

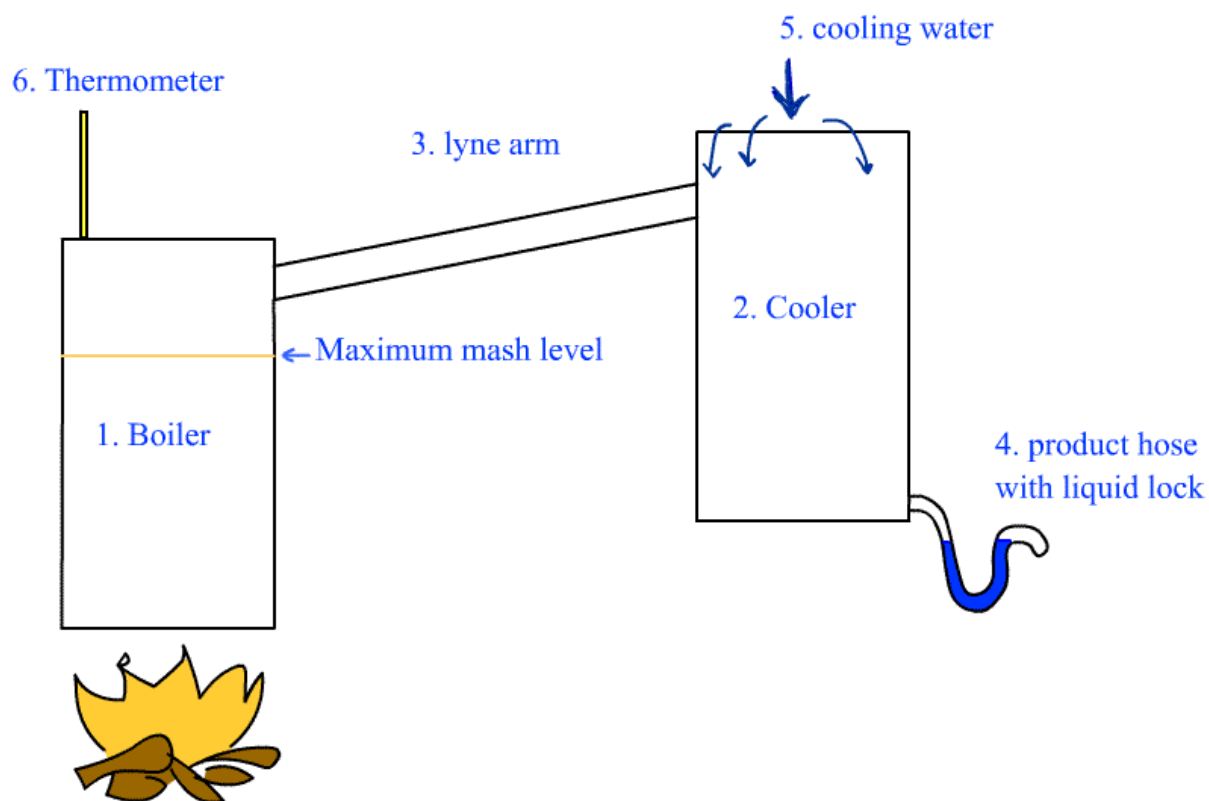
Fuel ethanol stills

A guideline how to build stills for fuel production.

Also available at:

www.distillery-yeast.com

Fuel ethanol still with lyne arm



Important! This description is for fuel ethanol stills, if the stills are going to be used to provide drinkable alcohol as well all parts need to be food grade quality and ethanol resistant. Do not use solder containing lead, or galvanized pipes since it will be poisonous.

1. Boiler, can be made of an oil drum for instance (200 litres/50 US gallon or smaller) and be heated by fire, steam, with a gas burner or an electric heater.

2. Cooler, made of empty oil drum. The cooling is provided by cooling water running on the outside of the barrel. Cover the drum with a thin layer of cloth. Water will moist the cloth and evaporate from the drum providing enough cooling. Excess water is collected at the bottom of barrel. If heat is provided by open fire, make absolutely sure that the cooler is in a well ventilated area, ethanol fumes are highly inflammable. To make it safer it's possible heat the still with steam instead. Boil water in a large vessel and feed the steam via a hose to the still and directly into the mash. That way the heater and the still can be separated by a wall for instance.

