FM-32-01
Orig. 3/05
Rev. 1/2015

Public Protection Cabinet
Department of Housing, Buildings & Construction
Division of Fire Prevention
101 Sea Hero Road, Suite 100
Frankfort, Kentucky 40601-5405
Phone # 502-573-0382 Fax # 502-573-1004

Investigation Response Report

1. ***SFMO* CASE NUMBER:** 1504241113FIRT

2. ***EOC* INCIDENT NUMBER:** 20152462

3. **FACILITY (PROPERTY):** Silver Trail Distillery

4. **STREET:** 136 Palestine Road

5. **CITY:** Hardin **COUNTY:** Marshall

6. **GPS LOCATION: N36° 45' 44.44" / W88° 12' 25.59"**

TIME AND DATE OF OCCURENCE

7. **TIME OF OCCURRENCE:**
DAY OF WEEK: Friday **DATE:** 4-24-15
TIME (MILITARY TIME): 10:32:46TIME ZONE: ☒ **CENTRAL** ☐ **EASTERN**

8. **WEATHER CONDITIONS AT TIME OF INCIDENT: TEMP** 59F **WIND DIRECTION** ESE 8.1 mph

9. **NAME(S) OF PERSON REPORTING INCIDENT: Sheila Balentin**
CAN BE REACHED AT THIS ADDRESS: 5402 Aurora Highway
PHONE NO.: 270-354-9657

10. **SFMO RESPONSE REQUESTED BY:** Marshall Co. EM Director Frank Murphy
TIME OF REQUEST (MILITARY TIME): 12:01 EST DATE OF REQUEST: 4-24-15

OCCUPANCY, INCIDENT TYPE & ENERGY SERVICE

11. **OCCUPANCY TYPE:**
☐ **SINGLE FAMILY** ☐ **MULTI-FAMILY (APARTMENT)** ☒ **BUSINESS**
☐ **HEALTHCARE** ☐ **INDUSTRIAL** ☐ **SCHOOL**
☐ **UNIVERSITY** ☐ **CORRECTIONS** ☐ **PLACE OF WORSHIP**
☐ **MOBILE/MANUFACTURED HOME** ☐ **OTHER:**

IF MOBILE/MANUFACTURED HOME: ☐ **DATA PLATE COULD NOT BE LOCATED**
YEAR: MAKE: MODEL:
SERIAL NO.: HUD NO.:

12. **INCIDENT OCCUPANCY TYPE:**
☒ **FIXED FACILITY** ☐ **TRANSPORTATION** ☐ **OTHER:**

13. **CONSTRUCTION TYPE:** ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

14. TYPE OF INCIDENT: ☒ FIRE ☐ EXPLOSION ☐ FIRE/EXPLOSION
☐ SPILL/LEAKAGE ☒ OTHER: alcohol still event

15. UTILITIES: ☒ ELECTRIC ☐ NATURAL GAS ☒ PROPANE ☐ OTHER:
UTILITIES DISCONNECTED: ☐ YES ☐ NO

RESPONDERS & INVESTIGATORS

16. SFMO PRIMARY INVESTIGATOR
NAME: Bill Compton BADGE NUMBER: 104
NOTIFICATION MADE – DAY OF WEEK: Friday DATE: 4-24-15 TIME (MILITARY TIME): 1113
ARRIVED ON SCENE: DAY: Friday DATE: 4-24-15 TIME (MILITARY TIME): 12:21

17. SFMO SECONDARY INVESTIGATOR
NAME: Laroy Martin BADGE NUMBER: 53
NOTIFICATION MADE – DAY OF WEEK: Friday DATE: 4-24-15 TIME (MILITARY TIME): 11:38
ARRIVED ON SCENE: DAY: Friday DATE: 4-24-15 TIME (MILITARY TIME): 12:02

☐ SEE NARRATIVE FOR ADDITIONAL SFMO INVESTIGATORS

18. NAME OF PRIMARY RESPONDING FIRE DEPARTMENT: Aurora Ross Fire Department
PHONE NO.:
HOW WAS FIRE DEPARTMENT NOTIFIED? Marshall County Dis
ARRIVED ON SCENE: DAY: Friday DATE: 4-24-15 TIME (MILITARY TIME): 10:43

19. NAME OF FIRST-IN FIREFIGHTER:
NAME OF FIRST-IN FIREFIGHTER'S DEPARTMENT NAME:

20. ADDITIONAL RESPONDING AGENCIES:
☐ KENTUCKY STATE POLICE *(KSP)* ☒ SHERIFF ☐ LOCAL POLICE DEPT.
☐ ALCHOL TOBACCO & FIREARMS *(ATF)* ☒ EMERGENCY MEDICAL SERVICES *(EMS)*
☐ KENTUCKY MEDICAL EXAMINATORS OFFICE *(KY ME)* ☐ COUNTY CORONER
☐ NATIONAL RESOURCES *(NR)* ☒ OTHER: Hardin-South Marshall FD. Fairdealing-Olive FD. East Marshall FD, Marshall Co. EM. Dept. Of Housing Boiler Division. Kentucky OSHA.

☐ SEE LIST OF OUTSIDE AGENCY INVESTIGATORS

OCCUPANTS

NO.	NAME	SEX	ADULT / MINOR	INJURED	DEATH
1.	Jay Rogers	☒ M ☐ F	☒ A ☐ M	☒ YES ☐ NO	☐ YES ☒ NO
2.	Kyle Rogers (date of death 5-11-15)	☒ M ☐ F	☒ A ☐ M	☒ YES ☐ NO	☒ YES ☐ NO
3.		☐ M ☐ F	☐ A ☐ M	☐ YES ☐ NO	☐ YES ☐ NO
4.		☐ M ☐ F	☐ A ☐ M	☐ YES ☐ NO	☐ YES ☐ NO
5.		☐ M ☐ F	☐ A ☐ M	☐ YES ☐ NO	☐ YES ☐ NO
6.		☐ M ☐ F	☐ A ☐ M	☐ YES ☐ NO	☐ YES ☐ NO
7.		☐ M ☐ F	☐ A ☐ M	☐ YES ☐ NO	☐ YES ☐ NO
8.		☐ M ☐ F	☐ A ☐ M	☐ YES ☐ NO	☐ YES ☐ NO
9.		☐ M ☐ F	☐ A ☐ M	☐ YES ☐ NO	☐ YES ☐ NO
10.		☐ M ☐ F	☐ A ☐ M	☐ YES ☐ NO	☐ YES ☐ NO

☐ SEE ATTACHMENT FOR LIST OF OCCUPANTS

21. OTHER: INJURY: ☒ YES ☐ NO NAME(S): Jay Rogers
OTHER: DEATH: ☒ YES ☐ NO NAME(S): Kyle Rogers (5-11-15)

OWNER, TENANT & WITNESS INFORMATION

22. NAME OF OWNER: Spencer Balentine OWNER'S PHONE NO.: 270-474-3052
CAN BE REACHED AT THIS ADDRESS (INCLUDE STREET, CITY & COUNTY): 5402 Aurora Highway Hardin, Ky.

HOW LONG HAS THE OWNER OWNED THE PROPERTY? 1987(land) After residence was build moved into structure in 1999. Distillery building built in 1998 and interior completed in 2010 by Ricky Conner

23. **NAME OF TENANT:** Silver Trails Distillery/Balencorp **TENANT'S PHONE NO.:** 270-474-3052
CAN BE REACHED AT THIS ADDRESS (INCLUDE STREET, CITY & COUNTY): 136 Palestine Road Hardin, Ky.

☒ **SEE WITNESS LOG FOR WITNESS INFORMATION.**

24. **OCCUPANT STATMENT**
A. **NAME OF INTERVIEWED PARTY:** Spencer Balentine
B. ☒ **OWNER** ☐ **TENANT** ☐ **OTHER (SPECIFY):**
C. **DATE OF INTERVIEW:** 4-24-15
D. **ANY KNOWN MECHANICAL TROUBLE WITH:** ☐ **PLUMBING** ☐ **HEATING** ☐ **ELECTRICAL**
☒ **NO TROUBLE KNOWN AT THE TIME INTERVIEW**
IF YES, DESCRIBE:
E. **HAVE ANY REPAIRS BEEN MADE RECENTLY?** ☐ **YES** ☒ **NO**
IF YES, WHEN AND WHAT WAS REPAIRED?
IF YES, WHOM MADE REPAIRS:

25. **HAVE YOU EXPERIENCED ANY OTHER FIRE(S) AT THIS FACILITY (PROPERTY)?** ☐ **YES** ☒ **NO**
IF YES, WHEN, WHAT WAS THE CAUSE AND LOCATION OF FIRE(S)?

26. **PROTECTION:** ☐ **SMOKE ALARM** ☐ **FIRE ALARM SYSTEM** ☐ **SPRINKLER** ☒ **NONE**
IS SMOKE ALARM, DID SMOKE ALARM NOTIFY OCCUPANTS? YES ☐ **NO** ☐ **UNKNOWN**

INSURANCE

27. ☐ **NO INSURANCE ON FACILITY/PROPERTY**

TENANT'S INSURANCE
NAME: Silver Trail Distillery/Balencorp **PHONE NO.** 270-474-3052
NAME OF INSURANCE COMPANY: Cincinnati Mutual - Agent: Peel & Holland
INSURANCE CO PHONE NO.
AMOUNT OF INSURANCE COVERAGE: $200.000 equipment and contents

OWNER'S INSURANCE
NAME: Spencer Balentine **PHONE NO.**
NAME OF INSURANCE COMPANY:
INSURANCE CO PHONE NO.
AMOUNT OF INSURANCE COVERAGE: $

INVESTIGATION NARRATIVE, CONCLUSTION AND RECOMMENDATIONS

INVESTIGATION NARRATIVE

On the morning of Friday, April 24th at 11:13 (CST) I received a call from Deputy State Fire Marshal Randy Thompson requesting that I respond to an alcohol still explosion at 136 Palestine Road in Hardin. Deputy Thompson further advised me that two employees had been burned as a result of the event and had been transported via air ambulance to a burn center. I advised Deputy Thompson that I had taken the day off and would have to get back to my residence to be able to respond. I asked that he make arrangements to have Deputy Laroy Martin respond to the scene as well due to my delayed response. After returning home and getting ready I went en route to the scene at 11:45. At 12:21 I arrived at 136 Palestine Road Hardin, KY to find multiple fire departments and emergency response agencies working the incident. Deputy Laroy Martin's vehicle was also on scene. I observed what appeared to be the smoldering remains of a metal sided pole barn that had been consumed by fire. I saw no visible debris field that would typically result from an explosion. Metal tin was lying outside of the building perimeter but it appeared to be as a result of firefighters dragging it out of the scene during overhaul operations, which were still in progress. Upon checking with personnel on scene as to where Deputy Martin was, they explained to me that he was at the still owner's residence, which was on site, interviewing the still owner. I had to walk past the fire scene to get to the owners residence. As I walked pass the fire scene to the residence I saw what appeared to be the remains of the alcohol still lying in the gravel driveway on the north end of the building. Upon reaching the residence I found Deputy Laroy Martin communicating with the still owner, Spencer Balentine. I advised Mr. Balentine that I would need to complete a recorded interview later, but that for the time being I needed to get a brief overview of what had occurred. Mr. Balentine advised that he was at his residence finishing up eating breakfast when he heard a pop. His wife was ironing at the time and said she thought something had happened up at the distillery. Upon looking out his window he noticed that the large metal door on the north end of the building was pushed out. He ran up to the distillery from his residence to find his two employees that were working in the distillery at the time to be outside

and severely injured. He shut off the propane at the tank and inquired what happened with Jay Rogers, his second distiller. Jay Rogers advised that the still had blew. Mr. Balentine went inside the distillery and saw what he thought was flaming mash on the walls. He helped his employees down to his residence and had his wife call 911. Mr. Balentine advised there was nothing out of the ordinary that had occurred prior to the event. Upon asking if there had been any issues with the still, he advised that on the second run of the still after purchase the seam that secured the bottom to the sidewall split. The split was approximately 3 inches wide and allowed the liquid in the pot to squirt out of the split in a flat stream looking similar to the end of a paint brush. He further explained that he reached out to the manufacturer of the still, Revenoor Stills, and got advice on how to repair the split. There had been no further mechanical issues with the still. After talking briefly with Mr. Balentine, Deputy Martin and I returned back to the distillery to review the remains at the scene. We advised Mr. Balentine that we would return in a few hours to conduct a recorded interview.

Deputy Martin and I walked back up to the remains of the distillery so I could start my on scene examination. Fire Department personnel confirmed that the structure was still standing upon their arrival with fire and smoke visible. I was able to confirm that the tin that I saw lying on the perimeter of the scene, some of which was stacked, was as a result of overhaul of the fire. A complete survey of the perimeter of the structure revealed no indications of a debris field resulting from an explosion. The only thing that was visibly displaced from its original resting place in the structure was the still itself. The still was originally located on a metal framed platform on the north end of the structure. The platform measured 6' in length (N-W) and 5' in width (S-E). The platform was positioned 12' 2" from the north end of the structure's concrete slab and 11' from the west wall. The platform was covered with sheet metal with the exception of a circular opening of 3' 10" on the top where the still's base rested. The opening on the top exposed the interior of the platform where four burners were located that directly fired the still. On the top, south end of the platform was aluminum diamond tread plate installed as a stepping area to access the still. It should be noted there was absolutely no visible signs of any displacement or movement of the platform or any of its components as a result of an explosion/blast wave. There was another rectangular still adjacent to the platform. The other still was located 2' off the southwest corner of the main still platform and 3' off the west wall. The still was placed perpendicular to the west wall. There were also no physical signs of displacement of this still as a result of an explosion/blast wave either. For that matter there were no physical signs inside the remains of the structure of any explosion or blast wave. The only obvious physical indications of anything being displaced as a result of an incident at the facility was the copper still that was now resting in the driveway on the north end of the remains of the structure. The body of the copper still (aka the "pot") was located approximately 50' from the north end of the structure in the gravel driveway lying on its side. The copper column of the still, which would have been bolted to the top of the pot, was located in proximity to the pot and approximately 72' from the end of the structure. Also located 95' from the north end of the building in the gravel driveway was a round stainless steel plate. The plate appeared to be utilized as an access opening in the top of the pot of the copper still. Closer examination of the pot revealed the side wall of the pot to be intact. However, the bottom of the still was folded back away from the side walls and only remained attached at one narrow point. The bottom of the pot, the side adjacent to the burners, showed signs of scorching of the metal where the burners were located. Additionally, one area showed much greater signs of heat damage than the other three. Further examination of the copper pot revealed the following items to be connected: (1) sight glass with valve at bottom, (2) three outlets capped with threaded plugs in side wall, (3) one clean out inside at base with ball valve, (4) eight electric heating elements in side wall never connected to electric, (5) one temp gauge in side wall, (6) one temperature and pressure relief valve in top of pot with discharge pipe terminating near base of pot and (7) large opening in pot's top for filling. The pressure and temperature relief valve was identified as a model LLL100XL produced by Watts and rated at 150 psi and 210°F. The column was also constructed of copper and was approximately 4" in diameter. The column would have been installed in the center of the top of the pot of the still. The bottom of the column contained two metal flanges that were bolted together. The bottom flange was installed to the top center of the copper pot. At some point during the event the column was ripped off the top of the pot just below where the pots flange was secured to the pot. Upon viewing inside the bottom of the column, through the holes in the flange, I could see a metal plate with holes in it. Behind the metal plate and viewed through the holes were what appeared to be glass balls. Being the column is sealed there was no way to access the inside of the column past the plate to investigate further. Also, found in the column was a temperature gauge, an intake and discharge connection for the water coil inside the column, and a discharge port from the column to vapor/product to travel to a condenser. The condenser was found lying directly adjacent to the pot. Also found in the area was other copper tubing that used to be connected to the still.

Both stills were direct fired by utilization of liquefied propane gas. The facility was serviced by a 500 gallon propane tank that was located approximately 85' north from the northwest corner of the distillery behind an old wooden smoke house. At the time of my examination the tank reflected 65% product. The tank was equipped with a Rego Model LV4403 High Pressure First Stage Regulator. Located on the back side of the building secured to the concrete wall was a Rego Model LV4403 Low Pressure Second Stage Regulator. However, the configuration of the piping and placement of the regulator in the piping allowed not only low pressure but high pressure gas flow to the inside of the distillery. Further investigation revealed that both of the stills inside of the facility were operating on high pressure service. It was determined that the low pressure service fed heaters inside the structure. The burners to both stills were controlled by way of needle valves at each still. Examination of the burners for the still involved in the event revealed no safety shut off devices for the burners. I was unable to see whether the smaller still had safety shut off devices for the burners or not. There were a total of 4 ball type shut off valves controlling the flow of propane to the stills: a master ball valve on the west wall controlling flow to both stills, two ball valves on the small still one each controlling a manifold with two needle valves, and one ball valve on the large still controlling a single manifold with four needle valves. Also

located on the rear west concrete wall of the structure was a ball valve connected to the supply line coming out of the ground from the tanks. An additional safety shut off valve was installed to control the flow of the high pressure gas into the facility. All ball valves controlling both stills, the master valve inside on the west wall and both control valves at the rear of the structure were all in open position at the time of inspection. Based upon examination of the scene there was inadequate evidence to support the event that occurred at this facility to be related to a propane release. All propane piping at the facility was completed by Ricky Conner with Greg's Service. The propane tank is owned by the facility and was last filled by Fortner Gas approximately one week prior to the event.

After completing a detailed review of the scene, Deputy Martin and I returned to the Balentine residence just down from the distillery to complete a recorded interview of Spencer Balentine. The recorded interview is attached as a matter of record of the case file. Mr. Balentine stated that he started the still at 07:00 the morning of the incident and stayed with the still until his second distiller, Jay Rogers, arrived. Upon the arrival of a third employee, Kyle Rogers, Mr. Balentine walked down to his residence to have breakfast. Mr. Balentine stated that as soon as he got up from the table from eating breakfast he heard a "pop". Mr. Balentine's wife, Sheila, was also in the residence and told Mr. Balentine that she thought something had happened at the distillery. Upon looking out the window Mr. Balentine could see that the large metal door on the north end of the structure was pushed out. He then ran up to the distillery from his residence and found Jay and Kyle Rogers in the area of the wooden smoke house that was away from the distillery. He stated that Jay Rogers was screaming for him to turn off the propane tank. Mr. Balentine then ran over to the propane tank to turn it off. Upon returning to where his employees were located he asked Jay Rogers what happened. Jay Rogers advised him that the still had blown. Mr. Balentine went inside the distillery and witnessed what he assumed was flaming mash on the walls. He was unsure as to whether he could extinguish the fire or not. Mr. Balentine stated that he ran back out to get his employees and stated it was all he could do to get them to his residence. Upon getting to his house me was met by his wife, Sheila Balentine, and advised her to call 911. He further explained that neither of his employees lost consciousness while he was with them. They waited for responders to arrive and emergency medical services treated the employees and waited for air ambulances to arrive to transport them to a burn center.

During the interview Mr. Balentine stated that the still in question was a 300 gallon unit produced by Revenoor Stills of Yamhill, Oregon. The still was ordered with electric heating elements but they were never wired up. Mr. Balentine advised that he utilized propane to fire the still because he found that he had better luck. He had a base constructed for the still to sit on which housed the 4 burners for the still. Installed in the base was a ventilation fan that pushed combustion gas to the exterior of the building by way of vent pipes. Upon asking Mr. Balentine how he regulated the temperature of the pot, he explained that he did so by cutting back on the propane burners. He also advised that the column temperature was regulated by water flow into the coils inside the column. Both the column and the pot had temperature gauges that allowed him to monitor temperatures. Mr. Balentine further stated that typically the pot of the still would be operated around 200°-204°F and the column around 190°F. Mr. Balentine confirmed that there were no pressure gauges installed anywhere in the still. I asked Mr. Balentine how much pressure would be expected to be produced by the still. Mr. Balentine could not advise. Paul Tomaszewski, who was at the Balentine's residence at the time of the interview, explained that the still's maximum pressure should not exceed 8 psi. Mr. Balentine stated that the 300 gallon still was the only still operating at the time of the event. He stated that the small still had been filled with mash but would not be started until the big still had finished its run. Mr. Balentine estimated that the 300 gallon still, at the time of the event, had only produced about 3 gallons of finished product. I also inquired with Mr. Balentine as to how much bottled product would have been in the facility at the time of the incident. He guessed there was 5-6 pallets that contained 60 cases each and each case contained a 12 pack of 750ml bottles. I inquired with Mr. Balentine as to whether he had ever experienced any problems with the still. He communicated that about the second time the still was run a split in the seam, where the side wall connected to the bottom next to the drain, occurred. Mr. Balentine advised he manually activated the pressure relief valve to let pressure off the still. Mr. Balentine contacted Revenoor Stills to get guidance as to how to repair the split. The split was repaired by Ricky Conner with Greg's Service. The split occurred approximately 3 years prior to this event. Mr. Balentine advised that the still had been run heavy, but that nothing out of the ordinary had been noticed the morning of the event. Mr. Balentine also advised that in February of this year the still had a problem with the tower bouncing in between 150°-210°F. The pot's temperature stayed consistent but the batch took an additional 3-4 hours longer than normal to distill. It should be noted that Janeen Lockard, Boiler Inspector with the Kentucky Department of Housing and Chris Williams, Investigator with the Kentucky Department of Labor responded to take part in the investigation but were not present during my recorded interview with Mr. Balentine.
After completing Mr. Balentine' s interview I focused my efforts on trying to reach out to Silver Trail's insurance company, Cincinnati Mutual, concerning securing the still and its components for a joint examination by all interested parties. I finally was able to secure approval from Cincinnati Mutual Field Claims Superintendent James Wells via email at 19:45 to secure the still and its components. The still and components were secured at 20:39 at the scene and then transported by Aurora Ross Fire Chief Ricky Sirls on a trailer, with me escorting it, to the Marshall County Sheriff's Department impound yard located behind the Sheriff's Department at 52 Judicial Drive in Benton. The still was off loaded at the impound lot at 22:16 without incident. All parties departed the impound lot to continue review of the still at a later date.

