Leak Detection and Repair

A Best Practices Guide

UNITED STATES • ENVIRONMENTAL PROTECTION AGENCY

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Disclaimer

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1.0 Purpose

In general, EPA has found significant widespread noncompliance with Leak Detection and Repair (LDAR) regulations and more specifically, noncompliance with Method 21 requirements. In 1999, EPA estimated that, as a result of this noncompliance, an additional 40,000 tons of VOCs are emitted annually from valves at petroleum refineries alone.

This document is intended for use by regulated entities as well as compliance inspectors to identify some of the problems identified with LDAR programs focusing in on Method 21 requirements and describe the practices that can be used to increase the effectiveness of an LDAR program. Specifically, this document explains:

- The importance of regulating equipment leaks;
- The major elements of an LDAR program;
- Typical mistakes made when monitoring to detect leaks;
- Problems that occur from improper management of an LDAR program; and
- A set of best practices that can be used to implement effective an LDAR program.

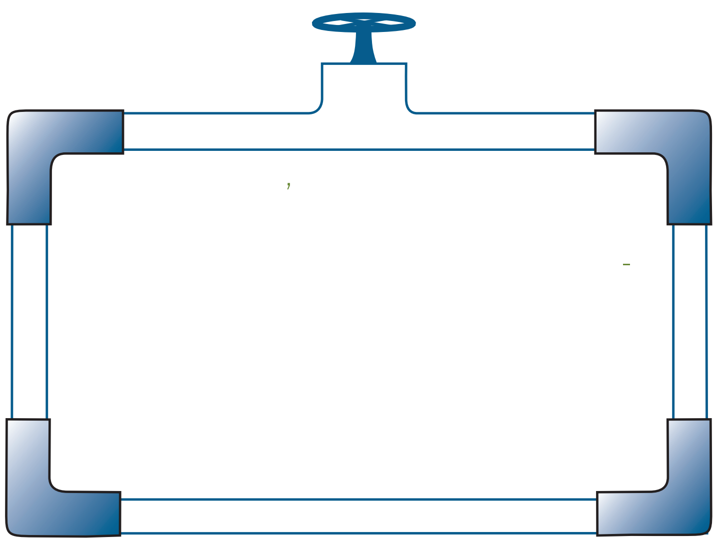
Some of the elements of a model LDAR program, as described in Section 7.0, are required by current Federal regulations. Other model LDAR program elements help ensure continuous compliance although they may not be mandated from a regulatory standpoint. Furthermore, State or local requirements may be more stringent than some elements of the model LDAR program, such as with leak definitions. Prior to developing a written LDAR program plan, all applicable regulations should be reviewed to determine and ensure compliance with the most stringent requirements.

2.0 Why Regulate Equipment Leaks?

EPA has determined that leaking equipment, such as valves, pumps, and connectors, are the largest source of emissions of volatile organic compounds (VOCs) and volatile hazardous air pollutants (VHAPs) from petroleum refineries and chemical manufacturing facilities. The Agency has estimated that approximately 70,367 tons per year of VOCs and 9,357 tons per year of HAPs have been emitted from equipment leaks. Emissions from equipment leaks exceed emissions from storage vessels, wastewater, transfer operations, or process vents.

VOCs contribute to the formation of ground-level ozone. Ozone is a major component of smog, and causes or aggravates respiratory disease, particularly in children, asthmatics, and healthy adults who participate in moderate exercise. Many areas of the United States, particularly those areas where refineries and chemical facilities are located, do not meet the National Ambient Air Quality Standard (NAAQS) for ozone. Ozone can be transported in the atmosphere and contribute to nonattainment in downwind areas.

Some species of VOCs are also classified as VHAPs. Some known or suspected effects of exposure to VHAPs include cancer, reproductive effects, and birth defects. The highest concentrations of VHAPs tend to be closest to the emission source, where the highest public exposure levels are also often detected. Some common VHAPs emitted from refineries and chemical plants include acetaldehyde, benzene, formaldehyde, methylene chloride, naphthalene, toluene, and xylene.



3.0 Sources, Causes And Control Of Equipment Leaks

A typical refinery or chemical plant can emit 600-700 tons per year of VOCs from leaking equipment, such as valves, connectors, pumps, sampling connections, compressors, pressure-relief devices, and open-ended lines.

Table 3.1 shows the primary sources of emissions from components subject to equipment leak regulations. In a typical facility, most of the emissions are from valves and connectors because these are the most prevalent components and can number in the thousands (Table 3.2). The major cause of emissions from valves and connectors is seal or gasket failure due to normal wear or improper maintenance.

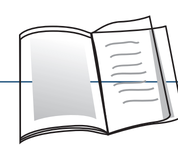
Previous EPA studies have estimated that valves and connectors account for more than 90% of emissions from leaking equipment with valves being the most significant source (Table 3.3). Newer information suggests that open-ended lines and sampling connections may account for as much as 5-10% of total VOC emissions from equipment leaks.

3.1 How are emissions from equipment leaks reduced?

Facilities can control emissions from equipment leaks by implementing a leak detection and repair (LDAR) program or by modifying/replacing leaking equipment with "leakless" components. Most equipment leak regulations allow a combination of both control methods.

- Leaks from open-ended lines, compressors, and sampling connections are usually fixed by modifying the equipment or component. Emissions from pumps and valves can also be reduced through the use of "leakless" valves and "sealless" pumps. Common leakless valves include bellows valves and diaphragm valves, and common sealless pumps are diaphragm pumps, canned motor pumps, and magnetic drive pumps. Leaks from pumps can also be reduced by using dual seals with or without barrier fluid.

- Leakless valves and sealless pumps are effective at minimizing or eliminating leaks, but their use may be limited by materials of construction considerations and process operating conditions. Installing leakless and sealless equipment components may be a wise choice for replacing individual, chronic leaking components.



LDAR is a work practice designed to identify leaking equipment so that emissions can be reduced through repairs. A component that is subject to LDAR requirements must be monitored at specified, regular intervals to determine whether or not it is leaking. Any leaking component must then be repaired or replaced within a specified time frame.

Table 3.1 – Sources of equipment leaks.

Pumps are used to move fluids from one point to another. Two types of pumps extensively used in petroleum refineries and chemical plants are centrifugal pumps and positive displacement, or reciprocating pumps.	**Leaks from pumps** typically occur at the seal.
Valves are used to either restrict or allow the movement of fluids. Valves come in numerous varieties and with the exception of connectors, are the most common piece of process equipment in industry.	**Leaks from valves** usually occur at the stem or gland area of the valve body and are commonly caused by a failure of the valve packing or O-ring.
Connectors are components such as flanges and fittings used to join piping and process equipment together. Gaskets and blinds are usually installed between flanges.	**Leaks from connectors** are commonly caused from gasket failure and improperly torqued bolts on flanges.
Sampling connections are utilized to obtain samples from within a process.	**Leaks from sampling connections** usually occur at the outlet of the sampling valve when the sampling line is purged to obtain the sample.
Compressors are designed to increase the pressure of a fluid and provide motive force. They can have rotary or reciprocating designs.	**Leaks from compressors** most often occur from the seals.
Pressure relief devices are safety devices designed to protect equipment from exceeding the maximum allowable working pressure. Pressure relief valves and rupture disks are examples of pressure relief devices.	**Leaks from pressure relief valves** can occur if the valve is not seated properly, operating too close to the set point, or if the seal is worn or damaged. Leaks from rupture disks can occur around the disk gasket if not properly installed.
Open-ended lines are pipes or hoses open to the atmosphere or surrounding environment.	**Leaks from open-ended lines** occur at the point of the line open to the atmosphere and are usually controlled by using caps, plugs, and flanges. Leaks can also be caused by the incorrect implementation of the block and bleed procedure.

Table 3.2 – Equipment component counts at a typical refinery or chemical plant.

Component	Range	Average
Pumps	10 – 360	100
Valves	150 – 46,000	7,400
Connectors	600 – 60,000	12,000
Open-ended lines	1 – 1,600	560
Sampling connections	20 – 200	80
Pressure relief valves	5 – 360	90

Source: "Cost and Emission Reductions for Meeting Percent Leaker Requirements for HON Sources." Memorandum to Hazardous Organic NESHAP Residual Risk and Review of Technology Standard Rulemaking docket. Docket ID EPA-HQ-OAR-2005-0475-0105.

Table 3.3 – Uncontrolled VOC emissions at a typical facility.

Component	Average Uncontrolled VOC Emissions (ton/yr)	Percent of Total Emissions
Pumps	19	3
Valves	408	62
Connectors	201	31
Open-ended lines	9	1
Sampling connections	11	2
Pressure relief valves	5	1
Total	653	

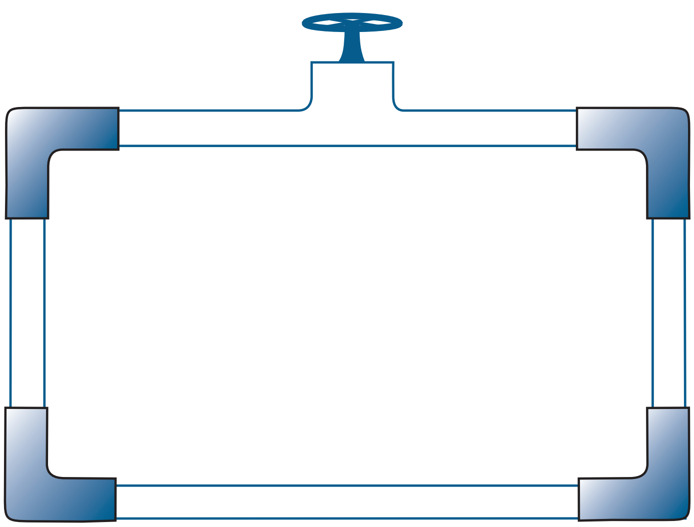
Source: Emission factors are from Protocol for Equipment Leak Emission Estimates, EPA-453/R-95-017, Nov 1995, and equipment counts in Table 3.2.

More recent data indicates that open-ended lines and sampling connections each account for approximately 5-10% of total VOC emissions.

3.2 What regulations incorporate LDAR programs?

LDAR programs are required by many New Source Performance Standards (NSPS), National Emission Standards for Hazardous Air Pollutants (NESHAP), State Implementation Plans (SIPs), the Resource Conservation and Recovery Act (RCRA), and other state or local requirements. There are 25 federal standards that require facilities to implement LDAR programs. Appendix A shows the 25 federal standards that require the implementation of a formal LDAR program using Method 21. Appendix B lists 28 other federal regulations that require some Method 21 monitoring, but do not require LDAR programs to be in place.

