

DISPLAY THIS CARD ON PRINCIPAL FRONTAGE OF WORK



CITY OF PORTLAND BUILDING PERMIT

This is to certify that AIM EVERGREEN LLC

Located At 26 EVERGREEN RD

Job ID: 2011-06-1490-CH OF USE

CBL: 329 - - A - 014 - 001 - - - -

has permission to Change of Use from spray insulation company to a distillery – Gin, Rum, Whiskey, tenant fit up provided that the person or persons, firm or corporation accepting this permit shall comply with all of the provisions of the Statues of Maine and of the Ordinances of the City of Portland regulating the construction, maintenance and use of the buildings and structures, and of the application on file in the department.

Notification of inspection and written permission procured before this building or part thereof is lathed or otherwise closed-in. 48 HOUR NOTICE IS REQUIRED.

A final inspection must be completed by owner before this building or part thereof is occupied. If a certificate of occupancy is required, it must be

Fire Prevention Officer

Amie Paulk 9/21/11

Code Enforcement Officer / Plan Reviewer

**THIS CARD MUST BE POSTED ON THE STREET SIDE OF THE PROPERTY
PENALTY FOR REMOVING THIS CARD**

City of Portland, Maine - Building or Use Permit Application

389 Congress Street, 04101 Tel: (207) 874-8703, FAX: (207) 8716

Job No: 2011-06-1490-CH OF USE	Date Applied: 6/22/2011	CBL: 329 - - A - 014 - 001 - - - - -	
Location of Construction: 26 EVERGREEN DR	Owner Name: AIM EVERGREEN LLC	Owner Address: c/o Bibeau & Co., 340 Fore St. PORTLAND, ME 04101	Phone:
Business Name:	Contractor Name:	Contractor Address:	Phone:
Lessee/Buyer's Name: New England Distilling, LLC - Ned Wight	Phone: 207-415-6406 <i>Ned</i>	Permit Type: CHANGE OF USE	Zone: I-M
Past Use: spray installation co.	Proposed Use: Manufacturing - Change of use to distillery - tenant fit up	Cost of Work: 40000.00	CEO District:
		Fire Dept: <input checked="" type="checkbox"/> Approved <i>w/conditions</i> <input type="checkbox"/> Denied <input type="checkbox"/> N/A	Inspection: Use Group: Type: <i>3B F-1</i> <i>IBC 200P</i> Signature: <i>JMB</i>
Proposed Project Description: Change of use to New England Distilling		Pedestrian Activities District (P.A.D.) <i>9/21/11</i>	
Permit Taken By:	Zoning Approval		

<p>1. This permit application does not preclude the Applicant(s) from meeting applicable State and Federal Rules.</p> <p>2. Building Permits do not include plumbing, septic or electrical work.</p> <p>3. Building permits are void if work is not started within six (6) months of the date of issuance. False informatin may invalidate a building permit and stop all work.</p>	<p>Special Zone or Reviews</p> <p><input type="checkbox"/> Shoreland</p> <p><input type="checkbox"/> Wetlands</p> <p><input type="checkbox"/> Flood Zone</p> <p><input type="checkbox"/> Subdivision</p> <p><input type="checkbox"/> Site Plan</p> <p><input type="checkbox"/> Maj <input type="checkbox"/> Min <input type="checkbox"/> MM</p> <p>Date: <i>OK w/conditions</i> <i>6/28/11 ABM</i></p>	<p>Zoning Appeal</p> <p><input type="checkbox"/> Variance</p> <p><input type="checkbox"/> Miscellaneous</p> <p><input type="checkbox"/> Conditional Use</p> <p><input type="checkbox"/> Interpretation</p> <p><input type="checkbox"/> Approved</p> <p><input type="checkbox"/> Denied</p> <p>Date:</p>	<p>Historic Preservation</p> <p><input checked="" type="checkbox"/> Not in Dist or Landmark</p> <p><input type="checkbox"/> Does not Require Review</p> <p><input type="checkbox"/> Requires Review</p> <p><input type="checkbox"/> Approved</p> <p><input type="checkbox"/> Approved w/Conditions</p> <p><input type="checkbox"/> Denied</p> <p>Date: <i>ASU</i></p>
	CERTIFICATION		

I hereby certify that I am the owner of record of the named property, or that the proposed work is authorized by the owner of record and that I have been authorized by the owner to make this application as his authorized agent and I agree to conform to all applicable laws of this jurisdiction. In addition, if a permit for work described in the appication is issued, I certify that the code official's authorized representative shall have the authority to enter all areas covered by such permit at any reasonable hour to enforce the provision of the code(s) applicable to such permit.

SIGNATURE OF APPLICANT	ADDRESS	DATE	PHONE
RESPONSIBLE PERSON IN CHARGE OF WORK, TITLE		DATE	PHON

1-6-12 DWM/BKL/John Martell rec 878-9⁵~~9~~59 Final/CO

Provide vent on hand sink

P+T to terminate at floor

Cover plate on elec

Fire OK

BUILDING PERMIT INSPECTION PROCEDURES

Please call 874-8703 or 874-8693 (ONLY)

or email: buildinginspections@portlandmaine.gov

With the issuance of this permit, the owner, builder or their designee is required to provide adequate notice to the city of Portland Inspections Services for the following inspections. Appointments must be requested 48 to 72 hours in advance of the required inspection. The inspection date will need to be confirmed by this office.

- **Please read the conditions of approval that is attached to this permit!! Contact this office if you have any questions.**
- **Permits expire in 6 months. If the project is not started or ceases for 6 months.**
- **If the inspection requirements are not followed as stated below additional fees may be incurred due to the issuance of a "Stop Work Order" and subsequent release to continue.**

The project cannot move to the next phase prior to the required inspection and approval to continue, REGARDLESS OF THE NOTICE OF CIRCUMSTANCES.

IF THE PERMIT REQUIRES A CERTIFICATE OF OCCUPANCY, IT MUST BE PAID FOR AND ISSUED TO THE OWNER OR DESIGNEE BEFORE THE SPACE MAY BE OCCUPIED.



PORTLAND MAINE

Strengthening a Remarkable City, Building a Community for Life • www.portlandmaine.gov

Director of Planning and Urban Development
Penny St. Louis

Job ID: 2011-06-1490-CH OF USE

Located At: 26 EVERGREEN

CBL: 329 - - A - 014 - 001 - - - -

Conditions of Approval:

Zoning

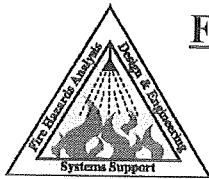
1. Separate permits shall be required for any new signage.
2. This permit is being approved on the basis of plans submitted. Any deviations shall require a separate approval before starting that work.

Fire

1. The facility shall comply with all requirements and recommendations contained within the Fire Hazard Assessment from Fire Risk Management, Inc. and dated 9/16/2011.
2. To be clear, pad locks are not permitted on exit doors. EXIT doors having key-operated locks from the egress side are not permitted for industrial occupancies by NFPA 101 *Life Safety Code*. Locks, if provided, shall not require the use of a key, a tool, or special knowledge or effort for operation from the egress side.
3. A monitored fire alarm system is required. A separate Fire Alarm Permit is required.
4. Installation of a fire alarm system requires a Knox Box to be installed per city ordinance.
5. All construction shall comply with City Code Chapter 10.
6. Fire extinguishers are required per NFPA 10.
7. Emergency lights and exit signs are required. Emergency lights and exit signs are required to be labeled in relation to the panel and circuit and on the same circuit as the lighting for the area they serve.
8. Any cutting and welding done will require a Hot Work Permit from Fire Department.
9. The ventilation system requires a separate HVAC permit.
10. Separate permits are required for electrical and heating installations.
11. An annual Fire Permit is required from the City Clerk's Office for *Flammable or Combustible Liquids, other than motor fuel dispensing*.

Building

1. Application approval based upon information provided by applicant. Any deviation from approved plans requires separate review and approval prior to work.
2. Separate permits are required for any electrical, plumbing, sprinkler, fire alarm HVAC systems, heating appliances, including pellet/wood stoves, commercial hood exhaust systems and fuel tanks. Separate plans may need to be submitted for approval as a part of this process.
3. A ventilation system is required for this use and shall be installed per ASHRAE 62.1, a separate permit is required.



FIRE RISK MANAGEMENT, INC

1 Front St., Bath, ME 04530
207/442-7200 [-7272 (fax)]
FRM@fireriskmgt.com

Date: 16 September, 2011

Memo Report

From: W. Mark Cummings, P.E.
To: Mr. Ned Wight; New England Distilling, LLC
CC: Capt. Keith Perone; Fire Prevention Division, Portland Fire Department
Subject: **Fire Hazards Assessment of the New England Distilling Site at 26 Evergreen Dr., Unit B, Portland, ME.**

A review of the proposed installation/construction of a new distilling operation to be located within Unit B of the industrial building located at 26 Evergreen Drive in Portland, ME was conducted on 3 August, 2011. The purpose of this review was to evaluate the proposed operations and materials associated with the distillation process to ascertain potential fire/explosion and life safety hazards that may be present. The end result for this assessment is to develop recommendations to mitigate any potential fire and life safety hazards identified.

Background

The proposed distillery is intended to occupy the middle portion (Unit B; $\leq 3000\text{ft}^2$) of an existing industrial building; which is currently dividend into three separate tenant spaces, separated by fire barriers that reportedly have a 2-hour fire rating. The stated plan for this distillery is to produce quantities of a number of alcoholic beverages (spirits); including whiskey, gin, and rum. To produce these various beverages, a small still is to be installed in the space, which will be used to distill the various liquids; producing a range of alcoholic beverages with alcoholic contents ranging from 40% to 60% by volume. Resulting from discussions with the owner (Mr. Ned Wight), it was ascertained that a portion of the space will be used to store some of the finished products, including the whiskey and rum that will be stored in wooden (oak) barrels as part of the overall aging process for these beverages. An exact quantity that is likely to be stored in this facility at any one time is not specifically known at this time. It is intended that the gin product, which will be stored in glass (750 ml) containers within cardboard cases, is to be stored on site for only a relatively short period of time prior to being shipped to clients. As such, this product will likely represent a small(er) percentage of the total product being stored on site. It is estimated that the quantity of this product would not exceed that which would be contained on more than four (4) shipping pallets; 1080 liters (285 gal) at any one point in time. Due to the aging process associated with the rum and whiskey products, these will be initially stored within wooden barrels. Based on the planned production schedule for these beverages, it is estimated that the maximum quantity of rum that might be stored on site at any given time would be less than 1500 gallons; with an expected maximum quantity of whiskey that will stored on site being upwards of 5000 gallons. However, it is anticipated that these maximum quantities would not be achieved until after several years of operation. Prior to leaving the distillery, both the rum and whiskey products will be transferred from the wood barrels to glass containers that will be placed in cardboard cases and installed on pallets in preparation for shipment.