3. Lyne arm, Empty 2" pipe 1-1.5 meters long. Copper or stainless steel is best but galvanized pipe may do, it will last long. Be aware that galvanized pipe is unsuitable for consumer grade alcohol . The lyne arm should be at an upwards angle towards the cooling drum which increase strength in the vapour some. The angle is not critical, as long as it is upwards to the cooler. Seal around the pipe at the drum either with silicone or flour/water paste. Or weld it in place.

4. Hose or pipe at the bottom of the cooler. It is important to make a U bend on the hose otherwise ethanol vapour may escape. Seal with silicone or rubber.

5. Cooling water, a constant flow of cooling water cools down the barrel. Since the cooler drum should be covered with thin layer of clothing (cotton for instance) the surface will be wet and water evaporate from the drum.

6. Thermometer, optional. When the temperature rises to 100 C the distillation is complete. Alternatively taste the product to see if there is any alcohol left.

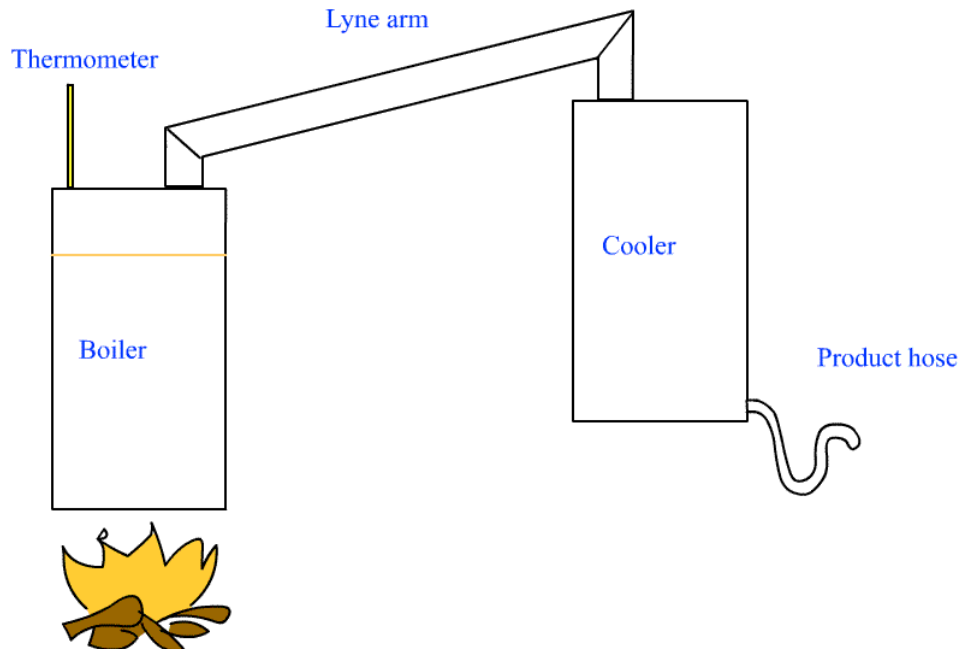
This still will provide an end product over 50 % if the boiler isn't heated too much. There are many different alternatives to this simple pot still. Using a lyne arm to provide extra strength is a simple and old technique used at whisky distilleries. If the top part of the boiler is covered with mineral wool as insulation the still becomes faster.

Make sure there is at least 30 cm (1 foot) free space in the boiler when it is filled up with mash.

To empty the drum, either weld a ball valve at the bottom side of the drum or use a hose as a siphon.

