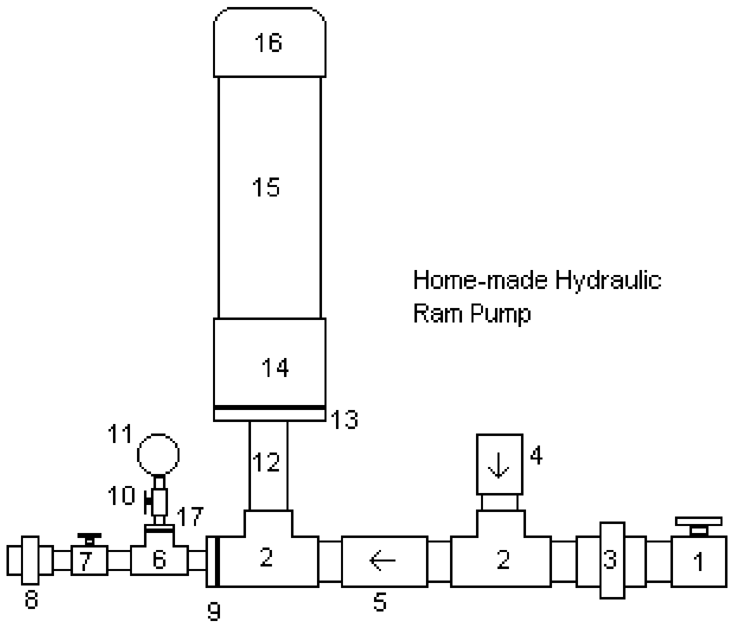
CLEMSON UNIVERSITY Cooperative Extension Service

Home-made Hydraulic Ram Pump

This information is provided as a service to those wanting to try to build their own hydraulic ram pump. The data from our experiences with one of these home-made hydraulic ram pumps is listed in Table 4 near the bottom of this document. The typical cost of fittings for an 1-1/4" pump is currently $120.00 (U.S.A.) regardless of whether galvanized or PVC fittings are used.



Click here to see a picture of an old-style assembled ram pump with a threaded plug

(see notes below concerning glue cap (#16) versus threaded plug)

Table 1. Image Key

1	1-1/4" valve	10	1/4" pipe cock
2	1-1/4" tee	11	100 psi gauge
3	1-1/4" union	12	1-1/4" x 6" nipple
4	1-1/4" brass swing check valve (picture)	13	4" x 1-1/4" bushing
5	1-1/4" spring check valve	14	4" coupling
6	3/4" tee	15	4" x 24" PR160 PVC pipe
7	3/4" valve	16	4" PVC glue cap
8	3/4" union	17	3/4" x 1/4" bushing
9	1-1/4" x 3/4" bushing		

All connectors between the fittings are threaded pipe nipples - usually 2" long or shorter. This pump can be made from PVC fittings or galvanized steel. In either case it is recommended that the 4" diameter fittings be PVC fittings to conserve weight.

Conversion Note: 1" (1 inch) = 2.54 cm; 1 PSI (pound/square inch) = 6.895 KPa or 0.06895 bar; 1 gallon per minute = 3.78 liter per minute. PR160 PVC pipe is PVC pipe rated at 160 psi pressure.

Assembly and Operation Notes:

Pressure Chamber - A bicycle or "scooter tire" inner tube is placed inside the pressure chamber (part 15) as an "air bladder" to prevent water-logging or air-logging. Inflate the tube until it is "spongy" when squeezed, then insert it in the chamber. It should not be inflated very tightly, but have some "give" to it. (No information is available concerning pressure chamber sizes for the various sizes of ram pump. Make one somewhat larger for larger pumps - for instance, try a 6 inch diameter x 24 inch long pressure chamber for a 3 inch ram.)

A 4" threaded plug and 4" female adapter were originally used instead of the 4" glue-on cap shown in the image, This combination leaked regardless of how tightly it was tightened or how much teflon tape sealant was used, resulting in water-logging of the pressure chamber. This in turn dramatically increased the shock waves and could possibly have shortened pump life. If the bicycle tube should need to be serviced when using the glue cap the pipe may be cut in half then re-glued together using a coupling.

Valve Operation Descriptions - Valve #1 is the drive water inlet for the pump. Union #8 is the exit point for the pressurized water. Swing check valve #4 is also known as the "impetus" or "waste" valve - the extra drive water exits here during operation. The "impetus" valve is the valve that is operated manually at the beginning (by pushing it in with a finger) to charge the ram and start normal operation.

Valves #1 and #7 could be ball valves instead of gate valves. Ball valves may withstand the shock waves of the pump better over a long period of time.

The swing check valve (part 4 - also known as the impetus valve) *can* be adjusted to vary the length of stroke (please note that maximum flow and pressure head will be achieved with this valve positioned vertically with the opening facing up). Turn the valve on the threads until the pin in the clapper hinge of the valve is in line with the pipe (instead of perpendicular to it). Then move the tee the valve is attached to slightly from vertical, making sure the clapper hinge in the swing check is toward the top of the valve as you do this. The larger the angle from vertical, the shorter the stroke period (and the less potential pressure, since the water will not reach as high a velocity before shutting the valve). For maximum flow and pressure valve #4 should be in a vertical position (the outlet pointed straight up).

Swing check valve #4 should always be brass (or some metal) and not plastic. Experiences with plastic or PVC swing check valves have shown that the "flapper" or "clapper" in these valves is very light weight and therefore closes much earlier than the "flapper" of a comparable brass swing check. This in turn would mean lower flow rates and lower pressure heads.

The pipe cock (part 10) is in place to protect the gauge after the pump is started. It is turned off after the pump has been started and is operating normally. Turn it on if needed to check the outlet pressure, then turn it back off to protect the gauge.

Drive Pipe - The length of the drive pipe (from water source to pump) also affects the stroke period. A longer drive pipe provides a longer stroke period. There are maximum and minimum lengths for the drive pipe (see the paragraph below Table 2). The drive pipe is best made from galvanized steel (more rigid is better) but schedule 40 PVC can be used with good results. The more rigid galvanized pipe will result in a higher pumping efficiency - and allow higher pumping heights. Rigidity of the drive pipe seems to be more important in this efficiency than straightness of the drive pipe.

Drive pipe length and size ratios are apparently based on empirical data. Information from University of Georgia publications (see footnote) provides an equation from Calvert (1958) describing the output and stability of ram pump installations in relation to the ratio of the drive pipe length (L) to the drive pipe diameter (D). The best range is an L/D ratio of between 150 and 1000 (L/D = 150 to L/D = 1000). Equations to use to determine these lengths are:

Minimum inlet pipe length: L = 150 x (inlet pipe size)

Maximum inlet pipe length: L = 1000 x (inlet pipe size)

If the inlet pipe size is in inches, then the length (L) will also be presented in inches. If inlet pipe size is in mm, then L will be presented in mm.

Drive Pipe Length Example: If the drive pipe is 1-1/4 inches (1.25 inches) in diameter, then the minimum length should be L = 150 x 1.25 = 187.5 inches (or about 15.6 feet). The maximum length for the same 1-1/4 inch drive pipe would be L = 1000 x 1.25 = 1250 inches (104 feet). The drive pipe should be as rigid and as straight as possible.

Stand pipe or no stand pipe? Many hydraulic ram installations show a "stand pipe" installed on the inlet pipe. The purpose of this pipe is to allow the water hammer shock wave to dissipate at a given point. Stand pipes are only necessary if the inlet pipe will be longer than the recommended maximum length (for instance, if the inlet pipe were to be 150 feet in length in the above example where the maximum inlet length should only be 104 feet). The stand pipe - if needed - is generally placed in the line the same distance from the ram as the recommended maximum length indicated.

The stand pipe must be vertical and extend vertically at least 1 foot (0.3 meter) higher than the elevation of the water source - no water should exit the pipe during operation (or perhaps only a few drops during each shock wave cycle at most). Many recommendations suggest that the stand pipe should be 3 sizes larger than the inlet pipe. The supply pipe (between the stand pipe and the water source) should be 1 size larger than the inlet pipe.

The reason behind this is simple - if the inlet pipe is too long the water hammer shock wave will travel farther, slowing down the pumping pulses of the ram. Also, in many instances there may actually be interference with the operation of the pump due to the length of travel of the shock wave. The stand pipe simply allows an outlet to the atmosphere to allow the shock wave somewhere to go. Again this is not necessary unless the inlet pipe will have to be longer than the recommended maximum length.

Another option would be to pipe the water to an open tank (with the top of the tank at least 1 foot (0.3

meter) higher than the vertical elevation of the water source), then attach the inlet pipe to the tank. The tank will act as a dissipation chamber for the water hammer shock wave just as the stand pipe would. This option may not be viable if the tank placement would require some sort of tower, but if the topography allows this may be a more attractive option.

Click here to view sketches of these types of hydraulic ram pump installations
(loads in 70 seconds over 28.8 modem)

Operation - The pump will require some back pressure to begin working. A back pressure of 10 psi or more should be sufficient. If this is not provided by elevation-induced back pressure from pumping the water uphill to the delivery point (water trough, etc.), use the 3/4" valve (part 7) to throttle the flow somewhat to provide this backpressure.

