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Portable Instruments User's Manual for Monitoring VOC Sources

Portable Instruments User's Manual for Monitoring VOC Sources

by

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SECTION 1

INTRODUCTION

The U.S. Environmental Protection Agency (EPA) has promulgated New Source Performance Standards (NSPS) and National Emission Standards for Hazardous Air Pollutants (NESHAP's) for several categories of sources that emit volatile organic compounds (VOC's) and that require monitoring with portable detection instruments. The EPA has also issued control techniques guidelines (CTG's) for a number of source categories that emit VOC's. The source categories covered by the NSPS, NESHAP's, and CTG's include petroleum refineries, synthetic organic chemical plants, coating operations, and natural gas processing plants.

Fugitive VOC emissions at these sources occur at valves, pumps, drains, pressure relief devices, etc. If these points of fugitive emissions can be identified, the leaks can be repaired and the emissions can be eliminated.

This manual presents information on the principles of operation of currently available portable monitors and the field inspection techniques for the monitor's safe use in both screening and compliance determinations. This manual is intended to be used by State or local agencies.

The level of the inspection performed is often determined by the compliance history of the source and the regulatory requirements. If the inspection procedure involves the use of a sophisticated instrument to determine compliance with a regulation, it is classed as a Level 3 inspection, which is the most thorough and time-consuming level. Level 3 inspections are designed to provide a detailed engineering analysis of source compliance by use of measured operating parameters or emissions data. The Level 3 inspection for determining fugitive VOC emissions requires the use of portable hand-held instruments. These instruments include portable organic vapor monitors, thermocouples, and static pressure gauges.

The EPA has published Reference Method 21 to provide a technical method to test for leaks from these sources. Method 21 allows the user to select

one of several instruments available on the market if they meet the specifications and performance requirements, discussed in Section 2. A summary of the published specifications of many of the portable VOC monitors is presented in this manual.

Because the inspector will be using a reference test method and the acquired data may be used in an enforcement action against the facility, special care should be taken in the use of portable instruments during a Level 3 inspection. Calibration procedures must be strictly adhered to verify the acquired data.

SECTION 2

REGULATORY REQUIREMENTS

The use of portable VOC-detecting instruments is based primarily on requirements regarding control of leaks as contained in the NSPS and NESHAP's and in the CTG's published by EPA to provide guidance for State and local agencies in the development of their own regulations.

2.1 NEW SOURCE PERFORMANCE STANDARDS

Two categories of VOC emissions must be monitored: 1) emissions from sources controlled by carbon-bed absorbers, thermal incinerators, and vapor recovery systems; and 2) fugitive emissions from process equipment. Appendix A contains the NSPS requirements for the source categories in Table 1. The monitoring is to be performed as described in 40 CFR 60, Appendix A, Reference Method 21.

2.1.1 Determination of Volatile Organic Compound Leaks From Sources Controlled by Carbon-Bed Absorbers, Condenser Units, and Thermal or Catalytic Incinerators

Carbon-bed absorbers, condenser units, and thermal or catalytic incinerators are used to control emissions from the surface coating of metal furniture, automobiles and light-duty trucks, pressure-sensitive tape and labels, large appliances, metal coils, and beverage cans, and flexible vinyl and urethane coating and printing.

Carbon-bed absorption units, condenser units, and thermal or catalytic incinerators normally require onsite monitoring with stationary instruments rather than portable ones; however, some measurements can be made with portable instruments to verify both the operation of the control equipment and the on-site stationary monitoring results. Carbon-bed absorbers and condenser units require the use of both VOC-detection equipment and temperature-monitoring equipment. Thermal and catalytic incinerators also require the use of temperature monitoring equipment.

TABLE 1. NSPS VOC FUGITIVE (LEAK) EMISSION LIMITS

Source category	Equipment	Emission limit	Monitoring requirement
Subpart VV - Equipment Leaks of VOC in the Synthetic Organic Chemicals Manufacturing Industry	Valves	10,000 ppm by volume (ppmv)	Monthly
	Pumps	10,000 ppmv or visible leak from seal in pumps in liquid service	Monthly
	Compressors	Zero	No requirements
	Sampling connections	Zero	No requirements
	Open-ended lines	Zero	No requirements
	Pressure-relief devices	500 ppmv or less above background level	Periodic ^a
	Exception: plants processing only heavy liquids or solids and facilities producing beverage alcohol		
Subpart XX - Bulk Gasoline Terminals	All the loading racks at a bulk gasoline terminal that deliver gasoline into any delivery tank truck	10,000 ppmv	Monthly
Subpart GGG - Equipment Leaks of VOC in Petroleum Refineries	Valves	10,000 ppmv	Monthly
	Pumps	10,000 ppmv or visible leak	Monthly
	Sampling connections	Zero	No requirements

(continued)

TABLE 1 (continued)

Source category	Equipment	Emission limit	Monitoring requirement
Subpart KKK - Equipment Leaks of VOC from Onshore Natural Gas Processing Plants	Open-ended lines	Zero	No requirements
	Pressure relief device	500 ppmv or less above background level	Periodic ^a
	Valves	10,000 ppmv	Monthly
	Pumps	10,000 ppmv	Monthly
	Sampling connections	Zero	No requirements
	Open-ended lines	Zero	No requirements
	Pressure relief devices	10,000 ppmv	Periodic ^a

^aExcept in the case of pressure releases where the source must be monitored within 5 days of a pressure release.

In certain source categories, the NSPS regulations require adherence to an emission limit or some other operating parameter. Compliance with this requirement is monitored by onsite equipment. These standards apply to various surface coating operations and flexible vinyl and urethane coating and printing (Table 2).

Portable monitoring instruments can be used on the exit vent/stack side of the carbon absorbers and condenser units to detect breakthrough of the VOC's. A portable monitor used to perform this type of test must be sensitive in the 50 to 500 ppmv range. Such an instrument can detect VOC emissions that are over and above what would be expected from a controlled source. Because these portable instruments are continuous or semicontinuous, the probe only has to be put in the gas stream for the length of time necessary to exceed the response time specified in the instrument manual.

TABLE 2. NSPS VOC MONITORING REQUIREMENTS FOR SOURCES CONTROLLED BY CARBON-BED ABSORBERS AND THERMAL OR CATALYTIC INCINERATION

Source category	Equipment or operations	Emission limit or work practice	Monitoring requirements
Subpart EE - Surface Coating of Metal Furniture	All metal furniture surface coating operations applying organic coatings	0.90 kg/liter of coating solids applied	Temperature measurement with capture system and incineration
Subpart MM - Automobile and Light-Duty Truck Surface Coating Operations	Prime coating	0.16 kg/liter of applied coating solids per each prime coat operation	Permanent record of incinerator temperature, if applicable
	Guide coating	1.40 kg/liter of applied coating solids per each guide coat operation	Same as above
	Top coating	1.47 kg/liter of applied coating solids per each top coat operation	Same as above
	Exempt: plastic components and all-plastic bodies on separate lines		Same as above
Subpart RR - Pressure-Sensitive Tape and Label Surface Coating	Coating line inputting greater than 45 Mg (50 tons) VOC per 12-month period	0.2 kg of VOC per kg of coating solids applied	Facilities with thermal incinerators: temperature of incinerator's exhaust gases
		or 90% VOC emission reduction or an overall emission reduction equivalent to the 0.20 kg per kg of coating solids applied, whichever is less stringent	Facilities with catalytic incinerators: gas temperature upstream and downstream of the catalyst bed

(continued)

TABLE 2 (continued)

Source category	Equipment or operations	Emission limit or work practice	Monitoring requirements
	Coating line inputting less than 45 Mg (50 tons) VOC per 12-month period	Not subject to limits but subject to monitoring requirements	
Subpart SS - Industrial Surface Coating: Large Appliances	All large appliance surface coating line operations	0.90 kg/liter applied coating solids	Temperature measurement with capture system and incineration
Subpart TT - Metal Coil Surface Coating	Prime coating operations, finish coating operations, and combined prime and finish coating operations when finish coat is applied wet on wet over prime coat and cured simultaneously	0.28 kg/liter coating solids with no emission control 0.14 kg/liter coating solids with continuous emission control 10% VOC's applied (90% emission reduction) Prorated value with intermittent emission control	Continuous record of incinerator temperature, if applicable Same as above Same as above Same as above
Subpart WW - Beverage Can Surface Coating Industry	Two-piece beverage can coating:		
	Exterior base coating operation	0.29 kg VOC/liter of coating solids (except clear base coating)	Temperature measurement for incineration
	Clear base coating or overvarnish coating	0.46 kg VOC/liter of coating solids	Same as above

(continued)

TABLE 2 (continued)

Source category	Equipment or operations	Emission limit or work practice	Monitoring requirements
Subpart FFF - Flexible Vinyl and Urethane Coating and Printing	Inside spray coating	0.89 kg VOC/liter of coating solids	Temperature measurement for incineration
	Rotogravure printing line	Reduce gaseous VOC emissions by 85%	Continuous measurement and recording of the temperature of thermal incinerator exhaust gases or of the gas temperature upstream and downstream of a catalytic incinerator, installation of a continuous monitoring system for solvent recovery

Portable monitors also can be used to check the continuous monitor required at some sources. This measurement process is the same as that used for testing breakthrough.

A thermocouple can be used to check the exit gas temperature from a thermal or catalytic incinerator. A baseline stack temperature measurement should be taken at the time the incinerator's permanent thermocouple is calibrated. This baseline temperature measurement gives a reference point for future inspections.

2.1.2 Fugitive Emissions From Process Equipment

For the synthetic organic chemicals manufacturing industry, bulk gasoline terminals, petroleum refineries and on-shore natural gas processing plants (Table 1), NSPS requires periodic leak inspections of the equipment to determine if any fugitive VOC emissions are escaping. These leak inspections are performed with portable VOC-detecting equipment according to Reference Method 21. Equipment to be tested includes valves, pumps, seals, compressors, sampling connections, open-ended lines, and pressure-relief devices.

A portable VOC-detection monitor may be used for leak inspections. The probe must be inserted in the vicinity of a potential leak and must be moved around the area where the leak may occur. The leak must be compared against a background concentration, especially when the standards call for an emission limit of 0 or 500 ppmv. Field procedures for conducting leak inspection monitoring are discussed in Section 6 of this manual.

2.2 NATIONAL EMISSION STANDARDS FOR HAZARDOUS POLLUTANTS

For certain categories of sources, NESHAP's place a not-to-be-exceeded limit on fugitive emissions from processes, pumps, compressors, valves, pressure-relief systems, etc. These standards apply to vinyl chloride, ethylene dichloride, benzene, and volatile hazardous air pollutants (VHAP).

Emissions are monitored both by stationary onsite monitors and portable instruments, depending on the regulatory requirements. Table 3 lists the regulated facilities, emission standards (where monitoring is required), and monitoring requirements for fugitive emissions from process sources. The methods of detecting leaks and types of equipment to be inspected for leaks

TABLE 3. NESHAP MONITORING REQUIREMENTS FOR FUGITIVE EMISSIONS

Source category	Equipment or operations	Emission limit or equipment standard	Monitoring requirements
Subpart F - Vinyl Chloride	Ethylene dichloride manufacture	1) Ethylene dichloride purification: 10 ppmv ^a 2) Oxychlorination reactor: 0.2 g/kg (0.0002 lb/lb) of the 100% ethylene dichloride product	Source test Continuous monitor Source test Continuous monitor
	Vinyl chloride manufacture	10 ppmv ^a	Source test Continuous monitor
	Polyvinyl chloride manufacture		
	Reactor; stripper; mixing, weighing and holding containers; monomer recovery system	10 ppmv ^a	Source test Continuous monitor
	Reactor opening loss	0.02 g vinyl chloride/kg (0.00002 lb vinyl chloride/lb)	Source test Continuous monitor
	Reactor manual vent	No emissions	
	Sources following stripper	For each calendar day: 1) Using stripping technology - 2000 ppmv for polyvinyl chloride dispersion resins (excluding latex), 400 ppmv	Source test

(continued)

TABLE 3 (continued)

Source category	Equipment or operations	Emission limit or equipment standard	Monitoring requirements
		each for other polyvinyl chloride resins (including latex)	
		2) Other than stripping technology - 2 g/kg (0.002 lb/lb) product for dispersion polyvinyl chloride resins (excluding latex) 0.4 g/kg (0.0004 lb/lb) product for other polyvinyl chloride resins (including latex)	Source test
	Ethylene dichloride, vinyl chloride and/or polyvinyl chloride manufacture		
	Relief valve discharge	No discharge	No requirement
	Loading and unloading lines	0.0038 m ³ after each loading, or 10 ppm when contained by a control system	Source test Continuous monitor
	Slip gauges	10 ppm from the required control system	Source test Continuous monitor
	Pump; compressor and agitator seal	10 ppm from the required control system with seals	Source test Continuous monitor

(continued)

TABLE 3 (continued)

Source category	Equipment or operations	Emission limit or equipment standard	Monitoring requirements
12 Subpart J - Equipment Leaks (Fugitive Emission Sources) of Benzene	Leakage from relief valves	Rupture disk must be installed	No requirement
	Manual venting of gases	10 ppmv from a required control system	Source test Continuous monitor
	Opening of equipment	10 ppmv from a required control system	Source test Continuous monitor
	Samples (at least 10% by weight vinyl chloride)	Returned to system	No requirement
	Leak detection and elimination	Implementation of an approved program	Approved testing program
	In-process wastewater	10 ppmv before discharge	Source test Continuous monitor
	Pumps	No leakage (instrument reading <10,000 ppmv)	Monthly leak detection and repair program
	Compressors	Meet equipment specifications	No requirement
	Pressure-relief devices	No detectable emissions	No requirement
	Sampling connection systems	No VHAP emissions Meet equipment specifications	No requirement
	Open-ended valves or lines	Meet equipment specifications	No requirement

(continued)

TABLE 3 (continued)

Source category	Equipment or operations	Emission limit or equipment standard	Monitoring requirements
Subpart V - Equipment Leaks (Fugitive Emission Sources)	Valves	No leakage (instrument reading <10,000 ppmv)	Monthly leak detection and repair program
	Pressure-relief devices in liquid service and flanges and other connectors	No leakage (instrument reading <10,000 ppmv)	No requirement
	Product accumulator vessels or systems designed to produce or use >1,000 Mg/yr benzene	Meet equipment specifications	No requirement
	Closed-vent systems	No detectable emissions	No requirement
	Control systems:		
	Vapor recovery systems	Operate at 95% efficiency	No requirement
	Enclosed combustion devices	Operate at 95% efficiency	No requirement
	Flares	No visible emissions	No requirement
	Pumps, compressors, pressure relief devices, sampling connection systems, open-ended valves or lines, valves, flanges and other	Same as Subpart J	Same as Subpart J

(continued)

TABLE 3 (continued)

Source category	Equipment or operations	Emission limit or equipment standard	Monitoring requirements
	connectors, product accumulator vessels, and control devices		

^aBefore opening any equipment for any reason, the quantity of vinyl chloride is to be reduced so that the equipment contains no more than 2.0% by volume vinyl chloride or 0.0950 m³ (25 gal) of vinyl chloride, whichever is larger, at standard temperature and pressure.

are similar to those presented in Subsection 2.1.2. Table 3 also presents the requirements for leak detection and the emission limits. It should be noted that because vented discharges from NESHAP sources are controlled with thermal or catalytic incineration devices, these sources are monitored with temperature sensing devices. Appendix A contains the NESHAP's that are listed in Table 2.

2.3 INSTRUMENT SPECIFICATIONS

Limited portable VOC-detection instruments specifications are outlined in Appendix A of 40 CFR 60. The reader is encouraged to review Reference Method 21 (Appendix A) to become familiar with the required instrument specifications. It should be noted that no specifications concerning other types of instruments such as thermocouples and static pressure gauges are currently available.

SECTION 3

PORTABLE INSTRUMENT OPERATING PRINCIPLES

Various types of instruments are available for detecting organic vapors during inspections. These monitors involve a variety of detectors that operate on several different principles. Each detector has its own advantages, disadvantages, and sensitivity.

Other types of portable equipment used during source inspections include temperature monitors, flow monitors, and pressure gauges. This equipment is much smaller, less expensive, and easier to use than the portable VOC detectors.

3.1 VOC DETECTORS

Several types of portable VOC detectors can be used either as screening tools or to meet the requirements of EPA Method 21. These include:

- o Flame ionization detector (FID)
- o Photoionization (ultraviolet) detector (PID)
- o Nondispersive infrared detector (NDIR)
- o Catalytic combustion or hot wire detector.

The specifications of these instruments vary greatly with regard to sensitivity, range, and responsiveness. Table 4 lists the most common monitors currently in use and the associated detection principle, range, sensitivity, and response time of each.

3.1.1 Flame Ionization Detector

In an FID, the sample is introduced into a hydrogen flame. A concentration of even 0.1 ppm of a hydrocarbon produces measurable ionization, which is a function of the number of carbon ions present. A positively charged collector surrounds the flame, and the ion current between the flame and the collector is measured electronically. Pure hydrogen burning in air produces

TABLE 4. MOST COMMON PORTABLE VOC DETECTION INSTRUMENTS^a

Monitor	Detection principle	Range, ppm	Sensitivity	Response time, s
550, 551, 555 (AID, Inc.)	FID	0-200, 0-2000, 0-10,000	0.1 ppm at 0-200 ppm	5
OVA 108, 128 Century Systems, Inc. (Foxboro)	FID	0-10, 0-100, 0-1000	0.2 ppm (Model 128)	2
			0.5 ppm (Model 108)	2
PI-101 (HNU Systems, Inc.)	PID	0-20, 0-200, 0-2000	1 ppm	5
TLV Sniffer (Bacharach)	Catalytic combustion	0-500, 0-5000, 0-50,000	2.0 ppm	
Ecolyzer 400 (Energetics Science)	Catalytic combustion	0-100% LFL	1% LFL ^b	15
Miran 1A (Foxboro)	IR	ppm to %	1 ppm	1, 4, 10 and 40

^aDoes not necessarily represent all portable monitors currently being sold.

^bLower flammability limit.

very little ionization, so background effects are essentially masked by the hydrogen flame. The calibrated output current is read on a panel meter or chart recorder.

Organic compounds containing nitrogen, oxygen, or halogen atoms give a reduced response when compared to compounds without these atoms. The FID hydrocarbon analyzers are usually calibrated in terms of a gas such as methane or hexane, and the output is read in parts per million of carbon measured as methane or hexane.

Although nitrogen (N₂), carbon monoxide (CO), carbon dioxide (CO₂), and water vapor (H₂O) do not produce significant interferences, condensed water vapor can block the sample entry tube and cause erratic readings. Also, when oxygen (O₂) exceeds 4 percent, a significantly lower output reading can occur.

The relative response of the FID to various organic compounds, including those with attached oxygen, chlorine, and nitrogen atoms, varies from compound to compound.

3.1.2 Photoionization Detectors

In the photoionization process, ultraviolet light ionizes a molecule as follows: $R + h\nu \rightarrow R^+ + e^-$, where R^+ is the ionized species and $h\nu$ represents a photon with energy less than or equal to the ionization potential of the molecule. Generally all species with an ionization potential less than the ionization energy of the lamp are detected. Because the ionization potential of all major components of air (O_2 , N_2 , CO , CO_2 , and H_2O) is greater than the ionization energy of the lamps in general use, they are not detected.

The sensor consists of an argon-filled, ultraviolet (UV) light source that emits photons. A chamber adjacent to the sensor contains a pair of electrodes. When a positive potential is applied to one electrode, the field that is created drives any ions formed by the absorption of UV light to the collector electrode, where the current (proportional to the concentration) is measured.

3.1.3 Nondispersive Infrared Detector

Nondispersive infrared (NDIR) spectrometry is a technique based on the broadband absorption characteristics of certain gases. Infrared radiation is typically directed through two separate absorption cells: a reference cell and a sample cell. The sealed reference cell is filled with nonabsorbing gas, such as nitrogen or argon. The sample cell is physically identical to the reference cell and receives a continuous stream of the gas being analyzed. When a particular hydrocarbon is present, the IR absorption is proportional to the molecular concentration of that gas. The detector consists of a double chamber separated by an impermeable diaphragm. Radiant energy passing through the two absorption cells heats the two portions of the detector chamber differentially. The pressure difference causes the diaphragm between the cells in a capacitor to distend and vary. This variation in capacitance, which is proportional to the concentration of the component of gas present, is measured electronically.

The NDIR instruments are usually subject to interference because other gases (e.g., H_2O and CO_2) absorb at the wavelength of the gas of interest. Efforts to eliminate the interferences by use of reference cells or optical filters are only partially successful. For hydrocarbon (HC) monitoring, the detector is filled with one or several different hydrocarbons, which may be different from the HC contained in the sample; this causes a disproportionate response. Other sources of errors include gas leaks in the detector and reference cells, inaccurate zero and span gases, nonlinear response, and electronic drift.

3.1.4 Catalytic Combustion or Hot Wire Detector

The heat of combustion of a gas is sometimes used for quantitative detection of that gas. Suffering the same limitation as thermal conductivity, this method is nonspecific, and satisfactory results depend on sampling and measurement conditions.

One type of thermal combustion cell uses a resistance bridge containing arms that are heated filaments. The combustible gas is ignited in a gas cell upon contact with a heated filament; the resulting heat release changes the filament resistance, which is measured and related to the gas concentration.

Another combustion method uses catalytic heated filaments or oxidation catalysts. Filament temperature change or resistance is measured and related to gas concentrations.

3.2 THERMOCOUPLES

The temperature monitors most commonly used are direct-readout hand-held thermocouples. The thermocouple is composed of two wires of dissimilar metals that are joined at one end. When the joined end is heated, a voltage flow can be observed (Seebeck effect). A voltmeter is attached to the thermocouple, and the observed voltage is proportional to the measured temperature. A portable thermocouple assembly consists of a shielded probe, a connecting wire, and a voltmeter. The voltmeter may be a temperature conversion unit on a multimeter or a dedicated direct readout temperature unit. The voltmeter is battery-operated, small, and easily portable.

3.3 STATIC PRESSURE GAUGES

Among the several different available static pressure gauges, the most commonly used for this type of field work are the inclined manometer and the diaphragm gauge. A pressure tap is necessary for use of a portable static pressure gauge. The pressure tap basically consists of a small opening in the wall of a duct, which can be fitted with a connection and a hose to make pressure measurements. The tap should be far enough away from such disturbances as elbows and internal obstructions to make the effects of such disturbances negligible.⁴

The appropriate side, positive or negative, of the manometer or pressure gauge is connected by a rubber hose at the tap, and a pressure reading can be taken. It is often advantageous to disconnect a permanent pressure gauge and take a pressure reading at that point to compare it with the facility's instrumentation.

SECTION 4

ESTABLISHING AN AGENCY PROGRAM FOR THE USE OF PORTABLE INSTRUMENTS FOR MONITORING VOC AND AIR TOXICS SOURCES

The portable instruments used during VOC and air toxics source inspections require special care and attention to ensure that they provide results that are consistent with the agencies overall goal and objectives. A well developed and organized program is necessary to ensure selection of the proper instruments and adequate calibration procedures; the adoption of written measurement and recordkeeping procedures; and the taking of sufficient field notes during inspections. The purpose of this section is to help a regulatory agency establish a complete program for the use of portable instruments for VOC source inspections.

Factors to consider during the preparation of bid specifications include the instrument performance requirements of the promulgated regulations and the practical features that improve the instrument's reliability and make it more convenient to use. Detailed information is necessary concerning the type of laboratory and shop facilities that will be needed to support portable inspection instruments. These instruments should not be calibrated, maintained, and stored in an office.

4.1 SELECTION OF THE NECESSARY TYPES OF INSTRUMENTS

Selection of the types of instruments needed for source evaluation is based primarily on a review of the types of industrial facilities within the agency's jurisdiction and an evaluation of the inspection requirements inherent in the promulgated VOC regulations. Agencies should also determine if it is possible to select instruments that can be used for future air toxic control requirements as well as the already existing VOC regulations.

4.1.1 Organic Vapor Analyzers

Detector's Response--

One important criterion in the selection of organic vapor detectors is the response of the instrument to the specific chemical or chemicals present

in the gas stream. The abilities of the major classes of organic vapor analyzers to detect different organic chemicals differ substantially. The response factor, defined below, provides a convenient index of this property.

$$\text{Response Factor} = \text{Actual Concentration} / \text{Instrument Observed Concentration}$$

A response factor of 1.0 means that the instrument readout is identical to the actual concentration of the chemical in the gas sample. As the response factor increases, the instrument readout is proportionally less than the actual concentration. If the regulatory limit is 10,000 ppmv (observed), the use of an instrument with a response factor of 10 for the specific chemical(s) would allow an actual concentration of 100,000 ppmv. Conversely, the use of an instrument with a response factor of 0.1 would indicate that the regulatory limit of 10,000 ppmv had been exceeded when the actual concentration is only 1000 ppmv. It is desirable to select an instrument with response factors as close as possible to 1.0 for the specific compounds of interest.

Unfortunately, instrument response factors can be complex functions of numerous variables. The response factors depend on the chemical compound used to calibrate the organic vapor detector and on the concentration of organic vapor being analyzed.^{5,6} Published response factors that specify the value based on the instrument-determined concentration are preferred in the selection of an instrument because they are the most consistent with the regulatory format.

Fugitive leaks often will involve mixtures of organic vapors. Work done by Brown, Dubose, and Harris indicated that the response factor for a mixture of two organic compounds falls between the individual response factors for the compounds.⁷ This would suggest that the instrument offers no synergistic phenomenon and that weighted average response factors could be used to approximate instrument response to a mixture.

Representatives of instrument manufacturing companies contacted as part of this study generally believe that the response factors published by EPA and by their companies are sufficiently accurate.^{19,21,39} Slight differences, however, do exist between response factors determined by EPA and those reported by instrument manufacturers. These differences could be due to differences in the calibration procedures, the specific instrument model used in the work, or the specific instrument itself. Many instrument manufacturers, however,

believe that instrument-to-instrument variability in the response factors is slight and that the values remain relatively stable over the life of the instrument.^{19,21,39,40} Neither the EPA nor the instrument manufacturing companies, however, have specifically studied instrument-to-instrument variability or long-term response factor stability. One consulting firm has recommended that users routinely redetermine the response factors rather than relying on published values.²⁴ There are some who believe that routine re-determination of instrument-specific response factors by regulatory agencies is unnecessary in most cases. The most recent response factor data published by both EPA and the instrument manufacturers should be consulted before instruments are purchased. The response factor data compiled in Appendix B should assist regulatory agencies in their evaluation of the general capabilities of different styles of instruments. These data include a partial listing of the response factors determined for the Foxboro OVA-108 and the Bacharach TLV Sniffers.^{5,6} Limited response factor information concerning photoionization analyzers and one infrared analyzer has been abstracted from other sources.^{8,9}

A review of the response factor data shown in Appendix B indicates that a substantial difference exists among the four major categories of VOC instruments. The instruments capable of monitoring high concentrations of hydrocarbon compounds, which make up many of the VOC emissions, are not as useful for measuring some of the oxygenated and chlorinated organic compounds, which represent many of the air toxic emissions. Thus, it may be impossible to reconcile the needs of both the VOC and air toxics inspection programs by the selection of a single type of instrument.

Because response factor data are currently very limited, agencies may wish to use additional data in selecting organic vapor analyzers. In the case of photoionization units, the ionization potentials of organic compounds provide a qualitative index of the instrument's capability to detect the compound. A summary of ionization potential data provided by an instrument manufacturer¹⁰ is provided in Appendix C. In reviewing these data, the agency should note that an instrument often can detect compounds with ionization potentials slightly above the rating of the lamp. For example, a compound with an ionization potential of 10.5 eV could possibly be monitored with an

instrument having a 10.0 eV lamp.¹¹ Although the lamp's rating is based on the wavelength of the most intense emission line, there are often less intense emission lines at shorter wavelengths.

Range and Accuracy--

The ability of an instrument to measure 10,000 ppmv should be carefully considered if the instrument will be used to determine compliance with EPA Method 21 regulations. As indicated in Table 4, only a few of the currently available units can operate at 10,000 ppmv or above. Other units can operate at this concentration only by using dilution probes. Although dilution probes can be used accurately, they can also be a large source of error. Both changes in flow rate through the dilution probe and saturation of the charcoal tubes used to remove organic vapors from the dilution air can lead to large errors in the indicated organic vapor concentration. Dilution probes also complicate calibration and field span checks. For these reasons, they should be avoided whenever possible.

Generally, the instruments should have the desired accuracy at the concentration of interest. It should be noted that an accuracy of ± 5 percent is required for Method 21 work.

Ease-of-Use--

Ease of use is an important instrument selection criterion because of the conditions under which the field inspector must work. The instrument must be as light as possible because the inspector must walk over relatively large areas (in most facilities) to evaluate fugitive leaks from numerous valves and other sources. In some cases, a moderate amount of climbing is also necessary. After 4 to 6 hours, even a light instrument can seem uncomfortably cumbersome.

Table 5 contains information concerning the portability of some of the commercially available organic vapor instruments. As shown, the weights of the units and the manner in which they are used differ substantially.

Generally, instruments equipped with shoulder straps are the most convenient to use for fugitive VOC leak surveys.¹¹ The instrument readout on the hand-held probe is very important, because the inspector immediately sees when the probe has been placed in a very high VOC concentration. The hand-held gauge also slightly reduces the time involved in leak surveys.

TABLE 5. EASE-OF-USE OF ORGANIC VAPOR ANALYZERS

Instrument manufacturer	Type	Weight, lbs	Mode of use	Other comments
Century (Foxboro) 108	FID	13	Shoulder strap	Readout on probe
Century (Foxboro) 128	FID	13	Shoulder strap	Readout on probe Necessary to remove cover to adjust range
Photovac 10S50	PID	26	Case with handle	Necessary to open case at each measurement site
HNU PI-101	PID	9	Shoulder strap	
AID Model 585	PID	8	Small case with handle	
AID Model 712	FID	14	Shoulder strap	Readout on probe
Barachach TLV	Catalytic	5.5	Shoulder strap	
Ecolyzer 400	Catalytic	8	Shoulder strap	
Miran 1A	Infrared	12.5	Carrying handle	Necessary to set unit down at each measurement site

Intrinsic Safety--

All instruments used during field inspections of VOC source and air toxic sources must be intrinsically safe if they are to be used in potentially explosive atmospheres. Localized pockets of gas (and even particulates) within the explosive range can result from fugitive leaks and malfunctioning control devices. Intrinsic safety simply means that the instrument will not provide a source of ignition for the explosive materials when the instrument is used properly. Instrument designs are certified as intrinsically safe for certain types of atmospheres by organizations such as the Factory Mutual Research Corporation. Table 6 lists the types of atmospheres by safety classification. The conditions can be further classified according to Groups A through G,

TABLE 6. DEFINITIONS OF HAZARDOUS LOCATIONS IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE^a

Classification	Description
Class I locations	Areas where volatile flammable liquids and flammable gases are used and handled.
Division 1	Class I areas where hazardous concentrations are likely to occur in the course of normal operations.
Division 2	Class I areas where hazardous concentrations are probable only in the case of accidents or unusual operating conditions.
Class II locations	Areas where combustible dust may be present.
Division 1	Class II areas where combustible dust is likely to be present in explosive or ignitable concentrations in the course of normal operations.
Division 2	Class II areas where hazardous concentrations of combustible dust is probable only in the case of accidents or unusual operating conditions.
Class III locations	Areas where easily ignited fibers and materials that could result in combustible flyings are present.
Division 1	Class III areas where easily ignited fibers and materials are processed.
Division 2	Class III areas where easily ignited fibers and materials are stored or handled.

^aSources: References 12 and 13.

which denote the type of flammable vapor or combustible dust that may be present.

The large majority of the organic vapor analyzers are designed to be intrinsically safe in Class 1 areas. Factory Mutual, however, has certified only a few of the currently available commercial instruments to be intrinsically safe. Table 7 lists the present status of commercial instruments.

It should be noted that the information presented in Table 7 could change in the near future. At least one manufacturer has several applications pending concerning hazardous location approval.¹⁴

TABLE 7. INTRINSIC SAFETY RATINGS OF COMMERCIAL INSTRUMENTS, JANUARY 1986^a

Instrument manufacturer	Model	Atmosphere	Factory mutual approved
Foxboro	OVA-108	Class I, Division 1	Yes
Foxboro	OVA-128	Class I, Division 1	Yes
Bacharach	TLV ^b	Class I, Division 1 and 2	Yes
AID, Inc.	585	Class I, Division 2	No
AID, Inc.	712	Class I, Division 1	No
HNU Systems, Inc.	PI-101	Class I, Division 2	No

^aNot a complete listing of commercial instruments.

^bModel 0023-7356.

Other Considerations--

Several recent improvements have been made in probe design. As a result, agencies should carefully evaluate the probes available with the organic vapor analyzer models they are considering. By reviewing detailed drawings or examining "loaner" probes, agencies can determine if the probe is susceptible to leakage. Air infiltration through the probe has been a common problem in the past.^{15,16,17,18} This problem has been especially severe on telescoping-type extension probes.

Some older flame ionization analyzers have suffered hydrogen leaks due to cold creep of the TEFLON washers used to seal part of the pressurized hydrogen line.^{18,19} The hydrogen leak ignition problems reported in earlier studies,¹¹ however, may have been solved by redesigning the hydrogen line fittings.¹⁹ Agencies should examine the hydrogen line design on any FID that is being seriously considered for purchase to ensure that this will not be a problem.

4.1.2 Thermocouples

It should be noted that currently none of the battery-powered thermocouples are designed as intrinsically safe for either Class I or Class II atmospheres. Therefore, these instruments cannot be taken into or through

areas where there is a possibility of encountering explosive mixtures of organic vapor and/or dust. Conventional flashlights are also not intrinsically safe, and they should be replaced by explosion-proof flashlights.

4.2 INSTRUMENT SPARE PARTS AND ACCESSORIES

Portable instruments for inspection of VOC sources and air toxic sources are sophisticated units. Maintaining an available supply of certain accessory spare parts and routine replacement parts will minimize unnecessary downtime of these instruments and will help field inspectors to obtain high quality data.

4.2.1 Battery Packs

All of the organic vapor analyzers require a rechargeable battery pack to operate the sample pump and the electrical components. Failure of these battery packs is a common problem with these instruments.^{11,15,16} A replacement battery pack should be taken along on all field inspections in case an unexpected failure should occur. A spare is also useful when field work is being conducted during cold conditions, as such conditions reduce the useful operating time.¹⁹

A spare recharger is also necessary for the lead-acid gel battery packs used in some types of flame ionization analyzers, as these batteries must be recharged on an almost continuous basis to prevent loss of the charge. If a deep discharge occurs, the battery pack cannot be recharged by the unit supplied with the instrument.¹⁹ Thus, two rechargers are needed, one for the original instrument battery pack and one for the backup battery pack.

Spare rechargers are also recommended for the nickel-cadmium (Ni-Cd) battery packs commonly used in the photoionization instruments. Recent improvements in battery rechargers have significantly reduced the possibility of battery overcharge.²⁰ Only these newer style units should be used if the instrument has the Ni-Cd batteries.

A nonrechargeable 9-volt battery similar to those used in radios, is normally used in a thermocouple. As a result, a spare is recommended.

4.2.2 Detectors

The photoionization analyzers and the catalytic combustion analyzers have detectors that must be replaced after extended use. The inspectors should take replacement detectors with them on field trips in case they are needed.^{17,21}

For photoionization units, the key component is the ionization lamp within the detector. Inspectors should take at least one spare lamp on all field work in the event that one of the following may occur: the lamp is damaged by the deposition of nonvolatile components on the lamp window, the window is scratched during cleaning, the lamp is damaged by physical shock, or the lamp simply wears out.

The detectors of catalytic combustion analyzers are composed of a coated hot wire that is part of a Wheatstone bridge. Exposure to high concentrations of organic vapor can cause excessive volatilization of the catalyst from the wire surface.²¹ The sensor also can be damaged by the deposition of nonvolatile, noncombustible material. For these reasons, at least two replacement sensors should be taken on field inspections.

4.2.3 Particulate Filters

All organic vapor analyzers are subject to damage by the deposition of nonvolatile materials in the instrument probes and/or the instrument detectors. Most commercially available units include some form of particulate filters within the probes to collect this material. Several replacement filters should be taken along with the instruments because the filters are easily blinded.

Most experienced instrument operators consider it prudent to use a glass wool "Prefilter" in addition to the instrument filters to reduce further the chances of particulate deposition inside the instruments.^{11,16,17} A small section of plastic tubing with some glass wool is recommended for all organic vapor analyzers. Care must be taken, however, to ensure that the filter does not add excessive sample flow resistance.

4.3 LABORATORY AND SHOP SUPPORT FACILITIES

Because of their level of sophistication, organic vapor analyzers require laboratory and instrument shop support facilities. Regulatory agency inspectors should not attempt to store and calibrate the instruments in their

offices, as this practice can lead to significant safety problems and complicate the routine maintenance of the instruments.

4.3.1 Storage of Compressed Gases

One of the primary purposes of the laboratory facility is to provide a safe location for storage of the gas cylinders used to calibrate the organic vapor analyzers. These facilities are able to secure the cylinders firmly so they cannot be knocked over accidentally. Accidents involving even small gas cylinders in offices could have very serious consequences. Furthermore laboratories can and should store the cylinders in areas that are properly ventilated with exhaust hoods. Conversely, leaks of compressed gas in offices can lead to localized high concentrations of gases such as hexane, benzene, butadiene, and vinyl chloride, or even to localized pockets of explosive gas mixtures. For these reasons, it is very important to store and use the calibration cylinders, zero gas cylinders, and hydrogen cylinders (for flame ionization analyzers) in properly designed laboratory facilities.

Another important consideration is that the exhaust from organic vapor analyzers during calibration can be toxic. In the case of the photoionization analyzers, most of the inlet calibration gas is exhausted because the instruments are nondestructive. In the case of flame ionization detectors, however, low concentrations of phosgene and hydrogen chloride can be emitted when chlorinated hydrocarbons are used for calibration.²² Thus, the instrument should be placed in a location where the exhaust is captured by an approved hood and ventilation system.

4.3.2 Gas Flow Evaluation

Many of the organic vapor analyzers, especially the flame ionization detectors, are sensitive to the sample gas flow rate. Routine confirmation of proper flow rate is important, especially for those instruments that do not include a flow sensor. Flow rates are normally measured by use of a rotameter designed for flow rates between 0.5 and 5.0 liters per minute. The rotameter should be calibrated against a soap bubble flow meter.

4.3.3 Electrical Diagnostic Equipment

The extent to which malfunctioning organic vapor analyzers can be serviced by agency personnel is limited because the intrinsic safety of the

instrument can be voided inadvertently. Nevertheless, qualified agency instrument technicians should be equipped to check such basic operating parameters as the lamp voltages of photoionization units and the battery output voltages on all portable instruments.

4.3.4 Thermocouple Calibration Equipment

The thermocouple readout device and thermocouple probes should be calibrated at least twice a year. For convenience, the calibrations should be performed in-house with a conventional tube furnace. The field instrument and probes are compared against National Bureau of Standards (NBS) traceable thermocouple probes.

4.3.5 Static Pressure Calibration Equipment

All diaphragm-type static pressure gauges must be calibrated on at least a weekly basis. A relatively large U-tube manometer should be permanently mounted in the agency laboratory for calibration of 0 to 10 inch W.C. and the 0 to 60 inch W.C. gauges.²³ An inclined manometer is needed for calibration of the 0 to 2 inch W.C. gauges.

4.3.6 Storage Space

Adequate space should be provided to store the instruments, the necessary spare parts, and the routine calibration/maintenance records. The availability of convenient storage space removes the temptation to store the instruments in the trunk of a car, where they could be damaged by excessive vibration and shock or by excessive heat. A checklist should be posted near the stored units listing the spare parts that should be taken to jobsites to ensure adequate instrument performance during the inspection.

Adequate working area should be provided for the inspectors to calibrate and check-out the instruments before leaving for the field. The working area must be large enough to accommodate a 20 to 30 liter TEDLAR bag, the instrument, the gas cylinders, and any gas-blending equipment that may be necessary.

4.4 INSTRUMENT MAINTENANCE PROGRAM AND RECORDS

In most regulatory agencies, numerous individuals will use the portable organic vapor analyzers, thermometers, and static pressure gauges, and it is

unrealistic to expect all of them to be fully knowledgeable concerning instrument calibration and repair. It is also unrealistic to ask each of them to make independent determinations of organic vapor analyzer response factors or other performance data obtained on an infrequent basis. Therefore, one or two people should be assigned the responsibility for the overall maintenance of the instruments. Persons skilled in instrument calibration and/or repair are ideal for this assignment. They can make whatever nonroutine tests and measurements are necessary to ensure that the monitors continue to perform adequately. They can also instruct other agency personnel concerning the proper way to replace filters, detectors, and battery packs, to operate the unit; and to perform field span checks.

