DISTILLERIES

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1.0 SCOPE

This data sheet provides recommendations for the prevention of property losses at distilled spirits and food grade ethanol production facilities, commonly known as distilleries.

This data sheet does not address the following:

A. Storage of distilled spirits in intermediate bulk containers, wooden barrels and glass or plastic containers. Use Data Sheet 7-29, *Ignitable Liquid Storage in Portable Containers*.

B. Storage of distilled spirits in outdoor storage tanks. Use Data Sheet 7-88, *Outdoor Ignitable Liquid Storage Tanks*.

C. Grain handling, milling, feedstock preparation and distiller's dried grains with solubles (DDGS) operations. Use Data Sheet 7-76, *Combustible Dusts*.

D. Fuel-grade ethanol production facilities. Use Data Sheet 7-111A, *Fuel-Grade Ethanol*.

E. Distillation recovery of waste solvents. Use Data Sheet 7-2, *Waste Solvent Recovery*.

1.1 Hazards

Distilleries present a fire hazard due to the processing (distillation, pumping, mixing) of ethanol, an ignitable liquid with a closed cup flash point less than 100°F (38°C). The processing of ignitable liquids creates the potential for pool, spill and spray fires. Handling liquids with a flash point near or below ambient conditions will quickly produce flammable vapor that can be easily ignited if the liquid is accidentally released.

Distilleries may be at risk for explosions due to the accidental release of ethanol vapors from the distillation process. Distillation processes involve heating ethanol to its atmospheric boiling point to separate ethanol from water. Processes that boil ignitable liquids create the potential for a large release of flammable vapor that, if ignited inside a building or room, could produce an explosion. The handling of combustible dust also creates the potential for a dust explosion hazard in equipment or buildings where dust is not properly contained.

1.2 Changes

April 2026. This document has been completely revised. Significant changes include the following:

A. Removed the recommended separation distance for distillation operations with an explosion hazard. Previous guidance recommended a separation distance of 100 ft (31 m).

B. Revised guidance on fire-rated construction in Section 2.2.1.2 to include only distillation, boilers, dry material handling and warehouses.

C. Revised guidance for protection of load bearing steel members and exposed steel equipment supports in Section 2.2.1.3. Steel protection in accordance with Data Sheet 7-32, *Ignitable Liquid Operations*, is recommended in areas where liquids with greater than 70% alcohol by volume (ABV) may be present.

D. Revised guidance in Section 2.2.2 on explosion protection options for buildings with an identified explosion hazard. For some scenarios, damage-limiting construction may not be required.

E. Revised guidance on drainage and containment for distillation and distilled liquor handling. The new guidance references Data Sheet 7-32.

F. Revised guidance on ventilation in Section 2.3.2. The new guidance is based on Data Sheet 7-32. The previous standard provided limited guidance about the provision for mechanical ventilation in areas handling alcohol.

G. Added guidance for loading and unloading stations in Sections 2.4.1.2 and 2.5.1.4. These stations should be installed and protected in accordance with Data Sheet 7-32.

H. Revised protection guidance for distillery operation areas in Section 2.4.2. The mashing and fermenting areas are protected using the guidance for HC-2 occupancies in accordance with Data Sheet 3-26, *Fire Protection for Nonstorage Occupancies*. Distilled liquor handling operations are protected in accordance with Data Sheet 7-32.

I. Added guidance to Sections 2.4.3.1 and 2.4.3.2 for indoor storage of empty wooden barrels.

J. Revised protection guidance in Section 2.4.3.3 for outdoor storage of empty wooden barrels. Previous guidance specified distances based on the number of barrels stored. The new guidance is in accordance with Data Sheet 1-20, *Protection Against Exterior Fire Exposure*, which provides options in addition to space separation.

K. Added guidance in Section 2.5.2 on lower explosive limit (LEL) detection for distillation operations where an identified room/building explosion hazard exists.

L. Revised and clarified guidance on safety devices and safety systems for stills in Section 2.5.3 to align with existing guidance in other FM Data Sheets.

M. Revised guidance for ignition source control in Section 2.9. The updated recommendations are in accordance with Data Sheet 7-32.

2.0 LOSS PREVENTION RECOMMENDATIONS

2.1 Introduction

Use FM Approved equipment, materials and services whenever they are applicable. For a list of products and services that are FM Approved, see the *Approval Guide*, an online resource of FM Approvals.

2.1.1 General

2.1.1.1 Arrange all processes or tanks containing alcohol-water mixtures with greater than 20% alcohol by volume (ABV) to permit automatic, controlled shutdown in accordance with Data Sheet 7-32, *Ignitable Liquid Operations*.

2.1.1.2 Evaluate the potential for a room/building or equipment explosion hazard in accordance with Data Sheet 7-32.

2.1.2 Liquid Evaluation

2.1.2.1 Treat all alcohol-water mixtures with 20% or less ABV as non-ignitable liquids for fire hazard evaluations.

2.1.2.1.1 Evaluate alcohol-water mixtures with 20% or less ABV for potential equipment explosion hazards. These mixtures will still have a closed-cup flash point.

2.1.2.2 Treat all alcohol-water mixtures with greater than 20% ABV as an ignitable liquids.

2.2 Construction and Location

2.2.1 General

2.2.1.1 Provide noncombustible construction for all areas.

2.2.1.2 Isolate the following operations using minimum 1-hour fire rated construction and, where needed, building explosion protection per Section 2.2.2.

- Distillation
- Boilers
- Dry material handling
- Finished product and general-purpose warehouses

2.2.1.3 Protect load bearing steel structural members and steel equipment supports in accordance with Data Sheet 7-32 for areas where they could be directly exposed to a pool fire involving liquids that are greater than or equal to 70% ABV.

2.2.1.3.1 For areas where liquids less than 70% ABV are used, steel protection is not required.

2.2.2 Building Explosion Protection

2.2.2.1 Provide damage-limiting construction for buildings with distillation processes that operate above atmospheric pressure or produce greater than 50 gpm (190 L/min) of alcohol per individual piece of equipment.