As an alternative to throttling valve part 7 you may consider running the outlet pipe into the air in a loop and then back down to the trough to provide the necessary back pressure - a total of 23 feet of vertical elevation above the pump outlet should be sufficient. This may not be practical in all cases, but adding 8 feet of pipe after piping up a hill of 15 feet in elevation should not be a major problem. This will allow you to open valve #7 completely, preventing stoppage of flow by trash or sediment blocking the partially-closed valve. It is a good idea to include a tee at the outlet of the pump with a ball valve to allow periodic "flushing" of the sediment just in case.

Initially the pump will have to be manually started several times to remove all the air. Start the pump by opening valve 1 and leaving valve 7 closed. Then, when the swing check (#4) shuts, manually push it open again. The pump will start with valve 7 closed completely, pumping up to some maximum pressure before stopping operation. After the pump begins operation slowly open valve 7, but do not allow the discharge pressure (read on gauge #11) to drop below 10 psi. You may have to push valve #4 open repeatedly to re-start the pump in the first few minutes (10 to 20 times is not abnormal) - air in the system will stop operation until it is purged.

The unions, gate (or ball) valves, and pressure gauge assembly are not absolutely required to make the pump run, but they sure do help in installing, removing, and starting the pump as well as regulating the flow.

Pump Performance - Some information suggests that typical ram pumps discharge approximately 7 gallons of water through the waste valve for every gallon pressurized and pumped. The percentage of the drive water delivered actually varies based on the ram construction, vertical fall to pump, and elevation to the water outlet. The percentage of the drive water delivered varies from approximately 22% when the vertical fall to the pump is 1/2 (50%) of the elevation to the water outlet down to 2% when the vertical fall is 0.04 (4%) of the elevation to the water outlet. Rife Hydraulic Engine Manufacturing Company literature (http://www.riferam.com/) offers the following equation:

$$0.6 \times Q \times F/E = D$$

Q is the available drive flow in gallons per minute, F is the fall in feet from the water source to the ram, E is the elevation from the ram to the water outlet, and D is the flow rate of the delivery water in gallons per minute. 0.6 is an efficiency factor and will differ somewhat between various ram pumps. For instance, if 12 gallons per minute is available to operate a ram pump, then pump is placed 6 feet below the water source, and the water will be pumped up an elevation of 20 feet, the amount of water that may be pumped with an appropriately-sized ram pump is

0.6 x 12 gpm x 6 ft / 20 ft = 2.16 gpm

The same pump with the same drive flow will provide less flow if the water is to be pumped up a higher elevation. For instance, using the data in the previous example but increasing the elevation lift to 40 feet:

0.6 x 12 gpm x 6 ft / 40 ft = 1.08 gpm

Table 2. Typical Hydraulic Ram specifications *(Expected water output will be approximately 1/8 of the input flow, but will vary with installation fall (F) and elevation lift (E) as noted above. This chart is based on 5 feet of lift (E) per 1 foot of fall (F).)*

Drive Pipe Diameter (inches)	**Delivery Pipe Diameter** (inches)	**At Minimum Inflow**		**At Maximum Inflow**	
		Pump Inflow (gallons per minute)	**Expected Output** (gallons per minute)	**Pump Inflow** (gallons per minute)	**Expected Output** (gallons per minute)
3/4	1/2	3/4	1/10	2	1/4
1	1/2	1-1/2	1/5	6	3/4
1-1/4	1/2	2	1/4	10	1-1/5
1-1/2	3/4	2-1/2	3/10	15	1-3/4
2	1	3	3/8	33	4
2-1/2	1-1/4	12	1-1/2	45	5-2/5
3	1-1/2	20	2-1/2	75	9
4	2	30	3-5/8	150	18
6	3	75	9	400	48
8	4	400	48	800	96

Table 3. Test Installation Information

Drive Pipe Size	1-1/4 inch Schedule 40 PVC
Outlet Pipe Size	3/4 inch Schedule 40 PVC
Pressure Chamber size	4 inch PR160 PVC
Pressure Chamber Length	36 inches
Inlet Pipe Length	100 feet
Outlet Pipe Length	40 feet
Drive Water (Inlet) elevation above pump	4 feet

Elevation from pump outlet to delivery outlet 12 feet

Click here to see pictures of the test installation (loads in 38 seconds over 28.8 modem)

Table 4. Trial 1 Performance Data

	Expected Performance	At Installation (5/17/99)	After Installation (with water-log) (5/21/99)	After Clearing Water-log (6/20/99)
Shutoff Head	5 to 17 psi	22 psi	50 psi	22 psi
Operating Head	10 psi	10 psi	10 psi	10 psi
Operating Flow Rate	0.50 to 1.00 gpm	0.28 gpm	1.50 gpm	0.33 gpm

Note that we used a 4" threaded plug and a 4" female adapter for our test pump (instead of the recommended 4" glue cap (#16) shown in the figure). Two days after installation the pump air chamber was effectively water-logged due to leakage past the threads of these two fittings, which was shown by the pronounced impulse pumping at the outlet discharge point. If the pump were allowed to remain waterlogged it would shortly cease to operate - and may introduce damage to the pipe or other components due to pronounced water hammer pressure surges.

The large range of expected values for shutoff head is due to the unknown efficiency of the pump. Typical efficiencies for ram pumps range from 3 feet to 10 feet of lift for every 1 foot of elevation drop from the water inlet to the pump.

Hydraulic Ram Web Sites

Bamford Pumps
CAT Tipsheet 7
Green and Carter
Lifewater Rams
NC State's EBAE 161-92, "Hydraulic Ram Pumps"
RamPumps.com
Rife Rams
Solar Electric
The Ram Company
University of Warwick (UK) Ram Pump Publications
University of Warwick (UK) Ram pump system design notes

Some information for this web page - and the initial information concerning construction of a home-made hydraulic ram pump - was provided by University of Georgia Extension publications #ENG98-002 and #ENG98-003 (both Acrobat "pdf" files) by Frank Henning. Publication #ENG98-002 also describes the pumping volume equations for *hydraulic ram pumps.*

Last modified on 10/06/03
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Hydraulic Ram Pump System Sketches

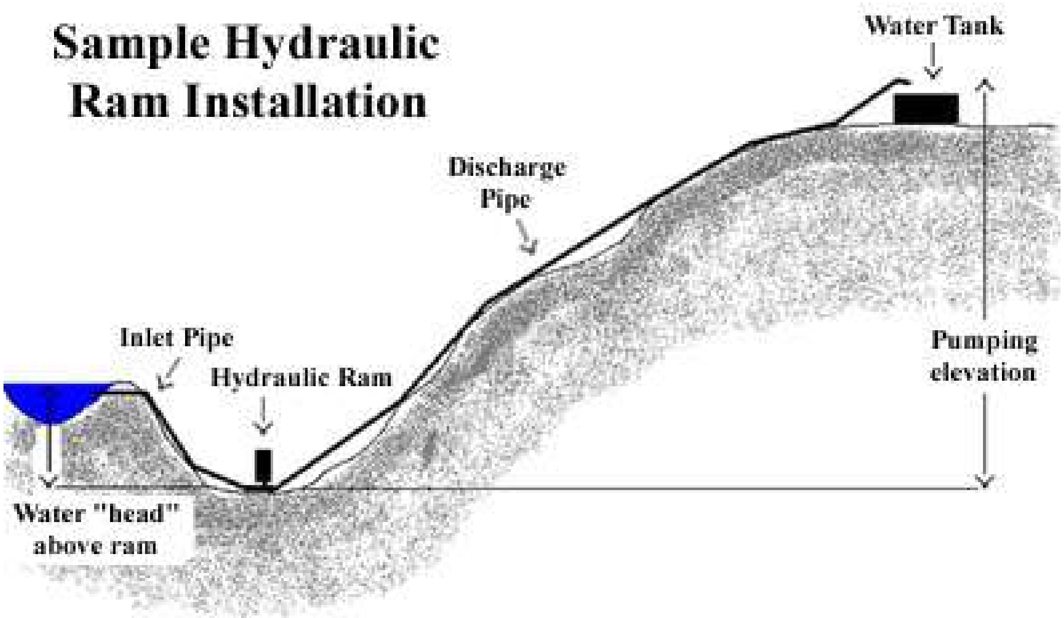

Figure 1. This installation is the "normal" ram system where the inlet pipe is less than the maximum length allowed. No stand pipe or open tank is required.