- NSPS (40 CFR Part 60) equipment leak standards are related to fugitive emissions of VOCs and apply to stationary sources that commence construction, modification, or reconstruction after the date that an NSPS is proposed in the Federal Register.
- NESHAP (40 CFR Parts 61, 63, and 65) equipment leak standards apply to both new and existing stationary sources of fugitive VHAPs.
- RCRA (40 CFR Parts 264 and 265) equipment leak standards apply to hazardous waste treatment, storage, and disposal facilities.
- Many state and local air agencies incorporate federal LDAR requirements by reference, but some have established more stringent LDAR requirements to meet local air quality needs.



A facility may have equipment that is subject to multiple NSPS and NESHAP equipment leaks standards. For example, a number of manufacturing processes listed in the Hazardous Organic NESHAP (HON) equipment leak standard (40 CFR 63, Subpart H) may utilize equipment for which other NESHAP or NSPS equipment leak standards could apply (such as 40 CFR 60, Subpart VV). In addition, one process line may be subject to one rule and another process line subject to another rule. Facilities must ensure that they are complying with the proper equipment leak regulations if multiple regulations apply.

4.0 What Are the Benefits of an LDAR Program?

When the LDAR requirements were developed, EPA estimated that petroleum refineries could reduce emissions from equipment leaks by 63% by implementing a facility LDAR program. Additionally, EPA estimated that chemical facilities could reduce VOC emissions by 56% by implementing such a program.

Table 4.1 presents the control effectiveness of an LDAR program for different monitoring intervals and leak definitions at chemical process units and petroleum refineries.

Emissions reductions from implementing an LDAR program potentially reduce product losses, increase safety for workers and operators, decrease exposure of the surrounding community, reduce emissions fees, and help facilities avoid enforcement actions.

Example – Emissions reductions at a typical SOCMI facility.

Applying the equipment modifications and LDAR requirements of the HON to the sources of uncontrolled emissions in the typical facility presented in Tables 3.2 and 3.3 would reduce the emissions per facility by approximately 582 tons per year of emissions, an 89% reduction.

Table 4.1 – Control effectiveness for an LDAR program at a chemical process unit and a refinery.

Equipment Type and Service	Control Effectiveness (% Reduction)		
	Monthly Monitoring 10,000 ppmv Leak Definition	Quarterly Monitoring 10,000 ppmv Leak Definition	500 ppm Leak Definition[a]
Chemical Process Unit			
Valves – Gas Service[b]	87	67	92
Valves – Light Liquid Service[c]	84	61	88
Pumps – Light Liquid Service[c]	69	45	75
Connectors – All Services			93
Refinery			
Valves – Gas Service[b]	88	70	96
Valves – Light Liquid Service[c]	76	61	95
Pumps – Light Liquid Service[c]	68	45	88
Connectors – All Services			81

Source: Protocol for Equipment Leak Emission Estimates, EPA-453/R-95-017, Nov 1995.

[a] Control effectiveness attributable to the HON-negotiated equipment leak regulation (40 CFR 63, Subpart H) is estimated based on equipment-specific leak definitions and performance levels. However, pumps subject to the HON at existing process units have a 1,000 to 5,000 ppm leak definition, depending on the type of process.

[b] Gas (vapor) service means the material in contact with the equipment component is in a gaseous state at the process operating conditions.

[c] Light liquid service means the material in contact with the equipment component is in a liquid state in which the sum of the concentration of individual constituents with a vapor pressure above 0.3 kilopascals (kPa) at 20°C is greater than or equal to 20% by weight.

4.1 Reducing Product Losses

In the petrochemical industry, saleable products are lost whenever emissions escape from process equipment. Lost product generally translates into lost revenue.

4.2 Increasing Safety for Facility Workers and Operators

Many of the compounds emitted from refineries and chemical facilities may pose a hazard to exposed workers and operators. Reducing emissions from leaking equipment has the direct benefit of reducing occupational exposure to hazardous compounds.

4.3 Decreasing Exposure for the Surrounding Community

In addition to workers and operators at a facility, the population of a surrounding community can be affected by severe, long-term exposure to toxic air pollutants as a result of leaking equipment. Although most of the community exposure may be episodic, chronic health effects can result from long-term exposure to emissions from leaking equipment that is either not identified as leaking or not repaired.

4.4 Potentially Reducing Emission Fees

To fund permitting programs, some states and local air pollution districts charge annual fees that are based on total facility emissions. A facility with an effective program for reducing leaking equipment can potentially decrease the amount of these annual fees.

4.5 Avoiding Enforcement Actions

In setting Compliance and Enforcement National Priorities for Air Toxics, EPA has identified LDAR programs as a national focus. Therefore, facilities can expect an increased number and frequency of compliance inspections and a closer review of compliance reports submitted to permitting authorities in an effort by the Agency to assess LDAR programs and identify potential LDAR problems. A facility with an effective LDAR program decreases the chances of being targeted for enforcement actions and avoids the costs and penalties associated with rule violations.

Example – Cost of product lost.

In previous rulemaking efforts, EPA has estimated that the average value of product lost due to equipment leaks is $1,370 per ton.[a]

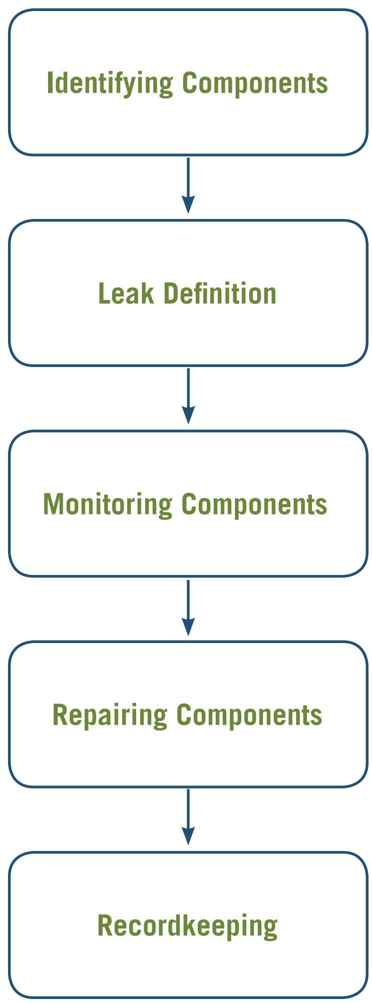
Applying this cost factor results in a potential savings of $730,000 per year per facility.

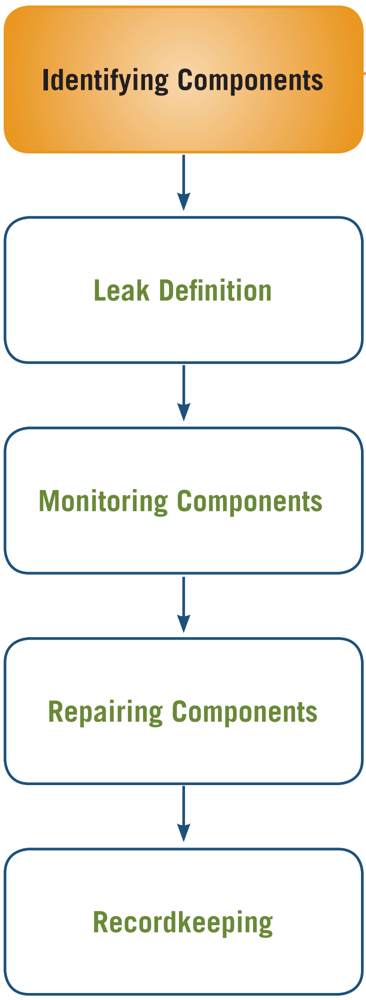
[a] Source: Hazardous Air Pollutant Emissions From Process Units in the Synthetic Organic Chemical Manufacturing Industry-Background Information for Proposed Standards, Vol. 1C-Model Emission Sources. Emission Standards Division, US EPA, Office of Air and Radiation, OAQPS, Research Triangle Park, NC. Nov 1992.

5.0 Elements of an LDAR Program

The requirements among the regulations vary, but all LDAR programs consist of five basic elements, which are discussed in detail in Sections 5.1 through 5.5.

For each element, this section outlines the typical LDAR program requirements, common compliance problems found through field inspections, and a set of best practices used by facilities with effective LDAR programs.





Current Requirements

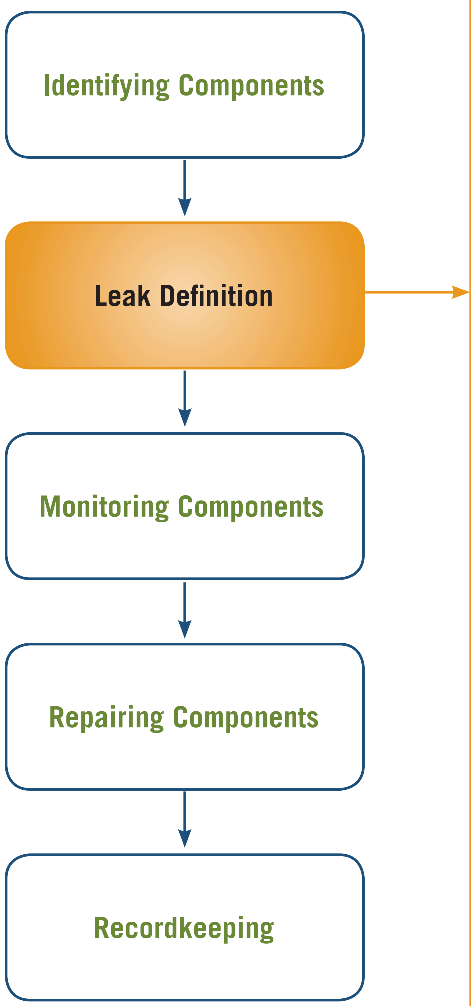
- Assign a unique identification (ID) number to each regulated component.
- Record each regulated component and its unique ID number in a log.
- Physically locate each regulated component in the facility, verify its location on the piping and instrumentation diagrams (P&IDs) or process flow diagrams, and update the log if necessary. Some states require a physical tag on each component subject to the LDAR requirements.
- Identify each regulated component on a site plot plan or on a continuously updated equipment log.
- Promptly note in the equipment log when new and replacement pieces of equipment are added and equipment is taken out of service.

Common Problems

- Not properly identifying all regulated equipment components.
- Not properly documenting exempt components (e.g., <300 hour exemption and <5 (or <10) weight % HAP).

Best Practices

- Physically tag each regulated equipment component with a unique ID number.
- Write the component ID number on piping and instrumentation diagrams.
- Institute an electronic data management system for LDAR data and records, possibly including the use of bar coding equipment.
- Periodically perform a field audit to ensure lists and diagrams accurately represent equipment installed in the plant.



Current Requirements

- Method 21 requires VOC emissions from regulated components to be measured in parts per million (ppm). A leak is detected whenever the measured concentration exceeds the threshold standard (i.e., **leak definition**) for the applicable regulation.
  - Leak definitions vary by regulation, component type, service (e.g., light liquid, heavy liquid, gas/vapor), and monitoring interval.
  - Most NSPS have a leak definition of 10,000 ppm. Many NESHAP use a 500-ppm or 1,000-ppm leak definition.
- Many equipment leak regulations also define a leak based on visual inspections and observations (such as fluids dripping, spraying, misting or clouding from or around components), sound (such as hissing), and smell.

