# How to Convert HVAC Tons to Amps

In the heating, ventilation and air conditioning (HVAC) industry, tons are used as a way to measure an air conditioner's cooling capacity. In particular, one HVAC ton is equivalent to 12,000 BTUs per hour. One BTU refers to the amount of heat required to raise the temperature of 1 lb. of water by 1 degree Fahrenheit. To convert tons to amps, you must first convert tons to BTUs per hour, after which you can convert this value to watts, then use the formula amps = watts / volts to solve for amps.

## Instructions

1. Convert tons to BTUs per hour by multiplying it by 12,000. Given an air conditioner with 2 tons of cooling power, for instance, multiply two by 12,000 to get 24,000 BTUs / hour.
2. Multiply BTUs / hour by .293 to convert it to watts. Given the example, multiply 24,000 by .293 to obtain 7032 watts.
3. Divide watts by the given voltage value. Air conditioners in the United States operate on 120 volts, so given the example, divide 7032 watts by 120 volts to obtain a final answer of 58.6 amps.

# How to Calculate BTU Hours to KW

BTU stands for a British thermal unit, which is the amount of energy required to raise one pound of water one degree Fahrenheit. BTUs per hour is a unit used to measure energy use, particularly in air conditioning and heating measurements. You can convert to BTU/hour from other units of energy such as watts, horsepower and tons. Accurately converting can help you determine how much energy your devices use in order to determine your energy bill.

## Instructions

1. Divide the number of watts by 0.2929 to convert to BTU/hour. For example, if you had 20 watts, you would divide 20 by 0.2929 to get 68.28 BTU/hour.
2. Divide the number of kilowatts by 0.0002929 to convert to BTU/h. For example, if you had 5 kW, you would divide 5 by 0.0002929 to get 17,070.67 BTU/hour.
3. Divide the number of horsepower by 0.0003928 to convert to BTU/hour. If you had 40 HP, you would divide 40 by 0.0003928 to get 101,832.99 BTU/hour.
4. Divide the number of tons by 0.00008333 to convert to BTU/hour. For example, if you had one ton, you would divide 1 by 0.00008333 to get 12,000 BTU/hour.

# How to Calculate BTU Requirement

BTU stands for "British Thermal Unit." It is a measurement of heat, and each individual unit represents the amount of heat required to raise 1 lb. of water 1 degree F. Each BTU is equivalent to roughly 252 calories of energy. Calculating BTU requirements is essential for determining the cost of many different types of energy consumption, the most prominent of these being home heating costs.

## Instructions

1. Determine the size of the area that requires the BTUs of energy. The area should be measured in feet, with the length, width and height all being determined seperately.
2. Determine the temperature at which the area will need to be kept. This temperature can be expressed in degrees Fahrenheit or Celsius.
3. Determine the lowest temperature that will be surrounding the area. This will most likely be the outside temperature.
4. Go to the BTU calculator found in the resources section of this article.
5. Select either "Fahrenheit" or "Celsius" from the options provided on the top of the Web page.

6. Enter the data gathered from Steps 1 through 3 into the appropriate fields on the Web page. Click "calculate."

## How to Calculate BTU for Heat

Metals take less energy to heat than water does.

The British thermal unit (Btu) is the heat needed to raise the temperature of a pound of water by a Fahrenheit degree. Other substances, however, absorb heat at different rates, with each having their own specific heat capacity. You can use Btus to calculate their heat requirements as well, but you must take into account their heat capacities and masses.

### Instructions

1. Subtract the substance's current temperature from the temperature you want it to reach. If, for instance, the substance is currently at 22 degrees Celsius, and you want to heat it to 31 degrees Celsius: 31 - 22 = 9 degrees.
2. Multiply this temperature rise by the substance's specific heat capacity. For a list of specific heat capacities, see the first link in "Resources." If, for instance, you are heating copper, which has a heat capacity of 0.386: 9 x 0.386 = 3.474.
3. Multiply the answer by the substance's weight, measured in grams. If it weighs, for instance, 1,500 grams: 3.474 x 1,500 = 5,211. This is the heat requirement, measured in joules.
4. Divide this answer by 1,055, the number of joules in a Btu: 5,211 ÷ 1,055 = 4.94, or approximately 5. The substance needs 5 Btus for you to heat it to 31 degrees.

## BTU Load Calculation

Knowing how powerful an air conditioner or furnace you need is one of the most important factors when shopping for a new HVAC -- heating, ventilation and air conditioning -- system. The BTU load, or temperature-change requirements, of your living space must be taken into account for effective air conditioning or heating. Without this knowledge, any such appliance you purchase is likely to be either insufficient or inefficient.

### BTU Loads

A living area's BTU load is the number of BTUs required to heat or cool it. BTU is the usual abbreviation for British thermal unit, a unit of heat energy used to measure the heating and cooling capabilities of air conditioners and furnaces. An appliance that closely matches your BTU load will provide the best service.

### Why Load Calculation is Important

Knowing your home or office's BTU load is a must when purchasing a new heater or air conditioner. An appliance with a rating much below the load level would have a hard time keeping the temperatures at ideal levels. An overly powerful air conditioner, however, can have equally detrimental effects, short-cycling by cooling the room too rapidly and then shutting off. This doesn't give the AC time to dehumidify the room properly, leaving too much moisture in the air. A furnace that is too powerful will also burn fuel inefficiently and cause excess pollution.

### Manual Calculation

A living area's BTU load can be roughly calculated using simple mathematical formulae. Multiply the square footage of the room by 31.25 to find the area BTU load. Multiply the square footage of any northward-facing windows by 15.24 and those of other windows by 80.64, multiplying the product of this equation by 1.4 if the windows are unshaded to find the total window BTU load. Multiply the usual number of occupants by 600 to find the occupant BTU load. Finally, multiply the wattage of any office equipment by 3.4 and that of all light

fixtures by 4.25 to find their BTU loads. Add all five numbers to calculate the total BTU load of the room or building.

**Other Means of Calculation**

If math isn't your strong suit, you can just as easily find the BTU load by other means. Consumer Reports provides an online tool that takes even more variables into account than the manual calculation, but automates the actual computation, giving you more accurate results for less work. Other similar websites also exist. For most accurate results, however, hire an air conditioning or heating professional to determine the exact BTU load of your home or office.

## How to Calculate Heating Load

Heat loading involves measuring and evaluating all of the heat sources that contribute to the temperature in a room or office. Many sources apply, including the sun, equipment running, lights and body heat from occupants. For homes, solar radiation from the sun is by far the biggest source as the sun bears down on the roof and walls. To this end, to calculate heat loading, you need to calculate the contribution from each source and add them together. You can then use the information to determine the size and rating of the air conditioning unit you need to cool the room or home.

### Instructions
1. Calculate the Area BTU using the formula: Area BTU = length (ft.) x width (ft.) x 31.25
2. Calculate the heat contribution from the solar heat radiating through windows. For the north facing windows, use the formula: North Window BTU = Area of North facing windows x 164. Find the area of each window by multiplying the length by the width. Add the areas of all north facing windows together and multiply by 164. If the north facing windows have no shading, multiply the final value by 1.4. For the south facing windows use the formula: South Window BTU = Area of South facing windows x 868. Follow the same procedures as with the north facing windows, except multiply the total area by 868 followed by 1.4 if no shading. The Total Window BTU will be the sum of the North Windows BTU and the South Window BTU.
3. Determine the number of occupants that normally occupy the space. Calculate the Occupant BTU using the formula: Occupant BTU = number of occupants x 600
4. Locate all of the equipment and appliances that occupy that space such as computers, printers, appliances, etc. Refer to the manufacturers tags and find the power in watts for each item. Add the power of all items together and multiply by 3.4 for the total Equipment BTU.
5. Find the contribution by the lights in the room or space using the formula: Lighting BTU = total lighting watts x 4.25.
6. Calculate the Total Heat Load BTU using the formula: Total Heat Load BTU = Area BTU + Total Window BTU + Occupant BTU + Equipment BTU + Lighting BTU.

## How to Calculate a Gas Furnace Size

Finding the appropriate size furnace is important. A furnace that is too small won't be able to heat the area effectively, and a furnace that is too large will short-cycle, causing it to turn off and on more often, which will use unnecessary energy and cost you money. There is a fairly simple way to size a gas furnace. Though it is not 100 percent accurate, it will provide a helpful guide for purchasing one.

### Instructions
1. Determine the amount of output BTU (British Thermal Units) you need to heat the area; output BTU is a measure of the amount of heat the furnace produces. As a

general rule, start with about 30 to 35 output BTUs per square foot; however, this can vary depending on climate and how well insulated the area is.

2. Now you need to know how to find the output BTU of a furnace. Generally, furnaces will have a list of product specifications. The trick is that many will list input BTU instead of output BTU to make it seem like they are better than they really are. Luckily, they are also required to list efficiency. So, if a furnace doesn't list its output BTU, locate its efficiency rating and its input BTU.
3. Multiply the furnace's input BTU by its efficiency. For example, if you were looking at a furnace specification list, and its listed efficiency is 85 percent, and its input BTU is 100,000. You would multiply 100,000 by .85 to get 85,000. This is the amount of output BTU the furnace has.
4. Compare the furnace's output BTU to the amount of BTU you need for the area. It is fine to have a difference of 10 to 15 percent, but any more than that and you will either be getting too large a furnace or too small a furnace.