2.2.2.2 Design damage-limiting construction in accordance with Data Sheet 1-44, *Damage-Limiting Construction*.

2.2.3 Drainage and Containment

2.2.3.1 Provide emergency drainage and containment for distillation operations and distilled liquid handling areas in accordance with Data Sheet 7-32.

2.2.3.1.1 Emergency drainage is not needed in manufacturing areas where:

A. Equipment and liquid transfer systems are arranged in accordance with Data Sheet 7-32.

B. Liquid leak detection system and fire detection system are provided and interlocked in accordance with Data Sheet 7-32.

2.2.3.2 Design emergency drainage using trench drains and containment in accordance with Data Sheet 7-83, *Drainage and Containment Systems for Ignitable Liquids*.

2.2.3.3 Provide curbs or ramps at doorways and other openings between alcohol processing areas and non-liquid handling areas.

2.2.3.3.1 Provide curbs around the perimeter of solid mezzanines with alcohol holdup in vessels.

2.2.3.4 Arrange exterior ignitable liquid operations or storage to prevent released liquids from exposing important equipment or buildings.

2.3 Occupancy

2.3.1 Housekeeping

2.3.1.1 Establish and implement a housekeeping program for ignitable liquids in accordance with Data Sheet 7-32.

2.3.1.2 Establish and implement a housekeeping program for combustible dusts in accordance with Data Sheet 7-76. Manual housekeeping activities are not considered a replacement for dust mitigation devices or equipment.

2.3.1.3 Provide sufficient engineering controls (e.g., tight equipment design, provision of industrial exhaust systems) to prevent the liberation of combustible dust or vapors that may result in residues deposited on buildings or equipment.

2.3.1.3.1 Design and install industrial exhaust systems in accordance with Data Sheet 7-78, *Industrial Exhaust Systems*.

2.3.2 Ventilation

2.3.2.1 Provide continuous low-level mechanical exhaust ventilation in all buildings where liquids with a closed cup flash point less than 100°F (38°C) are handled or produced.

2.3.2.1.1 Arrange ventilation as follows:

A. Provide suction points within 12 in. (0.3 m) of the floor.

B. Locate suction points at open tank lips, near equipment or dispensing areas (e.g., distillation column, doubler/thumper, condenser), and in any pits where flammable vapors may collect.

C. Provide low-level, fresh, make-up air, remote from the suction points.

D. Discharge exhaust outside the building.

E. Arrange the ventilation system for continuous operation and monitoring, so that any loss of ventilation will be promptly detected.

F. Provide a visual or audible failure alarm at an occupied location when any loss of ventilation is detected.

2.3.2.1.2 Design overall room ventilation rate to provide 1 cfm/ft^2 (0.3 m^3/min/m^2), including individual suction points for equipment.

2.4 Protection

2.4.1 General

2.4.1.1 Install automatic sprinklers in accordance with Data Sheet 2-0, *Installation Guidelines for Automatic Sprinklers*.

2.4.1.2 Protect loading and unloading stations for ignitable liquids in accordance with Data Sheet 7-32.

2.4.1.3 Protect equipment with an identified equipment explosion hazard in accordance with Data Sheet 7-32.

2.4.2 Distillery Operations

2.4.2.1 Install non-storage automatic sprinkler protection over all areas with combustible construction, combustible equipment (e.g., wooden or plastic tanks) and in-process storage of combustibles.

2.4.2.1.1 Design sprinklers in accordance with Data Sheet 3-26, *Fire Protection for Nonstorage Occupancies*, depending on the hazard classification of the occupancy.

2.4.2.1.2 Protect mashing and fermenting areas as a HC-2 occupancy in accordance with Data Sheet 3-26.

2.4.2.2 Install sprinklers under combustible tanks that contain non-ignitable liquids with a width or diameter greater than 3 ft (0.9 m) or an area greater than 10 ft^2 (0.9 m^2).

2.4.2.3 Design and install automatic sprinklers in areas handling or processing ignitable liquids (i.e., still houses, barrel dumping, tank rooms and bottling) in accordance with Data Sheet 7-32.

2.4.2.3.1 In distillation operations with intermediate, solid mezzanine levels, provide sprinklers in accordance with Data Sheet 7-32.

2.4.2.3.2 In distillation operations with intermediate, grated mezzanine levels, provide sprinklers in accordance with the following:

- Under the first tier of grated mezzanine above the floor, provide a 0.30 gpm/ft^2 (12 mm/min) over 50% of the ceiling demand area or the size of the mezzanine, whichever is smaller.
- For each grated mezzanine between the first tier above the floor and the ceiling, provide a 0.15 gpm/ft^2 (6 mm/min) over 50% of the ceiling demand area or the size of the mezzanine, whichever is smaller.

2.4.2.3.3 For finished product bottling operations arranged to automatically shut down all liquid flow in the event of a fire, design automatic sprinklers to provide a density of 0.2 gpm/ft^2 (8 mm/min) over an operating area of 3000 ft^2 (278 m^2), using ordinary temperature, K5.6 (K80) sprinklers.

2.4.2.4 Provide a 500 gpm (1900 L/min) hose stream allowance.

2.4.2.5 Design the water supply to provide full demand for 60 minutes.

2.4.3 Empty Wooden Barrel Storage

2.4.3.1 Protect indoor storage of empty wooden barrels with a moisture content greater than or equal to 8% as a Class 1 commodity in accordance with Data Sheet 8-9, *Storage of Class 1, 2, 3, 4 and Plastic Commodities*.

2.4.3.2 Protect indoor storage of empty wooden barrels with a moisture content of less than 8% as a Class 3 commodity in accordance with Data Sheet 8-9, *Storage of Class 1, 2, 3, 4 and Plastic Commodities*

2.4.3.3 Provide exposure protection or space separation for outdoor storage of empty wooden barrels in accordance with Data Sheet 1-20.

