

ENGINEERING DESIGN SEMINAR

SEPTEMBER 6, 1994 – NOVEMBER 11, 1994

ENVIRONMENTAL GUIDELINES

ENVIRONMENTAL GUIDELINES

Worker

Safety and Health

OSHA

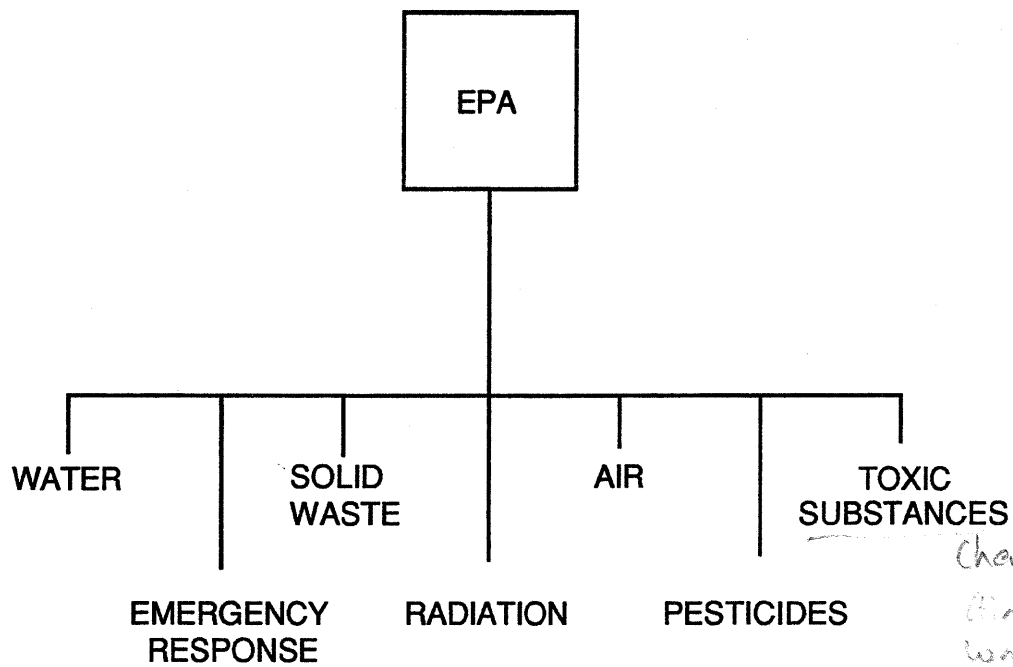
U.S. Occupational Safety and Health Administration

Environmental

Health and Protection

EPA

U.S. Environmental Protection Agency



*Chemical
Air pollution
Water pollution*

Safety Data sheet

Design Policies for Environmental Compliance

- Based directly on EPA/OSHA standards
- UOP established, where EPA/OSHA standards

Are not stringent enough

Do not address an area of our concern

Are not applicable

- UOP strives for plant designs which will be in full compliance or beyond.

Our clients expect this as part of our quality designs

UOP strives to be environmentally responsible

directly about to people

U. S. PRIMARY AND SECONDARY AMBIENT AIR QUALITY STANDARDS

wet

Contaminant	Period Of Measurement	Primary Standard (Maximum)		Secondary Standard (Maximum)	
		10 ⁻⁶ g/m ³	ppm	10 ⁻⁶ g/m ³	ppm
Sulfur Oxides (as SO ₂)	Annual arithmetic mean	80	0.03	—	—
	24 hour average*	365*	0.14*	—	—
	3 hour average*	—	—	1300*	0.5*
Particulate matter** (PM ₁₀)	Annual arithmetic mean	50—	—	50	—
	24 hour average*	150*	—	150*	—
Ozone	1 hour average*	235	0.12	235	0.12
Nitrogen dioxide	Annual arithmetic mean	100	0.053	100	0.053
Carbon monoxide	8 hour average*	10*	9*	10*	9*
		(in mg/m ³)		(in mg/m ³)	
	1 hour average*	40*	35*	40*	35*
Lead	Arithmetic mean averaged over a calendar quarter	1.5		1.5	