## How to Calculate KW Capacity of a Water Chiller

A chiller's cooling capacity depends on the rate at which it pumps water and the extent to which it reduces the water's temperature. Calculating the machine's capacity also takes into account water's specific heat capacity and other conversion factors, producing the machine's power in British Thermal Units (BTUs) per hour. A further conversion step can convert this value to tons, a common unit of power when describing heating and cooling devices. You can instead convert your result to a more standard unit of power -- the kilowatt.

### Instructions

1. Subtract the temperature of water entering the chiller from that of water leaving it. If water enters the chiller at 63 degrees Fahrenheit and leaves at 49: 63 - 49 = 14 degrees.
2. Multiply the result by the chiller's volumetric flow rate, measured in gallons per minute (gpm). If 230 gallons of water move through the chiller per minute: 14 x 230 = 3,220.
3. Multiply the answer by 500, finding the chiller's capacity in BTUs per hour: 3,220 x 500 = 1,610,000.
4. Divide your answer by 3,412 to convert your answer to kilowatts: 1,610,000 / 3,412 = 472 kW.

## How to Calculate Ton Capacity of Chillers

A chiller uses a refrigeration cycle to cool water. This chilled water then cools a larger area, such as a factory floor. Cooling equipment in this matter increases its efficiency by providing a steady thermal environment. You can derive a chiller's capacity from the temperature drop it creates and the volumetric flow of the water within it. This formula produces the chiller's capacity in British Thermal Units (BTUs). That scale directly corresponds with the more common unit of "tons" that cooling systems often use.

### Instructions

1. Subtract the temperature of water as its leaves the chiller from the temperature of the water as it enters it. If water enters the chiller at 64 degrees Fahrenheit and leaves at 51 degrees Fahrenheit: 64 - 51 = 13 degrees.
2. Multiply the result by your flow rate, which is measured in gallons per minute. If, for instance, the chiller must move 300 gallons per minute: 13 x 300 = 3,900 gallons per minute.
3. Multiply your answer by 500. This converts the volumetric flow rate to a mass flow rate, which is measured in pounds of water per hour. With this example:

3,900 x 500 = 1,950,000. This answer is the chiller's capacity measured in BTUs per hour.

4. Divide your answer by 12,000: 1,950,000 / 12,000 = 162.5. This is the chiller's capacity in tons.

## How to Figure GPM Water Flow on an Existing Chiller

Technicians calculate a chiller's volumetric flow rate similarly to how they find the flow rate in other pump systems. As with other systems, a chiller's flow rate depends on the chiller's pressure and the system's overall efficiency. This pressure is typically measured in terms of total dynamic head, a figure that considers the fluid's static pressure, the pressure the pump adds and pressure losses due to friction.

### Instructions

1. Multiply the fluid's horsepower by 3960. If the chiller works at 25 horsepower: 25 x 3960 = 99,000.
2. Multiply your answer by the pump's efficiency. If the pump works at 80 percent efficiency: 99,000 x 0.80 = 79,200.
3. Divide your answer by the total dynamic head, measured in feet. If the head equals 130 feet: 79,200 / 130 = 609.2. This answer is the chiller's flow rate, measured in gallons per minute.

## How to Calculate Chiller Efficiency

Cold water chillers see widespread application both in industry, commerce and architectural air conditioning. While they are used in predominantly larger venues, their efficiencies are still determined by the simple air conditioning concept of electrical energy-in (kW-hr) to energy-moved (Btu/hr (or Tons). Air conditioners and chillers are both basically heat pump systems, although chillers use recirculating water instead of air to convey heat on both evaporator and condenser aspects of their refrigeration cycles. Properly reconciling the various engineering units and conversion factors is vital to the efficiency calculation process. Have a question? Get an answer from an Appliance Repair Specialist now!

### Instructions
1.      **Water Chiller for Cool Room Space**



1. Define the water chiller application. In this instance, a chilled water system is used to keep food manufacturing areas near 40 degrees F. The chiller system is recirculating 40 gallons per minute of water that is chilled by 24 degrees F and using 24.8 kW/hr of electricity to produce the refrigeration. With this information you can calculate chiller efficiency in terms of the energy efficiency ratio, or EER, and the coefficient of performance, or COP, for chillers.

2. Calculate the chiller capacity in tons of refrigeration. The formula for total heat removed in a chiller installation is h = 500 X q X dt where h = total heat removed in Btu/hr, q is the chilled water flow rate in gpm, and dt is the chilled water's total temperature differential. Substituting, h = 500 X 40 gpm X 24

deg-F = 480,000 Btu/hr. If 1 Ton of refrigeration equals 12,000 Btu/hr, then the system has a cooling capacity of 40 Tons of refrigeration.

3. Calculate the system efficiency by the air conditioning efficiency formula EER = Btu/hr cooling/watts consumed. Substituting actual values, 480,000 Btu/hr/24.8 kW/hr = 480,000 Btu/hr/24,800 watts/hr = 19.35. This is very high cooling performance compared to the 2010 SEER standards of 13-14 for domestic air conditioning which reflects the higher efficiency of the chilled water strategy. COP would be the EER (19.35) X 0.293 = 5.67.

**2.**     **Chilled Water For Food Refrigeration**

1. Define the chilled water application. Seawater with a specific enthalpy of 0.94-Btu/lb/deg F is being chilled by 18-degrees F to keep seafood alive and fresh. If you know that the system uses 69.06 kW-hr to chill 6,000-gallons/hr of this recirculating seawater, you can calculate the chiller efficiency.

2. Calculate the total Btu/hr being removed by the chiller system. Since h = 500 X q X dt, and the heat capacity of seawater is only 0.94 Btu/lb, then the modified formula will be h = 500 X q X dt X 0.94 = 500 X 6,000 gph/100 gpm X 18 deg-F X 0.94 = 846,000 Btu/hr/12,000-Btu/hr/Ton = 70.5 Tons of refrigeration.

3. Calculate chiller system efficiency by dividing the 846,000 Btu/hr by the 69.06 kW-hr consumed to yield an EER of 12.25, and a COP of 3.59.

## How to Calculate GPM to BTU Tonnage

An industrial chiller pumps refrigeration fluid to lower an area's temperature. This helps to cool equipment, increasing its efficiency. The area's temperature drop is the effect that you can most easily measure, but this corresponds to an energy transfer, which is measured in British Thermal Units (BTUs) per hour. The greater the chiller's flow rate, measured in gallons per minute (GPM), the greater the rate of energy transfer.

### Instructions
1. Calculate the fluid's temperature change as it goes through the chiller. If, for instance, fluid enters the device at 72 degrees Fahrenheit and leaves at 55 degrees Fahrenheit: 72 - 55 = 17 degrees.
2. Multiply this answer by the flow rate through the device, measures in gallons per minute. With a flow rate of 320 gpm: 17 --- 320 = 5,440.
3. Multiply this answer by 500, a constant conversion factor: 5,440 --- 500 = 2,720,000. This is the chiller's total power, measured in BTUs per hour.

## How to Calculate Evaporator Sizing

Like similar Heating, Ventilation and Air Conditioning (HVAC) appliances, an evaporator pumps a refrigerant to lower the temperature. Larger evaporators cool larger spaces. Manufacturers size evaporators in terms of tons, a unit of power equal to 12,000 British Thermal Units (BTUs) per hour. Calculate this size from the evaporator's temperature range, which describes the fluid's temperature drop, and the volumetric flow rate, measured eventually in pounds of water per hour,

### Instructions
1. Subtract the evaporator's outgoing temperature from its incoming water temperature. If you want water to enter the evaporator at 60 degrees Fahrenheit and leave at 46 degrees Fahrenheit: 60 - 46 = 14.

2. Multiply the answer by your proposed volumetric flow rate, measured in gallons per minute. If the evaporator must move 400 gallons per minute: 14 x 400 = 5,600.
3. Multiply the answer by 500: 5,600 x 500 = 2,800,000. This answer is the evaporator's size, measured in BTUs per hour.
4. Divide the answer by 12,000: 2,800,000 / 12,000 = 233.33. This answer is the evaporator's size in tons.

## How to Calculate Volume Size of a Refrigerator

Refrigerators are sold with their internal capacity volume listed as cubic feet, regardless of what racks, shelving and unusual internal configurations take up space inside. For comparative purposes, you can calculate this number for your own refrigerator with a tape measure and three quick measurements. Calculate the volume of the freezer and refrigerator compartments separately. Since the interior of a refrigerator is just a box, use the formula for the volume of a box: length x width x height.

### Instructions
1. Measure the interior length, width and height in feet of the refrigerator inside the cooling chamber. Only measure parts of the refrigerator inside when it the door is closed.
2. Multiply the length times the width times the height. For instance, if the inside measured 2 feet by 3 feet by 2 feet, the volume would be: 2 x 3 x 2 = 12 cubic feet.
3. Find the average usable space inside your refrigerator by multiplying the total cubic feet by 65 percent if you have a side-by-side, or 78 percent if the freezer is located on the top or bottom. For the example, if a 12-cubic-foot refrigerator is a side-by-side, calculate: 12 x 65 percent = 7.8 cubic feet. If the freezer on top, calculate: 12 x 78 percent = 9.36 cubic feet.

## How to Install an Expansion Tank

An expansion tank is necessary in a closed whole house water system to allow for expansion of the water as it is heated. Closed water systems are systems that have a back flow preventer installed. Proper water pressure must be maintained in the plumbing system to prevent damage to appliances, faucets and dangerous explosions of the water heater or pressure relief valves. Expansion tanks should be installed in the cold water inlet pipe.

