



# SELECTING THE RIGHT PUMP

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Because the pump is literally the "heart of the system," careful consideration must be made in selecting the right pump. Seldom is there only one pump that will do the job. To make a wise choice, you'll need to know about pump types, how the pump is to be driven and the flow and pressure requirements for your specific spraying system and application.

To insure you can closely match the pump to your needs, Hypro manufactures five types of pumps: roller, centrifugal, diaphragm, turbine and piston pumps.



"Positive displacement" vs. "non-positive displacement"

Hypro's long line of pumps can be divided into two general categories: "positive displacement" and "non-positive displacement." Roller, diaphragm and piston pumps are positive displacement. That is, the flow from the pump is directly proportional to the pump speed. This positive flow is why all positive displacement pump hook-ups must include a relief valve and bypass line between the pump outlet and the nozzle shut-off valve.

Centrifugal and turbine pumps are non-positive displacement. In these pumps, a rotating impeller creates a centrifugal force that feeds the liquid through the system instead of capturing and discharging a fixed volume "per stroke" as rollers, pistons or diaphragms would do. Therefore, if the outlet is closed, the impeller simply continues to rotate harmlessly. That is why special relief valves are not required in centrifugal pump systems.



## Roller Pumps (positive displacement)

Roller pumps are the number one all-around choice by farmers throughout the world. The rollers (from 4 to 8, depending on the model) revolve inside the pump housing to force the spray solution through the outlet to the nozzle. Roller pumps have a low initial cost and are extremely versatile. They operate efficiently at PTO speeds of 540 and 1000 RPM and have a wide pressure range of up to 300 psi and flow rates of 2-74 gpm. Roller pumps are self-priming and easily adapt to PTO or gas engine drives. Specific seal, roller and casting materials can be selected for compatibility with certain herbicides, pesticides, fungicides and fertilizers.



## Centrifugal Pumps (non-positive displacement)

In centrifugal pumps, spray solution enters through the center of a rotating impeller that's driven at speeds up to 6000 RPM. Spray solution is forced to the outer edge of the housing. This centrifugal force is what delivers the liquid to the nozzle. Traditionally thought of as low to medium

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pressure pumps (0-180 psi), centrifugals can deliver high flow rates (up to 210 gpm). Because centrifugals have minimum surfaces to wear and no valves, they are very durable, easy to maintain and well suited for pumping abrasive and corrosive materials. Because Hypro's centrifugal pumps use a mechanical face seal, dry-running should be avoided.

Because centrifugal pumps operate at higher speeds, the PTO speed must be increased through a speedup gear drive or belt/pulley drive or driven by a gas engine or a highspeed hydraulic motor (Hypro has models specifically designed for each of these applications).



## Diaphragm Pumps (positive displacement)

Because of their design, diaphragm pumps provide excellent handling of abrasive and corrosive materials. The pumping cylinders (from 2 to 6) are separated from the piston chambers (Hypro's are oil-filled) by a synthetic diaphragm. This keeps the spray solution from contacting and corroding the internal pump components.

Diaphragm pumps are compact, self-priming and produce medium-to-high pressures (275 to 725 psi) with flow rates of 3.5 to 66 gpm. Driven by 540 rpm PTO or gas engine, diaphragm pumps are used for a variety of agricultural, horticultural and pest control spraying applications.



## Piston Pumps (positive displacement)

Piston pumps are not unlike an engine. That is, they have a shaft, pistons and "intake" and "exhaust" valves. On the down-stroke, the inlet valve opens, filling the chamber with solution. On the up-stroke, the outlet valve opens, and the piston forces the solution to the nozzle. Piston pumps deliver relatively low flow rate (up to 10 gpm) at high pressure (up to 400 psi). The replaceable piston cups can be of leather, fabric or Buna-N rubber, depending on the type of solution to be sprayed. They can be driven by 540 rpm PTO, gas engine or electric motor. Their low volume/high pressure capability permits use in general spraying as well as task-oriented applications such as spraying fence rows and ditches and hydrostatic testing.

## Hypro Pumps Identification Coding

Hypro uses serialized labeling to enable users to precisely identify the pump when ordering parts or requesting warranty service. Following is an example.



First line: Model Number Second line: Serial Number First digit: year (1=1991) Second through fourth digits:

consecutive day of the year the pump was manufactured.

**Fifth digit:** shift the pump was built on.

Sixth through ninth digits: consecutive pump number built on the shift

**Note:** see the individual pump pages in this catalog for information on decoding the pump's model number.

## PUMP DRIVES

How a pump is to be driven is often a primary consideration in selecting the proper type of pump. If the power source has already been determined, the following chart can be of further help in selecting the type of Hypro pump that is best suited to your needs.

