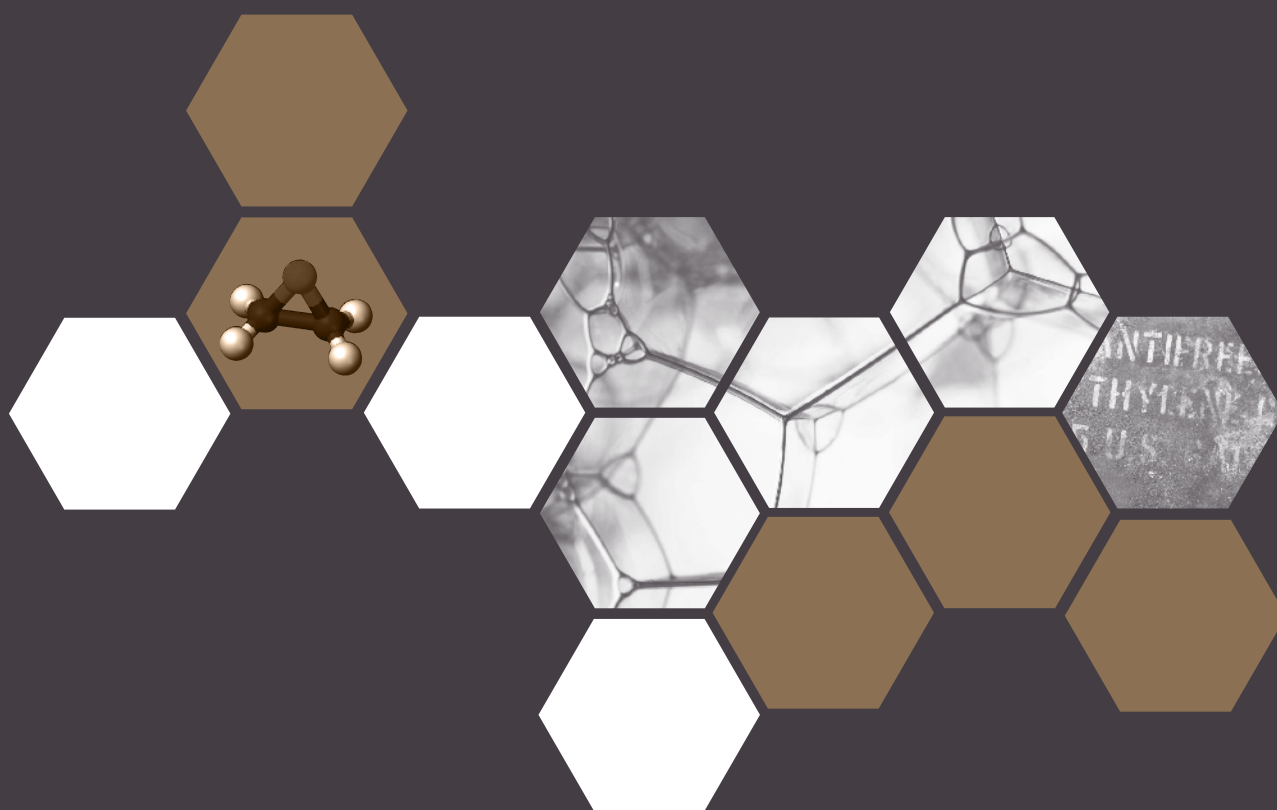


ethyleneoxide

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To the Reader

Manual Preparation

As members and affiliated companies of the American Chemistry Council, we support efforts to improve the industry's responsible management of chemicals. To assist in this effort, the American Chemistry Council's Ethylene Oxide/Ethylene Glycols Panel supported the creation and publication of this manual. The Panel is comprised of the following companies:

Balchem Corporation/ARC Specialty Products

BASF Corporation

Bayer Material Science LLC

Celanese Ltd.

Champion Technologies

Croda, Inc.

The Dow Chemical Company

Eastman Chemical Company

Honeywell

Shell Chemical LP

The development of this manual was led by the Panel's Ethylene Oxide Safety Task Group (EOSTG), a group comprised of producers and users of ethylene oxide. The EOSTG functions to generate, collect, evaluate and share information to support product stewardship with regard to ethylene oxide. The EOSTG formed a manual work group, chaired by Keith Vogel of Lyondell Chemical Company, to lead the development of this document. The following work group members provided significant contributions:

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11.0 Selected Regulations

11.1 Introduction

This Chapter is provided solely as background information and is not intended to substitute for up-to-date research should a specific legal question arise. It also is not intended to be a statement of legal requirements when using or handling EO. Please consult with qualified experts regarding compliance with all applicable laws and regulations. Although this Chapter is believed to be accurate, no warranty, expressed or implied, is made concerning the contents.

The following federal regulations are not represented as inclusive of all U.S. federal regulations that apply to manufacturing and handling EO. The list specifically does not include:

- Federal regulations promulgated after the Chapter was updated; and
- State and local regulations.

11.2 Regulations — Numerical with Subject Listed

Internal Revenue — Internal Revenue Service

26 CFR Part 52 — Environmental taxes.

.4682-3 — EO/CFC-12 is included on the list of imported taxable products. The EO/CFC-12 mixture is used in example 3 of this Section.

Labor — Occupational Safety and Health Administration (OSHA)

29 CFR Part 1910 — Occupational safety and health standards.

.19(h) — Applies the standards in 29 CFR Section 1910.1047 to the exposure of every employee to EO in every employment and place of employment covered by Sections 1910.12 (construction work), 1910.15 (shipyard employment), and 1910.16 (longshoring and marine terminals), in lieu of any other EO exposure standard that would otherwise be applicable.