### Instructions
1. Locate a place with enough room to install the expansion tank in the cold water line between the whole house pressure regulator and the input to the hot water heater. The tank can be placed horizontal, vertical or at any angle with the cold water pipe. The weight of the tank will need to be supported to avoid stress on the existing pipes.
2. Shut off the cold water supply to the house. Open any faucet to drain the water out of the pipe that you will cut to install the expansion tank.
3. Cut the ¾ inch, cold water inlet pipe and install the Sharkbite T fitting by pushing both ends of the cut pipe into two opposite sides of the T fitting. A small section of pipe may need to be cut out to allow room for the T fitting if the pipe will not slide apart after being cut.
4. Wrap several rotations around the male threads located on the expansion tank input stem with pipe thread seal tape.
5. Tighten the Sharkbite ¾ inch Female Adapter onto the expansion tank male threaded input location.

6. Cut a piece of pipe to desired length and insert one end into the remaining unused Sharkbite T fitting and one end into the Sharkbite Female adapter that is attached to the expansion tank.
7. Turn water supply on and check for leaks.

## How to Calculate the Minimum Flow Rate of the Cooling Water

Cooling water travels through a chiller, absorbing heat through coils or fins. The more quickly the water flows through the chiller, the more quickly the chiller transfers heat. The chiller's minimum flow rate is the flow rate that produces a desired cooling rate if the device works at 100 percent efficiency. In practice, the water usually will not cool at that rate without an even higher flow rate because it absorbs and releases additional heat through unexpected chiller regions.

### Instructions

1. Subtract the water's temperature as it leaves the chiller, measured in degrees Fahrenheit, from its temperature on entering it. For example, if water enters the chiller at 40 degrees Fahrenheit and leaves at 66 degrees Fahrenheit: 66 - 40 = 26 degrees.
2. Multiply this answer by 500, a figure that takes into account water's specific heat capacity: 26 --- 500 = 13,000.
3. Divide the cooling rate that you need, measured in British thermal units (BTUs) per hour by this answer. For example, if the chiller must absorb 3,840,000 BTUs each hour: 3,840,000 ÷ 13,000 = 295.4. This is the chiller's minimum cooling rate, measured in gallons per minute.

## How to Calculate Pipe Flow Rates

Piping systems are designed by selecting piping systems and materials that are compatible with the flowing media and selecting the pipe size that provides the best overall economy for the application. While a larger pipe size may cost more initially, it provides better operating efficiency, which can represent a quick payback. One of the best ways to optimize a pipe flow investment is to calculate the actual pipe flow rates on the basis of pressure losses that might needlessly inflate operating costs.

### Instructions

1. **Schedule 40-Steel Pipe Water Pumping**



1. Define the steel pipe application. An industrial well application requires pumping 425 gallons per minute (gpm) of water 575 feet away into an in-ground reservoir that is 80 feet higher than the pump at the well. If a 60-psi (pounds per square inch) pump is available, you can calculate the minimum Schedule 40-steel pipe size that would handle the flow and pressure constraints.

2. Determine the pressure available to provide the 425-gpm flow. Because the reservoir is 80 feet higher than the pump, some of the 60-psi pumping pressure will be lost pushing the water uphill. Dividing 80 feet/2.31 feet/psi yields a static pressure loss of 34.63 psi, which, when subtracted from the 60-psi pump pressure, leaves 25.37 psi to push the 425-gpm flow through the 575-foot pipe.

3. Scale the pressure drop per 100 feet of pipe, since this is how published pipe data is presented. Substituting values yields 25.37 psi/575 feet/100 feet = 4.41-psi drop per 100 feet at 425 gpm.

4. Consult published pipe pressure and flow data for Schedule 40-steel pipe to select a potential pipe size. The 4-inch Schedule 40-steel pipe pressure-loss to flow chart shows a loss of 5.5 psi for a 476-psi flow.

5. Calculate the flow with a 4.41-psi loss based on the 5.5-psi loss flow at 476 gpm. Since flow varies proportionately to the square root of pressure loss difference, extract the square root of (4.41 psi/5.5 psi) = square root of 0.8018 = 0.895 and multiply by the 476-gpm flow cited to yield 426.23 gpm, which would just work for 425 gpm.

**2.        Schedule 40-Steel Pipe Steam Flow**



1. Define the steam flow application. Saturated low pressure steam at 12 psi is flowing through 3-inch Schedule 40-steel pipe. If it loses 1.5 psi pressure at the end of 100 feet of the pipe, you can calculate the flow rate in pounds/hour (lb/hr) of steam.

2. Consult the Steam Flow Rate and Pressure Drop for Schedule 40 Pipe chart (see Resources) to find the reference points for the 3-inch pipe. The 1-psi drop flow value reads 1,670 lb/hr and the 2-psi value reads 2,400 lb/hr.

3. Calculate your flow at the 1.5-psi drop by taking the square root of (1.5/2.0) = 0.866 and multiplying by the 2,400 lb/hr at the higher pressure drop = 0.866 X 2,400 = 2,078.4 lb/hr with a 1.5-psi drop.

4. Compare against the calculation using the lower 1-psi drop value to interpolate the actual flow value. Square root (1.5/1) = 2,045.32 lb/hr. Adding half the difference to the lower value or (2,078.4 minus 2,045.32 = 33.08/2 + 2,045.32 = 2,061.86 lb/hr, which would be a reasonable interpolation result in light of the tabular data.

## How to Calculate Expansion Tank Sizes

Water, in the liquid stage, expands when you heat it and contracts when you cool it. Therefore, in closed hydronic systems, we need expansion tanks to allow for this expansion to go somewhere. Otherwise, the expansion would cause excess pressure that will damage our systems.

Calculate Expansion Tank Sizes

**Things You'll Need**

- Calculator
- Water expansion factor chart
- Pencil and paper

Instructions

1. **Calculate Expansion Tank Size**
   1. You will need to calculate the total amount, in gallons, of water in your system. If you do not know    this, you can use the following formula as an estimate.
      V=(L1+L2) * 4 * Dia2/24

      V: System volume in gallons

       L1: Length of loop          L2: Width of loop

      Dia: Diameter of largest water main in inches

   2. Next, you need to know your initial system temperature and final system temperature. This will assist in finding your expansion factor. Average fill temperature off a NYC street is 50 degrees Fahrenheit. For a chilled water system, you usually do a 50-degree to 90-degree swing, and for a hot water system, you do 50 degrees to 180 degrees.
   3. Using your temperatures locate the appropriate expansion factor. Multiply the expansion factor by the system volume and you will have your appropriate expansion volume. Expansion factor charts can be found online.
   4. Next, calculate your acceptance factor using the formula below:
      Acceptance factor (in PSI) = (1-(PI-Atm)/(P0-Atm))

       PI: Initial pressure in PSI

       P0: Final pressure in PSI

       Atm: Atmospheric pressure (14.7 PSI)

   5. Calculate your expansion tank volume. Do this by dividing the expansion volume by the acceptance factor, and this will give you the necessary size of the expansion tank in gallons.

## Proper Way to Connect an Expansion Tank to a Boiler

An expansion tank is designed to absorb excess water and water pressure in a closed hot water heat system. Without an expansion tank, the expansion of the heated water can cause "water hammer" or noise from the heating system. The tank allows the hot water heating system to maintain the proper volume of water despite the expansion and contraction of the water due to heating and cooling.

1.          **Installing an Expansion Tank in an Open System**

Expansion tanks are installed physically above the rest of the boiler. The open tank is often installed in an attic or loft above the boiler location. The expansion tank is connected by a T fitting to the main hot water line running from the boiler to the pump that feeds the radiators or other heat-dispensing fixtures. The elevated position of the tank serves an important purpose. High pressure, caused by the expansion of heated water, forces water up the pipe and into the expansion tank.

As the water cools and contracts, resulting in lower water pressure, gravity brings the water from the expansion tank and back into the boiler system. The expansion tank also serves as a recovery vessel for any water vented from the boiler. In the event the boiler overflows, the water ends up in the expansion tank rather than flowing down the drain. Expansion tanks also are generally used to introduce fresh water into the boiler system in the event of evaporation or other loss of water to the boiler system.

2.          **Installing an Expansion Tank in a Sealed System**

The expansion tank in a closed or sealed system can be installed near the level of the boiler. Air and water pressure within the system will facilitate the movement of the water rather than the gravity necessary in an open system. The expansion tank is attached to the system through a pipe that connects to the hot water system by a T fitting installed in the pipe returning to the boiler from the radiators.

The expansion tank of a sealed system is airtight with a pressure gauge and possibly a safety relief valve installed. Connections to the water system, for adding water if necessary, are also made at the expansion tank.

Some sealed system boilers incorporate the boiler and expansion tank in a single unit that also includes the gauges and safety valves necessary for the operation of the heating system.

# How to Convert Boiler Horsepower to BTUs

The amount of steam that a boiler is able to produce is measured in horsepower (HP). For every 34.5 lbs. of 212 degree Fahrenheit water that the boiler can convert to steam in one hour, it is rated 1 HP. This measurement is primarily used to indicate the amount of power a boiler can provide to a steam-powered engine. For other applications, such as heating, it is more common to use the British Thermal Unit (BTU). The BTU represents the amount of heat energy needed to raise the temperature of 1 lb. of water by 1 degree Fahrenheit. Since BTUs are more common in heating and air conditioning, it can be useful to know how to covert HPs to BTUs. Have a question? Get an answer from a Handyman now!



A boiler can heat a home or push a train.