			You can us	e these pu	mp types:	
If your power source is:		Roller	Centrifugal	Turbine	Diaphragm	Piston
	direct coupled	~			<	~
540 rpm PTO	through gear drive:		<b>~</b>			
	through belt/pully:		<b>~</b>			
	direct coupled	~				
1000 rpm PTO	through gear drive:		<b>~</b>	✓		
	through belt/pulley:		~			
Hydraulic Motor			~			
12 Volt DC Motor		~				
	direct coupled	~	<			
Gas Motor	through gear reduct:	✓			~	~
	through belt/pulley:	~	<b>~</b>		~	>
Electric Motor	direct coupled	~	~			
	through belt/pulley:	~	~		~	>

## Pump shaft rotation

With many pumps, you need to specify which direction the shaft rotates . . . either clockwise (CW) or counter clockwise (CCW). Hypro Corporation's rules on shaft rotation are as follows:

## Rule #1 "Eyes on the end"

Always view the rotation when you're facing the end of the drive shaft. If it turns clockwise, it's a clockwise shaft. Always use this rule for determining rotation of the pump shaft and for the power source shaft (PTO, for example). Once you've determined the rotation of the power source shaft, remember Hypro rule #2:

## Rule #2 "Opposites attract"

A clockwise (CW) rotating PTO shaft will require a counterclockwise (CCW) rotating pump shaft, and vice versa. All shaft rotation references in this catalog are based on these two rules.



# DETERMINING PUMP FLOW AND PRESSURE REQUIREMENTS

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Every pumping task has an optimum volume and pressure requirement. Determining that optimum (and selecting the pump that delivers it) is key to an efficient and economical spraying system operation.

Pressure requirements for agricultural pumps are dependent on both material to be applied and application targets. Soil applied herbicides generally require a relatively low pressure pump rating of 30-60 psi with foliar applied herbicides at the top end of that range and slightly higher. Insecticides and fungicides require higher pressure ratings of 100 to 500 psi. Pressure must be sufficient, in the case of heavy foliage field crops and orchard crops, to penetrate the leaf cover. In the case of orchard crops, pressure must also be sufficient to carry material up and over as well as into the canopy.

A number of factors must be considered to properly determine the total flow you'll need from your pump. They include:

- Type of spray operation (broadcast, banding, low-level, etc.)
- The chemical's application rate, ground speed, boom width, hose length, tank agitation, etc.

The spray task is the first consideration in determining flow rate and pressure needs. The following formulas and calculations can help.

#### Calculating agitation requirements

The pump must produce enough flow for both the application rate and tank agitation requirements. Too little agitation will not keep the solution in proper suspension and too much agitation can cause foaming. Here are rule-ofthumb formulas for calculating how much additional pump flow you'll need for agitation.

#### Liquids:

Tank volume (gallons) x .05 = total agitation in gpm

#### Wettable Powders and Flowables:

Tank volume (gallons) x .125 = total agitation in gpm

**EXAMPLE:** If you'll be spraying a wettable powder from a 100 gallon tank, proper agitation will require 12.5 gpm additional flow from the pump.

#### Factor in an "Excess Flow" Requirement

It's wise to have some excess flow capacity so you'll not end up with an undersized pump because actual operation conditions can cause changes in spray system performance (such as normal pump wear, operating at less than rated speeds, etc.). Hypro recommends you add an additional 20% to your calculated total pump flow requirement to compensate for these variables.



#### Calculating pump flow for broadcast boom sprayers

Chemical application is measured in gallons-per-acre (gpa), whereas pump flow is stated in gallons-per-minute (gpm). To calculate the pump flow gpm required by a broadcast boom sprayer, multiply the gpa application rate (from the chemical label, usually 10-20 gpa) by the sprayer ground speed (5-10 mph). Multiply the sum by the boom width on your sprayer (in feet). Then, divide that number by 495. As a formula, it is written like this:

#### Flow required for boom (gpm) = <u>gpa x mph x boom width (ft.)</u> 495

The result will be the pump flow required to deliver the proper application rate at the boom's nozzles. Then calculate your total pump flow requirement (broadcast):

Flow required for boom:			gpm
Flow required for agitation:	+		gpm
Sub-total	=		gpm
Excess flow requirement:	х	1.20	
TOTAL PUMP FLOW NEEDED:	=		

