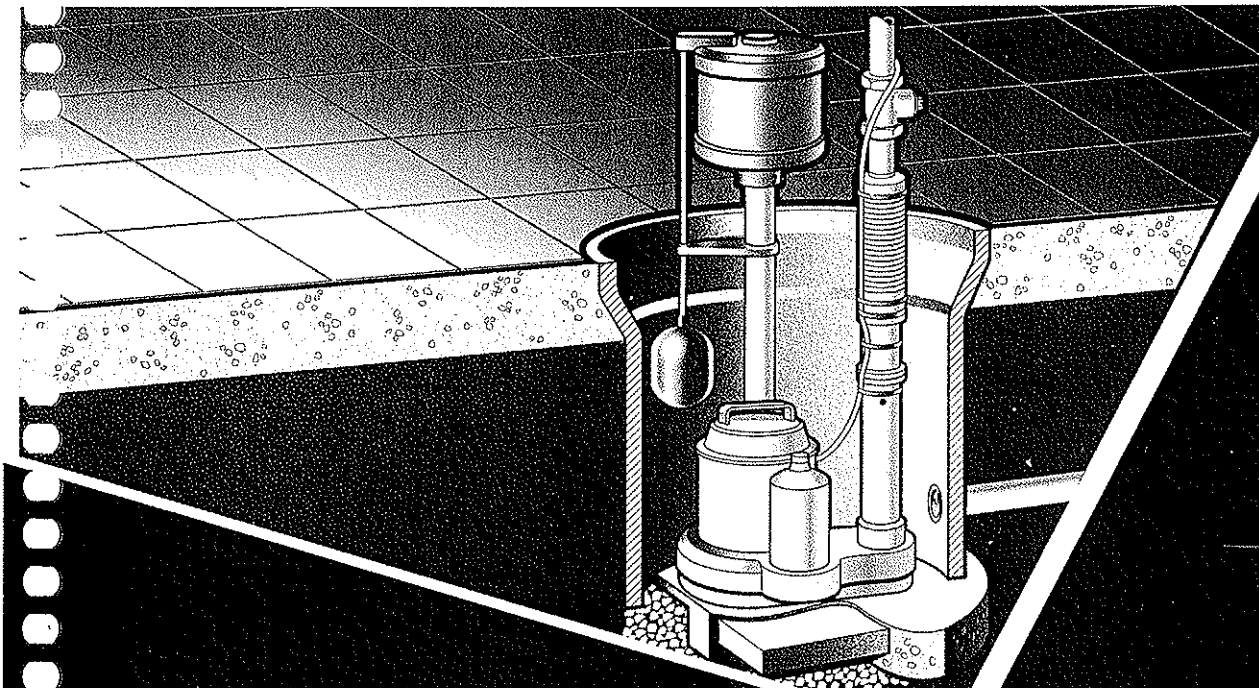
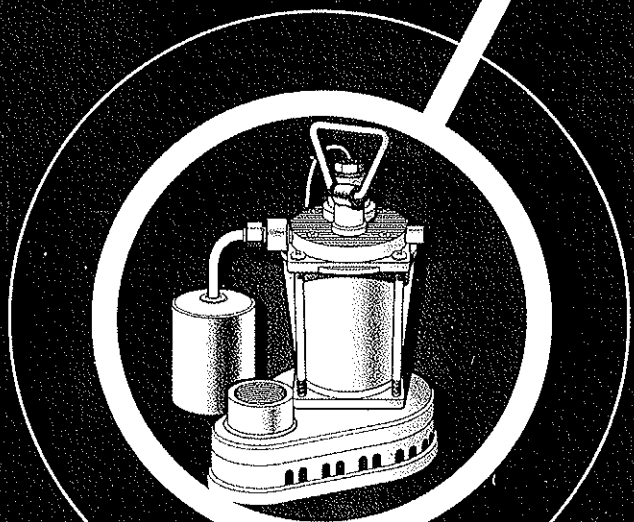
ASA UNIVERSITY

Specialty Products

Sump, Sewage, and Effluent Pumps©





BOOK #7

CERTIFICATE COURSE

SECOND EDITION

ProductPro®

The Standard in Product Knowledge Solutions

A publication by **ASA Education Foundation**

Specialty Products

Sump, Sewage, and Effluent Pumps©

from the

American Supply Association Education Foundation

ProductPro®

The Standard in Product Knowledge Solutions

HEADQUARTERS

ASA Education Foundation
1200 N. Arlington Heights Rd.
Suite 150
Itasca, IL 6014

tel: 630.467.0000
fax: 630.467.0001
web: www.asa.net
e-mail: info@asa.net

ASA Education Foundation

Welcome to the *ProductPro® Product Knowledge Training* series!

The Plumbing-Heating-Cooling-Piping (PHCP) and Industrial PVF industry is an important business channel. The products we sell keep people healthy, comfortable, and productive. In the United States, there are 4,000 PHCP/ Industrial PVF wholesaler-distributor locations; they generate billions of dollars in wholesale sales. It is an exciting and very competitive industry, and running a successful company requires cooperative efforts from educated and motivated employees.

To sell products in such a competitive atmosphere, it is crucial that all employees understand the products we sell. All of us need to be knowledgeable enough to provide our customers with the products they need to keep their operations running smoothly and their employees productive.

What you will learn from this training

This ProductPro® course is designed to give you an overview of information on sump, sewage, and effluent pumps. It includes definitions of common industry terms, descriptions of the major types of pumps, and information that will help you serve your customers when they come to buy sump, sewage, and effluent pumps from you.

Some of the products reviewed in this course may not be a part of your company's current inventory. Other products which may be stocked by your company may not be discussed in this course. Always refer to manufacturers' literature and recommendations on the products your company sells if unsure about a particular product.

To do your job well, it is important that you learn the details about specific items stocked by your company. The most complete and accurate information can be found in manufacturers' catalogs and materials. Be certain to spend time studying those materials.

Sump, Sewage, and Effluent Pumps© provides new warehouse, counter, and sales personnel with an overview of the operation and components of sump, sewage, and effluent pumps. It is NOT intended to provide the kind of complex, technical data which would enable employees to design or install pumps. This course includes definitions of common industry terms, descriptions of the components and functions of pumps, and other information that will help employees serve their customers more effectively.

How the course is organized

The ProductPro® courses are divided into separate chapters. Within each chapter you will read about a particular category of product and then test your progress with a short quiz that you can correct yourself. The course provides a glossary of terms at the back of the book to help you develop the vocabulary needed to enhance your ability to communicate well with your customers and colleagues. The glossary terms are highlighted in the text.

At the end of each self-correcting quiz, you will find *Applying What You've Learned* exercises so you can use the new information that you have learned within your own company. Once you understand the basic concepts presented, know the important facts, and can confidently answer the questions correctly on all the quizzes, you are ready to take the final course exam.

THIS COURSE INCLUDES AN ONLINE FINAL EXAM

This course is limited to a single user. When you are ready to take the final exam to earn your Certificate of Completion, please contact ASA at info@asa.net. ASA staff will contact you about how to register for the final exam.

Some hints for successful course completion

Read the learning objectives
Read the learning objectives at the beginning of each chapter. They will tell you what you should know when you complete the chapter. Go back after you read the material and ask yourself whether you are confident in your command of the material. If you are not, reread anything that you did not understand. Ask your supervisor or colleagues questions to help clarify the material you did not "get" the first time.

Search for the important ideas
Use a highlighter marker or a pen to highlight or underline the most important points as you read. Think about how each idea relates to the rest of the chapter. Write notes in the margins about points you don't understand or about how the material you read applies to your own company.

Ask lots of questions
Ask your supervisor or mentor about any points you do not understand. Particular questions you'll want to ask include whether the products you are studying are carried by your company, how well they sell, and how important they are in the overall inventory.

Apply what you are learning to your job
Always think about what you have just read or learned. Compare your company's products to the products you have read about in the book. Do the *Applying What You've Learned* exercises using the real setting of your job.

Pace yourself in your studying
Don't try to complete the course all at once. You will remember what you learn more effectively of you make sure you understand each chapter thoroughly before you move on to the next. Take some time to "plug in" what you have just studied before acquiring more new information.

Be proud of what you have accomplished

When you successfully complete the course, be sure to proudly displace your course certificate. You earned it. Then consider moving on to the other courses in this series:

- *Domestic Water Heaters*©
- *Domestic Water Well Pumps*©
- *Residential Hydronic Heating Systems*©
- *Residential Water Processing*©

Commit to learning something new every day

This course is just one step in developing your professional knowledge and your career skills. Read industry trade journals, study the manufacturers' literature, and attend any training the manufacturers offer. Listen to what company and industry experts says. Continue to enthusiastically take any additional training your company offers.

Visit the ASA Education Foundation website at www.asa.net regularly to find out about other learning opportunities to advance your career.

Acknowledgements

Developing new editions of the ProductPro® product knowledge training courses is an ambitious undertaking. During the creation and revision of this course, many individuals shared their expertise, input, and resources to significantly improve the interest and energy in the program.

Of special value were those reviewers, such as Marty Riback of Riback Supply Company, and Michael A. Babrowski of Zoeller Pump Company, who thoroughly and diligently reviewed the course text, quizzes, illustrations, and final exam to ensure accurate and highly readable instructions. Their expertise and experience ensure that the content demonstrates a high level of real world application that immediately can be put to use in employees day-to-day duties.

The Foundation expresses it very special gratitude to the visionaries who established and led the charge to develop the Karl E. Neupert Endowment Fund. Contributions that established the Fund were provided by hundreds of manufacturers, wholesalers, and individuals who recognized the need for a permanent endowment fund that would endure the ASA Education Foundation's ability to provide programs needed by the industry in perpetuity. Their generous contributions continue to make a major impact on the education and training opportunities available to the industry. We are deeply grateful for their commitment.

– The ASA Education Foundation

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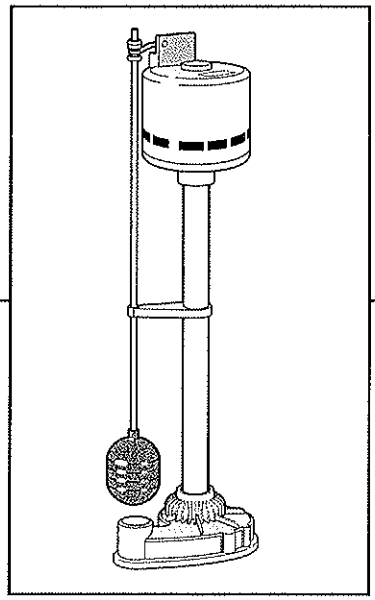
1 INTRODUCTION TO SUMP PUMPS

LEARNING OBJECTIVES

When you finish this Chapter, you will be able to:

1. Explain the factors that contributed to the increasing use of sump pumps in areas where they were not traditionally needed.
2. Discuss the purpose for installing drain tile around the outside of a house when a sump pump is installed.
3. Point out the uses and non-uses of sump pumps.
4. Describe the two basic types of sump pumps.



SUMP PUMPS

Sump Pumps

Many residences have an automatic electric pump installed to protect basements from flooding. The term **SUMP PUMP** is used to describe this pump. The term is also used to describe the pit itself that collects accumulated water in basements.

One function of a sump pump is to assist the sanitary sewer collection system when it is overwhelmed by water. Although the system is designed to handle heavy rains, it can be overloaded when many people connect their sump pump discharge hoses to the sanitary sewer. The sanitary system does not have capacity to carry this excess clear water and this leads to sewage backup in basements.

During normal weather conditions, sump pumps also perform important functions. They drain groundwater from under and around basement floors. Removing the groundwater reduces the possibility of the basement floors cracking and shifting from the water pressure. The basement area stays drier and feels less humid. Molds, mildew, and other problems associated with damp areas will not get the opportunity to occur if the basement is kept dry and clean.

Why is this electric pump called a sump pump? *Webster's New World Dictionary of the American Language* defines a **SUMP** as "a pit for draining, collecting or storing liquids; cistern,reservoir, cesspool, etc." So a sump pump is a pump for removing liquids from a sump.

Notice that the term "sump" has a wider meaning than simply the pit in which a sump pump is installed. When people use the word "sump," they may also be including the **PIT**, the **BASIN**, the **RECEIVER**, or the **CROCK**.

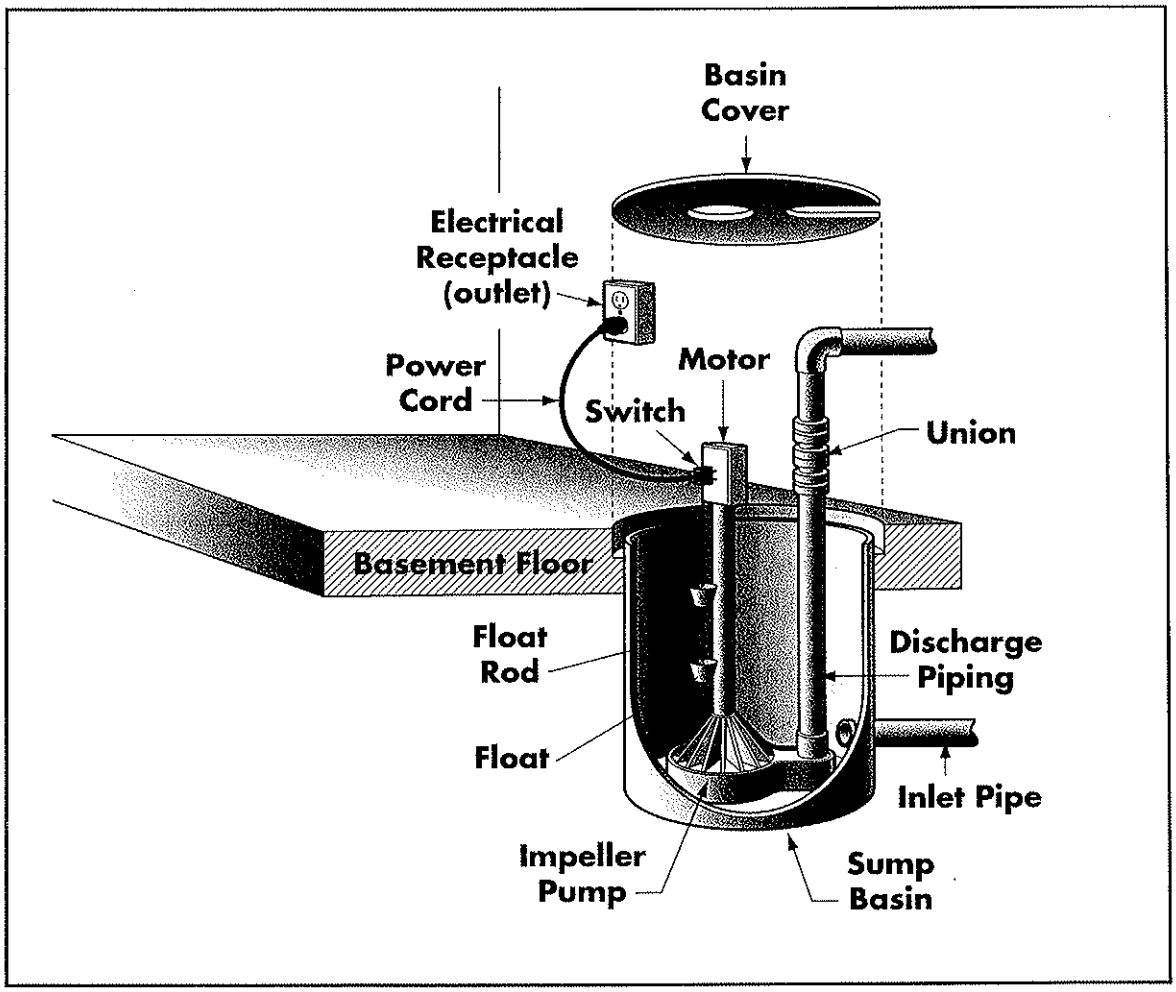
Uses and Needs

According to the **SUMP AND SEWAGE PUMP MANUFACTURERS ASSOCIATION (SSPMA)**, over a million sump pumps are sold a year. A customer may choose to buy a sump pump from a home center, hardware store, discount store—or from your company.

These small pumps are used mainly to remove water from basements or crawl spaces. Even several inches of water in a basement can damage appliances and furniture or items stored in the basement. Under some circumstances, water in a basement or crawl space could even damage the foundation of the house.

A simplified drawing showing the basic parts of a sump pump system appears below.

SUMP PUMP LABELED



SP 3.1.01

Traditionally, sump pumps were needed only in the northeastern, mid-Atlantic, and Great Lakes regions of the United States. However, due to the growth of cities and the great increase in the amount of soil that has been paved over for use in highways and paved parking lots, flooding problems in basements or crawl spaces have become increasingly common in other parts of the country.

With more paved-over areas and more buildings built on what Nature had designated as flood plains or natural wetlands, runoff from rain has no way of seeping into the soil. So the rainwater seeps into basements or backs up from overloaded storm drains.

This means sales figures for sump pumps will probably continue to increase as paving and building activities increase.

Many sump pumps are used for new homes. It is common for communities to require that all new homes be built with basement sump pumps already installed. However, because of the problems with reduced soil area for absorption of rainwater mentioned previously, many owners of older homes find that they face basement flooding problems for the first time and now need to install sump pumps.

A homeowner customer may be less knowledgeable about sump pumps than your regular plumbing contractor customers. In order to serve these homeowners as well as you serve your plumbing contractors, it is important that you understand how sump pumps work, why they sometimes don't work, what is required for installation, and what kind of repair and maintenance may be required.

You may have the opportunity to win a new customer for your company if the customer sees that your company hires knowledgeable, helpful salespeople.

Sump Pump Systems in New Homes

In the case of a new home, the sump is usually a round receptacle formed of concrete which has been poured into a pit dug below the level of the basement floor. The sump should be located in the lowest point of the basement, where water would naturally accumulate.

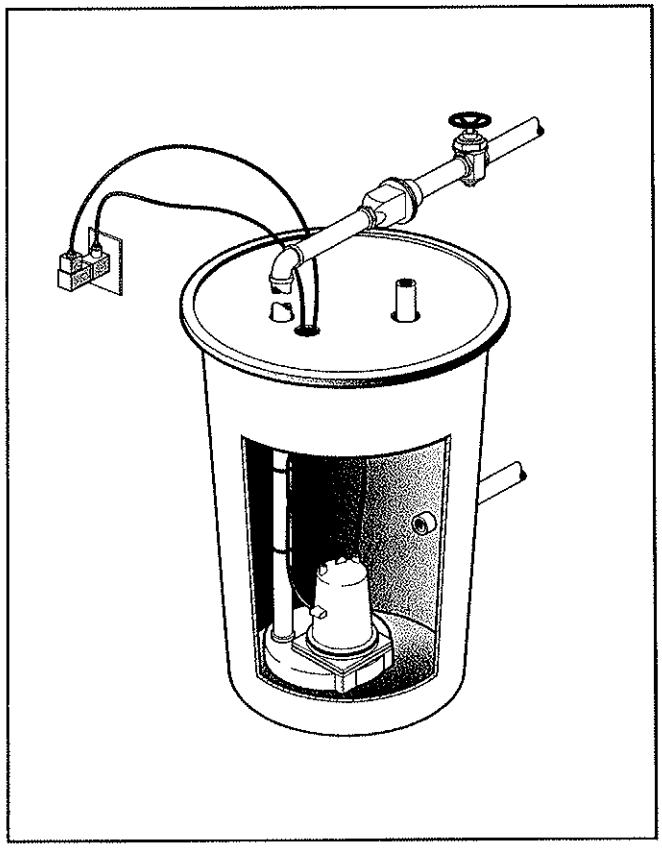
When building a new home, it is common to install **DRAIN TILE** (pipe with holes in it) underground around the outside of the foundation and/or inside the basement walls to direct the drainage into the sump. The sump pump then pumps the water out through the discharge pipe into the storm drain.

The use of drain tile around the house helps control water that may otherwise form standing pools or large puddles in the lawn or yard. The drain tile will also help prevent water from seeping into the basement through basement walls or running in through basement level window wells.

Sump Pump Systems in Existing Homes

If a sump needs to be installed in an older home or any other home without a built-in sump, a pre-formed manufactured sump may be purchased. Sump pits may be made of concrete, steel, plastic, or other materials. Local plumbing codes dictate what kind of sump pits may be used, so you should become familiar with local code requirements for your area.

SUMP PIT



SP 3.1.02

Installation of a new sump in an existing house generally requires that the basement floor be cut with a masonry drill or other concrete-cutting tool and a pit be excavated below the floor to the required level. If a manufactured sump pit is installed, the top of the pit should be level with the basement floor.

An under-floor inlet pipe may be used to carry water to the sump pit. Or instead of a pre-manufactured pit being used, the bottom of the excavated pit may be left open and filled with gravel to allow water to simply seep into the sump pit. If a gravel bottom is used, *the pump must be placed on a firm hard surface, such as concrete blocks, above the gravel.* If the pump is placed directly on the gravel, the gravel will clog the pump **IMPELLER** and the pump will not be able to operate.

It will help you serve your customer if you are knowledgeable about what is required to properly install a sump pump in an older home and what kind of pre-formed sump pit can be installed.

Other Sump Pump Uses

- Sometimes a particular appliance or household device such as a wet bar will be set up to drain into the sump and the pump will pass that water out to the drain.
- Occasionally a small sump-type pump may be placed in a window well to prevent build up of water there.

Sump Pumps Are Not Acceptable for Some Functions

- Sump pumps *cannot be used* for drinking water.
- Sump pumps should not be used for pumping aquarium water or other such fish tanks.
- Sump pumps cannot be used for sewage water.
- Water containing sewage should be removed with special sewage pumps designed for that purpose, not with sump pumps. Sump pumps *should not be sold or used* for pumping out septic tanks, for example.
- Sump pumps cannot handle water with debris, dirt chunks, gravel, stones or other solid matter. Such debris will clog the pump and make pumping operations impossible.
- *Sump pumps must NEVER be used to pump out chemicals, hazardous material of any kind, or flammable liquids such as gasoline. In addition, sump pumps must not be used in any area designated as a hazardous location.*

Be certain you are familiar with the appropriate uses for the sump pumps your company sells. If you have any questions about the appropriate usage, check with the pump manufacturer.

The Two Major Components of Sump Pumps

There are two major components to a sump pump:

1. the pump itself, and
2. the motor to run the pump.

Types of sump pumps differ mainly in how the power is furnished to run the motor and where the motor is located in relation to the pump and the sump pit.

Most sump pumps are run by an electric motor powered by regular household 115 volt AC current. However, a **BACKUP SUMP PUMP** uses other types of power sources.

Pedestal Pumps and Submersible Pumps

There are two basic types of sump pumps:

1. **PEDESTAL SUMP PUMP** (also called **COLUMN** or **UPRIGHT SUMP PUMP**)
2. **SUBMERSIBLE SUMP PUMP**

There are variations of these two basic types including backup and **EMERGENCY SUMP PUMPS** which are powered by batteries instead of household current as is customary. There are even water-powered sump pumps which work on city water pressure instead of electric power, although these are not very common and you may not sell them.