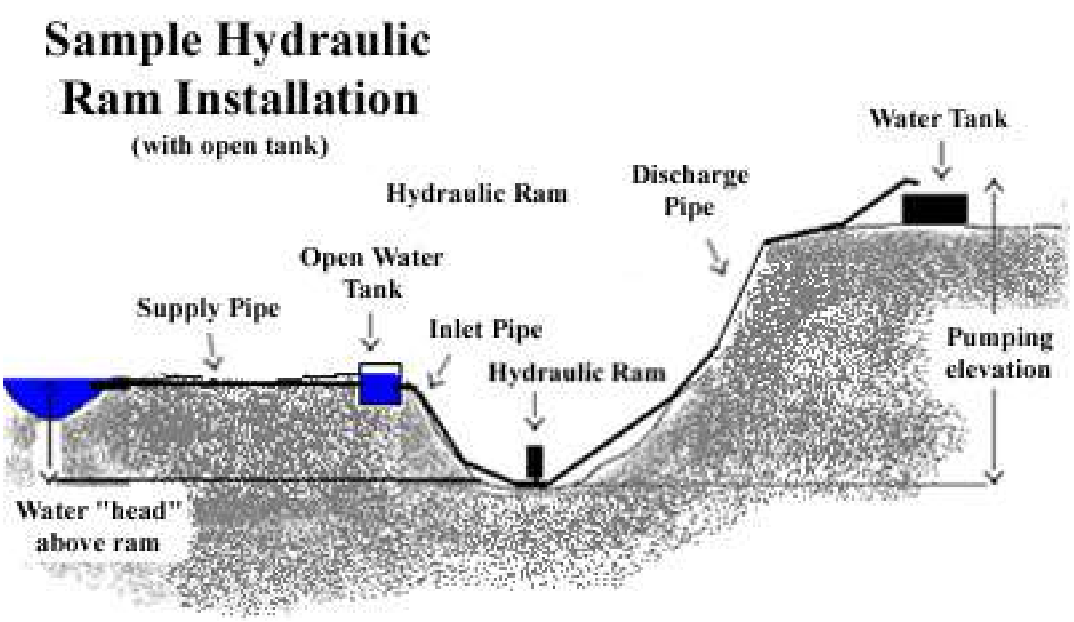

Figure 2. This installation is one option used where the inlet pipe is longer than the maximum length allowed. The open water tank is required to allow dissipation of the water hammer shock wave.

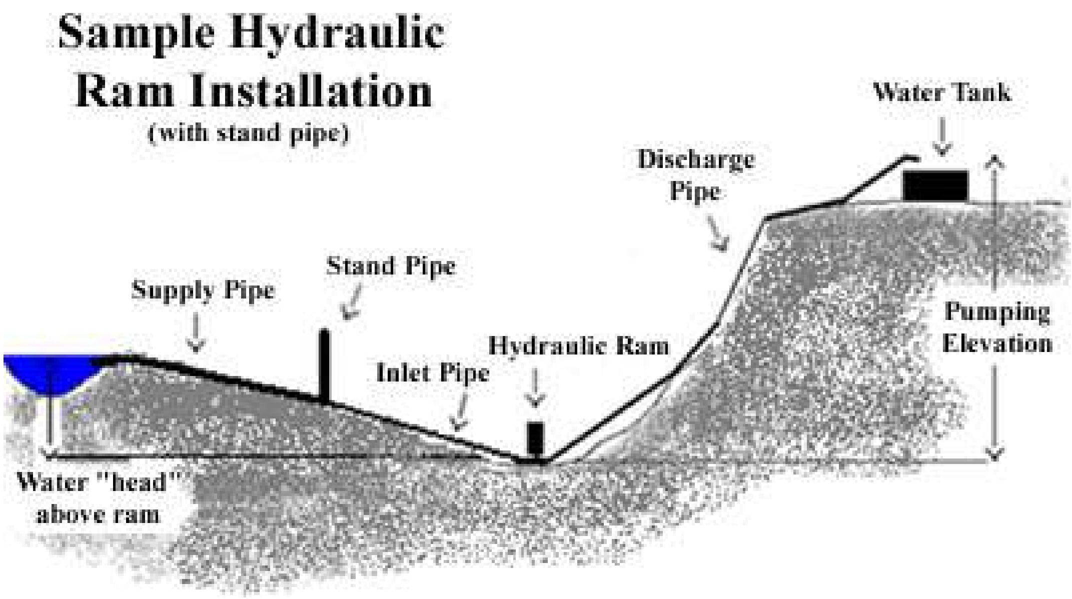

Figure 3. This installation is another option used where the inlet pipe is longer than the maximum length allowed. The stand pipe (open to atmosphere at the top) is required to allow dissipation of the water hammer shock wave.

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Water
Pumps
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Throughout the 116 years that we have been in business, Rife continues to be family run and owned, priding itself on its quality products made in the USA. Upon entering our third century of existence, we continue to retain the ideals that we have held sacred since 1884:

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Home-made Hydraulic Ram Test Installation

Figure 1. The ram pump installed and operating. Note the water exiting the waste valve and the rock used to hold the pump upright and anchor it.

Figure 2. The 1-1/4 inch Schedule 40 PVC drive pipe supplying the ram pump. Note the curves in the pipe due to the geometry of the stream channel. The pump worked quite well despite the lack of straightness of the pipe.

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The Bamford "Hi-Ram Pump ®"

Introduction

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[Pump Installation] [File Downloads] [New Applications] [Links] [Contact Us]

"Hi-Ram Pump ®" - A New, Simple and Economical Pump - Powered by Water.
An Australian Invention - Australian Patent No. 741896

The pump is quiet and is operated solely by the energy in a flow of water entering from above the pump. It uses no external source of power such as electricity, petrol or diesel.

A basic version of the "Hi-Ram Pump"
(The steel pipe on the left is the drive pipe entering the pump)

Particularly in developing countries, the choices for pumping water are often limited because reliable or affordable sources of power are not available. The idea of a water pump powered by water is not new, but is very relevant in a world where energy conservation is increasingly important. The hydraulic ram pump, invented more than 200 years ago, is one such pump.

Although the principle of operation of the Bamford Hi-Ram Pump is similar to that of a traditional

hydraulic ram pump, the new pump is considerably different in its construction and operating characteristics.

As is described in the section "About the Pump", the Bamford Hi-Ram Pump uses an inlet flow of water at low pressure to pump some of that water to a higher pressure or height. The pump has a self-sustaining cycle of operation about one second long. One typical installation is where water diverted from a stream drives the pump, with some of the water going up hill to a greater height, and the remaining water going to waste back to the stream.

The basis of the pump is a new waste valve mechanism with two moving parts, both of which can be very easily removed for maintenance or to adjust the pump.

In comparison with conventional hydraulic ram pumps, some of the different characteristics of the Bamford Hi-Ram Pump are as follows:

Its performance can be quickly adjusted for different pumping conditions, by using alternative moving parts in the valve mechanism.

Although the basic pump is very simple, additional components can be used to improve its performance in special roles.

It will work against both high and low output heads, thereby covering a much wider range of operating conditions.

The pump will operate when totally underwater (but the inlet flow of water to operate the pump must come from another source above the surface of the water).

The water going to waste need not spill out around the pump, but can be piped away for further use.

Depending on the operating conditions, the pump can be constructed wholly or partly from metal, plastics or other materials.

When constructed of non-metallic materials, the pump emits little noise.

The pump can be arranged to supply compressed air (but needs an air inlet pipe if underwater).

The pump can be arranged to provide a direct mechanical output to drive other devices.

The capability of the pump to "suck in" air can also be used to suck in water so that the pump acts as a suction pump for small suction heads.

Production pumps are now available as a basic water pump of the type shown above. Additional parts for the pump to product compressed air, or provide a mechanical output, or act as a suction pump are normally not provided. Provision of pumps for special applications needs to be the subject of a special order.

However, just in case of misunderstanding, you cannot pump water from a well or pool of water by just lowering the pump into the water - the pump must be driven by a flow of water coming from above the pump.

The Bamford Hi-Ram Pump considerably extends the usefulness of such devices for developing countries. Its ability to produce compressed air could be of particular use. Its ability to give a mechanical output could provide a means to pump clean drinking water from another source.

With reduced manufacturing costs and simplicity, the Bamford Hi-Ram Pump also has the potential to establish new roles in developed countries, and significantly increase the market for pumps using the hydraulic ram principle.

Queries from potential manufacturers or licensees are welcome.

Pumps are available for export, and more information about price and availability is shown in the "Latest News" Page.