2.5 Equipment and Processes

2.5.1 General

2.5.1.1 Arrange equipment controls in accordance with Data Sheet 7-110, Industrial Control Systems.

2.5.1.2 Design and install tanks containing ignitable liquids and ignitable liquid transfer systems in accordance with Data Sheet 7-32.

2.5.1.3 Design and install pressure vessels in accordance with Data Sheet 12-2, *Vessels and Piping*, as well as applicable codes, standards, state and local laws and regulations.

2.5.1.4 Design and arrange loading/unloading stations for ignitable liquids in accordance with Data Sheet 7-32.

2.5.2 Distillation Operations

2.5.2.1 Where a room/building explosion hazard exists, provide lower explosive limit (LEL) detection, arranged as follows:

A. Use point LEL detectors.

B. Locate LEL detectors at floor level, next to the pot still/column, on solid mezzanines around the still/column, near the condenser, near the doubler/thumper and at the entrance to building ventilation systems.

C. Arrange the detector to alarm at a maximum of 20% of the LEL and to provide an alarm at a constantly attended location.

D. Interlock the pot still and/or distillation column with the LEL detection to initiate an automatic controlled shutdown that includes deenergizing the distillation operation and stopping liquid feeds at 25% of the LEL.

E. Provide vacuum relief to prevent equipment implosions, if deenergizing the distillation operation will create a vacuum in the equipment.

2.5.2.2 Arrange alcohol streams from the still operation to discharge in areas designed for ignitable liquid operations. For example, do not discharge heads or tails into the beer well.

2.5.3 Stills

2.5.3.1 Provide a vacuum relief device piped outdoors to a safe location.

2.5.3.2 Provide a pressure relief device piped outdoors to a safe location.

2.5.3.3 Where a still operates at or below atmospheric pressure, provide an emergency relief vent in accordance with Data Sheet 7-32.

2.5.3.4 Arrange any relief valves or emergency venting devices to discharge in accordance with Section 2.5.3.5.

2.5.3.4.1 Where an engineered collection system for relief valve discharge is required, refer to Data Sheet 7-49, *Emergency Venting of Vessels*.

2.5.3.5 If provided, install condenser vents as follows:

A. Pipe vents to outdoor locations.

B. Size vents to discharge the maximum vapor generation possible at zero feed and maximum heating within the pressure limitations of the protected equipment.

C. Terminate vents a minimum of 20 ft (6.1 m) above the ground and a minimum of 6 ft (1.8 m) above roof level.

D. Locate vents so that vapor will not re-enter the building.

E. Provide flame arrestors for vent terminals.

2.5.3.6 Provide a temperature control system using one of the following options:

A. Interlock the heating supply to shut down and sound an audible alarm when cooling-water failure is detected.

B. Provide standby pumps or gravity supplies of cooling water.

2.5.3.7 For steam-heated stills, provide a pressure relief valve on the steam supply, downstream of the reducing valve, with a setting of 5 to 10 psi (0.3 to 0.7 bar) above the normal operating pressure.

2.5.3.7.1 If the steam heating system is designed for a working pressure equal to or greater than the maximum main line steam pressure upstream of the reducing valve, a pressure relief valve is not needed.

2.5.3.8 Provide high- and low-liquid level switches, interlocked to stop feed pumps and sound an alarm on equipment with alcohol concentrations greater than 20% ABV.

2.5.3.9 Provide a high-temperature sensor, interlocked to sound an audible alarm and shut off the heating supply if temperature exceeds 50°F (30°C) above the normal operating temperature of the unit.

2.5.3.10 Provide a manual means (e.g., buttons, switches, levers, etc.) to initiate a controlled shutdown at a constantly attended remote location.

2.5.3.11 Where gauges are needed, use FM Approved gauging devices. Protect the glass against mechanical damage.

2.5.3.12 Provide armored rotameters and specific gravity indicators where possible, or with other instrumentation not subject to accidental breakage or leakage.

2.6 Operation and Maintenance

2.6.1 Purge process tanks, stills and other equipment containing ignitable liquids with steam or an inert gas before opening for inspection or repair.

2.6.1.1 Wash equipment with water or other non-hazardous liquid following purging.

2.6.1.2 Confirm that a flammable atmosphere is not present in tanks or vessels that could contain methane-producing bacteria prior to inspection or repair.

2.6.1.3 Apply line breaks or other positive isolation procedures where necessary to prevent inadvertent admission of flammable vapors into vessels undergoing inspection or repair.

2.6.2 Develop standard operating procedures (SOPs) and emergency operating procedures (EOPs) for distillery operations, based upon manufacturer's operations and maintenance manuals, industry best practice guidelines, site experience and/or process safety findings. At a minimum, include the following:

- Cold-start, hot-restart and normal shut down (SOP)
- Emergency shutdown procedure (EOP)
- Restart after automatic trip or emergency shutdown (EOP)
- Operator equipment walkdowns (SOP)
- Normal operational procedures (i.e., sampling, clean-in-place, etc.)
- Jumper/force management (SOP)
- Abnormal or upset conditions (EOP)
- Loss of support systems such as cooling water, electricity, process gases, pollution control system, etc. (EOP)
- Safe process shutdown in the event of fire (EOP)

2.6.3 Create an asset integrity program in accordance with Data Sheet 9-0, *Asset Integrity*, that includes important production equipment (stills, etc.), support systems and site-owned/responsible utilities.

2.6.4 Maintain pressure vessels, tanks and piping systems in accordance with Data Sheet 12-2.

2.6.5 Maintain and inspect process instrumentation and interlocks in accordance with Data Sheet 7-45, *Safety Controls, Alarms and Interlocks*.

2.7 Training

2.7.1 Create a training program for all employees who work in or have access to areas containing or processing special hazards in accordance with the following data sheets.