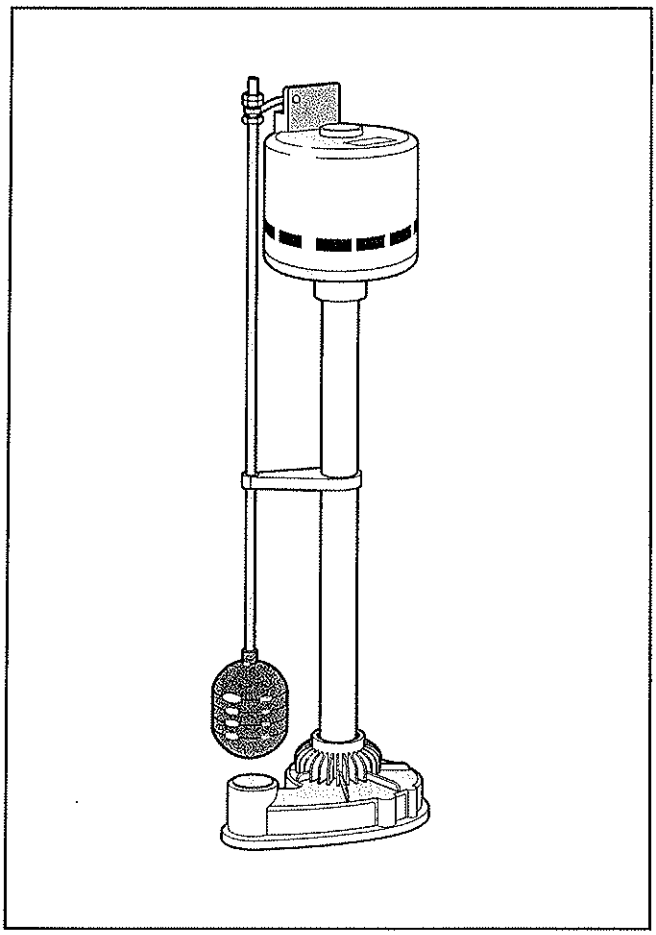
"Sumpless" sump pumps may use the basement floor drain as the receiver instead of a sump pit.

Sewage pumps and **EFFLUENT PUMPS** operate basically like sump pumps except for handling sewage solids. Sewage pumps are designed to pump sewage liquid and solids, and effluent pumps are designed to pump "gray water" which contains very small solids.

Pedestal Pump Motors Are Above and Outside the Pit

The **PEDESTAL PUMP** is so-named because the electric motor that runs the pump is placed outside and above the sump pit on a pedestal or column.

PEDESTAL SUMP PUMP



SP 3.1.03

Advantages of Pedestal Pumps

Pedestal sump pumps have several advantages:

1. They are generally cheaper than submersible sump pumps.
2. They are easy to install.
3. If the motor goes bad, it is easy to replace the motor without having to replace the pump portion of the sump system.

Disadvantages of Pedestal Pumps

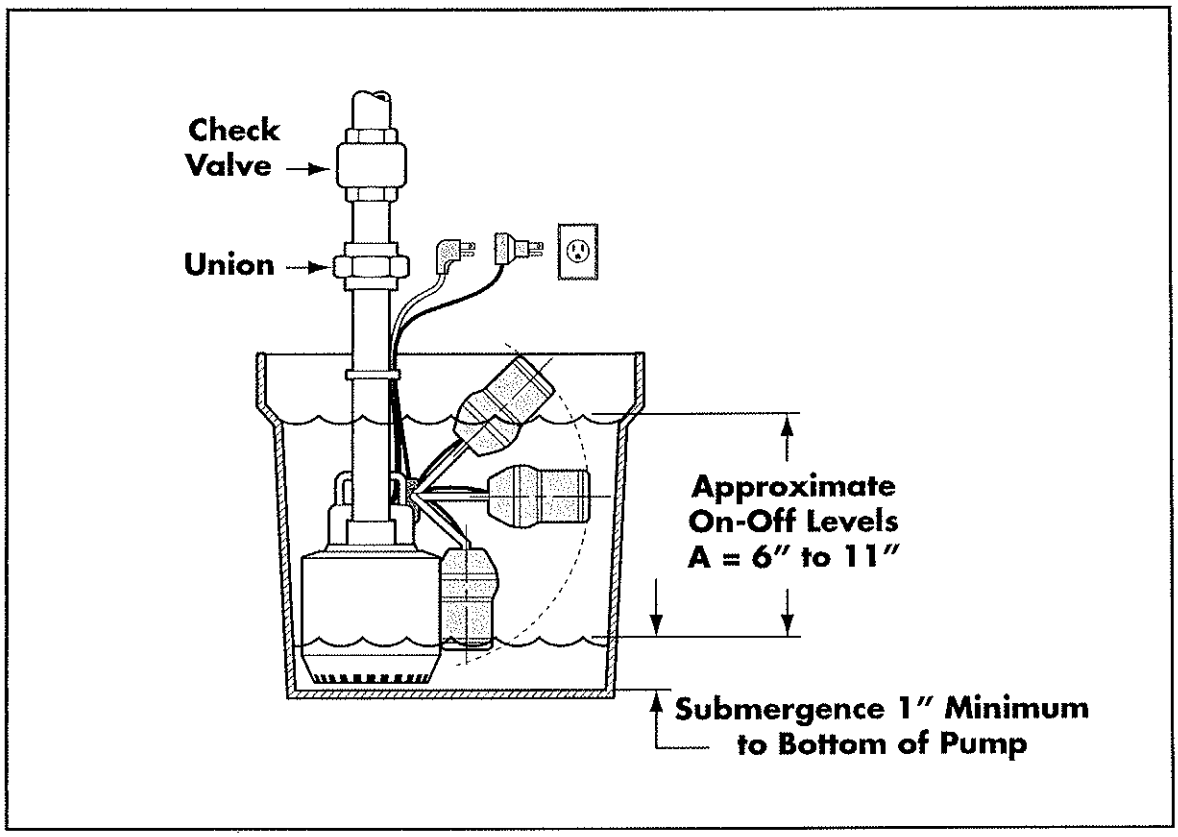
However, pedestal sump pumps also have disadvantages. These include:

1. The motor on the pedestal sticks up into the basement area. This may be a disadvantage if the basement is used as living space and may pose special problems if children play in the basement and may be injured by (or damage) the pump.
2. The pedestal pump is likely to be noisier than the submersible. This is because the motor is not enclosed within the sump pit as is the case with the submersible pump.
3. Generally a pedestal pump has a shorter life expectancy that a submersible pump since the motor is running in air.

Submersible Pump Motors Are Submerged in the Sump Pit

Submersible sump pumps have watertight motors which are enclosed with the pump housing. Both the pump and the motor are installed in the sump pit.

SUBMERSIBLE SUMP PUMP



SP 3.1.04

Advantages of Submersible Pumps

The **SUBMERSIBLE SUMP PUMP** has several advantages over the pedestal pump:

1. The entire pump/motor assembly is underground, in the sump pit, so there is nothing extending into the living space of the basement and nothing above floor level to cause injury to children playing or to be easily damaged by children.
2. Submersibles are quieter than pedestal pumps because both pump and motor are totally enclosed within the pit, the noise is deadened by the surrounding pit.
3. Submersible generally last longer because the motor is cooled by the water.

Disadvantages of Submersible Pumps

Like the pedestal pump, the submersible has its disadvantages which include:

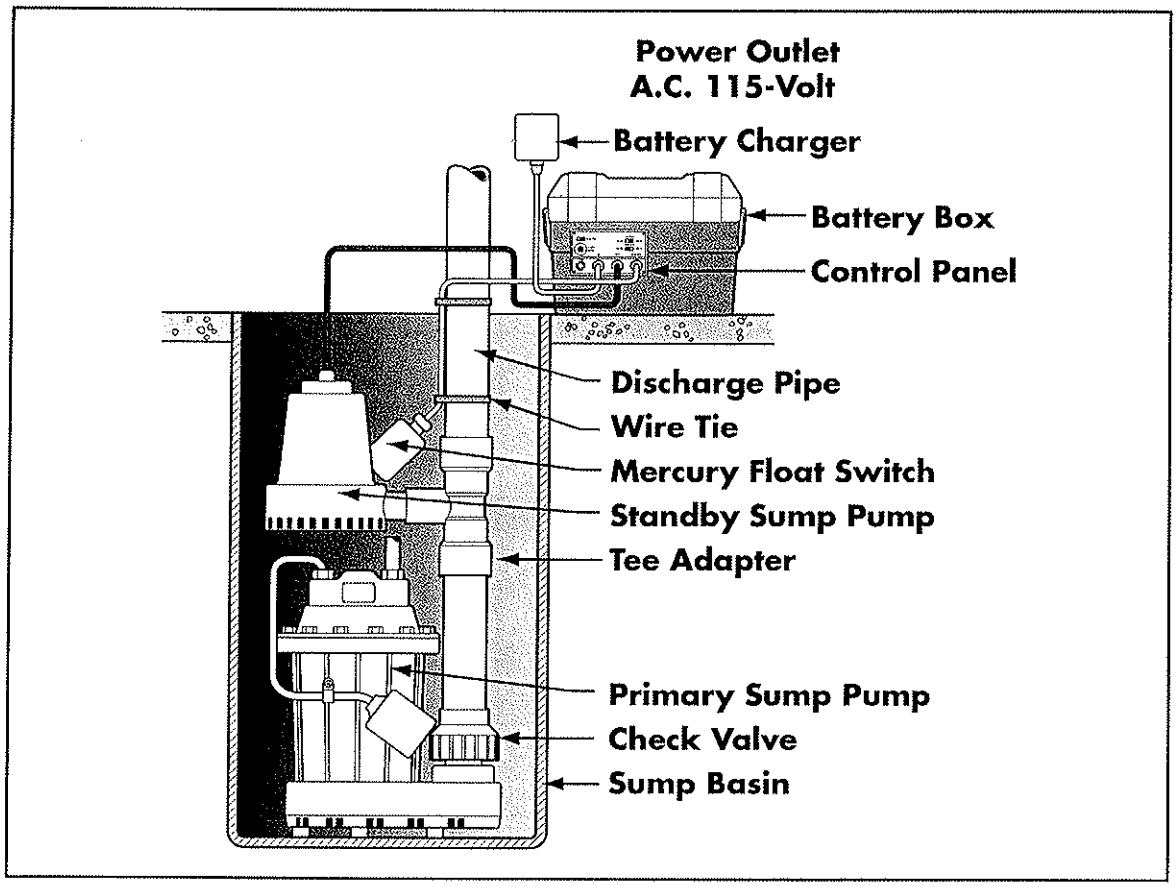
1. The submersible is generally more expensive than the pedestal.
2. If the motor goes bad, a whole new pump/motor combination must be purchased.

Backup Sump Pump

A backup sump pump may be needed if:

- the primary sump pump fails;
- the primary sump pump can't handle all the water; or
- the electric power fails in the house.

BACKUP SUMP PUMP



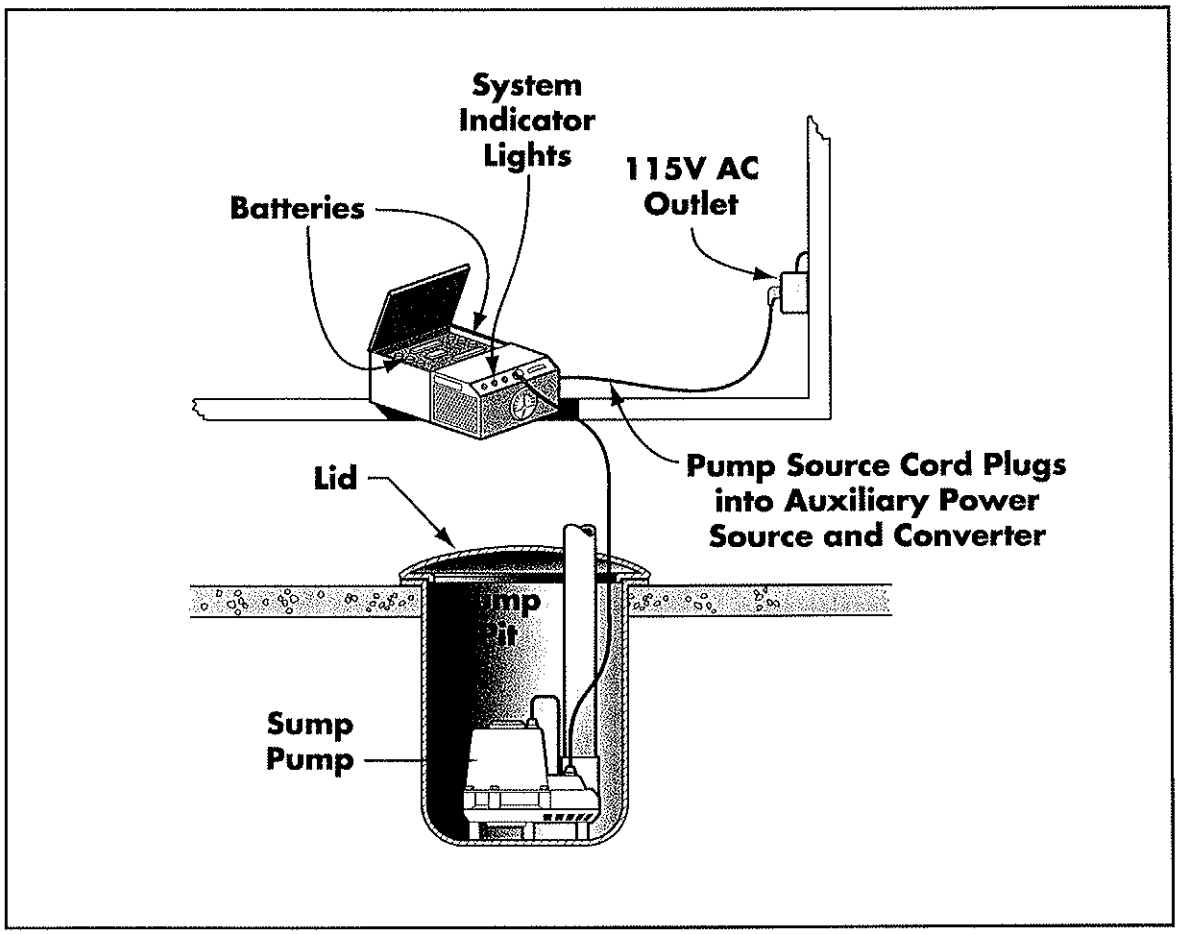
SP 3.1.05

A **BACKUP PUMP**, also called a **STANDBY PUMP**, is installed (as shown on page 11) on top of the primary pump so that the secondary (backup) pump is activated if the water level gets high in the sump basin.

Power Requirements for the Backup Pump

The backup pump has a direct current (DC) motor and comes with a battery pack/power converter which requires one or more 12v batteries (automotive). The battery charger/converter plugs into standard 115v household current and converts it to DC current to keep the battery charged. An LED control panel indicates the condition of the battery to avoid battery failure. The battery must be purchased separately. Backup pumps may also be referred to as *emergency sump pumps*.

POWER REQUIREMENTS FOR A SUMP PUMP AND PIT



SP 3.1.06

If the household power goes off or the backup pump's **FLOAT SWITCH** registers high water, the pump will kick on and begin using the battery. The backup pump is usually equipped with a high water alarm (sound or light or both) to notify the homeowner that the backup pump has kicked on and is now on the battery.

If frequent power failures are common but the homeowner does not feel that it is likely that water will get high enough to require a second (backup) pump, there are separately purchasable power packs that use 12v direct current (DC) batteries as an emergency power source but *convert the direct current into 115v alternating current (AC)* which will power a standard AC-powered sump pump in case of household power failure.

The power cord from a standard sump pump plugs into the power pack/converter, which plugs into the household AC receptacle to make use of AC power when it is available to keep the batteries charged. (See diagram on page 12).

Local Codes Regulate Pump Installations

As with all plumbing-related products, sump, sewage, and effluent pumps and installations are regulated by local codes.

Plumbing codes, sanitary codes, electrical codes, and even zoning codes may affect choice and installation of the kinds of pumps being discussed in this book.

In order to serve your customer effectively, you must be familiar with the basics of these codes in your area so that you do not sell the customer a product he/she cannot use.

Stay Current with Sump Pump Types and Features

Your company may not carry all of the types of sump pumps described above. Some of the pumps you carry may have slightly different features or accessories.

The best way to learn about the sump pumps you carry is to read your manufacturer's product literature and take any training that the company or manufacturer may offer.

REVIEW QUIZ – INTRODUCTION TO SUMP PUMPS

Answers appear on page 18

DIRECTIONS: Carefully read each question and circle the correct answer. There is only one correct answer per question. When you have finished, check your answers.

1. Approximately how many sump pumps are sold in the U.S. annually?
   a. 1 million
   b. 2 million
   c. 100,000
   d. 500,000

2. Why are sump pumps being required in areas of the country where they were not previously used?
   a. More people have moved into swampy areas.
   b. More wetlands have been developed for people's use.
   c. Sump pumps are less expensive to operate than tradition sewage systems.
   d. Sump pumps prevent water from standing in the basement.

3. What factor determines which kind of sump pump basin can be used in a particular area?
   a. Amount of rainfall
   b. Cost of installation
   c. Age of the building
   d. Local codes

4. The two major parts of a sump pump are the
   a. pump and the motor.
   b. check valve and the union.
   c. pump and the sump basin.
   d. battery charger and the power outlet.

5. What are the two basic types of sump pumps?
   a. Primary and backup
   b. Standard and backup
   c. Pedestal and submersible
   d. Pedestal and effluent

REVIEW QUIZ – INTRODUCTION TO SUMP PUMPS

Answers appear on page 18

6. Which one of these is **not** an advantage of a pedestal pump?
   a. Cheaper than a submersible pump
   b. Last longer than a submersible pump
   c. Easier to replace the motor
   d. Less noisy than a submersible pump

7. One advantage of a submersible pump is that
   a. the motor and pump can be installed underground.
   b. they are easier to install than a pedestal pump.
   c. the life expectancy is shorter than a pedestal pump.
   d. they are less expensive than a pedestal pump.

8. A backup pump may be needed if the
   a. power cord from the primary pump fails.
   b. primary pump can't handle all the water.
   c. homeowner cannot remove water from the basement.
   d. standard plumbing in the residence fails.

9. Unlike backup pumps, which type of current do standard sump pumps use?
   a. 12v AC
   b. 12v DC
   c. 115v AC
   d. 115v DC

10. Separately-purchasable power packs for backup sump pumps use an emergency power source that permits
    a. 115v household current to be converted in 12v direct current.
    b. 12v direct current to be converted in 115v household current.
    c. the standard pump to take over the operation of the backup pump.
    d. the backup pump to signal the homeowner that the standard pump has failed.

REVIEW QUIZ – INTRODUCTION TO SUMP PUMPS

Answers appear on page 18

11. What is the standard definition of the word "sump"?
    a. A pit for draining, collecting or storing liquids
    b. The bottom of an areas used to store liquid
    c. The pump used to remove sewage from a basement
    d. The main storage area for water in a residence

12. When can a sump pump be used to pump out sewage?
    a. When used for pumping out septic tanks
    b. Never because a special pump is needed
    c. Occasionally when small amounts of sewage are present
    d. Never because the pump is used only for drinking water

APPLYING WHAT YOU HAVE LEARNED:

By observing and asking questions, fill in the blanks. If you are not sure of the answers, ask your supervisor.

A. What type(s) of sump pumps does your company sell? Are other types of pumps available that your company does not sell?

_____

_____

_____

B. In what cases would you not recommend a sump pump for a residential customer?

_____

_____

_____

ANSWERS TO REVIEW QUIZ

CHAPTER 1

INTRODUCTION TO SUMP PUMPS

Answers for INTRODUCTION TO SUMP PUMPS (pages 14 – 16)

1. a. 1 million
2. b. More wetlands have been developed for people's use.
3. b. Local codes
4. a. pump and the motor.
5. c. Pedestal and submersible
6. d. Less noisy than a submersible pump
7. a. the motor and pump can be installed underground.
8. b. primary pump can't handle all the water.
9. c. 115v AC
10. b. 12v direct current to be converted in 115v household current.
11. a. A pit for draining, collecting or storing liquids
12. b. Never because a special pump is needed

Applying what you have learned:

A. Depends on the company

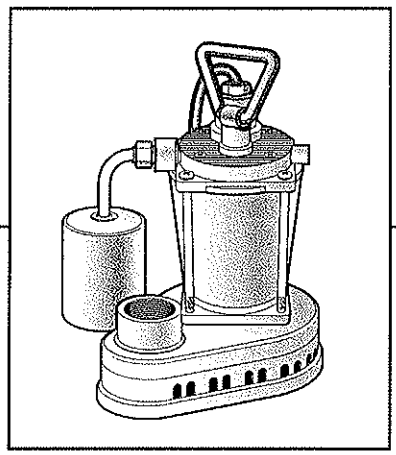
B. Answers may vary but could include that sump pumps cannot be used to handle water with debris, dirt chunks, gravel, stones, or other solid matter. They cannot be used to provide drinking water and should never be used to pump out chemicals or hazardous materials.

2 PUMP SYSTEMS

LEARNING OBJECTIVES

When you finish this Chapter, you will be able to:

1. Identify and describe the major components of a typical pump system.
2. Explain why the pump should not be place directly on the gravel drainage bed.
3. Recommend a typical horsepower range for the motors that service sump pumps.
4. Differentiate between standard sump pump motors and the motors on backup or emergency pumps.