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Home Page **http://www.bamford.com.au**

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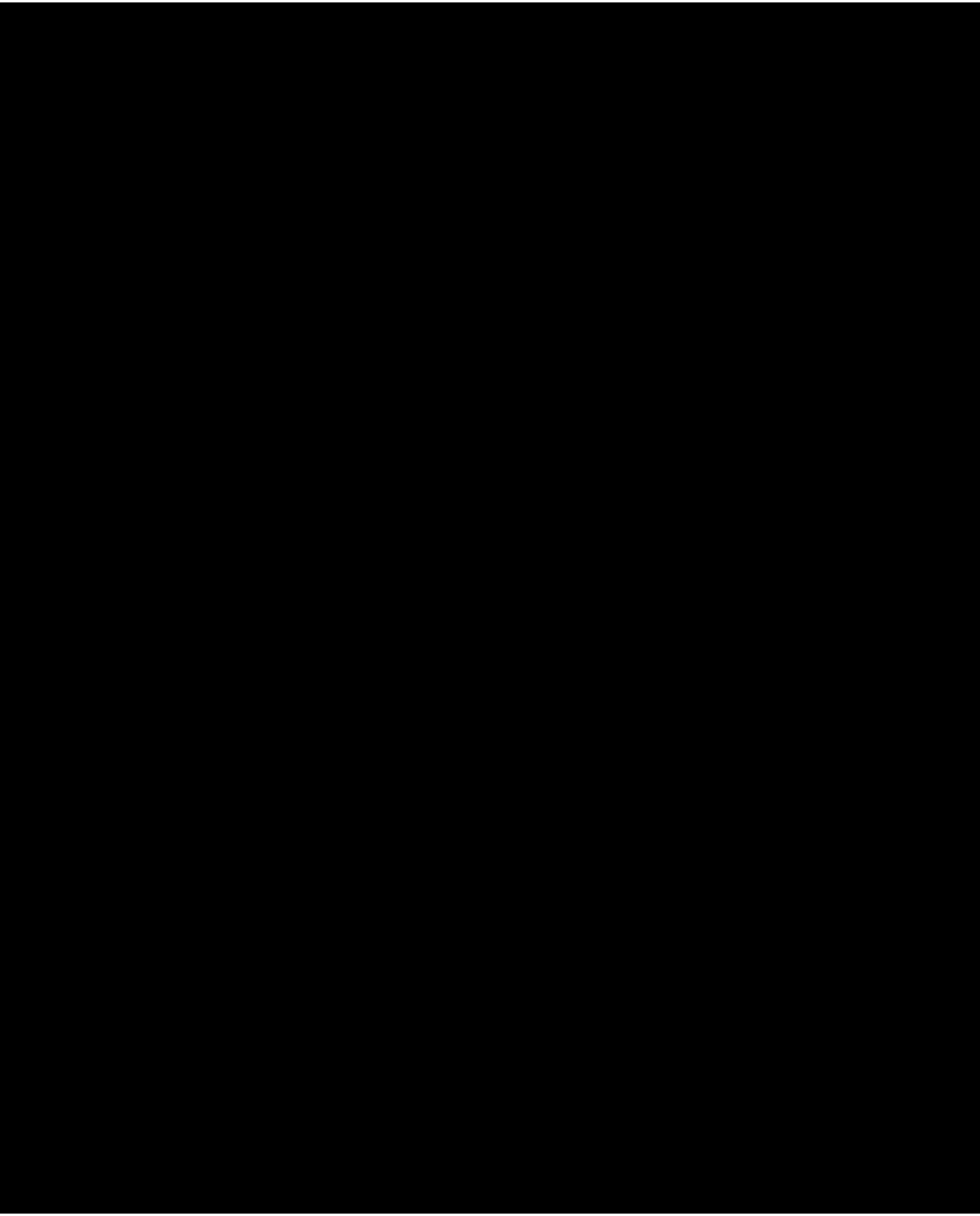
Green & Carter have been manufacturing RAM pumps for over **200 years**.

The Vulcan hydraulic RAM is still our only product, consequently our knowledge on the subject is second to none meaning you can deal with us in perfect confidence.



Hydraulic Ram Pumps

Low maintenance pumping of water without electricity!

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Hydraulic ram pumps are a time-tested technology that use the energy of a large amount of water falling a small height to lift a small amount of that water to a much greater height. In this way, water from a spring or stream in a valley can be pumped to a village or irrigation scheme on the hillside.

Depending on the difference in heights between the inlet pipe and the outlet pipe, these water pumps will lift 1-20 percent of the water that flows into it. In general, a ram can pump approximately one tenth of the received water volume to a height ten times greater than the intake. A hydraulic ram pump is useful where the water source flows constantly and the usable fall from the water source to the pump location is at least 91 cm (3 ft).

Since ram pumps can only be used in situations where falling water is available, their use is restricted to three main applications:

- lifting drinking water from springs to settlements on higher ground.
- pumping drinking water from streams that have significant slope.
- lifting irrigation water from streams or raised irrigation channels.

Ram Pump Advantages include:

1. Inexpensive
2. Very simple construction and easy to install yourself.
3. Does not consume petrol, diesel or electricity.
4. Minimum maintenance.
5. Pollution free.
6. Quiet pumping 24 hours per day.

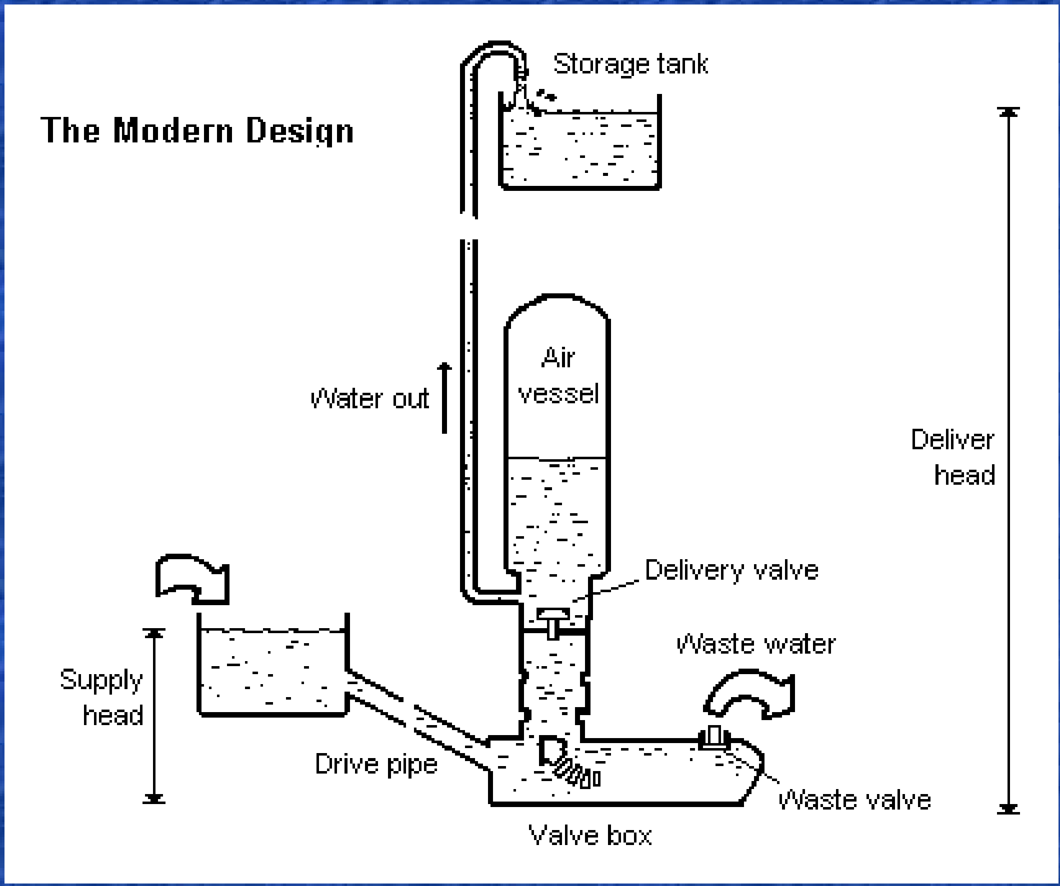
Hydraulic Ram Pump Links

- **Designing a Hydraulic Ram Pump** (Water for the World)
- Ram pump History and Design (Center for Alternative Technology - UK)
- Hydraulic Ram Book - How & Where They Work (Atlas Publications - North Carolina)
- Ram Pump Technical Notes (Dev. Technology Unit - UK)
- Build Your own Ram Pump (Clemson University)
- Ramp Pump Design Specifications (Institute for Appropriate Technology)
- Highlifter Ram Pump (25 page book providing step-by-step instructions on designing, making, installing and operating a hydraulic ram waterpumping system)
- Hydraulic ram pumps Engineering Principles (North Carolina Extension Service)
- Hydraulic Ram Pump System Design and Application (Research, Development and Technology Adaptation Center, Addis Ababa, Ethiopia)
- Pictures of Ram Pumps (D. Burger - UK)
- Ram Pumps (Internet Glossary of Pumps)
- Gravi-Chek Pump (Updated Ram Design)

Suppliers of Hydraulic Ram Pumps

- "Highlifter" and Ram water pumps (California)
- Aquatic Ecosystems Inc (Florida)
- Folk Ram Pump Supplier (USA)

- York Industries (Pennsylvania)
- Alternative Energy Engineering (California)



Sling Pump Links

- Sling Pump
- Sling Pump for Agricultural Watering
- Sling Pump Fact Sheet for Agriculture
- Sling Pumps for Sale
- Rife Sling Pumps

North Carolina Cooperative Extension Service

Water Quality & Waste Management

Hydraulic Ram Pumps

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A hydraulic ram (or water ram) pump is a simple, motorless device for pumping water at low flow rates. It uses the energy of flowing water to lift water from a stream, pond, or spring to an elevated storage tank or to a discharge point. It is suitable for use where small quantities of water are required and power supplies are limited, such as for household, garden, or livestock water supply. A hydraulic ram pump is useful where the water source flows constantly and the usable fall from the water source to the pump location is at least 3 feet.