A. Data Sheet 7-32 for handling and processing ignitable liquids

B. Data Sheet 7-76 for handling and processing combustible dusts

C. Data Sheet 10-3, *Hot Work Management*

D. Data Sheet 10-8, *Operators*

2.7.2 Provide training for new employees (including operators, emergency response team members and security personnel), as well as refresher programs (as needed) for current employees.

2.8 Human Factor

2.8.1 Create an emergency response plan in accordance with Data Sheet 10-1, *Pre-Incident and Emergency Response Planning*, and the following data sheets, depending on the specific hazards.

A. Data Sheet 7-32 for handling and processing ignitable liquids

B. Data Sheet 7-76 for handling and processing combustible dusts

2.9 Ignition Source Control

2.9.1 Provide FM Approved, hazardous location rated electrical equipment in accordance with Table 2.9.1.

Table 2.9.1. Electrical Equipment Ratings

Area	*Required Rating*
Mashing and Fermenting	Ordinary
Distillation, Tank Rooms, Barrel Dumping and Filling, Bottling	In accordance with Data Sheet 7-32

2.9.2 Electrically bond and ground equipment handling ignitable liquid heated (by environment or process conditions) to or above its flash point in accordance with Data Sheet 5-8, *Static Electricity*, Data Sheet 5-19, *Switchgear and Circuit Breakers*, and Data Sheet 5-20, *Electrical Testing*.

3.0 SUPPORT FOR RECOMMENDATIONS

3.1 General

3.1.1 Types of Distilleries

Distilleries can be categorized by size, equipment and operational complexity, with variations based on geographic location and cultural tradition. At the smallest scale, craft or micro-distilleries are often independently owned and focus on small-batch, high-quality spirits. These distilleries typically use traditional equipment like copper pot stills, open-top fermenters and manual bottling lines. Hazards in these settings include a higher risk of fire or explosion due to manual handling of flammable ethanol vapors and limited automation.

Medium-sized distilleries bridge the gap between craft and industrial operations. They often use a mix of pot and column stills, with partial automation to improve consistency and safety. These distilleries face moderate hazards, including mechanical risks from semi-automated equipment and chemical exposure from cleaning agents.

At the largest scale, industrial or commercial distilleries produce hundreds of thousands to millions of cases annually. These facilities typically use continuous column stills, closed fermentation tanks and fully automated systems. While automation reduces some manual hazards, the scale introduces new risks such as high-pressure systems, large volumes of flammable materials and significant environmental impacts like wastewater and emissions.

Geography can play a crucial role in shaping distillery design and operation. In Scotland, whiskey distilleries commonly use traditional pot stills and age spirits in oak barrels for years in cool, damp climates, which slows maturation and enhances complexity. In contrast, Caribbean rum distilleries benefit from warm, humid conditions that accelerate aging and influence flavor. Japanese distilleries often blend Scottish techniques with meticulous attention to water purity and fermentation control, producing refined whiskies with a distinct character. Meanwhile, emerging distilleries in Africa and Oceania may experiment with local grains, fruits and botanicals, often combining traditional methods with modern sustainability practices.

Table 3.1.1 summarizes common characteristics for each of the different distilleries.

Table 3.1.1. Common Characteristics for Different Distillery Types

Category	*Craft/Micro-Distillery*	*Medium-Sized Distillery*	*Industrial/Commercial Distillery*
Ownership	Independent, local	Regional or national	Corporate, global
Focus	Artisanal quality, innovation	Balance of tradition and efficiency	High-volume, consistency
Stills Used	Copper pot stills	Hybrid (pot + column) stills	Continuous column stills
Fermentation	Open-top, small batch	Stainless steel tanks	Large, closed automated tanks
Bottling	Manual or semi-automated	Semi-automated	Fully automated, high-speed lines
Aging Facilities	Small barrel rooms	Medium warehouses	Climate-controlled rickhouses

3.1.2 Fire and Explosion Hazards in Distilleries

Process fire and explosion hazards are present during distilling but are considered negligible during mashing and fermenting.

Ignitable liquid hazards are also present in varying degrees in the different distilled-liquor handling areas. The flash and fire points of alcohol/water mixtures are shown in Figure 3.1.2.