PUMP SYSTEMS

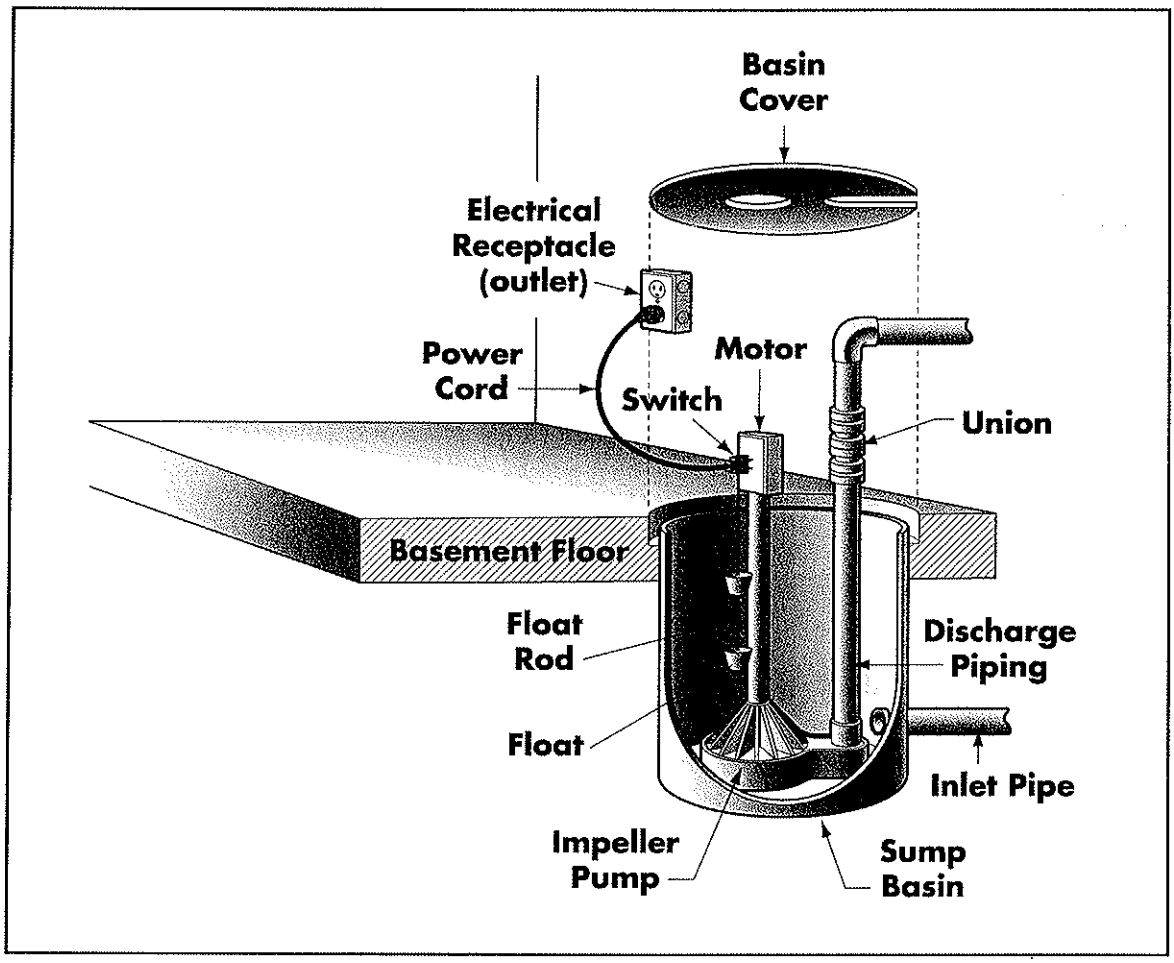
Major Parts of the Pump System

Working sump, sewage pumps, and effluent pumps are actually part of pump systems, because there are several more components that are needed, in addition to the pump, to remove the water. The basic system components are the same for any of these three types of pumps, although the sizes of one or more components may vary, depending upon the type of pump system.

Basic system components include the:

- sump or basin
- pump itself
- motor
- discharge pipe assembly
- float switch or pressure switch to turn the pump on
- discharge pipe assembly
- power cord
- check valve

SUMP PUMP



SP 3.2.01

Where to Place the Sump

The sump is also called the basin, receptacle, pit, receiver, or crock. The sump is the container which holds the pump.

As previously mentioned, newer homes in areas which are likely to have basement flooding problems probably have a sump in the basement. Commonly this basin is poured concrete.

However, if there is no concrete sump, a pre-formed sump may be purchased for installation. It may be necessary to cut the concrete floor and excavate for the sump installation. These manufactured sumps may be made of concrete, tile, steel, fiberglass, or polyethylene. Local plumbing codes determine what kinds of sumps may be installed.

The pit should be placed below the level of the basement floor. The sump basin should be located in the part of the basement which is at the lowest level and placed about six inches away from the basement wall.

For safety reasons and to help prevent debris from falling into the sump, it should have a cover. The cover will also help contain any possible odors. It is recommended that the sump cover be capable of supporting at least 200 pounds.

Typical Depth of a Sump Pit

A sump pit is usually from 14 inches to 18 inches in diameter, although some are smaller. The basin is generally about 24 inches deep, although some may be shallower—especially for pedestal pumps.

Proper Placement of the Sump Pump

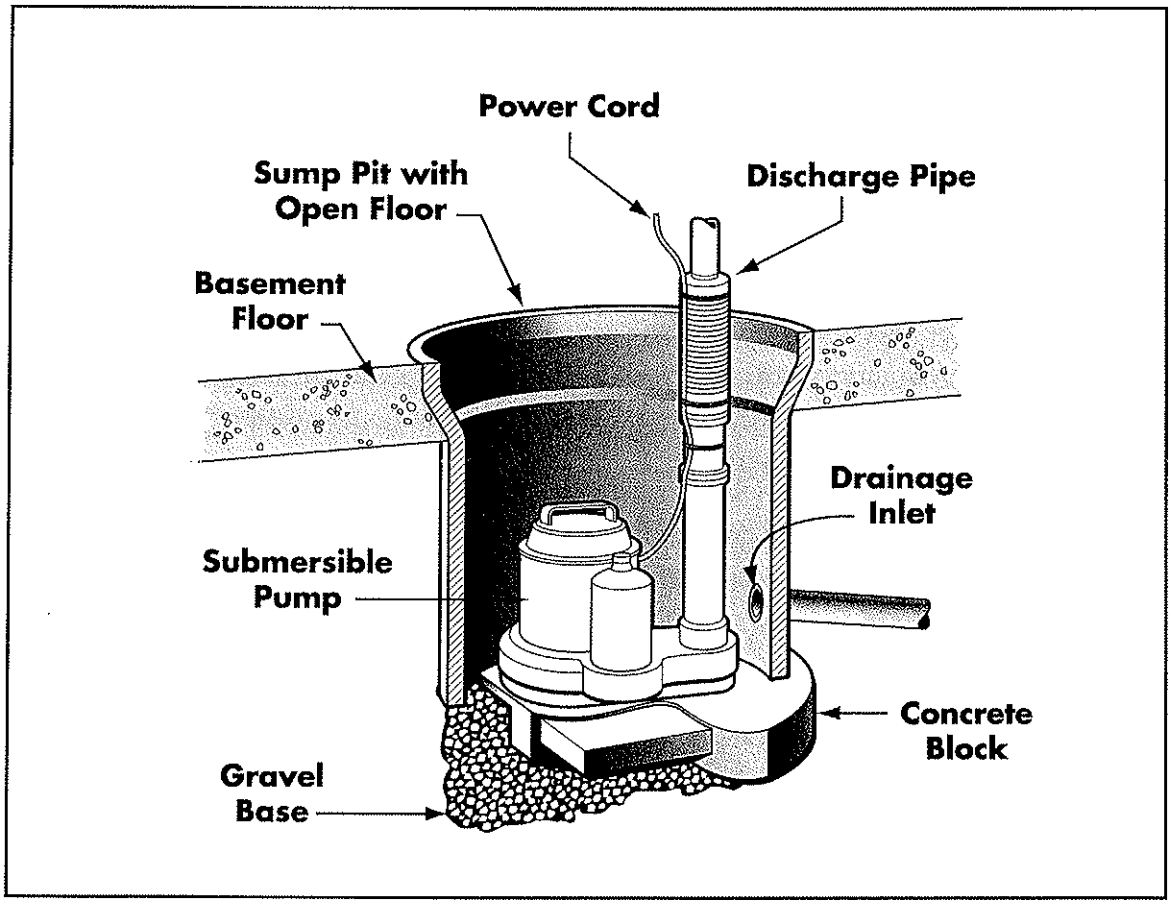
The sump pit typically has a solid, level, hard floor. If the pump does not sit on something hard and level a flat surface, it will probably not be properly balanced and may not work properly.

Often, the water is brought into the basin through an inlet pipe from the drain tile or drainage pipe around the foundation. However, sometimes the bottom of the sump is left open and the sump sits on a gravel bed which allows water to seep up into the pit from the soil.

If the sump basin is sitting on a gravel base, a hard, flat, level platform must be created above the gravel for the pump to sit on. Often concrete blocks are used.

If the pump is placed directly on the gravel, the gravel will get into the impeller blades of the pump and stop the pump.

SUMP PUMP ON A GRAVEL BASE

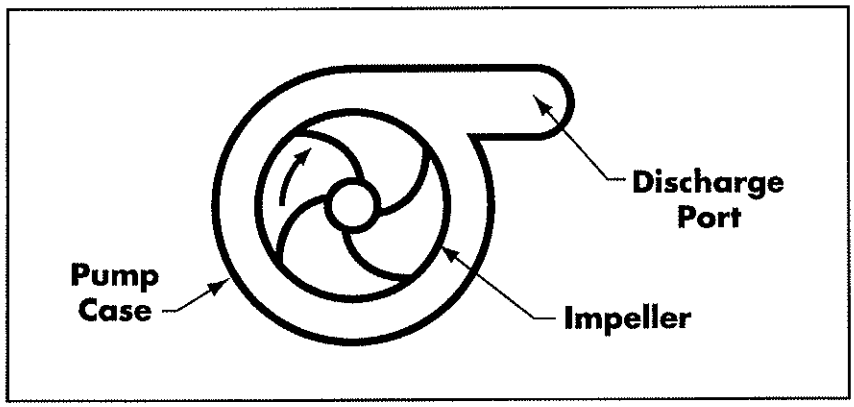


SP 3.2.02

How the Pump in a Sump Pump Works

The pump used in a sump pump is a rotary pump which operates on the basis of centrifugal force. Centrifugal pumps are commonly used to move liquids through a piping system. The basic mechanism is a fan-like mechanism called the **IMPELLER**. It is enclosed in the pump housing, which is usually made of brass, bronze, cast iron, aluminum, or molded plastic. A sump pump is likely to have a three- or four-vane impeller, while an effluent or sewage pump impeller may have only two blades.

CORRECT IMPELLER ROTATION



SP 3.2.03

The water enters the pump through a screen or fine grate at the top or bottom of the impeller chamber and is sucked into the center of the impeller. As the impeller turns, the water is thrown out towards the wall of the impeller chamber (called the **VOLUTE**) by centrifugal force. As it hits the circular wall of the volute, the water flows around the volute wall and into the discharge pipe.

The swift motion of the water creates a high pressure within the chamber, and the rapid movement of the water out of the chamber into the outlet (discharge pipe) creates suction to draw more water in.

Some pumps have a very small **ANTI-AIRLOCK HOLE** (or air bleed hole) in the base of the pump to help prevent the pump from becoming airlocked, which will cause the pump to stop running. It is normal for a small spray of water to come from this hole while the pump is running.

Sump Pumps are Designed to be Clearwater Pumps

Now that you see how the pump works, you can see why it is so important to keep dirt and debris out of the vanes or blades of the impeller.

Sump pumps are designed to be clearwater pumps. Most sump pumps have a strainer or a screen at the top or the bottom of the impeller chamber to help prevent solid materials from getting into the impeller blades.

Some sump pumps can handle very small solids, typically only one-eighth (1/8) to one quarter (1/4) inch. If a certain model pump can handle solids, the maximum size of the solids, given in inches and millimeters (mm), will be indicated in the manufacturer's literature.

However if your customer needs a pump to remove water with solids any larger than mentioned above, you should probably suggest a sewage pump instead of a sump pump.

Because it is not always possible to know that there are solids in the drain water, safety goggles should be worn around operating pumps, especially if the sump lid has been removed.

Pump Ratings

All pumps are rated for capacity, head, and horsepower.

- **CAPACITY** refers to how many gallons or liters it can pump per minute or per hour.
- **HEAD** refers to the maximum height (feet or meters) to which the pump can pump the water.
- **HORSEPOWER**, a unit of power equal in the United States to 745.7 watts, is the horsepower of the pump motor.

As we will see later, effluent, and sewage pumps are also rated for the size of solids they can handle.

We will discuss these performance factors in more detail.

Horsepower Range for Sump Motors

Most sump pumps are powered by electric motors that plug into standard household 115v alternating current (AC) electrical outlets. The motor is enclosed in a housing which may be made of brass or bronze, cast iron, aluminum or molded polymer (plastic).

Typically, motors used for sump pumps range from one sixth (1/6) to one half (1/2) horsepower (HP). Horsepower for a pump is not universal and not all 2 HP pumps are equal. The pump application is more important than its HP. Heavy duty sewage or effluent pumps may have more powerful motors. Voltage requirements and horsepower are listed on the pump nameplate.

Safety Precautions

Because the combination of water and electricity is so dangerous, important safety precautions need to be taken with pumps.

The pump should plug into its own separate circuit or line, with its own fuse or circuit breaker. The line should be properly grounded and breakered in accordance with the National Electrical Code and all appropriate local codes. Use of a Ground Fault Circuit Interrupter (GFCI) is recommended.

The plug-in receptacle on the wall should be at least four feet above the basement floor to prevent the outlet from being covered by water. The receptacle should accept only three-prong grounded plugs. If the plug-in receptacle which is to be used for the pump accepts only two-prong plugs, the receptacle must be replaced (by an electrician) with a grounded receptacle that will take a three-prong grounded plug.

The power cord attached to the electric motor should never be modified in any way. The third prong ground must not be removed nor should an adapter plug (converting a three-prong to two-prong plug) ever be used. An extension cord should **NEVER** be used for the pump.

DANGER! Water on the Floor

Additional precautions are needed if there is water on the floor. Neither the pump nor the **DISCHARGE PIPING** should be touched if the pump is plugged in.

The pump must be unplugged before any part of the discharge piping or the pump housing is touched or handled.

The pump should **NEVER** be handled with wet hands or when the handler has wet feet.

If the basement floor is wet, no one should walk on the wet area until the power is shut off. If it is necessary to walk on any portion of a floor that has wet spots, rubber boots should be worn.

If there is standing water in the basement, the household power should be shut off at the main circuit box before anyone walks into the basement.

If the circuit box or panel is in the basement, and it is necessary to walk on wet floor or through standing water to get to the circuit box, the electric power company should be called to shut off the power to the house. Or call the local fire department for further instructions.

If there is water in the basement, this means that: (1) the pump has failed, or (2) the pump cannot keep up with the inflow of water, or (3) the power has failed so the pump can't operate. If it is necessary to replace the pump, all of the above mentioned precautions must be taken.

Failure to take the safety precautions listed above could result in serious shock or death.

In fact, the above precautions should be taken any time there is water in any basement that is wired for electricity—even if the house does **NOT** have a sump pump.

Importance of the Column in a Pedestal Sump Pump

As was previously discussed, the pedestal sump pumps motor is located on the outside and about two feet above the sump. The motor on a pedestal pump is not watertight.

The piece supporting the motor is called the **COLUMN**. The column may be metal or molded plastic. Enclosed within the column is the drive shaft to turn the impeller.

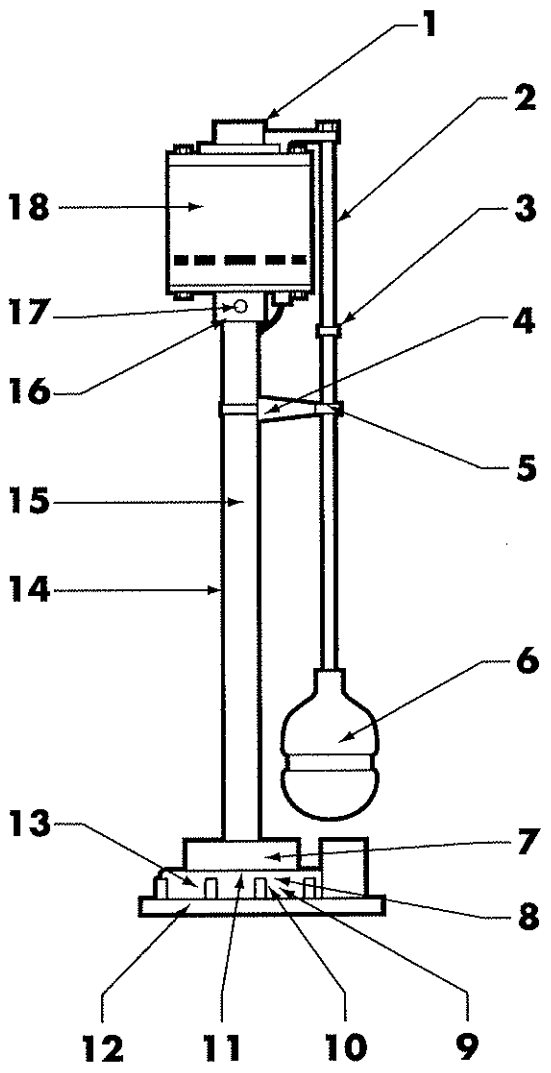
On top of the motor is the switch, which will be activated by the **FLUID LEVEL SENSING CONTROL (FLOAT)**.

Attached to the column may be one or more brackets or guide rings to help keep the **FLOAT ROD** in proper position.

Floats and float rods will be discussed later in this text.

COLUMN PEDESTAL PIPE

Ref. No.	Description
1	Automatic Switch
2	Float Rod
3	Rubber Stop Washer
4	Bracket
5	Rod Guide
6	Float
7	Support, Column
8	Washer (not shown)
9	Stub Shaft (not shown)
10	Plate, Bearing (not shown)
11	Base, Top
12	Base, Bottom
13	Impeller
14	Column
15	Drive Shaft (not shown)
16	Adapter, Motor
17	Screw, Motor
18	Motor (1/3 hp, 115 v, 1 ph)



SP 3.2.04

Housing Must Be Corrosion Resistant

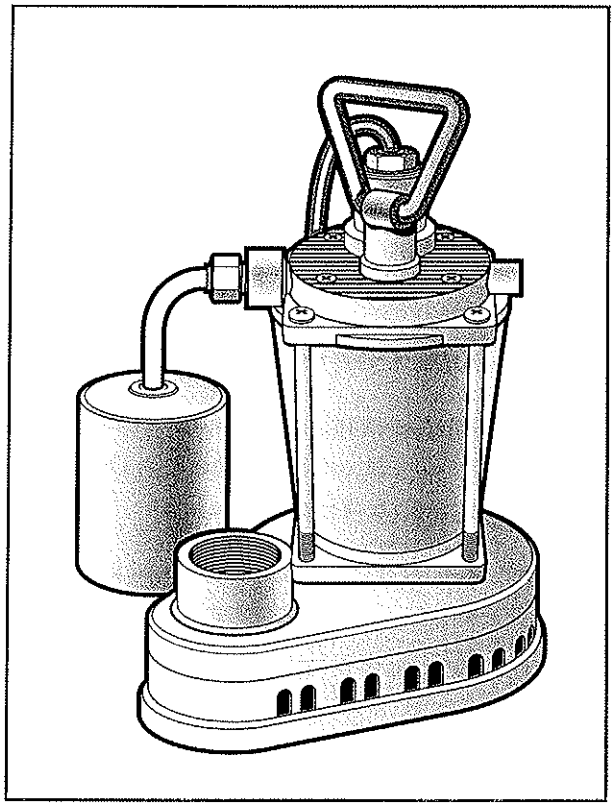
If the pump is a submersible, the watertight motor is part of the whole pump assembly, sitting enclosed in a housing right on top of, and attached to, the impeller assembly.

Because both the motor housing and the pump housing will be under water much of the time (so much they are called **WETTED PARTS**), the housings and the pump must be made of materials that are corrosion resistant.

On top of the motor housing is a switch, which will be activated by the fluid level sensing control mechanism of the float. The power cord is also attached to the top of the motor.

There may be a handle or ring on top for lifting the pump.

WATERTIGHT MOTOR



SP 3.2.05

Battery Usage for a Backup Pump Motor

Backup pumps have motors that run on DC power and are powered by 12v DC battery packs. Often the backup pump comes as a packaged system including the battery pack, a converter which changes household AC current to the DC current needed by the backup pump motor, a charger unit that keeps the batteries charged when the pumps are not needed, and a control panel with indicator lights to show the condition of the batteries and other system operations information.

The length of time the batteries will run the pump without recharging depends upon the type of battery used, the condition of the battery, and whether the backup pump runs intermittently or continuously.

Eight to 24 hours would be a typical time range for a battery backup pump to run without recharge.

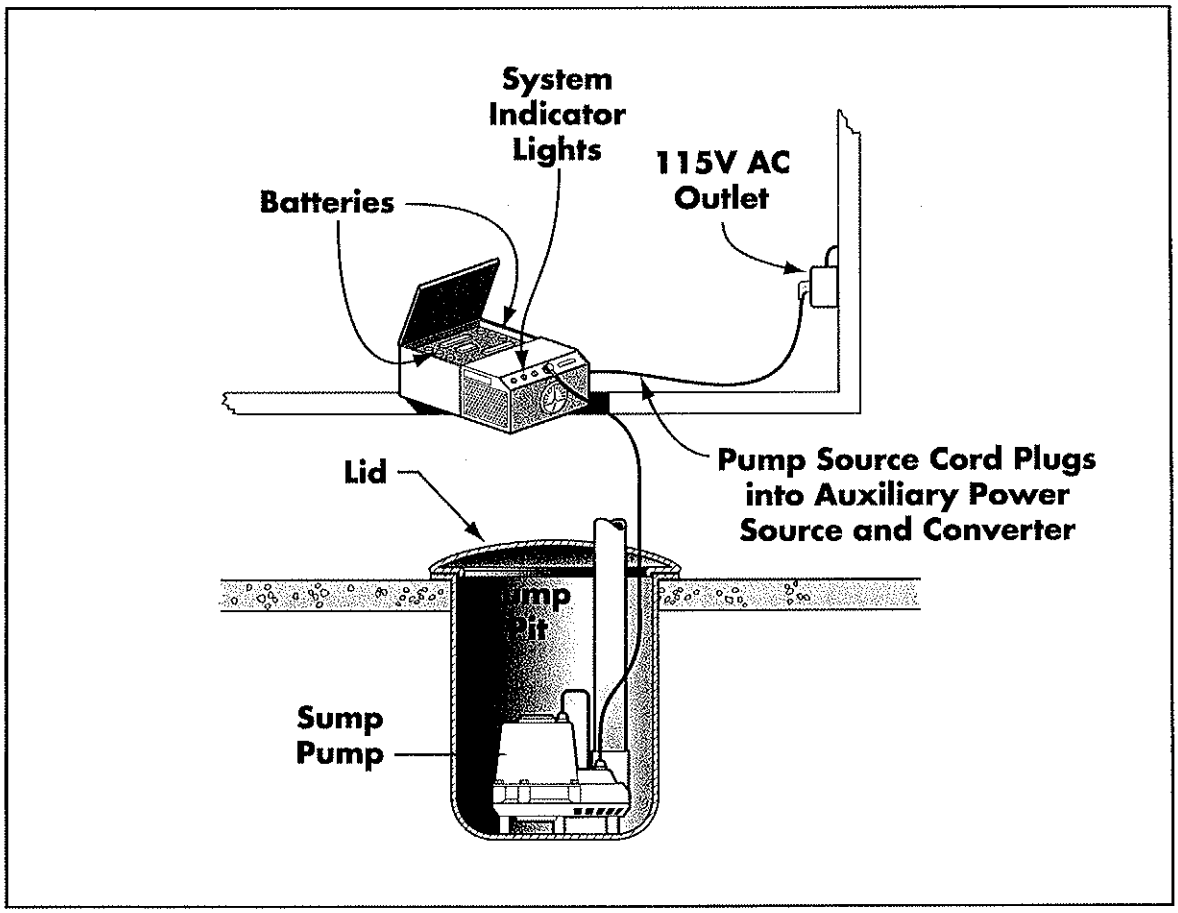
A backup pump system usually includes an alarm to warn the pump owner that the primary pump (or the electricity) has failed and the backup pump system has kicked in. Then the owner can take steps to prevent battery run down before the backup pump stops running.

There are, however, emergency pumps which operate simply on a 12v DC battery such as an automotive or a marine battery instead of making use of a backup system package.

Power Pack Converters

Some companies make separately purchasable power packs with converters that convert in the other direction: from the 12v DC current produced by the batteries included in the power pack to 115v AC power.