Principles of Operation

Components of a hydraulic ram pump are illustrated in Figure 1. Its operation is based on converting the velocity energy in flowing water into elevation lift. Water flows from the source through the drive pipe (A) and escapes through the waste valve (B) until it builds enough pressure to suddenly close the waste valve. Water then surges through the interior discharge valve (C) into the air chamber (D), compressing air trapped in the chamber. When the pressurized water reaches equilibrium with the trapped air, it rebounds, causing the discharge valve (C) to close. Pressurized water then escapes from the air chamber through a check valve and up the delivery pipe (E) to its destination. The closing of the discharge valve (C) causes a slight vacuum, allowing the waste valve (B) to open again, initiating a new cycle.

The cycle repeats between 20 and 100 times per minute, depending upon the flow rate. If properly installed, a hydraulic ram will operate continuously with a minimum of attention as long as the flowing water supply is continuous and excess water is drained away from the pump.

System Design

A typical hydraulic ram pump system layout is illustrated in Figure 2. Each of the following must be considered when designing a hydraulic ram pump system:

1. available water source
2. length and fall of the drive pipe for channeling water from the source to the pump
3. size of the hydraulic ram pump
4. elevation lift from the pump to the destination
5. desired pumping flow rate through the delivery pipe to the destination.

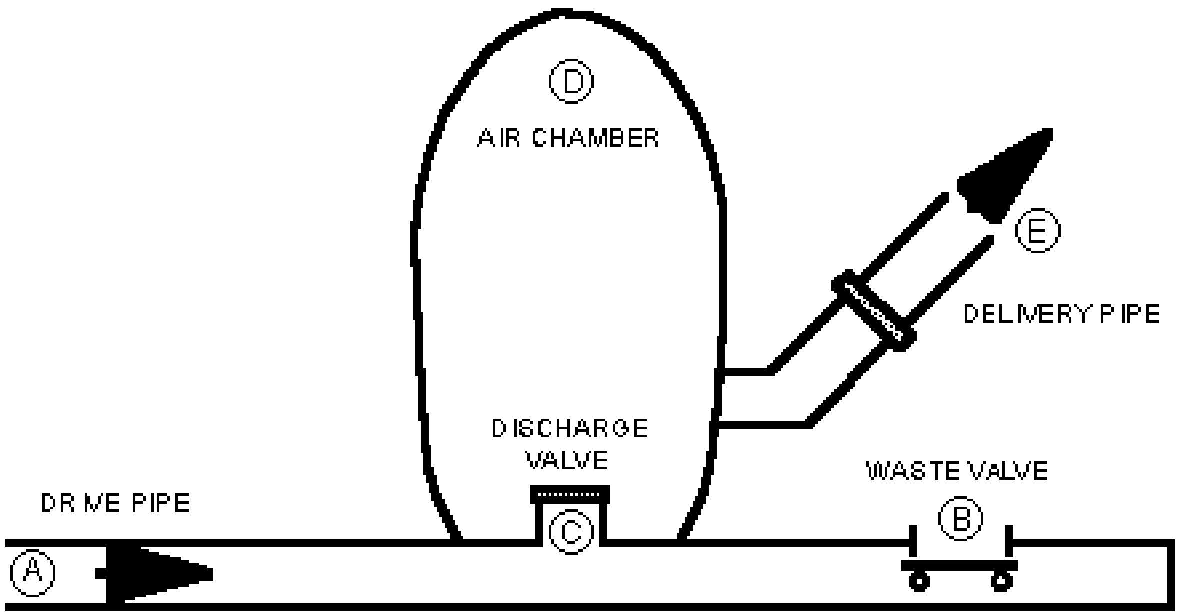


Figure 1. Hydraulic ram pump components.

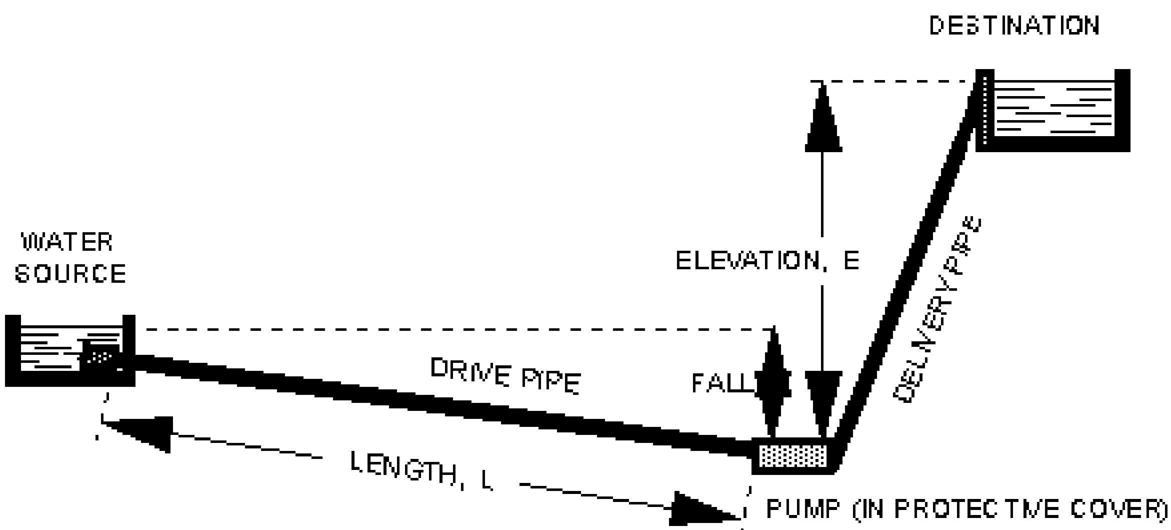


Figure 2. Hydraulic ram pump system layout

A hydraulic ram pump system is designed to deliver the desired pumping flow rate for a given elevation lift. The range of available flow rates and elevation lifts is related to the flow quantity and velocity from the water source through the drive pipe. The mathematical relationship for pumping flow rate is based upon the flow rate through the drive pipe, the vertical fall from the source through the drive pipe, and the vertical elevation lift from the pump to the point of use. These variables are illustrated in Figure 2. Equation 1 is used to calculate pumping rate:

$$Q = 1440 \times \left[\frac{E \times S}{(L / F)} \right]$$

where:

Q=pumping rate in gallons per day (gpd)
E=efficiency of a hydraulic ram pump installation, typically equal to 0.6
S=source flow rate through the drive pipe in gallons per minute (gpm)
L=vertical elevation lift from the pump to the destination in feet
F=vertical fall from the source through the drive pipe in feet.

To convert the p~umping rate expressed in gallons per day(gpd) to gallons per minute(gpm), divide by 1440. The following example illustrates an application of Equation 1.

Example.
A hydraulic ram will be used to pump water from a stream with an average flow rate of 20 gpm up to a water tank located 24 feet vertically above the pump. The vertical fall through the drive pipe in the stream to the pump is 4 feet. Assume a pumping efficiency of 0.6. What is the maximum pumping rate from the hydraulic ram pump?

In this example, E = 0.6, S = 20 gpm, L = 24 feet, and F = 4 feet. The resulting pumping rate, Q, is calculated as:

$$Q = 1440 \times \left[\frac{0.6 \times 20}{(24 / 4)} \right] = 2880 \text{ gpd}$$

The maximum pumping rate delivered by the hydraulic ram pump operating under these conditions is 2880 gallons per day, or 2 gallons per minute.

The example shows how the pumping rate, Q, is directly related to the source flow rate, S. If S were to double from 20 gpm to 40 gpm, the resulting pumping rate would also double to 5760 gpd, or 4 gpm.

The example also shows how the pumping rate, Q, is inversely related to the ratio of vertical elevation lift to vertical fall, L/F. If L were to double from 24 feet to 48 feet, the lift to fall ratio, L/F, would double from 6 to 12. The resulting pumping rate would decrease by half to 1440 gpd, or 1 gpm.

Table 1 lists maximum pumping rates, Q, for a range of source flow rates, S, and lift to fall ratios, L/F, calculated using Equation 1 with an assumed pumping efficiency, E, of 0.6. To illustrate the use of Table 1, consider a hydraulic ram system with S = 30 gpm, L = 150 feet, and F = 5 feet. The calculated lift to fall ratio, L/F, is 30. The resulting value for Q is 864 gpd, or 0.6 gpm.

Table 1. Maximum pumping rates for a range of source flow rates and lift to fall ratios assuming a pumping efficiency of 0.6.