# DETERMINING PUMP FLOW AND PRESSURE REQUIREMENTS



## Calculating pump flow for banding sprayers

First, multiply the band width (in inches) by the number of rows to determine the total width (w). Then, multiply the application rate (gpa from the chemical label) by the ground speed (mph). Multiply that result by the total width (w) calculated earlier. Then divided the result by 5940. Here's how the formula appears:

#### Flow required or nozzles (gpm) = <u>gpa x mph x w</u> 5940

For total pump flow requirement (banding), calculate:

Flow required for boom:		gpm
Flow required for agitation:	+	gpm
Sub-total	=	gpm
Excess flow requirement:	х	1.20
TOTAL PUMP FLOW NEEDED:	=	



# Calculating pump flow for low and high pressure hand gun spraying

For low-level spraying with a hand gun, such as for lawn and turf care, professional applicators typically "walk" the lawn at about 1,000 sq. ft. per minute. That means the "gpm" rate of the hand gun will generally be the same as "gallons per 1,000 sq. ft." To determine your total pump flow requirement:

Flow rate of hand gun/nozzl		gallons per	
			1,000² (same
			as gpm)
Flow required for agitation:	+		gpm
Sub-total	=		gpm
Excess flow requirement:	х		
TOTAL PUMP FLOW NEEDED	: =	1.20	

Use this same method for calculating the pump flow requirement for high pressure spraying, such as trees. Even though the application "rate" is usually a visual saturation of the tree, the known gpm factor will be the handgun nozzle output, which is the rate you use for the calculation.

# DETERMINING PUMP FLOW AND PRESSURE REQUIREMENTS

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For most hand gun chemical spraying, 40 psi at the nozzle is typical. To properly select a pump that can deliver the right nozzle pressure, you must consider the normal "pressure drop" that occurs within the length of hose. The amount of pressure drop through the hose depends on hose length, hose diameter and flow rate. For example, as the accompanying chart shows, 300' of ½" hose spraying at 6 gpm, will have a pressure drop of approximately 120 psi. That means you need a pump delivering at least 160 psi in order to insure 40 psi at the nozzle.

NOTE: When determining the total pump pressure requirement for high tree spraying, you must also consider the spray height (or reach) you need to attain. Generally, pumps of up to 700 psi are used for this purpose.



Pressure Loss at Various Rates of Flow of Water Through Hose\* at temperature of 68° Fahrenheit (20°C.)(\*¼ inch to 1 inch inside diameter)



# Inside Diameter Hose Size

# HAND-HELD SPRAY GUN PERFORMANCE AT VARIOUS PRESSURES AND NOZZLE SIZES

#### HAND-HELD SPRAY GUN PERFORMANCE AT VARIOUS PRESSURES AND NOZZLE SIZES

When selecting system components for hand gun spraying factors such as flow rate, vertical "throw", nozzle size, spray pattern and pressure must be considered. The following chart provides data for capacity (gpm) and maximum vertical throw in feet (ft.) at a variety of pressures and nozzle sizes, as well as for "cone" or "straight" spray patterns.

**NOTE:** Data for this chart is based on Hypro Models 3381-0010, 3381-0011 and 3381-0013 spray guns.



HYPRO		EQUIV.	PRESSURE	200 SET	) PSI TING	350 SET	PSI	500 SET	) PSI	60 SE	0 PSI	650 SET	) PSI	700 SET	) PSI	850 SET	) PSI TING
#	IN mm	#	PERFORMANCE	Cone	Straight	Cone	Straight	Cone	Straight	Cone	Straight	Cone	Straight	Cone	Straight	Cone	Straight
3385-2300	2.3	14	capacity in gpm max throw (ft)	2.1 11.4	2.7 29	2.7 12.9	3.7 33.9	3.4 14.8	4.5 37.9	3.8 16.6	4.9 41.5	3.8 17	5 41.7	3.9 17.7	5.1 42	4.2 19	5.8 45.7
3385-3000	3	23	capacity in gpm max throw (ft)	2.9 11.7	4.6 29.2	3.7 12.9	6.3 33.9	4.8 13.8	7.5 36.2	5.2 15.6	8.4 40.8	5.3 16	8.5 40.7	5.4 16.2	8.6 42	6 17	9.6 44.1
3385-3500	3.5	29	capacity in gpm max throw (ft)	5.8 13.6	6 36.2	7.9 19	8.2 41.2	9.6 22.6	9.9 45.3	10.7 25.5	11.1 50	11 25.5	11.3 51	11.2 27	11.6 51.5	12.4 28.8	12.8 54
3385-4000	4	40	capacity in gpm max throw (ft)	7 15.1	7.3 37.7	9.6 20.6	9.9 42.8	11.6 24.3	12 47	12.9 27.2	13.5 53	13.2 27.2	13.8 54	13.6 28.5	14.1 55	15 29	15.6 59
3385-4500	4.5	54	capacity in gpm max throw (ft)	8.2 18.1	8.9 39.2	11.1 22.2	12 44.3	13.4 26	14.5 50.1	15 30.6	16.3 54	15.4 30.6	16.6 56	15.7 31	17 57	17.4 31.5	18.9 62
3385-5000	5	67	capacity in gpm max throw (ft)	9.8 19.6	10.2 40.7	13.3 23.8	13.8 47	16 27.5	16.7 53.3	18 32.3	18.7 59	18.4 32.3	19.1 61	18.9 32.8	19.5 62	20.8 32.8	21.6 67
3385-5500	5.5	79	capacity in gpm max throw (ft)	10.7 19.6	11.5 42.2	14.4 23.8	15.6 50.7	17.4 29	18.8 57	19.6 34	21 63	20 34	21.5 64	20.4 34.5	22 65	22.6 34.5	24.4 70
3385-6000	6	91	capacity in gpm max throw (ft)	11.5 21.1	12.6 43.7	15.6 25.3	17.1 54	18.8 30.7	20.6 60	21 35.6	23.2 66	21.5 35.6	23.7 67	22 36	24.2 68	24.4 36	26.9 74
3385-7000	7	117	capacity in gpm max throw (ft)	11.5 21.1	13.5 46.8	15.6 25.3	18.4 57	18.8 30.7	22.2 63	21 37.4	25 70	21.5 37.4	25.4 71	22 38	26 72	24.4 38	29 77