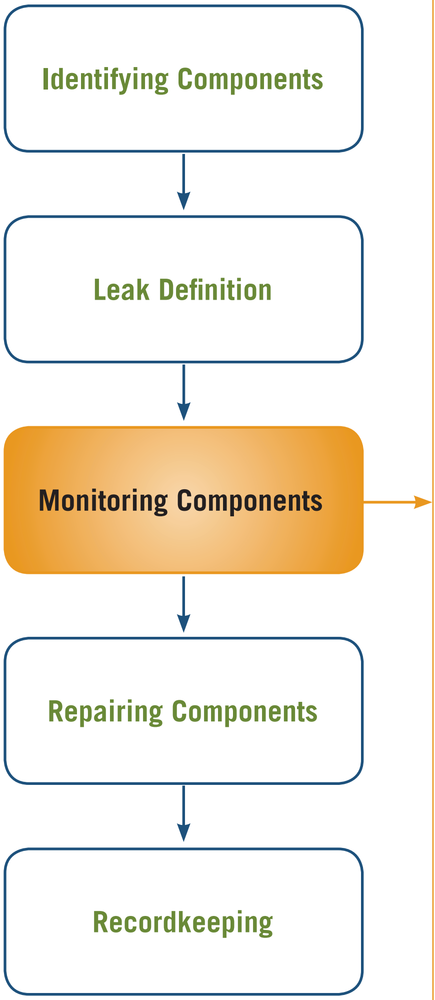
  Note: The LDAR requirements specify weekly visual inspections of pumps, agitators, and compressors for indications of liquids leaking from the seals.

Common Problems

- Using the wrong leak definition for a particular component due to confusion at facilities where multiple LDAR regulations apply.

Best Practices

- Utilize a leak definition lower than what the regulation requires.
- Simplify the program by using the lowest leak definition when multiple leak definitions exist.
- Make the lowest leak definition conservative to provide a margin of safety when monitoring components.
- Keep the lowest leak definition consistent among all similar component types. For example, all valves in a facility might have a leak definition of 500 ppm.



The **monitoring interval** is the frequency at which individual component monitoring is conducted. For example, valves are generally required to be monitored once a month using a leak detection instrument, but the monitoring interval may be extended (e.g. to once every quarter for each valve that has not leaked for two successive months for Part 60 Subpart VV, or on a process unit basis of once every quarter for process units that have less than a 2% leak rate for Part 63 Subpart H).

Current Requirements

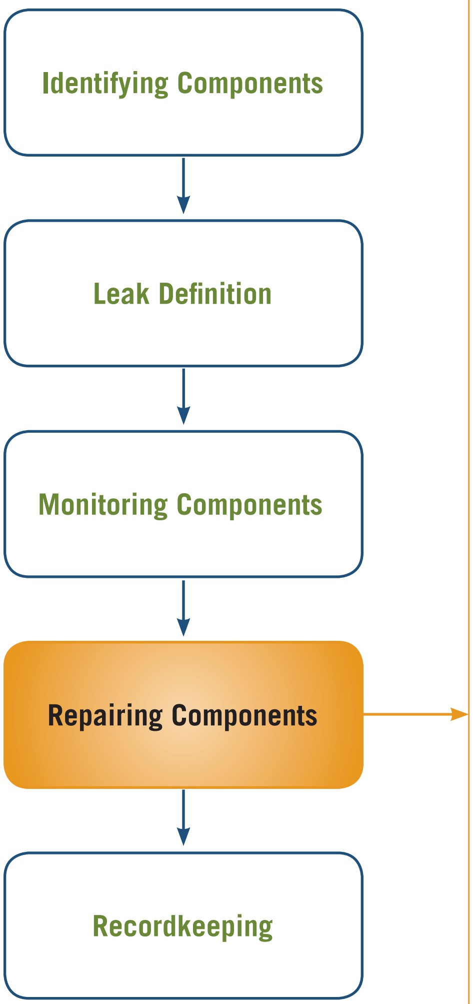
- For many NSPS and NESHAP regulations with leak detection provisions, the primary method for monitoring to detect leaking components is EPA Reference Method 21 (40 CFR Part 60, Appendix A).
- Method 21 is a procedure used to detect VOC leaks from process equipment using a portable detecting instrument.
- Appendix C of this guide explains the general procedure and Appendix D presents the complete Method 21 requirements.
- Monitoring intervals vary according to the applicable regulation, but are typically weekly, monthly, quarterly, and yearly. For connectors, the monitoring interval can be every 2, 4, or 8 years. The monitoring interval depends on the component type and periodic leak rate for the component type.

Common Problems

- Not following Method 21 properly.
- Failing to monitor at the maximum leak location (once the highest reading is obtained by placing the probe on and around the interface, hold the probe at that location approximately two times the response rate of the instrument).
- Not monitoring long enough to identify a leak.
- Holding the detection probe too far away from the component interface. The reading must be taken at the interface.
- Not monitoring all potential leak interfaces.
- Using an incorrect or an expired calibration gas.
- Not monitoring all regulated components.
- Not completing monitoring if the first monitoring attempt is unsuccessful due to equipment being temporarily out of service.

Best Practices

- Although not required by Method 21, use an automatic (electronic) data logger to save time, improve accuracy, and provide an audit record.
- Audit the LDAR program to help ensure that the correct equipment is being monitored, Method 21 procedures are being followed properly, and the required records are being kept.
- Monitor components more frequently than required by the regulations.
- Perform QA/QC of LDAR data to ensure accuracy, completeness, and to check for inconsistencies.
- Eliminate any obstructions (e.g., grease on the component interface) that would prevent monitoring at the interface.
- If a rule allows the use of alternatives to Method 21 monitoring, Method 21 should still be used periodically to check the results of the alternative monitoring method.



Current Requirements

- Repair leaking components as soon as practicable, but not later than a specified number of calendar days (usually 5 days for a first attempt at repair and 15 days for final attempt at repair) after the leak is detected.
- First attempts at repair include, but are not limited to, the following practices where practicable and appropriate:
- Tightening bonnet bolts
- Replacing bonnet bolts
- Tightening packing gland nuts
- Injecting lubricant into lubricated packing
- If the repair of any component is technically infeasible without a process unit shutdown, the component may be placed on the Delay of Repair list, the ID number is recorded, and an explanation of why the component cannot be repaired immediately is provided. An estimated date for repairing the component must be included in the facility records.

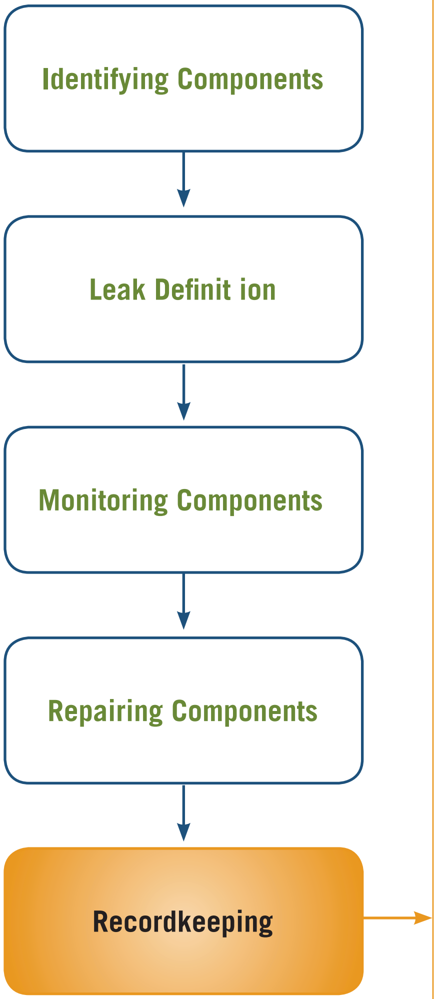
  Note: The “drill and tap” method for repairing leaking valves is generally considered technically feasible without requiring a process unit shutdown and should be tried if the first attempt at repair does not fix the leaking valve. See section 6.7 for a discussion of “drill and tap”.
- The component is considered to be repaired only after it has been monitored and shown not to be leaking above the applicable leak definition.

Common Problems

- Not repairing leaking equipment within the required amount of time specified by the applicable regulation.
- Improperly placing components on the Delay of Repair list.
- Not having a justifiable reason for why it is technically infeasible to repair the component without a process unit shutdown.
- Not exploring all available repair alternatives before exercising the Delay of Repair exemption (specifically as it pertains to valves and “drill and tap” repairs).

Best Practices

- Develop a plan and timetable for repairing components.
- Make a first attempt at repair as soon as possible after a leak is detected.
- Monitor components daily and over several days to ensure a leak has been successfully repaired.
- Replace problem components with “leakless” or other technologies.



Current Requirements

For each regulated process:

- Maintain a list of all ID numbers for all equipment subject to an equipment leak regulation.
- For valves designated as "unsafe to monitor," maintain a list of ID numbers and an explanation/review of conditions for the designation.
- Maintain detailed schematics, equipment design specifications (including dates and descriptions of any changes), and piping and instrumentation diagrams.
- Maintain the results of performance testing and leak detection monitoring, including leak monitoring results per the leak frequency, monitoring leakless equipment, and non-periodic event monitoring.

For leaking equipment:

- Attach ID tags to the equipment.
- Maintain records of the equipment ID number, the instrument and operator ID numbers, and the date the leak was detected.
- Maintain a list of the dates of each repair attempt and an explanation of the attempted repair method.
- Note the dates of successful repairs.
- Include the results of monitoring tests to determine if the repair was successful.

Common Problems

- Not keeping detailed and accurate records required by the applicable regulation.
- Not updating records to designate new components that are subject to LDAR due to revised regulations or process modifications.

Best Practices

- Perform internal and third-party audits of LDAR records on a regular basis to ensure compliance.
- Electronically monitor and store LDAR data including regular QA/QC audits.
- Perform regular records maintenance.
- Continually search for and update regulatory requirements.
- Properly record and report first attempts at repair.
- Keep the proper records for components on Delay of Repair lists.

6.0 What Compliance Problems Have Been Found With Current LDAR Programs?

Many regulatory agencies determine the compliance status of LDAR programs based on a review of submitted paperwork. Some conduct walk-through inspections to review LDAR records maintained on site and perform a visual check of monitoring practices. However, a records review will not show if monitoring procedures are being followed. Similarly, the typical walkthrough inspection will not likely detect improper monitoring practices since operators will tend to ensure that they are following proper procedures when they are being watched.