POWER PACK W/ SUMP PUMP AND SUMP PIT



SP 3.2.06

Such a power pack/converter allows the homeowner to use a standard sump pump that has an AC motor as a backup pump instead of purchasing a backup/standby pump unit with a DC motor.

As with any battery-powered device, the power lasts only as long as the batteries are sufficiently charged. The power pack comes with a control panel which shows condition of the batteries and the quality of the power supply.

Automatic and Manuel Activation

A sump, sewage, or effluent pump motor is generally turned on by a switch activated by a fluid level sensing device in a float that senses the level of water in the basin and activates a switch to turn the pump off and on appropriately.

Most domestic sump pumps are automatically controlled, which means that the pump will start automatically whenever the water level reaches the pre-set turn-on level and turn off at a pre-set turn-off level.

The automatic control offers the advantage of not requiring family members to be home to turn on the pump—or to remember to turn it off!

Some sump pumps are manually controlled, in case the owner wants to switch the pump on whenever it rains heavily, for example. Pumps should never be turned on if there is no water in the sump.

Some pumps with **PIGGY-BACK PLUGS** (discussed later) can be either manually or automatically controlled.

Switch Cycle

The turn-on and turn-off levels determine the pump's **SWITCH CYCLE**. For example, if the turn-on level is set at 12 inches of water and the turn-off at six inches, the pump will be said to have a "six-inch switch cycle" because the distance between the two levels is six inches.

Pumps sold at retail generally have switch cycle levels pre-set at the factory and the level cannot be varied easily.

Some pumps sold through wholesale houses, however, are made so that the turn-on level can be varied by changing the position of the float and/or the length of the tether on the float.

Running a Sump Pump

The lower the turn-on level, the more often the pump will turn on. Turning on and off is hard on the pump, and a low turn-on level will shorten the life of the pump.

However, it is important not to set the turn-on level too high—or the pump may not keep up. This is especially true if high water levels are common in the particular home or building.

Generally it is recommended that a sump pump should run one-third (1/3) as long as it is off. That is, run for three minutes, then off for nine minutes.

Most pumps have a power overload switch that will shut the pump off if it gets too hot because of improper power supply or a clogged impeller that would cause the pump to run too long—or other problems which might cause improper on/off functioning. This switch cannot be manually controlled but will reset itself when the problem is solved.

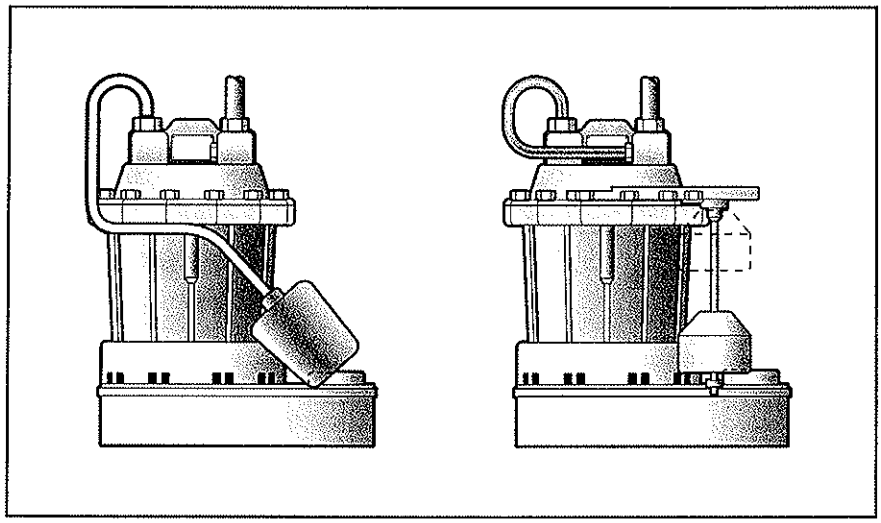
Categories of Switches

There are several possible kinds of fluid level sensing devices that activate switches on sump, sewage, or effluent pumps. The two general categories of switches are **WIDE-ANGLE SWITCHES** (which float out at an angle to the pump) and **VERTICAL SWITCHES** (which hang vertically, parallel to the pump).

A **FLOAT SWITCH** is a float with a switch mechanism inside. The switch portion is activated by the rising level of the water. Float switches are generally found on submersible pumps, including sewage and effluent pumps.

Some floats are mercury-activated float switches, but most floats now are mechanical and mercury-free, for environmental reasons.

SUMP PUMP SWITCHES



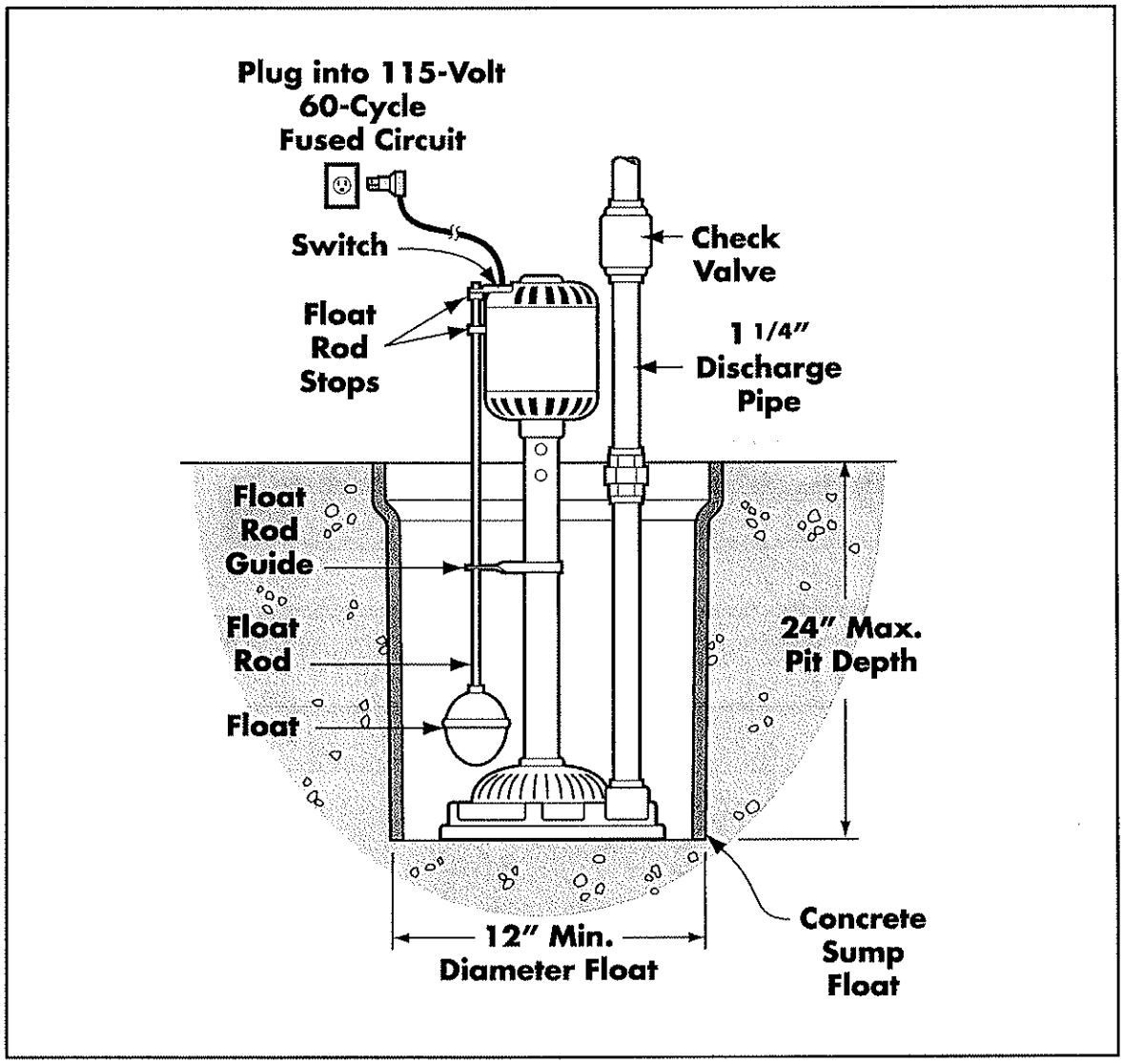
SP 3.2.07

Pedestal Pumps Typically Have Vertical Switches

A pedestal pump typically would have a vertical switch mechanism, with a float connected to a float rod. The float rod rises as the float rises on the water. The rising float rod trips the motor switch at the top of the motor housing when the float reaches the turn-on level.

The float rod is held in place, vertically, by the rod guide, which is attached to the column. The float hangs exactly vertically, parallel to the column and perpendicular to the floor of the sump.

PEDESTAL PUMP



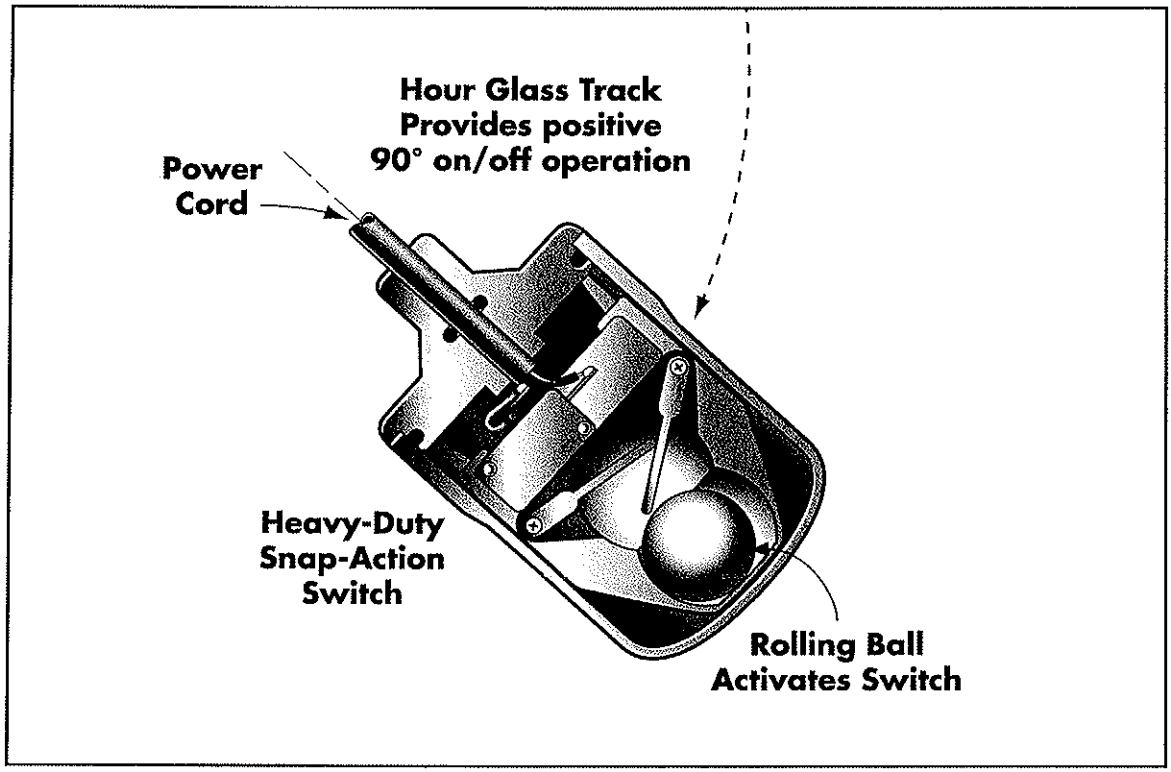
SP 3.2.08

Submersible Pumps Usually Have Wide-Angle Float Switches

A submersible pump usually has a wide-angle float switch that is attached to a power cable.

The float rises on the water to float out at an angle to the motor housing—rather than hanging vertically. At greatest extension, the float may be floating at a 90° angle (parallel to the sump floor) or even at a greater angle.

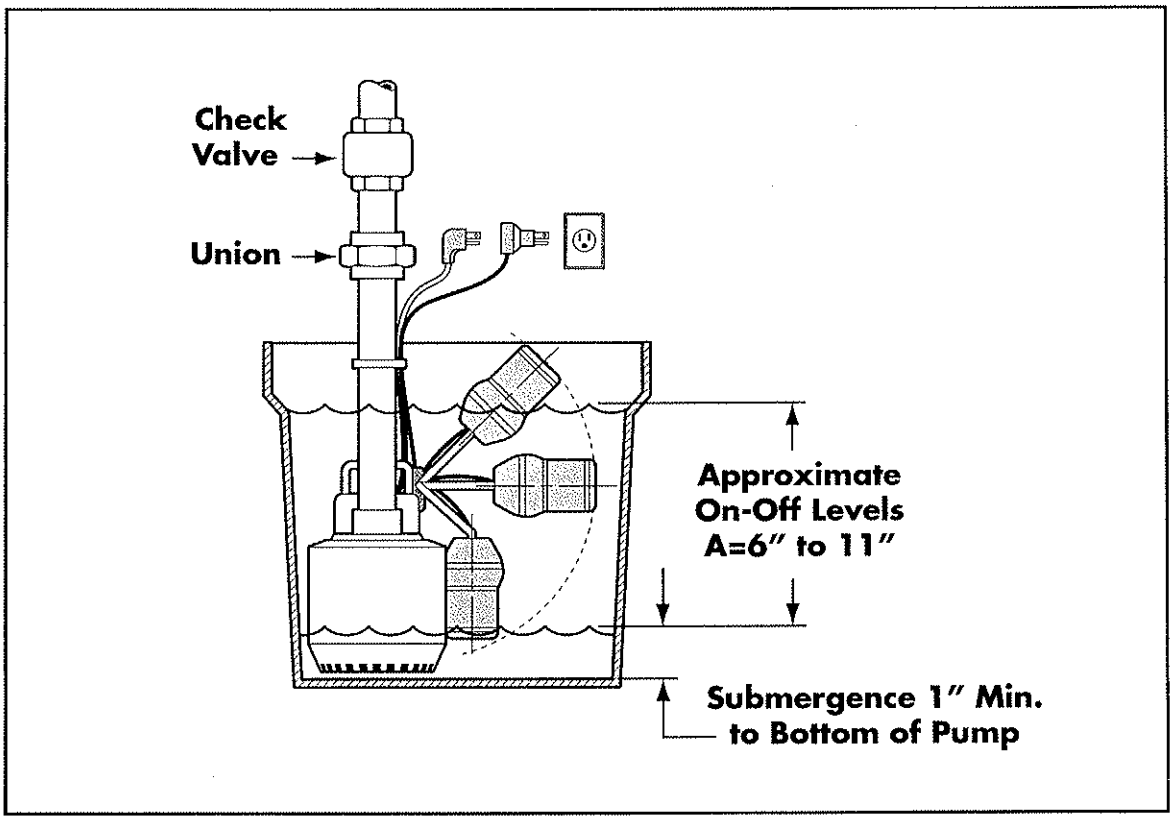
SUBMERSIBLE PUMP



SP 3.2.10

The wide-angle float actually has the switch inside. The switch uses a rolling ball to turn the switch on or off, depending upon the position of the float.

WIDE ANGLE FLOAT



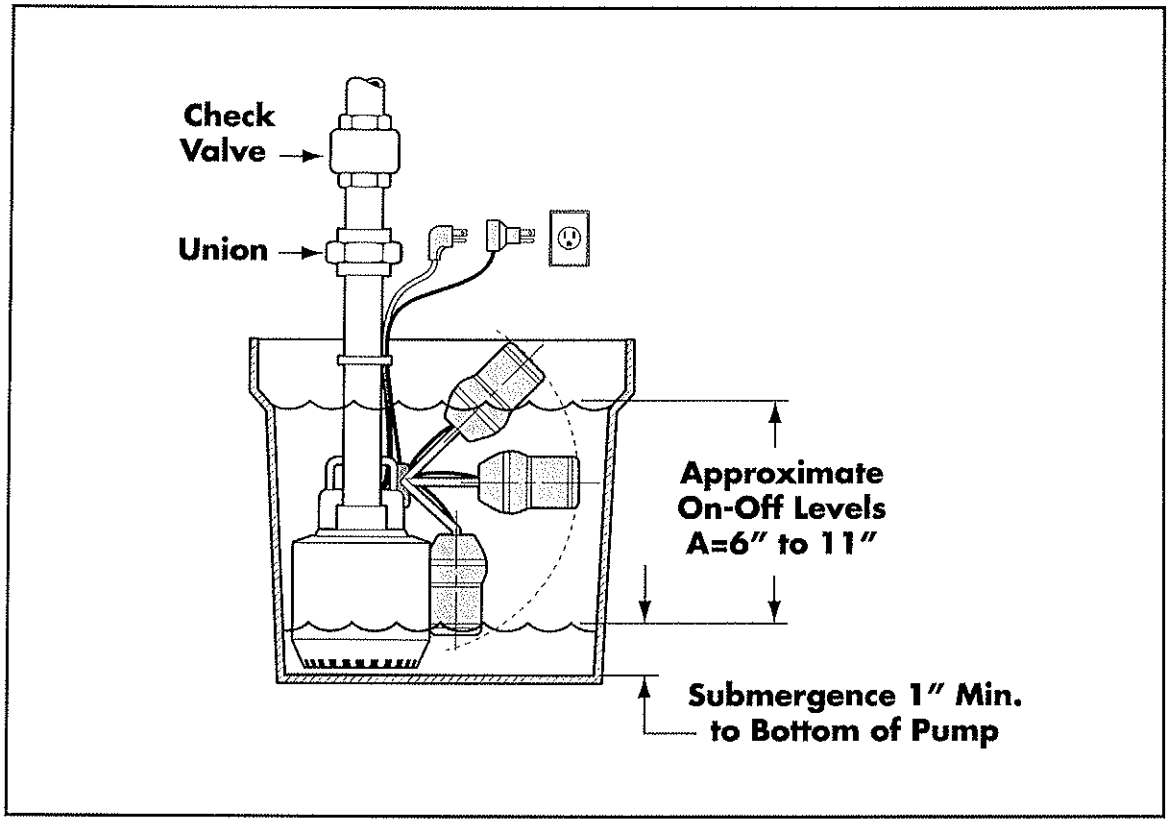
SP 3.2.11

Piggy-back Plug

The other end of the switch cable may be wired to the pump motor at the top of the motor housing. Or the cable from the pump may actually plug into the back of the plug on the end of the power cord which comes from the switch, which then plugs into the electrical receptacle on the wall. This is called a **PIGGY-BACK PLUG**, and the switch arrangement is called a piggy-back switch.

The *piggy-back switch* arrangement generally allows the pump to be switched from automatic control to manual control. To set the pump up for manual control, plug the pump in directly, by-passing the piggy-back plug. The motor will run until unplugged.

PIGGY BACK PLUG



SP 3.2.12

Sump Pump Basin Must be Wide Enough

It is extremely important that the sump basin be wide enough that the float can float freely at all times. If the float is prevented from floating freely, it will not activate the switch properly and the pump motor may not function properly.

Diaphragm Switch

Another type of float switch which might be found on a submersible is a fluid-level-sensing **DIAPHRAGM SWITCH**.

A flexible diaphragm inside the float responds to the pressure of the water as the water level rises and activates a switch within the float when the turn-on level is reached.

A diaphragm switch is usually attached directly to the pump (rather than being on a tether) and has a piggy-back plug. Typically, the diaphragm switch hangs more vertically than a wide-angle float switch. The diaphragm switch power cord also incorporates a small plastic vent tube which is needed for the diaphragm switch to operate.

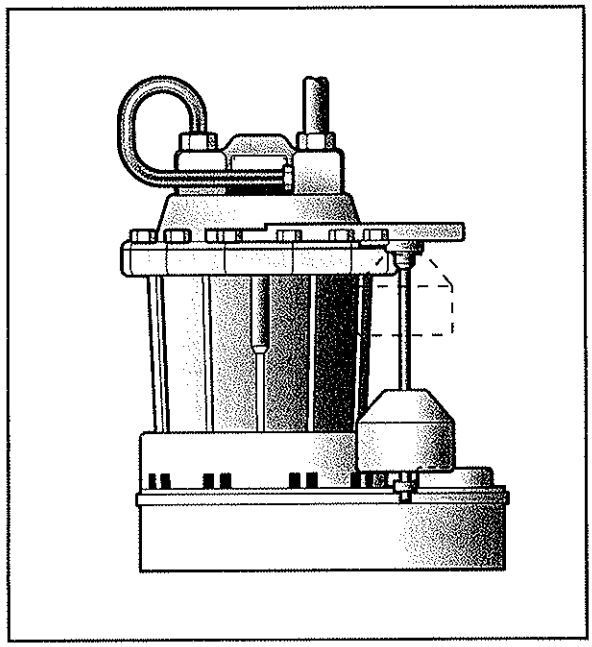
Care should be taken so the cord does not get pinched or that this tube does not get dirt in it.

Submersible Pumps Can Have Vertical Switches

Submersible sump pumps that are small in diameter and designed to fit in sumps with unusually small diameters may have **VERTICAL FLOAT SWITCHES**, rather than wide-angle floats. Vertical floats allow the pumps to fit into the smaller basins.

Vertical floats do not have the switches in the float. Instead, the float is mounted on a guide rod that attaches to a switch located in a housing at the top of the guide rod, similar to the float switch on a pedestal pump. The up and down motion of the float controls the switch.

SUMP PUMP SWITCH



SP 3.2.13

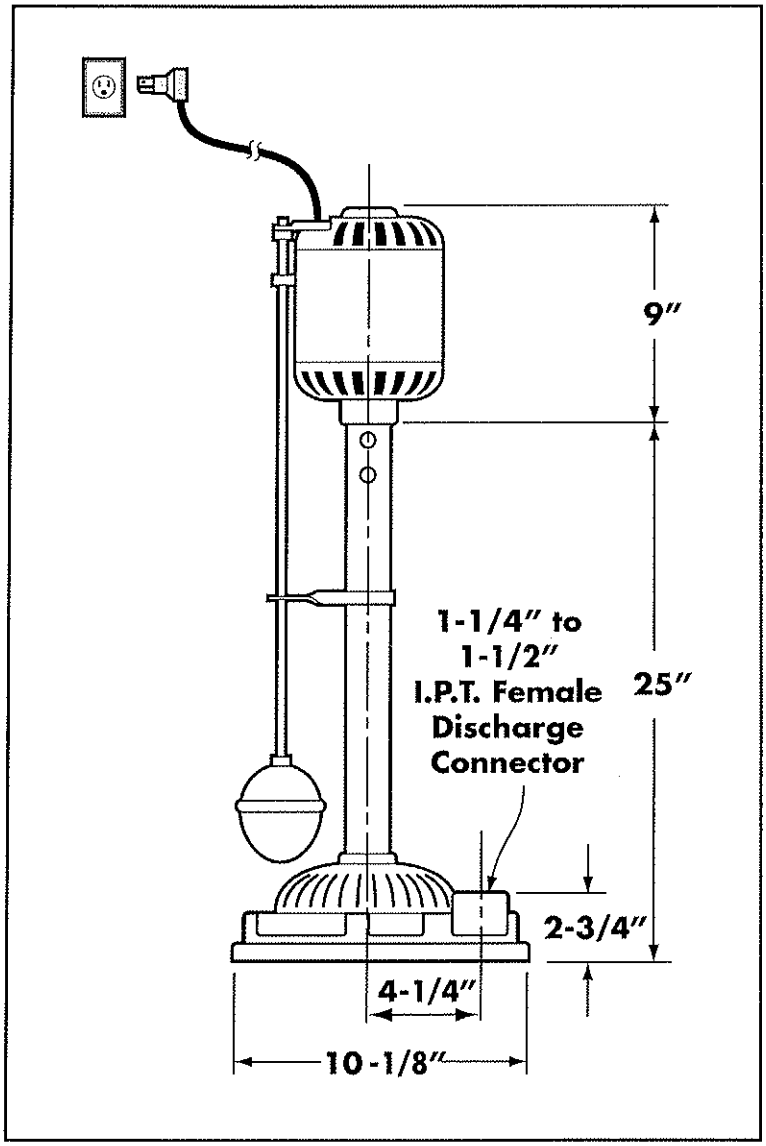
Discharging Pumped Water

The water that is pumped out goes into the **DISCHARGE OUTLET** and then into the discharge piping. The discharge outlet is the short female-threaded pipe which is molded into one side of the pump.