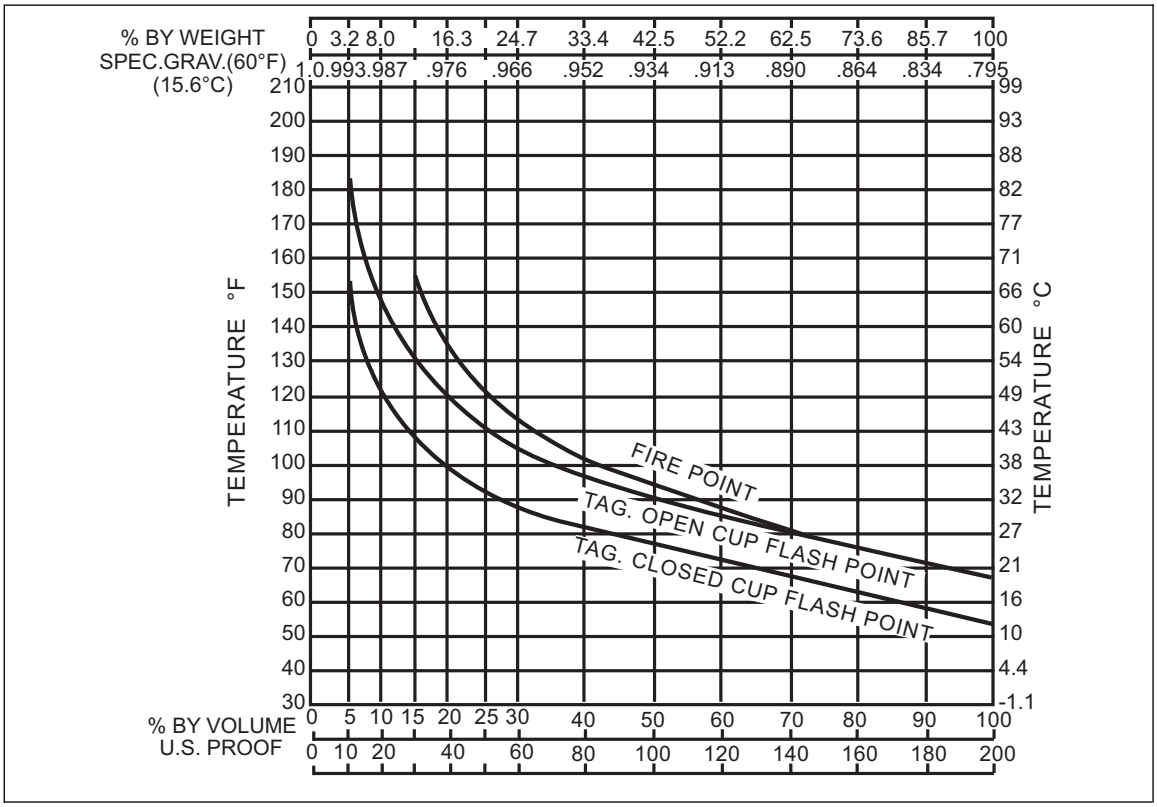

Fig. 3.1.2. Flash and fire points of alcohol/water mixtures

Ethanol is water-miscible and has a lower heat of combustion and radiant heat energy than some other ignitable liquids of equivalent flashpoint. The quantity of water needed to extinguish fires in alcohol-water mixtures depends upon the temperature of the liquid above its fire point and the effectiveness of mixing. Additional information on water-miscible liquids can be found in Data Sheet 7-32A, *Ignitable Liquid Evaluation and Classification*.

Bottled distillery products vary in alcohol by volume content as shown in Table 3.1.2.

Table 3.1.2. Alcohol by Volume (ABV) Content of Various Distilled Products

Distilled Product	*U.S. Proof*	*ABV, % by volume*
Whiskeys	80-100	40-50
Gins	80-95	40-47½
Vodkas	80-100	40-50
Rums	80-140	40-70
Brandies	80-140	40-70
Cordials, Liqueurs	40-100	20-50
Cocktails	20-100	10-50
Alcohol (Neutral Spirits)	110-192	55-96

4.0 REFERENCES

4.1 FM Data Sheets

Data Sheet 1-20, *Protection Against Exterior Fire Exposure*
Data Sheet 1-44, *Damage-Limiting Construction*
Data Sheet 2-0, *Installation Guidelines for Automatic Sprinklers*
Data Sheet 3-26, *Fire Protection for Nonstorage Occupancies*
Data Sheet 5-8, *Static Electricity*
Data Sheet 5-19, *Switchgear and Circuit Breakers*
Data Sheet 5-20, *Electrical Testing*
Data Sheet 7-2, *Waste Solvent Recovery*
Data Sheet 7-29, *Ignitable Liquid Storage in Portable Containers*
Data Sheet 7-32, *Ignitable Liquid Operations*
Data Sheet 7-32A, *Ignitable Liquid Evaluation and Classification*
Data Sheet 7-45, *Safety Controls, Alarms, and Interlocks*
Data Sheet 7-49, *Emergency Venting of Vessels*
Data Sheet 7-76, *Combustible Dusts*
Data Sheet 7-78, *Industrial Exhaust Systems*
Data Sheet 7-83, *Drainage and Containment Systems for Ignitable Liquids*
Data Sheet 7-88, *Outdoor Ignitable Liquid Storage Tanks*
Data Sheet 7-110, *Industrial Control Systems*
Data Sheet 7-111A, *Fuel-Grade Ethanol*
Data Sheet 8-9, *Storage of Class 1, 2, 3, 4 and Plastic Commodities*
Data Sheet 9-0, *Asset Integrity*
Data Sheet 10-1, *Pre-Incident and Emergency Response Planning*
Data Sheet 10-3, *Hot Work Management*
Data Sheet 10-8, *Operators*
Data Sheet 12-2, *Vessels and Piping*

APPENDIX A GLOSSARY OF TERMS

Alcohol by Volume (ABV): The standard measure of the volume of alcohol contained in a volume of an alcoholic beverage, expressed as a percent.

Combustible Dust: Organic materials such as wood, paper, rubber, plastics, fiber, food and tobacco, along with other materials such as metals, which exist in the form of particles less than 500 µm in the largest dimension.

Condenser: A heat exchanger which is used to cool and condense alcohol or spirt vapor after production in the still.

Condenser Vent: A small opening on the condenser that allows unwanted gases to escape. This vent increases the efficiency of the condenser by keeping the alcohol vapor flow smooth during distillation.

Distillation: The process of taking a fermented beverage, such as beer or wine, and separating the alcohol from it to create whiskey, vodka, gin or any other hard liquor or spirits.

Distilled-Liquor Handling: The processes that occur after distillation, including blending and bottling.

Distilled Spirits: An alcoholic beverage distilled from grains, fruits or other fermentable ingredients.

Doubler: A vessel where condensed alcohol from the still is boiled for the final stage of distillation.

Fermenting: The process where sugars are converted by yeast to alcohol, carbon dioxide and heat.

Mash: Any material that can be used, or intended for use, in the fermenting process.

Mashing: The start of the brewing process where crushed grains are mixed with water to form the mash.

Proof: The ethyl alcohol content of a liquid at 60°F (15.5°C), stated as twice the percent of alcohol by volume (ABV).

Regauging: The process of remeasuring the contents of a cask to confirm the number of liters remaining in the cask and the alcohol by volume.

Rickhouse: (Also known as a rack house or barrel house.) A specialized warehouse used for aging distilled spirits, primarily whiskey, in wooden barrels.

Seal Pot: A safety device used to accomplish emergency relief venting and, in some cases, vacuum relief venting of stills.

Still: A piece of equipment that separates alcohol vapor from a liquid mixture and then converts the vapor to a higher proof alcohol.