Only those persons assigned responsibility for the instruments should make any routine repairs other than the replacement of detectors, photoionization lamps, battery packs and particulate filters, which can be replaced by the inspector and the replacements noted in a log or report provided to the person who has been assigned responsibility for the unit. This reduces the chance of the intrinsic safety of an instrument being inadvertently bypassed by an unqualified individual. The instruments should be returned to the manufacturers for any nonroutine repairs.

Records should be maintained on each instrument including all routine calibrations, any response factor determinations, and all repair notes. Problems reported by field personnel should be briefly summarized in a chronological record. The file should contain at least one copy of each operating manual and a list of all part numbers (if not included in the manual).

4.5 COSTS

4.5.1 Instruments and Accessories

Cost data for various organic vapor analyzers and other instruments have been compiled to illustrate the capital and operating costs. These data are presented simply to help regulatory agencies prepare realistic budgets. They should not be used for comparison of different instruments, as each instrument has different applications and capabilities.

The cost data are based on verbal quotes and published price lists prepared by instrument manufacturers. The data were obtained in December 1985

and were confirmed in January 1986. Cost data presented in earlier reports^{24,25,26} are generally out-of-date. All of the price information presented in this section should be confirmed because price increases are expected in the near future.

Also included are the costs of various accessories believed to be helpful in ensuring high-quality field data and acceptable instrument availability. Organic vapor analyzers require numerous accessories and spare parts and the cost of these should be included in the original budgets.

The yearly operating cost estimates presented herein are based on the use of the instrument for 50 days a year, 6 hours a day. It has been assumed that laboratory calibration will be performed before any field work begins and that field span checks will be performed at least twice a day. Costs of calibration gases for the field span checks are based on the disposable-type cylinders offered by several different suppliers.

The cost of the HNU PI-101, the Foxboro OVA 108, and the Bacharach TLV Sniffers are presented in Tables 8, 9, and 10, respectively. The specified costs apply to the intrinsically safe model, which is the only type that regulatory agencies should use. The tables represent the kind of information that should be compiled regardless of which type of instrument or model is being considered.

The relatively large fraction of the basic analyzer cost represented by the accessories reflects the high cost of spare battery packs and rechargers needed because of the vulnerability of intrinsically safe battery packs when not cared for properly. When a battery pack fails, getting a replacement could take anywhere from 1 week to several months; therefore, having spare battery packs and chargers is a necessary expense.

Another major component that drives the accessory costs up is the detector cells. The detector in each of the instruments has one or more sensitive components. Exposure to high temperature, moisture, particulates, or very high organic vapor concentrations can cause premature failure. Regulatory agencies that use these instruments for a variety of purposes ranging from leak surveys to roof monitor emission surveys are likely to damage the detectors occasionally regardless of how carefully the inspectors conduct the field work.

TABLE 8. ESTIMATED COSTS OF HNU MODEL PI-101 PHOTOIONIZATION ANALYZER

Equipment and supplies	Cost, \$ ^a
Analyzer, Model 81-IS-101-100 (intrinsically safe), with corrosion-resistant detector chamber	5245
Accessories ^b	
Spare 10.2 eV lamp	300
Span gas cylinder regulator	99
Instrument carrying case	250
Spare battery pack	200
Spare recharger	360
Spare probe extension	30
Spare fan	<u>240</u>
Subtotal	1479
	<u>Cost/year, \$</u>
Expendable supplies	
Calibration gas cylinder (3 cylinders per year minimum)	150
Particulate filters	20
Cleaning compound (\$24 per unit, 1 unit required)	25
Replacement lamp	300
Yearly factory service	<u>300^c</u>
Subtotal	795

^aAll cost data provided by HNU Systems, Inc.^{27,28}

^bNecessary accessories and supplies specified by Richards Engineering.

^cDoes not include \$40 shipping charges.

TABLE 9. ESTIMATED COSTS FOR FOXBORO MODEL 108 FID TYPE ORGANIC VAPOR ANALYZER^a

Equipment and supplies	Cost, \$
Analyzer, with GC option	5200
Accessories ^b	
Spare battery pack	460
Spare recharger	427
Spare probe	40
Recorder (intrinsically safe)	460
Ignitors	32
Pump valves (package of 10)	15
Pump diaphragm	20
Mixer/burner assemblies	200
Washers, TEFLON (package of 12)	18
Washers, brass (package of 12)	15
Calibration kit regulator and case	<u>90</u>
	Subtotal 1777
	<u>Cost/year, \$</u>
Service and supplies	
Yearly factory service	110 ^c
Chart paper (\$60/6 rolls, 6 rolls/year)	60
Flame arrestors (package of 10)	9
Calibration gas for field span checks (4 at \$63)	252
Factor determinations (2 cylinders at \$82 each)	164
Hydrogen gas (< 0.5 ppm HC)	<u>60</u>
	Subtotal 736

^aInstrument related cost data provided by Foxboro.²⁹ Calibration gas and hydrogen gas cost data.^{30,31,32}

^bNecessary accessories and supplies specified by Richards Engineering.

^cDoes not include \$40 shipping charges.

TABLE 10. ESTIMATED COSTS FOR BACHARACH TLV SNIFFER^a

Equipment and supplies	Cost, \$
Analyzer, Model 53-7-TLV	1580
Accessories ^b	
In-line filter and water trap assembly	62
Battery charger	56
Spare battery pack	392
Spare detector cell	115
Calibration kit (regulator, case and 2 cylinders)	<u>212</u>
Subtotal	837
	<u>Cost/year, \$</u>
Service and supplies ^b	
Factory servicing	100 ^c
Calibration gas for field span checks (4 at \$63)	252
Calibration gases for office calibrations and response factor checks (2 cylinders at \$73)	146
Replacement detector	<u>115</u>
Subtotal	613

^aInstrument related cost data provided by Bacharach, Inc.³³ Calibration gas data.^{30,31,32}

^bNecessary accessories and supplies specified by Richards Engineering.

^cDoes not include \$40 shipping charges.

TABLE 11. ESTIMATED COSTS FOR OMEGA PORTABLE THERMOMETER^a

Equipment and supplies	Cost, \$
Analyzer, Model 871	225.00
Accessories ^b	
Beaded probes, 6 feet (2 probes)	51.20
Carrying case	<u>10.00</u>
	Subtotal 61.20
	<u>Cost/year, \$</u>
Service and supplies ^b	
Replacement batteries (5 at \$3 each)	15.00
Calibration (semiannual at \$50 each)	<u>100.00</u>
	Subtotal 115.00

^aCost data provided by Omega Engineering, Inc.³⁴

^bNecessary accessories and supplies specified by Richards Engineering.

The yearly operating cost of each instrument includes a fee for factory service. This is considered a desirable precaution because the instruments are used for compliance determination and because only limited repair/adjustment of intrinsically safe instruments should be attempted by agency personnel.

One of the main yearly operating costs is for calibration gases (certified to plus or minus 2%) shipped in disposable cylinders. Assuming each field span check requires 1 to 2 minutes and the instrument draws 2 liters per minute, the average disposable cylinder will be adequate for only 10 to 20 measurements (assuming 40 liters of compressed gas). At a rate of approximately \$70 per replacement cylinder^{30,31,32} each span check would cost between \$3.50 and \$7.00. Although that is not a high price to ensure high-quality data, some agencies may wish to investigate less expensive alternatives. One alternative is a gas-transfer system. With this approach, calibration gas would be supplied by the same large cylinder used for the laboratory

calibrations and be transported by means of a standard sampling cylinder. The total cost of the components of the sample cylinder system would be \$300 to \$500.^{30,35} This includes a 1-liter, high-pressure, stainless steel sampling cylinder with needle valves, a 10-liter TEDLAR bag, a carrying case, and a regulator. The uncertainty in the cost estimate is due to the lack of available cost data concerning regulators to transfer gas from a large cylinder to a sample cylinder. With the sample cylinder approach, the cost of the calibration gas itself is essentially negligible because sufficient gas would be available from the main laboratory cylinder, which should be purchased once a year. Whereas the initial cost is moderately high, the yearly cost is quite low because the cost of disposable cylinders is eliminated. Another advantage is that the sampling cylinder would only have to be pressurized to approximately 325 psig to provide adequate gas for two span checks per day. This is lower than the 1000 psig used in some types of disposable cylinders. Additional work is necessary to determine if the transfer approach is a safe and economical alternative to the use of disposable cylinders.

The costs of the thermocouple thermometer, shown in Table 11, include the cost of semiannual recalibration against NBS-traceable thermocouples. Although this is a relatively simple procedure, it is assumed that regulatory agencies will not be equipped to perform this calibration. Therefore, the cost for outside calibration has been listed.

The cost of static pressure gauges ranges from \$25 to \$50 apiece, depending on the range of the unit and the manufacturer. Although no accessories or supplies are generally necessary to maintain these instruments, some attrition of the units can be expected if they are treated especially roughly.

4.5.2 General Equipment

Certain basic equipment is necessary to support the instruments used for inspections of VOC and air toxics sources. The cost for this equipment is presented in Table 12. All of the equipment is used and stored in an instrument laboratory or an instrument shop. The general laboratory equipment is used primarily for calibration of the organic vapor analyzers and for the routine determination of instrument-specific response factors.

TABLE 12. GENERAL EQUIPMENT COSTS

Item	Quantity	Cost/unit, \$	Total cost, \$	Reference
20-liter TEDLAR bags	2	22	44	35
Bag evacuation pump	1	250	250	35
Cylinder gas regulators	2	198	396	30
Rotameters, stainless steel with needle valve and baseplate	2	123	246	36
Soap bubble flow meter	1	80	80	
Cylinder brackets	2	27	54	30
TOTAL			1070	

4.6 PREPARING BID SPECIFICATIONS

Each type of organic vapor analyzer and thermometer is produced by several different manufacturers. Many of the instrument models offered by the manufacturers come with different options that are tailored to certain applications. Because of the diversity of commercially available instruments, the bid specifications must be prepared carefully.

An instrument that is to be used for VOC leak surveys must meet the EPA Reference Method 21 specifications summarized earlier in Section 3 and presented in Appendix A. An important performance criterion specified is that the readability of the meter scale must be to plus or minus 5 percent of the leak definition concentration, which is 10,000 ppmv in certain industries. To reach this concentration, some instruments must include a dilution assembly. Another important criterion is that the instrument be intrinsically safe for Class I, Division 1 and 2 environments. If a recorder is specified, it also should be intrinsically safe (some are not).

The specific organic chemicals that will be monitored should be identified before bids are solicited. Instruments have considerably different capabilities, and only those with reasonable response factors for the specific chemicals of interest should be used.

The list of accessories and spare parts should be used along with information supplied by the manufacturers on spare parts to determine those that are necessary. Including these items on the bid list will facilitate a more complete evaluation of the total cost of the different instruments.

SECTION 5

INSTRUMENT CALIBRATION AND EVALUATION

Instruments used to determine compliance of industrial facilities must be accurately calibrated on a routine basis. The calibration precision tests, response time, and response factor tests also should be performed to confirm that the instruments are operating properly for the specific application(s). This section presents various calibration and instrument evaluation options available to regulatory agencies that are establishing an instrument program for VOC and air toxics sources.

5.1 INSTRUMENT CALIBRATION REQUIREMENTS AND PROCEDURES

5.1.1 VOC Analyzers

Calibration Procedures--

Calibration requirements for VOC instrumentation are specified in EPA Method 21 and in the specific NSPS applicable to sources of fugitive VOC emissions. The requirements pertaining to calibration are briefly summarized here, and the complete Method 21 regulations are presented in Appendix A.

- o The instruments should be calibrated daily.
- o The gas concentration used for calibration should be close to the leak definition concentration.
- o The calibrant gas should be either methane or hexane.
- o A calibration precision test should be conducted every month.
- o If gas blending is used to prepare gas standards, it should provide a known concentration with an accuracy of ± 2 percent.

The daily calibration requirement specified in Method 21 and in the various NSPS gives individual instrument operators some flexibility. The calibration could consist of a multipoint calibration in the lab, or it could be a single-point "span check."³⁷

Neither Method 21 nor the applicable NSPS specifies where the calibration takes place. Obviously it would be simpler to conduct the calibration test in the agency laboratory rather than after arrival at the plant being inspected; however, the calibration could conceivably shift sufficiently to affect the accuracy of the leak detection measurements. The degree of possible shift has not been documented for the various commercially available instruments. Although a survey of several major instrument manufacturers indicated that most believe that the units are "calibration stable,"^{19,21,38,39} no distinct study has been conducted to demonstrate confidence in the calibration after the instrument has been subjected to vibration during transit. Because of the suspected potential for calibration shifts in all of the organic vapor analyzer types, one should consider conducting at least a single-point span check after the instrument arrives onsite. This concern is shared by several consultants,^{16,17} an EPA engineer involved in the development of Method 21³⁷ and by a number of instrument manufacturers' representatives.^{19,38,40} Chehaske has recommended that a span test be run at a midpoint of the day and at the conclusion of the field work.¹⁶

Although the span checks discussed above would in most cases qualify as the daily calibrations required by the NSPS; a separate calibration test for organic vapor analyzers should be conducted whenever possible. Calibrations performed in the regulatory agency laboratory as compared to calibrations that are conducted in the field are conducted under more controlled conditions because uniform day-to-day calibration gas temperatures and calibration gas flow rates can be maintained in the laboratory.¹⁷ Furthermore, the initial calibration test provides an excellent opportunity to confirm that the entire instrument system is working properly before it is taken into the field. The laboratory calibration data should be carefully recorded in the instrument calibration/maintenance notebook discussed in Section 4, and this calibration should be considered as the official calibration required by the regulations.

The laboratory calibration is best performed by the personnel assigned primary responsibility for the maintenance and testing of all the agency organic vapor analyzers. This ensures the use of proper and consistent procedures. If instrument problems are identified, the instrument can either be repaired or the field inspector can be issued another unit that is operating properly.

Laboratory Calibrations--

As specified in the EPA-promulgated NSPS, the instruments used in accordance with Method 21 must be calibrated by using either methane or hexane at concentrations that are close to the leak-detection limits. In most cases, the leak-detection limit is 10,000 ppmv, however, for certain sources, it is 500 ppmv above the background levels.

Methane-in-air is generally the preferred calibrant gas for the high concentration range.⁴¹ A hexane-in-air concentration of 10,000 ppmv should not be prepared because it is too close to the lower explosive limit. Also, some hexane can condense on the calibration bag surfaces at this high concentration.¹¹ If hexane-in-air calibrations are necessary, the chosen concentration should be a compromise between the need for adequate calibration of leak-detection levels and the practical safety and reproducibility problems inherent in the use of hexane. The EPA has taken the position that the choice of calibrant gas does not affect the ability of instruments to detect fugitive leaks.⁴¹

Some VOC instruments, such as photoionization and infrared instruments, do not respond to methane (Section 3). With these units, a different calibration gas should be used. If the inspection is concerned primarily with one specific organic compound (e.g., hexane), that compound can be used for calibration. In other cases, a calibration gas that adequately represents the expected mixture of organic compounds that could be leaking from the source should be used. The calibration gases recommended by the instrument manufacturers are shown in Table 13 as a general guide to inspectors.

TABLE 13. RECOMMENDED CALIBRATION GASES FOR ROUTINE INSTRUMENT SERVICE

Type of instrument	Manufacturer	Calibration gas	Reference
FID	Foxboro	Methane	19
FID	HNU Systems, Inc.	Benzene	20
PID	AID Inc.	Benzene	38
Catalytic combustion	Bacharach	Hexane	43

The calibration procedures for each instrument model are specified in the instruction manuals. Material presented in this section is intended to emphasize the importance of certain calibration procedures discussed in these various instruction manuals.

Regardless of the type of VOC instrument, the flow rate of the gas during calibration should be approximately equal to the flow rate during normal use of the instrument, as flow rate influences the measured concentration.²⁴ Proper flow rate is very important for the FID instruments.

The two main calibration techniques that can be used are 1) commercially prepared calibration gas mixtures or 2) blended calibration gas mixtures. The commercially prepared calibration mixtures are more convenient, but they are slightly more expensive than the calibration mixtures blended onsite. When commercially prepared mixtures are used, a large cylinder containing a certified concentration of calibration gas (balance of gas mixture is air) is used to fill a TEDLAR bag. The instrument simply withdraws a gas sample from the bag at a rate of 0.5 to 3.0 liters a minute, depending on the normal sampling rate. The estimated time required for the calibration is shown in Table 14.

TABLE 14. CALIBRATION TIME REQUIREMENTS WHEN USING COMMERCIALY PREPARED CALIBRATION GASES

Activity	Time required, minutes
Set up instrument	2
Instrument warmup and calibration assembly setup	10
Flush sample bags	5
Fill bags with calibration gas and with zero air	2
Reset instrument	5
Record results in notebook or on logsheet	<u>2</u>
Total	26

Obtaining the desired calibration gas mixture in commercially prepared cylinders is sometimes impractical. In such cases, the mixture can be prepared by blending the calibration compound with hydrocarbon-free air in a large TEDLAR or TEFLON bag. This is a much more time-consuming procedure.

For example, the specific steps in the procedures used by Menzies and Fasano⁸ are as follows:

1. Flush and evacuate bag three times with hydrocarbon-free air.
2. Fill bag with hydrocarbon-free air.
3. Inject a known volume of test compound into the bag.
4. Permit at least 1 hour of equilibration to ensure adequate evaporation (if sample is liquid) and mixing.
5. Draw gas sample from the bag.

Menzies and Fasano prepared the hydrocarbon-free air by passing compressed air through silica gel (for air drying), charcoal, and a high efficiency filter. As long as the charcoal bed is not saturated with water and/or organic vapor, it should adequately remove organic vapor. Charcoal beds do not remove methane, however. Menzies and Fasano metered the hydrocarbon-free air into the bag by using a rotameter. Presumably, they used precision rotameters or other accurate gas flow monitors to achieve a known concentration within the required accuracy of ± 2 percent. They injected the calibration compound (a liquid in their work) into the bag with a microliter syringe.

Calibration time requirements can be high. Menzies and Fasano recommended an equilibration time of 1 hour to inject the liquid into the gas. Even when a calibration gas is introduced into a bag, the equilibration time should be between 15 and 30 minutes. Additional time is required to flush the bags several times with VOC-free air. Time requirements for a bag sample calibration are summarized in Table 15.

Because of the lengthy calibration time required by this approach, it would be especially helpful to have an instrument specialist conduct the procedure. This person could calibrate several instruments simultaneously, as much of the time is spent in 1) waiting for the instrument to warmup, 2) waiting for the bag evacuation pump to empty the TEDLAR bag, and 3) waiting for the gas sample to equilibrate in the bag.

When charcoal beds are used to provide the VOC-free air, a routine check should be made to determine breakthrough of organic compounds.²⁴ This is done by passing a low-hydrocarbon-concentration gas stream (approximately 10 to 50 ppmv) through the bed for a period of 5 to 10 minutes. If the bed has not

TABLE 15. CALIBRATION TIME REQUIREMENTS WHEN CALIBRATION GAS MIXTURES ARE BLENDED

Activity	Time required, minutes
Setup instrument	2
Instrument warmup and calibration assembly setup	15
Empty and flush bags	10
Inject calibration compound and equilibrate	30 to 60
Set calibration and zero	5
Record results in notebook or on logsheet	2
Total	75 to 105

become saturated, the outlet hydrocarbon concentration should be low. Obviously, methane should not be used as the hydrocarbon because charcoal is ineffective in adsorbing methane.

Field Span Check Procedures--

The following are some of the various ways to calibrate the portable instrument onsite:

- o Use large pressurized gas cylinders transported to inspection sites.
- o Use certified gas cylinders provided by the source being inspected.
- o Use disposable gas cylinders with the appropriate gas composition and concentration.
- o Use a gas sampling cylinder with a gas blending system.

Transporting large pressurized gas cylinders is generally impracticable because most agencies do not have the vehicles necessary for this purpose. It is not safe to transport unsecured, pressurized gas cylinders in personal or State-owned cars. Furthermore, there are specific Department of Transportation (DOT) regulations governing the shipping of compressed gases.

Using the source's gas cylinders is certainly the least expensive approach for a regulatory agency; however, the appropriate gas cylinders are not always available. Also, the use of the source's cylinders prevents the agency from

making a completely independent assessment of the VOC fugitive leaks and from evaluating the adequacy of the plant's leak-detection program.

Using disposable cylinders of certified calibration gas mixtures is relatively simple because no onsite blending is necessary and the cylinders are easily transported. The calibration gas mixture may be fed to the instrument directly by using a preset regulator that provides constant gas flow and pressure; or the gas can be fed into a TEDLAR or TEFLON bag, from which it is drawn into the portable instrument.

A third approach involves the use of a stainless steel gas sample cylinder with a small TEDLAR sample bag. A small quantity of calibration gas is drawn from a large cylinder of certified gas mixture (at the agency's main laboratory) into the small transportable gas sample cylinder. The calibration gas is kept at a relatively low pressure to minimize safety problems during transport of the material to the jobsite. The compressed gas is transferred to the TEDLAR bag through a regulator and needle valve. At a pressure of 325 psig, a 1 liter sample cylinder should provide enough span check gas for two field checks. Zero air can be supplied by drawing ambient air through a small charcoal filter. This approach is very inexpensive because the agency is using small quantities of the certified calibration gas mixture from the main cylinder at the laboratory and they are not purchasing any disposable cylinders. Some additional development work on this simple approach is necessary to ensure that a regulator is available to transfer the gas from the main cylinder to the sample cylinder at pressures reaching several hundred psig. Most regulators have a delivery pressure limit of 100 psig.^{30,31} It is also necessary to confirm that the compressed gas can be transferred safely. It should be noted, however, that this is the same approach used to fill the hydrogen fuel cylinders on the flame ionization analyzers. Therefore, an approach of this type should be feasible.

Relatively little time is required for the span checks when portable cylinders of certified gas mixtures or transfer gas sample cylinders are used. The time required for various activities is indicated in Table 16. It should be noted that the instrument warmup must be done anyway, therefore this time should not be "charged" against the span check. The overall time commitment to the field span checks is not excessive when one considers the clear indication of organic vapor analyzer performance that these checks provide.

TABLE 16. TIME REQUIRED FOR FIELD SPAN CHECKS

Activity	Time required, minutes
Initial span check	
Assemble and leak-check instrument	4
Warmup instrument and assembly of span check equipment	10
Monitor span check gas	2
Record results in field notes	<u>2</u>
Subtotal	18
Midday span check	
Return to location of span check assembly	15
Fill bag/start span check system	4
Monitor span check gas	2
Record results in field notes	<u>2</u>
Subtotal	23
Final span check	
Fill bag/start span check	4
Monitor span check gas	2
Record results in field notes	2
Empty bag and pack span check equipment	<u>4</u>
Subtotal	12

The field span check should be performed as far away as possible from potential sources of fugitive VOC. It should also be performed in areas where there are no large AC motors or other equipment that generate strong electrical fields, as such equipment can have an adverse effect on certain types of instruments (e.g., photoionization analyzers).¹⁹ The charcoal filter used in the "clean air" supply should be routinely regenerated to avoid the possibility of saturation. The charcoal filter should be checked occasionally for saturation by supplying a moderate, known concentration of VOC and then checking the measured exit concentration after several minutes.

Data concerning the span checks should be recorded in the inspector's field notes. This will demonstrate that the specific unit operated properly during the period in which compliance information was obtained at the

inspection site. If gauges are provided with the instrument, the field inspector also should occasionally note the instrument sample gas flow rate.

5.1.2 Thermocouples

Thermocouples may be tested in several ways. The simplest method for testing is checking a thermocouple in an ice bath and in boiling distilled water. There are electronic "ice point" reference circuits commercially available to check thermocouple operation. There also is an isothermal zone box test equipment to test the thermocouple in a different range. There are several suggestions for thermocouple operation. These include:³

1. Use the largest wire possible that will not shunt heat away from the measurement area
2. Avoid mechanical stress and vibration that could strain the wires
3. Avoid steep temperature gradients
4. Use the thermocouple wire well within its temperature rating
5. Use the proper sheathing materials in hostile environments.

5.2 ROUTINE LABORATORY EVALUATION OF INSTRUMENT PERFORMANCE

Routine laboratory evaluation of instrument performance must be conducted. This evaluation includes determination of response factors, determination of response time, determination of instrument sample flow rates, and calibration precision tests.

5.2.1 Determination of Response Factors

When published response factors for the organic compounds being monitored are much greater than 1 (approaching 10) or much smaller than 1 (approaching 0.1), however, it would be prudent to measure the response factor for these specific compounds. A response factor of 10 is the maximum allowed by Method 21, which means that the meter response was 10,000 ppmv when the actual concentration was 100,000 ppmv. Although Method 21 does not specify a lower limit to the response factor, a response factor value of 0.1 means the observed concentration is 10,000 ppmv when the actual concentration is only 1,000 ppmv. The general procedure for measuring the response factor is presented in Method 21 (Appendix A).

5.2.2 Determination of Response Time

The response time of the organic vapor analyzer is an important operating variable. A decrease in instrument response time due either to leakage downstream of the pump or to increased flow resistance through instrument probes and filters can slow down the field work.

For compliance with Method 21 specifications, the response time should be checked before initially using the instruments in the field and whenever the sample flow system has been changed. Agency personnel should conduct this test more frequently, however, to confirm that no leakage of sample air has occurred downstream of the pump. The use of soap solution is the only alternative to identify sample gas leakage after the instrument pump,¹⁸ and it is difficult to apply and observe soap solution in the cramped areas around the instrument pumps. Instructions for conducting response factor tests are included in Section 4.4.3 of Method 21.

5.2.3 Determination of Instrument Sample Flow Rate

For organic vapor analyzers, especially those without flow monitors, the sample flow rate should be measured on a routine schedule. A calibrated rotameter or other flow sensor should be used to determine the flow rate when the typical particulate filters, prefilters, and other flow restrictions are in place. If an instrument rotameter is used, its adequacy should be checked.

The fact that instrument response is relatively insensitive to sample flow rate (i.e., photoionization analyzers) does not eliminate concern over proper flow rate. The tip of the sensor probe operates much like a small hood, and reductions in sample flow rate reduce the effectiveness of pollutant capture. Furthermore, if the probe is not oriented correctly, the "high" pressure organic vapor plume acts like a strong cross-draft across the probe inlet. For these reasons, maximum capture effectiveness is essential, and reduced sample flow rates should be of concern regardless of the type of organic vapor analyzer used.

5.2.4 Calibration Precision Tests

Calibration precision tests must be made before the analyzer is placed in operation and at 3-month intervals thereafter. The general procedures are discussed in Section 4.4.2 of Method 21. As with the other instrument

evaluation procedures, this test is best performed by instrument specialists who are assigned responsibility for routine calibration and maintenance of all the agency's portable instruments (discussed in Section 4.4 of this manual).

5.3 ROUTINE FIELD-ORIENTED EVALUATIONS OF INSTRUMENT CONDITIONS AND PERFORMANCE

Several instrument performance checks should be made before the inspector leaves for the jobsite and during the routine screening of possible fugitive VOC sources. The field-check procedures are in addition to, not a replacement for, the calibration procedures discussed earlier. The daily calibration, the field span checks, and the routine field performance checks are necessary to confirm that the instrument is operating properly. Preferably, the initial instrument checks should be made by the regulatory agency's instrument specialist assigned responsibility for the monitors. Brief notes concerning each day's initial instrument checks should be included in the main instrument evaluation/maintenance notebook kept in the instrument laboratory. The inspectors make the field checks by using the instruments at the jobsite and documentation of these field checks should be part of the inspectors' field notes.

5.3.1 Initial Instrument Checks

It is very important that a few simple instrument checks be made before the inspector leaves for the jobsite. The appropriate field checks for each instrument can be found in the instruction manual supplied by the instrument manufacturer. The following common factors, however, should be checked regardless of the type of instrument:

- o Leak checks including integrity of sample line and adequacy of pump operation
- o Probe condition
- o Battery pack status
- o Detector condition
- o Spare parts and supplies.

All of these checks can be made in a period of 5 to 15 minutes. Repairs to the detectors, batteries, and probes usually can be accomplished quickly if

a set of spare parts is kept on hand. Some of the checks that should be made before field work is begun are discussed in the following subsections.

Leak Checks--

To leak check the probes on units with flow meters, the probe outlet should be plugged for 1 to 2 seconds while the sample pump is running. If the sample flow rate drops to zero, there are no significant leaks in the entire sampling line. If any detectable sample flow rate is noted, further leak checks will be necessary to prevent dilution of the VOC sample gas during screening tests. The leak checks involve a step-by-step disassembly of the probe/sample line starting at the probe inlet and working back toward the instrument. At each step, the probe/sample line is briefly plugged to determine if inleakage is still occurring at an upstream location. Once the site of leakage has been determined, the probe/sample line is repaired and reassembled. To confirm that the probe/sample line is now free of air infiltration, the probe is again briefly plugged at the inlet to demonstrate that the sample flow rate drops to zero.

When leaks are detected, there is sometimes a tendency to overtighten the fittings, especially those between the instrument body and the end of the sample line. With some types of fittings (e.g., Swagelok fittings) over tightening can damage the fitting and even lead to persistent leaks.³⁸

Units that do not have flow monitors should be leak-tested by installing a rotameter on the sample line as close as possible to the inlet to the instrument body. The leak-testing procedure described above can then be followed. Also, the sound of the pump should be noted, as this provides one qualitative means of identifying pluggage. It should be noted, however, that pump noise is useless for identification of probe leakage because the pump continues to receive air due to the infiltration.

One report states that the catalytic combustion units should not be leak-tested by plugging the probe.²⁴ Short-term loss of sample flow would reportedly lead to high detector temperatures. One manufacturer, however, reports that the detector used on their instrument is the same as the detector used on a diffusion-controlled sampler and that the short-term loss of sample flow would not be a significant problem.²¹

When more than one probe can be attached to the instrument body, each probe should be tested. Only those that can be sealed properly should be packed for field use.

Probe Condition--

The probes for some instruments can contain a number of independent components, especially those that dilute the sample before analysis. The physical condition of the probe should be visually-checked before use. These checks include, but are not limited to:

- o Presence of any organic deposits on the inside of the probe
- o Presence of clean particulate filter in the probe
- o Condition of orifice(s) used to control dilution air flow into the sample probe
- o Condition of sealing "O" ring or other sealing assembly used to prevent inadvertent dilution of sample flow.

Any deposits found should be removed, or a different probe should be used. Cleaning instructions can be found in the manufacturers' operating manuals. Generally, the probes are cleaned with acetone and then carefully purged of any acetone vapor before assembly.¹⁹

Battery Pack Status Checks--

Checking the battery pack is particularly important because it can be a source of frequent problems. The battery pack condition is normally checked by simply switching the instrument to the "Battery Check" position and observing the dial setting. If the battery appears at all weak, a new battery pack should be installed. Most batteries fail because they have not been recharged sufficiently.

The Ni-Cd batteries, used in many photoionization, catalytic, and infrared instruments, must be charged for 8 to 12 hours for each 8 hours of operation. These batteries are very vulnerable to overcharging. Recent improvements in the Ni-Cd battery chargers, however, have substantially reduced the chance of overcharging.³⁸ Despite a common misconception, the lead acid-gel batteries commonly used in FID instruments are not subject to overcharging, and they should be left on the battery pack recharger whenever the instrument is not in use.¹⁹

During cold weather, weak batteries will operate for only a short period. In fact, if the unit is to be operated in cold conditions for most of the inspection day, it would be helpful to bring a second battery pack along so the battery pack can be replaced at midday.¹⁹

Detector Condition--

Each of the instruments includes a key component within the VOC detector. Rather than an initial calibration (recommended earlier in Section 5.1), some inspectors check the detector status by briefly monitoring automobile exhaust. This is not generally advisable because condensable organic compounds and particulate matter can deposit in the probe, partially plug the filters, and even damage the detector. If a qualitative response test is desired, an organic vapor source, such as a cigarette lighter (do not take into plants to be inspected), certain marking implements, liquid paper thinner, or a small sample bag should be used. A complete calibration is preferred over these qualitative response checks.

The flame ionization instruments are checked by depressing the ignitor button for several seconds. If the unit will not ignite after repeated attempts, there may be problems with the batteries, ignitor, or hydrogen supply. Most of these problems cannot be solved immediately; therefore, other instruments will have to be used until the repairs are completed. Hydrogen leak problems are much less prevalent with newer instruments.¹⁹ Failure of the catalytic units to respond to organic vapor is often due to failure of the main detector cell, an easily replaced component.

Spare Parts and Supplies--

Most of the instruments used on VOC inspections are sophisticated instruments rather than simple "off-the-shelf" items. Each requires some spare parts and supplies to ensure that the inspection is not terminated prematurely. Table 17 provides a partial listing of the recommended spare parts for each general type of instrument. All of the parts listed should be carried to the jobsite. Other spare parts (discussed in Section 4) should be left at the instrument laboratory/shop. Further information is available in the manufacturers' operating manuals and from the manufacturers' representatives.

TABLE 17. PARTIAL LISTING OF RECOMMENDED ONSITE SPARE PARTS
AND SUPPLIES FOR PORTABLE INSTRUMENTS

Instrument	Spare parts and supplies
Flame ionization detectors	Battery pack Particulate filters Glass wool TYGON tubing (1 foot)
Photoionization detectors	Window cleaning kit Spare lamp Particulate filters Glass wool Dilution probe TYGON tubing (1 foot) Rotameter Battery pack
Nondispersive infrared detectors	Battery pack Particulate filter Rotameter Glass wool TYGON tubing (1 foot)
Catalytic combustion units	Detector Battery pack Particulate filter Rotameter TYGON tubing (1 foot)
Thermocouples	Battery Probe

5.3.2 Routine Performance Checks During Field Work

Several routine performance checks should be conducted during field work. These checks take very little time and demonstrate that the unit is continuing to perform in a proper manner. They also should be discussed briefly in the field notes.

Instrument Zero--

The instrument zero should be rechecked whenever it has been exposed to very high organic vapor concentrations and whenever organic liquids may have been inadvertently sucked into the probe.^{18,24,44} The instrument zero should be checked at least twice a day, even when these problems do not occur or are

not suspected. It can be checked by sampling background air at a location upwind of any possible VOC sources or by supplying some charcoal-filtered air to the analyzer. If the zero has drifted significantly, the probe particulate filter and the prefilter (if one is used) should be replaced. Also, the probe should either be cleaned or replaced. The instrument then should be recalibrated before the field work continues.

Instrument Response--

The instrument response should also be checked routinely during field testing because all of the instrument types are vulnerable to operating problems that can result in reduced sensitivity or complete loss of response. In the case of FID's, exposure to very high VOC concentrations (above 70,000 ppmv) can lead to flame out of the unit.¹⁹ It is sometimes difficult to hear the audible flame-out alarm over plant noise unless earphones (supplied with some models) are used. If the inspector fails to hear the flame-out alarm, he or she could miss a number of fugitive leaks.

The catalytic combustion units are also vulnerable to problems when exposed to very high concentrations. The detector can reach temperatures high enough to cause some loss of the catalyst coating.²¹ If done repeatedly, this can also shorten the life of the detector.²¹ Exposure to lead-containing gasoline can lead to some poisoning of the detector catalyst.²¹ For these reasons, the response should be checked whenever the unit is "pegged." The remaining gas in the TEDLAR bag used for span checks provides a convenient source of organic vapor to confirm instrument response.

Response problems of the photoionization and nondispersive infrared detectors result primarily from deposition of condensed organic compounds on the optical surface. The window should be cleaned at least once a day and whenever material might have been deposited as a result of exposure to high concentrations or entrained liquids.^{39,40,45} Unfortunately, contamination on the optical window is not always visible. Therefore, inspectors should simply assume the window is dirty and take the necessary time to use the cleaning solution. Instrument manufacturers recommend a solvent similar to methanol (instrument manufacturers should be contacted for specific recommendations) for routine cleaning.^{39,40} The cleaning compound is mildly abrasive and is intended only for stubborn deposits that cannot be removed by more gentle cleaners.²⁷

Battery Condition--

In the case of some FID's, weak batteries will not have enough power to operate the ignitor, even though a proper reading was obtained during the battery check.¹⁹ This can be a problem after the FID has been operated for several hours and after a number of flame-outs have occurred. Therefore, the instrument operator should check the battery condition several times during the day.

Probe/Sampling Line Leakage--

The probe and sampling line integrity should be checked several times a day by simply plugging the probe inlet. The flow rate indicated by the instrument meter (if one is present) and the sound of the instrument should be noted. Any potential leaks should be corrected before work is continued.

SECTION 6

FIELD INSPECTION PROCEDURES AND INSPECTION SAFETY

This section presents field measurement procedures for regulatory agency inspectors. The first subsection presents several basic reasons why the measurement procedures used by agency inspectors are inherently different from those that may be used by source personnel or their consultants. It also presents some important basic principles concerning the inspection of VOC and air toxic sources. The remaining subsections concern major types of sources for which portable inspection instruments have proven useful. Safety considerations have been integrated with the information concerning field inspection procedures and underlined to emphasize their importance as an essential part of all activities involving the portable instruments.

6.1 PRINCIPLES, REQUIREMENTS, AND LIMITATIONS OF AGENCY INSPECTIONS

One of the basic premises of the inspection techniques presented in this section is that the agency inspector does not have sufficient time to survey all potential sources of fugitive emissions independently or to monitor the performance of all air pollution control devices completely. Furthermore, each inspection involves a review of the permits, a review of operating records, and interviews with appropriate plant supervisory personnel. Because the use of portable instruments, the subject of this manual, composes only one part of the overall inspection, it is unrealistic to assume that agency inspectors can spend the majority of the inspection day using the portable instruments. Rather, inspectors must be able to select those few measurement activities that are most useful in the characterization of the overall conditions at the facility. In the case of fugitive VOC and air toxic leaks, the inspector must determine the monitoring accordingly.

Field inspection surveys conducted by plant personnel and consultants often involve a team of at least two individuals--one to operate the instrument and one to record the data and tag the appropriate sources.

Regulatory agencies usually send only one inspector. As a result, the inspection proceeds more slowly, as the inspector normally must set the instrument down to record the results. This problem cannot be solved by the use of continuous recorders because most of them are not intrinsically safe and should not be used.

The data obtained by regulatory agency inspectors must be of the highest quality reasonably possible because these data are used to determine the compliance status of the facility. Time should be allocated for the field span checks, response checks, and zero gas checks discussed in the earlier sections. It is preferable to have a limited set of data of unquestionably high quality than a large set of potentially inaccurate data.

6.1.1 Inspection Principles

Use of the baseline technique is the best approach to inspection of air pollution control devices such as carbon-bed adsorbers, incinerators, and vapor recovery. The baseline technique is based on the comparison of current inspection data against unit-specific performance data obtained in the past. Shifts in several operating parameters are used as an indication of problems. The portable instruments are used only when there are insufficient onsite equipment performance monitors or when reasonable questions arise concerning the adequacy of the onsite gauges. The basic principles of the baseline technique are as follows:

- o Only unit-specific data are used to evaluate performance.
- o Portable instruments are used when onsite gauges are either unavailable or unreliable.
- o Problems are identified by evaluating changes in a number of operating parameters and conditions.
- o The information is compiled in a methodical manner.
- o The inspection procedure is modified or limited to the extent necessary to ensure safety of the inspector, plant personnel, and the source's equipment.

The baseline technique is not directly applicable to the fugitive VOC and air toxics leak sources, as no directly observable valve or pump operating parameters govern the rate of fugitive emissions. These sources either leak or

they don't. For the fugitive leak sources, the baseline concept should be applied to the plant's leak-detection and repair program rather than to the individual leaking components. The adequacy of the leak-detection procedures is determined by spot-checking potential leaking sources and by rechecking those components that have been tagged previously. Changes over time in the leak-detection and repair program that could have an adverse impact on total emissions should be evaluated. In other words, the adequacy of a plant's leak-detection and repair program is evaluated by using leak data obtained during the current inspection and data obtained during previous inspections. This is a more accurate approach than simply evaluating what activities are conducted at what frequency in a given plant's program. The type of programs necessary at one plant and those at supposedly similar facilities can differ significantly.

6.1.2 General Safety Procedures

All agency personnel should have an occupational health medical examination before conducting any field inspections. This examination demonstrates that the inspector is physically capable of the stress associated with carrying the portable instruments, climbing ladders/stairs, and wearing the required respirators and other personnel protection equipment.⁴⁶ Annual medical examinations should be required.

All regulatory agencies should adopt and adhere to written safety procedures governing all routine activities of field personnel.⁴⁶ Specific safety procedures concerning the use of portable instruments and the types of industries the inspector will visit should be included in these procedures.

Because agency coworkers are rarely present, the inspector should insist that someone from the plant accompany him or her at all times to ensure that the inspector does not inadvertently enter unsafe areas, to assist the inspector in the event of accidental gas releases within the facility, to get help if the inspector is injured, and to provide general assistance and advice regarding safety.^{46,47} Inspectors should not work alone in the facility for any reason.

Prior to leaving for the jobsite, the inspector should obtain all necessary safety equipment. All the safety equipment, especially respirators, should be checked to confirm that they are in good working condition. The proper safety shoes should be worn for the conditions that exist at the facility being

inspected. Because safety shoe requirements differ, the plant should be consulted to determine the proper type of shoe before the inspector departs for the jobsite.