On Thursday, April 30th I met with Boiler Inspector Janeen Lockard, OSHA Investigator Chris Williams, Deputy Fire Marshal Laroy Martin and Engineer Rich Stogran with Engineer Design and Testing Corp. at the Marshall County Sheriff's impound lot for Mr. Stogran to get a cursory view of the still. Mr. Strogran represented Cincinnati Mutual, Silver Trail Distilleries insurance company. During this visit the tarp was removed from the still to allow a brief examination of the still. No components were

removed or manipulated. I did, however, utilize a bore scope type camera to view the inside of the pipe that the temperature and pressure relief valve was connected to. This was done from inside of the still by way of the large opening in the dome of the still where the stainless steel lid secured. No obstructions were noted. No attempt was made to view the interior of the discharge tube that was connected to the temperature and pressure relief valve. After Mr. Stogran briefly examined all of the components of the still we departed the scene and awaited the insurance company to put all parties on notice so a joint on site examination could be scheduled.

Unfortunately, as a result of the injuries he sustained at the Silver Trail Distillery still incident, employee Kyle Rogers passed away on May 11, 2015 at the Vanderbilt Burn Center in Nashville. Second Distiller Jay Rogers was still being treated at the Vanderbilt Burn Center for injuries sustained during the still incident.

Attempts were made by Boiler Inspector Janeen Lockard on the day of the incident to contact Revenoor Stills due to the incident with no contact being made. Additionally, Chief Boiler Inspector Rodney Handy also attempted to contact Revenoor Stills on Monday, April 27th and reached their voice mail. Chief Inspector Handy left a message for someone to return his call with no return call ever being received. Attempts were made by Cincinnati Mutual' s legal counsel, Daniel Hogan with Stutman Law, to reach Revenoor Stills and put them on notice and to schedule a joint onsite inspection. Attached with this case report as a matter of record are letters dated 4-27-15 and 4-29-15 from Stutman Law putting Revenoor Still's on notice. Also attached is a letter dated 5-12-15 from Stutman Law advising Revenoor that a joint onsite examination is scheduled for May 20th, 2015 at 09:00 at 136 Palestine Road, Hardin, Kentucky.

On the morning of May 20th at 08:00 I met Engineer Jim Middleton with Engineer Design and Testing at the Marshall County Sheriff's impound lot to retrieve the still and its components for transport back to Silver Trail Distillery at 136 Palestine Road Hardin. Mr. Middleton had drove a large cargo truck and had retained Slacks Body Shop to assist in the movement of the still and components. The components were loaded in the cargo truck, the still placed on Slacks roll back wrecker and were transported to the distillery without incident. Prior to start of the joint examination all parties taking part in the examination were required to sign in for attendance. A copy of the sign in sheet is attached to the case report as a matter of record. Prior to starting the examination several of the parties requested that Mr. Balentine give an overview of the circumstances leading up to the event since several of the parties were not privy to the information. During Mr. Balentine's overview of the circumstances he explained that he was first under the impression that the event knocked his employees out of the building. Since the day of the explosion he had communicated with Second Distiller Jay Rogers, who was still in the hospital, and found out that Jay and Kyle Rogers were not blown out of the building. Jay Rogers had assisted Kyle Rogers out of the building after the event had occurred. Additional information from Mr. Balentine revealed that whistling had previously been heard coming from around the stainless steel access plate in the top of the still. He also stated that it was not uncommon for chattering or rattling to occur in the column during distillation. Mr. Balentine also covered again the seam failure at the bottom of the pot and advised the crack in the weld was approximately 3 inches in length and was on the left side of the drain. The crack was repaired by Ricky Conner with Greg's Service with guidance of Revenoor Still's. Upon asking Mr. Balentine whether the copper discharge pipe for the temperature and pressure valve came with the still or not he explained that it did not. He further stated that Ricky Conner with Greg's Service installed the copper tube at his request. He also confirmed that the discharge tube terminated approximately 6 inches from the floor adjacent to the still. After the question and answer session all parties started a closer examination of the still. It was jointly agreed by all parties that the temperature and pressure relief valve would be unscrewed from the still so it could be examined. The copper discharge tube was spun off the relief valve to allow the removal of the valve. The valve was removed and examined. Visual examination revealed no obvious issues and the valve reflected no signs of debris that would have occluded the valve. After examination of the valve the focus centered on the column of the still. After all parties had an opportunity to examine the column it was jointly determined that the column would be cut open above the flange to expose the contents of the column. Upon opening the column we found the bottom of the column to be filled with glass balls. All glass balls were secured in two-one gallon evidence cans with one can being almost completely full and another being ¼ full. There was little indication of any type of trash or organic build up on the glass balls. It would be estimated that the first 14" of the base of the column contained the glass balls. Higher up in the column was a cooling coil with external connection through the side of the column. The top of the column was of course capped. Also examined during the visit was the still base that housed the burner assemblies. After examination of the burner assemblies it was jointly determined that the still platform and the burner assemblies would be retained by Engineering Design and Testing on behalf of Cincinnati Mutual. The platform, burners, and some associated piping were disassembled and secured by Jim Middleton in the cargo truck he brought to the scene. The last activity during the joint on site examination was to check the pressure of the propane gas in the gas piping system. Fortner Gas, who supplies propane to the facility, traveled to the site to perform a pressure test. Some parties on site for the examination opted to leave prior to the gas test due to time constraints on getting back to the airport to catch flights. The gas lines supplying propane to inside the facility were isolated at the back of the structure in proximity to the second stage regulator. Witnessed test by Fortner Gas reflected the pressure from the first stage regulator at the tank to be 11.25 psi and the pressure from the second stage regulator to be 14.75" water column. A leak check of interior supply lines and gas appliances inside was not attempted due to the structure, gas lines and appliances sustaining heavy fire damage, the still base and burners being removed, and the fact there was no evidence a propane incident had occurred. The pressure test of the propane system was the last activity during the joint examination. The remaining parties on site left afterwards.

On May 24th, 2015 I received an email from Spencer Balentine advising that the owner of Revenoor Stills had given a recorded interview regarding the Silver Trail Distillery incident to Whiskey Cast magazine and that I could listen to the interview on the Whiskey Cast website. The recorded interview is attached as a matter of record of the case file. On May 26th, 2015 I received an additional email from Mr. Balentine providing me a phone number as a possible direct line to the owner of Revenoor Stills, Terry Wilhelm. I called the number given to me by Mr. Balentine and left a voice mail. After a lengthy investigation on line I found a web page unrelated to distilling that had a Terry Wilhelm listed and reflected an address of Yamhill, Oregon. Also found on the web page was an email address that I sent an email to on May 27th, 2015 at 13:58 (EST) requesting that if I had reached Terry Wilhelm to please contact me back. Shortly after sending the email I was contacted on my state cell phone by Terry Wilhelm of Revenoor Stills. Mr. Wilhelm was completely cooperative and agreed to allow me to record our interview over the phone. The recorded interview is attached as a matter of record to the report. In communication with Mr. Wilhelm the reason that no contact was able to be made with him was due to conflict between family members and himself that resulted in a court order keeping him away from the Revenoor Still's facility. He explained he has not been on site since February 23, 2015 as a result of the order. Any phone messages or mailed correspondence that had been directed to him at Revenoor he has not received. Mr. Wilhelm stated that the stills that Revenoor produced, if everything is working correctly, are not a pressure vessel and that they are open to the atmosphere. He further explained that after production the pot and column are tested at 3 psi to check the integrity of the welds. He went on to say that at about 4-5 psi you will start to get cracks in the welds and that even if pressure does build up that the pot does not explode. He stated that the pot would typically bulge apart until a crack developed in the silver solder welds. Mr. Wilhelm relayed that the welds that seamed the components together were "tig" welds using Harris "0" Silver Solder. I inquired with Mr. Wilhelm as to why he utilized a temperature and pressure relief valve in the still if it was not a pressure vessel. He answered that it was primarily to keep the lawyers away and to act as a backup just in case the output on the still becomes blocked. Mr. Wilhelm further stated that 9 out of 10 times you would see a crack in a weld before the temperature and pressure relief valve activated. He further stated that steam build up could cause the temperature and pressure relief valve to operate. I went on to ask Mr. Wilhelm about the marbles being utilized in the column of the still. He proceed to explain the marbles provided a large surface area for water to condensate on which is a factor in the distillation process. He estimated there to be approximately 4 – 64 ounce cups of marbles in the column. Upon asking Mr. Wilhelm as to how many stills of this type he had produced he estimated around 30 a year in the 15 years he had owned Revenoor. I asked if he had any customers call regarding hearing chattering from inside the columns. He replied that only about 3-4 customers had called regarding the chattering but that chattering was not uncommon. I went on to ask Mr. Wilhelm about what the typical operating temperatures of the still would be. He responded that the pot would not normally operate higher than 202°F and the column between 183°-185°F. I questioned Mr. Wilhelm as to whether he recalled Spencer Balentine calling him regarding a split developing in the base of the pot shortly after purchase. He did recall the incident and told me that he explained to Mr. Balentine that anyone that could sweat pipes could use the silver solder to repair the problem. I asked Mr. Wilhelm as to why this would occur and he responded that it could be as a result of rough handling of the still or pressurizing the still when filling with water and not making sure a vent was open. Mr. Wilhelm was also asked if there was an issue with Mr. Balentine utilizing direct firing to operate the still since the still was constructed with 8 electric heating elements for operation. Mr. Wilhelm stated that even though the still was equipped to operate on electric there was no problem using direct firing for operation. At the conclusion of the interview Mr. Wilhelm assured me of his continued cooperation regarding the investigation.

On Thursday June 11th, 2015 I traveled to Vanderbilt Burn Center in Nashville, Tennessee to interview Second Distiller Jay Rogers. Mr. Rogers had made significant progress in his recovery from the burn injuries that he sustained at the Silver Trail Distillery incident. The recorded interview is attached as a matter of record of the case file. Mr. Rogers advised that the day of the event it started out as a typical cook day and he arrived around 08:00. He explained that Spencer Balentine had already lit the 300 gallon still and was with the still upon his arrival. It was further explained that it took 2-3 hours for the still to reach cooking temperature. Mr. Rogers also communicated that they were going to do a double run that day which meant operating both stills. His assistant Kyle Rogers arrived shortly after 09.00. They checked the temperature of the big still then lit the small 188 gallon still. As the stills were cooking they were checked and monitored continually. When the big still started producing product they discarded the first gallon and bottled the next three gallons to put off to the side. After bottling the last three gallons the product was then allowed to run into a 55 gallon stainless steel drum. The temperature of the pot was around 198° -199°F and the column temp had yet to reach 200°F. Jay Rogers stated that all four burners were on low and that he was waiting for the temperature to get high enough to turn off a burner. They had reached a point where they started pulling product off to check the proof and found that the run was going to be one of the best the still had ever produced. Jay Rogers stated that Kyle Rogers and he had started a conversation regarding baseball and the next thing he knew he they both were on the floor. He also stated that he heard things exploding behind him. He stated that he helped Kyle Rogers up and got him out of the building. As they were exiting the building he saw Spencer Balentine running from his house toward the distillery. Jay Rogers stated that after the event he continued to hear small explosions in the distillery. He communicated that at the time he got Kyle Rogers up that there was no fire inside the distillery. He also noticed that some of the burners were still lit where the still had been located. He further stated that the pops that he continued to hear after the event he believed to be the alcohol in the glass bottles popping. Jay Rogers also stated that a bottle of alcohol popped adjacent to Kyle Rogers which he felt was the reason he was burned worse. He further stated that he noticed the still and components in the driveway next to the distillery. Upon Spencer Balentine reaching the employees, Jay Rogers told Spencer to turn off the propane at the tank. Jay Rogers also stated that he thought that Mr. Balentine had turned off the burners to the still when he made entry into the distillery. Shortly thereafter emergency responders arrived on scene. Jay Rogers explained that he stayed conscious through the helicopter flight to the hospital. I reconfirmed with Jay Rogers

that the small still was in operation and the size of the still. He again stated the small still was operating at the time of the event and had a capacity of 188 gallons. I went on to question as to whether the building was standing after the event and Jay Rogers advised it was. I was also able to confirm that the sliding metal doors on the north end of the building were open. He also advised that the event had blown the doors outward. I inquired as to where they were both standing at the time of the event and Jay Rogers estimated they were approximately 5 feet away from the still. He marked for me their location on a sketch that Spencer Balentine had provided. I inquired with Jay Rogers as to if he had ever noticed the column chattering during distillation. He confirmed the column routinely made rattling and gurgling noises since he had operated the still. I then asked Jay Rogers if the small still had started to produce product at the time the event occurred and he responded it had not. I went on to ask him if on the day of the incident he had noticed a reduction of flow from the still and he stated that he did not. He did, however, confirm that months prior to the event during a run he noticed a problem with output. I also questioned Jay Rogers as to whether they was any fire or a fire ball with the event to which he responded there was not. He stated that the event sounded more like a pop similar to a back fire from a vehicle. Also asked was whether he noticed anything other than the still being displaced from the event. Jay Rogers advised that the still was all that he saw displaced inside the building. I advised Jay Rogers that Spencer Balentine had explained to me that about 4 runs prior to the event there was a problem with a run taking 3-4 hours longer than normal. He confirmed that was the case and that he had to deal with the still all day long on that batch. Also asked of Jay Rogers was whether he noticed any signs of liquid being discharged through the pressure relief valve discharge tube. He advised that was something that he checked and there were no signs of any discharge. I further inquired as to whether he was aware of any time that the relief valve had activated. He stated that during a cleaning run using water and vinegar that the relief valve activated. He also stated that he manually activated the valve at that time as well. I inquired as to what he considered the normal operating temperatures of the still. Jay Rogers responded that the pot temperature was normally between 202°-203°F and the column at 200°F. I further inquired as to what level the burners on the stills were operating at. Jay Rogers responded that all four burners on the large still were operating at low and he was almost ready to turn one of the burners off. The burners on the small still were operating at medium. Spencer Balentine had advised that Jay Rogers had found a marble stuck in a hole in the plate in the column that kept the marbles from falling out. Jay Rogers confirmed that he did find a marble seated in one of the holes in the plate. Water was flowed up into the column to knock the marble loose as well as a rubber mallet utilized to tap the side of the column. I inquired with Jay Rogers as to whether he had smelled any odors or smelled propane prior to the event. He responded that he had smelled nothing. I further questioned him as to whether when the event occurred he saw any type of fire ball and he responded there was not. He went on to say that the burns that he and Kyle Rogers sustained were scalds as a result of the hot mash in the still. He further stated that Kyle Roger's burns were worse than his due to the bursting gallon of alcohol that hit him in the back. He also confirmed that at the time of the event there would have been finished product from the large still in the 55 gallon stainless steel barrel.

Based upon my observations during my onsite examinations it is my opinion that the event that occurred at the Silver Trail Distillery was not associated with a propane release. Typical of a propane explosion is significant damage of the structure as well as a distinct debris field as a result of the blast. Spencer Balentine and Jay Rogers both confirm that the structure was still standing after the event. Jay Rogers also stated that the only things that he could tell that were displaced after the event were the metal sliding door on the north end of the building and the still itself. First responders arriving on scene also found the structure to still be intact and still standing. Jay Rogers, who was inside the structure when the event occurred, also confirmed there was no fireball with the event. He also confirmed no propane odors prior to the event. The bottom of the still was blown away from the side wall of the pot which is consistent with pressure build up inside the vessel. All indications are that the event directly involved the over pressurization of the still with subsequent failure which resulted in it being propelled out the north end of the structure.

There are several possible reasons or combination of reasons for the failure. One hypotheses is that the still, which is normally an open system, became restricted allowing the buildup of pressure causing its ultimate failure. This could happen due to the output of the still where the finished product is discharged becoming plugged. Based upon Jay Rogers statement there was not an issue with the output of the still as several gallons of finished product had already been produced with production ongoing at the time of the event. Over pressurization could occur if the column somehow became obstructed. As previously noted the column contained a significant amount of glass balls inside of the column. My understanding of the use of the glass balls "packing" is to allow for a large surface area to allow condensation to attach to during the distillation process. Unfortunately, placing objects inside the column can reduce flow which could ultimately result in unintentional over pressurization of the still. Witness statements regarding hearing a rattling or chatter noise coming from the column on the still may have been indication of pressure build up in the still. As stated in Purdue University's Cooperative Extension Service publication AE-117 ALCOHOL DISTALLATION: BASIC PRINCIPLES, EQUIPMENT, PERFORMANCE RELATIONSHIPS, AND SAFETY "Packing objects should stack loosely in the column, having a relatively large amount of exposed surface area, providing many surfaces for liquid and vapor flow to intermingle." Another issue with a "packed" column is the possibility of mash getting into the column where the glass balls are located. Publication AE-117 also states "care must be taken to keep mash from boiling over into the column." Additionally AE-117 suggests that "Packed columns require a feed that contains very few suspended solids to reduce the chance of plugging, column contamination, and cleaning problems." AE-117 further states "Pressure buildup of too much resistance occurs from the flow of gas up the column or the flow of product out of the condenser. The former can happen if: (1) the column is too small for the amount of liquid or gas being put through it, (2) a flow blockage develops due to an accumulation of solids in the column, or (3) a failure of a packing or plate assembly exists." Publication AE-117 also suggest the installation of

pop-off valves and pressure gauges to reduce the potential for "blow-out". The Revenoor Still which failed at the Silver Trail Distillery was equipped with a temperature and pressure relief valve manufactured by Watts. The valve, Model LLL100XL is rated for 150°psi and 210°F. The valve was installed in the top of the still in the vapor space. Being that the still was not designed or intended to be a pressure vessel, a pressure relief valve rated at 150 psi appears very excessive. Product information paperwork that was shipped with the Revenoor Still was provided to me in the course of this investigation. On the information sheet under "Safety and Maintenance" it states that "Each REVENOOR still is built with a safety valve and operated on less than one pound of pressure." This is in direct contradiction to the rating listed on the valve installed. If restriction did occur in the column or in the output it may be possible that the still failed before adequate pressure could be generated to operate the valve. It should also be noted that the Watts Model LLL100XL valve is only listed for use in water heaters and in this application has been utilized outside of its listing.

Another, but unlikely, hypotheses for the stills failure relates to a possible ignition of alcohol vapors produced during the distillation process. As previously stated the still was equipped with a Watts Model LLL100XL temperature and pressure relief valve. The valve is designed to activate when it reaches it temperature and or pressure threshold. The valves temperature rating is 210°F. During recorded interviews Spencer Balentine advised that the operating temperature of the pot on the still was 200°-204°F and Jay Rogers advised the temperature was 202°-203°F. The normal operating temperature of the still was within 8°F of the activation temperature of the temperature and pressure relief valve. If the still reached sufficient temperature it is possible that the valve could have activated releasing alcohol vapor out of the relief valve through the discharge pipe plumbed to the base of the still. The still was direct propane fired from the base which would have provided a competent ignition source for any ignitable mixture coming from the discharge tube. Although not probable fire could have flashed back through the relief valve discharge tube back into the pot. The environment inside the pot should be fuel rich and unable to sustain ignition. Additionally, the discharge of the vapor from the valve would be under pressure reducing the possibility of flash back.
Based upon the previously listed failure hypotheses the following recommendations are made to prevent similar events from occurring: (1) Listed pressure relief valves should be installed in the vapor space of the pot and column with the discharge remotely piped to the exterior of the building (2) Pressure gauges should be installed in the vapor space of the pot and the column.

Even though all physical evidence rules out the possibility of the event at the Silver Trail Distillery being related to propane, some issues of concern were discovered during this investigation. The direct fire burners utilized for the Revenoor Still were Model 23-116 Red Copy Cat High Pressure Burners rated for outdoor use. The burners had no safety installed so that in the event of a flame-out the flow of propane is automatically shut off. The National Fuel Gas Code (NFPA 54) section 9.1.4 Safety Shutoff Devices for Unlisted LP-Appliances Used Indoor states "Unlisted appliances for use with undiluted liquefied petroleum gases and installed indoors, except attended laboratory equipment, shall be equipped with safety shutoff devices of the complete shutoff type." Additionally, it was determined that the individual doing the propane work at the Silver Trail Distillery, Ricky Conner with Greg's Service, did not possess a Class E license to install propane utilization equipment as required by Kentucky Revised Statute 234.120 (1) (e). At this time and based upon available information and evidence, there is no indication that the event at the Silver Trail Distillery was anything other than an accident. Additional information may be forthcoming as a result of a forensic analysis of the still by an engineering firm retained by the insurance company for the distillery.