Based on the parameters outlined in the International Building Code (IBC), the occupancy classification that best "fits" this distillery operation would be that of a "Factory Industrial, F-1, Moderate-hazard" occupancy. The building in which the distilling operations are to take place is constructed of (reinforced) masonry (CMU) exterior walls that support (exposed) steel roof trusses. The roof of the facility is flat, consisting of corrugated metal attached to the steel trusses. As such, this building would be classified as having Type IIB construction,

as defined by the IBC. The space that will be used to house the distilling operations consists of approximately 3000 ft² of high bay area; with a ceiling height of approximately 18 ft, from the concrete floor to the underside of the metal roof. Within this space, installed along the north wall, a small office area has been constructed, which occupies approximately 500 ft². The office area has a ceiling height of approximately 8 ft and appears to be of wood frame and drywall construction. Also installed along the north exterior wall, between the office area and the West wall of the space, is a wood framed and sheathed room that is slightly more than 100 ft² in floor area. This space was previously used as a storage area having a controlled environment. It was stated that this area may continue to be used in this capacity in conjunction with the aging process for some of the beverages. It was stated that the planned location for the still was to be in the southeast corner of the space, adjacent to one of the large overhead doors.

The high bay area has no mechanical ventilation; other than a single unit heater that is installed near the ceiling in the northeast corner of the space and a single overhead (ceiling) fan that is centrally located within this area. The heating/ventilation equipment for the office area is installed above/on the ceiling of this area. Access and egress to the overall space is through two personnel doors, one in the north exterior wall, via the office area, and one in the south exterior wall within the high bay area. Additionally, two overhead doors are installed in the south exterior wall that also provide direct access to the high bay portion of space. It was stated during the site visit that the Federal Government has a requirement that all access doors to the space where the beverages are being produced/stored must have a padlock installed. This configuration would result in a conflict with the egress requirements of the Life Safety Code[®], NFPA 101, which is adopted in the State of Maine. However, the owner has indicated that at any time when the facility is occupied the padlocks will be removed from the doors that are needed to maintain adequate egress from the facility. Currently, the space (and building) is not provided with either an installed fire suppression or fire detection/notification system. A hand-held fire extinguisher is installed in the high bay area, adjacent to the door that connects this area to the office space.

Fire /Explosion Hazards

In general, all the individual, constituent materials used to support the distillation and packaging processes do not represent significant fire hazards. The primary fire fuel loading that will be present in this space will be the empty wood barrels and the cardboard cases that will ultimately be used in storing the finished products. Additionally, the building is supplied with natural gas, which is currently used as the fuel for both the office area heating system and the unit heater in the high bay area. It is planned that this source of fuel will also be used to supply the still's heating element (burner). A steel natural gas pipe line currently transits through the overhead of the high bay area and this line will be modified to also supply the fuel for the still's heating element. The heating element for the still will not be enclosed and as such, an open flame will be exposed to the surrounding environment.

The final stages of the distillation process are that which represent the greatest potential for a fire/explosion hazard; when the liquid has been distilled to the point that the alcohol content is increased to the point that the beverage becomes a "flammable liquid" and the ethanol (vapor) that is being produced by the distillation (boiling) process could result in the development of an ethanol/air mixture that is within its lower flammability limit (LFL). The still design being used by New England Distilling, LLC is very basic and is not one that is designed to operate under any significant pressure. The top of the still is a "friction fit" and only its weight will allow for any level of pressure increase; above ambient. At ambient atmospheric pressure, ethanol will boil at just over 78°C (172°F). Should the boiling rate within the still increase beyond that which is desired, the top of the still would lift, thereby releasing excessive pressure; albeit also releasing the ethanol vapor as well. With an auto-ignition temperature of approximately 426°C (800°F), it is unlikely that the surface temperatures of the still will ever approach the point that it might be expected that contact by an ethanol/air mixture with the still's hot surfaces could result in fire initiation. However, it is still this potential scenario, coupled with the open flame below the still, which represents the greatest risk for a fire/explosion hazard associated with the actual distillation process being used by New England Distilling.

Due to the alcoholic content, 40% to 60% by volume, of final products (liquids) being produced by the distillation process, these will primarily be classified as being Class IC flammable liquids, as defined by NFPA 30, the *Flammable and Combustible Liquids Code*. This classification stems from the fact that beverages with alcoholic contents in the range specified above will have flash points between 22.8°C and 37.8°C (73°F and 100°F). Another potential fire hazard that will be associated with the distillery's operation is that of a potential spill of these flammable liquids, such that they, and any vapor that might then be produced, could then be exposed to a potential ignition source. It is reported¹ that the evaporation rate for ethanol at "standard" ambient temperatures of approximately 25°C (77°F) is relatively low, such that even the presence of natural ventilation should be sufficient to prevent the development of an ethanol vapor cloud that would be exceed its lower flammability limit. However, if a spill was of significant volume (quantity) or if the area where a spill occurred was subject to "stagnant" air, the potential still exists that the LFL could be achieved. It is beyond the scope of this evaluation to attempt to determine a specific spill volume(s) that could result in such an occurrence.

The presence of other stored materials, such as the cardboard for the shipping cases and the empty wood barrels, will also cause an increase in the overall fire fuel loading (fire potential) within this space. Given that the wood (oak) has a relatively high ignition energy requirement, this represents a very low potential as being an "initial" fire source. The cardboard is much more readily "ignitable", but must still have another ignition source to result in fire initiation. Although not directly involved in the distillation process, the operations and materials associated with the office area also represent a potential source of fire initiation, including the heating equipment installed on the ceiling of the office. However, this risk is no greater than any other typical office location.

The overall evaluation of the New England Distilling facility included research of any available historical data involving fires and explosions associated with distilleries in general. Based on this initial research, it is apparent that, in general, fires resulting from the distillation processes themselves are extremely rare. Most of the historical data indicates that the greatest risk of fires involving distilled beverages is primarily that resulting when these beverages are exposed to the effects of fires that originated from other sources not directly involving the distillation process. When these (flammable) liquids are exposed to the thermal insult from an adjacent fire, they will begin to rapidly evaporate, potentially producing significant volumes of a flammable vapor. Equally, an adjacent fire can result in the failure of the packaging of the stored liquids, thus resulting in spillage and a significant increase in fire intensity and if sufficient flammable vapors are produced; an explosion.

Review and Assessment of Code & Standards Requirements

At the outset of this evaluation, it became apparent that the existing national building (IBC) and fire (NFPA) codes did not readily apply to the type and scope of distillery operations that are being proposed by New England Distilling. Since the use of the space by New England Distilling continues to fall within the "industrial" category of the existing building and no significant modifications are being made to this facility, the requirements of the International Building and Fire Codes (IBC & IFC) or the Maine Uniform Building & Energy Code (MUBEC) don't specifically apply to this situation; albeit the IBC & IFC (2009 ed.) were used as references in developing recommendations for this project, based on the requirements that would typically apply for new construction. Other codes that the State of Maine has adopted that are applicable to this project and that were used in the code evaluation for fire and life safety include the latest editions of the National Fire Protection Association's codes; NFPA 30 – *Flammable and Combustible Liquids Code*, NFPA 54 – the *National Fuel Gas Code*, and NFPA 101 – *The Life Safety Code*[®]. Additionally, the applicable Factory Mutual (FM) Global Property Loss Prevention Data Sheet, 7-74 – Distilleries, was reviewed and used as a source of information and reference, since much of the fire protection information provided in these sheets is based on historical data specific to that industry.

¹ *Potential Explosion Hazards due to Evaporating Ethanol in Whiskey Distilleries*, HSL/2003/08, H.S. Ledin, Health & Safety Laboratory, Buxton, England.

A primary focus for the review of both the IBC/IFC and NFPA 30 was to ascertain if there would be any limits on the amounts of flammable liquids (Class IC) that could be present/stored within the New England Distilling space. However, the published limits on the amounts of flammable liquids that can be stored, listed in both of these codes, were specifically exempted for alcoholic beverages that are contained in wood barrels and/or individual containers that do not exceed 1.3 gallons (5 liters); refer to para. 9.1.4 of NFPA 30 and para. 3401.2 of the IFC. Since New England Distilling has indicated the beverages produced by the still will be stored in either wooden barrels or individual 750 ml (0.2 gal) bottles, no specific code limitations exist for the amounts to be stored on site, such that no code restrictions exist that would further limit the expected maximum quantities of the various products outlined above. Also resulting from the exemptions provided for these products, no specific fire protection code requirements exist with regards to the "storage" of these liquids. NFPA 30 does, however, have specific requirements for "processing facilities" and those that "dispense, handle, transfer, or use" these liquids. The requirements that do apply to the New England Distilling operations are primarily to provide a fire detection/notification system and a ventilation system that is designed to prevent the accumulation of flammable vapors; refer to chapters 17 and 18 of NFPA 30. Without specifically performing calculations to ascertain a specific ventilation rate that will prevent the accumulation of flammable vapors, within 25% of the LFL, the code requires that a minimum ventilation rate of 1 cfm/ft² be provided. Given the approximate "foot print" of the high bay area where the distilling operations are to be performed, this would require that a ventilation system that can provide approximately 2400 cfm be installed. Furthermore, the inlet and exhausts for this system must be located within 12 inches of the floor and should be installed on opposite sides/ends of the room, such that the air movement will "sweep" vapors from all areas of the space. Chapter 17 of NFPA 30 also has separation requirements between a "processing" facility and any other facilities that could represent exposure hazards. Unfortunately, the requirements of this chapter do not adequately accommodate the New England Distilling situation; whereby these operations occupy only a portion of a multi-tenant building. However, given the specifics associated with the New England Distilling operation, coupled with the separation requirements outlined in Table 17.4.3 for the "process vessel", it would be necessary to keep the still at least 5 ft from any adjacent property line or building. If the 2-hour walls are to be considered the "property line", an argument can be made that the still should be located at least 5 ft from either of the two walls separating the New England Distillery from its two adjacent tenants. However, based on the specifics of the still configuration and the amounts of liquid involved, providing the 5-foot separation is not considered essential. The maintenance of this minimal separation distance between the still and fire wall is unlikely to provide any notable benefits, either to property protection or life safety, that would warrant this being a mandated code requirement for this operation.

As outlined above, many of the requirements in NFPA 30 do not apply to distilled spirits. Although in finished form these liquids are classified as flammable, they would not be considered a "hazardous" material. NFPA 30 does include some requirements with regards to containing and/or controlling spillage from storage containers. The plan for the New England Distilling facility includes some storage of the finished products, both in small containers and in the larger wooden barrels. The code specifically exempts any need for containment systems for the products stored in the small containers (≤ 5 liters). However, the need to provide containment where the barrels are to be stored is less clear. Currently, the facility is provided with two (2) floor drains within the high-bay area; one of which is located in the vicinity of the planned storage areas for the barrels. It is unknown if the municipal authorities have any restrictions that would require this drain to be isolated from these alcohol-containing products; albeit it is not believed that they represent any toxic risk to the municipal sewer system. Should a spill occur that results in some of the products entering the municipal sewer system, it is likely that these products would quickly be diluted below their flammable range, including the alcohol evaporating. Equally, there are no potential ignition sources within the immediate vicinity of the location where the products are to be stored; such that should a spill occur, there is no immediate danger of the product being ignited. With the possible exception of the filling process, which is being done manually and represents a very low risk of any significant spillage, the wood barrels do not present a high risk of spillage or being accidentally ruptured. Once filled, the barrels are not involved in any other process until such time has passed that the contents are ready to

be transferred into the smaller containers for distribution/sale, which will also be a manual process. Any time the products are being transferred to/from the different containers, which represents the highest risk for leakage/spillage, personnel will be present and can quickly take actions to mitigate any spill that might occur. For these reasons, along with the lack of any specific code applicability regarding distilled spirits, it is not considered necessary that any "containment" system be included for the storage area within this facility.

