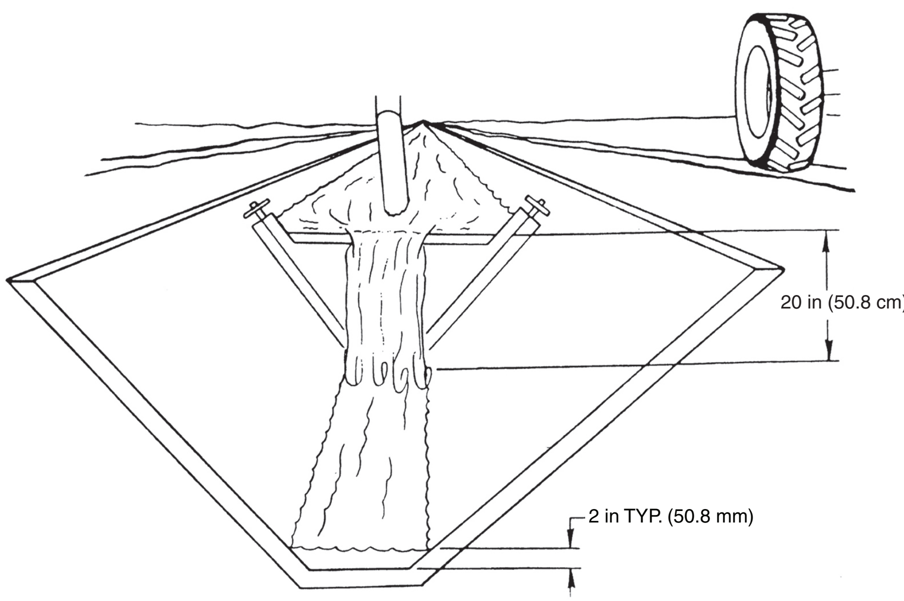
Overflow level - float kills engine.

Pump engine is started and run manually until water level reaches b, which is the desired working depth. Pump discharge into ditch should match system withdrawal from ditch, plus allowance for seepage and evaporization, to maintain working depth.



Dam at end of ditch slightly above desired working depth. In the event of system shutdown, water depth will increase and flow over dam until pump is manually shut off. Overflow water should be directed to tailwater pit, drainage ditch, etc.

A moving dam can be used on sloping concrete lined ditches. The dam should not be sized for total restriction of water flow. A minimum of 100 GPM (6.3 LPS) should be allowed to flow over the moving dam for proper operation.



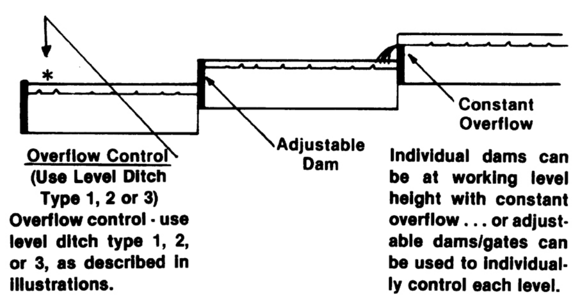
Moving Dam Available for Sloped Concrete Lined Ditches

A minimum of 100 GPM (LPS) should be allowed to flow over the weir to insure proper operation.

Stepped (Terraced) Ditches

If a slope in the length of the ditch can be divided into a few level steps or terraces with an acceptable amount of dirt work, this allows many of the advantages of a level ditch. With appropriate flow controls or gates at each of the dams that form the steps or terraces, overflow problems can be fairly easily dealt with. Water depth can also be controlled within each ditch section.

System management method will be affected by the number and timing of occasions where the suction inlet needs to be moved from one level to the next.



Ditch Maintenance

Earthen Ditch

The failure of earthen ditches can be traced to generally 6 causes:

- (a) Sedimentation
- (b) Excessive vegetation
- (c) Channel and bank erosion
- (d) Poor location and alignment
- (e) Improper width or depth
- (f) High water flow rate causing erosion of the banks

The sedimentation can be controlled if caused by caving of the side slopes to a flatter and wider construction. The inlet must also be so constructed as to not cause erosion and carry sediment load to the end of the ditch.

The control of excessive vegetation is necessary because it causes restricted flow and intake plugging.

Several methods of control are spraying, clearing, and burning. The most common control used today is spraying. There are several different sprays available and their use and application methods should be discussed with the local extension agent and chemical supplier. Burning may be used when the vegetation is dry or with flame burners for green vegetation. All of these methods may have to be done several times in a year to get adequate control.

To correct the other causes of ditch failure requires redesign and construction of the ditch. Even though the ditch was designed properly and maintenance was performed, clean-out work is often necessary either on annual, 2 year, 5 year, or other schedule. To perform the clean-out, the same equipment that constructed the ditch may be used. Note that the control of vegetation and erosion must also be done under the guidance, cable or furrow guidance, and on the berms of the ditch.

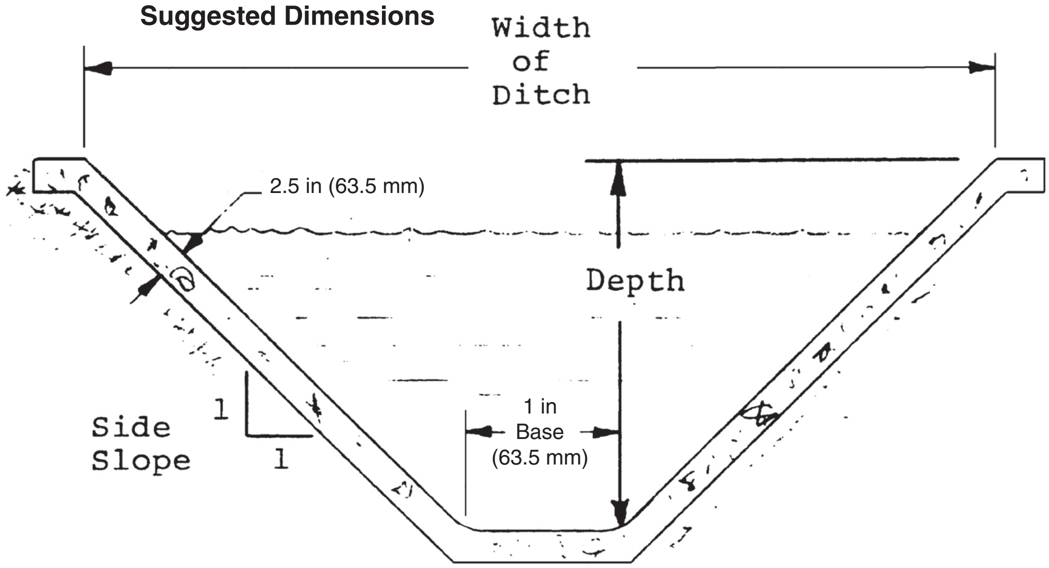
Lined Ditch

Ditches can be lined with several different materials to prevent losses due to seepage. Concrete is the most common. Other linings are asphalt, rock masonry, brick, soil cement, rubber and plastic. Lining a ditch also allows a more efficient design to be used and decreases maintenance on the ditch.

The design of concrete ditches will be addressed in this section.

Construction Design

Suggested Dimensions



Flow Maximum GPM/m³hr	Depth	Width	Minimum Depth of Water
1500 (341)	24 in (.61 m)	62 in (1.52 m)	20 in (.51 m)
2000 (454)	26 in (.66 m)	69 in (1.63 m)	23 in (.51 m)
2500 (568)	28 in (.71 m)	75 in (1.73 m)	25.5 in (.51 m)
3000 (681)	30 in (.76 m)	81 in (1.83 m)	27.5 in (.51 m)
3500 (795)	37 in (.94 m)	86 in (2.18 m)	29.5 in (
4000 (908)	39 in (.99 m)	90 in (2.28 m)	31 in (
4500 (1022)	41 in (1.04 m)	94 in (2.39 m)	33 in (

Ditch Maintenance (Continued)

These dimensions are for sloped ditches with slopes of 6 in (152 mm) or greater per mile. For level ditches the depth of ditch needs to be increased by 6 in (152 mm) and the width increased by 12 in (305 mm). These dimensions would still allow 20% freeboard to be designed into the depth of the ditch and water depth. To maintain the minimum depth of 20 in (0.51 m) in level ditch situations, the control depth would be as follows for 1 mile (1609.34 m) runs:

	Control Depth
1500 GPM (340 m3/hr)	22 in (0.56 m)
2000 GPM (454 m3/hr)	24 in (0.61 m)
2500 GPM (568 m3/hr)	26 in (0.66 m)
3000 GPM (681 m3/hr)	28 in (0.71 m)

NOTE

- **That the minimum depth must be maintained so that the intake of the lateral doesn't pump air. Increasing the base width doesn't change the required minimum depth. It does increase the flow capabilities of the ditch.**

Construction

The following are suggestions for construction of concrete ditch linings, taken from the ASAE Standard: ASAE S289. (Note - Spoil the top soil, build a road and cut the ditch.)

The standard thickness for concrete should be at least 2.5 in (63.5 mm) and be portland cement, Type I, IA, II, IIA or V. The suggested requirements for mix and strength are as follows:

Climate	Type of Concrete	Compressive Strength lb/In^2	Cement* Content Bags/Yd^3
Mild, annual 20 or less freeze thaw cycles	Non - Air-entrained	3000 (20.7 m Pa)	5.5 (70 bags/m3)
Moderate, annual 20 to 80 freeze thaw cycles	Air-entrained	3000 (20.7 m Pa)	5.75 (7.5 bags/m3)
Severe, annual over 80 freeze thaw cycles	Air-entrained	3500 (24.2 m Pa)	6.5 (8.5 bags/m3)

NOTE

- **For type V portland cement, sulphate-resistant, the cement content is to be increased by 20%.**

For complete details in design and construction see ASASE S289 or your local NRCS office.

Earthen and Lined Ditch Maintenance

If a sloped ditch is used, a movable dam must usually be employed to form a pool where the pump suction is located. Most sloped ditches must be lined to avoid erosion from the flowing water. Sloping ditches also require a constant overflow at the pump suction since it is virtually impossible to balance the water being discharged into the ditch and the variable distance it must flow to the rate at which it is being withdrawn. This constant overflow - plus the sudden overflow that can occur if the linear system and/or pump should sudden shut down - requires that some arrangement be made to handle the water at the end of the ditch.

One technique used is to have a tailwater pit and recirculatory pump to recirculate the overflow water to the uphill end of the ditch, or to other irrigation systems.

A tailwater pit should be of sufficient capacity to store all the water that might flow into it until the water source can be shut down, or some other provision must be made to dispose of the excess water.

Sloped Ditch/No Control

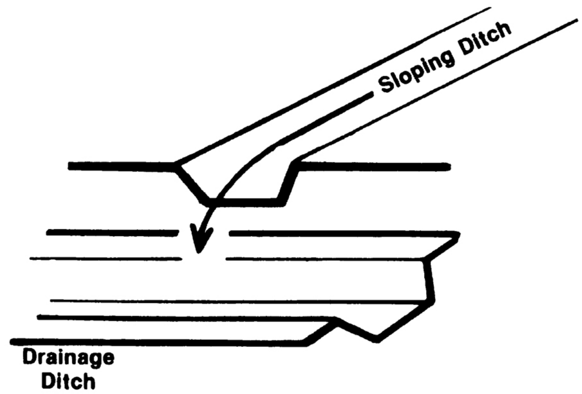
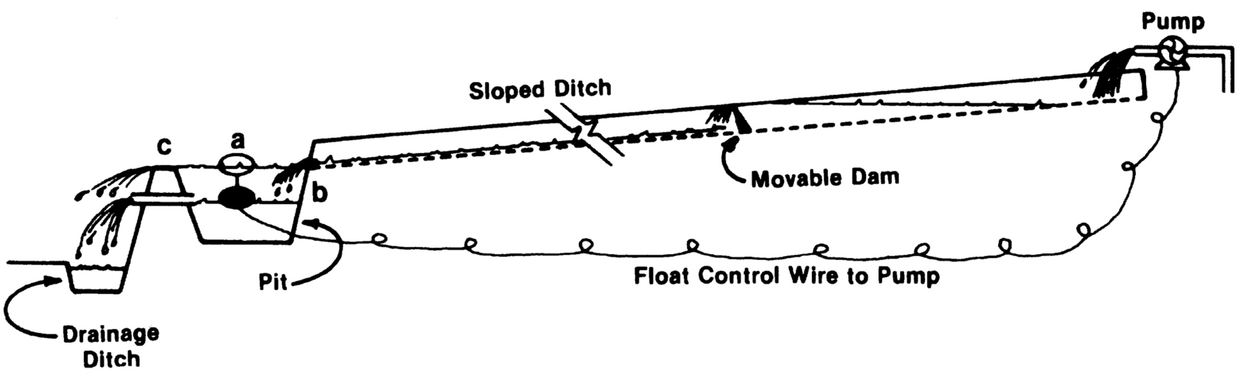


Figure 2-13-1

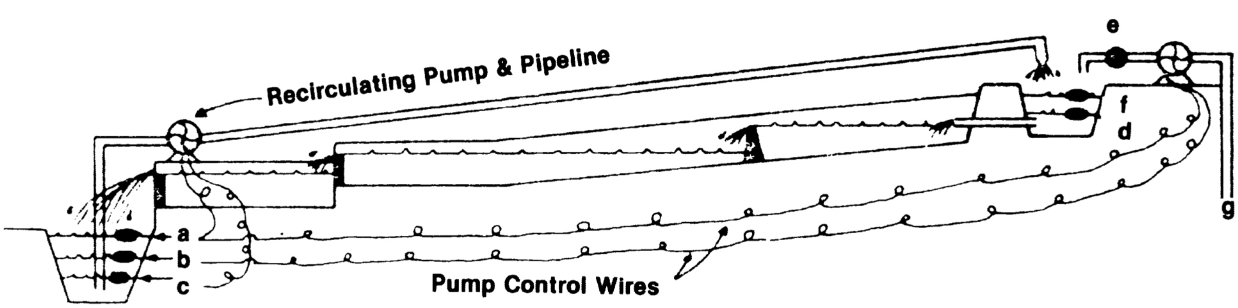
Sloped Ditch/Surge Pit/Pump Control



(a) Float control shuts off pump when water level exceeds normal drainage level.

(b) Normal drainage level from normal overflow past movable dam.

(c) Although pump will be shut off when level 'a' is reached, water will continue to flow out of the ditch. The pit acts as a surge tank, and/or an overflow for the pit can be provided.



Sloped or Stepped Ditch/Recirculating Control

(a) Overflow storage level in tailwater pit - everything shut off.

(b) Float control shuts off main water source **g**.

(c) Float control turns on recirculating pump.

(d) Float control opens electric valve and/or throttle on main water source.

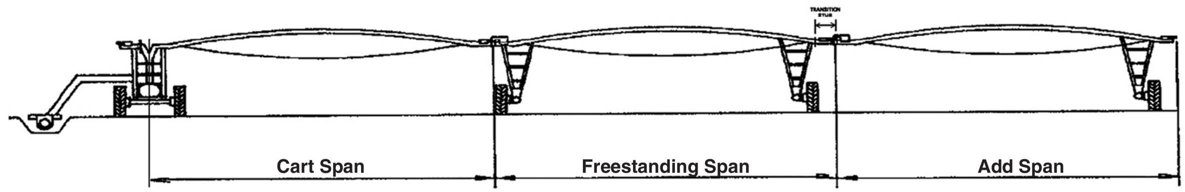
(e) Electric or throttle control on main water source.

(f) Float control is closing or has closed main source valve since recirculating pump is providing some of the water.

Rainger Linear Ditch Feed

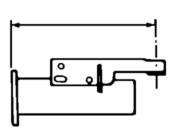
Span Layout and Tower Location Chart

(4-Wheel Cart and Swing Around)



ALL SPAN LENGTH DIMENSIONS ARE BALL TO BALL -

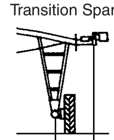
Pipe Diameter		Cart Span		Add Spans		Free Standing Without Transition		Transition Spans**		Outer Spacing Inches			Weight (Wet)		Span Crop Clearance		Overhang	
in	mm	ft	m	ft	m	ft	m	ft	m	108	90	30	lbs	kgs	ft	m	ft	m
MODEL 8000 SPANS																		
10	254	114.2	34.82	112.8	34.38	112.8	34.38	112.5	34.30				7328	3324	9.5	2.90	2.5	0.76
10	254	116.6	35.55	115.2	35.11	115.2	35.11	114.9	35.03				7462	3385	9.6	2.93	9	2.74
10	254	121.5	37.04	120.1	36.60	120.1	36.60	119.8	36.53				7716	3500	9.3	2.83	18	5.48
10	254	136.7	41.66	135.2	41.22	135.2	41.22	135.0	41.14				8503	3857	9.3	2.83	27	8.22
10	254	141.5	43.12	140.0	42.68	140.0	42.68	139.8	42.60				8752	3970	9.6	2.93	36	10.97
10	254	161.5	49.23	160.1	48.80	160.1	48.80	159.8	48.72				9788	4440	9.3	2.83	45	13.71
8 5/8	219	116.6	35.55	114.9	35.03	114.9	35.03	114.9	35.03				6311	2863	9.6	2.93	54	16.46
8 5/8	219	136.7	41.66	135.0	41.14	135.0	41.14	135.0	41.14				7151	3244	9.2	2.80	64	19.51
8 5/8	219	141.5	43.12	139.8	42.60	139.8	42.60	139.8	42.60				7352	3335	9.5	2.90	73	22.25
8 5/8	219	161.5	49.23	159.8	48.71	159.6	48.63	159.8	48.72				8084	3667	9.0	2.74	82	24.99
8 5/8	219	181.6	55.35	179.9	54.83	179.9	54.83	179.9	54.83				9024	4093	8.9	2.71	100.4	30.60
6 5/8	168	116.6	35.55	115.2	35.11	115.2	35.11						4884	2215	10.0	3.05		
6 5/8	168	136.7	41.66	135.2	41.22	135.2	41.22						5475	2483	10.0	3.05		
6 5/8	168	141.5	43.12	140.0	42.68	140.0	42.68						5616	2547	10.0	3.05		
6 5/8	168	161.5	49.23	160.1	48.80	160.1	48.80						6204	2817	10.0	3.05		
6 5/8	168	181.6	55.35	180.2	54.91	180.2	54.91						6792	3081	9.5	2.90		
6 5/8	168	186.4	56.81	184.9	56.37	184.9	56.37						6933	3145	9.5	2.90		
6 5/8	168	188.3	57.38	186.8	56.94	186.8	56.94						6989	3145	9.5	2.90		
6 5/8	168	206.4	62.92	205.0	62.48	205.0	62.48						7524	3145	9.3	2.83		
MODEL 800E (HALF PIPE)																		
10	254			112.5	34.29								7328	3324	9.5	2.90	2.5	0.76
10	254			135.2	41.20								8503	3857	9.3	2.83	9	2.74
8 5/8	219	136.7	41.66	135.2	41.22	135.2	41.22	135.0	41.14				7212	3271	9.1	2.77	18	5.49
8 5/8	219	159.1	48.51	157.7	48.07	157.7	48.07	157.4	47.99				8154	3698	9.3	2.83	27	8.23
8 5/8	219	181.6	55.35	180.2	54.91	180.2	54.91	179.9	54.83				9030	3080	9.5	2.90	36	10.97
6 5/8	168	136.7	41.66	135.2	41.22	135.2	41.22						5475	2483	10.0	3.04	45	13.72
6 5/8	168	159.1	48.51	157.7	48.07	157.7	48.07						6131	2780	10.0	3.04	54	16.46
6 5/8	168	181.6	55.35	180.2	54.91	180.2	54.91						6792	3080	9.5	2.90	64	19.51
6 5/8	168	204.0	62.19	202.6	61.75	202.6	61.75						7454	3379	9.5	2.90	73	22.25
																	82	24.99
																	100	30.48
MODEL 8120 SPANS										113		75.5						
10	254	110.7	33.74	109.7	33.44	109.7	33.44	108.8	33.17				7182	3258	8.2	2.50	2.5	0.76
10	254	120.8	36.83	119.9	36.53	119.9	36.53	119.0	36.26				7711	3498	8.4	2.56	9	2.74
10	254	128.7	39.23	127.7	38.94	127.7	38.94	126.9	38.67				8120	3683	8.4	2.56	18	5.49
8 5/8	219	143.7	43.81	142.3	43.37	142.3	43.37	142.0	43.29				7512	3405	9.8	2.99	27	8.23
8 5/8	219	162.6	49.56	161.2	49.12	161.2	49.12	161.2	49.12				8311	3767	9.6	2.93	36	10.97
8 5/8	219	181.5	55.32	180.0	54.88	180.0	54.88	180.0	54.88				9030	3084	9.4	2.86	45	13.72
6 5/8	168	143.7	43.81	142.3	43.37	142.3	43.37						5684	2576	9.8	2.99	54	16.46
6 5/8	168	162.6	49.56	161.2	49.12	161.2	49.12						6239	2828	9.6	2.93	64	19.51
6 5/8	168	181.5	55.32	180.0	54.88	180.0	54.88						6804	3084	9.4	2.86	73	22.25
6 5/8	168	200.4	61.07	198.9	60.63	198.9	60.63						7348	3336	9.4	2.86	82	24.99
																	100	30.48



** Choose type of TRANSITION required:
***Transitions of 0.00' available* OR**
Transition pipes used in conjunction with a last pipe when changing pipe diameters and also on all cart spans for center feeds.
NOTE: Dimension on Transition
NOTE: This transition is not used when going from 6 5/8 in to 6 in pipe or on a 10 in transition. 1.5 ft (.457 m)
TRANSITION PIPE NOT REQUIRED WITH INTERNATIONAL (8120) PIPE SPAN

Outlet Spacing Available

Transition Span



NOTE:

All cart spans have deep trussing which reduces crop clearance

Cart Span requires deep trussing.

Specifications for Linear-Ditch Feed

Inlets Available:

- 12 in (304 mm)
- 14 in (355 mm)
- 16 in (406 mm)

Screens Available:

- 12 in (304 mm) Single screens Capacity up to 1600 GPM (364 m3/hr)
- 12 in (304 mm) Double Screen Capacity up to 3200 GPM (725 m3/hr)
- 14 in (355 mm) Double screen inlet up to 4000 GPM (908 m3/hr) Floating or Rolling-level ditch
- 14 in (355 mm) Double screen inlet up to 3600 GPM (817 m3/hr) Rolling w/ movable dam (limited by ditch)
- 14 in (355 mm) Valmont non self cleaning floating (aluminum) up to 5000 GPM (1,135 m3/hr)
- 16 in (406 mm) Double float inlet sweeping self cleaning
- 16 in (406 mm) Double float inlet sweeping non self cleaning

CONSIDERATIONS FOR ALTITUDE, DITCH CONDITIONS AND CAPACITY, WATER CONDITIONS, AND OTHER FACTORS MAY INCREASE OR REDUCE THE INLET CAPACITY

Self Cleaning Screens Require:

- **50 GPM (11.35 m3/hr) Single Screen at 30 PSI (21 m)**
- **100 GPM (22.70 m3/hr) Double Screen at 30 PSI (21 m)**

The design flow should be considered when choosing a pump from the tables. The Machine Flow should be reduced by the screen cleaning requirement.

Moveable Dam Considerations

The ditch's water requirement may be greater when the machine is moving away from the water source than when it is moving toward the water source.

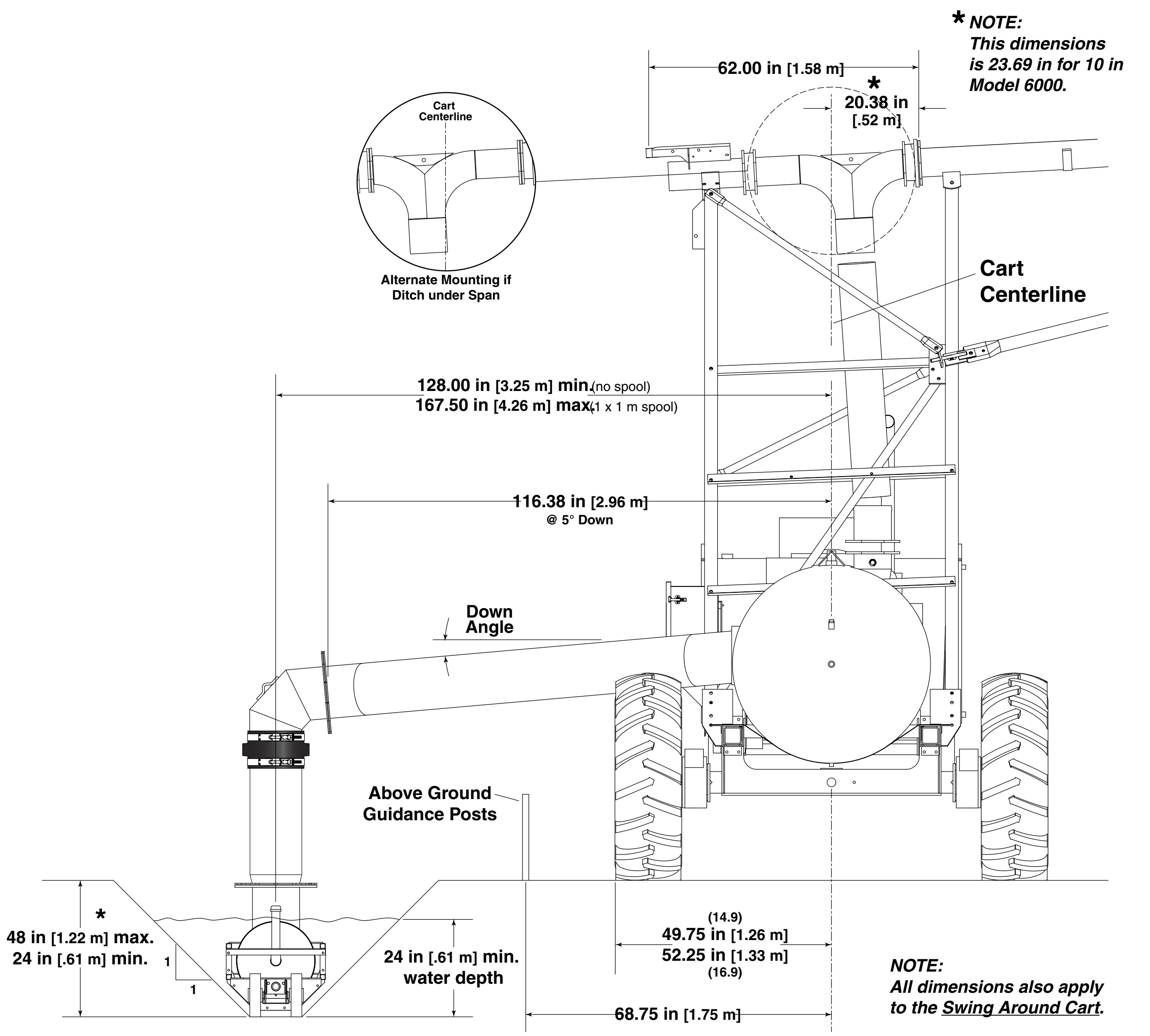
Extension Spools Available:

Concrete Ditch

- Rolling Non Self-Cleaning for 12 in (305 mm) Concrete Ditch
- Rolling Non Self-Cleaning for 24 in (610 mm) Concrete Ditch
- Rolling Self-Cleaning for 12 in (305 mm) Concrete Ditch
- Rolling Self-Cleaning for 24 in (610 mm) Concrete Ditch

Rainger Linear Ditch Feed

14 in and 12 in Rolling Inlet



Ditch Depth Relative to Suction Down Angle

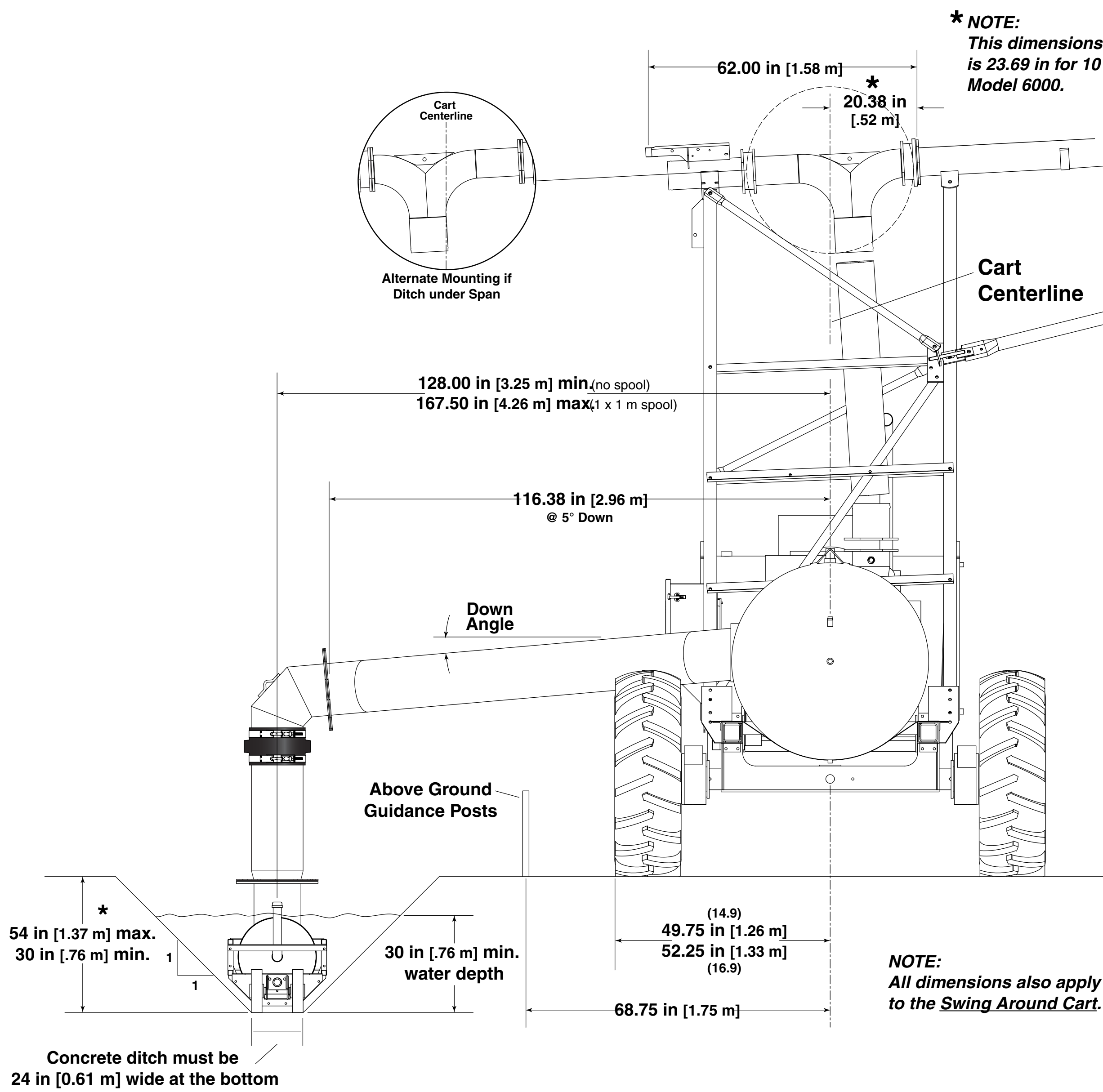
(suction should never be above 0°)

Down Angle	No Horizontal Spool	1m Horizontal Spool
0	23.5	23.5
5	33.0	36.5
10	42.5	49.0
13	48.0	57.0

When using a vertical spool, deeper ditches are possible. Add the spool length to the above values. Maximum vertical spool is 19.69 in (0.5 m).

The above values are for 14.9 in tires on the cart. For 16.9 in tires, substract 2 in from the above values.

16 in Rolling Inlet



Ditch Depth Relative to Suction Down Angle
(suction should never be above 0°)

Down Angle	No Horizontal Spool	1m Horizontal Spool
0	30.0	30.0
5	40.0	43.5
10	49.5	56.3
13	55.0	64.0

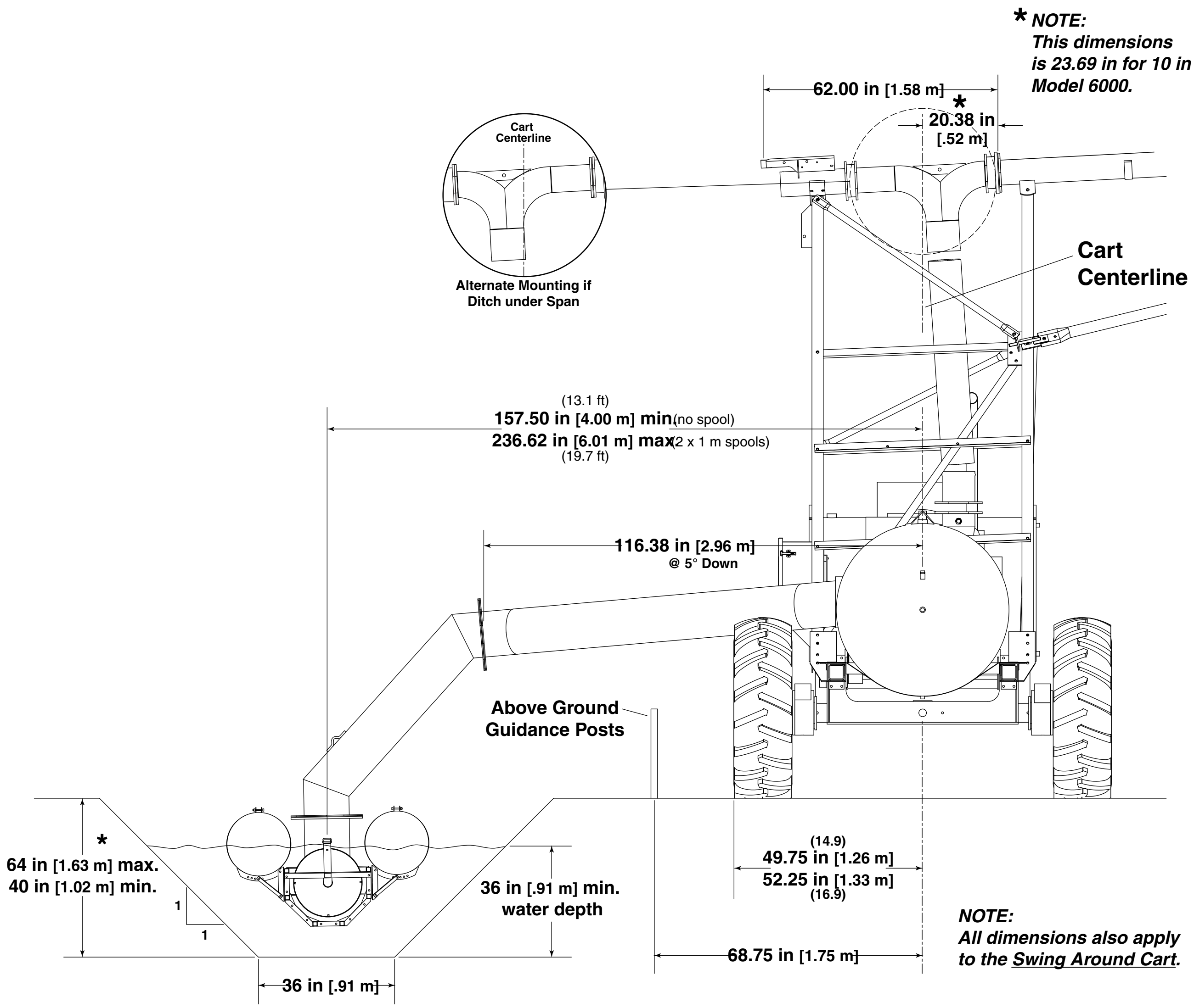
When using a vertical spool, deeper ditches are possible. Add the spool length to the above values. Maximum vertical spool is 19.69 in (0.5 m).

The above values are for 14.9 in tires on the cart. For 16.9 in tires, substract 2 in from the above values.

Rainger Linear Ditch Feed

14 in and 12 in Floating Self-Cleaning and 12 in Non-Self Cleaning Inlet

1:1 Side Slope Dirt Ditch

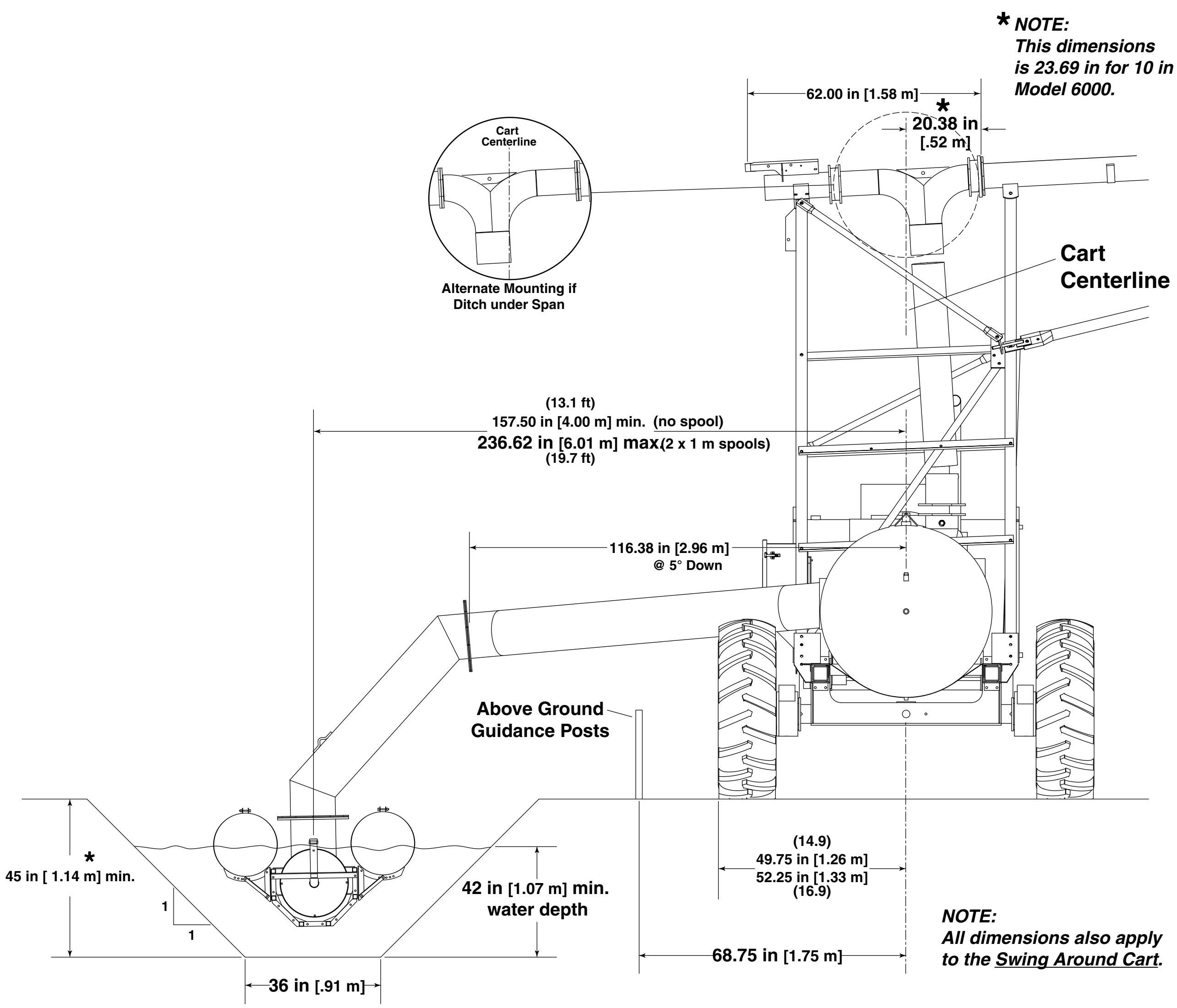


Floating Inlet and Dirt Ditch Dimensions with 1:1 side slopes

* Ditches may be deeper when using a vertical spool pipe above the inlet. Maximum vertical spool length is 19.69 in [.50 m].

16 in Floating Self-Cleaning

1:1 Side Slope Dirt Ditch



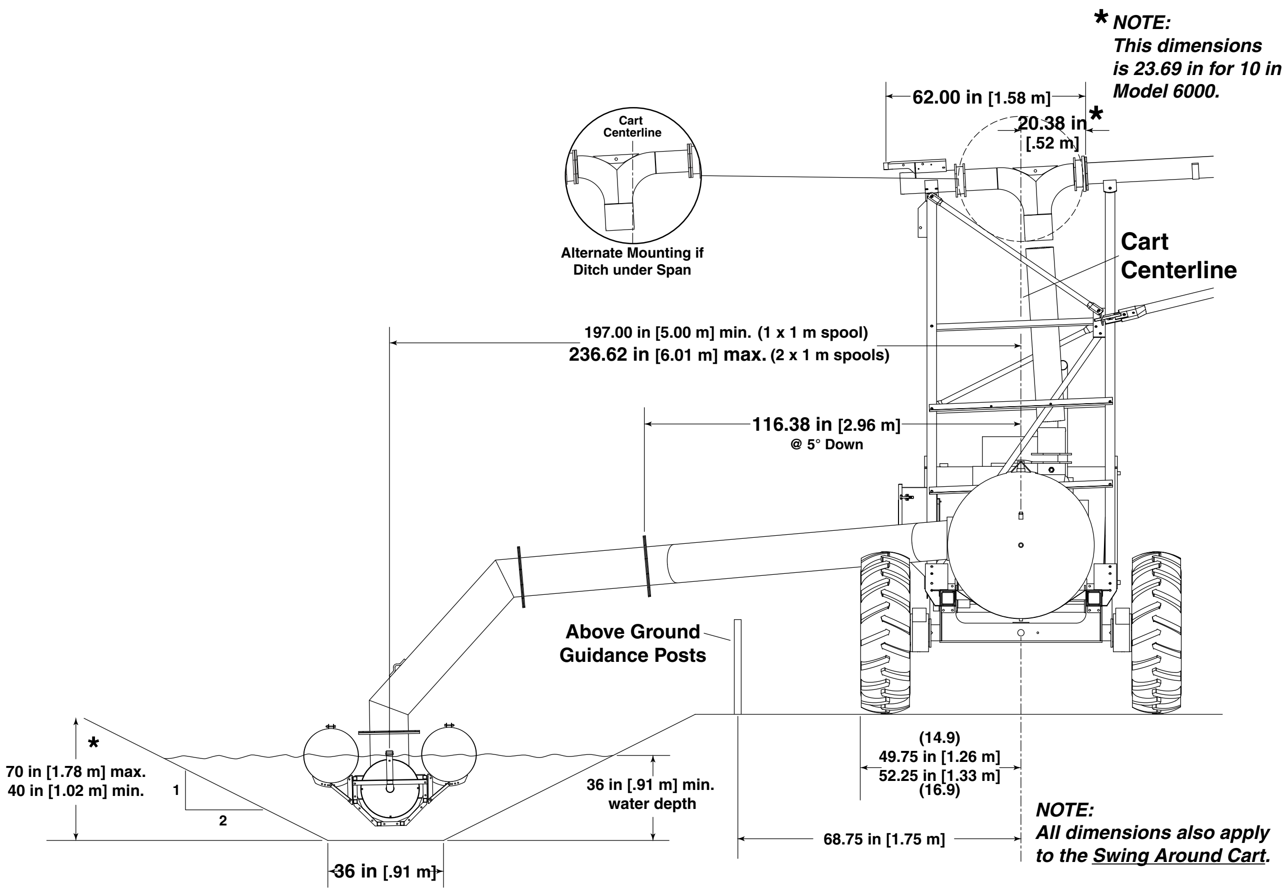
Floating Inlet and Dirt Ditch Dimensions with 1:1 side slopes

* Ditches may be deeper when using a vertical spool pipe above the inlet. Maximum vertical spool length is 19.69 in [.50 m].

Rainger Linear Ditch Feed

14 in and 12 in Floating Self-Cleaning and 12 in Non-Self Cleaning Inlet

2:1 Side Slope Dirt Ditch

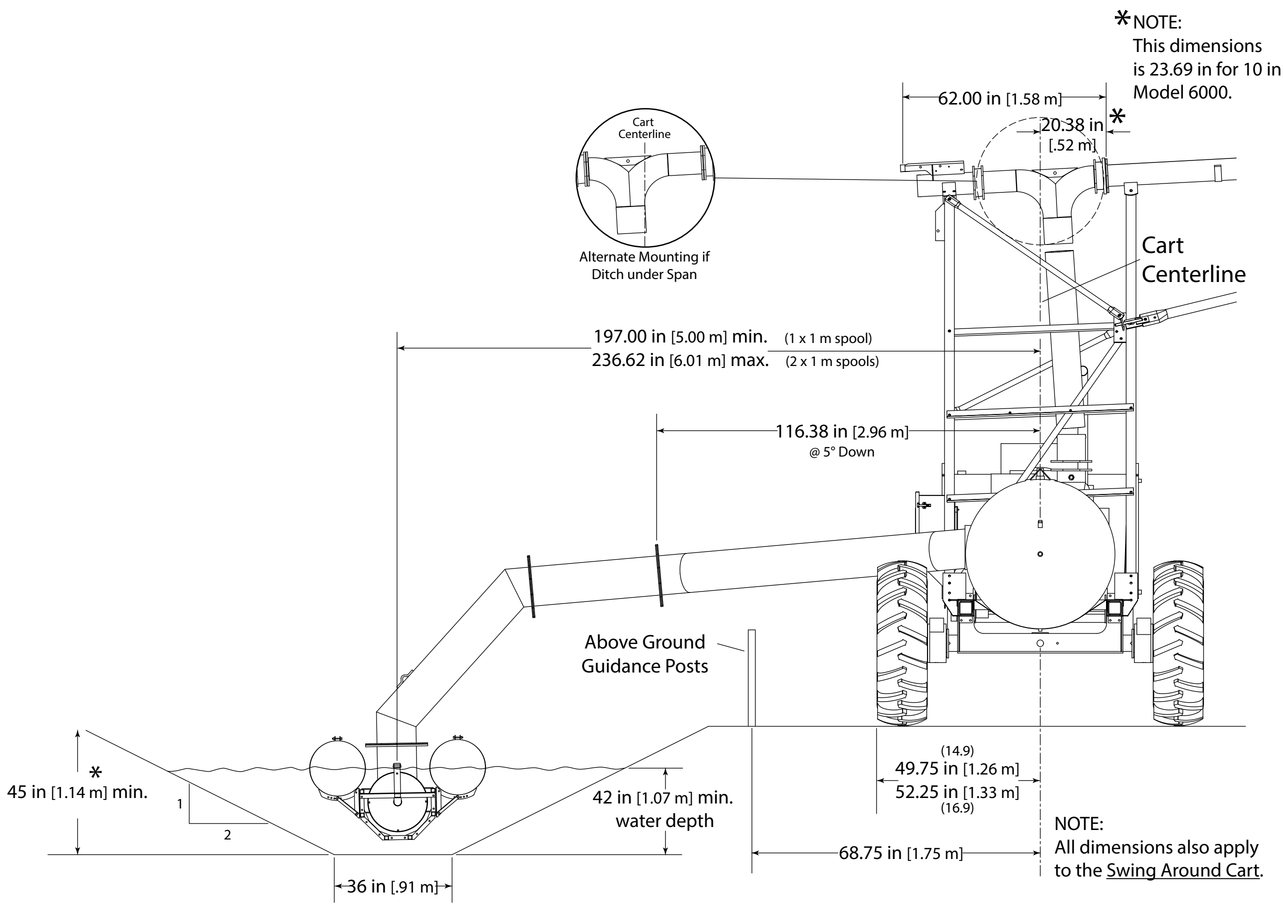


Floating Inlet and Dirt Ditch Dimensions with 2:1 side slopes
1 m (39.2 in) Extension Spool shown

* Ditches may be deeper when using a vertical spool pipe above the inlet. Maximum vertical spool length is 19.69 in [.50 m].

16 in Floating Self-Cleaning

2:1 Side Slope Dirt Ditch



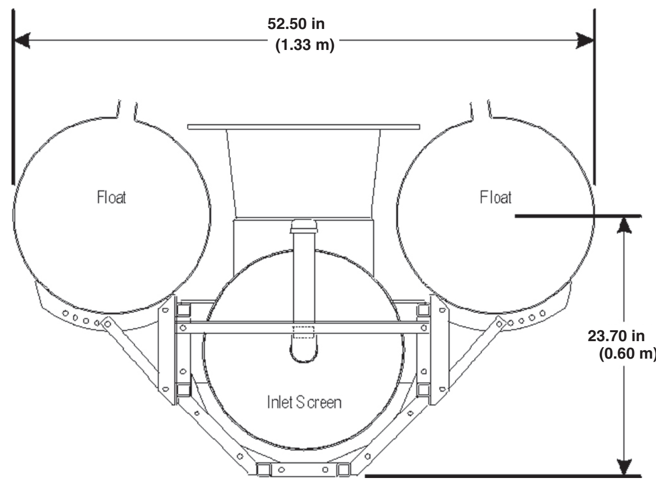
Floating Inlet and Dirt Ditch Dimensions with 2:1 side slopes
1 m (39.2 in) Extension Spool shown

* Ditches may be deeper when using a vertical spool pipe above the inlet. Maximum vertical spool length is 19.69 in [.50 m].

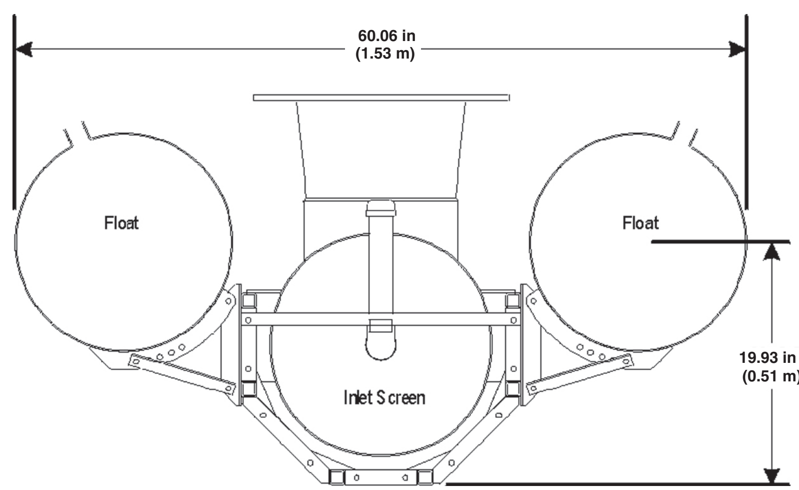
Rainger Linear Ditch Feed

14 in (355 mm) and 12 in (350 mm) Floating Inlets

The floats should be adjusted for optimum suction screen height.



Minimum Width for Floats with Maximum Depth



Maximum Width for Floats with Minimum Depth

NOTE

- **The inlet moves in toward the cart as it moves down. All dimensions are figured with the cart part level with the top of the ditch.**

Extension Spools Available

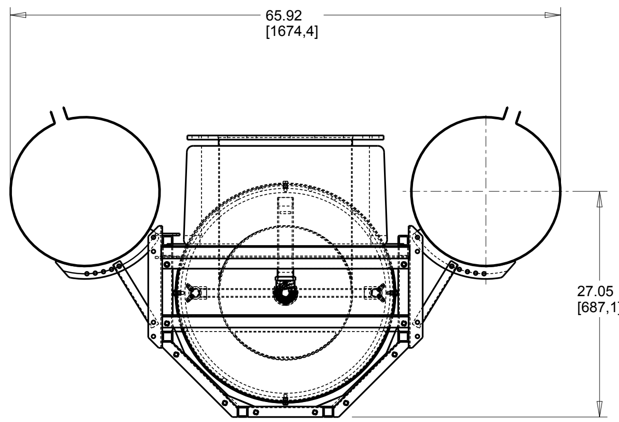
Diameter	Length
12 in (305 mm)	10 in (254 mm)
12 in (305 mm)	20 in (508 mm)
12 in (305 mm)	40 in (1 m)
14 in (356 mm)	10 in (254 mm)
14 in (356 mm)	20 in (508 mm)
14 in (356 mm)	40 in (1 m)

Other spools lengths are available contact Customer Service.

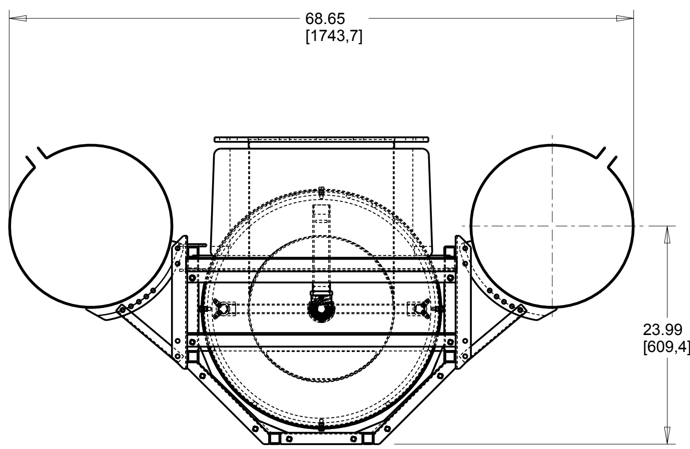
Additional Spools will affect the suction lift and the winch lifting capability.

16 in (406 mm) Floating Inlets

The floats should be adjusted for optimum suction screen height.



Minimum Width for Floats with Maximum Depth



Maximum Width for Floats with Minimum Depth

NOTE

- **The inlet moves in toward the cart as it moves down. All dimensions are figured with the cart part level with the top of the ditch.**

Extension Spools Available

Diameter	Length
16 in (406 mm)	10 in (254 mm)
16 in (406 mm)	20 in (508 mm)
16 in (406 mm)	40 in (1 m)

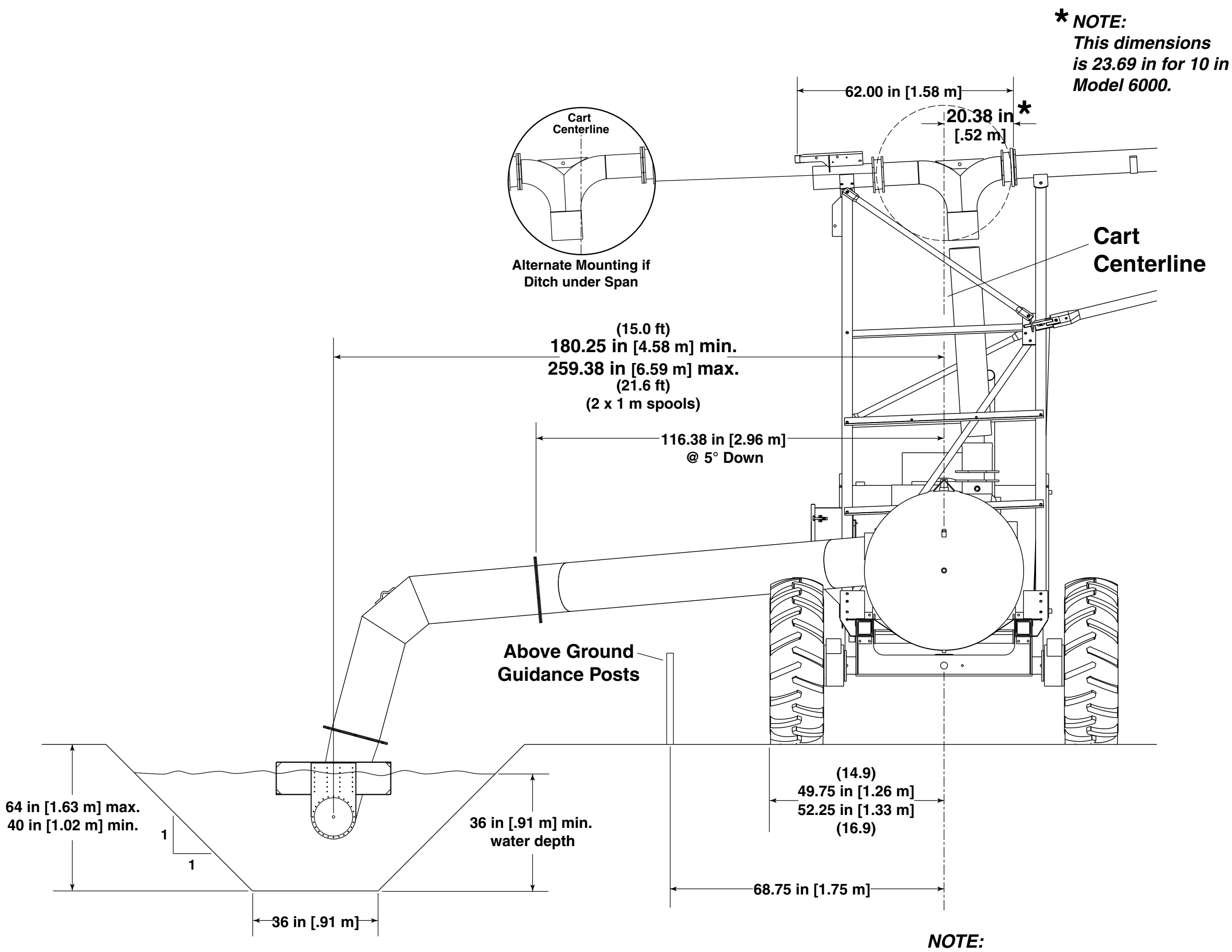
Other spools lengths are available contact Customer Service.

Additional Spools will affect the suction lift and the winch lifting capability.

Rainger Linear Ditch Feed

14 in (355 mm) Floating Non-Self-Cleaning Inlet

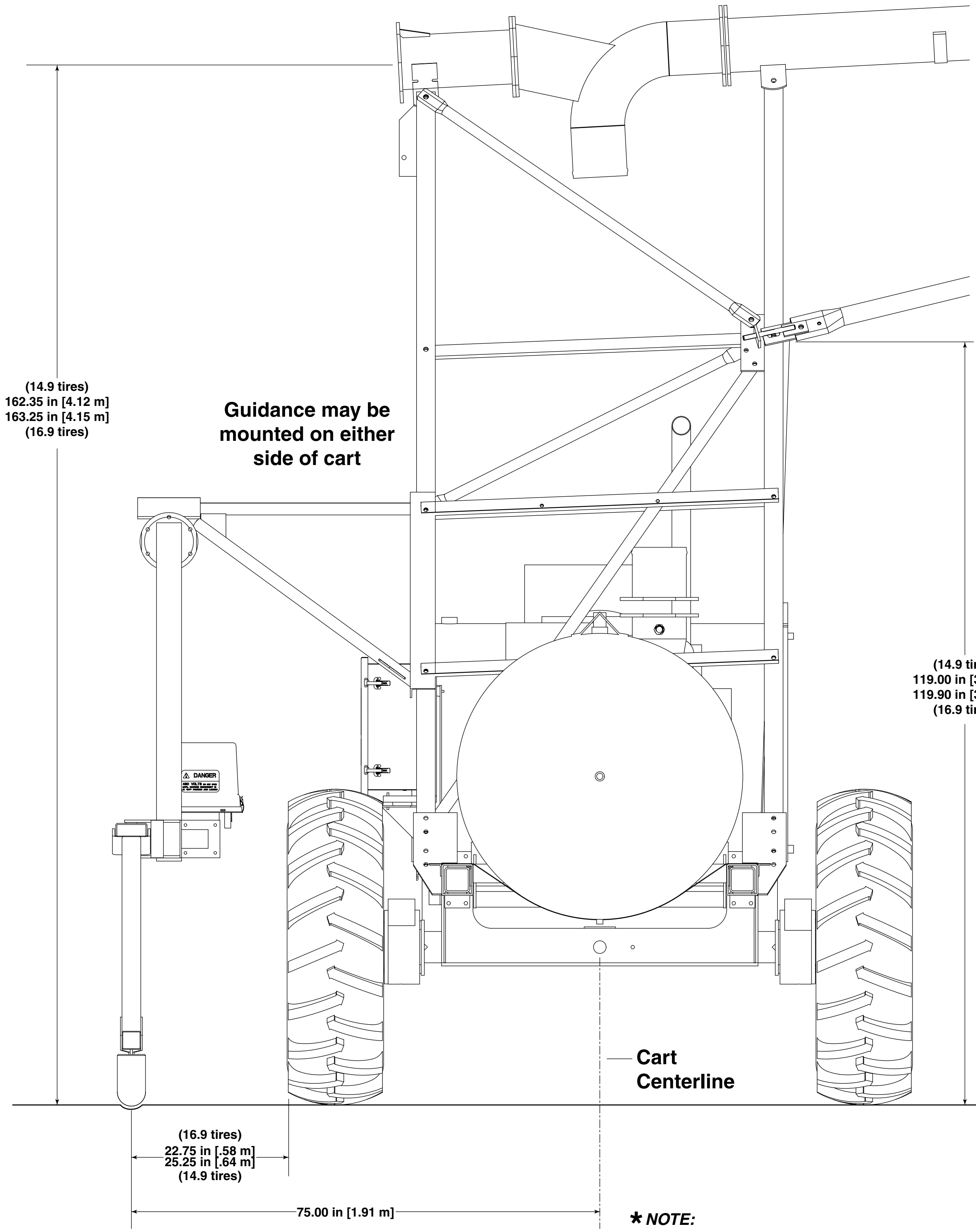
1:1 Side Slope Dirt Ditch



NOTE:
All dimensions also apply to the <u>Swing Around Cart</u>.

Guidance Option Dimensions

Furrow Guidance

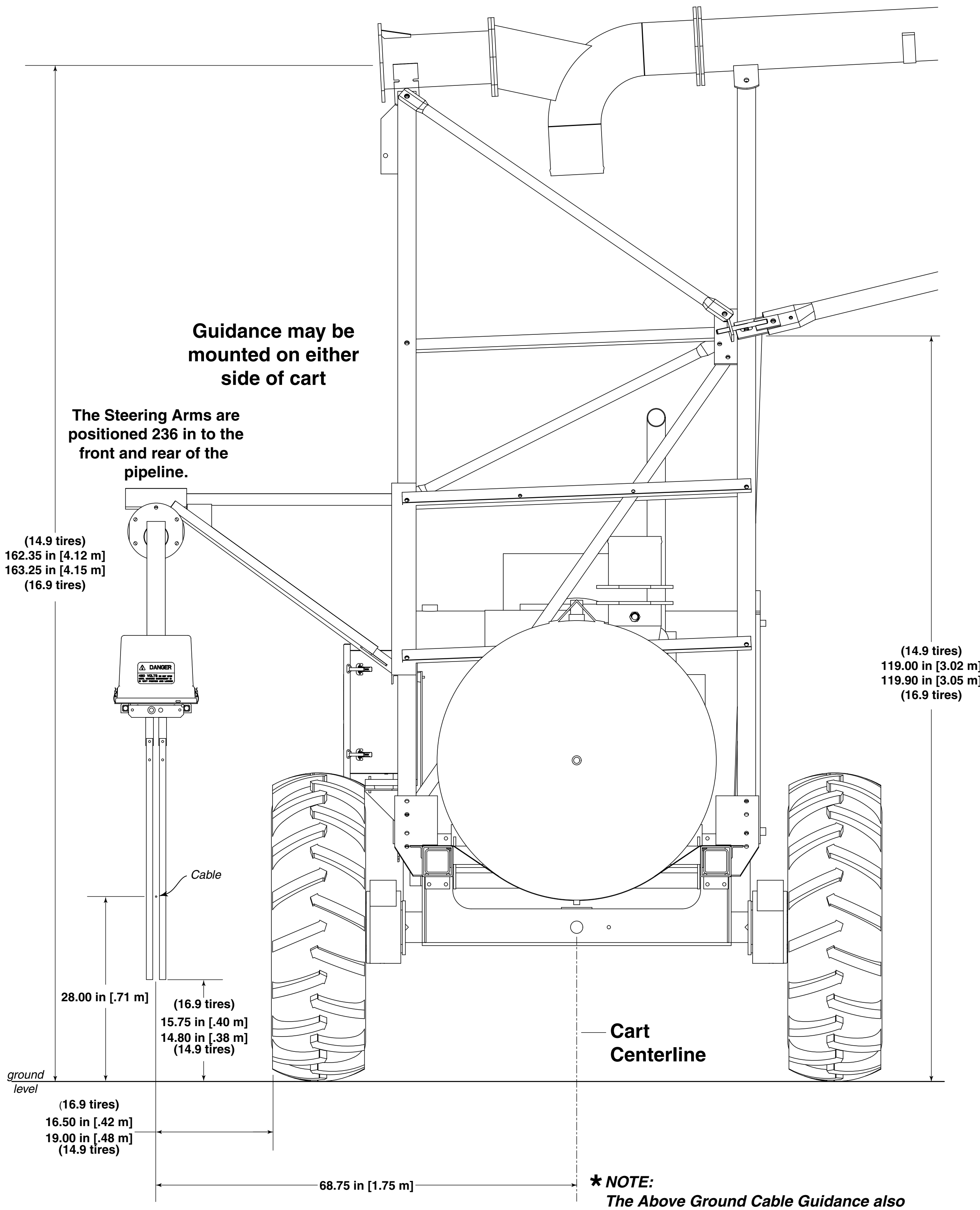


NOTE:
The Furrow Guidance hardware also mounts on the <u>Swing Around Cart</u>.

Rainger Linear Ditch Feed

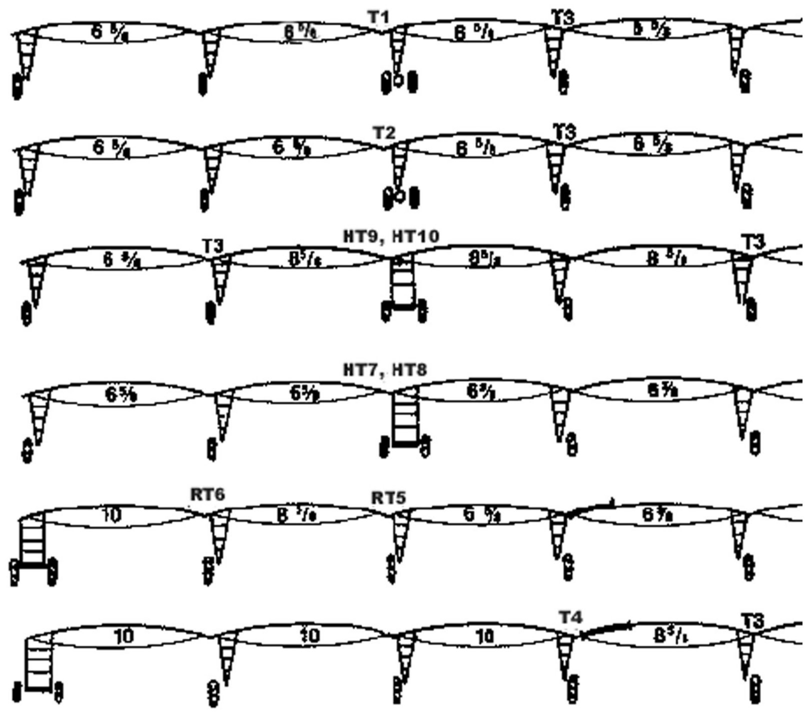
Guidance Option Dimensions

Above Ground Cable Guidance



***NOTE:**
The Above Ground Cable Guidance also mounts on the Swing Around Cart.

Transition Pipe Applications



Hose Drag

Hose Drag

Ditch Center Feed

Ditch Center Feed

Ditch End Feed

Ditch End Feed

The above diagrams depict typical applications of transition pipes. A transition pipe is required any time the cart is part of the centerfeed, any time you change pipe size from 8-5/8 in to 6-5/8 in or 10 in to 8-5/8 in, or a reverse transition pipe in the case of Example 5 on end feed systems.

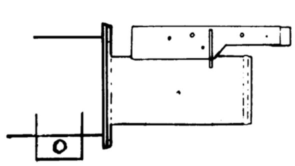
When calculating systems lengths, remember to add 1.5 ft (0.457 m) for standard and reverse transitions.

> **NOTE**
> **•0.00 ft Offset Transition is available.**

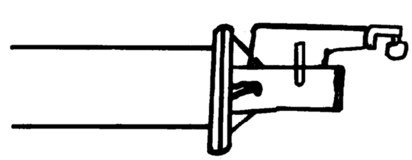
Part numbers for transition pipes:

- T1, 8-5/8 in to 8-5/8 in – 9330005
- T2, 6-5/8 in to 6-5/8 in – 1730255
- T3, 8-5/8 in to 6-5/8 in – 9360013
- T4, 10 in - 8-5/8 in – 9360017
- RT5, 8-5/8 in to 6-5/8 in Reverse – 9330006
- RT6, 10 in - 8-5/8 in Reverse – 9330007

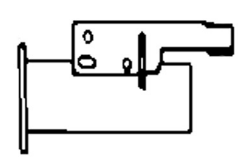
- HT7, 6 5/8 in with Valves 9361183
- HT8, 6 5/8 in without Valves 9361182
- HT9, 8 5/8 in, with Valves 9361180
- HT10, 8 5/8 in, without Valves 9361184



T1, T2, T3, T4
Standard Transitions



RT5 RT6
Reverse Transitions

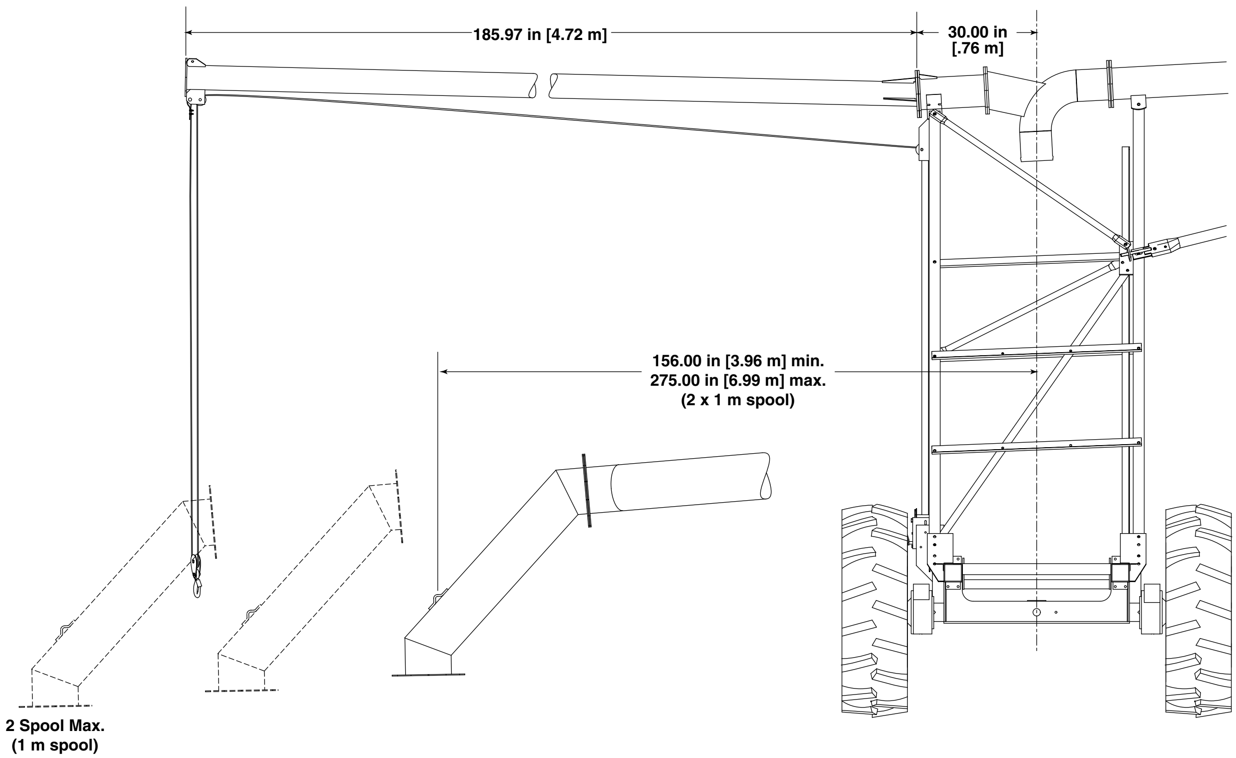


HT7, HT8, HT9, H
Hitch Transitions

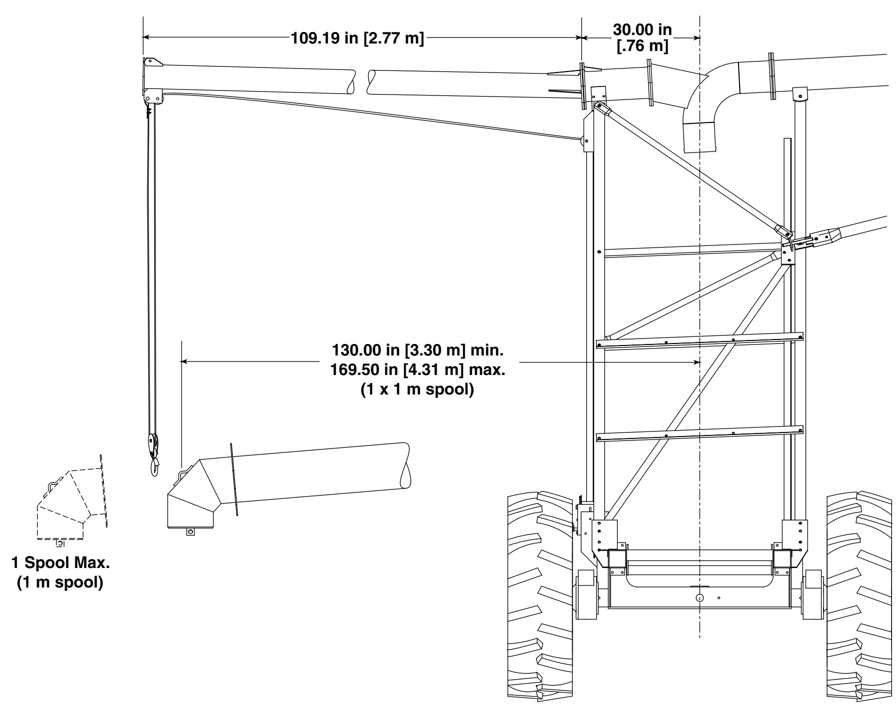
Rainger Linear Ditch Feed

End Feed Suction Lift

All Floating Inlets

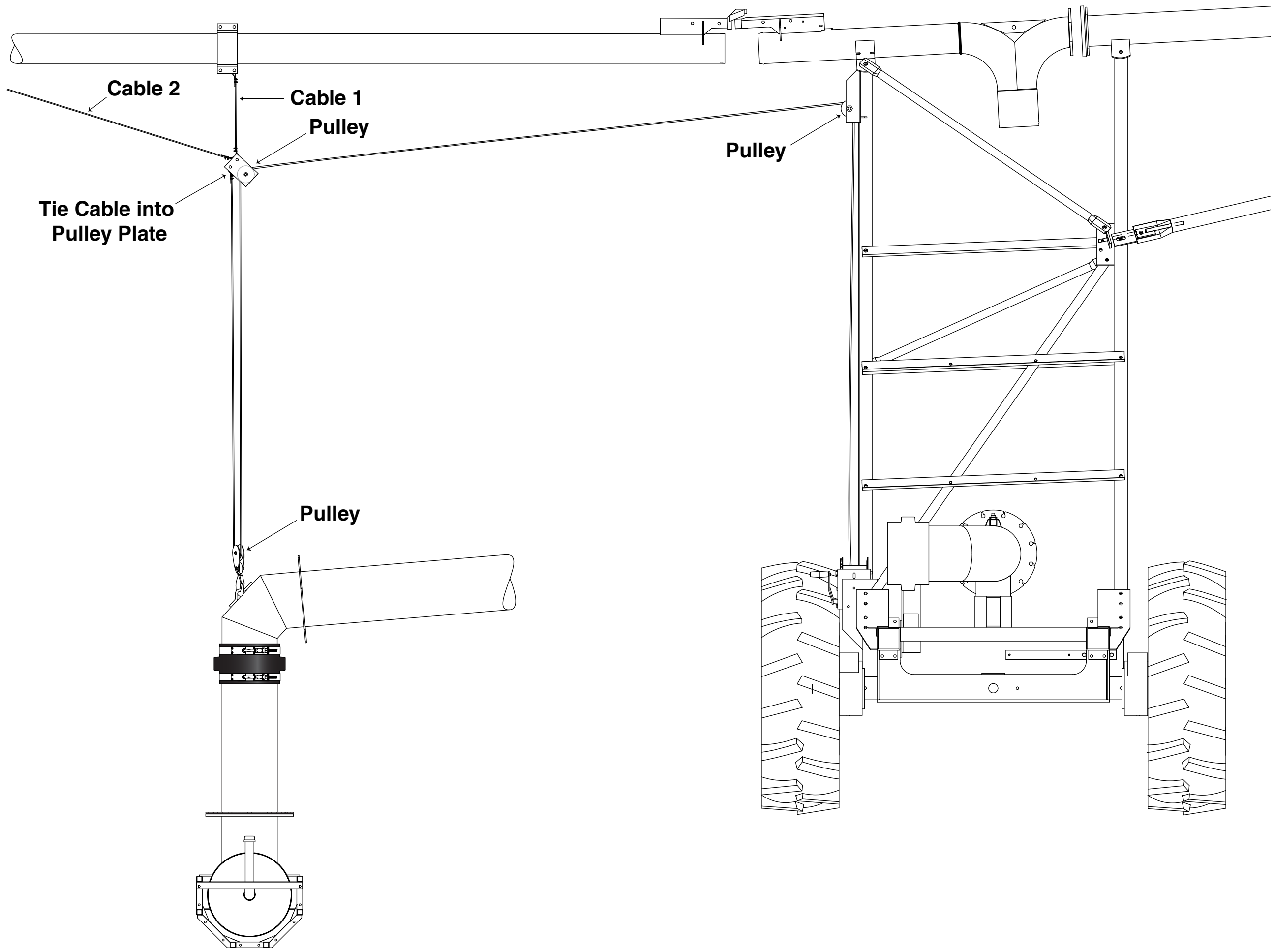


All Rolling Inlets

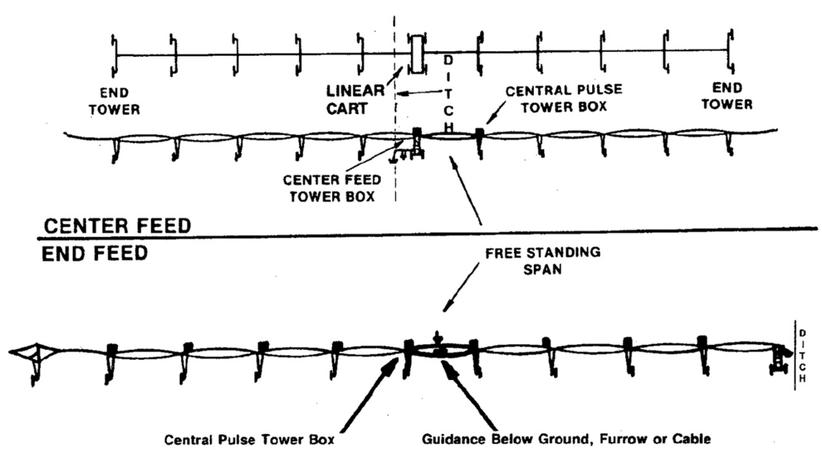


Center Feed Suction Lift

Double Cable Lift



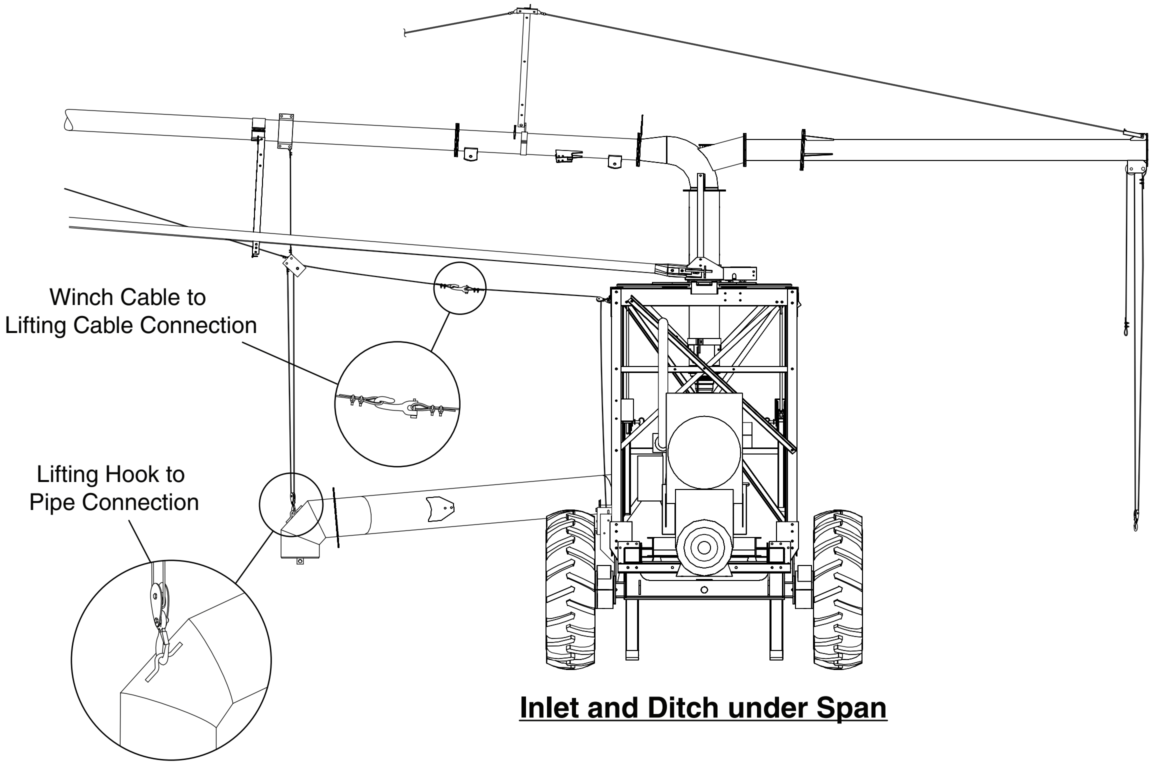
Tower Box Locations



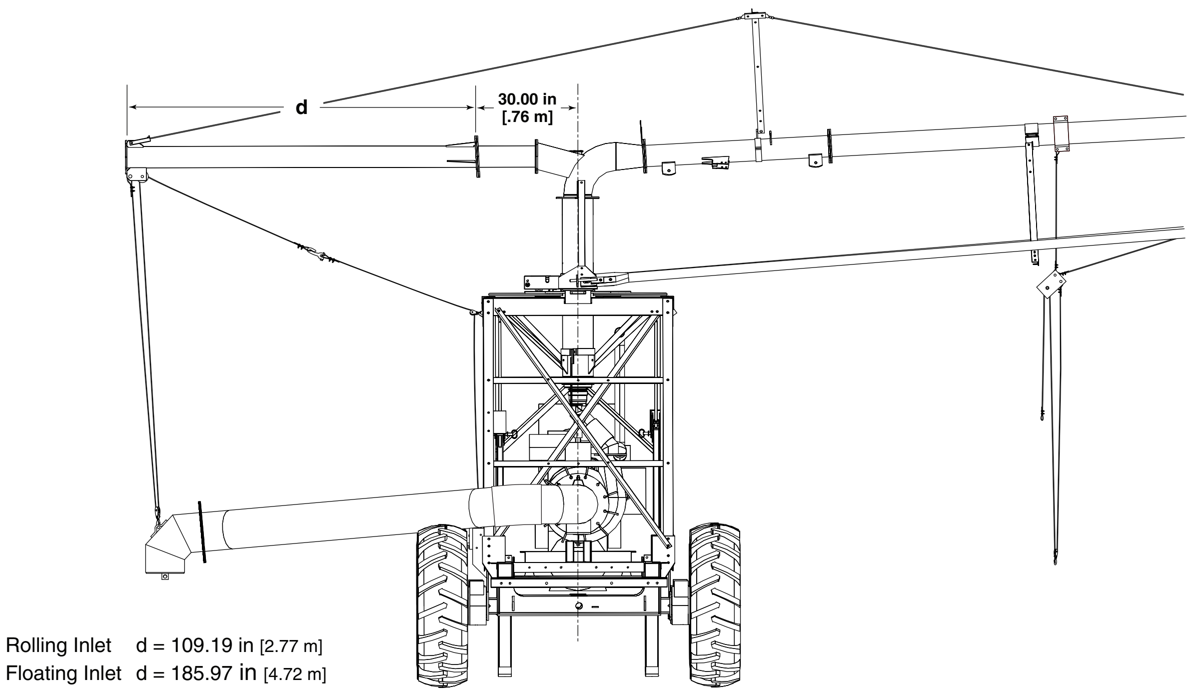
> **NOTE**
>
> **•When guidance is on the center of the machine, the central pulse tower box is mounted on the freestanding span.**

Rainger Linear Ditch Feed

Swing Around Suction Inlet Lifts



Inlet and Ditch under Span



Inlet and Ditch under Overhang

Swing Around Ditch Feed Linears require that the inlet be lifted from either side.

1. Detach the winch cable from the inlet lift cable and the lifting hook from the inlet pipe.
2. Swing machine 180°.
3. In the new position, re-attach the lifting hook to the inlet pipe and the winch cable to the inlet lift cable.

Linear Swing Around Anchors

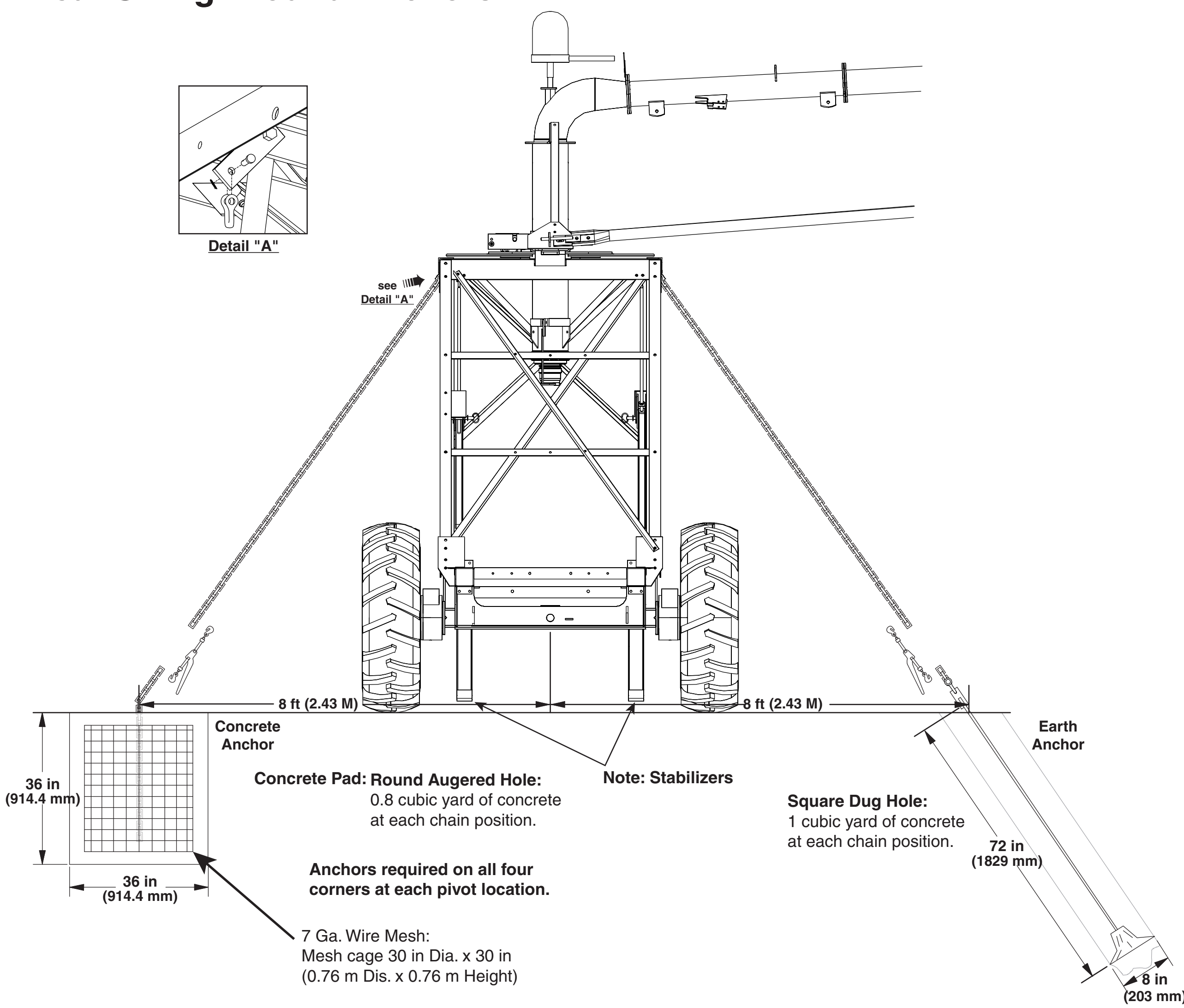


Figure 2-31-1

Swing Around Pivot Point

1. SOC default quantity on anchors is two, if anchors are selected based on system length.
2. Two anchors will be mounted on the tensile side of the cart (side opposite of swinging spans), on both the left and right sides. Additional anchors are available through SOC on at a time, which would be required if swinging at both ends of the field with a machine with more than 6 spans or 1000 ft (305 m).
3. The area around the cart where the machine is to swing around should be flat and in the same plane as the first span.
4. Prior to swinging around, make sure the stabilizers are vertical under the cart and are on solid ground or on another hard surface such as planks, boards, or concrete.
5. For machines greater than 1000 ft or 6 spans in length, anchor chains must be used to tie the cart down. Either earth anchors or concrete anchors may be used. (See Figure 2-31-1.)

Rainger Linear Ditch Feed

Pump Selection

Utilize the total system pressure requirement and refer to the correct pump chart as determined by the following instructions.

1. Decide on the diameter of the system inlet pipe to be used, and if it is an End Feed or Center Feed.
2. Find correct pump chart based on system capacity.

> **NOTE**
>
> **•More than one pump may meet your needs. Table 3 shows which Pump Chart combination corresponds to which requirements. Charts are based on the 12 in (305 mm) inlets and 14 in (356 mm) inlet and either center feed or end feed carts.**

Table 3

PUMP CHART	PUMP	FLOW		MIN PRESSURE		MAX PRESSURE		MAX SUCTION INLET LIFT	
		GPM	M3/HR	PSI	BAR	PSI	BAR	FT	M
A	CORNELL 4RBs OR PIONEER SC64C13	500 1000	113.5 227.1	26 10	1.8 0.7	89 80	6.1 5.5	19.9 14.1	6.07 4.30
B	CORNELL 5RBs OR PIONEER SC66C14	1000 1900	227.1 431.5	41 19	2.8 1.3	97 74	6.7 5.1	18 9.7	5.49 2.96
C	CORNELL 6RBs OR PIONEER SC86C14	1800 3500	408.8 794.9	33 16	2.3 1.1	89 67	6.1 4.6	15.4 6.4	4.69 1.95
D	CORNELL 8H OR PIONEER SC108C17	3300 4000	749.4 908.4	45 29	3.1 2.0	90 77	6.2 5.3	11.0 9.2	3.35 2.80
E	CORNELL 10RB OR PIONEER SC1010C14	3800 5000	863.1 1135.6	26 27	1.8 1.9	76 65	5.2 4.5	10.7 6.0	3.26 1.83

*Refer to pump chart for design information.

3. Locate the pressure (PSI or m) available from the pump chart that most nearly matches the system requirements.
4. Once pressure available is determined, pumping power, RPM, and suction lift can be read from the pump selection chart.

> **NOTE**
>
> **•All these values are at sea level and standard temperature and will need to be further adjusted.**

Elevation

Table 6

ELEVATION - FEET (ft)								
TEMP. F	**SEA LEVEL**	**1000**	**2000**	**3000**	**4000**	**5000**	**6000**	**7000**
70	0.77	-0.43	-1.61	-2.75	-3.85	-4.93	-5.96	-6.97
80	0.44	-0.76	-1.94	-3.08	-4.18	-5.26	-6.29	-7.30
90	0.00	-1.20	-2.38	-3.52	-4.62	-5.70	-6.73	-7.74
100	-0.58	-1.78	-2.96	-4.10	-5.20	-6.28	-7.31	-8.32
120	-2.29	-3.50	-4.67	-5.82	-6.92	-7.99	-9.02	-10.03

ELEVATION - METERS (m)								
TEMP. C	**SEA LEVEL**	**304**	**609**	**914**	**1219**	**1523**	**1828**	**2133**
21	0.23	-0.13	-0.49	-0.84	-1.17	-1.50	-1.82	-2.12
26	0.13	-0.23	-0.59	-0.94	-1.27	-1.60	-1.92	-2.22
32	0.00	-0.37	-0.73	-1.07	-1.41	-1.74	-2.05	-2.36
37	-0.18	-0.54	-0.90	-1.25	-1.58	-1.91	-2.23	-2.54
48	-0.70	-1.07	-1.42	-1.77	-2.11	-2.44	-2.75	-3.06

5. Suction lift capabilities:
   (a) The field suction lift capability must be adjusted for altitude and temperature.
   (b) If a flow meter is going to be used on the suction side of the pump, increase the field suction lift by one foot (305 mm).
   (c) Add the value obtained from Table 6 for the appropriate altitude and temperature adjustment to the field suction lift value.
   (d) Check the pump suction lift against the adjusted field requirement to see if adequate lift is available for the particular field situation.
   (e) If suction lift is not adequate:
      (i) Examine other pump charts for greater suction lift capability at same flow.
      (ii) Consider decreasing distance from minimum water level to the surface the cart tower runs on.
      (iii) Select different management method to reduce flow requirements.
      (iv) Reduce irrigated acreage to reduce flow requirement.
      (v) Redesign system to reduce pressure requirements, and maintain the same flow (applicable only on certain pumps).
6. The pressure loss through the system cart is shown in the Pump Performance Charts on page 2-34.
7. The friction loss in the inlet and Net Positive Suction Head Requirements (NPSHR) per the pumps are shown and included in the Pump Performance Charts on page 2-34.

Rainger Linear Ditch Feed

Pump Performance Charts

Chart A
Cornell 4 RB Pump Performance

CENTERFEED]
END FEED] - PRESSURE (PSI) AVAILABLE AT TOP OF CART (INCLUDES CART ELEVATION AND CART PIPE LOSSES.)

Altitude is assumed to be sea level *
Temperature is assumed to be 90 deg. F. (32.2 deg. C.)*
* See Table 6 on page 2-33 in Pump Selection for lift adjustments for altitude and temperature.

MAXIMUM ALLOWABLE SUCTION LIFT (FT) - IS THE DISTANCE MEASURED FROM BOTTOM OF CART DRIVE UNIT TIRES TO WATER LEVEL

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM					
		1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
500	9 INCHES						
	CENTER FEED (PSI)	26	28	31	33	35	38
	END FEED (PSI)	26	28	30	33	35	37
	PUMP (WATER) hp	12	13	14	15	16	17
	PUMP EFF.	77.6%	77.2%	76.7%	76.3%	75.8%	75.4%
	12 IN ALUMINUM INLET - FT LIFT	20.6	20.1	19.6	19.1	18.6	18.1
	12 IN SINGLE INLET - FT LIFT	20.6	20.1	19.6	19.2	18.7	18.2
	10 INCHES						
	CENTER FEED (PSI)	35	38	41	44	47	50
	END FEED (PSI)	35	38	41	44	47	50
	PUMP (WATER) hp	16	17	18	19	21	22
	PUMP EFF.	77.5%	77.0%	76.5%	76.0%	75.4%	74.9%
	12 IN ALUMINUM INLET - FT LIFT	20.6	20.1	19.6	19.1	18.6	18.1
	SUCTION 12 IN SINGLE INLET - FT LIFT	20.6	20.1	19.6	19.2	18.7	18.2
	10.75 INCHES						
	CENTER FEED (PSI)	44	47	51	54	57	60
	END FEED (PSI)	44	47	50	53	57	60
	PUMP (WATER) hp	19	20	22	23	25	26
	PUMP EFF.	76.4%	75.8%	75.1%	74.5%	73.8%	73.2%
	12 IN ALUMINUM INLET - FT LIFT	20.6	20.1	19.6	19.1	18.6	18.1
	SUCTION 12 IN SINGLE INLET - FT LIFT	20.6	20.1	19.6	19.2	18.7	18.2
	11.75 INCHES						
	CENTER FEED (PSI)	55	59	63	67	71	75
	END FEED (PSI)	55	59	63	67	71	75
	PUMP (WATER) hp	24	26	28	30	32	34
	PUMP EFF.	73.7%	73.0%	72.3%	71.6%	70.9%	70.2%
	12 IN ALUMINUM INLET - FT LIFT	20.6	20.1	19.6	19.1	18.6	18.1
	SUCTION 12 IN SINGLE INLET - FT LIFT	20.6	20.1	19.6	19.2	18.7	18.2
	12.75 INCHES						
	CENTER FEED (PSI)	67	71	76	80	85	89
	END FEED (PSI)	67	71	76	80	85	89
	PUMP (WATER) hp	30	32	34	36	39	41
	PUMP EFF.	71.7%	70.9%	70.0%	69.1%	68.3%	67.4%
	12 IN ALUMINUM INLET - FT LIFT	20.6	20.1	19.6	19.1	18.6	18.1
	SUCTION 12 IN SINGLE INLET - FT LIFT	20.6	20.1	19.6	19.2	18.7	18.2

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM					
		1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
600	9 INCHES						
	CENTER FEED (PSI)	24	27	29	31	34	36
	END FEED (PSI)	24	26	29	31	33	36
	PUMP (WATER) hp	13	14	15	17	18	19
	PUMP EFF.	80.4%	80.1%	79.7%	79.3%	79.0%	78.6%
	12 IN ALUMINUM INLET - FT LIFT	20.7	20.0	19.5	19.0	18.5	18.0
	SUCTION 12 IN SINGLE INLET - FT LIFT	20.8	20.1	19.6	19.1	18.6	18.1
	10 INCHES						
	CENTER FEED (PSI)	34	37	40	43	45	48
	END FEED (PSI)	34	37	39	43	45	48
	PUMP (WATER) hp	17	19	20	22	23	24
	PUMP EFF.	80.9%	80.4%	80.0%	79.5%	79.0%	78.6%
	12 IN ALUMINUM INLET - FT LIFT	20.3	19.9	19.4	18.9	18.5	18.0
	SUCTION 12 IN SINGLE INLET - FT LIFT	20.4	20.0	19.5	19.0	18.6	18.1
	10.75 INCHES						
	CENTER FEED (PSI)	42	46	49	52	55	59
	END FEED (PSI)	42	46	49	52	55	59
	PUMP (WATER) hp	21	23	24	26	28	29
	PUMP EFF.	80.1%	79.6%	79.0%	78.4%	77.9%	77.3%
	12 IN ALUMINUM INLET - FT LIFT	20.5	20.0	19.5	19.0	18.5	18.0
	SUCTION 12 IN SINGLE INLET - FT LIFT	20.6	20.1	19.6	19.1	18.6	18.1
	11.75 INCHES						
	CENTER FEED (PSI)	53	57	61	66	69	74
	END FEED (PSI)	53	57	61	65	69	74
	PUMP (WATER) hp	27	29	31	33	35	37
	PUMP EFF.	77.8%	77.3%	76.7%	76.2%	75.6%	75.1%
	12 IN ALUMINUM INLET - FT LIFT	20.3	19.9	19.4	18.9	18.5	18.0
	SUCTION 12 IN SINGLE INLET - FT LIFT	20.4	20.0	19.5	19.0	18.6	18.1
	12.75 INCHES						
	CENTER FEED (PSI)	66	70	75	79	86	89
	END FEED (PSI)	66	70	75	79	85	88
	PUMP (WATER) hp	34	35	38	40	44	45
	PUMP EFF.	75.0%	75.7%	74.0%	75.0%	73.0%	73.0%
	12 IN ALUMINUM INLET - FT LIFT	20.3	19.9	19.4	18.9	18.5	18.0
	SUCTION 12 IN SINGLE INLET - FT LIFT	20.4	20.0	19.5	19.0	18.6	18.1

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Valmont test data has been used to adjust the data for system loss and elevation within the system. Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design.