CONCLUSION

AREA OF ORIGIN: alcohol still
POINT OF ORIGIN: see narrative
HEAT SOURCE: see narrative
MATERIAL 1ST IGNITED: see narrative
CATEGORY: ☒ **ACCIDENTIAL** ☐ **NATURAL** ☐ **INCENDIARY**
☐ **UNDETERMINED** ☐ **OTHER:**

28. **ANY FIRE ACCELLERANT DISCOVERED:** ☐ **YES** ☒ **NO**
IF YES, DESCRIBE WHERE:
IF YES, DESCRIBE THE ENHANCERS DISCOVERED:

29. **PHOTOS TAKEN:** ☒ **YES** ☐ **NO** **IF YES, ADDITIONAL PHOTOS SUPPLIED BY?** Palma Briensburg Asst. Chief Todd Devine

30. **WAS ANYTHING REMOVED FROM SCENE?** ☒ **YES** ☐ **NO**
IF YES, BY WHOM? under direction of James Wells, Field Claims Superintendent with Cincinnati Mutual, still was secured at their request at 20:39 (CST) and transported to the Marshall County Sheriff's impound lot in Benton. Unloading of still was complete at 22:16 (CST).

31. **RECOMMENDATION TO PREVENT SIMILAR OCCURENCES:** SEE NARRATIVE

33. THE FOLLOWING INFORMATION WAS SUBMITTED TO THE DIVISION OF FIRE PREVENTION ALONG WITH THIS REPORT.

- ☒ DIGITAL CAMERA PICTURES (NUMBER OF CD'S)
- ☒ FIRE DEPARTMENT RUN REPORT
- ☒ COMPUTER AIDED DISPATCH *(CAD)* SHEET
- ☒ EMERGENCY OPERATIONS CENTER *(EOC)* REPORT
- ☐ GRAPH OR DRAWING
- ☐ OTHER: (PLEASE DESCRIBE)

DSFM SIGNATURE: _____ SFM Badge #: 104 Date: 7-23-15
RECEIVED BY: DATE:

WITNESS LOG

SFMO CASE NUMBER: 1504241113FIRT

1.	**NAME OF WITNESS:** Jay Rogers **ADDRESS OF WITNESS:** 812 Coopertown Rd **CITY, STATE & ZIP CODE:** Murray, Ky. **PHONE NO.:**
2.	**NAME OF WITNESS:** **ADDRESS OF WITNESS:** **CITY, STATE & ZIP CODE:** **PHONE NO.:**
3.	**NAME OF WITNESS:** **ADDRESS OF WITNESS:** **CITY, STATE & ZIP CODE:** **PHONE NO.:**
4.	**NAME OF WITNESS:** **ADDRESS OF WITNESS:** **CITY, STATE & ZIP CODE:** **PHONE NO.:**
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8.	**NAME OF WITNESS:** **ADDRESS OF WITNESS:** **CITY, STATE & ZIP CODE:** **PHONE NO.:**
9.	**NAME OF WITNESS:** **ADDRESS OF WITNESS:** **CITY, STATE & ZIP CODE:** **PHONE NO.:**
10.	**NAME OF WITNESS:** **ADDRESS OF WITNESS:** **CITY, STATE & ZIP CODE:** **PHONE NO.:**

STUTMAN

Daniel Hogan
hogand@stutmanlaw.com

April 27, 2015

VIA E-MAIL TRANSMISSION AND U.S. CERTIFIED MAIL

Terry D. Wilhelm
The Revenoor Company, Inc.
20275 NW Bishop Scott Rd
P.O. Box 602
Yamhill, OR 97148

Re: Cincinnati Insurance Company Insured: Balencorp, Inc.
Cincinnati Insurance Company Claim No.: 2431075
Date of Loss: 4/24/2015
Loss location: 136 Palestine Road, Hardin, KY

Dear Mr. Wilhelm:

Please be advised that our offices represent Cincinnati Insurance Company, the insurance carrier for Balencorp, Inc., in connection with the above-referenced matter. On April 24, 2015, an explosion occurred at Balencorp's distillery, causing substantial damages and seriously injuring two employees. According to our preliminary investigation, the explosion may have occurred at still manufactured by and purchased from your company. Under the circumstances, Revenoor may be responsible for the damage sustained by Cincinnati's insured. Therefore, we are placing you on notice of this potential claim.

We will be scheduling an inspection of the still and the explosion scene in the near future. To this end, please immediately advise your company's liability insurance carrier of the existence of Cincinnati's potential claim against you and the need to investigate this claim. I look forward to hearing from the appropriate representative of your company or insurance carrier in the very near future.

Very truly yours,

Daniel Hogan /s/

Daniel Hogan

DH:nfh

STUTMAN

Daniel Hogan
hogand@stutmanlaw.com

April 29, 2015

VIA E-MAIL TRANSMISSION AND U.S. CERTIFIED MAIL

Terry D. Wilhelm
The Revenoor Company, Inc.
20275 NW Bishop Scott Rd
P.O. Box 602
Yamhill, OR 97148

Re: Cincinnati Insurance Company Insured: Balencorp, Inc.
Cincinnati Insurance Company Claim No.: 2431075
Date of Loss: 4/24/2015
Loss location: 136 Palestine Road, Hardin, KY

Dear Mr. Wilhelm:

Please find a copy of my prior notice letter directed to your company dated April 27, 2015. To date, I have not received a response from your company and/or its insurance carrier. It is extremely important that you notify your liability insurance carrier about this loss as soon as possible. Your failure to do so may result in the denial of coverage by your insurance carrier. If that occurs, then you may be solely and personally responsible for the damages sustained by Cincinnati's insured.

Please turn this matter over to your insurance carrier immediately. If you do not have insurance, please contact me.

Thank you for your anticipated courtesy and cooperation.

Very truly yours,

Daniel Hogan /s/

Daniel Hogan

DH:nfh

STUTMAN

Michael J. Hopkins
hopkinsm@stutmanlaw.com

May 12, 2015

VIA E-MAIL TRANSMISSION & FIRST CLASS MAIL

Brook Laskey, Esquire
McCoy Leavitt Laskey LLC
1805 Rio Grande Blvd. NW, Suite 2
Albuquerque, NM 87104

Greg Connor
Greg's Service
338 Shamrock Lane
Dexter, KY 42036

Terry D. Wilhelm
The Revenoor Company, Inc.
20275 NW Bishop Scott Rd.
P.O. Box 602
Yamhill, OR 97148

Re: ***Cincinnati Insurance Company Insured: Balencorp, Inc., Claim No.: 2431075***
Date of Loss: 4/24/2015
Loss location: 136 Palestine Road, Hardin, KY

Dear All:

As you know, this office represents Cincinnati Insurance Company, the property insurance carrier for Balencorp, Inc., in connection with the above referenced matter. A still exploded on April 24, 2015 causing substantial damages to Balencorp's distillery as well as severely injuring two employees. We have placed each of you on notice of potential liability for the damages sustained by Cincinnati's insured.

Please allow this correspondence to confirm that the joint scene inspection is scheduled on Wednesday, May 20, 2015 at 9:00 a.m. at 136 Palestine Road, Hardin, Kentucky. Representatives of your companies and/or liability insurance carriers are invited to attend and participate in this inspection. Please be mindful that this will be the only opportunity you have to inspect and document the loss scene and to identify physical evidence to be preserved. After the inspection, the scene will be released for purposes of debris removal, cleanup and repair and any identified evidence will be retained. If you wish to attend and/or send a representative, please immediately contact me upon receipt of this correspondence.

Very truly yours,

Michael J. Hopkins /s/

Michael J. Hopkins

MJH:mmc
cc: Bill Compton, Fire Marshal *(via e-mail transmission)*
Tim Fitz, Cincinnati Insurance Company *(via e-mail transmission)*
James M. Wells, Cincinnati Insurance Company *(via e-mail transmission)*
Dean Harris, Engineering Design & Testing Corp. *(via e-mail transmission)*

SILVER TRAIL DISTILLERY JOINT EXAMINATION SIGN IN SHEET

Address:	136 Palestine Road Hardin, KY. 42048	**Meeting Date:**	5-20-15
Facilitator:	Bill Compton – Kentucky Fire Marshal's Office	**Time:**	09:00

Name	Title	Company	Phone	E-Mail
Bill Compton	Deputy	KY FIRE MARSHAL OFF	270-969-0961	bill.compton@ky.gov
LAROY Martin	Deputy	KY Fire Marshal off	270-227-9368	Laroy.Martin@ky.ga
Jaracen Lockard	State Boiler Inspector	State	270 5560789	jaracen.lockard@ky.gov
Chris Williams	OSH Compliance officer	KY OSH	270-227-8750	christopher.williams@ky.gov
MIKE MULLAVEY	DESIGN ENGINEER	WATTS	603-934-1168	MULLAVM@WATTS.COM
Scott DAVIS	Manager Engineer	Coexlon	301-915-9922	SGolaus@GEECW.com
Jim Middleton	Consulting Engr Lab Manager	EP&T	803-791-8800	jmiddleton@eptlaboratories.com
Jamie Slack	Towing	Slack's Body Shop	270-437-4441	Slacksbodyshop@gmail.com
Julius Ballance		JB Engineering	219-922-6171	JBEngineer@aol.com
Rick Jones	Attorney	Law Office of Rick Jones PLC	270 [illegible] -753-1295	rick@rickjoneslaw.net
PAUL TOMASZEWSKI	DISTILLER	MB ROLAND DISTILLERY	270-640-7744	paul@mbrdistillery.com
RICKY CONNER		GREGS SERVICE	270-226-5483	
SPENCER BALENTINE	BARGE OWNER	DISTILLERY	270-356 9657	Silvertrail20.spencer@gmail.com
HARVEY FRUMAN	ATTY	MC COY LEATHA for Watts Water	505 470 4729	hfruman@mcllaw

FORTNER GAS COMPANY PROPANE SAFETY CHECK

ACCOUNT # 1600560 DATE OF SERVICE CALL 5-20-2015

Customer Name Spencer & Shilua Balentine Time of Service Call: Arrived 1306 Departed _____

Address 136 Palmetto Rd City Hardin Phone # 270-354 9657

Purpose of Service: ___New Customer ___Change of Occupancy ___Out of Gas ___ Leak Complaint ___Driver Request X Other Service

Appliance	Central Heating	Space Heater	Water Heater	Range	Clothes Dryer	Fireplace
Manufacturer						
Serial #						
Manual Shut-off (installed/Existing)						
Red Tag (remove From service)						

TANK/CYLINDER

Size	Serial Number	Manufacturer	Manufacturer Date	DOT Cylinder Last Requalified	Location Tank/ Cylinder	Tank Condition	Relief Valve		Fittings Leak Test
							Condition	Cap on relief	
500	159132	Trinity	1994		ok	Good	Good 11/94	N/A	

PIPING/REGULATOR OPERATION/CONDITION

		Manufacturer	Model	Regulator Date Code	Regulator Condition	Reg. Vent Position/ Protection	Flow Pressure	Lock-up Pressure
Twin Stage							IN. W.C.	IN. W.C.
Two Stage	1ST	REGO	LV4403TR9	07/11	Good	DOWN	PSIG	11.25 PSIG
	2ND	REGO	LV4403B4	06/10	Good	~~Protected~~ DOWN with 90°	IN. W.C	14.75 IN. W.C.

PIPING SYSTEM LEAK CHECK

Pressure prior to Starting Leak check	Start Pressure	End Pressure	Start Time	End Time	Pressure Held (Yes or No)

Installed Presto Tap ✓ Yes ___ No NEW one Did Not do Leak Check per INSURANCE to Find Manchar Request

Comments: This inspection covers (propane/LP Gas) items and equipment visible and accessible to the service technician and represents the conditions existing on the date of inspection. It does not cover latent or manufacturing defects, and the internal working of sealed equipment, or structural components and cannot be construed to cover defects or unforeseen happenings.

X _____ (Customer Name / Print)

I, Tim Cook (Service Technician Name / Print)

I have been told what to do if I smell a gas odor or otherwise suspect a gas leak and have been told where to shut the gas supply off at the tank or cylinder.

I have smelled propane gas and can detect its odor.

I have received the Consumer Safety information and have been told to read and Share with all my family members and/or others living in the household.

I had gas system deficiencies and/or corrections, if any, clearly explained to me.

I am satisfied with the service work performed.

Customer Signature

Performed Odor Test ✓ Yes ___ No

Odor Detected: ✓ Yes ___ No

Consumer Safety Information supplied to customer:

Tim Cook

Service Technician Signature

AE-117

Purdue University
Cooperative Extension Service
West Lafayette, IN 47907

ALCOHOL DISTILLATION: BASIC PRINCIPLES, EQUIPMENT, PERFORMANCE RELATIONSHIPS, AND SAFETY

Eric Kvaalen, Doctoral Student in Chemical Engineering
Philip C. Wankat, Professor of Chemical Engineering
Bruce A. McKenzie, Extension Agricultural Engineer,
Purdue University

The purpose of this publication is to help you understand the distillation of ethyl alcohol. It first presents the basic principles involved in distillation and how the process works. The types of distillation equipment and systems that might be involved in a small fuel alcohol plant are then discussed, as are the performance and control criteria needed for a general evaluation of each. The publication concludes with a discussion of safety, along with some general selection, operation and management criteria useful in evaluating alternatives.

The information presented here hopefully will help you decide if you want to get into alcohol production, and if so, will help you evaluate the different options that are available to you. We will only cover those distillation processes and equipment capable of producing alcohol concentrations up to about 95.6 weight percent (wet basis).

Remember, this publication is *not* a design manual. Rather its goal is to give a general understanding of distillation processes and the performance of various equipment options in order to aid you in evaluating alcohol production proposals and give a basis for more detailed self-study. We will not discuss fermentation processes and equipment, or uses of the finished alcohol concentrate.

ETHYL ALCOHOL--A VIABLE ALTERNATIVE FUEL

The idea of ethyl alcohol as a liquid fuel is not new. It received considerable discussion and publicity in the 1920's and 1930's as a motor fuel. It was used as a fuel in several countries during World War II. Interest surfaced again in the U.S. in the mid 1970's, with the advent of the oil embargo and cartel and the rapidly escalating oil prices that resulted.

At the time of these rapid oil price increases, many people, particularly in the farming community, began to look seriously at ethyl alcohol and gasoline/alcohol blends as alternative fuels. However, by the early 1980's, increased U.S. oil production plus a significant drop in oil consumption due to high prices brought a corresponding world oversupply of oil and a marked drop in oil and gasoline prices. As a result, interest in alcohol fuels diminished sharply. Interestingly, the increased use of unleaded fuels and subsidies for fuels using 10 percent alcohol caused many oil companies to add ethyl alcohol to their gasoline as a non-lead octane improvement additive. Such fuels are not normally advertised as gasoline/alcohol blends.

If one accepts, however, that the long range price of oil and energy will continue to increase, then ethyl alcohol as a liquid fuel, especially for internal combustion spark ignition engines, will continue to be a potentially viable alternative fuel source. The fact that alcohol may be profitably manufactured from a variety of crop and forest residues, as well as from grains themselves, enhances its appeal to farm producers.

Ethyl Alcohol from "Beer"

Alcohol can be made from a variety of agricultural products by a three basic step sequence:

1. Breaking down the feed-stock (the raw material) chemically by a process which may involve cooking and adding enzymes.

2. Fermentating, i.e., the action of micro-organisms (usually yeast) to produce a "beer" (The term "beer" describes the liquid traction of a fermented mixture of water and ground or crushed grain that is usually no more than 10-12% alcohol, hence the similarity of the process and the final alcohol content to that of domestic beer.) containing a small percentage of alcohol, along with the remains of the feedstock, the yeast cells and various other substances dissolved in water.

3. Separating the alcohol from the water and other components in the beer, usually by distillation, to obtain the alcohol in a pure enough form to be used as fuel.

Fermenting grain (cooking it in water and treating it with enzymes to break down the starch and convert it to sugars) results in an alcohol concentration of roughly 5-10 percent. The finished concentration or "beer" depends on the amount of water used, the grain and the quality of the fermentation. This beer is so low in alcohol content that it is useless as a fuel and must be further concentrated to obtain mixtures that will ignite and burn. For this reason a distillation column is used to produce a higher alcohol concentration. (Several publications that discuss fermentation in considerable detail are listed at the end of this publication under "References.")

DISTILLATION--HOW IT WORKS

First of all, let's look at how distillation works. We are all generally familiar with how distilled water is produced. The water is heated, and the steam or water vapor conducted away in a tube. If the tube is looped downward and cooling is applied below the hump, the vapor is condensed and distilled water obtained. This is "simple" distillation- i.e., removing a volatile substance (water) from non-volatile substances (lime, impurities, etc.).

"Fractional" distillation is used to separate mixtures of two liquids with different boiling points, such as alcohol and water. Ethyl alcohol with 4 percent water boils at approximately 173° F, while water boils at 212° F. A mixture of the two liquids will boil at all temperatures between 173° and 212°, depending on

the ratio of alcohol to water.

Consider a beaker or a glass jug filled partially with a mixture of alcohol and water at some temperature. The top of the container is closed except for a small hole, to which a balloon is attached to keep air out. Thus, the vessel is at atmospheric pressure, but the enclosure above the liquid level is essentially undisturbed by air currents circulating around the jug.

After a period of time, the amount of water vapor and amount of alcohol vapor contained in the gaseous mixture above the liquid in the container will reach a constant value, depending on the temperature and pressure. The liquid and vapor mixtures reach an "equilibrium," a condition under which there is no net change in the liquid/vapor ratio or in the alcohol/water ratio within either the liquid or vapor mixture. However, the ratio of alcohol to water in the vapor phase is generally greater than the ratio in the liquid phase, because alcohol is usually more volatile than water (see Figure 1). It is this characteristic of a liquid-versus-vapor state of a substance that permits us to distill off an increasing concentration of alcohol from the alcohol/water mixture.

By bringing about a controlled series of successive sequences re-evaporation, condensation, re-evaporation and re-condensation), each re-condensation from the previous vapor state achieves a higher alcohol concentration. This is because the alcohol in the vapor is at a higher concentration than was the concentration in the liquid mixture from which it was vaporized.

Figure 1 shows the vapor-versus-liquid composition when the pressure is atmospheric. The dotted line in the figure represents an equal concentration of alcohol in both the liquid and the vapor state. Note that the alcohol concentration is consistently higher in the vapor phase than in the liquid phase for most of the range of the graph. The axes are explained later.

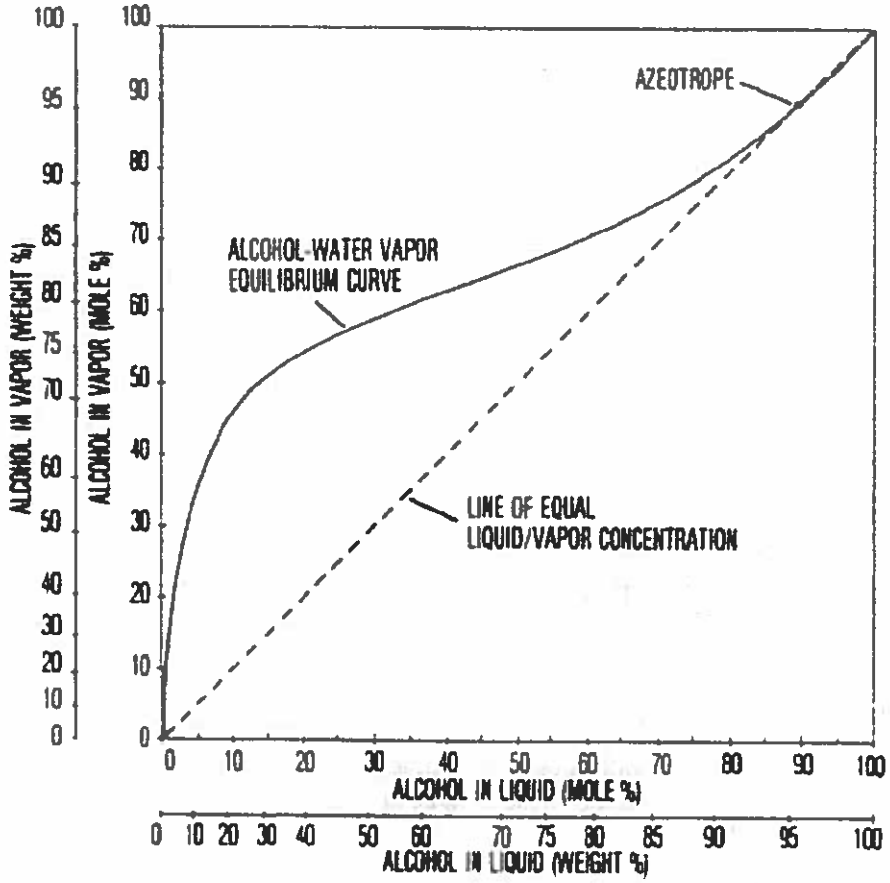

Figure 1. Equilibrium relationship between gaseous and liquid alcohol-water mixtures (atmospheric pressure).