Before entering the processing areas of the facilities, the inspector should discuss the instrument intrinsic safety with the appropriate plant representatives. Portable instruments that are not intrinsically safe should not be taken into Class I, Division 1 and Division 2 areas.

During the field survey, the inspector should use an organic vapor analyzer to help determine if conditions are safe. This is especially true when a tank with a floating roof is only partially full. These situations must be approached with great caution as they are similar to entering a confined area. Half-face cartridge-type respirators for organic vapor are limited to maximum concentrations of 50 ppmv. This concentration can be easily exceeded in the immediate vicinity of fugitive leaks. The inspector should use the organic vapor analyzer to determine if poorly ventilated areas have organic vapor concentrations in the breathing zone that are above the concentration limits of the respirator.

Inspectors rarely have the opportunity to acclimate to heat stress. Heat exhaustion and stroke can result from the physical exertion of carrying the instruments and from exposure to hot process equipment. Inspectors should plan to take regularly scheduled breaks and drink fluids to reduce the risk of heat exhaustion and heat stroke. These breaks are good times to check the zero drift or to perform the field span checks of the portable instruments.

6.2 SCREENING TESTS FOR VOC LEAKS FROM PROCESS EQUIPMENT

The primary purpose of the VOC leak-screening tests is to determine if the plant's leak-detection and maintenance program is adequate. The inspection consists of a review of the leak records and a field survey with an organic vapor analyzer.

6.2.1 Selecting an Inspection Strategy

Because the time available for the field survey is often limited, the most probable "leakers" should be targeted for evaluation. The inspector should consider the following factors to determine potential problem sources.

- o Specific components identified as leakers in the past
- o Type of service (e.g., gas, light liquid, heavy liquid)

- o Type of component (e.g., valves, pumps, flanges, compressors, open-ended lines, relief valves)
- o Pressure of line
- o Temperature of line
- o Specific design of component (e.g., type of pump seal, type of valve, type of valve packing)
- o Age of equipment/component
- o Volatility of specific organic compound(s) being handled
- o Presence of dripping liquids.

Because the field inspector does not have the luxury of spending hours to determine the optimum field survey strategy, it is recommended that field monitoring primarily emphasize the following: 1) those components/process areas with a demonstrated history of high leak rates, 2) valves in gas and light liquid service, 3) pumps in light liquid service, and 4) compressors. Data obtained during a number of EPA-sponsored studies and private studies have clearly indicated that these sources have the highest frequency of VOC leaks in refineries and synthetic organic chemical manufacturing industry plants.^{25,48,49,50} For example, data compiled by Wetherold et al.⁵¹ and shown in Table 18 indicate that valves and pumps in heavy liquid service leak much less frequently than those in gas service and in light liquid service (light liquid means a boiling point below that of kerosene; heavy liquid means a boiling point equal to or above that of kerosene). Investigators have generally concluded that most chemical plant and refinery components in heavy liquid service have a low probability of leaking.

The data presented in Table 18 clearly indicates that flanges are a relatively minor source of emissions. Although this is consistent with other studies of petroleum refineries, the flange leakage in some synthetic organic chemical manufacturing industry facilities may be higher, based on observations by Harvey and Nelson.⁴⁹ Nevertheless, flanges are not good targets for the field survey because they are numerous and their overall leak rate is less than those of other components.

Conversely, most refineries and synthetic organic chemical manufacturing industry plants have very few pumps and compressors, but the leak frequencies

TABLE 18. ESTIMATED LEAKAGE RATES FOR REFINERY COMPONENTS^a

Source type	Estimated percentage that are leaking
Valves	
Gas/vapor streams	29.3
Light liquid/two-phase streams	36.5
Heavy liquid streams	6.7
Flanges	3.1
Pump seals	
Light liquid streams	63.8
Heavy liquid streams	22.8
Compressor seals	
Hydrocarbon service	70.3
Hydrogen service	81.2
Drains	19.2
Relief valves	39.2

^aInformation abstracted from Table 1-1 in Reference 25.

appear to be high. Several of these should be included on the field survey. Any pump that has liquid dripping from the seal certainly should be monitored^{52,53} although this is not an entirely reliable indicator of excessive fugitive emissions.⁵²

Because of their large number in a typical refinery or synthetic organic chemical manufacturing industry plants, valves are considered dominant sources of fugitive VOC emissions,^{25,48,49} and a number of these should certainly be included on any field survey. Unfortunately, the EPA-sponsored studies indicate that a relatively small fraction of the valves are responsible for most of the emissions from this fugitive source. For example, Wetherold and Provost found that 3.6 percent of the valves were causing more than 90 percent of the fugitive emissions attributed to valves.²⁵ To the extent possible, the inspector should target the field survey toward the offending valves. The identification of the problem is complicated by the fact that a typical refinery could have more than 10,000 to 20,000 valves.^{49,54}

Soap solution can be used to help in the selection of the valves to monitor.^{47,48,50} The time required to spray the soap on the valve stem, however, is just slightly less than that required to monitor the emissions with an organic vapor analyzer. Soap screening techniques are more appropriate when the actual emissions are to be quantified by source bagging, which is a time-intensive approach. Source bagging is commonly practiced as part of special fugitive leak studies, but it is not a routine inspection tool.

During the field survey, inspectors should listen for any audible leaks, as this may help to locate "leakers" that were not suspected. Sometimes odors also can be of benefit in adjusting the field survey portion of the inspection. The effectiveness of both of these techniques is limited, however.⁵⁵

Another technique of limited usefulness is the "walk through" survey, in which a portable organic vapor analyzer is used to identify areas of high concentrations relative to background concentrations. Supposedly, these areas would be in the immediate area of fugitive leaks. Unfortunately, this technique does not appear to be a reliable indicator of fugitive leak locations. Weber and Mims found that the results could not be reproduced even when the technique was repeated almost immediately.⁵⁶

With regard to line pressure and temperature, Wetherold et al. found no significant relationship between these parameters and leak frequency in refineries,⁵¹ however, Langley et al. found that line pressure did correlate with leak frequency in selected synthetic organic chemical manufacturing industry facilities.⁵⁷ Inspectors should consider line pressure only as a secondary variable when attempting to evaluate the most important components and/or process areas.

6.2.2 Measurement Procedures

Fugitive leaks from valves in closed systems occur primarily from the valve stem packing gland. This packing material is intended to seal the process gas and/or liquids from the atmosphere. As the packing lubricant is lost or the packing material wears, some volatilization of organic vapors is possible.

For these types of valves, the emissions are monitored at the point where the valve stem leaves the packing gland. The normal procedure is to circumscribe this location with the probe within 1 centimeter of the valve stem. This close location is necessary because of the relatively poor capture

effectiveness inherent in the probe designs used on commercially available instruments. The capture effectiveness decreases very rapidly with distance from the probe. The presence of a strong cross-draft due to ambient wind further reduces the probe capture capability. For these reasons, the probe must be placed very close to the valve packing gland. It should be noted, however, that this brings the inspector into the immediate vicinity of the leak because of the short length of most probes. While monitoring the leak, the inspector could exceed the safe operating range of the respirator and even saturate the respirator cartridge. To minimize inhalation hazards, the inspector should terminate any screening tests when the concentration of organic vapor in the breathing zone exceeds the maximum safe concentration of his or her specific respirator.

Some EPA-sponsored work has indicated that fugitive emissions from sources such as valves could be reliably monitored at 5 centimeters from the valve stem rather than the 1-centimeter distance discussed above.⁵² A leak definition of 1000 ppmv at 5 centimeters appears equivalent to the conventional leak definition of 10,000 ppmv at 1 centimeter. The 5-centimeter distance is an attractive alternative because this lessens the chance that liquids on the surface of the valve will be carried into the instrument. For Method 21 inspections, however, leak definition of 10,000 ppmv at 1 centimeter should be used to ensure consistency with the regulation.

Valves used on the ends of drains or sample lines have two sources of leakage, the valve stem and the valve seat. Most sources use a double valve arrangement or incorporate a blind flange to protect against emission losses through the valve seat of the main shutoff valve. To confirm the adequacy of the drain or sampling line seal, the probe is usually placed at the center of the discharge pipe.

Fugitive emissions from pumps occur from the pump shaft seal used to isolate the process fluid from the atmosphere. The most commonly used seals are single mechanical seals, double mechanical seals, and packed seals. Monitoring is done within 1 centimeter of the seal and the rotating shaft. A rigid probe tip should not be used near the rotating shaft. The probe tip could break if the inspector were not able to hold the probe absolutely steady during the measurement. A flexible tip is usually added to the end of the rigid probe when sampling pumps.^{16,58}

Most pump shafts have shaft guards that protect against entrapment in the rapidly rotating shaft. With some instruments, it is difficult to reach through the guard to the location of the shaft and shaft seal. The guard should not be removed under any circumstances, and those pumps without guards should be approached very carefully. If there is any question concerning the safety of the measurement, it should not be performed. Pump monitoring safety should be discussed with plant personnel before the field survey portion of the inspection is initiated.

Several organic vapor analyzer problems can be caused by sampling gases having too high a concentration. At hydrocarbon concentrations above 70,000 ppmv, flame-out of flame ionization detectors can occur.¹⁹ High concentrations of hydrocarbons can lead to very high detector temperatures and the loss of catalyst in catalytic units. Condensation of a portion of these high concentration vapors on photoionization unit lamp windows can reduce the sensitivity of the instrument. The condensation of material in the probe and sampling lines can be a problem for all types of instruments. For these reasons, the inspector should monitor the hydrocarbon concentration while slowly approaching the valve stem, pump shaft seal, or other source. If the instrument gauge indicates high concentrations, the specific leak site on the valve stem or pump seal should be approached very carefully. In some cases, the concentration will exceed the leak definition even before the probe is placed close to the leak site. Obviously, in these cases, there is no need to move the probe closer and risk affecting the performance of the organic vapor analyzer. Furthermore, there is nothing to be gained by maintaining the probe at the leak site for two times the response time (a general rule) if the instrument already indicates a concentration above the leak. To the maximum extent possible, field inspectors should protect the organic vapor analyzers against high organic vapor concentrations.

The organic vapor analyzer probe should never be placed in direct contact with liquids during the monitoring of fugitive emissions. A portion of the liquid could be pulled into the probe and damage the instrument detector. If there is contact with liquid, it may be necessary to clean and/or repair the instrument.

The inspector also must exercise care when monitoring sources, such as valves and pumps, that handle heavy liquid streams at high temperatures. Relatively nonvolatile organic compounds can condense in the probe and the

detector. Both the instrument response to the emissions and the instrument return to zero may be slowed because of the condensation of these compounds. For fugitive VOC sources that have a highly variable leak rate, the maximum sustained concentration or maximum repeated concentration observed should generally be recorded.

Certain fugitive leak sources are subject to a "no detectable leak" regulation, i.e., the difference between the background organic vapor concentration and the concentration downstream of the source should not be greater than 500 ppmv. The background concentration is determined by placing the probe 1 to 2 meters upwind of the source. If other equipment interferes with the background measurement, the upwind monitoring location can be as close as 25 centimeters.

No heroic attempts should be made to reach valves and other fugitive sources in inaccessible locations. A relatively high percentage of the valves are often in difficult-to-reach locations.^{55,59}

6.3 INSPECTION OF CARBON-BED ADSORBERS

Carbon-bed adsorbers are used to recover valuable solvents used in the manufacturing process. Most larger systems are regenerative units with two or more carbon-bed vessels. The beds are isolated one by one for regeneration while the others remain on-line. Steam is the most common means of bed regeneration. Selection of the regeneration cycle is based on the need to maximize solvent recovery while minimizing steam consumption. The organic compounds desorbed from the bed during regeneration are condensed, along with the steam, in a condensor. The water and the solvents are then separated in a decanter. Unless the field inspector has a prior background in carbon-bed design and operation, it will be difficult to identify carbon-bed system problems by using only the control device gauges.

Portable inspection instrumentation is very useful for this type of air pollution control device because it provides a direct means of determining whether the removal efficiency has decreased since the baseline period. The effluent gas during the adsorption period from each separate bed should be between 50 and 500 ppmv, if the carbon bed is being operated properly and the adsorbent remains in good condition. If the bed is being operated too long between regeneration cycles or the adsorbent is no longer able to handle the

solvent loading, the effluent gas concentration increases dramatically. Emissions can also increase if the bed has become partially saturated with hard-to-remove compounds.

To determine if the carbon beds have a "breakthrough" condition, the inspector places the portable organic vapor analyzer near the exhaust of each individual bed.^{60,61} The emissions should be monitored several times during the adsorption cycle of each bed. Because the instrument usually is not calibrated for the specific solvents being handled, the value does not correspond directly with the actual concentration. Nevertheless, a comparison of the current value against effluent concentrations that were measured when the control system was working properly provides an indication of operating problems. A very high reading during the inspection is also a clear indication of bed problems.

Before being used in field work, the organic vapor analyzer should be calibrated for a moderately low concentration. A calibration to 10,000 ppmv methane is not appropriate when the emissions being measured are expected to be in the range of 50 to 500 ppmv.

Portable instruments generally can be used safely on the exhaust streams because the maximum organic vapor concentration is rarely above 25 to 50 percent of the lower explosive limit (LEL). Nevertheless, field inspectors should use only intrinsically safe instruments as other areas around the carbon bed or the facility could have potentially explosive vapors during unusual operating conditions.

No heroic efforts should be made to monitor carbon-bed exhaust vents that are in difficult to reach locations. These exhausts are often too high to reach with standard probes. Inspectors also must be careful to avoid the downdraft emissions from the vents. Even when the carbon-bed is operating properly, the organic vapor concentrations exceeds the maximum allowable concentration of cartridge-type respirators. When the bed is not operating properly, concentrations in the stack can be very high. Plume downdraft is quite common because the gas stream is not very hot, the exit velocities are low, and the vents are usually only 5 to 15 feet above the ground.

Carbon-bed performance problems identified by the organic vapor instruments can be confirmed by using a solvent material balance. Because it is relatively time-consuming, however, this exercise is generally performed only when the bed

emissions are abnormally high or when safety considerations preclude the use of measurements.

Static pressure gauges have a limited application in the inspection and evaluation of carbon-bed adsorbers. The gauge can be used to measure the static pressure drop across the bed if static pressure measurement taps are available above and below the bed. These data are useful in determining if the bed has collapsed (often caused by corrosion) or if the total gas flow rate to the carbon-bed has increased substantially.

6.4 INSPECTION OF THERMAL AND CATALYTIC INCINERATORS

Theoretically, thermometers should be very valuable for routine inspections of thermal and catalytic incinerators. On all types of incinerators, the operating temperature is one of the main variables determining the effectiveness of pollutant destruction. The independent measurement of the incinerator operating temperature during the inspection would be very useful in confirming proper operation. Unfortunately, however, the incinerators rarely have ports in which a thermocouple could be inserted to determine the temperature, partially because it is very difficult to obtain accurate measurements with portable thermometers. If the probe is placed within the direct line-of-sight of the burner flame, the radiant energy received by the probe can indicate higher-than-actual gas temperatures. Conversely, thermocouple probes partially or completely shielded by refractory baffles can indicate much lower-than-actual gas temperatures. Most facilities rely on permanently mounted temperature indicators installed with the incinerator rather than attempting to measure the incinerator temperature. Chances that an onsite gauge will be significantly in error are slight because failure of the onsite temperature monitor usually causes the incinerator to trip off-line. For these reasons, regulatory agency inspectors generally use the onsite gauge to confirm the proper operation of incinerators.

If an independent temperature measurement is needed, the inspector can monitor the incinerator stack temperature. A drop in this value compared with baseline data indicates a decrease in the incinerator operating temperature. Whereas actual incinerator conditions could not be reliably inferred from the stack temperature data alone, large decreases in the stack temperature could

demonstrate the need for a stack test. Most thermal and catalytic incinerator stacks, however, do not have appropriate ports for portable thermocouples, and many of those that do are in inaccessible locations. Inspectors must be extremely careful when making measurements on incinerator stacks. Potential problems include (but are not limited to) severe burns, heat stress, falls, and inhalation hazards. It should also be noted that battery-powered thermometers are generally not intrinsically safe; therefore, these instruments cannot be used in areas where potentially explosive gas mixtures or dust clouds could exist.

Although specific procedures have not yet been developed, organic vapor analyzers could conceivably be used as part of an incinerator inspection. A portion of the incinerator stack gas could be withdrawn and cooled to a gas temperature compatible with the organic vapor analyzer. Presumably, this would require that the instrument probe be replaced with a sampling train including a high-temperature probe, a condensor, a moisture trap, and a particulate filter arranged in series. The measured organic vapor concentration would provide a direct indication of the effectiveness of the incinerator. Actually, a procedure of this type would be difficult to implement at the present time for the following reasons:

- o The sampling train includes several bulky items that are time-consuming to setup and cumbersome to transport.
- o A traverse of the stack would be necessary to determine the presence of any stratification of partially combusted organic vapors.
- o Condensation of nonvolatile organic compounds could plug the particulate filter or damage the instrument detectors.
- o Failure to cool the stack gas adequately would result in damage to the instrument.
- o There is no assurance that the instrument will detect a sufficient fraction of the partially combusted organic compounds.

For these reasons, field inspectors do not currently use this technique. All of the sampling train problems probably could be worked out, however, the uncertainty of instrument response due to unknown organic compound species may preclude use of this technique. At the present time, it is recommended that regulatory agency inspectors not attempt to use organic vapor analyzers for the evaluation of incinerator effluent.

6.5 INSPECTION OF VAPOR RECOVERY SYSTEMS

Three major types of vapor recovery systems are commonly used at gasoline terminals: 1) carbon-bed adsorbers with followup gasoline absorption, 2) refrigeration, and 3) thermal oxidation. Portable instruments can be used to a limited extent to inspect these air pollution control systems.

Vapor recovery systems using carbon adsorbers are inspected in a manner similar to that described earlier for carbon-bed adsorbers in Subsection 6.3. If the exhaust vent for each bed (normally there are two beds) is accessible, the organic vapor analyzer probe can be used to confirm that the exhaust concentration during the adsorption cycle is less than 500 ppmv. Failure of the desorption process or saturation of the bed both lead to "breakthrough" and very high VOC concentrations during the adsorption cycle. In fact, the emissions from the carbon bed during severe malfunction can be within the explosive range.

The potentially high vapor concentrations necessitate that the probe initially be placed well downwind of the exhaust vent in an area where dilution of the effluent has already occurred. If the observed concentration is high (> 200 to 300 ppmv), the bed obviously is not operating properly and no further measurements are necessary. If the downwind concentration is very low, the probe can be advanced slowly toward the exhaust vent itself. If the observed concentration exceeds several thousand ppmv at any time, the measurements should be discontinued. This cautious approach is required because of the remote possibility that a significant static charge can accumulate on the instrument probe or the inspector's clothing as he or she walks around the unit. A spark in a cloud of gasoline vapors within the explosive range would have serious consequences. Therefore, the probe is never allowed to enter the exhaust plume at an area where explosive concentrations could conceivably exist.

Many carbon-bed vapor recovery systems do not have platforms above the beds to permit access to the exhaust vents, which are usually 10 to 15 feet above the ground. When this is the case, inspectors should not attempt to climb up to the vapor recovery systems to reach the exhaust vents.

Portable instruments have very little application in the inspection of the refrigeration and incinerator vapor recovery systems. In the case of the

refrigeration units, the normal exhaust concentrations are 30,000 to 50,000 ppmv, which are above the normal operating range of most instruments. Furthermore, the gasoline vapor concentration can be in the explosive range. Also access to the exhaust vents, normally 10 to 15 feet high, is generally very poor. The thermal incinerators rarely have measurement ports to permit the use of portable thermometers, and the inherent measurement accuracy problems are the same as those for large thermal and catalytic systems.

6.6 SURVEYING EMISSIONS FROM STACKS, VENTS, AND ROOF MONITORS

Regulatory agency personnel have expressed an interest in evaluating the organic vapor emissions from stacks, vents, and roof monitors as part of special inspections. Some of the principal objectives of these surveys are summarized below:

- o To evaluate possible sources of community odors.
- o To evaluate emissions from bypass stacks and vents believed to be sealed.
- o To evaluate adequacy of pollutant capture in specific process areas and buildings.
- o To identify sources of organic compounds not currently included on the plant emission inventory or covered by operating permits.

These activities are obviously different from those of a conventional source inspection. Unfortunately, most regulatory agencies currently do not have the necessary equipment to perform such evaluations. Presumably, the organic vapor analyzers purchased for inspection of VOC and air toxic sources could be used for these additional activities.

Stacks, vents, and roof monitors are difficult sources to measure with portable organic vapor analyzers. All of the commonly used instruments are easily damaged if particulate is carried into the instrument detector. Condensable organic vapors, condensable acid vapors, and moisture could severely damage the instrument detectors, the instrument pumps, and the entire sample-handling system. Thus, the instruments should include a moisture trap and a particulate filter, at the very minimum. An additional glass wool plug at the probe inlet would provide additional protection. Both the glass wool

and the instrument particulate filter should be changed if there is an indication that the sample flow rate has decreased during the survey.

High organic vapor concentrations can lead to flame-out of the FID's and damage to all types of instrument detectors. When high concentrations are expected, the instrument should include a dilution probe. As an alternative, the sample could be taken in a TEDLAR or TEFLON bag and diluted with hydrocarbon-free air before the instrument is used. If high VOC concentrations are accidentally found, the probe should not be left in the high concentration stream for a long time.

In sources of this type, the specific chemical compounds in the gas stream are rarely known. Lack of knowledge concerning the appropriate response factors makes it difficult to interpret the organic vapor analyzer meter readings. The instrument simply provides a qualitative indication of the presence or absence of high concentrations of organic vapors. In some compounds, the response may be so poor that small sources of emissions will not be reliably identified. To improve the reliability of detection, field inspectors could use two different types of analyzers. Combinations such as an FID and a PID, a catalytic unit and a PID, or an FID and an infrared unit would cover a much broader group of organic compounds. This also increases the time and difficulty of the survey, however.

Before conducting any surveys of stacks, vents, and roof monitors, regulatory agency personnel should carefully evaluate the potential safety hazards and the potential variability of emissions. It may be difficult to obtain good data even if the instruments are responding properly.

Many fugitive emissions passing up through the stacks, vents, and roof monitors are intermittent in nature. Some degree of luck is necessary to have the instrument at the right spot at the right time. The probability of detection is improved if the inspector is familiar with the plant operating cycles. Even with a good working knowledge of the plant operations, however, the inspector can miss the short-term emission events. Another major problem is the size of some of the vents and roof monitors. The probes used with the portable instruments are relatively short and would not be appropriate for traversing large open sources. Although the use of longer probes is possible, the additional flow resistance could have a detrimental effect on the

instrument's sample gas flow rate. This is important because some instruments, notably the FID, are especially sensitive to flow rate variation.

Several potentially serious safety problems must be considered before surveys of stacks, vents, and roof monitors are attempted:

- o Falls through weak roofs
- o Sudden exposure to potentially toxic compounds through inhalation if a pollutant downdraft exists
- o Heat stress around hot sources
- o Climbing hazards because of the cumbersomeness of the portable instruments and accessories.

The most important of the safety problems is the possibility of falls through weak roofs. Structural problems in portions of roofs are very common and it is often difficult to spot the weak areas. Agency inspectors must exercise extreme caution when walking across or working on roofs. Unfortunately, walking across the roofs is the only way to read most of the vents and roof monitors. The second major problem is the sudden exposure to high concentrations of potentially toxic organic compounds. Exposure can occur before the inspector can put on the respirator and the organic vapor concentrations can greatly exceed the allowable limits of the respirator. The problem is further compounded by the fact that some of the organic compounds are skin- and eye-absorbable, thus limiting the help provided by a respirator.

Based on the potential instrument damage, the uncertainties of instrument response, the variability of pollutant emissions, and the possible safety hazards, extreme care should be exercised in conducting these type of surveys. Obviously, if unsafe conditions exist with respect to these type of surveys they should not be conducted.

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APPENDIX A
REFERENCE METHOD 21 AND NSPS
AND NESHAPS REGULATIONS

REFERENCE METHOD 21

Method 21. Determination of Volatile Organic Compounds Leaks¹⁹⁶

1. Applicability and Principle.

1.1 Applicability. This method applies to the determination of volatile organic compound (VOC) leaks from process equipment. These sources include, but are not limited to, valves, flanges and other connections, pumps and compressors, pressure relief devices, process drains, open-ended valves, pump and compressor seal system degassing vents, accumulator vessel vents, agitator seals, and access door seals.

1.2 Principle. A portable instrument is used to detect VOC leaks from individual sources. The instrument detector type is not specified, but it must meet the specifications and performance criteria contained in Section 3. A leak definition concentration based on a reference compound is specified in each applicable regulation. This procedure is intended to locate and classify leaks only, and is not to be used as a direct measure of mass emission rates from individual sources.

2. Definitions.

2.1 Leak Definition Concentration. The local VOC concentration at the surface of a leak source that indicates that a VOC emission (leak) is present. The leak definition is an instrument meter reading based on a reference compound.

2.2 Reference Compound. The VOC species selected as an instrument calibration basis for specification of the leak definition concentration. (For example: If a leak definition concentration is 10,000 ppmv as methane, then any source emission that results in a local concentration that yields a meter reading of 10,000 on an instrument calibrated with methane would be classified as a leak. In this example, the leak definition is 10,000 ppmv, and the reference compound is methane.)

2.3 Calibration Gas. The VOC compound used to adjust the instrument meter reading to a known value. The calibration gas is usually the reference compound at a concentration approximately equal to the leak definition concentration.

2.4 No Detectable Emission. The local VOC concentration at the surface of a leak source that indicates that a VOC emission (leak) is not present. Since background VOC concentrations may exist, and to account for instrument drift and imperfect reproducibility, a difference between the source surface concentration and the local ambient concentration is determined. A difference based on meter readings of less than a concentration corresponding to the minimum readability specification indicates that a VOC emission (leak) is not present. (For example, if the leak definition in a regulation is 10,000 ppmv, then the allowable increase in surface concentration versus local ambient concentration would be 500 ppmv based on the instrument meter readings.)

2.5 Response Factor. The ratio of the known concentration of a VOC compound to the observed meter reading when measured using an instrument calibrated with the reference compound specified in the application regulation.

2.6 Calibration Precision. The degree of agreement between measurements of the same known value, expressed as the relative percentage of the average difference between

the meter readings and the known concentration to the known concentration.

2.7 Response Time. The time interval from a step change in VOC concentration at the input of the sampling system to the time at which 90 percent of the corresponding final value is reached as displayed on the instrument readout meter.

3. Apparatus.

3.1 Monitoring Instrument.

3.1.1 Specifications.

a. The VOC instrument detector shall respond to the compounds being processed. Detector types which may meet this requirement include, but are not limited to, catalytic oxidation, flame ionization, infrared absorption, and photoionization.

b. The instrument shall be capable of measuring the leak definition concentration specified in the regulation.

c. The scale of the instrument meter shall be readable to ± 5 percent of the specified leak definition concentration.

d. The instrument shall be equipped with a pump so that a continuous sample is provided to the detector. The nominal sample flow rate shall be $\frac{1}{2}$ to 3 liters per minute.

e. The instrument shall be intrinsically safe for operation in explosive atmospheres as defined by the applicable U.S.A. standards (e.g., National Electrical Code by the National Fire Prevention Association). 2 3

3.1.2 Performance Criteria.

a. The instrument response factors for the individual compounds to be measured must be less than 10.

b. The instrument response time must be equal to or less than 30 seconds. The response time must be determined for the instrument configuration to be used during testing.

c. The calibration precision must be equal to or less than 10 percent of the calibration gas value.

d. The evaluation procedure for each parameter is given in Section 4.4.

3.1.3 Performance Evaluation Requirements.

a. A response factor must be determined for each compound that is to be measured, either by testing or from reference sources. The response factor tests are required before placing the analyzer into service, but do not have to be repeated as subsequent intervals.

b. The calibration precision test must be completed prior to placing the analyzer into service, and at subsequent 3-month intervals or at the next use whichever is later.

c. The response time test is required prior to placing the instrument into service. If a modification to the sample pumping system or flow configuration is made that would change the response time, a new test is required prior to further use.

3.2 Calibration Gases. The monitoring instrument is calibrated in terms of parts per million by volume (ppmv) of the reference compound specified in the applicable regulation. The calibration gases required for monitoring and instrument performance evaluation are a zero gas (air, less than 10 ppmv VOC) and a calibration gas in air mixture approximately equal to the leak definition specified in the regulation. If cylinder calibration gas mixture are used, they must be analyzed and certified by the

manufacturer to be within ± 2 percent accuracy, and a shelf life must be specified. Cylinder standards must be either reanalyzed or replaced at the end of the specified shelf life. Alternately, calibration gases may be prepared by the user according to any accepted gaseous standards preparation procedure that will yield a mixture accurate to within ± 2 percent. Prepared standards must be replaced each day of use unless it can be demonstrated that degradation does not occur during storage.

Calibrations may be performed using a compound other than the reference compound if a conversion factor is determined for that alternative compound so that the resulting meter readings during source surveys can be converted to reference compound results. 213

4. Procedures.

4.1 Pretest Preparations. Perform the instrument evaluation procedures given in Section 4.4 if the evaluation requirements of Section 3.1.3 have not been met.

4.2 Calibration Procedures. Assemble and start up the VOC analyzer according to the manufacturer's instructions. After the appropriate warmup period and zero internal calibration procedure, introduce the calibration gas into the instrument sample probe. Adjust the instrument meter readout to correspond to the calibration gas value.

Note—If the meter readout cannot be adjusted to the proper value, a malfunction of the analyzer is indicated and corrective actions are necessary before use.

4.3 Individual Source Surveys.

4.3.1 Type I—Leak Definition Based on Concentration. Place the probe inlet at the surface of the component interface where leakage could occur. Move the probe along the interface periphery while observing the instrument readout. If an increased meter reading is observed, slowly sample the interface where leakage is indicated until the maximum meter reading is obtained. Leave the probe inlet at this maximum reading location for approximately two times the instrument response time. If the maximum observed meter reading is greater than the leak definition in the applicable regulation, record and report the results as specified in the regulation reporting requirements. Examples of the application of this general technique to specific equipment types are:

a. **Valves**—The most common source of leaks from valves is at the seal between the stem and housing. Place the probe at the interface where the stem exists the packing gland and sample the stem circumference. Also, place the probe at the interface of the packing gland take-up flange seat and sample the periphery. In addition, survey valve housings of multipart assembly at the surface of all interfaces where a leak could occur. 213

b. **Flanges and Other Connections**—For welded flanges, place the probe at the outer edge of the flange-gasket interface and sample the circumference of the flange. Sample other types of nonpermanent joints (such as threaded connections) with a similar traverse.

c. **Pumps and Compressors**—Conduct a circumferential traverse at the outer surface of the pump or compressor shaft and seal interface. If the source is a rotating shaft, position the probe inlet within 1 cm of the

shaft-seal interface for the survey. If the housing configuration prevents a complete traverse of the shaft periphery, sample all accessible portions. Sample all other joints on the pump or compressor housing where leakage could occur.

d. **Pressure Relief Devices**—The configuration of most pressure relief devices prevents sampling at the sealing seat interface. For those devices equipped with an enclosed extension, or horn, place the probe inlet at approximately the center of the exhaust area to the atmosphere.

e. **Process Drains**—For open drains, place the probe inlet at approximately the center of the area open to the atmosphere. For covered drains, place the probe at the surface of the cover interface and conduct a peripheral traverse.

f. **Open-Ended Lines or Valves**—Place the probe inlet at approximately the center of the opening to the atmosphere.

g. **Seal System Degassing Vents and Accumulator Vents**—Place the probe inlet at approximately the center of the opening to the atmosphere.

h. **Access Door Seals**—Place the probe inlet at the surface of the door seal interface and conduct a peripheral traverse.

4.3.2 Type II—"No Detectable Emission".

Determine the local ambient concentration around the source by moving the probe inlet randomly upwind and downwind at a distance of one to two meters from the source. If an interference exists with this determination due to a nearby emission or leak, the local ambient concentration may be determined at distances closer to the source, but in no case shall the distance be less than 25 centimeters. Then move the probe inlet to the surface of the source and determine the concentration described in 4.3.1. The difference between these concentrations determines whether there are no detectable emissions. Record and report the results as specified by the regulation.

For those cases where the regulation requires a specific device installation, or that specified vents be ducted or piped to a control device, the existence of these conditions shall be visually confirmed. When the regulation also requires that no detectable emissions exist, visual observations and sampling surveys are required. Examples of this technique are:

(a) **Pump or Compressor Seals**—If applicable, determine the type of shaft seal. Perform a survey of the local area ambient VOC concentration and determine if detectable emissions exist as described above.

(b) **Seal System Degassing Vents, Accumulator Vessel Vents, Pressure Relief Devices**—If applicable, observe whether or not the applicable ducting or piping exists. Also, determine if any sources exist in the ducting or piping where emissions could occur prior to the control device. If the required ducting or piping exists and there are no sources where the emissions could be vented to the atmosphere prior to the control device, then it is presumed that no detectable emissions are present. If there are sources in the ducting or piping where emissions could be vented or sources where leaks could occur, the sampling surveys described in this

paragraph shall be used to determine if detectable emissions exist.

4.3.3 **Alternative Screening Procedure.** A screening procedure based on the formation of bubbles in a soap solution that is sprayed on a potential leak source may be used for those sources that do not have continuously moving parts, that do not have surface temperatures greater than the boiling point or less than the freezing point of the soap solution, that do not have open areas to the atmosphere that the soap solution cannot bridge, or that do not exhibit evidence of liquid leakage. Sources that have these conditions present must be surveyed using the instrument techniques of 4.3.1 or 4.3.2.

Spray a soap solution over all potential leak sources. The soap solution may be a commercially available leak detection solution or may be prepared using concentrated detergent and water. A pressure sprayer or a squeeze bottle may be used to dispense the solution. Observe the potential leak sites to determine if any bubbles are formed. If no bubbles are observed, the source is presumed to have no detectable emissions or leaks as applicable. If any bubbles are observed, the instrument techniques of 4.3.1 or 4.3.2 shall be used to determine if a leak exists, or if the source has detectable emissions, as applicable. 213

4.4 **Instrument Evaluation Procedures.** At the beginning of the instrument performance evaluation test, assemble and start up the instrument according to the manufacturer's instructions for recommended warmup period and preliminary adjustments.

4.4.1 **Response Factor.** Calibrate the instrument with the reference compound as specified in the applicable regulation. For each organic species that is to be measured during individual source surveys, obtain or prepare a known standard in air at a concentration of approximately 80 percent of the applicable leak definition unless limited by volatility or explosivity. In these cases, prepare a standard at 90 percent of the saturation concentration, or 70 percent of the lower explosive limit, respectively. Introduce this mixture to the analyzer and record the observed meter reading. Introduce zero air until a stable reading is obtained. Make a total of three measurements by alternating between the known mixture and zero air. Calculate the response factor for each repetition and the average response factor.

Alternatively, if response factors have been published for the compounds of interest for the instrument or detector type, the response factor determination is not required, and existing results may be referenced. Examples of published response factors for flame ionization and catalytic oxidation detectors are included in Section 5.

4.4.2 **Calibration Precision.** Make a total of three measurements by alternately using zero gas and the specified calibration gas. Record the meter readings. Calculate the average algebraic difference between the meter readings and the known value. Divide this average difference by the known calibration value and multiply by 100 to express the resulting calibration precision as a percentage.

4.4.3 **Response Time.** Introduce zero gas into the instrument sample probe. When the meter reading has stabilized, switch quickly to the specified calibration gas. Measure the time from switching to when 90 percent of the final stable reading is attained. Perform this test sequence three times and record the results. Calculate the average response time.

5. Bibliography.

5.1 **DuBoise, D.A., and G.E. Harris.** Response Factors of VOC Analyzers at a Meter Reading of 10,000 ppmv for Selected Organic Compounds. U.S. Environmental Protection Agency, Research Triangle Park, N.C. Publication No. EPA 600/2-81-051. September 1981.

5.2 **Brown, G.E., et al.** Response Factors of VOC Analyzers Calibrated with Methane for Selected Organic Compounds. U.S. Environmental Protection Agency, Research Triangle Park, N.C. Publication No. EPA 600/2-81-022. May 1981.

5.3 **DuBoise, D.A., et al.** Response of Portable VOC Analyzers to Chemical Mixtures. U.S. Environmental Protection Agency, Research Triangle Park, N.C. Publication No. EPA 600/2-81-110. September 1981.

NSPS REGULATIONS

Subpart VV—Standards of Performance for Equipment Leaks of VOC in the Synthetic Organic Chemicals Manufacturing Industry ²⁰⁶

§ 60.480 Applicability and designation of affected facility.

(a)(1) The provisions of this subpart apply to affected facilities in the synthetic organic chemicals manufacturing industry.

(2) The group of all equipment (defined in § 60.481) within a process unit is an affected facility.

(b) Any affected facility under paragraph (a) of this section that commences construction or modification after January 5, 1981, shall be subject to the requirements of this subpart.

(c) Addition or replacement of equipment for the purpose of process improvement which is accomplished without a capital expenditure shall not by itself be considered a modification under this subpart.

(d)(1) If an owner or operator applies for one or more of the exemptions in this paragraph, then the owner or operator shall maintain records as required in § 60.486(i).²²⁷

(2) Any affected facility that has the design capacity to produce less than 1,000 Mg/yr is exempt from § 60.482.

(3) If an affected facility produces heavy liquid chemicals only from heavy liquid feed or raw materials, then it is exempt from § 60.482.

(4) Any affected facility that produces beverage alcohol is exempt from § 60.482.

(5) Any affected facility that has no equipment in VOC service is exempt from § 60.482.

§ 60.481 Definitions.

As used in this subpart, all terms not defined herein shall have the meaning given them in the Act or in Subpart A of Part 60, and the following terms shall have the specific meanings given them.

"Capital expenditure" means, in addition to the definition in 40 CFR 60.2, an expenditure for a physical or operational change to an existing facility that:

(a) Exceeds P, the product of the facility's replacement cost, R, and an adjusted annual asset guideline repair allowance, A, as reflected by the following equation: $P = R \times A$, where

(1) The adjusted annual asset guideline repair allowance, A, is the product of the percent of the replacement cost, Y, and the applicable basic annual asset guideline repair allowance, B, as reflected by the following equation: $A = Y \times (B \div 100)$.

(2) The percent Y is determined from

the following equation: $Y = 1.0 - 0.575 \log X$, where X is 2002 minus the year of construction; and²³⁰

(3) The applicable basic annual asset guideline repair allowance, B, is selected from the following table consistent with the applicable subpart:²²⁷

TABLE FOR DETERMINING APPLICABLE FOR B

Subpart applicable to facility	Value of B to be used in equation
VV	12.5
DDD	12.5
GGG	7.0
KKK	4.5

"Closed vent system" means a system that is not open to the atmosphere and that is composed of piping, connections, and, if necessary, flow inducing devices that transport gas or vapor from a piece or pieces of equipment to a control device.

"Connector" means flanged, screwed, welded, or other joined fittings used to connect two pipe lines or a pipe line and a piece of process equipment.

"Control device" means an enclosed combustion device, vapor recovery system, or flare.

"Distance piece" means an open or enclosed casing through which the piston rod travels, separating the compressor cylinder from the crankcase.

"Double block and bleed system" means two block valves connected in series with a bleed valve or line that can vent the line between the two block valves.²²⁷

"Equipment" means each pump, compressor, pressure relief device, sampling connection system, open-ended valve or line, valve, and flange or other connector in VOC service and any devices or systems required by this subpart.

"First attempt at repair" means to take rapid action for the purpose of stopping or reducing leakage of organic material to atmosphere using best practices.

"In gas/vapor service" means that the piece of equipment contains process fluid that is in the gaseous state at operating conditions.

"In heavy liquid service" means that the piece of equipment is not in gas/vapor service or in light liquid service.

"In light liquid service" means that the piece of equipment contains a liquid that meets the conditions specified in § 60.485(e).

"Liquids dripping" means any visible leakage from the seal including spraying, misting, clouding, and ice formation.

"Open-ended valve or line" means

any valve, except safety relief valves, having one side of the valve seat in contact with process fluid and one side open to the atmosphere, either directly or through open piping.

"Pressure release" means the emission of materials resulting from system pressure being greater than set pressure of the pressure relief device.

"Process improvement" means routine changes made for safety and occupational health requirements, for energy savings, for better utility, for ease of maintenance and operation, for correction of design deficiencies, for bottleneck removal, for changing product requirements, or for environmental control.

"Process unit" means components assembled to produce, as intermediate or final products, one or more of the chemicals listed in § 60.489 of this part. A process unit can operate independently if supplied with sufficient feed or raw materials and sufficient storage facilities for the product.

"Process unit shutdown" means a work practice or operational procedure that stops production from a process unit or part of a process unit. An unscheduled work practice or operational procedure that stops production from a process unit or part of a process unit for less than 24 hours is not a process unit shutdown. The use of spare equipment and technically feasible bypassing of equipment without stopping production are not process unit shutdowns.