Pump Performance Charts (Continued)

Chart A
Cornell 4RB Pump Performance

CENTERFEED]
END FEED] - PRESSURE (PSI) AVAILABLE AT TOP OF CART (INCLUDES CART ELEVATION AND CART PIPE LOSSES)

Altitude is assumed to be sea level *
Temperature is assumed to be 90 deg. F. (32.2 deg. C.)*
* See Table 6 on page 2-33 in Pump Selection for lift adjustments for altitude and temperature.

MAXIMUM ALLOWABLE SUCTION LIFT (FT) - IS THE DISTANCE MEASURED FROM BOTTOM OF CART DRIVE UNIT TIRES TO WATER LEVEL

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM					
		1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
700	9 INCHES						
	CENTER FEED (PSI)	21	24	26	28	31	33
	END FEED (PSI)	21	23	26	28	31	33
	PUMP (WATER) hp	14	15	17	18	19	20
	PUMP EFF.	80.0%	80.1%	80.0%	80.0%	80.0%	80.1%
	12 IN ALUMINUM INLET - FT LIFT	19.7	19.3	18.9	18.6	18.2	17.8
	SUCTION 12 IN SINGLE INLET - FT LIFT	19.8	19.4	19.1	18.7	18.3	18.0
	10 INCHES						
	CENTER FEED (PSI)	32	34	38	40	43	46
	END FEED (PSI)	32	34	38	40	43	46
	PUMP (WATER) hp	19	20	22	23	25	26
	PUMP EFF.	82.1%	81.8%	81.5%	81.3%	81.0%	80.8%
	12 IN ALUMINUM INLET - FT LIFT	19.7	19.3	18.9	18.6	18.2	17.8
	SUCTION 12 IN SINGLE INLET - FT LIFT	19.8	19.4	19.1	18.7	18.3	18.0
	10.75 INCHES						
	CENTER FEED (PSI)	40	43	47	50	53	57
	END FEED (PSI)	40	43	47	50	53	57
	PUMP (WATER) hp	23	25	27	28	30	32
	PUMP EFF.	82.5%	82.1%	81.7%	81.3%	80.9%	80.5%
	12 IN ALUMINUM INLET - FT LIFT	19.7	19.3	18.9	18.6	18.2	17.8
	SUCTION 12 IN SINGLE INLET - FT LIFT	19.8	19.4	19.1	18.7	18.3	18.0
	11.75 INCHES						
	CENTER FEED (PSI)	52	56	59	64	68	72
	END FEED (PSI)	52	56	59	64	68	72
	PUMP (WATER) hp	29	32	34	36	38	41
	PUMP EFF.	81.0%	80.8%	80.0%	80.0%	80.0%	78.4%
	12 IN ALUMINUM INLET - FT LIFT	19.6	19.3	18.9	18.6	18.2	17.7
	SUCTION 12 IN SINGLE INLET - FT LIFT	19.8	19.4	19.1	18.7	18.3	17.9
	12.75 INCHES						
	CENTER FEED (PSI)	64	69	73	78	82	87
	END FEED (PSI)	64	68	73	77	82	87
	PUMP (WATER) hp	36	39	41	44	47	50
	PUMP EFF.	79.6%	79.0%	78.4%	77.8%	77.3%	76.7%
	12 IN ALUMINUM INLET - FT LIFT	20.4	19.2	18.8	18.4	18.0	17.6
	SUCTION 12 IN SINGLE INLET - FT LIFT	20.5	19.3	19.0	18.6	18.2	17.8

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM					
		1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
800	9 INCHES						
	CENTER FEED (PSI)	18	20	23	25	27	30
	END FEED (PSI)	18	20	22	25	27	30
	PUMP (WATER) hp	15	16	17	19	20	21
	PUMP EFF.	77.8%	78.2%	78.6%	79.1%	79.5%	80.0%
	12 IN ALUMINUM INLET - FT LIFT	17.9	17.7	17.5	17.3	17.1	16.9
	SUCTION 12 IN SINGLE INLET - FT LIFT	18.1	17.9	17.7	17.5	17.3	17.1
	10 INCHES						
	CENTER FEED (PSI)	28	31	34	37	40	43
	END FEED (PSI)	28	31	34	37	40	43
	PUMP (WATER) hp	20	21	23	25	26	28
	PUMP EFF.	82.0%	82.1%	82.0%	82.0%	82.0%	82.1%
	12 IN ALUMINUM INLET - FT LIFT	18.5	18.2	17.9	17.5	17.2	16.9
	SUCTION 12 IN SINGLE INLET - FT LIFT	18.7	18.4	18.1	17.7	17.4	17.1
	10.75 INCHES						
	CENTER FEED (PSI)	37	41	44	48	51	55
	END FEED (PSI)	37	40	44	47	51	54
	PUMP (WATER) hp	24	26	28	30	32	35
	PUMP EFF.	84.2%	83.9%	83.5%	83.2%	82.8%	82.5%
	12 IN ALUMINUM INLET - FT LIFT	18.5	18.2	17.9	17.5	17.2	16.9
	SUCTION 12 IN SINGLE INLET - FT LIFT	18.7	18.4	18.1	17.7	17.4	17.1
	11.75 INCHES						
	CENTER FEED (PSI)	50	54	58	62	66	70
	END FEED (PSI)	50	53	57	62	66	69
	PUMP (WATER) hp	32	34	36	39	41	44
	PUMP EFF.	84.0%	83.5%	82.9%	82.4%	81.8%	81.3%
	12 IN ALUMINUM INLET - FT LIFT	18.5	18.2	17.9	17.5	17.2	16.9
	SUCTION 12 IN SINGLE INLET - FT LIFT	18.7	18.4	18.1	17.7	17.4	17.1
	12.75 INCHES						
	CENTER FEED (PSI)	62	66	71	76	81	85
	END FEED (PSI)	61	66	71	76	80	85
	PUMP (WATER) hp	39	42	45	48	51	54
	PUMP EFF.	82.0%	81.6%	81.2%	80.7%	80.2%	79.7%
	12 IN ALUMINUM INLET - FT LIFT	18.5	18.2	17.9	17.5	17.2	16.8
	SUCTION 12 IN SINGLE INLET - FT LIFT	18.7	18.4	18.1	17.7	17.4	17.0

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Valmont test data has been used to adjust the data for system loss and elevation within the system. Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design.

Pump Performance Charts (Continued)

Chart A
Cornell 4RB Pump Performance

CENTERFEED]
END FEED] - PRESSURE (PSI) AVAILABLE AT TOP OF CART (INCLUDES CART ELEVATION AND CART PIPE LOSSES.)

Altitude is assumed to be sea level *
Temperature is assumed to be 90 deg. F. (32.2 deg. C.)*
* See Table 6 on page 2-33 in Pump Selection for lift adjustments for altitude and temperature.

MAXIMUM ALLOWABLE SUCTION LIFT (FT) - IS THE DISTANCE MEASURED FROM BOTTOM OF CART DRIVE UNIT TIRES TO WATER LEVEL.

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM					
		1750 / 1775	1800 / 1825	1850 / 1875	1900 / 1925	1950 / 1975	2000 / 2025
	9 INCHES						
	CENTER FEED (PSI)	15	17	19	22	24	26
	END FEED (PSI)	14	17	19	21	23	26
	PUMP (WATER) hp	15	16	18	19	21	22
	PUMP EFF.	75.4%	75.9%	76.4%	77.0%	77.5%	78.0%
	12 IN ALUMINUM INLET - FT LIFT	16.4	16.1	15.8	15.6	15.3	15.0
	SUCTION 12 IN SINGLE INLET - FT LIFT	16.6	16.3	16.0	15.8	15.5	15.2
	10 INCHES						
	CENTER FEED (PSI)	25	28	31	33	36	39
	END FEED (PSI)	24	27	30	33	36	39
	PUMP (WATER) hp	20	22	24	26	28	29
	PUMP EFF.	80.4%	80.7%	81.0%	81.4%	81.7%	82.0%
	12 IN ALUMINUM INLET - FT LIFT	17.0	16.7	16.4	16.2	15.9	15.6
	SUCTION 12 IN SINGLE INLET - FT LIFT	17.2	16.9	16.6	16.4	16.1	15.8
900	10.75 INCHES						
	CENTER FEED (PSI)	34	38	41	45	48	51
	END FEED (PSI)	34	37	41	44	48	51
	PUMP (WATER) hp	25	28	30	32	34	36
	PUMP EFF.	84.1%	84.1%	84.0%	84.0%	84.0%	84.0%
	12 IN ALUMINUM INLET - FT LIFT	17.1	16.8	16.5	16.3	16.0	15.7
	SUCTION 12 IN SINGLE INLET - FT LIFT	17.3	17.0	16.7	16.5	16.2	15.9
	11.75 INCHES						
	CENTER FEED (PSI)	47	51	55	59	63	68
	END FEED (PSI)	46	51	55	59	63	67
	PUMP (WATER) hp	33	35	38	41	44	46
	PUMP EFF.	85.6%	85.2%	84.8%	84.4%	84.1%	83.7%
	12 IN ALUMINUM INLET - FT LIFT	16.9	16.7	16.5	16.2	16.0	15.7
	SUCTION 12 IN SINGLE INLET - FT LIFT	17.1	16.9	16.7	16.4	16.2	15.9
	12.75 INCHES						
	CENTER FEED (PSI)	59	64	69	74	78	83
	END FEED (PSI)	59	64	68	73	78	83
	PUMP (WATER) hp	41	44	47	51	54	58
	PUMP EFF.	84.3%	83.8%	83.3%	82.8%	82.3%	81.8%
	12 IN ALUMINUM INLET - FT LIFT	16.9	16.7	16.5	16.2	16.0	15.7
	SUCTION 12 IN SINGLE INLET - FT LIFT	17.1	16.9	16.7	16.4	16.2	15.9

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM					
		1750 / 1775	1800 / 1825	1850 / 1875	1900 / 1925	1950 / 1975	2000 / 2025
	9 INCHES						
	CENTER FEED (PSI)	10	12	15	17	19	22
	END FEED (PSI)	10	12	14	17	19	22
	PUMP (WATER) hp	14	16	17	19	20	22
	PUMP EFF.	68.8%	70.2%	71.6%	73.1%	74.5%	75.9%
	12 IN ALUMINUM INLET - FT LIFT	14.2	14.0	13.8	13.6	13.4	13.2
	SUCTION 12 IN SINGLE INLET - FT LIFT	14.5	14.3	14.1	13.9	13.7	13.5
	10 INCHES						
	CENTER FEED (PSI)	21	24	27	29	32	35
	END FEED (PSI)	20	23	26	29	32	35
	PUMP (WATER) hp	21	23	25	26	28	30
	PUMP EFF.	77.5%	78.1%	78.7%	79.4%	80.0%	80.7%
	12 IN ALUMINUM INLET - FT LIFT	15.1	14.9	14.7	14.4	14.2	14.0
	SUCTION 12 IN SINGLE INLET - FT LIFT	15.4	15.2	15.0	14.7	14.5	14.3
1000	10.75 INCHES						
	CENTER FEED (PSI)	31	34	38	41	44	48
	END FEED (PSI)	30	34	37	41	44	47
	PUMP (WATER) hp	26	29	31	33	36	38
	PUMP EFF.	82.1%	82.5%	82.9%	83.3%	83.7%	84.1%
	12 IN ALUMINUM INLET - FT LIFT	15.2	15.0	14.8	14.5	14.3	14.1
	SUCTION 12 IN SINGLE INLET - FT LIFT	15.5	15.3	15.1	14.8	14.6	14.4
	11.75 INCHES						
	CENTER FEED (PSI)	44	47	51	56	60	64
	END FEED (PSI)	43	47	51	55	59	64
	PUMP (WATER) hp	34	37	40	43	45	49
	PUMP EFF.	85.0%	85.2%	85.0%	85.0%	85.0%	85.2%
	12 IN ALUMINUM INLET - FT LIFT	15.0	14.8	14.6	14.4	14.2	14.0
	SUCTION 12 IN SINGLE INLET - FT LIFT	15.3	15.1	14.9	14.7	14.5	14.3
	12.75 INCHES						
	CENTER FEED (PSI)	57	61	66	71	76	80
	END FEED (PSI)	57	60	65	70	75	80
	PUMP (WATER) hp	44	46	50	53	57	61
	PUMP EFF.	85.7%	85.3%	84.9%	84.5%	84.2%	83.8%
	12 IN ALUMINUM INLET - FT LIFT	14.7	14.6	14.5	14.3	14.2	14.0
	SUCTION 12 IN SINGLE INLET - FT LIFT	15.0	14.9	14.8	14.6	14.5	14.3

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Valmont test data has been used to adjust the data for system loss and elevation within the system. Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design.

Pump Performance Charts (Continued)

Chart B
Cornell 5RB Pump Performance

CENTERFEED]
END FEED (PSI)] - PRESSURE (PSI) AVAILABLE AT TOP OF CART (INCLUDES CART ELEVATION AND CART PIPE LOSSES)

Altitude is assumed to be sea level *
Temperature is assumed to be 90 deg. F. (32.2 deg. C.)*
* See Table 6 on page 2-33 in Pump Selection for lift adjustments for altitude and temperature.

MAXIMUM ALLOWABLE SUCTION LIFT (FT) - IS THE DISTANCE MEASURED FROM BOTTOM OF CART DRIVE UNIT TIRES TO WATER LEVEL

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750 / 1775	1800 / 1825	1850 / 1875	1900 / 1925	1950 / 1975	2000 / 2025
1000	11 INCHES						
	CENTER FEED (PSI)	41	44	48	52	55	59
	END FEED (PSI)	41	44	47	51	55	58
	PUMP (WATER) hp	34	36	39	42	45	48
	PUMP EFF.	82.4%	81.9%	81.5%	81.0%	80.6%	80.2%
	12 IN ALUMINUM INLET	18.2	17.6	17.0	16.4	15.8	15.2
	12 IN SINGLE INLET - FT LIFT	18.5	17.9	17.3	16.7	16.1	15.5
	12 IN DOUBLE "T" INLET - FT LIFT	18.6	18.0	17.4	16.8	16.2	15.6
	12 INCHES						
	CENTER FEED (PSI)	54	58	62	66	70	74
	END FEED (PSI)	54	57	61	66	70	74
	PUMP (WATER) hp	43	46	49	53	56	59
	PUMP EFF.	82.5%	81.9%	81.4%	80.8%	80.3%	79.7%
	12 IN ALUMINUM INLET	18.2	17.6	17.0	16.4	15.8	15.2
	12 IN SINGLE INLET - FT LIFT	18.5	17.9	17.3	16.7	16.1	15.5
	12 IN DOUBLE "T" INLET - FT LIFT	18.6	18.0	17.4	16.8	16.2	15.6
	13 INCHES						
	CENTER FEED (PSI)	65	70	75	80	85	89
	END FEED (PSI)	65	70	74	80	84	89
	PUMP (WATER) hp	51	55	59	63	67	71
	PUMP EFF.	81.7%	81.1%	80.5%	79.8%	79.2%	78.5%
	12 IN ALUMINUM INLET	18.2	17.6	17.0	16.4	15.8	15.2
	12 IN SINGLE INLET - FT LIFT	18.5	17.9	17.3	16.7	16.1	15.5
	12 IN DOUBLE "T" INLET - FT LIFT	18.6	18.0	17.4	16.8	16.2	15.6
	13.5 INCHES						
	CENTER FEED (PSI)	71	76	82	87	92	97
	END FEED (PSI)	71	76	81	86	92	97
	PUMP (WATER) hp	56	60	65	69	74	78
	PUMP EFF.	81.2%	80.4%	79.7%	78.9%	78.2%	77.4%
	12 IN ALUMINUM INLET	18.2	17.6	17.0	16.4	15.8	15.2
	12 IN SINGLE INLET - FT LIFT	18.5	17.9	17.3	16.7	16.1	15.5
	12 IN DOUBLE "T" INLET - FT LIFT	18.6	18.0	17.4	16.8	16.2	15.6

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750 / 1775	1800 / 1825	1850 / 1875	1900 / 1925	1950 / 1975	2000 / 2025
1100	11 INCHES						
	CENTER FEED (PSI)	38	42	45	49	53	56
	END FEED (PSI)	38	41	45	49	52	56
	PUMP (WATER) hp	35	34	37	40	42	45
	PUMP EFF.	83.5%	83.2%	82.8%	82.5%	82.1%	81.7%
	12 IN ALUMINUM INLET	17.8	17.3	16.7	16.2	15.6	15.1
	12 IN SINGLE INLET - FT LIFT	18.1	17.6	17.0	16.5	15.9	15.4
	12 IN DOUBLE "T" INLET - FT LIFT	18.2	17.7	17.1	16.6	16.0	15.5
	12 INCHES						
	CENTER FEED (PSI)	51	56	60	64	68	73
	END FEED (PSI)	51	55	60	63	68	72
	PUMP (WATER) hp	45	44	47	50	53	57
	PUMP EFF.	83.8%	83.4%	83.0%	82.6%	82.2%	81.8%
	12 IN ALUMINUM INLET	17.8	17.3	16.7	16.2	15.6	15.1
	12 IN SINGLE INLET - FT LIFT	18.1	17.6	17.0	16.5	15.9	15.4
	12 IN DOUBLE "T" INLET - FT LIFT	18.2	17.7	17.1	16.6	16.0	15.5
	13 INCHES						
	CENTER FEED (PSI)	63	68	73	78	83	88
	END FEED (PSI)	62	67	72	77	82	87
	PUMP (WATER) hp	53	53	56	60	64	68
	PUMP EFF.	83.6%	83.1%	82.5%	82.0%	81.4%	80.9%
	12 IN ALUMINUM INLET	18.1	17.5	16.9	16.3	15.7	15.1
	12 IN SINGLE INLET - FT LIFT	18.4	17.8	17.2	16.6	16.0	15.4
	12 IN DOUBLE "T" INLET - FT LIFT	18.5	17.9	17.3	16.7	16.1	15.5
	13.5 INCHES						
	CENTER FEED (PSI)	69	74	80	85	90	96
	END FEED (PSI)	68	74	79	85	90	95
	PUMP (WATER) hp	59	58	62	66	70	75
	PUMP EFF.	82.8%	82.3%	81.8%	81.3%	80.7%	80.2%
	12 IN ALUMINUM INLET	18.1	17.5	16.9	16.3	15.7	15.1
	12 IN SINGLE INLET - FT LIFT	18.4	17.8	17.2	16.6	16.0	15.4
	12 IN DOUBLE "T" INLET - FT LIFT	18.5	17.9	17.3	16.7	16.1	15.5

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Valmont test data has been used to adjust the data for system loss and elevation within the system. Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design.

Pump Performance Charts (Continued)

Chart B
Cornell 5RB Pump Performance

CENTERFEED]
END FEED (PSI)] - PRESSURE (PSI) AVAILABLE AT TOP OF CART (INCLUDES CART ELEVATION AND CART PIPE LOSSES.)

Altitude is assumed to be sea level*
Temperature is assumed to be 90 deg. F. (32.2 deg. C.)*
* See Table 6 on page 2-33 in Pump Selection for lift adjustments for altitude and temperature.

MAXIMUM ALLOWABLE SUCTION LIFT (FT) - IS THE DISTANCE MEASURED FROM BOTTOM OF CART DRIVE UNIT TIRES TO WATER LEVEL.

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750 / 1775	1800 / 1825	1850 / 1875	1900 / 1925	1950 / 1975	2000 / 2025
1200	11 INCHES						
	CENTER FEED (PSI)	36	40	43	47	50	54
	END FEED (PSI)	35	39	42	46	50	53
	PUMP (WATER) hp	36	39	42	45	48	51
	PUMP EFF.	83.6%	83.5%	83.4%	83.3%	83.2%	83.1%
	12 IN ALUMINUM INLET	17.3	16.8	16.3	15.8	15.3	14.8
	12 IN SINGLE INLET - FT LIFT	17.7	17.2	16.7	16.2	15.7	15.2
	12 IN DOUBLE "T" INLET - FT LIFT	17.7	17.2	16.7	16.2	15.7	15.2
	12 INCHES						
	CENTER FEED (PSI)	49	53	58	62	66	71
	END FEED (PSI)	48	53	57	61	66	70
	PUMP (WATER) hp	47	50	54	58	62	66
	PUMP EFF.	84.3%	84.1%	83.9%	83.7%	83.4%	83.2%
	12 IN ALUMINUM INLET	17.3	16.8	16.3	15.7	15.2	14.7
	12 IN SINGLE INLET - FT LIFT	17.7	17.2	16.7	16.1	15.6	15.1
	12 IN DOUBLE "T" INLET - FT LIFT	17.7	17.2	16.7	16.1	15.6	15.1
	13 INCHES						
	CENTER FEED (PSI)	61	66	70	75	80	85
	END FEED (PSI)	60	65	70	75	80	85
	PUMP (WATER) hp	56	60	65	69	74	78
	PUMP EFF.	85.0%	84.5%	84.0%	83.6%	83.1%	82.7%
	12 IN ALUMINUM INLET	17.9	17.3	16.7	16.1	15.5	14.9
	12 IN SINGLE INLET - FT LIFT	18.3	17.7	17.1	16.5	15.9	15.3
	12 IN DOUBLE "T" INLET - FT LIFT	18.3	17.7	17.1	16.5	15.9	15.3
	13.5 INCHES						
	CENTER FEED (PSI)	67	72	78	83	88	94
	END FEED (PSI)	67	72	77	83	88	93
	PUMP (WATER) hp	62	66	71	76	81	86
	PUMP EFF.	84.4%	83.9%	83.4%	82.9%	82.4%	81.9%
	12 IN ALUMINUM INLET	17.9	17.3	16.7	16.1	15.5	14.9
	12 IN SINGLE INLET - FT LIFT	18.3	17.7	17.1	16.5	15.9	15.3
	12 IN DOUBLE "T" INLET - FT LIFT	18.3	17.7	17.1	16.5	15.9	15.3

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750 / 1775	1800 / 1825	1850 / 1875	1900 / 1925	1950 / 1975	2000 / 2025
1300	11 INCHES						
	CENTER FEED (PSI)	33	37	40	44	48	51
	END FEED (PSI)	33	36	39	43	47	50
	PUMP (WATER) hp	37	40	43	47	50	53
	PUMP EFF.	83.8%	83.7%	83.6%	83.5%	83.5%	83.4%
	12 IN ALUMINUM INLET	16.4	16.0	15.6	15.1	14.7	14.3
	12 IN SINGLE INLET - FT LIFT	16.8	16.4	16.0	15.5	15.1	14.7
	12 IN DOUBLE "T" INLET - FT LIFT	16.8	16.4	16.0	15.5	15.1	14.7
	12 INCHES						
	CENTER FEED (PSI)	47	51	55	59	64	68
	END FEED (PSI)	46	50	55	59	63	67
	PUMP (WATER) hp	48	52	56	60	64	68
	PUMP EFF.	85.1%	84.8%	84.6%	84.3%	84.1%	83.9%
	12 IN ALUMINUM INLET	16.8	16.3	15.8	15.3	14.8	14.3
	12 IN SINGLE INLET - FT LIFT	17.2	16.7	16.2	15.7	15.2	14.7
	12 IN DOUBLE "T" INLET - FT LIFT	17.2	16.7	16.2	15.7	15.2	14.7
	13 INCHES						
	CENTER FEED (PSI)	59	64	68	74	78	83
	END FEED (PSI)	58	63	68	73	78	82
	PUMP (WATER) hp	58	63	67	72	77	82
	PUMP EFF.	86.3%	85.9%	85.4%	85.0%	84.5%	84.0%
	12 IN ALUMINUM INLET	17.8	17.2	16.6	16.0	15.4	14.8
	12 IN SINGLE INLET - FT LIFT	18.2	17.6	17.0	16.4	15.8	15.2
	12 IN DOUBLE "T" INLET - FT LIFT	18.2	17.6	17.0	16.4	15.8	15.2
	13.5 INCHES						
	CENTER FEED (PSI)	65	71	76	81	87	92
	END FEED (PSI)	65	70	75	81	86	91
	PUMP (WATER) hp	64	69	74	80	85	90
	PUMP EFF.	85.7%	85.3%	84.9%	84.4%	84.0%	83.5%
	12 IN ALUMINUM INLET	17.8	17.2	16.6	16.0	15.4	14.8
	12 IN SINGLE INLET - FT LIFT	18.2	17.6	17.0	16.4	15.8	15.2
	12 IN DOUBLE "T" INLET - FT LIFT	18.2	17.6	17.0	16.4	15.8	15.2

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Valmont test data has been used to adjust the data for system loss and elevation within the system. Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design.

Pump Performance Charts (Continued)

Chart B
Cornell 5RB Pump Performance

CENTERFEED]
END FEED (PSI)] - PRESSURE (PSI) AVAILABLE AT TOP OF CART (INCLUDES CART ELEVATION AND CART PIPE LOSSES)

Altitude is assumed to be sea level *
Temperature is assumed to be 90 deg. F. (32.2 deg. C.)*
* See Table 6 on page 2-33 in Pump Selection for lift adjustments for altitude and temperature.

MAXIMUM ALLOWABLE SUCTION LIFT (FT) - IS THE DISTANCE MEASURED FROM BOTTOM OF CART DRIVE UNIT TIRES TO WATER LEVEL

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM					
		1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
1400	11 INCHES						
	CENTER FEED (PSI)	30	34	37	41	45	48
	END FEED (PSI)	30	33	37	40	44	47
	PUMP (WATER) hp	37	41	44	48	51	54
	PUMP EFF.	83.2%	83.3%	83.4%	83.5%	83.6%	83.8%
	12 IN ALUMINUM INLET	15.0	14.7	14.5	14.2	13.9	13.7
	12 IN SINGLE INLET - FT LIFT	15.5	15.2	15.0	14.7	14.4	14.2
	12 IN DOUBLE "T" INLET - FT LIFT	15.5	15.2	15.0	14.7	14.4	14.2
	12 INCHES						
	CENTER FEED (PSI)	44	49	53	57	61	66
	END FEED (PSI)	43	48	52	56	60	65
	PUMP (WATER) hp	49	54	58	62	66	71
	PUMP EFF.	85.8%	85.6%	85.3%	85.0%	84.8%	84.5%
	12 IN ALUMINUM INLET	16.3	15.8	15.3	14.7	14.2	13.7
	12 IN SINGLE INLET - FT LIFT	16.8	16.3	15.8	15.2	14.7	14.2
	12 IN DOUBLE "T" INLET - FT LIFT	16.8	16.3	15.8	15.2	14.7	14.2
	13 INCHES						
	CENTER FEED (PSI)	56	61	66	71	76	81
	END FEED (PSI)	56	60	65	70	75	80
	PUMP (WATER) hp	61	65	70	75	80	85
	PUMP EFF.	86.3%	86.1%	85.9%	85.7%	85.5%	85.3%
	12 IN ALUMINUM INLET	16.6	16.2	15.8	15.4	15.0	14.6
	12 IN SINGLE INLET - FT LIFT	17.1	16.7	16.3	15.9	15.5	15.1
	12 IN DOUBLE "T" INLET - FT LIFT	17.1	16.7	16.3	15.9	15.5	15.1
	13.5 INCHES						
	CENTER FEED (PSI)	63	68	73	79	84	90
	END FEED (PSI)	62	67	72	78	83	89
	PUMP (WATER) hp	66	72	77	83	88	94
	PUMP EFF.	86.4%	86.1%	85.7%	85.4%	85.0%	84.7%
	12 IN ALUMINUM INLET	17.0	16.5	16.0	15.6	15.1	14.6
	12 IN SINGLE INLET - FT LIFT	17.5	17.0	16.5	16.1	15.6	15.1
	12 IN DOUBLE "T" INLET - FT LIFT	17.5	17.0	16.5	16.1	15.6	15.1

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM					
		1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
1500	11 INCHES						
	CENTER FEED (PSI)	28	31	35	38	42	45
	END FEED (PSI)	27	30	34	37	41	44
	PUMP (WATER) hp	38	41	45	48	52	55
	PUMP EFF.	82.2%	82.4%	82.6%	82.9%	83.1%	83.5%
	12 IN ALUMINUM INLET	13.5	13.3	13.0	12.8	12.5	12.3
	12 IN SINGLE INLET - FT LIFT	14.1	13.9	13.6	13.4	13.1	12.9
	12 IN DOUBLE "T" INLET - FT LIFT	14.0	13.8	13.5	13.3	13.0	12.8
	12 INCHES						
	CENTER FEED (PSI)	41	45	50	54	58	63
	END FEED (PSI)	40	44	49	53	57	62
	PUMP (WATER) hp	50	55	59	64	68	72
	PUMP EFF.	85.0%	85.0%	85.0%	85.1%	85.2%	85.2%
	12 IN ALUMINUM INLET	15.0	14.6	14.2	13.9	13.5	13.1
	12 IN SINGLE INLET - FT LIFT	15.6	15.2	14.8	14.5	14.1	13.7
	12 IN DOUBLE "T" INLET - FT LIFT	15.5	15.1	14.7	14.4	14.0	13.6
	13 INCHES						
	CENTER FEED (PSI)	54	59	64	69	74	78
	END FEED (PSI)	53	58	63	68	73	77
	PUMP (WATER) hp	63	68	73	78	83	88
	PUMP EFF.	86.3%	86.3%	86.2%	86.2%	86.2%	86.1%
	12 IN ALUMINUM INLET	14.5	15.0	14.5	14.5	14.5	13.9
	12 IN SINGLE INLET - FT LIFT	15.1	15.6	15.1	15.1	15.1	14.5
	12 IN DOUBLE "T" INLET - FT LIFT	15.0	15.5	15.0	15.0	15.0	14.4
	13.5 INCHES						
	CENTER FEED (PSI)	60	65	71	76	80	87
	END FEED (PSI)	59	64	70	75	79	86
	PUMP (WATER) hp	69	74	80	85	89	97
	PUMP EFF.	86.2%	86.2%	86.1%	86.1%	86.1%	86.0%
	12 IN ALUMINUM INLET	15.5	15.3	15.1	14.8	14.6	14.4
	12 IN SINGLE INLET - FT LIFT	16.1	15.9	15.7	15.4	15.2	15.0
	12 IN DOUBLE "T" INLET - FT LIFT	16.0	15.8	15.6	15.3	15.1	14.9

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Valmont test data has been used to adjust the data for system loss and elevation within the system. Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design.

Rainger Linear Ditch Feed

Pump Performance Charts (Continued)

Chart B
Cornell 5RB Pump Performance

CENTERFEED]
END FEED (PSI)] - PRESSURE (PSI) AVAILABLE AT TOP OF CART (INCLUDES CART ELEVATION AND CART PIPE LOSSES.)

Altitude is assumed to be sea level*
Temperature is assumed to be 90 deg. F. (32.2 deg. C.)*
* See Table 6 on page 2-33 in Pump Selection for lift adjustments for altitude and temperature.

MAXIMUM ALLOWABLE SUCTION LIFT (FT) - IS THE DISTANCE MEASURED FROM BOTTOM OF CART DRIVE UNIT TIRES TO WATER LEVEL.

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
1600	11 INCHES						
	CENTER FEED (PSI)	25	28	32	35	39	42
	END FEED (PSI)	24	27	31	34	38	41
	PUMP (WATER) hp	38	42	46	49	53	56
	PUMP EFF.	80.0%	80.6%	81.3%	82.0%	82.6%	83.1%
	12 IN ALUMINUM INLET	12.1	11.9	11.6	11.3	11.0	10.8
	12 IN SINGLE INLET - FT LIFT	12.7	12.5	12.2	11.9	11.6	11.4
	12 IN DOUBLE "T" INLET - FT LIFT	12.6	12.4	12.1	11.8	11.5	11.3
	12 INCHES						
	CENTER FEED (PSI)	37	42	46	51	56	60
	END FEED (PSI)	36	41	45	50	54	59
	PUMP (WATER) hp	50	55	60	65	70	74
	PUMP EFF.	83.9%	84.2%	84.5%	84.9%	85.2%	85.5%
	12 IN ALUMINUM INLET	13.4	13.2	13.0	12.8	12.6	12.4
	12 IN SINGLE INLET - FT LIFT	14.0	13.8	13.6	13.4	13.2	13.0
	12 IN DOUBLE "T" INLET - FT LIFT	13.9	13.7	13.5	13.3	13.1	12.9
	13 INCHES						
	CENTER FEED (PSI)	51	56	61	66	71	76
	END FEED (PSI)	50	54	60	64	70	75
	PUMP (WATER) hp	64	69	75	80	86	91
	PUMP EFF.	86.0%	86.2%	86.0%	86.0%	86.0%	86.2%
	12 IN ALUMINUM INLET	13.7	13.9	13.8	13.8	13.3	12.7
	12 IN SINGLE INLET - FT LIFT	14.3	14.5	14.4	14.4	13.9	13.3
	12 IN DOUBLE "T" INLET - FT LIFT	14.2	14.4	14.3	14.3	13.8	13.2
	13.5 INCHES						
	CENTER FEED (PSI)	57	62	68	73	78	84
	END FEED (PSI)	56	61	67	72	77	83
	PUMP (WATER) hp	70	76	82	88	94	100
	PUMP EFF.	86.5%	86.4%	86.3%	86.2%	86.1%	86.1%
	12 IN ALUMINUM INLET	14.3	14.1	13.8	13.6	13.3	13.1
	12 IN SINGLE INLET - FT LIFT	14.9	14.7	14.4	14.2	13.9	13.7
	12 IN DOUBLE "T" INLET - FT LIFT	14.8	14.6	14.3	14.1	13.8	13.6

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
1700	11 INCHES						
	CENTER FEED (PSI)	21	24	28	31	35	39
	END FEED (PSI)	19	23	26	30	34	38
	PUMP (WATER) hp	38	42	46	50	53	57
	PUMP EFF.	74.8%	76.2%	77.6%	79.1%	80.5%	81.9%
	12 IN ALUMINUM INLET	9.7	9.6	9.5	9.4	9.4	9.3
	12 IN SINGLE INLET - FT LIFT	10.4	10.3	10.2	10.1	10.1	10.0
	12 IN DOUBLE "T" INLET - FT LIFT	10.2	10.1	10.0	9.9	9.9	9.8
	12 INCHES						
	CENTER FEED (PSI)	34	38	42	47	51	56
	END FEED (PSI)	32	37	41	46	50	55
	PUMP (WATER) hp	50	55	60	65	70	75
	PUMP EFF.	83.0%	83.3%	83.7%	84.0%	84.4%	84.8%
	12 IN ALUMINUM INLET	12.0	11.8	11.6	11.3	11.0	10.8
	12 IN SINGLE INLET - FT LIFT	12.7	12.5	12.3	12.0	11.7	11.5
	12 IN DOUBLE "T" INLET - FT LIFT	12.5	12.3	12.1	11.8	11.5	11.3
	13 INCHES						
	CENTER FEED (PSI)	47	52	57	63	68	73
	END FEED (PSI)	46	51	56	61	67	72
	PUMP (WATER) hp	64	70	76	82	88	94
	PUMP EFF.	86.0%	86.0%	86.1%	86.2%	86.3%	86.3%
	12 IN ALUMINUM INLET	13.0	12.7	12.4	12.1	11.8	11.5
	12 IN SINGLE INLET - FT LIFT	13.7	13.4	13.1	12.8	12.5	12.2
	12 IN DOUBLE "T" INLET - FT LIFT	13.5	13.2	12.9	12.6	12.3	12.0
	13.5 INCHES						
	CENTER FEED (PSI)	53	59	64	70	76	81
	END FEED (PSI)	52	58	63	69	74	80
	PUMP (WATER) hp	71	77	84	90	97	103
	PUMP EFF.	86.1%	86.2%	86.2%	86.2%	86.3%	86.3%
	12 IN ALUMINUM INLET	13.1	12.9	12.6	12.4	12.1	11.8
	12 IN SINGLE INLET - FT LIFT	13.8	13.6	13.3	13.1	12.8	12.5
	12 IN DOUBLE "T" INLET - FT LIFT	13.6	13.4	13.1	12.9	12.6	12.3

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Valmont test data has been used to adjust the data for system loss and elevation within the system. Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design.

Pump Performance Charts (Continued)

Chart B
Cornell 5RB Pump Performance

CENTERFEED]
END FEED (PSI)] - PRESSURE (PSI) AVAILABLE AT TOP OF CART (INCLUDES CART ELEVATION AND CART PIPE LOSSES)

Altitude is assumed to be sea level *
Temperature is assumed to be 90 deg. F. (32.2 deg. C.)*
* See Table 6 on page 2-33 in Pump Selection for lift adjustments for altitude and temperature.

MAXIMUM ALLOWABLE SUCTION LIFT (FT) - IS THE DISTANCE MEASURED FROM BOTTOM OF CART DRIVE UNIT TIRES TO WATER LEVEL

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
1800	11 INCHES						
	CENTER FEED (PSI)	16	20	23	28	32	36
	END FEED (PSI)	14	18	22	26	30	34
	PUMP (WATER) hp	37	42	46	51	54	58
	PUMP EFF.	68.2%	70.6%	73.0%	75.4%	77.8%	80.2%
	12 IN ALUMINUM INLET	6.8	6.8	7.1	7.3	7.6	7.8
	12 IN SINGLE INLET - FT LIFT	7.6	7.6	7.9	8.1	8.4	8.6
	12 IN DOUBLE "T" INLET - FT LIFT	7.3	7.3	7.6	7.8	8.1	8.3
	12 INCHES						
	CENTER FEED (PSI)	30	34	39	43	48	52
	END FEED (PSI)	29	33	37	42	46	51
	PUMP (WATER) hp	50	55	60	66	71	76
	PUMP EFF.	81.5%	81.2%	81.9%	82.6%	83.3%	84.0%
	12 IN ALUMINUM INLET	9.8	9.7	9.6	9.5	9.4	9.3
	12 IN SINGLE INLET - FT LIFT	10.6	10.5	10.4	10.3	10.2	10.1
	12 IN DOUBLE "T" INLET - FT LIFT	10.3	10.2	10.1	10.0	9.9	9.8
	13 INCHES						
	CENTER FEED (PSI)	43	48	53	59	64	69
	END FEED (PSI)	41	47	52	58	63	68
	PUMP (WATER) hp	64	70	76	83	89	95
	PUMP EFF.	84.6%	84.9%	85.2%	85.6%	85.9%	86.2%
	12 IN ALUMINUM INLET	10.9	10.8	10.7	10.5	10.4	10.2
	12 IN SINGLE INLET - FT LIFT	11.7	11.6	11.5	11.3	11.2	11.0
	12 IN DOUBLE "T" INLET - FT LIFT	11.4	11.3	11.2	11.0	10.9	10.7
	13.5 INCHES						
	CENTER FEED (PSI)	50	55	61	67	72	78
	END FEED (PSI)	48	54	60	65	71	77
	PUMP (WATER) hp	71	78	85	92	98	105
	PUMP EFF.	86.0%	86.1%	86.2%	86.2%	86.3%	86.4%
	12 IN ALUMINUM INLET	12.0	11.7	11.4	11.1	10.8	10.5
	12 IN SINGLE INLET - FT LIFT	12.8	12.5	12.2	11.9	11.6	11.3
	12 IN DOUBLE "T" INLET - FT LIFT	12.5	12.2	11.9	11.6	11.3	11.0

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
1900	11 INCHES						
	CENTER FEED (PSI)			18	23	27	31
	END FEED (PSI)			17	21	25	29
	PUMP (WATER) hp			43	49	53	58
	PUMP EFF.	NA	NA	70.6%	72.2%	73.9%	75.6%
	12 IN ALUMINUM INLET			4.2	4.4	4.6	4.8
	12 IN SINGLE INLET - FT LIFT			5.1	5.3	5.5	5.7
	12 IN DOUBLE "T" INLET - FT LIFT			4.8	5.0	5.2	5.4
	12 INCHES						
	CENTER FEED (PSI)	25	30	34	39	43	48
	END FEED (PSI)	24	28	33	37	42	47
	PUMP (WATER) hp	51	56	61	66	71	76
	PUMP EFF.	74.7%	76.4%	78.2%	79.9%	81.6%	83.3%
	12 IN ALUMINUM INLET	6.6	6.8	7.0	7.3	7.5	7.7
	12 IN SINGLE INLET - FT LIFT	7.5	7.7	7.9	8.2	8.4	8.6
	12 IN DOUBLE "T" INLET - FT LIFT	7.2	7.4	7.6	7.9	8.1	8.3
	13 INCHES						
	CENTER FEED (PSI)	39	44	49	55	60	66
	END FEED (PSI)	37	42	48	53	58	64
	PUMP (WATER) hp	64	70	76	83	89	96
	PUMP EFF.	82.9%	83.5%	84.1%	84.8%	85.4%	86.0%
	12 IN ALUMINUM INLET	8.5	8.6	8.6	8.7	8.8	8.8
	12 IN SINGLE INLET - FT LIFT	9.4	9.5	9.5	9.6	9.7	9.7
	12 IN DOUBLE "T" INLET - FT LIFT	9.1	9.2	9.2	9.3	9.4	9.4
	13.5 INCHES						
	CENTER FEED (PSI)	46	51	57	63	68	74
	END FEED (PSI)	44	50	55	61	67	72
	PUMP (WATER) hp	71	79	86	92	99	106
	PUMP EFF.	84.6%	84.9%	85.2%	85.6%	85.9%	86.2%
	12 IN ALUMINUM INLET	9.7	9.6	9.5	9.3	9.2	9.1
	12 IN SINGLE INLET - FT LIFT	10.6	10.5	10.4	10.2	10.1	10.0
	12 IN DOUBLE "T" INLET - FT LIFT	10.3	10.2	10.1	9.9	9.8	9.7

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Valmont test data has been used to adjust the data for system loss and elevation within the system. Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design.

Rainger Linear Ditch Feed

Pump Performance Charts (Continued)

Chart C
Cornell 6YB Pump Performance

CENTERFEED]
END FEED] - PRESSURE (FT) AVAILABLE AT TOP OF CART (INCLUDES CART ELEVATION AND PIPING LOSSES.)

Altitude is assumed to be sea level*
Temperature is assumed to be 90 deg. F. (32.2 deg. C.)*
* See Table 6 on page 2-33 in Pump Selection for lift adjustments for altitude and temperature.

MAXIMUM ALLOWABLE SUCTION LIFT (FT) - DISTANCE IS MEASURED FROM BOTTOM OF CART DRIVE UNIT TIRES.

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
1800	9.5 INCHES - 13 DEG.						
	CENTER FEED (PSI)	16	18	20	22	24	26
	END FEED (PSI)	15	17	19	21	23	25
	PUMP (WATER) hp	31	34	37	40	43	47
	PUMP EFF. %	81.2%	80.3%	79.4%	78.4%	77.5%	76.5%
	12 IN ALUMINUM INLET - FT LIFT	13.6	12.9	12.2	11.4	10.7	9.9
	12 IN SINGLE INLET - FT LIFT	14.4	13.7	13.0	12.2	11.5	10.7
	12 IN DOUBLE "T" INLET - FT LIFT	14.1	13.4	12.7	11.9	11.2	10.4
	14 IN DOUBLE "T" INLET - FT LIFT	14.7	14.0	13.3	12.5	11.8	11.0
	10 INCHES - 13 DEG.						
	CENTER FEED (PSI)	22	24	26	28	31	33
	END FEED (PSI)	20	22	24	27	29	31
	PUMP (WATER) hp	38	41	44	49	52	56
	PUMP EFF. %	81.8%	80.8%	79.7%	78.6%	77.6%	76.5%
	12 IN ALUMINUM INLET - FT LIFT	14.4	13.7	13.0	12.3	11.6	10.9
	12 IN SINGLE INLET - FT LIFT	15.2	14.5	13.8	13.1	12.4	11.7
	12 IN DOUBLE "T" INLET - FT LIFT	14.9	14.2	13.5	12.8	12.1	11.4
	14 IN DOUBLE "T" INLET - FT LIFT	15.5	14.8	14.1	13.4	12.7	12.0
	10.5 INCHES - 13 DEG.						
	CENTER FEED (PSI)	26	29	32	34	36	39
	END FEED (PSI)	25	28	30	32	35	37
	PUMP (WATER) hp	42	46	51	55	59	64
	PUMP EFF. %	85.4%	83.6%	81.8%	79.9%	78.0%	76.2%
	12 IN ALUMINUM INLET - FT LIFT	14.6	13.9	13.2	12.5	11.8	11.1
	12 IN SINGLE INLET - FT LIFT	15.4	14.7	14.0	13.3	12.6	11.9
	12 IN DOUBLE "T" INLET - FT LIFT	15.1	14.4	13.7	13.0	12.3	11.6
	14 IN DOUBLE "T" INLET - FT LIFT	15.7	15.0	14.3	13.6	12.9	12.2
	11 INCHES - 13 DEG.						
	CENTER FEED (PSI)	32	34	37	40	42	45
	END FEED (PSI)	30	33	35	38	41	44
	PUMP (WATER) hp	46	51	56	62	67	74
	PUMP EFF. %	89.2%	86.5%	83.7%	81.1%	78.5%	75.8%
	12 IN ALUMINUM INLET - FT LIFT	14.8	14.1	13.4	12.6	11.9	11.2
	12 IN SINGLE INLET - FT LIFT	15.6	14.9	14.2	13.4	12.7	12.0
	12 IN DOUBLE "T" INLET - FT LIFT	15.3	14.6	13.9	13.1	12.4	11.7
	14 IN DOUBLE "T" INLET - FT LIFT	15.9	15.2	14.5	13.7	13.0	12.3
	11 INCHES 0 DEG.						
	CENTER FEED (PSI)	34	37	40	43	46	49
	END FEED (PSI)	32	36	39	42	45	48
	PUMP (WATER) hp	54	59	64	69	74	80
	PUMP EFF. %	80.9%	79.8%	78.7%	77.6%	76.5%	75.4%
	12 IN ALUMINUM INLET - FT LIFT	14.8	14.1	13.4	12.6	11.9	11.2
	12 IN SINGLE INLET - FT LIFT	15.6	14.9	14.2	13.4	12.7	12.0
	12 IN DOUBLE "T" INLET - FT LIFT	15.3	14.6	13.9	13.1	12.4	11.7
	14 IN DOUBLE "T" INLET - FT LIFT	15.9	15.2	14.5	13.7	13.0	12.3

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
1900	9.5 INCHES - 13 DEG.						
	CENTER FEED (PSI)	14	17	19	21	23	25
	END FEED (PSI)	13	15	17	19	22	24
	PUMP (WATER) hp	31	34	37	40	44	47
	PUMP EFF. %	81.6%	81.1%	80.5%	80.0%	79.4%	78.9%
	12 IN ALUMINUM INLET - FT LIFT	13.1	12.4	11.7	11.0	10.3	9.6
	12 IN SINGLE INLET - FT LIFT	14.0	13.3	12.6	11.9	11.2	10.5
	12 IN DOUBLE "T" INLET - FT LIFT	13.7	13.0	12.3	11.6	10.9	10.2
	14 IN DOUBLE "T" INLET - FT LIFT	14.3	13.6	12.9	12.2	11.5	10.8
	10 INCHES - 13 DEG.						
	CENTER FEED (PSI)	20	23	25	27	30	32
	END FEED (PSI)	19	21	23	26	28	30
	PUMP (WATER) hp	38	41	45	49	52	56
	PUMP EFF. %	83.5%	81.6%	80.6%	79.6%	78.6%	77.6%
	12 IN ALUMINUM INLET - FT LIFT	14.0	13.3	12.6	11.9	11.2	10.5
	12 IN SINGLE INLET - FT LIFT	14.9	14.2	13.5	12.8	12.1	11.4
	12 IN DOUBLE "T" INLET - FT LIFT	14.6	13.9	13.2	12.5	11.8	11.1
	14 IN DOUBLE "T" INLET - FT LIFT	15.2	14.5	13.8	13.1	12.4	11.7
	10.5 INCHES - 13 DEG.						
	CENTER FEED (PSI)	25	28	30	33	35	37
	END FEED (PSI)	24	26	28	31	33	36
	PUMP (WATER) hp	44	48	52	56	60	64
	PUMP EFF. %	83.2%	82.3%	81.3%	80.4%	79.4%	78.5%
	12 IN ALUMINUM INLET - FT LIFT	14.3	13.6	12.9	12.1	11.4	10.7
	12 IN SINGLE INLET - FT LIFT	15.2	14.5	13.8	13.0	12.3	11.6
	12 IN DOUBLE "T" INLET - FT LIFT	14.9	14.2	13.5	12.7	12.0	11.3
	14 IN DOUBLE "T" INLET - FT LIFT	15.5	14.8	14.1	13.3	12.6	11.9
	11 INCHES - 13 DEG.						
	CENTER FEED (PSI)	30	33	36	39	41	44
	END FEED (PSI)	29	31	34	37	40	43
	PUMP (WATER) hp	51	56	60	65	69	74
	PUMP EFF. %	83.1%	82.1%	81.1%	80.1%	79.1%	78.1%
	12 IN ALUMINUM INLET - FT LIFT	14.5	13.8	13.1	12.3	11.6	10.9
	12 IN SINGLE INLET - FT LIFT	15.4	14.7	14.0	13.2	12.5	11.8
	12 IN DOUBLE "T" INLET - FT LIFT	15.1	14.4	13.7	12.9	12.2	11.5
	14 IN DOUBLE "T" INLET - FT LIFT	15.7	15.0	14.3	13.5	12.8	12.1
	11 INCHES 0 DEG.						
	CENTER FEED (PSI)	33	36	39	42	45	48
	END FEED (PSI)	31	34	38	41	44	47
	PUMP (WATER) hp	55	60	65	70	75	80
	PUMP EFF. %	82.6%	81.6%	80.6%	79.6%	78.6%	77.6%
	12 IN ALUMINUM INLET - FT LIFT	14.5	13.8	13.1	12.3	11.6	10.9
	12 IN SINGLE INLET - FT LIFT	15.4	14.7	14.0	13.2	12.5	11.8
	12 IN DOUBLE "T" INLET - FT LIFT	15.1	14.4	13.7	12.9	12.2	11.5
	14 IN DOUBLE "T" INLET - FT LIFT	15.7	15.0	14.3	13.5	12.8	12.1

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Valmont test data has been used to adjust the data for system loss and elevation within the system. Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design.

Pump Performance Charts (Continued)

Chart C
Cornell 6YB Pump Performance

CENTERFEED]
END FEED] - PRESSURE (FT) AVAILABLE AT TOP OF CART (INCLUDES CART ELEVATION AND PIPING LOSSES)

Altitude is assumed to be sea level *
Temperature is assumed to be 90 deg. F. (32.2 deg. C.)*
* See Table 6 on page 2-33 in Pump Selection for lift adjustments for altitude and temperature.

MAXIMUM ALLOWABLE SUCTION LIFT (FT) - DISTANCE IS MEASURED FROM BOTTOM OF CART DRIVE UNIT TIRES

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM					
		1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
2000	9.5 INCHES - 13 DEG.						
	CENTER FEED (PSI)	13	15	17	19	22	24
	END FEED (PSI)	11	13	15	18	20	22
	PUMP (WATER) hp	30	33	37	40	43	47
	PUMP EFF. %	82.2%	81.8%	81.4%	81.0%	80.7%	80.3%
	12 IN ALUMINUM INLET - FT LIFT	12.7	12.0	11.3	10.7	10.0	9.3
	12 IN SINGLE INLET - FT LIFT	13.6	12.9	12.2	11.6	10.9	10.2
	12 IN DOUBLE "T" INLET - FT LIFT	13.3	12.6	11.9	11.3	10.6	9.9
	14 IN DOUBLE "T" INLET - FT LIFT	14.0	13.3	12.6	12.0	11.3	10.6
	10 INCHES - 13 DEG.						
	CENTER FEED (PSI)	19	21	23	26	28	31
	END FEED (PSI)	17	19	22	24	26	29
	PUMP (WATER) hp	38	41	45	49	52	56
	PUMP EFF. %	84.0%	83.2%	82.3%	81.5%	80.6%	79.8%
	12 IN ALUMINUM INLET - FT LIFT	13.1	13.0	13.9	14.3	14.7	10.2
	12 IN SINGLE INLET - FT LIFT	14.0	13.9	14.8	15.2	15.6	11.1
	12 IN DOUBLE "T" INLET - FT LIFT	13.7	13.6	14.5	14.9	15.3	10.8
	14 IN DOUBLE "T" INLET - FT LIFT	14.4	14.3	15.2	15.6	16.0	11.5
	10.5 INCHES - 13 DEG.						
	CENTER FEED (PSI)	24	26	29	32	35	37
	END FEED (PSI)	22	25	27	30	33	35
	PUMP (WATER) hp	44	48	53	57	62	66
	PUMP EFF. %	84.1%	83.5%	82.7%	82.0%	81.2%	80.5%
	12 IN ALUMINUM INLET - FT LIFT	14.2	13.4	12.7	11.9	11.2	10.4
	12 IN SINGLE INLET - FT LIFT	15.1	14.3	13.6	12.8	12.1	11.3
	12 IN DOUBLE "T" INLET - FT LIFT	14.8	14.0	13.3	12.5	11.8	11.0
	14 IN DOUBLE "T" INLET - FT LIFT	15.5	14.7	14.0	13.2	12.5	11.7
	11 INCHES - 13 DEG.						
	CENTER FEED (PSI)	29	32	35	38	41	43
	END FEED (PSI)	28	30	33	36	39	41
	PUMP (WATER) hp	52	56	61	65	70	75
	PUMP EFF. %	84.5%	83.7%	82.8%	82.0%	81.1%	80.3%
	12 IN ALUMINUM INLET - FT LIFT	14.4	13.6	12.9	12.1	11.4	10.7
	12 IN SINGLE INLET - FT LIFT	15.3	14.5	13.8	13.0	12.3	11.6
	12 IN DOUBLE "T" INLET - FT LIFT	15.0	14.2	13.5	12.7	12.0	11.3
	14 IN DOUBLE "T" INLET - FT LIFT	15.7	14.9	14.2	13.4	12.7	12.0
	11 INCHES 0 DEG.						
	CENTER FEED (PSI)	32	35	38	41	44	47
	END FEED (PSI)	30	33	36	39	42	45
	PUMP (WATER) hp	56	61	66	71	76	81
	PUMP EFF. %	84.0%	83.2%	82.3%	81.5%	80.6%	79.8%
	12 IN ALUMINUM INLET - FT LIFT	14.4	13.6	12.9	12.1	11.4	10.7
	12 IN SINGLE INLET - FT LIFT	15.3	14.5	13.8	13.0	12.3	11.6
	12 IN DOUBLE "T" INLET - FT LIFT	15.0	14.2	13.5	12.7	12.0	11.3
	14 IN DOUBLE "T" INLET - FT LIFT	15.7	14.9	14.2	13.4	12.7	12.0

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM					
		1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
2100	9.5 INCHES - 13 DEG.						
	CENTER FEED (PSI)	11	14	16	18	20	22
	END FEED (PSI)	9	12	14	16	18	20
	PUMP (WATER) hp	30	33	36	40	43	46
	PUMP EFF. %	81.6%	81.5%	81.4%	81.3%	81.2%	81.0%
	12 IN ALUMINUM INLET - FT LIFT	12.0	11.4	10.7	10.1	9.5	8.7
	12 IN SINGLE INLET - FT LIFT	13.1	12.5	11.8	11.2	10.6	9.8
	12 IN DOUBLE "T" INLET - FT LIFT	12.7	12.1	11.4	10.8	10.2	9.4
	14 IN DOUBLE "T" INLET - FT LIFT	13.5	12.9	12.2	11.6	11.0	10.2
	10 INCHES - 13 DEG.						
	CENTER FEED (PSI)	17	20	22	24	27	30
	END FEED (PSI)	16	18	20	22	25	28
	PUMP (WATER) hp	38	41	45	48	53	57
	PUMP EFF. %	84.0%	83.7%	83.4%	83.1%	82.7%	82.4%
	12 IN ALUMINUM INLET - FT LIFT	13.3	12.6	11.9	11.2	10.5	9.8
	12 IN SINGLE INLET - FT LIFT	14.4	13.7	13.0	12.3	11.6	10.9
	12 IN DOUBLE "T" INLET - FT LIFT	14.0	13.3	12.6	11.9	11.2	10.5
	14 IN DOUBLE "T" INLET - FT LIFT	14.8	14.1	13.4	12.7	12.0	11.3
	10.5 INCHES - 13 DEG.						
	CENTER FEED (PSI)	23	25	28	30	33	36
	END FEED (PSI)	21	23	26	29	31	34
	PUMP (WATER) hp	45	49	53	57	61	66
	PUMP EFF. %	84.8%	84.3%	83.8%	83.3%	82.8%	82.3%
	12 IN ALUMINUM INLET - FT LIFT	13.8	13.1	12.4	11.8	11.1	10.4
	12 IN SINGLE INLET - FT LIFT	14.9	14.2	13.5	12.9	12.2	11.5
	12 IN DOUBLE "T" INLET - FT LIFT	14.5	13.8	13.1	12.5	11.8	11.1
	14 IN DOUBLE "T" INLET - FT LIFT	15.3	14.6	13.9	13.3	12.6	11.9
	11 INCHES - 13 DEG.						
	CENTER FEED (PSI)	28	31	34	37	40	43
	END FEED (PSI)	26	29	32	35	38	41
	PUMP (WATER) hp	52	57	62	67	72	76
	PUMP EFF. %	86.0%	85.2%	84.3%	83.6%	82.7%	81.9%
	12 IN ALUMINUM INLET - FT LIFT	14.1	13.3	12.6	11.8	11.1	10.4
	12 IN SINGLE INLET - FT LIFT	15.2	14.4	13.7	12.9	12.2	11.5
	12 IN DOUBLE "T" INLET - FT LIFT	14.8	14.0	13.3	12.5	11.8	11.1
	14 IN DOUBLE "T" INLET - FT LIFT	15.6	14.8	14.1	13.3	12.6	11.9
	11 INCHES 0 DEG.						
	CENTER FEED (PSI)	30	33	36	40	43	46
	END FEED (PSI)	29	32	35	38	41	44
	PUMP (WATER) hp	56	61	66	72	77	82
	PUMP EFF. %	85.0%	84.3%	83.6%	82.9%	82.1%	81.4%
	12 IN ALUMINUM INLET - FT LIFT	14.1	13.3	12.6	11.8	11.1	10.4
	12 IN SINGLE INLET - FT LIFT	15.2	14.4	13.7	12.9	12.2	11.5
	12 IN DOUBLE "T" INLET - FT LIFT	14.8	14.0	13.3	12.5	11.8	11.1
	14 IN DOUBLE "T" INLET - FT LIFT	15.6	14.8	14.1	13.3	12.6	11.9

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Valmont test data has been used to adjust the data for system loss and elevation within the system. Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design.

Rainger Linear Ditch Feed

Pump Performance Charts (Continued)

Chart C
Cornell 6YB Pump Performance

CENTERFEED]
END FEED] - PRESSURE (FT) AVAILABLE AT TOP OF CART (INCLUDES CART ELEVATION AND PIPING LOSSES.)

Altitude is assumed to be sea level*
Temperature is assumed to be 90 deg. F. (32.2 deg. C.)*
* See Table 6 on page 2-33 in Pump Selection for lift adjustments for altitude and temperature.

MAXIMUM ALLOWABLE SUCTION LIFT (FT) - DISTANCE IS MEASURED FROM BOTTOM OF CART DRIVE UNIT TIRES.

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM					
		1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
2200	9.5 INCHES - 13 DEG.						
	CENTER FEED (PSI)	10	12	14	16	18	20
	END FEED (PSI)	8	10	12	14	16	18
	PUMP (WATER) hp	30	33	36	39	42	46
	PUMP EFF. %	80.6%	80.8%	81.0%	81.2%	81.4%	81.6%
	12 IN ALUMINUM INLET - FT LIFT	11.4	10.8	10.2	9.5	8.9	8.2
	12 IN DOUBLE "T" INLET - FT LIFT	12.1	11.5	10.9	10.2	9.6	8.9
	14 IN DOUBLE "T" INLET - FT LIFT	13.0	12.4	11.8	11.1	10.5	9.8
	10 INCHES - 13 DEG.						
	CENTER FEED (PSI)	16	18	21	23	25	28
	END FEED (PSI)	14	16	19	21	23	26
	PUMP (WATER) hp	38	42	45	49	53	57
	PUMP EFF. %	84.0%	83.9%	83.7%	83.5%	83.3%	83.2%
	12 IN ALUMINUM INLET - FT LIFT	12.9	12.2	11.5	10.8	10.1	9.4
	12 IN DOUBLE "T" INLET - FT LIFT	13.6	12.9	12.2	11.5	10.8	10.1
	14 IN DOUBLE "T" INLET - FT LIFT	14.5	13.8	13.1	12.4	11.7	11.0
	10.5 INCHES - 13 DEG.						
	CENTER FEED (PSI)	22	24	27	29	32	34
	END FEED (PSI)	19	22	25	27	30	32
	PUMP (WATER) hp	46	50	54	58	62	67
	PUMP EFF. %	85.4%	85.0%	84.6%	84.2%	83.8%	83.4%
	12 IN ALUMINUM INLET - FT LIFT	13.3	12.7	12.0	11.3	10.6	10.0
	12 IN DOUBLE "T" INLET - FT LIFT	14.0	13.4	12.7	12.0	11.3	10.7
	14 IN DOUBLE "T" INLET - FT LIFT	14.9	14.3	13.6	12.9	12.2	11.6
	11 INCHES - 13 DEG.						
	CENTER FEED (PSI)	27	30	33	35	38	41
	END FEED (PSI)	25	28	31	33	36	39
	PUMP (WATER) hp	53	57	62	67	72	77
	PUMP EFF. %	86.7%	86.1%	85.4%	84.7%	84.1%	83.4%
	12 IN ALUMINUM INLET - FT LIFT	13.3	12.9	12.2	11.5	10.8	10.1
	12 IN DOUBLE "T" INLET - FT LIFT	14.0	13.6	12.9	12.2	11.5	10.8
	14 IN DOUBLE "T" INLET - FT LIFT	14.9	14.5	13.8	13.1	12.4	11.7
	11 INCHES - 0 DEG.						
	CENTER FEED (PSI)	27	32	33	36	38	45
	END FEED (PSI)	25	30	31	34	36	43
	PUMP (WATER) hp	53	62	63	68	72	83
	PUMP EFF. %	86.5%	85.5%	86.0%	84.5%	84.0%	83.0%
	12 IN ALUMINUM INLET - FT LIFT	13.4	13.0	12.3	11.5	10.8	10.1
	12 IN DOUBLE "T" INLET - FT LIFT	14.1	13.7	13.0	12.2	11.5	10.8
	14 IN DOUBLE "T" INLET - FT LIFT	15.0	14.6	13.9	13.1	12.4	11.7

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM					
		1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
2300	9.5 INCHES - 13 DEG.						
	CENTER FEED (PSI)	8	10	13	14	16	19
	END FEED (PSI)	NA	8	10	12	14	16
	PUMP (WATER) hp	29	33	36	39	42	45
	PUMP EFF. %	79.0%	80.1%	80.5%	80.9%	81.3%	81.7%
	12 IN ALUMINUM INLET - FT LIFT	10.8	10.2	9.6	8.9	8.3	7.6
	12 IN DOUBLE "T" INLET - FT LIFT	11.5	10.9	10.3	9.6	9.0	8.3
	14 IN DOUBLE "T" INLET - FT LIFT	12.5	11.9	11.3	10.6	10.0	9.3
	10 INCHES - 13 DEG.						
	CENTER FEED (PSI)	14	16	19	21	24	26
	END FEED (PSI)	12	14	17	19	22	24
	PUMP (WATER) hp	38	41	45	48	52	57
	PUMP EFF. %	82.0%	83.5%	84.0%	84.0%	85.0%	83.6%
	12 IN ALUMINUM INLET - FT LIFT	11.5	11.8	12.5	12.7	13.0	9.0
	12 IN DOUBLE "T" INLET - FT LIFT	12.2	12.5	13.2	13.4	13.7	9.7
	14 IN DOUBLE "T" INLET - FT LIFT	13.2	13.5	14.2	14.4	14.7	10.7
	10.5 INCHES - 13 DEG.						
	CENTER FEED (PSI)	20	23	25	28	30	33
	END FEED (PSI)	18	20	23	25	28	31
	PUMP (WATER) hp	45	49	54	58	63	67
	PUMP EFF. %	86.1%	85.7%	85.3%	84.9%	84.5%	84.1%
	12 IN ALUMINUM INLET - FT LIFT	13.0	12.3	11.6	11.0	10.3	9.6
	12 IN DOUBLE "T" INLET - FT LIFT	13.7	13.0	12.3	11.7	11.0	10.3
	14 IN DOUBLE "T" INLET - FT LIFT	14.7	14.0	13.3	12.7	12.0	11.3
	11 INCHES - 13 DEG.						
	CENTER FEED (PSI)	26	28	31	34	37	40
	END FEED (PSI)	23	26	29	32	35	38
	PUMP (WATER) hp	54	58	63	67	72	77
	PUMP EFF. %	86.7%	86.3%	85.9%	85.5%	85.1%	84.7%
	12 IN ALUMINUM INLET - FT LIFT	13.3	12.6	11.9	11.2	10.5	9.8
	12 IN DOUBLE "T" INLET - FT LIFT	14.0	13.3	12.6	11.9	11.2	10.5
	14 IN DOUBLE "T" INLET - FT LIFT	15.0	14.3	13.6	12.9	12.2	11.5
	11 INCHES - 0 DEG.						
	CENTER FEED (PSI)	28	31	34	37	40	43
	END FEED (PSI)	26	29	32	35	38	41
	PUMP (WATER) hp	58	63	68	73	78	84
	PUMP EFF. %	86.7%	86.1%	85.6%	85.1%	84.5%	84.0%
	12 IN ALUMINUM INLET - FT LIFT	13.4	12.7	12.0	11.2	10.5	9.8
	12 IN DOUBLE "T" INLET - FT LIFT	14.1	13.4	12.7	11.9	11.2	10.5
	14 IN DOUBLE "T" INLET - FT LIFT	15.1	14.4	13.7	12.9	12.2	11.5

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Valmont test data has been used to adjust the data for system loss and elevation within the system. Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design.

Pump Performance Charts (Continued)

Chart C
Cornell 6YB Pump Performance

CENTERFEED]
END FEED] - PRESSURE (FT) AVAILABLE AT TOP OF CART (INCLUDES CART ELEVATION AND PIPING LOSSES)

Altitude is assumed to be sea level *
Temperature is assumed to be 90 deg. F. (32.2 deg. C.)*
* See Table 6 on page 2-33 in Pump Selection for lift adjustments for altitude and temperature.

MAXIMUM ALLOWABLE SUCTION LIFT (FT) - DISTANCE IS MEASURED FROM BOTTOM OF CART DRIVE UNIT TIRES

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM					
		1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
2400	9.5 INCHES - 13 DEG.						
	CENTER FEED (PSI)		8	11	13	15	17
	END FEED (PSI)		NA	8	10	12	15
	PUMP (WATER) hp		32	36	39	42	46
	PUMP EFF. %	NA	77.1%	78.1%	79.1%	80.1%	81.1%
	12 IN ALUMINUM INLET - FT LIFT		9.2	8.7	8.1	7.6	7.0
	12 IN DOUBLE "T" INLET - FT LIFT		9.9	9.4	8.8	8.3	7.7
	14 IN DOUBLE "T" INLET - FT LIFT		11.0	10.5	9.9	9.4	8.8
	10 INCHES - 13 DEG.						
	CENTER FEED (PSI)	12	15	18	20	22	25
	END FEED (PSI)	10	12	15	17	20	22
	PUMP (WATER) hp	37	41	45	49	53	57
	PUMP EFF. %	82.9%	83.1%	83.3%	83.5%	83.7%	83.9%
	12 IN ALUMINUM INLET - FT LIFT	12.0	11.3	10.6	10.0	9.3	8.6
	12 IN DOUBLE "T" INLET - FT LIFT	12.7	12.0	11.3	10.7	10.0	9.3
	14 IN DOUBLE "T" INLET - FT LIFT	13.8	13.1	12.4	11.8	11.1	10.4
	10.5 INCHES - 13 DEG.						
	CENTER FEED (PSI)	14	21	24	27	29	32
	END FEED (PSI)	12	18	21	24	27	29
	PUMP (WATER) hp	38	50	54	59	64	68
	PUMP EFF. %	85.4%	85.3%	85.2%	85.0%	84.8%	84.7%
	12 IN ALUMINUM INLET - FT LIFT	12.4	11.8	11.2	10.5	9.9	9.2
	12 IN DOUBLE "T" INLET - FT LIFT	13.1	12.5	11.9	11.2	10.6	9.9
	14 IN DOUBLE "T" INLET - FT LIFT	14.2	13.6	13.0	12.3	11.7	11.0
	11 INCHES - 13 DEG.						
	CENTER FEED (PSI)	24	27	30	33	36	39
	END FEED (PSI)	22	25	28	30	33	36
	PUMP (WATER) hp	54	59	64	68	73	78
	PUMP EFF. %	86.6%	86.5%	86.4%	86.3%	86.2%	86.0%
	12 IN ALUMINUM INLET - FT LIFT	13.0	12.3	11.6	10.9	10.2	9.5
	12 IN DOUBLE "T" INLET - FT LIFT	13.7	13.0	12.3	11.6	10.9	10.2
	14 IN DOUBLE "T" INLET - FT LIFT	14.8	14.1	13.4	12.7	12.0	11.3
	11 INCHES - 0 DEG.						
	CENTER FEED (PSI)	27	30	33	36	39	42
	END FEED (PSI)	24	27	30	33	36	39
	PUMP (WATER) hp	58	63	68	74	79	84
	PUMP EFF. %	86.7%	86.4%	86.0%	85.7%	85.3%	85.0%
	12 IN ALUMINUM INLET - FT LIFT	13.1	12.4	11.7	10.9	10.2	9.5
	12 IN DOUBLE "T" INLET - FT LIFT	13.8	13.1	12.4	11.6	10.9	10.2
	14 IN DOUBLE "T" INLET - FT LIFT	14.9	14.2	13.5	12.7	12.0	11.3

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM					
		1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
2500	9.5 INCHES - 13 DEG.						
	CENTER FEED (PSI)			9	11	13	15
	END FEED (PSI)			NA	8	10	12
	PUMP (WATER) hp			36	38	42	45
	PUMP EFF. %	NA	NA	75.5%	77.1%	78.7%	80.5%
	12 IN ALUMINUM INLET - FT LIFT			7.7	7.2	6.8	6.4
	12 IN DOUBLE "T" INLET - FT LIFT			8.4	7.9	7.5	7.1
	14 IN DOUBLE "T" INLET - FT LIFT			9.6	9.1	8.7	8.3
	10 INCHES - 13 DEG.						
	CENTER FEED (PSI)	11	13	16	18	20	23
	END FEED (PSI)	NA	11	13	15	18	20
	PUMP (WATER) hp	37	41	45	49	52	57
	PUMP EFF. %	81.0%	81.5%	82.0%	82.6%	83.1%	83.7%
	12 IN ALUMINUM INLET - FT LIFT	11.3	10.7	10.1	9.4	8.8	8.2
	12 IN DOUBLE "T" INLET - FT LIFT	12.0	11.4	10.8	10.1	9.5	8.9
	14 IN DOUBLE "T" INLET - FT LIFT	13.2	12.6	12.0	11.3	10.7	10.1
	10.5 INCHES - 13 DEG.						
	CENTER FEED (PSI)	17	19	22	25	28	30
	END FEED (PSI)	14	17	19	22	25	28
	PUMP (WATER) hp	46	50	54	59	64	68
	PUMP EFF. %	84.3%	84.5%	84.7%	85.0%	85.2%	85.4%
	12 IN ALUMINUM INLET - FT LIFT	12.1	11.4	10.7	10.1	9.4	8.7
	12 IN DOUBLE "T" INLET - FT LIFT	12.8	12.1	11.4	10.8	10.1	9.4
	14 IN DOUBLE "T" INLET - FT LIFT	14.0	13.3	12.6	12.0	11.3	10.6
	11 INCHES - 13 DEG.						
	CENTER FEED (PSI)	23	25	29	31	34	37
	END FEED (PSI)	20	23	26	28	31	34
	PUMP (WATER) hp	55	59	64	69	74	79
	PUMP EFF. %	86.3%	86.3%	86.3%	86.2%	86.2%	86.2%
	12 IN ALUMINUM INLET - FT LIFT	12.4	11.8	11.1	10.5	9.8	9.1
	12 IN DOUBLE "T" INLET - FT LIFT	13.1	12.5	11.8	11.2	10.5	9.8
	14 IN DOUBLE "T" INLET - FT LIFT	14.3	13.7	13.0	12.4	11.7	11.0
	11 INCHES - 0 DEG.						
	CENTER FEED (PSI)	25	28	31	35	38	41
	END FEED (PSI)	22	25	28	32	35	38
	PUMP (WATER) hp	58	63	69	75	80	85
	PUMP EFF. %	86.6%	86.5%	86.4%	86.3%	86.1%	86.0%
	12 IN ALUMINUM INLET - FT LIFT	12.7	12.0	11.1	10.4	9.7	9.2
	12 IN DOUBLE "T" INLET - FT LIFT	13.4	12.7	11.8	11.1	10.4	9.9
	14 IN DOUBLE "T" INLET - FT LIFT	14.6	13.9	13.0	12.3	11.6	11.1

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Valmont test data has been used to adjust the data for system loss and elevation within the system. Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design.

Rainger Linear Ditch Feed

Pump Performance Charts (Continued)

Chart C
Cornell 6YB Pump Performance

CENTERFEED]
END FEED] - PRESSURE (FT) AVAILABLE AT TOP OF CART (INCLUDES CART ELEVATION AND PIPING LOSSES.)

Altitude is assumed to be sea level*
Temperature is assumed to be 90 deg. F. (32.2 deg. C.)*
* See Table 6 on page 2-33 in Pump Selection for lift adjustments for altitude and temperature.

MAXIMUM ALLOWABLE SUCTION LIFT (FT) - DISTANCE IS MEASURED FROM BOTTOM OF CART DRIVE UNIT TIRES.

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
2600	9.5 INCHES - 13 DEG.						
	CENTER FEED (PSI)				9	11	13
	END FEED (PSI)				NA	8	11
	PUMP (WATER) hp				39	42	45
	PUMP EFF. %	NA	NA	NA	74.8%	77.0%	79.2%
	12 IN ALUMINUM INLET - FT LIFT				6.3	6.0	5.6
	12 IN DOUBLE "T" INLET - FT LIFT				7.0	6.7	6.3
	14 IN DOUBLE "T" INLET - FT LIFT				8.3	8.0	7.6
	10 INCHES - 13 DEG.						
	CENTER FEED (PSI)	10	11	14	16	19	21
	END FEED (PSI)	NA	8	11	13	16	18
	PUMP (WATER) hp	38	40	45	48	53	57
	PUMP EFF. %	78.7%	79.6%	80.5%	81.5%	82.4%	83.3%
	12 IN ALUMINUM INLET - FT LIFT	10.7	10.1	9.5	8.9	8.3	7.7
	12 IN DOUBLE "T" INLET - FT LIFT	11.4	10.8	10.2	9.6	9.0	8.4
	14 IN DOUBLE "T" INLET - FT LIFT	12.7	12.1	11.5	10.9	10.3	9.7
	10.5 INCHES - 13 DEG.						
	CENTER FEED (PSI)	15	18	20	23	26	29
	END FEED (PSI)	12	15	17	21	23	26
	PUMP (WATER) hp	46	50	55	60	64	68
	PUMP EFF. %	83.2%	83.7%	84.2%	84.8%	85.3%	85.8%
	12 IN ALUMINUM INLET - FT LIFT	11.7	11.0	10.3	9.7	9.0	8.3
	12 IN DOUBLE "T" INLET - FT LIFT	12.4	11.7	11.0	10.4	9.7	9.0
	14 IN DOUBLE "T" INLET - FT LIFT	13.7	13.0	12.3	11.7	11.0	10.3
	11 INCHES - 13 DEG.						
	CENTER FEED (PSI)	21	24	27	30	33	36
	END FEED (PSI)	18	21	24	27	30	33
	PUMP (WATER) hp	54	59	65	69	75	80
	PUMP EFF. %	86.0%	86.1%	86.1%	86.2%	86.3%	86.4%
	12 IN ALUMINUM INLET - FT LIFT	11.9	11.2	10.6	10.0	9.4	8.8
	12 IN DOUBLE "T" INLET - FT LIFT	12.6	11.9	11.3	10.7	10.1	9.5
	14 IN DOUBLE "T" INLET - FT LIFT	13.9	13.2	12.6	12.0	11.4	10.8
	11 INCHES - 0 DEG.						
	CENTER FEED (PSI)	23	26	30	33	36	39
	END FEED (PSI)	21	24	27	30	33	36
	PUMP (WATER) hp	59	64	69	75	81	86
	PUMP EFF. %	86.1%	86.2%	86.2%	86.2%	86.3%	86.3%
	12 IN ALUMINUM INLET - FT LIFT	12.0	11.4	10.8	10.1	9.5	8.9
	12 IN DOUBLE "T" INLET - FT LIFT	12.7	12.1	11.5	10.8	10.2	9.6
	14 IN DOUBLE "T" INLET - FT LIFT	14.0	13.4	12.8	12.1	11.5	10.9

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
2700	9.5 INCHES - 13 DEG.						
	CENTER FEED (PSI)				8	9	11
	END FEED (PSI)				NA	NA	8
	PUMP (WATER) hp				38	40	43
	PUMP EFF. %	NA	NA	NA	72.7%	76.1%	79.5%
	12 IN ALUMINUM INLET - FT LIFT				9.2	10.2	4.7
	12 IN DOUBLE "T" INLET - FT LIFT				10.0	11.0	5.5
	14 IN DOUBLE "T" INLET - FT LIFT				11.4	12.4	6.9
	10 INCHES - 13 DEG.						
	CENTER FEED (PSI)		9	12	14	17	19
	END FEED (PSI)		NA	9	11	14	16
	PUMP (WATER) hp		40	45	48	52	56
	PUMP EFF. %	NA	75.9%	77.6%	79.3%	81.0%	82.7%
	12 IN ALUMINUM INLET - FT LIFT		9.3	8.8	8.2	7.7	7.1
	12 IN DOUBLE "T" INLET - FT LIFT		10.1	9.6	9.0	8.5	7.9
	14 IN DOUBLE "T" INLET - FT LIFT		11.5	11.0	10.4	9.9	9.3
	10.5 INCHES - 13 DEG.						
	CENTER FEED (PSI)	13	16	18	21	24	27
	END FEED (PSI)	10	13	15	18	21	24
	PUMP (WATER) hp	44	49	54	59	64	69
	PUMP EFF. %	82.1%	82.7%	83.3%	83.8%	84.4%	85.0%
	12 IN ALUMINUM INLET - FT LIFT	11.0	10.4	9.8	9.1	8.5	7.8
	12 IN DOUBLE "T" INLET - FT LIFT	11.8	11.2	10.6	9.9	9.3	8.6
	14 IN DOUBLE "T" INLET - FT LIFT	13.2	12.6	12.0	11.3	10.7	10.0
	11 INCHES - 13 DEG.						
	CENTER FEED (PSI)	19	22	25	28	31	34
	END FEED (PSI)	16	19	22	25	28	31
	PUMP (WATER) hp	54	59	65	70	75	80
	PUMP EFF. %	84.9%	85.2%	85.5%	85.8%	86.1%	86.4%
	12 IN ALUMINUM INLET - FT LIFT	11.2	10.6	10.0	9.5	8.9	8.3
	12 IN DOUBLE "T" INLET - FT LIFT	12.0	11.4	10.8	10.3	9.7	9.1
	14 IN DOUBLE "T" INLET - FT LIFT	13.4	12.8	12.2	11.7	11.1	10.5
	11 INCHES - 0 DEG.						
	CENTER FEED (PSI)	21	24	27	31	34	37
	END FEED (PSI)	18	21	24	28	31	34
	PUMP (WATER) hp	57	64	69	75	81	87
	PUMP EFF. %	85.5%	85.7%	85.9%	86.1%	86.3%	86.5%
	12 IN ALUMINUM INLET - FT LIFT	11.4	10.8	10.2	9.7	9.1	8.5
	12 IN DOUBLE "T" INLET - FT LIFT	12.2	11.6	11.0	10.5	9.9	9.3
	14 IN DOUBLE "T" INLET - FT LIFT	13.6	13.0	12.4	11.9	11.3	10.7

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Valmont test data has been used to adjust the data for system loss and elevation within the system. Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design.

Pump Performance Charts (Continued)

Chart C
Cornell 6YB Pump Performance

CENTERFEED]
END FEED] - PRESSURE (FT) AVAILABLE AT TOP OF CART (INCLUDES CART ELEVATION AND PIPING LOSSES)

Altitude is assumed to be sea level *
Temperature is assumed to be 90 deg. F. (32.2 deg. C.)*
* See Table 6 on page 2-33 in Pump Selection for lift adjustments for altitude and temperature.

MAXIMUM ALLOWABLE SUCTION LIFT (FT) - DISTANCE IS MEASURED FROM BOTTOM OF CART DRIVE UNIT TIRES

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM					
		1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
2800	9.5 INCHES - 13 DEG.						
	CENTER FEED (PSI)						
	END FEED (PSI)						
	PUMP (WATER) hp						
	PUMP EFF. %	NA	NA	NA	NA	NA	NA
	12 IN ALUMINUM INLET - FT LIFT						
	12 IN DOUBLE "T" INLET - FT LIFT						
	14 IN DOUBLE "T" INLET - FT LIFT						
	10 INCHES - 13 DEG.						
	CENTER FEED (PSI)			9	12	15	17
	END FEED (PSI)			NA	9	11	14
	PUMP (WATER) hp			44	48	52	56
	PUMP EFF. %	NA	NA	74.4%	76.7%	78.9%	81.2%
	12 IN ALUMINUM INLET - FT LIFT			8.1	7.5	7.0	6.4
	12 IN DOUBLE "T" INLET - FT LIFT			8.9	8.3	7.8	7.2
	14 IN DOUBLE "T" INLET - FT LIFT			10.3	9.7	9.2	8.6
	10.5 INCHES - 13 DEG.						
	CENTER FEED (PSI)	11	14	16	19	22	25
	END FEED (PSI)	NA	10	13	16	19	22
	PUMP (WATER) hp	44	49	54	59	64	69
	PUMP EFF. %	79.0%	80.1%	81.2%	82.2%	83.3%	84.3%
	12 IN ALUMINUM INLET - FT LIFT	10.4	9.8	9.2	8.5	7.9	7.3
	12 IN DOUBLE "T" INLET - FT LIFT	11.2	10.6	10.0	9.3	8.7	8.1
	14 IN DOUBLE "T" INLET - FT LIFT	12.6	12.0	11.4	10.7	10.1	9.5
	11 INCHES - 13 DEG.						
	CENTER FEED (PSI)	16	20	23	26	29	32
	END FEED (PSI)	13	16	19	23	26	29
	PUMP (WATER) hp	53	59	65	71	76	81
	PUMP EFF. %	83.0%	83.7%	84.3%	85.0%	85.6%	86.3%
	12 IN ALUMINUM INLET - FT LIFT	10.7	10.1	9.5	8.9	8.3	7.7
	12 IN DOUBLE "T" INLET - FT LIFT	11.5	10.9	10.3	9.7	9.1	8.5
	14 IN DOUBLE "T" INLET - FT LIFT	12.9	12.3	11.7	11.1	10.5	9.9
	11 INCHES - 0 DEG.						
	CENTER FEED (PSI)	19	22	25	29	32	35
	END FEED (PSI)	16	19	22	26	29	32
	PUMP (WATER) hp	58	64	69	75	81	87
	PUMP EFF. %	84.0%	84.4%	84.9%	85.4%	85.9%	86.4%
	12 IN ALUMINUM INLET - FT LIFT	10.8	10.2	9.7	9.1	8.6	8.0
	12 IN DOUBLE "T" INLET - FT LIFT	11.6	11.0	10.5	9.9	9.4	8.8
	14 IN DOUBLE "T" INLET - FT LIFT	13.0	12.4	11.9	11.3	10.8	10.2

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM					
		1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
2900	9.5 INCHES - 13 DEG.						
	CENTER FEED (PSI)						
	END FEED (PSI)						
	PUMP (WATER) hp						
	PUMP EFF. %	NA	NA	NA	NA	NA	NA
	12 IN ALUMINUM INLET - FT LIFT						
	12 IN DOUBLE "T" INLET - FT LIFT						
	14 IN DOUBLE "T" INLET - FT LIFT						
	10 INCHES - 13 DEG.						
	CENTER FEED (PSI)					10	15
	END FEED (PSI)					NA	12
	PUMP (WATER) hp					45	56
	PUMP EFF. %	NA	NA	NA	NA	77.0%	79.0%
	12 IN ALUMINUM INLET - FT LIFT					6.2	5.5
	12 IN DOUBLE "T" INLET - FT LIFT					7.0	6.3
	14 IN DOUBLE "T" INLET - FT LIFT					8.6	7.9
	10.5 INCHES - 13 DEG.						
	CENTER FEED (PSI)	9	11	14	17	20	23
	END FEED (PSI)	NA	8	11	13	16	19
	PUMP (WATER) hp	44	49	54	59	64	68
	PUMP EFF. %	74.4%	76.3%	78.1%	80.0%	81.8%	83.6%
	12 IN ALUMINUM INLET - FT LIFT	9.5	9.0	8.4	7.9	7.4	6.8
	12 IN DOUBLE "T" INLET - FT LIFT	10.3	9.8	9.2	8.7	8.2	7.6
	14 IN DOUBLE "T" INLET - FT LIFT	11.9	11.4	10.8	10.3	9.8	9.2
	11 INCHES - 13 DEG.						
	CENTER FEED (PSI)	15	18	21	24	27	31
	END FEED (PSI)	11	14	17	21	24	27
	PUMP (WATER) hp	53	59	64	71	76	82
	PUMP EFF. %	80.8%	81.8%	82.9%	84.0%	85.0%	86.1%
	12 IN ALUMINUM INLET - FT LIFT	9.7	9.4	8.8	8.3	7.7	7.1
	12 IN DOUBLE "T" INLET - FT LIFT	10.5	10.2	9.6	9.1	8.5	7.9
	14 IN DOUBLE "T" INLET - FT LIFT	12.1	11.8	11.2	10.7	10.1	9.5
	11 INCHES - 0 DEG.						
	CENTER FEED (PSI)	17	21	24	27	30	34
	END FEED (PSI)	14	17	20	24	27	30
	PUMP (WATER) hp	58	64	70	76	81	88
	PUMP EFF. %	82.6%	83.1%	83.9%	84.6%	85.4%	86.2%
	12 IN ALUMINUM INLET - FT LIFT	10.0	9.4	8.9	8.3	7.8	7.3
	12 IN DOUBLE "T" INLET - FT LIFT	10.8	10.2	9.7	9.1	8.6	8.1
	14 IN DOUBLE "T" INLET - FT LIFT	12.4	11.8	11.3	10.7	10.2	9.7

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Valmont test data has been used to adjust the data for system loss and elevation within the system. Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design.

Rainger Linear Ditch Feed

Pump Performance Charts (Continued)

Chart C
Cornell 6YB Pump Performance

CENTERFEED]
END FEED] - PRESSURE (FT) AVAILABLE AT TOP OF CART (INCLUDES CART ELEVATION AND PIPING LOSSES.)

MAXIMUM ALLOWABLE SUCTION LIFT (FT) - DISTANCE IS MEASURED FROM BOTTOM OF CART DRIVE UNIT TIRES.

Altitude is assumed to be sea level.*
Temperature is assumed to be 90 deg. F. (32.2 deg. C.)*
* See Table 6 on page 2-33 in Pump Selection for lift adjustments for altitude and temperature.

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM					
		1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
3000	9.5 INCHES - 13 DEG.						
	CENTER FEED (PSI)						
	END FEED (PSI)						
	PUMP (WATER) hp						
	PUMP EFF. %	NA	NA	NA	NA	NA	NA
	12 IN ALUMINUM INLET - FT LIFT						
	12 IN DOUBLE "T" INLET - FT LIFT						
	14 IN DOUBLE "T" INLET - FT LIFT						
	10 INCHES - 13 DEG.						
	CENTER FEED (PSI)						
	END FEED (PSI)						
	PUMP (WATER) hp						
	PUMP EFF. %	NA	NA	NA	NA	NA	NA
	12 IN ALUMINUM INLET - FT LIFT						
	12 IN DOUBLE "T" INLET - FT LIFT						
	14 IN DOUBLE "T" INLET - FT LIFT						
	10.5 INCHES - 13 DEG.						
	CENTER FEED (PSI)		9	13	15	18	21
	END FEED (PSI)		NA	9	11	14	17
	PUMP (WATER) hp		49	56	61	65	70
	PUMP EFF. %	NA	72.0%	74.0%	76.0%	78.0%	80.0%
	12 IN ALUMINUM INLET - FT LIFT		10.2	7.9	7.8	7.7	7.6
	12 IN DOUBLE "T" INLET - FT LIFT		8.9	8.8	8.7	8.6	8.5
	14 IN DOUBLE "T" INLET - FT LIFT		10.5	10.4	10.3	10.2	10.1
	11 INCHES - 13 DEG.						
	CENTER FEED (PSI)	12	15	19	22	25	29
	END FEED (PSI)	8	11	15	18	21	25
	PUMP (WATER) hp	52	58	65	70	76	82
	PUMP EFF. %	NA	79.2%	80.7%	82.2%	83.7%	85.2%
	12 IN ALUMINUM INLET - FT LIFT	9.0	8.5	8.0	7.5	7.0	6.5
	12 IN DOUBLE "T" INLET - FT LIFT	9.9	9.4	8.9	8.4	7.9	7.4
	14 IN DOUBLE "T" INLET - FT LIFT	11.5	11.0	10.5	10.0	9.5	9.0
	11 INCHES - 0 DEG.						
	CENTER FEED (PSI)	15	18	22	25	28	32
	END FEED (PSI)	11	14	18	21	24	28
	PUMP (WATER) hp	57	64	70	76	82	88
	PUMP EFF. %	79.5%	80.7%	81.9%	83.2%	84.4%	85.7%
	12 IN ALUMINUM INLET - FT LIFT	9.1	8.6	8.1	7.6	7.1	6.6
	12 IN DOUBLE "T" INLET - FT LIFT	10.0	9.5	9.0	8.5	8.0	7.5
	14 IN DOUBLE "T" INLET - FT LIFT	11.6	11.1	10.6	10.1	9.6	9.1

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM					
		1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
3100	9.5 INCHES - 13 DEG.						
	CENTER FEED (PSI)						
	END FEED (PSI)						
	PUMP (WATER) hp						
	PUMP EFF. %	NA	NA	NA	NA	NA	NA
	12 IN ALUMINUM INLET - FT LIFT						
	12 IN DOUBLE "T" INLET - FT LIFT						
	14 IN DOUBLE "T" INLET - FT LIFT						
	10 INCHES - 13 DEG.						
	CENTER FEED (PSI)						
	END FEED (PSI)						
	PUMP (WATER) hp						
	PUMP EFF. %	NA	NA	NA	NA	NA	NA
	12 IN ALUMINUM INLET - FT LIFT						
	12 IN DOUBLE "T" INLET - FT LIFT						
	14 IN DOUBLE "T" INLET - FT LIFT						
	10.5 INCHES - 13 DEG.						
	CENTER FEED (PSI)						
	END FEED (PSI)						
	PUMP (WATER) hp						
	PUMP EFF. %	NA	NA	NA	NA	NA	NA
	12 IN ALUMINUM INLET - FT LIFT						
	12 IN DOUBLE "T" INLET - FT LIFT						
	14 IN DOUBLE "T" INLET - FT LIFT						
	11 INCHES - 13 DEG.						
	CENTER FEED (PSI)						
	END FEED (PSI)						
	PUMP (WATER) hp						
	PUMP EFF. %	NA	NA	NA	NA	NA	NA
	12 IN ALUMINUM INLET - FT LIFT						
	12 IN DOUBLE "T" INLET - FT LIFT						
	14 IN DOUBLE "T" INLET - FT LIFT						
	11 INCHES - 0 DEG.						
	CENTER FEED (PSI)						
	END FEED (PSI)						
	PUMP (WATER) hp						
	PUMP EFF. %	NA	NA	NA	NA	NA	NA
	12 IN ALUMINUM INLET - FT LIFT						
	12 IN DOUBLE "T" INLET - FT LIFT						
	14 IN DOUBLE "T" INLET - FT LIFT						

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Valmont test data has been used to adjust the data for system loss and elevation within the system. Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design.

Pump Performance Charts (Continued)

Chart D
Cornell 6RB Pump Performance

CENTERFEED]
END FEED] - PRESSURE (FT) AVAILABLE AT TOP OF CART (INCLUDES CART ELEVATION AND PIPING LOSSES)

Altitude is assumed to be sea level *
Temperature is assumed to be 90 deg. F. (32.2 deg. C.)*
* See Table 6 on page 2-33 in Pump Selection for lift adjustments for altitude and temperature.

MAXIMUM ALLOWABLE SUCTION LIFT (FT) - DISTANCE IS MEASURED FROM BOTTOM OF CART DRIVE UNIT TIRES

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM					
		1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
1800	11.0 INCHES						
	CENTER FEED (PSI)	33	36	38	42	45	49
	END FEED (PSI)	31	34	37	40	44	47
	PUMP (WATER) hp	52	57	61	67	72	78
	PUMP EFF. %	81.5%	80.5%	79.5%	78.5%	77.4%	76.4%
	12 IN ALUMINUM INLET - FT LIFT	14.1	13.6	12.9	12.3	11.7	11.1
	12 IN SINGLE INLET - FT LIFT	14.9	14.4	13.7	13.1	12.5	11.9
	12 IN DOUBLE "T" INLET - FT LIFT	14.6	14.1	13.4	12.8	12.2	11.6
	14 IN DOUBLE "T" INLET - FT LIFT	15.2	14.7	14.0	13.4	12.8	12.2
	12.0 INCHES						
	CENTER FEED (PSI)	46	50	54	57	61	65
	END FEED (PSI)	44	48	52	56	60	63
	PUMP (WATER) hp	69	75	81	86	93	99
	PUMP EFF. %	81.8%	80.9%	79.9%	79.0%	78.0%	77.1%
	12 IN Aluminum INLET - FT LIFT	14.8	14.1	13.4	12.7	12.0	11.3
	12 IN SINGLE INLET - FT LIFT	15.6	14.9	14.2	13.5	12.8	12.1
	12 IN DOUBLE "T" INLET - FT LIFT	15.3	14.6	13.9	13.2	12.5	11.8
	14 IN DOUBLE "T" INLET - FT LIFT	15.9	15.2	14.5	13.8	13.1	12.4
	13.0 INCHES						
	CENTER FEED (PSI)	58	63	67	72	76	81
	END FEED (PSI)	57	61	66	70	75	79
	PUMP (WATER) hp	86	92	99	107	114	122
	PUMP EFF. %	81.2%	80.2%	79.2%	78.2%	77.2%	76.2%
	12 IN ALUMINUM INLET - FT LIFT	14.9	14.1	13.4	12.7	12.0	11.3
	12 IN SINGLE INLET - FT LIFT	15.7	14.9	14.2	13.5	12.8	12.1
	12 IN DOUBLE "T" INLET - FT LIFT	15.4	14.6	13.9	13.2	12.5	11.8
	14 IN DOUBLE "T" INLET - FT LIFT	16.0	15.2	14.5	13.8	13.1	12.4
	13.5 INCHES						
	CENTER FEED (PSI)	66	70	75	80	85	90
	END FEED (PSI)	65	69	73	79	83	88
	PUMP (WATER) hp	97	103	111	120	128	136
	PUMP EFF. %	80.1%	79.1%	78.0%	77.0%	76.0%	75.0%
	12 IN ALUMINUM INLET - FT LIFT	14.9	14.1	13.4	12.7	12.0	11.3
	12 IN SINGLE INLET - FT LIFT	15.7	14.9	14.2	13.5	12.8	12.1
	12 IN DOUBLE "T" INLET - FT LIFT	15.4	14.6	13.9	13.2	12.5	11.8
	14 IN DOUBLE "T" INLET - FT LIFT	16.0	15.2	14.5	13.8	13.1	12.4

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM					
		1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
1900	11.0 INCHES						
	CENTER FEED (PSI)	32	35	38	41	44	47
	END FEED (PSI)	30	33	36	40	43	46
	PUMP (WATER) hp	53	58	62	68	72	78
	PUMP EFF. %	82.6%	82.0%	81.4%	80.8%	80.2%	78.6%
	12 IN ALUMINUM INLET - FT LIFT	13.4	12.9	12.4	11.8	11.2	10.6
	12 IN SINGLE INLET - FT LIFT	14.3	13.8	13.3	12.7	12.1	11.5
	12 IN DOUBLE "T" INLET - FT LIFT	14.0	13.5	13.0	12.4	11.8	11.2
	14 IN DOUBLE "T" INLET - FT LIFT	14.6	14.1	13.6	13.0	12.4	11.8
	12.0 INCHES						
	CENTER FEED (PSI)	44	48	52	56	60	64
	END FEED (PSI)	43	47	51	54	58	62
	PUMP (WATER) hp	70	76	82	88	94	100
	PUMP EFF. %	83.2%	82.4%	81.6%	80.9%	80.1%	79.3%
	12 IN ALUMINUM INLET - FT LIFT	14.5	13.8	13.1	12.4	11.7	11.0
	12 IN SINGLE INLET - FT LIFT	15.4	14.7	14.0	13.3	12.6	11.9
	12 IN DOUBLE "T" INLET - FT LIFT	15.1	14.4	13.7	13.0	12.3	11.6
	14 IN DOUBLE "T" INLET - FT LIFT	15.7	15.0	14.3	13.6	12.9	12.2
	13.0 INCHES						
	CENTER FEED (PSI)	58	62	66	71	75	80
	END FEED (PSI)	56	60	65	69	74	78
	PUMP (WATER) hp	88	95	102	109	117	125
	PUMP EFF. %	82.7%	81.8%	80.9%	80.0%	79.1%	78.2%
	12 IN ALUMINUM INLET - FT LIFT	14.5	13.8	13.1	12.4	11.7	11.0
	12 IN SINGLE INLET - FT LIFT	15.4	14.7	14.0	13.3	12.6	11.9
	12 IN DOUBLE "T" INLET - FT LIFT	15.1	14.4	13.7	13.0	12.3	11.6
	14 IN DOUBLE "T" INLET - FT LIFT	15.7	15.0	14.3	13.6	12.9	12.2
	13.5 INCHES						
	CENTER FEED (PSI)	64	69	74	79	84	88
	END FEED (PSI)	63	67	72	77	82	87
	PUMP (WATER) hp	98	106	113	122	130	139
	PUMP EFF. %	81.9%	80.9%	80.0%	79.0%	78.0%	77.0%
	12 IN ALUMINUM INLET - FT LIFT	14.5	13.8	13.1	12.4	11.7	11.0
	12 IN SINGLE INLET - FT LIFT	15.4	14.7	14.0	13.3	12.6	11.9
	12 IN DOUBLE "T" INLET - FT LIFT	15.1	14.4	13.7	13.0	12.3	11.6
	14 IN DOUBLE "T" INLET - FT LIFT	15.7	15.0	14.3	13.6	12.9	12.2

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Valmont test data has been used to adjust the data for system loss and elevation within the system. Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design.