- Flashlight
- Screwdrivers
- Calculator

**Instructions**

1. Disconnect power from the boiler and allow it to cool completely.
2. Remove panels or covers, if necessary, with a screwdriver to gain access to the manufacturer's label.
3. Find the HP rating on the manufacturer's label, using a flashlight if necessary. Make note of the HP rating.
4. Multiply the HP rating by 33,472 to calculate the BTU per hour rating. Make note of the BTU per hour rating for future reference.
5. Replace any panels or covers that were removed and restore power to the boiler.

**Tips & Warnings**

- Horsepower is usually rated per hour. If your boiler provides a horsepower per minute (HP/min) rating, multiply the HP/min rating by 60 then multiply by 33,472 to calculate BTUs per hour.

## How to Calculate Boiler Steam Flows

Modern steam boilers create easily utilized energy for many heating, processing, and mechanical and electrical power-generation applications. They can derive their incoming energy from many types of fuels: electricity, co-generation, sunlight, nuclear and waste heat from other processes. Being able to calculate boiler steam flows from any of the parameters surrounding a boiler, including boiler horsepower, kilowatts, fuel-flow rates, feedwater flow, combustion air flow, or steam use data provides a complete picture of boiler performance.



This industrial boiler serves many users with pressurized, saturated steam.

**Things You'll Need**

- Calculator
- Boiler system parameters

<u>Instructions</u>

1. Use boiler horsepower to calculate steam flow. Boiler horsepower is not related to mechanical horsepower. It is a boiler industry rating that predicates the amount of saturated steam a boiler will generate starting with water at 212 degrees Fahrenheit and 0 pounds per square inch gauge (psig-- meaning atmospheric pressure) and ending with steam at 212 F and 0 psig. For example, if a boiler is rated at 50 bhp, then it will produce 50 bhp x 34.5 pounds per hour (lb/hr) = 1,725 lb/hr of steam under these conditions.

2. Use btu/hr (British thermal units/hour) heat input rate to calculate boiler steam flow. It takes 970.28 btu/hr to produce 1 pound of steam at the above conditions. If 50 million btu/hr are being applied to the boiler, divide by the 970.28-btu/lb to yield 51,531-lb/hr steam flow. This is an average industrial boiler.

3. Calculate boiler steam flow with a known kilowatt hour (kWh) usage in an electrically heated boiler. If 1-kWh can produce 3.517 pounds of steam at the above zero-psig and 212-deg-F conditions, then 1,000 kWh will produce 3,517 lb/hr of steam.

4. Compute the flow rate of steam from a boiler based on burning 20 gallons/hour of No. 6 fuel oil, assuming normal 85 percent boiler combustion efficiency. The accepted btu/gallon conversion rate for No. 6 fuel oil is 150,000 btu/gal. A boiler burning 20 gallons per hour would produce [(150,000 btu/gal x 20 gal/hr) / 970.28 btu/lb] x 0.85 (efficiency) for a total of 2,628.1 lb/hr of steam.

5. Calculate the combustion-air mass required to burn the 20 gallons of No. 6 fuel oil above. Since the air-fuel stoichiometric ratio is 14.4 pounds of air per pound of fuel, the boiler's burner would need 20 gallons x 7.95 lb/gal for No. 6 fuel oil, or 2,289 pounds of air to burn the oil. This would in turn yield a total flow of 2,628.1 lb/hr of steam. Therefore, knowing the amount of combustion air flow during an hour for a given boiler, you can back-calculate to compute the steam flow. This means a boiler will produce about 2,628.1 lb/hr / 2,289 lb/hr of combustion air consumed, or about 1.15 pounds of steam for every pound of air.

**Tips & Warnings**

- Calculating steam flow using different parameters tells the operator the complete story about his boiler.

- There are large boilers burning several different fuels simultaneously where combustion air flow can be used to infer a steam flow. The interesting thing about boilers is that once the air-mass-to-steam-mass flow ratio has been determined for a given boiler, all carbon-based fuels will require just about the same amount of air to produce 1 pound of steam, whether they are wood, coal, oil or natural gas. This

phenomenon makes it easy to compute steam production from total air flow rate when a combination of fuels is being used at once.

- Boilers need to be started and run up slowly to alleviate stresses in their boiler tubes and headers.

## How to Convert Steam to BTU

BTU, or British Thermal Units, is a measure of energy commonly used in calculations related to heating systems. In the U.S., the term "heat units" sometimes replaces Btu. In situations where steam powers heating systems, it is necessary to understand the relationship between the amount of steam and the heat energy it provides. Converting pounds of steam into an energy value in Btu is straightforward.



Steam provides the energy for many heating systems around the world.

**Things You'll Need**

- Calculator

### Instructions

1. Enter the value in pounds of steam into the calculator. Make sure that the entry is correct before proceeding to the next step.
2. Multiply the value from the previous step by 1,194, the number of Btu in 1 lb. of low-pressure steam. (Reference 2) The result is the steam value converted into Btu. For example, 500 lbs. of steam equals 579,000 Btu --- 500 x 1,194 = 579,000.
3. Divide the result by 1,194. If the answer is not equal to the original value in pounds of steam, there was an error in the calculations. Repeat the calculations until the answer is correct.

### Tips & Warnings

- For most heating design purposes, a conversion rate of 1,000 Btu to 1 lb. of steam is close enough to be satisfactory, and it is much easier to calculate. For example, 500 lbs. of steam equals 500,000 Btu.

- Always double-check the results before using them if they are part of a heating design or another project where legal regulations or safety issues are involved.

## How to Calculate CFM in HVAC

In order to have a comfortable living space or room, you need to have a properly designed HVAC system. If you have too little airflow in a space, it may take a really long time to heat or cool to the desired temperature. It could never reach the desired temperature if airflow is really low. Too much airflow will result in a drafty feeling to the room and inefficient heating or cooling. Both of these can put a strain on your energy bill.

**Instructions**

1. Measure the length and width of a room where you need to calculate the required airflow. Multiply these together to get the square footage of the room, i.e., if the room is 10 ft x 10 ft, the square footage would be 100. sq. ft. Airflow is measured in CFM, or cubic feet per minute. It is a measurement that shows how much air flows into a space per minute. You want 1 CFM per square foot, so the above room's requirement would be 100 CFM. For rooms with a lot of windows or have long periods of direct sunlight, you want 2 CFM per square foot.
2. Continue measuring each room and calculating the CFM requirement for each.
3. Add up each room's required CFM. This total is the amount of CFM your HVAC unit needs to produce in order to properly heat or cool the space.
4. If you don't already have a HVAC unit for the space, purchase one at your local HVAC retailer that matches your CFM requirement. Install the HVAC unit per manufacturer's instructions.
5. Using your Ductulator, match each room's CFM requirement to your planned friction rate. Most HVAC systems use a friction rate of 0.1" water column per 100 feet of duct. As you match each room's CFM to the Ductulator, it will give you the size of duct you need to run to the room.
6. Work back from the farthest room. As you add a room, make sure you add the CFM and increase the duct size accordingly. Install the HVAC duct from each room to the HVAC unit. A professional HVAC installer may need to be contacted for proper duct installation.

## How to Calculate the CFM of a Room

Keeping your home at a comfortable temperature is an extremely important consideration for most homeowners. The term "CFM" is an acronym that stands for "cubic feet per minute," a term used to describe a fan's efficiency in terms of airflow. Determining the CFM of a room is a mathematical process of figuring the room's cubic area as well as the rate at which you desire the air to circulate throughout the room. Calculating the CFM of a room helps when choosing a fan.

**Instructions**
1. Measure the room's width and length. Also measure the height of the room from the ceiling to the floor.
2. Multiply the three measurements from step 1 to determine the cubic footage of the room. For instance, if a room is 8 feet wide, 10 feet long and 8 feet high, multiply 8 times 10 times 8 to get 640 cubic feet.
3. Multiply the cubic volume of the room by the number of times you want the air to turn over or exchange in an hour. For example, if you expect the air to be exchanged twice per hour, multiply 2 times 640 to get 1,440.
4. Divide your answer from step 3 by 60 to calculate CFM. In this example, you would divide 1,440 by 60 to get a CFM of 24.

## How to Calculate the CFM of a Blower

Many industrial processes require continuous aeration. Sewage treatment, for instance, uses aerobic microbes that respire constantly as they break down sludge. An industrial blower provides the necessary oxygen by

maintaining a steady flow of air into the reaction chamber. You can estimate a blower's volumetric flow rate from the reactants' oxygen absorption rate. The other relevant factors are temperature and the pressure of air at the blower's discharge point.

### Instructions

1. Add 460 to the temperature at the discharge point, measured in degrees Fahrenheit, to convert it to degrees Rankine. If, for instance, air leaves the blower at 80 degrees: 80 + 460 = 540 degrees Rankine.
2. Multiply the Rankine temperature by the number of pounds-moles of oxygen that is transferred each minute. If, for instance, 8 pounds-moles of oxygen reach the reactants each minute: 540 x 8 = 4,320.
3. Multiply this product by 10.73, which is the gas constant: 4,320 x 10.73 = 46,354.
4. Divide the result by the pressure at the gas discharge point, measured in pounds per square inch. If this pressure, for instance, measures 15 pounds per square inch: 46,354 / 15 = approximately 3,090. This answer is the blower's volumetric flow rate, measured in cubic feet per minute.

## How to Calculate the CFM for an Exhaust Fan

An exhaust fan helps pull impure air out of your home and brings fresh air in. Generally these fans are connected by a duct to the exterior of the home, which helps to ensure you have high-quality indoor air at all times. Exhaust fans are rated in units of cubic feet per minute, or CFM. To calculate the CFM needed for an exhaust fan in a room, you will need to take a few measurements and do some simple calculations.