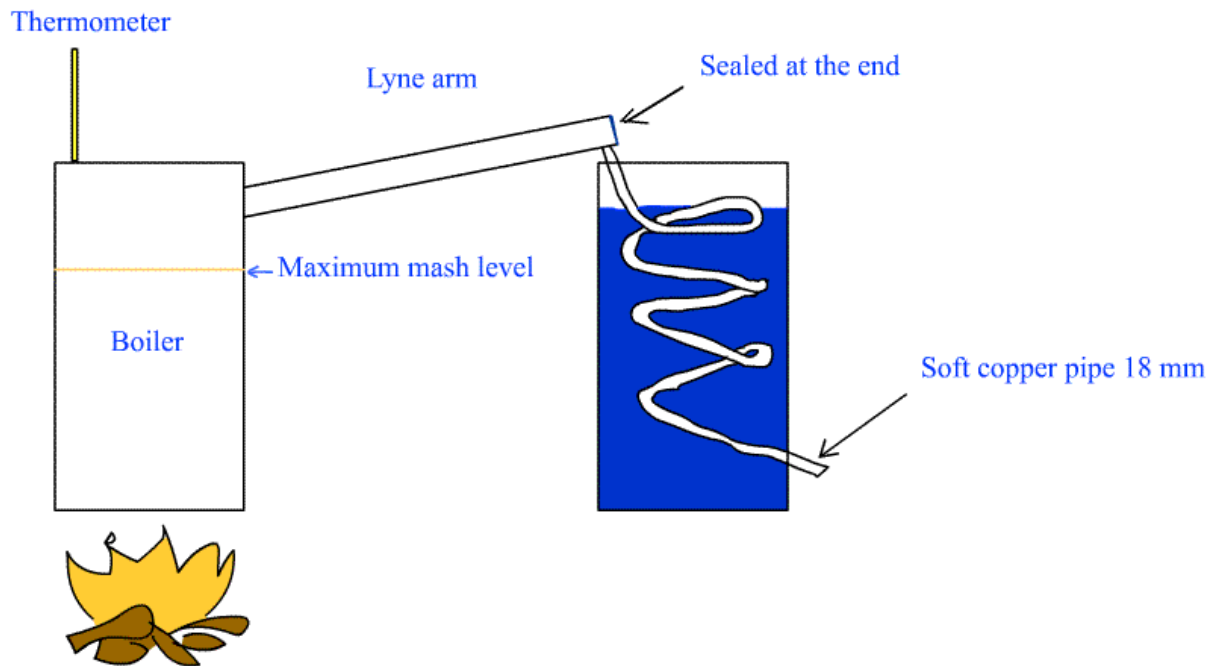
Variations

Alternative placement of the lyne arm



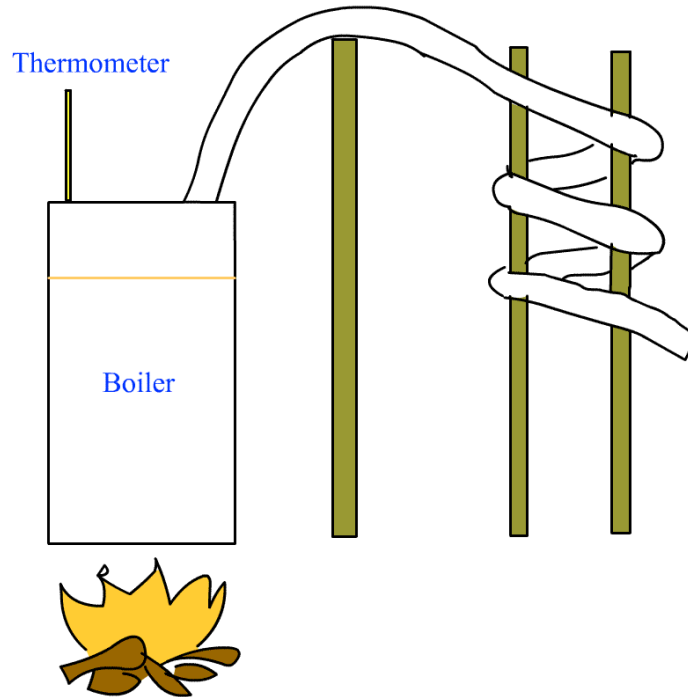
Instead of mounting the lyne arm onto the side of the barrels the lyne arm can use the barrel connectors on the lid. A common type of oil drum has a 2" tap onto the lid. Use a connector to fasten the lyne arm to the 2" tap.

Alternative cooling



From the top of the lyne arm a soft copper tube is connected that is in a barrel of water. The barrel can be made of plastic and doesn't have to be as large as the boiler, 30 litre barrel is enough if cooling water is constantly fed to the barrel.