Lift to Fall	Maximum Pumping Rate, Q (gpd)							
Ratio. *L/F*	Source Flow Rate, *S* (gpm)							
(ft/ft)	2	5	10	15	20	30	50	100
2	864	2,160	4.320	6,480	8.640	12,960	21,600	43,200
3	576	1,440	2.880	4,320	5.760	8,640	14,400	28,800
4	432	1,080	2.160	3,240	4.320	6,480	10,800	21,600
5	346	864	1.728	2,592	3.456	5,184	8,640	17,280
6	288	720	1.440	2,160	2.880	4,320	7.200	14,400
7	247	617	1.234	1,851	2.469	3,703	6.171	12,343
8	216	540	1.080	1,620	2.160	3,240	5,400	10,800
9	192	480	960	1,440	1,920	2,880	4,800	9,600
10	173	432	864	1,296	1.728	2,592	4.320	8,640
12	144	360	720	1,080	1.440	2,160	3.600	7,200
14	123	309	617	926	1,234	1,851	3,086	6,171
16	108	270	540	810	1.080	1,620	2,700	5,400
18	96	240	480	720	960	1,440	2.400	4,800
20	86	216	432	648	864	1,296	2.160	4,320
25	69	173	346	518	691	1,037	1,728	3,456
30	58	144	288	432	576	864	1,440	2,880
35	49	123	247	370	494	741	1.234	2,469
40	43	108	216	324	432	648	1.080	2,160
45	38	96	192	288	384	576	960	1,920
50	35	86	173	259	346	518	864	1,728
60	29	72	144	216	288	432	720	1,440

60	29	72	144	216	288	432	720	1,440
70	25	62	123	185	247	370	617	1,234
80	22	54	108	162	216	324	540	1,080
90	19	48	96	144	192	288	480	960
100	17	43	86	130	173	259	432	864

Hydraulic ram pumps are sized based upon drive pipe diameter. The size of drive pipe selected depends upon the available source water flow rate. All makes of pumps built for a given size drive pipe use about the same source flow rate. Available sizes range from 3/4-inch to 6-inch diameters, with drive pipe water flow requirements of 2 to 150 gpm. Hydraulic ram pumps typically can pump up to a maximum of 50 gpm (72,000 gpd) with maximum elevation lifts of up to 400 feet.

Approximate characteristics of hydraulic ram pumps for use in selecting pumps are listed in Table 2. The recommended delivery pipe diameter is normally half the drive pipe diameter. For the system described in the example above, the available source water flow rate is 10 gpm. From Table 2, a pump with a 1-inch drive pipe diameter and a 1/2-inch delivery pipe diameter is selected for this system.

Table 2. Hydraulic ram pump sizes and approximate pumping characteristics.
Consult manufacturer's literature for specific pumping characteristics.

```
-------Pipe Diameter-------  ---------------Flow rate--------------

Min. Drive   Min. Discharge  Min. Required Source  Maximum Pumping

-----------inches----------  ---------gpm--------  ------gpd------


  3/4             1/2                 2               1,000
1                 1/2                 6               2,000
1 1/2             3/4                14               4,000
2               1                    25               7,000
2 1/2           1 1/4                35              10,000
3               1 1/2                60              20,000
6               3                   150              72,000
```

Installation

The location of the water source in relation to the desired point of water use determines how the hydraulic ram pump will be installed. The length of drive pipe should be at least 5 times the vertical fall to ensure proper operation. The length of delivery pipe is not usually considered important because friction losses in the delivery pipe are normally small due to low flow rates. For very long delivery pipes or high flow rates, friction losses will have an impact on the performance of the hydraulic ram pump. The diameter of the delivery pipe should never be reduced below that recommended by the manufacturer.

To measure the available source water flow rate from a spring or stream, build a small earthen dam with an outlet pipe for water to run through. Place a large bucket or barrel of known volume below the outlet pipe, and measure the number of seconds it takes to fill the container. Then calculate the number of gallons per minute flowing through the outlet. For example, if it takes 30 seconds to fill a 5-gallon bucket, the available source water flow rate is 10 gpm. The lowest flow rates are typically in the summer months. Measure the flow rate during this period to ensure that the year-round capacity of the system is adequate.

Purchasing a System

Prices for hydraulic ram pumps range from several hundred to several thousand dollars depending on size and performance characteristics. Contact manufacturers to determine prices and ordering specifications. Send the information listed in Table 3 to the manufacturer to assist in sizing your system properly.

Table 3: Information to provide to the manufacturer for sizing your system.

```
1.      Available water supply in gpm   _________
2.      Vertical fall in feet measured from the source
        water level to the foundation on which the ram
        pump will rest   _________
```

```
3.      Distance from the water source to the ram
        pump in feet   _________
4.      Vertical elevation lift in feet measured from
        the ram pump foundation to the highest point to
        which water is delivered   ________
5.      Distance from the ram pump to the destination tank
        in feet   _________
6.      Desired pumping flow rate to the destination tank
        in gpd   _________
```

This fact sheet adapted from materials prepared by the California, Florida, and South Carolina Cooperative Extension Services.

A partial list of hydraulic ram pump suppliers is below:

Columbia Hydraulic Ram
Skookum Co., Inc.
8524 N. Crawford St.
Portland, OR 97203

Blake Hydram
Ar & Do Sales Co.
4322 Mt. Vernon Rd. SE
Cedar Rapids, IA 52403
Pacific Hydro Corp.
400 Forbes Blvd.
San Francisco, CA 94080

Rife Hydraulic Engine Mfg. Co.
316 W. Poplar St.
PO Box 790
Norristown, PA 19401
C.W. Pipe, Inc.
PO Box 698
Amherst, VA 24521

EBAE 161-93

Crayfish Farming

Redclaw Crawfish

Farm Books for Sale

Small Business Idea

Books

Red Claw and Crayfish Suppliers (USA)

RamPumps.com

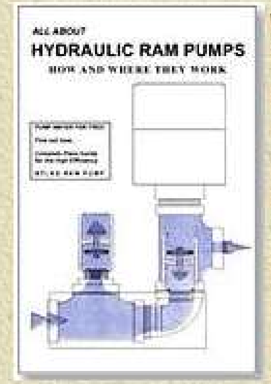
Small Business Idea
Raising Red Claw Crayfish

Sam the Site Guide
Welcome to Rampumps.com!

Click on me to review the fine books on ram water pumps, red claw crayfish and small scale crayfish aquaculture.

Special Book Offer

All About Hydraulic Ram Pumps How and Where They Work



With this book you can have all of the information needed in order to build, install and maintain YOUR OWN RAM PUMP

Detailed plans outlining step by step procedures for ease of construction.

Free Shipping & Handling!

Buy it Now! **$14.53**

View Shopping Cart

Small Scale Crayfish Farming for Food and Profit

Buy it Now! **$14.53**

Red Claw-Raising The Giant Australian Freshwater Crayfish

Buy it Now! $14.53

BOOK REVIEWS CRAWFISH FARMING......

From 'SMALL FARM TODAY' by Ron Macher, editor: "Both of these booklets ('Small Scale Crayfish Farming' and 'Red Claw! Raising the Giant Australian Freshwater Crayfish') offer inexpensive, detailed information on the possibilities of raising crayfish for food and profit on a small acreage. There are not many crayfish reference books, and these two small books pack all the information you will need into a tiny price."

Reviewer: A reader from Paintsville, KY: "This is an excellent source of information for people who want to start a crayfish farming business. It covers all aspects, including pond and tank culture, sexing, feeding requirements, and sources for crayfish".

To view your orders and their statuses. Enter the card number that was used to place the order

Card Number

View Orders

Small Business Idea Crawfish Farming!

Small Business Opportunity Crawfish Farming

Red Claw and Crayfish Suppliers ***(USA)***

Farmers Turn Red Claw Pastime Into Profit

Millpond Crawfish Farm

All books are 8.5" X 5.5",
3 color HD paper cover with clear coating.
Pages are all semi-gloss paper, saddle stitch,
with illustrations and photos.

Mail Order Form

Postal Address:

Rampumps.com
1435 Long Ridge Road
Hiawassee, Georgia 30546 USA

Free Shipping and Handling

The Ram Company

Pumping water without electricity

[English | Espanol]

The *Fleming Hydro-Ram* was developed to give people like you a cost effective way to pump water without electricity. To further this goal they have added *Solar Pumps* to their inventory. The Ram pumps have been tested and improved to pump the most water for the least cost and with the least amount of trouble. Each pump carries their name and they stand behind every one sold.

For more information check out some of the following links:

- History of the Hydraulic Ram.
- The Fleming Hydro-Ram, how it works.
- What a Hydro-Ram can do for you.
- How much water will it pump?
- Operational Requirements.
- Descriptive picture of Fleming Hydro-Ram.
- Advantages of a Solar Pump.
- Check out our Solar Submersible Pumps.
- Or, examine complete submersible pump system packages.
- Prices and features available.
- Free evaluation upon request.

The Ram Company

1-800-227-8511 (Virginia)
512 Dillard Hill Road
Lowesville, VA 22967
Email rhfleming@theramcompany.com

***This Site Designed & Maintained by* Mattox & Associates**
Lynchburg, Virginia
Providing Macintosh Solutions for Home and Business

Development Technology Unit
Publications

DTU

Water Lifting

The main internal publications of the DTU are **Working Papers**, **Technical Releases** and **Research Notes.** Most DTU publications are available here for download in a number of formats and hard copies of Working Papers are available free on request to the DTU. Technical Releases will also be sent free on request but only to addressees **in developing countries.**

- **Technical Notes** contain descriptions of designs/techniques for use by manufacturers, extension agents and users of equipment, written in fairly simple English to make them more accessible to technicians speaking other languages.
- **Working Papers** are used for descriptions of research findings and are written for a "professional" audience: comments are welcome. In some cases revised versions are subsequently published in outside journals.
- **Research Notes** are smaller outputs from our research,progress reports of research undertaken by the DTU but as yet incomplete, case study material, and exceptional undergraduate research reports. Often these notes form the basis of fuller Working Paper

This section also contains references to external **Papers and Articles** written by members and associates of the DTU where they are available on-line

Technical Releases

***Ram Pump System Design Notes*, 19pp**

Basic design notes for ram pump systems, covering site selection, basic surveying, pump selection, intake design, settling tanks, Drive system and water distribution

HTML

PDF 600kb

Note: scan of the original document.