The discharge piping is connected to the discharge outlet and the pumped-out water is carried out of the house. Depending upon local codes and individual situations, the discharged water may go into the storm drain, the household drainage system, a dry well, or a natural drainage area outside the building.

When planning the discharge piping arrangements, the shortest possible pipe runs should be used to prevent unnecessary friction loss which will increase the head and could lower the capacity.

DISCHARGE PIPING



SP 3.2.14

Discharge Piping Recommendations

The discharge piping does not usually come as part of the pump package from the manufacturer.

If this is a new pump assembly, you will need to sell your customer the pipe, fittings, and valves needed to complete the pump system.

Schedule 40 PVC pipe is generally recommended.

However, sometimes flexible plastic hosing is sometimes used for sump pumps, especially for temporary situations or where vibration transmission could be a problem.

As always, you should be familiar with local code requirements related to acceptable piping.

Sump pumps for residential use usually have 1-1/4 inch or 1-1/2 inch discharge connections. Sewage pumps which handle solids may have different pipe size requirements.

The discharge pipe diameter should be at least as large as the diameter of the discharge connection on the pump, larger may be even better.

To use smaller diameter discharge pipe would restrict the flow of the discharged water, increase friction loss, and cause the pump to provide a substandard performance.

A union should be installed in the discharge line just above the top of the sump pit so that the pump can easily be removed for repair or replacement.

A check valve is recommended to prevent backflow of the discharged water.

Be sure to ask the customer what kind of fittings will be needed to connect the discharge pipe to the pipe that feeds into the drain, and sell the fittings too so a return trip will not be needed.

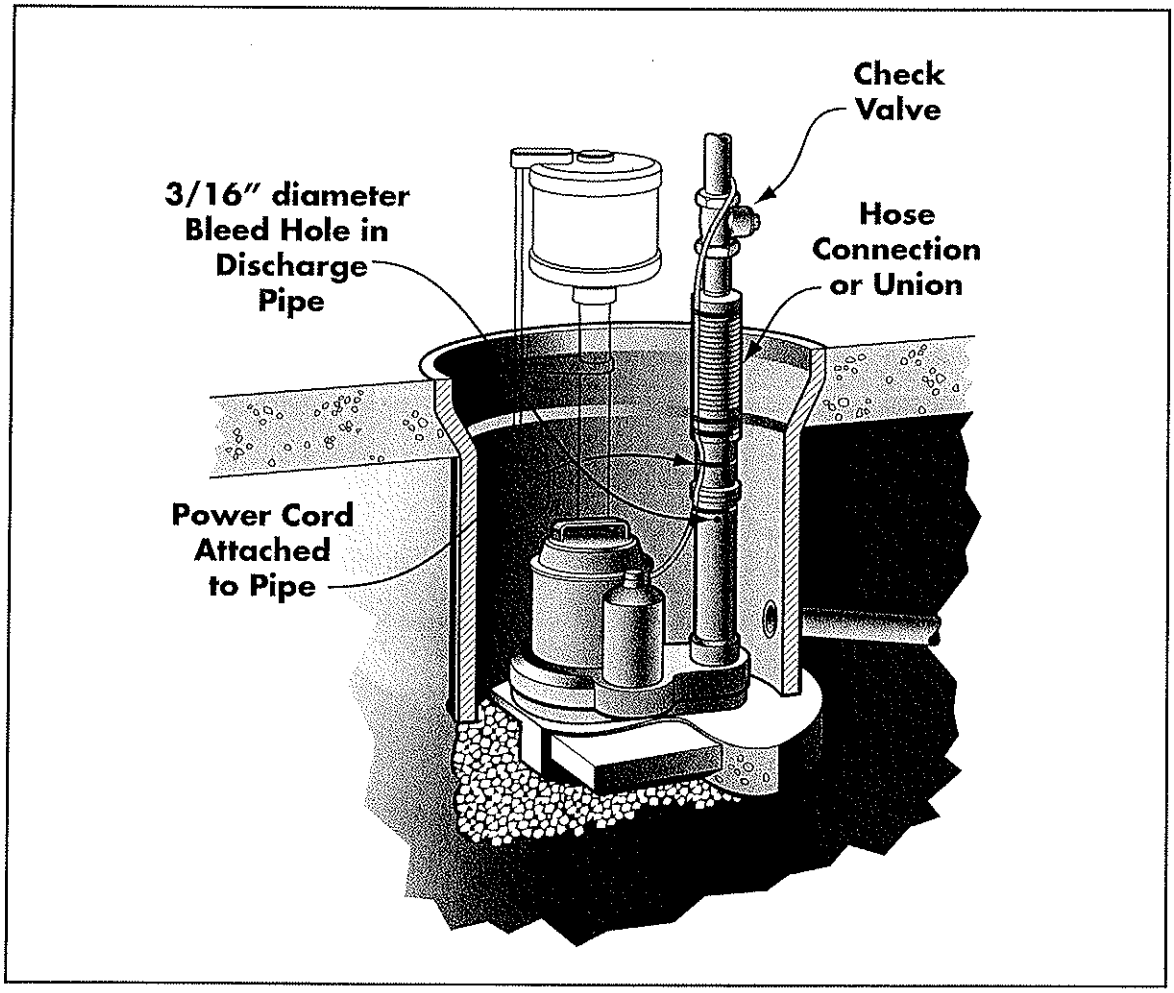
Preventing Airlock

Some pumps will have **AIR BLEED HOLES** (relief holes) manufactured into the pump housing to prevent airlock. (It is normal for these holes to have a small spray of water coming out of them.)

The relief hole will help prevent airlock. Airlock prevents a pump from pumping water-even though it's running.

Almost all manufacturers recommend that to prevent airlocking a relief hole of 1/8 to 3/16 inch diameter should be drilled in the discharge pipe below the floor line, between the pump discharge outlet and the check valve. The size of the air relief hole may depend upon the type of pump you are installing. Ask the manufacturer for advice about the size of the hole.

PUMP SHOWING BLEED HOLE



SP 3.2.15

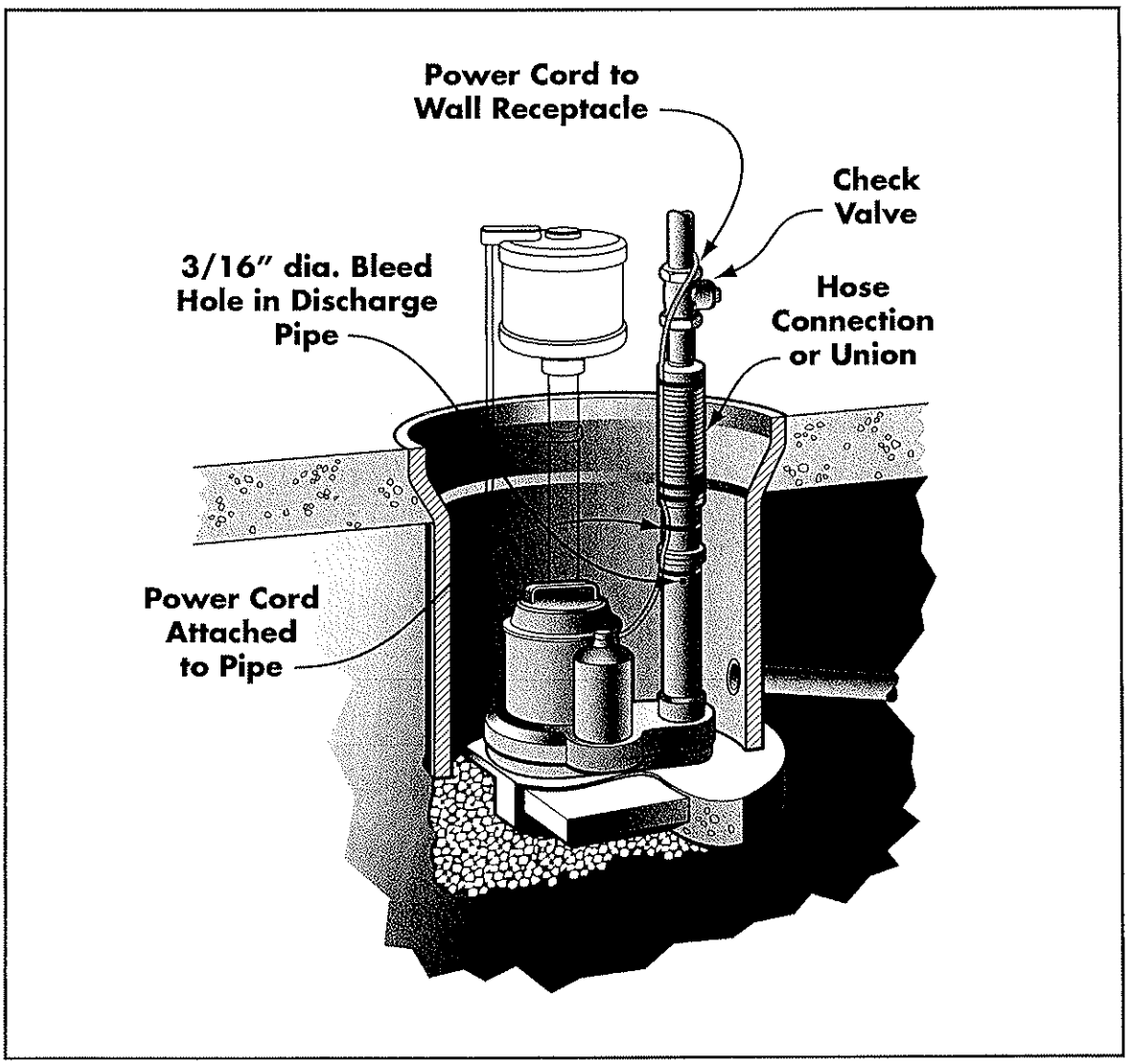
Taping the Power Cord

The power cord from the motor and/or the float switch is often taped to the discharge piping to hold the cord in place and out of the way. Electrical tape (or other suitable fastener) is used.

It is important that the tape not be tight enough to kink the cord and that the cord not be bent where it exits the pump motor.

The cord also should not interfere with the motion of a float control, nor should the cord be allowed to drape over the motor.

PUMP SHOWING THE POWER CORD



SP 3.2.16

Control Panel Functions

Sometimes a pump system will be controlled by an electrical control panel or control box. This is especially likely if the system is a backup system with two pumps, warning alarms or battery charge packs or a sewage pump system which alternates the operation of dual (duplex) pumps in the system.

The control panels may be used to:

- control the operation of the primary and/or backup pump
- control the operation of duplex sewage pumps
- activate an alarm when the backup system comes on
- show that the backup pump is operating
- indicate the condition of the batteries
- provide circuit breakers, if needed
- provide other electrically-controlled functions

Additional Accessories

Additional system accessories such as alarms, junction boxes, replacement float switches, and replacement motors for pedestal pumps are probably part of your inventory, and you should always be ready to suggest such accessories when appropriate.

Your knowledge about what your customer needs may be what brings customers back to your company. Customer satisfaction is your most important product.

REVIEW QUIZ – PUMP SYSTEMS

Answers appear on page 48

DIRECTIONS: Carefully read each question and circle the correct answer. There is only one correct answer per question. When you have finished, check your answers.

1. All of the following are major components of a sump pump system **EXCEPT**
   a. Discharge pipe
   b. Impeller
   c. Power cord
   d. Motor

2. The sump basin generally should be placed six inches away from the wall and in the
   a. driest point in the basement.
   b. highest point in the basement.
   c. lowest point of the basement.
   d. wettest part of the basement.

3. What creates the suction of the sump pump?
   a. Centrifugal force throws water into the pump's impeller and into the volute.
   b. Rotation of the impeller draws water into the pump.
   c. Centrifugal force throws water out of the pump's impeller into the outlet.
   d. Water entering through the blade is forced into the discharge pipe.

4. Most sump pumps cannot handle solids in the water because solids
   a. do not pass through sump pump screens.
   b. are better handled by sewage pumps.
   c. are trapped in the sump pump motor.
   d. clog the impeller.

5. What is the typical depth for a pit used for a sump pump?
   a. 12 inches
   b. 24 inches
   c. 36 inches
   d. 48 inches

6. Why is it important that the pump **not** be placed directly on the gravel drainage bed?
   a. Gravel will get into the pump impeller and stop the pump
   b. Water might seep into the basement and damage the pump.
   c. Gravel may be drawn into the drainage inlet.
   d. The pump may fall into the drainage bed.

REVIEW QUIZ – PUMP SYSTEMS

Answers appear on page 48

7. How will you know if a particular sump pump can handle solids without clogging up?
   a. No sump pump can handle solids.
   b. Check the manufacturer's literature for that model.
   c. Check the capacity rating for that model.
   d. Confirm that the pump is not placed directly on the gravel drainage bed.

8. How far above the basement floor should the electrical receptacle be placed to accept the sump pump plug-in?
   a. 2 feet
   b. 3 feet
   c. 4 feet
   d. 5 feet

9. If there main circuit box is in the basement and standing water is present, what should the homeowner do?
   a. Shut off the power at the main circuit box.
   b. Wear rubber boots to get to the main circuit box and shut off the power.
   c. Call the power company to turn the power off.
   d. Shut off the main circuit box and call the power company.

10. Why must the motor for a submersible sump pump be watertight and corrosion resistant?
    a. It will be submerged in the water in the sump.
    b. The motor must be supported above the sump.
    c. The drive shaft must be protected to turn the impeller.
    d. It helps to keep the float in proper position.

11. How do the motors on backup pumps differ from standard pump motors?
    a. Standby pumps operate on AC power.
    b. Backup pumps usually run on 12v DC power.
    c. Standard pumps operate on batteries.
    d. Standard pumps convert AC power to DC power.

REVIEW QUIZ – PUMP SYSTEMS

Answers appear on page 48

12. A 4-inch switch cycle means that the pump will turn off
    a. when the water is 4 inches high in the basement.
    b. every 4 minutes while the basement is drained.
    c. when the water is 4 inches lower than when the pump switched on.
    d. every 4 minutes to conserve power and rest the pump.

13. If a pump runs for 2 minutes, how long should it be off?
    a. 2 minutes
    b. 4 minutes
    c. 6 minutes
    d. 8 minutes

14. The two common categories of float switches are
    a. wide-angle and vertical.
    b. replacement and vertical.
    c. piggy-back and wide-angle.
    d. diaphragm and piggy-back.

15. To keep the power cord in place, out of the way of floats, it is usually fastened to the
    a. check valve.
    b. hose connection.
    c. discharge pipe.
    d. wall receptacle.

APPLYING WHAT YOU HAVE LEARNED:

By observing and asking questions, fill in the blanks. If you are not sure of the answers, ask your supervisor.

A. Does your company sell only residential pumps or does it also sell industrial, municipal, or agricultural pumps? What is the proportion of sales of each product?

_____

_____

_____

B. Does your company sell more pedestal or submersible sump pumps? Why?

_____

_____

_____

ANSWERS TO REVIEW QUIZ

CHAPTER 2

PUMP SYSTEMS

Answers to REVIEW OF PUMP SYSTEMS (pages 44 – 46)

1. b. Impeller
2. c. lowest point of the basement.
3. c. Centrifugal force throws water out of the pump's impeller into the outlet.
4. d. clog the impeller.
5. b. 24 inches
6. a. Gravel will get into the pump impeller and stop the pump.
7. b. Check the manufacturer's literature for that model.
8. c. 4 feet
9. c. Call the power company to turn the power off.
10. a. It will be submerged in the water in the sump.
11. b. Backup pumps usually run on 12V DC power.
12. c. when the water is 4 inches lower than when the pump is switched on.
13. c. 6 minutes
14. a. wide-angle and vertical.
15. c. discharge pipe.

Applying what you have learned:

A. Depends on the company

B. Depends on the company

3 PUMP PERFORMANCE

LEARNING OBJECTIVES

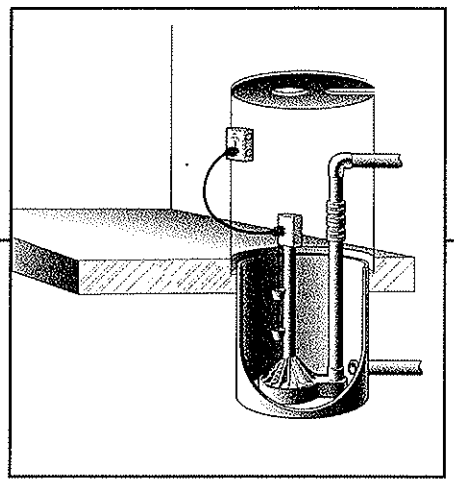
When you finish this Chapter, you will be able to:

1. Demonstrate how the capacity and head of a particular pump can be shown on a pump performance curve.

2. Calculate the capacity of a pump in gallons per minute using a performance ratings chart.

3. Explain the rules regarding electrical maintenance of sump pumps.

4. Discuss some problems related to float switches and explain how these problems might be resolved.



PUMP OPERATION

Pump Performance

Standards for sump, sewage, and effluent pump manufacture and testing have been created by the **SUMP AND SEWAGE PUMP MANUFACTURERS ASSOCIATION (SSPMA)**.

According to the SSPMA, when the SSPMA Certified Pump mark is "used by a manufacturer to identify a sump or sewage pump/motor unit, the assures the purchaser that the manufacturer has tested and certifies the performance of the product in accordance with the Sump, Effluent and Sewage Pump Standards of the Sump & Sewage Pump Manufacturers Association."

Conformance to these standards is voluntary and manufacturers are not required by law or the industry to meet these standards.

Manufacturers which adhere to these standards may indicate this by stating that their pumps are "Tested and rated in accordance with SSPMA Standards."

Manufacturers which are licensed by SSPMA may also use the "SSPMA Certified" seal on their products to indicate adherence to the standards.

Standard Performance Ratings

There are three standard performance ratings that are generally given for sump pumps:

1. Motor horsepower
2. Capacity
3. Head

As we will see later in this course, sewage and effluent pumps are also rated by the size of solids they can handle.

Horsepower

HORSEPOWER is a unit of work established by James Watt who lived until 1819. Watt wanted to measure the amount of energy required to raise coal out of a coal mine and so he created "horsepower" as the unit of measure.

One horsepower is equivalent to 33,000 foot-pounds of work performed in one minute. To help you better understand the concept of horsepower, cars typically have 125 to 200 horsepower, but some high-performance cars have upwards of 400 horsepower.

The horsepower of the pump motor affects how much water can be pumped. Sump pump motors usually are in the 1/6 to 1/2 horsepower range. Heavy duty sewage pump motors may be larger than this.

The horsepower requirement for a house is determined by the area of drainage connected to the sump, the depth to groundwater, the depth of the basement, and many other factors.

Pump Capacity

CAPACITY refers to pump output, the amount of water a pump can move, measured in gallons per minute (gpm) or per hour (gph) or in liters per minute (lpm) or per hour (lph).

The capacity of a sump pump is related to the strength of the motor, specified in horsepower, as well as the size of the outlet pipe.

Head

HEAD is the maximum height, in feet or meters, that the pump can lift water through the discharge piping (called **STATIC HEAD**) *plus* the calculated friction loss from all the pipe and fittings (called **FRICTION HEAD**). This combination of static head and friction head is often called **TOTAL DYNAMIC HEAD**, but most people simply call it *head*.

It is important to determine what the highest point in the discharge pipe run is. The highest point may NOT be directly above the pump. If the horizontal run has to run uphill to the drain outlet, the highest point in the run may be at the drain outlet.

Sizing a Pump

The more energy the pump must put out to lift the water (head), the less energy is available for pumping the water out (capacity). Or, we say, "As head increases, capacity decreases."

When you are helping to size a pump for a customer, being able to calculate the head in the customer's discharge pipe run is crucial, especially since the customer probably will not know what capacity is needed in a pump. But, with your help, customers can calculate the needed head.

Head figures must include the *static head* (height) plus the calculated friction loss *(friction head)* for the length of the vertical and the horizontal pipe runs plus the various fittings and valves that are included in the piping system.

Your manufacturer's catalog or other reference materials will help you calculate friction loss for each type of fitting and kind of pipe used in the run.

For example, a 3/4 inch 90° elbow creates as much friction loss as two feet of straight pipe, and the check valve may be equivalent to five or six feet of pipe.

Generally speaking, most sump pumps sold for residential single-family use—that is, for clear water in basements from rain or seepage-are in the standard capacity range of 15 to 20 gpm.

Therefore, if you can help the customer calculate the head correctly, you can help choose the pump needed by choosing a pump with a standard capacity figure.

Of course, larger buildings or homes that have more severe flooding problems will require pumps with larger capacities. And as we shall see later, sewage pump sizing has some additional requirements to consider.