### Instructions

1. Calculate the volume of the room. Measure the length, width and height of the room in feet. Multiply these three numbers.
2. Which gives you the volume of the room in cubic feet. For instance, for a room that is 8 feet square and 8 feet tall, multiply 8 by 8 by 8 to get 512 cubic feet.
3. Determine how often you would like the exhaust fan to be able to exchange all of the air in the room. If you would like to have completely fresh air every five minutes, for example, then this is the exchange time.
4. Divide the number of cubic feet by the number of minutes you would like it to take to exchange all of the air in the room. This will give you the required CFM. In a 200-square-foot room, if you would like completely fresh air every five minutes, divide 200 by 5. This gives you a required 40 CFM for the exhaust fan.

## How to Calculate CFM for Ducts

Air flow, usually calculated in cubic feet per minute (CFM), can be calculated by the area of a duct's cross section and the velocity of the air itself. You may be able to reference the velocity, but if not, a device may be required to measure it for you. These devices measure velocity based on pressure. Assuming you can acquire the necessary data, calculating the CFM is relatively painless.

### Instructions

1. **Square Ducts**

2. Measure two consecutive sides of the duct, in inches.
3. Convert inches into feet by dividing each measurement by 12.
4. Calculate the cross-sectional area of the duct by multiplying the two numbers together.
5. Multiply the cross-sectional area by the air velocity, measured in feet per minute, to calculate air flow in CFM.

2. **Round Ducts**

1. Measure the diameter of the opening.
2. Convert the measurement into inches by dividing it by 12.
3. Divide the diameter by two to calculate the radius.
4. Square the radius and multiple it by PI, or 3.14, to calculate the area.
5. Multiply the area by the air velocity, measured in feet per minute, to calculate air flow in CFM.

## How to Calculate CFM From RPMs

Developers of air-movement mechanisms such as fans and compressors must consider the basic relationship between fan or impeller speed in rpm (revolutions per minute) and volumetric air flow in CFM (cubic feet per minute). While these machines have different operating principles, their common characteristic is that each revolution of their spinning input shaft will result in a certain amount of volumetric air (or gas) flow through them when they are operating as designed according to their pitch or displacement factor.

### Instructions

1. **Axial Ventilation Fans**

2.



1. Define the axial fan application. According to the general fan law governing axial fans, you will need to know the fan blade diameter and pitch (blade tilt or attack angle) along with the rpm variable to calculate CFM. In this example, a small household fan on a stand has a three-bladed plastic fan with a 1-foot diameter and an 8-inch effective pitch. This means that each revolution of the running fan blows the one-foot-diameter column of air coming through the fan 8 inches toward you after accounting for efficiency losses. The fan is running at 1,200 rpm.
2. Calculate the linear velocity of the air through the running fan. If each revolution moves the air 8 inches, then 1,200-revolutions per minute multiplied by 8 inches means the air 9,600 is being moved at inches per minute, or 800 feet in one minute. Another way of looking at it is that the fan is moving an 800-foot-long column of air that is 1 foot in diameter through space each minute.
3. Calculate the CFM (volumetric flow of air) at 1,200 rpm. The volume of the column of air described in Step 2 is pi (3.1416) x fan radius squared (0.5-feet squared) times the column length in feet. This would be 3.1416 x 0.25 square feet x 800 feet = 628.32 cubic feet per minute at 1200 rpm.

3. **Centrifugal Blower Fan (Squirrel Cage-Blower)**

1. Define the blower application. In this example, the centrifugal blower in a window air conditioner circulates 600 CFM on the "LO" setting when the blower motor is spinning at 800 rpm. You can calculate how much air would it circulate in "HI" mode, when the motor rotates at 1200 rpm.

2. Define the terms in the general centrifugal fan formula and rearrange them to use the formula to solve for the higher air flow: CFM 1/CFM 2 = RPM 1/RPM 2 x (D1/D2)^3 (cubed). The (D1/D2)^3 is 1, since the impeller diameter stays the same, so CFM 2 = CFM 1 x (RPM 2/RPM 1).

3. Substitute your parameters in the equation to calculate the higher airflow:

   CFM 2 = 600 CFM x 1200 rpm/800 rpm = 900 CFM

4. **Reciprocating Compressor Applications**

   1. Define the compressor application. A shop compressor with a piston in a cylinder has a net displacement of 10 cubic inches. It normally turns at 600 rpm. You can calculate many cubic feet of air it takes in at atmospheric pressure and the approximate cubic feet of compressed air it supplies if it has an overall 10-1 compression ratio.
   2. Calculate the incoming volumetric air flow. If the compressor takes in 10 cubic inches of air for each revolution, then CFM input = 600 RPM x 10 cubic inches/1728 cubic inches/cubic foot = 3.47 CFM.
   3. Calculate the outgoing compressed air volumetric flow. Since the compression ratio is 10-1,

## How to Calculate Pump GPM

For a healthy pool, you want all the water in your pool to pass through its filter every so often. This is called the turnover rate. It is generally advisable to have a turnover rate of four to 10 hours, depending on the frequency of pool usage, with higher use pools requiring quicker turnover rates. If you know the total volume of your pool, you can calculate the pump's flow rate, in gallons per minute (gmp), needed to accommodate the desired flow rate. This ensures you purchase a pump adequate for your needs.



You can calculate the required flow rate gpm of a swimming pool's water pump.

**Things You'll Need**

- Tape measure

**Instructions**

1. **Calculating Pool Volume**

2. Measure the length, width and average depth of the pool in feet.
3. Multiply the length, width and depth to calculate the volume in cubic feet. As an example, a 20 foot by 30 foot by 6 foot pool will have a volume of 3,600 cubic feet.

4. Multiply the product by 7.5 to convert to total gallons. In the example, 3,600 times 7.5 equals 27,000 gallons.

**2. Calculate Pump Flow Rate**

1. the turnover rate desired. For constant use pools, you might want a four-hour turnover. For an infrequently used pool, you might use 10 hours. In the example, say you want an eight-hour turnover.
2. Convert hours to minutes by multiplying by 60, since there are 60 minutes in an hour. In the example, eight hours times 60 minutes per hour equals 480 minutes.
3. Divide the total pool volume, in gallons, by the turnover rate, in minutes. In the example, 27,000 gallons divided by 480 minutes equals a required flow rate of 56.25 gallons per minute.

## How to Convert GPM to Cooling Rate in Tons

Factories use heat exchangers or chillers to regulate an area's temperature. The machine absorbs heat from an area that produces it and carries it to a different location. The medium that carries the heat is a refrigeration fluid that absorbs and releases heat as it experiences differing pressures. A standard formula for finding a chiller's cooling capacity from its flow rate in gallons per minute determines the cooling rate in British Thermal Units (BTUs) per hour. One refrigeration ton is a cooling rate of 12,000 BTUs per hour.

### Instructions

1. Multiply the exchanger's flow rate in gallons per minute by 500, a conversion constant. For example, if 350 gallons flow through the unit each minute: 350 --- 500 = 175,000.
2. Multiply this answer by the fluid's temperature change as it passes through the heat exchanger. For example, if the fluid rises 21 degrees Fahrenheit in temperature: 175,000 --- 21 = 3,675,000. This is the chiller's cooling rate, measured in BTUs per hour.
3. Divide this rate by 12,000, which is the number of BTUs per hour in a ton: 3,675,000 ÷ 12,000 = 306.25. This is the unit's cooling rate, measured in tons.

## How to Calculate HVAC Tonnage

When installing a heating and cooling system into a location, it is imperative to first determine the heating and cooling needs of the location. The needs will determine the HVAC system needed in the room. HVAC stands for heating, ventilating, and air conditioning, all of which are part of the building design for mid size buildings and larger. The following will walk through calculating the heating and cooling thermal units (BTU) and how to convert that number into tons.

### Things You'll Need

- Measuring Tape (metric)
- Wattage labels for all equipment at the location
- Wattage labels for all lighting
- Calculator

### Instructions

1. Measure the area of the room and convert that figure into BTU's. The area of the room is determined by multiplying the length and width. The measurement must be

in meters, (1 foot equals .3048 meters). Multiply the area by 337 to figure out the area BTU.

Room BTU = Length x Width x 337

2. If there are north or south-facing windows in the location, calculate the BTU for each window by measuring the area of each. For north-facing windows, multiply the area by 165. For south-facing windows, multiply the area by 870. If you live in the Southern Hemisphere, reverse the calculations (165 for south, 870 for north)

3. Calculate the BTU of the number of people who use the location. Multiply the occupants by 400 for the BTU.

4. Any equipment in the room needs to be measured for their BTU output. To determine the output, multiply the total wattage for the equipment by 3.5.

5. Determine the lighting BTU by multiplying total wattage for the lighting by 4.25.

6. Add the figures from steps one through five. The result is your total heat load. Multiply this number by two to determine the amount of cooling required.

7. Convert your heating and cooling load to tons by dividing the BTUs by 12,000. The resulting figure is the HVAC tonnage.

## How to Size an HVAC System

A good heating, ventilation and air-conditioning system (also known as an HVAC) is essential to keep you comfortable and healthy in your home or office. The size of an HVAC affects its efficiency and operating cost. Although there are more precise methods for sizing an HVAC system, using the "rule of thumb" method is very simple.

### Instructions
1. Determine the square footage of the property. Look at the blueprints or measure the property with a tape measure.
2. Divide the number of square feet by 400. This will give you a ballpark estimate of the number of cooling tons required for your HVAC system.
3. Factor in specifics like the amount of insulation in the property, appliances that generate heat, windows, roofing and climate.
4. Fine-tune your estimate. Divide the property's square footage by anywhere from 300 to 500, based on additional factors.