\* Figures shown are guidelines for vertical throw.

\*\* Pressures based on relief valve settings at straight throw.

# RECOMMENDED PUMP PLACEMENT



### PTO direct-mount

Location of PTO driven pumps and pump drive units can have a significant effect on pump life. Mounting the pump directly to the PTO is always a good choice. Even though installation is relatively easy, use caution to insure the shaft does not get bent or damaged. Always use a quality, properly secured coupler and provide adequate support for the pump itself in order to withstand the extreme bouncing and vibration the system must endure. PTO mounting shields should always be used for maximum safety and protection.



#### Tumble rod mounting

The best tumble rod installation occurs when the distance from the PTO U-joint to the hitch is **equal** to the distance from the hitch to the pump U-joint. For 540 RPM PTO shafts, the distance from the hitch pin to the pump shaft should be 14 inches. For 1000 RPM 1%" PTO shafts, the distance is 16 inches. For 1000 RPM 1%" PTO shafts, the distance is 20 inches.

If direct PTO mounting is not convenient or desired, then mount the pump in a convenient position on the pull-behind sprayer and connect it to the tractor PTO with a "tumble rod" power shaft. Exercise caution when using this approach to insure: (1) the tumble rod is level; (2) the hitch pin is the center-point; and (3) turn angles greater than 45° can be avoided. Failure to follow these 3 points can cause "power shocks" within the pump and drive units and increase wear on seals, gears and, in the case of diaphragm pumps, the diaphragms themselves.

Power shocks occur when the PTO shaft knuckle and the universal joint at the pump end of the tumble rod turn faster on the inside of the turning angle than on the outside. To prevent these vibrations, the angle of the tumble rod to the tractor PTO shaft and the angle of the tumble rod at the pump shaft should be as close to equal as possible. This will cancel out the fluctuations.



#### NOZZLES

Worn, damaged or plugged nozzles are costly. . . to the environment and your bottom line. As nozzles wear out, their orifices become enlarged, resulting in over application and uneven application of chemicals. Nozzle manufacturers report that just a 10% increase in flow from worn nozzles represent a loss of \$2,000 to \$10,000 on a twice-sprayed 1,000 acre farm (at \$10-\$50/acre chemical cost). And when the potential environmental and crop damage is considered, the real cost is almost immeasurable. The good news is, monitoring and maintaining nozzle performance is one of the easiest ways to help keep a spraying system operating accurately and efficiently.

- 1. As a rule, replace nozzles at the beginning of the spraying season or every 40 hours, whichever comes first.
- 2. Only use the nozzle type that is recommended for your particular spraying application.
- 3. Calibrate your spraying system regularly to compensate for normal nozzle wear.
- 4. Add a spray monitor to catch uneven performance and plugged nozzles.





# SPRAYER CALIBRATION



#### SPRAYER CALIBRATION

Improperly calibrated sprayers threaten the wallet and the environment. A few minutes spent calibrating a sprayer can ensure expensive inputs go where they are supposed to and at their recommended rate. Proper calibration exposes under-pressured systems and worn tips that can sabotage a spray program and its budget. Follow these steps to calibrate your sprayer safely and effectively.

