WALTHERS CORNERSTONE® SERIES

HO Scale
Structure Kit
933-2977

FERMENTATION TANKS

Thanks for purchasing this Cornerstone® kit. All parts are made of styrene plastic, so use only styrene compatible paints and glues. Please read these instructions and study the drawings before starting.

Since the 1970s ethanol, or grain alcohol, has been promoted as a clean-burning, renewable alternative to gasoline. As the push toward reduced emissions, cleaner air and lower dependence on imported oil increases, ethanol has found favor as a gasoline additive. About 70% of the gasoline sold in the U.S. in 2007/08 contained some ethanol, mostly in a 10% blend. With over six million flexible fuel vehicles on the highways as of 2007/08, the 85% ethanol-15% gasoline blend called E85 was becoming widely available at gas stations.

Ethanol is big business—especially for railroads. Raw materials, or feedstocks, for ethanol production can come from many sources as diverse as sugar cane, municipal solid waste, wood, kudzu and various grains. Corn is most common, with about 70% of new plants proposed in 2009 using corn or other materials in combination with corn. With plenty of rail-served grain handling and petroleum infrastructure already in place across the continent, railroads are perfectly poised to handle ethanol related traffic.

The ethanol production process begins with unloading corn in a shed that accommodates hoppers and trucks. Railroads haul corn from rural elevators in covered hoppers. Carload lots and entire unit trains move to ethanol plants—how much each receives is dependent on plant size and location. For example, a 100 million gallon per year plant (typical sizes range from 50 to 110 million gallons) that receives 60% of its corn by rail gets about 17 cars per day, the rest arrives by truck from local producers. Inside the unloading shed corn is dumped into below-ground bins; augers and an elevator conveyor leg move it to storage silos. In many cases, a 10-day supply of corn is kept at the plant.

The transformation of corn into ethanol and DDG (dried distillers grains, a protein-rich co-product of ethanol used in animal feed) begins once it enters the processing center where the corn is milled and mixed with water to make mash. Enzymes are added to break down starches into simple sugars such as dextrose. Ammonia is added to control pH and to feed the yeast during fermentation. The mash is cooked to reduce levels of unwanted bacteria, then cooled and piped to fermentation tanks where yeast is added.

The fermentation tanks are where ethanol is actually made. The large tanks hold liquid mash while yeast digests the sugars to produce ethanol and carbon dioxide. In-tank agitators keep the mixture moving to prevent the settling of solids. Temperature control, using cool water, during all these steps is essential—too cool and fermentation is slowed, too hot and the yeast is killed before it can convert the sugars into ethanol.

The fermentation building is positioned between the tanks, beer well and alongside the processing center. It houses circulating pumps, temperature monitoring equipment and other support apparatus. During fermentation mash is continuously circulated between the tanks and cooling units in the building.

The tanks hold each batch of mash for 42-48 hours as the yeast does its work. Including filling, fermentation, emptying and cleaning, the process takes about 55 hours. The mixture of alcohol and solids, now called beer (but not the kind you would drink) is piped into the beer well (the slightly larger fermentation tank adjacent to the fermentation tanks) which, in turn, feeds mash into the distillation equipment in the processing center. Some fermentation continues in the beer well, but the mixture is no longer subject to continuous circulation and cooling.

Distillation yields 190 proof (95 percent by volume) ethanol. Solids in the liquid, called stillage, are removed. Further dehydration of the alcohol in molecular sieve tanks yields 200 proof, or essentially pure, ethanol. As the ethanol is piped to storage tanks, 5% gasoline is added to make it unfit for human consumption (drinkable ethanol is subject to beverage taxes). At this point, the finished product is ready to ship in tank cars. The water from distillation is cooled in the cooling tower and reused within the plant.

Stillage, the leftover corn solids minus the starch, is moved to the energy center where it's processed into DDG. In the energy center building, DDG is dried, pelletized and shipped to the storage shed for eventual shipment in covered hoppers. A 100 million gallon per year plant ships 10 cars of ethanol and nine hoppers of DDG pellets daily.