Azeotropic Mixtures

The previous relationships of alcohol-water mixtures hold true up to alcohol concentrations of about 95.6 percent. At this concentration, the two substances quit boiling separately (i.e., the alcohol in the vapor phase is no longer more concentrated than in the liquid phase), and fractional distillation no longer works. A mixture of this composition is called an "azeotropic mixture".

Generally, a third substance must be introduced into the mixture to permit separation by distillation, or some other separation scheme must be used. The details of separating the azeotrope are discussed briefly later.

Types of Distillation Processes Most Applicable to the Farm

There are two general types of distillation processes that appear applicable to farm-size fuel alcohol production with present technology. One is the *continuous-feed distillation column system*, in which a beer containing a constant alcohol content is continuously pumped into a column. The other is a *pot-type distillation system*, in which a batch of beer, with the heavy solids (spent grain) not removed, is simply boiled in place to vaporize the alcohol. The alcohol-water vapors are then forced to flow through a

distillation column to bring about concentration.

These two processes are discussed in detail in the following pages. There are other fractional distillation systems that may or may not use a column as we normally think of such units. They include centrifugal techniques, mechanical rotating wipers in a tube, etc., and are not discussed here.

CONTINUOUS -FEED DISTILLATION COLUMN PROCESS

A simplified schematic of a continuous distillation column is presented in Figure 2. The column consists of a long tube, which includes a stripping section (the lower portion) and a rectifying section (the upper portion). There is a condenser located on the top end of the column and an optional reboiler on the bottom.

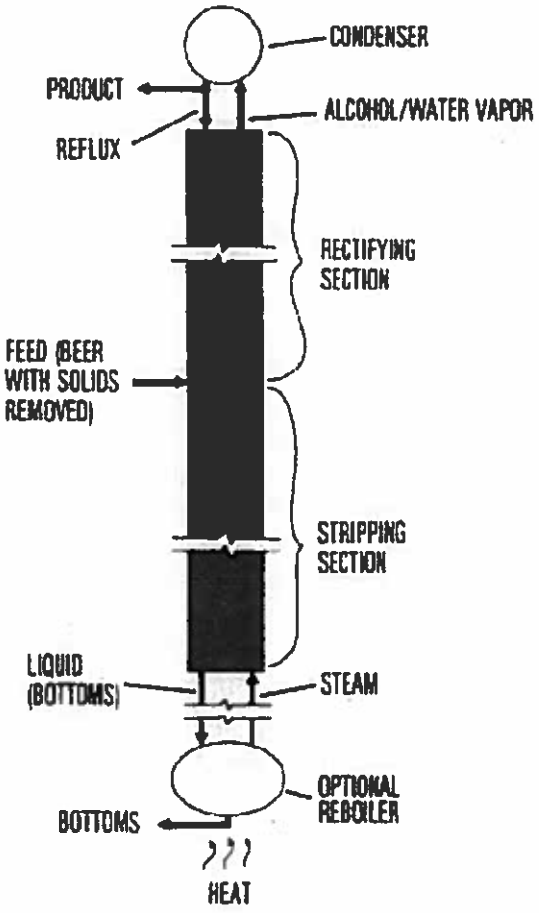

Figure 2. A continuous distillation process.

The process involves a controlled flow of liquid beer (preferably preheated and with all solids removed), which is fed into the top of the stripping portion of the column. The liquid alcohol-water mixture (beer) trickles downward through the column, its flow impeded or slowed by either a series of plates or continuous packing. It passes vapor (a mixture of water vapor and alcohol vapor, but no air) which moves up. The source of the water vapor is either steam injected from a boiler or vapor produced in the reboiler. The plates or packing serve to cause good mixing of the vapor and liquid, allowing the alcohol to

evaporate and the water to condense.

At any given point along the column, there is more alcohol in the vapor than in the liquid, but not as much as there should be according to the equilibrium principle. Since the alcohol concentration in the vapor has not reached equilibrium, its vapor pressure causes it to evaporate out of the liquid, and water condenses out of the vapor.

These two processes must happen simultaneously, because the first (the vaporization) *requires* heat and the second (condensation) *produces* heat. In a well designed and insulated column, all the heat supplied by the condensation goes into the evaporation of the alcohol.

About the same amount of alcohol evaporates as the amount of water that condenses. Thus, the *vapor* (moving up the column) constantly increases in alcohol content, whereas the *liquid* (flowing down) constantly loses alcohol This means that the top of the column will have high alcohol content in both liquid and vapor, and the bottom low in alcohol content.

The column shown can be operated either in a "continuous mode" or a "batch mode", similar to continuous versus batch grain drying processes. The next two paragraphs describe the differences between these modes.

In a continuous operation, the column is brought to a balanced-operation state. It consists of a continuous feed input of beer, continuous outflow of "bottoms" (Bottoms is a mixture of condensate water and some beer, in which not all alcohol was removed or distilled), steam input from a boiler or reboiler (for process heat and to make up for inefficiencies) and an output of highly concentrated alcohol vapor. Alcohol vapor is condensed and a large fraction refluxed (recirculated) into the top of the column to control the final concentration of the product output. This reflux flow is required to produce a downward flowing liquid stream in the top section of the column. Without the reflux stream, there can be no liquid in the rectifying section of the column, which means no separation would then occur in the rectifying section. The remaining highly-concentrated alcohol-water condensate or distillate is collected as product. Once the column is brought into an operating balance in "continuous mode," the operation is ideally sustained night and day, week after week, because each time it is shut down and must be restarted, the start-up and shut-down result in appreciable losses in energy and efficiency.

In a batch operating mode, the column is started, brought to a balanced performance and operated until the quantity (or batch) of beer on hand is distilled. The column must then be shut down, cooled and cleaned, ready for start-up for the next batch. Batch operation and performance will be discussed later.

Actual Operation in the Still

Let us now describe the continuous-feed distillation column process in the still as seen in Figure 2. The "stripping" section and the "rectifying" section of the column are shown in the figure as a single vertical column unit, which is the preferred configuration. They may, however, be built side by side, interconnected with tubing to return the output of the stripping unit to the rectifying section and vice versa. This makes the total height shorter, but requires a pump to lift liquid from the bottom of the second column to the top of the first. Tubing must be quite large and well insulated. The vapor for the stripping section is supplied either by steam injected at the bottom of the column or by the reboiler, which collects some of the liquid (mainly water) coming out the bottom of the column and boils it to produce the vapor.

As the vapor moves out of the stripper, the rectifying section increases the alcohol concentration by

allowing the vapor flow to move up the column against some of the final liquid product flow (reflux) moving down. When the vapor finally reaches the top of the rectifying section, it should have a concentration of 80-95 percent alcohol, depending on the column length and the operating conditions used.

The concentrated alcohol-water vapor of 80-95 percent is then condensed to liquid in the condenser by cooling it. Roughly 2/3 to 3/4 of the final liquid is returned to the rectifying section of the still as "reflux" (a liquid of high alcohol concentration). It provides a highly volatile source of alcohol vapor to facilitate a high final-product concentration and to condense out some of the remaining water vapor. This reflux is necessary to obtain a concentrated alcohol product.

The remaining liquid flowing from the condenser (about 1/3 to 1/4 of the total) is the finished product, ready for whatever use is intended. The ratio of amount of alcohol returned to the column to amount collected as product is called the "reflux ratio." This ratio controls both product purity and amount of energy required for the distillation. The higher the reflux ratio, the purer the alcohol product and the more energy that is required for distillation.

The incoming beer feed, if well-filtered, may be used as part of the cooling fluid in the condenser. This will bring about condensation of the reflux and finished product, while at the same time preheating the beer feed just before it enters the stripper section. Thus, a minimum of added heat is needed to bring about the initial alcohol vaporization (stripping) operation.

When the reflux liquid reaches the bottom of the rectifier, it enters the feed input level and joins the feed, which is preheated beer. The mixture enriches the alcohol content of the hot beer and facilitates the vaporizing (stripping) process as the liquids flow down against the upward flow of steam and alcohol vapor. As the steam moves upward, it causes the alcohol to vaporize from the liquid as some of the water vapor condenses.

If the vapor composition at every point in the entire column is plotted versus the corresponding composition of the liquid, the result is the two lines (operating lines) of Figure 3, shown superimposed on the equilibrium diagram of Figure 1. The axes are based on how many alcohol molecules there are per hundred molecules, rather than on a weight basis (This is because one alcohol molecule evaporates for every water molecule that condenses: thus, the number of molecules of vapor passing a given point per second doesn't change as you move up the column, and the same goes for the liquid. So if the stripper has, for instance, four times as many molecules of liquid as of gas passing some point near the top, it will also have four times as many molecules of liquid as of gas passing some other point near the bottom This means that if the molecular composition of the gas changes by percent in a certain segment of the column, then the molecular composition of the liquid has to change by percent in the same segment, regardless of where that segment is.) The two lines in Figure 3 are straight, having a constant slope when axes of molecular percent are used. (Weight percent is also shown on the horizontal axis, so conversion can be made very easily.) The slope of an operating line is directly related to the ratio of flows of liquid to vapor: the higher the slope, the more liquid flow to vapor flow there is.

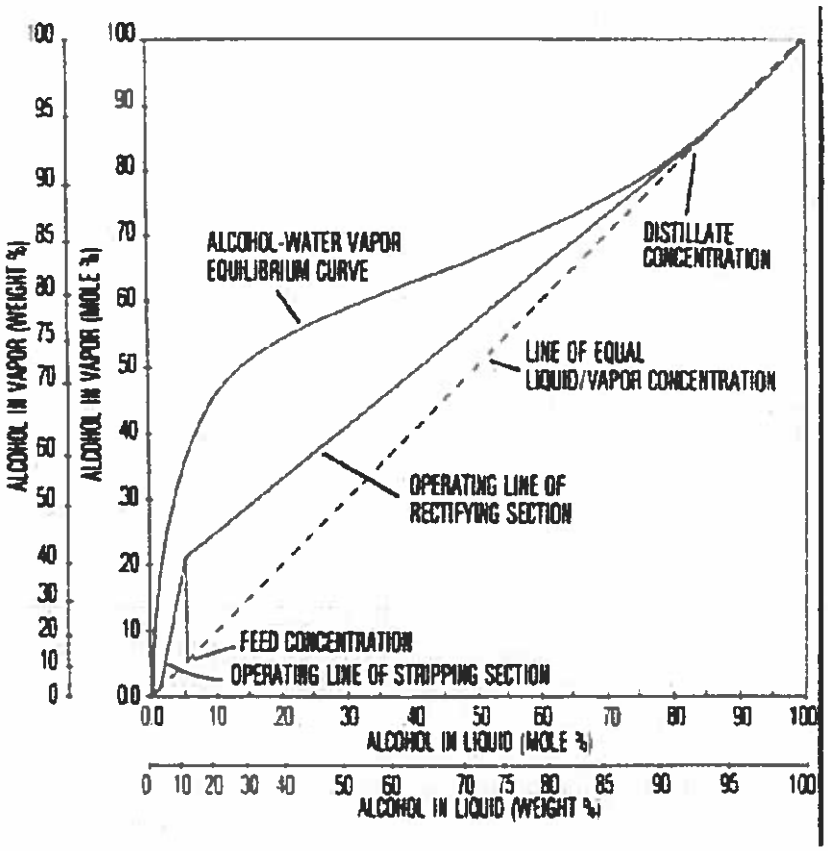

Figure 3. Operating lines for stripping and rectifying.

The "operating line" of the rectifying section intersects the dotted line of equal vapor and liquid compositions at the high end. This is because the reflux (the liquid added at the top) was part of the vapor which has now been condensed and now has the same composition as the vapor. The higher the alcohol concentration in the product, the smaller will be the slope of the operating line (since operating and equilibrium lines cannot intersect) and the greater the reflux will have to be. Hence, less product is obtained per pound of vapor if the product is higher in alcohol, and more energy is used per pound of product.

The equilibrium curve in the figure has a "sway-back" at high concentrations. To get a product really close to the azeotrope, the slope of the operating line must be increased to almost 45 degrees. This means increasing the amount of reflux liquid until it almost equals the amount of vapor flowing up, thereby increasing the reflux ratio sharply. This procedure leaves less actual product, since most of the condensed vapors have to be sent back down the column. Consequently, it takes about twice as much energy to get a gallon of 95 percent alcohol (by weight) as it does to get a gallon of 85 percent alcohol.

Plate or Tray-Type Columns

The length of column necessary to bring about a given concentration of final product is determined from the operating relationships presented in Figure 3. Consider a column constructed with "plates" along its entire length as shown in Figure 4. Liquid introduced into a plate-type column forms a shallow pool on each plate. The liquid flows across the plate, while the gas bubbles up through holes in the plate (called a sieve tray). Each plate or tray has a short section of tubing cut through the plate.

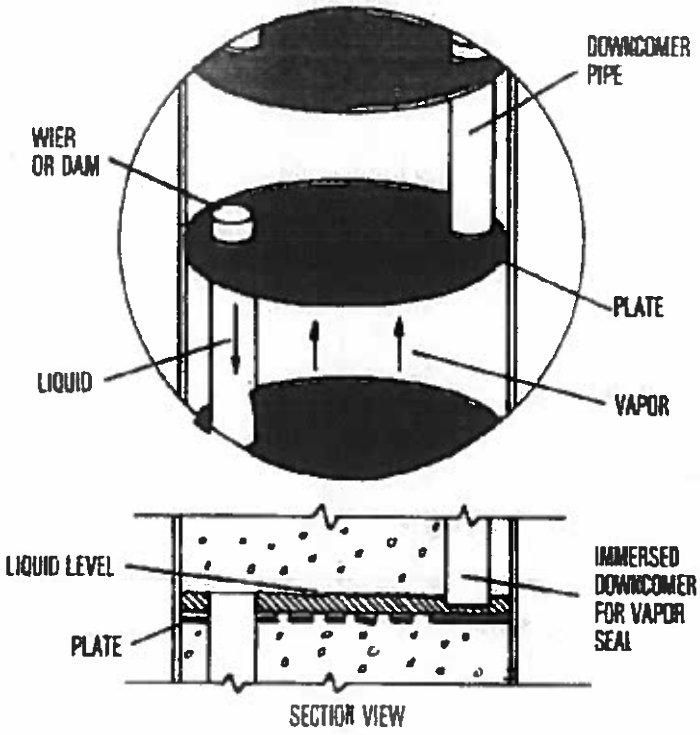

Figure 4. Sieve tray plate of a staged column. Each plate retains a liquid layer, the depth of which is controlled by the height of the weir. The holes in each plate are small enough that the vapor bubbles keep the liquid from passing through. The slight pressure of the alcohol-water vapor created by the reboiler, or pot, forces the vapor to bubble through the holes, bringing about intimate contact between the vapor (initially at lower alcohol concentration) and the liquid (which is at slightly higher concentration). Vapor of increased alcohol concentration leaves the surface of each successive plate while traveling upward through the column.

The assembly is similar to a toadstool, with the hollow stem positioned off to one side of the cap about 1/4 of the way in from one edge. The top end of the tube projects above the plate surface; the lower end stops just above the surface of the plate below. The tube is projected above the plate surface in order to form a miniature dam (called a "weir") to maintain a depth of liquid on the plate. As the liquid level rises, overflow occurs into the downcomer pipe to the next plate below.

The discharge end of each downcomer pipe must be positioned close to the surface of the plate below, so that the free end will be immersed in the liquid level on that plate. This forms a liquid seal over the open end to keep vapor from entering the pipe. By positioning successive downcomer pipes on opposite sides of each sieve tray, the liquid flows across each plate, minimizing any stagnate flow sections and helping move any solids that might accumulate from the distillation column.

Sometimes the holes in the sieve tray are covered with caps or checkvalves to help prevent the liquid from coming down through the hole. If the vapor flow remains strong, however, it will prevent counterflow itself. Ideally, when the liquid leaves a plate in its flow downward, it should be in equilibrium with the vapor flowing upward from the same plate.

Now we have a theoretical basis to predict the alcohol content of the liquid and vapor at any plate or

stage along the column. If we want an alcohol content in the final product of 85 percent (moles per mole), then we can read from Figure 5 what liquid concentration would be in equilibrium with the final vapor concentration (Remember, this is the same as the product concentration.)

This liquid concentration is that which is on the surface of the top plate. If we know the composition of the liquid flowing down the downcomer between the top plate and the second one, we can look at the operating line on Figure 5 to determine the vapor composition flowing up between the two plates. Because the liquid descending from the second plate must be in equilibrium with the vapor rising from it, we can now determine the liquid composition below the second plate from the equilibrium curve.

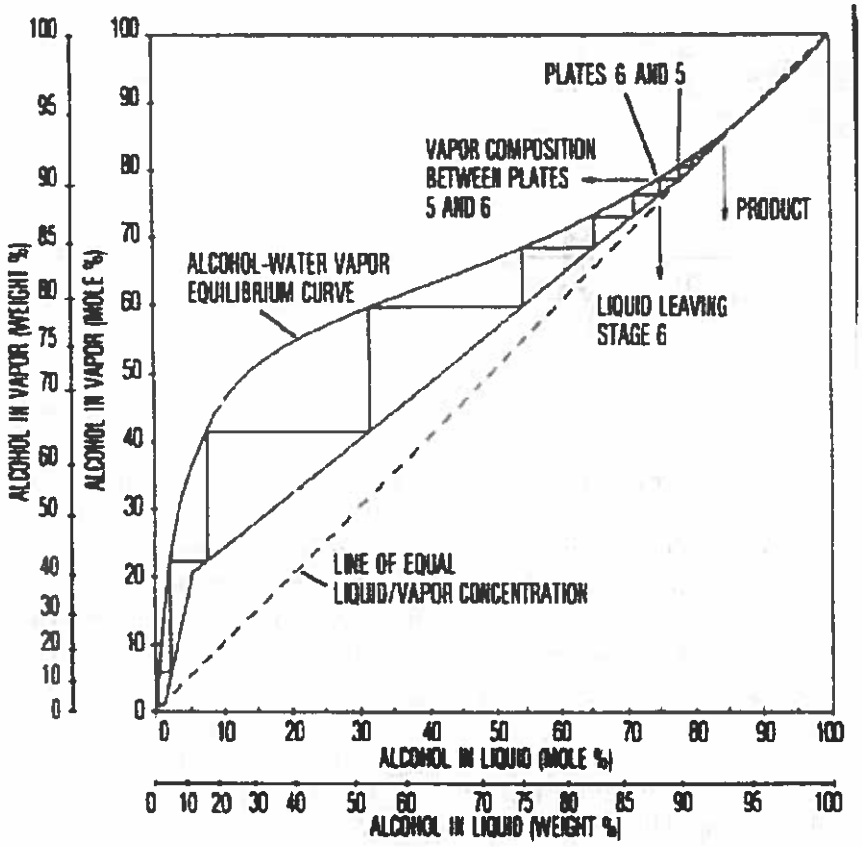

Figure 5. Stepping-off procedure to determine the necessary number of ideal plates.

This procedure, shown on Figure 5, is the method used to determine the ideal number of stages or plates needed for a given set of operating conditions. In actual practice, it usually takes roughly 1 1/2 to 2 times as many actual stages as this theoretical analysis predicts. Calculations for the column design need to be precise and are usually done by computer (Column length depends on feed concentration and desired product purity, but not on amount of feed column diameter depends on feed flow rate and reflux ratio. Column cross sectional area is controlled by the allowable vapor flow rate. Since vapor flow rate is directly proportional to feed rate, the column area is directly proportional to the feed rate. Double the feed rate and the column area must double, column diameter will be proportional to the square root of the feed rate. Vapor flow rate also increases as the reflux ratio increases Thus, the required column diameter will also increase when the reflux ratio is increased).(Column design is usually done by the column manufacturer, not by the user.)

Packed Columns

An alternative to a plate-type unit is the packed column. In distillation columns larger than 4 feet in diameter, trays or plates have been found generally more economical for alcohol production. But in small columns, the cost of fabrication, installation and maintenance of plates often makes a packed unit less expensive and more workable.

Another consideration is the ease of cleaning deposits that may form in the course of time. In the case of plate-type columns, deposits can sometimes be removed with a chemical rinse: other times trays may have to be scrubbed (through portholes) or packing taken out and cleaned. Small-diameter plate columns are difficult to clean inside, since port holes are quite small.

A packed column is filled with solid objects, with a relatively large amount of open space for liquid and vapor flow. The objective of a packed column, as with a plate column, is to bring about intimate contact between the liquid and the vapor without too much flow resistance. Packing objects should stack loosely in the column, having a relatively large amount of exposed surface area, providing many surfaces for liquid and vapor flow to intermingle.

Packing material may range in size from 1/4 inch for small columns (2-4 inch diameter) to 2 inches in length and/or breadth for large columns (2 feet in diameter or more). Several examples of commercial packings are shown in Figure 6. For alcohol production, ceramic, polypropylene plastic or stainless steel packings may be desirable. The important criteria are: (1) efficiency of contact between the liquid and the vapor, (2) amount of resistance to flow, (3) flow capacity (amount of vapor flow per square foot of area that can occur before the vapor will prevent the liquid from coming down), (4) resistance of the packing to corrosion or dissolving and (5) cost.