Stainless steel hose

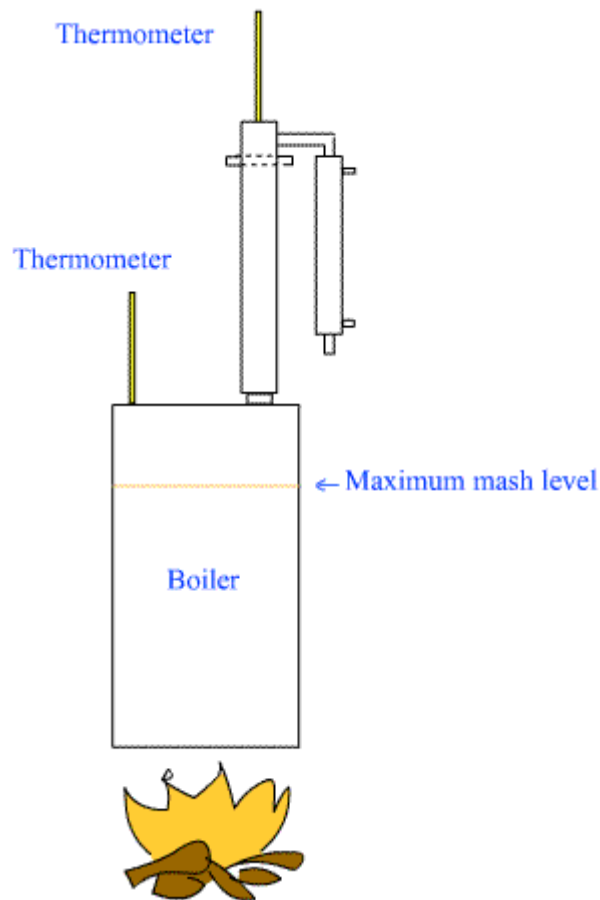


Flexible stainless steel or aluminium hoses are used in the car industry for instance. A 2" hose about 10 metres suit fine as an air cooled condenser. Using air alone as a cooling medium for a condenser limits the cooling capacity but makes the installation simple. Drawback is that the distillation takes longer time. Simply don't top up the boiler with mash to avoid the distillation run to take to too long time. The cooling becomes much more efficient if hose is exposed to breeze.

Make sure to let the pipe go upwards first about a metre to get some reflux back into the boiler, this works as a lyne arm and increases strength. The condenser can be in either in a spiral shape down, winded around sticks or anything else as long as the hose always goes in a downwards direction to avoid that condensate accumulate in the hose.

A long steel pipe works the same way.

Fuel Ethanol still with column



Boiler, can be made of an oil drum for instance (200 litres/50 US gallon or smaller) and be heated by fire, steam, with a gas burner or an electric heater.

Alcohol is highly inflammable. If open fire is used as heat source; make sure the still is in a well ventilated area.