TR10a C*omputerised Ram Pump Calculators: A short Users Guide*, 12pp

A guide to installing And running the DTU's WINPUMP, PUMPDATA and DOSPUMP freeware programmes used for calculating minimum, maximum and actual delivery water, drive flow, delivery head, drive head and pump efficiency. The programmes themselves can be downloaded here (256k zipped).

HTML | 400kb

Note: scan of the original document.

TR10b *Ram Pump System Calculators*, 10pp

Two cardboard based calculators, the Ram Pump System Design Calculator for feed and delivery heads and flows, and the Friction Headloss Calculator for pipe friction.

HTML | 200kb

Note: scan of the original document.

TR11 *DTU S1 Hydraulic Ram Pump : User Instructions/Drawings*, 12pp

Describes the installation and use of the DTU S1 ram pump, a steel ram pump suitable for drive heads of 2 to 15 metres and drive flows of 20 to 60 l/m. It typically yields a deliver head of up to 80m and a delivery flow of 0.5-10 l/m. The pump has been designed for local manufacture in small workshops and for ease of maintenance. A complete set of working drawings for the pump's manufacture is also provided.

HTML | 300kb

Note: scan of the original document.

TR12 *DTU P90 Hydraulic Ram Pump: User Instructions/Drawings*, 34pp

A Description and complete set of working drawings for the DTU P90 ram pump, a plastic bodied ram pump suitable for drive heads of up to 3 metres and drive flows of 100 to 360 l/m. It typically yields a deliver head of up to 20m and a delivery flow of 3-40 l/m. The pump has been designed for local manufacture in small workshops and for ease of maintenance.

HTML | 740kb

Performance data and design criteria are provided for the M3.2 a prototype of the P60 which will be of interest to designers and researchers.

Note: scan of the original document.

TR13 *New Developments in Hydraulic Ram Pumping*, 6pp

Written for ram pump enthusiasts, researchers and manufacturers. The paper describes current (1996) trends in ram pump and system design including their simplification, the use of contained air, new materials and performance improvements.

HTML

70kb

TR14 *DTU S2 Hydraulic Ram Pump : User Instructions/Making an S2 Pump/Drawings*, 44pp

Describes the DTU S2 ram pump, a steel ram pump suitable for drive heads of 2 to 15 metres and drive flows of 40 to 120 l/m. It typically yields a deliver head of up to 100m and a delivery flow of 1-25 l/m. The pump has been designed for local manufacture in small workshops and for ease of maintenance. A complete set of working drawings and instructions for the pump's manufacture is also provided.

Note: scan of the original document.

HTML

1.0Mb

TR15 *How Ram Pumps Work*, 17pp

Describes what is happening inside working ram pump and how changes in design can effect performance. It covers such topics as the pump cycle, closure velocity, tuning, shock waves and recoil.

Note: scan of the original document.

HTML

330kb

TR16 *Introduction to Hydraulic Ram Pumps and the DTU Range*, 15pp

Explains what ram pumps are, how they work, ram pump systems, site selection and pump selection criteria. The DTU range of ram pumps is also described

Note: scan of the original document.

HTML

370kb

TR-RWH 09 - *Low cost handpumps for water extraction from below ground water tanks - Instructions for manufacture*, 28pp

Four low-cost handpumps are considered in this document. The document is the culmination of a summer's voluntary work by Warwick student (and qualified machinist), Vince Whitehead. The manual describes in detail the construction of 4 simple designs of handpump, and was developed as a training manual for teaching artisans in Uganda how to make the pumps.

HTML

450kb

Working Papers

WP32 *Potential for Non-motorised Irrigation of Small Farms in Manicaland*, T.H. Thomas (1991), 27pp

The Working Paper describes the findings of two studies and records the initial test performance of two pumps (one water- powered, the other human-powered) installed near the Model Farm of CATC in Manicaland in Zimbabwe. The aims of the study carried out between mid-August and mid-September 1989 were:

- to identify major social, economic or geographical constraints on the expansion of irrigation of small plots in Communal Areas
- to develop a better specification for water-lifting devices
- to examine the agricultural options available for the use of extra water.

Note: scan of the original document.

HTML

800kb

WP33 *Performance Comparison of DTU and Commercial Hydraulic Ram Pumps*, T.D. Jeffery (1991), 39pp

This paper details the performance of the DTU Mark 6.4 hydraulic ram pump in comparison to commercial models run under similar conditions. Details of the performance of a number of commercial pumps tested at Delft University, Netherlands are used for comparison.

Note: scan of the original document.

HTML

700kb

WP34 *The Treadle Pump*, (1991), 37pp

Using a treadle pump to lift water to a height of 5 metres it is poss ible for a farmer to irrigate approximately 0.25 hectares of land. The pump can be used for long periods of time because of good ergonomic design. The cost of construction is low and ~e pump can provide an appropriate technology for smallholders with little capital to spend on irrigation.

HTML

800kb

Note: scan of the original document.

WP39 *The Performance Testing of Treadle Pumps*,
T.H. Thomas (1993), 10pp

A good treadle pump satisfies many user criteria including some that can be tested under laboratory conditions. The paper describes a set of laboratory tests and suggests performance thresholds that should be reached in them. The tests relate either to efficiency or to ease of priming. Under the description of priming tests there is included an analysis of the effect of any 'dead volume' of trapped air upon the maximum suction head of a pump during priming and during steady operation.

HTML

260kb

Note: scan of the original document.

WP41 *Algebraic Modelling of the Behaviour of Hydraulic Ram Pumps*,
T.H. Thomas (1994), 26pp

The mathematical analysis of hydraulic ram-pumps began soon after their invention in the late 18th century. However simple models of adequate accuracy for use by system designers, pump manufacturers, installers and operators are still not available. This paper describes algebraic models of varying complexity for use by system and pump designers and by those involved in training installers and users. It argues that a pump plus drivepipe, rather than pump alone is the natural unit for modelling and for characterising performance in applications literature. Behaviour is shown to depend primarily upon three parameters. The first is λ the ratio of peak drive flow (which depends upon tuning) to the pump's maximum flow with its impulse valve locked open. The second is μ, the ratio of peak drive flow to the 'Joukowski' flow just sufficient to achieve the system delivery head. The third is R, the ratio of delivery head to drive head. The analysis shows some of the trade-offs entailed in tuning, indicates the optimum choice of drivepipe and explains certain forms of malfunction observable in the field. Several 'rules of thumb' are derived. The paper also indicates areas where the greater precision of computer simulation over algebraic modelling is desirable.

HTML

650kb

Note: scan of the original document.

Research Notes

Undrgraduate Project Report – *Development and Selection of Low Cost Handpumps for Domestic Rainwater Water Tanks in E. Africa,*
V. Whitehead (2001), 65pp

This report gives details of the development and selection of a handpump suitable for use with domestic rainwater harvesting tanks in East Africa. The objective of the project was to develop a small low cost handpump, which can be manufactured, maintained and repaired with a minimum of tools and skill and that the materials can be found in most local hardware outlets and markets.

1.3 Mb

Four designs were proposed which were selected from a range of pump technologies for low head and low flow rates. From these, two were selected for their ease of manufacture, low skill level and expected reliability. The two handpumps ('Harold' and the 'Enhanced inertia') were subjected to a series of performance and durability tests.

Papers and Articles

Economically viable domestic roofwater harvesting
Terry Thomas
20th WEDC Conference, Colombo, Sri Lanka, (1995)

35 kb

Hydraulic Ram Pump

Research Programme

D
T
U

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Ram Pump Programme

np system design notes

Ram pum

1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 Next

This Document is also available as a high resolution PDF file (580kb)

DTU Home | Animal Traction | Building Materials | Landmine Clearance | Rainwater Harvesting | Water Lifting | DTU Publications

HYDRAULIC RAM MADE FROM STANDARD PLUMBING PARTS

Cooperative Extension Service/The University of Georgia
College of Agriculture and Environmental Sciences/Athens

There are a number of companies that manufacture hydraulic rams. While manufactured rams come pre-assembled and offer the highest degree of convenience and efficiency, they can be quite expensive. Fortunately, inexpensive ram pumps can be assembled from pipe fittings that are commonly available at most hardware and farm stores.

Assembly is fairly quick and easy. All that is needed is a pair of pipe wrenches, Teflon tape or other thread sealant, PVC cleaning solvent and PVC cement. Table 1. lists all of the parts shown in Figure 1. When assembling threaded fittings liberally apply thread sealant, or use 3-4 turns of Teflon tape and tighten all fittings securely to prevent leaks.

All ram pump fittings except the delivery pipe should be made of either of galvinized steel, brass, or schedule 40 or higher PVC. The delivery pipe can be made of any material provided it can withstand the pressure leading to the delivery tank. Make sure that the swing check and the spring loaded check valves are installed as shown in Figure 1. The flow direction arrow on the body of the swing check valve must point down. The valve below the pressure guage should be kept closed except while making readings in order to protect the guage from water hammers.