### Tips & Warnings

- This "rule of thumb" sizing can be applied to sections of a property. If you want to install a system for only a few rooms, calculate the square footage of those rooms only.

## How to Convert Pipe Size to GPM

Pipe sizing is measured by the internal diameter of the pipe, not the overall outside diameter. Once determined, the overall volume can be calculated. Pipe flow is described in gallons per minute (GPM). Shorter lengths of pipe will have a greater flow than a longer length of the same diameter. This is caused by internal resistance of the pipe itself. By the same reasoning a larger diameter pipe will have a greater flow or GPM than a smaller pipe at the same pressure or flow rate. Pressure is described as pounds per square inch (PSI). The square-inch measurement is determined by the area of the pipe. The pounds are the amount of force that is placed on the liquid to "push" it through the enclosed space.

- Measuring Tape or Ruler

**Instructions**
1. Find the cross-section area of the pipe. Area is equal to pi times the radius squared or (a = 3.14 * r^2). A two-inch diameter pipe would have a cross-section area of 3.14 times 1^2 or 3.14 square inches.
2. Understand that water will have a certain pressure associated with the height of that water. One pound of water pressure, or 1 PSI, is equal to 2.31 feet of elevation in height. In other words, a one-inch column or pipe of water that is 2.31 feet high will have a pressure of 1 PSI. The overall height---not volume---of the pipe corresponds to the pressure. A six-inch diameter pipe that is 2.31 feet high will only have 1 PSI.
3. Find the volume of the two-inch diameter pipe in Step 1 that has a length of 10 feet. Ten feet is equal to 120 inches. Multiply 3.14 square inches, the cross sectional area, times the length. The volume of the pipe is equal to 376.8 cubic inches of volume.
4. Convert cubic inches into cubic feet. One cubic foot equals 1,728 cubic inches. Divide 376.8 cubic inches by 1,728 cubic inches per cubic foot and the answer is .218 cubic feet. This means that the two-inch diameter pipe that is 10 feet long has an internal volume of .218 cubic feet.
5. Calculate the amount of water that can be contained in the section of pipe at any given time. One cubic foot of water is equal to 7.48 gallons. Multiply 7.48 gallons by .218 cubic feet and the amount of water in the pipe is equal to 1.63 gallons.
6. Find the GPM if the flow of water is one foot per second. Multiply the one-foot per second flow by 60 seconds per minute and the flow is now 60 feet per minute. In other words the water will flow through the 10-foot pipe six full volumes for every minute. Since the piping contains 1.63 gallons per 10 feet of pipe, multiply 1.63 by six and the final GPM is equal to 9.78 GPM of water flow from the two-inch diameter pipe.

## How to Convert BTU to GPM

The amount of heat exchange in a heating or refrigeration system can be expressed in British Thermal Units (BTU) per hour. This unit of measurement is valid when considering either the amount of thermal energy absorbed in a heating process or the amount of energy rejected in a cooling process. The BTU/Hour measurement of a device is related to the gallons per minute of liquid flow in the device, and the two units of measurement can be derived from one another with some basic arithmetic.

**Instructions**
1. Measure the difference in temperature between the liquid inside and outside of the heat exchanger.
2. the difference by 500 if the liquid flowing through the device is water, or by 485 if it is antifreeze.
3. Determine the BTU/Hour rating of your device. It should be posted either directly on the device or in the owner's manual.
4. Divide the BTU/Hour rating determined in Step 3 by your result from Step 2 in order to calculate the gallons per minute of flow in your device.

## How to Determine GPM in Hot Water Coils

Hot water coils are used for a variety of purposes, primarily in air-heating applications. The gallons per minute, or GPM, is a useful calculation to know. It represents how much water passes through the coil every minute,

and is important for determining the coil's efficiency and knowing what kind of coil to purchase in order to replace a hot water coil. GPM can be easily calculated if you know a little about the coil.

1. Determine the BUTH of your coil, or British thermal units per hour (BTU/hr). This is the amount of energy that is either transferred to or from the fluid in the coil.This information is usually provided by the manufacturer of the unit.
2. Calculate the leaving water temperature, or LWT, and entering water temperature, or EWT. This can be measured using the coil itself. The entering water temperature is measured from the coil marked "water in" and the leaving water temperature is measured from the coil marked "water out." If you know the temperature difference (TD), this can also be used in your final equation.
3. Put your numbers into this simple equation: GPM = Q / 500 * (LWT - EWT). So, subtract the EWT from the LWT, or use the TD, which is the same number. Multiply by 500. Q is your BUTH. Divide Q by the result of your earlier calculation. This is the GPM

## How to Calculate GPM From PSI

Pressure information such as pressure drops through sections of piping is usually related to flow capacity in gallons per minute (GPM). Each piping system is unique due to a variety of factors including smoothness and the way sections join, but generally pressure has to increase as a function of the square of flow increase. Therefore, if flow doubles, pressure has usually had to quadruple to affect the change in a flowing system. Manufacturers of different types of piping publish flow-pressure data about their products. You can use this data to calculate GPM from pounds per square inch (PSI).

1. Define a pipeline flowing system. If water has to be pumped through a 2-inch Schedule 40 polyvinyl chloride (PVC) plastic pipe from a well to a pond 400 feet away, calculate how many GPM the system is delivering. The pressure gauge on the pipe at the well head reads 66 PSI and the one at the pond 50.8 PSI.
2. Subtract the lower value, 50.8 PSI, from 66 PSI to determine pressure loss through the pipe. This equals 15.2 PSI over the 400 feet of pipe, or 3.8 PSI per 100 feet of pipe length.
3. Read the pressure-drop flow correlation about 2-inch Schedule 40 PVC plastic pipe from the tabular flow versus pipe-loss data chart. The flow rate corresponding to 3.8 PSI loss to 100 feet of 2-inch Schedule 40 PVC plastic pipe is 75 GPM.
4. Determine the pressure loss at one-half of 75 GPM, or 37.5 GPM, to confirm the approximate square-power relationship between pressure and flow. Interpolating between 35 GPM and 40 GPM, the pressure loss computes to a value between 0.9 and 1.2 PSI loss per 100 feet of pipe. Since 37.5 GPM is halfway between the two flow readings of 35 and 40 GPM, the interpolation will work out to about 0.707 of the way between 0.9 and 1.2 PSI loss (again the square function). So the loss would be: 1.2 PSI -- 0.9 PSI = 0.3 PSI X 0.707, which is 0.2121 PSI greater than the 0.9 PSI value, or 1.1121 PSI.

Multiplying 1.1121 PSI by 4 to check against twice the flow yields a value of 4.45 PSI, or only 0.55 PSI greater than actually measured. This difference of about 14 percent greater pressure drop would only work out to be about a 6 percent flow difference, which is close enough to support the general square-power relationship between flow and pressure, especially in piping that can vary that much in interior size and smoothness.

## How to Calculate the GPM of Water

The flow rate of your water system is important for making decisions about appliances that use water. These measurements also help determine which types of sprinkler heads to buy, or whether you have sufficient water

pressure to run a large irrigation system. Use a container marked with units of measurement and some math to calculate your system's gallons per minute. This process can be applied to any device that has a water outlet, including hoses, sprinklers, shower heads and sinks.

<u>**Instructions**</u>
1. Set the container near the water outlet to be measured.
2. Turn on the water so that it begins to fill the container. Turn the valve or control handle all the way open. At the same time that the water begins flowing, start the stopwatch.
3. Allow the water to run for 15 seconds. Stop the water exactly when the stopwatch reaches 15 seconds.
4. Read the measurement mark where the water stopped inside the container. If the units of measurement are not in gallons, you will have to use a conversion calculator to change the number to gallons. Use one of the many free online conversion calculators as needed.
5. Multiply the measurement by 4. This represents a full minute of fill time. This is also the total gallons per minute that your device consumes. For example, a measurement of .25 gallons after 15 seconds, multiplied by 4 equals 1 gallon per minute.

**Tips & Warnings**

- Consider swapping out high-glow faucet nozzles of 2.2 gallons per minute or more with a more restrictive nozzle to save water.

## How to Calculate GPM in Pipe

When working with pipes, it's important to know the flow rate to confirm that the pipe meets requirements, or to know how much fluid is being supplied. Flow rate is measured by gallons per minute, or GPM. Given key information about the piping system, the flow rate can be calculated using the appropriate engineering formulas. The general formulas are quite involved and require some technical expertise to use. However, for specific cases, the formulas can be greatly simplified.

<u>**Instructions**</u>
1. Get the details for the piping system and fluid. For example: pipe material is plastic; length is 200 feet; diameter is 3/4 inches; inlet pressure is 30 pounds-per-square-inch (PSI); outlet pressure is 20 PSI; fluid is water at room temperature (approximately 68F).
2. Use the correct formula.
   For this example, a formula for a good approximation is: GPM = 3.0877 x p^0.5415, where "P" represents the pressure drop in PSI per 100 feet of pipe. The ^0.5415 represents a function on a scientific calculator which raises a number to a power. The button to is usually indicated by "Y" with a small raised "X," or vice versa.

3. Carry out the calculations.

   The total pressure drop is 30 PSI minus 20 PSI, which equals 10 PSI for 200 feet of pipe. The formula requires pressure drop per 100 feet. To get this, divide the total pressure drop by the pipe length and multiply by 100. In this case, it is 10 divided by 200 times 100, which equals 5 PSI. To get the flow, multiply 3.0877 by 5 raised to the power of .5415, which equals 7.38. The flow is 7.38 GPM.