Rainger Linear Ditch Feed

Pump Performance Charts (Continued)

Chart D
Cornell 6RB Pump Performance

CENTERFEED]
END FEED] - PRESSURE (FT) AVAILABLE AT TOP OF CART (INCLUDES CART ELEVATION AND PIPING LOSSES.)

Altitude is assumed to be sea level.*
Temperature is assumed to be 90 deg. F. (32.2 deg. C.)*
* See Table 6 on page 2-33 in Pump Selection for lift adjustments for altitude and temperature.

MAXIMUM ALLOWABLE SUCTION LIFT (FT) - DISTANCE IS MEASURED FROM BOTTOM OF CART DRIVE UNIT TIRES.

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM					
		1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
2000	11.0 INCHES						
	CENTER FEED (PSI)	30	33	36	39	43	46
	END FEED (PSI)	28	32	35	38	41	44
	PUMP (WATER) hp	53	58	63	68	73	78
	PUMP EFF. %	84.2%	83.5%	82.7%	82.0%	81.2%	80.5%
	12 IN ALUMINUM INLET - FT LIFT	12.9	12.3	11.8	11.2	10.7	10.1
	12 IN SINGLE INLET - FT LIFT	13.8	13.2	12.7	12.1	11.6	11.0
	12 IN DOUBLE "T" INLET - FT LIFT	13.5	12.9	12.4	11.8	11.3	10.7
	14 IN DOUBLE "T" INLET - FT LIFT	14.2	13.6	13.1	12.5	12.0	11.4
	12.0 INCHES						
	CENTER FEED (PSI)	43	47	51	55	59	63
	END FEED (PSI)	41	45	49	53	57	61
	PUMP (WATER) hp	71	77	83	89	96	102
	PUMP EFF. %	84.7%	84.0%	83.2%	82.5%	81.7%	80.9%
	12 IN ALUMINUM INLET - FT LIFT	14.3	13.6	12.9	12.2	11.5	10.8
	12 IN SINGLE INLET - FT LIFT	15.2	14.5	13.8	13.1	12.4	11.7
	12 IN DOUBLE "T" INLET - FT LIFT	14.9	14.2	13.5	12.8	12.1	11.4
	14 IN DOUBLE "T" INLET - FT LIFT	15.6	14.9	14.2	13.5	12.8	12.1
	13.0 INCHES						
	CENTER FEED (PSI)	56	61	65	70	74	79
	END FEED (PSI)	54	59	64	68	73	77
	PUMP (WATER) hp	89	97	104	112	119	127
	PUMP EFF. %	84.2%	83.4%	82.6%	81.8%	81.0%	80.2%
	12 IN ALUMINUM INLET - FT LIFT	14.3	13.6	12.9	12.2	11.5	10.8
	12 IN SINGLE INLET - FT LIFT	15.2	14.5	13.8	13.1	12.4	11.7
	12 IN DOUBLE "T" INLET - FT LIFT	14.9	14.2	13.5	12.8	12.1	11.4
	14 IN DOUBLE "T" INLET - FT LIFT	15.6	14.9	14.2	13.5	12.8	12.1
	13.5 INCHES						
	CENTER FEED (PSI)	63	68	73	78	83	88
	END FEED (PSI)	61	66	71	76	81	86
	PUMP (WATER) hp	100	108	116	124	133	142
	PUMP EFF. %	83.5%	82.6%	81.7%	80.8%	80.0%	79.1%
	12 IN ALUMINUM INLET - FT LIFT	14.3	13.6	12.9	12.2	11.5	10.8
	12 IN SINGLE INLET - FT LIFT	15.2	14.5	13.8	13.1	12.4	11.7
	12 IN DOUBLE "T" INLET - FT LIFT	14.9	14.2	13.5	12.8	12.1	11.4
	14 IN DOUBLE "T" INLET - FT LIFT	15.6	14.9	14.2	13.5	12.8	12.1

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM					
		1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
2100	11.0 INCHES						
	CENTER FEED (PSI)	29	32	35	38	41	44
	END FEED (PSI)	27	30	33	36	39	42
	PUMP (WATER) hp	53	58	63	68	74	79
	PUMP EFF. %	85.8%	85.0%	84.2%	83.4%	82.6%	81.8%
	12 IN ALUMINUM INLET - FT LIFT	12.2	11.6	11.0	10.5	9.9	9.3
	12 IN SINGLE INLET - FT LIFT	13.3	12.7	12.1	11.6	11.0	10.4
	12 IN DOUBLE "T" INLET - FT LIFT	12.9	12.3	11.7	11.2	10.6	10.0
	14 IN DOUBLE "T" INLET - FT LIFT	13.7	13.1	12.5	12.0	11.4	10.8
	12.0 INCHES						
	CENTER FEED (PSI)	43	46	50	53	57	61
	END FEED (PSI)	41	44	48	51	55	59
	PUMP (WATER) hp	73	78	85	90	97	104
	PUMP EFF. %	86.0%	85.3%	84.5%	83.8%	83.0%	82.3%
	12 IN ALUMINUM INLET - FT LIFT	14.0	13.3	12.6	11.9	11.2	10.5
	12 IN SINGLE INLET - FT LIFT	15.1	14.4	13.7	13.0	12.3	11.6
	12 IN DOUBLE "T" INLET - FT LIFT	14.7	14.0	13.3	12.6	11.9	11.2
	14 IN DOUBLE "T" INLET - FT LIFT	15.5	14.8	14.1	13.4	12.7	12.0
	13.0 INCHES						
	CENTER FEED (PSI)	56	60	64	69	73	78
	END FEED (PSI)	54	58	62	67	71	76
	PUMP (WATER) hp	91	99	106	114	122	130
	PUMP EFF. %	85.8%	85.0%	84.1%	83.3%	82.4%	81.6%
	12 IN ALUMINUM INLET - FT LIFT	14.0	13.3	12.6	11.9	11.2	10.5
	12 IN SINGLE INLET - FT LIFT	15.1	14.4	13.7	13.0	12.3	11.6
	12 IN DOUBLE "T" INLET - FT LIFT	14.7	14.0	13.3	12.6	11.9	11.2
	14 IN DOUBLE "T" INLET - FT LIFT	15.5	14.8	14.1	13.4	12.7	12.0
	13.5 INCHES						
	CENTER FEED (PSI)	62	67	72	77	82	87
	END FEED (PSI)	61	65	70	75	80	85
	PUMP (WATER) hp	102	110	118	127	136	144
	PUMP EFF. %	85.0%	84.2%	83.4%	82.5%	81.6%	80.8%
	12 IN ALUMINUM INLET - FT LIFT	14.0	13.3	12.6	11.9	11.2	10.5
	12 IN SINGLE INLET - FT LIFT	15.1	14.4	13.7	13.0	12.3	11.6
	12 IN DOUBLE "T" INLET - FT LIFT	14.7	14.0	13.3	12.6	11.9	11.2
	14 IN DOUBLE "T" INLET - FT LIFT	15.5	14.8	14.1	13.4	12.7	12.0

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Valmont test data has been used to adjust the data for system loss and elevation within the system. Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design.

Pump Performance Charts (Continued)

Chart D
Cornell 6RB Pump Performance

CENTERFEED]
END FEED] - PRESSURE (FT) AVAILABLE AT TOP OF CART (INCLUDES CART ELEVATION AND PIPING LOSSES)

MAXIMUM ALLOWABLE SUCTION LIFT (FT) - DISTANCE IS MEASURED FROM BOTTOM OF CART DRIVE UNIT TIRES

Altitude is assumed to be sea level *
Temperature is assumed to be 90 deg. F. (32.2 deg. C.)*
* See Table 6 on page 2-33 in Pump Selection for lift adjustments for altitude and temperature.

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM					
		1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
2200	11.0 INCHES						
	CENTER FEED (PSI)	27	30	33	37	40	43
	END FEED (PSI)	25	28	31	35	38	41
	PUMP (WATER) hp	54	58	63	69	74	79
	PUMP EFF. %	86.1%	85.6%	85.0%	84.3%	83.7%	83.2%
	12 IN ALUMINUM INLET - FT LIFT	11.5	10.9	10.3	9.8	9.2	8.6
	12 IN DOUBLE "T" INLET - FT LIFT	12.2	11.6	11.0	10.5	9.9	9.3
	14 IN DOUBLE "T" INLET - FT LIFT	13.1	12.5	11.9	11.4	10.8	10.2
	12.0 INCHES						
	CENTER FEED (PSI)	41	44	48	52	56	60
	END FEED (PSI)	38	42	46	50	54	58
	PUMP (WATER) hp	73	79	86	92	99	106
	PUMP EFF. %	87.0%	86.3%	85.7%	84.9%	84.3%	83.7%
	12 IN ALUMINUM INLET - FT LIFT	13.7	13.0	12.3	11.6	10.8	10.2
	12 IN DOUBLE "T" INLET - FT LIFT	14.4	13.7	13.0	12.3	11.5	10.9
	14 IN DOUBLE "T" INLET - FT LIFT	15.3	14.6	13.9	13.2	12.4	11.8
	13.0 INCHES						
	CENTER FEED (PSI)	54	59	63	68	72	77
	END FEED (PSI)	52	57	61	66	70	75
	PUMP (WATER) hp	93	101	108	116	124	132
	PUMP EFF. %	86.8%	86.1%	85.3%	84.6%	83.8%	83.1%
	12 IN ALUMINUM INLET - FT LIFT	13.7	13.0	12.3	11.6	10.8	10.2
	12 IN DOUBLE "T" INLET - FT LIFT	14.4	13.7	13.0	12.3	11.5	10.9
	14 IN DOUBLE "T" INLET - FT LIFT	15.3	14.6	13.9	13.2	12.4	11.8
	13.5 INCHES						
	CENTER FEED (PSI)	60	65	70	75	80	86
	END FEED (PSI)	58	63	68	73	78	83
	PUMP (WATER) hp	102	110	119	128	137	147
	PUMP EFF. %	87.5%	86.5%	85.5%	84.5%	83.3%	82.2%
	12 IN ALUMINUM INLET - FT LIFT	13.7	13.0	12.3	11.6	10.8	10.2
	12 IN DOUBLE "T" INLET - FT LIFT	14.4	13.7	13.0	12.3	11.5	10.9
	14 IN DOUBLE "T" INLET - FT LIFT	15.3	14.6	13.9	13.2	12.4	11.8

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM					
		1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
2300	9.5 INCHES - 13 DEG.						
	CENTER FEED (PSI)	26	29	32	35	38	41
	END FEED (PSI)	23	26	29	33	36	39
	PUMP (WATER) hp	54	59	64	69	74	80
	PUMP EFF. %	86.7%	86.1%	85.7%	85.3%	85.0%	84.6%
	12 IN ALUMINUM INLET - FT LIFT	10.8	10.2	9.6	9.0	8.4	7.8
	12 IN DOUBLE "T" INLET - FT LIFT	11.5	10.9	10.3	9.7	9.1	8.5
	14 IN DOUBLE "T" INLET - FT LIFT	12.5	11.9	11.3	10.7	10.1	9.5
	10 INCHES - 13 DEG.						
	CENTER FEED (PSI)	39	43	47	51	55	58
	END FEED (PSI)	37	41	45	48	52	56
	PUMP (WATER) hp	74	81	87	93	100	107
	PUMP EFF. %	87.6%	87.1%	86.6%	86.1%	85.5%	85.0%
	12 IN ALUMINUM INLET - FT LIFT	13.3	12.6	12.0	11.3	10.6	9.9
	12 IN DOUBLE "T" INLET - FT LIFT	14.0	13.3	12.7	12.0	11.3	10.6
	14 IN DOUBLE "T" INLET - FT LIFT	15.0	14.3	13.7	13.0	12.3	11.6
	10.5 INCHES - 13 DEG.						
	CENTER FEED (PSI)	17	58	23	26	28	76
	END FEED (PSI)	15	55	21	24	26	74
	PUMP (WATER) hp	40	103	51	55	59	135
	PUMP EFF. %	87.0%	87.2%	86.0%	85.0%	85.0%	84.5%
	12 IN ALUMINUM INLET - FT LIFT	13.4	12.7	12.0	11.3	10.6	9.9
	12 IN DOUBLE "T" INLET - FT LIFT	14.1	13.4	12.7	12.0	11.3	10.6
	14 IN DOUBLE "T" INLET - FT LIFT	15.1	14.4	13.7	13.0	12.3	11.6
	11 INCHES - 13 DEG.						
	CENTER FEED (PSI)	60	65	70	75	80	84
	END FEED (PSI)	58	63	67	73	77	82
	PUMP (WATER) hp	106	114	123	132	141	150
	PUMP EFF. %	87.8%	87.0%	86.2%	85.4%	84.5%	83.7%
	12 IN ALUMINUM INLET - FT LIFT	13.4	12.7	12.0	11.3	10.6	9.9
	12 IN DOUBLE "T" INLET - FT LIFT	14.1	13.4	12.7	12.0	11.3	10.6
	14 IN DOUBLE "T" INLET - FT LIFT	15.1	14.4	13.7	13.0	12.3	11.6

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Valmont test data has been used to adjust the data for system loss and elevation within the system. Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design.

Pump Performance Charts (Continued)

Chart D
Cornell 6RB Pump Performance

CENTERFEED]
END FEED] - PRESSURE (FT) AVAILABLE AT TOP OF CART (INCLUDES CART ELEVATION AND PIPING LOSSES.)

Altitude is assumed to be sea level*
Temperature is assumed to be 90 deg. F. (32.2 deg. C.)*
* See Table 6 on page 2-33 in Pump Selection for lift adjustments for altitude and temperature.

MAXIMUM ALLOWABLE SUCTION LIFT (FT) - DISTANCE IS MEASURED FROM BOTTOM OF CART DRIVE UNIT TIRES.

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM					
		1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
2400	11.0 INCHES						
	CENTER FEED (PSI)	24	27	30	33	36	40
	END FEED (PSI)	21	25	28	31	34	37
	PUMP (WATER) hp	53	59	64	69	74	80
	PUMP EFF. %	87.0%	86.7%	86.3%	86.0%	85.6%	85.3%
	12 IN ALUMINUM INLET - FT LIFT	10.1	9.5	8.9	8.3	7.7	7.1
	12 IN DOUBLE "T" INLET - FT LIFT	10.8	10.2	9.6	9.0	8.4	7.8
	14 IN DOUBLE "T" INLET - FT LIFT	11.9	11.3	10.7	10.1	9.5	8.9
	12.0 INCHES						
	CENTER FEED (PSI)	38	42	46	50	53	57
	END FEED (PSI)	36	39	43	47	51	55
	PUMP (WATER) hp	76	82	88	95	101	109
	PUMP EFF. %	88.1%	87.7%	87.2%	86.8%	86.3%	85.9%
	12 IN ALUMINUM INLET - FT LIFT	12.4	11.9	11.3	10.7	10.2	9.6
	12 IN DOUBLE "T" INLET - FT LIFT	13.1	12.6	12.0	11.4	10.9	10.3
	14 IN DOUBLE "T" INLET - FT LIFT	14.2	13.7	13.1	12.5	12.0	11.4
	13.0 INCHES						
	CENTER FEED (PSI)	52	56	60	65	69	74
	END FEED (PSI)	49	54	58	63	67	72
	PUMP (WATER) hp	96	104	111	120	128	136
	PUMP EFF. %	88.8%	88.2%	87.6%	87.0%	86.3%	85.7%
	12 IN ALUMINUM INLET - FT LIFT	13.1	12.4	11.7	11.0	10.3	9.6
	12 IN DOUBLE "T" INLET - FT LIFT	13.8	13.1	12.4	11.7	11.0	10.3
	14 IN DOUBLE "T" INLET - FT LIFT	14.9	14.2	13.5	12.8	12.1	11.4
	13.5 INCHES						
	CENTER FEED (PSI)	60	63	68	73	79	83
	END FEED (PSI)	57	61	66	71	76	81
	PUMP (WATER) hp	110	116	125	134	143	152
	PUMP EFF. %	88.4%	87.8%	87.1%	86.5%	85.8%	85.1%
	12 IN ALUMINUM INLET - FT LIFT	13.1	12.4	11.7	11.0	10.3	9.6
	12 IN DOUBLE "T" INLET - FT LIFT	13.8	13.1	12.4	11.7	11.0	10.3
	14 IN DOUBLE "T" INLET - FT LIFT	14.9	14.2	13.5	12.8	12.1	11.4

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM					
		1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
2500	11.0 INCHES						
	CENTER FEED (PSI)	22	25	28	32	35	38
	END FEED (PSI)	19	22	25	29	32	35
	PUMP (WATER) hp	53	59	64	70	75	80
	PUMP EFF. %	86.2%	86.2%	86.1%	86.0%	86.0%	85.9%
	12 IN ALUMINUM INLET - FT LIFT	9.4	8.8	8.2	7.5	6.9	6.3
	12 IN DOUBLE "T" INLET - FT LIFT	10.1	9.5	8.9	8.2	7.6	7.0
	14 IN DOUBLE "T" INLET - FT LIFT	11.3	10.7	10.1	9.4	8.8	8.2
	12.0 INCHES						
	CENTER FEED (PSI)	36	40	44	48	52	56
	END FEED (PSI)	34	37	41	45	49	53
	PUMP (WATER) hp	76	82	89	96	103	110
	PUMP EFF. %	88.6%	88.3%	87.9%	87.5%	87.2%	86.8%
	12 IN ALUMINUM INLET - FT LIFT	11.8	11.3	10.8	10.3	9.8	9.3
	12 IN DOUBLE "T" INLET - FT LIFT	12.5	12.0	11.5	11.0	10.5	10.0
	14 IN DOUBLE "T" INLET - FT LIFT	13.7	13.2	12.7	12.2	11.7	11.2
	13.0 INCHES						
	CENTER FEED (PSI)	50	54	59	64	68	73
	END FEED (PSI)	47	52	57	61	66	70
	PUMP (WATER) hp	97	105	114	122	130	139
	PUMP EFF. %	89.5%	89.0%	88.4%	87.8%	87.3%	86.7%
	12 IN ALUMINUM INLET - FT LIFT	12.8	12.1	11.4	10.7	10.0	9.3
	12 IN DOUBLE "T" INLET - FT LIFT	13.5	12.8	12.1	11.4	10.7	10.0
	14 IN DOUBLE "T" INLET - FT LIFT	14.7	14.0	13.3	12.6	11.9	11.2
	13.5 INCHES						
	CENTER FEED (PSI)	57	62	67	72	77	82
	END FEED (PSI)	54	60	64	70	74	79
	PUMP (WATER) hp	117	118	130	140	148	155
	PUMP EFF. %	83.0%	88.7%	85.7%	85.5%	85.2%	86.3%
	12 IN ALUMINUM INLET - FT LIFT	12.8	12.1	11.4	10.7	10.0	9.3
	12 IN DOUBLE "T" INLET - FT LIFT	13.5	12.8	12.1	11.4	10.7	10.0
	14 IN DOUBLE "T" INLET - FT LIFT	14.7	14.0	13.3	12.6	11.9	11.2

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Valmont test data has been used to adjust the data for system loss and elevation within the system. Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design.

Pump Performance Charts (Continued)

Chart D
Cornell 6RB Pump Performance

CENTERFEED]
END FEED] - PRESSURE (FT) AVAILABLE AT TOP OF CART (INCLUDES CART ELEVATION AND PIPING LOSSES)

MAXIMUM ALLOWABLE SUCTION LIFT (FT) - DISTANCE IS MEASURED FROM BOTTOM OF CART DRIVE UNIT TIRES

Altitude is assumed to be sea level *
Temperature is assumed to be 90 deg. F. (32.2 deg. C.)*
* See Table 6 on page 2-33 in Pump Selection for lift adjustments for altitude and temperature.

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM					
		1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
2600	11.0 INCHES						
	CENTER FEED (PSI)	20	23	26	30	33	36
	END FEED (PSI)	17	21	24	27	30	33
	PUMP (WATER) hp	54	59	64	69	75	81
	PUMP EFF. %	85.4%	85.6%	85.8%	86.0%	86.2%	86.4%
	12 IN ALUMINUM INLET - FT LIFT	8.7	8.1	7.5	6.8	6.2	5.6
	12 IN DOUBLE "T" INLET - FT LIFT	9.4	8.8	8.2	7.5	6.9	6.3
	14 IN DOUBLE "T" INLET - FT LIFT	10.7	10.1	9.5	8.8	8.2	7.6
	12.0 INCHES						
	CENTER FEED (PSI)	35	39	43	46	50	54
	END FEED (PSI)	32	36	40	43	47	51
	PUMP (WATER) hp	76	83	90	97	104	111
	PUMP EFF. %	89.3%	88.9%	88.5%	88.1%	87.8%	87.4%
	12 IN ALUMINUM INLET - FT LIFT	11.1	10.6	10.1	9.6	9.1	8.6
	12 IN DOUBLE "T" INLET - FT LIFT	11.8	11.3	10.8	10.3	9.8	9.3
	14 IN DOUBLE "T" INLET - FT LIFT	13.1	12.6	12.1	11.6	11.1	10.6
	13.0 INCHES						
	CENTER FEED (PSI)	49	53	58	62	67	72
	END FEED (PSI)	46	50	55	59	64	69
	PUMP (WATER) hp	99	107	115	124	132	141
	PUMP EFF. %	89.6%	89.2%	88.8%	88.4%	88.0%	87.6%
	12 IN ALUMINUM INLET - FT LIFT	12.0	11.4	10.8	10.2	9.6	9.0
	12 IN DOUBLE "T" INLET - FT LIFT	12.7	12.1	11.5	10.9	10.3	9.7
	14 IN DOUBLE "T" INLET - FT LIFT	14.0	13.4	12.8	12.2	11.6	11.0
	13.5 INCHES						
	CENTER FEED (PSI)	55	61	66	71	76	81
	END FEED (PSI)	53	58	63	68	73	78
	PUMP (WATER) hp	111	120	130	138	148	158
	PUMP EFF. %	89.7%	89.1%	88.6%	88.2%	87.7%	87.3%
	12 IN ALUMINUM INLET - FT LIFT	12.2	11.6	11.0	10.3	9.7	9.0
	12 IN DOUBLE "T" INLET - FT LIFT	12.9	12.3	11.7	11.0	10.4	9.7
	14 IN DOUBLE "T" INLET - FT LIFT	14.2	13.6	13.0	12.3	11.7	11.0

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM					
		1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
2700	11.0 INCHES						
	CENTER FEED (PSI)	18	21	24	28	31	34
	END FEED (PSI)	15	18	21	25	28	31
	PUMP (WATER) hp	53	58	64	70	75	80
	PUMP EFF. %	84.7%	85.1%	85.4%	85.8%	86.1%	86.5%
	12 IN ALUMINUM INLET - FT LIFT	9.6	9.1	8.3	5.9	5.3	4.8
	12 IN DOUBLE "T" INLET - FT LIFT	8.6	8.1	7.3	6.7	6.1	5.6
	14 IN DOUBLE "T" INLET - FT LIFT	10.0	9.5	8.7	8.1	7.5	7.0
	12.0 INCHES						
	CENTER FEED (PSI)	34	37	41	44	48	52
	END FEED (PSI)	30	34	38	41	45	49
	PUMP (WATER) hp	78	84	91	97	105	112
	PUMP EFF. %	88.7%	88.5%	88.4%	88.2%	88.0%	87.9%
	12 IN ALUMINUM INLET - FT LIFT	10.2	9.7	9.2	8.8	8.3	7.8
	12 IN DOUBLE "T" INLET - FT LIFT	11.0	10.5	10.0	9.6	9.1	8.6
	14 IN DOUBLE "T" INLET - FT LIFT	12.4	11.9	11.4	11.0	10.5	10.0
	13.0 INCHES						
	CENTER FEED (PSI)	47	52	56	61	65	70
	END FEED (PSI)	44	49	53	58	62	67
	PUMP (WATER) hp	101	109	117	126	134	143
	PUMP EFF. %	89.5%	89.3%	89.0%	88.8%	88.6%	88.4%
	12 IN ALUMINUM INLET - FT LIFT	11.1	10.6	10.1	9.6	9.1	8.6
	12 IN DOUBLE "T" INLET - FT LIFT	11.9	11.4	10.9	10.4	9.9	9.4
	14 IN DOUBLE "T" INLET - FT LIFT	13.3	12.8	12.3	11.8	11.3	10.8
	13.5 INCHES						
	CENTER FEED (PSI)	55	60	64	69	74	79
	END FEED (PSI)	52	56	61	66	71	76
	PUMP (WATER) hp	114	123	132	141	150	160
	PUMP EFF. %	89.6%	89.3%	89.0%	88.7%	88.4%	88.1%
	12 IN ALUMINUM INLET - FT LIFT	10.9	10.8	10.5	10.2	9.8	8.6
	12 IN DOUBLE "T" INLET - FT LIFT	11.7	11.6	11.3	11.0	10.6	9.4
	14 IN DOUBLE "T" INLET - FT LIFT	13.1	13.0	12.7	12.4	12.0	10.8

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Valmont test data has been used to adjust the data for system loss and elevation within the system. Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design.

Pump Performance Charts (Continued)

Chart D
Cornell 6RB Pump Performance

CENTERFEED]
END FEED] - PRESSURE (FT) AVAILABLE AT TOP OF CART (INCLUDES CART ELEVATION AND PIPING LOSSES.)

Altitude is assumed to be sea level*
Temperature is assumed to be 90 deg. F. (32.2 deg. C.)*
* See Table 6 on page 2-33 in Pump Selection for lift adjustments for altitude and temperature.

MAXIMUM ALLOWABLE SUCTION LIFT (FT) - DISTANCE IS MEASURED FROM BOTTOM OF CART DRIVE UNIT TIRES.

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM					
		1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
2800	11.0 INCHES						
	CENTER FEED (PSI)	16	19	22	26	29	32
	END FEED (PSI)	13	16	19	22	26	29
	PUMP (WATER) hp	54	59	64	70	76	80
	PUMP EFF. %	81.9%	82.7%	83.5%	84.4%	85.2%	86.1%
	12 IN ALUMINUM INLET - FT LIFT	9.1	8.5	7.9	7.2	4.7	4.0
	12 IN DOUBLE "T" INLET - FT LIFT	8.0	7.4	6.8	6.1	5.5	4.8
	14 IN DOUBLE "T" INLET - FT LIFT	9.4	8.8	8.2	7.5	6.9	6.2
	12.0 INCHES						
	CENTER FEED (PSI)	31	35	39	43	47	51
	END FEED (PSI)	28	32	35	39	43	47
	PUMP (WATER) hp	77	84	91	99	106	113
	PUMP EFF. %	87.9%	88.0%	88.1%	88.2%	88.3%	88.4%
	12 IN ALUMINUM INLET - FT LIFT	11.2	8.9	8.4	8.0	7.5	7.1
	12 IN DOUBLE "T" INLET - FT LIFT	10.1	9.7	9.2	8.8	8.3	7.9
	14 IN DOUBLE "T" INLET - FT LIFT	11.5	11.1	10.6	10.2	9.7	9.3
	13.0 INCHES						
	CENTER FEED (PSI)	46	50	55	59	64	69
	END FEED (PSI)	42	47	51	56	61	65
	PUMP (WATER) hp	103	111	120	128	136	145
	PUMP EFF. %	89.5%	89.4%	89.3%	89.2%	89.1%	89.0%
	12 IN ALUMINUM INLET - FT LIFT	10.3	9.9	9.4	9.0	8.5	8.1
	12 IN DOUBLE "T" INLET - FT LIFT	11.1	10.7	10.2	9.8	9.3	8.9
	14 IN DOUBLE "T" INLET - FT LIFT	12.5	12.1	11.6	11.2	10.7	10.3
	13.5 INCHES						
	CENTER FEED (PSI)	61	58	63	68	73	78
	END FEED (PSI)	58	55	59	64	69	74
	PUMP (WATER) hp	131	125	134	144	153	162
	PUMP EFF. %	89.5%	89.4%	89.2%	89.1%	89.0%	88.8%
	12 IN ALUMINUM INLET - FT LIFT	10.6	10.1	9.7	9.2	8.8	8.3
	12 IN DOUBLE "T" INLET - FT LIFT	11.4	10.9	10.5	10.0	9.6	9.1
	14 IN DOUBLE "T" INLET - FT LIFT	12.8	12.3	11.9	11.4	11.0	10.5

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM					
		1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
2900	11.0 INCHES						
	CENTER FEED (PSI)	14	17	20	24	27	30
	END FEED (PSI)	11	14	17	20	23	26
	PUMP (WATER) hp	54	59	65	71	76	80
	PUMP EFF. %	78.8%	80.1%	81.5%	82.9%	84.3%	85.6%
	12 IN ALUMINUM INLET - FT LIFT	8.5	7.8	7.2	6.5	5.9	3.2
	12 IN DOUBLE "T" INLET - FT LIFT	7.3	6.6	6.0	5.3	4.7	4.0
	14 IN DOUBLE "T" INLET - FT LIFT	8.9	8.2	7.6	6.9	6.3	5.6
	12.0 INCHES						
	CENTER FEED (PSI)	29	33	37	41	45	49
	END FEED (PSI)	26	30	34	37	41	45
	PUMP (WATER) hp	78	85	93	100	107	114
	PUMP EFF. %	87.1%	87.5%	87.8%	88.2%	88.5%	88.9%
	12 IN ALUMINUM INLET - FT LIFT	10.5	10.1	7.6	7.2	6.7	6.2
	12 IN DOUBLE "T" INLET - FT LIFT	9.3	8.9	8.4	8.0	7.5	7.0
	14 IN DOUBLE "T" INLET - FT LIFT	10.9	10.5	10.0	9.6	9.1	8.6
	13.0 INCHES						
	CENTER FEED (PSI)	44	48	53	58	62	67
	END FEED (PSI)	41	45	50	54	59	63
	PUMP (WATER) hp	104	112	121	130	139	147
	PUMP EFF. %	89.4%	89.4%	89.3%	89.3%	89.2%	89.2%
	12 IN ALUMINUM INLET - FT LIFT	9.6	9.1	8.7	8.2	7.8	7.3
	12 IN DOUBLE "T" INLET - FT LIFT	10.4	9.9	9.5	9.0	8.6	8.1
	14 IN DOUBLE "T" INLET - FT LIFT	12.0	11.5	11.1	10.6	10.2	9.7
	13.5 INCHES						
	CENTER FEED (PSI)	51	56	61	66	71	76
	END FEED (PSI)	47	53	57	63	67	73
	PUMP (WATER) hp	117	127	136	146	155	165
	PUMP EFF. %	89.7%	89.6%	89.5%	89.4%	89.2%	89.1%
	12 IN ALUMINUM INLET - FT LIFT	9.8	9.3	8.9	8.4	8.0	7.5
	12 IN DOUBLE "T" INLET - FT LIFT	10.6	10.1	9.7	9.2	8.8	8.3
	14 IN DOUBLE "T" INLET - FT LIFT	12.2	11.7	11.3	10.8	10.4	9.9

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Valmont test data has been used to adjust the data for system loss and elevation within the system. Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design.

Pump Performance Charts (Continued)

Chart D
Cornell 6RB Pump Performance

CENTERFEED]
END FEED] - PRESSURE (FT) AVAILABLE AT TOP OF CART (INCLUDES CART ELEVATION AND PIPING LOSSES)

Altitude is assumed to be sea level *
Temperature is assumed to be 90 deg. F. (32.2 deg. C.)*
* See Table 6 on page 2-33 in Pump Selection for lift adjustments for altitude and temperature.

MAXIMUM ALLOWABLE SUCTION LIFT (FT) - DISTANCE IS MEASURED FROM BOTTOM OF CART DRIVE UNIT TIRES

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
3000	11.0 INCHES						
	CENTER FEED (PSI)	11	15	18	21	25	28
	END FEED (PSI)	NA	11	14	17	21	24
	PUMP (WATER) hp	53	59	64	70	76	80
	PUMP EFF. %	74.5%	76.6%	78.7%	80.8%	83.0%	85.1%
	12 IN ALUMINUM INLET - FT LIFT	5.6	5.0	4.3	3.7	3.0	2.3
	12 IN DOUBLE "T" INLET - FT LIFT	6.5	5.9	5.2	4.6	3.9	3.2
	14 IN DOUBLE "T" INLET - FT LIFT	8.1	7.5	6.8	6.2	5.5	4.8
	12.0 INCHES						
	CENTER FEED (PSI)	27	31	35	39	43	47
	END FEED (PSI)	23	27	31	35	39	43
	PUMP (WATER) hp	78	85	93	100	107	115
	PUMP EFF. %	86.5%	86.9%	87.3%	87.7%	88.1%	88.5%
	12 IN ALUMINUM INLET - FT LIFT	7.6	7.2	6.7	6.3	5.8	5.3
	12 IN DOUBLE "T" INLET - FT LIFT	8.5	8.1	7.6	7.2	6.7	6.2
	14 IN DOUBLE "T" INLET - FT LIFT	10.1	9.7	9.2	8.8	8.3	7.8
	13.0 INCHES						
	CENTER FEED (PSI)	43	47	51	56	60	65
	END FEED (PSI)	39	43	47	52	56	61
	PUMP (WATER) hp	105	114	122	131	140	149
	PUMP EFF. %	89.3%	89.3%	89.3%	89.3%	89.3%	89.3%
	12 IN ALUMINUM INLET - FT LIFT	8.6	8.2	7.8	7.3	6.9	6.5
	12 IN DOUBLE "T" INLET - FT LIFT	9.5	9.1	8.7	8.2	7.8	7.4
	14 IN DOUBLE "T" INLET - FT LIFT	11.1	10.7	10.3	9.8	9.4	9.0
	13.5 INCHES						
	CENTER FEED (PSI)	49	55	59	65	69	75
	END FEED (PSI)	46	51	56	61	65	71
	PUMP (WATER) hp	118	129	138	148	158	168
	PUMP EFF. %	89.6%	89.6%	89.5%	89.4%	89.4%	89.3%
	12 IN ALUMINUM INLET - FT LIFT	9.0	8.5	8.1	7.6	7.2	6.7
	12 IN DOUBLE "T" INLET - FT LIFT	9.9	9.4	9.0	8.5	8.1	7.6
	14 IN DOUBLE "T" INLET - FT LIFT	11.5	11.0	10.6	10.1	9.7	9.2

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
3100	11.0 INCHES						
	CENTER FEED (PSI)	8	11	15	19	22	26
	END FEED (PSI)	NA	NA	11	15	18	22
	PUMP (WATER) hp	51	58	64	71	76	81
	PUMP EFF. %	68.8%	71.6%	74.4%	77.3%	80.1%	83.0%
	12 IN ALUMINUM INLET - FT LIFT	4.9	4.2	3.5	2.9	2.2	1.5
	12 IN DOUBLE "T" INLET - FT LIFT	5.8	5.1	4.4	3.8	3.1	2.4
	14 IN DOUBLE "T" INLET - FT LIFT	7.5	6.8	6.1	5.5	4.8	4.1
	12.0 INCHES						
	CENTER FEED (PSI)	25	29	33	37	41	45
	END FEED (PSI)	21	25	29	33	37	41
	PUMP (WATER) hp	78	86	93	101	108	116
	PUMP EFF. %	85.2%	85.8%	86.3%	86.9%	87.4%	88.0%
	12 IN ALUMINUM INLET - FT LIFT	6.8	6.3	5.8	5.3	4.9	4.4
	12 IN DOUBLE "T" INLET - FT LIFT	7.7	7.2	6.7	6.2	5.8	5.3
	14 IN DOUBLE "T" INLET - FT LIFT	9.4	8.9	8.4	7.9	7.5	7.0
	13.0 INCHES						
	CENTER FEED (PSI)	40	45	50	54	59	63
	END FEED (PSI)	36	41	45	50	54	59
	PUMP (WATER) hp	105	114	124	133	142	151
	PUMP EFF. %	89.0%	89.1%	89.1%	89.2%	89.3%	89.4%
	12 IN ALUMINUM INLET - FT LIFT	7.7	7.3	6.9	6.4	6.0	5.6
	12 IN DOUBLE "T" INLET - FT LIFT	8.6	8.2	7.8	7.3	6.9	6.5
	14 IN DOUBLE "T" INLET - FT LIFT	10.3	9.9	9.5	9.0	8.6	8.2
	13.5 INCHES						
	CENTER FEED (PSI)	48	53	58	63	68	73
	END FEED (PSI)	44	49	54	59	64	69
	PUMP (WATER) hp	115	125	136	145	155	165
	PUMP EFF. %	89.4%	89.4%	89.4%	89.4%	89.4%	89.4%
	12 IN ALUMINUM INLET - FT LIFT	8.3	7.9	7.5	7.0	6.6	6.2
	12 IN DOUBLE "T" INLET - FT LIFT	9.2	8.8	8.4	7.9	7.5	7.1
	14 IN DOUBLE "T" INLET - FT LIFT	10.8	10.4	10.0	9.5	9.1	8.7

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Valmont test data has been used to adjust the data for system loss and elevation within the system. Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design

Pump Performance Charts (Continued)

Chart D
Cornell 6RB Pump Performance

CENTERFEED]
END FEED] - PRESSURE (FT) AVAILABLE AT TOP OF CART (INCLUDES CART ELEVATION AND PIPING LOSSES.)

MAXIMUM ALLOWABLE SUCTION LIFT (FT) - DISTANCE IS MEASURED FROM BOTTOM OF CART DRIVE UNIT TIRES.

Altitude is assumed to be sea level *
Temperature is assumed to be 90 deg. F. (32.2 deg. C.)*
* See Table 6 on page 2-33 in Pump Selection for lift adjustments for altitude and temperature.

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750/1775	1800/1825	1850/1875	1900/1925	1950/1975	2000/2025
3200	11.0 INCHES						
	CENTER FEED (PSI)	NA	8	12	15	19	23
	END FEED (PSI)	NA	NA	8	11	15	19
	PUMP (WATER) hp	50	57	64	70	76	81
	PUMP EFF. %	61.5%	65.3%	69.1%	73.0%	76.8%	80.6%
	12 IN ALUMINUM INLET - FT LIFT	4.0	3.4	2.5	1.9	1.3	NA
	12 IN DOUBLE "T" INLET - FT LIFT	4.9	4.3	3.4	2.8	2.2	1.6
	14 IN DOUBLE "T" INLET - FT LIFT	6.7	6.1	5.2	4.6	4.0	3.4
	12.0 INCHES						
	CENTER FEED (PSI)	23	27	31	35	39	43
	END FEED (PSI)	19	23	27	30	34	38
	PUMP (WATER) hp	78	86	94	101	109	116
	PUMP EFF. %	83.8%	84.5%	85.3%	86.0%	86.8%	87.6%
	12 IN ALUMINUM INLET - FT LIFT	5.7	5.3	4.8	4.4	3.9	3.5
	12 IN DOUBLE "T" INLET - FT LIFT	6.6	6.2	5.7	5.3	4.8	4.4
	14 IN DOUBLE "T" INLET - FT LIFT	8.4	8.0	7.5	7.1	6.6	6.2
	13.0 INCHES						
	CENTER FEED (PSI)	38	43	48	52	57	62
	END FEED (PSI)	34	39	43	48	53	57
	PUMP (WATER) hp	106	115	125	134	144	154
	PUMP EFF. %	88.8%	88.9%	89.0%	89.2%	89.3%	89.4%
	12 IN ALUMINUM INLET - FT LIFT	6.8	6.4	6.0	5.6	5.2	4.8
	12 IN DOUBLE "T" INLET - FT LIFT	7.7	7.3	6.9	6.5	6.1	5.7
	14 IN DOUBLE "T" INLET - FT LIFT	9.5	9.1	8.7	8.3	7.9	7.5
	13.5 INCHES						
	CENTER FEED (PSI)	55	51	56	62	67	72
	END FEED (PSI)	51	47	52	58	63	68
	PUMP (WATER) hp	129	122	132	142	152	162
	PUMP EFF. %	89.3%	89.3%	89.4%	89.5%	89.5%	89.6%
	12 IN ALUMINUM INLET - FT LIFT	7.8	7.4	7.0	6.6	6.2	5.8
	12 IN DOUBLE "T" INLET - FT LIFT	8.7	8.3	7.9	7.5	7.1	6.7
	14 IN DOUBLE "T" INLET - FT LIFT	10.3	9.9	9.5	9.1	8.7	8.3

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750/1775	1800/1825	1850/1875	1900/1925	1950/1975	2000/2025
3300	11.0 INCHES						
	CENTER FEED (PSI)						
	END FEED (PSI)						
	PUMP (WATER) hp						
	PUMP EFF. %	NA	NA	NA	NA	NA	NA
	12 IN ALUMINUM INLET - FT LIFT						
	12 IN DOUBLE "T" INLET - FT LIFT						
	14 IN DOUBLE "T" INLET - FT LIFT						
	12.0 INCHES						
	CENTER FEED (PSI)	21	25	28	33	37	41
	END FEED (PSI)	16	20	24	28	32	36
	PUMP (WATER) hp	79	87	94	103	110	118
	PUMP EFF. %	80.2%	81.6%	83.0%	84.3%	85.7%	87.1%
	12 IN ALUMINUM INLET - FT LIFT	4.8	4.4	4.0	3.5	3.1	2.6
	12 IN DOUBLE "T" INLET - FT LIFT	5.7	5.3	4.9	4.4	4.0	3.5
	14 IN DOUBLE "T" INLET - FT LIFT	7.6	7.2	6.8	6.3	5.9	5.4
	13.0 INCHES						
	CENTER FEED (PSI)	36	41	46	50	55	60
	END FEED (PSI)	32	36	41	45	50	55
	PUMP (WATER) hp	107	117	127	135	145	155
	PUMP EFF. %	87.5%	87.9%	88.2%	88.6%	88.9%	89.3%
	12 IN ALUMINUM INLET - FT LIFT	5.8	5.4	5.0	4.5	4.1	3.7
	12 IN DOUBLE "T" INLET - FT LIFT	6.7	6.3	5.9	5.4	5.0	4.6
	14 IN DOUBLE "T" INLET - FT LIFT	8.6	8.2	7.8	7.3	6.9	6.5
	13.5 INCHES						
	CENTER FEED (PSI)	45	49	55	60	65	71
	END FEED (PSI)	41	46	51	56	62	67
	PUMP (WATER) hp	110	119	129	140	150	160
	PUMP EFF. %	89.0%	89.1%	89.2%	89.4%	89.5%	89.7%
	12 IN ALUMINUM INLET - FT LIFT	7.3	6.9	6.5	6.1	5.7	5.3
	12 IN DOUBLE "T" INLET - FT LIFT	8.2	7.8	7.4	7.0	6.6	6.2
	14 IN DOUBLE "T" INLET - FT LIFT	9.8	9.4	9.0	8.6	8.2	7.8

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Valmont test data has been used to adjust the data for system loss and elevation within the system. Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design.

Pump Performance Charts (Continued)

Chart D
Cornell 6RB Pump Performance

CENTERFEED]
END FEED] - PRESSURE (FT) AVAILABLE AT TOP OF CART (INCLUDES CART ELEVATION AND PIPING LOSSES)

Altitude is assumed to be sea level *
Temperature is assumed to be 90 deg. F. (32.2 deg. C.)*
* See Table 6 on page 2-33 in Pump Selection for lift adjustments for altitude and temperature.

MAXIMUM ALLOWABLE SUCTION LIFT (FT) - DISTANCE IS MEASURED FROM BOTTOM OF CART DRIVE UNIT TIRES

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM					
		1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
3400	11.0 INCHES						
	CENTER FEED (PSI)						
	END FEED (PSI)						
	PUMP (WATER) hp						
	PUMP EFF. %	NA	NA	NA	NA	NA	NA
	12 IN ALUMINUM INLET - FT LIFT						
	12 IN DOUBLE "T" INLET - FT LIFT						
	14 IN DOUBLE "T" INLET - FT LIFT						
	12.0 INCHES						
	CENTER FEED (PSI)	18	22	26	30	34	38
	END FEED (PSI)	13	17	21	25	29	33
	PUMP (WATER) hp	79	87	95	102	110	117
	PUMP EFF. %	76.5%	78.4%	80.4%	82.3%	84.3%	86.3%
	12 IN ALUMINUM INLET - FT LIFT	3.9	3.4	2.9	2.5	2.0	1.5
	12 IN DOUBLE "T" INLET - FT LIFT	4.9	4.4	3.9	3.5	3.0	2.5
	14 IN DOUBLE "T" INLET - FT LIFT	6.9	6.4	5.9	5.5	5.0	4.5
	13.0 INCHES						
	CENTER FEED (PSI)	34	39	44	48	53	58
	END FEED (PSI)	29	34	39	43	48	53
	PUMP (WATER) hp	108	118	128	138	147	157
	PUMP EFF. %	86.2%	86.8%	87.4%	88.0%	88.6%	89.2%
	12 IN ALUMINUM INLET - FT LIFT	4.7	4.3	3.9	3.6	3.2	2.8
	12 IN DOUBLE "T" INLET - FT LIFT	5.7	5.3	4.9	4.6	4.2	3.8
	14 IN DOUBLE "T" INLET - FT LIFT	7.7	7.3	6.9	6.6	6.2	5.8
	13.5 INCHES						
	CENTER FEED (PSI)	43	48	53	58	63	69
	END FEED (PSI)	39	44	49	54	59	65
	PUMP (WATER) hp	106	116	126	136	146	156
	PUMP EFF. %	88.4%	88.6%	88.8%	89.1%	89.3%	89.5%
	12 IN ALUMINUM INLET - FT LIFT	6.7	6.3	5.9	5.5	5.1	4.7
	12 IN DOUBLE "T" INLET - FT LIFT	7.6	7.2	6.8	6.4	6.0	5.6
	14 IN DOUBLE "T" INLET - FT LIFT	9.2	8.8	8.4	8.0	7.6	7.2

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM					
		1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
3500	11.0 INCHES						
	CENTER FEED (PSI)						
	END FEED (PSI)						
	PUMP (WATER) hp						
	PUMP EFF. %	NA	NA	NA	NA	NA	NA
	12 IN ALUMINUM INLET - FT LIFT						
	12 IN DOUBLE "T" INLET - FT LIFT						
	14 IN DOUBLE "T" INLET - FT LIFT						
	12.0 INCHES						
	CENTER FEED (PSI)	14	19	23	28	32	36
	END FEED (PSI)	NA	13	18	22	27	31
	PUMP (WATER) hp	76	87	95	104	111	118
	PUMP EFF. %	71.8%	74.5%	77.2%	79.9%	82.6%	85.3%
	12 IN ALUMINUM INLET - FT LIFT	3.0	2.5	2.0	1.5	1.0	NA
	12 IN DOUBLE "T" INLET - FT LIFT	3.9	3.4	2.9	2.4	1.9	1.4
	14 IN DOUBLE "T" INLET - FT LIFT	6.0	5.5	5.0	4.5	4.0	3.5
	13.0 INCHES						
	CENTER FEED (PSI)	32	36	41	46	51	56
	END FEED (PSI)	26	31	36	41	46	51
	PUMP (WATER) hp	107	118	128	139	148	158
	PUMP EFF. %	84.7%	85.6%	86.5%	87.3%	88.2%	89.1%
	12 IN ALUMINUM INLET - FT LIFT	3.7	3.3	2.9	2.6	2.2	1.8
	12 IN DOUBLE "T" INLET - FT LIFT	4.6	4.2	3.8	3.5	3.1	2.7
	14 IN DOUBLE "T" INLET - FT LIFT	6.7	6.3	5.9	5.6	5.2	4.8
	13.5 INCHES						
	CENTER FEED (PSI)	41	46	51	56	62	67
	END FEED (PSI)	37	42	47	52	58	63
	PUMP (WATER) hp	104	114	124	134	143	153
	PUMP EFF. %	87.1%	87.6%	88.0%	88.5%	88.9%	89.4%
	12 IN ALUMINUM INLET - FT LIFT	6.1	5.7	5.3	5.0	4.6	4.2
	12 IN DOUBLE "T" INLET - FT LIFT	7.0	6.6	6.2	5.9	5.5	5.1
	14 IN DOUBLE "T" INLET - FT LIFT	8.6	8.2	7.8	7.5	7.1	6.7

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Valmont test data has been used to adjust the data for system loss and elevation within the system. Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design

Pump Performance Charts (Continued)

Chart E
Cornell 8H Pump Performance

CENTER FEED]
END FEED] - PRESSURE (PSI) AVAILABLE AT TOP OF CART (INCLUDES CART ELEVATION AND CART PIPE LOSSES.)

Altitude is assumed to be sea level *
Temperature is assumed to be 90 deg. F. (32.2 deg. C.)*
* See Table 6 on page 2-33 in Pump Selection for lift adjustments for altitude and temperature.

MAXIMUM ALLOWABLE SUCTION LIFT (FT) - IS THE DISTANCE MEASURED FROM BOTTOM OF CART DRIVE UNIT TIRES TO WATER LEVEL.

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
3300	13.25 INCHES						
	CENTER FEED - PSI	43	48	53	58	64	69
	END FEED - PSI	38	43	49	54	59	64
	PUMP (WATER) - hp	123	134	145	157	169	180
	PUMP EFF. - %	86%	86%	86%	86%	86%	86%
	12 IN DOUBLE "T" INLET - FT LIFT	8.8	8.5	8.1	7.6	7.2	6.8
	14 IN DOUBLE "T" INLET - FT LIFT	10.7	10.4	10.0	9.5	9.1	8.7
	14 IN DOUBLE "Y" INLET - FT LIFT	13.5	13.2	12.8	12.3	11.9	11.5
	14 IN ALUMINUM SUCTION - FT LIFT	11.7	11.4	11.0	10.5	10.1	9.7
	13 .75 INCHES						
	CENTER FEED - PSI	50	55	61	66	71	77
	END FEED - PSI	45	51	56	61	67	72
	PUMP (WATER) - hp	137	149	161	174	186	198
	PUMP EFF. - %	87%	87%	86%	86%	86%	86%
	12 IN DOUBLE "T" INLET - FT LIFT	9.3	8.8	8.3	7.7	7.2	6.6
	14 IN DOUBLE "T" INLET - FT LIFT	11.2	10.7	10.2	9.6	9.1	8.5
	14 IN DOUBLE "Y" INLET - FT LIFT	14.0	13.5	13.0	12.4	11.9	11.3
	14 IN ALUMINUM SUCTION - FT LIFT	12.2	11.7	11.2	10.6	10.1	9.5
	14.25 INCHES						
	CENTER FEED - PSI	58	64	69	76	83	87
	END FEED - PSI	53	59	65	71	78	82
	PUMP (WATER) - hp	156	167	181	196	211	221
	PUMP EFF. - %	86%	87%	86%	86%	86%	86%
	12 IN DOUBLE "T" INLET - FT LIFT	9.5	8.9	8.3	7.8	7.2	6.6
	14 IN DOUBLE "T" INLET - FT LIFT	11.4	10.8	10.2	9.7	9.1	8.5
	14 IN DOUBLE "Y" INLET - FT LIFT	14.2	13.6	13.0	12.5	11.9	11.3
	14 IN ALUMINUM SUCTION - FT LIFT	12.4	11.8	11.2	10.7	10.1	9.5
3500	13.25 INCHES						
	CENTER FEED - PSI	39	44	49	54	59	65
	END FEED - PSI	33	39	44	49	54	59
	PUMP (WATER) - hp	119	131	143	154	166	178
	PUMP EFF. - %	85%	85%	85%	86%	86%	86%
	12 IN DOUBLE "T" INLET - FT LIFT	7.0	6.7	6.4	6.0	5.7	5.3
	14 IN DOUBLE "T" INLET - FT LIFT	9.1	8.8	8.5	8.1	7.8	7.4
	14 IN DOUBLE "Y" INLET - FT LIFT	12.2	11.9	11.6	11.2	10.9	10.5
	14 IN ALUMINUM SUCTION - FT LIFT	10.4	10.1	9.8	9.4	9.1	8.7
	13 .75 INCHES						
	CENTER FEED - PSI	45	51	56	62	68	73
	END FEED - PSI	40	45	51	57	62	68
	PUMP (WATER) - hp	133	146	159	171	184	196
	PUMP EFF. - %	86%	86%	86%	86%	87%	87%
	12 IN DOUBLE "T" INLET - FT LIFT	7.3	6.9	6.5	6.2	5.8	5.4
	14 IN DOUBLE "T" INLET - FT LIFT	9.4	9.0	8.6	8.3	7.9	7.5
	14 IN DOUBLE "Y" INLET - FT LIFT	12.5	12.1	11.7	11.4	11.0	10.6
	14 IN ALUMINUM SUCTION - FT LIFT	10.7	10.3	9.9	9.6	9.2	8.8
	14.25 INCHES						
	CENTER FEED - PSI	54	60	65	72	77	83
	END FEED - PSI	49	55	60	66	72	78
	PUMP (WATER) - hp	151	165	178	191	204	219
	PUMP EFF. - %	87%	87%	87%	87%	87%	87%
	12 IN DOUBLE "T" INLET - FT LIFT	7.7	7.2	6.7	6.3	5.8	5.3
	14 IN DOUBLE "T" INLET - FT LIFT	9.8	9.3	8.8	8.4	7.9	7.4
	14 IN DOUBLE "Y" INLET - FT LIFT	12.9	12.4	11.9	11.5	11.0	10.5
	14 IN ALUMINUM SUCTION - FT LIFT	11.1	10.6	10.1	9.7	9.2	8.7

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
3400	13.25 INCHES						
	CENTER FEED - PSI	41	46	51	56	62	67
	END FEED - PSI	36	41	46	51	57	62
	PUMP (WATER) - hp	119	131	142	153	165	176
	PUMP EFF. - %	85%	85%	86%	86%	86%	86%
	12 IN DOUBLE "T" INLET - FT LIFT	8.2	7.6	7.3	6.9	6.6	6.3
	14 IN DOUBLE "T" INLET - FT LIFT	10.2	9.6	9.3	8.9	8.6	8.3
	14 IN DOUBLE "Y" INLET - FT LIFT	13.1	12.5	12.2	11.8	11.5	11.2
	14 IN ALUMINUM SUCTION - FT LIFT	11.3	10.7	10.4	10.0	9.7	9.4
	13 .75 INCHES						
	CENTER FEED - PSI	48	53	58	64	69	75
	END FEED - PSI	43	48	53	59	64	70
	PUMP (WATER) - hp	138	150	162	175	187	200
	PUMP EFF. - %	86%	86%	86%	86%	86%	86%
	12 IN DOUBLE "T" INLET - FT LIFT	8.3	7.9	7.5	7.0	6.6	6.1
	14 IN DOUBLE "T" INLET - FT LIFT	10.3	9.9	9.5	9.0	8.6	8.1
	14 IN DOUBLE "Y" INLET - FT LIFT	13.2	12.8	12.4	11.9	11.5	11.0
	14 IN ALUMINUM SUCTION - FT LIFT	11.4	11.0	10.6	10.1	9.7	9.2
	14.25 INCHES						
	CENTER FEED - PSI	56	62	68	74	79	85
	END FEED - PSI	51	57	63	69	74	80
	PUMP (WATER) - hp	155	168	181	196	209	223
	PUMP EFF. - %	88%	87%	87%	87%	87%	86%
	12 IN DOUBLE "T" INLET - FT LIFT	8.7	8.2	7.7	7.1	6.6	6.0
	14 IN DOUBLE "T" INLET - FT LIFT	10.7	10.2	9.7	9.1	8.6	8.0
	14 IN DOUBLE "Y" INLET - FT LIFT	13.6	13.1	12.6	12.0	11.5	10.9
	14 IN ALUMINUM SUCTION - FT LIFT	11.8	11.3	10.8	10.2	9.7	9.1
3600	13.25 INCHES						
	CENTER FEED - PSI	37	42	47	52	57	63
	END FEED - PSI	31	36	41	47	52	57
	PUMP (WATER) - hp	113	125	136	147	158	169
	PUMP EFF. - %	84%	84%	85%	85%	86%	86%
	12 IN DOUBLE "T" INLET - FT LIFT	6.0	5.7	5.4	5.0	4.7	4.4
	14 IN DOUBLE "T" INLET - FT LIFT	8.2	7.9	7.6	7.2	6.9	6.6
	14 IN DOUBLE "Y" INLET - FT LIFT	11.4	11.1	10.8	10.4	10.1	9.8
	14 IN ALUMINUM SUCTION - FT LIFT	9.6	9.3	9.0	8.6	8.3	8.0
	13 .75 INCHES						
	CENTER FEED - PSI	43	49	54	60	66	71
	END FEED - PSI	37	43	49	54	60	66
	PUMP (WATER) - hp	126	138	151	162	174	186
	PUMP EFF. - %	85%	86%	86%	86%	87%	87%
	12 IN DOUBLE "T" INLET - FT LIFT	6.3	6.0	5.7	5.3	5.0	4.7
	14 IN DOUBLE "T" INLET - FT LIFT	8.5	8.2	7.9	7.5	7.2	6.9
	14 IN DOUBLE "Y" INLET - FT LIFT	11.7	11.4	11.1	10.7	10.4	10.1
	14 IN ALUMINUM SUCTION - FT LIFT	9.9	9.6	9.3	8.9	8.6	8.3
	14.25 INCHES						
	CENTER FEED - PSI	52	58	64	69	76	82
	END FEED - PSI	46	52	58	64	70	76
	PUMP (WATER) - hp	144	157	170	182	195	208
	PUMP EFF. - %	86%	87%	87%	87%	87%	87%
	12 IN DOUBLE "T" INLET - FT LIFT	6.7	6.3	5.9	5.5	5.1	4.7
	14 IN DOUBLE "T" INLET - FT LIFT	8.9	8.5	8.1	7.7	7.3	6.9
	14 IN DOUBLE "Y" INLET - FT LIFT	12.1	11.7	11.3	10.9	10.5	10.1
	14 IN ALUMINUM SUCTION - FT LIFT	10.3	9.9	9.5	9.1	8.7	8.3

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Valmont test data has been used to adjust the data for system loss and elevation within the system. Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design.

Pump Performance Charts (Continued)

Chart E
Cornell 8H Pump Performance

CENTER FEED]
END FEED] - PRESSURE (PSI) AVAILABLE AT TOP OF CART (INCLUDES CART ELEVATION AND CART PIPE LOSSES)

* See Table 6 on page 2-33 in Pump Selection for lift adjustments for altitude and temperature.

MAXIMUM ALLOWABLE SUCTION LIFT (FT) - IS THE DISTANCE MEASURED FROM BOTTOM OF CART DRIVE UNIT TIRES TO WATER LEVEL

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
3700	13.25 INCHES						
	CENTER FEED - PSI	34	39	44	50	55	60
	END FEED - PSI	28	33	38	44	49	54
	PUMP (WATER) - hp	124	137	149	161	173	184
	PUMP EFF. - %	82%	83%	83%	84%	85%	86%
	12 IN DOUBLE "T" INLET - FT LIFT	5.5	4.6	4.3	3.9	3.6	3.3
	14 IN DOUBLE "T" INLET - FT LIFT	7.8	6.9	6.6	6.2	5.9	5.6
	14 IN DOUBLE "Y" INLET - FT LIFT	11.2	10.3	10.0	9.6	9.3	9.0
	14 IN ALUMINUM SUCTION - FT LIFT	9.4	8.5	8.2	7.8	7.5	7.2
	13 .75 INCHES						
	CENTER FEED - PSI	41	47	52	58	63	69
	END FEED - PSI	35	41	46	52	58	63
	PUMP (WATER) - hp	138	152	165	179	192	205
	PUMP EFF. - %	85%	85%	85%	86%	86%	86%
	12 IN DOUBLE "T" INLET - FT LIFT	5.4	5.1	4.6	4.2	3.9	3.6
	14 IN DOUBLE "T" INLET - FT LIFT	7.7	7.4	6.9	6.5	6.2	5.9
	14 IN DOUBLE "Y" INLET - FT LIFT	11.1	10.8	10.3	9.9	9.6	9.3
	14 IN ALUMINUM SUCTION - FT LIFT	9.3	9.0	8.5	8.1	7.8	7.5
	14.25 INCHES						
	CENTER FEED - PSI	50	56	62	68	74	79
	END FEED - PSI	44	50	56	62	68	74
	PUMP (WATER) - hp	158	173	188	201	216	229
	PUMP EFF. - %	86%	86%	86%	87%	87%	88%
	12 IN DOUBLE "T" INLET - FT LIFT	5.7	5.3	5.0	4.6	4.3	3.9
	14 IN DOUBLE "T" INLET - FT LIFT	8.0	7.6	7.3	6.9	6.6	6.2
	14 IN DOUBLE "Y" INLET - FT LIFT	11.4	11.0	10.7	10.3	10.0	9.6
	14 IN ALUMINUM SUCTION - FT LIFT	9.6	9.2	8.9	8.5	8.2	7.8
3900	13.25 INCHES						
	CENTER FEED - PSI	28	34	39	44	50	55
	END FEED - PSI	21	27	32	38	43	49
	PUMP (WATER) - hp	123	137	149	162	173	185
	PUMP EFF. - %	78%	79%	81%	82%	84%	85%
	14 IN DOUBLE "Y" INLET - FT LIFT	8.8	8.5	8.2	8.0	7.7	7.4
	14 IN ALUMINUM SUCTION - FT LIFT	7.0	6.7	6.4	6.2	5.9	5.6
	13 .75 INCHES						
	CENTER FEED - PSI	36	41	47	53	58	64
	END FEED - PSI	29	35	40	46	52	57
	PUMP (WATER) - hp	139	153	167	180	193	207
	PUMP EFF. - %	82%	82%	83%	84%	85%	86%
	14 IN DOUBLE "Y" INLET - FT LIFT	9.3	9.0	8.7	8.4	8.1	7.8
	14 IN ALUMINUM SUCTION - FT LIFT	7.5	7.2	6.9	6.6	6.3	6.0
	14.25 INCHES						
	CENTER FEED - PSI	45	51	57	63	69	75
	END FEED - PSI	38	44	50	57	63	69
	PUMP (WATER) - hp	158	173	189	204	219	233
	PUMP EFF. - %	85%	85%	86%	86%	87%	87%
	14 IN DOUBLE "Y" INLET - FT LIFT	9.9	9.5	9.2	8.8	8.5	8.1
	14 IN ALUMINUM SUCTION - FT LIFT	8.1	7.7	7.4	7.0	6.7	6.3

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
3800	13.25 INCHES						
	CENTER FEED - PSI	31	37	42	47	53	58
	END FEED - PSI	25	30	36	41	46	52
	PUMP (WATER) - hp	125	137	150	145	174	185
	PUMP EFF. - %	80%	81%	82%	93%	84%	85%
	12 IN DOUBLE "T" INLET - FT LIFT	NA	NA	NA	NA	NA	NA
	14 IN DOUBLE "T" INLET - FT LIFT	6.2	5.9	5.6	5.3	5.0	4.7
	14 IN DOUBLE "Y" INLET - FT LIFT	9.8	9.5	9.2	8.9	8.6	8.3
	14 IN ALUMINUM SUCTION - FT LIFT	7.9	7.6	7.3	7.0	6.7	6.4
	13 .75 INCHES						
	CENTER FEED - PSI	38	44	50	55	61	67
	END FEED - PSI	32	38	43	49	55	60
	PUMP (WATER) - hp	138	152	166	179	193	206
	PUMP EFF. - %	84%	84%	85%	85%	86%	86%
	12 IN DOUBLE "T" INLET - FT LIFT	NA	NA	NA	NA	NA	NA
	14 IN DOUBLE "T" INLET - FT LIFT	6.6	6.3	6.0	5.6	5.3	5.0
	14 IN DOUBLE "Y" INLET - FT LIFT	10.2	9.9	9.6	9.2	8.9	8.6
	14 IN ALUMINUM SUCTION - FT LIFT	8.3	8.0	7.7	7.3	7.0	6.7
	14.25 INCHES						
	CENTER FEED - PSI	47	53	59	65	71	77
	END FEED - PSI	41	47	53	59	65	71
	PUMP (WATER) - hp	158	173	187	202	216	231
	PUMP EFF. - %	85%	86%	86%	87%	87%	87%
	12 IN DOUBLE "T" INLET - FT LIFT	NA	NA	NA	NA	NA	NA
	14 IN DOUBLE "T" INLET - FT LIFT	7.0	6.7	6.4	6.0	5.7	5.4
	14 IN DOUBLE "Y" INLET - FT LIFT	10.6	10.3	10.0	9.6	9.3	9.0
	14 IN ALUMINUM SUCTION - FT LIFT	8.7	8.4	8.1	7.7	7.4	7.1
4000	13.25 INCHES						
	CENTER FEED - PSI	25	31	36	41	47	53
	END FEED - PSI	19	24	29	35	40	46
	PUMP (WATER) - hp	125	138	151	162	174	186
	PUMP EFF. - %	74%	76%	78%	80%	82%	84%
	14 IN DOUBLE "Y" INLET - FT LIFT	7.7	7.5	7.3	7.1	6.8	6.6
	14 IN ALUMINUM SUCTION - FT LIFT	5.9	5.7	5.5	5.3	5.0	4.8
	13 .75 INCHES						
	CENTER FEED - PSI	33	39	45	51	56	62
	END FEED - PSI	26	32	38	44	49	55
	PUMP (WATER) - hp	139	154	168	182	195	208
	PUMP EFF. - %	80%	81%	82%	83%	84%	86%
	14 IN DOUBLE "Y" INLET - FT LIFT	8.4	8.1	7.8	7.6	7.3	7.0
	14 IN ALUMINUM SUCTION - FT LIFT	6.6	6.3	6.0	5.8	5.5	5.2
	14.25 INCHES						
	CENTER FEED - PSI	42	48	54	61	67	73
	END FEED - PSI	35	41	48	54	60	66
	PUMP (WATER) - hp	158	174	190	205	220	235
	PUMP EFF. - %	84%	84%	85%	85%	86%	87%
	14 IN DOUBLE "Y" INLET - FT LIFT	9.0	8.7	8.4	8.0	7.7	7.3
	14 IN ALUMINUM SUCTION - FT LIFT	7.2	6.9	6.6	6.2	5.9	5.5

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Valmont test data has been used to adjust the data for system loss and elevation within the system. Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design.

Rainger Linear Ditch Feed

Pump Performance Charts (Continued)

Chart F
Cornell 10RB Pump Performance

CENTER FEED
END FEED] - PRESSURE (PSI) AVAILABLE AT TOP OF CART (INCLUDES CART ELEVATION AND CART PIPE LOSSES.)

Altitude is assumed to be sea level*
Temperature is assumed to be 90 deg. F. (32.2 deg. C.)*
* See Table 6 on page 2-33 in Pump Selection for lift adjustments for altitude and temperature.

MAXIMUM ALLOWABLE SUCTION LIFT (FT) - IS THE DISTANCE MEASURED FROM BOTTOM OF CART DRIVE UNIT TIRES TO WATER LEVEL.

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
3800	12.00 INCHES - 13º						
	CENTER FEED - PSI	22	25	28	30	33	36
	END FEED - PSI	15	18	21	24	27	30
	PUMP (WATER) - hp	95	104	113	121	130	140
	PUMP EFF. - %	82%	81%	81%	80%	80%	79%
	14 IN DOUBLE "Y" INLET - FT LIFT	9.5	8.6	7.8	6.9	6.1	5.2
	14 IN ALUMINUM SUCTION - FT LIFT	7.6	6.7	5.9	5.0	4.2	3.3
	13.00 INCHES - 13º						
	CENTER FEED - PSI	35	39	42	46	50	54
	END FEED - PSI	29	33	36	40	43	47
	PUMP (WATER) - hp	131	143	154	167	178	192
	PUMP EFF. - %	82%	81%	80%	79%	79%	78%
	14 IN DOUBLE "Y" INLET - FT LIFT	9.9	9.2	8.5	7.7	7.0	6.3
	14 IN ALUMINUM SUCTION - FT LIFT	8.0	7.3	6.6	5.8	5.1	4.4
	13.50 INCHES - 13º						
	CENTER FEED - PSI	41	44	48	53	57	60
	END FEED - PSI	34	38	42	46	50	54
	PUMP (WATER) - hp	146	158	170	184	197	211
	PUMP EFF. - %	82%	81%	81%	80%	79%	78%
	14 IN DOUBLE "Y" INLET - FT LIFT	10.3	9.6	8.9	8.2	7.5	6.8
	14 IN ALUMINUM SUCTION - FT LIFT	8.4	7.7	7.0	6.3	5.6	4.9
	13.50 INCHES - FULL TRIM						
	CENTER FEED - PSI	48	34	37	41	45	48
	END FEED - PSI	42	26	29	33	37	40
	PUMP (WATER) - hp	166	145	157	170	183	196
	PUMP EFF. - %	83%	85%	84%	84%	83%	82%
	14 IN DOUBLE "Y" INLET - FT LIFT	10.8	6.9	6.2	5.4	4.7	3.9
	14 IN ALUMINUM SUCTION - FT LIFT	8.9	5.0	4.3	3.5	2.8	2.0
4000	12.00 INCHES - 13º						
	CENTER FEED - PSI	19	22	25	28	31	34
	END FEED - PSI	12	15	19	21	24	27
	PUMP (WATER) - hp	95	104	114	122	131	141
	PUMP EFF. - %	83%	82%	82%	81%	81%	80%
	14 IN DOUBLE "Y" INLET - FT LIFT	8.5	7.7	6.9	6.0	5.2	4.4
	14 IN ALUMINUM SUCTION - FT LIFT	6.7	5.9	5.1	4.2	3.4	2.6
	13.00 INCHES - 13º						
	CENTER FEED - PSI	33	37	41	44	48	52
	END FEED - PSI	26	30	34	37	41	45
	PUMP (WATER) - hp	132	144	156	168	181	194
	PUMP EFF. - %	84%	83%	82%	81%	80%	80%
	14 IN DOUBLE "Y" INLET - FT LIFT	9.1	8.3	7.6	6.8	6.1	5.3
	14 IN ALUMINUM SUCTION - FT LIFT	7.3	6.5	5.8	5.0	4.3	3.5
	13.50 INCHES - 13º						
	CENTER FEED - PSI	39	43	47	51	55	59
	END FEED - PSI	32	36	40	44	48	52
	PUMP (WATER) - hp	148	161	173	188	201	214
	PUMP EFF. - %	84%	83%	82%	81%	81%	80%
	14 IN DOUBLE "Y" INLET - FT LIFT	9.3	8.6	7.9	7.2	6.5	5.8
	14 IN ALUMINUM SUCTION - FT LIFT	7.5	6.8	6.1	5.4	4.7	4.0
	13.50 INCHES - FULL TRIM						
	CENTER FEED - PSI	46	51	55	60	64	69
	END FEED - PSI	39	44	48	53	57	62
	PUMP (WATER) - hp	167	182	197	211	226	242
	PUMP EFF. - %	84%	83%	83%	82%	81%	81%
	14 IN DOUBLE "Y" INLET - FT LIFT	9.8	9.2	8.6	7.9	7.3	6.7
	14 IN ALUMINUM SUCTION - FT LIFT	8.0	7.4	6.8	6.1	5.5	4.9

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
3900	12.00 INCHES - 13º						
	CENTER FEED - PSI	20	23	26	29	32	35
	END FEED - PSI	14	17	20	22	25	28
	PUMP (WATER) - hp	95	104	113	121	130	139
	PUMP EFF. - %	82%	82%	81%	81%	80%	80%
	14 IN DOUBLE "Y" INLET - FT LIFT	8.9	8.1	7.3	6.4	5.6	4.8
	14 IN ALUMINUM SUCTION - FT LIFT	7.1	6.3	5.5	4.6	3.8	3.0
	13.00 INCHES - 13º						
	CENTER FEED - PSI	34	38	41	45	49	53
	END FEED - PSI	28	31	35	39	42	46
	PUMP (WATER) - hp	132	144	155	168	180	193
	PUMP EFF. - %	83%	82%	81%	80%	79%	79%
	14 IN DOUBLE "Y" INLET - FT LIFT	9.5	8.7	8.0	7.2	6.5	5.7
	14 IN ALUMINUM SUCTION - FT LIFT	7.7	6.9	6.2	5.4	4.7	3.9
	13.50 INCHES - 13º						
	CENTER FEED - PSI	40	44	48	52	56	60
	END FEED - PSI	33	37	41	45	49	53
	PUMP (WATER) - hp	147	160	172	186	199	212
	PUMP EFF. - %	83%	82%	81%	81%	80%	79%
	14 IN DOUBLE "Y" INLET - FT LIFT	9.5	9.0	8.3	7.7	7.0	6.3
	14 IN ALUMINUM SUCTION - FT LIFT	7.7	7.2	6.5	5.9	5.2	4.5
	13.50 INCHES - FULL TRIM						
	CENTER FEED - PSI	47	52	57	61	66	70
	END FEED - PSI	40	45	50	54	59	64
	PUMP (WATER) - hp	167	181	196	210	225	241
	PUMP EFF. - %	83%	83%	82%	81%	81%	80%
	14 IN DOUBLE "Y" INLET - FT LIFT	10.2	9.6	9.0	8.4	7.8	7.2
	14 IN ALUMINUM SUCTION - FT LIFT	8.4	7.8	7.2	6.6	6.0	5.4
4100	12.00 INCHES - 13º						
	CENTER FEED - PSI	19	21	24	27	30	33
	END FEED - PSI	11	14	17	19	23	26
	PUMP (WATER) - hp	96	104	114	122	131	141
	PUMP EFF. - %	83%	82%	82%	82%	81%	81%
	14 IN DOUBLE "Y" INLET - FT LIFT	8.1	7.3	6.5	5.6	4.8	4.0
	14 IN ALUMINUM SUCTION - FT LIFT	6.2	5.4	4.6	3.7	2.9	2.1
	13.00 INCHES - 13º						
	CENTER FEED - PSI	32	36	39	43	47	51
	END FEED - PSI	25	29	32	36	39	43
	PUMP (WATER) - hp	132	145	156	169	181	195
	PUMP EFF. - %	84%	84%	83%	82%	81%	80%
	14 IN DOUBLE "Y" INLET - FT LIFT	8.7	7.9	7.2	6.4	5.7	4.9
	14 IN ALUMINUM SUCTION - FT LIFT	6.8	6.0	5.3	4.5	3.8	3.0
	13.50 INCHES - 13º						
	CENTER FEED - PSI	37	41	45	50	54	58
	END FEED - PSI	30	34	38	42	46	51
	PUMP (WATER) - hp	147	161	174	188	201	216
	PUMP EFF. - %	84%	84%	83%	82%	81%	81%
	14 IN DOUBLE "Y" INLET - FT LIFT	8.9	8.2	7.5	6.8	6.1	5.4
	14 IN ALUMINUM SUCTION - FT LIFT	7.0	6.3	5.6	4.9	4.2	3.5
	13.50 INCHES - FULL TRIM						
	CENTER FEED - PSI	45	50	54	59	63	68
	END FEED - PSI	38	42	47	52	56	61
	PUMP (WATER) - hp	169	184	198	213	228	244
	PUMP EFF. - %	84%	84%	83%	83%	82%	81%
	14 IN DOUBLE "Y" INLET - FT LIFT	9.3	8.7	8.1	7.4	6.8	6.2
	14 IN ALUMINUM SUCTION - FT LIFT	7.4	6.8	6.2	5.5	4.9	4.3

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Valmont test data has been used to adjust the data for system loss and elevation within the system.
Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design.

Pump Performance Charts (Continued)

Chart F
Cornell 10RB Pump Performance

CENTER FEED
END FEED] - PRESSURE (PSI) AVAILABLE AT TOP OF CART (INCLUDES CART ELEVATION AND CART PIPE LOSSES)

Altitude is assumed to be sea level *
Temperature is assumed to be 90 deg. F. (32.2 deg. C.)*
* See Table 6 on page 2-33 in Pump Selection for lift adjustments for altitude and temperature.

MAXIMUM ALLOWABLE SUCTION LIFT (FT) - IS THE DISTANCE MEASURED FROM BOTTOM OF CART DRIVE UNIT TIRES TO WATER LEVEL

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM					
		1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
	12.00 INCHES - 13°						
	CENTER FEED - PSI	17	20	23	26	29	32
	END FEED - PSI	NA	12	15	18	21	24
	PUMP (WATER) - hp	95	104	114	123	133	142
	PUMP EFF. - %	83%	83%	82%	82%	82%	81%
	14 IN DOUBLE "Y" INLET - FT LIFT	7.8	6.9	6.1	5.2	4.4	3.5
	14 IN ALUMINUM SUCTION - FT LIFT	6.0	5.1	4.3	3.4	2.6	1.7
	13.00 INCHES - 13°						
	CENTER FEED - PSI	31	35	38	42	46	50
	END FEED - PSI	23	27	31	35	38	42
	PUMP (WATER) - hp	133	146	157	170	183	196
	PUMP EFF. - %	85%	84%	84%	83%	82%	81%
	14 IN DOUBLE "Y" INLET- FT LIFT	8.2	7.4	6.6	5.9	5.1	4.3
	14 IN ALUMINUM SUCTION - FT LIFT	6.4	5.6	4.8	4.1	3.3	2.5
4200	13.50 INCHES - 13°						
	CENTER FEED - PSI	37	41	45	49	53	57
	END FEED - PSI	29	33	37	41	45	49
	PUMP (WATER) - hp	150	162	175	190	203	217
	PUMP EFF. - %	85%	84%	84%	83%	82%	81%
	14 IN DOUBLE "Y" INLET - FT LIFT	8.3	7.6	6.9	6.2	5.5	4.8
	14 IN ALUMINUM SUCTION - FT LIFT	6.5	5.8	5.1	4.4	3.7	3.0
	13.50 INCHES - Full Trim						
	CENTER FEED - PSI	44	48	53	58	62	67
	END FEED - PSI	36	41	46	50	55	59
	PUMP (WATER) - hp	169	184	199	214	230	246
	PUMP EFF. - %	85%	85%	84%	83%	83%	82%
	14 IN DOUBLE "Y" INLET - FT LIFT	8.9	8.1	7.5	6.8	6.2	5.6
	14 IN ALUMINUM SUCTION - FT LIFT	7.1	6.3	5.7	5.0	4.4	3.8
	12.00 INCHES - 13°						
	CENTER FEED - PSI	14	17	20	23	26	29
	END FEED - PSI	NA	NA	11	15	18	21
	PUMP (WATER) - hp	97	104	113	124	133	142
	PUMP EFF. - %	79%	81%	81%	82%	82%	82%
	14 IN DOUBLE "Y" INLET - FT LIFT	6.9	6.1	5.2	4.3	3.5	2.6
	14 IN ALUMINUM SUCTION - FT LIFT	5.1	4.3	3.4	2.5	1.7	NA
	13.00 INCHES - 13°						
	CENTER FEED - PSI	29	33	36	40	44	48
	END FEED - PSI	21	24	28	32	35	39
	PUMP (WATER) - hp	136	147	159	172	184	198
	PUMP EFF. - %	86%	85%	85%	84%	83%	83%
	14 IN DOUBLE "Y" INLET - FT LIFT	7.2	6.4	5.6	3.9	3.1	3.3
	14 IN ALUMINUM SUCTION - FT LIFT	5.4	4.6	3.8	2.1	1.3	1.5
4400	13.50 INCHES - 13°						
	CENTER FEED - PSI	35	38	42	47	51	54
	END FEED - PSI	26	30	34	38	42	46
	PUMP (WATER) - hp	151	164	177	192	205	219
	PUMP EFF. - %	86%	85%	85%	84%	83%	83%
	14 IN DOUBLE "Y" INLET - FT LIFT	7.3	6.6	5.9	5.2	4.5	3.8
	14 IN ALUMINUM SUCTION - FT LIFT	5.5	4.8	4.1	3.4	2.7	2.0
	13.50 INCHES - Full Trim						
	CENTER FEED - PSI	42	46	51	55	60	64
	END FEED - PSI	34	38	43	47	52	56
	PUMP (WATER) - hp	172	187	203	217	234	249
	PUMP EFF. - %	86%	86%	85%	84%	84%	83%
	14 IN DOUBLE "Y" INLET - FT LIFT	7.6	7.0	6.4	5.7	5.1	4.5
	14 IN ALUMINUM SUCTION - FT LIFT	5.8	5.2	4.6	3.9	3.3	2.7

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM					
		1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
	12.00 INCHES - 13°						
	CENTER FEED - PSI	16	19	22	25	28	31
	END FEED - PSI	NA	11	14	17	20	23
	PUMP (WATER) - hp	96	105	115	124	133	142
	PUMP EFF. - %	81%	82%	82%	82%	82%	82%
	14 IN DOUBLE "Y" INLET - FT LIFT	7.4	6.5	5.7	4.8	4.0	3.1
	14 IN ALUMINUM SUCTION - FT LIFT	5.5	4.6	3.8	2.9	2.1	1.2
	13.00 INCHES - 13°						
	CENTER FEED - PSI	30	34	37	41	45	48
	END FEED - PSI	22	26	29	33	37	40
	PUMP (WATER) - hp	133	145	157	170	183	196
	PUMP EFF. - %	86%	85%	84%	84%	83%	82%
	14 IN DOUBLE "Y" INLET - FT LIFT	7.7	6.9	6.2	5.4	4.7	3.9
	14 IN ALUMINUM SUCTION - FT LIFT	5.8	5.0	4.3	3.5	2.8	2.0
4300	13.50 INCHES - 13°						
	CENTER FEED - PSI	36	40	44	48	52	56
	END FEED - PSI	28	32	36	40	44	48
	PUMP (WATER) - hp	151	164	177	191	205	219
	PUMP EFF. - %	86%	85%	84%	83%	83%	82%
	14 IN DOUBLE "Y" INLET - FT LIFT	7.9	7.2	6.5	5.7	5.0	4.3
	14 IN ALUMINUM SUCTION - FT LIFT	6.0	5.3	4.6	3.8	3.1	2.4
	13.50 INCHES - FULL TRIM						
	CENTER FEED - PSI	42	47	52	56	61	66
	END FEED - PSI	34	39	44	48	53	58
	PUMP (WATER) - hp	169	185	200	215	231	248
	PUMP EFF. - %	86%	85%	85%	84%	83%	82%
	14 IN DOUBLE "Y" INLET - FT LIFT	8.2	7.6	7.0	6.3	5.7	5.1
	14 IN ALUMINUM SUCTION - FT LIFT	6.3	5.7	5.1	4.4	3.8	3.2
	12.00 INCHES - 13°						
	CENTER FEED - PSI	12	15	18	22	25	28
	END FEED - PSI	NA	NA	NA	13	16	20
	PUMP (WATER) - hp	94	104	114	124	131	143
	PUMP EFF. - %	80%	81%	81%	82%	82%	83%
	14 IN DOUBLE "Y" INLET - FT LIFT	6.7	5.8	4.9	4.0	3.1	2.2
	14 IN ALUMINUM SUCTION - FT LIFT	4.8	3.9	3.0	2.1	1.2	NA
	13.00 INCHES - 13°						
	CENTER FEED - PSI	28	31	35	39	42	46
	END FEED - PSI	19	23	26	30	34	37
	PUMP (WATER) - hp	134	147	159	172	184	198
	PUMP EFF. - %	86%	86%	85%	84%	84%	83%
	14 IN DOUBLE "Y" INLET - FT LIFT	6.8	6.0	5.2	4.5	3.7	2.9
	14 IN ALUMINUM SUCTION - FT LIFT	4.9	4.1	3.3	2.6	1.8	1.0
4500	13.50 INCHES - 13°						
	CENTER FEED - PSI	33	37	41	45	49	54
	END FEED - PSI	24	28	32	37	40	45
	PUMP (WATER) - hp	150	164	178	192	206	221
	PUMP EFF. - %	86%	86%	85%	85%	84%	83%
	14 IN DOUBLE "Y" INLET - FT LIFT	6.8	6.1	5.4	4.7	4.0	3.3
	14 IN ALUMINUM SUCTION - FT LIFT	4.9	4.2	3.5	2.8	2.1	1.4
	13.50 INCHES - FULL TRIM						
	CENTER FEED - PSI	41	45	49	54	58	63
	END FEED - PSI	32	36	40	45	50	54
	PUMP (WATER) - hp	173	187	202	218	233	250
	PUMP EFF. - %	87%	86%	86%	85%	84%	84%
	14 IN DOUBLE "Y" INLET - FT LIFT	7.0	6.4	5.8	5.2	4.6	4.0
	14 IN ALUMINUM SUCTION - FT LIFT	5.1	4.5	3.9	3.3	2.7	2.1

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Valmont test data has been used to adjust the data for system loss and elevation within the system.
Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design.

Pump Performance Charts (Continued)

Chart F
Cornell 10RB Pump Performance

CENTER FEED
END FEED] - PRESSURE (PSI) AVAILABLE AT TOP OF CART (INCLUDES CART ELEVATION AND CART PIPE LOSSES.)

MAXIMUM ALLOWABLE SUCTION LIFT (FT) - IS THE DISTANCE MEASURED FROM BOTTOM OF CART DRIVE UNIT TIRES TO WATER LEVEL.

Altitude is assumed to be sea level*
Temperature is assumed to be 90 deg. F. (32.2 deg. C.)*
* See Table 6 on page 2-33 in Pump Selection for lift adjustments for altitude and temperature.

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
4600	13.00 INCHES - 13°						
	CENTER FEED - PSI	26	30	34	37	41	45
	END FEED - PSI	17	21	25	28	32	36
	PUMP (WATER) - hp	134	147	161	172	186	199
	PUMP EFF. - %	86%	86%	85%	85%	84%	84%
	14 IN DOUBLE "Y" INLET - FT LIFT	6.3	5.5	4.7	4.0	3.2	2.4
	14 IN ALUMINUM SUCTION - FT LIFT	4.4	3.6	2.8	2.1	1.3	NA
	13.50 INCHES - 13°						
	CENTER FEED - PSI	32	36	40	44	48	52
	END FEED - PSI	23	27	31	35	39	43
	PUMP (WATER) - hp	153	166	179	194	208	222
	PUMP EFF. - %	87%	86%	86%	85%	85%	84%
	14 IN DOUBLE "Y" INLET - FT LIFT	6.2	5.5	4.8	4.1	3.4	2.7
	14 IN ALUMINUM SUCTION - FT LIFT	4.3	3.6	2.9	2.2	1.5	NA
	13.50 INCHES - FULL TRIM						
	CENTER FEED - PSI	39	44	48	53	57	62
	END FEED - PSI	30	34	39	43	48	53
	PUMP (WATER) - hp	172	188	204	219	235	252
	PUMP EFF. - %	87%	87%	86%	85%	85%	84%
	14 IN DOUBLE "Y" INLET - FT LIFT	6.4	5.8	5.2	4.6	4.0	3.4
	14 IN ALUMINUM SUCTION - FT LIFT	4.5	3.9	3.3	2.7	2.1	1.5
4800	13.00 INCHES - 13°						
	CENTER FEED - PSI	23	27	31	35	39	43
	END FEED - PSI	13	17	21	25	29	33
	PUMP (WATER) - hp	135	148	161	175	188	201
	PUMP EFF. - %	85%	85%	85%	85%	85%	85%
	14 IN DOUBLE "Y" INLET - FT LIFT	5.4	4.6	3.8	3.0	2.2	1.4
	14 IN ALUMINUM SUCTION - FT LIFT	3.4	2.6	1.8	NA	NA	NA
	13.50 INCHES - 13°						
	CENTER FEED - PSI	29	33	37	42	46	50
	END FEED - PSI	19	24	27	32	36	40
	PUMP (WATER) - hp	153	168	181	195	209	224
	PUMP EFF. - %	86%	86%	86%	86%	85%	85%
	14 IN DOUBLE "Y" INLET - FT LIFT	4.8	4.2	3.6	2.9	2.3	1.7
	14 IN ALUMINUM SUCTION - FT LIFT	2.8	2.2	1.6	NA	NA	NA
	13.50 INCHES - FULL TRIM						
	CENTER FEED - PSI	36	41	46	50	55	59
	END FEED - PSI	26	31	36	40	45	49
	PUMP (WATER) - hp	173	189	206	221	237	254
	PUMP EFF. - %	87%	87%	87%	86%	86%	85%
	14 IN DOUBLE "Y" INLET - FT LIFT	5.1	4.5	3.9	3.4	2.8	2.2
	14 IN ALUMINUM SUCTION - FT LIFT	3.1	2.5	1.9	1.4	NA	NA

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
4700	13.00 INCHES - 13°						
	CENTER FEED - PSI	24	28	32	37	40	44
	END FEED - PSI	15	19	23	27	31	35
	PUMP (WATER) - hp	134	147	160	174	187	200
	PUMP EFF. - %	86%	86%	85%	85%	85%	85%
	14 IN DOUBLE "Y" INLET - FT LIFT	5.8	5.0	4.2	3.4	2.6	1.8
	14 IN ALUMINUM SUCTION - FT LIFT	3.9	3.1	2.3	1.5	NA	NA
	13.50 INCHES - 13°						
	CENTER FEED - PSI	31	35	39	43	47	51
	END FEED - PSI	21	25	29	34	37	42
	PUMP (WATER) - hp	151	166	179	194	208	223
	PUMP EFF. - %	87%	87%	86%	86%	85%	85%
	14 IN DOUBLE "Y" INLET - FT LIFT	5.5	4.8	4.2	3.5	2.9	2.2
	14 IN ALUMINUM SUCTION - FT LIFT	3.6	2.9	2.3	1.6	NA	NA
	13.50 INCHES - FULL TRIM						
	CENTER FEED - PSI	38	43	47	52	56	61
	END FEED - PSI	28	33	37	42	46	51
	PUMP (WATER) - hp	174	190	204	221	236	253
	PUMP EFF. - %	87%	87%	87%	86%	86%	85%
	14 IN DOUBLE "Y" INLET - FT LIFT	5.8	5.2	4.6	4.0	3.4	2.8
	14 IN ALUMINUM SUCTION - FT LIFT	3.9	3.3	2.7	2.1	1.5	NA
4900	13.00 INCHES - 13°						
	CENTER FEED - PSI	21	25	29	33	37	42
	END FEED - PSI	10	15	19	23	27	31
	PUMP (WATER) - hp	132	147	160	174	187	201
	PUMP EFF. - %	85%	85%	85%	85%	85%	85%
	14 IN DOUBLE "Y" INLET - FT LIFT	4.9	4.1	3.3	2.5	1.7	NA
	14 IN ALUMINUM SUCTION - FT LIFT	3.0	2.2	1.4	NA	NA	NA
	13.50 INCHES - 13°						
	CENTER FEED - PSI	27	32	36	40	44	49
	END FEED - PSI	17	21	26	30	34	38
	PUMP (WATER) - hp	153	167	182	195	210	225
	PUMP EFF. - %	86%	86%	86%	86%	86%	85%
	14 IN DOUBLE "Y" INLET - FT LIFT	4.1	3.5	2.9	2.2	1.6	1.0
	14 IN ALUMINUM SUCTION - FT LIFT	2.2	1.6	NA	NA	NA	NA
	13.50 INCHES - FULL TRIM						
	CENTER FEED - PSI	35	39	44	49	53	58
	END FEED - PSI	24	29	34	38	43	48
	PUMP (WATER) - hp	174	190	207	222	239	256
	PUMP EFF. - %	87%	87%	87%	86%	86%	86%
	14 IN DOUBLE "Y" INLET - FT LIFT	4.3	3.7	3.2	2.6	2.1	1.5
	14 IN ALUMINUM SUCTION - FT LIFT	2.4	1.8	NA	NA	NA	NA

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Valmont test data has been used to adjust the data for system loss and elevation within the system.
Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design.

Pump Performance Charts (Continued)

Chart G
Pioneer SC64C10 Pump Performance

CENTERFEED]
END FEED] - PRESSURE (PSI) AVAILABLE AT TOP OF CART (INCLUDES CART ELEVATION AND CART PIPE LOSSES)

Altitude is assumed to be sea level *
Temperature is assumed to be 90 deg. F. (32.2 deg. C.)*
* See Table 6 on page 2-33 in Pump Selection for lift adjustments for altitude and temperature.

MAXIMUM ALLOWABLE SUCTION LIFT (FT) - IS THE DISTANCE MEASURED FROM BOTTOM OF CART DRIVE UNIT TIRES TO WATER LEVEL

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
300	9.00 INCHES						
	CENTER FEED (PSI)	25	27	29	32	34	36
	END FEED (PSI)	25	27	29	32	34	36
	PUMP (WATER) hp	7	8	8	9	10	10
	PUMP EFF.	75.9%	75.0%	74.1%	73.2%	72.3%	71.4%
	12 IN SINGLE INLET - FT LIFT	25.6	25.5	25.4	25.2	25.1	25.0
	12 IN ALUMINUM INLET - FT LIFT	25.6	25.5	25.4	25.2	25.1	25.0
	10.25 INCHES						
	CENTER FEED (PSI)	38	42	45	47	50	53
	END FEED (PSI)	38	41	45	47	50	53
	PUMP (WATER) hp	11	12	12	13	14	15
	PUMP EFF.	73.0%	72.1%	71.1%	70.1%	69.2%	68.2%
	12 IN SINGLE INLET - FT LIFT	26.1	26.0	25.9	25.7	25.6	25.5
	12 IN ALUMINUM INLET - FT LIFT	26.1	26.0	25.9	25.7	25.6	25.5
500	9.00 INCHES						
	CENTER FEED (PSI)	13	16	18	21	23	26
	END FEED (PSI)	13	16	18	21	23	26
	PUMP (WATER) hp	10	10	11	12	13	13
	PUMP EFF.	59.6%	61.9%	64.1%	66.4%	68.6%	70.9%
	12 IN SINGLE INLET - FT LIFT	24.3	24.3	24.2	24.2	24.1	24.0
	12 IN ALUMINUM INLET - FT LIFT	24.2	24.2	24.1	24.1	24.0	23.9
	10.25 INCHES						
	CENTER FEED (PSI)	31	34	37	40	43	46
	END FEED (PSI)	30	34	37	40	43	46
	PUMP (WATER) hp	13	14	15	16	17	18
	PUMP EFF.	83.2%	83.1%	83.0%	82.9%	82.8%	82.7%
	12 IN SINGLE INLET - FT LIFT	24.6	24.6	24.5	24.5	24.4	24.3
	12 IN ALUMINUM INLET - FT LIFT	24.5	24.5	24.4	24.4	24.3	24.2

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
400	9.00 INCHES						
	CENTER FEED (PSI)	21	23	25	28	29	32
	END FEED (PSI)	21	23	25	28	29	32
	PUMP (WATER) hp	8	9	10	10	11	11
	PUMP EFF.	74.8%	75.3%	75.8%	76.4%	76.9%	77.4%
	12 IN SINGLE INLET - FT LIFT	25.4	25.3	25.2	25.0	24.8	24.7
	12 IN ALUMINUM INLET - FT LIFT	25.4	25.3	25.2	25.0	24.8	24.7
	10.25 INCHES						
	CENTER FEED (PSI)	35	38	41	45	48	51
	END FEED (PSI)	35	38	41	44	47	50
	PUMP (WATER) hp	12	13	14	15	16	17
	PUMP EFF.	81.3%	80.7%	80.0%	79.4%	78.7%	78.1%
	12 IN SINGLE INLET - FT LIFT	25.6	25.5	25.4	25.3	25.2	25.1
	12 IN ALUMINUM INLET - FT LIFT	25.6	25.5	25.4	25.3	25.2	25.1
550	9.00 INCHES						
	CENTER FEED (PSI)	NA	10	13	16	18	21
	END FEED (PSI)	NA	10	13	16	18	21
	PUMP (WATER) hp	9	10	11	12	12	13
	PUMP EFF.	45.6%	49.0%	52.5%	55.9%	59.4%	62.9%
	12 IN SINGLE INLET - FT LIFT	23.7	23.6	23.6	23.5	23.4	23.3
	12 IN ALUMINUM INLET - FT LIFT	23.7	23.6	23.6	23.5	23.4	23.3
	10.25 INCHES						
	CENTER FEED (PSI)	27	31	34	37	40	44
	END FEED (PSI)	27	30	33	37	40	43
	PUMP (WATER) hp	12	13	14	15	16	17
	PUMP EFF.	79.6%	80.3%	81.1%	81.8%	82.6%	83.4%
	12 IN SINGLE INLET - FT LIFT	23.7	23.7	23.7	23.7	23.7	23.7
	12 IN ALUMINUM INLET - FT LIFT	23.7	23.7	23.7	23.7	23.7	23.7

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Valmont test data has been used to adjust the data for system loss and elevation within the system. Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design.

Rainger Linear Ditch Feed

Pump Performance Charts (Continued)

Chart H
Pioneer SC64C13 Pump Performance

CENTERFEED]
END FEED] - PRESSURE (PSI) AVAILABLE AT TOP OF CART (INCLUDES CART ELEVATION AND CART PIPE LOSSES.)

Altitude is assumed to be sea level*
Temperature is assumed to be 90 deg. F. (32.2 deg. C.)*
* See Table 6 on page 2-33 in Pump Selection for lift adjustments for altitude and temperature.

MAXIMUM ALLOWABLE SUCTION LIFT (FT) - IS THE DISTANCE MEASURED FROM BOTTOM OF CART DRIVE UNIT TIRES TO WATER LEVEL.