EPA's National Enforcement Investigations Center (NEIC) conducted a number of sampling investigations of LDAR programs at 17 petroleum refineries. Appendix E summarizes the comparative monitoring results, and Appendix F contains a copy of the 1999 Enforcement Alert that explains the monitoring results. The investigations consisted of records review and comparative leak monitoring (comparing the leak rate found by NEIC to the facility's historic leak rate) at a subset of the facility's total components. These investigations have shown a pattern of significantly higher equipment leak rates (5%) than what the refineries reported (1.3%). While there have been improvements since 1999, facility audits are still showing significantly elevated leak rates, especially in the chemical manufacturing industries.

The discrepancy in leak rates indicates that monitoring staff may not be complying with Method 21 procedures. Failure to accurately detect leaks may be due to a lack of internal quality control oversight or management accountability for the LDAR programs regardless of whether the monitoring is done by contractors or in-house personnel.

Each leak that is not detected and repaired is a lost opportunity to reduce emissions. In the October 1999 Enforcement Alert, EPA estimates that an additional 40,000 tons of VOCs are emitted annually from petroleum refineries because leaking valves are not found and repaired.

Several important factors contribute to failing to identify and repair leaking components:

1. **Not identifying all regulated components/units in inventory**

   If a facility does not properly identify all of its regulated components, some leaks may go unidentified. Unidentified components may leak or have existing leaks that will worsen over time if the components are not properly identified, monitored and repaired. Facilities can fail to identify regulated components when new processes are constructed, existing process are modified, or new or revised equipment leak regulations are published.

2. **Not monitoring components**

   In some cases, the number of components reported to have been monitored may indicate problems with monitoring procedures. What facility inspectors have found:

   - A data logger time stamp showed valves being monitored at the rate of one per second with two valves occasionally being monitored within the same 1-second period.

- At one facility, a person reported monitoring 8,000 components in one day (assuming an 8-hour work day, that represents one component every 3.6 seconds).
- Records evaluations showed widely varying component monitoring counts, suggesting equipment might not always be monitored when required.
- Equipment was marked "temporarily out of service" because the initial inspection attempt could not be performed. However, the equipment was in service for most of the period, and no subsequent (or prior) inspection attempts were performed to meet the monitoring requirement.

However, even when records show a realistic number of components are being monitored, if there are no oversight or accountability checks, then there is no guarantee that components are actually being monitored.

A well-trained LDAR inspection team (two people) can monitor approximately 500-700 valves per day.

3. Insufficient time to identify a leak

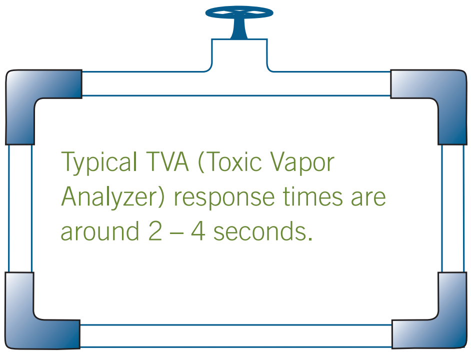
In other cases, facilities are not following proper monitoring procedures, resulting in a lower number of leaking components being reported.

- If a worker moves the probe around the component interface so rapidly that the instrument does not have time to properly respond, then a component may never be identified as leaking.
- If a worker fails to find the maximum leak location for the component and then does not spend twice the response time at that location, then the monitoring instrument will not measure the correct concentration of hydrocarbons and the leak may go undetected. **Optical leak imaging shows the importance of identifying the maximum leak location, as hydrocarbons are quickly dispersed and diluted by air currents around the component**.

4. Holding the probe away from the component interface

The probe must be placed at the proper interface of the component being analyzed. Placing the probe even 1 centimeter from the interface can result in a false reading, indicating that the component is not leaking, when in fact it is leaking. Eliminate any issues (e.g., grease on the component interface) that prevent monitoring at the interface (e.g., remove excess grease from the component before monitoring or use a monitor that won't be impacted by the grease and is easy to clean.

For equipment with rotating shafts (pumps and compressors), Method 21 requires the probe be placed within 1 centimeter of the shaft-seal interface. Placing the probe at the surface of the rotating shaft is a safety hazard and should be avoided.



5. Failing to properly maintain monitoring instrument

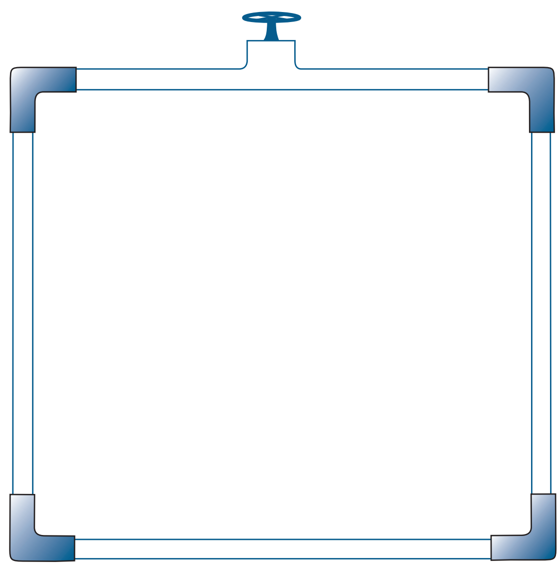
Factors that may prevent the instrument from identifying leaks are:

- Not using an instrument that meets the specifications required in Method 21, section 6.
- Dirty instrument probes;
- Leakage from the instrument probes;
- Not zeroing instrument meter;
- Incorrect calibration gases used; and
- Not calibrating the detection instrument on a daily basis.

6. Improperly identifying components as "unsafe" or "difficult" to monitor

Components that are identified as being "unsafe to monitor" or "difficult to monitor" must be identified as such because there is a safety concern or an accessibility issue that prevents the component from being successfully monitored.

All unsafe or difficult-to-monitor components must be included on a log with identification numbers and an explanation of why the component is "unsafe to monitor" or "difficult to monitor." Monitoring can be deferred for all such components, but the facility must maintain a plan that explains the conditions under which the components become safe to monitor or no longer difficult to monitor.

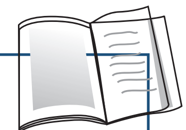


7. Improperly placing components/units on the "Delay of Repair" list

Generally, placing a leaking component on the "Delay of Repair" list is permissible only when the component is technically infeasible to repair without a process unit shutdown (e.g., for valves the owner/operator must demonstrate that the emissions from immediate repair will be greater than waiting for unit shutdown).

Repair methods may exist, such as "drill and tap" for valves, that allow leaks to be fixed while the component is still in service. Failing to consider such repair methods before exercising the "Delay of Repair" list may constitute noncompliance with repair requirements (usually 15 days under federal LDAR standards).

Components placed on the "Delay of Repair" list must be accompanied by their ID numbers and an explanation of why they have been placed on the list. These components cannot remain on the list indefinitely – they must be repaired by the end of the next process unit shutdown.



Drill and Tap is a repair method where a hole is drilled into the valve packing gland and tapped, so that a small valve and fitting can be attached to the gland. A packing gun is connected to this fitting and the small valve is opened allowing new packing material to be pumped into the packing gland.

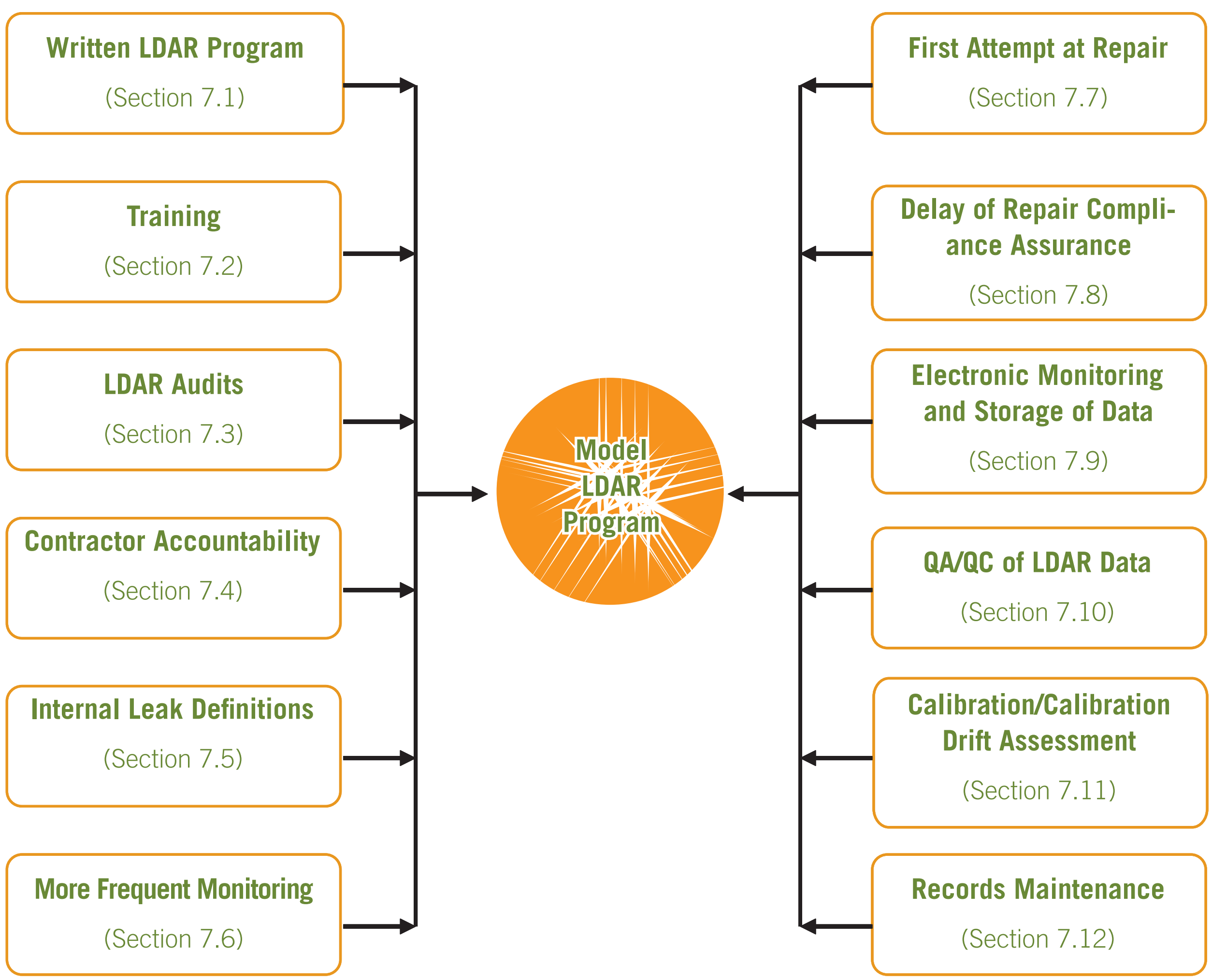
Many companies consider this a permanent repair technique, as newer, pumpable packing types are frequently superior to the older packing types they replace. Packing types can be changed and optimized for the specific application over time.