## How to Calculate the GPM of Water Flowing From a Pipe

The number of gallons that flow through a pipe each minute (GPM) depends on the pressure differential across it. A higher pressure differential forces more water through the pipe, and a greater flow rate corresponds with a

greater pressure drop. At a known pressure, a longer pipe produces a lower flow of water. A wider pipe, however, allows a greater flow because it creates a wider cross-sectional area of pipe.



Wider pipes release more gallons each minute.

<u>**Instructions**</u>

1. Find the pipe's cross-sectional area by multiplying pi by the square of its radius. If this pipe has a radius, for instance, of 0.035 meters: 3.142 x (0.035 ^ 2) = 0.003849.
2. Multiply the result by the square of the same radius: 0.003849 x (0.035 ^ 2) = 4.715 x 10^-6.
3. Multiply your answer by the pipe's pressure differential. If this differential, for instance, measures 40,000 Pascals: 4.715 x 10^-6 x 40,000 = 0.1886.
4. Multiply this answer by 12.5, a value connected with water's viscosity: 0.1886 x 12.5 = 2.358.
5. Divide the answer by the pipe's length. If the pipe, for instance, is 18 meters long: 2.358 / 18 = 0.131.
6. Multiply the answer by 15,850 to convert it to gallons per minute: 0.131 x 15,850 = 2,076 gallons per minute.


## <u>How to Calculate Water Flow From Pressure</u>

Flow in a flowing system always goes from higher pressure to lower pressure in that the pressure provides the driving force to move the fluid or gas. Pressure usually drops uniformly as a function of the square of net flow increases. Therefore, pressure at the flow source must quadruple to double flow in most flow piping systems. On this basis, and the wealth of physical data for many piping and tubing systems, you can calculate water flow from net pressure changes in a defined system.

Water flow through pressurized pipes can be calculated from pressure losses.

<u>**Things You'll Need**</u>

- Calculator

<u>**Instructions**</u>



1.  Define the flow-pressure relationship in the application. In this example, clear filtered water in a 4-foot-high swimming pool is being drained to fill an in-ground pool that will replace it. The new pool is 100 feet away, and the ground there is about 5 feet lower, so a 100-foot-long garden hose with a smooth inner diameter of 5/8 inch is being used to let gravity do its work of draining the old pool. From this information, you can calculate the water flow rate as the first pool empties from static head pressure alone.



2.  Calculate the pressure head heights at the beginning and end of the emptying process. With the first pool filled, the water level is 4 feet high. The water flows through the hose from a drain at the bottom of the first pool, and from there drops 5 feet over the 100 feet of ground to the top of the in-ground pool, where it pours in from the open hose end at the top. Static pressure height therefore equals 4 feet + 5 feet = 9 feet when draining begins, and 5-feet when the pool is empty.

3.  Calculate the head pressure at each of the head heights. Since each 2.31 feet of water height converts to 1 pound per square inch (psi), the available static pressure at a sealed hose outlet will be 9/2.31 = 3.9 psi when full, and 2.16 psi when empty.



4.  Calculate the flow as a result of pressure at both pressure values from Step 3. Since the 5/8 inch inner diameter (ID) inner hose liner is smooth PVC plastic, its flow performance is virtually identical to PVC plastic pipe of the same ID, which happens to be nominal ½ inch Schedule 40 PVC pipe with a 0.622-inch ID. Consulting the pressure loss chart for this PVC pipe, it has a loss of 35.5 psi at a flow of 10 gpm. Dividing the 3.9 psi above by 35.5 psi = 0.1098, and taking the square root results in 0.331 X 10 gpm = 3.31 gpm for the starting flow. Dividing 2.16 psi by 35.5 psi and taking the square root results in 0.2467 X 10 gpm = 2.466 gpm.

5.  Validate the flow results for this equivalent-pipe pressure-to-flow calculation method against an online calculator for garden hose. Dividing the 3.9 psi pressure loss value by 40 psi (normal water spigot pressure, which would drive 11 gpm with this hose) and extracting the square root yields 0.3122 X 11 gpm = 3.43 gpm. This shows a difference of (3.43-3.31 gpm)/3.31 gpm of 3.7 percent, which is reasonable for flow in similar plastic pipes. Dividing 2.16 psi/40 psi and

extracting the square root yields 0.232 X 11 gpm = 2.55 gpm versus 2.466 gpm using the chart, again a reasonable 3.4 percent difference.

## How to Convert Pressure to FT/S

The greater the pressure that acts on a pipe, the faster that the water within it moves. The other factors that affect the water's flow rate is the pipe's width and length. Wider pipes allow water to go through them at a higher rate, and longer pipes, at a constant pressure, reduce the flow rate. If you calculate water's flow rate using poise, the standard unit of water's viscosity, this produces the flow rate in meters per second. A meter contains 3.3 feet.



Water travels quickly through wide pipes.

### Instructions
1. Multiply the water's pressure, measured in pascals, by the pipe's squared radius, measured in meters. For example, a pressure of 10,000 pascals drives the water through a pipe with a radius of 0.2 meters: 10,000 --- $0.2^2$ = 400 newtons.
2. Divide this answer by the pipe's length, measured in meters. For example, if the pipe measures 250 meters in length: 400 ÷ 250 = 1.6 N/m.
3. Divide this answer by 0.08, a value that takes into account water's viscosity: 1.6 ÷ 0.08 = 20. This is the flow speed through the pipe, measured in meters per second.
4. Multiply this answer by 3.3, which is the number of feet in a meter: 20 --- 3.3 = 66. This is the water's flow speed in ft/s.

## How to Convert GPM to FPS

When calculating the flow of water in a pipe, scientists and engineers convert the amount of water traveling during a given time frame to a speed. For example, if you calculated the flow of water to be 34 gallons per minute (GPM), you can convert that to feet per second (FPS). You will need to know variables such as the area of the object the water is running through. But that sounds more complicated than it is in practice. With a little effort and some simple math, the conversion can be done quickly.

Converting gallons per minute to feet per second takes only a few calculations.

<u>**Instructions**</u>
1. Convert GPM into cubic feet by multiplying by .1337. For example; 34 GPM x . 1337 = 4.54 cubic feet per minute.
2. Examine the object the water is flowing through. In most instances, it will be a metal pipe, such as those used in sewers. Calculate the cross-sectional area of the pipe in square feet. The formula for the cross-sectional area of a pipe is Pi/4 (outside diameter - inside diameter.) For example; the cross-sectional area of a pipe with an outside diameter of 4 feet and inside diameter of 2 feet would be 3.14/4 (4-2) = 1.57 square feet.
3. Divide the cubic feet measurement by the cross-sectional area to get linear feet per minute. For our example; 4.54/1.57 = 2.89 feet per minute.
4. Convert feet per minute into feet per second by dividing by 60. In our example; 2.89 / 60 = .048 FPS.

## How to Convert Pipe Size to GPM

Pipe sizing is measured by the internal diameter of the pipe, not the overall outside diameter. Once determined, the overall volume can be calculated. Pipe flow is described in gallons per minute (GPM). Shorter lengths of pipe will have a greater flow than a longer length of the same diameter. This is caused by internal resistance of the pipe itself. By the same reasoning a larger diameter pipe will have a greater flow or GPM than a smaller pipe at the same pressure or flow rate. Pressure is described as pounds per square inch (PSI). The square-inch measurement is determined by the area of the pipe. The pounds are the amount of force that is placed on the liquid to "push" it through the enclosed space.

<u>**Things You'll Need**</u>

- Measuring Tape or Ruler

<u>**Instructions**</u>
1. Find the cross-section area of the pipe. Area is equal to pi times the radius squared or (a = 3.14 * r^2). A two-inch diameter pipe would have a cross-section area of 3.14 times 1^2 or 3.14 square inches.
2. Understand that water will have a certain pressure associated with the height of that water. One pound of water pressure, or 1 PSI, is equal to 2.31 feet of elevation in height. In other words, a one-inch column or pipe of water that is 2.31 feet high will have a pressure of 1 PSI. The overall height---not volume---of the pipe corresponds to the pressure. A six-inch diameter pipe that is 2.31 feet high will only have 1 PSI.

3. Find the volume of the two-inch diameter pipe in Step 1 that has a length of 10 feet. Ten feet is equal to 120 inches. Multiply 3.14 square inches, the cross sectional area, times the length. The volume of the pipe is equal to 376.8 cubic inches of volume.
4. Convert cubic inches into cubic feet. One cubic foot equals 1,728 cubic inches. Divide 376.8 cubic inches by 1,728 cubic inches per cubic foot and the answer is .218 cubic feet. This means that the two-inch diameter pipe that is 10 feet long has an internal volume of .218 cubic feet.
5. Calculate the amount of water that can be contained in the section of pipe at any given time. One cubic foot of water is equal to 7.48 gallons. Multiply 7.48 gallons by .218 cubic feet and the amount of water in the pipe is equal to 1.63 gallons.
6. Find the GPM if the flow of water is one foot per second. Multiply the one-foot per second flow by 60 seconds per minute and the flow is now 60 feet per minute. In other words the water will flow through the 10-foot pipe six full volumes for every minute. Since the piping contains 1.63 gallons per 10 feet of pipe, multiply 1.63 by six and the final GPM is equal to 9.78 GPM of water flow from the two-inch diameter pipe.