Appendix A to Section 119 — List of highly hazardous chemicals, toxics and reactives. The appendix contains a listing of toxic and reactive highly hazardous chemicals that present a potential for a catastrophic event at or above the threshold quantity (TQ). EO is listed, and the TQ is 5,000 pounds.

.178(c)(2)(i) — Prohibits use of power-operated industrial trucks in atmospheres containing hazardous concentration of EO.

.1000 —

Table Z-1 — Lists limits for air contaminants and refers to 29 CFR Section 1910.1047 for EO limits.

.1047 —

- (a) Specific regulation covering all exposure scenarios to EO except those below the action level (still requires retention of objective data for exempted operations).
- (b) Establishes action level of 0.5 ppm, 8-hour time-weighted average (TWA).
- (c) Establishes permissible exposure limits of 1 ppm, 8-hour TWA and 5 ppm excursion limit (15-minute average).
- (d) Requires exposure monitoring, including initial, periodic, and termination samples, and periodic sampling every 3 or 6 months, depending on exposure levels. Also includes standards for accuracy of monitoring and employee notification of monitoring results.
- (e) Requires establishment of regulated areas where EO concentrations may exceed 8-hour TWA or EO concentrations exceed or can reasonably be expected to exceed the excursion limit.
- (f) Delineates methods of compliance with exposure requirements including engineering controls (preferred) and personal protective equipment (PPE). Where the TWA or excursion limit is exceeded, requires employer to establish and implement compliance program.
- (g) Outlines approved respiratory protection and PPE.

- (h) Requires written emergency response plan, including employee alerting procedures, for each workplace where there is a possibility of an emergency.
- (i) Outlines mandated medical surveillance plan; required for all employees who are or may be exposed at or above the action level (0.5 ppm) for 30 days or more per year, without regard to respiratory protection, and for any employees exposed during an emergency event. Exams must be done prior to assignment to the work area, annually, at termination or reassignment, after an emergency exposure, and where symptoms of over-exposure exist or when the employee requests medical advice concerning the effects of current or past exposure on reproductive capabilities.
- (j) EO hazards communication requirements include signs at demarcation zone, precautionary labels on containers, developing MSDSs as required, and initial and annual employee training programs.
- (k) Recordkeeping requirements include objective data to support exempted operations (retained as long as employer relies on the data), exposure measurements (30-year retention period) and medical surveillance records (duration of employment plus 30-year retention period).
- (l) Permits employee or designated representative to observe any monitoring of employee exposure.
- (m) Lists effective dates. All requirements took effect by December 6, 1988.
- (n) Appendices A, B, C, and D provide non-mandatory samples of an EO MSDS, technical guidelines, medical surveillance guidelines, and sampling and analytical methods, respectively.

29 CFR Part 1915 — Occupational safety and health standards for shipyard employment.

.1000 — Refers to 29 CFR Section 1910.1047 for EO limits.

.1047 — Applies the standards in 29 CFR Section 1910.1047 to shipyard employment.

29 CFR Part 1926 — Safety and health regulations for construction.

.55 —

Appendix A — 1970 American Conference of Governmental Industrial Hygienists' Threshold Limit Values of Airborne Contaminants. EO is included on the list, which refers to 29 CFR 1926.1147 for EO limits.

.64 —

Appendix A — List of highly hazardous chemicals, toxics and reactives. The appendix contains a listing of toxic and reactive highly hazardous chemicals which present a potential for a catastrophic event at or above the TQ. EO is listed and has a TQ of 5,000 pounds.

.1147 — Applies the standards in 29 CFR Section 1910.1047 to the construction industry.

National Defense — Department of the Army

32 CFR Part 627 — The Biological Defense Safety Program, technical safety requirements.

.31(d)(6) — The PPE requirements for gloves state that sterilization of nondisposable gloves either before use or before reuse is usually done with EO or formaldehyde gas. Sterilized gloves must be aerated in flowing sterile (filtered) air at 21°C or higher for a minimum of 24 hours prior to use to prevent skin burns and irritation from residual decontaminants.

.33(e) — Provides requirements for using vapors and gases as a method of decontamination. States that formaldehyde, EO, peracetic acid, betapropiolactone, methyl bromide, and glutaraldehyde have all been used successfully as space sterilants where they can be employed in closed systems and with controlled conditions of temperature and humidity. Of these, methyl bromide, beta-propiolactone, and glutaraldehyde are not recommended because of their toxic properties. Peracetic acid can readily decompose with explosive violence in a concentrated state and must be used only in a diluted state and with extreme care. Formaldehyde and EO are both regulated by OSHA for their potential human carcinogenicity, but do have permissible exposure levels (unlike

beta-propiolactone, for example) and can be used safely under controlled conditions.

(2) Provides specific requirements for EO. EO sterilization will only be conducted in a sterilizer designed for that purpose and designed to maintain potential exposure levels below the current OSHA standard. EO is effective against all microorganisms, including spores, molds, pathogenic fungi, and highly resistant thermophilic bacteria. All materials to be used in contact with human skin (for example, clothing, shoes, masks and adhesive tape) must be aerated for at least 24 hours after sterilization and prior to use. Concentrations of 500 to 1000 ppm are required for sterilization. Specific OSHA requirements for the use of EO are found in 29 CFR Section 1910.1047.

Navigation and Navigable Waters — U.S. Coast Guard (USCG)

33 CFR Part 126 — Handling of dangerous cargo at waterfront facilities.

.3 — Defines dangerous cargo to include all hazardous materials listed in 49 CFR Parts 170 through 179, which includes EO. Topics addressed by Part 126 include the designation of waterfront facilities, permits required for handling dangerous cargo, supervision and control of dangerous cargo, and conditions for conducting welding and hotwork.

33 CFR Part 127 — Waterfront facilities handling liquefied natural gas (LNG) and liquefied hazardous gas.

.1209 — Requires each waterfront facility handling LNG to provide respiratory protection equipment for each employee in the marine transfer area for LNG during the transfer of EO. The equipment must protect the wearer from EO's vapor for at least 5 minutes.