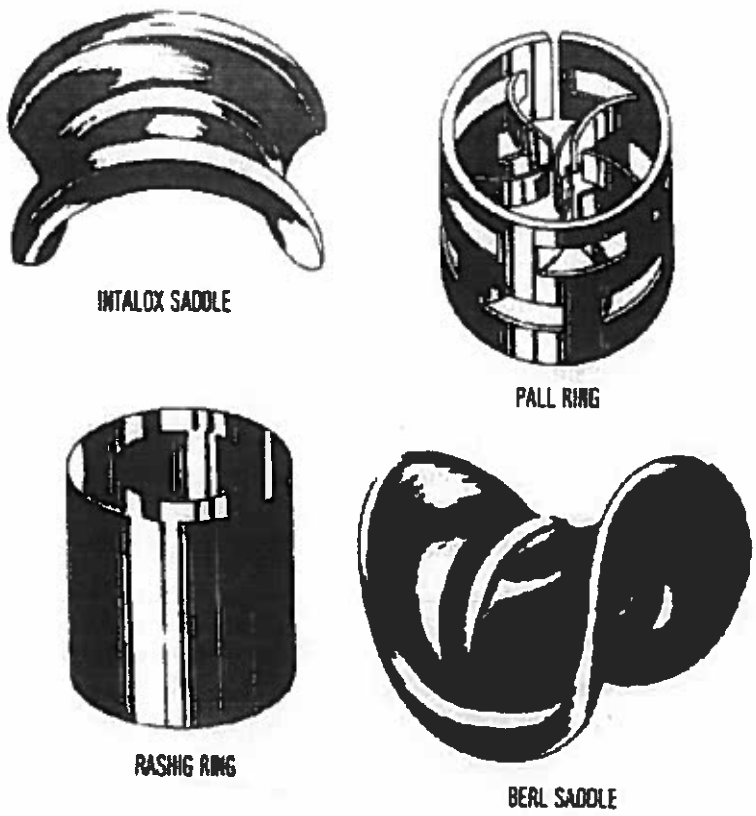

Figure 6. Four common types of packing.

The efficiency of contact between the liquid and the vapor determines a factor known as the "height equivalent to a theoretical plate" or HETP. A HETP is estimated as follows:

* First, find the actual alcohol separation occurring in a test section of height h.

* Next, use an analysis like Figure 5 to determine the number of equilibrium stages required to give the separation observed.

* Then, divide height of test section by number of stages.

Marbles are poor packing. They do not spread the liquid coming down the column enough to get an efficient exposure of liquid-gas interaction. Marble packing, therefore, gives a large HETP value, requiring a tall column. Also, the inside of the marble is not available for flow, so large diameter columns are required.

Another important consideration in deciding on packing material is how long the packing will hold up in a hot alcohol solution. Durable packing like stainless steel may last indefinitely but is expensive initially. Thus, cost-benefit ratio must be considered.

Some general estimates of packing properties are commonly used. The *size* of the packing should normally be less than 1/8 of the diameter of the column. The HETP varies with the size of packing, from about 1 1/2 feet (for 1-inch packing) to about 2 1/2 feet (for 2-inch packing). Below 1 inch in size, the

HETP usually remains above 1 foot.

The HETP usually gets worse (larger) if the flow is either too high or too low. If flexibility in operation rate is desired, a packing should be chosen that has a low HETP over a large range of flows. The approximate ratio of the highest to the lowest flow rates which yield good HETP values is known as the "turndown ratio". Pall rings and Intalox saddles are good in this respect, with turndown ratios above 6.

If we know the HETP, we can estimate the required column length. With an assumed HETP of 1 1/2 feet and an ideal number of trays in the rectifying section often, we need a rectifying section 15 feet tall. The HETP will determine the *actual* number of plates needed; the number should *not* be doubled.

All of the previous discussion has considered distillation processes in terms of a constant feed of beer of uniform alcohol content. Such processes can be operated either as a continuous or as a batch procedure.

POT-TYPE DISTILLATION PROCESS

In the pot distillation process, the entire batch of beer is heated to boiling in a large container, and the alcohol-water vapors are collected and channeled into a distillation column. Such a process will always be a batch procedure and involves only the use of a rectifying column, since the Stripping is done as the alcohol vapors are boiled off from the vat. A pot distillation process is illustrated in Figure 7.

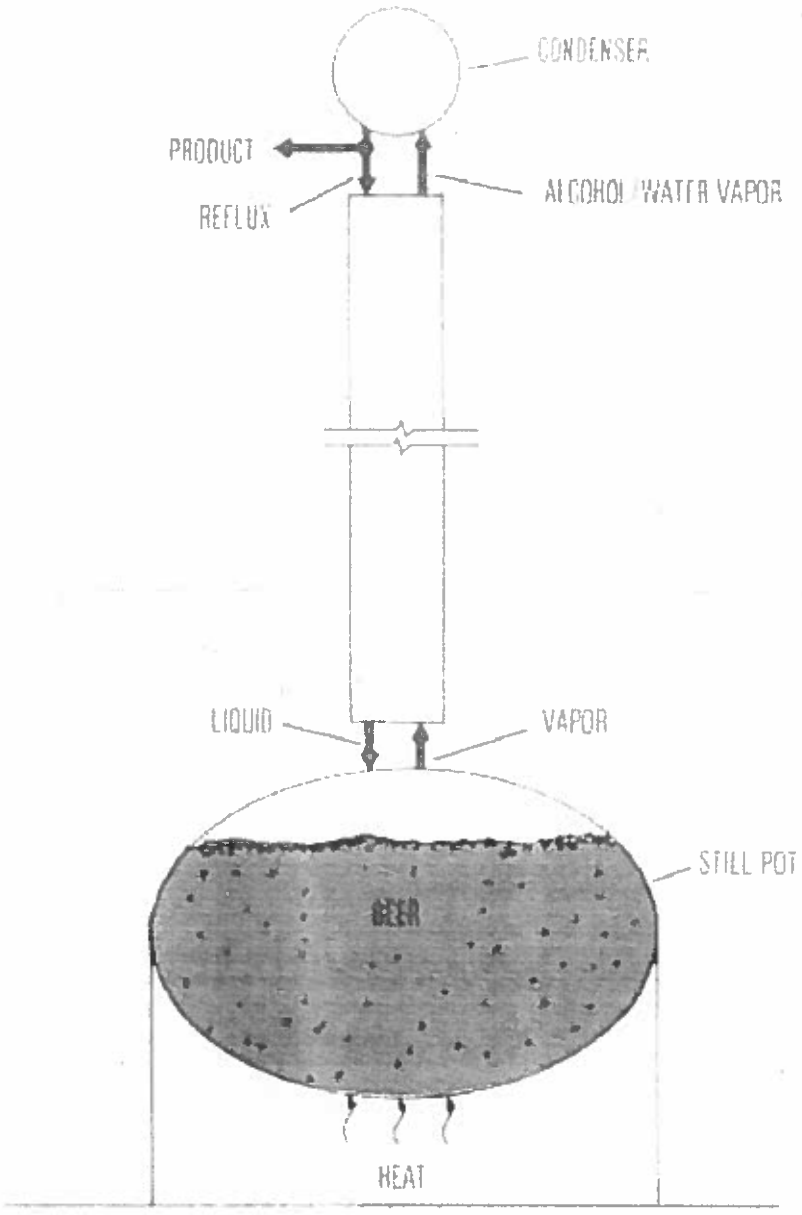

Figure 7. A pot-type batch distillation process.

The process has the characteristic that, as alcohol vapor is boiled off from the beer, the concentration of alcohol in the beer becomes less and less. As the beer loses its alcohol content, the alcohol product also decreases in concentration. To prevent this, the reflux ratio must be raised.

Recall that higher reflux ratios usually mean higher proof. Raising the reflux ratio means getting less product from a given amount of vapor produced, hence a greater energy cost. When almost all the alcohol has been boiled out of the beer, the process is stopped and the spent stillage (formerly beer) is removed.

The basic advantage of this pot distillation process is its simplicity. It does not require a constant supply of beer, which is often not available in minimum-labor fuel alcohol processes. It also provides a very simple equipment system. with cooking, fermentation and boiling for distillation carried out in the same

vessel. This procedure may aid in sterilizing equipment between successive batches, since cooking and fermenting in the same vessel tends to heat-sterilize. Separation of the spent grain and large solids from the beer prior to heating for distillation is not necessary, an added advantage.

It is possible to approach a continuous batching operation in a three-vessel, one-column pot system. A batch of grain would be cooked and fermented every 72 hours, with one batch ready for distillation every 24 hours.

The disadvantage of the pot distillation process and its system simplicity is lower distillation efficiency, because of the diminishing alcohol concentration in the beer under continuous boiling. Typically, a pot distillation unit requires about three times as much energy as an equivalent continuous distillation system, based on (by weight) feed 8 percent, stillage 0.4 percent and product 90 percent. Less stored heat may be used at the end of cooking when the slurry is rapidly cooled for fermentation; and heat losses during cooking and distillation heating cannot be minimized as readily as with the constant-feed process. Insulation applied to the pot to conserve heat during cooking and distillation heating may hinder cooling necessary to fermentation in the summer. Thus, amount of energy required per gallon of alcohol for the pot distillation process is high.

OTHER DISTILLATION METHODS

Vacuum Distillation

Carrying out distillation using a vacuum (low pressure) allows use of lower temperatures and attains higher alcohol concentrations. For instance, at 42 mm Hg pressure (about 6 percent of atmospheric pressure (Normal atmospheric pressure is 760 mm Hg (millimeters of mercury column), equivalent to 30 inches of Hg or 14.7 psi. Thus, 6 percent of 14.7 psi is approximately 0.88 psi.), the temperature at the bottom of the column need only be about 35° C (95° F) and the top about 20° C (68° F). This makes it hard to condense the vapor, since there is a smaller temperature difference between the vapor and the coolant (whether air or water). But this pressure may be advantageous if heat is supplied at only 35° C Here, waste heat from other machinery or solar heat might be exploited.

In the vacuum process, the azeotrope (or point where distillation ceases to work) moves toward 100 percent as the pressure is lowered. At a pressure below 1/10 atmosphere, the azeotrope disappears, enabling distilling all the way to 100 percent alcohol. However, the difference in volatility (vaporizability) between the water and the alcohol is still very small, requiring a high reflux ratio (more than 20). The amount of energy used is around 15,000 BTU/pound alcohol produced, which compares to combustion energy of around 11,500 BTU/pound alcohol.

By holding the condenser near 0° F, a vacuum of around 4 mm Hg could be created. The volatility difference would be great enough that the energy cost would be about 6000 BTU/pound. The column, however, would have to be very large to accommodate the large volume of low-pressure vapor. Vacuum distillation appears uneconomical in commercial applications.

Azeotropic Distillation

This is the term used for the process that produces 100 percent alcohol with the help of an organic solvent and two additional distillations. It is used by large plants to produce industrial absolute alcohol. In the process, a solvent, such as pentane or gasoline, is added to the product (alcohol which is not water-free) coming out of the usual distillation column. This mixture is fed into a distillation column which divides it

into a top product (a distillate of an exact composition determined by the solvent) and a bottom product, which can be controlled to produce pure alcohol by adjusting the amount of solvent added. The distillate of this column is fed to a third column, which distills out the solvent, leaving as the bottom product a mixture of just alcohol and water. This bottom product is returned to the first alcohol-water column.

Ideally, no solvent is added to the system once it's working, because it is recycled and never gets out. This process is obviously more complicated than the usual distillation system and requires an expert to design.

Adsorption

There are several other methods of producing 100 percent alcohol under development that look promising. One adsorption process uses a final column packed with organic material, such as finely ground, very dry cornmeal. Cornmeal is a stable and inexpensive (5-10 cents per pound) selective absorbent of water from ethanol/water vapor. Laboratory results show that the adsorption of water from ethanol by cornmeal gives an anhydrous (water-free) product, starting from 190 proof vapors from a distillation column. The process uses two parallel columns packed with cornmeal or other organic materials, with one column used for adsorption, while the other is being regenerated (by forcing a hot inert gas through the organic bed to evaporate the water absorbed). The combustion energy of the ethanol product can exceed the energy needed to carry out the dehydration by a factor of 10.

This process may have special advantages for use in small scale plants. Further development on the practical aspects of using this technology is not discussed here.

COLUMN START-UP, OPERATION, AND SHUT-DOWN

Start-Up and Operation

In a *continuous flow* column, the first step of start-up is to turn on the cooling fluid to the condenser, so that when the heat is applied later there will be no danger of pressure build-up. Then, if direct steam is used instead of a reboiler, the steam can be turned on to flush out the air in the system. This is similar to purging a steam heating system in a house.

If direct steam is *not* being used, water should be fed into the column at the feed point. This water will run down to the reboiler and provide steam. Once the air has been sufficiently diluted with steam, there is no possibility of explosive mixtures being present. However, it is best to force practically all the air out of the system and through the condenser, so it won't interfere with alcohol separation and heat transfer in the condenser.

Once the system has been purged of air, the reflux ratio can be set and the beer flow started. After sufficient time (depending on column size, flow rate, etc.-usually several hours), alcohol will spread throughout the column according to the design. The product will not attain the desired concentration until this distribution balance is reached. It can be recycled back into the beer tank until this occurs. Or, a quicker method is to reflux everything until the desired composition is reached, setting the reflux ratio to continue this concentration. The amount of time in either case depends on column size but usually runs several hours.

If a continuous flow column is used to process batches of beer, be sure the column is small enough that the start-up time will be relatively small compared to the total run time. Short run times are undesirable,

because of the long start-up, shut-down and cleaning time involved.

Planning the reflux flow and control system is an important factor in product quality control and process management. One design uses a condensate reservoir, with the reflux rate controlled by a variable-speed pump drawing from the reservoir. Another design has a gravity flow of reflux from the reservoir, regulated by an automatic or manual valve. The reservoir may be designed with an overflow into the product line to maintain a constant pressure on the gravity reflux feed.

A sufficient liquid level in a reboiler used to supply steam to the column is important from a performance and safety standpoint. The reboiler is under a slight pressure and therefore must be a pressure vessel. It usually has a gasketed and bolted lid. Welded steam outlet and stillage return lines connect the reboiler to the column. The liquid return enters the reboiler below the desired liquid level. The outflow of bottoms can be controlled by regulating the back-pressure in the bottoms line, in turn controlling the level of liquid in the pot. The pot must be designed so it can be completely drained to ease clean-out.

In a batch system using *pot-type distillation*, the usual procedure is to start the condenser cooling fluid, and then turn on the heat below the vat or boiler containing the beer. An outlet must be provided for air escape. (See previous discussion concerning how to obtain the desired product quality.)

Shut-Down

During shut-down of a *continuous system*, the first step is to shut off the feed and divert the product. This keeps low-quality alcohol produced during shut-down from entering the product st&rage tank. The alcohol remaining in the column can then be distilled out and added to the next batch of beer. A complete sequence is as follows:

1. Turn off feed and steam entering the reboiler.
2. Shut off heat.
3. Increase reflux to 100 percent (no product output).
4. Wait until condenser temperature has cooled to below 100° F.
5. Open vent to the column.
6. Drain column out of the bottom, leaving the air vent at the top open. (Caution: bottoms liquid may be very hot.)
7. Turn off condenser cooling water.

Because cooling water for the condenser will be needed throughout shut-down, it is the last flow to be stopped. The exact order in the above steps is not critical, since steps 1-3 are performed in rapid sequence. The important point is not to vent the column until it has cooled down, to avoid loosing a lot of alcohol vapor which might burn, smell or explode.

In a *pot system*, the shut-down consists of turning off the heat and allowing air to enter as the vapors condense. It may be possible to catch the liquid draining from the column, so that the alcohol it contains won't be lost with the stillage. The material will initially be very hot, requiring caution in collection and

handling.

SOLIDS REMOVAL

Most distillation processes require that the spent grain and all solids be removed from the beer before the feed is delivered to the column. However, the two "exceptions" discussed below do not require solids removal before distillation.

One exception is the occasional plate- or tray-type column, designed to pass the mash (beer plus all solids) through stripper section, using a combination of large holes in the plates and large diameter downcomer pipes between plates. This helps move the mash (which is like sloppy oatmeal or mush) down the column. Such a design can be quite effective in stripping the alcohol from the spent grain and solids as well as from the beer; but it tends to be low in energy efficiency and presents problems in flow uniformity, due to column plugging and changing solids percentage in the feed. This type column must be designed by an expert. Handling all solids with the beer may also present some pumping problems along with problems in clean-up.

A second exception is the batch procedure using pot distillation. The beer and mash are simply boiled together to evaporate the alcohol. The mixture in the pot must be well stirred to prevent the solids from baking onto the pot surface; and care must be taken to keep the mash from boiling over into the column.

In this process, the liquid condensate from the column returns to the pot or batch tank being boiled. When the alcohol concentration in what was the beer (now stillage water and distillers grain) reaches a point where further distillation is not practical, the entire slurry is transferred to a holding tank for processing or feeding. Since most animal nutritionists do not foresee the feasibility of feeding much of the stillage water, the mash will probably have to be separated, even if it is fed wet.

Packed columns require a feed that contains very few suspended solids to reduce the chance of plugging, column contamination and cleaning problems. Most plate- or tray-type columns can handle a small concentration of suspended solids without plugging or cleaning problems under continuous operation, provided the heavy solids have been removed. Plate or sieve columns may be easier to clean than packed columns if the plates are easily removed or accessible.

The heavy solids usually sink to the bottom of the fermentation vat or tank once agitation is stopped. Some of the beer can then be withdrawn in such a way that none of the remaining heavy solids are withdrawn.

Several farm fuel production installations use a section of "U" trough or round tube auger conveyor, on which a perforated housing has been rigged on the lower side. The perforated bottom of the, conveyor may also be covered with a 12-16 mesh screen similar to fly screen. In operation, the auger conveyor is inclined upward at a 15-25 degree angle and the slurry fed into the lower intake end. The auger conveys the stillage over the screen bottom, with the liquids and fine suspended solids passing through the screen. The larger grain particles are retained and carried to the top of the incline, where they are discharged into a vehicle or holding chamber. The auger flight, in scraping the mash across the screen, does a reasonably good job of maintaining flow and clearing the screen surface. Commercial filters, sieves and screens are also available in stationary, rotary and vibrating arrangements.

Continuous flow conveyors or extractors that compress the stillage grain to improve beer removal are common in commercial distilleries. Similar designs sized for small-scale plants are under development.

Keep in mind that separating solids before distillation can result in up to a 20 percent alcohol loss if extraction design is too simple.

INSULATION AND HEAT RECOVERY

A loss of heat along the column causes increased condensation and reduced evaporation. Thus, the amount of vapor diminishes in the upward part of the column, where the flow of liquid is also less than at the bottom. Where heat loss occurs, more vapor has to be produced in the reboiler or steam generator, resulting in a loss in energy efficiency.

In Figure 3, the effect of heat loss is that the bottom line (the rectifier line) curves up and the upper line (the stripper line) curves down. This means that in the stripper, the "size" or magnitude of the steps considered in the stepping-off procedure (Figure 5) is decreased, sharply decreasing process efficiency as well.

The distillation column should be well insulated to prevent loss of heat and to protect against burns. Two to three inches of fiberglass blanket insulation is good. On columns located outdoors because of size and safety, the insulation blanket will shield the column from increased heat loss due to wind currents. Exposed insulation blanket may require weather shielding to maintain its performance.

Heat recovery from cooling hot mash for fermentation, from stillage in the column bottoms during distillation and from heat absorbed in the condenser can be an important source of energy efficiency. A detailed discussion of heat recovery techniques is outside the scope of this publication; but it is important to note the potential for energy conservation or heat wastage in a spirits distillation process. The incoming beer feed to the column, for instance, should be used as the cooling fluid for the condenser as much as possible, in order to reclaim condensation heat to preheat the beer, thus using and saving energy. However, savings are not as great if distillers dry solids are produced (spent grain and solids are dried).

The rest of the condensation (over and above what the beer preheating can do) is generally obtained using water. The water-heating capability of a condenser on a 50-gallon-per-day (2-gallon-per-hour) alcohol plant can provide 500,000 BTUs per day of heating for buildings. The reclaimed heat available, however, is basically the amount of heat put into the bottom of the column in the form of steam or reboiler heat. Heat reclamation is cost-effective only if the heat saved is used efficiently elsewhere as process or space heat. To use waste heat inefficiently just because it is easily available simply lowers overall system efficiency.

The lines carrying the beer through the condenser for the dual preheating/cooling function slowly accumulate a protein layer on their inside wall, hampering flow and heat transfer. The protein must be removed periodically with a caustic (strong base) soda.

Hot stillage water discharged from the base of the stripping column may also be reclaimed and either used to preheat the beer, used to preheat water for the next cooking cycle or recycled directly info the next batch as the water for cooking and starch hydrolysis. Up to 1/3 of the stillage water may be recycled as cooking water for the next batch, provided accumulation of chemical substances from previous fermentations is not a problem. Any of these waste-heat sources may also be utilized in space or water heating.