In general, all pertinent requirements associated with the Life Safety Code® (NFPA 101) are currently being met at the New England Distilling space, with only one exception that was noted during the site visit; the lack of an exit sign for the door connecting the office and high bay areas. This door represents the requisite second means of egress from the high bay area. It is unknown if correction of this item is a responsibility for the tenant or landlord. It was stated that due to Federal regulations, it will be necessary to install padlocks on all doors that access the (high bay) area where the distilled liquids are to be stored. In general, NFPA 101 does not allow locks involving the need for keys to be installed on doors required for egress, but para. 7.2.1.5.4.1 does provide an allowance for this, along with other specific measures that must also be implemented, including the installation of a sign that indicates the door shall not be locked when the building is occupied.

The FM Data Sheet (7-74) that addresses distilleries does include recommendations to provide a fire sprinkler system. The primary function of this system would be for property (asset) protection and not for life safety. The installation of fire suppression systems is always encouraged, albeit not a code requirement in this instance. Although not specifically stated in this data sheet, it is likely that the requirements outlined in this data sheet are intended for much larger operations; those that are located in dedicated buildings/facilities and likely involving much more complex distillation systems and greater quantities of flammable liquids.

Summary and Recommendations:

The research associated with this fire hazard assessment indicates that, in general, fires resulting directly from distillery operations are rare. However, should a fire occur that ultimately exposes/involves the distilled products (flammable liquids), the results could be catastrophic. Based on this assessment and the historical data reviewed, it is likely that the office area or the other building systems within the New England Distilling facility likely represent a greater risk of fire than does the actual distilling operations. This is based on the fact that the distilling operations will only occur while the facility is manned, such that any problem that might occur during these operations should be immediately identified and corrective measures implemented. However, this is not meant to imply that the operation of this distillery is not without inherent fire risks. Equally, it is recommended that specific measures be implemented to further mitigate the potential for damage to the building and the operation of the adjacent tenants, along with complying with all pertinent code requirements.

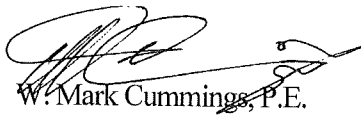
Based on the results of this assessment, including the site inspection, the following recommendations are provided:

1. Provide an approved exit sign for the door connecting the office and high bay areas. *[code requirement]*
2. Install a sign that is readily visible and meets the requirements of NFPA 101 (para. 7.2.1.5.4.1), along with all other code requirements, in the vicinity of the egress doors from the high bay area. *[code requirement]*
3. Provide an installed fire detection/notification system. Based on the requirements within NFPA 30 for "processing facilities", this system is needed to provide early warning to occupants of the building, not just New England Distilling employees. Equally, given that no fire suppression is installed within this building, this system will provide early notification to the responding Fire Department; either directly or via a central monitoring station. Since a security system is already scheduled to be installed and monitored by a third party, the fire detection/notification could also be monitored by the same entity. Given that the greatest risk to both the building and responding firefighters will be a fire occurring when the facility is not occupied, coupled with the storage of flammable liquids on site, early notification will significantly improve the fire safety of this facility. *[code requirement]*
4. Provide a means for emergency disconnect (closure) of the natural gas fuel supply system. It is recommended that the ability to remotely shut off the fuel supply to the still's heating element be provided to ensure that if a problem occurs with the still's operation, access to shut off the fuel supply will be readily accessible. A remote

manual shutoff (pull station) located by the exit from the high bay area is recommended. Although the code (NFPA 54) does include a requirement [*code requirement*] for such a shut off device, it does not specifically mandate the type or location.

5. Provide a mechanical ventilation system within the high bay area. [*code requirement*] This system is needed to ensure no accumulation of potentially flammable vapors can occur, which could then present a fire risk; especially in the vicinity of electrical systems/components. Since the vapors will be heavier than air and would accumulate near the floor, the inlet and exhaust for the ventilation system must be within 12 inches of the floor. Absent of any specific calculations to determine the minimum ventilation rate required for the specific configuration used at the New England Distilling facility, it is recommended that a ventilation rate of at least 2400 cfm be provided. Based on the stated proposed layout for the facility (see attached sketch), it would be recommended that the location for the exhaust inlet air (vent) be located at the northeast corner of the high bay area, with the exhaust fan being in the opposite corner. This would facilitate movement of air "away" from the proposed location for the still (open flame).
6. Given the configuration of the still's heating element that involves an open flame, it is recommended that no combustible materials be located/stored any closer than 10 feet from the still.

Should there be any questions regarding this assessment and the recommendations contained herein, please do not hesitate to contact me.



W. Mark Cummings, P.E.

IM-

2011-06-14-92

4510



General Building Permit Application

If you or the property owner owes real estate or personal property taxes or user charges on any property within the City, payment arrangements must be made before permits of any kind are accepted.

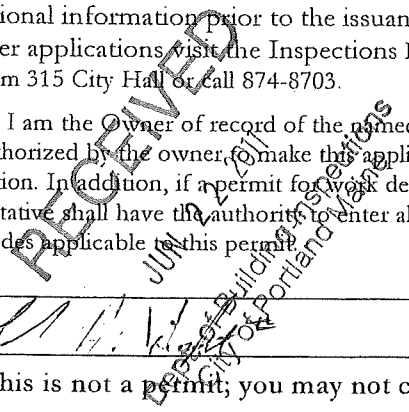
Location/Address of Construction: <u>26 Evergreen Dr., unit B Portland ME 04103</u>		
Total Square Footage of Proposed Structure/Area <u>3000</u>	Square Footage of Lot <u>40,808</u>	Number of Stories <u>1</u>
Tax Assessor's Chart, Block & Lot Chart# Block# Lot# <u>329 A 14</u>	Applicant * must be owner, Lessee or Buyer* Name <u>New England Distilling, LLC</u> Address <u>26 Evergreen Dr., unit B</u> City, State & Zip <u>Portland, ME 04103</u>	Telephone: <u>207-415-6406</u>
Lessee/DBA (If Applicable) <u>New England Distilling, LLC</u>	Owner (if different from Applicant) Name <u>AIM Evergreen, LLC</u> <u>c/o Bibeau & Co.</u> Address <u>340 Fore St.</u> City, State & Zip <u>Portland, ME 04101</u>	Cost Of Work: \$ <u>40,000</u> C of O Fee: \$ <u>75</u> Total Fee: \$ <u>495</u>
Current legal use (i.e. single family) <u>industrial (IM)</u> Number of Residential Units <u>—</u> If vacant, what was the previous use? <u>spray insulation company</u> Proposed Specific use: <u>Distillery, small</u> Is property part of a subdivision? <u>no</u> If yes, please name _____ Project description: <u>I would like to operate a small distillery producing whiskey, rum, and gin. I will have a gas fired still, open fermenters, produce and bottle on site.</u>		
Contractor's name: _____ Address: _____ City, State & Zip _____ Telephone: _____ Who should we contact when the permit is ready: <u>Ned Wight</u> Telephone: <u>415-6406</u> Mailing address: <u>26 Evergreen Dr. Unit B Portland ME 04103</u>		

11.2.2.9

Please submit all of the information outlined on the applicable Checklist. Failure to do so will result in the automatic denial of your permit.

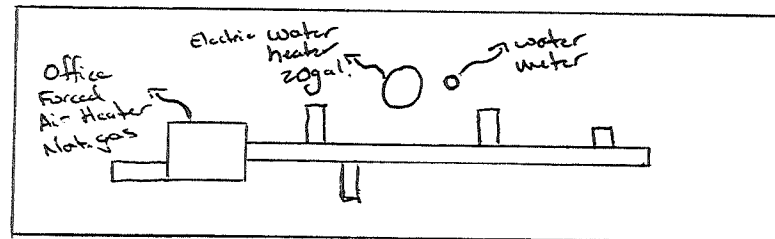
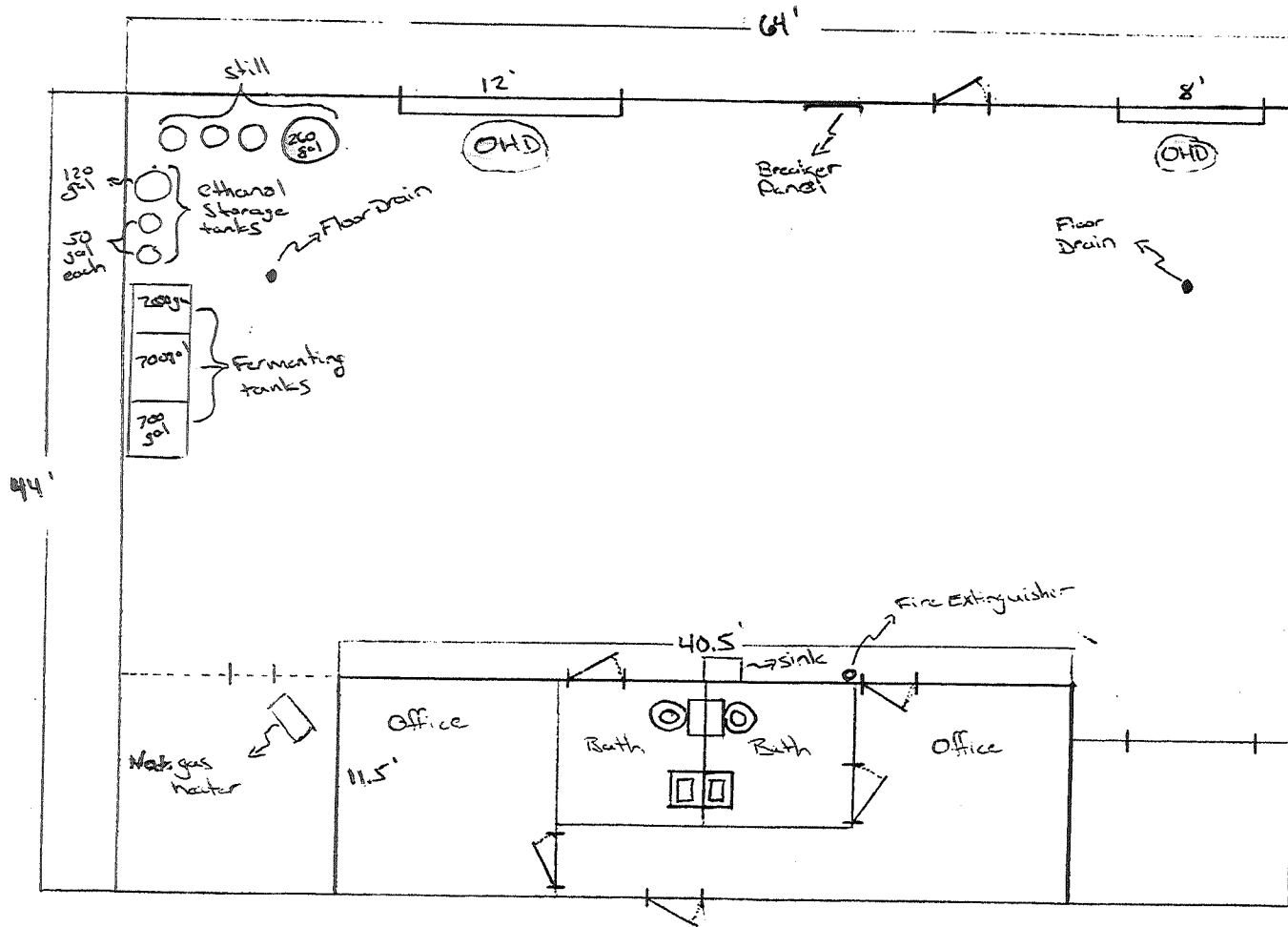
In order to be sure the City fully understands the full scope of the project, the Planning and Development Department may request additional information prior to the issuance of a permit. For further information or to download copies of this form and other applications visit the Inspections Division on-line at www.portlandmaine.gov, or stop by the Inspections Division office, room 315 City Hall or call 874-8703.