33 CFR Part 154 — Facilities transferring oil or hazardous material in bulk.

.105 — Defines hazardous material to include all hazardous materials listed in 49 CFR Parts 170 through 179, which includes EO. Requirements for facilities including operations manual and procedures, equipment requirements, facility operations, vapor control systems, and response plans for facilities.

33 CFR Part 160 — Ports and waterways safety — general.

.109 — District Commander or Captain of the Port may direct the handling, loading, unloading, storage, and movement (including the emergency removal, control and disposition) of explosives or other dangerous articles and substances on any structure on or in the navigable waters of the United States, or any land structure or shore area immediately adjacent to those waters. Also allows District Commander or Captain of the Port to conduct examinations to assure compliance with the safety equipment requirements for structures. Applies to DOT hazardous material, which includes EO.

Protection of Environment — U.S. Environmental Protection Agency (EPA)

40 CFR Part 52, Subpart O — Illinois.

.741 —

Appendix A — List of chemicals defining synthetic organic chemical and polymer manufacturing. Includes EO.

40 CFR Part 60 — Standards of performance for new stationary sources.

Subpart VV — Standards of performance for equipment leaks of volatile organic compounds (VOC) in the synthetic organic chemicals manufacturing industry (SOCMI).

.489 — Includes EO on list of chemicals that are produced, as intermediates or final products, by process units covered under this subpart. The applicability date for process units producing one or more of these chemicals is January 5, 1981.

Subpart III — Standards of performance for VOC emissions from the SOCMI air oxidation unit processes.

.617 — EO is included on the list of chemicals affected by Subpart III.

Subpart NNN — Standards of performance for VOC emissions from SOCMI distillation operations.

.667 — EO is included on the list of chemicals affected by Subpart NNN.

Subpart RRR — Standards of performance for VOC emissions from SOCMI reactor processes.

.707 — EO is included on the list of chemicals affected by Subpart RRR.

40 CFR Part 61 — National emissions standards for hazardous air pollutants (NESHAP).

.01 — Lists substances that, pursuant to Section 112 of the Clean Air Act (CAA), have been designated as HAPs. EO is listed and the *Federal Register* citation for the EO listing decision is 50 Fed. Reg. 40286 (Oct. 2, 1985).

40 CFR Part 63 — NESHAPs for source categories.

Subpart D — Regulations governing compliance extensions for early reductions of HAPs.

.74(f), Table 1 — List of high-risk pollutants. EO is listed with a weighting factor of 10.

Subpart E — Approval of state programs and delegation of federal authorities.

.99 — Lists the specific source categories that have been delegated to the air pollution control agencies in each state, including the following for EO: Alaska (EO sterilizers); Arizona (EO sterilization facilities); Idaho (EO sterilizers); Louisiana (EO sterilizers); Nevada (EO sterilization facilities); New Mexico (EO sterilizers); Oklahoma (EO sterilizers); Oregon (EO sterilizers); and Washington (EO sterilizers).

Subpart F — National emission standards for organic HAPs from the SOCM1.

Table 1 — Synthetic Organic Chemical Manufacturing Industry Chemicals. Lists EO in Group I.

Table 2 — Organic Hazardous Air Pollutants. Lists EO.

Table 4 — Organic Hazardous Air Pollutants Subject to Cooling Tower Monitoring Requirements in Section 63.104. Lists EO.

Subpart G — National emission standards for organic HAPs from the SOCM1 for process vents, storage vessels, transfer operations, and wastewater.

Table 9 — Organic HAPs Subject to the Wastewater Provisions for Process Units at New and Existing Sources and Corresponding Fraction Removed (Fr) Values. EO is listed with an Fr value of 0.98.

Table 34 — Fraction Measured (Fm) and Fraction Emitted (Fe) for HAP Compounds in Wastewater Streams. EO is listed with a Fm value of 1.00 and a Fe value of 0.50.

Table 36 — Compound Lists Used for Compliance Demonstrations for Enhanced Biological Treatment Processes. EO is included on List 2.

Subpart O — EO emissions standards for sterilization facilities.

.360 — All sterilization sources using one ton EO in sterilization or fumigation operations are subject to the emissions standards in Section 63.362, except as specified. Subpart O does not apply to EO sterilization operations at stationary sources such as hospitals, doctors' offices, clinics, or other facilities whose primary purpose is to provide medical services to humans or animals.

.361 — Defines sterilization facility as "any stationary source where ethylene oxide is used in the sterilization or fumigation of materials."

.362 — Provides standards for EO commercial sterilizers and fumigators for sterilization chamber vent, aeration room vent, and chamber exhaust vent.

.363 — List the compliance and performance provisions for owners and operators of sources subject to the EO emissions standard. Facilities must demonstrate continuous compliance with each operating limit and work practice standard required under this section, except during periods of startup, shutdown, and malfunction.

.364 — Lists monitoring requirements. Provides specific requirements for sterilization facilities using acid-water scrubbers, catalytic oxidation or thermal oxidation, or through the use of another control device. Requires computation of a 24-hour average daily and requires installation, calibration, operation, and maintenance of a monitor to measure EO.

.365 — Lists test methods and procedures for performance testing, efficiency determination at the sterilization chamber vent, concentration determination, efficiency determination at the aeration room vent (not manifolded), determination of baseline parameters for acid-water scrubbers, and compliance demonstration.

.366 — List reporting, construction and reconstruction, and notification requirements.