"Quarter" means a 3-month period; the first quarter concludes on the last day of the last full month during the 180 days following initial startup.

"Replacement cost" means the capital needed to purchase all the depreciable components in a facility.²²⁷

"Repaired" means that equipment is adjusted, or otherwise altered, in order to eliminate a leak as indicated by one of the following: an instrument reading or 10,000 ppm or greater, indication of liquids dripping, or indication by a sensor that a seal or barrier fluid system has failed.

"Sensor means a device that measures a physical quantity or the change in a physical quantity such as temperature, pressure, flow rate, pH, or liquid level.

"In-situ sampling systems" means nonextractive samplers or in-line samplers.

"Synthetic organic chemicals manufacturing industry" means the industry that produces, as intermediates or final products, one or more of the chemicals listed in § 60.489.

"In vacuum service" means that equipment is operating at an internal

pressure which is at least 5 kilopascals (kPa) below ambient pressure.

"Volatile organic compounds" or VOC means, for the purposes of this subpart, any reactive organic compounds as defined in § 60.2 Definitions.

"In VOC Service" means that the piece of equipment contains or contacts a process fluid that is at least 10 percent VOC by weight. (The provisions of § 60.485(d) specify how to determine that a piece of equipment is not in VOC service.)

§ 60.482-1 Standards: General.

(a) Each owner or operator subject to the provisions of this subpart shall demonstrate compliance with the requirements of § 60.482-1 to § 60.482-10 for all equipment within 180 days of initial startup.

(b) Compliance with § 60.482-1 to § 60.482-10 will be determined by review of records and reports, review of performance test results, and inspection using the methods and procedures specified in § 60.485.

(c)(1) An owner or operator may request a determination of equivalence of a means of emission limitation to the requirements of § 60.482-2, -3, -5, -6, -7, -8, and -10 as provided in § 60.484.

(2) If the Administrator makes a determination that a means of emission limitation is at least equivalent to the requirements of § 60.482-2, -3, -5, -6, -7, -8, or -10, an owner or operator shall comply with the requirements of that determination.

(d) Equipment that is in vacuum service is excluded from the requirements of § 60.482-2 to § 60.482-10 if it is identified as required in § 60.486(e)(5).²²⁷

§ 60.482-2 Standards: Pumps in Light Liquid Service.

(a)(1) Each pump in light liquid service shall be monitored monthly to detect leaks by the methods specified in § 60.485(b), except as provided in § 60.482-1(c) and paragraphs (d), (e), and (f) of this section.

(2) Each pump in light liquid service shall be checked by visual inspection each calendar week for indications of liquids dripping from the pump seal.

(b)(1) If an instrument reading of 10,000 ppm or greater is measured, a leak is detected.

(2) If there are indications of liquids dripping from the pump seal, a leak is detected.

(c)(1) When a leak is detected, it shall be repaired as soon as practicable, but not later than 15 calendar days after it is detected, except as provided in § 60.482-9.

(2) A first attempt at repair shall be made no later than 5 calendar days after each leak is detected.

(d) Each pump equipped with a dual mechanical seal system that includes a barrier fluid system is exempt from the requirements of paragraph (a), provided the following requirements are met:

(1) Each dual mechanical seal system is:

(i) Operated with the barrier fluid at a pressure that is at all times greater than the pump stuffing box pressure; or

(ii) Equipment with a barrier fluid degassing reservoir that is connected by a closed vent system to a control device that complies with the requirements of § 60.482-10; or

(iii) Equipped with a system that purges the barrier fluid into a process stream with zero VOC emissions to the atmosphere.

(2) The barrier fluid system is in heavy liquid service or is not in VOC service.

(3) Each barrier fluid system is equipped with a sensor that will detect failure of the seal system, the barrier fluid system, or both.

(4) Each pump is checked by visual inspection, each calendar week, for indications of liquids dripping from the pump seals.

(5)(i) Each sensor as described in paragraph (d)(3) is checked daily or is equipped with an audible alarm, and

(ii) The owner or operator determines, based on design considerations and operating experience, a criterion that indicates failure of the seal system, the barrier fluid system, or both.

(6)(i) If there are indications of liquids dripping from the pump seal or the sensor indicates failure of the seal system, the barrier fluid system, or both based on the criterion determined in paragraph (d)(5)(ii), a leak is detected.

(ii) When a leak is detected, it shall be repaired as soon as practicable, but not later than 15 calendar days after it is detected, except as provided in § 60.482-9.

(iii) A first attempt at repair shall be made no later than 5 calendar days after each leak is detected.

(e) Any pump that is designated, as described in § 60.486(e) (1) and (2), for no detectable emission, as indicated by an instrument reading of less than 500 ppm above background, is exempt from the requirements of paragraphs (a), (c), and (d) if the pump:

(1) Has no externally actuated shaft penetrating the pump housing.

(2) Is demonstrated to be operating with no detectable emissions as indicated by an instrument reading of less than 500 ppm above background as

measured by the methods specified in § 60.485(c), and

(3) Is tested for compliance with paragraph (e)(2) initially upon designation, annually, and at other times requested by the Administrator.

(f) If any pump is equipped with a closed vent system capable of capturing and transporting any leakage from the seal or seals to a control device that complies with the requirements of § 60.482-10, it is exempt from the paragraphs (a)-(e).

§ 60.482-3 Compressors.

(a) Each compressor shall be equipped with a seal system that includes a barrier fluid system and that prevents leakage of VOC to the atmosphere, except as provided in § 60.482-1(c) and paragraph (h) and (i) of this section.

(b) Each compressor seal system as required in paragraph (a) shall be:

(1) Operated with the barrier fluid at a pressure that is greater than the compressor stuffing box pressure; or

(2) Equipped with a barrier fluid system that is connected by a closed vent system to a control device that complies with the requirements of § 60.482-10; or

(3) Equipped with a system that purges the barrier fluid into a process stream with zero VOC emissions to the atmosphere.

(c) The barrier fluid system shall be in heavy liquid service or shall not be in VOC service.

(d) Each barrier fluid system as described in paragraph (a) shall be equipped with a sensor that will detect failure of the seal system, barrier fluid system, or both.

(e)(1) Each sensor as required in paragraph (d) shall be checked daily or shall be equipped with an audible alarm.

(2) The owner or operator shall determine, based on design considerations and operating experience, a criterion that indicates failure of the seal system, the barrier fluid system, or both.

(f) If the sensor indicates failure of the seal system, the barrier system, or both based on the criterion determined under paragraph (e)(2), a leak is detected.

(g)(1) When a leak is detected, it shall be repaired as soon as practicable, but not later than 15 calendar days after it is detected, except as provided in § 60.482-9.

(2) A first attempt at repair shall be made no later than 5 calendar days after each leak is detected.

(h) A compressor is exempt from the requirements of paragraphs (a) and (b), if it is equipped with a closed vent system capable of capturing and transporting any leakage from the seal

to a control device that complies with the requirements of § 60.482-10, except as provided in § 60.482-3(i).

(i) Any compressor that is designated, as described in § 60.486(e) (1) and (2), for no detectable emissions, as indicated by an instrument reading of less than 500 ppm above background, is exempt from the requirements of paragraphs (a)-(h) if the compressor:

(1) Is demonstrated to be operating with no detectable emissions, as indicated by an instrument reading of less than 500 ppm above background, as measured by the methods specified in § 60.485(c); and

(2) Is tested for compliance with paragraph (i)(1) initially upon designation, annually, and at other times requested by the Administrator.

(j) Any existing reciprocating compressor in a process unit which becomes an affected facility under provisions of § 60.14 or 60.15 is exempt from § 60.482 (a), (b), (c), (d), (e), and (h), provided the owner or operator demonstrates that recasting the distance piece or replacing the compressor are the only options available to bring the compressor into compliance with the provisions of § 60.4823 (a), (b), (c), (d), (e), and (h).

§ 60.482-4 Standards: Pressure relief devices in gas/vapor service.

(a) Except during pressure releases, each pressure relief device in gas/vapor service shall be operated with no detectable emissions, as indicated by an instrument reading of less than 500 ppm above background, as determined by the methods specified in § 60.485(c).

(b)(1) After each pressure release, the pressure relief device shall be returned to a condition of no detectable emissions, as indicated by an instrument reading of less than 500 ppm above background, as soon as practicable, but no later than 5 calendar days after the pressure release, except as provided in § 60.482-9.

(2) No later than 5 calendar days after the pressure release, the pressure relief device shall be monitored to confirm the conditions of no detectable emissions, as indicated by an instrument reading of less than 500 ppm above background, by the methods specified in § 60.485(c).

(c) Any pressure relief device that is equipped with a closed vent system capable of capturing and transporting leakage through the pressure relief device to a control device as described in § 60.482-10 is exempted from the requirements of paragraphs (a) and (b).

§ 60.482-5 Standards: Sampling connection systems.

(a) Each sampling connection system shall be equipped with a closed purge system or closed vent system, except as provided in § 60.482-1(c).

(b) Each closed purge system or closed vent system as required in paragraph (a) shall:

(1) Return the purged process fluid directly to the process line with zero VOC emissions to the atmosphere; or

(2) Collect and recycle the purged process fluid with zero VOC emissions to the atmosphere; or

(3) Be designed and operated to capture and transport all the purged process fluid to a control device that complies with the requirements of § 60.482-10.

(c) In-situ sampling systems are exempt from paragraphs (a) and (b).

§ 60.482-6 Standards: Open-ended valves or lines.

(a)(1) Each open-ended valve or line shall be equipped with a cap, blind flange, plug, or a second valve, except as provided in § 60.482-1(c).

(2) The cap, blind flange, plug, or second valve shall seal the open end at all times except during operations requiring process fluid flow through the open-ended valve or line.

(b) Each open-ended valve or line equipped with a second valve shall be operated in a manner such that the valve on the process fluid end is closed before the second valve is closed.

(c) When a double block-and-bleed system is being used, the bleed valve or line may remain open during operations that require venting the line between the block valves but shall comply with paragraph (a) at all other times.²²⁷

§ 60.482-7 Standards: Valves in gas/vapor service in light liquid service.

(a) Each valve shall be monitored monthly to detect leaks by the methods specified in § 60.485(b) and shall comply with paragraphs (b)-(e), except as provided in paragraphs (f), (g), and (h), § 60.483-1, 2, and § 60.482-1(c).

(b) If an instrument reading of 10,000 ppm or greater is measured, a leak is detected.

(c)(1) Any valve for which a leak is not detected for 2 successive months may be monitored the first month of every quarter, beginning with the next quarter, until a leak is detected.

(2) If a leak is detected, the valve shall be monitored monthly until a leak is not detected for 2 successive months.²²⁷

(d)(1) When a leak is detected, it shall be repaired as soon as practicable, but

no later than 15 calendar days after the leak is detected, except as provided in § 60.482-9.

(2) A first attempt at repair shall be made no later than 5 calendar days after each leak is detected.

(e) First attempts at repair include, but are not limited to, the following best practices where practicable:

(1) Tightening of bonnet bolts;

(2) Replacement of bonnet bolts;

(3) Tightening of packing gland nuts;

(4) Injection of lubricant into lubricated packing.

(f) Any valve that is designated, as described in § 60.486(e)(2), for no detectable emissions, as indicated by an instrument reading of less than 500 ppm above background, is exempt from the requirements of paragraph (a) if the valve:

(1) Has no external actuating mechanism in contact with the process fluid,

(2) Is operated with emissions less than 500 ppm above background as determined by the method specified in § 60.485(c), and

(3) Is tested for compliance with paragraph (f)(2) initially upon designation, annually, and at other times requested by the Administrator.

(g) Any valve that is designated, as described in § 60.486(f)(1), as an unsafe-to-monitor valve is exempt from the requirements of paragraph (a) if:

(1) The owner or operator of the valve demonstrates that the valve is unsafe to monitor because monitoring personnel would be exposed to an immediate danger as a consequence of complying with paragraph (a), and

(2) The owner or operator of the valve adheres to a written plan that requires monitoring of the valve as frequently as practicable during safe-to-monitor times.

(h) Any valve that is designated, as described in § 60.486(f)(2), as a difficult-to-monitor valve is exempt from the requirements of paragraph (a) if:

(1) The owner or operator of the valve demonstrates that the valve cannot be monitored without elevating the monitoring personnel more than 2 meters above a support surface.

(2) The process unit within which the valve is located either becomes an affected facility through § 60.14 or § 60.15 or the owner or operator designates less than 3.0 percent of the total number of valves as difficult-to-monitor, and²²⁷

(3) The owner or operator of the valve follows a written plan that requires monitoring of the valve at least once per calendar year.

§ 60.482-8 Standards: Pumps and valves in heavy liquid service, pressure relief devices in light liquid or heavy liquid service, and flanges and other connectors.

(a) Pumps and valves in heavy liquid service, pressure relief devices in light liquid or heavy liquid service, and flanges and other connectors shall be monitored within 5 days by the method specified in § 60.485(b) if evidence of a potential leak is found by visual, audible, olfactory, or any other detection method.

(b) If an instrument reading of 10,000 ppm or greater is measured, a leak is detected.

(c)(1) When a leak is detected, it shall be repaired as soon as practicable, but not later than 15 calendar days after it is detected, except as provided in § 60.482-9.

(2) The first attempt at repair shall be made no later than 5 calendar days after each leak is detected.

(d) First attempts at repair include, but are not limited to, the best practices described under § 60.482-7(e).

§ 60.482-9 Standards: Delay of repair.

(a) Delay of repair of equipment for which leaks have been detected will be allowed if the repair is technically infeasible without a process unit shutdown. Repair of this equipment shall occur before the end of the next process unit shutdown.

(b) Delay of repair of equipment will be allowed for equipment which is isolated from the process and which does not remain in VOC service.

(c) Delay of repair for valves will be allowed if:

(1) The owner or operator demonstrates that emissions of purged material resulting from immediate repair are greater than the fugitive emissions likely to result from delay of repair, and

(2) When repair procedures are effected, the purged material is collected and destroyed or recovered in a control device complying with § 60.482-10.

(d) Delay of repair for pumps will be allowed if:

(1) Repair requires the use of a dual mechanical seal system that includes a barrier fluid system, and

(2) Repair is completed as soon as practicable, but not later than 6 months after the leak was detected.

(e) Delay of repair beyond a process unit shutdown will be allowed for a valve, if valve assembly replacement is necessary during the process unit shutdown, valve assembly supplies have been depleted, and valve assembly supplies had been sufficiently stocked before the supplies were depleted. Delay

of repair beyond the next process unit shutdown will not be allowed unless the next process unit shutdown occurs sooner than 6 months after the first process unit shutdown.

§ 60.482-10 Standards: Closed vent systems and control devices.

(a) Owners or operators of closed vent systems and control devices used to comply with provisions of this subpart shall comply with the provisions of this section.

(b) Vapor recovery systems (for example, condensers and adsorbers) shall be designed and operated to recover the VOC emissions vented to them with an efficiency of 95 percent or greater.

(c) Enclosed combustion devices shall be designed and operated to reduce the VOC emissions vented to them with an efficiency of 95 percent or greater, or to provide a minimum residence time of 0.75 seconds at a minimum temperature of 816°C.

(d)(1) Flares shall be designed for and operated with no visible emissions as determined by the methods specified in § 60.485(g), except for periods not to exceed a total of 5 minutes during any 2 consecutive hours.

(2) Flares shall be operated with a flame present at all times, as determined by the methods specified in § 60.485(g).

(3) Flares shall be used only with the net heating value of the gas being combusted being 11.2 MJ/scm (300 Btu/scf) or greater if the flare is steam-assisted or air-assisted; or with the net heating value of the gas being combusted being 7.45 MJ/scm or greater if the flare is nonassisted. The net heating value of the gas being combusted shall be determined by the methods specified in § 60.485(g).

(4) Steam-assisted and nonassisted flares shall be designed for and operated with an exit velocity, as determined by the methods specified in § 60.485(g)(4), less than 18 m/sec (60 ft/sec).

(5) Flares used to comply with this subpart shall be steam-assisted, air-assisted, or nonassisted.

(6) Air-assisted flares shall be designed and operated with an exit velocity less than the velocity, V_{max} , as determined by the methods specified in § 60.485(g)(5).

(e) Owners or operators of control devices used to comply with the provisions of this subpart shall monitor these control devices to ensure that they are operated and maintained in conformance with their designs.

(f)(1) Closed vent systems shall be designed and operated with no detectable emissions, as indicated by an

instrument reading of less than 500 ppm above background and visual inspections, as determined by the methods specified in § 60.485(c).

(2) Closed vent systems shall be monitored to determine compliance with this section initially in accordance with § 60.8, annually and at other times requested by the Administrator.

(g) Closed vent systems and control devices used to comply with provisions of this subpart shall be operated at all times when emissions may be vented to them.

§ 60.483-1 Alternative standards for valves—allowable percentage of valves leaking.

(a) An owner or operator may elect to comply with an allowable percentage of valves leaking of equal to or less than 2.0 percent.

(b) The following requirements shall be met if an owner or operator wishes to comply with an allowable percentage of valves leaking:

(1) An owner or operator must notify the Administrator that the owner or operator has elected to comply with the allowable percentage of valves leaking before implementing this alternative standard, as specified in § 60.487(b).

(2) A performance test as specified in paragraph (c) of this section shall be conducted initially upon designation, annually, and at other times requested by the Administrator.

(3) If a valve leak is detected, it shall be repaired in accordance with § 60.482-7(d) and (e).

(c) Performance tests shall be conducted in the following manner:

(1) All valves in gas/vapor and light liquid service within the affected facility shall be monitored within 1 week by the methods specified in § 60.485(b).

(2) If an instrument reading of 10,000 ppm or greater is measured, a leak is detected.

(3) The leak percentage shall be determined by dividing the number of valves for which leaks are detected by the number of valves in gas/vapor and light liquid service within the affected facility.

(d) Owners and operators who elect to comply with this alternative standard shall not have an affected facility with a leak percentage greater than 2.0 percent.

§ 60.483-2 Alternative standards for valves—skip period leak detection and repair.

(a)(1) An owner or operator may elect to comply with one of the alternative work practices specified in paragraphs (b) (2) and (3) of this section.

(2) An owner or operator must notify the Administrator before implementing

one of the alternative work practices, as specified in § 60.487(b).

(b)(1) An owner or operator shall comply initially with the requirements for valves in gas/vapor service and valves in light liquid service, as described in § 60.482-7.

(2) After 2 consecutive quarterly leak detection periods with the percent of valves leaking equal to or less than 2.0, an owner or operator may begin to skip 1 of the quarterly leak detection periods for the valves in gas/vapor and light liquid service.

(3) After 5 consecutive quarterly leak detection periods with the percent of valves leaking equal to or less than 2.0, an owner or operator may begin to skip 3 of the quarterly leak detection periods for the valves in gas/vapor and light liquid service.

(4) If the percent of valves leaking is greater than 2.0, the owner or operator shall comply with the requirements as described in § 60.482-7 but can again elect to use this section.

(5) The percent of valves leaking shall be determined by dividing the sum of valves found leaking during current monitoring and valves for which repair has been delayed by the total number of valves subject to the requirements of § 60.483-2.

(6) An owner or operator must keep a record of the percent of valves found leaking during each leak detection period.

§ 60.484 Equivalence of means of emission limitation.

(a) Each owner or operator subject to the provisions of this subpart may apply to the Administrator for determination of equivalence for any means of emission limitation that achieves a reduction in emissions of VOC at least equivalent to the reduction in emissions of VOC achieved by the controls required in this subpart.

(b) Determination of equivalence to the equipment, design, and operational requirements of this subpart will be evaluated by the following guidelines:

(1) Each owner or operator applying for an equivalence determination shall be responsible for collecting and verifying test data to demonstrate equivalence of means of emission limitation.

(2) The Administrator will compare test data for the means of emission limitation to test data for the equipment, design, and operational requirements.

(3) The Administrator may condition the approval of equivalence on requirements that may be necessary to assure operation and maintenance to achieve the same emission reduction as

the equipment, design, and operational requirements.

(c) Determination of equivalence to the required work practices in this subpart will be evaluated by the following guidelines:

(1) Each owner or operator applying for a determination of equivalence shall be responsible for collecting and verifying test data to demonstrate equivalence of an equivalent means of emission limitation.

(2) For each affected facility for which a determination of equivalence is requested, the emission reduction achieved by the required work practice shall be demonstrated.

(3) For each affected facility, for which a determination of equivalence is requested, the emission reduction achieved by the equivalent means of emission limitation shall be demonstrated.

(4) Each owner or operator applying for a determination of equivalence shall commit in writing to work practice(s) that provide for emission reductions equal to or greater than the emission reductions achieved by the required work practice.

(5) The Administrator will compare the demonstrated emission reduction for the equivalent means of emission limitation to the demonstrated emission reduction for the required work practices and will consider the commitment in paragraph (c)(4).

(6) The Administrator may condition the approval of equivalence on requirements that may be necessary to assure operation and maintenance to achieve the same emission reduction as the required work practice.

(d) An owner or operator may offer a unique approach to demonstrate the equivalence of any equivalent means of emission limitation.

(e)(1) After a request for determination of equivalence is received, the Administrator will publish a notice in the Federal Register and provide the opportunity for public hearing if the Administrator judges that the request may be approved.

(2) After notice and opportunity for public hearing, the Administrator will determine the equivalence of a means of emission limitation and will publish the determination in the Federal Register.

(3) Any equivalent means of emission limitations approved under this section shall constitute a required work practice, equipment, design, or operational standard within the meaning of Section 111(h)(1) of the Clean Air Act.

(f)(1) Manufacturers of equipment used to control equipment leaks of VOC may apply to the Administrator for

determination of equivalence for any equivalent means of emission limitation that achieves a reduction in emissions of VOC achieved by the equipment, design, and operational requirements of this subpart.

(2) The Administrator will make an equivalence determination according to the provisions of paragraphs (b), (c), (d), and (e).

§ 60.485 Test methods and procedures.

(a) Each owner or operator subject to the provisions of this subpart shall comply with the test method and procedure requirements provided in this section.

(b) Monitoring, as required in §§ 60.482, 60.483, and 60.484, shall comply with the following requirements:

(1) Monitoring shall comply with Reference Method 21.

(2) The detection instrument shall meet the performance criteria of Reference Method 21.

(3) The instrument shall be calibrated before use on each day of its use by the methods specified in Method 21.

(4) Calibration gases shall be:

(i) Zero air (less than 10 ppm of hydrocarbon in air); and

(ii) A mixture of methane or n-hexane and air at a concentration of approximately, but less than, 10,000 ppm methane or n-hexane.

(5) The instrument probe shall be traversed around all potential leak interfaces as close to the interface as possible as described in Reference Method 21.

(c) When equipment is tested for compliance with no detectable emissions as required in § 60.482-2(a), -3(i), -4, -7(f), and -10(e), the test shall comply with the following requirements:

(1) The requirements of paragraphs (b)(1)-(4) shall apply.

(2) The background level shall be determined, as set forth in Reference Method 21.

(3) The instrument probe shall be traversed around all potential leak interfaces as close to the interface as possible as described in Reference Method 21.

(4) The arithmetic difference between the maximum concentration indicated by the instrument and the background level is compared with 500 ppm for determining compliance.

(d)(1) Each piece of equipment within a process unit is presumed to be in VOC service unless an owner or operator demonstrates that the piece of equipment is not in VOC service. For a piece of equipment to be considered not in VOC service, it must be determined that the percent VOC content can be reasonably expected never to exceed 10 percent by weight. For purposes of

determining the percent VOC content in the process fluid that is contained in or contacts equipment, procedures that conform to the general methods described in ASTM E-260, E-166, E-169 (incorporated by reference as specified in § 60.17) shall be used.

(2) If an owner or operator decides to exclude non-reactive organic compounds from the total quantity of organic compounds in determining the percent VOC content of the process fluid, the exclusion will be allowed if:

(i) Those substances excluded are those considered as having negligible photochemical reactivity by the Administrator; and

(ii) The owner or operator demonstrates that the percent organic content, excluding non-reactive organic compounds, can be reasonably expected never to exceed 10 percent by weight.

(3)(i) An owner or operator may use engineering judgment rather than the procedures in paragraphs (d) (1) and (2) of this section to demonstrate that the percent VOC content does not exceed 10 percent by weight, provided that the engineering judgment demonstrates that the VOC content clearly does not exceed 10 percent by weight. When an owner or operator and the Administrator do not agree on whether a piece of equipment is not in VOC service, however, the procedures in paragraphs (d) (1) and (2) shall be used to resolve the disagreement.

(ii) If an owner or operator determines that a piece of equipment is in VOC service, the determination can be revised only after following the procedures in paragraphs (d) (1) and (2).

(e) Equipment is in light liquid service if the following conditions apply:

(1) The vapor pressure of one or more of the components is greater than 0.3 kPa at 20° C. Vapor pressures may be obtained from standard reference texts or may be determined by ASTM D-2879 (incorporated by reference as specified in § 60.17).

(2) The total concentration of the pure components having a vapor pressure greater than 0.3 kPa at 20° C is equal to or greater than 20 percent by weight; and

(3) The fluid is a liquid at operating conditions.

(f) Samples used in conjunction with paragraphs (d), (e), and (g) shall be representative of the process fluid that is contained in or contacts the equipment or the gas being combusted in the flare.

(g)(1) Reference Method 22 shall be used to determine the compliance of

flares with the visible emission provisions of this subpart.

(2) The presence of a flare pilot flame shall be monitored using a thermocouple or any other equivalent device to detect the presence of a flame.

(3) The net heating value of the gas being combusted in a flare shall be calculated using the following equation:

$$H_T = K \left(\sum_{i=1}^n C_i H_i \right)$$

Where:

H_T = Net heating value of the sample, MJ/scm; where the net enthalpy per mole of offgas is based on combustion at 25° C and 760 mm Hg, but the standard temperature for determining the volume corresponding to one mole is 20°.

$$K = \text{Constant.} \left(\frac{1}{1.740 \times 10^7} \right) \left(\frac{\text{g mole}}{\text{ppm}} \right) \left(\frac{\text{MJ}}{\text{scm}} \right) \left(\frac{\text{kcal.}}{\text{scm}} \right)$$

where

$$\text{standard temperature for } \frac{\text{g mole}}{\text{scm}} \text{ is } 20^\circ\text{C}$$

C_i = Concentration of sample component i in ppm, as measured by Reference Method 18 and ASTM D2504-67 (reapproved 1977) (incorporated by reference as specified in § 60.17).

H_i = Net heat of combustion of sample component i , kcal/g mole. The heats of combustion may be determined using ASTM D2382-76 (incorporated by reference as specified in § 60.17) if published values are not available or cannot be calculated.

(4) The actual exit velocity of a flare shall be determined by dividing the volumetric flowrate (in units of standard temperature and pressure), as determined by Reference Method 2, 2A, 2C, or 2D as appropriate; by the unobstructed (free) cross sectional area of the flare tip.

(5) The maximum permitted velocity, V_{max} , for air-assisted flares shall be determined by the following equation:

$$V_{max} = 8.706 + 0.7084(H_T)$$

V_{max} = Maximum permitted velocity, m/sec.
8.706 = Constant.

0.7084 = Constant.

H_T = The net heating value as determined in paragraph (g)(4).

(Sec. 114 of the Clean Air Act as amended (42 U.S.C. 7414))

§ 60.486 Recordkeeping requirements.

(a)(1) Each owner or operator subject to the provisions of this subpart shall comply with the recordkeeping requirements of this section.

(2) An owner or operator of more than one affected facility subject to the provisions of this subpart may comply with the recordkeeping requirements for

these facilities in one recordkeeping system if the system identifies each record by each facility.

(b) When each leak is detected as specified in § 60.482-2, -3, -7, -8, and § 60.483-2, the following requirements apply:

(1) A weatherproof and readily visible identification, marked with the equipment identification number, shall be attached to the leaking equipment.

(2) The identification on a valve may be removed after it has been monitored for 2 successive months as specified in § 60.482-7(c) and no leak has been detected during those 2 months.

(3) The identification on equipment except on a valve, may be removed after it has been repaired.

(c) When each leak is detected as specified in § 60.482-2, -3, -7, -8, and § 60.483-2, the following information shall be recorded in a log and shall be kept for 2 years in a readily accessible location:

(1) The instrument and operator identification numbers and the equipment identification number.

(2) The date the leak was detected and the dates of each attempt to repair the leak.

(3) Repair methods applied in each attempt to repair the leak.

(4) "Above 10,000" if the maximum instrument reading measured by the methods specified in § 60.485(a) after each repair attempt is equal to or greater than 10,000 ppm.

(5) "Repair delayed" and the reason for the delay if a leak is not repaired within 15 calendar days after discovery of the leak.

(6) The signature of the owner or operator (or designate) whose decision it was that repair could not be effected without a process shutdown.

(7) The expected date of successful repair of the leak if a leak is not repaired within 15 days.

(8) Dates of process unit shutdown that occur while the equipment is unrepaired.

(9) The date of successful repair of the leak.

(d) The following information pertaining to the design requirements for closed vent systems and control devices described in § 60.482-10 shall be recorded and kept in a readily accessible location:

(1) Detailed schematics, design specifications, and piping and instrumentation diagrams.

(2) The dates and descriptions of any changes in the design specifications.

(3) A description of the parameter or parameters monitored, as required in § 60.482-10(e), to ensure that control devices are operated and maintained in

conformance with their design and an explanation of why that parameter (or parameters) was selected for the monitoring.

(4) Periods when the closed vent systems and control devices required in § 60.482-2, -3, -4, and -5 are not operated as designed, including periods when a flare pilot light does not have a flame.

(5) Dates of startups and shutdowns of the closed vent systems and control devices required in § 60.482-2, -3, -4, and -5.

(e) The following information pertaining to all equipment subject to the requirements in § 60.482-1 to -10 shall be recorded in a log that is kept in a readily accessible location:

(1) A list of identification numbers for equipment subject to the requirements of this subpart.

(2)(i) A list of identification numbers for equipment that are designated for no detectable emissions under the provisions of § 60.482-2(e), -3(i) and -7(f).

(ii) The designation of equipment as subject to the requirements of § 60.482-2(e), -3(i), or -7(f) shall be signed by the owner or operator.

(3) A list of equipment identification numbers for pressure relief devices required to comply with § 60.482-4.

(4)(i) The dates of each compliance test as required in § 60.482-2(e), -3(i), -4, and -7(f).

(ii) The background level measured during each compliance test.

(iii) The maximum instrument reading measured at the equipment during each compliance test.

(5) A list of identification numbers for equipment in vacuum service.

(f) The following information pertaining to all valves subject to the requirements of § 60.482-7 (g) and (h) shall be recorded in a log that is kept in a readily accessible location:

(1) A list of identification numbers for valves that are designated as unsafe-to-monitor, an explanation for each valve stating why the valve is unsafe-to-monitor, and the plan for monitoring each valve.

(2) A list of identification numbers for valves that are designated as difficult-to-monitor, an explanation for each valve stating why the valve is difficult-to-monitor, and the schedule for monitoring each valve.

(g) The following information shall be recorded for valves complying with § 60.483-2:

(1) A schedule of monitoring

(2) The percent of valves found leaking during each monitoring period.

(h) The following information shall be recorded in a log that is kept in a readily accessible location:

(1) Design criterion required in § 60.482-2(d)(5) and § 60.482-3(e)(2) and explanation of the design criterion; and

(2) Any changes to this criterion and the reasons for the changes.

(i) The following information shall be recorded in a log that is kept in a readily accessible location for use in determining exemptions as provided in § 60.480(d):

(1) An analysis demonstrating the design capacity of the affected facility.

(2) A statement listing the feed or raw materials and products from the affected facilities and an analysis demonstrating whether these chemicals are heavy liquids or beverage alcohol, and

(3) An analysis demonstrating that equipment is not in VOC service.

(j) Information and data used to demonstrate that a piece of equipment is not in VOC service shall be recorded in a log that is kept in a readily accessible location.

(k) The provisions of §§ 60.7 (b) and (d) do not apply to affected facilities subject to this subpart.

(Sec. 114 of the Clean Air Act as amended (42 U.S.C. 7414))

(Approved by the Office of Management and Budget under the control number 2080-0012)

§ 60.487 Reporting Requirements.

(a) Each owner or operator subject to the provisions of this subpart shall submit semiannual reports to the Administrator beginning six months after the initial start up date.

(b) The initial semiannual report to the Administrator shall include the following information:

(1) Process unit identification.

(2) Number of valves subject to the requirements of § 60.482-7, excluding those valves designated for no detectable emissions under the provisions of § 60.482-7(f).

(3) Number of pumps subject to the requirements of § 60.482-2, excluding those pumps designated for no detectable emissions under the provisions of § 60.482-2(e) and those pumps complying with § 60.482-2(f).

(4) Number of compressors subject to the requirements of § 60.482-3, excluding those compressors designated for no detectable emissions under the provisions of § 60.482-3(i) and those compressors complying with § 60.482-3(h).

(c) All semiannual reports to the Administrator shall include the following information, summarized from the information in § 60.486:

(1) Process unit identification.

(2) For each month during the semiannual reporting period,

(i) Number of valves for which leaks were detected as described in § 60.482(7)(b) or § 60.483-2.

(ii) Number of valves for which leaks were not reported as repaired in § 60.482-7(d)(1).²²⁷

(iii) Number of pumps for which leaks were detected as described in §§ 60.482-2(b) and (d)(6)(i).

(iv) Number of pumps for which leaks were not repaired as required in §§ 60.482-2(c)(1) and (d)(6)(ii).

(v) Number of compressors for which leaks were detected as described in § 60.482-3(f).

(vi) Number of compressors for which leaks were not repaired as required in § 60.482-3(g)(1), and²²⁷

(vii) The facts that explain each delay of repair and, where appropriate, why a process unit shutdown was technically infeasible.

(3) Dates of process unit shutdowns which occurred within the semiannual reporting period.

(4) Revisions to items reported according to paragraph (b) if changes have occurred since the initial report or subsequent revisions to the initial report.

(d) An owner or operator electing to comply with the provisions of §§ 60.483-1 and -2 shall notify the Administrator of the alternative standard selected 90 days before implementing either of the provisions.

(e) An owner or operator shall report the results of all performance tests in accordance with § 60.8 of the General Provisions. The provisions of § 60.8(d) do not apply to affected facilities subject to the provisions of this subpart except that an owner or operator must notify the Administrator of the schedule for the initial performance tests at least 30 days before the initial performance tests.

(f) The requirements of paragraphs (a) through (c) of this subsection remain in force until and unless EPA, in delegating enforcement authority to a State under Section 111(c) of the Act, approves reporting requirements or an alternative means of compliance surveillance adopted by such State. In that event, affected sources within the State will be relieved of the obligation to comply with the requirements of paragraphs (a) through (c) of this subsection, provided that they comply with the requirements established by the State.

(Sec. 114 of the Clean Air Act as amended (42 U.S.C. 7414))

(Approved by the Office of Management and Budget under the control number 2080-0012)

§ 60.488 Reconstruction.

For the purposes of this subpart.

(a) The cost of the following frequently replaced components of the facility shall not be considered in calculating either the "fixed capital cost of the new components" or the "fixed capital costs that would be required to construct a comparable new facility" under § 60.15: pump seals, nuts and bolts, rupture disks, and packings.

(b) Under § 60.15, the "fixed capital cost of new components" includes the fixed capital cost of all depreciable components (except components specified in § 60.488 (a)) which are or will be replaced pursuant to all continuous programs of component replacement which are commenced within any 2-year period following the applicability date for the appropriate subpart. (See the "Applicability and designation of affected facility" section of the appropriate subpart.) For purposes of this paragraph, "commenced" means that an owner or operator has undertaken a continuous program of component replacement or that an owner or operator has entered into a contractual obligation to undertake and complete, within a reasonable time, a continuous program of component replacement.

§ 60.489 List of chemicals produced by affected facilities.

(a) The following chemicals 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.