I hereby certify that I am the Owner of record of the named property, or that the owner of record authorizes the proposed work and that I have been authorized by the owner, to make this application as his/her authorized agent. I agree to conform to all applicable laws of this jurisdiction. In addition, if a permit for work described in this application is issued, I certify that the Code Official's authorized representative shall have the authority to enter all areas covered by this permit at any reasonable hour to enforce the provisions of the codes applicable to this permit.

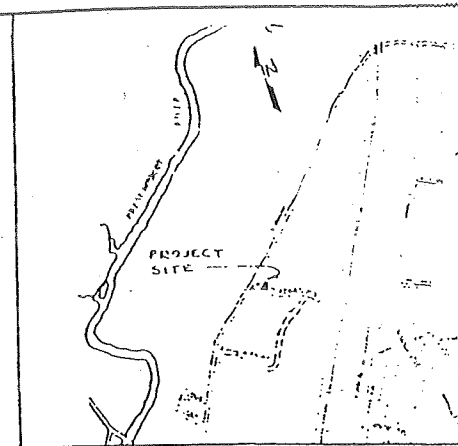
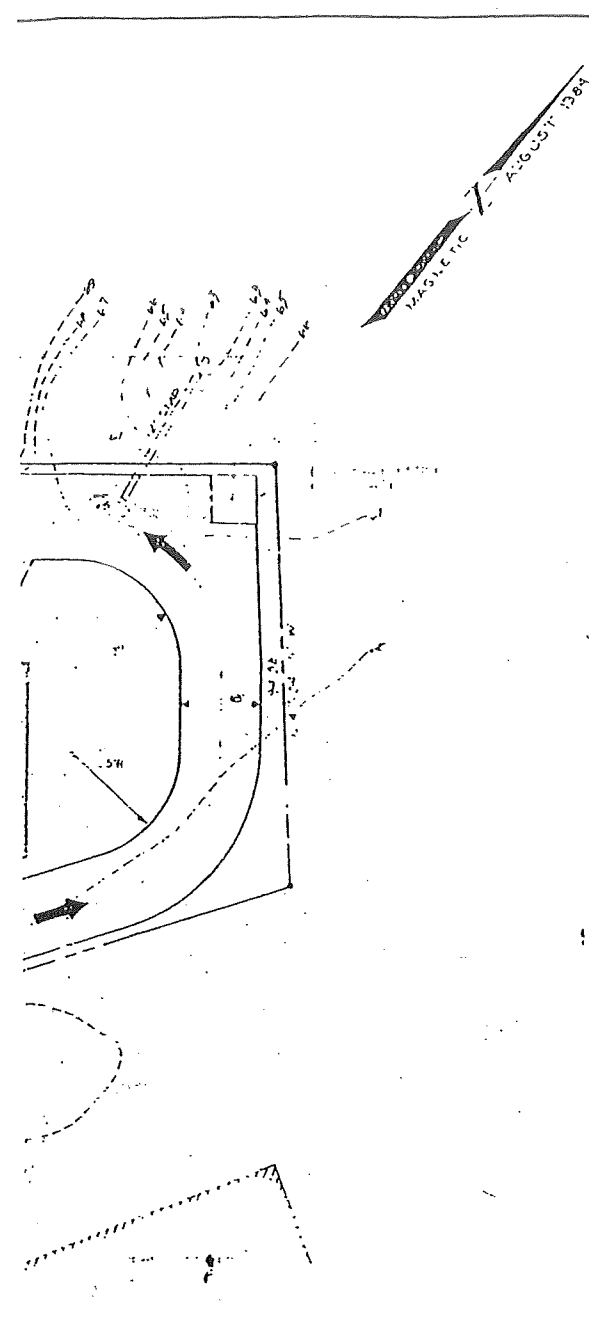
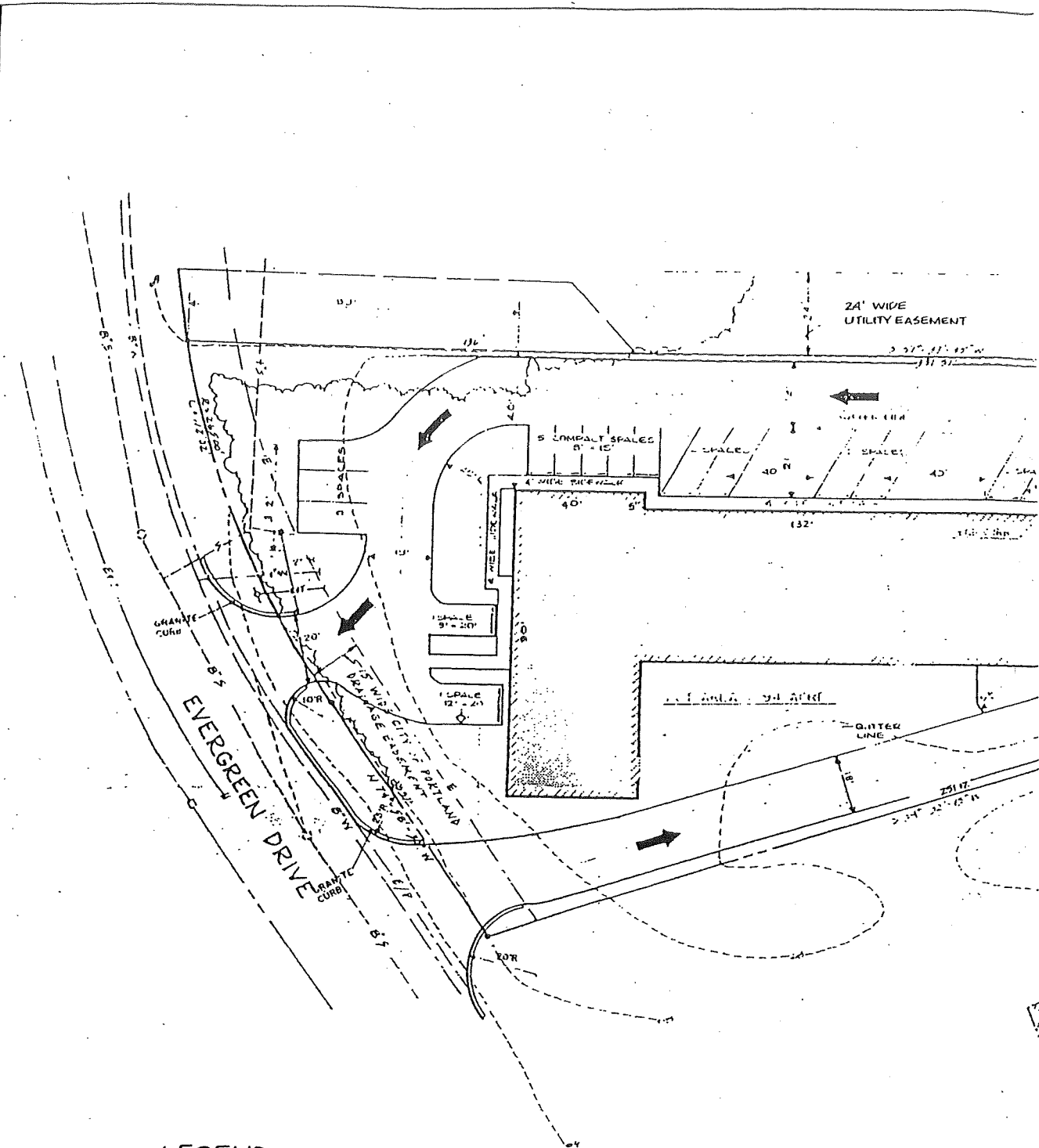


Signature: [Signature] Date: 6.21.2011

This is not a permit; you may not commence ANY work until the permit is issued



2nd floor - utilities



LOCATION MAP
1" = 120'

APPROVAL:
CITY OF PORTLAND
PLANNING BOARD

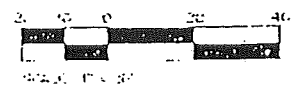
DATE _____

- NOTES**
- Lot 3 is part of Lot 1, in the Evergreen Industrial Park Subdivision approved by the City of Portland Planning Board on June 2, 1987.
 - Topographic Survey and particular bounds obtained from final Subdivision Plan for Michael Laplante, Lot 1, Evergreen Industrial Park, Riverside Street, Portland, Maine, by DeLuca Technical, Inc. dated January 11, 1987.
 - Property is located in 1st zone. Space and Bulk requirements are:
Minimum Side Yard -- Principal Building 25'
Minimum Front Yard -- Principal Building 25'
Minimum Rear Yard -- Principal Building 25'
 - Automobile parking required is 1 space per 1000 square feet of work area.
Work Area = 9500 s.f. or 10 spaces
Amount provided is 11 full size and 3 compact spaces.
Total spaces = 14