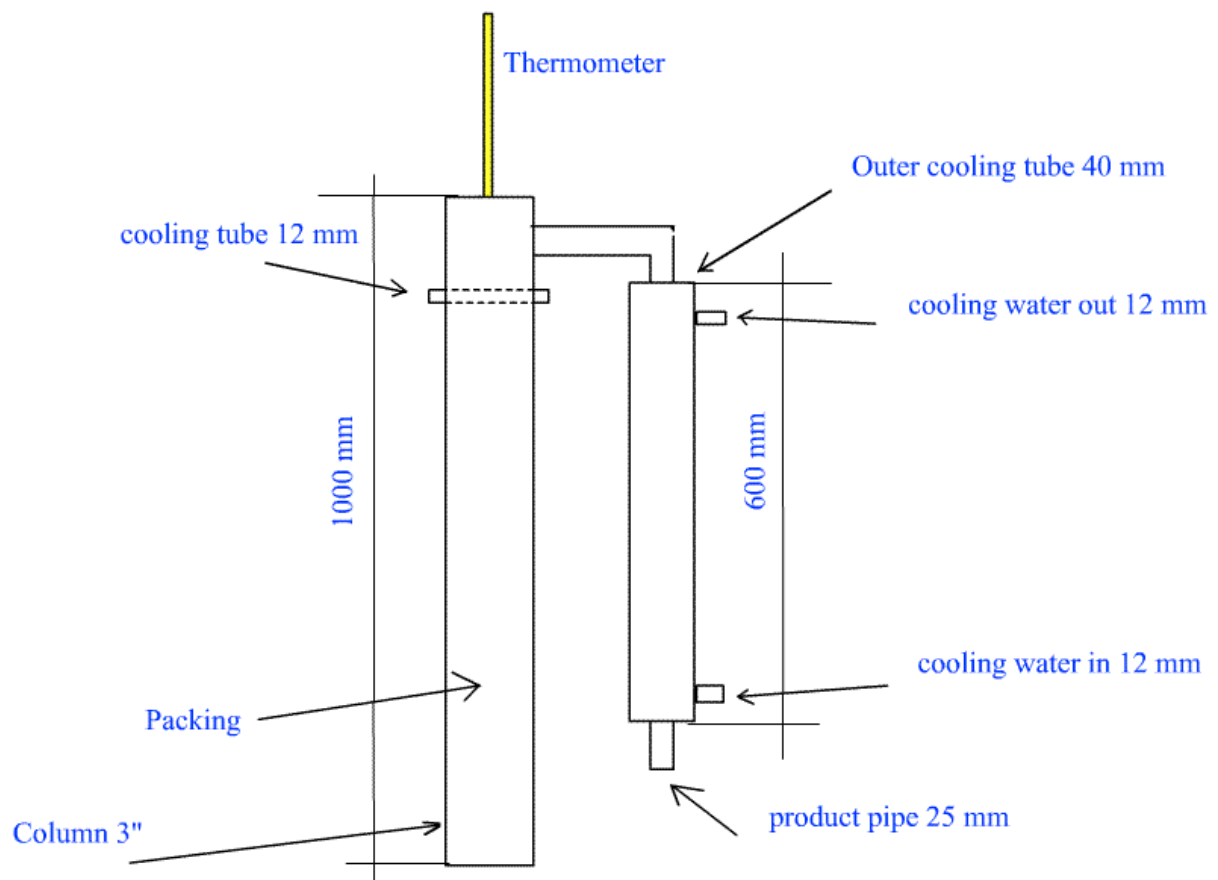
With a column strength and quality can easily be improved. This still is easy to operate and provide some reflux over packing to improve strength to at least 60-70 % even if the cooling water flow is unregulated. If the still is run slowly, that is, if the water flow is high the still can deliver higher strength.

Connect the column either to the drum opening or make a new hole onto the lid to connect the column.

Connect a hose from the product outlet on the column to the product vessel and make sure it is in safe distance from the heat source.

The thermometer on the boiler will tell when the distillation is done. When the temperature is 100C or close to 100, it is time to turn the still off.

Detailed instruction about the column:



Material, either copper or stainless steel. The column should be about 3" to provide enough speed to a 200 litre boiler. One metre high is enough to give rather good separation.

A bit from the top, drill a hole through the column and weld/solder a 12 mm pipe in place that goes through the column. This is the cooling tube. It provides the column with some reflux that will help to increase strength. More than one can be used, mount them a few cm apart. Using more will increase strength but reduce speed. Don't use more than four tubes.

At the top, mount a thermometer. If the temperature is close to 78 °C the strength is over 90 %. If the temperature is too high either reduce heat or increase water flow.

The product cooler is made from a 25 mm pipe with an outer shell made from a 40 mm pipe. The sizes is not critical, they are recommendations. Product pipe can be 18-40 mm. Gap between product pipe and outer cooling pipe is best to keep between 3-10 mm. Too large gap and the cooling capability will suffer. As an alternative to a bent pipe and a condenser that goes straight down a condenser at 45 degree angle downward can be welded onto the column.

Packing: It is essential to have some kind of packing into the column. There are several options. Either use 9 mm raschig rings made of ceramics. Or cut 10 mm copper pipe in 10 mm pieces. Or use pot-scrubbers that are made from stainless steel. Lathe cuttings from stainless steel are a very good packing. This is the preferred choice.