* Value not to be exceeded more than once a year

** Particles with aerodynamic diameter ≤ 10 micrometers

attainment area
Non attainment area ; 4/4
more difficult
attainment

APPENDIX 1
REGULATORY REQUIREMENTS FOR ABOVE-GROUND STORAGE TANKS

Reference U.S. EPA Regulation →	Standards of Performance for Volatile Organic Liquid Storage Vessels - (40 CFR 60 - K _b) <i>Code Federal Regulation</i>	National Emission Standard for Benzene Emissions from Benzene Storage Vessels (40 CFR 61 -Y)	HON Rule (note 3) (40 CFR 63 - G)	HON Rule (note 3) (40 CFR 63 - G)
Tank Contents →	Hydrocarbon	Benzene	Hydrocarbon	Wastewater (note 5)
Pollutant →	VOC's	Benzene	HAP's	HAP's
Maximum True Vapor Pressure (psia) (note 2) ↓	-	-	-	-
> 0		> 4 M ³ Cap. (note 4) Option d or e		< 75 M ³ Cap. Option a
> 0.1			> 151 M ³ Cap Option b,c, or e	
> 0.75	> 151 M ³ Cap. Option b,c, or e			> 151 M ³ Cap. Option b,c, or e
> 1.9			38 < Cap. < 151 M ³ Option b,c, or e	75 < Cap. < 151 M ³ Option b,c, or e
> 4.0	75 < Cap. < 151 M ³ Option b,c, or e			
> 11.1	> 75 M ³ Cap. Option e	All sizes Option e	All sizes Option e	All sizes Option e

APPENDIX 1 (continued)
REGULATORY REQUIREMENTS FOR ABOVE-GROUND STORAGE TANKS

Notes:

- (1) Numbers indicate tank capacity. Letters indicate the compliance alternatives in Section 3 that shall be used to satisfy the referenced regulation.
- (2) For liquids stored at ambient temperature, the maximum true vapor pressure will be determined at the local maximum monthly average temperature (as reported by the National Weather Service, for U.S. locations). For liquids stored above or below ambient temperature, the temperature used will be the highest calendar-month average liquid storage temperature. It is anticipated that for many cases we encounter, using the rundown temperature will be the most conservative and appropriate course of action for the design specification.
- (3) This is the National Emission Standard for Hazardous Air Pollutants (NESHAP) for the Synthetic Organic Chemical Manufacturing Industry (SOCMI). More simply this is the Hazardous Organic NESHAP, or "HON" Rule.
- (4) UOP requirements are more stringent than U.S. federal regulations. (i.e., breakpoint for the regulation is 38 M³, while UOP breakpoint is 4 M³. Also, the federal standard allows a floating roof alternate, while UOP standard is only an internal floating roof.
- (5) Requirement shown is for when wastewater is simply stored. If mixing, heating, or treating done as part of an exothermic reaction, then requirements are only options b,c, or e.

Fugitive Source Emissions

- In-line Valves
- Open-end Valves
- Flanges
- Pressure-relief Devices
- Pump Seals
- Unit Drains
- Compressor Seals
- Cooling Tower
- Wastewater Facilities
- Ditches
- Sumps

What Is It?

Is the concentration high enough to cause harm?

YOU NEED ESTABLISHED EXPOSURE CRITERIA BECAUSE

- Indicate Degree of Hazard to You and Your Employees
- Are a Handy Reference

EXPOSURE CRITERIA

Threshold Limit Value

- Time Weighted Average
- Established by A.C.G.I.H.
- 8 Hr Day/Working Lifetime
- No Adverse Effect

Immediate Danger to Life or Health

IDLH

- By NIOSH/OSHA
Research
- Max. Level 30 Minute Escape
- No Escape Impairing Symptoms
- No Irreversible Health Effects

Emergency Response Planning Guideline

ERPG

- Public Emergency Limits
- Accidental, Uncontrollable Event
- No Irreversible Effects

ACGIH TLV'S

15
50 minute

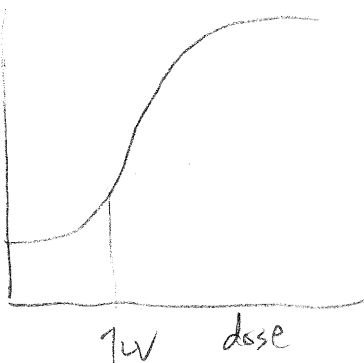
Substance	TWA		STEL	
	ppm	mg/m ³	ppm	mg/m ³
Gasoline	300	900	500	1500
HF	C 3	C 2.5	-	-