.367 — Owners or operators of a source subject to Section 63.362 must comply with the recordkeeping requirements in Section 63.10(b) and (c). All records required to be maintained must be maintained so that they can be readily accessed and are suitable for inspection. The most recent two years of records must be retained onsite or be accessible to an inspector while onsite. The records of the preceding three years, where required, may be retained offsite. Records may be maintained in hard copy or computer-readable form including on paper, microfilm, computer, computer disk, magnetic tape, or microfiche.

.368 — EPA or authorized authority, such as the applicable state, local, or tribal agency, can implement and enforce this Subpart.

Subpart U — NESHAPs: Group I polymers and resins.

.482 — “Epichlorohydrin elastomer” is defined as an elastomer formed from the polymerization or copolymerization of epichlorohydrin (EPI). The main epichlorohydrin elastomers include epi-ethylene oxide (EO) copolymer. Epoxies produced by the copolymerization of EPI and bisphenol A are not epichlorohydrin elastomers.

Table 5 — Known organic HAPs emitted from the production of elastomer products. Table provides elastomer products/subcategories for listed chemicals, including EO.

Subpart DD — NESHAPs from off-site waste and recovery operations.

Table 1 — EO is included on the list of HAPs, with a Method 305 fraction measure factor (fm 305) of 1.0.

Subpart JJ — National emission standards for wood furniture manufacturing operations.

Table 2 — List of volatile HAPs (VHAP). EO is included.

Table 4 — Pollutants excluded from use in cleaning and washoff solvents. EO is listed.

Table 6 — VHAP of potential concern. EO is listed with 0.09 tons per year de minimis value.

Subpart GGG — National emission standards for pharmaceuticals production.

Table 2 — Lists EO as a partially soluble HAP.

Table 8 — Lists 1.0 as the fraction measured (F_m) for EO in wastewater streams.

.1423 —

“Epoxide” is defined as a chemical compound consisting of a three-membered cyclic ether. Only emissions of epoxides listed in Table 4 of this Subpart, including EO, are regulated by the provisions of this Subpart (Subpart PPP, Sections 1420-1439).

“Extended Cookout (ECO)” is defined as a control technique that reduces the amount of unreacted EO and/or propylene oxide (epoxides) in the reactor. This is accomplished by allowing the product to react for a longer time period, thereby having less unreacted epoxides and reducing epoxides emissions that may have otherwise occurred.

Subpart PPP — Known organic HAPs from polyether polyol products.

Table 4 — Lists EO as a known organic HAP from polyether polyol products.

Subpart EEEE — NESHAPs: Organic liquids distribution (non-gasoline).

Table 1 — Lists EO as an organic HAP.

Subpart FFFF — NESHAPs: Miscellaneous organic chemical manufacturing.

Table 8 — Lists EO as a partially soluble HAP.

Subpart UUUU — NESHAPs for cellulose products manufacturing.

.5480 — Lists EO as one of the HAPs emitted in greatest quantity from cellulose products manufacturing operations.

.5610 —

“Cellulose ether process” is defined to include a manufacturing process that includes the following process steps: (i) reaction of cellulose with sodium hydroxide to produce alkali cellulose; (ii) reaction of the alkali cellulose with a chemical compound(s), such as EO, to produce a particular cellulose ether; (iii) washing and purification of the cellulose ether; and (iv) drying of the cellulose ether.

“Extended cookout (ECO)” is defined to include as a cellulose ether process change that reduces the amount of one of several unreacted chemicals, including EO, leaving the reactor. This is accomplished by allowing the product to react for a longer time, thereby leaving less unreacted EO and reducing emissions of EO that might have occurred otherwise.

Subpart XXXX — NESHAPs: Rubber Tire Manufacturing

Table 16 — EO is listed as a selected HAP.

Subpart GGGGG — NESHAPs: Site remediation

Table 1 — EO is listed with an f_{m305} (fraction measure factor in Method 305, 40 CFR Part 63, Appendix A) of 1.0.

Subpart HHHHH — NESHAPs: Miscellaneous coating manufacturing.

Table 7 — EO is included on the list of partially soluble HAPs in wastewater that are subject to management and treatment requirements

40 CFR Part 68 — Chemical accident prevention provisions.

.130 —

Table 1 — List of regulated toxic substances and TQs for accidental release prevention. EO is listed with a TQ of 10,000. EO was listed based on the following:

- (a) Mandated by congress; and
- (b) On EHS list, vapor pressure 10mm Hg or greater.

Table 2 — List of regulated toxic substances and TQs for accidental release prevention. EO is listed with a TQ of 10,000. EO was listed based on the following:

- (a) Mandated by congress; and
- (b) On EHS list, vapor pressure 10mm Hg or greater.

Appendix A — Table of toxic endpoints. EO is listed with toxic endpoint of 0.09 mg/L.

40 CFR Part 180 — Tolerances and exemptions from tolerances for pesticide chemicals in food.

.151 — Establishes tolerances for residues of the “antimicrobial agent and insecticide” EO, when used as a postharvest fumigant in or on copra coconut, whole spices, and black walnuts. EO

may be safely used as a fumigant for the control of microorganisms and insect infestation in ground spices and other processed natural seasoning materials, except mixtures to which salt has been added, in accordance with prescribed conditions.

.910 — Residues of listed materials are exempted from the requirement of a tolerance when used in accordance with good agricultural practice as inert or occasionally active ingredients in pesticide formulations applied to growing crops or to raw agricultural commodities after harvest. Inert ingredients include mixtures produced using EO, and mixtures containing EO.

.920 — Listed materials are exempted from the requirement of a tolerance when used in accordance with good agricultural practice as inert or occasionally active ingredients in pesticide formulations applied to growing crops only. Inert ingredients include mixtures produced using EO, and mixtures containing EO.

.930 — Listed materials are exempted from the requirement of a tolerance when used in accordance with good agricultural practice as inert or occasionally active ingredients in pesticide formulations applied to animals. Inert ingredients include mixtures produced using EO, and mixtures containing EO.