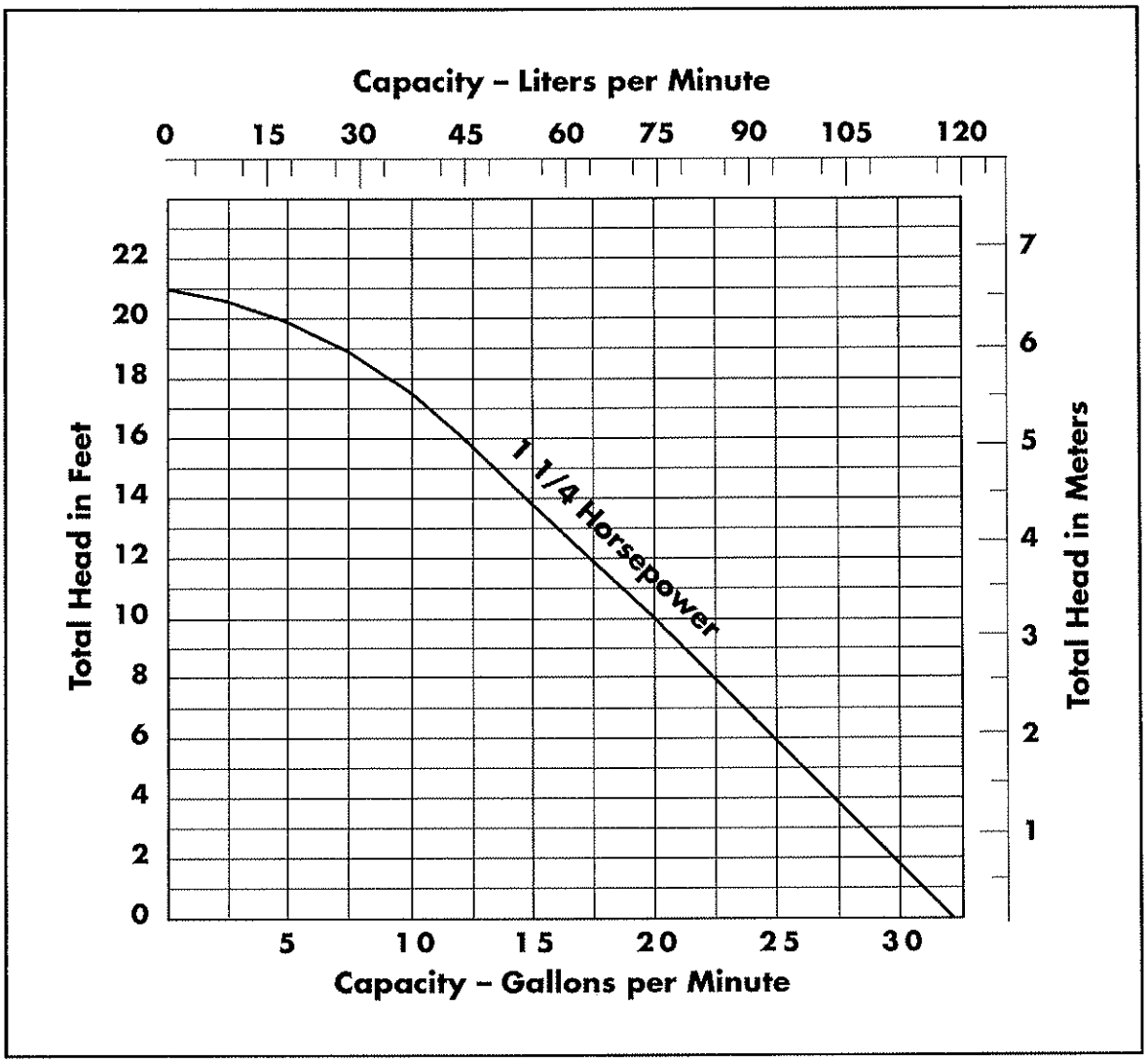
Pump Performance Curve

The capacity and the head of a particular model of pump are often shown by a **PUMP PERFORMANCE CURVE** on a graph like the one shown below.

The pump will pump water at any of the points shown below the level of the curve. At any of the points above the curve, the pump will not pump water.

Notice, as was indicated before, as the head required goes up, the capacity the pump can produce goes down.

PUMP PERFORMANCE CURVE



SP 3.3.2g

Performance Ratings and Product Capabilities

The performance ratings may also be given in abbreviated form in a table such as shown below.

Performance Ratings	
Head (feet of water)	Gallons per hour (gph)
10	2400
15	2000
20	1300
22	960

SP 3.3.1t

Maximum head and maximum capacity, along with other pump specifications, may also be shown in tables or charts similar to the one shown below.

PRODUCT CAPABILITIES

Capacities to	30 gpm	113.6 lpm
Heads to	21 feet	6.4 m
Pumps Down Range (Switch Off-On)	5 inches	127 mm
Solids Handling	1/8 inch	3.18 mm
Liquids Handling	Drain Water	
Intermittent Liquid Temp	Up to 140 F	Up to 60 C
Motor	1/4 hp shaded pole, 300 rpm	
Electrical	115 volts, 8.0 amps, 1 ph, 60 hz	
Acceptable pH Range	5-9	
Discharge, NPT	1-1/4 inches	31.8 mm
Minimum Sump Diameter	12 inches	304.8 mm
Housing	Anodized Aluminum Alloy	
Motor Cap Discharge Base Impeller	Polypropylene	
Power Cord	10 feet	
Mechanical Seal	Carbon & Ceramic	

SP 3.3.2t

Basic Rules for Pump Maintenance

Now we will review the basic maintenance steps that a customer should understand to get maximum performance from a pump, and then we will look at some troubleshooting tips. While these tips and rules given apply specifically to sump pumps, many of the tips will also apply to sewage and effluent pumps.

The first maintenance rule for any pump should be: Read the owner's manual and the instructions that come with the pump.

While most sump, sewage, and effluent pumps operate on the same general principles, you should become familiar with how the particular pumps you sell work and familiar with the manufacturer's instructions for installation and maintenance for those pumps.

You should study all the manufacturer's literature about the pumps you sell so that you can answer customer's questions about installation, operation, and maintenance of the pumps.

If your company or manufacturer offers training on pump operation and maintenance, take the training provided.

Never Let a Pump Run Dry

Most pumps will be damaged if they are allowed to run dry. So a pump should never be allowed to run unless there is enough water in the sump or basin to activate the turn-on switch.

In the case of sump pumps which do not run regularly or often, the pump owner should check for proper operation regularly by filling the sump to the turn-on level and check to see if the pump kicks on.

Power Supply Must Match the Needs of the Pump

It is also very important that the power supply match the needs of the pump. The pump should have its own properly-grounded electrical circuit of appropriate voltage. Extension cords should never be used.

Care should be taken that the power cord does not get cut or kinked up, preventing power from getting to the pump and creating possible shock conditions.

It is important that no one touch or attempt to service the pump while it is running because the person could receive a dangerous shock. The pump should be unplugged before anyone touches the pump or the discharge piping or the water.

Sump Pump Cleaning

The pit should be cleaned out before installation and regularly thereafter. The pump screen or inlet opening should also be cleaned every three or four months to prevent clogging. If necessary, the impeller itself may have to be cleaned out.

Debris of any kind in the basin can be caught up into the impeller and will clog the pump. If the floor of the sump used for a sump pump is open, with gravel in place for added drainage of the water into the sump, the pump must be placed on a stable base above the gravel.

Gravel or debris can also be thrown out by the centrifugal motion of the pump if the cover of the sump is left off. If it is necessary to work around the pump when the pump is operating without the cover in place, safety glasses should be worn.

When a Pump's Motor Stops Working

In most cases, pump motors do not need oiling or other maintenance. Any kind of tampering with the pump may void the manufacturer's warranty.

The motor on a pedestal pump may be replaced if necessary. Because a submersible pump has the motor sealed right in the same housing with the pump, the whole pump must be replaced if the motor ceases to function properly.

Troubleshooting Sump Pumps

The next few pages contain a few troubleshooting tips to help you understand possible problems your customers may ask you about.

Remember that tampering with the pump may void the warranty, so consult with your manufacturer about what to do if a pump is malfunctioning and still under warranty.

Your manufacturer's literature will probably contain further troubleshooting and maintenance tips for the pumps you carry. Always refer to that literature first.

The Sump and Sewage Pump Manufacturers Association (SSPMA) offers a detailed document entitled "SSPMA Trouble Shooting Chart" for purchase at a small charge. Your company may want to purchase this document to help you answer your customer's questions about pump problems.

The Motor Will Not Start or Run Properly

What is the first problem to consider if the motor won't run? If the motor will not start or run, the first problem to consider is that there may be a power supply problem.

- Perhaps the household power has gone off or the household voltage is too low (or even too high), or the batteries in the battery pack are dead.
- Maybe the electrical receptacle into which the pump is plugged is dead or the power to the receptacle may be turned off if it is controlled by an off/on manual switch.
- A fuse may have blown or a circuit breaker has been tripped, either in the household supply or control panel used for the pump.
- The power cord may be damaged and need repair or re-placement. (It is safer to let an electrician repair it.)
- The control panel or control box may need replacing.

Another set of possible problems to look at if the motor won't run are problems related to switches that control the motor.

- The automatic turn-on switch on the motor may need replacing.

- The internal power overload switch on the motor may have been tripped because the impeller is jammed up and cannot operate or for some other reason that caused overload. This switch cannot be reset manually but will reset itself when the problem is corrected.

Problems with the float or the float switch may also cause the motor not to turn on properly.

- The float that activates a float switch may have become waterlogged (filled with water) and need replacing.
- The switch portion of the float switch may not work.
- The float may be jammed against the wall of the sump and not be able to move freely enough to reach switch-on level.
- The float rod on a pedestal pump may be stuck against the sump cover and therefore not operating the switch.

The Pump Turns On and Off Excessively or Will Not Stop

If the pump turns on and off too often or will not stop running, several possibilities exist.

- The motor itself is defective.
- The automatic switch is faulty.
- A float or float rod is jammed against the sump or the sump cover.
- Debris in the sump is causing the float or float rod to get jammed or preventing it from controlling the switch cycle correctly.

The Motor Runs but the Pump Doesn't Work

- The pump inlet and/or impeller may be clogged.
- The impeller may be damaged.
- The pump may be airlocked because of lack of an air bleed hole in the pump housing or discharge pipe or because the air bleed hole is blocked.

- The shaft connecting the impeller and the motor may be loose at either end or both ends.
- The motor may be running backwards.

Conditions related to discharge of the water could also cause the pump to pump insufficient water (or none).

- The discharge outlet or pipe could be blocked or clogged.
- The discharge pipe diameter could be too small.
- The check valve could be defective or installed in the wrong direction.
- The total dynamic head may be too great for the capacity of the pump.

The Pump is Noisy

Sometimes the problem is that the pump is too noisy. Problems may include the following.

- The pump may be defective or worn out.
- The shaft may be loose at the impeller and/or motor end.
- The impeller may be loose or rubbing against something.
- The motor may be excessively noisy. (Replace if possible.)
- There may be gravel, stones, or debris in the bottom of the sump being thrown around or sucked into the impeller.
- The pump may not be positioned securely in the sump.
- The discharge piping may be connected tightly to the floor joists causing vibration from the pump to be transferred to the joists. If code allows, consider using flexible hose for part of the discharge piping to help eliminate vibration.

For additional help in understanding the operating characteristics of the sump pumps you sell, consult your manufacturer's literature and take any product training your manufacturer or your company makes available.

REVIEW QUIZ – PUMP PERFORMANCE

Answers appear on page 66

DIRECTIONS: Carefully read each question and circle the correct answer. There is only one correct answer per question. When you have finished, check your answers.

1. What does the "SSPMA Certified Pump" logo mean when it appears on a product?
   a. The manufacturer is a member of the Sump and Sewage Pump Manufacturers Association (SSPMA).
   b. The pump meets the basic industry standards for pumps.
   c. The pump meets the SSPMA voluntary standards.
   d. The manufacturer has tested the pump.

2. To what does pump capacity refer?
   a. How much water can be pumped in the 1/6 to 1/2 horsepower range
   b. Maximum height to which the pump can lift the water
   c. Total gallons of water that are pumped
   d. The amount of water a pump can move per minute or hour

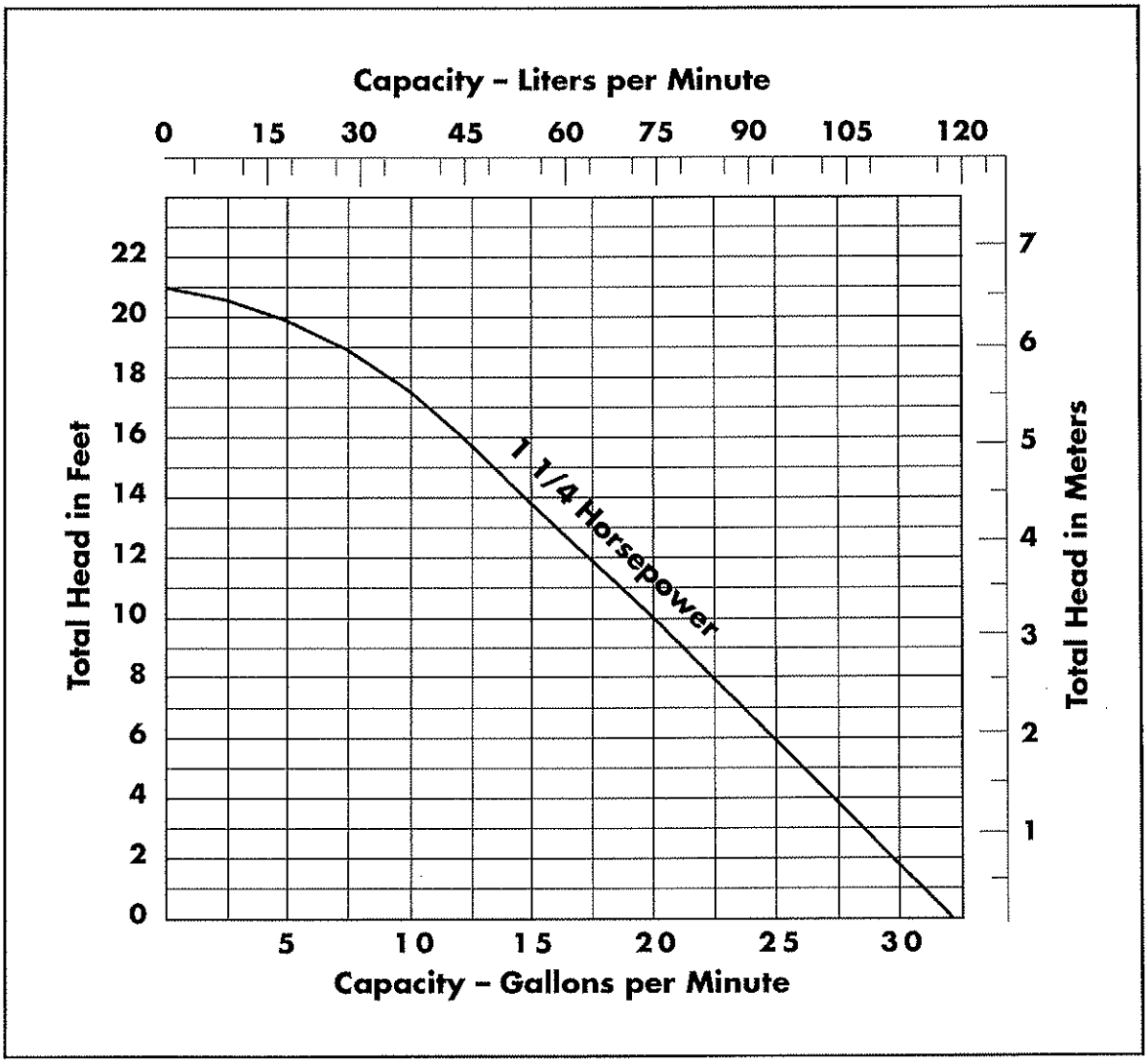
3. What is a good method of estimating sump pump size for a typical single-family residence with seepage problems?
   a. Survey other property owners in the area to determine what has been effective for them.
   b. Calculate the total head needed and figure that a capacity of 15 gpm to 20 gpm will be needed.
   c. Calculate the friction loss for the length of the vertical and horizontal pipe runs plus the valves in the piping system.
   d. Determine the length of the total piping system and consult your manufacturer's catalog for suggestions.

REVIEW QUIZ – PUMP PERFORMANCE

Answers appear on page 66

Use the pump curve below to answer questions 4, 5, and 6.

PUMP PERFORMANCE CURVE



SP 3.3.2g

4. What is the approximate capacity of the pump at 10 feet of head?
   a. 5 gallons per minute (gpm)
   b. 10 gallons per minute (gpm)
   c. 20 gallons per minute (gpm)
   d. 30 gallons per minute (gpm)

REVIEW QUIZ – PUMP PERFORMANCE

Answers appear on page 66

5. What is the approximate capacity at 18 feet of head?
   a. 10 gpm
   b. 15 gpm
   c. 20 gpm
   d. 25 gpm

6. What is the maximum head (feet and meters) for this pump?
   a. 21 feet of head or about 6.5 meters
   b. 18 feet of head or about 5.5 meters
   c. 14 feet of head or about 4.5 meters
   d. 12 feet of head or about 4 meters

7. What is the first rule for effective maintenance of a pump?
   a. The pit should be cleaned out before installation and then on a regular basis.
   b. Read the owner's manual and the manufacturer's instructions.
   c. Do not service the pump while it is running.
   d. The pump should have its own properly-grounded electrical circuit of appropriate voltage.

8. What should be replaced if the pump motor on a submersible pump stops working?
   a. The motor
   b. The shaft
   c. The impeller and motor
   d. The entire pump

9. What is the first problem to consider if the motor won't run?
   a. The motor may be running backwards.
   b. There may be a power supply problem related to household power.
   c. The automatic turn-on switch on the motor may need replacing.
   d. The discharge diameter could be too small.

10. What impeller conditions could cause the pump to run but not pump water?
    a. The total dynamic head may be too great for the capacity of the pump.
    b. The pump may be defective or worn out.
    c. The automatic switch may be faulty.
    d. The shaft that connects the impeller to the motor may be loose.

REVIEW QUIZ – PUMP PERFORMANCE

Answers appear on page 66

11. How might the check valve prevent the pipe from pumping?
    a. The pump inlet could be clogged.
    b. The valve could be installed in the wrong direction.
    c. The automatic switch is faulty.
    d. The float is waterlogged.

12. What happens if the total dynamic head of the installation is too great for the pump that has been installed?
    a. The pump won't pump water out.
    b. The pump will become noisy.
    c. Gravel will be sucked into the impeller.
    d. The power cord may be damaged.

APPLYING WHAT YOU HAVE LEARNED:

By observing and asking questions, fill in the blanks. If you are not sure of the answers, ask your supervisor.

A. What type of pump performance curve does your company use?

_____

_____

_____

B. In what case would you recommend a replacement sump pump for a residential customer?

_____

_____

_____

ANSWERS TO REVIEW QUIZ

CHAPTER 3

PUMP PERFORMANCE

Answers to REVIEW OF PUMP PERFORMANCE (pages 61 – 64)

1. c. The pump meets the SSPMA voluntary standards.
2. d. The amount of water a pump can move per minute or per hour
3. b. Calculate the total head needed and figure that a capacity of 15 gpm to 20 gpm will be needed.
4. c. 20 gallons per minute (gpm)
5. a. 10 gpm
6. a. 21 feet of head or about 6.5 meters
7. b. Read the owner's manual and the manufacturer's instructions.
8. d. The entire pump
9. b. There may be a power supply problem related to household power.
10. d. The shaft that connects the impeller to the motor may be loose.
11. b. The valve could be installed in the wrong direction.
12. a. The pump won't pump water out.

Applying what you have learned:

A. Depends on the company

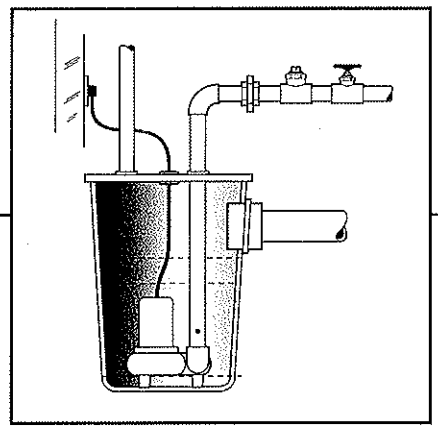
B. Depends on the company

4 SEWAGE AND EFFLUENT PUMPS

LEARNING OBJECTIVES

When you finish this Chapter, you will be able to:

1. Generalize about the uses of residential sump pumps.
2. Summarize how municipal sanitary systems typically treat waste.
3. Explain the factors on which sewage pumps are performance-rated.
4. Given the pipe size and minimum gpm, calculate the capacity a pump would have to put out to provide the recommended velocity.



SEWAGE SYSTEM PUMPS

Sewage Pumps

As you have read throughout this course, sewage systems have two types of pumps:

- sewage pumps
- effluent pumps

The Sump and Sewage Pump Manufacturers Association (SSPMA) defines a **SEWAGE PUMP** as "A pump powered by an electric motor for the removal of wastewater containing solids of up to 2" diameter."

The word "effluent" means an "outflowing of water from a natural body of water, or from a man-made structure." Generally, when the effluent is man-made, such as the outflow from a sewage treatment facility, it is considered to be pollution. An **EFFLUENT PUMP** moves septic effluent out of a septic treatment tank into an absorption system (or other effluent treatment system) for further treatment and ultimate disposal or discharge to the environment.

Uses for Sewage Pumps

There are several uses for sewage pumps, depending upon the kind of sanitary system being used.

For example, a home in a city or town may be hooked into the municipal sanitary system. However, if there is a toilet and/or bath in the basement of the house, a sewage pump may be needed to move the wastewater and the sewage solids **UP TO** the level of the municipal sanitary line, which depends upon gravity flow.

The pipes from each house flow to a sewer main that typically runs down the middle of the street. The sewer mains flow into progressively larger pipes until they reach the wastewater treatment plant which is usually located in a low-lying area. When gravity cannot do all the work because of higher ground, the sewer system will include a grinder pump or a lift station to move the wastewater up over a hill.

Grinder Pumps

Municipal sewage systems generally work on a gravity flow basis, with the sanitary lines under the streets are laid in such a way that the sewage can flow gradually downhill into the treatment plant.

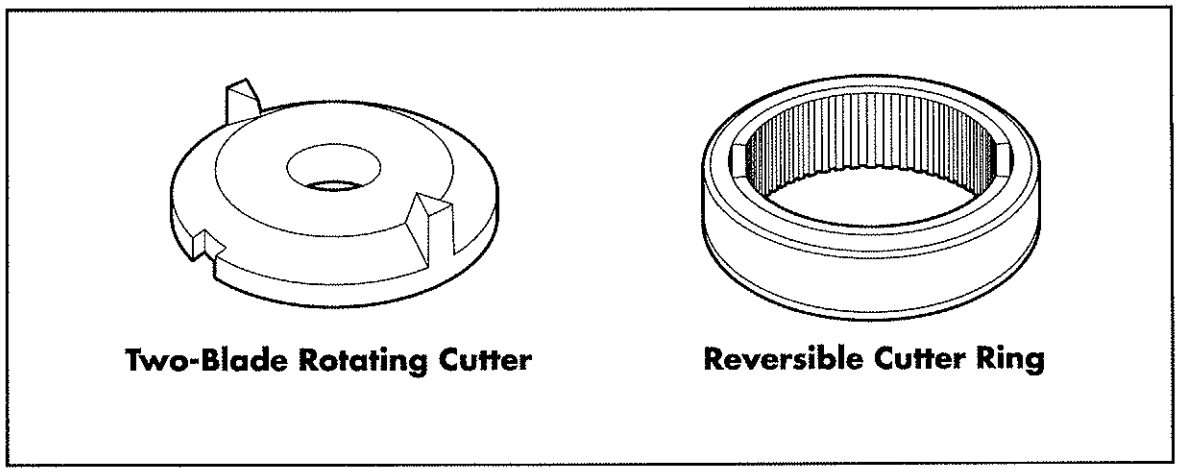
If, however, the town is built on hilly terrain so that some of the sewer lines must run uphill all or part of the way to the treatment plant, the sanitary piping system may have to be pressurized in order to move the sewage along to the treatment plant.

If the municipal sewer system is pressurized, smaller sewer pipe may have to be used to help maintain the pressure as the pipes run up and down the hills to the plant. Individual homes or businesses attached to such a pressurized sewer system may have to have grinder pumps instead of standard sewage pumps to pump the sewage into the lines.

A **GRINDER PUMP** has a cutter assembly which grinds the sewage solids into smaller pieces. This is necessary so that the solids will not clog up the smaller pipes on the sewer lines.