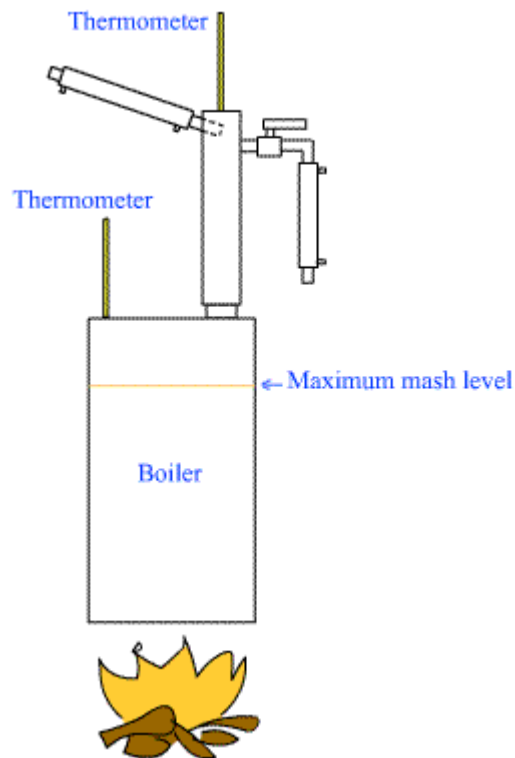
If raschig rings are used it's necessary to have some kind of packing holder at the bottom of the column. A plate with many holes. Pot-scrubbers and cuttings doesn't need any plate, it will stay in place by the column wall.

Fill the column with packing from the bottom up to the cooling tube.

Cooling water should be connected from the bottom of the cooler, out at the top and into the cooling tube.

Make sure there is at least 30 cm (1 foot) free space in the boiler when it is filled up with mash.