7.0 Model LDAR Program

Experience has shown that facilities with an effective record of preventing leaks integrate an awareness of the benefits of leak detection and repair into their operating and maintenance program. This section outlines some of the major elements of successful LDAR programs. These program elements were developed from:

- Evaluation of best practices identified at facilities with successful LDAR programs, and
- Analysis of the root causes of noncompliance at facilities that were found to have recurring violations of LDAR regulatory requirements.

LDAR programs that incorporate most or all of the elements described in the following sections have achieved more consistent results in their LDAR programs, leading to increased compliance and lower emissions.



7.1 Written LDAR Program

A written LDAR program specifies the regulatory requirements and facility-specific procedures for recordkeeping certifications, monitoring, and repairs. A written program also delineates the roles of each person on the LDAR team as well as documents all the required procedures to be completed and data to be gathered, thus establishing accountability. The plan should identify all process units subject to federal, state, and local LDAR regulations and be updated as necessary to ensure accuracy and continuing compliance.

Elements:

- An overall, facility-wide leak rate goal that will be a target on a process-unit-by-process-unit basis;
- A list of all equipment in light liquid and/or in gas/vapor service that has the potential to leak VOCs and VHAPs, within process units that are owned and maintained by each facility;
- Procedures for identifying leaking equipment within process units;
- Procedures for repairing and keeping track of leaking equipment;
- A process for evaluating new and replacement equipment to promote the consideration of installing equipment that will minimize leaks or eliminate chronic leakers;
- A list of "LDAR Personnel" and a description of their roles and responsibilities, including the person or position for each facility that has the authority to implement improvements to the LDAR program; and
- Procedures (e.g., a Management of Change program) to ensure that components added to each facility during maintenance and construction are evaluated to determine if they are subject to LDAR requirements, and that affected components are integrated into the LDAR program.

Within thirty (30) days after developing the written facility-wide LDAR program, submit a copy of the Program to EPA and to the appropriate state agency.

7.2 Training

A training program will provide LDAR personnel the technical understanding to make the written LDAR program work. It also will educate members of the LDAR team on their individual responsibilities. These training programs can vary according to the level of involvement and degree of responsibility of LDAR personnel.

Elements:

- Provide and require initial training and annual LDAR refresher training for all facility employees assigned LDAR compliance responsibilities, such as monitoring technicians, database users, QA/QC personnel, and the LDAR Coordinator;
- For other operations and maintenance personnel with responsibilities related to LDAR, provide and require an initial training program that includes instruction on aspects of LDAR that are relevant to their duties (e.g., operators and mechanics performing valve packing and unit supervisors that approve delay of repair work). Provide and require "refresher" training in LDAR for these personnel at least every three years.
- Collect training information and records of contractors, if used.

7.3 LDAR Audits

Whether LDAR monitoring is done in house or contracted to third parties outside the company, the potential exists for LDAR staff not to adhere correctly to the LDAR program. Internal and third-party audits of a facility LDAR program are a critical component of effective LDAR programs. The audits check that the correct equipment is being monitored, Method 21 procedures are being followed, leaks are being fixed, and the required records are being kept. In short, the audits ensure that the LDAR program is being conducted correctly and problems are identified and corrected.

Elements:

- Review records on a regular cycle to ensure that all required LDAR-related records, logs, and databases are being maintained and are up to date.
- Ensure and document that the correct equipment is included in the LDAR program and that equipment identified as leaking is physically tagged with the equipment ID number.
- Observe the calibration and monitoring techniques used by LDAR technicians, in particular to ensure the entire interface is checked and the probe is held at the interface, not away from the interface.
- Retain a contractor to perform a third-party audit of the facility LDAR program at least once every four (4) years.
- Perform facility-led audits every four (4) years.
  - Use personnel familiar with the LDAR program and its requirements from one or more of the company's other facilities or locations (if available).
  - Perform the first round of facility-led LDAR audits no later than two (2) years after completion of the third-party audits outlined above, and every four (4) years thereafter.
  - This rotation ensures that the facility is being audited once every two (2) years.
- If areas of noncompliance are discovered, initiate a plan to resolve and document those issues.
- Implement, as soon as practicable, steps necessary to correct causes of noncompliance, and prevent, to the extent practicable, a recurrence of the cause of the noncompliance.
- Retain the audit reports and maintain a written record of the corrective actions taken in response to any deficiencies identified.

7.4 Contractor Accountability

Contractors performing monitoring are frequently compensated for the number of components they monitor, which might provide an incentive to rush through monitoring procedures and not adhere to Method 21 requirements for response time, monitoring distance, etc. If this happens, some equipment leaks may not be detected. To overcome this potential problem, facilities should have in place sufficient oversight procedures to increase the accountability of contractors.

Elements:

- Write contracts that emphasize the quality of work instead of the quantity of work only.
- Require contractors to submit documentation that their LDAR personnel have been trained on Method 21 and facility-specific LDAR procedures.
- Ensure that the contractor has a procedure in place to review and certify the monitoring data before submitting the data to the facility.
- Review daily results of contractor work to ensure that a realistic number of components are being monitored.
- Perform spot audits in the field to ensure that Method 21 procedures are being followed. This can include spot-checking monitored components with another hydrocarbon analyzer or following LDAR personnel as they perform monitoring.
- Have periodic reviews of contractor performance (e.g., quarterly or semi-annually) to resolve issues and correct problems.

7.5 Internal Leak Definition for Valves and Pumps

The varying leak definitions that can apply to different process units and components can be confusing and lead to errors in properly identifying leaks. To counter this potential problem, operate your LDAR program using an internal leak definition for valves and pumps in light liquid or gas vapor service. The internal leak definition would be equivalent to or lower than the applicable definitions in your permit and the applicable federal, state, and local regulations. Monitoring against a uniform definition that is lower than the applicable regulatory definition will reduce errors and provide a margin of safety for identifying leaking components. The internal leak definition would apply to valves and pumps (and possibly connectors) in light liquid or gas vapor service.

Elements:

- Adopt a 500-ppm or lower internal leak definition for VOCs for all valves in light liquid and/or gas vapor service, excluding pressure relief devices.
- Adopt a 2,000-ppm or lower internal leak definition for pumps in light liquid and/or gas/vapor service.
- Record, track, repair, and monitor leaks in excess of the internal leak definition. Repair and monitor leaks that are greater than the internal leak definitions but less than the applicable regulatory leak definitions within thirty (30) days of detection.

Consent Decrees between EPA and many chemical facilities subject to the HON require using a 250-ppm leak definition for valves and connectors and a 500-ppm leak definition for pumps.

Note: If a state or local agency has lower leak definitions, then the internal leak definition should be set to the lowest definition or even lower to include/allow for margin of error.

7.6 More Frequent Monitoring

Many regulations allow for less frequent monitoring (i.e. skip periods) when good performance (as defined in the applicable regulation) is demonstrated. Skip period is an alternative work practice found in some equipment leak regulations and usually applies only to valves and connectors. After a specified number of leak detection periods (e.g., monthly) during which the percentage of leaking components is below a certain value (e.g., 2% for NSPS facilities), a facility can monitor less frequently (e.g., quarterly) as long as the percentage of leaking components remains low. The facility must keep a record of the percentage of the component type found leaking during each leak detection period.

Experience has shown that poor monitoring rather than good performance has allowed facilities to take advantage of the less frequent monitoring provisions. To ensure that leaks are still being identified in a timely manner and that previously unidentified leaks are not worsening over time, implement a plan for more frequent monitoring for components that contribute most to equipment leak emissions.

Elements:

- Monitor pumps in light liquid and/or gas vapor service on a monthly basis.
- Monitor valves in light liquid and/or gas vapor service – other than difficult-to-monitor or unsafe-to-monitor valves – with no skip periods.

Consent Decrees between EPA and many chemical facilities subject to the HON require semiannual monitoring of connectors.

7.7 Repairing Leaking Components

To stop detected leaks while they are still small, most rules require a first attempt at repair within 5 days of the leak detection and a final repair within 15 days. However, any component that cannot be repaired within those time frames must be placed on a "Delay of Repair" list to be repaired during the next shutdown cycle.

First attempts at repair include, but are not limited to, the following best practices where practicable and appropriate:

- Tightening bonnet bolts;
- Replacing bonnet bolts;
- Tightening packing gland nuts; and
- Injecting lubricant into lubricated packing.

Elements:

- Schedule the "first attempt at repair" of those components that the monitoring personnel are not authorized to repair consistent with the existing regulatory requirements.
- Monitor the component for which a "first attempt at repair" was performed no later than the next regular business day to ensure the leak has not worsened.
- If the first attempt at repair has not succeeded then other methods, such as "drill and tap" should be employed where feasible. Drill and tap procedures are no longer considered extraordinary practices.

7.8 Delay of Repair Compliance Assurance

Any component that cannot be repaired during the specified repair interval must be placed on a "Delay of Repair" list to be repaired during the next shutdown cycle. Delay of repair compliance assurance procedures ensure that the appropriate equipment is justifiably on the "Delay of Repair" list and that facilities have a plan to fix these components.

Elements:

- Have the unit supervisor approve in advance and certify all components that are technically infeasible to repair without a process unit shutdown.
- Continue to monitor equipment that is placed on the "Delay of Repair" list in the facility's regular LDAR monitoring. For leaks above the internal leak definition rate and below the regulatory rate, put the equipment on the "Delay of Repair" list within 30 days.
- Implement the following repair policies and procedures within 15 days of implementing the written LDAR program:
  - For valves, other than control valves or pressure relief valves, that are leaking at a rate of 10,000 ppm or greater and cannot be feasibly repaired without a process unit shutdown, use "drill and tap" repair methods to fix the leaking valve, unless you can determine and document that there is a safety, mechanical, or major environmental concern posed by repairing the leak in this manner.
  - Perform up to two "drill and tap" repair attempts to repair a leaking valve, if necessary, within 30 days of identifying the leak.

7.9 Electronic Monitoring and Storage of LDAR Data

Electronic monitoring and storage of LDAR data will help evaluate the performance of monitoring personnel (via time/date stamps), improve accuracy, provide an effective means for QA/QC, and retrieve records in a timely manner for review purposes. Incorporate and maintain an electronic database for storing and reporting LDAR data. Use data loggers or other data collection devices during all LDAR monitoring.

Elements:

- Use best efforts to transfer, on a daily basis, electronic data from electronic data logging devices to the database.
- For all monitoring events in which an electronic data collection device is used, include a time and date stamp, operator identification, and instrument identification.
- Paper logs can be used where necessary or more feasible (e.g., small rounds, re-monitoring fixed leaks, or when data loggers are not available or broken), and should record, at a minimum, the monitoring technician, date, and monitoring equipment used.
- Transfer any manually recorded monitoring data to the database within 7 days of monitoring.
- Review records to identify "problem" components for preventative maintenance (repair prior to anticipated failure) or for replacement with "leakless" technology.