.940 — Lists pesticide chemicals that, when used as ingredients in an antimicrobial pesticide formulation, may be applied to dairy processing equipment, and food-processing equipment and utensils. Pesticide chemicals include mixtures produced using EO, and mixtures containing EO.

.960 — Residues resulting from the use of the listed polymers as inert ingredients in a pesticide chemical formulation are exempted from the requirement of a tolerance, if such use is in accordance with good agricultural or manufacturing practices. EO is included as a substance used to create a listed polymer.

.1001 —

(c) Residues of the listed materials are exempted from the requirement of a tolerance when used in accordance with good agricultural practice as inert or occasionally active ingredients in pesticide

formulations applied to growing crops or to raw agricultural commodities after harvest. Listed inert ingredients include mixtures produced using EO, and mixtures containing EO.

- (d) Listed materials are exempted from the requirement of a tolerance when used in accordance with good agricultural practice as inert or occasionally active ingredients in pesticide formulations applied to growing crops only. Listed inert ingredients include mixtures produced using EO, and mixtures containing EO.
- (e) Listed materials are exempted from the requirement of a tolerance when used in accordance with good agricultural practice as inert or occasionally active ingredients in pesticide formulations applied to animals. Listed inert ingredients include mixtures produced using EO, and mixtures containing EO.

40 CFR Part 261 — Identification and listing of hazardous waste.

.33(f) — EO is listed as U115 (U list waste).

Appendix VIII — EO is included on the list of hazardous constituents list.

40 CFR Part 266 — Standards for the management of specific hazardous wastes and specific types of hazardous waste management facilities.

Appendix V — Risk specific dosages (risk specific doses (10^{-5}). EO is listed with a unit risk of $1.0E-04$ m^3/g and an RsD of $1.0E-01$ $\cdot g/m^3$.

Appendix VII — Nonmetals: Residue concentration limits. EO is listed with a concentration limit for residues of $3xE-04$ mg/kg .

40 CFR Part 268 — Land disposal restrictions.

.40 — Lists treatment standards for hazardous wastes. Includes waste code, waste description and treatment/regulatory subcategory, regulated hazardous constituent, and concentrations in wastewater, and nonwastewater. EO is listed as follows:

Under waste code F039 as a regulated hazardous constituent, with a concentration of 0.12 mg/L in wastewater; and

Under waste code U115 with technology codes (WETOX or CHOXD) fb CARBN or CMBST, or concentration 0.12 mg/L in wastewater, and technology codes CHOXD or CMBST in nonwastewater.

.48 — Lists universal waste treatment standards. Includes EO, and the listed wastewater standard is a concentration of 0.12 mg/L in wastewater.

40 CFR Part 302 — Designations, reportable quantities and notification requirements for CERCLA hazardous substances.

.4 — Lists EO as a hazardous substance under CAA Section 112 and Section 3001 of the Resource Conservation and Recovery Act (RCRA) with a final reportable quantity of 10 pounds.

Appendix A — Sequential CAS Registry Number list of CERCLA hazardous substances. Includes EO.

40 CFR Part 355 — Emergency planning and notification.

Appendix A — The list of extremely hazardous substances and their threshold planning quantities. EO is listed with a reportable quantity (RQ) of 10 pounds and a threshold planning quantity of 1,000 pounds. There is a note for EO: "Chemicals on the original list that do not meet toxicity criteria but because of their high production volume and recognized toxicity are considered chemicals of concern ('Other chemicals')."

Appendix B — The list of extremely hazardous substances and their threshold planning quantities. EO is listed with an RQ of 10 pounds and a threshold planning quantity of 1,000 pounds. There is a note for EO: "Chemicals on the original list that do not meet toxicity criteria but because of their high production volume and recognized toxicity are considered chemicals of concern ('Other chemicals')."

40 CFR Part 372 — Toxic chemical release reporting: Community right-to-know.

.65 — EO is listed effective January 1, 1987.

40 CFR Part 414 — Organic chemicals, plastics, and synthetic fibers.

.60(a) — EO is included on list of aliphatic organic chemicals.

40 CFR Part 721— Significant new uses of chemical substances.

.3680 — SNUR requirements for EO adduct of fatty acid ester with pentaerythritol. The significant new use is release to water.

.3700 — SNUR requirements for fatty acid, ester with styrenated phenol, EO adduct. The significant new uses are the hazard communication program and release to water.

.3800 — SNUR requirements for formaldehyde, condensated polyoxyethylene fatty acid, ester with styrenated phenol, EO adduct. The significant new uses are the hazard communication program and release to water.

.7000 — SNUR requirements for polymer of disodium maleate, allyl ether, and EO. The significant new uses are the hazard communication program and industrial, commercial, and consumer activities.

Shipping — USCG

46 CFR Part 150 — Compatibility of cargoes.

Table 1 — The alphabetical list of cargoes includes chemical name, group number, footnote, CHRIS code, and related CHRIS codes. EO is included on the list, and is in group 0, with footnote 1, and CHRIS code EOX. EO, propylene oxide mixture is also listed, and it is in group 16, footnote 1, CHRIS code EPM.

Table 2 — This table lists the grouping of cargoes. EO is included in group 0, unassigned cargoes. EO, propylene mixtures are included in group 16, alkylene oxides.

46 CFR Part 151 — Barges carrying bulk liquid hazardous material cargoes.

Table 151.05 to Subpart 151.05 — Summary of Minimum Requirements. The Table lists requirements for cargo identification, hull type, cargo segregation tank, tanks, cargo transfer, environmental control, fire protection, special requirements in 46 CFR Part 151, electrical hazard class and group, temperature control installation, and tank internal inspection period. EO is included in the Table.

.50-10(a) — For the purpose of this part, alkylene oxides are considered to be EO and propylene oxide.