A heat exchanger between the partially heated feed coming from the condenser and the very hot stillage from the bottom of the column can save some energy by further increasing the preheat on the beer feed

before it enters the column.

Be sure to evaluate the cost-benefit ratio when considering use of heat exchangers or heat storage systems. Process design and choice of equipment should consider energy conservation practices.

FACTORS AFFECTING ENERGY USE AND COLUMN SIZE

This publication does not present details of any particular column design or of input-output conditions. However, some general relationships between product condition and flow versus column size, number of stages and energy use can be illustrated. Tables 1-5 were generated by computer analysis to illustrate the basic physical and performance relationships. They show typical process response and sensitivity as design and operating factors are varied.

A few principles are:

* Energy usage increases when there is less alcohol in the feed stream or when the product concentration is raised (Tables 1-3).

* There is a trade-off between energy usage and column length. Columns can usually be made shorter by using more energy (Table 4).

* The degree to which the feed is preheated also affects the energy usage, as long as preheating is done "for free" by using the feed as a cooling fluid in the condenser and/or by using heat exchangers (Table 5).

Thus, the best way to operate is to have a good fermentation (high alcohol content in beer), not to try to go much above 90 percent by weight alcohol in the distillate and to preheat the feed (in the condenser, if not also with a heat exchanger). In this way, one can produce alcohol for around 1800 BTU/pound (11,000-12,000 BTU/gallon), which can be burned without further concentration in a slightly modified gasoline engine. However, this 90 percent alcohol will not mix satisfactorily with gasoline to form gasohol.

Assumptions for Table Calculations

Where not otherwise stated in Tables 1-5, the stillage is 0.4 percent, the feed 8 percent and the product 90 percent ethanol by weight. Energy is in BTUs per pound product, while diameter is for 50 gallon-per-hour feed with a packed column using plastic Intalox saddles for packing.

A 0.4 percent ethanol content in the stillage and an 8 percent ethanol content in the feed calculates as a 5 percent overall ethanol loss. (If the feed were only 4-6 percent ethanol concentration, the loss ratio will be much higher). A 5 percent continuous loss would mean a substantial loss of profit. The 0.4 percent loss level should not necessarily be considered as a desired loss level, but rather as a typical illustration (see Table 3).

In Table 1, the column entitled "reflux ratio" is the external reflux ratio -i.e., the ratio of liquid condensate returned as reflux to that kept as product. Having chosen this ratio and the concentration of stillage, feed and product, the ideal number of stages required in the rectifying and stripping sections, as well as the energy, are then determined.

The diameter is not strictly determined; the diameter given is a recommended value generated by computer. In practice, a standard-size commercially available column or pipe which is as large or slightly larger than the listed diameter would be used.

The "energy ratio in/out" column is the ratio of energy required for distillation to energy produced by burning the product.

Note that as the feed concentration goes up from 1 percent alcohol to 12 percent, the reflux ratio becomes quite low. This means that the amount of energy required also tails dramatically. This is why it is important to have a good fermentation and to produce a high concentration of alcohol in the beer.

Table 1. Varying the Feed (product = 90%, bottoms = 0.4%).

Beer feed (wt.%)	Reflux ratio	Rectifying column stages	Stripping column stages	Energy use (BTU/lb.)	Column diameter (in.)	Energy ratio in/out
1	33.9	7	2	15300	4.3	1.5
2	16.1	7	3	7510	5.0	.73
3	10.1	7	4	4870	5.1	.47
4	7 1	7	5	3580	5.2	.35
5	5.4	7	6	2810	5.2	.27
6	4.6	7	6	2460	5.4	.24
8	3.5	8	5	1980	5.7	.19
9	3	8	6	1760	5.7	.17
10	2.7	8	6	1630	5.8	.16
11	2.5	8	6	1540	6.0	.15
12	2.3	8	6	1450	6.1	.14

Table 2 shows that the amount of energy needed increases as the alcohol concentration in the product increases. But since the energy given by burning is also higher for higher product concentration, the energy-in to energy-out ratio is rather constant up to about 93 percent. After this point, the ratio increases dramatically because of the "sway back" in the equilibrium curve discussed in the text (i.e., the reflux ratio has to be much higher). Here the energy cost is much higher, too. Notice also that the length of the column (number of stages) gets very great as the desired product concentration approaches the azeotrope (95.6 percent).

Table 2. Varying the Distillate Concentration (feed = 8%, bottoms = 0.4%).

Alcohol product (wt.%)	Reflux ratio	Rectifying column stages	Stripping column stages	Energy use (BTU/lb.)	Column diameter (in.)	Energy ratio in/out
50	.2	2	11	811	4.9	.15
50	4	2	6	946	5.3	.18
60	.7	2	10	1050	5.1	.16
60	1	2	6	1230	5.5	.19
70	1.2	3	10	1230	5.1	.16
70	1.5	3	6	1390	5.4	.18
80	1.8	4	12	1400	5.0	.15
80	2.2	4	7	1590	5.4	.18
85	2.3	5	9	1550	5.2	.16
85	2.7	5	6	1730	5.5	.18
90	2.6	9	11	1580	5.1	.15

90	3	8	7	1760	5.3	.17
90	3.5	8	5	1980	5.7	.19
93	3	18	10	1690	5.1	.16
93	4	14	6	2110	5.7	.20
93	5	13	4	2530	6.3	.24
95	5.5	67	4	2660	6.4	.24
95	6	53	3	2870	6.6	.26
95	7	41	3	3280	7.1	.30
95	8	36	3	3690	7.5	.34
95.5	8.5	90	3	3860	7.7	.35
95.5	12	57	3	5290	9.0	.48

In Table 3, note that more stages are needed in the bottom section (the stripping section) to get less alcohol in the bottoms. Again, the effect can also be achieved to an extent by using more energy. Also notice here that the amount of energy needed per unit of product is constant, given a constant feed concentration, product concentration and reflux ratio. Thus, no energy is saved by recovering more of the alcohol from the beer; but one would, of course, save on the raw material of the fermentation.

Table 3. Varying Bottoms Concentration (feed = 8%, product = 90%).

Alcohol bottoms concentration (wt.%)	Alcohol loss (wt.%)	Reflux ratio	Rectifying column stages	Stripping column stages	Energy use (BTU/lb.)	Column diameter (in.)	Energy ratio in/out
3	35.3	3	8	3	1760	4.4	.17
2	23.3	3	8	3	1760	4.8	.17
1	11.5	3	8	5	1760	5.1	.17
.5	5.7	3	8	7	1760	5.3	.17
.5	5.7	5	7	3	2640	6.5	.26
.2	2.3	3	8	9	1760	5.4	.17
.2	2.3	5	7	5	2640	6.6	.26
.1	1.1	3	8	12	1760	5.4	.17

The alcohol loss levels (column 2) for various levels of bottoms concentration (even at a bottoms concentration of only 0.1 percent) is over 1 percent of the total. Adding only three stages from 9 to 12 in the stripping column cut the alcohol loss more than half. Losses in the bottoms are very important from a profit standpoint. The key question is, "How much can I afford to lose?"

Table 4 gives a larger range of reflux ratios for the same feed, product and bottoms. Note again the trade-off between energy Usage and column length. We can get the same results by using a small reflux ratio (low energy) and a column of 26 total stages, *or* with a high reflux ratio (high energy) and only nine column stages.

Table 4. Varying Reflux Ratio (bottoms = O.4%, feed = 8%, product = 90%).

Reflux ratio	Rectifying column stages	Stripping column stages	Energy use (BTU/lb.)	Column diameter (in.)	Energy ratio in/out

2.5	10	16	1540	5.0	.15
3	8	7	1760	5.3	.17
3.5	8	5	1980	5.7	.19
4	7	5	2200	6.0	.21
5	7	4	2630	6.5	.26
6	7	3	3070	7.1	.30
8	6	3	3950	8.0	.38
10	6	3	4830	8.9	.47

Table 5 shows the effects of preheating the feed on energy requirements. The 86° F feed represents un-preheated beer. A temperature of 173° F is approached by preheating in the condenser only, while 198° F (the boiling point of 8 percent alcohol) can also be reached by using a heat exchanger with the stillage. A perfect heat exchanger could actually vaporize about 1.4 percent of the beer, leading to the lowest energy usage. Small changes in the temperature of the feed can cause rather large changes in the reflux ratio needed, and hence in the energy cost.

Table 5. Varying the Feed Conditions (bottoms = 0.4% feed = 8%, product = 90%).

State of feed	Reflux ratio	Rectifying column stages	Stripping column stages	Energy use (BTU/lb.)	Column diameter (in.)	Energy ratio in/out
2% vaporized	2.9	9	12	1490	4.9	.15
2% vaporized	3	9	10	1540	5.0	.15
2% vaporized	3.5	8	7	1760	5.3	.17
198 F	2.5	10	16	1540	5.0	.15
198 F	2.6	9	11	1580	5.1	.15
198 F	2.9	8	8	1710	5.3	.17
198 F	3.2	8	6	1840	5.5	.18
173 F	2.9	8	6	1930	5.6	.19
173 F	2.9	8	6	1930	5.6	.19
86 F	1.4	12	7	2470	6.3	.24
86 F	1.9	9	5	2690	6.6	.26

FUEL FOR PROCESS HEAT

Ideally, fuel sources for cooking and distilling fuel alcohol would come from solid fuels, such as coal, wood and crop residues. Such practice would minimize the amount of high-quality liquid and gaseous fuels consumed for heating and increase the total quantity of liquid fuels available. Alternative fuels include: natural and LP gas and fuel oil; alcohol product: mined solid fuels (coal, peat, anthracite); crop and forest residues, farm and forest fuel crops and combustible wastes: methane gas produced from animal wastes and biomass; and solar radiation.

Liquid and gaseous fuels have the advantage of clean burning and easy combustion control. They are high in quality, portable, expensive and storable with high value alternative uses.

Solid fuels can save on the amount of premium liquid and gaseous fuels that must be consumed, but present air pollution and process control problems that are not easily solved. Harvest, handling and conversion technology for crop, forest and other cellulosic materials needs further development.

Methane gas from animal and industrial wastes and biomass presents an interesting possibility as a source of process fuel, but requires a major investment in technology and production plant to produce.

Solar heating requires concentrating collectors (e.g., parabolic) to produce the likely process temperatures and overall performance needed. It also limits operation to daytime hours and sunny days or requires a way of storing energy at high temperatures.

In planning any fuel alcohol production plant, whether an individual farm unit, a small cooperative project or a large community or industrial fuel alcohol plant, consideration must be given to the short-and long-run availability and price of alternative fuels. The implications in plant design and operation, if solid fuels are used or needed in the future, must be seriously evaluated.

The alcohol product itself may be used to fuel the process. However, this basically spends one unit of high-quality liquid fuel to save one unit of another type of fuel, making the unit of alcohol fuel unavailable for replacing imported or domestic oil.

SAFETY AND CONTROLS

Alcohol distillation involves some dangers besides the ordinary risks of large, complex equipment.

Explosion or Burning

The first danger is that of explosion or burning of the alcohol. Most farmers immediately recognize the potential explosion or fire dangers of distilling a petroleum fraction to produce gasoline. Alcohol and gasoline fuels share these common risks-a primary reason they are such excellent fuel sources for spark ignition engines, which actually use a controlled explosion to produce power Table 6 lists some characteristics of both fuels.

Table 6. Characteristics of Ethanol and Gasoline.[1]

Characteristic	Ethanol	Gasoline
Flash point	55 F	-44 F
Ignition temperature	689 F	536 F
Vapor flammability limit (% by volume)	3.3-19	1.4-7 6
Specific gravity (Water equals 1)	0.8	0.8
Vapor density (Air equals 1)	1.6	3-4
Boiling point	172 F	100-400 F

1 "Suggested Underwriting Guidelines for Ethanol Production", Special Release, October, 1980

In accordance with the National Fire Protection Association's pamphlet #30, "Flammable and Combustible Liquid Code"(Pamphlet #30 "Flammable and Combustible Liquid Code", National Fire

Protection Association. 60 Batterymarch Street, Boston, MA 02110.US), any liquid with a flash point (the lowest temperature at which that fuel will give off flammable vapors) less than 73° F and a boiling point 100° F or above is classified as a Class I-B flammable liquid. The ignition temperature (in the table) is the lowest temperature that vapors will ignite. Since both ethanol and gasoline are classified as Class I-B flammable liquids, the same safety considerations given to the production, storage and handling of gasoline must also be used with ethanol.

Alcohol vapor is explosive when mixed with air in amounts ranging from 3-19 percent by volume, at room temperature and atmospheric pressure. Gasoline vapor is explosive when mixed with air in the range of from 1.4-7.6 percent by volume for the same temperature and pressure conditions. Both alcohol and gasoline vapors are heavier than air, which may add to their accumulation in enclosed areas or in low-lying ground depressions around or down stream from the vapor source.

Handling such volatile fuels must always be cautious and planned. Gasoline is one suggested additive that can be applied to ethyl alcohol fuels to denature the alcohol and render it unfit for human consumption. Be sure to treat both products with equal caution when combining them. Adding alcohol to diesel fuel to make "diesohol" increases the volatility of diesel fuel, requiring added safety precautions.

The basic precautions for handling alcohol fuels and alcohol-gasoline or alcohol-diesel blends are:

1. Never smoke anywhere in or around the buildings or process equipment.

2. Have interconnected electrical grounding of all process equipment and storage components to minimize the risk of a spark from static electricity or a ground fault occurring in the presence of an explosive mixture.

3. Install adequate gauges and controls to permit rapid monitoring and control of the process.

A distillation column contains no air in normal operation, so there is no danger of the vapor or liquid inside catching fire or exploding. But air is present during column start-up and shut-down. As long as you maintain no possibility of a spark or source of ignition, the danger is minimal. The way to do so is to purge the column of any presence of air by starting the column on water without any alcohol. This replaces the air with steam before the alcohol is introduced.

Another precaution is to guard against leaks, which would allow alcohol vapor and air to mix in the column. Leaks are most likely with vacuum distillation, whereas the slight positive pressure normally accompanying "atmospheric" distillation will keep air from leaking into the still. Keeping air out of the column also makes the column and the condenser more efficient.

Blow-Out of Components

A second danger is a blow-out of components due to pressure build-up. Source of the pressure is the steam produced by constant heating of the reboiler, or that injected from a separate steam generator. Pressure builds up if too much resistance occurs from the flow of gas up the column or the flow of product out of the condenser. The former can happen if: (1) the column is too small for the amount of liquid or gas being put through it, (2) a flow blockage develops due to an accumulation of solids in the column, or (3) a failure of a packing or a plate assembly exists. Be sure that there is an outlet to the atmosphere somewhere downstream from the condenser, such as in the storage tank for the product.

To avert high-pressure blow-outs of plumbing and equipment, pressure gauges and pop-off valves should be installed in the following places: (1) in the condenser to sense product pressure, (2) near the base of the stripping and rectifying column sections to sense internal column pressure, and (3) in the reboiler steam chamber or the steam injector nozzle to sense steam pressure being applied.

All pop-off or pressure relief valves should be placed in such a way that discharge is directed away from any place where an operator or a visitor might be sprayed. This discharge should be vented out-of-doors. Test all pressure relief valves periodically to make sure that they are operable and set for the correct pressure.

The system should also be equipped with automatic shut-off controls on the heat going to the reboiler or the steam to the injector. If the temperature at the bottom of the column reaches more than a few degrees above the boiling point of water (212° F). the shut-off controls will activate. This happens if either the pressure in the column gets too high or the reboiler runs nearly dry.

A good control concept and good-quality control equipment go hand in hand with top process performance and safety. When things work right, the safety risk is always at the minimum. Remember that a continuously operating distillation process must simultaneously and continuously monitor and regulate: (1) beer feed rate and temperature, (2) column pressure and temperature (for both the stripping and the rectifying sections), (3) reflux- to-product flow rate to control the column discharge temperature and alcohol vapor concentration, and (4) heat application to the reboiler or steam flow from the injector.

Ideally, each control function can modulate the flow of fluid, vapor or energy and maintain a continuous balance of the process. Installing sight gauges for water level, pressure and temperature will provide added visual information to evaluate system performance.

WHERE DO I GO FROM HERE?

The discussion of alcohol distillation processes presented in this publication is not intended to teach process design, but rather understanding. The following references should be useful in further developing that understanding. If a decision is made to pursue the design and development of a small-scale alcohol production and distillation system, competent technical consultant(s) should be employed.

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**These publications are generally only available at libraries associated with Land Grant universities (usually your agricultural university), community and junior colleges interested in agriculture and alternative energy, and organizations involved in research on alcohol fuels and alternative energy. Several of the titles are accessible for reading only (not check out) from a small special alcohol fuel reference library supplied to the county Extension offices in Indiana.*

For more information, contact Dirk Maier, Agricultural and Biological Engineering, phone: 317-494-1175 or e-mail: maier@ecn.purdue.edu

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Features

- Model SL100XL Extended inlet model for installations with thick insulation. Suitable for water heaters with up to 1¾" (44.5mm) of insulation.
- Model L100XL Extended inlet model for installations with thick insulation. Suitable for water heaters with up to 2" (50.8mm) of insulation.
- Model LL100XL Extra extended inlet model. Suitable for water heaters with up to 2½" (63.5mm) of insulation.
- Model LLL100XL Extra extended inlet model. Suitable for water heaters with up to 3" (76mm) of insulation.
- Thermostats with special protective coating.
- All bronze body.
- Stainless steel spring.
- Thermostat is accurate and proven. Exclusively designed and manufactured by Watts.

Specifications

Temperature & Pressure Relief Valves

Each hot water storage heater shall be equipped with a CSA and ASME rated automatic temperature and pressure relief valve to protect the heater from excessive pressure and excessive temperature. The device shall be design certified, rated and listed by CSA to the requirements of ANSI Z21.22; and by the National Board to the requirements of ASME Section IV. The BTU discharge capacity of the device shall be in excess of the BTU input rating of the heater. Watts Series SL100XL, L100XL, LL100XL or LLL100XL.

⚠ WARNING

This device is designed for emergency safety relief and shall not be used as an operating control.

NOTE: The information contained herein is not intended to replace the full product installation and safety information available or the experience of a trained product installer. You are required to thoroughly read all installation instructions and product safety information before beginning the installation of this product.

***IMPORTANT:** INQUIRE WITH GOVERNING AUTHORITIES FOR LOCAL INSTALLATION REQUIREMENTS*

WATTS®

Series SL100XL, L100XL, LL100XL and LLL100XL

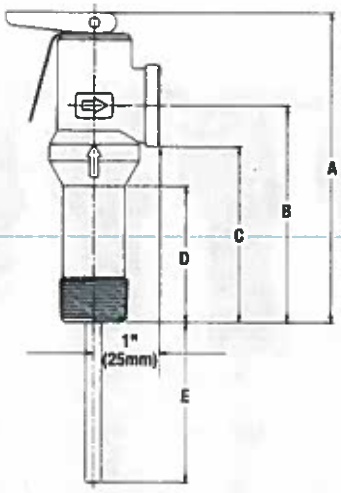
Model SL100XL Suitable for water heaters with up to 1¼" (44mm) of insulation

Model. L100XL Suitable for water heaters with up to 2" (50.8mm) of insulation

Model LL100XL Suitable for water heaters with up to 2½" (63.5mm) of insulation

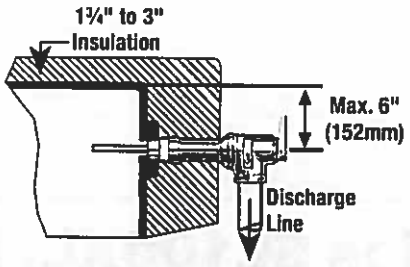
Model LLL100XL Suitable for water heaters with up to 3" (76mm) of insulation

Dimensions — Weights



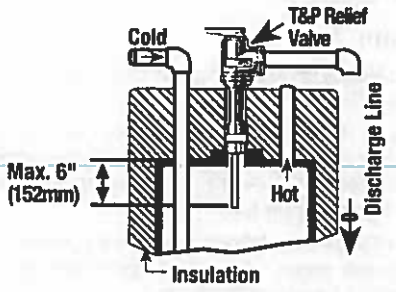
Direct Side Tapping

Vertical discharge line must be installed with its direction downward.



For Heaters with Direct Top Tapping

Use standard or extra length extension thermostat.