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
500	10.00 INCHES						
	CENTER FEED (PSI)	36	39	42	45	47	51
	END FEED (PSI)	36	39	42	45	47	50
	PUMP (WATER) hp	17	18	19	20	22	23
	PUMP EFF.	75%	74%	73%	73%	72%	71%
	12 IN SINGLE INLET - FT LIFT	20.6	20.3	20.0	19.6	19.3	19.0
	12 IN ALUMINUM INLET - FT LIFT	20.5	20.2	19.9	19.5	19.2	18.9
	11.00 INCHES						
	CENTER FEED (PSI)	47	51	54	58	62	65
	END FEED (PSI)	47	51	54	58	62	65
	PUMP (WATER) hp	21	23	25	26	28	30
	PUMP EFF.	73%	73%	72%	71%	70%	70%
	12 IN SINGLE INLET - FT LIFT	20.6	20.3	20.0	19.6	19.3	19.0
	12 IN ALUMINUM INLET - FT LIFT	20.5	20.2	19.9	19.5	19.2	18.9
	12.00 INCHES						
	CENTER FEED (PSI)	60	64	69	73	77	82
	END FEED (PSI)	60	64	69	73	77	82
	PUMP (WATER) hp	27	29	31	33	36	38
	PUMP EFF.	72%	71%	70%	69%	68%	67%
	12 IN SINGLE INLET - FT LIFT	20.6	20.3	20.0	19.6	19.3	19.0
	12 IN ALUMINUM INLET - FT LIFT	20.5	20.2	19.9	19.5	19.2	18.9
	13.00 INCHES						
	CENTER FEED (PSI)	74	79	84	89	95	100
	END FEED (PSI)	74	79	84	89	95	100
	PUMP (WATER) hp	33	36	39	42	45	48
	PUMP EFF.	70%	69%	68%	67%	66%	65%
	12 IN SINGLE INLET - FT LIFT	20.6	20.3	20.0	19.6	19.3	19.0
	12 IN ALUMINUM INLET - FT LIFT	20.5	20.2	19.9	19.5	19.2	18.9
700	10.00 INCHES						
	CENTER FEED (PSI)	33	36	39	42	44	47
	END FEED (PSI)	33	36	38	42	44	47
	PUMP (WATER) hp	21	22	24	25	27	28
	PUMP EFF.	79%	79%	78%	78%	78%	77%
	12 IN SINGLE INLET - FT LIFT	18.5	18.1	17.7	17.4	17.0	16.6
	12 IN ALUMINUM INLET - FT LIFT	18.3	17.9	17.5	17.2	16.8	16.4
	11.00 INCHES						
	CENTER FEED (PSI)	45	48	52	56	59	62
	END FEED (PSI)	45	48	51	55	59	62
	PUMP (WATER) hp	26	28	29	32	33	36
	PUMP EFF.	81%	80%	81%	80%	80%	78%
	12 IN SINGLE INLET - FT LIFT	18.6	18.2	17.8	17.5	17.1	16.7
	12 IN ALUMINUM INLET - FT LIFT	18.4	18.0	17.6	17.3	16.9	16.5
	12.00 INCHES						
	CENTER FEED (PSI)	57	62	66	70	75	79
	END FEED (PSI)	57	61	66	70	74	79
	PUMP (WATER) hp	32	35	37	40	43	45
	PUMP EFF.	80%	80%	79%	78%	78%	77%
	12 IN SINGLE INLET - FT LIFT	18.6	18.2	17.8	17.5	17.1	16.7
	12 IN ALUMINUM INLET - FT LIFT	18.4	18.0	17.6	17.3	16.9	16.5
	13.00 INCHES						
	CENTER FEED (PSI)	71	76	81	86	92	97
	END FEED (PSI)	71	76	81	86	91	96
	PUMP (WATER) hp	40	43	46	49	52	55
	PUMP EFF.	80%	79%	78%	78%	77%	76%
	12 IN SINGLE INLET - FT LIFT	18.6	18.2	17.8	17.5	17.1	16.7
	12 IN ALUMINUM INLET - FT LIFT	18.4	18.0	17.6	17.3	16.9	16.5

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
600	10.00 INCHES						
	CENTER FEED (PSI)	34	37	40	43	46	49
	END FEED (PSI)	34	37	40	43	46	49
	PUMP (WATER) hp	19	20	21	23	24	26
	PUMP EFF.	77%	77%	76%	76%	76%	76%
	12 IN SINGLE INLET - FT LIFT	19.5	19.2	18.9	18.5	18.2	17.8
	12 IN ALUMINUM INLET - FT. LIFT	19.4	19.1	18.8	18.4	18.1	17.7
	11.00 INCHES						
	CENTER FEED (PSI)	46	50	53	57	60	64
	END FEED (PSI)	46	49	53	57	60	64
	PUMP (WATER) hp	24	25	27	29	31	33
	PUMP EFF.	77%	77%	76%	76%	75%	75%
	12 IN SINGLE INLET - FT LIFT	19.5	19.2	18.9	18.5	18.2	17.8
	12 IN ALUMINUM INLET - FT LIFT	19.4	19.1	18.8	18.4	18.1	17.7
	12.00 INCHES						
	CENTER FEED (PSI)	59	63	67	72	76	80
	END FEED (PSI)	59	63	67	72	76	80
	PUMP (WATER) hp	30	32	34	37	39	41
	PUMP EFF.	77%	76%	75%	75%	74%	73%
	12 IN SINGLE INLET - FT LIFT	19.5	19.2	18.9	18.5	18.2	17.8
	12 IN ALUMINUM INLET - FT LIFT	19.4	19.1	18.8	18.4	18.1	17.7
	13.00 INCHES						
	CENTER FEED (PSI)	73	78	83	88	93	99
	END FEED (PSI)	72	78	83	88	93	98
	PUMP (WATER) hp	36	39	42	45	48	51
	PUMP EFF.	76%	75%	74%	73%	72%	72%
	12 IN SINGLE INLET - FT LIFT	19.5	19.2	18.9	18.5	18.2	17.8
	12 IN ALUMINUM INLET - FT LIFT	19.4	19.1	18.8	18.4	18.1	17.7
800	10.00 INCHES						
	CENTER FEED (PSI)	32	34	37	40	43	45
	END FEED (PSI)	31	34	37	40	42	45
	PUMP (WATER) hp	22	24	25	27	29	30
	PUMP EFF.	80%	80%	80%	79%	79%	79%
	12 IN SINGLE INLET - FT LIFT	17.3	16.9	16.5	16.2	15.8	15.4
	12 IN ALUMINUM INLET - FT LIFT	17.1	16.7	16.3	16.0	15.6	15.2
	11.00 INCHES						
	CENTER FEED (PSI)	43	46	49	53	57	60
	END FEED (PSI)	42	46	49	53	57	60
	PUMP (WATER) hp	28	30	32	35	37	39
	PUMP EFF.	81%	81%	81%	81%	80%	80%
	12 IN SINGLE INLET - FT LIFT	17.3	16.9	16.5	16.2	15.8	15.4
	12 IN ALUMINUM INLET - FT LIFT	17.1	16.7	16.3	16.0	15.6	15.2
	12.00 INCHES						
	CENTER FEED (PSI)	55	59	64	68	73	77
	END FEED (PSI)	55	59	63	68	73	77
	PUMP (WATER) hp	35	38	41	43	46	49
	PUMP EFF.	81%	81%	81%	81%	80%	80%
	12 IN SINGLE INLET - FT LIFT	17.3	16.9	16.5	16.2	15.8	15.4
	12 IN ALUMINUM INLET - FT LIFT	17.1	16.7	16.3	16.0	15.6	15.2
	13.00 INCHES						
	CENTER FEED (PSI)	69	74	79	84	90	95
	END FEED (PSI)	69	74	79	84	89	95
	PUMP (WATER) hp	43	46	50	53	56	59
	PUMP EFF.	82%	81%	81%	80%	80%	80%
	12 IN SINGLE INLET - FT LIFT	17.3	16.9	16.5	16.2	15.8	15.4
	12 IN ALUMINUM INLET - FT LIFT	17.1	16.7	16.3	16.0	15.6	15.2

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Valmont test data has been used to adjust the data for system loss and elevation within the system. Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design.

Pump Performance Charts (Continued)

Chart H
Pioneer SC64C13 Pump Performance

CENTERFEED]
END FEED] - PRESSURE (PSI) AVAILABLE AT TOP OF CART (INCLUDES CART ELEVATION AND CART PIPE LOSSES.)

Altitude is assumed to be sea level *
Temperature is assumed to be 90 deg. F. (32.2 deg. C.)*
* See Table 6 on page 2-33 in Pump Selection for lift adjustments for altitude and temperature.

MAXIMUM ALLOWABLE SUCTION LIFT (FT) - IS THE DISTANCE MEASURED FROM BOTTOM OF CART DRIVE UNIT TIRES TO WATER LEVEL.

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
900	10.00 INCHES						
	CENTER FEED (PSI)	29	32	35	37	40	43
	END FEED (PSI)	28	31	34	37	40	43
	PUMP (WATER) hp	24	26	28	29	31	33
	PUMP EFF.	78%	78%	79%	79%	79%	80%
	12 IN SINGLE INLET - FT LIFT	15.9	15.5	15.1	14.8	14.4	14.0
	12 IN ALUMINUM INLET - FT LIFT	15.7	15.3	14.9	14.6	14.2	13.8
	11.00 INCHES						
	CENTER FEED (PSI)	41	44	48	51	55	58
	END FEED (PSI)	40	44	47	51	54	58
	PUMP (WATER) hp	30	33	35	37	39	42
	PUMP EFF.	82%	82%	82%	82%	81%	81%
	12 IN SINGLE INLET - FT LIFT	15.9	15.5	15.1	14.8	14.4	14.0
	12 IN ALUMINUM INLET - FT LIFT	15.7	15.3	14.9	14.6	14.2	13.8
	12.00 INCHES						
	CENTER FEED (PSI)	53	57	61	66	70	74
	END FEED (PSI)	52	57	61	65	70	74
	PUMP (WATER) hp	38	41	44	47	49	52
	PUMP EFF.	83%	82%	82%	82%	81%	81%
	12 IN SINGLE INLET - FT LIFT	15.9	15.5	15.1	14.8	14.4	14.0
	12 IN ALUMINUM INLET - FT LIFT	15.7	15.3	14.9	14.6	14.2	13.8
	13.00 INCHES						
	CENTER FEED (PSI)	67	72	77	82	87	93
	END FEED (PSI)	66	71	77	82	87	92
	PUMP (WATER) hp	46	50	53	57	60	64
	PUMP EFF.	83%	83%	83%	82%	82%	81%
	12 IN SINGLE INLET - FT LIFT	15.9	15.5	15.1	14.8	14.4	14.0
	12 IN ALUMINUM INLET - FT LIFT	15.7	15.3	14.9	14.6	14.2	13.8
1100	10.00 INCHES						
	CENTER FEED (PSI)	24	27	29	32	35	38
	END FEED (PSI)	23	26	29	31	34	37
	PUMP (WATER) hp	27	29	31	33	35	37
	PUMP EFF.	73%	74%	75%	75%	76%	77%
	12 IN SINGLE INLET - FT LIFT	12.9	12.5	12.1	11.7	11.3	10.9
	12 IN ALUMINUM INLET - FT LIFT	12.6	12.2	11.8	11.4	11.0	10.6
	12 IN DOUBLE "T" INLET - FT LIFT	13.8	13.4	13.0	12.6	12.2	11.8
	11.00 INCHES						
	CENTER FEED (PSI)	35	39	42	46	50	53
	END FEED (PSI)	35	38	42	46	49	52
	PUMP (WATER) hp	34	37	40	42	45	47
	PUMP EFF.	78%	79%	79%	80%	80%	81%
	12 IN SINGLE INLET - FT LIFT	12.8	12.4	12.0	11.7	11.3	10.9
	12 IN ALUMINUM INLET - FT LIFT	12.5	12.1	11.7	11.4	11.0	10.6
	12 IN DOUBLE "T" INLET - FT LIFT	13.7	13.3	12.9	12.6	12.2	11.8
	12.00 INCHES						
	CENTER FEED (PSI)	49	52	57	62	66	70
	END FEED (PSI)	48	52	57	62	66	69
	PUMP (WATER) hp	44	46	50	54	57	59
	PUMP EFF.	81%	82%	82%	83%	83%	83%
	12 IN SINGLE INLET - FT LIFT	12.5	12.2	11.9	11.6	11.3	11.0
	12 IN ALUMINUM INLET - FT LIFT	12.2	11.9	11.6	11.3	11.0	10.7
	12 IN DOUBLE "T" INLET - FT LIFT	13.4	13.1	12.8	12.5	12.2	11.9
	13.00 INCHES						
	CENTER FEED (PSI)	62	67	72	78	83	88
	END FEED (PSI)	62	67	72	77	82	88
	PUMP (WATER) hp	53	56	60	64	68	72
	PUMP EFF.	84%	84%	84%	84%	84%	84%
	12 IN SINGLE INLET - FT LIFT	12.0	12.4	13.5	14.0	15.0	11.0
	12 IN ALUMINUM INLET - FT LIFT	11.7	12.1	13.2	13.7	14.7	10.7
	12 IN DOUBLE "T" INLET - FT LIFT	12.9	13.3	14.4	14.9	15.9	11.9

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
1000	10.00 INCHES						
	CENTER FEED (PSI)	27	29	32	35	38	41
	END FEED (PSI)	26	29	31	35	37	40
	PUMP (WATER) hp	26	27	29	31	33	35
	PUMP EFF.	76%	76%	77%	77%	78%	78%
	12 IN SINGLE INLET - FT LIFT	14.5	14.1	13.7	13.3	12.9	12.5
	12 IN ALUMINUM INLET - FT LIFT	14.2	13.8	13.4	13.0	12.6	12.2
	11.00 INCHES						
	CENTER FEED (PSI)	38	41	45	49	52	56
	END FEED (PSI)	38	41	44	48	52	55
	PUMP (WATER) hp	32	35	37	40	42	44
	PUMP EFF.	80%	81%	81%	81%	82%	82%
	12 IN SINGLE INLET - FT LIFT	14.5	14.1	13.7	13.3	12.9	12.5
	12 IN ALUMINUM INLET - FT LIFT	14.2	13.8	13.4	13.0	12.6	12.2
	12.00 INCHES						
	CENTER FEED (PSI)	51	55	59	64	68	72
	END FEED (PSI)	50	54	59	63	67	72
	PUMP (WATER) hp	40	43	46	50	53	56
	PUMP EFF.	83%	83%	83%	83%	82%	82%
	12 IN SINGLE INLET - FT LIFT	14.5	14.1	13.7	13.3	12.9	12.5
	12 IN ALUMINUM INLET - FT LIFT	14.2	13.8	13.4	13.0	12.6	12.2
	13.00 INCHES						
	CENTER FEED (PSI)	64	70	75	80	85	90
	END FEED (PSI)	64	69	74	80	85	90
	PUMP (WATER) hp	49	53	57	60	64	68
	PUMP EFF.	84%	84%	84%	84%	83%	83%
	12 IN SINGLE INLET - FT LIFT	14.5	14.1	13.7	13.3	12.9	12.5
	12 IN ALUMINUM INLET - FT LIFT	14.2	13.8	13.4	13.0	12.6	12.2
1200	10.00 INCHES						
	CENTER FEED (PSI)			26	29	32	35
	END FEED (PSI)			25	28	31	34
	PUMP (WATER) hp	NA	NA	33	35	37	39
	PUMP EFF.			70%	72%	74%	75%
	12 IN SINGLE INLET - FT LIFT			10.1	9.8	9.5	9.3
	12 IN ALUMINUM INLET - FT LIFT			9.7	9.4	9.1	8.9
	12 IN DOUBLE "T" INLET - FT LIFT			11.1	10.8	10.5	10.3
	11.00 INCHES						
	CENTER FEED (PSI)	33	36	39	43	46	50
	END FEED (PSI)	32	35	38	42	46	50
	PUMP (WATER) hp	37	39	42	45	47	50
	PUMP EFF.	76%	76%	77%	78%	79%	79%
	12 IN SINGLE INLET - FT LIFT	10.7	10.4	10.1	9.7	9.4	9.1
	12 IN ALUMINUM INLET - FT LIFT	10.3	10.0	9.7	9.3	9.0	8.7
	12 IN DOUBLE "T" INLET - FT LIFT	11.7	11.4	11.1	10.7	10.4	10.1
	12.00 INCHES						
	CENTER FEED (PSI)	45	49	54	58	62	67
	END FEED (PSI)	44	49	53	57	62	66
	PUMP (WATER) hp	45	49	52	56	59	63
	PUMP EFF.	80%	81%	81%	81%	82%	82%
	12 IN SINGLE INLET - FT LIFT	10.6	10.3	10.0	9.6	9.3	8.9
	12 IN ALUMINUM INLET - FT LIFT	10.2	9.9	9.6	9.2	8.9	8.5
	12 IN DOUBLE "T" INLET - FT LIFT	11.6	11.3	11.0	10.6	10.3	9.9
	13.00 INCHES						
	CENTER FEED (PSI)	59	64	69	75	80	85
	END FEED (PSI)	58	64	69	74	79	84
	PUMP (WATER) hp	55	60	64	68	72	76
	PUMP EFF.	83%	83%	84%	84%	84%	84%
	12 IN SINGLE INLET - FT LIFT	10.6	10.3	10.0	9.7	9.4	9.1
	12 IN ALUMINUM INLET - FT LIFT	10.2	9.9	9.6	9.3	9.0	8.7
	12 IN DOUBLE "T" INLET - FT LIFT	11.6	11.3	11.0	10.7	10.4	10.1

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Valmont test data has been used to adjust the data for system loss and elevation within the system. Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design.

Pump Performance Charts (Continued)

Chart H
Pioneer SC64C13 Pump Performance

CENTERFEED]
END FEED] - PRESSURE (PSI) AVAILABLE AT TOP OF CART (INCLUDES CART ELEVATION AND CART PIPE LOSSES.)

Altitude is assumed to be sea level*
Temperature is assumed to be 90 deg. F. (32.2 deg. C.)*
* See Table 6 on page 2-33 in Pump Selection for lift adjustments for altitude and temperature.

MAXIMUM ALLOWABLE SUCTION LIFT (FT) - IS THE DISTANCE MEASURED FROM BOTTOM OF CART DRIVE UNIT TIRES TO WATER LEVEL.

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
1300	10.00 INCHES						
	CENTER FEED (PSI)						33
	END FEED (PSI)						31
	PUMP (WATER) hp	NA	NA	NA	NA	NA	41
	PUMP EFF.						70%
	12 IN SINGLE INLET - FT LIFT						6.8
	12 IN ALUMINUM INLET - FT LIFT						6.6
	12 IN DOUBLE "T" INLET - FT LIFT						8.2
	11.00 INCHES						
	CENTER FEED (PSI)	33	32	36	39	43	47
	END FEED (PSI)	33	31	35	39	42	46
	PUMP (WATER) hp	40	41	44	47	50	53
	PUMP EFF.	76%	72%	74%	75%	76%	77%
	12 IN SINGLE INLET - FT LIFT	7.8	8.0	7.8	7.6	7.2	6.9
	12 IN ALUMINUM INLET - FT LIFT	7.4	7.6	7.4	7.2	6.8	6.5
	12 IN DOUBLE "T" INLET - FT LIFT	9.0	9.2	9.0	8.8	8.4	8.1
	12.00 INCHES						
	CENTER FEED (PSI)	42	46	51	55	59	64
	END FEED (PSI)	41	46	50	54	58	63
	PUMP (WATER) hp	48	52	55	59	63	66
	PUMP EFF.	78%	78%	79%	80%	80%	81%
	12 IN SINGLE INLET - FT LIFT	8.3	8.0	7.7	7.3	7.0	6.7
	12 IN ALUMINUM INLET - FT LIFT	7.9	7.6	7.3	6.9	6.6	6.3
	12 IN DOUBLE "T" INLET - FT LIFT	9.5	9.2	8.9	8.5	8.2	7.9
	13.00 INCHES						
	CENTER FEED (PSI)	55	61	66	71	77	82
	END FEED (PSI)	55	60	65	71	76	81
	PUMP (WATER) hp	58	63	67	72	76	80
	PUMP EFF.	81%	82%	82%	83%	83%	84%
	12 IN SINGLE INLET - FT LIFT	8.0	7.8	7.6	7.3	7.1	6.9
	12 IN ALUMINUM INLET - FT LIFT	7.6	7.4	7.2	6.9	6.7	6.5
	12 IN DOUBLE "T" INLET - FT LIFT	9.2	9.0	8.8	8.5	8.3	8.1

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
1400	10.00 INCHES						
	CENTER FEED (PSI)						
	END FEED (PSI)						
	PUMP (WATER) hp	NA	NA	NA	NA	NA	NA
	PUMP EFF.						
	12 IN SINGLE INLET - FT LIFT						
	12 IN ALUMINUM INLET - FT LIFT						
	12 IN DOUBLE "T" INLET - FT LIFT						
	11.00 INCHES						
	CENTER FEED (PSI)					39	43
	END FEED (PSI)					38	42
	PUMP (WATER) hp	NA	NA	NA	NA	52	55
	PUMP EFF.					73%	74%
	12 IN SINGLE INLET - FT LIFT					4.7	4.5
	12 IN ALUMINUM INLET - FT LIFT					4.2	4.0
	12 IN DOUBLE "T" INLET - FT LIFT					6.0	5.8
	12.00 INCHES						
	CENTER FEED (PSI)	38	42	47	51	56	60
	END FEED (PSI)	37	41	46	50	55	59
	PUMP (WATER) hp	50	54	57	62	65	69
	PUMP EFF.	74%	75%	76%	78%	79%	80%
	12 IN SINGLE INLET - FT LIFT	5.5	5.3	5.1	4.9	4.7	4.5
	12 IN ALUMINUM INLET - FT LIFT	5.0	4.8	4.6	4.4	4.2	4.0
	12 IN DOUBLE "T" INLET - FT LIFT	6.8	6.6	6.4	6.2	6.0	5.8
	13.00 INCHES						
	CENTER FEED (PSI)	52	57	63	68	73	78
	END FEED (PSI)	51	56	62	67	72	77
	PUMP (WATER) hp	61	66	70	75	80	84
	PUMP EFF.	80%	80%	81%	82%	82%	83%
	12 IN SINGLE INLET - FT LIFT	11.7	5.3	5.0	4.8	4.5	4.2
	12 IN ALUMINUM INLET - FT LIFT	11.2	4.8	4.5	4.3	4.0	3.7
	12 IN DOUBLE "T" INLET - FT LIFT	13.0	6.6	6.3	6.1	5.8	5.5

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Valmont test data has been used to adjust the data for system loss and elevation within the system. Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design.

Pump Performance Charts (Continued)

Chart I
Pioneer SC66C14 Pump Performance

CENTERFEED]
END FEED (PSI)] - PRESSURE (PSI) AVAILABLE AT TOP OF CART (INCLUDES CART ELEVATION AND CART PIPE LOSSES).

Altitude is assumed to be sea level*
Temperature is assumed to be 90 deg. F. (32.2 deg. C.)*
* See Table 6 on page 2-33 in Pump Selection for lift adjustments for altitude and temperature.

MAXIMUM ALLOWABLE SUCTION LIFT (FT) - IS THE DISTANCE MEASURED FROM BOTTOM OF CART DRIVE UNIT TIRES TO WATER LEVEL.

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
1200	11.50 INCHES						
	CENTER FEED (PSI)	44	47	51	55	58	62
	END FEED (PSI)	43	47	50	54	57	61
	PUMP (WATER) hp	47	50	54	58	62	66
	PUMP EFF.	75.8%	75.2%	74.6%	74.0%	73.5%	72.9%
	12 IN SINGLE INLET - FT LIFT	17.7	17.4	17.2	16.9	16.7	16.4
	12 IN DOUBLE "T" INLET - FT LIFT	17.7	17.4	17.2	16.9	16.7	16.4
	12 IN ALUMINUM INLET - FT LIFT	17.3	17.0	16.8	16.5	16.3	16.0
	12.00 INCHES						
	CENTER FEED (PSI)	49	53	57	61	65	69
	END FEED (PSI)	49	53	57	60	64	68
	PUMP (WATER) hp	52	56	60	64	68	73
	PUMP EFF.	76.0%	75.4%	74.8%	74.2%	73.7%	73.1%
	12 IN SINGLE INLET - FT LIFT	18.5	18.2	17.9	17.5	17.2	16.9
	12 IN DOUBLE "T" INLET - FT LIFT	18.5	18.2	17.9	17.5	17.2	16.9
	12 IN ALUMINUM INLET - FT LIFT	18.1	17.8	17.5	17.1	16.8	16.5
1400	11.50 INCHES						
	CENTER FEED (PSI)	40	44	47	51	55	58
	END FEED (PSI)	40	43	47	50	54	57
	PUMP (WATER) hp	48	52	56	60	64	68
	PUMP EFF.	77.2%	77.2%	76.8%	76.5%	76.1%	75.8%
	12 IN SINGLE INLET - FT LIFT	15.6	15.3	15.0	14.7	14.4	14.1
	12 IN DOUBLE "T" INLET - FT LIFT	15.6	15.3	15.0	14.7	14.4	14.1
	12 IN ALUMINUM INLET - FT LIFT	15.1	14.8	14.5	14.2	13.9	13.6
	12.00 INCHES						
	CENTER FEED (PSI)	47	50	54	58	62	66
	END FEED (PSI)	46	50	53	57	61	65
	PUMP (WATER) hp	58	61	65	70	74	79
	PUMP EFF.	76.0%	77.5%	77.1%	76.7%	76.4%	76.0%
	12 IN SINGLE INLET - FT LIFT	16.7	16.4	16.1	15.7	15.4	15.1
	12 IN DOUBLE "T" INLET - FT LIFT	16.7	16.4	16.1	15.7	15.4	15.1
	12 IN ALUMINUM INLET - FT LIFT	16.2	15.9	15.6	15.2	14.9	14.6

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
1300	11.50 INCHES						
	CENTER FEED (PSI)	41	45	49	53	56	60
	END FEED (PSI)	41	45	48	52	55	59
	PUMP (WATER) hp	48	52	56	60	64	68
	PUMP EFF.	76.5%	76.2%	75.9%	75.6%	75.2%	74.9%
	12 IN SINGLE INLET - FT LIFT	16.7	16.4	16.1	15.9	15.6	15.3
	12 IN DOUBLE "T" INLET - FT LIFT	16.7	16.4	16.1	15.9	15.6	15.3
	12 IN ALUMINUM INLET - FT LIFT	16.3	16.0	15.7	15.5	15.2	14.9
	12.00 INCHES						
	CENTER FEED (PSI)	48	52	56	60	64	68
	END FEED (PSI)	47	51	55	59	63	67
	PUMP (WATER) hp	54	58	63	67	71	76
	PUMP EFF.	76.7%	76.4%	76.1%	75.8%	75.4%	75.1%
	12 IN SINGLE INLET - FT LIFT	17.6	17.3	17.0	16.7	16.4	16.1
	12 IN DOUBLE "T" INLET - FT LIFT	17.6	17.3	17.0	16.7	16.4	16.1
	12 IN ALUMINUM INLET - FT LIFT	17.2	16.9	16.6	16.3	16.0	15.7
1500	11.50 INCHES						
	CENTER FEED (PSI)	39	42	46	50	53	57
	END FEED (PSI)	38	41	45	49	52	56
	PUMP (WATER) hp	52	56	60	65	69	73
	PUMP EFF.	78.1%	77.8%	77.5%	77.2%	77.0%	76.7%
	12 IN SINGLE INLET - FT LIFT	14.5	14.2	13.9	13.5	13.2	12.9
	12 IN DOUBLE "T" INLET - FT LIFT	14.4	14.1	13.8	13.4	13.1	12.8
	12 IN ALUMINUM INLET - FT LIFT	13.9	13.6	13.3	12.9	12.6	12.3
	12.00 INCHES						
	CENTER FEED (PSI)	45	49	52	57	61	65
	END FEED (PSI)	44	48	51	56	60	64
	PUMP (WATER) hp	52	56	60	65	69	73
	PUMP EFF.	78.5%	78.5%	78.1%	77.7%	77.4%	77.0%
	12 IN SINGLE INLET - FT LIFT	16.0	15.6	15.3	14.9	14.6	14.2
	12 IN DOUBLE "T" INLET - FT LIFT	15.9	15.5	15.2	14.8	14.5	14.1
	12 IN ALUMINUM INLET - FT LIFT	15.4	15.0	14.7	14.3	14.0	13.6

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Valmont test data has been used to adjust the data for system loss and elevation within the system. Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design.

Pump Performance Charts (Continued)

Chart I
Pioneer SC66C14 Pump Performance

CENTERFEED]
END FEED (PSI)] - PRESSURE (PSI) AVAILABLE AT TOP OF CART (INCLUDES CART ELEVATION AND CART PIPE LOSSES.)

Altitude is assumed to be sea level*
Temperature is assumed to be 90 deg. F. (32.2 deg. C.)*
* See Table 6 on page 2-33 in Pump Selection for lift adjustments for altitude and temperature.

MAXIMUM ALLOWABLE SUCTION LIFT (FT) - IS THE DISTANCE MEASURED FROM BOTTOM OF CART DRIVE UNIT TIRES TO WATER LEVEL.

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750 / 1775	1800 / 1825	1850 / 1875	1900 / 1925	1950 / 1975	2000 / 2025
1600	13 INCHES						
	CENTER FEED (PSI)	36	40	44	47	51	55
	END FEED (PSI)	35	39	42	46	50	54
	PUMP (WATER) hp	53	57	62	66	70	75
	PUMP EFF.	76.7%	76.9%	77.1%	77.2%	77.4%	77.6%
	12 IN SINGLE INLET - FT LIFT	12.7	12.5	12.3	12.0	11.8	11.6
	12 IN DOUBLE "T" INLET - FT LIFT	12.6	12.4	12.2	11.9	11.7	11.5
	12 IN ALUMINUM INLET - FT LIFT	12.1	11.9	11.7	11.4	11.2	11.0
	13.5 INCHES						
	CENTER FEED (PSI)	43	47	51	55	59	63
	END FEED (PSI)	42	46	49	54	58	62
	PUMP (WATER) hp	60	64	69	74	79	84
	PUMP EFF.	78.5%	78.4%	78.3%	78.2%	78.0%	77.9%
	12 IN SINGLE INLET - FT LIFT	14.5	14.2	13.9	13.7	13.4	13.1
	12 IN DOUBLE "T" INLET - FT LIFT	14.4	14.1	13.8	13.6	13.3	13.0
	12 IN ALUMINUM INLET - FT LIFT	13.9	13.6	13.3	13.1	12.8	12.5
1800	13 INCHES						
	CENTER FEED (PSI)	31	35	39	42	46	50
	END FEED (PSI)	30	34	37	41	45	49
	PUMP (WATER) hp	55	60	65	69	74	79
	PUMP EFF.	74.6%	75.0%	75.4%	75.9%	76.3%	76.7%
	12 IN SINGLE INLET - FT LIFT	9.8	9.5	9.2	9.0	8.8	8.5
	12 IN DOUBLE "T" INLET - FT LIFT	9.5	9.2	8.9	8.7	8.5	8.2
	12 IN ALUMINUM INLET - FT LIFT	9.0	8.7	8.4	8.2	8.0	7.7
	13.5 INCHES						
	CENTER FEED (PSI)	37	41	45	50	54	58
	END FEED (PSI)	35	40	44	48	53	57
	PUMP (WATER) hp	62	67	73	78	84	89
	PUMP EFF.	75.8%	76.3%	76.8%	77.2%	77.7%	78.2%
	12 IN SINGLE INLET - FT LIFT	11.3	11.2	11.1	10.9	10.7	10.6
	12 IN DOUBLE "T" INLET - FT LIFT	11.0	10.9	10.8	10.6	10.4	10.3
	12 IN ALUMINUM INLET - FT LIFT	10.5	10.4	10.3	10.1	9.9	9.8

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750 / 1775	1800 / 1825	1850 / 1875	1900 / 1925	1950 / 1975	2000 / 2025
1700	13 INCHES						
	CENTER FEED (PSI)	33	37	41	45	49	53
	END FEED (PSI)	32	36	40	44	48	52
	PUMP (WATER) hp	54	59	63	68	73	77
	PUMP EFF.	75.6%	76.0%	76.4%	76.8%	77.2%	77.6%
	12 IN SINGLE INLET - FT LIFT	11.2	11.0	10.8	10.6	10.4	10.2
	12 IN DOUBLE "T" INLET - FT LIFT	11.0	10.8	10.6	10.4	10.2	10.0
	12 IN ALUMINUM INLET - FT LIFT	10.5	10.3	10.1	9.9	9.7	9.5
	13.5 INCHES						
	CENTER FEED (PSI)	39	44	48	52	56	61
	END FEED (PSI)	38	43	47	51	55	59
	PUMP (WATER) hp	61	66	71	76	81	86
	PUMP EFF.	77.0%	77.4%	77.8%	78.1%	78.5%	78.9%
	12 IN SINGLE INLET - FT LIFT	12.9	12.7	12.6	12.4	12.3	12.1
	12 IN DOUBLE "T" INLET - FT LIFT	12.7	12.5	12.4	12.2	12.1	11.9
	12 IN ALUMINUM INLET - FT LIFT	12.2	12.0	11.9	11.7	11.6	11.4
1900	13 INCHES						
	CENTER FEED (PSI)	26	30	35	39	43	47
	END FEED (PSI)	25	29	33	37	41	46
	PUMP (WATER) hp	55	60	66	71	76	81
	PUMP EFF.	69.3%	70.6%	71.9%	73.3%	74.6%	75.9%
	12 IN SINGLE INLET - FT LIFT	8.1	7.8	7.5	7.3	7.0	6.7
	12 IN DOUBLE "T" INLET - FT LIFT	7.8	7.5	7.2	7.0	6.7	6.4
	12 IN ALUMINUM INLET - FT LIFT	7.2	6.9	6.6	6.4	6.1	5.8
	13.5 INCHES						
	CENTER FEED (PSI)	34	39	43	47	51	55
	END FEED (PSI)	33	37	41	45	49	54
	PUMP (WATER) hp	63	69	74	80	85	91
	PUMP EFF.	74.8%	75.3%	75.8%	76.3%	76.8%	77.3%
	12 IN SINGLE INLET - FT LIFT	9.8	9.6	9.4	9.2	9.0	8.8
	12 IN DOUBLE "T" INLET - FT LIFT	9.5	9.3	9.1	8.9	8.7	8.5
	12 IN ALUMINUM INLET - FT LIFT	8.9	8.7	8.5	8.3	8.1	7.9

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Valmont test data has been used to adjust the data for system loss and elevation within the system. Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design.

Pump Performance Charts (Continued)

Chart J
Pioneer SC86C14 Pump Performance

CENTERFEED]
END FEED] - PRESSURE (FT) AVAILABLE AT TOP OF CART (INCLUDES CART ELEVATION AND PIPING LOSSES.)

Altitude is assumed to be sea level*
Temperature is assumed to be 90 deg. F. (32.2 deg. C.)*
* See Table 6 on page 2-33 in Pump Selection for lift adjustments for altitude and temperature.

MAXIMUM ALLOWABLE SUCTION LIFT (FT) - DISTANCE IS MEASURED FROM BOTTOM OF CART DRIVE UNIT TIRES.

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
1800	11.50 INCHES						
	CENTER FEED	44	48	51	55	59	63
	END FEED	43	47	50	54	57	61
	PUMP (WATER) hp	67	73	78	84	90	96
	PUMP EFF.	81.0%	80.3%	79.6%	78.9%	78.1%	77.4%
	12 IN SINGLE INLET - FT LIFT	16.4	16.2	15.9	15.7	15.4	15.1
	12 IN DOUBLE INLET - FT LIFT	16.1	15.9	15.6	15.4	15.1	14.8
	12 IN ALUMINUM INLET - FT LIFT	15.6	15.4	15.1	14.9	14.6	14.3
	14 IN DOUBLE "T" INLET - FT LIFT	16.7	16.5	16.2	16.0	15.7	15.4
	12.00 INCHES						
	CENTER FEED	51	55	59	63	67	70
	END FEED	50	53	57	61	65	69
	PUMP (WATER) hp	76	82	88	95	101	107
	PUMP EFF.	81.1%	80.1%	79.1%	78.1%	77.2%	76.2%
	12 IN SINGLE INLET - FT LIFT	16.3	16.1	15.9	15.7	15.5	15.3
	12 IN DOUBLE INLET - FT LIFT	16.0	15.8	15.6	15.4	15.2	15.0
	12 IN ALUMINUM INLET - FT LIFT	15.5	15.3	15.1	14.9	14.7	14.5
	14 IN DOUBLE "T" INLET - FT LIFT	16.6	16.4	16.2	16.0	15.8	15.6
	13.00 INCHES						
	CENTER FEED	63	68	73	77	82	87
	END FEED	62	66	71	76	81	86
	PUMP (WATER) hp	95	103	111	119	127	136
	PUMP EFF.	78.3%	77.3%	76.3%	75.3%	74.4%	73.4%
	12 IN SINGLE INLET - FT LIFT	16.8	16.5	16.2	15.9	15.6	15.3
	12 IN DOUBLE INLET - FT LIFT	16.5	16.2	15.9	15.6	15.3	15.0
	12 IN ALUMINUM INLET - FT LIFT	16.0	15.7	15.4	15.1	14.8	14.5
	14 IN DOUBLE "T" INLET - FT LIFT	17.1	16.8	16.5	16.2	15.9	15.6
	14.00 INCHES						
	CENTER FEED	76	81	87	92	98	103
	END FEED	74	80	86	91	96	102
	PUMP (WATER) hp	116	126	135	145	155	165
	PUMP EFF.	75.6%	74.6%	73.6%	72.6%	71.6%	70.6%
	12 IN SINGLE INLET - FT LIFT	16.7	16.5	16.3	16.0	15.8	15.6
	12 IN DOUBLE INLET - FT LIFT	16.4	16.2	16.0	15.7	15.5	15.3
	12 IN ALUMINUM INLET - FT LIFT	15.9	15.7	15.5	15.2	15.0	14.8
	14 IN DOUBLE "T" INLET - FT LIFT	17.0	16.8	16.6	16.3	16.1	15.9

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
1900	11.50 INCHES						
	CENTER FEED	43	46	50	54	58	62
	END FEED	41	45	49	53	57	60
	PUMP (WATER) hp	69	75	81	86	92	98
	PUMP EFF.	81.2%	80.8%	80.4%	80.0%	79.7%	79.3%
	12 IN SINGLE INLET - FT LIFT	15.3	15.1	14.9	14.7	14.5	14.3
	12 IN DOUBLE INLET - FT LIFT	15.0	14.8	14.6	14.4	14.2	14.0
	12 IN ALUMINUM INLET - FT LIFT	14.4	14.2	14.0	13.8	13.6	13.4
	14 IN DOUBLE "T" INLET - FT LIFT	15.6	15.4	15.2	15.0	14.8	14.6
	12.00 INCHES						
	CENTER FEED	49	53	58	62	66	70
	END FEED	48	52	56	60	64	68
	PUMP (WATER) hp	78	84	91	97	104	110
	PUMP EFF.	81.3%	80.7%	80.1%	79.5%	78.9%	78.3%
	12 IN SINGLE INLET - FT LIFT	15.5	15.2	15.0	14.7	14.5	14.2
	12 IN DOUBLE INLET - FT LIFT	15.2	14.9	14.7	14.4	14.2	13.9
	12 IN ALUMINUM INLET - FT LIFT	14.6	14.3	14.1	13.8	13.6	13.3
	14 IN DOUBLE "T" INLET - FT LIFT	15.8	15.5	15.3	15.0	14.8	14.5
	13.00 INCHES						
	CENTER FEED	62	67	72	76	81	86
	END FEED	60	65	70	75	80	84
	PUMP (WATER) hp	97	104	112	121	129	138
	PUMP EFF.	80.5%	79.5%	78.5%	77.5%	76.4%	75.4%
	12 IN SINGLE INLET - FT LIFT	15.6	15.4	15.2	15.0	14.9	14.7
	12 IN DOUBLE INLET - FT LIFT	15.3	15.1	14.9	14.7	14.6	14.4
	12 IN ALUMINUM INLET - FT LIFT	14.7	14.5	14.3	14.1	14.0	13.8
	14 IN DOUBLE "T" INLET - FT LIFT	15.9	15.7	15.5	15.3	15.2	15.0
	14.00 INCHES						
	CENTER FEED	75	80	86	91	97	103
	END FEED	73	79	84	90	96	101
	PUMP (WATER) hp	118	128	138	148	158	169
	PUMP EFF.	77.6%	76.6%	75.6%	74.6%	73.6%	72.6%
	12 IN SINGLE INLET - FT LIFT	15.9	15.6	15.4	15.1	14.9	14.6
	12 IN DOUBLE INLET - FT LIFT	15.6	15.3	15.1	14.8	14.6	14.3
	12 IN ALUMINUM INLET - FT LIFT	15.0	14.7	14.5	14.2	14.0	13.7
	14 IN DOUBLE "T" INLET - FT LIFT	16.2	15.9	15.7	15.4	15.2	14.9

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Valmont test data has been used to adjust the data for system loss and elevation within the system.
Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design.

Pump Performance Charts (Continued)

Chart J
Pioneer SC86C14 Pump Performance

CENTERFEED]
END FEED] - PRESSURE (FT) AVAILABLE AT TOP OF CART (INCLUDES CART ELEVATION AND PIPING LOSSES.)

Altitude is assumed to be sea level*
Temperature is assumed to be 90 deg. F. (32.2 deg. C.)*
* See Table 6 on page 2-33 in Pump Selection for lift adjustments for altitude and temperature.

MAXIMUM ALLOWABLE SUCTION LIFT (FT) - DISTANCE IS MEASURED FROM BOTTOM OF CART DRIVE UNIT TIRES.

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM					
		1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
2000	11.50 INCHES						
	CENTER FEED	41	45	49	53	57	61
	END FEED	39	43	47	51	55	59
	PUMP (WATER) hp	71	76	82	88	94	100
	PUMP EFF.	81.6%	81.3%	81.0%	80.8%	80.5%	80.3%
	12 IN SINGLE INLET - FT LIFT	14.4	14.1	13.9	13.6	13.4	13.2
	12 IN DOUBLE INLET - FT LIFT	14.1	13.8	13.6	13.3	13.1	12.9
	12 IN ALUMINUM INLET - FT LIFT	13.5	13.2	13.0	12.7	12.5	12.3
	14 IN DOUBLE "T" INLET - FT LIFT	14.8	14.5	14.3	14.0	13.8	13.6
	12.00 INCHES						
	CENTER FEED	47	51	56	61	65	69
	END FEED	45	50	54	59	63	67
	PUMP (WATER) hp	79	86	92	100	106	113
	PUMP EFF.	81.6%	81.3%	81.0%	80.7%	80.4%	80.1%
	12 IN SINGLE INLET - FT LIFT	14.5	14.2	13.9	13.7	13.4	13.1
	12 IN DOUBLE INLET - FT LIFT	14.2	13.9	13.6	13.4	13.1	12.8
	12 IN ALUMINUM INLET - FT LIFT	13.6	13.3	13.0	12.8	12.5	12.2
	14 IN DOUBLE "T" INLET - FT LIFT	14.9	14.6	14.3	14.1	13.8	13.5
	13.00 INCHES						
	CENTER FEED	61	66	70	76	80	85
	END FEED	59	64	69	74	79	83
	PUMP (WATER) hp	99	106	115	124	132	141
	PUMP EFF.	82.0%	81.1%	80.1%	79.2%	78.2%	77.3%
	12 IN SINGLE INLET - FT LIFT	14.8	14.5	14.3	14.0	13.8	13.6
	12 IN DOUBLE INLET - FT LIFT	14.5	14.2	14.0	13.7	13.5	13.3
	12 IN ALUMINUM INLET - FT LIFT	13.9	13.6	13.4	13.1	12.9	12.7
	14 IN DOUBLE "T" INLET - FT LIFT	15.2	14.9	14.7	14.4	14.2	14.0
	14.00 INCHES						
	CENTER FEED	74	80	85	90	96	102
	END FEED	72	78	83	89	94	100
	PUMP (WATER) hp	121	131	141	151	161	172
	PUMP EFF.	79.5%	78.5%	77.5%	76.5%	75.6%	74.6%
	12 IN SINGLE INLET - FT LIFT	15.0	14.7	14.4	14.2	13.9	13.6
	12 IN DOUBLE INLET - FT LIFT	14.7	14.4	14.1	13.9	13.6	13.3
	12 IN ALUMINUM INLET - FT LIFT	14.1	13.8	13.5	13.3	13.0	12.7
	14 IN DOUBLE "T" INLET - FT LIFT	15.4	15.1	14.8	14.6	14.3	14.0

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM					
		1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
2100	11.50 INCHES						
	CENTER FEED	40	43	47	51	55	59
	END FEED	38	41	45	49	53	57
	PUMP (WATER) hp	72	78	84	90	96	102
	PUMP EFF.	82.2%	81.9%	81.6%	81.3%	81.1%	80.8%
	12 IN SINGLE INLET - FT LIFT	13.3	13.1	12.9	12.6	12.4	12.2
	12 IN DOUBLE INLET - FT LIFT	13.2	12.9	12.6	12.4	12.1	11.8
	12 IN ALUMINUM INLET - FT LIFT	12.2	12.0	11.8	11.5	11.3	11.1
	14 IN DOUBLE "T" INLET - FT LIFT	13.7	13.5	13.3	13.0	12.8	12.6
	12.00 INCHES						
	CENTER FEED	46	50	54	59	63	67
	END FEED	44	48	52	57	61	65
	PUMP (WATER) hp	81	87	94	101	108	115
	PUMP EFF.	82.2%	81.9%	81.6%	81.3%	80.9%	80.6%
	12 IN SINGLE INLET - FT LIFT	13.6	13.3	13.0	12.8	12.5	12.2
	12 IN DOUBLE INLET - FT LIFT	13.7	13.4	13.1	12.7	12.4	12.1
	12 IN ALUMINUM INLET - FT LIFT	12.5	12.2	11.9	11.7	11.4	11.1
	14 IN DOUBLE "T" INLET - FT LIFT	14.0	13.7	13.4	13.2	12.9	12.6
	13.00 INCHES						
	CENTER FEED	60	65	69	75	79	84
	END FEED	58	63	67	73	77	82
	PUMP (WATER) hp	101	109	117	126	134	143
	PUMP EFF.	83.3%	82.5%	81.7%	80.9%	80.1%	79.3%
	12 IN SINGLE INLET - FT LIFT	14.1	13.8	13.5	13.1	12.8	12.5
	12 IN DOUBLE INLET - FT LIFT	13.8	13.5	13.2	12.9	12.6	12.3
	12 IN ALUMINUM INLET - FT LIFT	13.0	12.7	12.4	12.0	11.7	11.4
	14 IN DOUBLE "T" INLET - FT LIFT	14.5	14.2	13.9	13.5	13.2	12.9
	14.00 INCHES						
	CENTER FEED	73	78	84	89	95	101
	END FEED	71	77	82	87	93	99
	PUMP (WATER) hp	123	133	143	153	164	175
	PUMP EFF.	81.3%	80.3%	79.3%	78.3%	77.4%	76.4%
	12 IN SINGLE INLET - FT LIFT	14.2	13.9	13.6	13.3	13.0	12.7
	12 IN DOUBLE INLET - FT LIFT	11.8	11.5	11.3	11.0	10.8	10.5
	12 IN ALUMINUM INLET - FT LIFT	13.1	12.8	12.5	12.2	11.9	11.6
	14 IN DOUBLE "T" INLET - FT LIFT	14.6	14.3	14.0	13.7	13.4	13.1

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Valmont test data has been used to adjust the data for system loss and elevation within the system.
Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design.

Pump Performance Charts (Continued)

Chart J
Pioneer SC86C14 Pump Performance

CENTERFEED]
END FEED] - PRESSURE (FT) AVAILABLE AT TOP OF CART (INCLUDES CART ELEVATION AND PIPING LOSSES.)

Altitude is assumed to be sea level*
Temperature is assumed to be 90 deg. F. (32.2 deg. C.)*
* See Table 6 on page 2-33 in Pump Selection for lift adjustments for altitude and temperature.

MAXIMUM ALLOWABLE SUCTION LIFT (FT) - DISTANCE IS MEASURED FROM BOTTOM OF CART DRIVE UNIT TIRES.

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
2200	11.50 INCHES						
	CENTER FEED	38	42	46	50	54	57
	END FEED	36	40	44	48	51	55
	PUMP (WATER) hp	73	79	85	92	98	105
	PUMP EFF.	82.7%	82.4%	82.1%	81.8%	81.5%	81.2%
	12 IN ALUMINUM INLET - FT LIFT	11.1	10.8	10.6	10.3	10.1	9.8
	12 IN DOUBLE INLET - FT LIFT	11.8	11.5	11.3	11.0	10.8	10.5
	14 IN DOUBLE "T" INLET - FT LIFT	12.7	12.4	12.2	11.9	11.7	11.4
	12.00 INCHES						
	CENTER FEED	44	48	53	57	61	66
	END FEED	42	46	51	55	59	64
	PUMP (WATER) hp	82	89	96	103	110	118
	PUMP EFF.	82.8%	82.5%	82.2%	81.9%	81.5%	81.2%
	12 IN ALUMINUM INLET - FT LIFT	11.4	11.1	10.8	10.5	10.2	9.9
	12 IN DOUBLE INLET - FT LIFT	12.1	11.8	11.5	11.2	10.9	10.6
	14 IN DOUBLE "T" INLET - FT LIFT	13.0	12.7	12.4	12.1	11.8	11.5
	13.00 INCHES						
	CENTER FEED	59	64	68	73	78	83
	END FEED	57	61	66	71	76	81
	PUMP (WATER) hp	102	111	119	128	137	146
	PUMP EFF.	84.7%	83.9%	83.1%	82.3%	81.6%	80.8%
	12 IN ALUMINUM INLET - FT LIFT	12.2	11.8	11.4	11.1	10.7	10.3
	12 IN DOUBLE INLET - FT LIFT	12.9	12.5	12.1	11.8	11.4	11.0
	14 IN DOUBLE "T" INLET - FT LIFT	13.8	13.4	13.0	12.7	12.3	11.9
	14.00 INCHES						
	CENTER FEED	72	78	83	89	94	100
	END FEED	70	76	81	87	92	98
	PUMP (WATER) hp	125	136	146	156	167	179
	PUMP EFF.	82.8%	81.9%	80.9%	80.0%	79.0%	78.1%
	12 IN ALUMINUM INLET - FT LIFT	12.5	12.1	11.7	11.3	10.9	10.5
	12 IN DOUBLE INLET - FT LIFT	13.2	12.8	12.4	12.0	11.6	11.2
	14 IN DOUBLE "T" INLET - FT LIFT	14.1	13.7	13.3	12.9	12.5	12.1

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
2300	11.50 INCHES						
	CENTER FEED	41	40	44	48	52	55
	END FEED	38	38	42	45	49	53
	PUMP (WATER) hp	82	81	87	93	100	106
	PUMP EFF.	81.9%	81.9%	81.8%	81.8%	81.7%	81.7%
	12 IN ALUMINUM INLET - FT LIFT	9.8	9.5	9.3	9.0	8.8	8.5
	12 IN DOUBLE INLET - FT LIFT	10.5	10.2	10.0	9.7	9.5	9.2
	14 IN DOUBLE "T" INLET - FT LIFT	11.5	11.2	11.0	10.7	10.5	10.2
	12.00 INCHES						
	CENTER FEED	42	47	51	55	59	64
	END FEED	40	45	49	53	57	61
	PUMP (WATER) hp	83	90	98	104	112	119
	PUMP EFF.	83.4%	83.1%	82.7%	82.4%	82.0%	81.7%
	12 IN ALUMINUM INLET - FT LIFT	10.4	10.1	9.8	9.4	9.1	8.8
	12 IN DOUBLE INLET - FT LIFT	11.1	10.8	10.5	10.1	9.8	9.5
	14 IN DOUBLE "T" INLET - FT LIFT	12.1	11.8	11.5	11.1	10.8	10.5
	13.00 INCHES						
	CENTER FEED	58	62	67	72	77	82
	END FEED	55	60	65	70	75	80
	PUMP (WATER) hp	104	113	121	131	140	149
	PUMP EFF.	85.8%	85.1%	84.3%	83.6%	82.8%	82.1%
	12 IN ALUMINUM INLET - FT LIFT	11.1	10.8	10.4	10.1	9.7	9.3
	12 IN DOUBLE INLET - FT LIFT	11.8	11.5	11.1	10.8	10.4	10.0
	14 IN DOUBLE "T" INLET - FT LIFT	12.8	12.5	12.1	11.8	11.4	11.0
	14.00 INCHES						
	CENTER FEED	68	77	82	87	93	99
	END FEED	66	74	80	85	91	96
	PUMP (WATER) hp	123	138	148	159	170	181
	PUMP EFF.	84.4%	83.5%	82.6%	81.7%	80.7%	79.8%
	12 IN ALUMINUM INLET - FT LIFT	11.8	11.3	10.8	10.4	9.9	9.4
	12 IN DOUBLE INLET - FT LIFT	12.5	12.0	11.5	11.1	10.6	10.1
	14 IN DOUBLE "T" INLET - FT LIFT	13.5	13.0	12.5	12.1	11.6	11.1

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Valmont test data has been used to adjust the data for system loss and elevation within the system.
Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design.

Rainger Linear Ditch Feed

Pump Performance Charts (Continued)

Chart J
Pioneer SC86C14 Pump Performance

CENTERFEED]
END FEED] - PRESSURE (FT) AVAILABLE AT TOP OF CART (INCLUDES CART ELEVATION AND PIPING LOSSES.)

Altitude is assumed to be sea level*
Temperature is assumed to be 90 deg. F. (32.2 deg. C.)*
* See Table 6 on page 2-33 in Pump Selection for lift adjustments for altitude and temperature.

MAXIMUM ALLOWABLE SUCTION LIFT (FT) - DISTANCE IS MEASURED FROM BOTTOM OF CART DRIVE UNIT TIRES.

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
2400	11.50 INCHES						
	CENTER FEED	35	39	43	46	50	54
	END FEED	32	36	40	44	48	51
	PUMP (WATER) hp	76	83	89	95	101	108
	PUMP EFF.	81.1%	81.3%	81.5%	81.8%	82.0%	82.2%
	12 IN ALUMINUM INLET - FT LIFT	8.6	8.3	8.0	7.8	7.5	7.2
	12 IN DOUBLE INLET - FT LIFT	9.3	9.0	8.7	8.5	8.2	7.9
	14 IN DOUBLE "T" INLET - FT LIFT	10.4	10.1	9.8	9.6	9.3	9.0
	12.00 INCHES						
	CENTER FEED	40	45	49	53	57	62
	END FEED	38	42	47	51	55	59
	PUMP (WATER) hp	84	92	95	106	113	121
	PUMP EFF.	82.7%	82.6%	86.5%	82.4%	82.3%	82.3%
	12 IN ALUMINUM INLET - FT LIFT	9.1	8.8	8.5	8.2	7.9	7.6
	12 IN DOUBLE INLET - FT LIFT	9.8	9.5	9.2	8.9	8.6	8.3
	14 IN DOUBLE "T" INLET - FT LIFT	10.9	10.6	10.3	10.0	9.7	9.4
	13.00 INCHES						
	CENTER FEED	56	61	66	71	76	80
	END FEED	54	58	63	68	73	78
	PUMP (WATER) hp	107	115	124	133	142	150
	PUMP EFF.	85.8%	85.3%	84.8%	84.3%	83.9%	83.4%
	12 IN ALUMINUM INLET - FT LIFT	10.3	9.9	9.5	9.1	8.7	8.3
	12 IN DOUBLE INLET - FT LIFT	11.0	10.6	10.2	9.8	9.4	9.0
	14 IN DOUBLE "T" INLET - FT LIFT	12.1	11.7	11.3	10.9	10.5	10.1
	14.00 INCHES						
	CENTER FEED	70	76	81	86	92	98
	END FEED	67	73	79	84	89	95
	PUMP (WATER) hp	129	140	151	161	173	184
	PUMP EFF.	85.9%	85.0%	84.1%	83.2%	82.2%	81.3%
	12 IN ALUMINUM INLET - FT LIFT	11.1	10.6	10.1	9.6	9.1	8.6
	12 IN DOUBLE INLET - FT LIFT	11.8	11.3	10.8	10.3	9.8	9.3
	14 IN DOUBLE "T" INLET - FT LIFT	12.9	12.4	11.9	11.4	10.9	10.4

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
2500	11.50 INCHES						
	CENTER FEED	33	37	41	45	48	52
	END FEED	31	34	38	42	46	50
	PUMP (WATER) hp	78	84	91	97	103	110
	PUMP EFF.	80.5%	80.8%	81.1%	81.5%	81.8%	82.1%
	12 IN ALUMINUM INLET - FT LIFT	7.3	7.0	6.7	6.5	6.2	5.9
	12 IN DOUBLE INLET - FT LIFT	8.0	7.7	7.4	7.2	6.9	6.6
	14 IN DOUBLE "T" INLET - FT LIFT	9.2	8.9	8.6	8.4	8.1	7.8
	12.00 INCHES						
	CENTER FEED	39	43	48	51	56	60
	END FEED	36	41	45	49	53	57
	PUMP (WATER) hp	86	94	101	108	115	123
	PUMP EFF.	81.8%	82.0%	82.2%	82.4%	82.6%	82.8%
	12 IN ALUMINUM INLET - FT LIFT	7.8	7.5	7.2	7.0	6.7	6.4
	12 IN DOUBLE INLET - FT LIFT	8.5	8.2	7.9	7.7	7.4	7.1
	14 IN DOUBLE "T" INLET - FT LIFT	9.7	9.4	9.1	8.9	8.6	8.3
	13.00 INCHES						
	CENTER FEED	55	60	64	70	74	79
	END FEED	52	57	62	67	72	76
	PUMP (WATER) hp	110	118	127	136	144	153
	PUMP EFF.	85.7%	85.5%	85.3%	85.1%	84.8%	84.6%
	12 IN ALUMINUM INLET - FT LIFT	9.3	8.9	8.5	8.1	7.7	7.3
	12 IN DOUBLE INLET - FT LIFT	10.0	9.6	9.2	8.8	8.4	8.0
	14 IN DOUBLE "T" INLET - FT LIFT	11.2	10.8	10.4	10.0	9.6	9.2
	14.00 INCHES						
	CENTER FEED	69	74	80	85	91	96
	END FEED	66	72	77	83	88	94
	PUMP (WATER) hp	132	143	154	164	176	187
	PUMP EFF.	86.4%	85.7%	84.9%	84.2%	83.4%	82.7%
	12 IN ALUMINUM INLET - FT LIFT	10.1	9.7	9.2	8.8	8.3	7.8
	12 IN DOUBLE INLET - FT LIFT	10.8	10.4	9.9	9.5	9.0	8.5
	14 IN DOUBLE "T" INLET - FT LIFT	12.0	11.6	11.1	10.7	10.2	9.7

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Valmont test data has been used to adjust the data for system loss and elevation within the system.
Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design.

Pump Performance Charts (Continued)

Chart J
Pioneer SC86C14 Pump Performance

CENTERFEED]
END FEED] - PRESSURE (FT) AVAILABLE AT TOP OF CART (INCLUDES CART ELEVATION AND PIPING LOSSES.)

Altitude is assumed to be sea level*
Temperature is assumed to be 90 deg. F. (32.2 deg. C.)*
* See Table 6 on page 2-33 in Pump Selection for lift adjustments for altitude and temperature.

MAXIMUM ALLOWABLE SUCTION LIFT (FT) - DISTANCE IS MEASURED FROM BOTTOM OF CART DRIVE UNIT TIRES.

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM					
		1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
2600	11.50 INCHES						
	CENTER FEED	32	36	39	43	46	50
	END FEED	29	33	36	40	43	47
	PUMP (WATER) hp	79	86	92	99	105	112
	PUMP EFF.	79.9%	80.3%	80.6%	81.0%	81.3%	81.7%
	12 IN ALUMINUM INLET - FT LIFT	6.0	5.7	5.4	5.1	4.8	4.5
	12 IN DOUBLE INLET - FT LIFT	6.7	6.4	6.1	5.8	5.5	5.2
	14 IN DOUBLE "T" INLET - FT LIFT	8.0	7.7	7.4	7.1	6.8	6.5
	12.00 INCHES						
	CENTER FEED	38	41	46	49	54	58
	END FEED	35	38	43	47	51	55
	PUMP (WATER) hp	90	95	103	109	117	124
	PUMP EFF.	81.0%	81.4%	81.8%	82.2%	82.6%	83.0%
	12 IN ALUMINUM INLET - FT LIFT	6.5	6.2	5.9	5.7	5.4	5.2
	12 IN DOUBLE INLET - FT LIFT	7.2	6.9	6.6	6.4	6.1	5.9
	14 IN DOUBLE "T" INLET - FT LIFT	8.5	8.2	7.9	7.7	7.4	7.2
	13.00 INCHES						
	CENTER FEED	53	58	63	68	73	78
	END FEED	50	55	60	65	70	75
	PUMP (WATER) hp	112	121	129	139	147	156
	PUMP EFF.	85.3%	85.2%	85.2%	85.2%	85.1%	85.1%
	12 IN ALUMINUM INLET - FT LIFT	8.3	7.9	7.5	7.1	6.7	6.3
	12 IN DOUBLE INLET - FT LIFT	9.0	8.6	8.2	7.8	7.4	7.0
	14 IN DOUBLE "T" INLET - FT LIFT	10.3	9.9	9.5	9.1	8.7	8.3
	14.00 INCHES						
	CENTER FEED	67	73	78	84	90	96
	END FEED	64	70	76	82	87	93
	PUMP (WATER) hp	134	145	156	168	179	190
	PUMP EFF.	87.0%	86.4%	85.8%	85.2%	84.7%	84.1%
	12 IN ALUMINUM INLET - FT LIFT	9.3	8.8	8.4	7.9	7.5	7.0
	12 IN DOUBLE INLET - FT LIFT	10.0	9.5	9.1	8.6	8.2	7.7
	14 IN DOUBLE "T" INLET - FT LIFT	11.3	10.8	10.4	9.9	9.5	9.0

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM					
		1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
2700	11.50 INCHES						
	CENTER FEED	28	32	36	40	44	49
	END FEED	25	29	33	37	41	46
	PUMP (WATER) hp	76	84	91	99	106	114
	PUMP EFF.	79.4%	79.8%	80.1%	80.5%	80.8%	81.2%
	12 IN ALUMINUM INLET - FT LIFT	5.1	4.7	4.3	3.8	3.4	3.0
	12 IN DOUBLE INLET - FT LIFT	5.9	5.5	5.1	4.6	4.2	3.8
	14 IN DOUBLE "T" INLET - FT LIFT	7.3	6.9	6.5	6.0	5.6	5.2
	12.00 INCHES						
	CENTER FEED	35	40	44	48	52	56
	END FEED	32	36	40	45	49	53
	PUMP (WATER) hp	89	97	104	112	119	127
	PUMP EFF.	80.4%	80.8%	81.2%	81.6%	82.0%	82.4%
	12 IN ALUMINUM INLET - FT LIFT	5.1	4.8	4.5	4.3	4.0	3.7
	12 IN DOUBLE INLET - FT LIFT	5.9	5.6	5.3	5.1	4.8	4.5
	14 IN DOUBLE "T" INLET - FT LIFT	7.3	7.0	6.7	6.5	6.2	5.9
	13.00 INCHES						
	CENTER FEED	52	56	61	66	71	76
	END FEED	49	53	58	63	68	73
	PUMP (WATER) hp	115	124	132	142	150	159
	PUMP EFF.	85.0%	85.0%	85.1%	85.2%	85.2%	85.3%
	12 IN ALUMINUM INLET - FT LIFT	7.4	6.9	6.5	6.2	5.8	5.1
	12 IN DOUBLE INLET - FT LIFT	8.2	7.7	7.3	7.0	6.6	5.9
	14 IN DOUBLE "T" INLET - FT LIFT	9.6	9.1	8.7	8.4	8.0	7.3
	14.00 INCHES						
	CENTER FEED	66	71	77	83	89	94
	END FEED	62	68	74	80	85	91
	PUMP (WATER) hp	137	148	158	170	182	193
	PUMP EFF.	87.3%	86.9%	86.5%	86.1%	85.6%	85.2%
	12 IN ALUMINUM INLET - FT LIFT	8.3	7.8	7.4	6.9	6.5	6.0
	12 IN DOUBLE INLET - FT LIFT	9.1	8.6	8.2	7.7	7.3	6.8
	14 IN DOUBLE "T" INLET - FT LIFT	10.5	10.0	9.6	9.1	8.7	8.2

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Valmont test data has been used to adjust the data for system loss and elevation within the system.
Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design.

Rainger Linear Ditch Feed

Pump Performance Charts (Continued)

Chart J
Pioneer SC86C14 Pump Performance

CENTERFEED]
END FEED] - PRESSURE (FT) AVAILABLE AT TOP OF CART (INCLUDES CART ELEVATION AND PIPING LOSSES.)

Altitude is assumed to be sea level*
Temperature is assumed to be 90 deg. F. (32.2 deg. C.)*
* See Table 6 on page 2-33 in Pump Selection for lift adjustments for altitude and temperature.

MAXIMUM ALLOWABLE SUCTION LIFT (FT) - DISTANCE IS MEASURED FROM BOTTOM OF CART DRIVE UNIT TIRES.

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM					
		1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
2800	11.50 INCHES						
	CENTER FEED		31	35	39	43	47
	END FEED		28	32	36	40	44
	PUMP (WATER) hp	NA	86	93	102	109	117
	PUMP EFF.		79.0%	79.5%	80.0%	80.3%	80.7%
	12 IN ALUMINUM INLET - FT LIFT		2.9	2.6	2.3	2.0	1.7
	12 IN DOUBLE INLET - FT LIFT		3.7	3.4	3.1	2.8	2.5
	14 IN DOUBLE "T" INLET - FT LIFT		5.1	4.8	4.5	4.2	3.9
	12.00 INCHES						
	CENTER FEED	34	38	42	46	50	54
	END FEED	30	35	38	43	47	51
	PUMP (WATER) hp	90	99	106	114	121	130
	PUMP EFF.	79.7%	80.2%	80.6%	81.1%	81.5%	81.9%
	12 IN ALUMINUM INLET - FT LIFT	3.9	3.6	3.3	2.9	2.6	2.3
	12 IN DOUBLE INLET - FT LIFT	4.7	4.4	4.1	3.7	3.4	3.1
	14 IN DOUBLE "T" INLET - FT LIFT	6.1	5.8	5.5	5.1	4.8	4.5
	13.00 INCHES						
	CENTER FEED	49	54	59	64	69	74
	END FEED	45	51	56	61	66	71
	PUMP (WATER) hp	116	125	135	143	153	162
	PUMP EFF.	83.8%	84.1%	84.4%	84.8%	85.1%	85.4%
	12 IN ALUMINUM INLET - FT LIFT	5.6	5.3	5.0	4.7	4.4	4.1
	12 IN DOUBLE INLET - FT LIFT	6.4	6.1	5.8	5.5	5.2	4.9
	14 IN DOUBLE "T" INLET - FT LIFT	7.8	7.5	7.2	6.9	6.6	6.3
	14.00 INCHES						
	CENTER FEED	63	69	75	81	87	93
	END FEED	60	66	72	77	84	90
	PUMP (WATER) hp	139	151	162	173	185	197
	PUMP EFF.	86.4%	86.3%	86.2%	86.1%	86.0%	85.9%
	12 IN ALUMINUM INLET - FT LIFT	7.1	6.7	6.3	5.9	5.5	5.1
	12 IN DOUBLE INLET - FT LIFT	7.9	7.5	7.1	6.7	6.3	5.9
	14 IN DOUBLE "T" INLET - FT LIFT	9.3	8.9	8.5	8.1	7.7	7.3

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM					
		1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
2900	11.50 INCHES						
	CENTER FEED			33	37	42	47
	END FEED			29	34	38	43
	PUMP (WATER) hp	NA	NA	95	103	112	121
	PUMP EFF.			77.9%	78.9%	79.8%	80.7%
	12 IN ALUMINUM INLET - FT LIFT			1.5	1.1	NA	NA
	12 IN DOUBLE INLET - FT LIFT			2.3	1.9	1.4	1.0
	14 IN DOUBLE "T" INLET - FT LIFT			3.9	3.5	3.0	2.6
	12.00 INCHES						
	CENTER FEED	31	36	40	44	48	52
	END FEED	28	32	36	41	44	49
	PUMP (WATER) hp	90	98	107	116	123	131
	PUMP EFF.	79.3%	79.7%	80.1%	80.5%	81.0%	81.4%
	12 IN ALUMINUM INLET - FT LIFT	2.4	2.1	1.8	1.5	1.1	NA
	12 IN DOUBLE INLET - FT LIFT	3.2	2.9	2.6	2.3	1.9	1.6
	14 IN DOUBLE "T" INLET - FT LIFT	4.8	4.5	4.2	3.9	3.5	3.2
	13.00 INCHES						
	CENTER FEED	47	52	58	63	68	73
	END FEED	44	49	54	60	64	69
	PUMP (WATER) hp	119	129	138	149	157	165
	PUMP EFF.	82.4%	83.0%	83.6%	84.3%	84.9%	85.5%
	12 IN ALUMINUM INLET - FT LIFT	4.9	4.5	4.1	3.8	3.4	3.0
	12 IN DOUBLE INLET - FT LIFT	5.7	5.3	4.9	4.6	4.2	3.8
	14 IN DOUBLE "T" INLET - FT LIFT	7.3	6.9	6.5	6.2	5.8	5.4
	14.00 INCHES						
	CENTER FEED	54	60	65	71	76	81
	END FEED	50	56	61	67	72	78
	PUMP (WATER) hp	130	140	150	161	171	181
	PUMP EFF.	84.7%	85.0%	85.2%	85.5%	85.8%	86.0%
	12 IN ALUMINUM INLET - FT LIFT	5.4	5.0	4.6	4.3	3.9	3.5
	12 IN DOUBLE INLET - FT LIFT	6.2	5.8	5.4	5.1	4.7	4.3
	14 IN DOUBLE "T" INLET - FT LIFT	7.8	7.4	7.0	6.7	6.3	5.9

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Valmont test data has been used to adjust the data for system loss and elevation within the system.
Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design.

Pump Performance Charts (Continued)

Chart J
Pioneer SC86C14 Pump Performance

CENTERFEED]
END FEED] - PRESSURE (FT) AVAILABLE AT TOP OF CART (INCLUDES CART ELEVATION AND PIPING LOSSES.)

Altitude is assumed to be sea level*
Temperature is assumed to be 90 deg. F. (32.2 deg. C.)*
* See Table 6 on page 2-33 in Pump Selection for lift adjustments for altitude and temperature.

MAXIMUM ALLOWABLE SUCTION LIFT (FT) - DISTANCE IS MEASURED FROM BOTTOM OF CART DRIVE UNIT TIRES.

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
	11.50 INCHES						
	CENTER FEED						
	END FEED						
	PUMP (WATER) hp	NA	NA	NA	NA	NA	NA
	PUMP EFF.						
	12 IN DOUBLE INLET - FT LIFT						
	14 IN ALUMINUM INLET - FT LIFT						
	14 IN DOUBLE "T" INLET - FT LIFT						
	14 IN DOUBLE "Y" INLET - FT LIFT						
	12.00 INCHES						
	CENTER FEED		32	37	42	47	52
	END FEED		28	33	38	43	49
	PUMP (WATER) hp	NA	98	108	116	125	133
	PUMP EFF.		77.0%	78.6%	80.3%	81.9%	83.5%
	12 IN DOUBLE INLET - FT LIFT		1.5	1.5	1.5	1.5	1.5
	14 IN ALUMINUM INLET - FT LIFT		3.8	3.8	3.8	3.8	3.8
	14 IN DOUBLE "T" INLET - FT LIFT		5.1	4.9	4.6	4.3	4.1
	14 IN DOUBLE "Y" INLET - FT LIFT		5.7	5.7	5.7	5.7	5.7
3000	13.00 INCHES						
	CENTER FEED	45	50	55	60	65	71
	END FEED	41	46	51	56	62	67
	PUMP (WATER) hp	120	130	140	150	159	168
	PUMP EFF.	81.2%	82.0%	82.7%	83.5%	84.2%	85.0%
	12 IN DOUBLE INLET - FT LIFT	3.7	3.5	3.3	3.0	2.7	2.5
	14 IN ALUMINUM INLET - FT LIFT	6.0	5.8	5.6	5.3	5.0	4.8
	14 IN DOUBLE "T" INLET - FT LIFT	5.3	5.1	4.9	4.6	4.3	4.1
	14 IN DOUBLE "Y" INLET - FT LIFT	7.9	7.7	7.5	7.2	6.9	6.7
	14.00 INCHES						
	CENTER FEED	52	58	63	69	74	79
	END FEED	57	63	68	74	79	84
	PUMP (WATER) hp	132	143	153	164	174	184
	PUMP EFF.	83.5%	84.0%	84.5%	85.0%	85.5%	86.0%
	12 IN DOUBLE INLET - FT LIFT	4.7	4.5	4.3	4.0	3.7	3.5
	14 IN ALUMINUM INLET - FT LIFT	7.0	6.8	6.6	6.3	6.0	5.8
	14 IN DOUBLE "T" INLET - FT LIFT	6.3	6.1	5.9	5.6	5.3	5.1
	14 IN DOUBLE "Y" INLET - FT LIFT	8.9	8.7	8.5	8.2	7.9	7.7

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
	11.50 INCHES						
	CENTER FEED						
	END FEED						
	PUMP (WATER) hp	NA	NA	NA	NA	NA	NA
	PUMP EFF.						
	12 IN DOUBLE INLET - FT LIFT						
	14 IN ALUMINUM INLET - FT LIFT						
	14 IN DOUBLE "T" INLET - FT LIFT						
	14 IN DOUBLE "Y" INLET - FT LIFT						
	12.00 INCHES						
	CENTER FEED				37	43	49
	END FEED				33	39	45
	PUMP (WATER) hp	NA	NA	NA	113	124	135
	PUMP EFF.				78.0%	79.5%	81.0%
	12 IN DOUBLE INLET - FT LIFT				NA	NA	NA
	14 IN ALUMINUM INLET - FT LIFT				3.1	2.8	2.6
	14 IN DOUBLE "T" INLET - FT LIFT				3.6	3.3	3.1
	14 IN DOUBLE "Y" INLET - FT LIFT				5.0	4.7	4.5
3100	13.00 INCHES						
	CENTER FEED	43	48	53	58	63	69
	END FEED	38	44	49	54	59	64
	PUMP (WATER) hp	122	132	143	153	163	172
	PUMP EFF.	80.2%	81.0%	81.7%	82.5%	83.2%	84.0%
	12 IN DOUBLE INLET - FT LIFT	2.3	2.1	1.9	1.6	1.3	1.1
	14 IN ALUMINUM INLET - FT LIFT	4.8	4.6	4.4	4.1	3.8	3.6
	14 IN DOUBLE "T" INLET - FT LIFT	4.0	3.8	3.6	3.3	3.0	2.8
	14 IN DOUBLE "Y" INLET - FT LIFT	6.7	6.5	6.3	6.0	5.7	5.5
	14.00 INCHES						
	CENTER FEED	50	56	61	66	72	78
	END FEED	55	61	67	72	77	83
	PUMP (WATER) hp	134	145	157	167	178	189
	PUMP EFF.	83.0%	83.5%	84.0%	84.5%	85.0%	85.5%
	12 IN DOUBLE INLET - FT LIFT	3.3	3.1	2.9	2.6	2.3	2.1
	14 IN ALUMINUM INLET - FT LIFT	5.8	5.6	5.4	5.1	4.8	4.6
	14 IN DOUBLE "T" INLET - FT LIFT	5.0	4.8	4.6	4.3	4.0	3.8
	14 IN DOUBLE "Y" INLET - FT LIFT	7.7	7.5	7.3	7.0	6.7	6.5

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Valmont test data has been used to adjust the data for system loss and elevation within the system.
Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design.

Pump Performance Charts (Continued)

Chart J
Pioneer SC86C14 Pump Performance

CENTERFEED]
END FEED] - PRESSURE (FT) AVAILABLE AT TOP OF CART (INCLUDES CART ELEVATION AND PIPING LOSSES.)

Altitude is assumed to be sea level*
Temperature is assumed to be 90 deg. F. (32.2 deg. C.)*
* See Table 6 on page 2-33 in Pump Selection for lift adjustments for altitude and temperature.

MAXIMUM ALLOWABLE SUCTION LIFT (FT) - DISTANCE IS MEASURED FROM BOTTOM OF CART DRIVE UNIT TIRES.

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
3200	11.50 INCHES						
	CENTER FEED						
	END FEED						
	PUMP (WATER) hp	NA	NA	NA	NA	NA	NA
	PUMP EFF.						
	12 IN DOUBLE INLET - FT LIFT						
	14 IN ALUMINUM INLET - FT LIFT						
	14 IN DOUBLE "T" INLET - FT LIFT						
	14 IN DOUBLE "Y" INLET - FT LIFT						
	12.00 INCHES						
	CENTER FEED						
	END FEED						
	PUMP (WATER) hp	NA	NA	NA	NA	NA	NA
	PUMP EFF.						
	12 IN DOUBLE INLET - FT LIFT						
	14 IN ALUMINUM INLET - FT LIFT						
	14 IN DOUBLE "T" INLET - FT LIFT						
	14 IN DOUBLE "Y" INLET - FT LIFT						
	13.00 INCHES						
	CENTER FEED	40	45	50	56	61	67
	END FEED	36	41	46	52	57	62
	PUMP (WATER) hp	122	133	144	156	166	176
	PUMP EFF.	79.2%	80.0%	80.7%	81.5%	82.3%	83.0%
	12 IN DOUBLE INLET - FT LIFT	NA	NA	NA	NA	NA	NA
	14 IN ALUMINUM INLET - FT LIFT	3.0	2.9	2.8	2.6	2.5	2.4
	14 IN DOUBLE "T" INLET - FT LIFT	2.1	2.0	1.9	1.7	1.6	1.5
	14 IN DOUBLE "Y" INLET - FT LIFT	4.9	4.8	4.7	4.5	4.4	4.3
	14.00 INCHES						
	CENTER FEED	48	54	59	64	70	76
	END FEED	54	59	65	70	76	81
	PUMP (WATER) hp	137	148	159	170	181	192
	PUMP EFF.	81.9%	82.5%	83.1%	83.8%	84.4%	85.0%
	12 IN DOUBLE INLET - FT LIFT	1.9	1.7	1.5	1.2	NA	NA
	14 IN ALUMINUM INLET - FT LIFT	4.6	4.4	4.2	3.9	3.6	3.4
	14 IN DOUBLE "T" INLET - FT LIFT	3.7	3.5	3.3	3.0	2.7	2.5
	14 IN DOUBLE "Y" INLET - FT LIFT	6.5	6.3	6.1	5.8	5.5	5.3

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
3300	11.50 INCHES						
	CENTER FEED						
	END FEED						
	PUMP (WATER) hp	NA	NA	NA	NA	NA	NA
	PUMP EFF.						
	12 IN DOUBLE INLET - FT LIFT						
	14 IN ALUMINUM INLET - FT LIFT						
	14 IN DOUBLE "T" INLET - FT LIFT						
	14 IN DOUBLE "Y" INLET - FT LIFT						
	12.00 INCHES						
	CENTER FEED						
	END FEED						
	PUMP (WATER) hp	NA	NA	NA	NA	NA	NA
	PUMP EFF.						
	12 IN DOUBLE INLET - FT LIFT						
	14 IN ALUMINUM INLET - FT LIFT						
	14 IN DOUBLE "T" INLET - FT LIFT						
	14 IN DOUBLE "Y" INLET - FT LIFT						
	13.00 INCHES						
	CENTER FEED	38	43	48	53	59	64
	END FEED	33	38	43	48	54	59
	PUMP (WATER) hp	122	133	144	155	167	178
	PUMP EFF.	78.8%	79.5%	80.2%	81.0%	81.7%	82.5%
	12 IN DOUBLE INLET - FT LIFT	NA	NA	NA	NA	NA	NA
	14 IN ALUMINUM INLET - FT LIFT	NA	NA	NA	NA	NA	NA
	14 IN DOUBLE "T" INLET - FT LIFT	NA	NA	NA	NA	NA	NA
	14 IN DOUBLE "Y" INLET - FT LIFT	2.7	2.6	2.5	2.4	2.2	2.1
	14.00 INCHES						
	CENTER FEED	51	57	64	70	76	83
	END FEED	46	53	59	65	71	78
	PUMP (WATER) hp	149	163	176	189	201	214
	PUMP EFF.	81.5%	82.2%	83.0%	83.7%	84.5%	85.2%
	12 IN DOUBLE INLET - FT LIFT	NA	NA	NA	NA	NA	NA
	14 IN ALUMINUM INLET - FT LIFT	3.0	3.0	3.0	3.0	3.0	3.0
	14 IN DOUBLE "T" INLET - FT LIFT	2.0	2.0	2.0	2.0	2.0	2.0
	14 IN DOUBLE "Y" INLET - FT LIFT	4.8	4.8	4.8	4.8	4.8	4.8

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Valmont test data has been used to adjust the data for system loss and elevation within the system.
Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design.

Pump Performance Charts (Continued)

Chart K
Pioneer SC1010C14 Pump Performance

CENTERFEED]
END FEED] - PRESSURE (PSI) AVAILABLE AT TOP OF CART (INCLUDES CART ELEVATION AND CART PIPE LOSSES.)

Altitude is assumed to be sea level*
Temperature is assumed to be 90 deg. F. (32.2 deg. C.)*
* See Table 6 on page 2-33 in Pump Selection for lift adjustments for altitude and temperature.

MAXIMUM ALLOWABLE SUCTION LIFT (FT) - IS THE DISTANCE MEASURED FROM BOTTOM OF CART DRIVE UNIT TIRES TO WATER LEVEL.

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
3800	12.00 IN x 21.5 DEG.						
	CENTER FEED (PSI)	14	18	22	25	30	34
	END FEED (PSI)	7	11	15	19	23	28
	PUMP (WATER) hp	79	90	102	113	125	138
	PUMP EFF. - %	76.5	76.5	76.5	76.5	76.5	76.5
	14 IN DOUBLE "Y" INLET - FT LIFT	9.7	8.9	8.1	7.2	6.4	5.6
	14 IN ALUMINUM INLET - FT LIFT	7.8	7.0	6.2	5.3	4.5	3.7
	12.50 IN x 21.5 DEG.						
	CENTER FEED (PSI)	21	25	28	31	34	38
	END FEED (PSI)	15	18	21	25	28	31
	PUMP (WATER) hp	96	106	117	127	136	146
	PUMP EFF. - %	80.1	80.0	77.9	77.8	77.6	77.5
	14 IN DOUBLE "Y" INLET - FT LIFT	9.5	8.8	7.9	7.1	6.3	5.6
	14 IN ALUMINUM INLET - FT LIFT	7.6	6.9	6.0	5.2	4.4	3.7
	13.00 IN x 21.5 DEG.						
	CENTER FEED (PSI)	28	31	35	39	42	46
	END FEED (PSI)	22	25	29	33	36	39
	PUMP (WATER) hp	113	123	134	146	157	169
	PUMP EFF. - %	81.7	81.0	80.3	79.5	78.8	78.0
	14 IN DOUBLE "Y" INLET - FT LIFT	9.4	8.8	7.9	7.1	6.3	5.6
	14 IN ALUMINUM INLET - FT LIFT	7.5	6.9	6.0	5.2	4.4	3.7
	13.50 IN x 21.5 DEG.						
	CENTER FEED (PSI)	34	38	42	46	49	54
	END FEED (PSI)	28	32	36	40	43	48
	PUMP (WATER) hp	127	139	151	163	174	193
	PUMP EFF. - %	83.0	82.0	82.0	81.0	80.0	78.0
	14 IN DOUBLE "Y" INLET - FT LIFT	9.3	8.7	7.8	7.0	6.2	5.5
	14 IN ALUMINUM INLET - FT LIFT	7.4	6.8	5.9	5.1	4.3	3.6
	14.00 IN x 21.5 DEG.						
	CENTER FEED (PSI)	41	45	49	54	58	63
	END FEED (PSI)	34	39	43	47	52	57
	PUMP (WATER) hp	146	159	173	187	202	218
	PUMP EFF. - %	82.4	81.5	80.6	79.7	78.7	77.8
	14 IN DOUBLE "Y" INLET - FT LIFT	9.3	8.7	7.8	7.0	6.2	5.5
	14 IN ALUMINUM INLET - FT LIFT	7.4	6.8	5.9	5.1	4.3	3.6
	14.00 IN x FULL TRIM						
	CENTER FEED (PSI)	54	59	65	71	77	83
	END FEED (PSI)	48	52	59	65	71	77
	PUMP (WATER) hp	187	201	221	241	262	279
	PUMP EFF. - %	80.5	79.8	78.5	77.5	77.0	77.0
	14 IN DOUBLE "Y" INLET - FT LIFT	9.3	8.6	7.7	6.8	6.0	5.2
	14 IN ALUMINUM INLET - FT LIFT	7.4	6.7	5.8	4.9	4.1	3.3

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
3900	12.00 IN x 21.5 DEG.						
	CENTER FEED (PSI)	13	16	19	22	25	28
	END FEED (PSI)	6	10	13	16	19	22
	PUMP (WATER) hp	81	91	99	110	117	125
	PUMP EFF. - %	75.7	76.0	76.3	75.5	76.7	77.0
	14 IN DOUBLE "Y" INLET - FT LIFT	9.4	8.6	7.8	6.9	6.1	5.3
	14 IN ALUMINUM INLET - FT LIFT	7.6	6.8	6.0	5.1	4.3	3.5
	12.50 IN x 21.5 DEG.						
	CENTER FEED (PSI)	20	24	27	31	34	37
	END FEED (PSI)	14	17	21	24	27	30
	PUMP (WATER) hp	97	107	118	128	138	148
	PUMP EFF. - %	80.5	80.0	79.5	79.0	78.5	78.0
	14 IN DOUBLE "Y" INLET - FT LIFT	9.3	8.4	7.6	6.8	6.0	5.1
	14 IN ALUMINUM INLET - FT LIFT	7.5	6.6	5.8	5.0	4.2	3.3
	13.00 IN x 21.5 DEG.						
	CENTER FEED (PSI)	27	30	34	38	41	45
	END FEED (PSI)	20	24	27	31	34	38
	PUMP (WATER) hp	113	124	134	146	157	170
	PUMP EFF. - %	81.7	81.2	80.6	80.1	79.5	79.0
	14 IN DOUBLE "Y" INLET - FT LIFT	9.1	8.3	7.5	6.7	5.9	5.1
	14 IN ALUMINUM INLET - FT LIFT	7.3	6.5	5.7	4.9	4.1	3.3
	13.50 IN x 21.5 DEG.						
	CENTER FEED (PSI)	34	37	41	45	49	53
	END FEED (PSI)	28	31	35	39	43	47
	PUMP (WATER) hp	132	142	155	167	179	192
	PUMP EFF. - %	82.6	82.0	81.4	80.8	80.2	79.5
	14 IN DOUBLE "Y" INLET - FT LIFT	8.9	8.3	7.4	6.7	6.0	5.2
	14 IN ALUMINUM INLET - FT LIFT	7.1	6.5	5.6	4.9	4.2	3.4
	14.00 IN x 21.5 DEG.						
	CENTER FEED (PSI)	39	44	48	52	57	62
	END FEED (PSI)	33	37	41	46	50	55
	PUMP (WATER) hp	147	160	173	186	201	217
	PUMP EFF. - %	82.4	82.0	81.4	80.8	80.2	79.6
	14 IN DOUBLE "Y" INLET - FT LIFT	8.9	8.2	7.4	6.6	5.9	5.1
	14 IN ALUMINUM INLET - FT LIFT	7.1	6.4	5.6	4.8	4.1	3.3
	14.00 IN x FULL TRIM						
	CENTER FEED (PSI)	54	58	64	69	74	79
	END FEED (PSI)	47	51	57	62	67	73
	PUMP (WATER) hp	190	203	221	239	257	273
	PUMP EFF. - %	81.0	80.5	79.6	78.7	77.8	77.5
	14 IN DOUBLE "Y" INLET - FT LIFT	9.1	8.2	7.3	6.4	5.5	4.7
	14 IN ALUMINUM INLET - FT LIFT	7.3	6.4	5.5	4.6	3.7	2.9

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Valmont test data has been used to adjust the data for system loss and elevation within the system. Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design.

Rainger Linear Ditch Feed

Pump Performance Charts (Continued)

Chart K
Pioneer SC1010C14 Pump Performance

CENTERFEED]
END FEED] - PRESSURE (PSI) AVAILABLE AT TOP OF CART (INCLUDES CART ELEVATION AND CART PIPE LOSSES.)

Altitude is assumed to be sea level*
Temperature is assumed to be 90 deg. F. (32.2 deg. C.)*
* See Table 6 on page 2-33 in Pump Selection for lift adjustments for altitude and temperature.

MAXIMUM ALLOWABLE SUCTION LIFT (FT) - IS THE DISTANCE MEASURED FROM BOTTOM OF CART DRIVE UNIT TIRES TO WATER LEVEL.

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
4000	12.00 IN x 21.5 DEG.						
	CENTER FEED (PSI)	12	15	18	21	24	27
	END FEED (PSI)	5	8	11	14	17	20
	PUMP (WATER) hp	80	90	99	110	117	126
	PUMP EFF. - %	75.7	76.0	76.3	75.5	76.7	77.0
	14 IN DOUBLE "Y" INLET - FT LIFT	8.6	7.9	7.1	6.4	5.6	4.8
	14 IN ALUMINUM INLET - FT LIFT	6.8	6.1	5.3	4.6	3.8	3.0
	12.50 IN x 21.5 DEG.						
	CENTER FEED (PSI)	19	23	26	29	32	35
	END FEED (PSI)	12	16	19	22	25	28
	PUMP (WATER) hp	98	109	118	128	137	148
	PUMP EFF. - %	80.3	80.0	79.6	79.2	78.9	78.5
	14 IN DOUBLE "Y" INLET - FT LIFT	8.6	7.9	7.1	6.4	5.6	4.8
	14 IN ALUMINUM INLET - FT LIFT	6.8	6.1	5.3	4.6	3.8	3.0
	13.00 IN x 21.5 DEG.						
	CENTER FEED (PSI)	25	29	32	36	40	44
	END FEED (PSI)	19	22	25	29	33	37
	PUMP (WATER) hp	114	125	135	147	157	169
	PUMP EFF. - %	81.3	81.0	80.7	80.5	80.2	80.0
	14 IN DOUBLE "Y" INLET - FT LIFT	8.5	7.8	7.0	6.3	5.5	4.7
	14 IN ALUMINUM INLET - FT LIFT	6.7	6.0	5.2	4.5	3.7	2.9
	13.50 IN x 21.5 DEG.						
	CENTER FEED (PSI)	32	35	39	44	48	52
	END FEED (PSI)	25	28	32	37	41	45
	PUMP (WATER) hp	131	141	153	167	180	194
	PUMP EFF. - %	83.0	82.3	81.7	81.1	80.6	80.0
	14 IN DOUBLE "Y" INLET - FT LIFT	8.5	7.8	7.0	6.3	5.5	4.7
	14 IN ALUMINUM INLET - FT LIFT	6.7	6.0	5.2	4.5	3.7	2.9
	14.00 IN x 21.5 DEG.						
	CENTER FEED (PSI)	38	42	47	51	56	61
	END FEED (PSI)	31	35	40	45	49	54
	PUMP (WATER) hp	146	159	173	189	205	220
	PUMP EFF. - %	83.7	83.0	82.2	81.3	80.4	79.5
	14 IN DOUBLE "Y" INLET - FT LIFT	8.5	7.8	7.0	6.2	5.3	4.5
	14 IN ALUMINUM INLET - FT LIFT	6.7	6.0	5.2	4.4	3.5	2.7
	14.00 IN x FULL TRIM						
	CENTER FEED (PSI)	52	57	62	67	73	78
	END FEED (PSI)	45	50	55	61	66	71
	PUMP (WATER) hp	191	205	223	240	259	277
	PUMP EFF. - %	81.5	81.0	80.2	79.5	78.8	78.0
	14 IN DOUBLE "Y" INLET - FT LIFT	8.5	7.7	6.9	5.8	5.1	4.4
	14 IN ALUMINUM INLET - FT LIFT	6.7	5.9	5.1	4.0	3.3	2.6

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
4100	12.00 IN x 21.5 DEG.						
	CENTER FEED (PSI)	10	13	16	19	22	26
	END FEED (PSI)	NA	6	9	12	15	19
	PUMP (WATER) hp	79	89	96	107	115	126
	PUMP EFF. - %	75.7	76.0	76.4	76.8	77.2	77.5
	14 IN DOUBLE "Y" INLET - FT LIFT	8.2	7.4	6.6	5.8	5.1	4.4
	14 IN ALUMINUM INLET - FT LIFT	6.3	5.5	4.7	3.9	3.2	2.5
	12.50 IN x 21.5 DEG.						
	CENTER FEED (PSI)	18	21	24	27	30	34
	END FEED (PSI)	10	13	16	19	23	27
	PUMP (WATER) hp	98	107	116	125	136	148
	PUMP EFF. - %	79.3	79.3	79.3	79.2	79.2	79.2
	14 IN DOUBLE "Y" INLET - FT LIFT	8.2	7.4	6.6	5.8	5.1	4.3
	14 IN ALUMINUM INLET - FT LIFT	6.3	5.5	4.7	3.9	3.2	2.4
	13.00 IN x 21.5 DEG.						
	CENTER FEED (PSI)	23	28	31	35	39	43
	END FEED (PSI)	16	20	24	28	32	36
	PUMP (WATER) hp	112	125	135	147	159	171
	PUMP EFF. - %	81.4	81.3	81.0	80.8	80.6	80.4
	14 IN DOUBLE "Y" INLET - FT LIFT	8.2	7.4	6.6	5.8	5.1	4.3
	14 IN ALUMINUM INLET - FT LIFT	6.3	5.5	4.7	3.9	3.2	2.4
	13.50 IN x 21.5 DEG.						
	CENTER FEED (PSI)	30	35	38	42	47	51
	END FEED (PSI)	23	27	31	35	39	44
	PUMP (WATER) hp	129	143	153	167	181	194
	PUMP EFF. - %	83.2	82.7	82.3	81.8	81.4	81.0
	14 IN DOUBLE "Y" INLET - FT LIFT	8.2	7.4	6.6	5.8	5.0	4.2
	14 IN ALUMINUM INLET - FT LIFT	6.3	5.5	4.7	3.9	3.1	2.3
	14.00 IN x 21.5 DEG.						
	CENTER FEED (PSI)	36	41	45	50	55	59
	END FEED (PSI)	29	34	38	43	48	52
	PUMP (WATER) hp	144	160	174	190	206	221
	PUMP EFF. - %	83.9	83.3	82.6	81.8	81.0	80.2
	14 IN DOUBLE "Y" INLET - FT LIFT	8.2	7.4	6.6	5.8	5.0	4.2
	14 IN ALUMINUM INLET - FT LIFT	6.3	5.5	4.7	3.9	3.1	2.3
	14.00 IN x FULL TRIM						
	CENTER FEED (PSI)	50	55	61	66	71	77
	END FEED (PSI)	43	48	53	58	64	70
	PUMP (WATER) hp	188	205	222	240	259	278
	PUMP EFF. - %	82.4	81.8	81.1	80.4	79.7	79.0
	14 IN DOUBLE "Y" INLET - FT LIFT	8.2	7.4	6.6	5.8	4.9	4.1
	14 IN ALUMINUM INLET - FT LIFT	6.3	5.5	4.7	3.9	3.0	2.2

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Valmont test data has been used to adjust the data for system loss and elevation within the system. Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design.

Pump Performance Charts (Continued)

Chart K
Pioneer SC1010C14 Pump Performance

CENTERFEED]
END FEED] - PRESSURE (PSI) AVAILABLE AT TOP OF CART (INCLUDES CART ELEVATION AND CART PIPE LOSSES.)

Altitude is assumed to be sea level*
Temperature is assumed to be 90 deg. F. (32.2 deg. C.)*
* See Table 6 on page 2-33 in Pump Selection for lift adjustments for altitude and temperature.

MAXIMUM ALLOWABLE SUCTION LIFT (FT) - IS THE DISTANCE MEASURED FROM BOTTOM OF CART DRIVE UNIT TIRES TO WATER LEVEL.