The cutter assembly is consists of a cutter ring, usually reversible, and a cutter with two blades, which rotates inside the cutter ring as the sewage is pumped through. Grinder pumps are usually designed to operate effectively at very high head pressures, up to 100 feet or more, as needed for the pressurized sewer systems.

CUTTER ASSEMBLY



Two-Blade Rotating Cutter **Reversible Cutter Ring**

SP 3.4.01

Private Sanitary Systems

In a private sanitary system, the sewage pump pumps all the sewage into the septic tank. In the septic tank, natural biochemical processes break down some of the sewage solids into liquids and gasses.

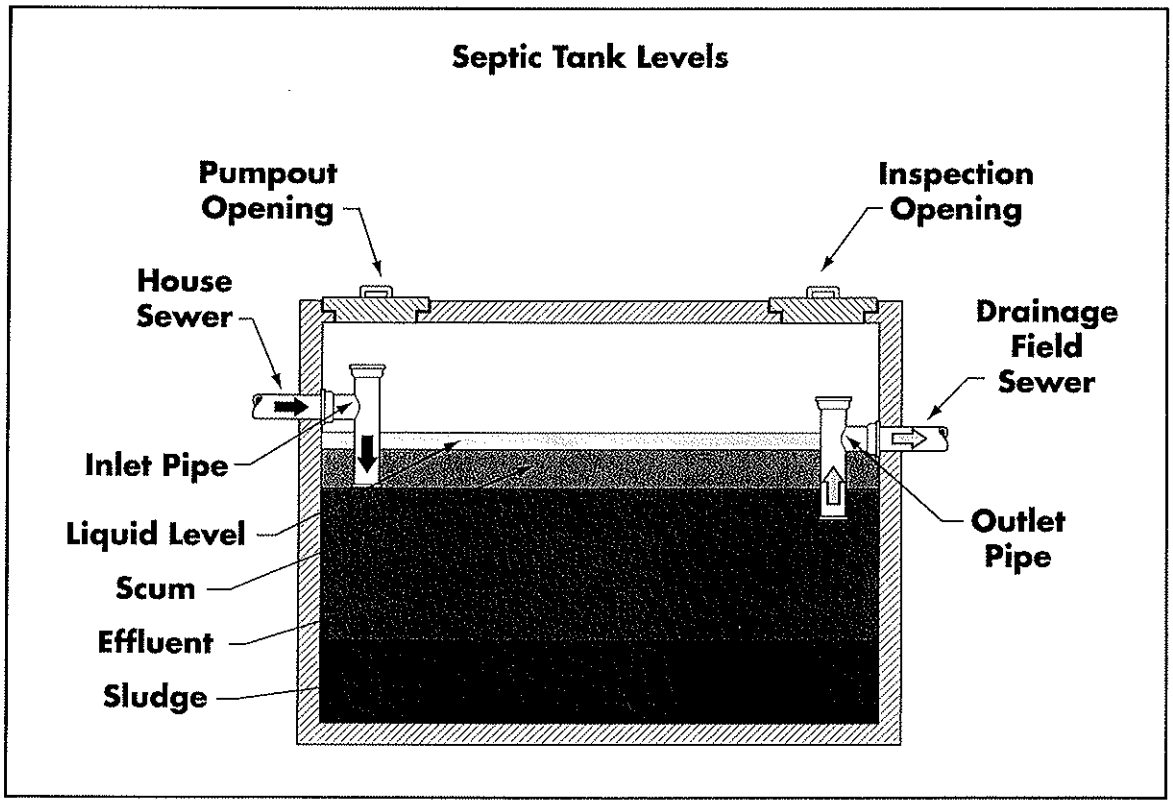
As a result of these biochemical changes, three levels of sewage are found in a septic tank. At the bottom of the tank is the residue of the solids which have not been converted into liquid or gas. This residue is called **SLUDGE**.

At the top of the tank is a layer of oily substances, which are lighter than water and therefore float. This layer is called **SCUM**.

The scum and the sludge must be cleaned out of the septic tank on a regular basis, possibly every two or three years. This is done by professionals who pump the sludge/scum out of the septic tank (into portable holding tanks commonly called "honey wagons") and then dispose of it properly according to regulations.

In between the scum and the sludge is a dirty liquid called effluent. The effluent makes up most of the material held in a septic tank.

SEPTIC TANK



SP 3.4.02

This effluent is piped out of the tank and through perforated pipe into the drainage field, also called the **LEACH FIELD**, where it finally percolates through soil or sand and is purified. Then the effluent seeps down into the water-bearing aquifer below.

Effluent Pumps

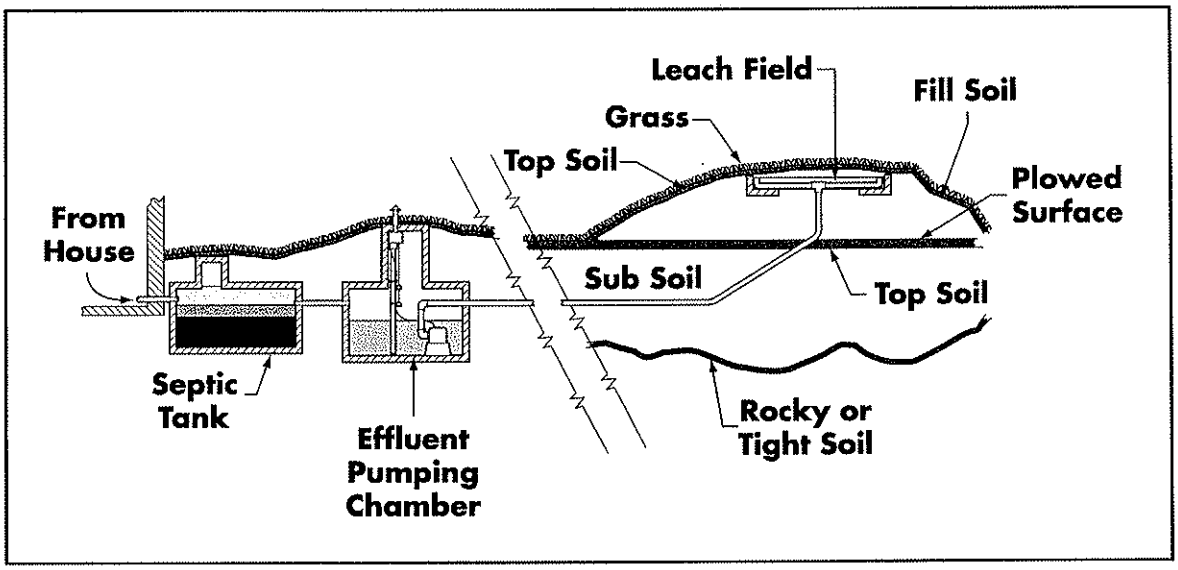
If the leach field is at a higher altitude than the septic tank, or if there is concern that the effluent may not be evenly distributed throughout the leach field by gravity alone, an effluent pump may be used to pump the effluent out of the septic tank and into the perforated pipe in the drainage field.

SSPMA defines an **EFFLUENT PUMP** as "A pump powered by an electric motor for the removal of natural or artificial pretreated liquid waste discharge from an onsite sewage disposal system." While effluent pumps are not designed to handle large solids, most can handle very small solids, up to 3/4 inch in diameter.

If an effluent pump is used, it may be enclosed within a pit or basin which is actually within the septic tank itself, placed at the proper level to allow just the gray water to enter the effluent pit. Then the effluent pump moves the effluent liquid out through the septic outlet into the drainage pipe.

Or the effluent pit may be located outside the septic tank as an alternative placement.

MOUND-TYPE SEPTIC SYSTEM



SP 3.4.03

Rating the Performance of a Sewage Pump

Sewage pumps are performance-rated on the same three factors as sump pumps plus a fourth factor. These factors are:

1. Capacity
2. Head
3. Horsepower

   plus

4. Solids-handling capabilities

Solids-handling capability is also of major importance in sewage pump performance.

Sewage Pumps Must Handle Sewage Solids

Almost all of what was previously discussed in this course about sump pump operations also applies to sewage pumps.

However, there are several differences between sump pump systems and sewage pump systems. In the next few pages, we will note some differences between the two.

The most important difference is that sewage pumps must handle sewage solids.

By SSPMA definition, a sewage pump is expected to be able to handle sewage solids up to 2 inches in diameter. Some pumps will handle larger solids; some may have smaller size limits.

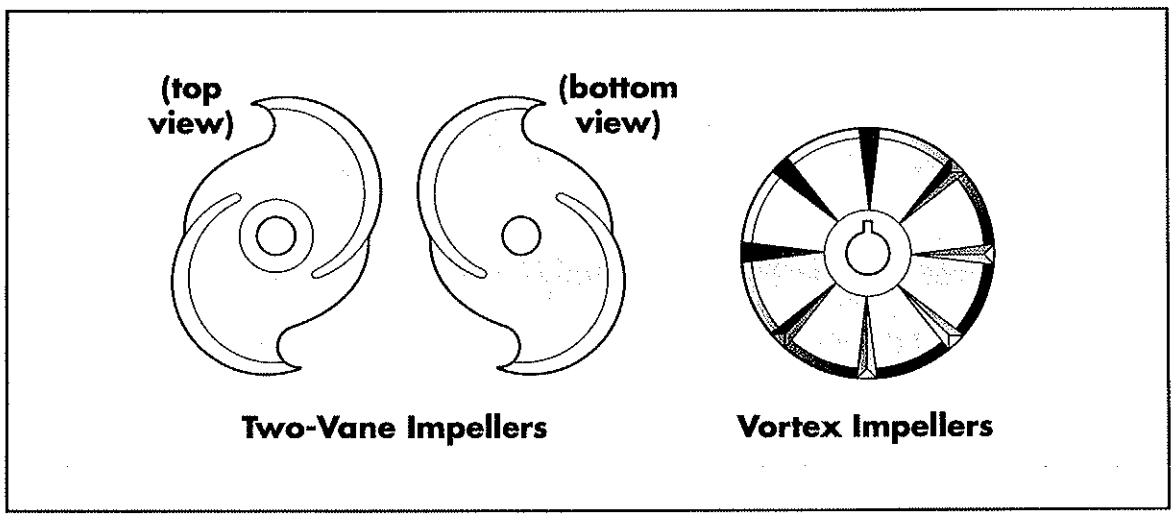
The pump specifications will tell the solids-handling capabilities of a particular pump. Generally, a pump handling 2 inch solids should provide satisfactory service for most residential uses.

Sewage Pump Impellers

Because of the solids handling and possible clogging problems, sewage pump impellers may have *vanes*, flat blades mounted as part of a set in a circle so as to rotate under the action of liquid, that are farther apart and/or fewer in number than the vanes of the sump pumps.

Other pumps have **VORTEX IMPELLERS** which are recessed and generally do not come in contact with the solids at all. The impeller creates a sort of whirlpool of water (vortex) which moves the liquids and solids along and into the discharge outlet.

SEWERAGE PUMP IMPELLERS



SP 3.4.04

Sufficient Velocity Keeps the Discharge Piping Clog-Free

It is important to be sure that the sewage pump you choose and the discharge piping you install are capable of allowing the fluid plus-solids to move through at sufficient velocity to keep the discharge piping from clogging up.

When designing a sewage pumping system the velocity should be between two and five feet per second. Below two feet per second, solids can drop out and cause a clog. After five feet per second, water hammer could damage the system.

The velocity depends upon the output capacity (in gpm or gph) of the pump and the size of the discharge piping. Your manufacturer will provide you with needed information about necessary velocity. Below is a sample velocity chart.

Minimum Flow to Maintain Recommended Velocity of 2 Feet per Second in Various Pipes	
Pipe Size (inches)	Minimum gpm
1-1/4	9
1-1/2	13
2	21
3	46
4	80

SP 3.4.1t

Additional Differences Between Sewage and Sump Pumps

There are several other ways in which sewage pumps differ from sump pumps. Another difference between sump pump systems has to do with the basin the pump is placed in.

Because of the sewage and the toxic gases that build up inside, the sewage basin must be vented to the outside of the building, either by connection to the main vent stack or by having a vent directly to outside. Also, the seals around the inlet and outlet must be airtight, and the basin cover must be airtight.

Chemically speaking, sewage liquid is very aggressive and corrosive in nature, so many of the metal parts of sewage pumps are made of cast iron and stainless steel and other parts are made of other corrosion-resistant materials.

Sizing of sewage pumps is somewhat more complex than sizing of sump pumps. There are several approaches to use when sizing sewage pumps.

Your manufacturer may have a rule-of-thumb method for calculating the required capacity of a sewage pump. Be sure to ask your manufacturer about such sizing procedures.

One common rule is that any pump that can produce 32 gpm, meet the required head requirements, and handle 2-inch solids should be able to serve most residential needs.

Another general rule for residential sewage pumps is that a one-bathroom house requires a 20 gpm pump, and 30 gpm pump is needed for a two-bathroom house.

Of course, the pump must also meet head requirements of the particular installation.

Pump Sizing Methods

The Sump and Sewage Pump Manufacturers Association (SSPMA) also has inexpensive materials available on sizing, installation and maintenance of sewage pumps.

The next few pages show the SSPMA recommended method of sizing pumps. Because the same household appliances and fixtures are served by the sewage system as are served by the water distribution system, the methods of calculating needed flow are similar.

The needed flow (pump capacity) depends upon the number and kind of plumbing fixtures and appliances in the house or building.

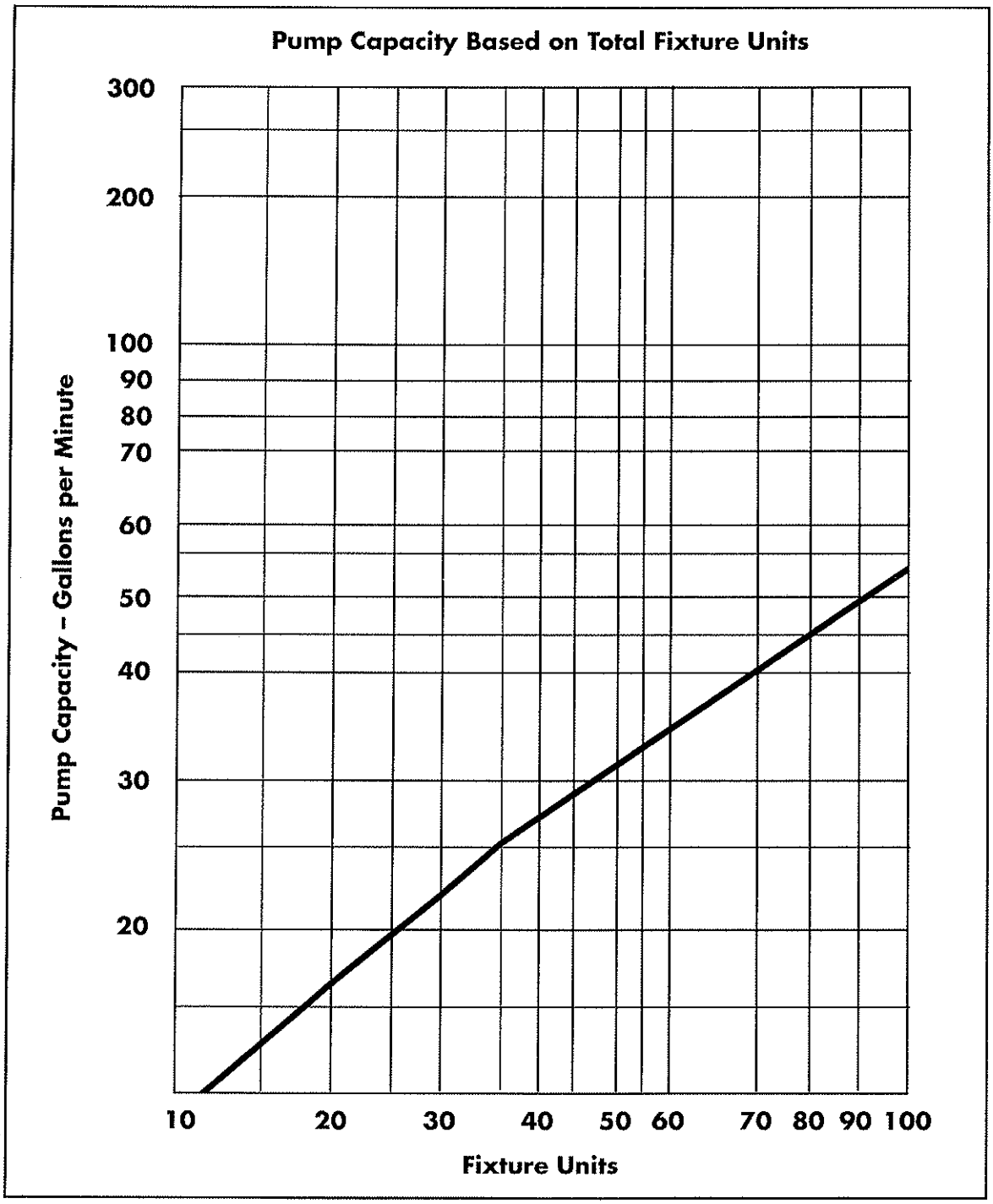
Each fixture is given a **FIXTURE UNIT VALUE** for use in calculations.

Fixture / Appliance	Fixture Unit Value
Kitchen sink	2
Kitchen sink with disposal	3
Dishwasher	2
Lavatory (1-1/2" trap)	1
Bathtub (1-1/2" trap)	2
Bathtub (2" trap)	3
Shower	2
Water Closet	3
Bathroom group (lavatory, bath or shower, water closet)	6
Laundry Tray	2
Washing machine	2
Water softener	4
Swimming pool (per 1000 gallons)	1

SP 3.4.2f

For example, a house with one bathroom group, a powder room with a water closet and a lavatory, plus a kitchen sink with disposal, and a washing machine would have 15 fixture units. After you have the fixture unit count, you can locate the needed pump capacity on the graph below.

PUMP CAPACITY GRAPH



SP 3.4.2g

Notice that according to the graph, only about 6 gpm would be needed to service the 15 fixture-unit house mentioned previously.

What capacity, according to the graph, may be needed for a household with two full bathrooms, a kitchen sink with disposal, a dishwasher, a washing machine, a laundry tray, and a water softener?

The household would have 25 fixture units. For 25 fixture units, a pump with a minimum of about 18 gpm capacity is indicated on the graph.

If you remember the two manufacturers' rules of thumb (32 gpm pump for all residences or a 30 gpm pump for two bathrooms), the capacity on the graph is considerably below the rule-of-thumb figures given.

Manufacturers' suggestions are given to help prevent under-sizing of sewage pumps and to cover most residential applications for standard residential planning.

Check with your **OWN** manufacturer to see what the suggested typical rule-of-thumb is for sewage pump capacity—and use it.

However, if you are sizing for larger commercial or industrial uses or unusual situations, you might use the fixture-unit method.

Choosing the Right Pump

As with sump pumps (or any other pump), the total dynamic head against which the pump must pump must be calculated as part of the sizing of the pump.

Head for sewage pumps is calculated the same way as for sump pumps. Total head will include both static head (height, in feet or meters, from the minimum water level in the basin to the highest point in the total discharge piping run) plus the friction head from the pipe, fittings, and valves.

Remember that the highest point for calculating static head may not be in the vertical pipe run but may actually be in the horizontal pipe run to the drainage connection. The minimum water level in the basin will generally be the set shut-off point for the pump.

Once you know the capacity needed, the total head required, and the solids handling capabilities, you are ready to choose the pump.

PRODUCT CAPABILITIES

Capacities to	95 gpm	360 lpm
Heads to	18 feet 19 feet shutoff	5.5 m 5.8 m
Pumps Down Range Float Switch	9-10 inches	228-254 mm
Solids Handling	2 inches	50.8 mm
Liquids Handling	Raw sewage, effluent, drain water	
Intermittent Liquid Temperature	Up to 140 F	Up to 60 C
Motor	1/2 hp shaded pole, 1625 rpm	
Electrical	115 volts, 12 amps, 1 ph, 60 Hz	
Acceptable pH Range	6-9	
Discharge, NPT	2 inches	50.8 mm
Minimum Sump Diameter Simplex	18 inches Duplex	457 mm 30 inches 762 mm

SP 3.4.3t

Simplex and Duplex Systems

A home or residence may use only one sewage pump. A sewage pump system with a single pump is called a **SIMPLEX SYSTEM**.

A commercial or industrial building may want to use two pumps and program the controls so that the pumping is divided between the two. The first one will pump for awhile, then it will switch off and the other pump will kick on. The two-pump system is called a **DUPLEX SYSTEM**.

A duplex system eases the workload for both pumps and provides a backup system in case one pump fails. If a pump fails to kick on when its turn to pump comes, the other pump will continue to pump but an alarm will be activated to notify the owner that one pump is not working. The alarm will continue until it is shut off or something is done, to correct the situation, such as installing a new pump, to correct the situation pump.

Both pumps in a duplex system are placed in the same basin.

On the product chart below, note that two different basin sizes are indicated: the smaller size for a simplex system, the larger size for a duplex system.

PRODUCT CAPABILITIES

Capacities to	135 gpm	510 lpm
Heads to	27 feet	8.23 m
Maximum Spherical Solids	2 inches	50.6 mm
Liquids Handling	Domestic sewage and drain water	
Intermittent Liquid Temperature	1/2 hp, 1625 rpm PSC (1 Ph), oil-filled 115 volts, 9.0 amps, 1 ph. 60 Hz 230 volts, 4.5 amps, 1 ph, Hz	
Third Party Approvals	CSA	
Acceptable pH Range	5-9	
Specific Gravity	.9-1, 1	
Viscosity	28-35 SSU	
Discharge, NPT	2 inches	50.8 mm
Minimum Sump Diameter Simplex Duplex	24 inches 36 inches	61 cm 91.4 cm

SP 3.4.4t

Sizing Up the Sewage Basin

Once you have determined the size sewage pump you need, your manufacturer's literature will probably indicate which sewage basin is suggested or at least what size basin you need. A solid cover may be used where pipes discharge underground.

Generally, it is recommended that basins not be less than 18 inches in diameter and 24 inches deep.

Duplex systems will require larger basins, with enough room for the two pumps to be separated and for the controls on both pumps to hang freely as needed.

To the right is a table with general basin size ranges given.

Sewage Basin Sizing	
Pump Capacity	Minimum Diameter
Up to 35 gpm	18 inches
35 to 60 gpm	24 inches
60 to 100 gpm	36 inches
100 to 150 gpm	48 inches

SP 3.4.5t

Choosing the Appropriate Basin Cover

The basin cover must be chosen to fit either a simplex or a duplex system, since the duplex cover will have two openings for the two discharge pipes, one from each pump.

Any basin cover will have a connection for venting, which must be according to local codes.

Choosing the Appropriate Discharge Piping

The discharge piping must not be less in diameter than the discharge outlet of the pump and must be large enough for the size of the solids to be handled.

The discharge piping may be larger than the pump discharge, but for maximum performance, there are minimum pump capacities recommended as indicated in the table on the right.

Discharge Piping Flow Minimums	
Pipe Size	Minimum Flow
2 inches	21 gpm
2-1/2 inches	30 gpm
3 inches	30 gpm

SP 3.4.6t

Unions, Check Valves, and Shut-off Valves

A union should be installed on the discharge pipe above the basin cover to make it easy to remove a pump if necessary. It is recommended that a check valve be installed after the union to prevent backflow after the pumping cycle (check local codes).