- A Pot Still is a traditional distillation device used to produce spirits like whiskey and rum. Made typically of copper, it operates in batches and consists of a large pot, a swan neck, and a condenser. As the fermented liquid is heated, alcohol vapors rise, condense, and are collected as a distilled spirit. In a two-still process, a wash still is used in the first distillation of the mash, also known informally as beer, to produce low wine, which is then sent to the spirit still where the semi-finished spirit is produced.
- A Column Still, also known as a continuous still, is a modern distillation apparatus used to produce large quantities of high-purity spirits like vodka, gin and some types of whiskey. Unlike pot stills, it operates continuously, allowing fermented liquid to be fed in and distilled product to be drawn off without stopping. It consists of tall columns with plates or trays that separate alcohol from other components more efficiently.

Still House: The area of the distillery or facility where the distillation process takes place.

Stillage: The liquid and solid residue that remains after the fermentation and distillation of a mash or other substance.

Thumper: A vessel used to perform a final stage of distillation by sparging alcohol vapor from the still through a level of liquid alcohol.

Wines, low and high are different stages of the distillate:

- Low wines are the result of the first distillation in a pot still. They typically contain around 20–30% ABV and include a mix of alcohol, water and various flavor compounds. These are not yet suitable for consumption and are usually distilled again.
- High wines are produced during the second distillation or after final stages like thumpers or doublers. This run separates the desirable portion of the alcohol from the undesirable parts. High wines have a higher ABV and are much purer, forming the base of the final spirit that will be aged or bottled.

APPENDIX B DOCUMENT REVISION HISTORY

The purpose of this appendix is to capture the changes that were made to this document each time it was published. Please note that section numbers refer specifically to those in the version published on the date shown (i.e., the section numbers are not always the same from version to version).

April 2026. This document has been completely revised. Significant changes include the following:

A. Removed the recommended separation distance for distillation operations with an explosion hazard. Previous guidance recommended a separation distance of 100 ft (31 m).

B. Revised guidance on fire-rated construction in Section 2.2.1.2 to include only distillation, boilers, dry material handling and warehouses.

C. Revised guidance for protection of load bearing steel members and exposed steel equipment supports in Section 2.2.1.3. Steel protection in accordance with Data Sheet 7-32, *Ignitable Liquid Operations*, is recommended in areas where liquids with greater than 70% alcohol by volume (ABV) may be present.

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M. Revised guidance for ignition source control in Section 2.9. The updated recommendations are in accordance with Data Sheet 7-32.

January 2010. Minor editorial changes were made for this revision.

January 2000. This revision of the document has been reorganized to provide a consistent format.

This document does not have any revision history.

APPENDIX C DISTILLED SPIRITS PRODUCTION PROCESS

C.1 General

Distilleries primarily produce whiskeys, gins, vodkas, rums, brandies and similar beverages. Industrial grain alcohol, denatured alcohol and stock feed are by-products.

Distilled spirits production is based on the principle that ethanol boils at a lower temperature than water. The basic steps in the production of distilled spirits are mashing and fermenting, distillation, and distilled-liquor handling as shown in Figure C.1.