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
4200	12.00 IN x 21.5 DEG.						
	CENTER FEED (PSI)	9	12	15	18	22	25
	END FEED (PSI)	NA	NA	7	10	14	17
	PUMP (WATER) hp	78	89	96	107	117	126
	PUMP EFF. - %	75.0	75.4	76.0	76.5	77.0	77.5
	14 IN DOUBLE "Y" INLET - FT LIFT	7.6	6.8	6.1	5.4	4.7	4.0
	14 IN ALUMINUM INLET - FT LIFT	5.8	5.0	4.3	3.6	2.9	2.2
	12.50 IN x 21.5 DEG.						
	CENTER FEED (PSI)	16	19	22	26	29	32
	END FEED (PSI)	8	12	15	18	21	25
	PUMP (WATER) hp	95	107	117	127	136	147
	PUMP EFF. - %	78.9	79.0	79.2	79.3	79.4	79.5
	14 IN DOUBLE "Y" INLET - FT LIFT	7.6	6.8	6.0	5.3	4.6	3.9
	14 IN ALUMINUM INLET - FT LIFT	5.8	5.0	4.2	3.5	2.8	2.1
	13.00 IN x 21.5 DEG.						
	CENTER FEED (PSI)	22	26	30	34	37	42
	END FEED (PSI)	14	19	22	26	30	34
	PUMP (WATER) hp	112	125	136	148	159	173
	PUMP EFF. - %	81.2	81.2	81.1	81.0	80.9	80.8
	14 IN DOUBLE "Y" INLET - FT LIFT	7.7	6.8	5.9	5.0	4.2	3.8
	14 IN ALUMINUM INLET - FT LIFT	5.9	5.0	4.1	3.2	2.4	2.0
	13.50 IN x 21.5 DEG.						
	CENTER FEED (PSI)	28	33	37	41	45	50
	END FEED (PSI)	21	26	29	33	38	42
	PUMP (WATER) hp	128	143	154	168	182	196
	PUMP EFF. - %	83.4	83.0	82.5	82.0	81.5	81.0
	14 IN DOUBLE "Y" INLET - FT LIFT	7.8	6.9	6.1	5.3	4.5	3.7
	14 IN ALUMINUM INLET - FT LIFT	6.0	5.1	4.3	3.5	2.7	1.9
	14.00 IN x 21.5 DEG.						
	CENTER FEED (PSI)	35	40	44	49	54	58
	END FEED (PSI)	27	32	36	41	46	51
	PUMP (WATER) hp	145	160	174	190	206	223
	PUMP EFF. - %	84.6	84.0	83.3	82.6	81.8	81.0
	14 IN DOUBLE "Y" INLET - FT LIFT	7.8	6.9	6.1	5.3	4.5	3.6
	14 IN ALUMINUM INLET - FT LIFT	6.0	5.1	4.3	3.5	2.7	1.8
	14.00 IN x FULL TRIM						
	CENTER FEED (PSI)	48	54	59	65	70	76
	END FEED (PSI)	41	46	52	57	62	68
	PUMP (WATER) hp	189	206	224	242	260	279
	PUMP EFF. - %	82.7	82.2	81.6	81.0	80.4	79.7
	14 IN DOUBLE "Y" INLET - FT LIFT	7.8	6.9	6.0	5.2	4.3	3.5
	14 IN ALUMINUM INLET - FT LIFT	6.0	5.1	4.2	3.4	2.5	1.7

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
4300	12.00 IN x 21.5 DEG.						
	CENTER FEED (PSI)		10	13	16	19	23
	END FEED (PSI)		NA	5	8	11	15
	PUMP (WATER) hp	NA	88	96	106	115	126
	PUMP EFF. - %		74.0	74.7	75.5	76.3	77.0
	14 IN DOUBLE "Y" INLET - FT LIFT		6.3	5.6	4.8	4.1	3.3
	14 IN ALUMINUM INLET - FT LIFT		4.4	3.7	2.9	2.2	1.4
	12.50 IN x 21.5 DEG.						
	CENTER FEED (PSI)	14	18	21	25	28	32
	END FEED (PSI)	6	10	13	17	20	24
	PUMP (WATER) hp	95	107	116	128	138	150
	PUMP EFF. - %	77.7	78.0	78.4	78.9	79.2	79.5
	14 IN DOUBLE "Y" INLET - FT LIFT	7.1	6.4	5.6	4.8	4.0	3.3
	14 IN ALUMINUM INLET - FT LIFT	5.2	4.5	3.7	2.9	2.1	1.4
	13.00 IN x 21.5 DEG.						
	CENTER FEED (PSI)	20	25	28	32	36	40
	END FEED (PSI)	12	17	20	24	28	32
	PUMP (WATER) hp	111	125	135	147	160	173
	PUMP EFF. - %	81.0	81.0	81.0	81.0	81.0	81.0
	14 IN DOUBLE "Y" INLET - FT LIFT	7.3	6.4	5.5	4.7	4.0	3.2
	14 IN ALUMINUM INLET - FT LIFT	5.4	4.5	3.6	2.8	2.1	1.3
	13.50 IN x 21.5 DEG.						
	CENTER FEED (PSI)	28	32	36	40	45	48
	END FEED (PSI)	20	24	28	32	37	40
	PUMP (WATER) hp	130	145	156	170	184	197
	PUMP EFF. - %	83.4	83.0	82.6	82.2	81.9	81.5
	14 IN DOUBLE "Y" INLET - FT LIFT	7.4	6.5	5.7	4.8	4.0	3.1
	14 IN ALUMINUM INLET - FT LIFT	5.5	4.6	3.8	2.9	2.1	1.2
	14.00 IN x 21.5 DEG.						
	CENTER FEED (PSI)	34	39	43	48	52	57
	END FEED (PSI)	26	31	35	40	44	49
	PUMP (WATER) hp	148	163	176	191	207	222
	PUMP EFF. - %	84.5	84.0	83.5	82.9	82.3	81.7
	14 IN DOUBLE "Y" INLET - FT LIFT	7.4	6.5	5.7	4.8	4.0	3.1
	14 IN ALUMINUM INLET - FT LIFT	5.5	4.6	3.8	2.9	2.1	1.2
	14.00 IN x FULL TRIM						
	CENTER FEED (PSI)	47	53	57	63	69	74
	END FEED (PSI)	39	45	49	55	61	66
	PUMP (WATER) hp	188	207	223	242	262	281
	PUMP EFF. - %	83.3	82.8	82.2	81.5	80.9	80.3
	14 IN DOUBLE "Y" INLET - FT LIFT	7.5	6.6	5.7	4.8	3.9	3.0
	14 IN ALUMINUM INLET - FT LIFT	5.6	4.7	3.8	2.9	2.0	1.1

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Valmont test data has been used to adjust the data for system loss and elevation within the system. Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design.

Rainger Linear Ditch Feed

Pump Performance Charts (Continued)

Chart K
Pioneer SC1010C14 Pump Performance

CENTERFEED]
END FEED] - PRESSURE (PSI) AVAILABLE AT TOP OF CART (INCLUDES CART ELEVATION AND CART PIPE LOSSES.)

Altitude is assumed to be sea level*
Temperature is assumed to be 90 deg. F. (32.2 deg. C.)*
* See Table 6 on page 2-33 in Pump Selection for lift adjustments for altitude and temperature.

MAXIMUM ALLOWABLE SUCTION LIFT (FT) - IS THE DISTANCE MEASURED FROM BOTTOM OF CART DRIVE UNIT TIRES TO WATER LEVEL.

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM					
		1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
4400	12.00 IN x 21.5 DEG.						
	CENTER FEED (PSI)			12	15	18	22
	END FEED (PSI)			NA	7	10	13
	PUMP (WATER) hp	NA	NA	97	107	116	126
	PUMP EFF. - %			73.6	74.7	75.8	77.0
	14 IN DOUBLE "Y" INLET - FT LIFT			4.8	4.2	3.5	2.8
	14 IN ALUMINUM INLET - FT LIFT			3.0	2.4	1.7	1.0
	12.50 IN x 21.5 DEG.						
	CENTER FEED (PSI)	13	16	20	23	27	30
	END FEED (PSI)	5	8	11	15	18	22
	PUMP (WATER) hp	97	108	118	129	139	150
	PUMP EFF. - %	76.9	77.4	77.9	78.4	79.0	79.5
	14 IN DOUBLE "Y" INLET - FT LIFT	6.5	5.7	5.0	4.2	3.5	2.7
	14 IN ALUMINUM INLET - FT LIFT	4.7	3.9	3.2	2.4	1.7	0.9
	13.00 IN x 21.5 DEG.						
	CENTER FEED (PSI)	19	23	27	32	35	39
	END FEED (PSI)	11	15	19	23	27	31
	PUMP (WATER) hp	112	125	137	151	163	175
	PUMP EFF. - %	81.0	81.0	81.1	81.2	81.2	81.3
	14 IN DOUBLE "Y" INLET - FT LIFT	6.6	5.8	5.0	4.2	3.4	2.6
	14 IN ALUMINUM INLET - FT LIFT	4.8	4.0	3.2	2.4	1.6	0.8
	13.50 IN x 21.5 DEG.						
	CENTER FEED (PSI)	26	30	35	39	43	47
	END FEED (PSI)	17	22	26	30	34	39
	PUMP (WATER) hp	129	143	157	171	184	198
	PUMP EFF. - %	83.3	83.0	82.7	82.4	82.1	81.8
	14 IN DOUBLE "Y" INLET - FT LIFT	6.6	5.8	5.0	4.2	3.4	2.6
	14 IN ALUMINUM INLET - FT LIFT	4.8	4.0	3.2	2.4	1.6	0.8
	14.00 IN x 21.5 DEG.						
	CENTER FEED (PSI)	33	38	42	47	51	55
	END FEED (PSI)	25	29	34	38	43	47
	PUMP (WATER) hp	150	164	178	194	209	223
	PUMP EFF. - %	84.4	84.0	83.6	83.1	82.6	82.2
	14 IN DOUBLE "Y" INLET - FT LIFT	6.7	5.9	5.1	4.2	3.4	2.5
	14 IN ALUMINUM INLET - FT LIFT	4.9	4.1	3.3	2.4	1.6	0.7
	14.00 IN x FULL TRIM						
	CENTER FEED (PSI)	46	51	57	62	67	73
	END FEED (PSI)	37	43	48	54	59	65
	PUMP (WATER) hp	190	208	226	245	263	283
	PUMP EFF. - %	83.8	83.2	82.6	82.0	81.4	80.8
	14 IN DOUBLE "Y" INLET - FT LIFT	6.8	5.9	5.1	4.2	3.4	2.5
	14 IN ALUMINUM INLET - FT LIFT	5.0	4.1	3.3	2.4	1.6	NA

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM					
		1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
4500	12.00 IN x 21.5 DEG.						
	CENTER FEED (PSI)			10	13	16	20
	END FEED (PSI)			NA	NA	8	11
	PUMP (WATER) hp	NA	NA	96	105	116	126
	PUMP EFF. - %			72.2	73.5	74.7	76.0
	14 IN DOUBLE "Y" INLET - FT LIFT			4.4	3.7	3.0	2.3
	14 IN ALUMINUM INLET - FT LIFT			2.5	1.8	1.1	NA
	12.50 IN x 21.5 DEG.						
	CENTER FEED (PSI)	10	14	18	22	25	28
	END FEED (PSI)	NA	5	9	13	16	20
	PUMP (WATER) hp	93	105	116	128	139	149
	PUMP EFF. - %	75.8	76.5	77.2	78.0	78.7	79.5
	14 IN DOUBLE "Y" INLET - FT LIFT	6.0	5.2	4.4	3.7	3.0	2.3
	14 IN ALUMINUM INLET - FT LIFT	4.1	3.3	2.5	1.8	1.1	NA
	13.00 IN x 21.5 DEG.						
	CENTER FEED (PSI)	15	22	25	28	33	37
	END FEED (PSI)	7	13	16	20	24	28
	PUMP (WATER) hp	105	124	135	146	160	173
	PUMP EFF. - %	80.2	80.5	80.7	81.0	81.2	81.5
	14 IN DOUBLE "Y" INLET - FT LIFT	6.0	5.3	4.5	3.8	3.0	2.2
	14 IN ALUMINUM INLET - FT LIFT	4.1	3.4	2.6	1.9	1.1	NA
	13.50 IN x 21.5 DEG.						
	CENTER FEED (PSI)	24	29	33	37	41	46
	END FEED (PSI)	15	20	24	28	33	37
	PUMP (WATER) hp	128	144	158	171	185	199
	PUMP EFF. - %	83.2	83.0	82.8	82.6	82.5	82.3
	14 IN DOUBLE "Y" INLET - FT LIFT	6.1	5.3	4.5	3.7	2.9	2.1
	14 IN ALUMINUM INLET - FT LIFT	4.2	3.4	2.6	1.8	1.0	NA
	14.00 IN x 21.5 DEG.						
	CENTER FEED (PSI)	31	36	40	45	50	54
	END FEED (PSI)	22	27	31	36	41	46
	PUMP (WATER) hp	147	164	178	193	209	225
	PUMP EFF. - %	84.3	84.0	83.7	83.4	83.2	83.0
	14 IN DOUBLE "Y" INLET - FT LIFT	5.9	5.4	4.8	4.3	3.7	2.1
	14 IN ALUMINUM INLET - FT LIFT	4.0	3.5	2.9	2.4	1.8	NA
	14.00 IN x FULL TRIM						
	CENTER FEED (PSI)	44	50	55	60	66	72
	END FEED (PSI)	35	41	47	52	57	63
	PUMP (WATER) hp	188	210	228	246	265	285
	PUMP EFF. - %	83.9	83.5	82.9	82.3	81.8	81.2
	14 IN DOUBLE "Y" INLET - FT LIFT	6.0	5.4	4.8	4.2	3.6	1.9
	14 IN ALUMINUM INLET - FT LIFT	4.1	3.5	2.9	2.3	1.7	NA

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Valmont test data has been used to adjust the data for system loss and elevation within the system. Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design.

Pump Performance Charts (Continued)

Chart K
Pioneer SC1010C14 Pump Performance

CENTERFEED]
END FEED] - PRESSURE (PSI) AVAILABLE AT TOP OF CART (INCLUDES CART ELEVATION AND CART PIPE LOSSES.)

Altitude is assumed to be sea level*
Temperature is assumed to be 90 deg. F. (32.2 deg. C.)*
* See Table 6 on page 2-33 in Pump Selection for lift adjustments for altitude and temperature.

MAXIMUM ALLOWABLE SUCTION LIFT (FT) - IS THE DISTANCE MEASURED FROM BOTTOM OF CART DRIVE UNIT TIRES TO WATER LEVEL.

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
4600	12.00 IN x 21.5 DEG.						
	CENTER FEED (PSI)				11	15	18
	END FEED (PSI)				NA	5	9
	PUMP (WATER) hp	NA	NA	NA	104	114	124
	PUMP EFF. - %				72.4	74.1	75.8
	14 IN DOUBLE "Y" INLET - FT LIFT				3.0	2.3	1.6
	14 IN ALUMINUM INLET - FT LIFT				1.1	NA	NA
	12.50 IN x 21.5 DEG.						
	CENTER FEED (PSI)		13	16	20	23	27
	END FEED (PSI)		NA	7	11	14	18
	PUMP (WATER) hp	NA	107	118	128	139	149
	PUMP EFF. - %		75.0	76.0	77.0	78.0	79.0
	14 IN DOUBLE "Y" INLET - FT LIFT		4.5	3.8	3.1	2.3	1.6
	14 IN ALUMINUM INLET - FT LIFT		2.6	1.9	1.2	NA	NA
	13.00 IN x 21.5 DEG.						
	CENTER FEED (PSI)	15	20	24	28	31	36
	END FEED (PSI)	6	11	14	18	22	27
	PUMP (WATER) hp	108	123	136	148	161	175
	PUMP EFF. - %	79.7	80.0	80.3	80.6	80.9	81.2
	14 IN DOUBLE "Y" INLET - FT LIFT	5.3	4.6	3.9	3.2	2.4	1.6
	14 IN ALUMINUM INLET - FT LIFT	3.4	2.7	2.0	1.3	NA	NA
	13.50 IN x 21.5 DEG.						
	CENTER FEED (PSI)	22	27	31	35	40	45
	END FEED (PSI)	13	18	22	26	31	36
	PUMP (WATER) hp	126	141	156	170	185	201
	PUMP EFF. - %	83.1	83.0	82.9	82.8	82.7	82.6
	14 IN DOUBLE "Y" INLET - FT LIFT	5.5	4.7	3.9	3.2	2.4	1.6
	14 IN ALUMINUM INLET - FT LIFT	3.6	2.8	2.0	1.3	NA	NA
	14.00 IN x 21.5 DEG.						
	CENTER FEED (PSI)	29	34	39	44	48	53
	END FEED (PSI)	20	25	30	34	39	44
	PUMP (WATER) hp	146	163	179	195	210	226
	PUMP EFF. - %	84.2	84.0	83.8	83.6	83.5	83.3
	14 IN DOUBLE "Y" INLET - FT LIFT	5.6	4.8	3.9	3.1	2.3	1.6
	14 IN ALUMINUM INLET - FT LIFT	3.7	2.9	2.0	1.2	NA	NA
	14.00 IN x FULL TRIM						
	CENTER FEED (PSI)	41	49	54	59	65	70
	END FEED (PSI)	31	40	45	50	56	61
	PUMP (WATER) hp	183	211	229	248	268	289
	PUMP EFF. - %	84.4	83.8	83.2	82.6	81.9	81.3
	14 IN DOUBLE "Y" INLET - FT LIFT	5.7	4.9	4.0	3.2	2.4	1.6
	14 IN ALUMINUM INLET - FT LIFT	3.8	3.0	2.1	1.3	NA	NA

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM 1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
4700	12.00 IN x 21.5 DEG.						
	CENTER FEED (PSI)				10	13	17
	END FEED (PSI)				NA	NA	7
	PUMP (WATER) hp	NA	NA	NA	104	114	124
	PUMP EFF. - %				71.8	73.7	75.5
	14 IN DOUBLE "Y" INLET - FT LIFT				2.4	1.8	1.2
	14 IN ALUMINUM INLET - FT LIFT				NA	NA	NA
	12.50 IN x 21.5 DEG.						
	CENTER FEED (PSI)		11	14	18	21	25
	END FEED (PSI)		NA	5	8	12	16
	PUMP (WATER) hp	NA	104	115	128	138	150
	PUMP EFF. - %		74.0	75.1	76.3	77.4	78.5
	14 IN DOUBLE "Y" INLET - FT LIFT		3.9	3.2	2.6	1.9	1.2
	14 IN ALUMINUM INLET - FT LIFT		2.0	1.3	NA	NA	NA
	13.00 IN x 21.5 DEG.						
	CENTER FEED (PSI)	13	18	22	26	30	34
	END FEED (PSI)	NA	8	12	16	21	25
	PUMP (WATER) hp	107	122	135	148	162	175
	PUMP EFF. - %	79.0	79.5	79.9	80.4	80.8	81.3
	14 IN DOUBLE "Y" INLET - FT LIFT	4.6	4.0	3.3	2.6	1.9	1.2
	14 IN ALUMINUM INLET - FT LIFT	2.7	2.1	1.4	NA	NA	NA
	13.50 IN x 21.5 DEG.						
	CENTER FEED (PSI)	21	25	30	34	39	44
	END FEED (PSI)	11	16	20	24	29	34
	PUMP (WATER) hp	128	142	157	171	186	202
	PUMP EFF. - %	82.3	82.5	82.6	82.7	82.8	83.0
	14 IN DOUBLE "Y" INLET - FT LIFT	4.8	4.1	3.4	2.6	1.9	1.2
	14 IN ALUMINUM INLET - FT LIFT	2.9	2.2	1.5	NA	NA	NA
	14.00 IN x 21.5 DEG.						
	CENTER FEED (PSI)	28	33	37	42	47	52
	END FEED (PSI)	18	23	28	33	37	42
	PUMP (WATER) hp	148	164	179	195	211	226
	PUMP EFF. - %	84.0	84.0	84.0	84.0	84.0	84.0
	14 IN DOUBLE "Y" INLET - FT LIFT	4.9	4.2	3.5	2.7	1.9	1.2
	14 IN ALUMINUM INLET - FT LIFT	3.0	2.3	1.6	NA	NA	NA
	14.00 IN x FULL TRIM						
	CENTER FEED (PSI)	40	47	52	57	63	69
	END FEED (PSI)	31	37	43	48	53	59
	PUMP (WATER) hp	188	211	229	247	268	288
	PUMP EFF. - %	84.5	84.0	83.5	83.0	82.5	82.0
	14 IN DOUBLE "Y" INLET - FT LIFT	5.1	4.3	3.5	2.7	1.9	1.2
	14 IN ALUMINUM INLET - FT LIFT	3.2	2.4	1.6	NA	NA	NA

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Valmont test data has been used to adjust the data for system loss and elevation within the system. Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design.

Pump Performance Charts (Continued)

Chart K
Pioneer SC1010C14 Pump Performance

CENTERFEED]
END FEED] - PRESSURE (PSI) AVAILABLE AT TOP OF CART (INCLUDES CART ELEVATION AND CART PIPE LOSSES.)

Altitude is assumed to be sea level*
Temperature is assumed to be 90 deg. F. (32.2 deg. C.)*
* See Table on page 2-33 in Pump Selection for lift adjustments for altitude and temperature.

MAXIMUM ALLOWABLE SUCTION LIFT (FT) - IS THE DISTANCE MEASURED FROM BOTTOM OF CART DRIVE UNIT TIRES TO WATER LEVEL.

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM					
		1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
4800	12.00 IN x 21.5 DEG.						
	CENTER FEED (PSI)						
	END FEED (PSI)						
	PUMP (WATER) hp	NA	NA	NA	NA	NA	NA
	PUMP EFF. - %						
	14 IN DOUBLE "Y" INLET - FT LIFT						
	14 IN ALUMINUM INLET - FT LIFT						
	12.50 IN x 21.5 DEG.						
	CENTER FEED (PSI)			12	16	20	24
	END FEED (PSI)			NA	6	10	14
	PUMP (WATER) hp	NA	NA	115	126	138	149
	PUMP EFF. - %			73.5	75.0	76.5	78.0
	14 IN DOUBLE "Y" INLET - FT LIFT			2.7	2.0	1.3	NA
	14 IN ALUMINUM INLET - FT LIFT			NA	NA	NA	NA
	13.00 IN x 21.5 DEG.						
	CENTER FEED (PSI)	10	14	19	23	28	33
	END FEED (PSI)	NA	NA	9	13	18	23
	PUMP (WATER) hp	100	116	130	144	160	175
	PUMP EFF. - %	77.9	78.5	79.1	79.8	80.4	81.0
	14 IN DOUBLE "Y" INLET - FT LIFT	4.2	3.5	2.8	2.1	1.4	NA
	14 IN ALUMINUM INLET - FT LIFT	2.2	1.5	NA	NA	NA	NA
	13.50 IN x 21.5 DEG.						
	CENTER FEED (PSI)	19	24	28	32	37	42
	END FEED (PSI)	9	14	18	22	27	32
	PUMP (WATER) hp	126	142	156	170	186	202
	PUMP EFF. - %	81.8	82.0	82.2	82.5	82.8	83.0
	14 IN DOUBLE "Y" INLET - FT LIFT	4.3	3.6	2.9	2.2	1.5	NA
	14 IN ALUMINUM INLET - FT LIFT	2.3	1.6	NA	NA	NA	NA
	14.00 IN x 21.5 DEG.						
	CENTER FEED (PSI)	25	31	36	40	45	50
	END FEED (PSI)	15	21	26	30	35	40
	PUMP (WATER) hp	145	164	180	195	211	228
	PUMP EFF. - %	83.5	83.6	83.7	83.8	83.9	84.0
	14 IN DOUBLE "Y" INLET - FT LIFT	4.4	3.7	3.0	2.3	1.6	NA
	14 IN ALUMINUM INLET - FT LIFT	2.4	1.7	NA	NA	NA	NA
	14.00 IN x FULL TRIM						
	CENTER FEED (PSI)	39	45	50	56	62	67
	END FEED (PSI)	29	35	40	46	52	57
	PUMP (WATER) hp	189	211	229	249	269	289
	PUMP EFF. - %	84.1	83.8	83.5	83.2	82.8	82.5
	14 IN DOUBLE "Y" INLET - FT LIFT	4.5	3.8	3.1	2.4	1.7	NA
	14 IN ALUMINUM INLET - FT LIFT	2.5	1.8	NA	NA	NA	NA

GALLONS PER MINUTE (GPM)	PUMP TRIM	ENGINE PUMP RPM					
		1750 1775	1800 1825	1850 1875	1900 1925	1950 1975	2000 2025
4900	12.00 IN x 21.5 DEG.						
	CENTER FEED (PSI)						
	END FEED (PSI)						
	PUMP (WATER) hp	NA	NA	NA	NA	NA	NA
	PUMP EFF. - %						
	14 IN DOUBLE "Y" INLET - FT LIFT						
	14 IN ALUMINUM INLET - FT LIFT						
	12.50 IN x 21.5 DEG.						
	CENTER FEED (PSI)			10	14		
	END FEED (PSI)			NA	NA		
	PUMP (WATER) hp	NA	NA	114	127	NA	NA
	PUMP EFF. - %			72.6	74.2		
	14 IN DOUBLE "Y" INLET - FT LIFT			1.9	1.3		
	14 IN ALUMINUM INLET - FT LIFT			NA	NA		
	13.00 IN x 21.5 DEG.						
	CENTER FEED (PSI)	10	14	18	23		
	END FEED (PSI)	NA	NA	8	12		
	PUMP (WATER) hp	105	121	134	148	NA	NA
	PUMP EFF. - %	76.6	77.5	78.4	79.2		
	14 IN DOUBLE "Y" INLET - FT LIFT	3.4	2.8	2.2	1.5		
	14 IN ALUMINUM INLET - FT LIFT	1.5	NA	NA	NA		
	13.50 IN x 21.5 DEG.						
	CENTER FEED (PSI)	17	23	27	31		
	END FEED (PSI)	7	12	17	21		
	PUMP (WATER) hp	126	143	158	172	NA	NA
	PUMP EFF. - %	81.8	82.0	82.2	82.5		
	14 IN DOUBLE "Y" INLET - FT LIFT	3.7	3.0	2.3	1.6		
	14 IN ALUMINUM INLET - FT LIFT	1.8	1.1	NA	NA		
	14.00 IN x 21.5 DEG.						
	CENTER FEED (PSI)	23	29	34	39		
	END FEED (PSI)	13	19	23	28		
	PUMP (WATER) hp	145	164	180	195	NA	NA
	PUMP EFF. - %	83.0	83.2	83.4	83.6		
	14 IN DOUBLE "Y" INLET - FT LIFT	3.8	3.1	2.4	1.6		
	14 IN ALUMINUM INLET - FT LIFT	1.9	1.2	NA	NA		
	14.00 IN x FULL TRIM						
	CENTER FEED (PSI)	36	43	48	54		
	END FEED (PSI)	26	32	38	43		
	PUMP (WATER) hp	187	209	229	248	NA	NA
	PUMP EFF. - %	83.4	83.3	83.3	83.2		
	14 IN DOUBLE "Y" INLET - FT LIFT	3.9	3.2	2.4	1.7		
	14 IN ALUMINUM INLET - FT LIFT	2.0	1.3	NA	NA		

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Valmont test data has been used to adjust the data for system loss and elevation within the system. Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design.

Engine Selection

John Deere									
Net continuous Horsepower including fan, air cleaner and muffler, if equipped									
Engine Pump RPM	Gen. Sheave Size 5V		Tier III and IT4						
		4045T-84	4045H-99	4045H-115	6068H-139	6068H-185	6068H-200	6090H-300	6135H-450
		997987	998576	997986	997988	999009	997143	997955	997985
1750	7	60	73	97	125	139	189	268	403
1850	7.4	63	75	100	129	143	194	270	405
1975	7.9	66	77	103	133	148	196	270	405
2100	8.4	68	78	104	130	153	188	270	405

John Deere						
Net continuous Horsepower including fan, air cleaner and muffler, if equipped						
Engine Pump RPM	Gen. Sheave Size 5V	Tier I Export				
		4045T-99	4045T-125	6068T-155	6068T-185	6068T-200
		995701	995702	995703	995704	997145
1750	7.0	75	91	118	134	161
1850	7.4	79	95	123	139	167
1975	7.9	82	98	126	144	171
2100	8.4	84	102	130	149	173

⚠ CAUTION

- **BE SURE THAT THE HORSEPOWER REQUIREMENT HAS BEEN ADJUSTED FOR TEMPERATURE AND ALTITUDE EFFECT BEFORE USING THIS TABLE.**

Caterpillar
Engine Selection Horsepower

Engine Sheave - 7.4 in P.D., 5V Section

ENGINE PUMP RPM	GEN SHEAVE SIZE	C9-ATAAC TIER II
1800	7.0	
1900	7.4	268
2000	7.9	266
2100	8.4	265

Rainger Linear Ditch Feed

Generator Sheave Selection

For optimum generator speed 1850 to 1875 RPM		
Engine Sheave	Generator Sheave	Engine RPM
5V section 7.4 in diameter	7.0	1750 - 1774
	7.4	1850 - 1875
	7.9	1975 - 2002
	8.4	2100 - 2128

Adjustment for Temperature and Altitude

John Deere

John Deere Tier III and IT4											
Turbocharged engines ("T" and "H" suffix)											
Temperature	F	77	82	87	92	97	102	107	112	117	122
	C	25	28	31	33	36	39	42	44	47	50
Feet	Meters										
0	0	1.000	1.003	1.005	1.008	1.010	1.013	1.015	1.018	1.020	1.023
1000	305	1.000	1.003	1.005	1.008	1.010	1.013	1.015	1.018	1.020	1.023
2000	610	1.000	1.003	1.005	1.008	1.010	1.013	1.015	1.018	1.020	1.023
3000	914	1.000	1.003	1.005	1.008	1.010	1.013	1.015	1.018	1.020	1.023
4000	1219	1.000	1.003	1.005	1.008	1.010	1.013	1.015	1.018	1.020	1.023
5000	1524	1.000	1.003	1.005	1.008	1.010	1.013	1.015	1.018	1.020	1.023

John Deere Tier I Export											
Turbocharged engines ("T", "A" and "H" suffix)											
Temperature	F	77	82	87	92	97	102	107	112	117	122
	C	25	28	31	33	36	39	42	44	47	50
Feet	Meters										
0	0	1.000	1.003	1.005	1.008	1.010	1.013	1.015	1.018	1.020	1.023
1000	305	1.000	1.003	1.005	1.008	1.010	1.013	1.015	1.018	1.020	1.023
2000	610	1.000	1.003	1.005	1.008	1.010	1.013	1.015	1.018	1.020	1.023
3000	914	1.000	1.003	1.005	1.008	1.010	1.013	1.015	1.018	1.020	1.023
4000	1219	1.000	1.003	1.005	1.008	1.010	1.013	1.015	1.018	1.020	1.023
5000	1524	1.000	1.003	1.005	1.008	1.010	1.013	1.015	1.018	1.020	1.023
6000	1829	1.000	1.003	1.005	1.008	1.010	1.013	1.015	1.018	1.020	1.023
7000	2134	1.000	1.003	1.005	1.008	1.010	1.013	1.015	1.018	1.020	1.023

John Deere Tier I Export											
4045D Naturally Aspirated engine											
Temperature	F	77	82	87	92	97	102	107	112	117	122
	C	25	28	31	33	36	39	42	44	47	50
Feet	Meters										
0	0	1.000	1.008	1.015	1.023	1.030	1.038	1.045	1.053	1.06	1.068
600	183	1.000	1.008	1.015	1.023	1.030	1.038	1.045	1.053	1.06	1.068
1100	335	1.015	1.023	1.030	1.038	1.045	1.053	1.061	1.068	1.076	1.084
1600	488	1.030	1.038	1.045	1.053	1.061	1.069	1.076	1.084	1.092	1.100
2100	640	1.045	1.053	1.061	1.069	1.076	1.084	1.092	1.100	1.108	1.116
2600	792	1.060	1.068	1.076	1.084	1.092	1.100	1.108	1.116	1.124	1.132
3600	1097	1.090	1.098	1.106	1.115	1.123	1.131	1.139	1.147	1.155	1.164
4600	1402	1.120	1.128	1.137	1.145	1.154	1.162	1.170	1.179	1.187	1.196
5600	1707	1.150	1.159	1.167	1.176	1.185	1.193	1.202	1.210	1.219	1.228
6600	2012	1.180	1.189	1.198	1.207	1.215	1.224	1.233	1.242	1.251	1.260
7600	2317	1.210	1.219	1.228	1.237	1.246	1.255	1.264	1.274	1.283	1.292

Adjustment for Temperature and Altitude (Continued)

Caterpillar

**Adjustment For
Temperature and Altitude**

Caterpillar Turbo Charged (T)
Turbo Charged and After Cooled (TA)

ALTITUDE ABOVE SEA LEVEL

TEMPERATURE	F / C	75 / 24	85 / 29	95 / 35	105 / 41	115 / 46
FEET	**METERS**					
0	0	1.00	1.01	1.01	1.02	1.02
500	152	1.00	1.01	1.01	1.02	1.02
1500	457	1.01	1.01	1.02	1.02	1.03
2500	762	1.01	1.02	1.02	1.03	1.03
3500	1067	1.02	1.02	1.03	1.03	1.04
4500	1372	1.02	1.03	1.03	1.04	1.04
5500	1676	1.03	1.03	1.04	1.04	1.05
6500	1981	1.03	1.04	1.04	1.05	1.05
7500	2286	1.04	1.04	1.05	1.05	1.06
8500	2591	1.04	1.05	1.05	1.06	1.06

Add pumping horsepower (Kw) and generator horsepower (Kw) - multiply the total by factor from the table above to find the adjusted engine horsepower (Kilowatts) required.

TABLE DATA Generated using following: Subtract 0.5% for every 10 F above 75 F
Subtract 0.5% for every 1000 ft above 500 ft

Table of Contents

Hose Drag - Rainger Linear Design Worksheet

CUSTOMER ________________________________ DEALER _____

DATE ____________________________________ SALESMAN ________________________________

1. Area Irrigated - _____________ Acres
2. System Discharge - _____________ GPM
   (Refer to System Capacity Worksheet)
3. Desired End Pressure - _____________ PSI
4. *Pressure Regulators Included - ___ Yes ___ No
5. Total System Length - _______________ ft
6. _________ End Feed _________ Center Feed
7. Altitude Above Sea Level - _____________ ft
8. Maximum Operating Temperature - ________ °F
9. Hose Diameter ________
10. Field Elevation Change __________ ft
11. **Total System Pressure Requirement**

> **NOTE**
>
> • **Each side of a center feed system must be handled separately. Design pressure requirement based upon side with largest head loss.**

Determine Percentage of Total Length of Each Pipe Diameter and Their Multipliers

Pipe Size	Length	Percent Length	Table 3 - Multiplier
6-5/8 in (168 mm)	ft		
8-5/8 in (219 mm)	ft		
		100%	

Determine pressure loss for an all 168 mm (6-5/8 in) system (see page 3-21).

OR

Use VTools spreadsheet linear design on V2O.

				Total Friction Loss
			=	_____________
System Pressure Loss, PSI	=	_____________		_____________
Desired End Pressure PSI (Required for Sprinklers)	+	_____________	+	_____________
Pressure Regulators, Add 5 PSI (except on 10 PSI package)	+	_____________	+	_____________
Field Elevation Change __________ ft + 2.31	±	_____________	±	_____________
Pressure Loss through Cart Including Elevation (see page 3-21)	+	_____________	+	_____________
Pressure Loss through Hose (see page 3-21)	+	_____________	+	_____________
Total Pressure Requirement for System		_____________		_____________

Hose Drag - Linear Design Worksheet (Continued)

12. **Generator Size and Horsepower Requirement (See Linear Section)**

    Number of Spans ________

    Machine Speed ______ Standard ______ High

    Booster Pumps ______ None ______ 1 ______ 2

    ** Generator Size ______ Kw (see page 3-13)

    Power Required ______ hp (see page 3-13)

13. **Engine Selection (see Towable Section)**

    Generator Horsepower (step 12) + ______ hp

    Derating Factors x _____(starting on page 3-14)

    Adjusted Kw Requirement _____________ hp**

    Brand/Model _________________
    (See page 3-13.)

    Available Engine Horsepower___________ hp

* Pressure regulators should be considered on hose drag linears even if they are on flat ground to compensate for the difference in pressure due to friction in the main water supply line.

** Review power and motor size design requirements for specified hose on 2-wheel cart.

Rainger Linear Hose Drag

Checklist

Critical Items

I. Span Layout
   A. Diameter and lengths
   B. Free-standing span-location and length
   C. Farming practices
      1. Furrow height
      2. Row direction
      3. Row width
   D. Tire sizes and locations
   E. Heavy duty gearboxes
   F. Motor RPM locations
   G. Water control for pipeline or pump
   H. Cart shut-off valve

II. Guidance Installation
   A. Below ground
      1. Location of buried wire
      2. Trench teardrop
      3. Hand layout/staking of wire
   B. Furrow
      1. Dimensions
      2. Survey location
   C. Cable
      1. Survey location
   D. GPS

III. Riser Location
   A. Survey riser positions
   B. Riser spacing
   C. Concrete

IV. Hose Lengths
   A. Length
   B. Size

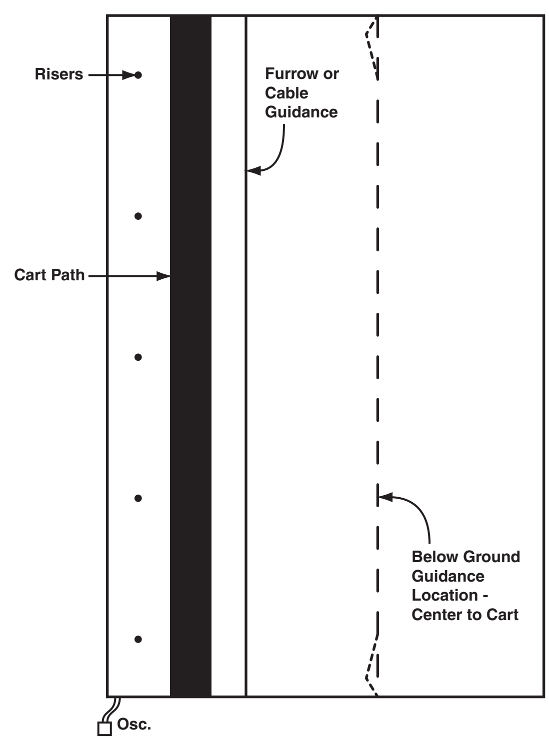
V. Riser to Cart Dimensions

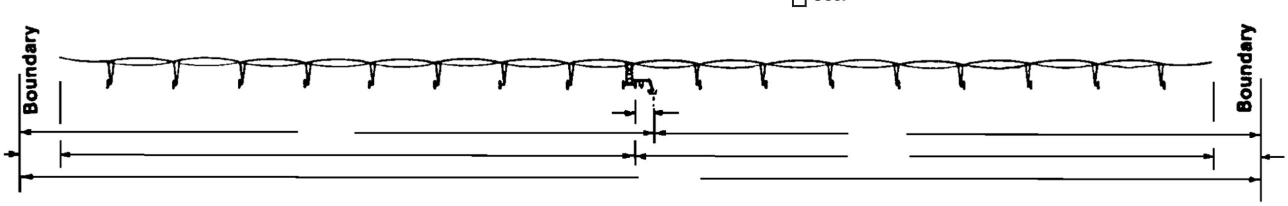
VI. Hose Handling
   A. Hose layout
   B. Timing and method of hose movements
   C. Depth of water application

VII. Special Sprinkler Packages
   A. Adjustable boombacks
   B. Adjustable height drops
   C. Drive unit drains

VIII. Installation Time
   A. Cart
   B. Floating alignment per tower
   C. Guidance
      1. Below ground
      2. Cable
      3. Furrow
      4. GPS

IX. Cart Path
   A. Elevate cart path–no run off or spraying on path
   B. Professionally survey field for boundaries and square field ends
   C. Field slopes





Linear Hose Feed and 4 Wheel Swing Around Guidelines

System Spans And Profiles

Linear cart available as standard profile only; 6-5/8 in (168 mm), 8-5/8 in (219 mm) or 10 in (254 mm) diameters. Swing Around cart available as standard profile only; 6-5/8 in (168 mm) or 8-5/8 in (219 mm) diameters.

> **NOTE**
> **•Deep Trussing required on all cart spans.**

1. **Low Profile**
   (a) Available with all spans.
   (b) No Cart spans available as low profile.
   (c) For Swing Around, first span and first drive unit must be standard profile.
2. **High Profile**
   (a) Available on all 6-5/8 in (168 mm), 8-5/8 in (219 mm) and 10 in (254 mm) spans.
   (b) No Cart spans available in high profile.
   (c) For Swing Around, first span and first drive unit must be standard profile.
3. **Ultra High Profile**
   (a) Available on all 6 5/8 in (168 mm) and 8 5/8 in (219 mm) linear spans.
   (b) Cart in standard profile only, first drive unit from the cart can be high profile.
   (c) Not available on swing around.

Tire Requirements

1. 14.9 x 24 or 16.9 x 24 tires **MUST** be used on the cart.

   Location of free-standing span should be noted on order.

System Length

1. End Feed with cable guidance or furrow guidance at cart 1300 ft (396 m) maximum length.

   Center Feed or End Feed with furrow guidance located in the center of the machine 2600 ft (792 m) maximum length.

   End Feed or Center Feed with below ground located in the center of the machine - 3200 ft (975 m) maximum length.

   Center Feed with cable guidance located in the center of the machine - 3200 ft (975 m) maximum length.

   GPS Guidance is designed to properly operate on machine lengths between 150 ft to 3200 ft (45 m to 975 m).

   The length of run must be two times the length of the machine.

> **NOTE**
> **•Maximum length from guidance hardware to furthest end of machine - 1600 ft (488 m).**

Maximum Length Swing Around Linear – 1300 ft (396 m) with cart mounted cable guidance or furrow guidance; 1600 ft (487 m) with below ground guidance or furrow guidance located at the center of the machine. Cart anchors must be used for Swing Arounds longer than 1000 ft (304 m) or 6 spans.

Base Beams

1. 4-Wheel Cart linears (except Universal Linear) are only available with non-tow base beams.
2. 4-Wheel Hose Drag Linear cart available as swing around.

Electrical

1. Maximum control panel voltage 505 volts, 60 Hz. (400 volts, 50 Hz.)
2. Minimum voltage at the last drive unit 440 volts, 60 Hz. (350 volts, 50 Hz.)
3. Maximum machine current 30 amps unless the 45 amp package is used.
   (a) 45 amp package includes a control panel which has a larger capacity disconnect and contactors. This package must be used on all machines with amp draw exceeding 30.0 amps.
   (b) Drive unit fuse package includes fuse block and (3) fuses for fusing the drive unit motors. Must be fused in the following instances:
      (i) Whenever the 45 amp package is used on an end feed machine.
      (ii) Whenever a 5 hp (3.7 Kw) or 7.5 hp (5.6 Kw) booster pump is used.
      (iii) On a center feed machine if the total current draw of the cart exceeds 30.0 amps a 45 amp panel is required.
4. One second time delay - This is used on any span that shows the tendency to rapidly start and stop due to the floating alignment. This delay is an option which may be ordered as necessary, for high-speed motors. Typically one half of the spans are ordered with time delays.
5. Induced voltage package consists of a relay and high resistance heater. Used in conjunction with system using the time delay not because of the time delay. This is used whenever any one second time delay units are used in order to insure there is no induced voltage on the opposite run wire.

Linear Hose Feed and 4 Wheel Swing Around Guidelines (Continued)

Guidance

(See machine length for limitations.)

1. Above ground cable (located at cart only) - The cable is supported 28 in (711 mm) above the ground by a support post located every 80 ft (24 m).
2. Below ground guidance - Available on all linears. The below ground guidance wire must be trenched in rather than ripped in. Straightness of the wire is of the utmost importance for proper machine operation. Refer to the hose drag design section for special consideration concerning wire burial. End field wire burial needs curved section. See Service Manual for details.

   Cord Drag Linear: Make sure to allow approximately 15 ft (4.5 m) to 20 ft (6 m) of cable for making connections, i.e. a 450 ft (137.1 m) cable will have 430 ft (131 m) of linear run. 8 AWG copper Type W "Mining Cable".
3. Furrow guidance can be located on Linear 4 Wheel Hose Drag, Ditch Feed, Universal Cart or Free-Standing span drive unit).

   Furrow must not vary more than two (2) inches (50 mm) from straight.
4. GPS guidance for proper operation the length of run must be twice the length of the machine.

Alignment

1. Full floating alignment:
   (a) May be used on all linears.
   (b) Required for all linears of six spans or more. Optional on five spans or less. It is recommended that the sprinklers adjacent to the drive units be lowered below the pipeline to avoid spraying on the alignment system.
2. Modified Alignment:
   (a) Available for all linears with five spans or less.
   (b) It is recommended that the sprinkler adjacent to the drive units be lowered below the pipeline to avoid spraying on the alignment system.

Wheel Tracks

1. Depth - Maximum allowable depth 4 in (101 mm).
2. Please inform the customer that they are responsible for maintaining wheel track depth to a maximum of 4 in (101 mm). Track fillers, tillers, small discs, drive unit booms or floatation tires can be used to control the depth of wheel tracks. Special caution should be taken with the swing around linear when in pivot operation in controlling wheel track depth to a maximum of 4 in (101 mm).
3. Wheel track establishment - On a new machine, the first pass should be made with the machine running dry at 100% timer setting. The return pass should be made while applying water at 100%. On a machine operating in existing tracks which have become too deep, perform the following:
   (a) Disc the tracks down deeper than the existing wheel track depth.
   (b) Run the machine dry over the soil at 100% timer setting. Make the return pass applying water at 100%.
   (c) If any portion of the previous track remains, disc the track again and re-establish the track. Repeat this procedure until the machine is operating on a flat level track.
   (d) Typically linear machines need larger tire on heavy soils to minimize wheel track depth.
   (e) If berms are built, a wide-flat area of 3 ft (1 m) is recommended and compacted to prevent wheel tracks.

Motor/Tire Combination

1. The motor-tire combination must maintain a minimum 25% increased differential ground speed on intermediate drive units compared to end drive units (or cart on end feed).

Tire Loading

1. Side walls of some tires will deteriorate more rapidly when loaded excessively, especially in hot climates.
2. Reduced air pressure may allow for better flotation/surface area, less compaction and reduced wheel tracks.

Added Cart Weight

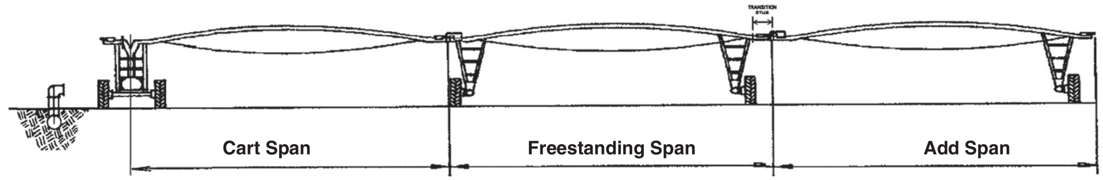
1. Weight bracket (to add 3000 lb) for either concrete baskets or tractor front-end weights may be added to the cart as required for increasing the hose pulling capability. The cart tires may be filled with a weight additive and other weights added to the cart frame as needed. The System Order Configurator (SOC) will provide guidelines depending on hose diameter and length.

NOTE

- **Hose side inlet is not allowed on Rainger Swing Around Cart.**

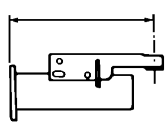
Span Layout and Tower Location Chart

(4-Wheel Cart and Swing Around) NO 10 in on Swing Around



ALL SPAN LENGTH DIMENSIONS ARE BALL TO BALL -

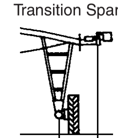
Pipe Diameter		Cart Span		Add Spans		Free Standing Without Transition		Transition Spans**		Outer Spacing Inches			Weight (Wet)		Span Crop Clearance		Overhang	
in	mm	ft	m	ft	m	ft	m	ft	m	108	90	30	lbs	kgs	ft	m	ft	m
MODEL 8000 SPANS																		
10	254	114.2	34.82	112.8	34.38	112.8	34.38	112.5	34.30				7328	3324	9.5	2.90	2.5	0.76
10	254	116.6	35.55	115.2	35.11	115.2	35.11	114.9	35.03				7462	3385	9.6	2.93	9	2.74
10	254	121.5	37.04	120.1	36.60	120.1	36.60	119.8	36.53				7716	3500	9.3	2.83	18	5.48
10	254	136.7	41.66	135.2	41.22	135.2	41.22	135.0	41.14				8503	3857	9.3	2.83	27	8.22
10	254	141.5	43.12	140.0	42.68	140.0	42.68	139.8	42.60				8752	3970	9.6	2.93	36	10.97
10	254	161.5	49.23	160.1	48.80	160.1	48.80	159.8	48.72				9788	4440	9.3	2.83	45	13.71
8 5/8	219	116.6	35.55	114.9	35.03	114.9	35.03	114.9	35.03				6311	2863	9.6	2.93	54	16.46
8 5/8	219	136.7	41.66	135.0	41.14	135.0	41.14	135.0	41.14				7151	3244	9.2	2.80	64	19.51
8 5/8	219	141.5	43.12	139.8	42.60	139.8	42.60	139.8	42.60				7352	3335	9.5	2.90	73	22.25
8 5/8	219	161.5	49.23	159.8	48.71	159.6	48.63	159.8	48.72				8084	3667	9.0	2.74	82	24.99
8 5/8	219	181.6	55.35	179.9	54.83	179.9	54.83	179.9	54.83				9024	4093	8.9	2.71	100.4	30.60
6 5/8	168	116.6	35.55	115.2	35.11	115.2	35.11						4884	2215	10.0	3.05		
6 5/8	168	136.7	41.66	135.2	41.22	135.2	41.22						5475	2483	10.0	3.05		
6 5/8	168	141.5	43.12	140.0	42.68	140.0	42.68						5616	2547	10.0	3.05		
6 5/8	168	161.5	49.23	160.1	48.80	160.1	48.80						6204	2817	10.0	3.05		
6 5/8	168	181.6	55.35	180.2	54.91	180.2	54.91						6792	3081	9.5	2.90		
6 5/8	168	186.4	56.81	184.9	56.37	184.9	56.37						6933	3145	9.5	2.90		
6 5/8	168	188.3	57.38	186.8	56.94	186.8	56.94						6989	3145	9.5	2.90		
6 5/8	168	206.4	62.92	205.0	62.48	205.0	62.48						7524	3145	9.3	2.83		
MODEL 800E (HALF PIPE)																		
10	254			112.5	34.29								7328	3324	9.5	2.90	2.5	0.76
10	254			135.2	41.20								8503	3857	9.3	2.83	9	2.74
8 5/8	219	136.7	41.66	135.2	41.22	135.2	41.22	135.0	41.14				7212	3271	9.1	2.77	18	5.49
8 5/8	219	159.1	48.51	157.7	48.07	157.7	48.07	157.4	47.99				8154	3698	9.3	2.83	27	8.23
8 5/8	219	181.6	55.35	180.2	54.91	180.2	54.91	179.9	54.83				9030	3080	9.5	2.90	36	10.97
6 5/8	168	136.7	41.66	135.2	41.22	135.2	41.22						5475	2483	10.0	3.04	45	13.72
6 5/8	168	159.1	48.51	157.7	48.07	157.7	48.07						6131	2780	10.0	3.04	54	16.46
6 5/8	168	181.6	55.35	180.2	54.91	180.2	54.91						6792	3080	9.5	2.90	64	19.51
6 5/8	168	204.0	62.19	202.6	61.75	202.6	61.75						7454	3379	9.5	2.90	73	22.25
																	82	24.99
																	100	30.48
MODEL 8120 SPANS										113		75.5						
10	254	110.7	33.74	109.7	33.44	109.7	33.44	108.8	33.17				7182	3258	8.2	2.50	2.5	0.76
10	254	120.8	36.83	119.9	36.53	119.9	36.53	119.0	36.26				7711	3498	8.4	2.56	9	2.74
10	254	128.7	39.23	127.7	38.94	127.7	38.94	126.9	38.67				8120	3683	8.4	2.56	18	5.49
8 5/8	219	143.7	43.81	142.3	43.37	142.3	43.37	142.0	43.29				7512	3405	9.8	2.99	27	8.23
8 5/8	219	162.6	49.56	161.2	49.12	161.2	49.12	161.2	49.12				8311	3767	9.6	2.93	36	10.97
8 5/8	219	181.5	55.32	180.0	54.88	180.0	54.88	180.0	54.88				9030	3084	9.4	2.86	45	13.72
6 5/8	168	143.7	43.81	142.3	43.37	142.3	43.37						5684	2576	9.8	2.99	54	16.46
6 5/8	168	162.6	49.56	161.2	49.12	161.2	49.12						6239	2828	9.6	2.93	64	19.51
6 5/8	168	181.5	55.32	180.0	54.88	180.0	54.88						6804	3084	9.4	2.86	73	22.25
6 5/8	168	200.4	61.07	198.9	60.63	198.9	60.63						7348	3336	9.4	2.86	82	24.99
																	100	30.48



** Choose type of TRANSITION required:
Transitions of 0.00' available **OR**
Transition pipes used in conjunction with a last pipe when changing pipe diameters and also on all cart spans for center feeds.
NOTE: Dimension on Transition
NOTE: This transition is not used when going from 6 5/8 in to 6 in pipe or on a 10 in transition. 1.5 ft (.457 m)
TRANSITION PIPE NOT REQUIRED WITH INTERNATIONAL (8120) PIPE SPAN

Outlet Spacing Available (shaded cells)

Transition Span



NOTE:

All cart spans have deep trussing which reduces crop clearance

Rainger Linear Hose Drag

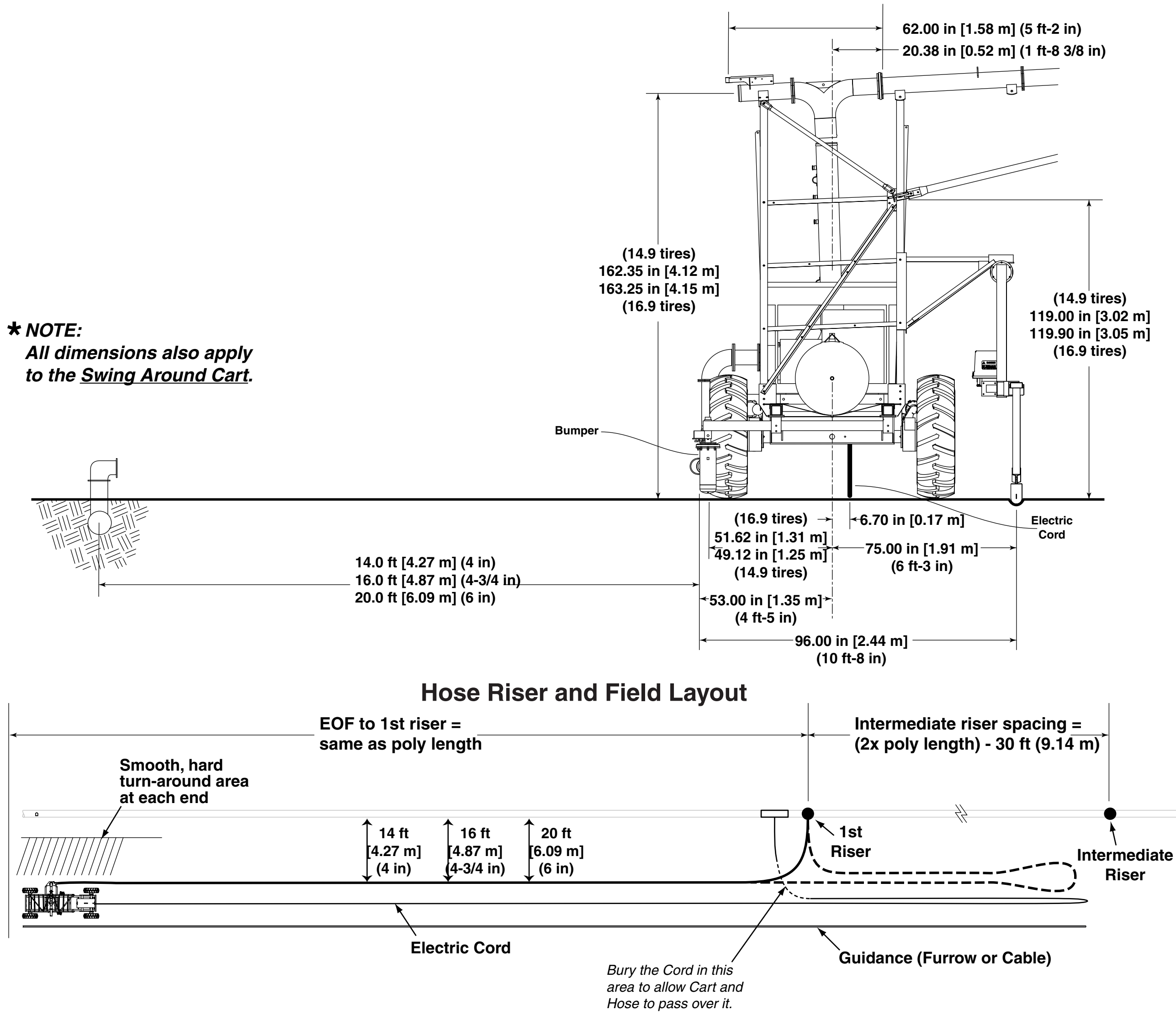
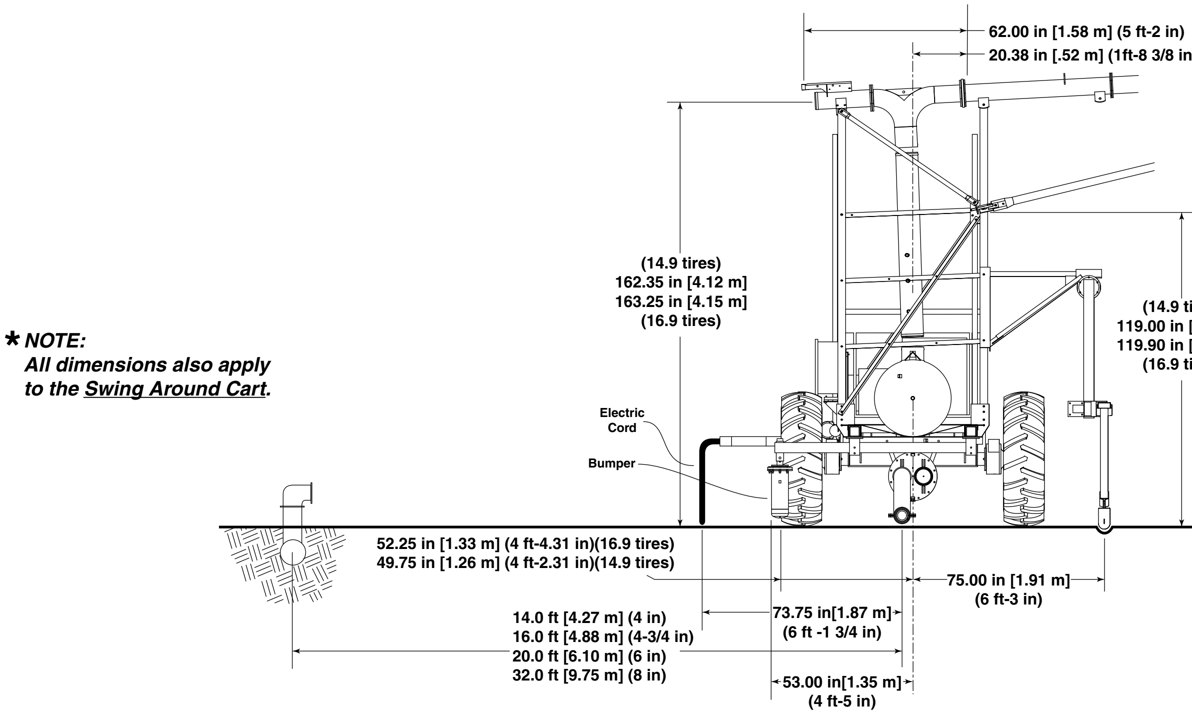


Figure 3-8-1

- The side inlet hose drag is designed to reverse at the ends of the field without disconnecting the poly hose from the cart.
- The swivel elbow should be adjusted outward to an angle of at least 10˚ in order for the machine to reverse consistently.
- Bumpers may be installed to push the poly-hose out of the way of the cart tires.
- The cart path must be maintained in a smooth, hard condition, to allow the poly-hose to slide freely over the surface.
- At the ends of the field, where the reversing takes place, allow a smooth, hard area to the swivel side of the cart.
- Hard poly hose must be connected to the side inlet at the cart.
- The side-inlet configuration will greatly reduce hose handling labor compared to the center-inlet configuration, but should not be expected to auto-reverse completely unattended.
- Due to the tight bending radius in the poly and the stresses of auto-reversing, it is recommended to use heavier (SDR 11) wall poly-pipe for side inlet hose drags.
- Side inlet on Rainger carts have a limited length for the first span, it must be less than 163 ft (49.6 m) in length.
- 8-5/8 cart spans required when pulling the following:
  - » 4 in poly hose - 1131 ft max
  - » 4-3/4 in poly hose - 819 ft max
  - » 6 in poly hose - 507 ft max

Hose Drag Center Pull



Hose Riser and Field Layout

Without Bumpers

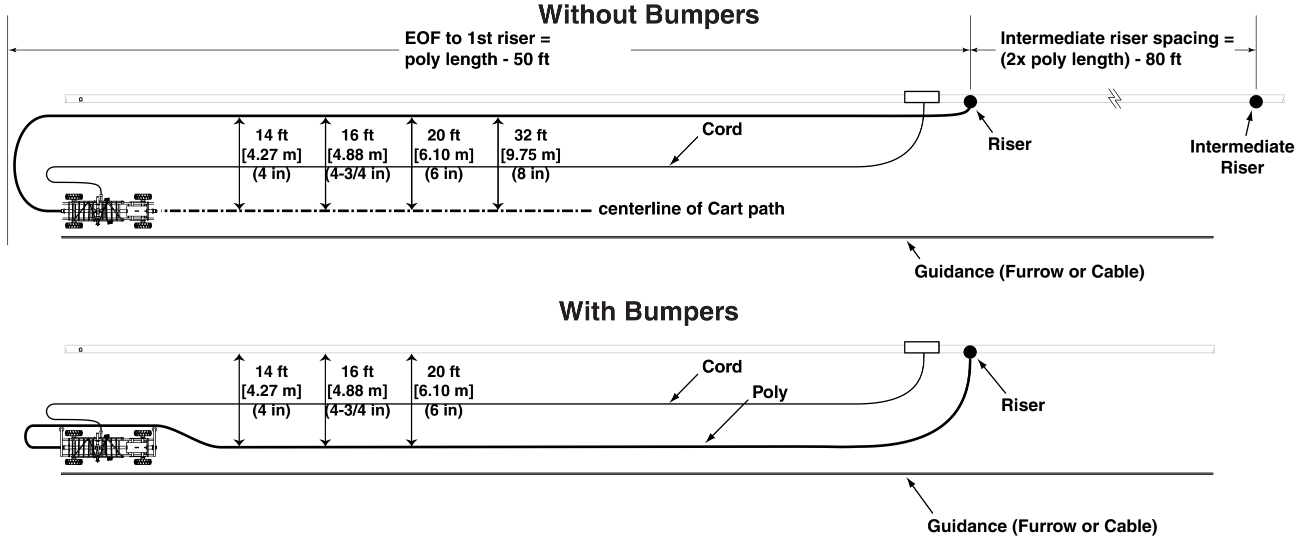
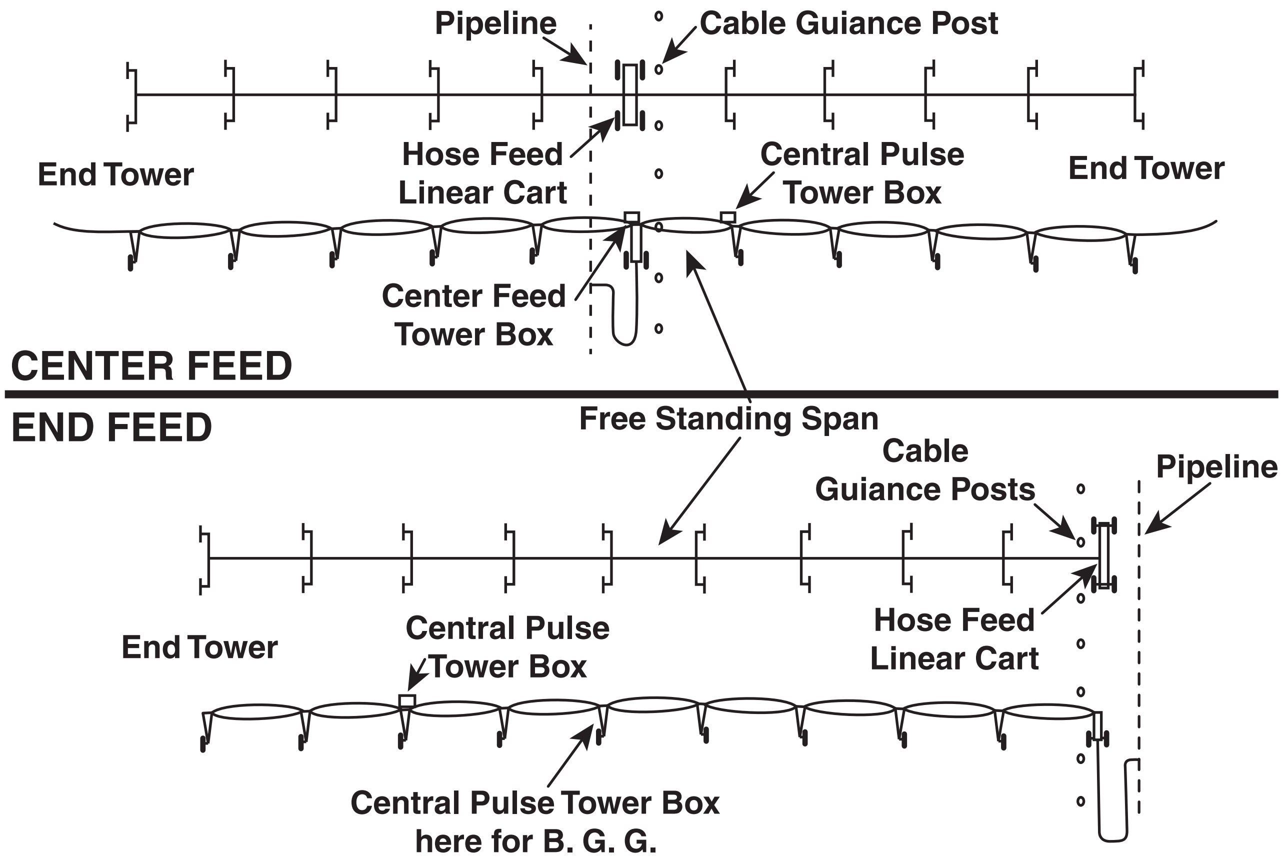


Figure 3-9-1

- Bumpers may be installed to reduce hose handling labor, but may require heavier wall that the standard SDR 17 (SDR 13.5 or SDR 11) poly due to the tighter bending radius. Heavier wall is recommended when using bumpers with 8 in (203 mm) poly.
- The cart path must be maintained in a smooth, hard condition, to allow the poly-hose to slide freely over the surface.
- The Linear Hose Drag Cart can be equipped with a engine driven booster pump for an additional pressure boost after exiting the hose. Refer to the Ditch Feed Pump tables on page 2-83 for pump sizing and horsepower data.
- Cord Drag Linear: Make sure to allow approximately 15 ft (4.5 m) to 20 ft (6 m) of cable for making connections, i.e. a 450 ft (137.1 m) cable will have 430 ft (131 m) of linear run. 8 AWG copper Type W “Mining Cable.”

Rainger Linear Hose Drag

Tower Box Locations - Hose Feed Linear Machine



Linear Swing Around Anchors

Swing Around Pivot Point

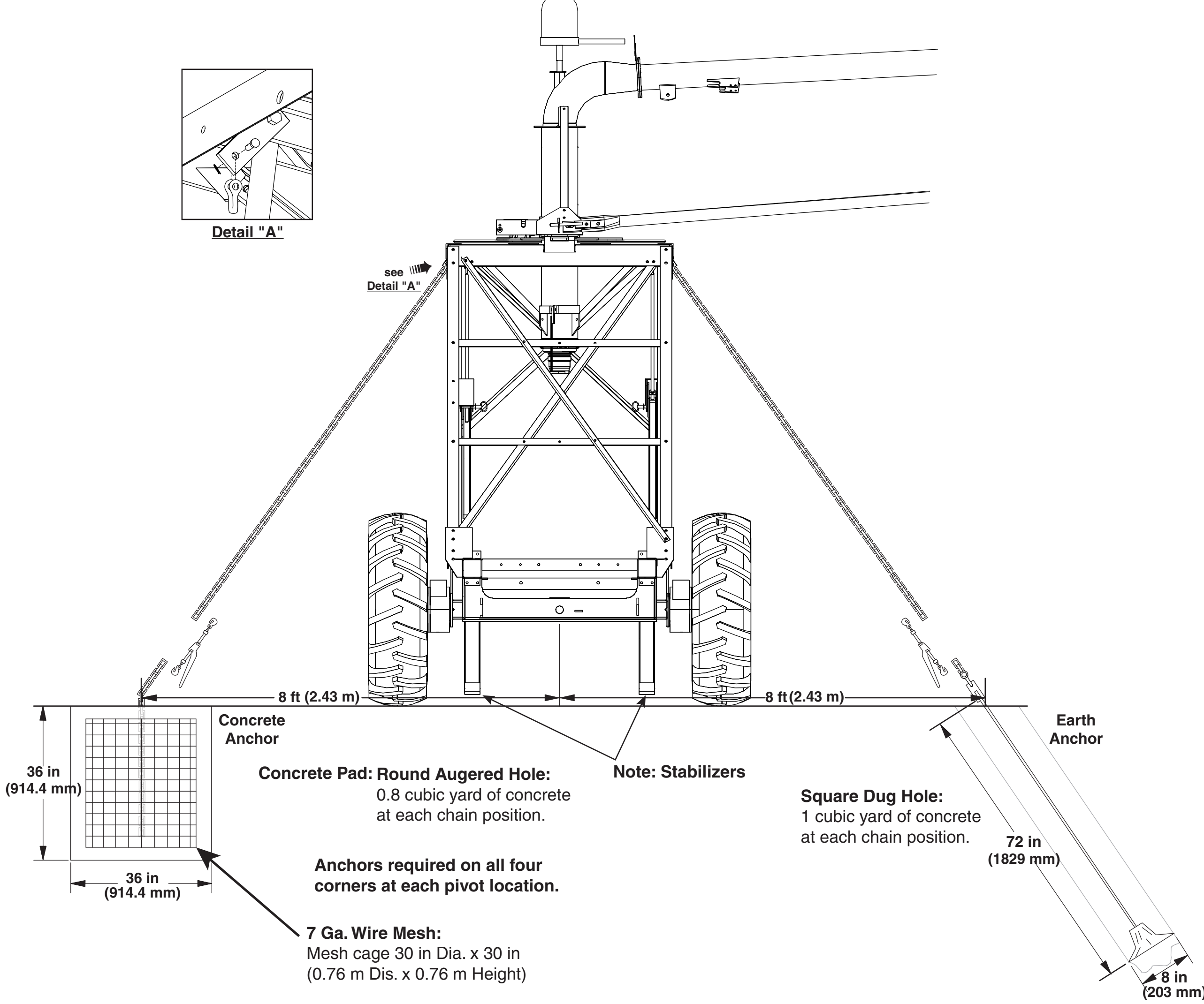
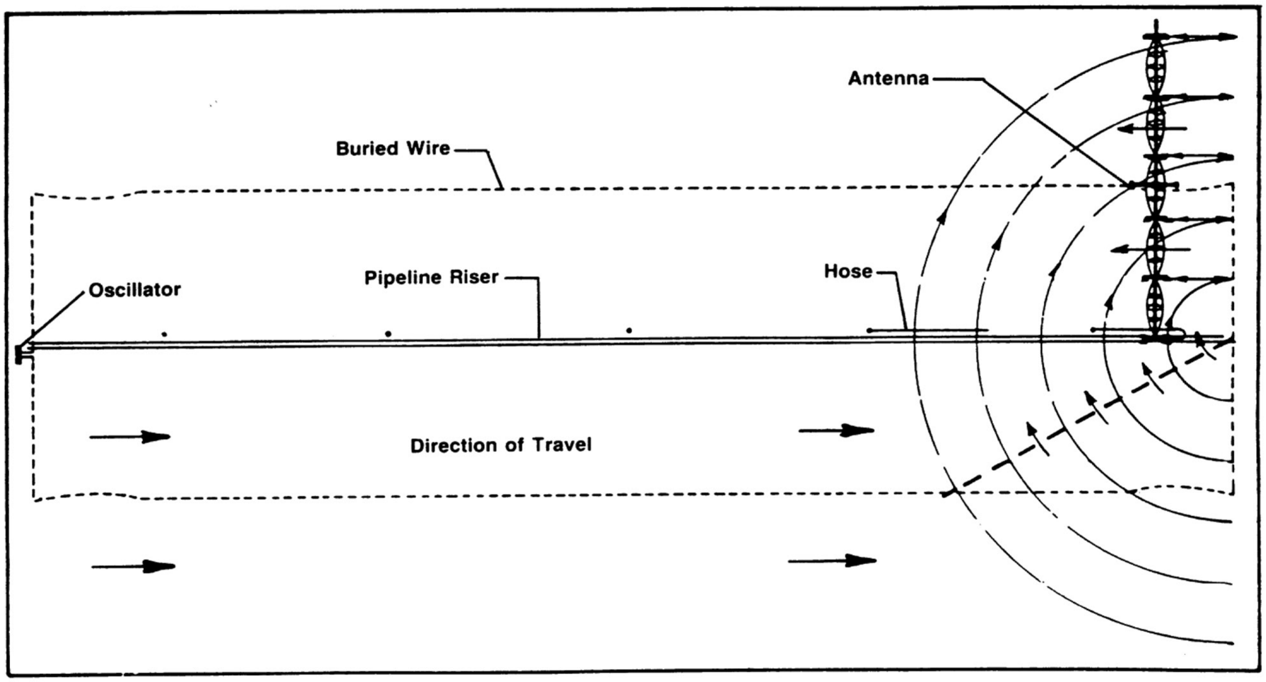


Figure 3-11-1

1. The area around the cart where the machine is to swing around should be flat and in the same plane as the first span.
2. Prior to swinging around, make sure the stabilizers are vertical under the car and are on solid ground or on another hard surface such as planks, boards, or concrete.
3. For machines greater than 1000 ft (305 m) or 6 spans in length, anchor chains must be used to tie the cart down. Either earth anchors or concrete anchors may be used. (See Figure 3-11-1.)
4. Some machine configurations, such as the use of large foot print tires, and some field conditions may require anchoring the cart on machines shorter than the recommendation above.
5. Side inlet is not allowed on Rainger Swing around cart.

Rainger Linear Hose Drag

Swing Around Linear Hose Feed System



Engine/Generator Specifications @ Sea Level and 85° F

Perkins

Engine and Generator Size	hp Available (kW)	Tier	Amp Output
3 – cylinder 403D-15 w/5 kW	20 (14.9)	IT4	8.00 Amps
3 – cylinder 403D-15 w/7.5 kW	20 (14.9)	IT4	11.25 Amps
3 – cylinder 403D-15 w/10.0 kW	20 (14.9)	IT4	15.00 Amps
4 – cylinder 404D-22 w12 kW	29 (21.6)	IT4	18.00 Amps
4 – cylinder 404D-22 w/15 kW	29 (21.6)	IT4	22.50 Amps
4 – cylinder 404D-22 w/19.0 kW	29 (21.6)	IT4	28.00 Amps
4 – cylinder 404D-22T w/20 kW	38 (28.3)	IT4	30.00 Amps
4 – cylinder 404D-22T w/25 kW	38 (28.3)	IT4	38.00 Amps

John Deere

4 – cylinder 4024T w/20 kW**	39 (29.1)	IT4	30.00 Amps
4 – cylinder 4024T w/25 kW**	39 (29.1)	IT4	38.00 Amps
4 – cylinder 4024T w/30 kW**	39 (29.1)	IT4	45.00 Amps
4 - cylinder 4045T - 74 w/40 kW**	61 (45.5)	III	60.00 Amps

Yanmar

3 – cylinder 3TNV70 w/5 kW**	10 (7.5)	IT4	8.00 Amps
3 – cylinder 3TNV88 w/7.5 kW**	23 (17.2)	IT4	11.00 Amps
3 – cylinder 3TNV88 w/10 kW**	23 (17.2)	IT4	15.00 Amps
4 – cylinder 4TNV88 w/12 kW**	31 (23.1)	IT4	18.00 Amps
4 – cylinder 4TNV88 w/15 kW**	31 (23.1)	IT4	23.00 Amps

**** Contact Valmont for availability of John Deere and Yanmar Engines.**

Lima Generator Efficiency and Amps									
Size	5 kW	7.5 kW	10 kW	12 kW	15 kW	20 kW	25 kW	30 kW	40 kW
Efficiency	0.809	0.826	0.837	0.847	0.872	0.868	0.876	0.884	0.884
Max. amps	8A	11A	15A	18A	23A	30A	38A	45A	60A

Amp draw additions for various standard speed options.
Change hose drag cart motor to 1-1/2 hp, add 1.6 amps.
Add ANY ancillary equipment amp draw to load requirements shown in tables.

Rainger Linear Hose Drag

Adjustment for Temperature and Altitude

Perkins Interim Tier 4											
Turbocharged engines (ET, ETA and ETTA suffix)											
Temperature	F	77	82	87	92	97	102	107	112	117	122
	C	25	28	31	33	36	39	42	44	47	50
Feet	Meters										
0	0	1.000	1.003	1.005	1.008	1.010	1.013	1.015	1.018	1.020	1.023
1000	305	1.000	1.003	1.005	1.008	1.010	1.013	1.015	1.018	1.020	1.023
2000	610	1.000	1.003	1.005	1.008	1.010	1.013	1.015	1.018	1.020	1.023
3000	914	1.000	1.003	1.005	1.008	1.010	1.013	1.015	1.018	1.020	1.023
4000	1219	1.000	1.003	1.005	1.008	1.010	1.013	1.015	1.018	1.020	1.023
5000	1524	1.000	1.003	1.005	1.008	1.010	1.013	1.015	1.018	1.020	1.023
6000	1829	1.000	1.003	1.005	1.008	1.010	1.013	1.015	1.018	1.020	1.023
7000	2134	1.000	1.003	1.005	1.008	1.010	1.013	1.015	1.018	1.020	1.023

Perkins Interim Tier 4											
403D and 404D Naturally Aspirated engines											
Temperature	F	77	82	87	92	97	102	107	112	117	122
	C	25	28	31	33	36	39	42	44	47	50
Feet	Meters										
0	0	1.000	1.008	1.015	1.023	1.030	1.038	1.045	1.053	1.06	1.068
600	183	1.000	1.008	1.015	1.023	1.030	1.038	1.045	1.053	1.06	1.068
1100	335	1.015	1.023	1.030	1.038	1.045	1.053	1.061	1.068	1.076	1.084
1600	488	1.030	1.038	1.045	1.053	1.061	1.069	1.076	1.084	1.092	1.100
2100	640	1.045	1.053	1.061	1.069	1.076	1.084	1.092	1.100	1.108	1.116
2600	792	1.060	1.068	1.076	1.084	1.092	1.100	1.108	1.116	1.124	1.132
3600	1097	1.090	1.098	1.106	1.115	1.123	1.131	1.139	1.147	1.155	1.164
4600	1402	1.120	1.128	1.137	1.145	1.154	1.162	1.170	1.179	1.187	1.196
5600	1707	1.150	1.159	1.167	1.176	1.185	1.193	1.202	1.210	1.219	1.228
6600	2012	1.180	1.189	1.198	1.207	1.215	1.224	1.233	1.242	1.251	1.260
7600	2317	1.210	1.219	1.228	1.237	1.246	1.255	1.264	1.274	1.283	1.292

Adjustment for Temperature and Altitude

Perkins Tier III Export DT, DTA and DETA suffix											
Temperature	F	77	82	87	92	97	102	107	112	117	122
	C	25	28	31	33	36	39	42	44	47	50
Feet	Meters										
0	0	1.000	1.003	1.005	1.008	1.010	1.013	1.015	1.018	1.020	1.023
1000	305	1.005	1.008	1.010	1.013	1.015	1.018	1.020	1.023	1.025	1.028
2000	610	1.010	1.013	1.015	1.018	1.020	1.023	1.025	1.028	1.030	1.033
3000	914	1.015	1.018	1.020	1.023	1.025	1.028	1.030	1.033	1.035	1.038
4000	1219	1.020	1.023	1.025	1.028	1.030	1.033	1.035	1.038	1.040	1.043
5000	1524	1.025	1.028	1.030	1.033	1.035	1.038	1.040	1.043	1.046	1.048
6000	1829	1.030	1.033	1.035	1.038	1.040	1.043	1.045	1.048	1.051	1.053
7000	2134	1.035	1.038	1.040	1.043	1.045	1.048	1.051	1.053	1.056	1.058

John Deere Tier III and IT4 Turbocharged engines (T and H suffix)											
Temperature	F	77	82	87	92	97	102	107	112	117	122
	C	25	28	31	33	36	39	42	44	47	50
Feet	Meters										
0	0	1.000	1.003	1.005	1.008	1.010	1.013	1.015	1.018	1.020	1.023
1000	305	1.000	1.003	1.005	1.008	1.010	1.013	1.015	1.018	1.020	1.023
2000	610	1.000	1.003	1.005	1.008	1.010	1.013	1.015	1.018	1.020	1.023
3000	914	1.000	1.003	1.005	1.008	1.010	1.013	1.015	1.018	1.020	1.023
4000	1219	1.000	1.003	1.005	1.008	1.010	1.013	1.015	1.018	1.020	1.023
5000	1524	1.000	1.003	1.005	1.008	1.010	1.013	1.015	1.018	1.020	1.023

John Deere Tier I Export Turbocharged engines (T, A and H suffix)											
Temperature	F	77	82	87	92	97	102	107	112	117	122
	C	25	28	31	33	36	39	42	44	47	50
Feet	Meters										
0	0	1.000	1.003	1.005	1.008	1.010	1.013	1.015	1.018	1.020	1.023
1000	305	1.000	1.003	1.005	1.008	1.010	1.013	1.015	1.018	1.020	1.023
2000	610	1.000	1.003	1.005	1.008	1.010	1.013	1.015	1.018	1.020	1.023
3000	914	1.000	1.003	1.005	1.008	1.010	1.013	1.015	1.018	1.020	1.023
4000	1219	1.000	1.003	1.005	1.008	1.010	1.013	1.015	1.018	1.020	1.023
5000	1524	1.000	1.003	1.005	1.008	1.010	1.013	1.015	1.018	1.020	1.023
6000	1829	1.000	1.003	1.005	1.008	1.010	1.013	1.015	1.018	1.020	1.023
7000	2134	1.000	1.003	1.005	1.008	1.010	1.013	1.015	1.018	1.020	1.023

Rainger Linear Hose Drag

Adjustment for Temperature and Altitude (Continued)

John Deere Tier I Export 4045D Naturally Aspirated engine											
Temperature	F	77	82	87	92	97	102	107	112	117	122
	C	25	28	31	33	36	39	42	44	47	50
Feet	Meters										
0	0	1.000	1.008	1.015	1.023	1.030	1.038	1.045	1.053	1.06	1.068
600	183	1.000	1.008	1.015	1.023	1.030	1.038	1.045	1.053	1.06	1.068
1100	335	1.015	1.023	1.030	1.038	1.045	1.053	1.061	1.068	1.076	1.084
1600	488	1.030	1.038	1.045	1.053	1.061	1.069	1.076	1.084	1.092	1.100
2100	640	1.045	1.053	1.061	1.069	1.076	1.084	1.092	1.100	1.108	1.116
2600	792	1.060	1.068	1.076	1.084	1.092	1.100	1.108	1.116	1.124	1.132
3600	1097	1.090	1.098	1.106	1.115	1.123	1.131	1.139	1.147	1.155	1.164
4600	1402	1.120	1.128	1.137	1.145	1.154	1.162	1.170	1.179	1.187	1.196
5600	1707	1.150	1.159	1.167	1.176	1.185	1.193	1.202	1.210	1.219	1.228
6600	2012	1.180	1.189	1.198	1.207	1.215	1.224	1.233	1.242	1.251	1.260
7600	2317	1.210	1.219	1.228	1.237	1.246	1.255	1.264	1.274	1.283	1.292

Yanmar Tier III and IT4 (3TNV and 4TNV Engines)											
Temperature	F	77	82	87	92	97	102	107	112	117	122
	C	25	28	31	33	36	39	42	44	47	50
Feet	Meters										
0	0	1.000	1.009	1.017	1.026	1.034	1.043	1.051	1.060	1.068	1.077
600	183	1.000	1.009	1.017	1.026	1.034	1.043	1.051	1.060	1.068	1.077
1100	335	1.020	1.029	1.037	1.046	1.055	1.063	1.072	1.081	1.089	1.098
1600	488	1.040	1.049	1.058	1.067	1.075	1.084	1.093	1.102	1.111	1.120
2100	640	1.060	1.069	1.078	1.087	1.096	1.105	1.114	1.123	1.132	1.141
2600	792	1.080	1.089	1.098	1.108	1.117	1.126	1.135	1.144	1.153	1.163
3600	1097	1.120	1.130	1.139	1.149	1.158	1.168	1.177	1.187	1.196	1.206
4600	1402	1.160	1.170	1.180	1.190	1.199	1.209	1.219	1.229	1.239	1.249
5600	1707	1.200	1.210	1.220	1.231	1.241	1.251	1.261	1.271	1.282	1.292
6600	2012	1.240	1.251	1.261	1.272	1.282	1.293	1.303	1.314	1.324	1.335
7600	2317	1.280	1.291	1.302	1.313	1.324	1.334	1.345	1.356	1.367	1.378

Center-Inlet Hose Drag Cart

Center-Inlet Hose Drag Cart
Maximum Hose Pull Lengths with 14.9 x 24 Tires
4.500 in (114.3 mm) O.D. (3.793 in (96.3 mm) I.D.) SDR 13.5 Poly Hard Hose

Hose Length	Cart Motor RPM	DU Motor RPM	LRDU Motor RPM	Minimum Cart Weight Required	Maximum Poly Length (all guidance types)
STANDARD DRIVE TRAIN (cast iron gear)					
Center Feed - Standard Speed	34	43	34	8200 lb (3719 kg)	897 ft (273.4 m)
Center Feed - High Speed	56	68	56	10700 lb (4853 kg)	1131 ft (344.7 m)
End Feed - Standard Speed	34	43	34	10700 lb (4853 kg)	1131 ft (349.7 m)
End Feed - High Speed	56	68	56	8000 lb (3628 kg)	858 ft (261.5 m)
HEAVY DUTY DRIVE TRAIN (bronze gear)					
Center Feed - Standard Speed	34	43	34	12800 lb (5805 kg)	1365 ft (416.0 m)
Center Feed - High Speed	56	68	56	16500 lb (7484 kg)	1755 ft (534.9 m)
End Feed - Standard Speed	34	43	34	16500 lb (7484 kg)	1755 ft (534.9 m)
End Feed - High Speed	56	68	56	12500 lb (5805 kg)	1326 ft (404.1 m)

NOTE

- **16.9 Tires increase traction, but decrease the motor's pulling capability by 4.4% compared to 14.9 Tires.**

Assumptions: 1. The above values are maximums allowed. Weight will be added to the Cart to achieve the necessary traction.

2. The cart path is smooth and hard packed.

Guidelines: Reduce hose lengths by 2% for each 1% of slope that the cart must climb.

For electric cord drags (450 ft (137 m) of cord) decrease the maximum allowable hose length by 4%.

Traction is better on hard-packed earth than on loose soil.

Pulling excessive hose lengths may lead to over-heated motors and/or reduced gear life on center drives and wheel gearboxes.

Riser Spacing: Edge of field to first riser: Hose length minus 50 ft (15 m).

Intermediate riser spacing: (2 x hose length) minus 80 ft (24 m).

Weight: Actual cart weight is based on SOC entries and assumes full tanks and 3000 lb (1360 kg) for weight racks. Actual cart weights are printed on order summary.

Max Coil Length: 4.500 in (114.3 mm) O.D. - 1000 ft (304.8 m) MAX

5.563 in (141.3 mm) O.D. - 500 ft (152.4 m) MAX

6.625 in (168.3 mm) O.D. - 500 ft (152.4 m) MAX

Center-Inlet Hose Drag Cart (Continued)

Center-Inlet Hose Drag Cart
Hose Pull Lengths with 14.9 x 24 Tires
5.563 in (141.3 mm) O.D. (4.491 in (114.1 mm) I.D.) SDR 11 Poly Hard Hose

Hose Length	Cart Motor RPM	DU Motor RPM	LRDU Motor RPM	Minimum Cart Weight Required	Maximum Poly Length
STANDARD DRIVE TRAIN (cast iron gear)					Span Mounted Guidance
Center Feed - Standard Speed	34	43	34	8200 lb (3719 kg)	585 ft (178.3 m)
Center Feed - High Speed	56	68	56	10700 lb (4853 kg)	741 ft (225.9 m)
End Feed - Standard Speed	34	43	34	10700 lb (4853 kg)	741 ft (225.9 m)
End Feed - High Speed	56	68	56	8000 lb (3628 kg)	546 ft (166.4 m)
HEAVY DUTY DRIVE TRAIN (bronze gear)					Span Mounted Guidance
Center Feed - Standard Speed	34	43	34	12800 lb (5805 kg)	897 ft (273.4 m)
Center Feed - High Speed	56	68	56	14000 lb (6350 kg)	975 ft (297.2 m)*
End Feed - Standard Speed	34	43	34	14000 lb (6350 kg)	975 ft (297.2 m)*
End Feed - High Speed	56	68	56	12500 lb (5805 kg)	858 ft (261.5 m)

6.625 in (168.3 mm) O.D. (5.348 in (135.8 mm) I.D.) SDR 11 Poly Hard Hose

Hose Length	Cart Motor RPM	DU Motor RPM	LRDU Motor RPM	Minimum Cart Weight Required	Maximum Poly Length
STANDARD DRIVE TRAIN (cast iron gear)					All Guidance Types
Center Feed - Standard Speed	34	43	34	8200 lb (3719 kg)	390 ft (118.9 m)
Center Feed - High Speed	56	68	56	10700 lb (4853 kg)	507 ft (154.5 m)
End Feed - Standard Speed	34	43	34	10700 lb (4853 kg)	507 ft (154.5 m)
End Feed - High Speed	56	68	56	8000 lb (3628 kg)	390 ft (118.9 m)
HEAVY DUTY DRIVE TRAIN (bronze gear)					All Guidance Types
Center Feed - Standard Speed	34	43	34	12800 lb (5805 kg)	624 ft (190.2 m)
Center Feed - High Speed	56	68	56	16500 lb (7484 kg)	780 ft (237.7 m)
End Feed - Standard Speed	34	43	34	16500 lb (7484 kg)	780 ft (237.7 m)
End Feed - High Speed	56	68	56	12500 lb (5805 kg)	585 ft (178.3 m)

8.625 in (219.1 mm) O.D. (7.549 in (191.7 mm) SDR 17 Poly Hard Hose

Hose Length	Cart Motor RPM	DU Motor RPM	LRDU Motor RPM	Minimum Cart Weight Required	Maximum Poly Length
HEAVY DUTY DRIVE TRAIN (bronze gear)					All Guidance Types
Center Feed - Standard Speed	34	43	34	12800 lb (5805 kg)	351 ft (106.9 m)
Center Feed - High Speed	56	68	56	16500 lb (7484 kg)	468 ft (142.6 m)
End Feed - Standard Speed	34	43	34	16500 lb (7484 kg)	468 ft (142.6 m)
End Feed - High Speed	56	68	56	12500 lb (5805 kg)	351 ft (106.9 m)

NOTE

- **16.9 Tires increase traction, but decrease the motor's pulling capability by 4.4% compared to 14.9 Tires.**

Assumptions: 1. The above values are maximums allowed. Weight will be added to the Cart to achieve the necessary traction.

2. The cart path is smooth and hard packed.

Guidelines: Reduce hose lengths by 2% for each 1% of slope that the cart must climb.

For electric cord drags (450 ft (137 m) of cord) decrease the maximum allowable hose length by 4%.

Traction is better on hard-packed earth than on loose soil.

Pulling excessive hose lengths may lead to over-heated motors and/or reduced gear life on center drives and wheel gearboxes.

Riser Spacing: Edge of field to first riser: Hose length minus 50 ft (15 m).

Intermediate riser spacing: (2 x hose length) minus 80 ft (24 m).

Weight: Actual cart weight is based on SOC entries and assumes full tanks and 3000 lb (1360 kg) for weight racks. Actual cart weights are printed on order summary.

Max Coil Length: 4.500 in (114.3 mm) O.D. - 1000 ft (304.8 m) MAX

5.563 in (141.3 mm) O.D. - 500 ft (152.4 m) MAX

6.625 in (168.3 mm) O.D. - 500 ft (152.4 m) MAX

Valley Linear Side-Inlet Hose Drag Cart

Side-Inlet Hose Drag Cart
Maximum Hose Pull Lengths with 14.9 x 24 Tires
4.500 in (114.3 mm) O.D. (3.793 in (96.3 mm) I.D.) SDR 13.5 Poly Hard Hose

Hose Length	Cart Motor RPM	DU Motor RPM	LRDU Motor RPM	Minimum Cart Weight Required	Maximum Poly Length (span mounted guidance)**	Minimum Cart Weight Required	Maximum Poly Length (cart mounted guidance)
STANDARD DRIVE TRAIN (cast iron gear)							
Center Feed - Standard Speed	34	43	34	8200 lb (3719 kg)	897 ft (273.4 m)	8200 lb (3719 kg)	897 ft (273.4 m)
Center Feed - High Speed	56	68	56	10700 lb (4853 kg)	1131 ft (344.7 m)	10700 lb (4853 kg)	1131 ft (344.7 m)
End Feed - Standard Speed	34	43	34	10700 lb (4853 kg)	1131 ft (349.7 m)	10700 lb (4853 kg)	1131 ft (344.7 m)
End Feed - High Speed	56	68	56	8000 lb (3628 kg)	858 ft (261.5 m)	8000 lb (3628 kg)	858 ft (261.5 m)
HEAVY DUTY DRIVE TRAIN (bronze gear)							
Center Feed - Standard Speed	34	43	34	12800 lb (5805 kg)	1365 ft (416.0 m)	10700 lb (4853 kg)	1131 ft (344.7 m)
Center Feed - High Speed	56	68	56	14000 lb (6350 kg)	1482 ft (451.7 m)*	10700 lb (4853 kg)	1131 ft (344.7 m)
End Feed - Standard Speed	34	43	34	14000 lb (6350 kg)	1482 ft (451.7 m)*	10700 lb (4853 kg)	1131 ft (344.7 m)
End Feed - High Speed	56	68	56	12500 lb (5805 kg)	1326 ft (404.1 m)	10700 lb (4853 kg)	1131 ft (344.7 m)

Note: 16.9 Tires increase traction, but decrease the motor's pulling capability by 4.4% compared to 14.9 Tires
Note: Side inlet on Rainger carts have a limited length for the first span, it must be less than 163 ft (49.6 m) in length. SIDE INLET NOT ALLOWED ON SWING AROUND CART.

Assumptions:
1. The above values are maximums allowed. Weight will be added to the Cart to achieve the necessary traction.
2. The cart path is smooth and hard packed.

Guidelines:
Reduce hose lengths by 2% for each 1% of slope that the cart must climb.
For electric cord drags (450 ft (137 m) of cord) decrease the maximum allowable hose length by 4%.
Traction is better on hard-packed earth than on loose soil.
Pulling excessive hose lengths may lead to over-heated motors and /or reduced gear life on center drives and wheel gearboxes.
8-5/8 in cart span is required on side inlet hose drags for poly lengths exceeding the following: 4.5 in (114.3 mm) - 1131 ft (344 m), 5.375 in (136.5 mm) - 819 ft (249 m), 5.563 in (141.3 mm) - 741 ft (225.9 m), and 6.625 in (168.3 mm) - 507 ft (154.5 m).
Riser spacing: EOF to first riser: Same as hose length; Intermediate riser spacing = (2 x hose length) minus 30 ft (9 m).
**GPS is considered span mounted guidance.

Weight:
Actual cart weight is based on SOC entries and assumes full tanks and 3000 lb (1360 kg) for weight racks. Actual cart weights are printed on order summary.

Valley Linear Side-Inlet Hose Drag Cart (Continued)

Side-Inlet Hose Drag Cart
Hose Pull Lengths with 14.9 x 24 Tires
5.563 in (141.3 mm) O.D. (4.491 in (114.1 mm) I.D.) SDR 11 Poly Hard Hose

Hose Length	Cart Motor RPM	DU Motor RPM	LRDU Motor RPM	Minimum Cart Weight Required	Maximum Poly Length (span mounted guidance)	Minimum Cart Weight Required	Maximum Poly Length (cart mounted guidance)
STANDARD DRIVE TRAIN (cast iron gear)							
Center Feed - Standard Speed	34	43	34	8200 lb (3719 kg)	585 ft (178.3 m)	8200 lb (3719 kg)	585 ft (178.3 m)
Center Feed - High Speed	56	68	56	10700 lb (4853 kg)	741 ft (225.9 m)	10700 lb (4853 kg)	741 ft (225.9 m)
End Feed - Standard Speed	34	43	34	10700 lb (4853 kg)	741 ft (225.9 m)	10700 lb (4853 kg)	741 ft (225.9 m)
End Feed - High Speed	56	68	56	8000 lb (3628 kg)	546 ft (166.4 m)	8000 lb (3628 kg)	546 ft (166.4 m)
HEAVY DUTY DRIVE TRAIN (bronze gear)							
Center Feed - Standard Speed	34	43	34	12800 lb (5805 kg)	897 ft (273.4 m)	10700 lb (4853 kg)	741 ft (225.9 m)
Center Feed - High Speed	56	68	56	14000 lb (6350 kg)	975 ft (297.2 m)*	10700 lb (4853 kg)	741 ft (225.9 m)
End Feed - Standard Speed	34	43	34	14000 lb (6350 kg)	975 ft (297.2 m)*	10700 lb (4853 kg)	741 ft (225.9 m)
End Feed - High Speed	56	68	56	12500 lb (5805 kg)	858 ft (261.5 m)	10700 lb (4853 kg)	741 ft (225.9 m)

6.625 in (168.3 mm) O.D. (5.348 in (135.8 mm) I.D.) SDR 11 Poly Hard Hose

Hose Length	Cart Motor RPM	DU Motor RPM	LRDU Motor RPM	Minimum Cart Weight Required	Maximum Poly Length (span mounted guidance)	Minimum Cart Weight Required	Maximum Poly Length (cart mounted guidance)
STANDARD DRIVE TRAIN (cast iron gear)							
Center Feed - Standard Speed	34	43	34	8200 lb (3719 kg)	390 ft (118.9 m)	8200 lb (3719 kg)	390 ft (118.9 m)
Center Feed - High Speed	56	68	56	10700 lb (4853 kg)	507 ft (154.5 m)	10700 lb (4853 kg)	507 ft (154.5 m)
End Feed - Standard Speed	34	43	34	10700 lb (4853 kg)	507 ft (154.5 m)	10700 lb (4853 kg)	507 ft (154.5 m)
End Feed - High Speed	56	68	56	8000 lb (3628 kg)	390 ft (118.9 m)	8000 lb (3628 kg)	390 ft (118.9 m)
HEAVY DUTY DRIVE TRAIN (bronze gear)							
Center Feed - Standard Speed	34	43	34	12800 lb (5805 kg)	624 ft (190.2 m)	10700 lb (4853 kg)	507 ft (154.5 m)
Center Feed - High Speed	56	68	56	14000 lb (6350 kg)	663 ft (202.1 m)*	10700 lb (4853 kg)	507 ft (154.5 m)
End Feed - Standard Speed	34	43	34	14000 lb (6350 kg)	663 ft (202.1 m)*	10700 lb (4853 kg)	507 ft (154.5 m)
End Feed - High Speed	56	68	56	12500 lb (5805 kg)	585 ft (178.3 m)	10700 lb (4853 kg)	507 ft (154.5 m)

Note: 16.9 Tires increase traction, but decrease the motor's pulling capability by 4.4% compared to 14.9 Tires

Note: Side inlet on Rainger carts have a limited length for the first span, it must be less than 163 ft (49.6 m) in length. SIDE INLET NOT ALLOWED ON SWING AROUND CART.

Assumptions: 1. The above values are maximums allowed. Weight will be added to the Cart to achieve the necessary traction.
2. The cart path is smooth and hard packed.

Guidelines: Reduce hose lengths by 2% for each 1% of slope that the cart must climb.
For electric cord drags (450 ft (137 m) of cord) decrease the maximum allowable hose length by 4%.
Cord drag linear; Make sure you allow approximately 20 ft of cable for making connections. i.e. a 450 ft cable will have 430 ft of linear run.
Traction is better on hard-packed earth than on loose soil.
Pulling excessive hose lengths may lead to over-heated motors and /or reduced gear life on center drives and wheel gearboxes.
8-5/8 in cart span is required on side inlet hose drags for poly lengths exceeding the following: 4.5 in (114.3 mm) - 1131 ft (344 m), 5.375 in (136.5 mm) - 819 ft (249 m), 5.563 in (141.3 mm) - 741 ft (225.9 m), and 6.625 in (168.3 mm) - 507 ft (154.5 m).

Riser spacing: EOF to first riser: Same as hose length; Intermediate riser spacing = (2 x hose length) minus 30 ft (9 m).
**GPS is considered span mounted guidance.