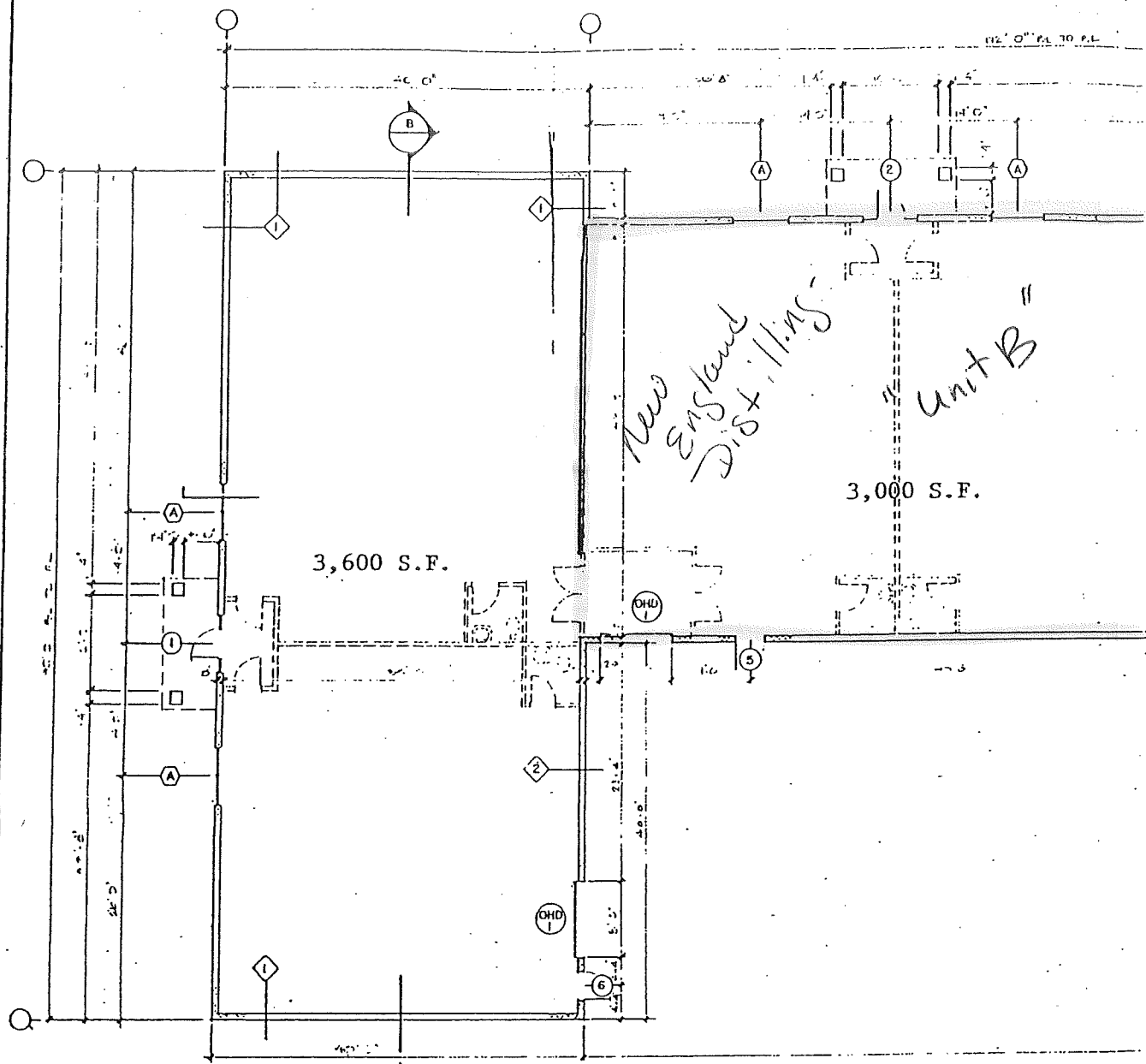
LEGEND

- s--- EXISTING SANITARY SEWER
- p--- PROPOSED SANITARY SEWER
- t--- TREE LINE
- w--- EXISTING WATER MAIN
- w--- PROPOSED WATER MAIN
- o EXISTING MANHOLE
- kt--- PROPOSED ELECTRIC AND TELEPHONE
- p--- PROPERTY LINE
- e--- EASEMENT LINE
- p--- EXISTING EDGE OF PAVEMENT
- g--- PROPOSED GRANITE CURB
- o IRON PIPE FOUND
- o HAY BALES
- o SILT FENCE
- p--- PROPOSED SPOT GRADES
- c--- EXISTING CONTOUR
- c--- PROPOSED CONTOUR
- o TEST PIT
- c--- EXISTING CULVERT
- o PROPOSED MANHOLE
- p--- PROPOSED UTILITY POLE
- p--- PRECAST PARKING LOT CURB
- g--- EXISTING SPOT GRADES
- k--- KIR KIP
- fd--- 4" FOUNDATION DRAIN

NOT CHECKED



PREPARED FOR: RIVERGREEN ASSOCIATES 2 HUNTER LANE FALMOUTH, MAINE 04103		
PROJECT: WAREHOUSE FACILITY LOT 3 OF LOT 1 SUBDIVISION FOR MICHAEL LAPLANTE EVERGREEN INDUSTRIAL PARK, PORTLAND, MAINE		
SITE PLAN		
DeLUCA - HOFFMAN ASSOCIATES, INC. CONSULTING ENGINEERS 1888 CONGRESS STREET PORTLAND, MAINE 04102 (207) 778-1181		
DESIGNED MJD	DATE 3/4/88	SHEET NO. 1
DRAWN MH	SCALE 1" = 20'	
CHECKED MJD	JOB NO.	



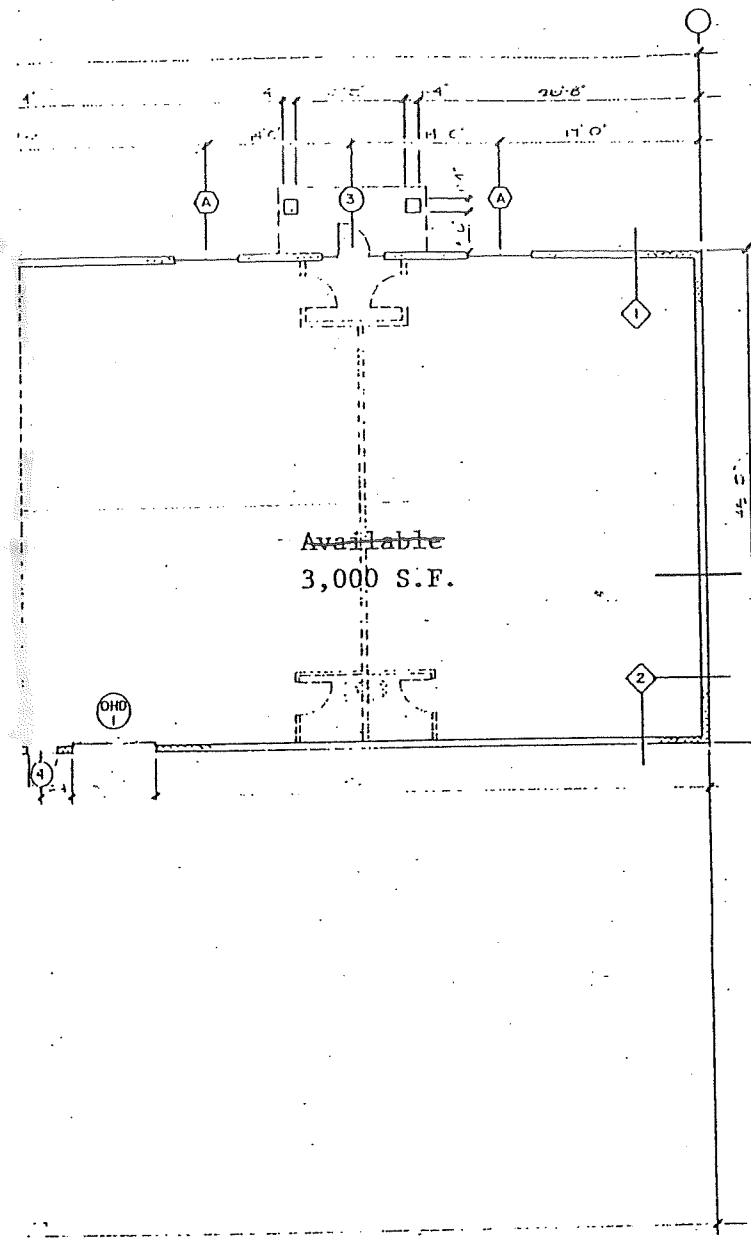
3,600 S.F.

3,000 S.F.

New England Dist. Ill. MS.
Unit B

FLOOR PLAN
1/8" = 1'-0"

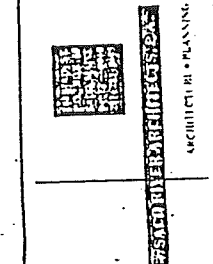
NOTES



Available
3,000 S.F.

△ REVISIONS

Drawn By
Checked By
Job No.



NO	DATE	PHASE

RIVERGREEN ASSOCIATES
RIVERSIDE INDUSTRIAL PARK
PORTLAND, MAINE

City of Portland, Maine - Building or Use Permit

389 Congress Street, 04101 Tel: (207) 874-8703, Fax: (207) 874-8716

Permit No: 08-0085	Date Applied For: 01/28/2008	CBL: 329 A014001
-----------------------	---------------------------------	---------------------

Location of Construction: 26 EVERGREEN DR	Owner Name: EVERGREEN HORIZONS CORPO	Owner Address: 893 BEACH POND RD	Phone:
Business Name:	Contractor Name: David Garand Enterprises, Inc.	Contractor Address: 114 County Road Gorham	Phone (207) 839-1310
Lessee/Buyer's Name	Phone:	Permit Type: Alterations - Commercial	

Proposed Use: Office/Warehouse - Interior Renovations / Divide space into 3 separate business spaces w/ office and warehouse use	Proposed Project Description: Interior Renovations / Divide space into 3 separate business spaces w/ office and warehouse use
---	--

Dept: Zoning	Status: Approved with Conditions	Reviewer: Marge Schmuckal	Approval Date: 01/29/2008
Note:	Ok to Issue: <input checked="" type="checkbox"/>		
1) This property shall remain warehousing with office space. Any change of use shall require a separate permit application for review and approval. It is considered to be a change of use if the entire areas are office space only.			
2) This permit is being approved on the basis of plans submitted. Any deviations shall require a separate approval before starting that work.			
3) Separate permits shall be required for any new signage.			

Dept: Building	Status: Approved with Conditions	Reviewer: Jeanine Bourke	Approval Date: 02/15/2008
Note:	Ok to Issue: <input checked="" type="checkbox"/>		
1) All penetrations through rated assemblies must be protected by an approved firestop system installed as tested in accordance with ASTM 814 or UL 1479, per IBC 2003 Section 712.			
2) Separate permits are required for any electrical, plumbing, or HVAC systems. Separate plans may need to be submitted for approval as a part of this process.			

Dept: Fire	Status: Approved with Conditions	Reviewer: Capt Greg Cass	Approval Date: 01/31/2008
Note:	Ok to Issue: <input checked="" type="checkbox"/>		
1) Storage of products other than Ordinary hazard class prohibited.			

Comments:
2/1/2008-gg: received site plan exemption as of 1/31/08, IT WAS NOT APPLICABLE, NO CHANGE OF USE PER MARGE /gg (put with permit) (Jeanie)
2/15/2008-jmb: Spoke with John L. To determine type of construction. The allowable height and area table 503 determines it can be type 3B. Ok for combustible framing.
1/26/2009-Ldobson: invoice for C of O Per previous Comments not a change of use no C of O needed Removed line from invoice LJD

Harpur Hill, Buxton, SK17 9JN
Telephone: +44 (0)114 289 2000
Facsimile: +44 (0)114 289 2050



**Potential Explosion Hazards due to
Evaporating Ethanol In Whisky Distilleries**

HSL/2003/08

**Project Leader: H. S. Ledin
Author(s): H. S. Ledin MSc PhD DIC
Science Group: Fire and Explosion Group**

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EXECUTIVE SUMMARY

Ethanol is a highly flammable liquid with a relatively low flash point, ≈ 21 °C – the flash point is dependent on the alcohol concentration. There is a concern that evaporating ethanol could pose an explosion hazard in bonded warehouses and in stills rooms. A literature search was carried out to ascertain the incident rate of explosions in distilleries. It appears that explosions occur only very rarely. A report from the mid-1960's suggested that explosions leading to fatalities and casualties as well as substantial destruction of buildings happen, apparently as a result of a preceding fire in many cases, but that very severe incidents occur fairly rarely.