A bike, weelbarrow or scooter inner tube serves as an air bladder for the pressure tank. Insert the inner tube into the pressure tank and fill it slightly with air (less than 10 psi). Some inner tubes may need to be folded in order to fit them inside the pressure tank casing. The sealed volume of air contained in the tube prevents either water-logged or air-logged conditions in the pressure tank.

There are several nonessential, but useful parts included in this ram assembly. The ball valves, union fittings, and guage assembly are all optional. The ball valves on both the drive and delivery pipes are helpful for starting the ram and controlling its flow. The union fittings, also on both the drive and delivery pipes, are helpful for removing the ram for maintenance and/or repairs. The gauge assembly is useful for making pressure readings, especially while starting the ram. Any or all of these fittings can be left out of the ram assembly without affecting pump performance. However, the absence of these parts will make it more difficult to start and maintain the ram.

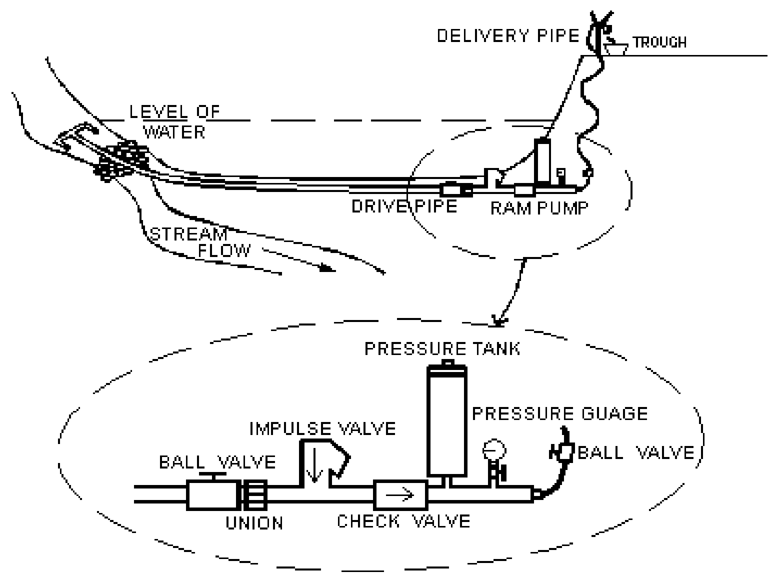

Figure 1. Hydraulic Ram Assembly

With the exception of the pressure tank's air bladder, all air trapped in the drive pipe, ram assembly, and delivery pipe must be displaced with water before these rams will pump properly. A few minutes of manual operation, and several re-starts, may be required to displace the trapped air

Pumping to Low Elevations

If the discharge elevation (delivery head) is less than 30 feet, it may be necessary to install either a ball valve or an adjustable pressure relief valve on the discharge (watering trough) end of the delivery pipe. Either of these valves can be used to regulate the water flow through the delivery pipe, which in turn regulates the back pressure on the ram assembly. A back pressure of up to 10 - 12 psi (as read on the pressure gauge) may be required for proper ram performance.

Table 1. Parts List for Hydraulic Rams Made up of Standard Plumbing Parts

Metal Ram Pump

1. Screened water supply
2. 1¼” drive pipe
2. 1¼” ball valve
3. 1¼” x 2" nipple
4. 1¼” union
5. 1¼” x 2" nipple
6. 1¼” tee
7. 1¼” close nipple
8. 1¼” brass swing check valve
9. 1¼” close nipple
10. 1¼” spring loaded check valve
11. 1¼” x 2" nipple
12. 1¼” tee
13. 1¼” x 2" nipple
14. 4" x 1¼” reducing coupling
15. 4" threaded pipe 36" long
16. Inner tube (slightly inflated)
17. 4" pipe cap
18. 1¼”close nipple
19. 1¼” x ¾” reducing coupling
20. ¾” x 2" nipple
21. ¾” tee
22. ¾” x ¼” bushing
23. ¼” x 2" nipple
24. ¼” ball valve
25. Pressure gauge
26. ¾” x 2" nipple
27. ¾” union
28. ¾” x 2" nipple
29. ¾” ball valve
30. ¾” delivery pipe

PVC Ram Pump

1. Screened water supply
2. 1¼” drive pipe
3. 1¼” ball valve
4. 1¼”union
5. 1¼” slip x male adaptor
6. 1¼” threaded tee
7. 1¼” close nipple
8. 1¼” brass swing check valve
9. 1¼” close nipple
10. 1¼” spring loaded check valve
11. 1¼” slip x male adaptor
12. 1¼” slip x slip female tee
13. 1¼” male adaptor
14. 4” x 1¼” reducing coupling
15. 4” pipe 36” long
16. Inner tube
17. 4” pipe cap
18. 1¼” x ¾” reducing coupling
19. ¾” tee
20. ¾” x ¼” slip x female bushing
21. ¼” x 2” nipple
22. ¼” threaded ball valve
23. Pressure gauge
24. ¾” union
25. ¾” ball valve
26. ¾” delivery pipe

Adjusting the Ram

These rams can be adjusted in one of two ways. The swing check valve may be adjusted by first rotating it so that its pivot is in line with the drive pipe and then twisting the valve and tee away from the vertical by as much as 30 degrees. This allows the swinging flap to partially close, which shortens the stroke period. The other way to adjust these rams is to alter the length of the drive pipe. Lengthening the drive pipe will increase the stroke period. Conversely, shortening the drive pipe will shorten the stroke period.

References

Much of the information contained in this publication is adapted from the following publications:

Rife Manuel of Information. 1992. Rife Hydraulic Engine Manufacturing Co., Box 367, Wilkes-Barre, PA, U.S.A.

Stevens-Guille, Peter. 1978. An Innovation in Ram Pumps for Domestic and Irrigation Use. Appropriate Technology, Vol. 5 No. 1.

Watt, S.B. 1978. A Manual on the Hydraulic Ram for Pumping Water. Intermediate Technology Publications, Southampton Row, London WC1B 4HH, UK.

This publication (Misc Eng. Pub. # ENG98-003) was prepared by:
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1785
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CLEMSON
EXTENSION

South Carolina Irrigation Pages

Extension Home

Clemson Home

This web site is provided to furnish information about irrigation systems, practices, management, and research in South Carolina. The information presented is garnered from work done by the Clemson University Cooperative Extension Service and many other sources. Identifying details for the source of the information are provided as the information is presented.

Irrigation Design

Basic information used in irrigation design including pipe sizing and friction loss, elevation loss, velocity head, sprinkler placement, application equations, and other items useful in designing a system. This section will not teach how to design, but will provide information that may not be readily available.

Irrigation Management

Proper management is the key to successful irrigation. This section identifies several different management schemes and how they are implemented. Also includes information and references on the water needs of various crops and monthly normal precipitation amounts for stations in SC, NC, and Georgia.

Agricultural Irrigation Equipment

Descriptions and images of many different types of irrigation equipment including pumps, filters, traveling guns, drip, and other related equipment. Also includes a listing of **Agricultural Irrigation Equipment Suppliers** in South Carolina as well as a listing of **alternative pumping systems** for livestock producers.

Home-made Hydraulic Ram Pump Plans

Plans and a list of materials for construction of a hydraulic ram pump from common items found in local hardware stores.

Residential and Commercial (Turf) Irrigation Equipment

Descriptions and images of many different types of irrigation equipment including pumps, filters, spray heads, sprinklers, drip, water meters, and other related equipment. Also includes a listing of **Residential and Commercial (Turf) Irrigation Equipment Suppliers** in South Carolina.

SCDHEC Environmental Quality Control (EQC) Permit Request forms

Links to SCDHEC EQC Forms page as well as individual links to well drilling and dam construction/alteration forms.

Irrigation Research in South Carolina

Links and information on on-going and past research with irrigation in South Carolina.

Irrigated Acreage in South Carolina

A listing for each year of the actual acreage irrigated in South Carolina by county and irrigation method as well as by crop. This information is compiled for inclusion in the Irrigation Journal's annual irrigation survey each year.

Irrigation-Related Sites

A list of many varied irrigation sites on the web, including such sites as **Richard Mead's MicroIrrigation Forum** and **Thomas Stein's Virtual Irrigation Library** as well as many manufacturers and suppliers. Sites containing articles of interest are also included.

Check back often! Over the next few months we hope to revise many sections at this site and add many others. Our vision is that of a site that has specific sections - such as "irrigation management", "irrigation equipment", or "alternative pumping systems" - with a wealth of information and related web links located in that area.

Last modified on 09/08/03
This site created and maintained by Bryan Smith,
Clemson University Cooperative Extension, Laurens County.

CLEMSON EXTENSION

South Carolina Irrigation Pages

Irrigation Home

Extension Home

Clemson Home

Irrigation Equipment

South Carolina Agricultural Irrigation Equipment Suppliers

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(loads in 114 seconds)

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Drip

Filters

Injectors

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Piping / Hoses

Pressure Tanks

Pumps

Alternative Pumping Systems

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Home-made Hydraulic Ram

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Solar Powered Pumps

Wind Powered Pumps