Weight: Actual cart weight is based on SOC entries and assumes full tanks and 3000 lb (1360 kg) for weight racks. Actual cart weights are printed on order summary.

Hose and Cart Friction Loss

Hose and Cart Friction Loss

Table 5

Loss In PSI

GPM	330 ft OF 5 in Traveler Hose	Poly-Hose: 4.500 in O.D. **SDR 13.5** 3.809 in I.D. 0997223		5.563 in O.D. **SDR 11** 4.491 in I.D. 0999836		6.625 in O.D. **SDR 17** 5.799 in I.D. 0992556		6.625 in O.D. **SDR 11** 5.348 in I.D. 0997928		8.625 in O.D. **SDR 17** 7.549 in I.D. 0997119		Pressure Drop Thru Hose Cart (Includes Elevation From Ground to System Pipeline)
		PSI Loss Per Foot	Per 100 ft	PSI Loss Per Foot	Per 100 ft	PSI Loss Per Foot	Per 100 ft	PSI Loss Per Foot	Per 100 ft	PSI Loss Per Foot	Per 100 ft	
100		0.003	0.32									
200	1.1	0.012	1.17	0.007	0.67	0.002	0.14	0.006	0.61			5.5
300	2.3	0.025	2.47	0.014	1.42	0.004	0.41	0.010	1.03			5.8
400	3.9	0.042	4.21	0.024	2.42	0.007	0.70	0.016	1.56	0.002	0.19	6.1
500	5.9	0.064	6.36	0.037	3.66	0.011	1.05	0.022	2.19	0.003	0.29	6.6
600	8.1			0.051	5.13	0.015	1.48	0.029	2.91	0.004	0.41	7.0
700	10.9			0.068	6.82	0.020	1.97	0.037	3.73	0.005	0.54	7.5
800	14.0			0.087	8.73	0.025	2.52	0.046	4.64	0.007	0.70	8.1
900	17.4			0.109	10.85	0.031	3.13	0.056	5.64	0.009	0.87	8.7
1000	21.1			0.132	13.19	0.038	3.80	0.067	6.72	0.011	1.05	9.4
1100	25.2					0.045	4.54	0.074	7.90	0.013	1.26	10.1
1200	29.6					0.053	5.33	0.092	9.16	0.015	1.48	10.9
1300	34.4					0.062	6.18	0.105	10.51	0.017	1.71	11.7
1400	39.4					0.071	7.09	0.119	11.94	0.020	1.96	12.5
1500	44.7					0.081	8.05	0.135	13.45	0.022	2.23	13.3
1600	50.4					0.091	9.07			0.025	2.51	14.2
1700	56.4					0.102	10.15			0.028	2.81	15.2
1800						0.113	11.28			0.031	3.13	16.2
1900						0.125	12.47			0.035	3.45	17.3
2000						0.137	13.71			0.038	3.80	18.5

Minimum pressure required in Poly Hose at the Cart 25 PSI

Minimum pressure required in Traveler Hose at the Cart 70 PSI

MAXIMUM PRESSURE 100 PSI

Friction Losses are for 39 ft lengths on 5.375, 5.563, 6.625 and 8.625 O.D (c=130)

Losses for coils will be 80% of the chart values (c=150)

Hazen Williams formula:

$$Pf = \frac{.009015(L)}{D^{4.8655}} \left(\frac{100\,Q}{C}\right)^{1.85}$$

Rainger Linear Hose Drag

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Universal Linear Design

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Universal Linear Design Guidelines

Cart

1. End feed only.
2. Hose drag OR Ditch Feed.
3. Swivel cart (for L-shaped fields).
4. Non tow OR Towable.
5. Swing around - dry mode.

Machine Spans and Profiles

1. 6 5/8 in (168 mm) spans only.
2. 8 Drive Units or 1260 ft (384 m), whichever comes first.
3. Standard Profile Pivot only.
   (a) High and Ultra High remaining spans.
4. Spans available.
   115.2 ft (35.11 m)
   135.2 ft (41.20 m)*
   140.0 ft (42.67 m)
   142.3 ft (43.37 m)+
   157.5 ft (48.00 m)**
   160.0 ft (48.76 m)
   161.2 ft (49.13 m)+
   180.0 ft (54.86 m)*
   184.8 ft (56.32 m)
   186.7 ft (56.90 m)
   204.9 ft (62.45 m)

*** Export Spans**

**** Export Only**

+ International Spans

5. All current overhangs.

Base Beams

Universal linears are available with tow or non-tow base beams.

Electrical

1. Maximum control panel voltage 505 volts, 60 Hz. (400 volts, 50 Hz.)
2. Minimum voltage at the last drive unit 440 volts, 60 Hz. (350 volts, 50 Hz.)

Hose Diameters And Lengths

1. Hard hose 4 in (101 mm), 4.5 in (114 mm), 4.75 in (120 mm) and 6 in (152 mm)
2. Soft hose 5 in (127 mm)
3. Refer to hose table for allowable lengths.

Ditch Feed

1. Side ditch.
2. Straddle ditch.

Machine Controls

1. ClassicPlus.
2. ClassicPlus with Auto Reverse.
3. AutoPilot.

Guidance

1. Below ground guidance - **Available on Hose Drag ONLY**. The below ground guidance wire must be trenched in rather than ripped in. Straightness of the wire is of the utmost importance for proper system operation. Refer to the hose drag design section for special consideration concerning wire burial. End of field wire burial needs curved section. See Service Manual for details.
2. Furrow guidance - cart mounted.
   Hose drag - **Outside OR Below Cart**.
   Ditch feed - **Outside OR Below Cart**.
3. Above ground cable - **Ditch feed only**.
   Cable outside of cart.
   Cable below cart.

Alignment

1. Modified alignment only.

Motor Speed

1. High Speed requires:
   Cart 2-56 RPM 1.5 hp worm drive
   Last span 1-56 RPM 1.5 hp worm drive
   Intermediate spans 68 RPM helical drive
2. Standard Speed requires:
   Cart 2-30 RPM 1 hp worm drive
   OR
   2-30 RPM 1 1/2 hp worm drive
   Last span 1-30 RPM 1 hp worm drive
   Intermediate spans 34 RPM helical drive

End Gun

1. End gun control requires 12 conductor span cable on all spans - from control panel only.
2. All booster pumps available.
3. All end guns available.

Universal Linear Design Guidelines (Continued)

Tires

1. All tires except retreads or 38 in (0.96 m) are available. Tires on cart and last drive unit must be the same. The cart is standard with 14.9 x 24 tires.

Tire Loading

1. Side walls of some tires will deteriorate more rapidly when loaded excessively, especially in hot climates.

Cart Path

Cart path must be smooth, level, and compacted. Special attention must be taken to prevent rutting and/or erosion along or across the path. Excessive moisture on the cart should be minimized.

Wheel Tracks

1. Depth - Maximum allowable depth 4 in (101 mm).
2. Please inform the customer that they are responsible for maintaining wheel track depth to a maximum of 4 in (101 mm). Track fillers, tillers, small discs, drive unit booms or floatation tires can be used to control the depth of wheel tracks. Special caution should be taken with the swing around linear when in pivot operation in controlling wheel track depth to a maximum of 4 in (101 mm).
3. Wheel track establishment - On a new system, the first pass should be made with the system running dry at 100% timer setting. The return pass should be made while applying water at 100%. On a system operating in existing tracks which have become too deep, perform the following:
   (a) Disc the tracks down deeper than the existing wheel track depth.
   (b) Run the system dry over the soil at 100% timer setting. Make the return pass applying water at 100%.
   (c) If any portion of the previous track remains, disc the track again and re-establish the track. Repeat this procedure until the system is operating on a flat level track.

Percentage Timer

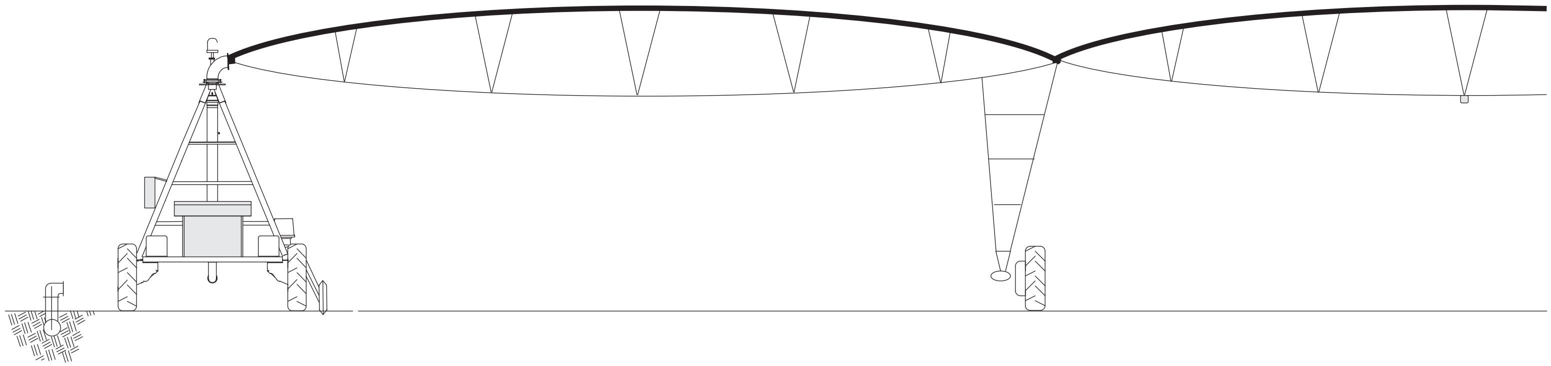
1. The 120 second setting is recommended on all Universal linears for all panels when operating at less than 20%. The Standard panel is equipped with a solid state timer preset for the 120-second operation. Minimum operating percentage allowable as a 30 second timer – 40% Minimum operating percentage allowable as a 60 second timer – 20%.

Swing Around

It is recommended that the Universal Linears should be designed ONLY as a swing around unit. In the event that the machine is not used as a swing around, then the spans should be swung occasionally to assure that the swivel is properly greased over the entire surface area.

Span Layout and Tower Location Chart (4 Wheel Cart)

Universal Linear
Span Layout and Tower Location Chart (4 Wheel Cart)
Other Spans



ALL SPAN LENGTH DIMENSIONS ARE BALL TO BALL

CART SPAN		ADD SPANS		PIPE DIAMETER		OUTLET SPACING inches			WEIGHT (WET)		SPAN CROP CLEARANCE		OVERHANG	
ft	m	ft	m	in	mm	108	90	30	lbs	Kgs	ft	m	ft	m
116.9	35.63	115.1	35.08	6 5/8	168				4884	2215	10.0	3.04	9	2.74
137.1	41.78	135.2	41.20	6 5/8	168				5475	2483	10.4	3.16	18	5.48
141.9	43.25	140.0	42.67	6 5/8	168				5616	2547	10.7	3.26	27	8.23
161.9	49.34	160.0	48.76	6 5/8	168				6204	2814	10.7	3.26	36	10.97
181.9	55.44	180.0	54.86	6 5/8	168				6792	3080	10	3.04	45	13.72
186.7	56.90	184.8	56.32	6 5/8	168				6933	3144	10	3.04	54	16.46
188.6	57.48	186.7	56.90	6 5/8	168				6989	3170	10	3.04	64	19.51
		204.9	62.45	6 5/8	168								73	22.25
													82	24.99
													100	30.48
EXPORT SPANS														
137.1	41.79	135.2	41.20	6 5/8	168				5475	2483	10.4	3.17	as	
159.4	48.58	157.5	48.00	6 5/8	168				6131	2780	10.7	3.26	above	
181.9	55.44	180.0	54.87	6 5/8	168				6792	3080	10	3.05		
		202.5	61.72	6 5/8	168									

INTERNATIONAL SPANS

CART SPAN		ADD SPANS		PIPE DIAMETER		OUTLET SPACING centimeters			WEIGHT (WET)		SPAN CROP CLEARANCE		OVERHANG	
ft	m	ft	m	in	mm	287		190	lbs	kgs	ft	m	ft	m
144.2	43.95	142.3	43.37	6 5/8	168				5684	2576	9.8	299	as	
163.2	49.71	161.2	49.13	6 5/8	168				6239	2828	9.6	2.93	above	
181.9	55.44	180.0	54.86	6 5/8	168				6804	3084	9.4	2.86		
		198.9	60.62	6 5/8	168									

Pivot Flex is standard and included in Cart Span dimensions

Universal Linear Design

Universal System Amperage

System continuous amp draw must be known to determine generator size and supply wire size to the irrigation system. Amp draw is based on the electrical load to the system, i.e., number of drive motors, high-speed, booster pump, etc.

Formula for calculating the average amperage draw for various system configurations is shown below.

Design current = 125% of the full load current of the largest motor, plus 110% of the full load current of the remaining motors multiplied by their duty cycle with the system running at 100%.

Helical Drive Standard Speed

Amps = (No. of Spans - 1) (0.91) (1.1) + A

Center drive gear boxes on the cart and end tower are worm drives. Standard speed is 30 RPM, High speed is 56 RPM.

Helical Drive High Speed

Amps = (No. of Spans - 1) (0.91) (1.8) + B

Universal Cart

"A" - Standard Speed

Booster Pump Size	Amps Adder (A)
0	6.56
2 hp (1.5 kW)	11.28
5 hp (3.73 kW)	15.40
7.5 hp (5.6 kW)	17.90

Universal Cart

"B" - High Speed

Booster Pump Size	Amps Adder (B)
0	8.80
2 hp (1.5 kW)	13.42
5 hp (3.73 kW)	17.54
7.5 hp (5.6 kW)	20.04

Motor		Std.	Hi Speed	2 hp	5 hp	7.5 hp
Amp Draw	**Helical Drive**	**1.1**	**1.8**			
Amp Draw	**Booster Pump**			**4.0**	**7.3**	**9.3**

$$hp = \frac{(\sqrt{3})(V)(A)(PF)}{(746)(EFF)}$$

A = Average amp Draw

PF = Power Factor (.8)

EFF = See chart below.

V = Volts (480)

Lima Generator Efficiency and Amps									
Size	5 kW	7.5 kW	10 kW	12 kW	15 kW	20 kW	25 kW	30 kW	40 kW
Efficiency	0.809	0.826	0.837	0.847	0.872	0.868	0.876	0.884	0.884
Max. amps	8A	11A	15A	18A	23A	30A	38A	45A	60A

Amp draw additions for various standard speed options.

Change hose drag cart motor to 1-1/2 hp, add 1.6 amps.

Add ANY ancillary equipment amp draw to load requirements shown in tables.

Universal Standard and High Speed

Universal Standard Speed

For 1 1/2 hp Motors on Cart Add 1.6 amps (Standard Speed ONLY)

Universal Standard Speed

No Booster Pump

SPANS	AMPS	GEN	hp	FUSE
2	7.6	7.5	8.3	12
3	8.7	7.5	9.4	12
4	9.8	10.0	10.6	12
5	10.8	10.0	11.8	12

Universal Standard Speed

2 hp Booster Pump

SPANS	AMPS	GEN	hp	FUSE
2	12.3	10	13.0	15.0
3	13.4	10	14.2	15.0
4	14.5	12	15.3	15.0
5	15.5	12	16.3	17.5

Universal Standard Speed

5 hp Booster Pump

SPANS	AMPS	GEN	hp	FUSE
2	16.5	12	17.3	17.5
3	17.5	15	18.4	20.0
4	18.6	15	19.3	20.0
5	19.7	15	20.4	20.0

Universal Standard Speed

7.5 hp Booster Pump

SPANS	AMPS	GEN	hp	FUSE
2	19.0	15	19.6	20
3	20.0	15	20.7	25
4	21.1	20	21.9	25
5	22.2	20	23.0	25

Universal High Speed

Universal High Speed

No Booster Pump

SPANS	AMPS	GEN	hp	FUSE
2	10.4	7.5	11.3	12.0
3	12.1	10.0	12.7	15.0
4	13.7	10.0	14.5	15.0
5	15.4	12.0	16.1	17.5

Universal High Speed

2 hp Booster Pump

SPANS	AMPS	GEN	hp	FUSE
2	15.1	12	15.8	17.5
3	16.7	12	17.6	17.5
4	18.3	15	19.0	20.0
5	20.0	15	20.7	20.0

Universal High Speed

5 hp Booster Pump

SPANS	AMPS	GEN	hp	FUSE
2	19.2	15	19.9	20
3	20.8	15	21.6	25
4	22.5	15	23.3	25
5	24.1	20	24.8	25

Universal High Speed

7.5 hp Booster Pump

SPANS	AMPS	GEN	hp	FUSE
2	21.7	15	22.4	25
3	23.3	20	24.0	25
4	25.0	20	25.7	25
5	26.6	20	27.4	30

Generator size is based on starting motor amperage requirements.

Horsepower is based on average running amperage requirements.

For Ditch Feed Universal Linears add the Pump Motor amperage to the machine load.

Pump Motor	Amps
10 hp	16.3
15 hp	23.8
20 hp	30.0
25 hp	40.0
30 hp	45.0

Lima Generator Efficiency and Amps

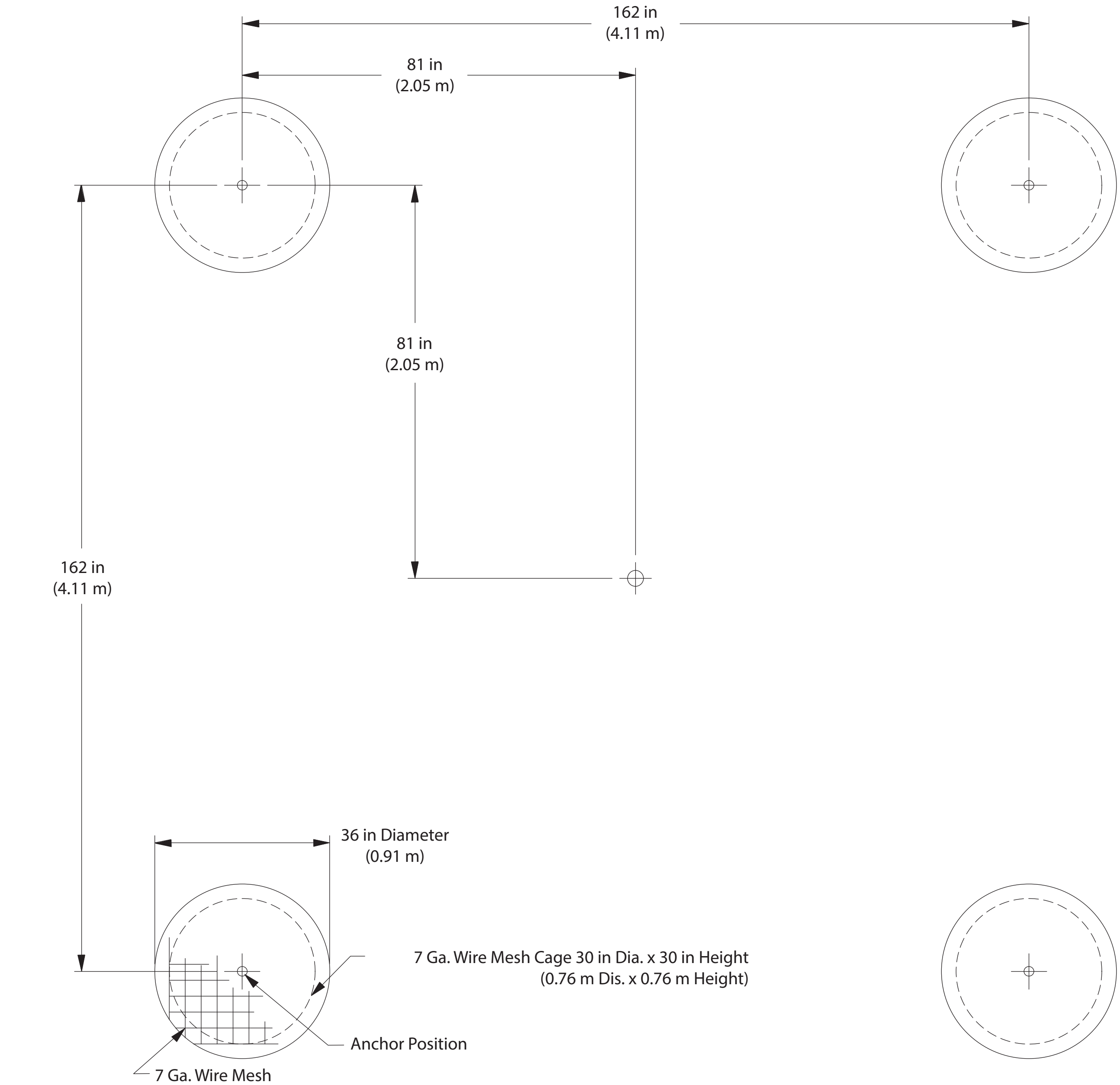
Size	5 kW	7.5 kW	10 kW	12 kW	15 kW	20 kW	25 kW	30 kW	40 kW
Efficiency	0.809	0.826	0.837	0.847	0.872	0.868	0.876	0.884	0.884
Max. amps	8A	11A	15A	18A	23A	30A	38A	45A	60A

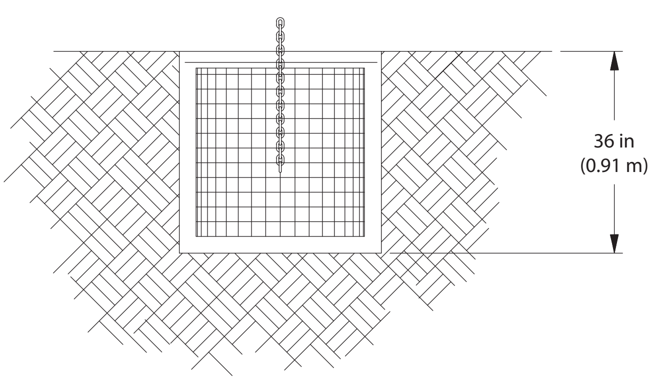
Maximum amp draw for Engine/Generator is 60 amps.

Maximum amp draw for Electric Cord Drag-Hose Drag option is 30 amps.

Maximum amp draw for Ditch Straddle Electric Cord Drag option is 100 amps.

Universal Linear Anchor Pad Specifications

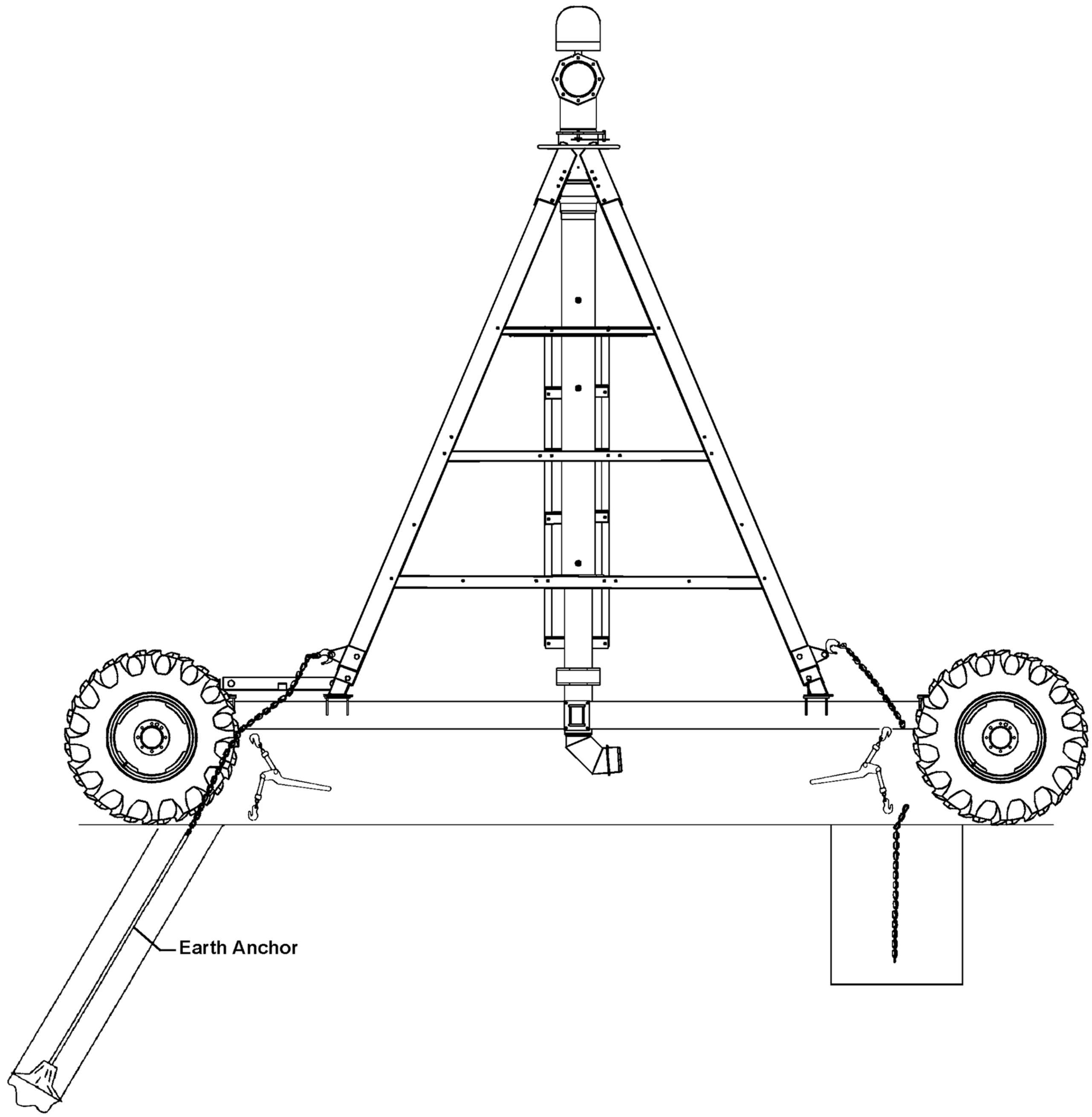




Concrete Pad: 0.75 cubic yard (0.6 m^3) of concrete at each chain position.

[Total Concrete: 3 cubic yards (2.4 m^3)]

Universal Linear Pivot Tie Down



Universal Linear Design

Universal Linear Cart with Furrow Guidance

Dimensions

	Tire Size 11.2 x 24	Tire Size 14.9 x 24	Tire Size 16.9 x 24
DIM. A	63.75 in 1.61 m	65.88 in 1.67 m	66.88 in 1.69 m
DIM. B	33.25 in 0.84 m	31.12 in 0.79 m	30.12 in 0.76 m
DIM. C	160.75 in 4.08 m	162.88 in 4.13 m	163.88 in 4.16 m

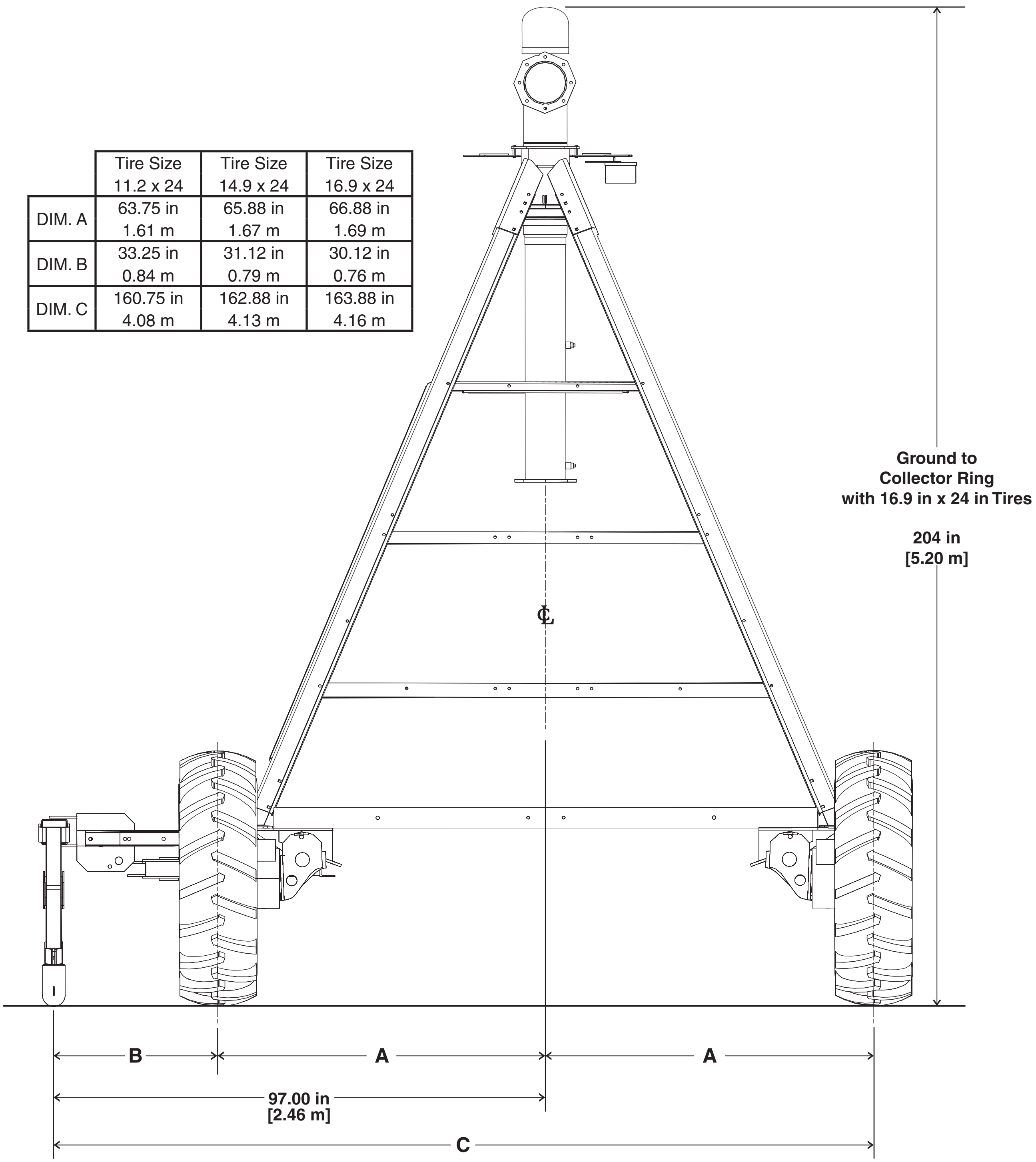
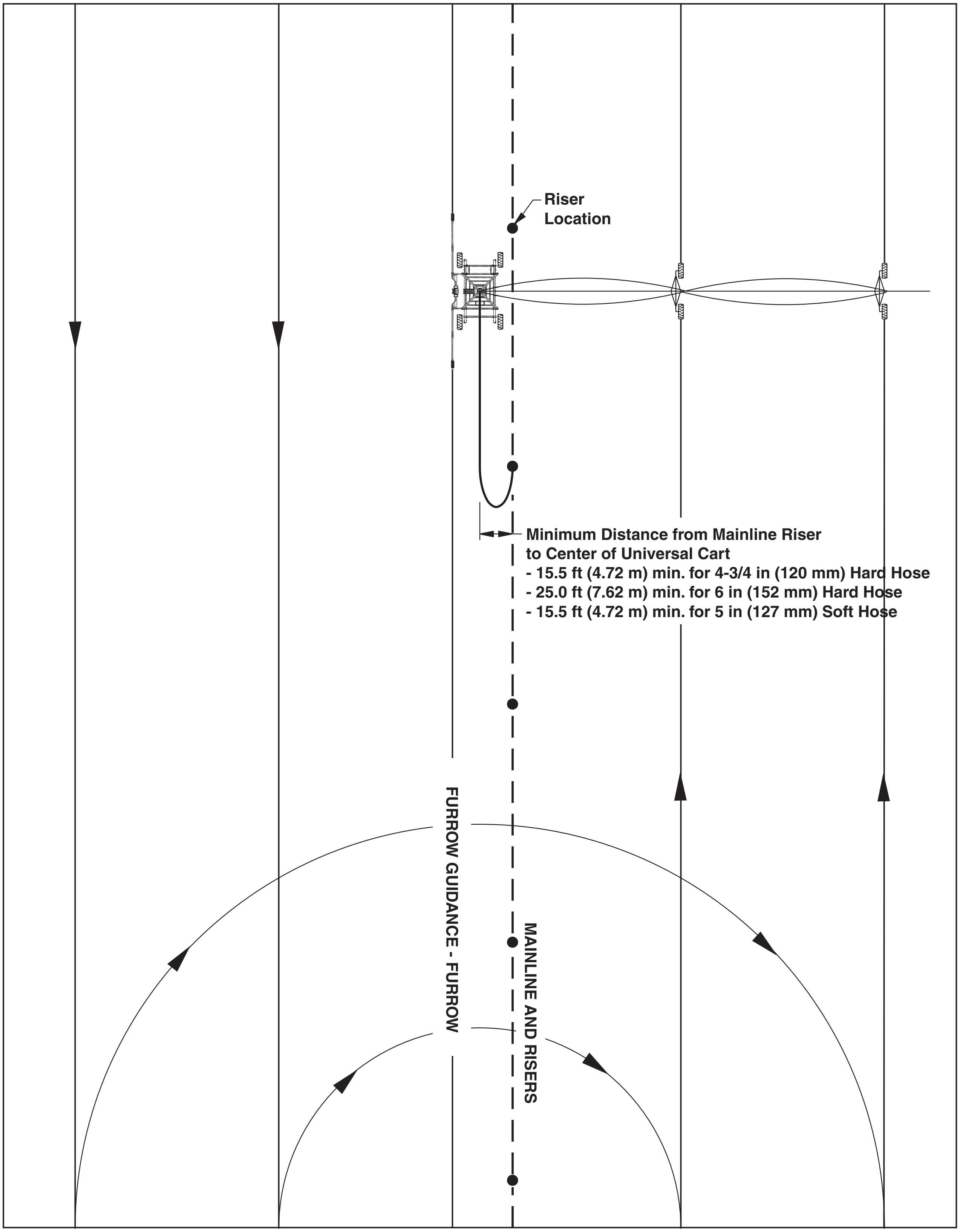


Figure 4-10-1

Universal Linear Field Layout



Refer to Page 4-20 for % Slope Capability and Hose Specifications.
Refer to Page 4-21 for Hose Handling.

Universal Linear Design

Above Ground Cable Guidance Installation and Adjustment

1. The Linear Guidance equipment consists of either an above ground cable that is supported by a line of 0.75 in (19 mm) pipe posts.
2. Linear post should be 60 ft (18.28 m) apart.

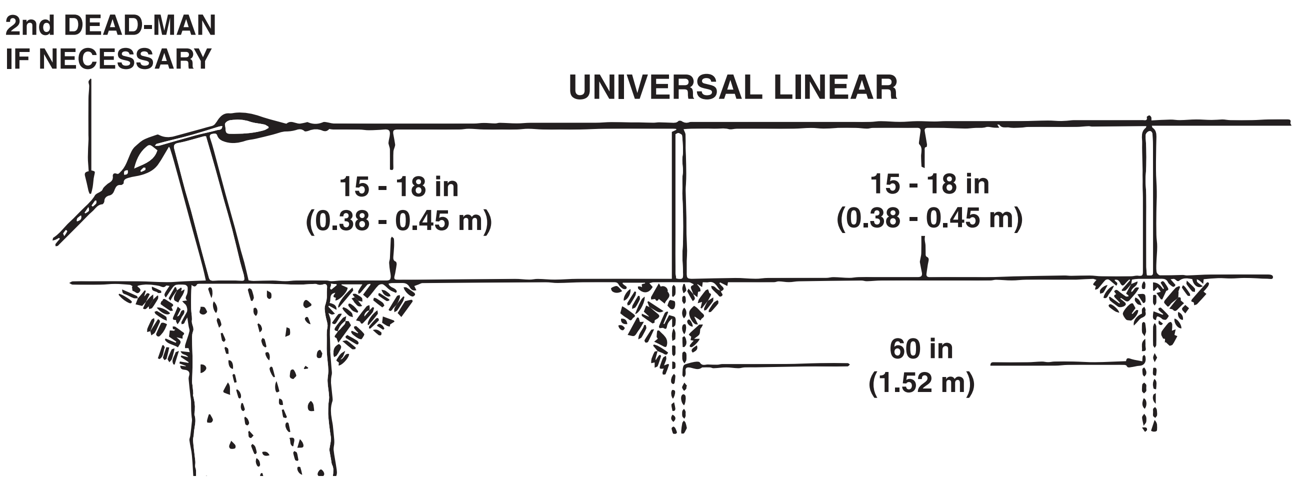
The location of the posts can be either under the cart or outside the cart. The preferred location is to either side of the swivel point of the guidance arm. When the guidance is location under the cart a minimum of 12 in (305 mm) from the inside of the tire is required with a maximum of 36 in (0.91 m) from the inside of the tire.

The cart configuration will determine the best location. On Straddle ditch machines the ditch size will determine the location on the cable. The post should be placed as close to ditch as possible OR a minimum of 12 in (0.30 m) from inside of tire. The cable guidance will use a wheel roller located on the top of the cable. On Hose Drag machines, the hose loop can interfere with the post and the swing around capability, therefore it is **NOT OFFERED** with cable guidance.

> ⚠ **WARNING**
>
> • **THE CABLE GUIDANCE (WITH ROLLER WHEEL) INCORPORATES A CABLE BREAK SAFETY SKID WHICH MUST BE INSTALLED TO STEER ARM TOWARD MACHINE NOT AWAY FROM MACHINE.**

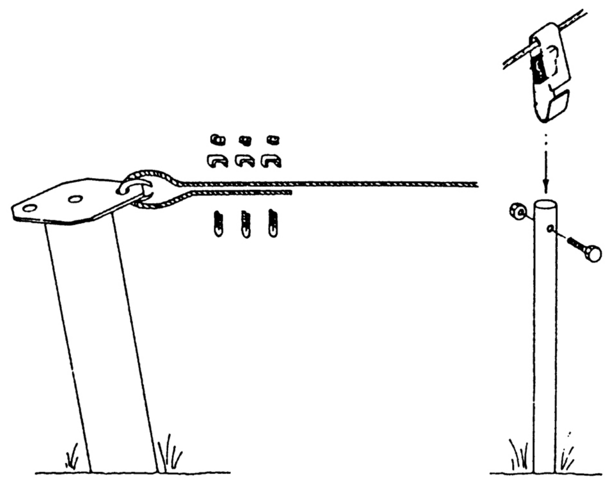
3. During the installation phase, there are two critical points to be observed.
   (a) The posts **must** be located in a perfectly straight line.
   (b) The cable **must** be properly tensioned.

Posts: It is recommended that the posts be aligned with a transit to assure a straight line installation. They should be located every sixty feet (1.82 m) and exactly parallel to the ditch (Ditch Feed). The two end posts, which are heavy duty welded assemblies, must be solidly embedded in concrete, and should be back sloped to withstand the cable tension. All posts should extend 15-18 in (0.38-0.45 m) above ground level.

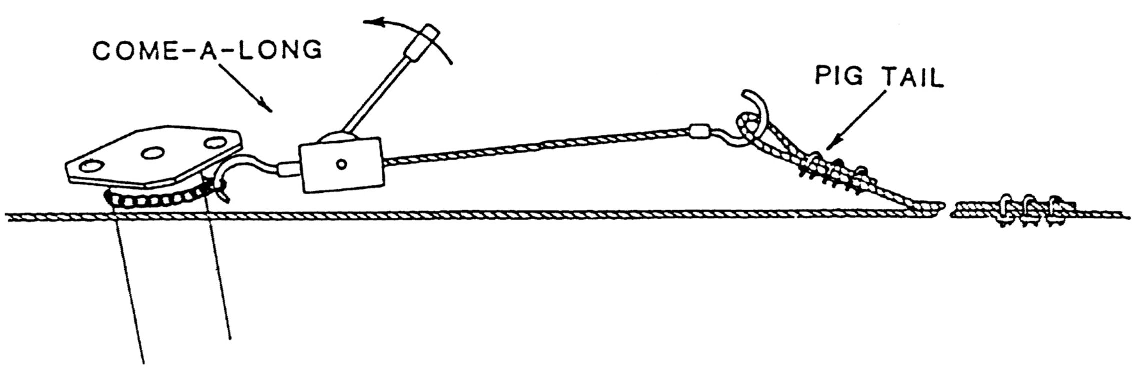


Above Ground Cable Guidance Installation and Adjustment (Continued)

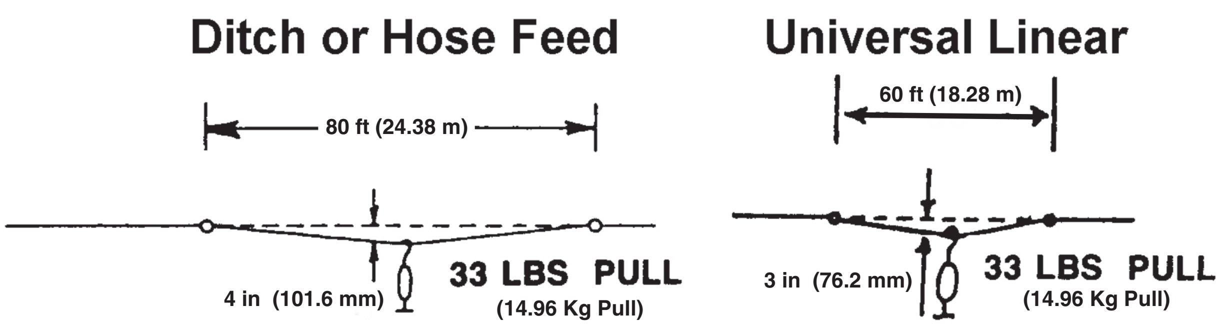
4. **Cable:** The cable is attached to the intermediate posts with two small interlocking clips that are inserted into the top of the pipe and then bolted in place. At one end of the cable, permanently attach the cable to the dead-man or end post using a cable eyelet and at **least** three cable clamps. A wheel will ride on top of the cable.



At the end of the cable, fasten it to a vehicle and pull as much of the slack out of the cable as possible. Then attach a 40-50 in (1.01 - 1.27 m) pigtail loop to the main cable and hook a 2-ton come-a-long to the pig-tail loop and the end post.



The final tension of the cable needs to be approximately 2000 lbs (900 kg). This 2000 lbs (900 kg) can be determined by attaching a fish scale to the main cable halfway between two intermediate posts. A 33 lbs (15 kg) pull on the scale should yield a 3 inch (75 mm) deflection in the cable for a Universal Linear.



If the tension is correct, permanently fasten the main cable to the end post as at the first end post and remove both the come-a-long and the pig-tail.

Guidance Cable Splicing and Post and Cart Position

Cable Splicing

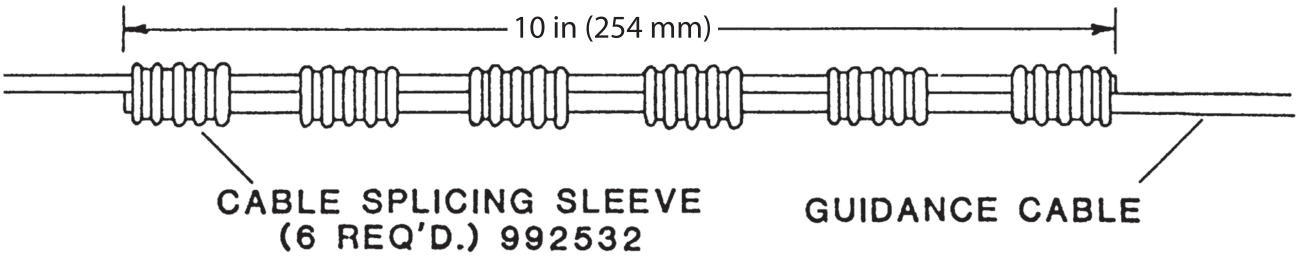


Figure 4-14-1

Cut replacement cable to proper length. Using six splicing sleeves as shown, splice cables together. IMPORTANT: Each sleeve is to be crimped in four places using cable swaging tool (PN 0992531). Start crimping sleeves from one end of the splice and work to the other end, leaving no gaps between the cables. Pull spliced cable tight and reattach to guidance stakes.

Cable Guidance Post and Cart Position

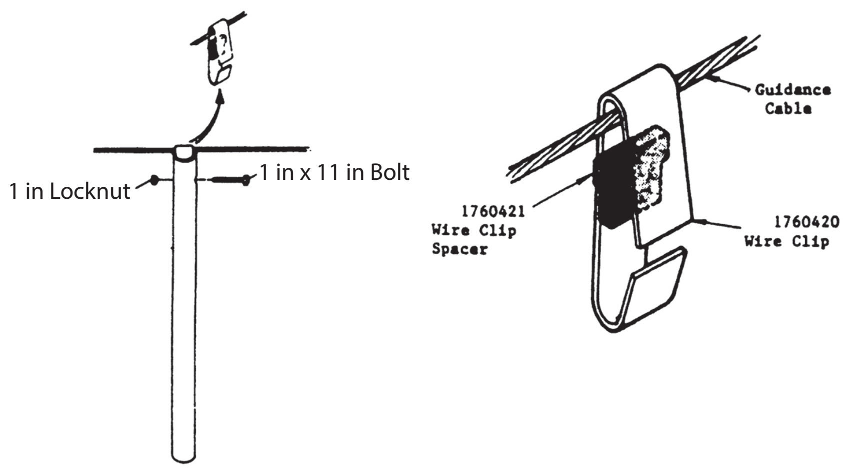


Figure 4-14-2

1760420 Clip and spacer must be used with the steering arm extensions, 1731047.

The cable should be parallel with the edge of the cart frame and the cart should be level, and the sensing roller wheels over the cable.

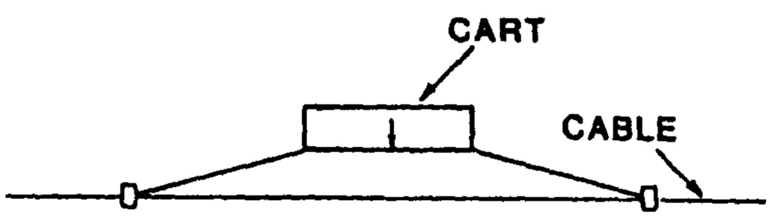


Figure 4-14-3

Roller wheels on the cable.

Universal Cable or Furrow Guidance

The furrow has a "V" shaped bottom 4 to 6 in (100-152 mm) deep with a maximum width at the top of 6 in (152 mm). The guide wheel should roll in the furrow at a minimum depth of 3 in (76 mm), and a maximum of 6 in (152 mm).

A three foot wide path on each side of the furrow should be kept clear of any obstructions that could prevent the system guidance hardware from functioning properly. This path should have no parallel or perpendicular ridges or furrows through it.

End-of-Field Shutdown

End-of-field shutdown is accomplished by placing an angle in the furrow where you want the system to stop. The furrow should be angled away from the drive unit so that when the leading guide wheel has traveled forward 10 feet (3 m), it has angled over 2 feet (0.5 m). This sudden angle change in the guidance arm will stop the system.

NOTE

- **Do not have the straight portion of the furrow go beyond where the angled end-of-field stop furrow is placed.**

Adjustment Procedure

1. Stretch a string from one pivot point, across the opposite pivot point, and out to the guide wheel. Place a board under the guide wheel and mark the location of the string on the board. From this mark, measure 7 in (177 mm) away in the direction opposite the drive unit. Mark this location on the board and place the guide wheel on it. This is the neutral running position of the guide wheel.
2. Move the actuator arm, (after loosening nuts), so it is centered directly over the basebeam. Be sure the steering box control arms are crossed over the actuator arm, tighten the nuts. (See Figure 4-15-1.)
3. Set the safety positions by moving the guide wheel 16 in (406 mm) to the right of neutral. At this location adjust the safety switch actuating lever so the safety switch plunger is just being depressed. Repeat the procedure for the other safety after moving the guide wheel 16 in (406 mm) to the left of neutral. After both safety positions have been set, return the guide wheel to the neutral position.

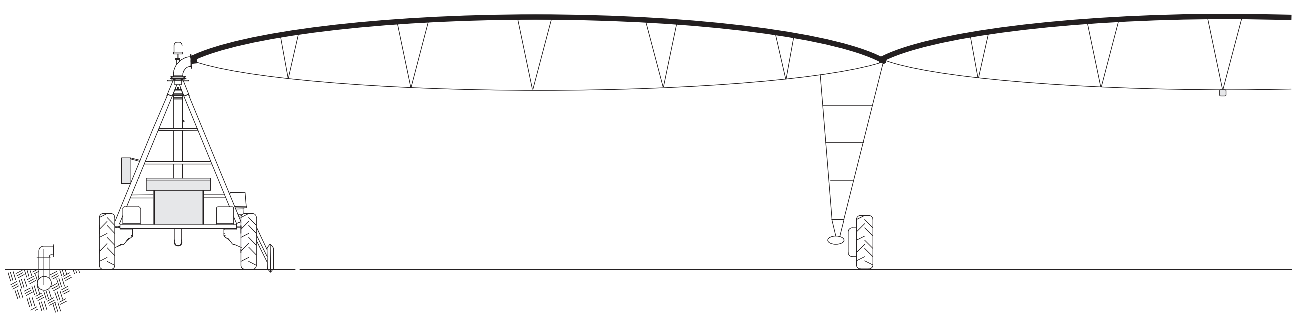
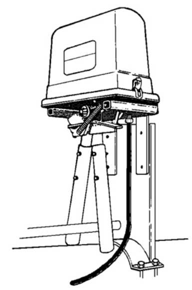


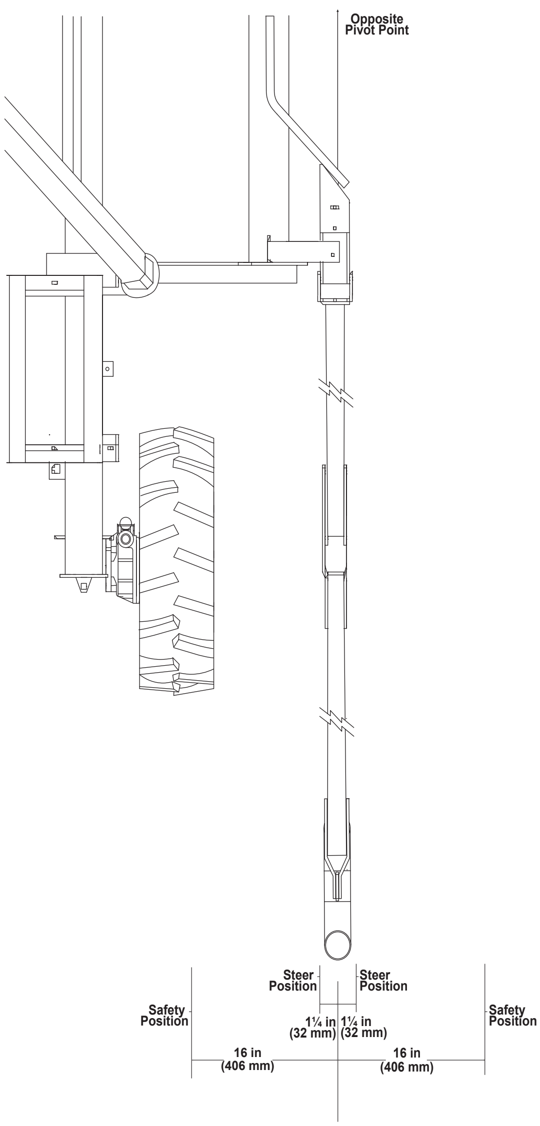
Figure 4-15-1

Universal Cable or Furrow Guidance (Continued)

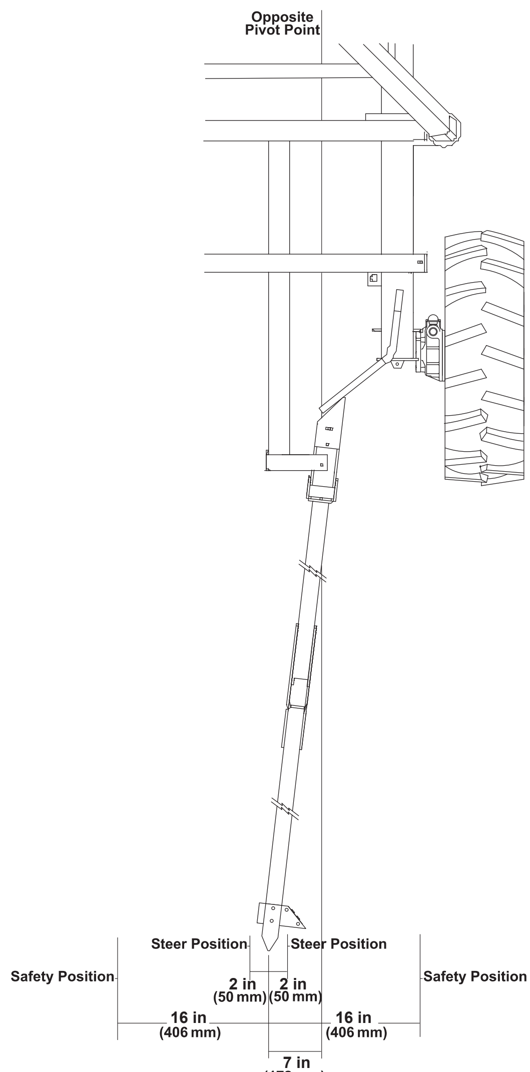
4. Set the steering switches by moving the guide wheel 1.25 in (31.75 mm) to the right of neutral. At this location adjust the corresponding steering switch so it is just depressed. Repeat the procedure by moving the guide wheel 1.25 in (31.75 mm) to the left of neutral and adjust that steering switch accordingly. After both steering switches have been set, return the guide wheel to the neutral position.
5. Final adjustment is made to the steering switch stops so the guidance box actuator arms do not bottom out of the steering switches. Do this by adjusting the stop cap screw inward two full turns beginning at the point that the steering switch is activated.
6. Repeat procedure for the other side. A distance of 12 in (304.8 mm) from guide arm pivot point to the furrow must be maintained. NEVER try to reposition the system when there are established wheel tracks. This could cause severe structural damage to the system.



Guidance Outside of Cart



Guidance Inside of Cart



Drop Spans

Model 8000, Model 8120 (6 5/8 in (168 mm) only)

Machine Spans and Profiles

1. Available on all span lengths, 6 5/8 in (168 mm) spans only.
2. Available only on standard profile spans.
3. Available on towable and non-towable machines.
4. Available with all traction options.

Machine Length

1. Allow an additional 3 feet of system length for the drop span hardware.
2. No maximum length restriction other than the standard restrictions.
3. Five (5) spans minimum length is required.

Guidance

1. All Guidance types are allowed except GPS Guidance.
2. With either Below Ground Guidance or Cart Mounted Furrow Guidance, the pulse timer box must be located on the 3rd to last drive unit. The outer 1 or 2 spans may be dropped.

Slope Capability

1. Slopes at the location where the span is dropped should be limited to 5%.
   (a) Dirt work may be required to insure the ball hitches align when picking up the dropped span.
2. No ridge crop limitations.

Machine Alignment

1. Modified alignment is the only type allowed on Universal Linears.
2. If GPS positioning is being used, the antenna cannot be located on the dropped spans. Move it to the inner part of the machine.

Machine Speed

1. With spans dropped, the end drive unit speed will no longer match the cart speed. The machine should not be run faster than 80% to avoid shutdown. The machine will steer more than normal in this configuration.

⚠ WARNING

- **LINEAR MACHINES ARE SUSCEPTIBLE TO VARIATIONS IN LOCATION RELATIVE TO THE WHEEL TRACK. THE OPERATOR SHOULD BE PRESENT WHEN THE MACHINE RETURNS TO THE POINT WHERE SPANS WERE DROPPED, TO MAKE SURE IT STOPS IN THE CORRECT LOCATION AND THAT THERE IS NO CONTACT BETWEEN SPANS.**

Drop Spans (Continued)

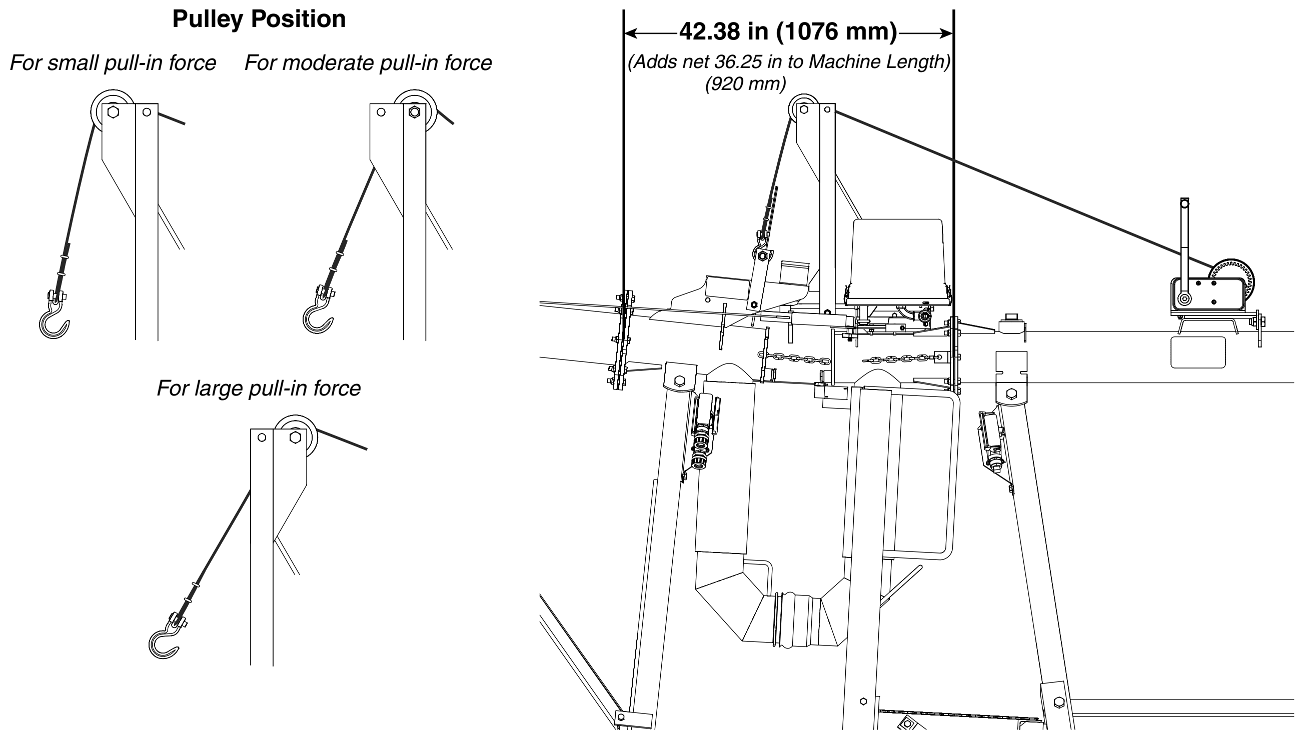


Figure 4-18-1

Drop Span Details

On machines with drop spans there are some special considerations that need to be made for proper operation both during setup by the dealer and operation by the customer.

When operating a machine with a drop span there are several different methods that can be used to reduce the time spent disconnecting/connecting the spans. Following these methods will also assist in proper management of the machine with respect to application of water. Please read and consider this section carefully.

It must also be noted that there is a possibility for an extreme increase in the mainline and cart pressure when the drop span is used on a machine without a properly functioning VSD. This is due to restricting the machines flow rate, in some cases quite significantly. Prior to ordering a drop span, it would be best to perform analysis of the effect it may have on a particular system.

Procedure to Adjust Percent Timer

The slow down timer will not be used when dropping span(s) on a linear machine. The reduction in machine flow when dropping off span(s) will result in the cart pressure increasing or staying the same if using a VFD. The slow down timer must be set to 80% in the drop span box to allow the new end tower to not run ahead of the next to last tower when running at high percent timer settings.

Drop Spans (Continued)

Sprinkler Package With Pressure Regulators

For sprinklers with pressure regulators, no adjustment to the percent timer setting is needed.

Sprinkler Package Without Pressure Regulators

For sprinklers without pressure regulators a higher percent timer setting must be calculated to apply the same application depth without the drop spans. Use Formula 1.1 to calculate the correct percent timer setting.

> ⚠ **CAUTION**
>
> - **IT IS IMPORTANT TO REMEMBER THAT THE HIGHEST PERCENT TIMER SETTING TO USE WHEN DROPPING SPAN(S) IS 80%. THIS IS DUE TO THE LAST SPAN HAVING A DIFFERENT CENTER DRIVE RPM COMPARED TO THE LAST DROP SPAN.**

Formula 1.1

For **unregulated** machines:

- $\sqrt{P2/P1} \times P_m$ (%) = Adjusted Percent Timer Setting (%).

*See Figure 1 below for a graph to help solve for $\sqrt{(P2/P1)}$.

Where:

- P1 = Cart inlet pressure when all spans are present.
- P2 = Cart inlet pressure when spans are dropped (should be greater than P1).
- P_m = Percent timer setting that the machine was set at before the spans were dropped.

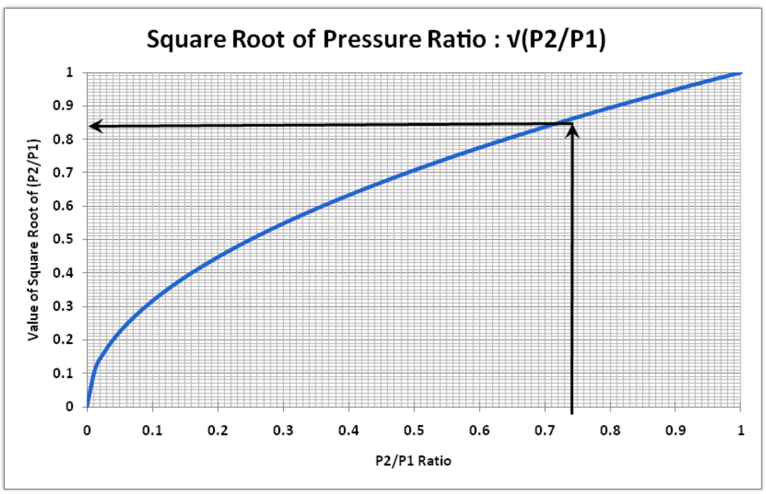


Figure 1

Graph of the square root of P2/P1. This can be used when a calculator with the square root function is not available. Divide P2 by P1, and then find that value on the x-axis. Follow that value up until you hit the curved line, then from that point go horizontally to the y-axis; this is the value of the square root of P2/P1.

Special Considerations

Special considerations are required if any of the following applies, you may wish contact Valley:

- The drop span tire size doesn't match LRDU tire size.
- You are unsure of how to select the end gun/end gun nozzle to be used on the drop span.
- If you have any other questions or concerns regarding the drop span.

There may be other special considerations that need to be accounted for, and in most cases there will be a solution. Some general solutions to allow the slowdown timer to be used (rather than having to adjust the machines percent timer) include:

- Changing the tire size on drop span or LRDU.
- Adjusting the pump.
- Changing the sprinkler package.
- Changing or adding an end gun and/or end gun nozzle on the drop span.

Conclusion

Using a drop span is an effective way to pick up additional acres in an irregular shaped field; however, special considerations need to be made in its application, operation, and setup. Utilizing the slowdown timer feature can greatly aid in proper operation in combination with one of the operation methods discussed. Care must be taken to ensure maximum mainline and/or pivot pressure doesn't get exceeded when utilizing the drop span.

Universal Hose Drag Cart % Slope Capability

5.563 in (141.3 mm) O.D. (4.491 in (114.1 mm) I.D. SDR 11 Poly Hard Hose

Hose Length	Maximum Intermediate Riser Spacing	Distance Edge Field to First Riser*	Normal Riser Spacing Mile Run**	SLOPE CAPABILITY
STANDARD DRIVE TRAIN with Tee Connection				
++351 ft (106.9 m)	622 ft (189.5 m)	311 ft (94.7 m)	582 ft (177.3 m)	2%
HEAVY DUTY DRIVE TRAIN with Tee Connection^				
++431 ft (131.3 m)	782 ft (238.3 m)	391 ft (119.1 m)	742 ft (226.1 m)	4%
• •351 ft (106.9 m) **maximum for elbow or single connection**				0%

6.625 in (168.3 mm) O.D. (5.348 in (135.8 mm) I.D. SDR 11 Poly Hard Hose

Hose Length	Maximum Intermediate Riser Spacing	Distance Edge Field to First Riser*	Normal Riser Spacing Mile Run**	SLOPE CAPABILITY
STANDARD DRIVE TRAIN with Tee Connection				
++312 ft (95.0 m)	544 ft (165.8 m)	272 ft (82.9 m)	504 ft (153.6 m)	0%
HEAVY DUTY DRIVE TRAIN with Tee Connection^				
++390 ft (118.8 m)	700 ft (213.3 m)	350 ft (106.6 m)	655 ft (199.6 m)	0%
• •312 ft (95.1 m) **maximum for elbow or single connection**				0%

++ Maximum hose length

Electric Cord Option - **Electric cord decreases hose length by 4% with the other cart design please recheck this and slope limit is different thus another parameter.**

Tire Size - If slippage becomes a problem on some soils the customer can add tubes and fluid in the tires OR additional weight on cart.

***Distance from the edge of field to first riser is 40 ft (12.1 m) less for a swing around linear.**

**** Distance is after placement of first riser.**

MAXIMUM HOSE LENGTH FOR HIGH SPEED is 312 ft (95.09 m) of 6 in (152 mm) or 390 ft (118.8 m) of 4.75 in (120.6 mm) hose.

Cord Drag Linear: Make sure you allow approximately 15 ft to 20 ft of cable for making connections. i.e. a 450 ft cable will have 430 ft of linear run. 8 AWG copper Type W "Mining cable."

Max Coil lengths: 5.563 in (141.3 mm) - 500 ft (152.4 m)
6.625 in (168.2 mm) - 500 ft (152.4 m)

^Heavy Duty Drive Train: Refers to bronze gear/steel worm version of the wheel gearboxes on the Universal cart.

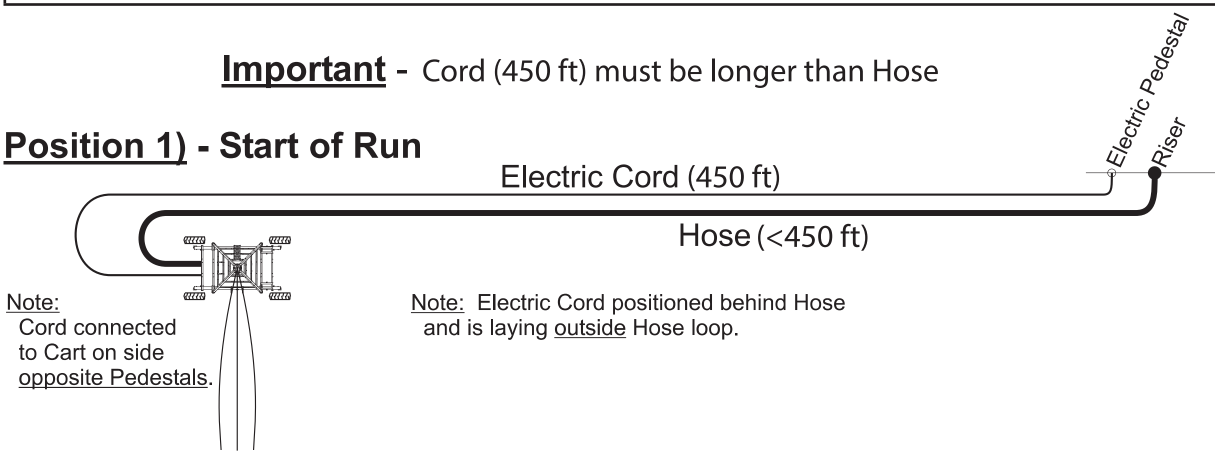
Electric Cord Hose Drag

NOTE

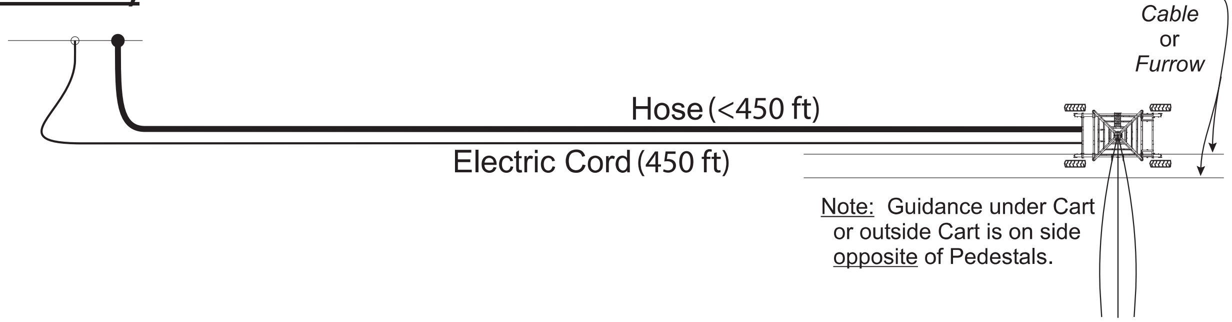
- **Make sure you allow approximately 20 ft of cable for making connections, i.e. a 450 ft cable will have 430 ft of linear run.**
- **450 ft cord will not pull 450 ft since 15 to 20 ft of cable may be required for connections on the cart this is always forgot about and a you cannot splice in the extra cable to make up for that loss.**

Important - Cord (450 ft) must be longer than Hose

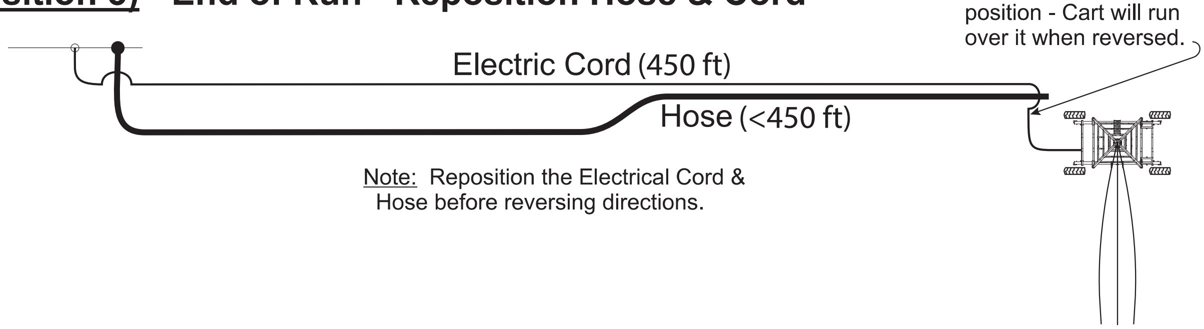
Position 1) - Start of Run



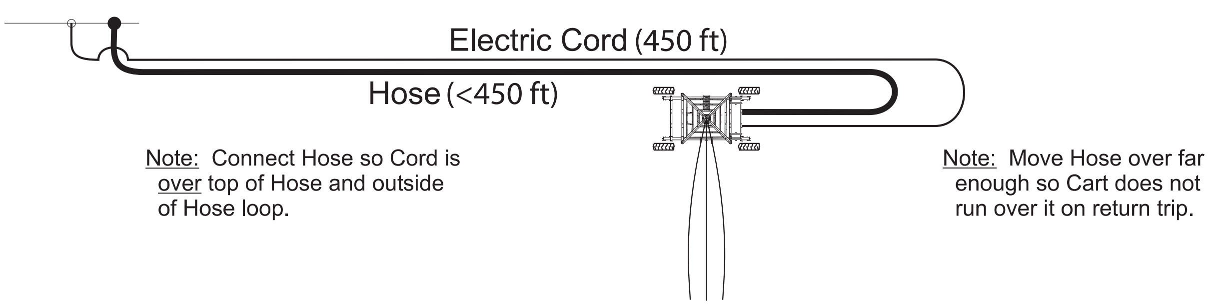
Position 2) - End of Run



Position 3) - End of Run - Reposition Hose & Cord

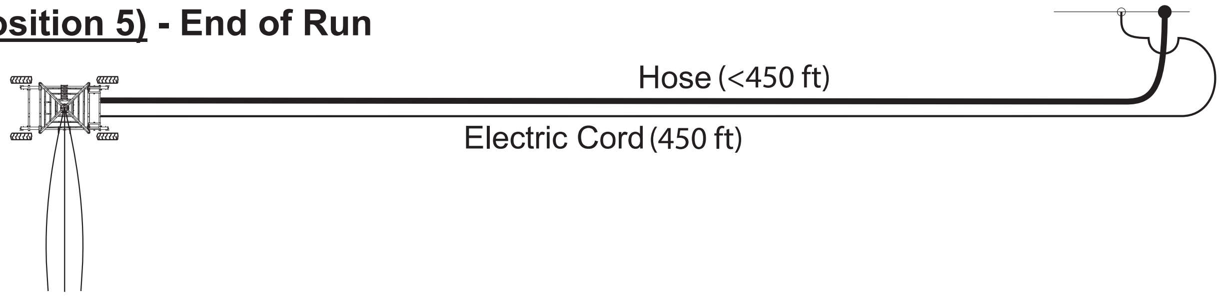


Position 4) - Reverse Direction - Hose & Cord Hook-up at Start or Run

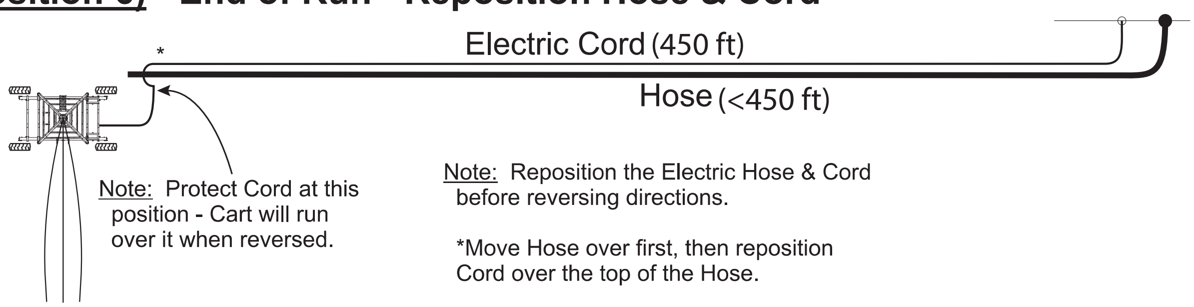


Electric Cord Hose Drag (Continued)

Position 5) - End of Run



Position 6) - End of Run - Reposition Hose & Cord



Note: Protect Cord at this position - Cart will run over it when reversed.

Note: Reposition the Electric Hose & Cord before reversing directions.

*Move Hose over first, then reposition Cord over the top of the Hose.

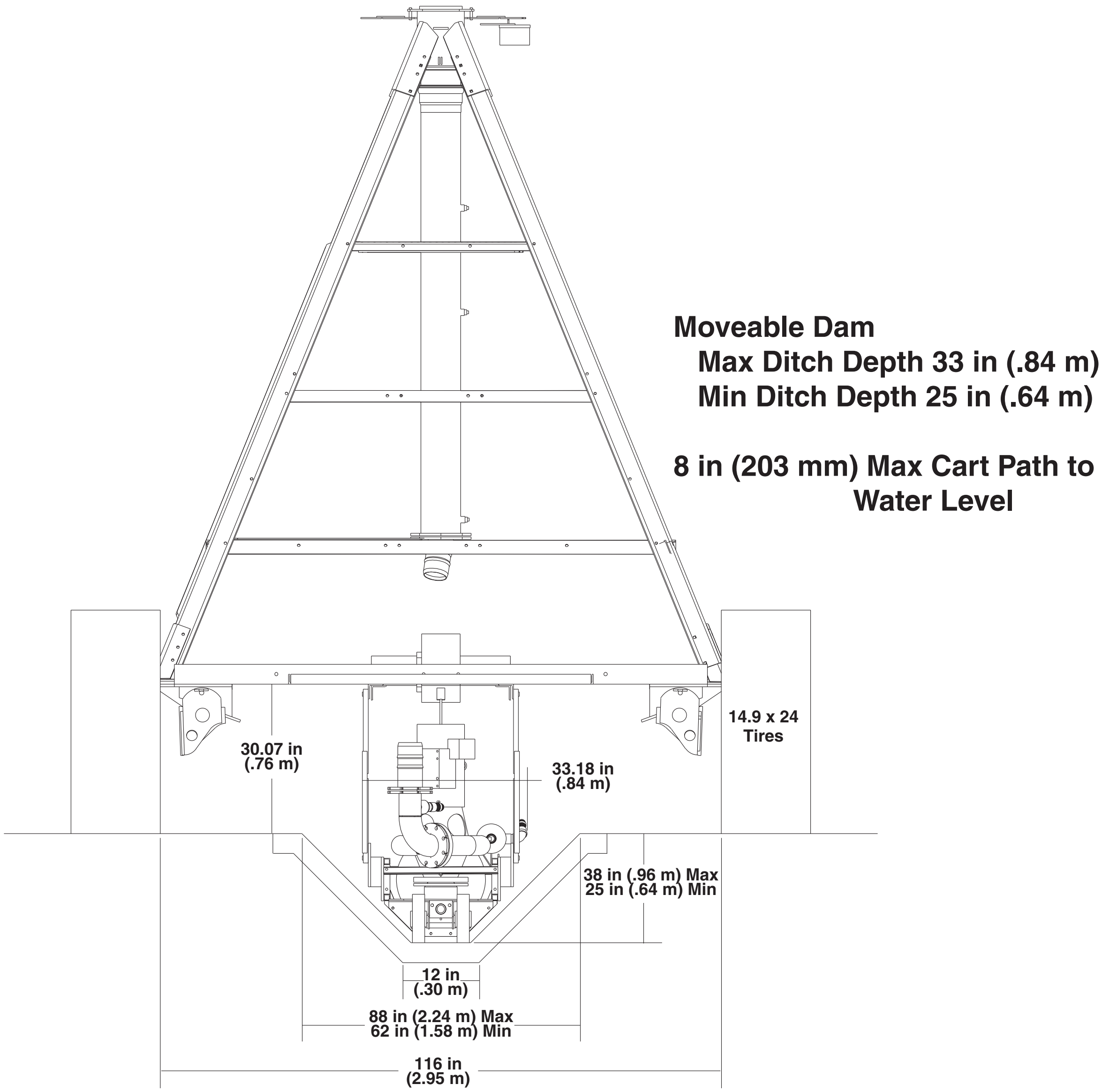
Move Hose over far enough so Cart does not run over it when reversed.

Note: Reconnect Hose as in **Position 1) - Start of Run -** Cord outside of Hose loop.

> **NOTE**
>
> - **Make sure you allow approximately 20 ft of cable for making connections, i.e. a 450 ft cable will have 430 ft of linear run.**
> - **450 ft cord will not pull 450 ft since 15 to 20 ft of cable may be required for connections on the cart this is always forgot about and a you cannot splice in the extra cable to make up for that loss.**

Specifications for Ditch Feed Universal Linear - Straddle Ditch

Water Level Must Be Up To The Pump Volute Centerline



Minimum ditch width 44 in (1.1 m) with straight sides

The Cart Path must be parallel to bottom of ditch.

General Conditions for use with Moveable Dam:

- Ditch bottom must be 12 in (304.8 mm).
- Inlet MUST be oriented for winch to be on upstream side of the cart.

The inlet linkage must be adjusted to following conditions:

1. On ditches less than 27 in (0.68 m) deep the inlet wheels are to be less than 1 in (25 mm) above the bottom surface of the ditch.
2. On ditches greater than 27 in (0.68 m) the bottom face of the pump motor must be above the level of the cart path to protect the motor in case of a ditch overflow.

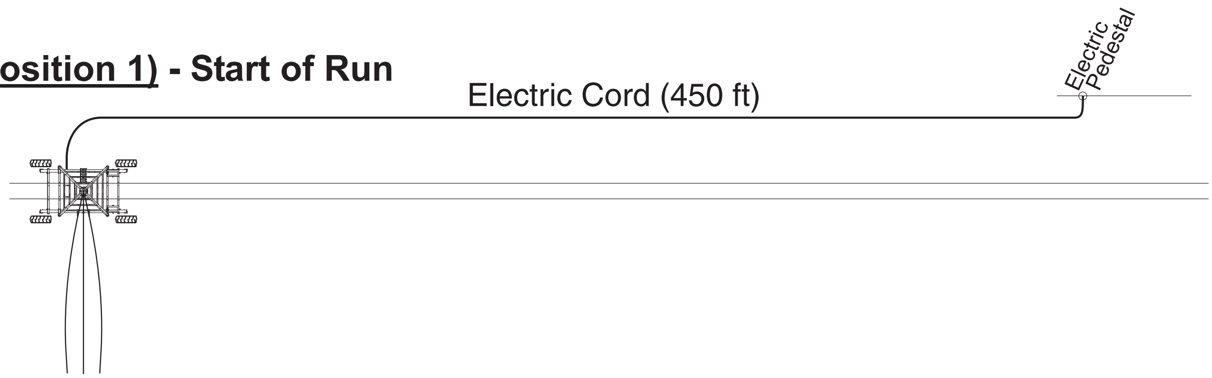
Universal Linear Design

Cord Drag Option

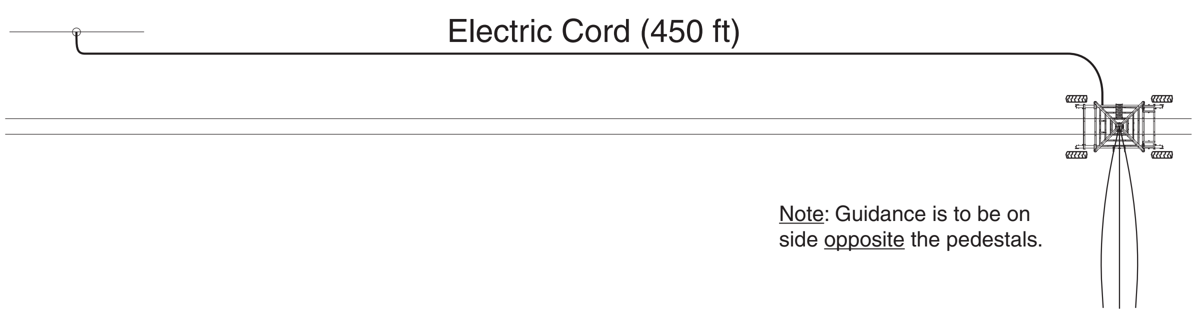
> **NOTE**
> - **Make sure you allow approximately 15 ft to 20 ft of cable for making connections, i.e. a 450 ft cable will have 430 ft of linear run. 8 AWG copper Type W "Mining cable."**

Ditch Straddle ONLY

Position 1) - Start of Run



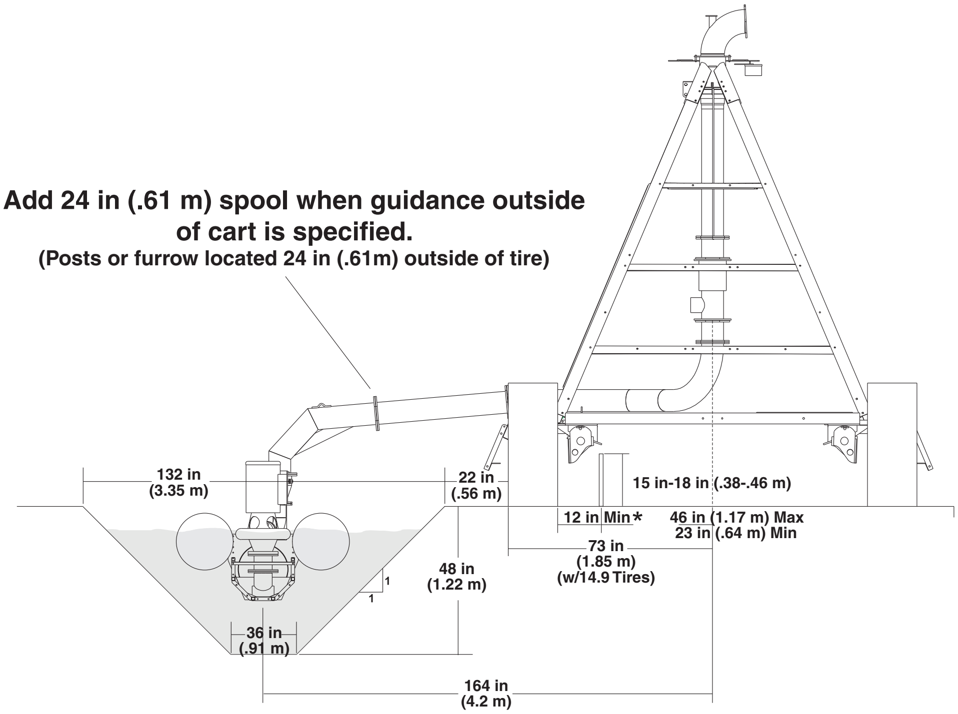
Position 2) - End of Run



Universal Floating Inlet

1:1 Side Slope

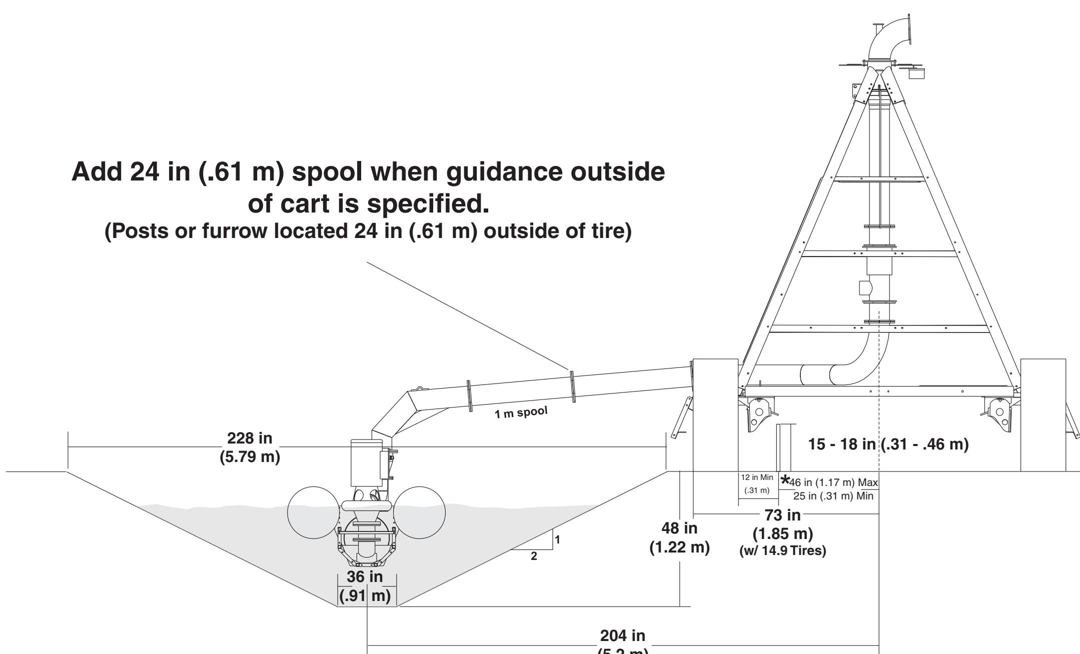
Minimum Water Depth 36 in (0.9 m)



* Dimensions also apply to furrow location.

2:1 Side Slope

Minimum Water Depth 36 in (0.9 m)



* Dimensions also apply to furrow location.

Universal Linear Design

Pump, Motor and Impeller Selection

Total Gallons Per Minute (Gpm)	Cornell 4RB Pump Performance 60 HZ Impeller Trims available (Inches)	8.00	8.50	9.00	9.50	10.00	10.50	10.75	11.38	12.75
200	Side Ditch Pressure (PSI)	21	25	29	33	37	43	49	56	73
	Straddle Ditch Pressure (PSI)	22	26	31	35	39	45	50	57	74
	Pump (Water) hp	6.0	6.8	7.7	8.8	9.9	11.1	13.0	15.0	21.5
	Pump hp available	10	15	20	20	25	25	20	25	30
	Pump Eff. (%)	55.1	54.6	54.1	53.4	52.8	52.4	55.0	52.0	50.0
300	Side Ditch Pressure (PSI)	21	25	29	33	37	45	48	55	72
	Straddle Ditch Pressure (PSI)	22	26	31	35	39	47	49	56	73
	Pump (Water) hp	7.4	8.5	9.7	10.9	12.2	14.0	15.0	17.5	24.5
	Pump hp available	10	15	20	20	25	25	20	25	30
	Pump Eff. (%)	64.4	64.4	64.3	63.8	63.1	62.2	61.5	60.0	57.0
400	Side Ditch Pressure (PSI)	20	23	28	32	37	43	47	54	72
	Straddle Ditch Pressure (PSI)	21	24	29	34	39	45	48	55	73
	Pump (Water) hp	8.5	9.7	11.1	12.5	14.1	16.0	17.0	20.0	27.0
	Pump hp available	10	15	20	20	25	25	20	25	30
	Pump Eff. (%)	72.3	72.7	73.0	72.8	72.2	71.3	70.5	68.5	64.0
500	Side Ditch Pressure (PSI)	19	22	28	31	36	41	46	53	NA
	Straddle Ditch Pressure (PSI)	20	23	29	33	38	43	47	54	NA
	Pump (Water) hp	9.5	10.9	12.4	14.1	16.1	18.3	19.0	23.0	NA
	Pump hp available	10	15	20	20	25	25	20	25	NA
	Pump Eff. (%)	75.8	76.5	77.6	77.7	77.4	76.7	76.5	75.0	NA
600	Side Ditch Pressure (PSI)	16	20	25	30	34	41	NA	52	NA
	Straddle Ditch Pressure (PSI)	17	21	26	32	36	43	NA	53	NA
	Pump (Water) hp	10.2	11.9	13.6	15.6	17.7	20.4	NA	25.0	NA
	Pump hp available	10	15	20	20	25	25	NA	25	NA
	Pump Eff. (%)	77.1	78.8	80.1	80.5	80.6	80.4	NA	78.5	NA
700	Side Ditch Pressure (PSI)	12	17	22	28	32	38	NA	NA	NA
	Straddle Ditch Pressure (PSI)	13	18	23	29	34	40	NA	NA	NA
	Pump (Water) hp	10.3	12.5	14.4	16.7	19.2	21.9	NA	NA	NA
	Pump hp available	10	15	20	20	25	25	NA	NA	NA
	Pump Eff. (%)	75.6	77.5	80.0	81.3	82.1	82.4	NA	NA	NA
800	Side Ditch Pressure (PSI)		13	19	25	29	35	NA	NA	NA
	Straddle Ditch Pressure (PSI)		14	20	26	31	37	NA	NA	NA
	Pump (Water) hp		12.6	15.1	17.6	20.2	23.4	NA	NA	NA
	Pump hp available	NA	15	20	20	25	25	NA	NA	NA
	Pump Eff. (%)		75.6	77.8	80.3	81.9	83.9	NA	NA	NA
900	Side Ditch Pressure (PSI)			14	20	26	31	NA	NA	NA
	Straddle Ditch Pressure (PSI)			15	21	27	33	NA	NA	NA
	Pump (Water) hp			15.1	18.1	20.9	24.3	NA	NA	NA
	Pump hp available	NA	NA	20	20	25	25	NA	NA	NA
	Pump Eff. (%)			75.5	77.9	80.4	83.1	NA	NA	NA

Pressure (PSI) available at the top of the cart (includes cart elevation, cart pressure losses and suction losses).
Maximum allowable suction lift (Ft) - is the distance measured from the bottom of the cart drive unit tires to water level in the ditch (all suction losses and pump elevation included).

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design.

Altitude is assumed to be sea level*
Temperature is assumed to be 90 deg. F. (32.2 deg. C.)*
* See Table 6 on page 4-28 for lift adjustments for altitude and temperature.

Self Cleaning inlets require 50 GPM @ 30 PSI. Add this amount to the total system requirement.
Pressure at the pipeline should be at least 24 PSI.

Pump, Motor and Impeller Selection (Continued)

Total Liters Per Second (Lps)	Cornell 4RB Pump Performance 50 HZ Impeller Trims available (Inches)	8.00	8.50	9.00	9.50	10.00	10.50	10.75	11.38	12.75
12.6 (200 GPM)	Side Ditch Pressure (PSI)	13	16	19	22	25	29	32	37	49
	Straddle Ditch Pressure (PSI)	14	17	20	23	26	30	33	38	50
	Pump (Water) hp	3.9	4.5	5.1	5.7	6.4	7.3	8.2	9.3	13.0
	Pump hp available	10	15	20	20	25	25	20	25	30
	Pump Eff. (%)	58.6	58.3	58.0	57.3	56.7	56.1	55.6	55.0	52.0
18.9 (300 GPM)	Side Ditch Pressure (PSI)	13	16	20	24	27	30	31	36	49
	Straddle Ditch Pressure (PSI)	14	17	21	25	28	32	32	37	50
	Pump (Water) hp	4.8	5.4	6.2	7.0	7.9	9.1	9.5	11.2	15.5
	Pump hp available	10	15	20	20	25	25	20	25	30
	Pump Eff. (%)	69.7	70.0	70.1	69.7	69.0	67.8	65.0	64.0	60.0
25.2 (400 GPM)	Side Ditch Pressure (PSI)	11	14	17	22	25	29	30	35	48
	Straddle Ditch Pressure (PSI)	12	15	18	23	26	30	31	36	49
	Pump (Water) hp	5.5	6.4	7.2	8.2	9.3	10.5	11.0	13.0	17.5
	Pump hp available	10	15	20	20	25	25	20	25	30
	Pump Eff. (%)	75.4	75.9	76.7	76.8	76.4	75.7	73.5	72.5	68.5
31.5 (500 GPM)	Side Ditch Pressure (PSI)	10	12	15	20	23	27	30	35	47
	Straddle Ditch Pressure (PSI)	10	13	16	21	24	28	31	36	48
	Pump (Water) hp	6.1	7.1	8.0	9.3	10.5	12.0	13.0	15.0	20.0
	Pump hp available	10	15	20	20	25	25	20	25	30
	Pump Eff. (%)	77.2	78.7	80.1	80.4	80.5	80.3	78.0	78.0	76.0
37.9 (600 GPM)	Side Ditch Pressure (PSI)		10	13	17	22	26	29	34	46
	Straddle Ditch Pressure (PSI)		11	14	18	23	27	30	35	47
	Pump (Water) hp		7.5	8.5	10.1	11.4	13.2	14.2	16.5	22.0
	Pump hp available	NA	15	20	20	25	25	20	25	30
	Pump Eff. (%)		77.2	79.8	81.2	82.3	82.7	81.0	81.0	79.0
44.1 (700 GPM)	Side Ditch Pressure (PSI)			10	15	19	23	26	31	45
	Straddle Ditch Pressure (PSI)			11	16	20	24	27	32	46
	Pump (Water) hp			9.0	10.6	12.2	14.1	15.0	17.5	24.0
	Pump hp available	NA	NA	20	20	25	25	20	25	30
	Pump Eff. (%)			77.0	79.9	81.4	83.8	81.5	82.8	82.5
50.4 (800 GPM)	Side Ditch Pressure (PSI)				11	15	21	22	28	43
	Straddle Ditch Pressure (PSI)				12	16	22	23	29	44
	Pump (Water) hp				10.6	12.5	14.8	15.5	18.0	26.0
	Pump hp available	NA	NA	NA	20	25	25	20	25	30
	Pump Eff. (%)				76.4	79.1	82.0	80.0	82.5	84.5
56.8 (900 GPM)	Side Ditch Pressure (PSI)					11	16	19	25	40
	Straddle Ditch Pressure (PSI)					12	17	20	26	41
	Pump (Water) hp					12.3	14.9	15.7	19.0	27.0
	Pump hp available	NA	NA	NA	NA	25	25	20	25	30
	Pump Eff. (%)					74.1	77.8	77.0	79.5	86.0

Pressure (PSI) available at the top of the cart (includes cart elevation, cart pressure losses and suction losses).
Maximum allowable suction lift (Ft) - is the distance measured from the bottom of the cart drive unit tires to water level in the ditch (all suction losses and pump elevation included).

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design.

Altitude is assumed to be sea level*
Temperature is assumed to be 90 deg. F. (32.2 deg. C.)*
* See Table 6 on page 4-28 for lift adjustments for altitude and temperature.

Self Cleaning inlets require 50 GPM @ 30 PSI. Add this amount to the total system requirement.
Pressure at the pipeline should be at least 24 PSI.

Pump, Motor and Impeller Selection (Continued)

1. Suction lift capabilities:
   (a) The field suction lift capability must be adjusted for altitude and temperature.
   (b) If a flow meter is going to be used on the suction side of the pump, increase the field suction lift by one foot (305 mm).
   (c) Add the value obtained from Table 6 for the appropriate altitude and temperature adjustment to the field suction lift value.

Table 6

ELEVATION - FEET								
TEMP. F	**SEA LEVEL**	**1000**	**2000**	**3000**	**4000**	**5000**	**6000**	**7000**
70	0.77	-0.43	-1.61	-2.75	-3.85	-4.93	-5.96	-6.97
80	0.44	-0.76	-1.94	-3.08	-4.18	-5.26	-6.29	-7.30
90	0.00	-1.20	-2.38	-3.52	-4.62	-5.70	-6.73	-7.74
100	-0.58	-1.78	-2.96	-4.10	-5.20	-6.28	-7.31	-8.32
120	-2.29	-3.50	-4.67	-5.82	-6.92	-7.99	-9.02	-10.03

ELEVATION - METERS								
TEMP. C	**SEA LEVEL**	**304**	**609**	**914**	**1219**	**1523**	**1828**	**2133**
21	0.23	-0.13	-0.49	-0.84	-1.17	-1.50	-1.82	-2.12
26	0.13	-0.23	-0.59	-0.94	-1.27	-1.60	-1.92	-2.22
32	0.00	-0.37	-0.73	-1.07	-1.41	-1.74	-2.05	-2.36
37	-0.18	-0.54	-0.90	-1.25	-1.58	-1.91	-2.23	-2.54
48	-0.70	-1.07	-1.42	-1.77	-2.11	-2.44	-2.75	-3.06

   (d) Check the pump suction lift against the adjusted field requirement to see if adequate lift is available for the particular field situation.
   (e) If suction lift is not adequate:
      (i) Examine other pump charts for greater suction lift capability at same flow.
      (ii) Consider decreasing distance from minimum water level to the surface the cart tower runs on.
      (iii) Select different management method to reduce flow requirements.
      (iv) Reduce irrigated acreage to reduce flow requirement.
      (v) Redesign system to reduce pressure requirements, and maintain the same flow (applicable only on certain pumps).
2. The pressure loss through the system cart is shown in the Pump tables on page 4-26.
3. The friction loss in the inlet and Net Positive Suction Head Requirements (NPSHR) per the pumps are shown and included in the Pump Tables on page 4-26.