.50-10(q) — The special requirements for EO contained in Section 151.50-12 must also be observed.

.50-12 —

(a)

- (1) EO shall be carried in fixed, independent, pressure vessel type cargo tanks, designed, constructed, arranged and, if necessary, equipped with machinery to maintain the cargo temperature below 90°F except as otherwise provided for in paragraph (a)(3) of this section.
- (2) EO shall be loaded at a temperature below 70°F.
- (3) When EO is to be transported at or near atmospheric pressure, the Commandant may permit the use of alternate methods of storage which are consistent with the minimum requirements of this subpart.

(b)

- (1) All cargo tanks shall be constructed of a carbon steel or stainless steel acceptable to the Commandant. Impurities of copper, magnesium and other acetylide-forming metals shall be kept to a minimum. The chemical composition of all steel used shall be submitted to the Commandant for approval prior to fabrication. Aluminum, copper and other acetylide-forming metals, such as silver, mercury, magnesium, and their alloys shall not be used as materials of construction for tanks or equipment used in handling EO.
- (2) Cargo tanks shall meet the requirements of Class I pressure vessels.
- (3) Cargo tanks shall be designed for the maximum pressure of vapor or gas used in discharging the cargo but in no case shall the design pressure of such tanks be less than 75 pounds per square inch gauge. The tank shell and heads shall not be less than 5/16-inch thick.

(c)

- (1) Cargo tanks shall be located below deck in holds or enclosed spaces with the domes or trunks extended above the weather deck and terminating in the open. Provisions shall be made to maintain the

- watertightness of the deck by means of watertight seals around such domes or trunks. The holds or enclosed spaces, in which the EO tanks are located, shall not be used for any other purpose. However, in open hopper type barges of a suitable design approved for such service, the weatherdeck may not be required to be watertight.
- (2) All cargo tanks shall be installed with the manhole openings and all tank connections located above the weatherdeck in the open.
- (3) Tanks shall be electrically bonded to the hull.
- (4) No welding of any kind shall be done on cargo tanks or supporting structure unless authorized by the Commandant.
- (d) All cargo tanks, piping, valves, fittings, and similar equipment which may contain ethylene oxide in either the liquid or vapor phase, including the vent risers, shall be insulated. Flanges need not be covered, but if covered, a small opening shall be left at the bottom of the flange cover to detect leaks. Insulation shall be of an approved incombustible material suitable for use with EO, which does not significantly lower the autoignition temperature and which does not react spontaneously with EO. The insulation shall be of such thickness as to provide a thermal conductance of not more than 0.075 B.t.u. per square foot per degree Fahrenheit differential in temperature per hour.
- (e)
- (1) When cooling systems are installed to maintain the temperature of the liquid below 90°F, at least two complete cooling plants, automatically regulated by temperature variations within the tanks shall be provided; each to be complete with the necessary auxiliaries for proper operation. The control system shall also be capable of being manually operated. An alarm shall be provided to indicate malfunctioning of the temperature controls. The capacity of each cooling system shall be sufficient to maintain the temperature of the liquid cargo at or below the design temperature of the system.
- (2) An alternate arrangement may consist of three cooling plants, any two of which shall be sufficient to maintain the temperature of the liquid cargo at or below the design temperature of the system.
- (3) Cooling systems requiring compression of EO are prohibited.
- (f) In addition to the shutoff valve required, all tank connections larger than one-half inch inside pipe size, except safety relief valves and liquid level gauging devices, shall be fitted with either internal back pressure check valves or internal excess flow valves in conjunction with a quick closing stop valve operable from at least two remote locations. The quick closing stop valve shall be of the "fail safe" type acceptable to the Commandant and shall be equipped with a fusible plug designed to melt between 208°F and 220°F, which will cause the quick closing valve to close automatically in case of fire. The quick closing valve shall be located as close to the tank as possible.
- (g) Piping systems intended for EO service shall not be used for any other product and shall be completely separate from all other systems. The piping system shall be designed so that no cross connections may be made either through accident or design.
- (h) Each safety relief valve shall be set to start to discharge at not less than 75 pounds per square inch gauge, nor more than the design pressure of the tank.
- (i) The filling density shall not exceed 83 percent.
- (j)
- (1) The cargo shall be shipped under a suitable protective inerting gas system, such as nitrogen. When nitrogen gas is used, the gas inerting system shall be so designed that the vapor space above the liquid cargo will be filled and maintained with a gas mixture of not less than 45 percent nitrogen. Other gases proposed for inerting use may be given consideration by the Commandant. Original charging only of protective inerting gas at the loading facility is not

considered adequate. A sufficient amount of spare inerting gas as approved by the Commandant shall be provided on the vessel in order to maintain the proper concentration of the gas in the event of normal leakage or other losses.

- (2) Any inerting gas selected should be at least 98 percent pure and free of reactive materials, such as ammonia, hydrogen sulfide, sulfur compounds, and acetylene.
- (k) Prior to loading, a sample from the cargo tank will be taken to insure that the pad gas will meet the requirements of paragraph (j) of this section and that the oxygen content of the vapor space will be not more than 2 percent maximum. If necessary, a sample will be taken after loading to insure the vapor space meets this requirement.
- (l) The cargo piping shall be inspected and tested at least once in each two calendar years.
- (m) In those cases where the cargo transfer hose used is not part of the barge's equipment, the person in charge of the transfer operation shall determine that the provisions of Section 151.50-10(k) have been met before using this hose. A certificate of test, supplied by the transfer facility, will be considered as adequate for this determination.
- (n) The provisions of Section 151.50-10 shall be complied with as a requirement for shipping EO.
- (o) A hydrostatic test of 1½ times the design pressure shall be made on the cargo tanks at least once in each four years at the time the internal examination is made and at such other times as considered necessary by the Officer in Charge, Marine Inspection.