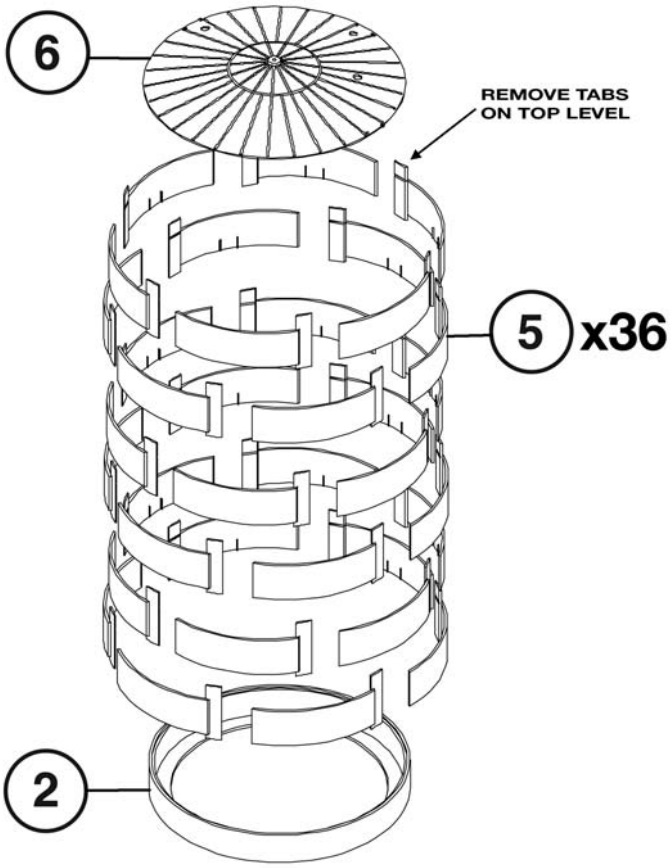
On Your Layout

The fermentation tanks are an essential part of the North American Ethanol complex—they're where ethanol-producing chemical reactions take place. The kit includes three fermentation tanks, a beer well and fermentation building designed for placement next to the processing center. For more detail, add the Fermentation Tank Detail Kit, #933-2981, sold separately. The detail kit includes agitator details, exterior stairways, walkways and a carbon dioxide scrubber and stack. This structure kit is part of the North American Ethanol series. The rest of the kits in the series make it easy to model an entire ethanol plant.

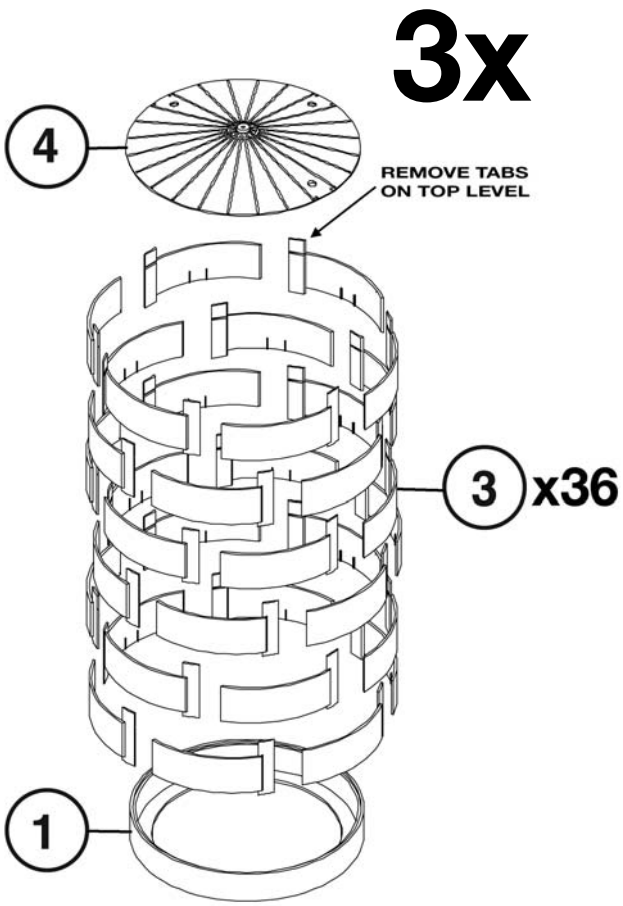
Ethanol plants rely heavily on rail service. Inbound traffic includes covered hoppers of corn and tank cars of gasoline. Outbound loads include ethanol tank cars and covered hoppers of DDG pellets. A steady flow of empty cars doubles the volume of cars, so plants often have their own switcher. The PROTO 2000® EMD SW1200 is ideal for your ethanol facility.

Cars serving the facility are easily modeled with Gold Line™ Evans 4780 Cubic Foot Covered Hoppers, Trinity 6351 4-Bay Covered Hoppers and Trinity 30,145-Gallon Tank Cars.