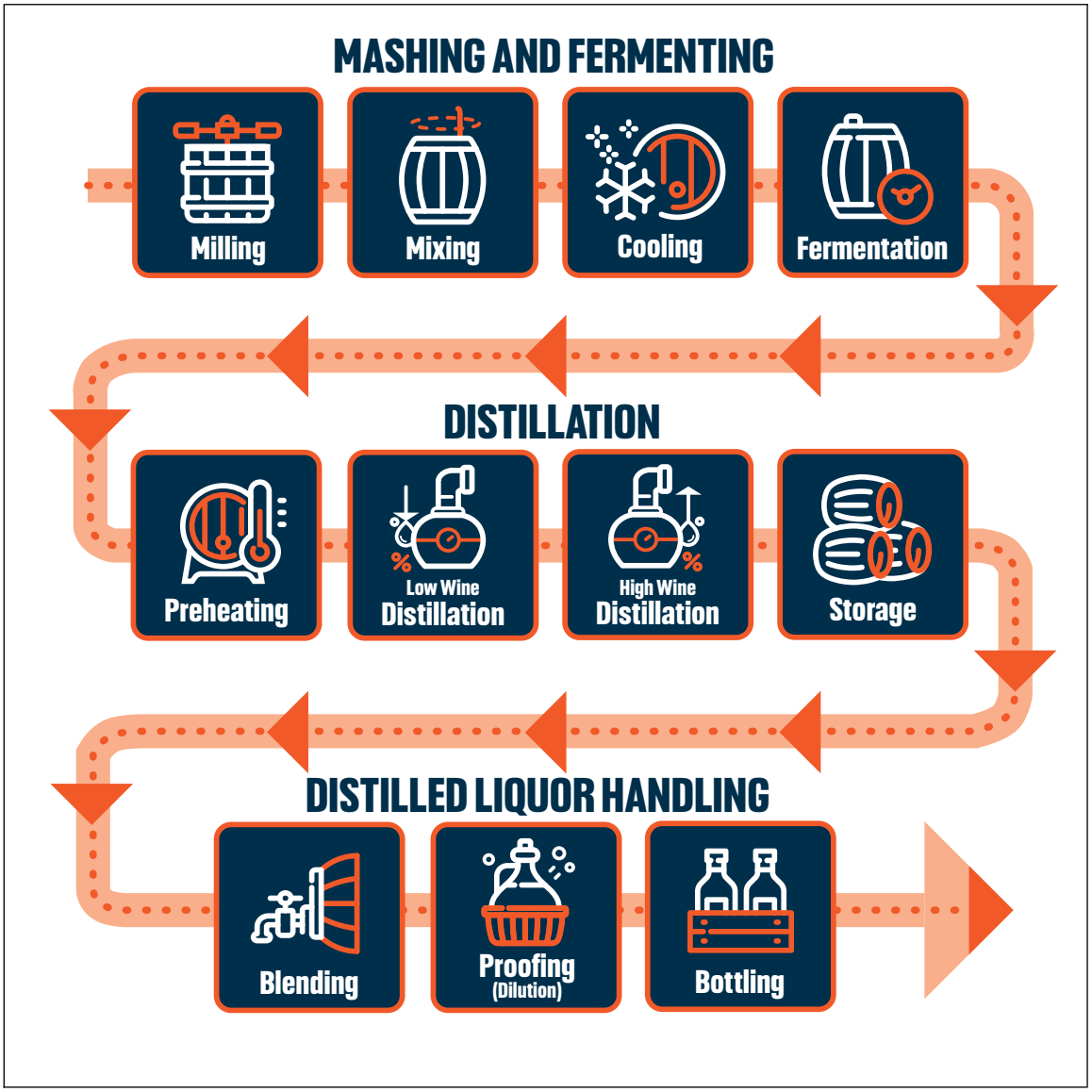

Fig. C.1. Distilled spirits production flow diagram

C.2 Mashing and Fermenting

The mashing process in distillation involves converting starches from grains into fermentable sugars. This process begins by milling the grains to break them down, then mixing them with hot water to create a mash. The heat activates enzymes which break down the starches into simpler sugars. Once the starches are fully converted, the mash is cooled and transferred to fermentation tanks where yeast is added to begin the fermentation process.

The fermentation process uses yeast to convert sugars from the mash into alcohol and carbon dioxide. The yeast consumes sugars, producing alcohol and carbon dioxide as byproducts. This process typically takes several days, during which the temperature and pH levels are carefully monitored to ensure optimal fermentation. After fermentation is complete, the resulting liquid, known as ″wash″ or ″beer,″ is ready for distillation. Though the process is nonhazardous, it is essential to the distilling operation. An interruption could cause production losses.

Fermenting tanks may be wood or steel with either closed or open tops. The capacity will vary. Fermenting houses are generally single-fire area buildings of various sizes and types of construction.

The flow diagram for grain preparation and fermentation is shown in Figure C.2.

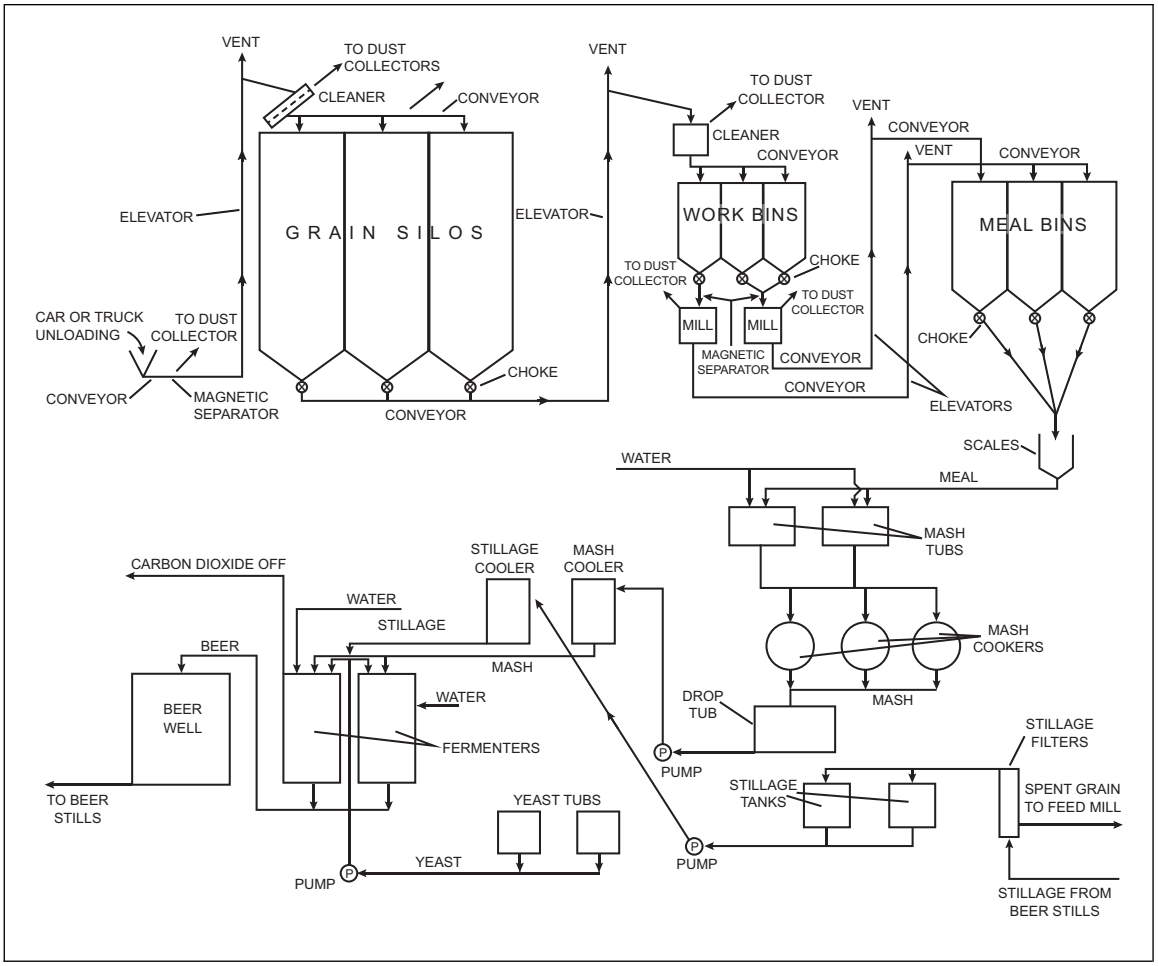

Fig. C.2. Flow diagram: grain preparation and fermentation

C.3 Distillation

The flow diagram for the distillation process is shown in Figure C.3. Distillation buildings are commonly the equivalent of several stories high and of various types of construction, with newer distilleries mostly using noncombustible construction. Because of the height of stills and rectifying columns, intermediate floors are usually limited to operating decks and platforms.