MODEL	SIZE		WIDTH		A		B		C		D		E		WEIGHT		C.S.A TEMP STEAM RATING
	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	lbs.	Kgs	
SL100XL	¾	20	1⅞	48	3 15/16	100	2½	63	1⅞	47	1¼	31	3 5/16	84	.58	.26	105,000 BTU/hr
L100XL	¾	20	1⅞	48	4 5/16	109	2 13/16	71	2 3/16	56	1 5/16	40	2 15/16	75	.61	.28	105,000 BTU/hr
LL100XL	¾	20	1⅞	48	4 13/16	122	3 5/16	84	2 11/16	68	2 1/16	53	2 7/16	62	.65	.29	105,000 BTU/hr
LLL100XL	¾	20	1⅞	48	5 1/16	132	3¾	94	3 1/16	79	2½	63	2 1/16	52	.68	.31	105,000 BTU/hr

⚠ WARNING

REINSPECTION OF T&P RELIEF VALVE: Temperature and Pressure Relief Valves should be reinspected AT LEAST ONCE EVERY THREE YEARS by a licensed plumbing contractor or authorized inspection agency, to insure that the product has not been affected by corrosive water conditions and to insure that the valve and discharge line have not been altered or tampered with illegally. Certain naturally occurring conditions may corrode the valve or its components over time, rendering the valve inoperative. Such conditions are not detectable unless the valve and its components are physically removed and inspected. Do not attempt to conduct this inspection on your own. Contact your plumbing contractor for a reinspection to assure continuing safety. **FAILURE TO REINSPECT THIS VALVE AS DIRECTED COULD RESULT IN UNSAFE TEMPERATURE OR PRESSURE BUILD-UP WHICH CAN RESULT IN SERIOUS INJURY OR DEATH AND/OR SEVERE PROPERTY DAMAGE.**

IMPORTANT: A relief valve functions in an emergency by discharging water. Therefore, it is essential that a discharge line be piped from the valve in order to carry the overflow to a safe place of disposal. The discharge line must be the same size as the valve outlet and must pitch downward from the valve and terminate at least 6"(152mm) above the floor drain where any discharge will be clearly visible. For 100DT discharge line consult your Watts agent.

WATTS®

A Watts Water Technologies Company

ISO 9001-2008 CERTIFIED

USA: Tel: (978) 688-1811 • Fax: (978) 794-1848 • www.watts.com
Canada: Tel: (905) 332-4090 • Fax: (905) 332-7068 • www.wattscanada.ca

One Year Warranty
REVENOOR stills are covered by limited warranty for one year after date of purchase. Within this one year from the date of purchase, the **REVENOOR** will repair or replace your still if it is found to be deficient by reason of defect in either workmanship or materials. This warranty will not apply if your still has been damaged in transit, (you should open and inspect your still for damage upon receipt, because the shipper is responsible for damage in transit) if it is damaged from abuse, misuse, negligence, or accident, if it is improperly installed or in anyway modified. Should it be necessary for the still to be returned to our factory for repairs, transportation cost to and from our factory are the owner's responsibility and must be prepaid.

Style and Capacity of still
Each of the **REVENOOR** stills are designed with a temperature controlled tower or column for added efficiency. The 5, 10, 25, 50 and 100 gallon stills are solid copper built to last a lifetime. The 300 and 1,000 gallon stills have a heavy duty, treated steel cooker and solid copper detachable column. The 300 and 1,000 gallon stills are offered in copper as an option for beverages.

The gallon size of the still is the cooker capacity. Example, a five gallon **REVENOOR** still holds five gallons of "beer," a 25 gallon still holds 25 gallons of "beer" etc. Each unit is listed with the actual alcohol production rates on the page that describes the still in more detail. As you will notice, the larger stills are more efficient and take considerably less attention.

Safety and Maintenance
REVENOOR stills are manufactured of very high-quality materials and are completely safe. Each **REVENOOR** still is built with a safety valve and operates on less than one pound of pressure. The temperatures for operation are from 173 to 210 degrees F. (78.3 to 98.8 C.) Alcohol doesn't ignite from fumes like gasoline will, therefore, it is much safer than gasoline, although it is a flammable liquid and must be treated as such. Since you are placing only the liquid in the still, maintenance and cleaning is no problem, as they very seldom need maintenance. These are very heavy duty, high-grade solid copper units with silver soldered fittings, built to last a lifetime and need only an occasional washing out.

What size do I need?
When making your decision on which size and type of still you want, you should first decide the amount of fuel you wish to produce. Then decide the type of heat best suited for your area and needs. The average auto uses 800 gallons of fuel per year and a single acre of sugar beets for example would yield about 1200 gallons of alcohol. If you purchase all of your ingredients you can still produce your own fuel for less than the price of gasoline. Each still size is listed with the related equipment following. The following **REVENOOR** stills offered will produce the specified amount of alcohol per run if your mash contains at least 15 % alcohol content in your beer and the time element for production is figured from the time the still is up to temperature.

Some folks have more time to produce fuel then do others. Therefore you may wish to set up a larger plant to produce a lot of fuel at one time and then shut it down until your reserves are running low. Or even keep a larger unit running continuously and sell your excess at a profit.

Assembly
The only tools needed to complete assembly of the **REVENOOR** five, ten, twenty-five and fifty gallon size stills are two 8" to 10" adjustable wrenches

How soon will I receive my still?
Full payment is due with the order of the **REVENOOR** 1 ½, 5, 10, 25 and 50 gallon size stills. All Revenoor stills are built after you place your order. The 1 ½, 5, 10 and 25 gallon stills usually ship in 30 days. The continuous systems and related equipment are made to your special order and normally take 45 days before shipping. We require a minimum 65 % deposit on all special orders to start and the balance to be received before shipment of order unless otherwise instructed in a written bid. On all special orders the 65 % deposit must be forfeited if the order is cancelled or not accepted. All stills are shipped freight COD or can be picked up at our location.

Trade-Ins
If you prefer to start out with a smaller unit to get the feel of alcohol production and then wish to move up to a larger sized unit, we will allow you full price paid on a larger unit. Of course, your trade-in must still be in good condition so it can be resold. However, if you have purchased your still from a dealer, you will have to make arrangements for a trade-in with them. We also have several units in stock that are trade-ins that are discounted from the original price. These trade-ins are completely reconditioned and carry a normal one year warranty the same as a new unit. Since stock on trade-in stills fluctuate almost daily, it will be necessary to phone or write us for availability.

Prices subject to change without notice!

We hope the information we have furnished you is helpful and we look forward to helping you to be fuel independent. Some of our customers have purchased units from us and have put them aside for future use or for emergency purposes.

This is also a smart idea for three major reasons:

1. They beat the rapidly rising inflation factor or price increases caused from raw materials, labor, etc.
2. The U.S. Government is still issuing free permits and tax credits.
3. They have the unit when they want and need it.

Propane-Fired Stills
The propane models are supplied with a cast iron burner, heating head, adjustable regulators, pilot assembly, thermal couple and safety shut down.

ALL PRICES ARE F.O.B. factory (unless otherwise stated.)

The following high quality accessories are included with each of the **REVENOOR** stills:

Free instruction manual	Free "**Simple Sour Mash to Simple Alcohol Fuel**" book
Stainless Steel Thermometers	Safety pop-off valve
Vinometer (beer Hydrometer)	Hydrometer (for testing proof of alcohol)
Large plastic beaker	Yeast

Barters or Trades of Products or Services
Do you have a product or a service that you think that we might be interested in? Currently, we are looking for someone to overhaul and semi restore a John Deere 70 Diesel tractor. We are also interested in a D4/D6 CAT Crawler with hydraulics.

The following are US Government published production yields for various crops. Keep in mind that with the sour mash method that these yields are ¼ the total since many crops can be used 4 times for fermentation.

Material	Yield per ton In Gallons	Yield per acre In Gallons
Wheat	85.0	79.0
Buckwheat	83.4	34.2
Grain sorghum	79.5	121.00
Barley	79.2	83.0
Rye	78.8	54.0
Molasses, blackstrap	70.4	45.0
Oats	63.6	57.0
Sweet potatoes	34.2	190.0
Potatoes	22.7	299.0
Figs, fresh	21.0	31.5
Jerusalem artichokes	20.0	1200.0
Grapes (all varieties)	15.1	90.4
Pears	11.5	49.3
Plums	10.9	21.8

Material	Yield per ton In Gallons	Yield per acre In Gallons
Corn	84.00	214.0
Raisins	81.4	101.7
Rice, rough	79.5	175.0
Dates, dry	79.0	126.0
Prunes, dry	72.0	82.8
Sorghum cane	70.4	500.0
Figs, dry	59.0	29.5
Yams	27.3	94.0
Sugar beets	22.9	412.0
Pineapples	20.0	78.0
Sugar cane	15.2	
Apples	14.4	140.0
Peaches	11.5	84.0
Carrots	9.8	121.0

AURORA ROSS FIRE DEPARTMENT INCIDENT REPORT

INCIDENT DATE: 4-24-15	DAY OF WEEK:	INCIDENT #: 2015-025
DISPATCH TIME: 1032	ARRIVAL TIME: 1043	SCENE CLEARED TIME: 1318

INCIDENT LOCATION: 136 Palestine Road
PHONE NUMBER: (270) 354-9657
LAT/LONG:
CITY: Hardin ZIP: 42048 PROPERTY OWNER: Spencer Balentine

TYPE OF SITUATION FOUND:
- [X] INHAB. STRUCTURE FIRE (111)
- [ ] UNINHAB. STRUCT. FIRE (112)
- [ ] MOBILE HOME FIRE (121)
- [ ] CAR FIRE (132)
- [ ] BRUSH FIRE (142)
- [ ] 10-45 (322)
- [ ] 10-46 (324)
- [ ] LOST PERSON (341)
- [ ] RESCUE (300)
- [ ] GOOD INTENT (600)
- [ ] FALSE ALARM (700)
- [ ] SEVERE WEATHER (815)
- [ ] FIRE OTHER (100)
- [ ] EMS ASSIST (311)

ACTIONS ON SCENE (MAX OF 3)
- [X] EXTINGUISH (11)
- [X] SALVAGE/O-H (12)
- [ ] SEARCH (21)
- [ ] EXTRICATE (23)
- [ ] BLS (32)
- [ ] ID HAZ MAT (41)
- [ ] VENTILATE
- [ ] FORC. ENTRY (52)
- [ ] SCENE LIGHT (57)
- [ ] OPER. APPAR. (58)
- [ ] M/A MANPWR (73)
- [ ] M/A APPAR. (74)
- [ ] M/A EQUIP (75)
- [ ] TRAFFIC CONT (78)
- [ ] SEVERE WX (79)
- [ ] INVESTIGATE (86)

*****COMPLETE FOR FIRES*****

PROPERTY TYPE: [ ] RESIDENTIAL [X] COMMERCIAL [ ] N/A
NUMBER OF BUILDINGS INVOLVED: 1 NUMBER OF ACRES BURNED: Ø

AREA OF ORIGIN:
- [ ] OTHER (00)
- [ ] BEDROOM (21)
- [ ] DINING ROOM (23)
- [ ] KITCHEN (24)
- [ ] BATHROOM (25)
- [ ] LAUNDRY RM (26)
- [ ] OFFICE (27)
- [ ] GARAGE (47)
- [ ] ELEC. CONDUIT (52)
- [ ] HVAC (55)
- [ ] LOWER CRAWL (71)
- [ ] PORCH (72)
- [ ] ATTIC (74)
- [ ] VEHICLE ENGINE (83)
- [ ] PASSENGER COMP (81)
- [ ] CARGO AREA (82)
- [ ] VEHICLE (80)
- [ ] WILDLAND (95)
- [X] OTHER (00)
- [ ] UNKNOWN (UU)

HEAT SOURCE:
- [ ] ARCING (13)
- [ ] HOT/SMOLDERING (40)
- [ ] OPEN FLAME (50)
- [ ] LIGHTNING (73)
- [ ] FIRE SPREAD (80)
- [X] UNDETERMINED (UU)
- [ ] OTHER (00)

ITEM FIRST IGNITED:
- [ ] STRUCT. COMPONT (10)
- [ ] INSULATION (18)
- [ ] INTERIOR WALL (15)
- [ ] FURNITURE (20)
- [ ] APPLIANCE (25)
- [ ] STORAGE SUPPLIES (50)
- [ ] COOKING MATERIAL (70)
- [X] UNDETERMINED (UU)
- [ ] OTHER (00)

*****STRUCTURE FIRES ONLY*****

STRUCTURE TYPE:
- [ ] OTHER (0)
- [X] ENCLOSED BLDG (1)
- [ ] FIXED MOBILE (2)
- [ ] OPEN (3)

BUILDING STATUS:
- [ ] OTHER
- [ ] UNDER CONSTR. (1)
- [X] NORMAL USE (2)
- [ ] VACANT (5)

BUILDING STORIES: 1
FLOOR SIZE: 30x40
EST. SQ. FOOTAGE:

SMOKE DETECTORS? Y (N) U
DID THEY PERFORM? Y (N) U

FIRE SPREAD:
- [ ] OBJECT OF ORIGIN (1)
- [ ] ROOM OF ORIGIN (2)
- [ ] FLOOR OF ORIGIN (3)
- [X] BUILDING OF ORIGIN (4)
- [ ] BEYOND BUILDING (5)

ITEM CONTRIBUTING TO FLAME SPREAD
- [X] OTHER (00)
- [ ] STRUCTURAL COMPONENT (10)
- [ ] FURNITURE (20)
- [ ] STORAGE (50)
- [ ] UNDETERMINED (UU)

TYPE OF MATERIAL FOR FLAME SPREAD
- [X] OTHER (00)
- [ ] FLAMBLE GAS (10)
- [ ] FLAMBLE LIQ (20)
- [ ] SOLIDS/CHEM (30)
- [ ] PLASTICS (41)
- [ ] NATURAL PRD (50)
- [ ] WOOD/PAPER (60)
- [ ] FABRIC/TEXT (70)
- [ ] UNDETERMINED

SUPPRESSION FACTORS (MAXIMUM OF 3)
- [ ] BUILDING DESIGN (100)
- [ ] ROOF COLLAPSE (112)
- [ ] CEILING COLLAPSE (131)
- [ ] ACCELERANT USED (283)
- [ ] ILLEGAL DRUG OPERATION (222)
- [ ] DIFFICULT TO VENTILATE (132)
- [ ] FLOOR COLLAPSE (141)
- [ ] WOOD TRUSS CONSTRUCTION (185)
- [ ] METAL TRUSS CONSTRUCTON (186)
- [X] BUILDING CONTENTS (300)
- [ ] POOR FD ACCESS (434)
- [ ] INADEQ WATER SUPPLY (532)
- [ ] TROUBLE FINDING LOC. (436)
- [ ] NONE (NNN)

*****MOBILE PROPERTY FIRES ONLY*****

MOBILE PROPERTY TYPE:
- [ ] PASSENGER (11)
- [ ] AIRCRAFT (50)
- [ ] WATER CRAFT
- [ ] NONE (NN)
- [ ] FREIGHT VEHICLE (20)
- [ ] AGRICULTURAL VEH (60)

MOBILE PROPERTY FIRE FACTOR:
- [ ] NOT INVOLVED IN IGNITION, BUT BURNED (1)
- [ ] INVOLVED IN IGNITION, BUT DID NOT BURN (2)
- [ ] INVOLVED IN IGNITION AND BURNED (3)
- [ ] NONE (NN)

MAKE:	YEAR:	VIN:
INSURANCE CO:		LICENSE PLATE # / STATE:
INSURANCE AGENT:	POLICY #:	
PROPERTY OCCUPANT (IF OTHER THAN OWNER):		

Hydrant Used: [X] YES [ ] NO	1 1/2" HOSE USED - 100'	2 1/2" HOSE USED - 400'
ESTIMATED GALLONS WATER USED	54,000	

OFFICER IN CHARGE	RANK	MEMBER MAKING REPORT	RANK	DATE
Ricky Sirls	Chief	Marcia Sirls	FF/EMT	4/24/15

NFIRS

COMPLETE FOR AUTOMOBILE CRASHES ONLY

UNIT #1	UNIT #2
LICENSE # / STATE:	LICENSE # / STATE:
VIN #:	VIN #:
OWNER NAME:	OWNER NAME:
OWNER ADDRESS:	OWNER ADDRESS:
VEHICLE MAKE/MODEL/YEAR:	VEHICLE MAKE/MODEL/YEAR:
INSURANCE CARRIER:	INSURANCE CARRIER:
POLICY #:	POLICY #:
DRIVER:	DRIVER:
OCCUPANT:	OCCUPANT:
OCCUPANT:	OCCUPANT:
OCCUPANT:	OCCUPANT:
REMOVING WRECKER SERVICE:	REMOVING WRECKER SERVICE:

EQUIPMENT USED

☐ AXE ☐ HALLIGAN TOOL ☐ CUTTERS ☐ SPREADERS ☐ RAMS ☐ SAWS-ALL ☐ SCBA PACK(S) # USED _____

☐ FIRST AID SUPPLIES (SPECIFY): _____

NUMBER OF FIREFIGHTERS/ EMT'S ON SCENE: 19 TIME ON SCENE 11½

NUMBER OF OFFICERS ON SCENE: 5 TIME ON SCENE 11½

NUMBER OF APPARATUS 9 TIME ON SCENE 11½

****COMPLETE FOR ALL INCIDENTS****

APPARATUS ☐ 901 ☒ 902 ☒ 903 ☐ 904 ☐ ☐ ☐ ☒ 908 ☐ 909

PERSONNEL

☒ 911	DANNY KINCANNON	☐ 924		☐ 936	ABBY HEATH
☐ 912	KEITH SMITH	☒ 925	RICKY SIRLS	☐ 937	LOGAN HAWKS
☒ 913	CHRISTIE HAWKS	☒ 926	MARCIA SIRLS	☐ 938	J W DAVIS
☐ 914	HAROLD GIVENS	☐ 927	CHRIS BEECHUM	☐ 939	
☒ 915	MIKE GIVENS	☒ 928	RONNIE HEATH	☐ 940	
☒ 916	TROY ELFRANK	☒ 929	BECKY HARTLEY		
☐ 917	RONNIE MATHIS	☒ 930	TIM HARTLEY		
☒ 918	GARY HENRY	☐ 931	JEROME RAGSDEL		
☐ 919	JAMES KURIGER	☐ 932	BRAD WHYBARK		
☐ 920	TIM HOLLER	☐ 933	JOSH SIRESS		
☐ 921	RICHARD BOYAN	☐ 934	IAN BOYAN		
☐ 922		☒ 935	CHANDLER SIRLS		
☐ 923					

OTHER RESPONDERS

☒ MUTUAL AID, SPECIFY DEPARTMENT Hardin-South Marshall FD

☒ MUTUAL AID, SPECIFY DEPARTMENT Fairdealing-Olive FD

☒ MUTUAL AID, SPECIFY DEPARTMENT East Marshall FD

========NARRATIVE========

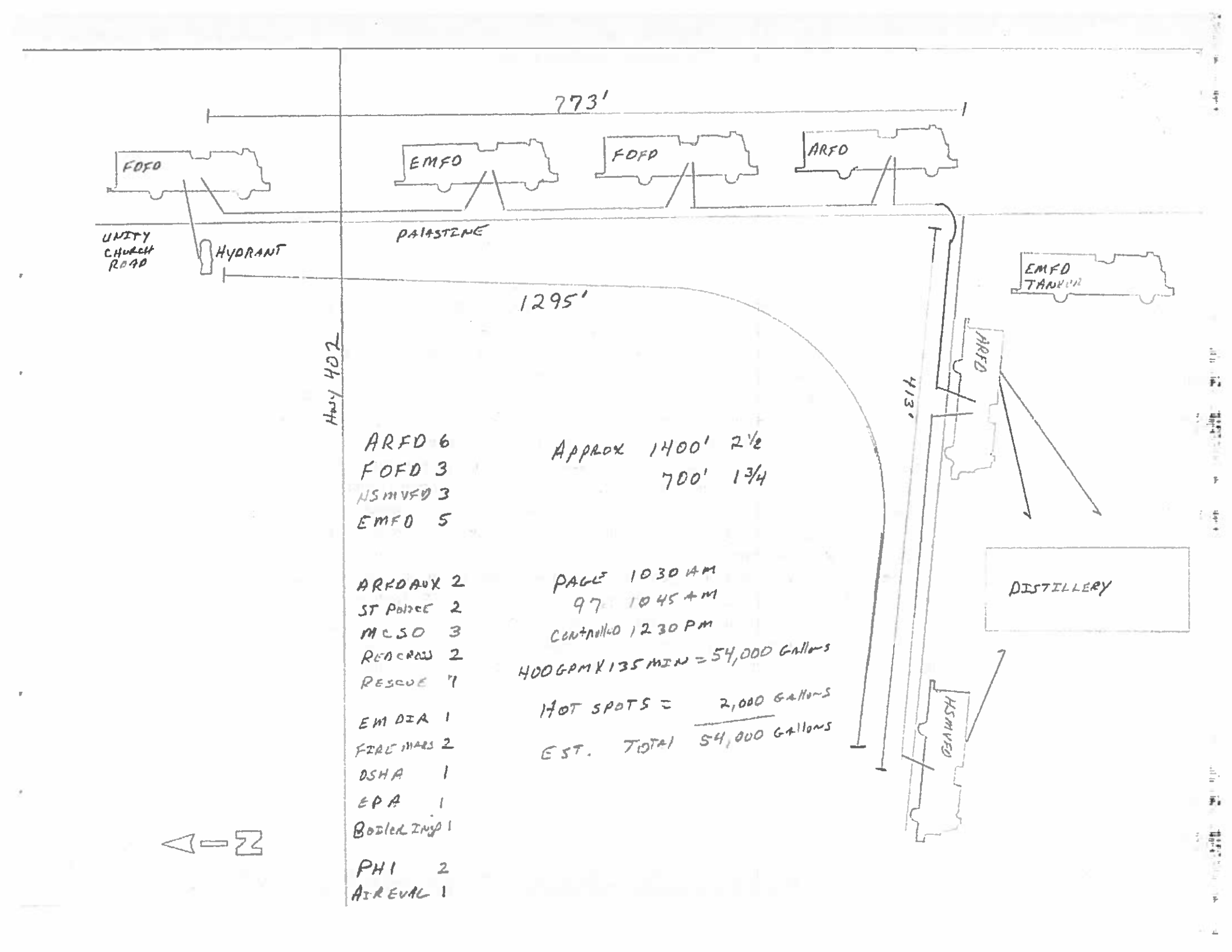
MC Rescue Squad
MC Sheriff's Office
Hate Fire Marshall

See attached

☐ Assisted EMS with patient packaging and provided emergency care ☐ Extricated patient from vehicle

☐ Provided traffic control for scene safety

Upon arrival, flames were coming out the northwest side of the building. Gray smoke was coming from the eaves of the east side the length of the building with flames visible through the eaves and the windows. Truck 902 was staged midway between Palestine Road and entrance to the distillery. Started a line and began spraying water on area in front of building. EMS arrived immediately behind us and went directly to owner's home. Shortly after EMS arrived, Hardin-South Marshall Fire Department arrived and staged below the building on the west side and started flowing water to minimize the potential of fire spread. Fairdealing-Olive Fire Department was requested for water supply and manpower and staged at hydrant located at the intersection of East Unity Church Road and Highway 402. East Marshall Fire Department arrived and staged at the south end of the building and provided water. At this time, I spoke with owner, Spencer Balentine concerning the cause of the fire. Spencer stated that he lit the still at 5:00 a.m. and went back home. He stated that he and his wife heard a pop, his wife called 911 and he headed for the distillery. Upon arrival he stated that Jay and Kyle were laying on the ground by the smokehouse. Spencer stated that from initial appearances they did not look severely hurt and he got them up and headed for the house to insure they received no further injuries. Both Kyle and Jay hollered to Spencer to shut the propane off. Spencer stated that his wife tended to both Kyle and Jay until EMS arrived. Spencer stated that he went to shut the propane off and had looked in the door and saw only a small flame but it appeared the still was split. I thanked Spencer for the information and continued working the fire scene.