7.10 QA/QC of LDAR Data

QA/QC audits ensure that Method 21 procedures are being followed and LDAR personnel are monitoring the correct components in the proper manner. Develop and implement a procedure to ensure QA/QC review of all data generated by LDAR monitoring technicians on a daily basis or at the conclusion of each monitoring episode.

Elements:

Some QA/QC procedures include:

- Daily review/sign-off by monitoring technicians of the data they collected to ensure accuracy and validity.
- Periodic review of the daily monitoring reports generated in conjunction with recordkeeping and reporting requirements.
- Quarterly QA/QC of the facility's and contractor's monitoring data including:
  - Number of components monitored per technician;
  - Time between monitoring events; and
  - Abnormal data patterns.

7.11 Calibration/Calibration Drift Assessment

Always calibrate LDAR monitoring equipment using an appropriate calibration gas, in accordance with 40 CFR Part 60, EPA Reference Test Method 21.

Elements:

- Conduct calibration drift assessments of LDAR monitoring equipment at the end of each monitoring shift, at a minimum.
- Conduct the calibration drift assessment using, at a minimum, approximately 500 ppm of calibration gas.
- If any calibration drift assessment after the initial calibration shows a negative drift of more than 10% from the previous calibration, re-monitor all valves that were monitored since the last calibration with a reading of greater than 100 ppm. Re-monitor all pumps that were monitored since the last calibration with a reading of greater than 500 ppm.

7.12 Records Maintenance

Organized and readily available records are one potential indication of an effective LDAR program. Well-kept records may also indicate that the LDAR program is integrated into the facility's routine operation and management. The equipment leak regulations specify recordkeeping and reporting requirements; incorporating the elements below will help ensure your facility LDAR records are thorough and complete.

Elements:

Records to maintain:

- A certification that the facility implemented the "first attempt at repair" program.
- A certification that the facility implemented QA/QC procedures for review of data generated by LDAR technicians.
- An identification of the person/position at each facility responsible for LDAR program performance as defined in the written program.
- A certification that the facility developed and implemented a tracking program for new valves and pumps added during maintenance and construction defined in the written program.
- A certification that the facility properly completed calibration drift assessments.
- A certification that the facility implemented the "delay of repair" procedures.
- The following information on LDAR monitoring:
  - (1) The number of valves and pumps present in each process unit during the quarter;
  - (2) The number of valves and pumps monitored in each process unit;
  - (3) An explanation for missed monitoring if the number of valves and pumps present exceeds the number of valves and pumps monitored during the quarter;
  - (4) The number of valves and pumps found leaking;
  - (5) The number of "difficult to monitor" pieces of equipment monitored;
  - (6) A list of all equipment currently on the "Delay of Repair" list and the date each component was placed on the list;
  - (7) The number of repair attempts not completed promptly or completed within 5 days;
  - (8) The number of repairs not completed within 30 days and the number of components not placed on the "Delay of Repair" list; and
  - (9) The number of chronic leakers that do not get repaired.
- Records of audits and corrective actions. Prior to the first third-party audit at each facility, include in your records a copy of each audit report from audits conducted in the previous calendar year and a summary of the actions planned or taken to correct all deficiencies identified in the audits.
- For the audits performed in prior years, identification of the auditors and documentation that a written plan exists identifying corrective action for any deficiencies identified and that this plan is being implemented.

8.0 Sources of Additional Information

Inspection Manual: Federal Equipment Leak Regulations for the Chemical Manufacturing Industry, EPA/305/B-98/011, December 1998.
http://cfpub.epa.gov/compliance/resources/publications/assistance/sectors/chemical/index.cfm

Vol 1: Inspection Manual
http://www.epa.gov/compliance/resources/publications/assistance/sectors/insmanvol1.pdf

Vol 2: Chemical Manufacturing Industry Regulations (3 parts on the Internet)
http://www.epa.gov/compliance/resources/publications/assistance/sectors/insmanvol2pt1.pdf
http://www.epa.gov/compliance/resources/publications/assistance/sectors/insmanvol2pt2.pdf
http://www.epa.gov/compliance/resources/publications/assistance/sectors/insmanvol2pt3.pdf

Vol 3: Petroleum Refining Industry Regulations
http://www.epa.gov/compliance/resources/publications/assistance/sectors/insmanvol3.pdf

1995 Protocol for Equipment Leak Emission Estimates, EPA-453/R-95-017, Nov 1995.
http://www.epa.gov/ttnchie1/efdocs/equiplks.pdf

Enforcement Alert, EPA Office of Enforcement and Compliance Assurance, EPA 300-N-99-014, Oct 1999.
http://www.epa.gov/compliance/resources/newsletters/civil/enfalert/emissions.pdf

National Petroleum Refinery Initiative, EPA.
http://www.epa.gov/compliance/resources/cases/civil/caa/refineryinitiative032106.pdf

Petroleum Refinery Initiative Fact Sheet, EPA.
http://www.epa.gov/compliance/resources/cases/civil/caa/petroleumrefinery-fcsht.html

Petroleum Refinery National Priority Case Results.
http://www.epa.gov/compliance/resources/cases/civil/caa/oil/

Draft Staff Report, Regulation 8, Rule 18, Equipment Leaks, Bay Area Air Quality Management District, Jul 1997.
http://www.baaqmd.gov/pln/ruledev/8-18/1997/0818_sr_071097.pdf

Standards of Performance for Equipment Leaks of VOC in the Synthetic Organic Chemicals Manufacturing Industry; Standards of Performance for Equipment Leaks of VOC in Petroleum Refineries; Proposed Rule, [EPA-HQ-OAR-2006-0699; FRL-] RIN 2060-AN71.
http://www.epa.gov/ttn/oarpg/t3/fr_notices/equip_leak_prop103106.pdf

Industrial Organic Chemicals Compliance Incentive Program, EPA Compliance and Enforcement.
http://www.epa.gov/compliance/incentives/programs/ioccip.html

Leak Detection and Repair Program Developments.
http://www.epa.gov/compliance/neic/field/leak.html

Compliance and Enforcement Annual Results: Important Environmental Problems / National Priorities.
http://www.epa.gov/compliance/resources/reports/endofyear/eoy2006/sp-airtoxics-natl-priorities.html

Portable Instruments User's Manual For Monitoring VOC Sources, EPA-340/1-86-015.
Inspection Techniques For Fugitive VOC Emission Sources, EPA 340/1-90-026a,d,e,f (rev May 1993) Course #380.

Environmental compliance assistance resources can be found at:

http://cfpub.epa.gov/clearinghouse/
http://www.assistancecenters.net/
http://www.epa.gov/compliance/assistance/sectors/index.html

Appendix A Federal Regulations That Require a Formal LDAR Program With Method 21

40 CFR Part	Subpart	Regulation Title
60	VV	SOCMI VOC Equipment Leaks NSPS
60	DDD	Volatile Organic Compound (VOC) Emissions from the Polymer Manufacturing Industry
60	GGG	Petroleum Refinery VOC Equipment Leaks NSPS
60	KKK	Onshore Natural Gas Processing Plant VOC Equipment Leaks NSPS
61	J	National Emission Standard for Equipment Leaks (Fugitive Emission Sources) of Benzene
61	V	Equipment Leaks NESHAP
63	H	Organic HAP Equipment Leak NESHAP (HON)
63	I	Organic HAP Equipment Leak NESHAP for Certain Processes
63	J	Polyvinyl Chloride and Copolymers Production NESHAP
63	R	Gasoline Distribution Facilities (Bulk Gasoline Terminals and Pipeline Breakout Stations)
63	CC	Hazardous Air Pollutants from Petroleum Refineries
63	DD	Hazardous Air Pollutants from Off-Site Waste and Recovery Operations
63	SS	Closed Vent Systems, Control Devices, Recovery Devices and Routing to a Fuel Gas System or a Process
63	TT	Equipment Leaks – Control Level 1
63	UU	Equipment Leaks – Control Level 2
63	YY	Hazardous Air Pollutants for Source Categories: Generic Maximum Achievable Control Technology Standards
63	GGG	Pharmaceuticals Production
63	III	Hazardous Air Pollutants from Flexible Polyurethane Foam Production
63	MMM	Hazardous Air Pollutants for Pesticide Active Ingredient Production
63	FFFF	Hazardous Air Pollutants: Miscellaneous Organic Chemical Manufacturing
63	GGGGG	Hazardous Air Pollutants: Site Remediation
63	HHHHH	Hazardous Air Pollutants: Miscellaneous Coating Manufacturing
65	F	Consolidated Federal Air Rule – Equipment Leaks
264	BB	Equipment Leaks for Hazardous Waste TSDFs
265	BB	Equipment Leaks for Interim Status Hazardous Waste TSDFs

Note: Many of these regulations have identical requirements, but some have different applicability and control requirements.

Appendix B Federal Regulations That Require the Use of Method 21 But Do Not Require a Formal LDAR Program

40 CFR		Regulation Title
Part	Subpart	
60	XX	Bulk Gasoline Terminals
60	QQQ	VOC Emissions from Petroleum Refinery Wastewater Systems
60	WWW	Municipal Solid Waste Landfills
61	F	Vinyl Chloride
61	L	Benzene from Coke By-Products
61	BB	Benzene Transfer
61	FF	Benzene Waste Operations
63	G	Organic Hazardous Air Pollutants from SOCMI for Process Vents, Storage Vessels, Transfer Operations, and Wastewater
63	M	Perchloroethylene Standards for Dry Cleaning
63	S	Hazardous Air Pollutants from the Pulp and Paper Industry
63	Y	Marine Unloading Operations
63	EE	Magnetic Tape Manufacturing Operations
63	GG	Aerospace Manufacturing and Rework Facilities
63	HH	Hazardous Air Pollutants from Oil and Gas Production Facilities
63	OO	Tanks – Level 1
63	PP	Containers
63	QQ	Surface Impoundments
63	VV	Oil/Water, Organic/Water Separators
63	HHH	Hazardous Air Pollutants from Natural Gas Transmission and Storage
63	JJJ	Hazardous Air Pollutant Emissions: Group IV Polymers and Resins
63	VVV	Hazardous Air Pollutants: Publicly Owned Treatment Works
65	G	CFAR – Closed Vent Systems
264	AA	Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities - Process Vents
264	CC	Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities - Tanks, Surface Impoundments, Containers
265	AA	Interim Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities – Process Vents
265	CC	Interim Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities - Tanks, Surface Impoundments, Containers
270	B	Hazardous Waste Permit Program – Permit Application
270	J	Hazardous Waste Permit Program – RCRA Standardized Permits for Storage Tanks and Treatment Units

Appendix C Method 21 General Procedure

Failure of facilities to follow Method 21 can lead to them not properly identifying and subsequently repairing leaking components. It is critical for facilities to refer to the complete text of Method 21 (see Appendix D) for detailed explanations of each general procedure found below and how to properly perform each step.