CAS No. *	Chemical
105-57-7	Acetal.
75-07-0	Acetaldehyde
107-89-1	Acetaldehyde
80-35-5	Acetamide
103-84-4	Acetanilide
64-19-7	Acetic acid
108-24-7	Acetic anhydride
67-64-1	Acetone
75-06-5	Acetone cyanohydrin
75-05-8	Acetonitrile
98-06-2	Acetophenone
75-38-5	Acetyl chloride
74-86-2	Acetylene
107-08-9	Acrolein
78-08-1	Acrylamide
79-10-7	Acrylic acid
107-13-1	Acrylonitrile
124-04-6	Adipic acid
111-89-3	Adiponitrile
(*)	Alkyl naphthalenes
107-18-6	Allyl alcohol
107-06-1	Allyl chloride
1321-11-5	Aminobenzoic acid
111-41-1	Aminocyclohexanecarboxylic acid
123-30-8	p-Aminophenol
628-63-7, 123-88-2	Aspi. acetates
71-41-0*	Amyl alcohol
110-88-7	Amyl amine
843-88-8	Amyl chloride
110-88-7*	Amyl mercaptane
1322-06-1	Amyl phenol

CAS No. *	Chemical
62-53-3	Aniline
142-04-1	Aniline hydrochloride
28181-52-4	Anisole
100-86-3	Anisole
118-82-3	Anthranic acid
84-86-1	Anthraquinone
100-82-7	Barbituric acid
55-21-0	Benzamide
71-43-2	Benzene
98-48-6	Benzenesulfonic acid
98-11-3	Benzenesulfonic acid
134-81-6	Benzil
78-03-7	Benzic acid
98-06-0	Benzic acid
118-63-6	Benzoin
100-47-0	Benzonitrile
118-61-9	Benzophenone
98-07-7	Benzoyl chloride
98-08-4	Benzoyl chloride
100-61-6	Benzyl alcohol
100-46-6	Benzylamine
120-51-4	Benzyl benzoate
100-44-7	Benzyl chloride
98-87-3	Benzyl dichloride
82-62-4	Biphenyl
80-06-7	Biphenyl A
10-86-1	Bromobenzene
27487-61-4	Bromonaphthalene
108-98-0	Bulacene
108-88-9	1-Butene
123-68-4	n-Butyl acetate
141-32-2	n-Butyl acrylate
71-36-3	n-Butyl alcohol
78-82-2	n-Butyl alcohol
75-65-0	1-Butyl alcohol
108-73-9	n-Butylamine
13652-84-8	n-Butylamine
75-44-9	n-Butylamine
98-73-7	p-tert-Butyl benzoic acid
107-68-0	1,3-Butylene glycol
123-72-8	n-Butylaldehyde
107-82-6	Butyne acid
108-31-0	Butyne anhydride
108-74-0	Butyrolactone
108-80-2	Caprolactam
75-1-86	Carbon disulfide
558-13-4	Carbon tetrabromide
56-23-6	Carbon tetrachloride
8004-35-7	Cellulose acetate
79-11-8	Chloroacetic acid
108-42-9	m-chloroaniline
98-51-2	p-chloroaniline
106-47-8	p-chloroaniline
35913-08-8	Chlorobenzaldehyde
108-90-7	Chlorobenzene
118-91-2, 535-80-8, 74-11-3*	Chlorobenzoic acid
2136-81-4	Chlorobenzotrithionide
2136-89-2	Chlorobenzotrithionide
5216-25-1*	Chlorobenzotrithionide
1321-03-5	Chlorobenzoyl chloride
25497-29-4	Chlorodifluoromethane
75-45-6	Chlorodifluoromethane
67-68-3	Chloroform
25506-43-0	Chloroform
98-73-3	o-chloronitrobenzene
100-00-5	p-chloronitrobenzene
25167-80-0	Chlorophenol
126-99-8	Chlorophene
7790-94-5	Chlorosulfonic acid
108-41-8	m-chlorotoluene
95-49-6	o-chlorotoluene
108-43-4	p-chlorotoluene
75-72-9	Chlorotrifluoromethane
108-38-4	m-cresol
95-48-7	p-cresol
108-44-5	p-cresol
1318-77-3	Mixed cresols
1319-77-3	Cresylic acid
4170-30-0	Crotonaldehyde
3724-85-0	Crotonic acid
98-82-8	Cumene
80-15-9	Cumene hydroperoxide
372-08-8	Cyanoacetic acid
508-77-4	Cyanogen chloride
108-80-5	Cyanuric acid
108-77-0	Cyanuric chloride
110-82-7	Cyclohexene
108-83-0	Cyclohexanol
108-94-1	Cyclohexanone
110-83-8	Cyclohexene
108-81-8	Cyclohexanone
111-78-4	Cyclooctadiene
112-30-1	Decanol

CAS No. *	Chemical
123-42-2	Diacetone alcohol
27578-04-1	Diaminobenzoic acid
85-78-1, 85-82-8, 564-00-7, 808-27-5, 808-31-1, 808-43-7, 27134-27-8, 57311-62-9*	Dichloroaniline
841-73-1	m-dichlorobenzene
95-50-1	o-dichlorobenzene
108-46-7	p-dichlorobenzene
75-71-8	Dichlorodifluoromethane
111-44-4	Dichloroethyl ether
107-08-2	1,2-dichloroethane (EDC)
98-23-1	Dichlorohydrin
28952-23-8	Dichloropropene
101-83-7	Dicyclohexylamine
109-88-7	Dithyrene
111-46-8	Dithyrene glycol
112-36-7	Dithyrene glycol diethyl ether
111-68-6	Dithyrene glycol dimethyl ether
112-34-6	Dithyrene glycol monobutyl ether
124-17-7	Dithyrene glycol monobutyl ether acetate
111-80-0	Dithyrene glycol monomethyl ether
112-15-2	Dithyrene glycol monomethyl ether acetate
111-77-3	Dithyrene glycol monomethyl ether
64-87-5	Dithyrene sulfide
75-37-6	Difluorobenzene
25167-70-8	Dibutylamine
26761-40-0	Dodecyl phenol
27554-26-3	Dodecyl phenol
674-82-8	Dioxane
124-40-3	Dioxybenzene
121-68-7	N,N-dimethylaniline
115-10-6	N,N-dimethyl ether
68-12-2	N,N-dimethylformamide
57-14-7	Dimethylhydrazine
77-78-1	Dimethyl sulfide
75-18-3	Dimethyl sulfoxide
67-68-5	Dimethyl sulfoxide
120-61-6	Dimethyl tartrate
98-34-3	3,5-dinitrobenzoic acid
51-28-5	Dinitrophenol
25321-14-6	Dinitrobenzene
123-81-1	Dioxane
646-06-0	Dioxane
122-38-4	Diphenylamine
101-84-6	Diphenyl oxide
102-08-9	Diphenyl urea
25265-71-8	Dipropylene glycol
25378-22-7	Dodecane
26675-17-4	Dodecylamine
27183-85-6	Dodecylphenol
108-88-6	Epichlorohydrin
64-17-5	Ethanol
141-43-5*	Ethenolamine
141-78-6	Ethyl acetate
141-97-9	Ethyl acetate acetate
140-88-5	Ethyl acrylate
75-04-7	Ethylamine
100-41-4	Ethylbenzene
74-86-4	Ethyl bromide
8004-57-3	Ethylcellulose
75-00-3	Ethyl chloride
105-38-5	Ethyl chloroacetate
105-56-6	Ethylcyanoacetate
74-85-1	Ethylene
98-49-1	Ethylene carbonate
107-07-3	Ethylene chlorohydrin
107-15-3	Ethylene diamine
108-83-4	Ethylene dibromide
107-21-1	Ethylene glycol
111-55-7	Ethylene glycol diacetate
118-71-4	Ethylene glycol dimethyl ether
111-78-2	Ethylene glycol monobutyl ether
112-07-2	Ethylene glycol monobutyl ether acetate
110-80-5	Ethylene glycol monomethyl ether
111-15-9	Ethylene glycol monomethyl ether acetate
108-86-4	Ethylene glycol monomethyl ether
110-49-6	Ethylene glycol monomethyl ether acetate
122-88-6	Ethylene glycol monophenyl ether
2807-30-8	Ethylene glycol monopropyl ether
75-21-8	Ethylene oxide
60-29-7	Ethyl ether
104-78-7	2-ethylhexanol
122-51-0	Ethyl orthoformate
85-82-1	Ethyl acetate
41882-71-1	Ethyl sodium azide
50-00-0	Formaldehyde
75-12-7	Formic acid

CAS No *	Chemical
84-18-8	Ferroc acid
110-17-8	Fumic acid
98-01-1	Furfural
58-81-5	Glycerol
29545-73-7	Glycerol dichlorohydrin
25791-98-2	Glycerol triether
56-40-8	Glycine
107-22-2	Glyoxal
118-74-1	Hexachlorobenzene
67-72-1	Hexachlorocyclopentadiene
38853-82-4	Hexadecyl alcohol
124-08-4	Hexamethylenesulfonamide
629-11-8	Hexamethylene glycol
100-97-0	Hexamethylenetetramine
74-90-8	Hydrogen cyanide
123-31-8	Hydroquinone
99-06-7	p-Hydroxybenzoic acid
26780-84-5	Isomylene
78-83-1	Isobutanol
110-19-0	Isobutyl acetate
118-11-7	Isobutylene
78-84-2	Isobutyraldehyde
79-31-2	Isobutyric acid
25338-17-7	Isodecanol
26952-31-6	Isodecyl alcohol
78-78-4	Isopentane
78-58-1	Isophorone
121-91-5	Isophthalic acid
78-78-5	Isoprene
67-43-0	Isopropanol
108-21-4	Isopropyl acetate
75-31-0	Isopropylamine
75-29-6	Isopropyl chloride
25188-08-3	Isopropylphenol
483-81-4	Kerosene
(*)	Linear alkyl sulfonate
123-01-3	Linear alkylbenzene (linear dodecylbenzene)
110-16-7	Maleic acid
108-31-6	Maleic anhydride
6915-15-7	Maleic acid
141-78-7	Maleic anhydride
121-47-1	Maleic acid
78-41-4	Maleic anhydride
563-47-3	Maleic anhydride
67-58-1	Methanol
78-20-9	Methyl acetate
105-45-3	Methyl acetoacetate
74-98-5	Methylamine
100-61-8	N-methylamine
74-83-9	Methyl bromide
37365-71-2	Methyl butanol
74-87-3	Methyl chloride
108-87-2	Methylcyclohexane
1331-22-2	Methylcyclohexanone
75-08-2	Methylene chloride
101-77-8	Methylene diamine
101-88-8	Methylene diphenyl diisocyanate
78-93-3	Methyl ethyl ketone
107-31-3	Methyl formate
108-11-2	Methyl isobutyl carbonyl
108-10-1	Methyl isobutyl ketone
80-62-6	Methyl methacrylate
77-75-8	Methylphenylol
98-83-9	p-methylstyrene
110-91-8	Morpholine
85-47-2	p-naphthalene sulfonic acid
120-18-3	p-naphthalene sulfonic acid
80-15-3	p-naphthol
135-19-3	p-naphthol
75-98-9	Nicotinic acid
88-74-4	o-nitroaniline
100-01-6	p-nitroaniline
91-23-6	o-nitroanisole
100-17-4	p-nitroanisole
98-95-3	Nitrobenzene
27178-83-2*	Nitrobenzoic acid (o,m, and p)
78-24-3	Nitroethane
75-52-5	Nitromethane
88-75-5	2-Nitrophenol
25322-01-4	Nitropropane
1321-12-6	Nitrotoluene
27215-95-8	Nonane
25154-52-3	Nonylphenol
27183-28-6	Octylphenol
123-62-7	Pentadecane
115-77-6	Pentacyanide
108-98-0	n-pentane
108-67-1	1-pentene
127-18-4	Perchloroethylene
584-42-3	Perchloromethyl mercaptan
84-70-2	o-phenylene
156-43-4	p-phenylene
108-95-2	Phenol

CAS No *	Chemical
98-87-8, 585-38-6, 609-46-1, 1333-38-7*	Phenolsulfonic acids
81-40-7	Phenyl anthranic acid
(*)	Phenylbenzidine
75-44-5	Phosgene
85-44-9	Phthalic anhydride
85-41-6	Phthalimide
108-98-6	p-picoline
110-65-0	Piperazine
9003-29-8	Polybenzenes
25038-28-7*	
25322-68-3	Polyethylene glycol
25322-68-4	Polypropylene glycol
123-38-8	Propionaldehyde
78-08-4	Propionic acid
71-23-8	n-propyl alcohol
107-10-8	Propylene
540-54-5	Propyl chloride
115-07-1	Propylene
127-00-4	Propylene dichlorohydrin
78-87-5	Propylene dichloride
57-56-6	Propylene glycol
75-68-9	Propylene oxide
110-88-1	Pyridine
108-51-4	Quinone
108-46-3	Resorcinol
27138-67-4	Resorcinic acid
68-72-7	Saccharic acid
127-09-3	Sodium acetate
532-32-1	Sodium benzoate
9004-32-4	Sodium carboxymethyl cellulose
3828-82-3	Sodium chlorosulfate
141-53-7	Sodium formate
138-02-6	Sodium phenate
118-44-1	Serbic acid
100-42-6	Styrene
110-15-6	Succinic acid
110-81-2	Succinonitrile
121-67-3	Sulfonic acid
128-33-0	Sulfonate
1401-65-4	Tannic acid
100-21-0	Terephthalic acid
78-34-5*	Tetrachloroethane
117-08-8	Tetrachlorophthalic anhydride
78-00-2	Tetraethyl lead
118-84-2	Tetrahydronaphthalene
85-43-8	Tetrahydrophthalic anhydride
75-74-1	Tetramethyl lead
110-80-1	Tetramethylenediamine
110-18-8	Tetramethylethylenediamine
108-88-3	Toluene
95-80-7	Toluene-2,4-diamine
584-84-9	Toluene-2,4-diisocyanate
26471-62-5	Toluene diisocyanates (mixture)
1333-07-9	Toluenesulfonamide
104-15-4*	Toluenesulfonic acid
98-58-9	Toluenesulfonyl chloride
26915-12-8	Toluidine
87-61-6, 108-70-3, 120-82-1*	Trichlorobenzenes
71-55-6	1,1,1-trichloroethane
78-00-5	1,1,2-trichloroethane
78-01-8	Trichloroethylene
75-69-4	Trichlorofluoromethane
96-18-4	1,2,3-trichloropropane
76-13-1	1,1,2-trichloro-1,2,2-trifluoroethane
121-44-8	Triethylamine
112-27-6	Triethylene glycol
112-49-2	Triethylene glycol dimethyl ether
7756-94-7	Triisobutylene
75-50-3	Trimethylamine
57-13-6	Urea
108-05-4	Vinyl acetate
75-01-4	Vinyl chloride
75-35-4	Vinylidene chloride
25013-15-4	Vinyl toluene
1330-20-7	Xylenes (mixed)
95-47-6	o-xylene
108-42-3	p-xylene
1300-71-6	Xylenol
1300-73-8	Xylenes

*CAS numbers refer to the Chemical Abstracts Registry numbers assigned to specific chemicals, isomers, or mixtures of chemicals. Some isomers or mixtures that are covered by the standards do not have CAS numbers assigned to them. The standards apply to all of the chemicals listed, whether CAS numbers have been assigned or not.

*No CAS number(s) have been assigned to this chemical, its isomers, or mixtures containing these chemicals.

*CAS numbers for some of the isomers are listed; the standards apply to all of the isomers and mixtures, even if CAS numbers have not been assigned.

Proposed/effective

46 FR 1136, 1/5/81

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48 FR 48328, 10/18/83 (206)

Revised

48 FR 22598, 5/30/84 (227)

49 FR 26738, 6/29/84 (230)

Subpart XX—Standards of Performance for Bulk Gasoline Terminals 195

§ 60.500 Applicability and designation of affected facility.

(a) The affected facility to which the provisions of this subpart apply is the total of all the loading racks at a bulk gasoline terminal which deliver liquid product into gasoline tank trucks.

(b) Each facility under paragraph (a) of this section, the construction or modification of which is commenced after December 17, 1980, is subject to the provisions of this subpart.

(c) For purposes of this subpart, any replacement of components of an existing facility, described in paragraph § 60.500(a), commenced before August 18, 1983 in order to comply with any emission standard adopted by a State or political subdivision thereof will not be considered a reconstruction under the provisions of 40 CFR 60.15.

[Note: The intent of these standards is to minimize the emissions of VOC through the application of best demonstrated technologies (BDT). The numerical emission limits in this standard are expressed in terms of total organic compounds. This emission limit reflects the performance of BDT.]

§ 60.501 Definitions.

The terms used in this subpart are defined in the Clean Air Act, in § 60.2 of this part, or in this section as follows:

"Bulk gasoline terminal" means any gasoline facility which receives gasoline by pipeline, ship or barge, and has a gasoline throughput greater than 75,700 liters per day. Gasoline throughput shall be the maximum calculated design throughput as may be limited by compliance with an enforceable condition under Federal, State or local law and discoverable by the Administrator and any other person.

"Continuous vapor processing system" means a vapor processing system that treats total organic compounds vapors collected from gasoline tank trucks on a demand basis without intermediate accumulation in a vapor holder.

"Existing vapor processing system" means a vapor processing system [capable of achieving emissions to the atmosphere no greater than 80 milligrams of total organic compounds per liter of gasoline loaded], the construction or refurbishment of which was commenced before December 17, 1980, and which was not constructed or refurbished after that date.

"Gasoline" means any petroleum distillate or petroleum distillate/alcohol blend having a Reid vapor pressure of 27.6 kilopascals or greater which is used

as a fuel for internal combustion engines.

"Gasoline tank truck" means a delivery tank truck used at bulk gasoline terminals which is loading gasoline or which has loaded gasoline on the immediately previous load.

"Intermittent vapor processing system" means a vapor processing system that employs an intermediate vapor holder to accumulate total organic compounds vapors collected from gasoline tank trucks, and treats the accumulated vapors only during automatically controlled cycles.

"Loading rack" means the loading arms, pumps, meters, shutoff valves, relief valves, and other piping and valves necessary to fill delivery tank trucks.

"Refurbishment" means, with reference to a vapor processing system, replacement of components of, or addition of components to, the system within any 2-year period such that the fixed capital cost of the new components required for such component replacement or addition exceeds 50 percent of the cost of a comparable entirely new system.

"Total organic compounds" means those compounds measured according to the procedures in § 60.503.

"Vapor collection system" means any equipment used for containing total organic compounds vapors displaced during the loading of gasoline tank trucks.

"Vapor processing system" means all equipment used for recovering or oxidizing total organic compounds vapors displaced from the affected facility.

"Vapor-tight gasoline tank truck" means a gasoline tank truck which has demonstrated within the 12 preceding months that its product delivery tank will sustain a pressure change of not more than 750 pascals (75 mm of water) within 5 minutes after it is pressurized to 4,500 pascals (450 mm of water). This capability is to be demonstrated using the pressure test procedure specified in Reference Method 27.

§ 60.502 Standard for Volatile Organic Compound (VOC) emissions from bulk gasoline terminals.

On and after the date on which § 60.8(a) requires a performance test to be completed, the owner or operator of each bulk gasoline terminal containing an affected facility shall comply with the requirements of this section.²¹³

(a) Each affected facility shall be equipped with a vapor collection system designed to collect the total organic compounds vapors displaced from tank trucks during product loading.

(b) The emissions to the atmosphere from the vapor collection system due to the loading of liquid product into gasoline tank trucks are not to exceed 35 milligrams of total organic compounds per liter of gasoline loaded, except as noted in paragraph (c) of this section.

(c) For each affected facility equipped with an existing vapor processing system, the emissions to the atmosphere from the vapor collection system due to the loading of liquid product into gasoline tank trucks are not to exceed 80 milligrams of total organic compounds per liter of gasoline loaded.

(d) Each vapor collection system shall be designed to prevent any total organic compounds vapors collected at one loading rack from passing to another loading rack.

(e) Loadings of liquid product into gasoline tank trucks shall be limited to vapor-tight gasoline tank trucks using the following procedures:

(1) The owner or operator shall obtain the vapor tightness documentation described in § 60.505(b) for each gasoline tank truck which is to be loaded at the affected facility.

(2) The owner or operator shall require the tank identification number to be recorded as each gasoline tank truck is loaded at the affected facility.

(3) The owner or operator shall cross-check each tank identification number obtained in (e)(2) of this section with the file of tank vapor tightness documentation within 2 weeks after the corresponding tank is loaded.

(4) The terminal owner or operator shall notify the owner or operator of each nonvapor-tight gasoline tank truck loaded at the affected facility within 3 weeks after the loading has occurred.

(5) The terminal owner or operator shall take steps assuring that the nonvapor-tight gasoline tank truck will not be reloaded at the affected facility until vapor tightness documentation for that tank is obtained.

(6) Alternate procedures to those described in (e)(1) through (5) of this section for limiting gasoline tank truck loadings may be used upon application to, and approval by, the Administrator.

(f) The owner or operator shall act to assure that loadings of gasoline tank trucks at the affected facility are made only into tanks equipped with vapor collection equipment that is compatible with the terminal's vapor collection system.

(g) The owner or operator shall act to assure that the terminal's and the tank truck's vapor collection systems are connected during each loading of a gasoline tank truck at the affected facility. Examples of actions to

accomplish this include training drivers in the hookup procedures and posting visible reminder signs at the affected loading racks.

(h) The vapor collection and liquid loading equipment shall be designed and operated to prevent gauge pressure in the delivery tank from exceeding 4.500 pascals (450 mm of water) during product loading. This level is not to be exceeded when measured by the procedures specified in § 60.503(b).

(i) No pressure-vacuum vent in the bulk gasoline terminal's vapor collection system shall begin to open at a system pressure less than 4.500 pascals (450 mm of water).

(j) Each calendar month, the vapor collection system, the vapor processing system, and each loading rack handling gasoline shall be inspected during the loading of gasoline tank trucks for total organic compounds liquid or vapor leaks. For purposes of this paragraph, detection methods incorporating sight, sound, or smell are acceptable. Each detection of a leak shall be recorded and the source of the leak repaired within 15 calendar days after it is detected.

(Approved by the Office of Management and Budget under control number 2060-0006)

§ 60.503 Test methods and procedures.

(a) Section 60.8(f) does not apply to the performance test procedures required by this subpart.

(b) For the purpose of determining compliance with § 60.502(h), the following procedures shall be used:

(1) Calibrate and install a pressure measurement device (liquid manometer, magnehelic gauge, or equivalent instrument), capable of measuring up to 500 mm of water gauge pressure with ± 2.5 mm of water precision.

(2) Connect the pressure measurement device to a pressure tap in the terminal's vapor collection system, located as close as possible to the connection with the gasoline tank truck.

(3) During the performance test, record the pressure every 5 minutes while a gasoline tank truck is being loaded, and record the highest instantaneous pressure that occurs during each loading. Every loading position must be tested at least once during the performance test. ²¹³

(c) For the purpose of determining compliance with the mass emission limitations of § 60.502(b) and (c), the following reference methods shall be used:

(1) For the determination of volume at the exhaust vent:

(i) Method 2B for combustion vapor processing systems.

(ii) Method 2A for all other vapor processing systems.

(2) For the determination of total organic compounds concentration at the exhaust vent, Method 25A or 25B. The calibration gas shall be either propane or butane.

(d) Immediately prior to a performance test required for determination of compliance with § 60.502(b), (c), and (h), all potential sources of vapor leakage in the terminal's vapor collection system equipment shall be monitored for leaks using Method 21. The monitoring shall be conducted only while a gasoline tank truck is being loaded. A reading of 10,000 ppmv or greater as methane shall be considered a leak. All leaks shall be repaired prior to conducting the performance test.

(e) The test procedure for determining compliance with § 60.502(b) and (c) is as follows:

(1) All testing equipment shall be prepared and installed as specified in the appropriate test methods.

(2) The time period for a performance test shall be not less than 6 hours, during which at least 300,000 liters of gasoline are loaded. If the throughput criterion is not met during the initial 6 hours, the test may be either continued until the throughput criterion is met, or resumed the next day with another complete 6 hours of testing. As much as possible, testing should be conducted during the 6-hour period in which the highest throughput normally occurs.

(3) For intermittent vapor processing systems:

(i) The vapor holder level shall be recorded at the start of the performance test. The end of the performance test shall coincide with a time when the vapor holder is at its original level.

(ii) At least two startups and shutdowns of the vapor processor shall occur during the performance test. If this does not occur under automatically controlled operation, the system shall be manually controlled.

(4) The volume of gasoline dispensed during the performance test period at all loading racks whose vapor emissions are controlled by the processing system being tested shall be determined. This volume may be determined from terminal records or from gasoline dispensing meters at each loading rack.

(5) An emission testing interval shall consist of each 5-minute period during the performance test. For each interval:

(i) The reading from each measurement instrument shall be recorded, and

(ii) The volume exhausted and the average total organic compounds concentration in the exhaust vent shall be determined, as specified in the appropriate test method. The average total organic compounds concentration shall correspond to the volume measurement by taking into account the sampling system response time.

(6) The mass emitted during each testing interval shall be calculated as follows:

$$M_{ti} = 10^{-3} KV_i C_i$$

where

M_{ti} = mass of total organic compounds emitted during testing interval i , mg

V_i = volume of air-vapor mixture exhausted m^3 at standard conditions.

C_i = total organic compounds concentration (as measured) at the exhaust vent, ppmv

K = density of calibration gas, mg/m^3 at standard conditions

= 1.83×10^6 , for propane

= 2.41×10^6 , for butane

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s = standard conditions, 20°C and 760 mm Hg

(7) The total organic compounds mass emissions shall be calculated as follows:

$$E = \frac{\sum_{i=1}^n M_{ti}}{L}$$

where:

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E = mass of total organic compounds emitted per volume of gasoline loaded, $mg/liter$.

M_{ti} = mass of total organic compounds emitted during testing interval i , mg.

L = total volume of gasoline loaded, liters.

n = number of testing intervals.

(f) The owner or operator may adjust the emission results to exclude the methane and ethane content in the exhaust vent by any method approved by the Administrator

[Sec. 114 of the Clean Air Act as amended (42 U.S.C. 7414)]

(Approved by the Office of Management and Budget under control number 2060-0006)

§ 60.504 [Reserved].

§ 60.505 Reporting and recordkeeping.

(a) The tank truck vapor tightness documentation required under 160.502(e)(1) shall be kept on file at the terminal in a permanent form available for inspection.

(b) The documentation file for each gasoline tank truck shall be updated at least once per year to reflect current test results as determined by Method 27. This documentation shall include, as a minimum, the following information:

(1) Test Title: Gasoline Delivery Tank Pressure Test—EPA Reference Method 27

(2) Tank Owner and Address.
 (3) Tank Identification Number.
 (4) Testing Location.
 (5) Date of Test.
 (6) Tester Name and Signature.
 (7) Witnessing Inspector, if any:
 Name, Signature, and Affiliation.
 (8) Test Results: Actual Pressure
 Change in 5 minutes, mm of water
 (average for 2 runs).
 (c) A record of each monthly leak
 inspection-required under § 60.502(j)
 shall be kept on file at the terminal for
 at least 2 years. Inspection records shall
 include, as a minimum, the following
 information:
 (1) Date of Inspection.
 (2) Findings (may indicate no leaks
 discovered; or location, nature, and
 severity of each leak).
 (3) Leak determination method.
 (4) Corrective Action (date each leak
 repaired; reasons for any repair interval
 in excess of 15 days).
 (5) Inspector Name and Signature.
 (d) The terminal owner or operator
 shall keep documentation of all
 notifications required under
 § 60.502(e)(4) on file at the terminal for
 at least 2 years.
 (e) [Reserved].
 (f) The owner or operator of an
 affected facility shall keep records of all
 replacements or additions of
 components performed on an existing
 vapor processing system for at least 3
 years.
 [Sec. 114 of the Clean Air Act as amended (42
 U.S.C. 7414)]

(Approved by the Office of Management and
 Budget under control number 2060-0006.)

§ 60.506 Reconstruction.

For purposes of this subpart:

(a) The cost of the following
 frequently replaced components of the
 affected facility shall not be considered
 in calculating either the "fixed capital
 cost of the new components" or the
 "fixed capital costs that would be
 required to construct a comparable
 entirely new facility" under § 60.15,
 pump seals, loading arm gaskets and
 swivels, coupler gaskets, overfill sensor
 couplers and cables, flexible vapor
 hoses, and grounding cables and
 connectors.

(b) Under § 60.15, the "fixed capital
 cost of the new components" includes
 the fixed capital cost of all depreciable
 components [except components
 specified in § 60.506(a)] which are or
 will be replaced pursuant to all
 continuous programs of component
 replacement which are commenced
 within any 2-year period following
 December 17, 1980. For purposes of this
 paragraph, "commenced" means that an
 owner or operator has undertaken a
 continuous program of component
 replacement or that an owner or
 operator has entered into a contractual
 obligation to undertake and complete,
 within a reasonable time, a continuous
 program of component replacement.

[Sec. 114 of the Clean Air Act as amended (42
 U.S.C. 7414)]

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48 FR 37578, 8/18/83 (195)

Revised

48 FR 56580, 12/22/83 (213)

Subpart GGG—Standards of Performance for Equipment Leaks of VOC in Petroleum Refineries ²²⁷

§ 60.590 Applicability and designation of affected facility.

(a)(1) The provisions of this subpart apply to affected facilities in petroleum refineries.

(2) A compressor is an affected facility.

(3) The group of all the equipment (defined in § 60.591) within a process unit is an affected facility.

(b) Any affected facility under paragraph (a) of this section that commences construction or modification after January 4, 1983, is subject to the requirements of this subpart.

(c) Addition or replacement of equipment (defined in § 60.591) for the purpose of process improvement which is accomplished without a capital expenditure shall not by itself be considered a modification under this subpart.

(d) Facilities subject to Subpart VV or Subpart KKK of 40 CFR Part 60 are excluded from this subpart.

§ 60.591 Definitions.

As used in this subpart, all terms not defined herein shall have the meaning given them in the Act, in Subpart A of Part 60, or in Subpart VV of Part 60, and the following terms shall have the specific meanings given them.

"Alaskan North Slope" means the approximately 80,000 square mile area extending from the Brooks Range to the Arctic Ocean.

"Equipment" means each valve, pump, pressure relief device, sampling connection system, open-ended valve or line, and flange or other connector in VOC service. For the purposes of recordkeeping and reporting only, compressors are considered equipment.

"In Hydrogen Service" means that a compressor contains a process fluid that meets the conditions specified in § 60.593(b).

"In Light Liquid Service" means that the piece of equipment contains a liquid that meets the conditions specified in § 60.593(c).

"Petroleum Refinery" means any facility engaged in producing gasoline, kerosene, distillate fuel oils, residual fuel oils, lubricants, or other products through the distillation of petroleum, or through the redistillation, cracking, or reforming of unfinished petroleum derivatives.

"Petroleum" means the crude oil removed from the earth and the oils derived from tar sands, shale, and coal.

"Process Unit" means components assembled to produce intermediate or final products from petroleum, unfinished petroleum derivatives, or other intermediates; a process unit can operate independently if supplied with sufficient feed or raw materials and sufficient storage facilities for the product.

§ 60.592 Standards.

(a) Each owner or operator subject to the provisions of this subpart shall comply with the requirements of § 60.482-1 to § 60.482-10 as soon as practicable, but no later than 180 days after initial startup.

(b) An owner or operator may elect to comply with the requirements of § 60.483-1 and § 60.483-2.

(c) An owner or operator may apply to the Administrator for a determination of equivalency for any means of emission limitation that achieves a reduction in emissions of VOC at least equivalent to the reduction in emissions of VOC achieved by the controls required in this subpart. In doing so, the owner or operator shall comply with requirements of § 60.484.

(d) Each owner or operator subject to the provisions of this subpart shall comply with the provisions of § 60.485 except as provided in § 60.593.

(e) Each owner or operator subject to the provisions of this subpart shall comply with the provisions of § 60.486 and § 60.487.

(Sec. 114 of Clean Air Act as amended (42 U.S.C. 7414))

§ 60.593 Exceptions.

(a) Each owner or operator subject to the provisions of this subpart may comply with the following exceptions to the provisions of Subpart VV.

(b)(1) Compressors in hydrogen service are exempt from the requirements of § 60.592 if an owner or operator demonstrates that a compressor is in hydrogen service.

(2) Each compressor is presumed not be in hydrogen service unless an owner or operator demonstrates that the piece of equipment is in hydrogen service. For a piece of equipment to be considered in hydrogen service, it must be determined that the percent hydrogen content can be reasonably expected always to exceed 50 percent by volume. For purposes of determining the percent hydrogen content in the process fluid that is contained in or contacts a compressor, procedures that conform to the general method described in ASTM E-260, E-168, or E-169 (incorporated by reference as specified in § 60.17) shall be used.

(3)(i) An owner or operator may use engineering judgment rather than procedures in paragraph (b)(2) of this section to demonstrate that the percent content exceeds 50 percent by volume, provided the engineering judgment demonstrates that the content clearly exceeds 50 percent by volume. When an owner or operator and the Administrator do not agree on whether a piece of equipment is in hydrogen service, however, the procedures in paragraph (b)(2) shall be used to resolve the disagreement.

(ii) If an owner or operator determines that a piece of equipment is in hydrogen service, the determination can be revised only after following the procedures in paragraph (b)(2).

(c) Any existing reciprocating compressor that becomes an affected facility under provisions of § 60.14 or § 60.15 is exempt from § 60.482 (a), (b), (c), (d), (e), and (h) provided the owner or operator demonstrates that recasting the distance piece or replacing the compressor are the only options available to bring the compressor into compliance with the provisions of § 60.482 (a), (b), (c), (d), (e), and (h).

(d) An owner or operator may use the following provision in addition to § 60.485(e): Equipment is in light liquid service if the percent evaporated is greater than 10 percent at 150°C as determined by ASTM Method D-86 (incorporated by reference as specified in § 60.18).

(e) Pumps in light liquid service and valves in gas/vapor and light liquid service within a process unit that is located in the Alaskan North Slope are exempt from the requirements of § 60.482-2 and § 60.482-7.

Proposed/effective

48 FR 279, 1/4/83

Promulgated

49 FR 22598, 5/30/84 (227)

PART 60—[AMENDED]

40 CFR Part 60 is amended as follows:

1. By adding a new Subpart GGG as follows:

Subpart GGG—Standards of Performance for Equipment Leaks of VOC in Petroleum Refineries

Sec.

60.590 Applicability and designation of affected facility.

60.591 Definitions.

60.592 Standards.

60.593 Exceptions.

60.594–60.599 [Reserved]

Subpart GGG—Standards of Performance for Equipment Leaks of VOC in Petroleum Refineries

§ 60.590 Applicability and designation of affected facility.

(a)(1) The provisions of this subpart apply to affected facilities in petroleum refineries.

(2) A compressor is an affected facility.

(3) The group of all the equipment (defined in § 60.591) within a process unit is an affected facility.

(b) Any affected facility under paragraph (a) of this section that commences construction or modification after January 4, 1983, is subject to the requirements of this subpart.

(c) Addition or replacement of equipment (defined in § 60.591) for the purpose of process improvement which is accomplished without a capital expenditure shall not by itself be considered a modification under this subpart.

(d) Facilities subject to Subpart VV or Subpart KKK of 40 CFR Part 60 are excluded from this subpart.

§ 60.591 Definitions.

As used in this subpart, all terms not defined herein shall have the meaning given them in the Act, in Subpart A of Part 60, or in Subpart VV of Part 60, and the following terms shall have the specific meanings given them.

"Alaskan North Slope" means the approximately 69,000 square mile area extending from the Brooks Range to the Arctic Ocean.

"Equipment" means each valve, pump, pressure relief device, sampling connection system, open-ended valve or line, and flange or other connector in VOC service. For the purposes of recordkeeping and reporting only, compressors are considered equipment.

"In Hydrogen Service" means that a compressor contains a process fluid that meets the conditions specified in § 60.593(b).

"In Light Liquid Service" means that the piece of equipment contains a liquid that meets the conditions specified in § 60.593(c).

"Petroleum Refinery" means any facility engaged in producing gasoline, kerosene, distillate fuel oils, residual fuel oils, lubricants, or other products through the distillation of petroleum, or through the redistillation, cracking, or reforming of unfinished petroleum derivatives.

"Petroleum" means the crude oil removed from the earth and the oils derived from tar sands, shale, and coal.

"Process Unit" means components assembled to produce intermediate or final products from petroleum, unfinished petroleum derivatives, or other intermediates; a process unit can operate independently if supplied with sufficient feed or raw materials and sufficient storage facilities for the product.

§ 60.592 Standards.

(a) Each owner or operator subject to the provisions of this subpart shall comply with the requirements of § 60.482-1 to § 60.482-10 as soon as practicable, but no later than 180 days after initial startup.

(b) An owner or operator may elect to comply with the requirements of § 60.483-1 and § 60.483-2.

(c) An owner or operator may apply to the Administrator for a determination of equivalency for any means of emission limitation that achieves a reduction in emissions of VOC at least equivalent to the reduction in emissions of VOC achieved by the controls required in this subpart. In doing so, the owner or operator shall comply with requirements of § 60.484.

(d) Each owner or operator subject to the provisions of this subpart shall comply with the provisions of § 60.485 except as provided in § 60.593.

(e) Each owner or operator subject to the provisions of this subpart shall comply with the provisions of § 60.486 and § 60.487.

(Sec. 114 of Clean Air Act as amended (42 U.S.C. 7414))

§ 60.593 Exceptions.

(a) Each owner or operator subject to the provisions of this subpart may comply with the following exceptions to the provisions of Subpart VV.

(b)(1) Compressors in hydrogen service are exempt from the requirements of § 60.592 if an owner or operator demonstrates that a compressor is in hydrogen service.

(2) Each compressor is presumed not to be in hydrogen service unless an owner or operator demonstrates that the piece of equipment is in hydrogen service. For a piece of equipment to be considered in hydrogen service, it must be determined that the percent hydrogen content can be reasonably expected always to exceed 50 percent by volume. For purposes of determining the percent hydrogen content in the process fluid that is contained in or contacts a compressor, procedures that conform to the general method described in ASTM E-260, E-168, or E-169 (incorporated by

reference as specified in § 60.17) shall be used.

(3)(i) An owner or operator may use engineering judgment rather than procedures in paragraph (b)(2) of this section to demonstrate that the percent content exceeds 50 percent by volume, provided the engineering judgment demonstrates that the content clearly exceeds 50 percent by volume. When an owner or operator and the Administrator do not agree on whether a piece of equipment is in hydrogen service, however, the procedures in paragraph (b)(2) shall be used to resolve the disagreement.

(ii) If an owner or operator determines that a piece of equipment is in hydrogen service, the determination can be revised only after following the procedures in paragraph (b)(2).

(c) Any existing reciprocating compressor that becomes an affected facility under provisions of § 60.14 or § 60.15 is exempt from § 60.482 (a), (b), (c), (d), (e), and (h) provided the owner or operator demonstrates that recasting the distance piece or replacing the compressor are the only options available to bring the compressor into compliance with the provisions of § 60.482 (a), (b), (c), (d), (e), and (h).

(d) An owner or operator may use the following provision in addition to § 60.485(e): Equipment is in light liquid service if the percent evaporated is greater than 10 percent at 150°C as determined by ASTM Method D-88 (incorporated by reference as specified in § 60.18).

(e) Pumps in light liquid service and valves in gas/vapor and light liquid service within a process unit that is located in the Alaskan North Slope are exempt from the requirements of § 60.482-2 and § 60.482-7.

2. By adding in alphabetical order the new terms "capital expenditure," "double block and bleed system," and "replacement cost" in § 60.481 of Subpart VV as follows:

§ 60.481 Definitions.

"Capital expenditure" means, in addition to the definition in 40 CFR 60.2, an expenditure for a physical or operational change to an existing facility that:

(a) Exceeds P, the product of the facility's replacement cost, R, and an adjusted annual asset guideline repair allowance, A, as reflected by the following equation: $P = R \times A$, where

(1) The adjusted annual asset guideline repair allowance, A, is the product of the percent of the replacement cost, Y; and the applicable basic annual asset guideline repair

allowance, B, as reflected by the following equation: $A = Y \times (B + 100)$;

(2) The percent Y is determined from the following equation: $Y = 1.0 - 0.575 \log X$, where X is the year of construction; and

(3) The applicable basic annual asset guideline repair allowance, B, is selected from the following table consistent with the applicable subpart:

TABLE FOR DETERMINING APPLICABLE FOR B

Subpart applicable to facility	Value of B to be used in equation
WW	12.5
DDO	12.5
GGG	7.0
KKK	4.5

"Double block and bleed system" means two block valves connected in series with a bleed valve or line that can vent the line between the two block valves.

"Replacement cost" means the capital needed to purchase all the depreciable components in a facility.

(Sections 111, 114, and 301(a) of the Clean Air Act, as amended (42 U.S.C. 7411, 7414, 7601(a)))

3. By adding paragraph (c) to § 60.482-6 as follows:

§ 60.482-6 Standards: Open-ended valves or lines.

(c) When a double block-and-bleed system is being used, the bleed valve or line may remain open during operations that require venting the line between the block valves but shall comply with paragraph (a) at all other times.

(Sections 111, 114, and 301(a) of the Clean Air Act, as amended (42 U.S.C. 7411, 7414, 7601(a)))

4. By revising paragraph (d)(1) of § 60.480 as follows:

§ 60.480 Applicability and designation of affected facility.

(d)(1) If an owner or operator applies for one or more of the exemptions in this paragraph, then the owner or operator shall maintain records as required in § 60.486(i).

(Sections 111, 114, and 301(a) of the Clean Air Act, as amended (42 U.S.C. 7411, 7414, 7601(a)))

5. By revising paragraph (d) of § 60.482-1 as follows:

§ 60.482-1 Standards: General

(d) Equipment that is in vacuum service is excluded from the requirements of § 60.482-2 to § 60.482-10 if it is identified as required in § 60.486(e)(5).

(Sections 111, 114, and 301(a) of the Clean Air Act, as amended (42 U.S.C. 7411, 7414, 7601(a)))

6. By revising paragraph (c)(2) and paragraph (h)(2) of § 60.482-7 as follows:

§ 60.482-7 Standards: Valves in gas/vapor and in light liquid service.

(c) *

(2) If a leak is detected, the valve shall be monitored monthly until a leak is not detected for 2 successive months.

(h) *

(2) The process unit within which the valve is located either becomes an affected facility through § 60.14 or § 60.15 or the owner or operator designates less than 3.0 percent of the total number of valves as difficult-to-monitor, and

(Sections 111, 114, and 301(a) of the Clean Air Act, as amended (42 U.S.C. 7411, 7414, 7601(a)))

7. By revising paragraphs (c)(2) (ii) and (vi) of § 60.487 as follows:

§ 60.487 Reporting requirements.

(c) *

(2) *

(ii) Number of valves for which leaks were not repaired as required in § 60.482-7(d)(1).

(vi) Number of compressors for which leaks were not repaired as required in § 60.482-3(g)(1), and

(Sections 111, 114, and 301(a) of the Clean Air Act, as amended (42 U.S.C. 7411, 7414, 7601(a)))

(Approved by the Office of Management and Budget under control number 2060-0067.)

8. By adding § 60.488 to Subpart VV as follows:

§ 60.488 Reconstruction.

For the purposes of this subpart:

(a) The cost of the following frequently replaced components of the facility shall not be considered in calculating either the "fixed capital cost of the new components" or the "fixed capital costs that would be required to construct a comparable new facility" under § 60.15: pump seals, nuts and bolts, rupture disks, and packings.

(b) Under § 60.15, the "fixed capital cost of new components" includes the fixed capital cost of all depreciable components (except components specified in § 60.488 (a)) which are or will be replaced pursuant to all continuous programs of component replacement which are commenced within any 2-year period following the applicability date for the appropriate subpart. (See the "Applicability and designation of affected facility" section of the appropriate subpart.) For purposes of this paragraph, "commenced" means that an owner or operator has undertaken a continuous program of component replacement or that an owner or operator has entered into a contractual obligation to undertake and complete, within a reasonable time, a continuous program of component replacement.

(Sections 111, 114, and 301(a) of the Clean Air Act, as amended (42 U.S.C. 7411, 7414, 7601(a)))

(Sections 111, 114, and 301(a) of the Clean Air Act, as amended (42 U.S.C. 7411, 7414, 7601(a)))

9. By revising paragraphs (a) (34), (35), and (36) by adding (a)(4) of § 60.17 of Subpart A—General Provisions as follows:

§ 60.17 Incorporation by reference.

(a) *

(34) ASTM E169-83 (Reapproved 1977), General Techniques of Ultraviolet Quantitative Analysis, IBR approved for § 60.485(d) and § 60.593(b).

(35) ASTM E168-87 (Reapproved 1977), General Techniques of Infrared Quantitative Analysis, IBR approved for § 60.485(d) and § 60.593(b).

(36) ASTM E280-73, General Gas Chromatography Procedures, IBR approved for § 60.485(d) and § 60.593(b).

(40) ASTM D86-78, Distillation of Petroleum Products, IBR approved for § 60.593(d).

(Sections 111, 114, and 301(a) of the Clean Air Act, as amended (42 U.S.C. 7411, 7414, 7601(a)))

Appendix A [Amended]

10. By redesignating the heading "5.2 Apparatus" as "5.1 Apparatus" in Method 18 of Appendix A as follows:

5.1 Apparatus

(Sections 111, 114, and 301(a) of the Clean Air Act, as amended (42 U.S.C. 7411, 7414, 7601(a)))

11. By revising the first equation in Section 6.2.1.1 in Method 18 of Appendix A as follows:

$$Q_p = Q_t \sqrt{\frac{P_1 T_1}{P_2 T_2}} \quad \text{Eq. 18-1}$$

(Sections 111, 114, and 301(a) of the Clean Air Act, as amended (42 U.S.C. 7411, 7414, 7601(a)))

12. By revising the citation "Citation 21 in section 8," to "Citation 18 in section 8," in 6.2.1.1 in Method 18 of Appendix A.