2 Wheel Linear Design

Design Guidelines

5 inch and 6 5/8 inch Model 8000 and Model 8120 - End Feed/Swing Around

Machine, Spans and Profiles

1. Low profile:
   (a) Available with all spans.
   (b) Carts available as standard profile ONLY.
2. 2-Wheel Cart is available as end feed only.
3. 2-Wheel Cart is available for single or multiple span machines as:
   (a) Non-swing around, non-towable.
   (b) Swing around, non-towable.
   (c) Swing around, towable.
   (d) Non-swing around, towable.
4. Model 8000 2-Wheel Cart is default in SOC with 2 center drive motors and standard duty gearboxes.
5. Model 8120 2-Wheel Cart is default in SOC with 1 center drive motor and standard duty gearboxes. Dual center drives are available and HD gearboxes which are preferred option.
6. 14.9 x 24 or 16.9 x 24 new tires **MUST** be used on cart the LRDU cart and last drive must match in RPM/speed and tire size.
7. **In all cases, the free-standing span should be located in the middle of the machine. Use the Reverse Tow package for towing multi-span machine / optional inlet when reversing.**

Machine Length (8120 and 8000)

1. Maximum number of spans/length:
   (a) Below ground guidance **– 8 spans**.
   (b) Furrow guidance **– 1600 ft (487 m)**.
   (c) Non swing around, non tow **– 8 spans**.
   (d) Swing around **– 8 spans**.
   (e) Towable **– 8 spans**.

Base Beams (Cart)

1. 2-Wheel Linear cart available with:
   (a) Non-tow base beams for non-swing, non-towable machines.
   (b) Towable basebeams for swing around, non-towable machines.
   (c) Towable basebeams and hitch for swing around, towable machines.
   (d) Available as an additional inlet for the last regular drive unit.

Electrical

1. Maximum control panel voltage 505 volts, 60 Hz. (400 volts, 50 Hz.)
2. Minimum voltage at the last drive unit 440 volts, 60 Hz. (350 volts, 50 Hz.)
3. Maximum machine current 30 amps.
4. One second time delay - This is used on any span that shows the tendency to rapidly start and stop. This delay is furnished with all machines with high-speed motors.
5. Induced voltage package consists of a relay and high current heater installed in control panel. This is used whenever any one second time delay units are used in order to insure there is no induced voltage on the opposite run wire.

Guidance

(See machine length for limitations.)

1. Furrow guidance – Available on all 2 Wheel linears cart mounted.
   (a) Furrow must not vary more than two (2) inches (50 mm) from straight.
   (b) The "V" shaped furrow must be 4 to 6 inches (100 to 150 mm) deep.
2. Below ground guidance - The below ground guidance wire must be trenched in rather than plowed in. Straightness of the wire is very important for proper machine operation. Refer to the guidance selection section, in this manual, for special consideration concerning wire burial. End of field wire burial must be installed with "tear drop" section. See the Linear Service Manual for more details.
3. GPS guidance - Available on all 2 wheel linears except swing around carts or towable carts.
   (a) Requires RTK Reference Station within 6 miles (154 km) of the machine.

Alignment

1. Modified alignment - Used on all 2 Wheel Linears 5 spans or less.
2. Full floating alignment - Required on all 2 Wheel Linears 6 spans or more.

Cart Inlets

1. Swivel Hose Inlet.
2. Ditch Feed Inlet.

Design Guidelines (Continued)

Wheel Tracks

1. Wheel tracks affect the linear machine's ability to steer.
2. Ensure correct tire pressure to reduce the possibility of deep wheel tracks.
3. Depth Requirements:
   (a) Regular drive unit must not exceed 4 inches (101 mm).
   (b) Single span swing around drive unit must not exceed 2 in (50 mm).
   (c) Do not allow wheel tracks at the cart.
4. Please inform the customer that they are responsible for maintaining wheel track depth to a maximum of 2 in - 4 in (50 - 100 mm). Track fillers, tillers, small discs, drive unit boombacks, part circle sprinklers or floatation tires can be used to control the depth of wheel tracks.

   Special care must be taken when starting the swing around linear in pivot operation as drive units start out of linear tracks. Because of this, wheel tracks must be maintained to a maximum depth of 2 in (50 mm) for the swing around linear.
5. Wheel track establishment - On a new machine, the first pass should be made with the machine running dry at 100% timer setting. The return pass should be made while applying water at 100%.
6. On a machine operating in existing tracks which have become too deep, perform the following:
   (a) Disc the tracks down.
   (b) Run the machine dry over the soil at 100% timer setting. Make the return pass applying water at 100%.
   (c) If any portion of the previous track remains, disc the track again and re-establish the track. Repeat this procedure until the machine is operating on a flat level track.
   (d) Typically, linear machines need larger tires on heavy soils to minimize wheel track depth.
   (e) If berms are built, a wide-flat, compacted area of 3 ft (1 m) is recommended to prevent wheel tracks.

Motor/Tire Combination

1. The motor-tire combination must maintain a minimum 25% increased differential ground speed on intermediate drive units compared to end and cart drive units.

Tire Loading

1. Side walls of tires will deteriorate more rapidly when loaded excessively, especially in hot climates.

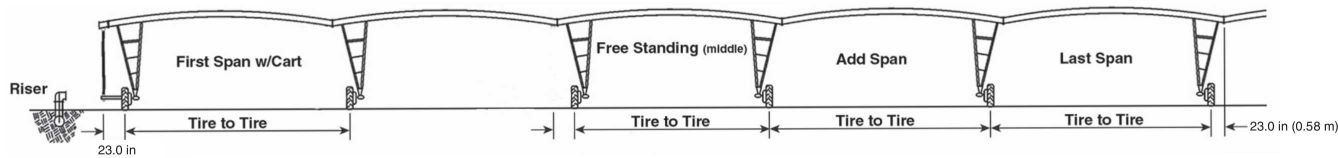
Cord Drag Linear

1. Make sure you allow approximately 15 to 20 ft of cable for making connections, i.e. a 450 ft cable will have 430 ft of linear run. 8 AWG copper Type W “Mining Cable”.

2 Wheel Linear Design

System Span Lengths - Span Layout and Tower Location Chart

System Span Lengths
Span Layout and Tower Location Chart (2 Wheel Cart)



All tire to tire dimensions are for 14.9 x 24 tires

Pipe Diameter		Free Standing w/Cart or Free Standing (middle)			Add Span		Outlet Spacing					Overhang		First Span w/Cart or Last Span	
		Tire to Tire			Ball to Ball or Tire to Tire									Flange to Ball	
in	(mm)	ft		(m)	ft	(m)	108 in	30 in	90 in	287 cm	190 cm	ft	(m)	ft	(m)
MODEL 8000															
6-5/8	168	110.8	+	33.77	115.1	35.08						6 5/8 in overhang		114.8	34.99
6-5/8	168	130.9	+	39.89	135.2	41.20						9	2.74	134.9	41.11
6-5/8	168	135.7	+	41.36	140.0	42.67						18	5.48	139.7	42.58
6-5/8	168	155.7	+	47.45	160.0	48.76						27	8.22	159.7	48.67
6-5/8	168	175.7	+	53.55	180.0	54.86						36	10.97	179.7	54.77
6-5/8	168	180.5	+	55.01	184.8	56.32						45	13.71	184.5	56.23
6-5/8	168	182.4	+	55.59	-186.7	56.90						54	16.45	186.4	56.81
***6-5/8	168	200.6	+	61.14	204.9	62.45						64	19.50	204.6	62.36
***6-5/8	168	220.7	+	67.27	225	68.58						73	22.25	220.4	67.18
												82	24.99		
MODEL 8120															
6-5/8	168	119.1	++	36.30	123.4	37.61						same as above		123.1	37.52
6-5/8	168	138.0	+	42.06	142.3	43.37						6 5/8" overhang		142.0	43.28
6-5/8	168	156.9	+	47.82	161.2	49.13								160.9	49.04
6-5/8	168	175.7	+	53.55	180.0	54.86								179.7	54.77
***6-5/8	168	194.6	+	59.31	198.9	60.62								198.6	60.53
												4 in Overhang			
5	127	138.0		42.06	142.3	43.37						19.2	5.85	142.0	43.28
5	127	156.9		47.82	161.2	49.13						28.5	8.69	160.9	49.04
5	127	175.7		53.55	180.0	54.86						37.2	11.34	179.7	54.77
5	127	194.6		59.31	198.9	60.62						55.9	17.04	199.2	60.72
												74.0	22.55		

+ Available as Poly Span
++ Available as Poly Span Only
x Outlet spacing available
*** Single Span Only

Drop Spans

Model 8000, Model 8120 (6 5/8 in (168 mm) only)

Machine Spans and Profiles

1. Available on all span lengths, 6 5/8 in (168 mm) spans only.
2. Available only on standard profile spans.
3. Available on towable and non-towable machines.
4. Available with all traction options.

Machine Length

1. Allow an additional 3 feet of system length for the drop span hardware.
2. No maximum length restriction other than the standard restrictions.
3. Five (5) spans minimum length is required.

Guidance

1. All Guidance types are allowed except GPS Guidance. GPS guidance is not allowed with drop spans.
2. Below Ground Guidance - The pulse timer box is located on the outer end of the free-standing span. Multiple spans may be dropped as long as 1 span is left outside of the free-standing span.
3. Cart Mounted Guidance – The pulse timer box is located on the 3rd tower from the end. The outer 1 or 2 spans may be dropped if 1 span is left outside of the free-standing span.

Slope Capability

1. Slopes at the location where the span is dropped should be limited to 5%.
   (a) Dirt work may be required to insure the ball hitches align when picking up the dropped span.
2. No ridge crop limitations.

Machine Alignment

1. Machines longer than 6 spans are required to have full-floating alignment. The full-floating alignment will be discontinued 1 drive unit prior to the drop span drive unit, and will be continued 1 drive unit beyond the drop span drive unit. Drop spans are also allowed on 5 span machines with modified alignment.
2. If GPS positioning is being used, the antenna can not be located on the dropped spans. Move it to the inner part of the machine.
3. If only one span is being dropped with full-floating alignment, there will be left over alignment components.

Machine Speed

1. With spans dropped, the end drive unit speed will no longer match the cart speed. The machine should not be run faster than 80% to avoid shutdown. The machine will steer more than normal in this configuration.

⚠ WARNING

- **LINEAR MACHINES ARE SUSCEPTIBLE TO VARIATIONS IN LOCATION RELATIVE TO THE WHEEL TRACK. THE OPERATOR SHOULD BE PRESENT WHEN THE MACHINE RETURNS TO THE POINT WHERE SPANS WERE DROPPED, TO MAKE SURE IT STOPS IN THE CORRECT LOCATION AND THAT THERE IS NO CONTACT BETWEEN SPANS.**

2 Wheel Linear Design

Drop Spans (Continued)

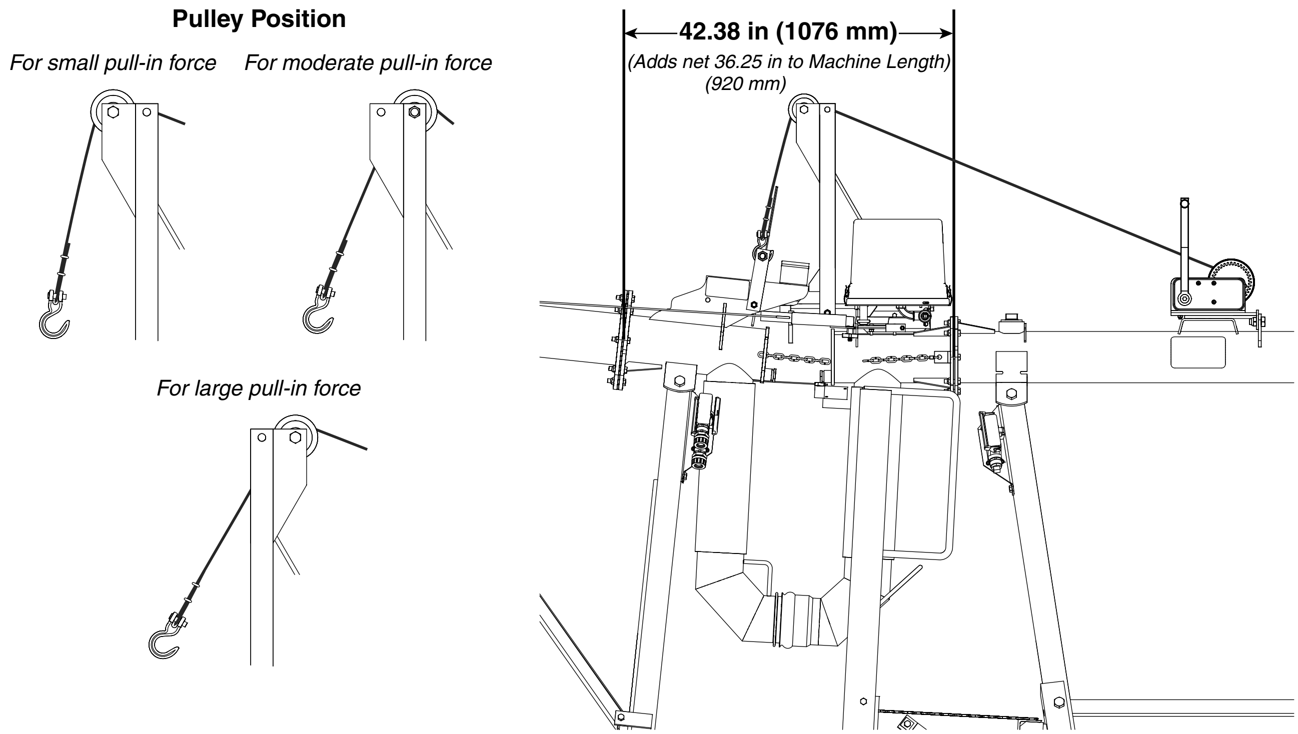


Figure 5-6-1

Drop Span Details

On machines with drop spans there are some special considerations that need to be made for proper operation both during setup by the dealer and operation by the customer.

When operating a machine with a drop span there are several different methods that can be used to reduce the time spent disconnecting/connecting the spans. Following these methods will also assist in proper management of the machine with respect to application of water. Please read and consider this section carefully.

It must also be noted that there is a possibility for an extreme increase in the mainline and cart pressure when the drop span is used on a machine without a properly functioning VSD. This is due to restricting the machines flow rate, in some cases quite significantly. Prior to ordering a drop span, it would be best to perform analysis of the effect it may have on a particular system.

Procedure to Adjust Percent Timer

The slow down timer will not be used when dropping span(s) on a linear machine. The reduction in machine flow when dropping off span(s) will result in the cart pressure increasing or staying the same if using a VFD. The slow down timer must be set to 80% in the drop span box to allow the new end tower to not run ahead of the next to last tower when running at high percent timer settings.

Drop Spans (Continued)

Sprinkler Package With Pressure Regulators

For sprinklers with pressure regulators, no adjustment to the percent timer setting is needed.

Sprinkler Package Without Pressure Regulators

For sprinklers without pressure regulators a higher percent timer setting must be calculated to apply the same application depth without the drop spans. Use Formula 1.1 to calculate the correct percent timer setting.

> ⚠ **CAUTION**
>
> **•IT IS IMPORTANT TO REMEMBER THAT THE HIGHEST PERCENT TIMER SETTING TO USE WHEN DROPPING SPAN(S) IS 80%. THIS IS DUE TO THE LAST SPAN HAVING A DIFFERENT CENTER DRIVE RPM COMPARED TO THE LAST DROP SPAN.**

Formula 1.1

For **unregulated** machines:

- √P2/P1 x Pm (%) = Adjusted Percent Timer Setting (%).

*See Figure 1 below for a graph to help solve for √(P2/P1).

Where:

- P1 = Cart inlet pressure when all spans are present.
- P2 = Cart inlet pressure when spans are dropped (should be greater than P1).
- P_m = Percent timer setting that the machine was set at before the spans were dropped.

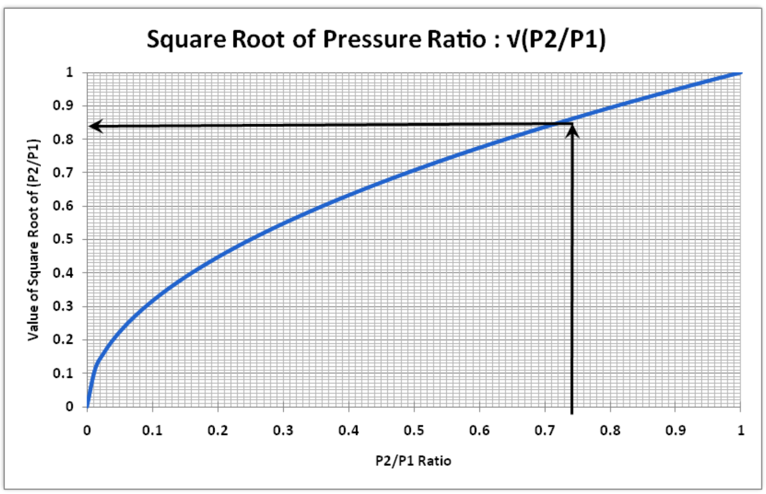


Figure 1

Graph of the square root of P2/P1. This can be used when a calculator with the square root function is not available. Divide P2 by P1, and then find that value on the x-axis. Follow that value up until you hit the curved line, then from that point go horizontally to the y-axis; this is the value of the square root of P2/P1.

Special Considerations

Special considerations are required if any of the following applies, you may wish contact Valley:

- The drop span tire size doesn't match LRDU tire size.
- You are unsure of how to select the end gun/end gun nozzle to be used on the drop span.
- If you have any other questions or concerns regarding the drop span.

There may be other special considerations that need to be accounted for, and in most cases there will be a solution. Some general solutions to allow the slowdown timer to be used (rather than having to adjust the machines percent timer) include:

- Changing the tire size on drop span or LRDU.
- Adjusting the pump.
- Changing the sprinkler package.
- Changing or adding an end gun and/or end gun nozzle on the drop span.

Conclusion

Using a drop span is an effective way to pick up additional acres in an irregular shaped field; however, special considerations need to be made in its application, operation, and setup. Utilizing the slowdown timer feature can greatly aid in proper operation in combination with one of the operation methods discussed. Care must be taken to ensure maximum mainline and/or pivot pressure doesn't get exceeded when utilizing the drop span.

2 Wheel Linear Design

Two Wheel Linear System Amperage

Standard Speed 34 RPM Helical on Ends and 43 RPM Helical for Intermediate Towers

No. Spans	1 Motor on 1 end (Amps)	Rec'd Gen. (kW)	2 Motors on 1 End (Amps)	Rec'd Gen. (kW)	2 Motors on 2 Ends (Amps)	Rec'd Gen. (kW)	2 Motors on 1 End w/1 Booster Pump (2 hp) (Amps)	Rec'd Gen. (kW)	2 Motors on 2 Ends w/1 Booster Pump (2 hp) (Amps)	Rec'd Gen. (kW)	2 Motors on 1 End w/2 Booster Pumps (2 hp) (Amps)	Rec'd Gen. (kW)	2 Motors on 2 Ends w/2 Booster Pumps (2 hp) (Amps)	Rec'd Gen. (kW)
1	2.59	5	3.80	5	5.01	7.5	8.63	7.5	9.84	10	13.03	12	14.24	12
2	3.61	5	4.82	7.5	6.03	7.5	9.67	10	10.88	12	14.07	12	15.28	15
3	4.65	7.5	5.86	7.5	7.07	10	10.72	10	11.93	12	15.12	15	16.33	15
4	5.69	7.5	6.90	10	8.11	10	11.76	12	12.97	15	16.16	15	17.37	20
5	6.74	7.5	7.95	10	9.16	12	12.80	15	14.01	15	17.20	15	18.41	20
6	7.78	10	8.99	10	10.20	12	13.85	15	15.06	15	18.25	20	19.46	20
7	8.82	10	10.03	12	11.24	15	14.89	15	16.10	20	19.29	20	20.50	20
8	9.87	12	11.08	15	12.29	15	15.94	20	17.15	20	20.34	20	21.55	20

High Speed 56 RPM Worms on Ends and 68 RPM Helicals for Intermediate Towers

No. Spans	2 Motors on 1 End (Amps)	Rec'd Gen. (kW)	2 Motors on 2 Ends (Amps)	Rec'd Gen. (kW)	2 Motors on 1 End w/1 Booster Pump (2 hp) (Amps)	Rec'd Gen. (kW)	2 Motors on 2 Ends w/1 Booster Pump (2 hp) (Amps)	Rec'd Gen. (kW)	2 Motors on 1 End w/2 Booster Pumps (2 hp) (Amps)	Rec'd Gen. (kW)	2 Motors on 2 Ends w/2 Booster Pumps (2 hp) (Amps)	Rec'd Gen. (kW)
Helical 1	6.21	7.5	8.19	10	10.94	10	12.92	12	15.34	12	17.32	15
Worm 1	8.80	7.5	11.60	10	13.42	12	16.22	12	17.82	12	20.62	15
2	10.43	7.5	13.23	10	15.05	15	17.85	15	19.45	15	22.25	20
3	12.06	10	14.86	12	16.68	15	19.48	15	21.08	15	23.88	20
4	13.69	12	16.49	15	18.31	20	21.11	20	22.71	20	25.51	20
5	15.32	12	18.12	15	19.94	20	22.74	20	24.34	20	27.14	20
6	16.95	15	19.76	20	21.57	20	24.37	20	25.97	20	28.77	25
7	18.58	20	21.39	20	23.20	20	26.00	25	27.60	25	N/A	N/A
8	20.21	20	23.02	20	24.83	20	27.63	25	29.23	25	N/A	N/A

Single Tower High Speed may be either Helical (68 RPM) or Worm (56 RPM)

Lima Generator Efficiency and Amps

Size	5 kW	7.5 kW	10 kW	12 kW	15 kW	20 kW	25 kW	30 kW	40 kW
Efficiency	0.809	0.826	0.837	0.847	0.872	0.868	0.876	0.884	0.884
Max. amps	8A	11A	15A	18A	23A	30A	38A	45A	60A

Amp draw additions for various standard speed options.
Change hose drag cart motor to 1-1/2 hp, add 1.6 amps.
Add ANY ancillary equipment amp draw to load requirements shown in tables.

Recommended Maximum Poly-Pipe Lengths

Model 8120 and 8000

Recommended Maximum Poly-Pipe Lengths
Cart Equipped with 14.9 x 24 Tires

Cart Drive		Recommended MAXIMUM Poly-Pipe Lengths, ft (m) Poly Pipe Size, inches (mm)		
Center Drive	Gear Box	4.5 in (114.3 mm) SDR 13.5	5.563 in (141.3 mm) SDR 11	6.625 in (168.2 mm) SDR 11
One Center Drive Motor Standard or High Speed	Standard	585 ft (178 m)	390 ft (118.8 m)	N/A
	Heavy Duty*	897 ft (273 m)	585 ft (178.3 m)	390 ft (118 m)
Two Center Drive Motors Standard or High Speed	Standard	624 ft (190 m)	429 ft (130.7 m)	312 ft (95 m)
	Heavy Duty*	975 ft (297.1 m)	624 ft (190.1 m)	468 ft (142 m)

Poly Pipe Dimensions

4.50 in (114.3 mm) O.D. x 3.793 in (97 mm) I.D. (SDR 13.5)

5.563 in (141.3 mm) O.D. x 4.491 in (114 mm) I.D. (SDR 11)

6.625 in (168.2 mm) O.D. x 5.420 in (137 mm) I.D. (SDR 11)

5.375 in (136.5 mm) and 6.625 in (168.2 mm) are available in lengths of 39 ft (11.8 m)

Maximum coil sizes available:

1000 ft (304.8 m) of 4.50 in (114.3 mm)

500 ft (152.4 m) of 5.563 in (141.3 mm)

500 ft (152.4 m) of 6.625 in (168.2 mm)

1. 16.9 x 24 tires increase traction, but decrease the motor's pulling capability by 4% compared to 14.9 x 24 tires.
2. Weight may be added to the cart to increase traction on heavy soils.
3. The above maximum hose lengths are at 0% slope. Hose lengths must be REDUCED by 2% for each 1% of slope climbed.
4. For cord drags, decrease the maximum allowable hose length by 4%.
5. Your actual hose pulling capability will depend on your local soil and field characteristics and may be less than or greater than the published values.
6. Pulling excessive hose lengths may lead to overheated motors and/or reduced gear life on center drive and/or wheel drive gearboxes.
7. Cord drag linear: Make sure you allow approximately 15 ft (4.5 m) to 20 ft (6.0 m) of cable for making connections, i.e. a 450 ft (137.1 m) cable will have 430 ft (131.0 m) of linear run. 8 AWG copper Type W "Mining cable."

NOTE

•Recommended using wheel gearbox shims (PN 9363166) to improve traction.

*Heavy Duty refers to bronze gear/steel worm version of the wheel gearboxes.

Poly-Pipe Pressure Losses

Poly-Pipe Pressure Losses
Loss in PSI

		3 inch Poly-Pipe ID = 3.088 in OD = 3.50 in Max. Length 950 ft (290 m)				4 inch Poly-Pipe ID = 3.793 in OD = 4.5 in Max. Length 750 ft (229 m)			4 3/4 inch Poly-Pipe ID = 4.705 in OD = 5.375 in Max Length 507 ft (154 m) - 13 pieces					6 inch Poly-Pipe ID = 5.348 in OD = 6.625 in Max Length 351 ft (106 m)-9 pieces		
GPM	LPS	PSI loss per foot	550 ft (167 m)	750 ft (228 m)	950 ft (389 m)	PSI loss per foot	450 ft (137 m)	750 ft (228 m)	PSI loss per foot	390 ft (118 m)	429 ft (130 m)	468 ft (142 m)	507 ft (154 m)	PSI loss per foot	312 ft (95 m)	351 ft (106 m)
100	6.3	0.0089	4.9	6.7	8.5	0.0026	1.2	2.0	0.0015	0.6	0.6	0.7	0.8	0.0005	0.2	0.2
200	12.6	0.0319	17.5	23.9	30.3	0.0094	4.2	7.1	0.0054	2.1	2.3	2.5	2.7	0.0019	0.6	0.7
300	18.9	0.0676	37.2	50.7	64.2	0.0199	9.0	14.9	0.0114	4.4	4.9	5.3	5.8	0.0041	1.3	1.4
400	25.2	0.1152	63.4	86.4	109.4	0.0339	15.3	25.4	0.0193	7.5	8.3	9.0	9.8	0.0070	2.2	2.5
500	31.5	0.1740	95.7	130.5		0.0513	23.1	38.5	0.0292	11.4	12.5	13.7	14.8	0.0106	3.3	3.7
600	37.8	0.2438	134.1			0.0718	32.3	53.9	0.0409	16.0	17.5	19.1	20.7	0.0148	4.6	5.2
700	44.2	0.3243				0.0955	43.0	71.6	0.0545	21.3	23.4	25.5	27.6	0.0197	6.1	6.9
800	50.5					0.1223	55.0	91.7	0.0697	27.2	29.9	32.6	35.3	0.0252	7.9	8.8
900	56.8					0.1521	68.4	114.1	0.0867	33.8	37.2	40.6	44.0	0.0314	9.8	11.0
1000	63.1					0.1848	83.2		0.1053	41.1	45.2	49.3	53.4	0.0381	11.9	13.4
1100	69.4					0.2204	99.2		0.1257	49.0	53.9	58.8	63.7	0.0455	14.2	16.0
1200	75.7					0.2589	116.5		0.1478	57.6	63.4	69.2	74.9	0.0534	16.7	18.7

Cart Pressure Loss
Including Standard Profile Cart Elevation of 12 ft (3.66 m)

Model 8120 or 8000 6 in Inlet		
GPM	LPS	PSI
100	6.3	5.33
200	12.6	5.47
300	18.9	5.59
400	25.2	5.79
500	31.5	6.02
600	37.8	6.37
700	44.2	6.75
800	50.5	7.05
900	56.8	7.48
1000	63.1	7.87
1100	69.4	8.40
1200	75.7	9.13

2 Wheel Swing Around Hose Drag Linear

There are two possible swing-around methods for the machine. The method used will depend on the length of the machine and the amount of accuracy and repeatability needed.

Method #1

Swing both tires to tow position and leave tow pin engaged on one of the cart wheels. Machine will pivot around the center of the fixed wheel.

This method is the simplest and requires no anchor and/or extra hardware on the cart. It can be used for single spans or where accurate tracking is not required.

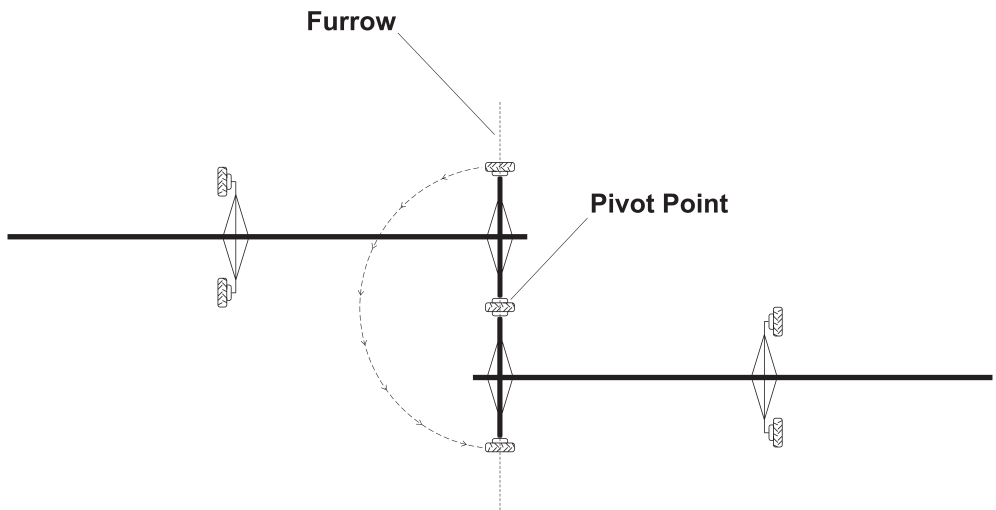


Figure 5-11-1

Method #2

Bury a concrete anchor in the field (in the furrow) with a chain buried in the concrete (see Figure 5-11-2) and extending 8 in to 10 in out of the concrete. Tie the machine to the anchor with a load binder attached to a short chain on the drive unit (see Figure 5-11-1). The machine will pivot around the center of the base beam.

This method is recommended for multiple span machines up to 6 spans. It will provide a more secure anchor point for insuring that the base beam remains over the furrow and that the other drive units follow the same track every time. For machines that are pivoted around multiple times per season and "track on track" operation is important, the 4-wheel swing-around cart should be used.

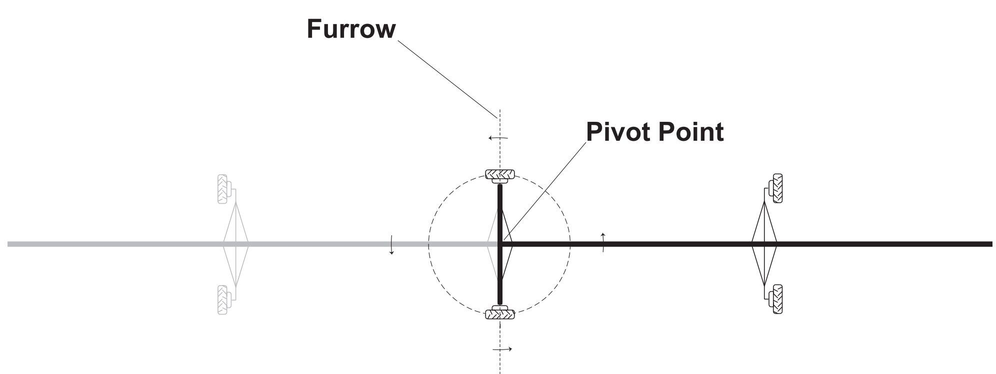


Figure 5-11-2

2 Wheel Linear Design

Pivot Tower Guidelines and Tower Box Location

Tower Guidelines

1. The area around the cart tower where the pivot wheels run must be completely smooth, flat and in the same plane as the first span.
2. A concrete or dry hard packed pivot surface is recommended for the cart span pivot wheels. If concrete, the pivot pad can be donut or circular shaped to minimize the amount of concrete needed or it can consist of a square or round slab. It should have appropriate rebar and thickness for the tower weight.

   Reference: A 3 ft (0.91 m) wide, 6 inches (152 mm) thick donut shaped pad, would require approximately 4 cubic yards (3.1 cubic meters) of concrete.
3. A pivot anchor set in concrete is required for Method #2 only. See illustration for this method. Anchors for a pivot point requires approximately 0.60 cubic yards (0.45 cubic meters) of concrete.

Tower Box Location 2 Wheel Linear

For non-swing around, non-towable, or both reverse and forward tow machines, the Freestanding span should be located in the middle span position.

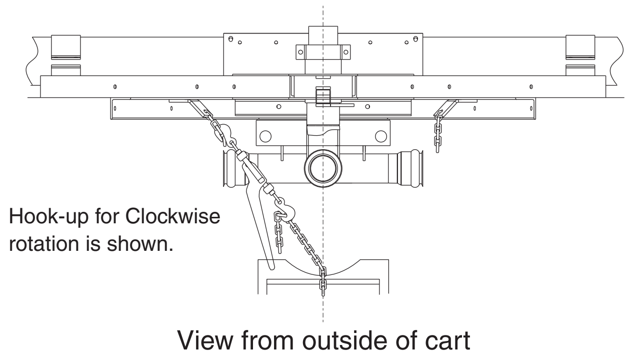


Figure 5-12-1 Viewing from outside the cart, attach the load binder to the left anchor chain for clockwise rotation and to the right anchor chain for counter clockwise rotation.

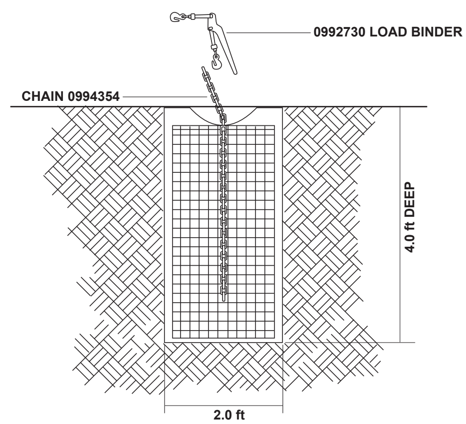


Figure 5-12-2

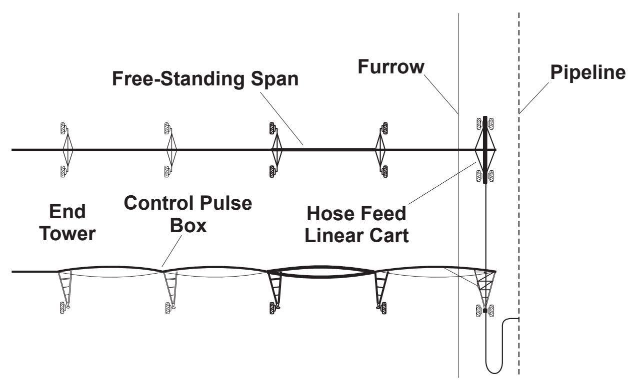


Figure 5-12-3

Furrow Guidance

- The furrow should have a “V” shaped bottom of 4 in (101 mm) to 6 in (152 mm) deep with a maximum width at the top of 6 inches (152 mm). The guide skid should be at a minimum depth of 3 inches (76 mm) and maximum of 6 in (152 mm).
- A 3 ft (0.9 m) wide path on each side of the furrow should be kept clear of any obstructions that could prevent the system guidance hardware from functioning properly. This path should have no parallel or perpendicular ridges or furrows through it.
- The base beam is the center point of rotation on systems that utilize the swing-around option. Therefore, the machine will need to be steered such that the skid on the guidance arm is back over the guidance furrow after swinging to resume operation in the opposite direction.
- The side inlet 2 wheel linear is designed to reverse at the ends of the field without disconnecting the poly-hose from the cart.
- The swivel elbow should be adjusted outward to an angle of at least 10˚ in order for the machine to reverse consistently.
- Bumpers may be installed to push the poly-hose out of the way of the cart tires.
- The cart path must be maintained in a smooth, hard condition to allow the poly-hose to slide freely over the surface.
- At the ends of the field, where the reversing takes place, allow a smooth, hard area to the swivel side of the cart.
- The side-inlet configuration will greatly reduce hose handling labor but should not be expected to auto-reverse completely unattended.
- Due to the tight bending radius in the poly, and the stresses of auto-reversing, it is recommended to use **heavier (SDR 11) wall poly-pipe** for side inlet hose drags.

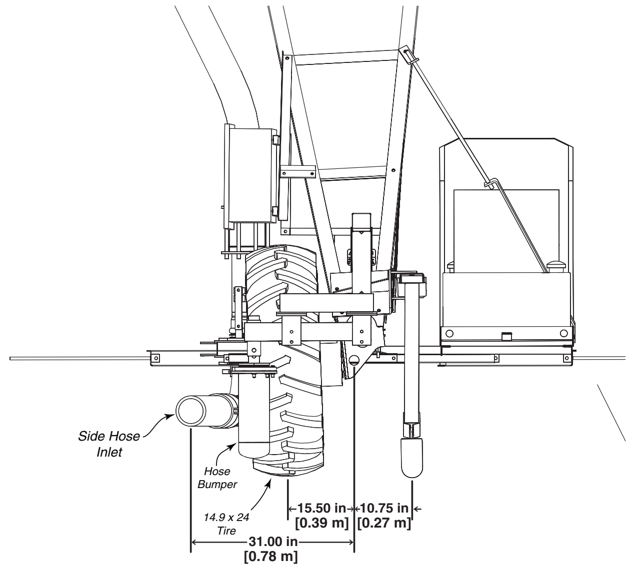


Figure 5-13-1 **Side Inlet**

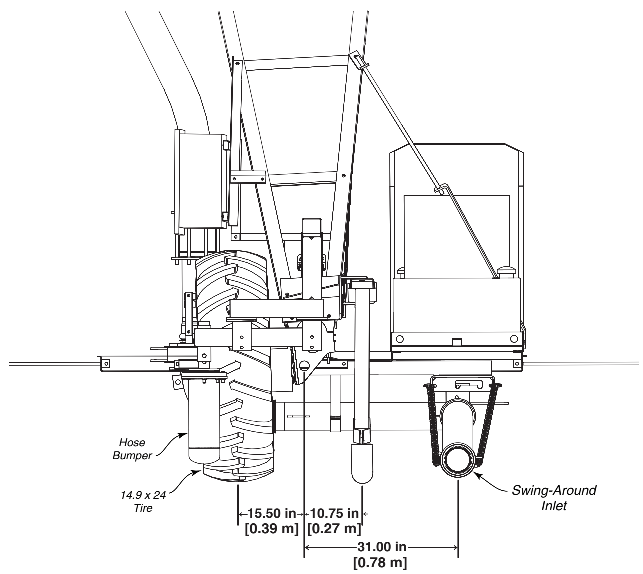
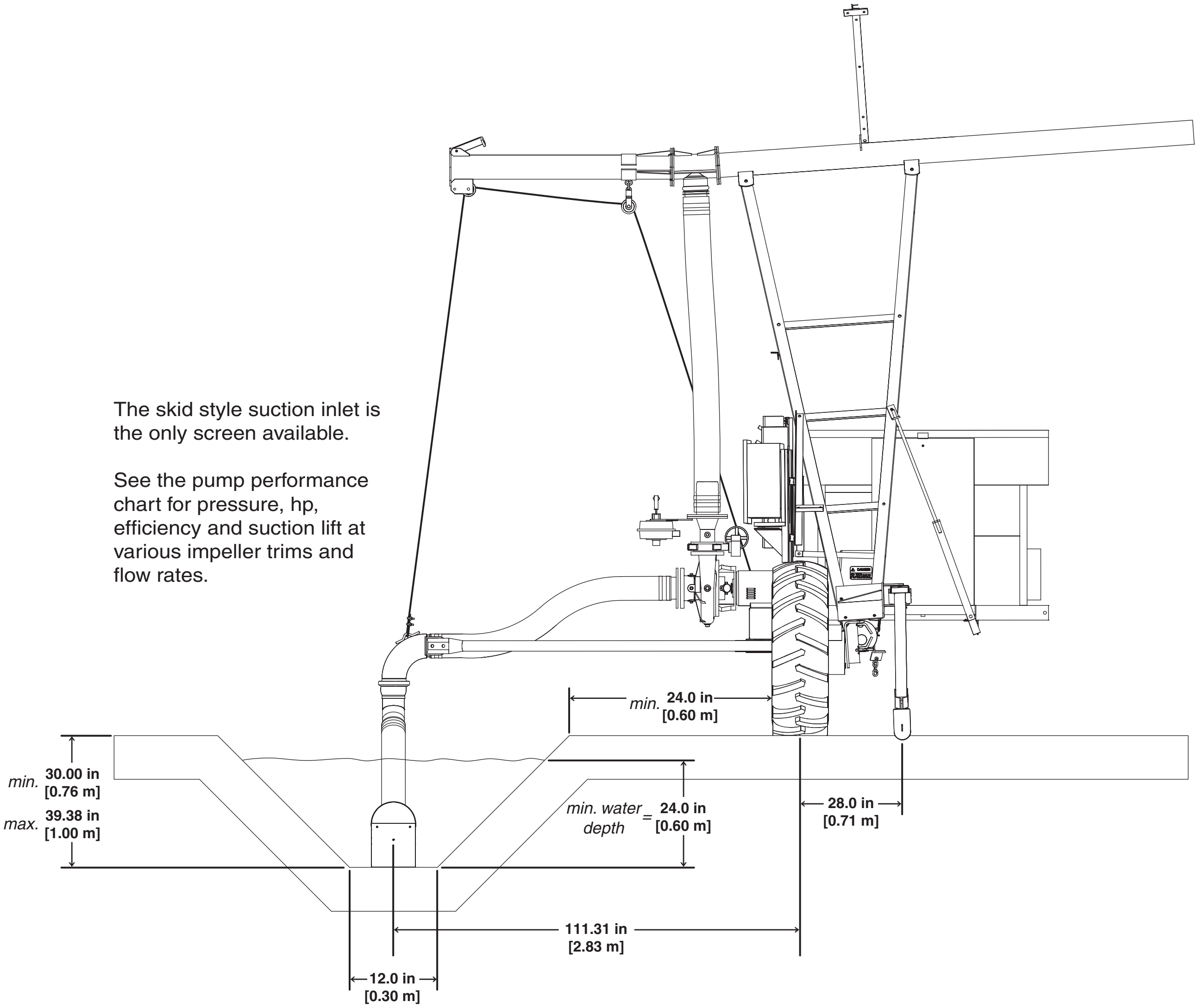


Figure 5-13-2 **Swing-Around Inlet**

2 Wheel Linear Design

Ditch Feed - Skid Style Inlet

For use in Earthen Ditches ONLY



- Maximum ditch depth (below ground level) — 1 m.
- Minimum water depth over Inlet Screen — 6.0 in [.15 m].
- Ditch side slopes from 1:1 to 2:1.
- Center of wheels (14.9 in x 24 in) to center of ditch — 111.31 in (9 ft - 3.31 in) [2.82 m].

Pump Selection

Utilize the total system pressure requirement and refer to the Pump, Motor and Impeller Selection chart on page 5-16 as determined by the following instructions:

1. The pipeline pressure is based on the 2 Wheel Ditch Feed End Feed Cart.
2. Find correct pump chart based on system capacity.
3. Locate the pressure (PSI or bars) available from the pump chart that most nearly matches the system requirements.
4. Once pressure available is determined, pumping power, RPM, and suction lift can be read from the Pump, Motor and Impeller Selection chart on page 5-16.

NOTE

- **All these values are at sea level and standard temperature and will need to be further adjusted.**

5. Suction lift capabilities:
   (a) The field suction lift capability must be adjusted for altitude and temperature.
   (b) Add the value obtained from Table 6 for the appropriate altitude and temperature adjustment to the field suction lift value.
   (c) Check the pump suction lift against the adjusted field requirement to see if adequate lift is available for the particular field situation.
   (d) If suction lift is not adequate:
   - Examine other pump charts for greater suction lift capability at same flow (see Pump, Motor and Impeller Selection chart beginning on page 5-16).
   - Consider decreasing distance from minimum water level to the surface the cart tower runs on.
   - Select different management method to reduce flow requirements.
   - Reduce irrigated acreage to reduce flow requirement.
   - Redesign system to reduce pressure requirements, and maintain the same flow (applicable only on certain pumps).
6. The pressure loss through the system cart is included in the Pump, Motor and Impeller Selection chart on page 5-16.
7. The friction loss in the inlet and Net Positive Suction Head Requirements (NPSHR) per the pumps are included in the Pump, Motor and Impeller Selection chart on page 5-16.

Table 6

Altitude and Temperature Adjustment Table

		ELEVATION - FEET						
TEMP. F	SEA LEVEL	1000	2000	3000	4000	5000	6000	7000
70	0.77	-0.43	-1.61	-2.75	-3.85	-4.93	-5.96	-6.97
80	0.44	-0.76	-1.94	-3.08	-4.18	-5.26	-6.29	-7.30
90	0.00	-1.20	-2.38	-3.52	-4.62	-5.70	-6.73	-7.74
100	-0.58	-1.78	-2.96	-4.10	-5.20	-6.28	-7.31	-8.32
120	-2.29	-3.50	-4.67	-5.82	-6.92	-7.99	-9.02	-10.03

		ELEVATION - METERS						
TEMP. C	SEA LEVEL	304	609	914	1219	1523	1828	2133
21	0.23	-0.13	-0.49	-0.84	-1.17	-1.50	-1.82	-2.12
26	0.13	-0.23	-0.59	-0.94	-1.27	-1.60	-1.92	-2.22
32	0.00	-0.37	-0.73	-1.07	-1.41	-1.74	-2.05	-2.36
37	-0.18	-0.54	-0.90	-1.25	-1.58	-1.91	-2.23	-2.54
48	-0.70	-1.07	-1.42	-1.77	-2.11	-2.44	-2.75	-3.06

Figure 5-15-1

2 Wheel Linear Design

Pump, Motor and Impeller Selection

Total Gallons Per Minute (GPM)		**Cornell 4RB Pump Performance** **60 HZ** (1760 RPM) Impeller Trims available (Inches)						
		8.00	**8.50**	**9.00**	**9.50**	**10.00**	**10.50**	**11.00**
	Pressure at pipeline (PSI)	22	26	30	34	39	44	50
	Pump (Water) hp	6.0	6.8	7.7	8.8	9.9	11.1	12.5
200	Pump hp available	10	15	20	20	25	25	30
	Pump Eff.	55.1%	54.6%	54.1%	53.4%	52.8%	52.4%	51.7%
	6 in Skid type inlet - Ft Lift	20.7	20.7	20.7	20.7	20.7	20.7	20.7
	Pressure at pipeline (PSI)	21	25	29	34	38	44	49
	Pump (Water) hp	7.4	8.5	9.7	10.9	12.2	14.0	15.9
300	Pump hp available	10	15	20	20	25	25	30
	Pump Eff.	64.4%	64.4%	64.3%	63.8%	63.1%	62.2%	61.0%
	6 in Skid type inlet - Ft Lift	20.3	20.3	20.3	20.3	20.3	20.3	20.3
	Pressure at pipeline (PSI)	20	24	28	33	37	43	48
	Pump (Water) hp	8.5	9.7	11.1	12.5	14.1	16.0	18.2
400	Pump hp available	10	15	20	20	25	25	30
	Pump Eff.	72.3%	72.7%	73.0%	72.8%	72.2%	71.3%	70.1%
	6 in Skid type inlet - Ft Lift	19.9	19.9	19.9	19.9	19.9	19.9	19.9
	Pressure at pipeline (PSI)	18	22	26	31	36	41	47
	Pump (Water) hp	9.5	10.9	12.4	14.1	16.1	18.3	20.5
500	Pump hp available	10	15	20	20	25	25	30
	Pump Eff.	75.8%	76.5%	77.6%	77.7%	77.4%	76.7%	75.7%
	6 in Skid type inlet - Ft Lift	19.3	19.3	19.3	19.3	19.3	19.3	19.3
	Pressure at pipeline (PSI)	15	20	24	29	34	40	45
	Pump (Water) hp	10.2	11.9	13.6	15.6	17.7	20.4	22.8
600	Pump hp available	10	15	20	20	25	25	30
	Pump Eff.	77.1%	78.8%	80.1%	80.5%	80.6%	80.4%	79.6%
	6 in Skid type inlet - Ft Lift	18.4	18.4	18.4	18.4	18.4	18.4	18.5
	Pressure at pipeline (PSI)	11	16	21	26	31	37	43
	Pump (Water) hp	10.3	12.5	14.4	16.7	19.2	21.9	24.9
700	Pump hp available	10	15	20	20	25	25	30
	Pump Eff.	75.6%	77.5%	80.0%	81.3%	82.1%	82.4%	82.4%
	6 in Skid type inlet - Ft Lift	16.3	16.4	16.7	16.9	16.9	16.9	17.0
	Pressure at pipeline (PSI)		12	17	22	27	34	39
	Pump (Water) hp		12.6	15.1	17.6	20.2	23.4	26.3
800	Pump hp available	NA	15	20	20	25	25	30
	Pump Eff.		75.6%	77.8%	80.3%	81.9%	83.9%	84.5%
	6 in Skid type inlet - Ft Lift		14.0	14.4	14.8	14.9	15.0	15.1
	Pressure at pipeline (PSI)			13	18	23	30	36
	Pump (Water) hp			15.1	18.1	20.9	24.3	27.8
900	Pump hp available	NA	NA	20	20	25	25	30
	Pump Eff.			75.5%	77.9%	80.4%	83.1%	85.0%
	6 in Skid type inlet - Ft Lift			11.8	12.1	12.5	12.6	12.7
	Pressure at pipeline (PSI)				13	18	25	32
	Pump (Water) hp				17.6	20.9	25.0	29.2
1000	Pump hp available	NA	NA	NA	20	25	25	30
	Pump Eff.				74.8%	77.3%	80.7%	82.9%
	6 in Skid type inlet - Ft Lift				9.0	9.3	9.4	9.5
	Pressure at pipeline (PSI)					12	20	27
	Pump (Water) hp					20.4	25.1	29.7
1100	Pump hp available	NA	NA	NA	NA	25	25	30
	Pump Eff.					70.8%	76.4%	80.3%
	6 in Skid type inlet - Ft Lift					5.1	5.6	6.2

Pressure (PSI) available at the top of the cart (includes cart elevation, cart pressure losses and suction losses.

Maximum allowable suction lift (ft) - is the distance measured from the bottom of the cart drive unit tires to water level in the ditch (all suction losses and pump elevation included).

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design.

Altitude is assumed to be sea level*
Temperature is assumed to be 90 deg. F. (32.2 deg. C.)*
*** See Table 6 on page 5-15 in Pump Selection for lift adjustments for altitude and temperature.**

Pump, Motor and Impeller Selection (Continued)

Total Liters Per Second (LPS)		Cornell 4RB Pump Performance **50 HZ** (1480 RPM) International ONLY Impeller Trims available (Inches)						
		8.00	**8.50**	**9.00**	**9.50**	**10.00**	**10.50**	**11.00**
12.6 (200 GPM)	Pressure at pipeline (PSI)	14	17	19	22	25	29	33
	Pump (Water) hp	3.9	4.5	5.1	5.7	6.4	7.3	8.2
	Pump hp available	10	15	20	20	25	25	30
	Pump Eff.	58.6%	58.3%	58.0%	57.3%	56.7%	56.1%	55.2%
	6 in Skid type inlet - Ft Lift	23.0	23.0	23.0	23.0	23.0	23.0	23.0
18.9 (300 GPM)	Pressure at pipeline (PSI)	13	16	19	22	25	29	33
	Pump (Water) hp	4.8	5.4	6.2	7.0	7.9	9.1	10.3
	Pump hp available	10	15	20	20	25	25	30
	Pump Eff.	69.7%	70.0%	70.1%	69.7%	69.0%	67.8%	66.2%
	6 in Skid type inlet - Ft Lift	22.6	22.6	22.6	22.6	22.6	22.6	22.6
25.2 (400 GPM)	Pressure at pipeline (PSI)	11	14	17	21	24	28	32
	Pump (Water) hp	5.5	6.4	7.2	8.2	9.3	10.5	11.9
	Pump hp available	10	15	20	20	25	25	30
	Pump Eff.	75.4%	75.9%	76.7%	76.8%	76.4%	75.7%	74.6%
	6 in Skid type inlet - Ft Lift	22.2	22.2	22.2	22.2	22.2	22.2	22.2
31.5 (500 GPM)	Pressure at pipeline (PSI)	9	12	15	19	22	26	30
	Pump (Water) hp	6.1	7.1	8.0	9.3	10.5	12.0	13.5
	Pump hp available	10	15	20	20	25	25	30
	Pump Eff.	77.2%	78.7%	80.1%	80.4%	80.5%	80.3%	79.4%
	6 in Skid type inlet - Ft Lift	21.6	21.6	21.6	21.5	21.5	21.6	21.6
37.9 (600 GPM)	Pressure at pipeline (PSI)		9	12	16	20	24	28
	Pump (Water) hp		7.5	8.5	10.1	11.4	13.2	15.0
	Pump hp available	NA	15	20	20	25	25	30
	Pump Eff.		77.2%	79.8%	81.2%	82.3%	82.7%	82.8%
	6 in Skid type inlet - Ft Lift		19.8	20.2	20.3	20.3	20.3	20.3
44.1 (700 GPM)	Pressure at pipeline (PSI)			9	13	17	21	26
	Pump (Water) hp			9.0	10.6	12.2	14.1	16.0
	Pump hp available	NA	NA	20	20	25	25	30
	Pump Eff.			77.0%	79.9%	81.4%	83.8%	85.0%
	6 in Skid type inlet - Ft Lift			18.0	18.4	18.4	18.5	18.6
50.4 (800 GPM)	Pressure at pipeline (PSI)				9	13	18	23
	Pump (Water) hp				10.6	12.5	14.8	17.1
	Pump hp available	NA	NA	NA	20	25	25	30
	Pump Eff.				76.4%	79.1%	82.0%	84.0%
	6 in Skid type inlet - Ft Lift				15.9	16.1	16.1	16.2
56.8 (900 GPM)	Pressure at pipeline (PSI)					9	13	18
	Pump (Water) hp					12.3	14.9	17.7
	Pump hp available	NA	NA	NA	NA	25	25	30
	Pump Eff.					74.1%	77.8%	81.1%
	6 in Skid type inlet - Ft Lift					13.2	13.3	13.5
63.1 (1000 GPM)	Pressure at pipeline (PSI)						8	13
	Pump (Water) hp						14.9	17.5
	Pump hp available	NA	NA	NA	NA	NA	25	30
	Pump Eff.						67.9%	75.0%
	6 in Skid type inlet - Ft Lift						9.2	9.8

Pressure (PSI) available at the top of the cart (includes cart elevation, cart pressure losses and suction losses.

Maximum allowable suction lift (ft) - is the distance measured from the bottom of the cart drive unit tires to water level in the ditch (all suction losses and pump elevation included).

Chart data is based on vendor supplied data of pump pressures, discharges and horsepower requirements. Equipment operating conditions may vary because of nozzle wear, pump impeller wear, etc. Designers may wish to compensate for these and other variables in their design.

Altitude is assumed to be sea level*
Temperature is assumed to be 90 deg. F. (32.2 deg. C.)*
* See Table 6 on **page 5-15 in Pump** Selection for lift adjustments for altitude and temperature.

2 Wheel Linear Design

Pump, Motor and Impeller Selection (Continued)

Pump Motor	Amps
10 hp	16.3
15 hp	23.8
20 hp	30.0
25 hp	40.0
30 hp	45.0

Lima Generator Sizing

Size	5 kW	7.5 kW	10 kW	12 kW	15 kW	20 kW	25 kW	30 kW	40 kW
Efficiency	0.809	0.826	0.837	0.847	0.872	0.868	0.876	0.884	0.884
Max. amp	8A	11A	15A	18A	23A	30A	38A	45A	60A

Maximum amp draw for Engine/Generator is 60 amps.

Maximum amp draw for Electric Cord Drag-Hose Drag option is 30 amps.

Maximum amp draw for Ditch Straddle Electric Cord Drag option is 100 amps.

Appendix

Appendix

Table of Contents

Sprinkler Packages

Selection of sprinkler packages is based upon a number of considerations: crops, soils, terrain and energy. Soil intake rates depend on soil particle size, surface condition (mulch, crust, aggregate size), slope, moisture content, density, layering and organic matter content.

Great care must be taken to design flow and sprinkler application rates to meet crop requirements and match intake capabilities of the soil. Normal design is to start with the lowest pressure sprinkler packages and work your way up in options and pressures till you select a package that fits the application.

High Pressure Impact Sprinklers typically have wider wetted areas and are used on heavy soils with slopes and higher flow requirements.

Low Angle, Low Pressure Impacts typically have larger water droplet sizes, less evaporation, wind drift and energy costs.

Rotating – Low – Medium Pressure Sprays typically have medium wetted areas and can be used on most soils and slopes.

Low Pressure Sprays typically have a reduced wetted areas and use the minimum energy for water distribution. When used with drops, wind drift and evaporation can be reduced.

Sprinklers

Selection Criteria

SPRINKLER SELECTION CRITERIA	FULL CIRCLE SPRAYS PADS									SPINNER			ROTATING SPRAY PADS									IMPACTS		
	SMOOTH			No. of Streams 30 to 36			No. of Streams <30			D6 Red or Purple			U4 Blue			D4 Green			D6 Red			Low Angle		High Angle
GPM	LOW < 3 GPM/Ac (.16 in/day)	MED 3-7 GPM/Ac (.16-.37 in/day)	HIGH >7 GPM/Ac (.37 in/day)	LOW < 3 GPM/Ac (.16 in/day)	MED 3-7 GPM/Ac (.16-.37 in/day)	HIGH >7 GPM/Ac (.37 in/day)	LOW < 3 GPM/Ac (.16 in/day)	MED 3-7 GPM/Ac (.16-.37 in/day)	HIGH >7 GPM/Ac (.37 in/day)	LOW < 3 GPM/Ac (.16 in/day)	MED 3-7 GPM/Ac (.16-.37 in/day)	HIGH >7 GPM/Ac (.37 in/day)	LOW < 3 GPM/Ac (.16 in/day)	MED 3-7 GPM/Ac (.16-.37 in/day)	HIGH >7 GPM/Ac (.37 in/day)	LOW < 3 GPM/Ac (.16 in/day)	MED 3-7 GPM/Ac (.16-.37 in/day)	HIGH >7 GPM/Ac (.37 in/day)	LOW < 3 GPM/Ac (.16 in/day)	MED 3-7 GPM/Ac (.16-.37 in/day)	HIGH >7 GPM/Ac (.37 in/day)	25 - 45 PSI	45 - 60 PSI	50 - 60 PSI
SOIL TYPE																								
Light	R	Y	G	Y	G	G	R	G	G	Y	G	G	Y	G	G	Y	G	G	Y	G	G	G	G	G
Medium	Y	G	G	G	G	G	Y	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
Heavy	G	G	G	G	G	Y	G	Y	R	G	G	Y	G	G	Y	G	G	Y	G	G	G	Y	G	G
SLOPE																								
Flat < 2%	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
Moderate 2 - 6%	G	G	Y	G	G	Y	G	G	Y	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
Steep > 6%	G	Y	R	G	Y	R	G	Y	R	G	Y	R	G	G	Y	G	G	Y	G	G	Y	G	G	G
END PRESSURE																								
<15 PSI	G	G	G	G	G	G	G	G	Y	Y	Y	Y	R	R	R	R	R	R	R	R	R	R	R	R
15 - 25 PSI	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	R	R	R
25 - 45 PSI	Y	Y	Y	Y	Y	Y	G	G	G	R	R	R	G	G	G	G	G	G	G	G	G	G	Y	Y
> 45 PSI	R	R	R	R	R	R	Y	Y	Y	R	R	R	Y	Y	Y	Y	Y	Y	R	R	R	R	G	G
SPACING / HEIGHT																								
> 11 Ft / > 8.5 Ft	R	R	R	R	R	R	R	R	R	R	R	R	G	G	G	G	G	Y	G	G	Y	G	G	G
7 - 11 Ft / 5-8.5 Ft	G	G	G	G	G	G	G	G	G	G	G	G	R	R	R	G	G	G	G	G	G	R	R	R
< 7 Ft / < 5 Ft	G	G	G	G	G	G	G	G	G	G	G	G	R	R	R	G	G	G	G	G	G	R	R	R
SOIL COMPACTION POTENTIAL	G	G	G	G	G	Y	G	G	Y	G	G	Y	G	G	Y	G	G	Y	G	G	G	R	Y	Y

G (green) Go - performs properly with good results
Y (yellow) Caution - questionable performance in some conditions
R (red) Do not use under most conditions

NOTE

- Low < 3 GPM/Acre involves deficient irrigation - soils, crops, and management methods must be carefully monitored

All impact sprinkler packages are based on medium to high GPM/Ac

360 Full Circle Low Pressure Sprays

Valley LEN Senninger Super Spray UP3 and LDN - UP3 Nelson D3000

6 PSI (0.41 bar), 10 PSI (0.68 bar), and 15 PSI (1.03 bar) nozzles slash horsepower requirements 10 to 40 percent by reducing initial investment in pumps and engines. Small atomized droplets are practically eliminated thus reducing evaporation losses. Distribution pads are used to adjust droplet size. See pad characteristics description.

20 PSI (1.38 bar) and 25 PSI (1.72 bar) nozzle - 360° pattern. Droplet sizes can be adjusted with different pads to produce fine droplets for heavy, flat soils and delicate crops where wind drift is minimal, or large droplets for coarse textured soils where the crops are not delicate.

Application Description

Pressure at the end of the machine **MUST** include the regulator if used and the addition of the highest elevation point in the field/2.31 when using PSI measurements.

9.00 ft (2.74 m) spacing on Model 8000 Spans. 75.5 and 113.3 inches (1.91 and 2.87 m) on Model 8120 Spans. 30 in (762 mm) spacing is available on Model 8000 spans.

Application rate at the outer end of pivot with VSN @ 1000 GPM for a 1/4 section = 3.7 in/hr with sprinklers at 12 ft (3.65 m) (227 M^3/hr for 400 m = 94 mm/hr) @ 3.65 m.

Application rate at the outer end of pivot with VSN @ 1000 GPM for a 1/4 section = 3.04 in/hr 12 ft ht (227 M^3/hr for 400 m = 77.2 mm/hr).

1.4) Drops on pivot, corner, or linear machines are available in galvanized steel, PVC, PE, and flexible hose.

1.5) Boom backs option is available – usually equipped with 180° sprays.

1.6) Extended drop assembly with furrow sock and boom back options available (not w/spinner).

1.7) General Application Guidelines: The 360˚ spray nozzle package was developed for distribution on pivot, corner and linear machines, and minimizes wind drift because of droplet size.

1.8) The LEN and LDN is recommended to be placed on drops with a height of 5 - 6 ft (1.5 - 1.8 m). The minimum height of 3 ft (1 m) will require closer sprinkler spacing.

Sprinklers

360 Full Circle Low Pressure Sprays

Fixed Sprays

Nelson D3030/3000	Nelson Trashbuster	Valley LEN
		
Pads Available		
Flat Smooth - Turquoise Concave Fine - Green Flat Fine - Yellow Convex Fine - Purple Concave Medium - Blue Flat Medium - Black Flat Course - Gray Multi-Trajectory Course - Orange Multi-Trajectory Medium - Brown Bubblewide - Tan Cotton Chem/Germination - White Corn Chem - Red Bubbler Hose Drag	Flat 30 - Yellow Concave 30 - Green Green Rotator Plate Blue Rotator Plate	Concave 24 Groove Concave 33 Groove Concave Double/Triple Flat 24 Groove Flat 33 Groove Flat Double/Triple Convex 24 Groove Convex 33 Groove Convex Double/Triple Corn Chemigation - Red Cotton Chemigation - White LEPA Bubbler Hose Drag

Senninger LDN UP3	Senninger Super Spray UP3
	
Pads Available	
Concave 24 Groove Concave 33 Groove Concave Double/Triple Flat 24 Groove Flat 33 Groove Flat Double/Triple Convex 24 Groove Convex 33 Groove Convex Double/Triple Corn Chemigation - Red Cotton Chemigation - White LEPA Bubbler Shroud Bubbler Hose Drag	Concave Deep 24, 36, 48 Concave Med 36 Concave Smooth Flat Deep 24, 36, 48 Flat Med 36 Flat Smooth Convex 24, 36, 48 Cotton Chem Corn Chem Hose Drag

Full Circle Rotating Sprays

Nelson A3030/A3000 - Nelson R3030/R3000 - Nelson S3030/S3000 - Nelson O3030/O3000

Senninger I-WOB - UP3 - Senninger Xi-WOB - UP3 - Senninger Xcel Wob UP3 TOP

Komet Precision Twister

Rotating sprays can provide larger wetted diameter on selected units. The units can be operated in a pressure range from 10 PSI (0.69 bar) up to 50 PSI (3.45 bar). Small atomized droplets are available on certain units for delicate crops. Distribution pads are used to adjust droplet size. See pad characteristics and throw description. Droplet sizes can be adjusted with different pads to produce fine droplets for heavy, flat soils and delicate crops where wind drift is minimal, or large droplets for coarse textured soils where the crops are not delicate.

Application Description

1. Pressure at the end of the machine **MUST** include the regulator if used and the addition of the highest elevation point in the field/2.31 when using PSI measurements.
2. 9.00 ft (2.74 m) spacing on Model 8000 Spans. 75.5 and 113.3 inches (1.92 and 2.88 m) on Model 8120 Spans. 30 in spacing is available on Model 8000 spans.
3. Application rate at the outer end of pivot with S3000 (Red plate) @ 1000 GPM for a 1/4 section = 2.55 in/hr with sprinklers at 6 ft (227 M3/hr for 400 m = 65 mm/hr @ 1.8 m).
4. Application rate at the outer end of pivot with I-Wob (Black plate) @ 1000 GPM for a 1/4 section = 2.24 in/hr @ 6 ft ht (227 M^3/Hr for 400 m = 57 mm/hr @ 1.8 m).
5. Application rate at the outer end of pivot with R3000 (Red plate) @ 1000 GPM for a 1/4 section = 2.00 in/hr @ 6 ft height (227 M3/hr for 400 m = 51 mm/hr @ 1.8 m).
6. Drops on pivot, corner, or linear machines are available in galvanized steel, PVC, PE, and flexible hose.
7. Boom backs option is available – usually equipped with 180° sprays.
8. Nelson Rotator can be positioned on the top of the pipeline **OR** on drops. When placed on drops the plate and pressure must be coordinated with the crop canopy height and spacing for proper coverage and potential crop damage.
9. The Senninger I-Wob, Nelson Orbiter and Nelson Nutator require a minimum of 2 ft (.6 m) of reinforced flexible hose upstream of the unit. A threaded weight or integrated weight on the bottom of the drop is recommended. If a weight is used above the drop a thread weight is recommended over a slip over the hose unit. Steel pipe fitting must be used in mounting this unit.

Sprinklers

Full Circle Rotating Sprays

Nelson S3030/S3000 Spinner	Nelson R3030/R3000 Rotator	Nelson O3030/O3000 Orbitor	Nelson A3030/A3000 Accelerator
			
Pressure Range			
Min 10 PSI (0.69 bar) Max 20 PSI (1.38 bar)	**Blue and Green Plate** Min 20 PSI (1.48 bar) Max 50 PSI (3.45 bar) **Red, Orange, Brown and White** Min 15 PSI (1.03 bar) Max 30 PSI (2.07 bar) **Olive** Min 10 PSI (0.69 bar) Max 15 PSI (1.03 bar)	Min 6 PSI (0.41 bar) Max 20 PSI (1.38 bar)	Min 6 PSI (0.41 bar) Max 15 PSI (1.38 bar)
Pads Available			
D6 - 12 Deg - Red D6 - 20 Deg - Purple D8 - Yellow Single - Beige Up - Top - Lime	U4 - Up-Top - Blue Up-Top White D4 - 8 Deg - Green D6 - 12 Deg - Red Multi Trajectory Orange Multi Trajectory Brown Multi Trajectory Olive	Black - Standard Angle Blue - Low Angle Purple - Small Droplet	Up-Top Navy D6 - Gold D4 - Maroon
Average Wetted Diameter			
38 ft (11.6 m) - 54 ft (16.5 m)	58 ft (17.7 m) - 74 ft (22.6 m)	50 ft (15.2 m) - 78 ft (17.7 m)	30 ft (9.1 m) - 54 ft (16.5 m)

Senniger I-Wob UP3	Senniger XI-Wob UP3	Senniger Xcel Wob UP3 Top	Komet Precision Twister
			
Pressure Range			
Min 10 PSI (0.69 bar) Max 20 PSI (1.38 bar)	Min 10 PSI (0.69 bar) Max 15 PSI (1.38 bar)	Only 10 PSI (0.69 bar)	Min 10 PSI (0.69 bar) Max 20 PSI (1.38 bar)
Pads Available			
Standard Angle 9 Groove - Black Low Angle 9 Groove - Blue Low Angle 6 Groove - White Standard Angle 6 Groove Fine - Grey	6 Groove - 10 Deg - Blue 6 Groove - 15 Deg - Black 9 Groove - 10 Deg - Grey Up-Top 6 Groove - White	Up-Top Blue	Standard Angle 10 Groove - Black Low Angle 10 Groove - Blue Ultra Low Angle 10 Groove - Yellow Up-Top PEAK - White
Average Wetted Diameter			
Up to 53 ft (16.2 m)	Up to 45 ft (13.7 m)	51 ft (15.5 m)	Up to 55 ft (16.8 m)

Part Circle Low Pressure Sprays

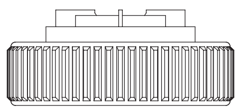
Senninger	Nelson Spray	Nelson Rota-tor	Senninger LDN	Valley LEN	Nelson Spin-ner
					

Can be used with pressures ranging from 6 PSI (0.41 bar) to 20 PSI (1.37 bar) with the same characteristics as full circle low pressure or rotating sprays.

Typical application includes mounting on boombacks or offsets or rigid drops in the drive unit area.

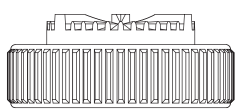
Sprinklers

Distribution Pads Available



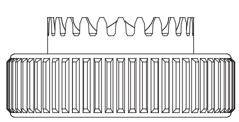
Smooth Spray Pads

This pad produces the smallest droplet for a gentle spray pattern. This pattern causes minimum soil disturbance. The small droplet reduces soil compaction and infiltrates best on heavy soil. The fine droplets are more susceptible to wind drift and evaporation. Suitable for pressures 6 - 25 PSI (0.41 - 1.72 bar).



Medium Groove Spray Pads

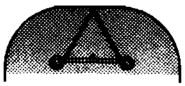
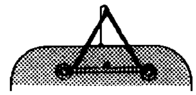
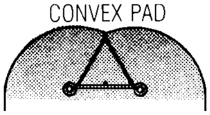
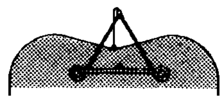
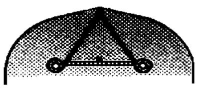
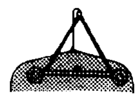
This pad creates larger drops and a slightly wider spray pattern than the smooth pads. The increased droplet size minimizes wind drift, yet is still small enough to infiltrate moderately heavy soils. The general purpose pad is for most average conditions and pressures (less than 40 PSI (2.75 bar)).



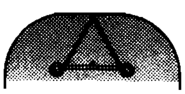
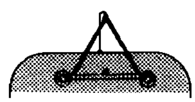
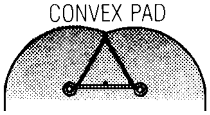
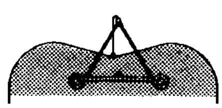
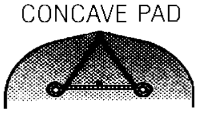
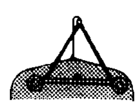
Deep Grooved Spray Pads

This pad produces large droplets and provides the application in small direct streams. This unit provides the greatest wind resistance and reduced evaporation losses. The large droplets make it unsuitable for some sensitive crops and light soil conditions where water does not move laterally. The uniformity is reduced under calm conditions. Suitable for pressures above 15 PSI (1.03).

Spray Nozzles

Spray Nozzles @ 10 PSI	Uniformity (No Wind)	Application Rate	Spray Nozzles @ 10 PSI - 48 in Drop	Uniformity (No Wind)	Application Rate
FLAT PAD 	GOOD	MEDIUM-HIGH	FLAT PAD 	GOOD-FAIR (Subject to Wind)	HIGH
CONVEX PAD 	GOOD (Subject to Wind)	MEDIUM-HIGH	CONCAVE PAD 	GOOD-FAIR (Subject to Wind)	HIGH
CONCAVE PAD 	GOOD-FAIR	HIGH	CONVEX PAD 	FAIR-POOR (Good Wind Fighter)	VERY HIGH (Sandy Soils Only)

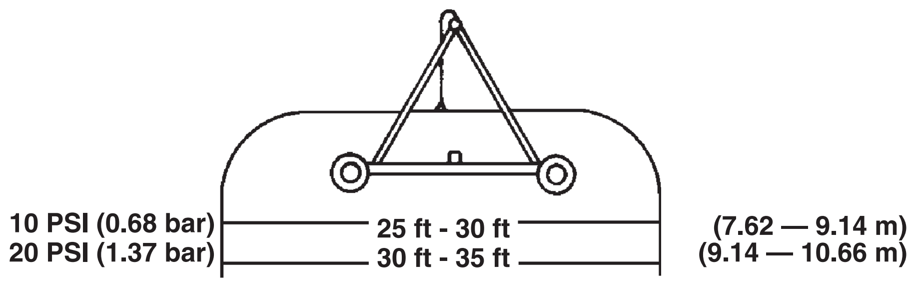
Drops are normally used in high wind or evaporation areas.

Spray Nozzles @ 20 PSI	Uniformity (No Wind)	Application Rate	Spray Nozzles @ 20 PSI - 80 in Drop	Uniformity (No Wind)	Application Rate
FLAT PAD 	GOOD	MEDIUM	FLAT PAD 	FAIR	HIGH
CONVEX PAD 	GOOD (Subject to Wind)	MEDIUM	CONCAVE PAD 	FAIR (Subject to Wind)	HIGH
CONCAVE PAD 	GOOD-FAIR	MEDIUM-HIGH	CONVEX PAD 	POOR (Good Wind Fighter)	VERY HIGH (Sandy Soils Only)

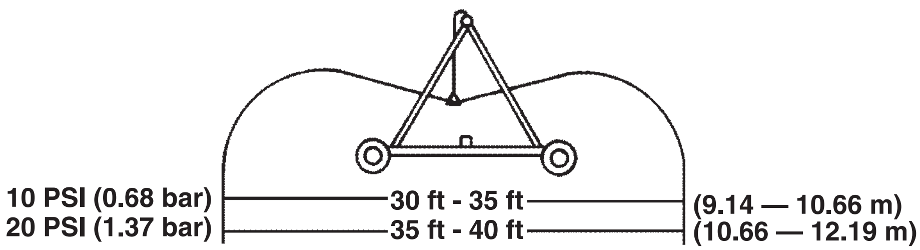
Drops

Drops @ 8.5 ft Ground Clearance with Fixed Sprays

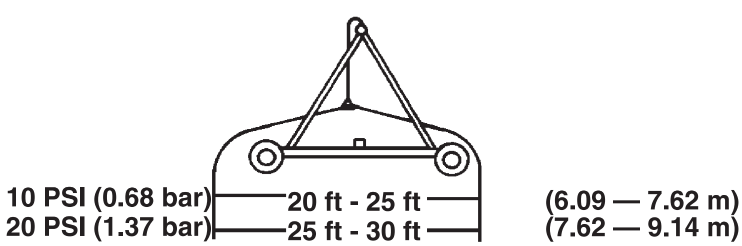
Flat



Concave



Convex



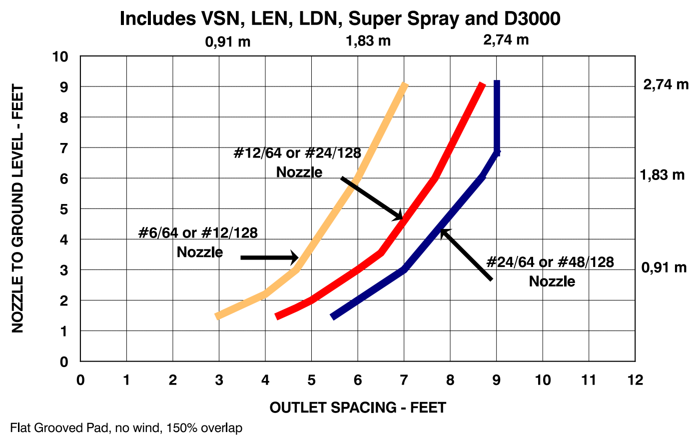
Recommend drops for high wind or evaporation areas.

Drops are 3/4 in (19.05 mm) pipe with different lengths compensate for crown in span.
Groove pad increased droplet size by 25% and range by 10% which
can be used to reduce wind drift and evaporation.

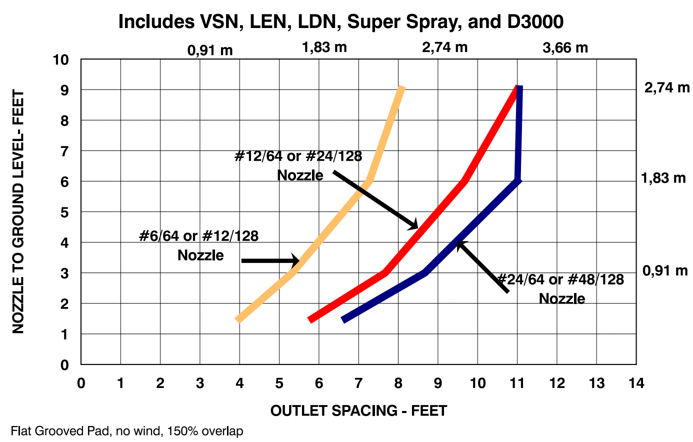
Drop Height – Spacing

The coordination of the height of the sprinkler above the ground surface and the spacing of the nozzles should be carefully reviewed. The graphs below show general guidelines for various sprinkler types and pressure variations. The drop heights and spacing of the sprinklers must be coordinated for proper overlap. The graphs DO NOT consider the crop canopy.

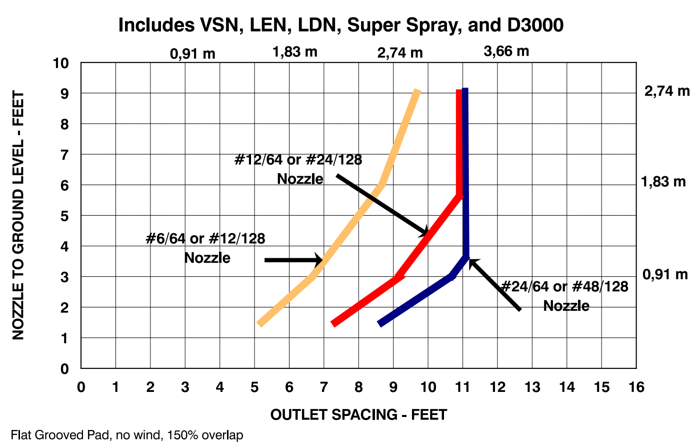
SPRAY NOZZLE SPACING at 6 psi (0,41 bars)



SPRAY NOZZLE SPACING at 10 psi (0,69 bars)



SPRAY NOZZLE SPACING at 15 psi (1,03 bars)



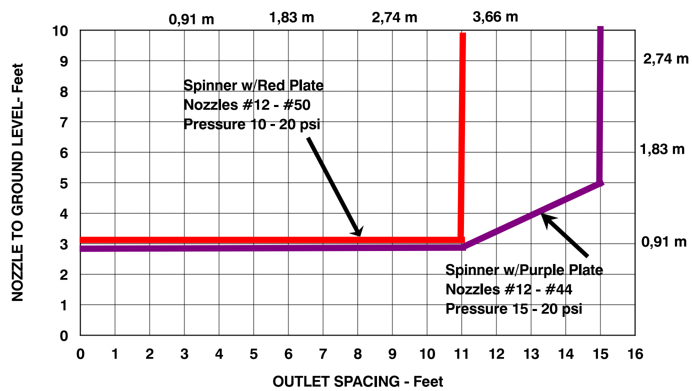
Spray pads are grooved.

Crop canopy which must be coordinated with the drop height.

Drop Height – Spacing (Continued)

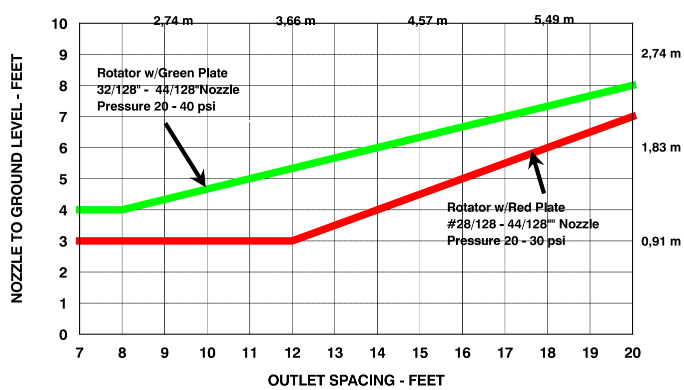
SPINNER SPACING

MAXIMUM



When nozzle is placed on drops 150% overlap

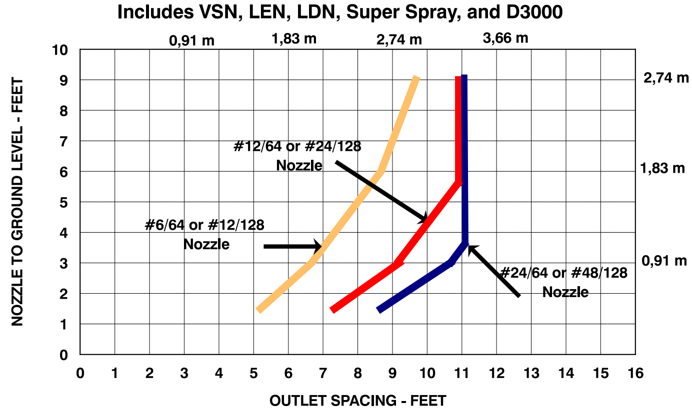
MAXIMUM ROTATOR SPACING



Spacing for maximum width should not exceed approximately 15% of machine length

SPRAY NOZZLE SPACING at 15 psi (1,03 bars)

Includes VSN, LEN, LDN, Super Spray, and D3000



Flat Grooved Pad, no wind, 150% overlap

Low Pressure Impact

Low pressure, low angle sprinklers of nearly equal size, spaced progressively closer utilizing nozzles to produce about the same sized droplet as a large higher pressure impact sprinkler. Saves energy, controls drift, increases efficiency.

Low Pressure Impacts

1.1) 9 ft (2.74 m), 18 ft (5.48 m), and 27 ft (8.22 m) spacing on system

1.2) 30 PSI (2.06 bar) recommended at outer end plus the pressure regulator + elevation /2.31

1.3) Application rate at the outer end of system @ 1000 GPM for a 1/.4 section = 1.8 in/hr

1.4) General application guidelines:

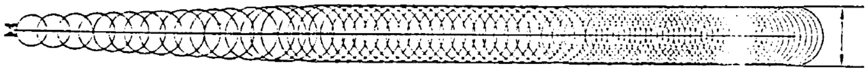
The best application for this sprinkler package is probably on lighter soils where adequate pressure is not available for the high pressure packages or where spray nozzles would cause excessive runoff.

Senninger 6° with Spiral Vanes	Nelson 15° Brass
	

Height - ft (m)	Average Wetted Diameter - ft (m)	
12 (3.65 m)	70-120 (21.33 - 36.57 m)	76-80 (23.16 - 24.38 m)

Sprinklers

Intermediate Spaced Impacts



50 PSI (3.45 bar) high and low angle sprinklers, spaced progressively closer together and utilizing nozzles to produce about the same sized droplet as a large higher pressure impact sprinkler.

Intermediate Spaced Impacts

1.1) 9 ft (2.74 m), 18 ft (5.48 m), and 27 ft (8.22 m) spacing on system

1.2) Application rate at the outer end of system with Senninger 25° @ 1000 GPM for a 1/4 section = 1.04 in/hr (227 M^3/hr for 400 m system = 26.4 mm/hr)

1.3) General application guidelines:

The best application for this sprinkler package is on heavy soils and severe slopes where the system is used for supplemental irrigation.

Senninger 6° **23° - 25° Plastic** **6° - 12° Plastic**	**Nelson 15°** **Brass**
	

Height - ft (m)		Average Wetted Diameter - ft (m)	
12	3.7	**23° - 25°** 85 -140 (25.9-42.7) **6° - 12°** 85-135 (25.9-41.1)	77-86 (23.5-26.2)

Variable Spaced Impacts

50 PSI (3.45 bar) smaller high and low angle sprinklers nearly equal size, spaced progressively closer together from pivot to end. Increased pattern overlap maximizes uniformity. Wide wetter area minimizes runoff on rolling terrain.

Variable Spaced Impacts

1.1) 9 ft (2.74 m), 18 ft (5.48 m), and 27 ft (8.22 m) spacing on system.

1.2) Application rate at the outer end of system with Nelson 15° @ 1000 GPM for a 1/4 section = 1.27 in/hr (227 M^3/hr for 400 m system = 32.3 mm/hr).

1.3) General application guidelines: The best application for this sprinkler package is on soils where the system is required to have maximum uniformity and rolling terrain with low intake rates, on rolling terrain where runoff could be a problem, or where the highest uniformity's are desired.

1.4) Standard tapered nozzles are used to maximize wetted diameter.

Nelson **15° Brass** **8° Plastic**	**Senninger** **6° Plastic** **23° Plastic**
	

Height - ft (m)		**Average Wetted Diameter - ft (m)**	
12	3.7	**15**° 77-90 (23.5-26.2)	**6**° 75-135 (22.8-4.1)
		8° 60-75 (18.3-22.8)	**23**° 85-122 (25.9-37.2)

Sprinklers

LEN Nozzle Performance GPM (LPS)

Nozzle Size Number 128th	Base Pressure PSI											
	6 PSI		10 PSI		15 PSI		20 PSI		25 PSI		30 PSI	
	GPM	lps	GPM	lps	GPM	lps	GPM	lps	GPM	lps	GPM	lps
8	0.27	0.017	0.35	0.022	0.43	0.027	0.50	0.032	0.56	0.035	0.61	0.038
9	0.34	0.021	0.45	0.028	0.55	0.035	0.63	0.040	0.70	0.044	0.77	0.049
10	0.43	0.027	0.55	0.035	0.68	0.043	0.78	0.049	0.88	0.056	1.00	0.063
11	0.52	0.033	0.67	0.042	0.82	0.052	0.94	0.059	1.06	0.067	1.16	0.073
12	0.62	0.039	0.80	0.050	0.98	0.062	1.13	0.071	1.26	0.079	1.38	0.087
13	0.73	0.046	0.94	0.059	1.15	0.073	1.33	0.084	1.48	0.093	1.62	0.102
14	0.84	0.053	1.08	0.068	1.33	0.084	1.53	0.097	1.72	0.109	1.88	0.119
15	0.97	0.061	1.25	0.079	1.53	0.097	1.77	0.112	1.98	0.125	2.17	0.137
16	1.10	0.069	1.42	0.090	1.74	0.110	2.01	0.127	2.25	0.142	2.46	0.155
17	1.24	0.078	1.61	0.102	1.97	0.124	2.27	0.143	2.54	0.160	2.78	0.175
18	1.40	0.088	1.81	0.114	2.21	0.139	2.56	0.162	2.86	0.180	3.13	0.197
19	1.56	0.098	2.01	0.127	2.46	0.155	2.84	0.179	3.18	0.201	3.48	0.220
20	1.73	0.109	2.24	0.141	2.74	0.173	3.16	0.199	3.54	0.223	3.88	0.245
21	1.91	0.121	2.47	0.156	3.03	0.191	3.50	0.221	3.91	0.247	4.28	0.270
22	2.10	0.132	2.71	0.171	3.32	0.209	3.83	0.242	4.28	0.270	4.69	0.296
23	2.30	0.145	2.97	0.187	3.63	0.229	4.20	0.265	4.69	0.296	5.14	0.324
24	2.51	0.158	3.23	0.204	3.96	0.250	4.57	0.288	5.11	0.322	5.60	0.353
25	2.72	0.172	3.51	0.221	4.30	0.271	4.97	0.314	5.55	0.350	6.08	0.384
26	2.94	0.185	3.80	0.240	4.65	0.293	5.37	0.339	6.01	0.379	6.58	0.415
27	3.18	0.201	4.10	0.259	5.03	0.317	5.80	0.366	6.49	0.409	7.11	0.449
28	3.42	0.216	4.42	0.279	5.41	0.341	6.25	0.394	6.98	0.440	7.65	0.483
29	3.65	0.230	4.71	0.297	5.77	0.364	6.66	0.420	7.45	0.470	8.16	0.515
30	3.91	0.247	5.05	0.319	6.18	0.390	7.14	0.450	7.98	0.503	8.74	0.551
31	4.13	0.261	5.33	0.336	6.53	0.412	7.54	0.476	8.43	0.532	9.24	0.583
32	4.39	0.277	5.66	0.357	6.94	0.438	8.01	0.505	8.96	0.565	9.81	0.619
33	4.68	0.295	6.04	0.381	7.39	0.466	8.54	0.539	9.55	0.603	10.46	0.660
34	4.97	0.314	6.41	0.404	7.85	0.495	9.07	0.572	10.14	0.640	11.10	0.700
35	5.27	0.332	6.80	0.429	8.33	0.526	9.62	0.607	10.75	0.678	11.78	0.743
36	5.57	0.351	7.19	0.454	8.81	0.556	10.17	0.642	11.37	0.717	12.45	0.785
37	5.94	0.375	7.66	0.483	9.39	0.592	10.84	0.684	12.12	0.765	13.28	0.838
38	6.35	0.401	8.20	0.517	10.04	0.633	11.60	0.732	12.96	0.818	14.20	0.896
39	6.67	0.421	8.61	0.543	10.54	0.665	12.17	0.768	13.61	0.859	14.91	0.941
40	7.01	0.442	9.05	0.571	11.09	0.700	12.80	0.808	14.31	0.903	15.68	0.989
41	7.36	0.464	9.50	0.599	11.63	0.734	13.43	0.847	15.02	0.948	16.45	1.038
42	7.75	0.489	10.01	0.632	12.26	0.773	14.16	0.893	15.83	0.999	17.34	1.094
43	8.09	0.510	10.45	0.659	12.79	0.807	14.77	0.932	16.52	1.042	18.09	1.141
44	8.49	0.536	10.96	0.691	13.42	0.847	15.50	0.978	17.33	1.093	18.98	1.197
45	8.93	0.563	11.53	0.727	14.12	0.891	16.31	1.029	18.23	1.150	19.97	1.260
46	9.30	0.587	12.01	0.758	14.71	0.928	16.98	1.071	18.99	1.198	20.80	1.312
47	9.73	0.614	12.57	0.793	15.39	0.971	17.77	1.121	19.87	1.254	21.77	1.373
48	10.10	0.637	13.04	0.823	15.97	1.008	18.44	1.163	20.61	1.300	22.58	1.425
49	10.52	0.664	13.58	0.857	16.63	1.049	19.20	1.211	21.47	1.355	23.52	1.484
50	10.96	0.691	14.15	0.893	17.32	1.093	20.00	1.262	22.37	1.411	24.50	1.546
51	11.42	0.720	14.74	0.930	18.05	1.139	20.84	1.315	23.30	1.470	25.53	1.611
52	11.86	0.748	15.31	0.966	18.76	1.184	21.66	1.367	24.21	1.527	26.53	1.674

This flow data was obtained under ideal test conditions and may be adversely affected by other hydraulic conditions.

Senninger Spray and I-Wob Nozzle Performance GPM (LPS)

Nozzle Size Number 64th	Base Pressure PSI											
	6 PSI		10 PSI		15 PSI		20 PSI		25 PSI		30 PSI	
	GPM	lps	GPM	lps	GPM	lps	GPM	lps	GPM	lps	GPM	lps
5	0.43	0.027	0.55	0.035	0.66	0.042	0.76	0.048	0.87	0.055	0.97	0.061
6	0.64	0.040	0.82	0.052	0.98	0.062	1.14	0.072	1.27	0.080	1.40	0.088
7	0.87	0.055	1.12	0.071	1.34	0.085	1.56	0.098	1.73	0.109	1.90	0.120
8	1.12	0.071	1.45	0.091	1.73	0.109	2.01	0.127	2.23	0.141	2.45	0.155
9	1.41	0.089	1.82	0.115	2.17	0.137	2.52	0.159	2.79	0.176	3.06	0.193
10	1.74	0.110	2.25	0.142	2.69	0.170	3.12	0.197	3.47	0.219	3.81	0.240
11	2.05	0.129	2.65	0.167	3.21	0.203	3.76	0.237	4.17	0.263	4.57	0.288
12	2.45	0.155	3.16	0.199	3.81	0.240	4.45	0.281	4.96	0.313	5.47	0.345
13	2.92	0.184	3.77	0.238	4.50	0.284	5.23	0.330	5.84	0.368	6.44	0.406
14	3.40	0.215	4.39	0.277	5.24	0.331	6.09	0.384	6.82	0.430	7.54	0.476
15	3.91	0.247	5.05	0.319	6.03	0.380	7.00	0.442	7.82	0.493	8.64	0.545
16	4.48	0.283	5.79	0.365	6.91	0.436	8.03	0.507	8.93	0.563	9.82	0.620
17	5.03	0.317	6.50	0.410	7.76	0.490	9.01	0.568	10.02	0.632	11.03	0.696
18	5.62	0.355	7.25	0.457	8.65	0.546	10.04	0.633	11.15	0.703	12.25	0.773
19	6.19	0.391	7.99	0.504	9.54	0.602	11.08	0.699	12.32	0.777	13.55	0.855
20	6.78	0.428	8.75	0.552	10.44	0.659	12.13	0.765	13.56	0.856	14.99	0.946
21	7.37	0.465	9.52	0.601	11.36	0.717	13.20	0.833	14.81	0.934	16.41	1.035
22	7.97	0.503	10.29	0.649	12.28	0.775	14.27	0.900	16.09	1.015	17.90	1.129
23	8.86	0.559	11.18	0.705	13.34	0.842	15.50	0.978	17.50	1.104	19.49	1.230
24	9.34	0.589	12.06	0.761	14.40	0.908	16.73	1.055	18.88	1.191	21.03	1.327
25	10.10	0.637	13.04	0.823	15.56	0.982	18.08	1.141	20.35	1.284	22.61	1.426
26	10.92	0.689	14.10	0.890	16.83	1.062	19.56	1.234	21.88	1.380	24.20	1.527

For the 180 degree spray deduct 4% of above figures.

This flow data was obtained under ideal test conditions and may be adversely affected by other hydraulic conditions.

Sprinklers

Nelson Spray Nozzle Performance GPM (LPS)

Nozzle Size Number 128th	Base Pressure PSI															
	6 PSI		10 PSI		15 PSI		20 PSI		25 PSI		30 PSI		40 PSI		50 PSI	
	GPM	lps	GPM	lps	GPM	lps	GPM	lps	GPM	lps	GPM	lps	GPM	lps	GPM	lps
9	0.34	0.021	0.44	0.028	0.53	0.033	0.62	0.039	0.69	0.044	0.76	0.048	0.87	0.055	0.97	0.061
10	0.42	0.026	0.54	0.034	0.66	0.042	0.76	0.048	0.85	0.054	0.93	0.059	1.07	0.068	1.20	0.076
11	0.50	0.032	0.65	0.041	0.79	0.050	0.92	0.058	1.02	0.064	1.12	0.071	1.29	0.081	1.45	0.091
12	0.61	0.038	0.79	0.050	0.96	0.061	1.11	0.070	1.24	0.078	1.36	0.086	1.57	0.099	1.76	0.111
13	0.71	0.045	0.92	0.058	1.13	0.071	1.30	0.082	1.46	0.092	1.59	0.100	1.84	0.116	2.06	0.130
14	0.82	0.052	1.06	0.067	1.29	0.081	1.49	0.094	1.67	0.105	1.83	0.115	2.11	0.133	2.36	0.149
15	0.95	0.060	1.23	0.078	1.51	0.095	1.74	0.110	1.95	0.123	2.14	0.135	2.47	0.156	2.76	0.174
16	1.08	0.068	1.40	0.088	1.71	0.108	1.98	0.125	2.25	0.142	2.42	0.153	2.80	0.177	3.13	0.197
17	1.22	0.077	1.58	0.100	1.93	0.122	2.23	0.141	2.50	0.158	2.74	0.173	3.16	0.199	3.53	0.223
18	1.36	0.086	1.75	0.110	2.14	0.135	2.48	0.156	2.77	0.175	3.03	0.191	3.50	0.221	3.91	0.247
19	1.53	0.097	1.97	0.124	2.41	0.152	2.79	0.176	3.12	0.197	3.41	0.215	3.94	0.249	4.41	0.278
20	1.70	0.107	2.19	0.138	2.69	0.170	3.10	0.196	3.47	0.219	3.80	0.240	4.39	0.277	4.90	0.309
21	1.84	0.116	2.38	0.150	2.91	0.184	3.36	0.212	3.76	0.237	4.12	0.260	4.76	0.300	5.32	0.336
22	2.04	0.129	2.64	0.167	3.23	0.204	3.73	0.235	4.17	0.263	4.56	0.288	5.27	0.332	5.89	0.372
23	2.22	0.140	2.86	0.180	3.50	0.221	4.05	0.256	4.52	0.285	4.96	0.313	5.72	0.361	6.40	0.404
24	2.44	0.154	3.16	0.199	3.86	0.244	4.46	0.281	4.99	0.315	5.47	0.345	6.31	0.398	7.06	0.445
25	2.64	0.167	3.41	0.215	4.17	0.263	4.82	0.304	5.38	0.339	5.90	0.372	6.81	0.430	7.61	0.480
26	2.87	0.181	3.70	0.233	4.53	0.286	5.23	0.330	5.85	0.369	6.41	0.404	7.40	0.467	8.28	0.522
27	3.07	0.194	3.97	0.250	4.86	0.307	5.61	0.354	6.27	0.396	6.87	0.433	7.94	0.501	8.87	0.560
28	3.35	0.211	4.32	0.273	5.29	0.334	6.11	0.385	6.83	0.431	7.48	0.472	8.64	0.545	9.66	0.609
29	3.58	0.226	4.62	0.291	5.66	0.357	6.53	0.412	7.30	0.461	8.00	0.505	9.24	0.583	10.33	0.652
30	3.83	0.242	4.94	0.312	6.06	0.382	6.99	0.441	7.82	0.493	8.56	0.540	9.89	0.624	11.06	0.698
31	4.06	0.256	5.24	0.331	6.41	0.404	7.40	0.467	8.28	0.522	9.07	0.572	10.47	0.661	11.71	0.739
32	4.36	0.275	5.63	0.355	6.89	0.435	7.96	0.502	8.90	0.562	9.75	0.615	11.26	0.710	12.59	0.794
33	4.65	0.293	6.00	0.379	7.35	0.464	8.49	0.536	9.49	0.599	10.39	0.656	12.00	0.757	13.42	0.847
34	4.94	0.312	6.37	0.402	7.81	0.493	9.01	0.568	10.08	0.636	11.04	0.697	12.75	0.804	14.25	0.899
35	5.20	0.328	6.72	0.424	8.23	0.519	9.50	0.599	10.62	0.670	11.64	0.734	13.44	0.848	15.02	0.948
36	5.47	0.345	7.06	0.445	8.65	0.546	9.98	0.630	11.16	0.704	12.23	0.772	14.12	0.891	15.79	0.996
37	5.84	0.368	7.54	0.476	9.24	0.583	10.67	0.673	11.92	0.752	13.06	0.824	15.08	0.951	16.86	1.064
38	6.18	0.390	7.97	0.503	9.77	0.616	11.28	0.712	12.61	0.796	13.81	0.871	15.95	1.006	17.83	1.125
40	6.85	0.432	8.85	0.558	10.84	0.684	12.51	0.789	13.99	0.883	15.33	0.967	17.70	1.117	19.79	1.249
42	7.60	0.479	9.81	0.619	12.01	0.758	13.87	0.875	15.51	0.979	16.99	1.072	19.61	1.237	21.93	1.384
44	8.33	0.526	10.75	0.678	13.17	0.831	15.20	0.959	17.00	1.073	18.62	1.175	21.50	1.356	24.04	1.517
46	9.12	0.575	11.77	0.743	14.41	0.909	16.64	1.050	18.61	1.174	20.38	1.286	23.54	1.485	26.31	1.660
48	9.96	0.628	12.86	0.811	15.75	0.994	18.19	1.148	20.33	1.283	22.28	1.406	25.72	1.623	28.76	1.814
50	10.77	0.679	13.91	0.878	17.03	1.074	19.67	1.241	21.99	1.387	24.09	1.520	27.82	1.755	31.10	1.962

This flow data was obtained under ideal test conditions and may be adversely affected by other hydraulic conditions.