1. **Evaluate Instrument Performance**

   Performance criteria for the monitoring instrument:

   - For each VOC measured, the response factor should be <10 unless specified in the applicable regulation. Response factor is 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 applicable regulation.
   - The calibration precision should be <10 percent of the calibration gas value. Calibration precision is 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.
   - The response time should be ≤30 seconds. Response time is the time interval from a step change in VOC concentration at the input of the sampling system to the time at which 90% of the corresponding final value is reached as displayed on the instrument readout meter.

2. **Calibrate Instrument**

   Before each monitoring episode:

   - Let the instrument warm up.
   - Introduce the calibration gas into the instrument probe.
   - Adjust the instrument meter readout to match the calibration gas concentration value.

3. **Monitor Individual components**

   When monitoring components:

   - Place the probe at the surface of the component interface where leakage could occur.
   - Move the probe along the interface periphery while observing the instrument readout.
   - Locate the maximum reading by moving the probe around the interface.
   - Keep the probe at the location of the maximum reading for 2 times the response factor.
   - If the concentration reading on the instrument readout is above the applicable leak definition, then the component is leaking and must be repaired.

Appendix D Method 21—Determination of Volatile Organic Compound Leaks

1.0 Scope and Application

1.1 Analytes.

Analyte	CAS No.
Volatile Organic Compounds (VOC)..........	No CAS number assigned.

1.2 Scope. This method is applicable for the determination of 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.

1.3 Data Quality Objectives. Adherence to the requirements of this method will enhance the quality of the data obtained from air pollutant sampling methods.

2.0 Summary of Method

2.1 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 6.0. A leak definition concentration based on a reference compound is specified in each applicable regulation. This method is intended to locate and classify leaks only, and is not to be used as a direct measure of mass emission rate from individual sources.

3.0 Definitions

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

3.2 Calibration precision means 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.

3.3 Leak definition concentration means 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.

3.4 No detectable emission means a local VOC concentration at the surface of a leak source, adjusted for local VOC ambient concentration, that is less than 2.5 % of the specified leak definition concentration. That indicates that a VOC emission (leak) is not present.

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

3.6 Response factor means 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 applicable regulation.

3.7 Response time means 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.

4.0 Interferences [Reserved]

5.0 Safety

5.1 Disclaimer. This method may involve hazardous materials, operations, and equipment. This test method may not address all of the safety problems associated with its use. It is the responsibility of the user of this test method to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to performing this test method.

5.2 Hazardous Pollutants. Several of the compounds, leaks of which may be determined by this method, may be irritating or corrosive to tissues (e.g., heptane) or may be toxic (e.g., benzene, methyl alcohol). Nearly all are fire hazards. Compounds in emissions should be determined through familiarity with the source. Appropriate precautions can be found in reference documents, such as reference No. 4 in Section 16.0.

6.0 Equipment and Supplies

A VOC monitoring instrument meeting the following specifications is required:

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

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

6.3 The scale of the instrument meter shall be readable to ±2.5 % of the specified leak definition concentration.

6.4 The instrument shall be equipped with an electrically driven pump to ensure that a sample is provided to the detector at a constant flow rate. The nominal sample flow rate, as measured at the sample probe tip, shall be 0.10 to 3.0 l/min (0.004 to 0.1 ft 3 /min) when the probe is fitted with a glass wool plug or filter that may be used to prevent plugging of the instrument.

6.5 The instrument shall be equipped with a probe or probe extension or sampling not to exceed 6.4 mm (1/4 in) in outside diameter, with a single end opening for admission of sample.

6.6 The instrument shall be intrinsically safe for operation in explosive atmospheres as defined by the National Electrical Code by the National Fire Prevention Association or other applicable regulatory code for operation in any explosive atmospheres that may be encountered in its use. The instrument shall, at a minimum, be intrinsically safe for Class 1, Division 1 conditions, and/or Class 2, Division 1 conditions, as appropriate, as defined by the example code. The instrument shall not be operated with any safety device, such as an exhaust flame arrestor, removed.

7.0 Reagents and Standards

7.1 Two gas mixtures are required for instrument calibration and performance evaluation:

7.1.1 Zero Gas. Air, less than 10 parts per million by volume (ppmv) VOC.

7.1.2 Calibration Gas. For each organic species that is to be measured during individual source surveys, obtain or prepare a known standard in air at a concentration approximately equal to the applicable leak definition specified in the regulation.

7.2 Cylinder Gases. If cylinder calibration gas mixtures are used, they must be analyzed and certified by the manufacturer to be within 2 % accuracy, and a shelf life must be specified. Cylinder standards must be either reanalyzed or replaced at the end of the specified shelf life.

7.3 Prepared Gases. Calibration gases may be prepared by the user according to any accepted gaseous preparation procedure that will yield a mixture accurate to within 2 percent. Prepared standards must be replaced each day of use unless it is demonstrated that degradation does not occur during storage.

7.4 Mixtures with non-Reference Compound Gases. Calibrations may be performed using a compound other than the reference compound. In this case, a conversion factor must be determined for the alternative compound such that the resulting meter readings during source surveys can be converted to reference compound results.

8.0 Sample Collection, Preservation, Storage, and Transport

8.1 Instrument Performance Evaluation. Assemble and start up the instrument according to the manufacturer's instructions for recommended warmup period and preliminary adjustments.

8.1.1 Response Factor. 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 at subsequent intervals.

8.1.1.1 Calibrate the instrument with the reference compound as specified in the applicable regulation. Introduce the calibration gas mixture to the analyzer and record the observed meter reading. Introduce zero gas until a stable reading is obtained. Make a total of three measurements by alternating between the calibration gas and zero gas. Calculate the response factor for each repetition and the average response factor.

8.1.1.2 The instrument response factors for each of the individual VOC to be measured shall be less than 10 unless otherwise specified in the applicable regulation. When no instrument is available that meets this specification when calibrated with the reference VOC specified in the applicable regulation, the available instrument may be calibrated with one of the VOC to be measured, or any other VOC, so long as the instrument then has a response factor of less than 10 for each of the individual VOC to be measured.

8.1.1.3 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 References 1–3 of Section 17.0.

8.1.2 Calibration Precision. 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.

8.1.2.1 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.

8.1.2.2 The calibration precision shall be equal to or less than 10 % of the calibration gas value.

8.1.3 Response Time. The response time test is required before 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 before further use.

8.1.3.1 Introduce zero gas into the instrument sample probe. When the meter reading has stabilized, switch quickly to the specified calibration gas. After switching, measure the time required to attain 90 % of the final stable reading. Perform this test sequence three times and record the results. Calculate the average response time.

8.1.3.2 The instrument response time shall be equal to or less than 30 seconds. The instrument pump, dilution probe (if any), sample probe, and probe filter that will be used during testing shall all be in place during the response time determination.

8.2 Instrument Calibration. Calibrate the VOC monitoring instrument according to Section 10.0.

8.3 Individual Source Surveys.

8.3.1 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:

8.3.1.1 Valves. The most common source of leaks from valves is the seal between the stem and housing. Place the probe at the interface where the stem exits 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.

8.3.1.2 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.

8.3.1.3 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.

8.3.1.4 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.

8.3.1.5 Process Drains. For open drains, place the probe inlet at approxima tely 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.

8.3.1.6 Open-ended Lines or Valves. Place the probe inlet at approximately the center of the opening to the atmosphere.

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

8.3.1.8 Access door seals. Place the probe inlet at the surface of the door seal interface and conduct a peripheral traverse.

8.3.2 Type II—"No Detectable Emission". Determine the local ambient VOC concentration around the source by moving the probe 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 as outlined in Section 8.3.1. 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:

8.3.2.1 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 in Section 8.3.2.

8.3.2.2 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 upstream of the control device. If the required ducting or piping exists and there are no sources where the emissions could be vented to the atmosphere upstream of 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 Section 8.3.2 shall be used to determine if detectable emissions exist.

8.3.3 Alternative Screening Procedure.

8.3.3.1 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 technique of Section 8.3.1 or 8.3.2.

8.3.3.2 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 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 Section 8.3.1 or 8.3.2 shall be used to determine if a leak exists, or if the source has detectable emissions, as applicable.

9.0 Quality Control

Section	Quality control measure	Effect
8.1.2......................................	Instrument calibration precision check.	Ensure precision and accuracy, respectively, of instrument response to standard.
10.0......................................	Instrument calibration.	

10.0 Calibration and Standardization

10.1 Calibrate the VOC monitoring instrument as follows. 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.

11.0 Analytical Procedures [Reserved]

12.0 Data Analyses and Calculations [Reserved]

13.0 Method Performance [Reserved]

14.0 Pollution Prevention [Reserved]

15.0 Waste Management [Reserved]

16.0 References

1. Dubose, 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, NC. Publication No. EPA 600/2–81051. September 1981.
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, NC. Publication No. EPA 600/2–81–022. May 1981.
3. DuBose, D.A. et al. Response of Portable VOC Analyzers to Chemical Mixtures. U.S. Environmental Protection Agency, Research Triangle Park, NC. Publication No. EPA 600/2–81–110. September 1981.

4. Handbook of Hazardous Materials: Fire, Safety, Health. Alliance of American Insurers. Schaumberg, IL. 1983.

17.0 Tables, Diagrams, Flowcharts, and Validation Data [Reserved]

Appendix E Summary of NEIC Comparative Monitoring Results of Leaking Valves at 17 Refineries

	Refineries Total	NEIC Total
Valves Monitored	170,717	47,526
Number of Leaks	2,266	2,372
Leak Rate (%)	1.3	5.0 (avg)
Emissions Rate (lb/hr)	1,177.0	2,775.5
Potential Emissions from Undetected Leaks (lb/hr)[a]	**1,598.5**	

Source: Enforcement Alert – Proper Monitoring Essential to Reducing 'Fugitive Emissions' Under Leak Detection and Repair Programs, EPA 300-N-99-014. US EPA Office of Enforcement and Compliance Assurance. Vol. 2, No. 9, Oct 1999.

[a] Potential Emissions from Undetected Leaks (lb/hr) = NEIC Total Emissions Rate (lb/hr) – Refineries Total Emissions Rate (lb/hr)

Appendix F Enforcement Alert

United States Environmental Protection Agency | Office of Enforcement and Compliance Assurance (2201A) | EPA 300-N-99-014

EPA **Enforcement Alert**

Volume 2, Number 9 | Office of Regulatory Enforcement | October 1999

Proper Monitoring Essential to Reducing 'Fugitive Emissions' Under Leak Detection and Repair Programs

The Clean Air Act requires refineries to develop and implement a Leak Detection and Repair (LDAR) program to control fugitive emissions. Fugitive emissions occur from valves, pumps, compressors, pressure relief valves, flanges, connectors and other piping components.