(Sections 111, 114, and 301(a) of the Clean Air Act, as amended (42 U.S.C. 7411, 7414, 7601(a)))

13. By changing the word "caped" to "capped" in section 6.2.2.1 in Method 18 of Appendix A.

(Sections 111, 114, and 301(a) of the Clean Air Act, as amended (42 U.S.C. 7411, 7414, 7601(a)))

14. By changing all the "mg/liter" to "g/liter" in section 6.2.2.3 in Method 18 of Appendix A.

(Sections 111, 114, and 301(a) of the Clean Air Act, as amended (42 U.S.C. 7411, 7414, 7601(a)))

15. By changing the word "with" to "within" in section 7.4.4.3 in Method 18 of Appendix A.

(Sections 111, 114, and 301(a) of the Clean Air Act, as amended (42 U.S.C. 7411, 7414, 7601(a)))

(FR Doc. 84-13848 Filed 5-28-84; 8:45 am)

BILLING CODE 6560-50-M

PART 60—[AMENDED]

40 CFR Part 60 is amended as follows:

1. The authority citation for Part 60 continues to read as follows:

Authority: 42 U.S.C. 7411, 7601(a).

2. By adding a new Subpart KKK as follows:

Subpart KKK—Standards of Performance for Equipment Leaks of VOC From Onshore Natural Gas Processing Plants

Sec.

60.630 Applicability and designation of affected facility.

60.631 Definitions.

60.632 Standards.

60.633 Exceptions.

60.634 Alternative means of emission limitation.

60.635 Recordkeeping requirements.

60.636 Reporting requirements.

60.637—60.639 [Reserved].

Subpart KKK—Standards of Performance for Equipment Leaks of VOC From Onshore Natural Gas Processing Plants

§ 60.630 Applicability and designation of affected facility.

(a) [1] The provisions of this subpart apply to affected facilities in onshore natural gas processing plants.

(2) A compressor in VOC service or in wet gas service is an affected facility.

(3) The group of all equipment except compressors (defined in § 60.631) within a process unit is an affected facility.

(b) Any affected facility under paragraph (a) of this section that commences construction, reconstruction, or modification after January 20, 1984, is subject to the requirements of this subpart.

(c) Addition or replacement of equipment (defined in § 60.631) for the purpose of process improvement that is accomplished without a capital expenditure shall not by itself be considered a modification under this subpart.

(d) Facilities covered by Subpart VV or Subpart GGG of 40 CFR Part 60 are excluded from this subpart.

(e) A compressor station, dehydration unit, sweetening unit, underground storage tank, field gas gathering system, or liquefied natural gas unit is covered by this subpart if it is located at an onshore natural gas processing plant. If the unit is not located at the plant site, then it is exempt from the provisions of this subpart.

§ 60.631 Definitions.

As used in this subpart, all terms not defined herein shall have the meaning given them in the Act, in Subpart A of Part 60, or in Subpart VV of Part 60; and the following terms shall have the specific meanings given them.

"Alaskan North Slope" means the approximately 69,000 square-mile area extending from the Brooks Range to the Arctic Ocean.

"Equipment" means each pump, pressure relief device, open-ended valve or line, valve, compressor, and flange or other connector that is in VOC service or in wet gas service, and any device or system required by this subpart.

"Field gas" means feedstock gas entering the natural gas processing plant.

"In light liquid service" means that the piece of equipment contains a liquid that meets the conditions specified in § 60.425(a) or § 60.636(b)(2).

"Natural gas liquids" means the hydrocarbons, such as ethane, propane, butane, and pentane, that are extracted from field gas.

"Natural gas processing plant" (gas plant) means any processing site engaged in the extraction of natural gas liquids from field gas, fractionation of mixed natural gas liquids to natural gas products, or both.

"Nonfractionating plant" means any gas plant that does not fractionate mixed natural gas liquids into natural gas products.

"Onshore" means all facilities except those that are located in the territorial seas or on the outer continental shelf.

"Process unit" means equipment assembled for the extraction of natural gas liquids from field gas, the fractionation of the liquids into natural gas products, or other operations associated with the processing of natural gas products. A process unit can operate independently if supplied with sufficient feed or raw materials and sufficient storage facilities for the products.

"Reciprocating compressor" means a piece of equipment that increases the pressure of a process gas by positive displacement, employing linear movement of the driveshaft.

"In wet gas service" means that a piece of equipment contains or contacts the field gas before the extraction step in the process.

§ 60.632 Standards.

(a) Each owner or operator subject to the provisions of this subpart shall comply with the requirements of § 60.482-1 (a), (b), and (d) and § 60.482-2 through § 60.482-10, except as provided in § 60.633, as soon as practicable, but no later than 180 days after initial startup.

(b) An owner or operator may elect to comply with the requirements of § 60.483-1 and § 60.483-2.

(c) An owner or operator may apply to the Administrator for permission to use an alternative means of emission limitation that achieves a reduction in emissions of VOC at least equivalent to that achieved by the controls required in this subpart. In doing so, the owner or operator shall comply with requirements of § 60.634 of this subpart.

(d) Each owner or operator subject to the provisions of this subpart shall comply with the provisions of § 60.485 except as provided in § 60.633(f) of this subpart.

(e) Each owner or operator subject to the provisions of this subpart shall comply with the provisions of § 60.486 and § 60.487 except as provided in § 60.633, § 60.635, and § 60.636 of this subpart.

(f) An owner or operator shall use the following provision instead of § 60.485(d)(1): Each piece of equipment is presumed to be in VOC service or in wet gas service unless an owner or operator demonstrates that the piece of equipment is not in VOC service or in wet gas service. For a piece of equipment to be considered not in VOC service, it must be determined that the percent VOC content can be reasonably expected never to exceed 10.0 percent by weight. For a piece of equipment to be considered in wet gas service, it must be determined that it contains or contacts the field gas before the extraction step in the process. For purposes of determining the percent VOC content of the process fluid that is contained in or contacts a piece of equipment, procedures that conform to the methods described in ASTM Methods E169, E168, or E260 (incorporated by reference as specified in § 60.17) shall be used.

§ 60.633 Exceptions.

(a) Each owner or operator subject to the provisions of this subject may comply with the following exceptions to the provisions of Subpart VV.

(b) (1) Each pressure relief device in gas/vapor service may be monitored quarterly and within 5 days after each pressure release to detect leaks by the methods specified in § 60.485(b) except as provided in § 60.632(c), paragraph (b)(4) of this section, and § 60.482-4(a)-(c) of Subpart VV.

(2) If an instrument reading of 10,000 ppm or greater is measured, a leak is detected.

(3) (i) When a leak is detected, it shall be repaired as soon as practicable, but no later than 15 calendar days after it is detected, except as provided in § 60.482-9.

(ii) A first attempt at repair shall be made no later than 5 calendar days after each leak is detected.

(4) (i) Any pressure relief device that is located in a nonfractionating plant that is monitored only by nonplant personnel may be monitored after a pressure release the next time the monitoring personnel are on site, instead of within 5 days as specified in paragraph (b)(1) of this section and § 60.482-(b)(1) of Subpart VV.

(ii) No pressure relief device described in paragraph (b)(4)(i) of this section shall be allowed to operate for more than 30 days after a pressure release without monitoring.

(c) Sampling connection systems are exempt from the requirements of § 60.482-5.

(d) Pumps in light liquid service, valves in gas/vapor and light liquid service, and pressure relief devices in gas/vapor service that are located at a nonfractionating plant that does not have the design capacity to process 283,000 standard cubic meters per day (scmd) (10 million standard cubic feet per day (scfd)) or more of field gas are exempt from the routine monitoring requirements of § 60.482-2(a)(1), § 60.482-7(a), and § 60.633(b)(1).

(e) Pumps in light liquid service, valves in gas/vapor and light liquid service, and pressure relief devices in gas/vapor service within a process unit that is located in the Alaskan North Slope are exempt from the routine monitoring requirements of § 60.482-2(a)(1), § 60.482-7(a), and § 60.633(b)(1).

(f) Reciprocating compressors in wet gas service are exempt from the compressor control requirements of § 60.482-3.

(g) In addition to the requirements for flares at § 60.482-10(d)(4), the following are allowed:

(1) Steam-assisted and nonassisted flares designed for and operated with an exit velocity, as determined by the methods specified in § 60.485(g)(4), equal to or greater than 18.3 m/sec (60 ft/sec) but less than 122m/sec (400 ft/

sec) if the net heating value of the gas being combusted is greater than 37.3 MJ/scm (1000 Btu/scf).

(2) Steam-assisted and nonassisted flares designed for and operated with an exit velocity, as determined by the methods specified in § 60.485(g)(4), less than 122 m/sec (400 ft/sec) and less than the velocity, v_{max} , as determined by the following equation:

$$\text{Log}_{10}(v_{max}) = (H_f + 28.8)/31.7$$

v_{max} = Maximum permitted velocity, m/sec.
28.8 = Constant.

31.7 = Constant.

H_f = The net heating value as determined in § 60.485 (g)(3).

(h) An owner or operator may use the following provisions instead of § 60.485(e):

(1) Equipment is in heavy liquid service if the weight percent evaporated is 10 percent or less at 150 °C as determined by ASTM Method D86 (incorporated by reference as specified in § 60.17).

(2) Equipment is in light liquid service if the weight percent evaporated is greater than 10 percent at 150 °C as determined by ASTM Method D86 (incorporated by reference as specified in § 60.17).

§ 60.634 Alternative means of emission limitation

(a) If, in the Administrator's judgment, an alternative means of emission limitation will achieve a reduction in VOC emissions at least equivalent to the reduction in VOC emissions achieved under any design, equipment, work practice or operational standard, the Administrator will publish, in the Federal Register a notice permitting the use of that alternative means for the purpose of compliance with that standard. The notice may condition permission on requirements related to the operation and maintenance of the alternative means.

(b) Any notice under paragraph (a) of this section shall be published only after notice and an opportunity for a public hearing.

(c) The Administrator will consider applications under this section from either owners or operators of affected facilities, or manufacturers of control equipment.

(d) The Administrator will treat applications under this section according to the following criteria, except in cases where he concludes that other criteria are appropriate:

(1) The applicant must collect, verify and submit test data, covering a period of at least 12 months, necessary to support the finding in paragraph (a) of this section.

(2) If the applicant is an owner or operator of an affected facility, he must commit in writing to operate and maintain the alternative means so as to achieve a reduction in VOC emissions at least equivalent to the reduction in VOC emissions achieved under the design, equipment, work practice or operational standard.

§ 60.635 Recordkeeping requirements.

(a) Each owner or operator subject to the provisions of this subpart shall comply with the requirements of paragraphs (b) and (c) of this section in addition to the requirements of § 60.486.

(b) The following recordkeeping requirements shall apply to pressure relief devices subject to the requirements of § 60.633(b)(1) of this subpart.

(1) When each leak is detected as specified in § 60.633(b)(2), a weatherproof and readily visible identification, marked with the equipment identification number, shall be attached to the leaking equipment. The identification on the pressure relief device may be removed after it has been repaired.

(2) When each leak is detected as specified in § 60.633(b)(2), the following information shall be recorded in a log and shall be kept for 2 years in a readily accessible location:

(i) The instrument and operator identification numbers and the equipment identification number.

(ii) The date the leak was detected and the dates of each attempt to repair the leak.

(iii) Repair methods applied in each attempt to repair the leak.

(iv) "Above 10,000 ppm" if the maximum instrument reading measured by the methods specified in § 60.635(a)

after each repair attempt is 10,000 ppm or greater.

(v) "Repair delayed" and the reason for the delay if a leak is not repaired within 15 calendar days after discovery of the leak.

(vi) The signature of the owner or operator (or designate) whose decision it was that repair could not be effected without a process shutdown.

(vii) The expected date of successful repair of the leak if a leak is not repaired within 15 days.

(viii) Dates of process unit shutdowns that occur while the equipment is unrepaired.

(ix) The date of successful repair of the leak.

(x) A list of identification numbers for equipment that are designated for no detectable emissions under the provisions of § 60.482-4(a). The designation of equipment subject to the provisions of § 60.482-4(a) shall be signed by the owner or operator.

(c) An owner or operator shall comply with the following requirement in addition to the requirement of § 60.486(j): Information and data used to demonstrate that a reciprocating compressor is in wet gas service to apply for the exemption in § 60.633(f) shall be recorded in a log that is kept in a readily accessible location.

(Approved by the Office of Management and Budget under control number 2060-0120)

§ 60.636 Reporting requirements.

(a) Each owner or operator subject to the provisions of this subpart shall comply with the requirements of paragraphs (b) and (c) of this section in addition to the requirements of § 60.487.

(b) An owner or operator shall include the following information in the initial semiannual report in addition to the

information required in § 60.487(b)(1)-(4): number of pressure relief devices subject to the requirements of § 60.633(b) except for those pressure relief devices designated for no detectable emissions under the provisions of § 60.482-4(a) and those pressure relief devices complying with § 60.482-4(c).

(c) An owner or operator shall include the following information in all semiannual reports in addition to the information required in § 60.487(c)(2)(i)-(vi):

(1) Number of pressure relief devices for which leaks were detected as required in § 60.633(b)(2) and

(2) Number of pressure relief devices for which leaks were not repaired as required in § 60.633(b)(3).

(Approved by the Office of Management and Budget under control number 2060-0120)

3. By revising paragraphs (a) (34), (35), (36), and (40) of § 60.17 of Subpart A—General Provisions to read as follows:

§ 60.17 Incorporation by reference.

(a) . . .

(34) ASTM E169-83 (Reapproved 1977), General Techniques of Ultraviolet Quantitative Analysis, IBR approved for § 60.485(d), § 60.593(b), and § 60.632(f).

(35) ASTM E168-87 (Reapproved 1977), General Techniques of Infrared Quantitative Analysis, IBR approved for § 60.485(d), § 60.593(b), and § 60.632(f).

(36) ASTM E280-73, General Gas Chromatography Procedures, IBR approved for § 60.485(d), § 60.593(b), and § 60.632(f).

(40) ASTM D86-78, Distillation of Petroleum Products, IBR approved for § 60.593(d) and § 60.633(h).

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NESHAPS REGULATIONS

**Subpart F—National Emission Standard
for Vinyl Chloride 28**

§ 61.60 Applicability.

(a) This subpart applies to plants which produce:

(1) Ethylene dichloride by reaction of oxygen and hydrogen chloride with ethylene.

(2) Vinyl chloride by any process, and/or

(3) One or more polymers containing any fraction of polymerized vinyl chloride.

(b) This subpart does not apply to equipment used in research and development if the reactor used to polymerize the vinyl chloride processed in the equipment has a capacity of no more than 0.19 m³ (50 gal).

(c) Sections of this subpart other than §§ 61.61; 61.64 (a) (1), (b), (c), and (d); 61.67; 61.68; 61.69; 61.70; and 61.71 do not apply to equipment used in research and development if the reactor used to polymerize the vinyl chloride processed in the equipment has a capacity of greater than 0.19 m³ (50 gal) and no more than 4.07 m³ (1100 gal).³⁸

§ 61.61 Definitions.

Terms used in this subpart are defined in the Act, in Subpart A of this part, or in this section as follows:

(a) "Ethylene dichloride plant" includes any plant which produces ethylene dichloride by reaction of oxygen and hydrogen chloride with ethylene.

(b) "Vinyl chloride plant" includes any plant which produces vinyl chloride by any process.

(c) "Polyvinyl chloride plant" includes any plant where vinyl chloride alone or in combination with other materials is polymerized.

(d) "Slip gauge" means a gauge which has a probe that moves through the gas/liquid interface in a storage or transfer vessel and indicates the level of vinyl chloride in the vessel by the physical state of the material the gauge discharges.

(e) "Type of resin" means the broad classification of resin referring to the basic manufacturing process for producing that resin, including, but not limited to, the suspension, dispersion, latex, bulk, and solution processes.

(f) "Grade of resin" means the subdivision of resin classification which describes it as a unique resin, i.e., the most exact description of a resin with no further subdivision.

(g) "Dispersion resin" means a resin manufactured in such away as to form fluid dispersions when dispersed in a plasticizer or plasticizer/diluent mixtures.

(h) "Latex resin" means a resin which is produced by a polymerization process which initiates from free radical catalyst sites and is sold undried.

(i) "Bulk resin" means a resin which is produced by a polymerization process in which no water is used.

(j) "Inprocess wastewater" means any water which, during manufacturing or processing, comes into direct contact with vinyl chloride or polyvinyl chloride or results from the production or use of any raw material, intermediate product, finished product, by-product, or waste product containing vinyl chloride or polyvinyl chloride but which has not been discharged to a wastewater treatment process or discharged untreated as wastewater.

(k) "Wastewater treatment process" includes any process which modifies characteristics such as BOD, COD, TSS, and pH, usually for the purpose of meeting effluent guidelines and standards; it does not include any process the purpose of which is to remove vinyl chloride from water to meet requirements of this subpart.

(l) "In vinyl chloride service" means that a piece of equipment contains or contacts either a liquid that is at least 10 percent by weight vinyl chloride or a gas that is at least 10 percent by volume vinyl chloride.

(m) "Standard operating procedure" means a formal written procedure officially adopted by the plant owner or operator and available on a routine basis to those persons responsible for carrying out the procedure.

(n) "Run" means the net period of time during which an emission sample is collected.

(o) "Ethylene dichloride purification" includes any part of the process of ethylene dichloride production which follows ethylene dichloride formation and in which finished ethylene dichloride is produced.

(p) "Vinyl chloride purification" includes any part of the process of vinyl chloride production which follows vinyl chloride formation and in which finished vinyl chloride is produced.

(q) "Reactor" includes any vessel in which vinyl chloride is partially or totally polymerized into polyvinyl chloride.

(r) "Reactor opening loss" means the emissions of vinyl chloride occurring when a reactor is vented to the atmosphere for any purpose other than an emergency relief discharge as defined in § 61.65(a).

(s) "Stripper" includes any vessel in which residual vinyl chloride is removed from polyvinyl chloride resin, except bulk resin, in the slurry form by the use of heat and/or vacuum. In the case of bulk resin, stripper includes any vessel which is used to remove residual vinyl chloride from polyvinyl chloride resin immediately following the polymerization step in the plant process flow.

(t) "Standard temperature" means a temperature of 20° C (69° F).³⁸

(u) "Standard pressure" means a pressure of 760 mm of Hg (29.92 in. of Hg).³⁸

§ 61.62 Emission standard for ethylene dichloride plants.³⁸

(a) Ethylene dichloride purification: The concentration of vinyl chloride in all exhaust gases discharged to the atmosphere from any equipment used in ethylene dichloride purification is not to exceed 10 ppm, except as provided in § 61.65(a). This requirement does not apply to equipment that has been opened, is out of operation, and met the requirement in § 61.65(b) (6) (i) before being opened.

(b) Oxychlorination reactor: Except as provided in § 61.65(a), emissions of vinyl chloride to the atmosphere from each oxychlorination reactor are not to exceed 0.2 g/kg (0.0002 lb/lb) of the 100 percent ethylene dichloride product from the oxychlorination process.

§ 61.63 Emission standard for vinyl chloride plants.

An owner or operator of a vinyl chloride plant shall comply with the requirements of this section and § 61.65.

(a) Vinyl chloride formation and purification: The concentration of vinyl chloride in all exhaust gases discharged to the atmosphere from any equipment used in vinyl chloride formation and/or purification is not to exceed 10 ppm, except as provided in § 61.65(a). This requirement does not apply to equipment that has been opened, is out of operation, and met the requirement in § 61.65(b) (6) (i) before being opened.

§ 61.64 Emission standard for polyvinyl chloride plants.

An owner or operator of a polyvinyl chloride plant shall comply with the requirements of this section and § 61.65.

(a) Reactor. The following requirements apply to reactors:

(1) The concentration of vinyl chloride in all exhaust gases discharged to the atmosphere from each reactor is not to exceed 10 ppm, except as provided in paragraph (a) (2) of this section and § 61.65(a).

(2) The reactor opening loss from each reactor is not to exceed 0.02 g vinyl chloride/kg (0.00002 lb vinyl chloride/lb) of polyvinyl chloride product, with the product determined on a dry solids basis. This requirement applies to any vessel which is used as a reactor or as both a reactor and a stripper. In the bulk process, the product means the gross product of prepolymerization and postpolymerization.

(3) Manual vent valve discharge: Except for an emergency manual vent valve discharge, there is to be no discharge to the atmosphere from any manual vent valve on a polyvinyl chloride reactor in vinyl chloride service. An emergency manual vent valve discharge means a discharge to the atmosphere which could not have been avoided by taking measures to prevent the discharge. Within 10

days of any discharge to the atmosphere from any manual vent valve, the owner or operator of the source from which the discharge occurs shall submit to the Administrator a report in writing containing information on the source, nature and cause of the discharge, the date and time of the discharge, the approximate total vinyl chloride loss during the discharge, the method used for determining the vinyl chloride loss, the action that was taken to prevent the discharge, and measures adopted to prevent future discharges.

(b) *Stripper*. The concentration of vinyl chloride in all exhaust gases discharged to the atmosphere from each stripper is not to exceed 10 ppm, except as provided in § 61.65(a). This requirement does not apply to equipment that has been opened, is out of operation, and met the requirement in § 61.65(b) (6) (i) before being opened.

(c) *Mixing, weighing, and holding containers*. The concentration of vinyl chloride in all exhaust gases discharged to the atmosphere from each mixing, weighing, or holding container in vinyl chloride service which precedes the stripper (or the reactor if the plant has no stripper) in the plant process flow is not to exceed 10 ppm, except as provided in § 61.65(a). This requirement does not apply to equipment that has been opened, is out of operation, and met the requirement in § 61.65(b) (6) (i) before being opened.

(d) *Monomer recovery system*. The concentration of vinyl chloride in all exhaust gases discharged to the atmosphere from each monomer recovery system is not to exceed 10 ppm, except as provided in § 61.65(a). This requirement does not apply to equipment that has been opened, is out of operation, and met the requirement in § 61.65(b) (6) (i) before being opened.

(e) *Sources following the stripper(s)*. The following requirements apply to emissions of vinyl chloride to the atmosphere from the combination of all sources following the stripper(s) [or the reactor(s) if the plant has no stripper(s)] in the plant process flow including but not limited to, centrifuges, concentrators, blend tanks, filters, dryers, conveyor air discharges, baggers, storage containers, and inprocess wastewater:

(1) In polyvinyl chloride plants using stripping technology to control vinyl chloride emissions, the weighted average residual vinyl chloride concentration in all grades of polyvinyl chloride resin processed through the stripping operation on each calendar day, measured immediately after the stripping operation is completed, may not exceed:

(i) 2000 ppm for polyvinyl chloride dispersion resins, excluding latex resins;

(ii) 400 ppm for all other polyvinyl chloride resins, including latex resins, averaged separately for each type of resin; or

(2) In polyvinyl chloride plants controlling vinyl chloride emissions with technology other than stripping or in

addition to stripping, emissions of vinyl chloride to the atmosphere may not exceed:

(i) 2 g/kg (0.002 lb/lb) product from the stripper(s) [or reactor(s) if the plant has no stripper(s)] for dispersion polyvinyl chloride resins, excluding latex resins, with the product determined on a dry solids basis;

(ii) 0.4 g/kg (0.0004 lb/lb) product from the strippers [or reactor(s) if the plant has no stripper(s)] for all other polyvinyl chloride resins, including latex resins, with the product determined on a dry solids basis.

§ 61.65 Emission standard for ethylene dichloride, vinyl chloride and polyvinyl chloride plants.

An owner or operator of an ethylene dichloride, vinyl chloride, and/or polyvinyl chloride plant shall comply with the requirements of this section.

(a) *Relief valve discharge*. Except for an emergency relief discharge, there is to be no discharge to the atmosphere from any relief valve on any equipment in vinyl chloride service. An emergency relief discharge means a discharge which could not have been avoided by taking measures to prevent the discharge. Within 10 days of any relief valve discharge, the owner or operator of the source from which the relief valve discharge occurs shall submit to the Administrator a report in writing containing information on the source, nature and cause of the discharge, the date and time of the discharge, the approximate total vinyl chloride loss during the discharge, the method used for determining the vinyl chloride loss, the action that was taken to prevent the discharge, and measures adopted to prevent future discharges.

(b) *Fugitive emission sources*. (1) *Loading and unloading lines*: Vinyl chloride emissions from loading and unloading lines in vinyl chloride service which are opened to the atmosphere after each loading or unloading operation are to be minimized as follows: 38

(i) After each loading or unloading operation and before opening a loading or unloading line to the atmosphere, the quantity of vinyl chloride in all parts of each loading or unloading line that are to be opened to the atmosphere is to be reduced so that the parts combined contain no greater than 0.0038 m³ (0.13 ft³) of vinyl chloride, at standard temperature and pressure; and

(ii) Any vinyl chloride removed from a loading or unloading line in accordance with paragraph (b) (1) (i) of this section is to be ducted through a control system from which the concentration of vinyl chloride in the exhaust gases does not exceed 10 ppm, or equivalent as provided in § 61.66.

(2) *Slip gauges*. During loading or unloading operations, the vinyl chloride emissions from each slip gauge in vinyl chloride service are to be minimized by ducting any vinyl chloride discharged

from the slip gauge through a control system from which the concentration of vinyl chloride in the exhaust gases does not exceed 10 ppm, or equivalent as provided in § 61.66.

(3) *Leakage from pump, compressor, and agitator seals*:

(i) *Rotating pumps*. Vinyl chloride emissions from seals on all rotating pumps in vinyl chloride service are to be minimized by installing sealless pumps, pumps with double mechanical seals, or equivalent as provided in § 61.66. If double mechanical seals are used, vinyl chloride emissions from the seals are to be minimized by maintaining the pressure between the two seals so that any leak that occurs is into the pump; by ducting any vinyl chloride between the two seals through a control system from which the concentration of vinyl chloride in the exhaust gases does not exceed 10 ppm; or equivalent as provided in § 61.66.

(ii) *Reciprocating pumps*. Vinyl chloride emissions from seals on all reciprocating pumps in vinyl chloride service are to be minimized by installing double outboard seals, or equivalent as provided in § 61.66. If double outboard seals are used, vinyl chloride emissions from the seals are to be minimized by maintaining the pressure between the two seals so that any leak that occurs is into the pump; by ducting any vinyl chloride between the two seals through a control system from which the concentration of vinyl chloride in the exhaust gases does not exceed 10 ppm; or equivalent as provided in § 61.66.

(iii) *Rotating compressor*. Vinyl chloride emissions from seals on all rotating compressors in vinyl chloride service are to be minimized by installing compressors with double mechanical seals, or equivalent as provided in § 61.66. If double mechanical seals are used, vinyl chloride emissions from the seals are to be minimized by maintaining the pressure between the two seals so that any leak that occurs is into the compressor; by ducting any vinyl chloride between the two seals through a control system from which the concentration of vinyl chloride in the exhaust gases does not exceed 10 ppm; or equivalent as provided in § 61.66.

(iv) *Reciprocating compressors*. Vinyl chloride emissions from seals on all reciprocating compressors in vinyl chloride service are to be minimized by installing double outboard seals, or equivalent as provided in § 61.66. If double outboard seals are used, vinyl chloride emissions from the seals are to be minimized by maintaining the pressure between the two seals so that any leak that occurs is into the compressor; by ducting any vinyl chloride between the two seals through a control system from which the concentration of vinyl chloride in the exhaust gases does not exceed 10 ppm; or equivalent as provided in § 61.66.

(v) *Agitator*. Vinyl chloride emissions from seals on all agitators in vinyl chloride service are to be minimized by in-

stalling agitators with double mechanical seals, or equivalent as provided in § 61.66. If double mechanical seals are used, vinyl chloride emissions from the seals are to be minimized by maintaining the pressure between the two seals so that any leak that occurs is into the agitated vessel; by ducting any vinyl chloride between the two seals through a control system from which the concentration of vinyl chloride in the exhaust gases does not exceed 10 ppm; or equivalent as provided in § 61.66.

(4) *Leakage from relief valves.* Vinyl chloride emissions due to leakage from each relief valve on equipment in vinyl chloride service are to be minimized by installing a rupture disk between the equipment and the relief valve, by connecting the relief valve discharge to a process line or recovery system, or equivalent as provided in § 61.66.

(5) *Manual venting of gases.* Except as provided in § 61.64(a)(3), all gases which are manually vented from equipment in vinyl chloride service are to be ducted through a control system from which the concentration of vinyl chloride in the exhaust gases does not exceed 10 ppm; or equivalent as provided in § 61.66.

(6) *Opening of equipment.* Vinyl chloride emissions from opening of equipment (including loading or unloading lines that are not opened to the atmosphere after each loading or unloading operation) are to be minimized as follows:

(i) Before opening any equipment for any reason, the quantity of vinyl chloride is to be reduced so that the equipment contains no more than 2.0 percent by volume vinyl chloride or 0.0950 m³ (25 gal) of vinyl chloride, whichever is larger, at standard temperature and pressure; and

(ii) Any vinyl chloride removed from the equipment in accordance with paragraph (b)(6)(i) of this section is to be ducted through a control system from which the concentration of vinyl chloride in the exhaust gases does not exceed 10 ppm, or equivalent as provided in § 61.66.

(7) *Samples.* Unused portions of samples containing at least 10 percent by weight vinyl chloride are to be returned to the process, and sampling techniques are to be such that sample containers in vinyl chloride service are purged into a closed process system.

(8) *Leak detection and elimination.* Vinyl chloride emissions due to leaks from equipment in vinyl chloride service are to be minimized by instituting and implementing a formal leak detection and elimination program. The owner or operator shall submit a description of the program to the Administrator for approval. The program is to be submitted within 45 days of the effective date of these regulations, unless a waiver of compliance is granted under § 61.11. If a waiver of compliance is granted, the program is to be submitted on a date scheduled by the Administrator. Approval of a program will be granted by the Administrator provided he finds:

(i) It includes a reliable and accurate vinyl chloride monitoring system for detection of major leaks and identification of the general area of the plant where a leak is located. A vinyl chloride monitoring system means a device which obtains air samples from one or more points on a continuous sequential basis and analyzes the samples with gas chromatography or, if the owner or operator assumes that all hydrocarbons measured are vinyl chloride, with infrared spectrophotometry, flame ion detection, or an equivalent or alternative method.

(ii) It includes a reliable and accurate portable hydrocarbon detector to be used routinely to find small leaks and to pinpoint the major leaks indicated by the vinyl chloride monitoring system. A portable hydrocarbon detector means a device which measures hydrocarbons with a sensitivity of at least 10 ppm and is of such design and size that it can be used to measure emissions from localized points.

(iii) It provides for an acceptable calibration and maintenance schedule for the vinyl chloride monitoring system and portable hydrocarbon detector. For the vinyl chloride monitoring system, a daily span check is to be conducted with a concentration of vinyl chloride equal to the concentration defined as a leak according to paragraph (b)(8)(vi) of this section. The calibration is to be done with either:

(A) A calibration gas mixture prepared from the gases specified in sections 5.2.1 and 5.2.2 of Test Method 106 and in accordance with section 7.1 of Test Method 106, or³⁸

(B) A calibration gas cylinder standard containing the appropriate concentration of vinyl chloride. The gas composition of the calibration gas cylinder standard is to have been certified by the manufacturer. The manufacturer must have recommended a maximum shelf life for each cylinder so that the concentration does not change greater than ± 5 percent from the certified value. The date of gas cylinder preparation, certified vinyl chloride concentration and recommended maximum shelf life must have been affixed to the cylinder before shipment from the manufacturer to the buyer. If a gas chromatograph is used as the vinyl chloride monitoring system, these gas mixtures may be directly used to prepare a chromatograph calibration curve as described in section 7.3 of Test Method 106. The requirements in section 5.2.3.1 and 5.2.3.2 of Test Method 106 for certification of cylinder standards and for establishment and verification of calibration standards are to be followed.³⁸

(iv) The location and number of points to be monitored and the frequency of monitoring provided for in the program are acceptable when they are compared with the number of pieces of equipment in vinyl chloride service and the size and physical layout of the plant.

(v) It contains an acceptable plan of action to be taken when a leak is de-

tected.

(vi) It contains a definition of leak which is acceptable when compared with the background concentrations of vinyl chloride in the areas of the plant to be monitored by the vinyl chloride monitoring system. Measurements of background concentrations of vinyl chloride in the areas of the plant to be monitored by the vinyl chloride monitoring system are to be included with the description of the program. The definition of leak for a given plant may vary among the different areas within the plant and is also to change over time as background concentrations in the plant are reduced.

(9) *Inprocess wastewater.* Vinyl chloride emissions to the atmosphere from inprocess wastewater are to be reduced as follows:

(i) The concentration of vinyl chloride in each inprocess wastewater stream containing greater than 10 ppm vinyl chloride measured immediately as it leaves a piece of equipment and before being mixed with any other inprocess wastewater stream is to be reduced to no more than 10 ppm by weight before being mixed with any other inprocess wastewater stream which contains less than 10 ppm vinyl chloride; before being exposed to the atmosphere; before being discharged to a wastewater treatment process; or before being discharged untreated as a wastewater. This paragraph does apply to water which is used to displace vinyl chloride from equipment before it is opened to the atmosphere in accordance with § 61.64(a)(2) or paragraph (b)(6) of this section, but does not apply to water which is used to wash out equipment after the equipment has already been opened to the atmosphere in accordance with § 61.64(a)(2) or paragraph (b)(6) of this section.³⁹

(ii) Any vinyl chloride removed from the inprocess wastewater in accordance with paragraph (b)(9)(i) of this section is to be ducted through a control system from which the concentration of vinyl chloride in the exhaust gases does not exceed 10 ppm, or equivalent as provided in § 61.66.

(c) The requirements in paragraphs (b)(1), (b)(2), (b)(5), (b)(6), (b)(7) and (b)(8) of this section are to be incorporated into a standard operating procedure, and made available upon request for inspection by the Administrator. The standard operating procedure is to include provisions for measuring the vinyl chloride in equipment ≥ 4.75 m³ (1,250 gal) in volume for which an emission limit is prescribed in § 61.65(b)(6) (i) prior to opening the equipment and using Test Method 106, a portable hydrocarbon detector, or an equivalent or alternative method. The method of measurement is to meet the requirements in § 61.67(g)(5)(i)(A) or (g)(5)(i)(B).³⁹

(Sec. 114 of the Clean Air Act as amended (49 U.S.C. 7414)). 447

§ 61.66 Equivalent equipment and procedures.

Upon written application from an owner or operator, the Administrator may approve use of equipment or procedures which have been demonstrated to his satisfaction to be equivalent in terms of reducing vinyl chloride emissions to the atmosphere to those prescribed for compliance with a specific paragraph of this subpart. For an existing source, any request for using an equivalent method as the initial measure of control is to be submitted to the Administrator within 30 days of the effective date. For a new source, any request for using an equivalent method is to be submitted to the Administrator with the application for approval of construction or modification required by § 61.07.

§ 61.67 Emission tests.

(a) Unless a waiver of emission testing is obtained under § 61.13, the owner or operator of a source to which this subpart applies shall test emissions from the source,

(1) Within 90 days of the effective date in the case of an existing source or a new source which has an initial startup date preceding the effective date, or

(2) Within 90 days of startup in the case of a new source, initial startup of which occurs after the effective date.

(b) The owner or operator shall provide the Administrator at least 30 days prior notice of an emission test to afford the Administrator the opportunity to have an observer present during the test.

(c) Any emission test is to be conducted while the equipment being tested is operating at the maximum production rate at which the equipment will be operated and under other relevant conditions as may be specified by the Administrator based on representative performance of the source.

(d) [Reserved]

(e) When at all possible, each sample is to be analyzed within 24 hours, but in no case in excess of 72 hours of sample collection. Vinyl chloride emissions are to be determined within 30 days after the emission test. The owner or operator shall report the determinations to the Administrator by a registered letter dispatched before the close of the next business day following the determination.³⁸

(f) The owner or operator shall retain at the plant and make available, upon request, for inspection by the Administrator, for a minimum of 2 years records of emission test results and other data needed to determine emissions.

(g) Unless otherwise specified, the owner or operator shall use test Test Methods in Appendix B to this part for each test as required by paragraphs (g)(1), (g)(2), (g)(3), (g)(4), and (g)(5) of this section, unless an equivalent method or an alternative method has been approved by the Administrator. If the Administrator finds reasonable grounds to dispute the results obtained by an equivalent or alternative method, he may require the use of a reference method. If the results of the reference

and equivalent or alternative methods do not agree, the results obtained by the reference method prevail, and the Administrator may notify the owner or operator that approval of the method previously considered to be equivalent or alternative is withdrawn.

Whenever Test Method 107 is specified, and the conditions in Section 1.1, "Applicability" of Method 107A are met, Method 107A may be used.⁷¹

(1) Test Method 106 is to be used to determine the vinyl chloride emissions from any source for which an emission limit is prescribed in §§ 61.62(a) or (b) § 61.63(a), or §§ 61.64(a) (1), (b), (c), or (d), or from any control system to which reactor emissions are required to be ducted in § 61.64(a) (2) or to which fugitive emissions are required to be ducted in § 61.65(b) (1) (ii), (b) (2), (b) (5), (b) (6) (ii), or (b) (9) (ii).

(i) For each run, one sample is to be collected. The sampling site is to be at least two stack or duct diameters downstream and one half diameter upstream from any flow disturbance such as a bend, expansion, contraction, or visible flame. For a rectangular cross section an equivalent diameter is to be determined from the following equation:

$$\text{equivalent diameter} = 2 \frac{(\text{length})(\text{width})}{\text{length} + \text{width}}$$

The sampling point in the duct is to be at the centroid of the cross section. The sample is to be extracted at a rate proportional to the gas velocity at the sampling point. The sample is to be taken over a minimum of one hour, and is to contain a minimum volume of 50 liters corrected to standard conditions.

(ii) Each emission test is to consist of three runs. For the purpose of determining emissions, the average of results of all runs is to apply. The average is to be computed on a time weighted basis.³⁸

(iii) For gas streams containing more than 10 percent oxygen the concentration of vinyl chloride as determined by Test Method 106 is to be corrected to 10 percent oxygen (dry basis) for determination of emissions by using the following equation:

$$C_{\text{corrected}} = C_{\text{u}} \frac{10.9}{20.9 - \text{percent } O_2}$$

where:

$C_{\text{corrected}}$ = The concentration of vinyl chloride in the exhaust gases, corrected to 10-percent oxygen.

C_{u} = The concentration of vinyl chloride as measured by Test Method 106.

20.9 = Percent oxygen in the ambient air at standard conditions.

10.9 = Percent oxygen in the ambient air at standard conditions, minus the 10.0-percent oxygen to which the correction is being made.

Percent O_2 = Percent oxygen in the exhaust gas as measured by Reference Method 3 in Appendix A of Part 60 of this chapter.

(iv) For those emission sources where the emission limit is prescribed in terms of mass rather than concentration, mass emissions in kg/100 kg product are to be determined by using the following equation:

tion:

$$C_{\text{ex}} = \frac{[C_{\text{u}}(2.60)Q10^{-6}][100]}{Z}$$

where:

C_{ex} = kg vinyl chloride/100 kg product.

C_{u} = The concentration of vinyl chloride as measured by Test Method 106.

2.60 = Density of vinyl chloride at one atmosphere and 20° C in kg/m³.

Q = Volumetric flow rate in m³/hr as determined by Reference Method 2 of Appendix A to Part 60 of this chapter.

10⁻⁶ = Conversion factor for ppm.

Z = Production rate (kg/hr).³⁸

(2) Test Method 107 is to be used to determine the concentration of vinyl chloride in each inprocess wastewater stream for which an emission limit is prescribed in § 61.65(b) (9) (i).

(3) Where a stripping operation is used to attain the emission limit in § 61.64(e), emissions are to be determined using Test Method 107 as follows:

(i) The number of strippers and samples and the types and grades of resin to be sampled are to be determined by the Administrator for each individual plant at the time of the test based on the plant's operation.

(ii) Each sample is to be taken immediately following the stripping operation.

(iii) The corresponding quantity of material processed by each stripper is to be determined on a dry solids basis and by a method submitted to and approved by the Administrator.

(iv) At the prior request of the Administrator, the owner or operator shall provide duplicates of the samples required in paragraph (g)(3)(i) of this section.

(4) Where control technology other than or in addition to a stripping operation is used to attain the emission limit in § 61.64(e), emissions are to be determined as follows:

(i) Test Method 106 is to be used to determine atmospheric emissions from all of the process equipment simultaneously. The requirements of paragraph (g)(1) of this section are to be met.

(ii) Test Method 107 is to be used to determine the concentration of vinyl chloride in each inprocess wastewater stream subject to the emission limit prescribed in § 61.64(e). The mass of vinyl chloride in kg/100 kg product in each in process wastewater stream is to be determined by using the following equation:

$$C_{\text{ex}} = \frac{[C_{\text{u}}R10^{-6}][100]}{Z}$$

where:

C_{ex} = kg vinyl chloride/100 kg product.

C_{u} = the concentration of vinyl chloride as measured by Test Method 107.