EMS Sector
Summary – Exposure Criteria for Various Compounds

<u>COMPOUND</u>	<u>TLV</u>	<u>IDLH</u>	<u>ERPG</u>
Hydrogen Fluoride	3 ppm	20 ppm	10 ppm: 10 min 5 ppm: 30-60 min
Ammonia	25 ppm	500 ppm	100 ppm: 10 min 100 ppm: 60 min
Chlorine	0.5 ppm	25 ppm	3C ppm: 10 min 2C ppm: 30 min 2C ppm: 60 min
Carbon Tetrachloride	5 ppm (A3)	300 ppm	30 ppm: 60 min
Hydrogen Chloride	5 ppm	100 ppm	7 ppm: 10 min 3 ppm: 30 min 3 ppm: 60 min
Boron Trifluoride	1 ppm	100 ppm	4 ppm: 10 min 2 ppm: 60 min
Chloroform	10 ppm (A2)	1000 ppm	200 ppm: 10 min 100 ppm: 60 min
Genetron® 1113	5 ppm	—	100 ppm: 10 min 20 ppm: 60 min
Methyl Mercaptan	0.5 ppm	400 ppm	10 ppm: 10 min 5 ppm: 60 min
Benzene	<u>0.1</u> 1 ppm (A2) ^(A1)	2000 ppm	
Methyl Isocyanate	0.02 ppm	20 ppm	

EXPOSURE CRITERIA: THEIR VALUE TO YOU

- Are You or Your Employees in Danger?
- Handy as Relative Reference of Hazard



OSHA BENZENE STANDARD

Permissible Exposure Limits (PEL)

- The time-weighted average (TLV-TWA) for an 8 hour workshift is 1.0 ppm.
- The action level (AL) is one-half of the TWA (or 0.5 ppm).
- The short-term exposure limit (STEL) is 5.0 ppm as averaged over **any** 15 minute work period.

Regulated Areas

- Employers shall establish a regulated area wherever the airborne concentration of benzene exceeds, or can be reasonably expected to exceed, the TLV-TWA of 1.0 ppm, or the STEL of 5.0 ppm for 15 minutes.
- Access to regulated areas shall be limited to authorized persons.

Exposure Monitoring

Determination of employee exposure shall be made from breathing zone air samples that are representative of **each** employee's average exposure to airborne benzene.

DESIGN DEVELOPMENTS FOR SAFETY AND ENVIRONMENT

Overview

- Inherent Safety
- Process Safety and Hazard Analysis
- Environmental Protection

Inherent Safety

"The essence of the inherently safer approach to plant design is the avoidance of hazards rather than their control by added-on protective equipment."

Trevor Kletz
Loughborough University

Inherent Safety Principles

Intensify – Use, store less quantity of a hazardous material

Substitute – Use a less hazardous material

Attenuate – Use hazardous material under less hazardous conditions

Simplify – Less opportunity for mistakes

Mistake Proof – Make incorrect action/assembly impossible (at least difficult!) or design to accommodate the mistake

Inherent Safety Example

- UOP developed fluidized-bed propane-butane dehydro process using Cr catalyst
- Based on extensive UOP FCC expertise
- UOP decided in 1978 to not offer this technology due to hazards of Cr⁺⁶ (carcinogenic)
- UOP instead developed and commercialized Oleflex Process utilizing fixed-bed Pt catalyst

Inherent Safety Principle Substitution

"What you don't have can't leak!"

Other Examples

- Drumless Condensers
- Less Inventory in Vessels
- Less Intermediate Storage
- Higher Design Pressure

OSHA 1910.119 Requirements (Process Safety Management Standard)

- Process Safety Information
- Process Hazard Analysis
- Operating Procedures
- Training
- Prestart-up Safety Review

Hot Work Permits

- Management of Changes
- Incident Investigation
- Emergency Planning

Basic Environmental Philosophy

- Source Elimination/Reduction
- Recycling
- Treatment
- Proper Disposal

Pollution Prevention

The essence of the pollution prevention approach to plant design is the avoidance or minimization of pollution rather than its control by added-on control equipment or its remediation left to the future.

Pollution Prevention Examples

- Seal-less Pumps
- Variable-Frequency-Drive Pumps
- Minimize Valves and Flanges
- Tanks Having Secondary Containment and Leak Detection
- No Underground Tanks or Vessels
- No Underground Process Drains/Sewers
- Above-Grade Closed Collection System

Wave of the Future

- Focus beyond regulations.
- Focus on prevention!

Why?