46 CFR Part 154 — Safety standards for self-propelled vessels carrying bulk liquefied gases.

.7 —

“Flammable cargoes” is defined to include several liquefied gases, including EO, from Table 4 (follows Section 154.1872).

“Toxic cargoes” is defined to include several liquefied gases, including EO, from Table 4 (follows Section 154.1872).

.22(a)(8) — To obtain an endorsed Certificate of Compliance to meet Section 154.1802(a) for a foreign flag vessel, whose flag administration issues IMO Certificates, and an endorsement for the carriage of EO, an application must be submitted to the USCG that includes a classification society certification that the vessel meets the requirements of Section 154.1725(a)(4), (5), and (7).

.1705(a) — EO must be carried in an independent tank type C that meets Section 154.701(a).

.1710 — When a vessel is carrying EO, the master must ensure that air is purged from the cargo tanks and associated piping before the cargo is loaded. The mast must also ensure that the air is excluded after the cargo is loaded by maintaining a positive pressure of at least 13.8 kPa gauge (2 psig) by either introducing a gas that is not reactive; is not flammable; and does not contain more than 0.2 percent oxygen by volume; or by controlling the cargo temperature.

.1720 — A refrigeration system that is used to cool EO must be an indirect refrigeration system that does not use vapor compression.

.1725 —

(a) A vessel carrying EO must:

- (1) Have cargo piping, vent piping, and refrigeration equipment that have no connections to other systems;
- (2) Have valves, flanges, fittings, and accessory equipment made of steel, stainless steel, except types 416 and 442, or other material specially approved by the Commandant (G-MSO);
- (3) Have valve disk faces, and other wearing parts of valves made of stainless steel containing not less than 11 percent chromium;
- (4) Have gaskets constructed of spirally wound stainless steel with teflon or other material specially approved by the Commandant (G-MSO);
- (5) Not have asbestos, rubber, or cast iron components in the cargo containment system and piping;
- (6) Not have threaded joints in cargo piping;

- (7) Have a water spray system under Section 154.1105 that protects the above deck cargo piping; and
 - (8) Have a nitrogen inerting system or on board nitrogen gas storage that can inert the vapor space of an EO cargo tank for a period of 30 days under the condition of paragraph (e) of this section.
- (b) The cargo hose used for EO must:
- (1) Be specially approved by the Commandant (G-MSO); and
 - (2) Be marked "For (Alkylene or Ethylene) Oxide Transfer Only."
- (c) EO must be maintained at less than 30°C (86°F).
- (d) Cargo tank relief valves for tanks containing EO must be set at 539 kPa gauge (78.2 psig) or higher.
- (e) The vapor space of a cargo tank carrying EO must be maintained at a nitrogen concentration of 45 percent by volume.
- (f) A vessel must have a method for jettisoning EO that meets the requirements of Sections 154.356 and 154.1872.

.1730 —

- (a) The master must ensure that before EO is loaded into a cargo tank:
- (1) The tank is thoroughly clean, dry, and free of rust;
 - (2) The hold spaces are inerted with an inert gas that meets the requirements of Section 154.1710(b)(1); and
 - (3) The cargo tank vapor space is inerted with nitrogen.
- (b) EO must be off loaded by a deepwell pump or inert gas displacement.
- (c) EO must not be carried in deck tanks.

.1872(d) — When EO is carried, the master must ensure that the emergency jettisoning piping with associated pumps and fittings is on-line and ready for use for an emergency.

Table 4 — Provides summary of minimum requirements for several cargoes, including EO.

Transportation — Research and Special Programs Administration

49 CFR Part 172 — Hazardous materials table, special provisions, hazardous materials communications, emergency response information, and training requirements.

.101 — Hazardous materials table. This table lists the proper shipping name, hazard class or division, identification number, packing group, label code, special provisions, packaging requirements, quantity limitations, and vessel stowage requirements for hazardous materials. The table includes EO and carbon dioxide mixture with more than 87 percent EO; EO and carbon dioxide mixtures with more than 9 percent but not more than 87 percent EO; EO and carbon dioxide mixtures with not more than 9 percent EO; EO and chlorotetrafluoroethane mixture with not more than 8.8 percent EO; EO and dichlorodifluoromethane mixture, with not more than 12.5 percent EO; EO and pentafluoroethane mixture with not more than 7.9 percent EO; EO and propylene oxide mixtures, with not more than 30 percent EO; EO and tetrafluoroethane mixture with not more than 5.6 percent EO; EO or EO with nitrogen up to a total pressure of 1MPa (10 bar) at 50 degrees C.

Table 1 to Appendix A — List of hazardous substances and RQs. EO is included, and the RQ for EO is 10 pounds (4.54 kg).

.102 — List of non-refrigerated liquefied compressed gases subject to portable tank code T50. Includes EO with nitrogen up to a total pressure of 1MPa (10 bar) at 50°C; EO and carbon dioxide mixture with more than 9 percent but not more than 87 percent EO; EO and dichlorodifluoromethane mixture with not more than 12.5 percent EO; EO and chlorotetrafluoroethane mixture, with not more than 8.8 percent EO; EO and pentafluoroethane mixture, with not more than 7.9 percent EO; and EO and tetrafluoroethane mixture, with not more than 5.6 percent EO.

49 CFR Part 173 — Shippers— general requirements for shipments and packagings.

.304a(a) — Liquefied gases (except gas in solution) must be offered for transportation, subject to the requirements in this section and Sections 49 CFR Sections 173.301 and 173.304, except that no DOT 4E or 39 packaging may be filled and shipped with a mixture containing EO, unless specifically authorized in this Part.