 The first step in any calibration effort is to check tractor speed. Mark off lengths of 100 and 200 ft. for measuring tractor speeds of 5 mph and 10 mph, respectively. Fill the sprayer tank half full of water, select the engine throttle setting and gear that you expect to use when spraying, then record the seconds required to drive the length of each course twice at their respective settings. Average the results of each set, and use the following equation to determine ground speed.

Speed = <u>Distance (ft.) x 60</u> Time (sec.) x 88

Repeat the test as needed until the correct speed is identified. Mark that setting on the tachometer or speedometer for in field reference.

2. Record the nozzle spacing, nozzle type, ground speed and product label application rate. Check to ensure all nozzles are of a uniform type.

- 3. Multiply the application rate (gpa) by the speed (mph) and the width of the spray pattern (w)\*. Divide this amount by 5940 (a constant), to determine the gallons per minute (gpm) produced by each nozzle.
- 4. To set correct pressure, operate the water filled sprayer in place to check for leaks and stoppages. Stop the sprayer, and replace one tip on the boom with an identical new tip and strainer. Check the tip product information sheet for recommended delivery rate and pressure that matches the gpm level calculated in Step 3.

Engage the sprayer and adjust for recommended pressure. Collect the volume of spray produced from the new nozzle tip over a one minute period. Measure the water, and fine tune the pressure setting until the calculated delivery rate is reached.

 Repeat the collection procedure with several tips on each boom section. If variations in flow in excess of 10% are produced from more than one tip, replace all old tips and screens.

\*If calibrating a sprayer for broadcast application, use boom length for spray pattern width. If calibrating for banding, use only actual spray pattern in inches (12 bands of 10" each on 30" rows equals spray pattern width of 120" on a 30' boom).

Directed applications with multiple nozzles require that the row or band in inches be divided by the number of nozzles directed at the row to calculate w (30"/3 nozzles X# of rows = w).

# HYPRO DIAPHRAGM PUMP GAS ENGINE APPLICATIONS

# WITH BRIGGS & STRATTON ENGINES

Spray Height	Pump Model	Engine	Spray Gun	Nozzle
25-30 ft.	9910-D12GRGI 3.2 gpm; 275 psi	3 hp %" Shaft Flange Mount	3381-0010 or 3381-0013	3385-2300
30-35 ft.	9910-D252GRGI 6 gpm; 275 psi	3 hp ¾" Shaft Flange Mount	3381-0010 or 3381-0013	3385-3000
35-40 ft.	9910-D30GRGI 9.5 gpm; 550 psi	5 - 5½ hp ¾" Shaft Flange Mount	3381-0010 or 3381-0013	3385-3000
45-50 ft.	910-D50GRGI 14 gpm; 550 psi	8 hp 1" Shaft Flange Mount	3381-0011	3385-4000
45-50 ft.	9910D503GRGI 14 gpm; 550 psi	8 hp 1" Shaft Flange Mount	3381-0011	3385-4000
50-57 ft.	9910-D813GRGI 18 gpm; 700 psi	14 hp 1" Shaft Flange Mount	3381-0011	3385-4500
60-68 ft.	9910-D1064GRGI 24 gpm; 700 psi	18 hp 1" Shaft Flange Mount	3381-0011	3385-6000

All GRGI pump models come complete with gear reduction and control valve.

# SYSTEM HOOK-UPS

**ROLLER PUMPS** 



## **TURBINE PUMP**



**CENTRIFUGAL PUMPS** 



#### **DIAPHRAGM PUMPS DIAPHRAGM PUMPS** High Pressure Pumps Low and Medium Pressure Pumps C Agitator Agitator Tank Shut-off Tank Shut-off **Bypass Line** 肍 lh Bypass Line Agitation Line Agitation Line Strainer Straine Control r Valve Ш Pump Pump Outlet Outlet Pressure Gauge 🚫 Relief Valve Pressure Relief Control Gauge Or Valve Valve Control Valve To Spray Gun **To Boom Nozzles** To Spray Gun To Boom Nozzles ٤ Boom Shut-off Boom Shut-off or Selector or Selector **SMALL TWIN PISTON PUMPS** Pulsation Dampener Filled Compound Pressure Pressure Gauge Nozzle Regulator Pump Gauge Line Strainer Spray Gun IN ou Unloader

**Bypass Back to Inlet** 

Valve



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Technical/Application	.800-445-8360
Order Department	.800-42HYPRO (800-424-9776)
FAX for fast delivery	.800-323-6496





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