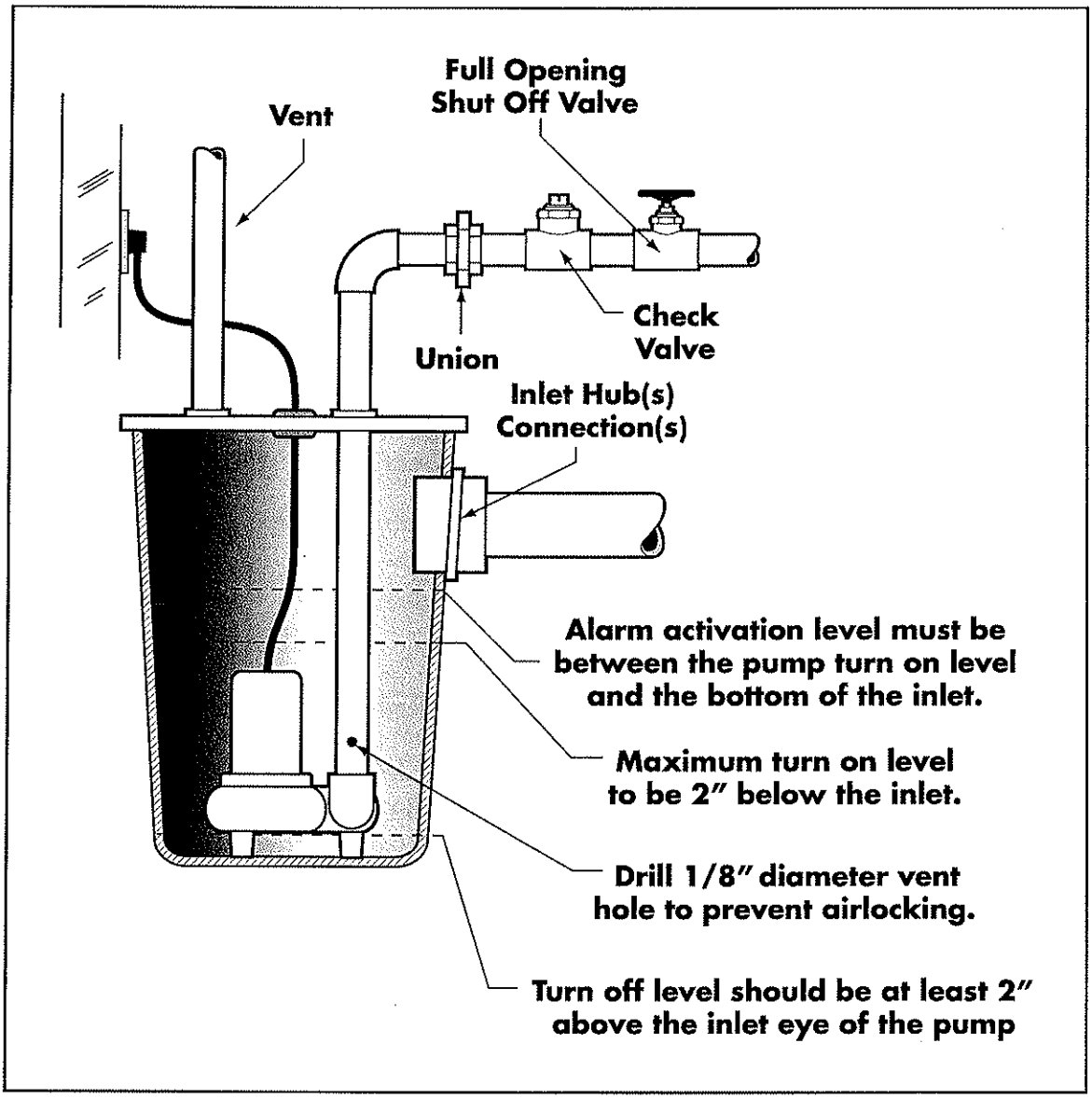
A shut-off valve following the check valve is recommended-so the check valve can be taken out for cleaning or the pump can be taken out for inspection, repair, or replacement.

If local codes allow, a portion of the piping could be flexible hose, which would help eliminate noise from vibration.

Sewage Pump Installation

Below is a drawing of a typical sewage pump installation. Notice that there needs to be a small air relief hole drilled in the discharge piping right above the discharge outlet of the pump in order to prevent airlocking.

TYPICAL SEWERAGE PUMP



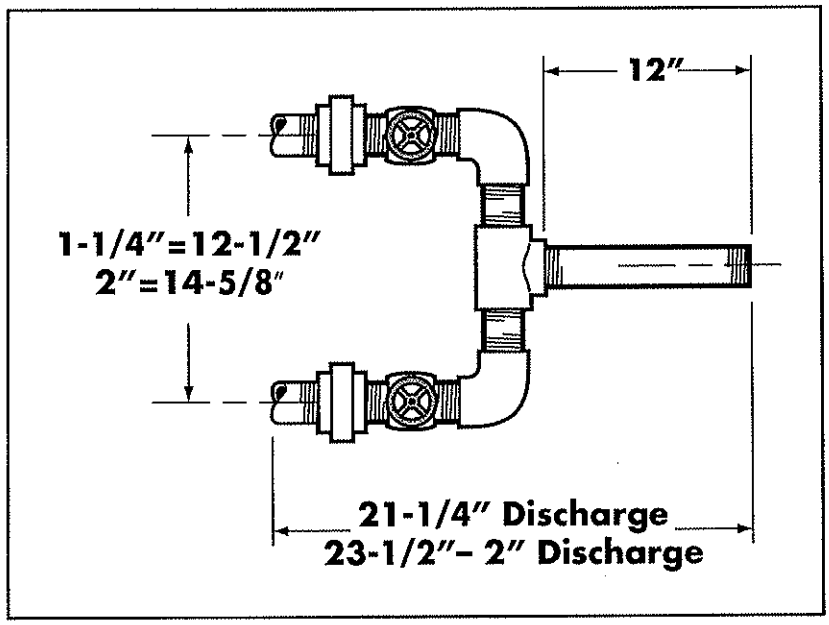
SP 3.4.05

Duplex System

Remember that in a duplex system, unlike sump pump installations, the second sewage pump is not a backup pump. In a sewage pump system, both pumps should be cycled to run equal amounts of time in a given time period and each pump must handle the full load in turn. Therefore, both pumps and both discharge pipes must be sized to handle the whole load.

Each pump has its own discharge pipe, but the two pipes are then teed into a single system discharge pipe.

DUPLEX DISCHARGE PIPING



SP 3.4.06

Power Supply System Must Match Power Supply Needs

Sewage pumps are offered in a variety of motor sizes. Motors may require 115v, 230v, or even 460v current, depending upon the power needed for the particular installation and pump capacity. The power supply available **MUST** match the power supply needs indicated on the nameplate of the pump and in the manufacturer's literature and specifications. A separate, properly grounded circuit must be provided for the pump system.

Pump System Accessories

Some pump motors, especially those that run on three-phase electrical systems, may require separate overload protection devices called **HEATERS**. Check your manufacturer's literature to see which of your pumps require heaters.

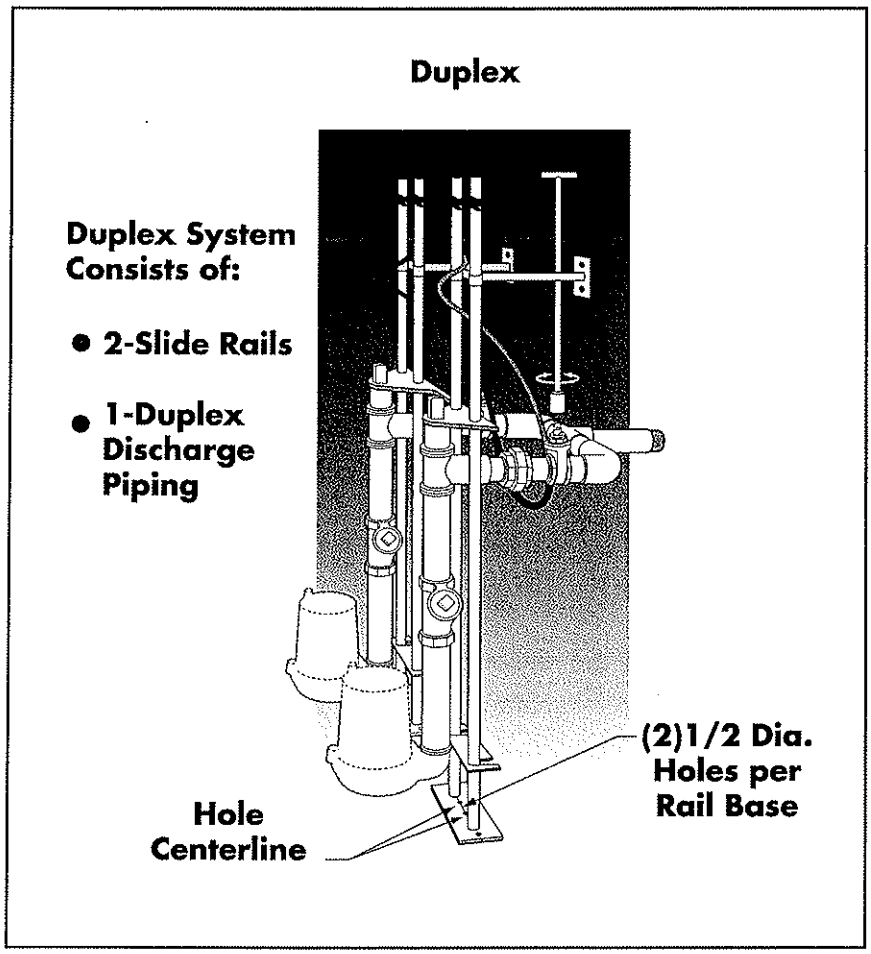
In addition, a pump or pump system may use alarms (either visual or sound), various control panels or control boxes, and other electrical accessories such as pump cycle timing devices or lightning arrestors. Your manufacturer's literature and your manufacturer's sales representatives can provide you with more information about such accessories.

Slide Rail (Lift-out Rail) Systems

The housings for sewage pumps are generally made of cast iron. This means that the pumps, especially larger ones, are heavy.

To make it easier to lift a pump from the basin and to make it unnecessary for a person to get down into the pit, a **SLIDE RAIL** (or *lift-out rail*) **SYSTEM** is sometimes used to lift the pump out. The pump is attached to one or more brackets or plates which slide up and down on a pair of guide rails, with a lifting cable attached for raising or lowering the pump. The whole slide rail system is inside the basin, attached for stability and support to the basin side.

SLIDE RAIL SYSTEM



SP 3.4.07

Slide rail systems are available for simplex and duplex systems.

Effluent Pumps are Sized the Same as Sewage Pumps

As previously discussed, effluent pumps are used for pumping the effluent liquid from septic tanks out to the leach field.

They are also used for other applications such as heavy duty sump pumping (especially if there are small solids), dewatering when the water to be removed is not contained in a basin, water transfer, or other uses around the home, business, or farm.

Effluent pumps are sized on the same basis as sewage pumps: total head, pump capacity, and solids-handling capabilities. Effluent pumps are designed to handle solids much smaller than a sewage pump—typically in the 3/4 inch range.

Troubleshooting Sewage and Effluent Pumps

Most of the troubleshooting tips given for sump pumps apply to sewage and effluent pumps. So refer back to those tips.

However, one particular problem with sewage pumps is that sewage pumps may run continuously or too often because of a problem with leaky plumbing fixtures or other leaking outlets.

Your manufacturer may provide training about troubleshooting or repair of pumps. Read manufacturers' literature and ask questions.

Knowledge is the Edge

Your customers are the reason you need to understand the products you sell. Your knowledge may be the main competitive edge that your company has over competitors.

REVIEW QUIZ – SEWAGE AND EFFLUENT PUMPS

Answers appear on page 92

DIRECTIONS: Carefully read each question and circle the correct answer. There is only one correct answer per question. When you have finished, check your answers.

1. What are two common uses for sewage pumps?
   a. To pump sewage uphill into a municipal sanitary sewer line or to pump sewage into a private septic tank
   b. To pump sewage downhill into a municipal sanitary sewer line or to pump sewage into a private septic tank
   c. To prevent water from seeping into the basement or to remove liquids from a sump
   d. To remove hazardous material of any kind or to pump sewage into a private septic tank

2. Instead of a standard sewage pump, a grinder pump is likely to be when the municipal sewage system
   a. works on a gravity flow basis.
   b. is not pressurized.
   c. is pressurized.
   d. handles only small solids.

3. What is the liquid called that makes up most of the material held in a septic tanks?
   a. Sludge
   b. Scum
   c. Effluent
   d. Leach

4. What is the substance called in a septic tank that has not been converted into a liquid or a gas?
   a. Sludge
   b. Scum
   c. Effluent
   d. Leach

REVIEW QUIZ – SEWAGE AND EFFLUENT PUMPS

Answers appear on page 92

5. Why are effluent pumps used in private sanitary systems?
   a. To break down some of the sewage solids into liquids and gases
   b. To pump the effluent from the septic tank out to the drainage field
   c. To purify the scum before it settles to the bottom of the septic tank
   d. To move the sewage solids to the municipal sanitary line

6. To prevent clogging, sewage pump impellers, unlike sump pump impellers, have
   a. no vanes.
   b. more vanes.
   c. bigger vanes.
   d. fewer vanes.

7. What size sewage pump would typically serve most residential needs?
   a. 12.5 gpm
   b. 20 gpm
   c. 30 gpm
   d. 32 gpm

8. One sizing rule says that a one-bathroom house requires a 20 gpm sewage pump and a two-bathroom house requires a
   a. 20 gpm pump.
   b. 30 gpm pump.
   c. 32 gpm pump.
   d. 35 gpm pump.

9. Using the fixture unit method of sizing a sewage pump, how many fixture units would a house with two bathrooms, a kitchen with a dishwasher and disposal, and a washing machine have?
   a. 6
   b. 10
   c. 15
   d. 19

10. What minimum diameter basin would be needed for a pump with a capacity of 65 gpm?
    a. 36 inches
    b. 24 inches
    c. 18 inches
    d. 12 inches

REVIEW QUIZ – SEWAGE AND EFFLUENT PUMPS

Answers appear on page 92

11. What should be installed on the discharge pipe above the basin cover to make it easier to remove the pump as needed?
    a. Shut-off valve
    b. Check valve
    c. Union
    d. Heater

12. Where should the turn-off level of a typical sewage pipe be set?
    a. at least 2 inches above the inlet
    b. at least 2 inches below the inlet
    c. level with the bottom of the inlet
    d. at the top of the inlet

APPLYING WHAT YOU HAVE LEARNED:

By observing and asking questions, fill in the blanks. If you are not sure of the answers, ask your supervisor.

A. Why should you understand the products you sell?

_____

_____

_____

B. Why could your product knowledge be the main competitive edge over your company's competitors?

_____

_____

_____

ANSWERS TO REVIEW QUIZ

CHAPTER 4

SEWAGE AND EFFLUENT PUMPS

Answers to REVIEW OF SEWAGE AND EFFLUENT PUMPS (pages 87 – 89)

1. a. To pump sewage uphill into a municipal sanitary sewer line or to pump sewage into a private septic tank
2. c. When the municipal sewage system is pressurized
3. c. effluent
4. a. Sludge
5. b. To pump the effluent from the septic tank out to the drainage field
6. d. fewer vanes.
7. d. 32 gpm
8. b. 30 gpm
9. d. 19
10. a. 36 inches
11. c. Union
12. a. At least 2 inches above the inlet of the pump

Applying what you have learned:

A. You need to understand your products to assist your customers.

B. Customers may be able to get the same or similar products from another company. However, dealing with a knowledgeable salesperson or serviceperson usually keeps a customer's loyalty.

THIS COURSE INCLUDES AN ONLINE FINAL EXAM

This course is limited to a single user. When you are ready to take the final exam to earn your Certificate of Completion, please contact ASA at info@asa.net. ASA staff will contact you about how to register for the final exam.

GLOSSARY OF TERMS

Air bleed hole: A very small hole used to prevent a pump from becoming airlocked and therefore unable to pump water. Some pumps have an air bleed hole manufactured into the pump housing. Generally it is recommended that an air bleed hole be drilled into the discharge piping. *Also called an anti-air lock hole or a relief hole.*

Anti-airlock hole: *SEE* Air bleed hole.

Backup sump pump: A pump installed in addition to the primary pump so that the secondary (backup) pump is activated if the water level gets high in the sump basin. Backup sump pumps usually operate on DC current from batteries. Sometimes called *Sometimes called standby or emergency sump pumps.*

Basin: *SEE* Sump.

Capacity: How much water a pump can move, rated in gallons or liters per hour or minute.

Check valve: A valve which prevents liquid from draining back in on direction. In this case, the check valve is placed in the discharge pipe to prevent liquid already pumped from draining back into the sump.

Column: The hollow pipe-like structure which supports the motor for a pedestal pump and houses the drive shaft that connects the motor to the impeller.

Column sump pump: *SEE* Pedestal sump pump.

Crock: *SEE* Sump.

Diaphragm switch: a liquid level sensor switch containing a flexible diaphragm that responds to the pressure of the water as the water level changes. It activates (on or off) a switch within the housing when certain liquid level is reached. Note: the air tube located inside the power cord must remain open for the switch to work.

Discharge outlet: Short female threaded pipe opening molded into one side of the pump volute.

Discharge piping: The pipe and valve system connected to the discharge outlet by which the pumped-out liquid is carried out of the building.

Drain tile: Perforated pipe used to direct drainage into a more desirable area. Drain tile is often used around the outside of a house to direct drainage into the sump.

Duplex system: A pump system in which two pumps alternate, on a regular programmed basis, to pump the sewage.

Effluent: The liquid left in the middle of a septic tank after the scum rises to the top of the tank and the sludge sinks to the bottom. *SEE ALSO* Scum, sludge.

Emergency sump pump: *SEE* Backup sump pump.

Pedestal sump pump: A sump pump which has the motor mounted on a column which sticks up out of the sump and above the basement floor. *Also called a column pump, an upright pump, or sometimes a vertical pump.*

Fixture unit value: An assigned value given to a kitchen, bathroom, or laundry fixture or water using appliance for the purpose of calculating household water flow.

Float: A lighter-than-water device attached to a pump to indicate changes in the water level in order to activate a switch to turn a pump on or off. As used on sump, sewage, or effluent pumps, floats are fluid level sensing devices. *SEE* Float switch.

Float rod: A rod which connects the vertical float of the pedestal pump with the switch attached to the motor on the top of the pump column.

Float switch: A float with a: switch mechanism inside. The switch portion is activated by the rising level of the water.

Fluid level sensing device: *SEE* Float.

Friction head: *SEE* Head.

Grinder pump: A type of high-head sewage pump which has a cutter assembly which grinds the sewage solids into smaller pieces. Usually used if the sewage is being pumped out of the individual building into a pressurized sewer system.

Head: The general term used to mean the maximum height, in feet or meters, that the pump can lift liquid through the discharge piping (called "static head") PLUS the calculated friction loss from all the pipe and fittings (called "friction head"). The more precise term for this combination of static head and friction head is "total dynamic head," but most people simply use the general term, "head."

Heater: An overload protector device use on three-phase pump motors.

Horsepower: In pump specifications, horsepower refers to the horsepower of the motor.

Impeller: The fan-like mechanism which creates suction and discharge in the pump.

Leach field: The loose soil or sand through which the effluent filters ("percolates") and is purified as it seeps down into the aquifer.

Lift-out slide rail: *SEE* Slide rail system.

Pedestal sump pump: A sump pump which has the motor mounted on a column which sticks up out of the sump and above the basement floor. Also called a column pump, an upright pump, or sometimes a vertical pump.

Piggy-back plug: A plug arrangement in which the plug on the end of the power cable from the pump plugs into the back of the plug on the end of the cord from the float switch, which plugs into the wall receptacle. This arrangement allows the pump to be either automatically controlled (if the cable from the float switch is plugged in) or manually controlled (if only the power cord direct from the pump is plugged in.) The combination of the two plugs makes up a piggy-back switch arrangement.

Piggy-back switch: *SEE* Piggy-back plug.

Pit: *SEE* Sump.

Pump performance curve: A graph which shows how much capacity a particular pump model can produce at a specific amount of head.

Receiver: *SEE* Sump.

Scum: The layer of oily substances that rise to the top of the septic tank as the sewage decomposes.

Sewage pump: "A pump powered by an electric motor for the removal of wastewater containing solids of up to 2" diameter." (SSPMA definition).

Simplex system: A pump system which uses only one sewage pump.

Slide rail system: A system by which a sewage pump can be installed or removed using guide rails, without a person having to get into the pit. Also called a lift-out rail system.

Sludge: The solid sewage residue that is not converted into liquid or gas and sinks to the bottom of the septic tank.

Standby pump: *SEE* Backup pump.

Static Head: *SEE* Head.

Submersible sump pump: A sump pump which has a motor that is enclosed within a water-tight housing. Both the pump and the motor are installed in the sump pit.

Sump: (1)"a pit for draining, collecting or storing liquids; cistern, reservoir, cesspool, etc." (*Webster's New World Dictionary of the American Language*): (2) the receptacle or container in which a sump pump, sewage pump, or effluent pump is placed. Also called a pit, crock, basin, receiver.

Sump and Sewage Pump Manufacturers Association (SSPMA): The association of manufacturers who make sump, sewage, and effluent pumps. SSPMA sets voluntary standards for these pumps. SSPMA can be contacted at P.O. Box 647, Northbrook, IL 60065, Phone 847 559-9233.

Sump pump: A pump designed to remove clear water from a container (sump or pit), usually used for removing drainage or rainwater see page from basements or crawl spaces.

Switch cycle: The difference, usually in inches, between the setting for pump turn-on and pump turn-off. If the pump turns on at 12 inches of water in the sump and turns off at three inches of water in the sump, the pump has a nine inch-switch cycle.

Total Dynamic Head: *SEE* Head.

Upright sump pump: *SEE* Pedestal sump pump.

Vertical float switch: A float switch arrangement in which the float hangs vertically, parallel to the pump and perpendicular to the floor of the basin, and is attached to a guide rod that activates the switch.

Vertical sump pump: *SEE* Pedestal sump pump.

Volute: The round chamber which houses the impeller and directs the discharged water.

Vortex impeller: A type of recessed impeller, used to creates a whirlpool effect ("vortex") in the pumped liquid. The vortex develops the suction and head required for umping. The pumped water ("pumpage") is not required to travel through the vane of the impeller.

Wetted parts: Parts of a pump which will be underwater much of the time when the pump is operating.

Wide-angle float switch: A float switch which is attached to a relatively long cord so that the float will float out at a wide on/off angle (90° or greater) to the pump as the water level changes.

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Specialty Products

Sump, Sewage, and Effluent Pumps©

Sump, Sewage, and Effluent Pumps© provides new warehouse, counter, and sales personnel with an overview of the operation and components of common types of sump, sewage, and effluent pumps. The course will help employees serve their customers more effectively when they come to purchase sump, sewage, or effluent pumps.

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