

## Section I: Introduction

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Ethanol is an organic chemical used in medical products, industrial solvents, alcoholic beverages, and many other applications. In recent years, ethanol has been used increasingly in motor vehicle fuels, and this particular use now dominates the demand for ethanol in the United States. The ethanol manufacturing industry has changed considerably and rapidly in response to this increased demand:

- Between 2000 and 2010, the number of ethanol manufacturing facilities in the U.S. nearly quadrupled.
- Over the same time frame, total nationwide ethanol production increased more than eight-fold. In 2010, U.S. facilities manufactured more than 13 billion gallons of ethanol, compared to just over 1.6 billion gallons in 2000.
- Corn is currently the primary feedstock for most ethanol production. However, to meet demands for alternative fuels, ongoing research and development is investigating how to manufacture ethanol from a much broader array of feedstocks.

As with any growing industry, it is important to ensure that health and safety management procedures keep up with the changing profile of the underlying manufacturing processes. This OSHA Technical Manual (OTM) chapter was prepared to educate readers about some of the safety and health hazards associated with the current and anticipated future production technologies for ethanol manufacturing facilities in the United States.

Information in this OTM chapter is organized as follows:

- [Section II](#) presents a profile of the U.S. ethanol manufacturing industry and describes the most commonly used production technologies.
- [Section III](#) identifies selected safety and health hazards associated with ethanol manufacturing.
- [Section IV](#) identifies some of the controls (engineering, administrative and personal protective equipment) typically used to prevent or mitigate these hazards.
- [Section V](#) outlines emergency planning requirements.
- [Section VI](#) discusses inspecting/investigating ethanol processing facilities.
- [Appendix A](#) summarizes hazards and controls discussed in this OTM chapter.
- [Appendix B](#) is a list of some of the OSHA standards relevant to ethanol manufacturing facilities.
- [Appendix C](#) reviews safe entry requirements for aboveground storage tanks.
- [Appendix D](#) discusses various options for producing ethanol from cellulosic materials.
- Last are the [references](#) and [glossary](#) sections, respectively. The glossary is a list of definitions for all terms shown in bold.

The contents of this OTM chapter reflect conditions in the ethanol manufacturing industry at the time of its composition. It is likely that this industry will continue to change in the future, particularly as viable production technologies are developed for feedstocks other than corn. General information is presented on production processes likely to be found at most ethanol manufacturing facilities. However, process design and safety systems are expected to vary from one facility to the next. An *extensive* account of unit operations and safety and health hazards for ethanol manufacturing facilities is presented, but should not be viewed as a *comprehensive* compilation of the equipment and hazards that exist at every facility in this industry.

In addition to complying with the requirements of the Hazard Communication Standard (HCS; [29 CFR 1910.1200](#)) when hazardous chemicals exist in the workplace, ethanol processing facilities must also be evaluated to determine if the requirements of the Process Safety Management of Highly Hazardous Chemicals standard (PSM; [29 CFR 1910.119\(a\)\(1\)\(i\)&\(ii\)](#)) apply. PSM requirements must be implemented when a process involves a highly hazardous chemical at or above the specified threshold

quantities, listed in [Appendix A of the standard](#) and/or involves 10,000 pounds or more of a flammable gas or liquid (e.g., ethanol, gasoline). However, there is an exemption ([OSHA, 1997](#)) for flammable liquids stored in atmospheric tanks or transferred and kept below their normal boiling point without the benefit of chilling or refrigeration. This exemption is applicable to flammable liquids in tanks, containers and pipes used only for storage and transfer. Similarly, *stored* flammable liquids in containers, including cans, barrels and drums are exempt from coverage by the PSM standard.

Process means any activity involving a highly hazardous chemical including any use, storage, manufacturing, handling, or on-site movement of such chemicals, or any combination of these activities. For purposes of this definition, any group of vessels which are interconnected and separate vessels which are located such that a highly hazardous chemical could be involved in a potential release, shall be considered a single process. Citations under [29 CFR 1910.119](#) will continue to be issued when the quantity of flammables in the process, not counting atmospheric storage, exceeds 10,000 pounds, or where the quantities in storage do not fall within the exception for other reasons (i.e., non-atmospheric storage, storage that relies on refrigeration, quantities in process and not actually in storage). [29 CFR 1910.119 Appendix C](#) provides non-mandatory compliance guidelines and recommendations for PSM.