Pressure Regulators

The below Figure 6-21-1 pertains to the impact of elevation on sprinkler flow. Systems that are not equipped with pressure regulators at the base of each sprinkler will experience variations in nozzle discharge as shown by the chart.

Pressure Regulators are optionally available to allow operation on varied terrain. A properly selected pressure regulator at the base of each sprinkler or spray nozzle will provide a constant flow rate over wide variations in elevation. They are normally recommended if there is a variation of 10% or more in water application.

Selection of the appropriate pivot pressure is vital with pressure regulators. Basically the pivot pressure must reflect pipeline friction loss, end pressure desired, pressure regulator loss (5 PSI (0.34 bar)) and the maximum field elevation above the pivot elevation.

$$\text{Pivot Pressure} = \text{Friction Loss} + \text{End Pressure} + \text{Pressure Regulator (5 PSI)} + \frac{\text{Highest Elevation in Field Above Pivot Point (ft)}}{2.31}$$

Metric

$$\text{Pivot Pressure (Bar)} = \text{Friction Loss} + \text{End Pressure} + \text{Pressure Regulator (0.34 bar)} + \frac{\text{Highest Elevation in Field Above Pivot Point (m)}}{10.2}$$

Effect of Elevation on Sprinkler Flow						
End Pressure			Maximum Elevation Variation in ft ** (m)			
6 PSI	(0.41 bar)		2.8	(0.85 m)	5.5	(1.67 m)
10 PSI	(0.68 bar)		4.5	(1.37 m)	9	(2.74 m)
15 PSI	(1.03 bar)		6.8	(2.07 m)	12.6	(3.84 m)
20 PSI	(1.37 bar)	} Spray	9	(2.74 m)	16	(4.87 m)
30 PSI	(2.06 bar)	} Nozzle	13	(3.96 m)	24	(7.31 m)
40 PSI	(2.75 bar)	}	17	(5.18 m)	33	(10.05 m)
50 PSI	(3.44 bar)	} Impact	22	(6.70 m)	41	(12.49 m)
60 PSI	(4.13 bar)	} Sprinkler	26	(7.92 m)	49	(14.93 m)
70 PSI	(4.82 bar)	}	31	(9.44 m)	57	(17.37 m)
			10% Variation in-Water Application		20% Variation in-Water Application	

Figure 6-21-1

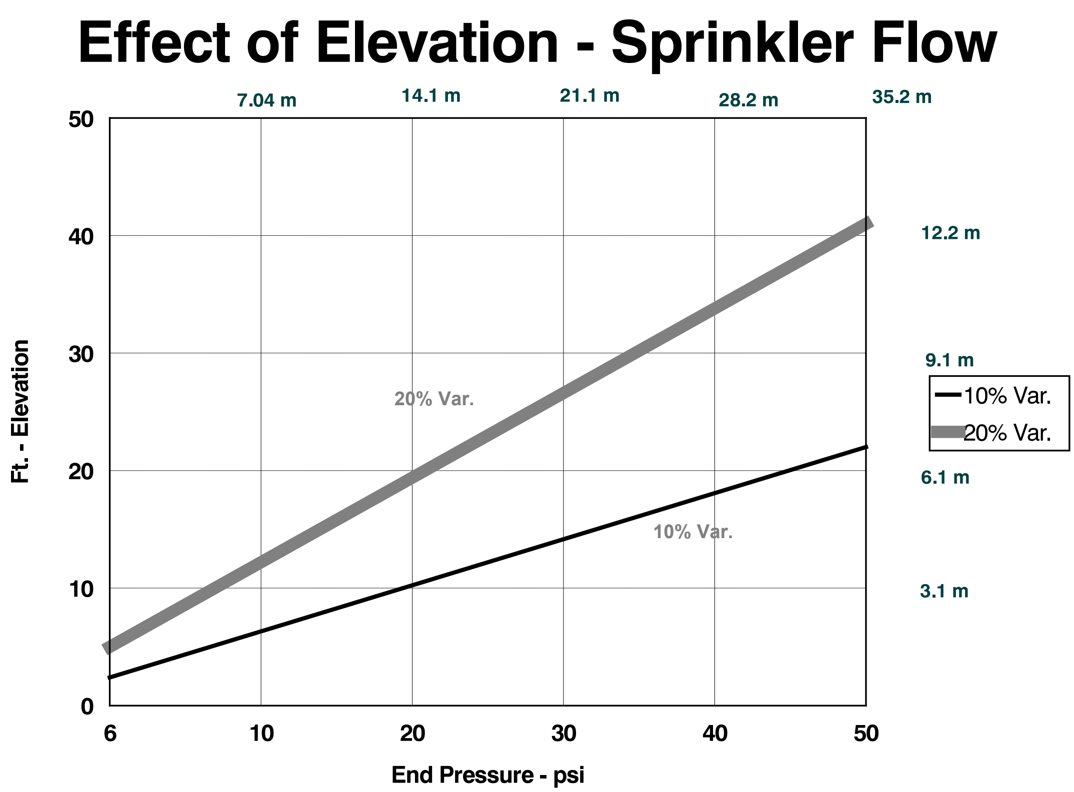
** For sprinklers without pressure regulating flow controls.*
***Above or below pivot elevation.*

Listed below are the maximum pressures which should be applied to the corresponding pressure regulators to insure proper operation.

Regulator		Max. Pressure Applied	
6 PSI	(0.41 bar)	120 PSI	(8.27 bar)
20 PSI	(1.37 bar)	120 PSI	(8.27 bar)
30 PSI	(2.06 bar)	120 PSI	(8.27 bar)
40 PSI	(2.75 bar)	120 PSI	(8.27 bar)
50 PSI	(3.44 bar)	120 PSI	(8.27 bar)

Damage to regulators as a result of higher than recommended pressures is not covered by warranty. Corner system pressure may vary as arm extends and retracts. Designer should verify pump curve to insure pressure increase does not exceed maximum pressure ratings of pressure regulator.

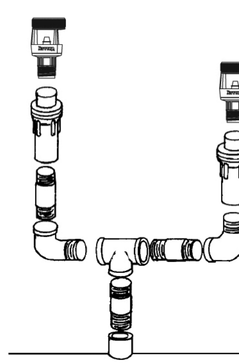
Pressure Regulators (Continued)



Formula for determining the Flow Deviation relative to elevation and end pressure:

$$\% \text{ Flow Deviation} = \frac{\text{Feet of Elevation Change}}{4.62 \times \text{End Pressure}} \times 100$$

When the flow in a regulator exceeds the regulator capacity a double regulator is required and will be mounted as shown below.



End Gun/Booster Pump

End guns can provide economical and effective irrigation coverage if designed and selected properly. The application under the end gun should be matched as closely as possible to the application under the system. This requires determining the gallonage of water needed for the effective end gun radius desired and selection of the proper end gun and nozzle size. It may also be necessary to incorporate a booster pump to optimize the end gun effectiveness on low pressure systems.

The following information is provided to assist you in the design and selection of end guns and booster pumps.

General Guidelines

The Recommended End Guns on page 6-27 lists the system length, system flow and various end guns recommended. This chart will indicate the end gun(s) that have the capacity to provide the water necessary to match that applied under the system.

All end guns require a minimum pressure for proper operation (see Figure 4 on page 6-26). Systems with low pressure sprinkler packages will require a booster pump for proper operation in most instances.

Effective range is also an important factor in end gun application. Range will be dependent on the end gun pressure, model and nozzle size of the end gun. Typical effective ranges of end guns at 40 PSI (2.76 bar), 50 PSI (3.45 bar), 60 PSI (4.14 bar) and 70 PSI (4.83 bar) are shown in Figure 5 on page 6-26 . The effective ranges shown will not necessarily be the ranges that are published by the end gun manufacturer but is the distance that the amount of water applied closely matches that under the system. Even though water application may extend past this point, it will progressively be less than that under the system.

Specific Design

Determining the specific end gun and nozzle for a system requires finding the flow necessary for the end gun. This is based on three factors - system length, system flow, and the effective end gun range desired. End gun gallonage is then determined by the following formula:

$$\text{E.G. Gal.} = (\text{Sys. GPM}) \times \left[\frac{(SL + EGR) - (SL)}{(SL + EGR)} \right]$$

SL = System Length

EGR = End Gun Radius

Once the end gun flow has been determined an end gun and nozzle size must be selected to match the gallonage requirement. Fig. 6 to Fig. 8 lists the nozzle sizes and ranges.

Achieving the range and flow requires the end gun to operate at the pressure specified on the charts shown for Figure 6, Figure 7 (see page 6-29), and Figure 8 (see page 6-30). If this system is a low pressure system, a booster pump will be required to increase the pressure.

Selection of the proper booster pump is dependent on the end gun flow required and the pressure needed to provide the flow and range. Refer to page 6-28 to view the pump curves of the booster pumps available. The pump that has the capacity for the flow needed must be used. Knowing that flow, you can determine the amount of pressure boost that the pump will provide. This value must then be added to the end pressure of the system to find the total pressure available from the pump.

Plumbing from the pump to the end gun includes various lengths and sizes of hose along with a valve and miscellaneous fittings. Depending on these variables, there will be a certain amount of friction loss (pressure drop) from the pump to the end gun. This loss must be subtracted from the pressure available at the pump to determine the actual pressure available at the end gun. The losses for the valves and hoses are shown on page 6-28.

METRIC

$$\text{E.G. Flow} = (\text{Sys. LPS}) \times \left[\frac{(SL + EGR) - (SL)}{(SL + EGR)} \right]$$

SL = System Length in Meters

EGR = End Gun Radius in Meters

End Gun/Booster Pump (Continued)

The procedure for design and selection of an end gun and pump can best be shown by the following examples:

Example #1

Model 8000	**English**	**Metric**
System Length:	1300 ft	396.2 m
System GPM:	600 GPM	37.85 lps
Effective End Gun Range Desired:	60 ft	18.29 m
Sprinkler Package:	Valley LEN (10 PSI)	0.68 bar
Overhang Length:	82 ft	25.0 m
Booster Pump:	2 hp	

STEP 1

End Gun GPM = Sys. GPM x $\frac{(SL + EGR) - (SL)}{(SL + EGR)}$

$= 600 \; \frac{(1300 \text{ ft} + 65 \text{ ft}) - (1300 \text{ ft})}{(1300' + 65')}$

$= 600 \; \frac{(65)}{(1365)}$

$= 600 \; (.048)$

$=$ 29 GPM

Metric Conversion

$37.85 \text{ lps} \; \frac{(396.2 \text{ m} + 19.81 \text{ m}) - (396.2 \text{ m})}{(396.2 \text{ m} + 19.81 \text{ m})}$

$37.85 \text{ lps} \; \frac{(19.81 \text{ m})}{(416.01 \text{ m})}$

37.85 lps (.048 m)

2.10 lps

STEP 2

Booster Pump and Plumbing: The Booster Pump Curve shows that a 2 hp pump will provide a pressure booster of 33 PSI. The total pressure available at the pump will be the 33 PSI (2.27 bar) boost plus the 10 PSI (0.68 bar) of the sprinkler package (43 PSI). Pressure loss through the end gun valve, fittings and hose is approximately 1 PSI. The end gun pressure will be 33 + 10 -1 = 42 PSI.

STEP 3

End Gun and Nozzle Selection: Reviewing the charts, the Nelson SR75 end gun will provide the 29 GPM using a 0.40 in nozzle at approximately 40 PSI (2.75 bar). The chart shows arrange of approximately 76 ft (23.16 m), but this is not the effective range. The 76 ft (23.16 m) must be multiplied by .78 to determine the effective radius.

76 ft (23.16 m) x .78 = 60 ft

This radius fits the desired coverage.

End Gun/Booster Pump (Continued)

Example #2

Model 8000

System Length - 2092 ft (637.6 m)

System GPM - 2500 GPM (157.72 lps)

Effective End Gun Radius Desire - 100 ft (30.48 m)

10 PSI End Pressure

5 hp Booster Pump

System Configuration: 10 - 135 ft /10 in

3 - 160 ft / 8-5/8 in

1 - 180 ft / 6 5/8 in

1 - 82 ft overhang

STEP 1

Required End Gun Gallonage $= 2500 \times \frac{(2092\text{ ft} + 105\text{ ft}) - (2092\text{ ft})}{(2092\text{ ft} + 105\text{ ft})}$

$= 2500 \quad \frac{(2197) - (2092)}{2197}$

$= 2500 \quad (.048)$

= 120 End Gun GPM

STEP 2

Booster Pump and Plumbing

Effective pressure boost for end gun =

41 PSI + 10 PSI – loss in valve and hose (approx. 8 PSI) = 43

STEP 3

End Gun and Nozzle Selection

120 GPM will require a Nelson SR100 0.80 in nozzle @ 40 PSI.

Effective range = 125 ft x .78 = 98 ft

End Gun/Booster Pump (Continued)

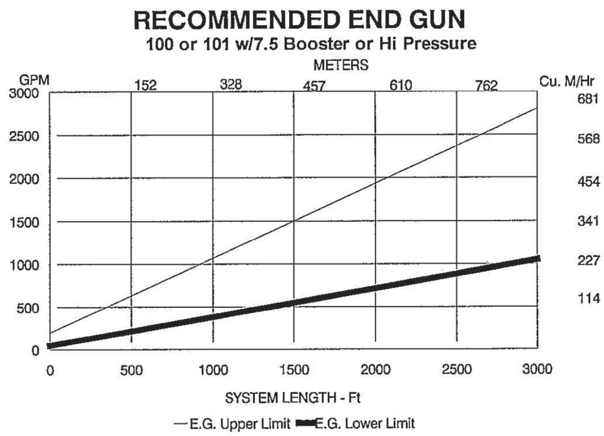
Figure 4

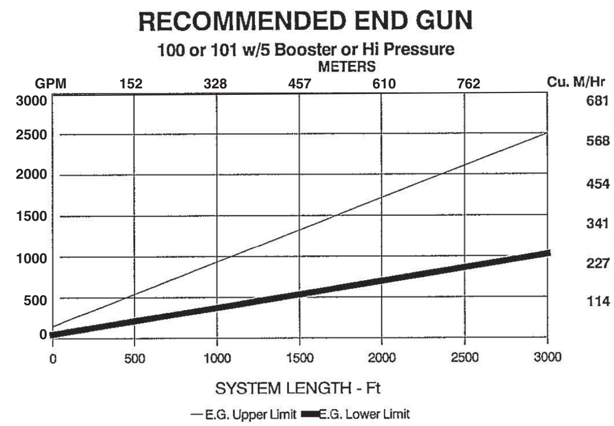
End Gun Type	Minimum Required Operating	
	PSI	Bar
65	30	2.06
85	30	2.06
100	30	2.06
150	50	3.44

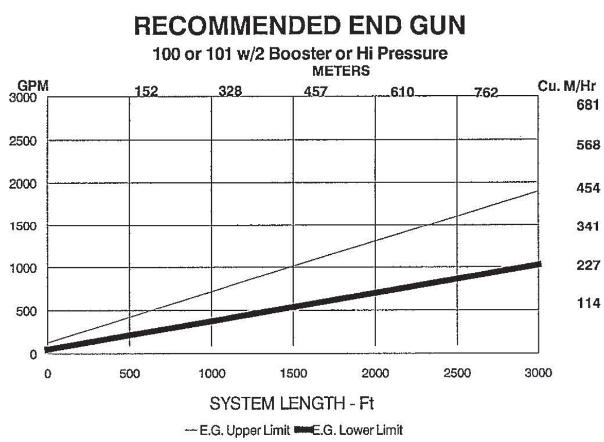
Figure 5

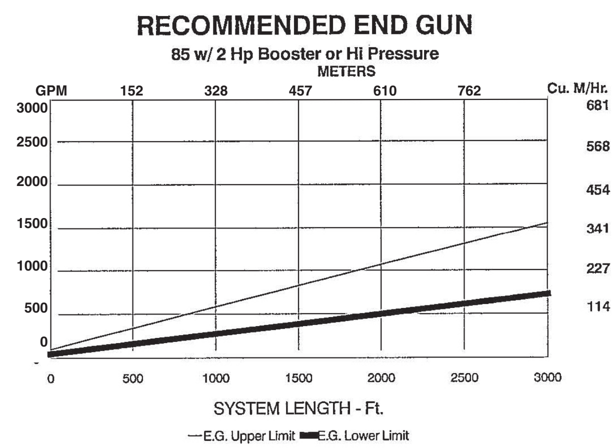
Typical Effective End Gun Ranges In Feet								
Pressure								
End Gun	40 PSI	(2.76 bar)	50 PSI	(3.45 bar)	60 PSI	(4.14 bar)	70 PSI	(4.83 bar)
65	37	11.3 M	40	12.2 M	44	13.4 M	46	14 M
85	68	20.7 M	76	23.2 M	79	24.1 M	81	24.7 M
100 or 101	90	27.4 M	96	29.3 M	101	30.8 M	107	32.6 M

Recommended End Gun

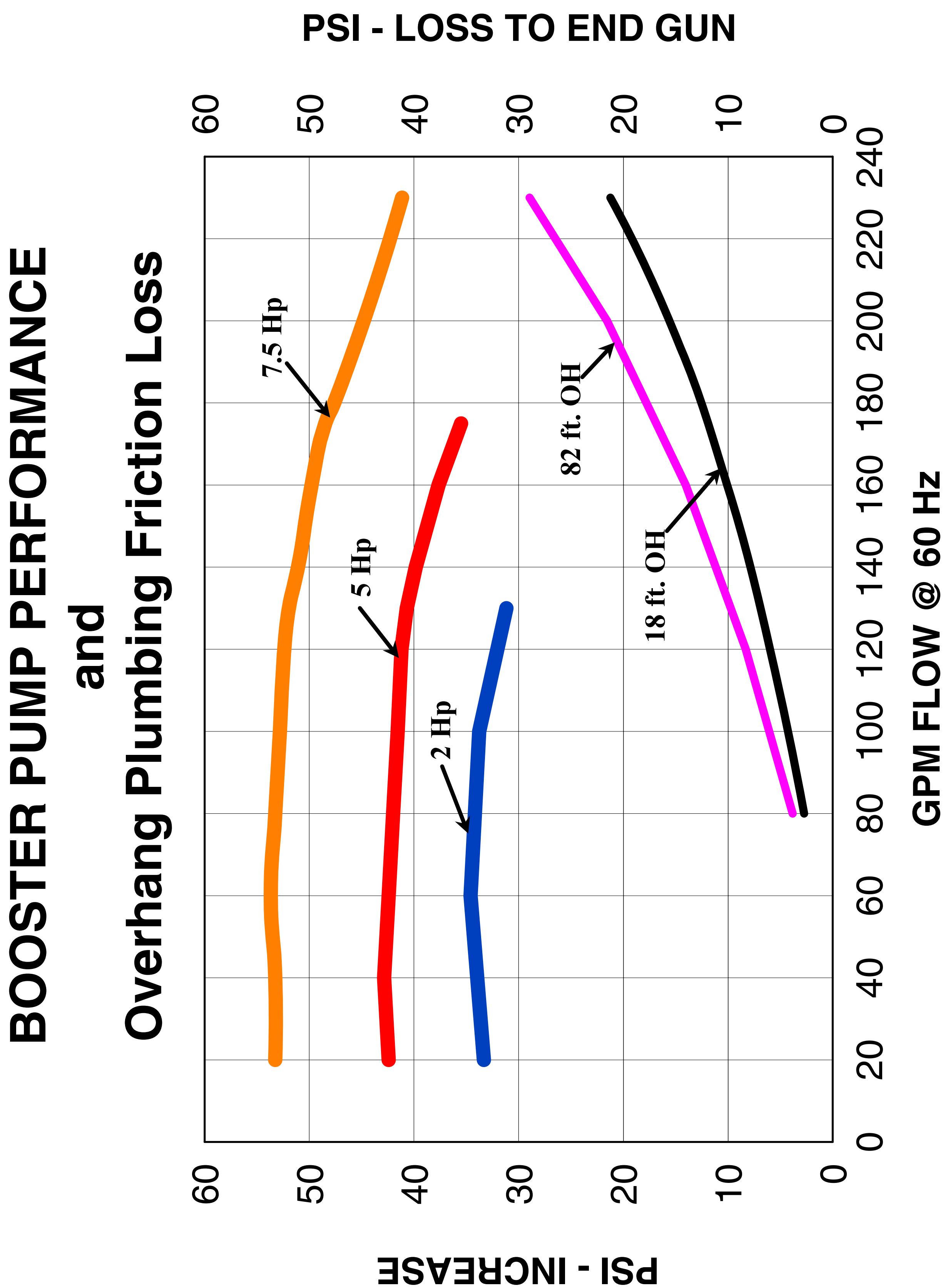








Booster Pump Performance



End Gun Performance

Rainbird 65 Series End Guns*

*Effective Radius = 69% of Max. Rad. Shown

Figure 6

PSI GPM	9/32 IN RAD FT	9/32 IN EFF RAD FT	9/32 IN MAX GPM	5/16 IN RAD FT	5/16 IN EFF RAD FT	5/16 IN MAX GPM	11/32 IN RAD FT	11/32 IN EFF RAD FT	11/32 IN MAX GPM	3/8 IN RAD FT	3/8 IN EFF RAD FT	3/8 IN MAX
40	14.6	39	57	17.7	41	59	21.1	41	60	24.4	43	62
45	15.5	40	58	18.9	42	61	22.5	43	63	26.0	45	65
50	16.3	41	60	20.0	43	63	23.8	45	65	27.5	46	67
55	17.2	43	62	21.0	45	65	25.0	46	67	29.1	48	70
60	18.0	45	65	22.0	46	67	26.1	48	69	30.6	50	73
65	18.8	46	67	23.0	48	69	27.4	48	70	32.0	51	74
70	19.5	48	70	23.9	49	71	28.5	50	72	33.2	52	75
75	20.3	49	71	24.8	50	73	29.6	51	74	34.5	52	76
80	20.9	50	72	25.7	52	75	30.6	52	76	35.7	53	77

Nelson P85 or Rainbird 85 Series End Guns*

*Effective radius = 78% of Max. Rad. Shown

Figure 7

PSI	13/32 IN GPM	13/32 IN EFF RAD FT	13/32 IN MAX RAD FT	7/16 IN GPM	7/16 IN EFF RAD FT	7/16 IN MAX RAD FT	15/32 IN GPM	15/32 IN EFF RAD FT	15/32 IN MAX RAD FT	1/2 IN GPM	1/2 IN EFF RAD FT	1/2 IN MAX RAD FT	17/32 IN GPM	17/32 IN EFF RAD FT	17/32 IN MAX RAD FT	9/16 IN GPM	9/16 IN EFF RAD FT	9/16 IN MAX RAD FT	5/8 IN GPM	5/8 IN EFF RAD FT	5/8 IN MAX RAD FT	5/8" X 7/32 IN GPM	5/8" X 7/32 IN EFF RAD FT	5/8" X 7/32 IN MAX RAD FT
15										26	37	47	28	37	48	39	34	44	49					
20										30	45	58	33	46	59	37	47	60	46	49	63	51	48	62
25										34	51	66	37	53	68	42	54	69	51	56	72	57	56	72
30										37	57	73	41	58	74	46	59	75	56	60	77	62	60	77
35										40	61	78	44	62	79	50	62	80	61	64	82	67	60	82
40										43	64	82	47	66	84	54	66	85	65	68	87	72	68	87
50	33	62	79	38	63	81	43	66	84	48	68	87	53	70	90	60	73	94	73	76	97	80	76	97
55	35	65	83	40	67	86	45	67	86	50	69	89	56	72	92	63	75	96	77	77	99	84	77	99
60	36	65	83	41	68	87	47	69	88	53	71	91	59	73	94	65	76	97	80	79	101	88	79	101
65	37	66	84	50	69	89	50	70	90	55	73	93	61	75	96	69	77	99	84	80	102	91	80	102
70	39	67	86	45	70	90	51	71	91	57	73	94	63	76	98	72	79	101	87	81	104	95	81	104
75	40	68	87	47	72	92	53	73	93	59	75	96	66	77	99	75	80	102	91	82	105	98	82	105
80	42	69	89	48	73	93	55	73	94	61	76	97	68	79	101	77	81	104	94	83	107	101	83	107
85	43	70	90	50	73	94	57	75	96	63	77	99	70	80	102	80	82	105	97	84	108	104	84	108
90	45	72	92	51	74	95	58	76	97	65	78	100	72	81	104	82	83	106	100	86	110	107	86	110
95	46	73	93	53	75	96	60	76	98	67	79	101	74	82	105	84	84	108	103	87	111	110	87	111
100	47	73	94	54	76	97	61	77	99	69	80	102	76	83	106	87	85	109	105	87	112	113	87	112

End Gun Performance (Continued)

Figure 8

Komet Twin Sr101 or Nelson Sr 100 "BIG GUN"
Effective Radius = 78% of Max. Rad. Shown

	.5 IN			.55 IN			.6 IN			.65 IN			.7 IN			.75 IN			.8 IN			.85 IN			.9 IN		
PSI	GPM	EFF RAD	MAX RAD	GPM	EFF RAD	MAX RAD	GPM	EFF RAD	MAX RAD	GPM	EFF RAD	MAX RAD	GPM	EFF RAD	MAX RAD	GPM	EFF RAD	MAX RAD	GPM	EFF RAD	MAX RAD	GPM	EFF RAD	MAX RAD	GPM	EFF RAD	MAX RAD
		FT	FT		FT	FT		FT	FT		FT	FT		FT	FT		FT	FT		FT	FT		FT	FT		FT	FT
40	47	75	96	57	79	101	66	83	106	78	87	111	91	90	115	103	94	120	118	98	125	134	100	128	152	102	131
50	50	80	102	64	83	107	74	87	112	87	91	117	100	95	122	115	100	128	130	103	132	150	106	136	165	109	140
60	55	84	108	69	88	113	81	84	120	96	98	125	110	101	130	126	105	135	143	109	140	164	114	146	182	115	147
70	60	88	112	75	93	119	88	98	125	103	102	131	120	107	137	136	110	141	155	115	147	177	118	151	197	121	155
80	64	92	118	79	97	124	94	101	130	110	106	136	128	111	142	146	115	147	165	119	152	189	122	157	210	126	162
90	68	95	122	83	101	129	100	105	135	117	110	141	135	115	147	155	119	153	175	130	167	201	127	163	223	132	169
100	72	99	128	87	105	134	106	109	140	123	114	146	143	119	152	163	123	158	185	126	162	212	131	168	235	137	175
110	76	103	132	92	108	139	111	113	145	129	118	151	150	122	157	171	126	162	195	130	167	222	134	172	247	138	177

Figure 8-M

METRIC
Komet Twin Sr101 or Nelson Sr 100 "BIG GUN"
Effective Radius = 78% of Max. Rad. Shown

	12.7 mm			13.9 mm			15.2 mm			16.5 mm			17.8 mm			19.1 mm			20.3 mm			21.6 mm			22.9 mm		
PSI	M³/HR	EFF RAD	MAX RAD	M³/HR	EFF RAD	MAX RAD	M³/HR	EFF RAD	MAX RAD	M³/HR	EFF RAD	MAX RAD	M³/HR	EFF RAD	MAX RAD	M³/HR	EFF RAD	MAX RAD	M³/HR	EFF RAD	MAX RAD	M³/HR	EFF RAD	MAX RAD	M³/HR	EFF RAD	MAX RAD
		M	M		M	M		M	M		M	M		M	M		M	M		M	M		M	M		M	M
28.2	10.67	22.8	29.2	12.94	24.0	30.7	14.98	25.2	32.3	17.71	26.5	33.8	20.66	27.4	35.0	23.39	28.6	36.5	26.79	29.8	38.0	30.43	30.4	39.0	34.51	31.0	39.9
35.2	11.35	24.3	31.0	14.53	25.2	32.6	16.80	26.5	34.1	19.75	27.7	35.6	22.71	28.9	37.1	26.11	30.4	39.0	29.52	31.3	40.2	34.06	32.3	41.4	37.47	33.2	42.6
42.2	12.49	25.6	32.9	15.66	26.8	34.4	18.39	25.6	36.5	21.80	29.8	38.0	24.98	30.7	39.6	28.61	32.0	41.1	32.47	33.2	42.6	37.24	34.7	44.4	41.33	35.0	44.8
49.3	13.62	26.8	34.1	17.03	28.3	36.2	19.98	29.8	38.0	23.39	31.0	39.9	27.25	32.6	41.7	30.88	33.5	42.9	35.20	35.0	44.8	40.19	35.9	46.0	44.73	36.8	47.2
56.3	14.53	28.0	35.9	17.94	29.5	37.7	21.34	30.7	39.6	24.98	32.3	41.4	29.06	33.8	43.2	33.15	35.0	44.8	37.47	36.2	46.3	42.92	37.1	47.8	47.69	38.4	49.3
63.4	15.44	28.9	37.1	18.84	30.7	39.3	22.71	32.0	41.1	26.57	33.5	42.9	30.65	35.0	44.8	35.20	36.2	46.6	39.74	39.6	50.8	45.64	38.7	49.6	50.64	40.2	51.5
70.4	16.35	30.1	39.0	19.75	32.0	40.8	24.07	33.2	42.6	27.93	34.7	44.4	32.47	36.2	46.3	37.01	37.4	48.1	42.01	38.4	49.3	48.14	39.9	51.2	53.36	41.7	53.5
77.4	17.25	31.3	40.2	20.89	32.9	42.3	25.20	34.4	44.1	29.29	35.9	46.0	34.06	37.1	47.8	38.83	38.4	49.3	44.28	39.6	50.8	50.41	40.8	52.4	56.09	42.0	53.9

Soil/Water Relationship

Water management is a term which has been often seen in publications in recent months to describe a process designed to conserve water and energy while maintaining an adequate supply of moisture to the plant. However, it is impossible to achieve total management of water without first understanding characteristics of soil, water and the plant. Within each of these three major areas there are facts which must also be understood to effectively design, operate and manage a sprinkler system. So far as the irrigator is concerned, the basic reason for purchasing equipment most likely is to increase yield levels for increased profits. In other words, an irrigator has purchased a management tool which enables him to be more effective, efficient and more profitable.

Irrigation scheduling is one facet of water management. Irrigation scheduling is the timely delivery of water in such quantity as to maintain optimum plant growth during the growth cycle. Timing of irrigation is more important than is the total application amount. An example might be in an area where 30 to 40 inches or more rainfall occurs during the year, but it falls at a time when the crops cannot use it. This is a case where total annual rainfall was entirely adequate. However, the timing was wrong. Even with irrigation delivery, systems can fall somewhat into the same category. If through mismanagement or failure to understand the crops requirement at the time it will be required, we can also end up in much the same way; not applying water at the right time which may result in yield reduction.

Therefore, you must understand the basic soil, water, plant characteristics and relationships to help you to better understand the irrigation scheduling process.

Soil/Water Relationship (Continued)

Soil Characteristics

Just as it was important to assess soil characteristics to determine the basic design of the irrigation system, it is equally important to assess these same characteristics if effective irrigation scheduling is to be the result. To better understand this, you must first look at the various soils and see the differences in the color, slope and in the way it feels when the soil is either wet or dry. If you have dug a trench or observed the soil along the road right-of-way, you may have seen what appeared to be layers of soil. These observations can be related to a specific reason, and do indeed exert a significant influence on water holding capacity, availability and intake rates which affect irrigation scheduling.

The soil profile or the root zone is generally composed of three different layers of soil. These layers may be called topsoil, subsoil, and parent material or they may be called A B C horizons. It really means the same thing, in that the upper level, which is generally referred to as the topsoil, is the area where the greatest amount of activity occurs. This is the portion of soil that is most developed in regard to tilth and fertility. This can be illustrated by observing what happens when deep plowing deposits the subsoil on top and then by observing the yield response. It takes time to bring the new topsoil to a highly productive state.

Soil Textural Classifications

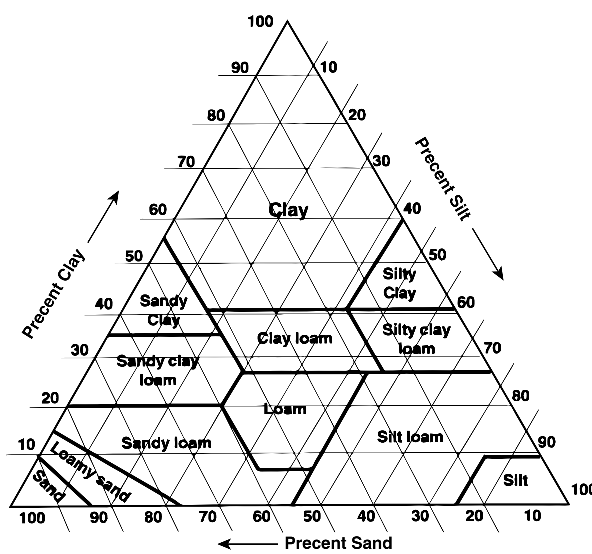
Different percentages of sand, silt and clay will comprise any soil. Reference to the table illustrates the three major classes and five general textures as related to soil textural classifications.

General terms:

Sandy soils -	Coarse-textured	Sands Loamy sands
Loamy soils -	Moderately coarse-textured	Sandy loam Fine sandy loam
	Medium-textured	Very fine sandy loam Loam Silt loam Silt
	Moderately fine-textured	Clay loam Sandy clay loam Silty clay loam
Clayey soils -	Fine-textured	Sandy clay Silty clay Clay

Each of the major soil textural classifications possesses characteristics identifiable by “feel”. For example, you can place a small amount of soil in the palm of your hand and while rubbing a sample between the thumb and palm detect certain characteristics. Sand will feel gritty and individual particles can be seen. The particles will be rough and feel much like sandpaper. Silt particles are smooth and will feel like face powder. Silt particles will be slightly sticky and plastic enough to hold its shape when wet. Clay size particles will feel slick and sticky when wet and a person will be unable to see the individual clay size particles with the naked eye. Very simply, soil texture refers to the size of the individual soil particle.

This table illustrates the proportion of sand, silt and clay for a different soil texture.



Soil Proportion Chart

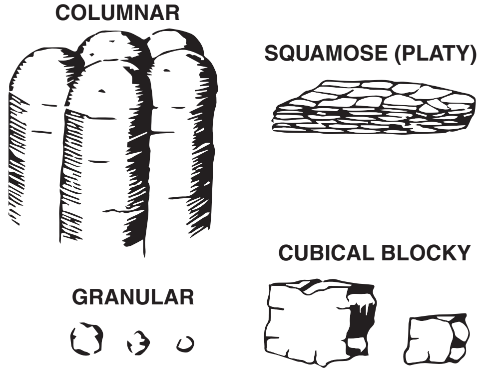
Soil/Water Relationship (Continued)

Soil Structure

The arrangement of the individual soil particles into groups, clusters or aggregates determines a soil's structure. A different structure results when the soil is dried, frozen, thawed, by the penetration of roots and with the action of organic and inorganic substances within the soil itself.

Some examples of soil structure are defined as: granular, blocky prismatic and platy. A specific structure depends on the manner in which granules or particles are bound together. These granules may function as one in some soils. With sand, a single grain may be the basic structure, or it may be held together loosely by other substances.

Soil structure affects intake rate, permeability, water holding capacity and availability per foot of profile. There will be a smaller percentage of pore space in the sandy soils than in the loams and clays. In the finer textured soils, when clusters or groups of particles function as one, pore space is increased which means improved water permeability. Soil structure will break down with excessive water movement, excessive tillage or plowing when it is too wet. This action may cause the soil surface to seal, reducing the infiltration rates and affecting water availability per foot of profile.



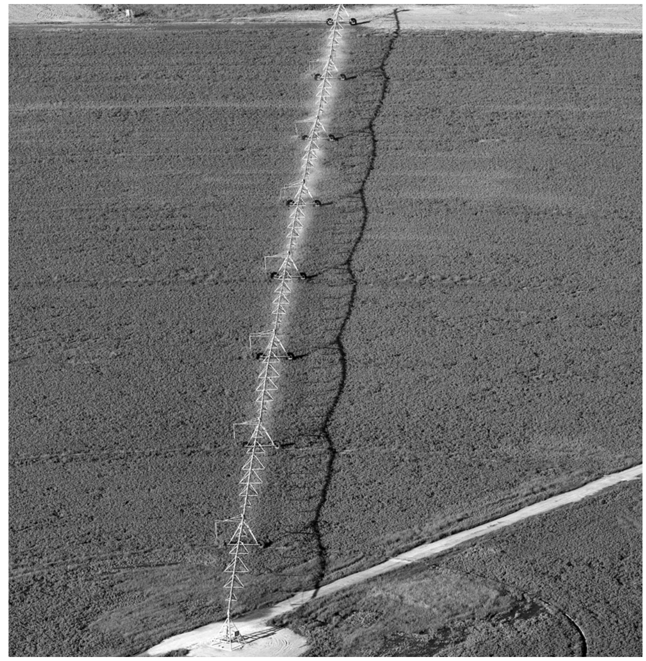
SOIL STRUCTURAL FORMS

Soil-Water Relationship

The role of schedulers of irrigation water does not end when an irrigation system has been installed in the field, nor does it end when the distribution system is actually applying water. That's why it's important to review other characteristics of the soil-water relationship.

Water Movement

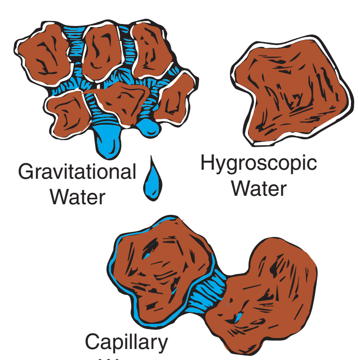
The ability of the soil to take in water influences the design of the distribution system. Water infiltration or intake rates of the soil should at least equal, if not exceed, the application rate of the distribution device. Water movement is also affected by slope, organic content, texture, structure, pore space, hard pans and chemical characteristics such as sodium status.



Understanding these characteristics will enable you to apply water in the right quantities without being wasteful. Water movement occurs in a soil along horizontal, vertical and lateral directions. This means that water will flow from an area that is wetter to an area that is drier, seeking equilibrium. Water movement also relates to adequate soil drainage which prevents the root zone from becoming waterlogged.

Types of Soil Water

When water is applied to the soil, it fills pore space in the soil and surrounds particles and clusters of soil. Gravity and capillary action aid in causing water movement to occur. Gravity tugs the water in a downward movement whereas capillary forces cause water to move in horizontal, diagonal and vertical directions. Water flowing between rows may not touch the total surface area, but after water has ceased flowing, you observe that moisture penetrates in the other areas.



Soil, Water, Crop Considerations

Soil/Water Relationship (Continued)

There are three basic types of soil water:

1. Gravitational-water – moves downward by gravity.
2. Capillary-water – moves horizontally, vertically or diagonally from soil particle to soil particle to seek equilibrium against the effects of gravity.
3. Hygroscopic moisture – a thin film of moisture that surrounds each soil particle or cluster and cannot be extracted by the plant.

Additional terms are defined as related to the quantitative question; i.e., how much, how quickly, when. These terms are saturation, field capacity, wilting point, water-holding capacity, and available water.

1. **Saturation.** Saturation is defined as the point at which free water stands on the soil surface. The surface will glisten and may even be ponded. This is a condition when run-off will likely occur on anything but level surface soils.
2. **Field capacity.** It is the quantity of water that is retained in the soil against the effect of gravity, usually measured 24 to 48 hours after a soaking rainfall or irrigation has ended. This is the upper range of the available plant moisture. It is also usually defined by the soils laboratory as a measurement at the 1/3 bar level.
3. **Wilting point.** It is the point at which the soil moisture level drops low enough so it cannot supply the plant with the necessary water to maintain plant turgor. Plant wilting will occur. This is the lower end of the available moisture range in the soil profile, and this is usually determined at the 15 bar level.
4. **Water holding capacity.** A soil profile has the capability to hold varying quantities of water depending on characteristics such as texture, structure, organic content, etc. However, not all of this water is available for the plant. The discussion of field capacity and wilting point should illustrate this. Therefore, water-holding capacity is the quantity of water that the soil profile can hold when it is in a dry state.
5. **Available water.** The quantity of water that is held in the soil between the point of field capacity and wilting point comprise that percentage of the soil water which can be extracted by the plant. This is available water with the upper 75% of this moisture being labeled as readily available moisture.

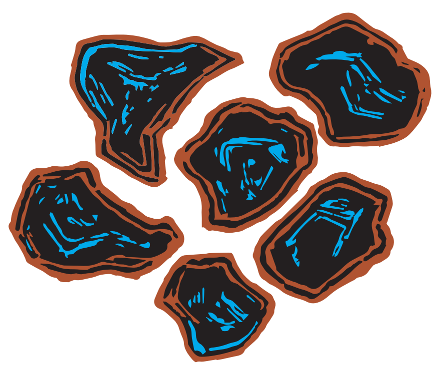
Approximate Available Soil Moisture in Various Textured Soils

	Available Moisture	
Soil Texture	**In/In**	**In/Ft**
Coarse sand and gravel	.04	0.5
Sands	.07	0.8
Loamy sands	.09	1.1
Sandy loams	.13	1.5
Fine sandy loams	.16	1.9
Loams and silt loams	.20	2.4
Clay loams and silty clay loams	.18	2.1
Silty clays and clays	.16	1.9

The water holding chart allows you to make the basic judgments of how much water will be required to replenish the soil and maintain it at a certain level of field capacity. This assures you of an adequate supply for plant growth by referring to the water holding chart.

Water

Water is retained in the soil against the effects of gravity. The plant must exert a certain amount of "pull power" to overcome the amount of tension holding water in the profile. Water contained in a soil sample can be removed by a laboratory device known as a pressure membrane apparatus. This data will be used to establish the database for the initial Comp-U-Water account. Moisture tension is usually expressed in terms of atmospheres of pressure and one atmosphere is equal to 14.72 lbs per square inch. Plants will extract moisture from the soil profile in the 0 to 15 atmosphere range with most of the water being extracted in the 0 to 2.53 atmosphere range. At the 15 atmosphere point, which approximates the 15 bar level, the plant will have extracted all of the water that it can from the soil and be in the wilting stage. The permanent wilting stage is imminent, and plant death will occur unless water is applied.



WILITING POINT

Soil/Water Relationship (Continued)

Water Storage Capacities of Soils

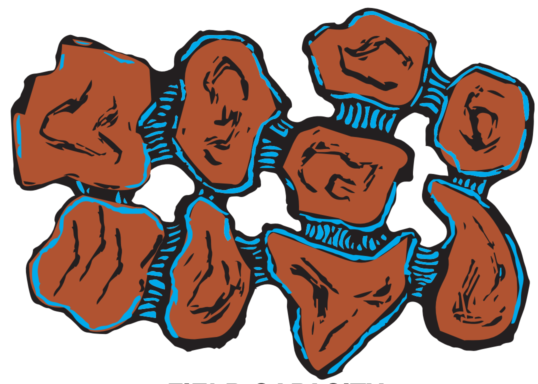
The soil's capacity to make available varying quantities of water, depending on texture, structure, depth of soil profile or rooting zone, will affect irrigation frequency and total application amount.

A growing plant will require varying quantities of water at different stages of plant growth. The water requirement commences at the time of seeding and will increase from emergence time. It peaks during the reproductive stage of growth and then gradually diminishes as the harvesting period nears. Plants are going to be the most vulnerable to water and stress generally in the early reproductive stages of plant growth. This might be identified as the flowering and the first stages of the fruit set. On corn, this would commence with the tassel and continue on through the silking and the soft dough stages. Grain sorghum's critical period exists during the boot, head extension, flowering and dough stages of growth. Wheat would be very similar, starting at the boot and extending through to the dough stages. Extreme moisture stress may cause as much as a 25% yield reduction even though the stress conditions exist for only a day or two with some crops. In extremely sensitive water use crops, such as potatoes, a day's delay may cause even greater yield loss and affect the quality.

To further discuss the water plant relationship, you must consider the consumptive use of the growing crop. Consumptive use is the quantity of water required on a daily basis to satisfy the crop needs. Consumptive use is a combined total of evaporation from the soil surface and transportation of water from the plant surfaces. This is the quantity of water, which should be replenished to assure an adequate supply of water exists to maintain crop growth.

The frequency of irrigation will be dependent upon how much water can be stored in the soil, daily withdrawal and the type of irrigation distribution method. For example: pivot irrigation systems will generally be operated more often than will the flood or the gravity irrigation method. Soils generally will not be able to accept the 4 to 6 inch depth of water applied by flooding, but they can accept the .75 to 1.5 inch application, which is usually applied by a pivot. This says that the cycle time between irrigations will be different on sprinkler systems as compared to cycle times for other methods of irrigation.

When the soil is at field capacity, the plant will not have to exert much pull power to extract water from the soil profile. If the soil moisture is allowed to diminish then the plant will have to work harder and harder to extract moisture from the soil. A greater pull power has to be exerted to overcome the increasing amount of tension that holds water in the soil at lower moisture levels.



FIELD CAPACITY

It is said by plant physiologists that water constitutes up to 90% of the weight of a fresh, lush growing plant. But only 1% of the total water is actually used in growth processes. The balance of water is used in transpiration, which in effect keeps the plant cool.

A plant will extract water from the soil profile through root contact with the soil moisture. Plants with a fibrous root system will take most of their moisture from the upper part of the soil profile. Research work conducted by government and state agencies has provided an extraction pattern shown here. This illustrates that the plant will extract up to 70% of its moisture from the top half of the root zone or a breakdown of 40-30-20-10% for each one- fourth of the root zone depth. Factors which affect plant consumptive water requirements are the crop, temperature, humidity, wind velocity, radiation, color of soil and slope.

When the scheduler determines the consumptive use from the tables, he may determine or predict seven days ahead the quantity of water needed to maintain a favorable crop-water balance.

Soil, Water, Crop Considerations

Soil/Water Relationship (Continued)

Water Balance

A balance exists between the availability of moisture and a condition, which encourages root penetration into the soil profile. It has been said that light, frequent applications of water may encourage development of roots along the upper portion of the soil profile. Whereas, longer periods between water application with deeper application of water will encourage deeper root penetration necessary to support the plant during its peak consumptive use period. Research has indicated that maintaining the soil moisture level slightly below field capacity assures that it is neither a "feast" situation nor is it allowing the crop to deplete the soil, which will approach the "famine" status. Proper irrigation scheduling provides for optimum plant growth and water utilization.

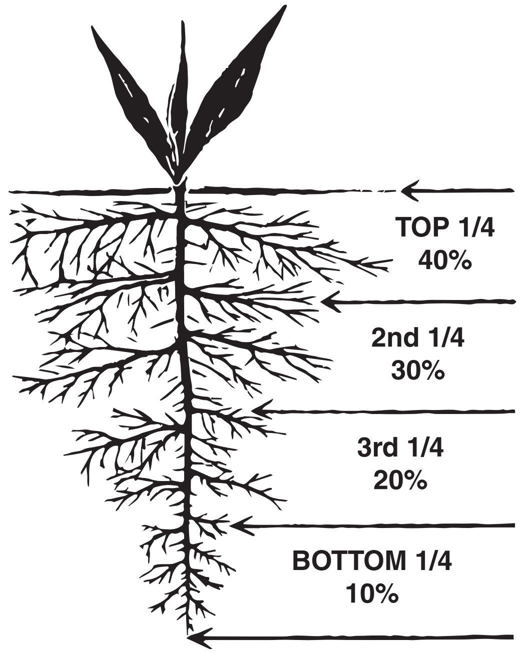


Figure 6-36-1

Figure 6-36-2

Soil Intake

Clay Loam Design GPM and operate system to make use of the water.

Silt Loam Holding capacity of the soil during peak consumptive use period on soils with slopes.

Sandy Loam Design GPM to crop needs.

Slopes	Potential GPM Reduction in Rolling Terrain on Silty/Clay Loam Soils to Reduce Runoff.
0 - 2 %	0 - 5 %
2 - 5 %	10 - 20 %
5 - 8 %	20 - 30 %
8 - 12 %	30 - 40 %

In addition to GPM reduction, booms can be used to reduce application rate. Runoff can also be reduced by minimum tillage, sub-mulching between the rows, furrow diking, and by deep ripping or chisel plowing.

Application Rates

Application rates, and thus depths, may possibly be limited by soil infiltration capacity. Many factors influence the infiltration (or intake) of water into the soil. These include soil type (particle size and distribution), surface condition (mulch, crust, aggregate size), moisture content, soil density, soil layering, organic matter content, and droplet size.

Most soils exhibit a higher **initial** infiltration rate, but as the soil profile approaches field capacity, the intake rate of water is reduced to what is called a final infiltration rate.

Theoretical Soil Infiltration Curve Plus Average Application Rate Curves for Three Types of Sprinkler Packages

Center pivot application rates often can exceed the infiltration rate of many soils. This indicates that some local ponding does indeed occur during the irrigation. On many soils and slopes, this is generally not detrimental.

Fortunately most of the water applied by center pivot systems occurs when a soil is taking water at a rate greater than the Final Intake Rate. Other factors assisting in matching the infiltration rate of soils to the application rate of center pivot include improved soil surface condition (mulches) and crop canopies that reduce the impact energy of the water droplets. Also, based on an observation, there is a tendency for the smaller droplets produced by low pressure spray nozzles to offset somewhat the limitations of application depths and intake rate experienced with conventional sprinklers.

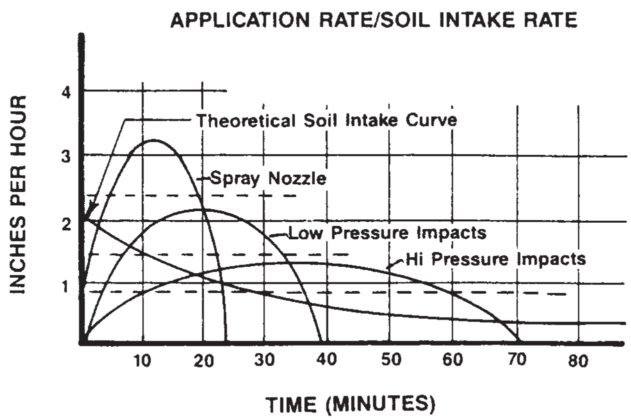


Figure 6-37-1 Application Rate Soil Intake Rate and Potential Runoff under High and Low Pressure Center Pivot Irrigation Systems at 1,200 ft (366 m) from Center of Rotation of 130-acre System, 76 h/revolution, and 750 GPM.

Typical Center Pivot Inches/Hour at Outer End

GPM	System Length in ft							
	700 ft		1,300 ft		1,900 ft		2,500 ft	
	R[1]	S[2]	R[1]	S[2]	R[1]	S[2]	R[1]	S[2]
500	1.7	3.4	1.1	2.2				
1,000	3.5	7.0	2.1	4.2	1.5	3.0		
1,500			3.2	6.4	2.3	4.6	1.8	3.6
2,000					3.0	6.0	2.4	4.8

Figure 6-37-2 Application Rate Comparison

Soil, Water, Crop Considerations

Crop/Water Requirements

Crop

Crop consumptive use is the most important item to consider in determining the irrigation water requirement. Refer to the table below for gross peak water requirements for various crops and climate conditions. Sprinkler irrigation efficiencies are programmed into the table for the various climates and crop consumptive needs.

The following table indicates the sprinkler irrigation requirements for crops during the average peak consumptive use period. The table assumes no rainfall is available to reduce the irrigation requirement. Obviously the initial equipment investment is greater when the irrigation system is designed to match this peak requirement. Often water or energy availability will prevent meeting this peak requirement.

Cool Climate

Average Maximum
Temperature 60°F to 80°F
Average Humidity 70%
Irrigation Efficiency 90% or above

Moderate Climate

Average Maximum
Temperature 80°F to 90°F
Average Humidity 60%
Irrigation Efficiency 90%

Hot Climate

Average Maximum
Temperature 90°F to 100°F
Average Humidity 50%
Irrigation Efficiency 85%

Desert Climate

Average Maximum
Temperature 100°F
Average Humidity below 50%
Irrigation Efficiency 75%
Multiply GPM/Acre x .1558 = liters/sec/Ha

GPM/Acre = $\frac{\text{In per Day}}{\mathbf{0.053}\ \text{(factor)}}$ **LPS/Ha =** $\frac{\text{MM per Day}}{\mathbf{8.64}}$

EXAMPLE

Corn: Moderate Climate = .26 inches/day

$$\text{GPM/Acre} = \frac{0.26}{0.053} = 4.9 \text{ GPM/Acre}$$

The Peak Consumptive Use Period is the number of days the crop consumes water above 85% of peak usage.

Fig 4. Typical Peak Consumptive Use Period

Crop	Peak Consumptive Use Period(Days)
Alfalfa	100-165 (depending on location)
Corn	45
Cotton	35-55 (depending on location)
Grass	155-200 (depending on location)
Wheat	30
Potatoes	45
Barley	30
Sugar Beets	65
Sorghum	45
Soybeans	50

Crop Consumptive Use

Fig. 3 Typical Gross Peak Water Requirements[1]*

	Cool Climate				Moderate Climate				Hot Climate				Desert Climate			
Crop	IN/ Day	MM/ Day	GPM/ Acre	LPS/ Ha	IN/ Day	MM/ Day	GPM/ Acre	LPS/ Ha	IN/ Day	MM/ Day	GPM/ Acre	LPS/ Ha	IN/ Day	MM/ Day	GPM/ Acre	LPS/ Ha
Alfalfa	.24	6.096	4.5	.70	.27	6.86	5.1	.79	.34	8.64	6.4	1.00	.45	11.43	8.5	1.32
Corn	.23	5.842	4.3	.67	.26	6.60	4.9	.76	.32	8.13	6.0	0.93	.45	11.43	8.5	1.32
Cotton	.20	5.080	3.8	.59	.22	5.59	4.2	.65	.27	6.86	5.1	0.79	.38	9.65	7.2	1.12
Grapes	.16	3.02	3.0	.47	.18	4.57	3.4	.53	.20	5.08	3.77	.59	.25	6.35	4.7	.73
Grass	.24	6.096	4.5	.70	.27	6.86	5.1	.79	.34	8.64	6.4	1.00	.47	11.94	8.9	1.39
Pasture	.23	5.842	4.3	.68	.26	6.60	4.9	.76	.30	7.64	5.7	.88	.32	8.12	6.04	.94
Peanut	.22	5.588	4.2	.65	.27	6.86	5.1	.79	.32	8.12	6.0	.94	.39	9.91	7.4	1.15
Potatoes	.20	5.080	3.8	.59	.25	6.35	4.7	.73	.34	8.64	6.4	1.00	.47	11.94	8.9	1.39
Sorghum	.21	5.334	4.0	.62	.26	6.60	4.9	.76	.32	8.13	6.0	0.93	.45	11.43	8.5	1.32
Soybeans	.22	5.588	4.2	.65	.23	5.84	4.3	.67	.30	7.62	5.7	0.89	.45	11.43	8.5	1.32
Sugar Beets	.20	5.080	3.8	.59	.23	5.84	4.3	.67	.30	7.62	5.7	0.89	.43	10.92	8.1	1.26
Sugar Cane[2]	NA	NA	NA	NA	.34	8.69	6.45	1.01	.39	10.00	7.43	1.16	NA	NA	NA	NA
Wheat	.20	5.080	3.8	.59	.23	5.84	4.3	.67	.29	7.37	5.5	0.86	.36	9.14	6.8	1.06

[1] The designer should consult regional or state research facilities for local daily ET values.

[2] Sugar cane values are an average from documents that report wide variance in ET based on site location and conditions.

** Assumption: Efficiency upon day and night irrigation average. GPM/Acre based on continuous day and night. All values above have been adjusted for the irrigation efficiencies indicated below.*

Figure 6-38-3

Establishing Gallonage Requirements

Water Consumptive Use Curve

Water Consumptive Use Curves for your particular crop and area can normally be obtained by contacting your local university or extension agent. The following example of a Consumptive Use Curve for corn was developed in Eastern Nebraska.

Fig 5. Crop Consumptive Use Curve - Corn

Clay loam soil AWC @ 2.25 in/foot — 6.75 in/fty Root Zone

Curved base on 85% application efficiency Total quantity of water removed by the crop from the water bank — 6.32 inches during this period. The irrigator will approach the 112th day having used all but approximately .5 in of the water in storage.

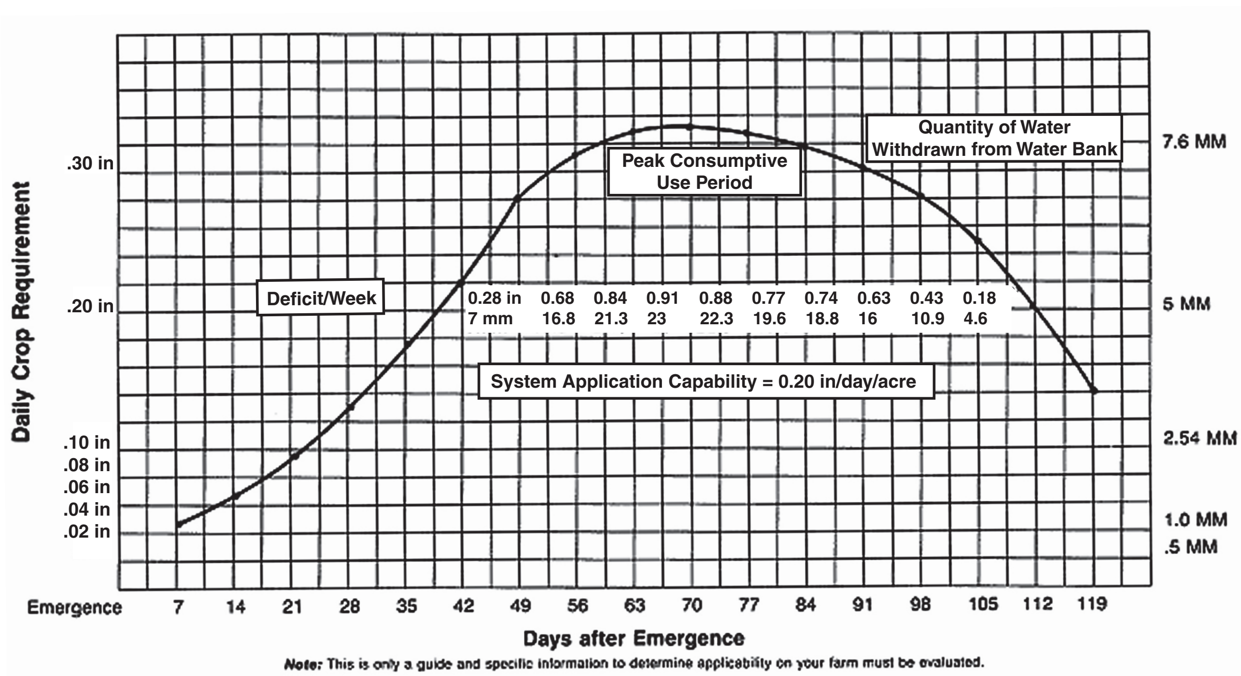


Figure 6-39-5

Soil, Water, Crop Considerations

Establishing Gallonage Requirements

Soil

Application depth or amount of water applied per irrigation is dependent on rooting depth, soil type and level of moisture in the soil. Be sure to divide this value by the irrigation efficiency to obtain the gross application depth required. The table indicates the total net amount of moisture available in the soil profile at field capacity.

Plant Feeder Root Profile

Crop	Feeder Root	Depth	Crop	Feeder Root	Depth	Crop	Feeder Root	Depth	Crop	Feeder Root	Depth
	M	FEET		M	FEET		M	FEET		M	FEET
Alfalfa	.9 - 1.8	3 to 6	Cucumbers	.46 - .6	1-½ to 2	Onions	.46	1-½	Peas	.6	2
Beans	.6	2	Grain	.6 - .76	2 to 2-½	Orchard	.9 - 1.5	3 to 5	Potatoes	.6	2
Beets	.6 - .9	2 to 3	Grain, Sorghum	.76	2-½	Pasture			Soy Beans	.6	2
Cabbage	.46 - .6	1-½ to 2	Grapes	.9 - 1.8	3 to 6	(Grasses Only)	.46	1-½	Strawberries	.3 - .46	1 to 1-½
Carrots	.46 - .6	1-½ to 2	Lettuce	.3	1	Pasture			Sweet Potatoes	.9	3
Corn	.76	2-½	Melons	.76 - .9	2-½ to 3	(With Clover)	.6	2	Tobacco	.6	2
Cotton	1.2	4	Nuts	.9 - 1.8	3 to 6	Peanuts	.46	1-½	Tomatoes	.3 - .64	1 to 2

a. Rooting depths of crops help identify the depth to which irrigation water should penetrate.

Figure 6-40-6

Moisture Available at Field Capacity and Soil Profile

Soil Type	Root Zone Depth		Field Capacity			Amount Held at Wilting Point		Available Moisture Plant Use	
	ft	m	in	mm	PERCENT	in	mm	in	mm
LIGHT SANDY	1	0.304	1.25	31.75	20%	0.25	6.35	1.00	25.40
	1.5	0.457	1.88	47.75		0.38	9.65	1.50	38.10
	2	0.610	2.50	63.50		0.50	12.70	2.00	50.80
	2.5	0.762	3.13	79.50		0.63	16.00	2.50	63.50
	3	0.914	3.75	95.25		0.75	19.05	3.00	76.20
	4	1.219	5.00	127.00		1.00	25.40	4.00	101.60
MEDIUM	1	0.304	2.25	57.15	25%	0.56	14.22	1.69	42.92
	1.5	0.457	3.38	85.85		0.85	21.59	2.53	64.26
	2	0.610	4.50	114.30		1.12	28.44	3.38	85.85
	2.5	0.762	5.62	142.74		1.41	35.81	4.21	106.93
	3	0.914	6.75	171.45		1.69	42.92	5.06	128.52
	4	1.219	9.00	228.60		2.25	57.15	6.75	171.45
HEAVY	1	0.304	3.67	93.21	35%	1.28	32.51	2.39	60.70
	1.5	0.457	5.50	139.70		1.92	48.76	3.58	90.93
	2	0.610	7.34	186.43		2.56	65.02	4.78	121.41
	2.5	0.762	9.17	232.91		3.20	81.28	4.97	126.23
	3	0.914	11.00	279.40		3.84	97.53	7.17	182.11
	4	1.219	14.68	372.87		5.12	130.04	9.56	242.82

Figure 6-40-7

NOTE

- **For optimum yield of high valued shallow rooted crops, maintain 67% available moisture.**
- **For lower valued deeper rooted crops, maintain 50% available moisture.**
- **For low value deep rooted crops, maintain 33% available moisture.**

Establishing Gallonage Requirements (Continued)

Water Banking

If only limited water is available for irrigation, a management practice called "water banking" appears attractive in providing the minimum irrigation requirement. This practice assumes the soil can store adequate quantities of available water within the root profile to essentially "carry" the crop through the peak consumptive use period until the irrigation system can again match the consumptive use of the crop. Obviously this scheme is best suited to deep-rooted crops and/or heavier textured soils and to crops having a relatively short peak consumptive use period.

The minimum reduction in GPM/Acre for the irrigation system is estimated as follows:

Potential Reduction in GPM/Acre =

$$\frac{\text{(Available Inches of Moisture in Root Profile)}\ \text{(1-Minimum Available Moisture \%)}}{\text{(Peak Consumptive Use Period)}\ \text{(Irrigation Efficiency)}\ (.053)}$$

Numerator: (See Figure 6 and 7) — (See Figure 7 and notes)

Denominator: (See Figure 4) — (See Climate Notes below Fig. 3)

EXAMPLE:

Assumption - Corn crop in hot climate with heavy soil. **Figure 3** shows Irrigation Efficiency of 85%. **Figure 4** shows Peak Consumptive Use Period of 45 days. **Figure 6** shows Root Profile of corn to be 2-1/2 feet. **Figure 7** shows Available Moisture in Root Profile to be 5.97 inches. The Note below **Figure 7** indicates a minimum of 50% available moisture is best for deeper rooted crops.

Potential Reduction = $\frac{\text{(5.97 inches) (1-.50)}}{\text{(45 days) (.85) (.053)}}$

GPM/Acre = 1.47 GPM/Acre

Figure 3 indicates 6.0 GPM/Acre is needed in a Hot Climate. Subtracting 1.47 from 6 leaves 4.53 GPM/Acre or indicates a 600 GPM center pivot gallonage on 131 acres should be adequate under the **given conditions, and good management**.

Dependable rainfall could also have an impact on system GPM/Acre requirements. Where the water banking equation results in a low GPM/Acre requirement such as the above example be leary of depending much on rainfall.

Chemigation

Irrigation Intelligence

Chemigation is the injection of chemicals into irrigation water for application to various crops and soils.

The capabilities of automated irrigation equipment are continuing to increase. Most all major chemical companies are expanding the list of chemicals (EPA approved and labeled) that can be injected into automated irrigation systems, such as, fertilizers, herbicides, fungicides, insecticides, nematicides, etc. Automated irrigation systems are ideal distribution units for applying agricultural chemicals in a properly diluted state. Nitrogen has been applied with irrigation water since the 1930s, but it has only been within the past eight to ten years that growers have utilized automated irrigation extensively to apply not only fertilizer, but many other agricultural chemicals. This works well due to the automated irrigation's ability to apply water at a coefficient of uniformity (CU) from 80 to 95%. While other forms of irrigation could accomplish the application, their uniformity of application typically ranges from 40 to 80%.

The use of automated irrigation systems has increased the emphasis being placed on the incorporation of chemicals with the irrigation water, and has created several new words - fertigation, insectigation, herbigation and fungigation (describing various chemicals applied with irrigation water). Thus, the pre or post emergent chemical application program can be closely matched to the soil characteristics and crop requirements for weed, insect, and fertility management, regardless of the growth stage.

Valley systems that are used to distribute chemicals provide numerous benefits to the irrigator:

1. Expanded utilization of the irrigation system. The irrigation system can be utilized as a large sprayer to apply chemicals, thus reducing or eliminating the need for ground rigs or aerial spraying.
2. Uniformity of application. Application of chemicals through an automated irrigation system has been proven to be superior in uniformity of coverage over conventional methods if the system is in good working order and operated properly.
3. Timely application. The center pivot or linear systems can apply chemicals on a timely basis regardless of ground cover, crop height or field conditions.
4. Controlled amounts of chemical. The amount, frequency and time of chemical application can be controlled to optimize chemical effectiveness and cost to provide for optimum yields. It is also possible that the total amount of nutrients needed may be reduced.
5. Chemical incorporation. Incorporation and/or activation of chemicals such as herbicides, can be easily accomplished through the amount of water applied.
6. Reduces compaction. Chemigation eliminates the soil compaction caused by ground application of chemicals. This will also provide savings in fuel for power units used to apply chemicals with ground applicators.
7. Reduces crop damage. Crop damage is reduced or eliminated by elimination of field applicator usage.
8. Reduced labor. Labor is substantially reduced by utilization of the irrigation system versus ground application.
9. Effective and economical. Chemigation has shown to be as effective or more effective than ground or aerial application, while saving one-third to one-half of the cost of conventional application.

Here are the considerations that must be evaluated for Proper Management of a Chemical Incorporation Program.

Fertigation

SOIL TYPE Fertigation works well on all soils, but is outstanding on sandier soils. Sandy soils usually have less nutrient holding capacity, so the smaller and more frequent applications of nitrogen applied by sprinkler will usually produce higher yields. The incorporated chemical must penetrate any soil readily, in order to be fully used. Fertigation can be accomplished on medium to fine textured soils, but the depth of water applied with the chemicals may be less than a heavy soaking irrigation. As an example, a normal irrigation might equal 1.25 inches while fertigation application would be .20 to .50 inches.

Irrigation Intelligence (Continued)

CROP REQUIREMENT- WHEN AND HOW MUCH

The basic fertility of many soils permits a crop to extract small nutrient requirements for many years before a deficiency may develop. However, some crops require significant amounts of nitrogen, phosphorous and potassium. Crop production cannot be maintained at profitable levels in most soils unless these primary nutrients are replenished. Nitrogen is the most easily replenished nutrient by the fertigation method. Crop scientists state that certain amounts of nutrients may be unused each year and can thus be carried over. Therefore, the residual supply of fertilizer may be enough for starting plant growth. If little or no residual nutrients exist, starter fertilizer should be applied at planting time and additional amounts applied as post emergence. The post emergent applications can utilize capabilities of the irrigation system. The grower should determine the nutrient use pattern of the crop and make certain that an adequate supply is available during each part of the plant's life. Yield goals should be established to plan the fertilizer program. The optimum quantity of fertilizer used will be determined by the needs of the plant and the timing of the irrigation/fertigation cycles.

SELECTION OF MATERIALS Liquid nitrogen (28% and 32%) solutions are widely accepted choices as sources of nitrogen applied by automated systems. This nitrate form of nitrogen can be easily placed in the root zone by irrigation, and with good irrigation control, leaching should not occur. This is one reason why the practice of fertigation is successfully used on sandy soils.

AMMONIUM POLYPHOSPHATE (APP) solutions, 10-34-0 and 11-37-0 have been successfully applied through sprinkler systems. However, there is questionable economic effectiveness when applying Liquid phosphorous because of the low mobility of phosphorous. The soil usually dictates lower cost, dry forms of this fertilizer. Ammonium polyphosphate solutions may react in hard water (high in calcium, magnesium and bicarbonate) to form a precipitant which, if severe, will plug nozzles. A simple compatibility test is described in the following paragraph and should be completed before injecting APP into the sprinkler system.

COMPATIBILITY TEST The University of Nebraska has developed a procedure which should be completed before injecting phosphate materials into the water. Either the grower or fertilizer dealer can perform the test as follows. A 1000 milliliter breaker or graduated cylinder is filled to the milliliter mark which corresponds to the GPM output of the well. For an 800 GPM well, add 800 milliliters of irrigation water to the graduated breakers or cylinder. Determine the injection rate in GPM of the ammonium polyphosphate solution. Add the number of milliliters of APP solution with a graduated medicine dropper, equal to GPM injection rate, to the graduated cylinder which contains the irrigation water. If the water turns cloudy it is likely that a precipitant will form. The local fertilizer dealer should be able to provide assistance if difficulty is encountered while performing this test. Note: A medicine dropper which is calibrated in milliliters or cubic centimeters should be used to measure the chemical.

Irrigation Intelligence (Continued)

ANHYDROUS AMMONIA is a cheaper source of nitrogen than most liquids. However, anhydrous ammonia is not recommended for application by sprinklers. Precipitants may plug the nozzles and application efficiency will be low. A precipitant may occur because of the tie-up of the ammonia with calcium, magnesium and other cations. Application efficiency is low because of nitrogen volatilizing.

POTASSIUM AND SULFUR Researchers usually have not recommended applications of potassium through systems for reasons similar to those used for phosphorus. However, field experience has revealed that potassium in light applications has been applied successfully by pivot systems to sandy soils. One hundred lbs/acre application of 20-0-4-5 (20 lbs nitrogen, 0 lbs phosphorous, 4 lbs potassium and 5 lbs sulfur) has worked well on the sandier soils of western Nebraska and Kansas. Sulfur, in the form of ammonium thiosulfate, can be applied by sprinkler and will move with the water into the soil.

ZINC has been applied through sprinkler systems with good results. Results of cooperative study between Valmont and Allied Chemical revealed that application of zinc mixed with nitrogen produced yield increases when applied to corn at tasseling. It is believed that foliar uptake accounted for the response. Some researchers indicate that zinc materials have limited mobility in fine textured soils and are mobile in lighter textured soils.

Herbigation

There are a number of herbicides now approved and labeled by the EPA for injection through automated irrigation systems. Injection of herbicides, as any other chemical, is not simply a matter of adding any herbicide during irrigation. There are a number of items that must be considered prior to herbicide injection. Herbicides selected for use through a center pivot or linear must be labeled for that type of application. Consult the label to find the recommended rate per acre for the soil type that is to be treated. When the number of acres to be covered are determined (be sure to consider if end gun is used), you can determine the amount of chemical that will be needed. Thiocarbamide herbicides are only toxic to germinating weed seeds. It is important that the herbicide be applied before the weed seeds germinate. Proper timing can spell the difference between good weed control and poor control. There are usually only two times when this criteria can be met: early in the spring, prior to germination, or immediately after cultivation.

A cultivation will allow the soil to warm quickly and bring moisture in contact with the weed seeds. These factors combine to stimulate rapid germination which means the herbicide must be applied within two days of cultivation. Application within one day is best.

Most weed seed is concentrated in the top two to three inches of soil. The application amount of water necessary to place the herbicide into the critical zone depends on both the chemical used and the soil type. Consult the labeling of the herbicide or contact your chemical distributor regarding application amounts for herbigation.

Generally, the amount of water applied with soluble herbicides will vary from 0.3 in sandy soils to about 13.4 in silt loam. Mobility of the herbicide will also be a factor in the amount of water applied.

Insectigation

Insectigation is relatively new in comparison to injection of fertilizers and herbicides. There are insecticides that are approved for application with automated irrigation equipment.

Lower water application is recommended for applying insecticides. Systemic insecticides require no more than %” of irrigation water for application and activation. The activity of a systemic insecticide will continue to provide protection as the plant roots absorb the material from initial and succeeding irrigations. Contact insecticides are effective when applied with .12 in to .20 in of irrigation water. Excessive irrigation amounts may tend to wash contact insecticides from the plant or leach systemic insecticides from the root zone. Your system should have the capability to apply water within .12 in to .20 in per pass.

Studies and field research has been and is presently being conducted by private and government agencies on mixing quantities of vegetable oil to any insecticide which contains an emulsifier. Initial results indicate that 1 in to 1%” of water can be applied by the system while injecting the insecticide, with very promising results. The insecticide clings to the plant while the water runs off. The vegetable oil, however, must be once refined cotton seed, soybean or peanut oil. If the oil has been refined further or has been hydrogenated, as for human food, it will not function properly.

Fungigation and Nemigation

Injection of fungicides and nematicides is relatively new in application through irrigation systems.

Irrigation Intelligence (Continued)

Numerous studies have been and are being conducted on injection of these chemicals.

There are presently a number of fungicides approved for application through irrigation systems on specific crops and in specific areas. These will no doubt increase as more testing is completed and labeling approved by the EPA.

Chemigation Requirements

EPA APPROVAL AND LABELING

Chemicals used in chemigation must have approval and be labeled by the EPA for injection through an irrigation system. Approval and labeling vary from state to state, therefore, the grower who wishes to apply products for weeds, insects or fungus controls must consult his chemical dealer or county extension office. Research is being conducted which will result in increased information regarding use of these materials.

WIND AS A FACTOR IN UNIFORMITY

All types of sprinkler systems are affected by wind. The disruption of the sprinkler's pattern is minimized with a continuously moving pivot or lateral move system. Systems generally benefit from closer or variable spacing of sprinkler heads along the lateral if there is much wind. Similarly, the more the patterns of other sprinklers overlap, the less will be the influence of the wind.

Other factors that influence the amount of disturbance by wind are the angle with which the sprinkler head shoots into the air and the size of droplet exposed to the wind. Generally, decreasing the angle of a sprinkler head from 28 degrees to 10 degrees or less will improve performance under windy conditions.

Chemigation is generally ill-advised if the wind velocity exceeds 15 mph for a center pivot or a lateral move system. You might consider chemigation at night when winds normally are more calm. This should present no problem provided the irrigation and chemical injection systems are coupled so that if one fails it will cause the other to turn off. With proper precautions and maintenance of all systems, it should not be necessary to "babysit" a chemigation run.

CHEMICAL CONSIDERATIONS

It is recommended that chemicals such as insecticides and fungicides be diluted in a nurse tank for injection into irrigation systems. Greater accuracy of calibration and distribution will be achieved by injecting a larger volume of diluted solution per hour.

Application of more or less than the quantity of irrigation water recommended for various chemicals may result in decreased chemical performance by removing the chemical from its zone of effectiveness.

Irrigation Intelligence (Continued)

Equipment Requirements

INJECTION EQUIPMENT

- Positive proportion pump (resistant to corrosion i.e. stainless steel) of proper size (gph)
- Chemical storage tank (size will vary depending upon use of diluted/non-diluted chemical)
- Agitation equipment for diluted chemicals to keep chemicals in suspension
- In-line strainers preceding injector pump
- Fittings (corrosion resistant), reinforced hoses, clamps and miscellaneous hardware
- Injector pumps should be removed, cleaned and stored when seasonal use is over. Solution tanks should be emptied and flushed with clean water. All flexible hoses should be stored inside.

SAFETY EQUIPMENT (ANTI-POLLUTION DEVICES)

- Positive check valve in mainline behind injection point
- Check valve between injector pump to mainline
- Vacuum relief valve for mainline
- Safety interlock system between injector pump and sprinkler system
- Normally closed solenoid valve between chemical tank and injector pump which is electrically interlocked to the irrigation system

IRRIGATION SYSTEM

- Water application capability of .12 in to 2 in per pass (minimal amounts of water are required for some chemicals). This may require high-speed capability in the irrigation system.
- Sprinkler packages having uniform distribution, i.e. all sprinklers sized and installed to manufacturer's recommendation. All sprinklers must not be worn and should be operating properly.
- System must be operated at the proper pivot pressure.
- Regardless of the type of sprinkler system (linear, solid set, wheel lines or hand lines), there are some common checks and precautions that should be observed before applying chemicals through any of them. Prime importance is insuring that the irrigation system is applying water uniformly over the area to be treated; the chemical will be distributed only as uniformly as the water, and most chemicals will redistribute very little in the soil. An over application in one area could result in phytotoxicity to the crop, while an under application would give poor coverage or control.
- Field experience has revealed that system components are usually unaffected by the more commonly used chemicals such as 28% to 32% nitrogen solution, APP and most approved herbicides, insecticides or fungicides. Concentrations of recommended fertilizer materials, although salty, will not damage galvanized surfaces. Painted surfaces have appeared to be more susceptible to the corrosive attack of fertilizers. The system should be thoroughly flushed at the completion of chemical application period. The grower should exercise caution in using solutions which will reduce the ph of the water to 6.5 or less. Solutions will react with increasing vigor as the water ph is lowered and may cause some component damage.
- Different types of chemicals require that minimum amounts of water be applied while applying the chemical. Water application amounts may vary from as little as .12 in per pass to 1 in per pass while injecting chemicals. Not all systems are capable of applying the small amounts of water necessary to optimize chemical effectiveness. Minimum amounts applied depend on system length, acres irrigated, system gallonage and system speed.

Example:

System Length = 1300 ft

System GPM = 900 GPM

Length of Run = 2600 ft

Acres Irrigated = 130 acres

	Standard Speed			Hi-Speed		
Tire Size	11.2 x 24	14.9 x 24	16.9 x 24	11.2 x 24	14.9 x 24	16.9 x 24
h./Rev. @ 100%	6.3 hrs	5.3 hrs	4.9 hrs	3.8 hrs	3.2 hrs	3.0 hrs
In./Rev. @ 100%	0.16 in 4.06 mm	0.14 in 3.56 mm	0.13 in 3.3 mm	0.10 in 2.54 mm	0.08 in 2.03 mm	0.07 in 1.78 mm

Systems sold today are available as standard speed and hi-speed. Anyone looking at purchasing a linear system should seriously consider the hi-speed option.

Irrigation Intelligence (Continued)

Refer to Design Considerations Section for determining hours per pass and inches of application.

Chemical Calculations
(Sample)

EXAMPLE #1: Fertigation

Figure 8. Amount of various nitrogen fertilizers required to give 20, 30 and 40 pounds of available nitrogen per acre.

Kind of fertilizer solutions	% Nit.	Wt (lb) per gal at 60° F	Rate of N per acre, lb 20 gal/ac	30 gal/ac	40 gal/ac
Urea-Ammonium Nitrate	28	10.65	6.7	10.0	13.4
Urea-Ammonium Nitrate	32	11.06	5.7	8.6	11.4

Figure 9. Computing number of acres irrigated per pass of linear machine with various lengths and length of run = 2600 ft.

Center-Pivot Sprinkler Length (radius) ft	Acres irrigated/pass
400	24
500	30
600	36
700	42
800	48
900	54
1000	60
1100	66
1200	72
1300	78
1400	84
1500	90
1600	96
1700	101
1800	107
1900	113

*This sample calculation is to be used as an example only. Refer to the chemical manufacturer's recommendation for application and the system Operator's Manual for specific data.

CALCULATION STEPS: EXAMPLE: Your field

Step 1 - Decide on amount of nitrogen fertilizer you want to apply per acre 30 lbs of N/ac _______

Step 2 - Decide on the kind of nitrogen fertilizer you want to apply (Figure 8) sol. 32% N _______

Step 3 - Determine the number of gallons of fertilizer solution needed per acre (Figure 8) 8.6 gal/ac _______

Step 4 - Determine the number of acres irrigated per pass of linear (Figure 9) 78 ac _______

Step 5 - Multiply gal/acre of fertilizer solution times acres irrigated per pass (Step 3 times Step 4) 671 gal/pass _______

Step 6 - Determine the amount of time for the linear sprinkler to make one revolution. See linear Manufacturers Operator's Manual and recommendation for your soil and crop 19.7 hrs. (.50 in water) _______

Step 7 - Calculate the rate of flow of fertilizer solution into the irrigation system. Divide gallons of fertilizer solution needed per pass (Step 5) by total time in hours per pass (Step 6) 34.1 gal/hr _______

Chemigation

Irrigation Intelligence (Continued)

The grower must take precautions to prevent contamination of the water supply should an injector pump or sprinkler system malfunction occur.

This problem may be eliminated by:

- Assuring that all safety circuits are operating at all times.
- Safety shut-off protection is provided independently of the system for the injector pump (if electric motor is operated). Example-the system should shut down if the supply tank empties or an injector line ruptures or even if a screen becomes plugged which stops the flow of material to the injector pump.

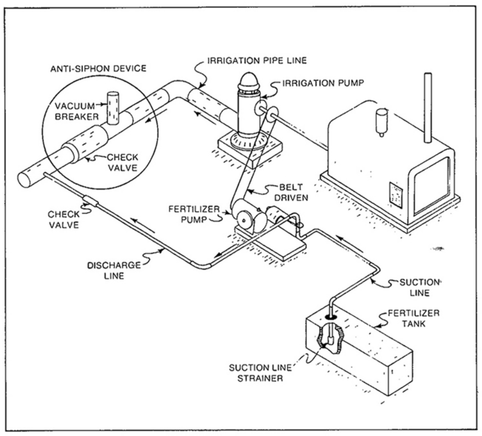


Figure 10. Anti-pollution devices and arrangement of valves. (engine drive)

- The sprinkler system and injector pump should be interlocked to cause injector pump shutdown if the pivot system shuts down for any reason.
- Install a check valve which prevents backwashing and dumping chemical into the ground water supply.
- Consult the irrigation dealer regarding specific recommendation for installing all necessary safety circuit controls for the brand of system and power unit being operated.
- Examples of proper hook up are illustrated in Figures 10 and 11.

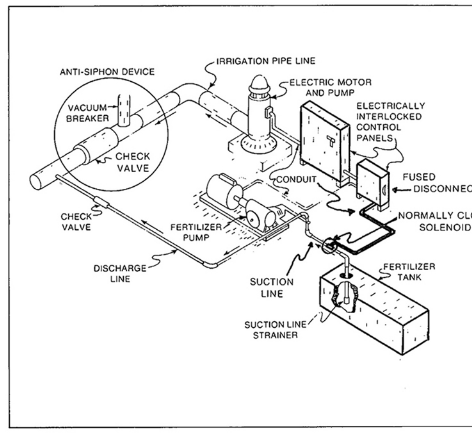


Figure 11. Anti-pollution devices and arrangements of valves. (electrical drive)

Companies With Approved Chemicals* Herbicides

- Monsanto
- Stauffer
- Mobay
- Shell
- Elanco

Fungicides

- Diamond Shamrock
- Union Carbide
- Thompson-Hayward
- Stauffer
- Rohm and Haas
- Chevron
- Uniroyal

Insecticides-Pesticides

- Mobay
- Union Carbide
- Uniroyal
- Dow Chemical

*The list of companies with chemicals labeled and approved for injection into irrigation systems is, to the best of our knowledge, complete and accurate at the date of printing. Chemicals each company has may only have limited approval for specific crops, applications and/or areas of the United States. Contact your chemical distributor concerning usage in your application and area.

Summary

- The grower will extend the system usefulness and value when it is used as a multi-purpose tool.
- Considerable experience has been accumulated regarding application or nitrogen solutions. "Spoon feeding" works well, especially on sandy soils.
- Fertilizer use efficiency often increases when applied with a sprinkler.
- Restraints caused by wet fields, poor weather conditions, ground cover or plant height are usually eliminated or significantly reduced when pivot systems are used to apply chemicals.
- Timeliness of application for maximum crop use efficiency is possible. Fertilizer is applied as the crop needs it.

⚠ CAUTION

•MAINTAIN THE SYSTEM, PUMPING PLANT AND INJECTOR EQUIPMENT IN GOOD OPERATING CONDITIONS. OPERATE AND PERFORM EACH STEP IN ACCORDANCE WITH THE MANUFACTURER'S OR DEALER'S RECOMMENDATIONS.

- Contact the dealer or manufacturer of the products used to obtain answers to questions.
- Contact local farm advisor or state university for data relating to your area.
- Additional information can be obtained by contacting the Market Manager-Agronomics at Valmont.

Possible Energy Savings and Power Comparisons

Possible Energy Savings

Under many soil and terrain conditions, it is possible to design systems that are capable of operating with greater efficiency by incorporating larger system pipeline sizes or low pressure sprinkler packages to increase hp savings.

$$\text{hp savings} = \frac{(PSI)^{*}\,(GPM)}{1200^{*}}$$

*70% pump efficiency

EXAMPLE: 1290 ft system - 800 GPM - 1200 hours of operation – 10 years.

Friction Loss 6 in Pipe = 15 PSI
Friction Loss 6 5/8 in Pipe = 9 PSI
6 PSI (savings)

$$\frac{(6) \times (800)}{1200} = 4 \text{ hp Savings}$$

100 hp = $4.80 (Diesel @ $.80/gal)

1 hp = $.048/hr

Present Worth of Energy Savings for Next 10 Years

@ 3% Energy Inflation and 10% Interest = hp savings x cost of hp-h x annual hr x 6.735**

4 x .048 x 1200 x 6.735 = $1,551.74

** Present worth factor (current value) of energy savings for next 10 years @ 3% energy inflation and 10% interest.

Power Comparisons

There are several power alternatives available for irrigation water pumping and powering the irrigation system. Each of these should be investigated to select best overall design. The availability and distance to 480 volt, 3 phase, electrical power may determine whether electrical power or an engine-generator system be used.

The energy cost should be evaluated from an operating cost (cost per horsepower-hour) and initial cost standpoint. The formulas below can be used to determine cost per horsepower hours. (These are based on assumed efficiencies.)

Electricity*: $\text{Cost/hp-h} = \frac{\text{Cost/kWh}}{1.18}$ Diesel: $\text{Cost/hp-h} = \frac{\text{Cost/Gallon}}{16.66}$

Natural Gas: $\text{Cost/hp-h} = \frac{\text{Cost/MCF (thousand cubic feet)}}{82.2}$ Propane: $\text{Cost/hp-h} = \frac{\text{Cost/Gallon}}{9.2}$

* Standby changes may need to be added to yearly hp cost

Example: Diesel Fuel Cost .75/gal, Electricity cost .6/Kwh, 1500 hours per year operation and 92 hp used.

Diesel Fuel Cost - $\frac{(1500 \text{ h/Yr}) \times (92 \text{ hp}) \times (.75/\text{Gal})}{16.66}$ = $6,212.50

Electricity Cost - $\frac{(1500 \text{ h/Yr}) \times (92 \text{ hp}) \times (.06/\text{Kw})}{1.18}$ = $7,016.90

Energy Costs

Comparison Charts, Power and Fuel Costs

Figure 24

Electricity – Cost per Hour of Pumping (based on Motor Efficiency of 88% or 1.18 hp-hr/kWhr)

Pump	Rates per Kilowatt - Hour										
Load hp	**1-1/2¢**	**2¢**	**2-1/2¢**	**3¢**	**4¢**	**5¢**	**6¢**	**7¢**	**8¢**	**9¢**	**10¢**
20	$ .25	$ .34	$ .42	$ .51	$ .68	$ .85	$ 1.02	$ 1.19	$ 1.36	$ 1.53	$ 1.70
30	.38	.51	.64	.76	1.02	1.27	1.53	1.78	2.04	2.29	2.54
40	.51	.68	.85	1.02	1.36	1.69	2.03	2.37	2.72	3.05	3.38
50	.64	.85	1.06	1.27	1.69	2.12	2.54	2.97	3.38	3.81	4.41
60	.76	1.02	1.27	1.53	2.03	2.54	3.05	3.56	4.06	4.56	5.08
75	.95	1.27	1.59	1.91	2.54	3.18	3.81	4.45	5.08	5.72	6.36
100	1.27	1.69	2.12	2.54	3.39	4.24	5.08	5.93	6.78	7.63	8.48
125	1.59	2.12	2.65	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60

Figure 25

Diesel – Cost per Hour of Pumping (based on 16.66 hp-hr/gallon and corrected for 5% drive loss)*

Pump	Fuel Cost per Gallon									
Load hp	**.90**	**1.00**	**1.10**	**1.20**	**1.30**	**1.40**	**1.50**	**1.60**	**1.70**	**1.80**
20	$ 1.10	$ 1.21	$ 1.31	$ 1.44	$ 1.56	$ 1.68	$ 1.80	$ 1.93	$ 2.05	$ 2.21
30	1.63	1.80	1.98	2.15	2.35	2.52	2.70	2.88	3.06	3.26
40	2.18	2.40	2.64	2.89	3.12	3.36	3.61	3.84	4.08	4.36
50	2.70	2.99	3.31	3.61	3.90	4.20	4.50	4.80	5.09	5.85
60	3.26	3.61	3.96	4.32	4.67	5.04	5.41	5.77	6.13	6.51
75	4.07	4.50	4.95	5.41	5.85	6.30	6.76	7.20	7.65	8.14
100	5.41	6.00	6.60	7.21	7.81	8.40	9.00	9.61	10.20	10.82
125	6.75	7.51	8.26	9.00	9.75	10.50	11.25	12.01	12.76	13.49

Figure 26

Propane – Cost per Hour of Pumping (based on 9.2 hp-hr/gallon and corrected for 5% drive loss)*

Pump	Fuel Cost per Gallon															
hp	**55¢**	**60¢**	**65¢**	**70¢**	**75¢**	**80¢**	**85¢**	**90¢**	**95¢**	**1.00**	**1.05**	**1.10**	**1.15**	**1.20**	**1.25**	**1.30**
20	$ 1.20	$ 1.30	$ 1.41	$ 1.52	$ 1.63	$ 1.74	$ 1.78	$ 1.85	$ 1.90	$ 1.96	$ 2.07	$ 2.18	$ 2.28	$ 2.39	$ 2.51	$ 2.61
30	1.79	1.96	2.12	2.28	2.44	2.60	2.69	2.77	2.85	2.94	3.10	3.26	3.42	3.58	3.75	3.91
40	2.39	2.60	2.82	3.04	3.26	3.48	3.59	3.70	3.81	3.92	4.13	4.34	4.56	4.78	4.99	5.21
50	2.99	3.26	3.53	3.80	4.07	4.34	4.48	4.62	4.76	4.90	5.17	5.44	5.70	5.97	6.26	6.53
60	3.59	3.92	4.24	4.56	4.89	5.22	5.38	5.54	5.70	5.86	6.19	6.52	6.84	7.18	7.50	7.82
75	4.48	4.90	5.30	5.70	6.11	6.52	6.72	6.93	7.22	7.34	7.75	8.16	8.55	8.97	9.38	9.79
100	5.98	6.52	7.06	7.60	8.15	8.70	8.97	9.24	9.51	9.78	10.32	10.86	11.40	11.96	12.49	13.03
125	7.47	8.16	8.84	9.52	10.19	10.86	11.20	11.54	11.88	12.22	12.90	13.58	14.28	14.94	15.62	16.30

*Nebraska Standards for Engine Performance considered attainable in practice. Efficiency of internal combustion engines can be expected to drop in normal use. Electric motor efficiency should change very little.

NOTE

- **All costs per hour are rounded to the nearest cent. Costs are for fuel or power only, no lubrication, repairs, etc.**

Possible Energy Savings

Corner and Electric System Design

Total Acres ______________________________
System Length ______________________________
Electric Irrigated Acres ______________________________
Corner Irrigated Acres ______________________________

<u>Water</u> Inches per Day / .053 = _____ / .053 = GPM Per Acre x Irrigated Acres = System GPM

______________ x ______________ = ______________

<u>System</u>

Pressure Loss: 6 in _____ 8 5/8 in _____
6 5/8 in _____ Combination _____

<u>hp</u>

	High Pres.	Low Pres.		High Pres.	Low Pres.
Pivot Pressure	= ___________	___________	x 2.31 =	___________	___________
Mainline Pipe Loss	= ___________	___________	x 2.31 =	___________	___________
Pump Pipe and Elbow Loss	=	___________	___________		x
2.31 =	___________	___________			
Pumping Level	= ___________	___________	=	___________	___________
Field and Pivot Elevation	= ___________	___________	=	___________	___________
	TOTAL HD. FT		=	___________	___________

hp = GPM x Hd. Ft / 2772 (70% Pumping Eff.)

High Pressure (______)___(______) / 2772 = ______ hp + Gen. hp

Low Pressure (______)___(______) / 2772 = ______ hp + Gen. hp

Energy Savings

Present Worth of Energy Savings for Next 10 years
@ 3% Energy Inflation and 10% interest = hp Savings x Cost Per hp-h x annual hours x (6.735)*

______________ x ______________ x ______________ = ______________

= ______________

* Present Worth Factor (Current Value) of Energy Savings for Next 10 Years @ 3% Energy Inflation and 10% Interest

High Pressure			**Low Pressure**		
System Cost	=	$	System Cost	=	$
Pump Cost	=	$	Pump Cost	=	$
Motor Cost	=	$	Motor Cost	=	$
Pipeline Cost	=	$	Pipeline Cost	=	$
			TOTAL	=	$

Initial investment Cost Differential = High - Low = $____________

Energy Costs

Electric System Yearly Operating Cost Comparison

Helical	Standard Speed	High Speed
	34 RPM	68 RPM
Motor Size	0.6 hp	1.2 hp
Full Load amps	1.1	1.8

The average current for a center pivot machine operating at 100% speed is equal to 1.25 x (nameplate current of largest motor) + [0.6 x (nameplate current of the remaining motors) X (Number of remaining motors)].

Assuming an eight (8) drive unit machine:

for 1 hp motor, average current = 1.25 (1.80) + 0.6 (7) (1.80)

9.81 amps at 100% speed

for 0.6 hp motor, average current = 1.25 (1.1) + .6 (7) (1.1)

6.00 amps at 100% speed

At 30% Average Percentage Timer speed:

for 1 hp motor average current = 0.3 (9.81) = 2.94 amps

for 0.6 hp motor, average current = 0.3 (6.00) = 1.80 amps

$$kW = \frac{\text{volts x amps x P.F. x 1.73}}{1{,}000}$$

We assume a P.F. of 50% for an eight drive unit machine.

for 1 hp motor average current = $\frac{460 \times 2.94 \times .5 \times 1.73}{1000} = 1.17$ kW

for 0.6 hp motor, average current = $\frac{460 \times 1.80 \times .5 \times 1.73}{1000} = 0.72$ kW

Summary:

The cost for operating an eight tower center pivot machine at 30% speed for 1500 hours at a rate of $.06 kWh is:

for 1 hp motor - $ = 1.17 kW x 1500 Hr. x $.06/kW-Hr.

= $105.30

for 0.6 hp motor - $ = 0.72 kW x 1500 Hr. x $.06/kW-Hr.

= $64.80

Alternate Comparison Method

Equivalent Energy Price for Irrigation for Different Types of Energy

FUEL "A"		FUEL "B"				
	Units	**Diesel**	**Gasoline**	**Propane**	**Nat. Gas**	**Electricity**
Diesel	Gal	1.000	0.693	0.551	4.936	0.071
Gasoline	Gal	1.443	1.000	0.796	7.126	0.102
Propane	Gal	1.814	1.257	1.000	8.955	0.128
Natural Gas	MCF	0.203	0.140	0.112	1.000	0.014
Electricity	Kw	14.124	9.785	7.785	69.718	1.000

To use this table

1. Find the energy source that you know the price in the FUEL "A" column
2. Under the FUEL "B" find the equivalent cost of the other energy
3. Multiply the known cost of energy by the equivalent under FUEL "B"

EXAMPLES:

Compare Diesel at 0.75 / gal to Electrical energy cost

0.75 x .071 = .053 / Kw

Compare Diesel at 0.75 / gal to Natural Gas

0.75 x 4.936 = 3.702

Compare Elec. at 0.08 / KwHr to Propane

0.08 x 7.785 = .6228 / gal Propane

Nebraska Pumping Plant Performance Criteria

Energy Source	Units	Bhp-hr/unit of Energy*	Whp-hr/unit of Energy **
Diesel	Gal	16.660	12.500
Gasoline	Gal	11.500	8.660
Propane	Gal	9.200	6.890
Natural Gas	MCF	82.200	61.700
Electricity	Kw	1.180	0.885

* Brake horsepower hours per unit of energy

**Water horsepower hours per unit of energy

Developed by Department of Biological Systems Engineering,

University of Nebraska-Lincoln

Energy Costs