Whisky is produced through a multi-stage process, of which distillation of the wash is the penultimate stage, by which the alcohol level in the whisky is raised to 70-80 %, by volume. The distillation takes place in copper distillers located in a stills room. Ethanol boils at a temperature of 78.4 °C. The surface of the copper vessel is at a temperature at or in excess of the boiling point of ethanol. The surface temperature is, however, well below the auto-ignition temperature of ethanol, which is around 426 °C, which precludes auto-ignition by the stills vessel surface. The whisky is then stored in casks, made of oak, in bonded warehouses for a minimum period of three years, used for blends, some single malts are exported after five to seven years, while other single malts are stored for eight to 40 years. A considerable amount of whisky is stored in these warehouses. The warehouses are often old, possibly of Victorian origin, and built with stone. The natural ventilation is an integral part in the maturing process of the whisky, lending it a particular quality, which will be different from region to region. It has been assumed that a typical air change rate is of the order of ten air changes per hour.

It is not within the remit of the present study to delve deeper into the potential sources of ignition. Possible sources of ignition are however likely to fall into one of the following categories - a lightning strike, open fire, discarded and still lit cigarettes, static electricity, sparks generated due to electrical faults, etc.

There appears to be a low probability of an explosion due to the ignition of an ethanol/air mixture. The evaporation rate of ethanol at 25 °C is too low; the natural ventilation would almost certainly be able to dilute the gas cloud ethanol concentration down to well below its lower flammability limit. However, the present study does not take into account the possibility of recirculation zones or stagnant regions, where the gas cloud could, potentially, become enriched so as to fall between the lower and upper flammability limit. It would be necessary to use more sophisticated tools, e.g. Computational Fluid Dynamics, to investigate gas build up in these regions.

OBJECTIVES

1. To investigate the likelihood of an explosion due to evaporating alcohol in a whisky distillery storage room
2. To investigate the likelihood of an explosion due to evaporating alcohol in a whisky stills room
3. To compile information about explosions in whisky and other spirits producing distilleries

MAIN FINDINGS

1. Explosions in distilleries appear to occur infrequently. There are only a few incidents reported in the literature, as a search through various databases, including HSE's major accidents database, revealed.
2. The results from the calculations suggest that there is not a problem with the formation of an explosive/flammable ethanol/air mixture, at the conditions assumed in the present study, e.g. ambient temperature. It is worth noting that possible build up of a flammable gas cloud in recirculation or stagnant regions, caused by the natural ventilation flow, have been ignored.

MAIN RECOMMENDATION

1. There are no recommendations.

1 INTRODUCTION

The present project was initiated to investigate the likelihood of an explosion due to evaporation of ethanol from pools caused by accidental spillage of whisky in distilleries.

Fleischman, Parris, Daley and Looby (1995) estimated the spillage at the cask filling stage to be just under 500 kg year⁻¹ for a medium size bourbon distillery, which represents roughly a loss of the order of 0.005 % of the annual production. Carter and Linsky (1974) studied the emission of ethanol from whiskey fermentation vats. Carter and Linsky quoted average ethanol emission figures of 182 g m⁻³ of grain input. UDV, the spirits and wine division of Diageo (with labels such as Guinness, classic single malts, Johnny Walker, etc.), produced an environmental report, Anon (2001), where it was suggested that an estimated 15,000 tonnes of ethanol was released into the atmosphere from maturing whisky in Scottish distilleries. Mascone (1978) investigated the ethanol losses in the American whiskey industry. Mascone estimated the loss of ethanol to be 3.2 kg barrel⁻¹ year⁻¹ during the ageing phase of whiskey production. However, of more concern is spillage in the stills room or in the warehouse. The loss of ethanol due to the evaporation from the casks, known as the angels' share, is not considered in the present study. The concern with evaporating ethanol is equally valid in distilleries producing other spirits, such as gin, vodka, etc.

Rasbash (1966) examined a number of incidents involving fire and explosion in spirits warehouses. Rasbash found that the incidents were rare occurrences. In one case, a fire started in the warehouse, which after several hours build up led to an explosion, which tore the building apart. The common theme in the incidents was that a fire would precede an explosion - radiation and convection enhancing the vaporisation of ethanol, destroying casks and/or structures leading to further spillage and subsequent ignition of the explosive mixture. Rasbash identified five mechanisms for the production of a flammable mixture:

- Evaporation of ethanol following a leak under normal temperature and pressure
- Evaporation of ethanol from a spillage into a hot ambient atmosphere, due to a fire
- Evaporation of ethanol onto a hot surface, heated by radiation from a fire
- Production of explosive mixture in a tank or cask
- Evaporation of ethanol into a oxygen deficient atmosphere, with a subsequent introduction of air

The current FOD/HSE PM84 Guidance Note, Anon (2000), which is concerned with explosive gas mixtures in gas turbine acoustic enclosures, sets an upper limit for the maximum acceptable gas cloud size (at 50 % LFL). The maximum acceptable gas cloud size is 0.1 % of the total enclosure volume. Experiments have shown that explosions involving gas clouds of that size give rise to negligible over-pressures. The PM84 recommendation has been adopted in the present study – though the layout of a stills room differs significantly from that of an acoustic enclosure.

There was some confusion over how the unit proof is defined. The British definition, Anon (2002a) and Anon (2002b) did not give any explanation of how the proof was calculated, while Anon (2002c) did – the whisky is mixed with gunpowder in some proportion. The mixture is then exposed to a naked flame to see if the flame would ignite the mixture. Table 4 shows the conversion between proof and volume fraction of ethanol. The American definition of proof is that proof is twice the volume fraction of ethanol. The British definition has been used in the calculations throughout the present report.

2 REPORTED EXPLOSIONS

A literature search was carried out to find references to explosions in distilleries. Only a few accidents could be found. In a couple of cases, there appears to be some confusion over the sequence of events, e.g. whether an initial fire caused the explosion or the explosion preceded a fire. The information obtained is scant.

2.1 PEORIA, ILLINOIS - 1935

A bonded warehouse, owned by Hiram Walker & Sons, in Peoria, Illinois, had started listing, Rasbash (1966). Remedial work had been undertaken in order to secure the building. However, the work was not finished and the building was still not in plumb. The lift was not working and the whiskey casks were therefore still stored in the building. Eyewitnesses claimed that they had heard an explosion. It was conjectured that a few whiskey casks might have been dislodged, but how and why they were dislodged is not known. It was never established what had acted as the ignition source.

2.2 PEKIN, ILLINOIS - 1954

A fire had started in American Distilling Company's distillery in Pekin, Illinois, in 1954. The fire built up over several hours. Two warehouses had been burned out. The radiation from the fire in an adjacent building led to the roof of one of the remaining warehouses getting very hot. The increased roof temperature in turn led to the ignition of an ethanol/air mixture. It was not known how the gas cloud had formed, but it is conceivable that an increased evaporation of ethanol due to the radiation from the fire had occurred.

2.3 AHMADNAGAR, INDIA

An explosion occurred in an industrial alcohol distillery in Ahmadnagar, India, on 20 December 1985, Anon (1985). It was an explosion in an acetic acid tank; the cause is not the ignition of evaporating alcohol so the incident is not directly relevant to this study. Nevertheless, there were five fatalities and 45 casualties because of the explosion.

2.4 PUERTO DE SANTA MARIA, SPAIN

An explosion and subsequent fire occurred at the Alcoholes del Puerto factory on 24 August 1988, Anon (1988). The explosion affected six tanks containing ethanol, the distillation plant and offices and personnel buildings. Seven people were killed in the accident, while four persons suffered burns and one person was reported missing. Unfortunately, there was no additional information with regards to the cause of the explosion, or what killed the seven people.

2.5 THONBURI, THAILAND

A series of explosions ripped through a whiskey distillery in Thonburi, Thailand on 14 June 1993, Anon (1993). There were four fatalities and at least 10 injured. The explosions were caused by a fire. The report suggested that the source of ignition were sparks from welding equipment. There were also environmental effects as dangerous chemicals were leaked into a river, Anon (1993).

2.6 LAWRENCEBURG, KENTUCKY, USA

A fire broke out in a warehouse at the Wild Turkey Bourbon distillery in Lawrenceburg, USA on 9th May 2000, Chellgren (2000) and Mazza (2000). A significant amount of bourbon,

between 15000 and 20000 casks, each of which held 53 gallons of whiskey (3000 - 4000 m³), was stored in the seven-story building. The warehouse was reduced to a pile of rubble by the fire. It was reported that workers at a nearby water treatment plant had heard a loud bang, as would be produced by an explosion. They went out to investigate what had happened and they then saw that one end wall and part of one of the sidewalls of the warehouse had been blown out - the warehouse then collapsed after about three minutes. The fire brigade concentrated their efforts on ensuring that the fire would not spread to any of the other eleven warehouses on site. There were no fatalities - though two firemen had to be taken to hospital suffering from heat exhaustion. A water treatment plant, which serves Lawrenceburg and surroundings with drinking water, had to be shut down as bourbon escaped into a nearby river and was about to be drawn into the water treatment plant intake.

2.7 ATCHISON, KANSAS, USA

An explosion took place in the Midwest Grain Inc. ethanol distillery in Atchison, Kansas on 13th September 2002. Four people were injured in the explosion. Eyewitness accounts reported that flames shot out of the windows of the factory, after which the fireball lifted into the air. The roof and one side of the building were completely destroyed by the blast. The strength of the blast was such that ceiling tiles and light lenses fell to the floor in a bowling alley some two blocks west of the distillery. The cause of the explosion is not known.

3 Calculations

3.1 ASSUMPTIONS AND SIMPLIFICATIONS

- The ethanol vapour pressure is not altered by the “active ingredients” in the whisky, which are not well characterised
- The age of the whisky does not affect the vapour pressure
- Equilibrium between the gas and the liquid phase is established
- Raoult’s Law is applicable to the ethanol/water mixture
- The conditions in the warehouse are fully mixed
- The emission rate does not change with time and corresponds to the maximum rate - e.g. after the soakage phase is completed (after 6-18 months) - not needed since it is assumed that equilibrium between the liquid and the vapour phase is established, see above
- Equipment in the stills and storage rooms does not affect the effectiveness of the natural ventilation - nor does it affect the fluid flow in the rooms
- Equilibrium between the gas and the liquid phase is established
- The storage room is 10 m wide, 10 m long and 5 m high
- The air change rate is 10 h^{-1}
- The temperature in the stills room and the storage room is 298.15 K, the humidity is 50 % and the pressure 101,325 Pa (1 atm)
- The temperature and pressure does not change appreciably
- The ambient air is initially made up of oxygen (20.9 % v/v) and nitrogen (71.1 % v/v)
- The concentrations of oxygen and nitrogen in the liquid phase is negligible
- The British definition of whisky strength has been used in the present report – the measurement of strength involved mixing the whisky with gunpowder and thereafter investigate whether a naked flame would ignite the mixture, Anon (2002C)

3.2 PHYSICAL PROPERTIES

3.2.1 Ethanol

TABLE 1: Physical properties of ethanol, at $P = 101,325 \text{ Pa}$ and $T = 298.15 \text{ K}$

Physical property	Value
Lower Flammability Limit (LFL)	3.5 % v/v
Upper Flammability Limit (UFL)	19.0 % v/v
Molecular weight	$46.07 \text{ kg kmol}^{-1}$
Flash point	285.15 K
Boiling point	351.45 K
Vapour pressure	7.9 kPa

The data was obtained from SAX, Anon (1999), except the vapour pressure, which was calculated from Equation 3. Olbrich (1980) quoted slightly different LFL and UFL values, but the SAX data has been used.