R = water flow rate in l/hr, determined in accordance with a method which has been submitted to and approved by the Administrator.

10⁻⁶ = Conversion factor for ppm.

Z = Production rate (kg/hr), determined in accordance with a method which has been submitted and approved by the Administrator.

(5) The reactor opening loss for which an emission limit is prescribed in § 61.64(a) (2) is to be determined. The number of reactors for which the determination

is to be made is to be specified by the Administrator for each individual plant at the time of the determination based on the plant's operation. For a reactor that is also used as a stripper, the determination may be made immediately following the stripping operation.

(i) Except as provided in paragraph (g) (5) (ii) of this section, the reactor opening loss is to be determined using the following equation:

$$C = \frac{W (2.60) (10^{-4}) (Cb)}{YZ}$$

where:

C = kg vinyl chloride emissions/kg product.

W = Capacity of the reactor in m³.

2.60 = Density of vinyl chloride at one atmosphere and 20° C in kg/m³.

10⁻⁴ = Conversion factor for ppm.

Cb = ppm by volume vinyl chloride as determined by Test Method 106 or a portable hydrocarbon detector which measures hydrocarbons with a sensitivity of at least 10 ppm.

Y = Number of batches since the reactor was last opened to the atmosphere.

Z = Average kg of polyvinyl chloride produced per batch in the number of batches since the reactor was last opened to the atmosphere.

(A) If Method 106 is used to determine the concentration of vinyl chloride (Cb), the sample is to be withdrawn at a constant rate with a probe of sufficient length to reach the vessel bottom from the manhole. Samples are to be taken for 5 minutes within 6 inches of the vessel bottom, 5 minutes near the vessel center, and 5 minutes near the vessel top.

(B) If a portable hydrocarbon detector is used to determine the concentration of vinyl chloride (Cb), a probe of sufficient length to reach the vessel bottom from the manhole is to be used to make the measurements. One measurement will be made within 6 inches of the vessel bottom, one near the vessel center and one near the vessel top. Measurements are to be made at each location until the reading is stabilized. All hydrocarbons measured are to be assumed to be vinyl chloride.

(C) The production rate of polyvinyl chloride (Z) is to be determined by a method submitted to and approved by the Administrator.

(ii) A calculation based on the number of evacuations, the vacuum involved, and the volume of gas in the reactor is hereby approved by the Administrator as an alternative method for determining reactor opening loss for postpolymerization reactors in the manufacture of bulk resins.

(Sec. 114 of the Clean Air Act as amended (42 U.S.C. 7414)). 44.47

§ 61.68 Emission monitoring.

(a) A vinyl chloride monitoring system is to be used to monitor on a continuous basis the emissions from the sources for which emission limits are prescribed in § 61.62(a) and (b), § 61.63(a), and § 61.64(a) (1), (b), (c), and (d), and for any control system to which reactor emissions are required to be ducted in § 61.64(a) (2) or to which fugitive emissions are required to be ducted in § 61.65

(b) (1) (ii), and (b) (2), (b) (5), (b) (6) (ii), and (b) (9) (ii). 30

(b) The vinyl chloride monitoring system(s) used to meet the requirement in paragraph (a) of this section is to be a device which obtains air samples from one or more points on a continuous sequential basis and analyzes the samples with gas chromatography or, if the owner or operator assumes that all hydrocarbons measured are vinyl chloride, with infrared spectrophotometry, flame ion detection, or an equivalent or alternative method. The vinyl chloride monitoring system used to meet the requirements in § 61.65(b) (8) (i) may be used to meet the requirements of this section.

(c) A daily span check is to be conducted for each vinyl chloride monitoring system used. For all of the emission sources listed in paragraph (a) of this section, except the one for which an emission limit is prescribed in § 61.62(b), the daily span check is to be conducted with a concentration of vinyl chloride equal to 10 ppm. For the emission source for which an emission limit is prescribed in § 61.62(b), the daily span check is to be conducted with a concentration of vinyl chloride which is determined to be equivalent to the emission limit for that source based on the emission test required by § 61.67. The calibration is to be done with either:

(1) A calibration gas mixture prepared from the gases specified in sections 5.2.1 and 5.2.2 of Test Method 106 and in accordance with section 7.1 of Test Method 106, or 38

(2) A calibration gas cylinder standard containing the appropriate concentration of vinyl chloride. The gas composition of the calibration gas cylinder standard is to have been certified by the manufacturer. The manufacturer must have recommended a maximum shelf life for each cylinder so that the concentration does not change greater than ±5 percent from the certified value. The date of gas cylinder preparation, certified vinyl chloride concentration and recommended maximum shelf life must have been affixed to the cylinder before shipment from the manufacturer to the buyer. If a gas chromatograph is used as the vinyl chloride monitoring system, these gas mixtures may be directly used to prepare a chromatograph calibration curve as described in section 7.3 of Test Method 106. The requirements in sections 5.2.3.1 and 5.2.3.2 of Test Method 106 for certification of cylinder standards and for establishment and verification of calibration standards are to be followed. 38

(Sec. 114 of the Clean Air Act as amended (42 U.S.C. 7414)). 44.47

§ 61.69 Initial report.

(a) An owner or operator of any source to which this subpart applies shall submit a statement in writing notifying the Administrator that the equipment and procedural specifications in § 61.65 (b) (1), (b) (2), (b) (3), (b) (4), (b) (5),

(b) (6), (b) (7), and (b) (8) are being implemented.

(b) (1) In the case of an existing source or a new source which has an initial startup date preceding the effective date, the statement is to be submitted within 90 days of the effective date, unless a waiver of compliance is granted under § 61.11, along with the information required under § 61.10. If a waiver of compliance is granted, the statement is to be submitted on a date scheduled by the Administrator.

(2) In the case of a new source which did not have an initial startup date preceding the effective date, the statement is to be submitted within 90 days of the initial startup date.

(c) The statement is to contain the following information:

(1) A list of the equipment installed for compliance.

(2) A description of the physical and functional characteristics of each piece of equipment.

(3) A description of the methods which have been incorporated into the standard operating procedures for measuring or calculating the emissions for which emission limits are prescribed in § 61.65 (b) (1) (i) and (b) (6) (i).

(4) A statement that each piece of equipment is installed and that each piece of equipment and each procedure is being used.

(Sec. 114 of the Clean Air Act as amended (42 U.S.C. 7414)). 44.47

§ 61.70 Semiannual report.

(a) The owner or operator of any source to which this subpart applies shall submit to the Administrator on September 15 and March 15 of each year a report in writing containing the information required by this section. The first semiannual report is to be submitted following the first full 6 month reporting period after the initial report is submitted. 30

(b) (1) In the case of an existing source or a new source which has an initial startup date preceding the effective date, the first report is to be submitted within 180 days of the effective date, unless a waiver of compliance is granted under § 61.11. If a waiver of compliance is granted, the first report is to be submitted on a date scheduled by the Administrator.

(2) In the case of a new source which did not have an initial startup date preceding the effective date, the first report is to be submitted within 180 days of the initial startup date.

(c) Unless otherwise specified, the owner or operator shall use the Test Methods in Appendix B to this part to conduct emission tests as required by paragraphs (c) (2) and (c) (3) of this section, unless an equivalent or an alternative method has been approved by the Administrator. If the Administrator finds reasonable grounds to dispute the results obtained by an equivalent or alternative method, he may require the use

of a reference method. If the results of the reference and equivalent or alternative methods do not agree, the results obtained by the reference method prevail, and the Administrator may notify the owner or operator that approval of the method previously considered to be equivalent or alternative is withdrawn.

(1) The owner or operator shall include in the report a record of any emissions which averaged over any hour period (commencing on the hour) are in excess of the emission limits prescribed in §§ 61.62(a) or (b), § 61.63(a), or § 61.64(a) (1), (b), (c), or (d), or for any control system to which reactor emissions are required to be ducted in § 61.64(a) (2) or to which fugitive emissions are required to be ducted in § 61.65 (b) (1) (ii), (b) (2), (b) (5), (b) (6) (ii), or (b) (9) (ii). The emissions are to be measured in accordance with § 61.68.

(2) In polyvinyl chloride plants for which a stripping operation is used to attain the emission level prescribed in § 61.64(e), the owner or operator shall include in the report a record of the vinyl chloride content in the polyvinyl chloride resin. Test Method 107 is to be used to determine vinyl chloride content as follows:

(i) If batch stripping is used, one representative sample of polyvinyl chloride resin is to be taken from each batch of each grade of resin immediately following the completion of the stripping operation, and identified by resin type and grade and the date and time the batch is completed. The corresponding quantity of material processed in each stripper batch is to be recorded and identified by resin type and grade and the date and time the batch is completed.³⁸

(ii) If continuous stripping is used, one representative sample of polyvinyl chloride resin is to be taken for each grade of resin processed or at intervals of 8 hours for each grade of resin which is being processed, whichever is more frequent. The sample is to be taken as the resin flows out of the stripper and identified by resin type and grade and the date and time the sample was taken. The corresponding quantity of material processed by each stripper over the time period represented by the sample during the eight hour period, is to be recorded and identified by resin type and grade and the date and time it represents.

(iii) The quantity of material processed by the stripper is to be determined on a dry solids basis and by a method submitted to and approved by the Administrator.

(iv) At the prior request of the Administrator, the owner or operator shall provide duplicates of the samples required in paragraphs (c) (2) (i) and (c) (2) (ii) of this section.

(v) The report to the Administrator by the owner or operator is to include the vinyl chloride content found in each sample required by paragraphs (c) (2) (i) and (c) (2) (ii) of this section, averaged separately for each type of resin, over each calendar day and weighted according to the quantity of each grade

of resin processed by the stripper(s) that calendar day, according to the following equation:

$$A_{T_i} = \frac{\sum_{G=1}^n P_{G_i} M_{G_i}}{Q_{T_i}} = \frac{P_{G_1} M_{G_1} + P_{G_2} M_{G_2} + \dots + P_{G_n} M_{G_n}}{Q_{T_i}}$$

where:

A = 24-hour average concentration of type, T, resin in ppm (dry weight basis).

Q = Total production of type T, resin over the 24-hour period, in kg.

T = Type of resin; i = 1, 2 . . . m where m is total number of resin types produced during the 24-hour period.

M = Concentration of vinyl chloride in one sample of grade G, resin, in ppm.

P = Production of grade G, resin represented by the sample, in kg.

G_i = Grade of resin; e.g., G₁, G₂, and G_n.

n = Total number of grades of resin produced during the 24-hour period.³⁸

(vi) The owner or operator shall retain at the source and make available for inspection by the Administrator for a minimum of 2 years records of all data needed to furnish the information required by paragraph (c) (2) (v) of this section: The records are to contain the following information:

(A) The vinyl chloride content found in all the samples required in paragraphs (c) (2) (i) and (c) (2) (ii) of this section, identified by the resin type and grade and the time and date of the sample, and

(B) The corresponding quantity of polyvinyl chloride resin processed by the stripper(s), identified by the resin type and grade and the time and date it represents.

(3) The owner or operator shall include in the report a record of the emissions from each reactor opening for which an emission limit is prescribed in § 61.64(a) (2). Emissions are to be determined in accordance with § 61.67(g) (5), except that emissions for each reactor are to be determined. For a reactor that is also used as a stripper, the determination may be made immediately following the stripping operation.

(Sec. 114 of the Clean Air Act as amended (42 U.S.C. 7414)). 4847

§ 61.71 Recordkeeping.

(a) The owner or operator of any source to which this subpart applies shall retain the following information at the source and make it available for inspection by the Administrator for a minimum of two years:

(1) A record of the leaks detected by the vinyl chloride monitoring system, as required by § 61.65(b) (8), including the concentrations of vinyl chloride measured, analyzed, and recorded by the vinyl chloride detector, the location of each measurement and the date and approximate time of each measurement.

(2) A record of the leaks detected during routine monitoring with the portable hydrocarbon detector and the action taken to repair the leaks, as required by § 61.65(b) (8), including a brief statement explaining the location and cause of each leak detected with the portable hydrocarbon detector, the date and time of the leak, and any action taken to eliminate that leak.³⁸

(3) A record of emissions measured in accordance with § 61.68.³⁸

(4) A daily operating record for each polyvinyl chloride reactor, including pressures and temperatures.³⁸

(Sec. 114 of the Clean Air Act as amended (42 U.S.C. 7414)). 4847

38 FR 8826, 4/6/73 (1)

as amended

41 FR 46560, 10/21/76 (28)
41 FR 53017, 12/3/76 (30)
42 FR 29005, 6/7/77 (38)
42 FR 41424, 8/17/77 (40)
43 FR 8800, 3/3/78 (47)
47 FR 39485, 9/8/82 (71)

**Subpart J—National Emission
Standard for Equipment Leaks
(Fugitive Emission Sources) of
Benzene** ⁹⁷

**§ 61.110 Applicability and designation of
sources.**

(a) The provisions of this subpart apply to each of the following sources that are intended to operate in benzene service: pumps, compressors, pressure relief devices, sampling connections, systems, open-ended valves or lines, valves, flanges and other connectors, product accumulator vessels, and control devices or systems required by this subpart.

(b) The provisions of this subpart do not apply to sources located in coke by-product plants.

(c)(1) If an owner or operator applies for one of the exemptions in this paragraph, then the owner or operator shall maintain records as required in § 61.246(i).

(2) Any equipment in benzene service that is located at a plant site designed to produce or use less than 1,000 megagrams of benzene per year is exempt from the requirements of § 61.112.

(3) Any process unit (defined in § 61.241) that has no equipment in benzene service is exempt from the requirements of § 61.112.

(d) While the provisions of this subpart are effective, a source to which this subpart applies that is also subject to the provisions of 40 CFR Part 60 only will be required to comply with the provisions of this subpart.

§ 61.111 Definitions.

As used in this subpart, all terms not defined herein shall have the meaning given them in the Act, in Subpart A of Part 61, or in Subpart V of Part 61, and the following terms shall have the specific meanings given them:

"In benzene service" means that a piece of equipment either contains or contacts a fluid (liquid or gas) that is at least 10 percent benzene by weight as determined according to the provisions of § 61.245(d). The provisions of § 61.245(d) also specify how to determine that a piece of equipment is not in benzene service.

"Semiannual" means a 6-month period: the first semiannual period concludes on the last day of the last month during the 180 days following initial startup for new sources; and the first semiannual period concludes on the last day of the last full month during the 180 days after June 6, 1984 for existing sources.

§ 61.112 Standards.

(a) Each owner or operator subject to the provisions of this subpart shall comply with the requirements of Subpart V of this part.

(b) An owner or operator may elect to comply with the requirements of § 61.243-1 and § 61.243-2.

(c) An owner or operator may apply to the Administrator for a determination of an alternative means of emission limitation that achieves a reduction in emissions of benzene at least equivalent to the reduction in emissions of benzene achieved by the controls required in this subpart. In doing so, the owner or operator shall comply with requirements of § 61.244.

§ 61.113-61.119 [Reserved]

38 FR 8826, 4/6/73 (1)

as amended

49 FR 23498, 6/6/84 (97)

Subpart V—National Emission Standard for Equipment Leaks (Fugitive Emission Sources)⁹⁷

§ 61.240 Applicability and designation of sources.

(a) The provisions of this subpart apply to each of the following sources that are intended to operate in volatile hazardous air pollutant (VHAP) service: pumps, compressors, pressure relief devices, sampling connection systems, open-ended valves or lines, valves, flanges and other connectors, product accumulator vessels, and control devices or systems required by this subpart.

(b) The provisions of this subpart apply to the sources listed in paragraph (a) after the date of promulgation of a specific subpart in Part 61.

(c) While the provisions of this subpart are effective, a source to which this subpart applies that is also subject to the provisions of 40 CFR Part 60 only will be required to comply with the provisions of this subpart.

§ 61.241 Definitions.

As used in this subpart, all terms not defined herein shall have the meaning given them in the Act, in Subpart A of Part 61, or in specific subparts of Part 61; and the following terms shall have specific meaning given them:

"Closed-vent system" means a system that is not open to atmosphere and that is composed of piping, connections, and, if necessary, flow-inducing devices that transport gas or vapor from a piece or pieces of equipment to a control device.

"Connector" means, flanged, screwed, welded, or other joined fittings used to connect two pipe lines or a pipe line and a piece of equipment.

"Control device" means an enclosed combustion device, vapor recovery system, or flare.

"Double block and bleed system" means two block valves connected in series with a bleed valve or line that can vent the line between the two block valves.

"Equipment" means each pump, compressor, pressure relief device, sampling connection system, open-ended valve or line, valve, flange or other connector, product accumulator vessel in VHAP service, and any control devices or systems required by this subpart.

"First attempt at repair" means to take rapid action for the purpose of stopping or reducing leakage of organic material to atmosphere using best practices.

"In gas/vapor service" means that a piece of equipment contains process fluid that is in the gaseous state at operating conditions.

"In liquid service" means that a piece of equipment is not in gas/vapor service.

"In-situ sampling systems" means nonextractive samplers or in-line samplers.

"In vacuum service" means that equipment is operating at an internal pressure which is at least 5 kilopascals (kPa) below ambient pressure.

"In VHAP service" means that a piece of equipment either contains or contacts a fluid (liquid or gas) that is at least 10 percent by weight a volatile hazardous air pollutant (VHAP) as determined according to the provisions of § 61.245(d). The provisions of § 61.245(d) also specify how to determine that a piece of equipment is not in VHAP service.

"In VOC service" means, for the purposes of this subpart, that (a) the piece of equipment contains or contacts a process fluid that is at least 10 percent VOC by weight (see 40 CFR 60.2 for the definition of volatile organic compound or VOC and 40 CFR 60.486(d) to determine whether a piece of equipment is not in VOC service) and (b) the piece of equipment is not in liquid service as defined in 40 CFR 60.481.¹¹²

"Open-ended valve or line" means any valve, except pressure relief valves, having one side of the valve seat in contact with process fluid and one side open to atmosphere, either directly or through open piping.

"Pressure release" means the emission of materials resulting from the system pressure being greater than the set pressure of the pressure relief device.

"Process unit" means equipment assembled to produce a VHAP or its derivatives as intermediates or final products, or equipment assembled to use a VHAP in the production of a product. A process unit can operate independently if supplied with sufficient feed or raw materials and sufficient product storage facilities.

"Process unit shutdown" means a work practice or operational procedure that stops production from a process unit or part of a process unit. An unscheduled work practice or operational procedure that stops production from a process unit or part of a process unit for less than 24 hours is not a process unit shutdown. The use of spare equipment and technically feasible bypassing of equipment without stopping production are not process unit

shutdowns.

"Product accumulator vessel" means any distillate receiver, bottoms receiver, surge control vessel, or product separator in VHAP service that is vented to atmosphere either directly or through a vacuum-producing system. A product accumulator vessel is in VHAP service if the liquid or the vapor in the vessel is at least 10 percent by weight VHAP.

"Repaired" means that equipment is adjusted, or otherwise altered, to eliminate a leak as indicated by one of the following: an instrument reading of 10,000 ppm or greater, indication of liquids dripping, or indication by a sensor that a seal or barrier fluid system has failed.

"Semiannual" means a 6-month period; the first semiannual period concludes on the last day of the last month during the 180 days following initial startup for new sources; and the first semiannual period concludes on the last day of the last full month during the 180 days after the effective date of a specific subpart that references this subpart for existing sources.¹¹²

"Sensor" means a device that measures a physical quantity or the change in a physical quantity, such as temperature, pressure, flow rate, pH, or liquid level.

"Volatile Hazardous Air Pollutant" or "VHAP" means a substance regulated under this subpart for which a standard for equipment leaks of the substance has been proposed and promulgated. Benzene is a VHAP.

§ 61.242-1 Standards: General.

(a) Each owner or operator subject to the provisions of this subpart shall demonstrate compliance with the requirements of § 61.242-1 to § 61.242-11 for each new and existing source as required in 40 CFR 61.05, except as provided in § 61.243 and § 61.244.

(b) Compliance with this subpart will be determined by review of records, review of performance test results, and inspection using the methods and procedures specified in § 61.245.

(c)(1) An owner or operator may request a determination of alternative means of emission limitation to the requirements of §§ 61.242-2, 61.242-3, 61.242-5, 61.242-6.

61.242-7, 61.242-8, 61.242-9 and 61.242-11 as provided in § 61.244.¹¹²

(2) If the Administrator makes a determination that a means of emission limitation is at least a permissible alternative to the requirements of §§ 61.242-2, 61.242-3, 61.242-5, 61.242-6, 61.242-7, 61.242-8, 61.242-9 or 61.242-11,

an owner or operator shall comply with the requirements of that determination.

(d) Each piece of equipment to which this subpart applies shall be marked in such a manner that it can be distinguished readily from other pieces of equipment.

(e) Equipment that is in vacuum service is excluded from the requirements of § 61.242-2, to § 61.242-11 if it is identified as required in § 61.246(e)(5).

§ 61.242-2 Standards: Pumps.

(a)(1) Each pump shall be monitored monthly to detect leaks by the methods specified in § 61.245(b), except as provided in § 61.242-1(c) and paragraphs (d), (e), and (f) of this section.

(2) Each pump shall be checked by visual inspection each calendar week for indications of liquids dripping from the pump seal.

(b)(1) If an instrument reading of 10,000 ppm or greater is measured, a leak is detected.

(2) If there are indications of liquids dripping from the pump seal, a leak is detected.

(c)(1) When a leak is detected, it shall be repaired as soon as practicable, but not later than 15 calendar days after it is detected, except as provided in § 61.242-10.

(2) A first attempt at repair shall be made no later than 5 calendar days after each leak is detected.

(d) Each pump equipped with a dual mechanical seal system that includes a barrier fluid system is exempt from the requirements of paragraph (a), provided the following requirements are met:

(1) Each dual mechanical seal system is:

(i) Operated with the barrier fluid at a pressure that is at all times greater than the pump stuffing box pressure; or

(ii) Equipped with a barrier fluid degassing reservoir that is connected by a closed-vent system to a control device that complies with the requirements of § 61.242-11; or

(iii) Equipped with a system that purges the barrier fluid into a process stream with zero VHAP emissions to atmosphere.

(2) The barrier fluid is not in VHAP service and, if the pump is covered by standards under 40 CFR Part 60, is not in VOC service.

(3) Each barrier fluid system is equipped with a sensor that will detect failure of the seal system, the barrier fluid system, or both.

(4) Each pump is checked by visual inspection each calendar week for indications of liquids dripping from the pump seal.

(5)(i) Each sensor as described in paragraph (d)(3) of this section is checked daily or is equipped with a audible alarm, and

(ii) The owner or operator determines, based on design considerations and operating experience, a criterion that indicates failure of the seal system, the barrier fluid system, or both.

(6)(i) If there are indications of liquids dripping from the pump seal or the sensor indicates failure of the seal system, the barrier fluid system, or both based on the criterion determined in paragraph (d)(5)(ii), a leak is detected.

(ii) When a leak is detected, it shall be repaired as soon as practicable, but not later than 15 calendar days after it is detected, except as provided in § 61.242-10.

(iii) A first attempt at repair shall be made no later than 5 calendar days after each leak is detected.

(e) Any pump that is designated, as described in § 61.246(e)(2), for no detectable emissions, as indicated by an instrument reading of less than 500 ppm above background, is exempt from the requirements of paragraphs (a), (c), and (d) if the pump:

(1) Has no externally actuated shaft penetrating the pump housing.

(2) Is demonstrated to be operating with no detectable emissions, as indicated by an instrument reading of less than 500 ppm above background, as measured by the method specified in § 61.245(c), and

(3) Is tested for compliance with paragraph (e)(2) initially upon designation, annually, and at other times requested by the Administrator.

(f) If any pump is equipped with a closed-vent system capable of capturing and transporting any leakage from the seal or seals to a control device that complies with the requirements of § 61.242-11, it is exempt from the requirements of paragraphs (a)-(e).

(g) Any pump that is located within the boundary of an unmanned plant site is exempt from the weekly visual inspection requirement of paragraphs (a)(2) and (d)(4) of this section, and the daily requirements of paragraph (d)(5)(i) of this section, provided that each pump is visually inspected as often as practicable and at least monthly.¹¹²

§ 61.242-3 Standards: Compressors.

(a) Each compressor shall be equipped

with a seal system that includes a barrier fluid system and that prevents leakage of process fluid to atmosphere, except as provided in § 61.242-1(c) and paragraphs (h) and (i) of this section.

(b) Each compressor seal system as required in paragraph (a) shall be:

(1) Operated with the barrier fluid at a pressure that is greater than the compressor stuffing box pressure; or

(2) Equipped with a barrier fluid system that is connected by a closed-vent system to a control device that complies with the requirements of § 61.242-11; or

(3) Equipped with a system that purges the barrier fluid into a process stream with zero VHAP emissions to atmosphere.

(c) The barrier fluid shall not be in VHAP service and, if the compressor is covered by standards under 40 CFR Part 60, shall not be in VOC service.

(d) Each barrier fluid system as described in paragraphs (a)-(c) of this section shall be equipped with a sensor that will detect failure of the seal system, barrier fluid system, or both.

(e)(1) Each sensor as required in paragraph (d) of this section shall be checked daily or shall be equipped with an audible alarm unless the compressor is located within the boundary of an unmanned plant site.¹¹²

(2) The owner or operator shall determine, based on design considerations and operating experience, a criterion that indicates failure of the seal system, the barrier fluid system, or both.

(f) If the sensor indicates failure of the seal system, the barrier fluid system, or both based on the criterion determined under paragraph (e)(2) of this section, a leak is detected.

(g)(1) When a leak is detected, it shall be repaired as soon as practicable, but not later than 15 calendar days after it is detected, except as provided in § 61.242-10.

(2) A first attempt at repair shall be made no later than 5 calendar days after each leak is detected.

(h) A compressor is exempt from the requirements of paragraphs (a) and (b) if it is equipped with a closed-vent system capable of capturing and transporting any leakage from the seal to a control device that complies with the requirements of § 61.242-11, except as provided in paragraph (i).

(i) Any Compressor that is designated, as described in § 61.246(e)(2), for no detectable emission as indicated by an instrument reading of less than 500 ppm above background is exempt from the

requirements of paragraphs (a)–(h) if the compressor:

(1) Is demonstrated to be operating with no detectable emissions, as indicated by an instrument reading of less than 500 ppm above background, as measured by the method specified in § 61.245(c); and

(2) Is tested for compliance with paragraph (i)(1) initially upon designation, annually, and at other times requested by the Administrator.

§ 61.242-4 Standards: Pressure relief devices in gas/vapor service.

(a) Except during pressure releases, each pressure relief device in gas/vapor service shall be operated with no detectable emissions, as indicated by an instrument reading of less than 500 ppm above background, as measured by the method specified in § 61.245(c).

(b)(1) After each pressure release, the pressure relief device shall be returned to a condition of no detectable emissions, as indicated by an instrument reading of less than 500 ppm above background, as soon as practicable, but no later than 5 calendar days after each pressure release, except as provided in § 61.242-10.¹¹²

(2) No later than 5 calendar days after the pressure release, the pressure relief device shall be monitored to confirm the condition of no detectable emissions, as indicated by an instrument reading of less than 500 ppm above background, as measured by the method specified in § 61.245(c).

(c) Any pressure relief device that is equipped with a closed-vent system capable of capturing and transporting leakage from the pressure relief device to a control device as described in § 61.242-11 is exempt from the requirements of paragraphs (a) and (b).

§ 61.242-5 Standards: Sampling connecting systems.

(a) Each sampling connection system shall be equipped with a closed-purge system or closed vent system, except as provided in § 61.242-1(c).

(b) Each closed-purge system or closed-vent system as required in paragraph (a) shall:

(1) Return the purged process fluid directly to the process line with zero VHAP emissions to atmosphere; or

(2) Collect and recycle the purged process fluid with zero VHAP emissions to atmosphere; or

(3) Be designed and operated to capture and transport all the purged process fluid to a control device that complies with the requirements of § 61.242-11.

(c) *In-situ* sampling systems are exempt from the requirements of paragraphs (a) and (b).

§ 61.242-6 Standards: Open-ended valves or lines.

(a)(1) Each open-ended valve or line shall be equipped with a cap, blind flange, plug, or a second valve, except as provided in § 61.242-1(c).

(2) The cap, blind flange, plug, or second valve shall seal the open end at all times except during operations requiring process fluid flow through the open-ended valve or line.

(b) Each open-ended valve or line equipped with a second valve shall be operated in a manner such that the valve on the process fluid end is closed before the second valve is closed.

(c) When a double block and bleed system is being used, the bleed valve or line may remain open during operations that require venting the line between the block valves but shall comply with paragraph (a) at all other times.

§ 61.242-7 Standards: Valves.

(a) Each valve shall be monitored monthly to detect leaks by the method specified in § 61.245(b) and shall comply with paragraphs (b)–(e), except as provided in paragraphs (f), (g), and (h) of this section, §§ 61.243-1 or 61.243-2, and § 61.242-1(c).

(b) If an instrument reading of 10,000 ppm or greater is measured, a leak is detected.

(c)(1) Any valve for which a leak is not detected for 2 successive months may be monitored the first month of every quarter, beginning with the next quarter, until a leak is detected.

(2) If a leak is detected, the valve shall be monitored monthly until a leak is not detected for 2 successive months.

(d)(1) When a leak is detected, it shall be repaired as soon as practicable, but no later than 15 calendar days after the leak is detected, except as provided in § 61.242-10.

(2) A first attempt at repair shall be made no later than 5 calendar days after each leak is detected.

(e) First attempts at repair include, but are not limited to, the following best practices where practicable:

(1) Tightening of bonnet bolts;
(2) Replacement of bonnet bolts;
(3) Tightening of packing gland nuts;
and

(4) Injection of lubricant into lubricated packing.

(f) Any valve that is designated, as described in § 61.246(e)(2), for no detectable emissions, as indicated by an instrument reading of less than 500 ppm

above background, is exempt from the requirements of paragraph (a) if the valve:

(1) Has no external actuating mechanism in contact with the process fluid;

(2) Is operated with emissions less than 500 ppm above background, as measured by the method specified in § 61.245(c); and

(3) Is tested for compliance with paragraph (f)(2) initially upon designation, annually, and at other times requested by the Administrator.

(g) Any valve that is designated, as described in § 61.246(f)(1), as an unsafe-to-monitor valve is exempt from the requirements of paragraph (a) if:

(1) The owner or operator of the valve demonstrates that the valve is unsafe to monitor because monitoring personnel would be exposed to an immediate danger as a consequence of complying with paragraph (a); and

(2) The owner or operator of the valve has a written plan that requires monitoring of the valve as frequent as practicable during safe-to-monitor times.

(h) Any valve that is designated, as described in § 61.246(f)(2), as a difficult-to-monitor valve is exempt from the requirements of paragraph (a) if:

(1) The owner or operator of the valve demonstrates that the valve cannot be monitored without elevating the monitoring personnel more than 2 meters above a support surface;

(2) The process unit within which the valve is located is an existing process unit; and

(3) The owner or operator of the valve follows a written plan that requires monitoring of the valve at least once per calendar year.

§ 61.242-8 Standards: Pressure relief devices in liquid service and flanges and other connectors.

(a) Pressure relief devices in liquid service and flanges and other connectors shall be monitored within 5 days by the method specified in § 61.245(b) if evidence of a potential leak is found by visual, audible, olfactory, or any other detection method, except as provided in § 61.242-1(c).¹¹²

(b) If an instrument reading of 10,000 ppm or greater is measured, a leak is detected.

(c)(1) When a leak is detected, it shall be repaired as soon as practicable, but not later than 15 calendar days after it is detected, except as provided in § 61.242-10.

(2) The first attempt at repair shall be made no later than 5 calendar days after

each leak is detected.

(d) First attempts at repair include, but are not limited to, the best practices described under § 61.242-7(e).

§ 61.242-9 Standards: Product accumulator vessels.

Each product accumulator vessel shall be equipped with a closed-vent system capable of capturing and transporting any leakage from the vessel to a control device as described in § 61.242-11, except as provided in § 61.242-1(c). ¹¹²

§ 61.242-10 Standards: Delay of repair.

(a) Delay of repair of equipment for which leaks have been detected will be allowed if the repair is technically infeasible without a process unit shutdown. Repair of this equipment shall occur before the end of the next process unit shutdown.

(b) Delay of repair of equipment for which leaks have been detected will be allowed for equipment that is isolated from the process and that does not remain in VHAP service.

(c) Delay of repair for valves will be allowed if:

(1) The owner or operator demonstrates that emissions of purged material resulting from immediate repair are greater than the fugitive emissions likely to result from delay of repair, and

(2) When repair procedures are effected, the purged material is collected and destroyed or recovered in a control device complying with § 61.242-11.

(d) Delay of repair for pumps will be allowed if:

(1) Repair requires the use of a dual mechanical seal system that includes a barrier fluid system, and

(2) Repair is completed as soon as practicable, but not later than 6 months after the leak was detected.

(e) Delay of repair beyond a process unit shutdown will be allowed for a valve if valve assembly replacement is necessary during the process unit shutdown, valve assembly supplies have been depleted, and valve assembly supplies had been sufficiently stocked before the supplies were depleted. Delay of repair beyond the next process unit shutdown will not be allowed unless the next process unit shutdown occurs sooner than 6 months after the first process unit shutdown.

§ 61.242-11 Standards: Closed-vent systems and control devices.

(a) Owners or operators of closed-vent systems and control devices used to comply with provisions of this subpart shall comply with the provisions of this section, except as provided in § 61.242-1(c). ¹¹²

(b) Vapor recovery systems (for example, condensers and adsorbers) shall be designed and operated to recover the organic vapors vented to them with an efficiency of 95 percent or greater.

(c) Enclosed combustion devices shall be designed and operated to reduce the VHAP emissions vented to them with an efficiency of 95 percent or greater or to provide a minimum residence time of 0.50 seconds at a minimum temperature of 780°C.

(d)(1) Flares shall be designed for an operated with no visible emissions as determined by the methods specified in § 61.245(e), except for periods not to exceed a total of 5 minutes during any 2 consecutive hours. ¹¹²

(2) Flares shall be operated with a flame present at all times, as determined by the methods specified in § 61.245(e).

(3) Flares shall be used only with the net heating value of the gas being combusted being 11.2 MJ/scm (300 Btu/scf) or greater if the flare is steam-assisted or air-assisted; or with the net heating value of the gas being combusted being 7.45 MJ/scm or greater if the flare is nonassisted. The net heating value of the gas being combusted shall be determined by the method specified in § 61.245(e).

(4) Steam-assisted and nonassisted flares shall be designed for and operated with an exit velocity, as determined by the method specified in § 61.245(e)(4), less than 18 m/sec (60 ft/sec).

(5) Air-assisted flares shall be designed and operated with an exit velocity less than the velocity, v_{max} , as determined by the method specified in § 61.245(e)(5).

(6) Flares used comply with this subpart shall be steam-assisted, air-assisted, or nonassisted.

(e) Owners or operators of control devices that are used to comply with the provisions of this subpart shall monitor these control devices to ensure that they are operated and maintained in conformance with their design.

(f)(1) Closed-vent systems shall be designed for and operated with no detectable emissions, as indicated by an instrument reading of less than 500 ppm above background and by visual inspections, as determined by the methods specified as § 61.245(c).

(2) Closed-vent systems shall be monitored to determine compliance with this section initially in accordance with § 61.05, annually, and at other times requested by the administrator.

(3) Leaks, as indicated by an instrument reading greater than 500 ppm

and visual inspections, shall be repaired as soon as practicable, but not later than 15 calendar days after the leak is detected.

(4) A first attempt at repair shall be made no later than 5 calendar days after the leak is detected.

(g) Closed-vent systems and control devices use to comply with provisions of this subpart shall be operated at all times when emissions may be vented to them.

§ 61.243-1 Alternative standards for valves in VHAP service—allowable percentage of valves leaking.

(a) An owner or operator may elect to have all valves within a process unit to comply with an allowable percentage of valves leaking of equal to or less than 2.0 percent.

(b) The following requirements shall be met if an owner or operator decides to comply with an allowable percentage of valves leaking:

(1) An owner or operator must notify the Administrator that the owner or operator has elected to have all valves within a process unit to comply with the allowable percentage of valves leaking before implementing this alternative standard, as specified in § 61.247(d).

(2) A performance test as specified in paragraph (c) of this section shall be conducted initially upon designation, annually, and at other times requested by the Administrator.

(3) If a valve leak is detected, it shall be repaired in accordance with § 61.242-7(d) and (e).

(c) Performance tests shall be conducted in the following manner:

(1) All valves in VHAP service within the process unit shall be monitored within 1 week by the methods specified in § 61.245(b).

(2) If an instrument reading of 10,000 ppm or greater is measured, a leak is detected.

(3) The leak percentage shall be determined by dividing the number of valves in VHAP service for which leaks are detected by the number of valves in VHAP service within the process unit.

(d) Owner or operators who elect to have all valves comply with this alternative standard shall not have a process unit with a leak percentage greater than 2.0 percent.

(e) If an owner or operator decides no longer to comply with § 61.243-1, the owner or operator must notify the Administrator in writing that the work practice standard described in § 61.242-7(a)-(e) will be followed.

§ 61.243-2 Alternative standards for valves in VHAP service—skip period leak detection and repair.

(a)(1) An owner or operator may elect for all valves within a process unit to comply with one of the alternative work practices specified in paragraphs (b)(2) and (3) of this section.

(2) An owner or operator must notify the Administrator before implementing one of the alternative work practices, as specified in § 61.247(d).

(b)(1) An owner or operator shall comply initially with the requirements for valves, as described in § 61.242-7.

(2) After 2 consecutive quarterly leak detection periods with the percentage of valves leaking equal to or less than 2.0, an owner or operator may begin to skip 1 of the quarterly leak detection periods for the valves in VHAP service.

(3) After 5 consecutive quarterly leak detection periods with the percentage of valves leaking equal to or less than 2.0, an owner or operator may begin to skip 3 of the quarterly leak detection periods for the valves in VHAP service.

(4) If the percentage of valves leaking is greater than 2.0, the owner or operator shall comply with the requirements as described in § 61.242-7 but may again elect to use this section.

§ 61.244 Alternative means of emission limitation.

(a) Permission to use an alternative means of emission limitation under Section 112(e)(3) of the Clean Air Act shall be governed by the following procedures:

(b) Where the standard is an equipment, design, or operational requirement:

(1) Each owner or operator applying for permission shall be responsible for collecting and verifying test data for an alternative means of emission limitation.

(2) The Administrator will compare test data for the means of emission limitation to test data for the equipment, design, and operational requirements.

(3) The Administrator may condition the permission on requirements that may be necessary to assure operation and maintenance to achieve the same emission reduction as the equipment, design, and operational requirements.

(c) Where the standard is a work practice:

(1) Each owner or operator applying for permission shall be responsible for collecting and verifying test data for an alternative means of emission limitation.

(2) For each source for which permission is requested, the emission reduction achieved by the required work practices shall be demonstrated for a minimum period of 12 months.

(3) For each source for which permission is requested, the emission reduction achieved by the alternative means of emission limitation shall be demonstrated.

(4) Each owner or operator applying for permission shall commit in writing each source to work practices that provide for emission reductions equal to or greater than the emission reductions achieved by the required work practices.

(5) The Administrator will compare the demonstrated emission reduction for the alternative means of emission limitation to the demonstrated emission reduction for the required work practices and will consider the commitment in paragraph (c)(4).

(6) The Administrator may condition the permission on requirements that may be necessary to assure operation and maintenance to achieve the same emission reduction as the required work practices of this subpart.

(d) An owner or operator may offer a unique approach to demonstrate the alternative means of emission limitation.

(e)(1) Manufacturers of equipment used to control equipment leaks of a VHAP may apply to the Administrator for permission for an alternative means of emission limitation that achieves a reduction in emissions of the VHAP achieved by the equipment, design, and operational requirements of this subpart.

(2) The Administrator will grant permission according to the provisions of paragraphs (b), (c), and (d).

§ 61.245 Test methods and procedures.

(a) Each owner or operator subject to the provisions of this subpart shall comply with the test methods and procedures requirements provided in this section.

(b) Monitoring, as required in § 61.242, § 61.243, and § 61.244, shall comply with the following requirements:

(1) Monitoring shall comply with Reference Method 21.

(2) The detection instrument shall meet the performance criteria of Reference Method 21.

(3) The instrument shall be calibrated before use on each day of its use by the procedures specified in Reference Method 21.

(4) Calibration gases shall be:

- (i) Zero air (less than 10 ppm of hydrocarbon in air); and ¹¹²
- (ii) A mixture of methane or n-hexane and air at a concentration of approximately, but less than, 10,000 ppm methane or n-hexane.

(5) The instrument probe shall be traversed around all potential leak interfaces as close to the interface as possible as described in Reference

Method 21.

(c) When equipment is tested for compliance with no detectable emissions, as required in §§ 61.242-2(e), 61.242-3(i), 61.242-4, 61.242-7(f), and 61.242-11(f), the test shall comply with the following requirements:

(1) The requirements of paragraphs (b)(1)-(4) shall apply.