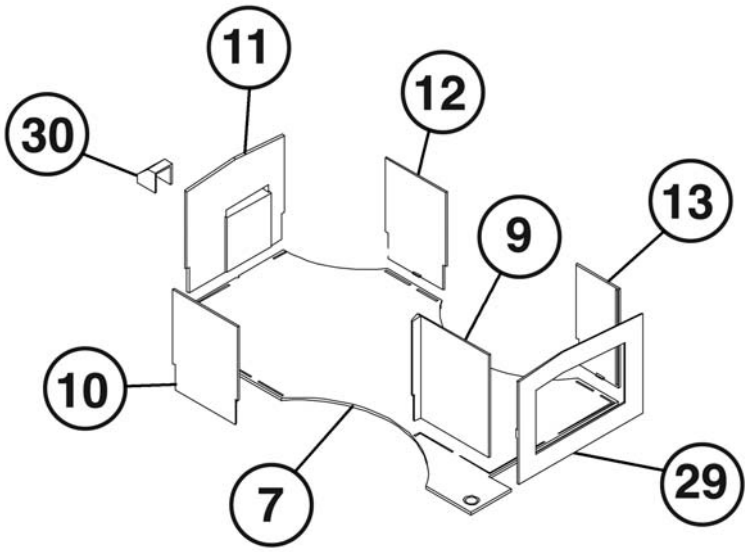
To build a larger ethanol plant, add more fermentation tanks by combining kits to create a larger fermentation facility. The largest plants have eight or more tanks. The components in this kit are also usable for other industries. The tanks resemble jacketed, insulated tanks used for storing temperature-sensitive materials.



1. On a flat surface, glue the first level of beer well segments (5) together, over lapping the ends. Then build on successive levels, staggering the segments. Note: The tabs on the tops of the segments will fit in between the raised ridges on the backs of the pieces that are stacked above. Cut off the tabs on the top most level. Once the well is completed, carefully insert the bottom segment level into the base (2). Note: By starting at one point on the base and inserting as you move around, the well will snap into the base. Then glue it in place. With the tabs on the upper level removed, glue on the top (6).



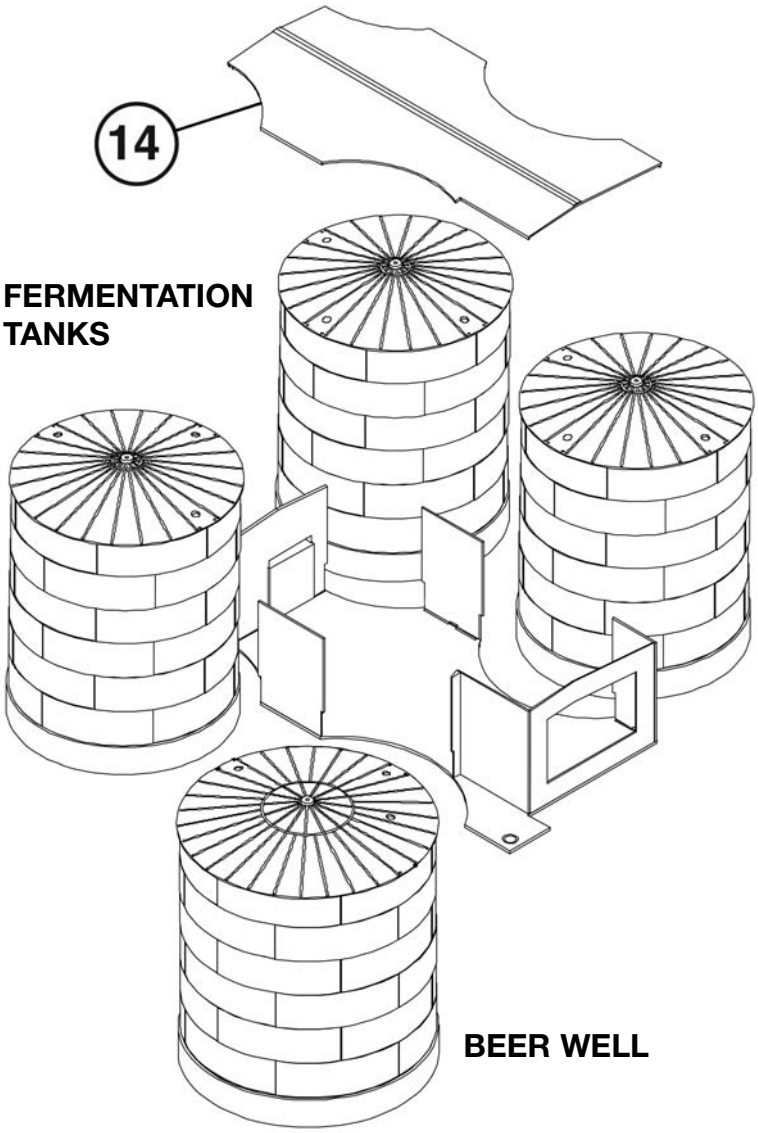
2. On a flat surface, glue the first level of fermentation segments (3) together, over lapping the ends. Build on successive levels, staggering the segments. Again, the tabs on the tops of the segments will fit in between the raised ridges on the backs of the pieces that are stacked above. Cut off the tabs on the top most level. When completed, carefully insert the bottom segment level into the base (1). When tank is fully inserted in base, glue in place. Glue the top (4) onto the tab less top segment. Follow this procedure two more times for a total of three fermentation tanks.