Comparison monitoring conducted by the U.S. Environmental Protection Agency's (EPA) National Enforcement Investigations Center (NEIC) shows that the number of leaking valves and components is up to 10 times greater than had been reported by certain refineries (*see Table, Page 2*). EPA believes this great disparity between what refineries are reporting and what EPA is finding may be attributable to refineries not monitoring in the manner prescribed in 40 CFR Part 60, Appendix A, Method 21.

Federal regulations require refiners to routinely monitor for leaks and to fix any equipment found leaking. Failure to identify leaking equipment results in necessary repairs not being made and continuing fugitive emissions of volatile organic chemicals (VOCs) and other hazardous chemicals. EPA estimates that the failure to identify and repair leaks at petroleum refineries could be resulting in additional VOC emissions of 80 million pounds annually. VOCs contribute to ground-level ozone, a principal component of smog, which can cause significant health and environmental problems.

> EPA estimates that leaks not found and repaired could be resulting in additional volatile organic chemical emissions of 80 million pounds annually.

About Enforcement Alert

"Enforcement Alert" is published periodically by the Office of Regulatory Enforcement to inform and educate the public and regulated community of important environmental enforcement issues, recent trends and significant enforcement actions.

This information should help the regulated community anticipate and prevent violations of federal environmental law that could otherwise lead to enforcement action. Reproduction and wide dissemination of this newsletter is encouraged.

See Page 4 for useful EPA Websites and additional resources.

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What the Law Requires

Specific requirements for refinery fugitive emissions are identified in 40 CFR Part 60, New Source Performance Standards (NSPS), and 40 CFR Parts 61 and 63, National Emission Standards for Hazardous Air Pollutants (NESHAP). Many State and local air agencies incorporate federal requirements but some have established more stringent requirements as authorized by law. The various regulations require refineries to implement an LDAR program to reduce fugitive emissions from valves, pumps, compressors, pressure relief valves, flanges, connectors, and other piping components.

Valves are usually the single largest source of fugitive emissions. Emissions from any single piece of equipment are usually small. Based on the large number of equipment components that can leak and are subject to LDAR requirements, however, cumulative emissions can be very large. To obtain a proper reading of emissions from leaking components the monitoring equipment must be calibrated cor-

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This publication is found on the Internet at http://www.epa.gov/oeca/ore/enfalert

Enforcement Alert

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Comparative Monitoring Results

Refinery	Company Monitoring: Valves/Leaks	NEIC Monitoring: Valves/Leaks	Leak Rate: Company/ NEIC (%)	Emissions Rate: Company/ NEIC (lb/hr)	Potential Emissions: Undetected Leaks (lb/hr)
A	7,694/170	3,363/354	2.3/10.5	38.8/106.6	67.8
B	7,879/223	3,407/216	2.8/6.3	44.0/73.5	29.5
C	3,913/22	2,008/108	0.6/5.4	18.3/90.1	71.8
D	2,229/26	1,784/24	1.2/1.4	15.5/17.1	1.6
E	5,555/96	2,109/112	0.7/5.3	50.7/125.8	75.1
F	42,505/124	3,053/53	0.3/1.7	154.7/382.3	227.6
G	14,307/226	3,852/236	1.6/6.1	122.2/369.7	247.5
H	20,719/736	3,351/179	3.6/5.3	332.2/469.7	137.5
I	5,339/9	2,754/84	0.2/3.1	16.9/76.6	59.7
J	8,374/78	2,981/55	0.9/1.8	50.8/78.5	27.7
K	6,997/101	1,658/114	1.4/6.9	56.1/201.2	145.1
L	12,686/26	3,228/125	0.2/3.8	34.9/84.0	49.1
M	4,160/40	1,926/222	1.0/11.5	25.7/192.2	166.5
N	5,944/29	2,487/106	0.5/4.3	26.1/112.3	86.2
O	7,181/112	2,897/130	1.6/4.5	60.8/140.9	80.1
P	8,532/203	4,060/181	2.4/4.5	98.8/167.5	68.7
Q	6,640/36	2,608/74	0.5/2.8	30.5/87.5	57.0
Total	170,717/2,266	47,526/2,372	1.3/5.0 (avg)	1,177.0/ 2,775.5	1,598.5

rectly and held at the component interface where leakage could occur (e.g., at the seal between the valve stem and housing) for a sufficient length of time to obtain a valid measurement.

LDAR Programs Should Consist of Several Processes

LDAR programs are generally comprised of four processes. Regulations vary but usually require refineries to:

- Identify components to be included in the program;
- Conduct routine monitoring of identified components;
- Repair any leaking components; and
- Report monitoring results.

Compliance issues associated with each of these processes have resulted in numerous enforcement actions by EPA Regional offices, State agencies, or local air boards, depending on the specific regulations. Common violations include:

- Failure to identify process units and components that must be monitored;
- Failure to follow prescribed monitoring procedures;
- Use of incorrect or expired calibration gasses;
- Failure to repair components within specified timeframes; and
- Failure to submit quarterly reports and maintain appropriate calibration and/or monitoring records.

Refinery Monitoring Reports; What EPA is Finding

During the past several years, NEIC has monitored for leaking components at refineries. For 17 facilities investigated by NEIC, the average leak rate reported by the facilities was 1.3 percent. The average leak rate determined by NEIC and confirmed by the facilities was 5.0 percent. One explanation for this difference in leak rates may be found in a report published by the Bay Area Air Quality Management District ("Rule Effectiveness Study"). The Bay Area Air Quality Management District determined that when valves were inspected at a distance of one centimeter (0.4 inches) from the component instead of at the interface with the component, as the regulations require,

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57 percent of the leaking valves would be missed when monitoring above the 500 ppm level.

Fugitive emissions account for 22 percent of all emissions from non-refineries but account for more than 55 percent of all refinery emissions identified in the 1996 Toxic Release Inventory (TRI). Since TRI includes only "reportable" hydrocarbons, total fugitive emissions were significantly larger than the 33 million pounds then identified by reporting refineries.

The failure to identify leaks means that they remain unrepaired and will continue to release VOCs and hazardous substances into the atmosphere. Emission estimates using a 50/50 split between components in gas/light liquid service (*see Table, Page 2*) suggest that these 17 refineries' annual fugitive emissions could be more than 6,000 tons per year greater than previously believed. Extrapolating this difference to all refineries larger than the smallest refinery investigated by NEIC also suggests that there may be an additional 80 million pounds of VOCs being emitted each year because refinery leaks are not being identified properly and repaired promptly, as required by LDAR programs. Significantly and as recognized by industry, fugitive emissions can be reduced by up to 90 percent if leaks are detected and repaired in a timely manner.

EPA Policies for Reducing, Eliminating Penalties for Self-Policing

EPA has adopted two policies designed to encourage the regulated community to comply with environmental laws.

For more information, see EPA's Audit Policy Website at: http://www.epa.gov/oeca/auditpol.html, and the Small Business Policy at: http://www.epa.gov/oeca/smbusi.html.

Regulatory Impacts of Inadequate Fugitive Monitoring

By not fully identifying all leaking components, refineries are likely causing the unnecessary release of excess hydrocarbons. The impacts of these additional hydrocarbon releases may result in:

- Additional VOC emissions that could worsen local or transboundry smog problems;
- Under reporting of fugitive emissions on the annual Toxic Reporting Inventory;
- Under reporting of various TRI chemicals on annual Form R submissions; and
- Delayed or denied permits for expansion.

Most LDAR regulations allow for decreased monitoring frequency if certain performance standards are consistently achieved. Monitoring frequency is decreased from quarterly to annual monitoring if less than two percent of the valves within a process unit are found leaking. Conversely, if greater than two percent of the valves are found to be leaking, monitoring must be conducted quarterly. EPA monitoring showing a greater than two percent leak rate has resulted in refineries reverting back to quarterly monitoring.

Improving Leak Detection Monitoring Reliability

Although not required under current LDAR programs, several practices appear to improve the reliability of monitoring data and LDAR compliance:

- Energetic LDAR coordinators (advocates) with the responsibility and authority to make things happen;
- Continuing education/refresher programs for plant operators. Plant operators can have a major impact on LDAR compliance;
- Diligent and well-motivated monitoring personnel;
- Use of a lower than required leak definition. Several refineries use a leak definition lower than the regulatory limit. For example, several refineries use a 500 ppm limit rather than the regulatory limit of 10,000 ppm;
- More frequent monitoring than required. Rather than monitoring annually, some refineries monitor quarterly. More frequent monitoring also may permit lower emissions to be reported on the annual Toxic Reporting Inventory and/or Form Rs; and
- Established Quality Assurance/Quality Control procedures. Several refineries have initiated a program to check the monitoring results submitted by the monitoring team (in-house or contractor).

EPA's Office of Enforcement and Compliance Assurance is encouraged by efforts currently underway by the National Advisory Committee on Environmental Policy and Technology (NACEPT) petroluem refining workgroup to find more cost-effective ways to identify significant leaks

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through new technology that allows for quick identification of the most significant losses. Meanwhile, however, the regulated industry is expected to comply fully with existing LDAR requirements.

Contact Ken Garing, National Enforcement Investigations Center, (303)236-6658;Email: garing.ken@epa.gov; Tom Ripp, Office of Compliance, Manufacturing, Energy and Transportation Division, (202564-7003;Email: ripp.tom@epamail.epa.gov; or Jim Jackson, Office of Regulatory Enforcement, Air Enforcement Division, (202) 564-2002;Email: jackson.james@epamail.epa.gov.

EPA'S Y2K Enforcement Policy

EPA's "Y2K Enforcement Policy is designed to encourage the expeditious testing of computer associated hardware and software that may be potentially vulnerable to Y2K problems.

Under this policy, which was published in the Federal Register on March 10, 1999, EPA intends to waive 100 percent of the civil penalties and recommend against criminal prosecution for environmental violations resulting from Y2K testing designed to identify and eliminate Y2K-related malfunctions. To receive the policy's benefits (e.g., waiver of penalties due to testing), regulated entities must address specific criteria and conditions identified in the policy.

For more about the Y2K Enforcement Policy, contact *Gary Jonesi, Office of Regulatory Enforcement, (202) 564-4002 or E-mail: jonesi.gary@epa.gov.*

Useful Websites

EPA's Technical Web site for Information Transfer and Sharing Related to Air Pollution Topics:
http://www.epa.gov/ttn/

Toxics Release Inventory (TRI):
http://www.epa.gov/opptintr/tri/

EPA Home Page:
http://www.epa.gov/epahome

National Enforcement Investigations Center:
http://www.epa.gov/oeca/oceft/neic/index.html

EPCRA Hotline: 1-800-424-9346. For callers in the DC area, please call (703) 412-9810. Also, the TDD is (800) 553-7672.

Office of Regulatory Enforcement
http://www.EPA.gov/oeca/ore.html

EPA Compliance Assistance Centers: http://www.epa.gov/oeca/mfcac.html

Small Business Gateway:
http://www.epa/gov/smallbusiness

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