Distillation operations are usually continuous, except for some pot-still operations for producing gin and certain types of whiskey, or redistillation of off-grade products. Beer is pumped through preheaters to the top of a beer still. Vapors are condensed and the condensate or “low wine” (40 to 70% alcohol) flows to small receivers. The “low wine” is then pumped to storage tanks or directly to steam-heated rectifying columns or doublers for further concentration into “high wines” (55 to 75% alcohol) or commercial alcohol (95% alcohol). High wines (or alcohol) and by-products such as aldehydes and fusel oil are pumped to storage tanks. Residue from the beer still is pumped to tanks for sale or processing as a constituent of stock feed. Stills are steam heated. Some units involve vacuum distillation at lower temperatures. Vacuum and pressure-relief devices are usually provided. In some older facilities, they discharge into the still building, creating an explosion hazard.

C.4 Distilled-Liquor Handling

After distillation, the liquor is usually handled in separate buildings or fire areas. Adequate cutoffs are typically provided, particularly in newer distilleries.

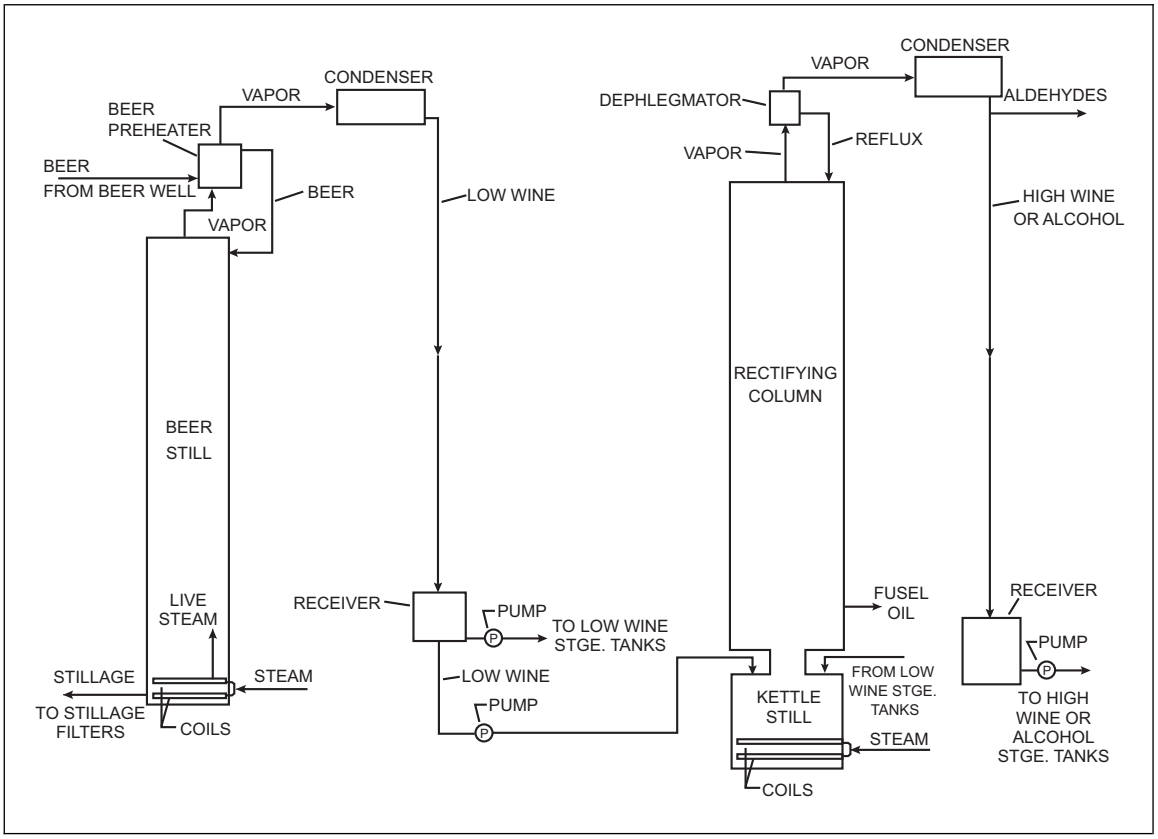

Fig. C.3. Simplified flow diagram: distilling

C.4.1 Wine-Tank Room

Raw spirits from the still buildings are usually stored temporarily in black iron, tin-lined copper or stainless-steel tanks of varying capacities in the wine-tank room or closed receiver building.

High-wine tanks and weigh tanks are typically made of black iron or lightweight tin-lined copper or stainless-steel. They vary in capacity from a few hundred to several thousand gallons. Although these tanks have locked covers, sealed valves and fittings, they may not be airtight, particularly in older facilities. Sampling for proof and gauging may be through manholes.

Tanks may be equipped with long, unprotected gauge glasses. Many elevated tanks are on wood or unprotected steel supports.

C.4.2 Cistern Room

After quality-control tests, the spirits are pumped to tanks of similar construction (except for black iron) in the cistern room. The primary process in the cistern room is reducing the alcohol content to the desired proof by adding distilled water. After the alcohol content is reduced, the spirits are typically transferred into various containers for storage and distribution. The final product is put into a variety of containers, including barrels. Filling can be by gravity flow or pumping with a valve arranged to shut off when the container is full. Leakage may occur if the filling equipment is not properly maintained.

C.4.3 Blending and Bottling

Spirits are usually blended by dumping barrels of aged spirits into troughs with screened outlets, from which they flow or are pumped into large storage tanks. Spirits from blending tanks or bonded storage are usually pumped into elevated, bottle-filling tanks at the bottling plants. Bottles are filled by gravity and vacuum.

Tanks in all the above processes have varying degrees of vapor tightness. Regulations require tanks and lines to be completely emptied of liquid, so bottom connections and centrifugal pumps are generally used.