3.2.2 Water

TABLE 2: Physical properties of water, at $P = 101,325 \text{ Pa}$ and $T = 298.15 \text{ K}$

Physical property	Value
Molecular weight	$18.04 \text{ kg kmol}^{-1}$
Boiling point	373.15 K
Vapour pressure	3.2 kPa

The vapor pressure for water was calculated from Equation 3.

3.3 RESULTS

Dalton's law relates the partial pressure of a species to the mole fraction of said species in the gas phase and the total pressure:

$$P_i = y_i P_{tot}, \quad (1)$$

where y_i is the mole fraction of species 'i' in the gas phase and P_{tot} is the total pressure.

It has been assumed that Raoult's law applies to the binary mixture. Raoult's law relates the partial pressure of a species to the mole fraction of said species in the liquid phase and the partial pressure the species would exert if it were a pure liquid:

$$P_i = x_i P_i^0, \quad (2)$$

where x_i is the mole fraction of species 'i' in the liquid phase and P_i^0 is the partial pressure of the pure species 'i'.

The vapour pressure of species 'i' varies with temperature and can be calculated using

$$\ln P_i^0 = a_i - \frac{b_i}{T - c_i} \quad [kPa], \quad (3)$$

where a_i , b_i and c_i are species dependent constants, T is the ambient temperature, in K. Table 3 shows the values of the constants used in equation 3.

TABLE 3: Species dependent constants in the vapour pressure equation

Species	a_i	b_i	c_i
Ethanol	16.19	3424.0	-55.72
Water	16.54	3985.0	-39.0

The mole fraction of species 'i' can be readily calculated using the following expression, a combination of equations 1 to 3:

$$y_i = 1000 \frac{x_i}{P_{tot}} \exp \left\{ a_i - \frac{b_i}{T + c_i} \right\}, \quad (4)$$

where the factor 1000 is used to convert the partial pressure to Pa.

TABLE 4: Conversion from proof to volume fraction of ethanol

Proof	Volume fraction of ethanol
70	40
75	43
80	46
90	52
100	56
105	60

It was necessary to carry out an iterative procedure in order to calculate the correct molecular volume, which unfortunately varies quite considerably for the ethanol/air mixture. A diagram in Atkins (1983), Figure 8.1 on page 216, proved to very useful.

3.3.1 70 proof whisky

The number of moles of species 'i' in the liquid mixture can be calculated with the following formula:

$$n_i = \frac{V_i}{V_{m,i}}, \quad (5)$$

where V_i is the volume fraction of species 'i' in the mixture and $V_{m,i}$ is the molecular volume, interpolated from Figure 8.1 in Atkins (1983). A mole fraction of ethanol was chosen, the corresponding molecular volumes were read from the graph, and a new mole fraction of ethanol could be calculated using Equation 4. A new set of molecular volumes can be read from the graph. This procedure is continued until the mole fractions have converged. There is some uncertainty in the results given the interpolation from a graph. Three iterations were required before the mole fractions could be considered to have converged. The calculations gave the following result; $n_A = 0.85$ and $n_B = 0.15$. The mole fraction of ethanol in the gas phase was 0.0125, which is below LFL for the ethanol/air mixture. Hence, there is no risk of an explosion or fire.

3.3.2 90 proof whisky

The procedure outlined in Section 3.4.1 was followed in the 90 proof case. The calculations of the mole fractions of the two species in the liquid phase yielded the following result; $n_A = 0.774$ and $n_B = 0.226$. The mole fraction of ethanol in the gas phase was 0.0176, which is below LFL for the ethanol/air mixture. Hence, there is no risk of an explosion or fire.

4 DISCUSSION AND CONCLUSIONS

4.1 DISCUSSION

A search through the HSE incident database as well as other databases did not yield a large number of reported incidents. The best source was a report by Rasbash (1966), which contained details of a few incidents involving explosions in whisky bonded warehouses. The information in the report is old – it relates to incidents, which took place between 1935 and 1966. There appears not to have been an update of the report or any other study undertaken since Rasbash's report was published, some 35 years ago. Most of the recent incidents, which were reported in Lloyds Casualty Reports, were described in such brief details as to make it difficult to assess the exact nature of the incidents. However, it would appear that the reported incidents involving explosions were not due to the ignition of an ethanol/air mixture, formed from natural evaporation or spillage.

The ethanol evaporation rate is low in a room at 25 °C, which could represent a typical maximum room temperature in a bonded warehouse. The calculations, carried out in the present study, indicate that the formation of a gas cloud with an ethanol concentration between the lower and upper flammability limits is unlikely. A number of assumptions have been made, though it is unlikely that these would significantly alter the conclusions of the present study. However, it must also be remembered that although the bonded warehouses are naturally ventilated, assuming a typical figure of ten air changes per hour, there could be regions of recirculating flow. The ethanol vapour could find its way into these regions of recirculation, thus giving rise to gas clouds with an ethanol concentration within the flammability limits. The present study does not consider fluid flow effects. A more sophisticated tool, e.g. Computational Fluid Dynamics, would have to be employed if it is desirable to investigate gas cloud build-up in stagnant regions of the warehouse.

Rasbash (1966) suggests that a fire in an adjacent building, if unsuccessfully checked, could lead to a temperature rise in the warehouse. The higher temperature could then result in an increased ethanol evaporation rate and, thus, to the formation of a gas cloud.

The scenario of spillage or leakage in the stills room is more complex. The temperature in the copper distillers is well above 25 °C, so that the surface temperature will also be relatively high, but well below the auto-ignition temperature of ethanol, which is around 430 °C. It is therefore not possible for the hot surface to auto-ignite the ethanol/air mixture. Rasbash (1966) correctly states that a hot surface would lead to an increased evaporation rate of ethanol. Moreover, Rasbash suggested that a hot surface would not necessarily lead to an explosion, if the fire were in the vicinity of the hot surface, as a relatively small fire would ensue. Rasbash (1966) did recognise that a flammable gas cloud could form if the fire was located a substantial distance away from the hot surface. The air change rate and the airflow pattern in the room would be two important factors in deciding whether an explosive mixture would form and where it would be located.

The production of an explosive mixture due to the heating up of a storage tank or cask is not considered explicitly in the present study. It is noted, however, that this scenario is a likely one. It is not known whether any experimental studies into the effects of flame engulfment of oak casks have been undertaken. It is therefore not possible to comment on how long a cask would stand up to a fire. The oak used to manufacture casks is a good insulator, see Table 5, so the temperature rise in the whisky would be relatively slow. A possible outcome of the flame engulfment of a cask is that the metal hoops, with high thermal conductivity, see Table 5, which hold the oak staves together, would heat up first. The transfer of heat to the contents of the cask is of course governed by the heat conductivity of the oak and not the steel. However, it is not clear what is the most likely failure mechanism. It is interesting to note

that the oak has nearly four times higher thermal expansion coefficient than the carbon steel used for the hoops, which means that the staves and the cask ends would expand more than the metal hoops for a given temperature difference. The temperature in a flame could be of the order of 500 °C to 1000 °C, at which steel would begin to soften. One possible failure mechanism would be that the steel hoops snap or get dislodged due to the large difference in thermal expansion between the wood and the steel, thus relieving the pressure in the cask. The ethanol vapour would then ignite. Further study would be required to establish the failure mechanism of flame-engulfed whisky containing oak casks.

Table 5: Physical Properties of oak and carbon steel, Kaye and Laby (1989)

Material	α K ⁻¹	λ W m ⁻¹ K ⁻¹
Oak	$35 \cdot 10^{-6} - 60 \cdot 10^{-6}$	0.14-0.17
Carbon steel	$\approx 16 \cdot 10^{-6}$	≈ 45

4.2 CONCLUSIONS

The calculations performed in the present study seem to indicate that there is very low probability of an explosion of ethanol/air mixture, formed either by a spillage or by natural evaporation. The assumed temperature, pressure and alcohol content of the whisky would be very unlikely to yield a gas cloud with an ethanol concentration in the flammable range.

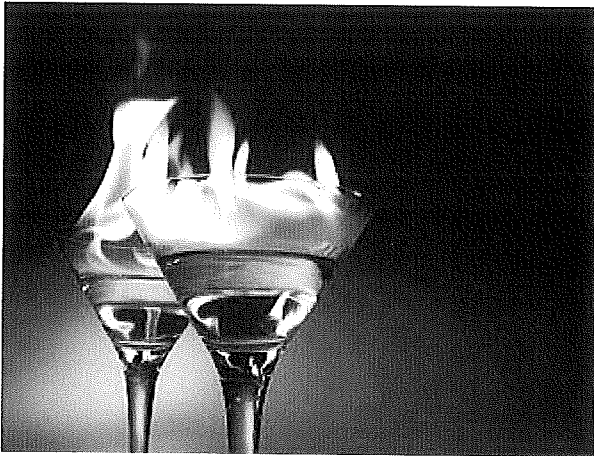
The failure mechanism of an oak cask is not known. There is a large difference between the thermal expansion coefficients of the oak and the steel hoops.

The accumulation of ethanol vapours at higher concentrations in a slow moving, recirculating flow, due to natural ventilation, cannot be ruled out. However, the effects of the natural ventilation have not been taken into account in the present study. A more sophisticated mathematical tool, e.g. CFD, would need to be employed in order to study the possible accumulation of ethanol in almost stagnant regions within the bonded warehouse.

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Flammability



These flaming cocktails illustrate that a distilled beverage will readily catch fire and burn. See also: Alcohol proof, Flash point, and Fire point

Liquor that contains 40% ABV (80 US proof) will catch fire if heated to about 79 °F (26 °C) and if an ignition source is applied to it. (This is called its flash point.^[10] The flash point of pure alcohol is 62.88 °F (17.16 °C), less than average room temperature.^[11])

The flash points of alcohol concentrations from 10% ABV to 96% ABV are shown below:^[12]

- 10% — 120 °F (49 °C) — wine
- 20% — 97 °F (36 °C) — fortified wine
- 30% — 84 °F (29 °C)
- 40% — 79 °F (26 °C) — typical whisky
- 50% — 75 °F (24 °C) — strong whisky
- 60% — 72 °F (22 °C)
- 70% — 70 °F (21 °C) — absinthe
- 80% — 68 °F (20 °C)
- 90% — 63 °F (17 °C) — neutral grain spirit
- 96% — 63 °F (17 °C)

Beverages that have a low concentration of alcohol will burn if sufficiently heated and an ignition source (such as an electric spark or a match) is applied to them. For example, the flash point of ordinary wine containing 12.5% alcohol is about 125 °F (52 °C).^{[13][10]}



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1.15 Technical Assistance.

1.15.1 The AHJ shall be permitted to require a review by an approved independent third party with expertise in the matter to be reviewed at the submitter's expense.

1.15.2 The independent reviewer shall provide an evaluation and recommend necessary changes of the proposed design, operation, process, or new technology to the AHJ.