Fuel Ethanol still using Vapor Management

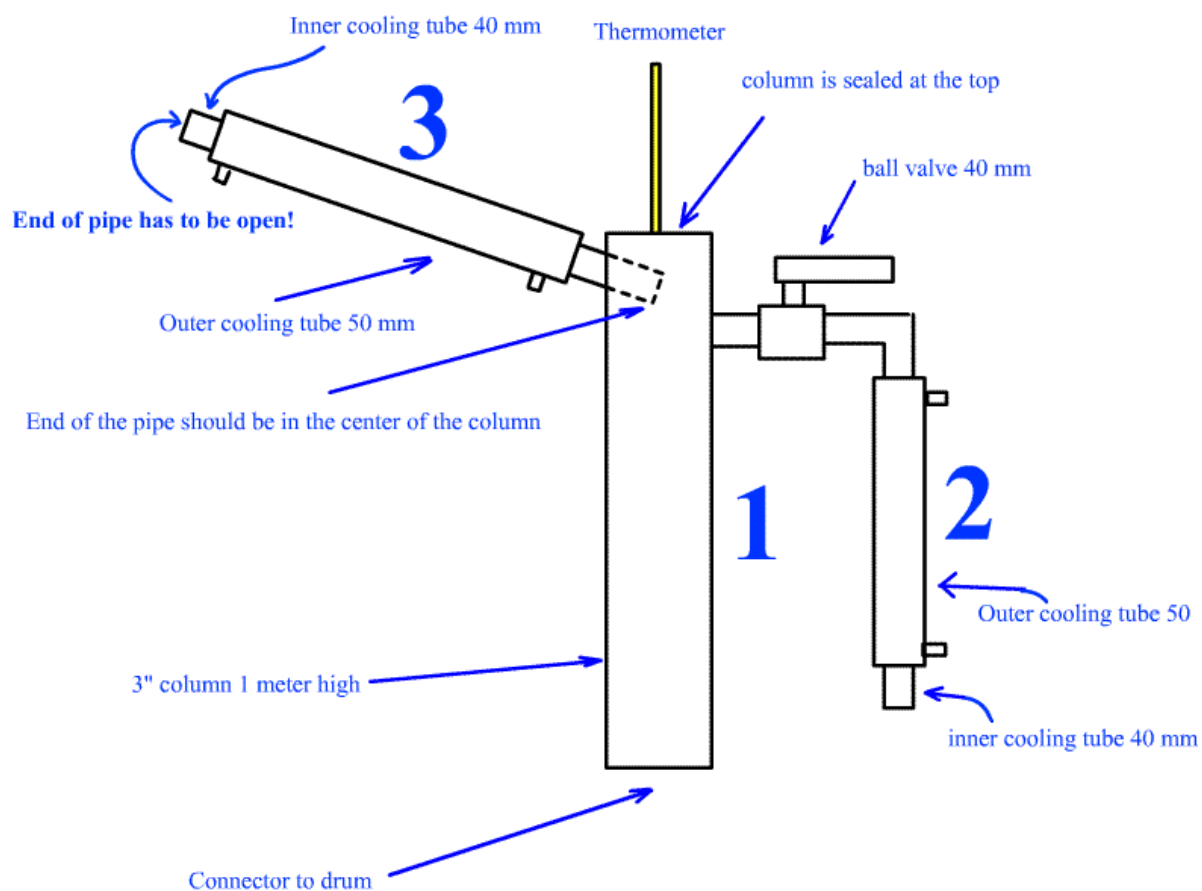


Boiler, can be made of an oil drum for instance (200 litres/50 US gallon or smaller) and be heated by fire, steam, with a gas burner or an electric heater.

Alcohol is highly inflammable. If open fire is used as heat source; make sure the still is in a well ventilated area.

The speed of this still is controlled by a ball valve. This makes it easier to adjust speed so it can produce high strength. It is capable of producing 95% alcohol and is independent on how much cooling water is used as long as enough is provided to cool down all vapor. It has a handy extra feature, when there is no alcohol left in the boiler the product flow will automatically stop.

Detailed instructions of the column:



1. Column, 3" one meter, filled with packing. The column should be filled with packing up to the product cooler's outlet. The outlet shouldn't be covered with packing. The top of the column is sealed.

2. Product cooler. From the side of the column a pipe is connected. Horizontally on the pipe a ball valve with the same diameter as the pipe is connected. Proper size on the pipe is about 30-40 mm. The cooler should be at least 700 mm. Either straight down as in the picture or at a 45-degree angle down. Using it in an angle down will balance the weight better since the reflux cooler is rather long.

3. Reflux condenser. Inner pipe 40 mm, one meter long, outer tube 50 mm diameter 800 mm long. A hole is made into the column and the cooler is welded into place, the angle is not critical but use something close to that on the picture. The bottom end in the column should be close to the center of the column. Important! The other end has to be open to air.

Connect cooling water like this:

Cooling water inlet at the bottom of the product cooler. Water from the outlet of the product condenser goes to bottom of the reflux condenser.

How to operate this still:

Make sure there is at least 30 cm (1 foot) free space in the boiler when it is filled up with mash.

The ball valve on the outlet determine the speed of the still. If it is almost closed, most vapor will go up to the reflux condenser, vapor condense and is returned to the column. This increase strength, speed goes down.

Use the thermometer at the top of the column to see if the speed is too high, if the temperature is above 78-79 °C close the valve a little and in a matter of minutes the temp goes down. The still is capable of producing an end product of 95,5% if fine cuttings are used as packing and the ball valve is just a little open. If the valve is opened too much strength will drop, speed increase. Even at fully opened some reflux will be provided by the reflux condenser so strength will be over 60-70%

Typical procedure:

Close the ball valve completely. Heat up the still and turn on cooling water. When the temperature start to rise at the top of the column, keep the valve closed for another 10 minutes. Then open the ball valve slightly and collect product. This will make high proof alcohol until the boiler temp is around 97 C. How much the valve can be opened depends on how much power is used and the alcohol content in the mash. Watch the top temperature, it should be steady at 78. If it rises, close the valve more. It takes a few runs to learn how much the valve can be opened to achieve high strength and good speed.

For producing high quality drinking alcohol it's necessary to first remove heads. At the beginning when the product start coming out, product will contain volatile substances called heads. Remove them slowly with the ball valve just a little opened. It has a strong smell and will taint the alcohol if not removed. It takes about an hour or two to remove them completely. After that pure ethanol is withdrawn until boiler temp is around 97 C. Run the still slow the first few runs to learn what quality can be achieved. Then increase speed. The slower the still is ran the better the quality become.

The thermometer on the boiler is optional but it is practical to see when it's time to stop distillation. When it's close to 100 °C it's time to turn the still off.

Packing: It is essential to have some kind of packing into the column. There are several options. Either use 9 mm raschig rings made of ceramics. Or cut 10 mm copper pipe in 10 mm pieces. Or use pot-scrubbers that are made from stainless steel.

Lathe cuttings from stainless steel are a very good packing. This is the preferred choice.

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Please note! this is general information, unfortunately we haven't got time to answer any specific questions about the stills. For latest update of this information always check www.distillery-yeast.com

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