.323 —

(a) For packaging EO in non-bulk packagings, silver mercury or any of its alloys or copper may not be used in any part of a packaging, valve, or other packaging appurtenance if that part, during normal conditions of transportation, may come in contact with EO liquid or vapor. Copper alloys may be used only where gas mixtures do not contain free acetylene at any concentration that will form copper acetylene. All packaging and gaskets must be constructed of materials which are compatible with EO and do not lower the auto-ignition temperature of EO.

(b) EO must be packaged in one of the following:

- (1) In 4G fiberboard boxes with inner glass ampoules or vials. Total quantity of EO may not exceed 100 grams (3.5 ounces) per package. The completed package must be capable of passing Packing Group I performance tests.
- (2) In 4G fiberboard boxes constructed with top and bottom pads and perimeter liner. Inner packagings must be aluminum receptacles of no more than 135 g (4.8 ounces) capacity cushioned with incombustible material. No more than 12 receptacles may be packed in one box, and no more than 10 boxes may be overpacked under the provisions of Section 173.25 of this part. Each completed package must be capable of passing Packing Group I performance tests.
- (3) In 4C1, 4C2, 4D or 4F wooden boxes or 4G fiberboard boxes with inner metal receptacles of no more than 340 g (12 ounces) capacity. The

metal receptacle must be capable of withstanding no less than a 1241.1 kPa (180 psig) burst pressure. No more than 12 receptacles may be packed in one box, and each receptacle may not be liquid full below 82°C (180°F). Each inner receptacle must be insulated and equipped with a relief device of the fusible plug type with yield temperature of 69°C to 77°C (156°F to 171°F). The capacity of relief device and insulation must be such that the charged receptacle will not explode when tested by the method described in CGA Pamphlet C-14 or other equivalent method. Each completed package must be capable of passing all Packing Group I performance tests.

- (4) In specification cylinders, as authorized for any compressed gas except acetylene. Pressurizing valves and insulation are required for cylinders over 4 L (1 gallon) capacity. Eductor tubes must be provided for cylinders over 19 L (5 gallons) capacity. Cylinders must be seamless or welded steel (not brazed) with a nominal capacity of no more than 115 L (30 gallons) and may not be liquid full below 82°C (180°F). Before each refilling, each cylinder must be tested for leakage at no less than 103.4 kPa (15 psig) pressure. In addition, each cylinder must be equipped with a fusible type relief device with yield temperature of 69°C to 77°C (157°F to 170°F). The capacity of the relief device and the effectiveness of the insulation must be such that the charged cylinder will not explode when tested by the method described in CGA Pamphlet C-14 or other equivalent method.
- (5) In 1A1 steel drums of no more than 231 L (61 gallons) and meeting Packing Group I performance standards. The drum must be lagged, of all welded construction with the inner shell having a minimum thickness of 1.7 mm (0.068 inches) and the outer shell having a minimum thickness of 2.4 mm (0.095 inches). Drums must be capable of withstanding a hydrostatic test pressure of 690 kPa (100 psig). Lagging must be of sufficient

- thickness so that the drum, when filled with ethylene oxide and equipped with the required pressure relief device, will not rupture when exposed to fire. The drum may not be liquid full below 85°C (185°F), and must be marked “THIS END UP” on the top head. Before each refilling, each drum must be tested for leakage at no less than 103 kPa (15 psig) pressure. Each drum must be equipped with a fusible type relief device with yield temperature of 69°C to 77°C (157°F to 170°F), and the capacity of the relief device must be such that the filled drum is capable of passing, without rupture, the test method described in CGA Pamphlet C-14 or other equivalent method.
- (c) When Section 172.101 of this subchapter specifies that a hazardous material be packaged under this section, only the following bulk packagings are authorized, subject to the requirements of subparts A and B of this part, the special provisions specified in column 7 of the Section 172.101 table, and paragraphs (d) through (j) of this section:
- (1) Tank cars. Class DOT 105J tank cars: Notwithstanding the requirements of Section 173.31(c), each tank car must have a tank test pressure of at least 20.7 Bar (300 psig) no later than July 1, 2006.
 - (2) Cargo tanks. Specification MC 330 and MC 331 cargo tank motor vehicles.
 - (3) Portable tanks. DOT 51 portable tanks.
- (d) The pressure relief devices must be set to function at 517 kPa (75 psig). Portable tanks fitted with non-reclosing devices made and in use prior to December 31, 1987, may continue to be used in EO service.
- (e) In determining outage, consideration must be given to the lading temperature and solubility of inert gas padding in EO as well as the partial pressure exerted by the gas padding.
 - (f) Each tank, loaded or empty, must be padded with dry nitrogen or other suitable inert gas of sufficient quantity to render the vapor space of the tank nonflammable up to 41°C (105°F). The gas used for padding must be free of impurities which may cause the EO to polymerize, decompose or undergo other violent chemical reaction.
 - (g) Copper, silver, mercury, magnesium or their alloys may not be used in any part of the tank or appurtenances that are normally in contact with the lading.
 - (h) Neoprene, natural rubber and asbestos gaskets are prohibited. All packing and gaskets must be made of materials which do not react with or lower the autoignition temperature of the lading.
 - (i) Each tank must be insulated with cork (at least 10 cm (4 inches) thick), or mineral wool, fiberglass or other suitable insulation material of sufficient thickness so that the thermal conductance at 16°C (60°F) is not more than 0.075 Btu per hour per square foot per degree F. temperature differential. Portable tanks made and in use prior to December 31, 1987, equipped with fusible plugs instead of a pressure relief valve or rupture disc, must have sufficient insulation so that the tank as filled for shipment will not rupture in a fire. The insulation on portable tanks or cargo tank motor vehicles must be protected with a steel jacket at least 2.54 mm (0.100 inch) thick, or as required by the specification. (j) Tank car tanks built after December 30, 1971, must be equipped with a thermometer well.