1.15.3 The AHJ shall be authorized to require design submittals to bear the stamp of a registered design professional.

1.15.4 The AHJ shall make the final determination as to whether the provisions of this *Code* have been met.

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GUIDE FLAMMABLE LIQUIDS (Polar / Water-Miscible) 127

POTENTIAL HAZARDS

FIRE OR EXPLOSION

- **HIGHLY FLAMMABLE: Will be easily ignited by heat, sparks or flames.**
- Vapors may form explosive mixtures with air.
- Vapors may travel to source of ignition and flash back.
- Most vapors are heavier than air. They will spread along ground and collect in low or confined areas (sewers, basements, tanks).
- Vapor explosion hazard indoors, outdoors or in sewers.
- Those substances designated with a "P" may polymerize explosively when heated or involved in a fire.
- Runoff to sewer may create fire or explosion hazard.
- Containers may explode when heated.
- Many liquids are lighter than water.

HEALTH

- Inhalation or contact with material may irritate or burn skin and eyes.
- Fire may produce irritating, corrosive and/or toxic gases.
- Vapors may cause dizziness or suffocation.
- Runoff from fire control may cause pollution.

PUBLIC SAFETY

- **CALL Emergency Response Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, refer to appropriate telephone number listed on the inside back cover.**
- As an immediate precautionary measure, isolate spill or leak area for at least 50 meters (150 feet) in all directions.
- Keep unauthorized personnel away.
- Stay upwind.
- Keep out of low areas.
- Ventilate closed spaces before entering.

PROTECTIVE CLOTHING

- Wear positive pressure self-contained breathing apparatus (SCBA).
- Structural firefighters' protective clothing will only provide limited protection.

EVACUATION

Large Spill

- Consider initial downwind evacuation for at least 300 meters (1000 feet).

Fire

- If tank, rail car or tank truck is involved in a fire, ISOLATE for 800 meters (1/2 mile) in all directions; also, consider initial evacuation for 800 meters (1/2 mile) in all directions.

EMERGENCY RESPONSE

FIRE

CAUTION: All these products have a very low flash point: Use of water spray when fighting fire may be inefficient.

Small Fire

- Dry chemical, CO₂, water spray or alcohol-resistant foam.

Large Fire

- Water spray, fog or alcohol-resistant foam.
- Use water spray or fog; do not use straight streams.
- Move containers from fire area if you can do it without risk.

Fire involving Tanks or Car/Trailer Loads

- Fight fire from maximum distance or use unmanned hose holders or monitor nozzles.
- Cool containers with flooding quantities of water until well after fire is out.
- Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank.
- ALWAYS stay away from tanks engulfed in fire.
- For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

SPILL OR LEAK

- ELIMINATE all ignition sources (no smoking, flares, sparks or flames in immediate area).
- All equipment used when handling the product must be grounded.
- Do not touch or walk through spilled material.
- Stop leak if you can do it without risk.
- Prevent entry into waterways, sewers, basements or confined areas.
- A vapor suppressing foam may be used to reduce vapors.
- Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers.
- Use clean non-sparking tools to collect absorbed material.


Large Spill

- Dike far ahead of liquid spill for later disposal.
- Water spray may reduce vapor; but may not prevent ignition in closed spaces.

FIRST AID

- Move victim to fresh air.
- Call 911 or emergency medical service.
- Give artificial respiration if victim is not breathing.
- Administer oxygen if breathing is difficult.
- Remove and isolate contaminated clothing and shoes.
- In case of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes.
- Wash skin with soap and water.
- In case of burns, immediately cool affected skin for as long as possible with cold water. Do not remove clothing if adhering to skin.
- Keep victim warm and quiet.
- Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves.

Date Modified: 2008-11-16


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28 Evergreen

① Electrical needs to be classified
No

② Separation from other uses
① Tank DR. ② Electrical controls make lists

Double sided
wall
5/8"

③ Sprinkler or Fire Alarm No

④ Quantity of product are you storing. possible storage of alcohol resistant foam.

⑤ 2nd flr? what is it.

51 Ingersoll Dr.

~~Alcohol~~ 473 Riverside

Graded Ethanol Storage.

Fire Extinguishers for us

Building walls

3x plus
51,000 gals

53 gals per barrel
up to 100 Barrels
less than 125 proof
60% alcohol

COMMERCIAL LEASE (NET LEASE)

1. PARTIES

AIM Evergreen, LLC, with a mailing address of c/o Bibeau & Co. 340 Fore Street, Portland, ME 04101 ("LANDLORD"), hereby leases to New England Distilling, LLC, with a mailing address of 26 Evergreen Drive, Unit B, Portland, ME 04103 ("TENANT"), and the TENANT hereby leases from LANDLORD the following described premises:

2. PREMISES

The Premises are deemed to contain 3,000± square feet and is located at 26 Evergreen Drive, Unit B, Portland, Maine, together with the right to use, in common with others entitled thereto, the hallways, stairways, and elevators, necessary for access to said leased premises and lavatories nearest thereto. The leased premises are accepted in "as is" condition except if specifically set forth to the contrary in this lease.

3. TERM

The term of this lease shall be for three (3) years, unless sooner terminated as herein provided, commencing on May 1, 2011 and ending on April 30, 2014. Rent commences June 1, 2011.

4. RENT

TENANT shall pay to the LANDLORD the following base rent:

<u>Lease Year(s)</u>	<u>Annual Base Rent</u>	<u>Monthly Rent</u>
1	\$15,000.00 NNN	\$1,250.00 NNN
2	\$15,450.00 NNN	\$1,287.50 NNN
3	\$15,913.50 NNN	\$1,326.12 NNN

payable in advance in equal monthly installments on the first day of each month during the term of this Lease without deduction or setoff, said rent to be prorated for portions of a calendar month at the beginning or end of said term, all payments to be made to LANDLORD or to such agent and at such place as LANDLORD shall from time to time in writing designate, the following being now so designated: *Aim Evergreen, LLC, c/o Bibeau & Co. 340 Fore Street, Portland, ME 04101*. If TENANT does not pay base rent, supplemental and additional rents, or other fees and charges within ten (10) days of the date on which such payment was due, then LANDLORD, in its sole discretion, may charge, in addition to any other remedies it may have, a late charge for each month or part thereof that TENANT fails to pay the amount due after the due date. The late charge shall be equal to four percent (4%) of the amount due LANDLORD each month in addition to the rent then due.

5. RENEWAL OPTION:

So long as TENANT has not been in default of this Lease during the term hereof, TENANT shall have the option to renew this Lease for two (2) three (3)-year options. In order to exercise TENANT'S option, TENANT shall notify LANDLORD in writing by Certified or Registered Mail of its intention to exercise its option not less than ninety (90) days prior to the end of the then current term, said renewal to be upon the same terms and conditions set forth in this Lease except for base rent which shall be at then fair market rates.

In the event that TENANT fails to perform its obligations under this Section, time being of the essence, the option shall be deemed not to have been exercised.

6. SECURITY

Upon the execution of this Lease, TENANT shall pay to LANDLORD the

RECEIVED

JUN 28 2011

Dept. of Building Inspections
City of Portland Maine

undertaking in connection herewith. All negotiations, considerations, representations and understandings between LANDLORD and TENANT are incorporated herein and no prior agreements or understandings, written or oral, shall be effective for any purpose. No provision of this Lease may be modified or altered except by agreement in writing between LANDLORD and TENANT, and no act or omission of any employee or agent of LANDLORD shall alter, change, or modify any of the provisions hereof. This Lease shall be governed exclusively by the provisions hereof and by the laws of the State of Maine. The headings herein contained are for convenience only, and shall not be considered a part of this Lease.

30. BROKERAGE:

TENANT warrants and represents to LANDLORD that it has not dealt with any broker, finder or similar person concerning the leasing of the leased premises, other than Nate Stevens of CBRE The Boulos Co. ("TENANT'S BROKER"). LANDLORD agrees to pay TENANT'S BROKER any commission due upon execution of this Lease, and in the event of any brokerage claims against LANDLORD by TENANT'S BROKER, TENANT agrees to defend the same and indemnify LANDLORD against any such claim. LANDLORD warrants and represents to TENANT that it has not dealt with any broker, finder or similar person concerning the leasing of the leased premises other than Tripp Corson of NAI The Dunham Group ("LANDLORD'S BROKER"). LANDLORD agrees to pay LANDLORD'S BROKER any commission due upon execution of this Lease, and in the event of any brokerage claims against TENANT by LANDLORD'S BROKER, LANDLORD agrees to defend the same and indemnify TENANT against any such claim. LANDLORD agrees to pay a commission upon execution of this Lease, to be split 50/50 with CBRE The Boulos Co. on the initial lease term, renewal, and purchase of the condominium.

31. OTHER PROVISIONS:

It is also understood and agreed that: TENANT shall be responsible for separate water sub meter.

32. RIGHT OF FIRST REFUSAL:

TENANT shall have the right of first refusal to lease any available space in the subject property that becomes available during the initial lease term and any options thereafter.

33. OPTION TO PURCHASE:

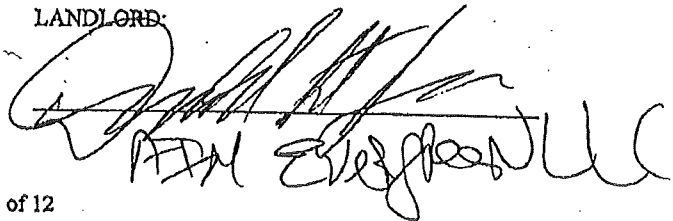
TENANT shall have the option to purchase Unit B at any time throughout the initial lease term for \$300,000.

DISCLAIMER: THIS IS A LEGAL DOCUMENT. IF NOT FULLY UNDERSTOOD,
CONSULT AN ATTORNEY.

IN WITNESS WHEREOF, the said parties hereunto set their hands and seals this 29 day of April, 2009. 2011

TENANT:

LANDLORD:



ADAM EVERGREEN

Legal Name of Tenant

Edward H. Wright III
Signature

Edward H. Wright III, Managing Member
NAME/TITLE

[Signature]
Witness to Tenant

Legal Name of Landlord

[Signature]
Signature

ADK EIR GREEN LLC
NAME/TITLE

[Signature]
Witness to Landlord

GUARANTY: For value received, and in consideration for, and as an inducement to LANDLORD to enter into the foregoing lease with New England Ditching TENANT, Edward H. Wright III ("GUARANTOR") does hereby unconditionally guaranty to LANDLORD the complete and due performance of each and every agreement, covenant, term and condition of the Lease to be performed by TENANT. The validity of this guaranty and the obligations of the GUARANTOR hereunder shall not be terminated, affected, or impaired by reason of the granting by LANDLORD of any indulgences to TENANT. This guaranty shall remain and continue in full force and effect as to any renewal, modification, or extension of the Lease, whether or not GUARANTOR shall have received any notice of or consented to such renewal, modification or extension. The liability of GUARANTOR under this guaranty shall be primary, and in any right of action which shall accrue to LANDLORD under the lease, LANDLORD may proceed against GUARANTOR and TENANT, jointly and severally, and may proceed against GUARANTOR without having commenced any action against or having obtained any judgment against TENANT. All of the terms and provisions of this guaranty shall inure to the benefit of the successors and assigns of LANDLORD and shall be binding upon the successors and assigns of GUARANTOR.

IN WITNESS WHEREOF, GUARANTOR has executed this Guaranty this 29 day of April, 2009, 200