(2) The background level shall be determined, as set forth in Reference Method 21.

(3) The instrument probe shall be traversed around all potential leak interfaces as close to the interface as possible as described in Reference Method 21.

(4) The arithmetic difference between the maximum concentration indicated by the instrument and the background level is compared with 500 ppm for determining compliance.¹¹²

(d)(1) Each piece of equipment within a process unit that can conceivably contain equipment in VHAP service is presumed to be in VHAP service unless an owner or operator demonstrates that the piece of equipment is not in VHAP service. For a piece of equipment to be considered not in VHAP service, it must be determined that the percent VHAP content can be reasonably expected never to exceed 10 percent by weight. For purposes of determining the percent VHAP content of the process fluid that is contained in or contacts equipment, procedures that conform to the methods described in ASTM Method D-2267 (incorporated by the reference as specified in § 61.18) shall be used.

(2)(i) An owner or operator may use engineering judgment rather than the procedures in paragraph (d)(1) of this section to demonstrate that the percent VHAP content does not exceed 10 percent by weight, provided that the engineering judgment demonstrates that the VHAP content clearly does not exceed 10 percent by weight. When an owner or operator and the Administrator do not agree on whether a piece of equipment is not in VHAP service, however, the procedures in paragraph (d)(1) of this section shall be used to resolve the disagreement.

(ii) If an owner or operator determines that a piece of equipment is in VHAP service, the determination can be revised only after following the procedures in paragraph (d)(1) of this section.

(3) Samples used in determining the percent VHAP content shall be representative of the process fluid that is contained in or contacts the equipment or the gas being combusted in the flare.

(e)(1) Reference Method 22 shall be

used to determine compliance of flares with the visible emission provisions of this subpart.

(2) The presence of a flare pilot flame shall be monitored using a thermocouple or any other equivalent device to detect the presence of a flame.

(3) The net heating value of the gas being combusted in a flare shall be calculated using the following equation:

$$H_T = K \left(\sum_{i=1}^n C_i H_i \right)$$

Where:

H_T = Net heating value of the sample. MJ/scm; where the net enthalpy per mole of offgas is based on combustion at 25°C and 760 mm Hg, but the standard temperature for determining the volume corresponding to one mole is 20°C.

K = Constant. 1.74×10^{-7} (1/ppm) (g mole/scm) (MJ/kcal) where standard temperature for (g mole/scm) is 20°C

C_i = Concentration of sample component i in ppm, as measured by Reference Method 18 of Appendix A of 40 FR Part 60 and ASTM D2504-67 (reapproved 1977) (incorporated by reference as specified in § 61.18).

H_i = Net heat of combustion of sample component i , kcal/g mole. The heats of combustion may be determined using ASTM D2382-76 (incorporated by reference as specified in § 61.18) if published values are not available or cannot be calculated

(4) The actual exit velocity of a flare shall be determined by dividing the volumetric flowrate (in units of standard temperature and pressure), as determined by Reference Method 2, 2A, 2C, or 2D, as appropriate, by the unobstructed (free) cross section area of the flare tip.

(5) The maximum permitted velocity, V_{max} , for air-assisted flares shall be determined by the following equation:

$$V_{Max} = 8.76 + 0.7084(H_T)$$

Where:

V_{Max} = Maximum permitted velocity, m/sec

8.76 = Constant.

0.7084 = Constant.

H_T = The net heating value as determined in paragraph (e)(3) of this section.

(Sec. 114 of the Clean Air Act as amended (42 U.S.C. 7414).)

§ 61.246 Recordkeeping requirements.

(a)(1) Each owner or operator subject to the provisions of this subpart shall comply with the recordkeeping requirements of this section.

(2) An owner or operator of more than one process unit subject to the provisions of this subpart may comply with the recordkeeping requirements for

these process units in one recordkeeping system if the system identifies each record by each process unit.

(b) When each leak is detected as specified in §§ 61.242-2, 61.242-3, 61.242-7, and 61.242-8, the following requirements apply:

(1) A weatherproof and readily visible identification, marked with the equipment identification number, shall be attached to the leaking equipment.

(2) The identification on a valve may be removed after it has been monitored for 2 successive months as specified in § 61.242-7(c) and no leak has been detected during those 2 months.

(3) The identification on equipment, except on a valve, may be removed after it has been repaired.

(c) When each leak, as detected as specified in §§ 61.242-2, 61.242-3, 61.242-7, and 61.242-8, the following information shall be recorded in a log and shall be kept for 2 years in a readily accessible location:

(1) The instrument and operator identification numbers and the equipment identification number.

(2) The date the leak was detected and the dates of each attempt to repair the leak.

(3) Repair methods applied in each attempt to repair the leak.

(4) "Above 10,000" if the maximum instrument reading measured by the methods specified in § 61.245(a) after each repair attempt is equal to or greater than 10,000 ppm.

(5) "Repair delayed" and the reason for the delay if a leak is not repaired within 15 calendar days after discovery of the leak.

(6) The signature of the owner or operator (or designate) whose decision it was that repair could not be effected without a process shutdown.

(7) The expected date of successful repair of the leak if a leak is not repaired within 15 calendar days.

(8) Dates of process unit shutdowns that occur while the equipment is unrepaired.

(9) The date of successful repair of the leak.

(d) The following information pertaining to the design requirements for closed-vent systems and control devices described in § 61.242-11 shall be recorded and kept in a readily accessible location:

(1) Detailed schematics, design specifications, and piping and instrumentation diagrams.

(2) The dates and descriptions of any changes in the design specifications.

(3) A description of the parameter or

parameters monitored, as required in § 61.242-11(e), to ensure that control devices are operated and maintained in conformance with their design and an explanation of why that parameter (or parameters) was selected for the monitoring.

(4) Periods when the closed-vent systems and control devices required in §§ 61.242-2, 61.242-3, 61.242-4, 61.242-5 and 61.242-9 are not operated as designed, including periods when a flare pilot light does not have a flame.

(5) Dates of startups and shutdowns of the closed-vent systems and control devices required in §§ 61.242-2, 61.242-3, 61.242-4, 61.242-5 and 61.242-9.

(e) The following information pertaining to all equipment subject to the requirements in § 61.242-1 to § 61.242-11 shall be recorded in a log that is kept in a readily accessible location:

(1) A list of identification numbers for equipment (except welded fittings) subject to the requirements of this subpart.

(2)(i) A list of identification numbers for equipment that the owner or operator elects to designate for no detectable emissions, as indicated by an instrument reading of less than 500 ppm above background, under the provisions of §§ 61.242-2(e), 61.242-3(i), and 61.242-7(f).

(ii) The designation of this equipment as subject to the requirements of § 61.242-2(e), 61.242-3(i), or 61.242-7(f) shall be signed by the owner or operator.

(3) A list of equipment identification numbers for pressure relief devices required to comply with § 61.242-4(a).

(4)(i) The dates of each compliance test required in §§ 61.242-2(e), 61.242-3(i), 61.242-4, and 61.242-7(f).

(ii) The background level measured during each compliance test.

(iii) The maximum instrument reading measured at the equipment during each compliance test.

(5) A list of identification numbers for equipment in vacuum service.

(f) The following information pertaining to all valves subject to the requirements of § 61.242-7(g) and (h) shall be recorded in a log that is kept in a readily accessible location:

(1) A list of identification numbers for valves that are designated as unsafe to monitor, an explanation for each valve stating why the valve is unsafe to monitor, and the plan for monitoring each valve.

(2) A list of identification numbers for valves that are designated as difficult to monitor, an explanation for each valve

stating why the valve is difficult to monitor, and the planned schedule for monitoring each valve.

(g) The following information shall be recorded for valves complying with § 61.243-2:

- (1) A schedule of monitoring.
 - (2) The percent of valves found leaking during each monitoring period.
- (h) The following information shall be recorded in a log that is kept in a readily accessible location:

(1) Design criterion required in § 61.242-2(d)(5) and § 61.242-3(e)(2) and an explanation of the design criterion; and

(2) Any changes to this criterion and the reasons for the changes.

(i) The following information shall be recorded in a log that is kept in a readily accessible location for use in determining exemptions as provided in the applicability section of this subpart and other specific subparts:

- (1) An analysis demonstrating the design capacity of the process unit, and
- (2) An analysis demonstrating that equipment is not in VHAP service.

(j) Information and data used to demonstrate that a piece of equipment is not in VHAP service shall be recorded in a log that is kept in a readily accessible location.

(Sec. 114 of the Clean Air Act as amended (42 U.S.C. 7414).)

(Approved by the Office of Management and Budget under control number 2080-0068)

§ 61.247 Reporting requirements.

(a)(1) An owner or operator of any piece of equipment to which this subpart applies shall submit a statement in writing notifying the Administrator that the requirements of §§ 61.242, 61.245, 61.246, and 61.247 are being implemented.

(2) In the case of an existing source or a new source which has an initial startup date preceding the effective date, the statement is to be submitted within 90 days of the effective date, unless a waiver of compliance is granted under § 61.11, along with the information required under § 61.10. If a waiver of compliance is granted, the statement is to be submitted on a date scheduled by the Administrator.

(3) In the case of new sources which did not have an initial startup date preceding the effective date, the statement shall be submitted with the application for approval of construction, as described in § 61.07.

(4) The statement is to contain the following information for each source

(i) Equipment identification number and process unit identification.

(ii) Type of equipment (for example, a pump or pipeline valve).

(iii) Percent by weight VHAP in the fluid at the equipment.

(iv) Process fluid state at the equipment (gas/vapor or liquid).

(v) Method of compliance with the standard (for example, "monthly leak detection and repair" or "equipped with dual mechanical seals").

(b) A report shall be submitted to the Administrator semiannually starting 6 months after the initial report required in § 61.247(a), that includes the following information:

(1) Process unit identification.

(2) For each month during the semiannual reporting period,

(i) Number of valves for which leaks were detected as described in § 61.242-7(b) of § 61.243-2.

(ii) Number of valves for which leaks were not repaired as required in § 61.242-7(d).

(iii) Number of pumps for which leaks were detected as described in § 61.242-2(b) and (d)(6).

(iv) Number of pumps for which leaks were not repaired as required in § 61.242-2(c) and (d)(6).

(v) Number of compressors for which leaks were detected as described in § 61.242-3(f).

(vi) Number of compressors for which leaks were not repaired as required in § 61.242-3(g).

(vii) The facts that explain any delay of repairs and, where appropriate, why a process unit shutdown was technically infeasible.

(3) Dates of process unit shutdowns which occurred within the semiannual reporting period.

(4) Revisions to items reported according to paragraph (a) if changes have occurred since the initial report or subsequent revisions to the initial report.

[Note.—Compliance with the requirements of § 61.10(c) is not required for revisions documented under this paragraph.]—112

(5) The results of all performance tests to determine compliance with § 61.242-2(e), § 61.242-3(i), § 61.242-4(a), § 61.242-7(f), § 61.242-11(f), § 61.243-1 and § 61.243-2 conducted within the semiannual reporting period.

(c) In the first report submitted as required in § 61.247(a), the report shall include a reporting schedule stating the months that semiannual reports shall be submitted. Subsequent reports shall be submitted according to that schedule, unless a revised schedule has been submitted in a previous semiannual report.

(d) An owner or operator electing to comply with the provisions of §§ 61.243-1 and 61.243-2 shall notify the Administrator of the alternative standard selected 90 days before implementing either of the provisions

(e) An application for approval of construction or modification, § 61.05(a) and § 61.07, will not be required if—

(1) The new source complies with the standard, § 61.242;

(2) The new source is not part of the construction of a process-unit; and

(3) In the next semiannual report required by § 61.247(b), the information in § 61.247(a)(4) is reported.

(Sec. 114 of the Clean Air Act as amended (42 U.S.C. 7414).) (Approved by the Office of Management and Budget under control number ICR-1153.)

38 FR 8826, 4/6/73 (1)

as amended

49 FR 23498, 6/6/84 (97)

APPENDIX B
ORGANIC VAPOR ANALYZER RESPONSE FACTORS

TABLE B-1. RESPONSE FACTORS FOR AID MODEL 580 AND MODEL 585
PHOTOIONIZATION TYPE ORGANIC VAPOR ANALYZERS^a
(10.0-eV Lamp)

Compound	Ionization potential, eV	Response factor
Acetone	9.58	1.7
Acetophenone	N.D.	4.2
Acrolein	N.D.	25.0
Ammonia	10.15	24.5
Aniline	7.70	0.6
Benzene	9.25	0.7
1,3 Butadiene	9.07	1.0
Carbon disulfide	10.0	2.3
Chlorobenzene	9.07	0.5
Cyclohexane	9.98	2.1
1,2-Dichloroethane	N.D.	50.0
Diethylamine	N.D.	2.0
Dimethyl sulfide	8.69	1.3
Ethyl benzene	8.75	1.7
Ethylene oxide	10.57	33.8
Ethyl ether	9.53	1.5
Hexane	10.18	11.3
Hydrogen sulfide	10.45	7.3
Isopropanol	10.16	19.8
Methyl ethyl ketone	9.53	1.6
Methyl isocyanate	10.57	12.5
Methyl mercaptan	9.4	1.3
Methyl methacrylate	N.D.	4.2
Nitric oxide	9.25	44.9
Ortho chloro toluene	8.83	0.5
Ortho xylene	8.56	0.8
Pyridine	9.32	0.6
Styrene	N.D.	3.3
Sec butyl bromide	9.98	1.7
Tetrachloroethene	9.32	1.6
Tetrachloroethylene	N.D.	1.9
Tetrahydrofuran	9.54	3.7
Toluene	8.82	0.5
Trichloroethylene	N.D.	1.3

^aSource: Reference 9.

TABLE B-2. RESPONSE FACTORS FOR THE MIRAN MODEL 1A/80 INFRARED ANALYZER^a

Compound	Wave-length, μm	Actual concentration, ppmv	Instrument concentration, ppmv	Response factor
Acetal	9.5	1,000	6,690	0.149
		5,000	23,400	0.214
		10,000	27,200	0.368
Acetyl-1-propanol, 3-	3.3	500	247	2.02
		1,000	813	1.23
	9.5	100	39	2.55
		500	217	2.30
		1,000	406	2.46
Benzoyl chloride	6.35	100	4,870	0.02
		500	5,080	0.10
		1,000	5,420	0.19
Carbon tetrachloride	5.7	500	115	4.35
		1,000	232	4.31
		10,000	390	25.6
Chloro-acetaldehyde	6.35	500	4,840	0.103
		1,000	5,680	0.176
		10,000	6,760	1.48
	9.5	500	76	6.58
		1,000	228	4.39
		10,000	1,880	5.32
	13.5	500	709	0.705
		1,000	2,300	0.435
		10,000	21,800	0.459
Chloroform	13.5	1,000	6,680	0.150
		5,000	22,200	0.225
		10,000	34,200	0.292
Dichloro-1-propanol, 2,3-	3.3	1,200	64.9	18.5
Diisopropyl Benzene, 1,3-	6.35	500	134	3.75
		1,225	507	2.42
	5.7	100	311	0.331
		500	343	1.47
		1,225	380	3.22
Diketene	3.3	5,000	354	14.1
		10,000	1,240	8.06

(continued)

TABLE B-2 (continued)

Compound	Wave-length, μm	Actual concentration, ppmv	Instrument concentration, ppmv	Response factor
Dimethylsulfide	5.7	1,000	2,280	0.439
		5,000	6,390	0.782
		10,000	8,600	1.16
	9.5	1,000	69.4	14.4
		5,000	377	13.4
		10,000	580	17.2
	5.7	1,000	822	1.22
		5,000	1,010	4.95
		10,000	1,180	8.47
	6.35	1,000	2,480	0.403
		5,000	4,590	1.09
		10,000	6,540	1.53
	9.5	1,000	15.3	65.4
		5,000	120	41.7
		10,000	270	37.0
Ethanol	3.3	1,000	3,830	0.261
		5,000	18,500	0.270
		10,000	34,300	0.292
	3.4	1,000	430	2.33
		5,000	3,420	1.46
		10,000	7,530	1.33
Ethylene glycol dimethyl ether	3.3	1,000	5,110	0.196
		5,000	21,100	0.237
		10,000	33,800	0.296
	3.4	1,000	2,310	0.433
		5,000	11,700	0.427
		10,000	20,600	0.485
Ethylene glycol monoethyl ether acetate	3.6	1,000	284	3.52
		5,000	1,870	2.67
		10,000	3,920	2.55
	3.6	1,000	50.8	19.7
		2,000	158	12.7
	5.7	200	2,590	0.0772
1,000		5,110	0.196	
2,000		6,960	0.287	

(continued)

TABLE B-2 (continued)

Compound	Wave-length, μm	Actual concentration, ppmv	Instrument concentration, ppmv	Response factor
Formaldehyde	8.8	1,000	261	3.83
		2,000	808	2.48
	9.5	200	472	0.424
		1,000	2,190	0.457
		2,000	3,470	0.576
	3.3	500	266	1.88
		1,000	916	1.09
	3.4	1,000	72.4	13.8
	Formic acid	5.7	500	4,990
5,000			23,600	0.212
10,000			31,300	0.319
Freon 12		8.8	5,000	1,000
	10,000		2,920	3.42
	9.5	500	1,190	0.420
		5,000	9,120	0.548
		10,000	14,100	0.709
	6.35	1212.5	5,940	0.204
		2,425	6,470	0.375
		4,850	7,490	0.648
	Furfural	8.8	1212.5	1,714
2,425			3,130	0.775
4,850			4,680	1.04
13.5		100	656	0.152
	500	5,470	0.0914	
	1,200	12,200	0.0984	
Glycidol	3.3	100	262	0.382
	3.6	100	572	0.175
	5.7	100	3,100	0.323
	6.35	100	6,540	0.0153
	9.5	1,000	132	0.758
Hydroxyacetone	5.7	100	1,950	0.0513
(continued)				

TABLE B-2 (continued)

Compound	Wave-length, μm	Actual concentration, ppmv	Instrument concentration, ppmv	Response factor
Methyl styrene, -	6.35	100	6,870	0.0146
	9.5	100	24.6	4.07
	3.3	1,030	976	1.06
		5,000	2,830	1.77
	5.7	103	330	0.312
		1,030	1,230	0.837
		5,000	1,570	3.18
	6.35	1,010	4,490	0.229
		5,000	6,960	0.718
	9.5	1,030	73.6	14.0
		5,000	178	28.1
	13.5	1,030	167	6.17
		5,000	948	5.27
Methylene chloride	3.3	5,000	1,740	2.87
		10,000	3,740	2.67
Pentanethiol, 1-	13.5	5,000	5,300	0.943
		10,000	10,500	0.952
Perchloromethyl-mercaptan	3.3	5,000	612	8.17
	3.6	5,000	64.0	78.1
	5.7	500	1,730	0.289
		1,000	3,410	0.293
		5,000	7,660	0.653
	8.8	5,000	426	11.7
	9.5	500	36.7	13.6
		1,000	132	7.58
		5,000	303	16.5
	13.5	500	3,800	0.132
		1,000	8,510	0.118
		5,000	38,600	0.130

(continued)

TABLE B-2 (continued)

Compound	Wave-length, μm	Actual concentration, ppmv	Instrument concentration, ppmv	Response factor
Tetrachloroethane, 1,1,2,1-	3.3	5,000	582	8.59
		10,000	1,010	9.90
	8.8	10,000	404	24.8
	13.8	1,000	20,000	0.0500
		5,000	73,000	0.0685
		10,000	101,000	0.0990
Trichloroethane, 1,1,1,-	3.3	1,000	266	3.76
		5,000	2,910	1.72
		10,000	5,920	1.69
	3.4	5,000	38.8	129.0
		10,000	421	23.8
Trichlorotrifluoroethane, 1,1,2-	8.8	1,000	5,840	0.171
		5,000	16,100	0.311
		10,000	18,500	0.541
	9.5	1,000	977	1.02
		5,000	3,690	1.36
		10,000	6,280	1.59
	13.5	5,000	1,100	4.55
		10,000	2,270	4.41

^aAbstracted from Reference 8.

TABLE B-3. RESPONSE FACTORS FOR THE HNU SYSTEMS, INC., MODEL PI-101
PHOTOIONIZATION ANALYZER^a

Compound	Actual concentration	Instrument concentration	Response factor
Acetal	1,000	925	1.1
	5,000	7,200	0.69
	10,000	13,200	0.76
Carbon disulfide	1,000	1,990	0.50
	10,000	12,900	0.78
Carbon tetrachloride	500	784	0.64
	1,000	1,070	0.94
	10,000	6,070	1.6
Chloroform	1,000	756	1.3
	5,000	2,550	2.0
	10,000	5,250	1.9
Diketene	1,000	148	6.8
	5,000	318	16.0
	10,000	460	22.0
Perchloromethyl mecaptan	5,000	103	48.0
Toluene	1,000	1,180	0.85
Tetrachloroethane, 1,1,2,2-	1,000	736	1.4
	5,000	1,170	4.3
	10,000	1,880	5.3
Trichloroethane, 1,1,	1,000	1,020	0.98
	5,000	6,170	0.81
	10,000	9,430	1.1
Trichlorotrifluoroethane 1,1,2-	5,000	155	32.0
	10,000	430	23.0

^aAbstracted from Reference 8.

TABLE B-4. RESPONSE FACTORS FOR FOXBORO OVA-108 AND BACHARACH TLV SNIFFER AT 10,000 ppmv RESPONSE^a

Compound	Response factor OVA-108 ^b	Response factor TLV sniffer ^b
Acetic acid	1.64	15.60
Acetic anhydride	1.39	5.88
Acetone	0.80	1.22
Acetonitrile	0.95	1.18
Acetyl chloride	2.04	2.72
Acetylene	0.39	B
Acrylic acid	4.59	B
Acrylonitrile	0.97	3.49 I
Allene	0.64	15.00
Allyl alcohol	0.96	X
Amylene	0.44	1.03
Anisole	0.92	3.91
Benzene	0.29	1.07
Bromobenzene	0.40	1.19
Butadiene, 1,3-	0.57	10.90
Butane, N	1.44 I	4.11
Butanol, sec-	0.76	1.25
Butanol, tert	0.53	2.17
Butene, 1-	0.56	5.84
Butyl acetate	0.66	1.38
Butyl acrylate, N-	0.70	2.57 I
Butyl ether, N	2.60	3.58 I
Butyl ether, sec	0.35	1.15
Butylamine, N	0.69	2.02
Butylamine, sec	0.70	1.56
Butylamine, tert-	0.63	1.95
Butyraldehyde, N-	1.29	2.30
Butyronitrile	0.52	1.47 I
Carbon disulfide	B	3.92
Chloroacetaldehyde	9.10	5.07
Chlorobenzene	0.38	0.88
Chloroethane	5.38 I	3.90 P
Chloroform	9.28	B
Chloropropene, 1-	0.67	0.87
Chloropropene, 3-	0.80	1.24
Chlorotoluene, M-	0.48	0.91
Chlorotoluene, O-	0.48	1.06
Chlorotoluene, P-	0.56	1.17 I
Crotonaldehyde	1.25	B
Cumene	1.87	B
Cyclohexane	0.47	0.70
Cyclohexanone	1.50	7.04
Cyclohexene	0.49	2.17
Cyclohexylamine	0.57	1.38
Diacetyl	1.54	3.28

(continued)

TABLE B-4 (continued)

Compound	Response factor OVA-108 ^b	Response factor TLV sniffer ^b
Dichloro-1-propene,2,3-	0.75	1.75
Dichloroethane, 1,1-	0.78	1.86
Dichloroethane,1,2-	0.95	2.15
Dichloroethylene,cis,1,2-	1.27	1.63
Dichloroethylene,trans,1,1-	1.11	1.66
Dichloromethane	2.81	3.85
Dichloropropane,1,2-	1.03	1.54
Diisobutylene	0.35	1.41
Dimethoxy ethane,1,2-	1.22	1.52
Dimethylformamide,N,N-	4.19	5.29
Dimethylhydrazine,1,1-	1.03	2.70
Dioxane	1.48	1.31
Epichlorohydrin	1.69	2.03
Ethane	0.65	0.69 I
Ethanol	1.78	X
Ethoxy ethanol, 2-	1.55	1.82
Ethyl acetate	0.86	1.43
Ethyl acrylate	0.77	X
Ethyl chloroacetate	1.99	1.59
Ethyl ether	0.97	1.14
Ethylbenzene	0.73	4.74 D
Ethylene	0.71	1.56
Ethylene oxide	2.46	2.40
Ethylenediamine	1.73	3.26
Formic acid	14.20	B
Glycidol	6.88	5.55
Heptane	0.41 I	0.73
Hexane,N-	0.41	0.69
Hexene,1-	0.49	4.69 D
Hydroxyacetone	6.90	15.20
Isobutane	0.41	0.55
Isobutylene	3.13	B
Isoprene	0.59	X
Isopropanol	0.91	1.39
Isopropyl acetate	0.71	1.31
Isopropyl chloride	0.68	0.98
Isovaleraldehyde	0.64	2.19 D
Mesityl oxide	1.09	3.14
Methacrolein	1.20	3.49 D
Methanol	4.39 P	2.01
Methoxy-ethanol,2-	2.25	3.13
Methyl acetate	1.74	1.85
Methyl acetylene	0.61	6.79
Methyl chloride	1.44	1.84
Methyl ethyl ketone	0.64	1.12
Methyl formate	3.11	1.94

(continued)

TABLE B-4 (continued)

Compound	Response factor OVA-108 ^b	Response factor TLV sniffer ^b
Methyl methacrylate	0.99	2.42
Methyl-2-pentanol,4-	1.66	2.00
Methyl-2-pentone,4-	0.56	1.63
Methyl-3-butyne-2-ol,2	0.59	X
Methylcyclohexane	0.48	0.84
Methylcyclohexene	0.44	2.79
Methylstyrene,a-	13.90	B
Nitroethane	1.40	3.45
Nitromethane	3.52	7.60
Nitropropane	1.05	2.02
Nonane-n	1.54	11.10
Octane	1.03	2.11
Pentane	0.52	0.83
Picoline,2-	0.43	1.18
Propane	0.55 I	0.60 P
Propionaldehyde	1.14	1.71
Propionic acid	1.30	5.08 D
Propyl alcohol	0.93	1.74
Propylbenzene,n-	0.51	B
Propylene	0.77	1.74 I
Propylene oxide	0.83	1.15
Pyridine	0.47	1.16
Styrene	4.22	B
Tetrachloroethane,1,1,1,2	4.83 D	6.91
Tetrachloroethane,1,1,2,2	7.89	25.40
Tetrachloroethylene	2.97	B
Toluene	0.39	2.68 D
Trichloroethane,1,1,1-	0.80	2.40
Trichloroethane,1,1,2-	1.25	3.69
Trichloroethylene	0.95	3.93
Trichloropropane,1,2,3-	0.96	1.99
Triethylamine	0.51	1.48
Vinyl chloride	0.84	1.06
Vinylidene chloride	1.12	2.41
Xylene, p-	2.12	7.87
Xylene, m-	0.40	5.87 D
Xylene, o-	0.43	1.40

^a Abstracted from Reference 6.^b I = Inverse estimation method

D = Possible outliers in data

N = Narrow range of data

X = No data available

B = 10,000 ppmv response unachievable

P = Suspect points eliminated.

APPENDIX C
IONIZATION POTENTIALS OF SELECTED ORGANIC COMPOUNDS

IONIZATION POTENTIAL DATA USEFUL FOR SELECTION OF PHOTOIONIZATION TYPE
ORGANIC VAPOR ANALYZERS^a

Chemical	Ionization potential	Chemical	Ionization potential
Acetaldehyde	10.21	3-butene nitrile	10.39
Acetamide	9.77	n-butyl acetate	10.01
Acetic acid	10.37	sec-butyl acetate	9.91
Acetone	9.69	n-butyl alcohol	10.04
Acetonitrile	12.22	n-butyl amine	8.71
Acetophenone	9.27	s-butyl amine	8.70
Acetyl bromide	10.55	t-butyl amine	8.64
Acetyl chloride	11.02	n-butyl benzene	8.69
Acetylene	11.41	s-butyl benzene	8.68
Acrolein	10.10	t-butyl benzene	8.68
Acrylonitrile	10.91	n-butyl formate	10.50
Allyl alcohol	9.67	1-butyne	10.18
Ammonia	10.15	n-butyraldehyde	9.86
Aniline	7.70	n-butyric acid	10.16
Anisole	8.22	n-butyronitrile	11.67
Benzaldehyde	9.53	Carbon dioxide	13.79
Benzene	9.25	Carbon monoxide	14.01
Benzenethiol	8.33	Chlorine	11.48
Benzonitrile	9.71	Chlorobenzene	9.07
Benzotrifluoride	9.68	1-chlorobutane	10.67
Biphenyl	8.27	2-chlorobutane	10.65
Bromine	10.55	1-chloro-2-fluorobenzene	9.16
1-bromobutane	10.13	1-chloro-3-fluorobenzene	9.21
2-bromobutane	9.98	1-chloro-2-methylpropane	10.66
1-bromo-2-chloroethane	10.63	2-chloro-2-methylpropane	10.61
Bromochloromethane	10.77	1-chloropropane	10.82
1-bromo-4-fluorobenzene	8.99	2-chloropropane	10.78
1-bromo-2-methylpropane	10.09	3-chloropropene	10.04
1-bromo-2-methylpropane	9.89	2-chlorothiophene	8.68
1-bromopentane	10.10	m-chlorotoluene	8.83
1-bromopropane	10.18	o-chlorotoluene	8.83
2-bromopropene	10.08	p-chlorotoluene	8.70
1-bromopropene	9.30	Crotonaldehyde	9.73
3-bromopropene	9.70	Cyanogen	13.80
2-bromothiophene	8.63	Cyclohexane	9.98
m-bromotoluene	8.81	Cyclohexanone	9.14
o-bromotoluene	8.79	Cyclohexene	8.95
p-bromotoluene	8.67	Cyclo-octatetraene	7.99
Butane	10.63	Cyclopentane	10.53
1,3-butadiene	9.07	Cyclopentanone	9.01
2,3-butadiene	9.23	Cyclopropane	10.06
1-butanethiol	9.14	Dedaborane	11.00
1-butene	9.58	Dibromochloromethane	10.59
cis-2-butene	9.13	Dibromodifluoromethane	11.07
Trans-2-butene	9.13	1,1 dibromoethane	10.19

1,2 dibromoethene	9.45	Ethyl nitrate	11.22
Dibromomethane	10.49	Ethyl propionate	10.00
1,3 dibromopropane	10.07	Ethyl thiocyanate	9.89
m-dichlorobenzene	9.12	Ethynylbenzene	8.82
o-dichlorobenzene	9.07	Fluorine	15.70
p-dichlorobenzene	8.94	Fluorobenzene	9.20
1,2 dichloroethane	11.12	o-fluorophenol	8.66
cis-dichloroethene	9.65	m-fluorotoluene	8.92
trans-dichloroethene	9.66	o-fluorotoluene	8.92
Diborane	12.10	p-fluorotoluene	8.79
Dichloromethane	11.35	Formaldehyde	10.87
1,2 dichloropropane	10.87	Formic acid	11.05
1,3 dichloropropane	10.85	Freon 11 (CFC13)	11.77
2,3 dichloropropene	9.82	Freon 12 (CF2C12)	12.91
Dibutyl amine	7.69	Freon 13 (CF3C1)	12.91
Diethoxymethane	9.70	Freon 22 (CHClF2)	12.45
N,N-diethyl acetamide	8.60	Freon 113 (CF3CC13)	11.78
Diethyl amine	8.01	2-furaldehyde	9.21
Diethyl ether	9.43	Furan	8.89
N,N-diethyl formamide	8.89	Hexane	10.18
Diethyl ketone	9.32	Heptane	10.08
Diethyl sulfide	8.43	2-Heptanone	9.33
Diethyl sulfite	9.68	1-hexene	9.46
Dihydropyran	8.34	Hydrogen	15.43
1,1 dimethoxyethane	9.65	Hydrogen bromide	11.62
Dimethoxymethane	10.00	Hydrogen chloride	12.74
Diiodomethane	9.34	Hydrogen cyanide	13.91
Diisopropylamine	7.73	Hydrogen fluoride	15.77
N,N-dimethyl acetamide	8.81	Hydrogen iodide	10.38
Dimethyl amine	8.2	Hydrogen sulfide	10.46
2,2-dimethyl butane	10.06	Hydrogen telluride	9.14
2,3-dimethyl butane	10.02	Iodine	9.25
3,3-dimethyl butanone	9.17	Iodobenzene	8.73
Dimethyl ether	10.00	1-iodobutane	9.21
N,N-dimethyl formamide	9.12	2-iodobutane	9.09
2,2-dimethyl propane	10.35	1-iodo-2-methylpropane	9.18
Dimethyl sulfide	8.69	1-iodo-2-methylpropane	9.02
Dipropyl amine	7.84	1-iodopentane	9.19
Dipropyl sulfide	8.30	1-iodopropane	9.26
Durene	8.03	2-iodopropane	9.17
Ethane	11.65	o-iodotoluene	8.62
Ethanethiol	9.29	m-iodotoluene	8.61
Ethene	10.52	p-iodotoluene	8.50
Ethyl acetate	10.11	Isobutane	10.57
Ethyl alcohol	10.48	Isobutyl amine	8.70
Ethyl amine	8.86	Isobutyl acetate	9.97
Ethyl benzene	8.76	Isobutyl formate	10.46
Ethyl bromide	10.29	Isobutyraldehyde	9.76
Ethyl chloride	10.98	Isobutyric acid	10.02
Ethyl disulfide	8.27	Isopentane	10.32
Ethylene oxide	10.57	Isoprene	8.85
Ethyl formate	10.61	Isopropyl acetate	9.99
Ethyl iodide	9.33	Isopropyl benzene	10.16
Ethyl isothiocyanate	9.14	Isopropyl ether	9.20
Ethyl methyl sulfide	8.55	Isovaleraldehyde	9.71

2,3-lutidine	8.85	Phenyl isocyanate	8.77
2,4-lutidine	8.85	Phenyl isothiocyanate	8.52
2,6-lutidine	8.85	Phosgene	11.77
Mesitylene	8.40	2-picoline	9.02
Mesityl oxide	9.08	3-picoline	9.02
Methane	12.98	4-picoline	9.04
Methanethiol	9.44	Propane	11.07
N-methyl acetamide	8.90	1-propanethiol	9.20
Methyl acetate	10.27	Propiolactone	9.70
Methyl alcohol	10.85	Propionic acid	10.24
Methyl amine	8.97	Propionitrile	11.84
Methyl bromide	10.53	Propionaldehyde	9.98
2-methyl-1-butane	9.12	Propyl acetate	10.04
3-methyl-1-butene	9.51	Propyl alcohol	10.20
3-methyl-2-butene	8.67	Propyl amine	8.72
Methyl butyl ketone	9.34	Propyl benzene	8.72
Methyl butyrate	10.07	Propylene	9.73
Methyl chloride	11.28	Propylene oxide	10.22
Methylcyclohexane	9.85	Propyl ether	9.27
4-methylcyclohexene	8.91	Propyl formate	10.54
Methyl disulfide	8.46	Propylene	10.36
Methyl ethyl ketone	9.53	Pyridine	9.32
Methyl formate	10.82	Pyrrole	8.20
2-methyl furan	8.39	Styrene	8.47
Methyl iodide	9.54	Thiolacetic acid	10.00
Methyl isobutyl ketone	9.30	Thiophene	8.86
Methyl isobutyrate	9.98	Tetrachloroethene	9.32
Methyl isopropyl ketone	9.32	Tetrachloromethane	11.47
Methyl isothiocyanate	9.25	Tetrahydrofuran	9.54
1-methyl naphthalene	7.96	Tetrahydropyran	9.26
2-methyl naphthalene	7.96	Toluene	8.82
2-methylpentane	10.12	Tribromomethane	9.27
3-methylpentane	10.08	Tribromofluoromethane	10.67
2-methyl propene	9.23	Tribromomethane	10.51
Methyl propionate	10.15	Trichloroethene	9.45
Methyl propyl ketone	9.39	Trichloromethane	11.42
Methyl thiocyanate	10.07	Triethylamine	7.50
a-methyl styrene	8.35	Trimethyl amine	7.52
Naphthalene	8.12	2,2,4-trimethyl pentane	9.86
Nitric oxide	9.25	Tripentyl amine	7.23
Nitrobenzene	9.92	Valeraldehyde	9.82
Nitrogen	15.50	Valeric acid	10.12
Nitrogen dioxide	9.78	Vinyl acetate	9.19
Nitroethane	10.81	Vinyl bromide	9.80
Nitromethane	11.00	Vinyl chloride	10.00
1-nitropropane	10.88	Vinyl methyl ether	8.93
2-nitropropane	10.71	Water	12.59
Oxygen	12.08	m-xylene	8.56
Ozone	12.08	o-xylene	8.56
Pentaborane	10.40	p-xylene	8.45
Pentane	10.35		
2,4 pentanedione	8.87		
1-pentene	9.50		
Phenetole	8.11		
Phenol	8.50		

^aSource: Reference 5.

GLOSSARY

- Accuracy:** The difference between the measured value and the true values which has been established by an accepted reference method procedure. In most cases, a value is quoted by the manufacturer, and no description is given to indicate how this value was obtained.
- Action Level:** A measured concentration value obtained with a portable VOC monitor. It indicates the need for repair.
- Calibration:** The method for determining the instrument response to calibration gases (dynamic calibration) or artificial stimuli (static calibration).
- Directed Maintenance:** Refers to a maintenance procedure in which the hydrocarbon detector is used during maintenance. The leak is monitored with the instrument until the repair reduces the measured concentration below the action level.
- Fugitive Emissions of VOC:** Generally refers to the diffuse release of vaporized hydrocarbon or other organic compounds. Fugitive emissions originate from equipment leaks and from large and/or diffuse sources.
- Ground:** 1. The electrical neutral line having the same potential as the surrounding earth. 2. The negative side of dc power supply. 3. Reference point for an electrical system.
- Interferences:** Any substance or species causing a deviation of instrument output from the value that would result from the presence of only the pollutant of concern.
- Leak:** A measured VOC concentration of the action level or greater, determined at a specified distance from the fugitive emission source (usually 0 cm). The concentration value that defines a leak can vary, depending on the regulation and the industry. A value of 10,000 parts per million by volume (ppmv) is by far the most often used and was used in this manual unless otherwise noted.
- No Detectable Emission:** A local VOC concentration at the surface of a source that indicates that a VOC emission (leak) is not present. Because background VOC concentrations may exist and to account for instrument drift and imperfect reproducibility, a difference between the source surface concentration and the local ambient concentration is determined. A difference based on a meter reading of less than 5 percent of the leak definition concentration indicates that a VOC emission is not present.

Precision: The degree of variation between repeated measurements of the same concentration.

Principle of Operation: The technique used to detect and measure the pollutant or parameter.

Process Stream: Process fluids such as reactants, intermediate products, final products, and by-products, that are contained within pipes, pumps, valves, etc., in a process unit. Steam, water, air, and other utility lines are not considered to be process streams.

Process Unit: Equipment assembled to produce an organic chemical as an intermediate or final product. A process unit can operate independently if supplied with sufficient feed or raw materials and sufficient storage facilities for the final product.

Range: The lower and upper detectable limits. (The lower limit is usually reported as 0.0 ppm. This is somewhat misleading and should be reported as the true lower detectable limit.)

Repair: Adjustment or alteration of leaking equipment that reduces the screening value from greater than or equal to the action level (i.e., $\geq 10,000$ ppmv) to below the action level (i.e., $< 10,000$ ppmv).

Response Factor: A correction factor that quantifies the difference in meter response that a portable VOC analyzer has for various hydrocarbons and substituted organic chemicals.

Response Time: The time interval from a step change in the input concentration at the instrument inlet to a reading of 90 percent (unless otherwise specified) of the ultimate recorded output. This measurement is the same as the sum of lag time and rise time.

Screening: The act of measuring the hydrocarbon concentration of a source with a portable hydrocarbon detector.

Screening Value: The hydrocarbon concentration (in ppmv) detected at a source with a portable hydrocarbon detector while traversing with the instrument probe around all the potential leak points of the source.

Source Type: Process unit equipment components that may emit fugitive emissions. Common source types of fugitive emissions are valves, pump seals, flanges, compressor seals, and sampling lines.

Thermocouple: The junction of two dissimilar metals which has a voltage output proportional to the difference in temperature between the hot junction and the lead wires (cold junction).

Type of Service: The physical state (gas, liquid, or both) of the material(s) contained in a specific pipeline or vessel. The terms liquid and gas are defined at operating condition of the process. Liquid process streams can be further subdivided into:

- ° Light VOC liquid--any process stream with a vapor pressure of equal to or greater than 0.3 kPa at 20°C (lighter than kerosene).
- ° Heavy VOC liquid--any process stream with a vapor pressure less than 0.3 kPa at 20°C.

Volatile Organic Compound (VOC): Any organic compound that participates in atmospheric photochemical reactions.

Warmup Time: The elapsed time necessary after startup for the instrument to meet stated performance specifications when the instrument has been shut down for at least 24 hours.