- Regulations Always Become More Stringent
- Less Expensive Over Time
- Less Liability



Material Safety Data Sheet

1. PRODUCT AND COMPANY IDENTIFICATION

Page 1 of 4
March 1993

PRODUCT: R-62 CATALYST

UOP
25 E. Algonquin Road
Des Plaines, IL 60017-5017
Telephone: 708-391-3189
FAX: 708-391-2953
Telex: 211442

Emergency Assistance

24 Hour Emergency Telephone Numbers:

USA:	UOP	708/391-2123
	Chemtec	800/424-9300
Canada:	Canutec	613/996-6666
Outside USA:	Chemtec	202/483-7616

2. COMPOSITION

<u>MATERIAL</u>	<u>CAS NO.</u>	<u>WT%</u>	<u>1992-93 ACGIH TLV-TWA (1992 OSHA PEL-TWA)</u>
Aluminum oxide (non-fibrous)	1344-28-1	<98	10 mg/m ³ as Al (10 mg/m ³ Total dust) (5 mg/m ³ Respirable dust)
Platinum	7440-06-04	---	1 mg/m ³ (1 mg/m ³)
Rhenium	7440-15-5	---	None established (None established)
Chloride, complexed with alumina		---	None established (None established)
Hydrogen sulfide	7783-06-4	<0.2	10 ppm 14 mg/m ³ (10 ppm) (14 mg/m ³)

ACGIH - American Conference of Governmental Industrial Hygienists
OSHA - Occupational Safety and Health Administration
TLV - Threshold Limit Value
TWA - Time Weighted Average
PEL - Permissible Exposure Limit

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW:

These grey spheres may present a nuisance dust hazard. Repeated or prolonged exposure may irritate eyes, skin and upper respiratory tract.

POTENTIAL HEALTH EFFECTS:

Primary Routes of Exposure: Contact with skin and eyes. Exposure may also occur via inhalation and ingestion if product dust is generated during handling/processing.

Skin Contact: May cause irritation with repeated or prolonged exposure.

Eye Contact: Product dust may cause irritation or reddening of the eye due to physical abrasion.

Inhalation: Repeated or prolonged inhalation of product dust may irritate upper respiratory tract.

Ingestion: This product is not considered toxic via ingestion.

4. FIRST AID MEASURES

- Skin: Wash affected parts with soap and water. If irritation develops, obtain medical attention.
- Eyes: Flush with water for at least 15 minutes. If irritation develops, obtain medical attention.
- Inhalation: Remove affected person to fresh air. If breathing is difficult, obtain medical attention.
- Ingestion: Induce vomiting. Obtain medical attention.

5. FIRE FIGHTING MEASURES

- Flash Point: Unused catalyst does not burn.
- Extinguishing Media: Unused catalyst will not burn, use media appropriate for surrounding fire (carbon dioxide, water spray, dry chemical or foam).
- Fire and Explosion Hazard: Spent catalysts, in their reduced state, can react with air and generate enough heat to spontaneously ignite residual organic material on the catalyst.

6. ACCIDENTAL RELEASE MEASURES

Isolate the affected areas, confine entry to the affected area to those individual who are wearing proper personal protective equipment. Special attention should be paid to respiratory and eye protection because recovery of dry catalyst can be expected to generate dust. Sweep, shovel or vacuum up the spilled material and place into appropriate container.

Do not load product recovered from a spill into reactor until proper evaluation of the catalyst's quality has been made. Catalyst waste material may be returned to manufacturer for metal recovery.

7. HANDLING AND STORAGE

Store in tightly closed, properly labeled containers. Avoid repeated or prolonged contact with skin. Avoid contact with eyes and inhalation of dust. Ground catalyst handling equipment to prevent static discharge in an explosive atmosphere.

8. EXPOSURE CONTROLS AND PERSONAL PROTECTION

- Respiratory: Where natural ventilation is inadequate, use mechanical ventilation, other engineering controls or an approved dust respirator to prevent inhalation of catalyst dust.
- Skin: Gloves and work uniform as necessary to prevent repeated or prolonged skin contact.
- Eye: Safety glasses or chemical goggles as necessary to prevent eye contact.

9. PHYSICAL AND CHEMICAL PROPERTIES

These data do not represent technical or sales specifications.