773'
FOFD
EMFO
FOFD
ARFD
UNITY CHURCH ROAD
HYDRANT
PALESTINE
1295'
Hwy 402
EMFO TANKER
ARFD
1314'
DISTILLERY
HSMVFD
ARFD 6
FOFD 3
HSMVFD 3
EMFO 5
ARFDAUX 2
ST POLICE 2
MCSO 3
REDCROSS 2
RESCUE 1
EM DIR 1
FIRE MARS 2
OSHA 1
EPA 1
BOILER INSP 1
PHI 2
AIREVAC 1
Approx 1400' 2½
700' 1¾
PAGE 1030 AM
97 1045 AM
CONTROLLED 1230 PM
400 GPM X 135 MIN = 54,000 Gallons
HOT SPOTS = 2,000 Gallons
EST. TOTAL 54,000 Gallons

Incident Number: 20236844 **Incident Type:** NORMAL **Priority:**

IC Number: 20150424-002131

Details

Received By	Received Date	Dispatched	Complaint:	
JASON	4/24/2015 10:31:00	4/24/2015 10:32:46	1070	STRUCTURE FIRE

Comment BARN HAS EXPLODED, POSSIBLY 2 SUBJECTS INSIDE

Disposition

C-COMPLETED

Location

ALI ESN: 034 **Call ESN:**

ALI Address: 5402 AURORA HWY, HARDIN **ALI Phone:** 270-354-9657

Location Address: 136 PALESTINE RD, HARDIN **Location Phone:** 270-354-9657

GIS Address: **Latitude:**

Landmark:: **Longitude:**

Caller

ALI Caller: BALENTINE, SPENCER

Location Caller: SPENCER BALENTINE

Raw ALI Feed

203
(270) 354-9657 10:31 04/24
5402 AURORA HWY HARDIN KY 034 RESD
BALENTINE, SPENCER P# 354-9657
LEC:WKRT
MARSHALL CO SHERIFF
AURORA-ROSS FIRE
BENTON AMBULANCE

Dispatched Units

ARFD **900** **Case Number:** **00025**

Status	Set Date/Time	Odometer	Comments	Set By
DSP	4/24/2015 10:32:46	0.00		LUKE
1076	4/24/2015 10:34:54	0.00		JASON
1097	4/24/2015 10:43:18	0.00		LUKE
1097	4/24/2015 22:07:38	0.00		PHILIP
STACKED	4/24/2015 22:11:50	0.00		
1098	4/24/2015 22:18:49	0.00		PHILIP

CCEMS **AIR** **Case Number:**

Status	Set Date/Time	Odometer	Comments	Set By
1076	4/24/2015 10:54:14	0.00		LUKE
1097	4/24/2015 11:13:59	0.00		LUKE
1098	4/24/2015 13:49:34	0.00		LUKE

ELEC **ELECTRIC** **Case Number:**

Status	Set Date/Time	Odometer	Comments	Set By

1076	4/24/2015 10:52:05	0.00		LUKE
1098	4/24/2015 13:49:28	0.00		LUKE

EMFD **400** **Case Number:** **00058**

Status	Set Date/Time	Odometer	Comments	Set By
1076	4/24/2015 10:44:16	0.00		LUKE
1097	4/24/2015 11:03:42	0.00		LUKE
1098	4/24/2015 14:06:36	0.00		LUKE

FOFD **700** **Case Number:** **00048**

Status	Set Date/Time	Odometer	Comments	Set By
DSP	4/24/2015 10:41:44	0.00		JASON
1076	4/24/2015 10:42:31	0.00		LUKE
1097	4/24/2015 11:03:39	0.00		LUKE
1098	4/24/2015 14:04:14	0.00		ANDREA

HSMFD **600** **Case Number:** **00028**

Status	Set Date/Time	Odometer	Comments	Set By
DSP	4/24/2015 10:32:52	0.00		LUKE
1076	4/24/2015 10:35:39	0.00	631	JASON
1097	4/24/2015 10:50:14	0.00		JASON
1098	4/24/2015 22:18:53	0.00		PHILIP

MCAS **A440** **Case Number:**

Status	Set Date/Time	Odometer	Comments	Set By
DSP	4/24/2015 10:36:17	0.00		LUKE
1076	4/24/2015 10:36:26	0.00	585.9 POW/DAR 1375	LUKE
1097	4/24/2015 10:48:56	0.00		LUKE
1076	4/24/2015 11:08:37	0.00	LZ	LUKE
1097	4/24/2015 11:14:19	0.00	AIREVAC 599.9	LUKE
1008-INSERV	4/24/2015 12:09:13	0.00		JASON
1098	4/24/2015 12:45:39	0.00	615.9	LUKE

MCAS **A834** **Case Number:**

Status	Set Date/Time	Odometer	Comments	Set By
DSP	4/24/2015 10:37:33	0.00		JASON
1076	4/24/2015 10:38:16	0.00	443.9 1376 CAR/CRIS	JASON
1097	4/24/2015 10:46:47	0.00	454.6	LUKE
1076	4/24/2015 11:08:31	0.00	LZ	LUKE
1008-INSERV	4/24/2015 11:41:46	0.00		LUKE
1008-INSERV	4/24/2015 12:32:56	0.00		JASON
1098	4/24/2015 13:32:00	0.00	479.4	LUKE

MCAS **MCAS** **Case Number:**

Status	Set Date/Time	Odometer	Comments	Set By
DSP	4/24/2015 10:33:56	0.00		JASON
1098	4/24/2015 10:36:17	0.00	AGENCY UNIT WAS AUTOMATICALLY CLEARED	LUKE
1098	4/24/2015 10:37:33	0.00	AGENCY UNIT WAS AUTOMATICALLY	JASON

CLEARED

MCRS DES1 Case Number: 00096

Status	Set Date/Time	Odometer	Comments	Set By
DSP	4/24/2015 10:54:08	0.00		JASON
1076	4/24/2015 10:54:42	0.00		LUKE
1097	4/24/2015 11:12:37	0.00		LUKE
1098	4/24/2015 22:18:57	0.00		PHILIP

MCRS R01 Case Number: 00096

Status	Set Date/Time	Odometer	Comments	Set By
DSP	4/24/2015 10:48:42	0.00		JASON
1098	4/24/2015 10:57:43	0.00		LUKE

MCRS RESCUE Case Number: 00096

Status	Set Date/Time	Odometer	Comments	Set By
DSP	4/24/2015 10:48:40	0.00		LUKE
1076	4/24/2015 10:51:17	0.00		LUKE
1097	4/24/2015 11:13:26	0.00		LUKE
1098	4/24/2015 13:49:23	0.00		LUKE

MCSO MC01 Case Number: 03538

Status	Set Date/Time	Odometer	Comments	Set By
DSP	4/24/2015 10:50:03	0.00		JASON
1076	4/24/2015 10:54:59	0.00		LUKE
1097	4/24/2015 11:02:36	0.00		LUKE
1098	4/24/2015 13:16:59	0.00		LUKE

MCSO MC18 Case Number: 03538

Status	Set Date/Time	Odometer	Comments	Set By
1097	4/24/2015 11:24:22	0.00		LUKE
1098	4/24/2015 13:04:03	0.00		JASON

MCSO MC20 Case Number: 03538

Status	Set Date/Time	Odometer	Comments	Set By
1076	4/24/2015 10:57:31	0.00		LUKE
1097	4/24/2015 11:09:24	0.00		LUKE
1098	4/24/2015 13:18:36	0.00		LUKE

MCSO MC45 Case Number: 03538

Status	Set Date/Time	Odometer	Comments	Set By
1076	4/24/2015 12:14:17	0.00		LUKE
1098	4/24/2015 12:27:41	0.00		LUKE

REDCRO REDCRO Case Number: 00006

Status	Set Date/Time	Odometer	Comments	Set By
DSP	4/24/2015 10:53:39	0.00		JASON
1076	4/24/2015 10:54:35	0.00		LUKE
1098	4/24/2015 13:49:31	0.00		LUKE

Incident Narrative

LUKE 4/24/2015 10:38:04 A834: CHECK FLIGHT STATUS

JASON	4/24/2015 10:38:50	AIR EVAC WILL START CREW 16 MINUTE FLIGHT TIME
JASON	4/24/2015 10:42:16	CALLING PHI FOR CHECKING STANDBY STATUS FOR SECOND COPTER
JASON	4/24/2015 10:47:43	PHI EN ROUTE
JASON	4/24/2015 10:49:50	400 RESPONDING
LUKE	4/24/2015 10:54:28	PHI AND AIR EVAC BOTH 76
JASON	4/24/2015 10:58:59	RESCUE TRUCK 100 EN ROUTE
LUKE	4/24/2015 11:05:47	R51 POINT OF CONTACT, LZ BEHIND ARFD
JASON	4/24/2015 11:14:20	706 ON SCENE
JASON	4/24/2015 11:16:58	A834-MCAS - LOG: LZ 458.1 AT 11097 AT LZ
LUKE	4/24/2015 11:21:07	MC01: 402 BEING SHUT DOWN
LUKE	4/24/2015 11:22:42	STATE FIRE MARSHALL UNIT HAS BEEN NOTIFIED 11:10
LUKE	4/24/2015 11:38:11	A834-MCAS - LOG: PHI HAS PATIENT AND LIFTING NOW
LUKE	4/24/2015 11:38:33	ROAD CLOSURE SENT OUT
JASON	4/24/2015 12:32:47	MC20-MCSO - LOG: 532NTD/KY
PHILIP	4/24/2015 19:34:54	RICKY SIRLS REQUESTED TO HAVE JULIE @ HEALTH DEPT CALL HIM

Complainants

Type: DL #: DL State:

SSN: DOB: Race: Gender: Phone:

Address:

Comments:

Vehicle

Vehicles

Make: Model: Style: Color: Year:

Tag Number: Tag State: Model:

Comments:

Wreckers

Wrecker Company	Service Area	Caller Requested	Responded	Call Date/Time

Radio Communications

ARFD-900	4/24/2015 10:32:46	DSP		LUKE
HSMFD-600	4/24/2015 10:32:52	DSP		LUKE
MCAS-MCAS	4/24/2015 10:33:56	DSP		JASON
ARFD-900	4/24/2015 10:34:54	1076		JASON
HSMFD-600	4/24/2015 10:35:39	1076	631	JASON
MCAS-A440	4/24/2015 10:36:17	DSP		LUKE
MCAS-MCAS	4/24/2015 10:36:17	1098	AGENCY UNIT WAS AUTOMATICALLY CLEARED	LUKE
MCAS-A440	4/24/2015 10:36:26	1076	585.9 POW/DAR 1375	LUKE
MCAS-A834	4/24/2015 10:37:33	DSP		JASON
MCAS-MCAS	4/24/2015 10:37:33	1098	AGENCY UNIT WAS AUTOMATICALLY CLEARED	JASON
MCAS-A834	4/24/2015 10:38:16	1076	443.9 1376 CAR/CRIS	JASON

FOFD-700	4/24/2015 10:41:44	DSP		JASON
FOFD-700	4/24/2015 10:42:31	1076		LUKE
ARFD-900	4/24/2015 10:43:18	1097		LUKE
EMFD-400	4/24/2015 10:44:16	1076		LUKE
MCAS-A834	4/24/2015 10:46:47	1097	454.6	LUKE
MCRS-RESCUE	4/24/2015 10:48:40	DSP		LUKE
MCRS-R01	4/24/2015 10:48:42	DSP		JASON
MCAS-A440	4/24/2015 10:48:56	1097		LUKE
MCSO-MC01	4/24/2015 10:50:03	DSP		JASON
HSMFD-600	4/24/2015 10:50:14	1097		JASON
MCRS-RESCUE	4/24/2015 10:51:17	1076		LUKE
ELEC-ELECTRIC	4/24/2015 10:52:06	1076		LUKE
REDCRO-REDCRO	4/24/2015 10:53:39	DSP		JASON
MCRS-DES1	4/24/2015 10:54:08	DSP		JASON
CCEMS-AIR	4/24/2015 10:54:14	1076		LUKE
REDCRO-REDCRO	4/24/2015 10:54:35	1076		LUKE
MCRS-DES1	4/24/2015 10:54:42	1076		LUKE
MCSO-MC01	4/24/2015 10:54:59	1076		LUKE
MCSO-MC20	4/24/2015 10:57:31	1076		LUKE
MCRS-R01	4/24/2015 10:57:43	1098		LUKE
MCSO-MC01	4/24/2015 11:02:36	1097		LUKE
FOFD-700	4/24/2015 11:03:39	1097		LUKE
EMFD-400	4/24/2015 11:03:42	1097		LUKE
MCAS-A834	4/24/2015 11:08:31	1076	LZ	LUKE
MCAS-A440	4/24/2015 11:08:37	1076	LZ	LUKE
MCSO-MC20	4/24/2015 11:09:24	1097		LUKE
MCRS-DES1	4/24/2015 11:12:37	1097		LUKE
MCRS-RESCUE	4/24/2015 11:13:26	1097		LUKE
CCEMS-AIR	4/24/2015 11:13:59	1097		LUKE
MCAS-A440	4/24/2015 11:14:19	1097	AIREVAC 599.9	LUKE
MCAS-A834	4/24/2015 11:16:58	LOG	LZ 458.1 AT 11097 AT LZ	JASON
MCSO-MC18	4/24/2015 11:24:22	1097		LUKE
MCAS-A834	4/24/2015 11:38:10	LOG	PHI HAS PATIENT AND LIFTING NOW	LUKE
MCAS-A834	4/24/2015 11:41:46	1008-INSERV		LUKE
MCAS-A440	4/24/2015 12:09:13	1008-INSERV		JASON
MCSO-MC45	4/24/2015 12:14:17	1076		LUKE
MCSO-MC45	4/24/2015 12:27:41	1098		LUKE
MCSO-MC20	4/24/2015 12:32:47	LOG	532NTD/KY	JASON
MCAS-A834	4/24/2015 12:32:56	1008-INSERV		JASON
MCAS-A440	4/24/2015 12:45:39	1098	615.9	LUKE
MCSO-MC18	4/24/2015 13:04:03	1098		JASON
MCSO-MC01	4/24/2015 13:16:59	1098		LUKE
MCSO-MC20	4/24/2015 13:18:36	1098		LUKE
MCAS-A834	4/24/2015 13:32:00	1098	479.4	LUKE
MCRS-RESCUE	4/24/2015 13:49:23	1098		LUKE
ELEC-ELECTRIC	4/24/2015 13:49:28	1098		LUKE

REDCRO-REDCRO	4/24/2015 13:49:31	1098	LUKE
CCEMS-AIR	4/24/2015 13:49:34	1098	LUKE
FOFD-700	4/24/2015 14:04:14	1098	ANDREA
EMFD-400	4/24/2015 14:06:36	1098	LUKE
ARFD-900	4/24/2015 22:07:38	1097	PHILIP
ARFD-900	4/24/2015 22:11:50	STACKED	
ARFD-900	4/24/2015 22:18:49	1098	PHILIP
HSMFD-600	4/24/2015 22:18:53	1098	PHILIP
MCRS-DES1	4/24/2015 22:18:57	1098	PHILIP

Incident Status Log

ACTIVE	JASON	4/24/2015 10:31:51	0	
DISPATCHED	JASON	4/24/2015 10:31:51	707	
CLOSED	PHILIP	4/24/2015 22:19:04	0	C - COMPLETED

Complaint Code Change Log

1070	04/24/2015 10:32:15	JASON

Attached ALI Feeds

JASON 4/24/2015 10:31:51

203
(270) 354-9657 10:31 04/24
5402 AURORA HWY HARDIN KY 034 RESD
BALENTINE, SPENCER P# 354-9657
LEC:WKRT
MARSHALL CO SHERIFF
AURORA-ROSS FIRE
BENTON AMBULANCE

LUKE 4/24/2015 10:36:33

202
(270) 354-9657 10:31 04/24
5402 AURORA HWY HARDIN KY 034 RESD
BALENTINE, SPENCER P# 354-9657
LEC:WKRT
MARSHALL CO SHERIFF
AURORA-ROSS FIRE
BENTON AMBULANCE

LUKE 4/24/2015 10:37:13

202
(270) 211-1237 10:36 04/24
723 E UNITY CHURCH RD HARDIN KY 041 WPH2
Verizon Wireless 2709781028 P# 211-1237
ALT# 270-978-1028 LEC:VZW
WIRELESS CALL
QUERY CALLER FOR LOCATION
QUERY CALLER FOR PHONE #
-088.206010 +36.763794

LUKE 4/24/2015 10:55:12

202
(270) 354-9657 10:47 04/24
5402 AURORA HWY HARDIN KY 034 RESD
BALENTINE, SPENCER P# 354-9657
LEC:WKRT
MARSHALL CO SHERIFF
AURORA-ROSS FIRE
BENTON AMBULANCE

Emergency Dispatch Data

NCIC Response Data

KY Emergency Management Incident Record:

Incident Number:	Date/Time Occurred	Date/Time Reported:	Reported To:	Status:
20152462	04/24/2015 11:45	04/24/2015 12:01	ginger.k.starrett	Open

Reported By:

Name: Frank Murphy
Phone: 270 205 8947
Alt. Phone:
Agency: Marshall CO EM
Email

Incident Type: FIRE - BUSINESS
Latitude:
Longitude:
Human Impact

Was anyone Evacuated?	Yes	Number Evacuated	2
Was anyone Injured?	Yes	Number Injured	2
Were there any Fatalities?	No	Number of Fatalities	0

Location:
County: MARSHALL,KY Community: Hardin EM Area: 01
Address: 136 Palestine RD

KCCRB Request No
Hazmat Teams deployed No
Area Manager on Scene
Declared State of Emergency No

Journal Entries

Reports that he is in route to a fire at a Moonshine distillery (Silver Trail Distillery). On scene are Marshal Co EMS, East Marshal Fire Dept, Aurora/Ross Fire Dept, Hardin Fire Dept, Marshal County Sheriff Dept,Marshal County Rescue. They are air lifting two people out. Does not know if any more people were in the building.Highway 402 & Palestine Rd will be closed to traffic until the scene is clear. He will call back as he has updates.

ginger.k.starrett 04/24/2015 12:03
Task: What type of business?-Distillery: Status = Completed

ginger.k.starrett 04/24/2015 12:03
Task: Any materials released to the air, water or soil?-Do not know at this time: Status = Completed

ginger.k.starrett 04/24/2015 12:03
Task: What type of materials are there?-Alcoholic making material: Status = Completed

ginger.k.starrett 04/24/2015 12:03
Contacted Randy Thompson,Fire Marshal by Phone.

ginger.k.starrett 04/24/2015 12:19
Contacted Robbie Francis, Environmental Protection by Phone.

ginger.k.starrett 04/24/2015 12:20
Task: Call the On Call Manager!-Briefed Tony Keithley by phone: Status = Completed

ginger.k.starrett 04/24/2015 12:20
Task: Is there any Hazmat involved?-Yes: Status = Completed

ginger.k.starrett 04/24/2015 12:20
Task: Has the Regional Response Manager been called?-Briefed EM-41 Mark Garland by email: Status = Completed

ginger.k.starrett 04/24/2015 12:25