## How to Calculate Water Flow, Volume & Pressure

You can calculate the flow rate, volume and pressure in a water tank using formulas from physics. Volume is the amount of space that an object takes up, and may be measured in liters, gallons, or cubic meters. Flow is the rate at which a certain volume of liquid passes through an opening; it may be measured in liters per second or gallons per minute. Pressure is the amount of force per square unit of area, and is measured in pounds per square inch (psi) or Newtons per square meter (pascals).


Calculate Water Flow, Volume & Pressure

### Things You'll Need

- Tape measure
- Stopwatch
- Bucket
- Calculator

### Instructions
1. **Calculating Volume**
2. Measure the width, length and height of the water in meters.

3. Multiply the width, length and height to compute the volume in cubic meters. The formula is V = WLH, where V is the volume, W is the width, L is the length and H is the height.
4. Convert cubic meters to liters by multiplying by 1,000. Convert cubic meters to gallons by multiplying by 264.17.

**2. Calculating Water Flow**
1. Place an empty container below the faucet or release valve.
2. Open the valve and use the stopwatch to time the water flow for 15 seconds.
3. Measure the number of liters or gallons in the container, and divide that number by 15. This gives the flow rate in liters per second or gallons per second. The formula is F = V/T, where F is the flow rate, V is the volume and T is the time.
4. To convert to liters per minute or gallons per minute, multiply the number you obtained above by 4.

**3. Calculating Pressure**
1. Use the hydrostatic pressure formula P = pgh, where p is the density of water in kg per cubic meter, g is the gravitational acceleration constant, h is the height of the water above the valve in meters and P is the pressure in pascals.

For water near the surface of the earth, p = 1,000 kg per cubic meter, and g = 9.81 meters per second squared.
2. Convert pascals to psi by dividing by 6,894.76.
3. Use this example as a guide to calculate water pressure in a tank.

The height of the water in a tank is 4 meters above the valve. Applying the hydrostatic pressure formula gives you P = (1,000)(9.81)(4) = 39,240 pascals. In pounds per square inch, the pressure is 39,240/6,894.76 = 5.69 psi.

## How to Calculate Gallons Per Minute From Water Pressure

A pump's discharge rate depends on water pressure. This pressure, when measured in feet of water, is also known as the "total dynamic head," which is equivalent height through which the fluid must be pumped. The value can also be calculated independently of pressure, using values such as the pump's static head, static lift and frictional losses. Besides pressure, the pump's output also depends on the system's efficiency. All other factors being equal, a less efficient pipe, by definition, moves less water per minute.



More pressure means a higher flow rate.

1. Multiply water horsepower by 3,960. If the pump works at 18 horsepower: 18 x 3960 = 71,280.
2. Multiply your answer by the pump's efficiency. If it runs at 90 percent efficiency: 71,280 x 0.90 = 64,152.
3. Divide your answer by the water's pressure, in feet of water. If the pressure equals 200 feet of water: 64,152 / 200 = 320.76. This is the pump's flow rate, measured in gallons per minute.

## How to Convert GPM to HP

Horsepower, or HP, is the amount of power required for a pump or turbine to transfer a fluid or to create a flow in the fluid. This depends on the rate the fluid is lifted and the height to which it is lifted. The rate is usually measured in gpm, which stands for gallons per minute, and the height is usually measured in feet. If a pump is pointed up into the air, it will pump fluid to a certain height, called the total head. All fluids will be pumped to the same height if the shaft is turning at the same revolutions per minute.



The horsepower of a pump or turbine can be calculated by knowing the flow rate of the system and the total head the system can exert.

### Things You'll Need

- Pump or turbine

### Instructions

1. Write down the following formula: Hp = (Q x H) ÷ (3,960 gallons per minute per foot x eff), where "Hp" stands for horsepower, "Q" stands for flow rate in gallons per minute, "H" stands for total head in feet, the 3,960 is a conversion factor to transfer from gallons per minute per foot to horsepower and "eff" stands for the efficiency of the hydraulic equipment being used, such as a pump or turbine.
2. Determine the discharge rate or flow rate of the liquid in the system. This quantity is usually found in the hydraulic system's manual or on the system itself. An impeller meter, orifice meter, or other measurement device may be used to take this measurement as well. Flow rates must be converted to gallons per minute for use in calculating the horsepower.
3. Determine the total head of the liquid in the system and convert the answer into feet. The total head a pump or turbine can produce is defined as the potential height or depth that the water level can reach; this value depends on the type

and strength of pump or turbine that is used in the system. An example of calculating the total head is as follows: If a waste water column exerts a pressure, Pe, of 0.433 pounds per inch for every foot of the column and the total pressure, Pt, on a gauge in the system reads 4 psi, then the total head H can be calculated with the equation H = Pt/Pe = 4 psi/ (.433psi/ft) = 9.24 ft.

4. Determine the efficiency of the pump or turbine by referring to the manual or it may be listed on the equipment. If not, contact the manufacturer for this information. The efficiency of the pump can also be determined if the ratio of the work being done by the system to the power or energy being supplied is known. Convert the efficiency percentage to a decimal when used to solve an equation. If, for example, a pump had an efficiency of 65 percent, then the decimal quantity would be 65 ÷ 100, or 0.65.

5. Plug all the predetermined values into the equation Hp = (Q x H) ÷ (3,960 gallons per minute per foot x eff) to calculate horsepower. For example, if the system had a pump with a known efficiency of 65 percent and the pump delivers 250 gallons per minute to a total head of 72 feet, the horsepower of the system is: (250 gallons per minute x 72 feet) ÷ (3,960 gallons per minute per feet x 0.65) = 6.99 horsepower.

## GPM to RPM Conversion

Most gallon per minute (GPM) to revolutions per minute (RPM) conversions relate to pumps. For example, if you're designing a pump to recirculate a spa, you need to know the speed at which the pump must run, given the size of the pump's cylinder. There are formulas to guide you in these conversions. The formulas use fixed and variable values; the variable values are usually estimates. The only way to completely adjust for the estimates is to conduct a real-world test to fix the variables.



GPM to RPM conversions involve estimates of pump efficiency.

### Pump Displacement

- If you think of a cylinder-driven pump -- just like a car engine -- you may think the output of the pump is the displacement times the revolutions. In other words, if you have a pump with a 1-gallon cylinder, it should pump one gallon for every revolution, and you can extrapolate from there -- not so. The hydrodynamics are not nearly so efficient. Each revolution of the pump pumps some factor less than the full volume of the cylinder.

### Conversion With an Output Test

- In real-world applications, the output depends on the design of of the cylinder, piston, intake and outlet ports, what's being pumped, how hot or cold it is and other factors. The most accurate way to convert GPM to RPM is to do a test. Run the pump at 1,000 RPM, for example. Once 1,000 RPM is reached, direct the fluid

being pumped into a measuring container for one minute. This will give you the accurate GPM measure of your pump at 1,000 RPM. With this measure, you can estimate the RPM of the pump if you know the amount of water being pumped every minute, thought it is an estimate. Just because the pump moves "X" amount of water at 1,000 RPM doesn't mean it will move 10 times "X" at 10,000 RPM.

**Output Variance With Speed**

- If your pump moves 10 gallons a minute at 1,000 RPM, you can estimate it will move 20 gallons at 2,000 RPM. Hydrodynamics conspires against the perfect scaling of revolutions to volume or volume to revolutions ratio. Here's one example. Imagine you're pumping something very viscous, such as oil. At low speeds, the effects of the oil's viscosity may have a negligible effect on its pumping efficiency -- 500 RPM, for example. At 5,000 RPM, the viscosity may play a bigger role in the pump efficiency. At some higher RPM, the viscosity may lock the liquid together like sand: Though it's liquid, it becomes as dense as it can be, effectively creating a limit to how fast the pump can pump it. Such efficiency curves apply to factors other than viscosity, too.

**Output Calculation**

- Understanding the limitations of the conversion, you start with one fixed ration and scale your conversion up or down. Let's say you measured your pump and know it pumps 100 gallons per minute at 1,000 RPM. The ratio is 1 gallon for every 10 RPM, or 1:10. Now if you measure the pump's output and find it has pumped 2.3 gallons in one minute, you can estimate its RPM is 2,300.

## How to Convert PSI to GPM Water

The pressure drop across a pipe determines how much water flows through it each minute. To accurately calculate the volumetric flow from the pressure drop, you must consider the pressure using the standard unit of Pascals rather than pounds per square inch (psi). The other relevant factors in the equation involve the pipe's dimensions, with wider, shorter pipers at a constant pressure differential producing a larger flow.



Increase water pressure to increase its flow rate.

**Instructions**
1. Multiply the pressure by 6,894.75 to convert it to Pascals. For example, if the pressure is 12 psi: 12 x 6,894.75 = 82,737 Pascals.
2. Multiply the pressure by the pipe's cross-sectional area. With a cross-sectional area, for instance, of 0.00786 square meters: 82,737 x 0.00786 = 650.31 Pascals.
3. Multiply the result by the square of the pipe's radius. If the radius measures, for instance, 0.05 meters in length: 650.31 x 0.05^2 = 1.626.
4. Divide the result by the pipe's length. With a length, for instance, of 25 meters: 1.626 / 25 = 0.065.

5. Divide the answer by 0.08, which describes water's viscosity: 0.065 / 0.08 = 0.8125. This is the flow through the pipe in cubic meters per second.
6. Multiply the result by 60: 0.8125 x 60 = 48.75. This is the flow in cubic meters per minute.
7. Multiply the result by 264.17: 48.75 x 264.17 = 12,878. This is the pipe's approximate volumetric flow in gallons per minute (gpm).