Boiling Point:	Not applicable	Solubility in Water:	Insoluble, will sink in water
Apparent Bulk Density:	~45 lbs/ft ³	% Volatile:	Not available
Vapor Pressure:	Not available	Appearance:	Grey spheres
Vapor Density:	Not available	Odor	Odorless
Pour Point:	Not applicable	pH:	Not applicable
Freezing Point:	Not applicable	Physical State:	Solid

10. STABILITY AND REACTIVITY

Stability:	Stable
Conditions to Avoid:	Leaving catalyst exposed to air.
Hazardous Decomposition Products:	Hydrogen sulfide will be released upon contact with air.
Hazardous Polymerization:	Will not occur
Incompatible Materials:	None currently known

11. TOXICOLOGICAL INFORMATION

No data currently available.

12. ECOLOGIC INFORMATION

No data currently available.

13. DISPOSAL CONSIDERATIONS

Used catalyst may be returned to manufacturer for metals recovery. Otherwise, waste material must be disposed in accordance with all applicable waste management regulations.

14. TRANSPORTATION INFORMATION

DOT Hazard Class: Not regulated
ID Number: Not applicable
IMO Hazard Class: Not regulated
ID Number: Not applicable

15. REGULATORY INFORMATION

U.S. TOXIC SUBSTANCE CONTROL ACT (TSCA): All the ingredients of this mixture are registered in accordance with TSCA.

U.S. SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA) TITLE III, SECTION 313: The following component(s) in this product is subject to the reporting requirements of section 313 of the Emergency Planning and Community Right-To-Know Act, 40 CFR 372: ---none---

EUROPEAN INVENTORY OF EXISTING COMMERCIAL CHEMICAL SUBSTANCES (EINECS): The components of this preparation are included on the EINECS.

CANADIAN HAZARDOUS PRODUCTS ACT: This product is not classified as a controlled product under regulations pursuant to the Federal Hazardous Products Act (e.g., WHMIS).

16. OTHER INFORMATION

For additional information concerning this product is readily available from UOP by telephoning, writing, or sending a facsimile message to the appropriate specialist:

**For health, safety & environmental
information, please contact:**

Product Stewardship Manager
Health, Safety and Environment Department
UOP
25 E. Algonquin Road
Des Plaines, IL 60017-5017 USA
Telephone: (708) 391-3189
Fax: (708) 391-2953

**For technical information, please
contact:**

Refining Catalysts Marketing Department
UOP
25 E. Algonquin Road
Des Plaines, IL 60017-5017 USA
Telephone: (708) 391-2239
Fax: (708) 391-3690

PRODUCT EMERGENCIES

If you have a product-related emergency, resulting in an incident such as a spill or release of product, human exposure, etc., and need assistance from UOP, please call us at the following number:

UOP 24-Hour EMERGENCY Telephone Number: (708) 391-2123

The data and recommendations presented in this data sheet concerning the use of our product and the materials contained therein are believed to be accurate and are based on information which is considered reliable as of the date hereof. However, the customer should determine the suitability of such materials for his purpose before adopting them on a commercial scale. Since the use of our products by others is beyond our control, no guarantee, express or implied, is made and no responsibility assumed for the use of this material or the results to be obtained therefrom. Information on this form is furnished for the purpose of compliance with Government Health and Safety Regulations and shall not be used for any other purposes. Moreover, the recommendations contained in this data sheet are not to be construed as a license to operate under, or a recommendation to infringe, any existing patents, nor should they be confused with state, municipal or insurance requirements, or with national safety codes.

UOP 2115

Date: March 1993

Revision Number: 1 - New Format

Supersedes: April 1991

directly affect the people

U. S. PRIMARY AND SECONDARY AMBIENT AIR QUALITY STANDARDS

well-being

Contaminant	Period Of Measurement	Primary Standard (Maximum)		Secondary Standard (Maximum)	
		10^{-6}g/m^3	ppm	10^{-6}g/m^3	ppm
Sulfur Oxides (as SO_2)	Annual arithmetic mean	80	0.03	—	—
	24 hour average*	365*	0.14*	—	—
	3 hour average*	—	—	1300*	0.5*
Particulate matter** (PM_{10})	Annual arithmetic mean	50—	—	50	—
	24 hour average*	150*	—	150*	—
Ozone	1 hour average*	235	0.12	235	0.12
Nitrogen dioxide	Annual arithmetic mean	100	0.053	100	0.053
Carbon monoxide	8 hour average*	10*	9*	10*	9*
		(in mg/m^3)		(in mg/m^3)	
	1 hour average*	40*	35*	40*	35*
Lead	Arithmetic mean averaged over a calendar quarter	1.5		1.5	