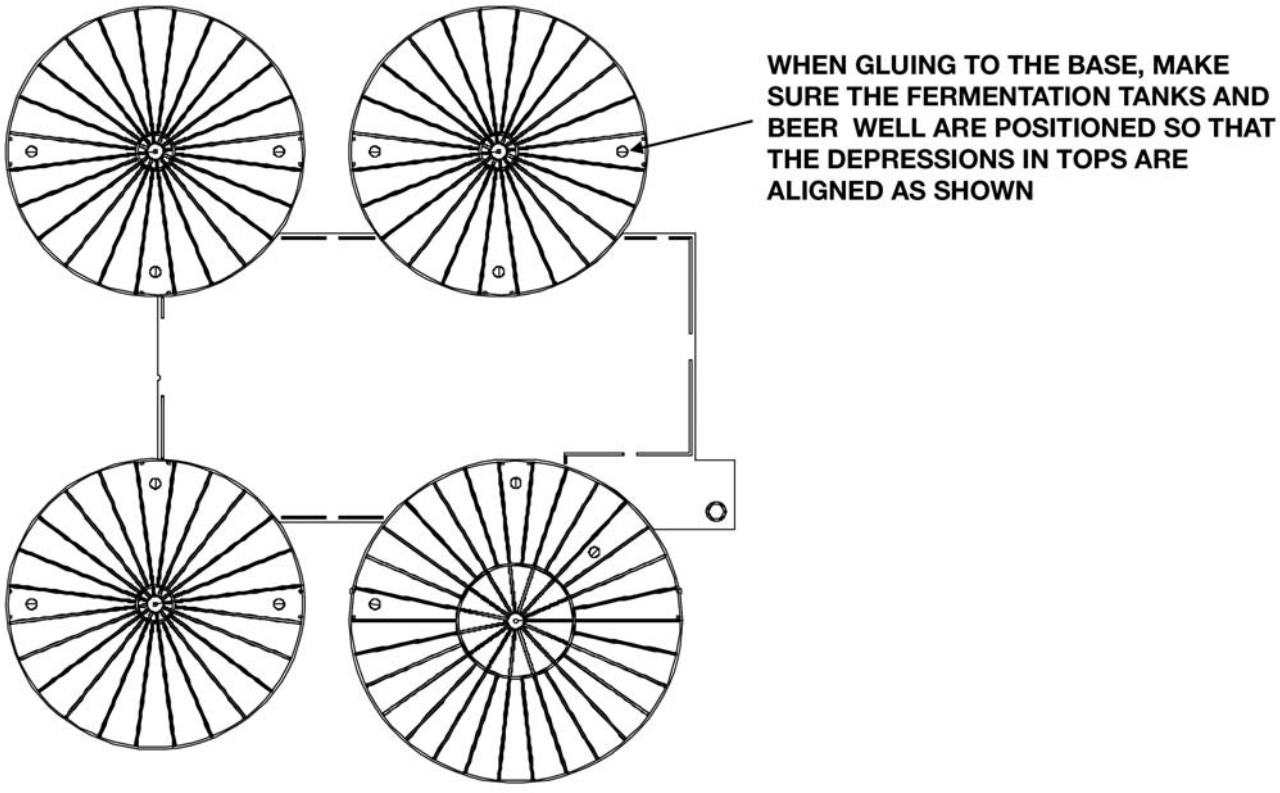


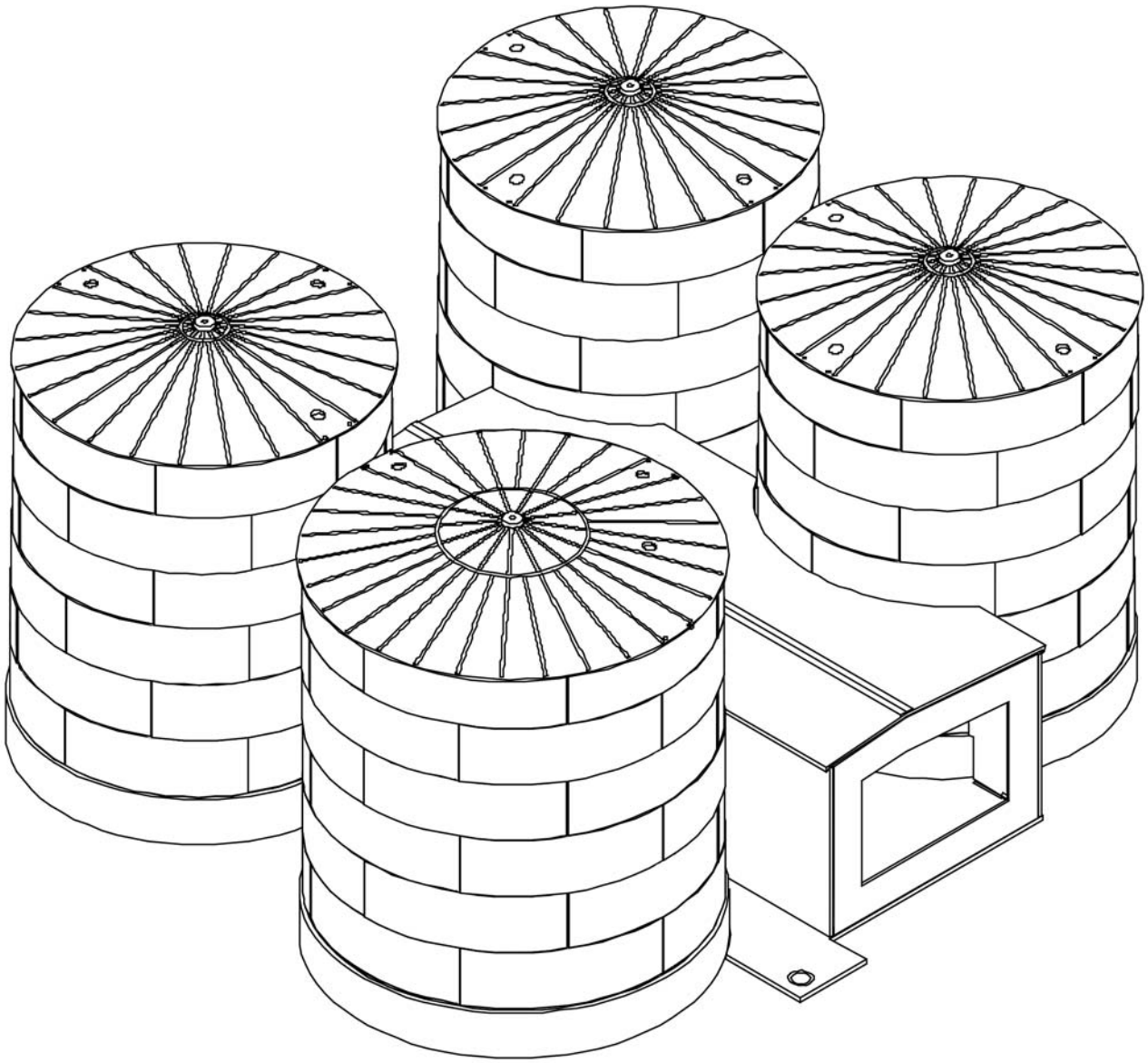
3. Glue the walls (9, 10, 11, 12, 13, 29) to the main base (7) as illustrated. Glue the wall vent (30) in place over the small door on wall #11.

4. Glue the beer well along with the three fermentation tanks to the main base. Note: If you are combining this kit with the Fermentation Tank Detail Kit, 933-2981 (available separately), make sure to align the round indentations on the tops as shown in top view illustration below. This is important as the walkways and piping attach at these points.

5. Once the tanks are in place, glue on the roof (14).







There are two options for applying signage to your structure. The first is by waterslide decals. This works well on smooth surfaces. Follow the instructions for “Decals” below. For the second option, useful on corrugated surfaces, follow the instructions for “Signs”.

DECALS

1. After cutting out the decal, dip in water for 10 seconds, remove and let stand for 1 minute. Slide decal onto surface, position and then blot off any excess water.

2. Lightly brush Micro Sol® on top. This will soften the decal, allowing it to conform to irregular surfaces. DO NOT TOUCH DECAL while wet!

3. When decal is thoroughly dry, check for any trapped air bubbles. Prick them with the point of a small pin or hobby knife blade and apply more Micro Sol®.

SIGNS

1. Carefully cut out sign, trimming as close as possible to the graphic. You will be using the paper backing as a sign board.

2. Apply white glue on the back of the sign and place in position on the wall.