* Value not to be exceeded more than once a year

** Particles with aerodynamic diameter ≤ 10 micrometers

attainment area

Non attainment area ;

4%

more difficult

and more stringent

Potential Sources of Specific Emissions from Oil Refineries

Emission	Source
Oxides of sulfur (SO ₂ , SO ₃)	Boilers, process heaters, catalytic cracking units, regenerators, treating units, H ₂ S flares, decoking operations, fluid cokers, and sulfur recovery plants
Hydrocarbons	Loading facilities, turnabouts, sampling, storage tanks, wastewater separators, blowdown systems, catalyst regenerators, pumps, valves, blind changing, cooling towers, vacuum jets, barometric condensers, air blowing, high pressure equipment handling volatile hydrocarbons, process heaters, boilers, compressor engines, flanged connections, and spills
Oxides of nitrogen (NO, NO ₂)	Process heaters, boilers, compressor engines, catalyst regenerators, and flares
Particulate matter	Catalyst regenerators, boilers, process heaters, decoking operations, incinerators, and fluid cokers
Aldehydes	Catalyst regenerators,
Ammonia (NH ₃)	Catalyst regenerators and foul water strippers
Odors (Hydrocarbons, aldehydes, ammonia, mercaptans, H ₂ S, sulfides and the like)	Treating units, air blowing, steaming, drains, tank vents, barometric condenser sumps, and wastewater separators
Carbon monoxide (CO)	Catalyst regenerators, decoking, compressor engines, incinerators and fluid coker burners

U. S. New Source Performance Standards for Refineries

FCC Units

Particulate: 1 kg/1000 kg coke burnoff ^{at} regeneration
CO: 500 ppmv ^{20 yrs ago} ~~high temp. regeneration~~
Opacity: 30 pct ^{100% black} ~~equilibrium~~
SO₂: 9.8 kg SO_x/1000 kg coke burnoff or feed S < 0.3 pct ^{10 yrs ago}

Fuel Gas Systems

H₂S: 230 mg/std m³-d (0.10 g/std m³-d or 160 ppmv)

Claus Sulfur Plant (>20 Lt/d)

If oxidation control system: 250 ppm SO₂ ^{tail gas unit}
If reduction control system: 300 ppm reduced S compounds
10 ppm H₂S

Storage Vessels (Tanks)

Refer to separate sheet

Fugitive Emissions

Discussion

EPA Standards for Storage Tanks

Tank Capacity	True Vapor Pressure* (Max.)	Compliance Alternatives
151 m ³ or greater (approx. 40,000 gal)	0.75 to <11.1 psia	1) External floating roof tank equipped with a liquid-mounted or mechanical shoe primary seal, a continuous rim-mounted secondary seal, and gasketed fittings;
	OR	OR
(75 m ³ to <151 m ³ (approx. 20,000 to 40,000 gal)	4.0 to <11.1 psia	2) Internal floating roof tank equipped with a liquid – mounted or mechanical shoe primary seal, or vapor – mounted continuous primary and secondary seals, and gasketed fittings; or
		3) Tank equipped with a closed vent system and a 95 pct effective control device
75 m ³ or greater (approx. 20,000 gal)	11.1 psia or greater	Tank equipped with a closed vent system and a 95 pct effective control device

6 months day a from now

New Standard.

TANK REQUIREMENTS

Below is a list of the various compliance alternatives or options used to meet the standards for emission control of storage tanks.

- a. Fixed Roof (e.g., cone type)
- b. External floating roof tank equipped with a liquid-mounted or mechanical shoe primary seal, a continuous rim-mounted secondary seal, and gasketed fittings.
- c. Internal floating roof tank equipped with a liquid-mounted or mechanical shoe primary seal, or vapor-mounted continuous primary and secondary seals, and gasketed fittings.
- d. Internal floating roof tank equipped with a liquid-mounted primary seal, a continuous secondary seal, and gasketed fittings.
- e. Tank equipped with a closed vent system and a 95 % effective control device. Examples of typical control devices are dedicated flares, incinerators, and carbon adsorbers.

The various compliance alternatives listed above are applied to various tank sizes based on their material content and vapor pressure at design temperature. Appendix 1 contains a table describing how these alternatives or options are applied in specifying tanks.